MEMO

October 10, 2013

Initial Response of the Collaborative to the Findings & Recommendations of


*Improving Public and Worker Safety at Oil Refineries*
Dear Task Force Leadership,

This Memo signals the intent of the Refinery Action Collaborative of the San Francisco Bay Area to engage in the process of contributing to, and helping to implement, the recommendations contained in the Draft Report of the Interagency Working Group on Refinery Safety (Report) of Governor Jerry Brown. We believe the Report has set the stage for meaningful and positive changes in the refinery sector. This Memo contains our initial assessment and recommendations in ten areas that we believe should be strengthened and/or clarified.

We recognize that the Report is an overarching assessment of a range of steps California will need to take to shift the culture in the refinery sector toward greater emphasis on health, safety and environmental performance, based on a foundation of inherent safety. We recognize that—to be implemented—nearly all of the recommendations in the report will require sustained effort on the part of government agencies, workers, communities, and refinery leaders. We stand ready to contribute to the success of this important and timely process.

We applaud the Working Group for successfully crafting a set of recommendations that, when implemented, will place California in a position of national leadership in refinery safety, health and environmental performance.

Section I. The Current Context

We believe the Report and the pending work of the Task Force are extraordinarily important; they have emerged on the California stage as a consequence of a nearly catastrophic industrial disaster. We strongly urge the Task Force to move as rapidly as possible during what we believe is an historic opportunity to make improvements in the health, safety and environmental performance of the state’s refineries. The outcome of this work will have implications for improving industrial practices at the 1,670 other hazardous process sites in California, and it will have significant consequences for the state’s future.

By 2050, California’s population is expected to grow by about 50%, from 36 to 55 million residents. While this expansion will likely be accompanied by a growing set of social, economic, and environmental problems, the magnitude of those problems will be determined in large part by the policy decisions California makes now and in coming years. The recommendations contained in the Report are not an exception: in charting a course to a sustainable future, California will need to guide industrial activity and development in such a way that it fully integrates matters of environmental quality and human health. In practice, if California is to create a future characterized by improving social, environmental, and economic conditions, industrial activity—including in the refinery sector—will need to solve, not exacerbate, the public and environmental health problems facing the state today.

The comments of the Collaborative contained in this initial Memo have been prepared in this spirit, wherein we believe the current set of conditions represents both an historic opportunity and a matter of great public importance. We believe that assertive and comprehensive action by California’s governmental bodies to reframe the state’s refinery regulatory structure is both warranted and timely.

Such action is supported by the findings of investigations following the August 6, 2012 fire at the Richmond, Chevron refinery. Findings by the California Attorney General’s office and Cal/OSHA portrayed a striking pattern of inattention and neglect on the part of Chevron in ways that endangered the lives of workers and Richmond residents over a period of at nearly 10 years.
The U.S. Chemical Safety and Hazard Investigation Board (CSB), in its *Interim Investigation Report on the Chevron Richmond Refinery Fire*, concluded that the state’s refinery regulatory structure is fundamentally broken and will require a thorough restructuring to be effective. These findings were articulated in testimony by CSB senior management before hearings of the California Legislature. CSB Western Regional Director Don Holmstrom testified in Richmond before a joint hearing convened by Assemblymember Nancy Skinner and Senator Loni Hancock that the Chevron, Richmond fire was not an unexpected event, and that California will be able to prevent another incident of this magnitude only through a comprehensive re-envisioning and re-structuring of its regulatory programs. The CSB concluded that changes made around the edges of existing programs would not be able to influence the poor safety culture at sites such as the Richmond, Chevron refinery, which the CSB and others have found is endemic in the California and U.S. refinery sector.

The data illustrate that the Chevron, Richmond fire was not an extreme outlier in the safety performance of the California refinery sector. In the five months following the Chevron fire (August 6, 2012 to January 14, 2013) the California refinery industry reported 30 to 35 upset events to the U.S. Department of Energy, including fires, hydrogen sulfide releases, unexpected flare events, mechanical breakdowns and others.\(^1\)

With some exceptions, other countries that refine oil have experienced a decline in major refinery incidents over the last decade, whereas the U.S. appears to be following the opposite trajectory. According to a report by SwissRe, the world’s second-largest reinsurer, the loss burden per refinery per 1000 barrels per day processed in the U.S. cluster of countries (U.S. $24,800) is about 3 times that of the EU cluster of countries (U.S. $8,500)\(^2,3\). SwissRe concluded that the higher losses experienced in the U.S. result in from the complexity of the refinery industry here and to problems in the refineries related to the following:

- A pushing, or daring, mode of operation;
- A compliance-driven focus on safety;
- Fluctuating and low levels of staffing;
- The extensive use of outside contractors;
- Conducting certain repairs, upgrades and changes while the refinery is actively operating;
- Allowing extensive time to pass (up to 6 years) between turnarounds, when major repair and upgrade work occurs;
- A low level of attention to ongoing maintenance;
- A “detached” workforce that results from continued changes;
- Workforce training that is limited to specific jobs, rather than whole systems;
- Vessel and pipe inspection processes that are largely self-regulated by individual companies.\(^4\)

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\(^4\) Zirngast, Ernt. op cit. pp. 24-29.
In a 2012 briefing to the CSB, SwissRe officials reported that the incident gap between U.S. refineries and those in other parts of the world had widened since their 2006 report.\(^5\)

In its April 2013 report, the CSB documented Chevron’s lack of attention to maintenance and metallurgy upgrades, which—if implemented—would likely have prevented the catastrophic piping failure and subsequent fire on August 6, 2012. The CSB found that Chevron had ignored at least six recommendations over a period of ten years (2002, 2006, 2007, 2009, 2011, 2012) by the company’s own technical personnel to upgrade the metallurgy and/or increase pipe inspections, including at the 4-sidecut piping where the failure occurred.\(^6\)

These recommendations by Chevron personnel were made during a period when catastrophic failures due to sulfidation corrosion were occurring on a regular basis in the refinery industry, including at Chevron’s El Paso, Texas refinery (1988), Chevron’s Pascagoula, Mississippi refinery (1988 and 1993), Chevron’s Salt Lake City, Utah refinery (2002), Chevron’s Richmond, California refinery (2007), the Silver Eagle refinery in Woods Cross, Utah (2009), the Regina, Saskatchewan, Canada refinery (2011), and the BP Cherry Point, Washington refinery (2012).\(^7\)

The CSB report shows that in 2010, Chevron technical personnel reiterated the need for a 100% component inspection protocol, stating:

*Sulfidation corrosion failures...are of great concern because of the comparatively high likelihood of “blowout” or catastrophic failure. This typically happens because corrosion occurs at a relatively uniform rate over a broad area, so a pipe can get progressively thinner until it actually bursts rather than leaking at a pit or local thin area. In addition, the process fluid is often above its autoignition temperature. The combination of these factors means that sulfidation corrosion failures frequently result in large fires. Chevron and the industry have experienced numerous failures from this mechanism and recent incidents have reinforced the need for revised inspection strategies and a robust PMI (Positive Materials Identification) program.*\(^8\)

The CSB found that the recommended component inspection program for high-risk piping “was not implemented at Richmond; therefore, the thin-walled low silicon 4-sidecut piping component remained in service until it catastrophically failed on August 6, 2012.” CSB concluded that Chevron’s reliance on over 100 temporary “clamps” on hydrocarbon and other process piping components “raised serious questions about its mechanical integrity program.” \(^9\)

CSB’s recommendations R9 to R14 are aligned with many of the recommendations made in both the June 2013 UC Berkeley LOHP report and the Working Group Report.\(^10\)

Clearly, improvements in safety, health and environmental performance continue to be urgently needed in the refinery sector in California, as well as nationally. California has an opportunity to provide national leadership in this arena by taking steps to improve transparency, accountability, and regulatory oversight in the State’s refineries. The SwissRe

\(^{5}\) Holmstrom, Don. (January 23, 2013). Western Regional Manager, U.S. Chemical Safety and Hazard Investigation Board, presentation at the United Steelworkers (USW) Local 5, Martinez, California.


\(^{8}\) CSB, *op cit.* p. 25.

\(^{9}\) CSB, *op cit.* pp. 62-63.

\(^{10}\) CSB, *op cit.* pp. 56-57.
findings suggest that in other nations and regions, these kinds of regulatory actions—such as embodied in the Safety Case approach—have greatly reduced upset events that endanger worker, public and environmental health, and they have done so without compromising the refinery industry’s efficiency or competitiveness. We believe the same thing can be achieved in California.

Section II. Initial Response to the Governor’s Working Group Report

1) Revisit and integrate the findings of the June 2013 UC Berkeley LOHP report.

In general, we support the Report’s categorization of findings and recommendations into the areas of Interagency Refinery Task Force; Emergency Response and Preparedness; Safety and Prevention of Hazardous Events; and Community Education and Alerts. This approach reflects that of the UC Berkeley Labor Occupational Health Program (LOHP) report of June 2013, which used three categories in its analysis: (1) Preparedness, Monitoring and Emergency Response; (2) Prevention; and (3) Sustainability. 11

At the same time, we strongly encourage the Task Force to revisit and integrate the findings and recommendations of the LOHP report, which captured the views of a diverse set of labor, community, and fire agency leaders in the course of 15 meetings in both Northern and Southern California. The LOHP report identifies problems that were raised repeatedly by individuals participating in these meetings, and it summarizes practical solutions to those problems. Many of these are missing from the Task Force draft.

LOHP’s section on Sustainability, for example, is missing entirely from the Report, yet the LOHP report identifies three critical issues in this section that can and should be addressed by the state’s refineries: (1) the health, safety and environmental implications of the increasing sulfur content of oil feedstocks; (2) the substantial energy footprint of refinery processes; and (3) the lack of attention to emissions of toxic air contaminants by the refineries. These problems are of great importance to local communities and to workers; they are linked to the state’s greenhouse gas reduction efforts; and they are essential to placing the state’s refineries on a more sustainable footing. They fall within the purview of the Task Force and we believe they should be addressed both in the Report and in the Task Force’s scope of work.

We have attached as Appendix A a comparison of the recommendations contained in the LOHP report against those of the Task Force report. The June 2013 LOHP report is attached as Appendix B. We hope these documents will help guide the Task Force in identifying and addressing areas that have been omitted from the Task Force draft report.

2) Shift the costs of emergency preparedness and response from public agencies to the industry.

We recognize that it is necessary to prepare for an incident while also working to prevent one, and the draft Task Force report reflects this approach. We believe that failures of the emergency response system are fundamentally an environmental justice issue, in that they disproportionately affect members of communities who live in closest proximity to the state’s refineries. Fire department responses to refinery incidents are also a drain on the resources of fire agencies. A refinery fire requires mutual aid from neighboring fire agencies.

departments, which are then less able to respond to incidents in their own jurisdictions, where citizens have paid for those services through their taxes. The refineries receive these public fire department services at no cost. For these reasons, cost-recovery should be included in every recommendation made in the Emergency Preparedness and Response section, and the refineries should be required to cover the costs of fire department training and equipment relevant to refinery emergency response.

Finally, the Task Force should make every effort to avert an emergency by taking regulatory actions—as outlined in this Memo—that will motivate the refineries to invest in inherent safety, preventative maintenance and other measures to protect community and worker health and safety.

3) Integrate inherent safety throughout the Report.

Inherent safety is recognized in high hazard industries as the foundation to effective prevention; it is also the key element in reducing the conditions that give rise to catastrophic events and the need for an emergency response. Inherent safety is thus the foundation of both prevention and emergency response.

Inherent safety should be a core theme in the Report; it should serve as the foundation for the majority of the Report’s recommendations; that is, each recommendation articulate the ways in which it will improve attention to, or investment in, inherent safety by refinery operators. The section on Emergency Response and Preparedness, for example, should acknowledge the role of inherent safety in preventing the conditions that give rise to an emergency, rather than simply describing how to improve emergency operations.

Inherent safety is the link between emergency response and prevention, and the report should reflect this fact.

4) Include timelines, implementation procedures, and reporting requirements throughout the Report.

Timelines and reporting are an important measure of accountability, both for the public and within government agencies. Aside from establishing the Task Force by September 1, 2013, the Report does not contain timelines or deadlines, nor does it contain descriptions of the procedures that the Task Force contemplates will be employed to implement the recommendations. We recognize that each recommendation will require a unique implementation schedule and procedure, each of which is inherently complicated; at the same time, to improve accountability, we believe it is necessary to include more detailed timelines, procedures and reporting processes in a subsequent draft of the Report.

In addition, many of the recommendations are vague. We identified nearly 20 questions over the recommendations listed under “Improved Area Plans” in the Emergency Response and Preparedness section. For example:

- To whom will the state Office of Emergency Services report on progress made in this section, and what timeline will they follow?
- What action does the term “should” require on the part of relevant parties in this section?
- What kinds of “trigger points” during a refinery incident would compel the incident commander to call for mutual aid?
- What does “significant communication with the public” mean?
- In what ways would the ARB and CUPAs be involved in an emergency response,
and how will this be integrated into the existing fire command structure?

- What procedures will be put in place to ensure that public fire agencies are in control of public communications during a refinery incident?
- Who will pay for the recommended training exercises between public agencies and refineries? Will these require payment of overtime and the purchase of personal protective equipment and specialized equipment?

5) Improve transparency by requiring proactive reporting by refineries to workers, the public and to agencies in all applicable recommendations.

Proactive reporting of information by refinery operators is a critical element to the successful implementation of the Report’s recommendations and should be included in many of the recommended changes. Former Cal/OSHA Chief Ellen Widess, for example, testified before the U.S. Chemical Safety Board that her agency found it difficult to obtain the information it needed to assess worker health and safety risks at the state’s refineries.

The refineries can and should be providing robust, real-time public information via the web of any emissions detected by plant monitoring stations; these data can be integrated with real-time meteorological data to provide both routine and emergency information to the public. The prevention strategies listed in sections 3.1 (a) (b) (c) (d) and (e) (pp. 27-28) should include some form of proactive reporting by refinery operators to workers, the public, and government agencies.

Disclosure by the refineries of the quality of crude oil entering the plant is necessary for assessing the efficacy of a plant’s safety measures and air pollution controls. Current and historic data should be reported to the Air Districts and to Cal/OSHA and should include, at a minimum, the density and sulfur content of the total crude slate processed and the volume of each named crude oil processed, at each refinery. Public reporting should include, at a minimum, annual averages of these data for each refinery, beginning by the end of 2013.

While we recognize that information disclosure alone is not usually sufficient to achieve continuing performance improvements by industry, the record of the Massachusetts Toxics Use Reduction Act (TURA) and the federal Toxics Release Inventory (TRI) illustrate that public reporting can be an effective means of motivating positive changes in industry.

Public reporting is also important for accountability on the part of government agencies. Many of the recommendations in the Report would benefit from a section describing proactive reporting procedures that the Task Force will put in place to ensure that the public remains informed.

There is a strong tradition in the U.S. of public interest groups analyzing and translating complex information from industry and government agencies into forms that are actionable by the public; this requires that the information be made available. We believe that mechanisms to ensure transparency are essential to most of the Report’s recommendations and should be included accordingly.

6. Improve accountability by requiring verification of industry-led assessments in all applicable recommendations.

There are multiple areas in the report that describe assessments or analyses conducted by the industry, including, for example, at 3.1(a), (b), (c), (d), (e) (pp. 27-28). We support shifting the “burden of proof” of safety from public agencies to the industry, as is required in the “Safety Case” approach; however, there is an inherent conflict-of-interest in requiring industry to accurately self-report its own safety and health deficiencies. We do not believe it is
sufficient to simply require industry to self-report.

All areas of the Report that include an industry self-reporting requirement must include a credible, transparent and robust oversight mechanism to ensure accountability. We believe this function might be most effective if performed by a private-sector auditor with demonstrated expertise in the area of interest, rather than by a government agency; however, for a third-party audit of this nature to be credible, it must (1) be paid through an industry-based consortium rather than by individual refinery operators, (2) include meaningful participation by worker and community representatives, (3) be fully transparent on all counts, including metrics used, communications conducted, processes examined and so forth, (4) require a public presentation of findings, and (5) include a mechanism for worker and community representatives and government agencies to appeal findings and recommendations.

Transparency, accountability and credibility are implemented in practice by proactive reporting on the part of refinery operators and credible third-party audits, respectively. As such, we strongly encourage the Task Force to (1) improve transparency by including the public and workers as recipients of information in all areas of the Report where information is generated for government agencies by refinery operators, (2) improve accountability by requiring third-party auditing of refinery-generated information, and (3) improve credibility by requiring that all auditing mechanisms include an oversight component that includes the five criteria noted above.

7) Ensure meaningful participation by worker and community representatives.

We define meaningful participation to include three elements:

1. **Timing.** Opportunities for participation should occur early in the process and should continue throughout;

2. **Authority.** Opportunities for participation should be made where actual decision-making takes place, not simply in an advisory or consultative role;

3. **Support.** Participation by community and worker representatives should be subsidized financially by the agency through fees assessed on the regulated industry.

The Report establishes a Labor Management Committee, Regional Safety Forums, and it expands the Safety Summit concept initiated in Contra Costa County’s Industrial Safety Ordinance (ISO). There is also discussion (p. 13 and p. 32) of the State Emergency Response Commission (SERC), the Local Emergency Planning Committees (LEPCs), and (p. 18) public meetings after safety plan reviews, as occurs under the ISO. It is not clear in the Report whether, or to what extent, any of these committees meet the three elements noted above.

We also strongly encourage the Task Force to include communities and environmental NGOs in studying the matter of Worker Involvement (3.5, p. 30).

8) Establish an integrated enforcement structure with meaningful financial penalties.

As currently structured, the agencies responsible for overseeing various aspects of health, safety and environmental performance in the refinery sector do not communicate with each other, nor do they coordinate their efforts. Cal/OSHA inspectors, for example, are unaware of the extent to which individual refineries have received fines for violations of environmental, CUPA, tax or other regulations.

California’s Labor Enforcement Task Force, which is working to address underground employment in the state, has recognized that
employers who violate environmental regulations are likely to violate other laws and regulations, such as those pertaining to worker health and safety, public reporting, taxation, and so forth. The Refinery Task Force should make every effort to coordinate the activities of the agencies working on refinery safety and produce an integrated enforcement strategy. That strategy should include (1) public reporting on the full extent of a refinery’s violations of California laws and regulations, and (2) penalties that escalate meaningfully if and when violations accumulate in number and severity across agencies.

Meaningful penalties are a matter of proportion in the refinery sector. Enforcement is addressed on page 29 of the Report and describes the need to improve capacity by (1) raising penalty levels, (2) increasing agency staffing, and (3) requiring refineries to provide timely information to regulatory agencies. Enforcement is also implied in the Emergency Response section in descriptions of changes to Hazardous Materials Area Plans. We support these recommendations.

Without a meaningful penalty structure, however, fines levied by agencies against refinery operators are unlikely to improve a plant’s safety culture or provide the motivation for launching potentially costly investments in inherent safety. Page 19 of the Report, for example, points out that Cal/OSHA’s proposed $1 million fine for violations related to the August 2012 Chevron fire is small relative to Chevron’s daily revenues of about $185 million. In addition, because Chevron subsequently appealed the citations, they were not required to abate the violations during the appeal process. The Bay Area Air Quality Management District issued a $25,000 fine to Chevron for the August 2012 fire. Clearly, the current scale of these penalties in the refinery sector is in need of revision.

The regulatory goal here is to internalize management’s motivation to continually improve inherent safety and safety performance in the interest of the plant’s competitive advantage, not simply out of fear of “getting caught” for noncompliance.

Penalties are one of many vehicles for meeting this objective, and no vehicle works well in isolation. Criminal charges, for example, do not often reach the highest levels of corporate decision-making where, in most cases, the origins of a weak safety culture at a specific facility are likely to be found. Both criminal and civil charges, when successfully adjudicated, do not necessarily motivate positive changes in a plant’s culture that endure over time.

In and of themselves, however, penalties for non-compliance should be integrated and cumulative across agencies; financial penalty levels should escalate as the number and severity of violations increases across agencies; and financial penalties should be assessed such that they are meaningful relative to a plant’s financial throughput.

9) Include action on industry permits as part of an integrated enforcement strategy.

In addition to the above, enforcement actions should be linked to a refinery’s “license to operate;” that is, by including in the enforcement portfolio the ability of agencies to take action on land-use permitting, discharge permitting, CEQA reviews and other regulatory processes that affect a refinery’s ability to expand or perform specific operations.

This approach is similar to many other California regulatory processes, including the issuance of driver’s licenses under the Department of Motor Vehicles, contractor’s licenses under the Contractor’s State Licensing Board, business licensing under the state Department of Consumer Affairs, and others.

The Report should articulate a full complement of regulatory tools, including (1) proactive disclosure of information by refinery operators
to agencies, the public and workers; (2) credible third-party verification of this information with oversight as noted above; (3) coordinated and escalating financial penalties across agencies; and (4) withholding of permits as part of the enforcement process. If deployed in a comprehensive manner, an enforcement strategy of this nature would begin to motivate continued learning, innovation and investment in inherent safety and environmental performance on the part of refinery operators.

A comprehensive regulatory structure would begin to correct, for example, the perverse incentives that currently exist around preventive maintenance performed during turn-around periods. Members of the United Steelworkers union Locals 5 (Bay Area) and 675 (Los Angeles) have pointed out repeatedly that the incentives in the refinery management structure motivate managers to defer turn-around periods for years, and to minimize both the scope and thoroughness of repair tasks performed during the turn-around periods themselves. The SwissRe report noted that the extensive time period between turn-arounds in the U.S. refinery industry is one of several contributors to the high loss rate in the U.S.

10) Outline the principles that will guide the Task Force in restructuring California’s regulatory framework.

The CSB pointed out in hearings and in its Interim Report that preventing another incident such as occurred on August 6, 2012 at the Richmond, Chevron refinery will require a deep re-structuring of the state’s regulatory programs, not simply isolated regulatory fixes. The CSB noted that such changes are needed to produce real improvements in the safety culture of the refinery sector, which, in turn, are prerequisite to motivating refinery investments in repairing, rebuilding, maintaining, and continually upgrading the refinery infrastructure and the systems that monitor and protect worker, community and environmental health and safety.

We have presented a set of recommendations, above, that we believe will help the Task Force build the foundation for continual improvement in the safety culture of California’s refinery sector. These recommendations grow out of a set of 12 principles that we believe are important in developing effective regulatory policy. Without assigning priority, these principles include the following:

1) Take immediate action to protect workers and residents who are most at risk;
2) Orient regulatory efforts toward inherent safety and primary prevention;
3) Require proactive generation of information by industry to agencies, workers, and the public;
4) Provide for credible auditing of industry-generated information;
5) Integrate meaningful participation in decision-making by workers and communities;
6) Coordinate outreach and enforcement actions across agencies and across the product or process lifecycle;
7) Develop penalties for non-compliance that are meaningful relative to a facility’s financial throughput;
8) Link regulatory non-compliance to an operator’s license to operate;
9) Post industry safety performance metrics online in forms that are accessible and understandable by the public;
10) Shift regulatory and oversight costs to the regulated industry;
11) Place the fewest demands on public agencies;
12) Leverage market forces wherever possible.

We believe these principles, some of which we have included in our recommendations, can help inform the Task Force as it finalizes the Report and as it implements the changes that are needed in the state’s regulatory framework. We suggest that the Report would benefit by a
brief description of the policy principles that the Task Force believe underpin its recommendations.

Thank you for considering our input regarding the Report, and we look forward to working with you on next steps.

On behalf of the Collaborative:

/s/

Diane Bailey
Senior Scientist
Natural Resources Defense Council

Charlotte Brody
Vice President for Health Initiatives
BlueGreen Alliance

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University of California, Berkeley

Miya Yoshitani
Associate Director
Asian Pacific Environmental Network

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### LOHP RECOMMENDATION

#### GOVERNOR'S WORKING GROUP RECOMMENDATION

**BUCK STOPS EMERGENCY RESPONSE**

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<td>Require that fire brigades and refinery fire departments operate with radios and frequencies that allow regular communication with public fire agencies. Ensure timely access to the refineries by public fire agencies for training, incident pre-planning and during a reported incident.</td>
<td>Cal OES (Governors’ Office of Emergency Preparedness) creating refinery specific elements in Hazardous Material Area Plans.</td>
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<td>This should include provisions that require refineries to submit a quarterly report to the public fire agency on all incidents that occurred on-site but were handled by plant personnel alone. This information is an indicator of potential problems. This information should also be made publicly available in a format that is easy-to-access and evaluate. The refineries should provide financial support for public fire agencies, including for training purposes, as noted below.</td>
<td>Cal OES with other state and local agencies to evaluate improvements to public input during emergency planning, enhanced public information, alerts and outreach during emergencies and enhanced public availability of air monitoring information.</td>
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<td>California should clarify that at a refinery incident, the responsibility for requesting additional resources and communicating with the public rests solely with the senior public fire officer on scene. “Trigger points” should be investigated as a mechanism for automatically deploying additional public agency resources to a major refinery incident; technical experts in air monitoring, exposure assessment, and toxicology should be incorporated into the incident command system to provide timely and accurate information to the public; these experts should be drawn from public agencies, not from refinery personnel.</td>
<td>CAL OES</td>
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<td>California should evaluate strategies for refineries to “pre-pay” public fire agencies for emergency response and equipment costs, including payments for overtime to back-fill positions for the duration of an incident, if necessary. When a refinery does not staff its own on-site fire department, the refinery should support the full costs of public fire agency staffing, training, and specialized equipment necessary for responding effectively to refinery incidents, including fires; hazardous materials releases to air, water, or soil; and technical rescues from confined spaces and other difficult-to-access sites at the refinery.</td>
<td>The Working Group will estimate the costs to implement the Task Force program and identify mechanisms for covering these costs. Costs should be funded through fees on refineries operating in California.</td>
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<td>California should ensure that air districts, in cooperation with refinery managers, the state Air Resources Board and public fire agencies, have the capacity to effectively monitor air contaminants during unusual refinery events and communicate this information to the public through the full range of potential media. The districts should also establish systems to communicate this information to health care providers, emergency responders and others. The refineries should carry the costs for the purchase and maintenance of state-of-the-art, real-time air monitoring equipment and communications systems.</td>
<td>Governors’ Office of Emergency Preparedness to clarify reporting thresholds for releases or threatened releases. Recommendations for what ARB and CAPCOA should have in their project plan. CAL ARP must be strengthened so refineries are required to do an annual compliance audit and submit it to CAL ARP and CUPAs should do an inspection and evaluate the CAL ARP RMP at least annually.</td>
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**CAL OES**
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<td>California should ensure that air districts, in cooperation with the state Air Resources Board, have the capacity to conduct air monitoring for toxic air contaminants, particulate matter, and other air pollutants on a routine basis and that they post that information online in an easily accessible and understandable format. The districts should establish systems to proactively communicate this information to the public, while also acknowledging areas of uncertainty. Health warning levels for both acute and chronic effects should be those established by the California EPA Office of Environmental Health Hazard Assessment (OEHHA) and should be calibrated for the actual mixed exposures that occur in the population, not simply for individual chemical substances. Warning levels should be calibrated for mixed exposures to children and other susceptible groups. The refineries should carry the costs for the purchase and maintenance of state-of-the-art, real-time air monitoring equipment and communications systems.</td>
<td>CA OES, Group, ARB, CAPCOA, Working Group</td>
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<td>California should require direct monitoring at emission points and reporting by all refineries. Air districts should post all flare and other upset events on a publicly accessible and useable website.</td>
<td>CAL OES, Group, ARB, CAPCOA, Working Group</td>
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<td>California should ensure that refineries fund the development of effective, audible warning sirens and a dedicated website that is accessible by hand-held devices and can be regularly updated by a public agency. These systems should be coupled with other outreach strategies to the public, including pre-arranged agreements with radio and television stations. Funding to support ongoing training of neighborhood-based, community emergency response teams (CERTs) would improve the ability of residents to respond to—and recover from—a major industrial incident.</td>
<td>CAL OES (Governors’ Office of Emergency Preparedness) creating refinery specific elements in Hazardous Material Area Plans. The Working Group will estimate the costs to implement the Task Force program and identify mechanisms for covering these costs. Costs should be funded through fees on refineries operating in California. Recommendations for what ARB and CAPCOA should have in their project plan.</td>
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<td>California should ensure that local transit districts have developed strategies to respond effectively in the event of an industrial emergency.</td>
<td>CAL OES (Governors’ Office of Emergency Preparedness) creating refinery specific elements in Hazardous Material Area Plans.</td>
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<td>California should require the refinery industry to conduct a comprehensive audit of corrosion damage, and the results should be reported publicly. A useful initial measure for providing information on corrosion damage is through reporting on the use of clamps and Management of Change (MOC) actions taken for each clamp. Ongoing auditing and public reporting of clamp usage, and its scheduled replacement time, should be required of the refineries to ensure that corrosion risks are identified, prioritized, and repaired.</td>
<td>CAL ARP must be strengthened so refineries are required to do an annual compliance audit and submit it to CAL ARP and CUPAs should do an inspection and evaluate the CAL ARP RMP at least annually. Plus incorporate S of the art prevention strategies into the CalARP and Cal/OSHA PSM programs through regulation or statute. For example, enforceable requirements for inherently safer systems could be incorporated into the CalARP and PSM programs, or they could be required in legislation adopting major components of the Contra Costa County ISO into California law. Five strategies are: 1. Require refineries to implement inherently safer systems to the greatest extent feasible. 2. Require refineries to perform periodic safety culture assessments. 3. Require refineries to adequately incorporate damage mechanism hazard reviews into Process Hazard Analysis. 4. Require refineries to complete root cause analysis after significant accidents or releases. 5. Require refineries to explicitly account for human factors.</td>
<td>Task Force</td>
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</tbody>
</table>
California should require the implementation of a transparent and robust preventive maintenance program at all refineries, including elements noted below. California should put in place procedures for workers to report unsafe operational conditions to a regulatory agency, in addition to reporting to plant managers.

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Responsible Parties</th>
<th>Task Force</th>
</tr>
</thead>
<tbody>
<tr>
<td>California should require refineries to disclose to government, employee representatives, and to a publicly accessible database normalized information on (i) maintenance and safety requests made, (ii) corrective actions taken or not taken, (iii) outcomes, (iv) root causes of the maintenance or safety problem, and (v) the management individual accountable. An accessible record of this type will highlight best practices among leading refineries and will allow government, the public, and workers to track refinery performance. Regulatory actions should be triggered based on the number of maintenance and safety requests left open and uncompleted over a defined period of time.</td>
<td>All in 28 B and Task Force to analyze patterns and trends in refineries’ worker safety and environmental performance to determine if additional regulatory authority is needed and to encourage the adoption of industry best practices at refineries, and identify what additional information is needed from refineries to enable regulatory agencies to provide more effective oversight; and convening of Refinery Safety Forums and expansion of safety summits.</td>
<td>Task Force</td>
</tr>
<tr>
<td>California should require refineries to report the number of contract workers hired each year who perform construction, maintenance and repair work inside the refinery, including those from outside the state; their duration of employment; their level of training; and the positions these workers fill</td>
<td>not addressed</td>
<td>Task Force</td>
</tr>
<tr>
<td>California should require that refineries operate with a tripartite labor-management-government structure for decisions pertaining to health, safety and environmental performance</td>
<td>Labor Management committee convened by Task Force that will consider TOP, protection of whistle-blowers, etc</td>
<td>Task Force</td>
</tr>
<tr>
<td>California should require refineries to disclose to government and to a publicly accessible database normalized information on (i) leading, lagging, and near-miss performance metrics, including both planned and unplanned flaring events; (ii) corrective actions taken or not taken; (iii) outcomes; (iv) root cause of deviations in the performance metric; and (v) the management individual accountable.</td>
<td>All in 28 B plus Task Force to develop recommendations after safety forums plus Cal OES with other state and local agencies to evaluate improvements to public input during emergency planning, enhanced public information, alerts and outreach during emergencies and enhanced public availability of air monitoring information.</td>
<td>Task Force, Cal OES</td>
</tr>
<tr>
<td>California should take steps to increase the effectiveness of the PSM unit by considering collaborations with sister agencies and by assessing PSM staffing levels and technical training. California should also enhance Cal/OSHA’s existing refinery permitting and inspection requirements, including those implemented by the PSM unit</td>
<td>28B plus more enforcement, more coordination between agencies</td>
<td>Task Force</td>
</tr>
<tr>
<td>California should (i) establish an interagency regulatory entity with broad authority to oversee the safety and environmental performance of the state’s refineries and other hazardous process industries</td>
<td>Task Force to study the safety case</td>
<td>Task Force</td>
</tr>
<tr>
<td>Evaluate the ISO for areas that are in need of modernization and strengthening, and then evaluate its efficacy as a statewide model</td>
<td>All in 28 B plus specific language on amending current PSM and CalARP programs through either rulemaking or legislation</td>
<td>Task Force</td>
</tr>
</tbody>
</table>

**SUSTAINABILITY**

California should require air districts to promulgate rules prohibiting increases in routine and episodic air emissions from refineries that result from the use of higher sulfur-content oil inputs. California should consider rules that would bar or limit the importation of refined oil products into the state.

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Responsible Parties</th>
<th>Task Force</th>
</tr>
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<tbody>
<tr>
<td>California should require the refineries to (i) conduct a comprehensive energy audit; (ii) produce an annual, detailed, online report on the results; and (iii) meet an energy reduction schedule.</td>
<td>Not addressed</td>
<td>Task Force</td>
</tr>
<tr>
<td>California should require refineries to rapidly and continually reduce emissions through the use of Best Available Control Technologies (BACT) or Best Available Retrofit Control Technologies (BARCT), as defined under the Federal Clean Air Act and elsewhere.</td>
<td>Not addressed</td>
<td>Task Force</td>
</tr>
</tbody>
</table>
SUMMARY REPORT

Refinery Safety in California:
Labor, Community and Fire Agency Views

March 27, 2013
Revised June 4, 2013

Michael P. Wilson, PhD, MPH
University of California, Berkeley
June 3, 2013

Prepared for:
Office of Governor Jerry Brown
Interagency Task Force on Refinery Safety

CENTER FOR OCCUPATIONAL AND ENVIRONMENTAL HEALTH (COEH)
LABOR OCCUPATIONAL HEALTH PROGRAM
About the Labor Occupational Health Program (LOHP)

The Labor Occupational Health Program (LOHP) operates under the aegis of the Center for Occupational and Environmental Health (COEH) at the University of California, Berkeley, School of Public Health. LOHP is one of the nation’s preeminent public university outreach programs for advancing community, worker and environmental health. In addition to its educational programs, LOHP organizes strategic partnerships, conducts participatory research, provides technical assistance, consults on occupational health standards and policies, and serves as a link between the University and workers, employers, government, and communities.

The California Legislature established LOHP’s parent organization, COEH, in 1978 (AB 3414) to support the University of California in conducting research, teaching and public service for the purpose of solving the state’s occupational and environmental health problems. COEH commissions policy-relevant research, provides technical assistance to policymakers and the public, and disseminates research findings and recommendations through peer-reviewed publications and special briefings. The Northern California COEH consists of researchers and practitioners at the UC campuses of Berkeley, San Francisco, and Davis.

About the Summary Report

This report responds to a January 2013 request for technical assistance by the Governor’s Interagency Taskforce on Refinery Safety. The report was first released by LOHP on March 27, 2013. This revision, released June 4, 2013, includes the views of the California Building and Construction Trades, as well as new information on the interim findings of the U.S. Chemical Safety and Hazardous Investigation Board (CSB) and updated information provided by labor unions, community groups, and fire agency officials that originally appeared in the 1st report.

This revision addresses the matter of construction, repair, and maintenance work performed during refinery turnaround periods. It is clearly in California’s interest to ensure that turnaround work (i) is performed by highly trained and skilled California workers; (ii) is of the highest possible quality; and (iii) is completed using the best safety, health and environmental practices.

The report notes that in the experience of the State Building and Construction Trades, during turnaround periods, refineries often hire unrepresented contractors—sometimes from out-of-state—whose workers are paid a lower hourly wage and are generally less trained, less skilled, and less able to speak up about safety and health hazards compared to permanent refinery workers and represented building trades journeypersons. The report makes initial recommendations on implementing a prevailing wage standard for refinery turnaround work and on improving the quality and safety of work performed by involving the State-approved building and construction trades apprenticeship programs.

The views and recommendations expressed in the report were gathered by the author from labor, community and fire agency leaders through conference calls, face-to-face meetings, participation in large public meetings, and in meetings convened for leaders of the Governor’s Interagency Task Force. During this same period, the author participated in an ongoing Refinery Safety Collaborative consisting of the United Steel Workers (USW) Local 5 and USW International, Communities for a Better Environment, the Asian Pacific Environmental Network, the Natural Resources Defense Council, and the California and national offices of the BlueGreen Alliance.
The author has taken great care to accurately reflect the views of labor, community and fire agency leaders in this report; however, the report is not a consensus document, and final responsibility for its content resides with the author. The views presented here do not necessarily represent those of the Regents of the University of California or the University of California, Berkeley.

The California Department of Industrial Relations provided funding for this report.

About the Author

Dr. Michael Wilson is Director of LOHP. He holds a PhD and Master of Public Health (MPH) in Environmental Health Sciences from the University of California, Berkeley, and a BA in Biology from the University of California, Santa Cruz. He holds diplomas from the Stanford Program in Pre-Hospital Care and the Harvard Trade Union Program. He serves in the National Response System with FEMA Task Force 4, hosted by the Oakland Fire Department.

Acknowledgments

The author extends his appreciation to all meeting participants who freely offered their experience and knowledge regarding safety, health and environmental practices in the refinery industry.
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MEETINGS

The author convened, participated in, and/or facilitated meetings in 2012-2013 as noted below. The official meetings of the Governor’s Interagency Task Force occurred in 2013 as follows:

- February 15 Public fire agencies
- March 13 Southern California labor and community groups
- March 15 Northern California labor and community groups
- March 18 Refinery managers and trade groups
- April 30 Building and construction trades

All other meetings noted below were organized for the purpose of gathering and clarifying information but were not expressly convened by LOHP on behalf of the Task Force.

<table>
<thead>
<tr>
<th>Date and location</th>
<th>Method</th>
<th>Participants</th>
</tr>
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<tbody>
<tr>
<td>November 6, 2012</td>
<td>Conference call</td>
<td>United Steelworkers (USW) International USW District 12 USW Local 5</td>
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<tr>
<td>University of California Berkeley</td>
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<tr>
<td>November 15, 2012</td>
<td>In-person meeting</td>
<td>Asian Pacific Environmental Network BlueGreen Alliance California BlueGreen Alliance National Communities for a Better Environment Labor Occupational Health Program Natural Resources Defense Council USW District 12 USW International USW Local 5</td>
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<tr>
<td>University of California Berkeley</td>
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<tr>
<td>University of California Berkeley</td>
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<tr>
<td>January 2, 2013</td>
<td>In-person meeting</td>
<td>Asian Pacific Environmental Network BlueGreen Alliance California BlueGreen Alliance National Cal/OSHA California EPA Communities for a Better Environment California Department of Industrial Relations Governor’s Office Labor Occupational Health Program, UC Berkeley Natural Resources Defense Council USW District 12 USW Local 5</td>
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<td>Date</td>
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| January 14, 2013   | University of California Berkeley | In-person meeting | Asian Pacific Environmental Network  
BlueGreen Alliance California  
BlueGreen Alliance National  
Communities for a Better Environment  
Labor Occupational Health Program, UC Berkeley  
Natural Resources Defense Council  
USW District 12  
USW Local 5 |
| January 23, 2013   | USW Local 5 Martinez, CA | In-person meeting | Asian Pacific Environmental Network  
BlueGreen Alliance California  
BlueGreen Alliance National  
California Department of Industrial Relations  
Cal/OSHA  
California EPA  
Communities for a Better Environment  
Governor’s Office  
Labor Occupational Health Program, UC Berkeley  
Natural Resources Defense Council  
U.S. Chemical Safety Board Chairman and Senior Staff  
USW District 12  
USW Local 5 |
| February 13, 2013  | University of California Berkeley | Conference call | BlueGreen Alliance, California  
Communities for a Better Environment, N. CA  
Communities for a Better Environment, S. CA  
Labor Occupational Health Program, UC Berkeley  
Labor Occupational Safety and Health Program, UCLA  
USW 675 |
| February 15, 2013  | California State Building Oakland, CA | In-person meeting [Task Force mtg] | Alameda County Fire Department  
California Department of Industrial Relations  
California Emergency Management Agency  
California Air Resources Board Emergency Response  
Contra Costa County Fire Department  
Contra Costa County Health Services Agency  
El Cerrito Fire Department  
El Segundo Fire Department  
Fremont Fire Department  
Labor Occupational Health Program, UC Berkeley  
Los Angeles County Fire Department  
Moraga-Orinda Fire Department  
Office of the State Fire Marshall  
Richmond Fire Department |
| February 27, 2013  | St. Mark’s Catholic Church Richmond, CA | In-person meeting | 124 members of the Richmond community  
Asian Pacific Environmental Network  
Communities for a Better Environment  
Labor Occupational Health Program, UC Berkeley  
Natural Resources Defense Council  
USW District 12  
USW Local 5 |
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<td>March 13, 2013</td>
<td>USW Local 675 Carson, CA</td>
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<td>[Task Force mtg] BlueGreen Alliance California</td>
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<td>BlueGreen Alliance National</td>
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<td>Communities for a Better Environment</td>
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<td>CSU Dominguez Hill Labor Studies</td>
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<td>Natural Resources Defense Council</td>
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<td>USW Local 675 retired</td>
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<td>Wilmington neighborhood leaders</td>
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<td>March 15, 2013</td>
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<td>In-person meeting</td>
<td>[Task Force mtg] Alliance of Californians for Community Empowerment</td>
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<td>Crockett-Rodeo Fenceline Committee</td>
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<td>Labor Occupational Health Program, UC Berkeley</td>
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<td>West County Toxics Coalition</td>
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<td>Worksafe</td>
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<tr>
<td>March 18, 2013</td>
<td>RAND Corporation Santa Monica, CA</td>
<td>In-person meeting</td>
<td>[Task Force mtg] Management representatives of California refineries and</td>
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<td>representatives of California and U.S. refinery trade associations.</td>
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<td>April 12, 2013</td>
<td>Richmond Progressive Alliance Richmond, CA</td>
<td>In-person meeting</td>
<td>[Task Force mtg] Asian Pacific Environmental Network</td>
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<td>BlueGreen Alliance California</td>
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<td>Communities for a Better Environment, N. CA</td>
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<td>Communities for a Better Environment, S. CA</td>
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<td>Labor Occupational Health Program, UC Berkeley</td>
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<td>Richmond Progressive Alliance</td>
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<td>USW Local 675</td>
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<tr>
<td>April 30, 2013</td>
<td>State Building and Construction Trades Council Sacramento, CA</td>
<td>In-person meeting</td>
<td>[Task Force mtg] Cal/OSHA</td>
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<td>Contra Costa Building and Construction Trades Council</td>
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<td>Internat’l Brotherhood of Electrical Workers Local 302</td>
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<td>International Brotherhood of Boilermakers</td>
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</table>
The author and LOHP staff prepared detailed notes from each of these meetings as the basis for the findings in the report. These notes are available on request. To facilitate interaction, the meetings were not recorded and a written transcript was not produced. The report’s findings are not intended to represent an exhaustive treatment of the issues.
INTRODUCTION

By 2050, California’s population is expected to grow by about 50%, from 36 to 55 million residents. This expansion will be accompanied by a growing set of social, economic, and environmental problems whose magnitude will be determined in large part by the policy decisions California makes now and in coming years. In charting a course to a sustainable future, government will need to guide industrial development in such a way that it fully integrates matters of environmental quality and human health. In practice, if California is to create a future characterized by improving social, environmental, and economic conditions, industrial development will need to solve, not exacerbate, the public and environmental health problems facing the state today.

To move California in this direction, government can benefit from the support of solution-oriented research and outreach efforts that organize the concerns and recommendations of stakeholders in areas of importance to California’s future. This report takes the first steps in serving that purpose in the area of refinery safety.

The report summarizes issues raised and recommendations made by labor, community and environmental leaders and fire agency officials regarding refinery safety and environmental performance. Many of the issues raised are not necessarily unique to the state’s 15 refineries and could be applied to the 1,680 hazardous Process Safety Management-designated facilities in California.

The report consists of three Sections: (I) preparedness, monitoring and emergency response; (II) prevention; and (III) sustainability. In each Section, the report presents a set problem statements, followed by examples, implications, and recommended action steps.

BACKGROUND

Refining oil—transforming crude petroleum into gasoline and other fuels—is an inherently dangerous process that requires continued attention to, and investment in, mechanical integrity and in the systems that are intended to protect health, safety and the environment. While the August 6, 2012 fire at Chevron, Richmond was catastrophic, the evidence from the Chemical Safety and Hazard Investigation Board described below indicates that it could have been prevented had Chevron followed the repeated maintenance and inspection recommendations of its own technical personnel.

Between August 6, 2012 and January 14, 2013, the California refinery industry reported 30 to 35 upset events to the U.S. Department of Energy, including small fires, hydrogen sulfide releases, unexpected flare events, mechanical breakdowns and others.\(^1\)

With some exceptions, other countries that refine oil have experienced a decline in major refinery incidents over the last decade, whereas the U.S. appears to be following the opposite trajectory. According to a report by Swiss Re, the world’s second-largest reinsurer, the loss burden per refinery per 1000 barrels per day (U.S. $24,800) processed in the U.S. cluster of countries is about 3 times that of the EU cluster of countries (U.S. $8,500).\(^2,3\)

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2 Zirngast, Ernst. (January 28, 2006). Oil and Petrochemical Industry Regional Differences. Different Loss Burden According to Cluster of Countries. Chemical Safety Board presentation, Washington D.C. Risk Engineering Services, SwissRe. p. 34. (Note: “U.S. cluster” is USA, Canada, UK and Australia. “EU cluster” is Europe,
concluded that the higher losses experienced in the U.S. result in part from the complexity of the refinery industry here and to problems related to the following:

- A pushing, or daring, mode of operation;
- A compliance-driven focus on safety;
- Fluctuating and low levels of staffing;
- The extensive use of outside contractors;
- Conducting certain repairs, upgrades and changes while the refinery is actively operating;
- Allowing extensive time to pass (up to 6 years) between turnarounds, when major repair and upgrade work occurs;
- A low level of attention to ongoing maintenance;
- A "detached" workforce resulting from continued changes;
- Workforce training that is limited to specific jobs, rather than whole systems;
- Vessel and pipe inspection processes that are largely self-regulated by individual companies.\(^4\)

In a 2012 briefing to the U.S. Chemical Safety and Hazard Investigation Board (CSB), Swiss Re officials reported that the incident gap between U.S. refineries and those in other parts of the world had widened since their 2006 report.\(^5\)

In its April 2013 *Interim Investigation Report on the Chevron Richmond Refinery Fire*, the CSB documented a striking lack of attention on the part of the Richmond Chevron refinery to maintenance and metallurgy upgrades, which—if implemented—would likely have prevented the catastrophic piping failure and subsequent fire on August 6, 2012, which enveloped 19 workers in a hydrocarbon vapor cloud and ultimately caused some 15,000 areas residents to seek medical attention for symptoms related to exposure to products of combustion. The CSB found that Chevron had ignored at least six recommendations over a period of ten years (2002, 2006, 2007, 2009, 2011, 2012) by Chevron technical personnel to upgrade the metallurgy and/or increase pipe inspections, including at the 4-sidecut piping where the failure occurred.\(^6\)

These recommendations by Chevron personnel were made during a period when catastrophic failures due to sulfidation corrosion were occurring on a fairly regular basis in the refinery industry, including at Chevron’s El Paso, Texas refinery (1988), Chevron’s Pascagoula, Mississippi refinery (1988 and 1993), Chevron’s Salt Lake City, Utah refinery (2002), Chevron’s Richmond, California refinery (2007), the Silver Eagle refinery in Woods Cross, Utah (2009), the Regina, Saskatchewan, Canada refinery (2011), and the BP Cherry Point, Washington refinery (2012).\(^7\)

The CSB reports show that in 2010, Chevron technical personnel reiterated the need for a 100% component inspection protocol, stating:

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4 Zirngast, Ernst. *op cit.* pp. 24-29.

5 Holmstrom, Don. (January 23, 2013). Western Regional Manager, U.S. Chemical Safety and Hazard Investigation Board, presentation at the United Steelworkers (USW) Local 5, Martinez, California.


“Sulfidation corrosion failures...are of great concern because of the comparatively high likelihood of “blowout” or catastrophic failure. This typically happens because corrosion occurs at a relatively uniform rate over a broad area, so a pipe can get progressively thinner until it actually bursts rather than leaking at a pit or local thin area. In addition, the process fluid is often above its autoignition temperature. The combination of these factors means that sulfidation corrosion failures frequently result in large fires. Chevron and the industry have experienced numerous failures from this mechanism and recent incidents have reinforced the need for revised inspection strategies and a robust PMI (Positive Materials Identification) program.” (8)

The CSB found that the recommended component inspection program for high-risk piping “was not implemented at Richmond; therefore, the thin-walled low silicon 4-sidecut piping component remained in service until it catastrophically failed on August 6, 2012.” CSB concluded that Chevron’s reliance on over 100 temporary “clamps” on hydrocarbon and other process piping components “raised serious questions about its mechanical integrity program.” (9)

CSB’s recommendations R9 to R14 are intended for the Governor of California and the California Legislature and are aligned with many of the recommendations made in this report. (10)

Clearly, improvements in safety, health and environmental performance continue to be urgently needed in the refinery industry in California as well as nationally. California has an opportunity to provide national leadership in this arena by taking steps to improve transparency, accountability, and regulatory oversight in the State’s refineries. The Swiss Re findings suggest that in other nations and regions, these kinds of regulatory actions—such as embodied in the Safety Case approach—have greatly reduced upset events that endanger worker, public and environmental health, and they have done so without compromising the refinery industry’s efficiency or competitiveness.
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SECTION I. PREPAREDNESS, MONITORING, AND EMERGENCY RESPONSE

[New material in subsections B, C, D, F, G, H, I]

Background

Many oil refineries train certain employees to function as members of on-site fire brigades, in addition to their primary, day-to-day responsibilities. Fire brigades may respond to fires, spills, rescues and other incidents that occur inside the plant boundaries. They will also respond to neighboring industrial facilities, if pre-arranged and requested to do so. Some large refineries, including the Chevron refinery in Richmond, California, also employ full-time firefighters, who serve as first responders and are supported by on-site fire brigades.

Fire brigades and on-site fire departments provide three benefits to the public: (1) a rapid response to a refinery incident; (2) increased staffing to supplement public fire agencies during a refinery incident; and (3) a source of technical expertise for public fire agencies during an incident.

A) On-site fire brigades, refinery fire departments, and public fire agencies operate on different radio frequencies and are not able to communicate with each other.

• Example: At the August 6, 2012 refinery fire in Richmond, fire brigades were unable to communicate by radio to on-site refinery firefighters, who were unable to communicate to public fire agencies.

• Implications: Communication failures impair the effectiveness of the response, make personnel accountability at an incident difficult, and endanger the health and safety of responders and the public.

• Action needed: California should require that fire brigades and refinery fire departments operate with radios and frequencies that allow regular communication with public fire agencies.

B) Sometimes public fire agencies are not allowed immediate access to a refinery when they arrive at the plant gate to investigate an incident. Some fire agencies have difficulty accessing refineries to conduct training and pre-planning exercises. In most jurisdictions, there is a lack of regular communication between the refinery and the fire agency on matters of public safety.

• Example: A refinery is a high hazard site that warrants continued communication, training and pre-planning between the refinery and public fire agencies, not only in preparation for major incidents but for smaller incidents that occur on site, including medical emergencies, hazardous materials incidents, and technical rescues, such as confined space rescue. In some jurisdictions, there is a lack of clarity between public fire agencies and refinery personnel over the importance of ongoing communication, training, access for pre-planning purposes, and access to investigate incidents reported by the public. In some cases, when a member of the public reports an incident at a refinery, the arrival of fire equipment at the plant gate comes as a surprise to plant personnel.

• Implications: A lack of regular communication and training between the refinery and public fire agencies can result in confusion and delays during an incident, which undermines the effectiveness of the response and potentially endangers firefighters and the public.
• **Action needed:** California should put in place a mechanism to ensure timely access to the refineries by public fire agencies for training, incident pre-planning and during a reported incident. This should include provisions that require refineries to submit a quarterly report to the public fire agency on all incidents that occurred on-site but were handled by plant personnel alone. This information is an indicator of potential problem areas in the plant and is essential for fire agency pre-planning. This information should also be made publicly available in a format that is easy-to-access and evaluate. The refineries should provide financial support for public fire agencies, including for training purposes, as noted below.

**C) A unified command approach is appropriate for most major incidents; however, in the case of large refinery incidents, there is an inherent conflict between refinery personnel, who are accountable to the corporation, and public fire officials, who are accountable to the public.**

• **Example:** This inherent conflict can potentially influence the nature of communications with the public and decisions about the need for additional fire resources. Refinery personnel may tend to “downplay” the severity of an incident in both requesting additional emergency resources and in communicating to the public. At the August 6, 2012 Richmond Chevron fire, important public fire agency resources were not requested; a joint information center was never established; media communications to the public were controlled mostly by the refinery; and communications from the incident to health care providers regarding the potential health implications of hazardous materials emitted during the fire did not occur.

• **Implications:** Members of the public and health care providers are left without adequate information regarding (i) the severity of an incident, (ii) the potential health effects of toxic materials released, particularly for sensitive subpopulations, and (iii) recommended courses of action. This prevents the public from taking protective actions, and it creates uncertainty among health care providers regarding health effects and the need for decontamination of patients prior to treatment.

• **Actions needed:** California should clarify that at a refinery incident, the responsibility for requesting additional resources and communicating with the public rests solely with the senior public fire officer on scene. “Trigger points” should be investigated as a mechanism for automatically deploying additional public agency resources to a major refinery incident; technical experts in air monitoring, exposure assessment, and toxicology should be incorporated into the incident command system to provide timely and accurate information to the public; these experts should be drawn from public agencies, not from refinery personnel.

**D) In responding to a major refinery incident, public fire agencies carry financial burdens, draw on neighboring agencies for mutual aid coverage, and leave their own jurisdictions with fewer available resources.**

• **Example:** A significant number of public fire agencies responded to the August 6 Chevron refinery fire, which produced wear-and-tear on equipment and reduced fire resources available to the public.
• **Implications:** The public bears the cost of a refinery incident in both fire department expenses and in heightened risks associated with fewer fire and emergency medical services (EMS) resources available to the 911 system during the course of the incident.

• **Actions needed:** California should evaluate strategies for refineries to “pre-pay” public fire agencies for emergency response and equipment costs, including payments for overtime to back-fill positions for the duration of an incident, if necessary. When a refinery does not staff its own on-site fire department, the refinery should support the full costs of public fire agency staffing, training, and specialized equipment necessary for responding effectively to refinery incidents, including fires; hazardous materials releases to air, water, or soil; and technical rescues from confined spaces and other difficult-to-access sites at the refinery.

**E) Insurers, employers, taxpayers, and residents carry the responsibility of paying for medical services rendered to individuals who seek medical attention as a consequence of a fire, hazardous materials leak, or other incident occurring at a refinery. There is also no system presently in place for tracking and documenting the health of these individuals in the wake of an incident.**

• **Example:** Following the August 6, 2012 Richmond Chevron fire, the cost of medical services for the approximately 15,000 individuals seeking medical attention for respiratory distress, eye irritation, anxiety and other symptoms exceeded $10 million, as reported by Chevron, which elected to pay these bills.\(^{(11)}\) The subsequent health status of these individuals has not been documented or tracked.

• **Implications:** Payment of medical bills typically falls to insurers, employers, taxpayers or residents. The true social and financial costs of these incidents are unknown because these financial data are not captured and the health status of affected individuals is not tracked over time.

• **Actions needed:** California should ensure that procedures are in place to facilitate payment by refineries of costs incurred for both immediate and long-term medical services related to a refinery incident. To do this, a system is needed to track and document both the short and longer-term health status of affected individuals, beginning with those who seek medical attention during—and in the immediate aftermath of—a refinery incident.

**F) During a refinery incident, regional air districts do not have sufficient capacity to monitor atmospheric conditions, plume travel, and real-time emissions, nor are they able to communicate this information effectively to the public.**

• **Example:** On August 6, 2012, the Bay Area Air Quality Management District (BAAQMD) collected a small number of samples and communicated to some members of the public that the air was free of toxic air contaminants. A large number of people, however, continued to visit health care facilities with

complaints of respiratory distress, burning of the eyes, and other symptoms.

- **Implications**: If the districts are not able to adequately assess the nature of refinery emissions during upset events and report that information to the public in a timely manner, it is not possible for residents, health care professionals and others to determine what protective actions are most appropriate. The public loses trust in the ability of government to protect public health and safety during a refinery incident.

- **Actions needed**: California should ensure that air districts, in cooperation with refinery managers, the state Air Resources Board and public fire agencies, have the capacity to effectively monitor air contaminants during unusual refinery events and communicate this information to the public through the full range of potential media. The districts should also establish systems to communicate this information to health care providers, emergency responders and others. The refineries should carry the costs for the purchase and maintenance of state-of-the-art, real-time air monitoring equipment and communications systems.

G) During routine refinery operations, regional air districts do not have sufficient capacity to monitor toxic air contaminants, particulate matter, and other air pollutants emitted by the refineries on a daily basis, nor are they able to effectively communicate information of this nature to the public.

- **Example**: The BAAQMD operates a small number of ambient air monitoring stations situated at various locations around the East Bay. These devices are not able to adequately capture routine refinery emissions.

- **Implications**: Without ongoing and comprehensive hazard and exposure information on refinery emissions, it is not possible to adequately assess the health and environmental effects of these emissions or their true costs to the public. The public loses trust in the ability of government to protect public and environmental health from refinery emissions.

- **Actions needed**: California should ensure that air districts, in cooperation with the state Air Resources Board, have the capacity to conduct air monitoring for toxic air contaminants, particulate matter, and other air pollutants on a routine basis and that they post that information online in an easily accessible and understandable format. The districts should establish systems to proactively communicate this information to the public, while also acknowledging areas of uncertainty. Health warning levels for both acute and chronic effects should be those established by the California EPA Office of Environmental Health Hazard Assessment (OEHHA) and should be calibrated for the actual mixed exposures that occur in the population, not simply for individual chemical substances. Warning levels should be calibrated for mixed exposures to children and other susceptible groups. The refineries should carry the costs for the purchase and maintenance of state-of-the-art, real-time air monitoring equipment and communications systems.

H) The Bay Area Air Quality Management District (BAAQMD) does not report the constituent chemical substances in vent gasses released by refineries and reported under
Regulation 12, Rules 11 and 12, Flare Monitoring at Petroleum Refineries.\textsuperscript{(12)}

- **Example:** The BAAQMD website reports aggregate “vent gas” and “non-methane hydrocarbons” but does not report the chemical substances that make up these emissions. Individual chemical constituents, such as acrolein, can be highly toxic and/or irritating; if present in high concentrations, individual chemical constituents can increase health risks associated with flaring and other upset events.

- **Implications:** Without information on chemical constituents, it is not possible for government agencies or the public to adequately assess the health risks or social costs associated with flare emissions and other upset events.

- **Actions needed:** California should require direct monitoring at emission points and reporting by all refineries. Air districts should post all flare and other upset events on a publicly accessible and useable website.\textsuperscript{(13)} The information provided should include the total release quantities of individual chemical constituents, as defined under (i) the federal Toxics Release Inventory and (ii) California’s Toxic Air Contaminant list, maintained by the Cal/EPA Air Resources Board.\textsuperscript{(14)} This information should also include releases of fine and ultra-fine particulate matter.

1) The emergency public warning system largely failed to function during the August 6 Chevron refinery fire, and there was no public agency providing regular updates to the public.

- **Example:** The automated phone system malfunctioned, and auditory alarms were not activated broadly or were simply not heard. There was no public agency website dedicated to providing essential information to the public, including incident updates, air quality status, sheltering instructions, special protections for those with asthma and other respiratory conditions, and steps to protect children.

- **Implications:** Residents in Richmond and neighboring areas could see a large black cloud of smoke coming from the refinery, but they did not know what actions they should take, where they could get information, or how serious their situation could become. They were therefore unable to make informed decisions and take appropriate actions.

- **Actions needed:** California should ensure that refineries fund the development of effective, audible warning sirens and a dedicated website that is accessible by hand-held devices and can be regularly updated by a public agency. These systems should be coupled with other outreach strategies.


to the public, including pre-arranged agreements with radio and television stations. Funding to support ongoing training of neighborhood-based, community emergency response teams (CERTs) would improve the ability of residents to respond to—and recover from—a major industrial incident.

J) Public transit lines were shut down during the August 6 Chevron refinery fire.

- Example: Without having developed an alternative plan, the Bay Area Rapid Transit (BART) train system stopped carrying passengers into Richmond, stranding passengers in outlying stations.

- Implications: BART’s shut-down made it very difficult for many residents to return to Richmond to take care of children and meet other needs during the incident.

- Action needed: California should ensure that local transit districts have developed strategies to respond effectively in the event of an industrial emergency. Shutting down transit lines might be appropriate in some cases; these decisions, however, should be made using pre-planned protocols and with information provided by emergency services personnel; they should not be made ad hoc or left to the individual judgment of bus and train operators.
SECTION II. PREVENTION

[New material in subsections C, D, G, H]

Background

The U.S. Chemical Safety and Hazard Investigation Board, the Federal and California OSHA programs, the United Steelworkers union, the U.S. EPA, the American Institute of Chemical Engineers, and the Contra Costa County Health Services Agency have all created recommendations for improving refinery safety, most of which focus on prevention strategies.

While many of these strategies have been adopted in California, improvements continue to be urgently needed, primarily because these efforts have not been able to correct an underlying lack of transparency and public accountability in the industry. In large part, the industry remains self-regulated: it operates in a regulatory environment that lacks robust performance requirements, substantive penalties, and other incentives. It is not required to identify and implement inherently safer systems.

As described by the CSB, above, the industry has responded to this weak regulatory environment by largely neglecting its investments in mechanical integrity, safety and environmental performance; the evidence indicates that these aspects of refinery operations have become tangential to the primary mission of the refinery industry.

A) The refineries have not proactively communicated information on corrosion damage to state, Federal or local government regulatory agencies, nor have they communicated this information to workers or the public.

- Example: After a corroded pipe burst in the August 6 Chevron incident, evidence of serious corrosion damage and deferred maintenance was uncovered throughout the Richmond refinery.

- Implications: Unless corrosion information is gathered and communicated proactively by the refineries, it is not possible for government, workers, or the public to understand the nature of this hazard and take steps to ensure that it is corrected.

- Actions needed: California should require the refinery industry to conduct a comprehensive audit of corrosion damage, and the results should be reported publicly. A useful initial measure for providing information on corrosion damage is through reporting on the use of clamps and Management of Change (MOC) actions taken for each clamp. Ongoing auditing and public reporting of clamp usage, and its scheduled replacement time, should be required of the refineries to ensure that corrosion risks are identified, prioritized, and repaired.

B) While workers have the authority to shut-down unsafe operations, the power to do so is continually undermined by plant managers; relying on shut-down actions taken by workers also shifts responsibility away from management’s obligation to ensure mechanical integrity through preventive maintenance.

- Example: Although workers raised concerns over corrosion at the Richmond Chevron refinery, corrosion problems were not prioritized and corrected by plant managers, and a hole subsequently opened in the crude unit side-cut piping on August 6. Chevron continued to operate the unit
under pressure while workers attempted to assess and repair the leak.

- **Implications**: The resulting catastrophic fire nearly killed 19 workers and ultimately caused some 15,000 residents of Richmond and surrounding communities to seek medical attention from area health care facilities.

- **Actions needed**: California should require the implementation of a transparent and robust preventive maintenance program at all refineries, including elements noted below. California should put in place procedures for workers to report unsafe operational conditions to a regulatory agency, in addition to reporting to plant managers.

  C) **Maintenance and safety problems identified by refinery workers are often not corrected for months or years.**

  - **Example**: Since 2002, Chevron repeatedly postponed replacing the corroded section of pipe that finally burst on August 6, 2012, despite repeated warnings by USW members and Chevron’s own technical personnel and of the potential for catastrophic failure resulting from corrosion damage at this and other sites at the refinery.

  - **Implications**: Refineries run an increasing risk of catastrophic failures due to loss of containment, which are accompanied by explosions, large fires and releases of combustion products and toxic air contaminants into surrounding communities.

  - **Actions needed**: California should require refineries to disclose to government, employee representatives, and to a publicly accessible database normalized information on (i) maintenance and safety requests made, (ii) corrective actions taken or not taken, (iii) outcomes, (iv) root causes of the maintenance or safety problem, and (v) the management individual accountable. An accessible record of this type will highlight best practices among leading refineries and will allow government, the public, and workers to track refinery performance. Regulatory actions should be triggered based on the number of maintenance and safety requests left open and uncompleted over a defined period of time.

  D) **Ensuring that turnaround work is performed by the most skilled and trained workforce is a matter of significant state and public interest. In the experience of the State Building and Construction Trades, some refineries hire unrepresented contract workers during turnarounds whose workers perform work that has significant implications for worker, public and environmental safety, yet these workers are often poorly paid, less trained and skilled, and less able to speak up about safety and health hazards compared to permanent refinery workers and represented building trades journeypersons.**

  - **Example**: During a typical turn-around period, thousands of workers are employed by outside contractors to perform construction, maintenance and repair tasks in a refinery. A varying number of these workers are unrepresented; some are itinerant workers from outside California.

  - **Implications**: The extensive use of unrepresented contract workers undermines refinery safety. If USW-represented refinery workers are augmented during turn-around periods by locally hired, skilled building trades workers who are paid the prevailing wage, local economies would benefit and California would help ensure that
turnaround work is of the highest quality and is performed using well-recognized standards for worker and community health and safety.

- **Action needed**: California should require refineries to report the number of contract workers hired each year who perform construction, maintenance and repair work inside the refinery, including those from outside the state; their duration of employment; their level of training; and the positions these workers fill. California should consider a requirement that contractors hired by refineries pay at least the prevailing wage for skilled labor and employ a certain percentage of workers who are either (i) graduates of a State-approved construction apprenticeship program, or (ii) are registered in a State-approved construction apprenticeship program. State-approved construction apprenticeship programs operating in the geographic area of refineries that do not already do so should include training in occupational safety and health, environmental protection, and basic emergency response practices relevant to the refinery industry.

**E) There is a need for much greater worker involvement in management decisions regarding health, safety and environmental performance.**

- **Example**: While represented workers at refineries can provide input into safety issues, they do not share decision-making authority with plant managers, whose economic interests are not consistently aligned with safety.

- **Implications**: Safety is continually marginalized in favor of production during both routine operations and turnovers.

- **Action needed**: California should require that refineries operate with a tripartite labor-management-government structure for decisions pertaining to health, safety and environmental performance. This structure would provide the authority for full-time workers and government to engage in tracking of leading and lagging indicators, near-miss reporting and investigation, and sharing of lessons for continuous improvement. The United Steelworkers (USW) *Triangle of Prevention* framework provides an analytical model for decision-making in this context.

**F) It is unknown whether and to what extent refineries are tracking and acting on leading, lagging, and near-miss performance indicators.**

- **Example**: Even under its Industrial Safety Ordinance, Contra Costa County is unable to identify, track and compare performance indicators among refineries; had it been able to do so, the County might have been made aware of extensive corrosion problems at the Richmond Chevron plant.

- **Implications**: A refinery that documents, tracks, publicly reports, and takes action based on performance indicators is more likely to identify problems early and operate more safely and efficiently, compared to refineries that pay less attention to performance indicators. It is currently not possible to identify the best and worst performing refineries in the state, which makes it difficult to take appropriately scaled regulatory and other actions.

- **Action needed**: California should require refineries to disclose to government and to a publicly accessible database normalized information on (i) leading, lagging, and near-miss...
performance metrics, including both planned and unplanned flaring events; (ii) corrective actions taken or not taken; (iii) outcomes; (iv) root cause of deviations in the performance metric; and (v) the management individual accountable. Regulatory actions should be triggered based on continuing failures in certain performance indicators, based on a to-be-determined set of metrics.

**G) The Process Safety Management (PSM) unit of the California Division of Occupational Safety and Health (Cal/OSHA) lacks both the staffing and the expertise in some areas necessary for overseeing the state’s 15 refineries and 1,680 other industrial facilities that handle large quantities of toxic, flammable, and explosive materials.**

- Example: The PSM unit is currently authorized to fill eight (8) field inspector positions. This small number of inspectors cannot effectively oversee the large number of hazardous process industries in the state, including the refineries. While this group has extensive experience in refinery operations and safety, it lacks personnel with advanced degrees in chemical engineering, process safety, environmental health sciences, mechanical engineering, and other relevant fields.

- Implications: The PSM unit is unable to adequately oversee the safety of California’s process industries; this places the safety of both workers and the public at risk.

- Actions needed: California should take steps to increase the effectiveness of the PSM unit by considering collaborations with sister agencies and by assessing PSM staffing levels and technical training. California should also enhance Cal/OSHA’s existing refinery permitting and inspection requirements, including those implemented by the PSM unit.

**H) California’s refineries are able to operate without having to demonstrate competence in health, safety and environmental performance to a regulatory agency or to the public.**

- Example: Unlike other nations that have implemented a Safety Case approach to manage hazardous process industries, there is no requirement in California that refineries proactively generate and disclose a broad set of information to government on their health, safety and environmental performance, nor is there an agency authorized to (i) receive and assess such information, (ii) grant or deny permission to a refinery to operate, or (iii) take other regulatory actions on the basis of that information.\(^\text{[16, 17]}\)

- Implications: California has placed its trust for worker and public safety and

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environmental protection largely in the hands of refinery operators, who are accountable not to the public but to the corporation.

- Action needed: California should (i) establish an interagency regulatory entity with broad authority to oversee the safety and environmental performance of the state’s refineries and other hazardous process industries; (ii) switch the ‘burden of proof’ to the process industries by requiring a demonstration of competence in health, safety and environmental performance as a condition of operation, similar to the Safety Case approach adopted by the European Union and elsewhere, and (iii) provide a mechanism for funding a new interagency process safety regulatory program through fees or other financial mechanisms paid by the state’s refineries and other hazardous process industries.

1) The Contra Costa County Industrial Safety Ordinance (ISO) is a nationally recognized regulatory program that has produced a marked decline in refinery incidents and could serve as a statewide model; there are also areas where it should be modernized and strengthened.\(^{18}\)

- Example: Incorporating inherent safety through choices in the types of materials, technology, feedstocks, and equipment used at a plant eliminates (or reduces) hazards at the source and is therefore the preferred method for reducing health, safety and environmental risks. Inherent safety is recommended in the ISO but is not required.

- Implications: The potential benefits of inherent safety in the refinery industry in Contra Costa County have not been fully realized.

- Action needed: Evaluate the ISO for areas that are in need of modernization and strengthening, and then evaluate its efficacy as a statewide model.

SECTION III. SUSTAINABILITY

A) The sulfur content of crude oil imports into California refineries has increased steadily since 1985 and is expected to continue to do so.

Example: The U.S. Energy Information Administration reports that the weighted average sulfur content of crude oil inputs for West Coast refineries increased from 1.05% in January 1985 to 1.35% in July 2012 (Figure 1).\(^{19}\)

Implications: When the total sulfur content in the crude oil used by refineries is greater than about 1.0%, the oil is classified as "sour" and is less expensive but more difficult to process. Sulfur impurities need to be removed prior to processing, which increases energy demands. Higher sulfur-content crude oil also produces toxic air contaminants (hydrogen sulfide and sulfur dioxide) and greenhouse gases (GHGs), and it increases the rate of corrosion throughout a refinery’s piping and mechanical systems.

Action needed: California should require air districts to promulgate rules prohibiting increases in routine and episodic air emissions from refineries that result from the use of higher sulfur-content oil inputs. California should consider rules that would bar or limit the importation of refined oil products into the state.

B) Refineries are the largest energy-using industry in California and the most energy intensive industry in the U.S.\(^{20}\) The state’s refineries have added energy intensive equipment, such as hydrogen plants and hydrotreaters, to process high sulfur-content crude oil inputs.

Example: The California Air Resources Board reports that the state’s 15 refineries are the largest industrial emitters of GHGs in the state, accounting for about 31 of 86 million total tons (CO\(_2\) equivalents) of GHGs released by industry in 2010, or about 36%. This is about 1 ton lower than the 32 tons released by the refineries in 2000. In 2010, refinery GHGs accounted for about 7% of the state’s total GHGs of 452 million tons.\(^{21}\)

Implications: GHG emissions are occurring as a result of direct plant emissions and from the increased energy required to process higher sulfur-content crude oil.

Actions needed: California should require the refineries to (i) conduct a comprehensive energy audit; (ii) produce an annual, detailed, online report on the results; and (iii) meet an energy reduction schedule. The audit should include energy uses by, for example, hydrogen plants, hydrotreaters, hydrocrackers, fluid catalytic crackers, cokers, sulfur recovery units, boilers and heaters. Beginning immediately, California should require the refineries to (i)

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replace old boilers, heaters, and other inefficient equipment, some of which were built over 50 years ago, and (ii) evaluate and implement U.S. EPA recommendations on available and emerging technologies for reducing greenhouse gas emissions in the refining industry. California should consider requiring refineries to replace a portion of grid energy used each year with alternative energy sources.

**C) Refineries are among the largest industrial emitters of toxic air contaminants in California.**

*Example:* The U.S. EPA Toxics Release Inventory (TRI) shows that refineries are the largest source of emissions of hazardous “1995 New Chemicals” in California, with reported releases of 2.8 million pounds in 2011.

*Implications:* Air contaminants are dispersed regionally, causing population-wide health effects and reducing quality of life; residents of communities that host a refinery—who are disproportionately minority and lower income—are exposed to toxic air contaminants at high levels and suffer higher rates of asthma, cancer and other diseases, relative to rates in California as a whole.

*Actions needed:* California should require refineries to rapidly and continually reduce emissions through the use of Best Available Control Technologies (BACT) or Best Available Retrofit Control Technologies (BARCT), as defined under the Federal Clean Air Act and elsewhere.


Figure 1. U.S. EIA trend data on West Coast sulfur content of crude oil to refineries (weighted average), 1985—2012.\(^{(24)}\)
