Crude Calculations: Understanding how economic evaluation can inform crude oil transport choices

Session: Dissecting “Wicked Problems” to Understand Choices: “Dangerous Goods” Movement Within the Great Lakes Basin & Coastal Waters

Restore America’s Estuaries 8th National Summit on Coastal and Estuarine Restoration and 25th Biennial Meeting of The Coastal Society Our Coasts, Our Future, Our Choice

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Intermodal rail movements in the United States and Chicago Bureau of Economic Analysis area, select years

- 2000: 5.74 millions (Chicago BEA area), 11.21 total
- 2005: 6.94 millions (Chicago BEA area), 14.50 total
- 2010: 6.20 millions (Chicago BEA area), 13.33 total
- 2011: 6.63 millions (Chicago BEA area), 13.83 total
- 2012: 6.94 millions (Chicago BEA area), 14.59 total
- 2013: 7.23 millions (Chicago BEA area), 15.17 total

Source: Chicago Metropolitan Agency for Planning analysis of 2013 Surface Transportation Board Carload Waybill Sample.
U.S. regional refinery capacity and complexity

Source: U.S. Energy Information Administration
Economic multiplier from increase of 100 jobs in rail equipment manufacturing

A Canadian National freight train is pictured on fire after several cars derailed between the Chicago suburbs of Bartlett and Elgin, Illinois (Reuters / Frank Polich) / Reuters
Comparing transportation options

**benefits**
- Transport efficiency
  - Costs
  - Intermodality
  - Time to reach refinery
- Economic development
  - Jobs, income (regional transfer)
- Proximity to Urban Area
  - Greater response capacity

**costs**
- Transport Risks
- Environmental & social damages (externalities)
- Intersections with water bodies, natural areas, soils, wetlands
- Freight interference (congestion)
- Foregone land-uses
- Economic development
- Freight infrastructure
- Proximity to Urban Area
- Larger impacted population
Economic Analysis of Risk 101

Standard economic approach

$$EV \ [X] = \sum (p_i \ [x_i] \ C[x_i])$$

Where:
EV = expected value
X = event
$$\sum$$ = sum
$$p_i$$ = probability of outcome $$x_i$$ occurring
C = consequences of $$x_i$$ (in dollars)

Black Swan Source: https://dinacitywildlife.com/about-2/
Crude Oil Spills Into Lake Michigan.
Source: Great Lakes News
Economic value of consequences & risk reduction

Event (X)

Market Impacts
- Direct Impact
- Indirect Impact
- Asset Value

Market analysis, Input-Output (I-O) models

Fiscal Impacts
- Increased Spending
- Reduced Revenue

Real estate, financial sector analysis

Non-Market Impacts
- Use Values
- Non-use Values

Public finance

Probability ($p_i$)

Willingness to pay to reduce risk

Economic Methods

Non-market valuation
Example: A typology of economic benefits from freshwater quality

<table>
<thead>
<tr>
<th>Benefit Class</th>
<th>Benefit Category</th>
<th>Examples</th>
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<tbody>
<tr>
<td>Use</td>
<td>In stream</td>
<td>Recreation (water skiing, fishing, swimming, boating)</td>
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<td>Commercial (fishing, navigation)</td>
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<td>Withdrawal</td>
<td>Municipal (drinking water, waste disposal)</td>
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<td>Agriculture (irrigation)</td>
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<td>Industrial/commercial (process treatment, waste disposal)</td>
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<td>Aesthetic</td>
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<td>Enhanced near water recreation (hiking, picnicking, photography)</td>
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<td>Enhanced routine viewing (commuting, office/home views)</td>
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<td>Ecosystem</td>
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<td>Enhanced recreation support (duck hunting)</td>
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<td>Non-use</td>
<td>Vicarious</td>
<td>Significant others (relatives, close friends)</td>
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<td>consumption</td>
<td>Diffuse others (American public)</td>
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<td>Stewardship</td>
<td>Inherent (preserving remote wetlands)</td>
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<td>Bequest (family, future generations)</td>
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Kalamazoo River.

Steve Carboy/Michigan Radio