IT'S ABOUT TIME

The Architecture of Climate Change

Derk Loorbach
Véronique Patteeuw
Léa-Catherine Szacka
Peter Veenstra

International
Architecture
Biennale
Rotterdam

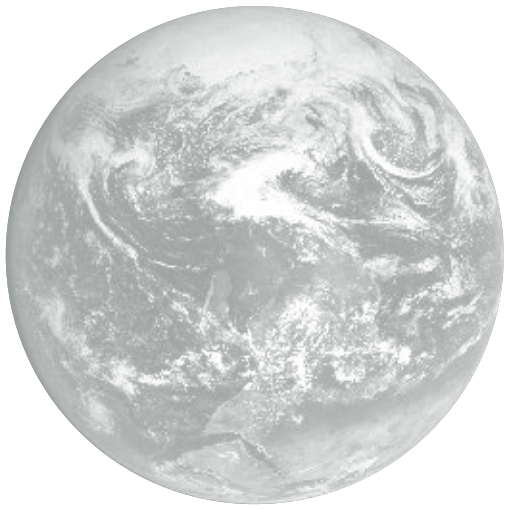
nai010 publishers

IT'S ABOUT TIME
The Architecture of Climate Change

Derk Loorbach
Véronique Patteeuw
Léa-Catherine Szacka
Peter Veenstra

International
Architecture
Biennale
Rotterdam

nai010 publishers



It's About Time 10
Acknowledgments 15

Timeline
1952 to 1972 17

Part 1:
Limitless Growth, Finite World

Chapter 1:
Uncertain Futures in the Contemporary Landscape, an Introduction 40

1972, a Pivotal Year
The Final Warning
Toward an Architecture of Change
Climate Change, Time, and Transition
A Growing Field of Research
A Convergence of Perspectives

Chapter 2:
Rebel Against Ignorance
The Club of Rome and Its Report
The Limits to Growth 52

The Club of Rome and the Notion of the Environment
From a 'Problématique' to the 'World3 Model'
Scientific Insights for a Wider Audience
Modelling Future Growth
Public Reception and Afterlife

Timeline
1973 to 1992 73

Part 2:
Sustainable Architectural Experiments: The Past

Chapter 3:
Architecture, Technology, and the Quest for Energy Efficiency 96

Solar Experiments
Autonomous Structures
Sustainable Urbanism

Chapter 4:
Circularity, Experimentation, and the Question of Impermanence 114

Salvaged Materials
Lightweight Building
The Disappearance of Architecture

Chapter 5:
Circularity, Experimentation, and the Question of Impermanence 134

Building with Earth
Building with Nature
Building an Image of Nature

Timeline
1993 to 2022 157

Part 3:
Architecture in Transition: The Present and Futures

Chapter 6:
The Transition Moment? 180

The Buildup
An Uncertain Future: The Dynamics of Transitions
Breaking Path Dependency
The Transition Twenties?
Living in the Transition Moment

Chapter 7:
Rethinking Architecture through Velocities The Ancestor, the Activist, and the Accelerator 196

The Ancestor
The Activist
The Accelerator
Parallel Velocities

Chapter 8:
Future Transitions 226

Business as Usual?
Forward to the Past
Designing Radical Transitions
Making Radical Transitions Visible and Tangible
Toward an Architecture for Change:
Contexts for Transformative Action

Bibliography 245
Index 250
Image credits 254
Biographies 256
Colophon 258

↑ Earthrise, taken on December 24, 1968, by Apollo 8 autronaut William Anders.

It's About Time

Saskia van Stein

As I write this, it was announced in the *NewScientist* that the world's most accurate clock – based on strontium atoms – will lose less than 1 second every 40 billion years, which is about three times the current age of the universe. This stable and highly accurate timekeeping stands in contrast to the continuum of the Earth's rotation itself, as melting polar ice is shifting the distribution of mass on our globe, affecting how it revolves – which has dictated our hours, minutes, and days for years. While we have no direct need for such extreme timekeeping, the clock could aid investigations in many areas of physics, including the implications of deep time and dark matter. This introduces scales of temporality that are almost impossible to comprehend, especially in relation to the short breath of our own human existence.

The Merriam-Webster dictionary gives two definitions of time: a) the measured or measurable period during which an action, process, or condition exists or continues: duration; and b) a nonspatial continuum that is measured in terms of events that succeed one another from past through present to future.

The phrase 'it's about time' is both a call to action and a question, perhaps even a promise. The classification of measurable duration or a linear progression of time may be at the heart of our current impasse in responding to the planetary polycrisis. Time – particularly in the Western world – has become synonymous with growth as linear accumulation, progress, and acceleration. Whereas all life of and on Earth – human and beyond – is essentially relational, gradually unfolding (and dying), unhurried and cyclical. How does one counter, leverage, or relate to the scale of a planet out of balance, and understand human agency in relation to these different, even contradictory, temporalities and scales of crisis? Our planetary system is squeaking and creaking at the seams, with a myriad of economic, environmental, ecological, and humanitarian implications at the heart of our changing climate. Examples of our global interconnectedness abound: weather patterns are increasingly erratic, the spread of viruses doesn't respect national borders, the loss of biodiversity threatens food sovereignty while population growth continues, and the scarcity of natural resources leads to high prices for gas, wood, water, or energy. This is in addition to the acute housing shortage, migration flows, lack of political vision, and growing populism leading to further social polarization, to name just a few concrete issues that connect our daily existence to the larger planetary whole. The speed at which we consume earth-bound resources is off-kilter and disproportionate to the slowness at which Mother Nature generates them. As a result, we note Overshoot Day on the calendar earlier and earlier each year. Although we're experiencing the consequences of these urgencies in closer and closer proximity, it seems harder and harder to act on them in solidarity.

Our kneejerk reaction to change is to hold on to and safeguard what we have – stasis, border control, and further fortification.

Yet we are inherently inseparable from time, our histories, each other, and our planet. Aristotle was right, after all, time is change. The current chain of events confronts us with a lack of power to change, or maybe even a lack of will to change, and the need to organize transitions for the benefit of all, not just a few. How can we embrace change less fearfully or understand our relationship with time in a more lived manner? For example, how de we calculate the time it takes to recover from a broken heart? How about the time it takes for an oyster to make a pearl from the irritation of a grain of sand? Or the rate at which a species mutates in response to environmental changes, for instance a whale's ability to adapt to warmer or more acidic waters? What can we learn from the symbiotic cultivation of the Three Sisters (corn, pumpkin, and beans) and their ability to adapt to varying local environments? How to value temporality as AI or machine learning technologies illustrate recursive time and reproduce knowledge in a split second? These examples hint at a different ratio, that of understanding time as the absence of predictability or control, and moving toward something more irregular, more porous, impermanent, an attitude that prepares us to anticipate inconsistency. In short, acknowledging a non-linear understanding of time and embracing a more adaptive relationship to uncertainty because it holds the promise of igniting positive change in ourselves, our communities, and our environments.

Anticipating the planetary challenges of our time will have vast spatial and humanitarian consequences. While predicting the future is inherently uncertain, climate disruption will have a significant impact on the role of the architect, as socially inclusive, climate-resilient, and equitable societies will require the linking of imagination, science, and design skills to the tasks at hand. An architecture with room for diversity and continuous adaptation, in which historical patterns of colonization, social injustice, and the extraction of labor, material, and energy are addressed. Building on the current extractive system will not lead us to the fundamental solutions and transformations we need to face. This calls for an architectural practice that provides tools and imaginaries to help confront the systemic; that analyzes, visualizes, and sketches alternative possibilities; and that finds 'spaces' not previously envisaged. An architecture that embraces alternative economic models – possibly enhanced by the use of advanced technologies – requires other knowledge and skills, but also new ideas about how we build, for whom, and with what materials. By integrating ecological thinking into the design ethos of the profession, into pedagogies, and ultimately into the thinking of those rooted in more conservative practices. The narrative of connectedness, embeddedness, and multi-relational design can be at the heart of the renaissance of architecture.

Architecture is increasingly becoming a favored source of gravity for capital in search of grounded materiality. This leads to endless feedback loops of speculation with expansion, demolition, and (re)building at its core. Breaking this cycle requires an

architectural profession (and its adjacent fields in the construction industry) to move away from short-term profit and shift its focus to the *longue durée*, acting on value creation beyond our own generation. This reinvention of architecture as long-term thinking calls for other design attitudes, for instance by understanding time as a design material that could incentivize and catalyze the change of our ways. Designing desired developments could provide opportunities for those who wish to organize differently or build *communally*. It is in the immaterial realm of jurisdiction, policymaking, and politics that architecture could play a role (by redesigning them). It is an investigation of the imperative to connect academic research in design with the wider public and to inspire action. The current reappreciation of the local, with its specific material cultures and aesthetics, will lead to different architectures. Capital-rich entities such as banks, insurers, and pension and investment funds are increasingly integrating the impacts of climate change into their long-term policies. Today's (integral) challenges require a different set of rules and a different vision – more oriented toward experimentation than risk management. In other words, the brief is widening to cultivate a design practice that promotes the creation of inclusive, sustainable, metabolic, and livable cities through proximity to amenities, hybrid special use, nature inclusion, zero carbon footprint, and an overall more circular way of designing. These transformations require a real and fundamental recalibration, decentralization, and redistribution – not a little, but radically.

Cultural institutions such as the International Architecture Biennale of Rotterdam (IABR) provide an arena for exploring futures in which building activities have a positive impact on people and the planet. Ultimately, by shaking up the community of architects and other stakeholders, by foregrounding contemporary issues in relation to the role(s) that the professions have to play, they can help develop methods to empower them to strengthen the narratives for an architectural discipline beyond extractive practices. This calls for professionals to bend their capacity toward socioecological issues, to seek inspiration from different time periods or different geo-localities, where proximity and distance are intertwined, where multiple values (beyond the monetary), impermanence, and relational embodied livelihoods are foregrounded. Or by designing technical interfaces, using data and (social) media that could shape positive narratives, civic participation, and connect the overall ecologies of urban life. The IABR aims to raise public awareness by offering perspectives and alternatives, while making concrete and active contributions by stimulating praxis rooted in architecture culture. Culture as change, change of culture. By focusing on creating 'space' for design-based research, imagination, and creativity, we aim to provide the conditions in which change can manifest. This implies that cultural institutions no longer be beacons of enlightenment, nor cling to a single grand narrative of human history. It invites institutions to make and hold the space for sophisticated ecologies, for a multiplicity of dialogues, for democratic decision-making, for the acquisition of knowledge. A home for explorations and testbeds

for an architecture of intergenerational, transcultural, and interspecies solidarities.

The future is collaborative. The authors of this book and the curators of the 10th IABR *It's About Time, an Architecture of Change* were brought together because of their specific yet complementary expertise. Together, they have merged, intertwined, and safeguarded their respective areas of expertise. The connection between meaningful histories and alternative futures; the science of academic research and the lived experience of practices; an understanding of the architectural object and the holistic foundation of landscapes; linking transition thinking with the seeds of participatory evolvement and implementation. I'm talking about Prof. Derk Loorbach, Professor of Socioeconomic Transitions, founding director of DRIFT, and principal investigator of the Design, Impact, Transition (DIT) platform at Erasmus University Rotterdam. PASZA Platform for Architectural Research, co-founded by Dr. Ir. Véronique Patteeuw, associate professor at the École Nationale Supérieure d'Architecture et du Paysage Lille, visiting lecturer at KU Leuven, and EPFL Lausanne, and scientific editor of *OASE journal for architecture*, and Dr. Léa-Catherine Szacka, senior lecturer in Architectural Studies at the University of Manchester and visiting lecturer at the Berlage, Delft University of Technology. And landscape designer Peter Veenstra, co-founder of LOLA Landscape Architects.

It is their commitment, generosity, and willingness to intellectually 'play' that I am indebted to. The 10th edition of the International Architecture Biennale Rotterdam bears the fruits of their labor and took place from 22 September to 13 November 2022 in the port area of Rotterdam, the Netherlands. The exhibition *It's About Time*, held in the Ferro, a former natural gas storage tank in a ruined state, brought together the work of the scenographers, graphic designers, spatial practitioners, and researchers – both young talents and established professionals. They all work in inspiring ways on alternative futures for our life on planet Earth, inviting us to be more aware of (our) time, and using their designs to combat the effects of climate change.

Acknowledgments

Derk Loorbach,
Véronique Patteeuw,
Léa-Catherine Szacka,
Peter Veenstra

The ideas for this book emerged during curatorial meetings in preparation for the 10th International Architecture Biennale Rotterdam (IABR), entitled 'IT'S ABOUT TIME: The Architecture of Change,' which took place from September to November 2022. We were brought together by the new director of the IABR, Saskia van Stein. Her insights, intuition, and guidance enabled us to merge our different backgrounds, areas of expertise, and perspectives into a powerful and compelling narrative. This book captures that narrative, which evolved and was greatly inspired by the many discussions, sessions, and encounters we had over the course of the Biennale.

The content of this book was developed in part during our preparatory research. We are extremely grateful to Saskia Lambers for her research on the historical timeline, to Theodora Gelali for image editing, and to Raymond Tang for his assistance in writing several of the timeline texts and his role in the image credits. Special thanks to architecture scholars Paul Bouet, Nicolas Dorval-Bory, and Emilien Robin for generously sharing their chronologies on environmental awareness in architecture in the twentieth century, and to authors Geert Buelens and Jaap Tielbeke for sharing their research on the Club of Rome and writings on the pivotal year of 1972.

The selection of contemporary projects, their themes and the plural understanding of time as proposed in this book were the result of discussions with many people. We think in particular of Emiliano Gandolfi, Saskia van Stein, Mathieu Berteloot, and Dirk Sijmons, but also of Encore Heureux, 2050+, and Anupama Kundoo, whose main pavilions challenged our curatorial choices. Throughout the process, we greatly enjoyed the essential support of our assistant curators Maria Christopoulou, Matthew Cook, Theodora Gelali, and Noortje Weenink, without whom we would not have come this far. We thank scenographers Richard Venlet, Alice Babini, and Leander Venlet for their translation of the exhibition's content into a spatial experience, and graphic designers Tobias Röttger, Susanne Stahl, and Kathrin Baumgartner (Stahl R) for the visual identity and graphic design of both the exhibition and this publication. Jack Bardwell translated the exhibition into personal spoken curatorial narratives. Maria Kley and Eef Cornelissen addressed the content of our exhibition with children, resulting in beautiful handmade sculptures. Lotte Haagsma and Chris Zwart wrote all the project texts, Maria van Tol was responsible for the translations, and D'Laine Camp (InOtherWords) beautifully edited all the texts of the exhibition and the chapters of this book. A special thank you to all of them.

The concept of time was further developed in 'Horizons,' an editorial series that brought together prolific architects, writers, artists, philosophers, and sociologists to reckon with the challenges of thinking and making futures today. Horizons was developed in

collaboration with *E-Flux* magazine. We are grateful to the authors for their contributions: Tim Ingold, Gökçe Günel, Stephanie Wakefiled, Glenn Dyer, Paul Bouet, Joost Vervoort, and Rahel Aima. We thank Nick Axel and Nikolaus Hirsch for making the series possible.

Our ideas for this book were further shaped and tested in a series of guided tours, lectures, discussions, and workshops that took place during the IABR. We are especially grateful to all the volunteers and participants in these events for their contributions, questions, reflections, and discussions. We would also like to thank all of those who helped us organize these moments of exchange. Especially our partners and the hundreds of professionals who participated in the various Transition Arena workshops, such as the municipalities of Amsterdam and Rotterdam, Delft University of Technology, the 'Hoogwaterbeschermingsprogramma,' and the collective of sustainable engineering and infrastructure partners. Thanks to Yonca Özbilge, Nienke Rothuizen, Melanie Hulsebosch, Roos Rookhuizen, Sabine van der Vooren, Vivian Ammerlaan, Noortje Jansen, Reineke Otten, Mick van der Vooren, Tim Verhoeven, Maaike Menheere, and Feline van Bakel for the organization and production.

The persons and institutions mentioned above represent only a part of our intellectual debts accumulated over a period of three years. They include, directly and indirectly, the authors of the many books mentioned in the bibliography and notes. However, we would especially like to thank a number of people who took some of their precious time to read the full manuscript and comment on the chapters and the structure of this book at their various stages of its completion. In particular, we are incredibly grateful to Tom Avermaete, Daniel Barber, and Elsa Devienne for their insights and suggestions.

We would like to dedicate this book to our dear friends and families, who have been hugely supportive and patient with our many absences and long working hours over the past three years.

1952 to 1972

1952_London's Great Smog

A London policeman wearing a mask for protection during the Great Smog of London in December 1952.

In the winter of 1952, the Great London Smog, a severe air contamination event that affected London, proved to be a powerful tool in raising public awareness of the impact of industrial pollution on air quality. A period of unusually cold weather, combined with an anticyclone and windless conditions, collected airborne pollutants – mostly from the use of coal – and formed a thick layer of smog over the city. The lethal haze (also known as 'killer fog') blanketed London for a period of five days (5 to 9 December 1952), causing major disruption by reducing visibility and even penetrating into indoor areas. According to government medical reports an estimated 4,000 to 12,000 people died as a direct result of the smog, and 100,000 more fell ill from the smog's effects on the respiratory system.

The exceptional smog of 1952 was caused in part by London's reliance on coal-fired power plants for electricity and heat, and diesel-powered buses for public transportation. The worst case of pollution in European history, the Great Smog was particularly poignant because of the images that circulated in the media: total chaos, the capital at a complete standstill for days, police officers using flames to direct traffic, people wearing white masks in the streets. These images, together with the number of deaths, made it impossible to ignore the severity of London's air pollution. The effect was direct and almost immediate: four years later, in 1956, the British Parliament passed the first Clean Air Act, establishing fog-free zones throughout the city and restricting the burning of coal in both domestic and industrial fires. Grants were made available to homeowners who wanted to switch to other heating sources, such as oil, natural gas, and electricity.

Considered a major event in the history of environmentalism, the Clean Air Act sealed a first moment of awareness and greatly contributed to improve public air in Britain.

1957_Trial over DDT spraying

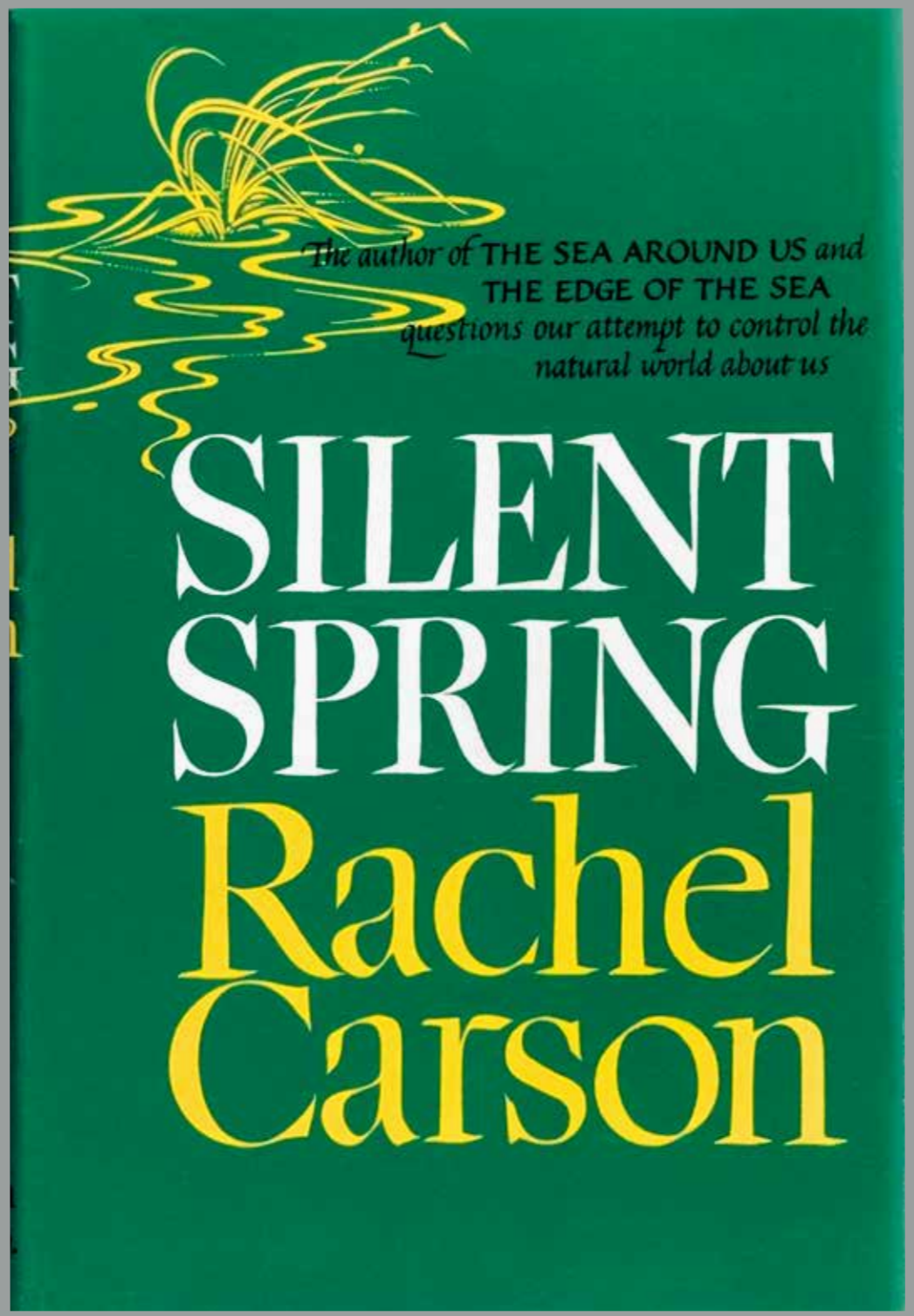
TBM spraying DDT insecticide during Western spruce budworm control project.
Eagle Creek Control Unit, Oregon.

From 1957 to 1960, American teacher, poet, writer, and environmentalist Marjorie Spock, along with six other homeowners on Long Island, New York, sued state and federal officials over health and environmental concerns, following the government's spraying of the insecticide DDT on Long Island. The plaintiffs sought a formal halt to DDT spraying, arguing that such spraying violated private property rights, and that DDT itself posed a risk of personal injury and property damage. Although the plaintiffs lost the case, their efforts set an early precedent for citizen environmental activism, and indirectly encouraged the creation of some of the first large-scale environmental protection measures in the United States.

Beginning in the 1940s, the United States government and public used the insecticide DDT (dichlorodiphenyltrichloroethane) domestically and around the world in campaigns to eradicate insect-borne diseases. At the time of the lawsuit, there was no scientific consensus on a definitive link between DDT and human bodily harm. While the state acknowledged that DDT posed a threat to various flora and fauna, it maintained that the economic benefits of the measured use of DDT outweighed these drawbacks. The state's defense included the argument that DDT was already present in the bodies of most Americans with no demonstrable harm. The court ultimately found that the plaintiffs' inability to prove substantial harm to their bodies or property, and the compelling empirical test data presented by the defendants, to be decisive factors in ruling against the plaintiffs.

The efforts of Marjorie Spock, her fellow plaintiffs, and the testimony given during the litigation provided much of the evidence for Rachel Carson's book *Silent Spring*. All of this indirectly contributed to, among other things, a national ban on the use of DDT in 1972.

1962_Silent Spring



Rachel Carson, *Silent Spring*, 1962. Published by Houghton Mifflin.

Rachel Carson at her microscope, 1951.

In 1962, American marine biologist Rachel Carson caused a worldwide stir with *Silent Spring*, a book in which she documented the harmful effects of mankind's war on insects. *Silent Spring* begins with a story of a town in the heart of America where humans and nature coexist until a mysterious disease disrupts this perfect place. 'No witchcraft,' Carson writes, 'no enemy action had silenced the rebirth of new life in this stricken world. The people had done it themselves.'

At the time, sprays, dusts, and aerosols containing non-selective chemicals were used in large quantities on American farmland. Carson argued that once these pesticides entered the biosphere, they could make their way up the food chain, threatening birds and fish and eventually sickening humans. In other words, the very products that were supposed to enhance food production were having a negative impact on nature. Much of the data and case studies that Carson drew on weren't new; the scientific community had known of these findings for some time, but Carson was the first to bring them together for the public and to draw stark and far-reaching conclusions.

Carson's book reached a wide audience and provoked explosive reactions. It became a *New York Times* bestseller, sold a million copies in 24 countries, and drew attention to the inextricable links between pollution and public health. But while the book was hailed as groundbreaking, it was also severely criticized by a billion-dollar pesticide industry, which claimed that the book was 'merely science fiction instead of fact.' Regardless of these reactions, the book had concrete repercussions. Shortly after its publication, President Kennedy appointed a committee to investigate the adverse effects of DDT, and in 1972 DDT was banned in the United States. While its inventor, Paul Hermann Müller, was awarded the Nobel Prize in Physiology or Medicine in 1948 'for his discovery of the high efficiency of DDT as a contact poison against several arthropods,' the publication of *Silent Spring* led to the creation of the Clean Air Act (1963), the National Environmental Policy Act (1969), and the US Environmental Protection Agency (1970).

1968_The Club of Rome

Presiding committee of the 'Club of Rome' pictured during its annual meeting in West-Berlin on 14 October 1974.

In April 1968, a two-day meeting at the Accademia dei Lincei in Rome brought together 36 European scientists, businessmen, academics, and diplomats who shared a profound concern for the long-term future of humanity and the planet. They called for reflection on 'the predicament of mankind.' Although the gathering – initiated by Italian industrialist Aurelio Peccei and Scottish scientist Alexander King – was fraught with disagreement, a core group of like-minded thinkers crystalized around three pillars: a global perspective, a long-term vision, and Peccei's concept of *problématique*, or cluster of interrelated global problems. An early warning concerning the environment, the meeting was meant to share ideas about the worldwide changes that were occurring as a consequence of human activity.

Looking for ways to translate Peccei's *problématique* into an analytical methodology, in August 1970 the Club of Rome commissioned an international team at the Massachusetts Institute of Technology (MIT) – led by the then 28-year-old Dennis Meadows – to research the implications of continued global growth. The scientific findings were compiled and made available to a wider audience in the book *The Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind.*

The Club of Rome began meeting regularly in 1972 and remained a loosely organized group. Over the years, the Club published over 45 reports. Today it has about 100 active members, 35 National Associations, and a full-time secretariat in Winterthur, Switzerland and a satellite office in Brussels, Belgium.

1968_Zero Population Growth

Pin with illustration of the Zero Population Growth movement in the 1960s.

In 1968, biologist Paul Ralph Ehrlich, entomologist Charles Lee Remington, and lawyer Richard Bowers founded Zero Population Growth. This American non-profit advocacy organization identifies unchecked population growth as the primary cause of environmental degradation and promotes population control measures and policies as a means of protecting the environment. Zero Population Growth introduced the topics of overpopulation and population control into the mainstream environmental discourse.

1968 was a turbulent year in the United States with the assassinations of Martin Luther King, Jr. and Robert F. Kennedy, the Vietnam War, the Civil Rights Act, and the first lunar orbit by Apollo 11. Against this backdrop, environmental concerns grew, and prior to the founding of Zero Population Growth, Paul Ralph Ehrlich and his wife Anne Howland Ehrlich published their book *The Population Bomb*. Its main message, in the retrospective words of the Ehrlichs, was 'that it can be a very bad thing to have more than a certain number of people alive at the same time, that Earth has a finite carrying capacity, and that the future of civilization was in grave doubt.'

The target demographic for both of the organization's advocacy efforts was initially the white middle-class majority, predicated on the argument that this demographic was disproportionately consuming resources and polluting the environment. Zero Population Growth chose 'Stop at Two' as its first slogan and partnered with other rights groups to fight for increased legalized access to contraceptives and wider reproductive rights for women to encourage families to have fewer children. The organization changed its name to Population Connection in 2002 and remains active in raising public awareness of overpopulation and population control issues, and in supporting various population control policies.

1969_Friends of the Earth

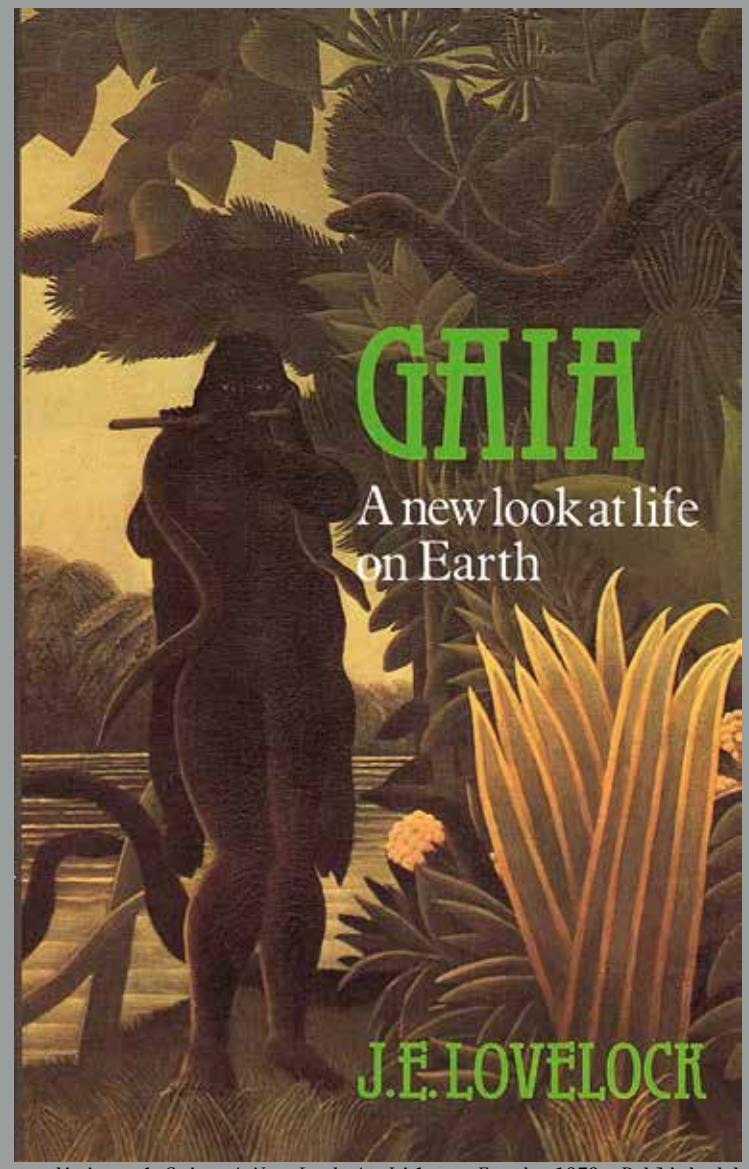
Ann Davidson, a member of Friends of the Earth, places an empty bottle among 2,000 outside the headquarters of Schweppes Ltd in London to protest against the dumping of bottles in the countryside.

In 1969, prominent American environmentalist David Brower founded Friends of the Earth, a US environmental nongovernmental organization that disseminated environmental ideas abroad. Today, Friends of the Earth International is the world's largest grassroots environmental federation, representing some 5,000 local organizations and activist groups in over 70 countries.

Brower had previously served as executive director of the well-known environmental organization Sierra Club and had overseen a series of successful 'coffee table' picture book publications credited with increasing the organization's membership and public awareness of environmental conservation. Brower resigned from the board following institutional policy disagreements over nuclear power and corporate influence, colleagues' concerns about his financial irresponsibility, and an internal election that left Brower effectively out of power. In the wake of these highly publicized disputes, Friends of the Earth emerged with the clear intention not to compete with the Sierra Club, but to stand alongside and strengthen many other environmental organizations. While the Sierra Club deliberately remained domestic, Friends of the Earth intended to spread its message and efforts abroad. Brower introduced the concept of an Earth National Park, an idea he had developed during his tenure at the Sierra Club, but that went beyond its domestic focus. It was a powerful statement that a focus on domestic environmental issues alone was insufficient to address the true scope and scale of the challenges facing humanity.

Friends of the Earth established largely autonomous branches around the world. Friends of the Earth International was founded in 1971 as an umbrella organization for four groups in France, Sweden, the United Kingdom, and the United States. The number of groups founded or co-opted under its representation has only grown.

1969_The Gaia Hypothesis



Cover of the first edition of *Gaia: A New Look At Life on Earth*, 1979. Published by Oxford University Press. Cover illustration by Henri Rousseau.

Beginning in 1969, the late English scientist James Ephraim Lovelock, biologist Lynn Margulis, and others developed the Gaia hypothesis, which posits that the Earth and all its ecosystems are one giant entity or organism. It proposed a holistic view of the Earth as a whole in which the biosphere (the sum of all organisms and the environments in which they live), the atmosphere, the hydrosphere (the sum of all water), and the pedosphere (the Earth's mantle) are interconnected, interdependent, and function as a single complex adaptive system. The Gaia hypothesis is often used to explain that the Earth's surface is maintained in a habitable state by self-regulating feedback mechanisms.

The Gaia hypothesis was developed in the context of emerging environmental and global awareness, stimulated in particular by space travel, in which Lovelock himself was involved as an engineer for NASA. The Gaia hypothesis triggered quite some debate, especially receiving criticism from evolutionary biologists who challenged the idea that the stable global biosphere could be the result of processes of natural selection and self-organization. However, the basic understanding of the world as one large complex ecosystem has since become mainstream.

The Gaia hypothesis is credited with creating the field of Earth System Science, based on an understanding of the Earth as a system of interacting systems. It laid the foundation for a rich tradition of holistic, global thinking across disciplines. Lovelock continued to work on the Gaia hypothesis for the rest of his life, developing a computer model (Daisyworld) and responding to the growing concerns about climate change. What began as a hypothesis and perspective has now become a warning: disrupting the stability of the global biosphere and its subsystems will potentially make the planet uninhabitable.

1969_Santa Barbara Oil Spill and the Cuyahoga River Fire

Work crews rake and shovel oil-soaked straw at the Santa Barbara harbor on 5 February 1969.

Two ecological disasters in the United States that took place in 1969 are often cited in the environmentalist historical canon as seminal in expanding public awareness of environmentalism and ushering in several legislative and institutional milestones.

On 28 January, an offshore oil well near the West Coast city of Santa Barbara experienced a blowout, spilling a total 4,200,000 gallons, or over 100,000 barrels, of crude oil into the immediate area. The blowout was caused by the willful negligence and inadequate safety measures of the oil platform operator, Union Oil, under the auspices of the United States Geological Survey. At the time, it was the largest oil spill in US waters. The slick stretched about 35 miles along the coast, killing thousands of birds, dolphins, fish, sea lions, and seals.

Five months later, on 22 June, the heavily polluted Cuyahoga River, which runs through the Midwestern city of Cleveland, caught fire for at least the fourteenth time since 1868. These fires, the largest of which had occurred 17 years earlier, were sparked by the ignition of the Cuyahoga's high levels of regional heavy industrial pollutants. The journalism of pioneering environmental reporter Betty Klaric and the political efforts of Cleveland mayor Carl B. Stokes helped bring the fire to worldwide attention.

These two events were not perceived at the time as isolated and unprecedented; rather, they were seen as symptoms of undue negligence toward the risk of environmental damage, which increased existing pressure on the government to protect the environment and further galvanized the growing grassroots environmental movement. The following year, the Environmental Protection Agency was formed, and 20 million people celebrated the first Earth Day. Images of the oil spill and the fire galvanized activists, politicians, and everyday people into action.

1970_Earth Day

Protests in Welland, Ontario, Canada during the very first Earth Day observed by tens of millions of people on 22 April 1970.

The first Earth Day was organized on 22 April 1970, when an estimated 20 million people nationwide participated in inaugural events at tens of thousands of locations, including elementary and secondary schools, universities, and community centers across the United States. The idea for Earth Day had evolved over a seven-year period in which Rachel Carson's *Silent Spring* had set the tone, but the major oil spill in the elite community of Santa Barbara, California, in 1969 had brought environmental issues to people's attention in a terribly visual way. Television played a major role in transmitting poignant images of the effects of environmental degradation. Across the United States, similar moments could be identified and distributed through the television set into the heart of American homes. People were aware, but politicians did not (always) follow.

Change came from Democratic US Senator Gaylord Nelson, who called on students to fight for environmental causes and to oppose environmental degradation with the same energy they were displaying at the time in opposing the Vietnam War. Seeing potential in the energy of the student anti-war protests, Nelson proposed a series of ecological teach-ins that soon spread to tens of thousands of initiatives in elementary and secondary schools, universities, and community centers across the United States. From bicycle rides in Denver to chalk art in the streets of New York, from Boy Scouts cleaning the water of polluted rivers to children planting flowers, the public response was unimaginable.

Earth Day 1970 would give voice to the emerging environmental consciousness and bring environmental concerns to the forefront. The media attention that followed had an important impact on the ensuing actions. Although the gravity of the 'act or die' message came through, Earth Day failed in one respect: it did not unite but divide the American people; it divided them, between those who were for environmental awareness and those who were against it. In fact, most of the participants in the very first Earth Day were young, white, and anti-Nixon voters. They criticized the growth economy that would become the central object of concern two years later in The *Limits to Growth*.

1971_Save Our Planet

Ernest Tino Trova, *Save Our Planet, Save Our People*, 1971. Published by the Olivetti Corporation.

In 1971, Olivetti Limited, in collaboration with UNESCO, sponsored the creation and production of six anti-pollution posters produced under the guidance of Jean Herzberg Lipman, a noted New York art patron and longtime editor of *Art in America*. Artists such as Roy Lichtenstein, Georgia O'Keefe, Edward Steichen, Ernest Trova, Alexander Calder, and Buckminster Fuller created manifesto posters, beginning with 'Save Our Planet' and continuing with a secondary slogan concerning the protection of water, air, wilderness, wildlife, people, and cities. The objective was to take a firm stand regarding the precarity of our ecosystems. Proceeds from the sale of these posters went to UN projects.

This campaign was part of the company's long-standing commitment to active protection of the environment. It was aware that decades of indiscriminate waste of raw materials and energy in the pursuit profit had seriously undermined the delicate balance of the world's ecosystems. Olivetti was committed to protecting the environment and therefore the planet.

The 'Save our Planet' series demonstrated the ways in which artists and industrialists could engage in the growing concern for the environment. Originally produced as lithographs but later reproduced and distributed on a large scale, these posters reached the homes of a wider public.

1971_Greenpeace

The crew of the *Phyllis Cormack* ('Greenpeace') left Vancouver on 15 September 1971 to stop nuclear testing on Amchitka Island, pioneering the environmental movement that became Greenpeace.

In September 1971, a group of North American activists, pacifists, and environmentalists boarded an old fishing boat (*the Phyllis Cormack*) to protest American nuclear tests planned for the tiny volcanic island of Amchitka, off the coast of Alaska. They set sail from Vancouver, Canada, but were eventually stopped. Motivated by the belief that individual, nonviolent action can create positive change, the group formed an organization called Greenpeace. A few years later, in 1979, the European, American, and Pacific offices decided to pool their resources to create Greenpeace International.

Greenpeace's first actions concerned the fight against nuclear power and the protection of the oceans. But the organization gradually broadened its fight to include climate change, pollution from toxic products, protection of forests, denunciation of GMOs and pesticides, and the promotion of renewable energy and organic agriculture. As an organization, it uses direct action, advocacy, research, and ecotage to achieve its goals.

The global network, which does not accept funding from governments, corporations, or political parties, consists of 26 independent national or regional organizations in over 55 countries in Europe, America, Africa, Asia, Australia, and the Pacific, with a coordinating body – Greenpeace International – in Amsterdam. For more than 40 years, Greenpeace has helped raise awareness of issues such as pollution, wildlife extinction, and climate change.

1972_Blue Marble

The Blue Marble, a photograph of the Earth taken on 7 December 1972 by the crew of the Apollo 17 spacecraft en route to the Moon.

The *Blue Marble,* a complete image of the Earth taken during the 1972 Apollo 17 mission, showed with great precision the juxtaposition and layering of the Earth's atmosphere, oceans, and mountainous topography. It depicted the planet's frailty, vulnerability, and isolation amid the vastness of space, and would become a symbol of a growing environmental movement.

The desire to grasp the Earth and see it from afar gained momentum in the 1960s. As part of this movement, in February 1966, biologist Stewart Brand released buttons with the text 'Why haven't we seen a photograph of the whole Earth yet?' urging NASA to release images of the Earth following the many Apollo missions that had gone into space since 1966. Brand believed that the image of the entire planet would have a powerful impact on the way environmental problems could be addressed. In 1968, American astronaut William Anders, who was part of the Apollo 8 mission, the first crewed voyage to orbit the Moon, took a picture of the Earth that later became known as *Earthrise*. Slightly tilted and only partially visible, the Earth appeared to rise from behind the moon's surface.

From the mid-1960s to the mid-1980s, abstract concepts such as climate, pollution, fragility, and extinction were translated into poignant images. On the one hand, they depicted the beauty of the planet and brought unfamiliar fauna and flora into the living room – think of the mesmerizing images of French oceanographer, explorer and filmmaker Jacques-Yves Cousteau and his observations of the underwater world. On the other hand, the images showed the severe damage caused by humans. At a time when the circulation of images was slowly taking on an unprecedented importance, the visual images, distributed through the national newspapers and on television, were important vectors in the campaigns that activated the masses in relation to ecological concerns.

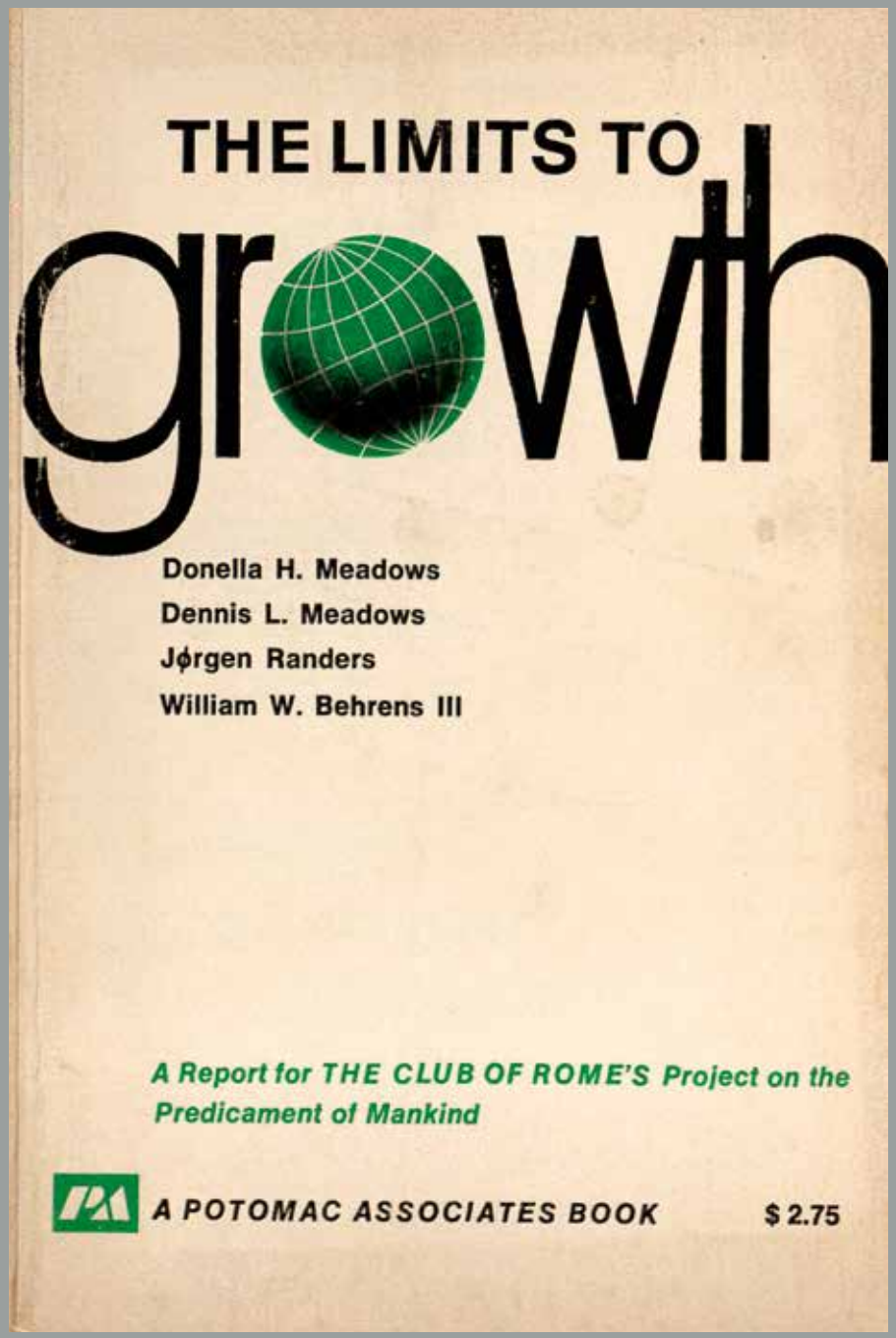
1972_Only One Earth

The opening meeting of the United Nations Conference on the Human Environment (UNCHE) held at Stockholm on 5 June 1972.

In 1972, 12,000 official delegates from 113 United Nations member states and 250 non-governmental organizations met in Stockholm from 5 to 16 June for the First United Nations Conference on the Human Environment. Although the UN had been concerned with the depletion of resources and their use since 1949, the Stockholm meeting – also known as the First Earth Summit – proposed for the first time to treat the environment on a solid scale and in terms of international collaboration. It's slogan, 'Only One Earth,' testified to the importance of this idea.

The event brought together an international community of scientists, researchers, and governments with only one item on the agenda: the global environment. The conference also emphasized the international nature of the environment and introduced the idea of the relationship between development and the environment. It led to 'the Stockholm Declaration on the Human Environment,' a set of 26 principles for the preservation and enhancement of the human environment, and an action plan with 109 recommendations for international environmental action. Several new programs, organizations and institutions were established as a result. The creation of UNEP, the UN Environment Program, was the most significant, as it anchored environmental concerns into the UN's structure. Furthermore, the Earth-Watch Program was founded, a network of observatories to monitor air pollution caused by industrial activity.

But the UN conference in Stockholm also showed the difficulty of addressing environmental concerns on a global scale. While the industrialized countries in the Global North seemed to have an urgent need to limit their growth, a vast number of poorer countries in the Global South were not at all eager to stop the (industrial) development that had only just begun in their countries. The conference did not reach any firm decisions. No international agreement was reached and no binding treaty was signed by the UN members. Does this mean that humanity failed in Stockholm? Yes and no, because it could also be argued that the event itself – merely a decade after Rachel Carson's book and only a few months after the publication of The Limits to Growth – was at the time a huge step toward greater environmental awareness.



Donella Meadows, Dennis Meadows, Jørgen Randers, and William Behrens III, *The Limits to Growth*, 1972. Published by Potomac Associates.

1972_The Limits to Growth

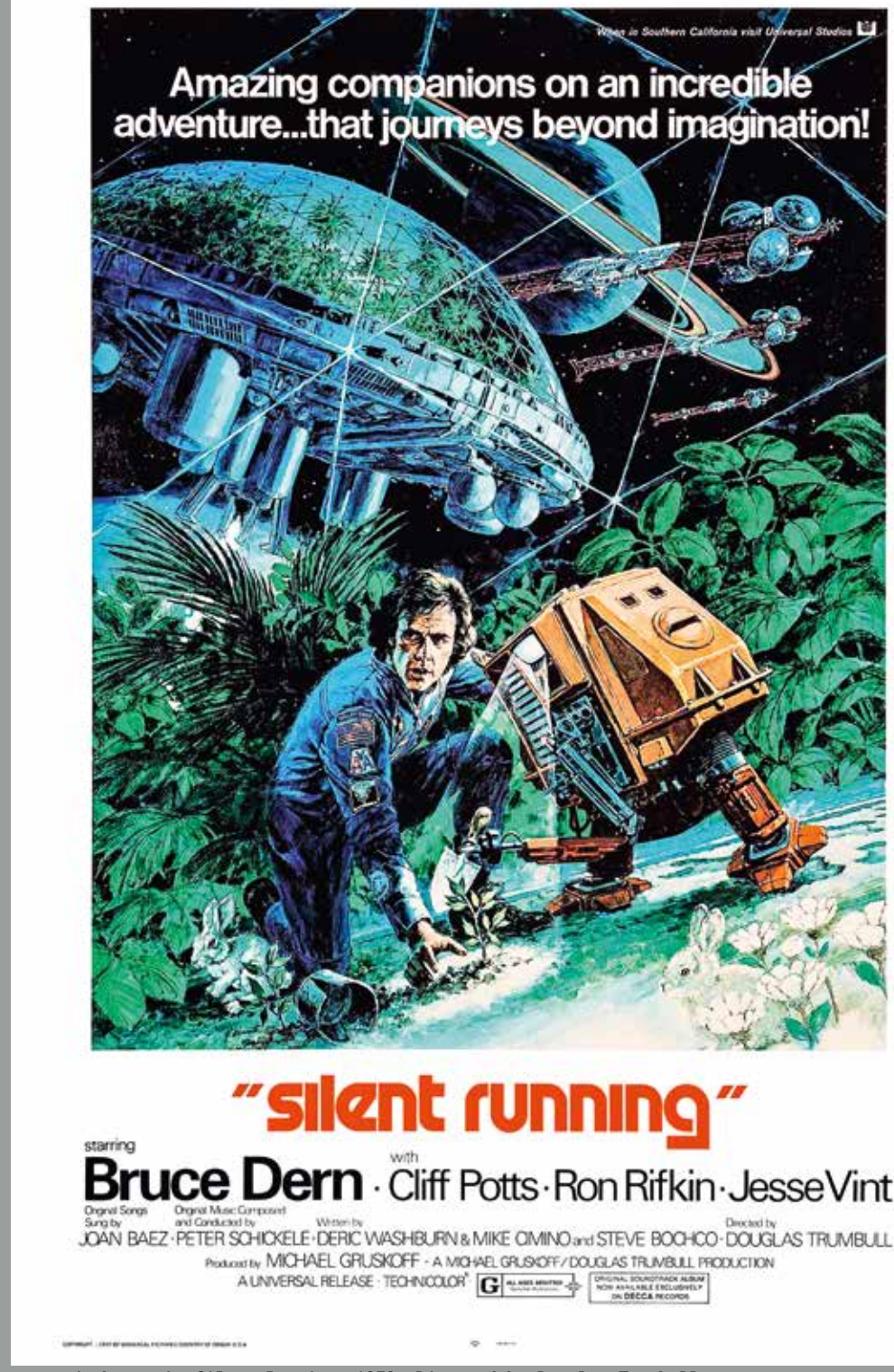
Presentation of *The Limits to Growth* at the Smithsonian. From left to right: William Behrens III, Jørgen Randers, Aurelio Peccei, Dennis Meadows, Donella Meadows (obscured by podium), and William Dietel.

Published on 2 March 1972, in a period of economic boom, *The Limits to Growth* sounded the alarm on the ever-increasing conditions of acceleration and the urgent need to act on them. Commissioned by the Club of Rome and written by an international team of researchers gathered at MIT, the report examined the implications of continued worldwide growth through five factors: population increase, agricultural production, non-renewable resource depletion, industrial output, and pollution generation. The research was based on system dynamics modelling, measuring the relations between these factors. It forecasted that, if there were no changes to historical growth trends, the limits to growth on earth would become evident in 100 years' time, leading to sudden and uncontrollable decline in both population and industrial capacity.

The technical report was translated into a version that makes the science accessible to a wider audience. This version is known as *The Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind*, and was written by lead author Donella Meadows, along with Dennis Meadows, Jørgen Randers, Jay Forrester, and William Behrens. With 30 million copies published in 30 languages, *The Limits to Growth* created a tremendous momentum, but also provoked immediate and fierce criticism.

As the Club of Rome had hoped, an incredibly broad and articulate debate ensued. The report was not unanimously received with applause, but its validity was questioned; some condemned it as 'hysterical computerized gloom,' others claimed that more research was needed before it could be fully used. Most of the criticism came from those who saw the book as a threat to their religious beliefs, businesses, or industries, or as a danger to their profits. In response, the book's lead authors, Dennis Meadows, Donella Meadows, and Jørgen Randers, published subsequent books in the following decades, sometimes nuancing some of the initial findings, but always reaffirming the general claim of their 1972 book.

Poster of the movie *Soylent Green*, 1973. Directed by Richard Fleisher.



Poster of the movie *Silent Running*, 1972. Directed by Douglas Trumbull.

In 1972, director Douglas Trumbull released the American environmental post-apocalyptic science fiction film *Silent Running*, which portrayed the year 2001, when all plant life on Earth had been wiped out by an unexplained cause. Despite the sense of doom and human failure, the film did offer a glimmer of hope: as many specimens as possible had been preserved in a series of enormous greenhouse-like geodesic domes attached to large cargo spaceships, part of a fleet of eight American Airlines Space Freighters stationed outside the orbit of Saturn. One year later, terror was brought to the cinemas with *Soylent Green*, a 1973 ecological science fiction film directed by Richard Fleisher that depicted a crude dystopian setting consistent with Paul Ehrlich's predictions in the book *The Population Bomb*. By 2022, New York had become a city of 40 million people, facing the cumulative effects of overpopulation, pollution, and global warming: severe shortages of food, water, and housing.

Both *Silent Running and Soylent Green* were part of what could be called eco-sci-fi movies, a genre that emerged in the 1970s. These films seemed to embrace, with a certain nostalgia, the memory of an environment and ecology that was disappearing on Earth. They also highlighted isolated heroes who served as doomsday prophets. These early forms of cinematic activism were followed by others that focused on the beauty of the planet and its potential loss, such as the 1972 science fiction movie *Solaris* by Russian film director Andrej Tarkovski, or the 1982 film *Koyaanisqatsi: Life out of Balance* by American director Godfrey Reggio. A series of books and comic strips published in that same period also drew attention to the urgency and magnitude of environmental problems. They focused on the very idea of survival: How can humanity endure on planet Earth? And more importantly, how can a planet in peril outlast the impact of human society? Films like *Silent Running* and *Soylent Green* may have reflected forms of eco-terrorism, but in the early 1970s their messages already offered a fair warning.

‘The real enemy then is humanity itself.’

Aurelio Peccei, 1968

Part 1:

Limitless Growth, Finite World

Chapter 1
Energiewende
energy-efficient
final warning
nature-positive
time horizon

Chapter 2
disruption
growth-oriented
long-term
problématique
State of Global Equilibrium

↑ Police officers spray activists during the protest against the expansion of RWE's Tagebau Garzweiler open-pit lignite mine to Luetzerath, Germany, 14 January 2023.

Chapter 1: Uncertain Futures in the Contemporary Landscape, an Introduction

Derk Loorbach, Véronique Patteeuw, Léa-Catherine Szacka, Peter Veenstra

In January 2023, close to ten thousand activists gathered in the German village of Lützerath, to prevent its destruction for the expansion of the Garzweiler II lignite mine. In a tumultuous five-day operation, over a thousand police officers entered and cleared the village, arresting hundreds of activists. It marked the end of an unsuccessful two-year effort from activists and residents to prevent the demolition of the village.[1] The Garzweiler II coal mine, located 30 kilometers west of Cologne and part of the Rheinisches Braunkohlerevier mining area, is the largest lignite mining area in Europe. Over the last hundred years, the exponential lignite extraction in the region has created an extraterrestrial landscape.[2]

The aggressive expansion of industrial wasteland and polluting resource extraction is hard to reconcile with Germany's ambitious climate plans. Dubbed the *Energiewende*, or energy transition, the plan to completely replace nuclear power and fossil fuels with renewables and to democratize energy production includes generous subsidies for solar panels, the construction of wind farms and the closure of all nuclear power plants by 2023.[3] At the same time, a third of the country's energy production is still based on lignite. This leads to the seemingly contradictory decision to bring forward the coal phase-out to 2030, while at the same time increasing energy production from coal-fired power plants and investing in the further expansion of fossil fuel, resource-intensive infrastructure, making additional emissions inevitable for the long-term future.

Just 20 kilometers from Lützerath lies the Hambach Forest, where activists have had more success. There, on the edge of another open pit lignite mine, a remaining 200 hectares of a natural oak forest is being protected by a community of around a hundred activists who live permanently in the forest in treehouses high above the ground. This preservation strategy was not only locally successful, but also had a profound media impact. The Hambach Forest Movement became a symbol of the energy transition, and is just one of the inspiring examples of how citizens and local communities are resisting destruction and showing ingenuity to inhabit the earth in a more enduring way. History is full of such ideas, experiments, and projects for sustainable futures, but many have failed to live up to the expectations they created. They remained marginal, experimental,

1 Jenny Hill, 'Lützerath Eviction: German Police Drag Climate Protesters from Coal Village,' *BBC News*, 11 January 2023, bbc.com/news/world-europe-64233676.

2 The Garzweiler II mine alone spans a surface of 46 km². The excavator machines used in the mine have been adjusted to these large dimensions: with a height of 106 m² they are the world's largest machines on land. The entire mining region is operated by energy company RWE, one of the 100 companies that were responsible for 71% of global greenhouse emissions between 1988 and 2015.

3 See: bmbf.de/bmbf/en/research/energy-and-economygerman-energy-transition/german-energy-transition_node.html.

↑ Still frame for the film Architecture of Everyday Activism, by Irene Feria Prados, Frieder Vogler, Rik de Brower, as presented at the exhibition It's about Time. The Architecture of Change, IABR 2022.

↓ The Tagebau Garzweiler is an open-pit lignite mine operated by RWE in the German state of North Rhine-Westphalia.

or too fragile to sustain. Or, to put it another way, mainstream institutions did not accept or support these alternative futures. The political, technological, and societal conditions were simply not there. But what if those conditions were to change? What if, for example, climate change and biodiversity loss, and the economic and political structures that drive them, began to destabilize? What if a momentum for deep and transformative change occurred? What if society actually started to experience the limits to growth that have been anticipated for so long?

1972, a Pivotal Year

This book tells the entwined stories of climate (in)action and architectural design. It begins in 1972, a pivotal year that marked the beginning of the end of ignorance in terms of an emerging environmental awareness on a global scale. In that year, the Club of Rome, an international group of academics, businessmen, diplomats, and industry leaders who were deeply concerned about the general conditions of life on planet Earth, published *The Limits to Growth*. The report provided a remarkably accurate outline of the global emergency we face today, showing that unless changes were made to historical growth trends in population growth, agricultural production, consumption of non-renewable natural resources, industrial production, and pollution, threats to the habitability of the Earth would become apparent in the twenty-first century, leading to a sudden and uncontrollable decline of life on Earth. Although the findings of the report were alarming, its authors were optimistic: back in 1972, they firmly believed that destructive growth trends could be reversed and that ecological and economic stability could be achieved. The sooner the world's population began to coordinate toward this goal, they claimed, the better the chances of achieving it. Dennis Meadows, Donella Meadows, Jorgen Randers, and Peter W. Behrens III argued that 'under the most sanguine conditions imaginable… growth must end within 100 years.'[4] Using the year 2072 as a horizon, they showed the possibility of a better future. In 2022, when this project began, we were right in the middle of that prospective timespan, with another 50 years ahead of us.

The Limits to Growth was just one of a growing number of publications warning of the dangers of fossil fuel-based economic growth. It coincided with the first UN environmental conference and was accompanied by a flood of public actions, initiatives, and policy proposals. In popular culture, the prevailing concern translated into films, television series, and comics that sometimes offered a prophetic view of the future. In architecture, pioneering designs had been depicting a sustainable future since long before the 1970s. Architects experimented with renewable materials, high-tech solar systems, utopian communes, and even inflatable architecture. They used the latest technologies, but also fell back on historical building techniques. Economic growth and globalization were long seen as the only way forward; technological innovation seemed to be the solution to every problem. Convinced that inspiration can also lie in

4 Peter Passell, Marc Roberts, and Leonard Ross, 'The Limits to Growth,' *The New York Times*, 2 April 1972.

the past, our research puts the previous 50 years into perspective and frames the incoherent accumulation of predictions, debates, experiments, and their ripple effects since 1972. What has been the role of architecture since then? Which design attitudes can be framed by reviewing historical examples? How can these lessons from the past help formulate a new set of design tools, methods, and practices?

The Final Warning

Over the past 50 years, the impact of mankind on planet Earth has taken on alarming proportions. Today we are confronted with the consequences of climate change, declining biodiversity, and social frictions that are of an overwhelming and seemingly hopeless magnitude and complexity. The effects of climate change are clearly manifesting themselves and will intensify and have progressively severe impacts. Today, the carbon concentration in the atmosphere is more than 50 percent higher than in premodern times [5], and 20 percent higher than what Johan Rockstrom and the Stockholm Resilience Centre identified as the planetary boundary – the threshold beyond which the changes to the Earth system may be irreversible and catastrophic.[6] It is not the only planetary boundary that has been exceeded. The loss of biodiversity is estimated to be 100 to 1,000 times faster than the natural extinction rate. Chemical pollution from elements like plastics and heavy metals has crossed the threshold, fertilizers have permanently disrupted the natural biochemical cycles and land-use changes have destabilized natural ecosystems. All these parameters indicate that human societies are living beyond the planet's means and that devastating human consequences such as mass migration are already manifesting.

The assessment reports issued by the Intergovernmental Panel on Climate Change (IPCC) since 1990 provide solid scientific proof of climate change and its causes and effects. The accompanying projected future scenarios have become more ominous, and the call for action more insistent. Upon the release of its sixth report in March 2023,[7] UN Secretary-General António Guterres said: 'This report is a clarion call to massively fast-track climate efforts by every country and every sector and on every timeframe. Our world needs climate action on all fronts: everything, everywhere, all at once.'[8] *The Guardian* reported shortly after: 'Scientists deliver "final warning" on climate crisis: act now or it's too late.'[9] As alarming headlines like these continue to appear, a growing number of professionals and citizens in the Western world is developing a sense of 'green guilt' regarding their lifestyle or the environmental impact of the industry in which they work. As they become aware of the severity of the climate problem, they also realize that they are trapped in economic, political, and institutional systems that are not working for the common good, but for profit and growth. But while individuals may feel hopeless about their potential impact, a critical mass is building.

5 See: theguardian.com/environment/2022/jun/06/carbon-dioxide-levels-increase-global-heating-study.

6 Johan Rockström et al., 'A Safe Operating Space for Humanity,' *Nature* 461 (2009), 472–475; Katherine Richardson et al., 'Earth beyond Six of Nine Planetary Boundaries,' *Science Advances* 9/37 (2023).

7 IPCC, *Sixth Assessment Report*, ipcc.ch/assessment-report/ar6/ (undated).

8 See: press.un.org/en/2023/sgsm21730.doc.htm.

9 Fiona Harvey, 'Scientists Deliver "Final Warning" on Climate Crisis: Act Now or It's too Late,' *The Guardian*, 20 March 2023, theguardian.com/environment/2023/mar/20/ipcc-climate-crisis-report-delivers-final-warning-on-15c.

10 William MacAskill, ffective Altruism: Introduction,' *Essays in Philosophy* 18/1 (2017), 2.

11 William MacAskill, *What We Owe the Future* (New York: Basic Books, 2022).

Toward an Architecture of Change

To achieve a climate-friendly and socially just world, radical changes are required in energy, mobility, circularity, food, and nature. Transition science and practice offer insights into the patterns and mechanisms of systems change, as well as in the ethics, practices, and logics for proactively and pragmatically contributing to them. These explorations do not have to start from scratch but can build on decades of research and experimentation. With the knowledge and skills that have been built up, opportunities for real change appear on the horizon. The current transition moment calls for an *architecture of change*.

How can architecture contribute to establishing a climate-positive and socially just world? Answering this question first requires fundamental changes in the way constructions are financed, organized, practiced, and valued. It implies a work ethic that puts ecological and social values first. It requires moving outside one's own discipline and finding alliances and co-creators in other fields. It suggests more experimental, reflexive, and modest practices. Most importantly, it calls for a collective journey or practice, one in which emerging ideas and practices in different domains achieve fundamental transformation at a systemic level. A practice in which we use the tools of architecture for change: by documenting, measuring, constructing, researching, and conceptualizing not (only) the product but the process of transformation in a physical, ecological, social, and economic terms.

Architecture's potential for change is enormous. How can we unleash this potential if we conclude that it has long been part of the problem? In our vision, there are three interrelated strengths of the profession that need to be directed toward an architecture of change. The first is its technological and research potential. Starting with a biodiversity-positive and socially just ambition: How can we quantify this ambition, and critically evaluate the effects of interventions to reach our goals? What are rational and calculated pathways and how (not) to leverage technology for a nature-positive future? What kind of scenarios and institutional conditions are needed, and how can they be constructed and translated into actual projects? Here we can learn from the effective altruist movements that argue for a rational approach to helping others as effectively as possible, how to maximize impact, and to act accordingly.[10] Or we could think of concepts such as long-termism, giving priority to improving the long-term future.[11] From this perspective, the goal is not to incorporate the latest sustainable technologies into the next building, but to help build a radically different long-term future. Second, architects are material experts. Being nature-positive means building while rethinking the growth paradigm: using resources that can be recirculated into the economy, using biobased materials, and building with as little energy and material as possible. In recent decades, many architects have shown us how to build energy-efficient, comfortable, and affordable circular buildings. There are

also a number of traditional practices and methods that can be studied and revitalized: building with nature. Third, architects are observers and trendsetters. They can engage, inspire, and mobilize. The tools of engagement, co-creation, community building, and facilitation of social innovation are well known and practiced, but rarely applied to achieve wider change in social and economic systems. Combined, these three strengths could constitute the transformative power of architecture.

Climate Change, Time, and Transition

The history of climate change and the history of architecture are intrinsically intertwined in many ways. To reveal those entanglements requires an alternative understanding of past, present, and future. One of the claims we make is that time is an essential yet neglected parameter in designing sustainable futures. Our ever-accelerating Western society is so focused on the here and now, on short-term gain and profit, that humans have lost the ability to see the fundamental, long-term patterns that drive society. The urgency of the climate crisis reinforces our short-termism: the immediate need for change leads us to a focus on optimizing the sustainability of current systems. In the process, we become oblivious to the deeply political design of our current socioeconomic systems: they have a history and determine our long-term future.

Using time as a lens forces us to see the bigger picture and start to appreciate the different velocities of change. It enables us to see deeper lying patterns and mechanisms that could lead to systems change in the long term. It allows us to appreciate what has been lost or marginalized in history, and to imagine sustainable futures. We thus explore time as a nonlinear or progressive pattern and ask ourselves the following questions: What happens when we start bending time? Can we envision a performative history in which the reciprocal engagements of climate action and architectural design contain the seeds for alternative futures? Can we start from a radical future to reinvent the present? Can we go forward to the past, and what new narratives would emerge?

Our aim is to provide an actionable long-term perspective for those concerned about climate change and interested in the role of architecture. We observe that society is fixated on the here and now. The urgency of climate change and the constant stream of alarming news amplify this. Most discussions revolve around problems and solutions that have to work in the limited concept of the 'short term.' Stretching time might allow us to better understand the time we live in and recognize the opportunities that lie ahead. Understanding current disruptive dynamics in a historical perspective helps to recognize the possibilities of future uncertain, relational, and non-linear transitions. In contrast to the strategy of forecasting, back-casting is then a way of imagining desirable futures and stepping back from that future toward the present to see where transformative action can be taken. In addition to diversifying the time horizon, different velocities are introduced to work on alternative futures, from the immediate to the long-term, and from resisting to embracing acceleration. Three complementary protagonists – the accelerator, the activist, and the ancestor – are introduced. They are grounded in the history of architecture of the last 50 years and consciously adopted in contemporary practice.

To understand how actors in the field of architecture can contribute to socially and climate-just futures, the following chapters also present the research and experiments of the past five decades, the knowledge and skills that have been acquired, and the opportunities for change that have appeared on the horizon – as that horizon draws uncomfortably close. Our historical perspective shows that knowledge of sustainability problems has never been enough for transformative action. Social movements, inventions, and a growing concern voiced by research have not been as powerful as economic ambitions, societal events, political shifts, and even deliberate sabotage. While environmental policies and climate agreements failed to change our course, numerous hopeful projects, ideas, and experiments have provided elements for building narratives for powerful futures. The urgency, awareness, and opportunities have put so much pressure on existing social and economic structures that systems change is emerging, at least to some degree. While the Western world should learn to let go of the systems it has created, architecture and design can bring hope and perspective, along with material change. By making visible what is possible and imagining what is needed, architects can guide and accelerate the transition moment in the right direction.

Our historical perspective and the fact that the foreseen long-term problems have now become short-term and existential concerns suggest that we have reached a point where things could shift radically. In this transition moment, where urgency, awareness and opportunity converge, it becomes possible to imagine profoundly different futures, or to seriously see the sustainable futures imagined as far back as the 1950s become reality. As conditions change rapidly, all the efforts of forward-thinking architects, engineers, activists, and scholars to build an economy within planetary boundaries may finally become a reality for all. This book tells their story, and ours.

A Growing Field of Research

Over the past few decades, and in line with larger social trends, ecological issues have moved to the center of the field of architectural research. The contemporary shift from a purely technological sustainability mindset to a broader ecological view seems to be the result of a so-called 'ecological turn' in the social sciences, which has now also affected the theory and history of architecture.

This book compiles dispersed knowledge – from environmental history, architecture history, transition theory, and contemporary

practice. It builds on historical research into the relationship between architectural practice, climate emergency, and transition theory. It aims to provide historical insights while supporting recent re-readings of primary sources. We think in particular of seminal works in architecture such as Buckminster Fuller's *Operating Manual for Spaceship Earth* (1969), Reyner Banham's *The Architecture of the Well-Tempered Environment* (1969), or Victor Papanek's *The Politics of Design* (1971). We were particularly interested in the major architecture journals, such as *Architectural Design*, *Architectural Review* and *L'Architecture d'Aujourd'hui*, which published special issues on architecture and ecology in the 1970s and 1980s.[12] While it is difficult to entirely map a field that is in full expansion, we go back to those important sources that, in one way or another, paved the way for our work.

Recently, various scholars have focused on energy efficiency as it relates to architecture. The Canadian Centre for Architecture (CCA) in Montreal opened the groundbreaking exhibition, 'Sorry out of Gas' in 2007, a show that captured the architectural innovation spurred by the 1973 oil crisis.[13] The book that resulted from this exhibition is a valuable reference for anyone interested in early experiments with managing energy sources, in experiments with passive and active solar technology, in earth shelter construction, improvements in insulation and construction materials, wind turbines, and the design of 'integrated systems.' [14] Building on this work, architecture historian Daniel Barber's work on solar houses and modern architecture and climate,[15] showed how the history of the post-war period was closely tied to energy, but also how modern architecture incorporated climate design before air-conditioning technologies were fully installed. Historian Barnabas Calder has, in his book *Architecture: From Prehistory to Climate Emergency*, proposed a history of architecture through energy use, from the prehistoric hut to the present day.[16] By placing the narrative of energy and architecture in a longer perspective, Calder offers a new history of architecture and a wider survey of the intertwined relationship between architecture and the environment. Also focusing on energy and architecture in the postwar period, Paul Bouet's dissertation explored the domestication of solar energy,[17] while historians such as Fanny Lopez and Lydia Kallipoliti and Caroline Maniaque examined projects of autonomy and DIY.[18] Together, these studies offer in-depth analyses of key projects and issues that frame today's quest for energy sufficiency.

A second set of sources deals with the collective efforts of scholars to map the field. The editors of the *SAGE Handbook of Architectural Theory*, published in 2012, include an important section dedicated to 'Nature/Ecology/Sustainability.' The chapter 'The Ecology Question in Architecture'[19] by architecture theorist Richard Ingersoll offers a rereading of the history of architecture through the lens of ecology. Another sign that environmental issues are at the forefront of the architectural discipline and research is the publication in 2018 of the fieldwork 'Architecture and the Environment,'[20] collectively written by a group of scholars belonging

12 See also the important work by Jeremy Till and Tatjana Schneider, especially: Jeremy Till, 'Architecture Criticism Against the Climate Clock,' *Architectural Review* (april 2023), 6–10.

13 Giovanna Borasi and Mirko Zardini, 'Sorry, Out of Gas: Architecture's Response to the 1973 Oil Crisis,' exhibition presented at the Canadian Centre for Architecture in Montreal from 7 November 2007 to 20 April 2008.

14 Giovanna Borasi and Mirko Zardini (eds.), *Sorry Out of Gas: Architecture's Response to the 1973 Oil Crisis* (Montreal: Canadian Centre for Architecture, 2007).

15 Daniel A. Barber, *A House in the Sun: Modern Architecture and Solar Energy in the Cold War* (Oxford: Oxford University Press, 2016); and Daniel A. Barber, *Modern Architecture and Climate: Design Before Air Conditioning* (Princeton: Princeton University Press, 2020).

16 Barnabas Calder, *Architecture from Prehistory to Climate Emergency* (Elmwood, LA: Pelican Books, 2022).

17 See: Paul Bouet, Domesticating Solar Energy: *Decolonization and Environmentalism in Postwar France* (Zurich: gta Verlag, 2025).

18 See: Fanny Lopez, *Dreams of Disconnection: From the Autonomous House to Self-Sufficient Territories* (Manchester: Manchester University Press, 2021); Lydia Kallipoliti, 'From Shit to Food: Graham Caine's Eco-House in South London, 1972–1975,' *Building & Landscape Journal of the Vernacular Forum* (March 2012); Caroline Maniaque-Benton and Meredith Gaglio (eds.), *Whole Earth Field Guide* (Cambridge, MA: MIT Press, 2016); and Caroline Maniaque-Benton, *French Encounters with the American Counterculture 1960–1980* (London: Routledge, 2011).

19 Richard Ingersoll, 'The Ecology Question in Architecture,' in: Greig Crysler, Stephen Cairns and Hilde Heynen (eds.), *The SAGE Handbook of Architectural Theory* (London: SAGE Publications, 2012), 573-589.

20 Sophie Hochhäusl et al., 'Architecture and the Environment,' *Architectural Histories* 6/1 (2018), 1–13.

21 Kim Förster (ed.), *Environmental Histories of Architecture* (Montreal: Canadian Centre for Architecture, 2022); Angelika Fitz and Elke Krasny, *Critical Care, Architecture and Urbanism for a Broken Planet* (Cambridge: MIT Publishers and Vienna: Architecture Centre Vienna, 2019).

to the European Architecture History Network (EAHN) interest group of the same name. Together with other publications such as the recent *Environmental Histories of Architecture*, edited by Kim Förster for the CCA, and the important book produced in the context of the exhibition 'Critical Care, Architecture and Urbanism for a Broken Planet' by Angelika Fitz and Elke Krasny, it helps to map the field and explore the manifold entanglements of the relationship between architecture and the environment.[21]

We also hope to provide a much-needed complement by bringing in perspectives from environmental studies, philosophy, and systems theory. In particular, we draw on the perspectives offered by the political history of climate awareness, the critique of modernity, and the politics and dynamics of systems change. The terms 'sustainable' and 'environment,' which began to proliferate in the late twentieth century, have often been defined in non-rigorous and contradictory ways. Environmental historians trace the development of environmental awareness, thinking, and movement – for instance Libby Robin and Sverker Sörlin in their *The Environment, A History of the Idea*. Complex adaptive systems theory, developed at the Santa Fe Institute in the United States and expanded on by resilience theorists such as Lance Gunderson and Buzz Holling in Panarchy, provides insight into the dynamics of systems change. It inspires thinking about how we can engage with systems change, as Donella Meadows does in Leverage Points.

The advanced understanding of environmental problems, combined with an ecological understanding of systems change, resonates with the reflections in environmental philosophy such as Bruno Latour's *We Have Never Been Modern*. It is part of a broader development in science and technology studies where authors such as Wiebe Bijker, in *Of Bicycles, Bakelites, and Bulbs: Toward a Theory of Sociotechnical Change*, start to understand our predicament as a result of interacting technological and institutional 'lock-in.' These different streams of thought came together around 2000 when Jan Rotmans, a complex systems and sustainability scholar, John Grin, governance expert, Johan Schot, a history of technology scholar, René Kemp, an economist and innovation researcher, and others united to lay the foundations for transitions research as compiled in *Transitions to Sustainable Development: New Directions in the Study of Long Term Transformative Change*.

The long-term focus on systems change that has developed in architecture and research more broadly has also been taken up in architectural practice and recent architecture biennials. As this book finds its origin in the 2022 IABR (International Architecture Biennale Rotterdam), it builds on the ideas and insights developed in previous editions. In 2020, the IABR exhibition 'Down to Earth' took Bruno Latour's thinking as its premise and asked if 'it would be possible to re-settle on earth' and 'redesign our living environment in a sustainable balance with other life forms.' It followed the earlier exhibition 'The Missing Link' (2018), which focused on closing the gap between daily practice and long-term goals with regard to climate change and growing inequality. Together with 'Next

Economy' in 2016, curated by Maarten Hajer and 'Urban by Nature' in 2014, curated by Dirk Sijmons, they are some of the many exhibitions that have previously explored the link between architecture, environment, and transition, and are a great source of inspiration for us to take our thinking a step further.

What is unique about this book, and what distinguishes it from the aforementioned studies, is its framing of the question of the environment through the lens of time. Equally important is the cross-reading of different fields of study: architecture, environmental history, and transition theory. In this book we focus, with a few exceptions, on the Western world – in the historical analysis, in the examples of contemporary practice, and in the ideas on how society might reinvent itself. We are aware of the limitations of this perspective, however, and hope that this work will serve as a source of inspiration and be pushed further by other writers and scholars, extending to other geographies and realities.

A Convergence of Perspectives

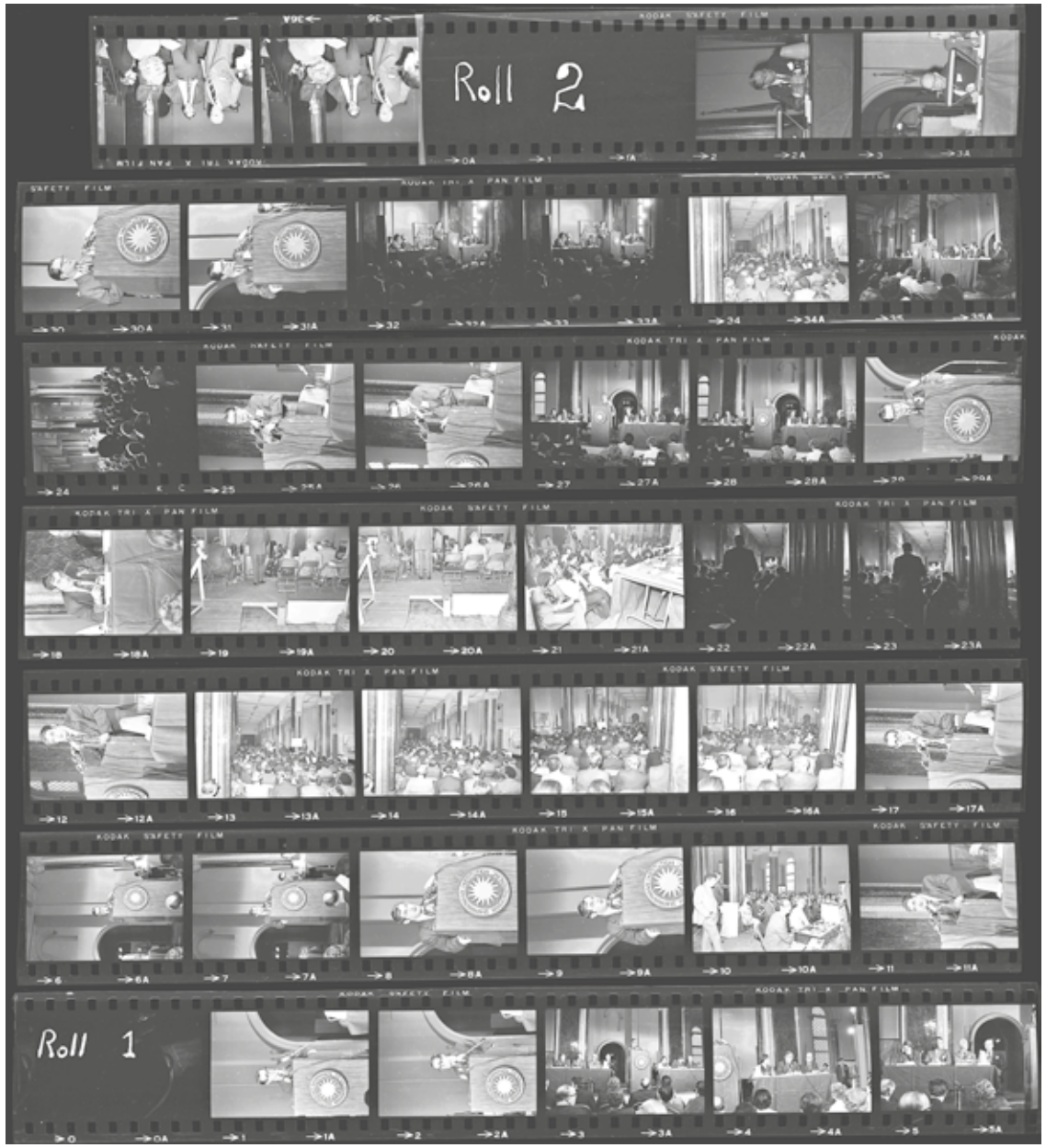
This book consists of a series of chapters and an illustrated timeline (1942 to 2022). The chapters are divided into three equal parts, covering the past, the present, and the future. Part One, 'Limitless Growth, Finite World,' can be read as an introduction and the basis of the book. It explains why and how environmental history, the history of architecture and the academic field of transition thinking are brought together. It also tells the story of the publication of The Limits to Growth, an event that served as a starting point. Part Two, 'Sustainable Architectural Experimentations: The Past,' looks back at experiments in the field of architecture that, in the light of today's challenges, have been fundamental to understanding the potential role of architecture in mitigating the effects of climate change. Part Three, 'Architecture in Transition: The Present and Futures,' looks at contemporary architectural practice and transition theory and explores possible paths to alternative futures. The timeline, consisting of 45 extended captions, runs throughout the book. It presents the interplay between growing environmental awareness and experimentation on the one hand, and skepticism and short-termism on the other. It shows that, in spite of all the resistance, the breeding ground for a desired transition has been prepared. By bringing together architecture, environmental history, and transition theory, we hope to contribute to the ongoing research on architecture in the current New Climate Regime, to paraphrase Bruno Latour. It creates a time-based perspective that underlines the urgency of the topic and provides hope and inspiration for action.

We were first brought together in 2022, on the occasion of the 10th International Architecture Biennale Rotterdam (IABR).[22] We wrote as a collective, each bringing a distinct perspective: Véronique Patteeuw and Léa-Catherine Szacka, both professors of the history and theory of architecture; Peter Veenstra, landscape architect; and Derk Loorbach, professor of sustainability transitions. The intuitive and non-linear process of connecting the theme of

22 Derk Loorbach, Véronique Patteeuw, Peter Veenstra, and Léa-Catherine Szacka co-curated the 10th edition of the International Architecture Biennale Rotterdam (IABR) in 2022. The exhibition ran from 22 September to 12 November 2022 and took place in an old gasometer, the Ferro Dome, in Rotterdam.

23 Many of the architectural projects that are used in this book were exhibited at the 10th edition of the International Architecture Biennale Rotterdam in 2022.

climate change to their different backgrounds and fields of research produced the narrative at the heart of this publication.[23] Each author brought his/her own expertise and writing style into the book. Derk Loorbach was the lead author for chapters 6 and 8, Véronique Patteeuw was the lead author for chapter 2 and co-lead with Lea-Catherine Szacka chapters 3, 4 and 5. Peter Veenstra was the lead-author for chapters 1 and 7. The assemblage of the eight chapters, brings focused perspectives on the three fundamental ingredients we share: an interest in historical experimentation, current practices, and transition theory. As such, this book can be used as both a handbook and a source of inspiration. It is intended for architects, educators, students, civic agents, and everyone involved in creating the plural futures of our contemporary landscape. It hopes to awaken the reader by the urgency of its message. It asserts that the momentum (awareness, urgency, and potential) to realize change has arrived, and that the field of architecture can play an important role in the transitions that lie ahead.



↑ Presentation of The Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind in the Smithsonian Institute in Washington, DC on 2 March 1972.

Chapter 2:
Rebel Against Ignorance The Club of Rome and Its Report The Limits to Growth

Lead author: Véronique Patteeuw

I consider the Club of Rome first of all an exciting adventure of the spirit — the exploration and discovery of man's condition in this age of his global empire. At a time of ever-expanding knowledge when we know incredibly much about so many things, we know incredibly little about our own changed condition. If the Club of Rome may be credited with any merit, it is to have been the first to rebel against this well-nigh suicidal ignorance. It is not, however, impossible to pursue the human revolution capable to change this course.[1]

1 Pentti Malaska, 'A Rebellion against Ignorance: A Commemoration of the Life's Work of Aurelio Peccei,' in: Pentti Malaska and Matti Vapaavuori (eds.), *The Club of Rome: 'The Dossiers' 1965–1984* (Helsinki: Finnish Association for the Club of Rome, 2005), 59.

2 Anthony Lewis, 'Abroad at Home,' *The New York Times*, 2 March 1972.

More than 50 years ago, on 2 March 1972, *The New York Times* previewed the soon to be published *The Limits to Growth*, a book described by journalist Anthony Lewis as 'likely to be one of the most important documents of our age.'[2] The book, commissioned by the nascent Club of Rome, quickly became a bestseller, selling over 30 million copies in 30 languages. It was the first published study to model our planet's interconnected systems, making clear that if growth trends in demography, industrialization, food production, resource depletion, and pollution continued unchanged, humanity would reach and then overshoot the carrying capacity of the Earth in the first decades of the twentieth century. The book

‘Silent Spring’ Is Now Noisy Summer

Pesticides Industry Up in Arms Over a New Book

By JOHN M. LEE

The $300,000,000 pesticides industry has been highly irritated by a quiet woman author whose previous works on science have been praised for the beauty and precision of the writing.

The author is Rachel Carson, whose "The Sea Around Us" and "The Edge of the Sea" were best sellers in 1951 and 1955. Miss Carson, trained as a marine biologist, wrote gracefully of sea and shore life.

In her latest work, however, Miss Carson is not so gentle,

Rachel Carson Stirs Conflict—Producers Are Crying 'Foul'

fending the use of their products. Meetings have been held in Washington and New York: Statements are being drafted and counter-attacks plotted.

A drowsy midsummer has suddenly been enlivened by the greatest uproar in the pesticides industry since the cranberry scare of 1959.

Miss Carson's new book is entitled "Silent Spring." The title is derived from an idealized situation in which Miss Carson envisions an imaginary town where chemical pollution has silenced "the voices of spring."

↑ John M. Lee, ‘“Silent Spring” is Now Noisy Summer,’ *The New York Times*, 22 July 1962.

→ The Club of Rome logo. ©Club of Rome

↓ The Club of Rome, meeting in Salzburg, 1974.

sparked worldwide interest and controversy, and remains, to this day, crucial for anyone seeking to understand the complex relationships underlying global environmental and economic trends.

The publication of *The Limits to Growth* was not an isolated event, as it built on at least a decade of environmental studies and concerns.[3] Yet, it was a turning point in the history of early environmental awareness. What was the genesis of this unconventional publication and its place within a larger discourse emerging in the Western Hemisphere in the postwar period of Great Acceleration?[4] What exactly was the book’s main argument? And how was its message received? Taking 1972 as a watershed moment and arguing the centrality of *The Limits to Growth* for today’s understanding of environmental awareness, this chapter repositions the report in its broader context.

The Club of Rome and the Notion of the Environment

The creation of the Club of Rome in the mid-1960s was part of a wider movement of environmental awareness in the decades following the Second World War, when, amid reconstruction and recrimination, ‘a new idea and a new narrative about the planet-wide impact of people’s behavior emerged.’[5] As Paul Warde, Libby Robin, and Sverker Sörin argued, the concept of the environment arose ‘out of a sense of urgency in dealing with looming challenges of unusual magnitude,’[6] but it was also, paradoxically, a ‘concept of peacetime,’ grounded in the midst of postwar reconstruction and dealing with the planet in the same way that war had done: totally and globally.[7]

The science of ecology has existed since the mid-nineteenth century. Its development toward the middle of the twentieth century resulted in a growing concern for the environment and an understanding of the fragility of ecosystems. Several books and actions were key to this convergence. An important early voice in this debate was that of American ecologist and ornithologist William Vogt, who, published *Road to Survival* as early as 1948. The book presented a history of the planet as a whole, making novel use of the term ‘environment.’[8] A commercial success, *Road to Survival* focused on interconnections and presented a ‘survival agenda’ distrustful of capitalism. By linking notions of ‘population growth but also water scarcity, soil erosion, overconsumption, overgrazing, overfishing, pests, industrial wastes, the retarding productivity of soils, and special loss,’ it became a major inspiration for modern environmentalism.[9]

But one cannot ignore the fundamental impact of Rachel Carson’s 1962 book *Silent Spring*, which the American biologist documented the harmful effects of mankind’s war on insects.[10] At the time, toxic insecticides were being applied in large quantities to American farmland. Carson argued that once these pesticides entered the biosphere, they could work their way up the food chain to threaten animals such as bird and fish, and eventually sicken

3 We refer to the timeline in this book and in particular to the entries prior to 1972.

4 J.R. McNeill, *Something New Under the Sun: An Environmental History of the Twentieth-Century World* (New York: WW Norton & Company, 2001).

5 Paul Warde, Libby Robin and Sverker Sörlin, *The Environment: A History of the Idea* (Baltimore: John Hopkins University Press, 2021), X.

6 Ibid., 23.

7 Ibid.

8 William Vogt, *Road to Survival* (Ann Arbor: University of Michigan, 1948).

9 Ibid. See also: Warde, Robin and Sörlin, *The Environment*, op. cit. (note 5), 23.

10 Rachel Carson, *Silent Spring* (Boston: Houghton Mifflin), 1962

humans. Much of the data and case studies that Carson drew on were not new; the scientific community had known about these findings for some time, but Carson was the first to bring them together for the general public and to draw stark and far-reaching conclusions.[11] The book reached a wide audience, as Carson had hoped. It became a *New York Times* bestseller, hailed as groundbreaking by some and harshly criticized by others.[12] Headlines such as 'Silent Spring, Merely Science Fiction Instead of Fact' testified to the fierce criticism with which the pesticide industry responded.[13] Despite these reactions, the book had concrete repercussions. It inspired an entire environmental movement that led to the creation of the Clean Air Act (1963), and later the National Environmental Policy Act (1969) and the US Environmental Protection Agency (1970).

With these and other premises in mind, on 27 September 1965, Italian industrialist Aurelio Peccei[14] delivered a speech at the National Military College in Buenos Aires on the occasion of the first meeting of ADELA, an international investment company he had founded to support the industrialization of Latin America.[15] His address, entitled 'The Challenge of the 1970s for the World of Today,' opened with the following reflection: 'The times in which we live are full of trouble and dangers. But we are so concerned with our personal affairs that we end up by losing all sense of the complex world that surrounds us.'[16] Combining his position as an industrialist expatriate in Latin-America with forward thinking, Peccei had, during his travels in the 1960s, been shocked by 'the poverty, disparities and injustice... found in Latin America, was alarmed by the explosive growth of population in the Third World countries and somewhat disenchanted by the influence of technology on societies at different levels.'[17] His 1965 speech stressed not only the risks of population growth and environmental degradation, but the need for a long-term global perspective.[18] Peccei's discourse, later translated into English and distributed at several United Nations events, caught the attention of Jermen Gvishiani, vice president of the Soviet Council for Science and Technology, and his Scottish colleague Alexander King, a senior officer of the European Productivity Agency. Peccei and King eventually met in 1967, an event that marked the start of a long-lasting exchange between two men who felt they had many common concerns. In addition to their shared vision of global dangers that could threaten mankind,[19] the they were united in their concern that these problems were not being sufficiently recognized or studied.[20]

Feeling the need to expand their conversations, Peccei and King organized a two-day meeting at Villa Farnesina in Rome in April 1968.[21] This meeting brought together a group of 30 individuals – scientists, educators, economists, humanists, industrialists, and national and international civil servants from ten different countries – who shared a profound concern for the long-term future of humanity and the planet. Among them were futurists Bertrand de Juvenel and Dennis Gabor (the Nobel Prize physicist), bankers

11 Special in *The New York Times,* 13 September 1962, nytimes.com/2012/09/23/magazine/how-silent-spring-ignited-the-environmental-movement.html.

12 The book sold 1 million copies in 24 countries, theguardian.com/science/2012/may/27/rachel-carson-silent-spring-anniversary.

13 Special in *The New York Times*, op. cit. (note 11).

14 After completing a PhD in economics from the University of Turin, Aurelio Peccei (1908–1984) joined Fiat in 1930 and went to Latin America as head of Fiat, to later become chairman of the board of Fiat Concord in Buenos Aires. In 1957, he became chairman of Italy's leading think tank, Italconsult. From 1964 to 1967, Peccei was temporarily appointed president and executive director of Olivetti, after which he remained development plan vice president of this group in Latin America.

15 In 1962, US Senator Javits and Vice President Hubert Humphreys, seeking ways to alleviate the appalling economic conditions in Latin America, took the initiative to persuade a number of prominent Americans, including David Rockefeller, to create a mechanism to provide industrial venture capital to innovative industrialists in the subcontinent. Peccei was obviously interested and cooperated with the new Investment Company ADELA Atlantic Development of Latin America. His now extensive knowledge of industry throughout Latin America was immensely useful to the American financiers.

16 Aurelio Peccei, 'The Challenge of the 1970s for the World of Today,' text from a lecture given at the National Military College, Buenos Aires, 27 September 1965, in: Pentti Malaska and Matti Vapaavuori (eds.), *The Club of Rome: 'The Dossiers' 1965–1984* (Helsinki: Finnish Association for the Club of Rome, 2005), 4.

17 Alexander King, 'The Launch of a Club,' in: Malaska and Vapaavuori, *The Club of Rome*, op. cit. (note 16), 52.

18 Ibid.

19 Such as over-population, environmental degradation, worldwide poverty, and the misuse of technology

20 King, 'The Launch of a Club,' op. cit. (note 17).

21 It was Peccei who obtained the financial means to support the first Rome meeting, by convincing the Agnelli Foundation – a foundation related to the Fiat Company – to finance the event.

22 Donella Meadows et al., *The Limits to Growth: A Report for the Club of Romes's Project on the Predicament of Mankind* (Washington: Potomac Associates, 1972), 9.

23 King, 'The Launch of a Club,' op. cit. (note 17).

24 Ibid., 53–54.

25 Convinced that they needed to avoid any form of bureaucratic organization, the men opted for the rather informal notion of a club: as such the Club of Rome was born, referring simply to the place of their first meeting.

26 King, 'The Launch of a Club,' op. cit. (note 17).

27 Ibid.

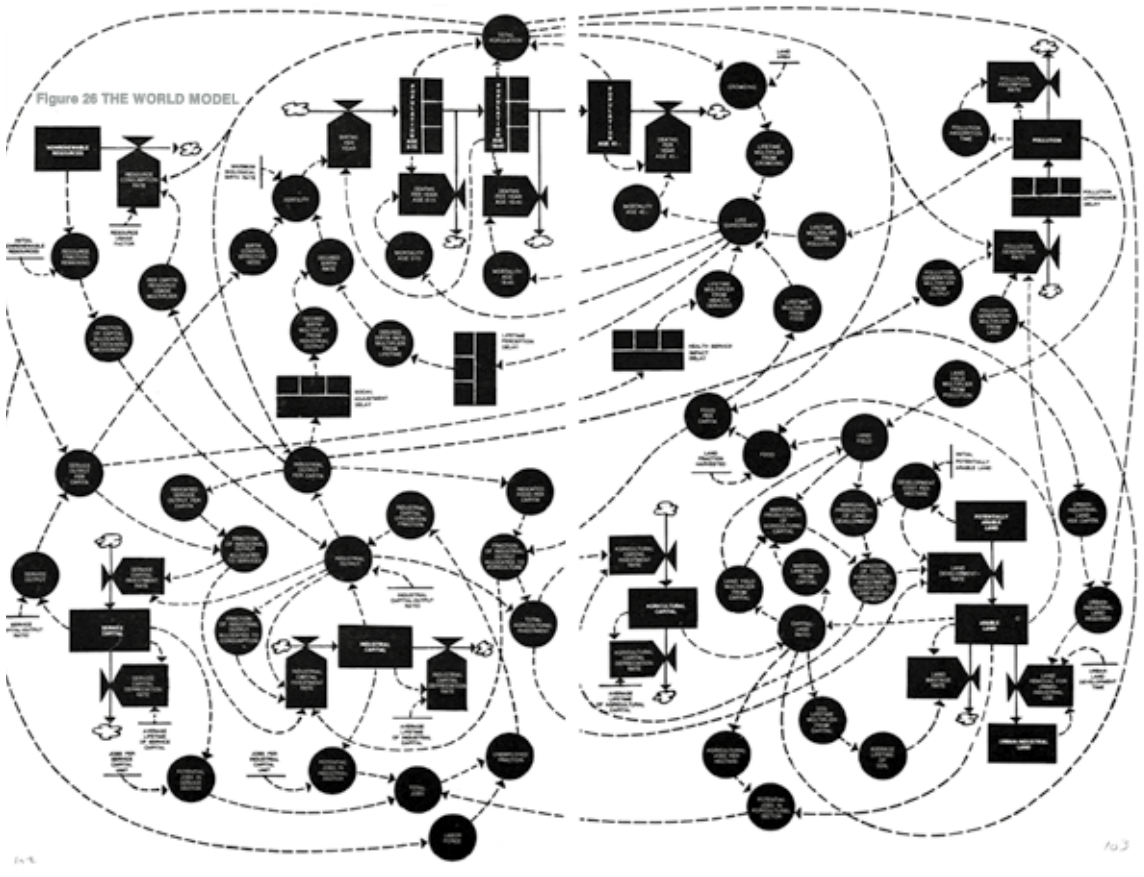
28 In *The Chasm Ahead*, published one year later in 1969, Aurelio Peccei would identify the explosive forces he saw at play on a global level between East and West and between North and South, as well as the disruptive impact of technology on the planetary systems.

Guido Carlo and Jean Saint-Geours, head of the French planning organization Pierre Massay, biologist Conrad Waddington, and Hugo Thiemann, director of the Batelle Institute in Geneva. In Rome, the participants met to discuss the present and future predicaments of mankind in an attempt to 'foster understanding of the varied but interdependent components-economic, political, natural, and social-that make up the global system in which we all live; to bring that new understanding to the attention of policy-makers and the public worldwide; and in this way to promote new policy initiatives and action.'[22]

The meeting was not an immediate success. The keynote address by systems scientist Erich Jantsch, which proposed a tentative 'Framework for Initiating Systems-wide Planning on a World Scale,' was too technical to inspire many of the invitees. The meeting was also overshadowed by politics, with the Vietnam War raging and a murmur of anti-Americanism in Europe. Deeply disappointed by the failure of this first meeting, Peccei invited a few of the participants to his home.[23] Alexander King recalls:

> Aurelio and I were bitterly disappointed, but not utterly discouraged. Closing the ranks, Aurelio invited a few of us to dinner at his apartment for a post mortem. We agreed that we had been naive; we knew too little about international politics; our presentation had been too flamboyant and too technical. However, we were more than ever convinced of the need for an independent international exposure of the oncoming world problems.[24]

Despite the apparent failure of this first meeting, the Club of Rome was born that evening and the next morning, when a group of six – Alexander King, Erich Jantsch, Hugo Thiemann, Jean Saint Geours, Max Kohnstamm, and Aurelio Peccei – decided unanimously to continue to act, albeit modestly at first, but with long-term ambitions.[25] King remembers: 'We agreed that we should have to go through a phase of self-education before facing a sophisticated audience again.'[26] The core group of like-minded thinkers crystalized around three pillars: first, they committed to identifying and exploring problems that were essentially planetary in scope; second, they proposed to tackle longer-term issues; third, they committed to working on what Peccei called a *problématique* – the latter referring not to a single or specific problem, but to a cluster of intertwined issues. The importance of the notion of the *problématique* stemmed from 'the need for a holistic approach in policy planning, or at least, serious considerations of cross-impacts before major policy changes are decided.'[27] And it was precisely the combination of Peccei and King's forward thinking and holistic approach that formed the basis for the Club of Rome's research on the Predicament of Mankind.[28]



↑ Charles Romine (left) with Jay Forrester (right), Director of the Digital Computer Laboratory at MIT, and the individual behind the World1 computer model that was critical to *The Limits to Growth*, during the filming of an educational program for American television, 1954.

↓ The world model flow diagram in formal System Dynamics notation from *The Limits to Growth* (New York: Universe Books, 1972), page 102.

From a 'Problématique' to the 'World3 Model'

In the years following their informal meeting in Rome, Peccei and King met separately and together with 17 world leaders, including Canadian Prime Minister Pierre Elliott Trudeau, and Austrian Chancellor Josef Klaus, before organizing the first conference in Bern in May 1970. Present at the Bern meeting were two men who would become crucial to the organization and the research being conducted. The first was Hasan Ozbekhan, a cyberneticist, philosopher, and planner of Turkish origin, who had been advocating the use of mathematical modeling techniques within a larger analytical project to understand and analyze world problems.[29] The second was Professor Jay Forrester, head of the System Dynamics Group at the Massachusetts Institute of Technology in Boston, who had developed the World1 model of global dynamics.[30] Following the Bern conference, Forrester presented his model during at a two-week meeting in Cambridge, USA. Forrester's work allowed the clear identification of many specific components of the *problématique*, while suggesting a technique for analyzing the behavior and relationships of these components. The presentation led to the launch of Phase One of the Project on the Predicament of Mankind, a study intended to clarify these global dynamics, to be conducted by an international team with financial support from the Volkswagen Foundation.[31]

Looking for ways to translate Peccei's *problématique* into an analytical methodology, in August 1970 the Club of Rome commissioned an international team at the Massachusetts Institute of Technology (MIT) – led by the then 28-year-old Dennis Meadows – to research the implications of continued worldwide growth.[32] Meadows' team consisted of 16 researchers from the United States, Turkey, Iran, Germany, and Norway, with backgrounds as diverse as agriculture, urban planning, sociology, and political science. Together they spent two years (1970–1972) exploring the possibility of exponential economic and demographic growth in the face of the planet's finite resources. To do this, they would survey five fundamental factors that would determine and, in their interactions, would ultimately limit growth on planet Earth. These five variables were population growth, agricultural production, consumption of non-renewable natural resources, industrial production, and pollution. For the very first time, these five factors were studied in a systemic and seemingly comprehensive way, and the World3 systems dynamics computer model that was used allowed the consequences of the interactions between planet Earth and human systems to be simulated. In inviting the MIT team to conduct the investigation, the Club of Rome had two immediate objectives in mind: first, to gain insight into the limits of the world system and the constraints it places on human numbers and activities; second, to identify and study the dominant elements, and their interactions, that influence the long-term behavior of world systems.[33]

29 Ozbekhan's approach was quite innovative at the time, as these models were almost exclusively used for military objectives. See: King, 'The Launch of a Club,' op. cit. (note 17).

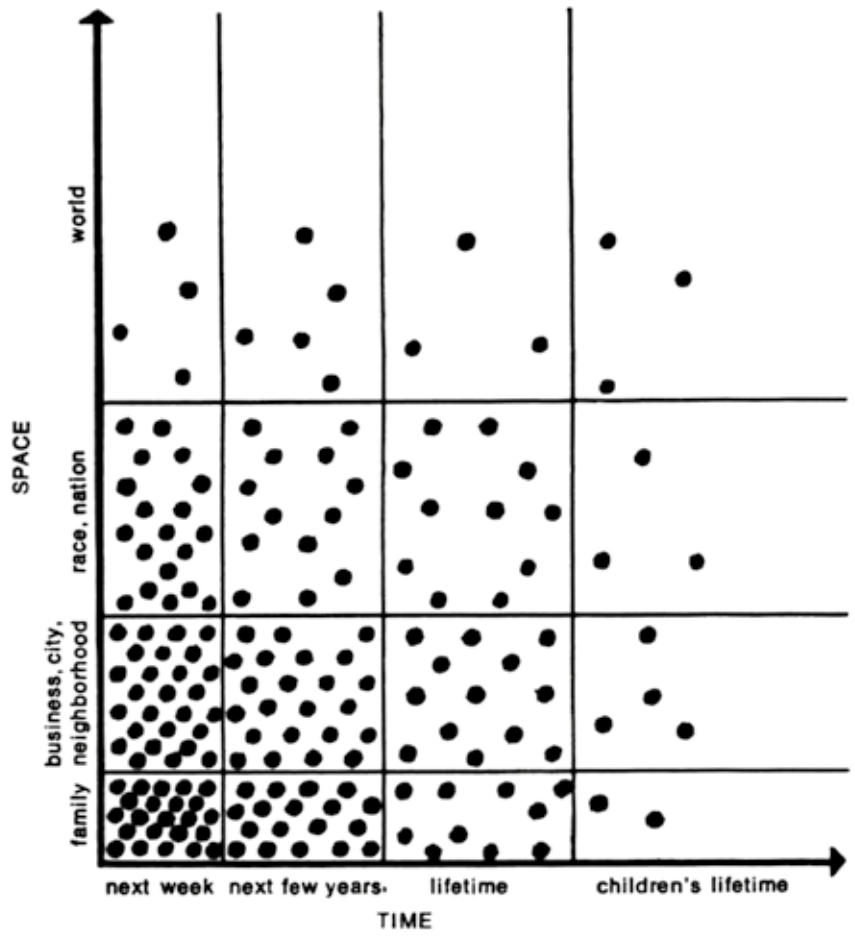
30 The prototype on which the research was based was designed by Jay W. Forrester (MIT). A description of that model has been published in: Jay W. Forrester, *World Dynamics* (Cambridge, MA: Wright-Allen Press, 1971).

31 The president of Potomac Associates, a young American consortium of consulting firms at that time, signed the foreword and mentioned how they 'enabled the publication of the book.' Meadows et al., *The Limits to Growth*, op. cit. (note 22), 11.

32 The study was organized at MIT and funded by the Volkswagen Foundation. For a more extensive reading of the study, we refer to the documentary 'Final Warning Limits to Growth' (2015), youtube.com/watch?v=kz9wjJjmkmc.

33 Alexander King et al. (the Executive Committee of the Club of Rome), 'Commentary,' in: Meadows et al., *The Limits to Growth*, op. cit. (note 22), 185.

Figure 1 HUMAN PERSPECTIVES



↑ Human perspectives graph from *The Limits to Growth* (New York: Universe Books, 1972), page 19.

34 A note about the authors: Dr. Donella Meadows, the lead author of *The Limits to Growth*, was a professor of Environmental Studies at Dartmouth College until her death in 2001, Dr. Dennis Meadows is professor emeritus of Systems Policy at the University of New Hampshire and president of the Laboratory for Interactive Learning, Dr. Jørgen Randers is professor of Climate Strategy at the Norwegian Business School, Dr. William Behrens is co-founder of ReVision Energy, a renewable energy contracting company based in Maine and New Hampshire.

35 Meadows et al., *The Limits to Growth*, op. cit. (note 22), 19.

36 Ibid., 10–11.

37 Ibid., 185.

Scientific Insights for a Wider Audience

The MIT researchers compiled their findings in a technical report, while simultaneously publishing a version of the report that made the scientific insights accessible to a wider audience. This second version is known as *The Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind*, and was written by lead author Donella Meadows, along with Dennis Meadows, Jorgen Randers, Jay Forrester, and William Behrens.[34] In its first edition, the book was 210 pages long, divided into five chapters, and included 48 figures and 6 tables.

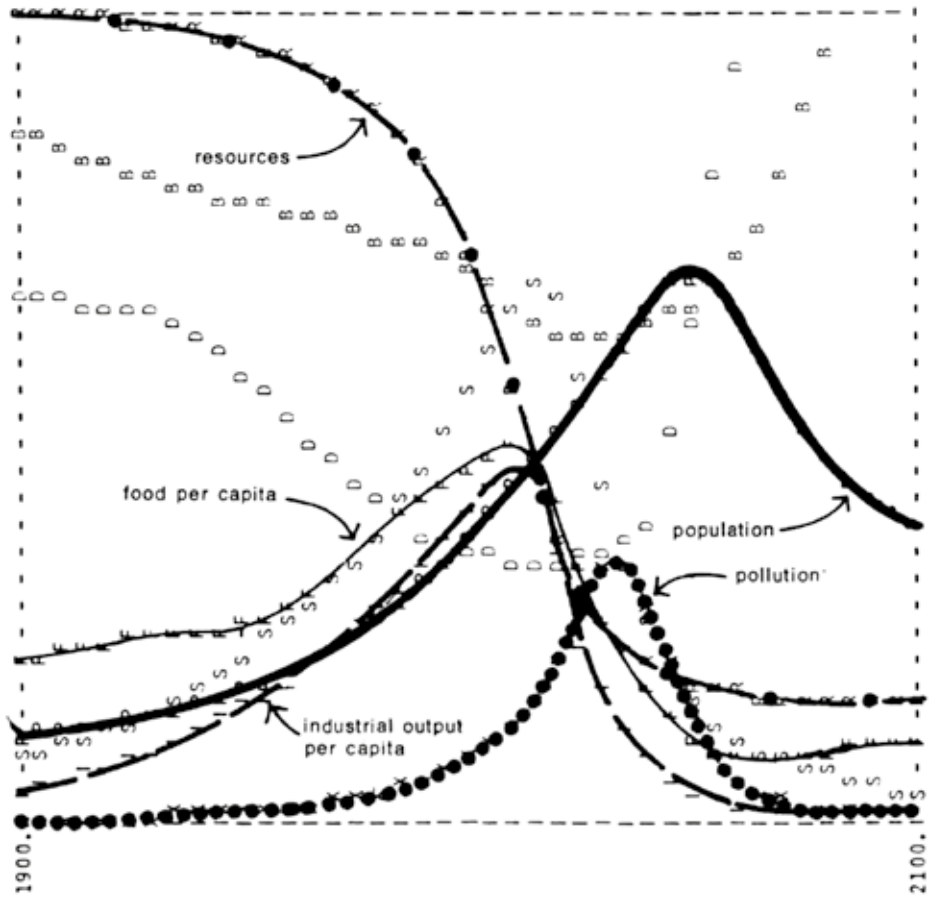
The Limits to Growth opens with a single graph. Taking up nearly half a page and containing nothing more than simple black-and-white lines and dots, the graph presents a field defined by the dimensions of space and time. On the vertical vector, space ranges from the nuclear space of the family, to the wider space of the neighborhood or city, to the more expansive space of race and nation, ending with the global space of the world. The horizontal vector displayed the dimension of time, ranging from the short term of 'next week' to the medium term of the 'next few years' to the longer term of a 'lifetime' and ending with the distant future of one's 'children's lifetime.' The graph, which looks like a child's drawing, illustrates the main argument of the book: that while most people are preoccupied with their immediate space and time frame, only very few of them have a global perspective that extends far into the future.[35]

The intent of the book was to examine 'the complex of problems troubling men [sic.] of all nations: poverty in the midst of plenty; degradation of the environment; loss of faith in institutions; uncontrolled urban spread; insecurity of employment; alienation of youth; rejection of traditional values; and inflation and other monetary and economic disruptions.' According to the authors of *The Limits to Growth*, these problems were all part of a bigger 'world *problématique*.' Although divergent, these problems shared – according to the researchers – three common characteristics: 'They occur to some degree in all societies; they contain technical, social, economic, and political elements; and, most important of all, they interact.'[36] Based on the models observed and analyzed, the research would provide an opportunity to make changes in the political, economic, and social systems of society to ensure that the observed crises would no longer occur. As such, the project was 'not intended as a piece of futurology. It was intended to be, and is, an analysis of current trends, of their influence on each other, and of their possible outcomes.'[37]

But while it is undeniable that the authors of *The Limits to Growth* were forward-thinking, it is also important to put the position of the members of the Club of Rome into a critical perspective. First, they were not the first to critically address the growth paradigm. They were certainly indebted to the writings of thinkers such as John Kenneth Galbraith, whose *The Affluent Society*

↑ Five of the 17 individuals behind the work found in *The Limits to Growth* report. From left to right: Jørgen Randers, Jay Forrester, Donella Meadows, Dennis Meadows, and William Behrens III.

Figure 35 WORLD MODEL STANDARD RUN



↑ The standard world model run diagram from Donella Meadows, Dennis Meadows, Jørgen Randers, and William Behrens III, *The Limits to Growth* (New York: Universe Books, 1972), page 124.

(1958) described the way in which the United States perpetuated income inequality in the post-Second World War era, becoming wealthy in the private sector while remaining poor in the public sector.[38] Second, all of the members of the Club of Rome were men, mostly from the West, and thus shared the extreme privilege of their positions. As Matthias Schmelzer argued in his account of the origins of the Club of Rome, the group was not only born within the Organization for Economic Co-operation and Development (OECD), but was also strongly influenced in its early stages by debates within this think tank of industrialized countries.[39]

Modelling Future Growth

With its five chapters and 189 pages, *The Limits to Growth* is a complete yet concise summary of the research. While chapters such as 'Nature of Exponential Growth' and 'Limits of Exponential Growth' introduce the reader to the five variables – population growth, agricultural production, consumption of non-renewable natural resources, industrial production, and pollution – the authors dedicate the core of the book to 'Growth in the World System,' a perspective in which the five variables are treated in an intertwined manner. To gain insights, a systemic analysis of the intertwined relationship between these factors was developed. The MIT team fed data on the five factors into the World3 computer model and tested the behavior of the model under several sets of assumptions. In the book, the World3 model is presented as a flowchart in formal System Dynamics notation with dots, full lines, and dotted lines as well as circles, rectangles, and clouds. This notation system models the complex relationships of 'cause and effect' between the criteria examined: population rate, agricultural capital, arable land, resource consumption, industrial capital, health services, life expectancy, pollution generation, and food production. [40]

These criteria depart from the five variables, but make them more concrete in their relation to the growth paradigm and map alternative patterns for the future of humanity. The binary relationships between two isolated trends – such as life expectancy and pollution, or food production and industrial output – were explored before being combined in a multivariate analysis of all factors, leading to the 'world model standard run.' This standard run model, frequently defined as the business-as-usual model, assumed 'no major change in the physical, economic, or social relationships that have historically governed the development of the world system.' The researchers based the dynamics of the variables on historical values and growth trends from 1900 to 1970. They explained their findings as follows:

> Food, industrial output, and population grow exponentially until the rapidly diminishing resource base forces a slowdown in industrial growth by the first decades of the twenty-first century. Because of natural delays in the system, both population and pollution continue to increase for some time after the peak of

38 Kenneth Galbraith, *The Affluent Society* (Boston: Houghton Mifflin, 1958).

39 Matthias Schmelzer, 'Born in the Corridors of the OECD': The forgotten Origins of the Club of Rome, Transnational Networks, and the 1970s in Global History,' *Journal of Global History* 12/1 (2017), 26–48. Literature on the embedded racism of the project and its assumptions indicate that the Club of Rome's research was also very authoritarian, characteristic of the aid and development programs of the period. It also seeded a rift and distrust among many environmentalist movements, especially in India and South America, who felt the USA/EU saw them as numbers to be optimized and delegitimated their local efforts. In other words, the report mimicked a lot of colonial attitudes. (These insights were given to the authors by Daniel Barber.)

40 Levels, or physical quantities that can be measured directly, are indicated by rectangles; rates that influence those levels by valves; and auxiliary variables that influence the rate equations by circles. Time delays are indicated by sections within rectangles. Real flows of people, goods, money, etcetera are shown by solid arrows and causal relationships by broken arrows. Clouds represent sources or sinks that are not important to the model behaviour.

industrialization. Population growth is finally halted by a rise in the death rate due to decreased food and medical services.[41]

In the subsequent chapter, 'Technology and the Limits to Growth,' the authors explored future scenarios, responding to the following questions: 'As the world system grows toward its ultimate limits, what will be its most likely behaviour mode? What relationships now existent will change as the exponential growth curves level off? What will the world be like when growth comes to an end?'[42] Six models sketched a pessimistic future. They all indicated the start of the collapse of industrial and agricultural production sometime during the second decade of the twenty-first century (that is, right now) and proposed scenarios of overshoot reached no later than 2100. Their more optimistic assumptions about the availability of natural resources would only postpone the collapse, not avoid it.[43]

The final chapter, 'The State of Global Equilibrium,' looked at how to stabilize growth in a world with finite resources. Three models that lead to more sustainable paths are identified. All three were based on specific interventions to curb economic growth and to reduce the consumption of natural resources. Model 1 started with the growth-regulating policies of the previous models, but added technological policies such as 'resource recycling, pollution control devices, increased lifetime of all forms of capital, and methods to restore eroded and infertile soil.'[44] The model also included value changes such as an increased emphasis on food and services rather than on industrial production. Model 2 did not assume strict restrictions of growth, but was based on a model in which population and capital were regulated within the natural delays of the system. By incorporating technological policies and value changes, this model avoided collapse and led to sustainability far into the future.

The conclusions of the book were both alarming and hopeful. The World3 model had shown the inevitable and devastating scenarios of collapse that humanity would face if no action was taken, but the authors remained hopeful because they also concluded that growth trends could be altered to establish 'a condition of ecological and economic stability.' Indeed, the final graph, the 'World Model with Stabilizing Policies Introduced in the Year 2000,' calls for action in the here and now, warning that if technological policies are delayed until the year 2000, the model – and the Earth system – will become unsustainable as 'population and industrial capital would reach levels high enough to create food and resource shortages before the year 2100.'[45] They called for a 'supreme effort' because this was 'a challenge for our generation' that 'cannot be passed on to the next.'[46] Alexander King, Saburo Okita, Aurelio Peccei, Eduard Pestel, Hugo Thiemann, and Carroll Wilson warned of the urgency of their findings. Their call, however, went unanswered, despite the repeated and numerous efforts to get the message out there.

41 Meadows et al., *The Limits to Growth*, op. cit. (note 22), 124.

42 Ibid., 122.

43 The researchers explored variables in which natural resource reserves were doubled or made 'unlimited,' in which pollution was controled or agricultural productivity increased, and in which humanity achieved 'perfect' birth control. From these variables, six models were projected. They represented possible scenarios in which population and industry grew to the limit of arable land; or in which birth control was tested as a policy to avert food problems or pollution. Regardless of these efforts or assumptions about the world's resources, the six models painted a pessimistic future. It is worth noting, however, that the authors of the report sometimes sounded authoritarian in their thinking. The scenario of achieving 'perfect' birth control, for instance, makes us believe in superior thinking on a global scale.

44 Meadows et al., *The Limits to Growth*, op. cit. (note 22), 165.

45 Ibid., 169.

46 Ibid., 193.

Public Reception and Afterlife

On 2 March 1972, *The Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind* was presented to the American public at a formal meeting in the Smithsonian Institute in Washington, DC.[47] A series of 39 black-and-white negatives is preserved in the archives of the Smithsonian Institute as a rare record of the event. They depict men (and a few women) in formal dress, sitting in rows on folded chairs in a very long and narrow space. A folded table on a small wooden fabricated stage covered with a dark cloth gave the event a serious air. We see Dennis Meadows speaking to the audience, and Aurelio Peccei, Jørgen Randers, and others sitting behind a table, answering questions with a stack of A0 black-and-white cardboard illustrations to make the research comprehensible. The timing of the presentation was not coincidental: the Club of Rome had chosen to publish and publicly present the book on the eve of two important events: in April of that year, the United Nations was holding the third session of its Conference on Trade and Development in Santiago de Chile, while in June 1972, it was organizing the United Nations Conference on the Environment in Stockholm, the first world conference to make the environment a major issue.

As the Club of Rome had hoped, an incredibly broad and articulate debate emerged. In the favorable climate of the early 1970s, *The Limits to Growth* and the Stockholm Conference generated a great deal of international interest, which contributed to clarifying some *standard* arguments used by many 'local' protagonists.[48] Peccei and Dennis Meadows were both invited to Stockholm to present their findings. In his address to the UN, Peccei reaffirmed the outcome of the report, making a plea for a better balance between humanity and the environment. However, the report was not unanimously applauded, but its validity was questioned, with some condemning it as 'hysterical computerized gloom' and others claiming that more research was needed before it could be fully used.

The book provoked a wide range of immediate and strong criticism. Most of it came from those who saw the book as a threat to their religious beliefs, their businesses or industries, or as an intrusion on their profits. The Catholic Church, for example, criticized the suggestion that overpopulation was one of mankind's major problems.[49] The World3 model was severely criticized for being imprecise or lacking sufficient data, but also because it 'treated the whole population of the world as a homogeneous group,' ignoring the difference between the Global North and the Global South; nor did it take into account 'the possibilities of political shocks or major technological shifts.'[50] While *The New York Times* had initially published an enthusiastic and encouraging preview of the book in March 1972, one month later, on 2 April, it released a second article, this time devastating. In it, economics writers Peter Passell, Marc Roberts, and Leonard Ross called the book an 'empty and misleading work.'[51] In their collective opinion:

47 'Limits to Growth' conference held in the Woodrow Wilson International Center for Scholars (WWICS) in the Smithsonian Institution Building, or Castle, with William W. Behrens III, Dennis L. Meadows, Donella H. Meadows, Jørgen Randers, Benjamin H. Read, Smithsonian Secretary S. Dillon Ripley, Aurelio Peccei, Alexander King, Carroll Wilson, William Watts, Stuart Udall, and Governor Rolf Edberg of Sweden.

48 Luigi Piccioni, 'Forty Years Later: The Reception of the Limits to Growth in Italy, 1971-1974', see: donellameadows.org/archives/forty-years-later-the-reception-of-the-limits-to-growth-in-italy-1971-1974/#5.

49 See: ibid., for an excellent reading of the reaction of the Catholic Church.

50 Warde, Robin and Sörlin, *The Environment*, op. cit. (note 5), 49.

51 Peter Passell, Marc Roberts, and Leonard Ross, 'The Limits to Growth,' *The New York Times*, 2 April 1972.

'It's imposing apparatus of computer technology and systems-jargon conceals a kind of intellectual Rube Goldberg device – one that takes arbitrary assumptions, shakes them up, and comes out with arbitrary conclusions that have a ring of science.' They criticized the book for being 'less than pseudoscience and little more than polemical fiction.'[52] In the weeks and months following the review, *The New York Times* received a record outpouring of letters from the scientific community (and lay correspondents) both supporting and rejecting their review, fueling a discussion about the relevance and credibility of the book that would last for decades.

The executive board of the Club of Rome had anticipated the criticism and had included a critical commentary on the final pages of the book. Structured around four points, the commentary nuanced some of the findings. First, it argued that the interactions studied by the researchers were only partial because the models could only account for a limited number of variables. Second, the possibilities of scientific and technological advances in solving certain problems were not given sufficient weight. History would prove that this would become one of the main criticisms of the book in the decades following its publication. Third, it explained that the possibility of discovering stocks of raw materials in areas was greater than the model assumed, but the authors aimed for a cautious approach. Fourth, the model was too 'technocratic' because it did not take into account critical social factors, such as the effects of adopting different value systems.[53] The auto-critique continued in the years after the book's publication in the numerous interviews, presentations, and debates in which the authors participated. In retrospect, on the occasion of the 40th anniversary of the book's publication, Dennis Meadows even suggested that they had failed to give the book a good title, because it was largely misunderstood as a result: 'We did not prove that there were limits, we assumed that there were. We did present information about the variety of physical limits – water, soils, metals, and other resources, in order to make the idea of limits plausible.'[54]

The reception of the book was amplified by the discussions it provoked in national contexts.[55] Nowhere was the response to the book as overwhelming as in the Netherlands, a country where half a million copies of the first Dutch edition were sold within the first few years. In the years leading up to the publication, copies of the leaked manuscript had been circulating in the country, reaching the desks of important politicians such as progressive left-wing opposition leader Joop den Uyl. He set up a committee to translate *The Limits to Growth* report into policy,[56] used the Club of Rome's thinking in his political campaign, and won the 1972 elections on a green and social platform. The ambitions of the newly formed government were huge, as they would work on the '*problématique*,' to paraphrase Peccei, but the oil crisis, which confirmed the Club of Rome's theory, ended its ambitions prematurely.

Parallel to the political reception, Dutch journalist Willem Oltmans made a documentary film about the Club of Rome, which premiered on national television on 26 September 1971.[57] It was

52 Ibid.

53 King et al., 'Commentary,' op. cit. (note 33), 186–188.

54 Dennis Meadows, 'Perspectives on the Limits of Growth: It Is too Late for Sustainable Development,' conference at the Smithsonian Institute, 2 March 2012.

55 Jaap Tielbeke, *We waren gewaarschuwd* (Amsterdam: Das Mag Uitgeverij, 2022).

56 The committee consisted of six heavyweights from three progressive parties: Hans van Mierlo and Hans Gruijters on behalf of D'66, Erik Jurgens of the Political Party Radicals (PPR), and Cees de Galan and Sicco Mansholt of the Labor party (PVDA). Den Uyl held the role of chairman. Boebie Brugsma, the journalist who pointed out the existence of the report, was secretary alongside Jan Pronk.

57 It was aired in the NOS television program *Panoramiek*.

during these months of optimism about the book's potential that Oltmans (after meeting Peccei) decided to collect and publish the reflections and opinions arising from the report. Initially aiming for a collection of 30 voices from fields as diverse as economics, systems engineering, biology, and ecology, the project grew into a two-volume publication with 125 interviews, including the voices of Margeret Mead, Paolo Soleri, Marshall McLuhan, Lewis Mumford, Dennis Gabor, Claude Levi-Strauss, Ivan Illich, Noam Chomsky, and Indira Ghandi. While the first volume collected voices from the Western world, the second volume included voices from the Soviet Union and the Southern Hemisphere.[58] Oltmans hoped that his 1,000 pages of gathered reflections would contribute 'to the broad discussion about the problems of our planet and the ever-expanding consciousness that the generation of today and tomorrow has no right to leave the children of tomorrow and the day after (living on) a garbage belt.'[59] In his interview with Oltmans, Peccei was fully aware of the turbulent reception of the book: 'One would have to be a fool not to expect criticism and censure when one mocks self-righteous morals or when one denounces false values and takes a radical stand against handed-down wisdom – or preferably, when one disenfranchises the holy goddess of growth who rules our commercial society.'[60]

Several new editions of *The Limits to Growth* were published after 1972. In 1992, to celebrate the 20th anniversary of the report and perhaps also to mark the importance of the United Nations Conference in Rio de Janeiro,[61] Dennis and Donella Meadows, together with Jørgen Randers, published *Beyond the Limits: Confronting Global Collapse, Envisioning a Sustainable Future*,[62] in which they attempted to address many of the criticisms raised against the 1972 publication. But despite the fact that by the early 1990s the environment was in far worse shape than it had been 20 years before, with some planetary boundaries being crossed and humanity more dependent than ever on fossil fuels, *Beyond the Limits* caused far less of a stir than the original publication. But the book was an important marker, because it detailed the relationship between increasing CO2 emissions from excessive fossil fuel consumption and deforestation and global warming. Something that had only briefly been mentioned in 1972.

Other publications followed: *Limits to Growth: The 30-Year Update* was published in 2004. A decade later, the Smithsonian Institution held a symposium entitled 'Perspectives on *Limits to Growth*' while the Volkswagen Foundation[63] organized another symposium entitled 'Already Beyond?' That year, it was not a collective endeavor, but book by a single author, *2050: A Global Forecast for the Next Forty Years* by Jørgen Randers, which once again tried to sound the alarm. Finally, in 2022, the book *Earth for All (Earth4all): A Survival Guide for Humanity* was published by the Club of Rome, to mark the 50th anniversary of the first Earth Summit in Stockholm and the initial publication of *The Limits to Growth*. Also based on computer modeling, *Earth for All* argues that the world will experience the consequences of further climate damage over the

58 Willem L. Oltmans, *Grenzen aan de groei (deel 1): 75 gesprekken over het rapport van de Club van Rome* (Utrecht/Antwerp: A.W. Bruna & Zoon, 1973); Willem L. Oltmans, *Grenzen aan de groei (deel 2): 50 gesprekken over het rapport van de Club van Rome* (Utrecht: A.W. Bruna & Zoon, 1974).

59 Willem L. Oltmans, 'Verantwoording,' in: Oltmans, *Grenzen aan de groei* (deel 1), op. cit. (note 58), 9.

60 Aurelio Peccei interviewed by Willem L. Oltmans, in: Oltmans, *Grenzen aan de groei (deel 1)*, op. cit. (note 58), 463. Translation by the authors.

61 The United Nations Conference on Environment and Development, also known as the Rio Conference or the Earth Summit, was a major United Nations conference held in Rio de Janeiro from 3 to 14 June 1992.

62 Dennis Meadows, Donella Meadows and Jørgen Randers, *Beyond the Limits: Confronting Global Collapse, Envisioning a Sustainable Future* (Vermont: Chelsea Green Publishing), 1992.

63 While the early work of the Club of Rome was supported by a grant from the Giovanni Agnelli Foundation in Italy, the MIT research project was largely backed by the Volkswagen Foundation.

next 50 years. However, the authors no longer see this as a single global catastrophe, but as an escalation of local breakdowns; breakdowns in which societies cease to function, often for environmental reasons. Localized social collapses will replace global environmental collapse, the book argues. It also identifies five goals or 'turnarounds' (ending poverty, addressing extreme inequality, empowering women, a healthy and sustainable food system, and clean energy) that, if achieved, would take the world in a rather drastic new direction.

Today, looking back on the 50-year history of *The Limits to Growth* and its reception, its two surviving authors take opposing positions. While Dennis Meadows looks back at *The Limits to Growth* with a certain sadness and frustration, claiming that the report in all its complexity has often been misunderstood, Jørgen Randers takes a more hopeful view. Indeed, over the years Meadows had made it his goal not only to explain the report, but also to frame its weaknesses while spreading the message. But his efforts have not always been heard. Today he claims: 'I have given hundreds of interviews on the report. I no longer find it useful to repeat the same hackneyed answers to the same hackneyed questions.'[64] Less bitter, Randers prefers to point to the new challenges that lie ahead, challenges that we could not have imagined in 1972. 'In 1972,' he says, 'the oldest of us was 29. We thought humanity would listen when we pointed out what is so obvious: the planet is small, increasingly populated and the consumption of physical resources per person is increasing so fast that there won't be enough to go around.'[65] Randers, who is still a full member of the Club of Rome, now proposes to shift the focus from growth in GDP per capita to the wellbeing of people. For the Norwegian economist, wellbeing means not only an increase in the income of workers, but also better health and education services, a stable climate, and less social inequality. Since wellbeing depends on a sense of progress in society, Randers argues that 'if you manage to build a society in which most citizens are convinced that well-being will be superior in the future, then you have political support for governmental action.'[66] His words echo those of Aurelio Peccei, who in 1973 was asked by an Australian journalist what the new status symbols would be in the year 2000. According to Peccei, they would be the inverse of his time: 'Prestige would stem from low consumption.'[67]

The personal reflections of Meadows and Randers reflect the social dynamics of today. On the surface, it seems that the environmental challenges have only become more complex, urgent, and existential, as if the warnings have been ignored. At the same time, there has undoubtedly been a massive response across society, from global commitments to sustainable development to local communities, cities, and professionals working to create change. *The Limits to Growth* helped guide and accelerate all these efforts, but the resistance to change and the persistence of the growth-oriented development model have so far outweighed all these efforts. The ambiguity of the message of *The Limits to Growth* may have played a role: a future of collapse triggers both efforts to change and efforts to prevent change. Today we still face this fundamental dilemma: if we don't accept the possibility of global disruption and collapse, we won't change course, but if the only future predicted is one of collapse, we will try to prevent it and hold on to what we have now. The Club of Rome's role as 'the consciousness of the world' might be even more necessary today than it was 50 years ago.

64 Dennis Meadows in an email to Jaap Tielbeke, see: Tielbeke, *We waren gewaarschuwd*, op. cit. (note 55), 11.

65 Jørgen Randers interviewed by Coralie Schaub, 'Rapport Meadows sur les limites de la croissance: Nous pensions que l'humanité écouterait,' *Libération*, 4 October 2022, 13.

66 Ibid.

67 RetroFocus, 'Computer Predicts the End of Civilisation,' 1973. ABC's *This Day Tonight* aired the story on 9 November 1973, youtube.com/watch?v=cCxPOqwCr1I&t=10s.

↓ United Nations officials look on as the Prime Minister of India, Indira Gandhi, speaks at the 1972 Stockholm United Nations Conference on the Human Environment.

1973 to 1992

1973_Oil Crisis

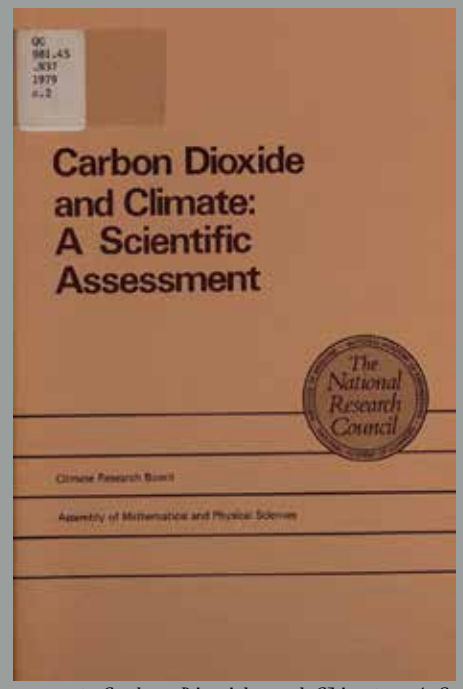
A father camps while reading a newspaper as his son rides a toy tractor on an empty highway during a car-free Sunday, 1973.

In October 1973, the Organization of Arab Petroleum Exporting Countries (OPAEC) announced that it would impose an oil embargo on countries that had supported Israel at any point during the Yom Kippur War (6 to 25 October 1973). The countries initially targeted by the embargo were Canada, Japan, the Netherlands, the United Kingdom, and the United States. The list of countries was later expanded to include Portugal, Rhodesia, and South Africa. The embargo was lifted in March 1974, but by then the price of oil had risen by nearly 300 percent.

Once implemented, the embargo caused a shock with many short- and long-term effects on the global economy and politics. It suddenly became 'slower, darker and chillier,' as Americans and Europeans had to learn to cut back on their consumption of gasoline and electricity: ration coupons; strict bans on fueling and using private cars on Sundays; special speed limits on highways and free-ways; restrictions on the lighting of billboards, department stores, offices, and some roads and streets; curfews and restrictions on the hours that television stations could broadcast were just a few of the measures that were put in place. The embargo also ended a long period of prosperity in the West that had begun after the Second World War.

The oil crisis brought the acute nature of our dependence on fossil fuels into sharp relief. It not only forced us to examine energy use and efficiency, but it also spurred accelerated innovation and research into renewable energy. Scientists, green activists, and inventors in several European countries and North America simultaneously turned to ideas of harnessing the wind, the sun, and geothermal water to produce electricity domestically. A whole new industry based on renewable energy was born out of the crisis.

1979_Charney Report



Cover of the 1979 scientific report *Carbon Dioxide and Climate: A Scientific Assessment* by Jule G. Charney, Akio Arakawa, D. James Baker, Bert Bolin, Robert E. Dickinson, Richard M. Goody, Cecil Leith, Henry M. Stommel, Carl I. Wunsch, Published by the National Academy of Science.

In the aftermath of the 1972 Stockholm conference, the growing international scientific consensus on environmental problems led to a series of confer-ences and reports. The character of the reports was very much defined by individuals and their ambition to bring science to the public: people like American meteorologist Jule Charney, an effective communicator both in the popular media and at the table of government officials.

In 1979, Charney chaired an 'ad hoc study group on carbon dioxide and climate' for the National Research Council. The resulting 22-page report, *Carbon Dioxide and Climate: A Scientific Assessment*, released that same year, is frequently referred to as the Charney Report. Written by a group of nine scientists, the report concluded with a strong statement: 'We believe therefore, that the equilibrium surface global warming due to doubled CO_2 will be in the range 1.5°C to 4.5°C, with the most probable value near 3°C.'

The report is one of the earliest modern scientific assessments of global warming. It paved the way for a global treaty to reduce carbon emissions.

The industry was already well aware of the issue. As Nathaniel Rich explains in his book *Loosing Earth*, oil companies such as Exxon and its predecessor Humble Oil had been tracking carbon dioxide problems since 1957, and their internal reports concluded that the burning of fossil fuels was increasing the concentration of carbon in the atmosphere. However, the intentions behind this ongoing research were not to protect the Earth, but to protect their industry by 'finding good reasons for alarm and better excuses to do nothing.'

But the Charney report had changed this cycle. Despite an aggressive defensive program that was launched by oil and gas companies, in 1980 President Carter signed the Energy Security Act, which prompted the National Academy of Science to start a research program analyzing the social and economic consequences of climate change, culminating in the report *Changing Climate*.

1979_Solar Panels on the White House

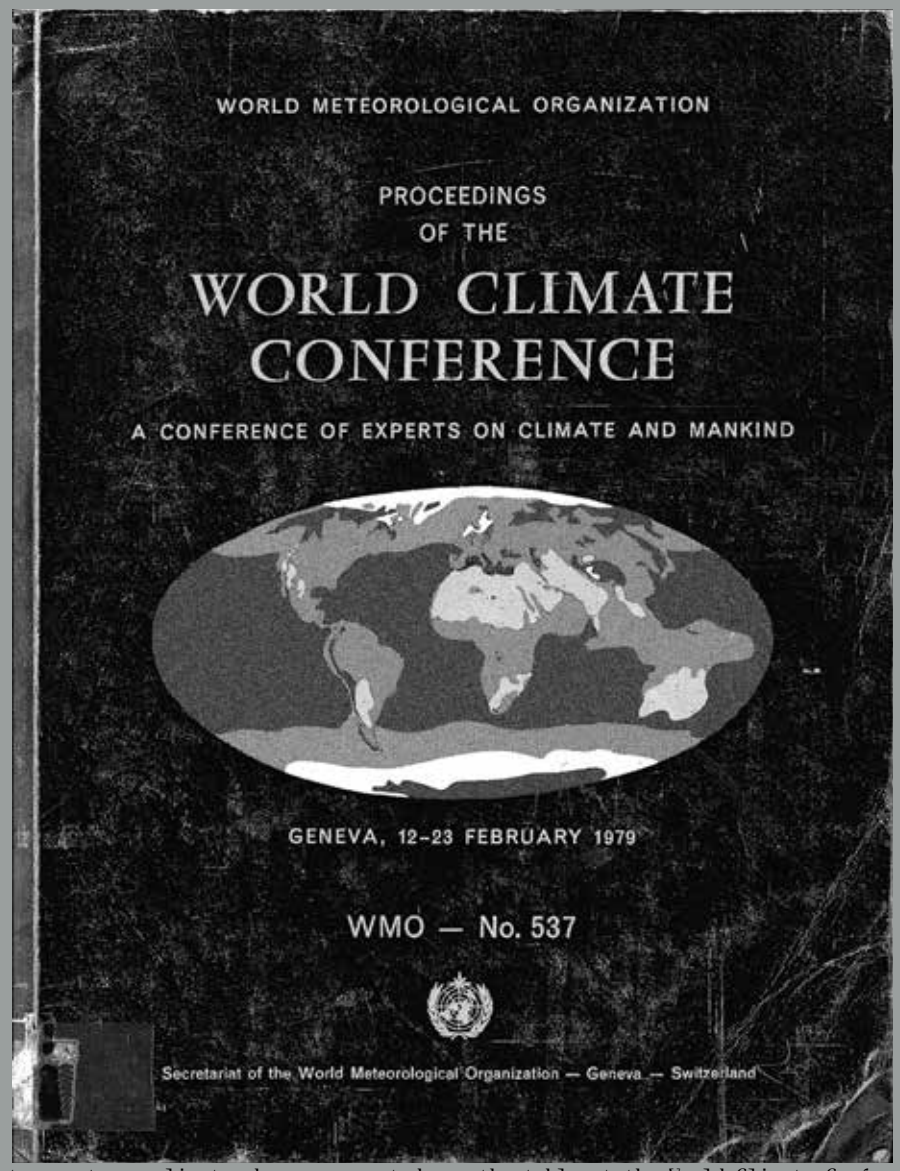
President Jimmy Carter speaks against a backdrop of solar panels at the White House, Wednesday, 21 June 1979, Washington, DC.

On 20 June 1979, the 39th President of the United States, Jimmy Carter, had 32 solar panels installed on the roof of the West Wing of the White House to harvest the sun's rays and heat water. His goal was to achieve 20 percent renewable energy by the year 2000. In the wake of the oil crisis, the installation of solar panels was a symbolic representation of Carter's environmental policies. A long-time environmentalist, Carter was the first American president to take decisive steps to promote solar energy. He freed up to 10 billion to support research into alternative energy, but the same government support was also used to develop and maintain other energy technologies, such as oil drilling and nuclear power. After years of battles with Congress and his political enemies, Carter's tenure saw the formulation of an energy policy (1977) that included tax credits, the creation of the Department of Energy (1977) and the Solar Energy Research Institute (1977), the National Energy Act (1978), and the launch of the first national Sun Day (3 May 1978). In other words, a pledge to wage the moral equivalent of war against an energy crisis.

But the White House solar panel installation survived for only seven years, as Ronald Reagan's administration quietly dismantled them in 1986. In a decade of increasing deregulation, denial, and disbelief, the solar panels, like the tax credits and research funds, had become objects of increasing indifference, and the strong environmental policies America had instigated under Carter were replaced by Reagan's neoliberal economic program.

The case of the White House's solar panels, directly connecting monumental architecture with environmental policy, is only one of many examples that testify to this hope. But it also testifies to the tension between scientific discoveries on the one hand and the logic of extractive markets and profit-driven forces on the other, leading to growing skepticism, criticism, and climate denial.

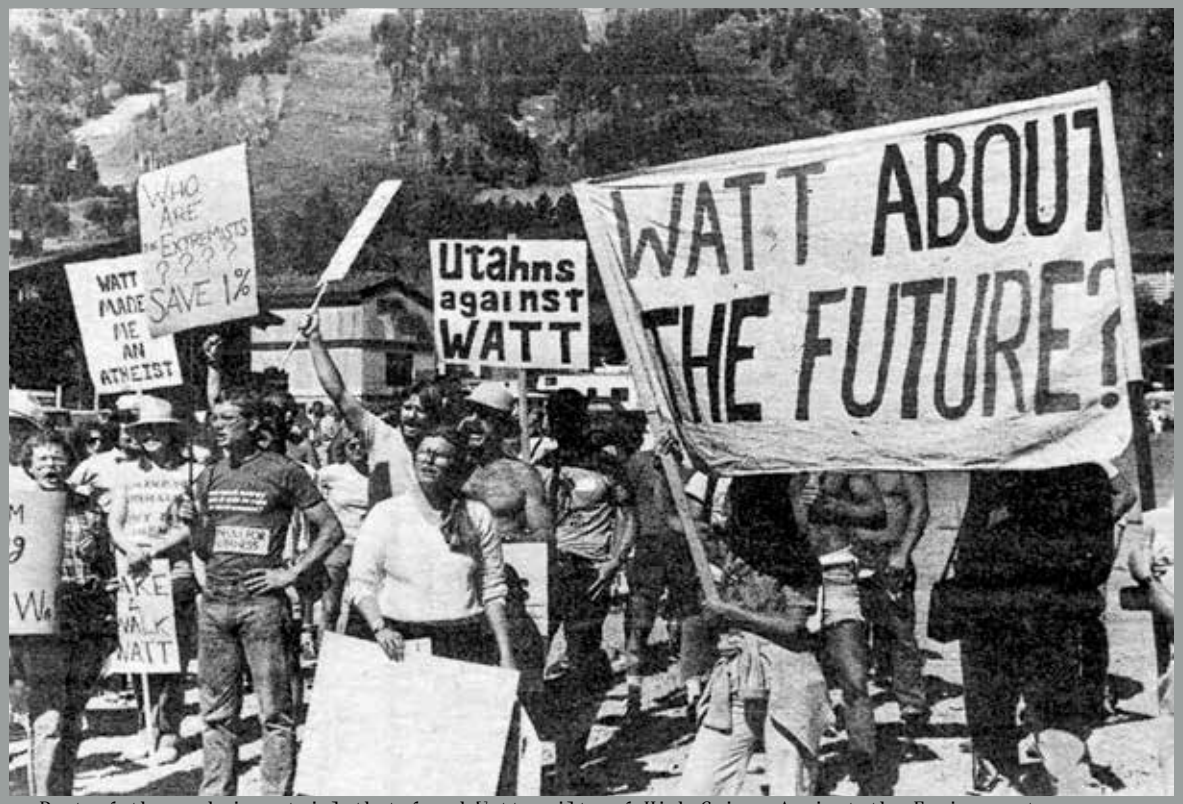
1979_World Climate Conference



The first reports on climate change presented on the table at the World Climate Conference in Geneva, 1979.

1979 was the year of the first World Climate Conference, now usually referred to as the First World Climate Conference (FWCC or WCC-1). Held in Geneva from 12 to 23 February of that year, the conference was organized by a committee chaired by Robert M. White and was the first event to explicitly address the climate as a whole. The first week was attended by some 350 specialists from 53 countries and 24 international organizations, representing a wide range of disciplines, including agriculture, hydrology, fishery, energy, environment, ecology, biology, medicine, sociology, and economics. At the end of the two-week conference a joint statement was issued: an 'appeal to the nations' warning of the consequences of human-induced climate change and calling on the world community to act quickly.

Two years later, on Saturday 22 August 1981, an article titled 'Study Finds Warming Trend That Could Raise Sea Level' made the front page of *The New York Times*. 'A team of Federal scientists said it had detected an overall warming trend in the earth's atmosphere extending back to the year 1880,' wrote journalist Walter Sullivan. Sullivan reported that scientists had predicted a global warming of almost unprecedented magnitude in the twenty-first century, which could lead to a worldwide rise in sea levels of 15 to 20 feet, and he also alluded to the difficulty of accepting the greenhouse theory because of 'the absence of observed warming coincident with the historic carbon dioxide increase.' In 1981, saving energy and developing alternative energy sources were presented as solutions to global warming.



Part of the mock jury trial that found Watt guilty of High Crimes Against the Environment.
'Rape & Run' Watt was inside a building to the rear at the time, trying to chum it up with the guys.
11 September 1981

1980_Earth First!

September 1, 1980

Memo To: the leading intellectual and literary lights of EARTH FIRST

From: Dave Foreman

Re: EARTH FIRST Statement of Principles and Membership Brochure

Hey, buckaroos ... enclosed is a very rough draft of the above. Read it, add, delete, edit, throw it out and write your own. Rough as it is, I figure putting something down on paper will be the only way to get you all thinking about it. Feel free to criticize everything: concept, approach, grammar, spelling, whatever.

EARTH FIRST STATEMENT OF PRINCIPLES

* Wilderness has a right to exist for its own sake

* All life forms, from virus to the great whales, have an inherent and equal right to existence

* Mankind is no greater than any other form of life and has no legitimate claim to dominate Earth

* Humankind, through overpopulation, anthropocentrism, industrialization, excessive energy consumption/resource extraction, state capitalism, father-figure hierarchies, imperialism, pollution, and natural area destruction, threatens the basic life processes of EARTH

* All human decisions should consider Earth first, humankind second

* The only true test of morality is whether an action, individual, social, or political, benefits Earth

* Humankind will be happier, healthier, more secure, and more comfortable in a society that recognizes humankind's true biological nature and which is in dynamic harmony with the total biosphere

* Political compromise has no place in the defense of Earth

* Earth is Goddess and the proper object of human worship

In the very first Earth First memo, founder Dave Foreman explains the concept and program of the then newly founded Earth First organization, 1980.

In 1980, a group of US activists disillusioned with the tactics of mainstream environmental organizations established Earth First!, a radical network of autonomous groups, promising 'no compromise in defence of Mother Earth.' The group gained attention with actions like 'tree sittings,' extreme wilderness proposals inspired by the writings of scientists like E.O. Wilson, and the publication of *Earth First! Journal.*

Earth First! was founded on and continues to operate according to the idea of 'deep ecology,' an environmental philosophy that emphasizes the intrinsic value of nature for itself, rather than the longstanding extrinsic value of nature for the sake of humanity. Although the decentralized structure of the organization sometimes led to conflicting actions and statements by member individuals and organizations, Earth First! finds common ground in, and is generally associated with, the tactics of civil disobedience and property violence. Actions around the world attributed to Earth First! include sit-ins, demonstrations, and the sabotage of institutional facilities, infrastructure, and equipment.

In 1992, younger members of Earth First! formed the Earth Liberation Front, an 'internal offshoot' group that engaged in actions generally deemed more radical than those of Earth First!. The new group came under the scrutiny of law enforcement because of its relative radicalism. Several individuals associated with Earth First! and the Earth Liberation Front have been, or are at the time of this writing, imprisoned for their actions, some serving life sentences.

1982_Wheatfield – A Confrontation

Agnes Denes, 'Wheatfield – A Confrontation', Battery Park Landfill, New York, 1982.

In May 1982, after months of preparation, Hungarian born American artist Agnes Denes planted a 2-acre wheat field on the Battery Park landfill in lower Manhattan, two blocks from Wall Street and the World Trade Center, facing the Statue of Liberty. Two hundred truckloads of dirt were brought in, and 285 furrows were dug and cleared of rocks and rubbish. The seeds were sown by hand and the furrows covered with soil. The field was then tended for four months, after which the crop was harvested on 16 August 1982, yielding over 1,000 pounds of healthy, golden wheat. The harvested grain later traveled to 28 cities around the world in an exhibition called 'The International Art Show for the End of World Hunger,' organized by the Minnesota Museum of Art (1987–1990). The seeds were carried away by people who planted them in many parts of the world.

Denes's work, *Wheatfield – A Confrontation*, was an example of how art and environmental concerns came together at many moments in the 1980s. Creating a powerful paradox, the resulting work was a field of wheat on land worth $4.5 billion and a symbol representing food, energy, commerce, world trade, and economics. But it also referred to mismanagement, waste, world hunger, and ecological concerns, and called attention to our misplaced priorities in a system dominated by capitalist logic. Ultimately, the work, located, as British art historian Katy Hessel wrote, 'between the pillars of capitalism and patriarchy, a stone's throw from Wall Street,' and still etched in the memory of those who witnessed it, provided a stunning visual reminder of our need for balance with nature.

1986_Chernobyl Disaster

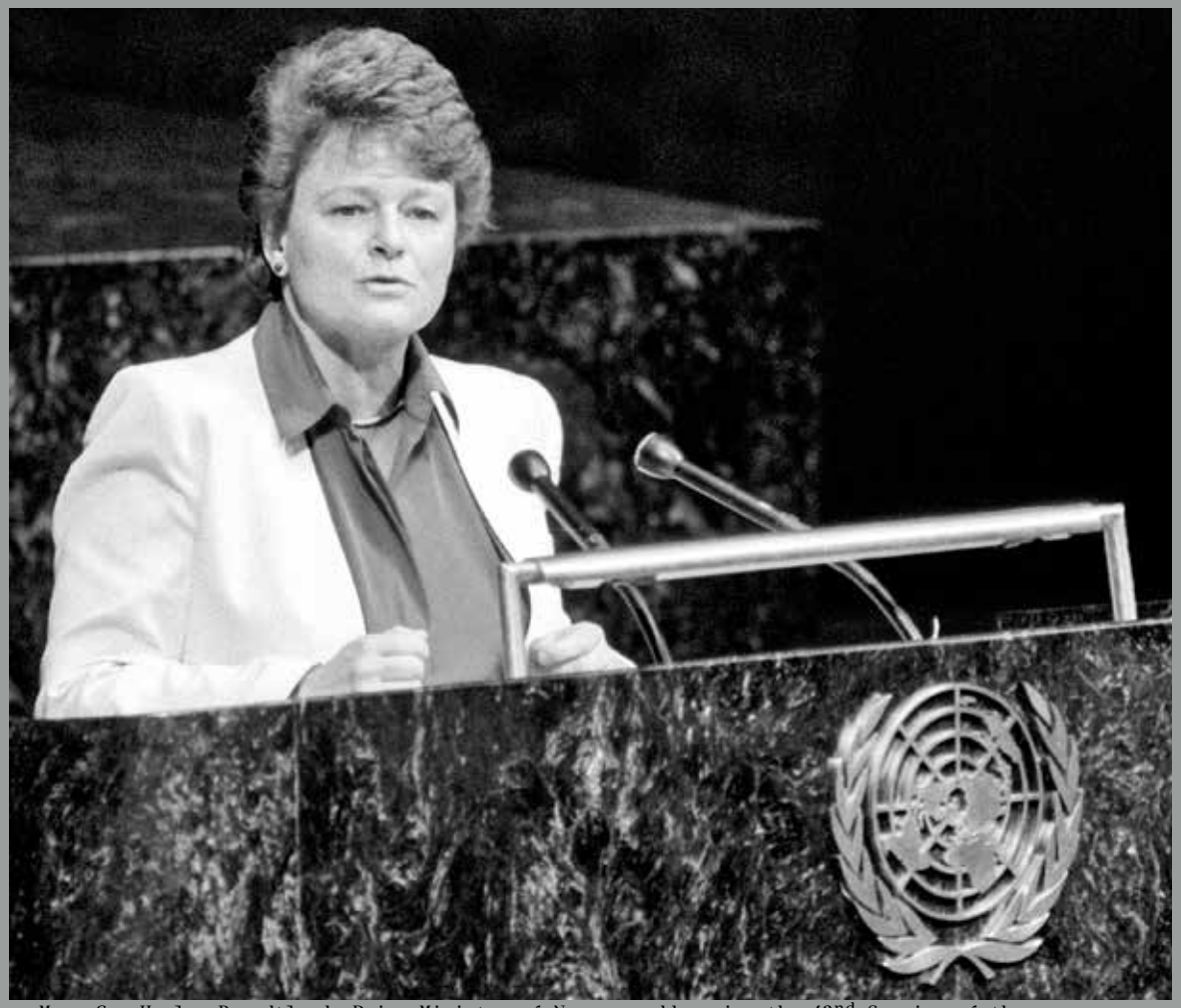
A Swedish farmer wearing anti-atomic gear shifts fodder contaminated by the radioactive cloud of Chernobyl in June 1986.

An aerial view of the damaged Chernobyl nuclear plant undergoing repair and containment work in 1986.

On 26 April 1986, a reactor unit exploded at a nuclear power plant in the Soviet (now Ukrainian) city of Chernobyl. The chain of events following this initial accident resulted in, among many other formally acknowledged and unacknowledged consequences, the immediate deaths of two plant workers, the deaths of at least 28 first responders and cleanup workers from acute radiation sickness, a disputed number of casualties ranging from 4,000 to 27,000 people, the displacement of some 200,000 people from the region, ten days of major releases of radioactive material, radiation contamination of every country in the northern hemisphere, higher rates of cancer in certain groups of individuals exposed to this contamination, reproductive dysfunction, increased mortality, genetic mutations in flora and fauna around the world, and the radioactive contamination of various soils and waters. All these and more are part of what has been termed the Chernobyl Disaster. Several international and national governmental institutions have ranked the Chernobyl Disaster as one of the most serious and severe, if not the worst, nuclear disaster of all time.

At the time of writing, a 2,600-km² exclusion zone surrounds the disaster site. Within it, remediation efforts are ongoing, although human activity is generally minimized. The lands within the exclusion zone are now considered one of the largest (and inadvertently created) nature reserves in Europe, with resilient and diverse populations of flora and fauna. After the 1986 Chernobyl Disaster, many countries took nuclear power off the political agenda, and the anti-nuclear movement seemed to have won.

1987_Brundtland Report



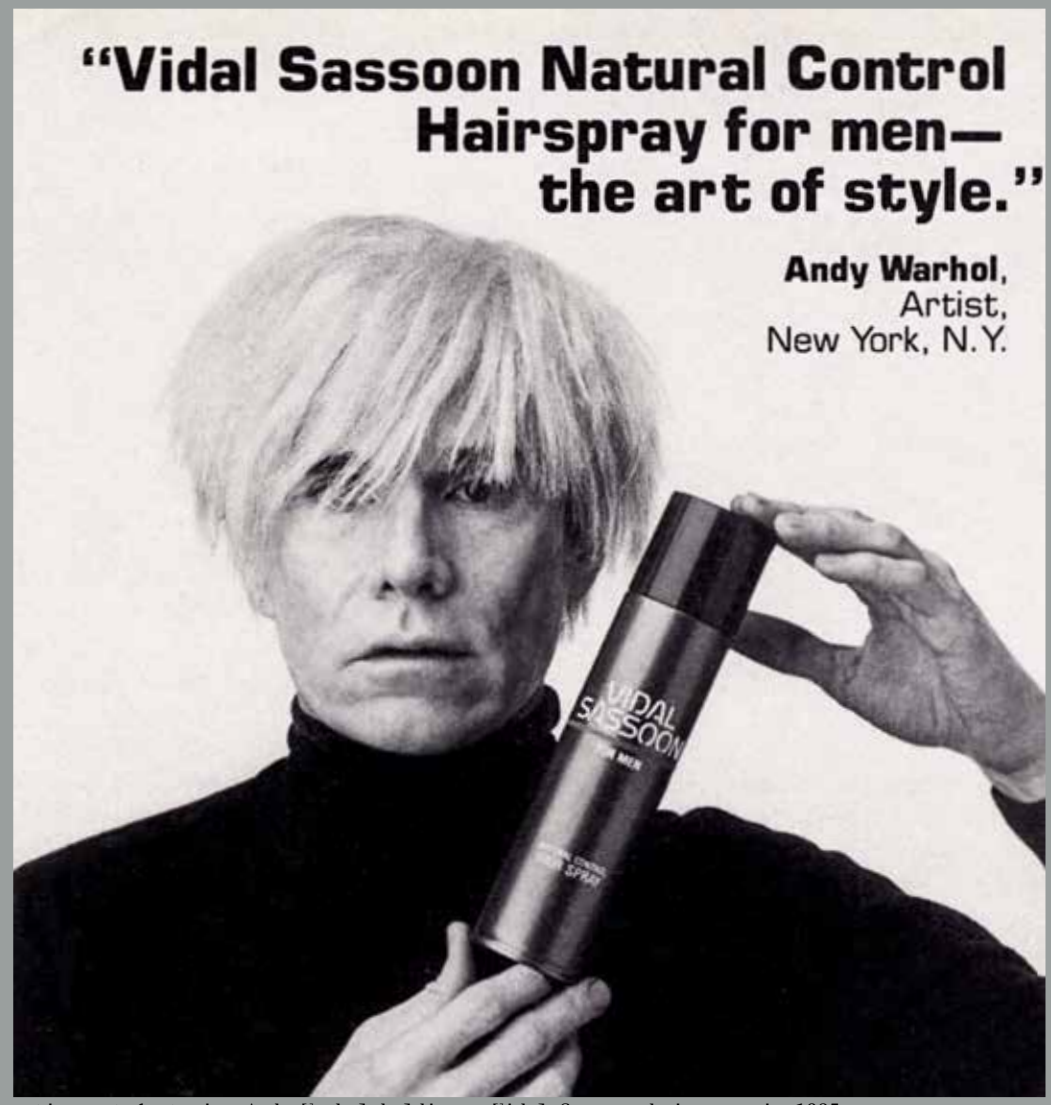
Mrs. Gro Harlem Brundtland, Prime Minister of Norway, addressing the 42nd Session of the General Assembly on Environment and Development, 1987.

In December 1983, the United Nations appointed Gro Harlem Brundtland, then Prime Minister of Norway, to head the World Commission on Environment and Development (WCED), which was charged with proposing a report on long-term environmental strategies. The commission operated from 1984 to 1987, and after 900 days of research produced *Our Common Future, A Report That Changes the World* – also known as the Brundtland Report.

The main challenge of the report was to normalize the concept of sustainable development. According to *Our Common Future*, sustainable development is 'development that meets the needs of the present without compromising the ability of future generations to meet their own needs.' *Our Common Future* referred to a number of issues such as poverty, food availability, population, and ecosystem management. Implicit in its definition of sustainable development is the concept of needs, which emphasizes the goal of meeting the basic needs the world's poor, and the idea that technology and social organization impose limits on the ability of the environment to provide for the world's present and future needs. The report raised the need for governments to move from an economic to a moral and ethical standpoint. Political will would ultimately be a key driver according to the report. In other words, national and international organizations must be willing to work together to achieve the objective.

The World Commission on Environment and Development and the publication of its report laid the groundwork for the 1992 United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro, also known as the Earth Summit and the subsequent Agenda 21, the United Nations' non-binding plan of action for sustainable development.

1987_Montreal Protocol



Advertisement featuring Andy Warhol holding a Vidal Sassoon hairspray in 1985.

In the 1980s, the challenge was to translate the scientific knowledge into a clear and compelling message that could be picked up by the press, the general public, and politicians. If protocols and conventions were to be signed, scientists first had to come up with an image that would help visualize the potential catastrophe and thus capture the public's imagination. That image finally came when three scientists discovered what they called a 'hole' in the ozone layer.

It was on 16 May 1985, in the scientific journal *Nature* that Joe Farman, Brian Gardiner, and Jonathan Shanklin, three scientists from the British Antarctic Survey, announced the discovery of abnormally low levels of ozone over the South Pole. A series of graphs and a bird's-eye animation of Antarctica showed how, over seven consecutive years, a large purple 'hole' grew and covered the South Pole. Although the ozone hole is not technically not a 'hole' with an absence of ozone, but a region of exceptionally low ozone in the stratosphere over Antarctica, the image was there. Their discovery had an impact on the public. Within two years, and in direct response to the *Nature* article and corroborating studies, 46 nations signed the Montreal Protocol, pledging to phase out substances known to cause ozone depletion. The scientists' discovery became a tangible example of humanity's ability to damage the Earth's atmosphere.

The relative speed and unanimity with which the treaty was adopted around the world led former UN Secretary-General Kofi Annan to call the Montreal Protocol 'perhaps the single most successful international agreement to date.' It showed how collaboration between scientists and policymakers can lead to rapid environmental decision-making. Workshops organized by the World Meteorological Organization (WMO), and later by the United Nations Environment Program (UNEP), led to the establishment of the Intergovernmental Panel on Climate Change (IPCC) in 1988.

1988_Ocean Dumping Ban Act

PUBLIC LAW 100-688—NOV. 18, 1988 102 STAT. 4139

Public Law 100-688
100th Congress

An Act

To amend the Marine Protection, Research, and Sanctuaries Act of 1972 to provide for termination of ocean dumping of sewage sludge and industrial waste, and for other purposes.

Nov. 18, 1988
[S. 2030]

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled,

Environmental protection.
Ocean Dumping Ban Act of 1988.
Safety.
33 USC 1401 note.

TITLE I—OCEAN DUMPING OF SEWAGE SLUDGE AND INDUSTRIAL WASTE

SEC. 1001. SHORT TITLE.

This title may be cited as the "Ocean Dumping Ban Act of 1988".

SEC. 1002. ESTABLISHMENT OF FEES AND PENALTIES FOR OCEAN DUMPING OF SEWAGE SLUDGE AND INDUSTRIAL WASTE.

The Marine Protection, Research, and Sanctuaries Act of 1972 (33 U.S.C. 1401 et seq.) is amended by striking the second section 104A and inserting in lieu thereof the following:

33 USC 1414a.

"SEC. 104B. OCEAN DUMPING OF SEWAGE SLUDGE AND INDUSTRIAL WASTE.

33 USC 1414b.

"(a) TERMINATION OF DUMPING.—
"(1) PROHIBITIONS ON DUMPING.—Notwithstanding any other provision of law—
"(A) on and after the 270th day after the date of the enactment of this section, no person (including a person described in section 104A(a)(1)(C)) shall dump into ocean waters, or transport for the purpose of dumping into ocean waters, sewage sludge or industrial waste, unless such person—
"(i) has entered into a compliance agreement or enforcement agreement which meets the requirements of subsection (c) (2) or (3), as applicable; and
"(ii) has obtained a permit issued under section 102 which authorizes such transportation and dumping; and
"(B) after December 31, 1991, it shall be unlawful for any person to dump into ocean waters, or to transport for the purposes of dumping into ocean waters, sewage sludge or industrial waste.
"(2) PROHIBITION ON NEW ENTRANTS.—The Administrator shall not issue any permit under this Act which authorizes a person to dump into ocean waters, or to transport for the purposes of dumping into ocean waters, sewage sludge or industrial waste, unless that person was authorized by a permit issued under section 102 or by a court order to dump into ocean waters, or to transport for the purpose of dumping into ocean waters, sewage sludge or industrial waste on September 1, 1988.
"(b) SPECIAL DUMPING FEES.—

The first page of the original Ocean Dumping of Sewage Sludge and Industrial Waste Ban Act, 18 November 1988.

In 1988, the United States Congress passed the Ocean Dumping Ban Act, a piece of legislation with multiple provisions for the protection of ocean waters. These include: a declaration that any dumping, and transport for the purpose of dumping, of municipal sewage and industrial waste into the ocean be unlawful after 31 December 1991; provisions for processes that direct special fees incurred while dumping, toward finding alternatives to ocean dumping; and the inclusion of four new national estuary areas that the Environmental Protection Agency must consider for its protection program. Concerns about ocean dumping explicitly listed in the legislation included the risk of adverse effects on marine and human health from hazardous biological waste.

This act was one of several amendments to the Marine Protection, Research, and Sanctuaries Act of 1972, which originally did not include provisions against waste discharged from sewage plants, industrial sites, and private vessels. Although an earlier amendment to the act in 1977 also attempted to ban ocean dumping, several parties, including New York City and eight municipalities in the states of New York and New Jersey, were able to circumvent this ban via a lawsuit against the Environmental Protection Agency.

As a result of the 1988 act, all private industrial waste and sewage sludge dumping ceased, but the municipal entities in New York and New Jersey continued their dumping activities until 1992. Landfilling became the most common alternative to ocean dumping. The Ocean Dumping Ban Act became a successful example of environmental awareness leading to new, effective legislation, despite fierce opposition to its implementation.

1988_Intergovernmental Panel on Climate Change (IPCC)

First session of the IPCC in 1988.

In 1988, the United Nations Environment Program and the World Meteorological Organization established the Intergovernmental Panel on Climate Change. The IPCC's initial mandate was to provide 'internationally coordinated scientific assessments of the magnitude, timing and potential environmental and socio-economic impact of climate change and realistic response strategies.' Although several intergovernmental organizations and environmental protection bodies had been established before, the name and directive of the IPCC clearly expressed a focus on the growing issue of climate change at the time.

The IPCC does not conduct its own research, but instead relies on existing scientific literature and voluntary expert review to gather and validate information for its work. This information is then compiled into several types of reports that have influenced intergovernmental climate policy. Assessment Reports, of which there are six at the time of this writing, are regular, comprehensive reports on the state of knowledge about climate change. These six reports have consistently and unequivocally concluded that global warming is occurring. Scenarios involving varying degrees of climate change mitigation, 'business as usual,' and adaptation of life around the world are consistent sections of these reports. Special Reports are produced on request to ensure more timely information on specific topics. Methodology Reports provide guidelines for governmental bodies on the preparation of greenhouse gas inventories.

Ultimately, the IPCC and its reports provide insight through information gathering. Its purpose has been to collect and construct a scientific consensus on human-induced climate change and to inform policy. It laid the foundations for the 1992 United Nations Framework Convention on Climate Change and the 1997 Kyoto Protocol – two treaties that require state signatories to reduce greenhouse gas emissions. To this day, the IPCC continues to bring the scientific evidence to political decision making, but increasingly with the observation that international treaties and commitments are not leading to the necessary action or reductions.

Rafe Pomerance, center, with other activists in Noordwijk, the Netherlands, in 1989 for the first major diplomatic meeting on global warming.

In 1989, the world was closer than ever to an international binding environmental treaty, but the market would decide otherwise. On 6 and 7 November 1989, in a moment of global optimism, Ed Nijpels, the Dutch Minister of the Environment, and Pier Vellinga, director of the Dutch National Climate Program, organized the Noordwijk Climate Conference, which brought together representatives from 68 countries at the Grand Hotel Huis ter Duin in the Netherlands. The goal of the conference was to create a binding agreement to reduce CO_2 emissions. The conference recognized 'the need to stabilize, while ensuring stable development of the world economy, CO_2 emissions and emissions of other greenhouse gases not controlled by the Montreal protocol.'

But while the ministers – or their representatives – had wholeheartedly accepted the Dutch invitation, not all of them were prepared to ratify with their eyes closed a draft declaration that effectively committed their countries to reducing their CO_2 emissions by 20 percent by the year 2000. Several delegations immediately expressed their reluctance to support a text that for some – notably China – meant a halt to industrial development and, for others – the United States, the Soviet Union, and Japan – was tantamount to economic suicide. The day before the agreement was to be signed, US Chief of Staff John Sununu scuttled the conference preventing the United States, Japan, the Soviet Union, and the United Kingdom from reaching an agreement.

The decade from 1979 to 1989 could have solved the climate crisis, because the conditions for success could not have been more favorable. The Noordwijk Conference testifies both to the opportunities of that decade and to the major forces against climate action that came from the fossil industry, associated lobbies, and propaganda campaigns.

1990_European Environment Agency

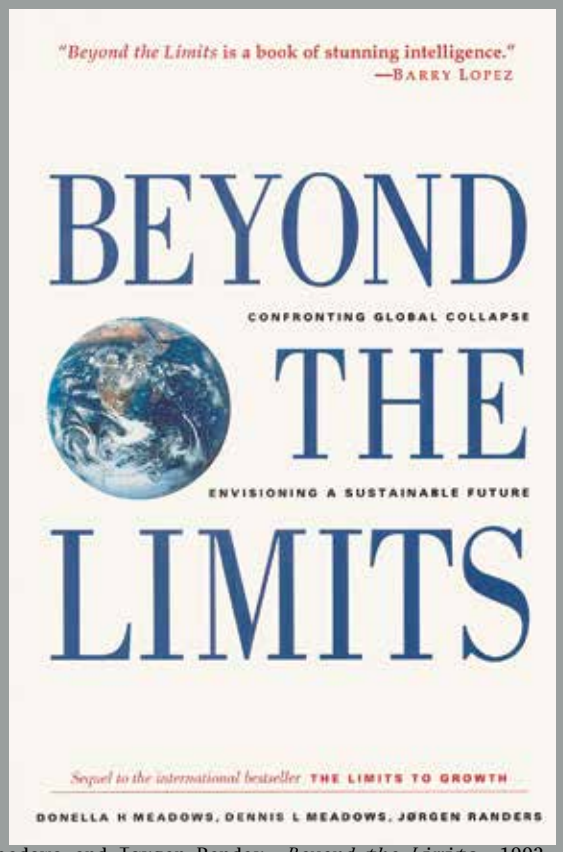
The European Environmental Agency's 25th-anniversary cover: celebrating its role in fostering sustainable futures through better environmental laws and an informed, active European citizenry.

On 7 May 1990, the now defunct Council of European Communities established the European Environment Agency and an associated European Environment Information and Observation Network. The agency provides policymakers, the press, and the public with relevant and timely reports on the state of the environment, climate change, and other issues in and around its 32 member and six associate countries. Every five years, the agency publishes the *State and Outlook of Europe Report*, a holistic, integrated assessment of the state of Europe's environment, linking a broad range of socioeconomic factors with environmental systems.

The EEA was established in the context of global political attention to climate change and the environment, but also at a turbulent time in Europe with the fall of the Berlin Wall and the need to unite the European continent. All EU countries are members, and the EEA works with national environmental agencies and its own EU-wide monitoring and data collection to assess the state of the environment and inform policy. Topics range from biodiversity and nature to waste and resources in a circular economy. Its reports include assessments of all significant ongoing European efforts to meet climate- and environment-related goals.

These assessments typically find that current efforts are insufficient to meet climate targets, but also suggest how policymakers should legislate accordingly. Over the past decade, the EEA has become more active in translating environmental awareness into strategic action, pushing for transformative change and new types of scenarios to support strategic policies that support the 'transition to a greener, climate-neutral and circular economy.'

1992_Beyond the Limits



Donella Meadows, Dennis Meadows and Jørgen Rander, *Beyond the Limits*, 1992. Published by the Chelsea Green Publishing Company.

It is no coincidence that Dennis Meadows, Jørgen Randers, and Donella Meadows published *Beyond the Limits* in 1992, a sequel that addressed many of the criticisms of their 1972 book. Like its predecessor, Beyond the Limits presented the results of the World3 computer model, focusing on the ability of the Earth to support contemporary economic and population growth. Its analytical framework relied on the concept of exponential growth and feedback loops to describe the world system. But, if *The Limits to Growth* was optimistic, 20 years later the conclusions were far more sobering. According to the 1992 study: 'Without significant reductions in material and energy flows, there will be in the coming decades an uncontrolled decline in per capita food output, energy use, and industrial output.'

But the book was not as successful as its predecessor. In its first weeks of publication, *Beyond the Limits* was largely ignored by the American press. It would sell only a fraction of the original report's number of copies and would be translated into only 15 languages. The authors were 20 years older, and although their writing contained the same hopeful thinking, it was colored by the little attention and little progress that had been made since 1972: 'Listen to the cynicism around you and pity those who believe it, but don't believe it yourself.'

The book testifies to an important moment in climate skepticism. Indeed, after the IPCC published its first report on climate change in 1990, climate skepticism accelerated. A wide range of academics with backgrounds in disciplines other than climate research began to question the science. 'The climate has always changed,' 'there is no consensus,' or 'models are unreliable' were popular arguments used to sow doubt. Skepticism and denial had built on vested interests that wanted to continue on the path of extractive growth, and played on the general belief that problems could be solved through innovation and technology. It has been a very effective strategy, funded by fossil-fuel and conservative parties such as the infamous Koch brothers and a wide range of institutes such as the Heartland Institute and the Clintel network.

1992_Earth Summit

United Nations Conference on Environment and Development (UNCED), 3 to 14 June 1992.
A population clock highlighted the increasing global population and decreasing productive land based on UN estimates and projections.

George Bush, President of the United States (1989–1993), address to the United Nations Conference on Environment and Development in Rio de Janeiro, 1992.

The United Nations Conference on Environment and Development (UNCED) was held in Rio de Janeiro, Brazil, from 3 to 14 June 1992. It was meant to celebrate the 20th anniversary of the Stockholm Conference and concluded with the 'Earth Summit,' a three-day event where leaders of 105 nations gathered to demonstrate their commitment to sustainable development. Issues addressed included 'the protection of air, land and water; conservation of biological diversity, forests, and natural resources; and sound management of wastes and technology.' One of the key moments of the conference was the so-called speech that 'silenced the world,' a six-minute impromptu address by 12-year-old Canadian climate activist Severn Cullis-Suzuki on 11 June: 'I am here to speak for all generations to come. I am here to speak on behalf of the starving children around the world whose cries go unheard,' said Cullis-Suzuki, who was later dubbed the voice of a generation. The speech received the attention of world leaders and a full minute of applause. It blew a wind of optimism through Rio.

The following day, on 12 June 1992, US president George H. W. Bush delivered a disturbing speech: 'Twenty years ago, at the Stockholm conference, a chief concern of our predecessors was the horrible threat of nuclear war, the ultimate pollutant. No more. Upon my return from Rio, I will meet with Russian President Yeltsin in Washington, and the subject we will discuss is cooperation, not confrontation. Twenty years ago, some spoke of the limits to growth. Today we realize that growth is the engine of change and the friend of the environment.' As if time had not brought any changes, Bush suggested the unconditional victory of neoliberalism on environmental activism.

No formal agreements were reached at the Rio Conference, which was heavily monopolized by the North-South divide. However, it was a moment of realization, highlighting how different social, economic and environmental factors were interdependent and evolve together, and how success in one sector requires action in others to be sustained over time.

‘There are no limits to growth and human progress, when men and women are free to follow their dreams.’

Ronald Reagan, 1985

Part 2:
Sustainable Architectural Experiments: The Past

Chapter 3
autonomy
energy reduction
self-sufficiency
solar communities
techno-optimism

Chapter 4
counterculture
DIY
Impermanence
light-weight
low-tech

Chapter 5
‘non-pedigreed’ architecture
archaic building techniques
craftsmanship
earth-based building
greenwashing
locally-sourced architecture
long-Term Perspective

↑ Ad for the *Progressive Architecture* October issue, September 1971.

Chapter 3: Architecture, Technology, and the Quest for Energy Efficiency

Lead authors:
Véronique Patteeuw and Léa-Catherine Szacka

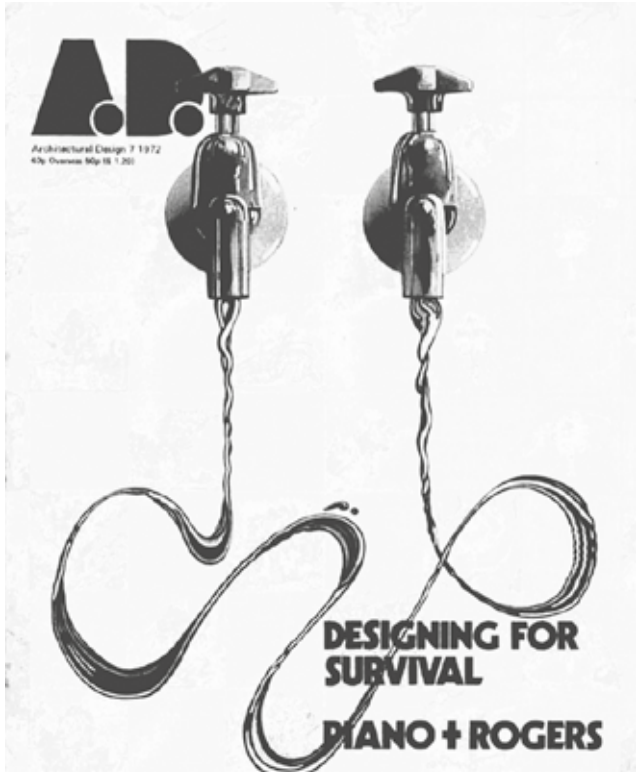
Someday, our appetite for energy will probably be satiated, and energy production will remain about constant. We shall have become a nation of philosophers.[1]

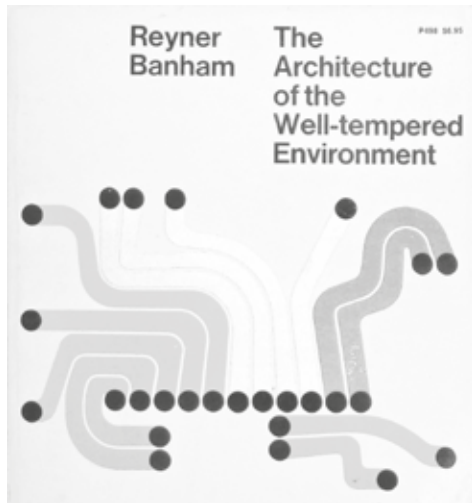
1 Eugène Ayres and Charles Scarlott, Energy Sources: The Wealth of the World (New York: McGraw Hill, 1952), 282.

2 *Progressive Architecture* (October 1971), 68.

At the turn of the 1970s, believing in technocratic solutions for a planet in peril, journals such as *Progressive Architecture, Architectural Design*, or the *RIBA Journal* devoted entire issues to the problem of fossil energy and the need to find sustainable alternatives. Their catchy covers and titles showed how the Anglo-Saxon architecture discourse of the time was adapting to the emergence of environmental awareness, while urging architects to develop a strong sense of responsibility as designers. All this came on the heels of decades of engagement by architects and designers with technological innovation and the search for accelerated structural change away from fossil and unsustainable energy consumption.

Progressive Architecture's October 1971 issue, 'Life Support Systems for a Dying Planet,' started with a simple question: 'What happens when our sources of energy run out, as they are expected to do (at our present rate of expenditure) within the foreseeable future? Is the planet really dying? Can the architect and the engineer contribute to the perpetuation of life on earth?'[2] Under the guidance of New York engineering firm Dubin-Mindell-Bloome Associates (who acted as consulting editors), the issue focused on technological solutions: it gathered articles on high-tech systems for energy consumption, waste disposal, energy reduction, and sewage treatment. More concerned with systems than with buildings, *Progressive Architecture* featured all kinds of technological inventions that could save energy, while discussing how some of NASA's technology could contribute to new mechanical systems for the building industry. According to the editors of the issue: 'If our planet is dying, it is not due to the energy crisis, but rather to the misuse of technology which is producing pollutants in the





↑ *Architectural Design*, July 1972.

↓ Reyner Banham, *The Architecture of the Well-tempered Environment* (Chicago: The University of Chicago Press, 1969).

production and use of power, and the contamination of the environment by the rapidly increasing volume of solid wastes and the methods for its disposal.'[3] In 'Buildings That Save Watt and More,' an eight-page, richly illustrated article, *Progressive Architecture* listed a few examples of recent projects that used different types or shapes of glass to achieve the most with the least use of energy and natural resources.[4]

The July 1972 issue of the radical British magazine *Architectural Design* (then edited by Monica Pigeon), with a cover designed by Adrian George showing two bathroom taps pouring raw oil on tree-ornamented tiles, was based on AD's contribution to the 1972 Royal Institute of British Architects (RIBA) conference entitle 'Designing for Survival.' Stressing the importance of this new way of thinking, Colin Moorcraft wrote in his editorial:

> The environmental crisis is not something for architects to think about only in their spare time, or as public-spirited citizens. Design decisions affect not only the internal and external environment, but also the use of land, the consumption of energy and materials, and the industrial process. Architects can create or minimize waste or pollution. They are part of the problem and must be part of the cure! [5]

Also in 1972, issue 9 of the *RIBA Journal* focused on energy. The cover of the journal featured the letter E, formed by the portraits of ten protagonists working on climate change and the problem of energy. Including the proceedings of the RIBA annual conference and contributions by protagonists such as Alexander Pike and John Frazer, the issue of the *RIBA Journal*, together with that of AD, offered a glimpse into the concerns of the time: survival, technology and high technology.[6]

Just a few years before these journals were published, British architecture critic and writer Reyner Banham had published *The Architecture of the Well-Tempered Environment*, a book in which he argued that technology, human needs, and environmental concerns needed to be considered as an integral part of architecture. In his book, Banham showed that although much architecture had been based on the exploitation of technological solutions and systems, modern architecture had hitherto been discussed and judged without any real concern for mechanical environmental control.[7] By doing so, he laid the foundations for a critical reflection on the control and exploitation of environmental technologies into architectural design: 'The intention was to write a purely architectural history; to consider what architects had taken to be the proper use and exploitation of mechanical environmental controls, and to show how this had manifested itself in the design of their buildings.'[8] In the midst of a period marked by an almost unquestioned belief in the benefits of economic growth and rapid technological advances, Banham was one of a growing number of thinkers who focused on environmental concerns.

3 *Progressive Architecture* (October 1971), 68.

4 'Buildings that Save Watt and More,' *Progressive Architecture* (October 1971), 104–111. The article included examples such as the Philadelphia United Fund Building by architects Mitchell/Giurgola Associates, a municipal building in Tempe, AZ, by Michael and Kemper Goodwin, a headquarters building for the North Carolina Cross and Blue Shield by architects Odell Associates, Inc., or the Toledo Edison building, designed by Sam born, Steketee, Otis and Evans.

5 Editors, 'This month… ,' *Architectural Design* (July 1972). Moorcraft had been writing the Recycling column for *AD* since September 1971. The columns appeared after an advertisement had been placed in cosmorama requesting input from the readers: 'The Editors of *AD* would like to hear of any ideas or scheme for the RECYCLING OR REGENERATION OF RESOURCES in any field (waste, solids, liquids, gases) which is currently being investigated by any organization, firm or individual, in any part of the world. Can YOU help by telling us of any?' see: Editors, 'Help!,' *Architectural Design* (June 1971), 334.

6 Looking at architectural periodicals from the 1960s and 1970s, we can discern the emergence of environmental awareness and the growing attention for the question of ecology and solar energy in the Anglo-Saxon architectural discourse. We can also observe such an interest in the French architecture magazine *L'Architecture d'Aujourdhui*, from the early 1970s to the early 1980s. For example, the May-June 1973 issue of L'AA was entitled 'Architecture de Soleil,' while the September 1977 'Architecture Solaire' was strictly dedicated to solar architecture. In June 1980, another special issue of L'AA was called 'Solaire Passif ou Actif?' questioning the possibility of using more passive and active solar technologies.

7 John A. Kouwenhoven, 'Review: Architecture as Environmental Technology,' *Technology and Culture* 11/1 (1970), 85.

8 Reyner Banham, *The Architecture of the Well-Tempered Environment* (London: The Architectural Press, 1984 [1969]), 14–15.

For Banham, environmental mediation has occurred throughout history according to three modes, in which the role of architecture was variable: the conservative mode (architecture isolates itself from the outside through its mass, its inertia, and guarantees an indoor climate), the selective mode (mobile opening or closing devices, such as a door or a shutter, regulate the indoor climate), and the regenerative mode (regulation is no longer done by architectural elements but exclusively by environmental technologies). In the book's second edition, published in 1984, Banham placed more emphasis on the regenerative mode, adding considerable new material on the use of energy, particularly solar energy, in human environments. In a chapter titled 'A Range of Methods,' for example, the historian wrote about 'one of the most complete and successful large solar buildings of the previous decade,' the 'second block of St George's County Secondary School in Wallasey (Cheshire, England),'[9] a building that, he said, offers 'an imaginative reappraisal of one of the oldest environmental controls known to man, massive structure functioning to conserve heat, plus an attempt at improved exploitation of the oldest and ultimate source of all environmental power, the sun.'[10]

One of the most important ways of making architecture energy efficient has always been the use of the sun's rays. Seen as a simple and democratic process, harvesting the sun seemed a promising solution to mitigate the environmental crisis in domestic settings.[11] Starting in the 1930s, major universities invested in active and passive solar technology. Later, architectural experiments sought to respond to scarce energy supplies, working with engineers and combining high and low technology solutions in pursuit of the dream of autonomy and self-sufficiency. For much of the twentieth century, however, the construction of solar houses was largely confined to the realm of scientific projects.[12] It was not until 1973, after the first oil crisis, that more and more public institutions in countries such as the United States, France, and Germany began to fund programs for solar buildings, including architectural competitions.[13]

History is replete with radical experiments in which the use of high and low technologies led to the production of controlled environments that played a fundamental role in accelerating the quest for an energy-efficient architecture. They may not have been widely adopted and often remained marginal, but they provide potential seeds for our future. What have we forgotten? And what can we learn from these historical attempts to accelerate change?

Solar Experiments

Perhaps the most prominent development has been the exploration of solar energy harvesting for buildings. From the late 1930s to the late 1950s, MIT's solar energy research program, led by liquid fuel expert Hoyt C. Hottel, built four test modules that looked like small bungalows on the university's campus.[14] While the first two modules (built in 1939 and 1947) were conceived only as detached research

9 Reyner Banham, *The Architecture of the Well-Tempered Environment* (London: The Architectural Press, 1984 [1969]), 280.

10 Ibid., 281.

11 See, for example: Daniel Barber, *A House in the Sun: Modern Architecture and Solar Energy in the Cold War* (Oxford: Oxford University Press, 2016). Barber explores how the history of the postwar period was closely related to energy. 'There was also, after the war, a brief but remarkably dynamic interest in what we now call alternative energy technologies, including wind, geothermal, and solar energy,' 2.

12 Giovanna Borasi and Mirko Zardini (eds.), *Sorry Out of Gas: Architecture's Response to the 1973 Oil Crisis* (Montreal: CCA Editions, 2007), 79. The authors mention that: 'Of the sixty or so solar houses built and identified around the world before the first oil crisis three-quarter were constructed either by universities or by solar engineers belonging to engineering faculties working in the field.'

13 Ibid., 43.

14 Solar House I (1939), Solar House II (1947), Solar House III (1949), and Solar House IV (1959).

15 Borasi and Zardini, *Sorry Out of Gas*, op. cit. (note 12), 79.

16 MIT began building solar houses in 1938 after receiving a donation from Godfrey Lowell Cabot in 1938, with a mandate to use them to convert solar energy for human use. Telkes was part of a solar energy research initiative at MIT.

17 Daniel Barber, 'The World Solar Energy Project, ca. 1954,' *Grey Room* 51 (Spring 2013), 64–93.

18 Borasi and Zardini, *Sorry Out of Gas*, op. cit. (note 12), 87.

19 The Nemethy family, willing to live in an experimental house heated only by the sun, moved in at the very end of 1948 and lived in the Sun House for several years.

20 Paul Bouet, 'How Did It Fail? Considering the Decline of Environmental Experiments,' in: *Proceedings of the Fifth International Conference of the European Architectural History Network* (Tallinn: Estonian Academy of Arts, 2018), 451–457.

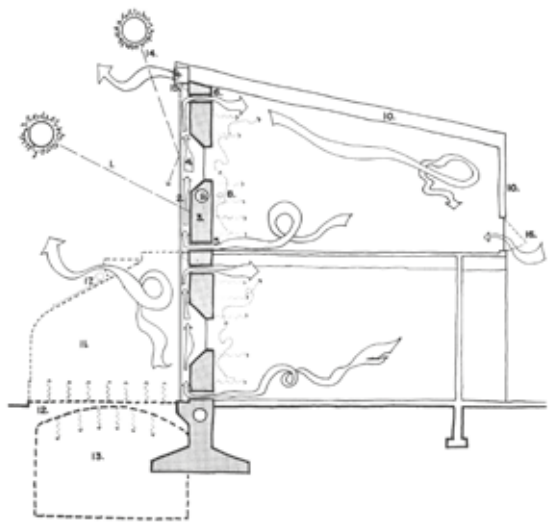
21 Borasi and Zardini, *Sorry Out of Gas*, op. cit. (note 12), 110.

laboratories, the third facility (built in 1949) started to replicate conditions more similar to a domestic environment.[15] It was not until the late 1950s, however, that economic and aesthetic considerations were incorporated into MIT's solar energy research program.

Concurrent with these early experiments, the first Sun House was built in Dover, Massachusetts, and completed in 1948. The project, conceived by architect Eleanor Raymond and mechanical engineer Maria Telkes, was an offshoot of MIT's interest in harnessing solar energy for human use.[16] The curiously large windows located on the front of the house were actually 18 heat-collecting panels, 2.5 meters high and with a surface area of 66 square meters, which fed heated air into three 'heat bins,' each located in a different room on the floor below. Interestingly, unlike others at the time, the Dover Sun House's heating unit's storage (20-liter drums) contained not water but Glauber's salts (sodium sulfate decahydrate), making the heating completely dependent on the phase change properties of these chemicals. In principle, the salts were supposed to melt and absorb heat on sunny days, then cool and recrystallize when the sun went down, thus releasing the stored heat back into the interior space. In practice, however, the system soon failed, as the heat could never be stored for more than a few days.[17]

A 'gendered-specific accomplishment' [18]–the house was designed by a woman architect, used technology developed by a woman engineer, and was funded by a woman sculptor, Amelia Peabody–the Dover Sun House was unique in that it relied entirely on solar energy. According to Telkes, the system would heat the house for 11 sunless days. Unfortunately, the lifecycle of the Glauber's salts was shorter than expected, and the Dover Sun House project began to fail after only three years.[19] Some 3,000 visitors toured the house to admire its revolutionary system, but the failure of the system eventually led to the installation of a conventional oil furnace in 1954.

A few years later, in the early in the 1960s, French-trained chemist and engineer Felix Trombe invented a form of indirect solar gain collector to harvest the sun's rays. The Trombe Wall, which was widely circulated through its canonical section, was a 30-to-60-centimeter-thick masonry wall made of concrete and glass. Utilizing the greenhouse effect, the Trombe Wall captured the sun's rays with a black glass façade facing south, heating the air between the glass and the masonry wall. The air 'was warmed and naturally distributed to the room at the back by upper vents, while part of the energy was stored in the wall and released at night.'[20] The wall was first used in two 80-square-meter experimental houses built by Trombe in 1967 at the Centre National de la Recherche Scientifique (CNRS) solar laboratory in Odeillo, France. Two years later, in 1969, Trombe collaborated with architect Jacques Michel to build a solar house in Chauvency-le-Château, where he adapted the Trombe Wall to work both as a heating device in winter and a cooling device in summer.[21] In 1973, the Trombe technology made its way to the



↑ Architect Eleanor Raymond's 1948 Dover Sun House with Dr. Maria Telkes (left).

← Felix Trombe's Solar House, Odeillo, France, 1967.

→ Illustration of the basic physics behind the Trombe Wall by architect Douglas Kelbaugh, who himself employed the wall in a house he designed.

22 Borasi and Zardini, *Sorry Out of Gas*, op. cit. (note 12), 117.

23 Fanny Lopez, Dreams of Disconnection: From the Autonomous House to Self-Sufficient Territories (Manchester: Manchester University Press, 2021), 153.

24 Ibid., 156.

25 Lydia Kallipoliti, 'From Shit to Food: The Eco House in South London (1972-1975),' *Buildings and Landscapes* 19/1 (2012), 99. See also: Grahame Caine, ' The Ecological House,' *Architectural Design* 42/3 (1972), 140-141.

26 Kallipoliti, 'From Shit to Food,' op. cit. (note 25).

27 Lopez, *Dreams of Disconnection*, op. cit. (note 23), 156.

United Stated when Douglas Keebaugh, a recent graduate of Princeton's School of Architecture, designed a house with a 56 square-meter, 38-centimeter-thick Trombe Wall.[22] Adapting the technology to local conditions, Keebaugh used the wall as both a heating and cooling device.

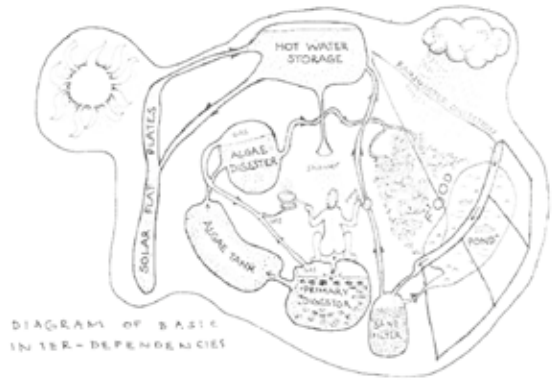
These early solar experiments were confined to the scientific realm of engineers, universities, and laboratories. As they took the form of more and more inhabitable homes, the solar houses remained experimental in scope and largely focused on technological inventions. The architecture was more than often a device to house the heating and cooling mechanisms invented by the engineers. The Integration of solar walls, panels, and heating systems into a domestic space began with the mechanisms themselves, rather than fully integrating them into the design process.

Autonomous Structures

The dream of autonomy, versatility, and adaptability was another aspect of architectural techno-optimism in the rise of environmentalism. Architects held the ambition to conceive structures that not only captured solar energy, but also produced energy from wind, snow, or waste. The main idea was that such energy production would make the buildings and their inhabitants independent of external energy resources, thus allowing for an autonomous or semi-autonomous way of living. Oscillating between a more radical approach, close to self-building and counterculture movements, and a later more technical and institutionalized approach, energy autonomy became a central topic of the 1970s.[23]

In 1972, British architecture student Graham Caine and his friends Bruce Haggart and Peter Crump of the architecture collective Street Farmers imagined an original model for sustainable living. Their Ecological House (renamed the Street Farmhouse) was part of 26-year-old Caine's final year project at the Architectural Association (AA). His eco-construction was built as a laboratory and a living experiment, inhabited by Cairn and his family until it was demolished in 1975, despite considerable attention from the British press. Parallel to the experiment, the group of young men published two fanzines, *Street Farmer 1* (1971) and *Street Framer 2* (1972), which featured 'provocative collages: urban guerrillas regreening the city and working the streets, and cow nibbling buildings.'[24] With the slogan 'from here to grow,' the Street Farmhouse proposed 'liberatory technology as a means of endowing "power to the people."'[25] Anarchist in essence, the project suggested 'that with the intelligent use of technology, each person can create living environments and habitation islands in the city, detached from the centralized networks of energy distributed by the state's authorities.'[26] Revolutionary in essence, it also sought to demonstrate that anyone, without any particular skills, could live independently of the central energy grid.[27]

Work on the Street Farmhouse started in 1970. An architectural statement for political and social reform that looked and functioned



↑ Graham Caine's diagram showing the basic interdependencies in the Ecological House.

↓ Alexander Pike, Model of the Autonomous House for the Scientific Research Council at Cambridge University, 1974.

like a spaceship, the Street Farmhouse was built on a site in the Borough of Woolwich in South London, and was supported by the Environmental Council of London and Alvin Boyarsky, then chairman of the AA.[28] Built at an estimated price of £1,000, the house was completely self-sustaining and included 'solar collection panels that collected heat and filtered rainwater, a series of tanks and digesters that converted human and vegetable waste to methane gas for cooking and nutriments for soil cultivation, as well as fishpond that acted on the fringe of the cycle as a heat sink, like an extra water storage tank and source of protein.'[29]

Also in 1972, British architects Alexander Pike and John Frazer presented their Autonomous Housing Project (AHP), a highly energy-efficient experimental structure conceived and designed by the Technical Research Division of the Department of Architecture at Cambridge University (of which Pike was program director).[30] In 1971, Pike had established a department at Cambridge University to continue Buckminster Fuller's work on autonomy (work that had begun with the Dymaxion House's first prototype in 1927, the Mechanical Wing in 1938, and the Standard of Living Package in 1948). The group was inspired by some technical aspects of Fuller's work on autonomous living standards. In addition to Pike and Frazer, the team included architect-engineers James Thring and John Littler, chemical biologist Gerald Smith, and a number of graduate students.[31] They used computer simulation programs and weather data from the past 12 years to try to save on full-scale experiment.[32]

In 1975, a prototype of the AHP was built as a laboratory to test and improve the energy systems of the house.[33] The AHP was composed of a wood and steel structure and adopted the form of a cube with an inclined south face, something between a Roman tent and a technological box, with a total surface area of 70 square meters distributed over two floors.[34] There was also an internal garden of 35 square meters for food production. The house was equipped with wind turbines mounted on a tower located in the center of the construction, a passive solar and geothermal installation that provided heating, water reuse systems, thermal storage, and a Clivius system digester that produced methane from organic waste: 'The wind provided electricity and space heating; the sun provided space and water heating; a methane digester transformed waste into gas for cooking; precipitation was collected, drinking water was retrieved from a well; and the greenhouse and a productive garden provided food.'[35] A third phase started In 1978, when a family moved into the house for two years to familiarize the public with the idea of the autonomous house.[36] For Pike, it was important to go beyond Fuller's experiments by aiming to generalize these experimental houses and adapt them to different climates and contexts. Beginning in 1973, Pike's Autonomous House generated a great deal of enthusiasm: publications, exhibitions, and conferences celebrated the success of the AHP, and the concept was exported to Japan and Russia.[37] But in March 1979, Pike's tragic death at the age 55 marked the end of the AHP, a project that was too institutional for the counterculture and too utopian for the institution.[38]

28 Kallipoliti, 'From Shit to Food,' op. cit. (note 25), 87–89.

29 Ibid., 97.

30 A sophisticated autonomous structure, the AHP stood out not only for its precocity – it was the inaugural study – but also in terms of institutional and industrial support, duration, and influence, as well as quantity. See: Fanny Lopez, 'Alexander Pike and the Autonomous Housing Project, 1971-79,' in: *Lopez, Dreams of Disconnection*, op. cit. (note 23), 133.

31 Piero Medici, 'Autonomous Houses and Architecture of Cybernetics in the 1970s Towards Limits and Undeveloped Potentials of the Sustainable,' *Sustainability* 14/10 (2022).

32 Alexander Pike, 'Autonomous House' lecture, Architectural Association, 3 February 1976, youtube.com/watch?v=IQA53mvsfOs.

33 Lopez, 'Alexander Pike,' op. cit. (note 30), 143.

34 Ibid., 149.

35 Medici, 'Autonomous Houses', op. cit. (note 31).

36 Lopez, 'Alexander Pike,' op. cit. (note 30), 143.

37 Ibid., 152.

38 Ibid., 158–159.

↑ Michael Jantzen's Solar Vacation House (south side), Illinois, USA, 1973.

↓ During worldwide gas shortages started by the 1973 oil crisis, tightly packed empty cars crowd an American gasoline station with a makeshift sign declaring 'NO GAS.'

39 Lopez, *Dreams of Disconnection*, op. cit. (note 23), 168.

40 See: Borasi and Zardini, *Sorry Out of Gas*, op. cit. (note 12).

41 Brenda and Robert Vale, *The New Autonomous House: Design and Planning for Self-Efficiency* (Universe Books/Open Library, 1975).

42 This category included the Ouroboros, a trapezoidal house built by students at the University of Minnesota School of Architecture, as well as the autonomous house designed by Simon Longland at the Department of Architecture of the University of Edinburgh, Alexander Pike's previously mentioned Autonomous House, Garrard Crouch's A-Frame House, James Thiring and Gerry Smith's house inspired by Pike's design, and a house designed by Breda Vale.

43 This category included the autonomous dome built by Jaap Hooft as a small experimental farm in the Netherlands, the Integrated Living System built by Robert Reines in New Mexico, and a house designed by C.G. Golueke and W.J. Oswald.

44 This category included Caine's Street Farm House, the Integrated Solar Dwelling designed by John Shore, and the Ecol built by the Minimum Cost Housing Group at McGill University in Montreal.

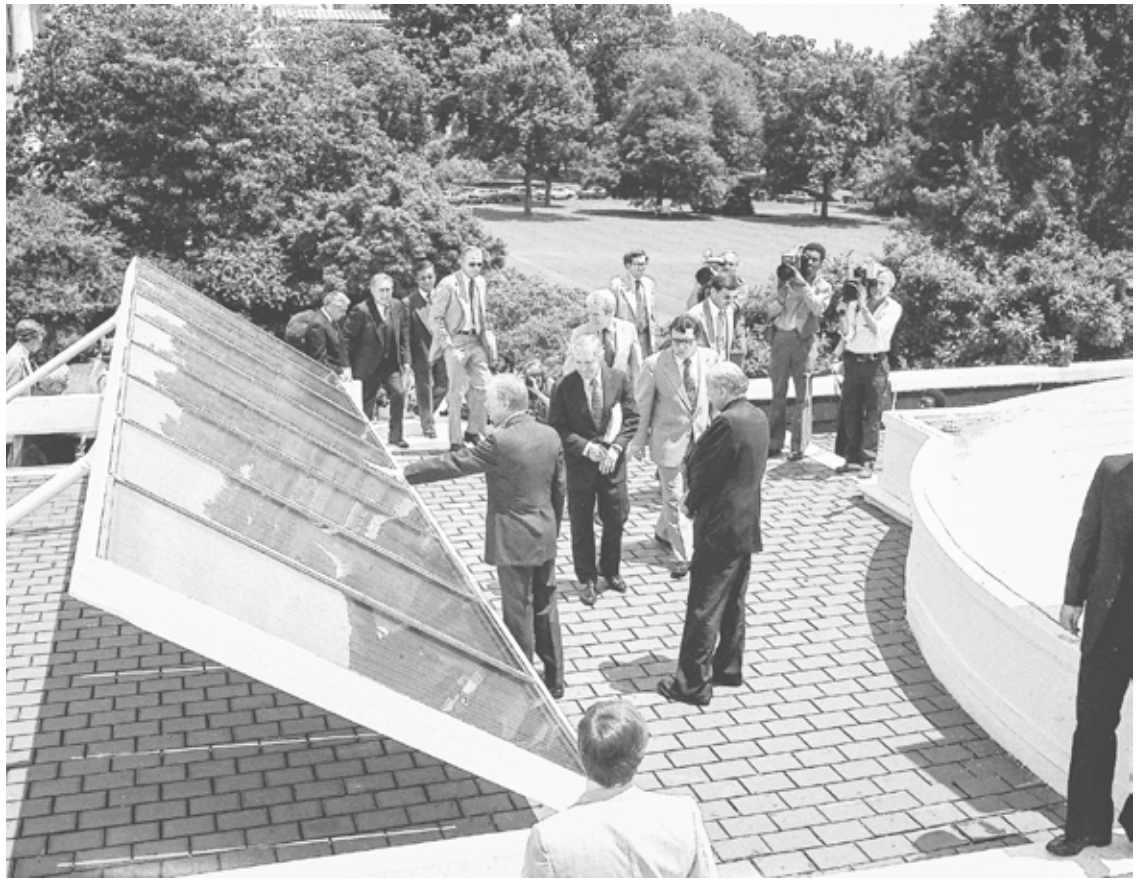
45 This last category included an urban house designed for the Conservation Tool and Technology Ltd., and Hillside Cottage.

Around the same time, in the immediate aftermath of the first oil crisis, examples of autonomous houses were also built in the United States, such as Michael Jantzen's self-sufficient Vacation House of 1973. Erected in the architect's parents summer resort in Carlyle, Illinois, the house was a small, two-story vacation retreat for two that was aesthetic and mechanized, while being driven primarily by the political component of autonomy. The shape of the house was influenced by aeronautical and aerospace design and included a maximum number of functions in a minimum amount of space.[39] Following in the footsteps of Buckminster Fuller, Jantzen used inexpensive steel agricultural building materials such as parts of a silo to form the roof of the house. The south-facing windows and two large south-facing translucent roof sections glazed with corrugated fiberglass were used to passively heat the house in winter, while electricity was provided by photovoltaic panels and a wind turbine. Following this first house, oscillating between technological innovation and works of art, Jantzen built a series of other solar-powered houses with a recognizable space-age aesthetic.

Projects for autonomous houses often ran parallel to a public campaign to convince people of the feasibility and advantages of these self-sufficient projects. The 1973 embargo imposed by the Organization of Petroleum Exporting Countries (OPEC) on the United States and other countries that supported Israel accelerated these efforts by highlighting the acute nature of our dependence on fossil fuels.[40] This political state of emergency not only forced the West to examine energy use and efficiency, but also stimulated accelerated innovation and research into renewable energy: scientists, green activists, and inventors from several European countries and North America simultaneously turned to ideas of harnessing natural elements to produce electricity domestically. In 1975, for example, Brenda and Robert Vale published *The New Autonomous House: Design and Planning for Self-Efficiency*, a book/manifesto offering down-to-earth suggestions for building homes that do not pollute the Earth or squander its resources.[41] In January 1976, *Architectural Design* devoted an entire issue to autonomous houses. For the occasion, the editors of the magazine listed and illustrated a series of autonomous housing projects, grouping them into four categories: the integrated/spacious,[42] the modular/compact,[43] the low-cost,[44] and the conversion houses.[45] All of these projects were essentially experimental, but they were examples of architects attempting to use technology to provide an architectural response to resource depletion, blurring the boundaries between high and low tech more and more.

Sustainable Urbanism

It was a long way from these isolated experiments to the widespread implementation of solar technology in architectural design. Although Bell Laboratories, a subsidiary of AT&T, made great strides in the area of photovoltaic technology and produced the first photovoltaic cell to convert solar energy into electricity in the 1950s, solar energy



↑ American President Jimmy Carter and the press on a tour of the newly installed White House solar panels, 20 June 1979.

was still not widely used at that time. In the late 1970s, in the midst of the second (Iranian) oil embargo, interest was sparked and the fate of renewable energy seemed to have taken a new turn with Jimmy Carter's decisive move to promote solar panels, but the target set by his administration 'to build 300,000 solar houses a year,' was never achieved.[46] Instead, only 0.20 percent of new single-family homes built in the United States between 1977 and 1985 were solar dwellings, a figure that speaks to the difficulty of 'scaling up' or closing the gap between technological possibilities and reality.[47]

In the 1970s and 1980s, architects and engineers sought to develop larger-scale projects, such as neighborhoods and towns, in which the sun played a crucial role. These solar communities were early examples of sustainable urbanism, a movement that sought to design cities and communities that were environmentally friendly, socially just, and economically viable. These architects and engineers combined solar technology with principles of architectural and urban design. In his recent book, *City, Climate and Architecture*, Sasha Roesler investigates the practice of climate control as a collective practice – rather than a practice of individual projects. Building on this idea, it is interesting to look at cases in which technology and an accelerated pace prompted collective projects that responded to fears of impending resource scarcity.

In 1970, Guy Rottier, a French-Dutch architect who had worked with Le Corbusier on the Unité d'Habitation in Marseille,[48] designed Ecopolis (a cross between a town and a house), a conceptual project for a 'novel form of town planning based on the fair redistribution of solar energy.'[49] The project relied on principles of self-sufficiency, efficient use of resources, and community participation. Working with heliophysicist Maurice Touchais, Rottier was one of the first modern architects to consider the impact of the poor distribution of sunlight in buildings. Together with Touchais, he developed *lumiducs*, tubes with reflective interior walls that, when connected to a sensor mirror, made it possible to illuminate blind and deep spaces while, incidentally, reducing pollution. Rather than harnessing the sun's rays to convert them into other forms of energy, Rottier wanted to exploit the sun's properties as a 'source of light and life.'[50]

To build his Ecopolis, Rottier started with a pyramidal shape. At the center of the pyramid, around a multi-level circulation system, he placed all the spaces that did not require direct sunlight. On the outer edges of the pyramid, he positioned the residences, to give each home a view to the outside. The sun also entered the building thanks to lumiducs, which allow light to enter deep volumes. They that were placed where there was normally no sun, thus providing a more livable environment in his city. The project reflected the heritage of modern thinking about the city and was closely related to certain utopias of the early twentieth century. However, Ecopolis was also a successful anticipation of the issues that would arise at the beginning of the twenty-first century, in which the majority of the world's population had become urbanized.[51]

46 Pierre-Édouard Latouche, 'Jimmy Carter Takes a Stand', cca.qc.ca/en/articles/issues/12/what-you-can-do-with-the-city/33270/jimmy-carter-takes-a-stand.

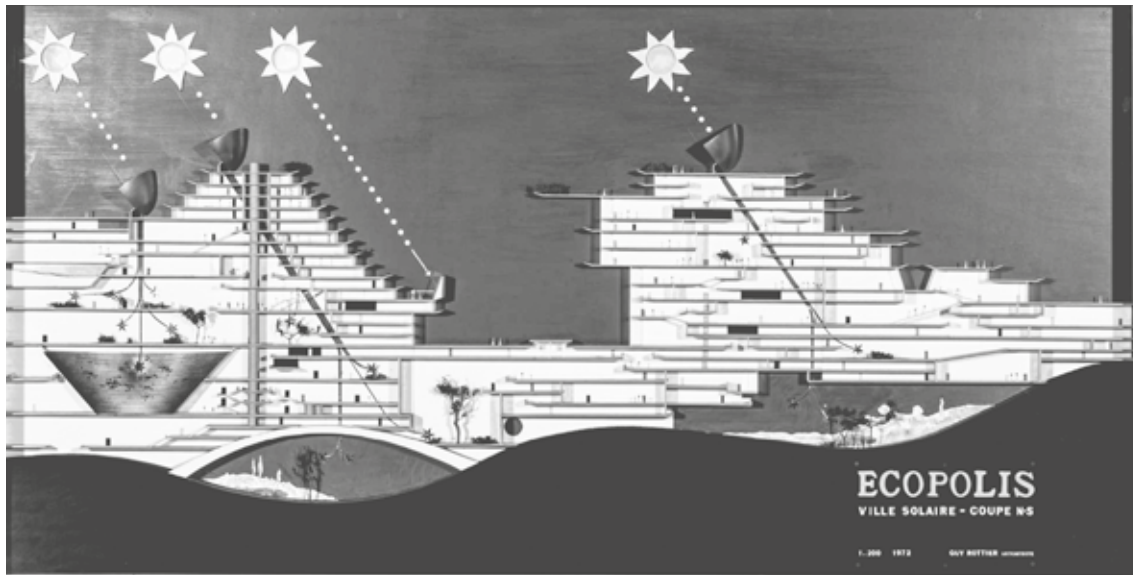
47 Ibid.

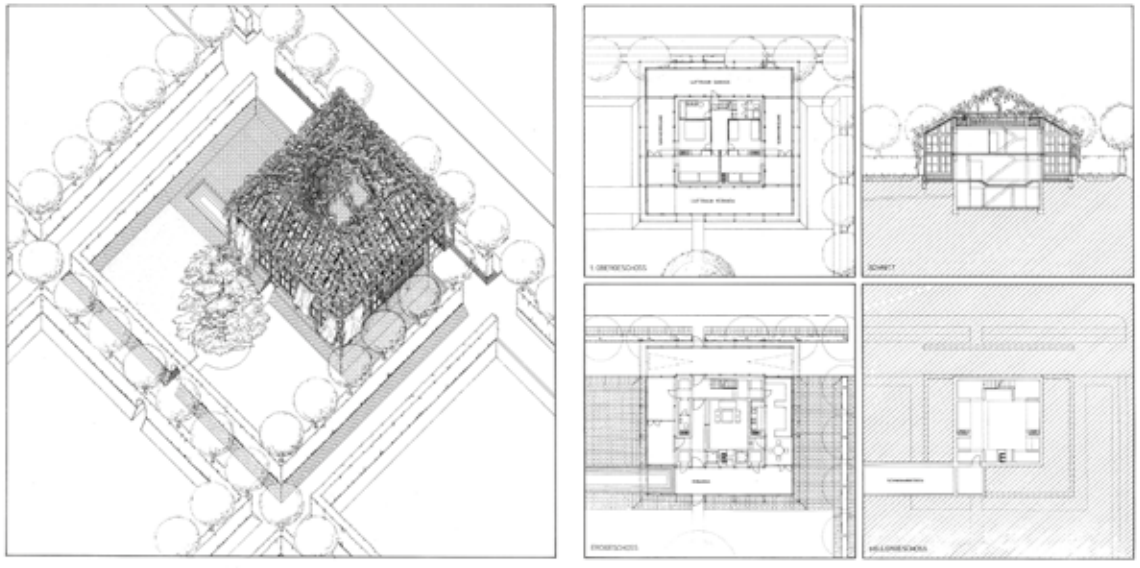
48 From Le Corbusier, Rottier had learned how to think about notions of architecture, urbanism, and the environment. Guy Rotter, *Vivre Autrement: 4 Prospectuers d'avenir* (Nice : Editions Gilletta, 2006), 23.

49 Ibid., 32. See also: Guy Rottier, 'L'architecture enterrée (ou l'anti-architecture),' Techniques et architecture 133 (1977).

50 FRAC Orléans collection, collections.frac-centre.fr/collection-art-architecture/rub/rub-64.html?authID=164&ensembleID=944.

51 Daniel Siret, 'Ecopolis, Rottier solaire,' in: Abdelkader Damani and Guy Rottier, *Architecture de l'errance, Liénart éditions* (Orleans: Frac Centre-Val de Loire, 2021), 34–39.





↑ Study of the Ecopolis Ville Solaire (Solar City) by Guy Rottier, 1970.

↓ Axonometric drawing of Oswald Mathias Ungers's Solar House, 1980.

52 'Concours de Landstuhl, R.F.A: Une opération réussite,' *L'Architecture d'Aujourd'hui* (June 1980), 68. Eight architecture firms took part in the competition: Bock-Cook-Hawley, Eissler-Hoffmann-Gump, Hellwig-Medium, Kramer-Weist, Mohl, Schneider-Wessling, Stedle-Herzog, and Ungers.

53 Anna Feng, Negotiating Ungers: The Aesthetics of Sustainability International Summer School 2018, KU Leuven, negotiating-ungers.eu/2018/index.html.

54 Mariabruna Fabrizi, 'Energy as Architectural Matter: Oswald Mathias Ungers' Solar House (1980),' socks-studio.com/2021/06/27/energy-as-architectural-matter-oswald-mathias-ungers-solar-house-1980/.

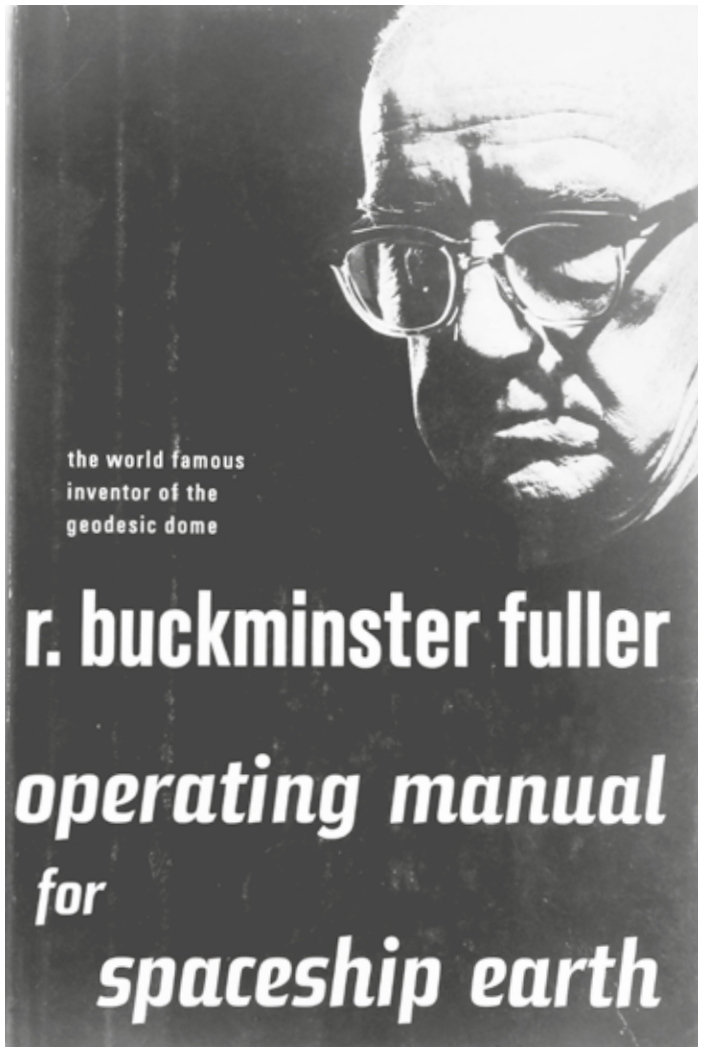
55 'Concours de Landstuhl,' op. cit. (note 52), 80.

Rottier, who presented his Ecopolis project at the 1973 international congress 'Le soleil au service de l'homme,' was fully committed to addressing pressing environmental issues. This conviction guided his work and shaped his progressive approach. However, the Ecopolis project has mostly been perceived as an example of 'top-down' planning, with designers and experts imposing their views on local communities.

In 1979, during the second oil crisis of the decade, the West German Ministry of Research and Technology invested 8 million DM and launched an international competition to build 400 prototypical solar houses in Landstuhl, a small town located 70 kilometers from Saarbrucken. The competition was seen as a model project for large-scale solar settlements throughout Germany. With a high technical and architectural level, this project was also intended to prove to the general public, which was poorly informed and often reluctant to use solar energy, that it is possible to combine the requirements of an architecture of quality with the constraints of solar technology.[52]

Advancing the idea of solar communities, German architect Oswald Mathias Ungers designed a contribution to the competition – a prototypical solar house with low energy distribution that could be developed on a large scale. While Ungers collaborated for the energy concept of the building with the Berlin-based Institut für Bau-, Umwelt- und Solartechnik (Institute for building, the environment, and solar technology), he argued that 'the energy efficiency of the design should not depend on construction and building technology, but should be understood as an architectural problem, an integral part of the design.'[53] In other words, for Ungers, energy efficiency was the most important aspect and an architectural matter that required 'formal solutions and typological inventions.'[54] For his project, Ungers used mainly passive solar systems: the orientation of differentiated climatic zones (buffer space); the minimization of external surfaces exposed to bad weather conditions; the use of materials such as glass, vegetation, and earth; the shape and specific organization of plans.[55]

Ungers's detached solar house was based on his recurring concept of 'the house within a house,' a trope that was then applied at different scales and levels. Following what Banham calls the 'conservative mode,' the layering of different volumes and the inertia of the built mass, allowed for intermediate areas with different climatic conditions. The outer layer of the house operated in a 'selective mode': by being opened or closed, it provided passive heating or ventilation according to seasonal weather fluctuations. Each zone of the house was also defined by a different materiality: while the core of the house was a stone structure that served as heat storage, the second layer (which housed technical services such as bathrooms, kitchens, toilets, and vertical distribution) was a greenhouse that functioned as a buffer zone between the central and outer layers. The final and outermost layer was made of greenery that covered the greenhouse to provide shade in summer. Never built, Ungers's proposal received a special award in the competition and ultimately



↑ R. Buckminster Fuller, *Operating Manual for Spaceship Earth* (Chicago: Southern Illinois University Press, 1969).

offered a particular form of eco-aesthetics that addressed the energy issue through the means of architecture itself.

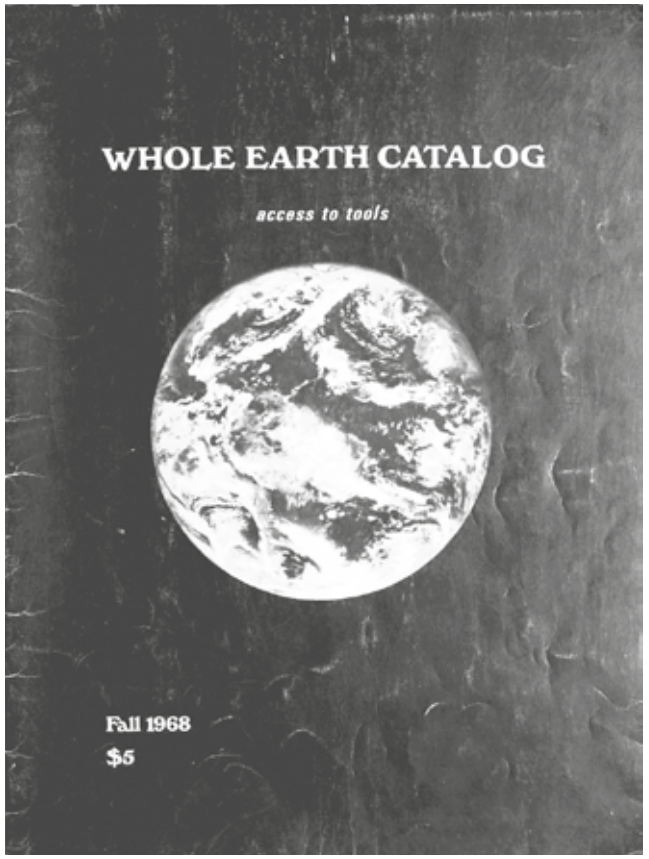
Rottier's Ecopolis and Ungers's Solar House are just two of many examples that sought to harvest the sun on a larger scale through the means of architecture. Be it by using typology, orientation, density, or tectonics, both Rottier and Ungers approached sustainable design from the position of the architect. It was within their role as designers and with the tools that were inherent to the discipline that they created new modes of controlled environments. Their experiments went beyond purely technological solutions. Although their projects were not realized, they had a profound impact on later generations.

In 1969, American architect and inventor Buckminster Fuller published his *Operating Manual for Spaceship Earth*, describing the Earth as a spaceship with a finite number of resources that could not be resupplied and offering a manual on how to understand, manage and preserve the planet. Critical of air and water pollution as well as the use of fossil fuels, Fuller encouraged the use of renewable energy and regenerative resources. Thus, even before the publication of *The Limits to Growth*, Fuller had claimed that we 'must operate exclusively on our vast daily energy income from the powers of wind, tide, water, and the direct Sun radiation energy.'[56] As Daniel Barber convincingly argues in his book *A House in the Sun*, the idea of capitalizing on free and natural resources had been embraced by architects long before the 1970s, especially in the post-war period, a period when interest in alternative energy sources was strong.[57] Interestingly, solar experiences shifted over the course of the twentieth century. From engineers and academics working on high-tech projects that sought to capture the sun's rays and store its energy, to projects influenced by the countercultural DIY movement in search of autonomy and self-sufficiency. The 1970s saw an acceleration of the experiments that had brought architects and engineers together several decades earlier. Banham's conservative, selective, and regenerative modes were pushed as a sense of urgency entered the field of architecture.

The wave of experimentation with new technologies and sustainable architecture that emerged in the 1970s continues to this day. It has created a library of failed futures that provides evidence, inspiration, and guidance for our future. In this chapter, we have only scratched the surface of what has been explored. Far from claiming to represent a movement or a trend, these examples, taken together, clearly show the many technological responses to the inevitable limits of our resources. They make clear that there is a vast potential in returning to these failed futures to reflect on the conditions that ultimately prevented these architects from becoming part of the 'cure.'

56 Richard Buckminster Fuller, *Operating Manual for Spaceship Earth* (Zurich: Lars Müller Publishers, 2008 [1969]), 40.

57 Daniel A. Barber, *A House in the Sun: Modern Architecture and Solar Energy in the Cold War* (Oxford: Oxford University Press, 2016). Barber explores how the history of the postwar period was closely related to energy: 'There was also, after the war, a brief but remarkably dynamic interest in what we now call alternative energy technologies, including wind, geothermal, and solar energy,' 2.



↑ Stewart Brand's 1967 campaign button urging NASA and the Soviet Union to release a photograph of the whole earth.

↓ First *Whole Earth Catalog*, Fall 1968.

Chapter 4: Circularity, Experimentation, and the Question of Impermanence

Lead authors:
Véronique Patteeuw and Léa-Catherine Szacka

Trapped inside a waste economy man finds an identity as a consumer. Once outside the trap, he finds enormous resources at his disposal — free.[1]

In the early 1960s, the field of architecture, in the midst of a decade of change and driven by the social and cultural landscape, pulsed with an electrifying energy as a wave of change swept through education, practice, and publishing. It is in this decade that an important number of countercultural little magazines saw the light of day, heralding two decades of experimentation and activism in architecture.

In February 1966, Stanford-educated biologist Stewart Brand produced buttons with the text: 'Why haven't we seen a photograph of the whole Earth yet?' The purpose of these badges was to urge NASA to release pictures of the Earth following the multiple Apollo missions that had gone into space since 1966.[2] Brand believed in the power of images: a photograph of the entire planet would be a galvanizing force in addressing global environmental challenges. Two years later, when he published the first issue of his countercultural magazine the *Whole Earth Catalog*, Brand proudly placed a NASA photograph on the cover. The image of the Earth captured both the planet's fragility and interconnectedness, challenging individuals to reevaluate their relationship with the planet. Published twice a year from 1968 to 1972 and reaching an estimated 7 to 8 million readers, Brand's Catalog provided an unparalleled resource on ecology, technology, energy, communications, and, most importantly, on experimentation.[3]

Often described as a blueprint for the counterculture movement, *The Whole Earth Catalog* (WEC) primarily published books and product reviews that promoted self-sufficiency and ecological living. An ten-person editorial team conducted interviews with editors of leading publications and wrote small reviews of specific products, providing 'access to tools' that would empower

1 Bill Voyd, 'Funk Architecture,' in: Paul Oliver (ed.), Shelter and Society (New York: Praeger, 1969), 156–157.

2 See: nasa.gov/mission_pages/apollo/missions/index.html.

3 Caroline Maniaque Benton and Meredith Gaglio (eds.), *Whole Earth Field Guide* (Cambridge, MA: MIT Press, 2016). See also: Caroline Maniaque Benton, *French Encounters with the American Counterculture 1960–1980* (London: Routledge, 2011). The readers of the WEC would become specialists in DIY. The catalogue can also be seen as the origin of the Internet. It provided access, allowing players to keep abreast of the latest developments in philosophy, architecture, and landscape design, but it also enabled them to distribute information on mainstream tools to foster a countercultural milieu.

'the individual to conduct his own education, find his own inspiration, shape his own environment.'[4] The Catalog gave a broad definition of the word 'tools': from informative tools – books, maps, professional journals, courses, and lessons – to specific utensils – gardening, carpentry, masonry, welding tools, chainsaws, fiberglass materials, tents, hiking boots, and potter's wheels – to the first synthesizers and computers for personal use. Its sections on 'Shelter' and 'Land Use' addressed the current state of architectural practice and materials research. Embracing Buckminster Fuller's Whole System ideas, the sections advocated for the rational use of materials and energy to create sustainable and environmentally conscious living.[5] Aiming to connect wilderness with technology and culture with nature in ways that were unconventional at the time, the WEC gave rise to a new community of environmental thinkers around what would come to be called 'sustainability.'

While the WEC was initially aimed at readers going back to the old land, literally dropping out of society and into new and alternative forms of communal living, it equally addressed readers that wanted to change their way of life from within, for Brand's countercultural perspective was fueled by a general ennui and loss of confidence in the status quo at the end of the 1960s. Indeed, in the years leading up to the publication of *The Limits to Growth* by the Club of Rome in 1972, a number of intellectuals, designers, and architects in the United States began to question the business-as-usual model. Their critical efforts led them to engage in experimental projects that emphasized circularity and self-sufficiency. For these protagonists of the self-build revolution, making shelter was seen as an act of personal transformation: departing from the ambition to build with the smallest possible footprint, their homes would use found materials, reuse waste, or be conceived as auto-regulating entities. In contrast to the technologically advanced examples presented in the previous chapters, the projects explored in this chapter testify to an engagement with material resources and their location in a sustainable and reversible fashion: low-tech and low-key, they were sometimes built at a slow pace, or according to alternative temporalities. Although many of their e would be short-lived, these architects brought an experimental practice to the field of architecture that paralleled the growing environmental awareness and questioned the (im)permanence of building. They explored forms of circular building and ephemeral architecture to the point where architecture would almost disappear altogether.

Salvaged Materials

In the 1960s, a number of architects experimented with circular building in projects for their own homes, testing the implementation of ecological thinking in their building practices. For these architects, close to countercultural communities and protagonists of the self-build revolution, making shelter was seen as an act of personal transformation – something that engaged them as individuals as much as it projected their work into built forms. Their interest in

4 *Whole Earth Catalog* (Fall 1969), opening page.

5 Simon Sadler, 'An Architecture of the Whole,' *Journal of Architectural Education* 61/4 (2008).

circular building was anchored in a belief in bottom-up practice and community making. They shared a desire for very lightweight architecture that was fully or partially reversible, and they understood circularity from the perspective of 'as found' – be it the remnants of market economy or building elements already on the market.

The 1960s in America provided an interesting context for several experimental engagements with circular building. Among the most famous was Drop City, a community-led settlement on an 8-hectare plot of land 40 kilometers from the town of Trinidad, southeast of the Colorado desert, founded in 1965 by artists Clark Richert and Gene Bernofsky. Associated with dropping out of mainstream life, and expressing a social commentary on the times, the community project was as much a reaction to consumerist society as it was to US foreign policy, particularly the Vietnam War.[6] By 1967, the community consisted of about 18 young people and children dedicated to simple communal living and the creative arts – from writing to painting, and from sculpture to filmmaking.[7]

After attending a lecture on Buckminster Fuller's low-cost, mass-produced dwellings, Richert and the Drop City community became fascinated with domed structures. Derived from the geometric subdivision of triangular polyhedra, Fuller's domes offered a revolutionary approach to structurally efficient construction. But while Fuller's domes were built with new materials, the Drop City community made inventive use of salvaged materials and discarded and found objects.[8] The larger domes housed a communal kitchen, a community hall, and a theatre, while the smaller ones were dedicated to housing. They were framed in wood and covered with old car tops in their natural, bright colors – flattened, cut to fit the geometry of the domes, and hammered together. A coating of tar covered the joints, while 10 centimeters of expanded polystyrene provided thermal insulation.[9]

A key figure in the evolution of the Drop City community was Steve Baer, an American pioneer of passive solar technology, who contributed significantly to the community's design explorations. Baer introduced the 'Zome,' a post-geodesic system that deviated from Fuller's orthodoxy. Zomes offered improved habitability and versatility, as these structures could be adapted to different spatial uses by expanding along an axis. Unlike Fuller's geodesic structures, they permitted additions with relative ease and could be built into an array of shapes with a smaller inventory of parts. 'Whereas the Fullerine dome could be enlarged solely through an increase in its radius and generated only circular plans, the ... Zome allowed its straight-sided plan to expand along an axis and so adapt to different spatial uses.'[10] In 1967, Fuller himself observed these 'bricolage' experimental interpretations of his work and recognized the innovative value of the Drop City project by awarding it the first Dymaxion Award. In his congratulatory letter, he wrote: 'Gentlemen: I take great pleasure in informing you that you have won the "Dymaxion Award" for 1967, for your remarkable initiative, spirit, and poetically economic structural accomplishments.'[11]

6 Mark Matthews, *Droppers: America's First Hippie Commune, Drop City* (Oklahoma: University of Oklahoma Press, 2010).

7 Charlotte Trego, 'Drop City: New Life for Junked Cars,' *Architectural Forum* (September 1967), 74–75.

8 See: vimeo.com/ondemand/dropcitydocumentary.

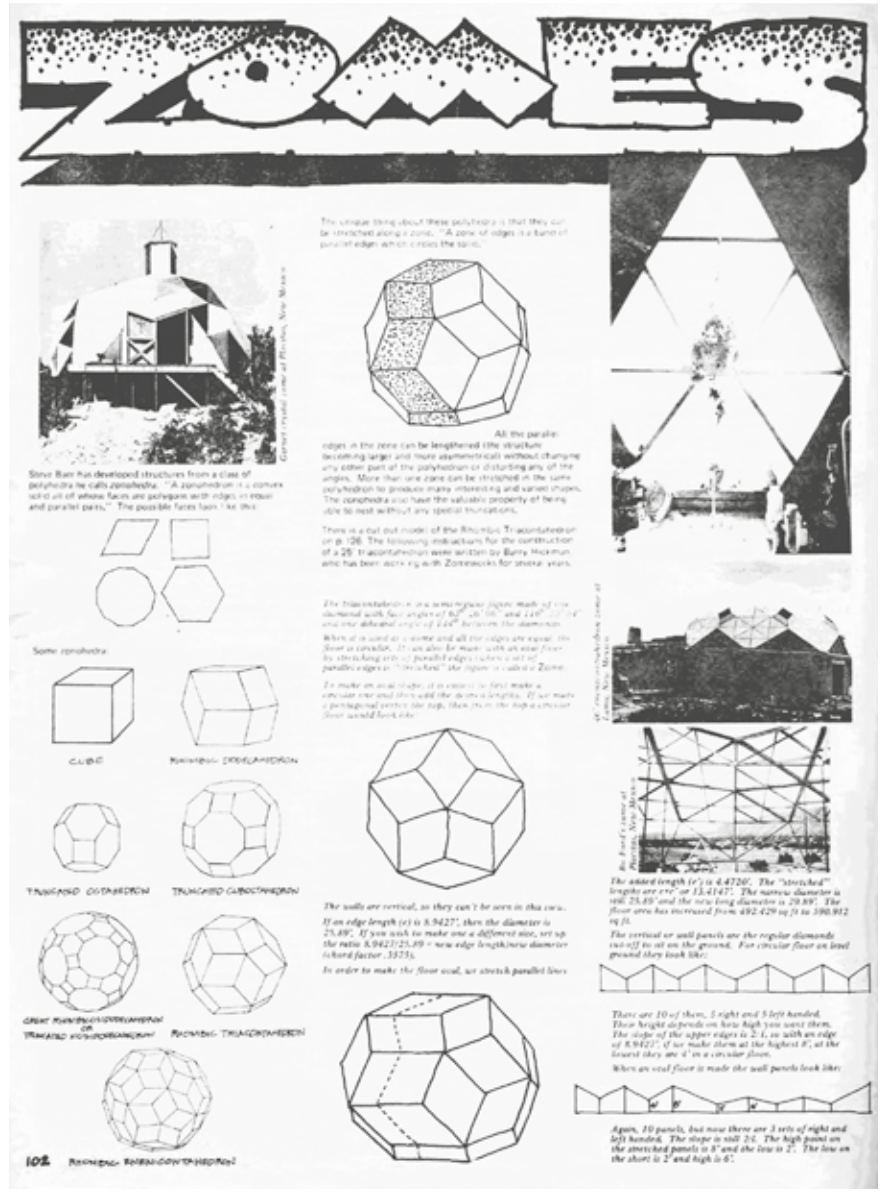
9 'Drop City, Colorado: coupoles géodesiques pour l'habitat hippie,' *L'Architecture d'Aujourd'hui* 141 (1968), 82–84.

10 Simon Sadler, 'Drop City Revisited,' *Journal of Architectural Education* 59/3 (2006), 10.

11 Matthews, Droppers, op. cit. (note 6), 165.

↑ Drop City, Trinidad, Colorado, USA, 1967.

↓ Drop City communard John Curl beside the first dome, 1967.



↑ Page on Zomes from the 1971 *Domebook 2*, the second of two publications full of articles concerning the construction of and life around various types of geodesic dome structures.

But Drop City was more than mere bricolage. It embraced questions of sustainability and alternative energy practices ahead of its time. For example, the community's commitment to reducing its dependence on conventional energy sources led to a 'solar heater' that consisted of several dozen old rearview mirrors, taken from junked cars and mounted on long steel rods. The idea was that the mirrors could be adjusted and steered to catch the sun and redirect its heat to warm a given space.[12] On an architectural level, the concept of 'ephemeralization,' a term coined by Fuller, took on new meaning in Drop City. For Fuller, ephemeralization expressed the ability of technological progress to do 'more and more with less and less until eventually you can do everything with nothing.'[13] According to Fuller, by increasing efficiency, one could achieve the same or more output (products, services, information, etcetera) while requiring less input (effort, time, materials, resources, etcetera). In Drop City, this approach was combined with a profound desire to liberate oneself from a normative model of life while defending an ecological perspective in relation to building and living. For the 'droppers,' architecture became a testing ground to explore Fuller's efficiency with radical environmental activism. The Zomes were lightweight structures clad in salvaged materials that could be easily dismantled without leaving a trace. Drop City's interest in circular building was anchored in a belief in bottom-up practice and in community making. 'Things have value only in their use. When one stops "owning" things another can begin to use them. Energy is transformed, not lost,' testified dropper Bill Voyd in 1969.[14] By providing a 'free workforce and pooling resources, a countercultural manifestation like Drop City could support the independent research into sustainability that was being circumvented by official federal funding.'[15] While Drop City's architectural experiments embodied the countercultural spirit of their time, defying social norms and reinventing the role of architecture in everyday life, their fusion of bricolage, artistic expression, sustainability, and alternative energy proposed a paradigm shift in building practice.

American architect Michael Reynolds, who drives around in an old Mercedes-Benz repaired with scrap metal from old washing machines that runs on recuperated grease from restaurants, has been called many things: Father Earth, Garbage Warrior, innovator, inventor, and mentor. After graduating from the University of Cincinnati in 1969, with a thesis project published in the April 1971 issue of *Architectural Record*, Reynolds moved to a patch of desert on the outskirts of Taos, New Mexico, where he began to experiment with his 'biotecture.' With less restrictive planning codes and public officials willing to grant him exemptions from state building regulations, Reynolds was able to use unconventional materials to construct a series of projects that experimented with zero-carbon building and living. He was followed by a dozen disciples who built accordingly, resulting in a set of self-sufficient houses made from natural and salvaged waste materials.

Reynold's first house, the Thumb House (1972), was constructed of 70,000 beer and soda cans, wired and cemented together, and

12 Trego, 'Drop City,' op. cit. (note 7).

13 Richard Buckminster Fuller, *Nine Chains to the Moon* (New York: Anchor Books, 1973 [1938]), 252–259.

14 Voyd, 'Funk Architecture,' op. cit. (note 1).

15 Sadler, 'Drop City Revisited,' op. cit. (note 10), 11.

powered by early solar panels. It was one of the first houses of its kind in the United States and laid the groundwork for Reynolds's self-sufficient homes, known as Earthships.[16] These energy-autonomous buildings met six criteria that exemplified Reynolds's take on 'biotecture': they were built with natural and recycled materials, they managed thermal solar heating and cooling, they integrated water recirculation and sewage systems in a nonpolluting manner, they approached electricity production in a non-exhaustive way, and they grew their own food. About 40 percent of a typical Earthship was built with natural or recycled materials: glass bottles, metal cans and plastic bottles, all salvaged from the dump by Reynolds and his disciples. While used tires were filled with rammed earth and used as retaining walls that functioned as a heating or cooling systems, metal cans and glass bottles were set in mortar and used to build the walls. The metal from discarded refrigerators, washing machines, or cars would then cover the roofs, and finally a mixture of sifted dirt from the site, sand, chopped straw, and water was used for the interiors. Each Earthship used its water four times through the application of sewage treatment planters called botanical cells.[17] The vessels incorporated planted greenhouses with gravity-operated skylights that provided buffer zones between the interior and exterior and regulated the sewage systems.

Reynolds, who was considered an outlaw by the architectural community, and his Earthships were often described as 'beatniks,' 'survivalists,' and 'deadbeats' by mainstream Americans.[18] Indeed, the architecture of the Earthships had the aesthetics and appearance of hippie architecture: the metal cans and plastic and glass bottles brought color to the walls, while the shapes were evocative and metaphorical. But while these self-sustaining houses made of tires, dirt, and garbage have long been an offbeat curiosity, they proposed an integrated approach to circularity with interiors that contained food-producing greenery or inhouse fishponds. They explored off-grid and climate-resilient living and were designed to bypass utilities and life-support systems while only using one-sixth of the energy of a conventional house. For Reynolds, Earthships were (and still are) 'a social mission that transcends architecture.' Vaguely echoing Buckminster Fuller, whose geodesic domes were considered radical concepts for Spaceship Earth, Reynolds was more inspired by Noah's Ark: 'Noah was building an ark to survive the coming storm. We're building vessels for the storm we're already in.'[19]

Parallel to a growing environmental consciousness, Steve Baer's Zomes at Drop City and Michael Reynolds's Earthships testified to the dispersed architectural experiments of countercultural America in the 1960s.[20] While Drop City used traditional architectural structures and covered them with salvaged materials, Reynolds used natural and recycled materials that were repurposed for architecture. Thinking outside the box, these architects and builders combined circular building with zero-carbon living, approaching architecture as affordable construction that provides homes in balance with the environment. As Caroline Maniaque-Benton wrote: 'The United States was not only perceived as the icon

16 Today, Reynolds's organization offers a comprehensive set of instruction manuals and videos and has a network of enthusiastic self-builders that extends across all seven continents.

17 Michael Reynolds, TEDXTamaya, 22 November 2009.

18 See: greenlivingmag.com/earthship-homes-the-return-journey/.

19 See: nytimes.com/1993/01/10/style/father-earth.html.

20 Rachel Carson's *Silent Spring* was published in 1962 and Paul Ehlrich's *Population Bomb* in 1968.

↑ Michael Reynolds in front of his can-house.

↓ Michael Reynolds, Earthship, located in Normandy, insulated with tires, while the interior consists of bottles inserted in cement made with mud and straw.

21 Caroline Maniaque-Benton, *French Encounters with the American Counterculture*, op. cit. (note 3), 3.

22 Nick Aspinwall, 'These Homes are Off-Grid and Climate Resilient: They're Also Built out of Trash,' *The Washington Post*, 4 January 2022.

23 Drop City was the victim of excessive media attention. While its inhabitants meant to withdraw from capitalist society, they became the centre of attention of dropouts, outlaws, and tourists.

24 'Controversy over Green Hero,' *Architectural Record* (June 2000), 36.

25 This text has benefitted from the research done by Margot Nossek on Lloyd Kahn, and by Marie Bourdon on Stewart Brand in the framework of the lecture series 'Architecture in the Age of Acceleration' (autumn 2023) at the EPFL.

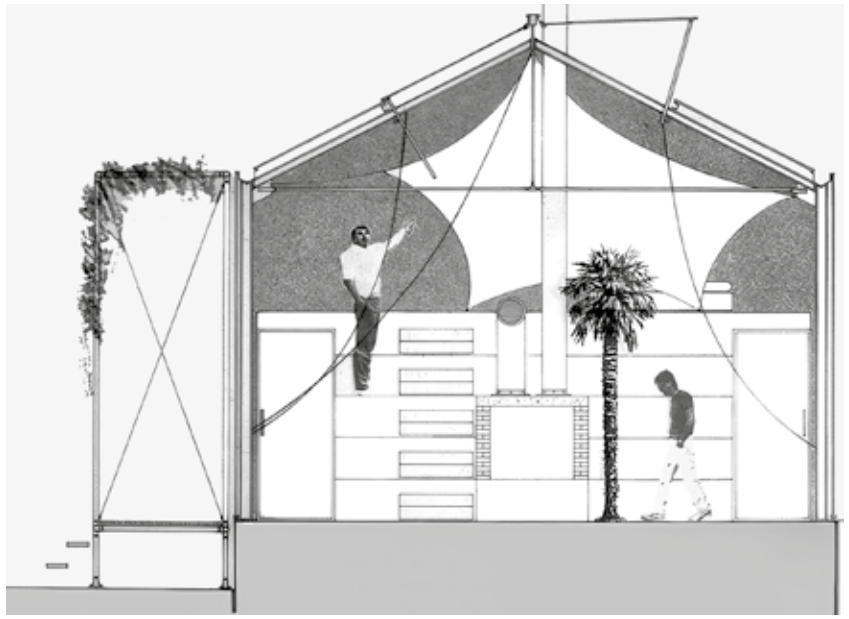
of modernity, but also as the driving force behind a return to nature.'[21] Directly involved in the realization of their own homes, they often lived the experience for several years before their structures finally collapsed. In the role of guinea pigs, they fully experienced their homes as learning environments in terms of construction, thermal regulation, or waste production. A great many problems need to be mentioned here. There were stories of failed and abandoned projects, sometimes after tens of thousands of dollars had been spent by the clients. Experimental, evolving, and imperfect, the Zomes, Shelters, and Earthships were subject to growing pains, sometimes too expensive for American families to afford:[22] While Drop City was a short-lived victim of its mediatization,[23] Reynolds gave up his New Mexico architecture and construction licenses after disputes with several clients.[24] But it is precisely these growing pains that make these projects relevant today. Failing in their attempt to build for the future, they testify to what we might call 'down design': a constructive practice based on practical reasoning that starts from the materials used and the act of building. Neither affecting a predetermined design nor indulging in abstract contemplation, the dome constructions of the Droppers, and the Earthships of Michael Reynolds could best be described as the opposite of the nihilism that the countercultural projects were sometimes mistaken for. They were measured understandings of the future of circular building.[25]

Lightweight Building

While the Zomes and Earthships were reactive (working with available scrap materials), in Europe in the decade following the American countercultural movement, other forms of activism were taken up by practicing architects. These architects were driven by ecological or economic concerns as they approached architecture in its relation to low cost and low weight, proposing affordable constructions in balance with the environment. Their energy-efficient architecture minimized building materials and their weight by working with available products or by proactively making circularity part of the initial design.

An interesting example is the early work of French architects Gilles Perraudin and Françoise-Hélène Jourda who, in 1984, proposed to convert an existing horticultural greenhouse into a house for a family with two children on a limited budget. In the early 1980s, Perraudin and Jourda were already driven by environmental concerns, increasingly working with products that were produced industrially and readily available. Their question was simple: 'Why invent a new model when it's already on the market?' The greenhouse – purchased and assembled on site by the manufacturer in three days – responded to the climate conditions they were looking for.

Built on a 1,000-square-meter plot planted with trees, the greenhouse offered its occupants a modular living space of 140 square meters, divided into a 'glazed house' with a double height



↑ Gilles Perraudin and Françoise-Hélène's Maison Serre in Lyon, France, 1984.

↓ Section of Gilles Perraudin and Françoise-Hélène's Maison Serre in Lyon, France, 1984.

26
The greenhouse served as workshop space to make the wooden components. For just 38,000 euros, the architects realized a house in which the client lived with his family for 12 years.

27
'Maison Serre, St Juste Lyon, 1984–1985,' *L'Architecture d'Aujord'hui* 241 (October 1985).

28
It can be argued that the low-budget house that French architects Anne Lacaton and Jean Philippe Vassal completed in 1993 near Bordeaux is a continuation of the Perraudin/Jourda house.

29
Benthem Crouwel Architects was founded in 1979.

30
Almere is a new town in the Netherlands, built on reclaimed polder land between 1959 and 1968.

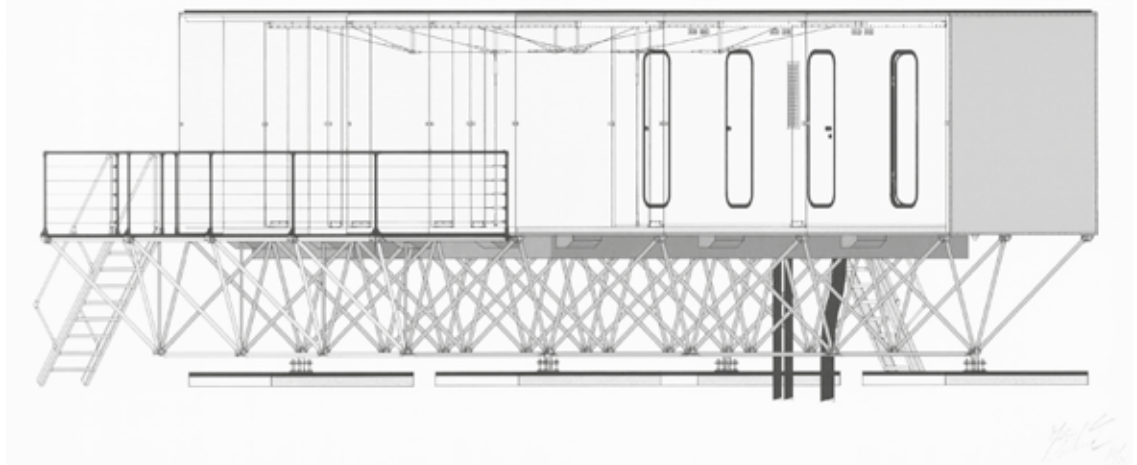
31
Jan Benthem in conversation with Karen McCartney, Museums of History NSW.

of 6.5 meters and a 'wooden house' made of two distinct and separate volumes positioned on either side of the greenhouse. While the glass house opened to the environment, the wooden volumes offered protection from it. A series of steps were inserted into the volume, a nod to the client's professional practice as an actor, but equally an attempt to bring a dynamic volume into the space. On top of the boxes, an extra room and an extra storage space were proposed. Built by the client himself to reduce costs,[26] these volumes contained the bathroom, kitchen, storage room, and vestibule on the north side and two bedrooms with their storage on the south side.[27] The project combined a bioclimatic proposal with the *detournement* of an industrial product without adapting it to the new program. Rather, standard climate control systems were kept such as sunscreens, natural ventilation, white clay-based paint on the glass walls, and two fully insulated lateral façades. While the low-cost catalogue construction, simply placed on a concrete slab, met the client's economic ambitions, the box-in-box principle met the designers' environmental convictions.[28]

In the early 1980s, young Dutch office Benthem Crouwel Architects showed a different take on ecological awareness with a project that explored ways of building a demountable house entirely from ready-made components.[29] The Benthem House was one of the ten winning designs in a competition held in 1982 in Almere, a newly built city in the Netherlands, that called for the design of an experimental house without building regulations.[30] The ten winners were awarded a plot of land, free of charge, on which the house could remain for a period of five years. The competition stipulated that the projects and their foundations had to be easily dismantled, leaving no trace on the land.

The house consisted of a closed area of 2×8 meters with two small bedrooms, a kitchen and a bathroom, and a fully glazed living area of 6×8 meters. The architects used precast concrete for the foundations, a spatial steel structure to support the lower floor, corrugated steel for the floor and roof, sandwich panels for the two bedrooms and service rooms (kitchen and bathroom), and 12-millimeter-thick single-pane reinforced glass for the living room. The house was built in three days by Jan Benthem and Mels Crouwel themselves, with the help of colleagues, friends, and family. Benthem lived in the house with his wife, son and two cats for 25 years. The extraordinarily high-tech construction resisted wind pressure in three ways: first, the space-frame floor structure was attached to concrete foundations; second, stabilizing fins were strategically placed at the seams of the tempered glass panels; and finally, two steel tension cables, anchored in the floor, secured the lightweight profiled steel roof.

In Almere, this small self-built house relied entirely on technological choices to reduce both material and construction costs. 'I studied at Delft Technical University, a school which was producing more engineers than architects. With this project, I thought I would produce the project much more as an engineer than as an architect,' recalled Jan Benthem in a recent interview.[31]



↑ Benthem Crouwel's Benthem House (also called Hard Glas), Almere, the Netherlands, 1982.

↓ Elevation of Benthem Crouwel's Benthem House (also called Hard Glas), Almere, the Netherlands,1982.

32 Ibid.

33 As suggested by Philippe Rizzotti in 'The Weight of a Building,' *Costruire Léger et Decarboné*, exhibition booklet *L'empreinte d'un habitat* (Paris: Pavillon de l'Arsenal, 2021).

34 Felicity D. Scott, Architecture or Techno-Utopia (Cambridge, MA: MIT Press, 2010).

35 This text is a reworked and extended version of: Véronique Patteeuw, 'The Inflation of Architecture,' *Matières* 18 (2024).

'In response to the competition, I proposed to reduce the house and every single component to the simplest and most technical solution. A very light house would have the least problems with the instable Dutch polder soil; a very solid construction would be both flexible and sustainable through time.'[32]

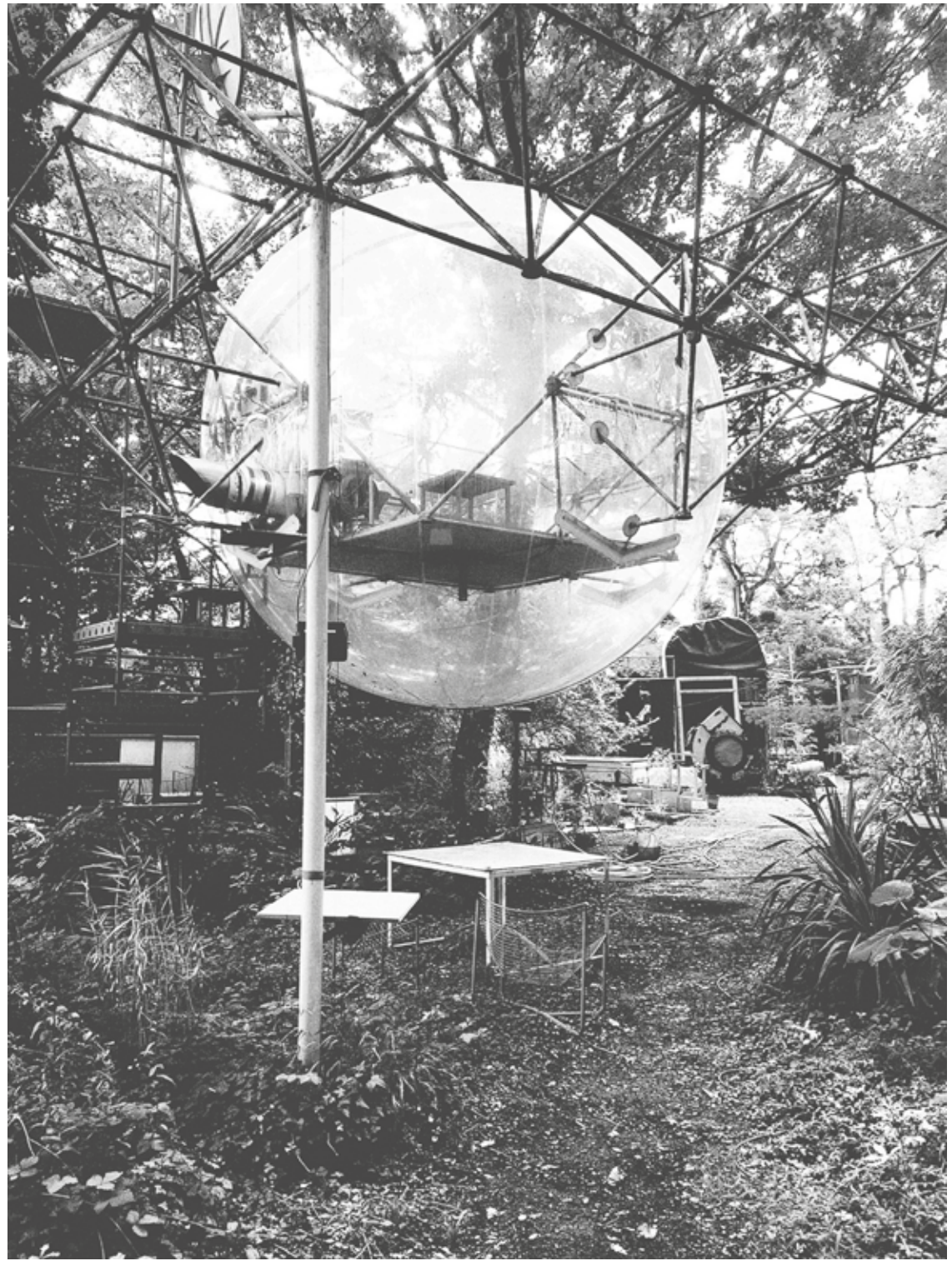
While Perraudin Jourda borrowed an existing greenhouse, Benthem Crouwel developed a 'temporary' project in prefabricated panels of tempered glass. The former aimed at an economy of means, the latter at an economy of weight on the site. But despite these fundamental differences, the two houses shared a common position: combining technological advances with environmental concerns, their architects sought to reduce the weight of their buildings and shrink their footprints.[33] They wanted to shorten construction times and explore the afterlife of their buildings. Ultimately, with an aesthetic distinctly different from that of hippie projects such as Drop City and Earthships, these architectures demonstrate a lesser-known facet of high-tech architecture, one that goes beyond mere technological advancement or the playful arrangement of prefabricated components, but timidly engages with environmental concerns.

The Disappearance of Architecture

In the 1960s and 1970s, interest in lightweight construction ran parallel to environmental debates within and outside the field of architecture. Architects and collectives such as Haus-Rucker-Co, Ant Farm, François Dallegret, Coop Himmelb(l)au, and Archigram questioned the permanence of a building with projects driven by techno-optimism that aimed to be autonomous, cheap, self-sufficient, easily transported, and quickly assembled. Their prosthetic devices and air-filled structures formulated a critical stance on the nature of architecture itself, altering perceptions of space, changing fundamental notions of structure and envelope, and eluding the laws of gravity. As Felicity Scott argued, these practices reflected a concern for the ecological future combined with the promise of a better world, as direct responses to a changing discourse on the nature of architecture.[34] Architecture dematerialized, took the form of inflatables, and (almost) disappeared. Was this the end of architecture?[35]

Inflatable architecture challenged the standard tenets of building, as structures with no fixed form that could not be described by means of the usual architectural representations of plan and section. Most inflatables were limited to temporary theoretical projects or research missions, and mostly refrained from proposing realistic living environments. Two lesser-known figures, however, were able to translate their experimental research into lived experience: German engineer and architect Hans-Walter Müller and Belgian architect and educator Lode Janssen. The story of their homes casts a different light on the utopian inflatables of the 1960s and 1970s.

↑ Oase No. 7 (Oasis Number 7) by Haus-Rucker-Co for the 1972 documenta 5 exhibition in Kassel, West Germany.



↑ Sound Structure with Resonance Ball by German architect and artist Hans-Walter Müller, here photographed in 2019.

Interested in kinetic structures from an early age, Hans-Walter Müller created several inflatable installations at the end of the 1960s before building his own home. His 1969 church in Montigny les Cormeilles could accommodate 200 churchgoers in a triangular inflatable weighing no more than 39 kilograms. In 1970, he realized an experimental balloon theater for the Fondation Maeght in Saint Paul de Vence. The structure could house 800 visitors to support performances by John Cage and Merce Cunningham. Müller's architecture sought to escape the laws of gravity: it was not based on the assembly or superimposition of building components, but found ways to extract itself from any classical and 'constructive' understanding of architecture.

It was exactly this quest that led Müller to leave his studio in Paris and, beginning in 1971, to build an inflatable house for himself and his wife on an experimental site near the airfield of La Ferté-Alais, south of the French capital. There, over the course of the last 50 years, he created a habitat composed of units, workshops, archival spaces, storage containers, and summer lounges. A large inflatable, 400 square meters in size, serves as the couple's workshop and houses the high-frequency welding machine used to assemble the strips of canvas used to construct the architecture on site.[36] The translucent walls are made of membranes a few millimeters thick, porous to the sight and touch, sometimes transparent, sometimes golden yellow or bright red. The interior, kept under pressure, produced a tension in the canvas that provided resistance and stability. Curved, zigzagged, covered in dead leaves, rain or snow, the envelopes transform with the seasons, constantly altering the perception of the outside space. Müller's inflatables not only propose experimental living close to nature, but also question the very nature of architecture itself. For him, architecture is both fragile and alive: the canvas is a skin, and the pump is a heart. It has to work constantly. If it stops, the architecture deflates and disappears.[37]

The dwelling built by Belgian architect Lode Janssens for himself and his family belongs to the same period as Müller's house. The 1969 moon landing device and the womb – two primordial forms of living – inspired Janssens to design a balloon house. At the end of a partially paved driveway leading to the back of a plot of land in Humbeek, north of Brussels, a large transparent PVC membrane, 14 meters in diameter, was used as a domestic space from 1973 to 1982, at a constant pressure of 1,47 millibar. In a vast open space, living areas, kitchen, study, and office were organized. The master bedroom, designed as a lunar excursion module cell, strongly reminiscent of Archigram's 1967 Living Pod and was situated at the center of the balloon. The children's bedrooms were separate, closed volumes, positioned outside of but connected to the balloon.

In Janssens' balloon house, living with nature became an intense experience. The balloon was neither insulated nor heated: it offered a microclimate that was 'undeniably unusual and far from stable,' as one visitor to the balloon recalled.[38] Indeed, the wind pushed the balloon gently, rain made noise on the membrane, and temperatures dropped when clouds passed. When snow covered the balloon, the interior darkened. Janssens' architecture sometimes clashed with reality. The plastic expanded more than calculated, the balloon leaked, and so much moss grew on the dome that the family had to sweep the circular windows to let in daylight. Janssens had planned to tear down the house when the experiment ended after about ten years. A blizzard beat him to the punch.

While Janssens' project is clearly reminiscent of the space race and a time of high-tech optimism, the architect claimed that his house was not a high-tech experiment, but rather handcrafted architecture. He saw the house not as a utopian statement, nor as an architectural project, but as 'a pedagogical experiment' for himself and his family, Aldo van Eyck's thresholds and Louis Le Roy's idea of guiding nature were more important references than the work of Archigram or Buckminster Fuller. 'We had formulated the ambition that afterward – after ten years of experimenting – we would share our findings as a common, not as a dogma, but as an example of a possible future of living. I wanted to experience that personally, at least once.'[39] Indeed, the building imposed conditions of impermanence: both the house and the act of dwelling were nomadic, unstable, and constantly shifting between new forms of appropriation. Retroactively, Janssens framed it like this: 'I was especially attracted to create a form of "de-architecturalization": how not to make any architecture. But this is definitely not anti-architecture. I sought more to create a conditioned, temporary environment.'[40]

Architecture historian Reyner Banham offered another take on inflatable dwellings in a comment on a house imagined by architect François Dallegret: 'They demonstrate the hollowness of the fear of many architects that acceptance of the dominance of environmental machinery will be "the end of creativity."'[41] Banham believed in the potential of technology, even if it would lead to the dematerialization of architecture. Inflatable architecture could indeed be positioned in between a low-tech DIY attitude and a high-tech belief in the capabilities of environmental machines. A stretched skin replaces the traditional walls; the internal pressure gives the envelope its strength. Only a small part of the construction consists of 'matter': air has replaced solid materials, and the skin between inside and outside – a few millimeters thick – is extremely delicate. Faced with the forces of nature, the inflatable volume is not rigid, but interacts with snow, light and wind, deforming in response to these impacts. Architecture dematerializes and – one might argue – almost disappears. Were these inflatable experiments a way of liberating oneself from the very act of building, or did they announce a new and more environmentally conscious era?

The houses by Hans-Walter Müller and Lode Janssens offered their occupants a lived experience, proposed a pedagogical project for future generations, and counterbalanced the paper architecture of their contemporaries. Separated from the outside by a thin membrane and in constant relationship with the environment, they introduced new ways of living. Both houses were open to students,

36 Philippe Rizzotti, *L'empreinte d'un habitat* (Paris: Pavillon de l'Arsenal, 2022), 54. See also: Hans-Walter Müller, 'Pourquoi le gonflable?,' *Techniques et Architectures* 304 (1975), 73–74.

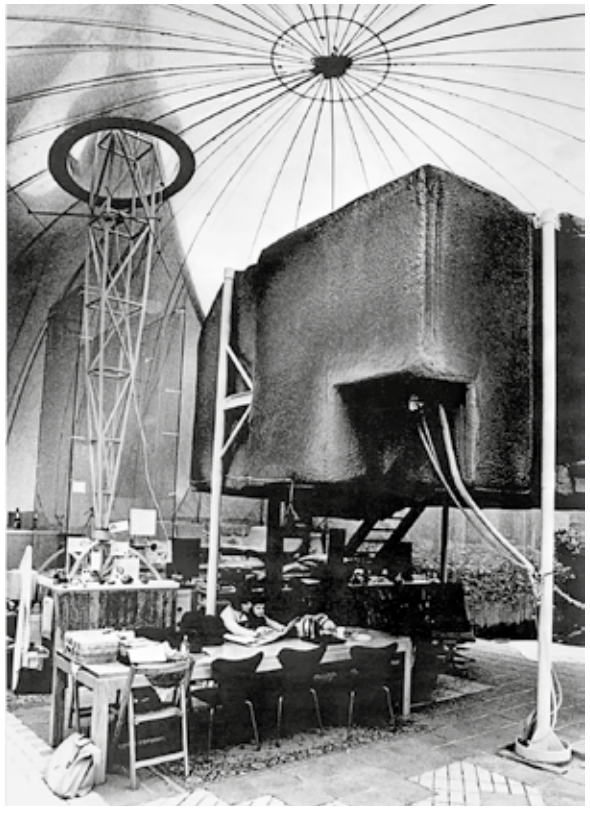
37 Benjamin Leclercg, 'Hans-Walter Müller, l'architecte qui gonfle des maisons "insolides,"' usbeketrica.com/fr/article/hans-walter-mueller-l-architecte-qui-gonfle-des-maisons-insolides.

38 Pieter Uyttenhove, 'Living and Building with Air,' in: Peter Swinnen and Nikolaus Hirsch, *A.J. Lode Janssens, 1,47 bar* (Leipzig: Spector Book, 2021), 163.

39 Peter Swinnen and A.J. Lode Janssens, 'A temporary datum,' in: ibid., 50.

40 Ibid., 52.

41 Reyner Banham, 'A Home Is Not a House,' Art in America 2 (1965), 73.



↑↓ Lode Janssens' Balloon House, Humbeek, Belgium, 1979.

architects, and interested laypeople (in fact, Müller's house can still be visited today). Closed off but uninsulated, these houses were the forerunners of many of today's projects that deal with different climates. They illustrate how the location of material resources and spaces in the territory is taken to extremes in a very impermanent way. Both Janssens and Müller sought an architecture that would be so light and impermanent that even the technologies of heating would not interfere.

The 1970s, often referred to as the golden age of activism, began with the establishment of Earth Day on 22 April 1970. For some architects, the solution was not only laying in the future, nor was it to be found in the past; they proposed to act in the immediate present. Blurring the boundaries between activism, circular building, and impermanence, they persistently explored the weight of the architectural project. Attempting to reduce the act of building to a minimum, their projects often included or relied on temporary constructions that succumbed to the intemperate conditions of nature and/or imposed harsh living conditions on their inhabitants. These homemade laboratories, where architects often lived as guinea pigs with their families, were important learning environments and remain key witnesses to the entanglement of architecture, building, and environmental awareness.

The circular, community-oriented, and pragmatic approaches described in this chapter show how architecture can activate new futures and challenge the status quo by acting in the here and now. Representing only a of the effervescent breath of activist projects that emerged around and after the 1970s, the examples presented here show forms of inventiveness in relation to architecture's footprint. It is an important role for architecture to play, but as the examples show, these efforts are often met with reluctance and skepticism by the field. The more activist approaches that challenge the status quo are not uncommon, but they are evidence of what is possible: many of the ideas and initiatives have found their way into the mainstream. They offer us hints of what an architect can do by embracing sustainability, community, and direct action, and thus form an important part of the architecture of change.

↑ Entrance to the exhibition 'Architecture Without Architects: A Short Introduction to Non-pedigreed Architecture,' curated by Bernard Rudofsky and presented at the MoMA, New York, USA, from 11 November 1964 to 7 February 1965.

↓ View of enlarged black-and-white photographs in the exhibition 'Architecture Without Architects: A Short Introduction to Non-pedigreed Architecture.'

Chapter 5: Materials, Materiality, Nature, and the Long-Term Perspective

Lead authors:
Véronique Patteeuw and Léa-Catherine Szacka

L'architecture la moins chère économiquement, n'est pas la moins chère en architecture.[1]

In November 1964, the Museum of Modern Art in New York (MoMA) opened the exhibition 'Architecture Without Architects: A Short Introduction to Non-Pedigreed Architecture.' Curated by Austrian architect, engineer, and critic Bernard Rudofsky, the show suggested, in an institutional context, that architecture could be produced by others than trained architects. It introduced the term 'non-pedigreed' architecture, which Rudofsky attributed to buildings that were not designed by formally trained architects, but whose status transcended that of the 'mere building.' More importantly, he argued that architects might have something valuable to learn from these often premodern forms of building.

With 200 enlarged black-and-white-photographs, the show offered a journey around the world to 'break down our narrow concepts of the art of building by introducing the unfamiliar world of non-pedigreed architecture.'[2] The photographs on display invited visitors to explore indigenous building traditions, visible in the diverse living conditions, architectures, and landscapes collected by Rudofsky. 'The beauty of this "primitive" architecture has often been dismissed as accidental, but today we recognize in it an art form that has resulted from human intelligence applied to uniquely human modes of life,' the curator emphasized in the exhibition catalogue.[3] For Rudofsky, there was a certain wisdom to be gleaned from these local constructions, something that went 'beyond economic and esthetic considerations, and touches the far tougher problem of how to live and let live.'[4]

Widely criticized at the time and often oversimplified as a mere humanist ode to threatened but authentic vernacular architectures around the world,[5] 'Architecture Without Architects' nonetheless became one of the most emblematic exhibitions in the history of MoMA.[6] It brought a broader concern for the environment to the center of architectural attention, in the very display of ancient and vernacular building traditions: 'There is much to learn from architecture before it became an expert's art,' Rudofsky insisted, before writing that these non-architects 'demonstrate an admirable talent for fitting

1 Hassan Fathy interviewed at his Ottoman-Mamluk, in: Borhane Alaouié (dir.), *Il ne suffit pas que Dieu soit avec les pauvres*, 1978, film-documentaire.fr/4DACTION/w_fiche_film/5407_0.

2 Bernard Rudofsky, *Architecture Without Architects: A Short Introduction to Non-Pedigreed Architecture* (New York: Museum of Modern Art, 1964), 1.

3 Ibid., cover.

4 Ibid.

5 Vernacular architecture refers to buildings built outside of any academic tradition and without professional guidance. See, for example: Felicity D. Scott, *Disorientation: Bernard Rudofsky in the Empire of Signs* (Berlin: Sternberg Press, 2016).

6 The great success of this exhibition was amplified by its widely distributed catalog. Interestingly, however, Luke Jones suggests that the idea of a vernacular architecture exhibition at MoMA had been proposed by Rudofsky as early as the 1940s, but was politely rejected by the museum, which was happy to acquire Rudofsky's collection of black-and-white photographs, but left them untouched in its archives. See: Luke Jones, 'Afterthoughts on Vernacular and Spontaneity,' medium.com/@tlukejones/afterthoughts-on-vernacular-and-spontaneity-63730aaade89.

↑ Canadian Minister of Justice Rod Basford, spouse of the Canadian prime minister Margaret Trudeau, and conference president Barney Danson, during the World Water Day walk at the 1976 United Nations Habitat I conference in Vancouver, Canada.

their buildings into the natural surroundings.' What Rudofsky was trying to communicate with his exhibition was that architects should learn from premodern architectural forms. His approach suggested an aesthetic and methodological shift; instead of trying to 'conquer' nature as we do, these approaches, he claimed, 'welcomed the vagaries of climate and the challenge of topography.'[7] While Rudofsky's exhibition marked a turning point in the attention paid to premodern architecture, it also elevated these buildings to the status of art. By approaching them with a purist gaze, and erasing any changes that had occurred over time, Rudofsky not only '[museumified] the vernacular, but in order to do so, he flattened down countless years of changes and efforts, failures and successes, into a fixed and idealized moment.'[8]

Despite Rudofsky's claim that 'exotic architecture,' unlike exotic art, 'has evoked no response, and is still relegated to the pages of geographic and anthropological magazines,'[9] an interest in vernacular architecture in relation to environmental challenges predated the 1964 exhibition. In fact, since the 1950s, German art historian Sibyl Moholy-Nagy and Polish architect Amos Rapoport had been highlighting the talents of anonymous house builders, emphasizing an architecture that did not belong to the fields of design specialists or the construction industry, but to a much older tradition.[10] Their work recognized indigenous regional architecture was as an important object of study, and served to criticize an institutionalized architectural practice that neglected the human and cultural aspects of building. More importantly, these interests in vernacular architecture and premodern forms of building allowed architects to explore alternative building practices in light of the growing environmental awareness of the time.

The link between building practices and environmental concerns was the focus of a number of governmental discussions in the 1970s.[11] The UN Conference on the Human Environment, held in Stockholm in 1972, recommended 'eco-development,' but also paved the way for an approach to human settlements within the broader context of environmental concerns.[12] The 'Habitat 1' meeting in Vancouver from 31 May to 11 June 1976, for instance, discussed inequalities in living conditions, social segregation, disease and poverty, but also the breakdown of traditional cultural values and the increasing degradation of life-supporting resources such as air, water, and land.[13] In Vancouver, participants exchanged on methods, diagnoses, and analyses on how to build socially and ecologically sustainable housing. The first World Climate Conference was held three years later, from 12 to 23 February 1979. Essentially a scientific conference, it was one of the first major international meetings on climate change and was attended by scientists from a wide range of disciplines. It has led to the establishment of the World Climate Program, but also to the creation of the Intergovernmental Panel on Climate Change (IPCC), which was established in 1988.

How does climate awareness relate to an interest in premodern forms of building? Do we see parallels between 'non-pedigreed' architecture and ecologically sustainable experiments? This chapter

7 Rudofsky, *Architecture Without Architects*, op. cit. (note 2), 4.

8 Vasileios Chanis, 'In Quest of Meaning: Revisting the Discourse around "Non-Pedigreed" Architecture,' tacit-knowledge-architecture.com/object/in-quest-of-meaning-revisiting-the-discourse-around-non-pedigreed-architecture-2/.

9 Rudofsky, *Architecture Without Architects*, op. cit. (note 2), 3.

10 See: Hilde Heynen, Sibyl Moholy-Nagy: *Architecture, Modernism and its Discontents* (London: Bloomsbury, 2019), particularly Chapter 2: 'Vernacular Architecture and the Uses of the Past.'

11 Felicity Scott, *Outlaw Territories: Environments of Insecurity/Architectures of Counterinsurgency* (Brooklyn: Zone Books, 2016).

12 UN Habitat 1 press release, habitat.scarp.ubc.ca/wp-content/uploads/2018/03/UN_RoundUpHabitatUNConferenceOnHumanSettlementsAdopts Declaration_11061976.pdf.

13 Vancouver Declaration 1976, documents-dds-ny.un.org/doc/UNDOC/GEN/N76/967/11/PDF/N7696711.pdf?OpenElement.

↑ House of the Indigenous Otomi people of Mexico, in the state of Hidalgo, photographed by Sibyl Moholy-Nagy, 1957.

explores architecture's relationship to the *long term*, envisioning approaches to the built environment that consider the wellbeing of generations to come. Starting from Roman Krznaric's 2020 book *The Good Ancestor: How to Think Long Term in a Short-Term World*, a reflection that invites us to build 'a society that overcomes its current myopic focus on the present,'[14] this chapter examines ancestral ways of thinking within architectural practice. It stresses the importance of time, history, and archaic building techniques within architectural practice, and the need to reevaluate and recontextualize alternative practices, materials, and methods for the transitions ahead.

Building with Earth

Over the course of the twentieth century, and often in parallel with a growing environmental awareness, architects have worked with locally sourced materials and developed strategies for integrating them into the designs of their projects. They have embraced ancestral *savoir-faire*, craftsmanship, and building traditions long considered antithetical to progress, modernity, and comfort. Their approaches have often involved the revival of archetypal modes of construction, taking up the primitive gesture of 'building,' using, for instance, logics of stacking, simple assemblages, or excavation in an attempt to root their projects in a specific local tradition and to link them explicitly to an environmental approach.[15]

An important example of twentieth-century architectural interest in local building was Egyptian architect Hassan Fathy, who proposed a heterodox interpretation of modernity in a country dominated by the Western gaze.[16] Claiming that architecture should be in tune with what he called a certain form of *arabité*, or Arabic culture, Fathy grounded himself in its region, climate, and building traditions. His interest in traditional values encouraged an environmentally appropriate approach to low-cost housing, using local materials (often mud bricks) and local knowledge.[17]

In 1942, Fathy realized one of his first mud-brick buildings: a residence for artist Hamid Said and his wife in the al-Marg neighborhood of Cairo. The house was exemplary for its use of premodern building techniques and materials. Built in two consecutive phases, it contained a simple studio and sleeping space with a large, vaulted loggia overlooking the palm grove that surrounded the property. The second phase of the house included a gallery with views of the central courtyard connecting both parts of the house.[18] The construction of the Hamid Said House coincided with a period of rising concern among Egypt's intellectual community about the detrimental effects of industrialization on traditional cultures. In the face of this threat, Egyptians felt a growing need to explore their traditions.[19] While for Said the house was intended to reconnect with Egypt's agricultural heritage, for Fathy it was a testament to his insistance that nature should take precedence in the design of new structures.[20]

14 Roman Krznaric, *The Good Ancestor: How to Think Long Term in a Short-Term World* (London: Penguin, 2020), 18.

15 Stéphane Bonzani, *l'Archaïque et ses possibles* (Geneva: Métis Presses, 2020).

16 The 'Western Gaze' succinctly expresses a particular, historically constituted way of perceiving and experiencing the world. It is a gaze that skims the surface; surveys the land from an ego-centered viewpoint; and invokes an active viewer (the subject) and a passive land (object). This active viewer is equated with 'culture' and the land with 'nature'; and viewer/culture are gendered male, land/nature are gendered female. Finally, the Western Gaze is about control. See, for example: Barbara Bender, 'Subverting the Western Gaze: Mapping Alternative Worlds,' in: Robert Layton and Peter Ucko (eds.), *The Archaeology and Anthropology of Landscape* (London: Routledge, 1999).

17 Le Corbusier's 1940 Murondins Houses project is another important example that precedes Fathy. See, for instance: Mary McLeod, 'To Make Something with Nothing': Le Corbusier's Proposal for Refugee Housing: Les Constructions "Murondins,"' *The Journal of Architecture* 23/3 (2018), 421–447.

18 James Steele, *The Hassan Fathy Collection: A Catalogue of Visual Documents at the Aga Khan Award for Architecture* (Bern: The Aga Khan Trust for Culture, 1989).

19 Ibid.

20 Fathy's choice to build with clay was also fostered by the outbreak of the war, which had blocked the import of iron and timber.

Fathy is best known for his 1969 book *Gourna: A Tale of Two Villages*,[21] which describes the architect's 1945 experiment to rehouse the inhabitants of Gourna, a village in Upper Egypt near Luxor.[22] Envisioned as a new village of houses in quaint streets and squares that would become a prototype for economical and sanitary housing sensitive to rural lifestyles, Gourna would make the most of local traditions by enhancing the value of manual labor.[23] Given the country's economic conditions, the architect opted to realize the village in mud-brick architecture with vaults without arches to save wood while maintaining aesthetic quality.[24] The project proposed working with local artisans and the buildings' users to revive premodern traditions of building with handmade, sun-dried mud bricks, and to provide an alternative to mass-produced, reinforced concrete housing projects. 'Tradition,' Fathy asserted, 'is not necessarily outdated and synonymous with immobility. What's more, tradition doesn't have to be ancient, but can very well have been established recently. Every time a worker encounters a new difficulty and finds a way to overcome it, he or she is taking the first step toward establishing a tradition.'[25]

Traditional ways of thinking about the building practice and its relationship to materials were also at the heart of the practice of Iranian-American architect Nader Khalili, who in the early 1980s invented the Super Adobe or Earthbag Construction system, a simple but highly effective construction method that consists of sandbags filled with earth and 'laid in courses to construct a structure that has compression strength based on the structural principle of domes, whilst barbed wire placed between the bags provides tensile strength, also making it earthquake resistant.'[26] Made of local and environmentally friendly materials, these structures are used to build shelters quickly, as they can be assembled without the need of skilled labor. Khalili's Super Adobe structures are inspired by the traditional arid house designs of his native Iran. Based on traditional principles but further developing them, they embody what Khalili qualifies as 'timeless principles and timeless materials.'[27]

Khalili spent five years studying vernacular desert architecture and the work of poet and philosopher Jalaluddin Rumi.[28] In 1984, Khalili developed the Super Adobe system in response to a NASA call for designs for human settlements on the Moon and Mars at the Lunar Bases and Space Activities of the 21st Century symposium.[29] The Super Adobe system was used during the Persian Gulf War when Khalili partnered with the United Nations Development Program (UNDP) and the United Nations High Commissioner for Refugees (UNHCR) to build emergency shelters for refugees sent to Iran. In 1988, Khalili worked on the design of a futuristic community for 5,000 inhabitants in New Cuyama, California. For this project, he built an on-site prototype and designed prefabricated vault modules that were fired, and glazed at a brick factory.

The interest in locally-sourced architecture in architectural practice ran parallel to an increase in attention to earth-based building in academic research and architecture culture. One of the oldest examples of this is CRAterre (le Centre de Recherche et

21 The book was translated into many languages, included French in 1970, with the provocative title *Construire avec le Peuple*. The American edition, Architecture for the Poor was published in 1973, almost three decades after the project's construction.

22 Hassan Fathy, *Architecture for the Poor* (Chicago: The University of Chicago Press, 1973).

23 Panayiota I. Pyla, 'Hassan Fathy Revisited: Postwar Discourses on Science, Development, and Vernacular Architecture,' *Journal of Architectural Education* 60/3 (2007), 28–39.

24 Thierry Paquot, 'Hassan Fathy, construire avec ou *pour* le peuple?,' *Cahiers d'histoire* 109 (2009), 15–25.

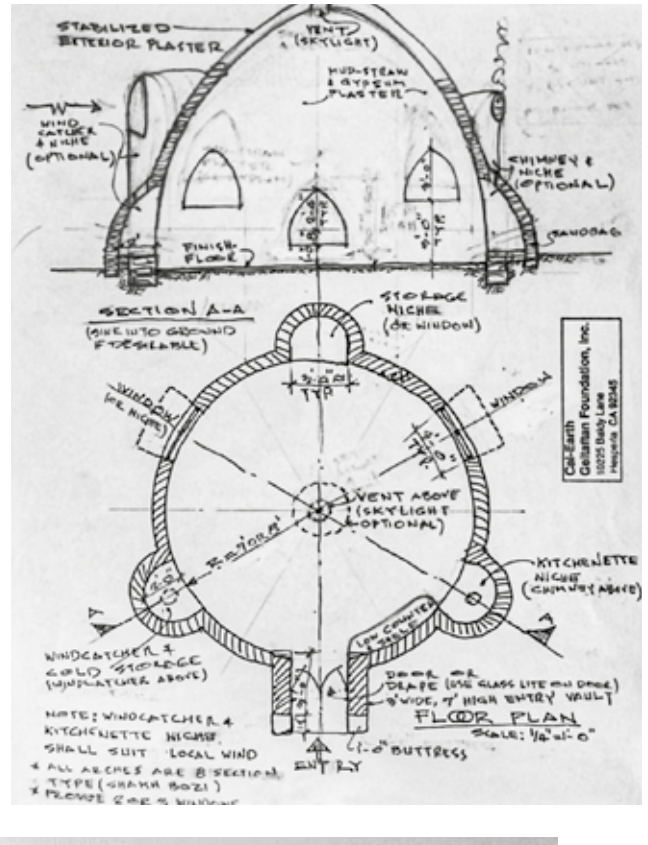
25 Fathy, *Architecture for the Poor*, op. cit. (note 24), 59.

26 Spatial Agency, spatialagency.net/database/nader.khalili.

27 K. Lauren de Boer, 'Building with Earth Is Sacred Work: An Interview with Nader Khalili,' *Earth Light* 32 (1998–1999), 21.

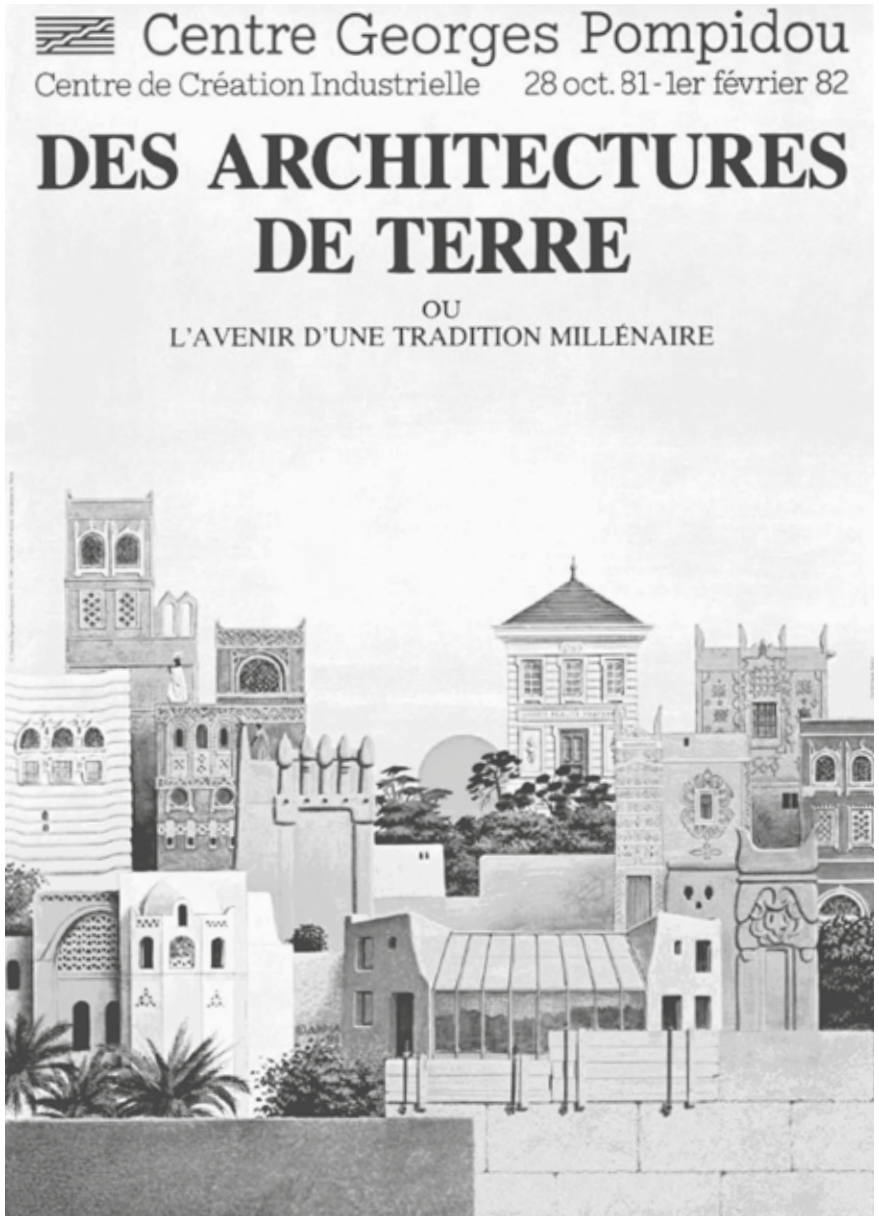
28 Spatial Agency, op. cit. (note 26).

29 See: calearth.org/pages/our-founder.



↑ Sketches of the Baninajar Refugee Camp in Iran, designed by Nader Khalili, and built with the Superadobe construction system.

↓ Iranian American architect Nader Khalili in front of a demonstrative structure built using the Superadobe construction system, 1980s.



↑ Poster of the exhibition 'Des architectures de terre: ou 'l'avenir d'une tradition millénaire' (Earthen Architecture: The Future of an Age-Old Tradition), Centre Pompidou, Paris, France, 1981.

30 'Craterre tourne l'architecture de la terre crue vers l'avenir,' *La revue durable* 19 (2006), 41–43.

31 In parallel, CRAterre initiated scientific research to understand the geological, physical, and chemical specificities of the material, in order to improve its constructive behavior and uses. See, among others: Jean Dethier, 'La CRAterre, l'expérience made in France,' *Ecologik*, dossier spéciale Architecture de terre, 12 (2010), 66–69.

32 Jean Dethier (dir.), 'Des architectures de terre ou l'avenir d'une tradition millénaire,' 28 October 1981 to 1 February 1982, Centre Georges Pompidou, Paris.

33 Organized only four years after the opening of the Centre Pompidou, the exhibition 'Des Architecture de Terre' was curated by Jean Dethier and produced by the Centre de Création Industrielle (CCI) of the Centre Georges Pompidou, co-produced in collaboration with the Deutsches Architektur-museum of the city of Frankfurt and the Fondation des Pays de France. In order to increase the impact of the main exhibition, the CCI published several hundred copies of a reduced version of the exhibition in a series of 90 color plates. This 'mini-exhibition,' made with the support of the Fondation des pays de France, was presented simultaneously with the main exhibition in more than 50 cities in France by the Regional Banks of Crédit Agricole.

d'Application en terre). The international research laboratory was founded in 1979 at the Grenoble School of Architecture by architect Patrice Doat, who was joined in 1981 by Hubert Guillaud. The two architects had developed a fascination for vernacular earth-based building in their diploma projects.[30] At its inception, CRAterre explored the universal testimonies of vernacular architecture in order to interpret its constructive intelligence. In 1989, Doat and Guillard's critical inventory of many ancient building techniques led to their 'Traité de construction en terre,' an encyclopedically exhaustive synthesis providing rationalized ancestral technical logics and know-how on earth-based building.[31] Over the years, CRAterre turned into a research laboratory and an international reference for building in earth.

In 1981, CRAterre participated in a major exhibition at the Centre Pompidou in Paris entitled 'Des architectures de terre ou l'avenir d'une tradition millénaire.'[32] Curated by Jean Dethier, the exhibition presented examples of earth architecture from around the world, including large-scale models that gave the show a scenographic appeal.[33] The aim of the exhibition was to challenge the common disdain for mud-brick architecture, which was too often associated with images of archaism and poverty. Dethier's contribution was to introduce earth architecture into the architecture discourse of the time and to reclaim its value in the aesthetic realm of the field. The exhibition was divided into two parts, one presenting the many facets of this little-known cultural heritage and the other showcasing numerous recent architectural achievements in earth. Focusing on tradition, modernity and the future, it included 17 giant earthen models of traditional architecture, each over 3 meters high; 250 photographs, many of them previously unpublished; some 50 original watercolor drawings of contemporary earthen architecture; around ten artistic creations commissioned from artists from five countries (ceramists, sculptors, cardboard makers, upholsterers); and an 'Earth Workshop' in which visual artists invited children to create earthen environments based on existing or imaginary architecture.

Parallel to the rise of postmodern architecture, in which questions of form, irony, and communication prevailed, some architects and scholars became interested in material approaches that harkened back to premodern practices. Their interest in archaic forms of building was based on tradition and the important lessons of vernacular thinking. Learning from the past, these architects developed practices that sought to build for the long term and invest in future generations.

Building with Nature

The second attitude that architects have adopted as a form of ancestral thinking in architecture has been to literally build with nature, sometimes even allowing nature free to dictate the forms, shapes, and experiences of the building. These architects and landscape designers integrated the environment directly

↑ Ian McHarg (right) and Mike Douglas (left) in *The Mike Douglas Show*, 29 August 1969.

34 See: americanarchive.org/catalog/cpb-aacip_512-v97zk56n58.

35 Ibid.

36 In 1959, McHarg first organized the course 'Man and the Environment' at the University of Pennsylvania, which became the most popular course on campus in the 1960s and 1970s.

37 Ian L. McHarg, Design with Nature (Philadelphia: The Falcon Press, 1969), cover. McHarg's book sold more than 250,000 copies and was compared by Lewis Mumford to the environmental clarion calls of Henry David Thoreau and Rachel Carson.

38 Frederick R. Steiner, 'The Ghost of Ian McHarg,' Log 13/14 (2008), 148.

39 McHarg, Design with nature, op. cit. (note 17), vii.

into their designs or used their buildings as a critical commentary on humanity's problematic relationship with nature. In the 1970s, partly in response to the first oil crisis, this kind of design attitude was reflected in the work of several architects, planners, and designers in Europe and the United States. Expanding the scope of landscape into that of architecture and architecture into that of landscape, these emblematic and sometimes visionary projects, such as those of Ian McHarg, Louis Le Roy, and Gilles Clement, reconnected with natural systems. Taking a radical stance against short-termism, they try to apply long-term planning and thinking, aiming to show that nature will survive the destructive economic civilization of modernity.

In the 1950s and 1960s, Scottish-American landscape architect and urban planner Ian McHarg urged landscape planners to adapt to ecology, not to compete with it. McHarg, a professor at the University of Pennsylvania, founded the university's Department of Landscape Architecture and Regional Planning in 1954. His course, 'Man and the Environment,' offered a broad exploration of the relationships between human evolution and natural history, based on a series of interviews McHarg conducted with geologists, botanists, anthropologists, and other scientists. The popularity of the course led him to host the CBS television series 'The House We Live In' in 1960 and 1961.[34] According to McHarg, the series was motivated by:

> … the belief that twentieth century man has no appropriate body of principles which allow him to deal with problems he confronts – as atomic man. The effects of twentieth century man, the most destructive agent known to history, upon his physical environment have been disastrous. If the pre-atomic era was characterized by man's concern for the acts of man to man, assuredly this post-atomic era must be characterized by a new concern for the acts of man upon his environment.[35]

McHarg's 1969 groundbreaking book *Design with Nature* argued a very simple fact: that humans should treat nature with respect.[36] Marking the high point of the ecological movement in the United States, *Design with Nature* showed that it was not just about design or nature as a separate, individual aspect, but about the cooperation between the two. More specifically, according to McHarg ecological wisdom could inform landscape planning and design. The book was hailed by the *Washington Post*'s architecture critic at the time, Wolf Von Eckardt, as 'one of the most important books of the century, a turning point in man's treatment of his environment.'[37] However, as by Frederick R. Steiner reminds us: 'McHarg's theories have been criticized and generally resisted because they are viewed as deterministic and anti-humanistic.'[38]

In the book's introduction, Louis Mumford described McHarg as an inspired ecologist who not only looked at ecology from the outside, but also saw the world from the inside: 'Nature, so far from being opposed and conquered, must rather be treated as an ally and friend, whose ways must be understood, and whose counsel must

be respected.'[39] While McHarg argued for a careful approach to both the ecology and landscape character in planning and design, he also explored how modern technologies could contribute to landscape research and was one of the first to approach this in a rational rather than intuitive manner. He proposed, for instance, to integrate sciences, arts, and planning in landscape architecture through what became known as the 'layer-cake method,' or suitability analysis, which predated and in part led to the invention of geographic information systems (GIS) and other mapping technologies.[40] In McHarg's wake, it's hard not to read much of the work of landscape architects as either an endorsement or a critique of his ideology and methods.

The call for a more integrated approach to design and nature was put into practice in the 1960s by Dutch visual artist Louis Le Roy. In 1973, Le Roy published *Natuur uitschakelen, natuur inschakelen* (Switch nature off, switch nature on), a book containing a long lesson in ecological principles based on the notion of 'wild gardening.'[41] For him, by intervening and designing less, mankind would leave room for a richer and more complex natural system that could sustain itself without help. In other words, Le Roy, like other Dutch contemporaries such as Constant Anton Nieuwenhuys, sought creative freedom and interaction between homo ludens, the playing human, and the environment within dynamic systems that have no beginning and no end, neither in space nor in time.[42]

In the 1960s, Le Roy developed a series of projects in public space based on ecological principles. In his view, modernist planning had led to both poor urban spaces and poor nature, and his goal was to restore natural complexity through a symbiotic development of built space and nature over a very long period of time. He rejected traditional park design and wanted parks to be made by citizens. After having created his own garden, Le Roy designed a richly varied public park and wildlife reservoir on a 1-kilometer-long, 15-meter-wide strip of land provided by the municipality of his hometown of Heerenveen. For the garden on President Kennedylaan, Le Roy took a lot of construction rubble and dug, stacked, sowed and planted haphazardly together with the residents. Over the years, Leroy's never-ending process created an increasingly complex system in which both humans and nature were allowed to take their course.

Le Roy's main argument was that humans are part of an ecosystem. This position, 'although not new as a standpoint, provided a counterweight to contemporary attitudes towards nature conservation.'[43] Following the garden experience on President Kennedylaan, Le Roy started his Eco-Cathedral, a project meant to develop over many centuries, based on the idea that the time scale of contemporary thinking was too short.[44] The town council provided a central strip of grass between the residential streets, called it a 'shift in popular opinion towards acceptance of "created" nature.' There, for 42 years, Le Roy piled up recycled paving materials and construction debris to create an ever-expanding structure of paths and buildings, some overgrown with vegetation. Indefinite

40 See also: Frederick Steiner and Ian McHarg, *Design with Nature Now* (Cambridge, MA: Lincoln Institute of Land Policy in association with the University of Pennsylvania Stuart Weitzman School of Design and The McHarg Center, 2019.

41 Louis Le Roy, *Natuur uitschakelen, Natuur inschakelen* (Deventer: Ankh-Hermes, 1973).

42 Ibid.

43 Jan Woudstra, 'From Counter Culture to Eco-Cathedral: The Continuing Legacy of Louis Guillaume le Roy,' *Dutch Crossing* 27/2 (2003), 276.

44 Ibid., 275.

45 Richard Ingersoll, 'Eat the City: The Case for Civic Agriculture,' *Places Journal* (June 2023).

46 Gilles Clément, *Manifeste pour le Tiers paysage* (Paris: Sens et Tonka), 2004.

47 Ibid. Translation taken from: manifattureknos.org/knos/media/images/events/tehpublicationmanifestoofthirdlandscape145x225mm2022webspreads.pdf.

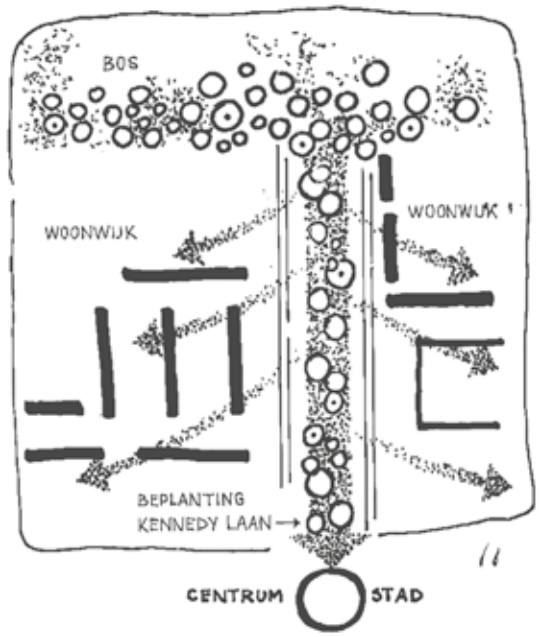
temporality and long-term thinking are at the heart of Le Roy's Eco-Cathedral, which is intended to evolve over 1,000 years. This is difficult to handle for politicians and administrators, who are usually only appointed or elected for a short period of time. In 2001, Le Roy founded the Stichting TIJD (Time Foundation) to continue his work after his death, and in 2005 he signed a contract with the municipality of Heerenveen to ensure the development of the Eco-Cathedral for the next 100 years.

Sharing an interest in long-term thinking with Louis Le Roy's, French gardener and landscape architect Gilles Clément places even greater emphasis on the idea that nature, if left alone, can flourish even in an urban setting. In 1995, together with artist Claude Courtecuisse and Empreint Paysage, Clément created an 8-hectare inaccessible or forbidden forest within the Parc Matisse in Lille. His Ile Derborence was realized close to the site of a vanished bastion of Vauban's old fortifications, on a 7-meter-high pedestal made of rubble from the construction site of the Gare de Lille-Europe1. A few species from the Northern Hemisphere (North America, Asia, Europe) were planted at the time of its creation and the environment was then left to evolve freely without human intervention. Derborence Island takes its name from the Derborence forest in Switzerland, one of the few remaining old-growth forests in Central Europe, which, due to its relative isolation and inaccessibility, has hardly been impacted by humans. For Clément, such unmanaged areas are not only important evolutionary habitats, but also havens for biodiversity.[45]

Clément's interest in unused remnants of the landscape led him to develop the concept of the *Tiers Paysage* (third landscape) in 2004.[46] In his manifesto, Clément argues that the spaces that are usually treated as neglected are the most important: they are privileged areas of receptivity for biodiversity and places of biological invention. They are the edges of roads, abandoned factories or quarries, or forgotten spaces:

> If we stop looking at the landscape as the object of an industry, we suddenly discover … a quantity of undecided spaces, devoid of function, that are difficult to name. This ensemble belongs neither to the territory of shadow nor to that of light. It's on the margins – on the edge of the woods, along the roads and rivers, in the forgotten corners of cultivations, where machines do not pass … There is no similarity of form between these fragments of landscape. Only one common point: they all constitute a refuge area for diversity. Everywhere else, diversity is driven out. This justifies bringing them together under a single term. I propose 'Third Landscape'… Third Landscape refers to Third State (not Third World) – space expressing neither power nor submission to power.[47]

Clément's text invites us to cultivate spaces of 'non-action' at all levels of our lives, at a time when climatic and economic imperatives can seem contradictory.

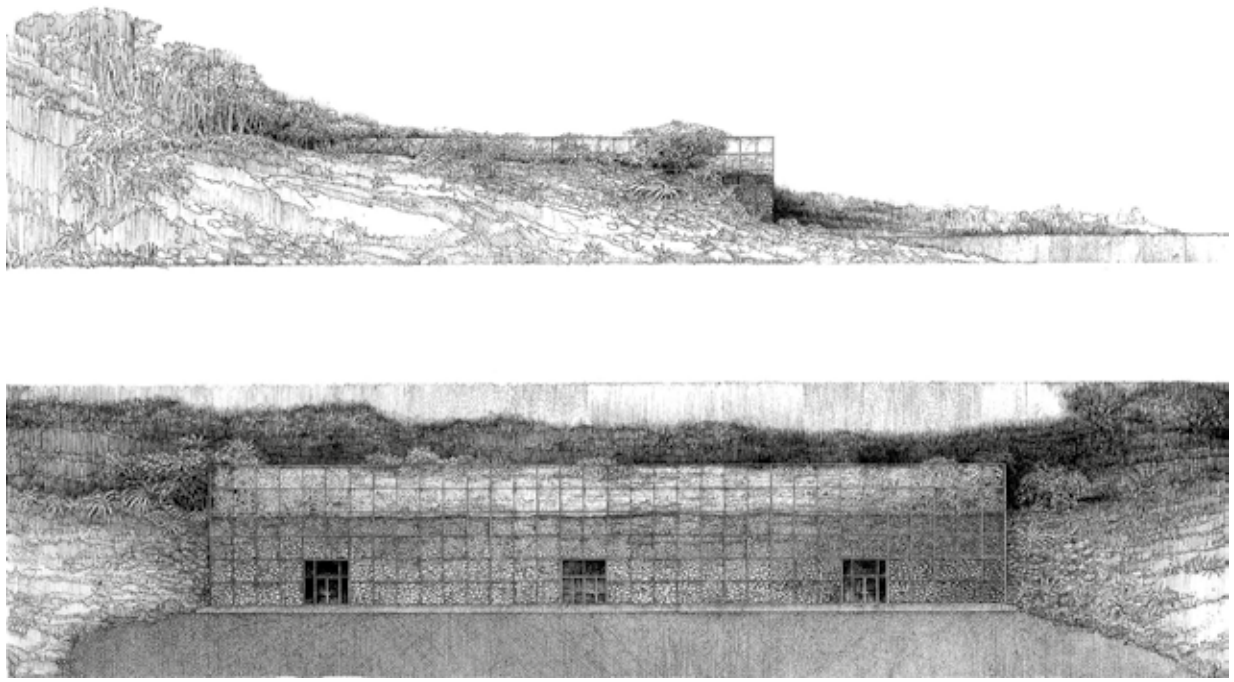


↑ Drawing by Louis le Roy, published in *Natuur uitschakelen natuur inschakelen*, 1973.

↓ Dutch artist Louis le Roy's Ecokathedraal in Mildam, the Netherlands.

↑ Gilles Clément, *Île Derborence*, Parc Matisse, Lille, France, 1995.

↓ Sketch by Gilles Clément from *Manifeste du Tiers paysage*, showing the development of the urban fabric in concentric patterns.



↑ SITE Inc., BEST Products Indeterminate Façade in Houston, Texas, USA, 1975.

48 Penelope Dean, 'Never Mind All That Environmental Rubbish, Get On With Your Architecture' *Architectural Design* 79/3 (2009), 24–29.

49 Architect James Wines on "Nature's Revenge," *MoMA Built Ecologies: Architecture and Environment*, youtube.com/watch?v=QTvWatIXfm4.

50 Dean, 'Never Mind,' op. cit. (note 48).

51 SITE Inc., *Architecture as Art* (New York: St. Martin's Press, 1980), 31.

52 Ibid.

The teaching of McHarg and the practices of Le Roy and Gilles Clément are just a few of the many architectural and artistic approaches that start from the natural environment. Their thinking encourages us to give nature a different status, one that not only needs to be preserved, but also needs space to grow and flourish. The concepts of *Design with Nature*, of the Eco-Cathedral, and of the *Tiers Paysage* are relatively recent examples of the operationalization of ancestral thinking in architectural practice. Obviously building on a long tradition, these three are interesting together because they each put forward a specific take on a long-term perspective in its relationship to architecture. They propose to embrace the generations to come, build cathedrals that last 300 years, or to leave land beyond the reach of humans, aiming for a *tiers paysage* to fully develop.

Building an Image of Nature

In parallel with the various efforts to let nature take its course, architects and planners have attempted to use nature as a means of renewing the architectural language. In these approaches, from the early 1980s, architecture's relationship with the environment unfolded through a connection to the natural landscape. Within the changing relationship between architecture, landscape, and the environment, some projects integrated ornamental layers of nature into their architecture; others proposed hyper-designed landscapes that encapsulated architecture. In other words, architects used landscape in various ways as a means of legitimacy and as a medium through which to *communicate* or *reinvent* the environment.[48] This section takes a look at the diverse efforts of architects and planners to use nature as a means of renewing architectural language in the wake of ecological consciousness. It also critically examines the historical precedents of greenwashing.

Artist and architect James Wines began exploring so-called 'green architecture' in the 1970s. Mixing context and content, Wines moved traditional boundaries while placing art where you least expect it.[49] He combined contemporary art and sculpture with architecture, often using his buildings as social critiques of both consumer culture and our misguided relationship with nature. SITE Inc. (Sculpture in the Environment), the architecture and environmental design firm founded by Wines in 1970, designed a series of highly unorthodox retail facilities for the American catalog showroom chain Best Products Company Inc. Three of these showrooms, designed between 1978 and 1980 – the Terrarium, the Rainforest, and the Forest showrooms – are exemplary in their use of vegetation and soil as a medium of environmental communication.[50]

SITE's unrealized project for the San Francisco 'Terrarium Showroom' (1978) proposed to use 'the volume of earth excavated during foundation preparations as the iconography of the finished building.'[51] Concretely, that meant that the generic box showroom would be fully integrated into its surroundings, as its exterior walls would be made of glass filled with local soil, stones, and vegetation, thus approximating 'the actual strata of the area.'[52] In the 'Hialeah

Showroom' (1978–1979) or 'Rainforest Building' in Miami, Florida, the showroom is treated as an extension of the surrounding landscape, enclosed by a glass façade. Its transparent skin supported a continuous waterfall from the roof level and contained the landscape elements.[53] The Best Products Company showroom in Richmond, Virginia (1978) departed from the premise that a commercial project such as the showroom could not be built on the site's existing forest. Wines proposed preserving most of the large oak trees and building the new structure around them. His project suggested a radical 'invasion of nature' in which the trees and the simple volume of the showroom would create a new environment, a kind of oasis that would challenge the typical visitor of a suburban parking lot.[54] While the Terrarium and Hialeah showrooms deployed earth and vegetation as a kind of wall appliqué, the Forest showroom attempted to preserve nature by building around it. As Penelope Dean argued, SITE's three Best Products Company showrooms reveal landscape to be an extension of architecture, understanding their architecture 'as "environmental sponges" capable of absorbing imagistic cues from the widest possible range of contextual sources.'[55] In these early projects, SITE was able to emphasize information and commentary, understanding landscape as a medium of communication.

In 1981, SITE proposed a project that combined environmental concerns with the challenging issue of housing and suburban sprawl. Their 'High-rise of Homes' proposed a vertical community of private homes within an existing or newly built concrete structure. The structure rose 20 stories and was U-shaped to allow sunlight to penetrated deep into the vertical community. While the ground floor contained community facilities, services, and offices, the upper floors provided flexible platforms for streets and plots where individual homes would be built. With clusters of village-like communities, SITE's project proposed an alternative to the generic, mass-produced urban high-rise apartment buildings of the time, offering a vertical structure in which each house would be unique, as it would be realized according to the owner's preferences. It also proposed an alternative to traditional housing design in the American suburban landscape, introducing high-density and personalized architecture with greenery. The 'High-rise of Homes' was never meant to see the light of day, but it remains an example of environmental utopianism and polemic, in which sustainable design was not a matter of a building's weight, but rather a matter of greenwashing the project. A decade later however, Wines himself questioned these very practices. In provocative terms, he pointed to the many attempts at green architecture, asserting that 'much of the ecologically motivated work today, acclaimed as green or contextual, is nothing more than a catalogue of environmental technology and land conservation systems tacked onto otherwise conventional buildings and landscapes.'[56] What the American architect seemed to condemn were instances in which architects tried to play the environmental card while still using conventional methods of construction.

53 Ibid.

54 Forest Building in MoMA collection, moma.org/collection/works/706.

55 Penelope Dean, 'Environment by Design,' *Proceedings of the 97th Annual Meeting of the Association of Collegiate Schools of Architecture* (2009), 201, acsa-arch.org/proceedings/Annual%20Meeting%20Proceedings/ACSA.AM.97/ACSA.AM.97.26.pdf; James Wines, Green Architecture (Milan: Taschen, 2000), 14. Wines theorized this aspect of SITE's work in: *De-architecture* (New York: Rizzoli, 1987).

56 James Wines, 'Passages – A Changing Dialogue,' l'ARCA 96 (1995), 53.

This way of considering nature for its symbolic value was at the heart of the projects proposed by Argentinian architect and industrial designer Emilio Ambasz, who was driven by green architecture long before it became fashionable.[57] It is interesting, however, to reflect on how sensitive the Argentinian architect's architecture really was to the environment. Ambasz believed that architecture was 'one specialized aspect of the making of man-made nature' and saw architecture as artificial nature, absorbed into the landscape.[58] Having spent much of his career producing hyper-designed landscapes that integrated architecture, his architectural style can best be described, in his own words, as 'green over gray.'[59] Ambasz's penchant for absorbing architecture into new postmodern forms of artificial nature led him to realize projects such as Fukuoka's ACROS center in the early 1990s or the Banca Degli Occhi in Veneto in 2009. But Ambasz's green architecture relied more on the creation of alternative images than on a real change in building methods. The merging of symbolic forms of nature or enveloping buildings while addressing questions of performativity were central to his projects in the 1990s. Interestingly, his work found resonance in numerous publications and articles at the time, and in the founding of The Emilio Ambasz Institute for the Joint Study of the Built and the Natural Environment at the Museum of Modern Art.[60]

In an essay published in 2000, Penelope Dean described this development as the de-disciplining of architecture from a sociocultural project into a technological specialization. Greening architecture as an attempt to insert projects into an environmental discourse was also at the heart of the retroactive practice of some architects at the time, including Wines himself. Moreover, Dean noted how Wines and others rewrote their projects into environmental history: 'Wines subsequently recasts several of his earlier projects as examples of green architecture in a "cultural context,"' claims Dean.[61] Ambasz, she says, 'deploys landscape as a design medium through which to reinvent both nature and artifice'[62] and 'suggests a way to rethink environmental surfaces.'[63]

In a similar vein, Mirko Zardini has referred to these approaches as the 'greenwashing of architecture.'[64] In his essay, the former director of the Canadian Centre for Architecture argued that: 'In light of this green functionalism, it is necessary to recontextualize the place of technology and metrics within our definitions of sustainability, as well as the place of sustainability within the architectural culture of the twenty-first century.'[65] While much effort is being put into technological solutions to environmental problems, buildings continue to be built and carbon emissions from buildings continue to increase. 'Precisely because architecture and urbanism are responsible for such a large ecological footprint, the improvement of certain aspects of performance, although necessary, is not sufficient.'[66]

57 Matt Shaw, 'An Architect Known for Building Castles in the "Vegetable Kingdom,"' *The New York Times*, 3 May 2023, nytimes.com/2023/05/03/style/architect-emilio-ambasz-design.html.

58 Emilio Ambasz, 'Why Not the Green over the Gray?,' *Domus* 772 (1995), 83.

59 Ibid.

60 See: moma.org/research/ambasz/.

61 Dean, 'Environment by Design,' op. cit. (note 55); Wines retroactively declared: 'I now prefer to see my writing [from the 1970s and 1980s] as transitional and leading toward the far more urgent challenges of an ecological initiative.' Wines, *Green Architecture*, op. cit. (note 55).

62 Penelope Dean, 'Never Mind All That Environmental Rubbish, Get On With Your Architecture' *Architectural Design* 79/3 (2009), 27.

63 Ibid., 28.

64 Mirko Zardini, '(Against) the Greenwashing of Architecture,' *New Geographies: Landscapes of Energy* 2 (2009).

65 Ibid., 141.

66 Ibid., 145.

↑ Emilio Ambasz, Fondazione Banca degli Occhi del Veneto Onlus medical research facility, Mestre, Italy, 2008.

In his 2020 book, *The Good Ancestor: How to Think Long Term in a Short-Term World*, philosopher Roman Krznaric suggests taking actions that will resonate for decades, centuries, even millennia to come. How can we think about future generations, use cathedral thinking, and integrate deep time into our daily actions? His call resonates with several, often artistic or experimental, practices in the past that integrated a long-term perspective into their projects. This chapter examined such ancestral ways of thinking within architectural practice. Dealing with questions of permanence or slowly evolving structures, most of the projects presented remained on the margins, developed only as forms of paper architecture, or confined to the realm of museums. Some were severely criticized or embedded in forms of greenwashing. Nevertheless, they represent an alternative to the more technological or activist projects a seen in the previous chapters.

Reconnecting to nature, older traditions, building materials and practices has been a powerful, yet always marginalized, force in architecture. While inspiring many, most ancestral efforts have not been translated into mainstream building and architecture. It is clear, however, that in building a sustainable future and assuming an end to the unlimited use of raw, new materials and fossil fuels, the ancestral approach provides a starting point for future survival. Stepping back, reconnecting with a sometimes distant or forgotten past, and taking responsibility for future generations is undoubtedly necessary. Learning from these examples and further exploring the library of human creativity and nature, we should ask how ancestral architecture can become a normal practice.

1993 to 2022

1997_Kyoto Protocol

Environment Agency chief Hiroshi Oki and Raul Estrada celebrated the adoption of the Kyoto Protocol, observed by UNFCCC executive secretary Michael Zammit-Cutaja, on 11 December 1997, in Kyoto, Japan.

On 11 December 1997, 192 parties ratified the Kyoto Protocol, committing to reduce emissions of six main greenhouse gases with individual reduction targets. These gases were carbon dioxide (CO2), methane (CH4), nitrous oxide (N20), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs) and sulfur hexafluoride (SF6).

The Kyoto Protocol, which came into force in 2005, sets binding reduction targets for 37 industrialized countries, economies in transition and the European Union. During the first commitment period (2008–2012), these targets would add up to an average reduction of 5 percent below 1990 levels. Certain groups of signatory countries were committed to different emission reduction targets and other responsibilities. Thirty-seven countries that could be considered 'developed' at the time had formally stated reduction targets. Twenty-four of these countries were also committed to providing financial support to developing countries to help them achieve their own adjusted reduction targets. The 15 countries that were members of the EU in 1997 adopted the 8 percent target, taking advantage of a provision in the Protocol known as the 'bubble,' which allowed countries with different individual targets to reach an overall target for the group.

The treaty was the first implementation of the 1992 United Nations Framework Convention on Climate Change, which required countries to adopt policies to reduce emissions, report regularly on progress, or provide financial assistance to developing countries to reduce greenhouse gas emissions. The Kyoto Protocol also established a rigorous monitoring, review, and verification system, as well as a compliance system to ensure transparency and hold parties accountable. The Kyoto Protocol was replaced by the 2015 Paris Agreement. Part of the rationale behind this newer treaty was to address the fact that many of the developing countries with lower reduction targets under the Kyoto Protocol were, or had become, some of the highest emitters of greenhouse gases, either in total or per capita. The economies of countries such as China, India and Indonesia grew rapidly in the early 2000s – and so did their greenhouse gas emissions.

2001_Anti-globalization

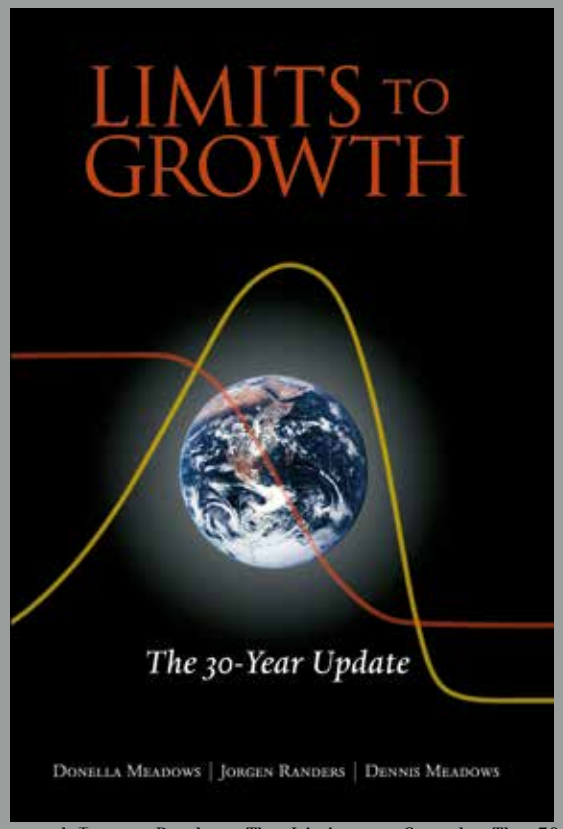
Smoke over a demonstration during the 27th G8 summit in Genoa, on 20 July 2001.

The turn of the millennium witnessed a wave of citizen activism against economic globalization, which could be described as the increasing interconnectedness and interdependence of the world's economies. In particular, this anti-globalization movement opposed the policies of various corporate or political supranational and multinational bodies that were seen as willing to erode national and local sovereignty in the pursuit of profit and market control, often at the expense of environmental, socioeconomic, and political wellbeing and stability. These bodies, such as the United Nations, its International Monetary Fund, the World Bank, the World Trade Organization, and the World Economic Forum, were seen as major contributors to, and perhaps beneficiaries of, various financial and debt crises.

Tens of thousands of individuals in the anti-globalization movement protested at major events around the world. Clashes with law enforcement were inevitable and became increasingly violent. These protests peaked during the July 2001 summit of the G8 multinational political organization in Genoa, Italy. Protesters representing a variety of interests from around the world mobilized in an estimated and unprecedented total of 200,000 to 300,000 people. Violent clashes were exacerbated by deliberate police criminality, including planting and fabricating evidence, the use of excessive force, perjury, and torture, and violent coercion through threats of rape and death. The police shot one activist in the head, killing him. This violence in Genoa inspired several other large protests throughout Italy and the rest of Europe.

The movement was hampered by the aftermath of the 9/11 attacks and the subsequent Global War on Terror. Increased anti-war activism diverted human resources from the movement and diluted its focus. More fundamentally, the anti-globalization movement found itself ideologically conflicted: the attack itself was seen as partially anti-globalist in nature, targeting instruments and symbols of imperialism and an unchecked free market.

2002_The Limits to Growth: The 30-Year Update



Donella Meadows, Dennis Meadows and Jørgen Rander, The Limits to Growth: The 30 year update, 2004. Published by the Chelsea Green Publishing Copmany.

In 2002 – one year after the untimely death of Donella Meadows – *The Limits to Growth*: The 30-Year Update was published. It was written by three of the lead authors of the original report: Donella Meadows, Dennis Meadows, and Jørgen Randers. The book allowed the MIT team to determine that developments in the three decades since the report was first published were quite similar to those modeled in the 1972 'Business as Usual' (BAU) scenario. In many ways, the message of *The Limits to Growth: The 30-Year Update* was another warning: overshoot could not be sustained without collapse. In the preface to the 2002 edition, Dennis Meadows and Jørgen Randers insisted on the fact that growth would continue for another decade or so, but that the collapse would be sudden, followed by a period of stagnation. One cannot help but see a striking resemblance to the recent relative resilience of the global economy since the 2008 crisis.

The 2002 book was also another attempt to correct the initial message of *The Limits to Growth*, which was often disliked and misunderstood. According to Randers it was often caricatured: 'Constantly we are portrayed as those MIT idiots who wanted to stop economic growth.' Both Meadows and Randers acknowledged that economic growth is necessary in certain countries to eliminate poverty, but warned against its blind pursuit: 'It is nonsensical to dismiss growth as good or bad,' they write in *The 30-Year Update*. 'We need to ask: Growth of what? For whom? At what cost? Paid for by whom? What are the needs and what is the best way to satisfy them? How much is enough?'

Despite its importance, *The 30-Year Update* would not benefit from the same media attention as the original. Its appearance went virtually unnoticed. Sales were down, and newspapers barely paid any attention to the book. Apparently, people were not waiting for systems scientists to warn once again that despite, or perhaps because of our growing prosperity, we are still on our way toward disaster.

2006_ An Inconvenient Truth

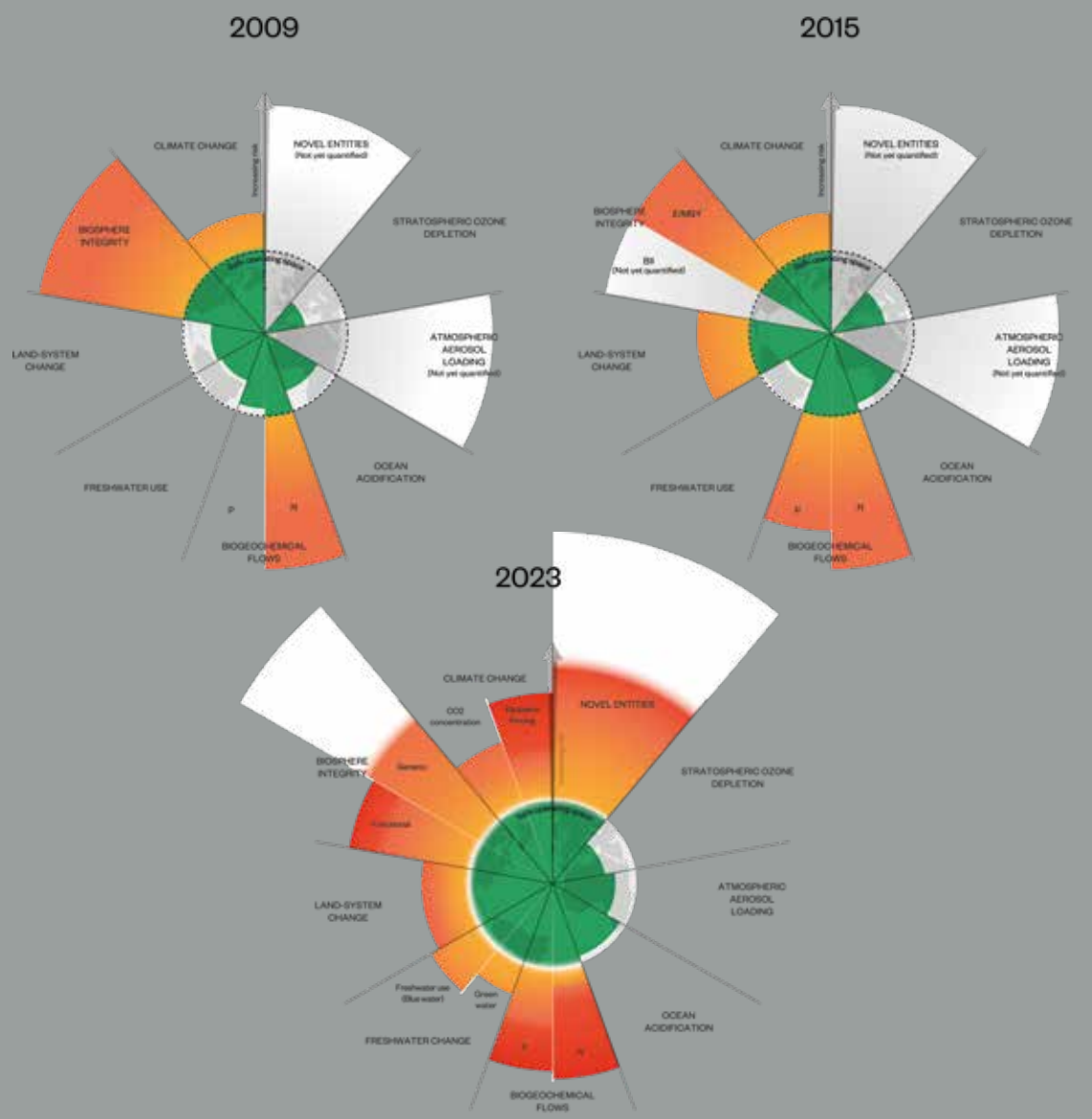
Poster of the movie *An Inconvenient Truth*, 2006. Directed by Davis Guggenheim.

In 2006, former US Vice President Al Gore released *An Inconvenient Truth*, a film and book that combined a series of Al Gore's presentations on environmental issues since 1989, with personal anecdotes that reinforced notions of urgency, personal responsibility, and morality in tackling climate change. The release of the film led to commercial and critical success around the world and was considered a major cultural moment that strengthened a weakened environmental movement.

The film is structured around several key sequential premises and arguments that ultimately conclude that climate change is real, that the Earth is warming, that this is caused by human activity, that unchecked rates of activity will have significant negative impacts on the future world, and that we must act to prevent catastrophe. These conclusions rely on a variety of scientific data, including various long-term observations of atmospheric and hydrospheric carbon dioxide levels, tracking of glacial melt, and atmospheric temperature records. Possible future scenarios are explored, including ones in which rising water levels due to melting polar ice caps eventually flood coastal regions around the world, hurricanes and typhoons increase in frequency and ferocity due to human-caused oceanic warming, and intense droughts.

Although the film narratively links scientific data and observations with powerful imagery associated with the effects of global warming and pollution, it avoids any outright declarative statements that had not yet been widely accepted by the scientific community. Several factual inaccuracies and errors did not prevent at least 19 prominent climate scientists from calling *An Inconvenient Truth* a factually and argumentatively sound work.

2009_Planetary Boundaries

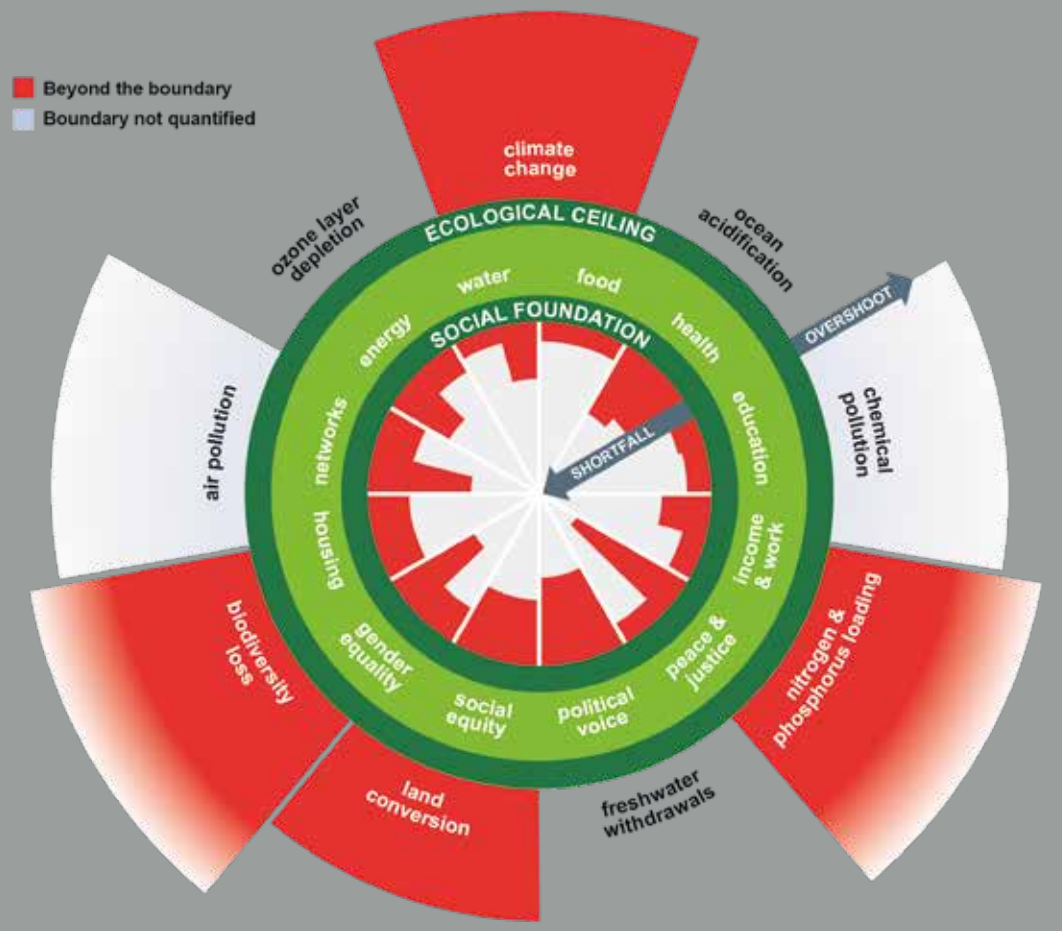


The evolution of the planetary boundaries framework.

In 2009, Swedish scientist and educator Johan Rockström and 28 collaborators published the article 'A Safe Operating Space for Humanity' in the scientific journal *Nature*. The article posits that if humanity wishes to limit its impact on the Earth's environmental subsystems within certain thresholds, to the extent that the Earth maintains a stable and self-regulating state, a framework is needed that clearly delineates and quantifies these thresholds. The article proposes nine so-called 'planetary boundaries,' or 'variables for control variables that are either at a "safe" distance from thresholds ... or at dangerous levels': 'climate change; rate of biodiversity loss (terrestrial and marine); interference with the nitrogen and phosphorus cycles; stratospheric ozone depletion; ocean acidification; global freshwater use; change in land use; chemical pollution; and atmospheric aerosol loading.' This framework of planetary boundaries has since been revised several times since, with the first quantification of all nine processes completed in 2023.

In the first 2009 paper, Rockström's research team concluded that three out of the nine planetary boundaries had already been crossed: in addition to climate change, biodiversity loss and the nitrogen cycle had reached dangerous levels. In the 2023 update, they counted six of the nine as overstepped, 'suggesting that Earth is now well outside of the safe operating space for humanity.' The introduction of the nine planetary boundaries was an important step in the expansion of environmental awareness, after the attention had been gravitating for years toward climate change and the underlying carbon problem.

2012_Doughnut Economy



The classic image of Kate Raworth's Doughnut economy. The extent to which boundaries are transgressed and social foundations are met are not visible on this diagram.

In 2012, British economist Kate Raworth introduced the 'doughnut economy,' a combination of the 2009 environmental 'planetary boundaries' with a 'social foundation' based on human needs. The combination resulted in a visual doughnut shape indicating 'the safe and just space for humanity' within which economies should operate. It combines planetary boundaries as the upper limit with supporting human needs – water, food, health, education, income and work, peace and justice, political vote, social equity, gender equality, housing, networks, and energy – as the foundation. In terms of thresholds and frameworks, the ability to maintain levels of pressure within acceptable thresholds and within one set of boundaries should not be at the expense of overshooting thresholds in another set.

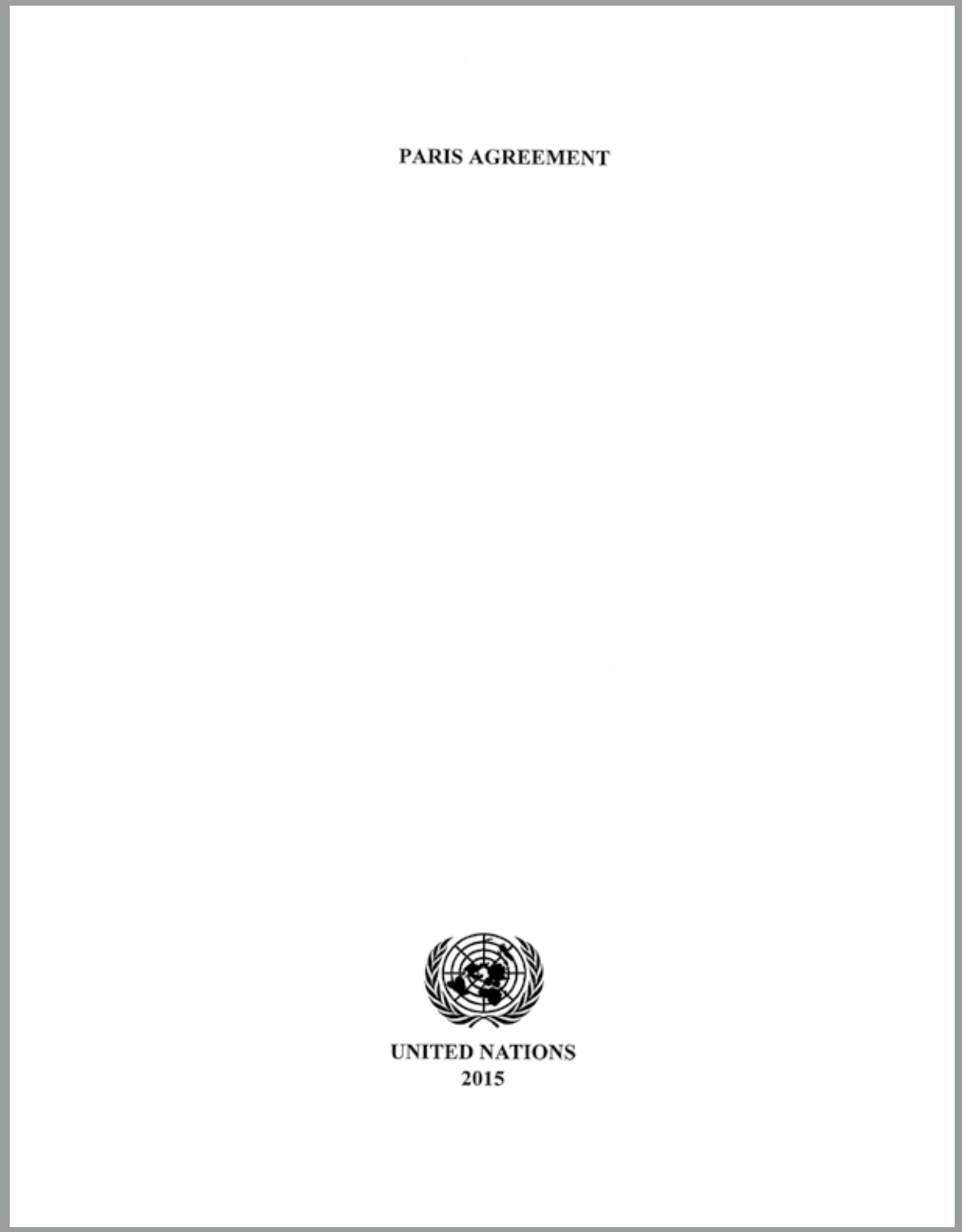
The introduction of the framework sparked both enthusiasm and criticism, as Raworth also presented it as an argument against mainstream economics and for a shift in economic education. Building on existing economic ideas, the doughnut model also recognized 'work' for the community and ecology as being critical, which is often ignored by classical economists (such as volunteer work, caring for one's family, or caring for the environment). In addition, the model implied a shift from a focus on growth to a focus on stability, prioritizing social and ecological values over economic profit. While Raworth's model was met with resistance, especially from scientists and mainstream economists, it quickly gained popularity in politics, business, and civil society, and was further developed in practice.

A 2018 study using the doughnut model found that of the nearly 150 nations analyzed, not a single one succeeded in maintaining social boundaries at a sustainable level of pressure on planetary boundaries. Although some social boundaries could likely be met at a reasonable level without exceeding planetary boundaries, nations would need anywhere from two to six times the level of resource use to meet all social boundary requirements. Based on this analysis, the doughnut model has become a tool to guide policy and strategy, with (local) governments, such as Amsterdam in the Netherlands, aspiring to become a 'doughnut city'.

On 12 December 2015, 196 parties came together at the COP21 and signed the Paris Agreement. The agreement, signed after two weeks of tense talks, concludes the multilateral climate change process and aims to limit global warming to 1.5°C above pre-industrial levels, or 'well below 2 degrees.' The agreement also aims to enhance the ability to adapt to the adverse impacts of climate change and to align financial flows with a path toward climate-resilient development. While the agreement was lauded by world leaders, it was also criticized by some environmentalists and analysts for being insufficiently binding.

It was the first time that a binding agreement brought so many nations, rich and poor, together to make ambitious efforts to combat climate change and adapt to its effects. But despite the global commitment, questions remain about how affective these agreements really are. The Paris Agreement has since then become a reference point for policies worldwide, but it is also increasingly being used in court cases where citizens or NGOs sue governments or even companies for not doing enough to meet the set targets. According to Ban Ki-moon, former UN Secretary-General: 'We have lost a lot of time. Five years after the agreement in Paris was adopted with huge expectations and commitment by world leaders, we have not done enough.'

But there has also been remarkable progress on climate change since 2015. According to the International Energy Agency, renewable energy will account for about 90 percent of new power generation capacity installed worldwide in 2020, and will be the largest source of power by 2025, displacing coal. Global emissions are expected to peak around 2030, and there is already a decline in emissions being measured in around 40 countries in 2024. At the same time, with recent projections putting the world on track for a 3-degree temperature rise, the commitments of the Paris Agreement will increasingly become a point of contention and pressure: Will it be another agreement broken, or will it have been the vehicle for transformative change that so many hoped for?


PARIS AGREEMENT

UNITED NATIONS
2015

The Paris Agreement document, adopted by 196 parties at the UN Climate Change Conference (COP21) in Paris, France, on 12 December 2015.

PARIS AGREEMENT

The Parties to this Agreement,

Being Parties to the United Nations Framework Convention on Climate Change, hereinafter referred to as "the Convention",

Pursuant to the Durban Platform for Enhanced Action established by decision 1/CP.17 of the Conference of the Parties to the Convention at its seventeenth session,

In pursuit of the objective of the Convention, and being guided by its principles, including the principle of equity and common but differentiated responsibilities and respective capabilities, in the light of different national circumstances,

Recognizing the need for an effective and progressive response to the urgent threat of climate change on the basis of the best available scientific knowledge,

Also recognizing the specific needs and special circumstances of developing country Parties, especially those that are particularly vulnerable to the adverse effects of climate change, as provided for in the Convention,

Taking full account of the specific needs and special situations of the least developed countries with regard to funding and transfer of technology,

Recognizing that Parties may be affected not only by climate change, but also by the impacts of the measures taken in response to it,

Emphasizing the intrinsic relationship that climate change actions, responses and impacts have with equitable access to sustainable development and eradication of poverty,

Recognizing the fundamental priority of safeguarding food security and ending hunger, and the particular vulnerabilities of food production systems to the adverse impacts of climate change,

Taking into account the imperatives of a just transition of the workforce and the creation of decent work and quality jobs in accordance with nationally defined development priorities,

Acknowledging that climate change is a common concern of humankind, Parties should, when taking action to address climate change, respect, promote and consider their respective obligations on human rights, the right to health, the rights of indigenous peoples, local communities, migrants, children, persons with disabilities and people in vulnerable situations and the right to development, as well as gender equality, empowerment of women and intergenerational equity,

Recognizing the importance of the conservation and enhancement, as appropriate, of sinks and reservoirs of the greenhouse gases referred to in the Convention,

Noting the importance of ensuring the integrity of all ecosystems, including oceans, and the protection of biodiversity, recognized by some cultures as Mother Earth, and noting the importance for some of the concept of "climate justice", when taking action to address climate change,

Affirming the importance of education, training, public awareness, public participation, public access to information and cooperation at all levels on the matters addressed in this Agreement,

Recognizing the importance of the engagements of all levels of government and various actors, in accordance with respective national legislations of Parties, in addressing climate change,

Also recognizing that sustainable lifestyles and sustainable patterns of consumption and production, with developed country Parties taking the lead, play an important role in addressing climate change,

Have agreed as follows:

Article 1

For the purpose of this Agreement, the definitions contained in Article 1 of the Convention shall apply. In addition:

(a) "Convention" means the United Nations Framework Convention on Climate Change, adopted in New York on 9 May 1992;

(b) "Conference of the Parties" means the Conference of the Parties to the Convention;

(c) "Party" means a Party to this Agreement.

Article 2

1. This Agreement, in enhancing the implementation of the Convention, including its objective, aims to strengthen the global response to the threat of climate change, in the context of sustainable development and efforts to eradicate poverty, including by:

(a) Holding the increase in the global average temperature to well below 2°C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5°C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change;

(b) Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production; and

(c) Making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development.

2. This Agreement will be implemented to reflect equity and the principle of common but differentiated responsibilities and respective capabilities, in the light of different national circumstances.

Article 3

As nationally determined contributions to the global response to climate change, all Parties are to undertake and communicate ambitious efforts as defined in Articles 4, 7, 9, 10, 11 and 13 with the view to achieving the purpose of this Agreement as set out in Article 2. The efforts of all Parties will represent a progression over time, while recognizing the need to support developing country Parties for the effective implementation of this Agreement.

Article 4

1. In order to achieve the long-term temperature goal set out in Article 2, Parties aim to reach global peaking of greenhouse gas emissions as soon as possible, recognizing that peaking will take longer for developing country Parties, and to undertake rapid reductions thereafter in accordance with best available science, so as to achieve a balance between anthropogenic emissions by sources and removals by sinks of greenhouse gases in the second half of this century, on the basis of equity, and in the context of sustainable development and efforts to eradicate poverty.

2. Each Party shall prepare, communicate and maintain successive nationally determined contributions that it intends to achieve. Parties shall pursue domestic mitigation measures, with the aim of achieving the objectives of such contributions.

3. Each Party's successive nationally determined contribution will represent a progression beyond the Party's then current nationally determined contribution and reflect its highest possible ambition, reflecting its common but differentiated responsibilities and respective capabilities, in the light of different national circumstances.

4. Developed country Parties should continue taking the lead by undertaking economy-wide absolute emission reduction targets. Developing country Parties should continue enhancing their mitigation efforts, and are encouraged to move over time towards economy-wide emission reduction or limitation targets in the light of different national circumstances.

5. Support shall be provided to developing country Parties for the implementation of this Article, in accordance with Articles 9, 10 and 11, recognizing that enhanced support for developing country Parties will allow for higher ambition in their actions.

6. The least developed countries and small island developing States may prepare and communicate strategies, plans and actions for low greenhouse gas emissions development reflecting their special circumstances.

7. Mitigation co-benefits resulting from Parties' adaptation actions and/or economic diversification plans can contribute to mitigation outcomes under this Article.

8. In communicating their nationally determined contributions, all Parties shall provide the information necessary for clarity, transparency and understanding in accordance with decision 1/CP.21 and any relevant decisions of the Conference of the Parties serving as the meeting of the Parties to this Agreement.

9. Each Party shall communicate a nationally determined contribution every five years in accordance with decision 1/CP.21 and any relevant decisions of the Conference of the Parties serving as the meeting of the Parties to this Agreement and be informed by the outcomes of the global stocktake referred to in Article 14.

10. The Conference of the Parties serving as the meeting of the Parties to this Agreement shall consider common time frames for nationally determined contributions at its first session.

11. A Party may at any time adjust its existing nationally determined contribution with a view to enhancing its level of ambition, in accordance with guidance adopted by the Conference of the Parties serving as the meeting of the Parties to this Agreement.

12. Nationally determined contributions communicated by Parties shall be recorded in a public registry maintained by the secretariat.

13. Parties shall account for their nationally determined contributions. In accounting for anthropogenic emissions and removals corresponding to their nationally determined contributions, Parties shall promote environmental integrity, transparency, accuracy, completeness, comparability and consistency, and ensure the avoidance of double counting, in accordance with guidance adopted by the Conference of the Parties serving as the meeting of the Parties to this Agreement.

14. In the context of their nationally determined contributions, when recognizing and implementing mitigation actions with respect to anthropogenic emissions and removals, Parties should take into account, as appropriate, existing methods and guidance under the Convention, in the light of the provisions of paragraph 13 of this Article.

15. Parties shall take into consideration in the implementation of this Agreement the concerns of Parties with economies most affected by the impacts of response measures, particularly developing country Parties.

2015_UN Sustainable Development Goals

The UN Sustainable Development Goals (SDGs), 2015. Also known as the Global Goals, they represent a shared agenda to end poverty, fight inequality and injustice, and protect the planet.

In 2015, all 193 member states of the United Nations adopted the 2030 Agenda for Sustainable Development and 17 accompanying Sustainable Development Goals (SDGs), a framework to guide member states' policy-making toward 'peace and prosperity for people and the planet.' Each of these goals, ranging from 'end poverty in all its forms everywhere' to 'take urgent action to combat climate change and its impacts,' lists specific targets for action and describes qualitative and quantitative indicators that can help measure development progress.

The SDGs replaced the Millennium Development Goals, a similar framework from 2000 to 2015 that failed to meet three out of its four targets. An independent scientific report for the United Nations 'Stockholm+50' meeting in 2022 – a midpoint in the intended lifespan of the 2030 Agenda for Sustainable Development – studied the rate of progress on the sustainability goals. The report found that there was a significant 'action gap' between intentions and results, and that member states were therefore not on track to meet all 169 targets within the 17 Sustainable Development Goals by 2030.

The SDGs have spread globally as a framework for sustainability engagement, well beyond government. Companies are making transparent how they contribute to specific goals, universities are working with the SDGs to focus their education and research, and many countries have (government-supported) SDG ambassadors, networks, and programs to engage citizens and wider audiences in sustainability. At the same time, critics point to the apolitical nature of the SDGs, as they mainly represent all the ambitions that no one can really object to, but cover up the trade-offs and internal conflicts. The reality of cherry-picking, with companies or organizations only focusing on a few of the goals, would allow for suboptimal solutions and work against more systemic change.

2015_The Gaia Hypothesis

Bruno Latour, 'Can Nature Be Recomposed? A Few Issues in Cosmopolitics,' MIT's Science & Technology Studies Program, 22 February 2010.

In 2015, the late French philosopher Bruno Latour presented his book *Face à Gaïa: Huit conférences sur le nouveau régime climatique (Facing Gaia: Eight Lectures on the New Climatic Regime*). It was the result of deliberations and lectures that built on the Gaia hypothesis (developed by James Ephraim Lovelock and Lynn Margulis in the 1970s). Latour reflected on the nature of our perceived relationship with Earth, possible actual natures of our relationship with Earth, and developed a new understanding of the Gaia hypothesis that overturns old preconceptions. The book contained the initial ideas that were elaborated in a series of later essays.

Many apparent proponents of the Gaia hypothesis, Latour argues, still perceive humanity as occupying an exceptional position relative to all other systems within the system of systems that is Gaia. In doing so, they mistakenly liken Gaia to a distinct organism and ultimately 'other' Gaia from ourselves. Understanding Gaia to be an organism implies, on a conceptual level, that its subsystems are merely mechanical processes that serve the functioning of the larger whole – merely cells serving the body. Rather, Latour argues, all life forms have 'agency and historicity,' and we should understand Gaia as the highly complex result of the interaction of all life forms.

This holistic perspective, in which humanity is inherently part of 'nature' and therefore forced to reconsider not only its position but also its agency, is a fundamental theme in Latour's work and in his critique of modernity. According to this perspective, the presumed rationality of humanity and its ability to control the environment is a dangerous illusion when combined with increasing privatization and globalization. Latour warns against the tendency for people frustrated by the lack of real progress to turn their backs on globalization and return to the national and local. Instead, Latour argues, we need to rethink what it means to 'belong' and learn again to embrace the Earth as an intrinsic part of Gaia.

2018_Fridays for Future

In August 2018, outside the Swedish parliament building, Greta Thunberg started a school strike for the climate. Her sign reads, *Skolstrejk för klimatet*, meaning, 'school strike for the climate.'

From 20 August to 9 September 2018, the then 15-year-old Swedish student Greta Thunberg sat in front of the Swedish parliament every day with a protest sign that read: 'Skolstrejk för Klimatet' (School strike for the climate). Thunberg's climate strikes had their origins in the strikes organized by a group of teenagers in February of the same year in response to the Florida shooting. They refused to go to school to demand stricter gun control.

Thunberg's action went viral on social media, inspiring students around the world to go on strike. Together with the activists who joined her, she introduced the hashtag *#FridaysForFuture*, which later grew into an international youth movement promoting strikes every Friday to put pressure on policymakers to keep the global temperature rise below 1.5°C above preindustrial levels, uphold the Paris Agreement, ensure climate justice, and listen to the best united science available. Thunberg's speech at the UN conference in Katowice later that year further motivated students around the world to take action. In 2019, a few globally coordinated climate strikes culminated in the Climate Protest on 20 September that year, which brought together 4 million people worldwide. That week, Thunberg delivered her now-famous speech at the UN headquarters in New York, accusing world leaders of ignorance and inaction:

'We are in the beginning of a mass extinction, and all you can talk about is money and fairy tales of eternal economic growth. How dare you!'

In the spring of 2020, the Covid-19 pandemic prevented further street protests, and the movement continued with online activism.

2020_Covid-19

Wild boars cross a road in a residential area after the government ordered residents to stay home to fight the spread of Covid-19 in Haifa, northern Israel, 16 April 2020.

On 30 January 2020, the World Health Organization (WHO) declared a public health emergency of international concern due to the rapid spread of the coronavirus disease 2019 (Covid-19) caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). In March 2020, the WHO made the assessment that Covid-19 had become a pandemic. During the pandemic, several countries and territories around the world implemented (social) restrictions with the intention of reducing the spread of the virus. By April 2020, more than 3.9 billion people had been told to stay at home by their governments.

The pandemic incited all kinds of interest groups to draw attention to their agendas, with subjects ranging from further globalization to more local sustainability. A more interesting take on the matter was proposed by French philosopher Bruno Latour, who on 29 March 2020, published 'Where to Land after the Pandemic?' a position paper that was almost immediately distributed and translated into 13 languages. Following a set of arguments proposed in *Down to Earth: Politics in the New Climatic Regime*, Latour stated in 'Where to Land after the Pandemic?' that 'the first lesson the coronavirus has taught us is also the most astounding: we have actually proven that it is possible, in a few weeks, to put an economic system on hold everywhere in the world and at the same time, a system that we were told it was impossible to slow down or redirect.'

While forcing everyone to slow down, the 2020–2022 pandemic affected societies around the world and posed fundamental challenges for current and future biodiversity conservation. The brief and sudden return of biodiversity to some otherwise densely populated areas of the planet, created a strong and impactful image. The pandemic also brought about changes that should have been implemented long ago and that had important consequences for our way of life: it accelerated scientific discoveries through the search for an effective vaccine against the disease, but it also encouraged people to collaborate, work and exchange in new ways (for example through the rapid spread of the use of new communication systems).

A sign at Bournemouth beach indicates that Friday is expected to be the hottest day of the year, with temperatures reaching up to 35°C (95°F) in Greater London, according to the Met Office.

In early 2021, several meteorological and climatological organizations reached consensus on two points: 2020 saw the second-highest global average temperatures ever recorded against several twentieth-century temperature baselines, but it also ended the warmest decade on record. Ocean heat content also peaked in 2020. These high global averages corresponded to several national temperature records and were accompanied by a spate of natural disasters and climatological shifts that impacted the wellbeing and stability of flora, fauna, and human society.

The United Nations World Meteorological Organization issued a summary report that, for the first time in the organization's history, linked these climatic shifts to trends in so-called 'extreme events,' including floods, droughts, hurricanes, heavy rain, heatwaves, wildfires, and landslides. Every decade since the 1990s has broken previous temperature records. Atmospheric greenhouse gas concentrations have increased. The oceans have gotten warmer. Ice sheet mass loss has accelerated. The two aforementioned trends raised sea levels. At any given moment in the decade, around 60 percent of the world's oceans was experiencing a marine heatwave that was debilitating or deadly to marine life. Millions of people around the world were affected or displaced by extreme events, sometimes via the impacts of climatic shifts and natural disasters on food and water supplies. These two temperature records were inextricably linked to several alarming global trends.

The significance of the event is almost forgotten against the backdrop of the record being broken. In 2021, in 2022, and yet again in 2023. As the 'hottest year on record' might just become 'the last year of measurement,' it has become clear that climate change has become a short-term problem that will be felt in the daily lives of more and more people. Not only in the more vulnerable communities of the Global South and marginalized areas, but also increasingly in the industrialized world, threatening vested interests and economic growth. Cynical as it may be, the 'hottest year on record' could ultimately become a driver of real change, more so than the scientific consensus on climate change.

2022_Transition Moment

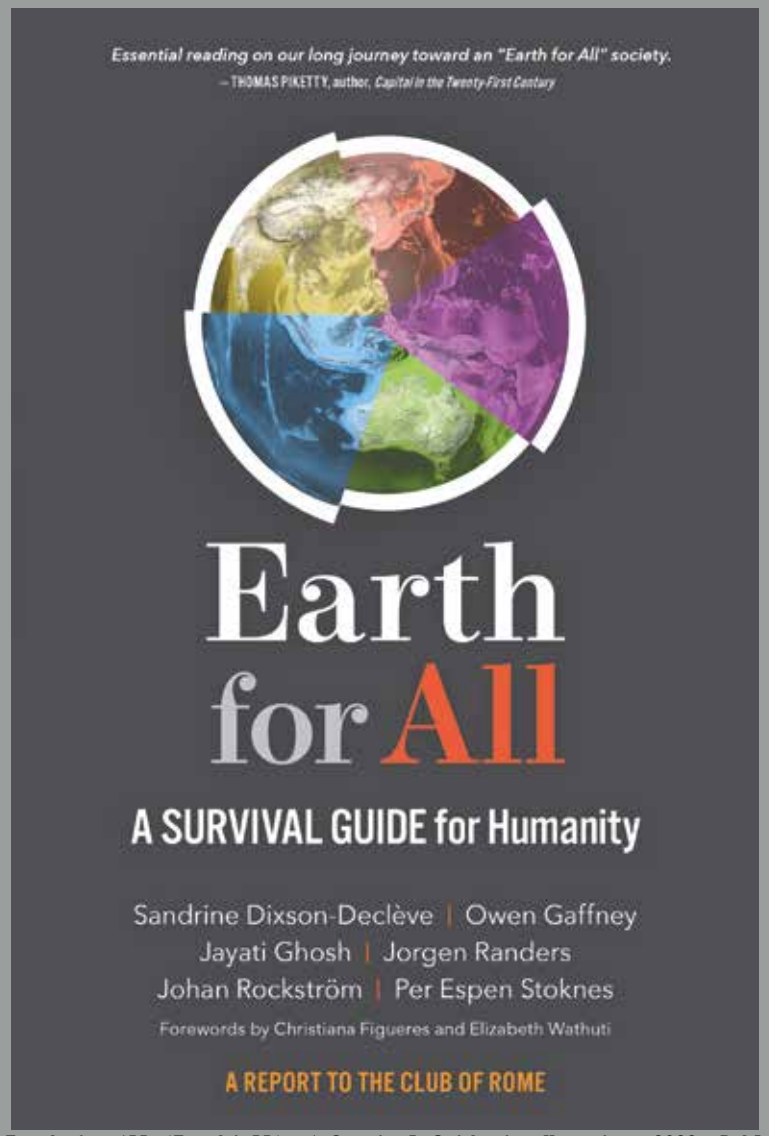
President Joe Biden signs the Inflation Reduction Act, marking a significant climate and healthcare investment and bolstering Democratic prospects ahead of the midterm elections on 16 August 2022.

In early 2020, Covid-19 disrupted the global economy and everyday life. It proved to be a major global shock, soon followed by increasing global geopolitical conflicts and wars, such as the Russian invasion of Ukraine and the occupation of Gaza. It coincided with increasing climate events, climate protests, and climate lawsuits. But it also came with a severe erosion of public institutions, a surge of populism across the Northern Hemisphere, and an attempt to take over the Capitol in the United States. The term 'transition twenties' was quickly coined to refer to the accumulation of crises and a global society spinning out of control.

Many researchers and commentators have identified 'polycrises' as symptoms of unsustainable economic development. They prove the thesis of *The Limits to Growth*: these disruptions, conflicts, and events are either caused by ecological degradation or are expressions of the political and social struggle for change. Historians draw parallels with the *fin the siècle* period, when massive societal, technological, environmental, and institutional changes took place in a relatively short period of time as part of the Industrial Revolution. But it is also clear that, unlike that period, there is no widely shared notion of progress, and many experience disruption as a threat to their vested interests, established lives, or positions.

The question is how future historians will look back on the transition moment: as a period through which we managed to navigate toward a stable, healthy future for people and planet, or as a period of escalating conflict that reinforced established power structures, furthering biodiversity loss and social injustice. Whether it's a doughnut, a circular, a social, or a green economy: we need to design for nature and share value, not profit, and, as Johan Rockström claimed: 'Transform or destabilize the world.'

2022_Earth for All



Club of Rome, *Earth for All (Earth4all): A Survival Guide for Humanity*, 2022. Published by New Society Publishers.

Half a century after *The Limits to Growth*, in 2022 *Earth for All: A Survival Guide for Humanity* was published. *Earth for All* was a report to the Club of Rome and a spiritual successor to 1972's *The Limits to Growth*, a non-technical report on the results of groundbreaking climatological computer modeling. It was led by authors that include Sandrine Dixson-Declève, the co-president of the Club of Rome, Jørgen Randers, one of the authors of *The Limits to Growth*, and Johan Rockström, developer of the planetary boundaries framework.

The report presents two scenarios from the Earth4All computer model. The first, 'Too Little Too Late,' is a business-as-usual scenario in which several variables, including population, poverty, GDP, inequality, food, and energy, continue at current rates and trends toward a modeled end date of 2100. In this scenario, environmental and societal sustainability targets are not met, and society pushes well beyond multiple planetary and societal boundaries. The second scenario, 'Giant Leap,' assumes a deep transformation of the world's economic systems toward resilience and sustainability. The changes involved, the authors contend, will be drastic and uncomfortable for individuals who are content with 'business as usual,' but there is no question that the resulting greater wellbeing for a greater number of people around the world will be worth it.

The report was accompanied by a broad campaign that sought to offer a more optimistic outlook as an antidote to the growing climate and ecological concerns. At the same time, as studies emerged showing that the world was following *The Limits to Growth* projections, *Earth for All* identified five 'turnarounds' that could redirect the course of economic development and thereby provide an alternative possible future for humanity.

‘The climate crisis has already been solved. We already have the facts and solutions. All we have to do is wake up and change.’

Greta Thunberg, 2018

Part 3:

Architecture in Transition:

The Present and Futures

Chapter 6
destabilization
multi-level perspective
optimization
out of equilibrium
path-dependency
tipping point
transformative innovation

Chapter 7
accelerator
activist
ancestor
bottom-up strategies
circular construction
non-extractive architecture
re-rooting
restorative architecture
scalable concepts
techno-optimism

Chapter 8
backcasting
forecasting
grand narrative
green growth
inclusive
phase out
regenerative
transformative action
transition governance

↑ Police use water cannons on Extinction Rebellion activists protesting fossil subsidies by blocking the A12 in The Hague, the Netherlands, 27 May 2023.

Chapter 6: The Transition Moment?

Lead author: Derk Loorbach

Our history ends in the present. From the first signs ofenvironmental awareness, through experiments in architecture and design, an evolving discourse on sustainability, and a now widely shared consensus on the need to move beyond optimization and efficiency, we have arrived at a crossroads. Architects have been working on sustainability for a long time, but in general architecture is still largely part of the problem: it is still helping to build a society based on fossil fuels and resource extraction at the expense of the environment and others. How can we understand our collective failure, how can we rethink where we are and where we could go, how can we understand the current moment?

We are living in a world sliding toward ecological collapse and a seeming collective inability to change course, in an era of enormous wealth and prosperity for more people than ever before in history, at least for the inhabitants of the Global North. We have the ability to develop artificial intelligence on top of the vast libraries of knowledge and invention historically accumulated; geopolitical conflict and nationalist, populist movements are on the rise; the world has committed at COP 28 in Dubai to 'phase down' fossil fuels and accelerate the build-up of renewables. We are living, to paraphrase Charles Dickens 'the best of times and the worst of times.' Much like the second half of the nineteenth century, society is caught between the turbulence caused by major external trends (digitization, aging populations, migration, geopolitical conflicts) and persistent problems that are a direct result of the economic and social structures that have been created.[1]

The biodiversity and climate crisis we find ourselves in is deeply intertwined with the extractive, capitalist, and linear model created over the last 150 years.[2] The current socioeconomic model has been successful in providing economic progress for some, but that has come at the expense of biodiversity and the wellbeing of others. To fundamentally address these crises will require deeper, transformative changes in how we collectively think, behave, and organize society and its institutions. In many ways, it feels like society is entering a transformative period in which old ways are no longer possible, while a new form has yet to be found; a phase in which clear solutions are absent, contested, or unavailable: social and cultural innovations are needed rather than technological ones.

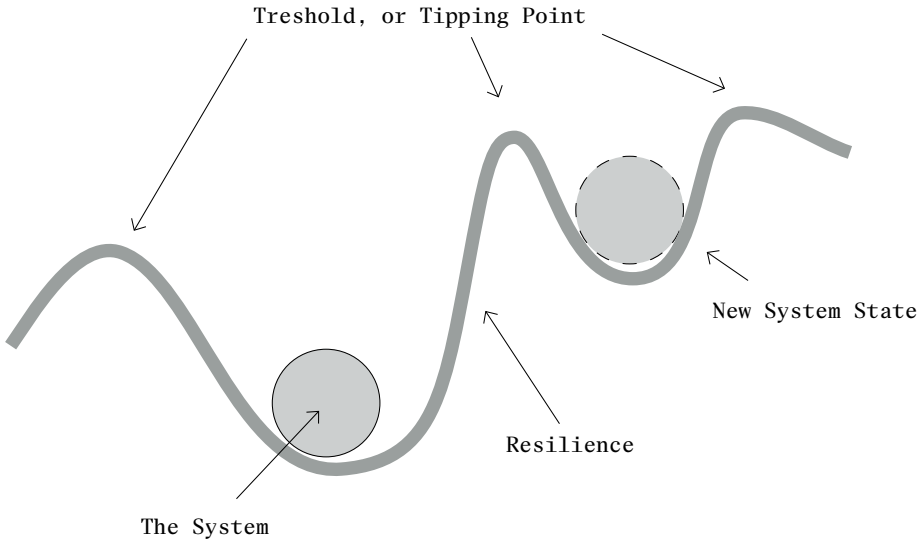
This process of complex systems moving out of equilibrium, or path-dependent development, is academically referred to as 'transition.'[3] The concept is rooted in complex systems theory,[4] but is used in many different scientific disciplines, from ecology, demography, and physics to developmental psychology and political

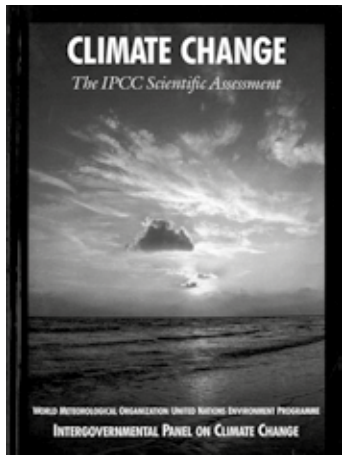
1 Tjerk Jan Schuitmaker, 'Identifying and Unravelling Persistent Problems,' *Technological Forecast and Social Change* 79/6 (2012), 1021-1031.

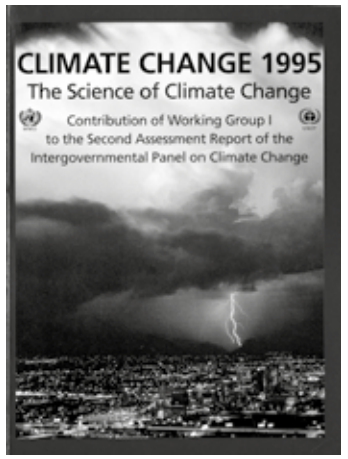
2 Carlota Perez, *Technological Revolutions and Financial Capital: The Dynamics of Bubbles and Golden Ages* (Cheltenham: Edward Elgar, 2003).

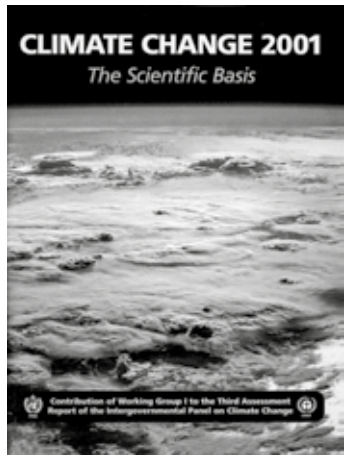
3 John Grin, Jan Rotmans, and Johan Schot, *Transitions to Sustainable Development: New Directions in the Study of Long Term Transformative Change* (New York: Routledge, 2010).

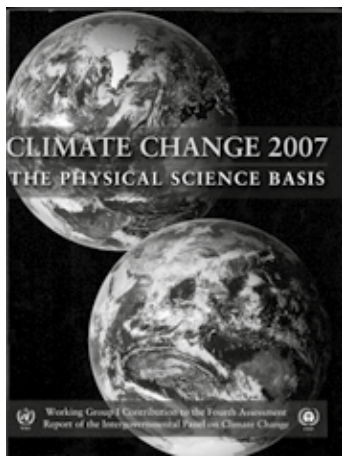
4 Jan Rotmans, Derk Loorbach, and René Kemp, 'Complexity and Transition Management,' *Journal of Industrial Ecology 13* (2009), 184-196; Gert de Roo, Jean Hillier and Joris Van Wezemael (eds.), *Complexity and Planning: Systems, Assemblages and Simulations* (Farnham: Ashgate Publishing, 2012).

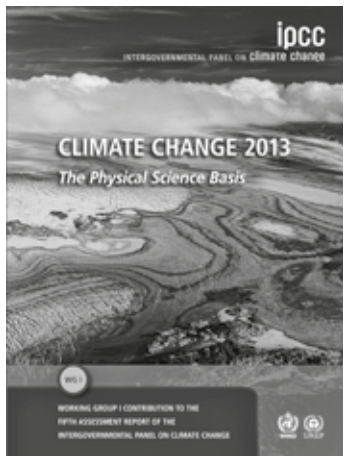


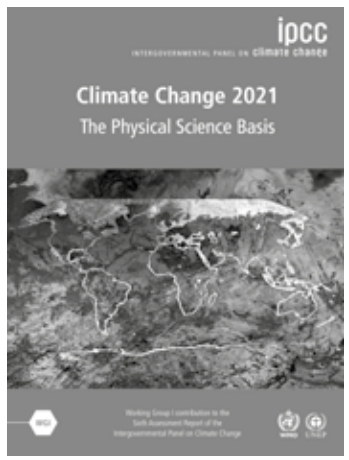












↑ Graph explaining the tipping point or threshold. In this case, the system is the ecosystems, where transitions can be associated with tipping points.

↓ Assessment Report covers by IPCC through the years.

science.[5] At their core, transitions are systemic shifts from one dynamic equilibrium to another: pressure builds until a tipping point is reached, after which the system changes fundamentally.[6] Sustainability transitions research explores these patterns and mechanisms in social systems. In essence, transitions are processes of build-up and break-down that create pressure to a point, after which a complex 'system' moves out of equilibrium and reorganizes itself.

In this chapter, we draw on sustainability transitions research to explore the present moment.[7] How did we get here, and what can it tell us about possible, plausible, or desirable futures?[8] Are we approaching or already past ecological tipping points leading to societal disruption,[9] or are we at the beginning of a new transformation toward a sustainable and just future?[10] What are future transition pathways and what is our role in them?[11] Societal transitions research builds on complex adaptive systems research and draws lessons from historical transitions to identify the patterns and mechanisms that drive large-scale, long-term systemic change in society. A key feature is their 'non-linearity': after a long period of build-up, disruptive and uncontrolled structural and institutional change occurs in a relatively short period (10 to 15 years) before a new dynamic equilibrium is reached.

Sustainability transitions research is positioned at the intersection of the past and the future, where the paths to collapse converge with alternative ideas, practices, and models that are emerging. In the iconic image of the Club of Rome, this is where all the trends begin to converge and reinforce each other. While population growth continues, the depletion of natural resources accelerates, and production and pollution peak before starting their decline. This business-as-usual scenario has unfortunately proven to be accurate (or we have somehow orchestrated it), but it does not tell the whole story. Across society, many people and institutions responded, and pioneers, activists, entrepreneurs, social innovators, researchers, and inventors explored alternatives. They may not have become mainstream, but according to transition theory, their time may yet come. The transition perspective thus provides a starting point for reframing and rethinking where we are and, more importantly, where we might be going.

The Buildup

To understand the current crises, concerns, and sociopolitical dynamics, we need to understand how we got here. As shown in the first part of this book, the environmental movement emerged in the second half of the century as modernization and (fossil) industrialization accelerated along with the rise of pesticides, plastics, carbon emissions, and biodiversity loss. The environmental problems this caused were initially addressed through further technological advances and regulation – for example, by regulating pollution, developing waste-management procedures, increasing efficiency in production, and phasing out harmful substances.

It was the period in which the Club of Rome, along with new

5 Connie J.G. Gersick, 'Revolutionary Change Theories: A Multilevel Exploration of the Punctuated Equilibrium Paradigm,' *The Academy of Management Review 16*/1 (1991), 10-36.

6 Carl Folke et al., 'Regime Shifts, Resilience, and Biodiversity in Ecosystem Management,' *Annual Review of Ecology, Evolution, and Systematics* 35 (2004), 557–581.

7 Derk Loorbach, Niki Frantzeskaki, and Flor Avelino, 'Sustainability Transitions Research: Transforming Science and Practice for Societal Change,' *Annual Review of Environment and Resources* 42/1 (2017), 599–626.

8 Joseph Voros, 'A Generic Foresight Process Framework,' *Foresight* 5/3 (2003), 10-21.

9 Tim M. Lenton et al., 'Tipping Elements in the Earth's Climate System,' *Proceedings of the National Academy of Sciences* 105/6 (2008), 1786–1793.

10 Per Olsson et al., 'The Concept of the Anthropocene as a Game-Changer: A New Context for Social Innovation and Transformations to Sustainability,' *Ecology and Society* 22/2 (2017), 31.

11 Lara Werbeloff, Rebekah Brown, and Derk Loorbach, 'Pathways of System Transformation: Strategic Agency to Support Regime Change,' *Environmental Science & Policy* 66 (2016), 119–128.

environmental NGOs like Greenpeace,[12] started to warn the world of its collision course. In the 1970s, it seemed that social and environmental movements were succeeding in mobilizing support for a shift to a different model of development. In 1974, Nixon established the Environmental Protection Agency EPA in the United States, and environmental policies were being developed in Europe. It culminated in the introduction of 'Sustainable Development' in 1987,[13] when Gro Harlem Brundtland led a UN commission that produced the landmark report that introduced the notion of 'development that does not harm the interest and possibilities of future generations.' It successfully galvanized efforts around the world, from international to local and from public to private.

As climate change and biodiversity loss could no longer be ignored as serious threats, a global response followed with the establishment of the UN Intergovernmental Panel on Climate Change (IPCC) and the Intergovernmental Panel on Biodiversity and Ecosystem Services (IPBES) in Rio in 1992. These bodies brought together the relevant scientific work on both topics and, through a global collaborative authoring and peer-review process, published 'Assessment Reports' and 'Summaries for Policy Makers' to support the development of science-based political consensus. Every six years, these reports provide an up-to-date picture of the world's geophysical dynamics – and each time they use stronger language to communicate the urgency, but without any legal implications. To translate science into policy, governments from most of the world's countries are brought together in 'Conferences of the Parties' (COPs) to discuss the scientific findings and propose policy mechanisms to mitigate them.

This global process is painstakingly slow: it took until the Paris Climate Agreement in 2015 to agree on a global ambition (1.5°C of post-industrial warming, or well beyond 2°C), and until the Glasgow Summit in 2021 to have 100 percent political agreement that climate change is real and man-made. While this in itself is significant and relevant, it is very clear that the issue is still contested around the world and there is certainly no agreement when it comes to alternatives and future directions. So far, no real and structural change has taken place. Emissions are still on the rise globally, except for a decline during the Covid-19 period.[14] While a few individual countries are showing a decoupling of economic growth and emissions, the overall trajectory is still one of continued increases in consumption and production, driving ecological degradation and climate instability.[15]

From a transition perspective, this is easy to understand: so far, we have focused mainly on the 'symptoms of unsustainability.'[16] In other words: CO_2 emissions are the direct cause of climate change, and governments aim to reduce them by introducing policies and technologies that mainly optimize a system that is in itself unsustainable. Beyond the effect of climate denial, it is the logic of existing institutional approaches that continue to drive innovation and optimization rather than addressing the fundamental unsustainability of an economic model based on fossil resources

12 Frank Zelko, Make It a Green Peace! The Rise of a Countercultural Environmentalism (Oxford: Oxford University Press, 2013).

13 World Commission on Environment and Development, Our Common Future (Oxford: Oxford University Press, 1987).

14 See, for details, the International Energy Agency's most recent emission report at this time: CO_2 Emissions in 2022, iea.org/reports/co2-emissions-in-2022.

15 For more details, see: Hannah Ritchie, 'Many Countries Have Decoupled Economic Growth from CO2 Emissions, Even If We Take Offshored Production into Account,' ourworldindata.org/co2-gdp-decoupling.

16 Jan Rotmans, René Kemp, and Marjolein van Asselt, 'More Evolution Than Revolution: Transition Management in Public Policy,' *Foresight* 3/1 (2001), 15–31.

17 Herman E. Daly, 'On Economics as a Life Science,' *Journal of Political Economy* 76/3 (1968), 392–406.

18 E.F. Schumacher, *Small Is Beautiful: A Study of Economics as If People Mattered* (London: Blond & Briggs, 1973).

19 Leopold Kohr, 'The City as Convivial Centre' (1974), panarchy.org/kohr/convivial.html.

20 Will Steffen et al., 'Planetary Boundaries: Guiding Human Development on a Changing Planet,'*Science* 347/6223 (2015).

21 Katherine Richardson et al., 'Earth beyond Six of Nine Planetary Boundaries,' *Science Advances* 9/37 (2023).

22 Marten Scheffer, 'Foreseeing Tipping Points,' *Nature* 467 (2010), 411–412.

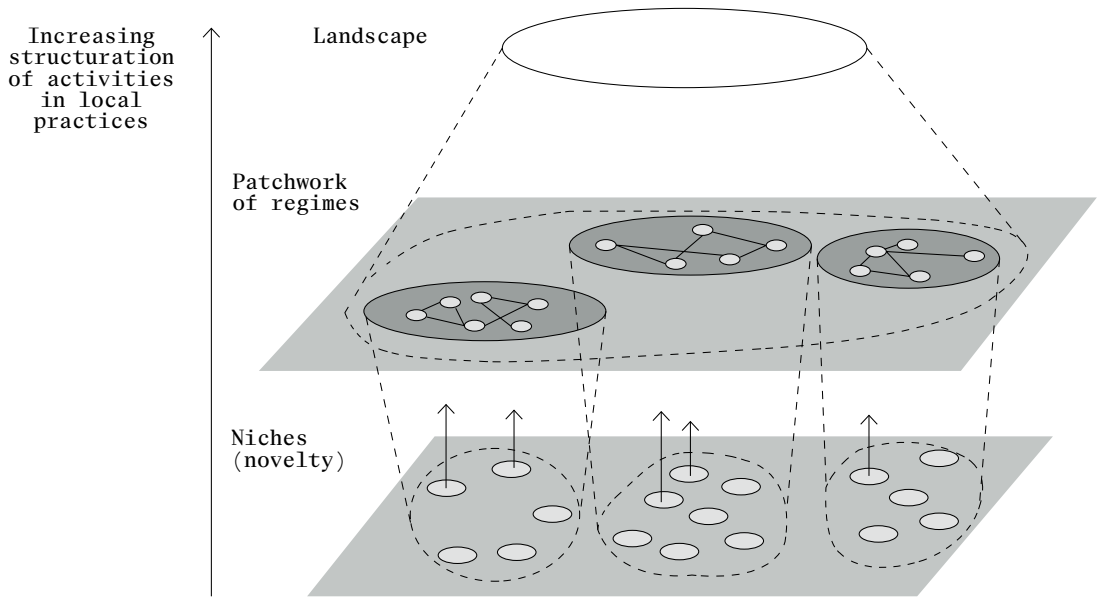
and extraction at this scale. But climate change is becoming increasingly difficult to deny, as it is rapidly becoming a short-term issue, and efforts to promote sustainability, decoupling, or green growth are not leading to the necessary transformative changes. The question is how, now that the pressure to change has become so great and the existing approaches have proven to be so inadequate, we can move to a different development path. Not one that helps to sustain a fossil economy, but one that helps us move to an economy that can truly sustain itself on a finite planet.

The concept of an economy within planetary boundaries that is not based on perpetual growth is not a new idea; it has been explored since the first signs of unsustainability. Authors such as Herman Daly[17] and E.F. Schumacher,[18] in line with the Club or Rome's message, explained in the 1970s how economic development focused on economic growth was itself the problem. Schumacher was inspired by his mentor Leopold Kohr, an Austrian economist who also argued for an alternative economic pathway and wrote about how cities, for example, needed to focus on compactness, health and community and the necessity to 'reduce the velocity of people.'[19] Ever since, scholars and practitioners have been experimenting with and exploring alternative ideas and practices. From a transition perspective, all this time has been needed for alternatives to develop, for systemic pressures to build, and for coming to terms with the fact that 'sustainable development' has in practice become part of the problem.

An Uncertain Future: The Dynamics of Transitions

The basic insight that transition research draws from all studies of complex adaptive systems is that if a system is *unsustainable*, it will eventually enter a period of nonlinear change. In other words, if it is impossible to maintain the current state of a system in the face of its changing context, its inability to adapt, and increasing competition, it will give way. It is by now clear that the post-industrial economic model is approaching the end of its lifecycle as we are transgressing the planetary boundaries.[20] This means that we face a deeply uncertain and potentially troubling future, and the longer we continue to destroy biodiversity, the more likely collapse becomes. Yet humanity itself is also reflexively responding to these dangers, creating more pressure for systemic change and mounting resistance from vested interests. A recent update of the planetary boundaries framework confirmed yet again that we are moving well beyond safe limits and have crossed all nine boundaries, leading to systemic disruption and potentially cascading ecosystem collapse.[21] In this paragraph, we synthesize findings from transition research to provide insight into the patterns and mechanisms underlying large-scale system change in society.

In ecosystems, transitions are associated with 'tipping points.'[22] The planetary boundaries concept, developed by a group of top



↓ Nested hierarchy of multiple levels, showing dynamic interactions over time leading to transitions and system innovations.

23 Johan Rockström et al., 'A Safe Operating Space for Humanity,' *Nature* 461(2009), 472–475.

24 René Kemp, Johan Schot, and Remco Hoogma, 'Regime Shifts to Sustainability through Processes of Niche Formation: The Approach of Strategic Niche Management,' Technology Analysis & Strategic Management 10/2 (1998), 175-198.

25 Anthony Giddens, 'Elements of the Theory of Structuration,' in: Anthony Elliott (ed.), The Blackwell Reader in Contemporary Social Theory (Hoboken, NJ: Wiley-Blackwell, 1999), 119–130.

26 Frank Geels, 'Technological Transitions as Evolutionary Reconfiguration Processes: A Multi-Level Perspective and a Case-Study,' *Research Policy* 31/8-9 (2002), 1257-1274.

27 Frank Geels and Johan Schot, 'Typology of Sociotechnical Transition Pathways,' *Research Policy* 36/3 (2007), 399–417.

28 Flor Avelino et al., 'Transformative Social Innovation and (Dis) empowerment,' *Technological Forecasting and Social Change* 145 (2019), 195–206.

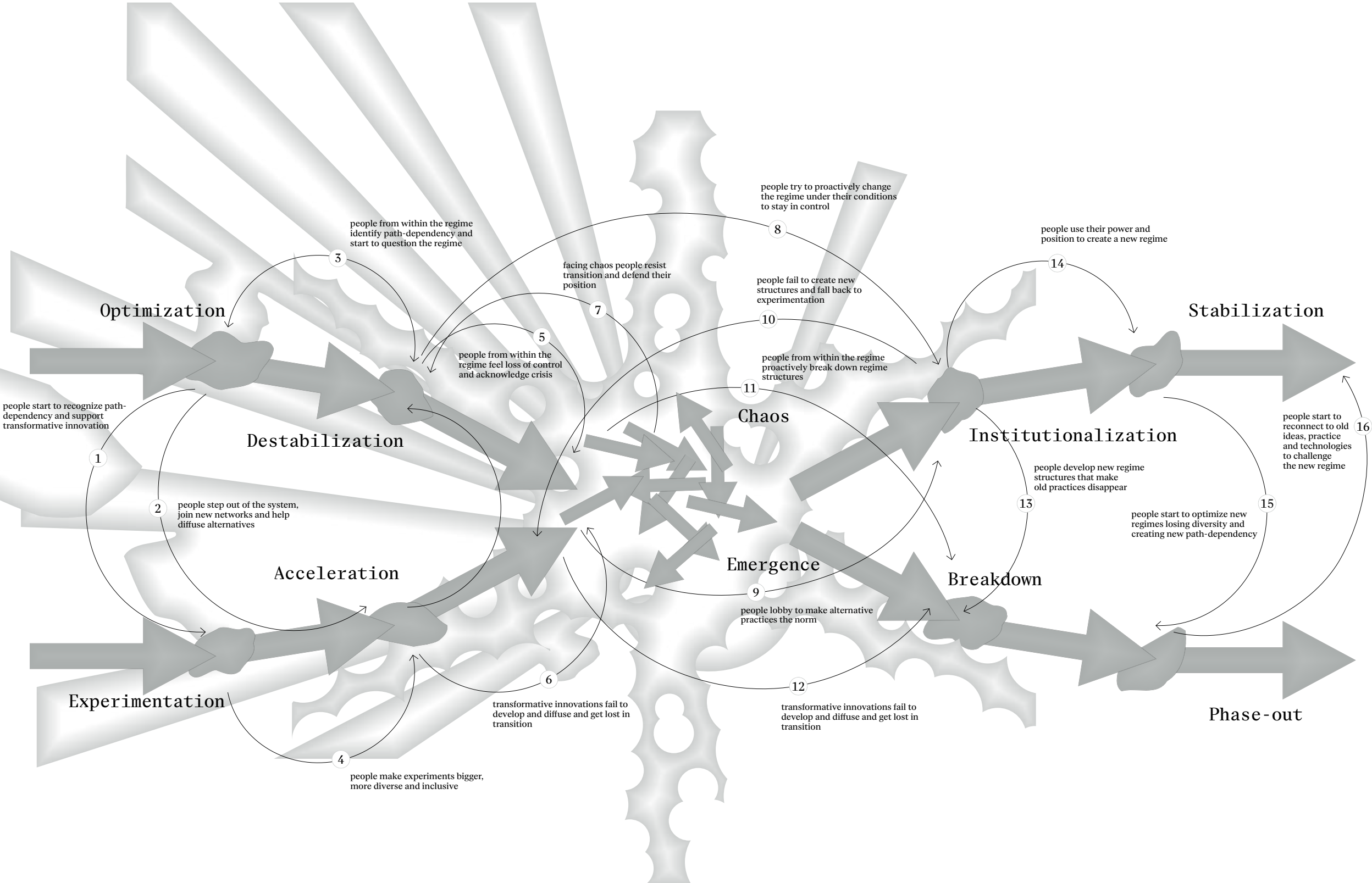
29 Aniek Hebinck et al., 'An Actionable Understanding of Societal Transitions: The X-curve Framework,' *Sustainability Science* 17/3 (2022), 1009–1021.

ecologists led by Johan Rockstrom, anticipates such climate and ecosystem tipping points.[23] In such cases, we are external observers and can identify exact tipping points or witness the change. In social systems, however, this is much more ambiguous. A crisis does not necessarily lead to fundamental change, and what is disruptive to one may be trivial to another. However, the underlying pattern identified in complex systems theory is found in numerous historical transitions that reveal an intriguing pattern. We humans develop over time what are referred to as 'societal regimes': shared values and culture, structures, and practices.[24] These regimes enable us to live our lives because they support the basic functions of society (for example, energy, mobility, care, education, finance, housing). At the same time, these regimes lock us in, they structure our lives and condition our behavior: because the road was built, and we bought the car, and we live far from our jobs, we commute, and thus need the road and everything related to it. Sociologists call this structuration: no one plans it, but our collective behavior and choices create a context within which we live our lives.[25]

The fascinating thing about transitions is that while these regimes can remain more or less stable for decades, there are always periods when their stability is disrupted. There are three basic forces that cause this, visualized in the so-called 'multi-level perspective.' [26] First, since a regime is normally accepted, effective, and logical, people work mainly to improve it. We call this optimization: increase efficiency, reduce pollution, and lower the costs. In the long run, however, this makes it harder to let it go, as we invest more and more in the way we have always done things. Second, the societal context changes: demographics, broader societal values, and (geo) political context. Or external events occur: wars, epidemics, natural disasters, economic or social crises. These 'landscape changes' increase the pressure on actors within the regime to continue to improve and adapt.[27]

Third, creatives, entrepreneurs, activists, researchers, visionaries, or other concerned or idealistic individuals may break away from dominant regimes and explore alternative ways of thinking, doing, and organizing. Such 'niches' or 'transformative social innovations' might initially be the very alternative.[28] People develop new technologies, ideas, visions, lifestyles, or business models. As pressure builds, more people will join, invest, adopt, or collaborate, accelerating the development and diffusion of these alternatives. These three processes are mutually reinforcing, and when the external pressures, internal tensions, and emerging alternatives come together, a period of chaotic and relatively rapid change can lead to societal norm shifts, institutional and political changes, and, in general, a transition to a new future regime. The so-called X-curve captures this process.[29]

The basic pattern is that as long as there are no fundamental or persistent problems, actors seek to *optimize* existing regimes. But as the context changes and it becomes harder to adapt through optimization, *destabilization* occurs: regimes lose societal support, individuals within the regime start to challenge it, and internal



↑ The X curve captures the non-linear patterns and dynamics of build-up and break-down in transitions as well as how individuals (can) engage with these.

conflicts and crises increase, potentially leading to *chaos* and possible *disintegration* and *breakdown*. On the other hand, there are always people who start experimenting before most of us feel any urgency. As more and more people join in over time, and as the quality of the alternatives improves, *acceleration* can occur, and new structures, cultures, and practices can *emerge*. When these dynamics of breakdown and buildup come together, a transition takes place: the drastic and relatively rapid *institutionalization* of a new regime, in which old and new elements often recombine.

These dynamics seem to represent a basic evolutionary pattern that is also present in sociocultural development. Historical transitions have often been driven by technological innovation, but show a consistent process of social acceptance of problems, convergence on future promises, and a creative process of developing a new regime while phasing out the old. The shift from horses to cars as the dominant mode of transportation, the hygiene movement in the early twentieth century, the industrial food revolution after the Second world War, and the shift from landlines to smartphones all involved technological breakthroughs, but they also profoundly changed our values, behaviors, and socioeconomic institutions. They transformed our physical environment, allowing us to go further and build higher, faster, and ever more.

Breaking Path Dependency

The development of societal regimes is 'natural,' but they are also constructed: we humans develop certain ideas, institutions, technologies, and routines in social systems that reinforce each other. They develop on the basis of shared ethics, values, and problems: often existing regimes that are perceived as problematic (the fossil energy regime, the industrial food regime) have historically emerged as responses to societal problems or crises. Because they make our lives easier and provide stability, societal regimes are desirable. Most people take them for granted or try to improve what is already there through innovation, efficiency, or optimization. But it is also human to break out of routine and explore alternatives.[30] Like ecosystems in a changing context, societal transitions areonly a matter of time: in the end we will move toward a new equilibrium one way or another. But societal transitions are highly contested and politicized: they threaten existing investments and positions, and are resisted by vested interests and groups that are threatened in some way. And the uncertainty associated with transitions leads to deep social unrest, conflict, and polarization.

Thus, paradoxically, transitions in social systems happen mainly *because of* social, cultural and institutional *path dependency*: the continuous optimization within a specific 'regime' (dominant ways of thinking, doing, and organizing). Ultimately, this becomes more and more expensive, difficult, and unmanageable as the society around it changes. One example is making internal combustion engines more and more efficient while at the same time making cars bigger, another is widening roads to relieve congestion while this

30 Benoit Godin and Dominique Vinck (eds.), *Critical Studies of Innovation: Alternative Approaches to the Pro-Innovation Bias* (Cheltenham: Edward Elgar, 2017).

31 Will Steffen et al., 'The Trajectory of the Anthropocene: The Great Acceleration,' *The Anthropocene Review* 2 (2015), 81–98.

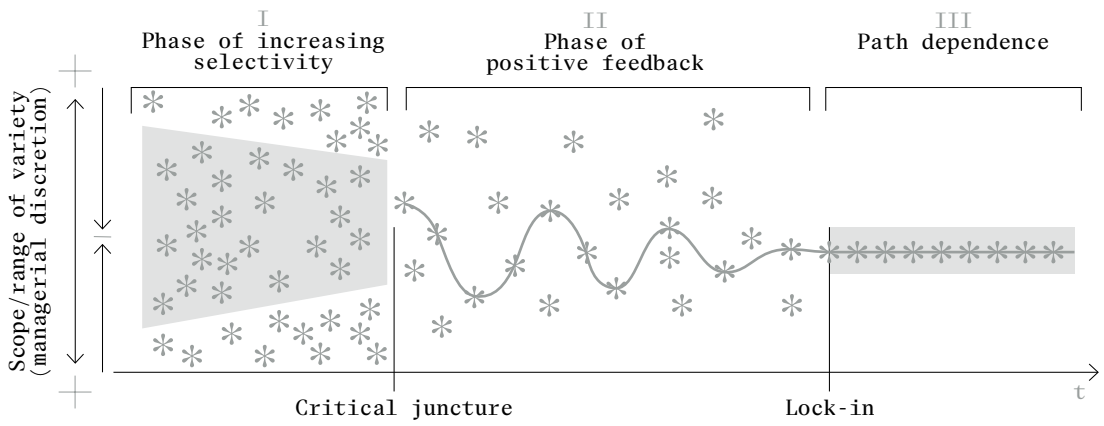
32 Elena Bennett et al., 'Bright Spots: Seeds of a Good Anthropocene,' *Frontiers in Ecology and the Environment* 14/8 (2016), 441–448.

attracts new traffic. In the process, whole industries, policy departments, research institutes, and behavioral routines develop that in themselves create inertia: individuals may deviate, but on a societal level most people will feel comfortable, attached, or interested in business as usual. That is, until the context changes and optimization is no longer sufficient to meet a changing demand or requirements. Inevitably, transformative change is then forced on the actors within the regime.

In contrast to historical transitions, which were largely driven by technological innovation and the prospect of progress, current transition pressures are perceived by many as threatening prosperity. Much more than in the past, institutional accumulated power and wealth are at stake: the dominant economic model itself is destabilizing. The current path dependency or 'lock-in' in developed economies is a combination of resistance to transformative change by vested interests and established institutions, combined with a widespread popular fear that the future might be worse if we have to make do with less. This makes current emerging transition pressures and potential future transitions ambiguous, contested, and uncertain: we clearly see the destabilization and emerging alternatives, and increasing external pressures on societal regimes, but so far governments, industries, and populist votes have prevented more proactive and managed system change. It is certain, however, that destabilization and disequilibrium will eventually occur, but how long it can be postponed, what will happen then, and where these transitions will take us are fundamentally uncertain. Only future historians will be able to tell.

The Transition Twenties?

Today we are witnessing the destabilization of the fossil, extractive economic regime. While there is still much controversy and doubt about climate change and its impacts and implications, it is scientifically beyond doubt that climate change and biodiversity loss are man-made and fundamentally problematic. As the ecological crisis is being felt by more and more people in their daily lives, it has increasingly become a short-term problem: the urgency to act is evident as floods, wildfires, storms, participation peaks, and droughts affect more and more local communities. Scientists have begun to refer to this as the Anthropocene: the era in which humanity has become the dominant force shaping the world and its ecology.[31] In contrast to these negative drivers, we can also see the momentum building through alternative practices, ideas, and technologies that have had or needed time to mature, develop, and grow as part of the human efforts to reshape our relationship with our natural environment in the modern era.[32] The possibilities for fundamentally changing our way of life toward a sustainable and just future are becoming clearer and more tangible: an economy within planetary boundaries that ensures the wellbeing of all life on Earth. Perhaps we needed this long buildup to move into transition?



↑ Breaking and creating organizational paths: Alternative route in face of path dependency.

[33] John Grin, 'The Politics of Transition Governance in Dutch Agriculture: Conceptual Understanding and Implications for Transition Management,' *International Journal of Sustainable Development* 15/1 (2012), 72–89.

The Netherlands can serve as a canary in the coal mine when it comes to understanding the transition moment. The country has a very fossil-based economy, given its natural gas reserves, the dominance of the Port of Rotterdam in Northwestern Europe, and its position as a logistics hub. It is a small but dense country below sea level, with a very successful economic policy of promoting industrial production, consumption, and intensive land use, including industrial farming. In recent decades, its policymakers have sought to avoid stricter environmental regulations and/or to invest in innovation and improved efficiency to meet environmental targets. But whether it is mobility, energy, or food, technological optimization combined with access to unlimited fossil resources is reaching its limits and increasingly crossing legal, social, and environmental boundaries.

Take the Dutch agricultural system, which is the result of a successful historical transition in the decades after the Second World War. It is highly efficient and productive, mainly because of pesticides and fertilizers, combined with economic policies and facilitated by the financial system.[33] Collectively, governments, banks, farmers, and universities have created a very successful regime, but one based on subsidized fossil fuels, profit maximization, industrial monocultures, and the externalization of environmental impacts. It has been known for decades that intensive livestock farming and monocultures exhaust the soil and release phosphates and nitrogen into the environment beyond what it can absorb. But policies have long sought to stimulate technological innovation and find ways to maintain the existing regime rather than to transform it, despite all the signals of its unsustainability.

When the highest court in the Netherlands used legal procedures to force the national government to adhere to its own rules and targets, the result was chaos: an unsustainable regime captured by vested interests, practices, and power structures and institutionalized through rules, routines, and existing practices. The national response was to bring all stakeholders together to try to reach an agreement on policies that would reduce the environmental impacts to within legal boundaries. Instead, farmer protests, along with deep societal conflicts and an undermining of the underlying science (mainly concerning the way in which the sources of nitrogen emissions were calculated and attributed), intensified the national stalemate. As European laws on water and soil quality become more stringent, environmental quality continues to deteriorate, and policies are partially captured by vested interests, it is hard to see how this can lead to anything but deeper conflict and chaos.

At the same time, alternatives have been developing for years: progressive consumers are changing their diets, entrepreneurial farmers are moving into biological, organic, and regenerative farming, social entrepreneurs are developing food networks, and retailers and supermarkets are beginning to support the emergence of an alternative market for plant-based, biological, nature-positive, or other building blocks of

a possible and sustainable future food regime. In the Netherlands, the need for transformative change in the food system has been evident for decades and on the political agenda for almost as long, but the dominant structures, interests, and practices are entrenched. The alternatives, while growing in numbers and strength and becoming more mainstream and accepted, remain alternatives. The farmer protest that started in the Netherlands in 2019 grew and became international in early 2024 with massive protests against the EU's policies for greening agriculture, leading to a massive backlash: pesticide reduction targets, sustainability ambitions, and nature restoration goals were all withdrawn or watered down to appease the sector. This is a living example of how the extractive model is coming to the end of its lifecycle and elements of an alternative future are becoming visible, creating a chaotic, uncertain, and increasingly polarized context in which no one is in control.

In this moment of transition, institutions and structures become fluid, norms are contested, vested interests are threatened, and uncertainty and polarization create chaos. In this context, alternatives emerge, new structures and coalitions form, new practices become mainstream, and alternative futures come within reach. Given the fundamental nature of the pressures that are building up and the ingrained unsustainability, these will not go away and will only worsen until structural change takes place: business as usual is the only future that is impossible.

The current moment of transition is a starting point: we are leaving the comfort of decades of stable but fossil-based, extractive, and linear growth in our developed economies and have to reinvent ourselves. Building on past transitions, this period will be disruptive and chaotic for years before a new stability is found. In many ways, the transition moment creates discomfort: it forces us to rethink our behaviors and routines.

Living in the Transition Moment

Whether and how one experiences the transition moment is deeply subjective. Depending on how informed and engaged one is, which transition one is referring to, or in which role one is speaking, one can find oneself in different places or dimensions of the X-curve. Most of this chapter, for example, is written based on a 'Western' transition discourse and takes the neoliberal economic model as the (unsustainable and unjust) context under pressure. In many developing economies, the context is fundamentally different, but similar patterns and mechanisms can be identified. How to understand dynamics of transition and their implications for the road ahead thus depends on the situation, context, and perspective. However, it is clear that the (lack of) transitions in developed economies are directly related to the extractive, colonial nature of neoliberal economic models and the destabilization caused by the global ecological and social crises they generate.

Unless the foundations of the extractive and fossil-based economic model change, the unsustainable path to destabilization

will continue until transitions occur. Strategies to innovate our way forward by improving or making existing economic models less bad are therefore problematic: it matters how one engages with the dynamics of transition. Awareness of the historical context in which we live and its long-term dynamics forces us to think beyond business as usual, to take a longer time horizon, and to imagine alternative futures. There are many different ways to do this: by connecting with deep time and adopting an ancestral attitude to preserve or revalue old practices, to move toward natural, circular, or indigenous ways. Or by embracing technology and the potential to scale new models to accelerate desired transitions. Or simply by disrupting the status quo and taking decisive action to change the course of history now. These different approaches or 'velocities' each have their role to pay, but together they could bring about transitions in an orchestrated way.

In the chaotic destabilization predicted by the *Limits to Growth*, we therefore have a choice. The next 50 years need not lead us to global collapse but could also see the emergence of an entirely new, unimaginable, and accelerated transition to a just and sustainable future. If we shift our attention from the problems and potentially dystopian futures to the social and technological alternatives developing in the niches, transformative innovators could collectively move society in the right direction. But it will require new strategies for designing the future; not extending or building on what already exists, but developing the radical alternative in small, incremental steps as an 'evolutionary revolution.'[34] Working with what has been lost or is already in the niche, exploring what could and should be, redefining and restructuring the way we live, and collaborating across domains and places in support of radical futures.

34 Rotmans, Kemp, and Van Asselt, 'More Evolution Than Revolution,' op. cit. (note 16).

↑ Etienne Malapert, Solar panels in Masdar City, 2015.

Chapter 7: Rethinking Architecture through Velocities: The Ancestor, the Activist, and the Accelerator

Lead author: Peter Veenstra

In the second half of the twentieth century, the rise of environmental awareness paralleled five decades of design research conducted by individuals, collective practices, and movements on how to implement innovative technologies (Chapter 3), build with low-tech methods (Chapter 4), and integrate premodern practices and alternative ways of building (Chapter 5). The experiments, research, and innovations focused on environmental and social sustainability were often driven by concerns about the unsustainability of the general course of society. They were often distinct, local, isolated, individual initiatives. Unlike movements in art or politics, these practices were not organized or united around a central philosophy, but consisted of dispersed individuals and collective initiatives that shared an interest in ecology and/or were motivated by forms of autonomous, self-sufficient, or low-tech building.

Many of these experiments were initially relatively invisible, and often unsuccessful, as the market favored cost-efficient, large-scale, fossil resource-based project development and construction, into which these alternatives did not fit. Nevertheless, these individual efforts and niche practices gradually diffused, professionalized, and even institutionalized over decades. As a result, a variety of attitudes, values, and practices emerged that architects, decision-makers, and stakeholders can now adopt to mitigate climate catastrophes and their associated ecological and social challenges. Although we are still a long way from solving these problems, we have not 'lost' 50 years, but rather the coexistence of several simultaneous initiatives has been instrumental in moving toward greater sustainability: if we look at the past five decades and weave red threads through history, we can see the potential of these threads for contemporary practice. We needed the past decades to get to where we are today.

As the sense of urgency continues to grow, more and more practitioners in the field of architecture are becoming aware of their role in mitigating the effects of climate change. They are working toward carbon-positive built environments; (re)using local materials; promoting regrowth, restorative, or non-extractive architecture;

↑ The Confluence of European Water Bodies, an initiative of the Embassy of the North Sea and TBA21-Academy, was founded in 2023 to represent Europe's rivers, lakes, seas, and lagunes in the legal, cultural, and political public domain.

working with alternative economies and commons; and applying biomimicry designs. They are also shifting the time horizon (toward a more distant future, from short-term profit to long-term value) and focus (from optimization of the existing to a radical rethinking of the systems that shape our living environment). Yet most of these ideas, initiatives, and actions are still being developed at the margins. Business as usual takes place in a competitive environment, with strict time, budget, and program constraints. The vast majority of the outcomes of these architects' efforts are predetermined by their clients, stakeholders, laws and regulations, contractors, and suppliers.

The dynamics of perpetual or limitless growth have led to an age of acceleration in which dominant practices, enabled by the logic of the market, politics, and the economy, are increasingly concerned with the short-term horizon, such as the next election or immediate profit.[1] This acceleration and its inherent focus on short-term gain and output challenges our understanding of architecture and calls into question the roles, tools, and methods of the practicing architect in relation to achieving long-term sustainability. Time pressure has become a dominant factor in both the working conditions of the architect and the environmental challenges we face. Narratives of climate change call for immediate action in order to avoid planetary collapse, and imply an urgent slowdown or reduction in consumption, extraction, and pollution. At the same time, alternative forms of value creation are not being scaled up fast enough and in fact need to be accelerated. This creates a paradox: to escape the pathway of growth and transition to a sustainable future, we need both acceleration and deceleration.

Based on this diagnosis, we have identified three distinct strategies, each with a different attitude toward time: consciously slowing down and returning to old habits, tools, and practices; taking immediate action and mobilizing communities; or accelerating transformative change with the help of technological innovation. These attitudes can be represented by three protagonists that fight against climate change: the ancestor, the activist, and the accelerator. Together, these attitudes represent different velocities of thought and action, building on the work of previous generations. They also identify the critical role that time can play in the broader processes of social change, whether through the engagement of architects, landscape designers, urban thinkers, public authorities, private stakeholders, communities, and/or individuals. In the following sections, each stance is explained and illustrated with notable recent projects.

The Ancestor

Ancestors slow down and take a deep-time perspective. They reconnect with natural systems, premodern practices, and knowledge to build for the long term. But they also study far-future scenarios, and apply long-term planning and thinking. Ancestors take a radical stance against short-termism, determinism, and optimization: they

1 Thomas Friedmann, *Thank You for Being Late: An Optimist's Guide to Thriving in the Age of Accelerations* (New York: Farrar Strauss & Giroux, 2016).

propose that nature will survive the destructive late capitalism, and that sustainable practices based on premodern knowledge will persist. They consider historical injustice, looking back to what has been lost, suppressed, and forgotten, while looking forward toward the wellbeing of future generations. Fundamentally altruistic and taking responsibility for the many generations to come, architecture of the ancestor is locally rooted and globally resonant.

Awareness of the scale and complexity of our current climate crisis leads to a logical response: big problems require big solutions and big ideas. Big ideas can bring about changes that may not be visible in the short term, but can make the necessary difference in the long term. In other words, long-term thinking opens the door to big ideas. American Ecologist Edward Wilson's 2016 book *Half-Earth* is a good example of this: it suggests that if we free half the Earth from human presence, we might be able to stop the decline of biodiversity.[2] After describing the mass extinction of species that is currently taking place, Wilson presents an action plan for preserving our planet's biodiversity. He suggests that we still have time to set aside half of the Earth and identifies specific places where the Earth's biodiversity can be reclaimed. Another example of a long-term big idea with the potential to guide short-term action is the book *Drinkable Rivers*, published in 2023 by Dutch philosopher Li An Phoa and journalist Maarten van der Schaaf.[3] The title of the book gives away the message: 'We propose to use drinkable rivers, as a guiding principle for our societies, as a replacement of economic growth. Drinkable rivers as an ancient and new compass, guided by the following, simple question: "Does this behavior, this measure, or this innovation contribute to drinkable rivers?"'[4] These two examples could be seen as suggestions for grand projects for humanity. For such ideas to become reality, changes would be needed on many other levels: cultural, political, and legal.

To shape a society that is sustainable in the long term, we need to move away from anthropocentrism. We need to engage with the long-term temporalities of geological formations, landscapes, and plant life in order to live in harmony with them. This calls for a different decision-making process, one in which entities without a voice are also represented. The Embassy of the North Sea is a courageous attempt to promote this. The project was inspired by Bruno Latour, who in his 2012 seminal book, *We Have Never Been Modern*, introduced the idea that non-humans such as animals, plants, rivers, and oceans should also have a voice in our democracy.[5] According to Latour, the modern separation of science and politics has led to a false and damaging distinction between nature and society. To give nonhumans a voice, he proposed the creation of a Parliament of Things. Having laid the groundwork, Latour expected others to take up the idea and establish his proposal. In 2018, inspired by Latour's vision, a group of Dutch philosophers, artists, and others founded the Embassy of The North Sea, an organism that seeks to emancipate the North Sea as a political actor. In order to see and understand the North Sea in all its diversity, they developed new forms of imagination, interaction, and representation.

2 Edward O. Wilson, Half-Earth: *Our Planet's Fight for Life* (New York: Liveright, 2016).

3 Li An Phoa and Maarten van der Schaaf, *Drinkable Rivers: How the River Became My Teacher* (Zandvoort, NL: Stichting Drinkable Rivers, 2023).

4 Ibid., see: drinkablerivers.org/our-story/#:~:text=We%20propose%20to%20use%20drinkable,innovation%20contribute%20to%20drinkable%20rivers%3F%E2%80%9D.

5 Bruno Latour, *We Have Never Been Modern* (Cambridge, MA: Harvard University Press, 2012).

6 For information, see: embassyofthenorthsea.com/.

7 Roman Krznaric, The Good Ancestor: *How to Think Long Term in a Short-Term World* (London: Ebury Publishing, 2020).

8 Roman Krznaric, *The Good Ancestor: Resources* (30 December 2021), romankrznaric.com/good-ancestor/resources.

9 Kim Stanley Robinson, *The Ministry for the Future* (London: Orbit, 2020).

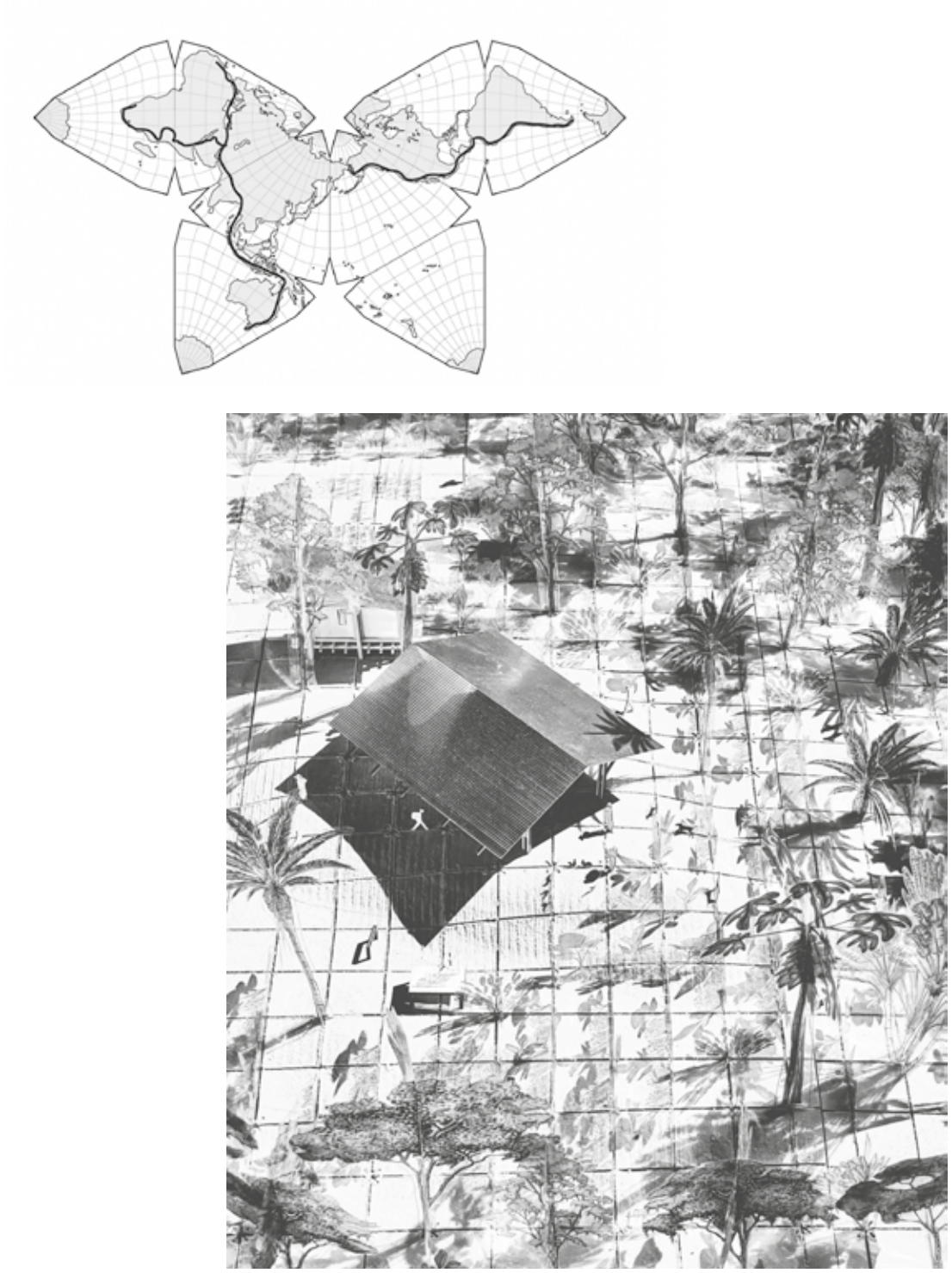
10 Arturo Escobar, *Designs for the Pluriverse: Radical Interdependence, Autonomy, and the Making of Worlds* (Durham, NC: Duke University Press, 2018).

In art installations, exhibitions, events, and writings they sought to create a learning trajectory of listening and speaking to the North Sea and all life within it, and ultimately to negotiate on behalf of the North Sea.[6]

By the same token, not only nonhumans but also the interests of future generations should be considered in the decisions made now. Philosopher Roman Krznaric, whose recent book *The Good Ancestor* was earlier mentioned in Chapter 5, suggests that we have both 'marshmallow brains,' which seek instant gratification, and 'acorn brains,' which want to plant seeds for the future beyond our own lifetimes.[7] By focusing only on our present needs and neglecting the consequences of our actions on forthcoming generations, we have brought our species perilously close to the brink of catastrophe. But by reflecting on what we are leaving to our descendants and future generations, we must take the long view and act decisively. Krznaric presents six ways to 'think long' as an antidote to short-termism, to become good ancestors and ensure a better life for future generations. One of the strategies proposed is cathedral thinking, which consists of planning projects beyond one's own lifetime. According to Krznaric, we will soon see an 'emerging global movement of "time rebels" dedicated to intergenerational justice and long-term thinking.'[8] In 2020, the same year as *The Good Ancestor* was published, Kim Stanley Robinson released his climate fiction novel *The Ministry for the Future*.[9] It elaborates on the idea of a global Ministry of the Future, bringing together the themes presented by the Ministry of the North Sea, Bruno Latour's writings, and Krznaric's multigenerational thinking.

Long-term thinking starts in the past. The course of society's development was set in the past, and this direction is maintained by the economic system, the political system, and all vested interests. To break our path dependency, it is important to understand the timeline from past to present to future. What kind of future could ancestral thinking produce? Colombian-American anthropologist Arturo Escobar offers a glimpse of this in his 2018 book *Designs for The Pluriverse*, in which he describes a world of worlds, designed and built locally and collaboratively, relating to the world in an indigenous manner.[10] He sees an important role for designers in developing alternative futures: 'Design has developed a new sensitivity to the environment and to human predicaments, and is more attuned to its ability to contribute to creating a better world; it becomes a medium in the service of society rather than solution-making expertise in the service of industry.'[11]

How does the notion of deep time and big ideas like drinkable rivers play out in concrete architecture and contemporary built environments? It is easier to think about the distant future of the landscape, often malleable, low-tech, and naturally dynamic, than the distant future of the city in all its complexity. How can we live together, at what density, in what kind of neighborhoods and housing? Much of the long-term thinking today focuses on restoring the climate, biodiversity, soil, and water systems. The narratives used in most restoration initiatives promote – in some



↑ Map of the World Park Project, developed by Richard J. Weller, proposing a continuous landscape of restored habitat with three major walking trails reaching from Patagonia to Alaska, Namibia to Turkey, and Australia to Morocco.

↓ The model of Proyecto de Conectividades Socio-Ecosistémicas (PCSE), by NGO Herencia Ambiental in collaboration with the Colombian architect office Taller, as presented at the exhibition *It's about Time. The Architecture of Change*, IABR 2022.

11 Ibid.

12 For more information about Richard Weller, see: richardweller.net/; for more information on the World Park Project, see: theworldpark.com/.

13 James Charles Collins and Jerry I. Porras, *Built to Last: Successful Habits of Visionary Companies* (New York: HarperCollins, 2002).

14 Norman Myers et al., 'Biodiversity Hotspots for Conservation Priorities,' *Nature* 403 (2000), 853–858.

form – a return to the past. When we examine the human relationship with these natural systems, we often look to premodern practices and indigenous cultures for inspiration. This is usually done while holding on to our modern achievements. How do our comfortable modern world and futures inspired by the premodern world relate to each other? And how do we take the first step toward those futures? After big ideas are initially advocated by philosophers, sociologists, ecologists, and artists, how can architects, landscape architects, and urban planners translate them into concrete projects and images of the future? How can they help societies overcome the path dependency described in Chapter 6?

Landscape architect Richard Weller's World Park Project is an extreme case of large-scale thinking in relation to the *longue durée*.[12] It addresses the issue of nature conservation on a scale that makes sense given the fact that many of our most precious natural areas are transnational and require collaboration on a scale larger than familiar political boundaries. The plan to establish a global nature reserve is presented as a *big*, *hairy*, *audacious goal*, intended to attract investors and provide them with an alternative to funding 'shooting rockets to the moon.'[13] The World Park Project speculatively brings together nations, states, landowners, and local authorities to jointly create a contiguous, restored habitat for biodiversity and recreation. The project starts with three recreational routes: the first runs from Australia to Morocco, the second from Turkey to Namibia, and the third from Alaska to Patagonia. The park connects 55 countries and 19 biodiversity hotspots.[14] The World Park Project is not only meant to encourage people to 'walk around the world,' but also to 'work on the world' by contributing to the restoration of biodiversity in the landscapes between the protected areas of natural beauty. The goal is to create more than 160,000 square kilometers of contiguous territory, allowing ecosystems to migrate and the planet to adapt to life-threatening climate change.Although it did not attract the targeted angel investors, it did catch the attention of UNESCO, which is seriously considering its implementation.

What could almost be seen as a pixel from Weller's World Park Project is the Proyecto de Conectividades Socio-Ecosistémicas (PCSE), by NGO Herencia Ambiental in collaboration with Taller, a Colombian architecture firm. Since 2012, the NGO has been working with nearly 200 families in Vereda Raiceros, in the department of Bolivar, to protect one of the country's most precious ecosystems: the dry tropical forest. The goal is to establish several socioenvironmental corridors in the Montes de María. They follow a sensitive, inclusive approach that combines large-scale thinking with individual people and collaborations. Together with Herencia Ambiental, the architects are helping the local community to increase the environmental, social, and financial sustainability of their activities by revitalizing community facilities, optimizing agricultural methods, and improving housing. In doing so, they support the governance of a region that has experienced social unrest in the past. Local families voluntarily enter into a signed agreement to protect the tropical forest and the most endangered fauna, often

↑ The Nandalal Sewa Samithi library building, 2018, by Anupama Kundoo Architects, realized as a social infrastructure facilitated by the social organization Nandalal Sewa Samithi.

↓ Atelier LUMA in Arles, France, 2021 by Assemble Studio, BC and Atelier LUMA.

found only there, on their land. The migratory routes of the jaguar, endemic to the region, are respected, even though they are traditionally considered a threat. The families take pride in their role as stewards of the area, motivated by their ancestral knowledge of how to treat Mother Earth.

At the urban scale, we can see many proposals that take a very long-term perspective to improve the relationship between city, infrastructure, and nature. The city of Madrid, for example, is planning a Metropolitan Forest around the city since 2020, partially on the ruins of failed real estate speculation projects that were part of the cause of the Great Spanish Depression that began in 2008. It fundamentally changes the future perspective of a city that has always expanded its boundaries with new housing. Another example of a radical rethinking of the city's infrastructure in relation to climate and the environment is Barcelona's plan for the Superblock, which transforms two-thirds of the famous city grid into green and pedestrian-friendly spaces. But the most impressive example of ancestor projects on an urban scale is Ringland in Antwerp. This project, which began around 2014 with a simple sketch, a fundraising festival, and a civil movement, aims to put Antwerp's ring road underground and cover it with a park. Traditionally, cities use infrastructure as a tool for spatial development. Ringland is not about development, but about transition: by creating an underground highway system, the public is provided with an improved air quality, programmable space for residential neighborhoods, and new transportation networks. Green spaces on the canopy also provide vital ecological links to areas around Antwerp. By now, the Flemish government, the City of Antwerp, and the Port Authority have secured a serious budget to realize large parts of it. Over time, the project's complexity increased dramatically. Intendant Alexander D'Hooghe speaks of a different kind of cathedral building: a cathedral-like organigram of advisors and stakeholders is involved in making the project a reality. The urban plan combines supra-local solutions with neighborhood functions and local programs for mobility, infrastructure, ecology, and urban development. Although the plan revolves around mobility and infrastructure design, it has a significant social and ecological impact. Thanks to a real budget, timeframe, and stakeholder support, the project is a successful example of a radical rethinking of the city. It shows that whenever a big and simple idea on such a scale approaches realization, it encounters infinite complexity. Keeping this simple idea alive while dealing with complex realities is crucial.

When we descend from the urban scale to the scale of the individual buildings and materials, the work of Indian architect Anupama Kundoo clearly expresses ancestral thinking. Kundoo argues against the Starbucksification of architecture – a standardization of the definition of quality that leads to bland and unsustainable buildings. Instead, she advocates the use of local materials, local labor, and taking time, and demonstrates this approach in her buildings. Kundoo sees time as a forgotten resource in architecture, while architecture is a process that embraces the present, the past, and the

future. She believes that an architect should invest more time in thinking, researching, sharing knowledge, and building, rather than focusing on optimization and time-saving processes. In one of her essays, Kundoo writes:

Since industrialization, there has been the notion that 'time is money,' or that urban people have no time, and therefore cannot make time to engage directly in producing what they need and offset the costs of their homes, as rural people used to do ... A lot of contemporary problems can be attributed to this wrong assumption. It is now assumed that if we could cut back on the time human beings need to devote to things, then we would be efficient; this eagerness for efficiency overlooks the condition of the human beings in the process, oblivious to whether human society is doing well or not.[15]

About the sense of urgency to solve the climate crisis, she says:

> Instead of responding to this with equally hasty action, we need to take the time required to think before we act, and invest even more time as we may need to radically rethink our future and create new habits that serve our purposes. We can no longer afford to think short-term and for the benefit of the few. In the end, our haste only leads to more delay.[16]

A final example of the same ancestral vision – albeit combined with a more accelerated approach – can be found in the practice of BC Materials. An offshoot of BC Architects, BC Materials' mission is to promote and grow 'earth construction' as a solution to counter the immense environmental impact of the traditional construction industry. By leveraging urban mineral waste streams (like excavated earth), BC Materials aims to encourage construction companies to use healthier, circular, and low-carbon building materials such as earth plaster, compressed earth blocks, and rammed earth. Planetary boundaries are seen as an opportunity to develop new building aesthetics. For Atelier Luma in Arles (FR), BC Materials researched the bioregional resources of the Camargue to develop building materials from agricultural and quarry waste streams in the region. From local quarries, large quantities of orange clay slurry and white debris sand were used; from agricultural fields, sunflower harvest waste provided strong fibers and light aggregates from sunflower stems and pith; and from a recycling center, building demolition waste was sorted and crushed into gravel. The harvesting of these materials resulted in six newly developed materials that are being used in the renovation of a former nineteenth-century train depot building. This will become a new workspace for the Atelier Luma design and research laboratory, including timber, metal, ceramic, and textile workshops, as well as dedicated algae and mycelium laboratories, meeting rooms, desk and production space, and a library and resource center.

15 Anupama Kundoo, 'Why Slow Architecture Matters: Anupama Kundoo Writes on the Power of Time' (28 November 2020), stirworld.com/think-opinions-why-slow-architecture-matters-anupama-kundoo-writes-on-the-power-of-time.

16 Ibid

17 Lieven De Cauter, *Ending the Anthropocene: Essays on Activism in the Age of Collapse* (Rotterdam: nai010 publishers, 2021), 7.

18 Giacomo D'Alisa, Federico Demaria and Giogos Kallisd, 'Degrowth: Degrowth, een vocabulaire voor een nieuw tijdperk,' *Permacultuur Magazine* 5 (2016), vocabulary.degrowth.org/wp-content/uploads/sites/4/2014/11/Degrowth-vocabulary_Introduction-Degrowth_Kallis-De- maria-Dalisa.pdf.

The Activist

By fostering a sense of urgency, activists detach themselves from accelerated life and reject abstract desk research. Rooted in counterculture, activists seek to change, replace, or challenge current power structures. To achieve critical mass, they build on social engagement and active citizenship. Their focus is on bottom-up initiatives and strategic actions. In the short term, activists disrupt and intervene in real, messy, and lived cities, actively involving local communities.

Because change does not happen overnight, it often takes decades of short-term action and engagement. The architecture of the activist is often low-tech and low-cost, temporary, and lightweight, based on circularity and reuse, and embedded in networks of care, resilience, and resistance. Compared with the first generation of activists in the 1970s, contemporary activists are aiming to scale up, collaborate, and use technology in order to increase their impact.

In his 2021 book *Ending the Anthropocene, Essays on Activism in the Age of Collapse*, philosopher and activist Lieven De Cauter states: 'It might well be that the collapse of our world system with its mantras of growth and acceleration, based on extraction and overconsumption, is the only hope for the biosphere.'[17] By exploring urban activism alongside broader reflections on civic action and social movements, De Cauter aims to define how to end the Anthropocene. According to him, immediate action is necessary – action that moves beyond the pressure and melancholy we feel in the face of our untenable regime and toward more hopeful futures.

Indeed, in reaction to the current climate crisis, a growing number of voices are urging us to act swiftly. Detached from the accelerated life, philosophers, scientists, and activists believe in re-rooting our ways of living and claim that the only way forward is through degrowth, a concept introduced in 1972 by French intellectual André Gorz to criticize the paradigm of economic growth as a social objective. According to Gorz, the faster we produce and consume goods, the more we change and damage the environment.[18] His plea for ecological realism suggested consuming less and less in order to preserve available reserves for future generations.

A crucial role in degrowth is played by citizens. Through collective sit-ins, urban picnics that reclaim the streets, and civil disobedience, activists subvert fixed models and harness the positive power of discontent to draw attention to the unsustainable conditions of everyday life for many humans and non-humans. Activists believe in the potential of stumbling forward: processes of improvisation, trial and error, and research based on experience. Action research allows stakeholders to be involved, but also makes it possible for projects to land. It is often based on collective endeavors, participation, and neighborhood work. Activism has taken many different forms, but all too often remains on the margins of society.

Over the past two decades, a growing number of architectural collectives have positioned activism at the core of their practices.

↑ Action to raise awareness of the island's biodiversity in Saint-Denis island, 2015 – ongoing, developed by Coloco.

↓ Tongnan Dafo Temple Wetland Park, developed by Turenscape, integrates flood-friendly design and local cultural heritage, enhancing urban vitality and ecological resilience in Chongqing.

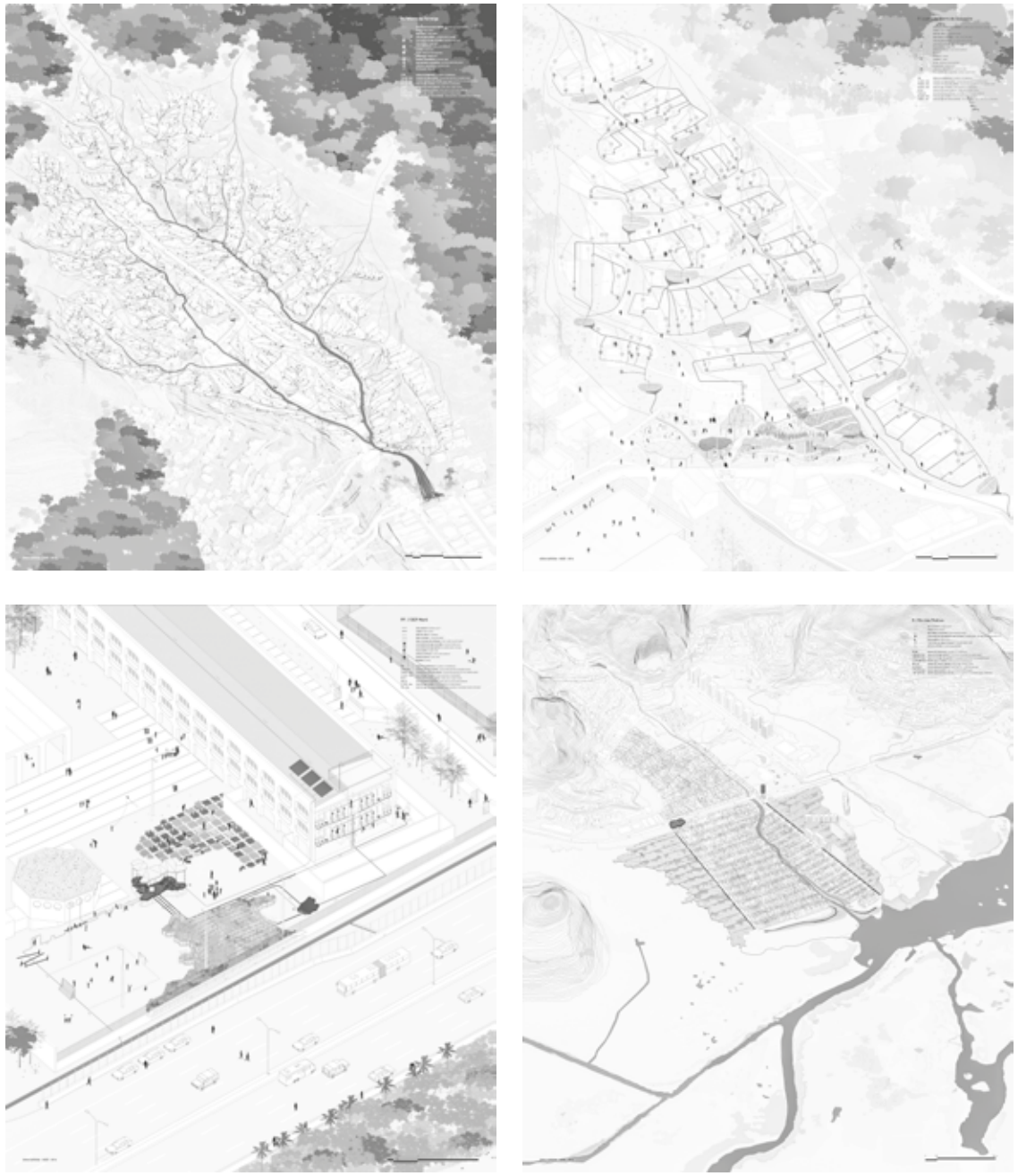
They investigate bottom-up strategies, temporary installations, and small-scale interventions in order to plant micro-seeds for change. Think of the urban fieldwork by Stalker in Rome (Walking as investigative practice), the installations by Raumlabor and Construct lab in Berlin, the activist gardening by Coloco in Paris or Montpellier, or projects like Park Farm in Brussels. These groups of architects, artists, and citizens no longer see architecture as an end in itself, but as a tool for social and spatial change. Their form of activism channels the frustrations and fascinations of individuals into a broader collective sphere. It also addresses the transition in very tangible terms and concrete situations, rather than abstractions.

On the other hand, new professions within the field of architecture – from curator to mediator, from architect to investigator – continue and amplify the work of these collective endeavors. Away from the streets, research agencies such as Forensic Architecture or Killing Architects produce architectural evidence in situations of human rights violations and environmental destruction. Bringing together architects, filmmakers, journalists, artists, lawyers, and scientists, these offices often use non-architectural means, such as lawsuits against the state or private industry, sometimes with a great impact and powerful consequences. Beyond civil disobedience and collective sit-ins, what might activism mean today and how might it contribute to social and climate transitions? How can architects and designers in general use the here and now to effect change? Which tools of activism can be put to use when thinking of urban and non-urban environments? How can activist projects be scaled up? And more importantly, how can architects and designers translate activism into spatial proposals for sustainable futures?

Most architects are not just producers of built form; they make studies, do research, present ideas, talk to politicians, teach, write. In this full range of activities, activism can play an important role; architects can use their position in the cultural field or their status as experts to advocate for a cause and influence others. A good example of this is landscape architect Kongjian Yu's efforts to make China's urban planning laws more climate-resilient. After returning from studying in the United States, he was shocked to see the relentless expansion of Chinese cities without regard for the natural conditions of the landscape. While establishing his design practice and the Peking University College of Architecture and Landscape Architecture, he began to write letters to mayors to convince them of an alternative model that integrates an ecological infrastructure based on natural systems. In the early 2000s, Yu proposed the Sponge City model. In this model, a natural water system is integrated into the city, where rainwater is distributed and retained as much as possible, discharged slowly, and cleaned in a natural way. It is a system of low-tech solutions, where nature does the work. After Beijing was devastated by floods that killed 79 people in 2013, the ideas of Yu and his colleagues became national policy in 2014, and the term Sponge City was coined. Yu's principles are now the standard for every urban and landscape plan in 30 of China's largest cities, including Beijing, Shanghai, and Shenzhen.[19]

19 Dingkun Yin et al., 'Sponge City Practices in China: From Pilot Exploration to Systemic Demonstration,' *Water* 14/10 (2022), 1531.

↑ Still from *Great Pla/ns*, a film by Janna Bystrykh, explores regenerative farming's role in restoring soils and reconnecting communities through sustainable cultivation practices.



↑ The research and design project Água Carioca, developed by OOZE, shows the potential of low-cost, low-tech, natural, self-sufficient and decentralized small-scale water management in informal settlements.

20 Theodor W. Adorno, Rolf Tiedemann and Christophe David, *Sur Walter Benjamin* (Paris: Éditions Allia, 1999).

21 All data is collected in the accompanying visitors guide.

Design is a powerful tool for communicating activist ideas. The architects of the French firm Encore Heureux and visual artist Bonnefrite created a powerful installation of protest posters called Énergies Désespoirs. In the spirit of Walter Benjamin, they gave order to pessimism, but also to optimism. The title probably refers to a characterization Adorno once gave to Walter Benjamin as 'the genius that is found by swimming against the tide with the energy of despair.'[20] The posters present two sides. On one side, depicted in black-and-white, visitors experience a world of collapsing biodiversity and climate crisis, resource depletion, environmental injustice, and pollution. On the other side, the posters show, in full color, a world being reconstructed through activism, citizen-led collaborations, and low-tech strategies. The threatening uninhabitability of the Earth, made visible by scientific data and developed in collaboration with the Ecole Urbaine de Lyon, is contrasted with contemporary initiatives that work toward recovery on different levels.[21] According to the makers, the posters explore two movements that define our changing world, as well as two vital emotions that motivate us to take action: fear and despair on the one hand, and energy inspired by others on the other.

Most of the impacts of climate change, like droughts and floods, are felt in low-income regions, often with little political stability. While governments and markets in high-income countries appear to be addressing at least some of the challenges of climate adaptation, this is less evident in the developing world. Climate adaptation and mitigation are less likely to happen in communities that cannot afford the costs of climate neutrality. Activist architects are turning to these communities to find solutions, often low-cost and low-tech. Ooze architects, for example, initiated the Água Carioca project for the favelas in Rio de Janeiro between 2012 and 2017. An analysis of the water situation in several of the city's informal settlements involved dialogues with various stakeholders: activists, civil servants, researchers, and community leaders. The result was a proposal for an urban circular system focused on water management, sanitation, and environmental improvement. The approach to water and sanitation in urban areas is fundamentally reversed. Instead of collecting wastewater from individual homes and transporting it to a treatment plant outside the city, water is treated and reused on site. Residents are encouraged to collectively create wetlands in their neighborhoods. The shift from a centralized to a decentralized model also creates a closer connection to the natural environment. With Agua Carioca, Ooze makes the natural water cycle spatially visible and physically tangible for its users. The key to this project is the simultaneous integration of spatial, social, technical, and ecological aspects into a systemic and scalable infrastructure design. A first prototype has been built in the area to test the feasibility of the system.

A similar example is the Still Standing project by designers Eytan Levi and Ben Hoyle. Between 1960 and 1975, two out of three people in the Soviet Union lived in prefabricated housing. Levi and Hoyle are exploring what to do with these residential buildings.

The modernist mass housing has remained in use much longer than expected and is now in various states of disrepair – since the collapse of the Soviet Union, most of the residents have become the owners of the apartments. The concrete is crumbling, and many residents are hoping for newly built apartments. Some of the apartment buildings are being demolished, others are being renovated, and many are neglected. With Still Standing, the designers present three bottom-up strategies for residents to collectively renovate and insulate their homes. By using contemporary wood construction techniques to replace the prefab concrete, they can give their buildings a new lease of life. According to the designers, such renovation strategies are increasingly necessary, as new construction becomes harder to justify in the face of climate change.

While most environmental and social activism starts on the margins, it has the potential to reach the mainstream. It takes persistence and often a long time to get there. It took architecture firm Superuse more than two decades to move from the fringes to the mainstream. For the past 25 years, Superuse has been working to develop circular architecture and a healthier building practices in general. The firm's work – including experimental installations, architectural projects, and strategies – is designed to bring about systemic changes in the construction industry.

After 25 years of experimentation, the office concludes that, on average, the Dutch construction industry manages to recycle only 8 percent of construction waste into useful products. But to meet the climate goals, we need to achieve 50 percent by 2030. So there is still a lot of work to be done. Superuse identifies six major paradigm shifts needed to reduce the polluting aspects of the professional practice. They range from changes in taxation, to the use of materials, to the role of the architect. As consultants on major projects and advisors on national policies for circular construction, they are now applying these lessons. In their own projects, such as the Boschgaard collective housing project, the architecture firm has had the opportunity to apply most of these alternative working methods, resulting in a project with more than 75 percent circularity.

Similarly, the Belgian design collective Rotor promotes the reuse of building materials in numerous ways. In a system of disposal, their proactive ‘mining’ of materials can be seen an activist approach. Over the course of nearly 20 years, they have managed to elevate and institutionalize their ideas. Founded in 2005, the office explores how the construction industry is organized and what an alternative practice might look like. In 2011, Rotor began working on a survey of dealers in reclaimed building materials. In 2016, they founded Rotor Deconstruction (RotorDC), a project to collect and trade used building materials in Brussels. In 2018, Rotor took the lead in an EU-funded project to promote the adoption of reuse practices by the construction industry in a large part of Northwest Europe, to establish a framework for insuring reused materials, and to develop a harmonized method to help project managers and policymakers set and measure reuse targets. By 2032, the project aims to increase the circulation of reclaimed building components by 50 percent.

↑ Models of the project Still Standing: Cooperative Strategies for the Renovation of Soviet Mass Housing, by Eytan Levi and Benjamin Hoyle.

↓ The Boschgaard collective housing project developed by Superuse.

↑ Saudi Arabia's 200m wide, 500m tall, and potentially 170km long mirrored glass linear city, THE LINE, under construction.

Through long-term commitment, collaboration, and technology-based tools, Rotor is demonstrating what contemporary activism can achieve.

The Accelerator

Accelerators embrace the challenge of time pressure and are committed to developing rational solutions at the scale and speed required to make a measurable contribution to solving the climate crisis in the time we have. They use innovation, standardization, scalable approaches, and digital tools, not only to solve today's problems while maintaining our standard of living (whereas activists and ancestors accept the possibility of living with less), but to make things better. Accelerators can support radical transitions by combining technological and social innovations and building desired alternatives that make the present obsolete. The architecture of accelerators is often neutral, flexible, and functional.
They propose systemic design methodologies, and provide new infrastructures: laboratories, smart storage, underground heat networks, smart power grids, solar highways, and shared mobility.

Since the mid-twentieth century, we have witnessed the onset of the Great Acceleration, 'the dramatic, continuous and roughly simultaneous surge in growth rate across a large range of measures of human activity' that also ushered in the age of the Anthropocene.[22] Often perceived pejoratively – in terms of humanity's impact on geology and its ecosystems – this acceleration is, according to some (like environmental historian John Robert McNeill, who elaborated on this in his book *The Great Acceleration*[23]) idiosyncratic to our current age and will come to a halt in the near future. Others, however, disagree and believe that we will never stop our rapid growth. What if slowness is not always the answer? What if, on the contrary, speed and ultra-modernity are the way out of humanity's predicament?

The idea that the solution to the climate crisis lies in technological innovation has often been criticized. According to anthropologist Gökçe Günel, 'the idea of "technical adjustments" offers a mode of response for dealing with climate change independent of ethical, moral, and political entailments … as a means for vaulting ahead to a future where humans will continue to enjoy technological complexity without interrogating existing social, political, and economic relations.'[24] She writes this in her 2019 publication *Spaceship in the Desert*, a book that analyzes the development of Masdar City in Abu Dhabi, which was designed in 2006 to be the world's first zero-carbon city.[25] This case illustrates the stark contrast between vision and reality: besides the fact that the financial crisis has severely slowed construction, the few buildings that have been built are now mainly dependent on the local fossil-fueled energy grid. History is full of attempts to be the first, most of which failed. Given the time left to solve the climate problem, we must ask ourselves whether we can afford to optimistically trust that new technologies will be the answer.

22 See: en.wikipedia.org/wiki/Great_Acceleration.

23 John Robert McNeill, The Great Acceleration: *An Environmental History of the Anthropocene Since 1945* (Cambridge, MA: Harvard University Press, 2016).

24 Rahel Aima, 'The Khaleeji Ideology: Horizons,' *e-flux Architecture* (October 2022), e-flux.com/architecture/horizons/498319/the-khaleeji-ideology/.

25 Gökçe Günel, *Spaceship in the Desert: Energy, Climate Change, and Urban Design in Abu Dhabi* (Durham, NC: Duke University Press, 2019).

But more fundamentally, she identifies how these kinds of projects work to 'produce and offer a status quo utopia, creating technological innovations with the goal of preserving the present during a time of ecological destruction.'[26]

A far more brutal example of techno-optimism – also ignoring social, political, and economic issues – is the development of The Line in Saudi Arabia: a proposed city for 9 million inhabitants with extreme proportions: 170 kilometers long, 200 meters wide, and 500 meters high. The ultimate goal is a hyperdense, carbon-neutral, car-free, year-round acclimatized pedestrian city, with all infrastructure underground. In the organization's own words, it will be 'a place of unparalleled social and economic experimentation.'[27] This experimentation may lead to new knowledge and insight, and in that sense progress of sorts, but the scale at which risks are being taken is irresponsible. As the ultimate Plug-in City[28] – a concept published in 1964 whose author, Peter Cook, helped design The Line half a century later – it will be completely disconnected from the landscape, drawing millions of people out of their social networks and into collective isolation. Every square meter will be expensive, leaving little room for socioeconomic diversity. And even if The Line were to achieve its goal of carbon neutrality upon completion, the embodied carbon and operational energy requirements of building the city will be enormous. While scaling up and accelerating the adoption of sustainable technologies and practices are generally recognized as important challenges, The Line is a stark illustration of the limits of scale and velocity.

A healthy skepticism about over-the-top innovative projects that ignore social and political issues should not lead to a general rejection of technological innovation and humanity's potential achievements. In *#Accelerate Manifesto: For an Accelerationist Politics*, Alex Williams and Nick Srnicek argue that ideas of acceleration and technological innovation have always been associated with capitalism and, in recent decades, as an indispensable tool of neoliberalism.[29] Williams and Srnicek argue that this is not true, and that left politics need not be antithetical to techno-social acceleration. They claim that the only future for the political left is to embrace acceleration. 'We believe the most important division in today's left is between those that hold to a folk politics of localism, direct action, and relentless horizontalism, and those that outline what must become called an accelerationist politics at ease with a modernity of abstraction, complexity, globality, and technology.'[30] They clearly sympathize with the latter: 'The material platform of neoliberalism does not need to be destroyed. It needs to be repurposed towards common ends. The existing infrastructure is not a capitalist stage to be smashed, but a springboard to launch towards post-capitalism.'[31] Williams and Senicek explicitly distance themselves from techno-utopianism, assuming that technology will never be sufficient to save humanity without sociopolitical action. Technological innovation cannot solve societal problems by itself, but it is necessary to empower agents of social change. But they also see direct action as insufficient in itself, and the rituals of

26 Ibid.

27 'The Line: A Revolution in Urban Living,' (n.d.) neom.com/en-us/regions/theline.

28 Peter Cook's Plug-in City was first published in *Archigram* 5 (1964).

29 Alex Williams and Nick Srnicek, *#Accelerate Manifesto: For an Accelerationist Politics* (Mexico City: Gato Negro, 2016).

30 Ibid.

31 Ibid.

32 Bruno Latour, *Down to Earth Politics in the New Climatic Regime* (Cambridge, UK/Medford, MA: Polity, 2018).

33 Bruno Latour, 'Protective Measures: An Exercise,' *Cultural Politics* 17/1 (2021), muse.jhu.edu/article/786386.

protest as a comforting substitute for effective success.

In March 2020, French philosopher Bruno Latour published 'Where to Land after the Pandemic?,' a statement paper that was directly translated into 13 languages. Following the arguments proposed in *Down to Earth Politics in the New Climatic Regime*,[32] Latour stated that 'the first lesson the coronavirus has taught us is also the most astounding: we have actually proven that it is possible, in a few weeks, to put an economic system on hold everywhere in the world and at the same time, a system that we were told it was impossible to slow down or redirect.'[33]

While forcing everyone to slow down, the 2020–2022 Covid-19 pandemic has accelerated many changes that should have been implemented long ago, with important consequences for our lifestyles and ecosystems. Major technological discoveries, but also wars and health crises, can accelerate change and rapidly project society into a future that previously seemed utopian. In what ways could acceleration be a useful tool or framework for designing and developing a sustainable future? What are the direct and indirect impacts of these accelerators on architecture? What if we could build social parameters into digital tools and technologies, accelerating social inclusion while upscaling local, marginal, or cultural initiatives? How could technologies enable new forms of labor and what would be the consequences for the architectural spaces we inhabit? What if new technologies allowed us to upscale the production of earth-based materials, or to use bio-sourced adjuvants to achieve better performances for earth-based architecture?

Computers, software, and information systems have dramatically increased the efficiency and intelligence of architects' design processes. Digital tools can help us better understand, interact with, and intervene in complex systems. The information available about soil, topography, water, climate, flood risk, potential heat islands, and local ecology – for almost any place in the world – is impressive. It enables designers to make better-informed, smarter decisions. Parametric, algorithm-based design tools can help architects process complex data and use it for meaningful interventions. The integration of AI has the potential to further enhance this productivity. These tools are likely to become even more effective for climate adaptation, ecological design, and increasing the efficiency of buildings. Some design firms have established an in-house group or department to explore, master, and apply these tools to their full potential in daily practice.

MVRDV NEXT is one such department. It develops and implements computational workflows and new technologies. The goal is to rationalize designs, speed up processes, make projects more efficient and adaptable, and explore a future that is equitable, data-driven, and green. One of the projects that has come out of this department is SolarScape. It is a research into methods for visualizing the interplay of spatial, legal, and environmental conditions. Based on a virtual model of the city of Rotterdam, SolarScape translates the regulatory framework of the 'Rotterdam High-rise Vision 2019' into a series of spatial scenarios. SolarScape

the production of plant-based meat substitutes requires only half the land needed to produce cultured meat. However, behavioral change on a societal level can be slow, and right now we cannot afford that patience. It is therefore vital to promote cultural change and technological innovation in parallel.

Lab meat is one of the technologies that could contribute to a broader protein transition. Other innovations in the food industry could help to replace meat production, such as the development of transgenic soybeans with high levels of animal protein, inserted using CRISPR/Cas technology, which could provide a low-cost alternative to cultured meat.[35] Another important question in all of these high-tech protein conversion solutions is who owns the technology. This is related to the scale at which it is produced. In the case of cultured meat, this could range from a limited number of global corporations to, eventually, kitchen meat labs in individual homes. A similar question arises in the transition of energy and mobility, and the answer has implications for the distribution of wealth and power. It will either widen the gap between rich and poor, or help to bring about greater equality.

In addition to tools and technologies, acceleration can be achieved by developing new design methods. Architect Vincent van der Meulen has developed such a method. With his firm, Kraaijvanger Architects, he is committed to designing buildings that have a positive footprint. Inspired by Paul Polman and Andrew Winston's book *Net Positive*, he concluded that the architecture industry was moving too slowly toward the promised Net Zero by 2050.[36] In order to achieve climate neutrality by then, the frontrunners should be net positive, balancing out the latecomers. The focus should be much broader than carbon. According to him, nearly every building built today still pollutes the air, water, and soil or damages biodiversity.

To go beyond greenwashing and prove nature-positivity in practice, he uses a structured design process with quantified targets and critical evaluation. Based on his experiences, he has written a manual, *Building with a Positive Footprint* (2022), to inspire others and accelerate the sustainability of the construction industry.[37] It starts with the ambition to leave each construction site in a better state than when it was found, following seven flows: air, water, energy, soil, biodiversity, building materials, and food. For each of these flows, he describes a practical road map that includes measuring, harvesting, minimizing use, storing, purifying, and finally compensating.

This method has had a positive impact, as Van der Meulen has proven in his early projects. It has attracted new clients with high sustainability ambitions, and is beginning to create its own market. One example of an upcoming project is the construction of Europe's largest hydrogen plant on Maasvlakte 2, near Rotterdam. According to Van der Meulen, the cost of his method is still 20 percent higher than conventional methods, but it will become more competitive in the future as it scales up.

The accelerator's first concern is the systemic change that is needed to mitigate climate change and biodiversity loss. As form

35 Ben Coxworth, 'Transgenic Soybeans Could Replace Pork, by Producing Pig Proteins,' *New Atlas* (30 June 2023), newatlas.com/science/moolec-piggysooy-soybeans-pig-proteins/.

36 Paul Polman and Andrew S. Winston, *Net Positive: How Courageous Companies Thrive by Giving More Than They Take* (Boston: Harvard Business Review Press, 2021).

37 Vincent van der Meulen, *Building with a Positive Footprint* (Rotterdam: nai010, 2023).

34 Nicolas Treich, 'Cultured Meat: Promises and Challenges,' *Environmental and Resource Economics* 79/1 (2021), 33–61.

measures the impact of new buildings on the sunlight in public spaces, and also generates a dynamic map based on algorithms that show options for densification that do not compromise the quality of public space. The three-dimensional map shows the potential for a radically different, almost mountain-like skyline, with buildings shaped by the sun's path. This example is a mono-dimensional approach to urban design, based on sunlight. The promise may lie in extending such a mono-dimensional approach to other parameters, such as access to public infrastructure, the amount of energy incorporated in the realization of the buildings, and the combination of expertise from different disciplines. As digital models of cities become more sophisticated, virtual simulations may begin to play a bigger role in urban planning. Architects, planners, and policymakers can help develop and use these technologies to enable cities to grow in a socially and environmentally sustainable way.

Transitions in sectors like energy, mobility, construction, and food all depend in part on technological innovation. They depend on the development of windmills, solar cells, car-sharing systems, circular materials, and so on. Architects can play an important role in adopting and adapting these new technologies in their projects and in exploring their spatial and social potential.

The technologies for the transition to climate neutrality that are ready for use today have their origins in research and experimentation decades ago (such as the development of solar energy). Likewise, the breakthrough technologies of the future are being researched and developed today.

When asked to research a technology that could be a breakthrough in reducing humanity's footprint on Earth, the 2050+ office decided to study lab-grown meat in their project Synthetic Cultures. The research sheds light on the history, current state, and likely impact of the new technology. More than three-quarters of the world's agricultural land is used for meat production, when pastures for grazing are combined with land used to grow crops for animal feed. Livestock farming also contributes significantly to environmental problems such as deforestation, greenhouse gas emissions, water depletion, and animal suffering.

If cultured meat could be produced on a large scale, it could provide an affordable, sustainable, and ethical alternative to animal products. Focusing on land use alone, a 2021 study by Nicolas Treich shows that cultured meat production requires 17 times less land than beef, three times less land than pork, and two times less land than chicken.[34] When you consider the potential to free up 50 percent of the world's agricultural land for nature restoration and carbon sequestration, it becomes clear that this technology is a potential gamechanger in the fight against climate change and biodiversity loss.

But this new technology also raises questions. First of all, it avoids a necessary cultural shift: it promises a sustainable future without giving up on the comforts of modern life. A more fundamental and effective approach would be to move the world toward a plant-based diet. Treich's same research shows that

↑ Solar Highway A37, designed by Studio Marco Vermeulen, visualized at the Holsloot junction.

↓ Still for the film *Synthetic Cultures*, by 2050+, as presented at the exhibition *It's about Time. The Architecture of Change*, IABR 2022.

↑ The advanced future climate impact research facility Ecotron, by noAarchitecten, at the National Park Hoge Kempen.

follows function, the landscape will change as a result of these transitions. However, there is also an opportunity to add a new layer of beauty to the landscape during this period. In the case of the energy transition, the consequences of a dry functional approach cannot be overlooked. Windmills and solar panels are starting to have a profound visual impact on rural and urban landscapes. For a long time, this was seen by professionals as negative but inevitable, a necessary evil that we would have to get used to, just as we have had to get used to the presence of innovations in the past. Designers tried to integrate the technology in the best possible way, but the solar panels and windmills themselves were just market standards – not considered for their formal properties. But now it has become clear that the resistance to more windmills or solar meadows is persistent and slowing down the development of renewable energy production.

After a first wave of innovation provided renewables as an economically viable alternative, a second wave offers aesthetic or less visible alternatives. Designers can embrace these innovations and contribute to a wider acceptance of the energy transition. Studio Marco Vermeulen designed the Solar Highway A37 using of solar panels in natural colors. The solar park is situated along the A37 highway in the Netherlands, over a length of 42 kilometers, and is expected to generate around 200 megawatts of solar energy. The panels are integrated into the topography, sound barriers, and residual space around intersections, taking into account both landscape and ecological values. The color of the panels, ranging from green to brown, is adapted to the type of landscape the highway crosses. Commissioned by the central government, this project accelerates the development of this aesthetic technology and, by allowing companies to scale up production, contributes to lower prices and higher energy efficiency of these panels.

Another undoubtedly beautiful example of accelerator aesthetics is Ecotron, a climate research laboratory in Belgium's Hoge Kempen, designed by Noa Architects. In an abstract volume measuring 100 by 10 by 4 meters, the effects of climate change on various ecosystems are studied. Rather than the typical 'R&D box,' the shiny volume, clad in polished stainless steel, looks like an attractive park folly. The building emphasizes the cutting-edge technology behind the ecosystem experiment while blending in with the natural environment.

Parallel Velocities

In the current transition moment, the dominant short-term and growth-oriented system is reaching its limits. It brings with it partial collapse, destabilization, and social conflict, but also the space for alternatives to break through. Alternatives that no longer approach architecture as a problem-solving discipline, but rather as a lever for achieving greater social and environmental goals. Taking responsibility for ecological and social issues means putting ecological and social regeneration and positive impact at the center,

and moving away from the idea that our built environment should be based on the qualities of soil, air, water, ecology, and community, and that the limits of these resources should condition growth.

Seizing the transition moment will require action at different velocities. In parallel, we need short-term action and experimentation, medium-term innovation, and long-term transformation. If there is one thing we have run out of time for, it is fighting each other over which attitude or velocity is the only right one. Activists blame long-term thinkers for escaping into the future and avoiding to take immediate action. Ancestral thinkers blame accelerators for their blind faith in progress, for only extending the status quo and not questioning the conventional consumerist lifestyle. Accelerators blame ancestors for being comfortably in their own righteousness, without bothering to really measure the impact of their actions. Activists blame accelerators for collaborating with the companies that wrecked the planet in the first place. But all these mutual attacks seem like wasted energy.

Luckily, both in past decades and in contemporary practice we see positive examples in each of the attitudes. The different attitudes are complementary and potentially mutually reinforcing. practice of the ancestor can be scaled up and accelerated, as in the work of BC Materials. The typical accelerator approach has value only when it is firmly grounded in ancestral philosophy, as in the work of Vincent van der Meulen. Contributing to innovations that could have a measurable positive impact while critically questioning the growth narrative, as activists do, makes sense, as can be seen in the Synthetic Cultures study. And when a practice manages to combine ancestral thinking with activism and an accelerator approach, as in the work of Kongjian Yu, the result can be impressive. Despite the fact that some actors and thinkers in architecture and spatial planning can be clearly identified with a specific velocity, these categories are not exclusive or sharply defined, and most exhibit interrelated attitudes. Looking at this from a more nuanced perspective, we would probably agree that most people identify themselves as accelerator-ancestor, activist-ancestor, or activist-accelerator, or even all three at once.[38] And we believe that all three attitudes are needed in distinct percentages in the transition to a just and nature-positive society.

38 Transition workshops were organized during the 10th Architecture Biennale Rotterdam. In these workshops, participants were asked to identify themselves with the velocities.

↑ A technician tends to cucumber walls at PlantLab's urban farm in Amsterdam, the largest indoor farm in Europe.

Chapter 8: Future Transitions

Lead author: Derk Loorbach

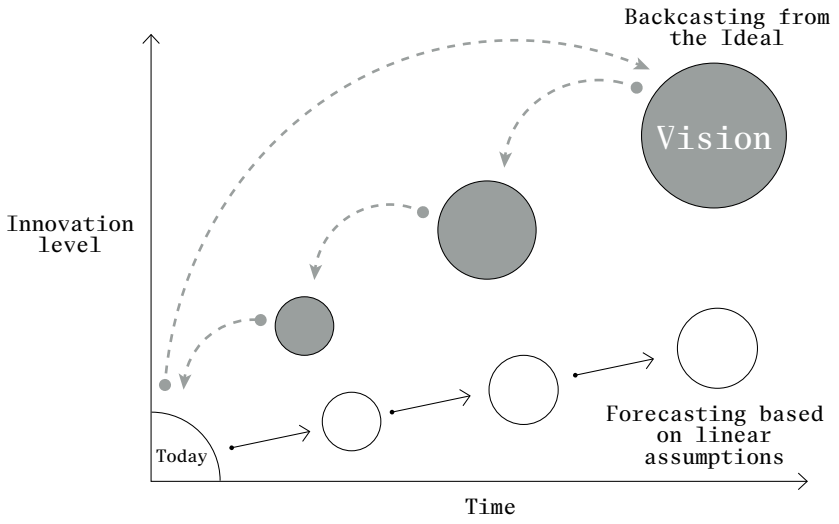
The transition moment is the period in which destabilization and chaos emerge, but it is uncertain and contested what the alternative to business as usual is. It is the liminal space between old and new that generates fundamental uncertainty and resistance: we are unable to stay the course as we reach the limits to growth, but an alternative idea of progress is lacking for most. It could lead to a world of collapse: ecological destruction combined with social conflicts and crises, increasing resistance and polarization. Yet it also implies that this may be the momentum for systemic change needed to move toward completely different, desired, or sustainable futures. Who will seize the moment and how will we navigate the turbulence, chaos, and disruption that lies ahead? Could the transition moment be the catalyst for activists, accelerators, and ancestors to come together and mainstream the alternative ideas, practices, and models that have been experimentally developed? This chapter explores a hopeful future as a counterweight to the stories of ecological collapse and climate breakdown: a nature-positive economy in which ecological, social, and technological innovations are combined to create an economy and built environment that provides energy, mobility, water, housing, care, and food for all.

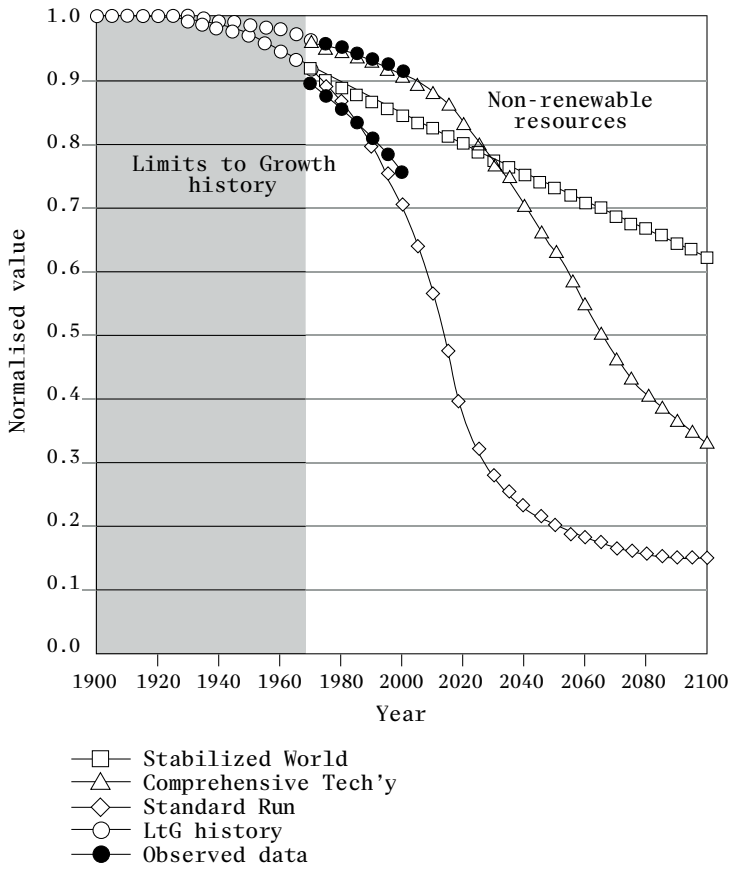
The human paradox of the 2020s is that we find ourselves in the midst of global destabilization, pandemics, geopolitical conflict, mass displacement, ecosystem collapse, and growing socioeconomic inequality, yet we continue to rely on the same mechanisms of progress that got us here. The dominant idea of economic growth to generate prosperity for all has become deeply engrained in our society and culture.[1] In developed countries, enormous amounts of wealth and comfort have been created and 'change' is either something that makes it even better or is perceived as a threat to it. We have become accustomed to fresh fruit all year round, uninterrupted supplies of energy, food, and resources, and a lifestyle of working for money to afford it all.

However, the premise of neoliberalism that betterment for all can be achieved through economic growth and technological innovation is unraveling. The extractive and fossil-based model threatens a future of growth and progress – seen by many as 'natural' – and fuels unrest in society, as the only alternative most people see is a future of less. This future is a version of the present in which many behaviors that are currently accepted and normalized (such as eating meat, driving cars, using plastics, or flying) have been banned, forbidden, or have become unattainable for most. The inability to see positive futures beyond an improved version of the present is a clear barrier to transformative change. The transition moment, however, opens up the possibility of moving beyond futures that are mere extensions of the present, commonly referred to as 'forecasting.' What is needed is the opposite: 'backcasting.'[2]

1 Graeme Maxton and Jørgen Randers, *Reinventing Prosperity: Managing Economic Growth to Reduce Unemployment, Inequality, and Climate Change* (Vancouver: Greystone Books, 2016).

2 Jaco Quist, Wil Thissen, and Philip Vergragt, 'The Impact and Spin-off of Participatory Backcasting: From Vision to Niche,' *Technological Forecasting and Social Change* 78/5 (2011), 883–897.





↑ Backcasting differs from forecasting by starting with an ambitious future vision rather than projecting past trends linearly into the future.

↓ Physicist Graham Turner's graph comparing 2010 data with the Limits to Growth hypothesis, showing resource depletion scenarios: baseline (green), technological solutions (red), and tech-social solutions (blue).

3 Francis Fukuyama, *The End of History and the Last Man* (New York/London/Toronto/Sydney: Free Press, 1992).

4 Bruno Latour, *We Have Never Been Modern* (Cambridge, MA: Harvard University Press, 1993).

5 Jean-François Lyotard, *The Postmodern Turn: New Perspectives on Social Theory* (Cambridge: Cambridge University Press, 1994).

Backcasting embraces transition in an attempt to imagine, construct, research, and build hopeful, creative, and transformative futures. This chapter explores how such an approach might help guide and accelerate sustainability transitions, and what role architecture might play in this.

Business as Usual?

Francis Fukuyama's famous book *The End of History* proclaimed in an overly confident way that liberal democracy was the final stage of humanity's ideological evolution.[3] His argument focused on parliamentary and representative democratic models ('the Western idea'), but in the public debate it was often linked to the broader ideas of individual freedom and a free market. The fall of the Berlin Wall and the collapse of the Soviet Union marked, for some at least, the end of the competition between two ideologies and different political and economic systems. The Industrial Revolution and the 'Western' model of capitalism, fueled by fossil energy and cheap resources extracted in (neo)colonial ways, had indeed been very successful in lifting people out of poverty and creating a consumer culture that promised everyone a prosperous life of luxury.

As old bipolarities, controversies, and competing ideologies faltered and the narrative of progress, capitalism, and consumption became the dominant story, intellectuals responded. In 1991, Bruno Latour wrote *Nous n'avions jamais été modernes* (translated into English and published in 1993 under the title *We Have Never Been Modern*).[4] Starting in 1989, he identified the fall of the Berlin Wall as closely related to the victory of neoliberalism. But, he argued, it was a win for neoliberal economic systems in complete denial of ecological issues. Latour argued that we could define the entire twentieth century (and especially its last two decades) as a period of grand denial: a century of abundance, freedom, and emancipation led by technological progress: modernization and modernity as a way of abandoning the past and our ties to the earth. The story of Western modernity could only be told by ignoring that it runs on finite resources and has negative impacts on others and the environment.

His reflections were part of a wave of postmodern philosophy that questioned the dominant 'modernist' and neoliberal narrative and replaced it with a 'reality' that was socially constructed and composed of a multiplicity of particular, contextual, esoteric, idealistic, personal, or private realities. Thinkers like Michel Foucault and Jacques Derrida posited an absence of universal truths, in which everyone can have their own perspective and understanding of the world. Their work undermined the dominant narrative of progress and the suggestion that there was only one way forward (neoliberal democracy based on economic growth). Or, as Jean-François Lyotard put it: 'The grand narrative of modernity, its emancipation, progress and democracy, has lost its credibility.'[5] Latour therefore asked: What is the alternative to modernity? This question is particularly pertinent today, as we are witnessing an 'apocalypse in slow motion' that is destroying the image of progress and the image of a future that most people still believe in.

Today's post-truth politics, conspiracy theories, digital bubbles and platforms, and the complex nature of the globalized world are in many ways what the postmodern philosophers anticipated. While governments and market actors still largely follow the path of technological innovation, financial progress, and economic growth, support is waning and pressure for change is growing. Conservative and populist forces are trying to resist: science and politics are under attack, fueled by an industry of doubt, especially when it comes to climate change and environmental disasters.[6] Developed economies are locked-in or path-dependent but unsustainable: their lifespan cannot be extended much longer,
and this inevitably means decline and breakdown. The prospect of ecological collapse further deepens the uncertainties and threatens even more what we have built and accumulated: we may lose it all.

At the heart of the old story of growth and progress is the idea that science and technology advance human possibilities. The Enlightenment is a progressive idea: by discovering and developing technologies, humans can live apart from nature and create ever better conditions. By stimulating competition and entrepreneurship, novelty and wealth are created, which in turn generate the(financial) means necessary to further invest in (technological) solutions.[7] 'Economic growth' is therefore a prerequisite for enabling progress and is achieved through investment, scaling, diffusion, and disruption. It also generates the financial means to solve social and environmental problems. This discourse incorporated the notion of 'sustainable development,' and more recently 'ecomodernism' and 'green growth': extending the old story of perpetual progress while making it 'less bad.'[8]

As early as 1972, *The Limits to Growth* hypothesized that the business-as-usual scenario would inevitably lead to systemic destabilization. Since those warnings were issued, urgency and awareness have grown, but the dominant path has persisted. In recent years, several planetary boundaries have been crossed and the path of linear, fossil-fueled progress has been seriously disrupted.[9] The basic premise of transitions research, in line with the projections of the Club of Rome, is that the only impossible future is business as usual. If the dominant story of fossil-based linear and extractive progress is coming to an end in our lifetime, what will our new realities look like? How can we begin to explore and create alternative and desirable futures?

Forward to the Past

The field of future studies explores the role that visions of the future play in social change.[10] The most dominant approach, also formally used in policy and business environments, is an extrapolation of emerging and current trends that could lead to alternative and different futures. These include the more dystopian or pessimistic 'collapse' scenarios or policy support scenarios. A second dominant approach to the future, more common in design and architecture, is speculative (and often more optimistic) scenarios that build on the promise of technological or social innovation. Both approaches are referred to as forecasting and, from a transition perspective, can be seen as a strategy to extend, prolong, and optimize the existing situation.

In architecture, spatial visions play an important role: how can we maintain our quality of life and develop our economy and society while taking into account projections of climate change and its effects? The Netherlands, for example, has a long tradition of spatial planning and dealing with climate change and water challenges using futures and forecasting scenarios. In 2022 and 2023 we could see several examples playing a role in the public debate. The Dutch national planning agency (PBL) has developed four different scenarios, assuming that either business leads, communities self-organize, digitization and AI dominate, or sustainability is prioritized. Each scenario has different spatial consequences, and by making them tangible, policymakers are provided with a basis for decision-making. In reality, elements of all these scenarios can be seen, and the choice for policymakers is which trend they want to reinforce.

A very different and more speculative type of scenario was produced by KuiperCompagnons and transition professor Jan Rotmans, entitled 'A country with a plan.' They envisioned a future Netherlands that has embraced climate change and sea level rise and has adjusted its housing, food, mobility, and energy systems to become adaptive and sustainable. By taking a specific trend (climate change) as given and speculating on what might be possible and desirable by 2100, KuiperCompagnons created a unique image that provoked debate and inspired thinking about the long term and the need for radical change. But it is largely divorced from the present and ignores the process of transformation that would lead to it: for most, it may stimulate debate, but it does not provide a starting point for (transformative) action.

Using nature-based solutions to reverse biodiversity loss and create socioecological resilience, Wageningen University in the Netherlands visualized a future in which water is given much more space, on the premise that restoring the natural dynamics in deltas and shifting to sustainable land use will help keep the country 'future-proof.' Much like KuiperCompagnons' vision, this image has sparked widespread debate and inspired a revival of the spatial planning debate in the Netherlands, which died in 2010 when the Ministry of Spatial Planning and the Environment (VROM) was abolished. However inspiring, these visions ignore the dynamic and inherently political nature of transitions.

Such forecasting visions are inspiring, exploratory, or speculative, but they ignore the structural uncertainty, disruption, and destabilization of our socioeconomic regimes as a necessary condition for a shift to a sustainable and just society. In the present transition moment, however, such desired, speculative futures are possible, but require a more strategic and transformative understanding of strategies that might create the conditions necessary to phase out the unsustainable and institutionalizing transformative innovations. This transition scenario approach is

6
Naomi Oreskes and Erik Conway, 'Defeating the Merchants of Doubt,' *Nature* 465 (2010), 686–687.

7
Benoit Godin, 'The Linear Model of Innovation: The Historical Construction of an Analytical Framework,' *Science, Technology, & Human Values* 31/6 (2006), 639–667.

8
Jason Hickel and Giorgos Kallis, 'Is Green Growth Possible?,' *New Political Economy* 25/4 (2020), 469–486.

9
Katherine Richardson et al., 'Earth Beyond Six of Nine Planetary Boundaries,' *Science Advances* 9/37 (2023).

10
Eleonora Masini, 'Rethinking Futures Studies,' *Futures* 38/10 (2006), 1158–1168.

↑ Holland Hydrogen 1, designed by Kraaijvanger Architects to be built with a positive footprint, will be one of the largest hydrogen plants in the world.

referred to as backcasting: formulating and visualizing desired futures as a starting point for a process of social learning, governance strategies, and experimentation.[11] Contrary to the forecasting approach that often dominates policymaking, backcasting presupposes that we cannot know our futures, but we do know what we want or need to move away from in the present. Rather than creating the illusion of predictability and control, as many of the science-policy-based strategy development processes do, backcasting proposes to abandon this illusion and embrace the potential of transformative innovation and transition points.[12]

The starting point for thinking about desired transitions is therefore a future that has successfully managed the problems of the present. A variety of such alternative socioeconomic discourses have emerged and are gaining popularity: circular, biobased, donut, or sharing economies.[13] All of these models explore dimensions of an economy that is not based on extraction, fossil resources, and the production of waste and emissions. They also imply the (at least partial) phasing out or abolition of certain forms of (fossil, extractive) growth and a shift toward ecological and social values over financial ones in policy and markets. Much like the more general notion of 'broad welfare' that is being adopted by government institutions, all alternative ideas about the future economy focus on finding ways to organize our society and provide basic human needs in a way that benefits people and the planet: a nature-positive economy.[14]

Designing Radical Transitions

The transition moment suggests that current crises and shocks will only worsen *until* society has structurally adapted at a deep economic, cultural, and behavioral level. Future shocks and disruptions are seen as inevitable.[15] In social systems, such shocks may or may not lead to transformative change. They raise the question of how we as humans respond: Do we seek control and return to the old stability (as seems to have happened with the economic crisis and Covid), or do we use the momentum to move away from stability in search of a new sustainable future? These social tipping points, however ambiguous, have occurred many times in history, and there is growing evidence that social tipping points exist.[16] Once enough people embrace an alternative, the majority will follow.

Transition scenarios assume the collapse of dominant regimes (their underlying values, structures, and practices), allowing alternatives to emerge and take hold. Including the inevitable rise of populism and authoritarianism, and the capture of vested interests, transition scenarios focus on how this context can be leveraged to accelerate the breakdown and build-up process toward desired futures as a *means of empowerment*. In transition governance, exploring future transitions with actors already working to advance them is thus a strategy for creating new shared discourses, networks, and actionable understandings of how 'transformative social innovation' with the potential to contribute to desired, sustainable, and just futures might further diffuse.[17] In contrast to technological

11 Quist, Thissen, and Vergragt, 'The Impact and Spin-off of Participatory Backcasting,' op. cit. (note 2).

12 John Robinson, 'Future Subjunctive: Backcasting as Social Learning,' *Futures* 35/8 (2003), 839-856.

13 Derk Loorbach et al., The Economic Crisis as a Game Changer? Exploring the Role of Social Construction in Sustainability Transitions,' *Ecology and Society* 21/4 (2016), article 15.

14 United Nations Environment Programme, *Adapt to Survive: Business Transformation in a Time of Uncertainty* (Nairobi: UNEP, 2021).

15 Marten Scheffer, 'Foreseeing Tipping Points,' *Nature* 467/7314 (2010), 411-412.

16 R. Alexander Bentley et al., Social Tipping Points and Earth Systems Dynamics,' *Frontiers in Environmental Science* 2/35 (2014).

17 Bonno Pel et al., 'Towards a Theory of Transformative Social Innovation: A Relational Framework and 12 Propositions,' *Research Policy* 49/8 (2020).

innovation, the diffusion and adoption of social innovations work quite differently.[18] They emerge everywhere through social entrepreneurship, citizen initiatives, action research, or entrepreneurial action, often in local contexts where actors seek to change, challenge, or replace existing regimes. They are the typical practices of accelerators, activists, and ancestors: cooperative, sharing, circular, and entrepreneurial ways to build, repair, co-produce, share, and consume, as well as basic income movements, community supported agriculture, local trading networks, and alternative currencies.

The historical chapters in Part 2 of this book show how such alternative ideas and practices have long been explored in architecture, leading to their widespread diffusion, as we saw in Chapter 7. There are indeed tangible alternatives to the dominant way in which we are building an unsustainable society and economy.[19] Yet many of the sustainable alternatives to the present will remain unseen, unappreciated, and marginal until circumstances change in their favor. What if we took these alternatives to dominant socioeconomic systems as starting points for visions of the future? What if we assumed that the collapse of parts of the current economy would inevitably create more space, support, and traction for radical alternatives? What if we explored the best possible transition to a nature-positive economy with the ingredients that are already here? Can we imagine and design how this would work, what it would look and feel like, how we would collectively manage it, and what it would mean for everyday life?[20]

'Radical transitions,' then, are about exploring, prefiguring, visualizing, and making tangible a future within planetary boundaries that is just for all. Their focus is on the institutional, social, economic, and cultural context needed for alternatives to become regimes. Designing radical transitions is the act of making visible what is already there on a small scale, but extrapolated to a societal scale.[21] It involves constructing stories about how we can collectively move through crisis and chaos to better futures. It is redefining progress as a shared journey to take responsibility for our commons and each other by changing the way we produce and consume. It involves architecture, design, research, culture, and transformative practices working together to help society understand reality in a different way. And guiding (political) action to create the conditions under which these desired futures could become reality. Our message here is to stop exploring the future from the present and start to reconstruct it from the transition moment.

Take, for example, a typical urban neighborhood where issues of poverty, employment congestion, segregation, and climate vulnerability are of concern to policymakers and other professionals. Analyzing problems and developing policies may lead to positive outcomes, but from a radical transitions perspective, we could also see another reality emerging. One in which citizens take initiatives, social entrepreneurs develop new business models, collectives produce energy or organize shared mobility, where professionals help to create new housing and living concepts by collaborating across society, policy, research, and business. Illustrator Jan Rothuizen captured this duality of coexisting realities in his 'Omdenkstad.' It is a graphic illustration of how design and creativity can help make radical transitions visible. It shows past, present, and (desired and potential) futures in one image, mapped on a neighborhood in Rotterdam, the Netherlands.

It is only when you look with different (transition) eyes that you begin to see what is happening and to see the potential. 'Transition governance' is thus an orchestrated process that allows people to zoom out and recognize transitional patterns in their own context in a way that gives them a more transformative understanding of their agency. In transition arenas or ateliers, individuals from government, business, research, and civil society are brought together in a process to collectively reflect on historical path dependencies, unsustainable and persistent problems, and the dynamics of transition, and then to formulate desired futures and transition scenarios. The IABR 2022: IT'S ABOUT TIME included a workshop space where municipalities such as Rotterdam and Amsterdam, together with the national water safety program or the network of large infrastructure and construction companies, used transition design to explore the implications of radical transitions for policy.

This led to visions of future cities without private cars, an end to building infrastructure, or freeing up rivers by removing locks and dams. Backcasting was then used to translate these into short-term interventions in specific contexts, building on what is (partially) already possible: a neighborhood with public mobility or a regenerative dike. While direct outputs and impacts can be realized, the indirect effects are much more important: participants are forced to reflect on their own role and position in the transition moment and their agency in supporting either optimization or transformation. This is especially true for actors, such as government officials, who are beginning to realize that their tools and approaches, as well as their institutional position, are all designed to sustain the existing regime through innovation and market-based policies that seek generic, efficient and procedural, low-risk steps forward. In practice, most sustainable alternatives are, by definition, locally rooted, prevent waste, emissions or other negative externalities, and retain value locally. This makes them difficult for policy (who do these alternatives represent, what is their legitimacy, how do they fit into procedures?) and business (how can they be profitable?). It is therefore not only a question of imagining how everybody could live sustainably, but also what the conditions could or should be that would make this possible.

Making Radical Transitions Visible and Tangible

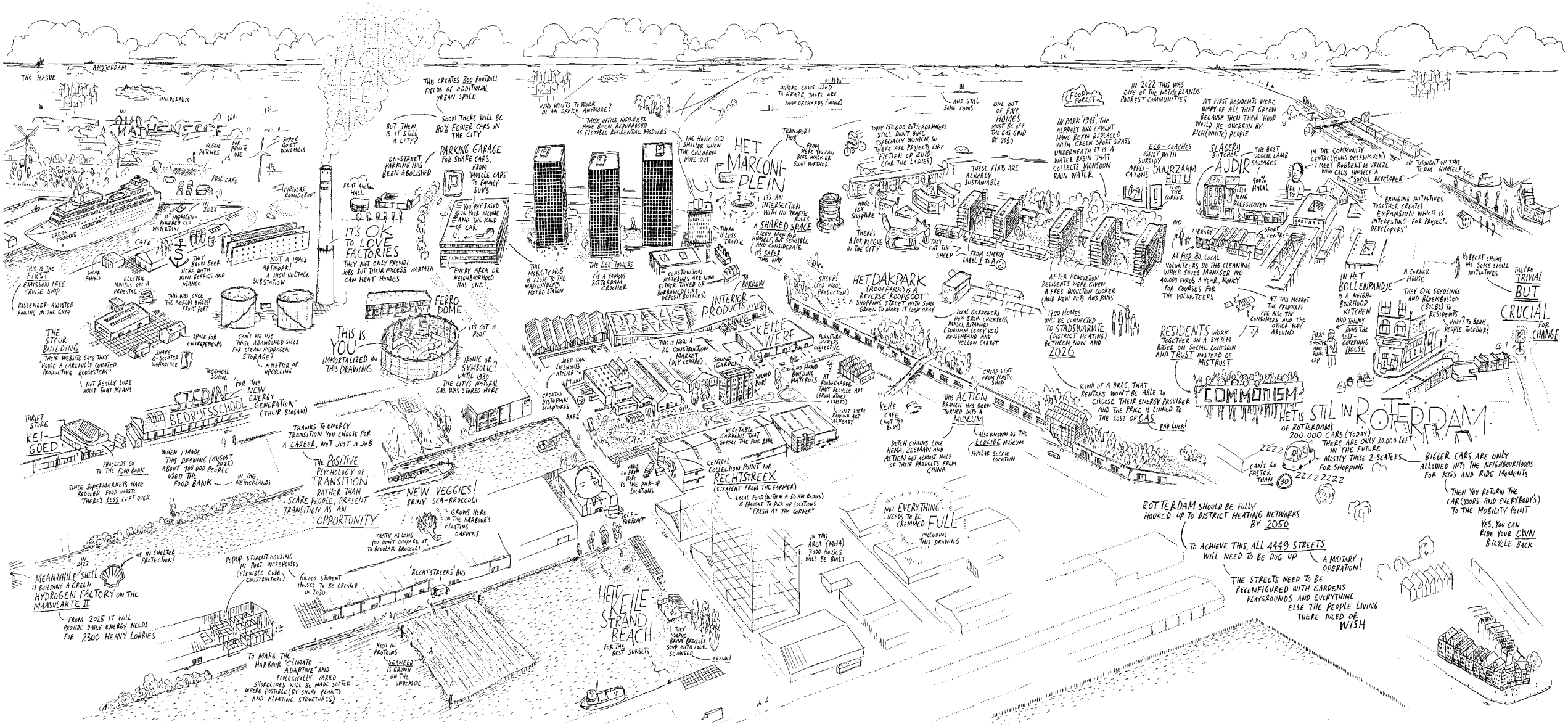
On a small scale, every professional involved in accelerating radical transitions could use backcasting approaches to engage and empower networks, and this is happening in niches around the world. At this moment of transition, however, it's time for these

18
Alex Haxeltine et al., 'Building a Middle-Range Theory of Transformative Social Innovation: Theoretical Pitfalls and Methodological Responses,' *European Public & Social Innovation Review* 2/1 (2017), 59–77.

19
Flor Avelino, Lara Monticelli, and Julia Wittmayer, 'How Transformative Innovation Movements Contribute to Transitions,' in: Jürgen Howaldt et al. (eds.), *Atlas of Social Innovation: A World of New Practices* (Munich: Oekom Verlag, 2019), 70–74.

20
Julia Wittmayer et al., 'Narratives of Change: How Social Innovation Initiatives Construct Societal Transformation,' *Futures* 112 (2019).

21
Derk Loorbach, 'Designing Radical Transitions: A Plea for a New Governance Culture to Empower Deep Transformative Change,' City, *Territory and Architecture* 9/1 (2022).



↑ A drawing of Rotterdam, developed by Jan Rothuizen for IABR 2022, depicting current actions and a vision of a climate-neutral city by 2050, aiming for a 55 percent CO_2 reduction by 2030.

↑ Still from *Great Pla/ns*, a film by Janna Bystrykh, explores regenerative farming's role in restoring soils and reconnecting communities through sustainable cultivation practices.

niches and all activists, accelerators, and ancestors to join forces and bring the experiences and strategies developed in these niches to scale. Could we start imagining and designing radical transitions when it comes to food, housing, or mobility? Can architecture help to develop the transition scenarios in a way that creates the legitimacy, support, evidence, investment, and commitment to transform our economy into a sustainable and just one? Let us explore what this would mean for food, construction, and mobility.

First, as is well known, our food system needs to shift to one that is largely plant-based, community-supported, and agroecological.[22] Agroecology is an umbrella term that has evolved over the past few decades to encompass all sorts of practices that combine food production with soil and biodiversity restoration.[23] While farming without toxins or fertilizers is often less productive in a narrow sense, it creates much more value in a broader sense. Scientists have long argued that we need to reduce meat production and consumption and move from monoculture to regenerative practices, but the global food industry and its importance to the global economy will hold on as long as possible. Similarly, our (urban) environment offers cheap and industrially produced food. While there are clear trends among some producers and consumers to make the shift themselves, governments and corporations have developed vested interests in the existing and unsustainable food system. Despite inertia and resistance, the dominant industrial food system is in an increasingly chaotic state: farmers and citizens are fighting back against policies that seek to reduce pesticides, livestock, and unsustainable practices. At the same time, alternatives are developing rapidly. Both dynamics reinforce each other in a dialectic of transition, but for the general public it is the resistance and possible decline of the industrial model that is most visible. The challenge is therefore to navigate through the chaos and offer future perspectives in which the shift to new diets goes hand in hand with the diffusion of a regenerative food production and the economic and institutional incentives that facilitate and reward it.

Second, our built environment needs to shift toward healthy, circular, and energy-positive buildings.[24] This would mean that perhaps no new buildings are built, or at least that all new buildings are developed in a sustainable way. It would also mean that renovation and retrofitting would develop in such a way as to transform the existing housing and office stock.[25] However, the prevailing practice is for regulations to gradually increase standards and requirements, while the vast majority of buildings developed today do not meet sustainable goals. Would it not be exciting to mandate the use of wood and biomass to store carbon, or to design buildings to generate more energy than they consume, or to ensure that materials can be reused? Existing policies and practices in the building sector, however, continue a process focused on increasing efficiency and performance within the existing model. The financial system is intertwined with dominant practices that use buildings as a way to store and generate capital – and consumers are mostly that, consumers. But it has been possible for decades to

22 Aniek Hebinck et al., 'Imagining Transformative Futures: Participatory Foresight for Food Systems Change,' *Ecology and Society* 23/2 (2018), article 16.

23 Colin Ray Anderson et al., 'From Transition to Domains of Transformation: Getting to Sustainable and Just Food Systems through Agroecology,' *Sustainability* 11/19 (2019).

24 Joshua Nielsen and Megan Farrelly, 'Conceptualising the Built Environment to Inform Sustainable Urban Transitions,' *Environmental Innovation and Societal Transitions* 33 (2019), 231-248.

25 Ricardo Pulselli et al., 'Future City Visions: The Energy Transition towards Carbon-Neutrality: Lessons Learned from the Case of Roeselare, Belgium,' *Renewable and Sustainable Energy Reviews* 137/1 (2021).

build in a way that is circular, biobased, energy positive, affordable, and comfortable, as we have shown in this book. It is also clear that community engagement and collaborative or cooperative forms of living improve social cohesion and can help lower prices and increase democratic ownership and control. What if we imagine a complete shift to a future built environment that supports communities, is nature positive, and where buildings actually contribute to mitigating climate change, providing nature-based solutions, and restoring biodiversity? What are the economic conditions that would make this possible, what would it mean for industry and architecture, which regulations would need to be put in place?

Third, we need a shift toward environmentally sustainable and socially inclusive mobility that minimizes ecological impact and resource use while maximizing the production of social, ecological, and economic value.[26] This implies a high degree of circularity, low energy consumption, no use of fossil fuels, and a high-density urban environment that allows for short(er) distances between facilities. The current path, however, is one in which there is a technological push toward electric mobility and a more diverse mobility system, adding new types of vehicles for comfort (from Uber to scooters and mopeds). It is obvious that for market players this direction meets their need to sell rides or vehicles for a profit. For governments, this is less obvious. Governments (as well as industries) have become dependent on revenues related to mobility (parking, taxes) and have developed institutions and interdependencies with the current mobility regimes. But they are also supposed to be responsible for air quality, public space, and sustainability. The general public is largely accustomed to the existing mobility systems, and changes – especially to car infrastructure and policies that aim to reduce car access – can count on strong resistance from those who see individual car use as a basic human right. But what if we imagine a radical transition away from private car use toward a collective mobility system that prioritizes walking, cycling, and public transportation, and additionally delivers shared mobility services for all in an efficient and affordable way? This could radically reduce the number of cars needed, freeing up public space and promoting healthy and safe urban environments that could benefit all citizens. It could build on emerging sharing schemes, but these are often profit-driven and in competition with the existing private car system. The most socially just and ecologically sustainable way forward would be to imagine mobility systems that are not-for-profit and managed to provide access for all while minimizing the use of resources, energy, and space.

26 Derk Loorbach et al., 'Transition Governance for Just, Sustainable Urban Mobility: An Experimental Approach from Rotterdam, the Netherlands,' *Journal of Urban Mobility* 1/2 (2021).

Toward an Architecture for Change: Contexts for Transformative Action

This transition moment requires radical thinking and pragmatic action. No one can change the world, but we are all part of the transition moment and thus can influence it. It requires us to combine the long-term ancestral perspective, the transformative acceleration potential of innovation, and the activist stance against further unsustainability and optimization, in defense and support of transformative innovation. While our individual sphere of influence is by definition limited, the transition perspective allows us to zoom out and recognize the global interconnectedness of locally rooted transitions: by developing the ability to zoom in and out, to see ourselves in context, and to find alliances beyond our own regimes and networks, it becomes possible to contribute to the organically emerging new discourses, structures, and practices.

The role of architecture in the transition moment is fundamentally changing: questions of how, what and whether we build must to lead to regenerative, circular, nature-based, and sustainable methods. As this happens, policies, funding, capacity, market structures, education, and professional practices will change accordingly. This is all happening as society at large goes through socioeconomic transitions. In this chaotic turbulence, it is clear that a Grand Narrative cannot be constructed from the top down. A postmodern and potentially transformative way forward would be to engage in the emergence of alternative, nature-positive futures and to start building them from the ground up, every time anew and in a different context. A narrative of self-organized sustainable economies would then emerge, facilitated by institutional change.

The three velocities of the architecture of change (ancestor, activist, and accelerator) are a powerful transformative force, especially when working together: they could help build, repair, and develop a just and sustainable world. What these approaches have in common is that they work on what is needed and desired from the perspective of future generations, in the short and long term. The transition perspective offers a way to integrate: to zoom out and see the historical path dependencies, the possibility of alternative futures, and the need to disrupt the present to create space for change. In this transition moment, we call on architecture to resist and move away from supporting a future built on fossil resources and perpetual growth, and instead work to support the emergence of radical transitions.

Whatever the label, we need new kinds of transformative collaborations in which diverse networks collectively reflect on *un*sustainability and take a radical long-term ambition as a starting point for diffusing, scaling, and institutionalizing transformative innovations. These would generate new positive futures and could bring agency over our common futures back to the local scale.

The new narrative is that we can achieve a nature-positive, just,and sustainable future for all by developing and living our own transformative stories. For this to happen, the context in which architecture works needs to change. From education to finance, from regulation to industry, the incentives and conditions must start supporting the three velocities, based on a commitment to long-term systemic change. To do this, architects need to collaborate outside their field and engage with other disciplines and professions. They must create the institutional, economic, and political context in which ancestors, accelerators, and activists can thrive. Shifting the dominant ways of thinking and working within ecological limits toward a socially just future is a transformative journey in itself. An existential journey that is possible, inspiring, and desirable. It is a journey toward an architecture of change based on the ancestral past, the activated present, and the accelerated future.

Bibliography

A

Adorno, Theodor W., Tiedemann, Rolf, and David, Christophe, *Sur Walter Benjamin* (Paris: Éditions Allia, 1999)

Aima, Rahel, 'The Khaleeji Ideology: Horizons,' *e-flux Architecture* (October 2022), e-flux.com/architecture/horizons/498319/the-khaleeji-ideology/

Alaouié, Borhane, (dir.), Il ne suffit pas que Dieu soit avec les pauvres, 1978, film-documentaire.fr/4DACTION/w_fiche_film/5407_0

Ambasz, Emilio, 'Why Not the Green over the Gray?,' *Domus* 772 (1995), 83

Anderson, Colin Ray, et al., 'From Transition to Domains of Transformation: Getting to Sustainable and Just Food Systems through Agroecology,' *Sustainability* 11/19 (2019)

Anonymous, 'Architect James Wines on "Nature's Revenge,"' *MoMA Built Ecologies: Architecture and Environment*, youtube.com/watch?v=QTvWatlXfm4

Anonymous, 'Buildings that Save Watt and More,' *Progressive Architecture* (October 1971), 104–111

Anonymous, 'Concours de Landstuhl, R.F.A: Une opération réussite,' *L'Architecture d'Aujourd'hui* (June 1980), 68

Anonymous, 'Controversy over Green Hero,' *Architectural Record* (June 2000), 36

Anonymous, 'Drop City, Colorado: coupoles géodesiques pour l'habitat hippie,' *L'Architecture d'Aujourd'hui* 141 (1968), 82–84

Anonymous, 'Maison Serre, St Juste Lyon, 1984–1985,' *L'Architecture d'Aujord'hui* 241 (October 1985)

Anonymous, 'The Line: A Revolution in Urban Living,' (n.d.) neom.com/en-us/regions/theline.

Aspinwall, Nick, 'These Homes are Off-Grid and Climate Resilient: They're Also Built out of Trash,' *The Washington Post*, 4 January 2022

Avelino, Flor, et al., 'Transformative Social Innovation and (Dis)empowerment,' *Technological Forecasting and Social Change* 145 (2019), 195–206

Avelino, Flor, Monticelli, Lara, and Wittmayer, Julia, 'How Transformative Innovation Movements Contribute to Transitions,' in: Howaldt, Jürgen et al. (eds.), *Atlas of Social Innovation: A World of New Practices* (Munich: Oekom Verlag, 2019), 70–74

Ayres, Eugène and Scarlott, Charles, *Energy Sources: The Wealth of the World* (New York: McGraw Hill, 1952)

B

Banham, Reyner, 'A Home Is Not a House,' *Art in America* 2 (1965)

Banham, Reyner, *The Architecture of the Well-Tempered Environment* (London: The Architectural Press, 1984 [1969])

Barber, Daniel A., *A House in the Sun: Modern Architecture and Solar Energy in the Cold War* (Oxford: Oxford University Press, 2016)

Barber, Daniel A., *Modern Architecture and Climate: Design Before Air Conditioning* (Princeton: Princeton University Press, 2020)

Barber, Daniel, 'The World Solar Energy Project, ca. 1954,' *Grey Room* 51 (Spring 2013), 64–93

Bender, Barbara, 'Subverting the Western Gaze: Mapping Alternative Worlds,' in: Robert Layton

Bennett, Elena, et al., 'Bright Spots: Seeds of a Good Anthropocene,' *Frontiers in Ecology and the Environment* 14/8 (2016), 441-448

Bentley, R. Alexander, et al., Social Tipping Points and Earth Systems Dynamics,' *Frontiers in Environmental Science* 2/35 (2014)

Boer, K. Lauren De, 'Building with Earth Is Sacred Work: An Interview with Nader Khalili,' *Earth Light* 32 (1998-1999), 21

Bonzani, Stéphane, *L'archaïque et ses possibles* (Geneva: Métis Presses, 2020)

Borasi, Giovanna and Zardini, Mirko (eds.), *Sorry Out of Gas: Architecture's Response to the 1973 Oil Crisis* (Montreal: Canadian Centre for Architecture, 2007)

Bouet, Paul, 'How Did It Fail? Considering the Decline of Environmental Experiments,' in: *Proceedings of the Fifth International Conference of the European Architectural History Network* (Tallinn: Estonian Academy of Arts, 2018), 451-457

Bouet, Paul, *Domesticating Solar Energy: Decolonization and Environmentalism in Postwar France* (Zurich: gta Verlag, 2025)

Buelens, Geert, *Wat we toen al wisten: De vergeten groene geschiedenis van 1972* (Amsterdam: Querido, 2022)

C

Caine, Grahame, 'The Ecological House,' *Architectural Design* 42/3 (1972), 140–141

Calder, Barnabas, *Architecture from Prehistory to Climate Emergency* (Elmwood, LA: Pelican Books, 2022)

Carson, Rachel, *Silent Spring* (Boston: Houghton Mifflin, 1962).

Cauter, Lieven De, Ending the Anthropocene: Essays on Activism in the Age of Collapse (Rotterdam: nai010 publishers, 2021), 7

Chanis, Vasileios, 'In Quest of Meaning: Revisting the Discourse around "Non-Pedigreed" Architecture,' tacit-knowledge-architecture.com/object/in-quest-of-meaning-revisiting-the-discourse-around-non-pedigreed-architecture-2/

Clément, Gilles, *Manifeste pour le Tiers paysage* (Paris: Sens et Tonka), 2004

Collins, James Charles, and Porras, Jerry I., *Built to Last: Successful Habits of Visionary Companies* (New York: HarperCollins, 2002)

Coxworth, Ben, 'Transgenic Soybeans Could Replace Pork, by Producing Pig Proteins,' *New Atlas* (30 June 2023), newatlas.com/science/moolec-piggy-sooy-soybeans-pig-proteins/

D

D'Alisa, Giacomo, Demaria Federico, and Kallisd, Giogos, 'Degrowth: Degrowth, een vocabulaire voor een nieuw tijdperk,' *Permacultuur Magazine* 5 (2016)

Daly, Herman E., 'On Economics as a Life Science,' *Journal of Political Economy* 76/3 (1968), 392-406

Dean, Penelope, 'Environment by Design,' *Proceedings of the 97th Annual Meeting of the Association of Collegiate Schools of Architecture* (2009), 201, acsa-arch.org/proceedings/Annual%20Meeting%20Proceedings/ACSA.AM.97/ACSA.AM.97.26.pdf

Dean, Penelope, 'Never Mind All That Environmental Rubbish, Get on with Your Architecture' *Architectural Design* 79/3 (2009), 24-29

Dethier, Jean, 'La CRAterre, l'expérience made in France,' *Ecologik*, dossier spéciale Architecture de terre, 12 (2010), 66–69

Dethier, Jean, (curator), 'Des architectures de terre ou l'avenir d'une tradition millénaire,' 28 October 1981 to 1 February 1982, Centre Georges Pompidou, Paris

E

Editors, 'Help!,' *Architectural Design* (June 1971), 334

Editors, 'This Month ... ,' *Architectural Design* (July 1972)

Escobar, Arturo, *Designs for the Pluriverse: Radical Interdependence, Autonomy, and the Making of Worlds* (Durham, NC: Duke University Press, 2018)

F

Fabrizi, Mariabruna 'Energy as Architectural Matter: Oswald Mathias Ungers' Solar House (1980),' socks-studio.com/2021/06/27/energy-as-architectural-matter-oswald-mathias-ungers-solar-house-1980/

Fathy, Hassan, *Architecture for the Poor* (Chicago: The University of Chicago Press, 1973)

Feng, Anna, Negotiating Ungers: The Aesthetics of Sustainability International Summer School 2018, KU Leuven, negotiating- ungers.eu/2018/index.html

Fitz, Angelika and Krasny, Elke, *Critical Care, Architecture and Urbanism for a Broken Planet* (Cambridge: MIT Publishers and Vienna: Architecture Centre Vienna, 2019)

Folke, Carl, et al., 'Regime Shifts, Resilience, and Biodiversity in Ecosystem Management,' *Annual Review of Ecology, Evolution, and Systematics* 35 (2004), 557–581

Förster, Kim (ed.), *Environmental Histories of Architecture* (Montreal: Canadian Centre for Architecture, 2022)
Friedmann, Thomas, *Thank You for Being Late: An Optimist's Guide to Thriving in the Age of Accelerations* (New York: Farrar Strauss & Giroux, 2016)

Fukuyama, Francis, *The End of History and the Last Man* (New York/London/Toronto/Sydney: Free Press, 1992)

Fuller, Richard Buckminster, *Nine Chains to the Moon* (New York: Anchor Books, 1973 [1938]), 252–259

Fuller, Richard Buckminster, *Operating Manual for Spaceship Earth* (Zurich: Lars Müller Publishers, 2008 [1969])

G

Galbraith, Kenneth, T*he Affluent Society* (Boston: Houghton Mifflin, 1958)

Geels, Frank, 'Technological Transitions as Evolutionary Reconfiguration Processes: A Multi-Level Perspective and a Case-Study,' *Research Policy* 31/8–9 (2002), 1257-1274

Geels, Frank, and Schot, Johan, 'Typology of Sociotechnical Transition Pathways,' *Research Policy* 36/3 (2007), 399–417

Gersick, Connie J.G., 'Revolutionary Change Theories: A Multilevel Exploration of the Punctuated Equilibrium Paradigm,' *The Academy of Management Review* 16/1 (1991), 10–36

Giddens, Anthony, 'Elements of the Theory of Structuration,' in: Elliott, Anthony, (ed.), *The Blackwell Reader in Contemporary Social Theory* (Hoboken, NJ: Wiley-Blackwell, 1999), 119–130

Godin, Benoit, 'The Linear Model of Innovation: The Historical Construction of an Analytical Framework,' *Science, Technology, & Human Values* 31/6 (2006), 639–667

Godin, Benoit, and Vinck, Dominique, (eds.), *Critical Studies of Innovation: Alternative Approaches to the Pro-Innovation Bias* (Cheltenham: Edward Elgar, 2017)

Grin, John, 'The Politics of Transition Governance in Dutch Agriculture: Conceptual Understanding and Implications for Transition Management,' *International Journal of Sustainable Development* 15/1 (2012), 72–89

Grin, John, Rotmans, Jan, and Schot, Johan, *Transitions to Sustainable Development: New Directions in the Study of Long Term Transformative Change* (New York: Routledge, 2010)

Günel, Gökçe, *Spaceship in the Desert: Energy, Climate Change, and Urban Design in Abu Dhabi* (Durham, NC: Duke University Press, 2019)

H

Harvey, Fiona, 'Scientists Deliver "Final Warning" on Climate Crisis: Act Now or It's too Late,' *The Guardian*, 20 March 2023, theguardian.com/environment/2023/mar/20/ipcc-climate-crisis-report-delivers-final-warning-on-15c

Haxeltine, Alex, et al., 'Building a Middle-Range Theory of Transformative Social Innovation: Theoretical Pitfalls and Methodological Responses,' *European Public & Social Innovation Review* 2/1 (2017), 59–77

Hebinck, Aniek, et al., 'An Actionable Understanding of Societal Transitions: The X-curve Framework,' *Sustainability Science* 17/3 (2022), 1009–1021

Hebinck, Aniek, et al., 'Imagining Transformative Futures: Participatory Foresight for Food Systems Change,' *Ecology and Society* 23/2 (2018), article 16

Heynen, Hilde, *Sibyl Moholy-Nagy: Architecture, Modernism and its Discontents* (London: Bloomsbury, 2019), particularly Chapter 2: 'Vernacular Architecture and the Uses of the Past'

Hickel, Jason, and Kallis, Giorgos, ' Is Green Growth Possible?,' *New Political Economy* 25/4 (2020), 469–486

Hochhäusl, Sophie et al., 'Architecture and the Environment,' *Architectural Histories* 6/1 (2018), 1-13

I

Ingersoll, Richard, 'Eat the City: The Case for Civic Agriculture,' *Places Journal* (June 2023).

Ingersoll, Richard, 'The Ecology Question in Architecture,' in: Crysler, Greig, Cairns, Stephen, and Heynen, Hilde (eds.), *The SAGE Handbook of Architectural Theory* (London: SAGE Publications, 2012), 573–589
IPCC, *Sixth Assessment Report*, ipcc.ch/assessment-report/ar6/ (undated)

K

Kallipoliti, Lydia, 'From Shit to Food: Graham Caine's Eco-House in South London, 1972-1975,' *Building & Landscape Journal of the Vernacular Forum* (March 2012)

Kemp, René, Schot, Johan, and Hoogma, Remco, 'Regime Shifts to Sustainability through Processes of Niche Formation: The Approach of Strategic Niche Management,' *Technology Analysis & Strategic Management* 10/2 (1998), 175–198

Kohr, Leopold, 'The City as Convivial Centre' (1974), panarchy.org/kohr/convivial.html

Kouwenhoven, John A., 'Review: Architecture as Environmental Technology,' Technology and Culture 11/1 (1970), 85

Krznaric, Roman, *The Good Ancestor: How to Think Long Term in a Short-Term World* (London: Ebury Publishing, 2020)

Kundoo, Anupama, 'Why Slow Architecture Matters: Anupama Kundoo Writes on the Power of Time' (28 November 2020), stirworld.com/think-opinions-why-slow-architecture-matters-anupama-kundoo-writes-on-the-power-of-time

L

L'Architecture d'Aujourd'hui, 'Architecture de Soleil,' May-June 1973

L'Architecture d'Aujourd'hui, 'Architecture Solaire,' September 1977

L'Architecture d'Aujourd'hui, 'Solaire Passif ou Actif?,' June 1980

Latouche, Pierre-Édouard, 'Jimmy Carter Takes a Stand', cca.qc.ca/en/articles/issues/12/what-you-can-do-with-the-city/33270/jimmy-carter-takes-a-stand

Latour, Bruno, 'Protective Measures: An Exercise,' *Cultural Politics* 17/1 (2021)

Latour, Bruno, *Down to Earth Politics in the New Climatic Regime* (Cambridge, UK/Medford, MA: Polity, 2018)

Latour, Bruno, *We Have Never Been Modern* (Cambridge, MA: Harvard University Press, 1993)

Le Roy, Louis, *Natuur uitschakelen, Natuur inschakelen* (Deventer: Ankh-Hermes, 1973)

Leclercg, Benjamin, 'Hans-Walter Müller, l'architecte qui gonfle des maisons "insolides,"' usbeketrica.com/fr/article/hans-walter-mueller-l-architecte-qui-gonfle-des-maisons-insolides.

Lewis, Anthony, 'Abroad at Home,' *The New York Times*, 2 March 1972

Loorbach, Derk, 'Designing Radical Transitions: A Plea for a New Governance Culture to Empower Deep Transformative Change,' City, *Territory and Architecture* 9/1 (2022)

Loorbach, Derk, et al., 'Transition Governance for Just, Sustainable Urban Mobility: An Experimental Approach from Rotterdam, the Netherlands,' *Journal of Urban Mobility* 1/2 (2021)

Loorbach, Derk, et al., The Economic Crisis as a Game Changer? Exploring the Role of Social Construction in Sustainability Transitions,' *Ecology and Society* 21/4 (2016), article 15.

Loorbach, Derk, Frantzeskaki, Niki, and Avelino, Flor, 'Sustainability Transitions Research: Transforming Science and Practice for Societal Change,' *Annual Review of Environment and Resources* 42/1 (2017), 599–626

Lopez, Fanny, *Dreams of Disconnection: From the Autonomous House to Self-Sufficient Territories* (Manchester: Manchester University Press, 2021)

Lyotard, Jean-François, *The Postmodern Turn: New Perspectives on Social Theory* (Cambridge: Cambridge University Press, 1994)

M

MacAskill, William, 'Effective Altruism: Introduction,' Essays in Philosophy 18/1 (2017), 2

MacAskill, William, What We Owe the Future (New York: Basic Books, 2022)

Malaska, Pentti and Vapaavuori, Matti (eds.), *The Club of Rome: 'The Dossiers' 1965–1984* (Helsinki: Finnish Association for the Club of Rome, 2005)

Maniaque-Benton, Caroline and Gaglio, Meredith (eds.), *Whole Earth Field Guide* (Cambridge, MA: MIT Press, 2016)

Maniaque-Benton, Caroline, *French Encounters with the American Counterculture 1960–1980* (London: Routledge, 2011)

Masini, Eleonora, 'Rethinking Futures Studies,' *Futures* 38/10 (2006), 1158–1168

Matthews, Mark, *Droppers: America's First Hippie Commune, Drop City* (Oklahoma: University of Oklahoma Press, 2010)

Maxton, Graeme and Randers, Jørgen, *Reinventing Prosperity: Managing Economic Growth to Reduce Unemployment, Inequality, and Climate Change* (Vancouver: Greystone Books, 2016)

McHarg, Ian L., *Design with Nature* (Philadelphia: The Falcon Press, 1969)
McLeod, Mary, 'To Make Something with Nothing': Le Corbusier's Proposal for Refugee Housing: Les Constructions "Murondins,"' *The Journal of Architecture* 23/3 (2018), 421-447

McNeill, J.R., *Something New Under the Sun: An Environmental History of the Twentieth-Century World* (New York: WW Norton & Company, 2001)

McNeill, John Robert, *The Great Acceleration: An Environmental History of the Anthropocene Since 1945* (Cambridge, MA: Harvard University Press, 2016)

Meadows Donella, et al., *The Limits to Growth: A Report for the Club of Romes's Project on the Predicament of Mankind* (Washington: Potomac Associates, 1972)

Meadows, Dennis, Meadows Donella, and Randers, Jørgen, *Beyond the Limits: Confronting Global Collapse, Envisioning a Sustainable Future* (Vermont: Chelsea Green Publishing, 1992).

Medici, Piero, 'Autonomous Houses and Architecture of Cybernetics in the 1970s Towards Limits and Undeveloped Potentials of the Sustainable,' *Sustainability* 14/10 (2022)

Meulen, Vincent van der, *Building with a Positive Footprint* (Rotterdam: nai010, 2023)

Milman, Oliver, 'Carbon Dioxide Levels Are Now 50% Higher Than during the Pre-Industrial Era,' *The Guardian*, 6 June 2022

Müller, Hans-Walter, 'Pourquoi le gonflable?,' *Techniques et Architectures* 304 (1975), 73–74
Myers, Norman, et al., 'Biodiversity Hotspots for Conservation Priorities,' *Nature* 403 (2000), 853–858

N

Nielsen, Joshua, and Farrelly, Megan, 'Conceptualising the Built Environment to Inform Sustainable Urban Transitions,' *Environmental Innovation and Societal Transitions* 33 (2019), 231–248

O

Olsson, Per, et al., 'The Concept of the Anthropocene as a Game-Changer: A New Context for Social Innovation and Transformations to Sustainability,' *Ecology and Society* 22/2 (2017), 31

Oltmans, Willem L., *Grenzen aan de groei (deel 1): 75 gesprekken over het rapport van de Club van Rome* (Utrecht/Antwerp: A.W. Bruna & Zoon, 1973)

Oltmans, Willem L., *Grenzen aan de groei (deel 2): 50 gesprekken over het rapport van de Club van Rome* (Utrecht: A.W. Bruna & Zoon, 1974)

Oreskes, Naomi, and Conway, Erik, 'Defeating the Merchants of Doubt,' *Nature* 465 (2010), 686–687

P

Paquot, Thierry, 'Hassan Fathy, construire *avec* ou *pour* le peuple?,' *Cahiers d'histoire* 109 (2009), 15–25

Passell, Peter, Roberts, Marc, and Ross, Leonard, 'The Limits to Growth,' *The New York Times,* 2 April 1972

Pel, Bonno, et al., 'Towards a Theory of Transformative Social Innovation: A Relational Framework and 12 Propositions,' *Research Policy* 49/8 (2020)

Perez, Carlota, *Technological Revolutions and Financial Capital: The Dynamics of Bubbles and Golden Ages* (Cheltenham: Edward Elgar, 2003)

Phoa, Li An, and Van der Schaaf, Maarten, *Drinkable Rivers: How the River Became My Teacher* (Zandvoort, NL: Stichting Drinkable Rivers, 2023)

Piccioni, Luigi, 'Forty Years Later: The Reception of the Limits to Growth in Italy, 1971-1974', see: donellameadows.org/archives/forty-years-later-the-reception-of-the-limits-to-growth-in-italy-1971-1974/#5

Pike, Alexander, 'Autonomous House' lecture, Architectural Association, 3 February 1976, youtube.com/watch?v=lQA53mvsfOs

Polman Paul and Winston, *Andrew S., Net Positive: How Courageous Companies Thrive by Giving More Than They Take* (Boston: Harvard Business Review Press, 2021)

Progressive Architecture (October 1971), 68

Pulselli, Ricardo, et al., 'Future City Visions: The Energy Transition towards Carbon-Neutrality: Lessons Learned from the Case of Roeselare, Belgium,' *Renewable and Sustainable Energy Reviews* 137/1 (2021)

Pyla, Panayiota I., 'Hassan Fathy Revisited: Postwar Discourses on Science, Development, and Vernacular Architecture,' *Journal of Architectural Education* 60/3 (2007), 28–39

Q

Quist, Jaco, Thissen, Wil, and Vergragt, Philip, 'The Impact and Spin-off of Participatory Backcasting: From Vision to Niche,' *Technological Forecasting and Social Change* 78/5 (2011), 883–897

R

Randers Jørgen interviewed by Coralie Schaub, 'Rapport Meadows sur les limites de la croissance: Nous pensions que l'humanité écouterait,' *Libération*, 4 October 2022, 13

RetroFocus, 'Computer Predicts the End of Civilisation,' 1973. ABC's *This Day Tonight* aired the story on 9 November 1973, youtube.com/watch?v=cCxPOqwCrII&t=10s

Richardson, Katherine, et al., 'Earth beyond Six of Nine Planetary Boundaries,' *Science Advances* 9/37 (2023)

Rizzotti, Philippe, *L'empreinte d'un habitat* (Paris: Pavillon de l'Arsenal, 2022)

Robinson, John, 'Future Subjunctive: Backcasting as Social Learning,' *Futures* 35/8 (2003), 839–856

Robinson, Kim Stanley, *The Ministry for the Future* (London: Orbit, 2020)

Rockström, Johan et al., 'A Safe Operating Space for Humanity,' *Nature* 461 (2009), 472–475

Roo, Gert de, Hillier Jean, and Van Wezemael, Joris, (eds.), *Complexity and Planning: Systems, Assemblages and Simulations* (Farnham: Ashgate Publishing, 2012)

Rotmans, Jan, Kemp, René, and van Asselt, Marjolein, 'More Evolution Than Revolution: Transition Management in Public Policy,' *Foresight* 3/1 (2001), 15-31

Rotmans, Jan, Loorbach, Derk, and Kemp, René, 'Complexity and Transition Management,' *Journal of Industrial Ecology* 13 (2009), 184–196

Rottier, Guy, 'L'architecture enterrée (ou l'anti-architecture),' *Techniques et architecture* 133 (1977)

Rottier, Guy, *Vivre Autrement: 4 Prospecteurs d'avenir* (Nice : Editions Gilletta, 2006)

Rudofsky, Bernard, *Architecture Without Architects: A Short Introduction to Non-Pedigreed Architecture* (New York: Museum of Modern Art, 1964)

S

Sadler, Simon, 'An Architecture of the Whole,' *Journal of Architectural Education* 61/4 (2008)

Sadler, Simon, 'Drop City Revisited,' *Journal of Architectural Education* 59/3 (2006)

Scheffer, Marten, 'Foreseeing Tipping Points,' *Nature* 467 (2010), 411–412

Schuitmaker, Tjerk Jan, 'Identifying and Unravelling Persistent Problems,' Technological Forecast and Social Change 79/6 (2012), 1021–1031

Schumacher, E.F., *Small Is Beautiful: A Study of Economics as If People Mattered* (London: Blond & Briggs, 1973)

Scott, Felicity D., Architecture or Techno-Utopia (Cambridge, MA: MIT Press, 2010)

Scott, Felicity D., Disorientation: Bernard Rudofsky in the Empire of Signs (Berlin: Sternberg Press, 2016)

Scott, Felicity D., *Outlaw Territories: Environments of Insecurity/ Architectures of Counterinsurgency* (Brooklyn: Zone Books, 2016)

Shaw, Matt, 'An Architect Known for Building Castles in the "Vegetable Kingdom,"' *The New York Times*, 3 May 2023

Siret, Daniel, 'Ecopolis, Rottier solaire,' in: Abdelkader, Damani and Guy, Rottier, *Architecture de l'errance, Liénart éditions* (Orleans: Frac Centre-Val de Loire, 2021), 34–39

SITE Inc., *Architecture as Art* (New York: St. Martin's Press, 1980)

Steele, James, *The Hassan Fathy Collection: A Catalogue of Visual Documents at the Aga Khan Award for Architecture* (Bern: The Aga Khan Trust for Culture, 1989)

Steffen, Will, et al., 'Planetary Boundaries: Guiding Human Development on a Changing Planet,' *Science* 347/6223 (2015)

Steffen, Will, et al., 'The Trajectory of the Anthropocene: The Great Acceleration,' *The Anthropocene Review 2* (2015), 81–98

Steiner, Frederick R. and McHarg, Ian, *Design with Nature Now* (Cambridge, MA: Lincoln Institute of Land Policy in association with the University of Pennsylvania Stuart Weitzman School of Design and The McHarg Center, 2019)

Steiner, Frederick R., 'The Ghost of Ian McHarg,' *Log* 13/14 (2008), 148

T

Tielbeke, Jaap, *We waren gewaarschuwd* (Amsterdam: Das Mag Uitgeverij, 2022)

Till, Jeremy, 'Architecture Criticism Against the Climate Clock,' *Architectural Review* (April 2023), 6–10.

Tim M. Lenton et al., 'Tipping Elements in the Earth's Climate System,' *Proceedings of the National Academy of Sciences* 105/6 (2008), 1786–1793

Trego, Charlotte, 'Drop City: New Life for Junked Cars,' *Architectural Forum* (September 1967), 74–75

Treich, Nicolas, 'Cultured Meat: Promises and Challenges,' *Environmental and Resource Economics* 79/1 (2021), 33–61

U

Ucko, Peter (eds.), *The Archaeology and Anthropology of Landscape* (London: Routledge, 1999)

United Nations Environment Programme, *Adapt to Survive: Business Transformation in a Time of Uncertainty* (Nairobi: UNEP, 2021)

V

Vale, Brenda and Robert, *The New Autonomous House: Design and Planning for Self-Efficiency* (Universe Books/ Open Library, 1975)

Vogt, William, *Road to Survival* (Ann Arbor: University of Michigan, 1948)

Voros, Joseph, 'A Generic Foresight Process Framework,' *Foresight* 5/3 (2003), 10–21

Voyd, Bill, 'Funk Architecture,' in: Oliver, Paul (ed.), *Shelter and Society* (New York: Praeger, 1969), 156–157

W

Warde, Paul, Robin, Libby, and Sörlin, Sverker, *The Environment: A History of the Idea* (Baltimore: John Hopkins University Press, 2021)

Werbeloff, Lara, Brown, Rebekah, and Loorbach, Derk, 'Pathways of System Transformation: Strategic Agency to Support Regime Change,' *Environmental Science & Policy* 66 (2016), 119–128

Whole Earth Catalog (Fall 1969)

Williams, Alex, and Srnicek, Nick, *#Accelerate Manifesto: For an Accelerationist Politics* (Mexico City: Gato Negro, 2016)

Wilson, Edward O., *Half-Earth: Our Planet's Fight for Life* (New York: Liveright, 2016)

Wines, James, 'Passages – A Changing Dialogue,' *I'ARCA* 96 (1995), 53

Wines, James, Green Architecture (Milan: Taschen, 2000), 14. Wines theorized this aspect of SITE's work in: *De-architecture* (New York: Rizzoli, 1987)

Wittmayer, Julia, et al., 'Narratives of Change: How Social Innovation Initiatives Construct Societal Transformation,' Futures 112 (2019)

World Commission on Environment and Development, *Our Common Future* (Oxford: Oxford University Press, 1987)

Woudstra, Jan, 'From Counter Culture to Eco-Cathedral: The Continuing Legacy of Louis Guillaume le Roy,' *Dutch Crossing* 27/2 (2003), 276

Y

Yin, Dingkun et al., 'Sponge City Practices in China: From Pilot Exploration to Systemic Demonstration,' *Water* 14/10 (2022), 1531

Z

Zardini, Mirko, '(Against) the Greenwashing of Architecture,' *New Geographies: Landscapes of Energy* 2 (2009)

Zelko, Frank, Make It a Green Peace! *The Rise of a Countercultural Environmentalism* (Oxford: Oxford University Press, 2013)

Index

#FridaysForFuture **170**
2050+ **15, 220, 222**
A House in the Sun: Modern Architecture **48, 100, 113, 245**
Accademia dei Lincei **22**
Accelerator **9, 47, 179, 197, 199, 217, 219, 220, 224, 225, 227, 234, 239, 241, 242**
Acorn brains **201**
Action research **207, 234, 256**
Activist **9, 24, 26, 29, 40, 41, 47, 74, 75, 86, 90, 107, 133, 155, 159, 170, 179, 180, 183, 187, 197, 199, 207, 209, 213, 214, 217, 225, 227, 234, 239, 241, 242**
ADELA **56**
Adorno **213, 245**
Adrian George **99**
Afterlife **7, 67, 127**
Age of Acceleration **123, 199**
Agenda **21, 82**
Agnes Denes **80**
Água Carioca **213**
Al Gore **161**
Aldo van Eyck **131**
Alex Williams **218**
Alexander Calder **28**
Alexander D'Hooghe **205**
Alexander King **22, 56, 57, 59**
Alexander Pike **99, 105, 107**
Alvin Boyarsky **105**
Amelia Peabody **101**
Amos Rapoport **137**
An Inconvenient Truth **161**
Ancestor **9, 24, 139, 179, 197, 199, 200, 201, 205, 217, 225, 227, 234, 239, 241, 242, 247**
Ancestral thinking **143, 151, 201, 205, 225**
André Gorz **207**
Andrej Tarkovski **34**
Angelika Fitz **49, 246**
Animal suffering **221**
Anne Howland Ehrlich **23**
Ant Farm **127**
Anthony Lewis **53**
Anthropocene **183, 191, 207, 217, 245, 247, 248, 249**
Anthropocentrism **200**
Anton Nieuwenhuys **146**
António Guterres **44**
Anupama Kundoo **15, 205, 206, 247**
Archigram **127, 130, 131, 218**
Architectural Association (AA) **103, 105, 248**
Architectural Design **49, 97, 99, 103, 107, 151, 153, 245, 246**
Architectural Record **120, 123, 245**
Architectural Review **48, 249**
Architecture Without Architects: A Short Introduction to Non-pedigreed Architecture **135, 137, 248**
Architecture From Prehistory to Climate Emergency **48**
AI (Artificial Intelligence) **12, 219, 231**
Art in America **28, 131, 245**
Arturo Escobar **201**
Atelier Luma **204, 206**
Aurelio Peccei **22, 33, 37, 53, 56, 57, 66, 67, 68, 69, 70**
Autonomous Housing Project (AHP) **105**
Backcasting **179, 227, 228, 229, 233, 235, 248**
Ban Ki-moon **164**
Barnabas Calder **48**
Battery Park landfill **80**
BC Architects **206**
BC Materials **206**
Bell Laboratories **107**
Ben Hoyle **213**
Benthem Crouwel Architects **125**
Bernard Rudofsky **135, 249**
Bertrand de Juvenel **56**
Betty Klaric **26**
Beyond the Limits: Confronting Global Collapse, Envisioning a Sustainable Future **69, 247**
Bill Voyd **115, 120**
Biomimicry **199**
Bioregional resources **206**
Biotecture **120, 121**
Bolivar **203**
Bonnefrite **213**
Boschgaard collective housing project **214**
Bottom-up **117, 120, 179, 207, 209, 214**
Brenda Vale **107**
Brian Gardiner **83**
British Antarctic Survey **83**
Bruce Haggart **103**
Brundtland Report **82**
Bruno Latour **49, 50, 169, 171, 200, 201, 219, 229**
Buckminster Fuller **28, 48, 105, 107, 113, 116, 117, 120, 121, 131**
Building with a Positive Footprint **220, 248**
Business as usual / Business-as-usual **9, 65, 85, 106, 175, 183, 191, 194, 195, 199, 227, 229, 230**
Buzz Holling **49**
Canadian Centre for Architecture (CCA) **48, 100, 153, 245, 246**
Carbon Dioxide and Climate: A Scientific Assessment **75**
Carbon sequestration **221**
Carbon-positive **197, 257**
Carl B. Stokes **26**
Caroline Maniaque-Benton **48, 115, 121, 123, 247**
Carroll Wilson **66, 67**
Centre de Recherche et d'Application en terre (CRAterre) **140, 143, 246**
Centre National de la Recherche Scientifique (CNRS) **101**
Centre Pompidou **143, 246**
Changing Climate **75**
Charles Lee Remington **23**
Chernobyl (disaster) **81**
Circular building **116, 120, 121, 133**
City, Climate and Architecture **109**
Civil disobedience **79, 207, 209**
Civil Rights Act **23**
Clark Richert **117**
Claude Courtecuisse **147**
Claude Levi-Strauss **69**
Clean Air Act **18, 20, 56**
Climate adaptation **213, 219, 257**
Climate agreement **93**
Climate neutrality **213, 220, 221**
Clintel network **89**
Clivius System **105**
Club of Rome **7, 15, 22, 33, 43, 52, 53, 54, 55, 56, 57, 59, 61, 65, 67, 68, 69, 70, 71, 116, 175, 183, 230, 246**
Colin Moorcraft **99**
Coloco **209**
Commons **199, 234**
Complex systems **49, 181, 187, 219**
Conrad Waddington **57**
Construct lab **209**
Coop Himmelb(l)au **127**
COP21 **165**
Council of European Communities **251**
Counterculture **48, 94, 103, 105, 115, 123, 207**
Countercultural **113, 115, 116, 120, 121, 123, 184, 249**
Covid-19 **171, 174, 184, 219**
Critical Care, Architecture and Urbanism for a Broken Planet **49, 246**
Critical mass **44, 207**
Cultured meat **220, 221, 249**
Cuyahoga River **26**
Daniel Barber **16, 48, 65, 100, 101, 113, 245, 258**
David Brower **24**
DDT (dichlorodiphenyltrichloroethane) **19, 21**
Deceleration **199**
Deep time / Deep-time **11, 155, 195, 199, 201**
Degrowth **207, 245**
Delft University of Technology **14, 16**
Dennis Gabor **56**
Dennis Meadows **22, 33, 43, 57, 59, 61, 63, 64, 66, 67, 68, 69, 70, 89, 160, 247**
Des architectures de terre ou l'avenir d'une tradition millénaire **143, 246**
Design with Nature **145, 146, 151, 247, 249**
Designing for Survival **99**
Designs for The Pluriverse **201, 246**
Destabilization **178, 187, 191, 194, 195, 224, 227, 230, 231**
Dirk Sijmons **15, 50**
Disruption **12, 18, 39, 61, 71, 174, 183, 185, 227, 230, 231, 233**
DIY **48, 94, 113, 115, 131**
Dome structures **119**
Donella Meadows **32, 33, 43, 49, 57, 61, 63, 64**
Doughnut economy **163**
Douglas Keebaugh **103**
Douglas Trumbull **35**
Down to Earth: Politics in the New Climatic Regime **171**
Drinkable Rivers **200, 248**

Drop City 1 **17, 118, 120, 121, 123, 127, 245, 247, 248**
Droppers **117, 120, 123, 124**
Dubin-Mindell-Bloome Associates **97**
Dutch Planning Agency (PBL) **231**
Dymaxion Award **117**
Dymaxion House **105**
E.F. Schumacher **185**
E.O. Wilson **79**
Earth construction **206**
Earth Day **27, 133**
Earth First! **79**
Earth for All (Earth4all): A Survival Guide for Humanity **69, 175**
Earth National Park **24**
Earth Summit **31, 69, 82**
Earthbag Construction system **140**
Earthrise **10**
Earthships **121, 122, 123, 127**
Eco-cathedral **146, 151, 249**
Ecole Urbaine de Lyon **213**
Ecological realism **207**
Ecopolis **109, 111, 113, 249**
Ecotron **223, 224**
Ed Nijpels **87**
Eduard Pestel **66**
Edward Steichen **28**
Edward Wilson **200, 249**
Eleanor Raymond **101**
Elke Krasny **49**
Embassy of the North Sea **198, 200, 201**
Emilio Ambasz **153, 154, 245**
Encore Heureux **15, 210, 211, 113**
Ending the Anthropocene, Essays on Activism in the Age of Collapse **207, 245**
Énergies Désespoirs **213**
Energiewende **39, 41**
Energy Security Act **75**
Enlightenment **13, 230**
Environmental Council of London **105**
Environmental Histories of Architecture **49, 246**
Environmental Protection Agency **21, 26, 56, 84, 184**
Erich Jantsch **57**
Ernest Trova **28**
European Productivity Agency **56**
Experimentation **8, 13, 45, 50, 51, 113, 115, 188, 189, 214, 218, 221, 225, 233**
Extraction **12, 41, 181, 185, 189, 207, 233**
Exxon **75**
Eytan Levi **213, 215**
Face à Gaïa: Huit conférences sur le nouveau régime climatique **169**
Fanny Lopez **48, 103, 105, 247**
Far-future scenarios **199**
Felix Trombe **101, 102, 103**
Final warning **7, 39, 44, 59, 246**
First United Nations Conference on the Human Environment **31**
First World Climate Conference (FWCC or WCC-1) **137**
Fondation Maeght **130**
Forecasting **46, 179, 187, 227, 228, 231, 233, 245, 248**
Forensic Architecture **209**
Francis Fukuyama **229, 246**
François Dallegret **127, 131**
Françoise-Hélène Jourda **123, 124, 125**
Frederick R. Steiner **145**
Friends of the Earth **24**
Frontrunners **220**
Gaia hypothesis **25, 169**
Garzweiler II **41, 42**
Gaylord Nelson **27**
Gene Bernofsky **117**
George H.W. Bush **91**
Georgia O'Keefe **28**
Gerald Smith **105**
Gilles Clement **145, 147, 149, 151, 245**
Gilles Perraudin **123, 124, 125, 127**
Glauber's salts **101**
Godfrey Reggio **34**
Gökçe Günel **16, 217, 246**
Graham Caine **48, 103, 247**
Grand narrative **13, 179, 229, 241**
Great Smog **18**
Green growth **185, 230, 246**
Greenpeace **29, 184**
Greenwashing **95, 151, 152, 153, 155, 220, 249**
Greta Thunberg **170, 177**
Gro Harlem Brundtland **82, 184**
Guido Carlo **57**
Guy Rottier **109, 110, 249**
Habitat 1 **136, 137**
Half-Earth **200, 249**
Hambach Forest Movement **41**
Hans-Walter Müller **127, 129, 130, 131, 247**
Hasan Ozbekhan **59**
Hassan Fathy **134, 139, 140, 246, 248, 249**
Haus-Rucker-Co **127, 128**
Heartland Institute **89**
Herencia Ambiental **202, 203**
Herman Daly **185, 246**
Hoyt C. Hottel **100**
Hubert Guillaud **143**
Hugo Thiemann **57, 66**
Ian McHarg **144, 145, 146, 249**
Impermanence 8 (table of content) **13, 94, 115, 131, 133**
Indira Ghandi **69**
Institut für Bau-, Umwelt- und Solartechnik **111**
Intergenerational justice **201**
Intergovernmental Panel on Climate Change (IPCC) **44, 83, 85, 137, 184**
International Architecture Biennale of Rotterdam (IABR) **13**
International Monetary Fund **159**
IPBES **184**
Ivan Illich **69**
Jacques Derrida **229**
Jacques Michel **101**
Jacques-Yves Cousteau **30**
Jalaluddin Rumi **140**
James Ephraim Lovelock **25, 169**
James Thring **105**
James Wines **151, 152, 153, 244**
Jan Benthem **125**
Jan Rotmans **49, 181, 184, 231, 246**
Jay Forrester **33, 58, 59, 61, 63**
Jean Dethier **143, 246**
Jean Herzberg Lipman **28**
Jean Saint-Geours **57**
Jean-Francois Lyotard **229, 247**
Jermen Gvishiani **56**
Jimmy Carter **76, 108, 109, 247**
Joe Farman **83**
Johan Rockström **44, 162, 174, 175, 187, 248**
Johan Schot **49, 181, 186, 246**
John Cage **130**
John Frazer **99, 105**
John Grin **49, 181, 193, 246**
John Kenneth Galbraith **61, 246**
John Littler **105**
John Robert McNeill **55, 217, 247**
John Sununu **87**
Jonathan Shanklin **83**
Joop den Uyl **68**
Jørgen Randers **32, 33, 61, 63, 64, 67, 69, 70, 89, 160, 175, 227, 247, 248**
Josef Klaus **59**
Jule Charney **75**
Kate Raworth **163**
Katy Hessel **80**
Killing Architects **209**
Kim Förster **49, 246**
Kim Stanley Robinson **201, 248**
Koch brothers **89**
Kofi Annan **83**
Kongjian Yu **208, 209, 225**
Koyaanisqatsi: Life out of Balance **34**
Kraaijvanger Architects **220, 232**
KuiperCompagnons **231**
Kyoto Protocol **85, 158**
L'Architecture d'Aujourd'hui **48, 111, 117, 245**
Lance Gunderson **49**
Landstuhl **111, 245**
Le Corbusier **109, 139, 247**
Leonard Ross **43, 67**
Lewis Mumford **69, 145**
Li An Phoa **200, 248**
Libby Robin **49, 55**
Lieven De Cauter **207, 245**
Lightweight **8, 117, 120, 123, 125, 127, 207**
Lille-Europe1 **147**
Limits to Growth: The 30-Year Update **69, 160**
Living Pod **130**
Localism **218**
Lock-in **49, 191, 192**
Lode Janssens **130, 131, 132**
Long-term thinking **13, 147, 200, 201**
Longue durée **13, 203**
Loosing Earth **75**
Louis Le Roy **131, 145, 146, 147, 148, 151, 247, 249**
Low-tech **94, 116, 131, 197, 201, 207, 209, 212, 213**
Lumiducs **109**
Lydia Kallipoliti **48, 103, 105, 247**
Lynn Margulis **25, 169**
Maarten Hajer **50**
Maarten van der Schaaf **200, 248**
Marc Roberts **43, 67, 248**
Margaret Mead **69**
Maria Telkes **101, 102**

Marine Protection, Research, and Sanctuaries Act **84**
Marjorie Spock **19**
Marshall McLuhan **69**
Marshmallow brains **201**
Martin Luther King jr **23**
Mass extinction **170, 200**
Massachusetts Institute of Technology (MIT) **22, 33, 59, 61, 65, 100, 101, 115, 127, 160, 246, 247, 248**
Matthias Schmelzer **65**
Maurice Touchais **109**
Max Kohnstamm **57**
Mechanical Wing **105**
Merce Cunningham **130**
Metropolitan Forest **205**
Michael Jantzen **106, 107**
Michael Reynolds **120, 121, 122, 123**
Michel Foucault **229**
Migratory routes **205**
Millennium Development Goals **168**
Minnesota Museum of Art **80**
Mirko Zardini **48, 100, 153, 245, 249**
MIT solar energy research program **100, 101**
Monica Pigeon **99**
Montreal Protocol **83, 87**
Multi-level perspective **187**
Museum of Modern Art in New York **134, 135, 151, 152, 153**
MVRDV NEXT **219**
Nader Khalili **140, 141, 245**
NASA **25, 30, 97, 114, 115, 140**
Nathaniel Rich **75**
National Academy of Science **75, 183**
National Energy Act **76**
National Environmental Policy Act **21, 56**
Nature (science journal) **44, 83, 162, 185, 187, 203, 230, 233, 245, 247, 248, 249**
Nature-positive **45, 193, 225, 227, 233, 234, 241**
Natuur uitschakelen, natuur inschakelen (Switch off Nature, Switch on Nature) **146, 148, 247**
Net Positive **220, 248**
Net Zero **220**
New York Times **21, 43, 53, 54, 56, 67, 68, 77, 153, 247, 248, 249**
Next Economy **49**
Niches **186, 187, 195, 235, 239**
Nick Srnicek **218, 249**
Noa Architects **224**
Noam Chomsky **69**
Non-extractive architecture **197**
Non-linearity **183**
Nonhumans **200, 201**
Noordwijk Climate Conference **87**
Ocean Dumping Ban Act **84**
Of Bicycles, Bakelites, and Bulbs: Toward a Theory of Sociotechnical Change **49**
Oil crisis **100, 106, 107, 111, 145, 245**
Olivetti Limited **28, 56**
Ooze architects **212, 213**
Operating Manual for Spaceship Earth **48, 112, 113, 246**
Optimization **181, 184, 187, 188, 190, 191, 193, 199, 206, 235, 241**
Organization for Economic Co-operation and Development (OECD) **65**
Organization of Arab Petroleum Exporting Countries (OPAEC) **74**
Organization of Petroleum Exporting Countries (OPEC) **107**
Oswald Mathias Ungers **110, 111, 113, 246**
Our Common Future **82, 184, 249**
Out of equilibrium **181, 183**
Overshoot day **11**
Panarchy **49**
Paolo Soleri **69**
Paradigm shifts **214**
Parc Matisse **147, 149**
Paris Climate Agreement **158, 164, 165, 170, 184**
Park Farm **209**
Parliament of Things **200**
Path dependency **188, 189, 190, 191, 192, 201, 203**
Patrice Doat **143**
Paul Hermann Müller **21**
Paul Polman **220, 248**
Paul Ralph Ehrlich **23, 34**
Paul Warde **55, 67, 249**
Penelope Dean **151, 152, 153, 246**
Peter Cook **218**
Peter Crump **103**
Peter Passell **43, 67, 248**
Peter W. Behrens III **32,33, 43, 61, 63, 64, 67**
Phase-out **41, 83, 231, 189**
Phyllis Cormack **29**
Pier Vellinga **87**
Pierre Elliott Trudeau **59**
Pierre Massay **57**
Planetary boundaries **44, 47, 69, 162, 163, 175, 185, 191, 206, 230, 234, 248, 249**
Plant-based diet **221**
Plug-in City **218**
Population growth **11, 23, 43, 55, 56, 59, 65, 66, 89, 183**
Post-capitalism **218**
Predicament of Mankind **22, 33, 52, 57, 59, 61, 67, 247**
President Kennedy **21**
Problématique **22, 57, 59, 61, 68**
Progressive Architecture **96, 97, 99, 245, 248**
Proyecto de Conectividades Socio-Ecosistémicas (PCSE) **202, 203**
Pseudoscience **68**
Rachel Carson **19, 20, 21, 27, 31, 55, 56, 121, 145, 245**
Radical transitions **217, 233, 234, 235, 239, 241, 247**
Raumlabor **209**
Regenerative **100, 113, 193, 211, 235, 238, 239, 241**
René Kemp **49, 181, 184, 187**
Restorative architecture **197**
Reuse **105, 116, 207, 213, 214, 239**
Reyner Banham **48, 98, 99, 100, 111, 113, 131, 245**

Rheinisches Braunkohlerevier **41**
RIBA Journal **97, 99**
Richard Bowers **23**
Richard Fleisher **34**
Richard Ingersoll **48, 49, 147, 246, 247**
Richard Weller **202, 203**
Ringland **205**
Road to Survival **55, 249**
Robert F. Kennedy **23**
Robert M. White **77**
Robert Vale **107, 249**
Roman Krznaric **139, 155, 201, 247**
Ronald Reagan **76, 93**
Rotor **214, 217**
Rotor Deconstruction (RotorDC) **214**
Roy Lichtenstein **218**
Rube Goldberg **68**
Saburo Okita **66**
SAGE Handbook of Architectural Theory **48, 49, 247**
Sandrine Dixson-Declève **175**
Santa Fe Institute **49**
Sasha Roesler **109**
Save Our Planet **28**
Scalable concepts **213, 217**
Scarcity **11, 55, 109**
School Strike for the Climate **170**
Sculpture in the Environment (SITE Inc.) **151, 249**
Self-build **103, 116, 121, 125**
Self-sufficiency **48, 100, 107, 109, 113, 115, 116, 120, 121, 127, 197, 212**
Severn Cullis-Suzuki **91**
Shelter **48, 115, 116, 123, 140, 249**
Sibyl Moholy-Nagy **137, 138, 246**
Sierra Club **24**
Silent Running **34, 35**
Silent Spring **19, 20, 21, 27, 54, 55, 56, 121, 245**
Smithsonian Institute **52, 67, 68**
Socioenvironmental corridors **203**
Solar energy **48, 76, 99, 100, 101, 130, 107, 109, 111, 113, 221, 224, 245**
Solar Energy in the Cold War **48, 100, 113, 245**
Solar Energy Research Institute **76**
Solar Highway A37 **222, 224**
Solar technology **48, 100, 107, 109, 111, 117**
Solaris **34**
SolarScape **219**
Sorry out of Gas **48, 100, 101, 103, 107, 245**
Soviet Council for Science and Technology **56**
Soylent Green **34, 35**
Spaceship in the Desert **217, 246**
Sponge City **208, 209, 249**
Stalker **209**
Standardization **205, 217**
Starbucksification **205**
State of Global Equilibrium **66**
Status quo utopia **218**
Steve Baer **117, 121**
Stewart Brand **30, 114, 115, 116, 123**
Stichting TIJD (Time Foundation) **147**
Still Standing **213, 214, 215**
Stockholm Conference 1972 **67, 75, 91**
Stockholm Resilience Centre **44**
Street Farmer **103**
Studio Marco Vermeulen **112, 113**
Stumbling forward **207**
Sun Day **76**
Sun House **101, 102**
Super Adobe **140**
Superblock **205**
Superuse Studios **214**
Sustainable Development Goals (SDGs) **168**
Sustainable technologies **45, 218**
Sverker Sörin **55**
Synthetic Cultures **221, 222, 225**
System Dynamics Group **59**
Taking time **205**
Taller Architects **202, 203**
Technical Research Division of the Department of Architecture at Cambridge University **105**
Techno-optimism **103, 127, 218**
Technocratic **68, 97**
Temporary installations **209**
The Affluent Society **61**
The Architecture of the Well-Tempered Environment **48, 99**
The Blue Marble **30**
The Environment, A History of the Idea **49**
The Good Ancestor: How to Think Long Term in a Short-Term World **139, 155**
The Great Acceleration **217**
The Guardian **44**
The House We Live In **145**
The International Art Show for the End of World Hunger **80**
The Limits to Growth: The 30-Year Update **160**
The Limits to Growth: A Report for the Club of Rome's Project on the Predicament of Mankind **22, 33, 61, 67**
The Line **218**
The Ministry for the Future **201**
The Missing Link **49**
The New Autonomous House: Design and Planning for Self-Efficiency **107**
The New York Times **53, 67, 68, 77**
The Politics of Design **48**
The Population Bomb **23, 34**
The predicament of mankind **22, 33, 57, 59, 61, 67**
The Trombe Wall **101**
The World Park Project **203**
Thumb House **120**
Tiers Paysage **147, 151**
Tipping point **183, 187, 233**
Transformative innovation **231, 233, 241**
Transition governance **233, 235**
Transition research **185**
Transitions to Sustainable Development: New Directions in the Study of Long-term Transformative Change **49**
UN Conference on the Human Environment **137**
Uncertainty **12, 190, 194, 227, 231**
UNEP **31, 83**
UNESCO **28, 203**
Unité d'Habitation **109**
United Nations Conference on Environment and Development (UNCED) **82, 91**
United Nations Development Program (UNDP) **140**
United Nations Environment Program (UNEP) **83**
United Nations Framework Convention on Climate Change **85, 158**
United Nations High Commissioner for Refugees (UNHCR) **140**
Unsustainability **184, 185, 193, 194, 197, 241**
Urban by Nature **50**
US Environmental Protection Agency **21, 56**
Vereda Raiceros **203**
Victor Papanek **48**
Vincent van der Meulen **220, 225**
Volkswagen Foundation **59, 69**
Wageningen University **231**
Walter Benjamin **213**
Walter Sullivan **77**
Washington Post **145**
We Have Never Been Modern **200, 229**
Wheatfield: A Confrontation **80**
Where to Land after the Pandemic? **171, 219**
Whole Earth Catalog **115**
Whole System ideas **116**
Wiebe Bijker **49**
Willem Oltmans **68**
William Anders **30**
William Behrens **33, 61**
William Vogt **55**
Wolf Von Eckardt **145**
Woolwich **105**
World Bank **159**
World Climate Program **137**
World Commission on Environment and Development (WCED) **82**
World Economic Forum **159**
World Health Organization (WHO) **171**
World Meteorological Organization (WMO) **83, 85, 173**
World Trade Organization **159**
World3 model **59, 65, 66, 67**
X-curve **187, 194**
Zero Population Growth **23**
Zero-carbon **120, 121, 217**
Zome **117, 120, 121, 123**

Image credits

Cover ©NASA. Catalogued by Johnson Space Center of the United States National Aeronautics and Space Administration/Wikipedia Commons.
3 ©NASA. Catalogued by Johnson Space Center of the United States National Aeronautics and Space Administration/Wikipedia Commons
10 ©NASA/Photograph: Bill Anders/Wikipedia Commons

Timeline

18 ©Keystone/Getty Images
19 ©Photo: R.B. Pope/USDA Forest Service, Pacific Northwest Region, State and Private Forestry, Forest Health Protection. Collection: Portland Station Collection; La Grande, Oregon./Wikipedia Commons
20 ©Universal Art Archive/ lamy Stock Photo
21 ©Science History Images/Alamy Stock Photo
22 ©ANP/Hoffman
23 Courtesy of Busy Beaver Button Museum
24 ©PA Images/Alamy Stock Photo
25 Used with permission of Oxford University Press – Books (US & UK), from "Gaia, a new look at life on earth", James Lovelock, 1979: permission conveyed through Copyright Clearance Center, Inc.
26 ©AP Photo/Wally Fong
27 ©Kim Chen/Alamy Stock Photo
28 ©Ernest T Trova under agreements dated September 13, 2007. Courtesy of Poster House Permanent Collection
30 ©NASA. Catalogued by Johnson Space Center of the United States National Aeronautics and Space Administration/Wikipedia Commons
31 ©United Nations. UN Photo by Yutaka Nagata
32 ©Album/Alamy Stock Photo
33 Courtesy of Dennis Meadows
34 ©BFA/Alamy Stock Photo
35 ©BFA / Universal Pictures / Alamy Stock Photo

Chapter 1

40 ©REUTERS/Christian Mang
42 ©Architectural Research: Irene Feria Prados, Frieder Vogler, Rik de Brower/Involved organization: Initiative Lützerath Lebt
42 ©Martin Falbisoner. This image is licensed under a Creative Commons Attribution-Share Alike 4.0 International license.

Chapter 2

52 Smithsonian Institution Archives, Acc. 11-009, Image No. 72–3011
54 From The New York Times. ©1962 The New York Times Company. All rights reserved. Used under license
54 ©Club of Rome. Courtesy of The Club of Rome
58 ©CBS. CBS Photo Archive/CBS via Getty Images
60 ©Club of Rome. From *The Limits to Growth*, 1972. Courtesy of The Club of Rome
62–63 ©Club of Rome. Courtesy of The Club of Rome
64 ©Club of Rome. Courtesy of The Club of Rome
71 ©United Nations. UN Photo by Yukata Nagata

Timeline

74 ©Photo collection Spaarnestad Subjects/ Nationaal Archief/Foroburo Peter Drent
75 ©National Academy of Science / Wikipedia Commons
76 ©AP Photo/Harvey Georges
77 ©WMO. Courtesy of WMO
78 ©Earth First! Journal. *From Earth First!*, Dustrud, Pete, et al., eds., Earth First! 2, no. 2 (21 December 1981).
79 ©Earth First!. Courtesy of Bron R. Taylor
80 ©Agnes Denes. Photograph: Véronique Patteeuw from the exhibition 'Extreme Tension. Art between Politics and Society', Neue Nationalgalerie, Berlin
81 ©STF/PRESSENS BILD/AFP
81 ©Volodymyr Repik/AP
82 ©United Nations. UN Photo by Yukata Nagata.
83 ©Retro AdArchives/Alamy Stock Photo
84 ©United States Congress. From Ocean Dumping Ban Act: Conference Report (to Accompany S. 2030). (1988). United States: U.S. Government Printing Office.
85 ©WMO.Courtesy of WMO
86–87 Courtesy of Daniel Becker
88 From European Environment Agency (EEA) 25th anniversary, Publications Office of the European Union, 2019
89 ©Chelsea Green Publishing Company. Courtesy of Chelsea Green Publishing Company
90 ©United Nations. UN Photo by Michos Tzovaras
91 ©Daniel GARCIA/AFP

Chapter 3

96 Archives of the US Modernist Architecture Magazine Library. From *Progressive Architecture* September 1971 issue.
98 From *Architectural Design A.D.* Volume XLII, 1972
98 Used with permission of Elsevier Science & Technology Journal, from *The Architecture of the Well-Tempered Environment*, Reyner Banham, Edition I, 1969: permission conveyed through Copyright Clearance Center, Inc.
102 Courtesy of the Frances Loeb Library at the Harvard University Graduate School of Design
102 ©SPOOL. From SPOOL Vol. 5 No. 1: Landscape Metropolis #4. This image is licensed under a Creative Commons Attribution 4.0 International License
102 Douglas Kelbaugh fonds. Collection Centre Canadien d'Architecture/Canadian Centre for Architecture, Montréal; Don de Douglas Kelbaugh/Gift of Douglas Kelbaugh
104 From *Survival Scrapbook 5: Energy*, 1973
104 John Donat/RIBA Collections
106 ©Michael Jantzen. Courtesy of Michael Jantzen, architect and photographer of the Solar Vacation House
106 Science History Images/Alamy Stock Photo
108 Courtesy: Jimmy Carter Presidential Library
110 ©Centre Pompidou, MNAM-CCI, Dist. GrandPalaisRmn/ Bertrand Prévost
110 Courtesy of the Ungers Archiv für Architekturwissenschaft
112 Courtesy of the Southern Illinois University Press

Chapter 4

114 Courtesy of Steward Brand
114 Courtesy of Steward Brand
118 ©Carl Iwasaki. Carl Iwasaki/The Chronicle Collection via Getty Images
118 Courtesy of John Curl
119 From *Domebook 2* by Lloyd Kahn & Bob Easton
122 ©Earthship Biotecture. Courtesy of Earthship Media/ Mike Reynolds
122 ©Jenny Parkins. This image is licensed under a Creative Commons Attribution-Share Alike 2.0 Generic License

124 ©JapArchitectes. Courtesy of Jourda Architectes Paris
126 ©Jannes Linders. Archives of Jannes Linders
126 ©Benthem Crouwel Architects. Archives of Benthem Crouwel Architects
128 Stadtarchiv Kassel, 0.553.007, Carl Eberth
128 ©Archiv Hans-Walter Müller
132 ©CIVA – Sint-Lukasarchief/Jos Vandenbreeden
132 Archive of A.J. Lode Janssens

Chapter 5

134 2024@Photo Scala, Florence. Digital image, The Museum of Modern Art, New York/Scala, Florence
134 2024@Photo Scala, Florence. Digital image, The Museum of Modern Art, New York/Scala, Florence
136 ©United Nations. UN Photo by Yukata Nagata
138 ©Sibyl Moholy-Nagy, c/o Pictoright Amsterdam 2024
141 ©CalEarth Inc./Geltaftan Foundation. Courtesy of CalEarth Inc
141 ©CalEarth Inc./Geltaftan Foundation. Courtesy of CalEarth Inc
142 ©Centre Pompidou, 1981; Conception graphique et illustration: Dominique Appia
144 Ian McHarg Collection, Photo of ILM and Mike Douglas in 1969, The Architectural Archives, University of Pennsylvania
148 Courtesy of Peter Wouda/Stichting TIJD
148 Wutsje/Wikimedia Commons/CC BY-SA 3.0
149 Gilles Clement, parc Matisse, Lille, L'île Derborence, 28 February 2007. Copyleft: This is a free work, you can copy, distribute, and modify it under the terms of the Free Art License. https://artlibre.org/licence/lal/en
149 +ACNE / Architecture Collected Neo Evolutionist
150 ©SITE – James Wines, LLC
154 ©Luca.favorido. This image is licensed under a Creative Commons Attribution-Share Alike 3.0 Unported License

Timeline

158 ©Kyodo News
159 ©Julian Röder. From the series "The Summits": G8 protests in Genoa, 2001
160 ©Chelsea Green Publishing Company. Courtesy of Chelsea Green Publishing Company
161 ©Paramount/ Cinematic / Alamy Stock Photo
162 ©Azote for Stockholm Resilience Centre, Stockholm University. Based on Richardson et al. 2023, Steffen et al. 2015, and Rockström et al. 2009. This image is licensed under the Creative Commons Attribution-NonCommercial 3.0. Licenced under agreement of use for primarily educational and research purposes.
163 ©DoughnutEconomics. This image is licensed under the Creative Commons Attribution-Share Alike 4.0 International license.
165–167 ©UNFCCC
168 ©United Nations
169 ©Jean Baptiste. This image is licensed under the Creative Commons Attribution-Share Alike 2.0 Generic license.
170 ©Anders Hellberg. This image is licensed under the Creative Commons Attribution-Share Alike 4.0 International license.171 ©REUTERS/Ronen Zvulun
172–173 ©Steve Parsons/ANP
174 ©MANDEL NGAN/AFP
175 Courtesy of Club of Rome

Chapter 6

180 ©EPA-EFE/Sem van der Wal/ANP
182 From Tavsoli, S., Sepehr, A., & Ghaderi, A. (2022). Investigation of Geological Diversity Based on the Degree of Sensitivity and the Amount of Equilibrium and Resilience of the Geosystem Case study: The Eastern Kopet-Dagh Zone). Geoconservation Research, Online First. https://doi.org/10.30486/gcr.2022.1965549.1113
182 All images courtesy of IPCC: Image 1: ©IPCC/Published by Cambridge University Press; Image 2: ©IPCC Image 3: ©IPCC ; Image 4:© Yann Arthus-Bertrand/ Altitude. All rights reserved. ©IPCC ; Image 5: ©Alisa Singer. All rights reserved. ©IPCC
186 From Geels, F. W. (n.d.). Multi-Level Perspective on System Innovation: Relevance for Industrial Transformation. In Environment & Policy (pp. 163–186). Kluwer Academic Publishers https://doi.org/10.1007/1-4020-4418-6_9
188–189 ©Derk Loorbach and Stahl R
192 From Callon, Michel, Raghu Garud and Peter Karnøe. "Organizational Paths: Path Dependency and Beyond." (2005)

Chapter 7

196 ©Etienne Malapert. From the series "The City of Possibilities", 2015. Courtesy of Etienne Malapert.
198 ©Embassy of the North Sea. Graphic: Eva van Bemmelen. Courtesy of Embassy of the North Sea
202 ©Richard J. Weller/Weitzman School of Design. University of Pennsylvania
204 ©TALLER Architects. Courtesy of TALLER Architects
206 Courtesy of Anupama Kundoo Architects/Photograph: Javier Callejas
206 ©Assemble Studio. Courtesy of Assemble Studio
208 ©Nicolas Deshais-Fernandez. Courtesy of Coloco
208 ©Turenscape. Courtesy of Kongjian Yu, Turenscape
210–211 ©Encore Heureux/Photo credit: Nicolas Trouillard. Courtesy of Encore Heureux
212 ©OOZE Architects and Urbanists. Courtesy of OOZE Architects and Urbanists
215 Courtesy of Eytan Levi and Benjamin Hoyle
215 ©Superuse. Courtesy of Superuse
216 ©OT SKY DRONE
222 ©Studio Marco Vermeulen. Courtesy of Marco Vermeulen
222 ©2050+. Courtesy of 2050+
223 ©noAarchitecten, Hasselt University. Courtesy of noAarchitecten

Chapter 8

226 ©Kadir van Lohuizen/NOOR
228 ©Creative Commons version 1.0
228 From Graham M Turner, 2008. "A Comparison of the Limits to Growth with Thirty Years of Reality," Socio-Economics and the Environment in Discussion (SEED) Working Paper Series 2008-09, CSIRO Sustainable Ecosystems.
232 ©Kraaijvanger Architects. Courtesy of Kraaijvanger Architects
236–237 ©Jan Rothuizen. Courtesy of Jan Rothuizen
238 ©BYSTRYKH/Photograph: Demir Purisic. Courtesy of Janna Bystrykh

Biographies

Derk Loorbach

Derk Loorbach is professor of Socio-economic Transitions and director of DRIFT, the Dutch Research Institute for Transitions, at the Erasmus University Rotterdam, the Netherlands. Loorbach's research focuses on the development of transition management in theory and practice through theory development and action research. Through his transdisciplinary work, he is actively involved in transitions in many sectors, from energy, mobility, food and health care to finance, education, and welfare. He is has contributed to the development of academic literature and theory, combining this with public speaking and contributions to more popular publications and events. In addition to his work at DRIFT, he is the academic lead for the EUR strategic platform Design Impact Transition (DIT), which seeks to accelerate the transformation of the university. He also chairs two foundations focused on sustainability transition (iFund and Lenteland). In 2022 he co-curated the 10th International Architecture Biennale of Rotterdam, 'It's About Time.'

Véronique Patteeuw

Véronique Patteeuw is an associate professor at the École Nationale Supérieure d'Architecture et du Paysage in Lille, where she combines research and teaching. In addition to her academic position in France, Patteeuw has been a visiting lecturer at the Harvard Study Abroad Program (2010), at the Catholic University Leuven (2019–2025) and the EPFL Lausanne (2020–2024). Since 2008, she has been the academic editor of the international peer-reviewed journal *OASE, Journal for Architecture*. Her research focuses on postwar architecture history and theory from an environmental perspective. Together with Mathieu Berteloot, Véronique Patteeuw directs Studio Spolia, a pedagogical unit that explores the transformation of as-found situations. She regularly contributes to journals such as *Matières, Architecture Theory Review, Les Cahiers de la Recherche Architecturale et Urbaine*, and *Log*, and co-edited *The Architect as Public Intellectual* (2024), *Authorship* (2022), *Modernities* (2021), and *Mediated Messages: Periodicals, Exhibitions and the Shaping of Postmodern Architecture* (2018). In 2020 she co-founded, with Léa-Catherine Szacka, PASZA, a Platform for Architectural Research focusing on late 20th century and early 21st century architecture culture. In 2022, she co-curated the 10th International Architecture Biennale of Rotterdam, 'It's About Time.'

Léa-Catherine Szacka

Léa-Catherine Szacka is senior lecturer in Architectural Studies at the University of Manchester. In addition to her position in Manchester, Szacka has been a lecturer at the Oslo School of Architecture and Design (2013–2017) and a visiting lecturer at the Harvard Study Abroad Program (2018), the Berlage Center for Advanced Studies in Architecture and Urban Design (2019–2024), the ETH Zurich (2020–2021), and the EPFL Lausanne (2024). Szacka's research focuses on the history of architecture exhibitions and the history and theory of postmodern architecture, especially from a media perspective. She is the author of *Exhibiting the Postmodern: The 1980 Venice Architecture Biennale* (2016), for which she was awarded the 2017 SAHGB Alice Davis Hitchcock Medallion, and of *Biennials/Triennials: Conversations on the Geography of Itinerant Display* (2019). She is also co-author of *Le Concert: Pink Floyd à Venise* (2017) and *Paolo Portoghesi: Architecture between History, Politics and Media* (2023), as well as co-editor of *Mediated Messages: Periodicals, Exhibitions and the Shaping of Postmodern Architecture* (2018) and *Concrete Oslo* (2018). In 2020 she co-founded, with Véronique Patteeuw, PASZA, a Platform for Architectural Research focusing on late 20th century and early 21st century architecture culture. In 2022, she co-curated the 10th International Architecture Biennale of Rotterdam, 'It's About Time.'

Peter Veenstra

Peter Veenstra is a landscape architect and co-founder of LOLA Landscape Architects, based in Rotterdam and Shenzhen. LOLA is an acronym for Lost Landscapes, which is born out of a fascination for the adventurous fringe, poetic leftover space, and spontaneous nature. With the office he has designed projects like Hongqiao Park in Shenzhen, Park Vijversburg in Tytsjerk, and the Adidas HQ Campus in Herzogenaurach. Through research by design, workshops, and exhibitions, Veenstra works on topics that deserve more attention in the field of (landscape) architecture. His recent research has focused on post-disaster landscapes, carbon-positive land use, automated afforestation, and climate adaptation in the urban environment. In 2013, he received the Rotterdam Maaskant Prize for Young Architects and in 2014 the TOPOS landscape award. Peter Veenstra co-wrote LOLA's first monograph *Lost Landscapes*, and the second in collaboration with Piet Oudolf, *In Search of Sharawadgi*. In 2022, he co-curated the 10th International Architecture Biennale of Rotterdam, 'It's About Time.'

Colophon

Publication

It's About Time
The Architecture of Climate Change

Authors
Derk Loorbach, Véronique Patteeuw, Léa-Catherine Szacka, Peter Veenstra

Editorial assistant
Theodora Gelali

Image editing
Raymond Tang

Research assistant timeline
Saskia Lambers

Peer review
Tom Avermaete, Daniel Barber, Elsa Devienne

Copy-editing
InOtherWords translation & editing
D'Laine Camp

Graphic design
Stahl R, www.stahl-r.de
Tobias Röttger, Susanne Stahl, Kathrin Baumgartner

Typefaces
Eliza, Founders Grotesk

Paper inside
Munken Print White 18, Profibulk

Paper cover
Gmund Action Vibrant Arsenic, Neobond

Lithography
Philipp Reuber,
PPP Pre Print Partner GmbH & Co. KG

Printing and binding
Gallery Print, Berlin

Publisher
IABR / nai010 publishers

International distribution
nai010 publishers
sales@nai010.com
www.nai010.com

Books distributed by nai010 are available internationally at selected bookstores and from the following distribution partners:
North, South and Central America – Artbook | D.A.P., New York, USA, dap@dapinc.com
Rest of the world – Idea Books, Amsterdam, the Netherlands, idea@ideabooks.nl

ISBN / EAN
978-94-6208-879-5

NUR 648
BISAC ARC000000, ARC018000
THEMA AMCR

It's About Time is also available as e-book (pdf)
ISBN 978-94-6208-901-3

Exhibition

It's About Time
The Architecture of Change

Director
Saskia van Stein

Curators
Derk Loorbach, Véronique Patteeuw, Léa-Catherine Szacka, Peter Veenstra

Exhibition coordination
Theodora Gelali

Assistant curator timeline
Saskia Lambers

Assistant curators
Maria Christopoulou, Matthew Cook, Noortje Weenink

Exhibition design
Richard Venlet with Alice Babini, Leander Venlet

Graphic design
Stahl R, www.stahl-r.de
Tobias Röttger, Susanne Stahl, Kathrin Baumgartner

Light design
Tim van't Hof with Quintes Belichting

Project texts
Lotte Haagsma, Chris Zwart

Copy-editing and translations
InOtherWords translation & editing
D'Laine Camp, Gerda ten Cate, Maria van Tol

Senior advisor
Emiliano Gandolfi

Events
Yonca Özbilge

Communication, pr and marketing
Nienke Rothuizen, Melanie Hulsebosch, Roos Rookhuizen, Sabine van der Vooren

Production and planning
Vivian Ammerlaan, Noortje Jansen, Reineke Otten, Mick van der Vooren, Tim Verhoeven

Education
Eef Cornelissen, Maria Kley

Ticketing and volunteers
Maaike Menheere

Intern
Feline van Bakel

Sound
Jack Bardwell

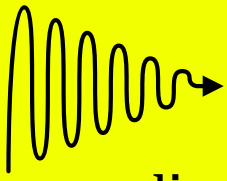
Construction, lighting and printing
Stijn van Aardenne, Bart Cuppens, Gido Cuppens, Jasper Droogers, Maurits Goossens, Juan Guerrero Gill, Henri Lammers, Bart Lentze, Jan Neggers, Henk Spronk

Thanks to
REVOLT, Aziz Yagoub

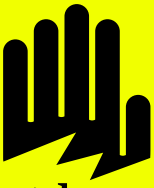
Thanks to IABR-sponsors
Bosch Beton
ROS Zand en Grindhandel
VING GVK

IABR is generously supported by
Ministerie van Onderwijs, Cultuur en Wetenschap
Dutch Ministry of Education, Culture and Science
Gemeente Rotterdam
City of Rotterdam

Bosch Beton · ROS Zand- en Grindhandel BV · VINK GVK · MARC ARCHITECTURAL CONSULTANCY · ENVELON A Member of Grenzebach · BENG SOLAR Solar Solutions · Rijksoverheid · Gemeente Rotterdam



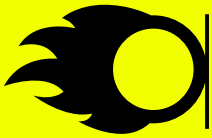
Act upon climate change as a short-term problem



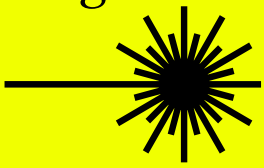
Root locally, resonate globally

Seize the transformative moment

Study systems: everything is connected



Think radical, act pragmatic

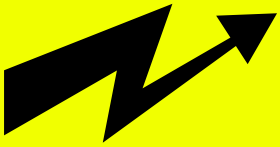


Create context for others to blossom

Develop capacities rather than knowledge

Connect to deep-time

Share value not profit



Scale up, scale out and scale deep

Design for desirable futures

Take time

The history of climate change and the history of architecture are connected in many ways: while architects contributed to building the fossil-fuel-driven world that has led to the current ecological collapse, they also explored and developed various alternatives to mitigate the effects of global warming. Using time as a conceptual lens, this book bridges the past, present, and future in new ways, leading to an architecture of climate change.

It's About Time presents historical and contemporary projects – from solar houses to autonomous structures and from earth buildings to green utopias – along with over 45 key moments in the history of environmental awareness. Applying transition research, the book conceptualizes the present as the moment in which awareness, urgency, and opportunity converge to point toward radically sustainable futures. It shows how the architect can integrate time into committed design practices at three distinct velocities: that of the activist, the accelerator, and the ancestor.

Serving as both a handbook and a source of inspiration for designers, *It's About Time* is intended for architects, educators, students, civic agents, and everyone involved in shaping the plural futures of our contemporary landscape. Urgent in its message, it asserts that the momentum to realize change has arrived, and that the field of architecture plays an important role in the systemic transitions we are moving toward.

9 789462 088795 >

nai010 publishers

International Architecture Biennale Rotterdam