Robust decision-making is the key to uncertain biomass futures

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Uncertain future

- Complex forest ecosystem
- Complex value chain
- Competition for biomass
- Competition for land-use
- Climate change
- Policy

There is no ‘business as usual’

Deep Uncertainty

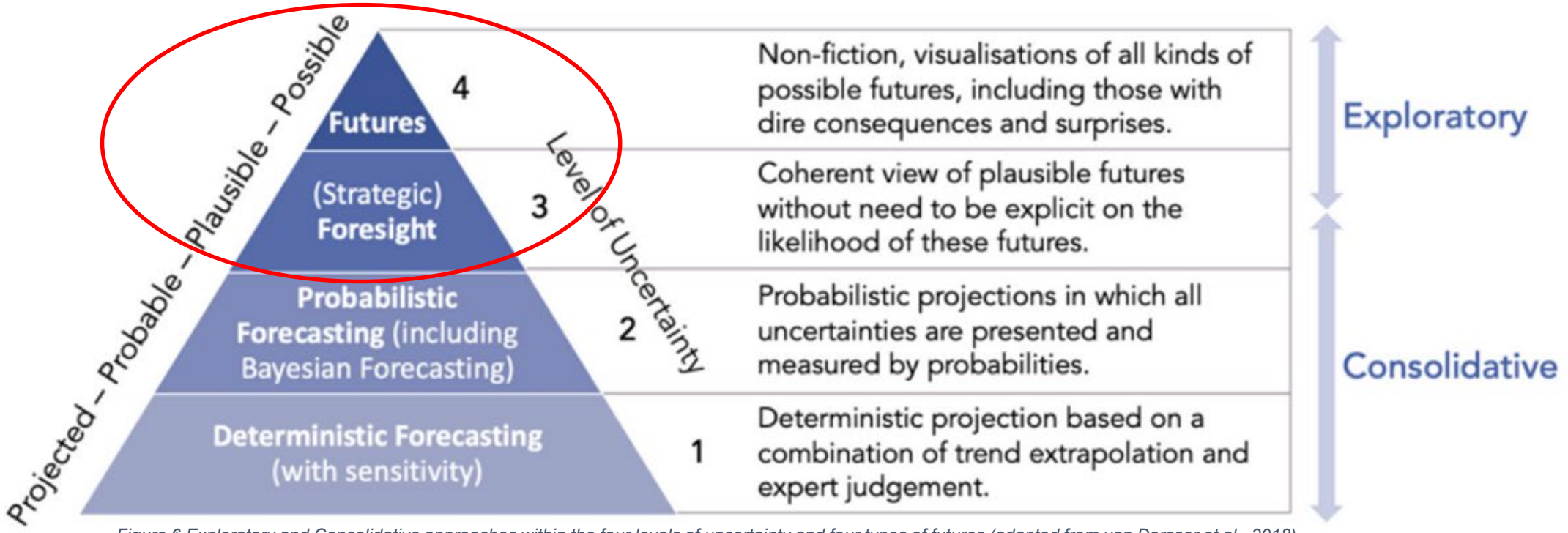


Figure 6 Exploratory and Consolidative approaches within the four levels of uncertainty and four types of futures (adapted from van Dorsser et al., 2018).

Analysts don't know, and/or decision-makers can't agree on:

- appropriate conceptual models
- probability distributions for parameters
- how to value the desirability of alternative outcomes (there will be trade-offs)

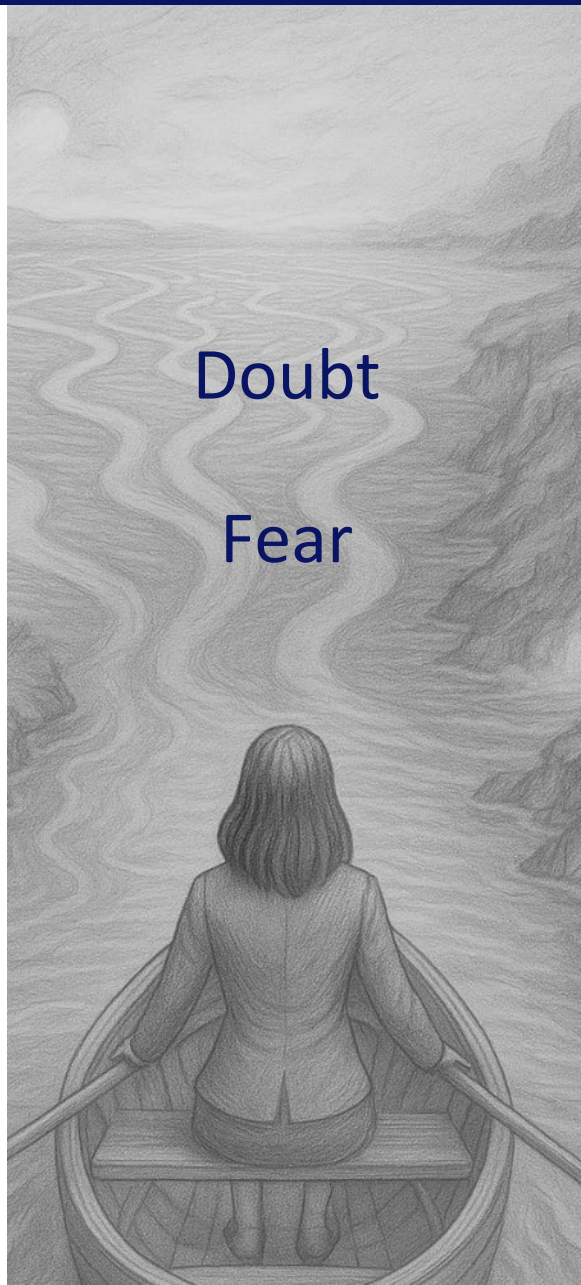
Challenge

- Increasing biomass demand
  - Decarbonisation; Circular economy
- Possibility of carbon debt
- Monitor & report forest C
  - Accountable for carbon loss
- Biomass projections for 2050 span four orders of magnitude
  - https://www.drax.com/sustainability/evidence-hub/

Impacts of sustainable biomass uncertainty

Impact on bio-based technology projects:

- Doubt & fear
- Weak policy commitment
- Erodes public confidence and support for bio-based technologies
- **Delays investment**

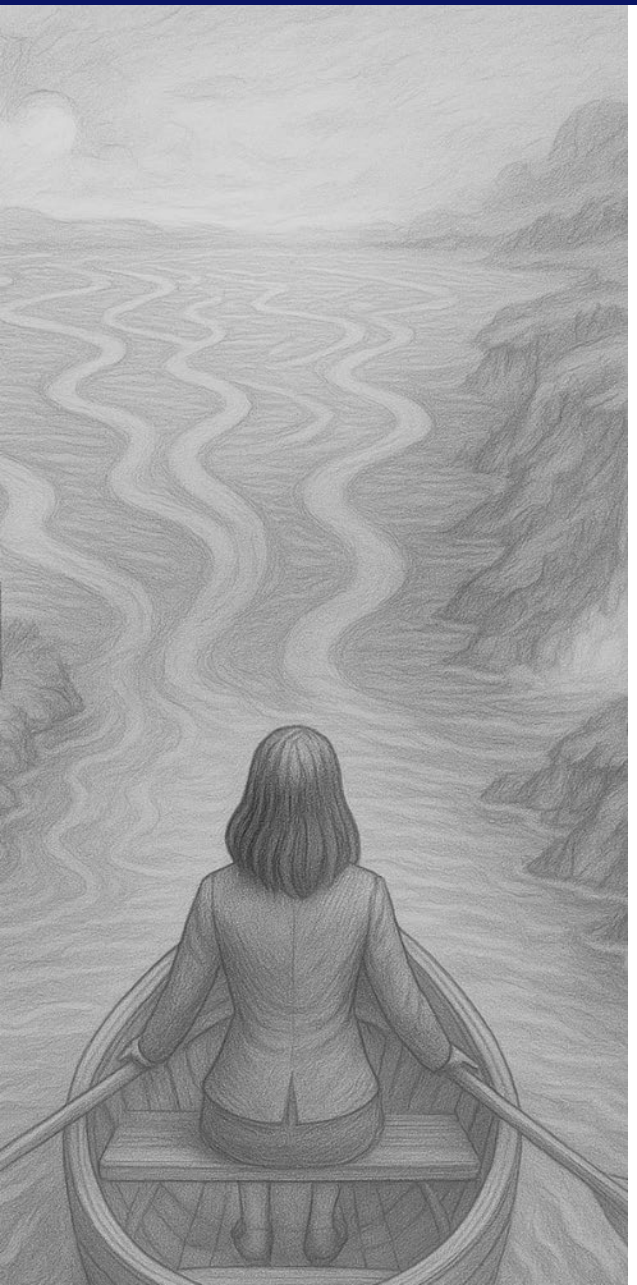


A new way of thinking – Decision-making under deep uncertainty

Mind-set shift

- Accept uncertainty
  - No optimal solution
  - Multiple paths
- Embrace uncertainty
  - Pursue robust strategy with low regrets
  - High confidence of good outcome or avoiding bad outcome

Mind-set shift



X What is the best use of biomass? - unanswerable

X How much biomass is there? - unanswerable

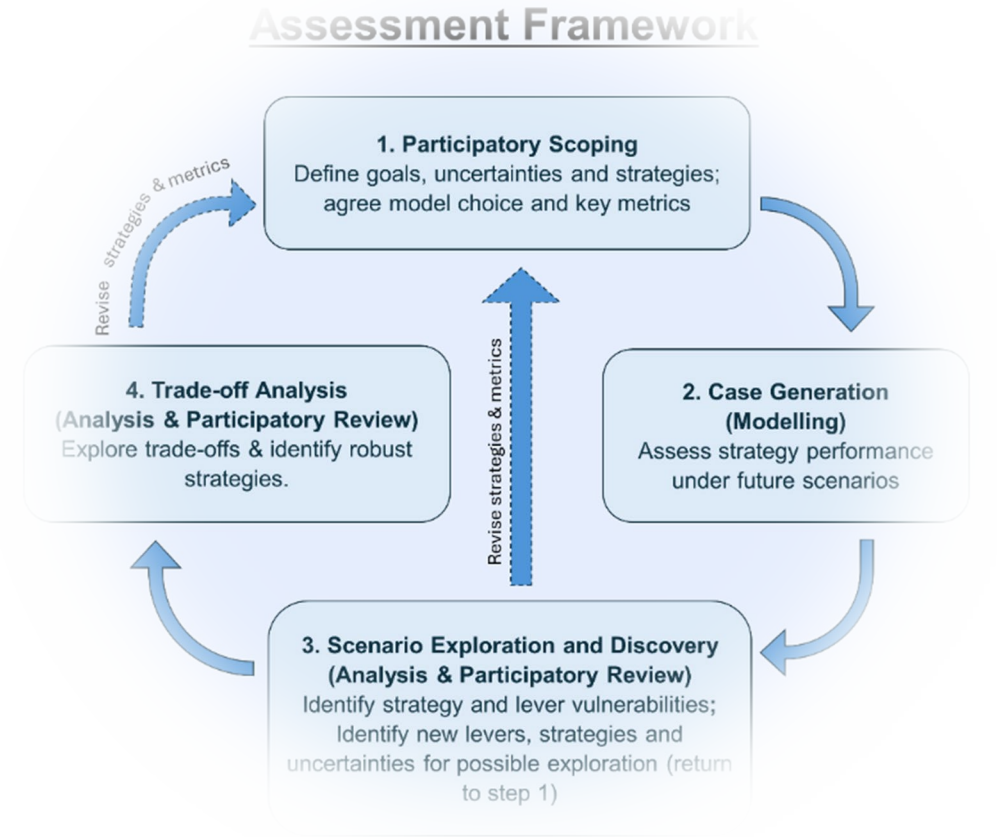
✓ Are forest carbon stocks in this sourcing area robust to a range of plausible futures?

✓ Is biomass sourcing strategy for this asset robust to future uncertainty?

Practical application RDM – forest carbon early warning tool

4 key steps:

1. Participatory scoping
2. Model plausible futures
3. Futures appraisal and insights
4. Trade-off analysis



1. Participatory scoping – XLRM

Key stakeholders = buy-in

- decision-makers &
- Subject matter experts

Objective

- Early warning tool: Are forest carbon stocks in sourcing area robust to future uncertainty (US South)

(Not controllable)	(Controllable)
Exogenous uncertainties (X)	**Levers (L) (i.e. strategies)**
1. Supply-demand price elasticities **2. Unit cost of biomass product** **3. Annual growth of biomass market demand from others (tested 'new operators entering market'** *(Forest growth rate; Natural disturbance; Price of carbon credits)* **Agree plausible range of values**	**1. Project biomass demand (scale of project)** **2. Location of sourcing area** **3. Size of sourcing area** **4. Feedstock composition (pulpwood, sawmill residues, forestry residues, other)** *(Supplier type (corporate vs non-corporate); Biomass transport type (rail/road/ship)*
Relationships (R)	**Performance metrics (M)**
Sub-regional timber supply (SRTS) model;	**1. Minimum G-to-D** **2. Time sustained G-to-D <1** **3. End-point G-to-D** **4. Cost of biomass** **5. Market leakage risk** *(GHG emissions; Lost revenue (foregone CDRs))*

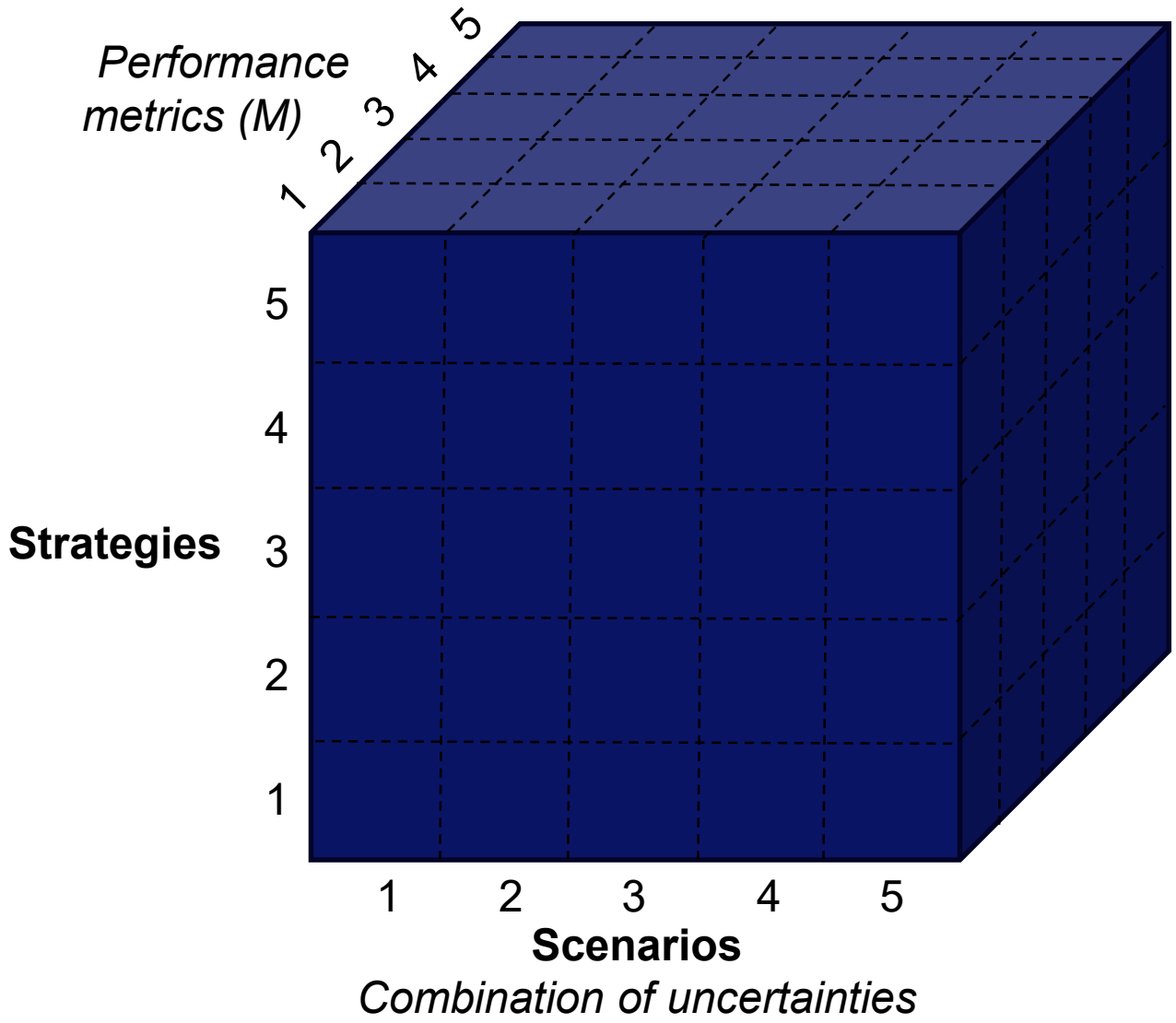
2. Model plausible futures

Systematic & transparent = Repeatable & auditable

Model:

- All combinations of uncertainties;
- for all uncertainty range values;
- for every strategy (only one in this example).

- Generate a complete set of performance metrics for every plausible future.



Vulnerability analysis

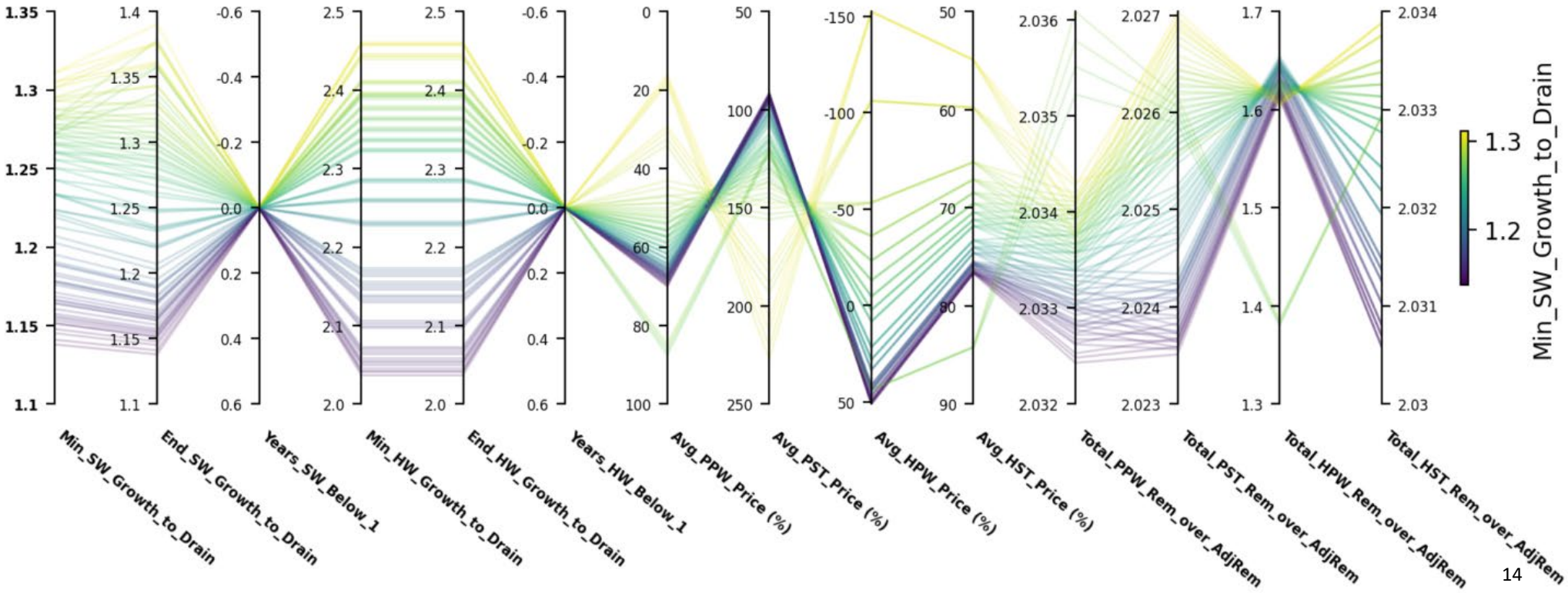
- Identify conditions leading to good/bad outcomes
- Calculate ‘Robustness’ (e.g. median) to compare/shortlist strategies

What conditions led to this? >>>> monitor parameters?; mitigation action?; avoid strategy?

Line = plausible future

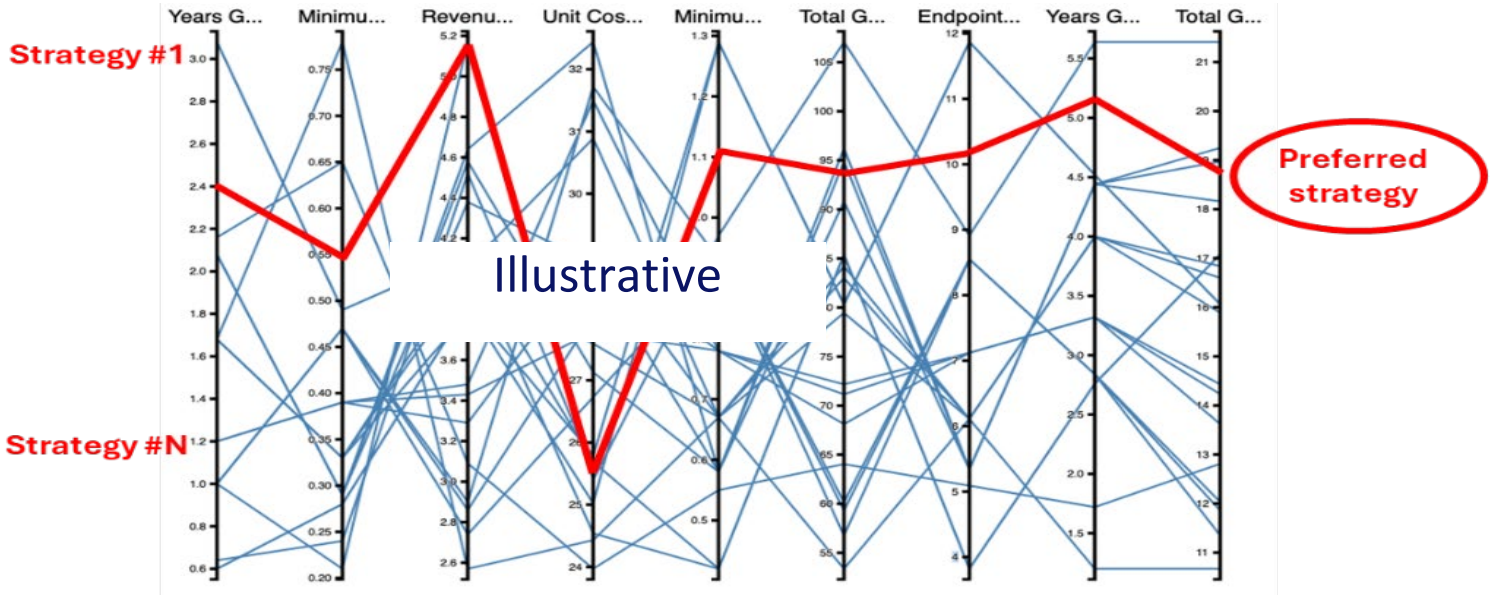
Top of axis = good/better

Yellow = ‘priority’ metric



Clear path to decision

- Compare the performance of multiple strategies
- Assess relative strengths and weaknesses
- Stakeholders deliberate around value-based preferences (which metrics are more important)



Example trade-off chart comparing robustness performance of all strategies, with the highest performing strategy highlighted in red.

Conclusions

Five success criteria:

- ✓ **Implementable**
- ✓ **Scientifically** informed decision-making
- ✓ Systemic, transparent, repeatable = **auditable**
- ✓ **Adaptable** to new standards and scientific insights
- ✓ Robust, **clear path forward**

RDM is **the key** to uncertain biomass futures

- Overcome decision paralysis
- Unlock policy commitment
- Encourage investment decisions
- Increase public confidence and support for bio-based technologies

Thank you

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