



Refiner's Perspective on Advanced Biofuels

Biomass R&D Technical Advisory Committee
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- Overview of the US Refining Industry
- Impact of the Renewable Fuels Standard
- Opportunities For Integration
- Policy Recommendations



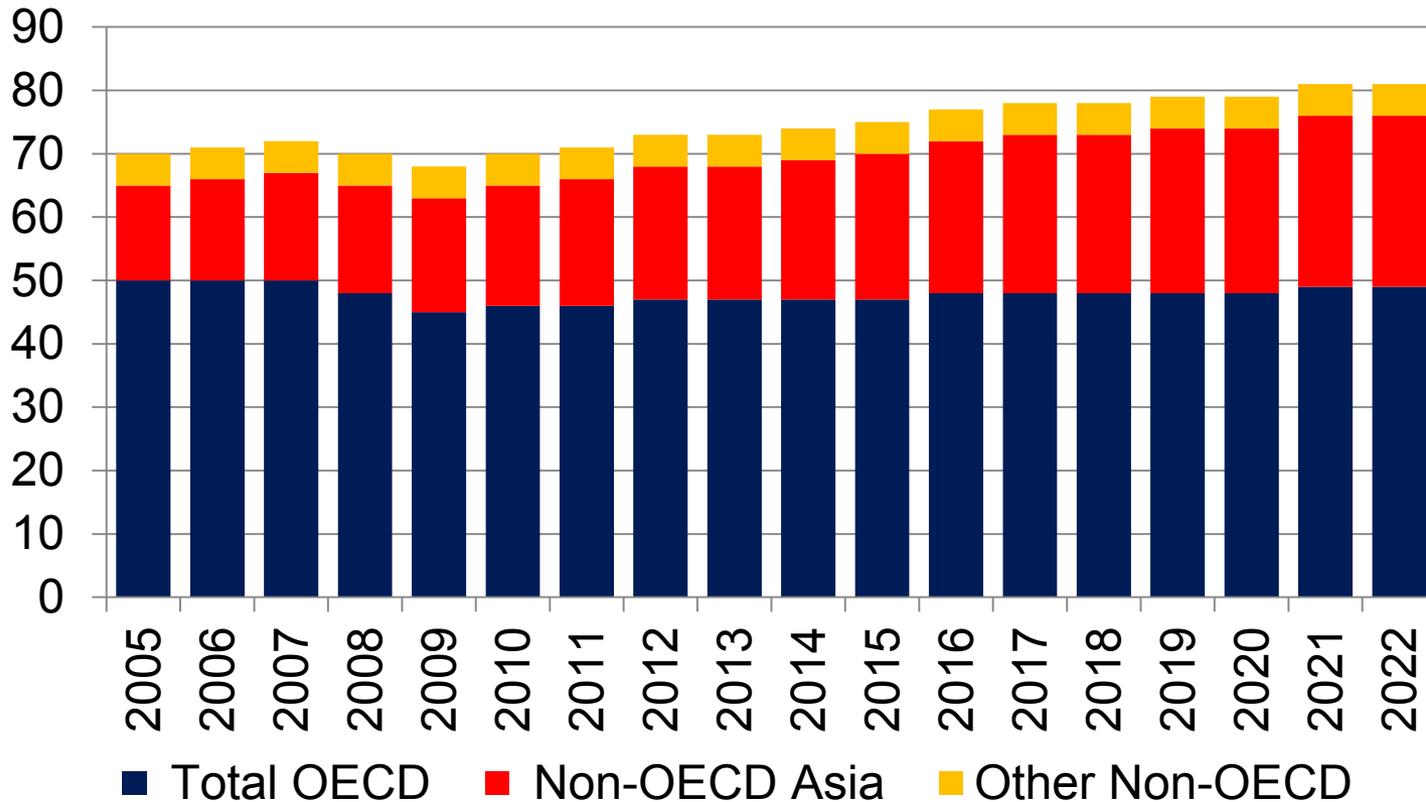
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Global Demand for Liquid Fuels

Global demand growth is projected to largely be limited to non-OECD Asia, where local refining capacity is being built

World Liquids Consumption, million barrels per day

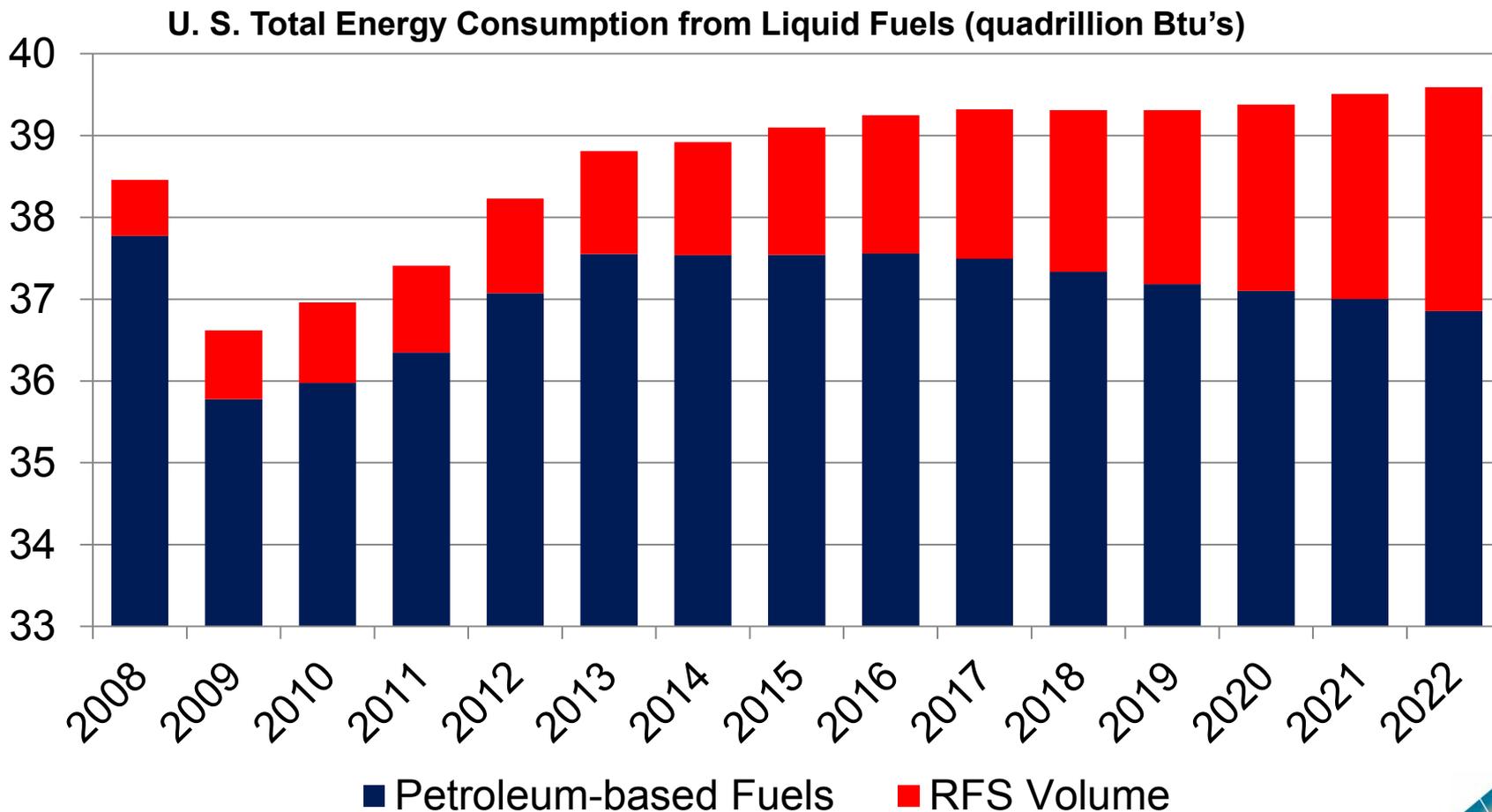


Source: EIA International Energy Outlook, 2011



U. S. Petroleum Product Demand

Petroleum product demand is not expected to recover to 2007 highs, and renewable fuels will continue to displace petroleum-based fuels



Source: EIA Annual Energy Outlook, 2011



Domestic refining capacity continues to decrease in the wake of declining petroleum product demand

	PADD 1		PADD 2		PADD 3		PADD 4		PADD 5		Total	
	#	MB/D	#	MB/D								
1990 - 2008	7	218	14	460	22	304	3	58	17	309	64	1,349
2009 – 2012*	5	764			1	17			1	68	7	849
Total	12	982	14	460	23	321	3	58	18	377	71	2,198

- For the first time since 1949, the US was a net exporter of petroleum products in 2011
- Competing in an export-oriented environment requires increasingly competitive facilities

* Includes projected closures announced for 2012



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Initial View

- Renewable fuels displace sales from petroleum products
- The RFS requires refiners to purchase biofuels from other companies, and blend them with our products for minimal uplift in value
- The RFS exposes refiners to risks regarding the integrity of the operation of biofuels producers
- Renewable Fuels are not cost competitive with petroleum fuels without mandates or subsidies
- Renewable Fuel

Alternative View

- ✓ Renewable fuels provide a growth market in transportation fuels
- ✓ Production of renewable fuels provides an opportunity to continue to produce refined fuels from lower cost feedstocks
- ✓ Production of renewable fuels gives the refiner increased control over RIN generation
- ✓ Integration of renewable fuel production into refineries can be competitive
- ✓ Renewable Feedstocks



RFS2 Impact on Refining Economics

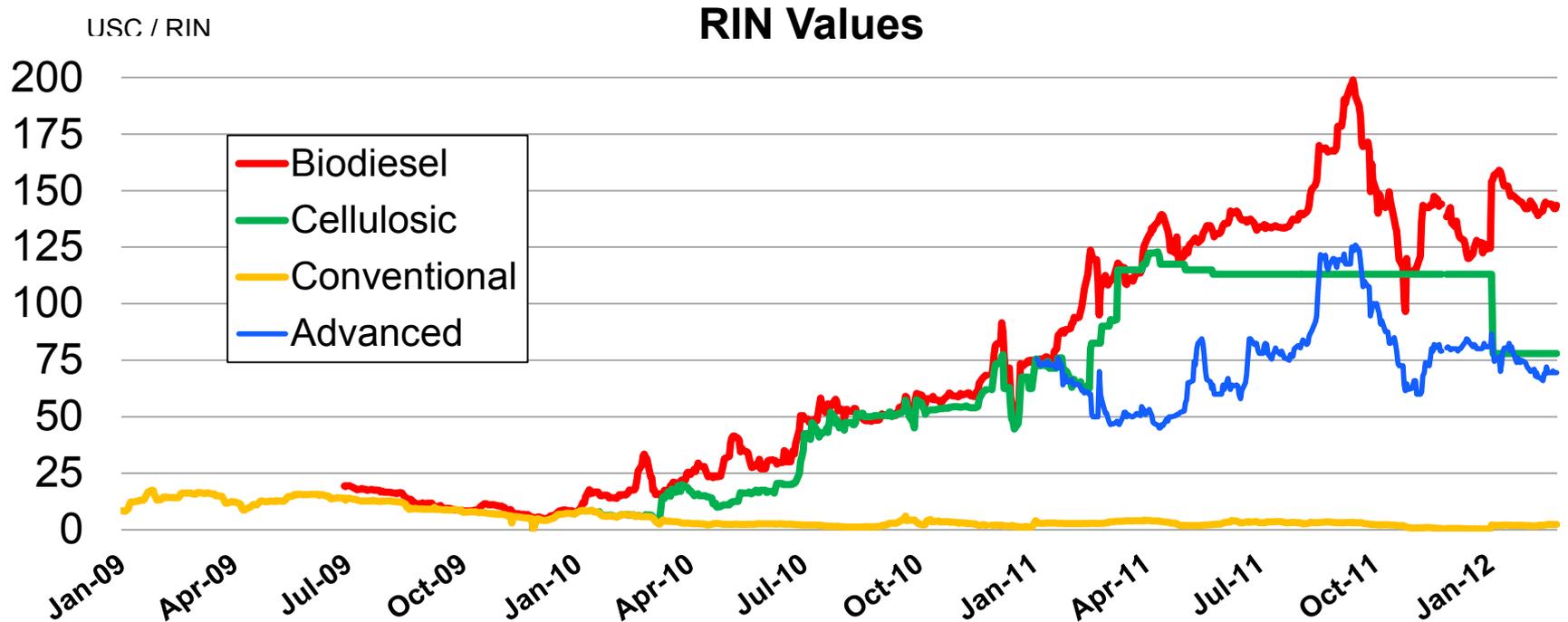
2012 Regulatory Volume Obligation	RVO,* %	RIN Value (cents, 2/24/12)	Cost per gallon
Biomass-based Diesel	0.91	142	1.29
Cellulosic	0.006	78	0.05
Advanced Biofuel	0.294	70	0.21
Conventional Biofuel	8.02	2	0.16
Total	9.23		1.71

- As obligated parties, refiners must “pay” for the production of gasoline and diesel by obtaining RINs per the annual Regulatory Volume Obligation
 - RIN obligation for a 100,000 B/D refinery is about \$25 million in 2012
- RIN costs manifest themselves in one of two ways:
 - Cost premium for the blended biofuel over the sales price of the finished product
 - Financial cost to purchase RIN from another party

The current cost for RFS2 being paid by obligated parties is roughly 2 cents per gallon for all gasoline and diesel consumed in the U. S.

* Renewable Volume Obligation, as a percent of the volume of gasoline and diesel introduced into commerce within the U. S.

RIN costs reflect economic drivers required to make the renewable fuel competitive with the petroleum-derived product



- Drivers of RIN cost volatility:
 - Changes to biofuel prices relative to petroleum product prices
 - Price incentives required to get renewable fuels to market
 - Changes in biofuels tax credits
 - Cellulosic RINs are anchored to EPA's waiver price

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- USDA “Regional Roadmap to Meeting the Biofuels Goals of the Renewable Fuels Standard” (2010) stated that 527 new biorefineries would be required to meet the requirements of RFS 2, at a cost of \$168 billion

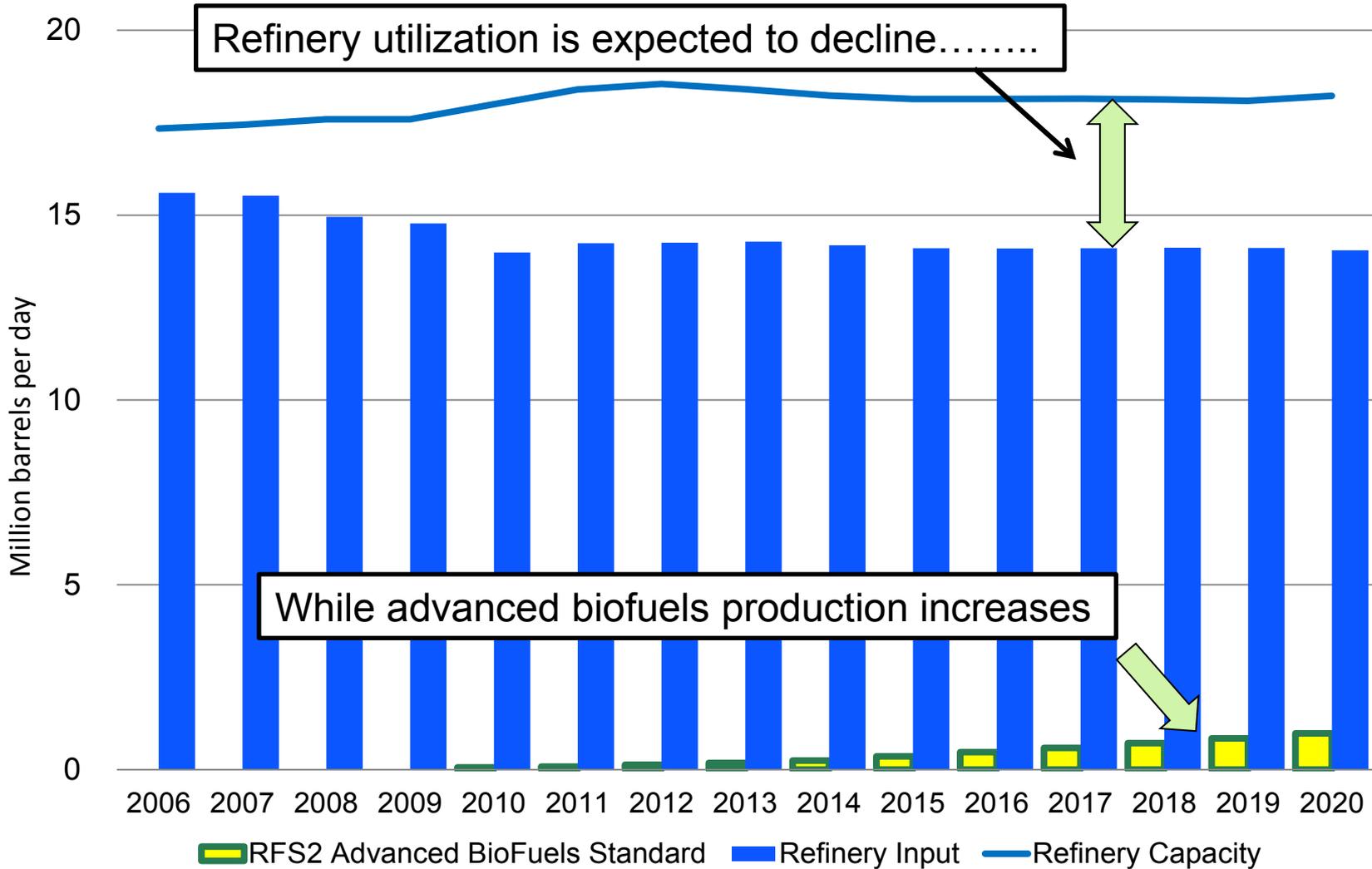
There is already steel in the ground that could be repurposed to supply much of this volume

- The NABC’s objectives call for:

Leveraging the existing petroleum refining industry to the maximum extent possible.



US Refinery Throughput

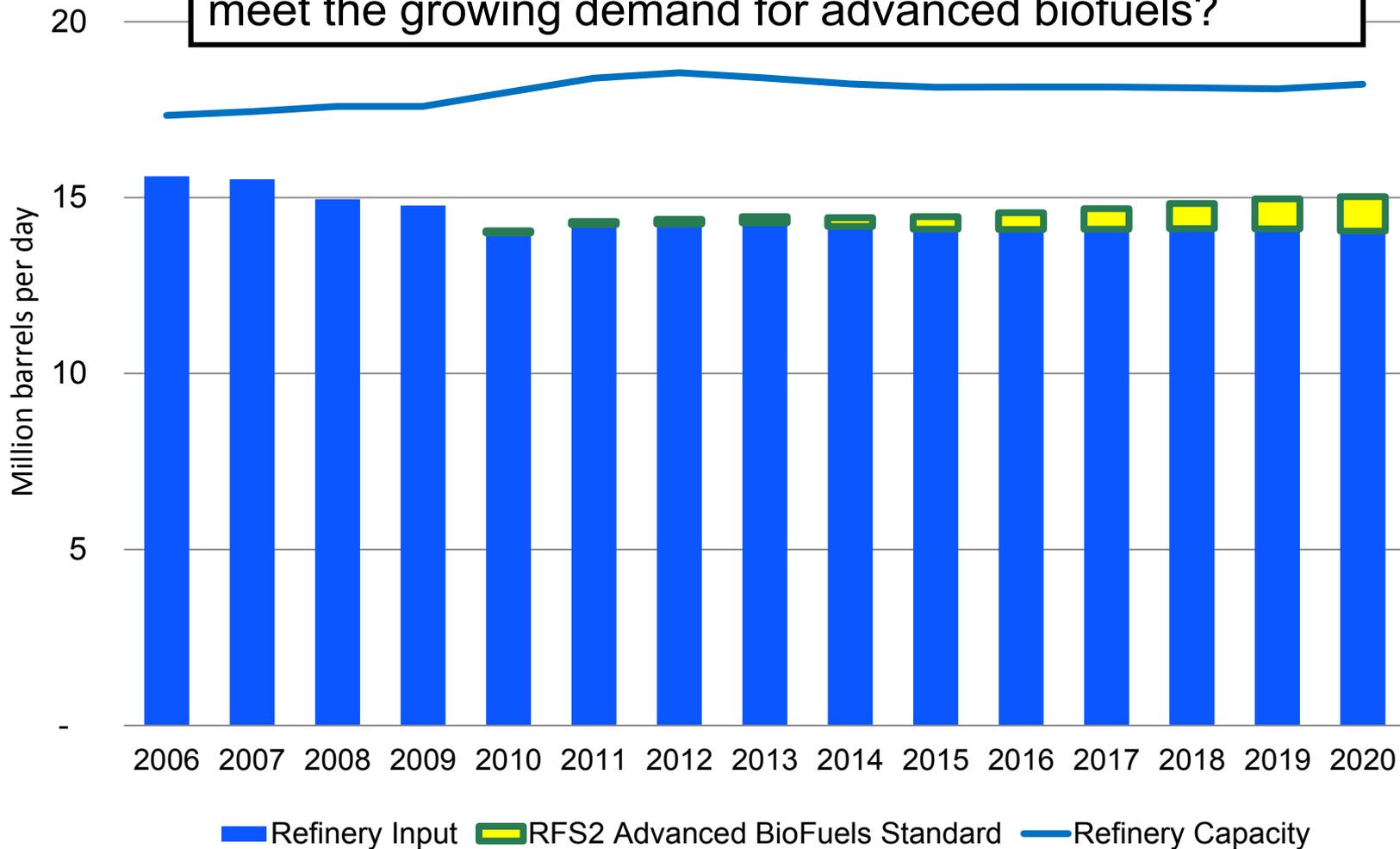


Source: EIA March 2009 AEO



The Challenge

How can we use the existing refining infrastructure to meet the growing demand for advanced biofuels?



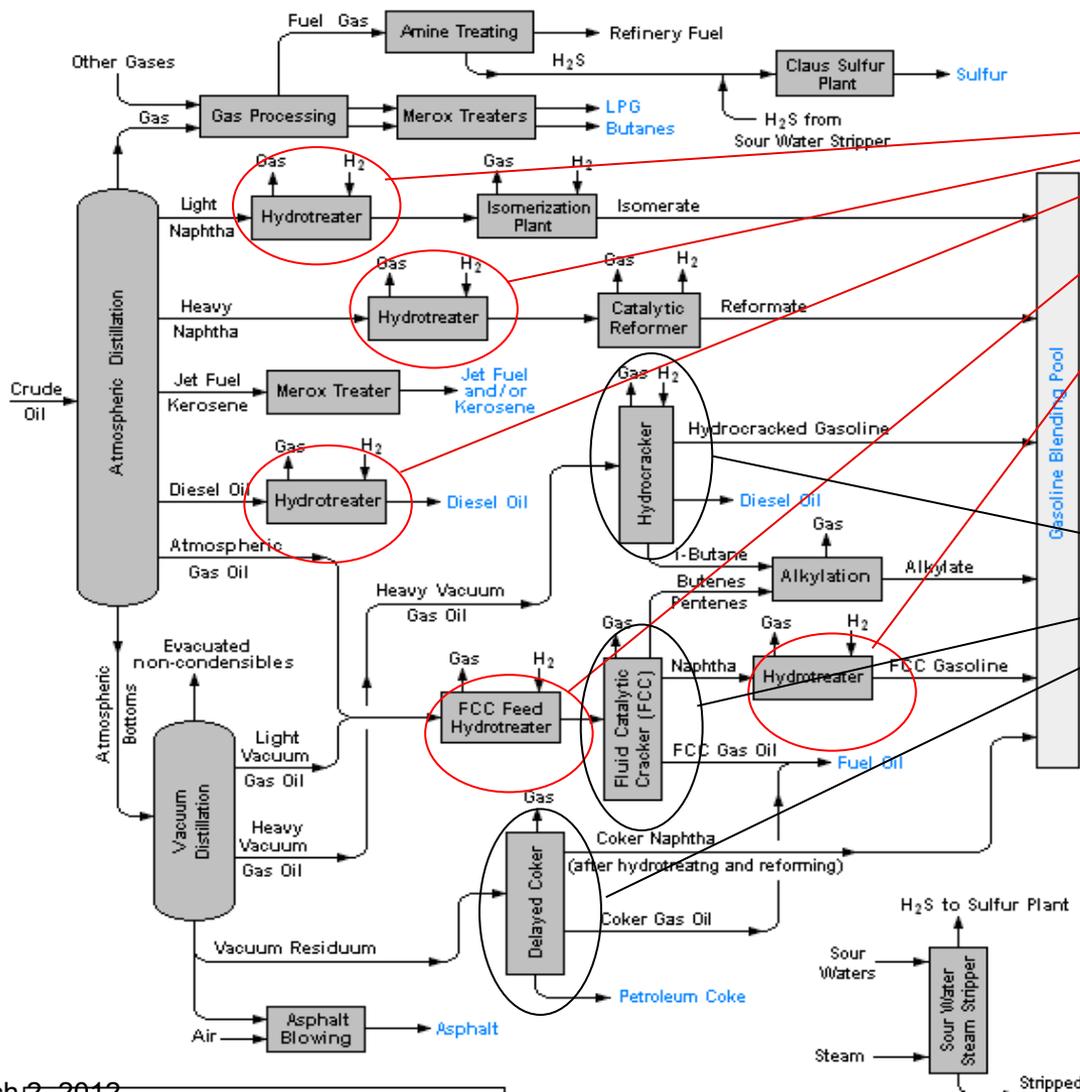
Source: EIA March 2009 AEO



- Refineries are complex facilities designed to produce hydrocarbon transportation fuels from feedstocks that contain a mixture of boiling ranges and are contaminated with non-hydrocarbon atoms
 - In biomass-based materials, the contaminant tends to be oxygen instead of sulfur
- Small amounts of renewable materials could be “co-processed” in existing refinery units along with the petroleum feedstocks
 - Fuels produced from the unit would be essentially unchanged, but would consist of a portion of renewable carbon
- Co-processing has been largely rendered uneconomic because of disadvantages within federal legislation
 - Net impact is a disadvantage of up to \$2/gallon versus conventional biodiesel plants



Refineries contain many potential insertion points for co-processing of a variety of biomass-derived feedstocks



Hydroprocessing Units

- Typically designed to remove sulfur
- Potentially suitable to deoxygenate triglycerides or other oils

Conversion Units

- Designed to break down larger molecules into smaller ones
- Potentially suitable for upgrading of pyrolysis oils into fuels

Source: Wikipedia



- Gasoline and diesel specifications have become increasingly stringent over the past decades in response to demand for lower vehicle emissions
 - Tier 3 gasoline being developed by EPA would further tighten
 - Gasoline and diesel are increasingly resembling “specialty chemicals”
- Refineries have significant capability to optimize fuel blends to maximize blendstock value
 - Alter blend ratios of different components using on-line instrumentation
 - Adjust operating conditions on process units to vary component qualities
- Refinery blending requires the production of “drop-in” fuels that can be transported in the existing product distribution system

Blending renewable fuels at the refinery allows the value of advanced biofuels products to be maximized by capitalizing on the refinery’s optimization flexibility



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- Co-processed renewable diesel should be treated equally with other methods of converting the same feedstocks to renewable fuels
 - Biomass Based Diesel RIN, not just Advanced Biofuel RIN
 - If the biodiesel blender's tax credit is reinstated, co-processed renewable diesel should also qualify
- Co-processed jet fuel should be given increased priority in the certification process to avoid slowing the deployment of advanced biofuels technologies
 - Many refineries would be unable to co-process because small amounts of co-processed material would unavoidably reach the jet fuel pool
- Legislation should recognize that relaxation of the E10 blend wall is not required as drop-in compatible technologies begin to ramp up production of non-ethanol biofuels

Leveraging the existing petroleum refining industry to the greatest extent possible can help advance the goals of the Renewable Fuels Standard

- Allows significantly lower capital cost by using existing infrastructure
- Facilitates increased renewable fuels production by allowing capital expenditures to focus on conversion of biomass to “crude oil,” reducing the added cost to upgrade to finished product
- Reduces operating costs due to economies of scale
- Allows capture of significant synergy value by integrating into the refining process
- Eliminates need to modify the vehicle fleet and distribution system for higher ethanol blends



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Thank you!

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