From Controversy to Consensus

A decision analysis for decommissioning California's offshore oil platforms

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CEO, Lumina Decision Systems
Los Gatos, California

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Bringing clarity to difficult decisions

Overview

- **The challenge:** How to decommission California's offshore oil platforms
- **Conflicting stakeholders**
- **Process:** Analyze options using an interactive decision model
- **Solution:** Can we satisfy all stakeholders?
- **Lessons:**

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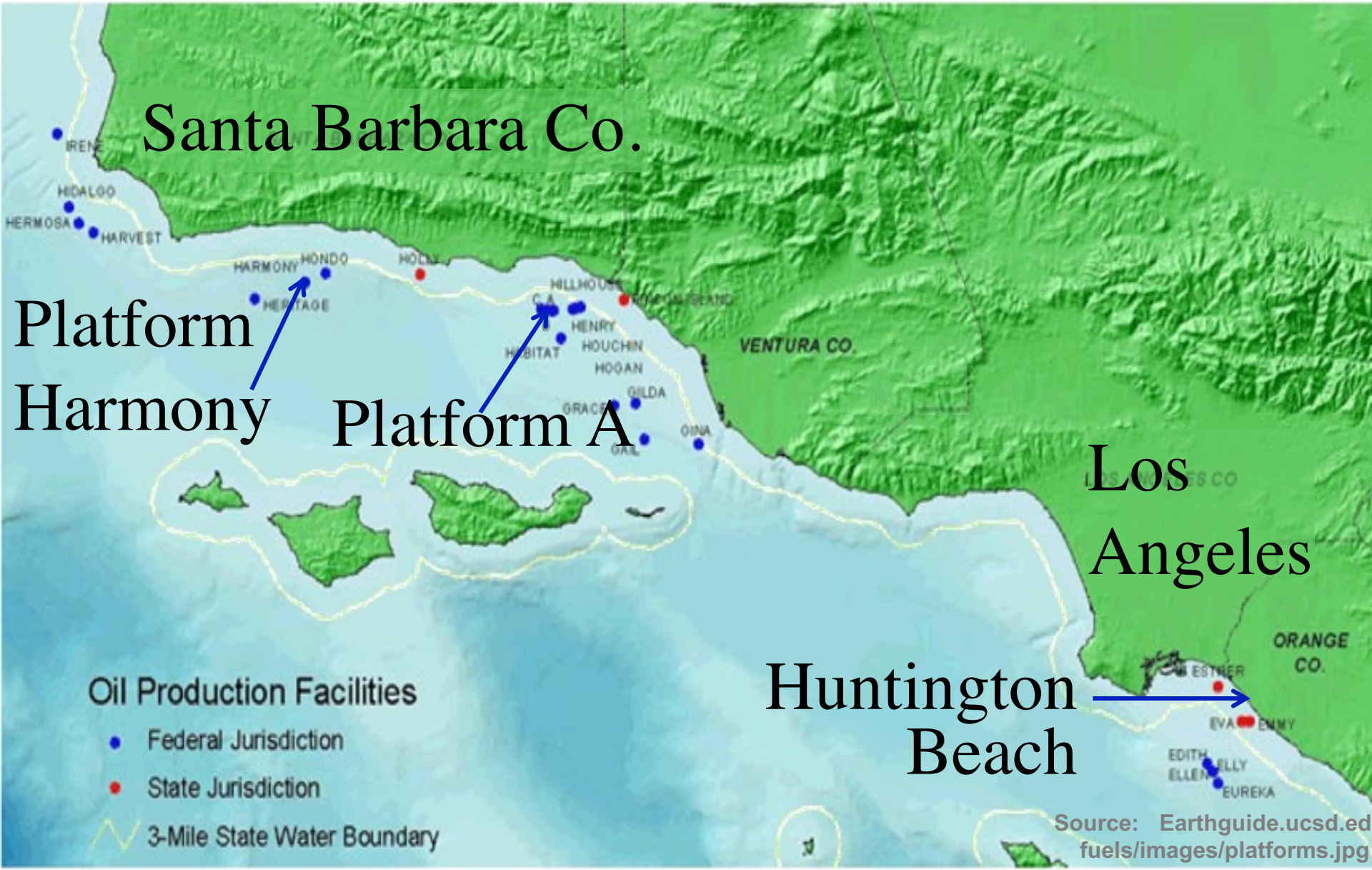
Huntington Beach, 1926

Huntington Beach, 2015

Oil and gas platforms in the Federal and State Waters of Southern California

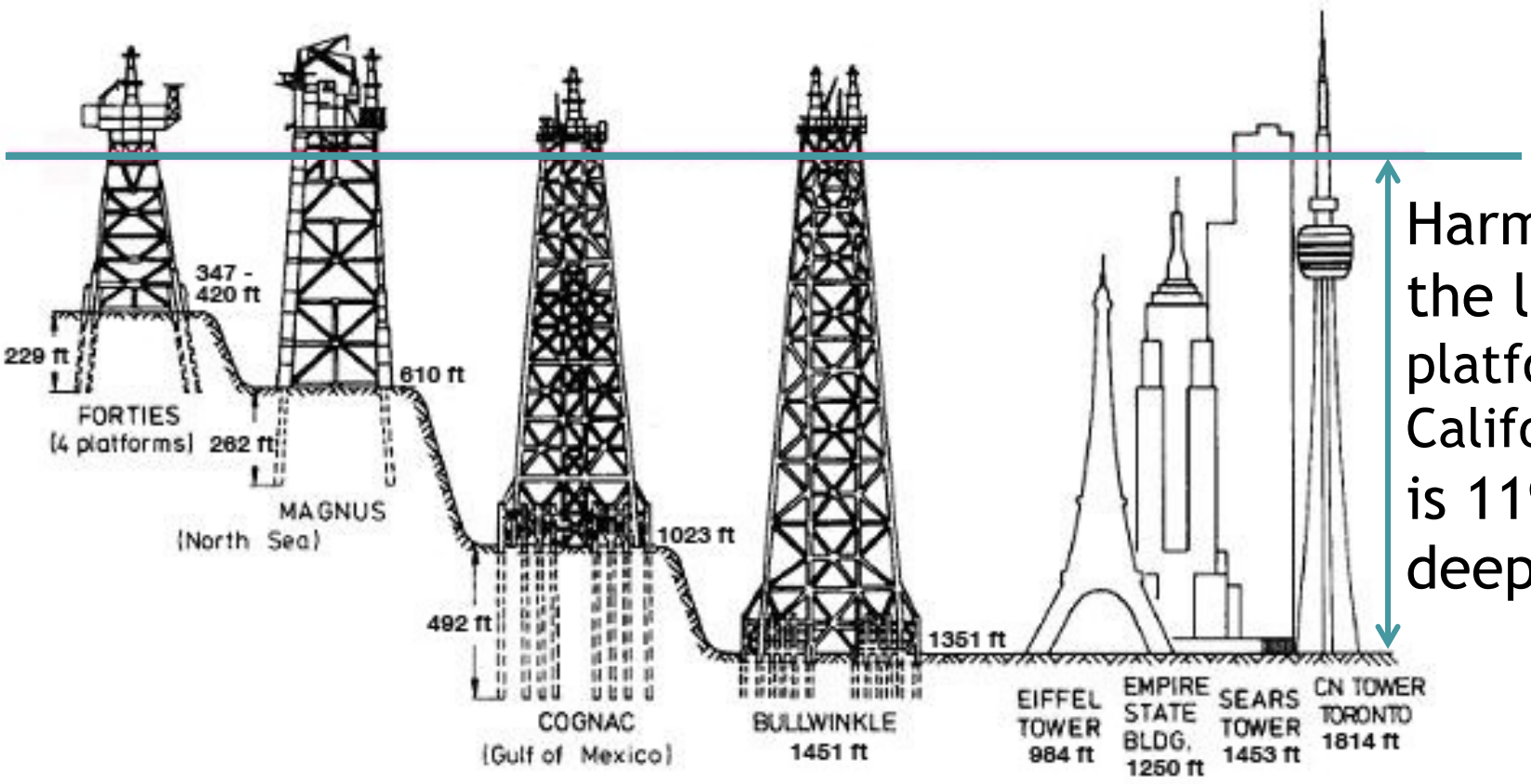


Source: Earthguide.ucsd.edu fuels/images/platforms.jpg

The Santa Barbara Oil Spill in 1969

from Platform A

How big are offshore oil platforms?



Harmony, the largest platform in California, is 1198 ft deep.

modified from http://synclaire.net/blog/2008/02/oil-platform-comparison

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How big are offshore oil platforms?

A segment of Platform Harmony before installation

Life under the platforms

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Selected stakeholder organizations

Federal and California gov.

NOAA — National Oceanic and Atmospheric Administration, U.S. Department of Commerce

The Great Seal of the State of California — Eureka

California Natural Resources Agency

California Department of Fish and Wildlife

California Coastal Commission

Environmental groups

Ocean Conservancy

Greenpeace

Sierra Club

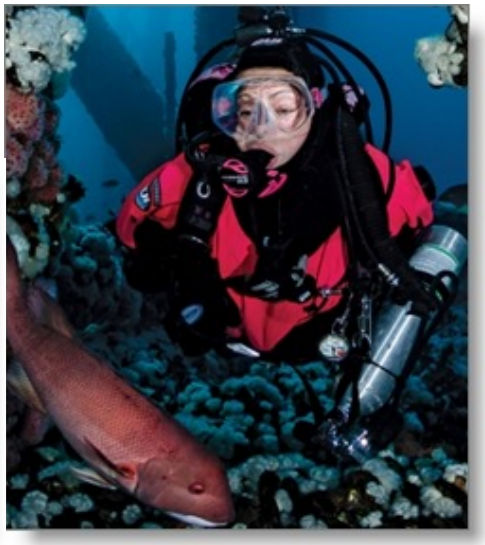
Owner operators of oil platforms

Chevron

Commercial and sport fishing

The Sportfishing Conservancy

Recreational divers



Project client:

Skyli McAfee, Executive Director

Multidisciplinary Team

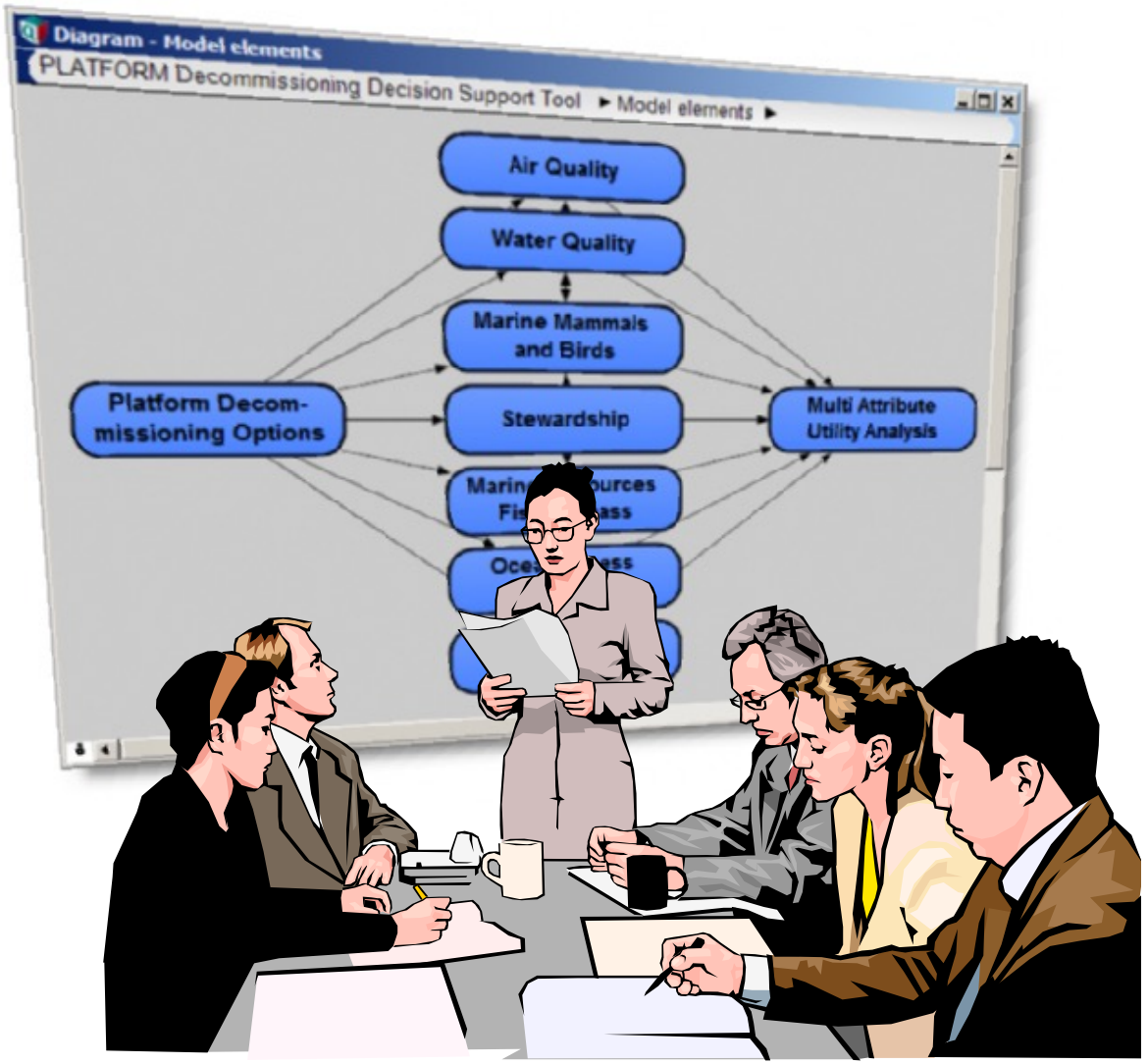
Brock Bernstein, PhD		Team lead, Project manager
Max Henrion, PhD	Lumina	Decision analyst
Surya Swamy	Lumina	Model developer
Daniel Pondella, PhD	Occidental College	Marine ecology, fisheries
Sarah Kruse, PhD	Ecotrust	Economist
John de Witt	Bowdoin College	Policy analysis
Astrid Scholz, PhD	Ecotrust	Economist
Andy Bressler	Texaco (ret.)	Offshore engineering
Peter Cantle	Bioresources	Air quality and emissions
Tim Setnicka	Superintendent Channel Islands National Park (ret.)	Federal policy, coastal management
Laurel Fink	Researcher	Marine ecology
Bridget McCann	Researcher	Legal and management

Advisory Committee

Todd Anderson	San Diego State University	**Fisheries**
Doug Anthony	Santa Barbara County	**Coast management, air emissions**
Ann Bull	Federal Minerals Management Service	**Regulation, compliance**
Robert Byrd	Proserv Offshore	**Decomm. engineering**
Alison Dettmer	California Coastal Commission	**Coastal management**
Dominic Gregorio	Calif. State Water Resources Control Board	**Water quality**
Linda Fernandez	University of California Riverside	**Environmental policy**
Grigg Gitschlag	National Ocean and Atmospheric Admin	**Resource management**
Alan Hager	California Dept. of Fish and Wildlife	**Legal & regulatory**
Sean Hecht	UCLA	**Environmental law**
Sonke Mastrup	California Dept. of Fish and Wildlife	**Resource management**
Michael McGinnis	University of California Santa Barbara	**Decommissioning history, sociology**
Mark Meier	State Lands Commission	**Regulation, compliance**
Mark Page	University of California Santa Barbara	**Fisheries**
Alan Winer	University of Southern California	**Air emissions**

PLATFORM: Decision Support Tool in analytica

visionary modeling



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analytica

visionary modeling

Open up the black box

Models have value only when your clients trust them. Influence diagrams make models radically transparent.

Embrace risk and uncertainty

Explore possible futures with fast Monte Carlo simulation. Find robust strategies to avoid threats and seize opportunities.

Low-code modeling

Analytica's Flow Architecture means you don't need to hire or be a coder —the way you do with R or Python.

Beyond the spreadsheet

The World has more than two dimensions. So does Analytica!

Discover what matters and why

Sensitivity analysis lets you find out how assumptions affect the results – giving you valuable insights.

Agility: Making modeling fast and fun

Use the extra time to extend your model, do more for your client, or just chill out.

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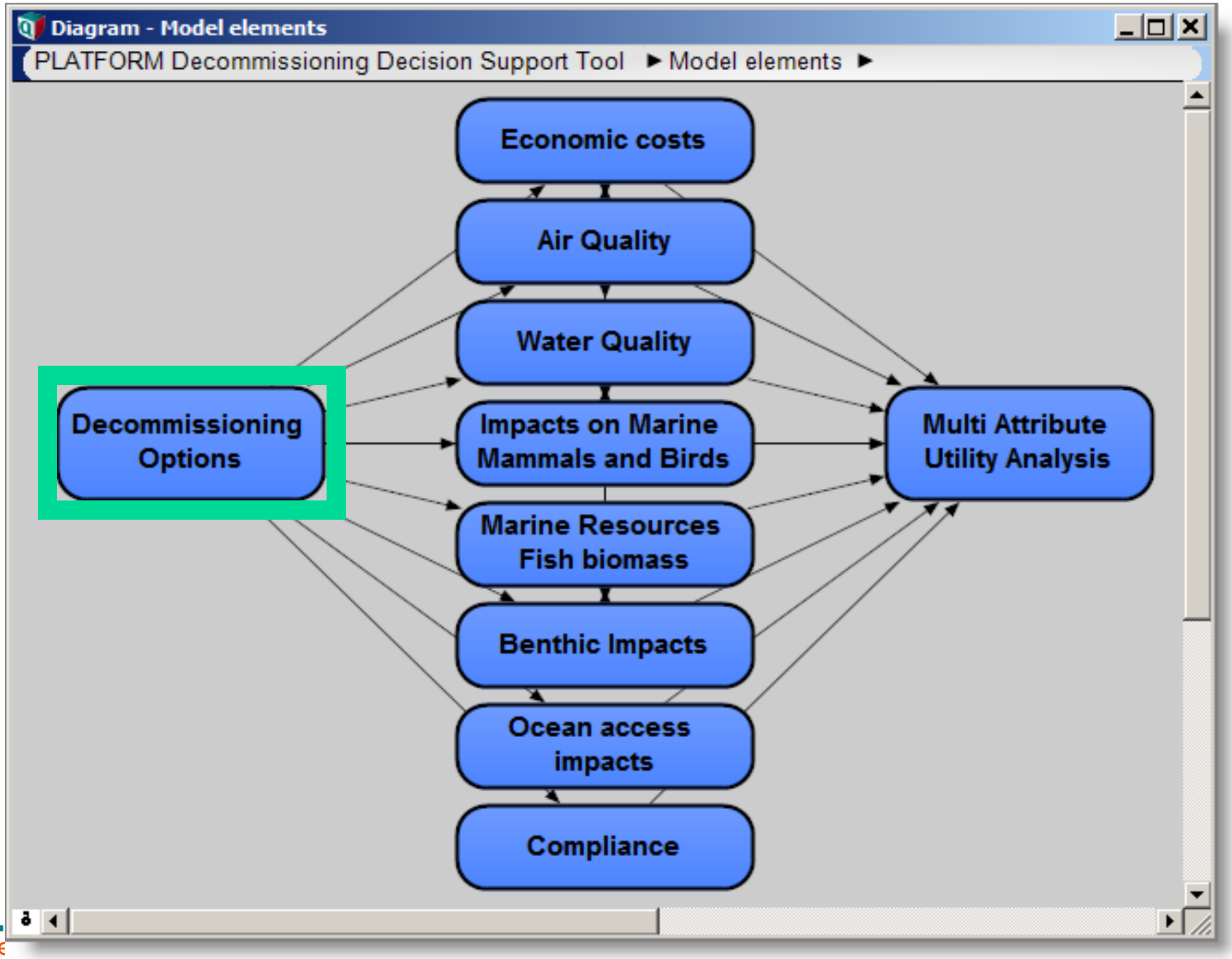
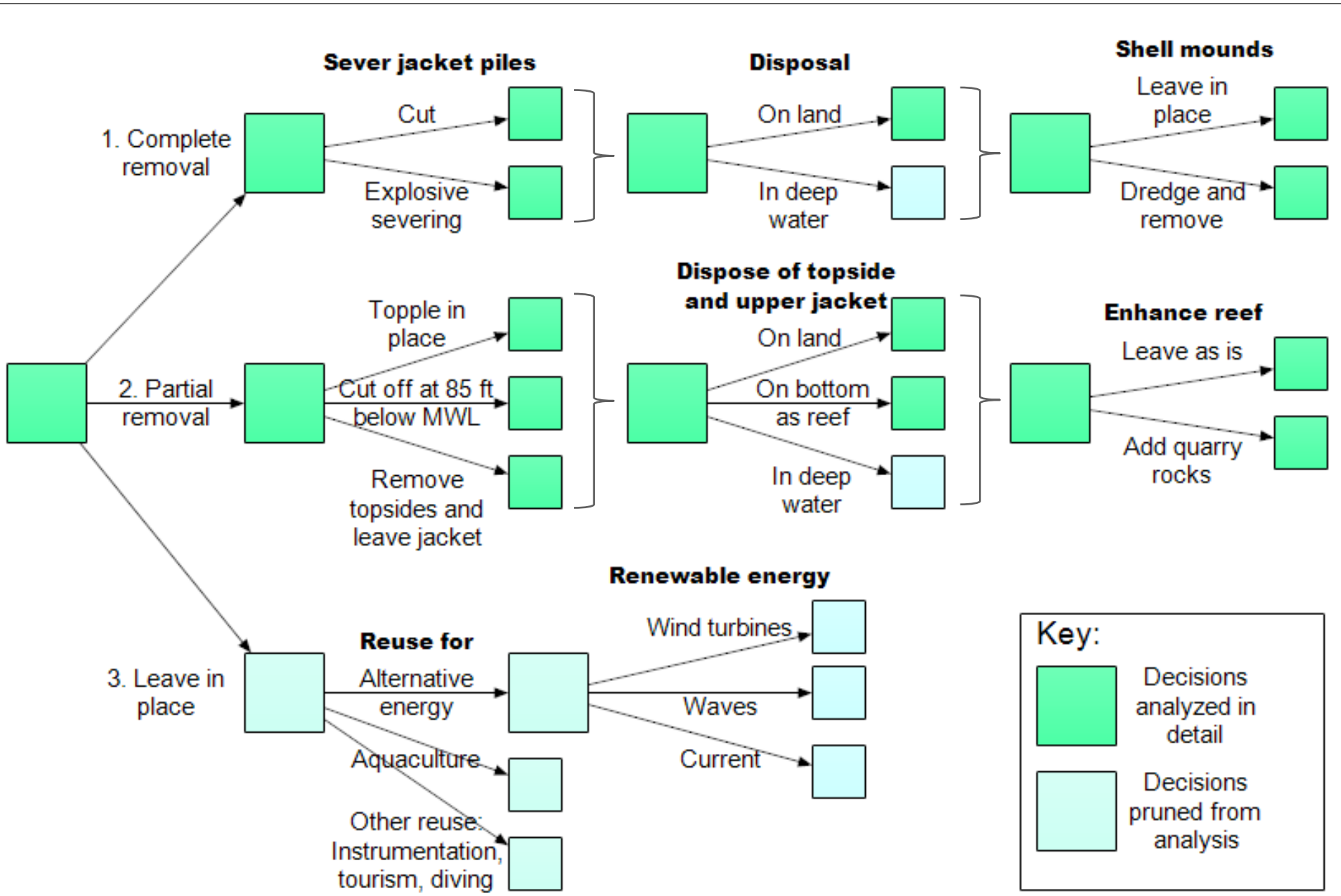
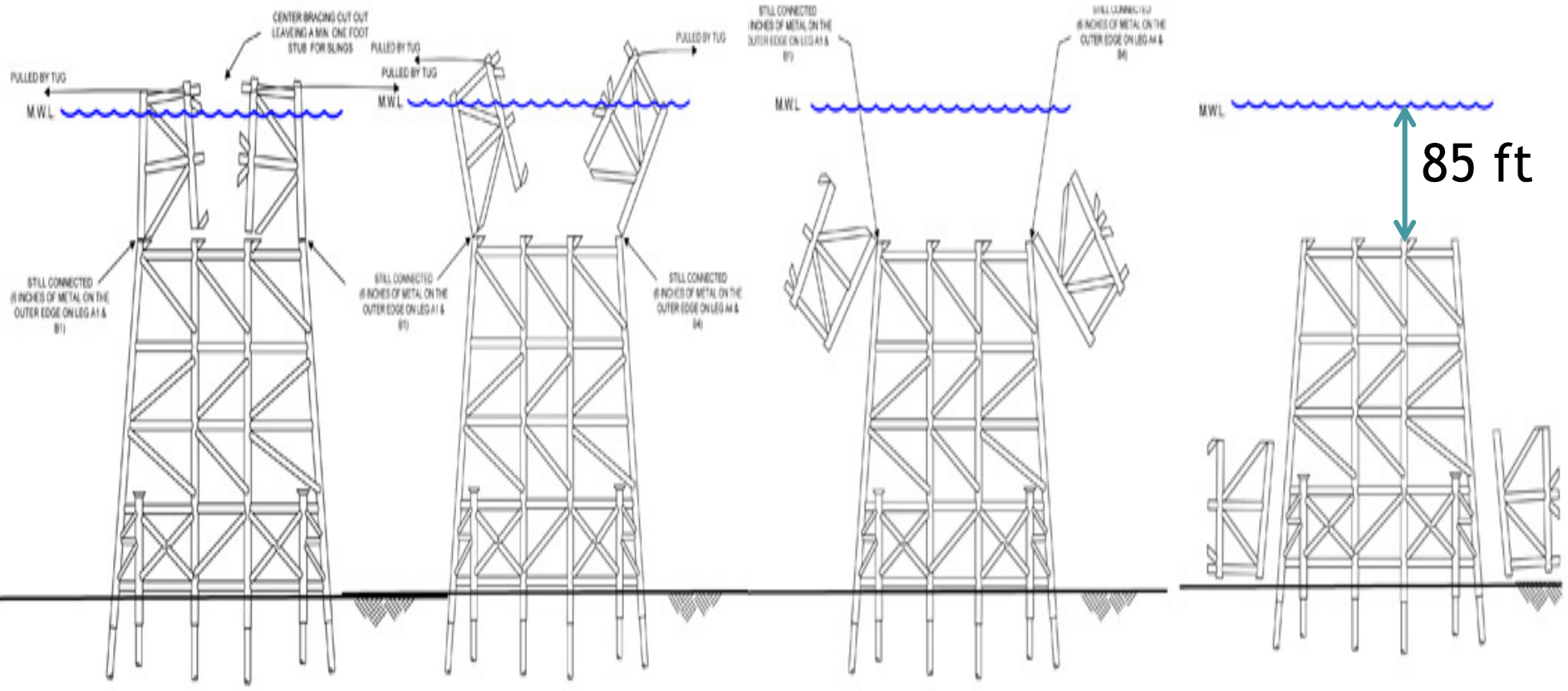


Diagram - Model elements
PLATFORM Decommissioning Decision Support Tool ► Model elements ►
Economic costs
Air Quality
Water Quality
Decommissioning Options
Impacts on Marine Mammals and Birds
Multi Attribute Utility Analysis
Marine Resources Fish biomass
Benthic Impacts
Ocean access impacts
Compliance

Decommissioning Options: A Decision Tree



Partial removal (“rigs to reefs”): Cut off at 85 ft below mean sea level



Step 1 Step 2 Step 3 Step 4

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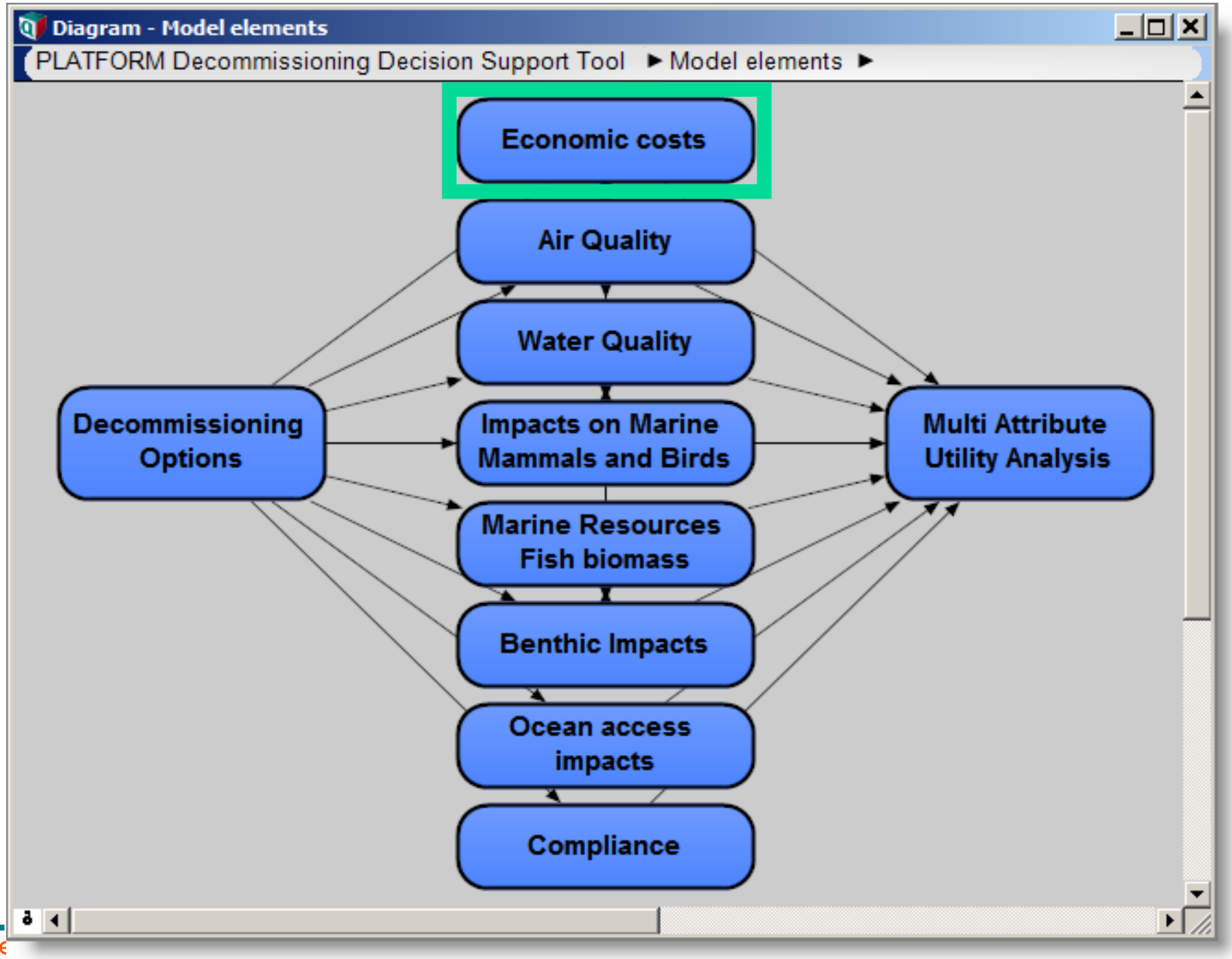
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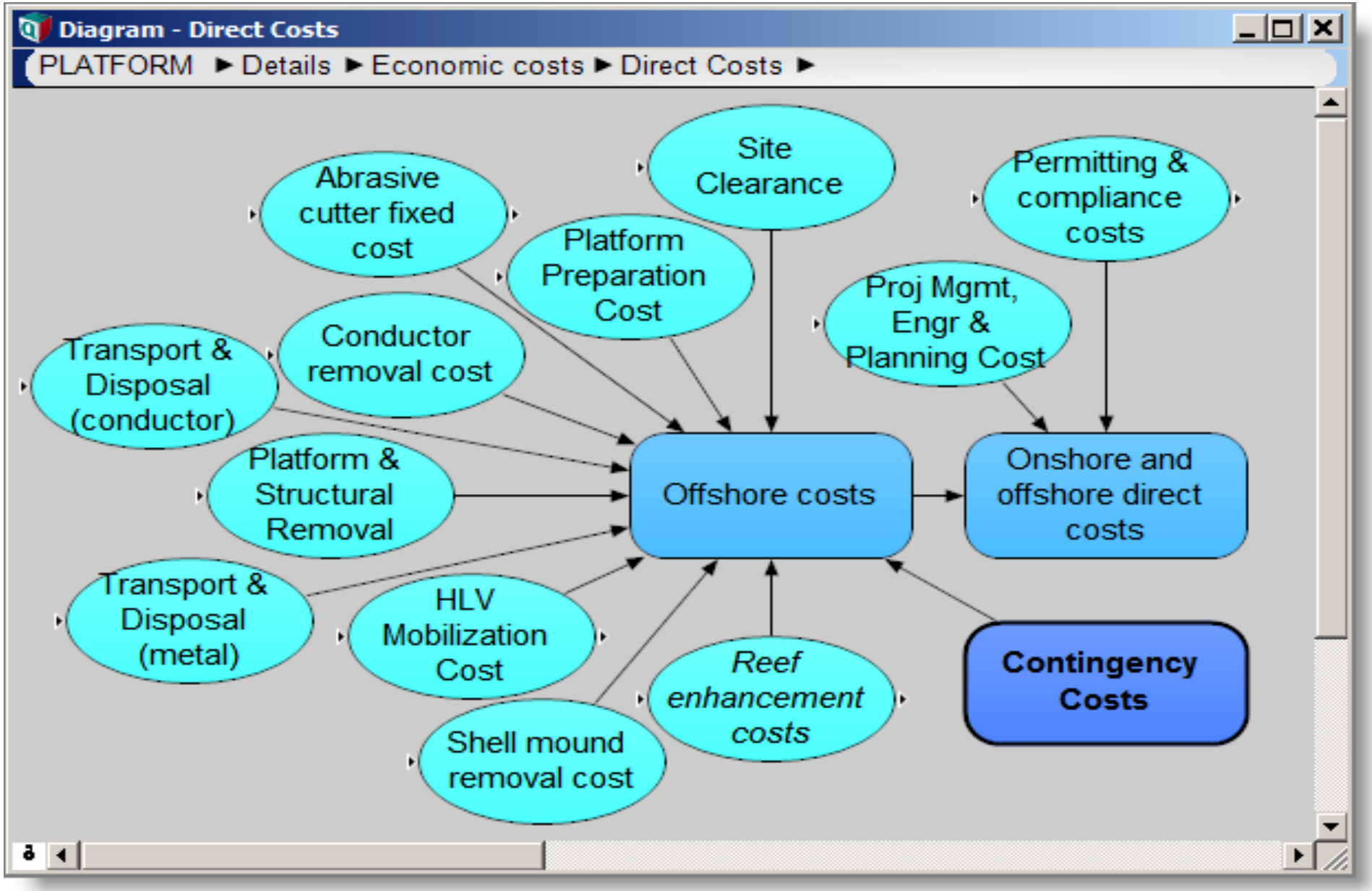
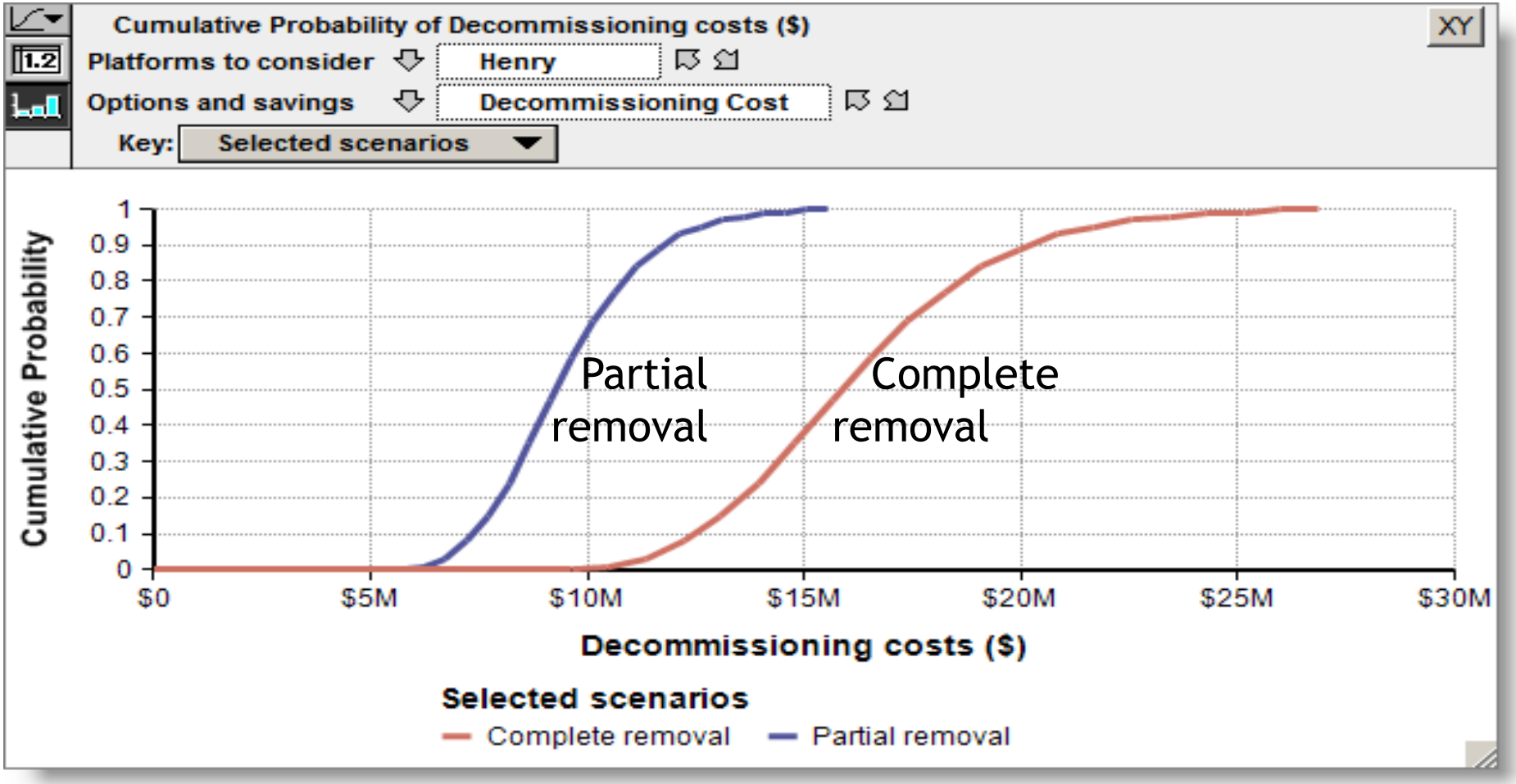
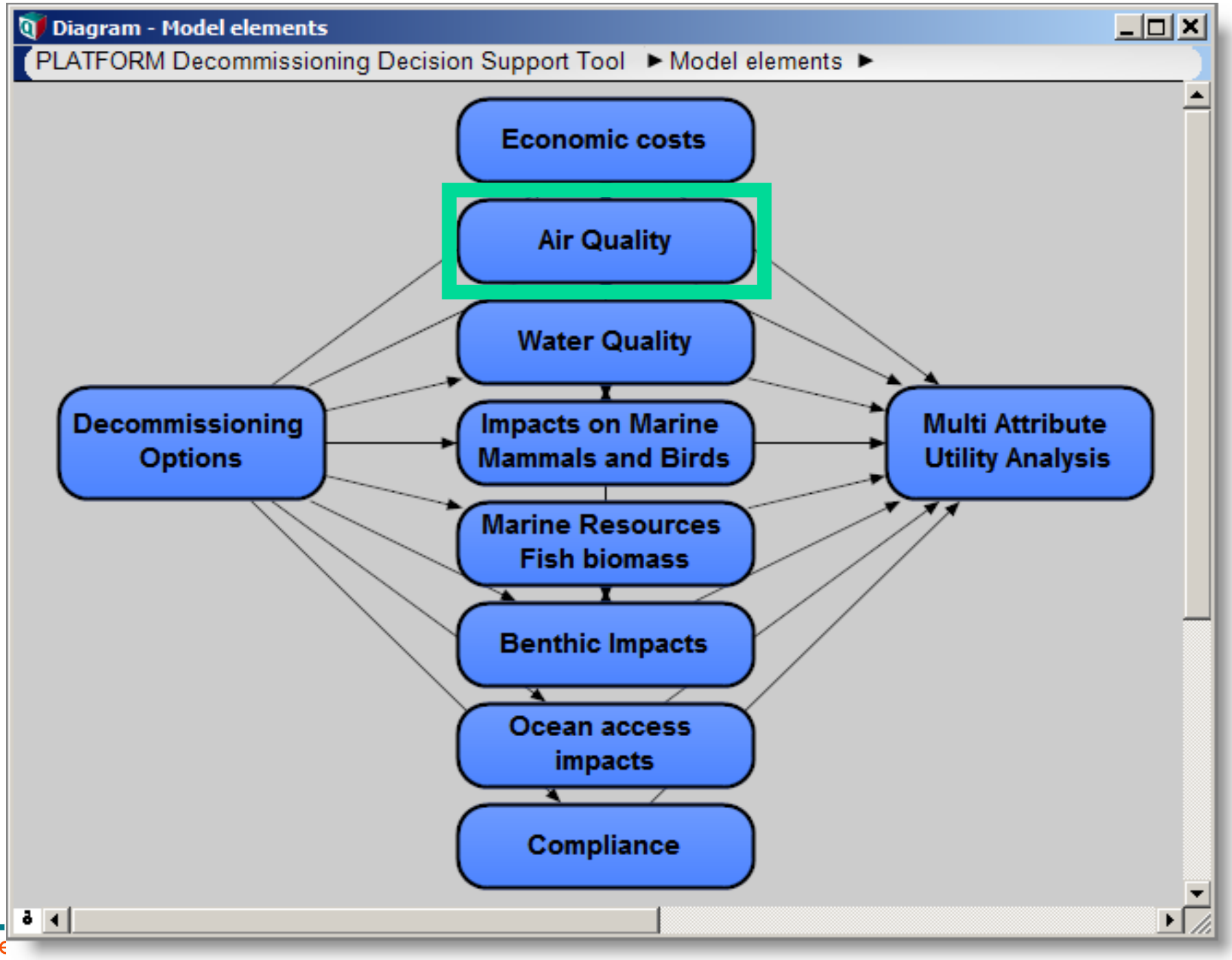
Economic costs of decommissioning



Probability distributions over decommissioning costs



Uncertainty from Monte Carlo about cost of complete and partial removal: Distributions calibrated to estimation errors in 120 past estimates from 40 decommissioning projects (Byrd, et al).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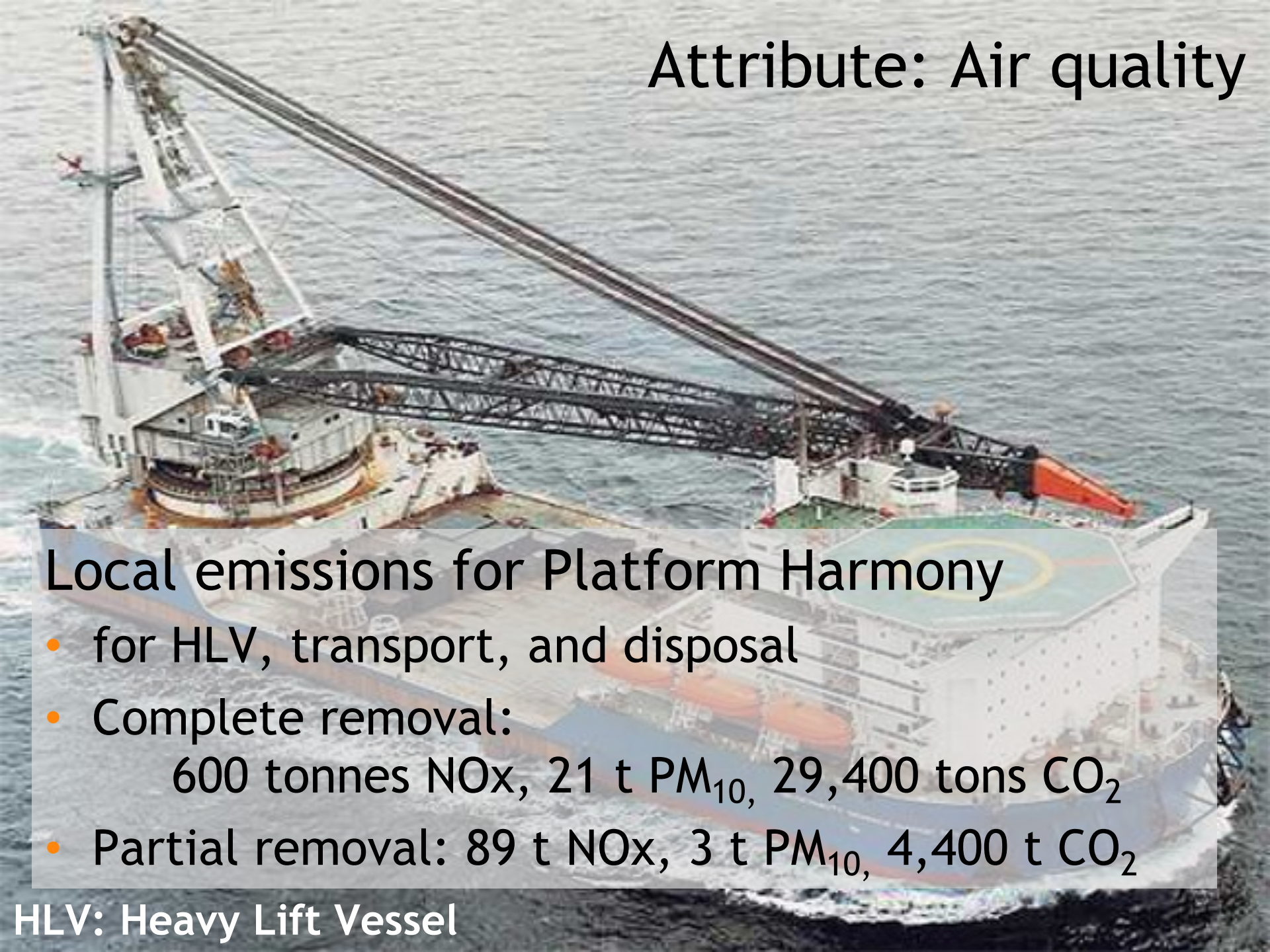
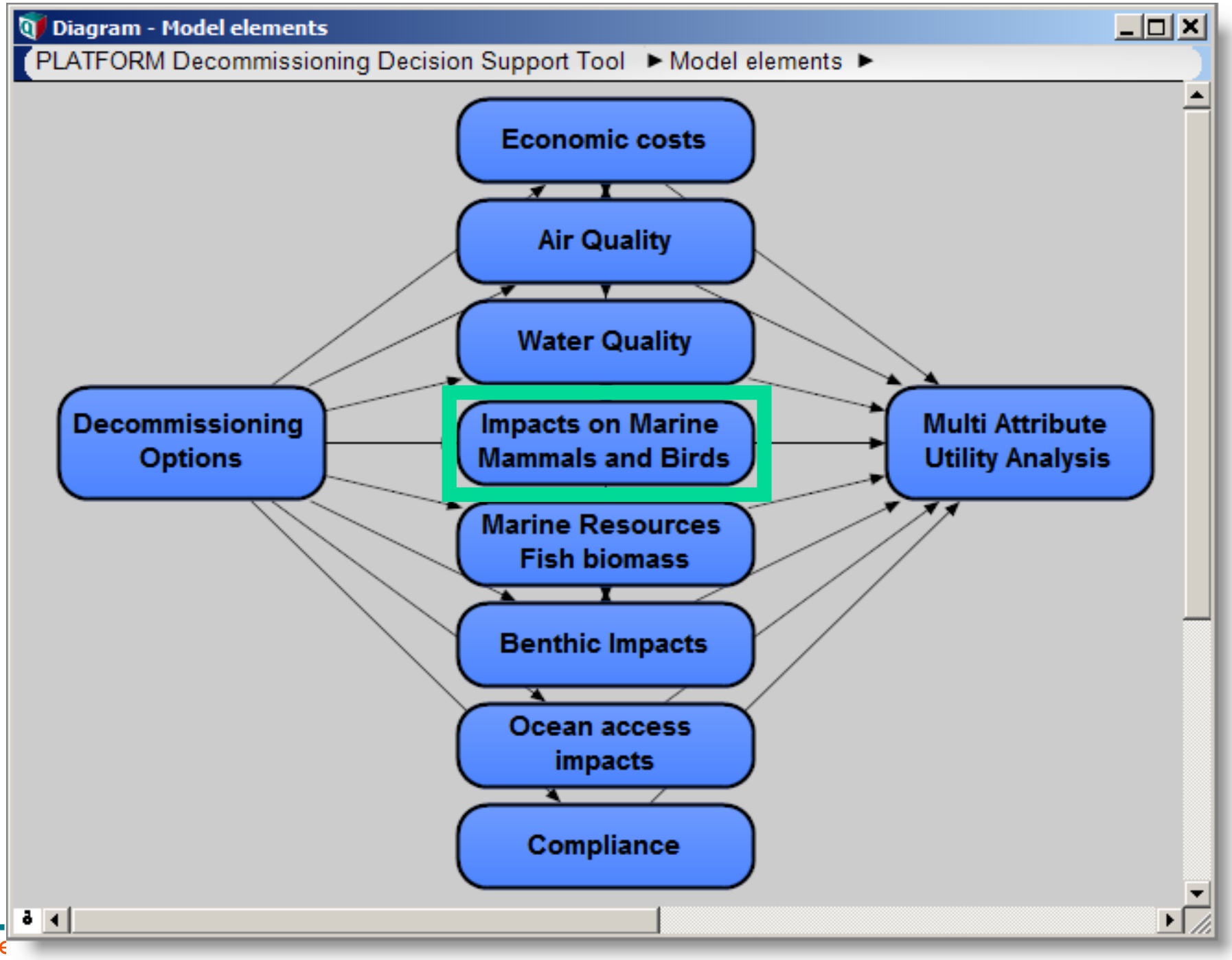


Attribute: Air quality

Local emissions for Platform Harmony

- for HLV, transport, and disposal
- Complete removal:
  600 tonnes NOx, 21 t $PM_{10,}$ 29,400 tons CO_2
- Partial removal: 89 t NOx, 3 t $PM_{10,}$ 4,400 t CO_2

HLV: Heavy Lift Vessel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Defining and scoring an attribute: Impacts on Marine Mammals

Attribute: Impacts or	
Level	**Description**
Best	Status quo, no effect
Good	
Medium	Slight effect son movement or migration of marine mammals
Poor	Some disturbance or disorientation
Worst	Disturbance, disorientation, and possible mortality

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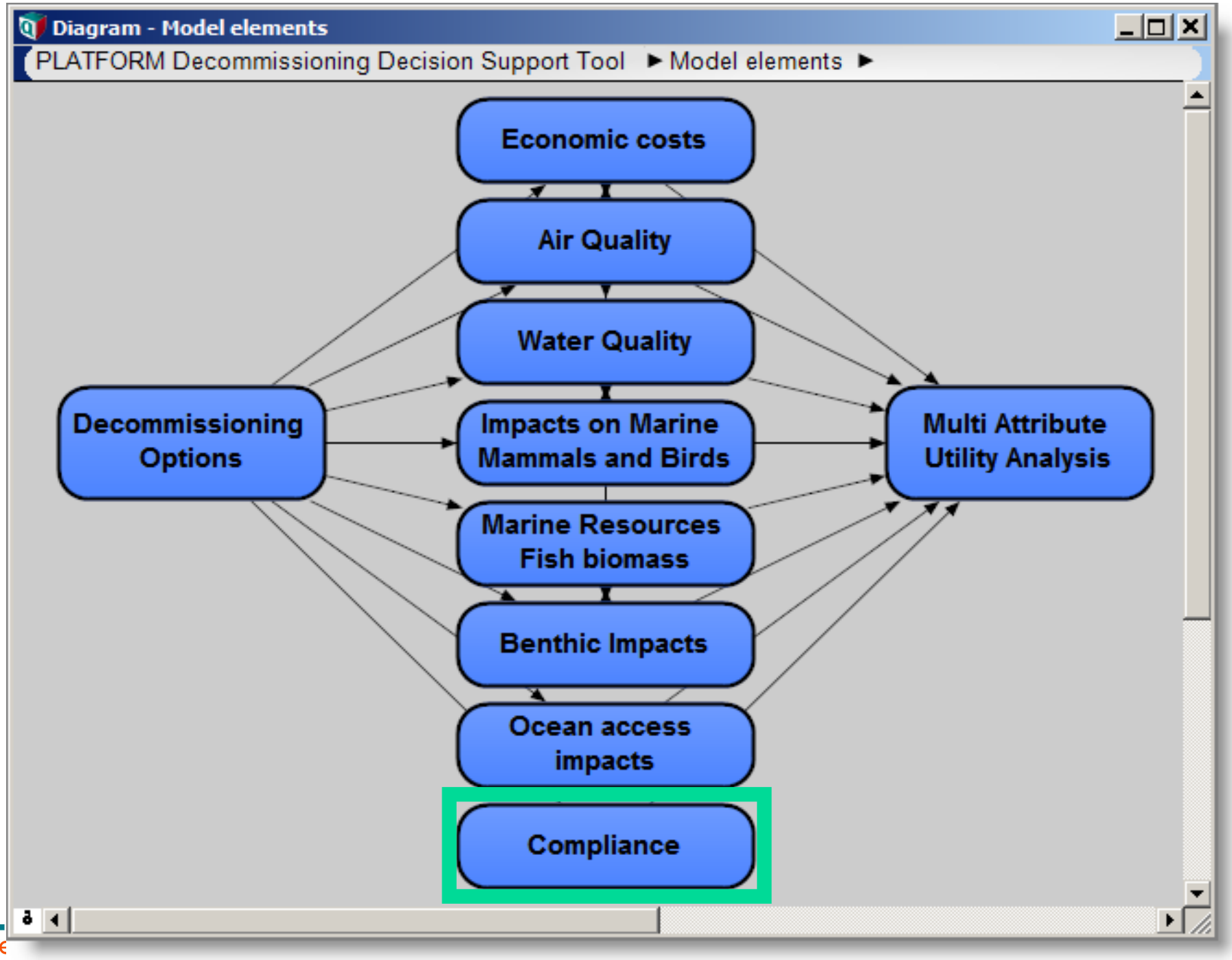
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Attribute: Strict compliance
with platform leases requiring complete removal

Attribute: Strict compliance			
Level	**Description**	**Decision options**	**Score**
Best	Platform is completely removed and sea bed restored, compliant with lease	Complete removal including shell mounds	100
Medium	Jacket up to 85 feet below MWL and shell mounds left in place, non-compliant with lease.	Partial removal of platform	0%
Worst	Entire platform left in place, non-compliant with lease.	Reuse of platform in place	0

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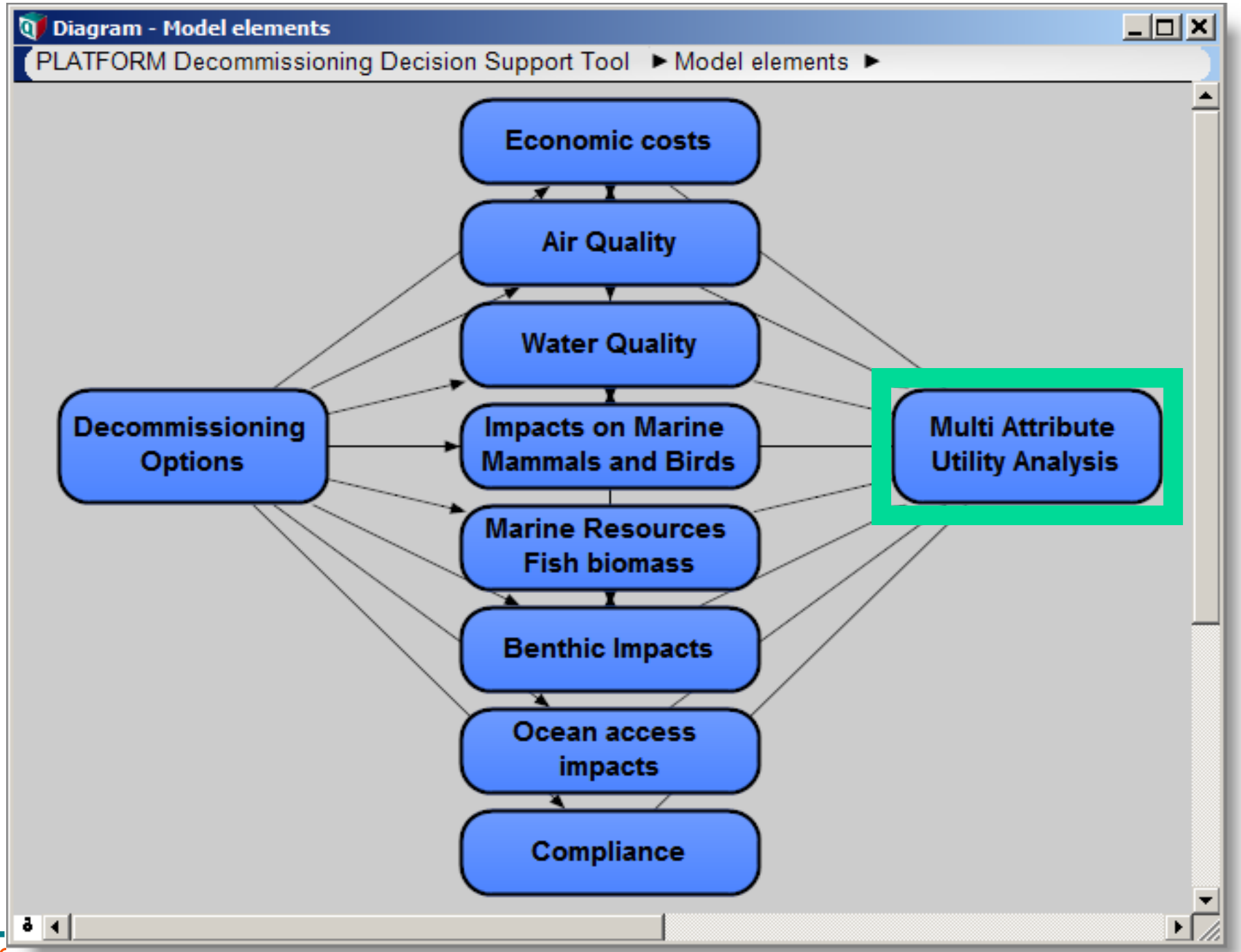
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Assessing Swing Weights by Attribute

Assessing swing weights by attribute				
Attributes	**Type**	**Best outcome**	**Worst outcome**	**Swing weight**
Costs	Quantitative	Status quo: $0	Complete removal: $250 million	100
Air quality	Qualitative	Status quo: Zero emissions.	Complete removal: Emissions from 4400 ton HLV onsite for 113 service days for complete removal.	40
Water quality	Qualitative	Status quo: No impact	Complete removal: Accidental discharge of contaminated material at surface, or shell mound removal with toxic sediment contaminates water column.	15
Marine mammals	Qualitative	Status quo: No impact	Complete removal: Explosive severing for complete removal causes disturbance, disorientation, and some mortality to marine mammals.	20
Birds	Qualitative	Deck removal: Reduced mortality from flight collisions. Loss of offshore roosting replaced by new	Deck removal: Loss of offshore roosting reduces fitness and survival, which outweighs reduced flight collisions.	10
Benthic impacts	Qualitative	Status quo: No impact	Complete removal: Anchoring or shell mound removal leads to widespread impact and spreading contaminants.	10
Fish production	Quantitative	Status quo: 10,000 Kg/y	Complete removal: Zero fish production	25
Ocean access	Quantitative	Removal: Adds 2 Sq N Mi	Status quo: Limits access	20
Strict compliance	Qualitative	Complete removal complies with lease	Partial or no removal violates lease.	50

SMARTS: Simple Multi-Attribute Rating Tool with Swing weights (Edwards & Barron,1994)

- Rate by swing – i.e. importance of change from worst to best outcome
- Select attribute with largest swing weight (100) and order attributes from largest to smallest
- Select weight for each attribute

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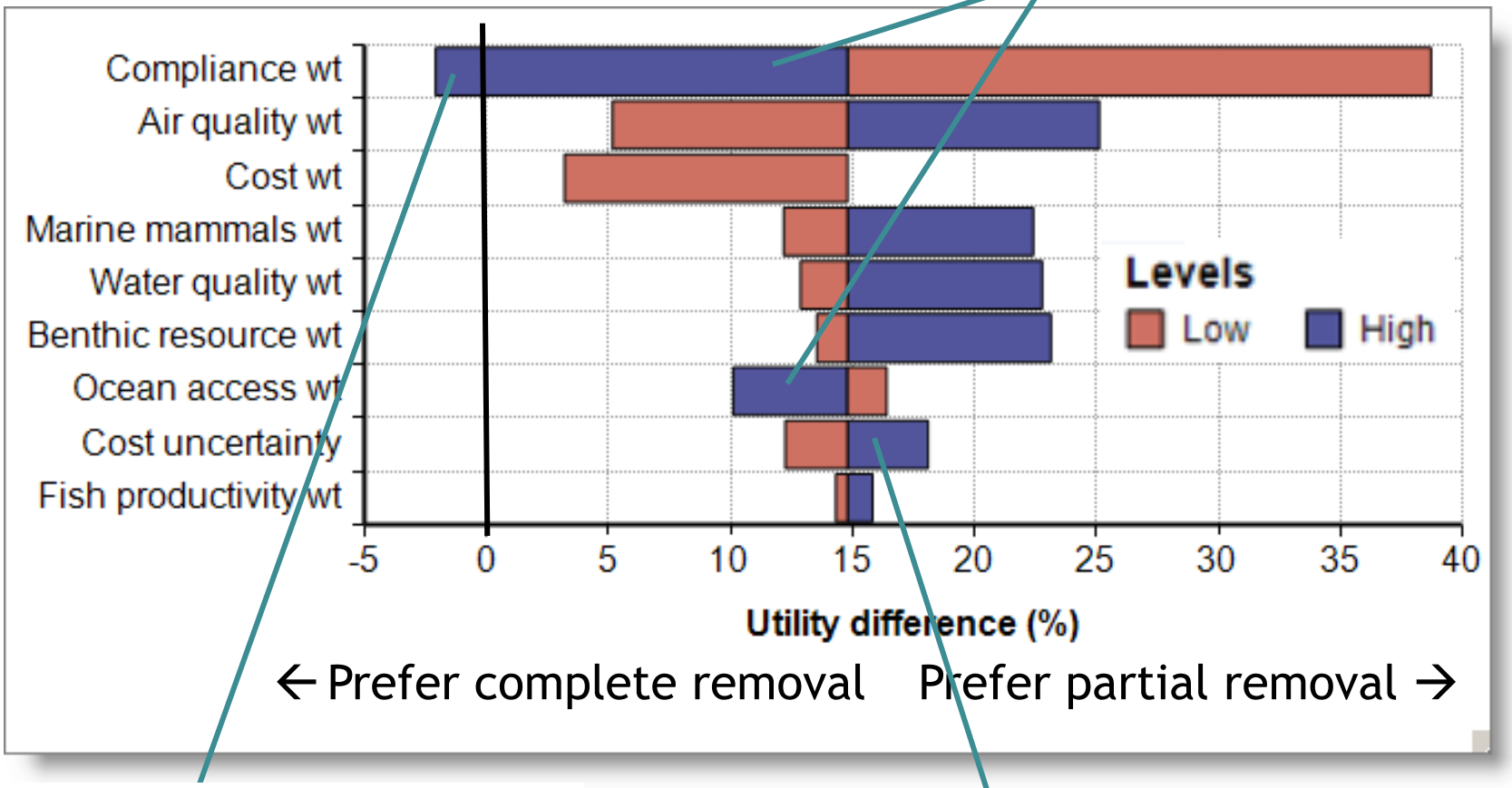
Tornado chart: sensitivity to swing weights and uncertainties

Each bar shows the effect on a variable of changing swing weight from 0 to 100

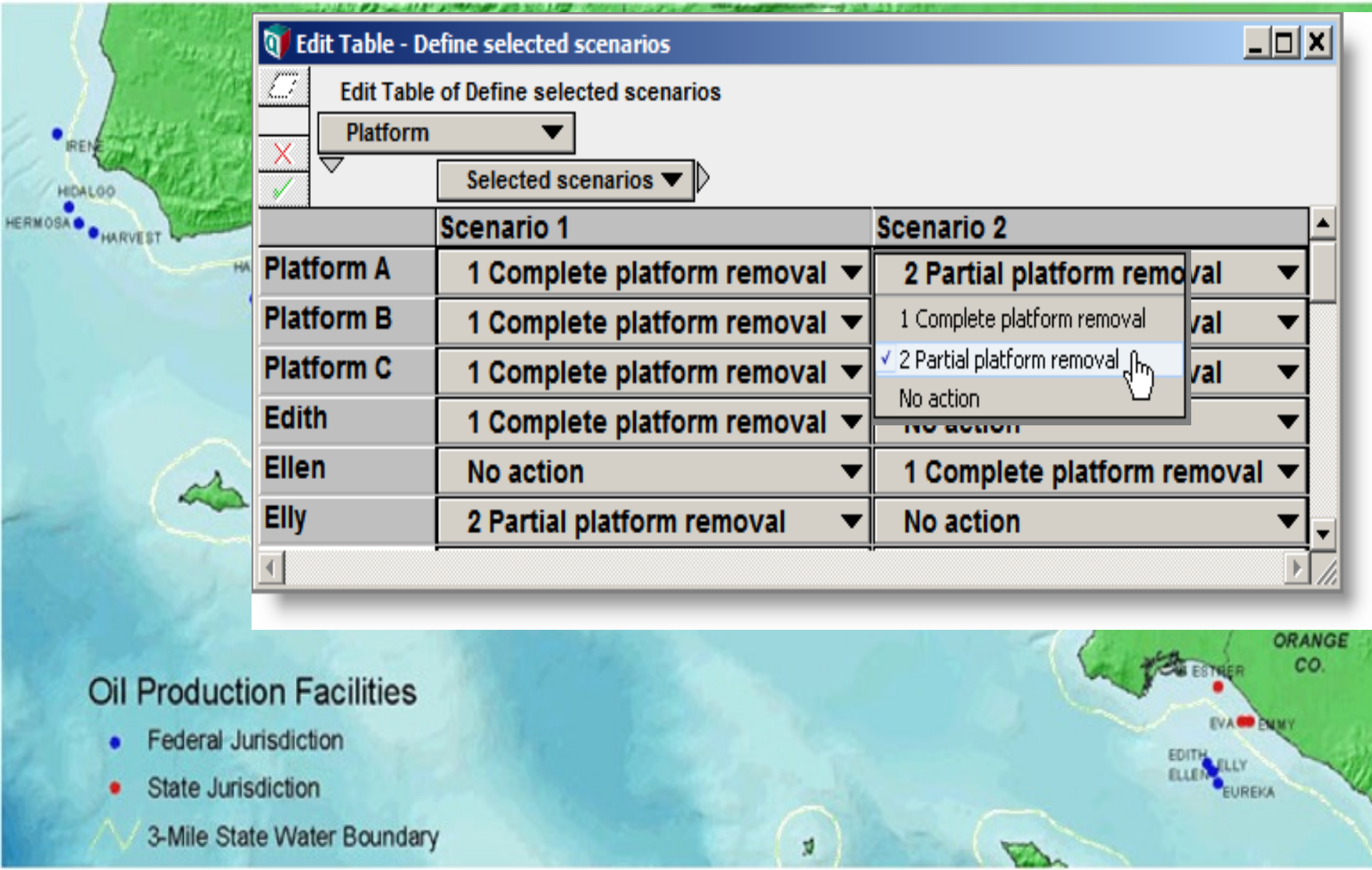
Higher level favors complete removal only for Compliance and Ocean access weight



Compliance weight is the only variable that could change preference from partial to complete removal

Sensitivity to Cost uncertainty (change from 10th to 90th percentile) is smaller than 7 preferences (swing weights)

Exploring scenarios:
Selecting an option for each Platform

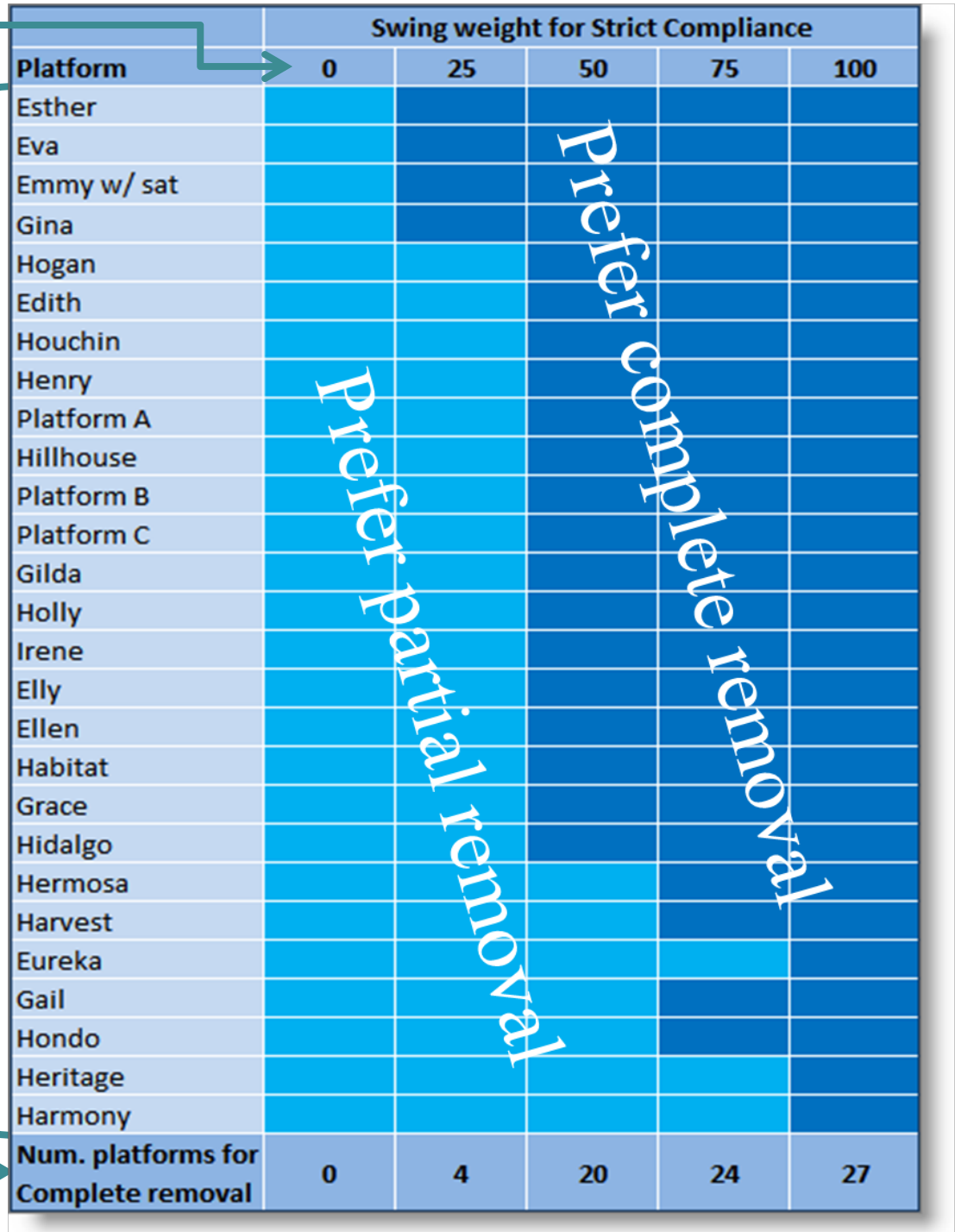


Changing swing weight on compliance

How weight on Strict Compliance changes the preferred decision

Platforms ordered by depth

Number of platforms for which complete removal is preferred



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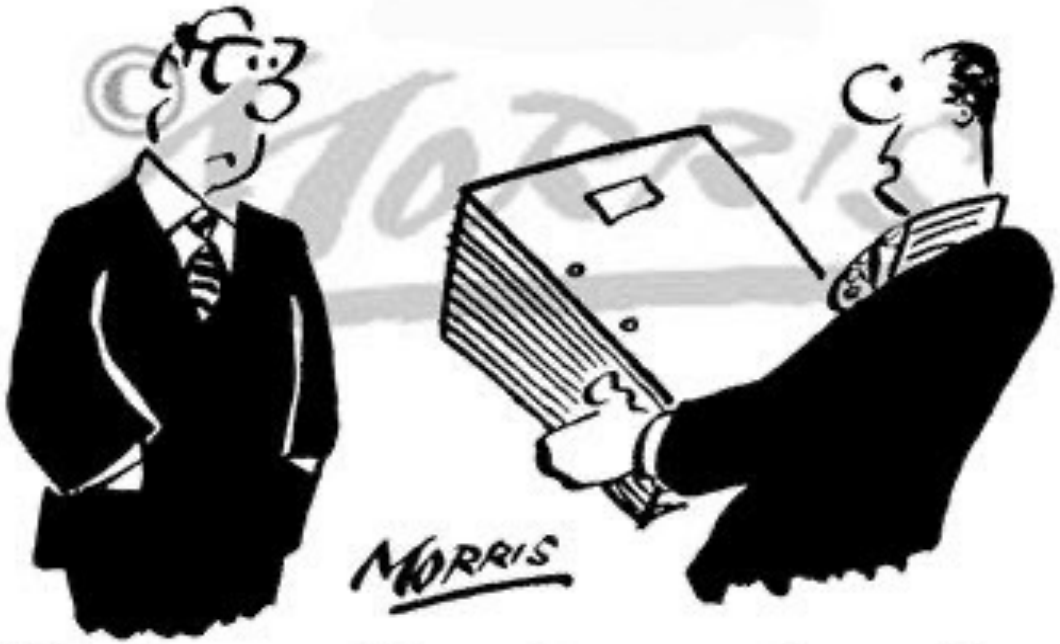
How to visualize and communicate results



"It's the report from the consultancy firm, they say it will help to clarify things."

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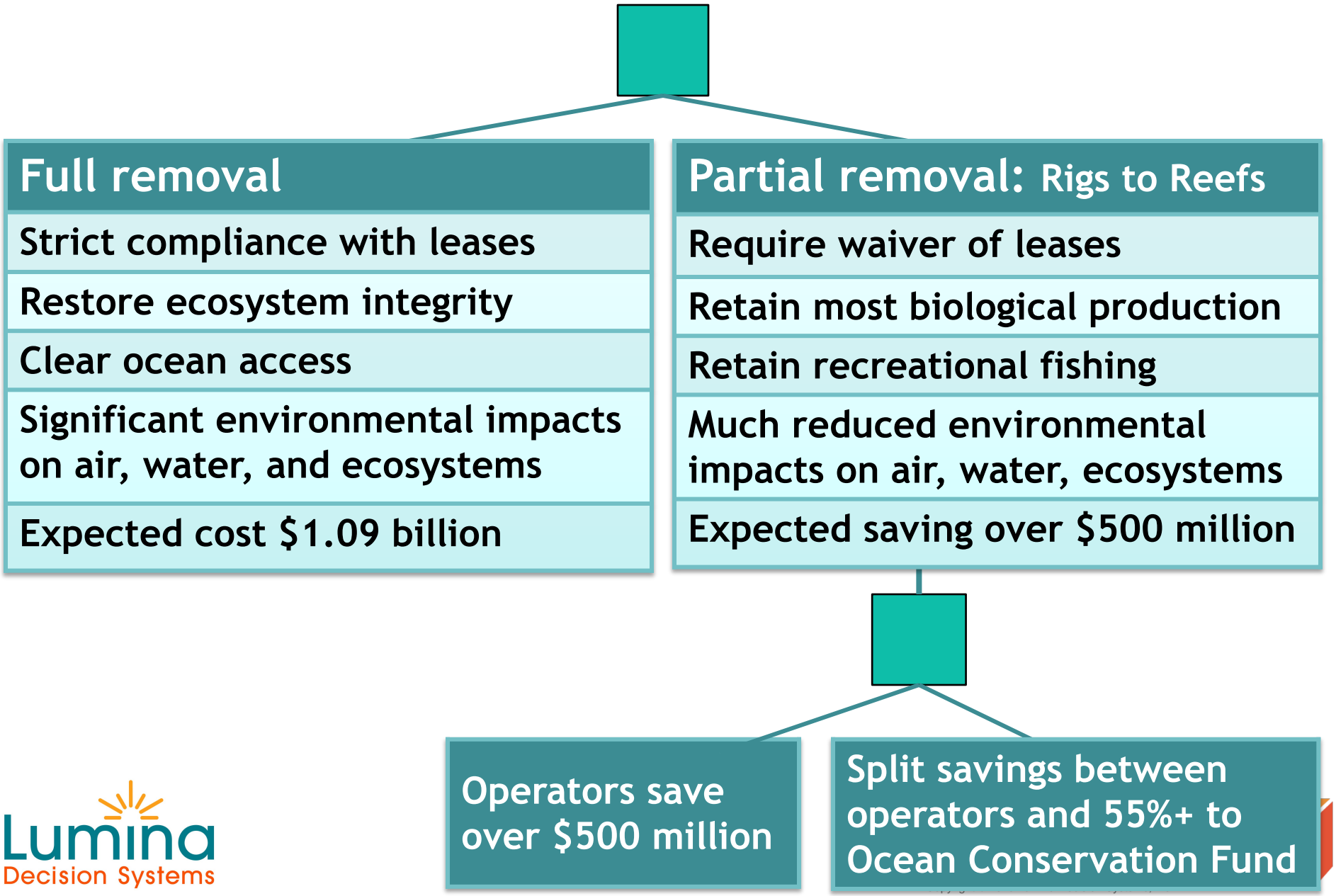
The essence of decision in one page



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Outcomes

- "Rigs-to-Reefs" bill AB 2503 passed by California State House with near consensus,
- Waived "strict compliance"
- Split the savings
- Signed by Governor Schwartzenegger.

Our Project received the *Decision Analysis Practice Prize* from the Society for Decision Professionals.

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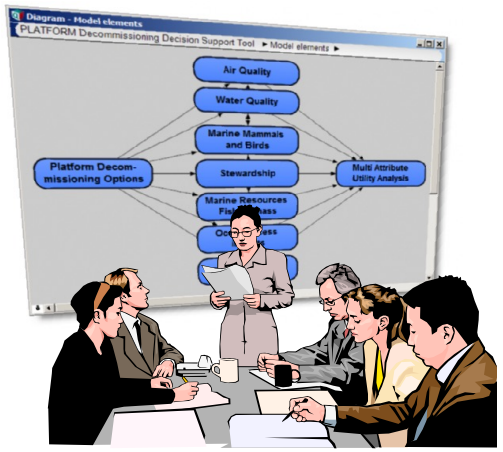
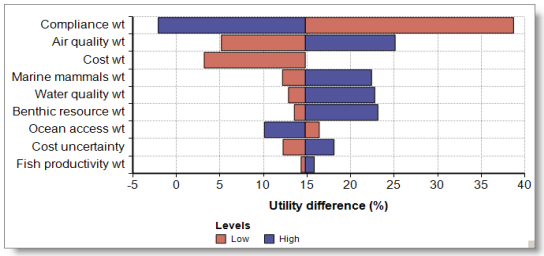
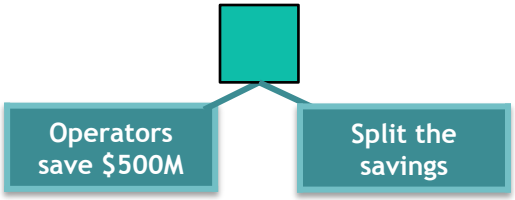
Lessons learned

- Influence diagrams help stakeholders formulate the decision problem
- Sensitivity analysis lets us work with approx numbers
- Ingenuity may generate better decision options
- Simplicity and clarity in communicating insights
- Stakeholders gain confidence and insight by exploring an interactive model
- Decision analysis can help illuminate decisions even when views conflict







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For more:

From Controversy to Consensus:

A Multi-attribute Decision Analysis for Decommissioning California's Offshore Oil Platforms

Max Henrion, Brock Bernstein & Surya Swamy

Visit www.Lumina.com/platform for links to

Case study

Film: Rigs to Reefs: Using Decision Analysis:

To download the **PLATFORM Analytica model**

(and download **Analytica Free**

Or email me Henrion@Lumina.com