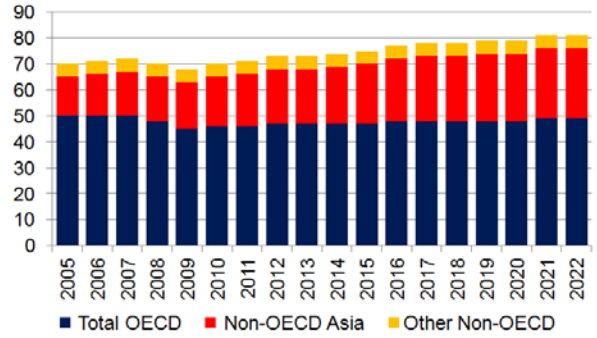
March 30, 2012

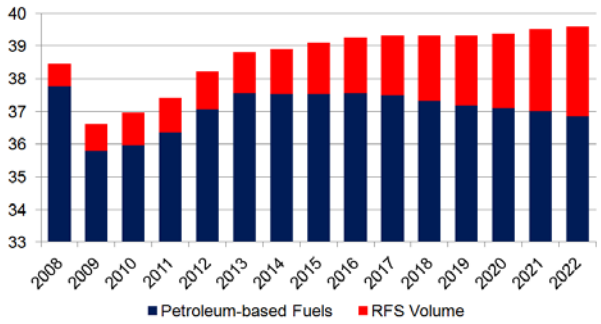
A Refiner's Perspective on Advanced Biofuels

Overview of the U.S. Refining Industry

Global demand growth is projected to largely be limited to non-OECD Asia, where local refining capacity is being built, while U.S. petroleum product demand is not expected to recover to 2007 highs, and renewable fuels will continue to displace petroleum-based fuels (EIA Annual Energy Outlook 2011).



World Liquids Consumption, million barrels per day



U.S. Total Energy Consumption from Liquid Fuels (quadrillion Btus)

Domestic refining capacity continues to decrease in the wake of declining petroleum product demand. For the first time since 1949, the U.S. was a net exporter of petroleum products in 2011. Competing in an export-oriented environment requires increasingly competitive facilities.

	PADD 1		PADD 2		PADD 3		PADD 4		PADD 5		Total	
	#	MB/D	#	MB/D	#	MB/D	#	MB/D	#	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

* Includes projected closures announced for 2012 (EIA Refinery Capacity, 2011)

Impact of the Renewable Fuels Standard (RFS)

The implications of the RFS to refiners are viewed in different ways; the initial view can be framed as:

- 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 in terms of the producer's compliance with RFS requirements
- Renewable fuels are not cost competitive with petroleum fuels without mandates or subsidies
- Renewable fuel

An alternative view might look like this:

- 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 (Renewable Identification Number) generation
- Integration of renewable fuel production into refineries can be competitive
- Renewable feedstocks

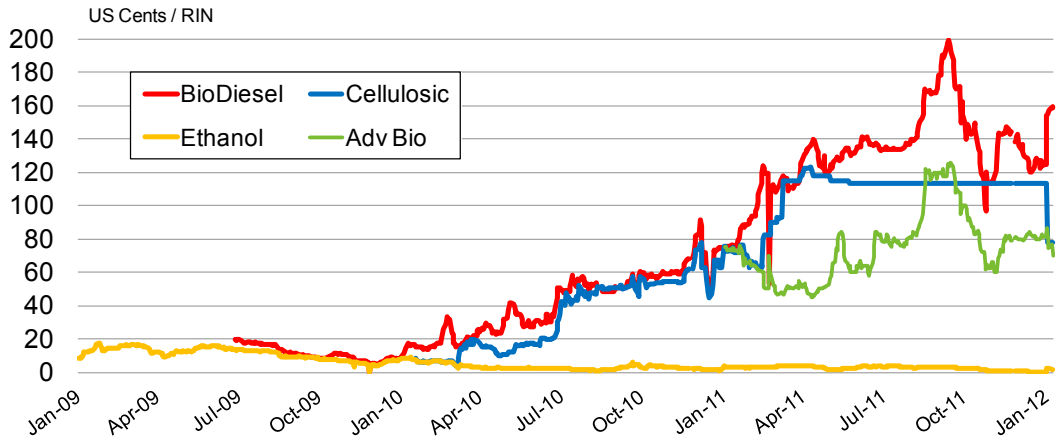
The RFS2 has had an impact on refining economics. The current cost for RFS2 being paid by obligated parties is roughly 2 cents per gallon for all gasoline and diesel consumed in the U.S. As obligated parties, refiners must "pay" for the production of gasoline and diesel by obtaining RINs per the annual Regulatory Volume Obligation. The RIN obligation for a 100,000 barrel per day refinery is about $25 million in 2012, and this cost will increase every year as RFS obligations increase. RIN costs manifest themselves in one of two ways: 1) cost premium for the blended biofuel over the sales price of the finished product, or 2) financial cost to purchase RIN from another party.

2012 Regulatory Volume Obligation	RVO,* %	RIN Value (cents, 1/10/12)	Cost per gallon
Biomass-based Diesel	0.91	158	1.44
Cellulosic	0.006	78	0.05
Advanced Biofuel	0.294	70	0.21
Conventional Biofuel	8.02	2	0.16
Total	**9.23**		**1.86**

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

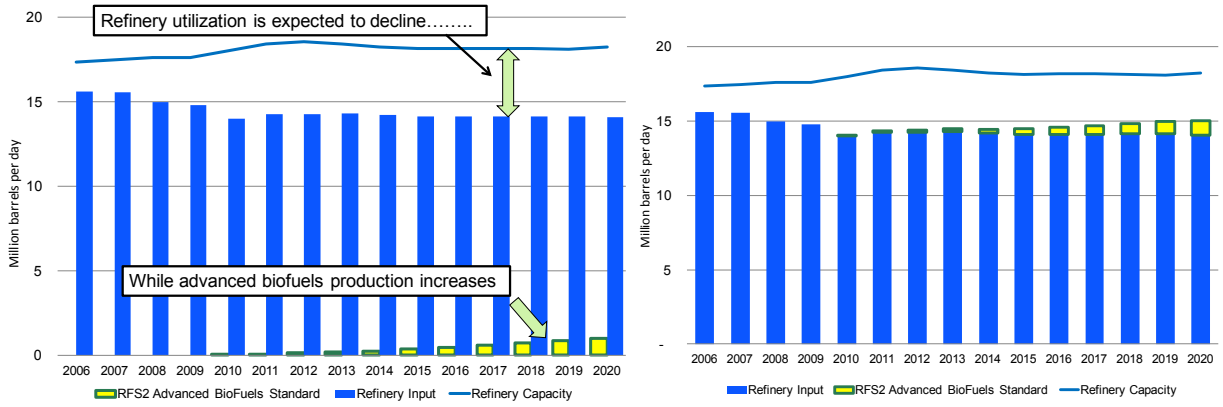
RIN costs reflect economic drivers required to make the renewable fuel competitive with the petroleum-derived product. Drivers of RIN cost volatility include:

- 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



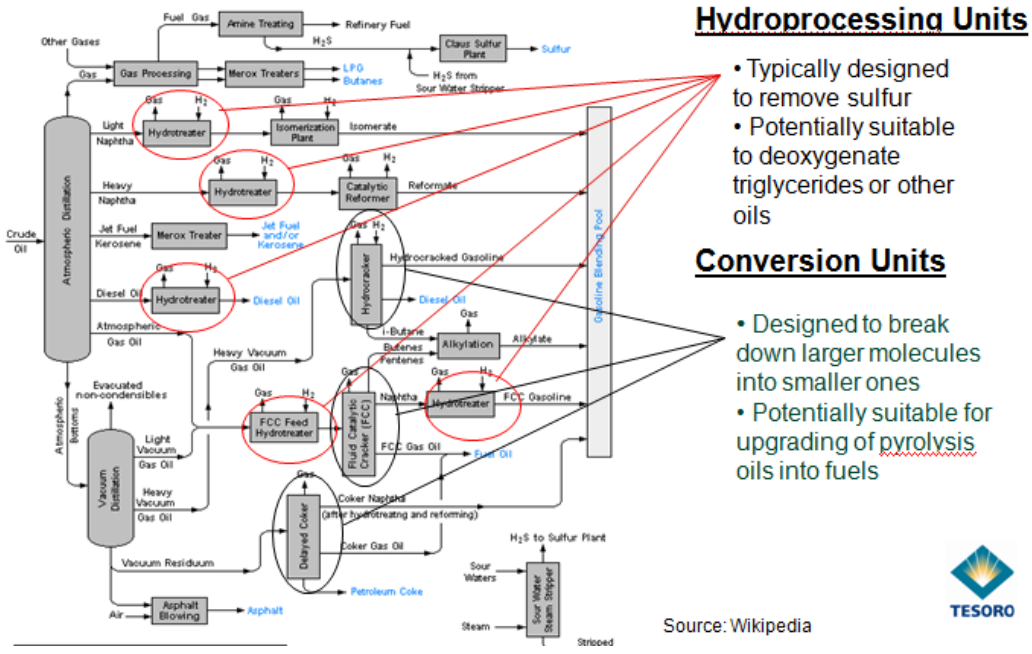
Opportunities for Integration

The 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. How can we use the existing refining infrastructure to meet the growing demand for advanced biofuels? Two options are discussed below – co-processing and blending.



U.S. Refinery Throughput vs. RFS2 Advanced Biofuels Standard (EIA March 2009 AEO)

Considering refinery co-processing, there are several important points to consider. 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, which result in a competitive disadvantage of up to $2/gallon versus conventional biodiesel plants that has crippled efforts at producing biofuels via this route. Refineries contain many potential insertion points for co-processing of a variety of biomass-derived feedstocks:



Blending renewable fuels at the refinery allows the value of advanced biofuels products to be maximized by capitalizing on the refinery's optimization flexibility. When considering refinery blending of renewable blendstocks, the following are important points to consider. Gasoline and diesel specifications have become increasingly stringent over the past decades in response to demand for lower vehicle emissions, causing gasoline and diesel to increasingly resemble "specialty chemicals." Tier 3 gasoline being developed by EPA would further tighten these specifications. Refineries have significant capability to optimize fuel blends to maximize blendstock value. For example, they can 1) alter blend ratios of different components using on-line instrumentation, or 2) 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.

Policy Recommendations
There are three recommendations that would help in removing the policy barriers for renewables.

1. Co-processed renewable diesel should be treated equally with other methods of converting the same feedstocks to renewable fuel. This product should qualify for a 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.

2. Co-processed jet fuel, including jet fuel produced by co-processing of pyrolysis oils, should be given increased priority in the certification process to avoid slowing the deployment of advanced biofuels technologies. This would alleviate the problem that would face many refineries that would be unable to co-process because small amounts of co-processed material would unavoidably reach the jet fuel pool.

3. Legislation should recognize that relaxation of the E10 blend wall is not required for RFS compliance as drop-in compatible technologies begin to ramp up production of non-ethanol biofuels.

In summary, the NABC objective of leveraging the existing petroleum refining industry to the greatest extent possible can help advance the goals of the Renewable Fuels Standard. Leveraging allows significantly lower capital cost by taking advantage of existing infrastructure, and production of renewable fuels could ramp up more quickly by focusing capital expenditures on conversion of biomass to "crude oil," instead of making extra investment to upgrade to finished product. Leveraging could also reduce operating costs due to economies of scale and allow capture of significant synergy value by integrating into the refining process. Finally, leveraging can eliminate the need to modify the vehicle fleet and distribution system for higher ethanol blends.

Prepared from a talk delivered at the at the January 2012 annual NABC meeting by Rick Weyen of Tesoro.