



Challenges to Ethanol Blending in the Southeast

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Marathon 

Marathon Oil Corporation



Upstream



Downstream



Integrated Gas



Oil Sands Mining

- ◆ In business since 1887
- ◆ Fourth-largest U.S.-based integrated oil company
- ◆ \$65 billion in revenues and other income in 2007
- ◆ Fifth-largest U.S. refiner

Marathon Downstream Segment



- ◆ Fifth-largest U.S. refiner
- ◆ Largest pipeline carrier in volumes delivered
- ◆ Largest private inland liquids barge fleet
- ◆ Third-largest terminal system among R&M companies
- ◆ Major supplier to independent marketers in Midwest & Southeast
- ◆ Retail marketing system of ~6,000 outlets in 18 states



Marathon's RM&T Operations



Marathon and Ethanol



- ◆ Nearly two decades of ethanol-blending experience
- ◆ One of the Nation's largest blenders of ethanol; largest in the Midwest
 - Blended over 600 million gallons of ethanol in 2007
- ◆ Extensive investment in terminal blending facilities
 - Midwest refineries supply lower-cost sub-octane gasoline to blend with high-octane ethanol
 - Major ethanol infrastructure project underway to bring ethanol blending to all Marathon markets by mid-2008
- ◆ Equity interest in two 110mm gal/yr ethanol manufacturing plants operated by The Andersons



Overview



- ◆ Refiners / importers will be challenged to meet vastly expanded Renewable Fuel Standard (RFS)
- ◆ Rapidly expanding domestic ethanol production (driven largely by RFS) is outpacing demand growth
 - Traditional markets nearing saturation
 - Expansion must come in discretionary markets
- ◆ Southeast is a logical, largely untapped market for ethanol blending
- ◆ Two significant factors have impeded ethanol's expansion in the Southeast:
 - Insufficient transportation and distribution infrastructure
 - Restrictive state fuel regulations

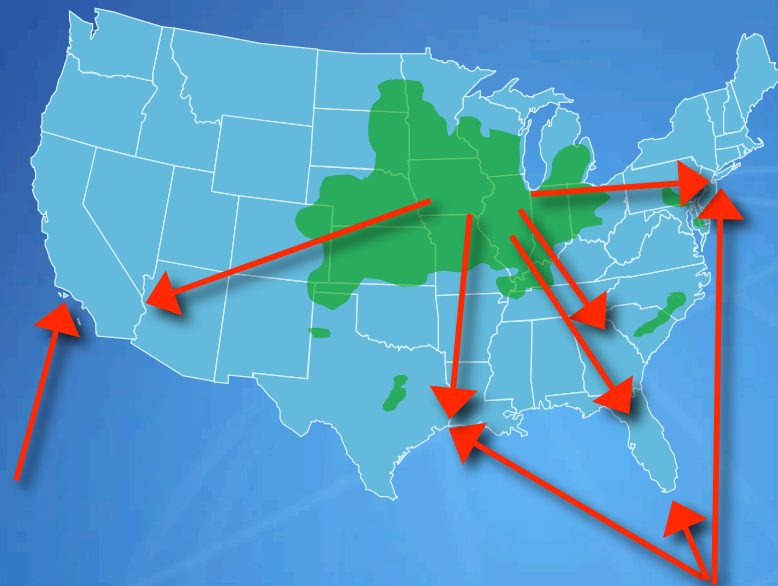
Distribution Patterns – Gasoline vs Ethanol



Gasoline



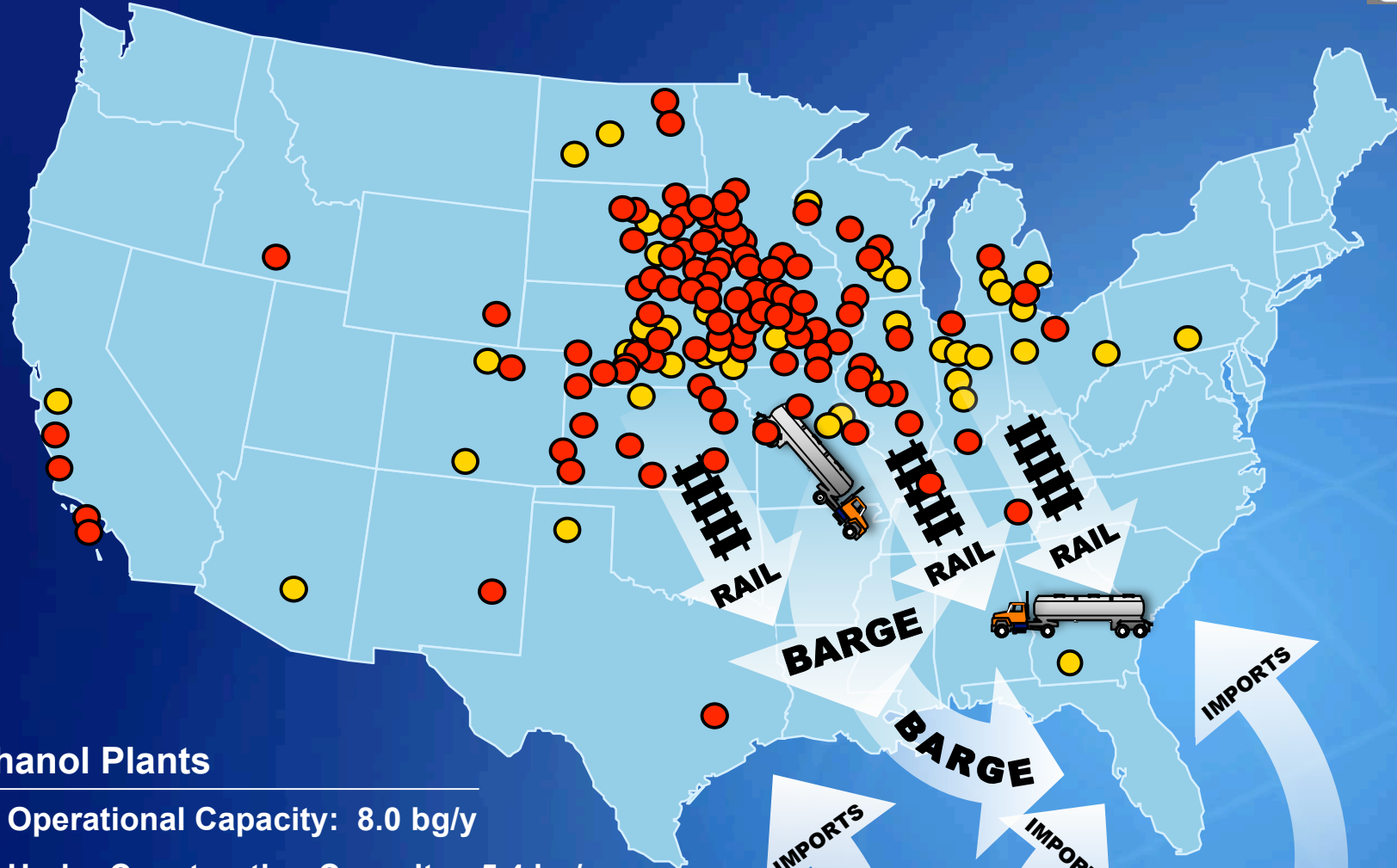
Ethanol



Ethanol Pipelines

- Unlikely to use existing products pipelines due to:
 - Ethanol's affinity for water, corrosivity, acts as solvent
- Pipelines for ethanol more commercially challenged than technically challenged
 - 110mm g/y ethanol plant equates to only 7,200 b/d

Ethanol Movement to Southeast



Ethanol Plants

- Operational Capacity: 8.0 bg/y
- Under Construction Capacity: 5.4 bg/y

Source: Renewable Fuels Association

Southeast Ethanol Logistics



◆ Rail Logistics

- Terminals typically not configured to receive rail cars (Atlanta the exception)
- Initially, new markets will need to rely on single railcar deliveries and rail-to-truck transfer locations
- Blenders lack railcars to move ethanol to market; producers will be called on to arrange shipments to market
- Rail / truck schedules are critical for reliable supply
- Supply chain complexity: producer / rail / transfer / truck
- Rail logistics to new markets will be challenged to keep up with ethanol production growth

Southeast Ethanol Logistics



◆ Marine Logistics

- Florida is large market and well positioned to receive waterborne supply from the Caribbean or Mississippi River
- Mississippi River deliveries require transfer facilities between inland tow barges and ocean-going vessels
- Marine terminals have limited available tankage to accommodate full vessels of ethanol
- Supply chain complexity: Mississippi barge transfers and two-porting vessels
- Marine logistics to new markets will be challenged to keep up with ethanol production growth

Southeast Ethanol Logistics



◆ Terminal / Blender Preparations

- Southeast states are discretionary (non-mandated) blend markets
- Many terminals still lack ethanol storage and blending infrastructure
- MLP terminals typically do not invest until guaranteed throughput commitments are in place
- To assure quality control of fuels marketed under their company brand, major oil companies generally have not permitted “splash blending” of ethanol
- Timing of investments will vary throughout the system; investments lag ethanol production growth

Ethanol Terminaling Issues



- ◆ Ethanol storage
 - Build new or convert existing tanks?
- ◆ Ethanol offloading capability
 - Barge, rail, truck?
- ◆ Pumps and piping
- ◆ Loading rack modifications
 - Meters
 - Computer-controlled blenders
- ◆ Permits
- ◆ Cost: \$300k - \$2.5 million +



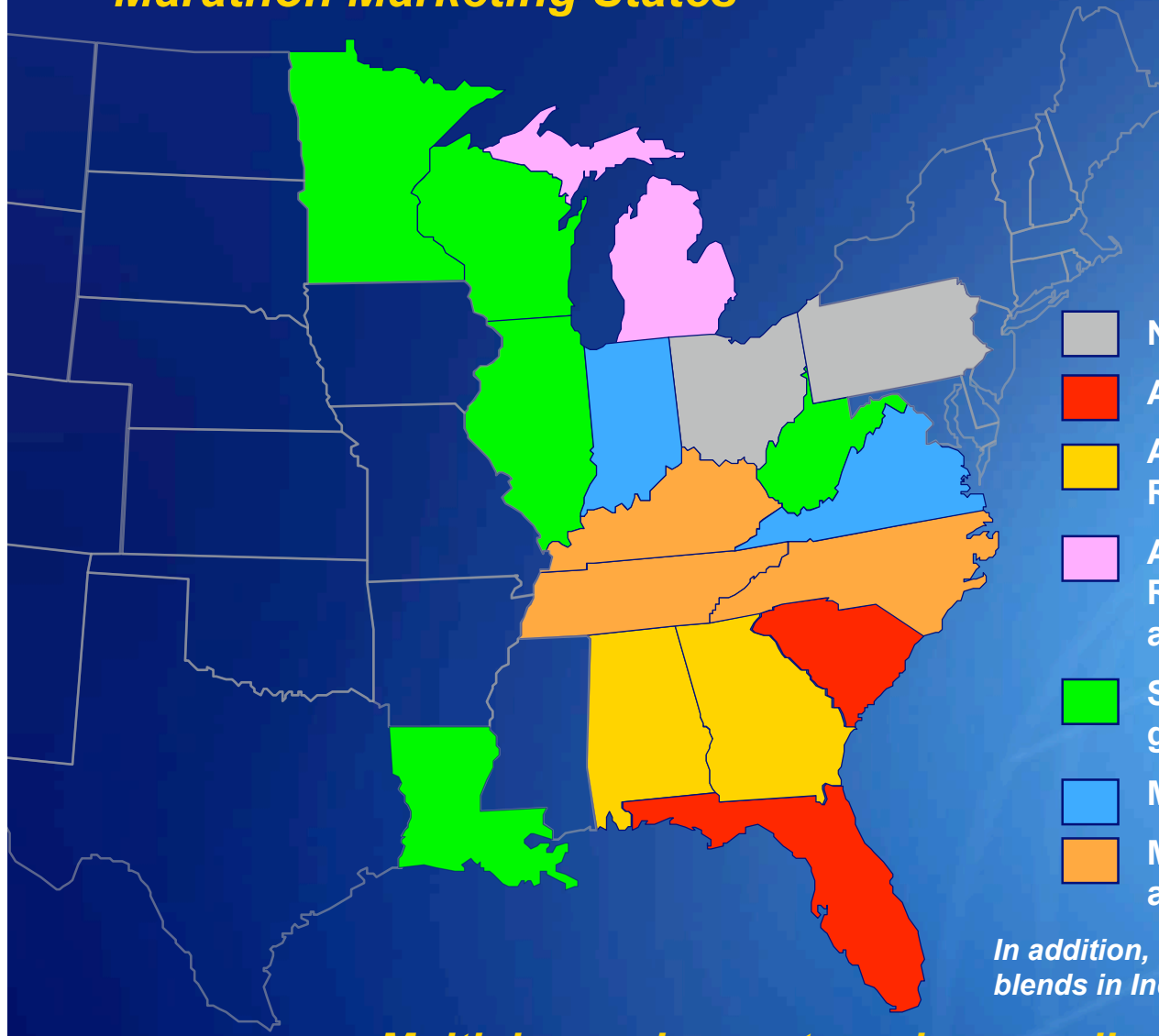
State Distillation / Volatility Specs Impacted by Blending Ethanol



- ◆ Vapor pressure: Pressure exerted by the vapor of a liquid when in equilibrium with the liquid
 - Reid vapor pressure (**RVP**): Standard test method to determine the vapor pressure of a liquid at 100°F
- ◆ Mid-point (T_{50}): Distillation temperature of a liquid when 50 vol% has been evaporated
- ◆ Vapor-liquid ratio temperature ($T_{v/l}$): Temperature at which the ratio of the volume of vapor formed at atmospheric pressure to the volume of liquid equals 20

Gasoline / Ethanol-Blend Regulations

Marathon Marketing States



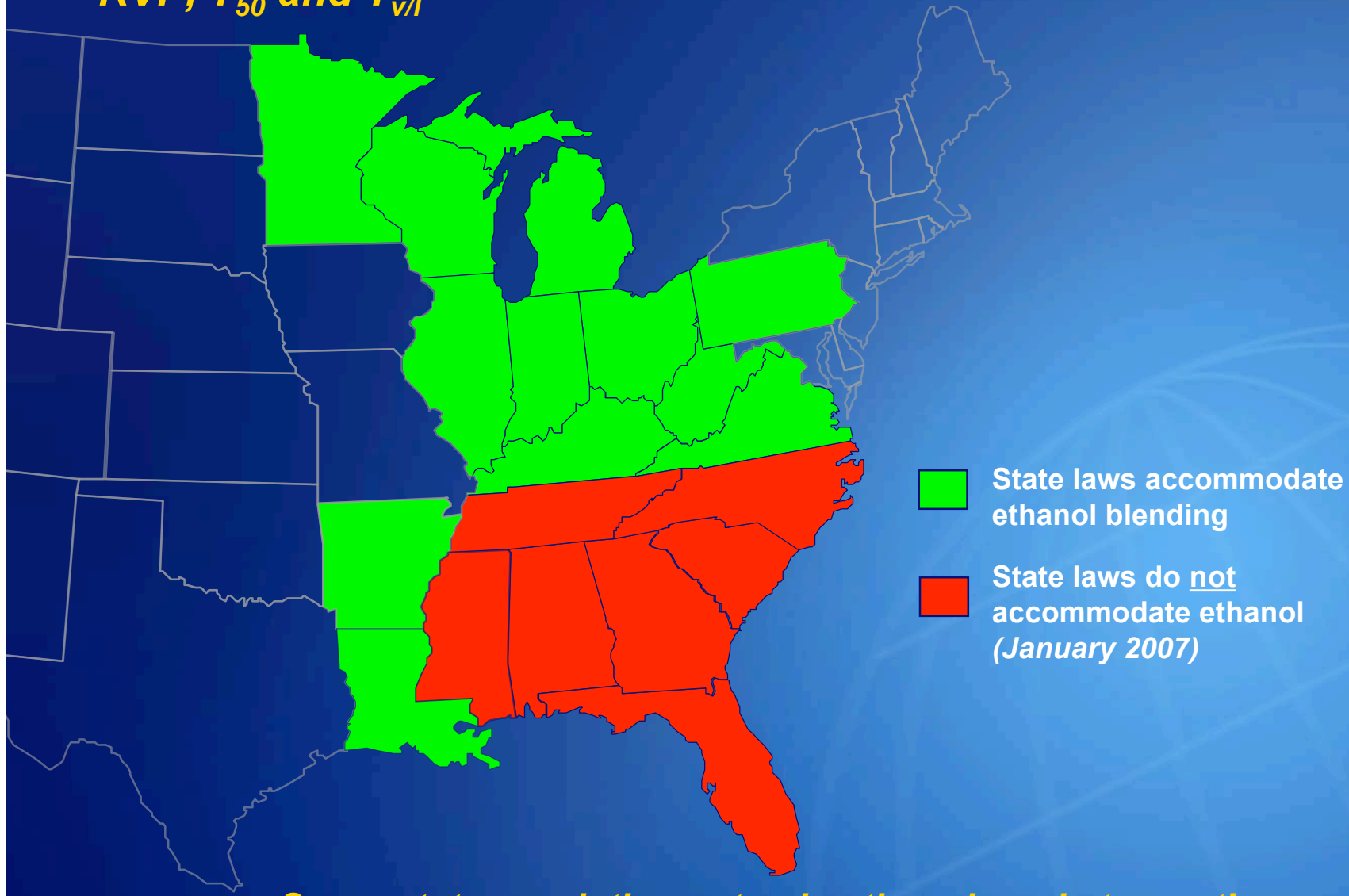
- Grey: No fuel quality laws
- Red: ASTM D 4814 specs apply
- Yellow: ASTM D 4814 specs with RVP modification
- Pink: ASTM D 4814 specs with RVP modification, accommodation process
- Green: Specs apply to either base gasoline or ethanol blend
- Blue: Max. T_{50} spec, no min.
- Orange: Modified ASTM specs (T_{50}) apply

In addition, $T_{v/1}$ specs do not apply to ethanol blends in Indiana, Kentucky and Virginia.

Multiple requirements make compliance difficult.

The Dilemma of Volatility Regulations

RVP, T_{50} and $T_{v/l}$



Some state regulations stymie ethanol market growth.

Ethanol in the Southeast



- ◆ **Ethanol won't be widely marketed in the Southeast until state gasoline regulations are revised to accommodate ethanol blends**
 - To penetrate new markets, refiners must be able to blend ethanol with fungible, conventional gasoline
 - Most publicly-held companies are unwilling to risk regulatory non-compliance
 - If base gasoline must be “tailored” for ethanol:
 - Gasoline yield is reduced and manufacturing costs increase, reducing the incentive to blend
 - New “boutique fuel” created ... with associated supply risks
 - Most terminals lack tankage to add a new slate of fuels
 - All Midwest states permit ethanol blending with ASTM-compliant gasoline. Consumer acceptance of ethanol blends (E-10) is widespread.

What Petroleum Suppliers Seek



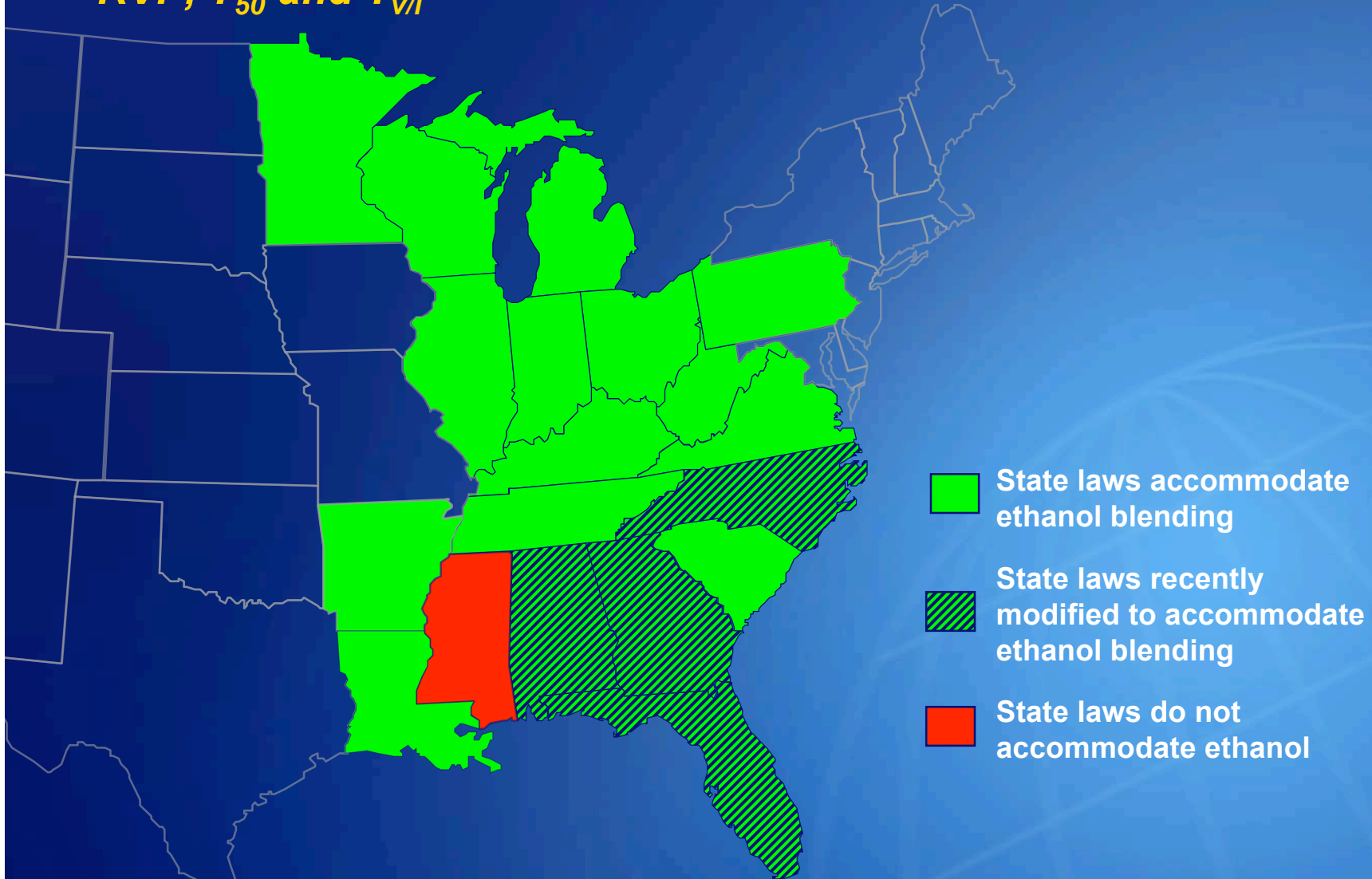
- ◆ The ability to blend up to 10 vol% ethanol with fungible, ASTM-compliant conventional gasoline without fear of potential regulatory non-compliance
 - Base gasoline *or* blended fuel must meet ASTM specifications (D 4814)
 - **Note:** A regulatory-compliance issue, not a fuel-performance issue

What Petroleum Suppliers Seek to Avoid

- ◆ Additional “boutique fuels” ... and associated supply risks

The Dilemma of Volatility Regulations

RVP, T_{50} and $T_{v/l}$



Significant progress in revising SE state ethanol-blend specifications.

Conclusions



- ◆ Substantial ethanol demand growth needed to meet 2008 RFS requirement
- ◆ Southeast is logical candidate for ethanol market expansion
- ◆ Infrastructure investment lags ethanol production-capacity growth
- ◆ Recent revisions to SE state fuel standards will facilitate ethanol's market penetration
- ◆ "Majors" rapidly expanding terminal blending to satisfy RFS RINs requirements
 - Accelerated transition to E-10 slate likely
 - Untested: Can transportation / distribution infrastructure consistently supply ethanol when / where needed?

