Refinery Strategy

Board of Directors Special Meeting
November 30, 2015

Eric Stevenson
Director of Meteorology, Measurement and Rules
Goals of the Refinery Strategy

- Reduce harmful emissions both regionally and within nearby communities
- Perform monitoring to measure impacts and identify potential opportunities to reduce emissions
- Limit emissions and protect health
- Ensure refinery operation changes will not increase health burden and ensure best practices over time
- Develop information over time to implement new regulatory programs
Bay Area Air Quality Management District

Refinery Strategy

Reduce Harmful Emissions: The Air District staff is developing a suite of regulations to reduce emissions of criteria pollutants from Bay Area refineries by 20 percent (or as much as feasible) by 2020. The first phase of these regulations will be considered by the Board in December 2015 and will:
- Reduce sulfur dioxide (SO₂) from coke-calcining
- Reduce organic compound and toxic emissions from equipment leaks and cooling towers
- Limit ammonia emissions from fluid catalytic cracking (FCC) units, which will reduce associated formation and emission of fine particulate matter (PM₂.₅)
In mid-2016, the second phase of the strategy will further reduce:
- SO₂ from FCC units and other refinery sources
- PM₂.₅ emissions from FCC units
- Nitrogen oxide (NOₓ) emissions from turbines

Continuous Monitoring: Draft Regulation 12, Rule 15, Petroleum Refining Emissions Tracking, will require:
- Continuously updated, state-of-the-art methods be used to calculate and report the total pollution from the refineries every year
- Extensive air quality monitoring to validate those pollution calculations and ensure surrounding communities are not subjected to unhealthy levels of pollution
- Requirements that will use emission inventories and monitoring data to identify potential reductions
- An energy audit identifying potential improvements to reduce GHGs
- New, more protective, Health Risk Assessments be performed to determine the health risk from toxic air pollutants

Limit Pollution & Protect Health: Draft Regulation 12, Rule 16, Petroleum Refining Emissions Limits and Risk Thresholds, will:
- Limit refinery criteria pollutant and toxic emissions to levels that minimize the health burden for the surrounding communities
- Require Health Risk Assessments have updated information every year as new emissions data are received

Ensure Best Practices: Air District staff is developing changes to the Air District permitting regulations to ensure that when refineries modernize or make significant changes to the type of crude oil they use, they will be required to use the best available control technology to reduce smog-forming, toxic, and climate pollutants. Over time, these changes to the permitting regulations will ensure the refineries use best practices and operate as efficiently and cleanly as possible.
Reduce Harmful Emissions

• 20% criteria pollutant reductions by 2020
  • Includes four specific refinery emission reduction regulations
  • Additional rulemaking is underway

• 20% reduction in risk by 2020
  • 12-16 sets total risk at 25 in 1 million
  • 12-15 HRA and additional monitoring requirements will aid in identifying sources for further reductions
### Reduce Harmful Emissions - Phase I

<table>
<thead>
<tr>
<th>Title</th>
<th>Pollutant(s)</th>
<th>Amount Reduced</th>
<th>Projected Completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rule 9-14: Petroleum Coke Calcining</td>
<td>SO₂</td>
<td>372 tpy</td>
<td>December 2015</td>
</tr>
<tr>
<td>Rule 6-5: Fluid Catalytic Cracking Units</td>
<td>Ammonia, PM</td>
<td>TBD</td>
<td>December 2015</td>
</tr>
<tr>
<td>Rule 8-18: Equipment Leaks</td>
<td>VOC, toxics, methane</td>
<td>1,227 tpy</td>
<td>December 2015</td>
</tr>
<tr>
<td>Rule 11-10: Cooling Towers</td>
<td>VOC, toxics, methane</td>
<td>997 tpy</td>
<td>December 2015</td>
</tr>
</tbody>
</table>

Total Reductions for 2015: **2,596 tons per year or 16%** of total refinery criteria pollutant emissions.

Phase II rulemaking planned for 2016 likely to exceed goal of 20% reductions by 2020.
Regulation 12, Rule 15 Elements

- Annual emissions inventories to determine emissions
- Fence line and community monitoring
- Crude oil composition characteristics used in future for permitting decisions
- Health Risk Assessments (HRAs) used to limit risk in nearby communities
- Energy audits used to develop Information for future regulatory action

Continuous Monitoring
Limit Pollution and Protect Health

Regulation 12, Rule 16

- Risk limit - 25 in 1 million using HRA required in 12-15
  - Future rule changes will likely incorporate this limit for all Bay Area facilities
  - Update information yearly to ensure changes don’t negatively impact health

- Implement refinery-wide criteria pollutant limits based on Potential To Emit (PTE) and National Ambient Air Quality Standards (NAAQS)
Ensure Best Practices

- Crude slate modifications trigger permitting review
  - Engineering review of criteria pollutants, GHG and TACs
- Best Available Control Technology (BACT) for criteria pollutants, GHG and TACs
  - New Source Review for all affected systems
Current Proposals
Towards 20% Reductions

- Regulation 9, Rule 14 addresses largest SO$_2$ source in the Bay Area
- Regulation 6, Rule 5 first step towards reducing PM from FCCUs
- Regulation 8, Rule 18 reduces VOC emissions from leaks
- Regulation 11, Rule 10 applies current standards to all cooling towers and identifies leaks earlier
Next Steps

- Presentations by WSPA and CBE
- Consider public comments and input
- Bring 12-15 and 12-16 to the Board for consideration in December
- Bring new and modified regulations in the Phase I of the 20% reduction by 2020 package to the Board for consideration in December
- Continue rule development and enact changes to permitting regulations and additional items in Phase II of the 20% by 2020 package
- Bring Phase II and permitting rules to Board for consideration in early 2016
Goals Achieved

- Limits set on risk and criteria pollutants
- Additional information collected to inform future emissions reductions for risk, criteria and GHG pollutants
- Achieves 16% emissions reduction with currently proposed rules
- Sets the stage for future rule making
  - Additional reduction measures to reach 20% reduction goal
  - Permitting changes will include GHG requirements
  - Permitting changes will include crude slate change review to ensure no emissions increases or use of BACT
  - Inform potential GHG rulemaking and monitor Cap-and-Trade progress
Refinery Emission Trends 1980-2015 and Main Causes of Changes

- **ROG (tpd)**
  - Reg. 8-18: Equipment Leaks
  - Reg. 8-5: Storage Tanks
  - Reg. 12-11: Flare Monitoring
  - Reg. 12-12: Refinery Flares

- **PM$_{2.5}$ (tpd)**
  - Began reporting condensable PM from certain refineries in 2009

- **NOx (tpd)**
  - Reg. 9-10: NOx at Refinery Heaters

- **SO$_2$ (tpd)**
  - Reg. 12-11: Flare Monitoring
  - Reg. 12-12: Refinery Flares
  - Scrubber at Valero per consent decree
Bay Area GHG Forecasts

GHG Emissions & Projections (Relative to 1990) with Committed & Expected Policies

[Graph showing GHG emissions and projections over time, with different sectors indicated by colors.]
Oil companies plan a switch to tar sands oil—inherently ‘dirtier’ oil that threatens our health, safety, and climate with potentially huge increases in air pollution and explosion hazards from their oil trains and refineries when they deliver and process this extreme oil.

We can stop this with emission limits that simply cap their refinery emissions before they switch to inherently ‘dirtier’ grades of oil.

Communities Presentation
30 November 2015 AQMD Special Board Meeting
by Greg Karras, Senior Scientist
Communities for a Better Environment (CBE)
From *Oil & Gas Journal* (2007)
From California Energy Commission.
Crude switching _already_ causes local refinery impacts:
1994 (Rodeo)—10X more Se release/barrel refined
1999 (Martinez)—Tosco refinery fire kills five workers
2007 (Richmond)—1st Chevron crude unit fire
2008 (Bay Area)—CO$_2$/bbl exceeds other US regions
2012 (Richmond)—2nd Chevron crude unit fire
Now (Bay Area)—more GHG, PM emit than in 1990s.

From attachments to CBE technical comments.
Total CO$_2$ emitted/m$^3$ oil refined by Bay Area refineries (circled) was the highest observed (see vertical axis) and predicted by oil quality (horizontal axis) among U.S. refining regions, as of 2008.


From CBE Attachment 13, American Chemical Society (2010) except for notes in red
Particulate matter (PM$_{2.5}$): direct industrial emissions in the San Francisco Bay Area. BAAQMD data (2010 SIP).

“Petroleum refineries account for the largest portion (93%) of the state-wide disparity score, or difference between the emissions burdens for people of color and non-Hispanic whites.”

From Pastor et al. (2010)—CBE Attachment 39.

This finding is based on population-weighted particulate emissions from all the major GHG emitting industries under cap-and-trade within 2.5 miles of these emitters.
**PM$_{2.5}$**
- All Sources / Total Bay Area
- Oil Refineries / 2.5 Mile Radius

**NO$_x$**
- All Sources / Total Bay Area
- Oil Refineries / 2.5 Mile Radius

**SO$_2$**
- All Sources / Total Bay Area
- Oil Refineries / 2.5 Mile Radius

**Annual tons emitted per square mile**

**Refinery source strength at 2.5 miles v. Bay Area Average.**
Data from BAAQMD; 2.5–mile boundary after Pastor et al. (See CBE Att. 40.)
Daily PM$_{2.5}$ levels in ambient air at the five nearest NAAQS stations to Bay Area refineries, Winter 2013/14. (ARB data.)
Outdoor *and* indoor PM$_{2.5}$ air concentrations: refinery-impacted (shaded) and control (plain) sites; Bay Area in Summer, 2006.

Boxes are interquartile ranges; black lines in boxes are medians; dashed vertical lines are 5th and 95th percentiles; circles are extreme data points. (CBE Att. 44.)
Crude feed quality drives refinery fuel energy intensity: averages observed in the Bay Area v. other U.S. regions, and combustion emissions potential for ‘tar sands’ oils.*

<table>
<thead>
<tr>
<th>Region</th>
<th>Crude feed (kg/m³)</th>
<th>Fuel energy intensity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>density</td>
<td>sulfur</td>
</tr>
<tr>
<td>East Coast</td>
<td>864</td>
<td>7.08</td>
</tr>
<tr>
<td>Midwest</td>
<td>863</td>
<td>11.7</td>
</tr>
<tr>
<td>Gulf Coast</td>
<td>879</td>
<td>14.9</td>
</tr>
<tr>
<td>SF Bay Area</td>
<td>900</td>
<td>11.9</td>
</tr>
<tr>
<td>Heavy Oil</td>
<td>957</td>
<td>27.8</td>
</tr>
<tr>
<td>Bitumen</td>
<td>1,030</td>
<td>45.5</td>
</tr>
</tbody>
</table>

* Data and potential from CBE Attachment 13; observed data are region-wide 2008 averages except Heavy Oil and Bitumen are world averages.
Staff’s Plan allows refinery emissions to increase:

Facility emissions potential exceeds piecemeal measures promise;

New facility ‘maximum potential to emit’ (PTE) ‘limits’ after tar sands projects could legalize and lock-in this emissions increase;

HRAs do not control local toxic impacts of refinery PM emissions;

The proposed GHG exemption allows a new climate threat from tar sands oil refining to be locked-in and increased local health impacts from increased refinery emissions of otherwise unregulated GHG co-pollutants—including PM$_{2.5}$ and wholly unregulated ultra-fine PM.

See CBE's and Stanford Law Clinic's comments on the Rule DEIR for details of this evidence.
Table 1. The enforceable numeric limits on refinery-wide emissions proposed\textsuperscript{a}

<table>
<thead>
<tr>
<th>Facility</th>
<th>GHG (metric tons/yr)</th>
<th>PM (tons/yr)</th>
<th>NO\textsubscript{x} (tons/yr)</th>
<th>SO\textsubscript{2} (tons/yr)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chevron Refinery, Plt. A-0010</td>
<td>4,473,000</td>
<td>529</td>
<td>974</td>
<td>400</td>
</tr>
<tr>
<td>Shell Refinery, Plt. A-0011</td>
<td>4,272,000</td>
<td>569</td>
<td>1,040</td>
<td>1,340</td>
</tr>
<tr>
<td>Phillips 66 Refinery, Plt. A-0016</td>
<td>1,512,000</td>
<td>56.0</td>
<td>275</td>
<td>433</td>
</tr>
<tr>
<td>Tesoro Refinery, Plt. B-2758/2759</td>
<td>2,456,000</td>
<td>180</td>
<td>1,080</td>
<td>707</td>
</tr>
<tr>
<td>Valero Refinery, Plt. B-2626</td>
<td>2,950,000</td>
<td>134</td>
<td>1,410</td>
<td>138</td>
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<tr>
<td>Martinez Cogen LP,\textsuperscript{b} Plt. A-1820</td>
<td>431,000</td>
<td>18.8</td>
<td>119</td>
<td>2.30</td>
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<tr>
<td>Air Liquide H\textsubscript{2} Plant,\textsuperscript{b} Plt. B-7419</td>
<td>855,000</td>
<td>17.3</td>
<td>12.9</td>
<td>2.48</td>
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<tr>
<td>Air Products H\textsubscript{2} Plant,\textsuperscript{b} Plt. B-0295</td>
<td>281,000</td>
<td>10.4</td>
<td>3.40</td>
<td>2.31</td>
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</tbody>
</table>

\textsuperscript{a} Annual facility-wide emission limits. GHG: greenhouse gas emissions (CO\textsubscript{2}e) as reported under Air Resources Board Mandatory Reporting; PM: filterable and condensable particulate matter; NO\textsubscript{x}: oxides of nitrogen; SO\textsubscript{2}: sulfur dioxide. PM, NO\textsubscript{x} and SO\textsubscript{2} as reported in the Facility’s annual emission inventory. \textsuperscript{b} The Martinez Cogen and Air Products facilities support Tesoro; Air Liquide supports Phillips 66.

From the community, environment, labor and academic groups’ specific proposal (revised 21 Sep 2015; previously delivered 18 Sep 2015; proposed in concept 27 March 2015).
Our ‘Caps’ *prevent* harm Staff’s plan could allow—they:

*Prevent* facility emission increases* that piecemeal measures allow;*

*Prevent local impacts from PM$_{2.5}$ emission increases HRAs allow;*

*Prevent a new climate threat and local health impacts of increasing ultra-fine PM by following ARB’s advice on local GHG caps needed to address otherwise unregulated toxic GHG co-pollutants;*

*Prevent the maximum potential to emit from new tar sands projects before they are locked-in and it may be too late to reverse them;* &

*Prevent a potential explosion of local oil train traffic to deliver tar sands oil by prohibiting the emissions increase from refining it here.*

* Our ‘Caps’ are the only Bay Area refinery emission limits proposed now that are specific, apply facility-wide and are enforceable on adoption—as they *require no change in current performance*. This fact also supports them as reasonable.  See CBE et al., 21 Sep 2015 Revision, for details.
The original need assessment for this Rule further supports the need to act on the evidence outlined above.

“The use of lower quality crude at refineries could potentially mean increased emissions of air contaminants such as sulfur containing pollutants ... Processing lower quality crudes also requires more intense processing and higher energy requirements, which can result in increased air emissions.”

From BAAQMD’s 30 May 2012 Draft Regulatory Concept Paper for this rulemaking at page 3; and BAAQMD’s 15 October 2012 Draft of this same ‘Concept Paper’ on the same page (p. 3).