DECISION SUPPORT FOR DEEP UNCERTAINTY

It's not what you think.
It is the way that you think that matters.
– Phillip Tetlock

Mark Workman

FORESIGHT TRANSITIONS

Imperial College London

What is this conversation all about?
– some primers

Deep Climate Uncertainty & Decision-Making in Business

Are we asking the right questions?

Are we seriously underestimating the extent of uncertainty?

Are we using the right tools for strategic decision making around Climate Change and Net Zero?

Environ. Res.: Climate 1 (2022) 025002 https://doi.org/10.1088/2752-5295/ac856f

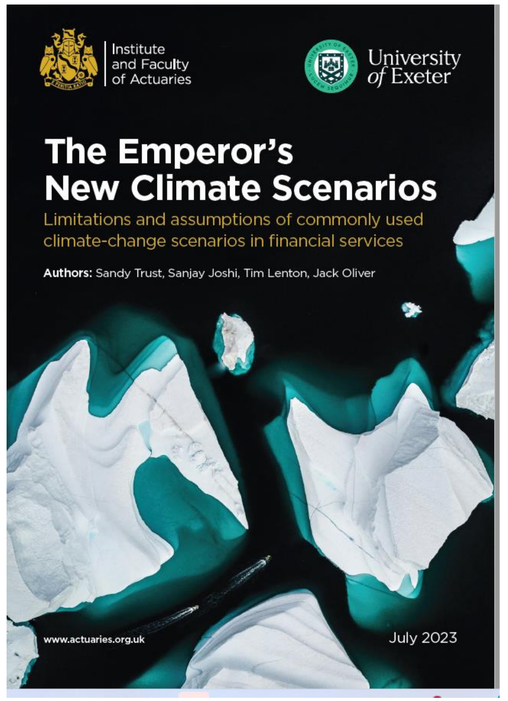
ENVIRONMENTAL RESEARCH
CLIMATE

PAPER

Acute climate risks in the financial system: examining the utility of climate model projections

A J Pitman[1,*], T Fiedler[2], N Ranger[3], C Jakob[4], N Ridder[1], S Perkins-Kirkpatrick[6], N Wood[5] and G Abramowitz[1]

- ***Provide little insight on how acute risks likely material*** to the financial sector ('material extremes') will change at a city-scale.
- If all Central Banks (+100 members of NGFS) use a methodology that is systemically biased, ***this could itself lead to a major systemic risk to the global financial system***.



Key findings

1. Climate models in financial services are ***underestimating risk***
2. Carbon budgets - smaller than anticipated - ***risks may develop more quickly***
3. Regulatory scenarios introduce consistency but also the ***risk of group think***.

AGENDA

1. Stories from the front line
2. Understanding uncertainty
3. Decision Support Toolbox

Cracks in the orthodoxy – an emerging issue

Across Net Zero domains, we see increasing concerns about the robustness of strategic and computational models:

- Climate change is now happening at a rate that climate scientists are struggling to model
- Assumptions around diffusion of deep decarbonisation technologies appear increasingly problematic
- Dominant models consistently fail to adequately reflect financial aspects of climate change & transition dynamics

Diverse in scope, these issues share a common cause:

Orthodox methods conceal the existence of uncertainty – at a time when uncertainty is rapidly proliferating

Effective climate response requires a broader toolbox that empowers decision-makers to engage with this uncertainty

"Could we be entering a period of non-linear climate change, where temperatures and extreme events do not increase smoothly as expected but instead come suddenly, more often and perhaps more powerfully? And if we are, how would we know?"

"……. climate threat that is now moving into uncharted territory."

Cracks in the orthodoxy
– evidence from the financial sector

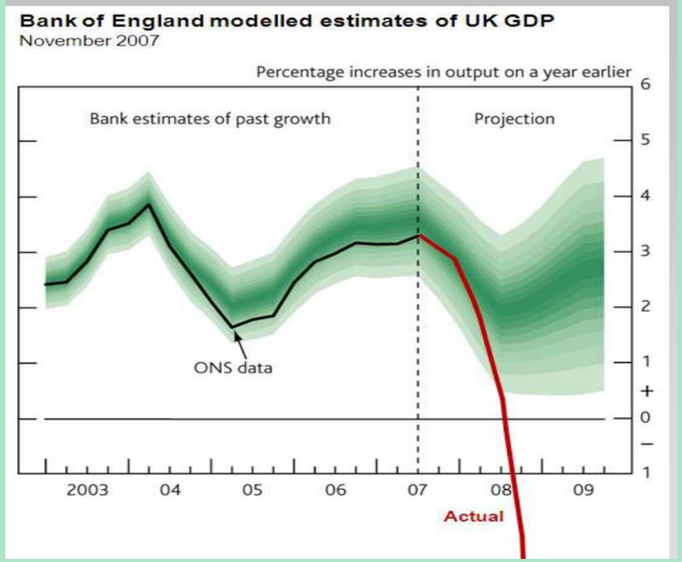
Topics previously considered to be subjected to scientific processes of `prediction' are now increasingly considered to be steeped in deep uncertainty.

In-spite of long run datasets from the past…..the ability to forecast is limited:

- Data is sparse;
- Data is inexact; and
- Structure of economies shifts over time *i.e.* the system is unbounded and complex adaptive.

…..does this sound familiar in terms of what we are doing when modelling impacts of climate change and net zero?

Can compare with what happened



Climate Capital Global Economy + Add to myFT

Financial models on climate risk 'implausible', say actuaries

Lack of understanding of full economic damage caused by 'hothouse' conditions, report finds

The consequences of passing climate 'tipping points' — self-reinforcing and irreversible negative planetary changes — were often not captured by the models, the researchers said © Noah Berger/AP

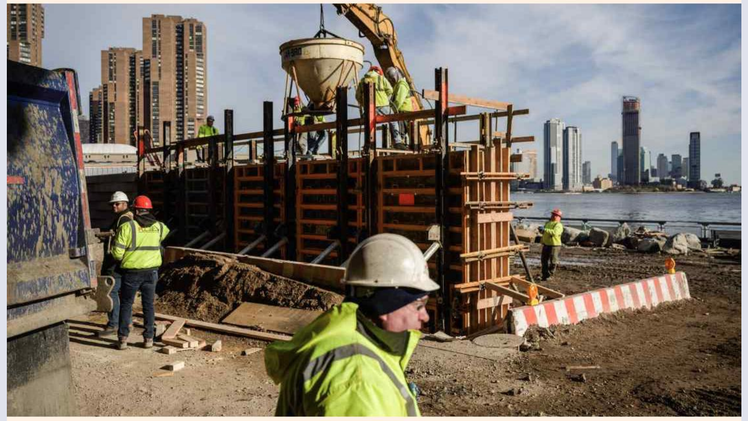
Are we using the right tools
….in order to allow the right questions to be asked?

Opinion **Business education**

Why it's time to prepare for the worst on climate change

Business and society must invest in adaptation now despite uncertainty about the impact

ROBERT PINDYCK + Add to myFT



Stemming the tide: Construction work on a sea wall to protect New York City from storm surges amid rising sea levels © Ed Jones/AFP via Getty Images

Despite call to action (FT 5th July 2023)…why is it that organisations don't feel able to cope with the effects of climate change…..

Extract from Dragonfly Strategic Outlook 2024 Report on the extent to which Corporates are seeking to integrate the implications of climate change into strategy development

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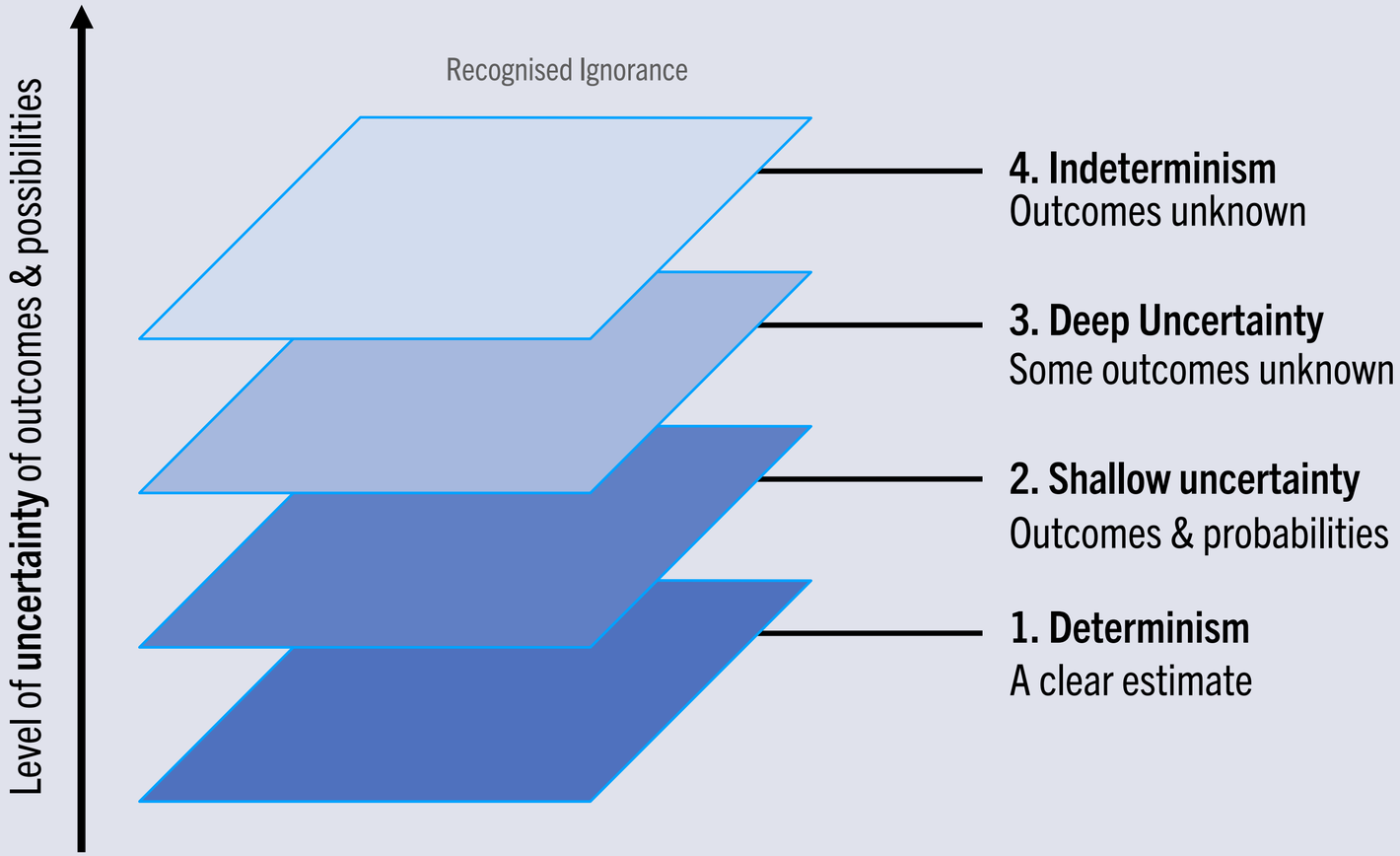
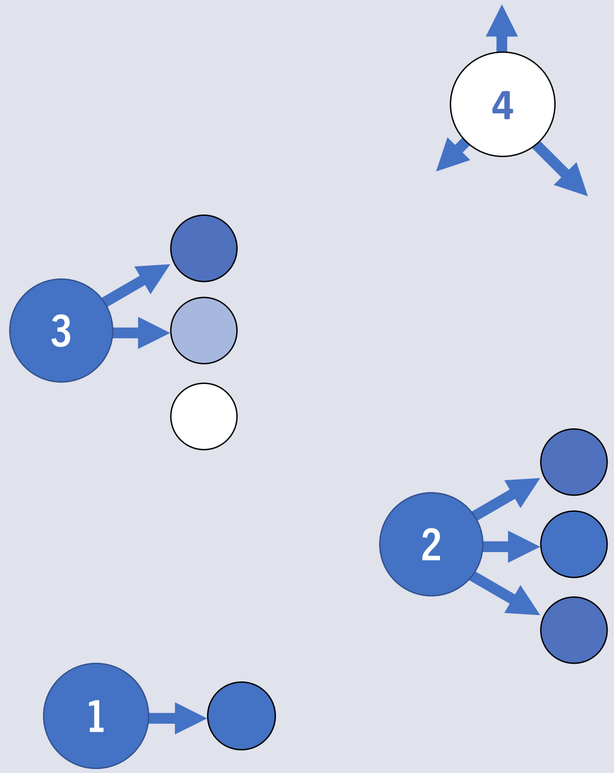
Different challenges…

… operate within differing levels of uncertainty



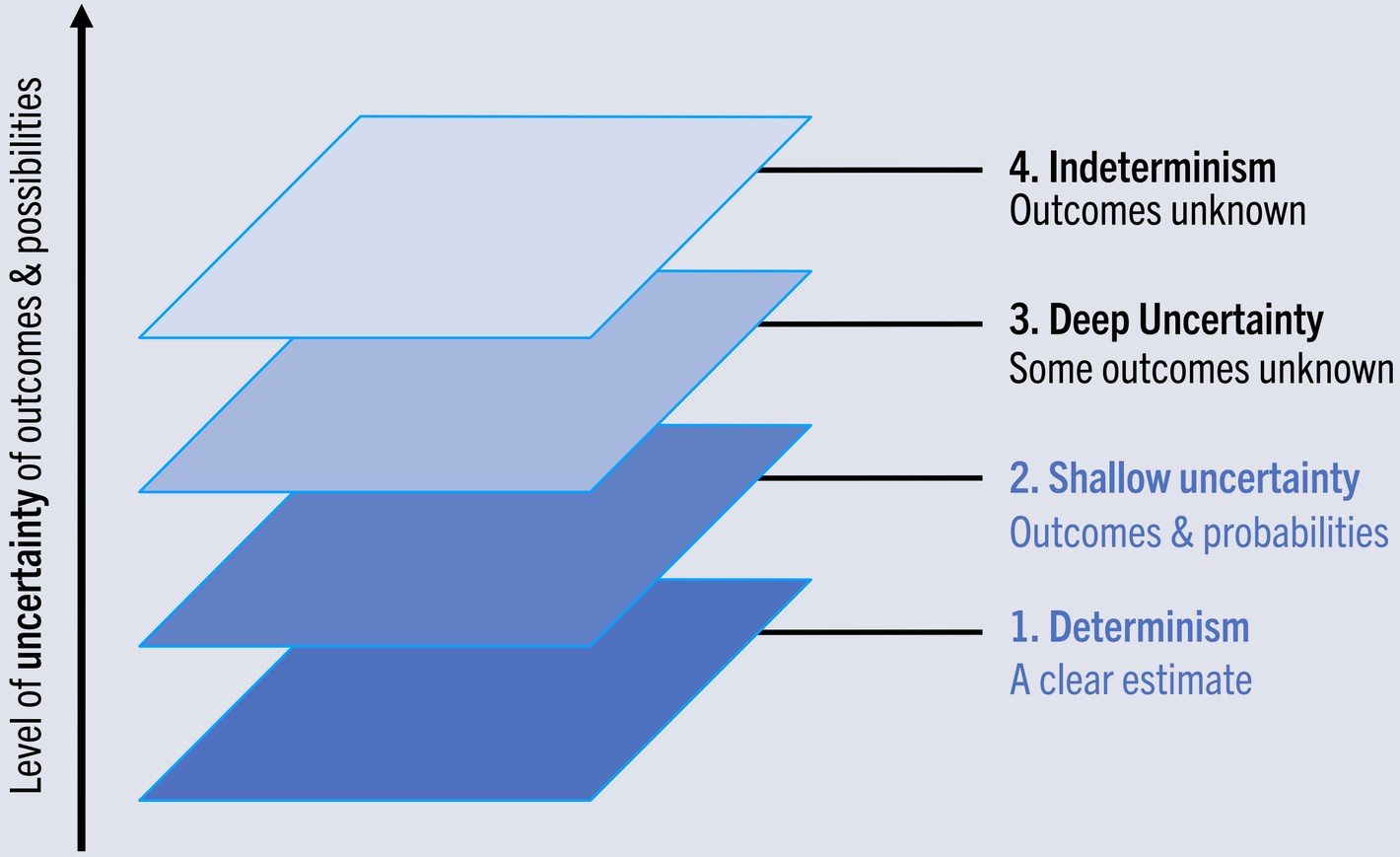


Different levels of uncertainty…
…can be characterised via a range of criteria

	SHALLOW UNCERTAINTY	DEEP UNCERTAINTY
Agreement on conceptual models? Identifying and describing the relationships among key driving forces that will shape long-term future	✓	✗
Agreement on how to reflect uncertainty? Probability distributions used to represent key variables and parameters in mathematical representations of these conceptual models	✓	✗
Agreed metrics to evaluate desirability? How to characterise and evaluate desirability of alternative outcomes	✓	✗

>> Lack of broad consensus in any criteria likely to indicate a landscape characterised by deep uncertainty

Different levels of uncertainty…
… require different decision-support tools



Exploratory approaches
Map assumptions onto consequences

Do not privilege any one set of assumptions.

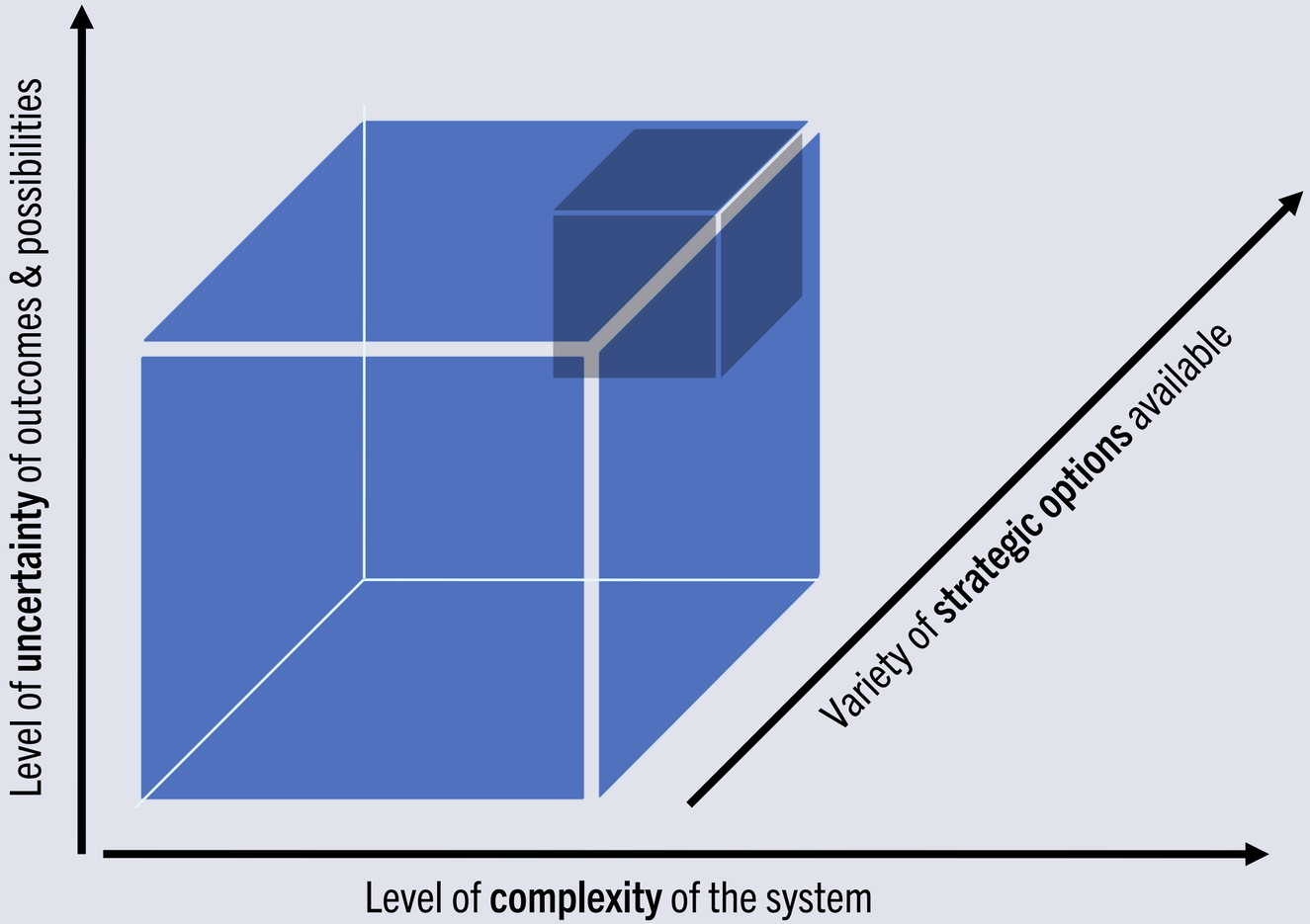
Iterative exploration & problem-solving.

Consolidative Approaches
Gather knowledge into a single package

Validate and then use as a surrogate for the real world

Prediction with quantitative dimension.

Uncertainty is not the only axis
Resulting in a high-dimensional option space



<u>High dimensional complexity</u>

Problem spaces also vary by levels of systemic complexity

Decision landscape also varies by diversity of possible strategic responses

Over-reliance on orthodox tools tends to reflect only part of this picture – inhibiting both understanding and response

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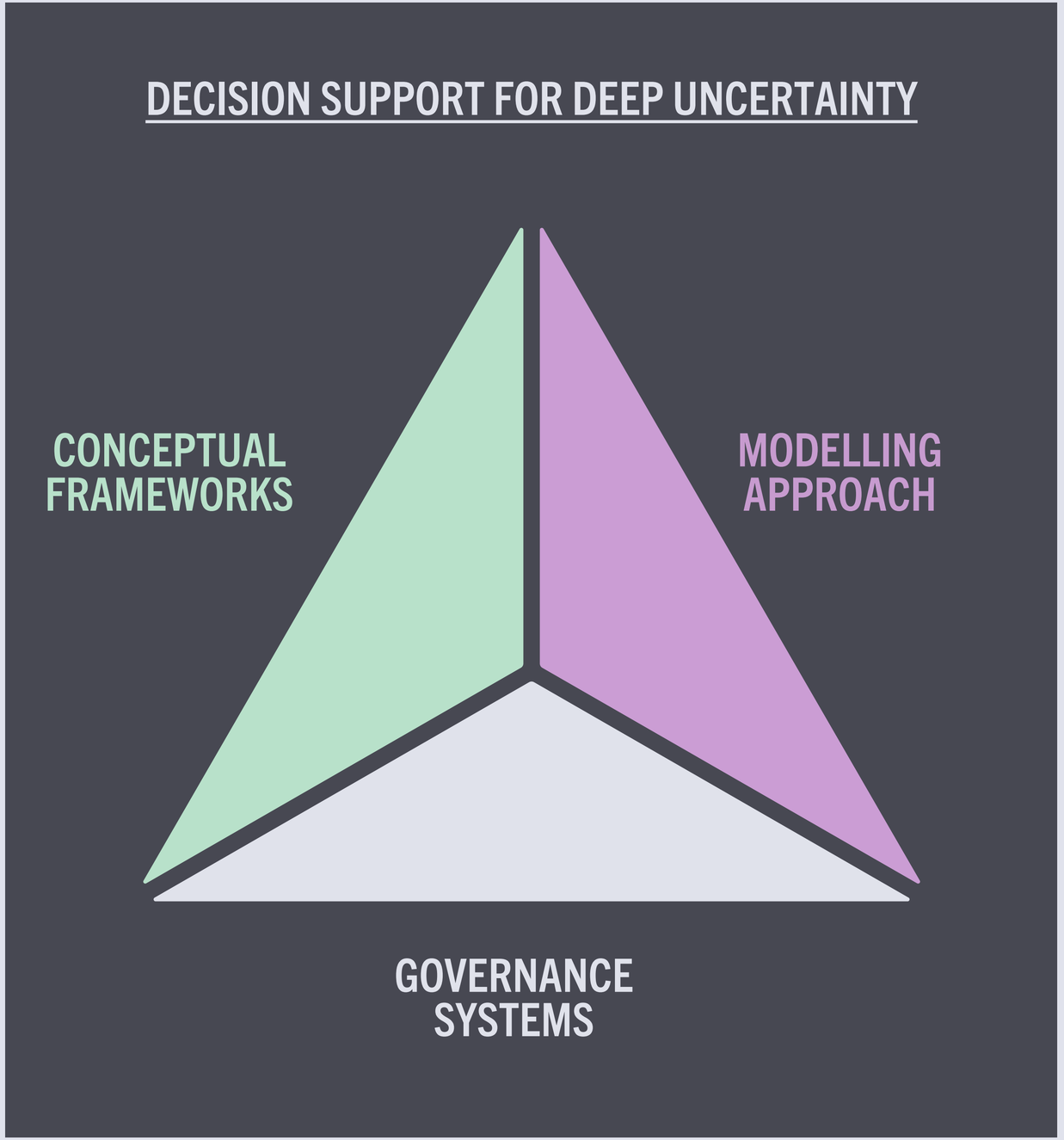
Deep uncertainty toolbox
Key components

Navigating complexity and deep uncertainty requires new tools and new ways of thinking at multiple levels

We identify 3 inter-related categories:

- The CONCEPTUAL FRAMEWORKS we use to structure our understanding of the landscape and strategic response
- The MODELLING APPROACH we use to generate, explore and evaluate past events and possible futures
- The GOVERNANCE SYSTEMS we use to select, enact and evaluate policy and strategy

These tools can used together in different to facilitate an exploratory approach to robust decision-making.



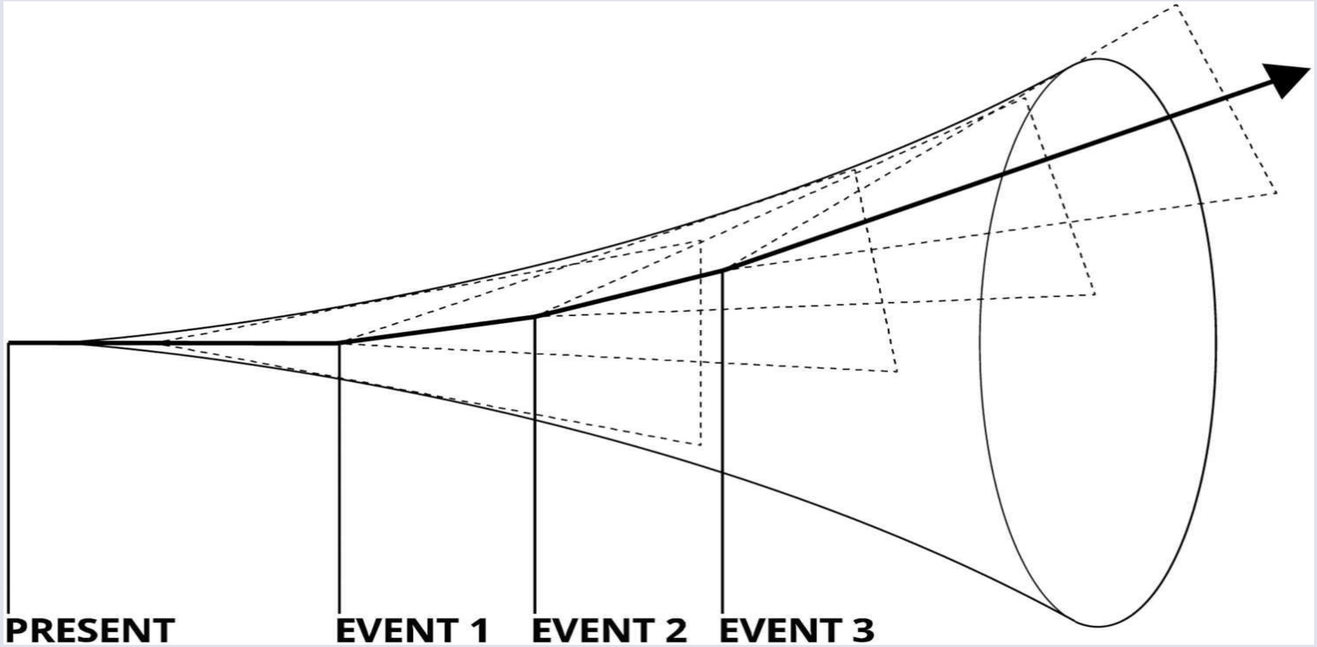
Consolidative modelling
What does it do?

Optimisation - seeking optimal outcomes under fixed assumptions, markets or actors have perfect knowledge of future conditions and minimise costs through optimally allocating resources.

Goal: Figure out your best-guess future and design the best policy you can for that future.

Conceptual framework: Optimisation and Maximize expected utility

Question: ‘What is most likely to happen?’

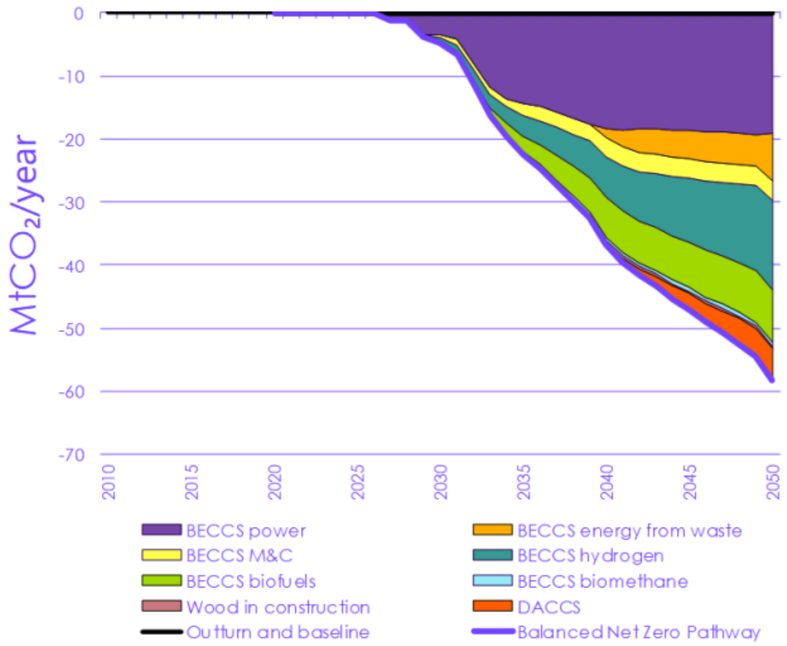


”Predict than act” Mindset - Questions:

- What will the future be?
- What is the best near-term decision?
- How sensitive is the decision to the conditions?

Consolidative modelling
Limitations of the orthodoxy

CLIMATE CHANGE COMMITTEE, 6CB



Source: BEIS (2020) *Provisional UK greenhouse gas emissions national statistics 2019*; CCC analysis. M&C = Manufacturing and Construction.

BECCS MODELING CHARACTERISED BY:

- Bioenergy with carbon capture and storage (BECCS)
- Direct Air Capture of CO2 with storage (DACCS)
- Wood in construction

Other types of removals have not been included in the scenario.

CCC presentation of a simulated GGR portfolio to achieve Net Zero excludes consideration of:

– full range of possible GGR solutions

– original parameters

– second order impacts (eg land use)

As a decision tool, this kind of modelling:

– "Black boxes" key analytical process

– Obscures uncertainties & tradeoffs

– Side-steps multiple socio-political dimensions

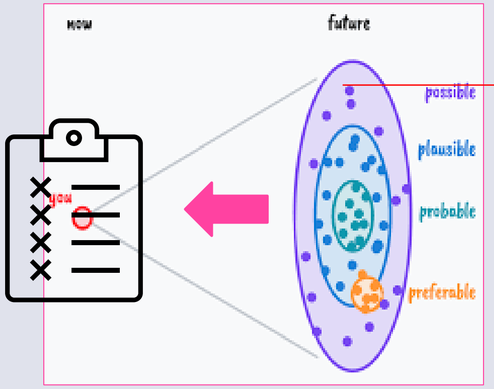
Decision support for deep uncertainty
Exploratory approaches - What does it do?

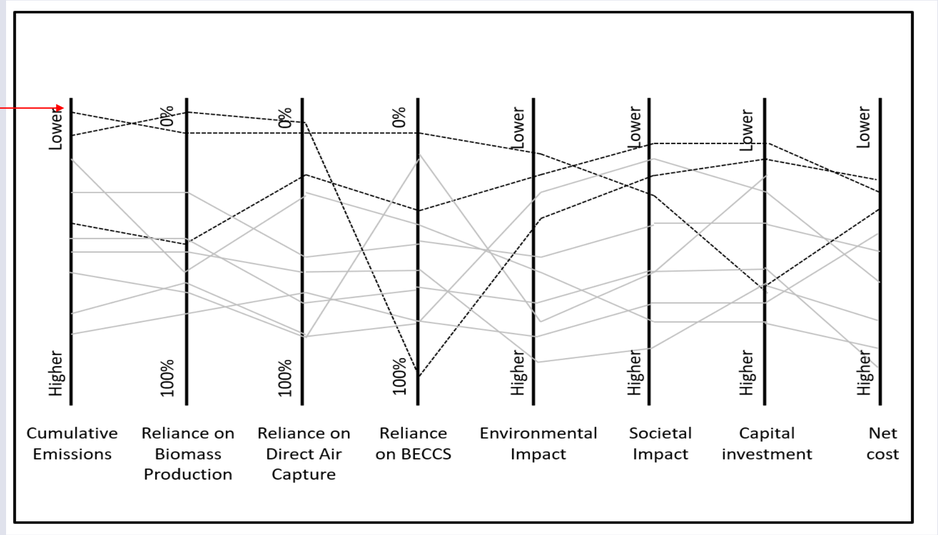
Robust Decision Making - explore and manage, rather than characterize *Deep Uncertainty*.

Goal: Identify greatest vulnerabilities across as full range of futures and identify the suite of policies that perform reasonably well across this range.

Conceptual framework: Minimise regret and assess assumptions.

Question: ‘How does the system work and when might the policies applied fail?’



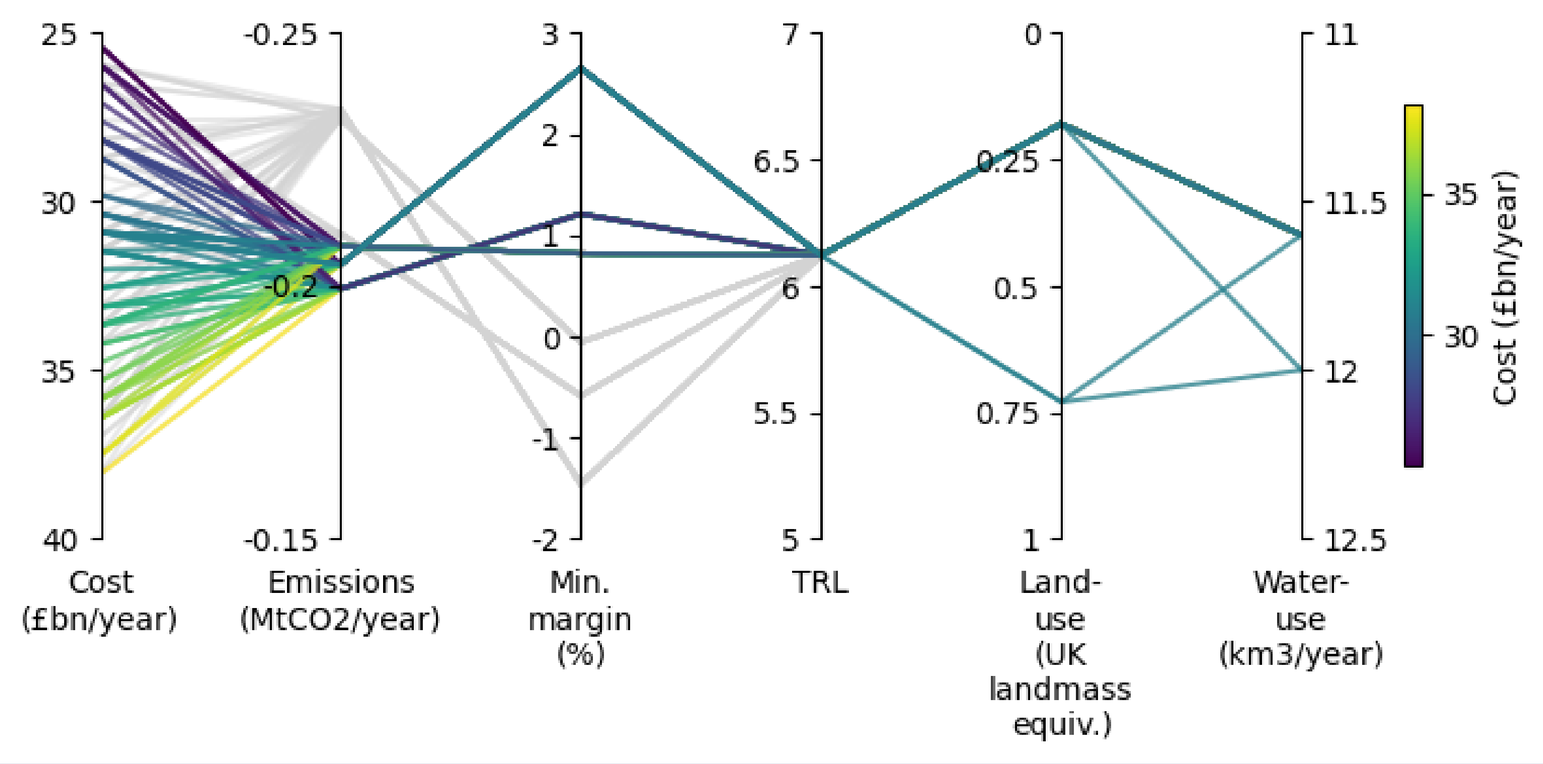


“Agree on Decisions”

- Propose strategy and decision context
- Use analytics to stress test strategy
- Identify new and revised strategies that are more robust

Decision support for deep uncertainty
Exploratory approaches

ROBUST DECISION MAKING - VULNERABILITY ANALYSIS



Vulnerability analysis was undertaken using six metrics to assess the strategies:

- cost of the modelled energy system;
- associated level of Net Zero emissions;
- marginal capacity of the modelled grid;
- Technology Readiness Level;
- Land Use footprint of GGR value chain; and
- Water Use (km^3/year).

As a decision tool, this kind of modelling enables:

- Transparency / replicability of analytical process
- Visibility of uncertainties

Decision support for deep uncertainty
Exploratory approaches

ROBUST DECISION MAKING - TRADE OFF ANALYSIS

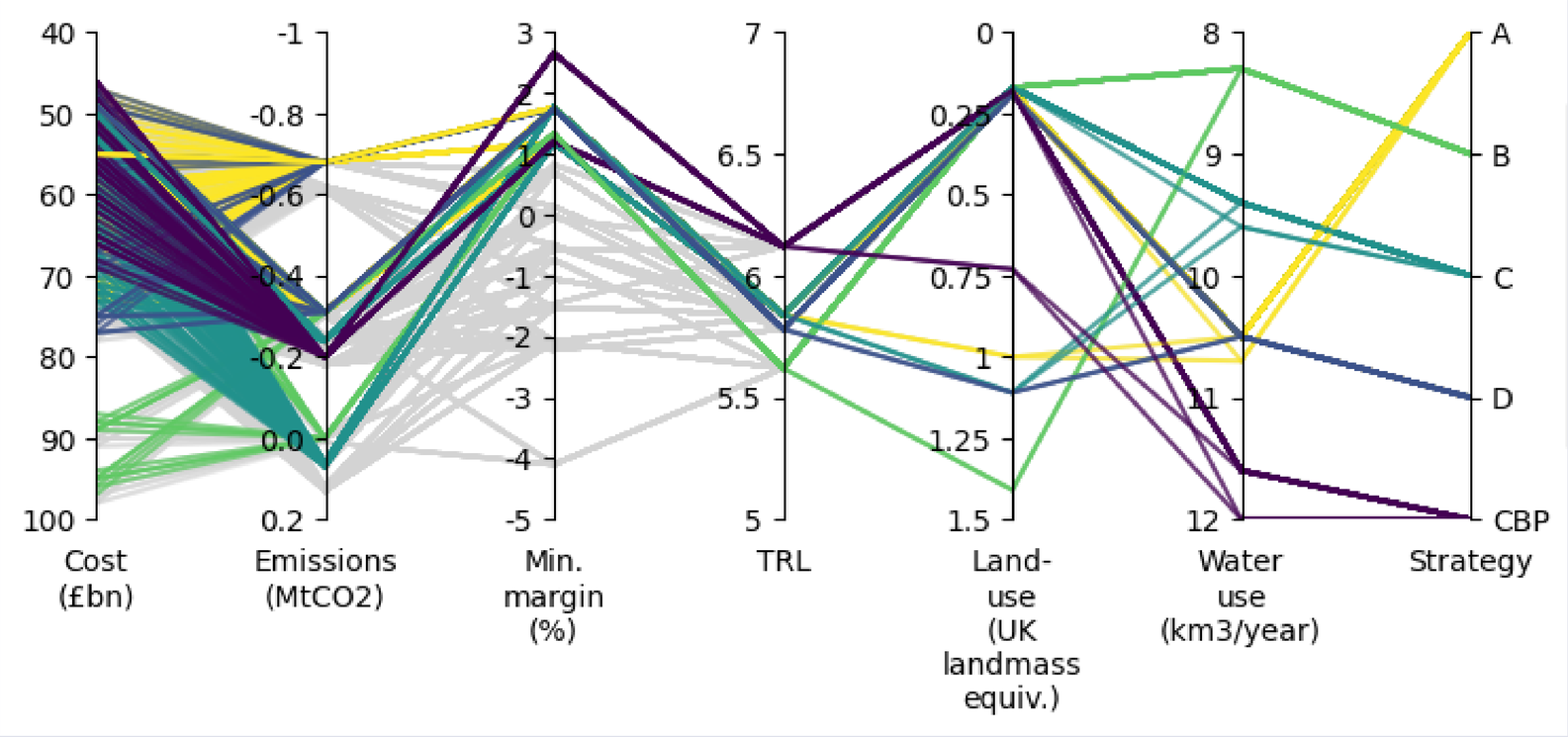


Table 1: $MtCO_2$ removed by each technology in 2050 in each strategy.

Strategy	BECCS-power	BECCS-H2	DACCS	EW	Biochar
CBP	33	23	5	0	0
A	25	23	2	3	5
B	23	15	0	10	10
C	25	18	2	3	10
D	25	23	0	5	5

As a decision tool, this kind of model enables *(Cont)*:

- Inclusion of multiple stakeholder perspectives and therefore socio-political dimensions
- Robustness in outcome

Decision support for deep uncertainty
Components of deep uncertainty toolbox

	CONCEPTUAL FRAMEWORKS	MODELLING APPROACH	GOVERNANCE SYSTEMS
DEFINITION	Use of strategic models, diagrams and frameworks that conceptualise a problem space and encourage exploration of multiple scenarios or strategic responses.	Use of exploratory modelling tools across decision life-cycle, including problem definition, strategic development and evaluation.	Diversifying beyond decision systems that over-rely on hierarchical and centralised approaches
USE CASE	Use of exploratory frameworks to enhance effectiveness of traditional consolidative modelling.	Incorporation of consolidative and exploratory approaches within coherent workflow.	Using participatory or decentralised models to enhance data collection, deliberation and civic engagement
EXAMPLE	Three Horizons Narrative based Future Scenarios	Robust Decision Making	Dynamic Adaptive Pathways Citizen Science Agile Workflows

Decision support for deep uncertainty
In summary

1. We see continued over-reliance on orthodox tools that conceal uncertainty, constrain optionality and hard-code systemic risk into strategic planning
2. As we navigate Net Zero and other complex challenges, planning processes needs to better delineate shallow and deep uncertainty – and respond accordingly
3. There is an urgent need to codify a decision support toolbox suitable for deep uncertainty, including conceptual frameworks, modelling approach and governance systems
4. Further work needs to be done within the sector to help key actors understand and apply deep uncertainty concepts to generate more robust policy and investment decisions

THANK YOU

`In a turbulent world, there's another set of cognitive skills that might matter more: the ability to rethink and unlearn.'

Adam Grant

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Some Useful References

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