Book-of-the-Future

THE CLIMATE DOOMESDAY BOOK

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The Climate Domesday Book
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The Climate Domesday Book is edited by Philip Ely and David Frohlich.

The **Book**-of-the**Future** team includes Philip Ely, David Frohlich, George Bairaktaris, Haiyue Yuan and Radu Sporea.

climatedomesday.com

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Angie Silva
Andrew Sunley-Smith
John Kinsella
Astha Sharma
Fiona Beck
Charlie Mgee
Zoë Sadokierski
Timo Rissanen
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Chris Flack
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with

The Formidable Vegetable Sound System
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Philip Ely
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Contributors

Philip Ely PhD lives on Noongar boodja and is Senior Lecturer in Design at Curtin University, Australia, where he leads postgraduate design programmes and research. He served his formative years working in the design industry at Total Design, Amsterdam, IBM Europe, Telstar Entertainment Group, Granada Media and Design Bridge. A graduate of University of Portsmouth, UCL and the University of Surrey, Philip is both a design practitioner and theorist and has written on entrepreneurship, new technology, design thinking and design culture. He was at the forefront of interactive design during the mid-1990s to mid-2000s , developing a range of interactive products and services for well-known brands. He has served as a director of social enterprises and creative startups and has held senior positions in both academia and industry. He is a Fellow of the Royal Society of Arts (RSA), Fellow of the Higher Education Academy, and an elected member of the International Society of Typographic Designers (ISTD). His design research interests and supervision spans the efficacy of design for innovation, behaviour change, meaningful design and the emergence of contemporary design paradigms.

David Frohlich PhD is Director of Digital World Research Centre at the University of Surrey and Professor of Interaction Design. He joined the Centre in January 2005 to establish a new research agenda on new media innovation with social and cultural benefit. Prior to joining Digital World, David worked for 14 years as a senior research scientist at HP Labs, conducting design research on the future of mobile, domestic and photographic technology. He has a PhD in psychology from the University of Sheffield and post-doctoral training in Conversation Analysis from the University of York. He has also held visiting positions at the Royal College of Art, and the Universities of York, Manchester, Sydney (UTS) and Melbourne, and is currently Visiting Researcher in the Department of Gerontology, Federal University of São Carlos, Brazil. He is also founding editor of the international journal Personal and Ubiquitous Computing.

Haiyue Yuan PhD received his BEng in Mobile Communication Systems and MSc in Finance at the University of Sheffield. He earned his PhD in Electronic Engineering/Human Computer Interaction (HCI) with the research focus on user aspects of stereoscopic 3D video interaction from the Centre for Vision, Speech, and Signal Processing at the University of Surrey in 2013. He continued to work as a Research Fellow at the Department of Computer Science and Centre for Vision, Speech, and Signal Processing at the University of Surrey, on a number of interdisciplinary projects. He joined the School of Computing and Institute of Cyber Security for Society at University of Kent as a Research Associate in Cyber Security in 2022. His research interests include HCI, Usable Security, Computational Cognitive Modeling, 3D video processing/applications, and Artificial Intelligence (AI) applications. Haiyue has developed and released a number of research software tools for the 'Next Generation Paper https://www.surrey.ac.uk/digital-world-research-centre/funded-projects/next-generation-paper-connecting-paper-web on both Google Play store and Apple App store. He also released an open-source software CogTool+ https://github.com/hyyuan/cogtool_plus for large scale human performance modeling. More information about Haiyue can be found at: https://www.hyuan.co.uk/.

George Bairaktaris lives in Guildford, Surrey, UK and is a PhD student at the Advance Technology Institute of University of Surrey, under the supervision of Dr Radu A. Sporea. He received his BEng degree in Electrical

and Electronic Engineering from the University of Surrey in 2019, during which he completed a placement year at the Research and Development department of Johnson Controls. He has also been involved in product development for a local drone manufacturer, Evolve Dynamics. During the summer of 2019, he completed entrepreneurship, business strategy, and consulting courses at Imperial College Business School. In his current role in University of Surrey, he is exploring printed electronics and emerging techniques for creating novel, intuitive, and flexible user interfaces. He is involved in multiple design projects and is always keen to “give it a go” or build “a quick proof-of-concept” for ideas generated over a pint.

Radu Sporea PhD is Senior Lecturer (Associate Professor) in Power Electronics and Semiconductor Devices at the Advanced Technology Institute (ATI), University of Surrey and holds an EPSRC Early Career Fellowship (2021-2026). Prior to this appointment he was Royal Academy of Engineering Academic Research Fellow (2011-2016), EPSRC PhD+ Fellow (2010-2011) and PhD researcher (2006–2010) in the same centre. Before joining Surrey, Radu studied Computer Systems Engineering at “Politehnica” University, Bucharest, Romania, and worked as a Design Engineer for Catalyst Semiconductor Romania, now part of ON Semiconductor, on ultra-low-power CMOS analog circuits. Radu’s was named an EPSRC Rising Star in 2014 and was the recipient of the I K Brunel Award for Engineering in 2015. He was presented the Vice Chancellor’s award for Early Career Teaching in 2017 and won the Tony Jeans Inspirational Teaching distinction in 2018. In 2021, he was a finalist of the Innovator of the Year prize at Surrey. Radu’s team focuses on three main topics: Advanced semiconductor device design, including transistors with increased tolerance to fabrication variability, improved energy efficiency and high gain; large area sensors and sensor arrays for smart environments, focusing on multi-modal low-cost integration in commercial manufacturing platforms and mass-market products; and Paper-based electronics and physical-digital interaction.

Over the last 10 years **Angie Silva** PhD has been exploring evolving and emerging social frameworks and innovative technical solutions that will serve and progress people and the planet. This work has been facilitated through her role as an academic and business advisor in Renewable Energy, Circular Economy, Sustainable Production and Consumption and Waste-Materials Management. Angie completed her PhD in Environmental Policy and Communications at Curtin University, awarded in November 2017, which included published works in high impact journals.

Andrew Sunley Smith PhD's work encompasses and manifests the areas and diverse practices of Pragmatic, Co-efficient Contemporary Art and Design. Focusing on direct physical forms of relational aesthetics, his work is driven by the ongoing social relevance and cultural resonance of contemporary art practices and its critical applications. His art forms and installations readily change to suit his ideas and his processes often involve upskilling and intensive fabrication processes in their manufacture and realisation. Velocity, combustion and even the landscape itself have been used as direct sculptural tools in his works. Sunley Smith has taught at The Glasgow School of Art, Bauhaus Universität, University New South Wales and Curtin University amongst many others. His most recent work includes Overload: for Crossing 21 at the 2021 Fremantle Biennale and currently serves as Concept and Creative Director of the contemporary art production space C P 2 0 in Hamilton Hill, Western Australia — an independently funded communal facility which focuses on more expansive, experimental creative art and design practices.

John Kinsella is a vegan, anarchist, pacifist and feminist and one of Australia's most highly regarded writers. He has written over twenty books of poetry as well as plays and fiction. His work is strongly influenced by the Western Australian landscape, for which he has received many awards including the Western Australian Premier's Book Award and the John Bray Award for Poetry from the Adelaide Festival. He has won fellowships from the Literature Board of the Australia Council. John is a supporter of worldwide indigenous land rights and a passionate environmentalist, writing critically and working collaboratively with artists, writers and musicians. John has taught at universities in Australia and at the Kenyon

College in the United States. He is the Founding Editor of the journal Salt in Australia, and serves as international editor at the Kenyon Review. He writes regularly on his website which he shares with his partner, Tracy Ryan, at https://poetsvegananarchistpacifist.blogspot.com/

Astha Sharma PhD is a research fellow at the School of Engineering, College of Engineering and Computer Science, The Australian National University (ANU). She is a Physicist and finds it closely tailored to her personality and is extremely passionate about applying physics to Energy applications. Her research interest focuses on developing low-cost silicon-based systems for solar water splitting, as an efficient, clean, and cheaper route to hydrogen production. She received her bachelors and master's degree in Physics from Fergusson College, Savitribai Phule Pune University, India. She was also awarded the prestigious INSPIRE scholarship by Department of Science and Technology, Government of India during her bachelor's and master's (2011-2016). She completed her PhD at the School of Engineering, College of Engineering and Computer Science at the ANU, under the supervision of Dr Fiona J. Beck, Dr Siva Karuturi and Prof. Kylie Catchpole. Her PhD focussed on developing perovskite-silicon tandem solar cell and earth abundant catalyst-based systems for direct solar hydrogen generation. She is now continuing this research further as a research fellow in the same group. Her research focus expands to computational modelling of photovoltaic based solar hydrogen generation systems to understand the system configurations and limitations and techno-economic analysis of direct solar hydrogen generation systems for large scale hydrogen generation applications.

Fiona J Beck PhD is a Senior Research Fellow at the Australian National University's (ANU) School of Engineering, where she leads a research group developing technologies for renewable energy and solar fuel applications. She is also Convener of the Hydrogen Fuels Project in the ANU's Zero-carbon energy for the Asia-Pacific Grand Challenge (https://www.anu.edu.au/research/research-initiatives/zero-carbon-energy-for-the-asia-pacific). Her research interests include solar energy, renewable fuels, and the wider challenges of energy change. Dr Beck has an MSci degree in Physics from The University of Glasgow (2006) and a PhD in Engineering from the ANU (2011). She has previously held prestigious international fellowships including a Discovery Early Career Researcher Award (DECRA 2018) from the ARC, and a Marie Curie Fellowship from the European Union (2012). She spent four years as a Research Fellow at ICFO - The Institute of Photonic Sciences in Barcelona post PhD, before joining the College of Engineering and Computer Science at the Australian National University as a Future Engineering Research Leader (FERL) Fellow in 2015.

Charlie Mgee & **The Formidable Vegetable Sound System** have been put on this increasingly shaky ground to sow the gardens of our minds with seeds of change in the funkiest way possible. The first band to ever turn down a show at Glastonbury due to the ecological impact (but then ending up playing anyway, due to the entire festival going online during the COVID lockdown), when they were still flying, Formidable Vegetable toured to over 20 countries and have been praised by the United Nations for "singing about the important issues of our time". Formidable Vegetable are using their unique brand of musical activism to compost problems and grow fertile, community-scale solutions in their place. Over the past decade, they have become a favourite on the Australian and international festival circuits, having played at some of the biggest events in the world alongside Radiohead, The Rolling Stones and Tame Impala.

Zoë Sadokierski PhD and **Timo Rissanen** PhD are based at the University of Technology Sydney's School of Design. Zoë is a book designer and writer; her practice-based research explores ways to communicate biodiversity loss and conservation to non-scientists. Timo is a fashion and textiles researcher with an interest in the interconnection between sustainability and social justice as they relate to the contemporary fashion industry. Their *Precarious Birds* collaboration is a 'conversation through making' in which they respond to a shared concern for the fate of birds in the Sixth Mass Extinction event: precariousbirds.net/

Chris Flack's career has taken him from one side of the world to the other and back again. Over the years, he's created a new time zone to put Te Anau on the map and exploded over 1000 ping pong balls to launch TEDx in New Zealand. Chris has rebranded Christmas for one of New Zealand's top magazines, and may well be the first person ever to get the design community to embrace Comic Sans (much to the dismay of all involved) to help fight cancer. Chris' latest passion project MATE ACT NOW uses a "digital protest" to create awareness of the ongoing need for climate action. At the heart of all his work is an honest simplicity and a love for the craft. He believes in developing relationships based on trust so that new ideas can come to life. Chris' ideas have been featured in everything from Mashable to Creative Review and his designs have graced the walls of the Mexican Museum of Design (MUMEDI). Chris has received awards from the Tokyo Type Directors Club, Clios, Communications Arts, AGDA and Best Design Awards and regularly "writes, judges and talks (too much) about design".

For too long (over a decade?) **Lucas Ihlein** has received gratifying attention for environmentally-focused socially-engaged artworks. All very nice, but it can be tiring to develop a reputation for making "worthy" art. Someone should remind him that seemingly pointless or playful stuff is important too. [Define "important" - Ed.] Like that time when he and Mickie Quick re-enacted Gilbert and George's performance Gordons Makes Us Drunk on a river cruise curated by Lara Thoms. Their Gordons got confiscated by an angry barman who accused the artists of contravening licencing laws. Lucas and Mickie tried to explain that the licence was safe since the booze was an artwork and a performance prop, but such Duchampian appeals fell on deaf ears. Luckily an auxiliary stash had been packed and the re-enactment was saved. In terms of formalist aesthetics, the piece was colourful and full of movement and rhythm: Lucas turned green (and had to ask his taxi driver to stop several times on the way home); while Mickie turned red (and had to pause for a midnight nap under some bushes in Hyde Park). That this inquiry into 20th century performance has never been cited in the historical record is testament to the fact that the art world these days just wants things that look "narrowly useful". Like, projects that build communities or try to stop pollution, and all that. Maybe Lucas' current dabbling in human manure composting will discover the holy grail of fun and utility. Meanwhile, http://lucasihlein.net

Gabrielle de Vietri is an artist, activist, a city councillor and the former Mayor of Yarra living on unceded Wurundjeri Woi Wurrung land. As an artist, Gabrielle has created collaborative public artworks in Australia and internationally to create shifts on social, environmental and political issues. She has carried out projects in non-traditional locations, and held exhibitions in major Australian institutions - Australian Centre for Contemporary Art (Melbourne), Queensland Art Gallery/Gallery of Modern Art, Institute of Modern Art (Brisbane), Perth Institute of Contemporary Arts, Artspace (Sydney), Bendigo Art Gallery, Monash University Museum of Art, Samstag Museum, Ian Potter Museum, Shepparton Art Museum - and internationally in public spaces, galleries and museums in Berlin, Toronto, Chicago, Auckland, Copenhagen and Singapore. She founded and co-directed *A Centre for Everything*, an independent learning platform for creative, politically-engaged community building, based in Collingwood. She is a Sidney Myer Fellow, a former board member of CLIMARTE, and a sought-after public speaker in diverse contexts - universities, cultural institutions, political events, and conferences, including EcoCity World Summit, AYCC's Powershift, NSW Greens Reboot Future and for Yo Yo Ma's 'Days of Action'. She is a founding member of the *Artists' Committee*, an informal association of artists and arts workers making public performative work at the intersection of ethics, culture and money. She became involved in local government after working towards social and political change through activism, law and the arts. Passionate about social and political change, she formed, led and contributed to many grassroots campaigns over the last decade including the community mobilisation against the East West toll-road, the Sydney Biennale/Transfield boycott, the Childrens' March for Nauru and other campaigns against immigration detention.

OurEden was created by a team of PhD graduates working in various fields of sustainable technologies. OurEden research and produce science-based

educational videos discussing aspects of climate change and sustainable technology. Climate change mitigation is a complex problem with many different technological, political and economic aspects. Therefore, OurEden's aim is to provide entertaining and easily digestible content explaining various climate related concepts to a general audience. By doing so OurEden hope that their videos will encourage positive behaviour change by helping people understand the best ways in which they can make a significant impact in keeping our planet healthy.

Brenna Quinlan is an illustrator and educator who strives to make the world a better place through her art and her actions. She has ridden a bicycle across the Americas, taught permaculture in Brasil, Chile and Argentina, and lived for four years at Melliodora, the permaculture demonstration site created by permaculture co-originator David Holmgren and his partner Su Dennett in Central Victoria, Australia. As an illustrator, Brenna has worked with the Australian Red Cross, the Stephanie Alexander Kitchen Garden Program, Plan International, Milkwood Permaculture, the Bob Brown Foundation, CSIRO and Costa Georgiadis, among others. As an educator, Brenna has taught alongside the biggest names in permaculture, including Rosemary Morrow, David Holmgren, Dan Palmer, and Hannah Moloney. She co-runs Grow Do It Permaculture Education, a project focused on bringing climate solutions to kids (and their grown ups) through art, music and creativity. Brenna is currently building her own strawbale house out of reclaimed materials in Western Australia on Noongar boodja. She acknowledges the traditional owners of this land, and that sovereignty was never ceded.

Sien Zhou is an emerging artist-designer, born in Taipei, Taiwan. In 2018, she decided to pack her bags and move out of her comfort zone so that she could become a more accomplished designer, moving to Australia to work and study. Sien is inspired by an artist teacher back in Taiwan who, at the age of 65, shows an enthusiasm for life that has motivated her with what she describes as "an attitude...a kind of persistence". Sien's parents have opposed her taking up an arts-based profession since she was a child, but this has not overwhelmed her. Instead, this has driven her hunger for learning and in disrupting the status quo. In her own words: "No one can limit you, and I think I am that kind of person who was born not to fit in. I was born to stand out, to speak up, to act out, and to live life out loud".

Mark Spencer is Founder of Climactic, a podcasting collective dedicated to telling stories from the climate community. Mark grew up an only child, homeschooled until 12. He was free to pursue his passions, and that meant lots of time at the library. A voracious reader of sci-fi and history led to the development of a big-picture mindset. Mark has worked a wide variety of jobs and lived many places, including the US, NZ, China and the UK, before settling permanently in Melbourne. Climate change has become his main interest, and through Climactic and other projects he seeks to engage more people in this greatest test of humanity.

How to use this book

Because this book is designed differently to many books you would have encountered before, we thought it best to provide you with a user manual.

You'll get enjoyment (we hope) from reading this book as it is in it's printed form but you'll get a lot more from it if you make use of the interactivity that we provide through the use of the magic bookmark.

The magic bookmark attached to the book is equipped with three buttons and five light sensors. When you place the bookmark over these black markers, you can make use of the play/pause button, and the volume control buttons.

When you are not using the magic bookmark, the screen that the book is connected to will display a title screen displaying *The Climate Domesday Book* logo.

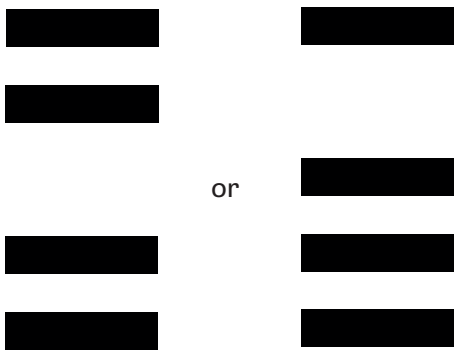
During audio playback, you will see this icon, alongside the title of the audio track being played. During video playback, you will see a video clip. For both, you can control the sound levels using the volume control buttons.

When you see markers on a page like this towards the spine of the book, you can rest the Magic Bookmark there to play an accompanying audio or video clip on a nearby screen.

We've also added a decorative ribbon at the top of pages that have interactivity.

Tip: Always rest the bookmark on the side of the markers to cover them up, so that the light sensors can 'read' the page.

You can test this page now to make sure the book is working. Every page is different, so sometimes you will see only one or two black stripes on a page. In this case, still lay the bookmark flat against the page so that it can see this is a different page to the last (see right).



or

After you have watched a video or listened to an audio clip, you can move the bookmark aside and turn a page. On the screen, you will be returned to the title screen.

Enjoy reading, watching and listening to *The Climate Domesday Book*, a survey of ideas as we imagine the future of energy.

Introduction

Words & Image: Philip Ely

THIS BOOK IS ABOUT CLIMATE CHANGE AND HOW WE MIGHT RESPOND TO IT.

You might have been put off by the ominous title 'Climate Domesday' or even drawn to it by curiosity. Whatever your motivation, let us state the obvious: what confronts us now is a clear and present danger. This does not mean that the end of human life is inevitable, but it is certainly becoming more plausible.

What follows is a book which aims to provoke thought and action to prevent the catastrophic end of life on earth. Much of it is interested in how we harness and use energy to live sustainably with all species on earth in mind. We've invited a wide range of contributions from scientists, artists, writers, designers and musicians who give us their views on what we must do to shape a preferable future for *all* species.

When we were approached to write and design this book, we were inspired by generations and cultures that have come before us. The title itself is inspired by the Norman conquerer, William I, who commissioned a survey of the land that he had conquered in 1086 known as the *Domesday Book*. The book was a record that (then) no man could refuse to be a part of. Whilst this old English spelling of the word 'doomsday' does not necessarily refer to the idea of the end of the world as it does in Norse mythology, it does refer to a day or time when something terrible might happen. However, it will not be a single event on a given day that will mark the ultimate consequences of human-induced climate change, but a series of events and domesdays. By referring to 'domesday' or doomsday, we draw attention to the urgency of what lies ahead.

Our other, more positive inspiration for this book comes from the 1960's counterculture movement in the United States, and specifically the publication of *The Whole Earth Catalog*, led by Stewart Brand. *The Whole Earth Catalog* became an invaluable resource for those who sought a different, post-industrial way of life. The eclectic catalogue of resources provided 'access to tools' — ideas, technologies, ways of living — some of which were available to purchase from Menlo Park, California. We will explore some of the ideas we encountered later in the book, but for now let us introduce you to the contributors to our twenty-first century ideas, people and technologies.

Angie Silva provides a view of emergent energy infrastructures that are already contributing to a sustainable future: edge technologies. In Australia, an abundance of sunshine is yet to be matched with a large-scale investment in solar and other renewable sources of energy. However, consumers and businesses are taking the initiative in the absence of serious federal and state government action, governments which continue to privilege fossil fuel and the extraction economy rather than harnessing the power of renewables.

Andrew Sunley Smith's three-part contribution builds on his experience of living 'off-grid' in remote Canada. His written contribution invites a

sustained period of solitary reading; taking time to pause and imagine the lived experience of remote survival. It is emotive, visceral and resolutely human: pain, humour, fear, injury, credulity and physicality. Above all, empathy. Empathy for the natural environment and the species within — dogs, horses, moose, fish, wasps and both likeable and unlikeable humans. Sunley Smith mourns the passing of one human (Rawson) who was "killed by a skyscraper" yet is abhored by another: "White trainers out here [?] — fuck off."

Sunley Smith is inspired by Henry David Thoreau's *Walden* (hence *My Walden* in this volume), published in 1854. Thoreau lived for two years and two months at Walden Pond in Concord, Masschusetts, earning a living by his hands only. It was approximately nine years since he initially went to live in the woods until the book was finally published after an earlier book — *A Week on the Concord and Merrimack Rivers* (written as a homage to his dead elder brother John) — failed to impress readers and publishers alike.

Sunley Smith picks up the transcendentalist Thoreauvian project with aplomb, taking us through the landscape of his mind and his environment. It is an account which connects country, land and living beings through embodiment, where the tools for living include not only axes and vehicles, but learned practices of smoking meat, sourcing and storage of firewood, the nurturing of essential plant foods and the tending of livestock. All of which is far removed from industrial manufacture, capital markets and the frenetic energy of 'progress'. Is this a necessary or idyllic model for a simpler life to come?

Critical discourse on the climate crisis draws attention to the need for ways of living which are more connected to land and in consideration of interspecies living. **John Kinsella** has been a passionate campaigner for the preservation of native bushland in his home state, Western Australia, and his contribution amplifies the plight of the state's mammalian emblem — the Numbat. Dryandra Woodland in Marradong Country has only just recently gained National Park status, yet it's native flora and fauna remain under threat in the largest remaining remnant of original vegetation in the western Wheatbelt region. Across Western Australia, native species and indigenous cutures are under serious threat from extraction industries — mining, oil and gas and large-scale industrial farming — dominating the economy and environment. [1]

Numbats (*Myrmecobius fasciatus*) are the only totally diurnal marsupial and although they used to be seen as far east as New South Wales (where they are now extinct), they are now confined to Dryandra Woodland. Their natural Wandoo habitat has been slowly cleared for farmland and been threatened by a non-indigenous fox population which the State Government has controlled by using 1080 poison.[2] (Foxes arrived with the colonists and have disrupted the ecosystem across Australia. They are not the only species that has done so). Kinsella speaks for a species that only marginally resisted extinction in the 1970s and is now endangered.[3]

Our transition away from extractive and exploitative technologies and ways of living is dependent on the ingenuity of a new generation of scientists intent on applying their knowledge to less nefarious means. Australian-based researchers **Astha Sharma** and **Fiona Beck** are working at the cutting edge of science and technology, in pursuit of the development of direct solar hydrogen generation systems. As they explain in their short chapter and video summarising an extensive research programme, Sharma & Beck see hydrogen fuel cells for vehcles as a cleaner alternative to petrol and diesel and the production of hydrogen for these fuel cells from rooftop (photo-voltaic, PV) solar panels may be one step closer.

They have been exploring direct solar hydrogen generation (DSHG) with a solar-hydrogen generation (STH) efficiency rating that is widely seen as being economically viable for future product development. They explain how combining Silicon (Si) and Petrovskite has the potential of achieving the 25% efficiency rating by 2025 set as a target by the US Department of Energy. Such efficiencies could see the widespread adoption of their technology and a revolution in energy production and use.

[1] We are hugely grateful for the introduction to John by Meri Fatin (http://merifatin.com/index.php/meri-fatin-work/) who interviewed him for two of her **rare air** podcast series, published in August 2018. You can listen to them on Apple, Spotify or Libsyn by searching for Meri Fatin or rare air.

[2] Nevill, S (2018) *Guide to Wildlife of Perth and Australia's South West*, Woodslane Press: Warriewood, NSW.

[3] Australian Government Department of Agriculture, Water and the Environment (2018) *Numbat: Year 3 Scorecard Summary (2018)* available from: https://www.awe.gov.au/environment/biodiversity/threatened/species/20-mammals-by-2020/numbat, last accessed 15 February, 2022.

Whilst we can hopefully rely on this new generation of scientists to help us design a better future, we cannot depend on the Prometheus of technology alone. There are alternative systems for living that we could do well to consider. Both **Charlie Mcgee** and **Brenna Quinlan** are doing their best to draw our attention to such alternatives not by academic publication but by doing and sharing their perspectives on permaculture through their creativity.

In the prologue to the revised edition of *Permaculture: Principles & Pathways Beyond Sustainability*, the co-originator of the permaculture concept, David Holmgren, gives special reference to Charlie's music in which he has translated the principles of permaculture into engaging lyrics accompanied by a high-energy, foot-stomping, electro-swing sound. It is a sound that one of us (Ely) encountered on a first visit to Fremantle (a few years before moving permanently to Australia) at a permaculture festival. When Charlie performed in Battersea, London a few months later, our draw to the infectious sound can only be described as pure 'fandom'! The album, *Permaculture: A Rhymer's Manual* is utterly replayable (so much so that David Holmgren now includes a copy in his *Principles Teaching Kit*). Fortunately, you don't just have to take our word for it — you can listen for yourself on the accompanying **Formidable Vegetable Sound System** music video.

The video itself features Charlie (and David Holmgren's) collaborator, Brenna Quinlan. Brenna has immersed herself in the principles of permaculture and develops a range of visual tools for education to promote these principles. Her colourful and friendly style of illustration has a serious message: we cannot go on as 'normal' plundering the earth of its natural resources without a consideration of permaculture ethics and design principles. Mgee and Quinlan practice what they preach and although they have, individually, experienced big-stage and televised coverage, their positivity for a better world deserves the widest audience.

Like John Kinsella before them, two more contributors draw attention to the plight of endangered species. **Zoë Sadokierski** and **Timo Rissanen** have worked on their Precarious Birds collaboration since 2018 and in *Avian Climate Messengers* they use their writing, design, illustration and cross-stitching talents to highlight the bird species being lost in the Sixth Mass Extinction.

Sadokierski has made her own editorial design choices as she weaves her own illustrations, photographer Nick Ritar and Rissanen's work through a beautifully crafted typographic layout (coincidentally choosing typefaces from the same typeface designer — Martin Majoor — as we have in other parts of this book). Sadokierski's informative and direct writing style is complimented by illustrations that demonstrate an acute and detailed understanding of bird species: Rissanen's threatened Munchique Wood-Wren; Sadokierski's fallen birds of bushfire and the often ridiculed Australian White Ibis (the 'bin chicken'). Perhaps the most arresting image of all is the smoke-hazed sun Sadokierski encountered on landing back in her home city, Sydney.

What links Sadokierski and Rissanen's chapter to the following one is the cataclysmic 2019-20 Australian bushfire season. We give coverage here of **Chris Flack** and his *Mate Act Now* campaign in response to the climate emergency. Over 200 designers contributed posters which are now available to download and share. Flack has initiated and curated an impressive portfolio of visual design work that helps to communicate the severity of the situation we are in. It must be serious if a two-year old also has to make his voice heard through a campain poster; Flack's son Leo makes his own visual contribution.

Lucas Ihlein is an Australian artist who explores the relationship between 'socially-engaged art, agriculture and environmental stewardship'. He is an adept communicator across media, which makes him the ideal collaborator for our book. Ihlein sheds light on the ground-breaking (and ground-measuring) work of inventor Allan Yeomans who, now in his eighties, is working hard to transition us to a different kind of carbon economy: one that rewards farmers for their efforts in CO_2 sequestration. Ihlein's passion

for improved environmental stewardship of land is reflected in both his writing and filmmaking, which is sharp, honest, informative, discursive and social. He shows us how we can confront the knottiest of challlenges through individual persistence and vision, but in a collective spirit. We now need to make the bold step of moving to a new carbon economy and value the stewards of our lands (farmers, pastoralists, indigenous land owners) to enable them to survive. It's a different type of extraction economy but one that our soils will be grateful for!

In compiling a book that both informs *and* provokes, we were referred to **Gabrielle de Vietri** and Will Foster and their collaboration *A Centre for Everything*. The rhetorical work that design and art has to perform (for example in the poster designs of *Mate Act Now*) has also to be reinforced with data. With evidence. De Vietri and Foster's work provides such evidence.

Fossil fuels + the Arts is an interactive data visualisation of arts patronage on the part of the fossil-fuel and mining industries in Australia. It connects major university galleries, state galleries, major festivals and contemporary arts organisations to the corporate and social infrastructure that supports the fossil fuels industry. Following the flow of capital, political influence and material resources, such forms of art and design are critical to a healthy, functioning democratic society. In a networked society such as ours, relationships between entities are never fixed and we should remain, as de Vietri and Foster are, persistently vigilant of these changing dynamics through the kinds of tools that they use in their work.

Whilst the path that Australian politicans and business leaders have taken remains oriented towards the fossil fuel business-as-usual, in the rest of the civilised world there are signs that even the largest oil and gas producers are taking the humanity- and planetary-responsible, renewables route. The **OurEden** team tell the unlikely but real story of how the Danish Oil and Natural Gas company transitioned to being 85% renewable.

For the busy Woodside, ExxonMobil, Chevron, BP and Shell executive, the short essay is also accompanied by an educational video which tells the story with data and image in only 1 minute, 39 seconds. Now there are no excuses for making that transition to renewables well within the time required to meet the Paris Climate Agreement targets. Even with the introduction of not-so-green hydrogen projects,[4] there is some way to go before Australian, American, British and Dutch companies can confidentally join the Danish 'pivot' champions.

[4] Matich, B (2021) *Fortescue capitalises on Woodside and McGowan's hydrogen greenwashing embarrassment [sic]* in pv magazine, pv magazine group GmbH & Co : Berlin, available at: https://www.pv-magazine-australia.com/2021/11/02/fortescue-capitalises-on-woodside-and-mcgowans-hydrogen-greenwashing-embarrassment/ , last accessed 16 February, 2022.

Our final contributor, **Sien Zhou**, reflects on her time in Western Australia — a biodiverse landscape the size of Europe which has recently experienced extreme weather events — and on the future of the planet. Given the desertification of many parts of the planet, Zhou imagines a world where we live underground, using our advanced technologies to secure the water and energy that we need to live.

Throughout the book we have injected our own critical reflections or provided information on other aspects to energy production and use. We take a look at nuclear energy and the waste that it creates, the power of our Sun and re-visit an idea of one of our inspirations, R. Buckminster Fuller, who imagined an interlinked, global energy network. In the penultimate chapter, we give an insight into the origin of the *Climate Domesday Book* and the technology behind it, whilst in the *Postscript* we discuss the environmental credentials of print and digital books. We've also provided links to useful resources for further reading, listening ot viewing in our Directory section.

The idea of a hybrid print-digital book placed in a public exhibition to provoke public discourse on the future of the climate and how we might live in the future joins a growing body of research in the field of 'speculative design'. Speculative design is emergent from the writing and design work of Anthony Dunne, Fiona Raby and a cohort of researchers at the Royal College of Art, London.[5] Speculative design is a form of design that is separated from the 'marketplace' and allows designers to not only explore new technical or aesthetic possibilities but also the implications of the science and technology we encounter in research institutions — and an opportunity to confront

[5] Dunne, A., & Raby, F. (2013) *Speculative Everything: Design, Fiction, and Social Dreaming*, The MIT Press: Cambridge, MA & London, England.

the major social, cultural and political issues that contemporary society encounters. Speculative design is described as a 'species' of design that joins other species of design such as 'Adversarial Design', 'Design Fiction', 'Critical Design', 'Anti-Design, 'Radical Design' under the genus *Discursive Design.*[6] For Tharp & Tharp:

[4] Tharp, B.M., & Tharp, S.M (2018) Discursive Design: Critical, Speculative and Alternative Things, The MIT Press: Cambridge, MA & London, England.

> "Speculative design encourages the imagination of alternatives and tends to be softer with regards any critical positioning. While its artifacts can still be highly provocative, the messaging itself is generally less alienating initially because the discourse takes a back seat to the speculative scenario—often the audience eases into the discourse after considering the "story" or context." (p.86)

You can judge for yourself whether we have been soft on criticality, but we do want to provoke new ideas and actions. Thus, when you interact with this book (reading, watching or listening) we want to encourage a deep consideration of the ideas of our contributors (the 'social dreaming' imagined by Dunne & Raby) — in particular on what we might do to confront the climate emergency — and to reflect on (and perhaps tell us) about your interactions with the medium of a print-digital book.

We have tried to present a diverse and balanced view of the future of energy and of the wider climate crisis. In designing and editing this book, we wanted to provide a prototype not only of the future of book publishing but also a prototype of how people can come together to share and disseminate ideas. It is a book as an event. A moment in time when a group of people — many of whom have never met face-to-face — came together with a common purpose: to alert as many people as possible to the 'what is?' so that we can shape a positive 'what if?' We hope this book is the first of many more.

Philip Ely

Innovating from the Edge.

An Energy System Revolution is underway

Angie Silva
Senior Lecturer & Researcher
Curtin Sustainability Policy Institute

Edge-consumers, edge-technologies, edge-entrepreneurialism are driving innovation.

In an energy system under transition, the edge isn't just at remote fringes of rural distribution networks, it's behind meters at every point of the grid.

The challenges the energy system is facing from the charge towards decarbonisation, distribution and digitisation are all manifesting from changes at the edges.

Critically, the answers to these challenges will be found, not in strict market control measures and imposed network controls but at the edges where solid inverters and smart control capacity provides virtual synchronised generation and synthetic inertia as well as fast, algorithmic, autonomous operation.

Energy innovation involves leveraging off the energy assets we have, while also incentivising and harnessing the rapid transition into clean and decentralised energy. Thus, energy system control now requires greater understanding, investment and research and development. Currently, effort is being put into the design of control systems that ensure reliable, robust, and economical operation of microgrids in either grid-connected or stand-alone mode.[1]

Control is now the consumers' prerogative.

[1] Olivares, D. E., Mehrizi-Sani, A., Etemadi, A. H., Cañizares, C. A., Iravani, R., Kazerani, M., Hajimiragha, A.H., Gomis-Bellmunt, O., Saeedifard, M., Palma-Behnke, R., Jiménez-Estévez, G. A., & Hatziargyriou, N. D. (2014). *Trends in Microgrid Control* in **IEEE Transactions on Smart Grid**, 5(4), 1905–1919. https://doi.org/10.1109/TSG.2013.2295514

"*The major insight of the past 12 years of operating in some of the most remote and power-poor areas of the world and then bringing those lessons into mature energy system undergoing significant transition, is that innovation in planning, in purchasing decisions, in operations and in control – is being driven from the edges. Not from the centre."*

Rod Hayes
CEO
Balance Services Group

Top: Ariel view of off-grid energy project at James Cook University (JCU) Orpheus Island Research Station.
Bottom: Western Power and Balance Service Group partner for Stand-Alone-System roll out.

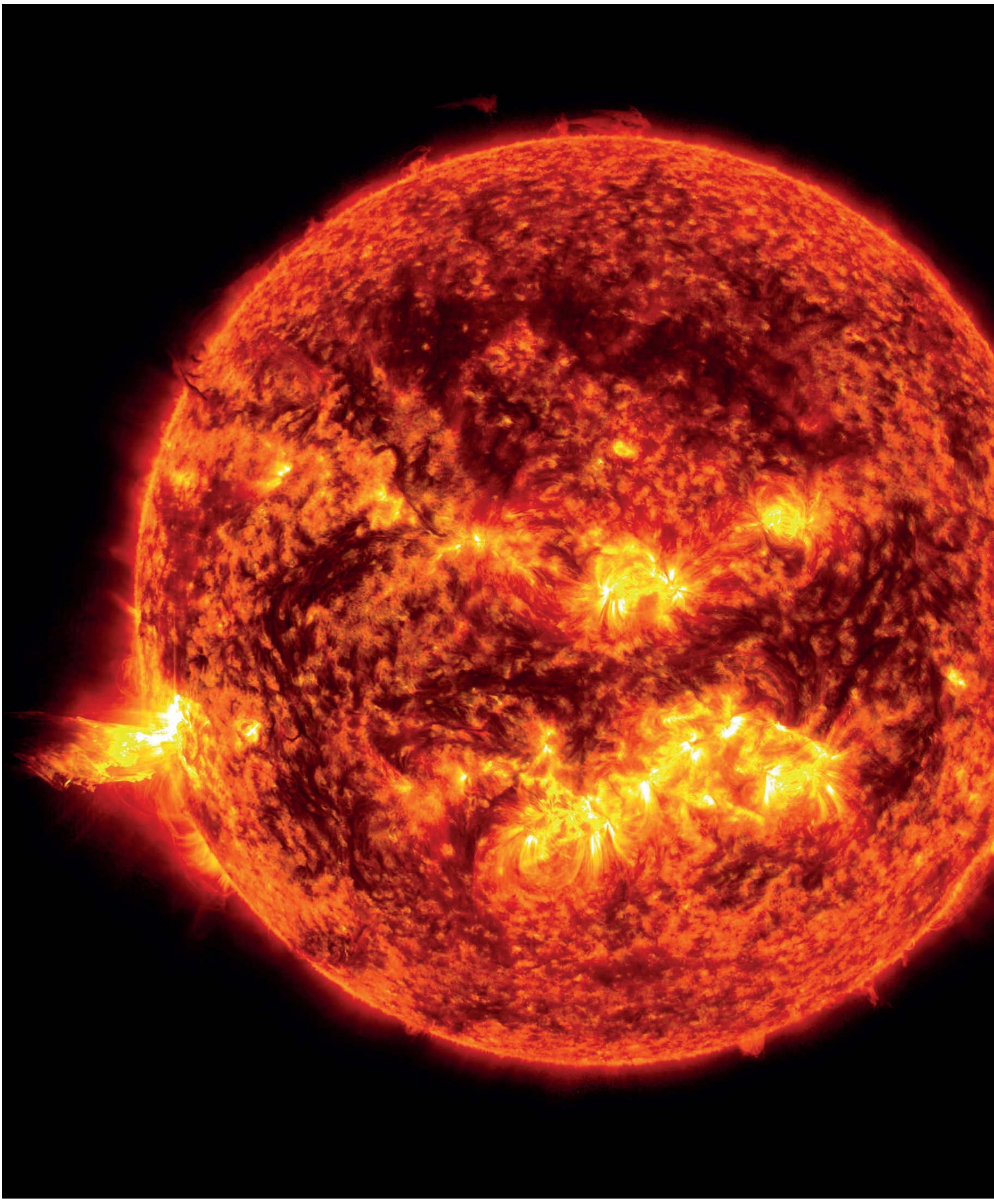
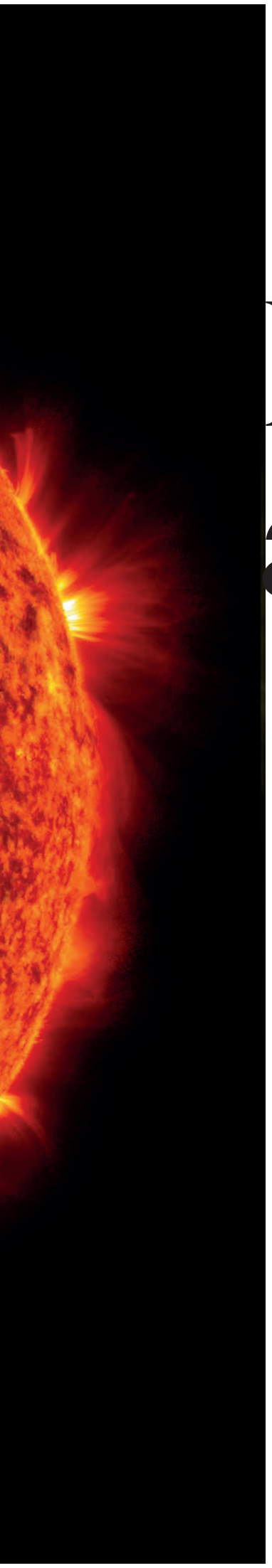


Image: Adobe Stock



Energy abundance

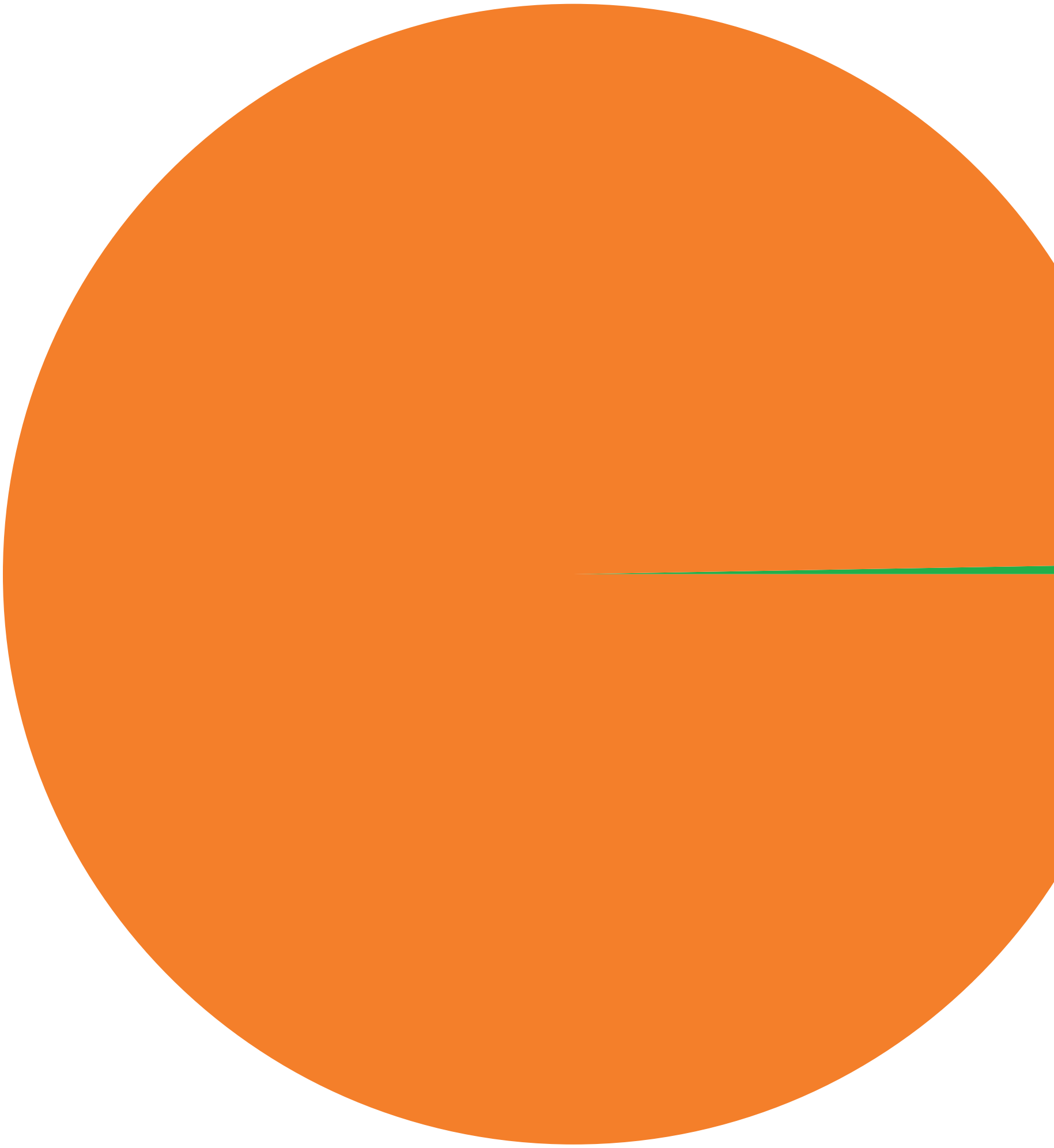
Words & Graphics: Philip Ely

WE DO NOT HAVE TO LOOK FAR to find a renewable source of energy in our solar system: the Sun. It may be heating our planet at levels soon to be unsustainable to life on earth, but that is because we have not looked after our own atmosphere.

We know that the sun provides energy essential to the flora and fauna around us, but are humans making the most of the energy that the sun provides?

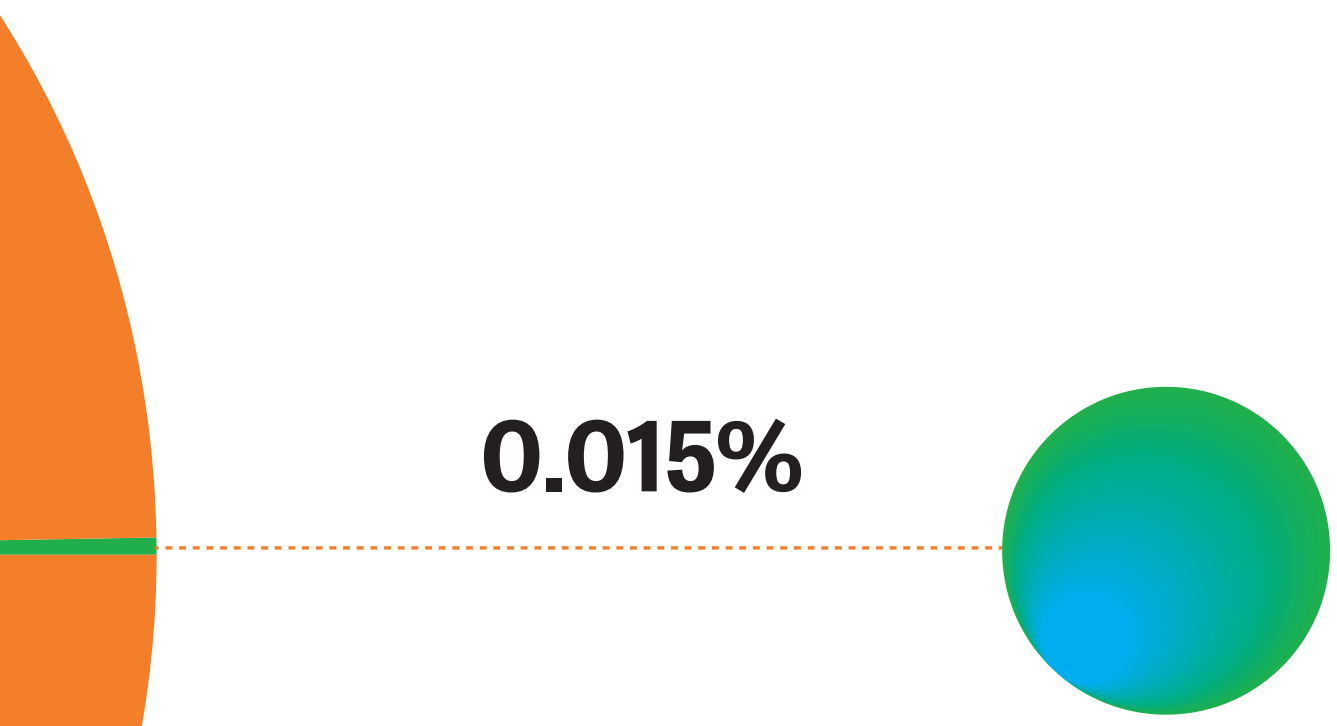
On the following pages, we draw on the work of theoretical physicist Geoffrey West to draw attention to the energy abundance in our own backyard.

Climate crisis? Not if we make a rapid transition away from fossil fuels and make full use of the Sun. س



Million trillion kilowatt-hours (10^{18})
of energy per year

Kilowatt-hours of energy from Sun to the Earth in one year



We use 150 trillion kilowatt-hours (1.5×10^{14}) of energy per year (0.015% of total available)

or...

Source: West, G (2017) *Scale: The Universal Laws of Life, Growth, and Death in Organisms, Cities, and Companies,* Penguin Press: New York, p. 240

1 hour of energy from = the Sun

1 year total energy needs

Source: West, G (2017) *Scale: The Universal Laws of Life, Growth, and Death in Organisms, Cities, and Companies*, Penguin Press: New York, p. 240

1 week of Sun =

168 years of energy

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2025 2131
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Extrapolated from: West, G (2017) *Scale: The Universal Laws of Life, Growth, and Death in Organisms, Cities, and Companies,* Penguin Press: New York, p. 240

My Walden

Carbon Supremacy

My Walden

Carbon Supremacy

Stimuli / Process / Outcome

A Formative Iteration of the Migratory Projects & Micro Gestures Series

= Creative practice informed by direct experience and the art of encounter

Over two years, Contemporary Artist Andrew Sunley Smith undertook a radical lifestyle experiment. After experiencing the politically imploding and increasingly xenophobic culture of the UK, and witnessing the national riots of its post recession discontent — and the growing culture of state agitated fascism and the establishment of the 'Border forces' — Sunley Smith strove to find and trial a more essential, bucolic life, closer and in direct rhythm with nature in Northern Ontario, Canada. For this , he left two highly regarded professional positions in Glasgow Scotland and took great risk both economically and personally.

Extending upon his interest in pragmatic outcomes and with a will to apply artistic skills and creative tenacity beyond institutional realms, the aim was not only to survive, but crucially to see if contemporary art still remained and could maintain any powerful purpose in this challenging situation.

Locating an 'in process & partially re-wilded 19 acre property' — that included solar panels, two natural ponds, significant forrest and meadow land, and a run down barn/dwelling — Sunley Smith was able to lease and trade labours for land and shelter from its owner. With purchase of an old truck which he restored, an available working tractor, rusty trailer, blunt chainsaw, neglected tools and animals and only a wood stove for heating, Sunley Smith managed to survive minus 36-38°C winters, providing a liberating sense of what he describes as independence within dependence of contemporary culture.

He also learned animal husbandry and to sustain himself on traded eggs, fish, vegetables and herbs grown from his own garden plot, along with meat products which he learned to process and preserve through smoking techniques. What was discovered was an intensive engagement in the success and unrelenting harshness of natural systems and also its awakening affect.

Manoeuvring off-grid takes planning, investment, patience and the removal of fear.

What follows on the next few pages is a partial and basic photographic account of this period: the realities and tactile intelligence required to realise a contemporary, pragmatic, timely and romantic ideal at a time of extensive up-skilling driven by the awareness of environmental catastrophe, exponentially related anxiety and the increasingly toxic affects of capitalist and neoliberal culture on its own peoples.

The project acknowledges the site and traditional owners of the land that taught the artist so much.

With profound thanks to The Algonquin and Mohawk First Nations peoples of Ontario, Canada. Their continuing fight, success and legacy throughout all systems imposed.

During this above time artforms were increasingly manifest in what can only be described as 'vision forms'. These were also produced in tests off grid - and through direct interaction with all elements above (including forrest and animals), the large scale works of the exhibition *'Carbon Supremacy'* — in its entirety — was fully conceived and conceptually clarified.

> *"Art, like knowledge should not be an object of cool disinterest for mere contemplation — nor a representational stand-in incapable of use, but an all encompassing, progressive tool comprised of the real, of stuff, of tolerant ideologies, of risks — in art at least; beyond the facile ocularcentricities that mesmerise our constant idiocies."*
> **Andrew Sunley Smith**

Inuksuk *(inuktitut)*
Point of reference / navigational landmark / marker of travel routes / food cache / place of veneration

All images on this double-page spread courtesy of Andrew Sunley Smith unless otherwise stated.

Post Colonial
Converted cedar barn, Solar, Fresh water, 19 acres of re-wilding land. Endemic species only.

Will exchange place for labours Mutually Beneficial?

Settler
Barn Provides: 46 Panels / approx 768 sq Feet = 14 to 15 KW system / 1, 680 to 2,100 kWh of electricity. Average North American Home uses : 877 kWh pcm - this needs 19-23 solar panels.

We are on traditional Mohawk & Algonquin land.

Provincial boundaries state Algonquin forrest to be 7,653 km2. As per 1893. *White lines.*

Bigger than some countries - Though carved up substantially smaller than originally defined by first nations.

Brunei (5,765 km^2), Trinidad & Tobago (5,130 km^2), Cape Verde (4,033 km^2), Samoa (2,842km^2), Luxembourg (2,586 km^2), almost as large as Jamaica (10,991 km^2).

All images on this double-page spread courtesy of Andrew Sunley Smith unless otherwise stated.

Ad Hoc: *This small patch of land and space can yield so much.*

The presence of the trees and sweetness of the air dominates first encounters.

It's late in the season - at least 8ft height x 11 ft long pile of wood needed [nothing here].

- It's a mess. Nice Ad - but so much to do.

They say 'a wall' of wood.

'1 cord' North American unit is:
8ft L x 4ft W x 4ft H

To gather.

I calculate:
11 ft L x 6.5 ft W x 8 ft H = 572 cubic feet / 16.9 cubic meters = 4.5 cords to be made ready.

Saw it, size it, split it, stack it to aerate. Peel old barks to dispel moisture.

Precision is everything.
Balances.

Heavier than it looks,

I'll Gather, not fell if possible - it's more work but essential, I'll not take deliveries - but trade if need.

I'll manage on less.

Spread labour through the months before the ground freezes.
Dig the artichokes before too.
Gather herbs
All deadwood
Cut the grass so the coyotes can't creep
Sharpen all blades
So much in disrepair

Acute angle of the file

The limb taker…

Meeting other 'pioneers'
Nature was not the problem - it's the human error. Always.

An average day - It's all work - but integrated, it can and should be pleasure too. Once I adapt.

All images on this double-page spread courtesy of Andrew Sunley Smith unless otherwise stated.

Catch the sun, check supplies,
sharpen, Boot liners,

Food all round - dutifully, check
contentment levels

That pile of trunks is looking at me,
how much rope do we have - could
I drag one. Down through the body,
glove pads shoulder, through the legs,
into ground

Don't yield.
Best method is to have a busy morning

That repetitive cutting action is
tearing my tendon, jarring it.
Acreage

Winter is cleansing -
Work out where best to store things -
defensive order

So quiet here, as never encountered.
never slept better - moist sweet air.

Catching fish is better than sitting in
traffic - not polluting either,
All ticking here is crickets - Louder
with life

take time to touch the long grass,

The life of so many horses

sense the weather

All healthy

I will

As death can also be.

Real Mass

billions of engines just ticking over

I miss nothing

How much hatred we pull through life,
no governance here. Just labour and avoiding injury.

No words, just all in body and brain - just push and adapt, feel the edges

I feel part of the weather

Sweating now, food soon — I've been at it for days, that pause on the step — overview. What you see — what you really see

when talking stops

The afternoon is for finishing, collect that wild rocket as I pass. It oxygenates the blood.

Efficiency of movement

Resting regulates hard labour
& wow
You should know pain.

you have to dig deep and never leave unfinished.

That beet, with fish + rocket.
Artichokes produce gas, I'm sure the originals made jokes

My body is awake on that.

Got to gather flat stone for the fire base.
Eat raw where possible, the fire cooks well, steady + keeps knees warm

Thermal mass

This dwelling, cedar clad, partly insulated — built on ground, no clearance or air gap though.
Permafrost. Dangerous.
Bad planning or zero awareness. Lack of intelligent conversation too — seen evidenced in the build

This is an issue.

That large frog is watching me - (how does it survive a winter)
You seem happy now - (but it's lean)?
Goes to ground I guess —
It looks tasty too… but never eat your friends.

but that will freeze at least a meter…

Cut through walls so the warm air can flow / No sense of pragmatics here Maximising fire.
Address the architecture.
Fill the gaps.

- how could they miss that...

Here - bad design can really kill.
Air gaps, gaping traps

Organise and ready tools - Machines for living
dwelling with no air gap - its directly on the permafrost.
A white mans building. If only they'd researched or raised the floor

That's going to hurt

No one is going to do it for you.

Fireflies, spring evenings - look at them all.
My eyes are better, adapted to the night.
No light pollution here.

Goodness for the senses.

Spring is easier. The grasses the hardest, all the clearing to plant
Everything grows so quickly.

That meadow will shred skin, all the shards - last time for shorts when doing this.

All the way up my arms, cut to shreds.

I got a fish bite with a piece of fried artichoke. Pole and line
Plenty of insects and worms for hooks - (though this always feels the most brutal).

Timeless sitting, more tuning in - this grass by the ponds is more comfortable than any chair.

Repose

Summer, so hot - Washing, Swimming,

Heaviest is the water cartage for plants.

Sweat for three hours, labour early morning, (sleep midday - avoid heat) - complete in afternoon.

Autumn, the mist and the moisture so damp from the ground.

Rained hard for days. Boggy

Will have to sort that next spring. Digging channels for run off

Furrows to satiate the drier patches.

The Adze. A tool of ergonomic genius.

I stand to stretch, look up and pause. Like an animal popping my head above the grass.

Noiseless, sound proof, head low, earth muffler - I can 'hear' each blade of grass.

Susurration. Silence - Peace.

The outside world is fog, electrical buzz, a sickener, sub base concretiser, Administrating nothing. You busy? or just greedy on data,

All that noise.

White noise - really. Reproduce, Codes and driftnets. Forcing water into sand

Back there - Open close, apply, push towards what?
Did I get paid? I don't want money.

how much do you want?
Dumb policy- Idiot managers - Cycle.

Hermetically sealed, shelf life, service culture, risk less and scheming to oppress

I cut through it.
Tore it off

There really is no stability. Your safety is just temporary illusion.

Agreed and shared Delusion.

I was going to weaponise,
- but the situation pushed me. I tried Not my character.
reason. Calm. Communication
Just their dumbness, government
funded supremacy, quota.

They'll never be brave enough to step out of line.

Conjuring violence

I'll take my quota - that's why sniping exists.
A prepping chest. An open broken heart. Fire Lighters

No where for the anger or rage to go. They have to carry it with them now & leave everything else.

It only creates hatred and enemies. Really not smart.

BorderForcersXenophobesRacistsFascistsHeteronormsShamersSizeistsJudgersLimiters Binary Brains
Not even worthy of punctuation

Your toxins will out, Suck out your tar. sicken and die. I wish you and your world dead.

He stood square, held that horses chest as it tried to crash the fence. Took that force. All others fled. The calmness of him.

My loyal friend. Defender. Protector. Wordless
Attack command is a hand gesture - for silence (Clever).

They know more about this place than us..
He tested me when I arrived, that big stick wrestle - checking out my competence
I see he reads my face, micro gestures. Shadows me on the tractor.

46 panels - but when the sun goes - it's the pile that provides.
That's a nice balance - Ancient + New
Crossflow.
The solars frozen over with snow. Deadwood + Solar

No way to leave the Co2 in the wood?

That old engine, polar warmer. Even fuel freezes here.

The dust is incredible. No care

Maintaining = connects you to being alive. A preservation necessity. All about energy economy.

Eradicating the freeloaders. Providing finite resources.

Considered - Resoluteness of action.
Fears got no purpose - only to stultify
A Numbness of mind or body - even worse together.
This deadly combination can reject reality. Then accidents.

Never get overcome by the vastness that surrounds you.

Fuck, there's no system here. - Just disarray.

You'd better have skills, methods or - you will perish.

One of these dogs will eventually die in a battle.

All that wet grass clogs the blades, it's heavy too. Here's more rain, right through.

Hope is the refuge of idiots.

There's a man there with a knife.

Keep going.

Black Bears have been round again - 3 dogs will see to them.

Turn out the lights.

Coyotes send a decoy - while the others run the fence line + look to cut in centrally.

= not enough on its own. Sensitivity and knowing,

Feeling when to act.

Smart.

Tuning in to the sun

- I can tell the time from the shadows here & temperature changes.

You get better at it.

Rawson died. Fell from a high rise. 17 floors. A skyscraper killed him. He loved life the most.

He could name buildings and architects globally.. Talented recall.

Why would an insomniac live that high up? sentence.

He went over the balcony. ..The end of his…

That city machine - bounced his organs out of his body.

The chickens are happy with their new quarters. Double story.
A fair price per dozen.

Egg production up.

More fuel.

Get the blood moving in the morning or you'll freeze all day.

Sweat can freeze in thermals, take breaks, dry out.

Wool - by far & always best, simple. + rain coat, good boots, & Grip. All seasons. Leather. Best.
Deciduous trees are best cut in winter.
If felling, split them as soon as possible, harder to do once dry.
Birch, Maple, Ash, Elm, Oak, Hickory, red cedar.

Cut the limb from below in the direction of its growth, upwards - easier.

Gloves with an air gap.

Frozen wood is fragile, easy to split, just heavy to lift - thaw it in the sun. Dries best without bark

All leaves are great organic compost.

Big trunks - saw horizontal - ground parallel - then turn them
No blade in that dirt.
Heavy job but precise, Even in pouring spring rain -

- but my fingers and knees are frozen

It will blunt.

Drenched to bone.

It's Beautiful.
J leads that band of offenders to log, like big kids

Their bond is caring + lots of swearing.
The trees don't usually argue, Just the landscape if your'e out of step.
If you get it wrong,

they'll answer by rolling and crushing you

The sun is only just up - evaporating mist, that earth scent again. Filling.

That little bird, the early one in the high tree - warns all others in the forrest of the hawk.
Bird species come in waves, a time frame for each. Very politely.

A humming bird - in reach of my hand - gathering.. 1 hour.

It's like an Album cover from the 70's, under the sleeve — endemic — bucolic.

I never knew places still existed like this

All that trouble for a 25c rubber seal.
Now the gears hold pressure & fluid. A year long at it. Filler, solder, new tyres and belts.

Remember to weigh down the rear, *so you don't slide out on the ice*

More Traction

Spruce, cedar, Birch. My senses are thanking me.
No Distraction.
There's more oxygen here, - the bio mass.
It's rich in life.
Affirming.
Gifts you when you provide your time.

I've never felt more alive.

Today I nearly lost my head, taking risk. 4ft chainsaw, that big snapped, fallen tree I've been at for weeks
It's balanced and some tonnage,
To lift, steady and cut and run - just there - but its going to grab and buck

precarious overhead

I feel it pulling

No second chance.

Even the dog is worried.

I felt the chain move the air just above my skull, I ducked, Very lucky.
A reminder to not take too much. Unnecessary risk.

But I got it.

It - nearly got me..

Will take me days to trim it and get it back.
But measuring just wastes time here, just do it.
Snow chains, useful grips for timber too.

5 tonnes probably

The power of the body, mind,

when all distractions are gone.

'I feel, therefore I am'

This site has incorporated me. I'm an element in this system.

My actions matter.

That big strapping frog thinks I'm ok, tilted left and he's gone now.

Dipping drinking dragon flys.

I need that compost, broader - big as the tractor bucket.

A rebuild.

The dogs will turn the soil.

Got to get planting - protection needs addressing

Seeding

The chickens are laying better. Comfort produces contentment. It's basic. They were neglected when I arrived. Starving prisoners.
A full foot of water frozen solid. Poor buggers. Fire on
Build room for them all - their bodies, their muscles.
They are smart.

- warm the feed.

Their contribution IS essential

Respect produces Respect

Even the wool carpets are on the bed.
Ice inside the windows.

That deer skin too

The door is frozen to the frame.
Cocoon until sun.

Heads wrapped.

Thermals on for days at a time.

Giants of success ; Sunmato!
What puny things we are.
Moose - *Mini bus scale* - you believe it when you see it..

Big as my hand.

Prehistoric size - they glide.

The yellow jackets arrive & are nesting. but I pass them each day, let them get on, they see me, register me and all spring - there is no bother.
These wasps and me.
Mostly people kill them - fear again.
That stupidity.

They come with notoriety - aggressive associations

Balanced.

Lack of exposure

W.A.S.P. - White Anglo Saxon People -

Way more dangerous.

The world burns outs there Sustainable's are hard for capitalism. As the advert said - You can't eat money.

+ there are better values and things to trade

We'll choke ourselves, deplete ourselves out.

Everything is now an expression of it (capital) - even escapism - but no escape here; more a trial, a test connect.

You need not perform here.

There's only the animals, trees and land

A giant raven - wingspan silhouette in flight - full across his back.
Latissimus dorsi - Spread

Edge to edge

Animism - Nations - First

A more balanced ideology than *status pretence.*

Non verbal - energy supplanters - just abundant communication.

Imagine us as silent creatures

Concrete now feels strange underfoot - my senses and body have changed.

A frozen pillow on a sidewalk

The snow cleanses.

There is no need to *shoot* -

Spectacularised Hollywood minds.

Nature is not a Disney film

I missed nothing of your culture -

You enforce that it's mine, but it's not.
I miss nothing

I no longer care for the systems outside - look where they lead us.

All you need is here.

But you never plan for human error.
No guarding against it,
Repeat, train, Repeat. Ramify

– like it has a will to be – all its own.
Stupid is the biggest danger.

Competency out here is different. It's all transparent.

I'm sure it would keep our population in check

Eco Fascism…

That little alarm bird again, from tallest tree – personifies all that friendship is.

Watchful

Shit, its freezing.

Never let exhaustion bring you down out here, NEVER in the snow

The stifling primary form of cities, puts tension in your body – through every orifice – like being between guillotines,

shavers of will.

A rebellion against enclosure

I couldn't walk on concrete for nearly a year.
You'd find me traversing and happy on the verges

– underfoot, no impact up the legs,

silence in the body

The air conditioners, just awful, so Alien.

The noise of people talking, so much talking, of nothing, about nothing in a nothing place.

So much Talking

Always getting, always ascending - bleating needs - there's no room for it out there.

Breath is all, don't waste it.

Try not to go right through - but around instead. (Warfare – ? Life Lesson ?)

Talk it, write it, copy it, send it –

is any blood still moving? organs stiffening, forced angles.

Stand up at the screen - just another variant of the super server.

Skeletal adjustment of a previous life.
Just get it all out.

& Then The Power.

Decades

I dreamt my armpits were black, running black,
my groin, arse, ears, nose, my eyes and where my feet contacted ground.
Black contact points..
All that was polluted in me?

the outside world?

A caught fish, black organs, translucent black flesh inside.

And all the forms came.

The whole show around me. A message in textures. An unmistakable feeling.

All this beauty and balance, turned black, scorched, gassed.. deceased.

Over 9,000 audience attended.

The stench of a burnt out culture.

Its forms, suprematist repeating, cycling, consuming ever more. In the detail, on the senses.

A petrified example of what's being put down.

Its methods, primary forms - macro and micro, its cyclical forces, dissipators, cutters, crushers, burners, heaters, clutches Removers, flayers. Colonisers, takers - Schemas.

When administration becomes religion
- poisoning all.
Belief is the problem

Fascism as form

Imprints, imparts from their tiny bent personalities.
No leadership there. Extractors, radiations and compressions.
In their comfort.
Dimly lit

they never left.

Like pot plants, birds in cages,

They'll die enclosed.

A quota - To destroy

That little bird that shouts out and shadows the hawk - warning ALL.

Those that listen - are those that care.

Avoid the frightened ones that only stare.

I think our bodies are leaner - muscles adapted.

The old tools work with the body better.
I mean when you swing that, it gives rest between blows - so your muscle can engorge or lengthen again…
that weird plastic- badly-balanced-thing, just causes repetitive stress..

Those old Swedish axes. Beautiful through applied knowledge

Direct Experience

White trainers out here - fuck off.

All that privilege - something invasive.

Ill observed.

Indicates to useless.

Vulnerable?

A white rabbit over tar sands.

Physiology / Simplicity - Listen to it. Respect it.
What our bodies are designed to do.

All this over complication - collections of nothing, Ghosts in object form

— just feelings never dealt with.

You'll trip and fall on that crap!

Wild rocket seeded between those rocks - you can taste its goodness.

Spruce tea, It's steam defrosts the air,
relaxes the nostrils
The most vitamin C.

Sweet, *Vitali TEA*

Hummingbirds again — precise in their business — how far have they come… no bigger than my thumb

Fixed in the air.

Earth just smells so rich.

'Hummingbird moths' on bushes too –

so strange.

The form of a black bear.

Moving like forrest junkies.

A hairy misanthrope - My kind.

Snowed in, the truck won't start. I'm not worried.

I'm in its rhythm

& your voices mean nothing.

We must operate differently

Hair snap freezes too.

Pass the dog - absorb the warmth
Slippage - Machinery was no match, just an approximate shield.

Chance to measure you, feel you, test against you..
This time planned, ready for your approach.

Wisdoms of calculated allowance.

Minus 37 Celsius.

Any further and flesh starts to freeze.

Apertures, frozen in snow.

It's stuck, Pour heat on.

Drenched me - all Fall

Wrapped frozen branches,
moisture expands all cracks. It will peel your skin.

Patella tendon, puckering ripple, like unwinding rope in tension

or the most gentle thing - unmoored - this lever.

Translucent finger tips

Bring it down, centred, accuracy is all.

My sweat, steady,

frozen in wool.

Live in you

Through my bones,

Drink you, slide over you

Drag my warmth across you.

Escape you, challenge you. Face you.

I know you are a killer, just your nature, your mass.

My prints covered over, another will pass… you care not
Recognised me for a moment.

I understand you - I see you.

Passed through me,
I pass through you — centre less,
steady.

You never lied. That I knew.

Cleansed, permeated, covered, flushed out, refreshed and forced

Always gentle — but worst of all — evading...

We only ever underestimated you,

We still think we have.

And —

Notes:

The ‘re-use centre’, at the end of my time.
Henry David Thoreau in a charity shop,

Prior revolt from grid.

Timed my range.

All variants of a steady character.

never remember being cold, no form to it.

Thought we’d measured

That arrogance.

Hope is the refuge of idiots

Lions in zoos are no longer lions.

There, the spine

Observations & Parallels

Not till we are lost, in other words, not till we have lost the world, do we begin to find ourselves, and realise where we are and the infinite extent of our relations

Henry David Thoreau. *Walden* **1845-54**

“

I went to the woods because I wished to live deliberately, to front only the essential facts of life, and see if I could not learn what it had to teach, and not, when I came to die, discover that I had not lived. I did not wish to live what was not life, living is so dear; nor did I wish to practise resignation, unless it was quite necessary. I wanted to live deep and suck out all the marrow of life, to live so sturdily and Spartan-like as to put to rout all that was not life, to cut a broad swath and shave close, to drive life into a corner, and reduce it to its lowest terms, and, if it proved to be mean, why then to get the whole and genuine meanness of it, and publish its meanness to the world; or if it were sublime, to know it by experience”

Henry David Thoreau, '*What I lived for*' in *Walden* 1854 [29th Printing, 1960] p.66

“No cockerels to crow nor hens to cackle in the yard. No yard! but unfenced Nature reaching up to your very sills. A young forest growing up under your meadows, and wild sumachs and blackberry vines breaking through into your cellar; sturdy pitch pines rubbing and creaking against the shingles for want of room, their roots reaching quite under the house. Instead of a scuttle or a blind blown off in the gale,—a pine tree snapped off or torn up by the roots behind your house for fuel. Instead of no path to the front-yard gate in the Great Snow,—no gate,—no front-yard,—and no path to the civilized world!”

Henry David Thoreau

'*Solitude*' in *Walden* 1854 [29th Printing, 1960] p.90

VIDEO

Credits:

Film by Graham Mathwin
Duration: 5 minutes 53 seconds.

Carbon Supremacy

Carbon Supremacy was a series of sculpted forms, imparted experiences, drawings, film elements and schema's in the form of a dramatic large scale installation created by Andrew Sunley Smith to explore notions of *Continual Combustion* and *Continuous Exhaustion* that highlighted our anxieties concerning our relentless and aggressive consumption of fossil fuels.

In an extension of core ideas within his large scale internationally reaching *Migratory Projects* (Australia / Denmark / Scotland) involving the use of vehicle engines as a destructive force, this project focused intimately on the issue of our continued use of fuel, oil and gas consumption and the growing presence of anxiety and evidence around climate crisis and carbon use.

Radiators, coolers, dissipators, primary architectural constructs and engine references all form the basis of these totemic sentinels to our cultural and current ecological breakdown. Colonial board room tables, 18th Century walnut chairs, legislative documents, sheets of lead, copper pipe, a lost humming bird, a deceased landscape rendered - deep in carefully selected torn, exploded tyre shred.

These quietly violent works aim to create an iconography of exhausted forms.

> *If we can see our culture as an engine, it is the most direct and best metaphor we have. Engines constantly consume, burn and exhaust as they continually move forward. Our houses, buildings, cities, and circuits are all engines. There is still very little we do on a daily basis that does not involve burning or consuming fossil fuel and resources".* [1]

The objects in this series pull from both historical and contemporary domestic and industrial forms as well as draw from the concerning emergent shifts in political ideologies observed while in Scotland, North America and Canada. The works were pushed further by witnessing the riots, destruction and civil unrest that erupted in light of the political and economic corruption that swept through the UK in 2011 where Sunley Smith witnessed and directly experienced the affects of cultural breakdown and its exponential paranoia first hand.

Presenting a tactile encounter and direct experience through artwork, the project intentionally put together a perceived outcome of what our current political mismanagement systems repeatedly deliver and align it with the emergent current forms of a dreaded Anthropocene disaster scenario. These elements and dynamics are deeply connected - yet have not had clear prior visual and experiential form. Many works — where possible — were produced off-grid using solar power, some with a small petrol generator, others were simply formed on-grid with routers and gas torches, speaking with the same language of the intensive aggressive industrial methods that commonly build our environments — so that the installation may be 'heard', discerned and imprinted.

Quietly brooding, disturbing and with somewhat of an intimidating presence the delicate hand crafted works, sculpted rendered, recycled, adapted, scaled up and pushed intentionally by perverse controlled combustion are an embodiment of the breakdown of industrialized culture and a visualizing of our continued relentless consumption of fossil fuels and cultural entropy folding out on an international scale.

[1] Andrew Sunley Smith (2010) *Migratory Projects: The New Co-efficiency in Contemporary Art*, Thorpe-Bowker: Australia, ISBN: 978-0-646-58330-3

Above: Detail of Carbon Supremacy at Fremantle Arts Centre Exhibition SPAN 2017, curated by Dr Ric Spencer. Photo credit: Rebecca Mansell.

Below: Detail of Carbon Supremacy. Photo credit: Paul Sutherland

Audience Numbers were above 9000.
Positive Critical Reviews.

Some folk walked right around and across the tyres, to get closer to the forms

Some were too scared to enter.

The previous director still complains about the enduring smell.

Everyone seems to remember the show.

Environmental Impact / Social Impact / Outcomes successful - Any ideological changes?

More Co_2 released - but in a form to experience and SEE - so that we might change. Impossible to miss, right?

Unheimlich.

Left: Detail of Carbon Supremacy featuring Thoreau's Walden (1960 edition)
Photo credit: Paul Sutherland

Above and Right: Further detail of Carbon Supremacy. All photographs: Paul Sutherland

SAVING THE

John Kinsella

NUMBAT

Image: John Kinsella, 2022

Saving the Numbat

from **Graphology Lambent (2021)**

1. numbat

Hesitation near midday
as termites sink into galleries
below open wandoo woodland

& beyond the reach
of numbat tongues.
In vacillation, this numbat

studies us with care or confidence
—
we only have our equivalents
to draw upon, but it eyes us for
longer

than we eye it — outstares, waits,
patient as doubt or as consoling
assessment might have it.

It is time for the numbat
to re-enter its den, to wait
for termites to rise again.

But who is inquisitive?
Now, recollecting, all images
have righted the midday

sun, throwing shadows
to clarify our
hesitation.

2. Theme

Here the theme is brought into focus
—
sharpening light, defining shape,
colour caught in transit of angles —
viewer to viewed — rainbow bee-eater
profile on branch now winging it
across our tri-chromatics, eliciting
opsin actions as if we were briefly
akin, or being called into the species,
an idea we invent out of 'nature',
overwhelmed in woodlands
we've left in the world for longer?

and from **Red Data Book (1994)**

The lists of endangered species
grow: all passes

before we want
to realize

that an attempt
to save is ludicrous

while destroying
habitat.

In Dryandra forest
numbats scratch out

a living. We assume
they are as conscious

of their bodies
as we are of ours —

can we be certain
that they're unaware

of how vulnerable
they are

to outside influence,
to being ended?

Their lifespans
so short.

Instinct—an unreliable
if determined partner.

This is why poetry
is a substitute

for love & not
vice versa. This

is why the red data
is the proof copy

for an anthology
of vanquished species.

Above: Numbat in Dryandra Woodland.
Photo credit: John Kinsella.

John Kinsella

Towards a hydrogen future

Research from Australia is set to revolutionise the production of hydrogen fuel with direct solar-hydrogen

Astha Sharma & Fiona Beck
Australian National University

Introduction

Rapid industrialisation in the last century has led to long-term changes in the climate or weather patterns of the Earth. Climate change has led to various issues like extreme weather events, increasing air pollution, rising sea levels, warmer and more acidic oceans, and damaged ecosystems, to name a few, and is seriously endangering human health and a lot of animal species.[1] Climate change is predominantly driven by global warming, which is the rise in earth's average surface temperature. According to Intergovernmental panel on climate change (IPCC), the observed global average temperature rise is mainly due to the increase in heat trapping green-house gas (GHG) concentration in the atmosphere and environmental changes as a result of human activities.[2] GHGs absorb and trap the heat radiated by earth's surface and release it gradually over time, which is important to maintain the earth's temperature. Increasing the amount of GHG in the atmosphere results in an imbalance in the natural process, resulting in an abrupt temperature rise. Sustained use of fossil fuels like coal, oil and gas for electricity, heat, transportation and industrial use is a major source of increased GHG emissions.[1]

Limiting the global temperature rise to below 1.5°C is essential to avoid the worst impacts of climate change.[2] The most significant GHG includes carbon dioxide, methane, nitrous oxide, and water vapour (which all occur naturally), and fluorinated gases (which are synthetic). The most significant GHGs include carbon dioxide, methane, nitrous oxide, and water vapour (which all occur naturally), and fluorinated gases (which are synthetic). Carbon dioxide accounts for around 76% of GHG emissions due to human activities and has a major impact even though it is not the most potent GHG due to higher concentration.[3]

Presently one-third of the GHG carbon dioxide emission comes from the energy intensive industry sectors and freight transport, which heavily depend on fossil fuels without any economically viable alternative.[4] While electricity grids and passenger cars can switch to renewable electricity as a source of clean energy, it is not feasible to electrify energy usage in all sectors. Deep decarbonisation is required in order to completely transition away from carbon-intensive fossil-fuels and reach net-zero emissions. To do this, we need alternate fuels that are based on

renewable energy for use in heavy freight and as a feedstock and fuel for industrial processes, that can provide long term solutions to fight the climate crisis.

Hydrogen, like electricity, is an energy carrier, and can be produced and stored in different ways depending upon the end use. It is not the primary source of energy (for example you cannot find fossil fuel H_2) but allows its transport and storage. Hydrogen has higher energy per unit mass, roughly three times of conventional petrol, and combines with oxygen to produce energy, with water or water vapour as a by-product. Since hydrogen contains a lot of energy per unit mass and contains no carbon, it can be used as a carbon free fuel, as long as it's produced by renewable energy. [5,6]

Hydrogen's flexibility in terms of production has made it attractive for use in a wide variety of applications, and it is already widely used as a feedstock for industry, for example to make ammonia for fertilizer. Recent years have seen increasing interest in hydrogen as an alternate energy source for applications like transportation and energy storage. Fuel cell electric vehicles powered by hydrogen are an attractive zero carbon alternative to petrol/diesel powered vehicles. They can be a preferable option for medium to heavy duty transport such as the freight sector where battery powered vehicles are currently limited due to shorter range and longer refuelling times. Hydrogen could also provide us with a way to export renewable energy around the world – from countries that have a lot of it – like Australia, to countries that do not have enough. The large number of applications of hydrogen also provides flexibility in terms of its use in the importing country.

Around 120 million tonnes of merchant hydrogen is currently produced every year, primarily for use in industries such as refineries, ammonia, and bulk chemicals.[7] Due to this, industry has well established hydrogen production and handling techniques. Unfortunately, the current hydrogen production methods relies heavily on the fossil fuels resulting in large amounts of GHG emissions, accounting for roughly 1% of the annual global GHG emissions.

Renewable Hydrogen Generation

One way to make hydrogen is by electrolysis or water splitting. Electrolysis is a process that splits water into hydrogen and oxygen using electricity to drive the reaction. This is a carbon dioxide GHG emission free process when produced using renewable electricity options such as wind and solar. Presently, less than 0.1% of hydrogen is produced by renewable electrolysis and is mostly used in applications that require high purity hydrogen. This is because it is much cheaper to make hydrogen from fossil fuels at the moment, which produces a lot of GHG emissions.

Standard technology to make renewable hydrogen requires an electrolyser (the component where the electrolysis reaction happens), a source of renewable energy, and additional components such as compressors and water flow systems. Additionally, the renewable energy supplied is not necessarily optimised to drive the electrolyser system and needs an additional power management device. Additional components such as invertors are also required. Together, these extra requirements are known as the 'balance of systems' and they can increase the cost of the renewable hydrogen.

Currently, electrolyser technology is very expensive, meaning that renewable hydrogen costs roughly three times more than fossil fuel-based hydrogen. Increasing demand for electrolysers is likely to reduce the cost in the near future as production scales up, and researchers are looking for ways to make them cheaper by improving the design, finding low-cost materials for fabricating electrolyser components, and optimising the operating conditions. However, scientists are also exploring new ways to make renewable hydrogen that could be substantially cheaper.

Direct Solar Hydrogen Generation

Direct solar hydrogen generation (DSHG) is one such promising method for renewable hydrogen generation, that converts water into hydrogen using sunlight.[8] It is based on so called photoelectrochemical devices, which, as the name suggests, combines solar to electrical energy conversion and electrical to chemical energy conversion in a single system.[9,10] Sunlight can be converted to electrical energy in certain materials, which can then be used to split water into hydrogen and oxygen. [9,10] This eliminates the need for separate power generation and complex

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infrastructure potentially reducing the costs and making it a promising approach for low-cost renewable hydrogen generation.

Our work focuses on developing direct solar hydrogen systems that use low-cost materials and existing solar cell technologies, combined in one system, to produce hydrogen cheaply and with high efficiency. Our system is combines the solar cells used to produce electrical energy from sunlight, directly with the catalyst coated electrodes where the water splitting reaction happens.

The 'solar to hydrogen efficiency' of a DSHG is the percentage of the solar energy that is stored in the hydrogen after production. This is a critical metric: the more efficient the system, the more hydrogen can be made from a DSHG panel. Since a DSHG panel and associated balance of systems will have a more or less fixed cost, higher efficiency means cheaper hydrogen, to make it economically viable and competitive to current fossil fuel-based techniques. The US department of energy has calculated a solar to hydrogen efficiency targets of 20% by 2020, and 25% by 2025 that need to be achieved to ensure the competitiveness of low-cost renewable hydrogen.

Silicon solar cells dominate the current photovoltaic (PV) market, meaning that close to 95% of the total solar panels that you see on people's roofs and solar farms are based on silicon solar cells.[11] This is because silicon solar cells are cheap, provides high efficiency and long-term durability. By using optimally connected silicon cells/panels to drive the water splitting reaction high solar to hydrogen efficiencies of up to 18% can be achieved.[12] Using silicon cells allows us to leverage an already established technology, making it possible to quickly scale up direct solar hydrogen generation systems.

One way to further improve the efficiency is to integrate silicon solar cell with another cell made of a different material. Such combination of cells of different materials are called tandem solar cells. *Figure 1* shows the schematic of a so called tandem solar cell, consisting of two solar cells made of different materials placed over on one another. The two materials absorb different parts of the sunlight, extracting most energy from the sun, increasing the achievable solar to hydrogen efficiency.[9]

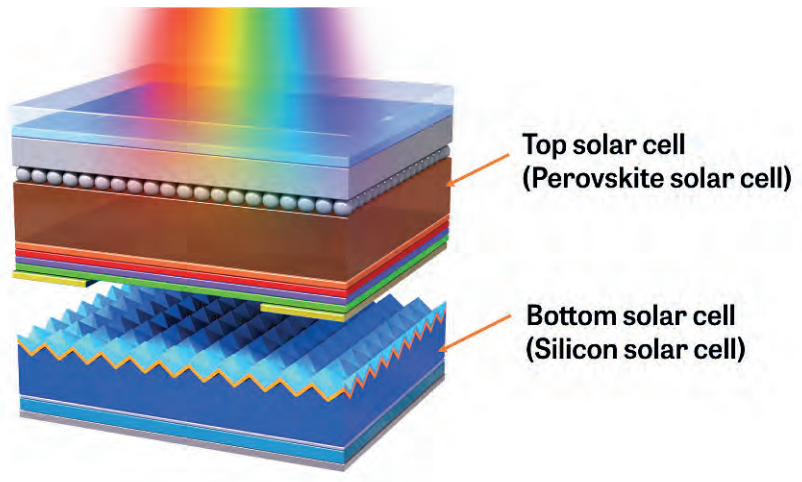

Figure 1: Schematic of a two-cell tandem configuration. On the top is the perovskite solar cell and silicon solar cell at the bottom (reproduced with permission from [13]).

Developing cheap and high-performance catalysts is also essential. A catalyst is a material that enables a chemical reaction to happen faster and with less energy. Most of the high-performance catalysts for the water splitting reaction are made of expensive and scarce noble metals like platinum and iridium. Reliance on expensive materials increases the cost of renewable hydrogen and scarcity can limit the ability to scale up these systems. We have developed catalysts made of materials like nickel and iron which are cheap and found abundantly in the earth. By combining two or more of this earth abundant metals, we can make catalysts that are cheap, easy to source, and have good performance.

Figure 2 (below) shows the schematic of our direct solar hydrogen system.

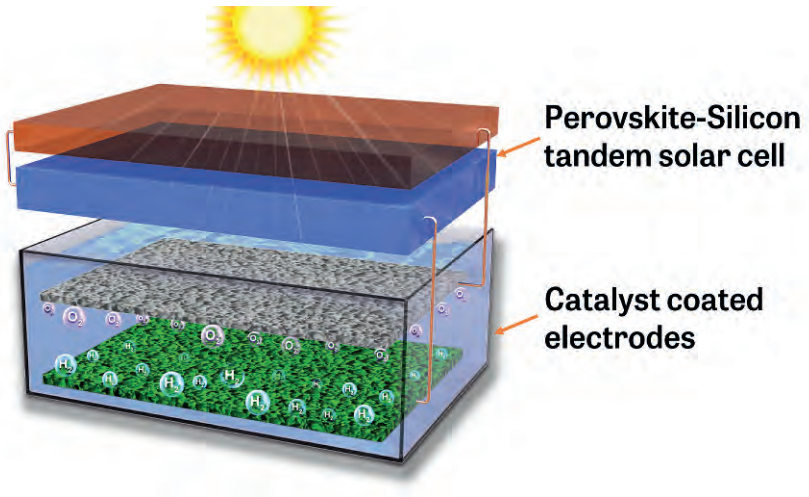

Figure 2: Schematic of the direct solar hydrogen generation system consisting of perovskite-silicon tandem solar cell integrated with Ni-based earth abundant catalyst integrated electrodes (reproduced with permission from [13]).

The perovskite-silicon tandem solar cell is shown by brown and blue blocks at the top. As discussed above, both cells absorb different parts of the sunlight, giving better efficiency. The tandem solar cell is designed to provide optimum voltage and current to drive the water splitting reaction very efficiently. The electrodes coated with low-cost nickel-based catalyst are shown in grey and green. They are emersed in an electrolyte in a chassis behind the solar panel. The system together functions like a single direct solar hydrogen generation panel and can be mounted like a standard solar panel. This module-like design eliminates the need for separate power generation and complex infrastructure, potentially making these systems cheaper. Like renewable electricity driven electrolyser system, direct solar hydrogen generation system will also include balance of system components such as pumps for electrolyte flow and gas compression and storage system.

Our system has a solar to hydrogen efficiency of 20%, meaning that one fifth of the sun's energy is converted and stored as chemical energy in hydrogen.[13] Critically, this means that our system has achieved the US Department of Energy 2020 solar to hydrogen efficiency target for DSTH systems to make them economically viable for large scale hydrogen generation.

It is possible to further improve the efficiency from 20%. Tandem solar cells are still in development and are getting more efficient. By using more efficient solar cells and optimising the way we connect up to the catalyst coated electrodes, we will still be able to reach the 2025 efficiency target of 25% for direct solar hydrogen generation set by US department of energy. Given the trajectory of improvement in perovskite cell performance over the past few years, direct solar hydrogen generation systems based on perovskite-silicon tandems have the potential to achieve the solar to hydrogen efficiency target of 25% by 2025 set by US-DOE for economically feasible large scale solar hydrogen generation.

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Future Outlook

Hydrogen is already used in industries like oil refining and ammonia and methanol production. As we look to reduce emissions rapidly over the next few decades, hydrogen could find use in a range of applications. Automobile companies and others have developed fuel cell cars and buses that are already available commercially, and have a range of concept designs for the future.[14] Germany launched *Cordia-iLint*, the world's first fuel cell passenger train for commercial purposes in 2018 and is currently expanding to other places.[15,16] Recently, airbus revealed three zero-emission commercial aircraft designs relying on hydrogen fuel, which it hopes to enter in commercial operation by 2035.[17] There is also increasing interest from industries, like steel making and mining, to incorporate renewable hydrogen in their operations and reduce their reliance on fossil fuels. In addition, countries with high energy needs and low renewable energy production, like Japan and Korea are also looking to import clean energy in the form of hydrogen-based fuels.

In order for these widespread applications of hydrogen to flourish, and more importantly to drive down GHG emissions, we need a supply of cheap, renewable hydrogen. While renewable electricity driven electrolysers are likely to be the forerunner in supplying this hydrogen, new technologies need to be explored to reduce costs. Direct solar hydrogen generation could radically reduce the cost of clean hydrogen fuels, if efficiencies continue to meet targets and the systems can be produced at low cost. Since our direct solar hydrogen generation system uses potentially low-cost silicon based tandem solar cells and cheap earth abundant catalysts, and has high efficiencies, we are one step closer to this goal. And it is a goal worth pursuing: if renewable hydrogen production can be scaled up quickly, it could help **avoid 7 gigatons (GT) of yearly carbon emissions** or 80GT accumulatively by 2050, providing one fifth of the emissions reductions needed to reach net zero emissions in 2050, and keep global temperature rises below 1.5 degrees C.[18]

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VIDEO

Credits:

Direct Solar-Hydrogen Generation by ANU

Watch a short explanatory video clip Astha and Fiona's ground-breaking Australian science.

"

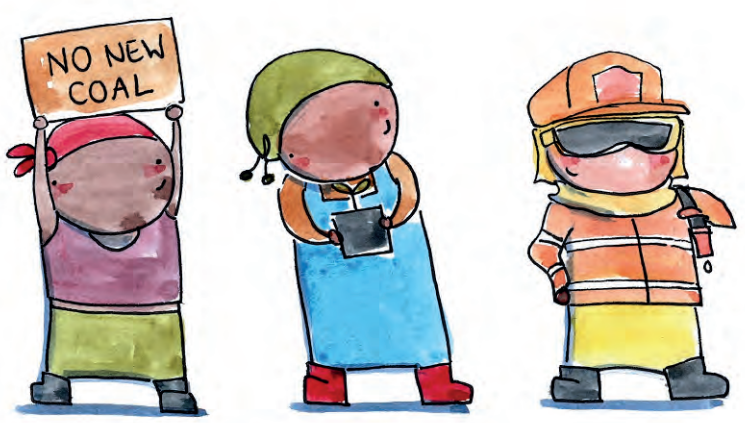
Direct solar hydrogen generation could radically reduce the cost of clean hydrogen fuels, if efficiencies continue to meet targets and the systems can be produced at low cost."

Astha Sharma &
Fiona J. Beck

Credits:

Climate Movement by Formidable Vegetable with Spoonbill.
Animated by Dropbear featuring illustrations by Brenna Quinlan.

www.formidablevegetable.com.au



Charlie Mgee
Founder
The Formidable Vegetable Sound System

It's been a dark couple of years, but even so, we have seen many positives come out of such difficult times, as people demand we move towards a new way of living within Earth's limits. Going back to 'business as usual' is no longer an option, so let's embrace the climate solutions that are in front of us, both globally and at the home scale. This is our chance to rise up and grow the changes we've been waiting for.

Permaculture is a scalable framework for ecological design, based on ethics and principles that are applicable to anybody from majority-world subsistence communities to government and corporate structures. By bringing it all back to Earth Care, People Care and Fair Share, we can truly grow a resilient Climate Movement.

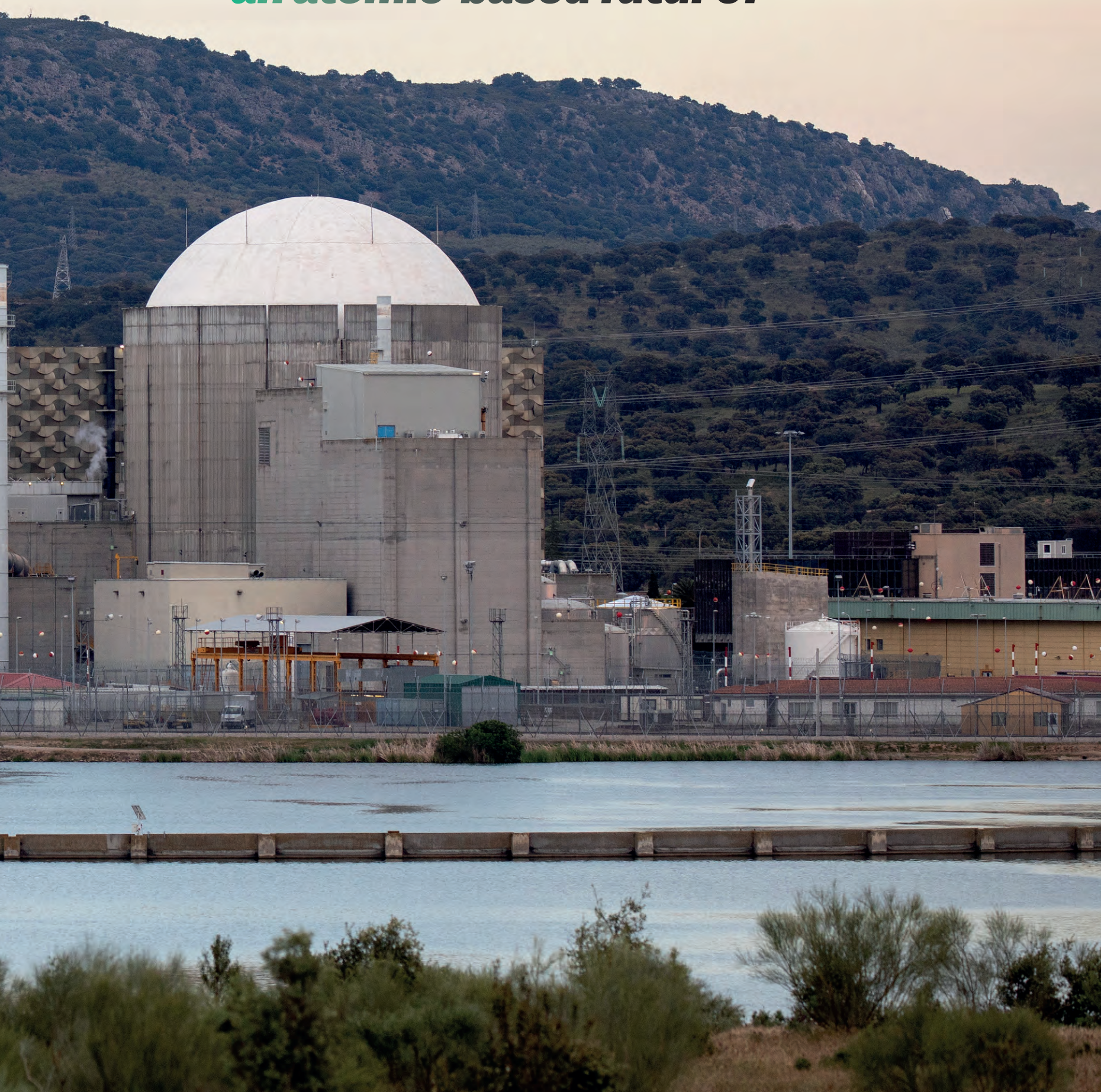
Above: Charlie Mgee and The Formidable Vegetable Sound System playing live. Photo credit: Charlie Mgee

Let's go

Image: Almaraz, nuclear power plant in the centre of Spain, surrounded by a green field. Photo credit: Adobe Stock

nuclear?

What are the merits of an atomic-based future?



The contrasting image of nuclear energy.

Top: Fragment fuel uranium rod element of nuclear reactor (Russian Federation). Photo: Adobe Stock

Bottom: Deserted technical room in mess in Pripyat (Ukraine) . Photo: Adobe Stock

In *Novacene: The Coming Age of Intelligence*, Gaia-theorist **James Lovelock** makes the (perhaps unexpected) proclamation that:

> "We must move to using nuclear energy temporarily until we can either harvest solar energy efficiently or find out how to use the almost infinite supply of nuclear fusion energy" [1]

In Australia, the need to rely on nuclear energy in a country with abundant sunshine appears to make "no economic or political sense"[2] according to **Ian Lowe AO**, Fellow of the Australian Academy of Technology and Engineering, who explains that — unlike other nuclear nations — Australia has "dodged a bullet"[3] when it comes to having to deal with the problem of radioactive waste. By contrast, France relies on 80% of it's electricity provided by nuclear power stations (with the remaining 20% provided by hydro-electric and fossil fuels).[4]

Although Australia currently does not have nuclear power production capability, it does remain the second largest supplier of uranium (the essential fuel for nuclear energy). It produced **13% (6203 tonnes) of world supply** in 2020 (World Nuclear Association, 2021). **A single site in Australia** — at BHP's Olympic Dam — **provides 6% of world supply** and it is estimated that Australia has total resources of uranium in the region of 1,692,700 tonnes, representing the highest percentage (28%) of any nation.[5]

Natural uranium resources (usually 99.3% uranium-238 and 0.7% uranium-235) for use in light water reactors require processing to create what is known as slightly enriched uranium, where the amount of uranium-235 is increased to between 2 and 5 per cent of the total[6]. The entire fuel production cycle looks a little like this (*Figure 1*):

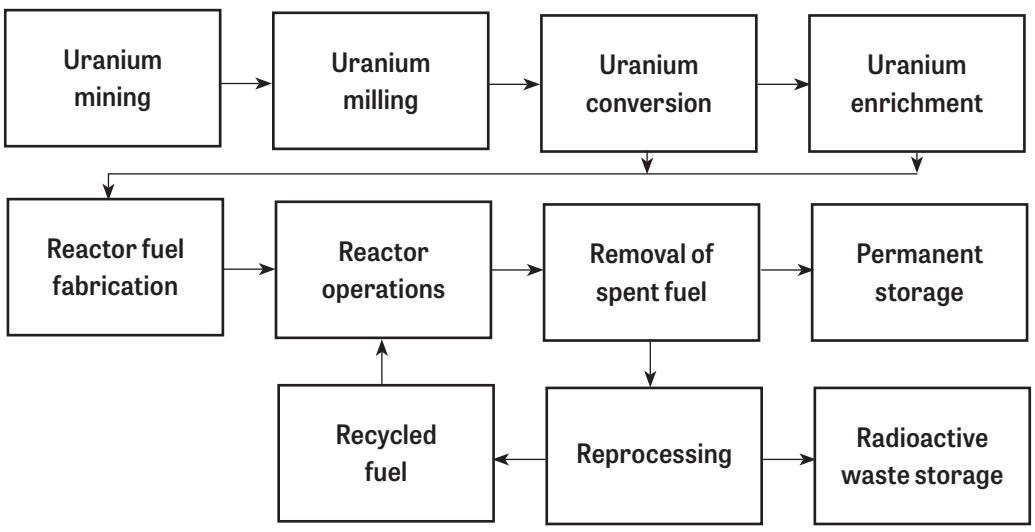


Figure 1: Flow chart showing the nuclear fuel cycle. [Based on Ferguson[7]] .

As Ferguson has suggested, reprocessing is not yet a cost-competitive endeavour and the initial uranium enrichment process itself is thwart with challenges given that the enrichment process (and technology developed for it) mean that peaceful use of uranium fuel can also lead to the processing of fuel for weapons.

The sensitivity around the technological development of reprocessing nuclear waste is manifest in the Classified agreement between the governments of the United States and Australia. The agreement covers the technology developed by Dr Michael Goldsworthy and Dr Horst Struve in Sydney, Australia which uses lasers to excite uranium-235 hexaflouride — a process known as molecular laser isotope separation (MLIS). The company that invented the process, SILEX (Separation of Isotopes by Laser EXcitation), signed an agreement with the US Department of Energy for 200,000 metric tons of depleted uranium hexafluoride (UF_6) which will act as 'feedstock' for an enrichment plant due to come online in the next decade.

Perhaps the better option is nuclear fusion which produces neglible radioactive waste and is far less dangerous.[8] Researchers at the Joint European Torus experiment in Oxfordshire recently broke a fusion heat record, generating 59 megajoules of heat in a five-second burst.[9] But there are many engineering hurdles ahead and the promise of nuclear-fusion energy could be a decade or two away. By then, it may be too late.

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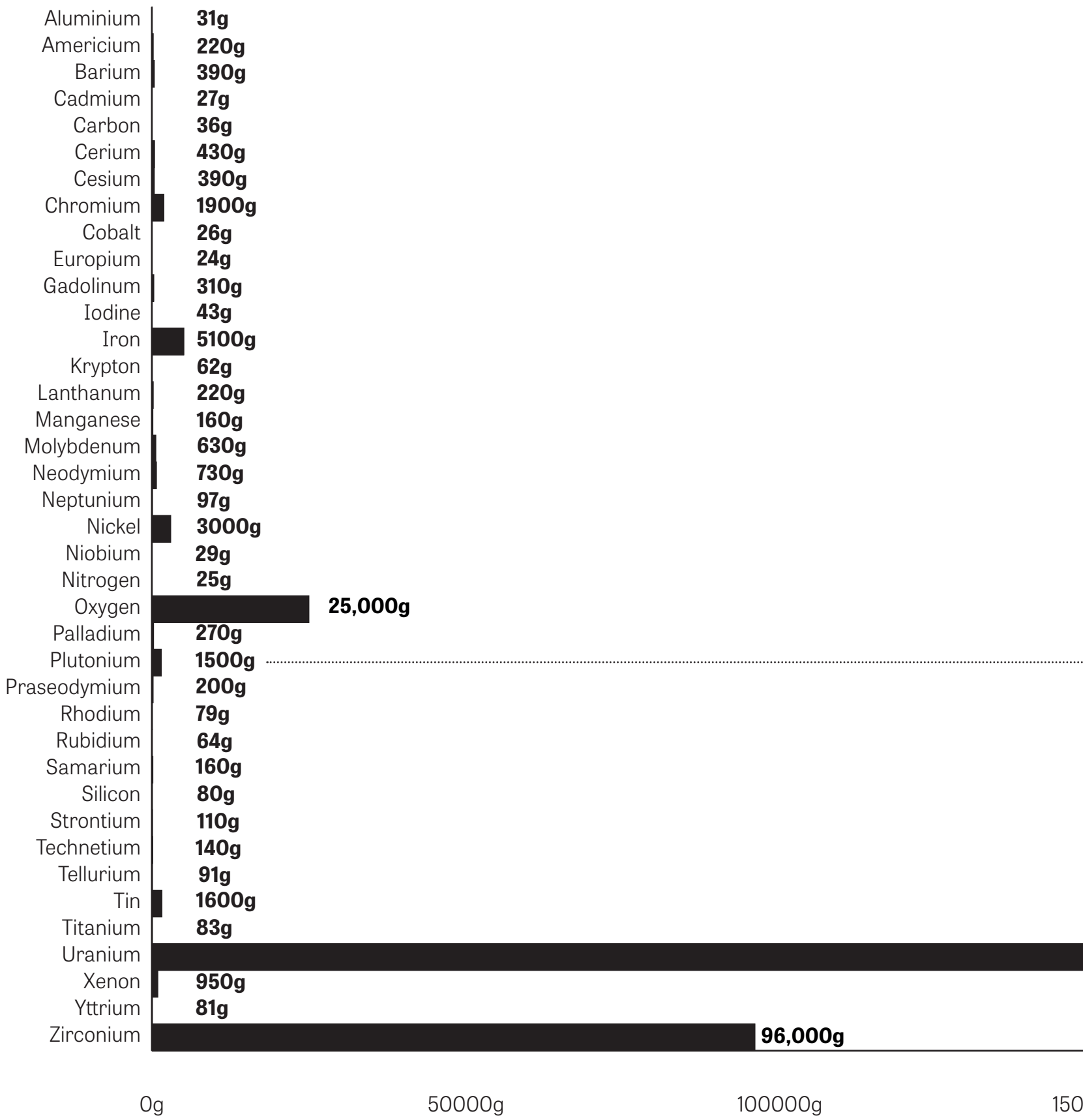

Data Source:
Tabak, J (2009) *Nuclear Energy*, Infobase Learning: New York, p.55

Infographic: Philip Ely, 2022

Average composition of spent boiling water reactor fuel

Spent fuel can take five years to cool down before it is safe to put into dry storage. Until then, it is stored in water-filled tanks.

A large commercial reactor produces between an estimated 300 and 600 kg of plutonium each year.

A small nuclear weapon can be created from less than 5 kg of plutonium-239.

Fortunately, plutonium is mixed with all these other elements and is both technically challenging and costly to process.

170,000g

000g 200000g

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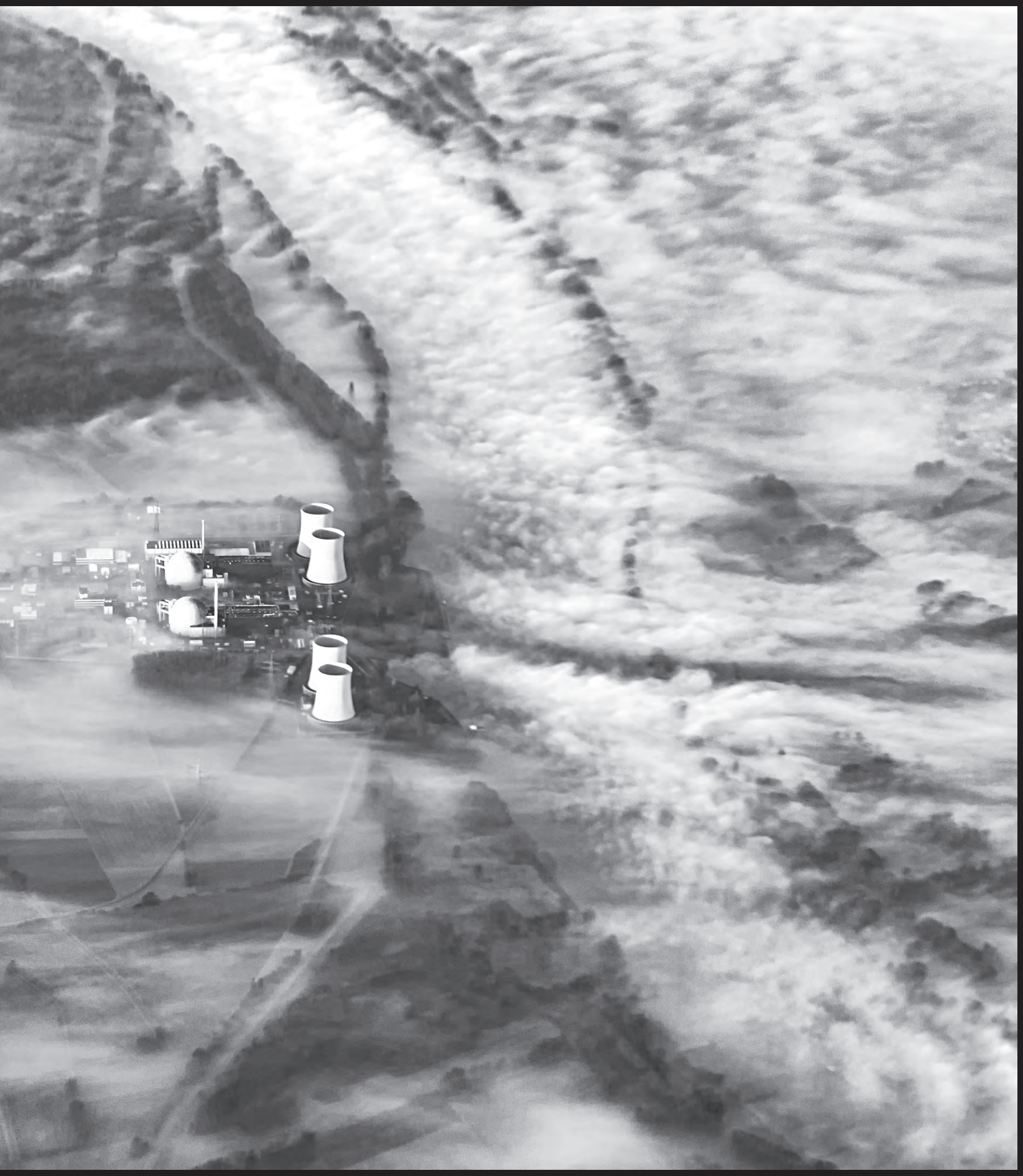
Image:
Aerial of Rhine Valley landscape in morning fog with electric pylons and atomic power plant Biblis.
Photo credit: Adobe Stock



AVIAN CLIMATE MESSENGERS

by ZOË SADOKIERSKI *and* TIMO RISSANEN

DRAWINGS —
Zoë Sadokierski
Southern black-throated finches,
Poephila cincta cincta
ENDANGERED

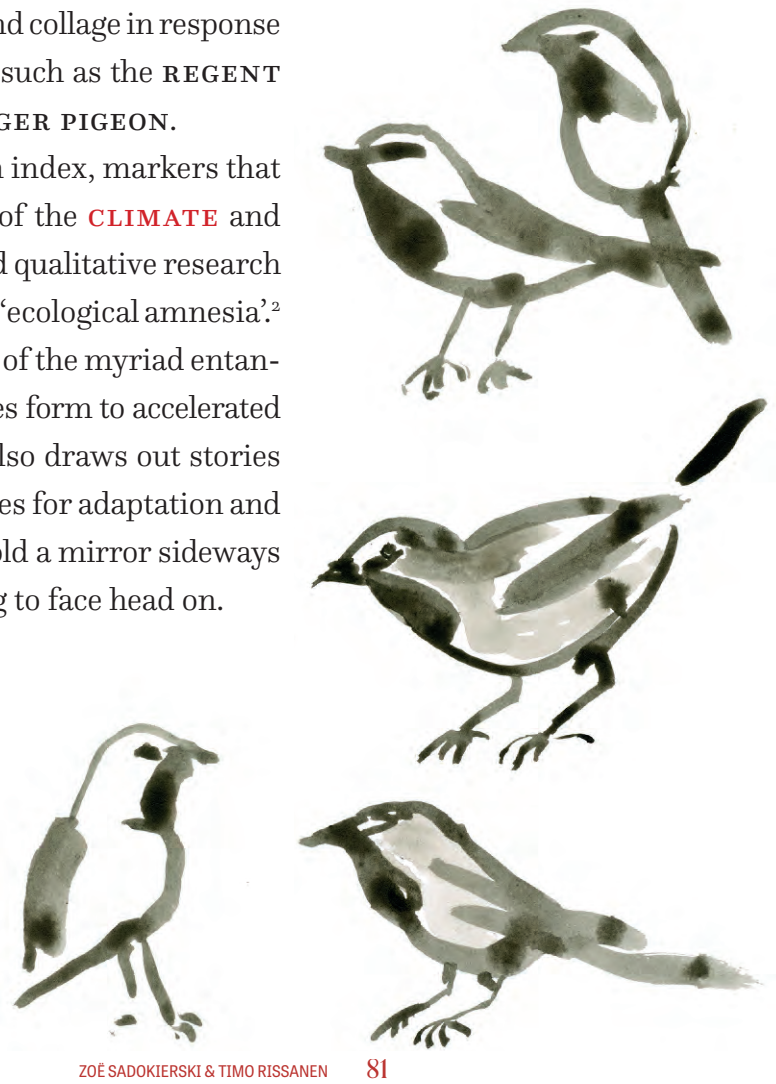
ALSO:
'*Adani finch*'. Adani's Carmichael coalmine in Queensland is destroying the best remaining habitat of this endangered species. The finch has become an ecological messenger, the canary in Adani's coalmine; this tiny bird has drawn public attention to the habitat destruction involved in extraction projects, but also how corporations such as Adani concoct superficial 'conservation plans' to avoid real responsibility for the places and inhabitants put in jeopardy in pursuit of corporate financial gain.

We began our Precarious Birds collaboration† in 2018 as a way to bear witness to the devastating loss of bird species in the SIXTH MASS EXTINCTION. The project is an ongoing '*conversation through making*': we talk, share readings, write, draw, cross-stitch and collage in response to the plight of ENDANGERED and EXTINCT bird species such as the REGENT HONEYEATER, MUNCHIQUE WOOD-WREN and PASSENGER PIGEON.

Within our critical creative practice, we use birds as an index, markers that point to the cultural, ecological and political dimensions of the CLIMATE and EXTINCTION CRISES: in addition to scientific data, we need qualitative research and storytelling to create 'cultural archives of loss' [1] to avoid 'ecological amnesia'.[2]

The artworks and stories we create communicate some of the myriad entanglements of humans, birds and landscapes. Our project gives form to accelerated and irrevocable losses of species and environments, but also draws out stories of resurrection, hopeful recovery and points to opportunities for adaptation and action. By focusing our attention on birds, we are able to hold a mirror sideways to the cascading ecological crises that can be overwhelming to face head on.

† www.precariousbirds.net



It is thought that PIGEONS can sense changes in the magnetic fields around them, enabling them to navigate using Earth's magnetic field, although the specifics of how this happens remain a mystery.

.....

In 2017 Zoë (*based in Sydney*) sent a message by CARRIER PIGEON to Timo (*based in NYC*). The message, emailed to PigeonGram (*based in Speaks, Texas*), was delivered on a slip of paper:

WE SHOULD DO A BOOK ABOUT PIGEONS.

BIRDS AS MESSENGERS

There is a long history of humans literally using birds as messengers. The military use of birds for message delivery dates back to ancient Egyptian, Greek and Roman civilisations.[3] In particular, PIGEONS — *Colomba livia*, OLD WORLD ROCK DOVE, HOMING or CARRIER PIGEON — were widely used for communicating over long distances until the invention of the telegram in the mid-1800s.

Birds also feature in metaphors, often referring to fatal interactions with humans: CANARY in the coal mine; dead as a DODO; a sitting DUCK; ALBATROSS around the neck. This entanglement of bird and human fate is drawn out in relation to the CLIMATE CRISIS in a report between Birdlife International and National Audubon Society[4]:

> *Over time and across cultures, birds have sent us signals about the health of our environment. The canary in the coal mine offered that most precious resource, time — a small window in which humans could escape toxic gases. [...] [birds] are powerful messengers for the natural world. They are telling us how climate change poses risks to nature and people worldwide.*[4]

Below, we share four accounts of birds bearing messages about the impact of the CLIMATE CRISIS on humans and nonhuman species alike.

. . . .

IMAGE —
Kookaburra,
Nick Ritar, 2020.
@milkwood_nick

FALLEN BIRDS OF MALLACOOTA | TIMO

On 2 January 2020, following the 2019 New Year's Eve bushfire that forced most of Mallacoota's residents onto a beach, Nick Ritar documented some of the avian victims, so that we could all bear witness. The birds had perished in flight and fallen into the ocean, later washing up on the beach. There is an eerie similarity between Ritar's photographs and American photographer Chris Jordan's images of dead ALBATROSS from Midway in the Pacific Ocean: fully grown ALBATROSS chicks killed by the ingested ocean plastic their parents mistook for food.

While fire is an inherent part of many Australian ecosystems, the scope of the 2019-20 Australian bushfire season was unprecedented, exacerbated by GLOBAL WARMING resulting

from human activity, namely from the burning of fossil fuels like coal, oil and gas. There is little comfort in knowing that the species documented by Ritar are relatively common or at least not at risk of imminent extinction. A report commissioned by the World Wildlife Fund for Nature estimated that nearly three billion mammals, birds and reptiles died in the 2019-20 Australian fires, including 180 million birds. According to Birdlife International, EASTERN BRISTLEBIRD, *Dasyornis brachypterus* (ENDANGERED), and REGENT HONEYEATER, *Anthochaera phrygia* (CRITICALLY ENDANGERED), were two species at immediate peril because of the fires. A recent assessment by Crates et al[5] notes the impact of the megafires on the REGENT HONEYEATER. For a species with less than 350 individuals spread across a vast area, a single megafire in the future could erase this HONEYEATER from Australia, and the planet. Birdlife Australia poignantly states:

> *While unprecedented, these fires were predicted. In 2008, the Governments of Australia's Federation commissioned a report by Professor Ross Garnaut to examine the impacts of* CLIMATE CHANGE *on Australia. The Garnaut report predicted that Australia's bushfire seasons would progressively lengthen and generally be more intense, and that the impacts would be observable by 2020. The predictions of Garnaut and many other climate scientists have proved right.*

IMAGE:
Whipbird,
Nick Ritar
2020.
@milkwood_nick

See Nick Ritar's original post:
www.instagram.com/ p/
B6oDZA1hniQ/

Accompanying the images,
Nick wrote:

> *I apologise for showing you this heartbreak, but I believe we must bear witness. This is what climate change looks like. Washed up on Bastion Point Beach this afternoon. There was a body every few metres. The beach is 15km long.*

During the megafires some CLIMATE CHANGE denialists claimed that arson was to blame for the fires, however several credible news outlets debunked the claim. Drawing from conversations with family and friends, I suspect that for some people the scope of CLIMATE BREAKDOWN and the fact that it is happening now, not in some abstract future, is too much to bear and the denial is a form of mental self-protection. For many, however, the denial is about protecting self-interest, financially and perhaps now even morally. Maybe a time will come when we will successfully prosecute individuals, corporations and governments that willfully delayed actions to reduce carbon emissions and/or spread misinformation and doubt for the same reason. Denial of CLIMATE CHANGE is in part an attempt to postpone the arrival of that time. Nick Ritar's images from Mallacoota document our time. Bear witness and remember that every living being on Earth is a relative.

. . . .

IMAGE:
Sydney sky,
3.30pm December 2019

RED SUN | ZOË

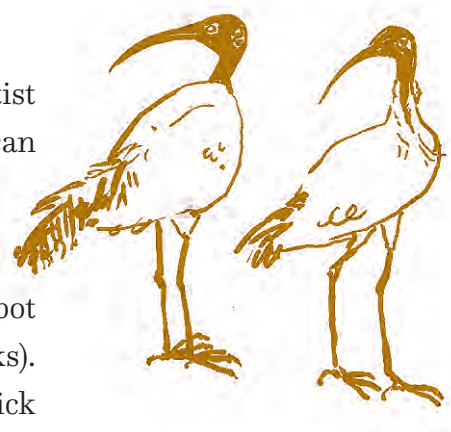
While overseas in November 2019, I caught snippets of news from home: bushfire smoke choking major cities; heritage-listed rainforests burning; farmers traumatised by the screams of dying animals. From afar, these unsettling accounts seemed fictional, like the 'raining frogs' scene in Paul Thomas Anderson's film *Magnolia*. Except in Anderson's film, the uncanny frog-storm is a narrative device used to pull the disperate plotlines together. In Australia, some politicians are instructed[6] ***not*** to link the catastrophic bushfires with CLIMATE CHANGE, led by prime minister Scott Morrison who sent 'thoughts and prayers' to affected communities but publicly suggested Australia could increase emissions without worsening the fire season. If wildfires consuming ***rainforest*** is not the time to talk about CLIMATE CHANGE, when is?

My plane descended into a landscape that looked more like Mars than Sydney in spring. Shuffling through the tunnel connecting the plane to the airport, the smell further discombobulated me — days before, at an artists' residency, a similar smell wafted from the chimneys of upstate New York homes as Timo and I crunched through Autumn snow, bird spotting. BLUE JAY, MOURNING DOVE, BLACK CAPPED CHICKADEE, HAWK. Autumn and spring should smell worlds apart.

Collecting my son from daycare at 3.30pm in an apocalyptic pink haze so dense we could barely see a few metres in front of us, I struggled to find ways to explain why it was not safe to play in the park before dinner that would make sense to a 3-year-old. At a time of year I associate with endless blue skies and outdoor play, I realised that this oppressive haze is how he knows spring: a time of indoor-only play, a season when his mum grimaces with smoke- induced sinus headaches, when water restrictions prevent planting a garden and soot-blackened ocean swims are unappealing. The world of his childhood is shockingly different to mine. How will the generation after him experience spring?

In addition to the deep trauma inflicted upon victims and rescuers of natural disasters, there is also psychological distress associated with a world changing so fast we barely recognise 'home'. The term solastalgia[7] refers to a homesickness experienced while still at home, a nostalgia for a familiar place made strange by transmuting climate and local ecologies. Returning from a month overseas to an uncanny version of home, I experienced solastalgia profoundly. This is not to equate solastalgia with the trauma experienced by those who lost lives and homes in the fires, but to recognise the spectrum of ways humans are affected by our CHANGING CLIMATE AND ENVIRONMENTS.

How can I prepare a child for a world I don't recognise? What stories can I



tell him, to prepare him for a future that makes Australian climate scientist Sophie Lewis publicly think twice about having a child at all?[8] What stories can I tell myself, to avoid infecting him with my anxiety and solastalgia?

A few months earlier, before the park was apocalyptic, I taught him to spot the difference between male and female IBISES (females have shorter beaks). We watch them beak around in the freshly cut grass for grubs, and pick through bins for less natural snacks. We talk about how IBIS should live in wetlands, not inner city parks, and why some kids throw sticks and chase them screaming 'bin chicken' while their parents laugh encouragement.

A few months later, the sky is clear but the park is again deserted: the play equipment has been cordoned off with police tape, to avoid the spread of the Corona-19 virus. Housebound, we gaze out to the park devoid of humans but alive with birds and all the creatures we can't see from the window. The IBIS pick through the grass and drink from the dog bowl.

. . . .

MUNCHIQUE WOOD-WREN | TIMO

The MUNCHIQUE WOOD-WREN lives in a specific band of cloud forests on the slope of the western Andes in Colombia. An inconspicuous bird best found by sound, it has only been known to science for two decades. As the CLIMATE WARMS, its cloud forest home is becoming drier and more prone to fires, further exacerbated by the clearing of forests. Simultaneously the forests are slowly shifting to higher altitudes chasing cooler temperatures. What happens if and when the mountain slopes run out? Will the great great grandchildren of today's WOOD-WRENS have a home? Does it matter if the WOOD-WREN disappears? Most people on the planet do not know it exists. It is not useful to humans beyond perhaps some interest from birdwatchers, and as a symbol for protecting the national park after which it is named. Although stunningly delicate up close, with a long white brow and a refined, streaked face, the wren is easily dismissed as just another small brown bird.

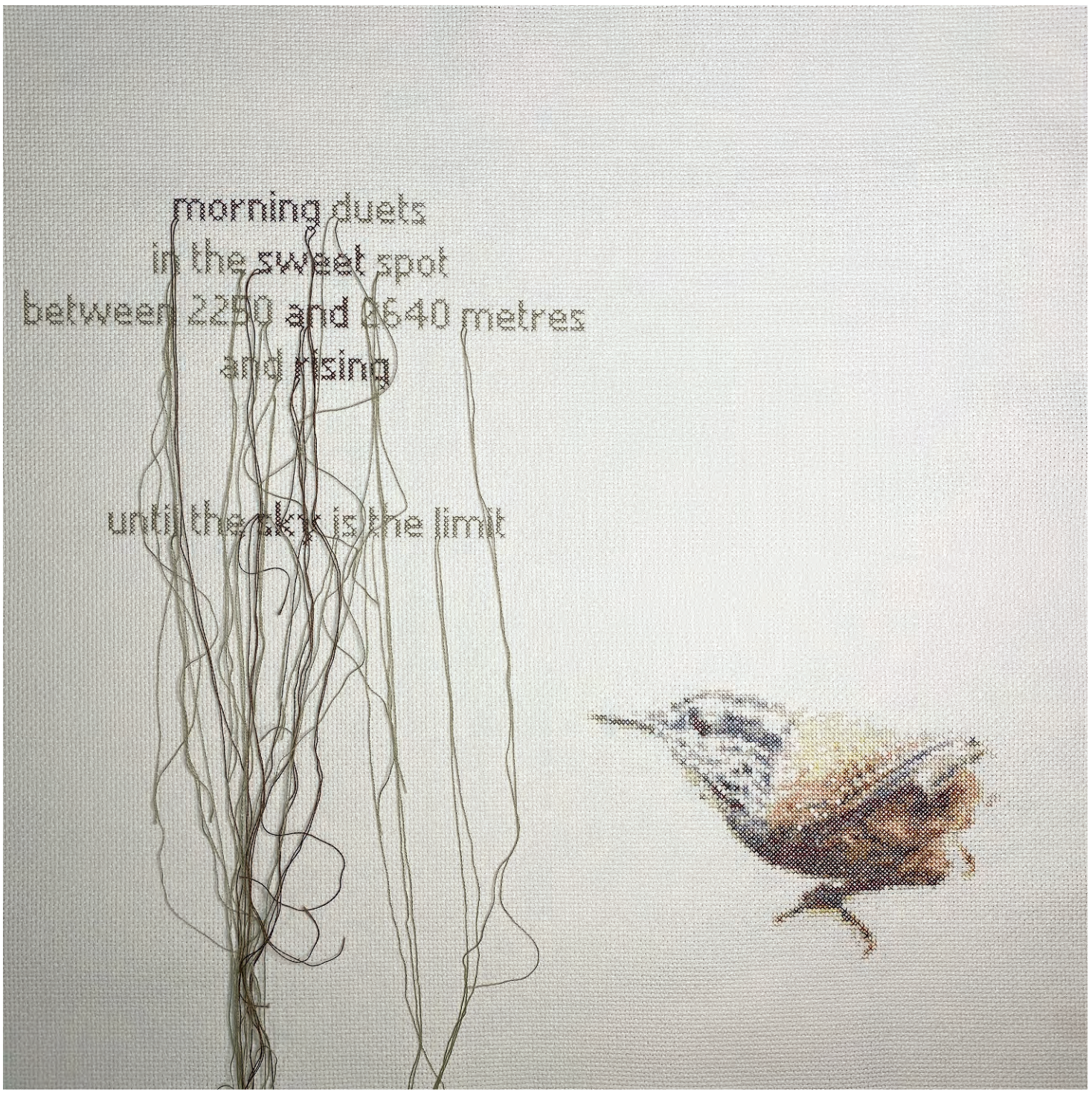
Yet it is a messenger of change happening in the Andes: it is entirely dependent upon a particular habitat that may one day no longer exist as THE PLANET WARMS. If we know that, how can we remain uninvolved, unmoved, neutral?

The MUNCHIQUE WOOD-WREN is delivering us a message now, to act on CLIMATE CHANGE such that MUNCHIQUE WOOD-WRENS can call the slopes of the Andes home for millennia to come.

IMAGE:

Timo Rissanen.

Cross-stitch pattern developed from an original photograph by Dr Paul Noakes, Colombia, Tanager Finch Reserve, January 2016: paul.noakes@nhs.net



IMAGE—
Timo Rissanen, 2020

morning duets
in the sweet spot
between 2250 and 2640 metres
and rising

until the sky is the limit

THE AUSTRALIAN WHITE IBIS | ZOË

Australians have a troubled relationship with our most infamous IBIS, the AUSTRALIAN WHITE IBIS (*Threskiornis molucca*). They have a distinct black head (wrinkled, a little scrotal in texture with crimson-pink highlights) ending in a sabre-like bill and alarming, raw-beef colouring under the wings. In comparison to our cuter native birds — say, the SUPERB FAIRY-WREN or LITTLE CORELLA — they are a frightful sight. Urban-dwelling ibises are grubby and, to human noses, smell funky. Due to garbage- scavenging, they are referred to as Bin Chickens. However, IBISES' natural habitat are inland wetlands — drought and habitat loss (*read*: CLIMATE CHANGE and human infrastructure projects) have driven these birds to our east coast cities. They pick through our bins and stalk our picnics because they are refugees, adapting to survive.

I like IBIS. In part because Thoth, the Egyptian god of knowledge and writing, frequently appears as an IBIS-headed being; it appeals to me that the ibis' long black beak resembles an ancient, inky writing tool.

Until the 1990s, the AFRICAN SACRED IBIS (*Threskiornis aethiopicus*) was classified as the same species as the AUSTRALIAN WHITE IBIS. Yet instead of reviled, the African sister-species is revered in Egyptian culture. Beyond the divine associations, these ibis played a key role in keeping river water clean and usable for humans.

I love that IBIS look more like dinosaurs than modern creatures. Birds survived the fifth mass EXTINCTION — the meteor impact best-known for wiping out the dinosaurs — but are not faring well in the SIXTH MASS EXTINCTION EVENT, in which humankind is wiping out our furred, scaled, feathered kin. The 2020 *Action Plan for Australian Birds* reports that in the past thirty years, an additional 82 Australian birds have been listed as at risk of EXTINCTION, including 27 listed as threatened based on the impact of the 2019-20 Black Summer bushfires.[8] More widely and anxiously reported than this statistic was the claim that koala populations were believed to be functionally EXTINCT following the fires — although not true of the entire Australian landscape, habitat loss is a serious threat to some local populations.

Would we harbour more affection for the AUSTRALIAN WHITE IBIS if they were more conventionally cute, and economically beneficial, bringing in the tourist dollars that koalas do? If our IBIS — currently classified Least Concern on the IUCN Redlist— begin to decline in numbers will we turn away, relieved that this constant reminder of large-scale human impact on the environment is out of sight, or feel guilt for what we have passively borne witness to? Or perhaps worse, will we not notice at all? Remember when you used to have to stop regularly to clear the insects off the windshield on a long car trip? Remember when the IBISES stalked our picnics and nested in the palm trees on roundabouts?

There are two lesser-known native Australian IBIS: STRAW-NECKED IBIS (*Threskiornis spinicollis*) and GLOSSY IBIS (*Plegadis falcinellus*).

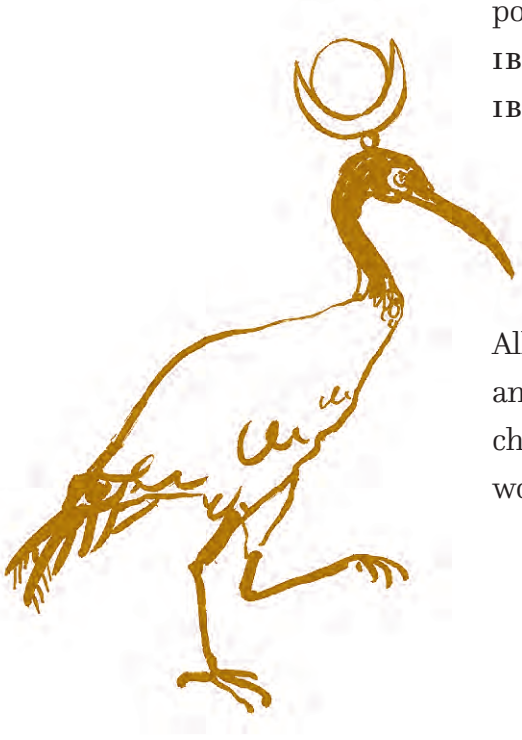
ALSO:

Rubbish Raptor;
Tip Turkey;
Picnic Pirate;
Dumpster Diver;
Sandwich Stealer.

Yet Australians love an underdog. In 2017, the IBIS came a narrow second to the MAGPIE in *The Guardian* newspaper's annual 'bird of the year' campaign. Paul Allatson and Andrea Conner[9] report that the WHITE IBIS has gone viral in popular culture, citing a proliferation of IBIS-adorned items for sale online, IBIS murals popping up in major cities around the country and even a trend for IBIS tattoos:

> *This* IBIS *juggernaut says a lot about Australian identity and culture in the 21st century — and human-animal relations in a time of environmental threat and uncertainty.*

Allatson and Conner conclude that AUSTRALIAN WHITE IBIS are tenacious and fearless 'environmental refugees', reminding us of the environmental challenges we face. Rather than mocking and even attacking these birds, humans would do well to pay attention to their remarkable resilience and adaptation.



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DRAWINGS—
Zoë Sadokierski, 2022

Black-throated finch [*poephila cincta*] specimens, drawn from photographs of specimens in the *Encyclopedia of Life*: eol.org

VIDEO

Credits:

Zoë Sadokierski

Watch a short video clip of Zoë Sadokierski illustrating these spreads.

Climate Action Now

IN APRIL 2020, CHRIS FLACK CURATED and initiated a digital climate protest — **Mate Act Now** — in response to the 2019/20 Australian bushfires. The website MateActNow.com was established and over 200 designers from across the world joined the climate action.

In 2020, Flack — alongside Liam Ooi, Adrien Taylor, Jack Mussett and Kevin Finn — published an extract from the campaign in a limited edition of 250 books. As the book's acknowledgements state: "..to our global leaders who have failed us miserably. Without your lack of efforts, this wouldn't have been possible". All leaders except, in their case, one: "Not you Jacinda, you're ace."

When the digital movement started, COVID-19 was only just starting to make its impact felt across the globe. Flack's original fundraising ambitions in response to the bushfires were soon superseded by a need for, as he describes it, "communities coming together". Here, it is the design community taking on the activist role, acting as philanthropists, educators and hackers.[1]

Graphic design has played a critical role in the politics of protest, as the *Hope to Nope: Graphic and politics 2008-2018* exhibition at London's *Design Museum* demonstrated. [2] It can simply represent and amplify marginal voices or provide — through what has been termed 'adversarial design' [3] — an agonistic (and therefore challenging) perspective on the status quo. When designers create posters, such posters are tools for the commons to use to hold elected (and often un-elected) officials to account. They are designed not only to inspire action amongst the populis, but to send a clear and direct message to their primary audience: the patriarchs, oligarchs and fossil-fuel apologists that seem intent on looking after shareholders before citizens.

We have included a selection of posters from Mate Act Now (including Flack's own contribution with his then 2-year old son Leo) and encourage you to view and share the gallery of posters on **MateActNow.com**.

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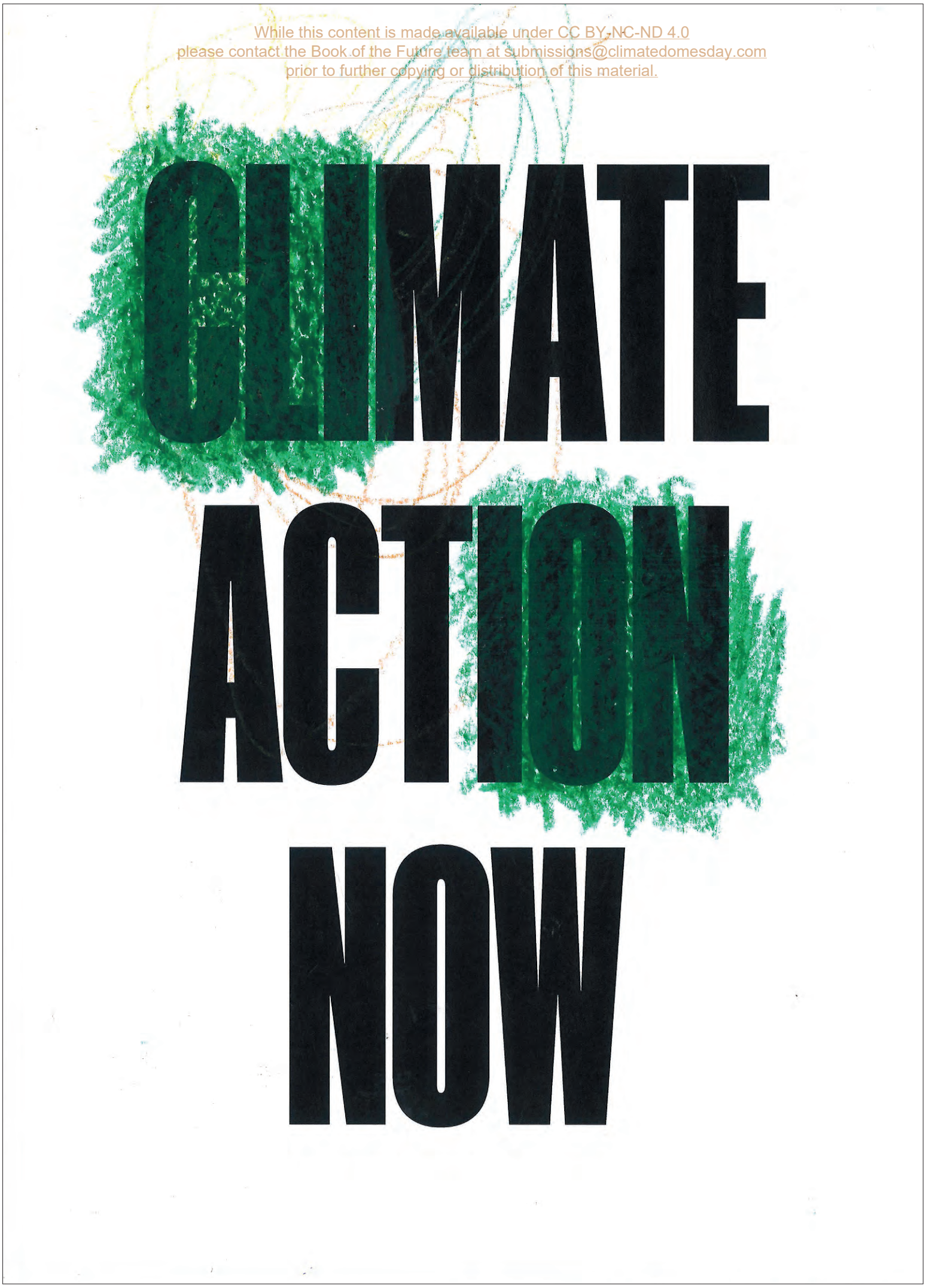
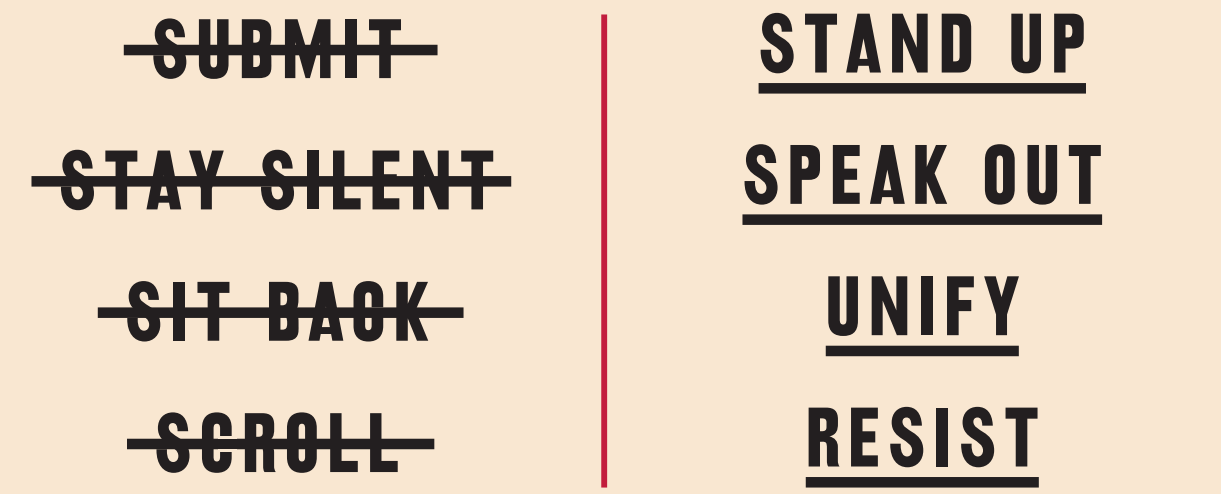


Image: Chris Flack & Leo Flack
Available from:
https://mateactnow.com/chris-leo-flack-age-2

Image: Harry Richards
Available from:
https://mateactnow.com/harry-richards



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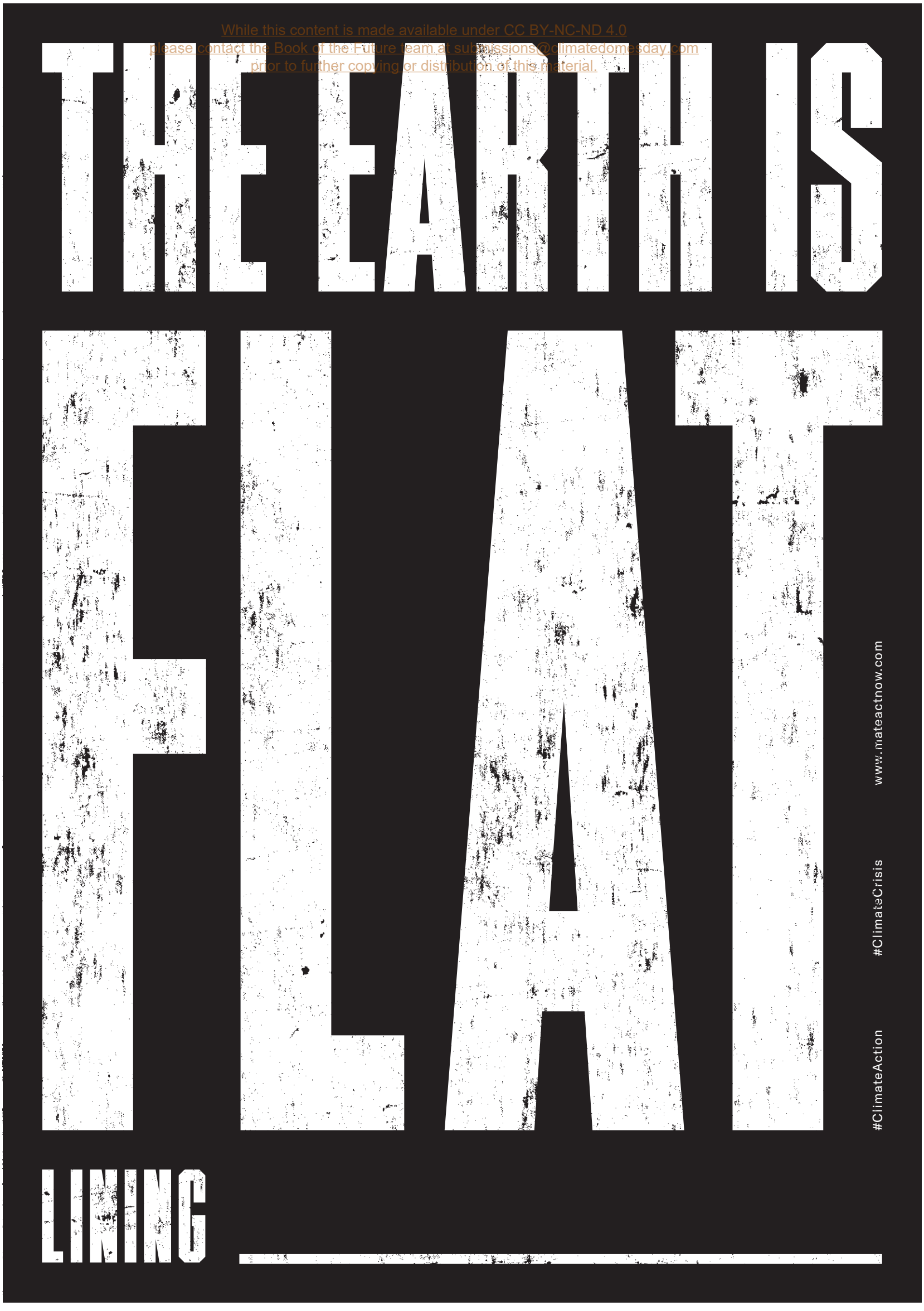
https://mateactnow.com/hardhat



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https://mateactnow.com/pete-conforto

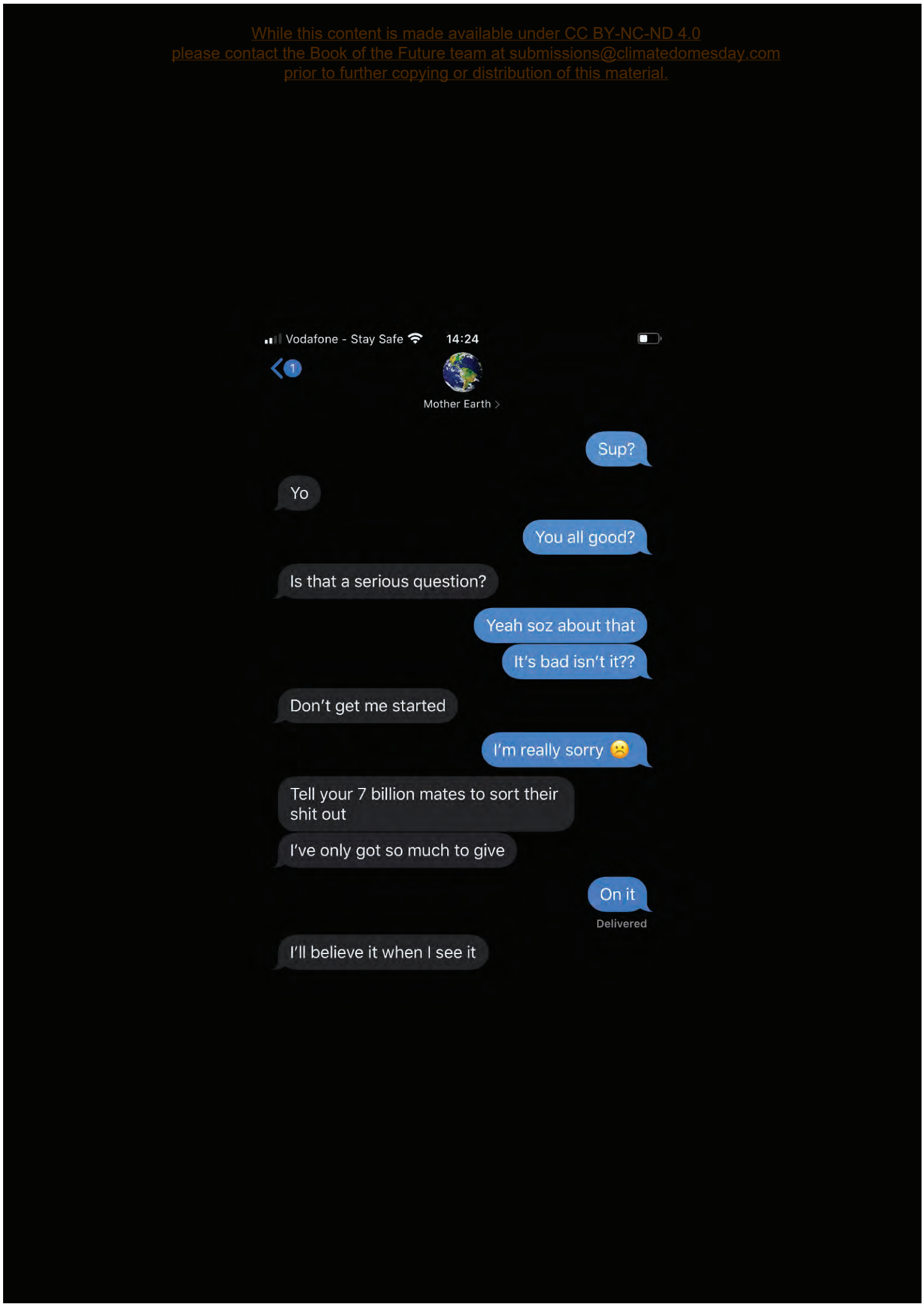

Image: Not Another™
Available from:
https://mateactnow.com/not-another

Mate Act Now =
Climate Action Now

#MateActNow
#ClimateChange

mateactnow.com

There are no jobs on a dead planet. Mate act now.

Hon Scott Morrison MP.
Member for Cook, NSW. Prime Minister of Australia.

On Thursday 9 February 2017, the current Prime Minister of Australia, Scott Morrison, addressed parliament brandishing a lump of coal. His objective was to undermine the opposing government's renewable energy policies. A futile political stunt that now symbolizes a short-sighted government with poor vision when it comes to climate policy.

In the off chance that any of our current political leaders suffering from short-sightedness or poor vision stumble across this poster, we have designed the layout with a focus on maximising legibility in order to ensure the clarity of our message and increase its impact.

The poster has been typeset using Atkinson Hyperlegible. A typeface that was developed by Applied NY in partnership with the Braille Institute. It was designed specifically to increase legibility for readers with low or poor vision and to improve comprehension.

band

Image: Studio Band
Available from:
https://mateactnow.com/studio-band

LET'S PAY OUR FARMERS TO END GLOBAL WARMING!

...this is the manifesto of ***Allan Yeomans****, inventor of the* ***Yeomans Carbon Still****.*

Lucas Ihlein
Artist and student at Kandos School of Cultural Adaptation
and *Senior Lecturer in Contemporary Arts*
School of the Arts, English and Media
University of Wollongong

VIDEO

Credits:

Baking Earth: Soil and the Carbon Economy - Carbon Farming Field Trip by Wayward 2019

Duration: 4 minutes

What if there were a method of carbon sequestration that actually worked?

I'm not talking about those "carbon capture and storage" fantasies, like pumping CO_2 deep into subterranean caves. I mean, something really viable. Well there is! What you do is this:

You "simply" take all the degraded farmland (and there is a LOT of it in Australia and around the world) and you switch over to regenerative agriculture techniques. When you do that, carbon dioxide is drawn down from the atmosphere into the soil in vast amounts. Increasing the amount of carbon in soil makes for a richer, healthier growing environment for plants, and more biodiversity underground (bacteria, fungi, worms etc). Less fertiliser and pesticides are needed. It's a switch with multiple benefits.

So what's holding us back? Well, there's a reason why "simply" has inverted commas in the previous paragraph. The trouble is, while many farming communities have the know-how to make this change, and while serious efforts are being made by agricultural innovators, there are still some strong barriers stopping widespread adaptation. Farmers can't "simply" swap over to a new system without massive investment in equipment, materials, and training. All this costs money. And if farmers are already in debt, or operating at low margins (as so many of them are) it's extra hard. So if we are serious about ending global warming, and getting farmers to contribute, then we need to give them some proper financial support.

Basically, we need to pay them to do this work. The organisation *Carbon Farmers of Australia* stages annual conferences on the subject, and has done great work in helping establish "carbon farming" as a term, and they've auspiced some projects to establish proof-of-concept.

Watch the video on this page to see carbon farming in action within regional Victoria (then come back to continue the read).

Allan Yeomans has been advocating to pay farmers for their services in carbon sequestration for ages. **He's even made a machine to do the measurements.**

In some ways, all this is not overly complicated. You "simply" work out how many tonnes of Co_2 a farmer has drawn down into their paddock, and pay them, at a per-tonne rate.

Where would all the money come from? Well, initially, everyone who emits carbon (ie, all of us) would be charged at a per-tonne rate, creating a pool of cash to support the work of the carbon farmers. Effectively, big carbon emitters would end up paying farmers to draw the carbon back down again.

Doesn't this sort of offset scheme just get the big emitters off the hook? Well, yes and no.

At the moment, they're churning out carbon dioxide willy-nilly anyway, so taxing the bejeezus out of them might send a strong message to exit the fossil fuel business pronto. But it's true that offset schemes are contested and problematic. For example, let's say Farmer Jones, working with an array of regenerative agriculture methods, pulls down 100,000 tonnes of carbon, thus offsetting the carbon emissions of Acme Coal & Gas. Huzzah, it's a zero-sum game! But not really, because it turns out that ACME's power station is built on a sensitive wetlands in California, obliterating the only known habitat of the Tijuana Spotted Frog. Nothing is going to offset that frog and the ecological network that thrives around it.

Also, the zero-sum game overlooks the fact that there are already more than a trillion excess tonnes of Co_2 in the atmosphere that need to be removed. So in accounting-speak, we're not just balancing the books - we've got a long-overdue carbon debt to pay. The capitalists are working out ways to make conversion to renewable energy production profitable (they're scheming in their underground lairs about that right now). Why not also outlaw billionaires while we're at it, freeing up a whole lot of ill-gotten resources. So, with all that done in the near-future, let's assume there's going to be plenty of money available to pay our farmers to do this work for the planet.

This brings us back to Allan Yeomans' manifesto, and his invention of the *Yeomans Carbon Still*. How does it actually work? It's an ingeniously simple device.

You can see it explained in the video on this page.

VIDEO

Credits:

Let's Pay Our Farmers To End Global Warming: Measuring Soil Carbon with the Yeoman Carbon Still by Lucas Ihlein
Music by Robin Grey

Duration: 9 minutes, 48 seconds

Photo: Allan Yeomans teaches grand-daughter Rhiannon Sutton-Yeomans how to use the *Yeomans Carbon Still* at the Monash University Museum of Art, 2019. Credit: photo by Christian Capurro

After "baking" your soil sample at 500 degrees celsius, the carbon burns off and is released into the atmosphere as Co_2 once more, and the soil loses an equivalent amount of weight. The weight-loss of the soil sample is equivalent to its original carbon content. You can then multiply this out over the total area of the farm to work out how much carbon the farmer has managed to sequester since the last measurement was made. Then you simply pay the farmer at the going per-tonne rate (the World Bank says this should be somewhere between **40-100 US Dollars per tonne of Co_2**).

As you can see, there's a big gap between what happens on the ground (literally, with soil and worms and water and plants and farmers) and what happens in global economies (the abstract circulation of numbers and currencies and stock markets). But hopefully you can also see how these two worlds are now so intimately connected that a new system of whole-world governance is going to be needed to legislate and regulate greenhouse gas emissions and carbon sequestration payments.

Effectively, if we've been operating for a few centuries with an economy pegged to the value of one shiny mineral - gold - it's now time to switch over to a carbon-based economy. Kim Stanley Robinson's novel *Ministry for the Future* calls the near-future global currency the "Carbon Coin".

In 2019, I worked with Allan Yeomans to showcase his *Yeomans Carbon Still* at the Monash University Museum of Art (MUMA), as part of an exhibition called *Shapes of Knowledge*. With Allan's grand-daughter Rhiannon, and his trusty assistant Darren, we regularly demonstrated the process of soil carbon measurement as a live performance, baking soil samples right there in the gallery. Sometimes it felt like we were the hosts of a perverse cooking show. The dramatisation of data collection in this way catalysed many lively conversations and awakenings — and **some of these are revealed in the video on this page**.

For many visitors to the museum (including students of art and design, science undergrads and researchers, farmers, and environmental policy professionals) the *Yeomans Carbon Still* made visible a whole new process, and the possibility for a positive future solution to climate change. During that exhibition, as an unlikely art object, the machine embodied a much needed sense of hope.

Allan's work is just one piece of a mega-puzzle. Around the world, thousands of folks are collaborating on ways to mitigate and reverse global warming. Right now, on the tiny tourist island of Albarella (near Venice) scientist **Augusto Zanella** is working with the *Yeomans Carbon Still*. Allan sent him two of the machines shortly after our MUMA exhibition. Augusto has been using them to test the carbon content of Albarella's soil, comparing it with a neighbouring protected nature reserve called Caleri. The *Carbon Still* has become a tool in Augusto's extensive kit as he tries to link a range of complex factors including human land-use, the carbon content of soils, and biodiversity.

While Augusto's research diverges from Allan's original and urgent intention for the *Carbon Still* (**To Pay Farmers!**) this new collaboration is ultimately part of a grand tradition of generative innovation. In June, Allan and I will speak at an online conference convened by Augusto, with researchers from many different disciplines exploring the crucial role of soil in the future of this planet. The conference is called *Humusica: Soil and Climate Warming*. Augusto's poetic conjoining of "humus" with "musica" is typical of this passionate network of scientists, striving to create harmonic resonance between diverse fields of endeavour. It is a pleasure to be an artist getting my hands dirty in this mix.

Art, at its best, does not merely visualise scientific data. Rather,

VIDEO

Credits:

Baking Earth: Soil and the Carbon Economy: The Monash Forum video by Wayward/Lucas Ihlein

Duration: 5 minutes, 1 second

Photo: Round table discussion on soil and the carbon economy at Monash University Museum of Art, 2019

Credit: Frame from *Baking Earth: Soil and the Carbon Economy: The Monash Forum* video by Wayward/Lucas Ihlein

it dramatises the difficult processes of problem setting, experimentation, and problem solving. These are the things I've tried to get at in the videos offered here.

My role is to catalyse connections that need a little help. Sometimes this means pestering Allan and Augusto (and many other players in this gigantic distributed game) to go beyond their labs and grapple with the communities that their work affects.

Without soil, we have no food. Without food, no life. We've done so much to ruin our soil in the last few centuries. We don't deserve the generosity of soil, but there you have it: farm well, grow better food, draw down carbon, stop climate change. Humusica. Soil is there to help, if only we can create the necessary social systems to make it all possible.

Baking Earth: Soil and the Carbon Economy was a project led by Lucas Ihlein, in collaboration with Allan Yeomans. It was exhibited as part of *Shapes of Knowledge*, curated by Hannah Mathews, at Monash University Museum of Art, 2019. Special thanks to Darren Williams and Rhiannon Sutton-Yeomans, all the staff at MUMA and at Yeomans Plow Co, and to Chris Yeomans.

Conne

cted Energy

Words & Image: Philip Ely

WE LIVE IN A WORLD DIVIDED BY POLITICS, religion, economics and geography. As a collective humanity, as we have explored on previous pages, we do not make the most of the resources and ideas available to us as we confront the biggest challenge our species has faced to date. It has been this way since the Enlightenment and the Industrial Revolution — yet it doesn't have to be this way. The future of life on earth does not have to take the path that humanity is shaping. There are alternatives.

In a rapidly developing technological world, tied to capitalist markets and the focus on development and progress, we spend little time revisiting ideas from the past. Our attention spans are shorter. We demand access to ideas in 'swipe-time'. Read a book? That'll take at least a week or two.

If we cast our eyes and minds backwards — to the super-abundance of concepts, theories, proclamations and voices of dissent that have come before us — a treasure trove of knowledge is available that just might help us navigate a future path that will be beneficial for the majority of living things on earth. One such voice is R.Buckminster Fuller.

In architectural spheres the mere mention of Buckminster Fuller can raise eyebrows. He is an iconoclast that has stimulated many a seminar and studio, inspired generations of architects, designers and engineers and provided governments and corporate entities with ideas that have saved lives or ruffled feathers. My own personal encounter with 'Bucky' came through the editor of his collection of essays, the late James Meller.

Meller introduced me to the ideas of Bucky through his own personal collection of cine-film footage taken on boating trips with the Fuller-Snyder family. As was evident from this footage, he had a particular passion for sailing which gave rise to a number of key concepts that have shaped Fuller's work, including the term 'trim tab' which are the small surfaces on a larger controlling surface of an aircraft (wings) or boat (rudder) which Fuller used

as a metaphorical device to describe leadership or personal empowerment. He even used the term to apply to himself and the official newsletter of the Buckminster Fuller Institute — *Trimtab*.

Fuller was a renowned designer, architect, engineer and futurist and his volume of work culminated in the publication of a final 'masterwork' *Critical Path* in 1981, only two years before his death. His archive (currently housed in Stanford Library) is extensive, with limited space to examine here. For those interested, a bibliography of his work is featured at the end of this chapter.

There are a number of ideas in *Critical Path* that are worth analysis and re-presentation, in particular related to the main topic of the current volume: the future of energy.

David E. Nye, a historian of technology, has drawn attention to Fuller's ideas about energy and how these were manifest in his designs and projects.[1] As Nye suggests, Fuller's concept of 'Spaceship Earth' resonated not only with the counterculturists of the new ecology movement but also with a wider public at the height of the 1970s energy crisis, but his interest in energy was decades in the making. Born in 1895, Fuller was a young boy when Einstein published his work on relativity and this disruption to Newtonian physics informed Fuller's two-volume *Synergetics*, a term that he coined which refers to the geometry found in nature's patterns of energy. It is a geometry that gave birth to the geodesic dome and to the idea that our artifically constructed tall-blocks of architectural modernism are inefficient energy structures that require radical re-designing.

It is in *Critical Path*[2] where Fuller's ideas are most easily understood. Reading it is like revisiting the writing of a fortune-teller: his ideas are strikingly prescient, some forty years later. For example, in the *Introduction*, Fuller proclaims that humanity is moving deeper into an unprecedented crisis, brought about by

> *"...cosmic evolution irrevocably intent upon completely transforming omnidisintegrated humanity from a complex of around-the-world, remotely-deployed-from-one-another, differently colored, differently credoed, differently cultured, differently communicating, and differently competing entities into a completely integrated, comprehensively interconsiderate, harmonius whole."*
>
> R.Buckminster Fuller (1981) p. xvii

He then suggests that cosmic evolution is also intent on

> *"making omni-integrated humanity omnisuccessful, able to live sustainingly at an unprecedentedly higher standard of living for all Earthians than has ever been experienced by any; able to live entirely within its cosmic-energy income instead of spending its cosmic-energy savings account (i.e., the fossil fuels) or spending its cosmic-capital plant and equipment account (i.e., atomic energy) — the atoms with which our Spaceship Earth and its biosphere are structured and equipped — a spending folly no less illogical than burning your house-and-home to keep the family warm on an unprecedentedly cold midwinter night."*
> *(ibid)*

Fuller describes the cosmic-energy income account as the gravity- and star-powered 'dividends' of water, tides, waves, wind, vegetation-produced alcohols, methane gas, vulcanism and 'more'. With the population of Earth then at around two billion, he suggests that we are using only "one four-millionth of one per cent of the rate of its energy income" (ibid) but later points out that 99% of humanity is not even aware of our capability to subsist, economically if only we are to invest in what he calls a "design science initiative and technological revolution" (p.xviii).

Writing in 1980 at the height of the Cold War and some twenty one years after the Moon landings, Fuller believed that the "shad-bone-like pattern" of technological development (the 'critical path') could see all of humanity integrated into an "omniharmonius, economically sucessful, one-world family" (ibid, p.xiv). The critical path that he maps out in the book he believes can be achieved through individual action built on the knowledge contained therein, a time investment for the reader that would involve "the rest of this hour to read the Introduction" and then "all the evenings of one week to read the Critical Path book itself" (ibid).

For those unable to make such an investment in time, I draw attention to one key idea in the book relevant to our current volume: the 'omni-world-integrating electrical-energy network' (p.253).

One reading of Fuller is his work as a critique of federal governments and big business, on their hold on energy resources and the social inequalities borne of the extremes of socialism and capitalism. He believed that the billions of dollars spent in both the U.S.A and U.S.S.R on weaponry would be better spent on *livingry* — the things that would advantage human life and control of the environment. Through engineering and aeronautics facilities across the globe, Fuller could imagine his design science revolution taking shape, led by a band of livingry-expert architects who until now had avoided engaging in the creation of weaponry.

One of the main projects that Fuller considered critical to livingry was a global energy network that distributed electricity through high-voltage cables across continents. Before the 1960s, practical limitations meant that electricity could only travel up to 350 miles (563 km). By the 1980s this has extended to 1500 miles (2414 km). Fuller believed that energy — and not money — was the most essential value system for humanity and that we could/should take full advantage of the day-into-night and night-into-day hemispheres to create a 24-hour energy system. It would be a system that would recognise the metabolic rate of our Universe and provide us with affordable energy for all.

Fuller drew this Ultra-High-Voltage World Electric Grid onto his Dymaxion Sky-Ocean Map (the only flat projection of Earth) connecting South America to North America; Canada to the Soviet Union; Asia (and Australasia) connecting to Europe and Africa. Fuller suggested that such a grid could supply electricity at the cost of 1 cent for 1 kWh (kilowatt-hour). The system, he believed, would put all humanity on the same accounting system and "integrate the world's economic interests and value systems and lead most swiftly to the realistic elimination of the 150 sovereign-nation systems" (p.253). He gave the plan for such an idea to the-then Canadian premier Pierre Trudeau (the father of the current incumbent Justin Trudeau) to present to the Soviet Union's General Secretary, Leonid Brezhnev. According to Fuller, Russian experts described the idea as "feasible...desirable." (p.xxxi).

Although Fuller's vision was never realised, an institute has been established to further the ambition of the project. The Global Energy Institute (**GENI**) was founded in 1986 by **Peter Meisen** and draws on (and celebrates) the work of R.Buckminster Fuller, sharing a vision "of a world in which all people have access to ecologically sustainable energy" (GENI, 2017)[3].

On the following spread, I have visualised part of the grid in action, titled *Whilst half the world sleeps, the rest generate*. The idea is not so far-fetched. A network of solar-powered servers has been created by **Tega Brain**, **Alex Nathanson** and **Benedetta Piantella**, directing internet traffic according to which server is generating the most power in relation to the sun. The project — **Solar Protocol** — is deserving of its own pages in a volume like ours but we provide you with the link to take a look for yourself: http://solarprotocol.net/

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Whilst half the world sleeps, the rest generates

A global energy grid

The red lines on the globe follow the rough path of R.Buckminster Fuller's World Electric Grid

Image: Philip Ely, 2022

Coal-fired art?

VIDEO

Credits:

Fossil fuels + the Arts by A Centre for Everything.
Featuring introduction by Gabrielle de Vietri

THE CHANCES ARE THAT YOU ARE READING THIS BOOK in a gallery setting. Or that the creative works that you have appreciated over the last few years at an arts or cultural festival have all come about thanks to the patronage of large corporate donors. Everything from documentary film to dance, from classical music to fine art painting has been supported by an acutely public-opinion-conscious corporate entity.

In 2019, artists **Gabrielle de Vietri** and **Will Foster** (collaborating as *A Centre for Everything*) created an interactive map — ***Fossil fuels + the Arts*** — as part of the work ***Maps of Gratitude, Cones of Silence and Lumps of Coal*** exhibited at Monash University Museum of Art.

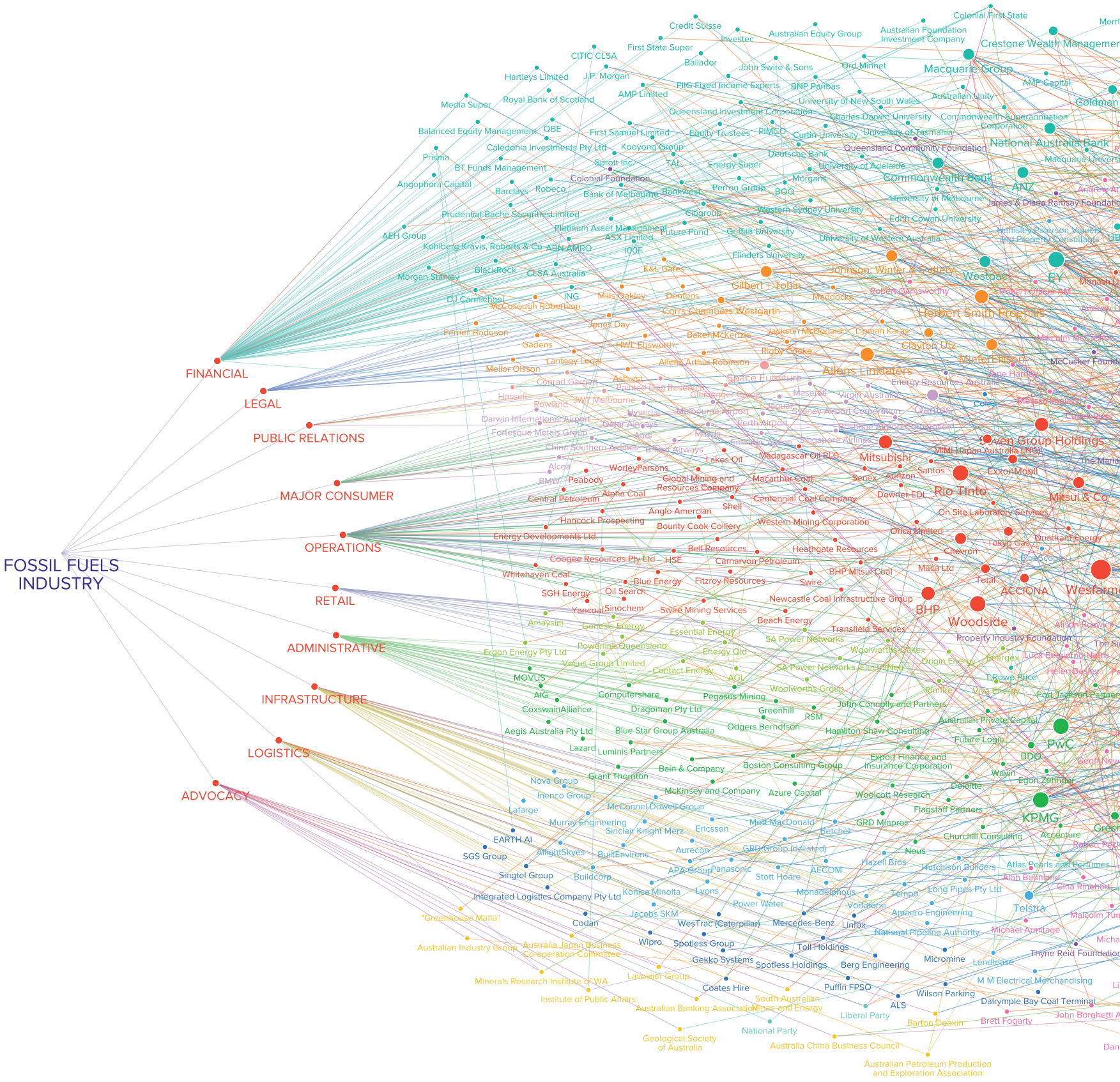
Here we provide an extract from Foster & de Vietri's work which provides the reader with an insight into the connections between major arts institutions and the fossil fuels industry. Greenwashing laid bare.

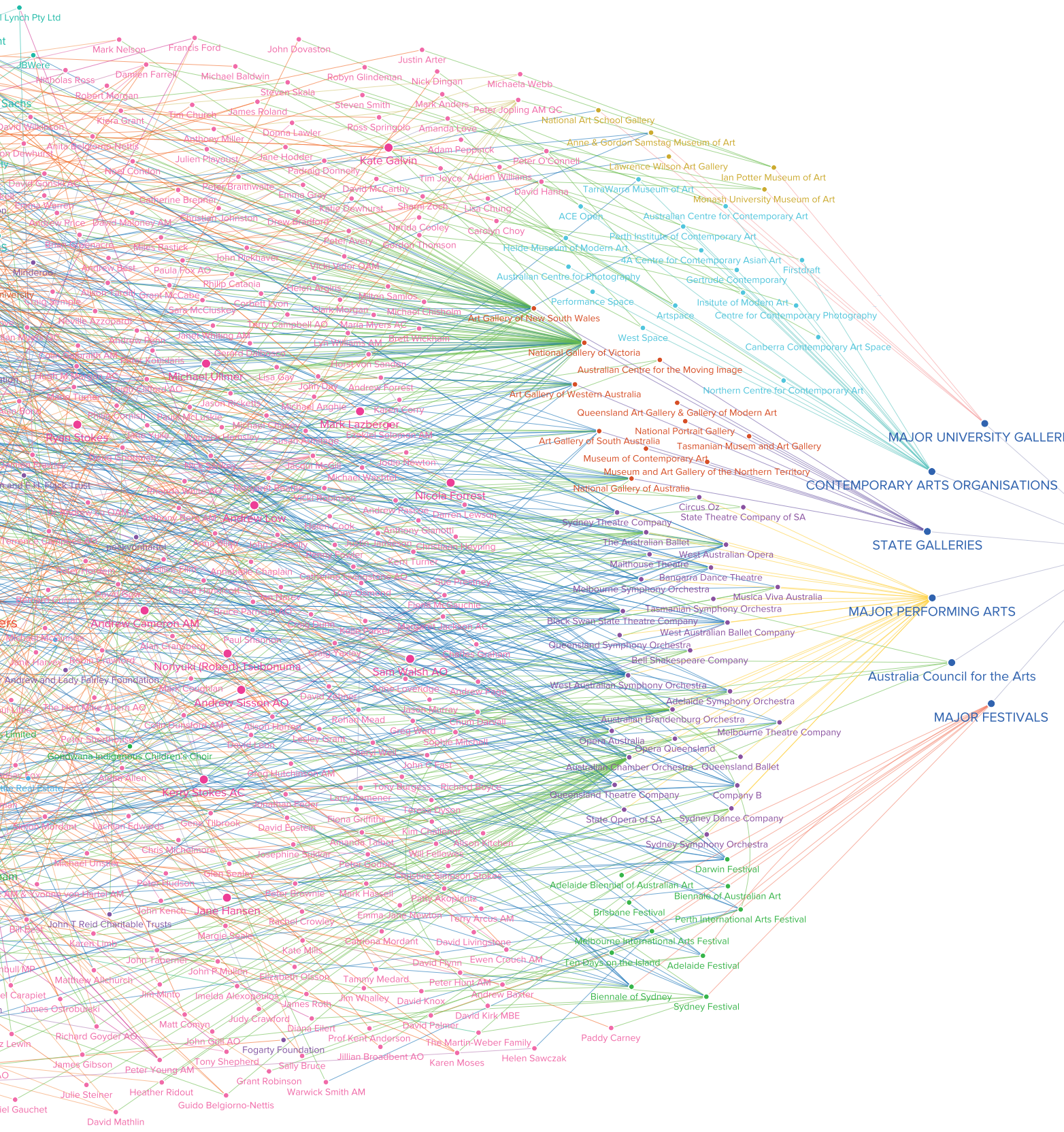
You can explore the interactive map for yourself at:

https://kumu.io/GdV/fossil-fuels-the-arts

This is a map to be studied closely. Lose yourself in the complex web of inter-fossil relations. The section *'A Closer Look'* is a 'zoom in' on the map and pages continue from one to the next so that you can follow a path between entities.

The Overview





A Closer Look

FOSSIL FUELS INDUSTRY

- FINANCIAL
- LEGAL
- PUBLIC RELATIONS
- MAJOR CONSUMER
- OPERATIONS
- RETAIL
- ADMINISTRATIVE
- INFRASTRUCTURE
- LOGISTICS
- ADVOCACY

Credi
First State Supe
CITIC CLSA
Hartleys Limited
J.P. Morgan
AMP Limited
Media Super
Royal Bank of Scotland
Balanced Equity Management
QBE
First Samuel Limited
Caledonia Investments Pty Ltd
Kooyong Group
Prisma
BT Funds Management
Sprott Inc.
TAL
Angophora Capital
Barclays
Robeco
Colonial Foundation
Bank of Melbourne
Prudential-Bache SecuritiesLimited
AEH Group
Platinum Asset Management
ASX Limited
Kohlberg Kravis, Roberts & Co
ABN AMRO
IOOF
Morgan Stanley
BlackRock
CLSA Australia
K&L Gates
DJ Carmichael
ING
Mills Oakley
McCullough Robertson
Jones Day
Ferrier Hodgson
Gadens
HWL Ebsworth
Lantegy Legal
Mellor Olsson
Ashurst
Conrad Gargett
Hassell
JWT Melbourne
Rowland
Hyundai
Darwin International Airport
Qatar Airways
Fortesque Metals Group
Audi
China Southern Airlines
Alcoa
WorleyParsons
BMW
Peabody
Central Petroleum
Alpha Coal
Hancock Prospecting
Energy Developments Ltd.
Coogee Resources Pty Ltd
HSE
Whitehaven Coal
Blue Energy
SGH Energy
Oil Search
Yancoal
Sinochem
Amaysim
Genesis Energy
Ergon Energy Pty Ltd
Powerlink Queensland
Vocus Group Limited
MOVUS
AIG
Computershare
CoxswainAlliance
Aegis Australia Pty Ltd
Blue Star Group
Lazard
Luminis Partners
Grant Thornton
Nova Group
Inenco Group
Lafarge
McConnel Dowell
Murray Engineering
Sinclair Knight Merz
EARTH AI
AlfightSkyes
BuiltEnvirons
SGS Group
Singtel Group
Buildcorp
Konica Minolta
Integrated Logistics Company Pty Ltd
Jacobs SKM
"Greenhouse Mafia"
Codan
Wipro
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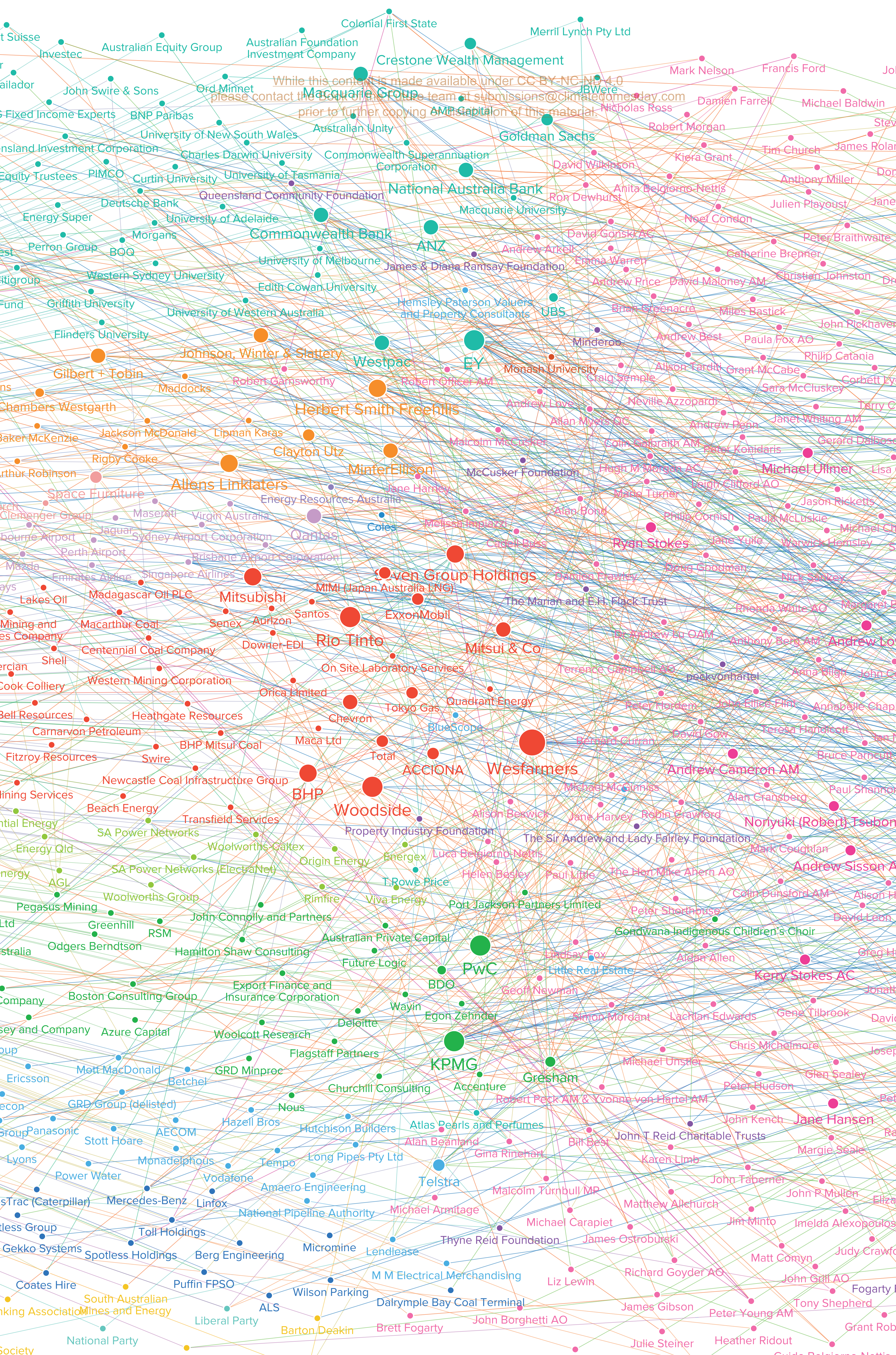
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Singapore Airlines
Seven Group Holdings
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Queensland Art Gallery & Gallery of Modern Art
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Susan Armitage
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Tasmanian Musem and Art Gallery
Museum of Contemporary Art
Jodie Newton
Jacqui McGill
Museum and Art Gallery of the Northern Territory
Michael Wachtel
National Gallery of Australia
Nicola Forrest
Vicki Robinson
Circus Oz
Andrew Pascoe
Darren Lewson
State Theatre Company of SA
Sydney Theatre Company
Helen Cook
Anthony Gianotti
The Australian Ballet
Justin Jamieson
Christiaan Heyning
West Australian Opera
Kerri Turner
Malthouse Theatre
Catherine Livingstone AO
Bangarra Dance Theatre
Sue Prestney
Melbourne Symphony Orchestra
Tony Osmond
Musica Viva Australia
Fiona McGauchie
Tasmanian Symphony Orchestra
Craig Dunn
Margaret Jackson AC
Black Swan State Theatre Company
West Australian Ballet Company
Queensland Symphony Orchestra
Craig Yaxley
Charles Graham
Bell Shakespeare Company
Sam Walsh AO
Anne Loveridge
Andrew Page
West Australian Symphony Orchestra
David Zehner
Adelaide Symphony Orchestra
Jason Murray
Rohan Mead
Chum Darvall
Australian Brandenburg Orchestra
Greg Ward
Melbourne Theatre Company
Lesley Grant
Sophie Mitchell
Opera Australia
Sheryl Weil
Opera Queensland
John C Fast
Australian Chamber Orchestra
Queensland Ballet
Tony Burgess
Richard Boyce
Queensland Theatre Company
Company B
Larry Kamener
Teresa Dyson
State Opera of SA
Sydney Dance Company
Fiona Griffiths
David Epstein
Kim Challenor
Sydney Symphony Orchestra
Amanda Talbot
Allison Kitchen
Josephine Sukkar
Will Fellowes
Darwin Festival
Peter Godber
Christine Simpson Stokes
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Peter Brownie
Mark Hassell
Biennale of Australian Art
Patty Akopiantz
Brisbane Festival
Rachel Crowley
Emma-Jane Newton
Terry Arcus AM
Perth International Arts Festival
Catriona Mordant
David Livingstone
Melbourne International Arts Festival
Kate Mills
David Flynn
Ewen Crouch AM
Ten Days on the Island
Adelaide Festival
Elizabeth Olsson
Tammy Medard
Peter Hunt AM
Andrew Baxter
Biennale of Sydney
Jim Whalley
David Knox
James Roth
Sydney Festival
David Kirk MBE
Diana Eilert
David Palmer
Paddy Carney
Prof Kent Anderson
The Martin-Weber Family
Jillian Broadbent AO
Karen Moses
Helen Sawczak
Sally Bruce
Warwick Smith AM

Australian Centre for Photography
Performance Space
Artspace
West Space
ACE Open
Heide Museum of Modern Art
Perth Institute of Contemporary Art
Australian Centre for Contemporary Art
4A Centre for Contemporary Asian Art
Gertrude Contemporary
Insitute of Modern Art
Centre for Contemporary Photography
Firstdraft
Canberra Contemporary Art Space
Northern Centre for Contemporary Art
TarraWarra Museum of Art
Monash University Museum of Art
Lawrence Wilson Art Gallery
Ian Potter Museum of Art
National Art School Gallery
Anne & Gordon Samstag Museum of Art

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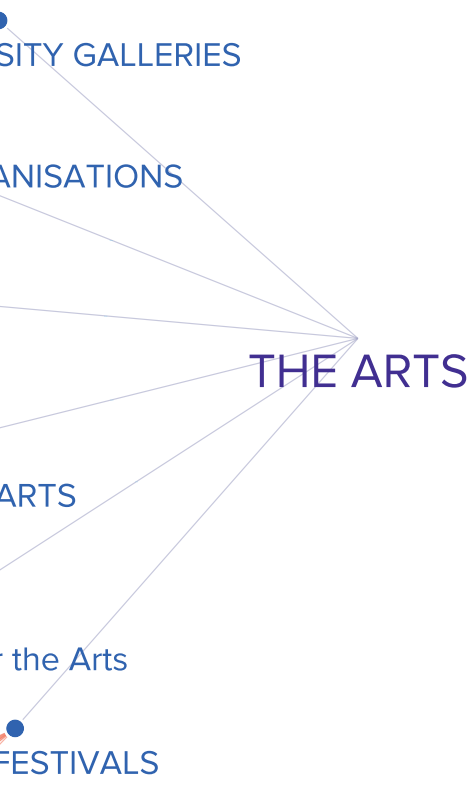


Credit:
A Centre for Everything (Gabrielle de Vietri and Will Foster)

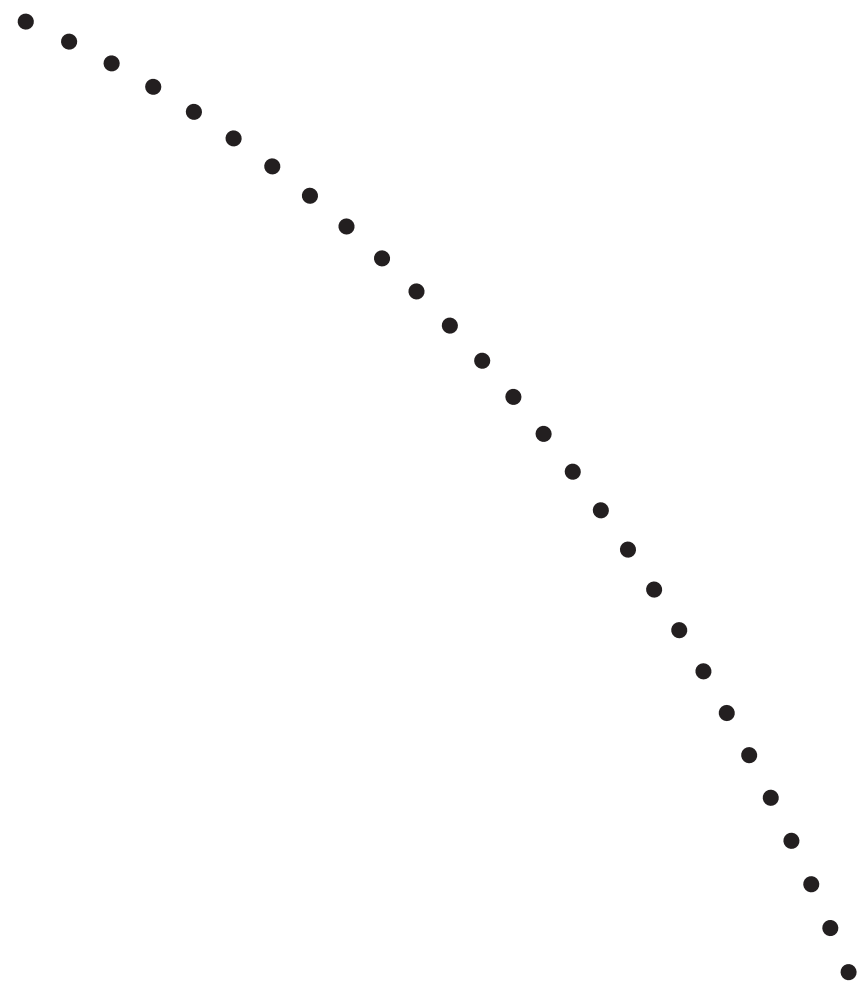
Fossil fuels + the Arts (2019)
created as part of *Maps of Gratitude, Cones of Silence and Lumps of Coal* (2019)
Interactive network map

Commissioned by Monash University Museum of Art

A Brief Reflection...

"[I]deas and the innovations they inspire require energy,……. and lots of it, to support the smart individuals who are thinking and to provide the appropriately stimulating environments and collective experiences we institutionalize in places such as universities, laboratories, parliaments, cafés, concert halls, and conference venues..."

West, G (2017) *Scale: The Universal Laws of Life, Growth, and Death in Organisms, Cities, and Companies,* Penguin Press: New York, pp. 238-239



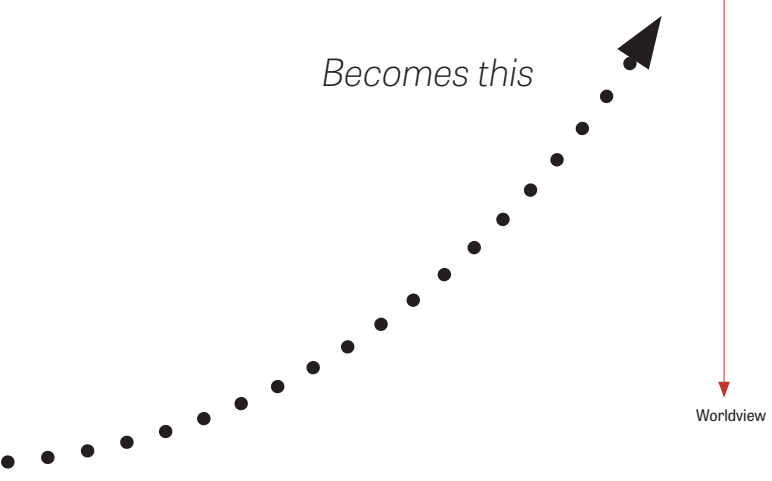
Just how much energy have we used to create this book? The reading, researching, calling, drawing, posting, printing. All with only two face-to-face meetings...the rest all online?

We'll come to this later in our *Postscript*.

This

Smart and ambitious people are drawn to cities, and this is where our new ideas are incubated, where entrepreneurship flourishes, and where wealth is created. Supporting all this is extremely expensive, so it is naïve to dissociate ideas from energy - one cannot flourish without the other. Of the trillions of thoughts, ideas, speculations, and proposals for new machines, new products, and new theories, only an infinitesimal minority ever lead to any significance. Almost all fall by the wayside, even though as a totality they all contribute a necessary background noise and weltanschauung for new and innovative phenomena to arise and blossom. All of this require huge amounts of energy: *ex nihilo nihil fit* **- nothing comes from nothing**

West, G (2017) *Scale: The Universal Laws of Life, Growth, and Death in Organisms, Cities, and Companies*, Penguin Press: New York, p.239



Ørsted.

The Oil Giant That Turned Green

Tim Sidnell
Ash Stott
Cameron Underwood
OurEden

We set our scene in the gorgeous land of Denmark. The year is 1972, a leap year.[2] The country crowns Margrethe II as the first Queen of Denmark since 1412, joins the European Economic Community and launches Dansk Naturgas - a state owned company overseeing Denmark's vast oil and gas reserves in the North Sea. Dansk Naturgas eventually becomes DONG (Danish Oil and Natural Gas).[3] Despite Denmark being leaders in nuclear physics research, they never actually built any nuclear power plants due to unfavourable public opinion, and even enacted a government ban on the technology, in 1985.[4] As a result, fossil fuel power plants reigned king for decades.

After selling fuels to power plants for many years, DONG eventually branches out and starts building its own power plants and selling electrical energy. They buy out power companies and electrical distribution groups throughout Denmark, giving birth to DONG Energy in March 2006. In doing so, they acquired what was the world's largest offshore wind farm, Horns Rev, comprising 80 turbines producing a total of 160 MW of clean electricity.[5] During this time, DONG's focus throughout Europe was designing highly efficient coal power plants and were working on a new behemoth plant in Greifswald, Germany.[1,6] But in March 2007, the European Commission put forward the 20-20-20 targets, to slash fossil fuel emissions and energy consumption by 20%, and increase Europe's share of renewables to 20%, all by the year 2020[7]. They also proposed a climate conference, right in the heart of Denmark, The Copenhagen Summit.[8]

At this time, 15% of DONG's electrical and thermal power were renewable, which represented 7% of its profits.[1] With an anti-coal movement growing both politically and socially, DONG faced a turning point. Coal was no longer cool and nuclear was not an option. Solar is good but it doesn't work around the clock that far from the equator. The clear winner had to be wind. A year before the Copenhagen summit (December 2008), DONG energy announced a wildly new vision for its future, something that no energy company had ever done before: to completely flip their generating portfolio on its head and become 85% renewable and 15% non-renewable by 2040.[1] Easy enough to say. Not so easy to do.

A few days into the Copenhagen summit, DONG's board scrapped the plans for

their Greifswal coal plant, freeing themselves to work on wind power. Both DONG and Denmark had been pioneers in wind energy, building several onshore farms and the world's first offshore wind farm, Vindeby, back in 1991.[9, 10] However, in the other nations DONG operated in, wind power was unpopular and expensive. Duncan Clark recalls UK government officials stating that offshore wind was simply too expensive. Back in 2008, the levelized cost of UK onshore wind power was 80 euros per MWh and offshore cost a whopping 130 euros per MWh. Meanwhile, coal power cost 40 euros and gas just 25.[11] And, as Marianne Wiinholt described, going renewable involved turning their back on their old way of doing things, and telling colleagues of many years that you no longer value what they do. Not disheartened by the numbers nor the naysayers, but fuelled by necessity, DONG set out ambitious targets, putting research into every aspect of offshore power generation. The farms had to be cheaper, more efficient and longer lasting. They strived for what the cost of power needed to be, not what they thought was achievable. This trickled down to a set of aims for each subdivision of the company and eventually objectives for each individual employee to work on over many months.

So how do you make wind farms cheaper? One simple answer is economies of scale. Build bigger turbines and more of them.[9] In 2009, DONG made a bulk purchase agreement with Siemens, one of the world's largest and most experienced wind turbine manufacturers, for 500 3.6 MW turbines. The huge upfront payment, which we estimate at around half a billion Euros, ensured a steady supply of generators for DONG's new wind farms but also investment for Siemens' research to improve the cost and performance of their units. Between 2002 and 2011, DONG invested an average of 2 billion euros a year into the wind industry and erected a new turbine every 2 days! In doing so, they helped break record after record. The average wind turbine output increased from 2.3 to 3.6 MW, they built the world's farthest offshore farm, Horns Rev 2 and in 2013 co-constructed the new champion for the world's largest wind farm, London Array, which dwarfed Horns Rev 2's output by 3 times and continues to provide power to over half a million British homes. [9, 12] But DONG wasn't done. By 2012, the cost of offshore wind energy had risen to a staggering 167 euros per MWh. So DONG UK set out to drive down the cost by 40%, to just 100 euros by 2020.[9] To achieve this, they ramped up their wind investment to 10 billion euros a year and installed an average of 1.5 turbines per day. Over time DONG's offshore wind capacity grew from 794 MW in 2012 to 3,000 MW in 2015. By 2018, they had already surpassed their target, achieving just 61 euros per MWh, [9] a reduction of 63%. Finally, in 2017 they phased out the use of coal and sold off their remaining oil and gas assets.

And just like that, DONG energy's transition was complete. They'd reached 85% renewable operation, a goal originally planned to take 32 years, in just 8 years. In celebration, they change their name to Ørsted - after the Danish Scientist Hans Christian Ørsted who first discovered the link between electricity and magnetism - findings which allow the generators in wind turbines to produce power. At this point, CEO, Henrik Poulsen steps down - having completed DONG's goal. But Ørsted has new goals.

In 2018 Ørsted bought out Deepwater wind, aiming to expand offshore wind projects in the United States. Their markets of interest now include nations across Europe and Southeast Asia, as well as the USA, India and many others. Ørsted currently generates 49% of electricity and 35% of thermal energy in Denmark and an estimated 88% of their profits come from renewables. It's the largest offshore wind company in the world, generating 16% of all wind power, and is a huge shareholder in wind farm cable laying and turbine manufacturing companies. They continue to invest 10 billion euros a year into the industry but now build more than 2 turbines each day. Ørsted now seeks to become carbon neutral by 2025, with zero carbon emissions by 2040 - another goal they publicly committed to at the 2019 climate summit.

Ørsted's history is not without failure. Some purchases were criticised in the media and even resulted in 6 government ministers stepping down. The first wind farm DONG built was almost a total failure. The turbines didn't perform as desired and had to be taken down, retrofitted to survive the offshore environment and re-erected. But doing something world-changing requires risk, hard work and a tremendous amount of self-belief. Jakob Bøss, a former DONG senior director stated "I never had any reservations this was the right thing to do. The world depends on energy, so we needed to make renewables work, otherwise, we wouldn't

be able to power modern society in the future." [1] Former CEO Henrik Poulsen said: "As a business, you have a much broader responsibility than just making money. It's not about what the company can do. It's about what the company can contribute to a more sustainable world".

As a result of Ørsted's work, a single wind turbine can now provide 12-14 MW of power, more than double the entire output of the first offshore wind farm. Modern turbines have blade diameters exceeding 220 m and one rotation can power an American home for 20 hours. The average wind farm now lasts 25 years and power output continues to grow exponentially.

Across EU nations, and many others, onshore and offshore wind power is now cheaper than coal and natural gas and the same is true for solar. But for some reason, many [13] still believe that renewables are more expensive than fossil fuels. Is this misconception what's stopping other fossil fuel giants from taking the same leap Ørsted did?

References:

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[2] https://en.wikipedia.org/wiki/1972

[3] https://en.wikipedia.org/wiki/%C3%98rsted_(company)

[4] https://world-nuclear.org/information-library/country-profiles/countries-a-f/denmark.aspx

[5] https://en.wikipedia.org/wiki/Horns_Rev

[6] https://www.wwf.de/fileadmin/fm-wwf/Publikationen-PDF/Dong_Energy_Final.pdf

[7] https://en.wikipedia.org/wiki/European_Union_climate_and_energy_package#:~:text=The%2027%20Heads%20of%20State,energy%20consumption%20in%20the%20EU and https://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/ec/104672.pdf

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[13] https://www.lazard.com/perspective/levelized-cost-of-energy-levelized-cost-of-storage-and-levelized-cost-of-hydrogen/

VIDEO

Credits:

Ørsted - The Oil GIANT That Turned Green
produced and presented by OurEden

Watch the summary video to this article.

You can view other OurEden climate science educational videos at:

https://www.youtube.com/c/OurEden/about

Getting the

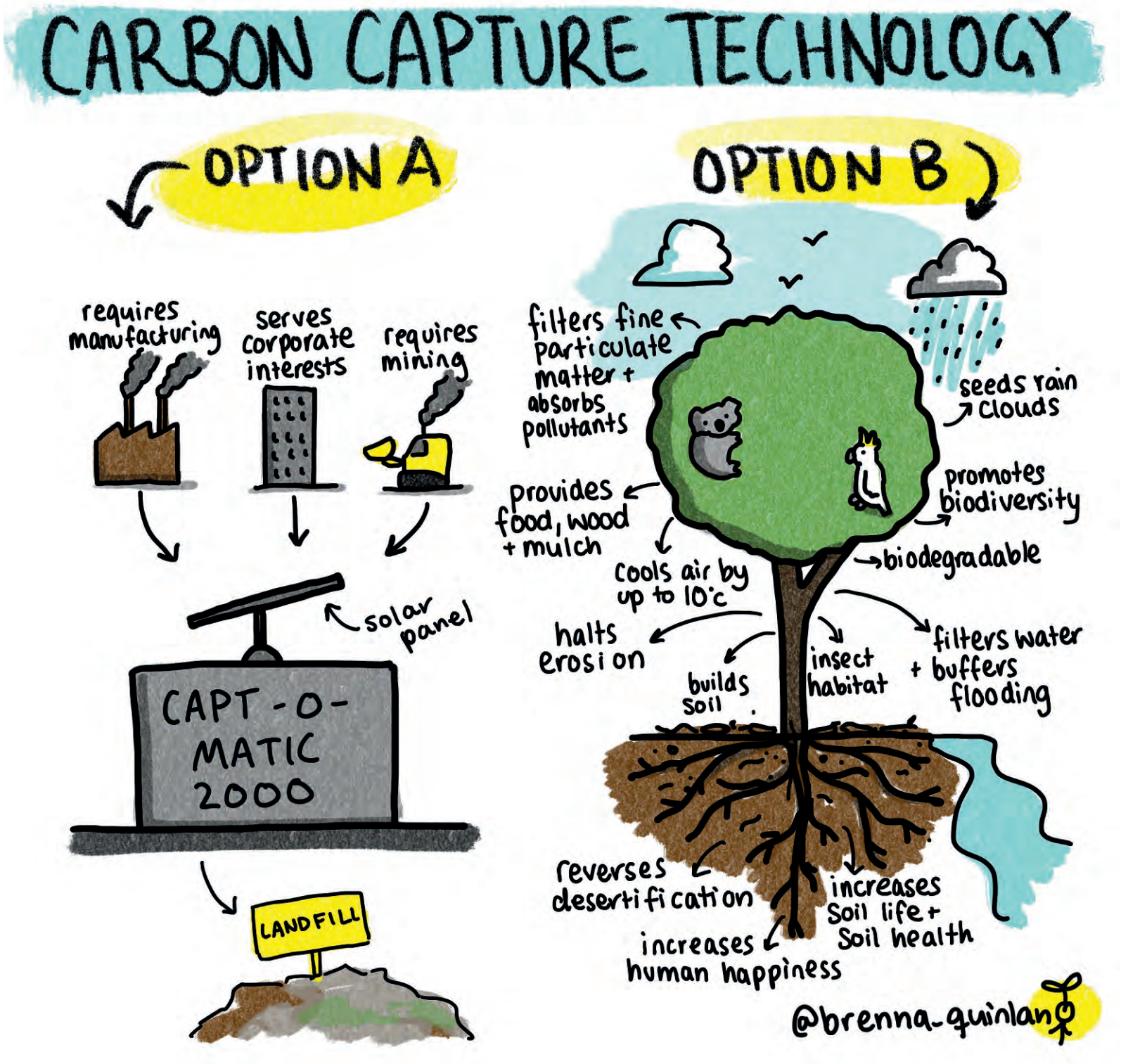
message out there

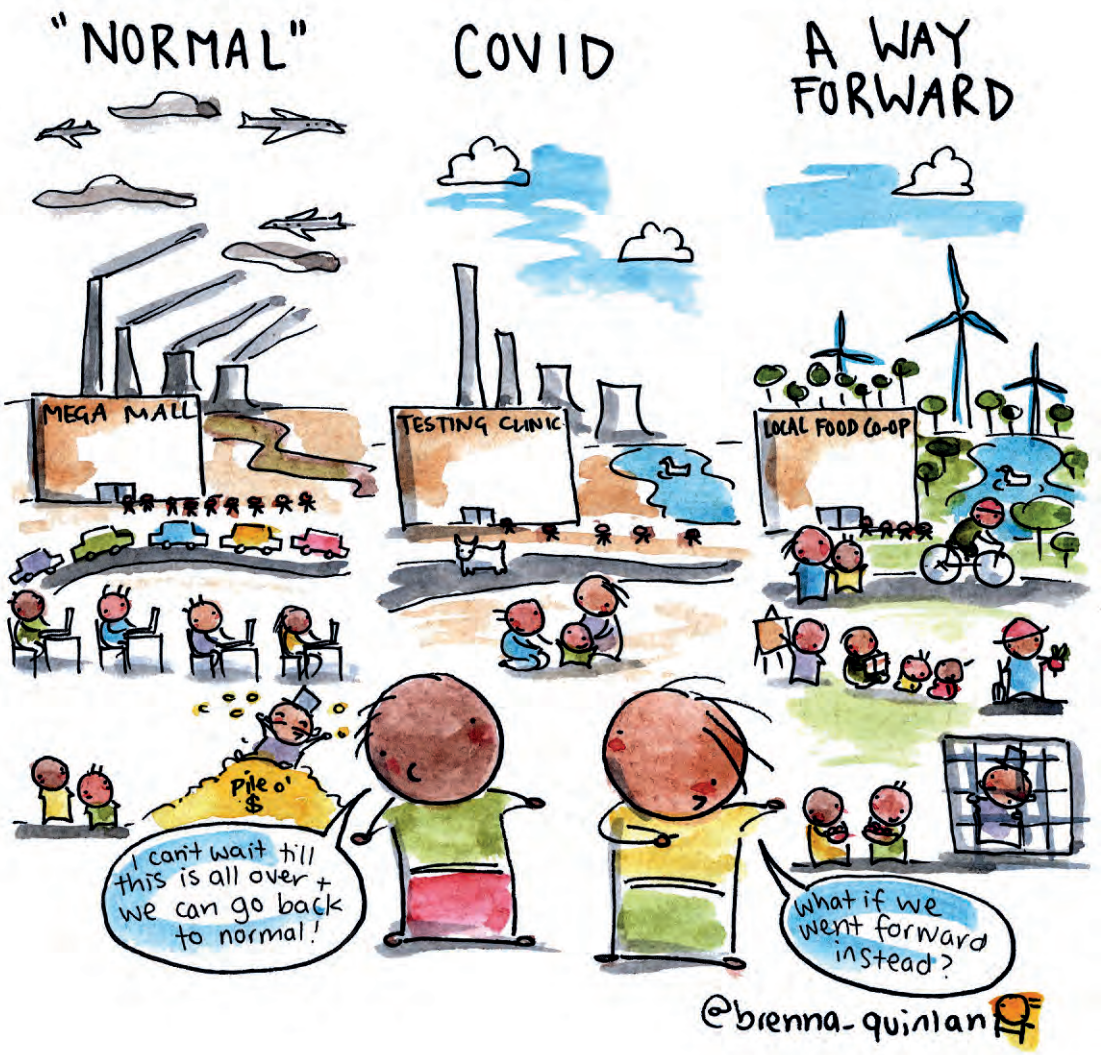
THE CLIMATE EMERGENCY REQUIRES US TO FACE UP to the systemic changes required to the way we live — how we grow our food, heat or cool our homes and how we travel from A to B. Brenna Quinlan is an artist and educator who is using her powers of communication to help shift mindsets.

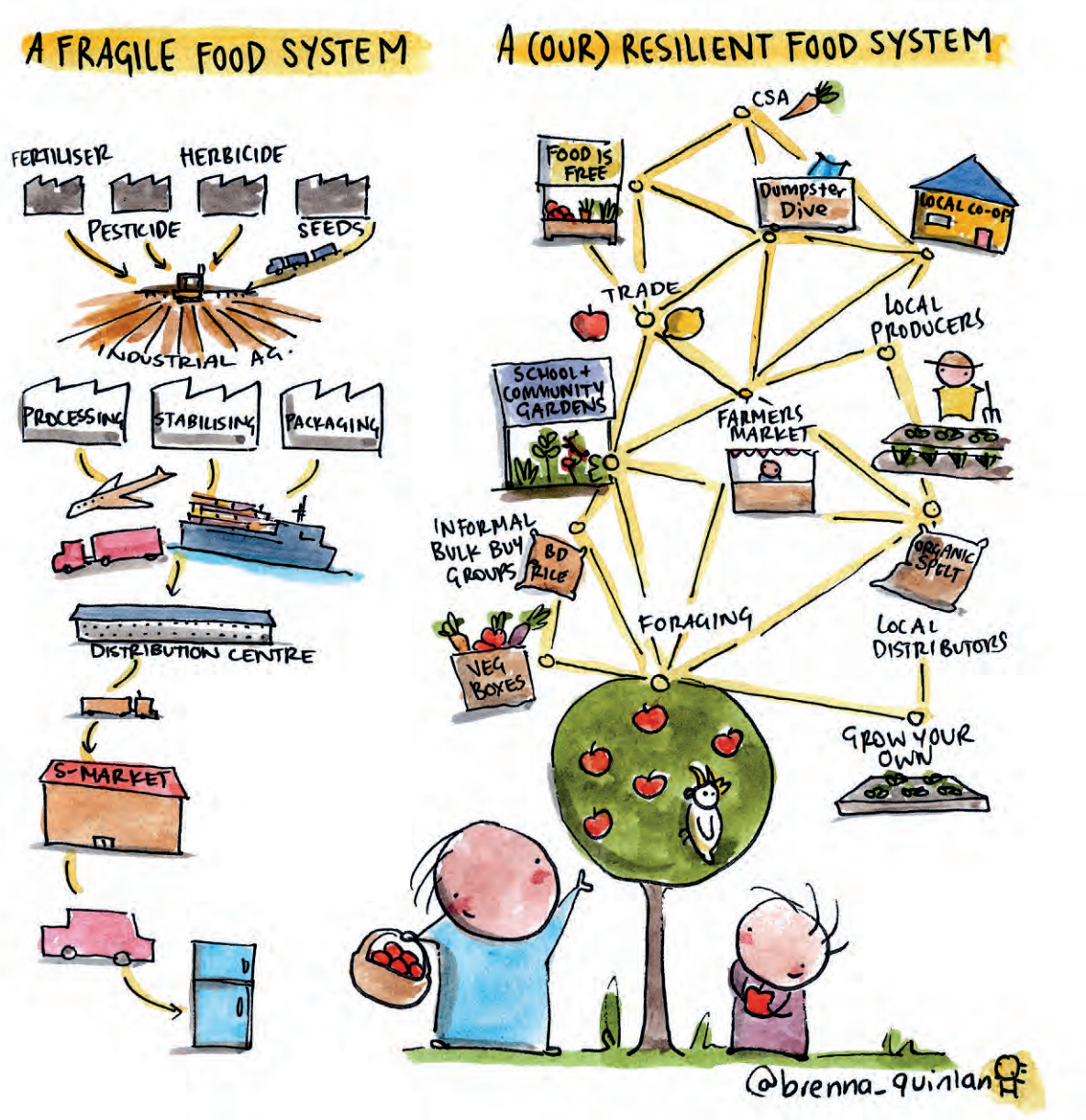
Quinlan lived for four years at Melliodora in Hepburn, Victoria which is Australia's most well-known permaculture demonstration site owned by permaculture co-originator David Holmgren and his partner Su Dennett. As a permaculture educator, she has co-taught alongside the biggest names in permaculture including Holmgren, Rosemary Morrow, Dan Palmer, and Hannah Moloney. She has featured on ABC Gardening's *My Garden Path*, sharing her passion for art and permaculture.

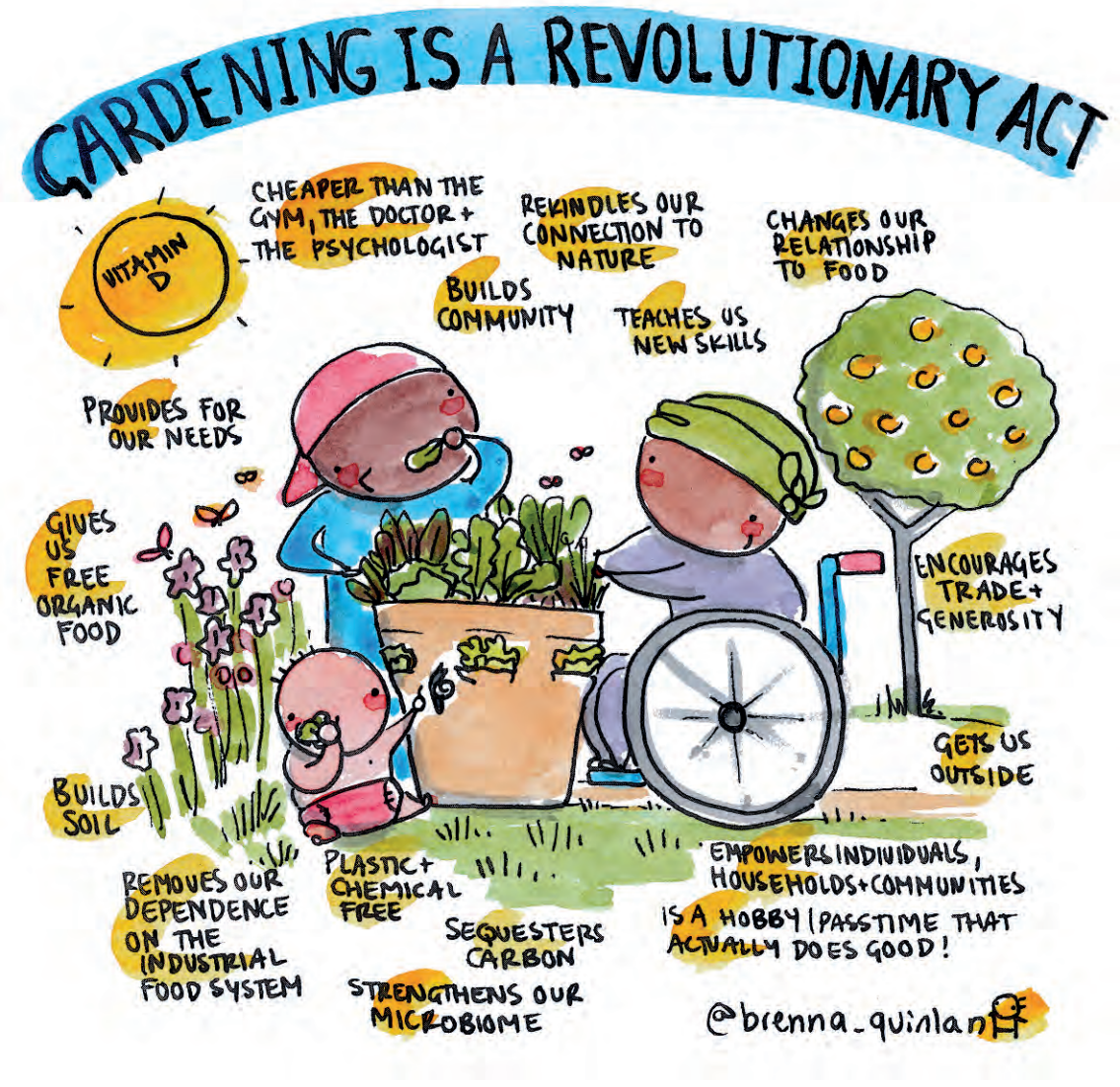
Quinlan co-runs *Grow Do It Permaculture Education*, a project focused on bringing climate solutions to kids (and their grown ups) through art, music and creativity. On the following pages we feature Quinlan's ideas on alternative (and preferable) futures that are clearly rooted in the permaculture ethos.

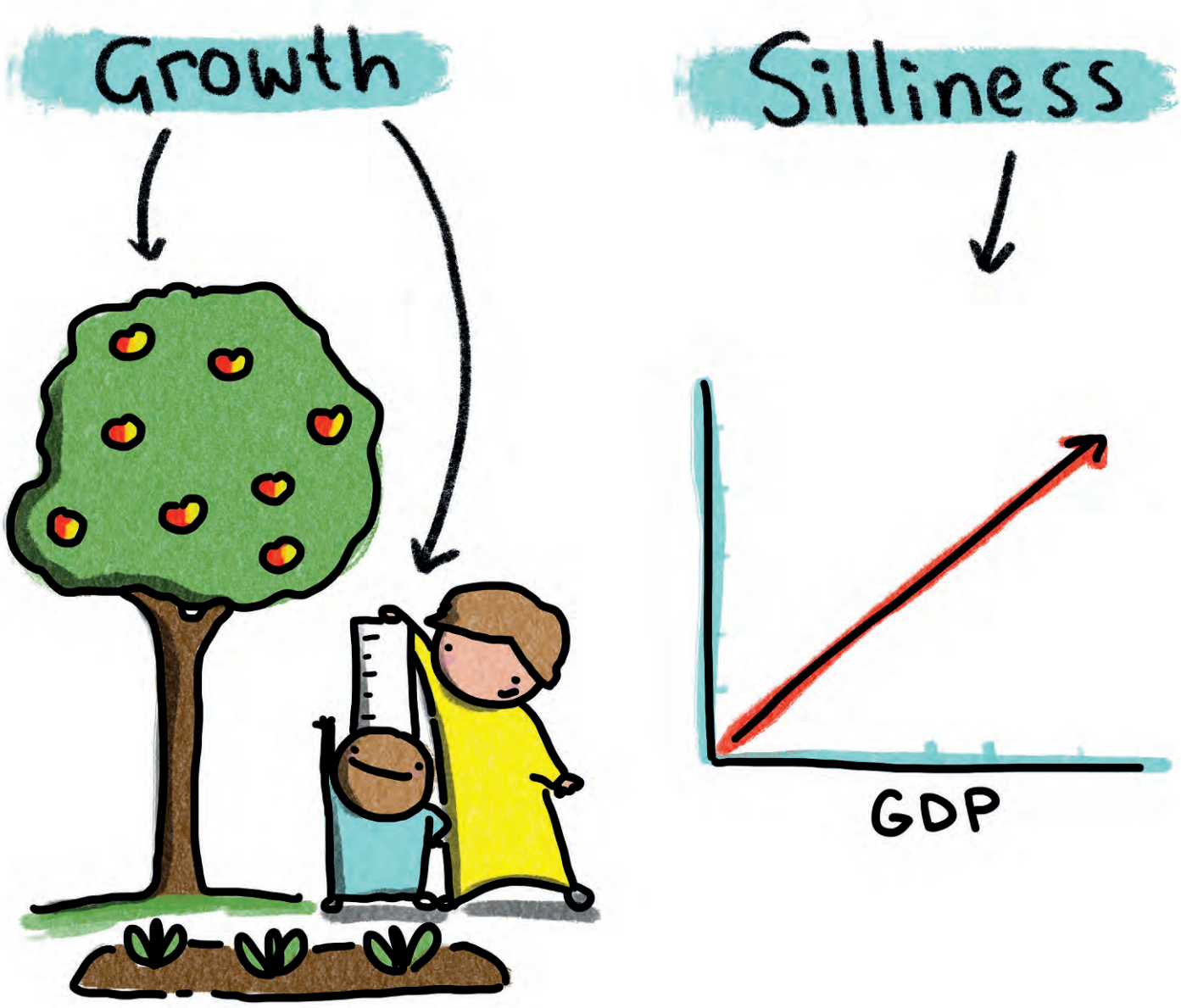
You can also view her illustrations in The Formidable Vegetable Sound System video on page 70.



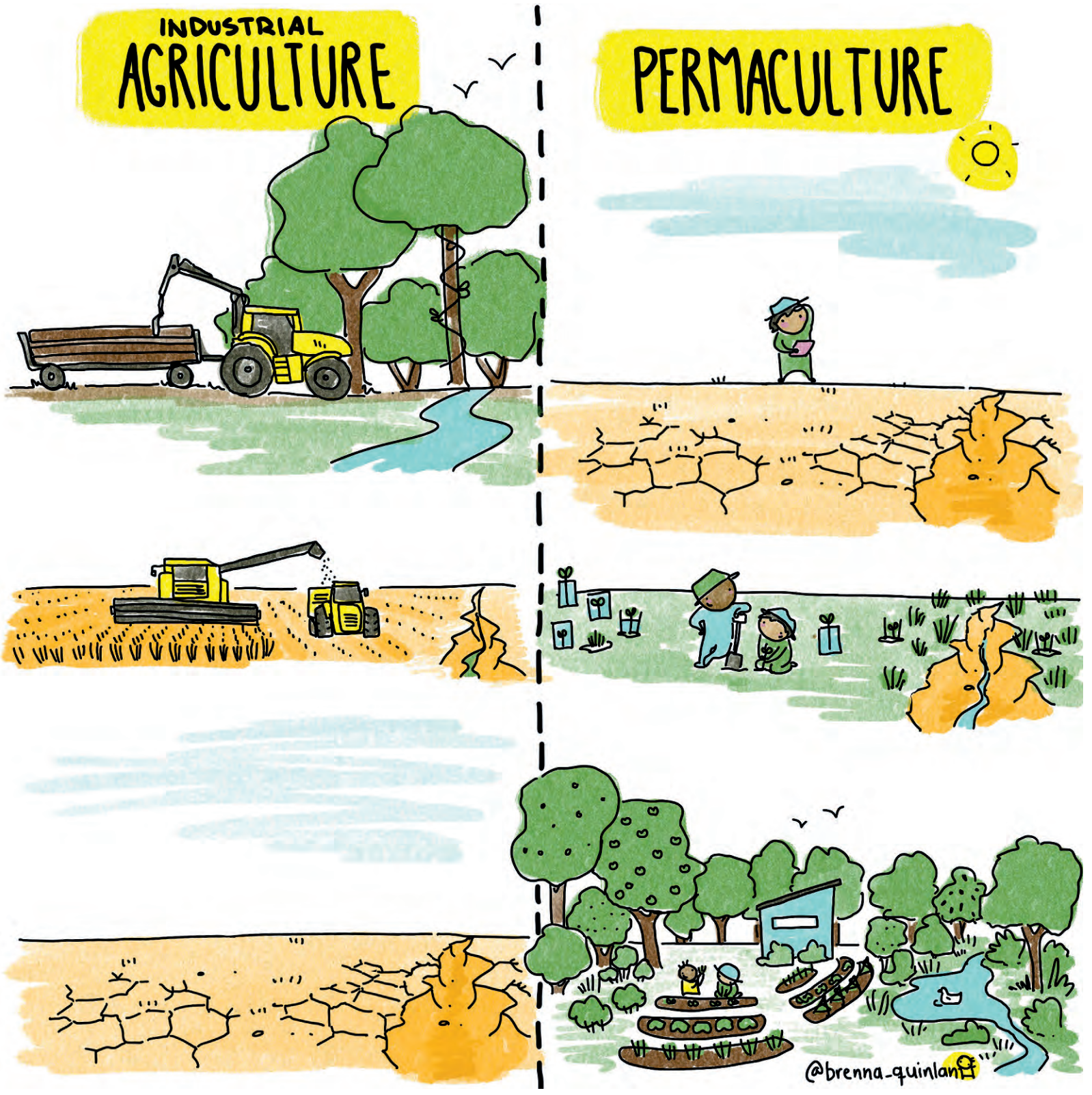


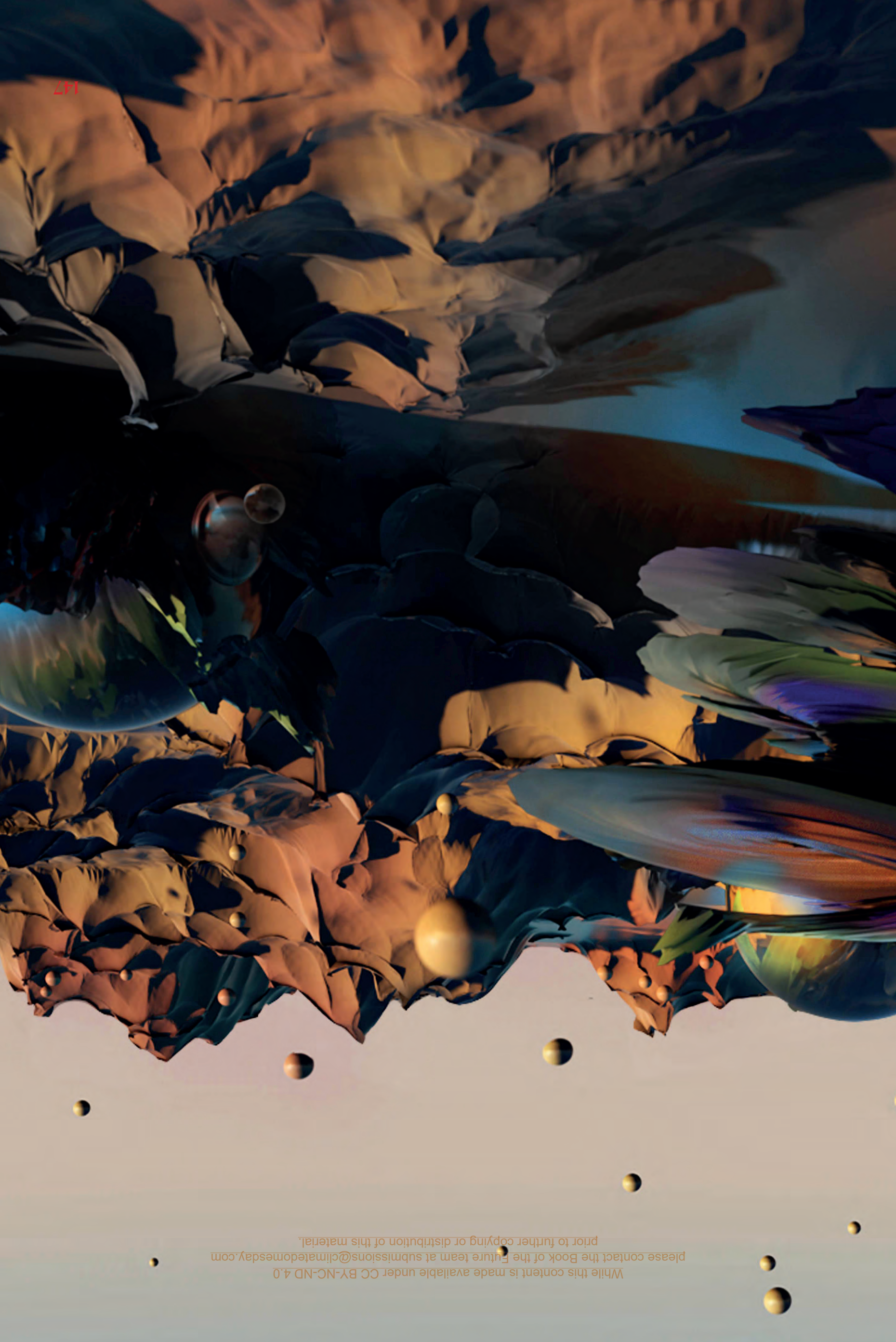




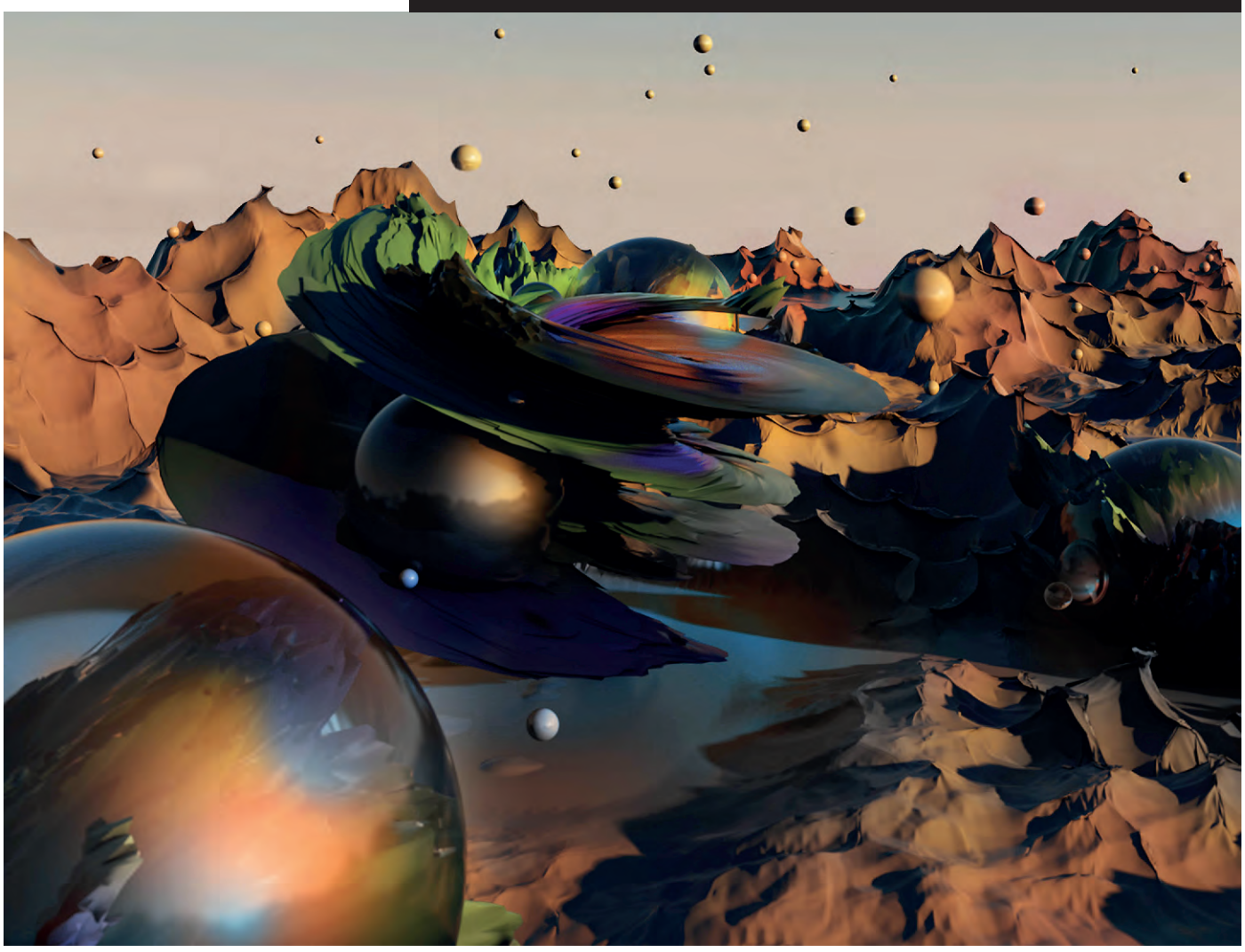


@brenna-quinlan





"I don't know if my vision of the future is positive or negative, but it will be drastically different."



VIDEO

Credits:

Film by Sien Zhou
Modelled and rendered in Cinema4D

Sien Zhou's vision for our planet sees hope in the underground

Words: Philip Ely
Images: Sien Zhou

PERTH-BASED DESIGNER SIEN ZHOU has been isolated from her family in Taipei, Taiwan since the outbreak of Covid-19. Despite relatively low incidents of the virus in Western Australia, the state — and the country at large — has experienced unprecedented bushfires. Tien's exposure to both catastrophe and the desert landscape of Western Australia has inspired her reflections on what our planet may look like in the future.

In Zhou's future Earth, much of human life is spent underground, whilst human-designed, spherical 'atmos' drones re-constitute the atmosphere. There are few signs of life as our species lives in a termite-world with rare incursions into manufactured lakes of water that provide much-needed hydration for the artifical foods that we are growing.

Zhou experiments daily with Cinema4D™ and Photoshop, sharing her designs on her Instagram account @sien_zhou_tw.

ENE

RGV

SUSTAINABLE DEVELOPMENT

001

LIGHT
RESOURCE

WATER

RESOURCE

JSE

003

EARTH RESOURCE

004

Making

the Book-of-the-Future

THE CLIMATE DOMESDAY BOOK

Words: David Frohlich

ORIGINS

The idea for the *Climate Domesday Book* came out of a recurrent conversation between Philip Ely and myself about how we could work together again. Philip had been my PhD student at the University of Surrey and then a post-doc working with me on the *Interactive Newsprint* project. This project was exploring the possibility of augmenting printed newspapers with embedded electronics to play audio that could be listened to whilst reading: a kind of radio-newspaper. We both loved the new combination of physical and digital interaction, especially as it applied to reading: Philip from his graphic and interactive design background, and me from my psychology and interaction design background. I subsequently went on to develop the ideas in two projects called *Light Tags* and *Next Generation Paper (NGP)*.

In August 2021, Philip was invited to contribute to the Energy Futures Visualisation project (manifest in the *Energaia* Exhibition at John Curtin Gallery) at Curtin University and I had finished the *NGP* project and was exploring 'NGP Markets' and commercial opportunities for the technology. We had a new platform for what we called 'a-books': augmented books with printed hotlinks that play on a nearby device. Perhaps this could be used in the exhibition somehow. *Figure 1* was an early sketch of the concept.

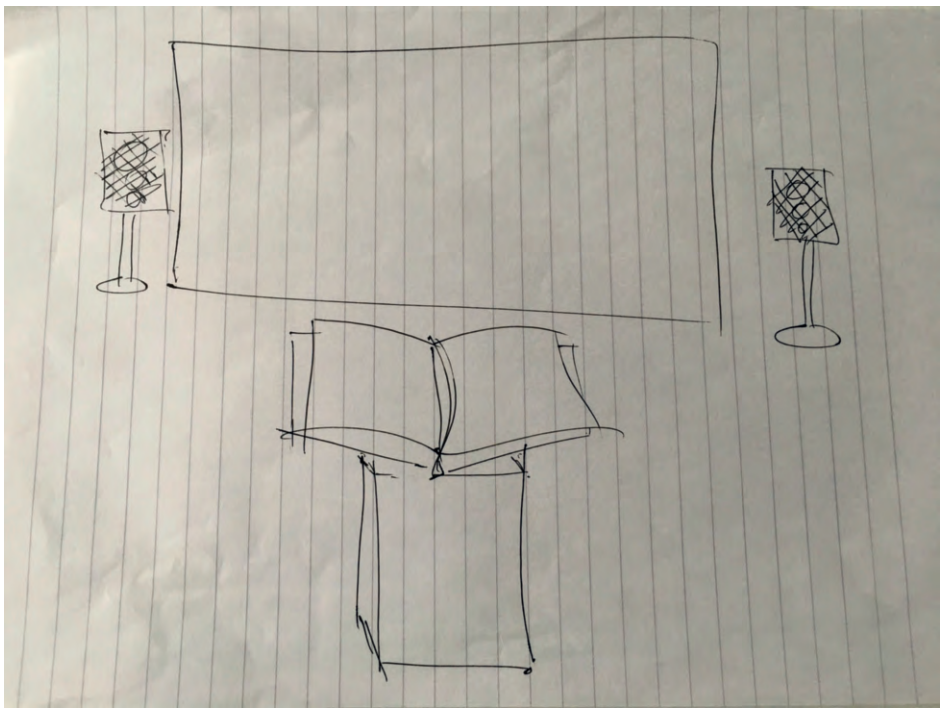


Figure 1: Early sketch of an exhibition a-book concept. Photo credit: David Frohlich.

My starting idea was for a pictorial book illustrating climate change in 'then' and 'now' photographs across double page spreads with accompanying audio narrative and infographic animations. Simple but depressing. Philip started talking about the genre and discipline of design fiction — imaginary articles on the planet written from the future looking back — and potential think-pieces representing positive responses to climate change and new forms of living. This might stimulate further debate and ideas. He remembered Stuart Brand's *Whole Earth Catalog* published between 1968 and 1972 and its role in the American Environmentalism movement. This led to the notion of an eclectic collection of multimedia essays taking stock of our approach to Net Zero futures, rooted in Perth and Western Australia and open to further issues (books) in other cities around the globe. It seemed fitting to us that a book about the future of the planet should itself be a futuristic book, designed to bring the best of paper and screen together in a new way. We had just invented a sustainable way of doing this through the *Magic Bookmark*, and decided to make this technology the central pillar of the *Climate Domesday Book*.

NEXT GENERATION PAPER AND THE MAGIC BOOKMARK

Next Generation Paper leverages 30 years of experimentation with augmented paper, which is real paper with a digital aura. Instead of designing paper-like displays which is the ultimate goal of the e-paper movement, why not continue to enjoy the beauty and tangibility of real paper but connect it to digital content and the web? This represents a third way between printed books and e-books which essentially combines the two to create paper-and-screen reading experiences through the a-book. Many research prototypes and niche products have done this in different ways over the

VIDEO

Credits:

Next Generation Paper (NGP) Project Overview
Produced and Directed by Jon Weinbren
Edited by Roxie Oliveira

Duration: 3 minutes, 15 seconds.

years, but we wanted to explore how this could be done in a generic way that publishers could use to augment any of their printed products with digital information. QR codes are the only generic solution for this today but these are limited in terms of the augmented reading experience they can support, and ugly when scattered throughout the pages of a book or magazine. The dream technology should look more like a printed web page whose highlighted hotlinks can be touched with a finger to play digital media on a nearby speaker or display. And those links need to be authored by publishers in a standard format with industry-standard tools. Our solution is based on the insight that many publishers already create and sell both print and e-book versions of their products using the very same tool. Adobe InDesign™ for example, supports the addition of interactive links and content for the e-book version of a document. These are designed to pop-up on-screen over the page content. Hotlinks are marked as icons in the text and the content is stored inside the exported e-book (EPUB3) file or points to the web. We use a minor variation of this common format in a new kind of a-book player app that takes input from a printed book to fetch and play the links on a smartphone *(Figure 2)*.

Figure 2: The Next Generation Paper approach and player. Photo credit: Centre for Vision, Speech and Signal Processing (CVSSP) at the University of Surrey

We use two technologies for this input: (a) image/speech recognition of the page or its spoken page number, or (b) printed/embedded electronics to recognise page turning actions and hand gestures while reading. We refer to these as second generation (2G) and third generation (3G) paper technologies respectively. They represent the application of augmented reality and Internet-of-Things (IoT) technologies to paper. The 2G augmented reality approach is mature technology which we have demonstrated in a commercial travel guide to Cornwall with our publishing partners Bradt Travel Guides (shown in *Figure 2* above). But the user experience can be a little awkward in taking a picture of a page with one hand whilst holding the book in the other. This model is currently used for AR experiences in galleries, but we still don't like it there when the digital content becomes private to a handheld device rather than shared with everyone. The 3G IoT technology is less mature but potentially more magical and suitable to the gallery context for an exhibition. We have demonstrated this in the lab on the same Cornwall guide book, using flexible photovoltaics to detect which page is open to light when reading. We call these photodetector modules *Light Tags*. The user simply turns a page to display the links *(Figure 3)*.

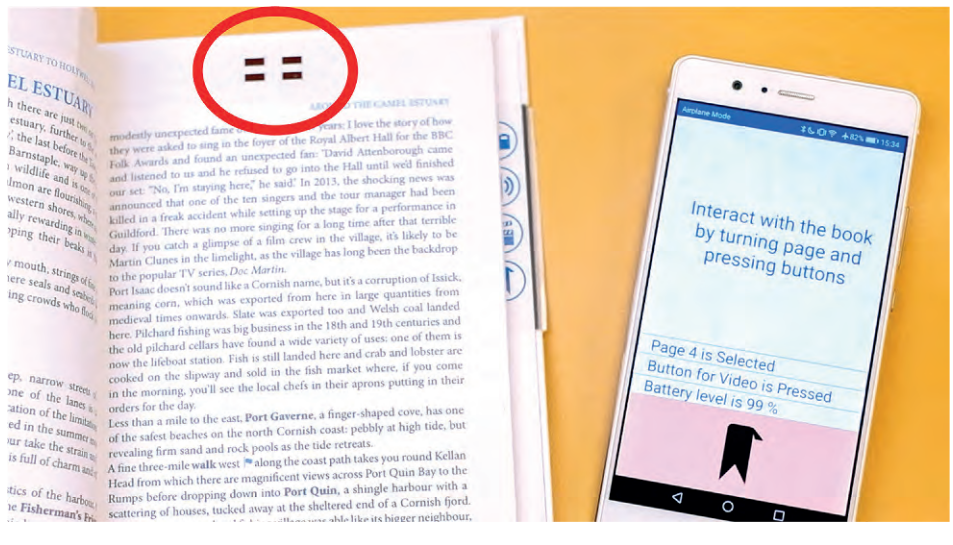


Figure 3: Light Tags working on a 3G version of the Cornwall guide. Photo credit: Centre for Vision, Speech and Signal Processing (CVSSP) at the University of Surrey

However, this solution is not easy to manufacture or recycle. Light Tags are made of organic materials which degrade over time and cannot currently

be printed on paper. So, our demo book was made with a plastic spacer containing the Light Tags, laminated between paper with 'windows' to let in the light. Each page had to be wired to an embedded Bluetooth chip in the spine of the book to communicate with the smartphone. A more manufacturable and sustainable solution is to put all the electronics into a smart 'Magic Bookmark' which can clip onto any book and read printed marks in the margins to signal the identity (page number) of any page.

Radu Sporea, George Bairaktaris and myself came up with the idea, and George has systematically explored different implementations as part of his PhD in Radu's printed electronics group at Surrey *(Figure 4)*. With funding from Curtin University, George has worked with Haiyue Yuan who developed all NGP software, to create a fully working prototype bookmark and *Climate Book App* for the exhibition. The specifications and software for this solution could be available from us for other groups to use to create their own *Climate Domesday* books for other cities. To test the technology we have made two working versions of the first Curtin book, one in Perth, Australia and one in Guildford, UK. We will show the Curtin version first but hope to show the Guildford version in Surrey (as I write) later in 2022.

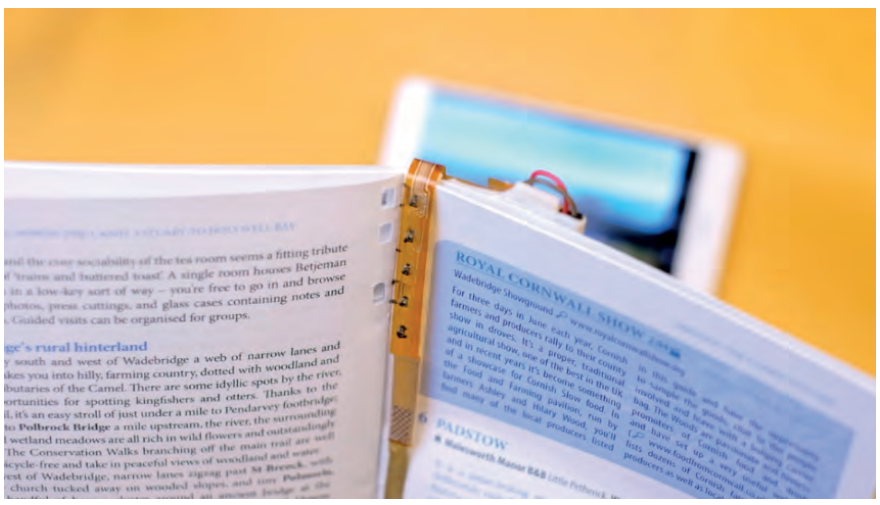


Figure 4: An early Magic Bookmark prototype

DESIGN ISSUES FOR THE CLIMATE DOMESDAY BOOK

The design team for the *Climate Domesday Book* is shown in *Figure 5* below and comprises Philip Ely, David Frohlich, George Bairaktaris and Haiyue Yuan. Radu Sporea supported us with expert advice from time to time, but became a second-time father during the process of making. Philip led the overall project and content design, George led the hardware design, Haiyue led the software design, and I led interaction design. As we have found before in these kinds of projects, all four kinds of design come together to create the user experience and have to be considered together in the making process. In this case, the multimedia content itself, supplied by our contributing authors, has the final and biggest influence on the readers, through the ideas it communicates and stimulates in them. But before that point, the design team had a number of decisions to make about how to present that content through the physical and digital materiality of this new reading medium.

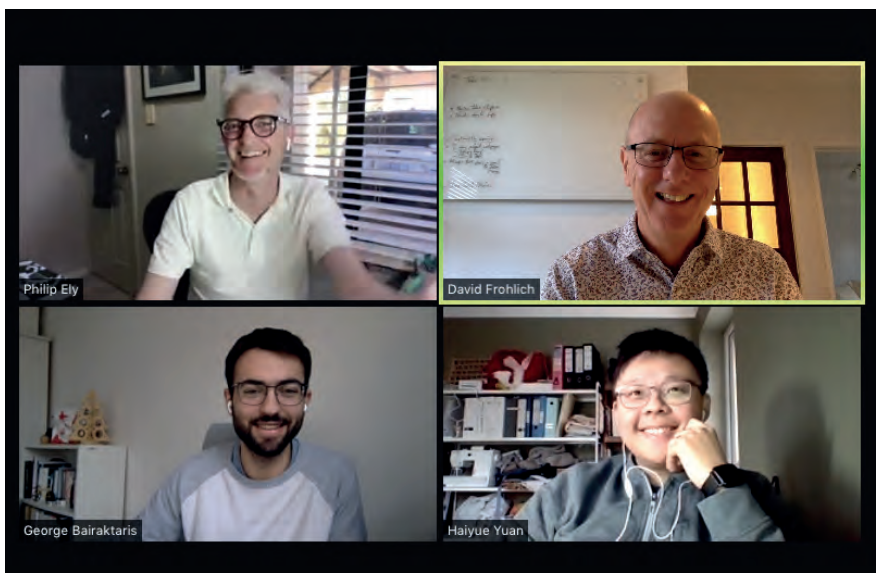


Figure 5: *The Climate Domesday Book* design team during a regular cross-timezone project meeting. Screenshot: David Frohlich.

It turned out that the early decision to make the book 'copyable' by other cities was an important determinant of how we designed it for exhibition in Perth. For example, we discussed and rejected the possibility of instrumenting the plinth on which the book would be placed in the exhibition, or requiring any kind of custom plinth design. Attachment of the bookmark to the book was also affected by this principle. Custom attachments to embed the bookmark in the book binding were ruled out in favour of a detachable bookmark that could be inserted into a simple slot created at the top of the spine. Other implementations might replace this with a clip. Modification of the NGP Player software for the project were done with a view to the authoring process for

VIDEO

Credits:

Printed Light Tags and the Magic BookMark: Using light to augment paper objects
Produced by Georgios Bairaktaris, David M.Frohlich & Radu A.Sporea.
Royalty-Free Music from Bensound
Stock footage provided by Videvo

Duration: 4 minutes, 47 seconds.

further books, and the code was kept as independent as possible from the content.

The size of the book and bookmark was another big consideration. Philip imagined a large hardback book for exhibition, similar to the large bibles on church lecturns. Eventually he settled on a near A3 portrait page size of 372mm x 246mm leading to a double page spread of 372mm x 492mm. This allowed George to design a large bookmark to match the book, with plenty of room for the electronics. However, the look and feel of that artefact was a matter for experimentation. George tried a number of fabrics, colours and sizes before settling on a pretty wide form factor shown in Figure 6. Here Haiyue is testing it with our own block bar code designed to fit in both left and right page inner margins. We discovered that bookmarks tend to fall on the inside left margin of the right hand page in the first half of any book, and the inside right margin of the left page in the second half. But we decided to print the code in both margins just to be safe. In one of these experiments George accidentally designed what I called 'the worst button in the world'. We wanted a Pause/Play toggle button in the tip of the bookmark to control linked media playback. He first programmed this with a 2.5-second delay to test the sensing element of the bookmark, until he had time to develop the part of the firmware responsible for reading the button press in time. Haiyue thought the button was broken as he repeatedly pressed it before waiting for the delay to elapse. This is a natural repair response users perform after about a 1 second null response from any technology: making the button unusable. Ironically it is only when you give up trying to make it work that the button works!

Needless to say we removed this feature pretty quickly.

Figure 6: Haiyue testing a giant bookmark from George. Video: Haiyue Yuan

A final cluster of design decisions were about what kind of linked media types to support with the book and how to control their playback in a gallery setting. Previously we had supported image, audio, video and weblinks for a personal book to be read by an individual on their own smartphone. Although that reader could close the book and stop reading at any time, they were not likely to leave it open for other readers to pick up where they left off. But this is exactly the situation for a shared book in a gallery. Furthermore, a personal smartphone has a full interface for controlling image browsing, audio and video playback and web browsing. In the gallery setting, we wanted to hide the smartphone client and relay its display to a large screen for multiple viewers. This incidentally removed access to all screen controls.

We therefore decided to support individual audio *or* video clip annotations on double page spreads, which could be played or paused from a single toggle button at the bottom of the bookmark.

This simplified the interaction and gave some direction to authors about the kind of accompanying content to create for their chapters. We felt that they should have discretion over how many of their pages had these annotations, leading to a mixture of interactive and non-interactive pages across the book. Links simply start playing automatically if present and users can pause or continue playback for that page. However, we designed additional feedback to be presented on screen about duration and progress of playback, and instructions displayed after a long delay indicating that someone has walked off. The logic of the interaction is shown in a flow diagram Haiyue created to programme it (*Figure 7* below).

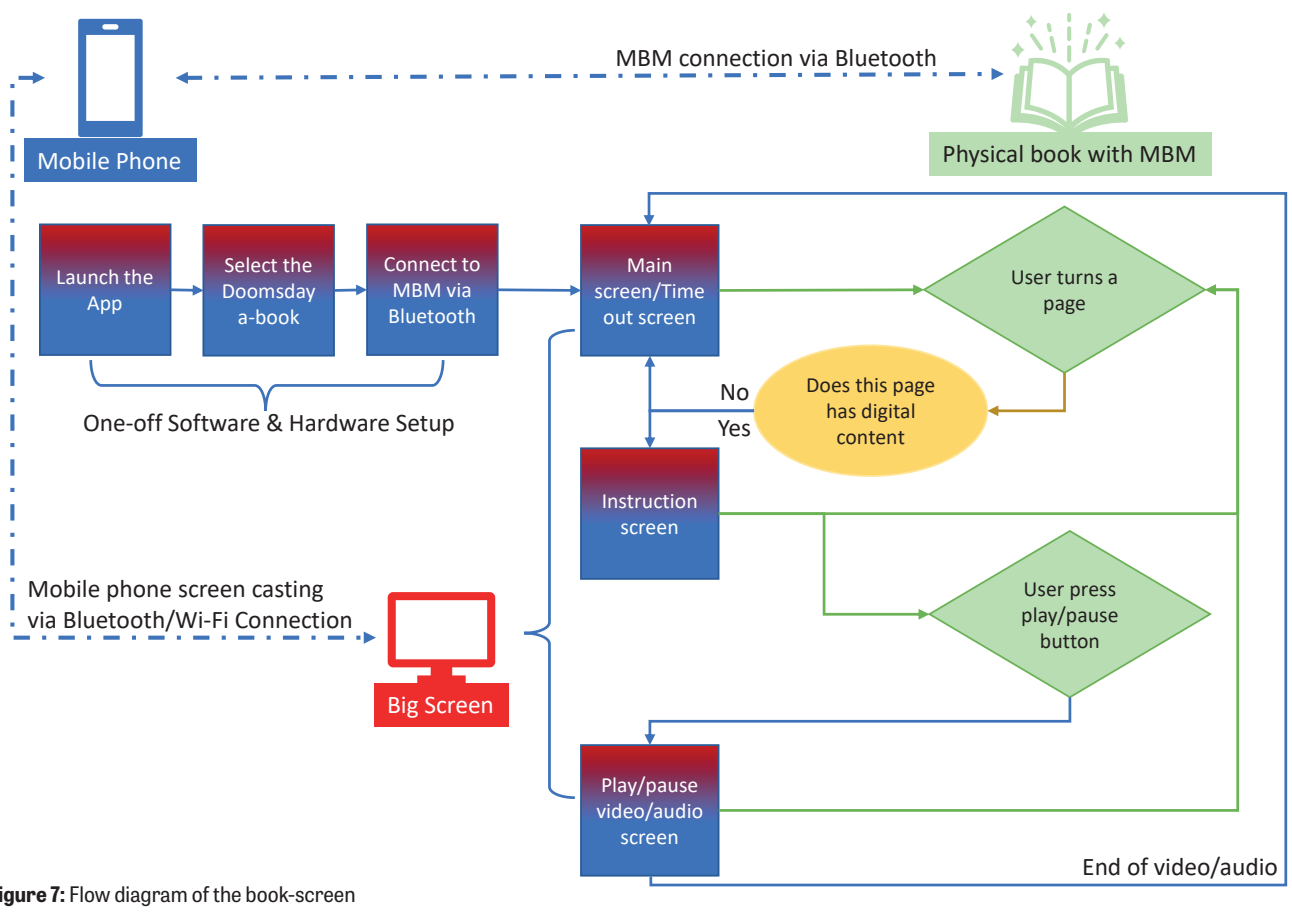


Figure 7: Flow diagram of the book-screen interaction. Image: Haiyue Yuan.

In general, we found in these discussions that the eventual user experience was always an emergent property of the interaction between content and platform, as triggered by the user. This was true for the traditional newspaper that Philip and I started off with on this journey, which is designed in a certain size, form factor and layout to lead the user through a series of articles and information. And it remains true of an interactive book for multiple readers, whose digital links become an extension of the carefully design printed content, to lead the readers on a mental journey of their own. In this respect, we hope those journeys help us all to reflect on the topics of climate change, energy and sustainability and what we can do about them in the future.

VIDEO

Credits:
Climate Domesday Book Magic Bookmark Proto v1
(test with andriod applicaiton)
Produced by George Bairaktaris

Duration: 3 minutes, 58 seconds.

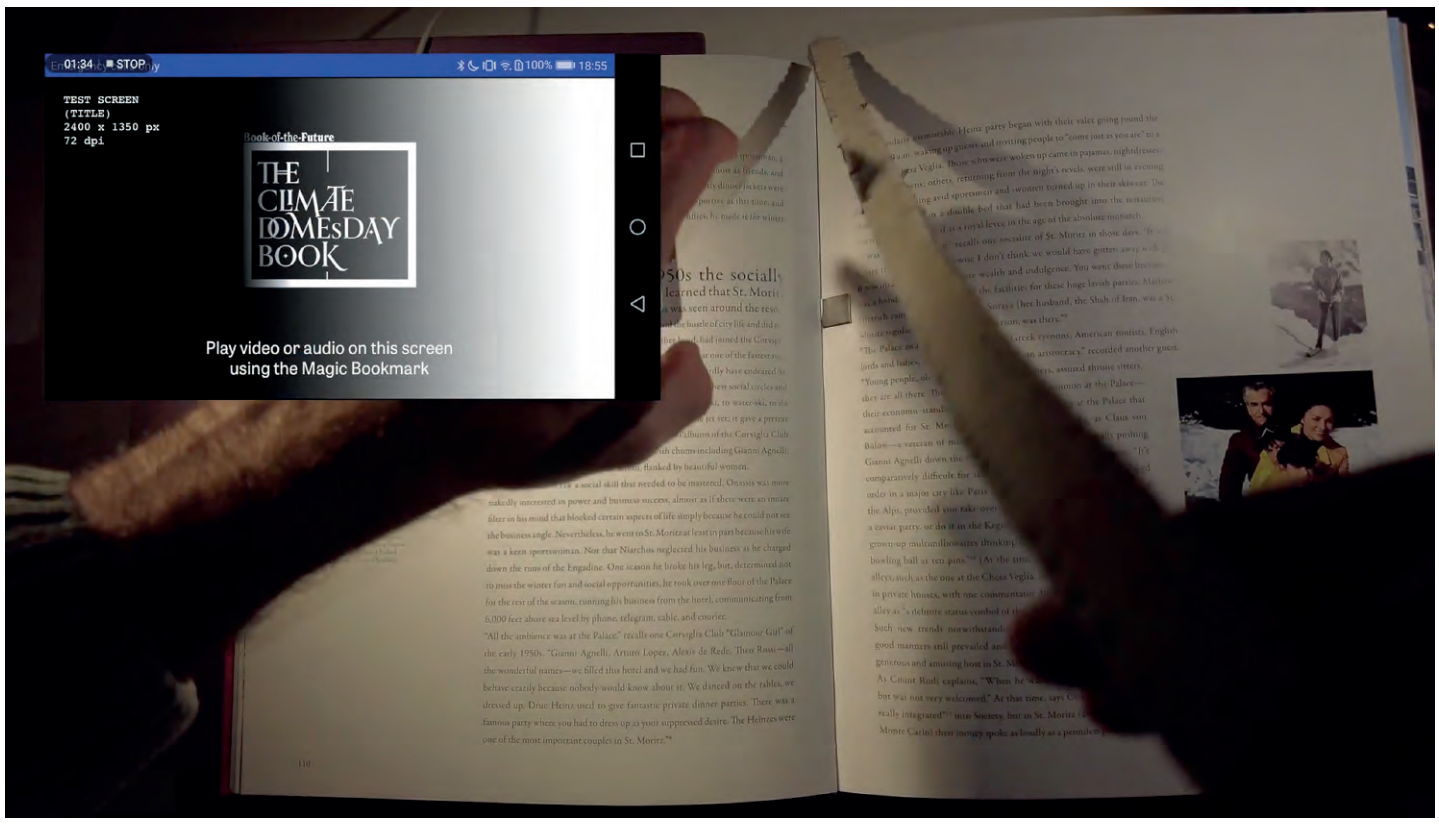


Figure 8: George tests the new Magic Bookmark on an already printed library book - as it connects with the app created by Haiyue. Image: George Bairaktaris

Watch a first prototype of the Magic Bookmark and the *Climate Domesday Book* android application being tested by George — by placing the real Magic Bookmark here on this page!

Postsc

cript

Why and What's Next?

Words: Philip Ely

IN THE CHAPTER *A BRIEF REFLECTION*, WE ASKED THE QUESTION: HOW MUCH ENERGY HAVE WE USED TO CREATE THIS BOOK? The honest answer is that we are not entirely sure. And here's why.

As David mentioned in the previous chapter, during the making of the book, we were ever-cognisant of the carbon cost of a hybrid print-digital book or any artefact (digital or physical) that we brought into being. No doubt there will be a nagging question in the minds of any reader of this book: surely a printed book is more costly to the environment than an app or website? Why didn't they just create an eBook that we could all read?

Our book was an experiment to explore the possible future of publishing formats; it is a speculative design in both content and form. A hybrid print-digital book raises important questions about the artifical and material worlds that we design. And it would seem that the issue of print versus digital as far as environmental sustainability is concerned is not as clear cut as we might think.

In 2021, Chinese researchers conducted a systematic literature review of the topic of the environmental sustainability of e-readers. Assumptions are often made that the environmental credentials of digital reading are better than those of printed material, but Qi Kang, Jinyi Lu and Jianhua Xu's review reveals conflicting results regarding the impacts of both formats.[1]

From Yang et al's review of a still-growing literature on the topic of print versus digital, it would appear that readers actually prefer printed material rather than digital materials, especially when the content is long or complex (p.2). Although digital materials are easier to store (taking up less physical space) and are easy to access, readers have a better comprehensoin of printed rather than digital. Who hasn't printed off that lengthy article at work to make better sense of it?

[1] Kang, Q., Lu, J., & Xu, J. (2021) *Is e-reading environmentally more sustainable than conventional reading? Evidence from a systematic literature review.* **Library and Information Science Research,** 43(3), 101105. https://doi.org/10.1016/j.lisr.2021.101105

Newer tablet devices that give readers a more paper-like user experience (e.g., page-turning and stylus/pen annotation) make e-Readers more attractive to the reading experience than their screen ancestors but the poor display performances of digital devices still make printed books attractive.

As far as the environmental preferences are concerned, Yang et al's findings reveal inconsistencies and inconclusiveness in much of the literature. One study from Maria Enroth conducted a study of printed versus digital learning aids and found that web-based material has **ten times** the environmental impact (CO_2 emissions) than a printed textbook when viewed on even low-energy computer equipment and a staggering **thirty times** more impact on high-energy computer equipment. [2]

When we consider the production costs of digital devices or paper books, it seems important to consider the use of such artefacts over their lifetimes. Yang et al provide data to remind us of the carbon cost of whole-of-life (from manufacture to disposal/recycle) computing devices. For example, Apple's iPhone 12 Pro Max (128GB storage, 5G technology) is said to produce 86 kg of carbon emissions during its life which is 8% more than it's previous generation. On the flipside, a MacBook Pro 13-inch laptop produced 185 kg of carbon emissions during its life cycle, a carbon footprint that decreased by 12% compared to a previous generation (Yang et al, p.3).

The pulp and paper production process, editorial work, transportation, storage, distribuition and storage necessary for paper books has a high environmental cost. Such costs are dependent on a number of variables including volume, geographic location and size. However, the authors point out that a number of studies have highlighted that the usage phase of books requires **virtually zero energy to operate** apart from the occasional use of low-energy reading lights.

Drawing on Japanese research in 2018,[3] Yang et al show clearly that the carbon cost of reading a paper book is approximately 1.15 kg of carbon on a first reading compared to the next highest (an e-book on a desktop computer) at approximately 0.9 kg. However, whilst the carbon cost of each subsequent nine readings of an ebook remain at the level of the first reading (approximately 0.85 kg for a desktop computer), the carbon cost of a paper book on a tenth reading is reduced to approximately 0.10 kg (p.8). Given that we do not share eBooks with each other (and even when we do their replication only increases carbon costs), the authors suggest that "digital and traditional media and information services are not just substitutes for each other, they can be combined and used at the same time" (p.8).

Further, through their systematic analysis, Yang et al believe that there is a dematerializing "prejudice" in the literature prevails, when in fact the idea that digital reading decreases environmental damage compared to print is **mostly not true**. However, there is still more analysis to be done considering the wider systems, processes and use patterns of both forms.

For instance, International Energy Agency (IEA) figures on global paper and paperboard output show an increased production output of 3% between 2010 and 2019, whilst the sector's global energy use increased by 'only' ~0.5%, which indicates a decoupling of energy use from production.[4] However, the industry is still **not on track** to reach a Net Zero emissions target by 2050.

[2] M Enroth (2009) *Environmental impact of printed and electronic teaching aids, a screening study focusing on fossil carbon dioxide emissions,* in **Advances in Printing and Media Technology,** Vol 36, 2009.

[3] Tahara, K., Shimizu, H., Nakazawa, K., Nakamura, H., & Yamagishi, K. (2018). *Life-cycle greenhouse gas emissions of e-books vs. paper books: A Japanese case study*. **Journal of Cleaner Production**, 189, 59–66.

[4] IEA (2021), Pulp and Paper, IEA, Paris https://www.iea.org/reports/pulp-and-paper

To be able to achieve this, the IEA suggest that while production is likely to increase annually by 1.5%, it will be necessary for energy consumption to increase at only 0.5% per year. The IEA believes that this energy-intensive industry could increase its use of bioenergy and alternative fuels (including pulup and paper by-products like black liqor) which currently accounts for 40% of energy use in the sector.

Compare this 'not on track' analysis to the IEA's report on data centres and data transmission networks which host and transmit our eBooks. Global data centre use in 2020 was a (whopping) 200-250 Terrawatt hours (TWh) which represents around 1% of all global final electricity demand.[5] However, this excludes energy used for cryptocurrency mining, which was estimated at ~100 TWh in 2020.[6] With the increase of Non-Fungible Tokens (NFTs), the carbon cost of trading and collecting digital artworks (music, JPEGs, GIFs, videos) that we might otherwise see collected in printed form is also likely to increase.

In relation to data transmission networks, like the example of the Apple laptops and smartphones, technological improvements may see both improvements and degradations in environmental performance. The IEA reports that 4G networks are five times more energy efficient than 3G and fifty times more efficient than 2G, but that a 5G antenna "currently consumes around three times more electricity than a 4G antenna".[7] However, the IEA reports that with the introduction of power-saving features, network providers [8] and operators [9] are suggesting that 5G networks could be 10 to 20 times more energy-efficient than 4G ones by 2025-2030.

Overall, the IEA gives data centres and data transmission networks a rating of **more efforts needed** to reach 2050 emissions targets. Neither pulp and paper production or data centres & data transmission networks offer us a steer on what's best for the planet in terms of print or digital. Unchecked consumption of either is not good for the planet, but as a species we will continue to want to find ways of communicating with each other and the demise of either technology (print or digital) is tethered to our continued existence.

In the meantime (like Qi Kang, Jinyi Lu and Jianhua Xu) we encourage further research like our own which asks questions about the environmental performance of the 'things' that we make, examine the impact of (and explore with) new technologies that are in train, find alternative ways of sharing, renting and lending our creative outputs and, in particular, explore new mixed approaches to the future of both publishing and the planet.

All of this intellectual work, whether in print or on-screen, will require calorific energy to sustain us. The question is, are we capable of capturing, storing and using this energy in ways that do not destroy the planet? Our first step may be in the complex and complicated task of measuring just how much energy (brain, solar, wind, biomass and water) goes into making books, films, websites and apps. Only once we've done this work, can we begin to redesign a better way of communicating through words and image.

[5] IEA analysis based on Masanet, E. et al. (2020). *Recalibrating global data center energy-use estimates*, **Science**, 367(6481), 984-986, https://doi.org/10.1126/science.aba3758 and Malmodin, J. (2020). *The power consumption of mobile and fixed network data services - The case of streaming video and downloading large files*, **Electronics Goes Green 2020+**, https://online.electronicsgoesgreen.org/wp-content/uploads/2020/10/Proceedings_EGG2020_v2.pdf.

[6] IEA analysis based on Cambridge Centre for Alternative Finance (2021), *Cambridge Bitcoin Electricity Consumption Index (CBECI)*, https://www.cbeci.org/.) and Gallersdörfer, U., L. Klaaßen and C. Stoll (2020), *Energy consumption of cryptocurrencies beyond bitcoin*, **Joule**, Vol. 4, No. 9, pp. 1843-1846, https://doi.org/10.1016/j.joule.2020.07.013.

[7] IEA (2021), Data Centres and Data Transmission Networks, IEA, Paris https://www.iea.org/reports/data-centres-and-data-transmission-networks

[8] https://www.huawei.com/ke/news/2019/7/opening-remarks-chairman-lianghua-2018-csr

[9] https://hellofuture.orange.com/en/5g-energy-efficiency-by-design/

DIREC

TORY

DURING THE COMPILATION OF THIS BOOK, we encountered a wealth of resources that we consider to be worth exploring further. On the following pages, we give reference to podcasts, documentary films, fiction and non-fiction books that we would recommend to add to your playlist and bookshelf.

If we'd organised ourselves sooner, perhaps we could have started up our own independent bookstore or streaming service in the spirit of the *Whole Earth Catalog* team in Menlo Park. Instead, we'll leave it up to you to choose your ethical store or service of choice.

At the tail end of the Directory, we've included four book covers from the Booklist from the publisher Verso, with their permission. We love books and wanted to give credit to the designers of these book covers — **Chantal Jahchan**, **Jonathan Pelham** and **Melissa Weiss** — by featuring them in our written and visual survey of ideas. They are as much a part of the zeitgeist as the writers that they wrap.

BOOKS

Down to Earth

Politics in the New Climatic Regime

Bruno Latour

Published by
Polity Press (2018)

The book has been reprinted 14 times since it's original publication in French in 2017. One of France's leading contemporary thinkers, Latour maps out the key attractors in current politics — national populism, the 'local', the 'global' and 'modernization' — and calls for a politics that moves towards the Earth.

Scale

The Universal Laws of Life, Growth, and Death in Organisms, Cities, and Companies

Geoffrey West

Published by
Penguin Books (2017)

We've drawn on this book a fair amount in this volume and for good reason, for Geoffrey West helps us make sense of the complexity of life on Earth. West explores a common conceptual framework that explains the organisation of animals, plants, human social behaviour, cities and companies — the notion of 'Scale'.

Climate Code Red

The Case for Emergency Action

David Spratt &
Philip Sutton

Published by
Scribe Publications (2008)

Anyone confused by the climate science would be well served by putting down their smartphone and reading about the climate under emergency conditions. The authors provide undeniable evidence of a drastically changing climate and the impact of life on Earth . Although data is over a decade old, it is still worth checking the sources they cite to see whether the predictions were warranted. The question the reader may ask themselves is whether we've left it all too late?

BOOKS

How to Blow Up a Pipeline
Learning to Fight in a World on Fire

Andreas Malm

Published by
Verso (2021)

Andreas Malm is a human ecologist who is also a climate activist.
In this book, Malm argues that environmental movements have for too long indulged in pacifist non-violent action, an approach that he believes does not suit the enormity of the crisis we confront. He does not advocate for human-to-human violent action, but a direct action that might disrupt the fossil fuel hegemony and provoke leaders into action.

The Anthropocene Unconscious
Climate Catastophe Culture

Mark Bould

Published by
Verso (2021)

Film and literature theorist Mark Bould takes up where **Amitav Ghosh**'s *The Great Derangement* left off in his analysis of how contemporary literature and film has dealt with the idea of climate change. Bould takes us deep under water, amongst living trees and the phantasmagorical in an account of how filmmakers and novelists are dealing with the idea of climate catastophe. It is a visceral and literary montage worth reading.

The Electric Information Age Book
McLuhan / Agel / Fiore and the Experimental Paperback

Jeffrey T. Schnapp & Adam Michaels

Published by Princeton Architectural Press (2012)

An analysis and extracts from what the authors describe as a new publishing genre emergent in the 1960s and '70s, the 'electric information age book' best exemplified by the writing of **Marshall McLuhan**, the graphic design of **Quentin Fiore** and the 'co-ordination' of **Jerome Agel**. Under the *Inventory Books* umbrella, the authors re-present and critique a mass-market paperback format that has inspired the ***Climate Domesday Book***.

BOOKS

Corona, Climate, Chronic Emergency

War Communism in the Twenty-First Century

Andreas Malm

Published by
Verso (2020)

Connecting our current preoccupation with zoonotic viruses, the state of the climate and the relentless pursuit of economic and technological growth, Malm reminds us that despite the ease by which post-humanist scholars attribute impending crises on the agency of non-humans, we are still responsible for the havoc that we wreak on each other and the planet. Time for us to do something about it?

White Skin, Black Fuel

On the Danger of Fossil Fascism

Andreas Malm and the Zetkin Collective

Published by
Verso (2021)

Our final Malm-ist recommendation — we promise. Here, the author and his comrades present what they believe is the "first systematic inquiry into the political ecology of the far-right in the climate crisis" exploring the connection between the history of the conjuncture between climate change and nationalist politics before reflecting on what this means for the future. Like Latour's *Down To Earth*, it aims to map out our future politics.

Drawdown

The Most Comprehensive Plan Ever Proposed to Reverse Global Warming

Edited by Paul Hawken

Published by
Penguin Books (2017)

With an accompanying online resource at www.drawdown.org, this book provides over 80 systemic changes we can make to energy, food, women and girl's lives, buildings and cities, land use, transport, and materials. An entire chapter on emergent technologies and ways of doing provides the most positive outlook on how we can reduce carbon emissions and design our way out of the climate emergency. But is anyone paying attention?

BOOKS

Designing Regenerative Cultures

Daniel Christian Wahl

Published by
Triarchy Press (2016)

In December 2021, Daniel Christian Wahl was awarded the RSA's Bicentenary Medal in recognition of his work in regenerative design. In this book, Wahl draws on an expansive literature to explore notions of transformative innovation, biologically-inspired design, health and resilience and living systems thinking. It is a design book that has been touted as 'The Whole Earth Catalog' for the 21st century and has helped shape the work of the RSA.

Good News for the Planet

31 Brilliant Ideas for Climate Action

What Design Can Do

Published by
What Design Can Do (2017)

The *What Design Can Do* collective, based in Amsterdam, produces an annual conference, meet-up events and issues global challenges to designers across the globe. In this book, the team cast a light on the pioneering design projects that are transforming horticulture, architecture, corporate communications, furniture, transportation and much more. Positivity in abundance. Follow them at www.whatdesigncando.com.

Novacene

The Coming Age of Hyperintelligence

James Lovelock with Brian Appleyard

Published by
Penguin Books (2019)

We've already revealed that Lovelock sees nuclear energy as the first step to carbon-less energy production and use, but in this volume he also sets out his belief that artificial intelligence and deep learning may take over the job that we humans seem incapable of doing: saving conscious life. The originator of the Gaia hypothesis makes perhaps his most contentious prediction: that we are about to pass on our gift of knowing to more intelligent beings.

BOOKS

The Last Whole Earth Catalog
Access to Tools

Edited by Stewart Brand

Published by
Penguin Books/Nowells Publications (1971)

The seventh (and final printing) of the Whole Earth Catalog — the last edition of the series — is a highly collectable book which stands as a testament to the counterculture movement in the USA in the 1960's. The Catalogs pre-date the Internet, yet the team behind them are responsible for seeding ideas that have directly led to the worldwide web, to the belief in human-made sustainable living and launched a hundred careers. Unmissable.

Design, Ecology, Politics
Towards the Ecocene

Joanna Boehnert

Published by
Bloomsbury Acdemic (2018)

The book is in three parts: *Design* introduces the role of design in society and the symbolic violence it enacts; *Ecology* explores philosophical thinking towards the Ecocene; and *Politics* examines how design is implicated in promoting the hegemonic interests and so-called 'social good'. With a particular focus on communication design, the book provokes designers and design theorists to think differently about design for ecology.

Permaculture
Principles & Pathways Beyond Sustainability (Revised Edition)

David Holmgren

Published by
Melliodora (2020)

This reprinted copy of the 2017 Edition brings the ideas of Permaculture bang up-to-date. Building on Holmgren's earlier work in *Permaculture One* (1978) with **Bill Mollison**, the book provides the ethics and design principles for permaculture — "conciously designed landscapes which mimic the patterns and relationships found in nature, while yielding an abundance of food, fibre and energy for provision of local needs." Try it.

BOOKS

Griffith Review 71
Remaking the Balance

Edited by Ashley Hay

Published by
Griffith University (2021)

This volume of the quarterly featuring essays, literature and poetry from across Australia explores our relationships with the animals, plants and minerals on Earth to provoke ideas about a more sustainable future. The diverse voices are realised through contributions such as **Jo Chandler**'s reflections on the emotional impact of climate change, contrasting with **Genevieve Bell**'s consideration of AI systems futures. Subscribe and order this back issue.

Watch Your Head
Writers & Artists Respond to the Climate Crisis

Edited by Kathryn Mockler and others

Published by
Coach House Books (2020)

Coming from a predominantly Canadian perspective, like the Australian contributions in our book (and those we recommend) this collection of writing and visual art speaks to the need for us to reconnect with land (with country), confront racism, and deal with the social inequalities brought about by climate change. As the editors say, these are "warnings to be heeded, directions given, field notes from the midst of the disaster". Take note.

Short Stories of Apocalypse

Lydia Millet
Sjón
Paul Kingsnorth
Ben Okri
Foreword by Alexis Wright
Published by
Emergence Magazine (2021)

Don't be put off by the title of this print edition of the online magazine *Emergence*, for this is a colelction of writing that may bring about melancholia, but this should be short-lived if — like us — you are provoked into action. **Ben Okri**'s contribution in particular requires you to pause... to think...to imagine 'what if?' You can also listen to the narratives at:

https://emergencemagazine.org/podcast/#playlists

BOOKS

The Ministry for the Future

Kim Stanley Robinson

Published by
Orbit Books (2020)

This is no typical science-fiction novel, grounded as it is in both plausible and preferable futures. There are no distant-galaxy aliens but instead a human species working desperately to reverse the climate catastrophe. Stanley Robinson has drawn on expert knowledge from climate science to tell a truly believable story of the closing decades of the climate crisis. The question is, do we avoid ultimate disaster and if so, how?

How to Thrive in the Next Economy

Designing Tomorrow's World Today

John Thackara

Published by
Thames & Hudson (2017)

This paperback edition from one of the design world's eminent thinkers is another one of those rare books that incites a feeling of hope. The originator of the ground-breaking *Doors of Perception* conference series, Thackara has drawn on his global knowledge networks to give us a blueprint of a post-carbon world covering such topics as soil health, depaving cities, social farming, two-wheeled freight, social money and ways of seeing and acting. Inspiring.

Design

Building on Country

Alison Page &
Paul Memmott

Published by
Thames & Hudson (2021)

This is a book for every Australian and for any designer or architect around the rest of the world. Page & Memmott show us the principles of Aboriginal design, grounded firmly in Country; in the local material, animal, vegetable and spiritual world. Indigenous Australians have prospered for over 65,000 years, yet we insist on looking North and West. Now is the time to look South and East to our longest surviving cultures and learn from them.

BOOKS

The Reef
A Passionate History

Iain McCalman

Published by
Scribe (2013)

The Great Barrier Reef is the canary in the coalmine. Whatever happens to the Reef is a reflection of our warming oceans and treatment of waste and pollution. This is a compelling account of the social, cultural and environmental history of the world's most treasured bio-region. It wasn't always this way — as McCalman explains. For the colonisers coming to Australian shores, this was a land of extreme danger and conflict.

Caps Lock
How Capitalism Took Hold of Graphic Design and How to Escape From It

Ruben Pater

Published by
Valiz (2021)

Valiz is a progressive publisher from Amsterdam and this title is another that lives up to expectation. The book is dedicated to "all those who fight against fascism, capitalism, patriarchy, and other forms of oppression" and provides a new perspective on graphic design which has been at the centre of the making of global capitalism. There is a new design activist movement emerging and in this book we meet the new advocates.

Operating Manual for Spaceship Earth

R. Buckminster Fuller

Published by
Lars Müller Publishers (2021)

It is difficult to choose just one book from the corpus of Bucky Fuller, but this one is a good starter for those unfamiliar with his work. This is the latest edition with a foreword by Bucky's grandson. Fuller abhores specialization, seeing this as thwarting humanity's progress. As far back as 1969 (when this book was first published), Fuller realised that we must rely less on fossil fuels and more on wind, water, tide and solar energy.

PODCASTS

The Long Time Academy

Available on all major podcast platforms:
https://www.thelongtimeacademy.com/

Produced by
Headspace Studios

Created and presented by Ella Saltmarshe and Lina Prestwood (https://www.thelongtimeproject.org/), this profound six-episode podcast takes the long view of life on earth. As they say: Life is short. Time is long. Contributors to the podcast include Celeste Headlee, Roman Krznaric, Toby Ord, Tyson Yunkaporta, Kate Raworth, Brian Eno. Superflux and many more. You will look differently at the world after this!

Free Thinking: Green Thinking
New thinking on the environment

Part of the BBC Radio 3 *Arts & Ideas* series

Produced by
BBC in co-operation with AHRC

There were 26 episodes produced in the lead-up to the COP26 climate conference in Glasgow. They showcase the cutting edge research funded by the Arts & Humanities Research Council, part of UKRI. From cryptocurrencies and blockchain to mushrooms, soil, willow, rivers and eco-criticism, the podcast shows how scientists and researchers are doing their bit to improve the planet.

Good Will Hunters

Available on Apple Podcasts and SoundCloud

Produced by
Good Will Media

Presented by Rachel Mason Nunn, this podcast focuses on international development and social aid. A diverse range of expert speakers are brought together by Mason Nunn, an anthropologist, social development specialist and speaker and writer. Produced in Australia, it follows the Southern rather than Northern Hemisphere seasonal cycle. The Spring '21 season (September) episodes 2, 4 and 5 are worth a listen.

Credits:

Climactic Promo by The Climactic Collective.
Presented by Mark Spencer

PODCASTS

#transitzone

Available on Apple Podcasts and SoundCloud

Produced by
Peter Clarke, Margo Kingston and Tim Dunlop

Journalists and writers Peter Clarke, Margo Kingston and Tim Dunlop tackle contemporary issues with precision, interviewing experts across disciplines. They are currently compiling new episodes related to contemporary democracy but previous epsiodes have tackled climate change, social inequality, pandemics, food, energy, privacy and women's rights. Clarke, Kingston and Dunlop represent the best in Australian journalism.

Climactic

Available on Apple, Google and Spotify

Produced by
The Climactic Collective

The Climactic Collective curates independent climate activists podcasts and produces it's own show fronted by Melbourne-based Mark Spencer. The Collective brings together over 20 shows from across Australia and New Zealand and the podcast has been downloaded over 300,000 times. At time of writing, there are over 315 episodes to download, with diverse and passionate voices intent on making a difference (see climactic.fm)

The RegenNarration Podcast

Available on Apple, Spotify, SoundCloud and Stitcher

Produced by
Anthony James

The RegenNarration is an independent podcast series which features high profile and grass-roots leaders from across Australia who are enabling the regeneration of life on Earth. As host Anthony James says: "[t]hey're changing the stories we live by, and the systems we create in their mould." James is an award-winning facilitator and educator, widely published writer and an Honorary Research Fellow at the University of Western Australia.

APPS & WEBSITES

Deep Time Walk: Earth History

Available on Apple App Store and Google Play

The Long Time Academy

Recommended by The Long Time Academy (and by one of our Editors), this freely-available app from the *Deep Time Walk* social enterprise (see https://www.deeptimewalk.org/) takes you on a 4.6km walk over 4.6 billion years of Earth's history. It is one app that will change your view on our life on earth. Accompanied by two narrators, the app will shift your perspective and stretch your legs!

Regenerative Futures programme

https://www.thersa.org/regenerative-futures

The RSA

Led by Josie Walden, this is one of three key thematic programmes led by the RSA (the others are on The Future of Work and Cities of Learning). The Regenerative Futures programme applies design and systems thinking to economic, environmental and social change. The team apply what they call the Living Systems approach alongside eight Design Principles. Join the Regeneration.

The 2000-Watt Society

https://www.2000-watt-society.org/

Watt Society

The aim of the 2000-Watt Society is to help cities around the world reduce their carbon footprint. The Society uses watts as a measuring unit to benchmark CO_2 emissions. From this perspective, 500 watts of non-renewable (fossil) fuel energy usage equates to about one ton of CO_2 per person per year. The goal is to aim for 2000 watts energy usage per person per year with 75% renewable-energy use.

APPS & WEBSITES

Half-Earth Project

https://www.half-earthproject.org/

E.O Wilson Biodiversity Foundation

The aim of the Half-Earth Project is to protect half the land and sea from pandemics, world war and climate change in an attempt to reverse the mass extinction that humanity is inflecting on the planet's biodiversity. Inspired by the late E.O Wilson the project brings together Deep science (including geo-spatial sciences, conservation, population, sustainability and restoration specialists, indigenous peoples advocates, economists), experts and celebrities to affect change.

The Overton Window

https://www.mackinac.org/OvertonWindow

Mackinac Center for Public Policy

The *Overton Window of Political Possibility* is Joseph Overton's observation that in a given public policy area there is only a narrow range of politically acceptable policies available to politicians if there are to remain attractive to their electorate. For example, if politicians suddenly increased taxes on all fossil-fueled cars on the road to unaffordable levels for citizens, the political consequence would be extreme.

Climate Action Tracker

https://climateactiontracker.org/climate-target-update-tracker/

Climate Analytics and NewClimate Institute

Is your country doing enough? This is an independent assessment of governments around the world and their actions to limit global warming to the 1.5°C agreed in the Paris Agreement. The post-COP26 update tells us that with current policies, we will be heading for a 2.7°C increase by the end of 2100 and we are already overheating the planet at 1.2°C. Australia, China, New Zealand and Japan are the poorest performers.

APPS & WEBSITES

Convergence

https://convergence.place/

Harry Lee Shang Lun with Cass Lynch

Convergence is a game about climate emergency that you can play with friends. Much like a role-playing game, it depends on access to the web and a tabletop. It was created by antidisciplinary artist Harry Lee Shang Lun, written in collaboration with Noongar researcher Cass Lynch.

EN-Roads

https://www.climateinteractive.org/en-roads/

Climate Interactive

This is a climate simulator designed for policy-makers, business leaders, educators, media and the public which allows you to simulate the effects of specific policy decisions on the climate. Used in conjunction with a systems thinking approach in a group setting, the tool displays a dashboard showing energy supply, transport, buildings and industry, growth, land and indusry emissions and carbon removal.

Website Carbon Calculator

https://www.websitecarbon.com/

Wholegrain Digital

Check to see if the website you have built or visited really does have those green credentials. When we visited *The Climate Domesday* website, we discovered that we are cleaner than 85% of web pages tested. You can add a carbon-emission tracking widget to your website too to make transparent your online carbon cost.

FILM & VIDEO

The Age of Stupid (2009)

https://spannerfilms.net/films/ageofstupid

Spanner Films

Starring Pete Postlethwaite as a man living alone in a devastated world of 2055, the film was originally crowd-funded and involved over 1,000 people in its production. It spawned a campaign to reduce CO_2 emissions by 10% by 2010 (10:10) which 12,000 people, 300 businesses and the UK Cabinet & Prime Minister signed up to. A follow-on short film, *What If? is* set in a parallel universe saw the final demise of all oil & gas companies.

The Age of Stupid revisited: what's changed on climate change? (2019)

The Guardian

The Age of Stupid director, Franny Armstrong revisit the peoplem and places from the film and wonders if we are still heading for the catastophe that is portrayed in the original film.

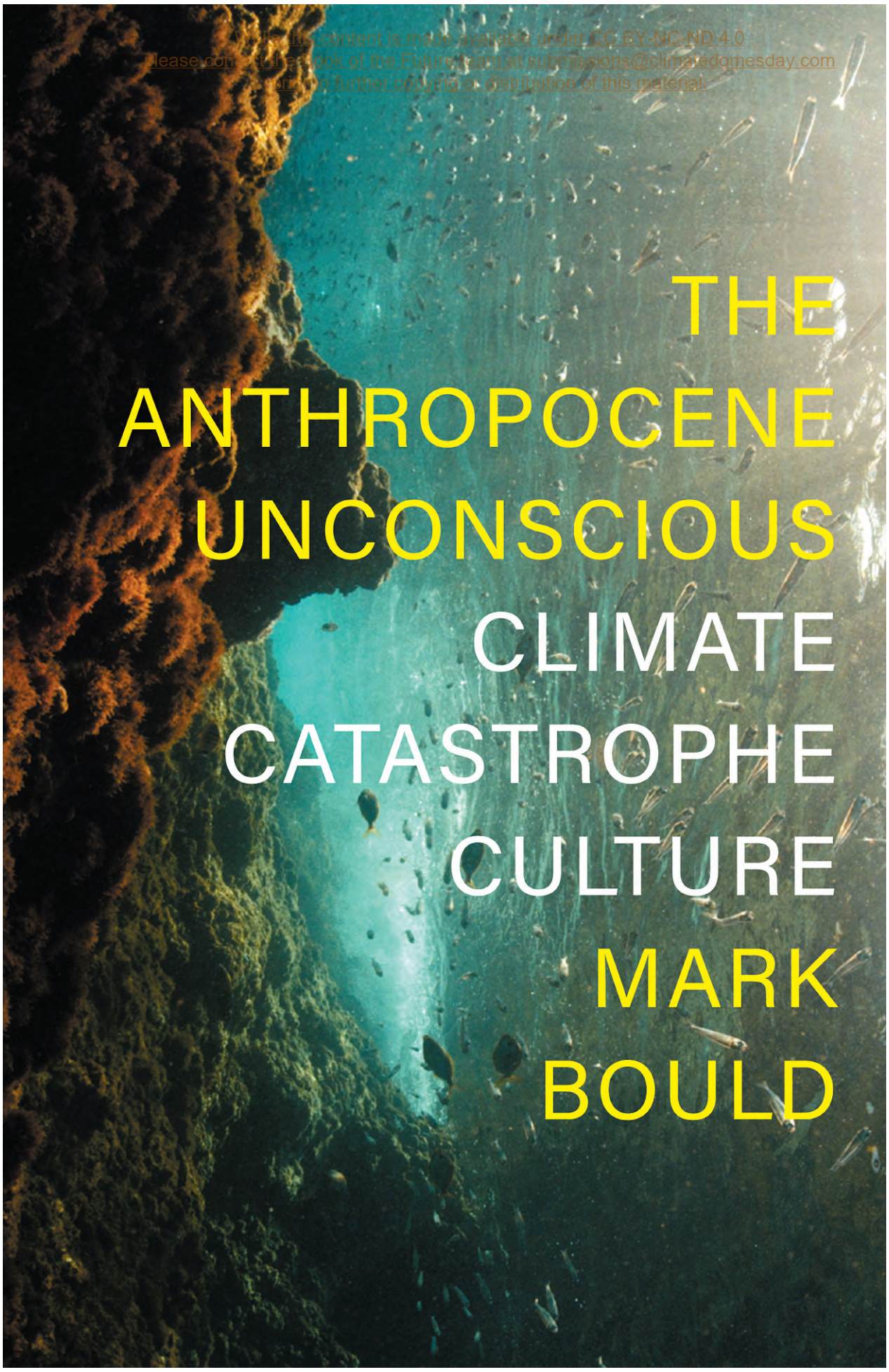
Available at: https://www.theguardian.com/environment/video/2019/mar/15/the-age-of-stupid-revisited-whats-changed-on-climate-change-video

Burning (2021)

Amazon Prime

Amazon Studios

Academy® & Emmy-award winning Australian filmmaker Eva Orner takes an unflinching look at the unprecedented, catastrophic Australian bushfires of 2019-2020. When you see a senior Fire Commissioner giving emotional testimony and a gas-powered Prime Minister believing that gas can still be part of a safe transition to renewables, you have to hope sense will finally prevail. A heartbreaking and important film.



Design: Melissa Weiss
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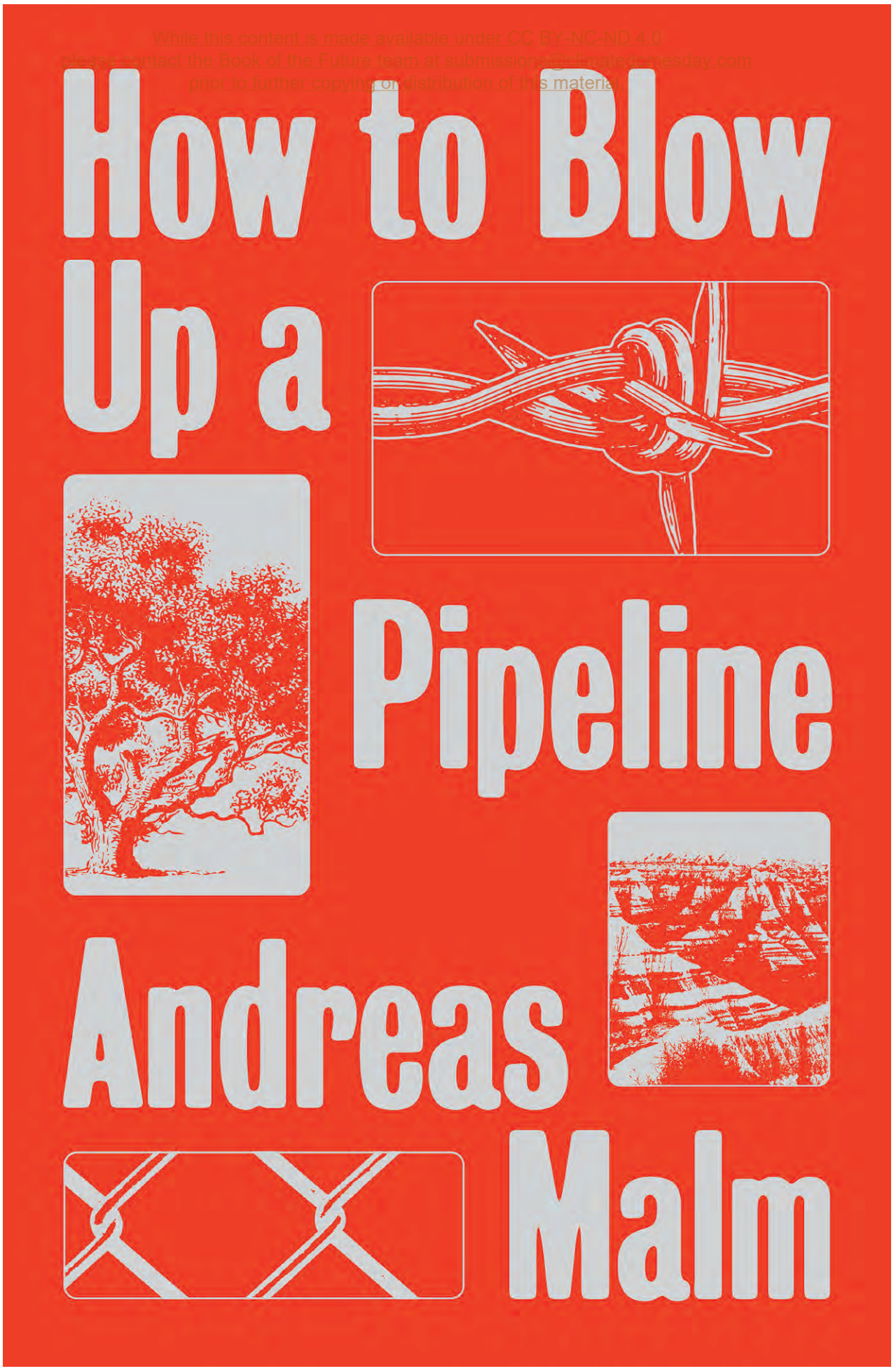

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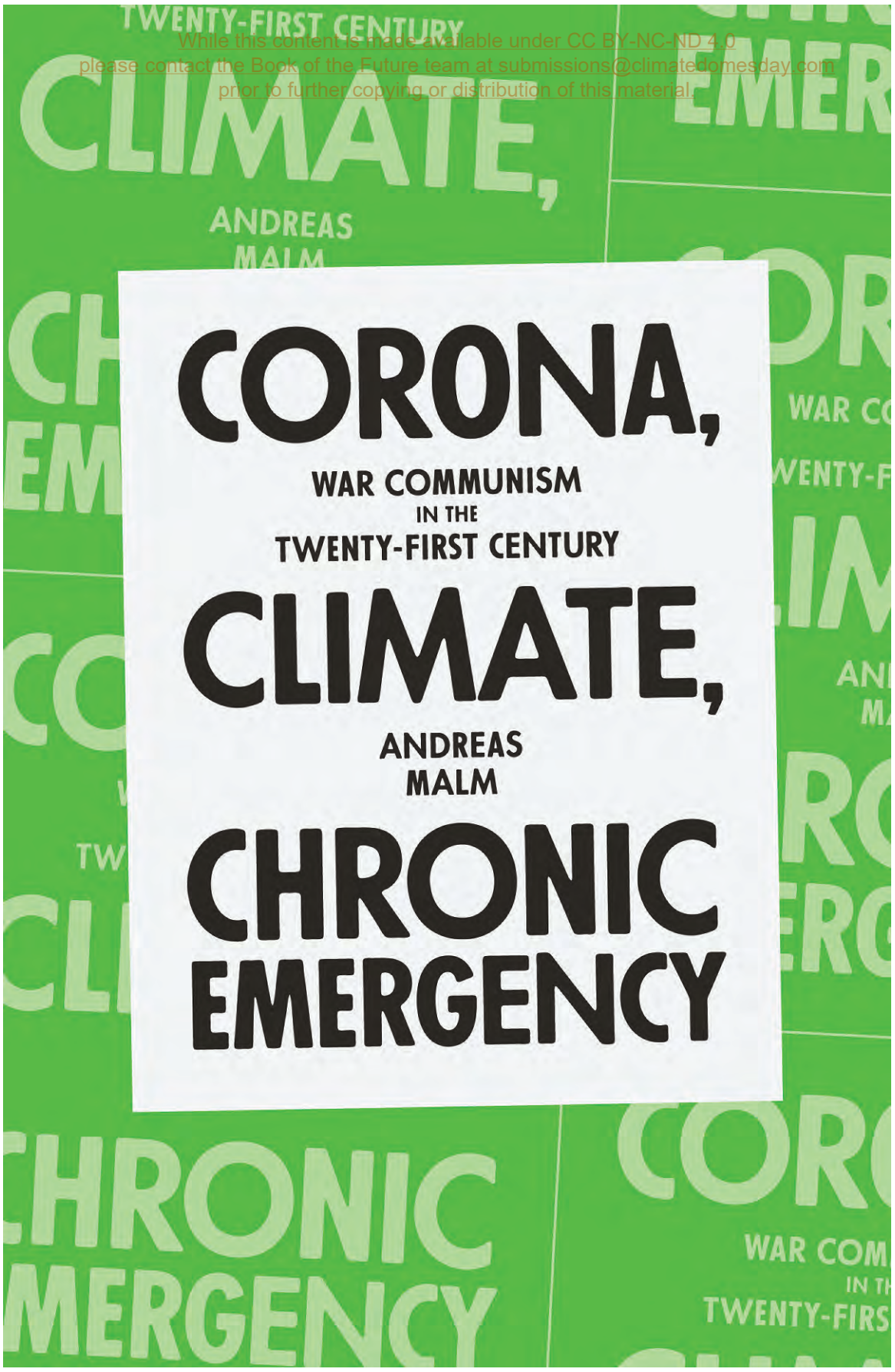

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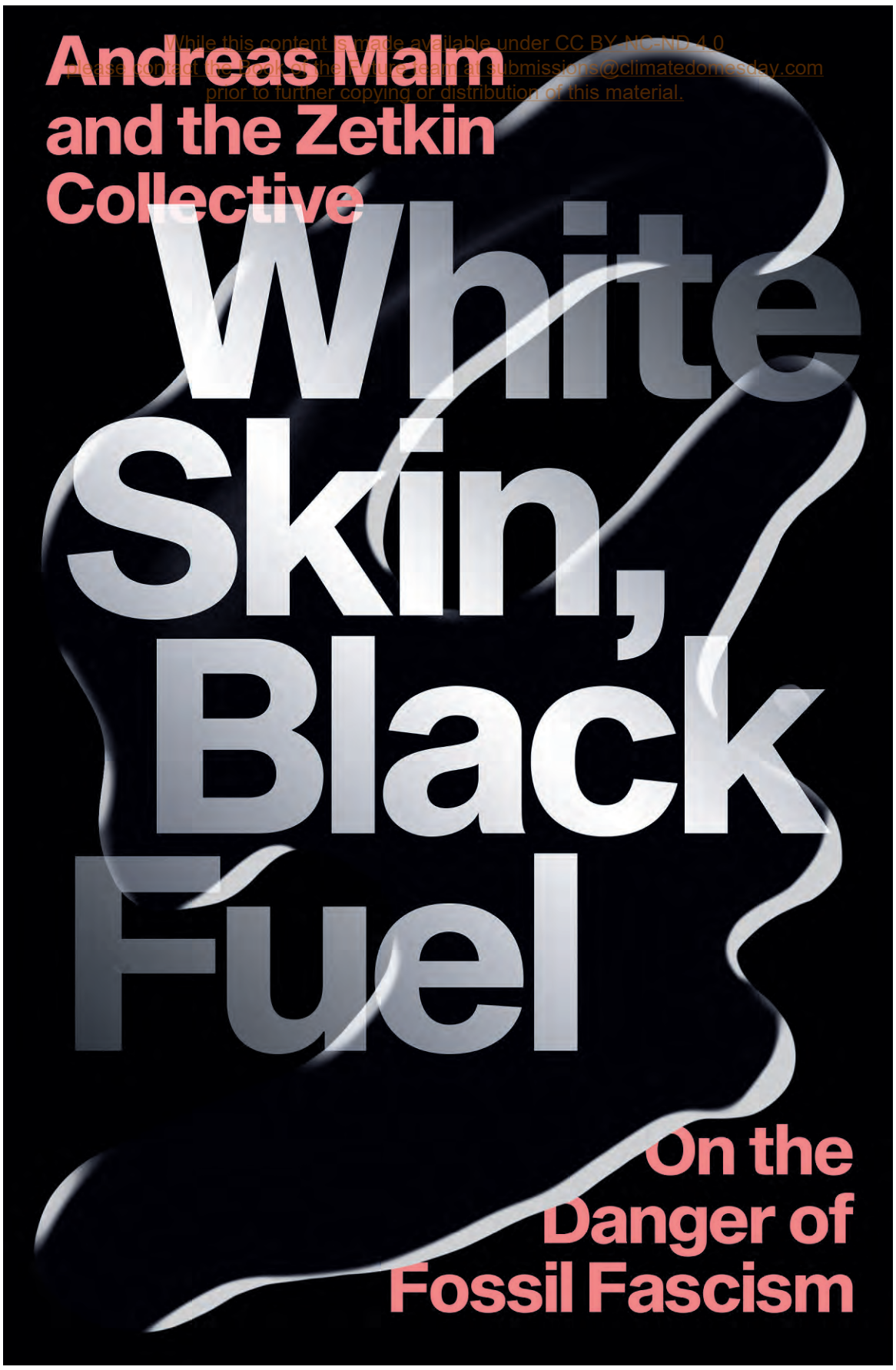

Design: Jonathan Pelham

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Hopefully not the End...but the Beginning.