



A Prescriptive Analysis of the Indiana Coal Transportation Infrastructure

June 5, 2007





Project Team

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- ☀ INDOT/JTRP Advisory Board



Project Rationale

- ☀ Use Indiana coal for economic development
- ☀ Issues
 - ☀ Technology – Coal composition
 - ☀ Infrastructure
 - ☀ Indiana has the coal
 - ☀ Indiana is at the center of the national rail infrastructure
 - ☀ Does Indiana have the rail infrastructure?



Project Rationale

- “Depending on the proximity of the customer to the mine and the transportation available for delivering coal to that customer, transportation cost can range from 4 to 41% of the delivered cost. As a consequence, the availability and cost of transportation constitute important factors in the marketability of coal”
- “A crucial challenge was to connect the DM&E to Chicago and Minneapolis, major hubs where its coal shipments could connect with railroads serving the power plants”
- “Otter Tail created a virtual railroad on paper-complete with hypothetical routes, equipment, and customers to show that even a brand-new rail line would be able to serve Otter Tail’s coal needs at a lower cost than BNSF”
- “Once equipped with scrubbers, utilities can buy coal from just about anywhere and still meet the new regulations. Utilities that once burned Indiana coal are expected to return to their roots to take advantage of lower transportation costs, because Indiana is closer than Wyoming”

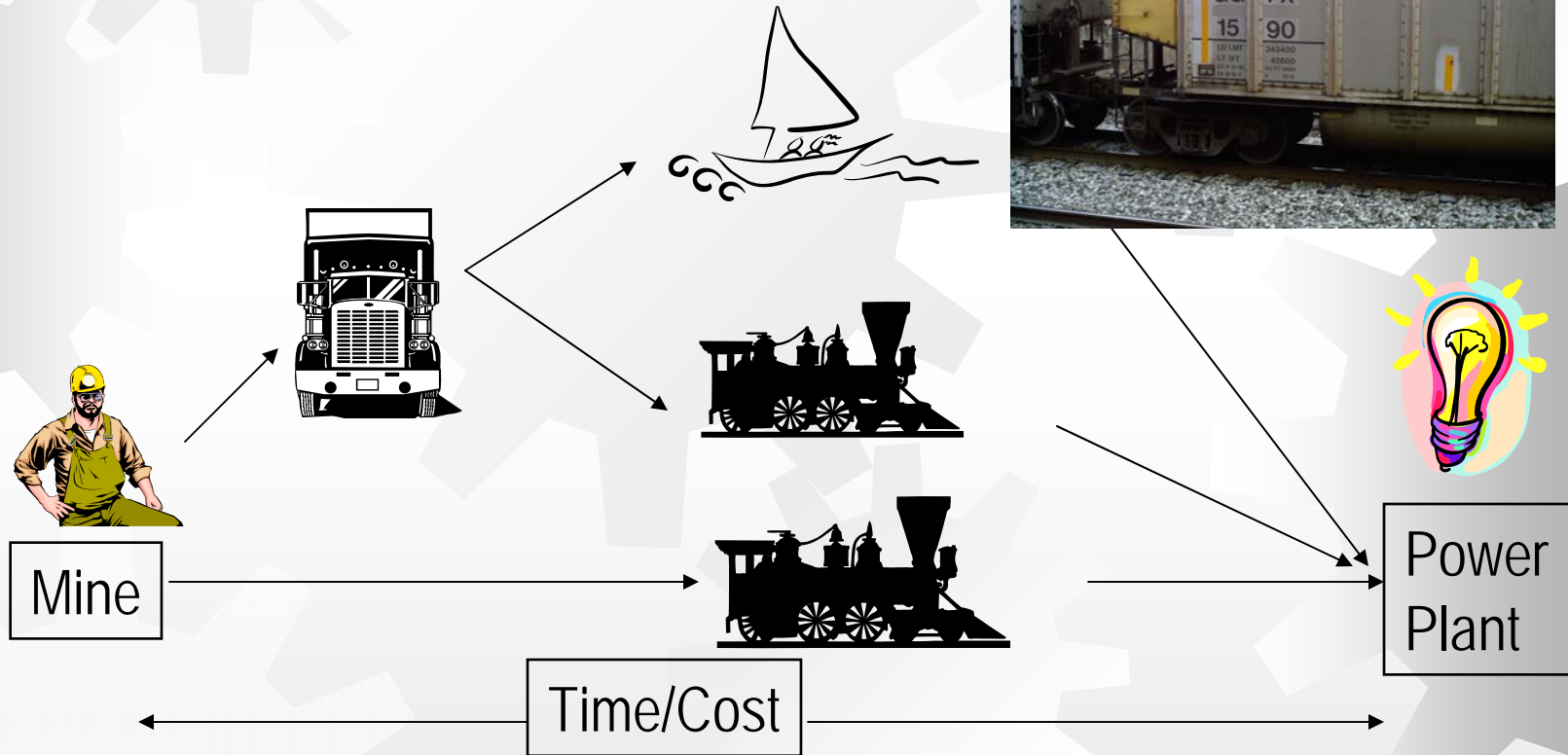


Project Tasks

- ☀ Characterize the demand and supply states of Indiana coal usage
- ☀ Characterize the transport methods of Indiana coal supply and demand
- ☀ Develop a simulated environment of Indiana coal supply and demand
- ☀ Develop a set of transportation infrastructure improvements to address bottlenecks in current Indiana coal Transportation Network
- ☀ Develop a Return on Investment Methodology and simple Portfolio Optimization Model

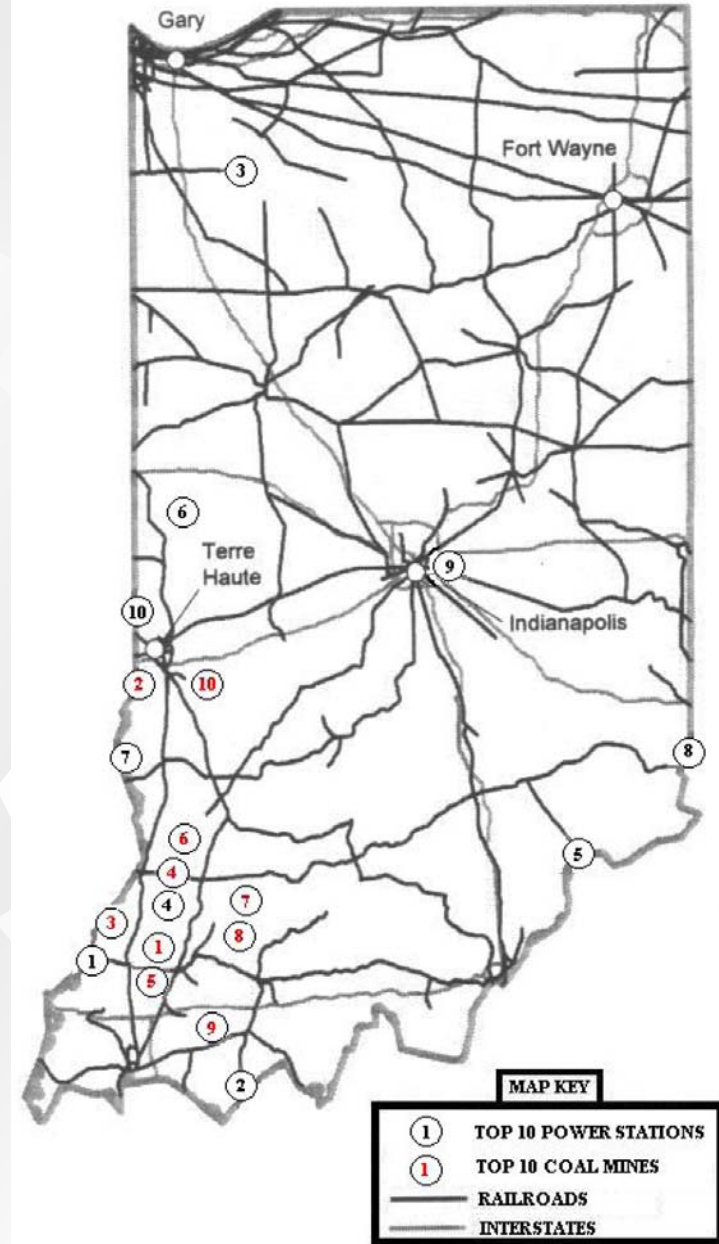
Infrastructure

☀ Supply Chain Concept



10 by 10

Limited Scope Study





Project Task 1

- ☀ Characterize the demand and supply states of Indiana coal usage
 - ☀ Demand Side
 - ☀ Where is coal consumed in Indiana?
 - ☀ Supply Side
 - ☀ Where is Indiana coal produced?

Top 10 Power Plants

COAL CONSUMPTION AT INDIANA'S TOP 10 POWER STATIONS

Rank	Plant Name	Operator	Consumption, 000 (tons) ('04 data)**	Rail/Barge *	Scrubbed	% IN Coal
1	Gibson Station	Duke Energy Indiana	9,583	Rail (NS)	Yes	79
2	Rockport	IMPCo, AEP	9,207	Barge (NS)	No	16
3	RM Schahfer	NIPSCo	5,026	Rail (NS)	Yes	21
4	Petersburg	IPL	5,213	Rail (ISRR)	Yes	100
5	Clifty Creek	IKECorp	4,470	Barge	No	22
6	Cayuga	Duke Energy Indiana	3,185	Rail (CSX/INDR)	No	64
7	Merom	HEREC	2,899	Rail (INDR)	Yes	100
8	Tanners Creek	IMPCo, AEP	2,581	Barge (CSX)	No	92
9	Harding Street	Duke Energy Indiana	1,877	Rail (ISRR)	No	100
10	Wabash River	Duke Energy Indiana	2,247	Rail (INDR)	No	100

* Rail provider, even if not currently utilized, indicated in parenthesis

SOURCE: ** 2006 US Coal Industry Map; Global Energy Decisions, LLC. 2006; Indiana Coal Council, Inc.

Top 10 Mines

COAL SUPPLY AT INDIANA'S TOP 10 COAL MINES

Rank	Mine Name	Mine Operator	Production, 000 (tons) '05	Rail Provider *
1	Somerville	Black Beauty Coal Company	8,144	ISRR (CSX, NS)
2	Farmersburg	Black Beauty Coal Company	3,846	CSX (INDR)
3	Gibson County	Gibson County Coal, LLC	3,506	CSX (NS, ISRR)
4	Prosperity	Five Star Mining Inc.	3,155	(CSX, ISRR)
5	Francisco	Black Beauty Coal Company	2,913	NS (CSX, ISRR)
6	Air Quality	Black Beauty Coal Company	2,131	CSX (ISRR)
7	Cannelburg	Solar Sources Inc.	1,989	ISRR (CSX)
8	Viking	Black Beauty Coal Company	1,548	ISRR (CSX)
9	Cypress Creek	Vigo Coal Co Inc.	1,288	NS/ISRR/SCS (CSX)
10	Miller Creek	Black Beauty Coal Company	1,016	(CSX, INRR, ISRR)

* Rail providers; parenthesis indicate other potential providers within a 15 mile radius

SOURCE: 2006; Indiana Coal Council, Inc.

NOTE: Rail Abbreviations:

CSX: CSX Transportation
 NS: Norfolk Southern Corporation
 INDR: The Indiana Rail Road
 ISRR: Indiana Southern Railroad
 SCS: Squaw Creek Southern



Project Task 2

- ☀ Characterize the transport methods of Indiana coal supply and demand

- ☀ Demand Side

- ☀ How does coal get to high-demand sites in Indiana?

- ☀ Supply Side

- ☀ How does coal produced in Indiana get moved?

10 by 10 Timetable

INDIANA COAL RAILROAD TIMETABLE: ROUTE 2

STATION NAME	MILE POST	TRACK				NOTATION	INTERLOCKS
		OWNER	NUMBER	CLASS	SPEED		
<i>READ DOWNWARD FOR SOUTHBOUND</i>							
CP HOLT	172.5	IN, INCR	1	1	10	T	1, CIND, CSXT
MOORESVILLE	185.0	INCR	1	2	25		
MARTINSVILLE	199.0	INCR	1	2	25		
WHITAKER	209.0	INCR	1	2	25	P	
SPENCER	221.5	INCR	1	2	25		
WORTHINGTON	240.5	INCR	1	2	25	P, Y	
SWITZ CITY	247.5	INCR	1	2	25	A	3
BEEHUNTER	254.5	INCR	1	1	40	A	4, 6
ELNORA	260.5	INCR	1	1	40	A	5
CHAPPEL	279.5	INCR	1	2	25	M	CSXT
PETERSBURG	296.5	INCR	1	2	25		
ASHBY YARD	298.0	INCR	1	2	25	B, E, Y	
OAKLAND CITY	308.5	INCR	1	2	25	A	NS
GRAY JCT	309.5	INCR	1	2	25		
BUCKSKIN	317.5	INCR	1	2	25	T	7
STRAIGHT LINE JCT	337.5	CSXT, INCR	1	2	25		
<i>BETWEEN STRAIGHT LINE JCT AND WANSFORD YARD CSXT TIMETABLE GOVERNS.</i>							
WANSFORD YARD	338.0	CSXT	1	1	10	Y	CSXT
<i>READ UPWARD FOR NORTHBOUND</i>							

SOURCE: *Comprehensive Railroad Atlas of North America*; compiled by Chad Pfitzer

Railroad Class Definitions

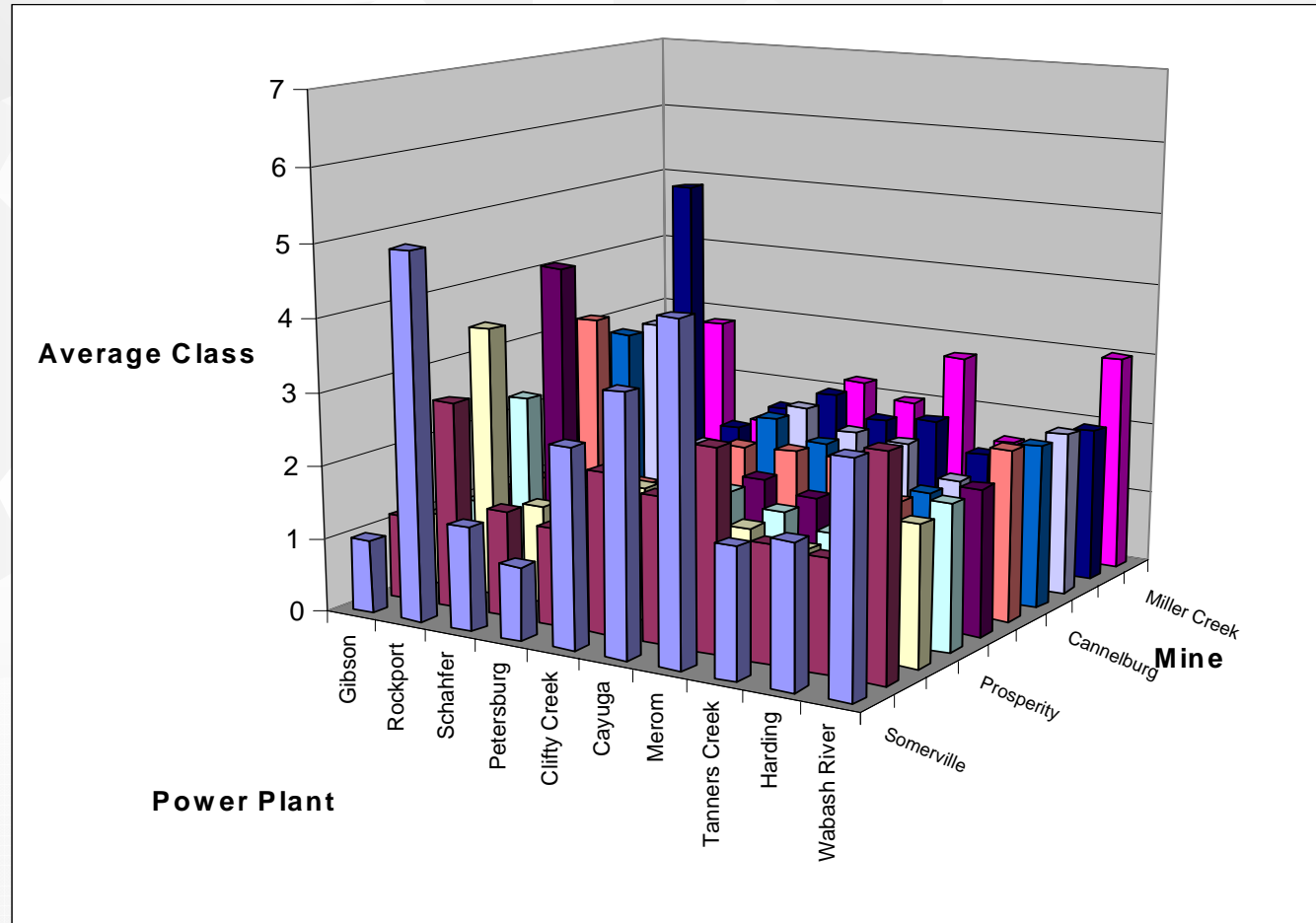
CLASS:

- 1: 136 lbs per yard welded rail; straight track; trackside signaling
- 2: 136 lbs per yard welded rail; track with high curvature; trackside signaling
- 3: 136 lbs per yard welded rail; straight track; no signaling
- 4: 136 lbs per yard welded rail; track with high curvature; no signalling
- 5: 136 lbs per yard jointed rail; straight track; no signaling
- 6: 136 lbs per yard jointed rail; track with high curvature; no signaling
- 7: 136 lbs per yard welded rail; straight track; trackside signaling, electrified

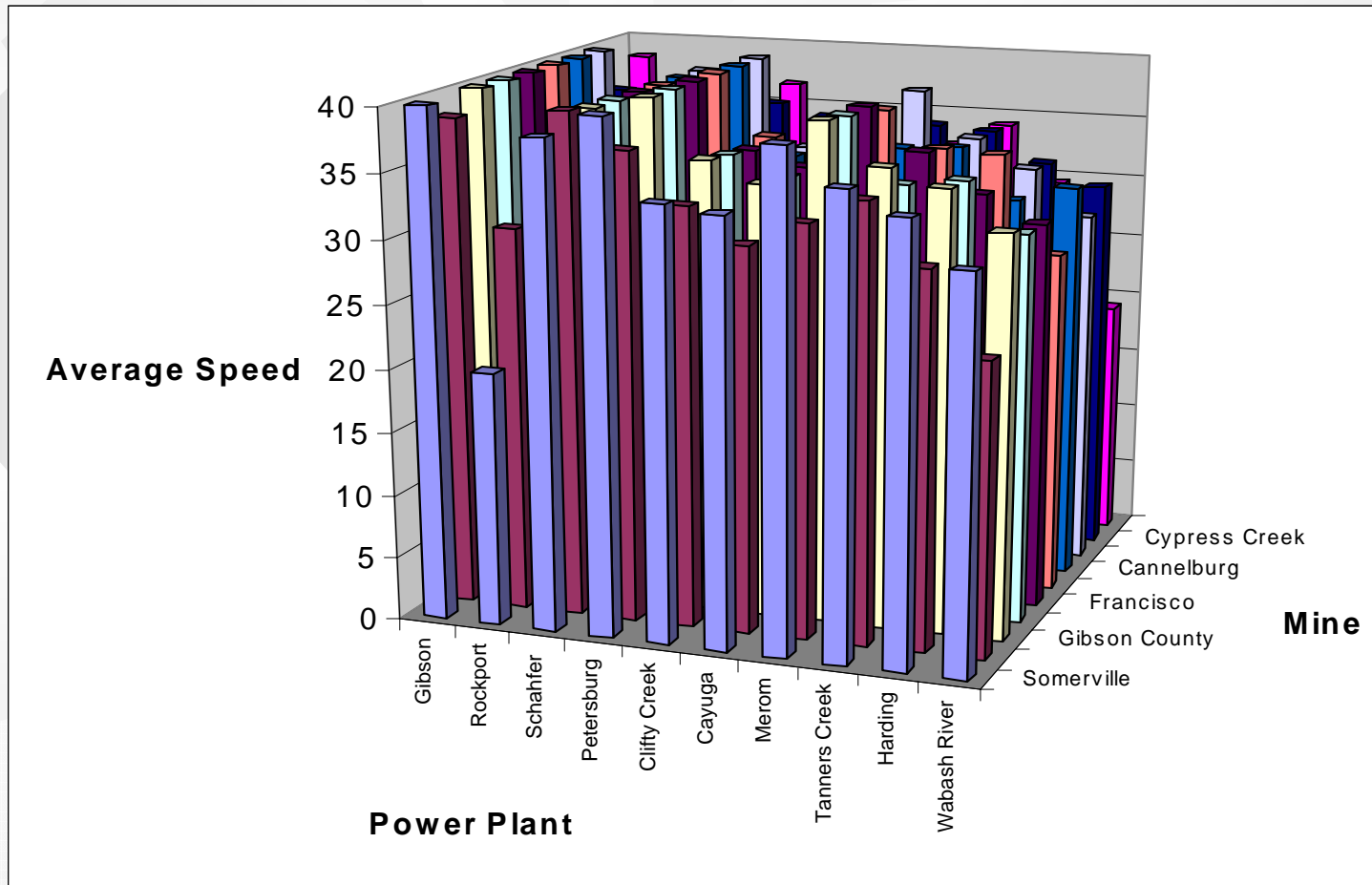
TRACK STRUCTURE				
Classification	Rail*	Tangent	Signaling	Notation
1	welded	straight	yes	-
2	welded	curved	yes	-
3	welded	straight	no	-
4	welded	curved	no	--
5	jointed	straight	no	-
6	jointed	curved	no	-
7	welded	straight	yes	Electrified

*: All rail 136 lbs per yard

Average Class(10 by 10)



Average Speed(10 by 10)





Project Task 3

- ☀️ Develop a simulated environment of Indiana coal supply and demand
 - 🌟 Use Task 1 & 2 data
 - 🌟 Construct a simulated rail environment to investigate
 - 🌟 Capacity Issues
 - 🌟 Cost Issues

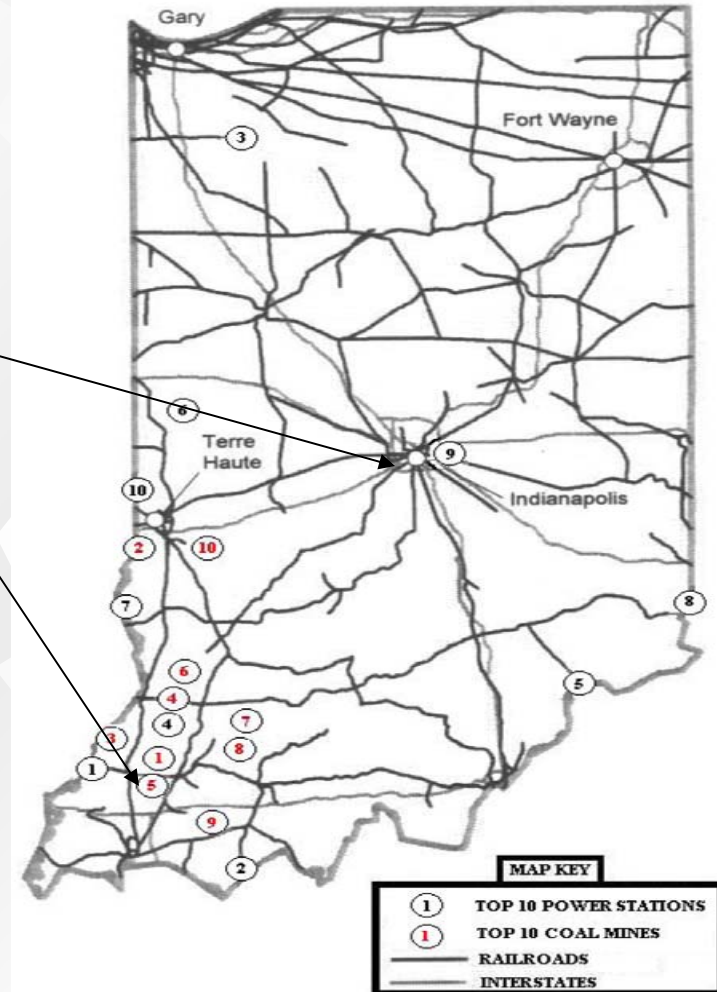
Model Architecture

INDIANA COAL RAILROAD TIMETABLE: ROUTE 2

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WANSFORD YARD	338.0	CSXT	1	1	10	Y CSXT
READ UPWARD FOR NORTHBOUND						

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

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





Modeling Process

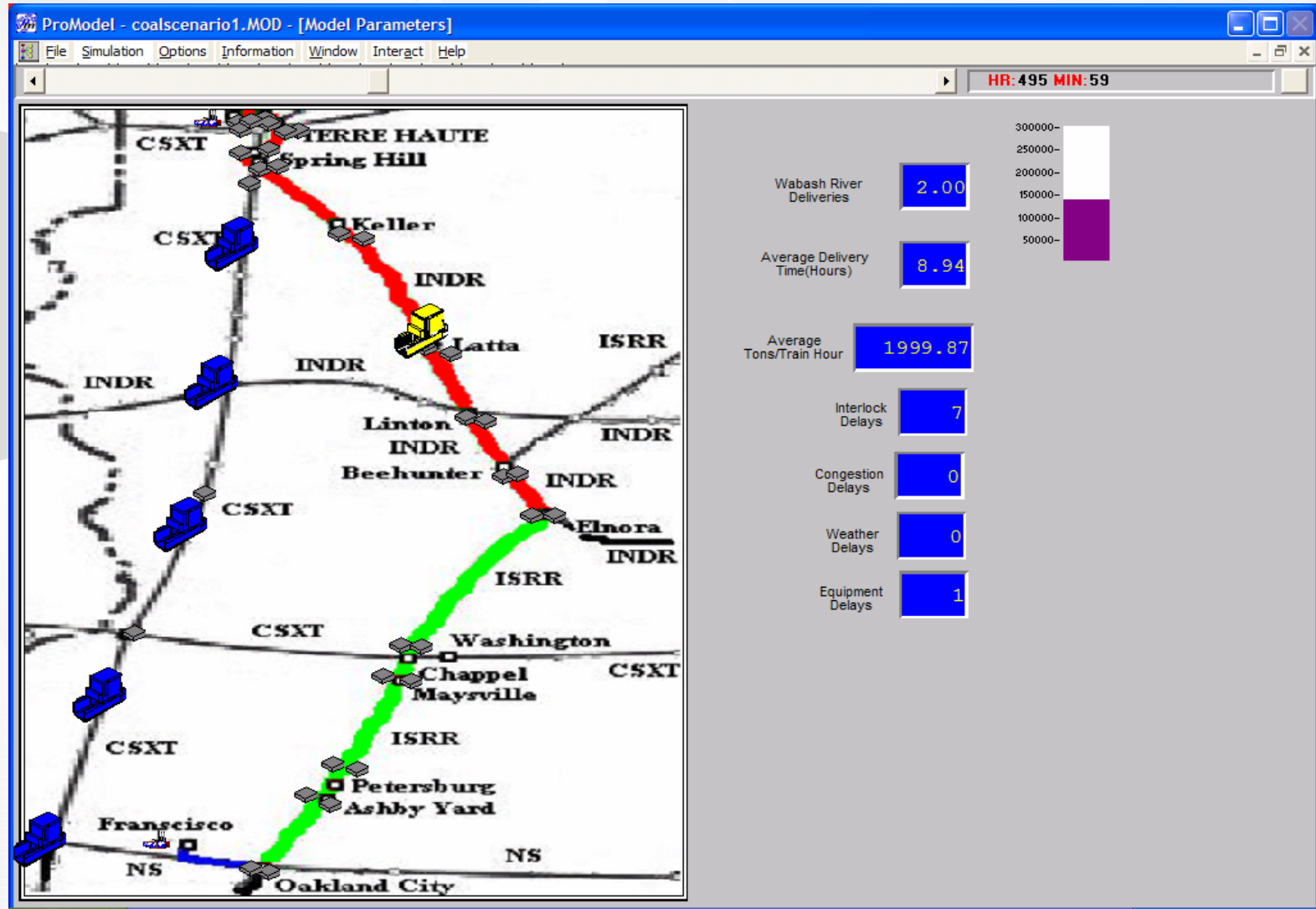
- ☀ Develop a Scenario
- ☀ Overlay the route using timetable information from 10 by 10
- ☀ Set model parameters
- ☀ Experiment

Project Task 4

- ✦ Develop a set of transportation infrastructure scenarios to demonstrate bottlenecks in current Indiana coal Transportation Network
 - ✦ 1 – Francisco Mine(5) to Wabash Valley(10)
 - ✦ 2 – Vincennes Railroad Relocation
 - ✦ 3 – Indiana Coal Corridor
 - ✦ Farmersburg Mine(2) to Schahfer Power Plant(3)
 - ✦ 4 – Indiana Coal Corridor
 - ✦ Scenario 3 + Light Rail Passenger service between Chicago union Station & Indianapolis

Scenario 1:

Francisco Mine to Wabash River

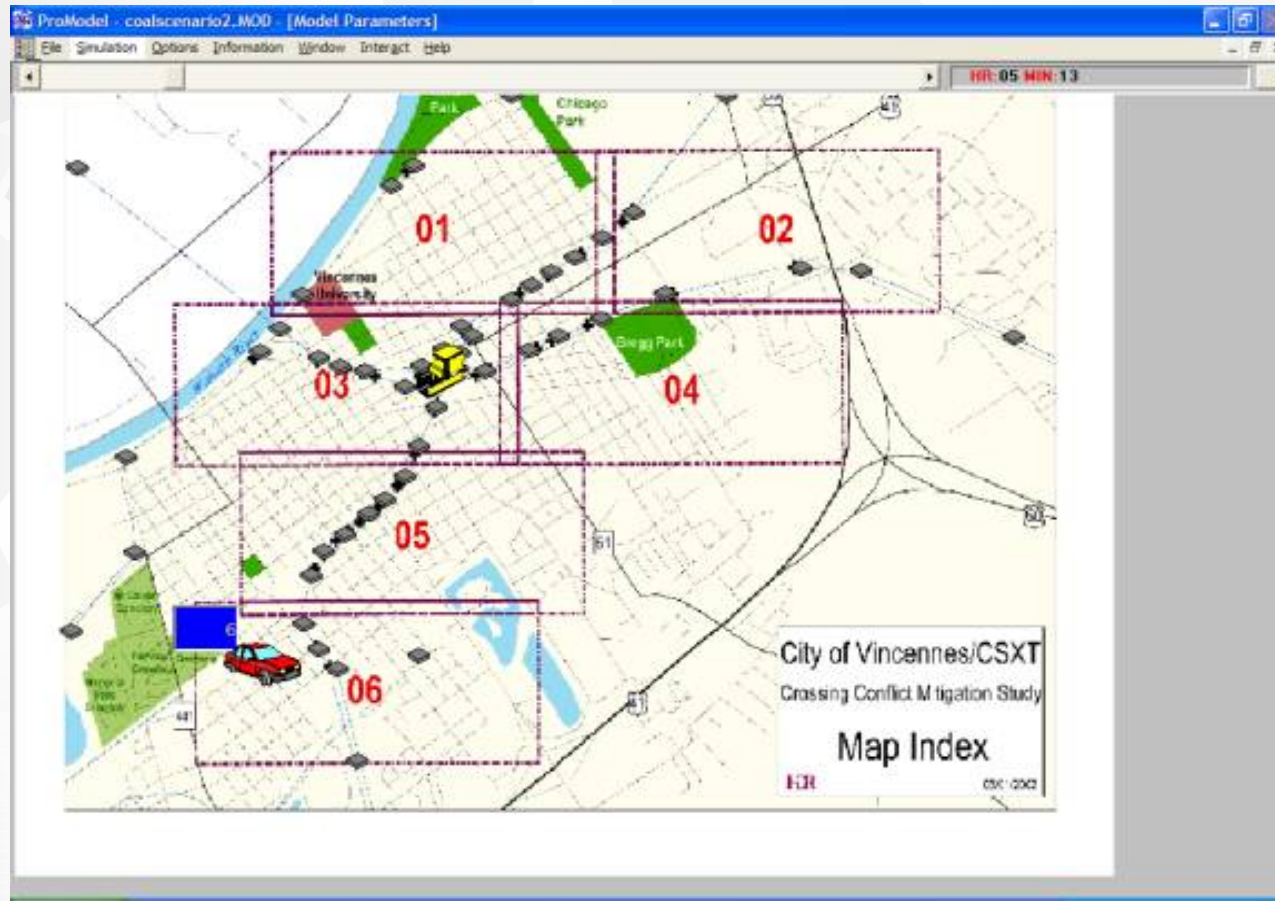




Scenario 1 Insights

- ☀ Power Plant coal inventory policies drive rail needs
- ☀ Detailed timetable permits accurate modeling and estimation of supply chain performance between two entities

Scenario 2: Vincennes Railroad Relocation



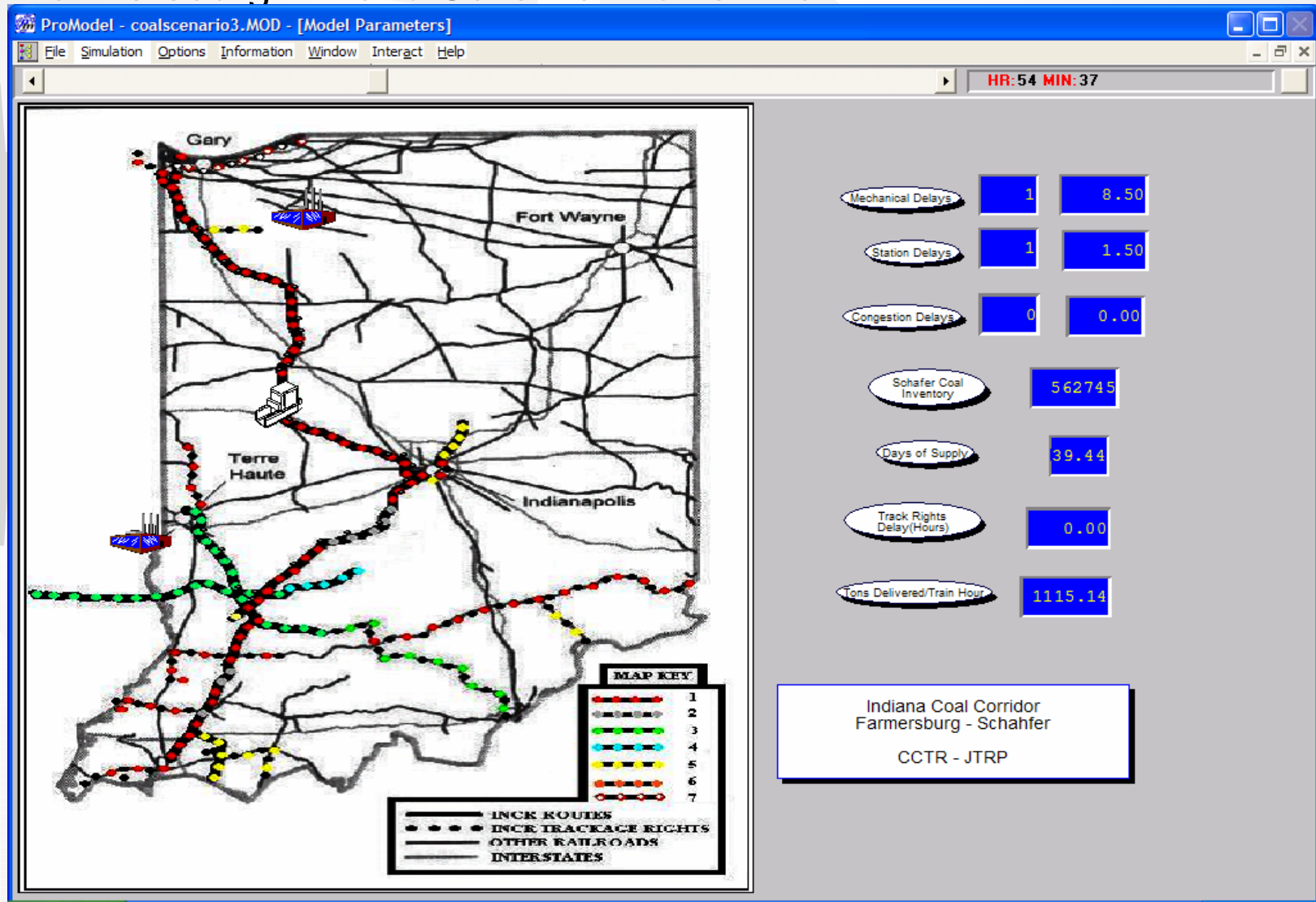


Scenario 2 Insights

- ✦ Modeling can be done at the vehicle level
- ✦ Static analysis using AADT figures may not provide compelling justification for large capital investment

Scenario 3: Indiana Coal Corridor

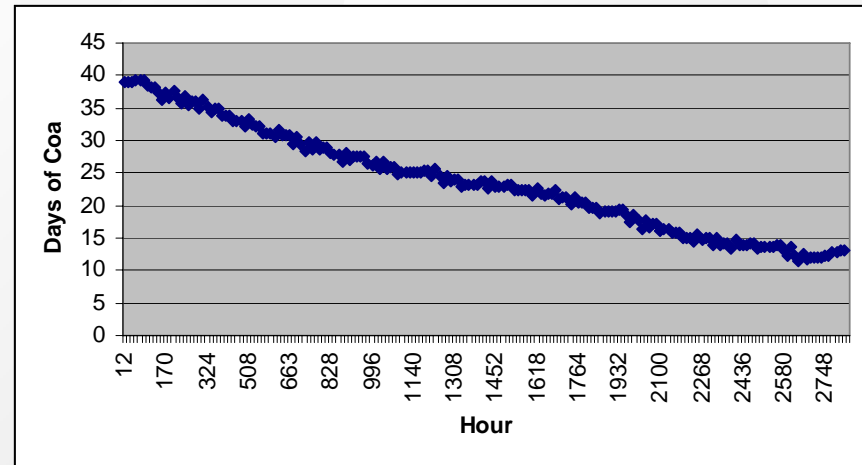
Farmersburg Mine to Schahfer Power Plant



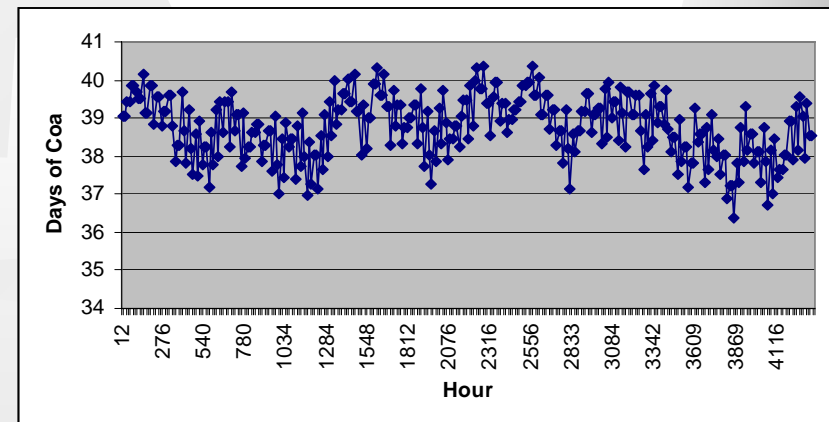
Scenario 3 Insights

Farmersburg Mine to Schahfer Power Plant

1 unit train cannot meet supply requirement



1 unit train on a Class 1 route can supply coal need





Scenario 4: Indiana Coal Corridor

Farmersburg Mine to Schahfer Power Plant

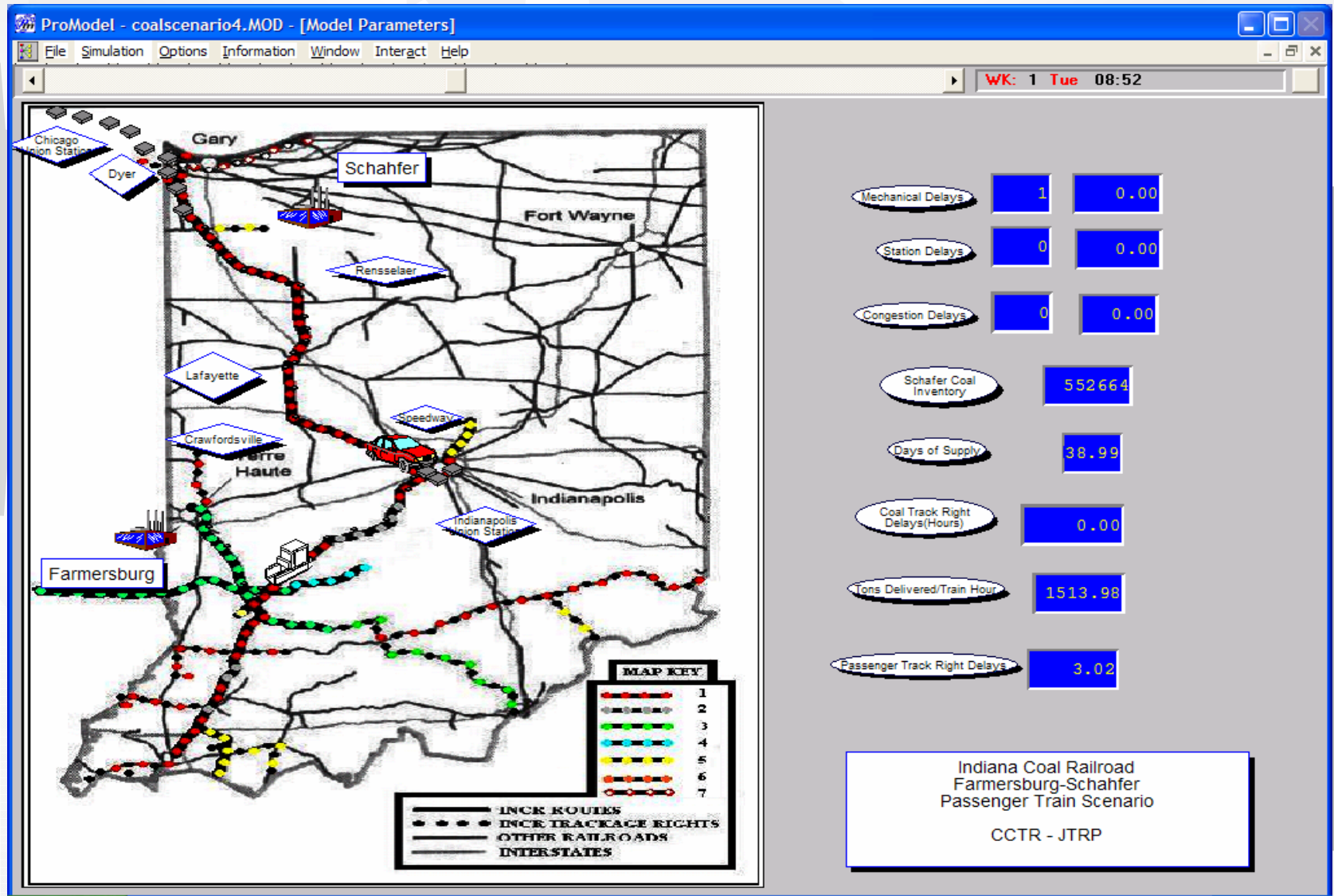
Light Passenger Rail from Chicago to Indianapolis

- ☀ Share access of Indiana Coal Corridor with High Speed Passenger Service from Chicago to Indianapolis
 - ☀ 1 train per day from Chicago Union Station to Indianapolis Union Station
 - ☀ Stops in Dyer, Rensselaer, Lafayette, Crawfordsville, Speedway

Scenario 4: Indiana Coal Corridor

Farmersburg Mine to Schahfer Power Plant

Light Passenger Rail from Chicago to Indianapolis





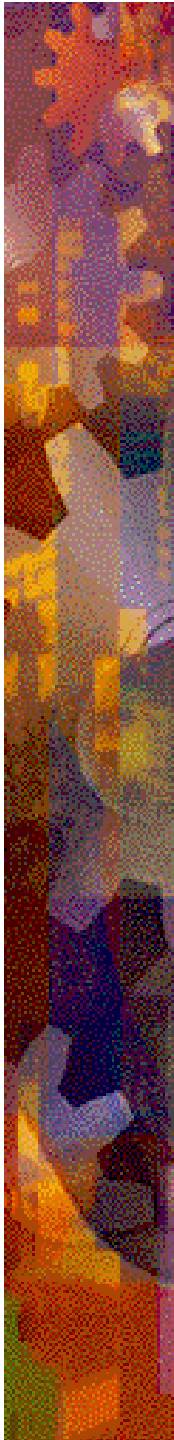
Scenario 4 Insights

- ☀ Current state of track would not support timely passenger rail between Chicago and Indianapolis
- ☀ Use model to analyze Design Issues
 - ☀ Schedule
 - ☀ Number of sidings



Indiana Coal Corridor Concept

- ✦ Joint government/industry project
- ✦ Develop a rail corridor:
 - ✦ High speed corridor between Indianapolis and Chicago
 - ✦ Move coal within state
 - ✦ Catalyst for economic development

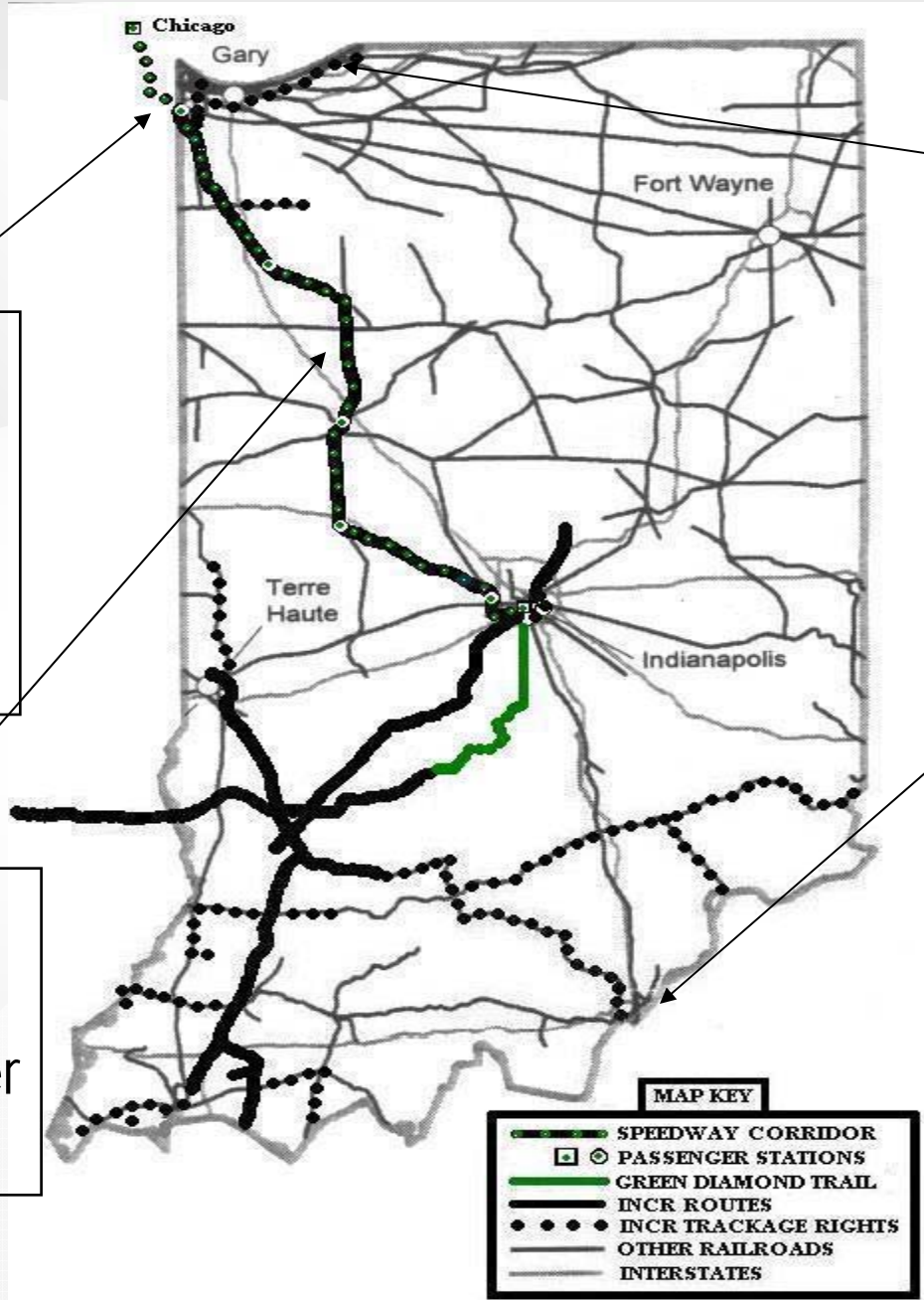


National East/West Rail Interchange access

High Speed Passenger Rail

Port of Indiana access

River Access



Project Task 5

- ☀ Develop a Return on Investment Methodology and simple Portfolio Optimization Model
 - ✳ Objective: Minimize Capital Investment
 - ✳ Constraints
 - ✳ Upgrade at least w miles Class 5
 - ✳ Upgrade at least x miles Class 4
 - ✳ Upgrade at least y miles Class 3
 - ✳ Upgrade at least z miles Class 2

Task 5 Example Solution

SCHEDULE 9.8: CYPRESS CREEK MINE - TANNERS CREEK POWER

CYPRESS CREEK MINE 0.0 INCR 1 5 20 T	0	5	20	0
BUCKSKIN 6.0 INCR 1 5 20 T	6	5	20	6
SOMERVILLE 9.0 INCR 1 1 40 T	9	1	40	3
GRAY JCT 13.0 INCR 1 1 40 -	13	1	40	4
OAKLAND CITY 14.0 INCR 1 1 40 A	14	1	40	1
ASHBY YARD 24.5 INCR 1 1 40 B,E,Y	24.5	1	40	10.5
PETERSBURG 26.0 INCR 1 1 40 -	26	1	40	1.5
CHAPPEL 43.0 INCR 1 2 25 M	43	2	25	17
ELNORA 62.0 INCR 1 1 40 A	62	1	40	19
ODON 68.0 INCR 1 3 40 -	68	3	40	6
CRANE 76.0 CSXT,	76	3	40	8
BEDFORD 100.0 CSXT 1 2 25 -	100	2	25	24
MITCHELL 110.0 CSXT 1 2 25 L, M, P, T	110	2	25	10

Cost/Mile	1	0.8	0.6	0.2	
DV	5	4	3	2	
0	0	1			0
6	0	1			6
3	0				
4	0				
1	0				
10.5	0				
1.5	0				
17	1			1	3.4
19	0				
6	1		1		3.6
8	0		1		4.8
24	0			1	4.8
10	0			1	2

	24	0	15	37	40.3
Min	10	0	15	35	

Upgrade

Don't Upgrade

Total Cost



Conclusions

- ☀ This project was defined as a scoping study to:
 - ☀ Demonstrate ‘proof of concept’ for simulation analysis of rail infrastructure
 - ☀ Build awareness of the transportation aspect of the coal economy



The Future

- ☀ Project Phase 2 Definition
- ☀ Widen the scope to examine import and export rail routes
- ☀ Develop an in-depth scenario with CCTR partner
- ☀ Analyze more scenarios
- ☀ Expand the optimization model(Task 5) to the entire 10X10
- ☀ Expand to include all coal consumption(Steel Industry)

The Future

Develop an in-depth scenario involving new rail infrastructure development

