



PORT HOUSTON
THE INTERNATIONAL PORT OF TEXAS™

Mobile Source Emissions at Port Houston. Can Hydrogen Help?

Ken Gathright | Environmental Compliance Coordinator | Port Houston | H2@Scale Workshop | May 23, 2017



Port Commission



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What is Port Houston?



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First, what is Port Houston?

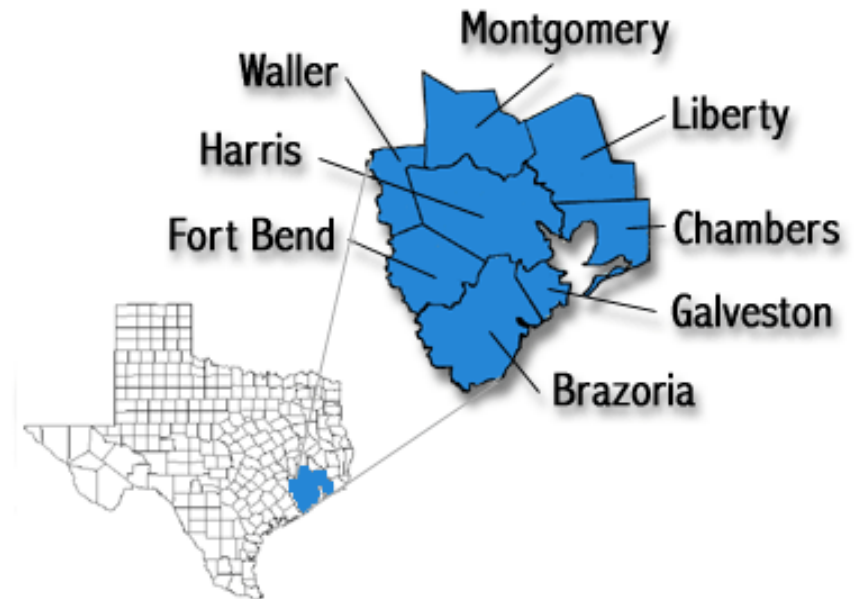
- Port Houston is comprised of 8 operating facilities among the 150+ private and public facilities that line the Houston Ship Channel.



Air Quality Houston-Galveston-Brazoria Area



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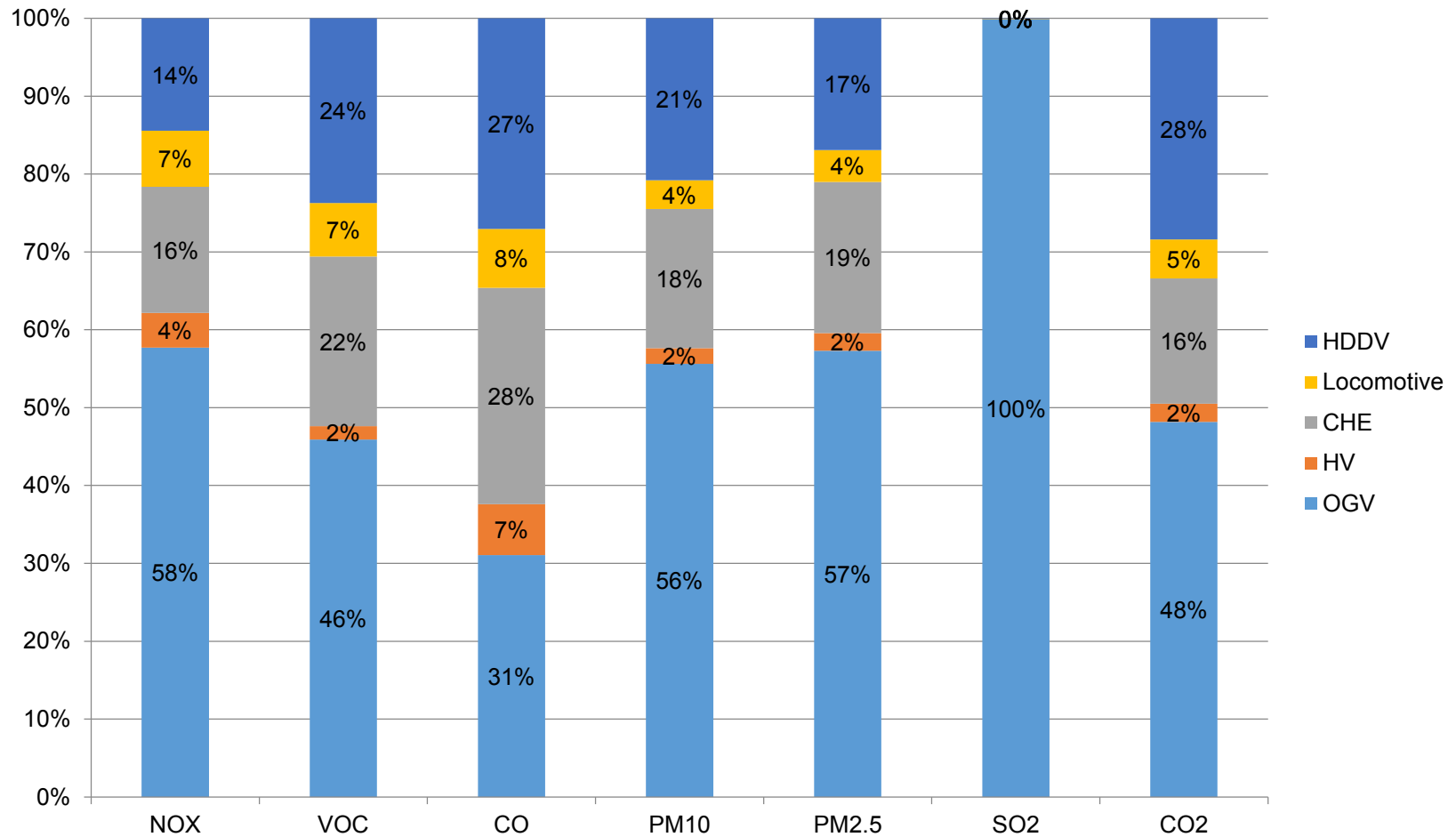


Nonattainment for Ground-level Ozone

2013 Port Houston Associated Goods Movement Air Emissions



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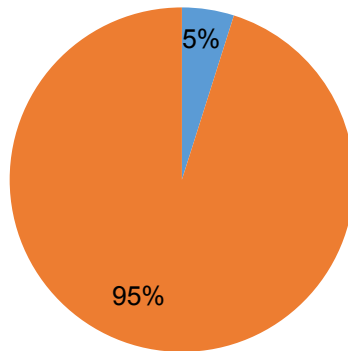
Port Houston Emissions Contribution In Houston Area



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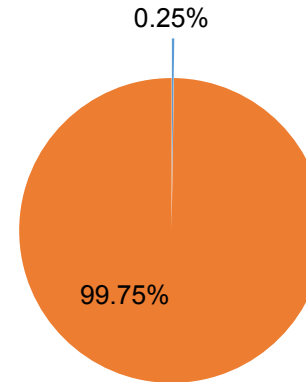
2011 Houston Galveston Brazoria SIP NOx emissions

■ Port Houston ■ Non Port Houston associated sources



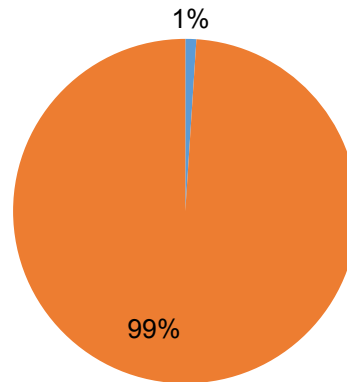
2011 Houston Galveston Brazoria SIP VOC emissions

■ Port Houston ■ Non Port Houston associated sources



2011 Houston Galveston Brazoria SIP PM2.5 emissions

■ Port Houston ■ Non Port Houston associated sources



Port Houston Container Drayage Trucking Characteristics



- Port Houston operates the Barbours Cut and Bayport container terminals.
- 17,205 trucks visited these terminals for a total of 1,208,226 truck trips in 2016.
- Average trip length (to and from terminal) is 50 miles.
- 622 different trucking companies visited these terminals.
 - 50 trucking companies that came the most accounted for 69% of the truck trips.

Port Houston Container Drayage Trucking Characteristics

Engine Model Year	NOx Standard (g/bhp-hr)	% of Trucks
1989 and older:	10.7	0.37%
1990	6	0.04%
1991-1997	5	13%
1998-2003	4	32%
2004-2006 ^a	2.375	31%
2007-2009 ^b	1.2	9%
2010 and newer	0.2	14%

a. Standard is actually 2.4 g/bhp-hr for NMHC+NOX but TCEQ assumes 2.375 g/bhp-hr for NOx.

b. Most manufacturers certified their 2007-2009 engines to a NOx limit of about 1.2 g/bhp-hr.

Current Hydrogen Port Drayage Demonstration Projects



- Toyota's Project Portal – Port of Long Beach/Port of Los Angeles
- US Hybrid/Jiangsu Dewei Advance Materials - Port of Long Beach/Port of Los Angeles
- Kenworth - Port of Long Beach/Port of Los Angeles
- Nikola Two
- Gas Technology Institute/US Hybrid - Houston

Barriers for Hydrogen Penetration into Drayage Truck Industry in Houston



- 80% of drayage trucking fleet is operated by independent owner/operators.
- There are no regulatory requirements or market forces that require or encourage replacement.
- Replacing an older truck with a hydrogen fuel cell truck only achieves an incremental improvement in NOx emissions compared to a newer diesel truck.
- A truck that has a 2010 or newer diesel engine achieves the following NOx reductions.
 - 96% NOx reduction in replacing a 1991 to 1997 truck
 - 95% NOx reduction in replacing a 1998 to 2003 truck
 - 92% NOx reduction in replacing a 2004 to 2006 truck
 - 83% NOx reduction in replacing a 2007 to 2009 truck

Barriers for Hydrogen Penetration into Drayage Truck Industry in Houston

- Cost of hydrogen fuel cell truck will be \$\$\$\$,\$\$\$\$.
- Cost of a more recent used diesel truck is \$\$,\$\$\$\$.



39 1

Updated: Tue, May 16, 2017 1:34 PM

2012 FREIGHTLINER CASCADIA 125

10 Spd; DD15 Detroit Engine Manufacturer 475 Horsepower; Diesel Fuel Type; Tandem Axle; Engine Brake; 2.47 Ratio; 295.75R/22.5 Tires; All Aluminum Wheels; 230 in Wheelbase; 40,000 lb Rear Axle Weight; 70 in Raised Roof Sleeper; Drive Side: Left Hand Drive; THESE TRUCKS ARE AVAILABLE AT BOTH LOCA...

Stock Number: 25375-25380TP

For Sale Price: USD \$44,500

Mileage: 568,000 mi

Engine Manufacturer: Detroit

Horsepower: 475

PORTER TRUCK SALES LP

Houston, Texas

Phone: (800) 956-2408

18 miles from you

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Updated: Tue, May 9, 2017 10:51 AM

2012 VOLVO VNL64T300

10 Spd OD; VIN #: 4V4NC9EH2CN559707; VED13 Volvo Engine Manufacturer 425 Horsepower; Tandem Axle; Engine Brake; 336 Ratio; All Steel Wheels; 176 in Wheelbase; Drive Side: Left Hand Drive; GREAT FUEL ECONOMY! THIS LOW MILE VNL300 TADC IS THE PERFECT TRUCK FOR LOCAL DELIVERY APPLICATIONS. POWERED B...

Stock Number: 217616

For Sale Price: USD \$43,950

Mileage: 298,979 mi

Engine Manufacturer: Volvo

Horsepower: 425

ARROW TRUCK SALES, INC. - HOUSTON

HOUSTON, Texas

Phone: (800) 875-0953

18 miles from you

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Updated: Mon, May 15, 2017 2:17 PM

2013 MACK PINNACLE CXU613

13 Spd OD; VIN #: 1M1AW07Y9DM029932; MP8 Mack Engine Manufacturer 505 Horsepower; Diesel Fuel Type; Tandem Axle; Engine Brake; 3.55 Ratio; 22.5 Tires; All Aluminum Wheels; 220 in Wheelbase; 70 in Mid Roof Sleeper; Drive Side: Left Hand Drive; Number of Beds: 1; Headache Rack

Stock Number: 02-U15801

For Sale Price: USD \$49,900

Mileage: 335,600 mi

Engine Manufacturer: Mack

Horsepower: 505

VANGUARD TRUCK CENTER - HOUSTON

Houston, Texas

Phone: (866) 401-7000

18 miles from you

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Barriers for Hydrogen Penetration into Drayage Truck Industry in Houston



- Other considerations
 - Fueling infrastructure
 - Service bay improvements
 - First responder training

How To Overcome These Barriers



- If there are no regulations requiring zero emission trucks - then market forces and economic incentives are needed.
 - Cargo/Freight owner can require that trucks be zero emissions.
 - Grants can cover the full incremental cost.
 - VW settlement money
 - Mobile Source Emission Reduction Credits could be generated and sold.
 - Marine terminals can offer discount on fees if zero emission trucks are used.

Other Potential Hydrogen Projects?



- Cargo Handling Equipment
 - Only battery powered terminal tractors are coming onto market. Not aware of any that are hydrogen fuel cell powered.
 - Can indoor hydrogen fuel cell forklift technology be adapted for larger outdoor forklifts?
- Rail
 - Appears that several prototypes have been built.

Other Potential Hydrogen Projects?



- Harbor Vessels
 - Port Houston owns a tour boat that could have potential for hydrogen fuel cell use.
- Ocean Going Vessels
 - While ship is docked, a hydrogen fuel cell could provide some of electric power for ship.
- Energy Storage
 - Future solar panels installations can be partnered with hydrogen electrolyzers and fuel cells to provide power at night.



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THANK YOU

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Questions?

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