



Ethanol and Pennsylvania: A Logistics Overview

September 5, 2007

CrossOver 2007

Penn State Center for Supply Chain Research





Ethanol and Pennsylvania: A Logistics Overview

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Impact of Ethanol (E10) on Pennsylvania's Infrastructure

- Project objectives:
 - Understand supply chain implications of ethanol blended gasoline
 - Identify supply chain issues pertaining to PA state-wide E10 adoption
 - Recommend areas of further research

Project Methodology

- Extensive Literature Review
 - Public sector information
 - Trade journals
- Interviews with various stakeholders or subject matter experts
 - College of Agriculture
 - PennDOT's Transportation Planning Research
 - PennDOT's Rail, Ports, and Waterways contact
 - BNSF and Norfolk Southern perspectives
 - Smeal's SC&IS faculty

Project Outline

- Ethanol drivers and overview of federal and state gasoline programs and requirements
- Current supply and demand of fuel ethanol
- Ethanol supply chain
 - Ethanol sources for PA consumption
 - Transportation mode and infrastructure evaluation
- Summary of issues
- Recommendations for further research

Pennsylvania Ethanol Policy

Policy

Supply / Demand

Supply Chain - Sources - Modes

Summary

- Philadelphia area
 - RFG area
 - Using E10 following 2006 MTBE switch
- Pittsburgh area
 - Boutique RVP requirements
 - RFG used to meet requirements
- PennSecurity Fuels Initiative
 - Proposed by Governor Rendell
 - If passed, would require E10 state-wide

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Slide 7

CJL4

Update all structuring slides to reflect "Ethanol supply chain" bullet changes.

Chris Liller, 4/27/2007

Ethanol Plant Locations

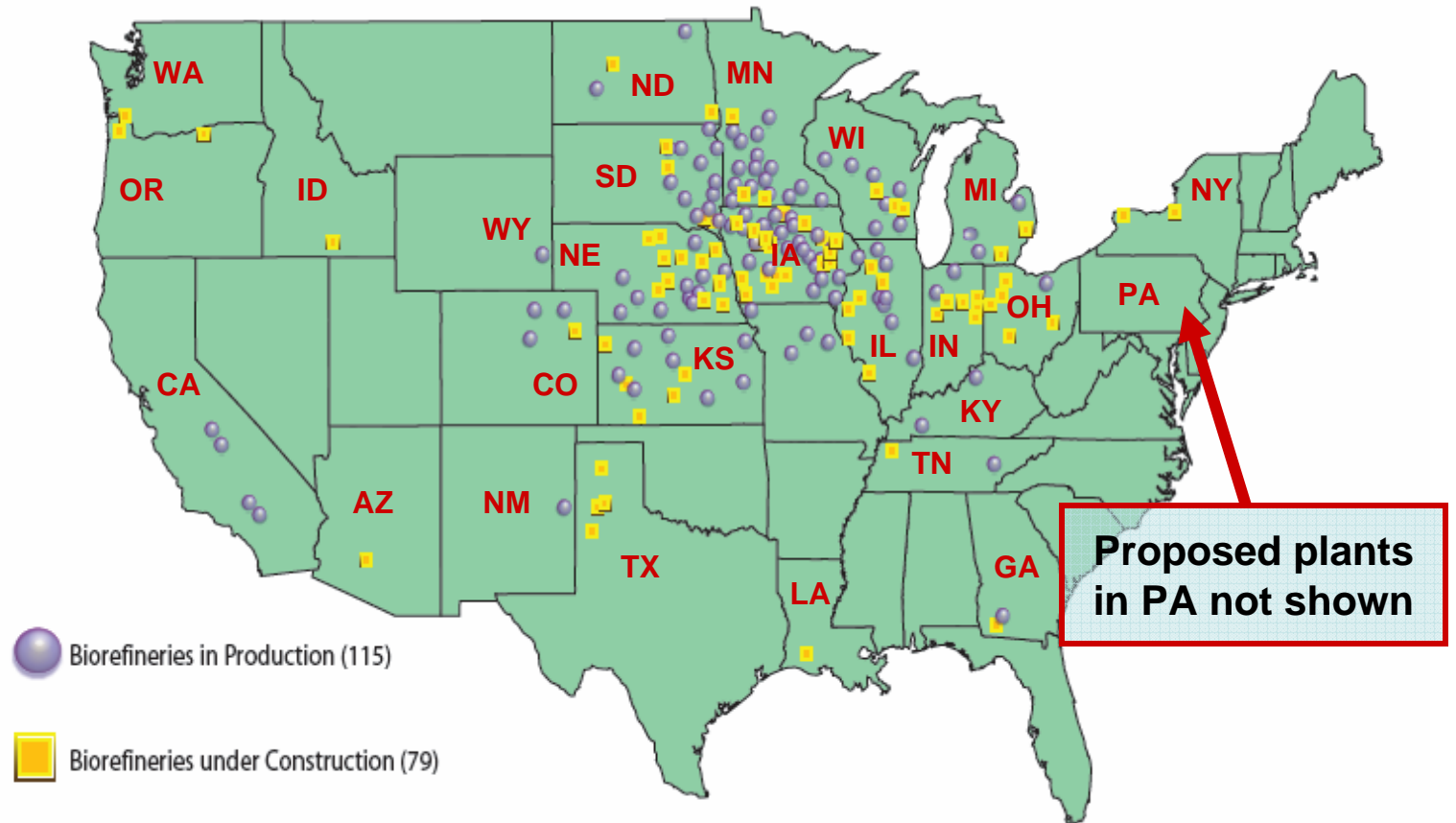
Policy

Supply /
Demand

Supply
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- Sources
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Summary



Source: Renewable Fuels Association
4.3.07

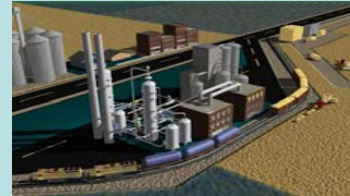
Typical Ethanol Supply Chain



1. Corn fields



2. Bulk truck transport preprocessed corn grains



3. Bio-refinery to produce ethanol



4. Ethanol shipped in tank cars*



5. Ethanol unloaded from tank cars to tank trucks at rail terminals *



6. Ethanol shipped in tank trucks to distribution terminals *



7. Ethanol unloaded from tank trucks for storage separately from gasoline



8. Ethanol blended with gasoline (arrived via pipelines) while loading to tank trucks



9. Last leg of transportation via tank trucks to retail gas stations.



10. Ethanol blended gasoline unloaded for underground storage at gas stations and made available for consumption

Areas of significant impacts:
Increased Inbound Complexity due to Ethanol

* Alternative modes used in some instances: pipeline, barge, etc.

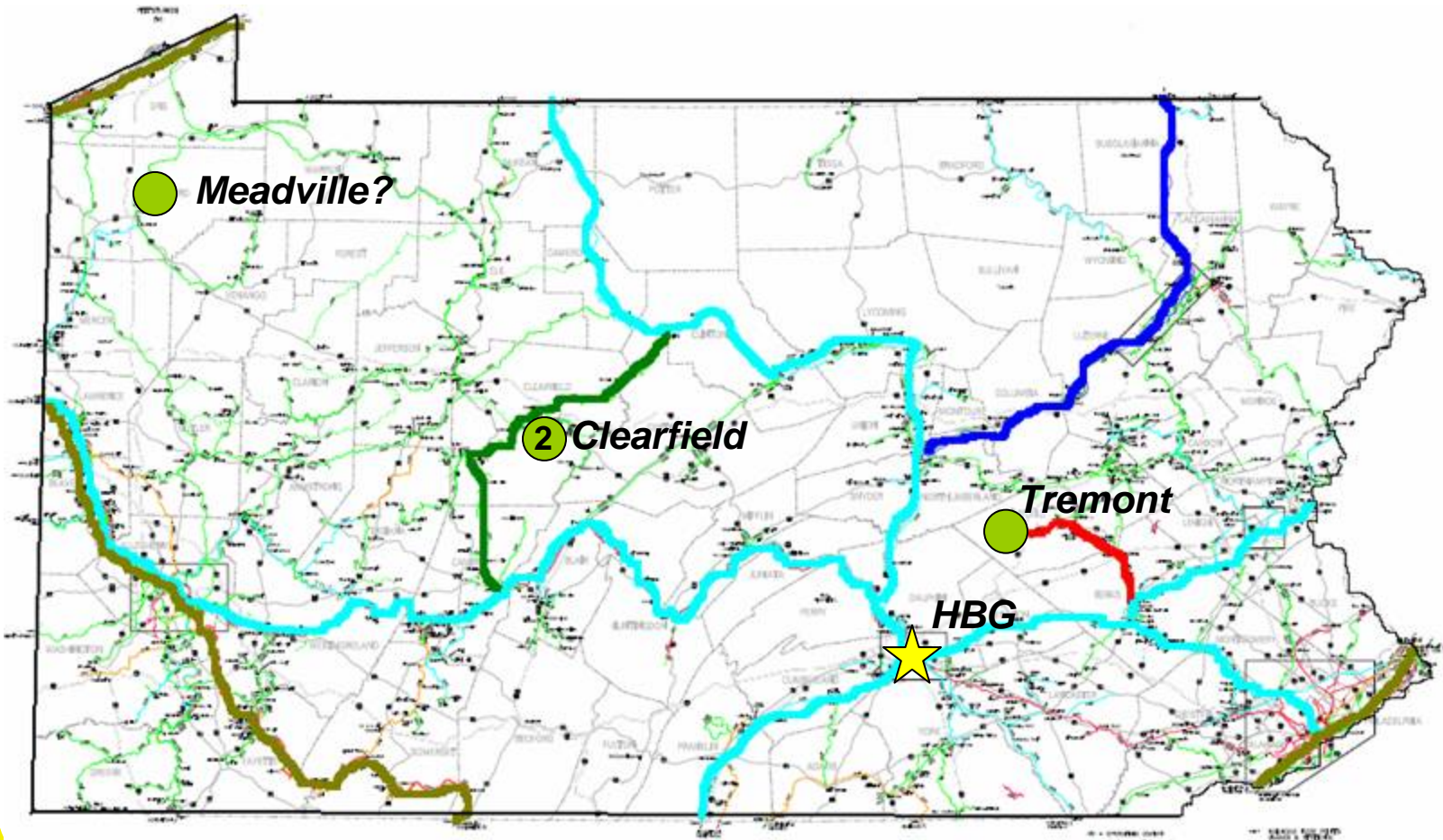
Map of PA Railroads and Proposed Plants

Policy

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Summary



NS — CSX — CPR — RBM&N — RJ Corman — Site of Proposed Ethanol Plants ○

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Ethanol Transportation: Types of Vessels

Mode	Size	Availability (New)	Efficiency (1T eth / 1g of fuel)
Rail Car	30,000 gal.	<ul style="list-style-type: none"> • Backlog into 2009 • 2007: 18,500 new deliveries projected 	386 mi
Barge	1,176,000 gal. <i>Approx 39 rail cars</i>	2 year backlog	522 mi
Truck	8,000 gal. <i>Approx 3.75 trailers to unload 1 rail car</i>		59 mi
Pipeline	n/a	None <ul style="list-style-type: none"> • Kinder Morgan investigating • 15 MMGY given as feasibility threshold 	n/a

Policy

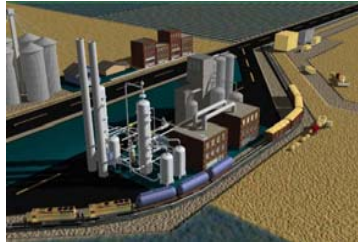
Supply / Demand

Supply Chain

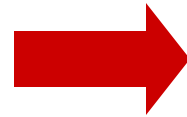
- Sources
- Modes

Summary

Logistics Cost and Management Impacts



Ethanol Supplier



Terminal Owner

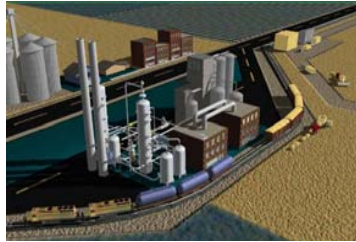


Retail Station

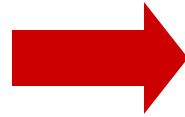
Transportation Carriers



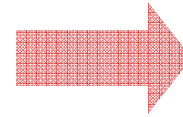
Logistics Cost and Management Impacts



Ethanol Supplier



Terminal Owner



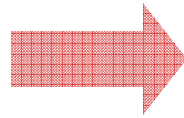
Retail Station

- Own tank cars
 - Tank cars (new): \$100,000 / car
 - Maintenance and management of tank cars
- Lease tank cars
 - Leasing fees
- Feedstock supply management
- Outbound byproduct logistics (DDGs)
- Transportation management (in-house or outsource)

Logistics Cost and Management Impacts



Ethanol Supplier



Terminal Owner



Retail Station

One-time set-up/conversion costs

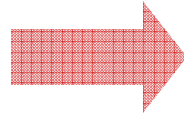
• Storage tanks (new)	\$450,000 for 25,000-barrel tank, taking 14 to 24 months to build
• Storage tanks (converted)	Approx. 20% of cost of a new tank, taking 60 to 90 days with all the required permits in place
• Unloading equipment and piping	\$20,000
• Blending equipment	\$300,000 to \$400,000 for 2 blending units
• Own rail spur track	
– Rail spur track	\$75 to \$95 / foot
– Unloading equipment & piping	\$15,000

(Continue next)

Logistics Cost and Management Impacts



Ethanol Supplier



Terminal Owner

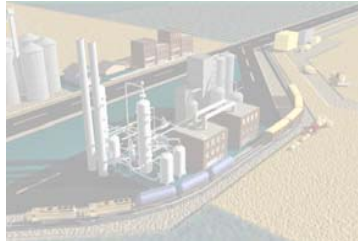


Retail Station

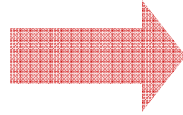
On-going costs and management

- Ethanol supply management
 - Due diligence of (ethanol) supply market
 - Sourcing strategies (contract and spot purchases, contract terms and management)
 - Additional suppliers to manage
- Storage and delivery optimization (utilization of dedicated tanks, pipes, and truck loading equipment)
- Transportation management (additional modes and carriers to manage)
- Inventory management
 - Additional SKUs to manage
 - Additional safety stock requirements (higher transportation variability by rail vs. pipeline, and higher risks of damage with more transfer points)

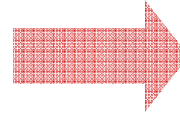
Logistics Cost and Management Impacts



Ethanol Supplier



Terminal Owner



Retail Station

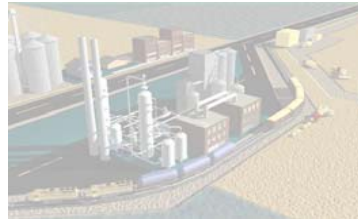
One-time set-up/conversion costs

- Water removal and cleaning
 - Water Removal \$400 / station
 - Tank Cleaning \$800 / station
 - “Water Bottoms” Removal \$400 / station
- Administrative and Labeling \$150 / station
- Pump and dispenser replacement Not available
- 10 micron “water sorb” filter Not available

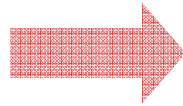
On-going costs

- Ongoing testing for water incursion Not available

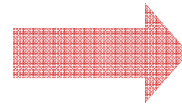
Logistics Cost and Management Impacts



Ethanol Supplier



Terminal Owner



Retail Station

Transportation Carriers



Rail carriers

- Mainline track: \$200 to \$300 / foot
- Car turnover management and optimization

Truck carriers

- Tank truck fleet (dedicated)
- Tank truck and equipment cleaning of prior content (mixed uses)

Transloaders

- Transload terminal and equipment investment
- Efficient rail-truck transload management
- Investment in dedicated pipelines from transloader to storage terminals

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Summary of Issues

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Summary

- Ethanol supply management
 - Ethanol supply capacity not a concern in the near future with Midwest producers as primary sources of supply
 - Local management of ethanol supply needs to be considered
 - Will require due diligence of ethanol supply market
- Long-haul transportation issues
 - Rail as primary long-haul transportation mode to PA
 - Incremental traffic from ethanol not a concern
 - Overall rail service and capacity could be a concern.
 - Ethanol rail terminals service continuing to develop along the eastern seaboard (NS and CSX)

Summary of Issues

Policy

Supply / Demand

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Summary

- Distribution and storage terminals
 - Inbound
 - Direct access to rail is limited
 - Direct rail to storage terminals is most efficient when available
 - Pipelines, trucks can also be used for terminal delivery
 - “Hub” terminals can reduce infrastructure investment
 - Inventory management is more complex with ethanol
 - Outbound
 - Storage and distribution requirements need to be considered
 - Blending stations can be a potential bottleneck

Summary of Issues

Policy

Supply / Demand

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Summary

- Proposed PA ethanol production
 - Concerns
 - Economic viability
 - Insufficient local feedstock
 - Benefits
 - Service to local market
 - Local use of byproduct (DDGs)
- Future cellulosic ethanol production
 - More local feedstock available
 - Significant logistics challenges

Areas for Further Study

Policy

Supply /
Demand

Supply
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Summary

- Case studies of distribution/storage terminals in states with widespread ethanol use
- Identification and investigation of supply chain best practices in similar industries
- Supply chain optimization study
 - GIS modeling of key stakeholder locations, routing alternatives and capacity
 - Supply chain network design and optimization from selected sources of ethanol to market destinations

Areas for Further Study

- Participation of Penn State or Pennsylvania Transportation Institute (PTI) in PA's new inter-agency ethanol committee
- Evaluate areas for state investment (e.g. infrastructure, production, etc.)
- Assess potential impact of cellulosic ethanol production in Pennsylvania

Questions?

