WE START WITH YES.

2017 International Emissions Inventory Conference by EPA

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U.S. REFINERY AIR POLLUTANTS

http://www.marathonrefinerycontractor.com/_Texas_Cit/

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Aug 16th, 2017

Background

Reducing air pollutant emissions from transportation is a target for U.S. major cities.

Accurate air pollutant emissions are needed for baseline petroleum fuels, including refining process

LCA provides a consistent platform for evaluating and comparing air pollutant emissions along the production pathways of transportation fuels

GREET model allows tracking of energy consumption and GHG/criteria pollutants emissions along transportation fuels production pathways

Objectives

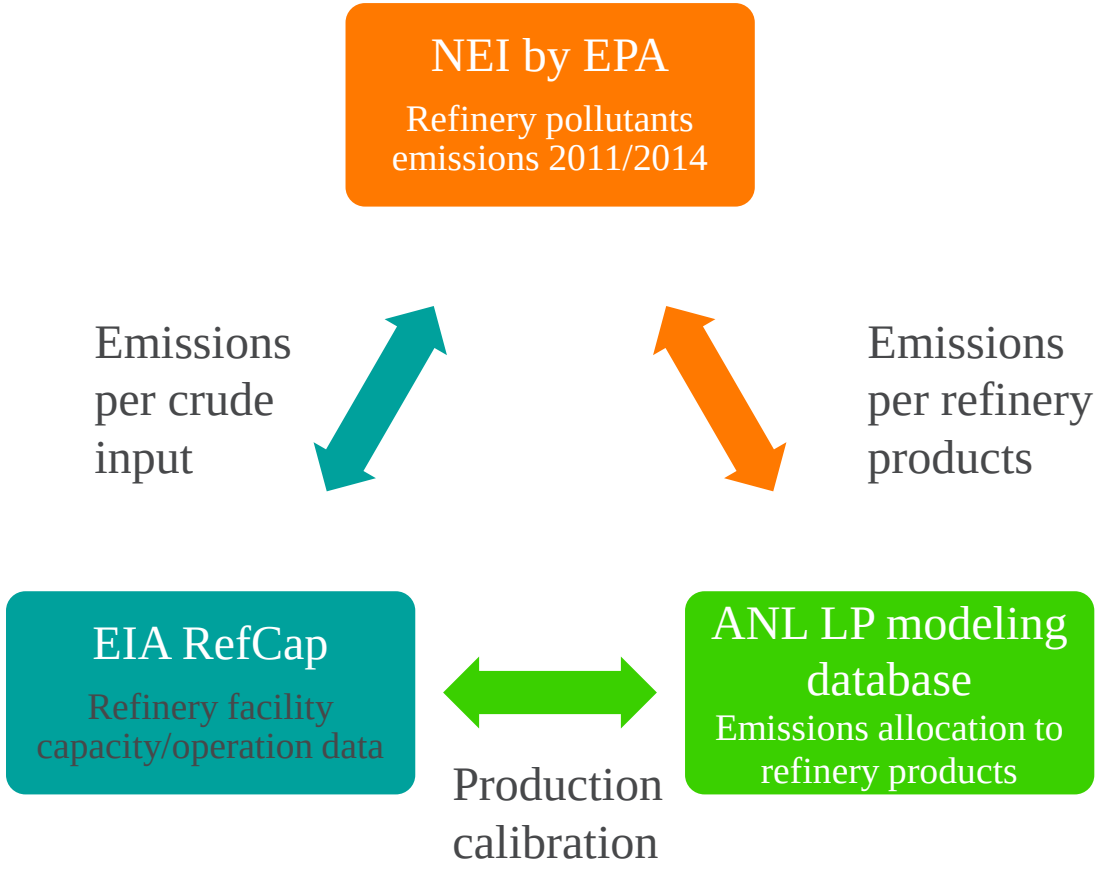
Specifically focus on refinery air pollutants emissions

Develop both PADD level and National level pollutants emission intensity

Develop an approach to allocate refinery air pollutants to each refinery product

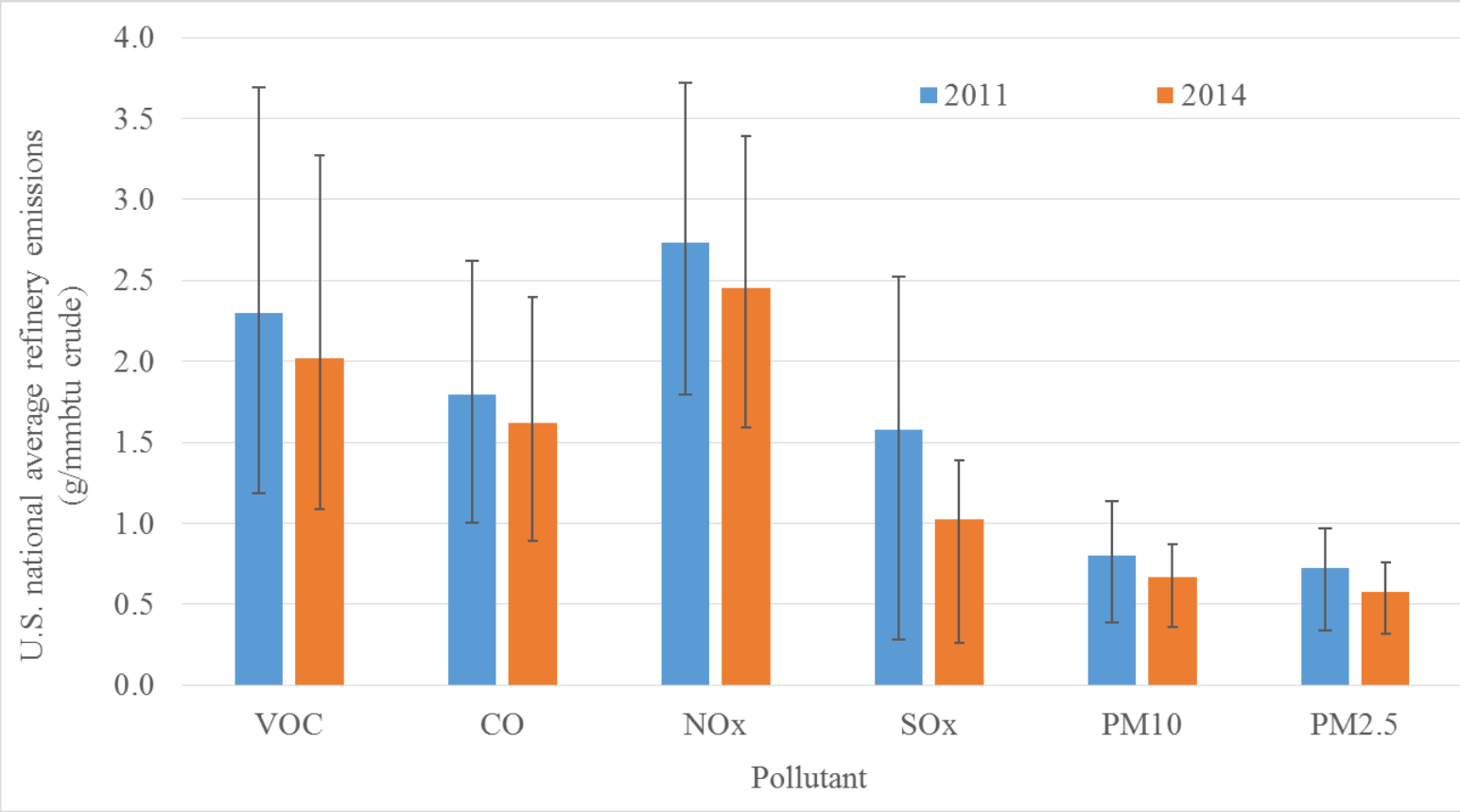
Derive refinery air pollutants emissions for refinery products, evaluate transportation fuels pollutants emissions along their life cycles

Acquire refinery air emissions and production data – approach



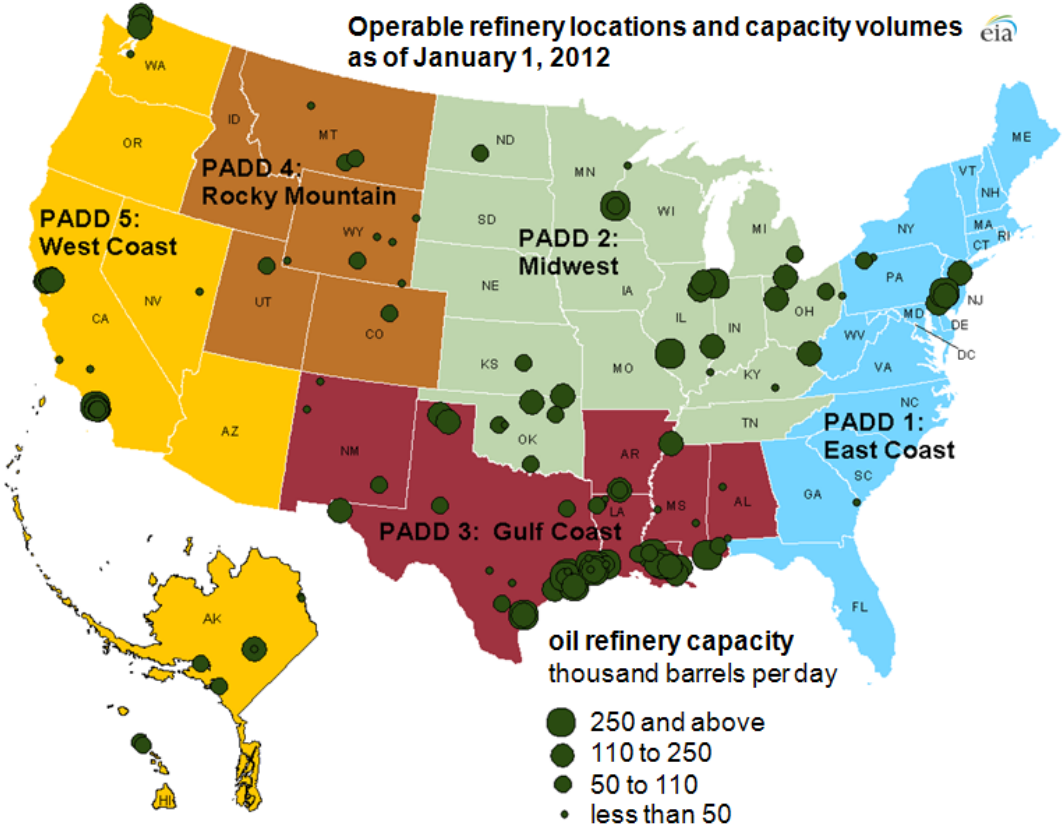
Part I: U.S. Refinery Air Pollutants Emission-Per Refinery Throughput

National average-2011 VS 2014



- National average refinery pollutant emissions decreased from 2011 to 2014

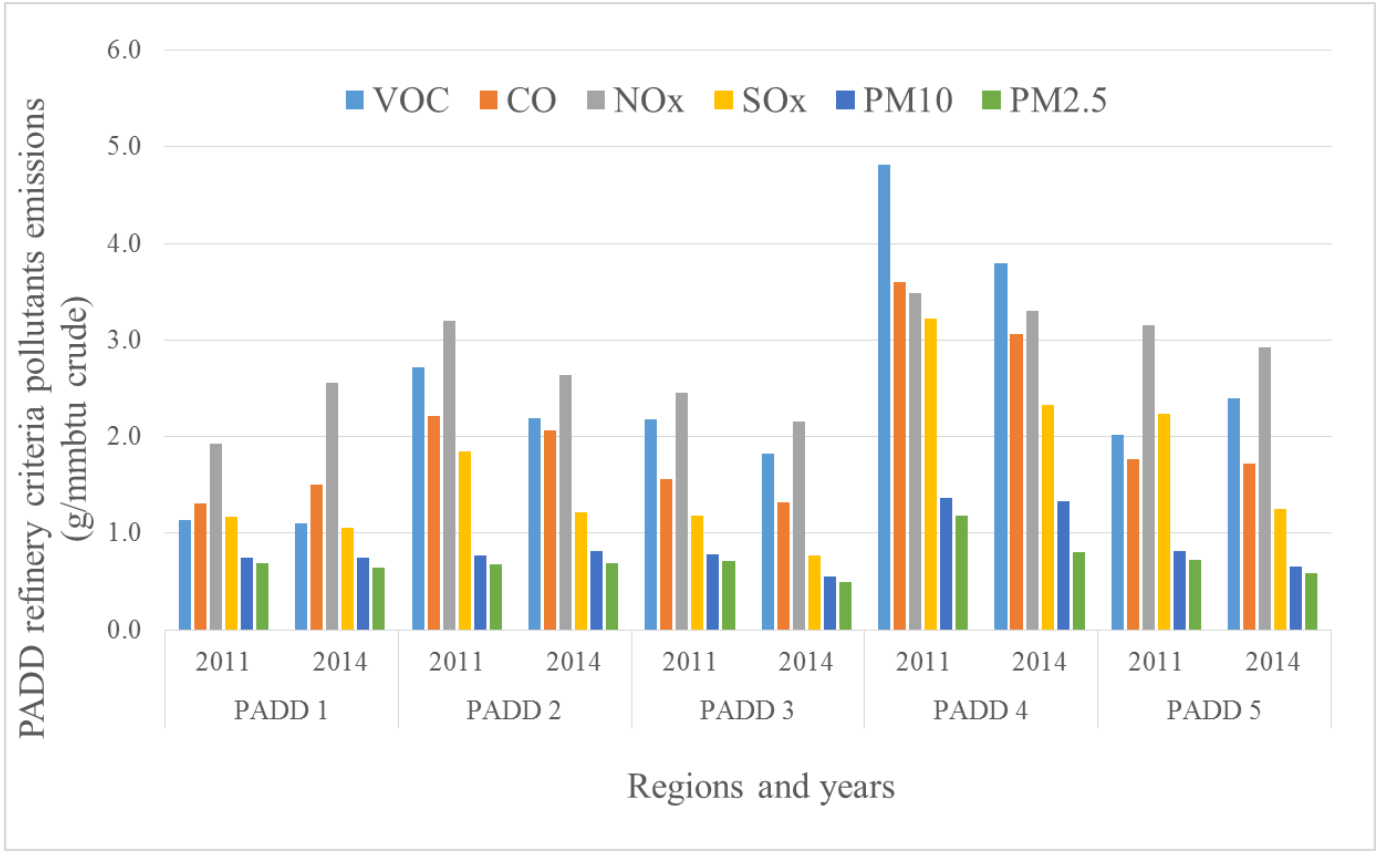
PADD variation in capacity and complexity



- U.S. refineries vary significantly from PADD to PADD, in capacity, complexity, crude slates, etc.

Source: https://www.eia.gov/todayinenergy/detail.php?id=7170

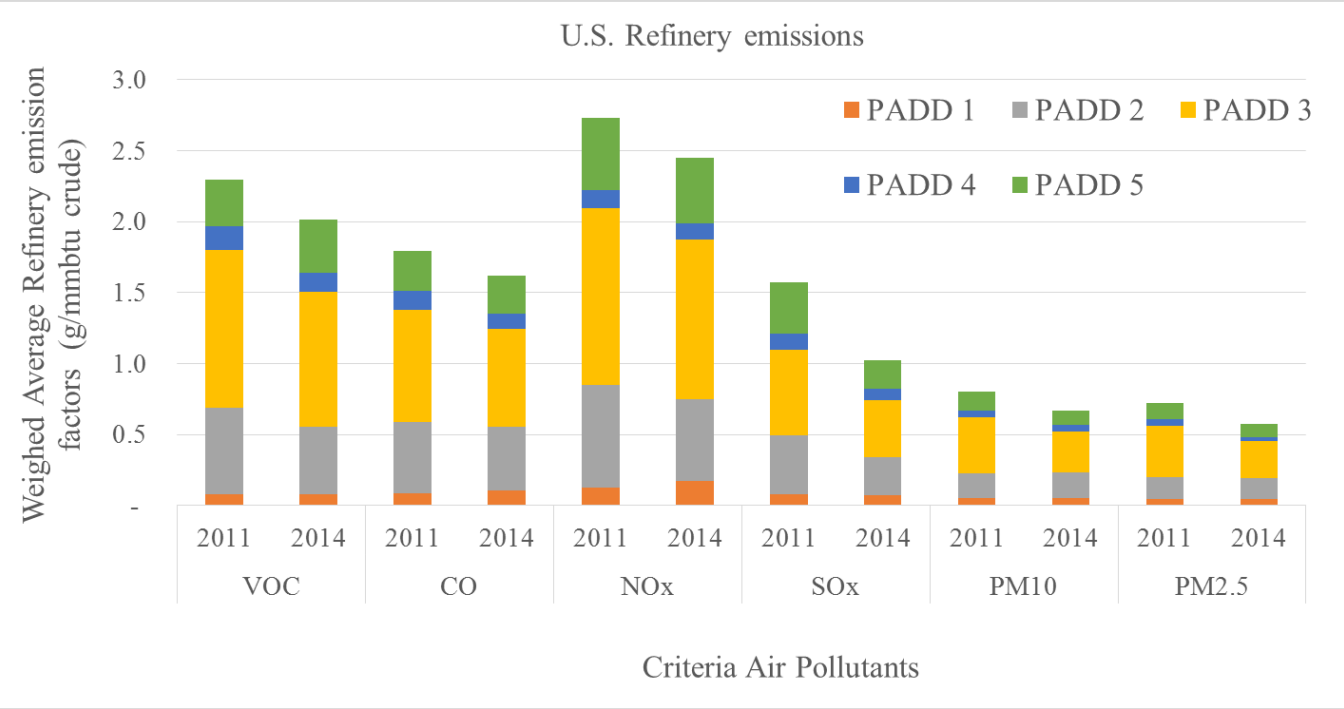
PADD emissions -2011/2014



- Average refinery pollutant emissions vary from PADD to PADD, per bbl of PADD average crude.

PADD contribution to national emissions with various capacity shares

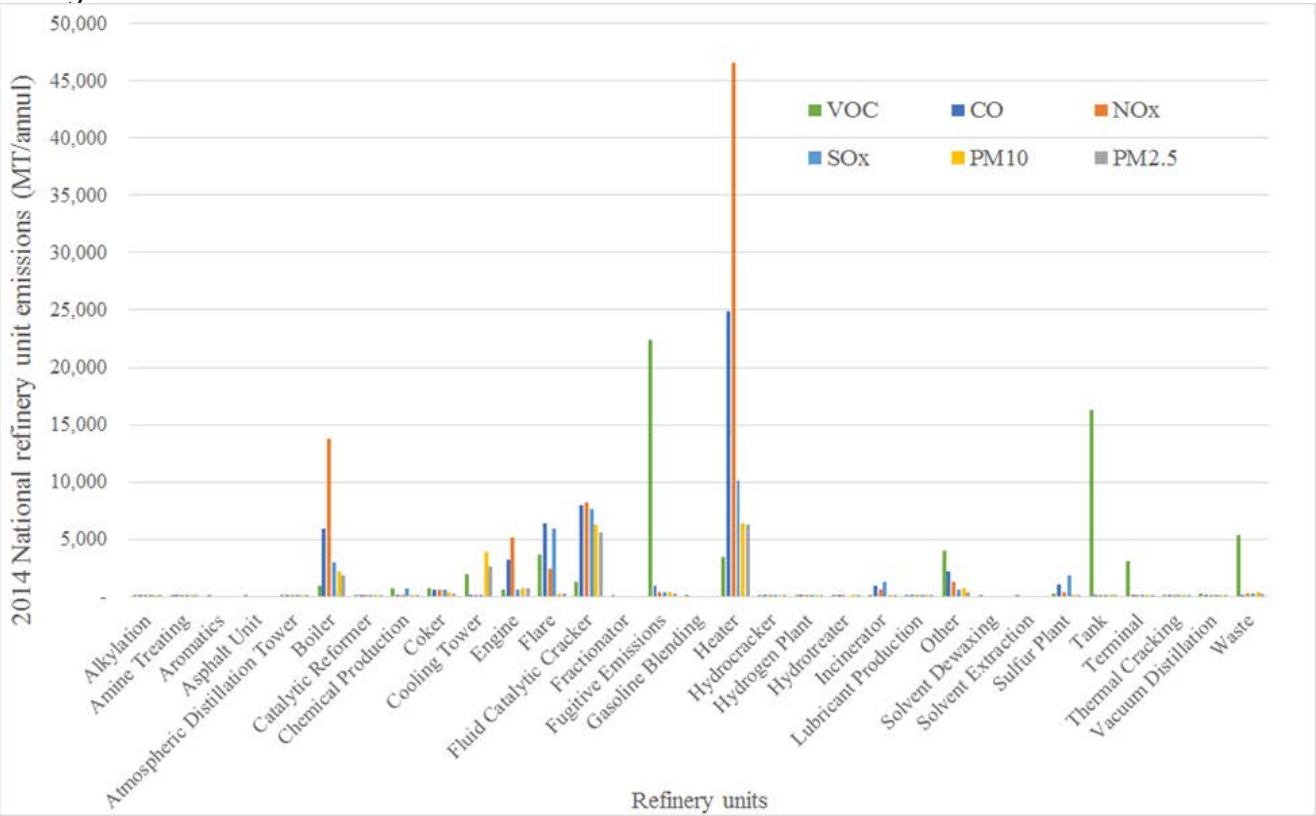
Year	PADD 1	PADD 2	PADD 3	PADD 4	PADD 5	US
2011	6.7%	22.5%	51.0%	3.6%	16.2%	100.0%
2014	6.9%	21.8%	52.1%	3.5%	15.7%	100.0%



- PADD 3 has the largest contribution per national average bbl of crude.

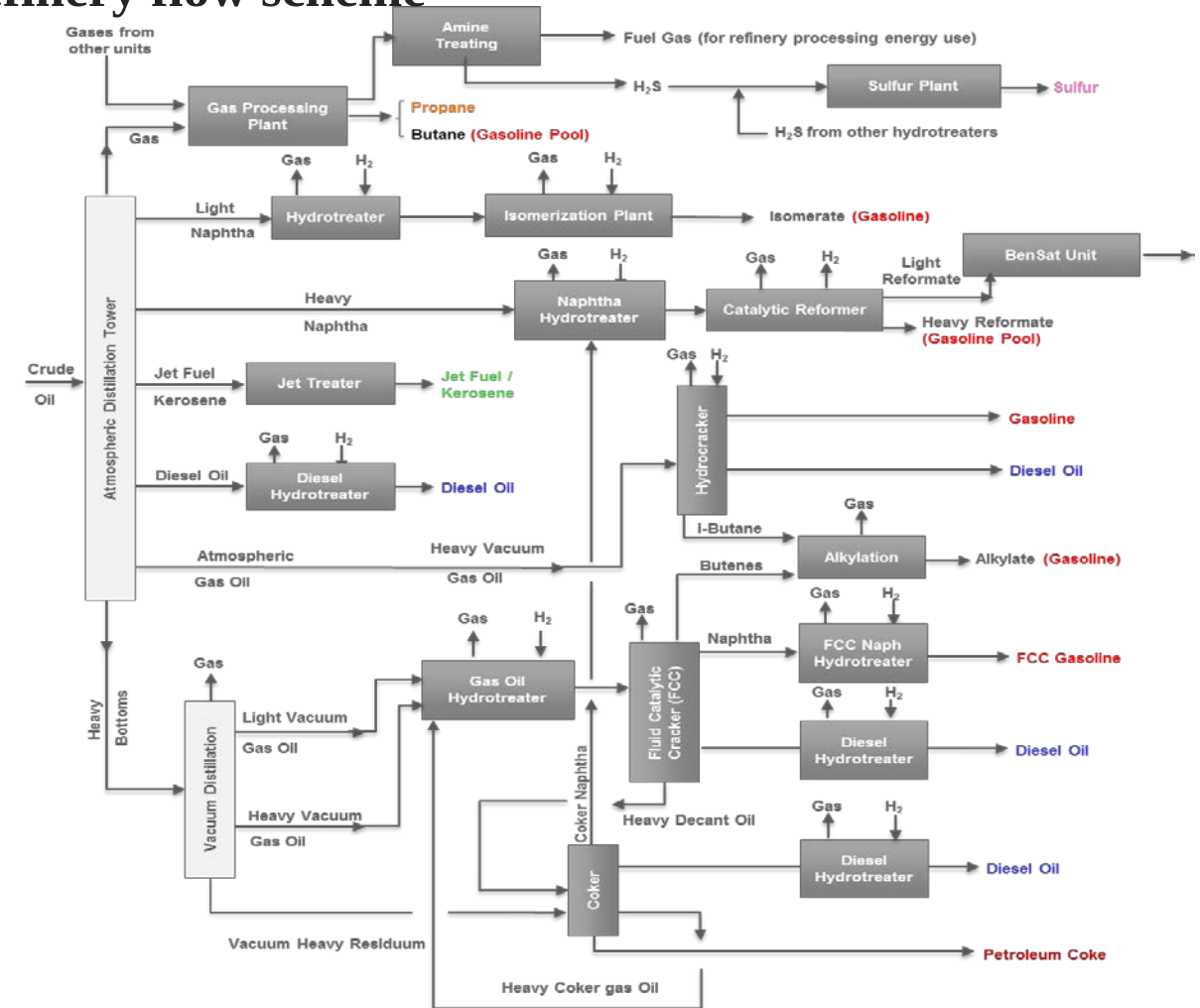
Part II: U.S. Refinery Air Pollutants Emission-LP Modeling Allocation

U.S. Refinery National Emission-2014



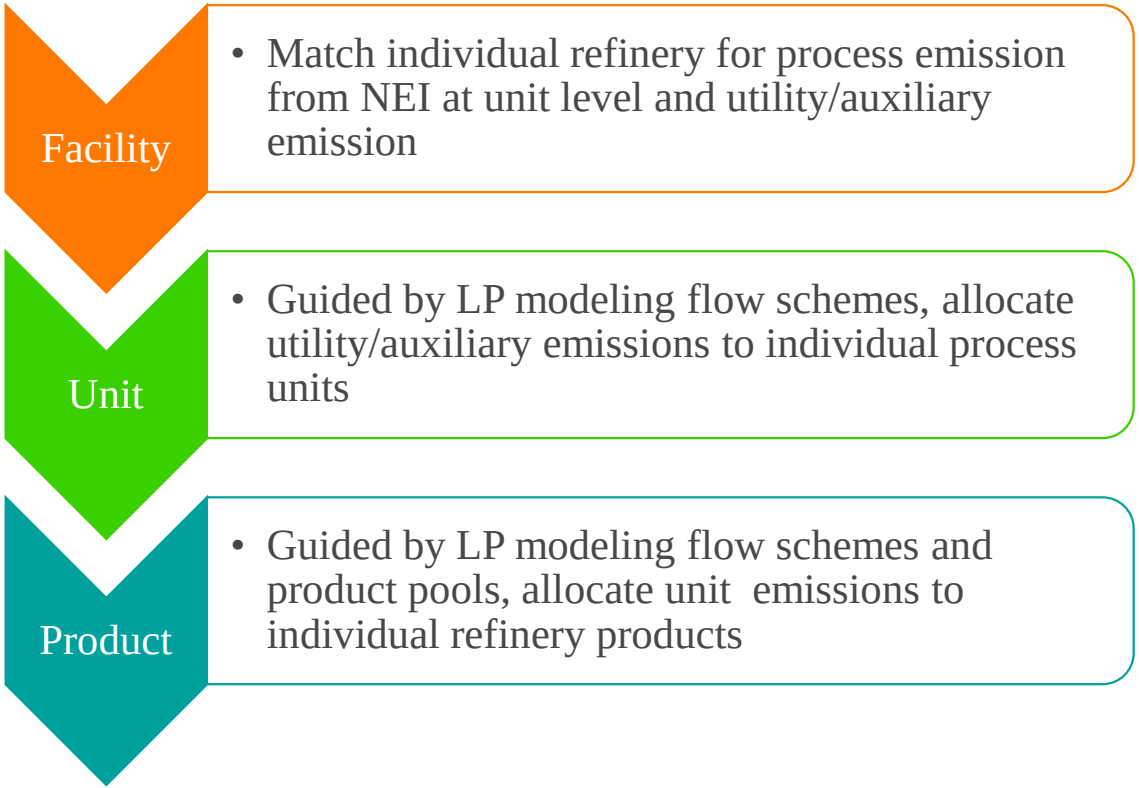
- Most pollutant air emissions are mainly sourced from combustion via heater, boiler, FCC, flare, and engine
- VOC is mainly sourced from fugitive emission, tank and waste

Refinery flow scheme

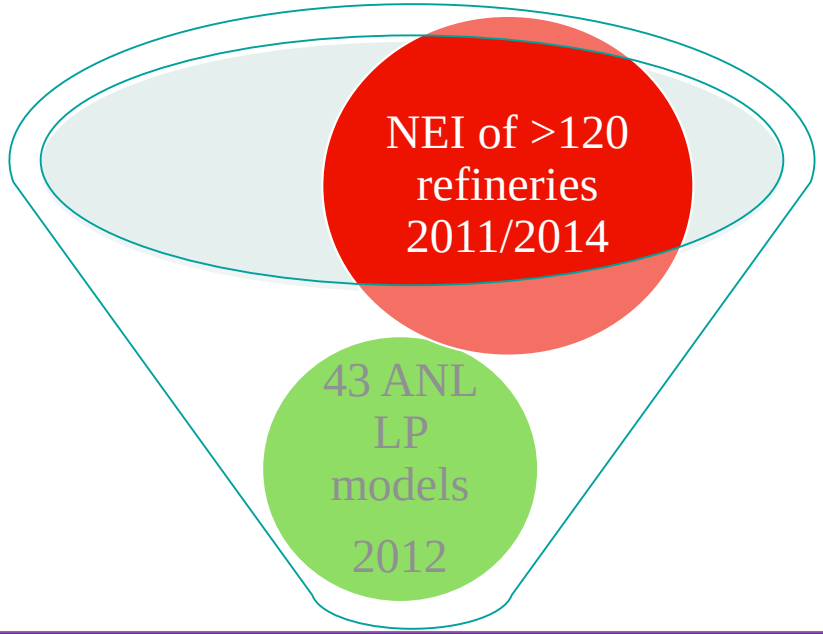


- Each individual refinery has unique configuration.
- Each fuel pool consists of several blending streams, sourced from various processing units.

Connect refinery air emissions inventory to refinery products – Approach



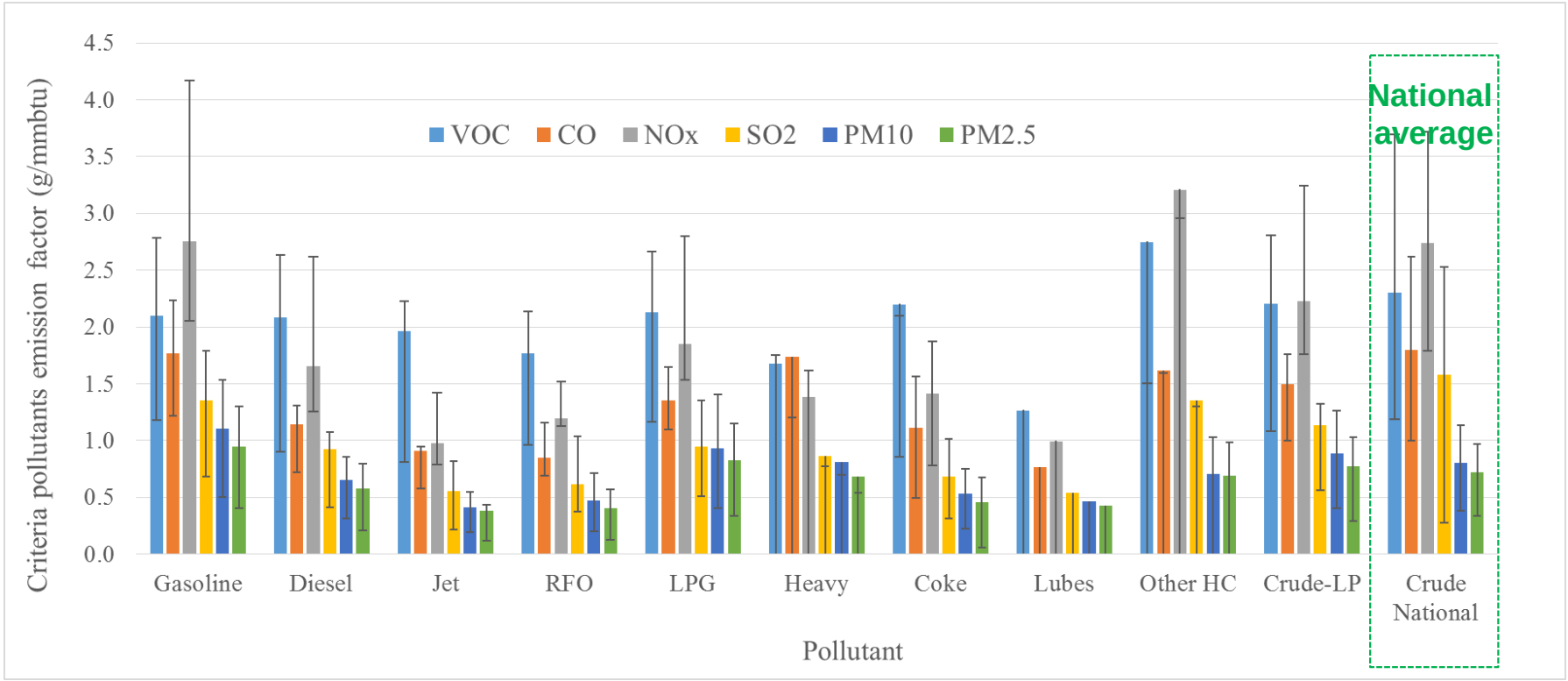
Connect refinery air emissions inventory to refinery operation – approach



Extra filter: minimal refinery operation change from 2011/2014 to 2012 to ensure consistency

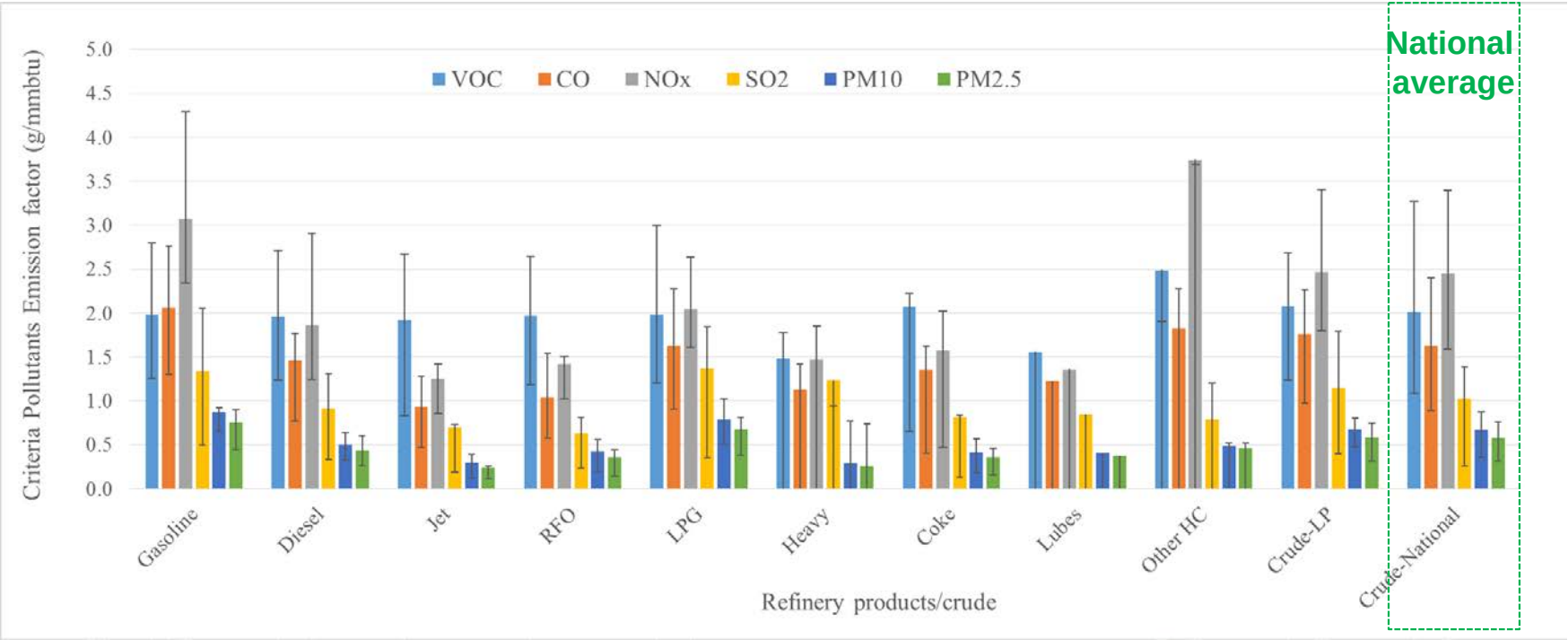
- Evaluated 14 refineries for 2011 emissions (23% of total U.S. refining capacity)
- 21 refineries for 2014 emissions (32% of total U.S. refining capacity)

Aggregated average pollutants emission–2011 NEI



- The product emission factors are based on 14 refineries (23% capacity)
- The crude emission factor is calculated in a national level (>120 facilities)
- The error bars indicate **1 quartiles and 3 quartiles by facility**
- The crude-LP is slightly to somewhat lower than crude-National

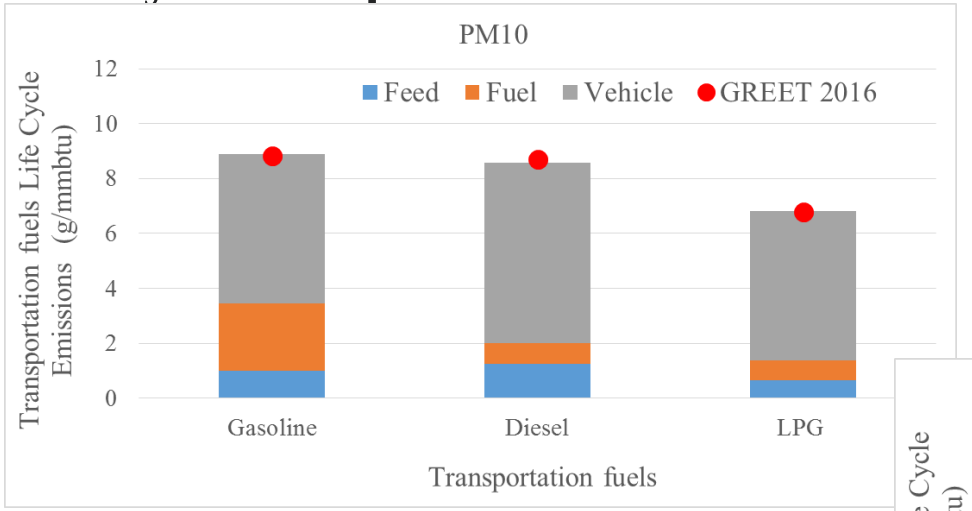
Aggregated average pollutants emission–2014 NEI



- The product emission factors are based on 21 refineries (capacity weighted)
- Close match between crude-LP and crude-national
- Implies a representativeness of the LP modeling derived results
- The crude-LP values are very close to Crude-National values.

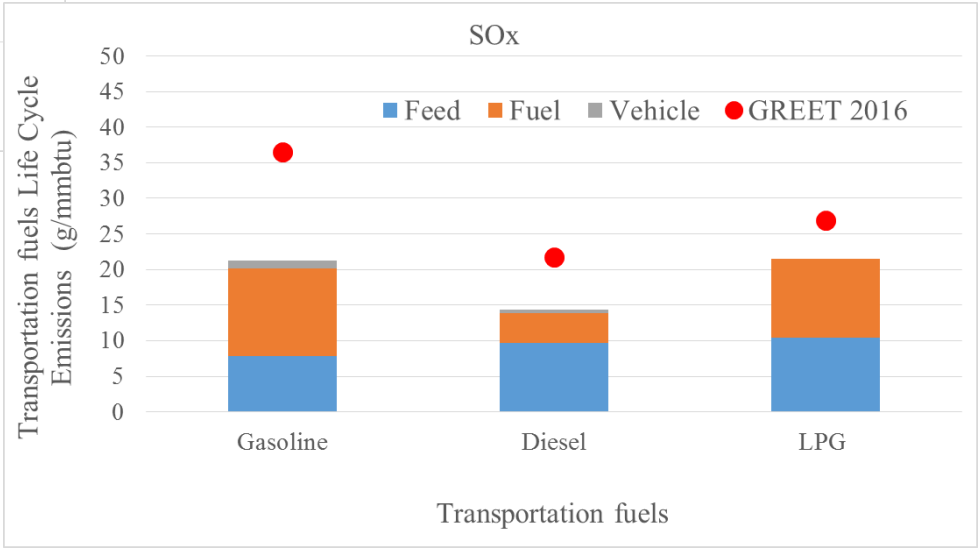
Part III: Transportation fuels Life Cycle Analysis on Air Pollutants

Life cycle transportation fuels air emissions



- Life cycle emissions of VOC, CO, PM10, PM2.5 are mainly sourced from vehicle operation stage (combustion)

- Life cycle emissions of SOx are mainly from feed recovery stage and fuel production stages.
- Life cycle emissions of NOx are from all stages.



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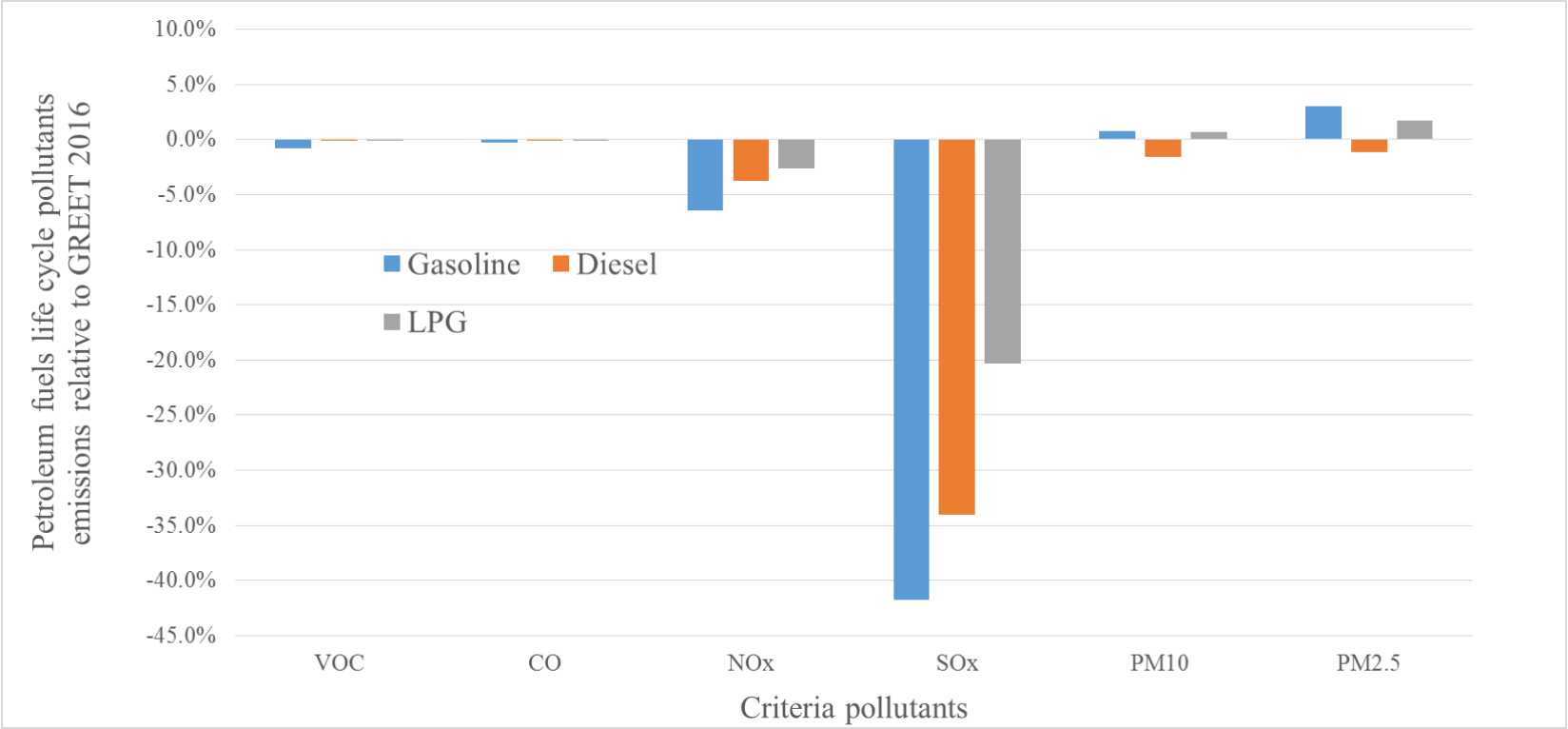
Life cycle emissions comparison with GREET 2016



- Relative to GREET 2016 values, the present results showed reduction for most pollutant emissions, except to PM emissions.

Conclusions

- New refinery criteria pollutants emissions per refinery throughput were developed
- The emissions per crude input vary among PADDs
- A methodology is developed to allocate refinery facility emissions to refinery products.
- Relative to GREET 2016, the updated results showed lower life cycle emissions for most pollutants, especially for SOx

Acknowledgement

- The authors would like to gratefully acknowledge the sponsorship of the Fuel Cell Technologies Office of the U.S. Department of Energy, under Contract No. DE-AC02-06CH11357

Thank you!