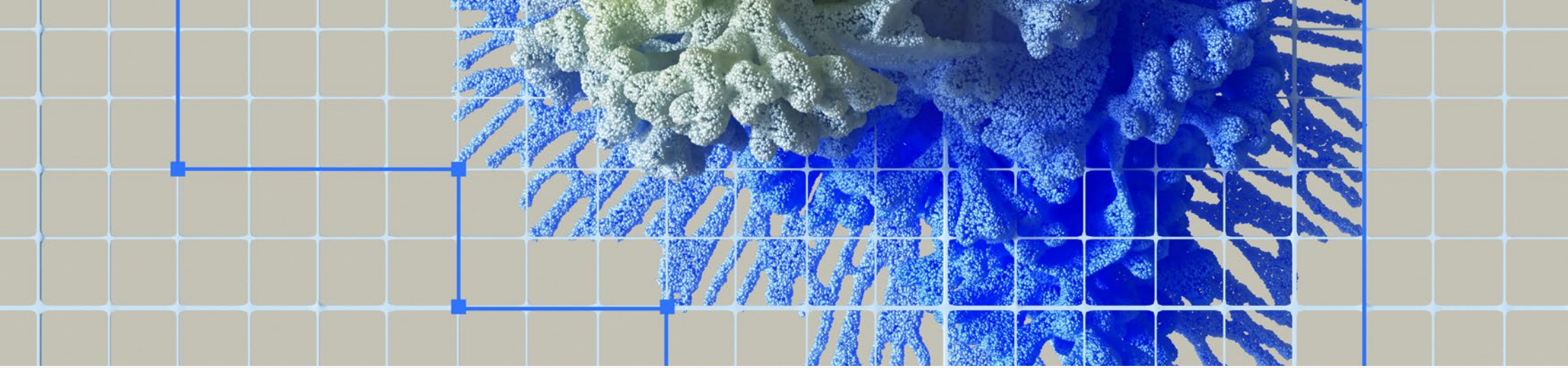


16 November 2022

# TRANSFORMATIVE INVESTMENT IN SUSTAINABILITY

## An Investment Philosophy for the Second Deep Transition

Johan Schot, Roberta Benedetti del Rio, Ed Steinmueller, Susanne Keesman

In collaboration with the Deep Transitions research team and Global Investors Panel

DEEP TRANSITIONS

SUPPORTED BY JAMES ANDERSON + BAILLIE GIFFORD & CO.

Utrecht University

CENTRE FOR GLOBAL CHALLENGES

UNIVERSITY OF SUSSEX BUSINESS SCHOOL

SCIENCE POLICY RESEARCH UNIT

Version 1.0



Lead authors: Johan Schot, Roberta Benedetti del Rio, Ed Steinmueller, Susanne Keesman

Contributing authors: Laur Kanger, Jack Davies, Victoria Ward, Bipashyee Ghosh, Caetano Penna, Phil Johnstone, Wendy Schultz, Carla Alvial Palavicino, Imogen Wade

Please use the following reference to cite the whole report: Schot, J.W., Benedetti del Rio, R., Steinmueller, W.E., Keesman, S.J. (2022). ***Transformative Investment in Sustainability. An Investment Philosophy for the Second Deep Transition***.

This report was written based on a year-long collaborative process between the Deep Transitions research team and the Global Investors Panel: a panel of 16 public and private investors whose contributions and insights to the panel sessions informed the contents of this report.

The panel consists of:
Nick Abel (CalSTRS – California State Teacher's Retirement System)
Dominic Burke (Lankelly Chase Foundation)
Yuni Choi (RS Group Asia)
Audrey Desiderato (Mirova SunFunder)
Kate Fox (Baillie Gifford)
Drew von Glahn (Collaborative for Frontier Finance)
Jonathan Hausman (Ontario Teachers' Pension Plan)
Lisa Jordan (Draper Richards Kaplan Foundation)
Atanas Kolev (European Investment Bank)
Göran Marklund (VINNOVA)
Katherine Ng (United Nations Principles for Responsible Investment)
Christopher Palmberg (Business Finland)
Roberta Benedetti del Rio (Impact investor, and senior advisor to Just Climate, a subsidiary of Generation Investment Management)
Dimple Sahni (Anthos Fund & Asset Management BV)
Sanjoy Sanyal (Caspian, Regain Paradise, Adelphi)
Daan du Toit (South African Department of Science and Innovation)

Design and illustrations by Naz Costante
3D rendered images by Deep Mind (Unsplash)

# Table of contents

# Take a quick tour of transformative investment

**This Philosophy is a deep dive into the theoretical backbone, process and impact of transformative investment. It provides a comprehensive guide to Deep Transitions thinking and the opportunities, challenges and implications of applying transformative investment in practice. The shorter Quick Guide is for developing an initial understanding of the Deep Transitions framework and the 12 transformative investment principles in particular.**

The Transformative Investment Philosophy, encapsulated in the 12 transformative investment principles, provides a framework for guiding thought and action in the investment community and broader society. Yet they are not an end point; they are a beginning. The 12 principles for transformative investment aid investors in their role of accelerating a Second Deep Transition via multi-level systems change. The principles are designed to catalyse fresh thinking; assist with investment goal setting, strategy and process development; and accelerate the broader take-up and application of Deep Transitions thinking.

Download the Quick Guide ↗


# Begin a bold journey towards transformation

**Beginning in 2023, the Deep Transitions Lab will act as the seed of a global community brought together by a shared ambition to invest in systems change. The Lab will serve as a platform within which to learn about, experiment with and disseminate the results of new forms and strategies of transformative investment.**

If you would like to discuss how we might collaborate in your own systems-change work; request an information pack on the Deep Transitions Lab; or for any other inquiry:

Contact us ↗

# Foreword

**As we write these words, unprecedented yet predicted heatwaves, droughts, floods, food shortages and wildfires rage across Africa, the Americas, Asia and Europe. Despite their global scale, such disasters are unevenly distributed and often impact the most vulnerable. Humankind's profound neglect of the natural world, especially in recent decades, is matched only by the renewed realisation of our dependence upon it. Many people and organisations are finally waking up to the fact that building a sustainable future for life on Earth requires a sustained effort to change our trajectory and transform the way we organise and structure our societies. Evidence-backed consensus among international organisations such as the Intergovernmental Panel on Climate Change (IPCC) and UN Office for Disaster Risk Reduction, is that a 'business-as-usual' approach will lead humanity down a path to catastrophe. Disruptive, fundamental and systemic change is needed to avoid widespread human suffering and loss.[1] In other words, the science confirms that the future looks bleak without major changes to the way we work and live.**

A monumental task lies ahead of us. It demands tremendous levels of public and private investment. While recognition of the critical role of finance for transformation has fuelled an increase in capital flowing towards building a sustainable future, there is a long way to go. Even the most ambitious investors find their efforts confounded by a system of rigid structures, narrow definitions and twisted incentives that block fundamental change. In many cases, the capital needed to spur deep transformation is sunk instead into systems optimisation, which leads to improvements in the short term, but in the long term only prolongs the status quo. Moving the needle of investment away from the relative comfort of systems optimisation and towards fundamental and lasting systems change is essential for our future.

It was with this in mind that, with the generous support of James Anderson and Baillie Gifford, we established a Global Investors Panel in 2021 to identify a new approach to investment. Working with a research team based at Utrecht University and the University of Sussex, the Panel considered how public and private investors could go beyond their current investment practices. Rejecting the lure of systems optimisation, the Panel and research team sought ways to change the direction of investment towards fundamental and lasting systems change.

Our aims are, by necessity, disruptive. We recognised from the outset that our ambitions would be uncomfortable to some, as they seek to challenge the values and beliefs of many who have contributed to, benefitted from and fundamentally believe in the current global system. This system has delivered the largest increase in global standards of living in human history, but its wealth has been unequally distributed and was accumulated at a cost: extraction from and exploitation of the natural world.

As a key driver of the global economy, investment has played a central role in accelerating the breakdown of our planet's natural systems and the concentration of capital in countries largely belonging to the Global North. Over the last decades, investment has continued to fuel industrial agriculture, consumption-based economies and the fossil fuel industry, often in the name of raising the global standards of living. These historical failures must be recognised and understood. Yet investment also has enormous potential to accelerate our movement towards a sustainable and just future. Select groups of front-runners within the investment community have long sought to use the power of capital for good.

Our ambition is to go further still, and embed a deep understanding of system-change dynamics into investment. To achieve this, the Panel and research team use the theory of Deep Transitions. Together, the Panel and research team asked how a Deep Transitions approach to systems change and transformation, grounded in rigorous research, might unlock new potential for investors seeking to build a better future. In Deep Transitions, we lay the foundations for understanding how fundamental change is brought about and decide how we can come together across disciplines to accelerate and deepen that change for the long term. Our core collective ambition is to translate this academic investigation into actionable takeaways, thereby applying the theory of Deep Transitions as the underpinning of a new type of investment: transformative investment.

## The Deep Transitions project

This project would not have succeeded without the commitment and collaboration of everyone involved. The Panel and research team committed to being creative, agile and ambitious throughout this investigation, believing that entering in a co-creation process was the most logical way to find breakthroughs and explore possibilities. This meeting of two worlds required each of us to reflect on our own positions, as individuals as well as in relation to the networks and broader context we are part of. We brought mutual respect and good humour to each session, engaging sincerely and without prejudice with ideas that might run counter to our own. To aid us in achieving this, the Panel and research team were joined by two facilitators who added their vital foresight, recommendations for collaborative practice, and storytelling expertise.

Through research, dialogue and structured meetings, the Panel gathered insights and momentum, culminating in a proposal for 12 principles of a transformative investment philosophy. This proposal is ambitious yet achievable, as it acknowledges and builds on the opportunities and constraints that investors face in order to find techniques that transcend existing sustainable investing approaches such as thematic, ESG and impact investing.

We remain, however, at the beginning of our work. We may have nurtured the seeds of a new practice but are still far from seeing its final form. Transformative investment now needs a transitional 'safe space' in which investors, academics and practitioners can experiment and accelerate learning. We propose a Deep Transitions Lab as the space for testing, refining and diffusing transformative investment. Working with public and private investors across the globe, as well as in partnership with policy-making actors through our sister project the Transformative Innovation Policy Consortium, we plan to begin implementing transformative investment through real-world applications.

We invite you, too, to join us in the Lab: small; focused; international and cross-cutting in reach, ambitious but achievable, disruptive but just. The ability to shape the future rests with us all.

Panel Co-chairs,
**Roberta Benedetti del Rio & Johan Schot**

# Acknowledgements

**This report would not have been possible without the insights and expertise of the Global Investors Panel. The members' willingness to embark on this journey with us and their continued commitment to the Panel's progress over the last one and a half years helped bring about a productive, enlightening exchange, as well as a fusion of academic and practical knowledge and awareness. Cutting-edge research requires its investigators to take leaps of faith, and we deeply appreciate our members' willingness to take this particular one with us. They dedicated a significant amount of time to understanding the Deep Transitions research framework and were willing to approach public and private investment from an angle they had never before applied to their work. The Panel comprised Nick Abel (California State Teacher's Retirement System, CalSTRS), Dominic Burke (Lankelly Chase Foundation), Yuni Choi (RS Group Asia), Audrey Desiderato (Mirova SunFunder), Kate Fox (Baillie Gifford), Drew von Glahn (Collaborative for Frontier Finance), Jonathan Hausman (Ontario Teachers' Pension Plan), Lisa Jordan (Draper Richards Kaplan Foundation), Atanas Kolev (European Investment Bank), Göran Marklund (VINNOVA), Katherine Ng (United Nations Principles for Responsible Investment), Christopher Palmberg (Business Finland), Roberta Benedetti del Rio (impact investor, and Senior Advisor to Just Climate, as well as co-chair of the Panel), Dimple Sahni (Anthos Fund & Asset Management BV), Sanjoy Sanyal (Regain Paradise, Adelphi, Caspian) and Daan du Toit (South African Department of Science and Innovation).**

We express our sincerest appreciation to James Anderson and Baillie Gifford. Without their generous financial contributions to the Deep Transitions research initiative, this project would not have flourished as it did. Their no-strings support allowed the team to combine fundamental academic work with practical application as they saw fit. It is unusual and inspiring to have supporters who made it possible for the research team to focus on the task rather than being distracted by the tasks typically required for fundraising efforts.

We also wish to thank the Utrecht University Centre for Global Challenges (UGlobe) and the University of Sussex Business School and its Science Policy Research Unit (SPRU) for providing financial support, a rigorous academic environment for transdisciplinary research, and generous and constructive academic exchange. Another important ally and inspiration for the context of our work has been the Deep Transitions sister project, the Transformative Innovation Policy Consortium (TIPC), with which we expect to find many more synergies and closer collaboration in the coming years.

The production of this report is deeply rooted in the work of the research team of the Deep Transitions project. In addition to the authors of this philosophy, the team comprised Laur Kanger, Bipashyee Ghosh, Caetano Penna, Jack Davies, Phil Johnstone, Carla Alvial Palavicino and Imogen Wade. We would also like to mention Frédérique Bone, Caitriona McLeish and Daniele Rotolo, who were researchers for the History Phase of the Deep Transitions project, which ran from 2018 to 2020.

We are hugely grateful to the communications team involved in this project, Jenny Witte and Geraldine Bloomfield. Their hard work, valuable insights and ability to challenge the research team in how to deliver our message to a non-academic audience were instrumental in bringing the insights of Deep Transitions to a broader audience.

The Panel's process was facilitated by Victoria Ward and Wendy Schultz, with the support of their fantastic colleagues James Stevens and Laura Humphrey at Jigsaw Foresight. Wendy and Victoria came on board in spring 2021 when COVID-19 was paralysing the world and forcing us to work remotely, which meant taking the Panel's activities online. Victoria's extensive knowledge of facilitation, ideas for shaping the digital Panel sessions, and ability to keep the energy up in online meetings were vital in making our Panel a success. Wendy's expertise in futures studies was instrumental in guiding the Panel and research team to develop the Three Future Worlds (see Annex 2), as was stress testing the process and developing a crowdsourcing campaign to validate them.

We are indebted to Joost Vervoort and the large group of futurists he mobilised. They helped us stress test the Deep Transitions Futures, providing many invaluable comments. They are: Roy Bendor, Alisha Bhagat, Jorge Camacho, Lydia Garrido, Idil Gaziulusoy, Aarti Gupta, Maarten Hajer, David Iwaniec, Per Koch, Aarathi Krishnan, Dan Lockton, Mauricio Mejía, Ian Miles, Jeroen Oomen, Jean Paul Pinto, Laura Pereira, Rafael Ramirez, Ozcan Saritas, Douglas K. R. Robinson, Alexander Rose, Scott Smith and Leah Zaidi.

Furthermore, we are thankful to our tireless support team, who provided a wide range of administrative support that was vital to making this project possible. Pip Bolton, for her care of the team and how she helped us keep focused. Nicky Wunderlich, for her organisational skills and sunny disposition. And Louisa King, for her diligent commitment to our work. We would also like to thank Stefan Gevaerts, who was our research assistant during this project, and Zara Karschay and Patrick Davies for copyediting and proofreading the Investment Philosophy in its final stages.

Finally, we would like to express our deep appreciation to Naz Costante, our graphic designer and illustrator, who made the Investment Philosophy come to life and has been a tremendous support and source of creativity along the way. Her steadfast patience helped us visualise our often-complex ideas into illustrations of our future world scenarios and a consistent visual language for our project. Her work was instrumental in improving the clarity of our output.

# Section One

# Introduction: A Stark and Urgent Choice

## Rising to the challenge: A Deep Transition

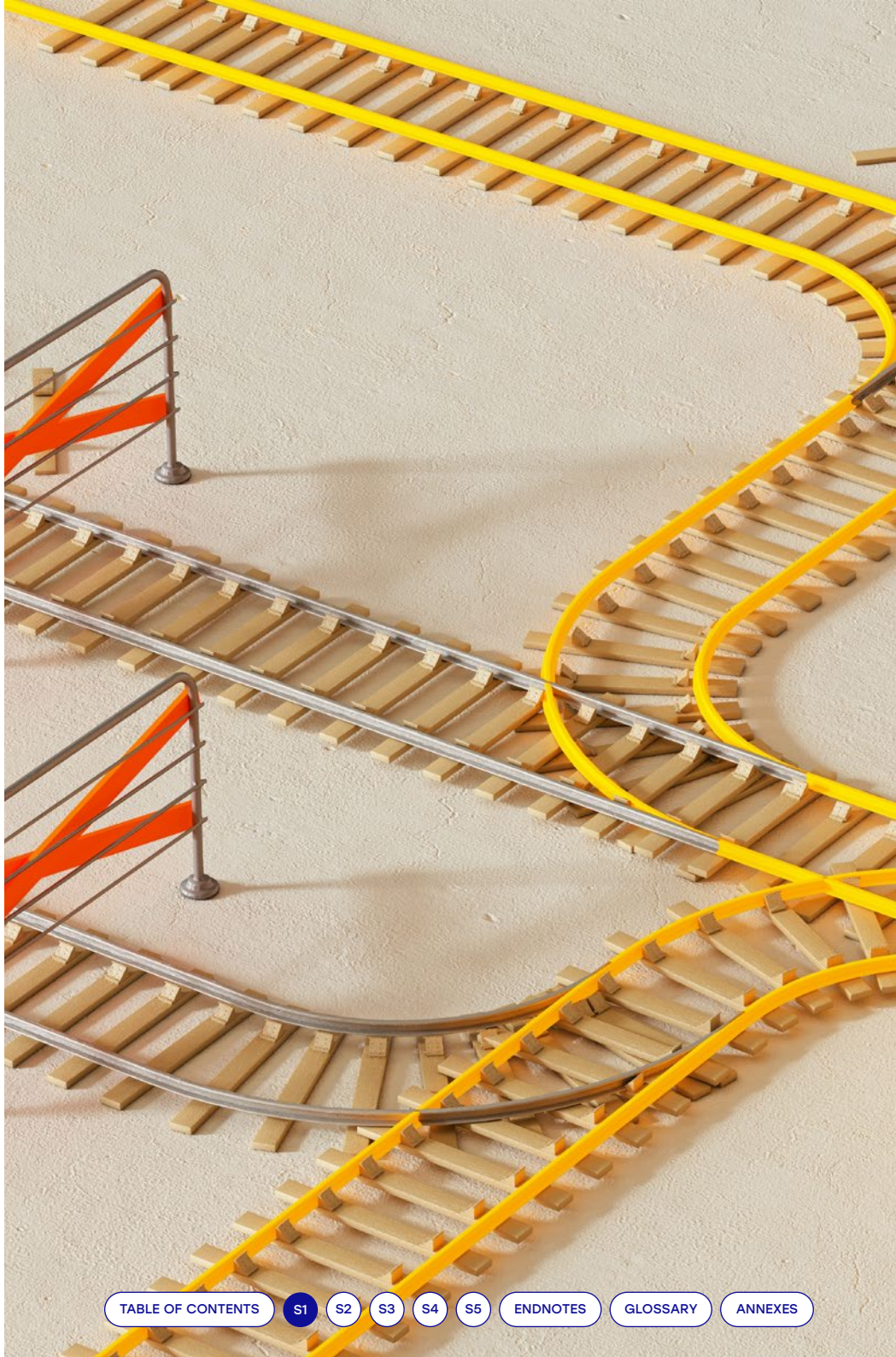
**Only a fifth of the way into the 21st century, humanity faces complex and interconnected environmental and social challenges. These challenges find their root cause in the Industrial Revolution, accompanied with rapid modernisation processes – this is the First Deep Transition – that have increased GDP growth in many parts of the world, thus reducing poverty and increasing global standards of living to an unprecedented level. Yet the fruits of this labour have not been distributed equitably. Categorisations such as race, nationality, gender and class play a substantial role in determining who benefits and who is excluded. Additionally, while this increase in global capital has built hospitals and schools and led to the largest democratisation of knowledge in human history, this success has been paid for in kind by humanity's exploitation of the natural world. The Earth's biocapacity limits are stretched,[2] environmental risks are profoundly aggravated,[3] and the potential for habitat resilience and adaptation continues to shrink.[4]**

As a result, humanity faces a stark and urgent choice: a breakdown or a breakthrough, as recently stated in the 2021 UN report of Secretary-General António Manuel de Oliveira Guterres, *Our Common Agenda*.[5] On our current trajectory, we are heading towards a breakdown, which in the human social sphere will result in displacement, violence, social tensions, political instabilities and inequality. Shocks, such as hurricanes, flash floods, heatwaves and droughts, are no longer a surprise. They are the beating rhythm of this new present and will continue to occur, leaving traumatic imprints on our social and organisational behaviours. The emotional cost of our current situation is real and scarring, and there is growing evidence of people suffering from climate anxiety and mourning the loss of their future.

However, the dawning realisation of our planetary crisis may also give rise to new aspirations that reinforce different values, such as stronger focuses on sufficiency, commonality, circularity, local trade and resilience. These values may bring about better social behaviours and norms, as well as planet-friendly ways of living. To achieve them, actors worldwide must rally for a breakthrough within this decade, and this breakthrough must constitute substantial system changes that traverse several industries, including energy, mobility, food, water, education and healthcare.

To meet this challenge, we must rise and address the environmental factors of climate change, ecological degradation, biodiversity loss and pollution, and the complex social issues of equality and equity on a local and global scale. Social inequalities and structural discrimination





have played a significant role in leading us along this path of environmental ruin, and the toxic spectre of colonialism threatens to return in a scramble to secure so-called 'green minerals'. Environmental and social justice must therefore go hand in hand.[6] Communities that rely on ecologically harmful practices, industries and economies must be included in efforts to transition away from these systems, and the peoples and states who are suffering the greatest impacts of the climate crisis – despite having done the least to cause it – must be placed front and centre in discussions of resilience, mitigation and acceptable risk.

The desired fundamental, systemic and lasting change must therefore be rooted in the principles of environmental sustainability and social justice. A Second Deep Transition is vital to achieving this goal.[7]

## Designing a new set of transformative investment principles for systems change

The need for system change was the premise for the work conducted in 2021 and 2022 by the Deep Transitions research team in collaboration with the Deep Transitions Global Investor Panel (the Panel).[8] Early in the process, it became apparent that investors must act collectively and in conjunction with scientists, policy makers and other actors to achieve their aims. The Panel and research team developed an Investment Philosophy, which provides a set of principles and a call to action for how investors, scientists and others can work and act together in order to avoid environmental breakdown and contribute to breakthroughs.

As the Panel worked on this Philosophy, the environment's rapid decline and fragility became even more acute, especially in light of the ongoing COVID-19 pandemic and the Russian invasion of Ukraine. The need to organise and intervene at the level of the system is relevant and urgent. The work of the Panel and others in solving this challenge is therefore critical. Through an extended dialogue between the Panel and research team, the Panel reached a key conclusion: promoting systems change requires transformative investment, a new type of investment practice committed to bringing about a fundamental change at a systems level. The rationale for, and main elements of, that transformative investment philosophy are crystallised in this document.

## Why the Deep Transitions framework is vital to transformative investment

The Deep Transitions framework, and its relevance to transformative investment and investors, are explored in more detail in Sections 2 and 3. Three aspects of the framework that the Panel found particularly compelling are the following:

1. **Perceiving contemporary problems from a long-term historical perspective:** This framework analyses the Industrial Revolution as the First Deep Transition. It shows convincingly that the climate and biodiversity crises and growing inequalities are integral to the socio-technical systems and the meta-rules that the First Deep Transition established. The only way to address today's global challenges is by changing these systems, replacing the old, unsustainable rules and practices of the First Deep Transition and thus enabling a Second Deep Transition.

2. **Reframing investment choices and their consequences:** Moving from systems optimisation to systems change can be achieved if systems change as an investment goal becomes the main focus. The need for system change is the primary purpose of Deep Transitions and can also become the primary purpose of transformative investing. While some optimisation cases may be a mere stepping stone towards change, Deep Transitions encourages a deliberate thinking framework to support investors (and others who effect change) and avoid lock-in decisions that shut down or delay pathways to desirable futures.

3. **Finding a common language:** Many international organisations and investors talk about systems change yet struggle to define, assess and theorise systems change, as no common understanding yet exists within the investment community for how multiple systems can change together. To remove this barrier, the Panel has been exploring and validating the Deep Transitions framework as a basis for creating a common language. With its vocabulary and novel insights, the framework can build a general theory of systems change for use in a private and public investment setting.

The time for investors to act collectively is now. Deep Transitions thinking offers a substantive, disciplined and actionable method of systems change that we believe has the potential to provide a necessary framework for transformative investment thinking and action. Section 2 of this Philosophy elaborates on some of the Deep Transitions framework's most salient points. Section 3 expands on the implications for investors informed by Deep Transitions, acting both individually and as a collective. Twelve principles that can act as a reference point for investment thinking and practice are laid out in Section 4. The concluding Section 5 presents the vehicle of a Deep Transitions Lab and an invitation to join a global community of practice that can collaborate and experiment for global learning and action.

# Section Two

# Deep Transitions as a Theory of Systems Change

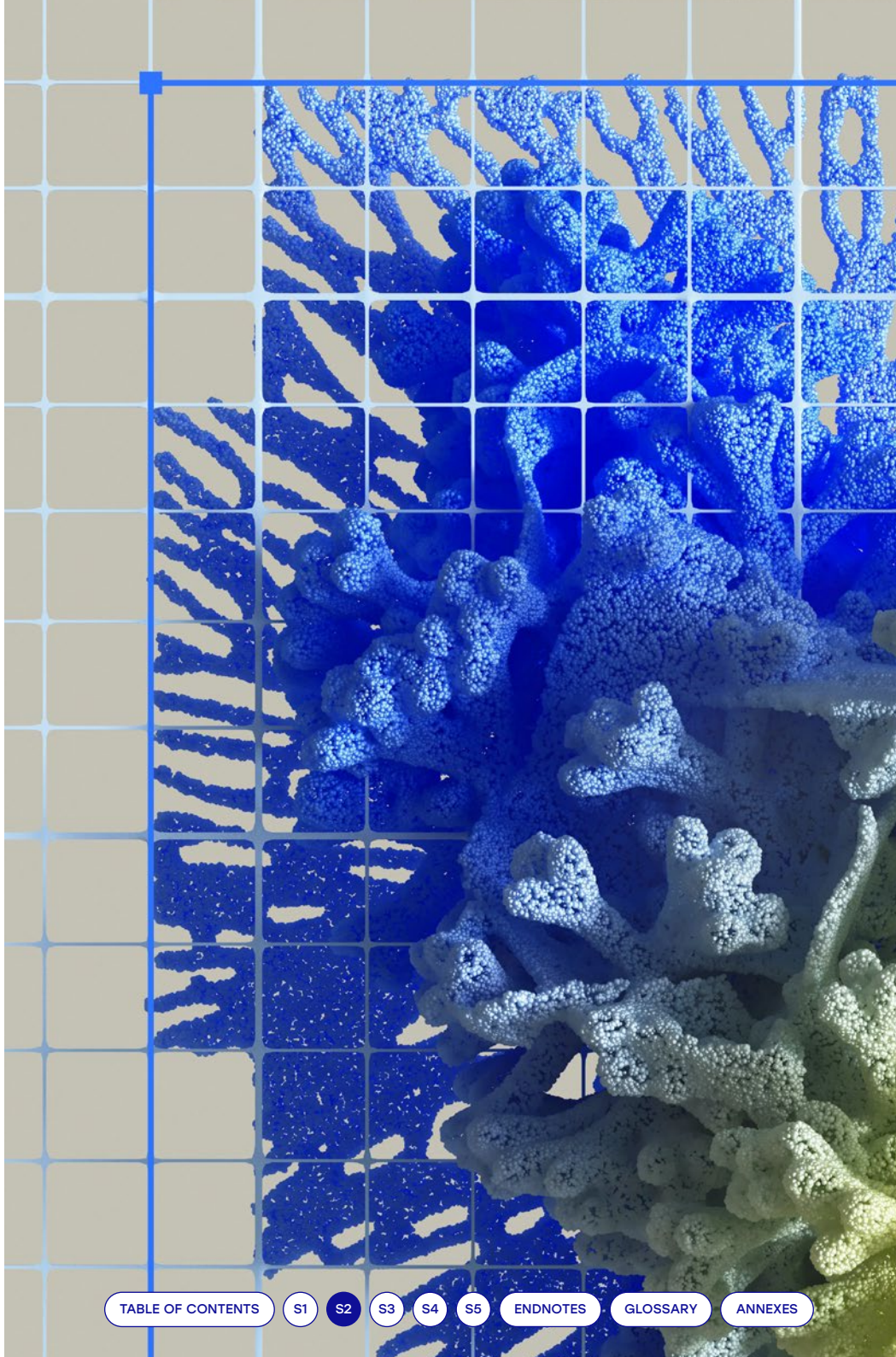
**To collaborate effectively, the Panel and research team needed to find common foundations of knowledge and understanding among the multiple theoretical foundations that are part of Deep Transitions theory.[9] The resulting framework is deeply rooted in 25 years of academic and practical work on sustainability transitions.[10] This section overviews the core elements of Deep Transitions theory, which constitute a rationale for transformative investment.**

## Deep Transitions as a structured theory of systems change

Deep Transitions sets a theoretical framework for understanding how systems change unfolds over time. The Deep Transitions framework is a theory of change that characterises how systems change occurs and illuminates the processes influencing its rate and direction. Such knowledge can aid actors who want to make a positive difference. By making decisions based on a transformative theory of change fully focused on systems change, actors can enhance the impact of the steps they take towards a sustainable future.

## The nature of systems change in Deep Transitions theory

Systems change is both fast and slow.[11] In the study of sustainability transitions, systems change is understood as an evolutionary process, constantly moving, acting slowly in principle but also subject to sudden accelerations. Systems change is characterised by myriad interacting variables that co-evolve across time and space. Importantly, a key consideration in Deep Transitions thinking is therefore that no actor is in a position to control the process, and no single or group of actor(s) can cause systems change in any deterministic way.[12] Actors, including investors, must therefore navigate systems change in this context of radical uncertainty. This navigation can be made more robust through a clear understanding of systems-change dynamics, increased collective action and coordination, and the explicit labelling of systems change as the desired outcome of investments.



## The notion of socio-technical systems in Deep Transitions

To analyse systems, Deep Transitions applies the concept of a socio-technical system.[13] When investors talk about systems change, this is the concept we propose they use. The value of this concept is that it highlights that systems change does not only refer to changes in technology but also to changes in politics, economics, society and culture. The concept also explains why systems are resilient to change. In this Investment Philosophy, systems change always implies socio-technical systems change.

A socio-technical system is configured by three interrelated components: (1) actors, (2) rules that guide actor behaviour and (3) elements that express rules (Figure 1 and Deep Dive box).[14] These components support each other: actors use rules to construct, curate and maintain the elements. These elements then keep the actors and rules in place because they generate sunk investments, specific interests, power relationships, cultures. Page 11 illustrates examples of the system components across the mobility, energy and food systems.

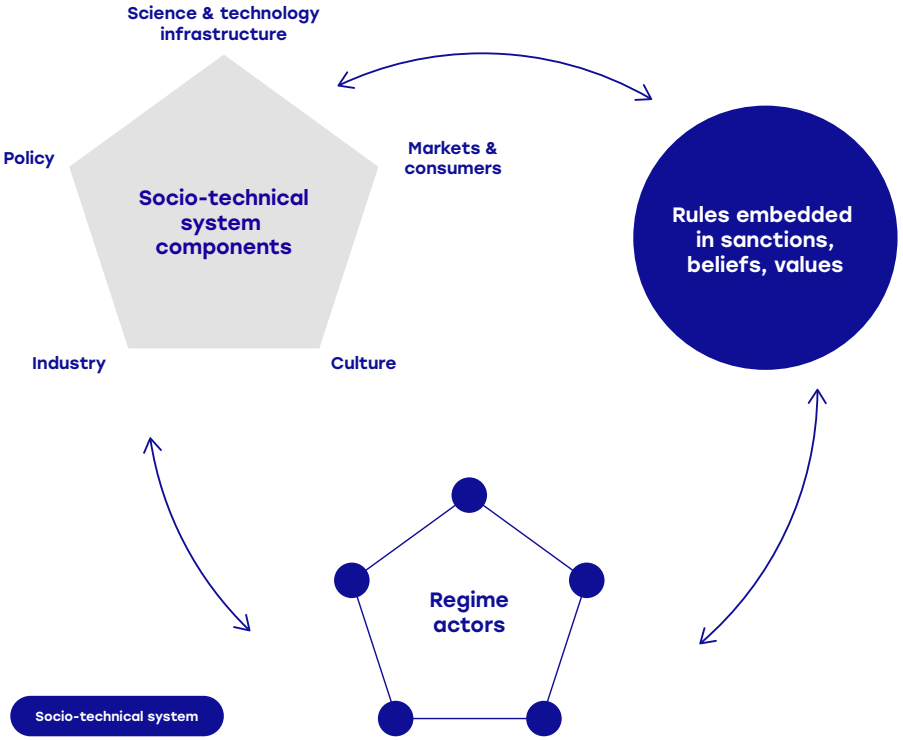



Figure 1: Configuration of the socio-technical system. Adapted from Grin, J., Rotmans, J., & Schot, J.W. (2011). *Transitions to Sustainable Development: New Directions in the Study of Long-term Transformative Change*. New York: Routledge

Deep Dive

### Components of a socio-technical system

**Elements** refer to a configuration of five aligned features within a system, visualised as a pentagon: (1) technology and infrastructures, (2) markets expressing specific consumer preferences, (3) industrial strategies and business models, (4) policies, and (5) broader cultural symbols and perceptions. Systems change is difficult because it is not enough to change one element independently; all other elements must also be changed.

**Actors** include regime actors, niche actors, intermediary actors and marginalised actors.[15] Regime actors are part of the dominant configuration of the system, while niche actors are those whose innovations and practices challenge the regime. Regime and niche actors can be found across the elements of technology, industry, policy, consumers/users and civil society, social movement and media. Intermediary actors bring niche and regime actors together, while marginalised actors are those who have no voice (yet) within the system. The latter group often comprises those who have to endure the negative consequences of the operation of a system and who must be brought into view and made part of the decision-making process if we wish systems change to be just and fair. Systems change requires a delicate balance between niche and regime actors, as well as involvement from intermediary and marginalised actors. It is important to consider power relations between these actors since they will shape the transition process and will be reconstituted.

**Rules** are used by actors to guide their behaviour, not only for instrumental reasons (because doing so makes it easier to be successful) but also because these rules are ultimately embedded in the values, beliefs and normative (and sometimes legal) sanctions that assist in internalizing beliefs and values and developing actors into active contributors to the system. Systems change demands a deeper change and shift of mindsets.[16] Rules can be understood as the 'genotype' of the system, expressed through the elements of the socio-technical system – the 'phenotype'. Sets of rules that are dominant within a single socio-technical system are known as a **regime**.[17]

When rules are well established across multiple systems, we define them as **meta-rules**.[18] Meta-rules strongly determine the structure and behaviour of multiple systems, influencing the standard practices and norms of behaviour in societies and economies. Historically, meta-rules emerge, and extend their reach to more systems, more actors, and more geographical spaces, through surges or waves. This augmentation through successive surges is important because if a first surge is limited in terms of its impact, a second surge can extend and deepen its impact. Given that a set of dominant rules within a single-system is a regime, a set of dominant meta-rules across multiple systems is described as a **meta-regime**.

Example

## Socio-technical systems in action: The mobility, energy and food systems

The image on the right provides an example of a system configuration for the mobility system, which is discussed on page 10. When viewing this report electronically, the buttons below can be used to also see examples for the energy- and food systems.

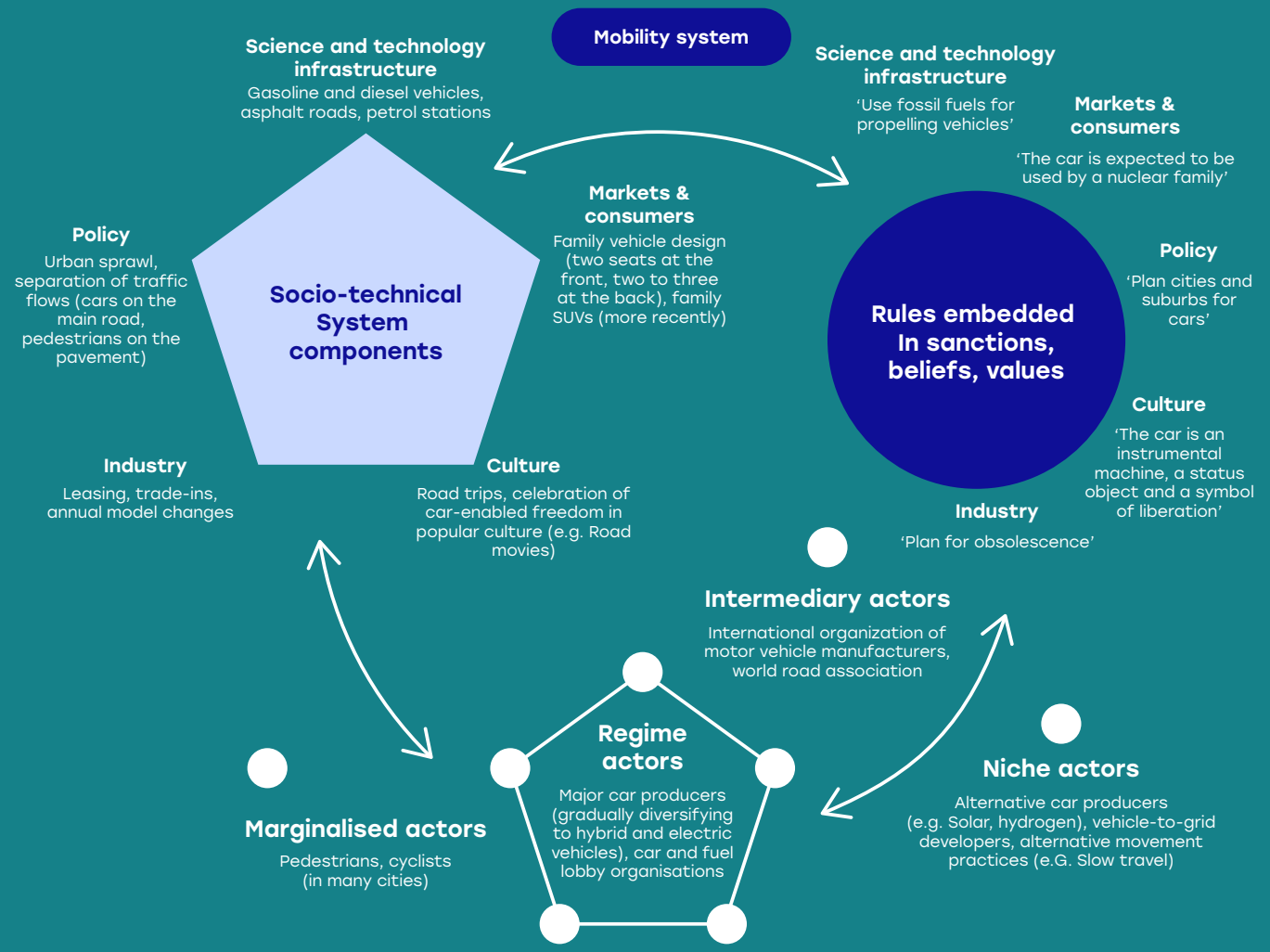



Figure 2: Components of the mobility system

View food system examples

View energy system examples

View mobility system examples

## Transformation requires changes to align across multiple socio-technical systems

The Deep Transitions theory of systems change necessitates changing the meta-rules that act across multiple socio-technical systems (Figure 1 and Table 1). For a Deep Transition to take root, single-system change alone is not enough. Systems are interlinked, and their dominant rules and practices mutually reinforce each other. Therefore, a Second Deep Transition requires change across multiple socio-technical systems moving in a similar sustainable direction. As the Second Deep Transition continues to emerge, so will a struggle to decide between various possible directionalities (pathways of development for the future of the socio-technical system). While these directionalities may compete for a time (one likely scenario is competition between the centralised and decentralised models of renewable energy production), eventually a turning point will be reached at which actors agree on a dominant directionality for the future system. As long as the multiple selected pathways do not contradict each other, this directionality may be hybrid, such as an energy system incorporating centralised and decentralised energy production.

This process of directionality is typically initiated in a small application area or niche by so-called niche actors – those who are not guided by dominant meta-rules but instead exploit unconventional opportunities and develop radical alternative practices and applications. Radical here means based on new rules or principles for a new socio-technical system, which would grow and become dominant over time. The rules themselves may not be stable or precisely defined at the start of the process. In fact, one of the aims of a niche construction process is to articulate, specify and standardise these rules better. If this happens, rules stabilise within the niche, and then niche applications will be ready to expand and scale. Eventually, niche applications may prevail over the current dominant system. To become successful, a transition needs some regime actors to open up for radical change: they must be prepared to reorient their strategies, redefine their primary purpose and invest substantially in niches. For example, the move to decarbonise the energy system needs the fossil fuel industry to become green energy producers. When regime actors do engage in these processes deeply and earnestly, rather than using them as window dressing or greenwashing, they become a de facto niche actor.

## Socio-technical systems are connected through linkages and couplings

In Deep Transitions thinking, systems change does not come about in one system at one place, diffusing from there to others. Such a simple notion of diffusion needs to be rejected, including the catching-up thinking embedded in it.[19] In other words, the Second Deep Transition will not develop solely in the Global North or South but will instead emerge concurrently in niches in many places across the world, with niche actors of all nationalities, cultures and ethnicities spearheading change. This continuing emergence of the Second Deep Transition will therefore need to be nurtured and made applicable to a wide range of contexts and settings. When this occurs, it leads to substantial global changes in individual systems that might have been initially isolated from each other. The Deep Transitions change process will accelerate when connections are made between relevant systems, actors and geographies. These connections are known as linkages or couplings.[20] Check the example box on the right to see examples of how couplings link together the energy, mobility and food systems. Couplings can be seen as pathways through which changes in one system can connect with changes in others.

Example

### Couplings in action: How rhetorical, structural and functional couplings bind together multiple systems

The emerging meta-rules associated with digitalisation and sustainability manifest themselves in a continuous stream of innovations, enabling new couplings between energy, mobility and food systems:

- Originating in the information and communications technology (ICT) industry, the language of servitisation (moving from selling products to delivering services) has become more popular in different systems. Discussions of energy, mobility and food 'as a service' can be seen as rhetorical couplings, creating a similar framing in debates about future directions for all three systems. The impact of this framing is perhaps the most disruptive in the mobility system, where the car is still predominantly seen as a product to be individually owned.
- The pervasive digital infrastructure serves as a structural coupling between systems. For example, information technologies are increasingly used to manage smart electrical grids in the energy system, coordinate autonomous vehicles in the mobility system, and employ precision agriculture in the food system.
- These developments, in turn, help consolidate specific functional couplings between the systems. For example, renewable energy can be used to power electric vehicles in the mobility system, and by extension, vehicle-to-grid solutions promise grid stabilisation for the energy system. Renewables can also be used as input to scale up agricultural activities such as solar irrigation or urban farming in the food system. Those by-products of agri-food activities can be used for bioenergy production in the energy system.

## Systems change can be catalysed by using a Transformative Theory of Change

In Deep Transitions, the dynamics that can produce systems change are referred to as leverage or intervention points.[21] Intervention points are the processes necessary for single- and multiple-system change that actors can catalyse, support, accelerate or otherwise impact. There are three categories of intervention points in Deep Transitions thinking: (1) intervention points focused on single-system change (including building and expanding niches and opening up regime actors for change, (2) intervention points focused on multiple-system change (creating, consolidating and breaking linkages between systems), and (3) a final intervention point that addresses broader repercussions of systems change, including on marginalised groups. For each intervention point, there are constituent subprocesses which

indicate that the broader intervention point is taking place. We call these subprocesses 'transformative outcomes'.[22] These outcomes refer to processes that can be designed and subsequently evaluated. Hence, they are dynamic, developing as a result of the interventions, and leading to a new transformative state of play. Intervention points are discussed in further detail in **Section 3**.

A Deep Transition consists of multiple-system changes in which niche and regime actors develop new niches to nurture alternative rules and meta-rules to those currently dominant. Actors can influence these transformations' directionality, speed and scope by targeting intervention points, which can be designed and assessed by looking at transformative outcomes. To support actors in this process, we use a theory-of-change model, a well-known practice in the investment world. Addressing intervention points and investing in sustainable and socially just futures require an explicit new theory of change that focuses on systems changes as informed by Deep Transitions thinking: a Transformative Theory of Change (TToC). The application box below provides more information on how this TToC may look.

Application

## Deep Transitions and a Transformative Theory of Change

A Transformative Theory of Change (TToC) consists of the following elements:[23]

**Inputs:** A system's components (actors, rules, system dimensions) that work in conjunction with mega-trends and shocks to shape the future of systems.

**Activities:** The actual interventions – for example, investment and actions taken by the project or company that requests funding.

**Outputs:** The tangible results of interventions, such as products, regulations, technologies, patents and publications.

**Transformative outcomes:** Are used to design interventions as well as measure their impact in terms of their intangible results (such as changes in beliefs and behaviour). They are indicators for when transition dynamics come into effect, and can help stretch the transformative potential of investments.

**Impact:** Establishing new systems that have new social and ecological consequences and therefore address identified problems such as climate breakdown, biodiversity loss and growing inequalities.

A TToC could help to construct pathways towards desirable future worlds such as the three outlined in **Annex 2**. A TToC should not be seen as a linear tool or one set in stone. Instead, it should be considered a dynamic theory with non-linear causations and feedback loops that can be used (1) to assess if investments will lead to transformative outcomes and impact in terms of system changes that address social and ecological challenges and (2) to monitor these outcomes and impacts in a way that can guide an engagement process with stakeholders.

Section 3, **Implication 2** provides more depth on how to use a TToC in an investment setting.

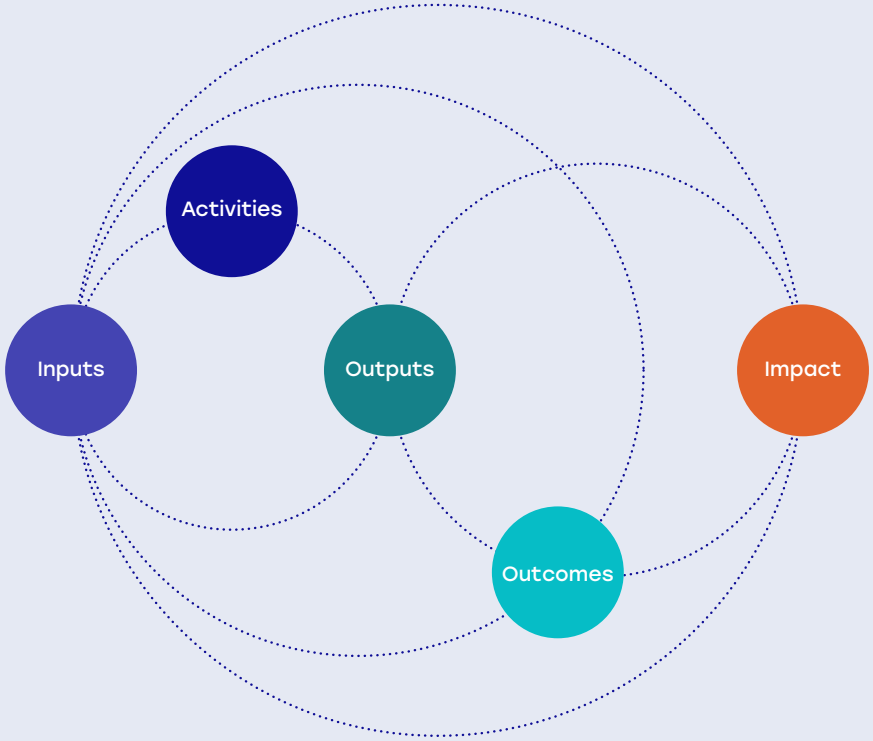



Figure 3: The Deep Transitions Transformative Theory of Change

## A brief history of the First and Second Deep Transition

Each TToC is located in a larger historical picture, as system change unfolds and accumulates directionality over a long period of time. To explore this, we can zoom out and look at the defining context of the First Deep Transition, which shaped our present-day society. The First Deep Transition started over 250 years ago with the Industrial Revolution and unfolded against the backdrop of pre-modern economies and societies. Over time, and after five successive surges of development (Figure 4), the First Deep Transition led to the installation of a specific set of socio-technical systems for the provision of energy, mobility, food, water, communication, education and more.[24] These systems have been diffused on a global scale and continue to dominate contemporary societies. While these systems may function differently at a local level, they all share similar meta-rules (Table 1).

Across the globe, there are also spaces where these First Deep Transition systems are not fully implemented, and alternative practices dominate. These practices are often framed as outdated and needing replacement (for example, rickshaws are a common means of transportation in South-East Asia). In Deep Transitions thinking, however, such practices may be considered niches that have the potential to contribute to the Second Deep Transition (rickshaws can be electrified and be developed further as an affordable option for the poor).

Over the last decade, it has become ever more apparent that the main development challenge is not to modernise old systems and practices according to the principles of the First Deep Transition systems but to change the systems themselves. These systems are, after all, the root cause of many social and environmental problems worldwide. The only way to address global challenges is by transforming these systems, thereby accelerating the Second Deep Transition.

The Second Deep Transition is already underway. Its first surge of development occurred in the 1970s and was led by a host of renewable niches – in particular, solar and wind energy. While the niches driving this surge have been growing in strength, the coming of a Second Deep Transition remains an undercurrent of contemporary development activity. The International Energy Agency (IEA) concludes that investments in renewables need to at least double from now if they are to reach the necessary climate goals set by the IEA.[25] At the same time, non-renewable consumption from the First Deep Transition continues to grow, as is visible in the continued investment in the oil and gas industries.[26] These trends follow a pattern set in the First Deep Transition, where the introduction and application of coal and steam technologies during the first and second surges did not initially affect the bulk of the economy in the Global North.

Investors have a choice: to either influence the arrival of the Second Deep Transition towards more sustainable futures or to delay its advent by investing in optimising the First Deep Transition systems currently in place, magnifying its adverse effects in the process.

The example box on the next page offers a deeper dive into the first surge of the Second Deep Transition.

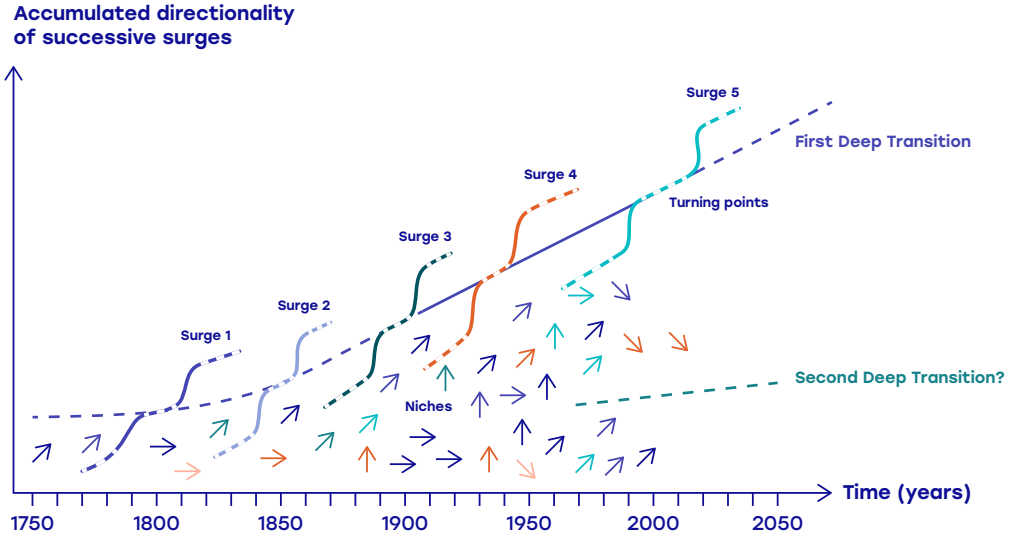



Figure 4: Successive surges of development of the First Deep Transition, and possible emergence of Second Deep Transition

| First Deep Transition | Second Deep Transition |
|---|---|
| Use and exploit fossil fuels | Decarbonise |
| Standardise, mechanise, mass produce | Customise and personalise |
| Design for obsolescence | Design for durability, recycle, reuse, repair |
| Mass consumerism, product ownership | Servitisation of products, design for a sharing economy |
| Globalise, centralise, build global value chains | Localise, decentralise, build direct relationships between producers and consumers |

Table 1: Examples of meta-rules of the First Deep Transition and possible meta-rules of the Second Deep Transition

Example

## The first surge of the Second Deep Transition: Renewable energy developments

Since its inception in the 1970s, the Second Deep Transition has undergone a long gestation period. Only in the past decade have renewable niches such as solar and wind accelerated beyond the expectations of many governments and key energy experts.[27] In 2021, renewables reached a tipping point, with solar and wind production doubling since the 2015 Paris Agreement to provide 10% of global electricity.[28] Accounting for hydropower and biomass, the share of renewables in the global electricity supply has increased to 29%. Additionally, the costs associated with renewables have plummeted in the past decade, with solar costs reduced by 90% and onshore wind by 70% between 2009 and 2021, leading the International Energy Agency (IEA) to declare solar the cheapest source of power in history.[29] Comparisons with other technologies are stark: offshore wind, which only a decade ago was considerably more expensive than conventional power sources, is now nine times cheaper than gas in the UK, while new renewables have become so cheap that they undercut the cost of existing coal-fired power plants in many parts of the world.[30] Recent investment patterns also reveal a shift in favour of renewables, accounting for 70% of new energy investment in 2021, at a total of $366 billion.[31]

Around the world, grids are operating more flexibly so that they might match increasingly diversified sources of supply and demand. This can be achieved by integrating new control systems and various storage technologies, the cost of which is also rapidly decreasing. Managing a 100% renewable-powered grid is becoming a reality for grid operators, and the increasing penetration of renewables in grids now contributes to transport decarbonisation, thus deepening the Second Deep Transition. Electric-car sales have tripled in two years, constituting 9.8% of global sales, while sales of heat pumps also seem to have turned a corner with a double-digit growth in sales and falling costs in many countries.[32] The renewables surge is set to continue. For example, the IEA net-zero scenario envisages that, by 2050, 90% of global electricity generation will come from renewables, with solar and wind constituting 70% of generated power.[33]

## Transformative investment: Investing in transition dynamics

Between April 2021 and June 2022, the Panel and research team explored and validated the Deep Transitions Transformative Theory of Change model as the methodological basis for action on systems change through investment practice. It provides a theoretical foundation and common language for introducing and sharing the results of a structured, supported shift in investment practices and processes. This shift is operationalised as transformative investment.

To conceptualise and implement transformative investment, the Panel and research team focused on defining a set of **transformative investment principles**. These build on and transcend thematic, ESG (environmental, social and corporate governance) and impact investing while engaging with the opportunities and constraints that investors face. In the public sphere, similar principles have been introduced under the banner of transformative innovation policy by the Transformative Innovation Policy Consortium, some of whose members have contributed to the Panel's work.[34]

The transformative investment principles introduced below reflect that, from a Deep Transitions perspective, private investors, as well as policy innovation agents, are a group of actors who can significantly influence sustainability transitions. They could therefore act as regime actors, who help to optimise and keep the current systems in place, or they could become niche actors who, through transformative investment, organise alternative practices and applications for financial and investment decisions in a way that leads to profound systems change.

The influence of these individual actors can be enhanced through a clear understanding of systems-change dynamics. The explicit targeting of systems change should be the desired outcome of investments. The effect can be even more remarkable when actors collaborate to apply a theory of change and accelerate learning. The Panel regards Deep Transitions theory as the underlying rationale and common ground, and transformative investment as the strategy to invest in multiple-system change.

Three major implications of adopting the Deep Transitions Transformative Theory of Change model in an investment setting are introduced in the next section.

## Section Three

# The Implications of Being a Transformative Investor

**For many investors, even those well-versed in ESG and impact investing, a shift in mindset is necessary to break free from existing investment processes and consider the bigger picture of transformative investment.**

The Panel and research team identified three significant implications of a new mindset required to amplify the transformative impact and influence of investors. This section addresses three implications transformative investment has for investors, summarised in Figure 5. This leads to the 12 transformative investment principles that underpin transformative investment, which are further detailed in Section 4.

## Implication 1: Shift the perspective to the transformative potential of investments

**At present, evaluations of impact investments beyond financial risk and return are typically focused on assessing the potential of a particular company, technology, project or initiative in achieving social and ecological goals such as reducing $CO_2$, air pollution or poverty, or generating jobs. Although these goals are crucial, placing them front and centre can end up obscuring the visibility of milestone system changes needed to achieve these goals. Therefore, the first necessity for investors engaging with Deep Transitions thinking is to focus on whether an investment and its indirect consequences contribute to systems changes that address social and ecological goals at a fundamental rather than cosmetic level.**

### The critical difference between system optimisation and system change

In the short term, system optimisation, such as efficiency improvements, may generate positive social and/or ecological effects. In the long term, however, system optimisation preserves the underlying dominant configuration of the system. It does not disrupt or replace the dominant practices and can thus only bring about incremental change. Optimisation is thus not enough to catalyse the breakthrough needed to adequately address global challenges (see Section 1 and Figure 6). Furthermore, optimisation may entrench the existing dominant and unsustainable regime by making it more efficient, hindering the future development of niches for system change. As a result, system optimisations can even delay systems transformation.

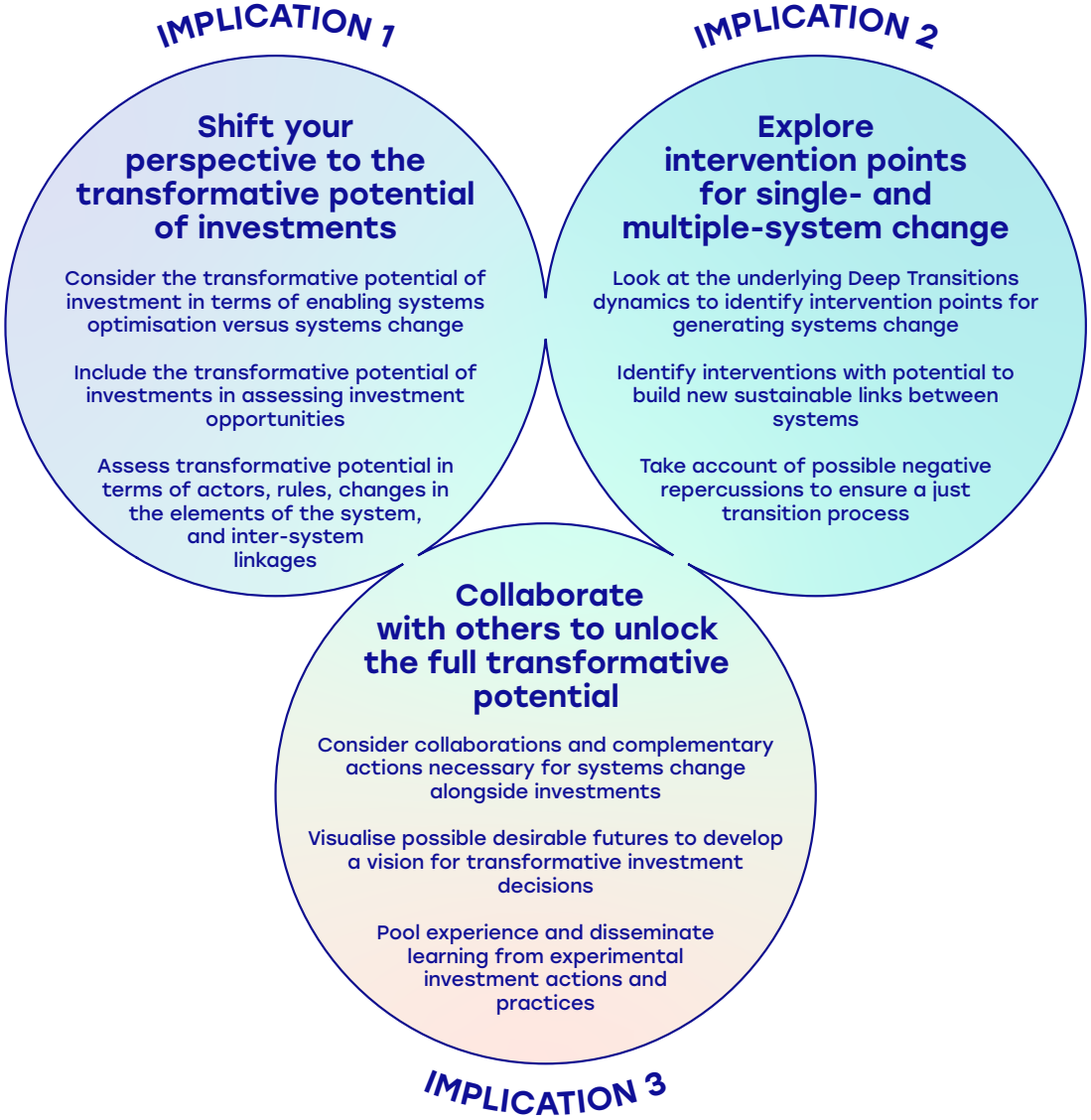



Figure 5: Summary of three implications

System change, unlike system optimisation, enables a fundamental reconfiguration of the system, including the development of new rules and meta-rules. This emphasis on rule development can provide a stable foundation for new sustainable and desirable systems to challenge the unsustainable practices of currently unsustainable regimes. In addition, systems change has a better chance of avoiding oppositional second-order effects that are often associated with systems optimisation, such as rebound effects and leakage effects.[35] Instead, when systems change happens, sustainable behaviour becomes the norm and is embedded in people's values and beliefs. This behavioural improvement and its subsequent permanence prevent gains in one part of the system from being dissipated elsewhere.

In the space between system optimisation and system change sits partial system redesign, in which a niche may disrupt and change some system elements while leaving others untouched. Partial system redesign may occur as a stepping stone towards systems change.

The difference between system optimisation, partial system redesign and system change must be regarded as stretching the investment process. Investors need to focus on unlocking the transformative potential of their interventions. Transformative investment is thus about achieving impact by changing the systems and their underlying rules. The example box opposite illustrates the difference between system optimisation, system change and partial system redesign.

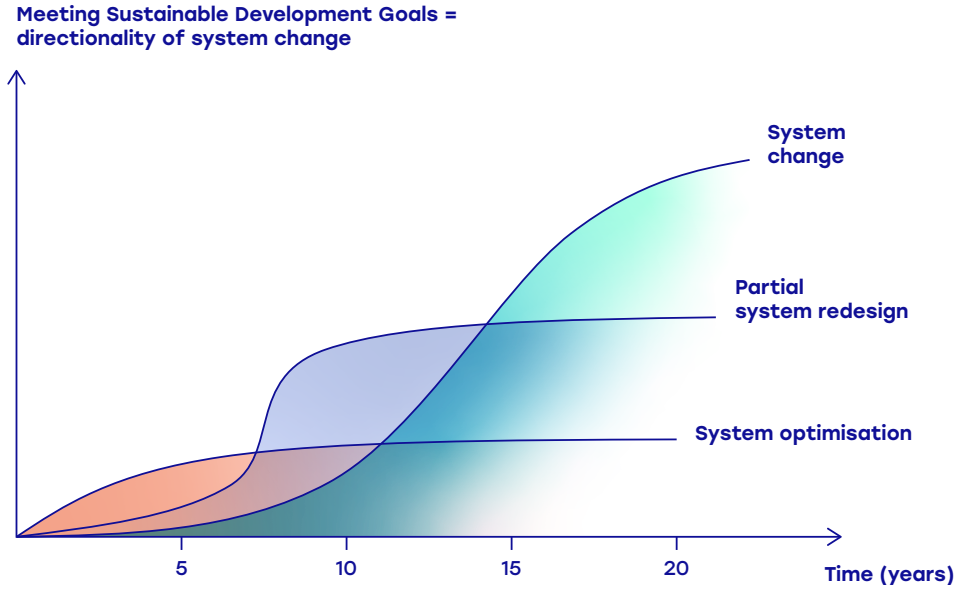



Figure 6: Comparing system optimisation, partial system redesign and system change in terms of their impact and the time needed to generate such impact. Adapted from Geels, F.W., Elzen, B., & Green, K. (2004). General introduction: System innovation and transition to sustainability. In Elzen, B., Geels, F.W., & Green, K. (eds.), *Systems Innovation and the Transition to Sustainability: Theory, Evidence and Policy*. Cheltenham: Edward Elgar, pp. 1–16.[36]

Example

## System optimisation, partial system redesign and system change in action: The example of the mobility system

The mobility system exemplifies how innovation and investment can become more transformative. Responding to heightened concerns about air pollution in the 1970s, car producers started developing cleaner solutions like Honda's Compound Vortex Controlled Combustion (CVCC) and the two-way catalytic converters developed by American manufacturers. In the decades that followed, innovation notably reduced the emissions of newer car models, including the introduction of CVCC-II and three-way catalytic converters. Nevertheless, these innovations mainly aimed to improve the existing system's efficiency, optimising the system rather than challenging its underlying rules. As the mobility system continued to rely on fossil fuels, private ownership and individually driven cars, the system continued to contribute to congestion, pollution and resource depletion.

The introduction of electric vehicles (EVs) has recently transformed some elements of the mobility system: the underlying technology (electric propulsion, batteries), the actors (with new actors emerging, such as Tesla), changes to industry structure (new resources, manufacturing capabilities, supply chains) and the infrastructure (charging). However, individual ownership still dominates, along with the personal (and therefore partial) use of assets and the reliance on an extractive economy (such as rare materials used in batteries). EVs can therefore be seen as an example of partial system redesign, which currently falls short of systems change but may nevertheless become a step in the right direction.

A more transformative approach would be to couple EVs with complementary innovations such as autonomous driving; connected fleet services; mobility-as-a-service business models that encourage giving up private car ownership; pod-based vehicles that can be flexibly disconnected from and reconnected to each other as required; designing for durability to maximise the life of the vehicle fleet; and designing for circularity to improve an EV's lifecycle from materials extraction to the end of its operations. This act of coupling could lead to the emergence of a new hybrid mobility system that combines elements from public and private transportation.

Application

## How investors can incorporate transformative potential into their decision making

When investors want to assess whether systems change is occurring, they can start by analysing four key processes that affect socio-technical systems change. These processes allow an investor to assess not only whether any given investment or portfolio of investments has transformative potential in terms of enabling systems change but also which dimensions have not yet changed and should be targeted by the investor to enhance the transformative potential of their investments.

### Configuration of actors within the system

Is the composition of actors, and the power dynamics between them, changing? Have new (niche) actors entered and acquired space in the system? Are actors from different systems collaborating?

For example, the current renewables revolution has brought in many user collectives and companies generating their own power, and a new industry for solar panels and wind turbines has been established.

### Rules embedded within the system

Are actors consciously or unconsciously applying different rules to guide their behaviour? Can new meta-rules be found across systems?

For example, decentralised electricity production has changed values and beliefs about how to produce and use electricity, with decentralisation offering a shift towards values of independence and self-sufficiency.

### Elements of the system

Are multiple system elements, including policy, technology, consumer behaviour, culture and industry (Figure 1) changing? Are connections visible between systems – for example, the emergence of policies that affect several systems?

For example, the EU 'Fit for 55' package of regulations attempts to shift the energy-system trajectory by setting a binding target of reducing greenhouse-gas emissions by 55% by 2030.[37] This radical policy change is coupled with a shift in industrial strategies towards power purchase agreements (PPAs). Developing PPAs with renewable energy providers helps decarbonise operations directly. This shift represents a change in both policy and industrial strategy.

### Inter-system linkages that bind multiple systems together

Are links between systems being created, strengthened, weakened or broken by changes in individual systems?

For example, the current food system is deeply connected to the chemicals system due to the former's extensive global use of fertilisers, pesticides and other products in industrial agriculture. A system change towards regenerative agriculture could remove the demand for artificial chemical inputs in the global food system, thus breaking the powerful link between these two systems.

# Implication 2: Identify intervention points in single and multiple systems to stretch the transformative potential of investments

Having established the difference between system optimisation, partial system redesign and system change, the next implication for investment practice is to consider the dynamics that can produce single- and multiple-system change and assess whether they have been implemented. As introduced in Section 2, these dynamics are considered leverage or intervention points when discussed in the context of Deep Transitions. They represent the different processes necessary to enable single- and multiple-system change, and that can be catalysed, supported, accelerated, or otherwise impacted by actors.

Deep Transitions thinking identifies three categories of intervention points:

1. **Three intervention points focused on single-system change:** In Deep Transitions thinking (see Section 2), there are three dominant elements required to change a single system: a) the niche, which develops and grows new alternatives to existing practices, b) the dominant regime, which is largely stable, resistant to change and needs to be opened up and unlocked to bring in new alternatives, and c) the landscape, which shapes the conditions of the niche and the regime and creates opportunities as well as challenges.

2. **Three intervention points focused on multiple-system change:** A Deep Transition requires actors to move beyond pursuing single system change (for instance, by developing individual niches). Instead, they must look at how to achieve multiple systems change by transferring, diffusing and linking change across multiple systems, including through the development of niche clusters.

3. **One intervention point to address the broader repercussions of systems change from the perspective of a just transition:** Any transition process generates conflict because it will generate broader social and ecological repercussions with winners and losers. These repercussions can include backlash from regime actors seeking to preserve the dominant system configuration, as well as from other actors and individuals who are simply resistant to change. Therefore, investors also need to consider addressing potentially uneven outcomes of transitions and their negative repercussions to ensure a just transition process, giving the people who have to confront these impacts a voice.[38] Therefore, the final, vital intervention point addresses the repercussions of creating, consolidating and breaking links. This step means acknowledging the various injustices and their unintended consequences resulting from single systems change and multiple systems change.

## Transformative outcomes help us assess whether an intervention point is occurring

For each of these intervention points we can identify transformative outcomes.[39] Transformative outcomes can be considered constituent subprocesses that help assess whether the broader intervention point will occur. These outcomes are required to elicit a larger process that can, in the long run, change the rules and meta-rules embedded in the system. As such, these outcomes develop as a result of the intervention points and are indicators for when transition dynamics come into effect, eventually leading to a new, transformative state of play.

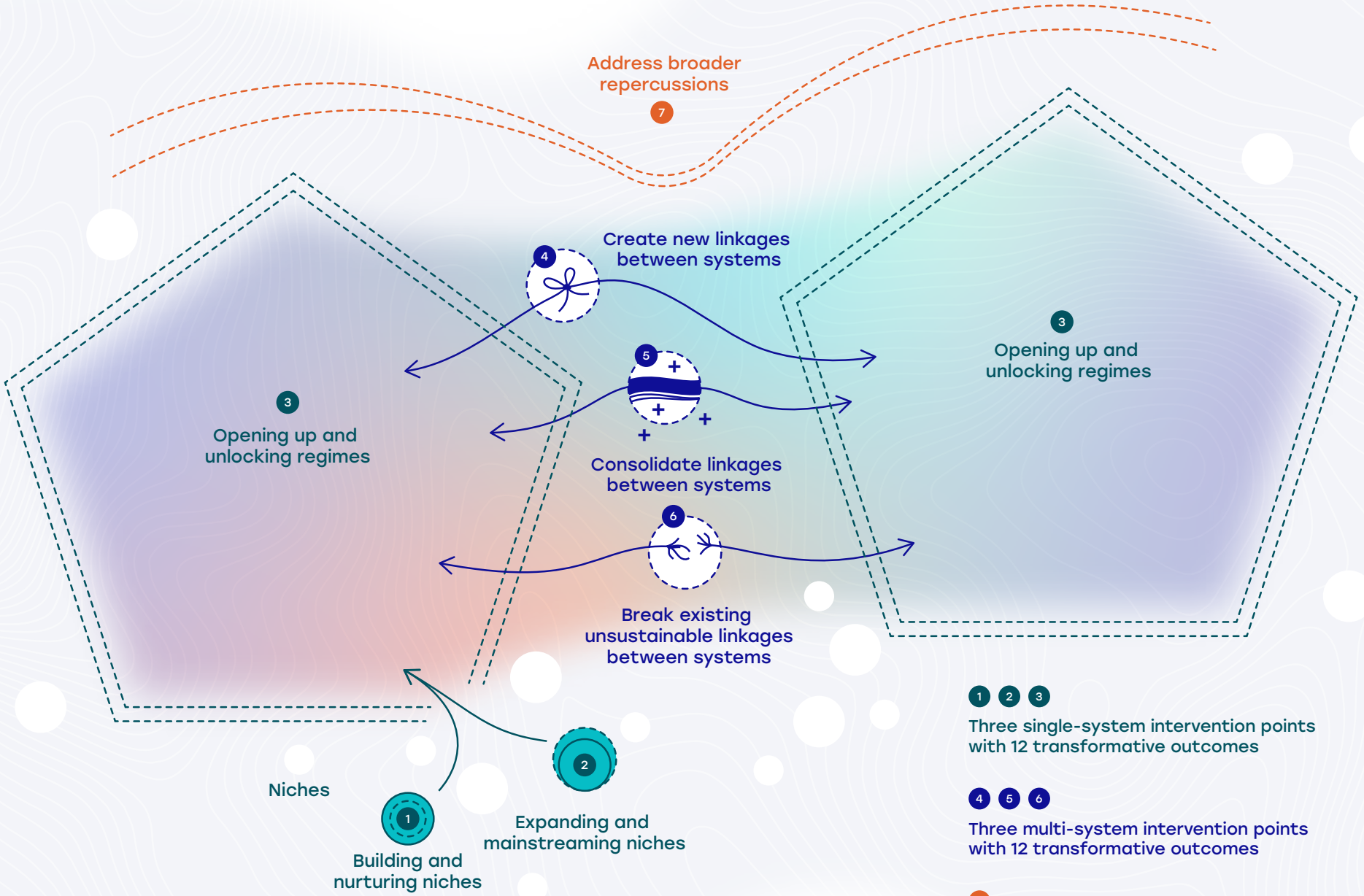
## How to use intervention points and transformative outcomes in investment

For investors, intervention points and transformative outcomes can measure the impact of investments and stretch their transformative potential in the way those points and outcomes contribute to single- and multiple-system change. Transformative outcomes can form the backbone of a new set of transformation metrics. Robust and valid tools and metrics that can assess contributions to systems change are central to the success of transformative investment. The development of actionable and auditable tools and metrics grounded in Deep Transitions theory will be a central task for the Deep Transitions Lab (see Section 5). The application box on pages 20 and 21 explores how seven intervention points and their twenty eight associated transformative outcomes might be defined.

## Using Deep Transitions to transform investment: A compass or a steering wheel?

It is important to reiterate that systems change is never the deterministic outcome of a single intervention, such as an investment. The real world can be unpredictable, and a large number of exogenous factors and interrelated dynamics can influence the pace and direction of systems change at any time. Therefore, while tools and metrics can indicate progress more generally, they cannot precisely quantify how transformative outcomes will take shape. As such, Deep Transitions should be used as a guiding compass rather than a steering wheel.

Application




1 2 3

Three single-system intervention points with 12 transformative outcomes

4 5 6

Three multi-system intervention points with 12 transformative outcomes

7

One intervention point to address the broader repercussions of systems change

## Intervention points and transformative outcomes for single-system change

A Deep Transition starts within one or more single systems. The Deep Transitions framework currently defines the following three intervention points, with 12 transformative outcomes, that are focused on single-system change:

1. **Build and nurture niches:** Niches provide spaces for building alternative practices, and it is from these practices that new rules and systems can emerge. Niche construction needs four transformative outcomes: (1.1) **shielding**, offering the niche protection against harsh market competition with patient, long-term finance, and putting in place other benefits; (1.2) **learning**, challenging rules dominant for all five system components (see Figure 1 on page 10), from technology, policy, user needs, business strategy and models through to cultural perceptions; (1.3) **networking** among niche, intermediary and marginalised actors, mobilising needed resources; and (1.4) **navigating expectations**, opening up for a range of visions and building a shared vision.

2. **Expand and mainstream niches:** For transitions to happen, niches must expand, become more mainstream and offer viable alternatives, and challenge dominant systems. The four transformative outcomes associated with this intervention point are: (2.1) **upscaling** adoption of new rules by users; (2.2) **replication** of niches in different contexts; (2.3) **circulation** of niche learnings, clustering and coordination of niches, and the emergence of intermediary actors; and (2.4) **institutionalisation** by developing, sharing and consolidating new rules, standards, values and beliefs that support niche development.

3. **Unlock and open up regimes:** Regime actors who believe in and value the prevailing dominant (unsustainable) rules and practices begin questioning their own behaviour and strategy. They begin to embrace the need to change the system and put substantial resources into niche development. Since many types of regime actors exist – including policy makers, politicians, consumers, business leaders, the labour force and non-governmental organisations – this intervention point can start with a selection of regime actors but eventually should destabilise the practices of the entire dominant regime. This intervention point has four transformative outcomes: (3.1) **destabilisation** of one or more of the system components, such as, in particular, putting in place a disruptive regulation; (3.2) **unlearning and deep learning** among regime actors, who begin to challenge their own assumptions; (3.3) **strengthening niche-regime interactions** to empower niches, providing more resources; and (3.4) **developing new interpretations** of landscape trends and shocks which are no longer congruent with their own rules, values and beliefs.

Figure on the previous page displays the transformative outcomes needed to achieve these intervention points.

## Intervention points and transformative outcomes for multiple-system change

A Deep Transition requires actors to move beyond pursuing single-system change and instead look to achieve change across multiple systems. The Deep Transitions framework currently defines the following three intervention points, with 12 transformative outcomes, that are focused on multiple-system change:

4. **Create links between systems** that previously did not exist: (4.1) actors begin to **align expectations for new functional connections** between systems; (4.2) systems become structurally linked by **new material flows** (in a value chain); and (4.3) **actors collaborate across systems** to support systems change; (4.4) **new meta-rules** emerge, cementing links among systems.

5. **Consolidate existing links between systems** by strengthening and boosting new, multi-system connections through: (5.1) **circulation of knowledge** and ideas across systems; (5.2) **scaling material flows** and resources across systems; (5.3) emergence of **new intermediary actors** and complementary actions, supporting the implementation of new business models; and (5.4) the standardisation of connections, making linkages stronger and more permanent.

6. **Breaking existing links between systems** by decoupling connections that have locked multiple systems into a mutual, unsustainable trajectory of development. This is done through: (6.1) **delegitimising existing links**; (6.2) **disrupting material flows**, (6.3) **replacing existing coalitions and networks**; and (6.4) questioning rules and meta-rules that support the need for specific links, eventually abandoning them and making space for new connections.

## Addressing the broader repercussions of systems change to ensure a just transition

Any transition process generates conflict because it will generate broader social and ecological repercussions with different winners and losers. Therefore, investors need to consider how they might address potentially uneven outcomes and negative repercussions of transitions to ensure a just transition process. This is the seventh intervention point, presently associated with four transformative outcomes:

7. Anticipating and mitigating various unjustices has four transformative outcomes: (7.1) **marginalised groups** are included in the process and their voices are recognised; (7.2) **rebound effects** in material flows among connected systems are identified and mitigated; (7.3) the process of creating, consolidating and breaking links is **inclusive**, considering the perspectives and needs of all relevant actors; and (7.4) various injustices are anticipated and mitigated by putting in place **compensation mechanisms**.

The example on page 22 illustrates how transition dynamics unfold in practice, highlighting where various intervention points and transformative outcomes can be found in the renewable energy transition.

Example

## Intervention points and transformative outcomes in action: Renewable energy in Europe

Renewable energy development in Europe shows transition dynamics and intervention points in action. Since the 1970s, renewable niches have been particularly well-nurtured in Denmark and Germany due to the activism of environmental movements in the civil societies of these two countries.[40] In the context of this social pressure, the governments of these countries introduced policies to assist in nurturing and protecting renewable niches, which included subsidising manufacturers of wind turbines and solar cells.[41]

Following the groundwork laid in the 1970s, the acceleration and scaling of renewable niches occurred 30 years later in the 2000s, with the introduction of feed-in tariffs that guaranteed the price for solar and wind power transmitted to the grid. The tariffs increased investment into and deployment of these technologies[42] and led to rapid learning and cost reductions. These policy interventions and trends were replicated in many other European countries.

The 2010s showed clear signs that the incumbent fossil-fuel–based energy regime was destabilising. Major utilities that traditionally focussed on coal, gas and nuclear energy were seeing profits falling due to the first wave of electricity system disruption. In contrast, new business models, including energy cooperatives, community energy and prosumerism (consumers becoming producers) began to challenge the status quo.[43] This led many incumbent providers to adapt and either invest more in renewables or develop new business models that focused on providing consumers with renewable rather than conventional energy services.

The next wave of energy system disruption requires that different systems are coupled, including energy and mobility. Recent reductions in the cost of electric vehicles and the piloting of two-way vehicle-to-grid technologies point to promising developments. The EU's strategy on energy system integration aims to accelerate linkages across multiple systems, creating new flexibility markets, and enable system integration through digitalisation.[44] The speed at which these vital coupling processes occurs are in part dependent on strategic investment decisions as well as new regulatory frameworks and business models. Another consideration with regard to intervention points is the economic consequence of declining use of fossil fuels in Europe, particularly in countries like Germany and Poland. The UK's experience with coal shows that workers dependent on coal mining were left with limited opportunities once the mines were closed. To mitigate social trauma, consideration must therefore be given to the regions and people – many of whom already belong to the poorest communities – who may be left behind in a transition from fossil fuels.[45] The EU seeks to manage the technological decline of fossil fuels through the Just Transition Mechanism, which can support regions and countries that face the most challenges in phasing out fossil fuels.[46]

# Implication 3: Collaborate to transform

Neither an individual nor a small group of investors can shape all intervention points, achieve all transformative outcomes, and unilaterally create systems change. The task at hand is not to plan a transition, since that would be impossible, but (1) to assess how to contribute to ongoing system-change processes that span many disparate aspects of socio-technical systems and (2) support those processes through coordinating with different types of actors at an international level, who are working concurrently across multiple sectors and systems. To achieve transformative change, investors must thus frame their self-perception as actors with influential but not unilateral roles in achieving change. Only by engaging and collaborating with others intentionally, deliberately and in a focused manner can investors unlock the transformative potential of their investments. In short, they must pursue collective action, which comprises several complementary actions.

## Complementary actions

Collective action not only demands a focus on investments that promise a return on investment; it must also include a suite of complementary actions. Examples of complementary actions may be funding social movements that pressure regime actors to change or to invest in platforms that help users to adopt sustainable practices. Supportive local regulations and policies can also be important complementary actions in which to invest. These actions may not bring about any financial return on investment but may be instrumental or necessary for creating the conditions needed for systems change. Public investment and philanthropy may focus on these actions and may have a more prominent role in transformative change when pursued with more alignment to investment. Yet investors who want to create impact should also consider these types of investments as they are fundamentally necessary to generate system change. Complementary actions can also create space for transformative change across time, such as when investment into one niche opens up opportunities for new niches and pathways for transformation thereafter. These temporally sequenced complementary actions are known as inter-temporal synergies.

Complementary actions are currently limited in investment practice, as the concept has often been beyond an investor's remit. In order to consider complementary actions, investors need to proactively re-evaluate their role, networks, influences and current collaborations both within and between the socio-technical systems in which they plan to achieve transformative change. The structured frameworks to identify intervention points and transformative outcomes (see pages 20 and 21) can be a helpful yardstick for allowing investors to identify and gauge the value of a complete set of interventions, including investments and complementary actions, necessary to accelerate systems change. The example box opposite demonstrates how complementary actions could aid the introduction of heat pumps for household use.

## Guiding collective action through imagination: Future visioning

Collective action requires multiple actors with diverse societal roles to collaborate towards achieving a shared goal. This coordination could start with aligning visions and thinking about different possibilities for the future, which can be achieved through horizon scanning and futures visualisation. When a diverse set of people and stakeholders collaborate on such future visioning, this work also contributes to a diversity of vision and broad-based engagement. Once agreement is reached on desirable futures, stakeholders can then identify clusters or ecologies of niches that may lead to the outlined future visions. As Deep Transitions theory tells us, the future does not solely depend on niche development. Also essential are the ways that regime actors open up to change, thus leading to destabilisation of the system, and how niche and regime actors respond to shocks and trends. Bringing these processes together in futures work will allow actors to carve out possible transition pathways and identify opportunities for orchestrated variety and selection.

Developing desirable futures is collaborative work that pluralises the future. Rather than a blueprint or planning model, the frontier of the future is broadened first by holding several preferred futures in mind and then projecting directions and pathways to inform the investment process.

Example

### Complementary actions in action: Stretching the potential of heat pumps

To understand the concept of complementary actions, consider the introduction of heat pumps for heating homes. The heat pump is a promising technology that has nonetheless struggled to acquire a significant market share in many countries. This relative lack of success is not the result of inherent faults of the technology but rather due to a lack of supporting processes needed to catalyse systems change. To enhance the transformative potential of heat pumps, investors and policy makers should target different change dimensions and system elements that comprise the broader system.[47]

New intermediary actors could be introduced and supported, such as (1) user platforms that reduce uncertainties and assist in educating consumers and (2) added competencies to the existing network of boiler repair and installation companies that assist users in transitioning to a new heating system.[48] Such companies would represent the public-facing side of a new industry introducing heat pumps in place of boilers. This industry would be shielded and fostered by complementary policy initiatives such as providing generous subsidies for those seeking to install heat pumps. Supported by community-driven consumer networks, consumer behaviour would shift to accommodate the slower functioning of heat pumps, relative to the heat-on-demand of boilers, and to help them go off-grid by using solar power.

## Three desirable futures, as developed by the Panel and research team

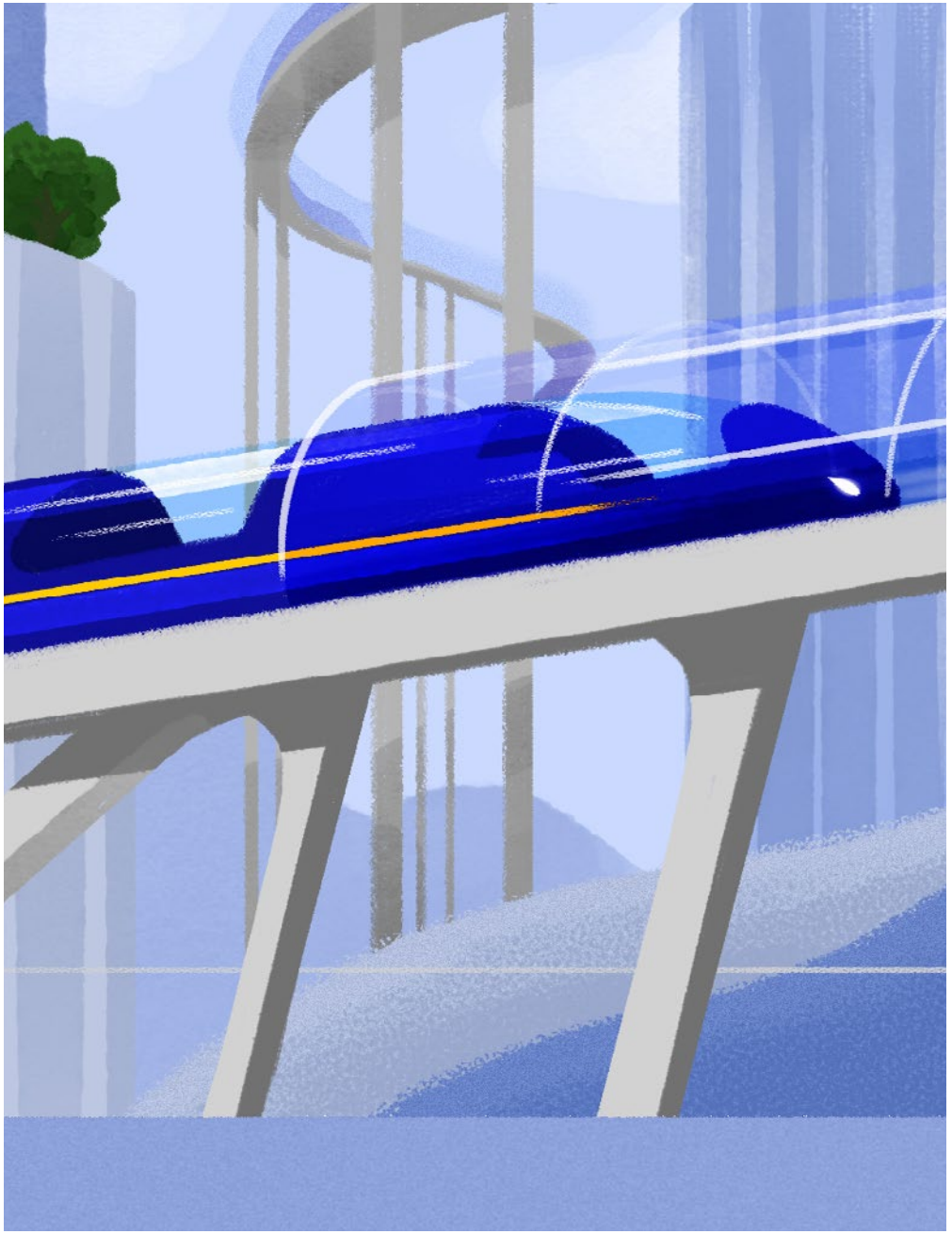
The power of futures work has become visible in the Deep Transition Futures project, particularly the Panel's work. Facilitated by a foresight specialist, the Panel and research team created and articulated three possible desirable future worlds that will be dominated by transformed and linked energy, mobility and food systems (Annex 2).[49]

- **After the Frugal Turn** (oriented around sufficiency in consumption)
- **First, Do No Harm** (focused on ecological regeneration and restoration)
- **Earthshot** (leaning on the promise of grand solutions)

Each of these three worlds imagines a set of transitions of linked energy, mobility and food systems, as well as different transition pathways of change for the next 30 years. They represent possible archetypes for our world's future. These futures, created through a mixed Deep Transitions futures studies method (see Annex 1), should not be seen as predictions or blueprints but as inspiring heuristics that help orient investment and serve as an antidote to pessimism. They can be extended to other not-yet-considered systems (for example, for basic needs such as housing, water, education, healthcare and security provision), as well as developed much further, including reframing them for local contexts. These heuristics help identify existing rules that underpin the current systems and the depth of shift required for alternatives to emerge in order to address sustainability challenges. A common feature of these worlds is that they make sustainable behaviour not only possible but the preferred and routine way of operating. Examining transition pathways to these worlds helps to explore the dynamics of multiple-system change that lead to achieving desirable futures. Such an examination can therefore help identify investable niches and pathways to drive forward the Second Deep Transition.

## From implications to principles: Applying Deep Transitions to the investment practice

The preceding implications of a Transformative Theory of Change for investment offer important and novel insights into the act of building a better future. However, they are neither comprehensive nor immediately deployable within the field of investment. To begin bridging the space between theory and practice, the Panel and research team developed a set of principles for transformative investment, which provides guidance for making investment choices focused on a just and sustainable transition.



## Section Four

# 12 Principles of a Transformative Investment Philosophy

## Who should apply these investment principles?

**The principles are a type of shorthand designed to aid investors in achieving systems change. They are a catalyst for fresh thinking, dialogue and decision making that is guided by systems change. The principles focus primarily on the role of private investors but are also applicable to and relevant for public actors, including in their linking with private investments. Whether focused on private companies or listed securities markets, across asset classes – with specific fiduciary and market-return responsibilities or with the ability to accept concessionary returns – all types of private investors can benefit from embedding these 12 principles in their research, analytical and decision-making processes.**

The Panel and research team have worked to ensure that these principles can catalyse challenging dialogue and decision making in any investment process. In reflecting the constraints within which many investors operate, these principles are also consistent with achieving positive financial value. Their deployment within investment practices even has the potential to help uncover (and even create) new investment opportunities in overlooked areas with high transformative potential. In the current context of ever-increasing uncertainty, change and frequency of shocks, these principles can also contribute to shielding investors from exposure to profound systemic risks. However, the role for 'experimental capital', as well as non-investment-related complementary actions, remains necessary and important.

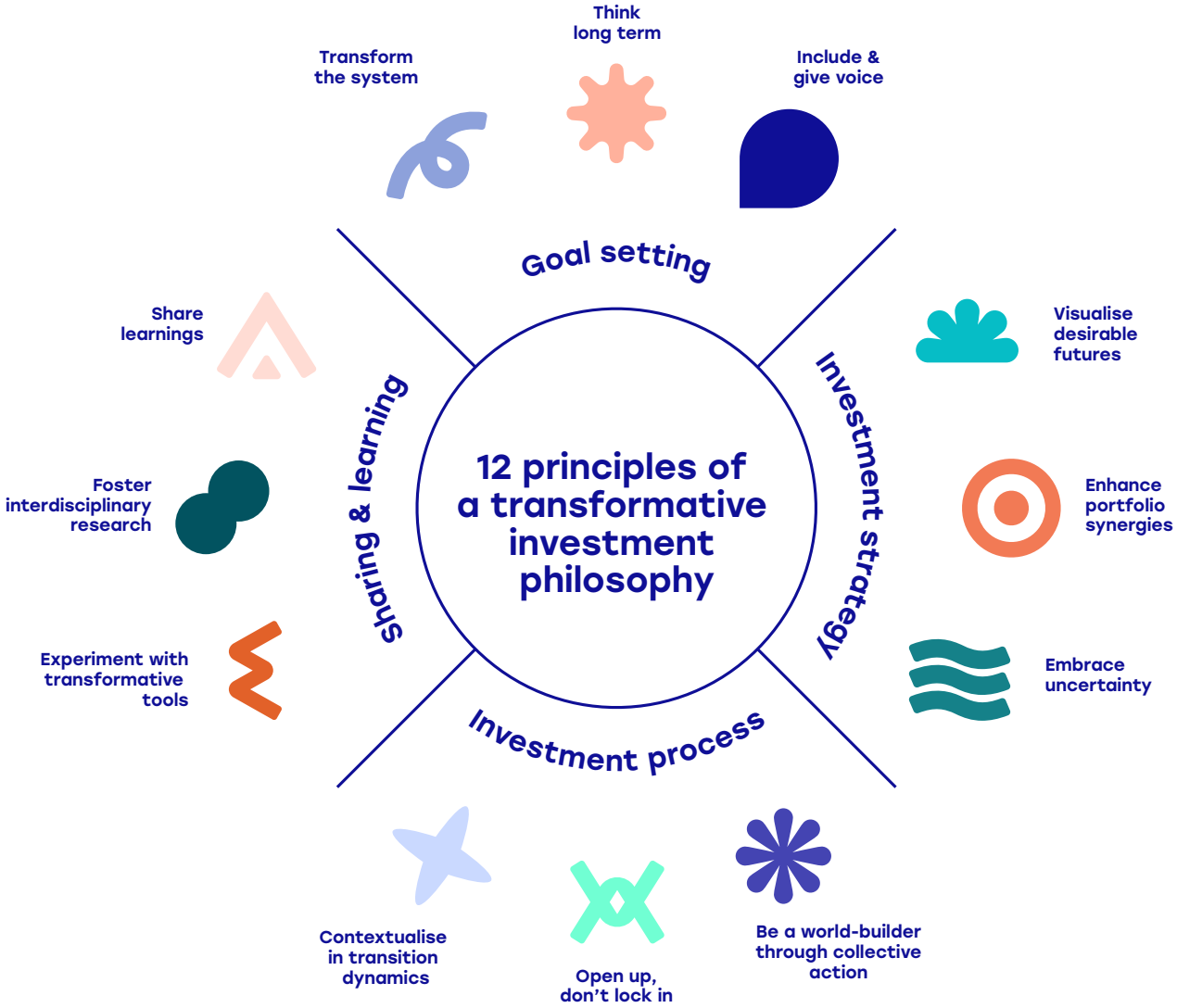



Figure 7: 12 principles of a transformative investment philosophy

# Goal-setting principles

Principles to set the course for and catalyse thinking on making transformative investment part of an organisation's practices

1

Goal setting

## Transform the system

**Transformation is the goal. Target systems change and deploy capital in a way that accelerates the Second Deep Transition.**

Target transformative potential rather than optimise specific impact outcomes or ESG criteria. Systems change is the only way to achieve a sustainable and desirable future. Accelerating this change process would limit the magnitude of the negative outcomes of the current dominant system and draw out a desirable alternative. In this sense, transformative investing transcends definitions of impact investing and ESG investing, although it has elements in common with both these investment types. Values, governance and incentive structures would also benefit from the overall goal of transformation.

2

Goal setting

## Think long term

**Focus on long-term systems change. Visualise outcomes in decades.**

It may take many years of investing to achieve the impacts of systems change. Nevertheless, efforts must be made towards building desirable worlds in the long term, not towards marginal relative optimisations in the near term. Financial returns would not necessarily take as long to materialise as system change outcomes, as markets anticipate future financial flows in asset prices. However, investment structures that allow for a patient approach, such as evergreen funds or funds that incentivise long-term holding periods, are more aligned with this principle of long-term change.

3

Goal setting

## Include & give voice

**Inspire stakeholder participation, including the ultimate owners of capital. Be accountable to them.**

Invite local communities and key stakeholders – such as buyers, suppliers and workers – to have a voice in assessing transformations that may significantly affect their lives. Make a conscious effort to be transparent, to offer such stakeholders broad-based engagement in the decision-making process, and to start a discussion about how to enhance stakeholders' and community participation (including the fair allocation of costs and benefits). Experiment, in collaboration with other investors, to determine the best way to implement this in practice. Ultimately, broad participation and ownership will lead to higher support, more understanding and greater implementation. Transparency and broad engagement are particularly relevant: transition dynamics should be grounded in a shared vision for a desirable future.

# Investment strategy-related principles

Principles that support the decision-making process when developing a strategy for investing in transformation

4

Investment strategy

## Visualise desirable futures

**Visualise desirable future worlds.**

Investors would benefit from defining the high-level characteristics of the preferred future world they seek to enable; developing, as far as possible, a visualisation of the characteristics of that future; and incorporating these in their investment strategies. The desirable worlds generated in the Panel process (see Annex 2) can provide a useful starting point. However, many more scenarios and future world visions are freely available as alternatives. Investors may also conduct similar world-building exercises to those undertaken by the Panel and research team.

5

Investment strategy

## Enhance portfolio synergies

**Take a portfolio approach to multiple-system change.**

Consider how to construct a portfolio (or a set of investment vehicles or policy programmes) for building a new meta-regime (for example, a circular economy) across systems. Investing across various aligned solutions can help accelerate growth and decrease risk across the portfolio, as niches can support one another.

6

Investment strategy

## Embrace uncertainty

**Expect a high level of investment risk and a need for experimental capital.**

Transformation comes with uncertainties. Transition pathways are hard to predict, and transformative investments are likely to be associated with a relatively high level of risk. High risks may lead to correspondingly high financial rewards (for example, in venture capital or growth investing), but this may not always be the case. To ensure transformative solutions can be scaled, experimental capital must be incorporated into blended finance structures, either alone or in a layered structure. This kind of funding can help kickstart solutions and fund proofs of concept. Funding could take the form of donations, concessionary capital, public funding or in-kind support. Experimental capital can create transformative investment opportunities that then become attractive to market-driven investors.

# Investment process-related principles

Principles that can help inspire, shape and stretch the investment process of an organisation

7



Investment process

## Contextualise in transition dynamics

**Actively consider each investment in its relationship with ongoing Deep Transition dynamics.**

Deep Transitions require multiple change processes involving many interacting actors over a long period and across a wide range of spatial contexts. Investments alone cannot create or steer a Deep Transition process. Instead, they can contribute to ongoing change processes and may be able to modulate their direction. Contributions (in this case, investments) can be made more effective by assessing if and how they connect to and influence transition dynamics. By focusing on transition-related intervention points and associated transformative outcomes, it is possible to develop and exploit a deeper understanding of systems change and Deep Transition dynamics in the investment process.

8



Investment process

## Open up, don't lock in

**Avoid lock-in solutions that impede deeper systems change.**

Investors and science, technology and innovation policy makers should consider carefully whether investments support systems optimisation or systems change, not just in a single system but across multiple systems. At times, investing in systems optimisation may be necessary as a stepping stone towards systems change. However, it could also end up blocking the potential for transformation and locking systems into unsustainable pathways, thus preventing change from happening. The potential lock-in of existing systems and the clash between short-term systems optimisation and long-term systems change should be taken into account when considering potential investments.

9

Investment process

## Be a world-builder through collective action

**Foster collective action among actors who commit to systems change.**

Transformational change requires parallel shifts in all aspects of a socio-technical system. Investors and policy makers gain from seeking opportunities to partner and collaborate with one another and with other actors to influence a system on multiple levels. One example of such an opportunity might be creating transition-enabling bundles, a package of complementary actions that includes investments and policy commitments. Collaborations can be established between investors with different risk–reward expectations (for example, through blended finance structures), between investors and policy makers, and with buyers, suppliers, intermediaries and other market participants. These collaborations can help decrease the inherent risk of investing in new niches and accelerating their expansion, and they may help to create investable opportunities where there are gaps.

# Principles for experimentation, sharing and continuous learning

Principles to support improvement and learning in the journey towards transformative investment

10

Sharing & learning

## Experiment with transformative tools

**Experiment with the transformative investment tools and support their development.**

Play with transformative investment tools and methods from the Deep Transitions framework. Contribute to their development as well as that of additional practices over time. Help strengthen the field of transformative investment and enhance its applicability to a broader base of investors.

11

Sharing & learning

## Foster interdisciplinary research

**Foster interdisciplinary research and collaboration to advance and realise the potential of transformative investments.**

Experimentation is necessary to support transformative investment. For example, a mix of researchers, investors, futurists, storytellers and graphic designers collaborated actively to shape the Panel process and its products, including these principles. Sustained interdisciplinary collaboration is a vital part of continued research efforts to assess, measure and monitor investments' transformational potential and performance over time. Learning and unlearning need to take place, by actors across the board. Making connections between research and investment practices and inviting other disciplines as equal experimentation partners will enrich investment practices with system transition knowledge while also helping to deepen and further the academic agenda.

12



Sharing & learning

## Share learnings

**Value transparency and share learnings by making them open source.**

This principle requires that stakeholders make available their lessons, data and insights, successes and failures, near misses, scrapes, surprises and unexpected outcomes. Open-source materials help foster replication and subsequent take-up by other investors and science, technology and innovation policy makers. We are at the initial stages of putting transformative investment into practice. Therefore, the willingness to share learnings and compare notes is vital for its evolution and endurance.

# Section Five

# Towards a Second Deep Transition: Establishing a Transformative Investment Lab

**The sustained interdisciplinary collaboration between the Panel and research team has created an opportunity for investors to guide their future actions. This Investment Philosophy provides a framework for steering thought and action towards achieving transformation. To leverage this opportunity most effectively, it will be necessary to develop a focal point where efforts can continue. This concluding section proposes to establish a Deep Transitions Lab as the locus of a global community brought together by a shared ambition to invest in systems change. The Lab will serve as a platform for interested parties to experiment with and disseminate the results of new forms and strategies of transformative investment, as informed by this Investment Philosophy.**

Table 2 on page 31 provides an overview of the design and value generated by the Deep Transitions Lab, setting out an ambitious proposal to accelerate action towards transformation.

## Experimentation for systems change

Experimentation is a central concept for the Deep Transitions Lab, as it allows investors and researchers to gain practical experience in implementing transformative investment principles through new strategies. This experimentation will fuel learning and refinement of the principles outlined and enable the development of tools and metrics needed to support their implementation. Experimentation is, therefore, a critical step in empowering investors to leverage the potential of transformative investment. At present, the Lab envisages four archetypes of experiments:

1. **Transformative investment experiment:** Before an investment decision is made in (a) a specific company, (b) a solution area of interest, such as a research roadmap, or (c) a new fund altogether, a research team working with investors will link a TToC with this specific investment opportunity or area of interest. This TToC will detail how the activities of this company, solution or area may influence specific Deep Transition processes and lead to systems change. These processes will be detailed in terms of transformative outcomes, allowing investors to appraise whether and how their investments may contribute to systems change, either in a single-system or a multiple-system context.

2. **Transformative monitoring experiment:** After an investment decision is taken, a TToC can also be developed and used to monitor the transformative impact of the given investment. During this process, the research team will suggest metrics to assess the transformative outcomes, as detailed in the TToC. The agreed-upon metrics will then be tracked over time.

3. **Transformative portfolio experiment:** Investors may want to assess the transformative investment potential of an existing portfolio without going through the lengthier process of building a TToC. In such cases, three questions can be raised to generate a transformative assessment:

    - Assessment of the synergies and trade-offs in terms of systems change across the investment portfolio.
    - Assessment of how a selection of identified future shocks and mega-trends might impact the portfolio.
    - Assessment of how the portfolio helps to construct certain desirable futures and may result in transition risks (stranded assets). This assessment can be compared to the three future worlds developed by the Panel (see Section 3 and Annex 2), a visualisation of the future already in use by the investor involved in a specific experiment.

    The transformative portfolio experiment can additionally lead to refining the overall investment strategy – for example, by increasing awareness of exposure to certain shocks or identifying investable meta-rules or sets of desirable systems changes. Such an experiment could also help identify missing types of investments and other non-investable complementary actions necessary for enhancing the transformative potential of the portfolio. This experiment could therefore also reveal other investors or actors who may have to be mobilised to maximise the transformative potential.

4. **Transformative bundle experiment:** This type of experiment is focused on identifying all core transformative changes, public and private investments, and complementary actions necessary for a specified systems change to be fostered over a specific period of time and within a defined geographical area. Focusing on a specific meta-rule or cluster of innovations in a specific geography could help to bound this experiment. This type of experiment can be thought of as the most complex and, at the same time, the most explicitly intentional and direct in creating systems change. For example, a bundle could be developed to identify changes, investments and complementary actions (including policy changes, regulation, construction of markets, cultural changes and industry changes) necessary for developing, say, a green hydrogen economy in a specific region or country. This experiment requires the active and committed participation of relevant actors who share complementary spheres of influence in the sector(s) and geography in question. Defining such bundles may help identify new investment opportunities and/or develop new investment vehicles. To put these bundles into action, experimental capital to help fund the infrastructure and research is very likely to be needed.

We envisage the Lab as an institutional home for experimentation in transformative investment as it moves beyond concept and into practice, a 'safe space' to be bold and accelerate collective action. Working with public and private investors from across the globe

| Design criteria | Value generation |
|---|---|
| Build a cross-cutting global community of practice | A platform for interaction between investment practitioners, policy innovators, foundations, individual donors, researchers and specialists across the globe. The Lab helps build a community of practice and provides leadership for developing new investment practices. The Lab organises a learning and capacity-building process for its partners, involving academics and universities important to mainstreaming transformative investment mindsets and using tools and metrics that measure systems change. |
| Develop a transformative mindset | The Deep Transitions framework provides a common language and novel insights into building a general theory of change that can be used in private and public investments that set out to achieve systems change. The Lab investigates if and how the transformative approach could help make investment decisions and help investors and researchers to embrace the Deep Transition mindset, developing relevant capabilities along the way. |
| Engage in disciplined real-time experimentation | Experimentation is at the heart of the Lab as it trials new ways to integrate transformative investing practices and tools within the investment processes of its partners. The word 'experiment' is deliberately chosen as the work involves trying out, prototyping and developing efforts towards achieving transformative investment in a systematic, documented, controlled and academically rooted way. |
| Imagine and construct desirable futures | Horizon-scanning methods develop desirable futures and look for emerging niches and transition pathways. These niches and pathways develop a worldbuilding context to strengthen a shared purpose and evaluate the impact of transformative investment decisions. |
| Grounded in a research-led approach | Experiments are objects for research. These objects will be compared and analysed, and the results will feed into a research agenda and ongoing experiments. In addition, academic work conducted within the Lab improves our understanding of Deep Transition dynamics to support and more effectively execute experiments and develop new resources, tools and metrics. |
| Create a centre for interdisciplinary training and career development | The Lab becomes a centre of excellence for the interdisciplinary training of investors and researchers of all career stages who aspire to make a difference in their professional environments. It does so by offering investors and researchers unique and rigorous training in the theories and tools necessary for undertaking transformative investment. The Lab provides a set of resources, events and activities to establish a robust learning programme for investors and public-funding practitioners, as well as for researchers and students from the Global North and Global South. |

Table 2: Design criteria for and value generated by the Deep Transitions Lab

(both from the Panel and new partners), as well as in partnership with policy-making actors through our sister project, the Transformative Innovation Policy Consortium, we plan to begin implementing and accelerating transformative investment through real-world experiments, the results of which will be rapidly disseminated for positive global change. Using the Lab as a home for interdisciplinary thinking will help drive action to influence tomorrow's world and foster a new generation of researchers, transformative investors and business leaders (see Table 2 on the previous page for more information about the envisaged mandate of the Deep Transitions Lab).

As encapsulated in its 12 principles in **Section 4**, this Transformative Investment Philosophy provides a framework for guiding thought and action in the investment community and broader society. These principles represent the beginning of what the Panel and research team expect to be a long process of iterations, experimentation and incorporation. The sustained interdisciplinary collaboration between the Panel and research team in co-creating the Philosophy can be considered a prototype for how cross-disciplinary efforts might work towards achieving transformation. To this end, to leverage this opportunity most effectively, the focal point of the Lab is a necessary next step, where efforts to practice, iterate and disseminate transformative investment principles can continue. Beginning in 2023, the Deep Transitions Lab will bring together a global community with a shared ambition to invest in systems change and a mission to contribute to the Second Deep Transition.

# Endnotes

1 In their latest assessment reports, the world's most authoritative bodies on climate change and biodiversity find that limiting global temperature rise to 1.5°C above preindustrial levels, halting biodiversity loss and ensuring just transitions will require systems change. Calls for systems change have further gained traction throughout the broader global climate-change community, reflecting an emerging consensus that current efforts have failed to spur deep greenhouse gas emissions reductions, halt biodiversity loss and reduce inequity at the speed and scale required to secure a more sustainable future. See, for example: IPCC (2018). *Global Warming of 1.5°C: An IPCC Special Report on the impacts of global warming of 1.5°C above pre-industrial levels and related global greenhouse gas emission pathways, in the context of strengthening the global response to the threat of climate change, sustainable development, and efforts to eradicate poverty*. [Masson-Delmotte, V., Zhai, P., Pörtner, H.-O., Roberts, D., Skea, J., Shukla, P.R., Pirani, A., Moufouma-Okia, W., Péan, C., Pidcock, R., Connors, S., Matthews, J.B.R., Chen, Y., Zhou, X., Gomis, M.I., Lonnoy, E., Maycock, T., Tignor, M., & Waterfield, T. (eds.).] Cambridge: Cambridge University Press. https://doi.org/10.1017/9781009157940 ; Steffen, W., Rockström, J., Richardson, K., & Schellnhuber, H.J. (2018). Trajectories of the earth system in the anthropocene. *PNAS*. Vol.115(33), pp.8252–8259. https://doi.org/10.1073/pnas.1810141115 ; Sachs, J.D., Schmidt-Traub, G., Mazzucato, M., Messner, D., Nakicenovic, N., & Rockström, J. (2019). Six transformations to achieve the Sustainable Development Goals. *Nature Sustainability*. Vol.2, pp.805–814. https://doi.org/10.1038/s41893-019-0352-9 ; IPBES. (2019). *Global Assessment Report on Biodiversity and Ecosystem Services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*. [Díaz, S., Settele, J., Brondízio, E.S., Ngo, H.T., Guèze, M., Agard, J., Arneth, A., Balvanera, P., Brauman, K.A., Butchart, S.H.M., Chan, K.M.A., Garibaldi, L.A., Ichii, K., Liu, J., Subramanian, S.M., Midgley, G.F., Miloslavich, P., Molnár, Z., Obura, D., Pfaff, A., Polasky, S., Purvis, A., Razzaque, J., Reyers, B., Roy Chowdhury, R., Shin, Y.J., Visseren-Hamakers, I.J., Willis, K.J., & Zayas, C.N. (eds.)]. Bonn, Germany: IPBES Secreteriat. https://doi.org/10.5281/zenodo.3553579 ; IEA. (2021). *World Energy Outlook 2021. Paris: IEA*. https://www.iea.org/reports/world-energy-outlook-2021 ; World Business Council for Sustainable Development. (2021). *Reporting Matters 2021*. https://www.wbcsd.org/Programs/Redefining-Value/Reporting-matters/Resources/Reporting-matters-2021 ; IPCC. (2022). *Climate Change 2022: Impacts, Adaptation and Vulnerability: Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. [Pörtner, H-O., Roberts, D.C., Tignor, M., Poloczanska, E.S., Mintenbeck, K., Alegría, A., Craig, M., Langsdorf, S., Löschke, S., Möller, V., Okem, A., & Rama, B. (eds.)]. Cambridge: Cambridge University Press. doi:10.1017/9781009325844 ; United Nations Office for Disaster Risk Reduction. (2022). *Global Assessment Report on Disaster Risk Reduction 2022: Our World at Risk: Transforming Governance for a Resilient Future*. Geneva; United Nations Department of Economic and Social Affairs, Population Division. (2022). *World Population Prospects 2022: Summary of Results*. UN DESA/POP/2022/TR/NO. 3.

2 Humanity has transgressed four known planetary boundaries: species extinction rate, deforestation, atmospheric $CO_2$ and the flow of nitrogen and phosphorus. These transgressions have caused the planet's climate to change 170 times faster than it would have via natural forces. It has therefore also increased the risk of irreversibly driving the Earth to become less hospitable to supporting life (see Steffen, W., Richardson, K., Rockström, J., Cornell, S.E., Fetzer, I., Bennett, E.M., Biggs, R., Carpenter, S.R., De Vries, W., De Wit, C.A., Folke, C., Gerten, D., Heinke, J., Mace, G.M., Persson, L.M., Ramanathan, V., Reyers, B., & Sörlin, S. (2015). Planetary boundaries: guiding human development on a changing planet. *Science*. Vol.347(6223). https://doi.org/10.1126/science.1259855; Westin, U., Ingdahl, W., & Shandwick, W. (2021). *Global Catastrophic Risks 2021: Navigating the Complex Intersections*. Global Challenges Foundation.

3 For example, in the 2022 *Global Assessment Report on Disaster Risk Reduction*, the United Nations Office for Disaster Risk Reduction warns that, 'at no other point in modern history has humankind faced such an array of familiar and unfamiliar risks and hazards, interacting in a hyperconnected and rapidly changing world'. The annual number of global weather, climate and biological disasters is projected to increase by around 40%, from around 400 in 2015 to 560 by 2030 (United Nations Office for Disaster Risk Reduction [2022], p.17; see note 1 for full citation).

4 For example, in their 2021 *Global Catastrophic Risks* report, the Global Challenges Foundation warns that: 'it appears unlikely that the international community will be able to prevent global warming from exceeding 1.5 degrees. In this context, we need to prepare for dealing with the consequences of an increasingly unstable ecological environment and mitigating the risk of a climate catastrophe' (Westin et al. [2021], p.23; see note 2 for full citation).

5 United Nations. (2021). *Our Common Agenda: Report of the Secretary-General*. New York. Available at: https://www.un.org/en/content/common-agenda-report/assets/pdf/Common_Agenda_Report_English.pdf

6 See, for example, the IPCC Working Group II 2022 report, cited in note 1, which finds with high confidence that the 'vulnerability of ecosystems and people to climate change differs substantially among and within regions [...] driven by patterns of intersecting socio-economic development, unsustainable ocean and land use, inequity, marginalization, historical and ongoing patterns of inequity such as colonialism' (p.12). The IPCC goes on to highlight the need for solutions that conform to principles of distributive justice (regarding the allocation of burdens and benefits), procedural justice (regarding agency and power in decision making) and recognition (referring to respect for and engagement with diverse cultures and perspectives).

7 Schot, J.W., & Kanger, L. (2018). Deep Transitions: Emergence, acceleration, stabilization and directionality. *Research Policy*. Vol.47(6), pp.1045–1059. https://doi.org/10.1016/j.respol.2018.03.009

8 See Annex 1 for more information on the mandate, aims and process of the Panel.

9 Schot & Kanger (2018) (see note 7); Schot, J.W., & Kanger, L. (2019). Deep Transitions: Theorizing the long-term patterns of socio-technical change. *Environmental Innovation and Societal Transitions*. Vol.32, pp.7–21. https://doi.org/10.1016/j.eist.2018.07.006

10 See, for example, Geels, F.W. (2002). Technological transitions as evolutionary reconfiguration processes: A multi-level perspective and a case-study. *Research Policy*. Vol.31(8–9), pp.1257–1274. https://doi.org/10.1016/S0048-7333(02)00062-8; Grin, J., Rotmans, J., & Schot, J.W. (2011). *Transitions to Sustainable Development: New Directions in the Study of Long-Term Transformative Change*. New York: Routledge; Markard, J., Raven, R., & Truffer, B. (2012). Sustainability transitions: An emerging field of research and its prospects. *Research Policy*. Vol.41(6), pp.955–967. https://doi.org/10.1016/j.respol.2012.02.013; Loorbach, D., Frantzeskaki, N., & Avelino, F. (2017). Sustainability transitions research: Transforming science and practice for societal change. *Annual Review of Environment and Resources*. Vol.42, pp.599–626. https://doi.org/10.1146/annurev-environ-102014-021340

11 Sovacool, B.K. (2016). How long will it take? Conceptualizing the temporal dynamics of energy transitions. *Energy Research & Social Science*. Vol.13, pp.202–215. https://doi.org/10.1016/j.erss.2015.12.020

12 Voβ, J-P., Bauknecht, D., & Kemp, R. (2006). *Reflexive Governance for Sustainable Development*. Elgar. https://doi.org/10.4337/9781847200266

13 Rip, A., & Kemp, R. (1998). Technological Change. In Rayner, S., & Malone, E.L. (eds.), *Human Choice and Climate Change: Vol. ii, Resources and Technology*. pp.327–399; Geels, F.W. (2005) *Technological Transitions and System Innovations: A Co-evolutionary and Socio-technical Analysis*. Edward Elgar Publishing.

14 Grin et al. (2011) (see note 10), p.53.

15 See, for example, Wittmayer, J.M., Avelino, F., van Steenbergen, F., & Loorbach, D. (2017). Actor roles in transition: Insights from sociological perspectives. *Environmental Innovation and Societal Transitions*. Vol.24, pp.45–56. https://doi.org/10.1016/j.eist.2016.10.003 ; Kivimaa, P., Boon, W., Hyysalo, S., & Klerkx, L. (2019). Towards a typology of intermediaries in sustainability transitions: A systematic review and a research agenda. *Research Policy*. Vol.48(4), pp.1062–1075. https://doi.org/10.1016/j.respol.2018.10.006

16 See, for example, Meadows, D. (1999). *Leverage points: Places to intervene in a system*. The Sustainability Institute. Available at https://donellameadows.org/archives/leverage-points-places-to-intervene-in-a-system/

17 Rules can also be viewed as institutions. See, for example, Fuenfschilling, L., & Truffer, B. (2014). The structuration of socio-technical regimes: Conceptual foundations from institutional theory. *Research Policy*. Vol.43(4), pp.772–791. https://doi.org/10.1016/j.respol.2013.10.010

18 Schot & Kanger (2018) (see note 7).

19 Kanger, L. (2022). The spatial dynamics of deep transitions. *Environmental Innovation and Societal Transitions*. Vol.44, pp.145–162. https://doi.org/10.1016/j.eist.2022.06.005

20 Schot & Kanger (2018) (see note 7).

21 Kanger, L., Sovacool, B.K., & Noorkõiv, M. (2020). Six policy intervention points for sustainability transitions: A conceptual framework and a systematic literature review. *Research Policy*. Vol.49(7). https://doi.org/10.1016/j.respol.2020.104072

22 Ghosh, B., Kivimaa, P., Ramirez, M., Schot, J.W., & Torrens, J. (2021). Transformative outcomes: Assessing and reorienting experimentation with transformative innovation policy. *Science and Public Policy*. Vol.48(5), pp.739–756. https://doi.org/10.1093/scipol/scab045

23 See, for example, Molas-Gallart, J., Boni, A., Giachi, S., & Schot, J.W. (2021). A formative approach to the evaluation of transformative innovation policies. *Research Evaluation*. Vol.30(4), pp.431–442. https://doi-org.proxy.library.uu.nl/10.1093/reseval/rvab016; Boni, A., Penna, C.R., Palavicino, C.A., Brodnik, C., Matti, C., Witte, J., Schot, J.W., Molas-Gallart, J., Weber, M., Mendez, P.F., Terrazas, P., & Keesman, S. (2021). *MOTION Handbook: Developing a Transformative Theory of Change*. Available at: https://www.tipconsortium.net/publication/motion-handbook-developing-a-transformative-theory-of-change/.

24 The concept of surges of development was originally introduced by Carlotta Perez [2010]. Technological revolutions and techno-economic paradigms. *Cambridge Journal of Economics*. Vol.34[1], pp.185–202. https://doi.org/10.1093/cje/bep051, and was later integrated within Deep Transitions theory (see, for example, Schot, J.W., Kanger, L. [2018] [see note 7])

25 IEA. (2021). *Renewables 2021*. Paris: IEA. https://www.iea.org/reports/renewables-2021

26 Espiner, T. (2022). Big banks fund new oil and gas despite net zero pledges. *BBC*. https://www.bbc.com/news/business-60366054

27 Enkhardt, S., & Beetz, B. (2018). IEA versus the reality of solar PV. *PV Magazine*. https://www.pv-magazine.com/2018/11/20/iea-versus-solar-pv-reality/

28 Ember. (2022). *Global Electricity Review 2022*. Ember. https://ember-climate.org/insights/research/global-electricity-review-2022/#supporting-material-acknowledgements

29 IEA. (2022). *World Energy Investment 2022*. Paris: IEA. https://www.iea.org/reports/world-energy-investment-2022; Lazard (2020). *Lazard's Levelized Cost of Energy Analysis - Version 14.0*. Lazard. https://www.lazard.com/media/451419/lazards-levelized-cost-of-energy-version-140.pdf

30 Evans, S. (2022). Analysis: Record-low price for UK offshore wind is nine times cheaper than gas. *Carbon Brief*. https://www.carbonbrief.org/analysis-record-low-price-for-uk-offshore-wind-is-four-times-cheaper-than-gas/; IRENA. (2020). *Renewable Power Generation Costs in 2020*. International Renewable Energy Agency (IRENA). https://www.irena.org/publications/2021/Jun/Renewable-Power-Costs-in-2020

31 BloombergNEF. (2022). Energy Transition Investment Trends 2022. Bloomberg. https://assets.bbhub.io/professional/sites/24/Energy-Transition-Investment-Trends-Exec-Summary-2022.pdf

32 IEA. (2021). Electric Vehicles. Paris: IEA. https://www.iea.org/reports/electric-vehicles; Rosenow, J., & Gibb, D. (2022). How heat pump sales are starting to take off around the world. *Carbon Brief*. https://www.carbonbrief.org/guest-post-how-heat-pump-sales-are-starting-to-take-off-around-the-world/

33 IEA. (2021). *Net Zero by 2050*. Paris: IEA. https://www.iea.org/reports/net-zero-by-2050

34 See, for example, Boni, A., Giachi, S., & Molas-Gallart, J. (2019). Key principles for a formative evaluation of transformative innovation policy: TIPC Policy Brief. Available at https://www.tipconsortium.net/resource/key-principles-for-a-formative-evaluation-of-transformative-innovation-policy/ ; Molas-Gallart et al. (2021) (see note 24).

35 Parrique, T., Barth, J., Briens, F., Kerschner, C., Kraus-Polk, A., Kuokkanen, A,. & Spangenberg, J.H. (2019). *Decoupling Debunked: Evidence and Arguments Against Green Growth as a Sole Strategy for Sustainability*. European Environmental Bureau. Available at https://eeb.org/library/decoupling-debunked/

36 Figure in Geels et al. (2004) is a popularisation adapted from Weterings, R., Kuijper, J., Smeets, E., Annokkée, G.J., & Minne, B. (1997). *81 Mogelijkheden, Technologie voor Duurzame Ontwikkeling. Eindrapport van de milieugerichte technologieverkenning*. The Hague: VROM (Department of Housing, Spatial Planning and Environment)

37 European Commission. (2022). Fit for 55. European Commission. https://www.consilium.europa.eu/en/policies/green-deal/fit-for-55-the-eu-plan-for-a-green-transition/

38 Swilling, M. (2019). *The Age of Sustainability: Just Transitions in a Complex World*. Routledge: London.

39 Ghosh et al. (2019). (see note 22).

40 Garud, R., & Karnøe, P. (2003). Bricolage versus breakthrough: Distributed and embedded agency in technology entrepreneurship. *Research Policy*. Vol.32(2), pp.277–300. https://doi.org/10.1016/S0048-7333(02)00100-2 ; Morris, C., & Jungjohann, A. (2016). *Energy Democracy: Germany's Energiewende to Renewables*. Palgrave Macmillan.

41 Johnstone, P., Rogge, K. S., Kivimaa, P., Farné Fratini, C., & Primmer, E. (2021). Exploring the re-emergence of industrial policy: Perceptions regarding low-carbon energy transitions in Germany, the United Kingdom and Denmark. *Energy Research & Social Science*. Vol.74. https://doi.org/10.1016/j.erss.2020.101889

42 Jacobsson, S., & Lauber, V. (2006). The politics and policy of energy system transformation: explaining the German diffusion of renewable energy technology. *Energy Policy*. Vol.34, pp.256–276. https://doi.org/10.1016/j.enpol.2004.08.029

43 Johnstone, P., Rogge, K.S., Kivimaa, P., Fratini, C.F., Primmer, E., & Stirling, A. (2020). Waves of disruption in clean energy transitions: Sociotechnical dimensions of system disruption in Germany and the United Kingdom. *Energy Research & Social Science*. Vol.59. https://doi.org/10.1016/j.erss.2019.101287

44 European Commission. (2020). EU strategy on energy system integration. European Commission. https://energy.ec.europa.eu/topics/energy-systems-integration/eu-strategy-energy-system-integration_en

45 Johnstone, P., & Hielscher, S. (2017). Phasing out coal, sustaining coal communities? Living with technological decline in sustainability pathways. *The Extractive Industries and Society*. Vol.4(3), pp.457–461. https://doi.org/10.1016/j.exis.2017.06.002 ; Foden, M., Fothergill, S., & Gore, T. (2014). *The state of the coalfields: Economic and social conditions in the former mining communities of England, Scotland and Wales*. Centre for Regional Economic and Social Research.

46 European Commission. (2019). The Just Transition Mechanism: Making sure no one is left behind. The Just Transition Mechanism. European Commission. https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/finance-and-green-deal/just-transition-mechanism_en

47 Martiskainen, M., Schot, J.W., & Sovacool, B. (2021). User innovation, niche construction and regime destabilization in heat pump transitions. *Environmental Innovation and Societal Transitions*. Vol.39, pp.119–140. https://doi.org/10.1016/j.eist.2021.03.001

48 Ibid.

49 Please note that these are working titles which may be subject to change.

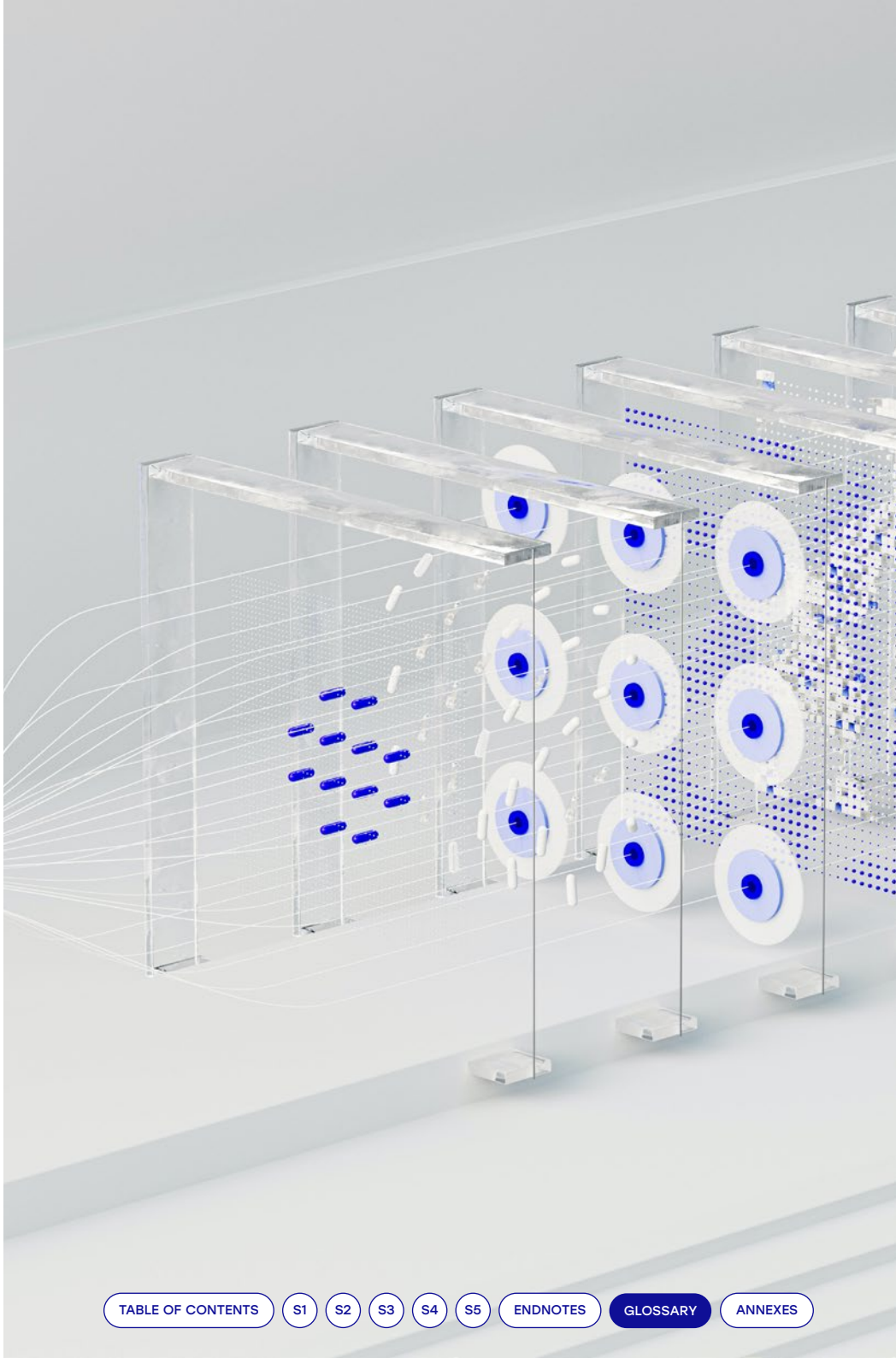
# Deep Transitions Transformative Investment Philosophy Glossary

## This glossary of critical terms supplements the Transformative Investment Philosophy specifically and Deep Transitions more generally.

### Actors
Individuals and groups who operate within or who are otherwise linked to a socio-technical system. In Deep Transitions thinking, actors can be proponents, enablers or opponents of transformative change and may seek to either accelerate and accomplish or block, divert or slow down transformative change. Actor motivations are guided by rules, meta-rules and system regimes, many of which could, in turn, influence these actors, even in an unconscious way. Actors who follow the dominant regime in a socio-technical system are known as regime actors. Those who refuse to follow the dominant regime and instead follow and implement alternative rules within the socio-technical system, by developing new niches, are known as niche actors. Intermediary actors are those who bring together various niche and regime actors, and marginalised actors are those who have as yet no voice within the system, despite being subject to its functioning and outputs.

### Coupling
A mechanism through which two or more socio-technical regimes become connected. Coupling is possible when two or more systems share similar rules or meta-rules, or when the socio-technical systems complement each other through their respective socio-technical configurations. Functional couplings refer to the linkage of multiple socio-technical systems through shared functions or purposes within the global economy. Structural couplings refer to materials, infrastructures or resources shared among multiple systems. Rhetorical couplings refer to multiple socio-technical systems that share symbolic meaning.

### Deep Transition
A series of connected and sustained transitions across a wide range of socio-technical systems that are aligned in their directionality. A Deep Transition is a multi-century process by which new meta-regimes across various systems are established and diffused across the globe. The process consists of several surges of development, touching all aspects of society, science, business, policy, market and culture.



## Directionality
Refers to the way in which socio-technical systems optimise their transition. Directionality comes from adopting a specific set of rules and meta-rules to guide a system's development. For example, socio-technical systems may be established to optimise linear or circular production and consumption, or to optimise a system that reduces poverty and inequality. Changing directionality means abandoning or destroying an older direction. The directionality of innovation is concerned with the idea that all innovations, whether systemic or technological, have a direction – a cumulative or potential path of evolution. As the Second Deep Transition continues, a struggle will occur between the possible development pathways that impact the future of the socio-technical system. While multiple directionalities may compete for some time – as observed in the centralised and decentralised models of renewable energy production – a turning point is eventually reached at which actors agree on or acquiesce to a dominant directionality. This directionality may be hybrid, such as an energy system that combines centralised and decentralised energy production.

## First Deep Transition
The First Deep Transition started with the Industrial Revolution. It included (1) the exploitation of coal as an energy source and (2) mechanical technology to create a global economy built upon mass and linear supply and demand. Both the source of energy and the nature of mechanisation experienced periodic surges. The First Deep Transition set in motion a constantly modernising world and culture in which certain underlying assumptions and rules, which were embedded across a range of socio-technical systems, became the modus operandum for organising the production, distribution and consumption of goods and services. For 250 years, these assumptions and rules have satisfied societal needs. Industrial modernity includes the economic development model that underpins the macro-level selection environment for most societies – this is the landscape that influences science, technology and innovation. The co-evolution of niches and regimes across five surges of development and their consolidation into meta-regimes helped construct industrial modernity, which follows several directionalities that have persisted since the Industrial Revolution. Prior to the First Deep Transition, no previous Deep Transition had occurred. The Industrial Revolution not only brought in new actors, rules and systems but also changed the way humans innovated, putting in place socio-technical systems without much consideration of adverse social and ecological consequences. Individual states were instead supposed to manage these consequences through a combination of regulation and subsidies for new developments that were not picked up by the market.

## Innovation
An idea or process (including processes of articulation, adaptation or customisation), where its novelty distinguishes it from earlier ideas and processes, and which is taken up and utilised by people other than the originator(s). The innovation might be a reinvention or reuse of older ideas and processes. Note that innovation is often embedded within a new product but can also be embedded within a new policy, a new perception or a new use of an existing product. The most interesting innovations in the context of Deep Transitions are those that contribute to new configurations of socio-technical systems.

## Intervention points
Specific areas, sites or opportunities for active intervention which, when tapped, would likely facilitate transformative change and thus develop multiple socio-technical systems. Each intervention point consists of a cluster of transformative outcomes.

## Landscape
Socio-technical systems are embedded in societies, economies and the natural world, which can be dynamic (typified as a series of long-term changes) or mega-trends (such as population growth, urbanisation, digitalisation, the rise of global superpowers, the growth of the middle class, individualisation, and the rise of a new sensitivity towards nature, climate change and the loss of biodiversity). These trends can lead to or be implicated by shocks such as a depression, famine and/or warfare. The product of these trends and shocks is a landscape in which actors move – the context within which action takes place. While actors are not in a position to change trends or shocks in the short term, they are nevertheless forced to adapt and respond to them. In evolutionary terms, the landscape forms a macro-selection environment for systems change and niche development.

Actors act based on their perceptions of landscape trends and shocks. Hence, the perception of such trends and shocks and any resulting expectations are crucial for Deep Transitions dynamics because they shape niche regime interactions. For example, when climate change (a landscape trend) became a more widely perceived threat to humanity and was labelled a climate crisis, more investment began to flow into niches that helped combat the crisis. Moreover, some regime actors, such as those active in the fossil fuel industry, and banks and investors supporting this industry, began to accept that coal-fired plants should be abandoned.

## Leakage effects
A negative outcome of system optimisation, in which the positive impacts from new or improved sustainable practices in one part of a socio-technical system are cancelled out by a corresponding shift towards the unsustainable practices or outcomes of another part of the system, or of an adjacent system.

## Meta-regime
A set of mutually aligned meta rules embedded in multiple-systems. The key aspect is that a set of meta rules, which are present across multiple-systems, coordinate in their development towards forming a regime of their own and, subsequently, set a directionality shared across multiple socio-technical systems. For example, mass production is a meta-regime that combines several meta-rules, including centralised production, global value chains, capital-intensive manufacturing processes, economies of scale, externalising the environmental cost of production, transporting mass-produced goods and relying on increasingly sophisticated infrastructure and technical skills. These rules operate across energy, food and automobility systems.

## Meta-rules
A rule manifest in multiple socio-technical systems – for example, the practice of using fossil fuels in energy, agriculture and mobility systems, therefore influencing not just single systems but the standard practices and norms of behaviour in societies and economies.

## Niche
Spaces for radical innovation that are insulated from the selection pressures of the dominant regime of a socio-technical system. For example, direct consumer agreements with farmers open up a space for innovation in the production and distribution of agricultural products. Actors search for alternatives to fight and alter the dominant regime's practices

and rules in this space – for example, the dominance of processed foods and supermarkets. The space could begin with a shared, collective opportunity to think, do and act differently. To become a niche, this opportunity also needs to be translated into practical application and, ultimately, practice. Experience accumulates in niches through networking and learning, as well as through developing shared and specific expectations that can guide further investments. Multiple niches within multiple systems may be grouped together in a 'niche cluster', a set of interconnected and mutually supporting niche innovations that have the power to transform multiple interconnected systems at the same time.

## Rebound effects

A negative outcome of system optimisation in which efficiency gains amplify unsustainable behaviours by allowing for, if not driving, an increase in demand or the use of the product or service that trades sustainability for efficiency.

## Regime

A relatively stable and aligned set of rules that guide the behaviour of a set of actors in a single socio-technical system. Regimes are the genotypes of socio-technical systems. By guiding the behaviour of actors that sustain and curate the system's development, regimes provide directionality.

## Rule

A constraint and enabler of human action, leading to regular patterns of practice that support and curate socio-technical systems. Many types of rules exist, ranging from regulative rules (explicit standards) through cognitive rules (implicit values and beliefs) to design rules and search rules (heuristics). In practical terms, rules often underlie policy, user and cultural routines, including the subjectively perceived framings and assumptions associated with these routines. Examples of formal rules include published standards, while informal rules are the rules of thumb or norms that people follow consciously or unconsciously.

Within socio-technical systems, rules are often tacit and collectively held or shared across several actors. They are the mechanism through which the different domains of a system, such as policy, market, science and culture, intersect. In other words, a system only exists due to rules intersecting and overlapping across its domains. Sets of rules that are coherently aligned with one another across various domains are the backbone of a socio-technical regime.

## Second Deep Transition

The social and ecological consequences of the First Deep Transition are the roots of the Second Deep Transition. This movement puts new socio-technical systems in place that address social and ecological challenges (for example, global warming) and change how we innovate, putting social and ecological targets at the centre of development. Key features that distinguish the Second Deep Transition from the First are the early signs of rupture in the values and beliefs of present-day society: limitless material growth, no planetary boundaries, and humanity's disregard for its impact on the natural world. The roots of the Second Deep Transition lie in the 1970s, amid growing criticism of consumerism and environmental degradation and an energy crisis that led to investment in renewables. It utilised the power of information and communications technologies. Currently, we live at the turning point of the fifth surge of the First Deep Transition, which overlaps with the first surge of the Second Deep Transition.

## Socio-technical systems

Systems for the provision of a certain societal need – for example, energy, mobility or food. They consist of a set of rules (a regime) that guide a configuration of actors who carry out tasks across and within a number of aligned system elements. These elements are (1) technologies (scientific theories, products, infrastructures), (2) cultural perception and symbols, (3) user preferences and market structures, (4) industry strategies, and (5) business models, policies and regulations. If rules and regimes are the genotypes of socio-technical systems, then system elements are the phenotypes.

Socio-technical systems can be nested within one another. A local system may be nested in a national and international system – for example, the socio-technical system of grid-distributed electricity includes elements such as power plants, electrical power cabling, safe-wiring newly constructed buildings, and the existence of public or private arrangements for generating and distributing electrical power. Market structures include electricity use in homes or businesses for illumination, heating, motors or electronic devices. A socio-technical system is a large system embedded in a society in which electricity is assumed to be necessary and present. Industry strategies and business models are consequently focused on acquiring cheap and easy access to electricity.

## Surge of development

A 40–60 year process in which a coalition of niche and regime actors working with a new set of technological opportunities install a new configuration of socio-technical systems (rules, actors, elements). The process begins small, and niches often emerge in several places independent of each other, but they end up aggregating and putting new systems in place that dominate local, national or global economies and societies. During the first phase of a surge, niches may develop in different and competing directions. However, a turning point can be reached when actors begin to group around a given directionality and accept a specific (set of) meta-regime(s) as the desirable future. Surges are driven by both public and private investment.

## Systems change

Occurs when a fundamental reconfiguration of the system takes place, including through the development of new rules and meta-rules. This, in turn, can provide a stable foundation for the emergence of new, fully sustainable and desirable systems that can challenge the unsustainable practices of current unsustainable regimes. Systems change also has a better chance of avoiding oppositional second-order effects, such as rebound or leakage effects often associated with systems optimisation. Instead, when systems change happens, sustainable behaviour becomes the norm. This prevents gains in one part of the system from being dissolved elsewhere.

## Systems optimisation

Innovations, developments and progress within a socio-technical system that improve the efficiency or otherwise support the continued functioning of the existing configuration and its dominant practices. In the short term, systems optimisation may bring social and/or ecological benefits and can generate positive outcomes. However, these positive outcomes are often cancelled out by rebound and leakage effects. One example is in energy efficiency improvements, which are often followed by increased overall consumption. Furthermore, systems optimisation may further entrench existing dominant and unsustainable regimes by making them more efficient and introducing additional sunk costs on the part of regime

actors, thereby hindering the future development of niches capable of catalysing systems change. As a result, system optimisations can delay systems transformation.

### Transformative Theory of Change

A theory of change is a conceptual framework that identifies a pathway towards creating change, consisting of inputs, activities, outputs, outcomes and impact. A Transformative Theory of Change (TToC) is a theory of change that focuses on achieving systems change. In Deep Transitions, we integrate transformative outcomes into this TToC as a means to unlock the transformative potential of a project or company.

### Transformative

In Deep Transitions thinking, the word 'transformative' has two important meanings when applied to innovation: (1) a break or distinction from past practices or routines, which opens up new possibilities for innovation and systems change broadly or across a variety of contexts (a qualitative statement of the potential of an innovation compared to other innovations), and (2) a process that establishes a new alternative configuration of a socio-technical system with a new directionality that addresses ecological and social challenges.

### Transformative outcomes

Results from specific transition processes such as learning, networking and shielding niches. The notion of outcomes creates a fit with the model of a theory of change. Actors who aim to enable transitions should intervene to induce these outcomes because they lead to changes in actor behaviour and eventually encourage actors to adopt new rules and systems change.

### Transition

The change from one socio-technical system to another, which implies a change of rules, regime, actors and system elements. The term usually operates on the premise that existing socio-technical systems are not socially or environmentally sustainable, and that there is a social, ecological and economic need for a new directionality within the system. This directionality is discovered and developed in niches.

# Annex 1: The Deep Transitions Panel Process

## The Global Investors Panel: A mandate for transformation

**Prior to launching the Global Investors Panel, the research team sought to identify and convene a diverse group of engaged expert investors to serve as its panellists. These investors were drawn from a variety of backgrounds in terms of their function, experience (private and public investors operating directly and indirectly across different sectors and financial scales) and demographics (with a particular focus on gender and global representation in terms of their background or specialism). Of all the investors approached to take part in the Panel, 16 were selected and agreed to participate. This group was brought together around a common purpose, mission and mandate, established as part of the Global Investors Panel's provisional terms of reference.**

The Panel's mandate adopted the starting point that while previous investments have led to high levels of wealth and welfare in the Global North, they have also led to increasing global ecological degradation and widespread social inequality. With this in mind, the Panel identified the need for investment into sustainable development, mitigation of climate change and, most importantly, global societal transformation to the order of trillions of dollars for many years to come. However, the Panel recognised that this challenge is not simply a question of scale; more money is not necessarily the most effective way to achieve transformational change. Thus, the Panel first and foremost resolved to explore how to invest in transformation and initiate and support the changes that might be capable of generating impact across economies and societies. By leveraging the Deep Transitions theoretical framework, the Panel would work with the research team to explore scenarios for sustainable development over the next 30 years and provide an opportunity to reflect on and improve current impact investment strategies.

The Panel's mandate established the core goal of developing an Investment Philosophy for public circulation that would:

1. outline the rationale for a Deep Transition as a new direction for innovation investment and policy,
2. describe the characteristics of an Investment Philosophy, thus hastening movement in a new direction and
3. reflect on the robustness of this Philosophy's application to a range of possible future developments or scenarios as produced by the research team working with the Panel.

A Panel chair was appointed to coordinate the Panel and its work with the research team. This individual was one of the 16 investors selected for the Panel and remained independent of the research team. The chair was compensated financially for the additional time dedicated to working on the project, a reflection of their role's importance in serving as a voice for the Panel and shaping the work program of the project. The remaining 15 panellists were not compensated for their time. All panellists agreed to invest an average of 4 to 6 hours per month into the Panel; attend Panel sessions regularly; engage with preparatory materials and work as needed and to the best of their abilities; contribute to external communication and generate impact; and protect all confidential information from public disclosure.

Finally, to balance and strengthen the collaboration between the Panel and research team, the project adopted a tripartite actor approach, which required adding a team of facilitators. Where the research team brought Deep Transitions theory into the work and the Panel complemented this with their applied investment expertise, the selected facilitators focused on convening stakeholders in the collaborative space and opening up possibilities for collaboration. As such, their role went beyond simply acting as a host and mediator and included a range of additional considerations, such as how to bridge knowledge hierarchies.

## The panel process: blocks, sessions and cycles

Deep Transitions Futures was carried out from September 2020 to December 2022. The Global Investors Panel Process started in March 2021. The core work of this Process was divided into three 'blocks': periods of collaboration and cocreation between the Panel and research team, as grouped by focus topic and project phase. Block 1 focused on 'setting the scene' and laying a common foundation for the project. Block 2 employed futures methodologies to identify and refine alternative futures that might bring about or accelerate progress toward the Second Deep Transition. Block 3 focused on developing a Transformative Investment Philosophy, which incorporates a theory of change for investor practice and society and specific indicators for measuring progress in change. All three blocks are discussed in further detail below. Within each block was a series of collaborative and individual activities, which included asynchronous (preparatory) research carried out by the research team, one-to-one interviews with Panel members, small group dialogue sessions, and full panel sessions that brought the Panel and research team together for live collaborative encounters that the facilitators led. The number of full panel sessions per block varied across blocks and was adjusted throughout the project to address shifting goals and needs.

The original plan was that these panel sessions would take place in situ. However, this was no longer possible due to the global COVID pandemic. Instead, the research team worked with the facilitators to design and carry out a digital version of the Process, with panel sessions taking place via Zoom and using a shared digital whiteboard on Miro as a functional working space.

Each full panel session required a panel session cycle (**Figure 8**). This cycle consisted of:

1. preparation, in which the research team undertook research tasks and prepared input for sessions in the form of briefing packs,
2. the session, in which the Panel and research team met for live collaborative encounters hosted by the facilitators,
3. analysis, in which the output of the session was collected and analysed, with summaries and reports prepared and shared with actors, and
4. reflection, in which the Panel, research team and facilitators engaged in reflection activities, including immediate feedback, open asynchronous feedback and specific reflection sessions held no later than two weeks after each panel session.

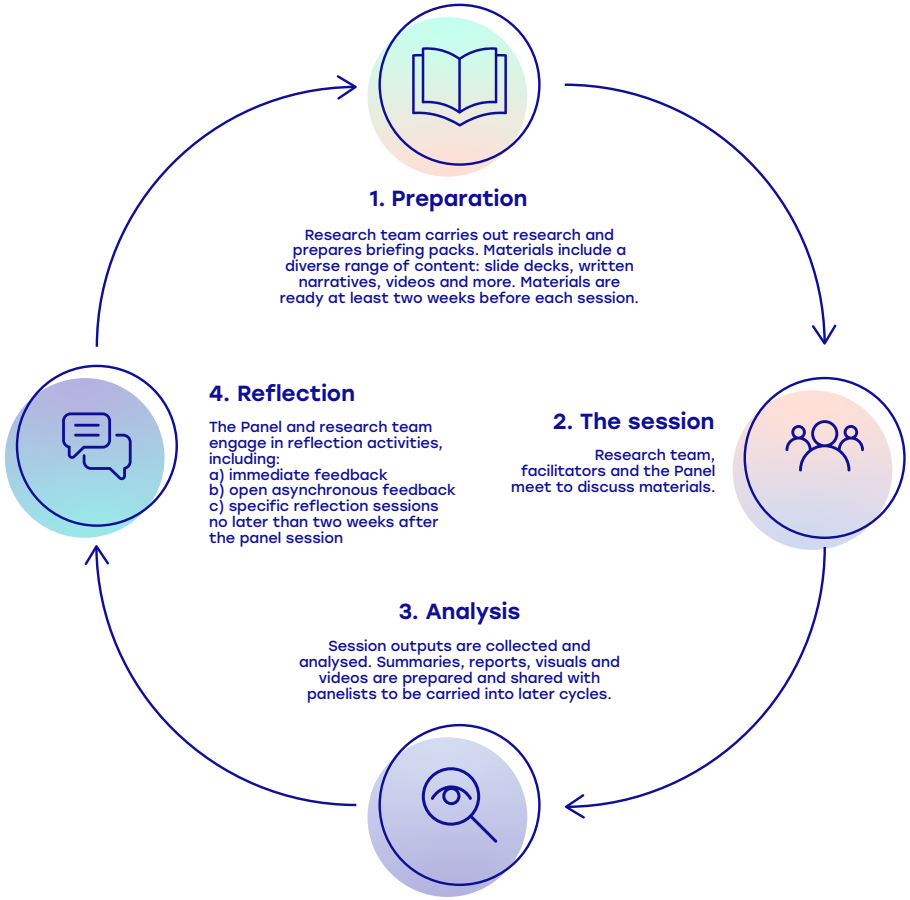



Figure 8: Panel process

## Block 1: Scoping the crisis through Deep Transitions theory

Block 1 was executed in the first half of 2021 and introduced the Panel to Deep Transitions theory, concepts and language. This block also explored the current sustainable investment strategies and policies, along with the barriers to implementation.

The block began with an initial one-to-one interview with each panellist, focused on understanding their initial perspective on sustainable finance. Two smaller sessions were then held for each panellist, one focusing on Deep Transitions theory and the other on sustainable finance. The former session included an introduction to Deep Transitions theory as a whole and socio-technical transitions in particular, while the latter session focused on understanding the Panel's current investment strategies. The goal was to bring to the fore demand (investment strategies of panellists) and supply (Deep Transitions theory), as well as identify particularly sensitive areas within the project, such as the primacy of wealth accumulation in investment. These sessions were also intended to help the Panel and research team get acquainted.

Block 1 closed with a full panel session (1.1) on 21 June 2021. This first full session aimed for panellists to get a good understanding of the Panel Process and to reach a standard definition of the gaps between core challenges and current investment strategy types, as in the direction of investments. This meeting filled a double gap, first between the status quo and a better future, and second between the current investment regime and what is needed to achieve this better future. The intention was also for the Panel to begin a process of second-order learning, where they would have a chance to question their own assumptions about their current investment strategy.

## Block 2: Addressing the critical role of investment

Block 2 was executed in the second half of 2021 and began with exploring and defining a series of possible alternative future visions of the world in 2050. This big-picture approach meant that the Panel and research team could address the global challenges of climate change, biodiversity loss and social inequality.

In the first full panel session of this block (2.1), the research team outlined nine alternative futures across three socio-technical systems (food, energy and mobility). These futures were consistent with Deep Transitions theory and with the Panel's articulation of the gap between challenges and current investment strategies. These alternative futures differed in the nature, timing and magnitude of rule changes necessary for their adoption by 2050. The following full panel session (2.2) built on Panel feedback from 2.1 and combined the nine single-system futures into three composite multi-system futures: (1) After the Frugal Turn, (2) First, Do No Harm and (3) From Moonshot to Earthshot (see **Annex 2**). Each scenario was based on a set of premises that addressed how individual and collective action may lead towards that scenario. In order to build a bridge from the present day to one or a combination of the three desirable future worlds, it was necessary to consider the critically important concept of couplings between systems and the strategic niches (both technological and institutional) that enable these couplings. These strategic niches, on which the Panel commented and expanded, helped to lay the foundations for a change in direction for how the entire system evolves.

In the last two sessions of Block 2, the Panel began working to bring together Deep Transitions theory with investment. To do this, they had to focus on the role of investment in enabling transitions, which began in a smaller dialogue session (9 November 2021) in which the Panel's individual points of view regarding current sustainable investment strategies, both public and private, and the challenges and opportunities for transformative investment, were explored. This dialogue session was followed by a full panel session (2.3) that focused on how to build a theory of change that links investment to strategic niche development and impact from the perspective of enabling the Second Deep Transition. These two final sessions worked in tandem, with the former gathering information on current sustainable investment strategies and methods in public and private contexts and the latter working on strategic niches informed by the earlier session.

## Block 3: Creating a shared vision of the future

Block 3 was executed in the first half of 2022 and it consolidated the work of Blocks 1 and 2, leading to the development and publication of a Transformative Investment Philosophy as well as a theory of change that considered the concept of transformative outcomes. This block began with stress testing and crowdsourcing initiatives, which were carried out in tandem and intended to bridge Blocks 2 and 3.

A series of three full panel sessions were held in this block to explore the integration and application of Deep Transitions theory within investment practices, leading to transformative investment. Session 3.1 was held in March 2022, where a design brief for the format and core content of the Philosophy was provided with Panel input. The remainder of the session was dedicated to an in-depth discussion that outlined ten principles which would become the foundations of transformative investment. These principles were grouped into three provisional themes. Following this session, the research team began working to incorporate Session 3.1 into an early draft of the Philosophy. In Session 3.2, the Panel and research team began to experiment with applying Deep Transitions theory to investment practices, (re-) introducing several concepts which could be deployed in investment planning to achieve the Second Deep Transition. The Panel worked in groups to cluster niches related to each of the three future worlds and positioned these in relation to four proposed intervention points. They then identified where specific transformative outcomes might occur or originate within each cluster. Session 3.2 culminated with a general discussion on the Panel's experiences of applying Deep Transitions theory to this investment planning exercise during the previous rounds of work.

Block 3 concluded with Session 3.3, which also served as the capstone to the Global Investors Panel Process as a whole. Session 3.3 was unique within the Process, as it consisted of four core sessions split across two days of in-person meetings in Utrecht, the Netherlands. The core aim of the session was to bring together all of the knowledge and insights acquired over the last 16 months of work and thus finalise the design and core content of transformative investment, the Investment Philosophy and the next phase of the Panel. This next phase consists of two core activities: (1) generating impact and (2) establishing a Deep Transitions Lab within which experimentation with transformative investment will occur. Panellists worked through a variety of core tasks, including further and final-round discussions on the initial ten core principles, to which the Panel added two additional principles, and an exercise in designing mock experiments to explore how Deep Transitions theory could be integrated into investment practices. The session closed with a strong commitment to carrying forward transformative investment into the next phase of work, albeit with a healthy degree of heterogeneity in individual panellist opinions regarding various aspects of the Philosophy.

## Timeline

The Deep Transitions Futures Global Investors Panel Process is divided into three core blocks of work.

1

## Block 1

**Expert workshop, February 2021**
To inform the methods adopted during the Panel, a workshop bringing together futures studies experts and members of the research team was held. Based on this workshop, the decision was made to adopt a future scenarios methodology, constructing multiple, exploratory and desirable futures in collaboration with the Panel.

**Designing socio-technical-system (STS) maps, February–June 2021**
Beginning in February 2021, the research team conducted mappings of each of the three focus socio-technical systems (STS): energy, mobility and food. These mappings identified Deep Transitions theory elements present in the three STS as they currently exist, including rules, niches, regimes, shocks and trends. These mappings were represented graphically in Miro, the online workspace used to facilitate collaboration between the research team and Panel during panel sessions. They served as the core input for the first full panel session, 1.1.

**One-to-one interviews, March–April 2021**
In a series of interviews, the research team explored panellists' perspectives on existing investment practices. These perspectives were used to inform the mutual recognition of a gap between existing practices and those needed for transformation.

**Dialogue sessions D.1, May 2021**
Following the completion of the one-to-one interviews with each panellist, the first of three dialogue sessions was held, exploring the topic of sustainable finance. Using results from the interviews as input, panellists discussed their own investment practices against the backdrop of the wider finance community.

**Dialogue sessions D.2, June 2021**
The second dialogue session focused on introducing the panellists to the core elements of Deep Transitions theory. This session also introduced panellists to the concept of socio-technical transitions and transformative outcomes more generally. Additionally, both dialogue sessions offered an opportunity for the research team and Panel to become further acquainted.

**Panel session 1.1, June 2021**
The first full panel session (1.1) pulled together the various outputs of the STS mappings, the one-to-one interviews and the two dialogue sessions to engage panellists in a discussion of the major challenges and failings present between each of the three STS, as well as an analysis of the role that finance plays in sustaining these challenges and its potential for overcoming them. Panellists were asked to consider the rules identified in each STS and classify them as either resilient or vulnerable. The core aim of Session 1.1 was to create a shared understanding of the need for a new approach to investment, a common vision for the purpose of the Panel.

2

## Block 2

Block 2 of the Panel focused on the co-creation of three distinct visions of the future, intended to guide panellists' imagination and thinking about the future while also familiarising them with the application of Deep Transitions theory to decision making. In adapting the 'future scenarios' methodology for the Panel, the research team took care to balance exploratory and desirable characteristics, creating space for panellists to experience, adapt and adjust

the futures while maintaining the core requirement that each should lead to a world that is both socially just and environmentally sustainable.

**Designing nine alternative futures, July–August 2021**
Using the identified lists of resilient and vulnerable rules identified by panellists in Session 1.1, the research team created a series of nine alternative desirable futures in the year 2050, broken down as three qualitatively distinct futures per STS. To produce these desirable futures the research team created wireframes or scaffolds of contexts and questions indicating how any one system would behave and manifest within any particular dimension (for example, 'how would gender roles manifest in this future?', or 'what would the staple crop be?'). The wireframes served both to improve the quality and validity of the futures (leaning on scanning research), while also increasing their experiential potential.

**Panel session 2.1, September 2021**
The first full panel session of Block 2 introduced the panellists to the nine alternative desirable futures. Panellists were split into three groups, each focused on a single STS (as far as possible panellists were matched to their expertise or interest), and asked to evaluate the desirability of these futures. In this context, desirability referred specifically to whether a future fulfilled the requirements of being both environmentally sustainable and socially just.

**Designing three composite future worlds, September–October 2021**
Following session 2.1, the research team revised the nine futures to account for panellists' input. These nine futures were subsequently categorized into three triplets, or composite future worlds: 'After the Frugal Turn', 'First, Do No Harm', and 'Earthshot'. These titles currently remain under review. Each of these composite worlds included one future from each STS, and so grouping was conducted according to synergies and compatibilities between the futures. They reflect archetypes of possible futures, but they were not intended to be strictly mutually exclusive and could in various geographies at various times overlap with one another.

**Panel session 2.2, October 2021**
In session 2.2 the panellists were introduced to the composite future worlds and were again asked to evaluate their desirability for further revision by the research team. Using the composite futures allowed the research team to introduce panellists to a core facet of Deep Transitions theory: cross-system linkages and couplings. These couplings between different STS are key sites of action that allow for concurrent and synchronous multiple-system change, the fundamental process of a Deep Transition. Panellists were further asked to identify any possible strategic niches, or niches that support couplings, as an exercise in the identification of investment potential for systems change.

**Dialogue sessions D.3, November 2021**
Following session 2.2 the research team hosted a third set of dialogue sessions, intended as information-gathering exercises focused on panellists' impressions of the concept of transformative investment. Whereas previous sessions covering finance had focused on current practices, these sessions explored the potential of a new approach to investment rooted in Deep Transitions theory. At this stage panellists had become familiar with the Deep Transitions Transformative Theory of Change (TToC) and socio-technical transitions, and so the research team were able to propose a series of core principles and concepts, such as a transition-enabling investment bundle, that brought together Deep Transitions theory and investment practice into a combined approach.

**Panel session 2.3, December 2021**
In session 2.3 one core strategic niche from each composite future was selected and its niche cluster (a collection of niches around it which mutually support one another) was mapped. These were 'Green hydrogen', 'Ecocoins' and 'Product-as-a-service'. Panellists were asked to incorporate the discussions of the previous dialogue sessions to consider how a transition-enabling investment bundle and other Deep Transitions–informed strategies could counteract barriers to investment and scaling of these niche clusters. Finally, the potential value of a TToC based on transformative outcomes (as metrics and milestones to aid progress towards systems change) was discussed.

3

## Block 3

Block 3 consolidated the previous work of the Panel and moved towards the final development and publication of a philosophy of transformative investment. The core challenge in this block was to integrate and apply Deep Transitions theory within investment practice in the form of the Investment Philosophy.

**Stress testing and crowdsourcing, January–March 2022**
In order to further evaluate and improve the desirability of the three futures, the research team engaged in two parallel processes: stress testing, which consisted of holding two expert workshops, and crowdsourcing, which consisted of an open public campaign distributed digitally. Both were information-gathering activities intended to inform the continuous re-design of the two futures.

**Panel session 3.1, March 2022**
Session 3.1 focused on three core objectives: (1) exploring and evaluating the results of the stress-testing and crowdsourcing activities, (2) identifying and defining core requirements of the Investment Philosophy, and (3) introducing the panellists to the 12 prototype principles of transformative investment.

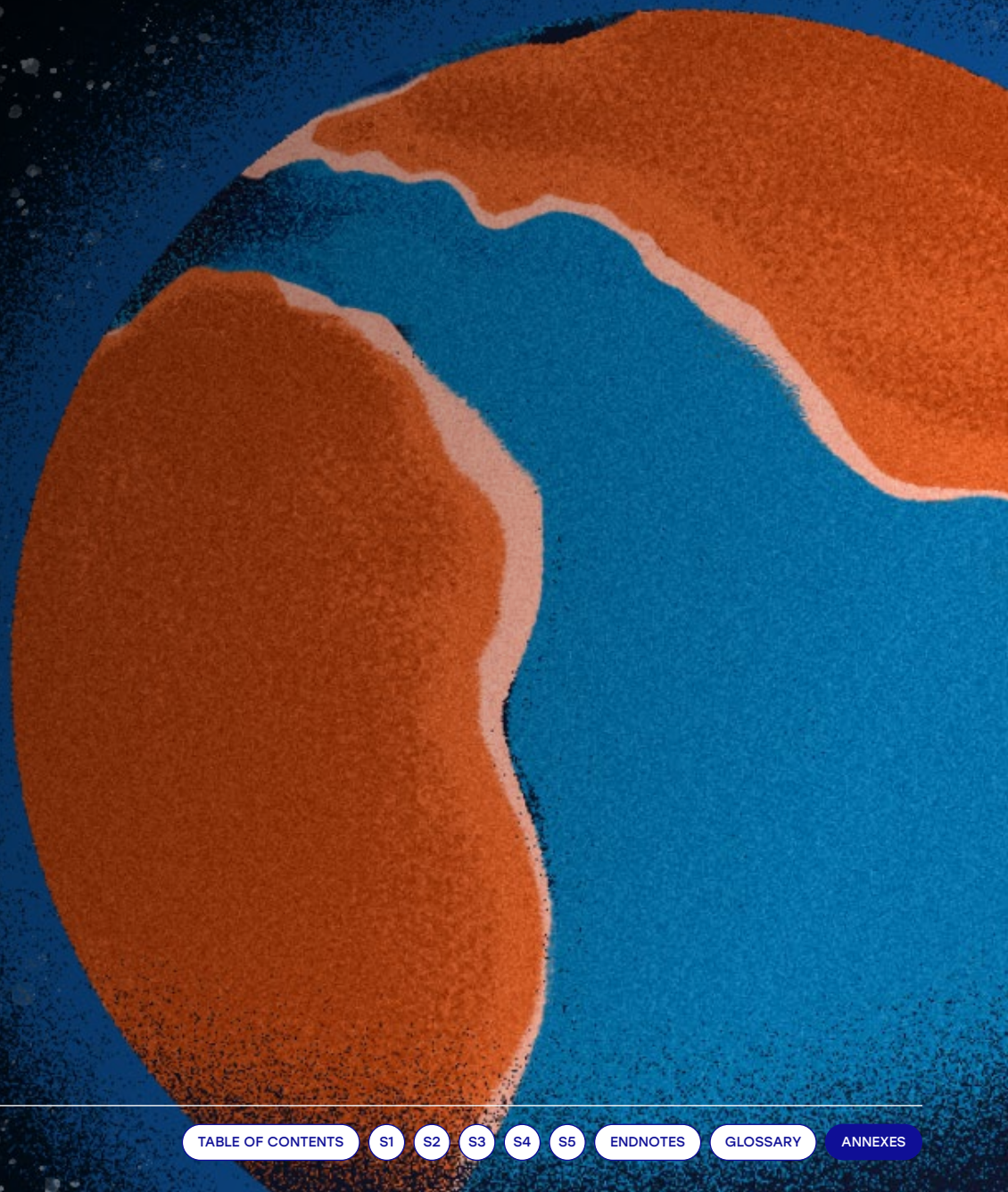
**Panel session 3.2, May 2022**
In this session, panellists experimented with the application of Deep Transitions theory within investment planning practice, testing the revised principles in conjunction with core Deep Transitions concepts and tools. Feedback was gathered on the integration and application of Deep Transitions theory within investment practices.

**Panel session 3.3, June 2022**
Session 3.3, which took place across two days, served as the capstone for Block 3 and the Panel as a whole. It saw the panellists gather in person on site in Utrecht, the Netherlands, for the first time to reflect, review, test, debate and finalise the core components of transformative investment. Particular attention was paid to the 12 principles, which were further refined ahead of their codification in the Investment Philosophy.

# Annex 2:
# Three Future Worlds

**This summary of three desirable future-world scenarios was generated by the Global Investors Panel Process (Annex 1).**

**For a quick overview, you can watch this short animation.**




## After the Frugal Turn

**Imagine a future in which limitless consumption is rejected in favour of living within the Earth's capacity for sustaining life. After continuously breaching the natural limits of the planet, humanity suffered through a series of unprecedented global disasters and shocks. This is a world in which humanity was forced to adapt, to reduce its global footprint and balance distribution of resources more equitably than ever before.**

**Energy** was the first system to change. Highly energised societies initially found it difficult to embrace the 'less is more' principle, but a combination of regulation and funding drove innovation for low-energy products, services, methods and industries. Best of all, these alternatives allowed the Global South to accelerate sustainable development while leapfrogging industrialisation.

In the **food** system, multiyear crop failures touched almost all regions worldwide, leading to the collapse of supply chains at local, regional and global levels. Scarcity and rationing fuelled a race to zero waste, optimising local, national and global agricultural systems so that everyone had access to sufficient food, with few excluded from enjoying the excess.

In the **mobility** system, it was difficult to shake the belief that individual mobility signified freedom. Difficult, that is, until societies embraced ways to localise provisions that corresponded to needs, one example of which was the 'food within a 300-kilometre radius' origin principle. With the accelerating digitisation of human interaction, a new era of green and shared vehicles and local agriculture reduced the environmental burden, especially in the Global North, where travel had once been frequent. Instead, people tended not to travel or opted for 'slower' means of transport, such as electric kayaks.

Challenges remain, and this world is far from equal or equitable. Nonetheless, striving for a more balanced relationship with nature and each other has improved the climate and increased global equality considerably.

## First, Do No Harm

**Imagine a world where biodiversity has plummeted and the degradation of millennia-old ecosystems has become ever more apparent. Populations are shaken out of our profound neglect and disregard for the world and its ecosystems. They are resolved towards transformation, working with and through nature and understanding that humans are only one part of a spectacular, indivisible web of life.**

First, we made tremendous gains in **renewable energy**, harnessing the entrepreneurial spirit of energy independence and sustainability and rapidly uniting communities worldwide in the progression towards total decarbonisation. What began as a bottom-up trend eventually reduced energy poverty rapidly, even in remote regions, resulting in a global society that was more connected, yet less intensely concentrated, than before.

Major investments in public transportation and **mobility-as-a-service** provided the means for radical change in the mobility system. The mobility-as-a-right movement demanded low-cost, fast and efficient public transit within and between communities, offering an alternative to the car-dominated approach of the 20th century. At first, these services were most effective in urban areas, but by the late 2030s they had also expanded to more remote regions.

Finally, **agriculture** adopted a mixture of traditional practices and new scientific understandings of ecological health, transforming the industry from being exploitative and polluting to one that not only embraces nature but also actively seeks to regenerate the natural world. Farmers are no longer only seen as food producers but more as ecological stewards, managing ecosystem health – including biodiversity and soil health – above all else.

We are beginning to see the fruits of our labour. Our negative impact on the planet, such as emissions and resource extraction, peaked in the 2030s. Biodiversity, which was once in freefall, has stabilised.

# Earthshot

**Inspired by the spirit of 20th-century missions to put humans on the moon, a new movement emerged in the 2020s that was determined to deliver on the promise of solving the grand challenges of our time through human ingenuity and entrepreneurial spirit. The result? A world that only 30 years prior would have sounded like a technological utopia.**

Renewable energy mega-projects helped decarbonise the energy system. The deployment of large solar **energy** farms in the world's deserts became the cornerstone of a globally designed energy infrastructure that would further balance global power dynamics through a principle of equitable interdependence. Ultrahigh-voltage transmission lines spread across the world, linking first provinces, then states, then entire regions and continents in a unified web.

As energy abundance was reached, an entirely new **mobility** infrastructure based on autonomous, connected, electric and shared vehicles became possible. Substantial green subsidies allowed lower-income markets to leapfrog developed countries directly into electric mobility, while electrified delivery by quadcopter drones drove innovation in product design to the point that aerial delivery became an option even for the most remote areas.

Growing networks of DIY biohacking communities brought together geneticists, farmers, students and enthusiasts to work towards transforming the **food** system. These networks designed new food products that would suit all conditions across the globe. Open-source digital libraries of genomes were established to allow new foods to rapidly proliferate at an international level, thwarting efforts from multibillion-dollar transnational companies to compete over proprietary products.

The realisation of 'green growth for all' through technological progress has been made possible with the consolidation and democratisation of global systems of innovation. Innovation, in turn, has allowed humanity to further decouple our societies from nature, releasing vast areas of land for rewilding while granting us the ability and wisdom to control and manage our remaining impact on the natural world. This world epitomises the triumph of *homo faber* and the ability of human beings to determine our fate through invention.

DEEP
TRANS
ITIONS