Stage II & ORVR: Will state proposal expose motorists to an increase in toxic benzene vapors at the petrol station - PART 2

Note: Please click on the images in the gallery to enlarge them.

Table 1: Cost Effectiveness: IEE = 0.86 lbs. VOC/1,000 gal, STBL = 1.0 lbs./1,000 gal

ORVR Alone vs. Stage II + ORVR + Processor

State of MA

Throughput Category gallons/year	# GDFs	2013 Net $/Ton	2013 Fuel Savings	2015 Net $/Ton	2015 Fuel Savings	2018 Net $/Ton	2018
Less than 120,000	598	($64,977.11)	$47,535.96	($101,726.06)	$39,821.60	($117,849.16)	$34,441.12
120,001 to 240,000	114	($27,109.10)	$27,186.12	($32,912.02)	$23,774.23	($38,296.39)	$19,697.10
240,001 to 500,000	371	($12,540.10)	$181,865.48	($15,256.11)	$152,549.82	($17,870.68)	$131,765.13
500,001 to 1,000,000	814	($5,416.58)	$808,826.68	($6,776.48)	$677,566.58	($8,066.33)	$586,017.41
1,000,001 to 2,000,000	894	($1,978.79)	$1,776,686.49	($2,648.34)	$1,488,315.77	($3,293.17)	$1,287,122.52
Greater than 2,000,000	241	($141.07)	$1,021,731.59	($455.11)	$855,920.30	($757.42)	$740,272.93
Grand Total	3,032						

Table 1 - Please click on the image to enlarge it.

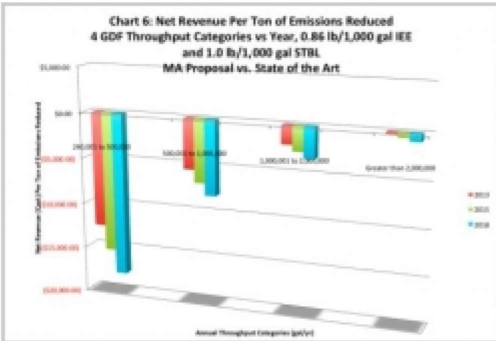

Chart 6 - Please click on the image to enlarge it.

Table 2: Cost Effectiveness: IEE = 0.86 lbs. VOC/1,000 gal, STBL = 2.5 lbs./1,000 gal

ORVR Alone vs. Stage II + ORVR + Processor

State of MA

Throughput Category gallons/year	# GDFs	2013 Net $/Ton	2013 Fuel Savings	2015 Net $/Ton	2015 Fuel Savings	2018 Net $/Ton	2018
Less than 120,000	598	($45,563.28)	$87,362.76	($50,119.66)	$79,648.40	($53,857.90)	$74,267.92
120,001 to 240,000	114	($14,201.09)	$49,863.32	($15,719.89)	$45,551.43	($16,965.87)	$42,474.30
240,001 to 500,000	371	($6,148.64)	$334,233.15	($6,887.51)	$304,729.52	($7,493.71)	$284,134.83
500,001 to 1,000,000	814	($2,283.46)	$1,486,481.68	($2,647.97)	$1,355,221.58	($2,947.08)	$1,263,672.41
1,000,001 to 2,000,000	894	($401.73)	$3,265,146.49	($583.99)	$2,976,825.77	($733.52)	$2,775,732.52
Greater than 2,000,000	241	$587.94	$1,877,768.58	$512.51	$1,711,952.90	$442.41	$1,596,304.98
Grand Total	3,032						

Table 2 - Please click on the image to enlarge it.

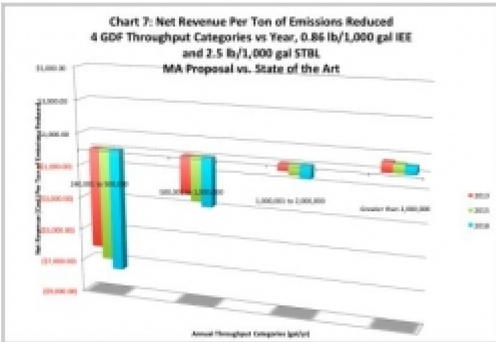

Chart 7 - Please click on the image to enlarge it.

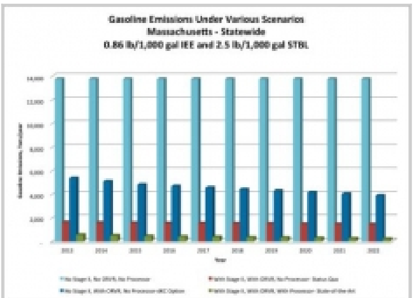

Chart 7b - Please click on the image to enlarge it.

Table 3: Cost Effectiveness: IEE = 7.0 lbs. VOC/1,000 gal, STBL = 4.0 lbs./1,000 gal

ORVR Alone vs. Stage II + ORVR + Processor

State of MA

Throughput Category gallons/year	# GDFs	2013 Net $/Ton	2013 Fuel Savings	2015 Net $/Ton	2015 Fuel Savings	2018 Net $/Ton	2018
Less than 120,000	598	($31,149.31)	$135,955.19	($33,200.24)	$118,203.88	($34,957.42)	$112,791.48
120,001 to 240,000	114	($9,396.44)	$72,694.57	($10,100.75)	$67,401.09	($10,665.83)	$64,506.17
240,001 to 500,000	371	($3,813.39)	$480,880.39	($4,158.29)	$452,221.30	($4,428.77)	$431,518.59
500,001 to 1,000,000	814	($1,150.34)	$2,141,113.80	($1,301.54)	$2,011,231.26	($1,434.99)	$1,919,152.75
1,000,001 to 2,000,000	894	$174.83	$4,707,922.41	$89.21	$4,417,790.54	$22.50	$4,215,934.59
Greater than 2,000,000	241	$860.20	$2,707,364.19	$828.08	$2,540,641.26	$796.80	$2,424,325.31
Grand Total	3,032						

Table 3 - Please click on the image to enlarge it.

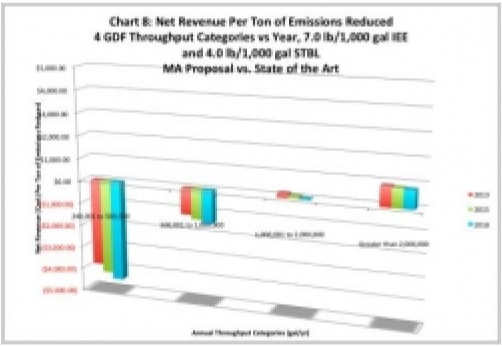

Chart 8 -

Please click on the image to enlarge it.

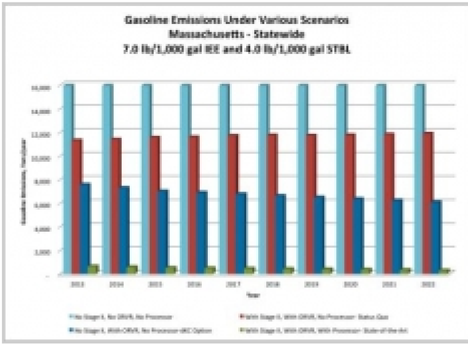

Chart 8b -

Please click on the image to enlarge it.

Article by Ted Tiberi, Luke Howard and Mike Heffernan, ARID Technologies, Inc.

This is Part 2 of the article. [FOLLOW THIS LINK] to read Part 1.

Economic Analysis

Assumptions used in the Cost Effectiveness calculations:

- Fuel Savings: $3.70/gallon
- Stage II Operating Expenses: $4,207/site-year
- Stage II Removal Expenses: $7,000 / site (33% allocated in 2013, 33% allocated in 2015, and 33% allocated in year 2018)
- State of MA Gasoline Throughput: 2,916,370,000 gallons per year; constant over period 2013 – 2022
- Uncontrolled Refueling Emissions: 7.01 lbs. / 1,000 gallons
- Stage II Overall Vapor Recovery Efficiency: 75%
- ORVR Vapor Recovery Efficiency: 98%, constant with no degradation
- 81 % of fuel dispensed to GDF equipped with Stage II Vacuum Assisted systems
- IEE = 0.86, 3.67, 7.0 lbs. / 1,000 gallons
- STBL: 0, 1.0, 2.5 and 4.0 lbs. / 1,000 gallons

If we exclude the first three throughput categories from above (< 500,000 gallons per year); The cost effectiveness for the three subsequent throughput categories show viable measures; where approximately 93% of MA gasoline throughput is controlled with the combination of Stage II + ORVR + Processor. Of particular note, the maximum cost per ton is shown to be $8,066, with a cost of $141 per ton for the best case. These figures are for very conservative IEE and STBL; please note that these cost effectiveness figures vary greatly from the dKC reported range of $21,000 to $32,000 per ton for Stage II enhancement.

If we exclude the first two throughput categories from above (< 240,000 gallons per year); The cost effectiveness for the four subsequent throughput categories show viable measures; where approximately 98% of MA gasoline throughput is controlled with the combination of Stage II + ORVR + Processor. Of particular note, the maximum cost per ton is shown to be $7,494, with a revenue stream of $598 per ton for the best case. These figures are for conservative IEE and STBL; please note that these cost effectiveness figures vary greatly from the dKC reported range of $21,000 to $32,000 per ton for Stage II enhancement.

Chart 7b, above shows that with an IEE of 0.86 lb/1,000 gal and STBL of 2.5 lb/1,000 gal, the Status Quo (existing conditions) are much more favorable than the MA DEP proposed case (Red bar vs. dark blue bar). It should also be noted that the green bar represents the State-of-the-Art approach using a vapor processor on the storage tanks.

In the above case, only the smallest throughput category can be excluded which allows for 98.7% of the MA GDF throughput to be effectively controlled. For the most favorable case, please note a revenue stream of $868 per ton for the largest throughput category of GDF.

Chart 8b, above, shows the state wide MA emissions including refueling emissions and Storage Tank Breathing Losses. The MA DEP proposal shows benefits in comparison to the Status-Quo case, however, the State-of-the-Art (SOA) case shows again the best results, with a large gap between SOA and the MA DEP proposed case.

Negative Health Impacts

At a non-Stage II GDF, in addition to the problem of Storage Tank Breathing Losses, STBL, non-ORVR vehicle refueling will directly expose the motorist (and nearby people) to carcinogenic vapors, increasing toxic exposure risk factors. Please reference this link for video of a refueling event with a non-ORVR vehicle refueling at a non-Stage II GDF:
http://www.youtube.com/watch?v=E8Hoj-_v0W4&feature=related

- This problem will be more prevalent at GDF refueling a higher proportion of non-ORVR vehicles. Such GDF are typically located in so-called Environmental Justice (or "EJ") areas.
- Motorists who refuel non-ORVR equipped vehicles at non-Stage II GDF will be directly exposed to carcinogenic vapors, thus creating unnecessary and unreasonable risks to public health, welfare and safety

In Massachusetts, the population of automobiles and SUV's is approximately 5 million (US Dept. of Transportation, Federal Highway Administration, Highway Statistics, 2010). Thus, if ORVR penetration is 85% in year 2013; then 15% or 750,000 vehicles do not have ORVR. Using an ORVR vapor recovery efficiency of 98%; upon refueling each "batch of 750,000 cars", the raw emissions will be equivalent to 50 x 750,000 or 37,500,000 vehicles. This far exceeds the total vehicle population by a factor of 7.5 times. In another context, the motorist refueling a non-ORVR vehicle at a non-Stage II GDF will be exposed to ***50 times the pollutants*** as a motorist refueling an ORVR vehicle.

Conclusion

In conclusion, the elimination of Stage II and sole reliance on ORVR technology does not provide the State of Massachusetts with optimal emissions reductions; in terms of both refueling and storage tank emissions. This action will increase emissions of VOC’s and HAPS, increase health risks to motorists, GDF employees and members of the Community, where the brunt of the emissions and negative health impacts will be borne by EJ Communities.

Overlooked in past studies and analyses on this topic are three key elements: 1.) The proper quantification and accounting for the IEE and the STBL from the Storage Tanks, 2.) The adverse health impacts from raw, uncontrolled emissions from non ORVR vehicles; especially the disproportionate share of this burden being borne by EJ Communities, and 3.) The positive impact of using active processors to enhance Stage II by managing storage tank pressure and significantly reducing IEE and STBL.

The optimal course of action is for MA DEP to require Enhanced Stage II via vapor processors with continuous pressure monitoring and remote data acquisition.

The detailed analysis above shows that the use of an active processor provides the following benefits to a GDF:

- *Control of VOC’s and HAP’s*
- *Reduction of Toxic Exposure Risk to motorists, GDF employees and members of Community*
- *Energy Recovery from saved gasoline*
- *Automatic monitoring and inspection through data logging and remote data acquisition system*
- *Continuous monitoring to reduce leaks in UST and Stage II piping system*
- *Leverage valuable existing hardware already installed at GDF*
- *Improve operating efficiency and associated profitability for GDF*
- *Allow both large capacity and small capacity GDF to earn benefits*

In comparison to ORVR Alone , the aggregate benefits for enhancing Stage II for the State of MA GDF operators with a vapor processor include $93 million in fuel savings while at the same time reducing emissions of volatile organic compounds and air toxics by over 62,000 tons; over the period 2013 - 2022.

Ted Tiberi is founder and president of ARID Technologies, Inc. He has a BS in chemical engineering from Pennsylvania State University and an MBA from Northwestern University’s Kellogg Graduate School of Management. He has twenty five years of experience in air pollution control and vapor recovery technology, and he is the author or co-author of several US patents.