# 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.
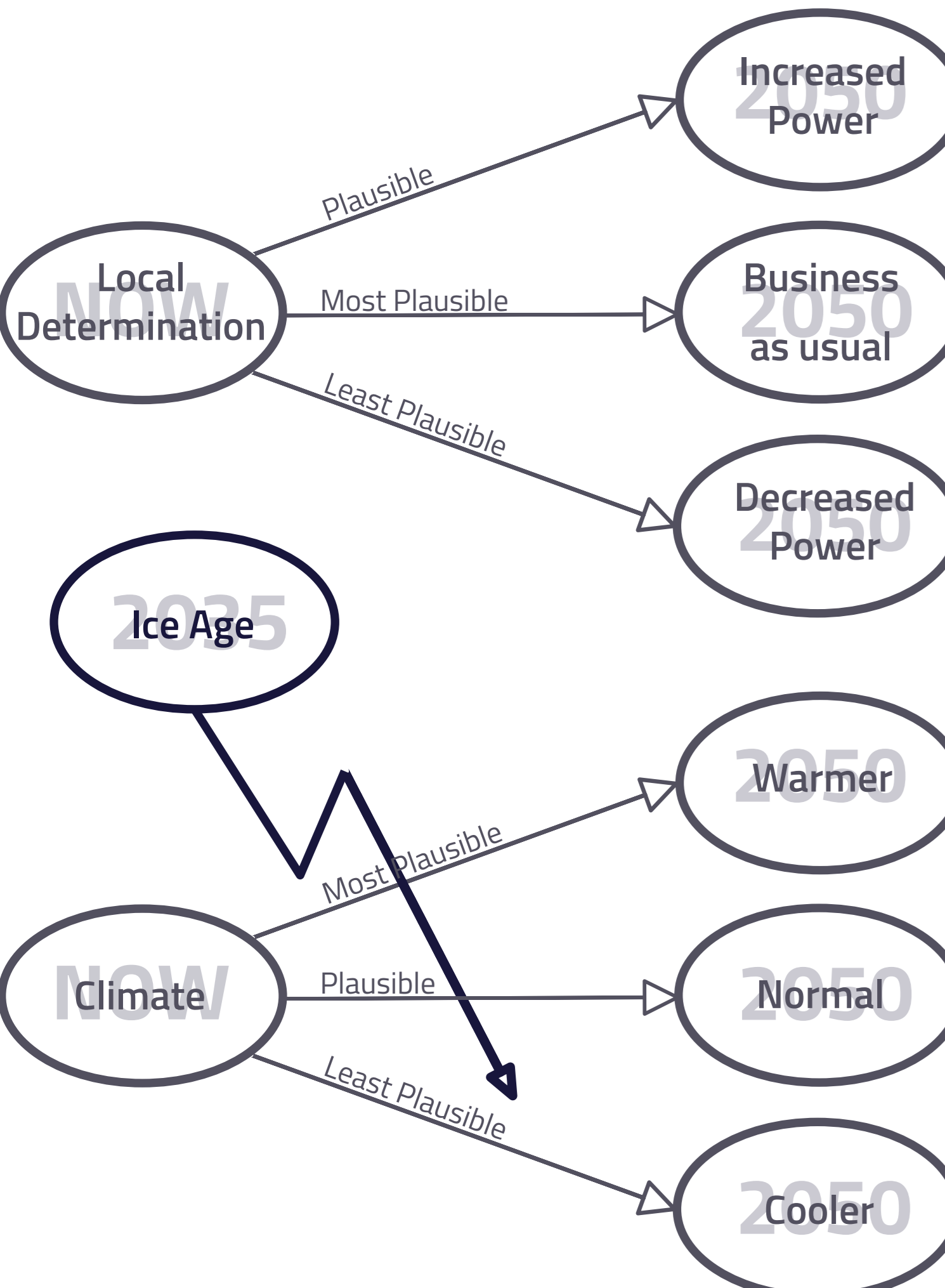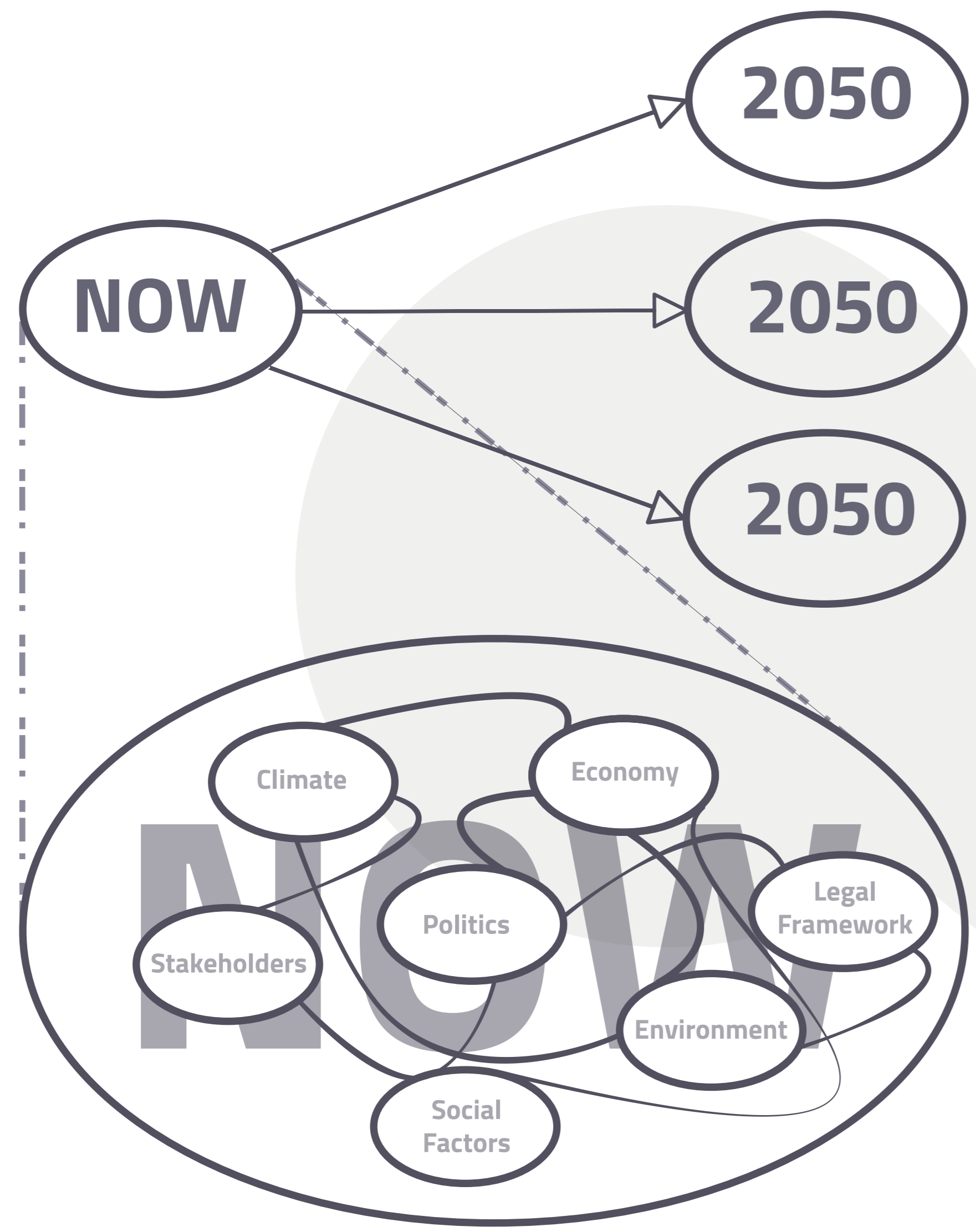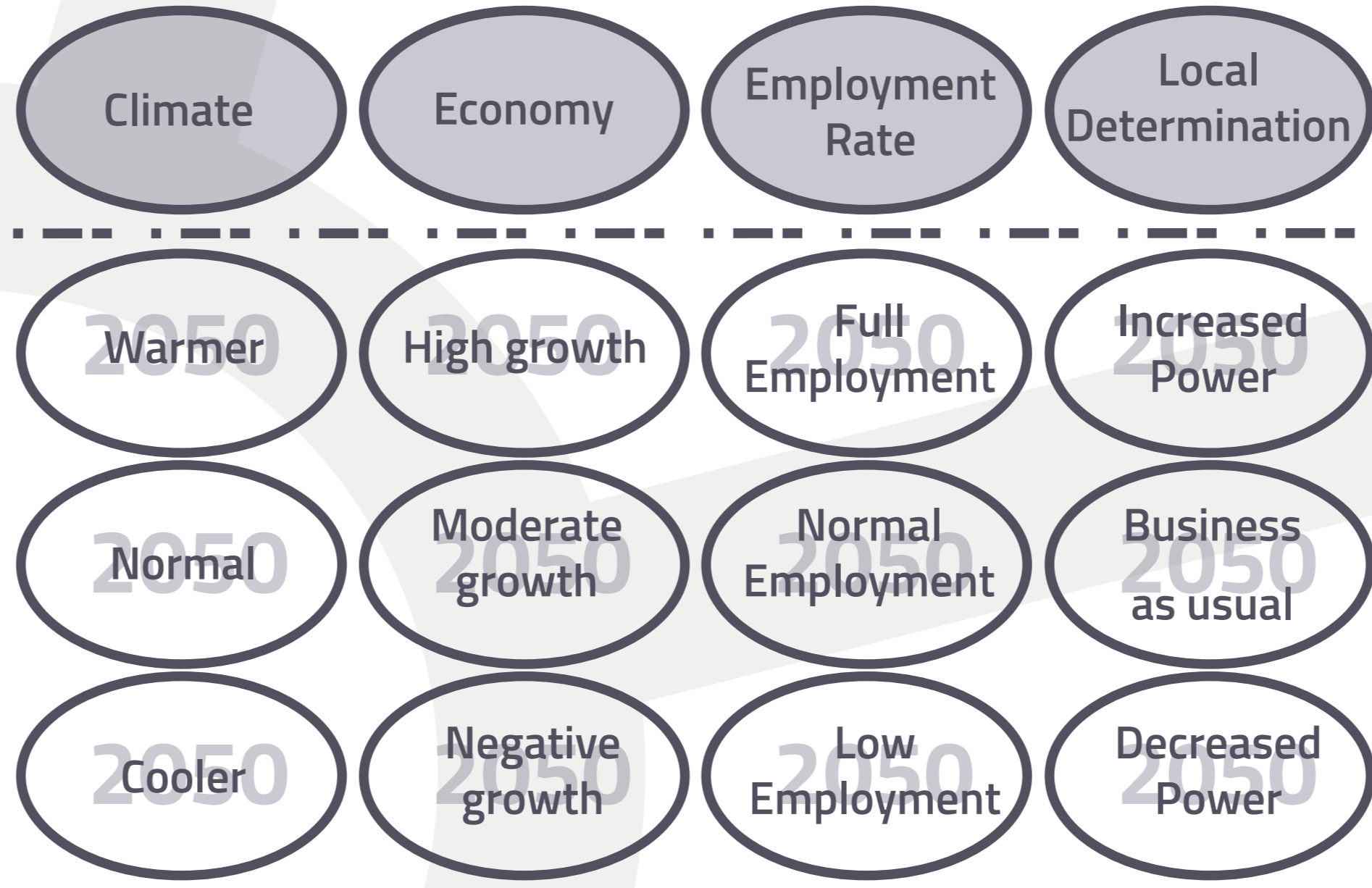
Key Factor - *quo vadis?*

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 generates the *Consistency Matrix*. This process is best done by several individuals. Results from participants are merged.

	Employment Rate		
Economy	Full Employment	Normal Employment	Low Employment
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*.
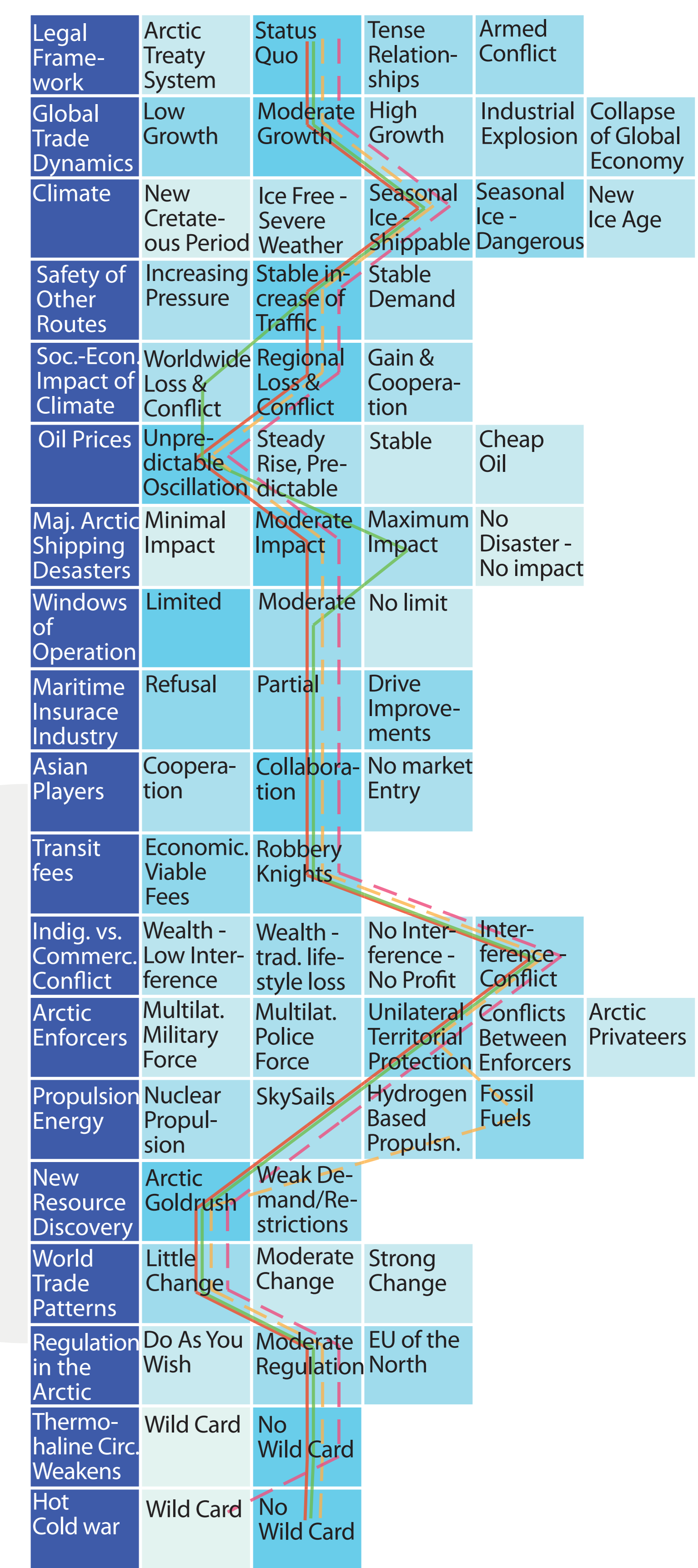
Climate	Economy	Employment Rate	Local Determination
Warmer	High growth	Full Employment	Increased Power
Normal	Moderate growth	Normal Employment	Business as usual
Cooler	Negative growth	Low Employment	Decreased Power

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 that -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.

Legal Framework	Arctic Treaty System	Status Quo	Tense Relationships	Armed Conflict	
Global Trade Dynamics	Low Growth	Moderate Growth	High Growth	Industrial Explosion	Collapse of Global Economy
Climate	New Cretaceous Period	Ice Free - Severe Weather	Seasonal Ice Shippable	Seasonal Ice - Dangerous	New Ice Age
Safety of Other Routes	Increasing Pressure	Stable increase of Traffic	Stable Demand		
Soc-Econ. Impact of Climate	Worldwide Loss & Conflict	Regional Loss & Conflict	Gain & Cooperation		
Oil Prices	Unpredictable Oscillation	Steady Rise, Predictable	Stable	Cheap Oil	
Maj. Arctic Shipping Desasters	Minimal Impact	Moderate Impact	Maximum Impact	No Disaster - No impact	
Windows of Operation	Limited	Moderate	No limit		
Maritime Insurace Industry	Refusal	Partial	Drive Improvements		
Asian Players	Cooperation	Collaboration	No market Entry		
Transit fees	Economic. Viable Fees	Robbery Knights			
Indig. vs. Commercl. Conflict	Wealth - Low Interference	Wealth - trad. lifestyle loss	No Interference - No Profit	Interference - Conflict	
Arctic Enforcers	Multilat. Military Force	Multilat. Police Force	Unilateral Territorial Protection	Conflicts Between Enforcers	Arctic Privateers
Propulsion Energy	Nuclear Propulsion	SkySails	Hydrogen Based Propulsn.	Fossil Fuels	
New Resource Discovery	Arctic Goldrush	Weak Demand/Restrictions			
World Trade Patterns	Little Change	Moderate Change	Strong Change		
Regulation in the Arctic	Do As You Wish	Moderate Regulation	EU of the North		
Thermohaline Circ. Weakens	Wild Card	No Wild Card			
Hot Cold war	Wild Card	No Wild Card			

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

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