

Final Report

Linde LLC
Contract Number MS10004
AB 2766 Heavy-Duty Alternative Fuel Engine Program



Executive Summary

Linde LLC (Linde) has partnered with the South Coast Air Quality Management District (SCAQMD) Mobile Source Air Pollution Reduction Review Committee (MSRC) in order to purchase and deploy three (3) trucks equipped with advanced, heavy-duty natural gas engines. As part of its agreement, Linde has developed a final report to outline the progress achieved to date, and the support it has received for natural gas engines that will allow Linde to reduce emissions and displace petroleum in the South Coast Air Basin. Linde operates the vehicles from its facility in Torrance, California. With the \$56,932 in grant support from the MSRC, Linde was able to deploy low emission technology within its operations in the South Coast region, an area that currently faces significant ambient air quality challenges.

Tasks Completed

Linde has completed the tasks required as part of contract MS10004 with the MSRC. Linde purchased three (3) heavy-duty natural gas trucks, equipped with a qualifying LNG engine. The following trucks were purchased by Linde:

Unit #	Make	Model	MY	VIN	GVWR
11885	Peterbilt	384	2011	1NPVD29X3BD131773	52,000
11886	Peterbilt	384	2011	1NPVD29X5BD131774	52,000
11890	Peterbilt	384	2011	1NPVD29X7BD131775	52,000

Each of the above trucks meet the requirements of Linde’s contract with the MSRC. They are each at least 14,001 pounds, equipped with dedicated natural gas engines certified by the California Air Resources Board (CARB) at or below a NOx standard of 0.2 grams brake horsepower-hour (g/bhp-hr). The vehicles will operate for a minimum of five (5) years, though they are expected to operate for their entire life expectancy. At least 85% of that operation will occur in the South Coast Air Basin.

The following table outlines the complete project schedule and list of tasks:

Task Description	Status
Order Vehicles	Complete
Submit Public Outreach Plan	Complete
Take delivery of vehicles and place into service	Complete
Implement Public Outreach Plan	Complete
Progress Report	Complete
Final Report	Complete

Results

Linde’s objective in deploying these natural gas vehicles is to demonstrate and implement extremely low-emission transportation strategies within its on-road fleet, as well as to provide a commercial success story that will make alternative fuels like natural gas a commercially viable and preferable fueling option. Natural gas contains less carbon than any other fossil fuel, and thus produces lower carbon dioxide (CO2) and greenhouse

gas (GHG) emissions per year. In fact, natural gas vehicles produce 20-30 percent fewer greenhouse gas emissions that comparable diesel vehicles. Natural gas is additionally less expensive that diesel, costing less energy per unit. Linde is quite familiar with the many benefits of natural gas, and as such it sought to provide these benefits to its own fleet.

The fuel use and miles travelled for each vehicle is provided on the tables below. The vehicles operated in the South Coast Air Basin a total of 93% of the time, surpassing the MSRC requirement to operate at least 85% of the time in the SCAQMD.

2011 Peterbilt 384 with Cummins LNG Engine (Linde Unit #11885)		
Deployment Date: April 24, 2011		
Time Period	Fuel Use	Miles Traveled
2011-Q2	583	3,011
2011-Q3	1,997	12,196
2011-Q4	1,610	11,549
2012-Q1	2,424	10,364
2012-Q2	2,184	9,611
2012-Q3	3,675	14,642
2012-Q4	1,512	7,168
2013-Q1	1,554	6,607
2013-Q2	2,127	10,607
2013-Q3	2,390	10,401
2013-Q4	2,828	13,321
2014-Q1	2,327	13,039
TOTAL	25,210	122,516
Average MPG	4.860	

2011 Peterbilt 384 with Cummins LNG Engine (Linde Unit #11886)		
Deployment Date: April 24, 2011		
Time Period	Fuel Use	Miles Traveled
2011-Q2	685	3,694
2011-Q3	1,877	10,640
2011-Q4	1,649	10,162
2012-Q1	875	4,824
2012-Q2	2,929	15,505
2012-Q3	3,063	14,719
2012-Q4	1,933	10,524
2013-Q1	2,679	13,710
2013-Q2	2,760	13,958
2013-Q3	1,497	7,323
2013-Q4	3,119	14,914
2014-Q1	2,997	15,677
TOTAL	26,062	135,650
Average MPG	5.205	

2011 Peterbilt 384 with Cummins LNG Engine (Linde Unit #11890)		
Deployment Date: April 25, 2011		
Time Period	Fuel Use	Miles Traveled
2011-Q2	1,439	7,356
2011-Q3	1,942	12,225
2011-Q4	3,155	18,873
2012-Q1	2,435	12,266
2012-Q2	2,391	13,392
2012-Q3	2,030	9,811
2012-Q4	3,132	16,138
2013-Q1	2,671	13,106
2013-Q2	2,109	10,578
2013-Q3	3,294	15,213
2013-Q4	1,679	8,092
2014-Q1	1,222	7,271
TOTAL	27,499	144,321
Average MPG	5.248	

Issues or Problems Encountered

During the course of the project, Linde did not encounter any significant issues or problems.

Budget

Linde has additionally provided the invoicing for this project with this final report. The approved cost breakdown for this project is:

Number of Qualifying Vehicle Purchases	AB 2766 Incentive per Unit	Maximum AB 2766 Discretionary Funds payable under this contract	Other funds applied	Total Cost
3	Not to exceed \$18,977	\$56,932	\$392,277	\$449,208

Conclusion

Natural gas is a clean, safe, and abundant fuel that is domestically produced, with 99 percent used in the United States coming from North America. Public and private fleets will be encouraged to switch from conventional fuels to natural gas by witnessing successful case studies from fleets like Linde. Linde remains committed to reducing emissions and creating cleaner solutions, such as the construction of alternative fuel natural gas vehicle deployment throughout the South Coast Air Basin.