Indiana Coal Movement
Indiana Rail Capacity/Potential

Center for Coal Technology Research
Energy Center

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Background

- Develop Methodology
  - 10 by 10 Routing Development
  - Rail Movement Parameters

- Analyze Scenarios
  - South to North Power Plant
  - South to Port of Indiana
  - Ohio River Power Plants
Findings to Date

- Transportation aspects of coal delivery by rail directly affect the amount of coal a power plant must keep on site
  - Variability of speed, congestion
  - Time(Route)
  - “Lot Size” of movement(Unit Train)
Methodology

INDIANA COAL RAILROAD TIMETABLE: ROUTE 2

<table>
<thead>
<tr>
<th>STATION NAME</th>
<th>MILE POST</th>
<th>TYPE</th>
<th>OWNER</th>
<th>NUMBER</th>
<th>TRACK</th>
<th>CLASS</th>
<th>SPEED</th>
<th>NOTATION</th>
<th>INTERLOCKS</th>
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<td>P</td>
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<td>T</td>
<td>CST</td>
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</tbody>
</table>

READ DOWNWARD FOR SOUTHBOUND

READ UPWARD FOR NORTHBOUND

SOURCE: Comprehensive Railroad Atlas of North America, compiled by Chad Hizer

Parameter | Type | Location
--- | --- | ---
Speed Factor |  |  
Weather Factor |  |  
Mechanical Delay |  |  
Congestion Delay |  |  
Station Delay |  |  
Train Length |  |  
Car Size |  |  
Days of Supply |  |  

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Scenario Assumptions

- Move coal from southern Indiana to Tanners Creek & Clifty Falls
  - Rail only
  - Rail to Mount Vernon, barge to power plants
Scenario Assumptions

The train is composed of 105 cars with a capacity of 286,000 pounds (15,015 tons/train)
The time to load a unit train at Francisco is T(3.75, 4.0, 4.25) hours
A barge holds 30 loads @ 1500 tons each (45,000 tons/barge)
The time to load a barge at Mt. Vernon is 4,200 tons/hour
The time to unload a barge at Tanners Creek is 30 hours
The time to unload a barge at Clifty Falls is 30 hours
Mt. Vernon load time is 4200/tons per hour
Barge speed is 5mph
The initial coal inventory at Mt. Vernon is 30,000 tons
The probability of a Mechanical Delay is 5%
The time for a Mechanical Delay is T(2,5,12) hours
The probability of a Station Delay is 2%
The time for a station Delay is T(1,2,8) hours
The time for a Congestion Delay is T(.25,4,8) hours
The probability of a Congestion Delay is based on Gross Ton/Mile:

<table>
<thead>
<tr>
<th>Gross Ton</th>
<th>Probability</th>
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<tr>
<td>0-4</td>
<td>1</td>
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<tr>
<td>5-9</td>
<td>3</td>
</tr>
<tr>
<td>10-19</td>
<td>3</td>
</tr>
<tr>
<td>20-29</td>
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<tr>
<td>30-39</td>
<td>10</td>
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<tr>
<td>40+</td>
<td>25</td>
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## Cycle Time Results

<table>
<thead>
<tr>
<th>From</th>
<th>To</th>
<th>Cycle Time (Hours)</th>
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<tbody>
<tr>
<td>Francisco</td>
<td>Clifty Falls</td>
<td>93.9</td>
</tr>
<tr>
<td>Francisco</td>
<td>Tanners Creek</td>
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<td>Francisco</td>
<td>Mt. Vernon-Clifty</td>
<td>227.4</td>
</tr>
<tr>
<td>Francisco</td>
<td>Mt. Vernon-Tanners</td>
<td>184.8</td>
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</table>
Cycle Time Results

![Cycle Time Results Graph]

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Equivalence of Barge/Rail

To deliver 2.1 million tons in a year, 1 Barge Tow = 1.51 Unit Trains

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Where is the Bottleneck?
Fixing the Bottlenecks

- Load/Unload Time Reduction
  - Infrastructure

- On Rail Time
  - Routing
    - Shortest Path Problem
  - Infrastructure
Bottleneck Routing

- Select routes based on
  - Maximum Speed amongst links
  - Minimum Miles between destinations
  - Minimize Congestion
Key System Design Parameters

Minimize the total amount of coal in the system
Recommendations for Further Work

- Complete the Ohio River scenarios
- Expand the model to examine/analyze flows outside Indiana
Recommendations

- “Both the rail transportation and the electric transmission systems are complex networks in which localized disruptions can have severe and widespread impacts. Research is needed to better understand the factors that control these large and complex networks to minimize the risks of cascading system disruptions.”
  - National Academy of Sciences

- Use the model to analyze Macro Scenarios
  - Reliability of Indiana rail network
  - Capacity of Indiana rail network
    - Internal vs. External capacity
  - Expand scope to include transmission detail
    - Mine – transport – produce – transmit – end use