Legislative and Regulatory Developments Likely to Affect the U.S. Refining Sector in the Next Decade

Round Table Discussion on U.S. Refining
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Dave Hirshfeld

MathPro Inc.

Key legislative and regulatory developments

- Proposed cap-and-trade system
- New CAFÉ (fuel economy) standards
- Renewable Fuels Standard 2 (RFS2)
- California Low Carbon Fuels Standard (LCFS)
- Additional sulfur standards

Proposed cap-and-trade system

- Part of Waxman-Markey bill (H.R. 2454); Senate slated to take up GHG control later this year
- U.S. refineries would have to purchase allowances covering GHG emissions from
  - Refinery operations
  - Consumer use of refined products
- Refineries would bear disproportionate share of GHG allowance costs
  - Compliance obligation: ≈ 43% of covered GHG emissions,
  - Free allowances: ≈2% of total, dropping to zero by 2026

Proposed cap-and-trade system. . .

- Would increase U.S. refining costs relative to off-shore refineries
- Increased refining costs would lead to. . .
  - Some destruction of U.S. demand for refined products
  - Increased imports of refined products
  - Reduced capacity utilization in U.S. refineries (up to 4 Mbpd)
  - Increased capacity utilization in foreign refineries
  - Export of investment, jobs, and $ from U.S. to suppliers
  - Negligible change in global GHG emissions

New CAFÉ standards

- Current CAFÉ standard is 27.5 mpg average for passenger cars (PC) and light-duty trucks (LDT)
- EISA2007 increases CAFÉ standard, starting in 2012 and reaching ≥35 mpg average in *2020*
- New standard just issued by NHTSA & EPA, starting in 2012 and reaching
  - 34.1 mpg average (39 mpg for PC; 30 mpg for LDT), and
  - 250 gm CO_2/mi (including fuel economy and AC)

  in *2016. Higher* standard to be set for 2017- 2020

New CAFÉ standards. . .

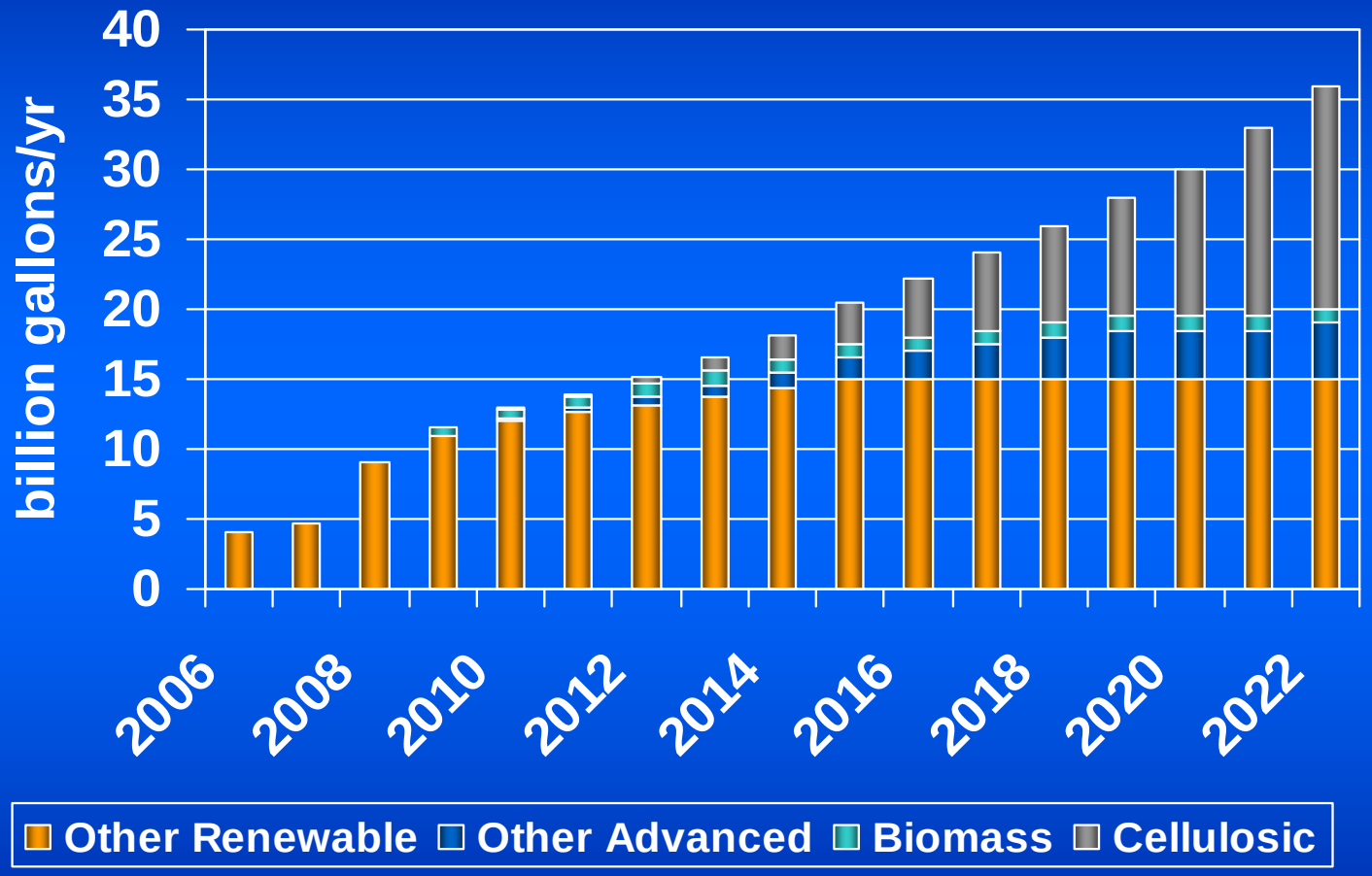
- Will depress (or even reverse) growth in demand for transportation fuels (gasoline + diesel)
  - *AEO2009* projects gasoline demand peaking in 2011 under the EISA2007 fuel economy standard
- Could lead to substantial changes in requirements for refinery-produced transportation fuels
  - High octane gasoline (high compression engines)
  - Heavy naphtha fuel (HCCI engines)
  - “Premium” (high-cetane) diesel fuel
  - Sharp decrease in G/D ratio (“dieselization” of vehicle fleet)

Renewable Fuels Standard 2 (RFS2)

- EISA2007 establishes new RFS, with increasing annual volume mandates
  - 11.1 bgy in 2009, 12.95 bgy in 2010, etc.
  - **36 bgy (2.4 M b/d)** in 2022

- RFS2 mandates annual volumes for four renewable fuel categories (defined by GHG reduction goals)
  - Renewable biofuel (corn ethanol, capped at 15 bgy)
  - Advanced biofuel (includes cellulosic ethanol and others)
  - Cellulosic ethanol (an advanced biofuel)
  - Biomass-based diesel

RFS2 annual volume mandates



Impending consequences of RFS2 include. . .

- Breaching of E10 “blend wall” in next two years,
  - Aggressive E85 roll-out ?
  - E10+ blends allowed into commerce?
  - EPA relaxes annual volume mandates?

- Increased ethanol imports, until cellulosic ethanol production ramps up
  - Corn ethanol production stays at 2009 level ⇨ 1/3 of 2015 ethanol mandate volume must come from imports
  - New corn ethanol capacity hard to finance (≈20% of capacity is shut down)

Future of RFS2 hinges on two BIG questions

- Is large-scale commercial production of cellulosic ethanol feasible?
  - Formidable scientific and engineering barriers
  - High capital requirements and operating costs
  - Feedstock markets as yet undeveloped
- Can cellulosic ethanol and other advanced biofuels meet RFS2 Life Cycle GHG reduction targets?
  - No commercial experience to rely on
  - Certification to be done by means of complex, unproven, and controversial LCA models – almost certain to be challenged

CA Low Carbon Fuels Standard (LCFS)

- California's LCFS program is an early CARB response to AB 32
  - AB 32 calls for reducing CA GHG emissions to 1990 levels by 2020
  - 25% reduction in GHG emissions vs. Business-as-Usual
- LCFS objective is to reduce "life cycle carbon intensity" of CA transportation fuel by 10% by 2020
  - Includes effects of direct and indirect land use change
  - Applies to gasoline and diesel fuel

LCFS intended to promote “low carbon fuels”

- Ethanol (corn, sugar cane, cellulosic)
- Bio-diesel/renewable diesel
- CNG, LNG
- Natural gas
- Electricity
- Hydrogen
- Other

(Most of these fuels require new vehicle types and fuel infrastructure)

LCFS: Hope springs eternal

Table VI-8
Contribution to Reducing GHG Emissions in the LCFS
For Fuels Substituting for Gasoline Fuel in 2020

Fuel Type	Percent of Reductions Provided by Each Fuel Type Substituting for Gasoline in 2020[1]			
	Scenario 1	Scenario 2	Scenario 3	Scenario 4
CA Low-CI Ethanol	2	2	2	2
Cellulosic Ethanol	44	43	38	28
Advanced Renewable Ethanol	43	41	36	27
Sugarcane Ethanol	0	3	3	3
Electricity	9	9	18	35
Hydrogen	2	2	3	5

[1] Baseline gasoline consists of 90% CARBOB and 10% Ethanol by volume.

Additional sulfur control standards

- ULSD standard (≤ 15 ppm Sul) extended to NRLM pool (2012-2014) – Definite; nationwide
- Gasoline standard tightened to < 10 ppm – Possible nationwide; new California RFG3 program essentially requires < 10 ppm Sul now
- Ocean marine fuel standard (ultimately ≤ 1000 ppm Sul), with possible curtailment of bunker fuel use – Probable

Additional sulfur control standards. . .

- Will increase call for refinery investment in sulfur control facilities
  - Mainly hydro-processing and H_2 production
  - These are “stay in business” investments; likely return low
- Marine fuel standard could be especially costly

Overall effects of these programs on the U.S. refining sector

- Reduced (or negative) growth in domestic demand
- Reduced utilization of U.S. refining capacity
- New requirements for “stay-in-business” investments
- Increased U.S. refining sector costs
- Added uncertainty regarding future requirements
- Continuing controversy