Decision Support for Nutrient Management in San Francisco Bay

Photo: www.pubs.usgs.gov

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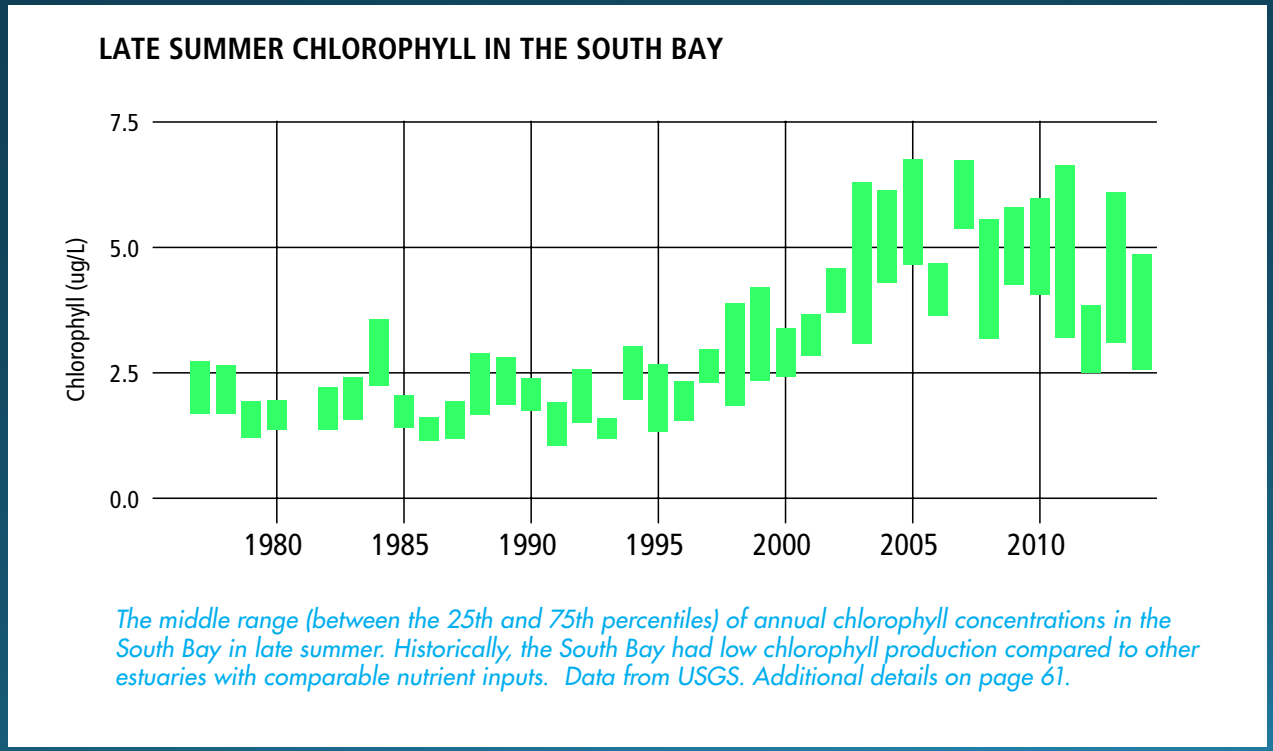
Outline

- Motivation
- Research questions
- Methods
- Next steps
- Questions and discussion

Bay Area decision-makers are ahead of the game

- Unique opportunity to develop technically robust and cost-effective solutions.



Graph from SFEI's Pulse of the Estuary, 2015

Nutrient control is a big investment for the long term – so how might it most effectively fit into other long-range planning for the region with regards to habitat restoration, climate resilience, and water infrastructure (e.g. drinking water, wastewater, and stormwater)?

Photo: Ryan Koenigs at www.sfestuary.org

Finding effective solutions

- Coordinating across many agency and individual goals, needs, and ideas about what should be done
- Collaborating regionally and across fields
- Reducing key uncertainties
- Understanding multiple objectives for long-range planning

Framework for decision-making

Photo: http://www.studynotes.ie/wiki/internal-structures-materials-engineering-notes/

What is multi-criteria decision analysis?

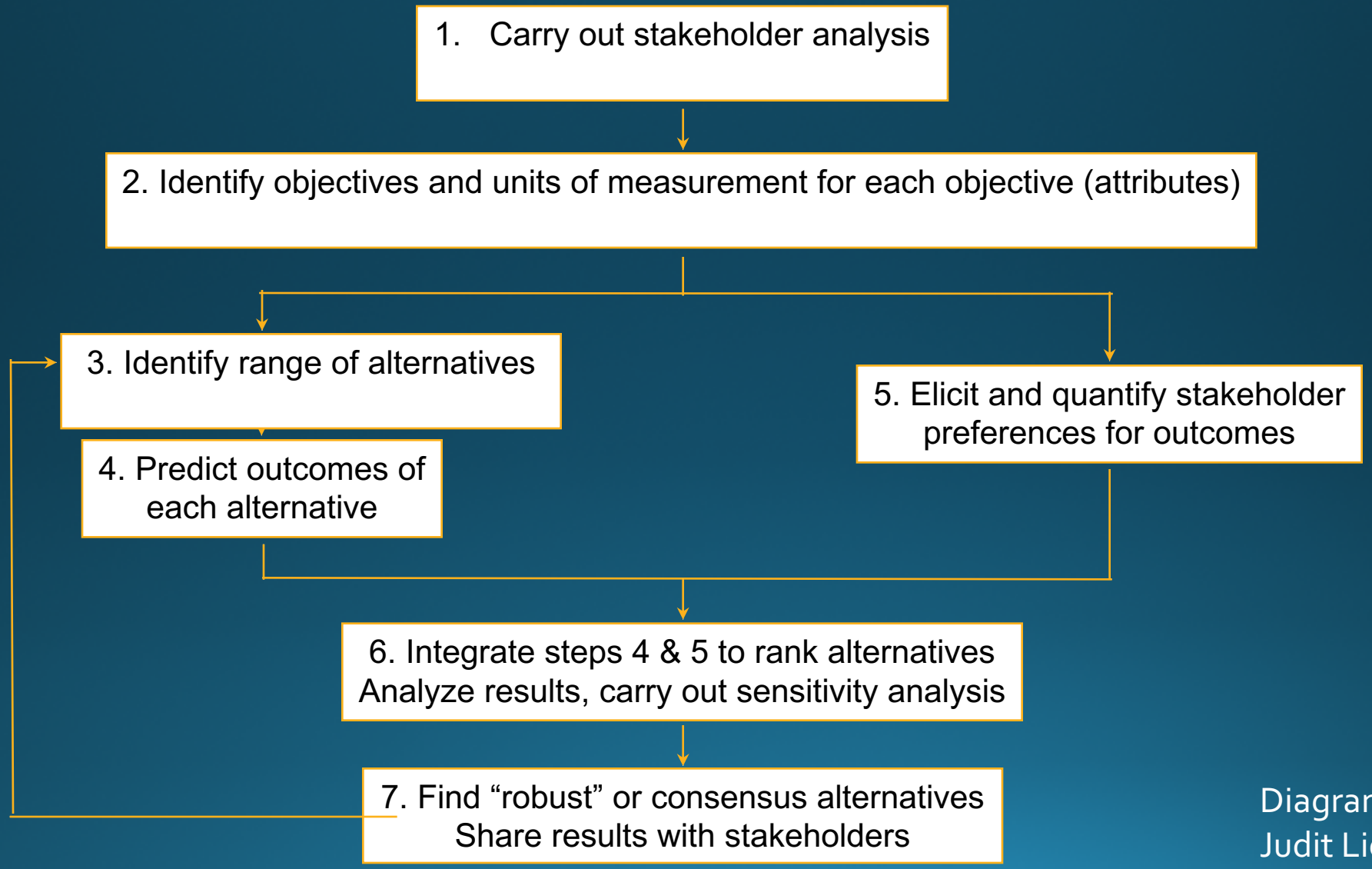


Diagram adapted from Judit Lienert, 2016

Research question 1: What are stakeholders' goals for nutrient management?

- What are major areas of agreement?
- Are stakeholder views related to professional role or scale of influence?
- How do decision-makers prioritize multiple goals?

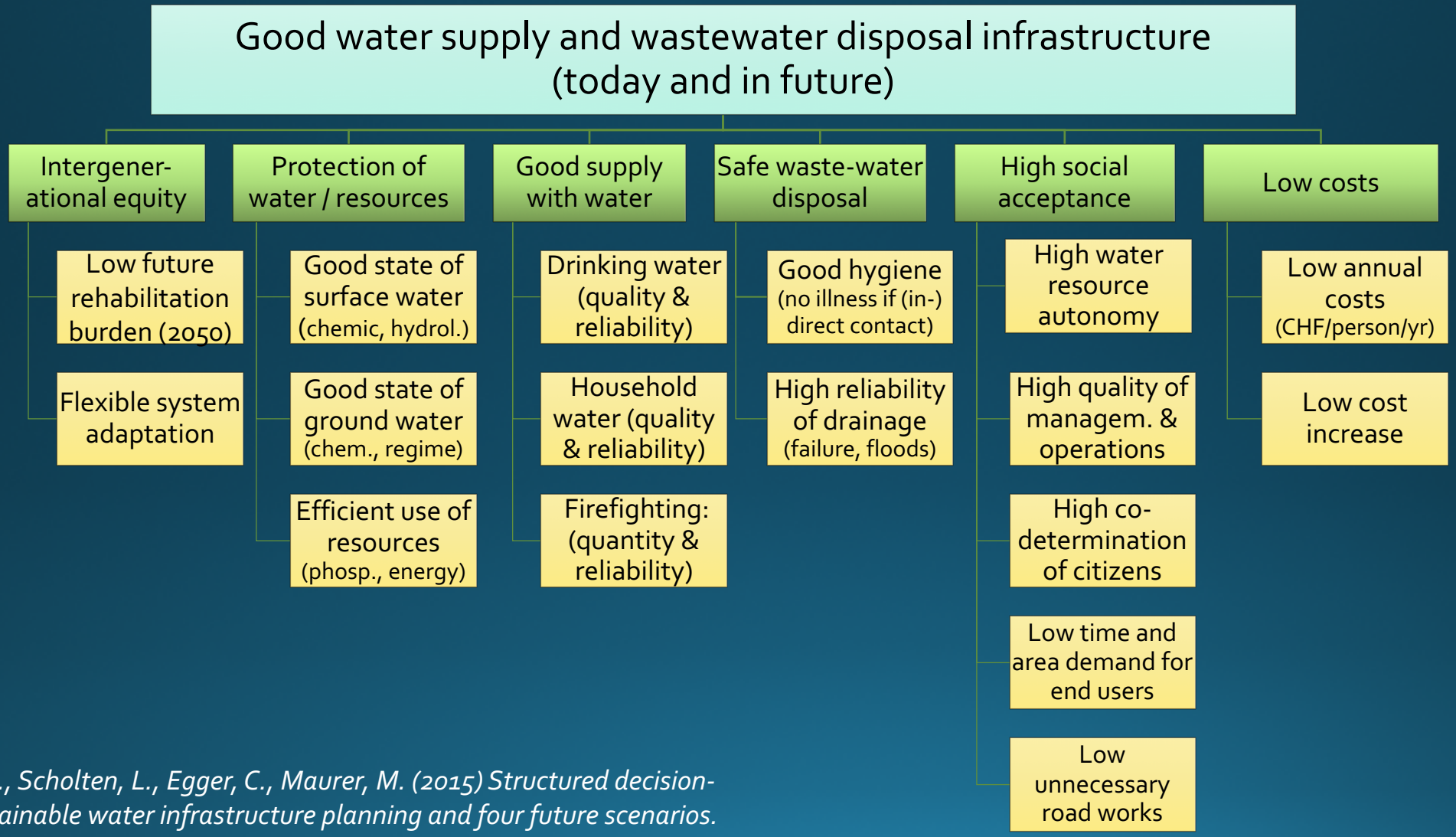
Interviews with key stakeholders

- Determine objectives for nutrient management and attitudes towards risk and uncertainty
- Cluster analysis to identify sub-groups of stakeholders

Who have I talked with?

- Alameda County Public Works Agency
- Association of Bay Area Governments
- Bay Area Air Quality Management District
- BACWA
- Bay Area Integrated Regional Water Management Plan
- Bay Area Water Supply and Conservation Agency
- BayKeeper
- Bay Planning Coalition
- Coastal Conservancy
- Contra Costa County Flood Control District
- Delta Diablo
- EBDA
- EBMUD
- EPA Region 9
- Fish and Wildlife Service
- HDR Consulting
- San Francisco Bay National Estuarine Research Reserve
- San Francisco Bay Regional Coastal Hazards Adaptation Resiliency Group
- San Francisco Bay Regional Water Quality Control Board
- San Francisco Bay Restoration Authority
- San Francisco Estuary Institute
- SFPUC
- San Jose-Santa Clara Regional Wastewater Facility
- Silicon Valley Clean Water
- South Bay Salt Pond Restoration Project
- State and Federal Contractors Water Agency
- Suisun Resource Conservation District
- Union Sanitary District
- USGS

Example: goals from Swiss Sustainable Water Infrastructure Planning



From: Lienert, J., Scholten, L., Egger, C., Maurer, M. (2015) Structured decision-making for sustainable water infrastructure planning and four future scenarios. EURO J. on Decision Processes 3(1-2): 107-140

Research question 2: How do various nutrient management alternatives measure up with regards to stakeholder objectives?

- Are there "robust" alternatives that meet most stakeholders' criteria for good nutrient management?
- Do these robust alternatives hold under different future scenarios (e.g., of differing ecological response to nutrients or different regulations)?

Multi-criteria decision analysis

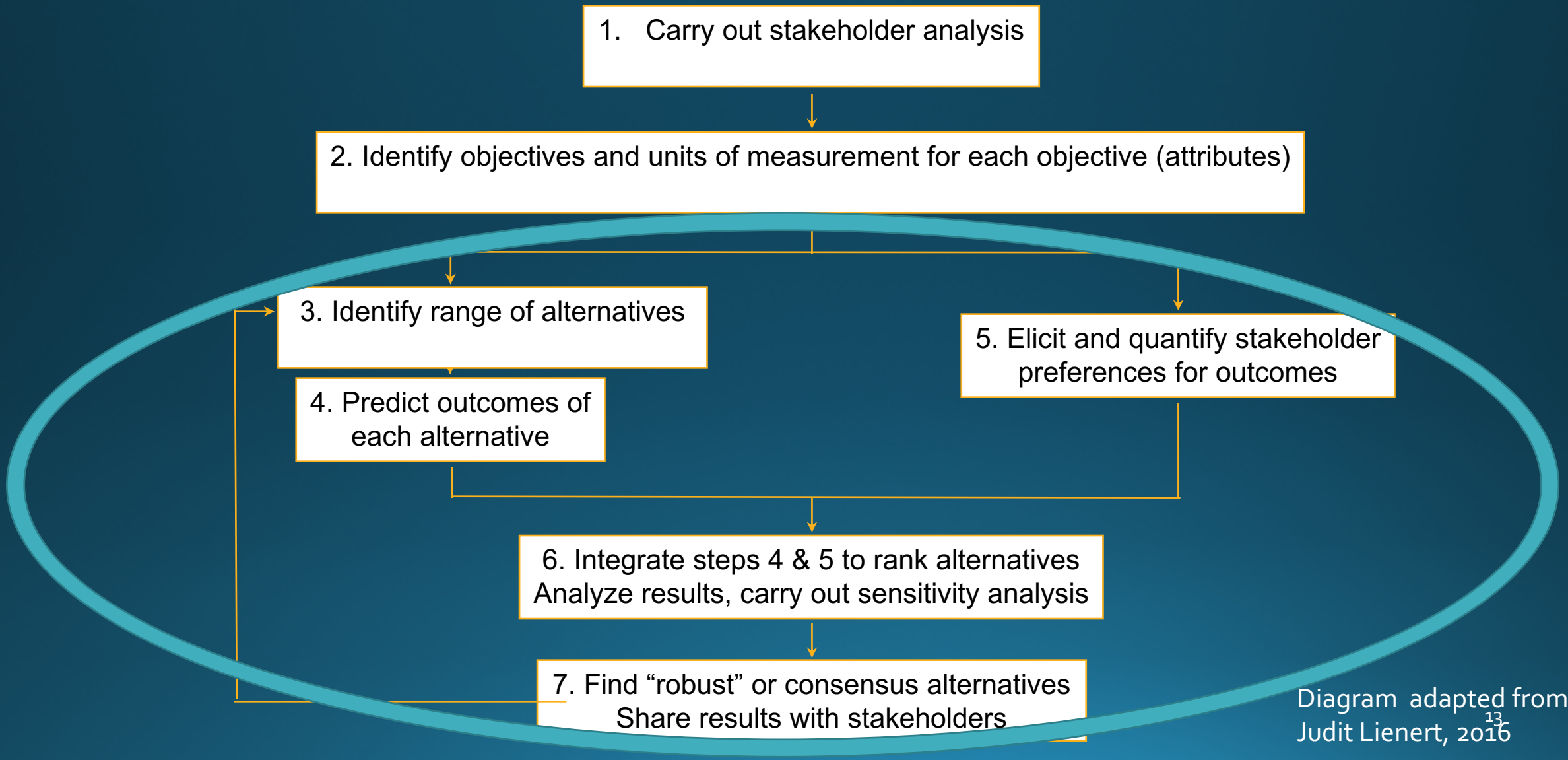


Diagram adapted from Judit Lienert, 2016

Collaboration with SFEI

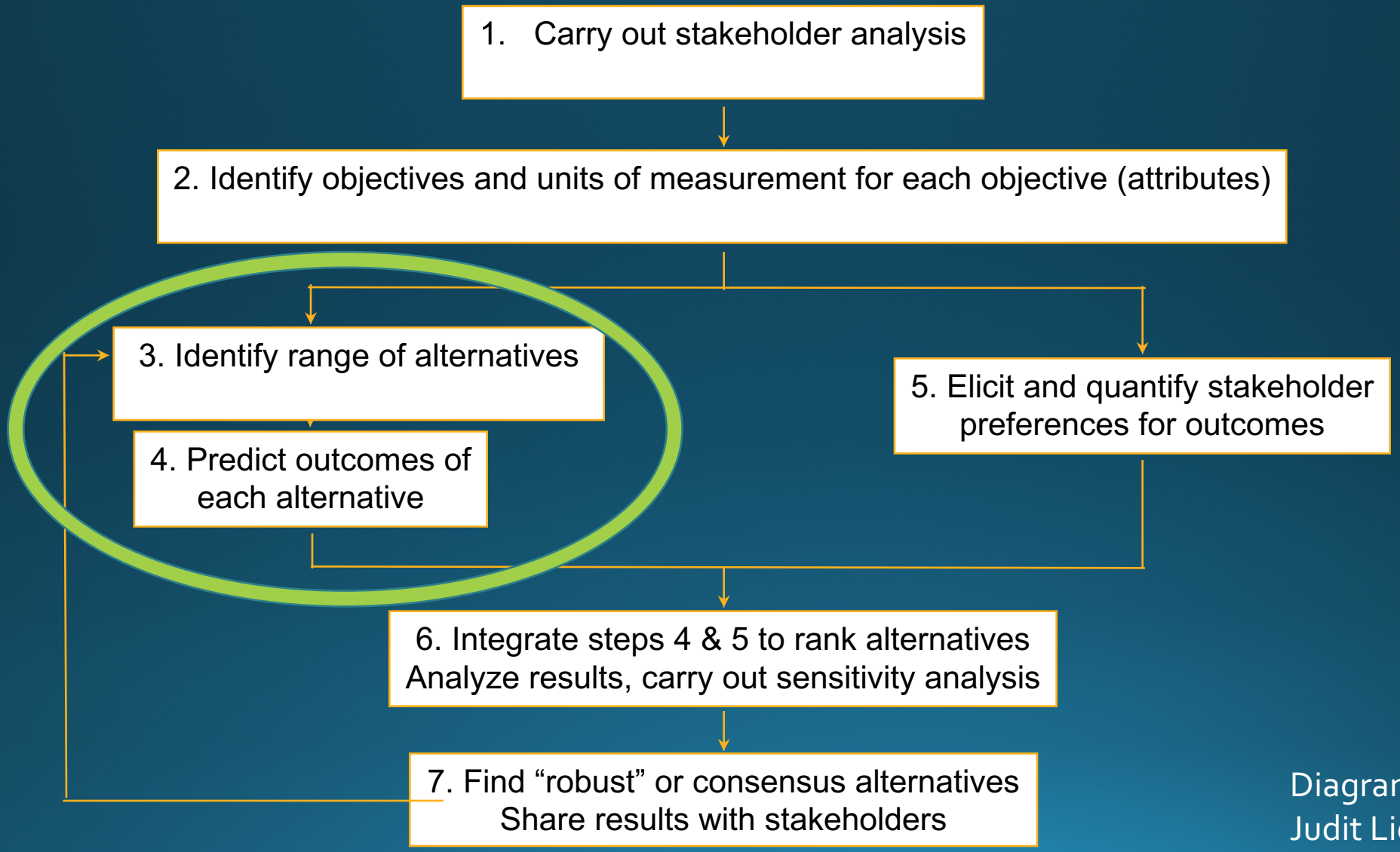


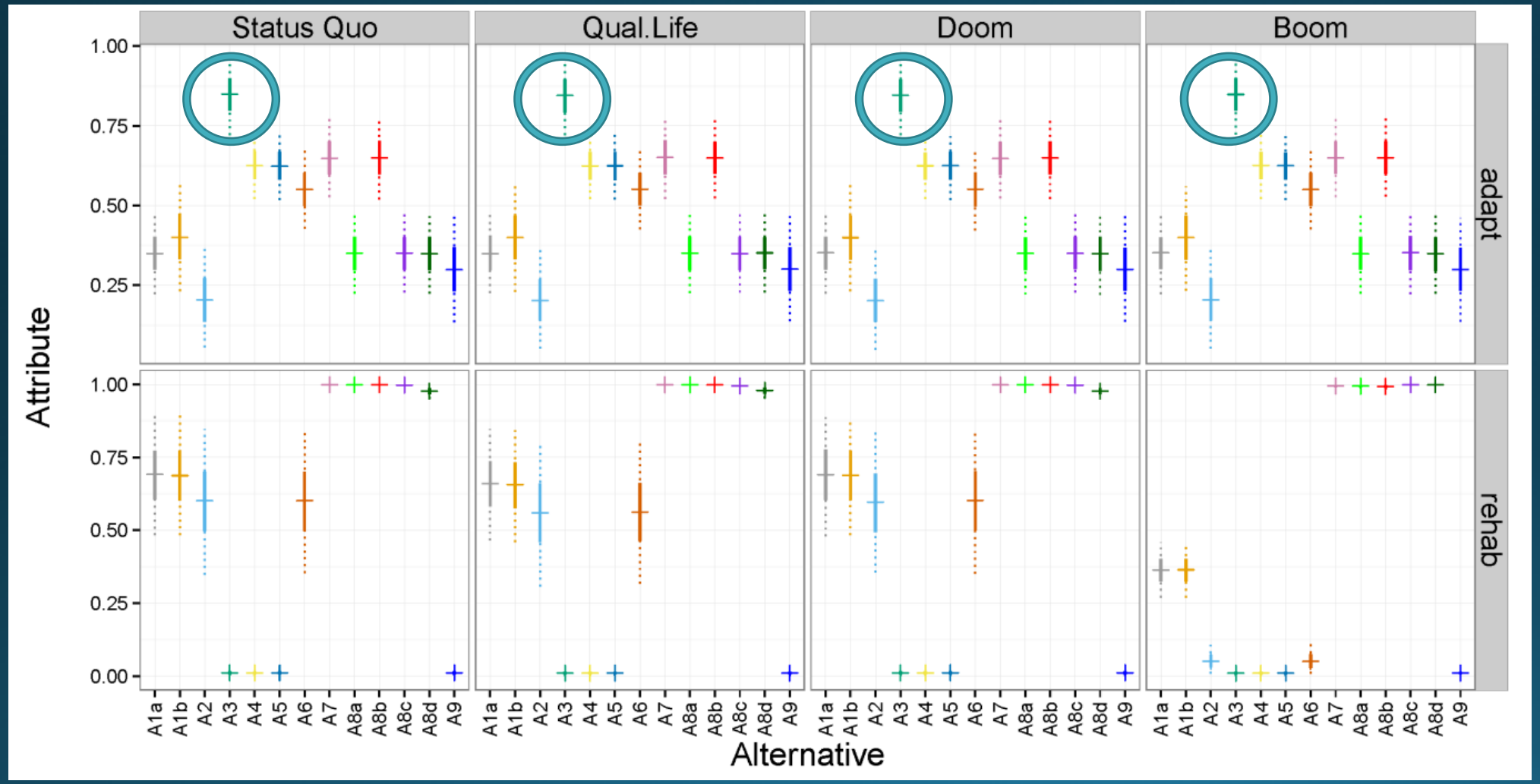
Diagram adapted from Judit Lienert, 2016

Provides useful insight

- Who would support different management alternatives, and why?
- Which management alternatives are likely to be acceptable to many people?
- Which variables are most likely to affect outcomes – where would reducing uncertainty change results?
- Which alternatives are likely to do well under a range of future scenarios?

What would work well regardless of future conditions?

Example from Switzerland: outcome of scenario-based multi-criteria decision analysis



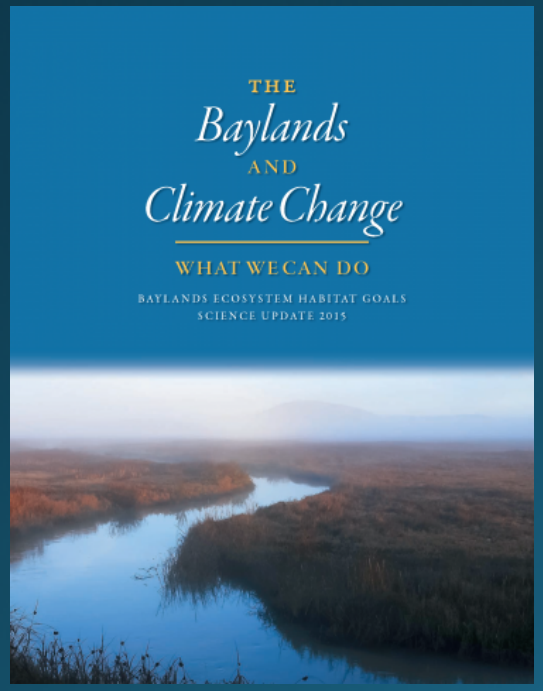
From: Zheng, J., Egger, C., Lienert, J. (2016) A scenario-based MCDA framework for wastewater infrastructure planning under uncertainty. Journal of Environmental Management 183 (3): 895-908.

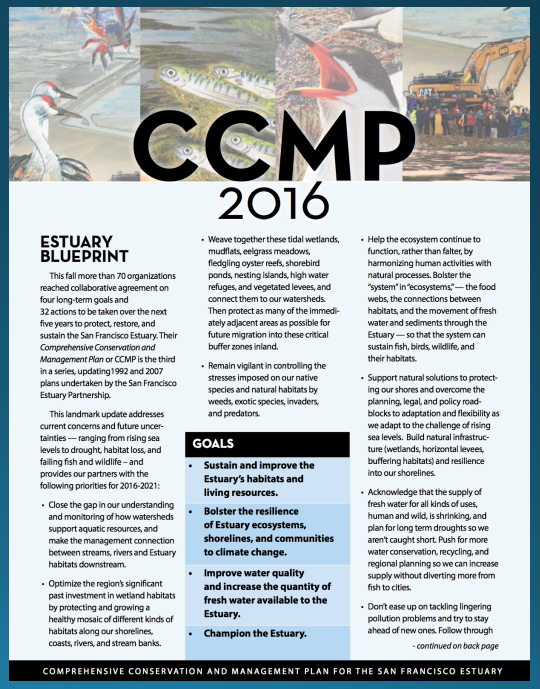
Research question 3: What are the institutional drivers and barriers to multi-benefit water infrastructure planning?

- What are the institutional contexts that support collaborative decision-making processes?
- What is the role of uncertainty and risk in the decision-making process? Which types of uncertainty do stakeholders perceive as most important to reduce in order to ensure sound decisions? How do stakeholders hedge against risk?
- How does decision-making about nutrients in the Bay compare to traditional modes of water infrastructure planning?

Document analysis

- Synthesize long-range planning goals
- Assess changes over time
- Determine institutional context for decision-making





Next steps

- Analyze interview data
- Assess stakeholder values
- Determine management alternatives and scenarios
- Perform multi-criteria decision analysis
- Share results with stakeholders
- Peer-reviewed publications

Thank you.

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Scenario planning: potential variables

- Population growth
- Sea level rise
- Water recycling
- Concern about phosphorous
- Concern about CECs
- Freshwater flows

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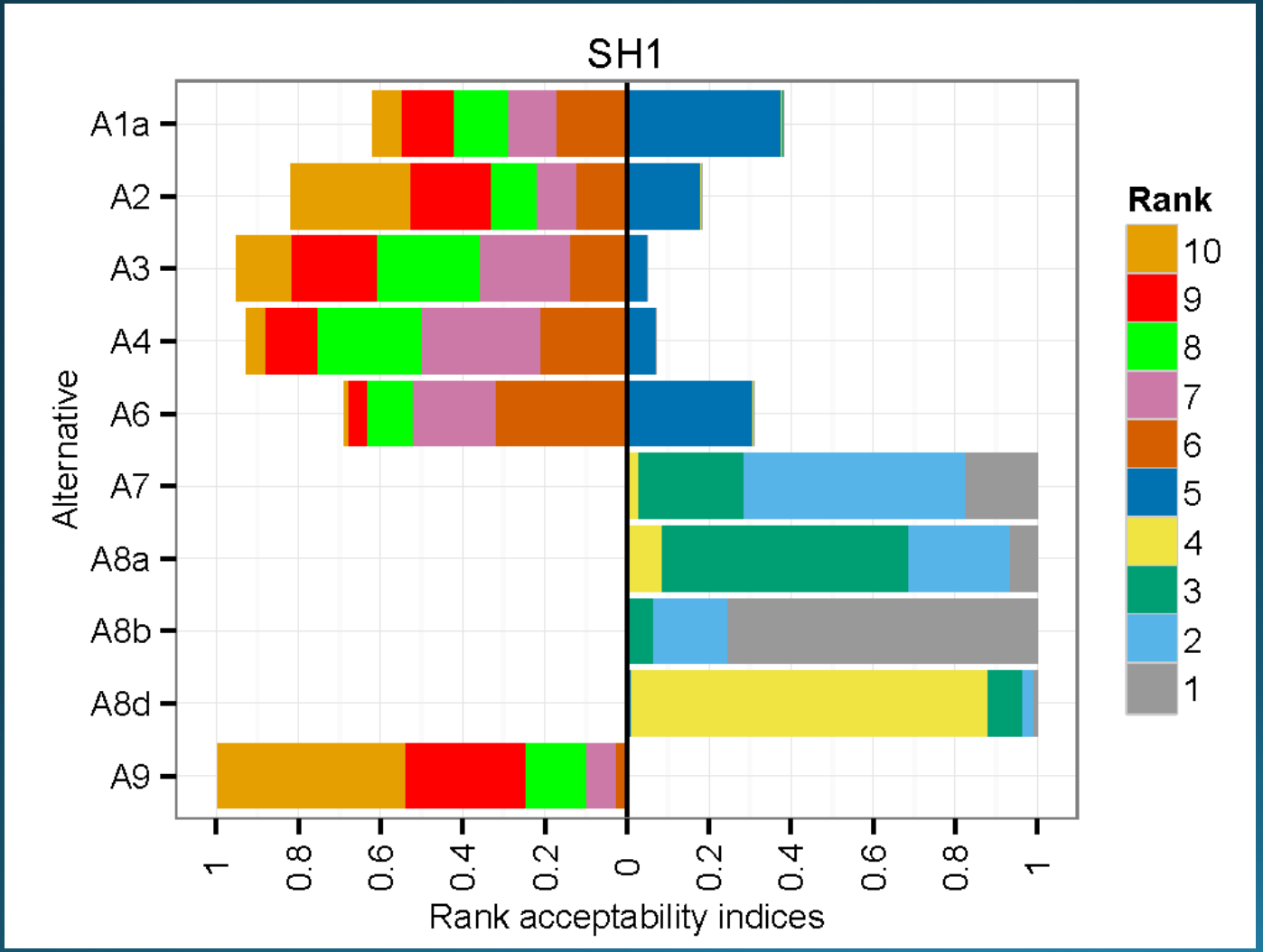
Who would support different alternatives?

Example from Switzerland: Acceptability of alternatives for a stakeholder



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