

Refinery Lead Time Assessment

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Summary: Even without the flexibilities provided by the Tier 3 Rule, most refineries should have no difficulty complying with the sulfur standard by January 1, 2017 or earlier. The various flexibilities that the Tier 3 rule provides to refiners - the ABT program, the small refiner delay provisions and the hardship provisions - assures for those limited instances where needed that there is additional time for complying.

1 LEAD TIME IS MORE THAN SUFFICIENT FOR MOST REFINERIES TO COMPLY BY JANUARY 1, 2017 OR EARLIER

As noted by EPA in its proposal, six main planning and action steps are required for refiners to comply with the Tier 3 sulfur standards:

1. the completion of scoping studies
2. process design for new or revamped refinery units or subunits
3. permitting
4. detailed engineering based upon the process design
5. field construction of the gasoline sulfur reduction facilities, and
6. Start-up and shakedown of the newly installed desulfurization equipment.

Because of refinery modifications that were made to comply with EPA's Tier 2 requirements, EPA estimates that 17 refineries are either already in compliance with the 10-ppm standard or expected to comply with simple process changes. In addition, many refineries will only need to revamp their existing FCC posttreaters to comply with Tier 3. EPA estimates that there are 66 such refineries and their revamps can be completed within two years or less. If these refiners begin each of these revamps in 2014, these refineries could be producing Tier 3 gasoline by 2016 if they choose to and could potentially begin generating early credits during 2016 or before.

	Estimated Compliance Timelines (Months)							
	0-3	3-6	6-9	9-12	12-15	15-18	18-21	21-24
Scoping Studies								
Process Design								
Permitting								
Detailed								

Engineering								
Field Construction								
Start-up/Shakedown								

EPA estimated that 16 refineries would likely require the construction of new grassroots FCC posttreaters to provide Tier 3 fuel. These grassroots FCC posttreaters, however, are expected to be in a moderate to light desulfurization mode because the refineries they will be installed in will already be complying with Tier 2 using an FCC pretreater. FCC naphtha from a refinery with an FCC pretreater is expected to only contain about 100 ppm sulfur. To comply with Tier 3, refiners installing these grassroots FCC posttreaters would only need to desulfurize the FCC naphtha down to 25 ppm (about a 75% reduction). In comparison, a single-stage FCC posttreater would have to desulfurize FCC naphtha from as high as 2400 ppm sulfur down to 25 ppm, a 99% sulfur reduction. The more moderate desulfurization service of the grassroots FCC posttreaters needed to comply with Tier 3 would be expected to streamline the scoping and design work.

In addition, only 2 of the 16 refineries which are projected to install grassroots units were projected by EPA to exceed particular permitting limits, and these solely did so based on the most conservative assumption that each would produce all the additional hydrogen on site using hydrogen plants (as opposed to using existing reforming capacity) and produce the electricity on site, to satisfy the needs of the new desulfurization equipment. When EPA provided a second heat demand estimate which assumes that refiners purchase their hydrogen and electricity from third parties, none of these refineries was projected to have emission increases which would require offsets. Thus, many of the grassroots units that EPA projected would be installed may end up with a streamlined permitting process.

Finally, in its proposal, EPA highlights its view that in reality, less lead time than estimated would actually be necessary. EPA noted that it held discussions with many refiners during most of 2011, and they have therefore been well aware of Tier 3 and are familiar with the likely requirements. During EPA's subsequent discussions with technology vendors and engineering firms, they explained to EPA that many refiners had already initiated, and by now, likely completed their scoping studies. Thus, actual time needed for designing, installing and starting of new desulfurization equipment for Tier 3 times would even be less than what was projected because many refineries may have already completed required scoping studies in anticipation of the Tier-3 standards. Moreover, lead times for those refineries that have yet to start the scoping process can also be expected to decrease, since fewer refineries will be competing for the services of the desulfurization vendors.

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2 THREE YEARS LEAD TIME WAS ADEQUATE FOR TIER 2 AND TIER 3 REQUIRES MUCH LESS INVESTMENT

For the Tier 2 analysis, EPA assumed that refiners would solely install **low-pressure** FCC posttreaters, which it believed could be scoped out, designed, installed and started up within a 3 year time period. However, For Tier 2 virtually all refiners installed both grassroots FCC pretreaters and posttreaters. Also many refiners installed **high-pressure** FCC pretreaters which required longer lead times for the procurement of the required equipment than the low pressure equipment estimated by EPA. Furthermore, those refiners that did not install high-pressure FCC pretreaters instead installed grassroots FCC posttreaters, many of which were designed for **severe desulfurization service**. The demands on the desulfurization vendors for scoping studies, and on the E & C industry for design and construction, and on the refiners to train their operations staff and start up the new units, was a lot greater for Tier 2 than what one would expect for Tier 3.

The total estimated investment cost for Tier 2 versus Tier 3 also highlights the difference in investment demands. The total investment for Tier-2 desulfurization processing units was estimated by EPA to be about \$6.1 billion, while the total investment for Tier-3 desulfurization processing units is estimated by EPA to be about \$2.1 billion. This simple comparison indicates that the Tier 3 lead time should be substantially less for most refineries to obtain necessary permits, secure engineering and construction (E&C) resources, install new desulfurization equipment and make all necessary retrofits to meet the proposed sulfur standards.

3 EPA PROVIDES BROAD FLEXIBILITIES SHOULD ANY REFINER HAVE LEAD TIME CHALLENGES

These flexibilities include the ABT program, the small refiner delay provisions and the hardship provisions. The ABT program allows a refiner, either within its own company or by purchasing credits on the open market, to have additional time for installing grassroots FCC posttreaters units. This would occur if refiners would reduce the sulfur levels of their gasoline through operational changes or revamps of their existing FCC pretreaters and posttreaters when the ABT Program begins in 2014. Potentially every

refinery with either an FCC pretreater or an FCC posttreater may be capable of generating early credits.

EPA estimated that sufficient credits could be generated early to allow many refineries to delay compliance until as late as 2020. The quantitative early credit analysis that EPA conducted showed that if refiners with an existing pretreater or posttreater would generate early credits by lowering their gasoline sulfur down to 20 ppm starting in 2014 and if revamps were started up in 2016, one year before the program start date, that almost 6 times more credits would be available to offset the early credit demand by the refiners installing grassroots posttreater units, assuming that they start up those units in 2018. Even if all grassroots postreaters were assumed to not start up until 2020, there would be almost 4 times more early credits available to those refiners installing grassroots postreaters assuming that the same early credit generation scenario would occur

Additional flexibility is also provided by the small refineries provisions which delays compliance for the refineries which refine less than a net of 75,000 barrels of crude oil per day until 2020. Three of the 16 FCC posttreater grassroots units that EPA projects will be installed would be by small refineries. However, small refineries could also decide to comply early and generate credits starting as early as 2014.

As in previous fuel programs, EPA is also proposing hardship provisions to accommodate a refiner's inability to comply with the proposed standard at the start of the Tier 3 program, and to deal with unforeseen circumstances that may occur at any point during the program. These provisions would be available to all refiners though relief would be granted on a case-by-case basis following a showing of certain requirements; primarily that compliance through the use of credits was not feasible.