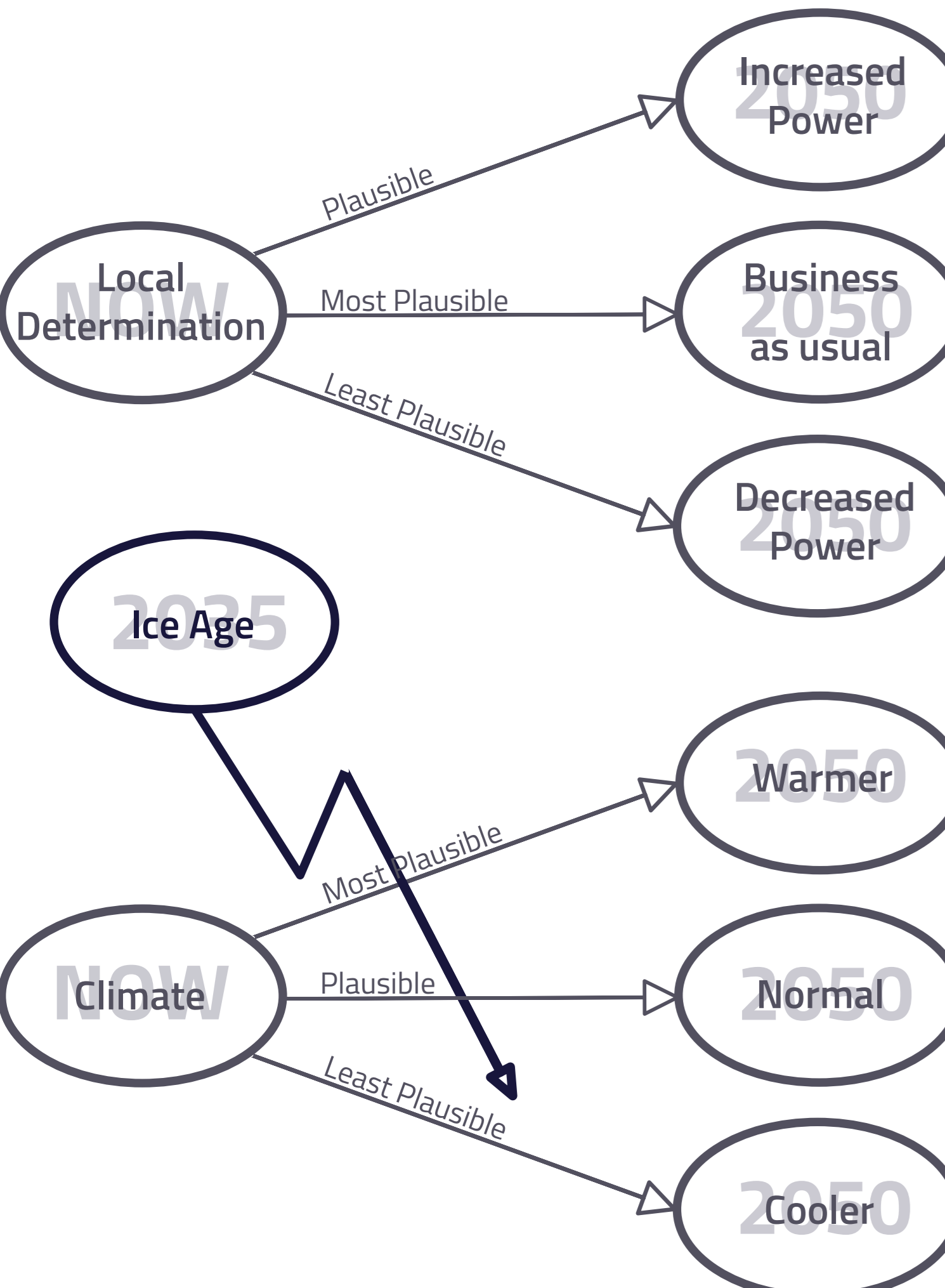
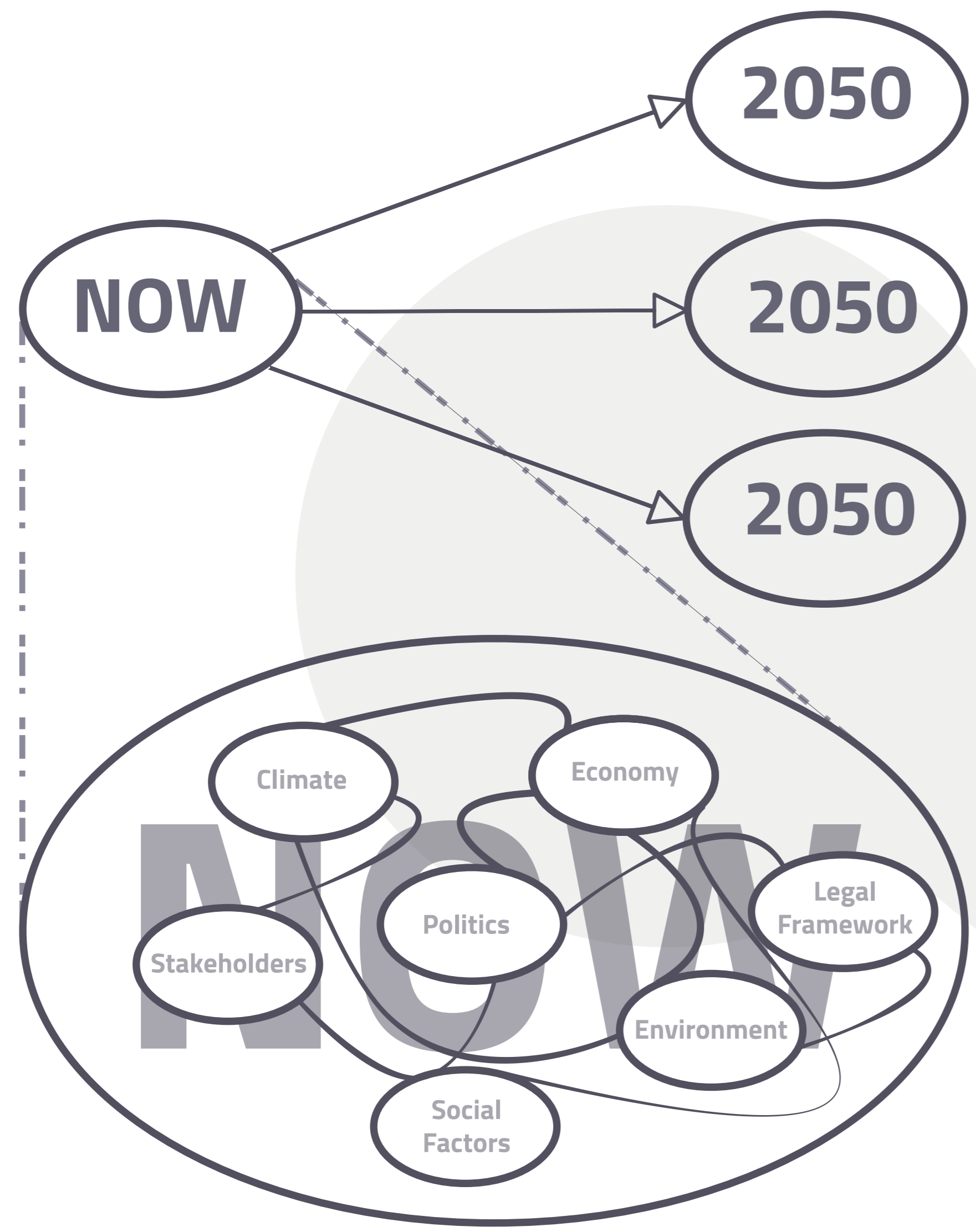


Robustness Analysis: Scenarios for Strategic Planning

Future or Futures?
It is inherently difficult to forecast the future. Thus, think in **multiple futures**, aka **scenarios**.

Limit the Field
The present and its future development are defined by many **Key Factors** and their interaction. For studying futures of a specific field carefully pick the most important Key Factors. This is done best during a workshop with stakeholders and experts.



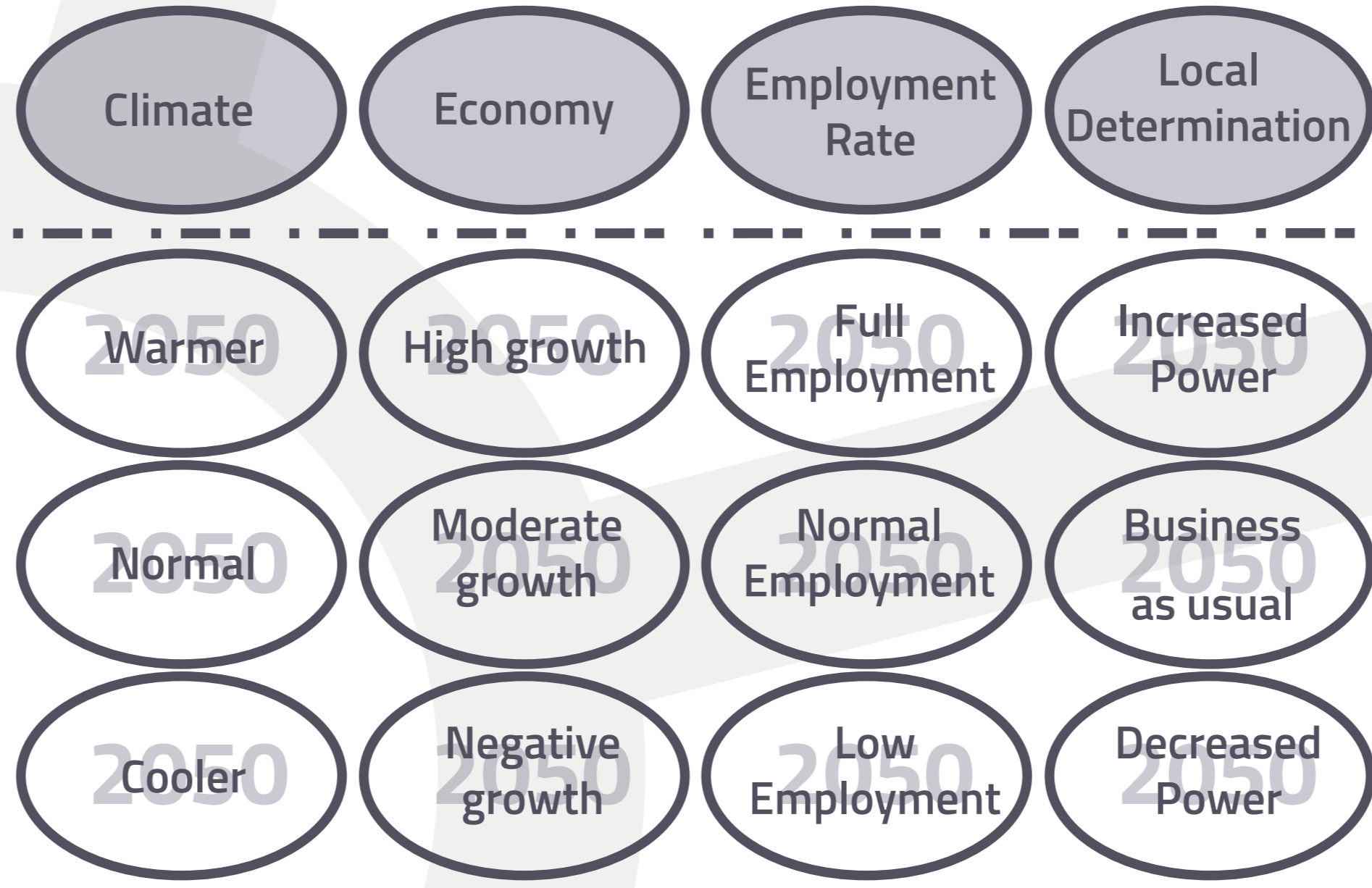
Key Factor - quo vadis?
In workshop, assign **Future Projections** (2-5) to each Key Factor. Rate their **Plausibility** (from 0 to 1). Think outside the box!

What if?
Find extreme, low plausibility, disruptive events - **Wild Cards**. Good strategy is resilient to these. Think outside the box!

Consistent Pairs
Compare each Future Projection to all other Future Projections. Is it consistent for a pair to appear in the same future? Assign **pairwise Consistency Values**, from -2 (totally inconsistent) to 2 (totally consistent). This process is best done by several individuals. Results from participants are merged.

	Full Employment 2050	Normal Employment 2050	Low Employment 2050
High growth	1.5	0.0	-0.5
Moderate growth	-0.5	1.0	0.0
Negative growth	-2.0	-0.5	1.0

Projection Bundles
Find all possible bundles of Future Projections. That is, all combinations of Future Projections, one from each Key Factor. This requires **software support**.



Evaluation: Plausible, Consistent, Robust

- Bundle Plausibility:** multiply all Plausibility values of a Projection Bundle.
- Bundle Consistency:** add all pairwise Consistency values of a Projection Bundle.
- Partial Inconsistencies:** count the occurrence of pairwise Consistency values smaller than -1.
- Total Inconsistencies:** discard all Projection Bundles with one or more pairwise Consistency value less than -1.5.
- Robustness:** find Projection Bundles that have **high** Plausibility and Consistency values and **no or few** Partial Inconsistencies.

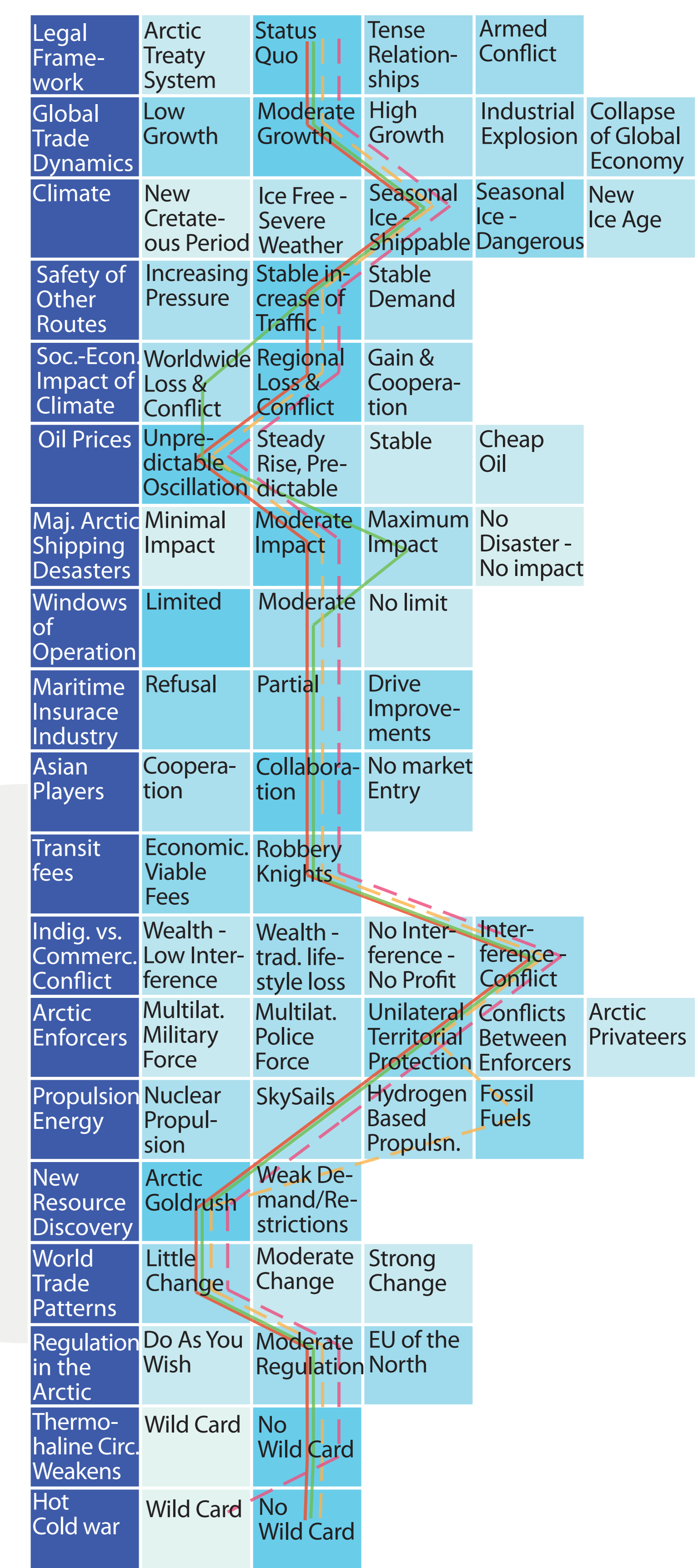
$$R = \left(\frac{\log(P) \cdot |C|}{1 + \mathcal{N}(pI)} \right)^{\frac{1}{2}}$$

where R is Robustness, P is Plausibility, |C| is the norm of the Consistency, and N(pI) is the number of Partial Inconsistencies.

Retrieve Raw Scenarios
The list of Projection Bundles is very long; many are similar.
Aim: Find 3-5 dissimilar Projection Bundles, these will be the Raw Scenarios.

Tools:
Distribution Plot: this gives information about the Projection Bundles' quality.
Multidimensional Scaling: maps the high-dimensional Projection Bundles in 2D. Similar Bundles are close together.
Clustering: sorts the Projection Bundles into groups based on similarities.

Morphological Box (shown on right): visualizes Projection Bundles over the set of Future Projections.



Write Scenarios
Based on the selected Raw Scenarios write well flowing Scenarios. Use similar Future Projections to point out possible variations. Discuss how the Scenarios are affected under occurrence of Wild Cards.

Open Scenario Processes
Make all above steps available for discussion. Invite all stakeholders to participate. Open discussion improves final product, acceptance, and buy-in.

Info
denamics GmbH provides strategy development processes utilizing scenarios, innovation management in the energy sector, and R&D and project development expertise for bleeding-edge energy technology.
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