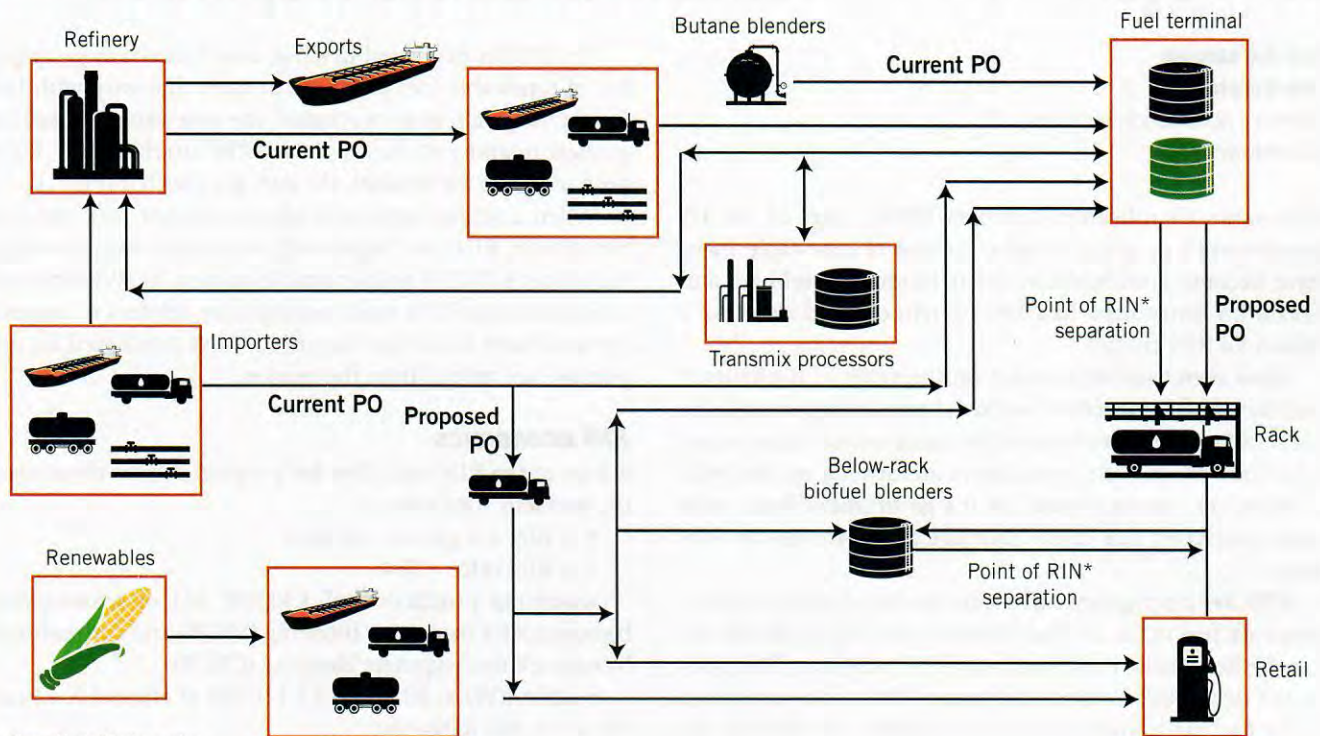


RENEWABLE FUEL STANDARD POINTS OF OBLIGATION (PO)

FIG. 2



*Renewable identification number.
Source: Valero Energy Corp. letter to US Environmental Protection Agency

ample, if a refiner blends 1,000 bbl of its ethanol into its 130,000 bbl of RBOB or CBOB, its out-of-pocket RIN costs are reduced by $1,000 \text{ b/d} \times 42 \text{ gal/bbl} \times 78\text{¢} \approx \$32,760/\text{day}$, or about \$12 million/year out of the \$157 million/year RVO cost of RINs.

According to news reports, refiners this year will spend more than \$15 billion to buy RINs to meet the total 2016 RVO of about 18 billion gal. Approximate expenditures for individual refiners, for example, are Philadelphia Energy Solutions, \$250 million; PBF Energy, \$320 million; CVR Refining, \$200 million; and Tesoro, \$1.2 billion.

Options for refiners

Refiners can respond to these pressures in several ways. For example, they can:

- Directly blend ethanol into RBOB or CBOB.

Since ethanol is corrosive and promotes crack corrosion and brittleness, it cannot be blended at a refinery or transported via pipeline, barge, or ship; instead, it is blended at the final distribution point, such as at marketing terminals, truck racks, and truck tanks.

The costs can be prohibitive. The cost of ethanol tanks, piping, metering, dosing equipment, and rack modification can be \$1-2 million/terminal. Maintenance can be \$500,000/year. Given the alternative of spending hundreds of millions of dollars per year buying RIN credits, expansion of ethanol-

handling capacity might be worthwhile.

Unless a refiner owns the ethanol and the attached RINs, it cannot earn RINs by subcontracting blending to a third party.

Complicating this strategy is the blend wall, the ethanol market limit imposed by the auto industry's concerns that ethanol concentrations above 10 vol % will damage engines and increase warranty burdens. Legislated RFS mandates now require more ethanol than the gasoline market can use at the 10% blending limit. The auto industry has taken EPA to court over its solution to the blend-wall problem: raising the blending limit.

- Export as much gasoline as possible to markets where the RFS does not apply.

Gasoline demand is high in regions such as Latin America, West Africa, and Asia, where much of product is conventional and specifications are less strict than in the US. Most of those markets allow processing with cheap, high-octane methyl tertiary butyl ether (MTBE), now banned in the US. Ethanol is used in Brazil at about the 25 vol % level, and other countries are experimenting with modest levels of ethanol. But they have no RVOs or RINs.

- Use higher-RIN fuels, such as renewable diesel and renewable naphtha, which lower volume requirements for meeting RVO quotas.

There are a number of higher-RIN fuels, such as biodiesel

made from fatty acid methyl esters (FAMES), renewable diesel, and renewable naphtha, which have RIN equivalencies 1.2-1.7 times that of corn ethanol. Whereas 1 gal of corn ethanol receives 1 RIN, for example, a gallon of FAME-type biodiesel receives 1.5 RIN; of nonester renewable diesel, 1.7 RIN; and of isobutanol, 1.3 RIN.

There are three problems with this approach.

Except for FAME biodiesel and renewable diesel, renewable naphtha and alternatives such as isobutanol are quite expensive and not commercially available in large quantities.

In addition, refiners are limited to using a maximum of 5 vol % biodiesel in commercial auto diesel (ASTM D975). This limits the RINs available via this back door.

A refiner also can maximize RINs by using renewable diesel (hydrogenated vegetable oil, or HVO), which has no established legal limits yet but is limited by density specifications. For example, Neste NexBTL can be used up to 30 vol % in European EN590 auto diesel. In the US, Colonial Pipeline has a specification allowing up to 5 vol % HVO.

- Consider biological ethyl tertiary butyl ether (bio-ETBE), an affordable and recognized renewable fuel, as a blend component.

The European Union is a massive user of bio-ETBE, made with biologically derived ethanol. The substance contains about 47% ethanol; the rest is isobutylene. It thus has an RIN equivalence of 0.47.

Bio-ETBE offers lower overall fuel production costs, volumetric fuel-gain profitability, and transportation and infrastructure cost advantages when compared with fuel-grade ethanol.

ETBE can be blended at the refinery and transported economically via conventional means, including pipelines, barges, and ships. It has highly desirable blending properties, such as 110+ octane and low, 4 psi Reid vapor pressure. It is recognized by EPA and qualifies as a renewable fuel for RIN credit against RVO. It increases the volume of saleable gasoline because achieving the 3.7 wt % oxygen content of 10 vol % ethanol blends requires more than twice the volume of additive--22 vol % for ETBE vs. 10 vol % for ethanol. It is 99% less water-soluble than ethanol and thus reduces the risk of contamination from leaky filling station tanks. And it is manufactured economically either by converting existing or mothballed MTBE plants or by building new units. Typical costs are about \$30 million for a new, 20,000-b/d ETBE plant and \$18 million for converting an existing MTBE unit.

In the US, politics pushed some state governments, such as those of California and New York, to not consider heavy bio-ethers as acceptable substitutes for ethanol. Reconsideration of those policies is in order, as are waivers allowing the use of bio-ETBE.

- Do nothing, and continue paying exorbitant RIN prices to meet RVO quotas.

- Continue advocating for a shift in the RVO point of obligation from refiners to ethanol blenders.

The EPA on Nov. 10 proposed to deny several petitions for a rulemaking that would, in various ways, shift at least some of the RIN burden to parties other than refiners and importers, such as ethanol blenders. At present, blenders are not RVO-obligated entities (Fig. 2).

The shift, like the RFS program itself, is highly politicized. Whether it will occur and succeed or become another avenue for fraud and get-rich-quick scheming remains to be seen.

Heavy burden

Clearly, the RFS and its RVOs have been a heavy burden for US refiners. There is no single solution applicable to all refiners. Not all refiners, for example, can increase fuel exports. And not all refiners can afford to build ethanol-blending facilities.

Juggling the use of higher-equivalency RIN biodiesel, renewable diesel, and other advanced biofuels can reduce onerous RIN costs only by 10-20%, but it's better than doing nothing. Unfortunately, one of the most economic solutions is impractical because of state bans on the use of bio-ETBE.

Refiners addressing the RIN problem need to conduct thorough economic analyses of available options to establish what's feasible and practical for them. **OGJ**

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