

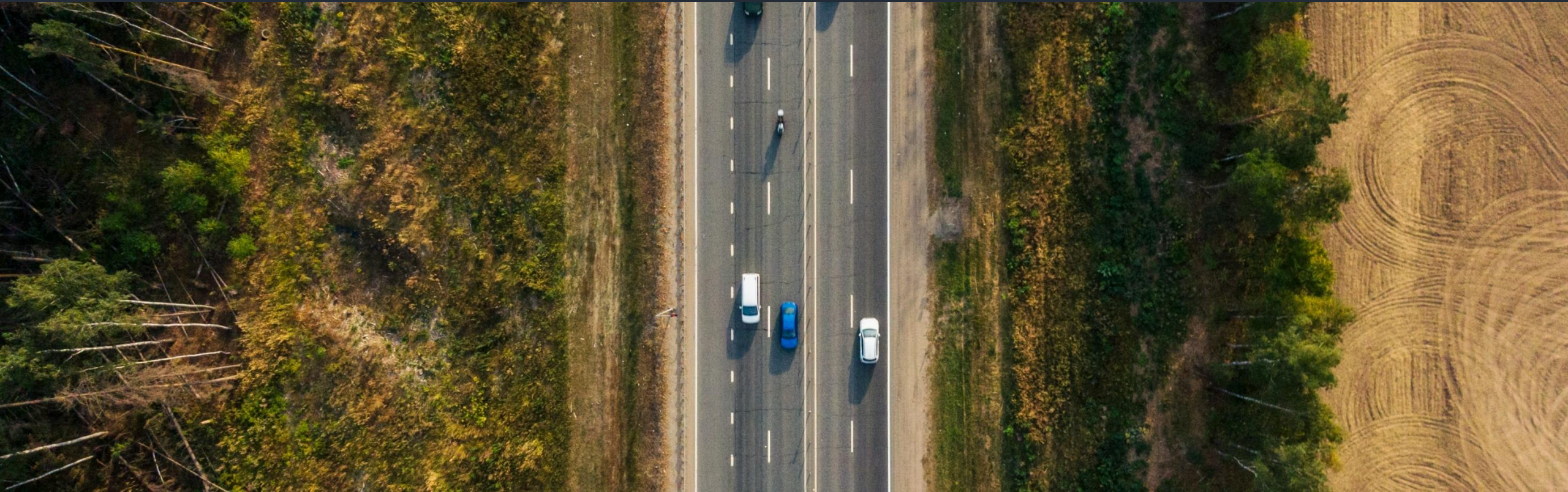
The rise and fall: climate change and inflation modelling



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Agenda

1

A complex world

2

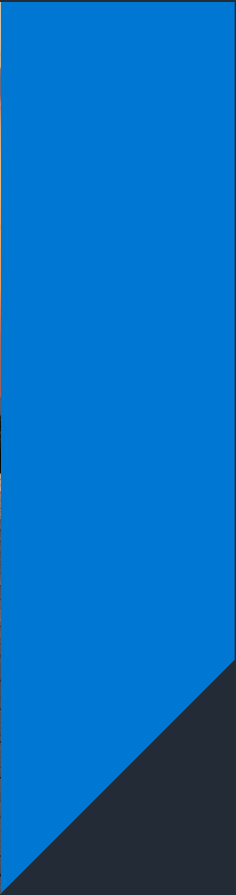
Causal modelling

3

Sustainability inflation model

4

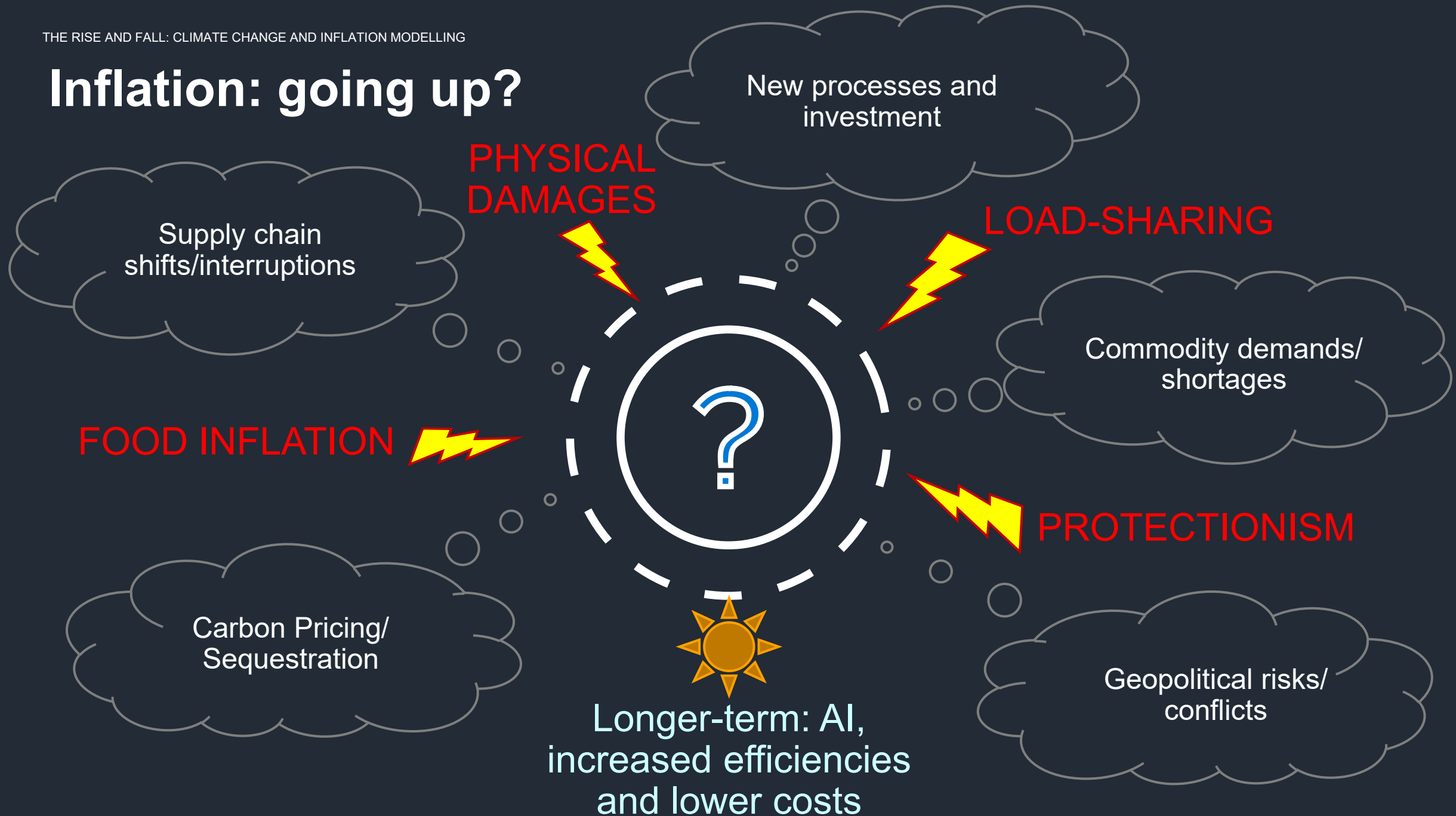
Informing actuaries



1. A complex world



Inflation: going up?

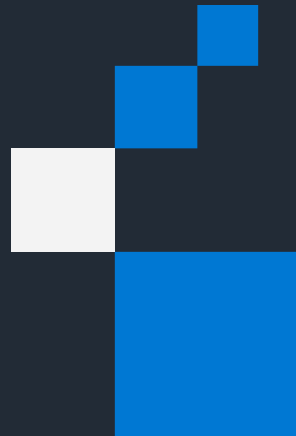


Inflation and Climate Change

Inflation is affected by climate change.

It is likely to be :

- **Higher, over a sustained period**
- **More volatile**



1

Transition Costs

Transitioning to a non-polluting model – which will involve upfront investment, the conversion of processes, and supply chain transformation.

2

Transition Efficiencies

Efficiencies gained could reduce costs in the long run... But that is a way away.

3

Physical Climate Factors

More severe weather damages assets and livelihoods, causes food and water insecurities, reduces the effectiveness of current production.

4

Instability

Severe weather and changes to climate create tension over resources, displace people and increase inequalities leading to geopolitical tension.

2. Causal modelling



The sustainability complexity problem

What makes climate-related risk so difficult to assess?

- Future is highly uncertain
- Multiple complex interactions
- Outcomes are non-linear
- Cross-cutting accelerator of risk

How can causal modelling help?

- Develop a holistic view of climate-related risks across a risk taxonomy
- Understand risk as an emergent property of a complex adaptive system
- Understand how drivers interconnect
- Explore scenarios that emerge non-linearly
- Explore dynamics in the tails of distributions

Causal modelling compared to traditional approaches

Frequency-severity modelling

- Typical process:

Select scenarios within identified risk taxonomy



Calibrate the distribution of losses under each scenario



Aggregate to derive the total loss distribution

- Generally, relies on historical data and subjective assumptions

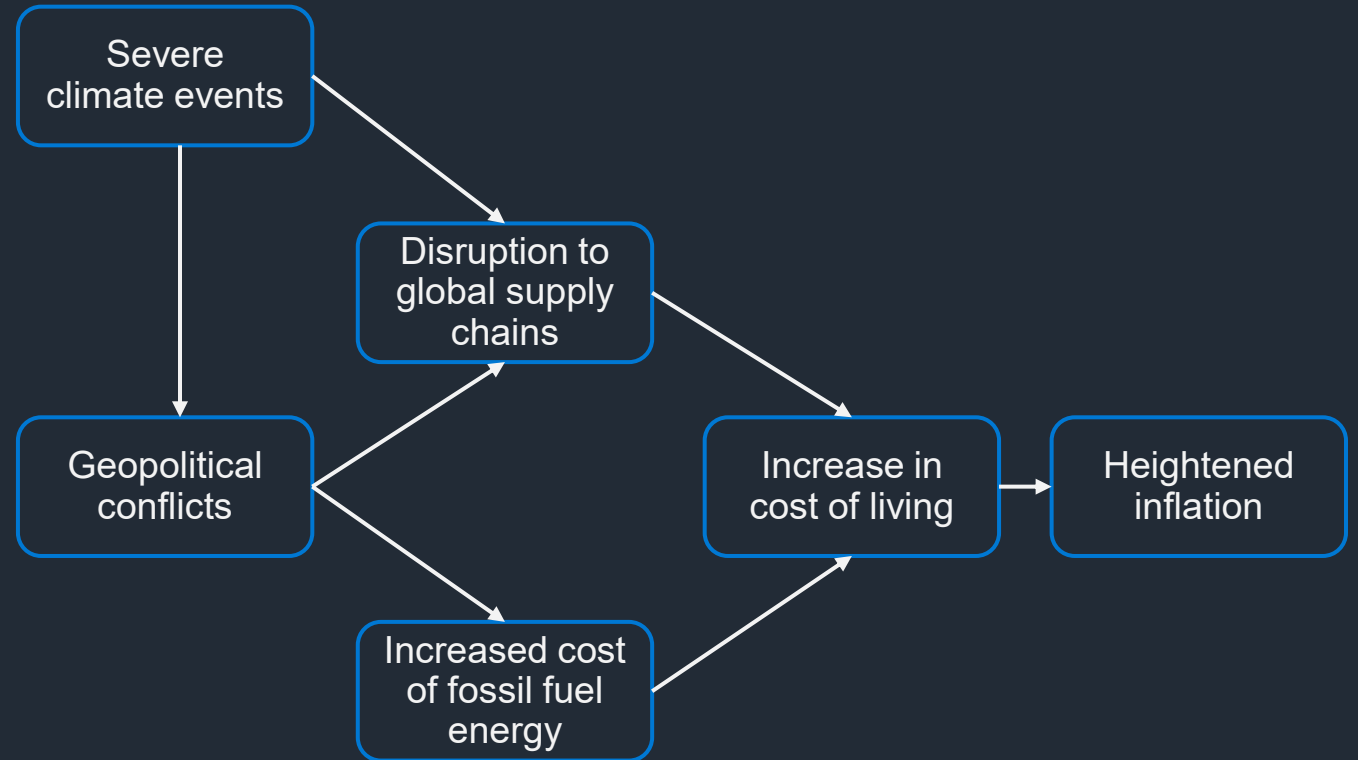
Causal modelling

- Based on conditional (Bayesian) narratives
- Not anchored by historical data
- Joint probability distribution removes reliance on subjective aggregation and correlation assumptions
- Better suited for complex risk systems

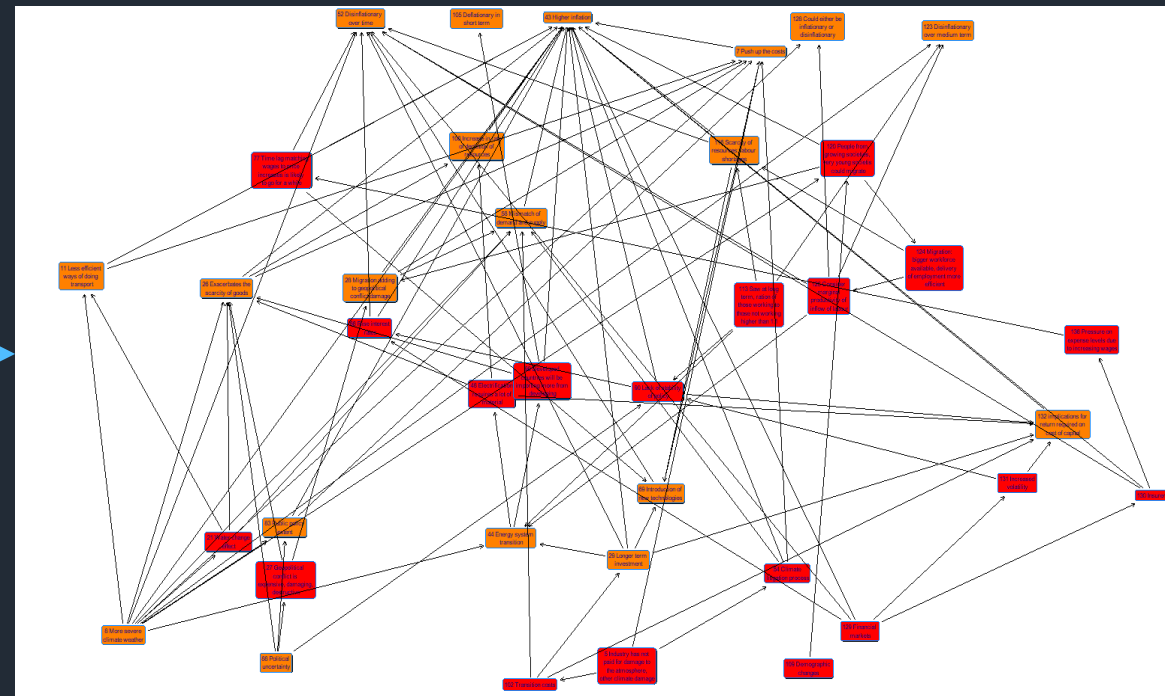
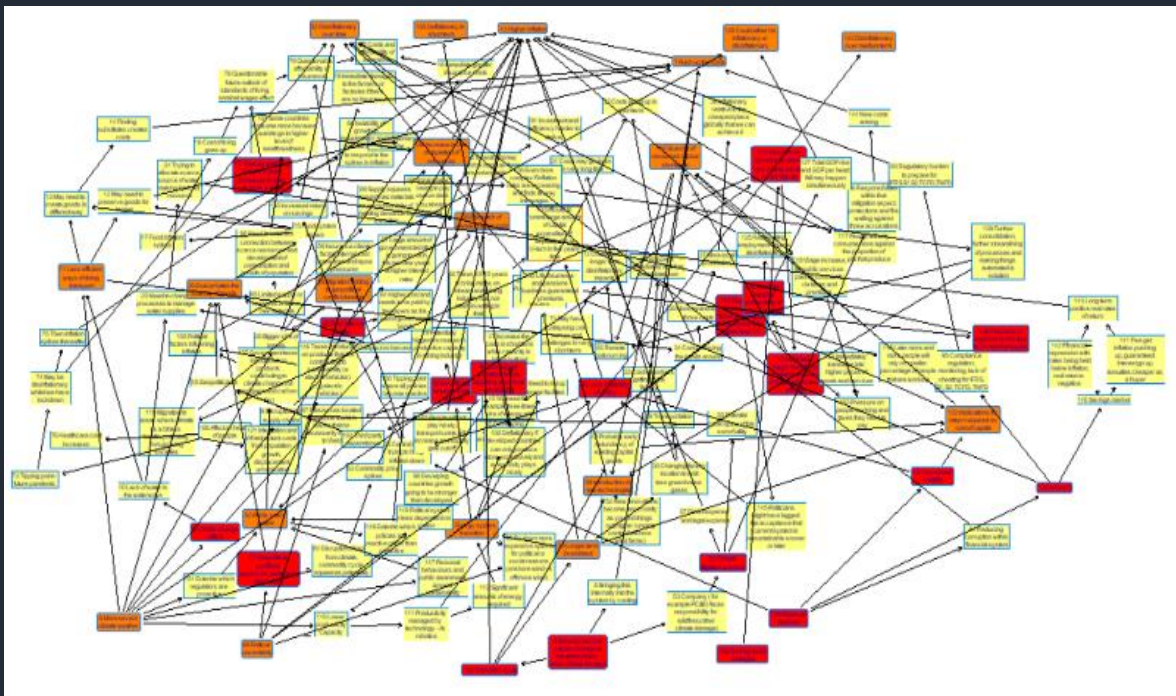
What is a causal model?

A causal model:

- Conditions outcomes on the states of underlying drivers that cause those events to occur
- Can be used to quantitatively assess complex systems by modelling causal factors and how they interact, allowing for interdependencies



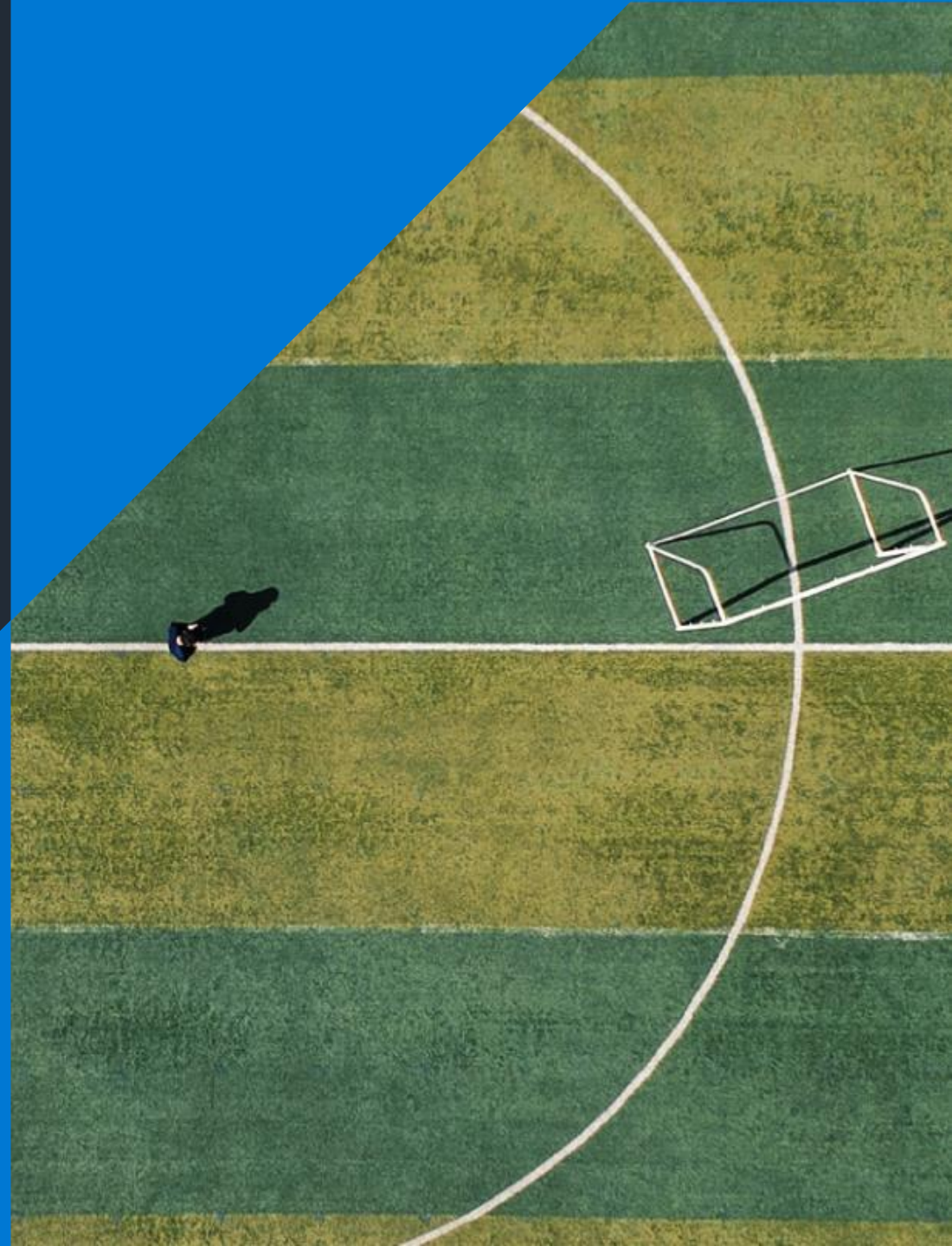
Causal modelling in practice: first stage “cognitive mapping”



Hold workshop with stakeholders and subject matter experts to identify (qualitatively) event chains leading to our key risk. Analyse these discussions to map the interconnected structure of the risk drivers.

Use complex risk analysis to identify critical concepts, and exclude non-critical concepts, creating a “minimally complex” view of the risk map.

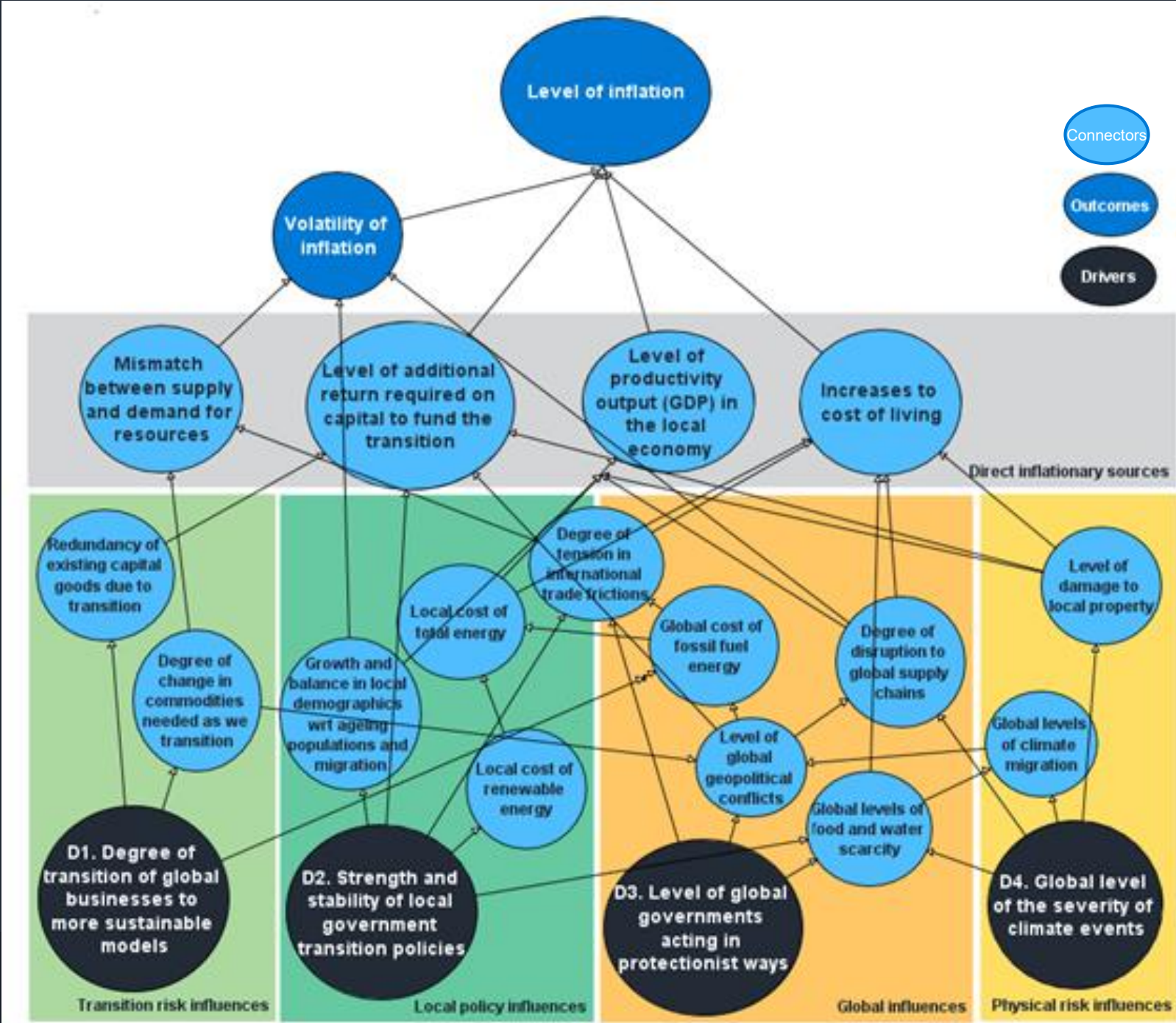
3. Sustainability Inflation Model



Building the sustainability inflation model

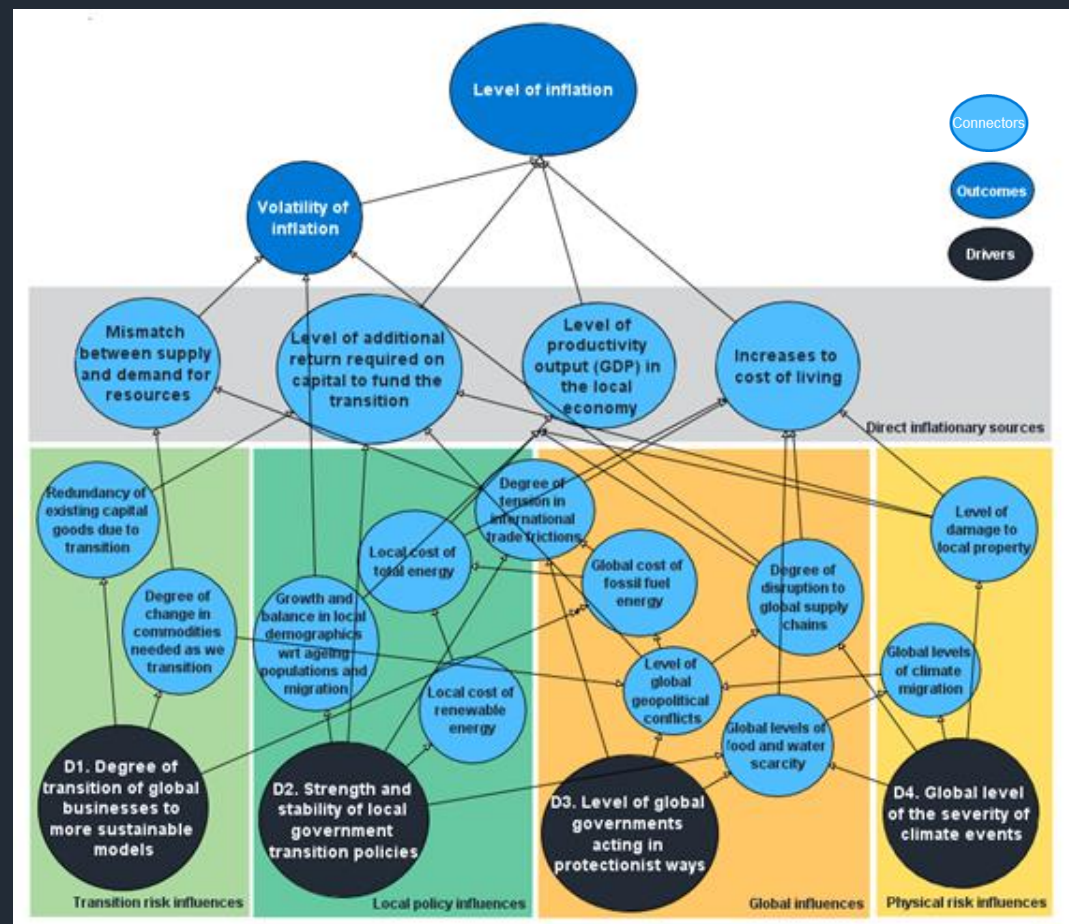
We developed a minimally complex map from a series of expert workshops.

We then converted the minimally complex map into a conditional narrative map (illustrated).



Sustainability inflation model

Model structure



Transition influences

- Stranded assets
- Change in materials needed

- Supply and demand
- GDP
- Cost of living
- Transition funding
- Level of inflation
- Volatility of inflation

Physical influences

- Property damage
- Supply chains

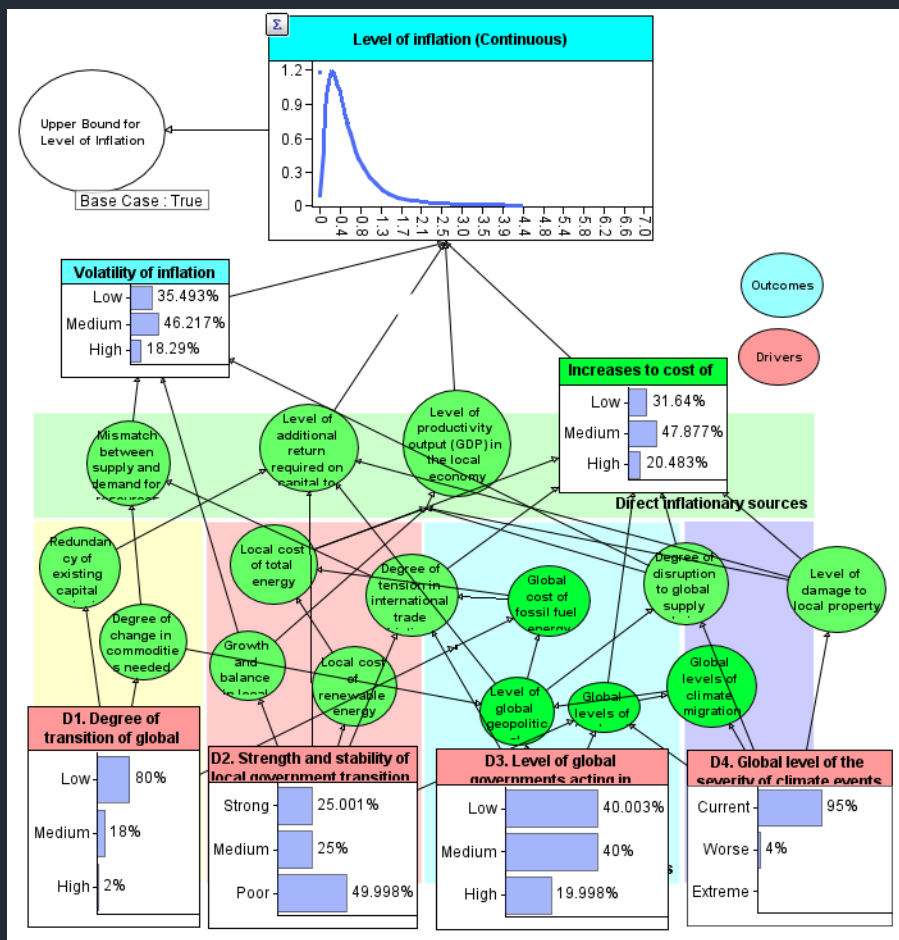
Local policy influences

- Renewable energy
- Stability

Global influences

- Trade and supply chains
- Geopolitics

Causal modelling in practice: model development and calibration



Source: Milliman Sustainability Inflation Model (calibrated model)

Convert minimally complex map to a conditional narrative map

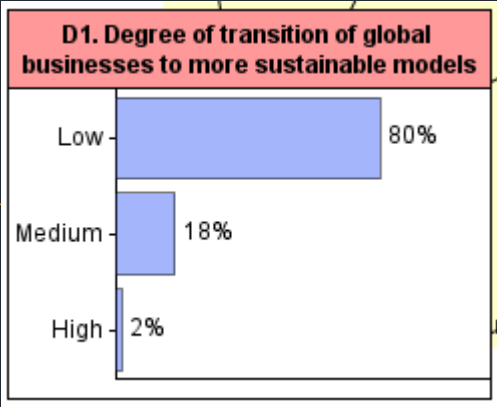
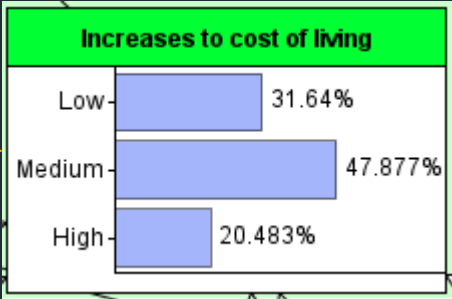
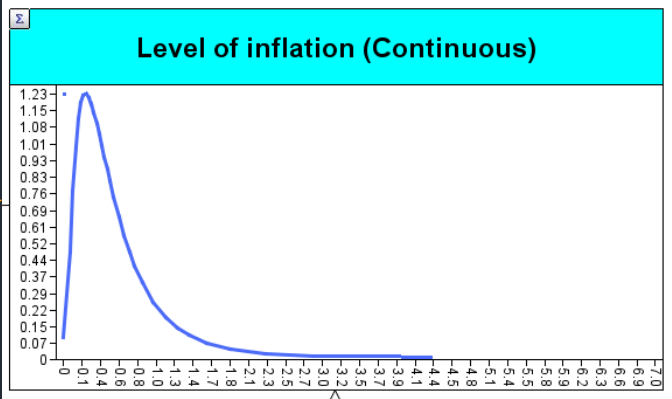
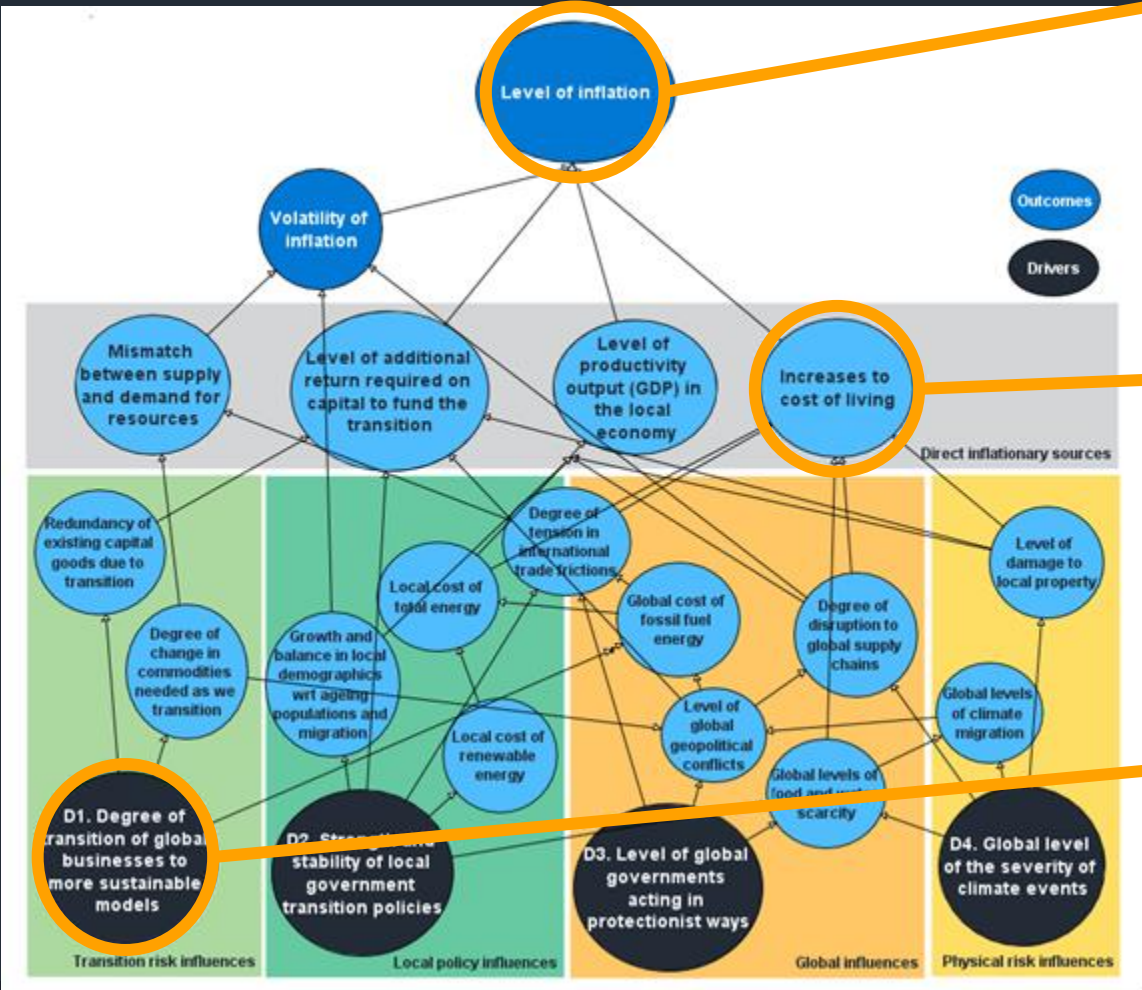
Determine appropriate states for each node

Source data to calibrate drivers

Calibrate remaining nodes based on states of predecessors

Sustainability inflation model

Model structure

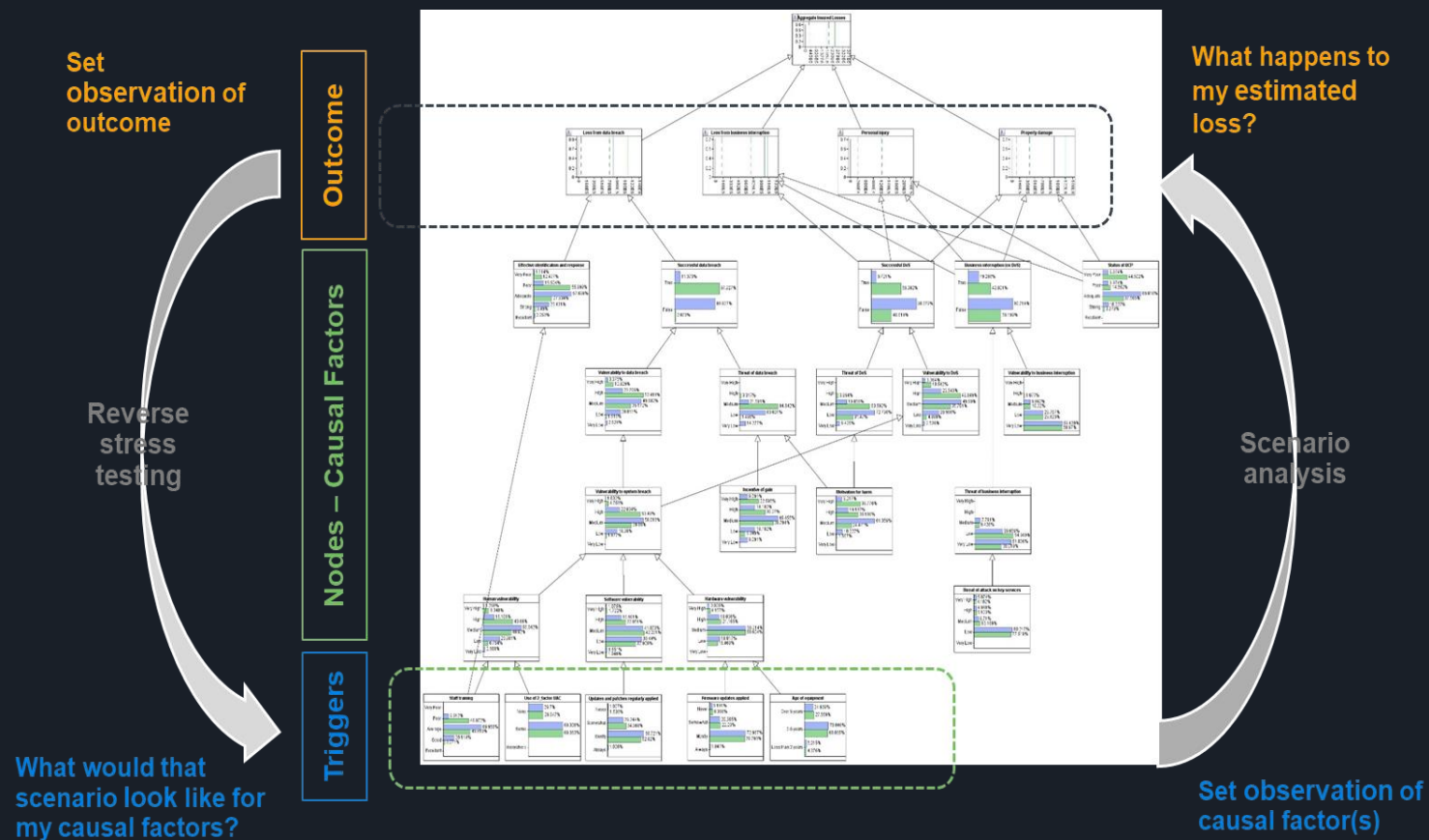


4. Informing strategy decisions



Causal modelling: two-way risk analysis

We can consider both “what if” scenario analysis, “how come?” reverse stress testing



Climate inflation analysis

Exploring scenarios in the causal model

A. Lack of global co-ordination

Significant increase in governments globally acting in protectionist ways

- Increased risk of geopolitical tensions
- Increased risk of food and water insecurity
- Impacts on cost of living in the domestic market

B. Creeping climate stresses

Similar impact:

- Moderate increase in governments globally acting in protectionist ways
- Moderate increase in severe weather events globally
- And businesses globally continue with transitioning to more sustainable business models

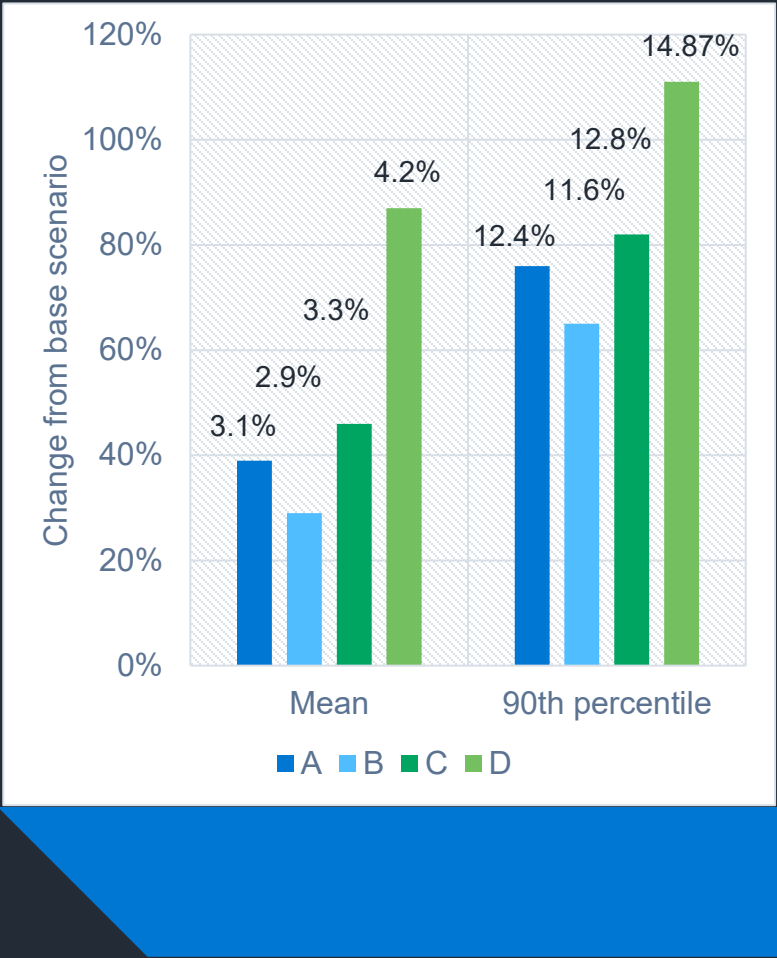
C. Removal of transition subsidies

If at the same time as the moderate climate-related stress environment in B, there is a significant increase in the local cost of renewable energy, there could be an uptick in inflation

D. Geopolitical conflicts

Or, if at the same time as the moderate climate-related stress environment in B a significant geopolitical risk event breaks out, this could have a significant inflation uptick.

Base Scenario	
Mean inflation	2.25%
90 th percentile	7.04%



For further details see The Actuary, Jan 2025: [The rise and fall: climate change and inflation modelling](#)

Implications for Actuaries

**Reality is complex
but new risk tools
can embrace not
ignore complexity.**



1

Embrace complexity within ORSA

- Include sustainability considerations within ORSA scenarios
- Address time horizon considerations

2

Sustainability of the inflation regime within internal and ALM models

- Residual inflation risk
- Influence on other residual risks

3

Inflation just one part

- Upgrade risk tools to reflect complex interactions
- Some themes emerge consistently (inflation, volatility)
- Short-term decision impactful narratives, core scenario and expanding ‘waterfront’ of stresses

Conclusion

- Climate, and sustainability, poses a complex problem
- Macro-economic impacts have often been ignored – especially their complex interactions
- Causal modelling can embrace the complexity helping to illustrate cumulative risks, tipping points and vulnerabilities.

Embracing complexity enriches the understanding of sustainability scenarios and vulnerabilities.





Thank you

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