

The Center for Supply Chain Research
Smeal College of Business
The Pennsylvania State University

The Road to E10 in Pennsylvania

Presented at:
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The Road to E10 in Pennsylvania



The Preparation



Game Day



**Towards the
Common Goal!**

Agenda

- **PREPARATION – Understanding the evolving business environment**
- **GAME DAY – Operating the emerging logistics of ethanol**
- **COMMON GOAL – Top three strategic priorities on the road to E10 in Pennsylvania**

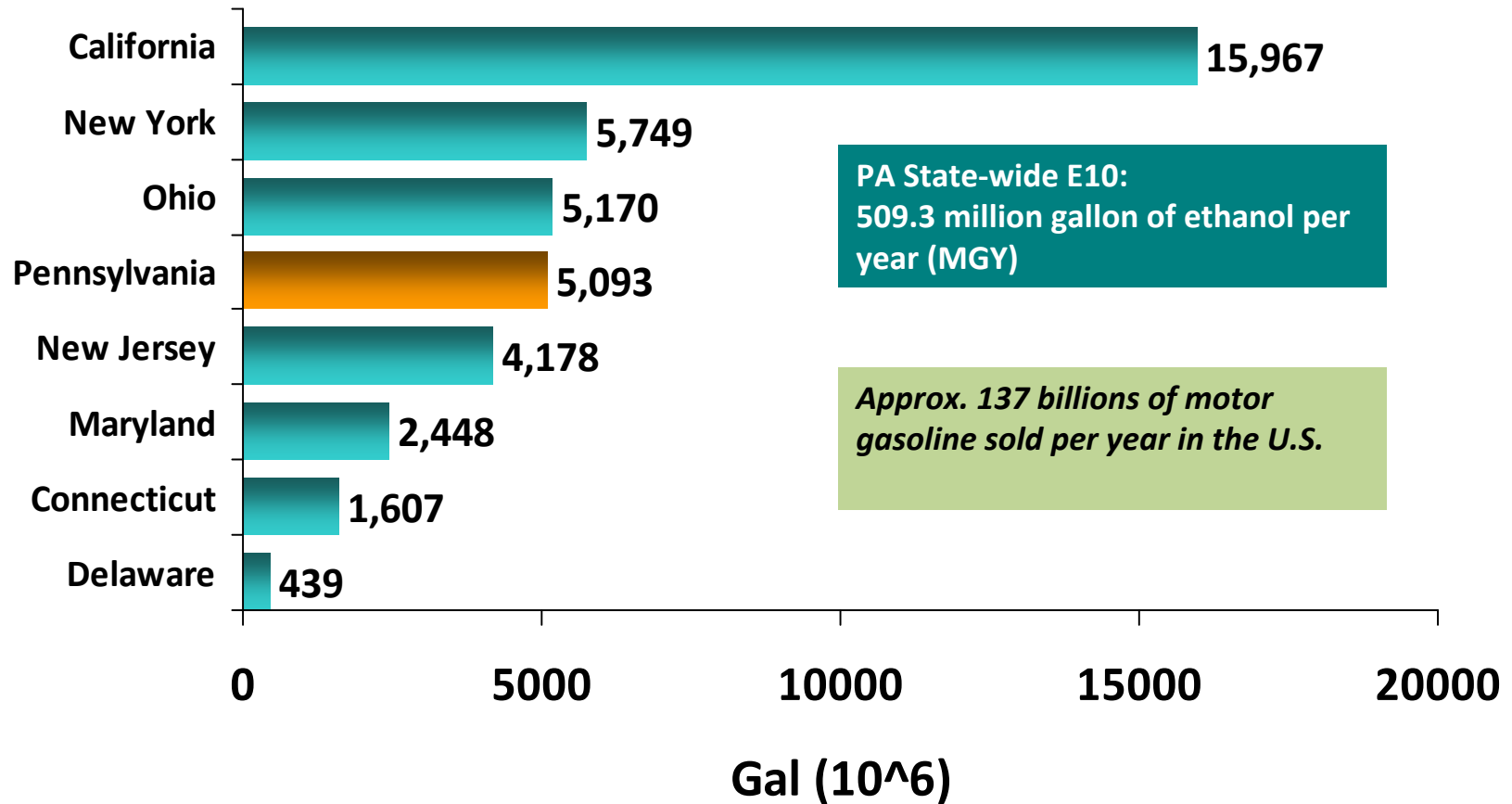


The Preparation

Understanding the evolving business environment

What is Demand?

2006 Motor Gasoline Sales



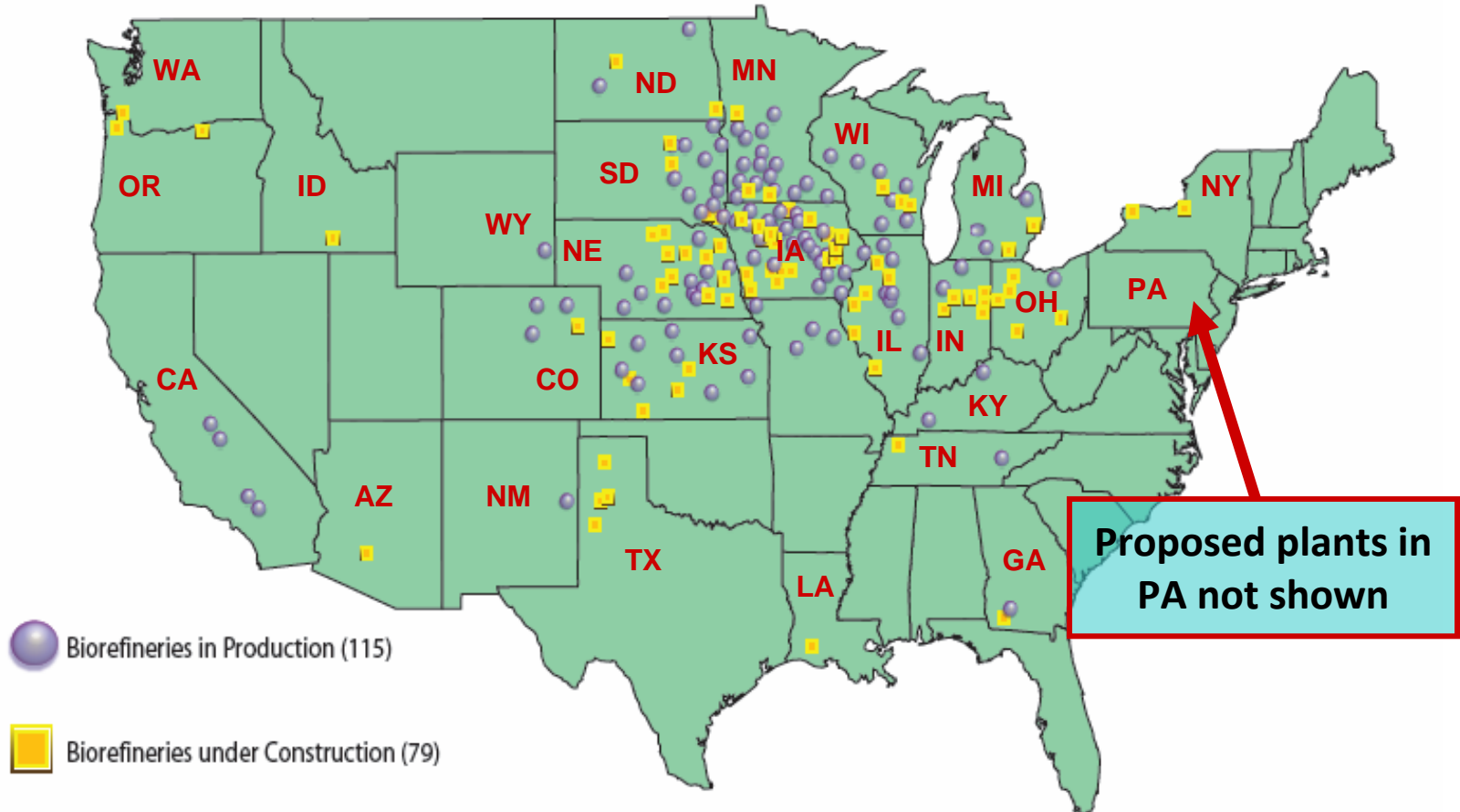
PREP

GAME DAY

COMMON GOAL

Where Is the Ethanol?

U.S. Ethanol Production

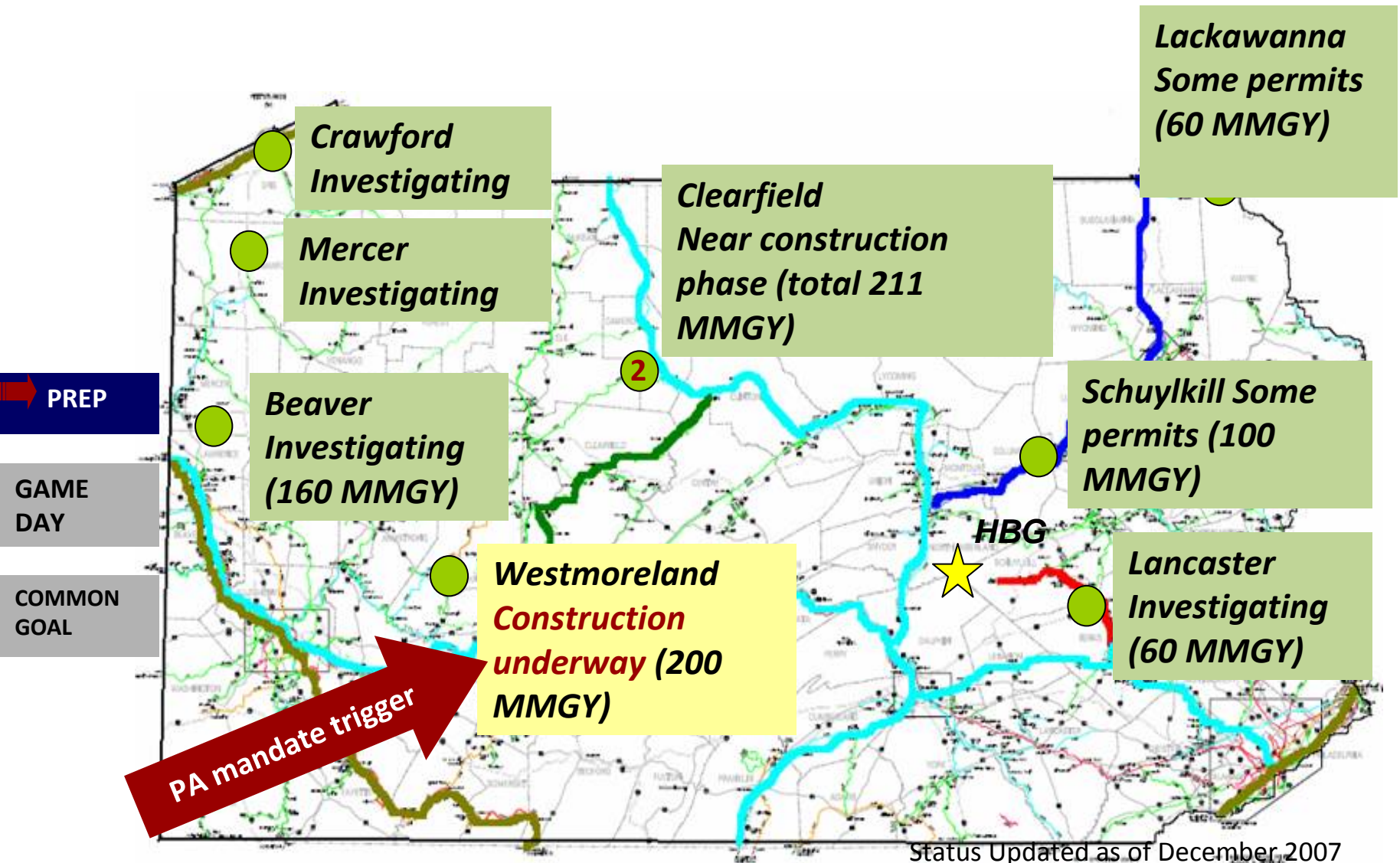


- PREP
- GAME DAY
- COMMON GOAL

Source: Renewable Fuels Association
4.3.07

Where Is the Ethanol?

Proposed Ethanol Plants in PA

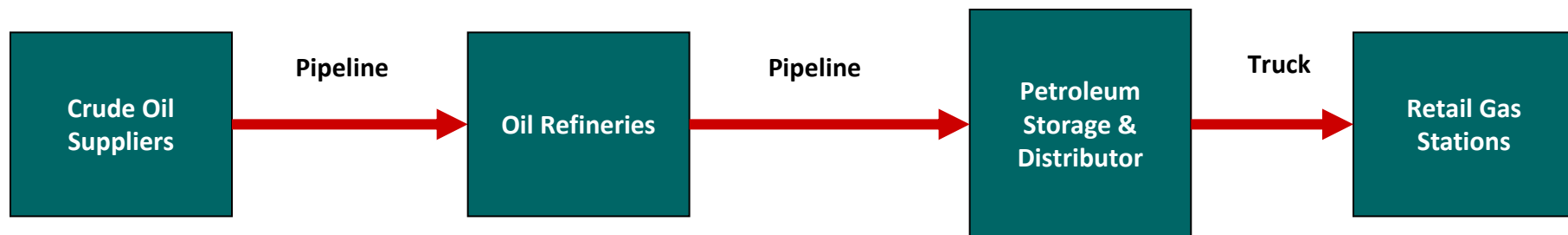


Game Day

Operating the emerging logistics of ethanol

How Do We Link Ethanol Supply with E10 Demand?

Petroleum Logistics before Ethanol



Highly streamlined supply chain with four key players, primarily driven by pipeline transportation

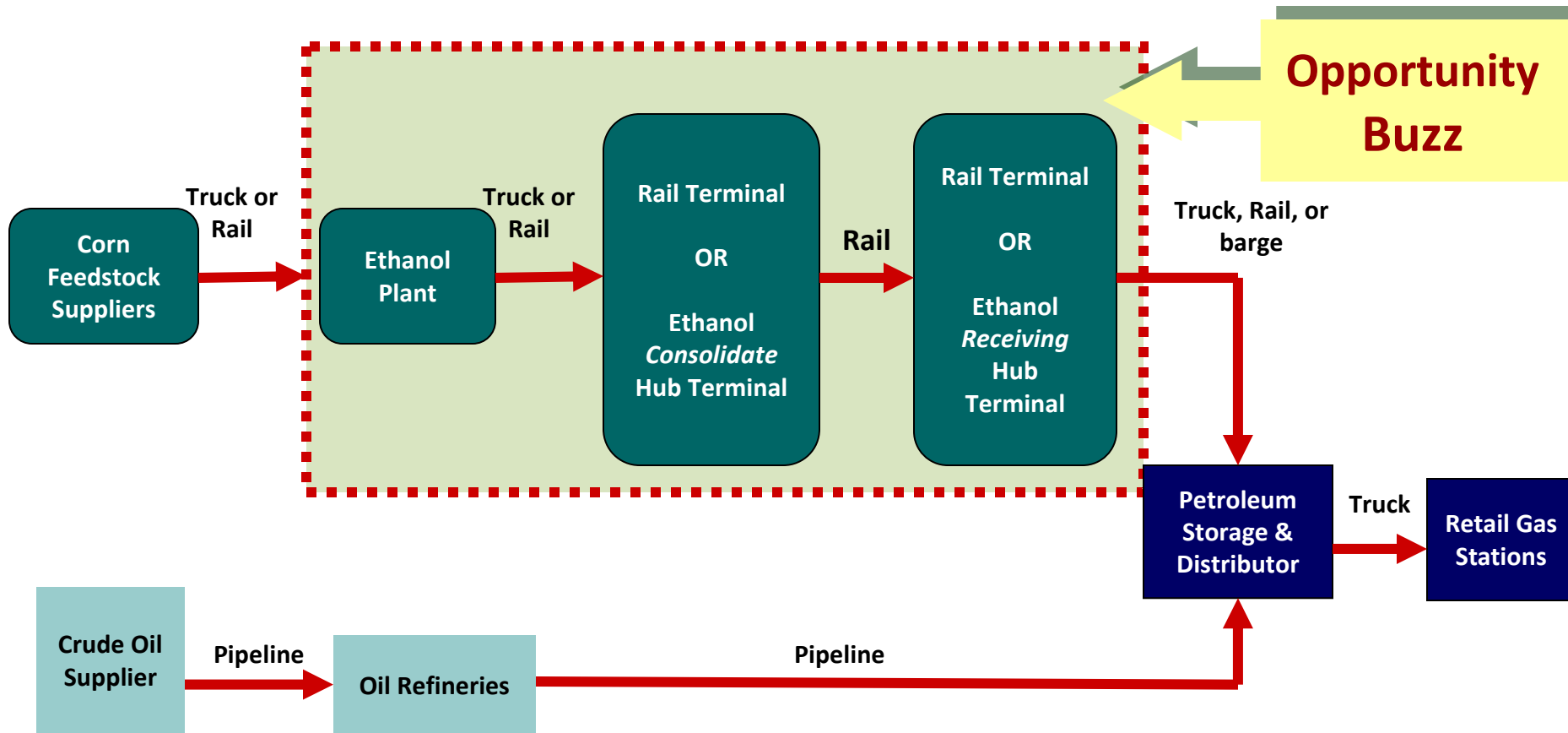
PREP

GAME DAY

COMMON GOAL

How Do We Link Ethanol Supply with E10 Demand?

Petroleum Logistics after Ethanol



Emerging ethanol supply chain infused into petroleum supply chain, creating substantial demand for rail transport service and newly constructed transport and logistics infrastructure.

What Does It Cost?

- **Estimates by the National Petrochemical and Refiners Association (NPRA) predict a 200% – 300% increase in transportation costs with ethanol.**
 - 3-5 cents per gallon for petroleum fuels
 - 13-18 cents per gallon for RFG with ethanol

PREP

→ GAME DAY

COMMON GOAL

The Common Goal

**Top three strategic priorities on the road to E10
in Pennsylvania**

Strategic Priorities

Utilize the rail-served hub terminals for consolidation and distribution of ethanol.

Redefine logistics management processes at petroleum storage and distribution facilities to accommodate use of rail and truck to move ethanol.

Build strategic relationships among petroleum distribution terminals, ethanol producers, and logistics service providers.

PREP

GAME DAY

COMMON GOAL



THANK YOU

We welcome your questions and
discussion

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BACKUP

Opportunity Buzz

- **Ethanol producers**
- **Rail carriers**
 - Rail services for feedstock, ethanol, and ethanol by-products
- **Ethanol hub terminals**
 - **Consolidation terminal** (Example: Manly Terminal, Manly, IA)
 - **Receiving terminal** (Examples: Lomita terminal, Carson, CA and Sewaren terminal, Sewaren, NJ)

PREP

GAME
DAY

COMMON
GOAL

Ethanol Terminal Example: Consolidation Terminal

○ Manly Terminal, Manly, IA

- Developed in 2006
 - Partnership among Kiewit Group Companies, Iowa Northern Railway Company and Kenan Advantage Group (KAG) Ethanol Logistics
- Over 20 MMG storage capacity and outbound unit train loading capability
- Eight hours truck-to-unit-train transload
- Rail service and direct tariff access to Class I Rail Carriers

Objective and Methodology

○ Objective

- Understand supply chain and logistics impacts pertaining to PA state-wide E10 adoption

○ Methodology

- Extensive Literature Review
- Interviews
 - BNSF and Norfolk Southern Railroads
 - Petroleum distributor
 - Experts in the subject matter
 - Smeal's Supply Chain and Information Systems
 - Agricultural Engineer



Legislation and Policy

Complexity of Boutique Fuel Programs & Ethanol Usage

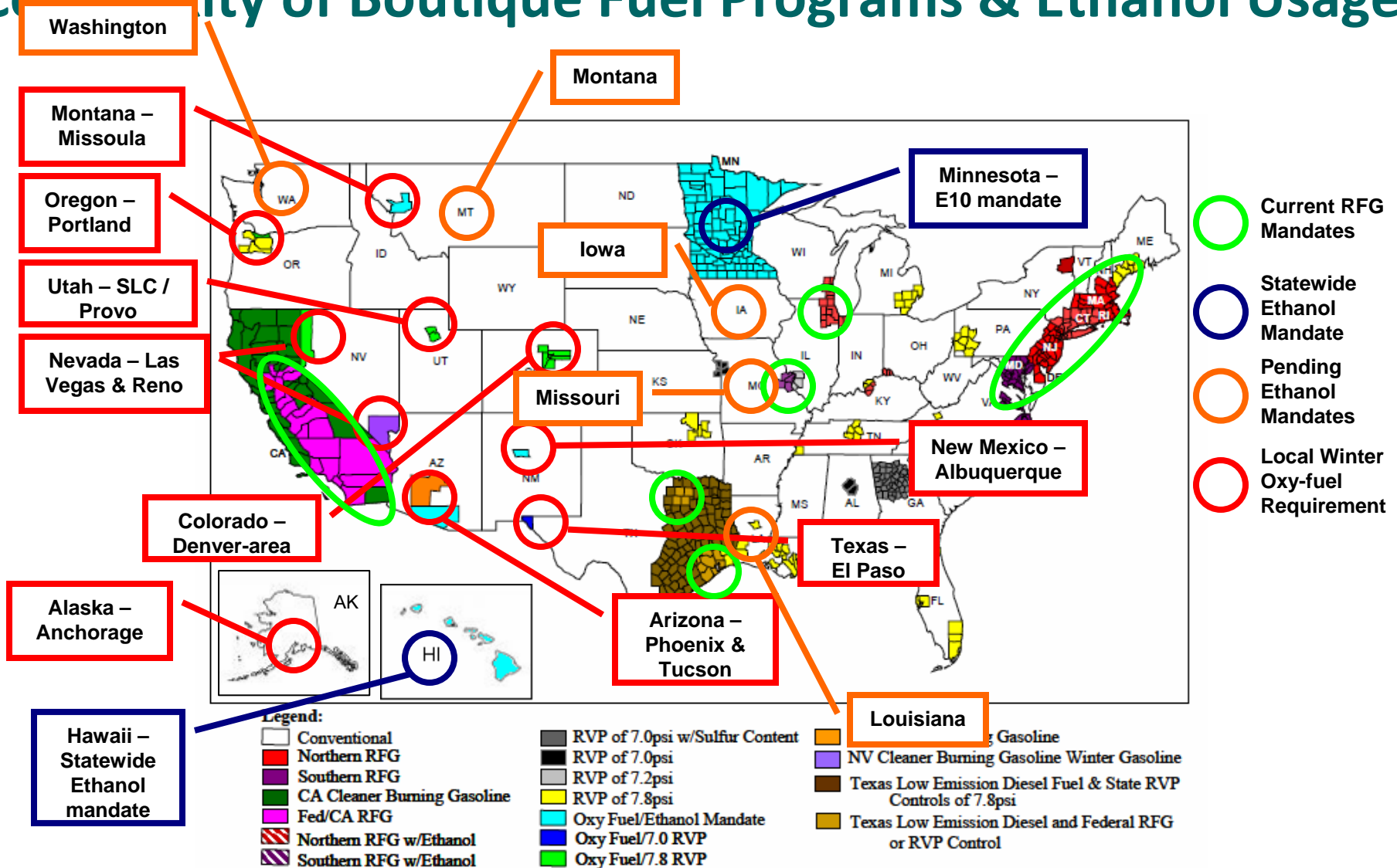


Figure 1. U.S. Gasoline Requirements

Sources: Environmental Protection Agency (EPA), 2006 *Boutique Fuels Report to Congress*. EPA Renewable Fuel Standard (RFS) Program, Draft Regulatory Impact Analysis, September 2006. <<http://www.epa.gov/otaq/renewablefuels/420d06008.pdf>>, Accessed 10 Apr 2007.

Drivers for Ethanol in PA

- **Clean Air Act of 1990**
 - Philadelphia RFG area – E10 used following 2006 MTBE switch
 - Localized boutique fuel in Pittsburgh
- **Renewable Fuel Standard Program of 2005 and the Energy Independence and Security Act (EISA) of 2007**
 - Reduce foreign oil dependence
 - Increase the volume of renewable fuel required to be blended into gasoline over time

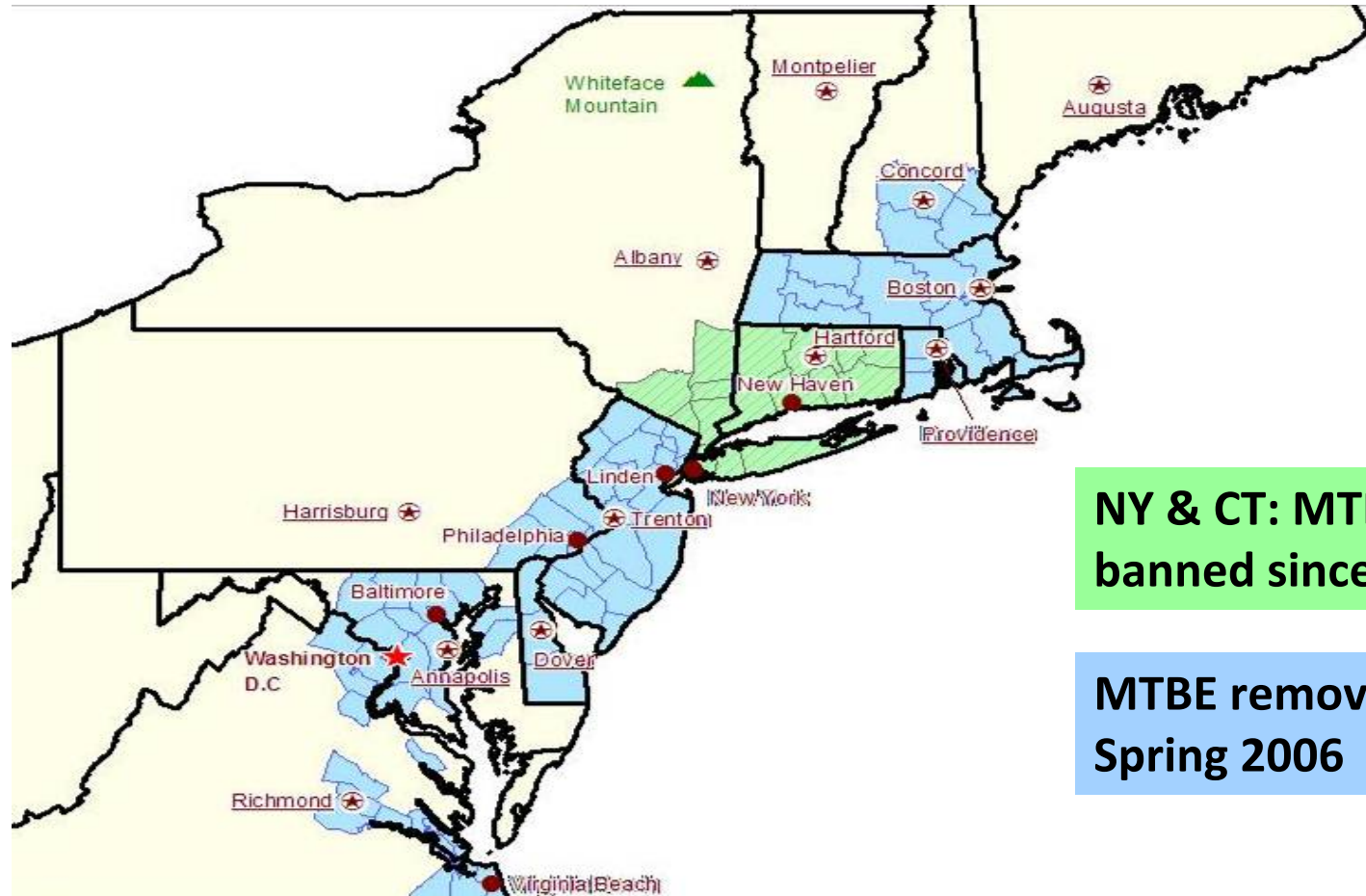
Clean Air Act

- **Oxygen content mandate**
 - The RFG program took effect in 1995 for selected areas around the U.S. (ozone non-attainment areas)
- **Other states and areas not required to use RFG could also opt-in to the program, leading to a variety of “boutique fuels” around the country.**

MTBE Phase Out

- **January 2004 – California, New York and Connecticut MTBE bans enacted**
- **April 2006 – Remainder of RFG areas (including Northeast / Mid-Atlantic) switch from MTBE to Ethanol**
- **This switch happened largely ahead of schedule.**
- **Petroleum refiners and distributors did not want to be held liable for MTBE contamination.**

MTBE Banned in Northeast and Mid-Atlantic



**NY & CT: MTBE
banned since 2004**

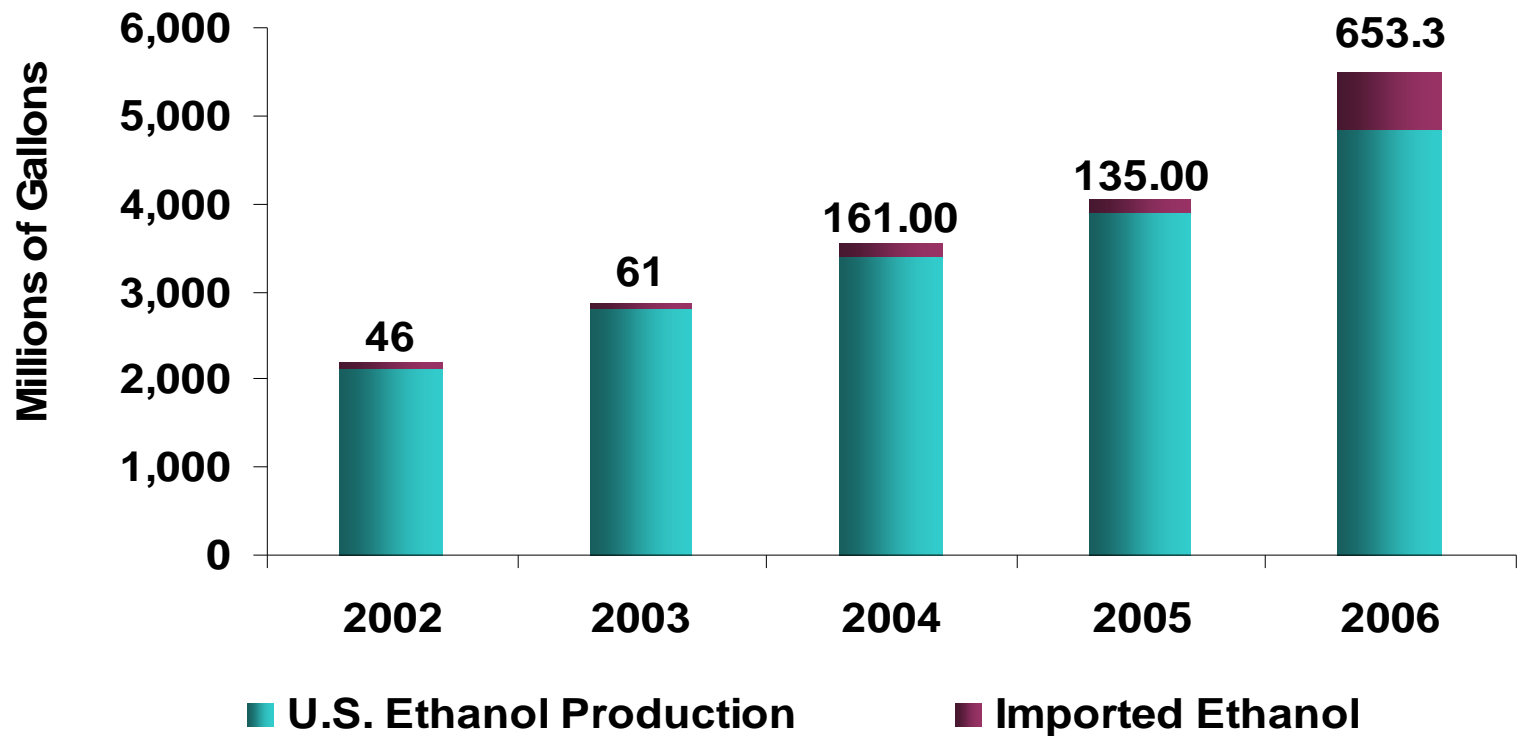
**MTBE removed
Spring 2006**



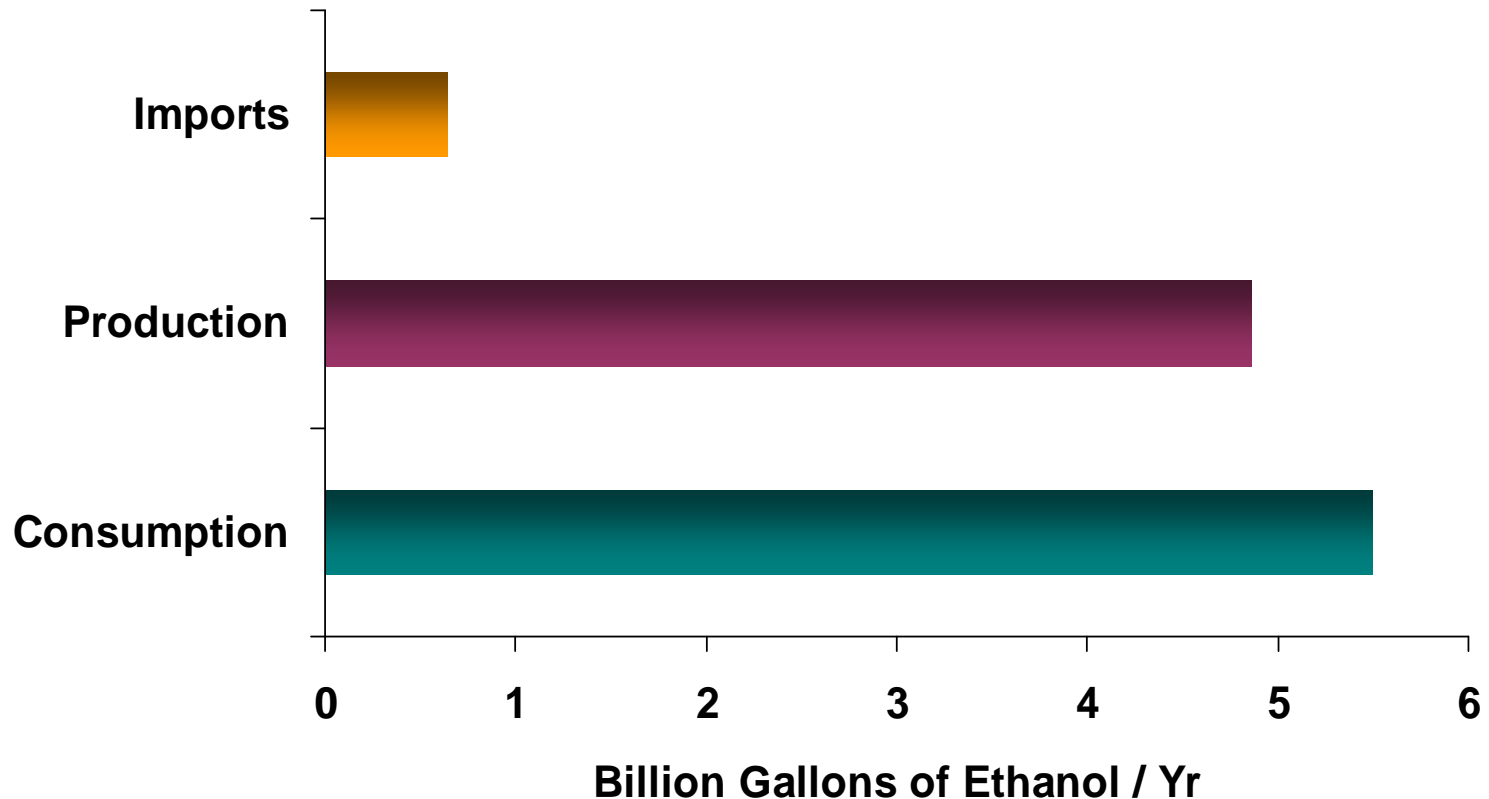
Demand and Supply Statistics

Ethanol Demand and Sources of Supply

- 2006: Imports filled gap between production and demand
- Production capacity increasing rapidly
 - April 2007 capacity: 5.8 billion gallons
 - Capacity under construction: 6.3 billion gallons



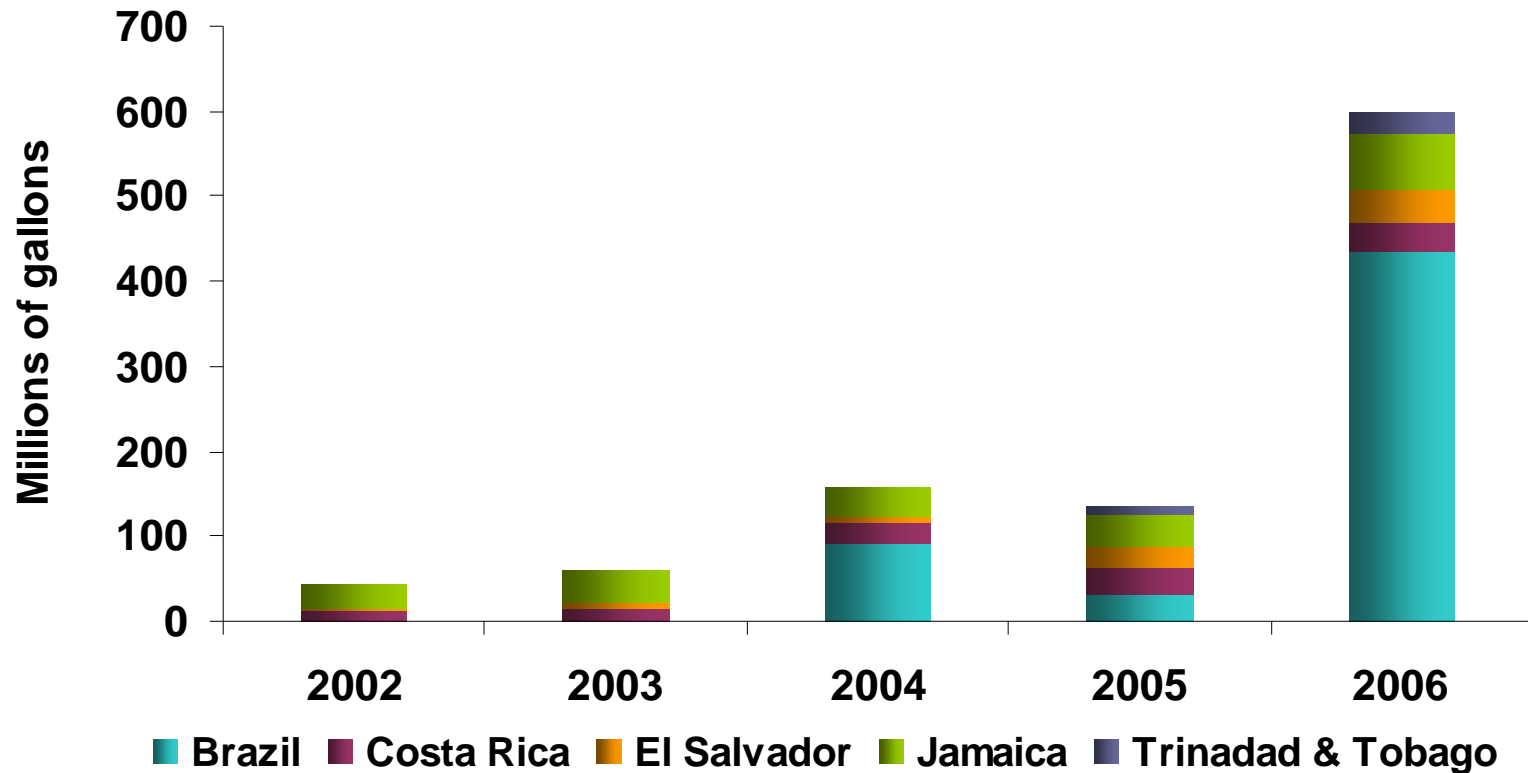
2006 U.S. Ethanol Use and Sources



Sources: Energy Information Administration (EIA), www.eia.doe.gov, December 2006 EIA-819 Monthly Oxygenate Report. Lamberty, Ron. "Ethanol Market Outlook for '07: Too Much Too Soon?". *EthanolToday*, Jan 2007. pp. 32-37. <http://www.ethanol.org/pdf/contentmgmt/Jan_07_ET_secondary.pdf>, accessed 10 Apr 2007.

Key Sources of U.S. Ethanol Imports

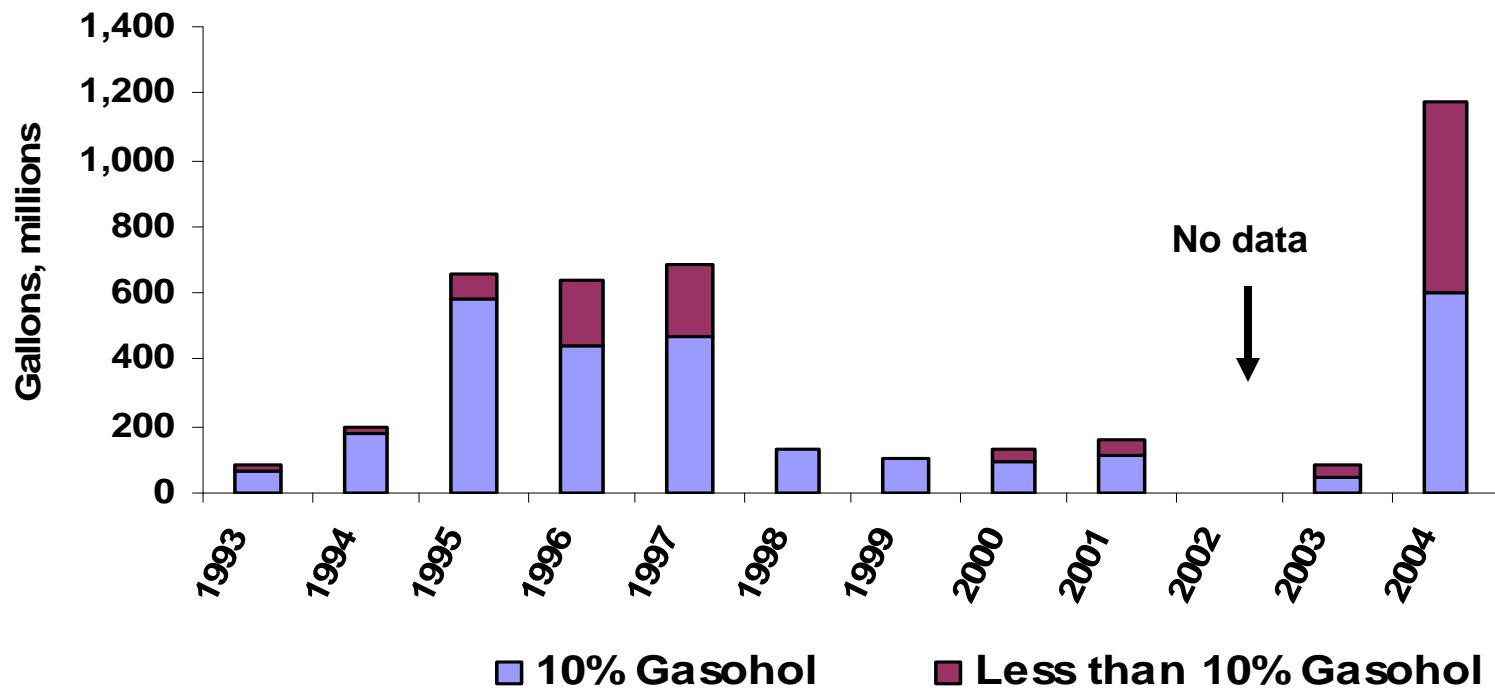
- Brazil ethanol imports subject to tariff
- Central American ethanol avoids tariffs through CAFTA



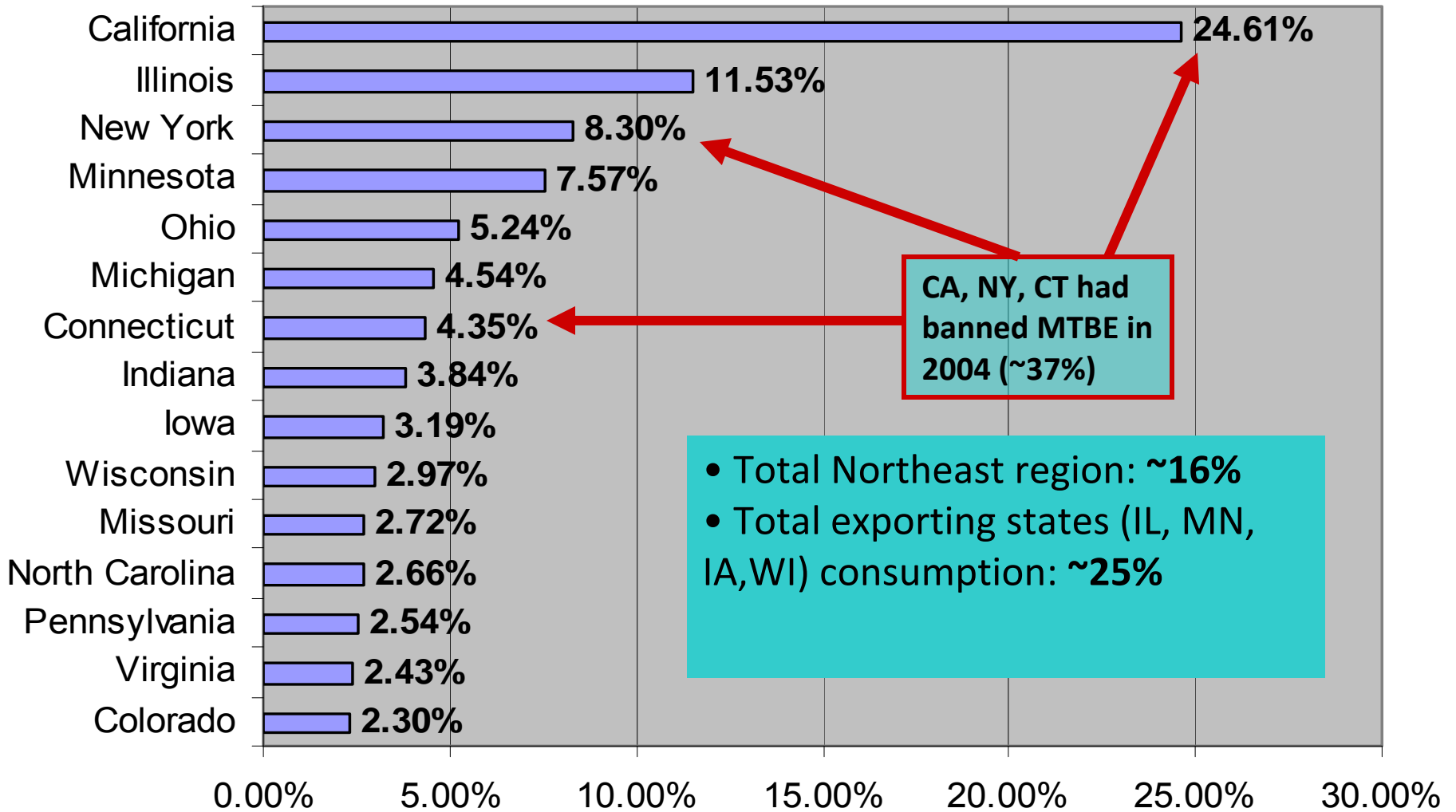
Pennsylvania Gasohol Consumption

Analysis of 2004 Data:

- 23% of PA gasoline was categorized as “gasohol”
- However, only 1.8% of total gasoline motor fuel was ethanol
- Of “less than 10% gasohol” blends, average ethanol content was 5.7%



State Share of U.S. Total Ethanol Used in Gasohol 2004



Note: Latest Available Data

Source: Highway Statistics Publications, Office of Highway Policy Information



PA Ethanol Plants & Rail Transportation and Hubs

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 uses of ethanol in reformulated gasoline (RFG)

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

PA Ethanol Sources of Supply

Alternatives	Pros	Cons
Refined ethanol from Midwest	Abundance of feedstock and production capacity in relation to their own consumption	Long transportation lead time to PA
Ethanol production in PA	<ul style="list-style-type: none"> ○ Shortest transportation lead time of refined ethanol 	<ul style="list-style-type: none"> ○ Limited capacity ○ Higher cost of raw materials due to transportation
Refined ethanol from closer sources: NY, OH, and neighboring states	Shorter lead time to PA than from Midwest	<ul style="list-style-type: none"> ○ Higher cost of raw materials (feedstock importers) ○ Proposed capacities small compared to local demand
Imported refined ethanol	<ul style="list-style-type: none"> ○ Abundance of supply, primarily from Brazil 	<ul style="list-style-type: none"> ○ Long transportation lead time to PA ○ Complexity from importation and tariff costs (54 cent/gallon tariff)

PA primary ethanol sources

PA secondary ethanol sources

PA alternative secondary ethanol sources

Ethanol Transportation: Types of Vessels

Mode	Size	Availability (New)	Efficiency (1 ton ethanol / 1 gallon 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	<p>None</p> <ul style="list-style-type: none"> ○ Kinder Morgan investigating ○ 15 billion gallon / yr given as feasibility threshold 	n/a

PA Plant – Transportation Impact

Est. Plant Capacity	100 MGY
Avg. Plant Efficiency	2.8 gallon / bushel
Feedstock Requirement	35.7x10 ⁶ bushel / yr
Railcar Traffic per year	8,547
Truck Traffic per year	25,397

- **Rail:** 2.5 railcars of corn feedstock are needed for every 1 railcar of refined ethanol
- **Truck:** 2 to 1 ratio of feedstock to refined ethanol by truck (lower ratio due to GVW limits)
- **Cellulosic ethanol** feedstock requirements are more demanding:
18,000 – 36,000 railcars / yr

Contrasting Competitive Markets: BNSF and Lomita Terminal Example

- **“Ethanol Express”**
 - Unit train service to Southern California (to the Lomita terminal, Carson, CA)
 - Offers significant savings over single car
- **Unit train challenges**
 - Supply side
 - Fragmented production
 - Small capacities per plant
 - Demand side
 - Inefficient transloading
 - Insufficient market demand
- **BNSF witnessing “huge growth” from ethanol**
- **However, even at projected volume increases, ethanol is still a very small portion of total rail volume (0.1%)**

BNSF
RAILWAY



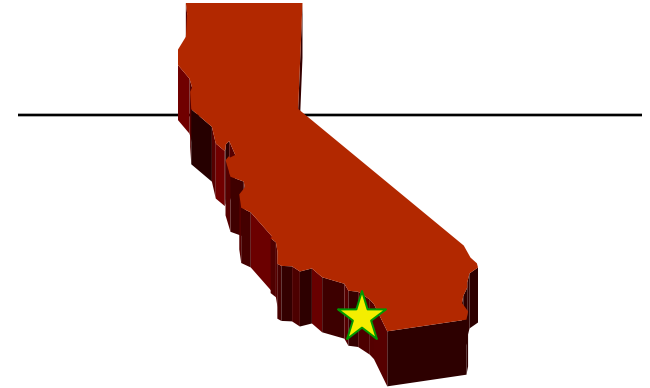
Contrasting Competitive Markets: NS and Sewaren Terminal Example

- **Runs unit trains to Sewaren, NJ (Sewaren terminal)**
- **Sees new terminals coming online, some with unit train capacity**
- **NS, CSX face different environment than BNSF**
 - Competition with water, truck
 - Similar routes and cities served
- **Competitive pricing is key**
 - Unit trains not practical everywhere
 - Single car rates need to be competitive to serve some markets
- **Not concerned about ethanol's incremental impact on traffic**
- **Willing to support "forward ethanol plants"**



Ethanol Terminal Example: Rail to Pipeline

- Lomita Terminal, Carson, CA
- Built in 2003 by US Development Corp (Purchased by Kinder Morgan in 2006)
- Unload 1 unit train (95-96 cars)/ 24 hrs
- Served by BNSF
- Turns over a train every 3 days
- Ethanol shipped by 3-mile pipeline to Shell storage terminal
 - Existing pipeline was converted to ethanol use
 - Shell then supplies other terminals by truck (acts as a “hub terminal”)



Ethanol Terminal Example: Rail to Barge (or Truck)

- Sewaren Terminal, Sewaren, NJ
- Owned by Motiva Enterprises
- Ethanol:
 - 2 million gallon / day current capacity
 - Largest east coast ethanol receiving point
- **Inbound:** Norfolk Southern railroad, tankers from Gulf Coast
- **Outbound:** Truck, barges/tankers to east coast cities
- **2007:** Expanding rail yard to handle a complete unit train (80 to 100 cars)



Ethanol Plants in PA

Construction Underway

○ **Westmoreland County**

- Commonwealth Renewable Energy Inc., Hempfield
 - A subsidiary of Anderson Group of Companies Inc. of Pittsburgh.
 - 200 MMGY capacity, PA first and the country's largest ethanol plant
 - As of August 2007
 - Under construction, one-year delay
 - Plan to produce 120 million gallons by the fourth quarter of 2008
 - Increase to 200 million gallons in 2009

Ethanol Plants in PA

Near Construction Phase

- **Clearfield County**

- **Sunnyside Ethanol, LLC, Curwensville**

- 88 MMGY capacity

- As of September 2007

- All permits necessary received, much of the design completed

- In the process of raising the remaining money needed for the project

- Construction expected to begin the first quarter of 2008, completion scheduled for early 2010

Ethanol Plants in PA

Near Construction Phase

- **Clearfield County**
 - **Bionol Clearfield LLC, Clearfield Technology Park**
 - Wholly-own subsidiary of BioEnergy International LLC
 - Approx \$28 million in state funding granted
 - Two plants total 123 MMGY capacity
 - 108 MMGY corn ethanol capacity
 - 15 MMGY cellulose ethanol capacity
 - **As of November 2007**
 - An air quality plan approved September
 - Construction expected to begin by January 2008

Ethanol Plants in PA

Some Permits Received

○ **Lackawanna County**

- Northeast Ethanol and Renewable Resources LTD, Mayfield
 - 60 MMGY capacity
 - As of November 2007
 - An air quality plan approved
 - Not yet obtain permits for storage tanks

○ **Schuylkill County**

- Green Renewable Energy, Ethanol & Nutrition-Holding LLC (GREEN), Porter and Frailey
 - 100 MMGY capacity
 - As of September 2007
 - Air quality permits received for truck terminal and storage portions of the facility
 - Air quality plan approval applications for manufacturing portion submitted September

Ethanol Plants in PA

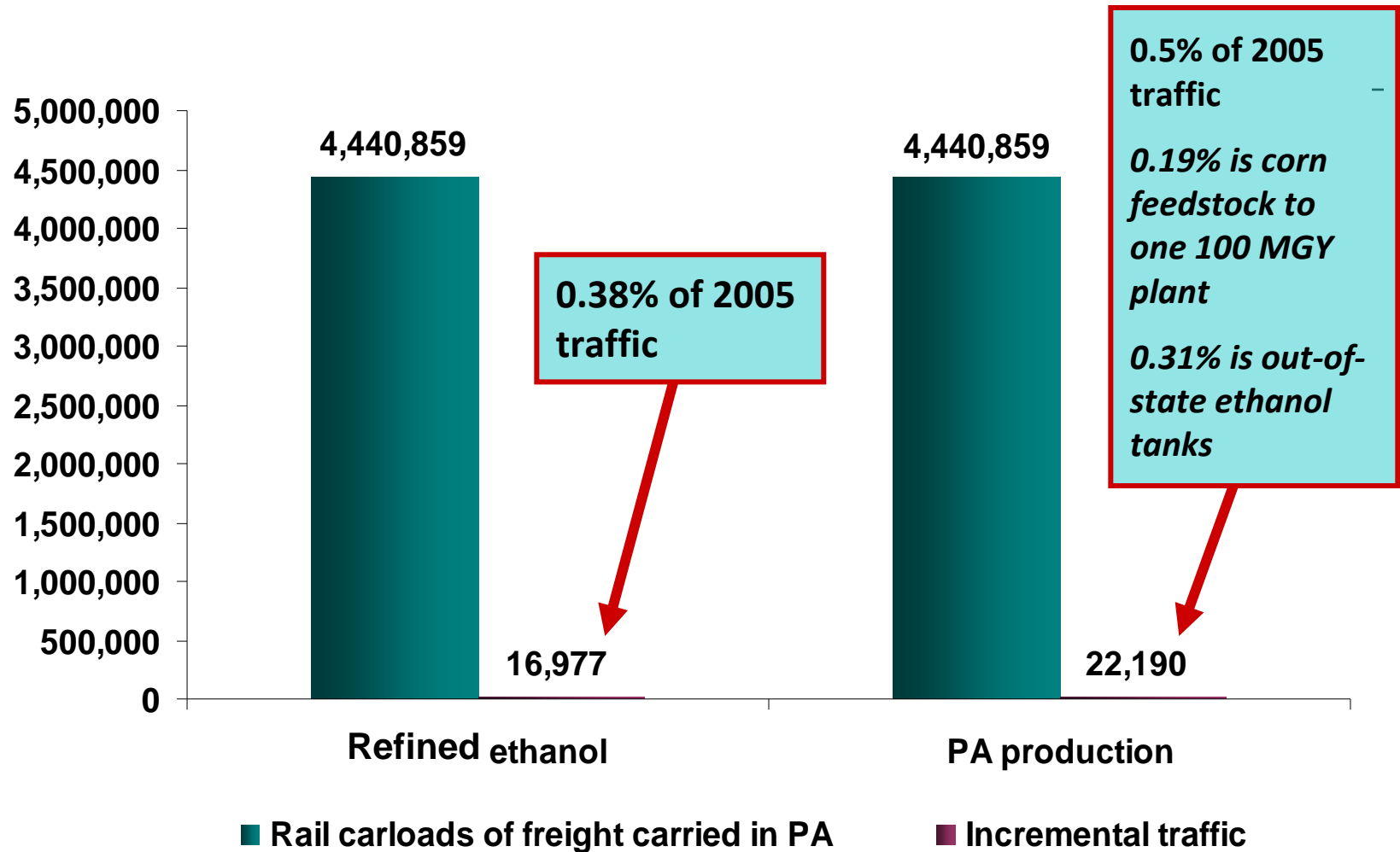
Investigating

- **Lancaster County**
 - Lancaster Biofuels, Conoy
 - 60 MMGY capacity
 - As of October 2007
 - Plans for the project not yet finalized
 - Hearing about the plan held in October 2007

- **Beaver County**
 - Sunnyside Ethanol LLC (Consus Ethanol LLC), Aliquippa Industrial Park
 - 160 MMGY capacity
 - As of August 2007
 - Working to acquire about 70 acres in the industrial park
 - Expect to begin production by 2010

- **Crawford or Mercer County**
 - Keystone Ethanol Energy Producers LLC (KEEP)
 - A Greenville company formed in August 2007
 - As of September 2007
 - KEEP hired a second consultant to review a \$37,000 taxpayer-funded feasibility study done in the 2006
 - Sites under consideration not disclosed
 - No timetable for construction

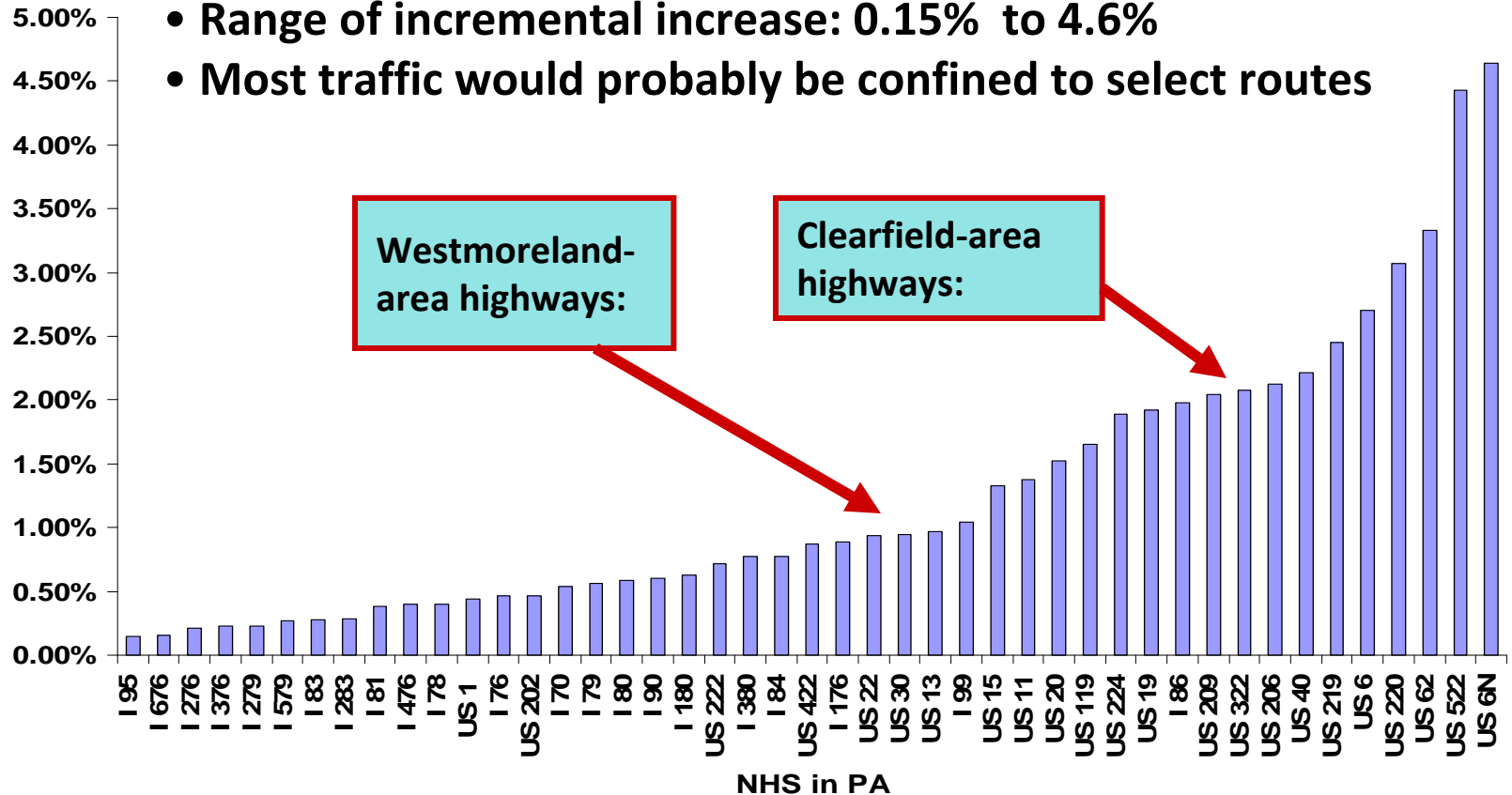
Incremental PA Rail Traffic from Ethanol



Incremental PA Truck Traffic from Ethanol

- Average daily incremental truck traffic: 175 trucks
- Does not include feedstock deliveries
- Daily truck traffic higher with periodic rail unloading
- Range of incremental increase: 0.15% to 4.6%
- Most traffic would probably be confined to select routes

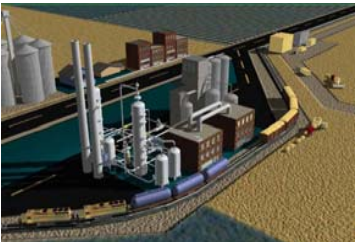
% of daily traffic





Logistics Implications

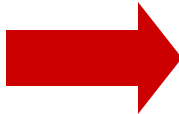
Logistics Cost and Management Impacts



Ethanol Supplier

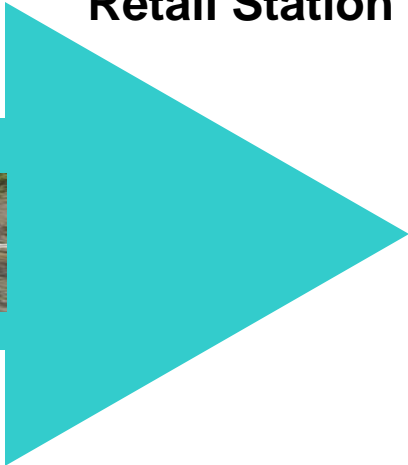


Terminal Owner

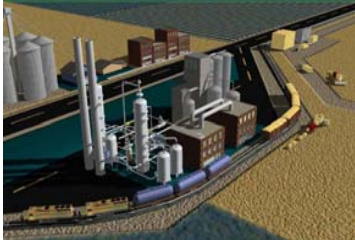


Retail Station

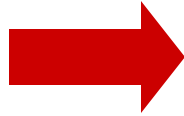
Transportation Carriers



Logistics Cost and Management Impacts



Ethanol Supplier



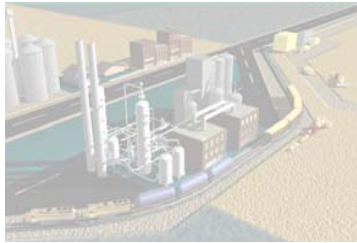
Terminal Owner



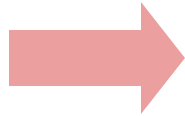
Retail Station

- 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)
- Volume consolidation and transportation management (in-house or outsource)

Logistics Cost and Management Impacts



Ethanol Supplier



Terminal Owner



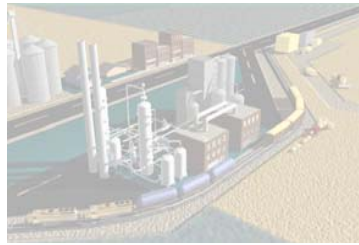
Retail Station

One-time set-up/conversion costs

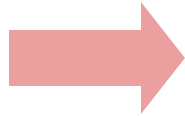
- **Storage tanks (new)** \$450,000 for 25,000-barrel tank, taking 14 to 24 months to build
- **Storage tanks (converted)** Approx. 20% of cost of a new tank, taking 60 to 90 days with all the required permits in place
- **Unloading equipment and piping** \$20,000
- **Blending equipment** \$300,000 to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

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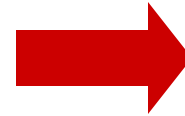
Logistics Cost and Management Impacts



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

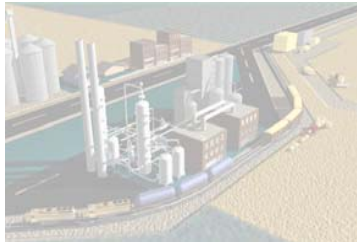
• **Storage and delivery optimization** (utilization of dedicated tanks, pipes, and truck loading equipment)

• **Transportation management** (additional modes and carriers to manage)

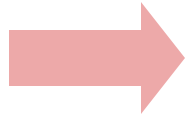
• Inventory management

- 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
- Tank Cleaning
- “Water Bottoms” Removal

\$400 / station

\$800 / station

\$400 / station

○ Administrative and Labeling

\$150 / station

○ Pump and dispenser replacement

Not available

○ 10 micron “water sorb” filter

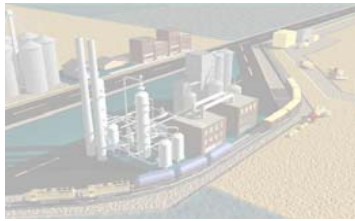
Not available

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 and ethanol hub terminals: the new significance

- Rail services for feedstock, ethanol, and ethanol by-products
- Rail-served transload terminal and equipment investment
- Efficient transload management
- Examples:
 - Consolidation terminal: Manly Terminal, Iowa
 - Receiving terminal: Lomita terminal, Carson, California, and Sewaren terminal, Sewaren, New Jersey



Ethanol Rail Services

Ethanol Express

- BNSF unit train: 95-96 ethanol tank cars
- Unit train deliveries from suppliers to the Lomita Terminal (Los Angeles)
- Single car shipments prevalent elsewhere
- Unit train
 - Significant savings available
 - Supply side: difficult to arrange
 - Minimum plant capacity of 100M gallons / yr required
 - At 100 MGY, one unit train would be built roughly every 10-11 days!
 - Otherwise, need to have a short line or switching railroad build unit trains from multiple plants to supply BNSF



Ethanol Express

- Demand side is crucial to unit train success
- Need a large demand in a concentrated area
- Also require a sophisticated terminal
 - Ability to quickly unload a unit train
 - Requires sufficient real estate
 - Space for a spur that can accommodate a single train of 96 cars
 - Space for the transloading facility
 - Permitting can also be a challenge
- Getting unloaded ethanol to storage terminals is also a challenge
 - Usually no rail access near existing terminals
 - Transloading to trucks slow, inefficient



Market for Ethanol

- Seeing “huge growth”
- However, ethanol shipping volume is “relatively small”
 - At future ethanol projections, assuming 100% movement by rail, ethanol would only comprise **0.1%** of total rail volume
- “Bring it on”
 - BNSF feels that they have sufficient capacity to handle ethanol for the foreseeable future
 - Efficiency is the key – move more toward unit trains
- The challenge is at the destination
 - Insufficient transloading terminal capacity
 - Inefficient unloading





Norfolk Southern Ethanol Service

- **Runs unit trains to Sewaren**
 - Additional capacity being added at Sewaren
 - Sewaren acts as a hub terminal
 - Rail to Sewaren
 - Terminal delivery by water from Boston to Baltimore
- **Sees new unit train capable terminals coming online soon**
 - Linden (Tremley Point), NJ
 - Philadelphia (Kinder Morgan)
- **Many other terminals being established, although these might not accept unit trains**
 - Providence
 - Alexandria





Norfolk Southern Ethanol Service

- **NS, CSX face different environment than BNSF**
 - Competition with water, truck
 - Similar routes and cities served

- **Competitive pricing is key**
 - Unit trains may not always be possible
 - Sufficient demand required (need 60-90 car demand/day)
 - Terminal capacity
 - Single car rates need to be competitive to serve some markets and customers





Norfolk Southern Ethanol Service

- **Not concerned about ethanol's incremental impact on traffic**
 - Even at 35 Billion gal/yr by rail, this is 4% of total rail volumes nationwide
- **Willing to support “forward ethanol plants”**
 - More feedstock cars to move
 - Foresee 60-70% feedstock by rail
 - Concerned that these plants are not economically feasible



PennSecurity Fuels Initiative Act of 2007

- **Statewide E10 mandate after PA ethanol production reaches 200 million gallons per year**
- **Passed the State House in June 2007**
- **Legislation to implement PennSecurity Fuel initiative now pending in Harrisburg**