2018 Seoul Bioethanol Conference

Seoul, South Korea

June 26, 2018

U.S. Bio-Ethanol Policy and Market Experience

James Miller

President

Agriculture & Biofuel Policy Consulting

Phoenix, Arizona

2018 Seoul Bioethanol Conference

- Growth Energy Background
- Goals of Renewable Fuel Policies
- U.S. Ethanol History
- Renewable Fuel Policy
- Global Potential

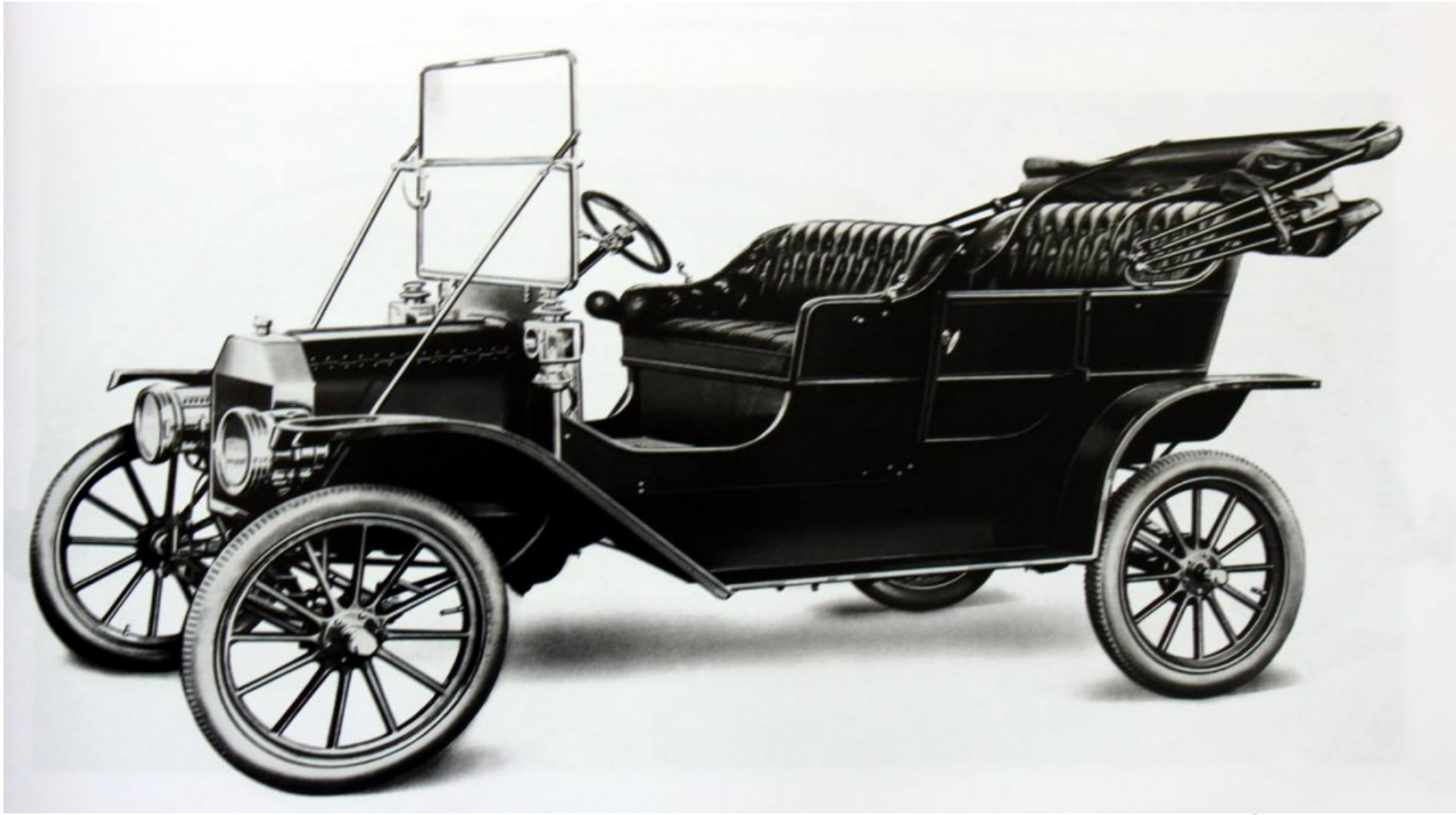
What is Growth Energy?

- Largest U.S. association representing renewable fuel producers
- Established in 2008
- Activities
  - Legislative and regulatory policy representation
  - Domestic market development
  - Global market development
  - Public affairs
- Founding Member of the Ethanol Export Steering Committee
  - Partners: Growth Energy, U.S. Grains Council, Renewable Fuels Association and Foreign Agricultural Service of the United States Department of Agriculture
  - Goal: Increase sustainable global production and utilization of ethanol to reduce reliance on oil for transportation fuel, including a role for trade
  - Provide technical information: ethanol production, use and benefits
  - Share U.S. policy and market experience
  - Establish on-going dialogue with partners

U.S./Global Renewable Fuel Program Priorities

- Enhance Domestic Rural Economic Opportunities
- Address Greenhouse Gas Emissions
- Reduce Environmental Damage & Health Impacts of Exhaust Emissions
- Constrain Fossil Fuel Demand, Diversify Supply, Provided Energy Security
- Create Consumer Economic/Performance Benefits
- Commercialize Cellulosic Ethanol Production

Ethanol History
1908 Ford Model T



A Brief History

- Model T – First flex-fuel vehicle
- Prohibition (1920 – 1933) – Established fossil fuel monopoly
- Introduction of Tetra-ethyl lead in 1920's – octane to reduce engine knock
- Phase-out of lead as human health hazard – 1970's
- Alternative octane sources: Aromatics, MTBE, Ethanol
- U.S. Clean Air Acts – Established oxygenate and vapor pressure requirements
- MTBE oxygenate of choice – fossil fuel products, readily available, inexpensive
- Beginning in 2002 states began banning MTBE due to groundwater pollution
- 25 states had bans in place by 2007
- Ethanol became replacement oxygenate and octane enhancer
- Renewable Fuel Standards established enforceable targets for blending biofuels
- Achieved effective 10% blend-rate in 2016
- Expansion of higher blend market occurring currently (E15)

U.S Biofuel Policy: Drivers of Production, Import & Export Growth

- Phase-out of MTBE (2002) due to groundwater contamination
- RFS I (2005) – First blending mandates established
- RFS II (2007) – Current legal requirements
- Increased Advanced Biofuel Demand - California's LCFS (2007)
- Investment in Technology & Innovation
  - Feedstock Production
  - Improved Bio-refining Efficiencies

2007 Renewable Fuel Standard Volume Requirements (Billion Gallons)

Renewable Identification Numbers

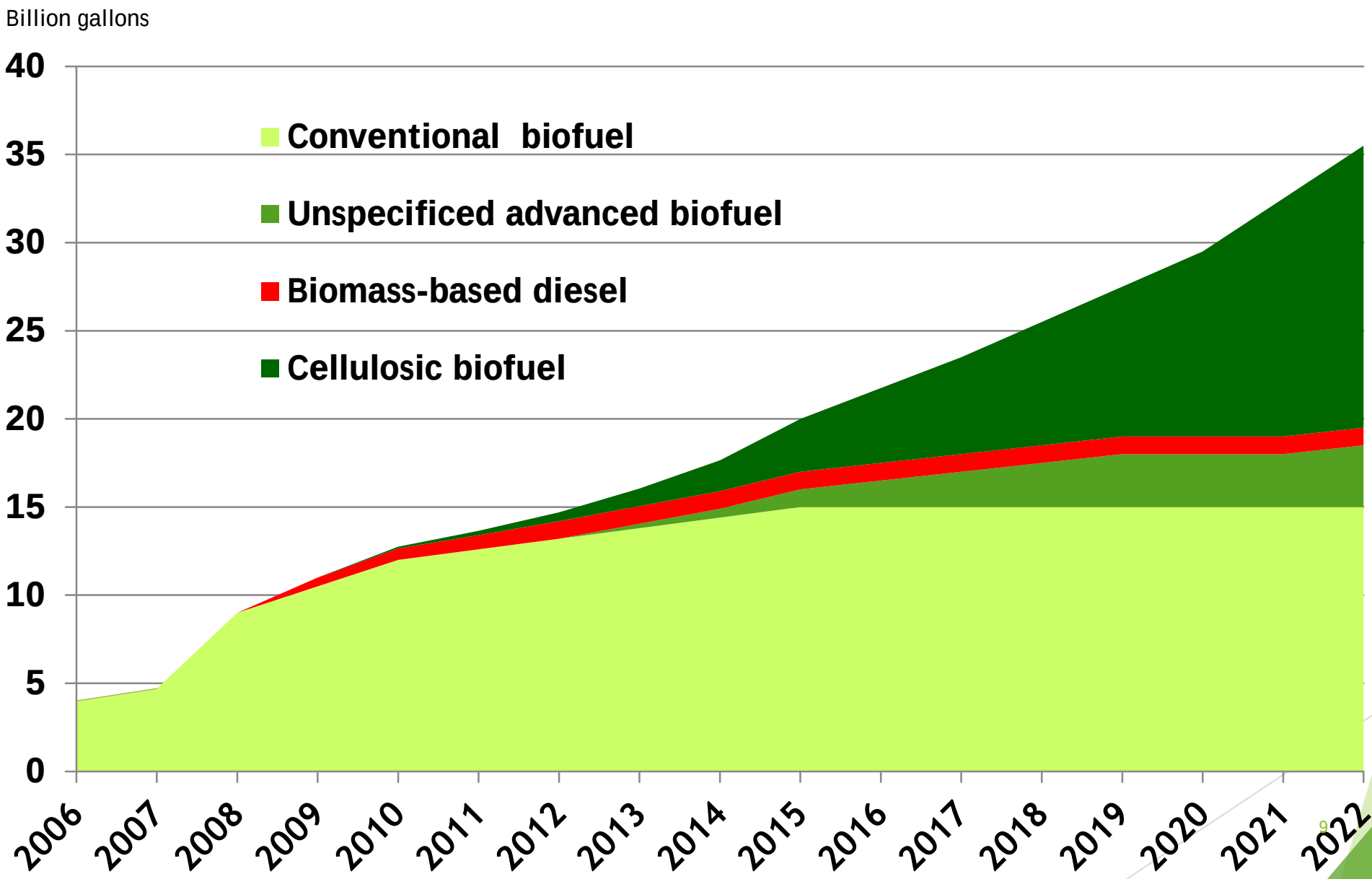
Table 2. EISA 2007 Renewable Fuel Standard Volume Requirements (Billion Gallons)

Year	RFS1 Biofuel Mandate in EPAct of 2005	RFS 2 Total Renewable Fuels	RFS 2 Cap on Cornstarch-Derived Ethanol	Portion from Advanced Biofuels			
				RFS2 Total Non-Cornstarch	RFS2 Cellulosic	RFS2 Biomass-based Diesel	RFS2 Other
2006	4.0						
2007	4.7						
2008	5.4	9.00	9.0	0.00	0.00	0.00	0.00
2009	6.1	11.10	10.5	0.60	0.00	0.00	0.10
2010	6.8	12.95	12.0	0.95	0.0065	1.15	0.29
2011	7.4	13.95	12.6	1.35	0.006	0.80	0.54
2012	7.5	15.20	13.2	2.00	0.00	1.00	1.00
2013	7.6[e]	16.55	13.8	2.75	0.014	1.28	1.46
2014	7.7[e]	18.15	14.4	3.75	1.75	>1.00	1.00
2015	7.8[e]	20.50	15.0	5.50	3.00	>1.00	1.50
2016	7.9[e]	22.25	15.0	7.25	4.25	>1.00	2.00
2017	8.1[e]	24.00	15.0	9.00	5.50	>1.00	2.50
2018	8.2[e]	26.00	15.0	11.00	7.00	>1.00	3.00
2019	8.3[e]	28.00	15.0	13.00	8.50	>1.00	3.50
2020	8.4[e]	30.00	15.0	15.00	10.50	>1.00	3.50
2021	8.5[e]	33.00	15.0	18.00	13.50	>1.00	3.50
2022	8.6[e]	36.00	15.0	21.00	16.00	>1.00	4.00

[e] Estimated

Source: "Renewable Fuel Standard (RFS) Overview and Issues," Congressional Research Service, March 14, 2013 [http://goo.gl/QEfXy], p. 3.

RFS2 Volumes Increase Over Time



2007 Bio-Ethanol Policy: Key Components

- Statute established annual renewable fuel volume requirements for 2008-2022 (RVOs)
- EPA announces RVO each year through federal rule-making process
- Allocates renewable fuel volume requirements among obligated parties based on market share – primarily oil refiners and fuel importers
- Includes overall targets for cellulosic, biomass-based diesel, other advanced biofuels
- Maximum cornstarch ethanol volume: difference between total annual requirement for biofuels and RVO specified for advanced biofuels – capped at 56.78 billion liters (15.0 billion U.S. gallons) for RFS compliance
- Volume based, does not specify blend-rates
- Provided EPA with specific waiver authorities if supplies not available or cause economic harm
- Provided alternative compliance mechanism through Renewable Identification Numbers (RINS)
- After 2022, U.S. EPA to establish volume requirements

EPA has reduced mandates, when fuels were not available or marketable

Legislated volume -- **Implemented volume**

Billion Ethanol Gallon Equivalents	2014		2015		2016		2017		2018	
Cellulosic Biofuel	1.75	0.03	3.0	0.12	4.25	0.23	5.5	0.311	7.0	0.288
Biomass-based Diesel	> 1.0	1.63	> 1.0	1.73	> 1.0	1.9	> 1.0	2.0	> 1.0	2.1
Advanced biofuel	3.75	2.67	5.5	2.88	7.25	3.61	9.0	4.28	11.0	4.29
Conventional Biofuel (Corn Ethanol)	14.4	13.6	15.0	14.1	15.0	14.5	15.0	15.0	15.0	15.0
Total Renewable Biofuel	18.15	16.28	20.50	16.93	22.25	18.11	24.00	19.28	26.00	19.29

Policy Enforcement

- EPA can levy substantial fines under the U.S. Clean Air Act

- Statute established Renewable Identification Numbers (RINs)
  - Compliance accounting mechanism for EPA
  - Flexibility for obligated parties to use RINs in lieu of physical blending to meet obligations
  - A RIN attaches to each gallon of renewable fuel at first point of sale
    - Renewable fuel producers do not receive any value for RINs
    - RINs are bought, sold and traded primarily among obligated parties
    - Each renewable fuel classification has a different RIN (conventional ethanol, biodiesel, etc.)
    - RINs for one classification can meet an obligation for a lower biofuel type
    - I.e. a cellulosic ethanol RIN can satisfy a conventional ethanol obligation but not vice-versa
  - RIN market prices can incentivize increased blending and infrastructure development

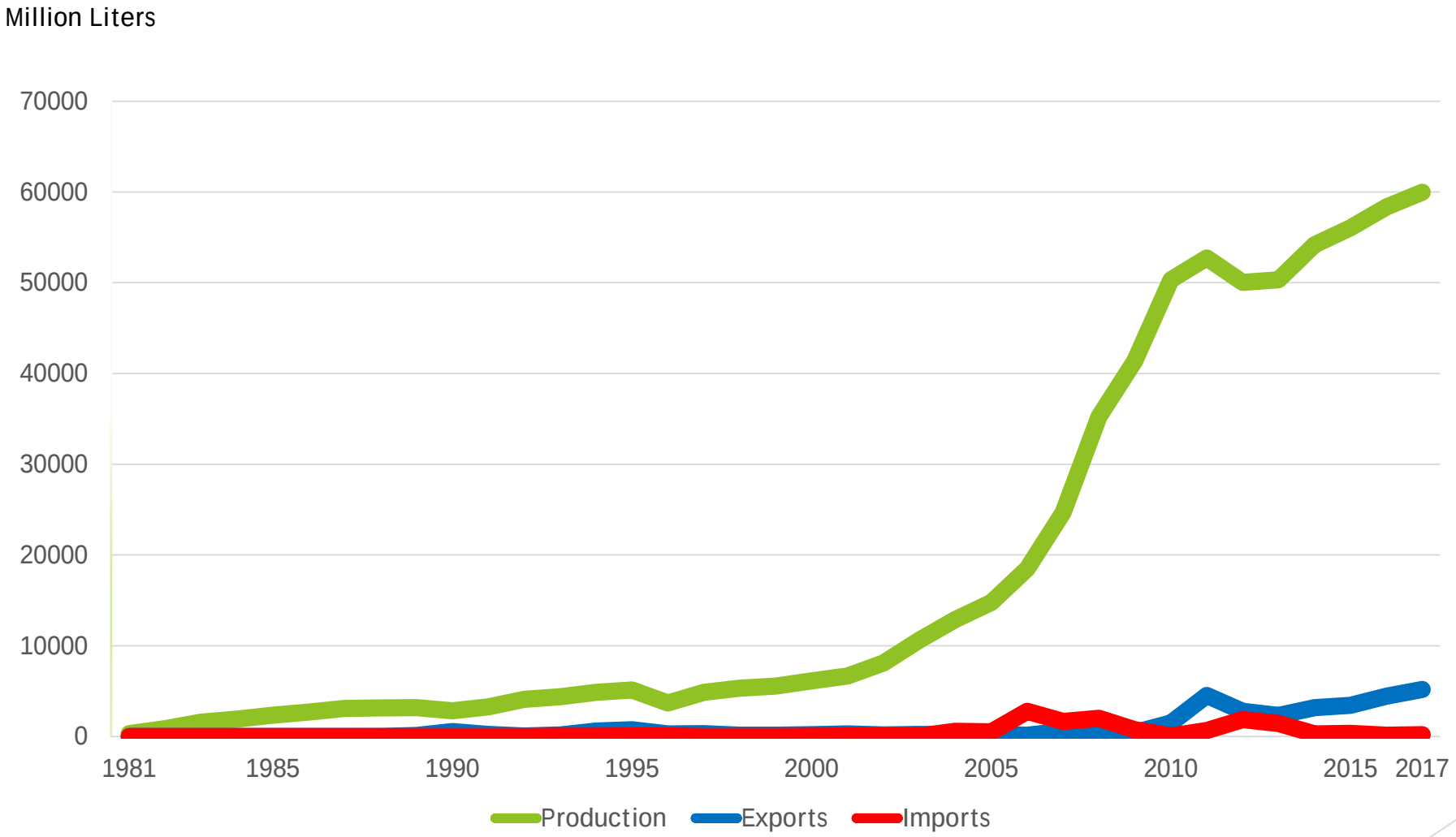
Results: Market Impact of the RFS

- U.S. is world's largest ethanol producer
  - Capacity 60 billion liters per year
  - Largest ethanol exporter – over 5 billion liters in 2017
  - Largest exporter of DDGS – 11 MMT in 2017

- Ethanol and co-products contribute over $40 billion to GDP annually

- Direct and indirect employment: 400,000 workers

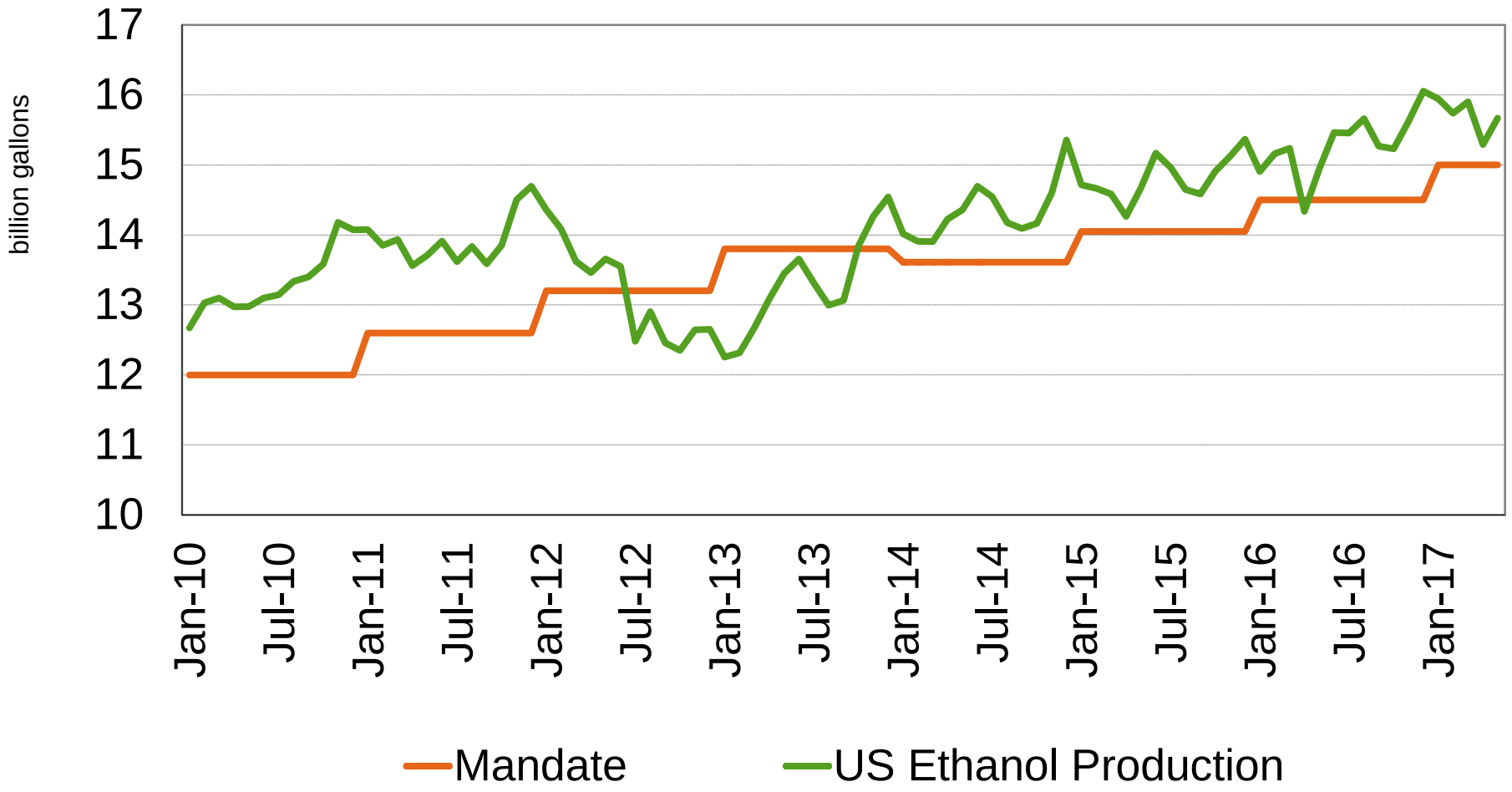
U.S. Ethanol Production, Exports, Imports



Source: USDA/FAS, GATS; USDA/ERS, Biofuel Statistics

1 U.S. Gallon = 3.7853 Liters

Ethanol Production Pace and Annual Mandate



Source: USDA

- U.S. ethanol production now outpaces domestic demand and RFS mandate
- Seeking demand expansion through higher blends at home (E15) and export sales

Global Opportunities: Potential New Markets Over 10 Years

- **Primary focus is on Asia Pacific region & the Americas:**
  - Ethanol usage is generally low globally
  - Fuel consumption growth is the fastest in the world.
  - Air quality problems are widespread and worsening

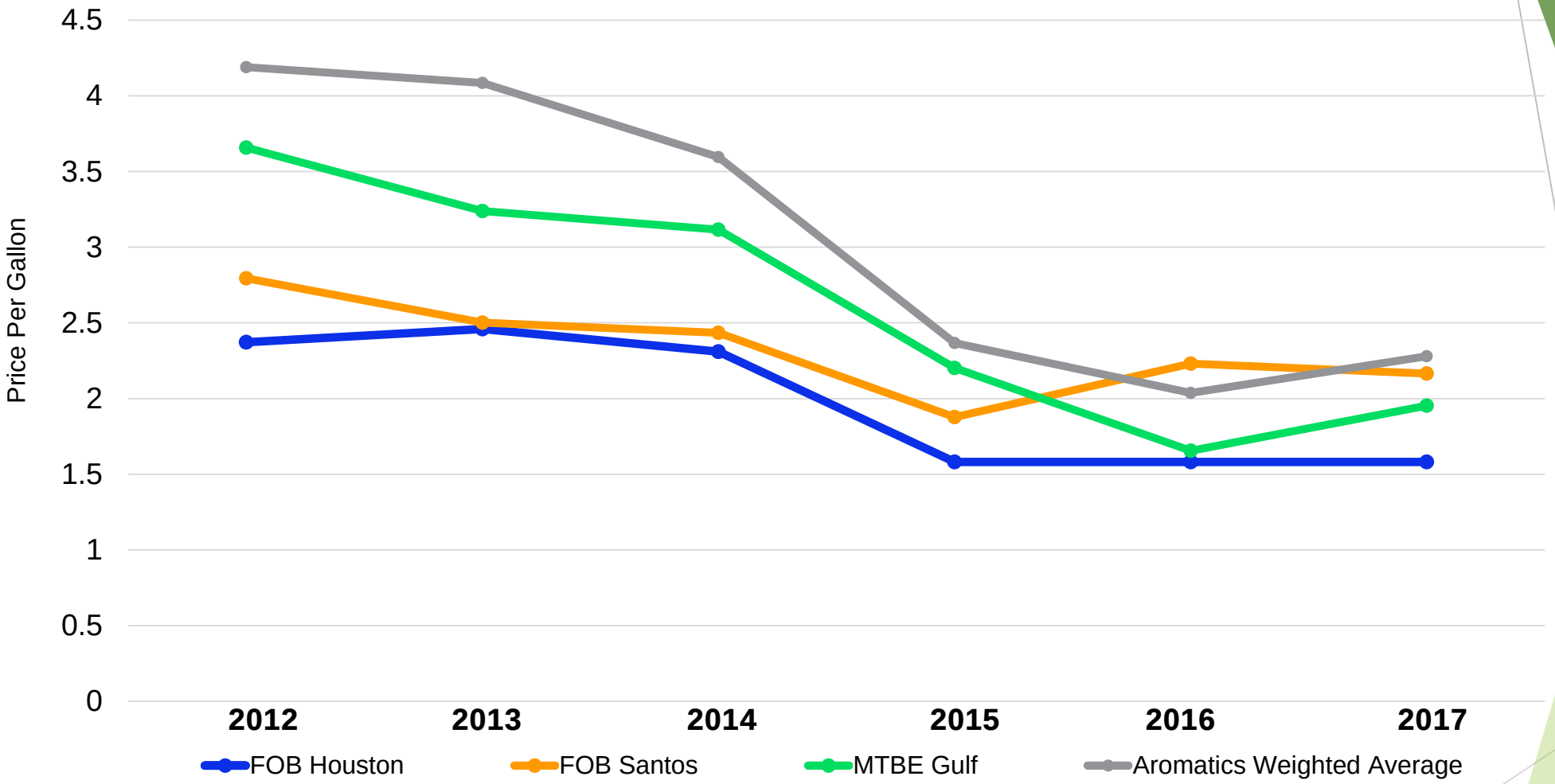
- **Mitigating GHG emissions has become increasingly important after COP-21 in Paris**.
  - New opportunities for fuel ethanol from all feedstocks.
  - New Life Cycle Analysis from US Department of Agriculture shows large improvement in GHG profile of corn ethanol over the past decade. Likely to exceed average 50% reduction vs gasoline within five years.

- **Octane advantages of ethanol blending**.
  - Gasoline refiners, blenders and consumers could benefit from a full cost/benefit analysis of ethanol.
  - Increasing concern about the impact of MTBE on groundwater
  - Displacing aromatics, which comprise 25-40% of gasoline to boost octane offer economic/environmental/health gains.

Background: Global Renewable Fuel Policies

- COP-21
  - Many parties identified increased use of renewable transportation fuels, including ethanol, as part of their strategy to meet their commitments
- Over 60 national economies have adopted renewable fuels policies
- Many governments characterize policies as mandates - few actually enforce them
  - Many have a policy goal of 10% or greater ethanol blend-rate
  - Most are still at less than 5% average blend-rate

Ethanol and Fossil Fuel Price Comparisons



Source: World Perspectives Inc.

Challenges

- Opposition from oil industry / others
- Renewable fuel policies: inconsistent enforcement, low blend rates
- Infrastructure:
  - Feedstock/refining capacity, import capacity, domestic blending/transportation capacity
- Differing policies, laws, regulations – need for harmonization
- Exchange rates / foreign exchange
- Rise of trade protectionism
  - Import limitations, administered prices, tariffs, AD/CVD, non-tariff trade barriers
- Product Specifications

Benefits of Policy, Enforcement & Trade

Achieve Policy Goals Sooner:

- Market certainty – investment, supply, risk management
- Reduces fossil fuel dependence
- Ethanol blending benefits – environment, health
- Value proposition – reduce blend stock costs, ethanol v. aromatics/MTBE, value of octane
- Consumer benefits of lower prices and fuel choices

QUESTIONS
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- **Contact Information –**

James Miller
President
Agriculture & Biofuel Policy Consulting
210 West San Juan Avenue
Phoenix, Arizona 85013

Telephone: (703) 989-9710
Email: abpcllc@outlook.com