Date: December 2, 2016

The association between high-greenhouse gas refinery processes and particulate matter

Charles Davidson. Hercules CA

The following documents and graphic insets make a strong case that high-GHG Bay Area refinery projects, such as the refining of tar sands bitumen, will locally increase both greenhouse gases (GHGs) and disease-causing particulate matter PM2.5 (microns).

The expected 8-fold increase in tar sands refining to the U.S. west coast by 2030 (per the Borealis Centre/NRDC study(1)) will result in a significant increase in refinery GHGs, because of the 2-3 fold increase in GHGs produced per barrel above the GHGs produced from refining traditional crudes [“All olls are not equal” quote from Carnegie Endowment paper, below (2)].

Relevant to Bay Area air quality, the high-GHG processes of tar sands extraction via mining and partial upgrading (initial refining into diluted bitumen, i.e., DilBit for transport) in Northern Alberta causes a large state-size plume of PM2.5, as can be seen on this map from [BerkeleyEarth.org](http://berkeleyearth.org) (http://berkeleyearth.org/air-quality-real-time-map/0. (3)

This indicates that there will be be a likely signifiant increase in industrial PM2.5 in the Bay Area if there is such a large increase in local tar sands refining.

The matter is significant because BAAQMD’s and CARB’s own data indicate that for the last three decades, GHGs and PM2.5 have mostly increased, as opposed to some other pollutants that have been better controlled, to a degree.

It is documented that reducing GHGs can and will tend to significantly reduce PM2.5.

In fact, the net effect of AB32 has already been found to reduce PM2.5 state-wide in California and also the disease-risk hazard [PM2.5 co-benefits of climate change legislation: California's AB 32, see quote below (3)).

This GHG/PM2.5 linkage, therefore, is a parallel up or down process, while the direction of both emissions ultimately depends on public policy.

In effect, an 8-fold increase of tar sands to Bay Area refineries will cause a residual "leakage" of the Canadian PM2.5 plume shown below) into the Bay Area, on account of the subsequent processing of Canadian bitumen into gasoline.

REFERENCES:

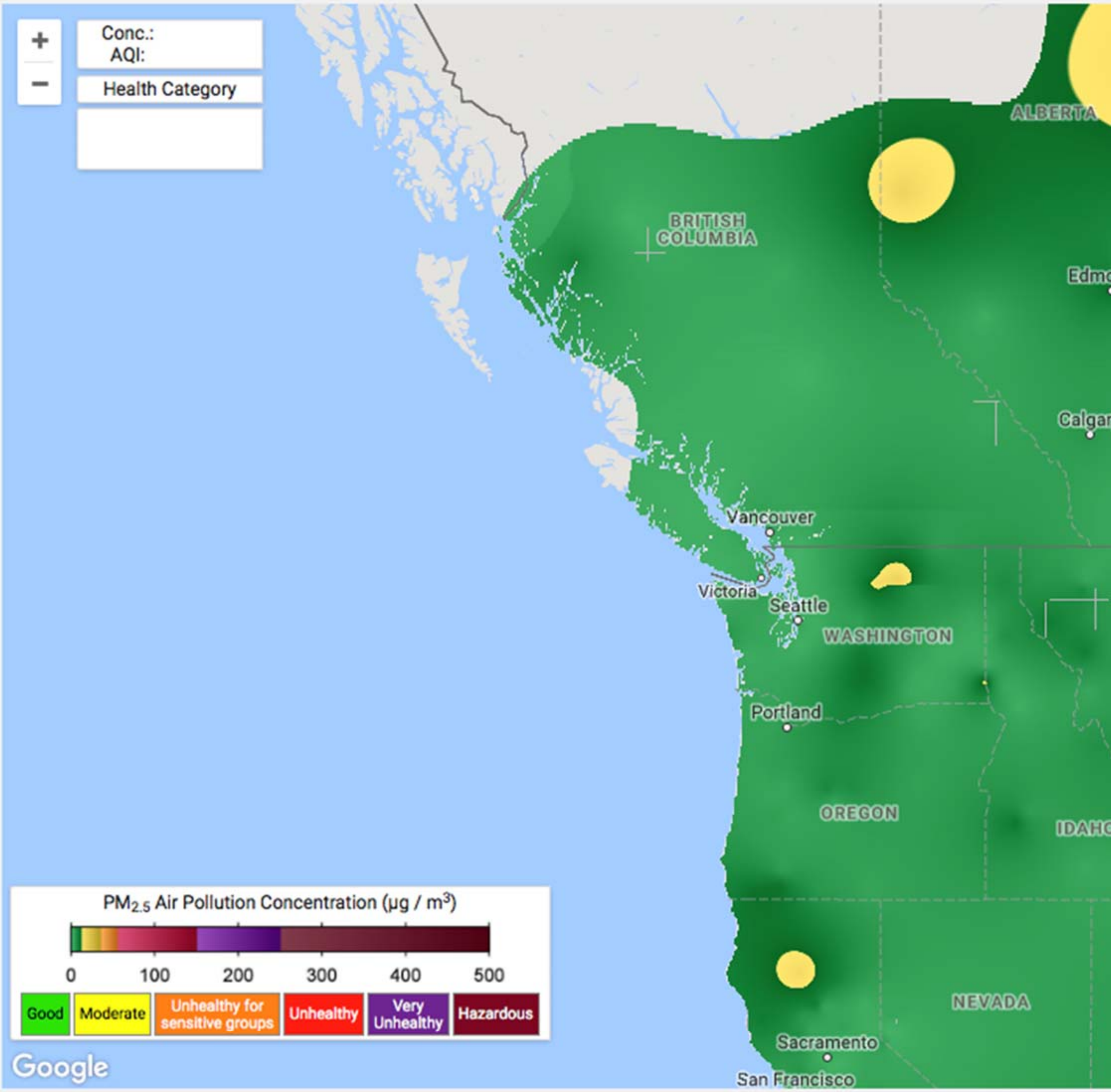
1) U.S. West Coast Refineries. Prepared for NextGen and NRDC. December 5, 2014 Borealis Centre for Environment and Trade Research. www.borealiscentre.org

2) KNOW YOUR OIL: CREATING A GLOBAL OIL-CLIMATE INDEX. DEBORAH GORDON ADAM BRANDT JOULE BERGERSON JONATHAN KOOMEY. 2015 Carnegie Endowment for International Peace

3) BerkeleyEarth.org (http://berkeleyearth.org/air-quality-real-time-map/0.

4) PM2.5 co-benefits of climate change legislation part 1: California's AB 32. Christina Zapata & Nicholas Muller & Michael J. Kleeman. Climatic Change 2012

Please see relevant brief quotes below from the above references.



Description

This map provides near real-time information on particulate matter air pollution less than 2.5 microns in diameter (P
infections, and other diseases.

The data presented here has been constructed from thousands of surface station measurements from around the w
quality conditions. The interpolation process is designed to smooth the data and remove some of the local noise i
based on PM_{10} observations.

Health indicators and qualitative descriptions are included based on the US EPA's air quality index (AQI) standard f

Climatic Change
DOI 10.1007/s10584-012-0545-y

$PM_{2.5}$ co-benefits of climate change legislation part 1: California's AB 32

Christina Zapata & Nicholas Muller & Michael J. Kleeman

Received: 20 May 2011 / Accepted: 6 July 2012

"The net effect of all AB 32 measures reduced statewide primary PM and NO_x emissions by ~1 % and ~15 %, respectively. Air quality simulations predict that these emissions reductions lower population- weighted $PM_{2.5}$ concentrations by ~6 % for California. The South Coast Air Basin (SoCAB) experienced the greatest reductions in $PM_{2.5}$ concentrations due to the AB 32 transportation measures while the San Joaquin Valley (SJV) experiences the smallest reductions or even slight increases in $PM_{2.5}$ concentrations due to the AB 32 measures that called for increased use of dairy biogas for electricity generation. The ~6 % reduction in $PM_{2.5}$ exposure associated with AB 32 predicted in the current study reduced air pollution mortality in California by 6.2 %, avoiding 880 (560–1100) premature deaths per year for the conditions in 2030. The monetary benefit from this avoided mortality was estimated at $5.4B/yr with a weighted average benefit of $35 k/tonne ($23 k/tonne–$45 k/tonne) of PM, NO_x, SO_x, and NH_3 emissions reduction.

KNOW YOUR OIL: CREATING A GLOBAL OIL-CLIMATE INDEX

DEBORAH GORDON ADAM BRANDT JOULE BERGERSON JONATHAN KOOMEY
2015 Carnegie Endowment for International Peace

ALL OILS ARE NOT CREATED EQUAL

- **Thirty global test oils were modeled during Phase 1 of the index.**

- **Greenhouse gas (GHG) emissions were analyzed throughout the entire oil supply chain—oil extraction, crude transport, refining, marketing, and product combustion and end use.**
- **There is an over 80 percent difference in total GHG emissions per barrel of the lowest GHG-emitting Phase 1 oil and the highest.**

Crude quality and the selected process units employed (that is, the refinery configura- tion), as well as the energy efficiency of the process units, all play important roles in deter- mining the energy requirements and emissions of an individual crude (or a crude blend).

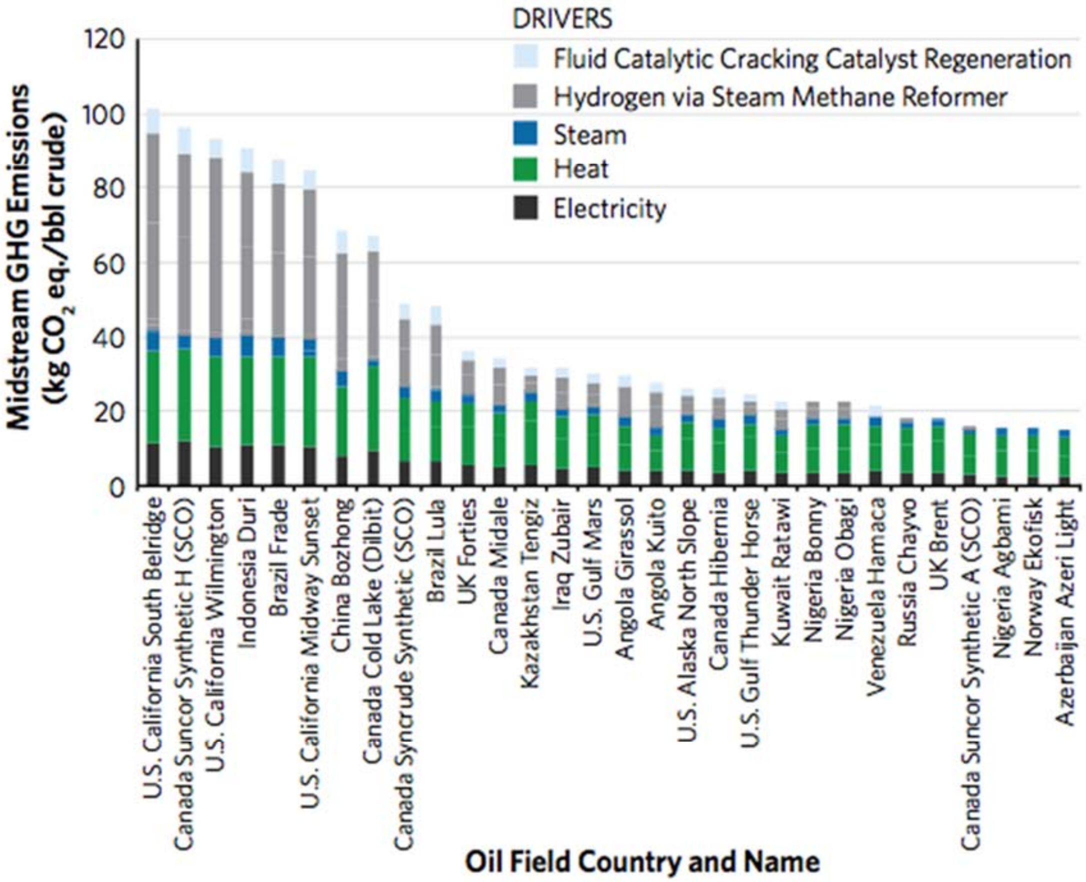
The unique amount of hydrogen required to process each crude is the major driver of refinery energy use and GHG emissions. The amount is dictated by the quality of the crude entering the refinery. Lighter crudes yield more hydrogen when refined, while heavier crudes lack hydrogen and often utilize hydrogen inputs during refining.

Based on this analysis, the top three ways to reduce GHG emissions at refineries that process heavier crude are to reduce the amount of hydrogen consumed, increase hydrogen production efficiency (and/or lower the GHG emissions intensity of hydrogen production), and capture carbon dioxide from the most concentrated, highest volume refinery sources. Those sources include fluid catalytic cracking units used to produce additional gasoline and steam methane reformer units used to make hydrogen on-site from natural gas.[9]

NOTE: DilBit is about 70-75% of a barrel of oil and 25-30% diluent (i.e., solvent), so a barrel is not composed of 100% bitumen and the GHG emissions of tar sands DilBit must be valued upward on the graph in order to compare it to a full barrel of oil.

FIGURE 7

Drivers of Midstream GHG Emissions for 30 Phase 1 OCI Test Oils



Source: Authors' calculations

Note: Unlike the other OCI test oils, Cold Lake dilbit is not composed of a full barrel of oil.