Perceptions of Objectivity, Shared Responsibilities, and Information Asymmetry at the Model-Policy Interface

Franziska Bock

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Context and starting point

- Long-term modelling sits at the **intersection of evidence-based science and Futures Studies** – two fields with greatly different assumptions about what makes valid, reliable, and objective knowledge [1]
- Models and model-based scenarios may falsely offer the illusion of sound or certain knowledge, creating a **"veneer of scientific legitimacy"** [2]
- **Scenarios are more likely to shape than foresee the future** [3] – e.g., in the form of self-fulfilling or self-defeating prophecies

What are modellers' beliefs concerning the certainty and objectivity of knowledge in energy modelling and scenarios, and how do they perceive the division of responsibility and information asymmetry at the model-policy interface?

Sources

1) *Bock & Pfenninger-Lee (2025): Rarely pure and never simple: Exploring perceptions of truth and objectivity in energy modelling and scenarios. https://doi.org/10.1016/j.erss.2025.104229*
2) *Pindyck (2017): The Use and Misuse of Models for Climate Policy. https://doi.org/10.1093/reep/rew012*
3) *Göke et al. (2023): A collective blueprint, not a crystal ball: How expectations and participation shape long-term energy scenarios. https://doi.org/10.1016/j.erss.2023.102957*

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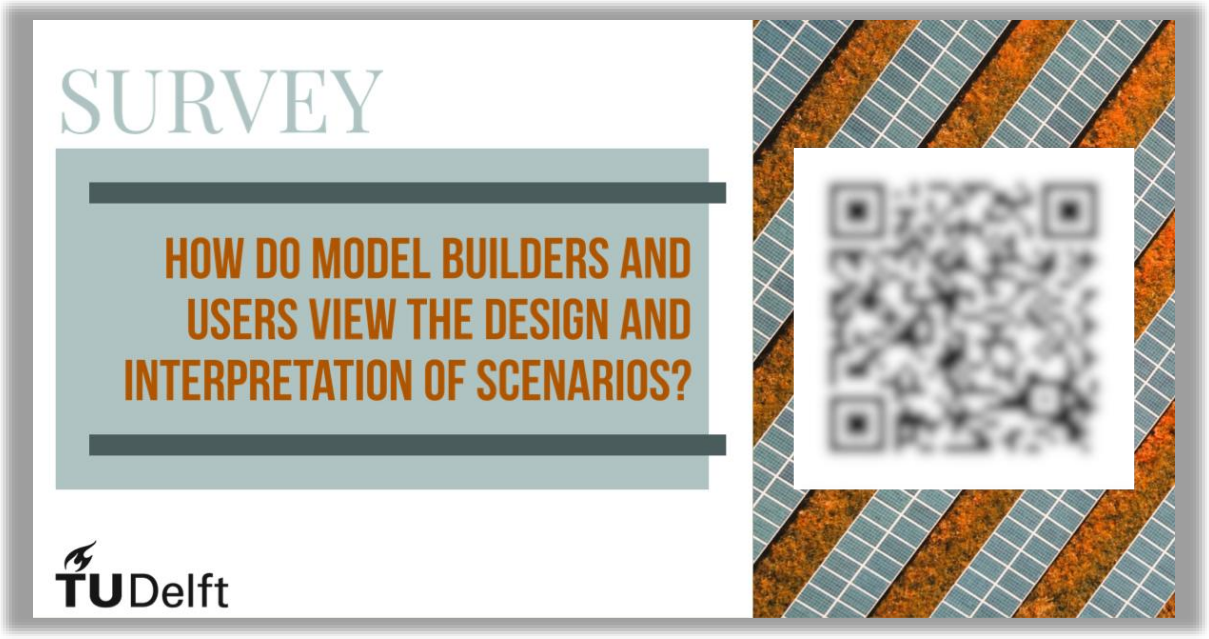
We asked model builders and users to share their perspectives



We addressed modellers and model users in an open call for survey participation between 23 Nov and 20 Dec 2023.

- Participants were invited to share their insights concerning…
  - Their epistemic beliefs and views on scenarios
  - Their opinion on the division of responsibilities & information asymmetry between modeller and policymaker
- Key facts about the 166 respondents:
  - From 51 different countries, speak 43 native languages
  - 51.4% based in Europe, 28.6% in Africa
  - 78.4% male
  - 61.7% hold doctoral degree / are doctoral candidates
  - 68.7% use energy or electricity system models, 38.0% use energy demand models, 20.5% use IAMs

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Insight 01

There is limited consensus among modellers regarding their epistemic beliefs and views on scenarios.

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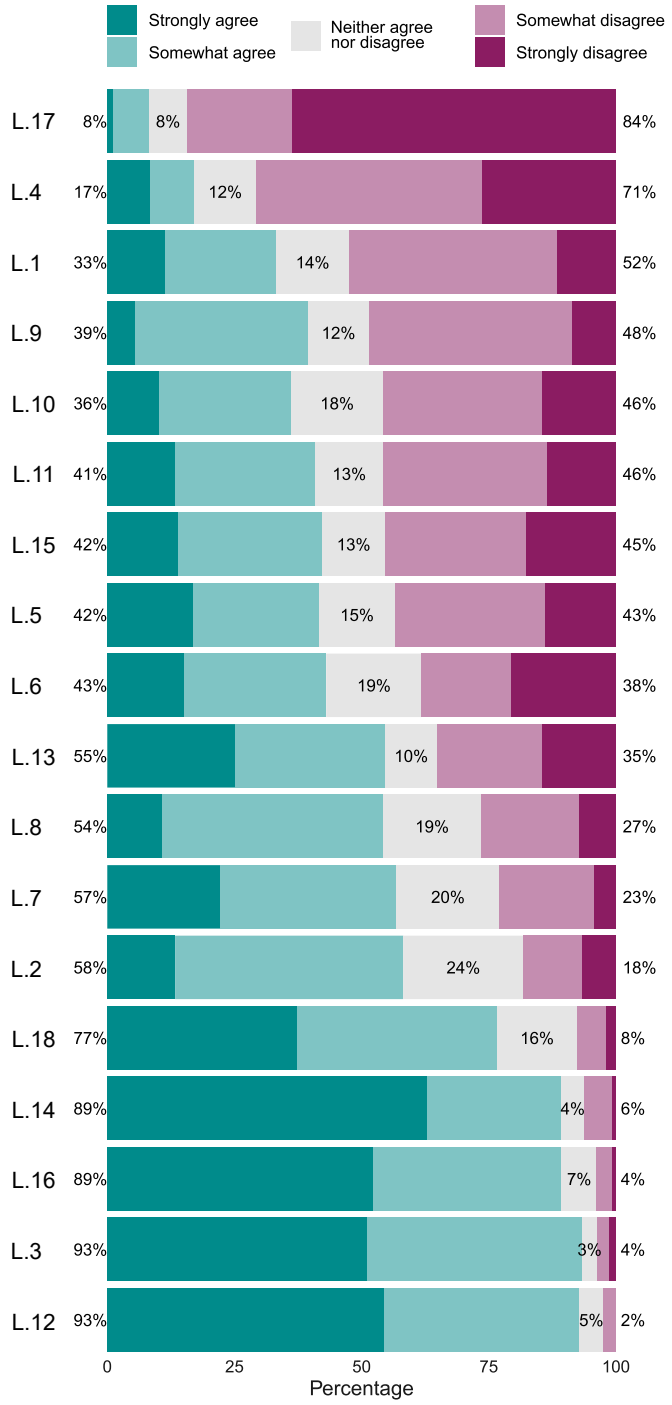
We see some consensus, and plenty of polarisation

- Epistemic beliefs are one's views on knowledge, how it is acquired, how certain it is, and what counts as truth.
- Likert items inspired by existing literature and questionnaires on epistemic beliefs [1-3]
- Statements include, for example…
  - *"In this field, modellers can come to the correct answer."*
  - *"In this field, true answers are more of an opinion than a fact."*
  - *"In this field, it is important to question the subjective choices a modeller makes in the light of their origin and worldview."*



Sources

1) *DeBacker et al. (2008): The Challenge of Measuring Epistemic Beliefs: An Analysis of Three Self-Report Instruments.* https://doi.org/10.3200/JEXE.76.3.281-314

2) *Hofer (2000): Dimensionality and Disciplinary Differences in Personal Epistemology.* https://doi.org/10.1006/ceps.1999.1026

3) *Schommer (1990): Effects of beliefs about the nature of knowledge on comprehension.* https://doi.org/10.1037/0022-0663.82.3.498

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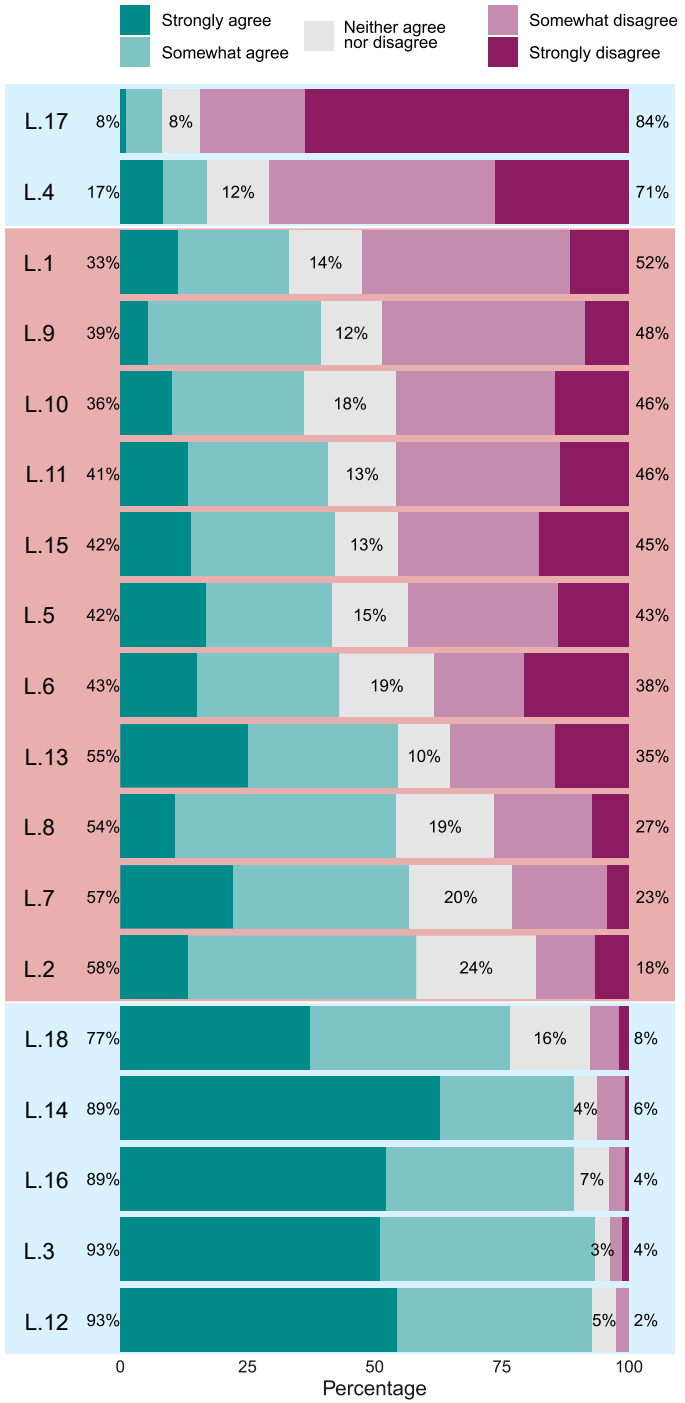

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Insight 02

We observe patterns in the respondents' assessment of different Likert statements which reveal two stylised worldviews.

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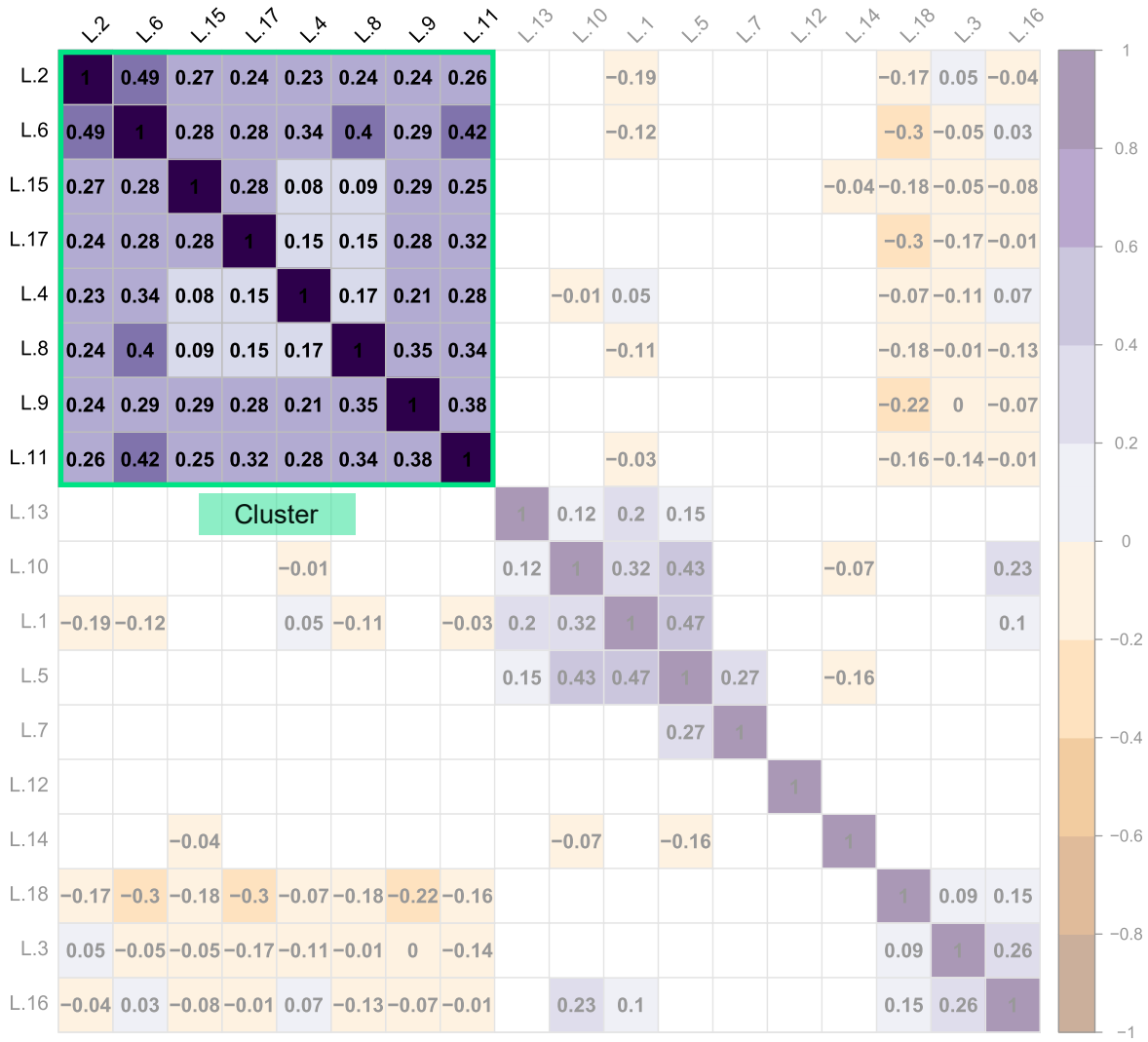
We explored associations between individual Likert statements

- Spearman's rank correlation coefficient
- Statistically significant correlations (p≤0.05) in hierarchical clustering order



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Two stylised worldviews emerge

The Positivist Modeller

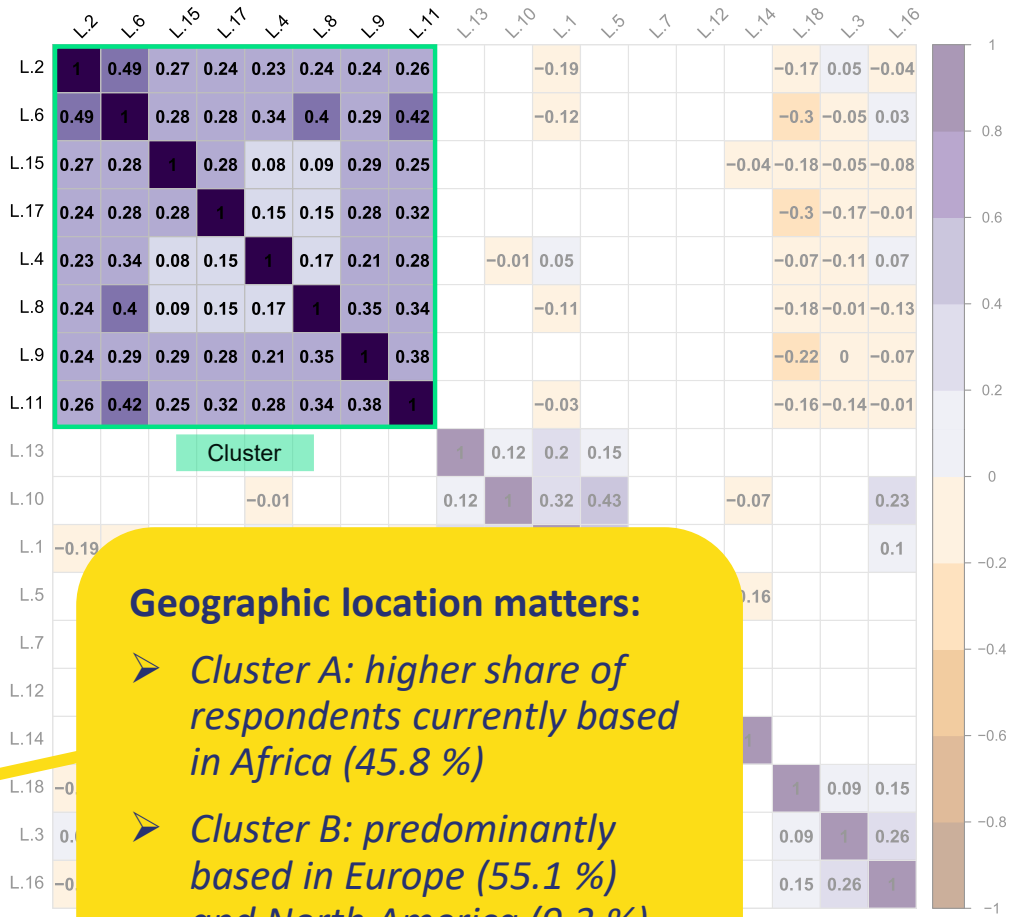
…has a weak to moderate tendency to ***agree*** with the statements in the Cluster and might…

- Believe that personal backgrounds are irrelevant
- Strive for correct answers and objective truth
- Assume universally accepted and time-consistent approaches
- Prefer direct recommendations and actionable results across different situations and contexts

The Postpositivist Modeller

…has a weak to moderate tendency to disagree with the statements in the Cluster and might…

- Stress that personal background significantly influences models and results
- Reject the idea of achieving objective truth
- Assume ever-evolving and diversely understood principles
- Promote a diversity of perspectives in modelling outcomes that analyse the available options for action



k-means Clustering Analysis:

- Cluster A: More agreeing, 35.5 % of sample (n = 59)
- Cluster B: More neutral/disagreeing, 64.5 % of sample (n = 107)

Geographic location matters:

- *Cluster A: higher share of respondents currently based in Africa (45.8 %)*
- *Cluster B: predominantly based in Europe (55.1 %) and North America (9.3 %)*

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Insight 03

According to modellers, modelling is a team sport – despite the information asymmetries between them and decision-makers.

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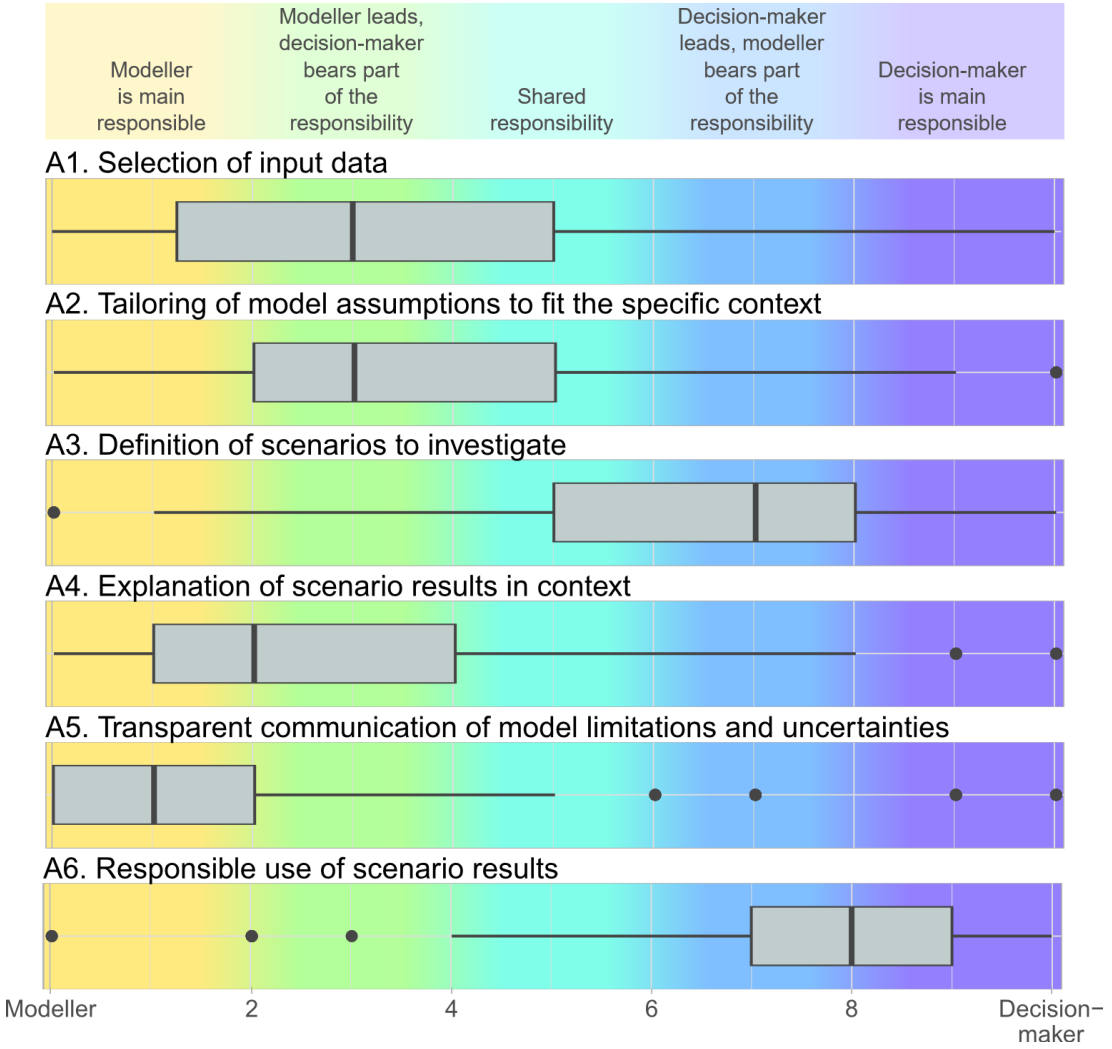
Modellers see modelling as a team sport

- **S1. Modeller and decision-maker communicate**
  - Modeller more responsible for transparent communication
  - Decision-maker more in charge of responsible scenario use
  - To a larger or lesser degree, a **shared burden** for the remaining four steps

➢ Modelling is a team sport.



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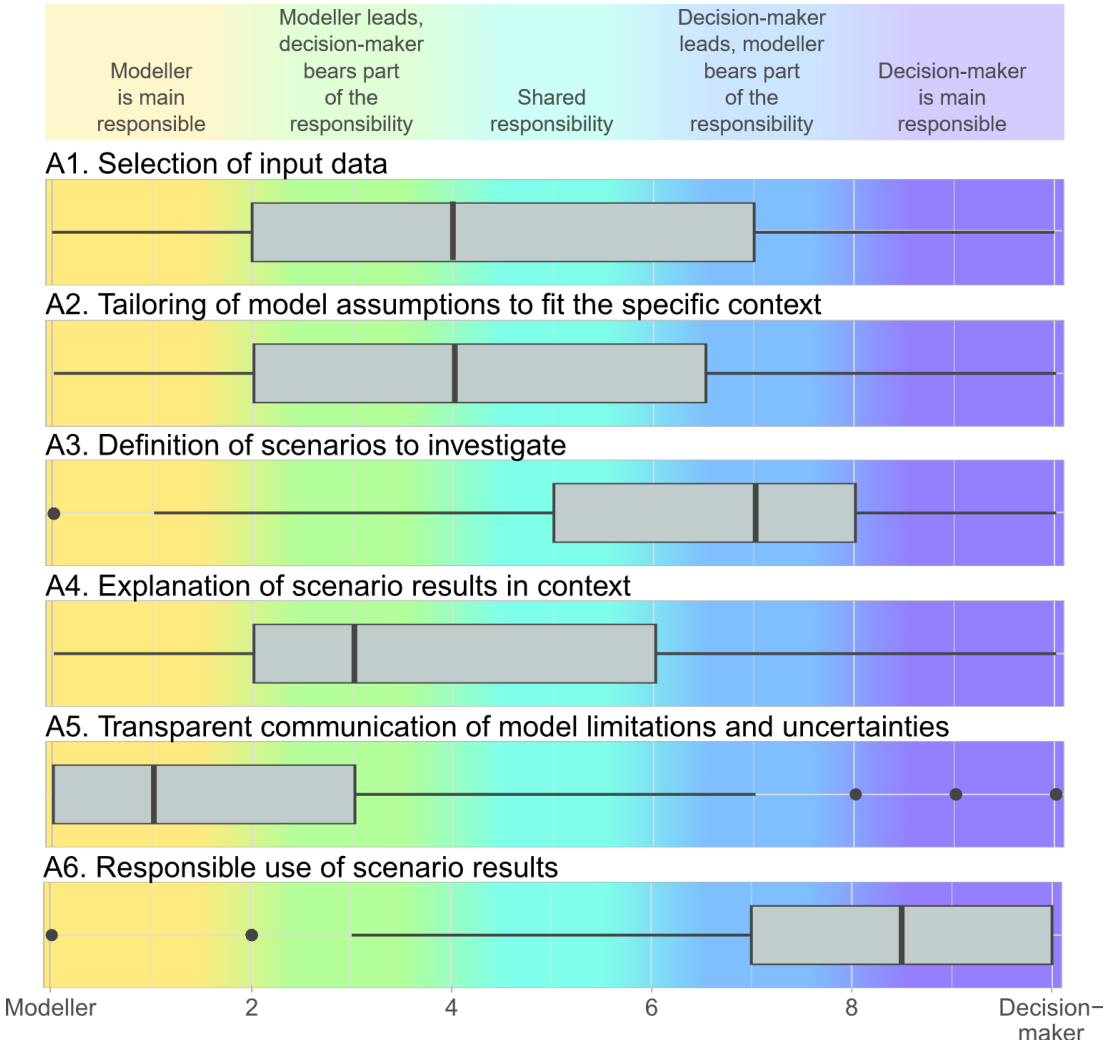
Modellers see modelling as a team sport

- **S2. Modeller and decision-maker communicate, and are from different national and cultural contexts**
  - *Result: higher information asymmetry*
  - Comparatively **higher responsibility** assigned to the **decision-maker**
  - Less agreement among respondents (lengthening boxes and whiskers)

➢ Modelling is a team sport – even more so when modeller and decision-maker have different backgrounds.



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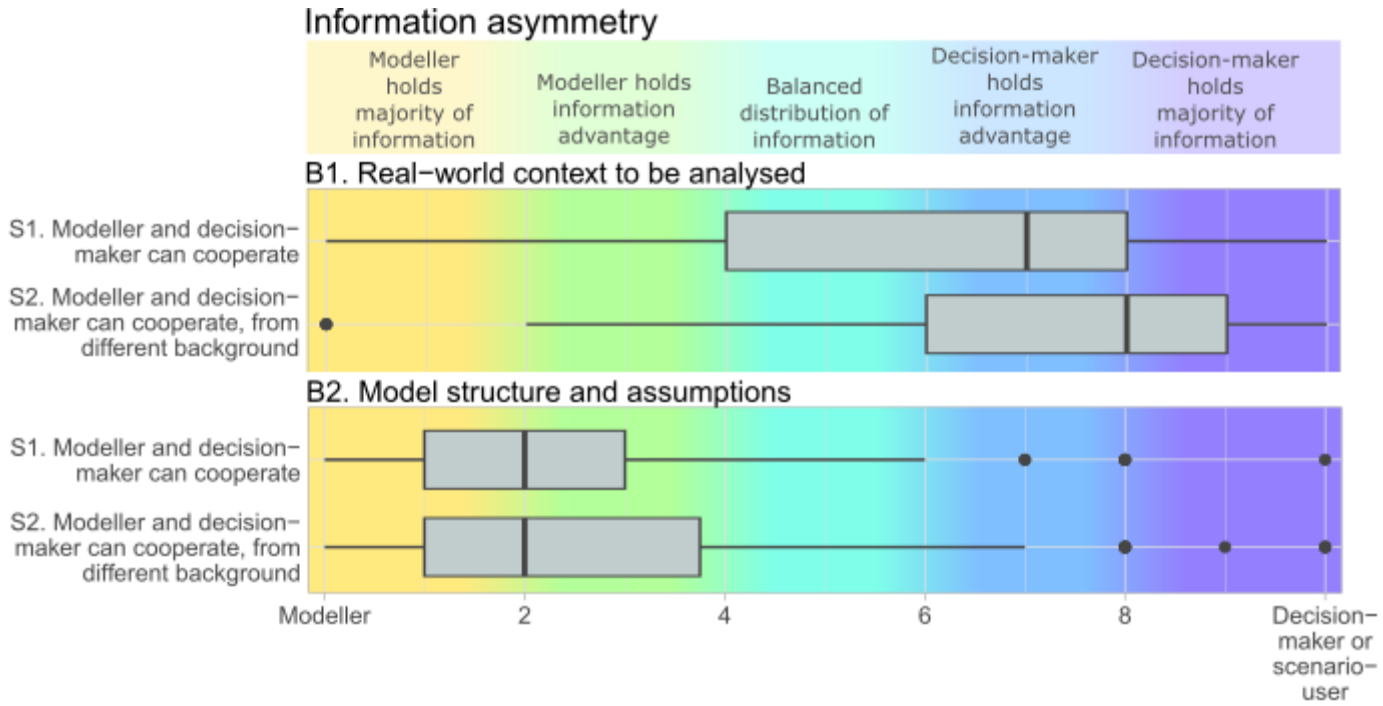
Division of responsibilities does not always match information availability



- There is a bilateral information asymmetry between modeller and decision-maker.
  - Modeller holds at least an information advantage concerning model structure and assumptions
  - Opinions regarding information on the real-world context are much more mixed
  - Under the assumption that the modeller and decision-maker do not come from the same background (S2), the information advantage shifts in favour of the decision-maker
  - The assumed **information availability does not always match the responsibilities** assigned to the parties by the survey respondents

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Implications for Modelling & Communicating Scenarios at the Science-Policy Interface

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Recap & implications for communication at the model-policy interface

- **Modellers are divided on whether there is any objectivity in models and scenarios – and that matters: do we present a possibility, or a truth?**
  - Notion of possibility may expand the perceived scope of action and provide agency to act
  - Notion of truth may reduce the perceived scope of action and effectively delegate decision-making power to the model, i.e., to developers of tool and scenarios
- **Modellers consider modelling a team sport – even more so when they work with decision-makers in a context different from their own background.**
  - Effective communication between modeller and decision-maker is essential for a relevant and fit-for-context model and scenario design
  - The larger the information assymetries, the higher the risk of ineffective communication

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The way forward

Let's reconsider how we…

a. **Set up modelling teams: what skills and expertise do we need?**

- Include social scientists and communication experts
- Create diverse modelling teams which comprise experts of different genders and cultural backgrounds

b. **Teach modelling as a craft: what knowledge is essential beyond the work with code and data?**

- On-the-job learning: foster discussion about the importance of epistemic beliefs within the modelling community
- Rethink capacity development programmes and higher education curricula,
  and include, i.a., perspectives from Science & Technology Studies (STS) as wells as Futures Studies

c. **Structure modelling projects: how can we better prepare for co-creation and participation?**

- Include required financial and personnel resources in project budgets from the onset

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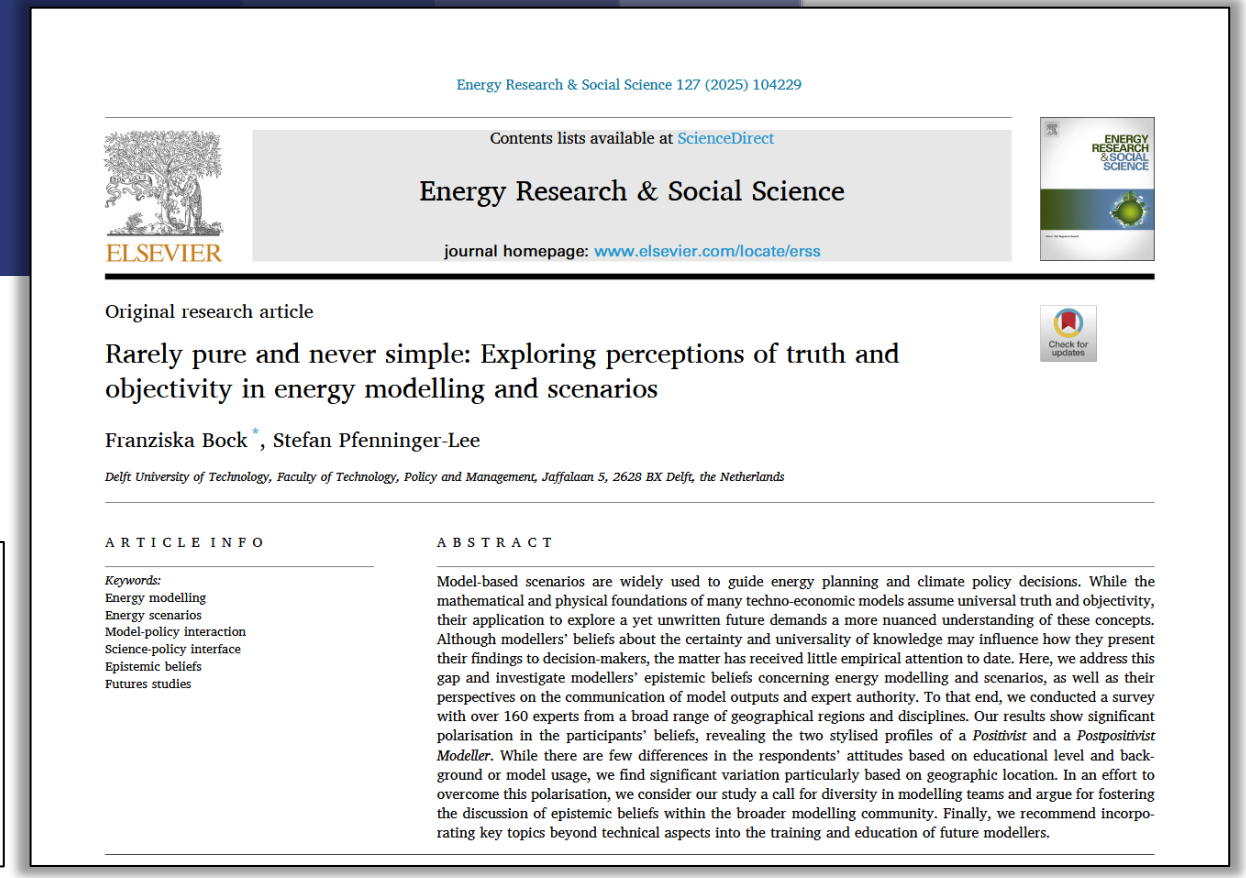
Franziska Bock

Doctoral Researcher
Dept. Engineering Systems and Services (ESS)
Faculty of Technology, Policy and Management (TPM)
Delft University of Technology

F.Bock@tudelft.nl

linkedin.com/in/franziskabock

re-integrate-au.eu



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Original research article

Rarely pure and never simple: Exploring perceptions of truth and objectivity in energy modelling and scenarios

Franziska Bock *, Stefan Pfenninger-Lee

Delft University of Technology, Faculty of Technology, Policy and Management, Jaffalaan 5, 2628 BX Delft, the Netherlands

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ABSTRACT

Model-based scenarios are widely used to guide energy planning and climate policy decisions. While the mathematical and physical foundations of many techno-economic models assume universal truth and objectivity, their application to explore a yet unwritten future demands a more nuanced understanding of these concepts. Although modellers' beliefs about the certainty and universality of knowledge may influence how they present their findings to decision-makers, the matter has received little empirical attention to date. Here, we address this gap and investigate modellers' epistemic beliefs concerning energy modelling and scenarios, as well as their perspectives on the communication of model outputs and expert authority. To that end, we conducted a survey with over 160 experts from a broad range of geographical regions and disciplines. Our results show significant polarisation in the participants' beliefs, revealing the two stylised profiles of a *Positivist* and a *Postpositivist Modeller*. While there are few differences in the respondents' attitudes based on educational level and background or model usage, we find significant variation particularly based on geographic location. In an effort to overcome this polarisation, we consider our study a call for diversity in modelling teams and argue for fostering the discussion of epistemic beliefs within the broader modelling community. Finally, we recommend incorporating key topics beyond technical aspects into the training and education of future modellers.

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