**From:** Ted Tiberi [ttiberi@aridtech.com]
**Sent:** Tuesday, September 25, 2012 2:37 PM
**To:** Santos Olivarez
**Subject:** Stage II and ORVR interaction
**Attachments:** ARID Technologies Response to Klausmeier Report 28 AUG 2012 State of MA with Foreword.pdf

Dear Santos,

I have attached ARID's comments on Stage II/ ORVR interactions.

We feel that removal of Stage II by TCEQ is a very bad decision which results in accelerated health risks and significantly increased emissions in Texas.

Please advise if I you and TCEQ would like to review our raw data and spreadsheets used to derive the charts and tables in this report.

Respectfully submitted,

Ted Tiberi

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ARID Technologies' Inc. Comments on the

ERG Project No.: 0277.00.001.001

# Air Program Support for Stage I and Stage II Programs in Massachusetts

# Draft Final Report for Public Review

## Prepared for:Massachusetts Department of Environmental Protection

## Prepared by:

**Eastern Research Group, Inc. 3508 Far West Blvd., Suite 210 Austin, TX 78731**

**de la Torre-Klausmeier Consulting 1401 Foxtail CoveAustin, TX 78704**

**27 August, 2012**

**Prepared for:**
***Massachusetts Department of Environmental Protection***

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## Foreword & Executive Summary

At the urging of the USEPA, various State Environmental Protection Agencies and Departments of Environmental Protection have begun to allow gasoline-dispensing facilities (GDF) to no longer use Stage II vapor recovery systems. The Stage II vapor recovery systems are designed to capture and return vapors displaced from vehicle tanks during the refueling process to the headspace of the underground storage tanks. These systems typically use a vacuum pump in conjunction with a coaxial hose (hose within a hose) that allows liquid gasoline to flow from the storage tank to the vehicle fuel tank; and recovered vapors to flow in the opposite direction; from the vehicle tank back to the underground tank. These systems provide an important means to limit exposure of the motorist to hazardous air pollutants such as benzene.

The other means of capturing these refueling emissions involves the use of a small carbon canister placed within the vehicle itself. The fill pipe of the vehicle is designed to reduce vapor flow back towards the nozzle (so-called "liquid seal"), and the vapors displaced from the vehicle tank are directed to the carbon canister, where the hydrocarbon vapors are selectively adsorbed within carbon pellets. The canister is cleaned or "regenerated" by a portion of engine intake air flowing back through the canister and allowing the hydrocarbons to be "desorbed" and directed back to the engine where they are burned as fuel. The carbon canister system is referred to as an ORVR system; On Board Refueling Vapor Recovery.

The overlap of these two systems working simultaneously results in air being ingested into the underground storage tanks when an ORVR equipped vehicle is refueled at a GDF using a Stage II vapor recovery system. During the refueling process, a large proportion of the hydrocarbon laden vapors are directed to the ORVR canister, and the vacuum pump of the Stage II system draws back a hydrocarbon lean stream which is predominately fresh air. The returned air reduces the concentration of the hydrocarbon vapors within the ullage (vapor space) of the underground gasoline storage tanks.

Since the concentration is reduced in the ullage, liquid gasoline will evaporate in an attempt to increase the concentration of the vapors back to the original or "equilibrium" concentration. The volume expansion of liquid to vapor phase gasoline is large; where 1 gallon of liquid will form 520 gallons of vapor, at 40% hydrocarbon concentration. The evaporation of the liquid gasoline will increase significantly the volume of vapors in the ullage space of the underground tanks, and therefore a corresponding increase in pressure will result. The pressure will quickly reach and then exceed the relief pressure of the pressure/vacuum (P/V) valves installed on the tank vents. The P/V valve in the USA will typically crack open at a positive pressure of +3.0 inches of H2O. This is a relatively low pressure as 1 atmosphere of pressure = 14.7 pounds per

square inch = 407 inches of H2O. Thus, if the storage tanks do not use any add on processor, the combination of Stage II used at the GDF and ORVR used on the vehicle results in significant emissions from the storage tanks, and the environmental and economic benefits from vapors which were recovered by the ORVR canister in the vehicle are now negated by the newly formed vapors which are exhausted from the underground storage tank. The vapors expelled from the storage tank are referred to as Incompatibility Excess Emissions (IEE).

The approach taken by the American Petroleum Institute (API), the Society of Independent Gasoline Marketers (SIGMA), the Petroleum Marketers of America (PMAA) and the United States Environmental Protection Agency (USEPA) recommends removing the Stage II systems and relying solely on the ORVR canisters for GDF vapor recovery. They assume that the IEE emissions are negligible, and that at some point the refueling emissions reduced by ORVR alone will exceed the emissions reduced by the Stage II systems. A study was conducted which defines a "cross-over" point where the ORVR emissions reductions equal the Stage II emissions reductions. Beyond this point in time, these groups and a consultant study argue that the Stage II systems show diminishing returns and that they should be deactivated. The State Agencies have all agreed with this analysis, and they are now issuing statements on when and how the Stage II systems can be deactivated.

The problem with this analysis is twofold: first, the GDF Stakeholder groups and USEPA have neglected the significant emissions from the underground storage tanks. Second, the refueling of non-ORVR vehicles at non-Stage II GDF will result in direct exposure of the motorist to toxic and carcinogenic vapors. On the first point, in a non-Stage II scenario, the underground storage tanks will ingest air during periods of busy pumping activity. When the pumping rate slows or altogether stops (when the station is closed), the ingested air will cause liquid fuel to evaporate, and the same dynamics as described above for IEE will lead to vapor growth and subsequent emissions from the underground storage tanks. ARID has quantified the IEE under non-Stage II situations, and the losses are much larger than the losses discussed by the consultant's study. On the second point, if 70% of vehicles have ORVR canisters; then 30% do not have the canisters. The 2009 US Bureau of Transportation Statistics lists 254 million registered vehicles in the USA; 30% of this figure means 76.2 million vehicles do not have ORVR canisters. For the unfortunate motorists who do not have ORVR canisters; they will earn the right to ingest benzene and other hazardous air pollutants during the refueling of their vehicle. These same people would not be directly exposed to this pollution if they were refueling their non-ORVR vehicle at a Stage II equipped GDF.

**Introduction**

ARID Technologies, Inc. was founded in 1993, and the company specializes in the design and manufacturing of vapor recovery equipment used at gasoline dispensing facilities. ARID does not manufacture Stage II vapor recovery equipment; however the company does manufacture a membrane based vapor processor called PERMEATOR. The ARID Permeator enhances existing Stage II vapor recovery technology by actively managing storage tank pressure, and this system has been operating in nearly 500 GDF, worldwide. By selectively separating hydrocarbon vapors from air, the storage tank pressure is reduced while at the same time valuable fuel is conserved and atmospheric emissions are avoided.

ARID submitted third-party reports, spreadsheets, studies and other data to Mr. Klausmeier in preparing his ERG/ dKC draft report submitted to the State of Massachusetts. ARID was not contacted directly by Mr. Klausmeier for clarification of any of the information we provided. ARID now takes this opportunity to provide our view on the report submitted by Mr. Klausmeier.

**Widespread Use**

As per our formal comments and technical calculations submitted to Ms. Eileen Hiney, ARID feels that MA DEP actions do not represent the optimum course of action for emissions reductions at GDF's. In fact, we are disappointed to state that MA DEP is taking actions that will increase emissions relative to proven, state-of-the-art alternatives. For some reason the dkC (Klausmeier) study did not consider the option for MA GDF to incorporate Stage II, ORVR and **active vapor processors**.

In addition to a sub-optimal result in emissions reductions, MA DEP possible Stage II Compliance Waiver will have adverse impacts on public health. Health risks to motorists, GDF employees, and members of the community in close proximity to GDF operations will be amplified due to increased ingestion of air toxics such as benzene. As highlighted in our submittal, the air toxics are generated from non-ORVR equipped vehicles refueling at non Stage II GDF. In fact, even motorists refilling an ORVR equipped vehicle will be subjected to such vapors if they refuel their vehicle at the same time that a motorist refuels their non-ORVR equipped vehicle at the same GDF.

The technology for Stage II enhancement has already been proven and is commercially robust.

**Details**

In general, vapor emissions at gasoline dispensing facilities (GDF) are comprised of **refueling emissions** and **storage tank emissions**. In turn, refueling emissions are generated at the nozzle/vehicle interface and at the outlet from the carbon canister used on the ORVR systems. The storage tank emissions are comprised of vent line emissions through the pressure/vacuum valve (p/v valve) and fugitive emissions through various point sources within the vapor containing hardware; where the vent & fugitive emissions are a function of storage tank pressure. The vent and fugitive emissions comprise the so-called "IEE" or incompatibility excess emissions. Let's refer to these emissions as IEE, version 1.

The goal for the GDF is to minimize the total emissions of VOC's and HAP's (Volatile Organic Compounds and Hazardous Air Pollutants); which is the sum of the refueling and storage tank emissions. Traditionally, a practical tradeoff existed where the A/L (Air to Liquid) ratio of the Stage II system could be increased to improve vapor collection at the nozzle/vehicle interface (improving collection efficiency); however, this increase in A/L results in air ingestion into the storage tank with a penalty in fuel evaporation, tank pressurization and the generation of both vent and fugitive emissions. With non-Stage II and ORVR alone, air ingestion via Stage II is eliminated, however air will still be ingested into the storage tanks through the vent line (the negative cracking pressure of the p/v valve is quickly reached); this air will cause fuel to evaporate in the storage tanks during slower pumping periods. In addition, non-Stage II refueling of non-ORVR vehicles will emit raw, uncaptured hydrocarbons directly into the vicinity of the refueling motorist; or to an adjacent motorist at the GDF or to the surrounding community. To adequately optimize a solution for the GDF, both sets of emissions must be considered simultaneously.

Why give up one molecule of toxic vapor capture or containment; especially if the means to capture and contain the vapor yield a favorable economic payback; while at the same time leveraging already installed hardware?

**ORVR and Stage II Emissions**

In our view, the concept of ORVR "widespread use" has been misunderstood and misinterpreted. The primary flaw centers on the "breakeven" or "cross over point"; where the refueling emissions from ORVR alone are said to equal the refueling emissions from Stage II. If total emissions are equal to refueling emissions alone; then this concept is valid. However, as described in the previous section of this Summary, the Total Emissions = Refueling Emissions + Vent Emissions + Fugitive Emissions. The ORVR only refueling emissions at the vehicle/fueling nozzle interface comprise only a small fraction of the total emissions with or without Stage II in place. In fact, these refueling emissions represent a smaller proportion of the total emissions than do the Vent and Fugitive Emissions. This concept is very important, and has been overlooked by the Regulatory Community for decades. Various "Draft Studies" which used overly complicated measurement techniques with vapor dilution schemes were conducted, and the use of simple, direct measurements has somehow been avoided. To break this pattern, ARID conducted third party studies and direct measurements of the IEE. On one site, the time required for set-up of the pressure sensor and dry gas flow meter was only 4 hours. There is no reason why State & Federal EPA cannot conduct a similar, straightforward test to directly measure the IEE, version 1.

Removal of Stage II means storage tank pressures and related storage tank vapor emissions will increase during slower pumping periods (IEE, version 2). ARID at the moment has non-Stage II GDF customers in the USA and Japan using our vapor processor technology. We have submitted with this report the typical pressure trace and storage tank emission data for such sites (Appendix 1). Ironically, the USEPA and Klausmeier / ERG report seems to recommend the elimination of Stage II (without considering enhancement via vapor processors); but then the report recommends the use of vapor processors to mitigate the *new problem* caused by Storage Tank Emissions (IEE, version 2), in an ORVR only environment. Seems counterproductive and not logical. The charts to follow will show why this approach is flawed.

In addition to creating the problem of Storage Tank Emissions (IEE, version 2), 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. In Massachusetts, 24.1% of the total number of GDF sites, or 240 sites with the highest throughput (Mean throughput of approximately 3,200,000 gallons per year dispensed) are located within the EJ areas (ERG, State of MA raw data spreadsheet made available on the ERG ftp server). Although the ERG report went to great lengths to explain carefully chosen boundaries defining "EJ Polygons" and "Inspection Center" data to minimize the %ORVR vs. % non-ORVR gap at GDF located within EJ Communities; direct observations with a consultant or MA DEP person in the field for a day or two will likely show a large discrepancy between ORVR and non-ORVR vehicles at such GDF (Alternatively, a check of vehicle registrations, cross referenced with geography should show a similar result). For example, the Cumberland Farms site at 798 Carew Street, Springfield, MA will likely have a large percentage of non-ORVR vehicles refueling on a regular basis. Also, the Hess site at 1701 Worcester St in Framingham, MA should experience a higher proportion of non-ORVR vehicles in their mix. In addition, the BJ's Wholesale Club site at 5 Way, Plymouth, MA will also have extra vapors within their refueling islands. Basically, how does MA DEP tell the disadvantaged people of Springfield, Framingham and Plymouth that they earn the right to ingest a higher proportion of carcinogenic vapors than their fellow citizens living in other cities in the Commonwealth? How many extra cases of lung cancer or leukemia in Springfield, Framingham, or Plymouth are acceptable to the MA DEP? These are serious questions, the responses by those entrusted with overseeing public health and minimizing exposure risks should be based on sound science and engineering.

**Further Analysis**

The cost of terminating the Stage II program and relying solely on ORVR will yield significant increases in emissions for MA in comparison to a State-of-the-Art alternative. These increases are further quantified and tabulated in the spreadsheet provided by ARID.

*Assumptions and inputs:*

ARID used the assumptions and inputs provided by USEPA, State of MA DEP, and ERG/ dKC. Our calculated data and charts are presented below. CHART 1 shows the cross over of refueling emissions with ORVR only and Stage II w/ORVR, with a y-axis in tons/year, statewide in MA. CHART 2, reproduces this chart, with a y axis in lb./1,000 gal; this CHART 2 provides good agreement with the dKC Chart shown as Figure 3-2; page 5, of the "August 22, 2012 Addendum". This dKC report takes into consideration the inputs of USEPA in their "Guidance on Removing Stage II Gasoline Vapor Control Programs from State Implementation Plans and Assessing Comparable Measures", H. Lynn Dail, Glen W. Passavant, 7 August, 2012. The important point on CHART2 is that this chart presents only Refueling Emissions Data; it does not include IEE, version 1 Storage Tank Emissions. The dKC data claims to take into account the appropriate IEE factors; but apparently the figures used are so small, that they make no appreciable impact on the curves. If Storage Tank Emissions were not important to the total vapor

losses; then the crossover point of the ORVR only emissions with the Stage II w/ORVR emission curve is very meaningful. However, since the Storage Tank Emissions (IEE, version 1) are so dominant, the cross over point is a curiosity, but not that meaningful when the total emissions are considered.

The fact that ARID was able to recreate the dKC data shows that our spreadsheet using logical inputs and algebra provides a good approximation to the techniques used in MOVES. ARID has no experience using the MOVES model; it is our understanding that the MOVES model was originally created by USEPA to calculate Motor Vehicle Emissions, more geared to the vehicle itself and not the GDF or the GDF storage tanks. From the MOVES2010b User Guide, June 2012, Page F-1, we found this description,

*"Only the most recent 31 model years of vehicles in the evaluation calendar year are simulated when MOVES is run. When the fleet is entirely composed of vehicles subject to ORVR rules, the only value of Stage II controls will be to control refueling vapors from vehicles with damaged ORVR systems. Until that time, having a Stage II control program always adds to the control of refueling losses, since there are always some vehicles without ORVR controls that will benefit from a Stage II program. The remaining Stage II benefits depend on the program design, including the scope (which stations have the program) and effectiveness (how much of the equipment is operational).* ***MOVES does not account for any effects on the emissions from refueling station gasoline storage tanks when Stage II is used in combination with vehicles equipped with ORVR systems."*** Thus, it is safe to say the MOVES2010b does not include a calculation algorithm for IEE. Since MOVES2010b does not include this algorithm, we also assume that MOVES2010a does not include an IEE algorithm either. (The MOVES2010a User Guide does not make a similar statement regarding ORVR/Stage II impact on GDF storage tank emissions.)

The inputs used in ARID's spreadsheet are as follows:

Year 2013 ORVR fuel volume: 84.87%; Year 2015: 90.39% fuel volume to ORVR and Year 2018: 94.24% fuel volume to ORVR equipped vehicles (Q orvri). State of MA fuel consumption in 2013 = 2,916,370,000 gallons; this volume was held constant throughout the ten-year interval from 2013 through 2022. Also, 99% of the fuel volume is dispensed through Stage II equipped GDF (Q sII); the emission rate is 7.01 lb./1,000 gallons dispensed, 98% ORVR vapor recovery efficiency (n orvr, with no subsequent degradation), and 81% of gasoline volume is dispensed to Stage II Vac-assist GDF, without ORVR Compatible gear (Q sIIVA). In addition, we used Stage II vapor recovery efficiency of 75% (n iuSII). At the end of the spreadsheet, we compared the USEPA formulas to our data by using CFi values of .0659, .0702, and .0733 for years 2013, 2015, and 2018, respectively.

A quick side note: 98% ORVR control efficiency means that 50 x the emissions will result from non-ORVR refueling. For example, 10 vehicles being refueled without ORVR will generate the same emissions as 500 cars being refueled with ORVR; assuming an ORVR vapor recovery efficiency of 98%.

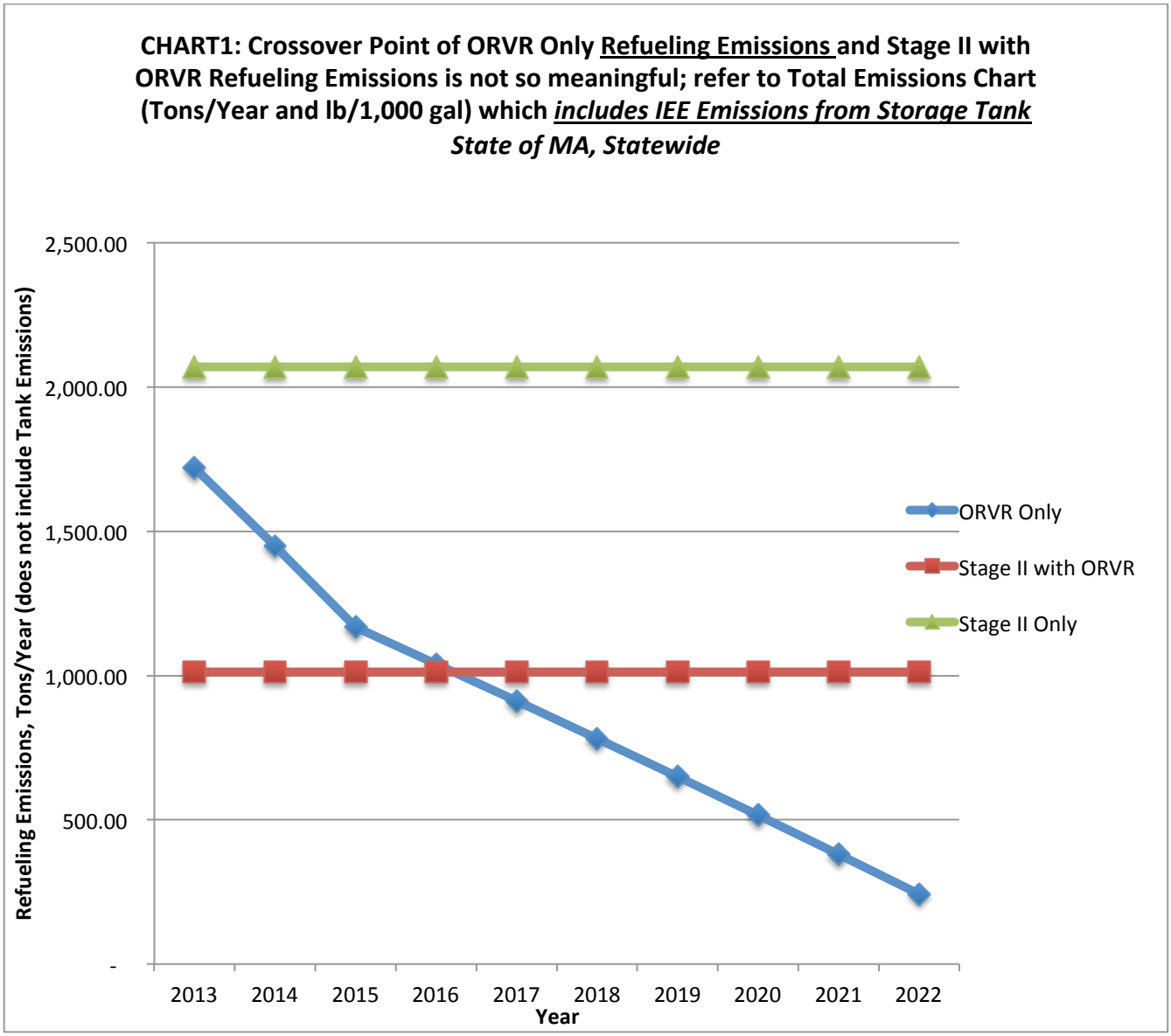


CHART1: Crossover Point of ORVR Only Refueling Emissions and Stage II with ORVR Refueling Emissions is not so meaningful; refer to Total Emissions Chart (Tons/Year and lb/1,000 gal) which includes IEE Emissions from Storage Tank
State of MA, Statewide
Refueling Emissions, Tons/Year (does not include Tank Emissions)
2,500.00
2,000.00
1,500.00
1,000.00
500.00
-
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Year
ORVR Only
Stage II with ORVR
Stage II Only

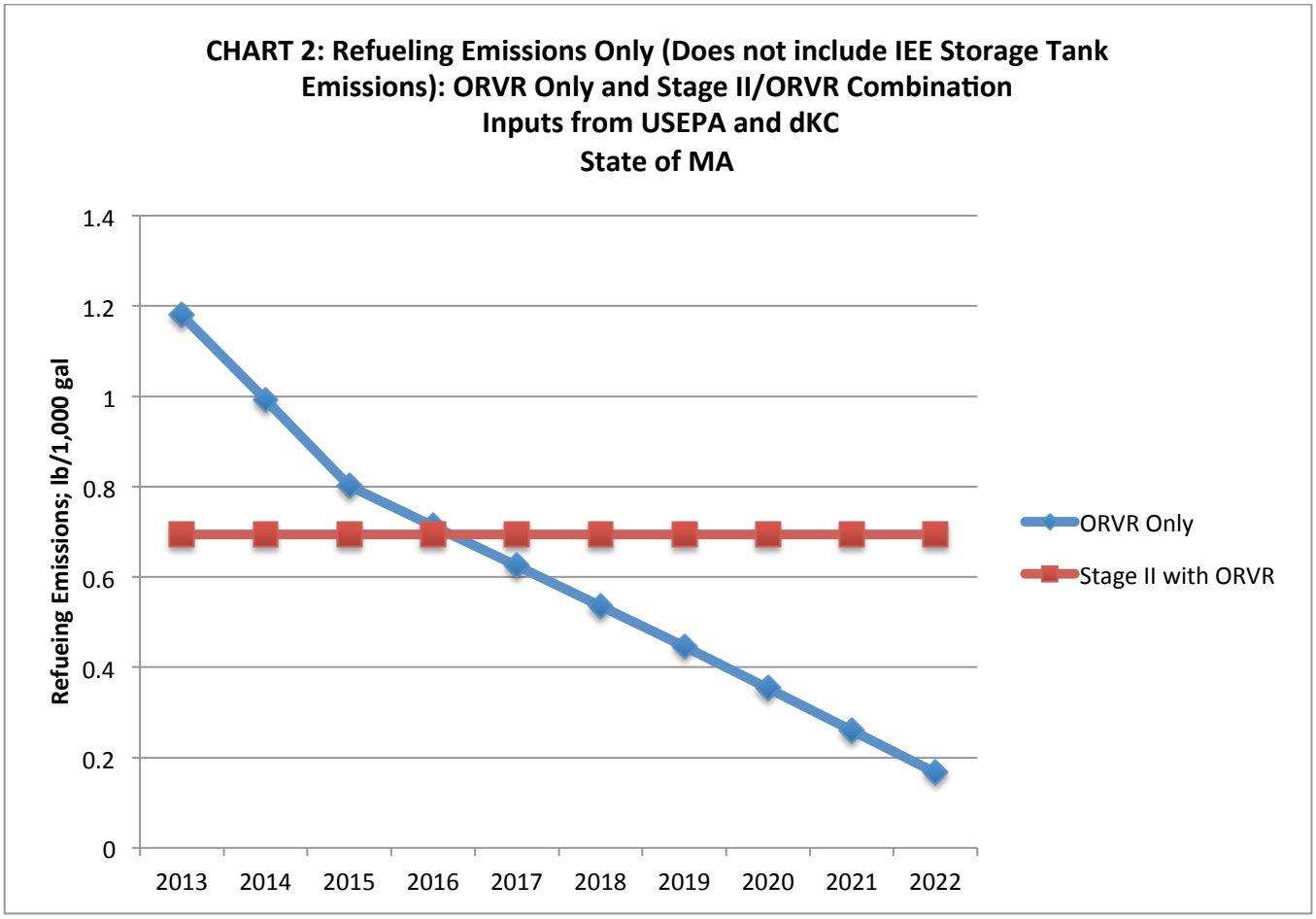
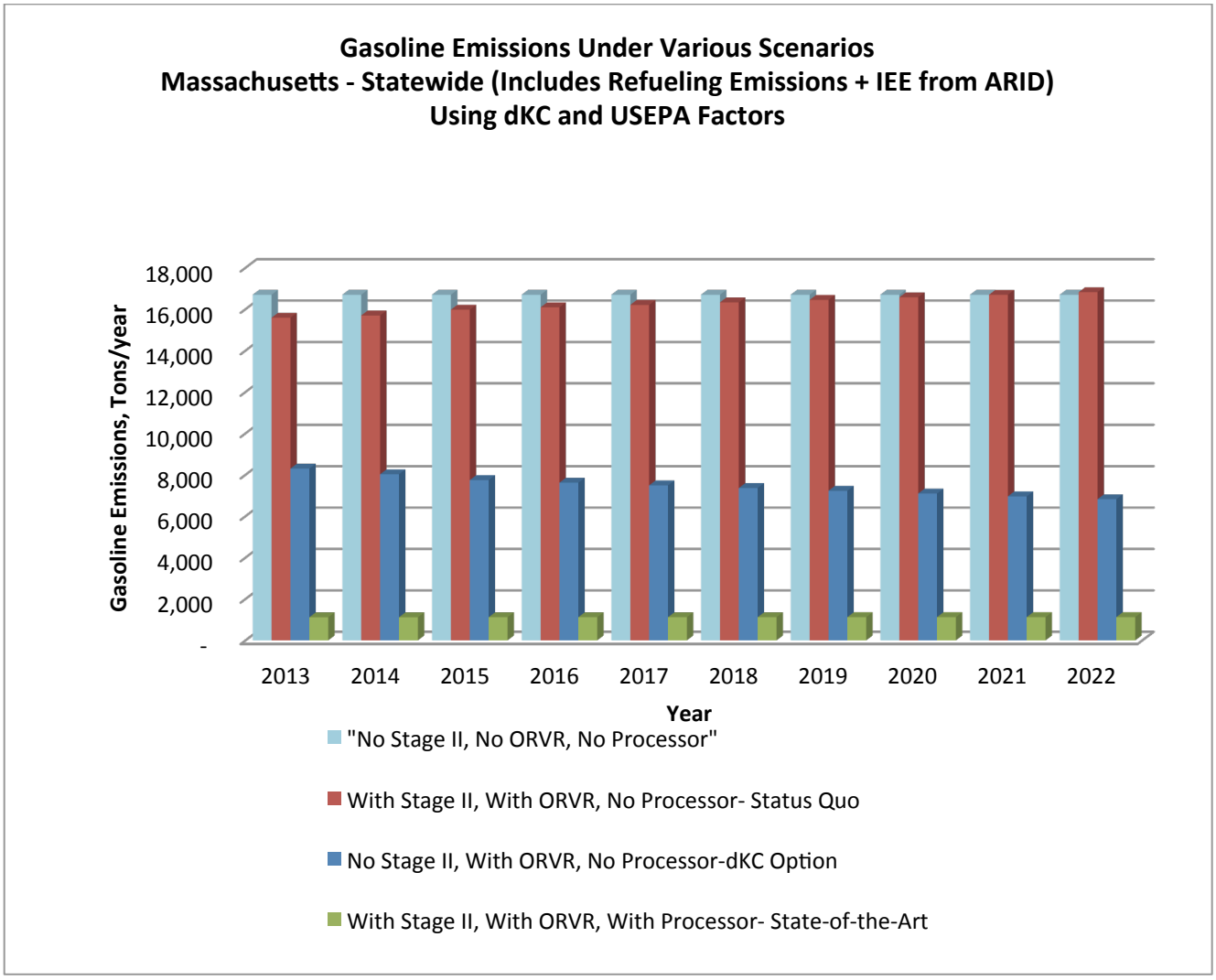



CHART3, below summarizes the Statewide MA Emissions in Tons/Year for four scenarios:

- Uncontrolled Case – No Stage II, No ORVR, No Vapor Processor
- Status Quo Case – With Stage II, With ORVR, No Vapor Processor
- dKC/USEPA Case – No Stage II, With ORVR Only, No Vapor Processor
- ARID, State-of-the-Art or MACT Case – With Stage II, With ORVR, With Vapor Processor

As seen in CHART3, the MACT Case shows compelling benefits in emissions reductions throughout the entire 10-year interval and represents the optimum case at all ORVR penetration rates. ARID used IEE quantified by field measurements and by our Evaporative Loss Model (ELM) in generation of this chart. As seen in the attached spreadsheet, the cost effectiveness of this option measures a revenue (not a cost) of + $637/ton of emissions reduced (*The former and following two cost/ton figures are for aggregate results, the costs per ton using the MA GDF populations are presented later in this report on page 12*). If we reduce the IEE used by ARID by a factor of 2 (50% reduction), then CHART4 shows the result. The cost effectiveness of this option measures a cost of $251/ton of emissions reduced; where values of $10,000 per ton still represent viable projects. If we further reduce the IEE used by ARID by a factor of 4 (75% reduction), then CHART 5 shows the result.

## Chart 3: Relative Emissions: Refueling & Storage Tank



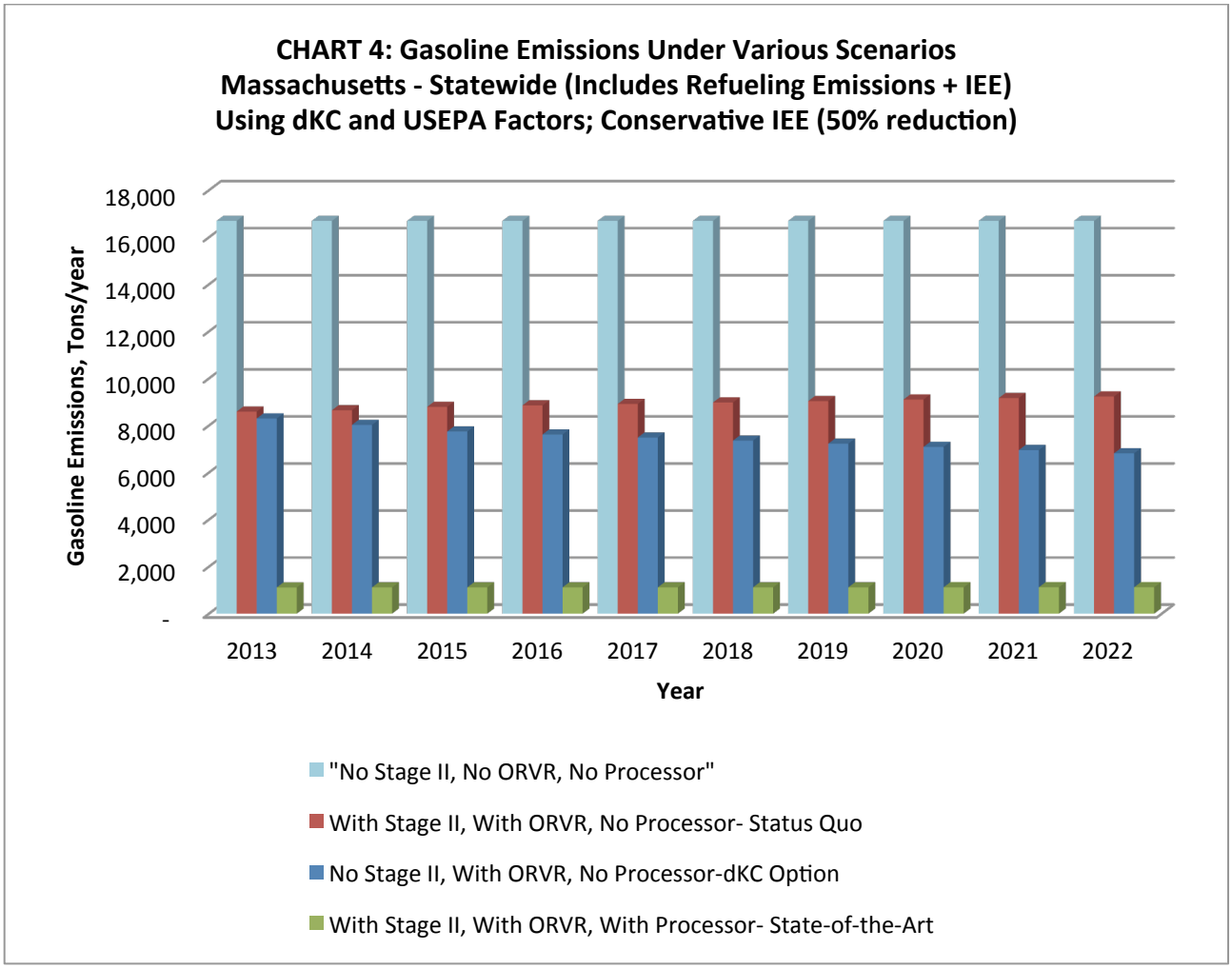


CHART 4: Gasoline Emissions Under Various Scenarios
Massachusetts - Statewide (Includes Refueling Emissions + IEE)
Using dKC and USEPA Factors; Conservative IEE (50% reduction)
Gasoline Emissions, Tons/year
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
-
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Year
"No Stage II, No ORVR, No Processor"
With Stage II, With ORVR, No Processor- Status Quo
No Stage II, With ORVR, No Processor-dKC Option
With Stage II, With ORVR, With Processor- State-of-the-Art

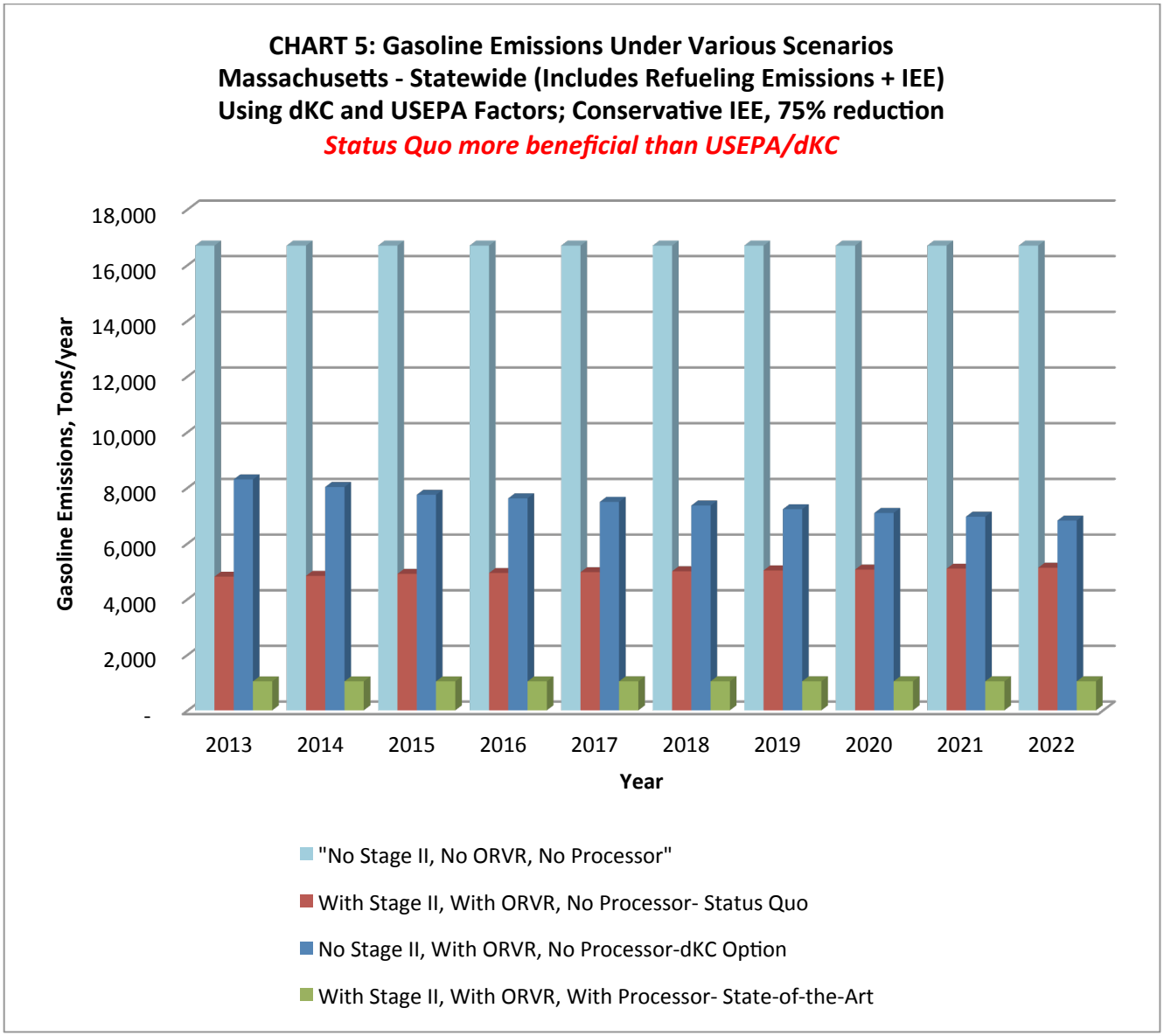


CHART 5: Gasoline Emissions Under Various Scenarios
Massachusetts - Statewide (Includes Refueling Emissions + IEE)
Using dKC and USEPA Factors; Conservative IEE, 75% reduction
Status Quo more beneficial than USEPA/dKC
Gasoline Emissions, Tons/year
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
-
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
Year
"No Stage II, No ORVR, No Processor"
With Stage II, With ORVR, No Processor- Status Quo
No Stage II, With ORVR, No Processor-dKC Option
With Stage II, With ORVR, With Processor- State-of-the-Art

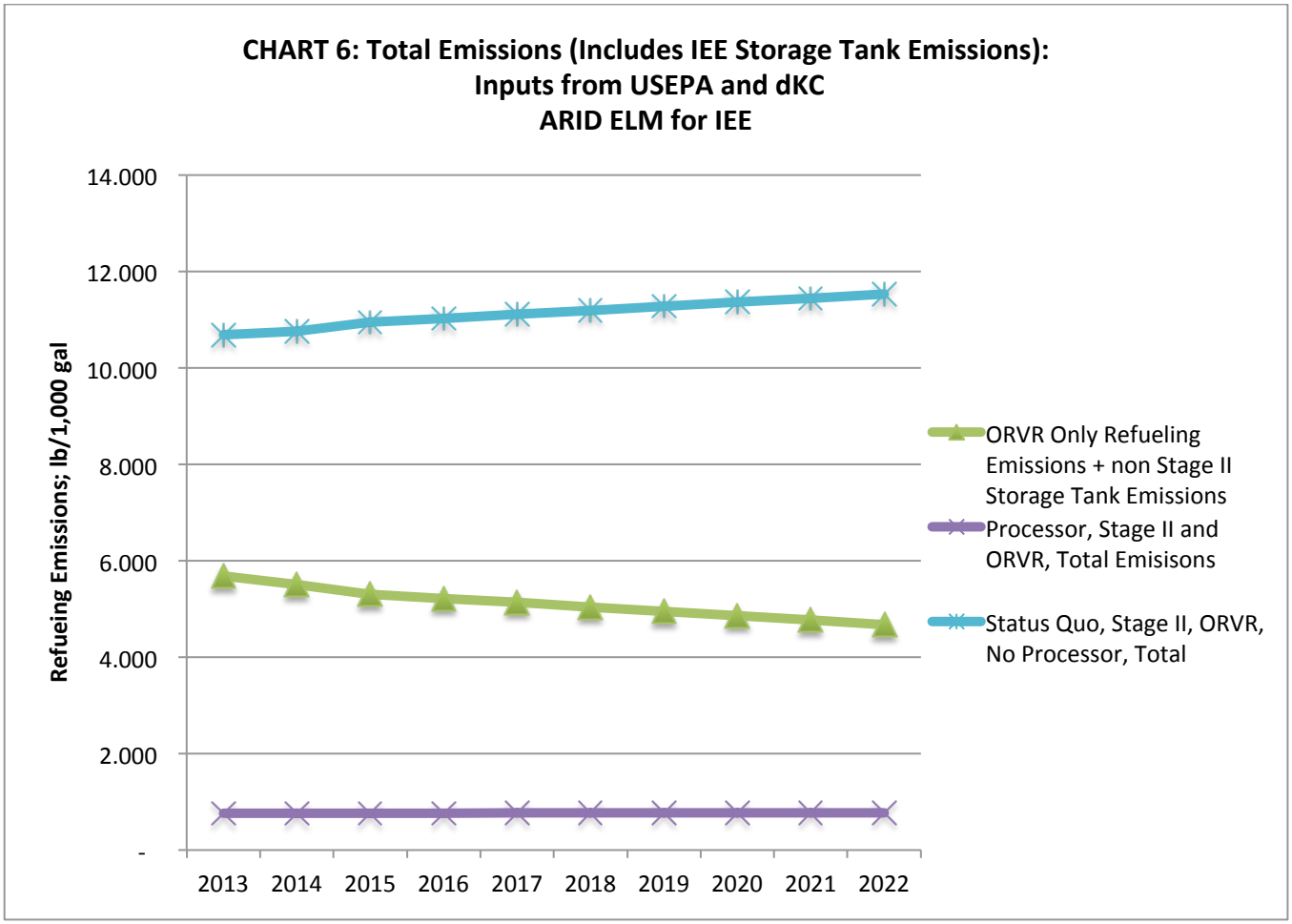



Chart 5 has an associated cost of $2,102/ton of emissions reduced with the MACT option again providing the best emission reductions throughout the entire interval. However, with extremely low IEE, CHART 5 shows that the Status Quo Option is actually more beneficial than the dKC and USEPA proposed options at all ORVR penetration rates throughout the entire interval. This CHART 5 is very important and clearly shows the impact of the Stage I only (non-Stage II, IEE, version 2) storage tank emissions. The weakness of the USEPA and dKC approach is exposed here as the non-Stage II Storage Tank emissions (IEE, version 2) cannot be reduced without the use of a processor. The magnitude of these IEE, version 2 emissions are increased due to air ingestion from ORVR only refueling, without Stage II systems in place.

On page 7 of the dkC "Addendum" report, Table 3-6 shows a cost per ton of emissions reduced of $19,790 for continued use of Stage II in year 2013. Table 3-7 shows a cost per ton of emissions reduced of $79,932 for continued use of Stage II in year 2015. By contrast, ARID's figures using a vapor processor

show the following costs :

The data for this chart is attached in Appendix 3 as “Cost Effectiveness Worksheet”; ARID uses the same MA GDF population distribution and throughput data as seen in the dKC report.

| Year | 50% IEE | 25% IEE |
|---|---|---|
| 2013 | $ (11.81)/ton | $ (1,623.72)/ton |
| 2015 | $ + 29.89/ton | $ (1,540.28)/ton |
| 2018 | $ + 66.15/ton | $ (1,467.87)/ton |

The cost effectiveness of using Stage II, ORVR and a vapor processor increases with time and becomes a revenue generator, not a cost component with the conservative 50% IEE assumption. Even with the most conservative assumption of IEE reduced by 75%, the data show a reduced cost per ton with increasing time. The gaps between dKC and ARID results are very large and significant. It should also be noted that in the original ERG/dKC Report, Table 3-6 on page 3-8 lists a cost per ton of emissions reduced of $170,760 for continued use of Stage II in year 2015; the gap from the old value to the new value (using USEPA factors) is $90,829 per ton; such wide variation calls into question the calculation techniques employed by dKC and USEPA.

CHART 6 shows the Total Emissions for three scenarios; using IEE from ARID ELM and expressed in lb./1,000 gallons of fuel dispensed. CHART 7 shows the Total Emissions for the same three scenarios; using Conservative IEE, reduced by 75%. Again, the results are expressed in lb./1,000 gallons of fuel dispensed, and the benefit of ARID approach (and Status Quo) can be seen in comparison to dKC/USEPA proposed approach. The magnitudes of the Storage Tank Emissions are very large in comparison to the refueling emissions.

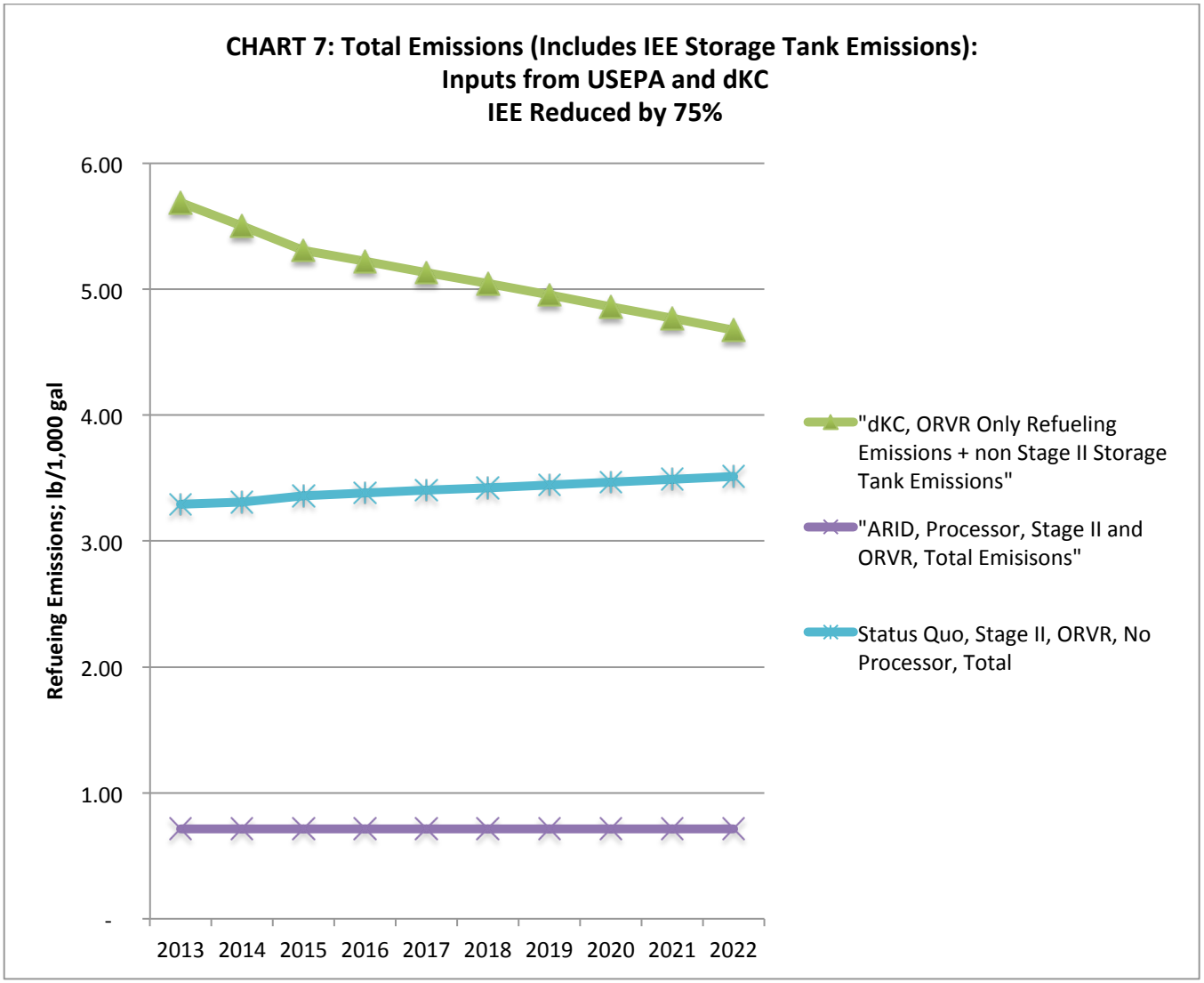


CHART 7: Total Emissions (Includes IEE Storage Tank Emissions):
Inputs from USEPA and dKC
IEE Reduced by 75%
Refueing Emissions; lb/1,000 gal
6.00
5.00
4.00
3.00
2.00
1.00
-
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
"dKC, ORVR Only Refueling Emissions + non Stage II Storage Tank Emissions"
"ARID, Processor, Stage II and ORVR, Total Emisisons"
Status Quo, Stage II, ORVR, No Processor, Total

Table 1: Summary of Inputs Used in Spreadsheet Model and USEPA Equations

| | ***2013*** | ***2015*** | ***2018*** |
|---|---|---|---|
| **QSII** | 0.99 | 0.99 | 0.99 |
| **Qorvr** | 0.849 | 0.903 | 0.943 |
| **n iuSII** | 0.75 | 0.75 | 0.75 |
| **Q sIIVA** | 0.81 | 0.81 | 0.81 |
| **Cfi** | 0.0659 | 0.0702 | 0.0733 |
| **n ORVR** | 0.98 | 0.98 | 0.98 |
| **n iuSII/orvr** | 0.9 | 0.9 | 0.9 |

**Explanation of Spreadsheet Tabs:**

**Tab1 Annual State of MA Raw Data**: We tabulate the Refueling Emissions and Storage Tank Emissions using the factors listed in Table 1. The 10 year fuel savings with State-of-the-Art approach vs. the Status Quo equal 151,195 tons, or 60,477,935 gallons; @ $4.0 per gallon, the savings are equal to $241,911,740. We then show the cost savings; revenue of + $1,600/ ton reduced of emissions is offset with financing and operating costs to yield net revenue of $637/ton for aggregate emissions reductions. The State-of-the-Art Approach with Enhancement of Stage II with a Processor shows an 85% reduction in emissions from the dKC Case (74,596 tons vs. 11,185 tons of emissions over the ten year period). On the sheet, the IEE is derived from ARID's ELM (Evaporative Loss Model) inputs.

**Tab2 Raw Data Conservative IEE**: We tabulate the Refueling Emissions and Storage Tank Emissions using the factors listed in Table 1. The 10 year fuel savings with State-of-the-Art approach vs. the Status Quo equal 78,621 tons, or 31,448,526 gallons; @ $4.0 per gallon, the savings are equal to $125,794,105. We then show the cost savings; revenue of + $1,600/ ton reduced of emissions is offset with financing and operating costs to yield net cost of $251/ton for aggregate emissions reductions. The State-of-the-Art Approach with Enhancement of Stage II with a Processor shows an 85.7% reduction in emissions from the dKC Case (74,596 tons vs. 10,674 tons of emissions over the ten year period). On the sheet, the IEE is derived from ARID's ELM (Evaporative Loss Model) inputs and then dividing by 2, for 50% reduction in IEE from Tab1 Case.

**Tab3 Raw Data Conservative IEE(2)**: We tabulate the Refueling Emissions and Storage Tank Emissions using the factors listed in Table 1. The 10 year fuel savings with State-of-the-Art approach vs. the Status Quo equal 39,311 tons, or 15,724,263 gallons; @ $4.0 per gallon, the savings are equal to $62,897,053. We then show the cost savings; revenue of + $1,600/ ton reduced of emissions is offset with financing and operating costs to yield net cost of $2,102/ton for aggregate emissions reductions. The State-of-the-Art Approach with Enhancement of Stage II with a Processor shows an 86.1% reduction in emissions from the dKC Case (74,596 tons vs. 10,397 tons of emissions over the ten year period). On the sheet, the IEE is derived from ARID's ELM (Evaporative Loss Model) inputs and then dividing by 4, for 75% reduction in IEE from Tab1 Case. For this Case, the Stage I only Storage Tank Emissions (IEE, version 2) exceed the IEE, version1 Storage Tank Emissions.

**Tab4 ORVR & Stage II, ORVR, tpy**: We list the Refueling Emissions in Tons/Year for three Cases: ORVR Only (blue line), Stage II with ORVR (red line) and Stage II Only (green line). This Chart tabulates the data for refueling emissions only, and Storage Tank IEE Emissions are not considered. The characteristic intersection of the ORVR Only and Stage II/with ORVR lines is shown around year 2016.

**Tab5 Tons per Year Statewide**: We list the Total Emissions (Refueling Emissions + IEE) by year for four Cases. The inputs for this chart are derived from the Tab1 Raw Data; where the IEE is based on ARID ELM. Four Cases are shown: No Stage II, No ORVR, No Processor (Uncontrolled Case) in light blue; With Stage II, With ORVR, No Processor- Status Quo in red; No Stage II, With ORVR, No Processor – dKC Option in dark blue; and With Stage II, With ORVR, With Processor – State of the Art, ARID Option in green. The ARID Option provides largest emissions reductions throughout each interval at all ORVR penetration levels.

**Tab6 Tons per Year Conserv**: We list the Total Emissions (Refueling Emissions + IEE) by year for four Cases. The inputs for this chart are derived from the Tab2 Raw Data Conservative IEE; where the IEE is based on ARID ELM divided by 2 for 50% reduction. Four Cases are shown: No Stage II, No ORVR, No Processor (Uncontrolled Case) in light blue; With Stage II, With ORVR, No Processor- Status Quo in red; No Stage II, With ORVR, No Processor – dKC Option in dark blue; and With Stage II, With ORVR, With Processor – State of the Art, ARID Option in green. The ARID Option provides largest emissions reductions throughout each interval at all ORVR penetration levels. The dKC Option provides marginally better emissions reductions than the Status Quo Case.

**Tab7 Tons per Year Cons (2)**: We list the Total Emissions (Refueling Emissions + IEE) by year for four Cases. The inputs for this chart are derived from the Tab3 Raw Data Conservative IEE (2); where the IEE is based on ARID ELM divided by 4 for 75% reduction. Four Cases are shown: No Stage II, No ORVR, No Processor (Uncontrolled Case) in light blue; With Stage II, With ORVR, No Processor- Status Quo in red; No Stage II, With ORVR, No Processor – dKC Option in dark blue; and With Stage II, With ORVR, With Processor – State of the Art, ARID Option in green. The ARID Option provides largest emissions reductions throughout each interval at all ORVR penetration levels. The dKC Option provides worse emissions reductions than the Status Quo Case throughout the entire interval. The very low IEE, version 1 storage tank emissions highlight the importance of the IEE, version 2 storage tank losses (Non-Stage II storage tank emissions). The lack of a processor on the dKC option points out the weakness and flaw in the USEPA and dKC option for removal of Stage II without use of a processor. This is a very dramatic and important slide. Many States have blindly jumped on the "bandwagon" of eliminating Stage II from future GDF constructed and/or allowing removal of Stage II from existing GDF. However, I doubt the head of the EPA organizations in CT, NY, NH, MA or other states have considered the impact of this slide or the associated charts in this study.

**Tab8 Refueling Emissions**: This chart is similar to chart in Tab4, however only two Cases are shown; ORVR only and Stage II with ORVR. In addition, the y-axis is scaled in lb./1,000 gallons. This chart is essentially equivalent to the dKC chart found in Figure 3-2; page 5 of the "August 22, 2012 Addendum". Please recall that this chart does not include IEE Storage Tank Emissions and shows an intersection of the curves at around year 2016 on the x-axis. This chart is important because it shows that ARID's

calculation technique yields essentially equivalent data to the method used by dKC; it also shows that dKC 's IEE values are so minimal that they do not impact the curve. The lack of a proper IEE value; where IEE , version 1 is a strong function of ORVR penetration represents a huge flaw in the dKC/USEPA study. It is such a large flaw, that reliance on the dKC/ERG data to remove Stage II vapor recovery at GDF in the United States represents reckless behavior with large negative impacts on human health and the environment.

**Tab9 Total Emissions**: This chart shows total emissions (Refueling Emissions + IEE Emissions) for three Cases. ORVR Only + IEE (dKC Case) in green; Processor, Stage II and ORVR (ARID, State of the Art) in purple, and Stage II, ORVR, No Processor (Status Quo) in light blue. The units are in lb./1,000 gal, and the IEE is taken from ARID's ELM (Tab1 Raw Data). Please note the dKC Case emissions are between 4 and 6 lb./1,000 gal throughout the entire interval.

**Tab10 Total Emissions (2)**: This chart shows total emissions (Refueling Emissions + IEE Emissions) for three Cases. ORVR Only + IEE (dKC Case) in green; Processor, Stage II and ORVR (ARID, State of the Art) in purple, and Stage II, ORVR, No Processor (Status Quo) in light blue. The units are in lb./1,000 gal, and the IEE is taken from ARID's ELM/4 (Tab3 Raw Data Conservative IEE (2)). Please note the dKC Case emissions are between 4 and 6 lb./1,000 gal throughout the entire interval. Please also note that the Status Quo emissions are below the dKC emissions throughout the entire interval at all ORVR penetration figures. The only emissions below 1.0 lb./1,000 gallons are the ARID Case.

**Tab11 TPY to lb./1,000 gal**: This sheet shows conversions of emissions levels from various raw data sheets. The typical conversion is from tons/year to lb./1,000 gal. This conversion is accomplished by multiplying tons/yr. by 2,000; then dividing by fuel throughput and then multiplying this result by 1,000. Another interesting calculation on this sheet can be found in columns O and P, Rows 25-34. Here we calculate the emissions reductions from ORVR and Stage II to compare with the USEPA equation proposed by Dail and Passavant. More on this in Tab12.

**Tab12 USEPA Equations**: Here we list the inputs for the spreadsheet raw data and the two equations presented by USEPA; namely the increment equation and the delta equation. The increment equation

= (QSII)*(1-Q orvr)*n iuSII – (Q sIIVA)*(CFi)

The delta equation = (Q SII)*(niuSII)-(Q sIIVA)*(CFi) – (Q orvr)*(n orvr)

For delta equation; ARID obtained -14.29%, -19.93%, and -24.10% for years 2013, 2015, and 2018, respectively. This is confusing, because Dail and Passavant reasoned that negative deltas mean that ORVR provides better refueling emissions reductions than Stage II; however, we know from our Tab8 Chart, that prior to 2016 we are seeing Stage II perform better than ORVR alone. So, I am confused on this point.

For increment equation; ARID obtained 5.87%, 1.52% and -1.71% for years 2013, 2015, and 2018, respectively. This shows good agreement with the dKC figures listed in his "Addendum" report, and the two positive numbers show qualitative agreement with the Tab8 chart; however, the magnitude of the

% reduction in refueling emissions figures do not match our data. For example, in Tab11, column P, rows 25-34 show the % reduction figures derived from our data (which correlates well with the dKC chart data). ARID obtains 69.97%, 15.3% and -22.8% emissions reductions for years 2013, 2015 and 2018, respectively. These figures are very far off of the USEPA predicted data. In an attempt to reconcile this gap, ARID derived the following equation for increment ARID =

(Q orvr * (1 – n orvr)+(1 – Qorvr))/(QsII * (1- niuSII/orvr))-1; where we introduce a new parameter, efficiency of Stage II/with ORVR; n iuSII/orvr. We assign a value of 0.9 to n iuSii/orvr.

Using this equation we obtain 69.7%, 16.2% and -23.4% for years 2013, 2015, and 2018, respectively. These figures represent close agreement with the actual calculated values of 69.97%, 15.3% and -22.8%. Perhaps we do not understand fully the use of the equation proposed by Dail and Passavant, or perhaps USEPA should check again on the derivation.

**Tab13 ORVR in use efficiency**: This sheet presents data taken by ARID from CARB 200 car tests. The CARB data was recorded during refueling of both ORVR and non-ORVR vehicles. The data allowed us to calculate an effective ORVR emission rate, and therefore to quantify an in-use ORVR efficiency on actual vehicles being refueled at the Grass Valley Chevron, in Grass Valley, California. The tabulated show that the ORVR in use efficiency is far below the 98% level used by USEPA and dKC in their guidance documents and summary reports.

**A Note about Pressure Integrity and Failure Modes**

In the Klausmeier study and comments by Petroleum Industry Lobbyists, the authors highlight the high failure rate of Stage II vacuum assisted systems in terms of vapor leakages, and they propose a lower than 86% in-use vapor recovery efficiency factor – in fact we used a 75% factor in our spreadsheet. It should be noted that GDF equipped with Stage II vacuum assisted systems (not equipped with vapor processors) operate at a relatively high pressure for a large majority of the time. With reference to the attached "Vent Line and Fugitive Emissions Study, National Gasoline Dispensing Facility" found in Appendix 2; page 6 shows that the storage tank pressure at this site exceeded + 2 inches of water column pressure for 93.73% of the time, during the interval 9 October – 20 November 2009. The cracking pressure of the p/v valve at this site is + 3 inches of water column. Since the storage tank is exerting a nearly constant, high backpressure on the storage tank hardware and associated piping, leaks are to be expected. In fact, the likelihood for leaks forming in the p/v valves, automatic tank gauge caps, overfill drain valves and other tank fittings is increased by the prevailing tank pressure. In addition, the pressure spikes during bulk tanker deliveries (Stage I operations) are also amplified by the high baseline starting pressure. It is ARID's contention that the use of active vapor processors such as PERMEATOR will yield a significant reduction in observed vapor leakages; since the storage tank pressure will be managed to a very low level; during normal operations and also during transient periods with bulk tanker deliveries. In addition, failure modes associated with A/L ratio failures are typically due to low A/L values; where again, the high back pressure in the storage tank does not allow the vacuum pump within the dispenser to reach its rated output level. By reducing the prevailing back pressure, the A/L ratios should revert back to their design values since the dispenser based vacuum pumps will not have to

overcome a high back pressure. As such, Stage II vapor recovery efficiencies will be increased, and the incidence of vapor leakages should be decreased.

It should also be noted that the ARID Permeator is equipped with pressure sensors, a data logger, and remote data acquisition equipment to provide continuous monitoring of storage tank pressure integrity; with outgoing alarms automatically sent if measured parameters fall outside of a prescribed range. (Please note that ARID's data acquisition and storage equipment was used in the NH Study referenced in the Klausmeier report).

**Cost Effectiveness**

As previously mentioned, ARID has developed a proprietary Evaporative Loss Model, the ELM is presented below:

## ARID TECHNOLOGIES - Evaporative Loss Model for Typical MA Stage II Vac-Assist site

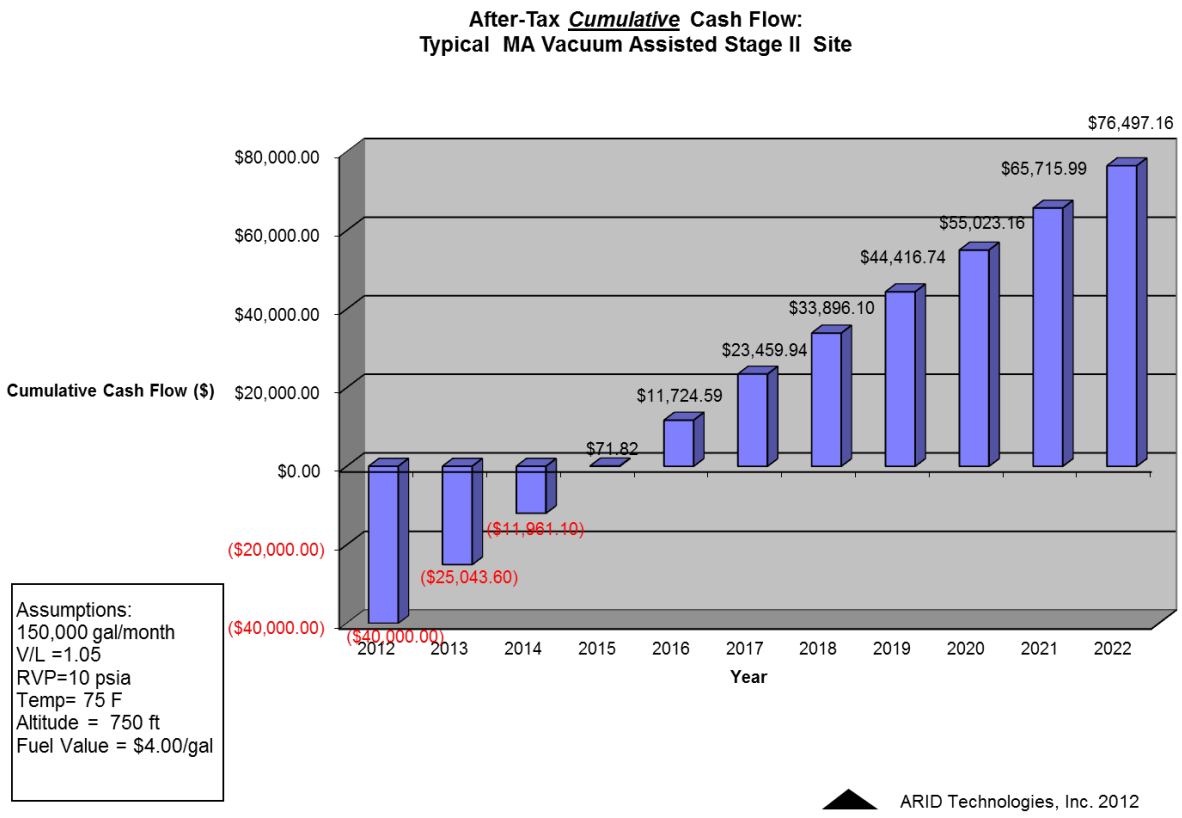
| INPUTS | | | | |
|---|---|---|---|---|
| Monthly Throughput (gallons) | 150,000 | | Vapor/Liquid Ratio | 1.05 |
| Monthly Gasoline Gallons Saved Yr 2010 | 314 | | Gasoline RVP | 10.00 |
| Daily Gasoline Gallons Saved Yr 2010 | 10.46 | | Storage Tank Temperature | 75.00 |
| Gasoline Saved, Year 2010, % of throughput | 0.209% | | Depreciation Life (yr) | 5.00 |
| System Installed Cost | $40,000.00 | | Altitude (feet above sea level) | 750 |
| Discount Rate | 10% | | Lessee Discount Rate (After Tax) | 10% |
| Value of Recovered Gasoline | $4.00 | | | |

| BENEFIT SUMMARY | | | |
|---|---|---|---|
| OWNING UNIT | | | |
| After Tax IRR | | 29% | |
| After Tax NPV @ | 10% | $30,567 | |
| Total Avoided Emissions (Tons) | | 103.02 | |
| | | | |
| ARID Technologies, Inc. | | | |
| 323 S. Hale Street, Wheaton, Illinois 60187 | | | 630.681.8500 |

| PRODUCT SAVINGS | Coefficients | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ORVR Vehicle Population | | | 84.9% | 87.6% | 90.4% | 91.7% | 92.9% | 94.2% | 95.6% | 96.9% | 98.3% | 99.6% |
| Evaporative Emissions, V/L =xx, Tons/Yr-Station | 1.05 | | 7.81 | 7.98 | 8.15 | 8.23 | 8.31 | 8.39 | 8.47 | 8.55 | 8.64 | 8.72 |
| Recovery with Membrane (Tons of Gasoline) | 99.3% | | 7.76 | 7.92 | 8.10 | 8.17 | 8.25 | 8.33 | 8.41 | 8.49 | 8.58 | 8.66 |
| Pounds of Gas Saved (1 ton =2,000 lbs) | | | 15,516.87 | 15,849.72 | 16,192.35 | 16,346.54 | 16,504.40 | 16,663.48 | 16,825.00 | 16,988.98 | 17,154.18 | 17,323.05 |
| Gallons of gas Saved (5.2 lb = 1 gallon) | | | 2,984.01 | 3,048.02 | 3,113.91 | 3,143.57 | 3,173.92 | 3,204.51 | 3,235.58 | 3,267.11 | 3,298.88 | 3,331.36 |

| CASH FLOW FOR PURCHASED UNITS | Coefficients | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Value of Liquid Gasoline Saved | $4.00 | | $11,936.06 | $12,192.09 | $12,455.66 | $12,574.26 | $12,695.69 | $12,818.06 | $12,942.31 | $13,068.44 | $13,195.52 | $13,325.42 |
| Bulk Tanker Loading Savings | | | $3,129.23 | $3,129.23 | $3,129.23 | $3,129.23 | $3,129.23 | $3,129.23 | $3,129.23 | $3,129.23 | $3,129.23 | $3,129.23 |
| Subtotal Product Savings | | | $15,065.29 | $15,321.32 | $15,584.89 | $15,703.49 | $15,824.92 | $15,947.29 | $16,071.54 | $16,197.68 | $16,324.75 | $16,454.65 |
| Annual Capital, Operating & Maintenance Expenses | 1.50% | ($40,000.00) | ($600.00) | ($600.00) | ($600.00) | ($600.00) | ($600.00) | ($600.00) | ($600.00) | ($600.00) | ($600.00) | ($600.00) |
| Depreciation: 5 year ACRS | | | ($16,000.00) | ($9,600.00) | ($5,760.00) | ($4,320.00) | ($4,320.00) | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 |
| Incremental Operating Income | | | ($1,534.71) | $5,121.32 | $9,224.89 | $10,783.49 | $10,904.92 | $15,347.29 | $15,471.54 | $15,597.68 | $15,724.75 | $15,854.65 |
| Incremental Tax Expense | 32.00% | | ($491.11) | $1,638.82 | $2,951.96 | $3,450.72 | $3,489.57 | $4,911.13 | $4,950.89 | $4,991.26 | $5,031.92 | $5,073.49 |
| Incremental Net Income After Tax | | | ($1,043.60) | $3,482.50 | $6,272.92 | $7,332.77 | $7,415.35 | $10,436.16 | $10,520.65 | $10,606.42 | $10,692.83 | $10,781.16 |
| Add Back Depreciation | | | $16,000.00 | $9,600.00 | $5,760.00 | $4,320.00 | $4,320.00 | $0.00 | $0.00 | $0.00 | $0.00 | $0.00 |
| **After Tax Cash Flow** | | **($40,000.00)** | **$14,956.40** | **$13,082.50** | **$12,032.92** | **$11,652.77** | **$11,735.35** | **$10,436.16** | **$10,520.65** | **$10,606.42** | **$10,692.83** | **$10,781.16** |
| **Cumulative Cash Flow** | | **($40,000.00)** | **($25,043.60)** | **($11,961.10)** | **$71.82** | **$11,724.59** | **$23,459.94** | **$33,896.10** | **$44,416.74** | **$55,023.16** | **$65,715.99** | **$76,497.16** |
| Volume saved/month (gallons) | | **330.20** | 313.86 | 319.19 | 324.69 | 327.16 | 329.69 | 332.24 | 334.82 | 337.45 | 340.10 | 342.81 |
| % Throughput Saved | | **0.22** | 0.209 | 0.213 | 0.216 | 0.218 | 0.220 | 0.221 | 0.223 | 0.225 | 0.227 | 0.229 |
| gallons saved per day | | **11.01** | 10.46 | 10.64 | 10.82 | 10.91 | 10.99 | 11.07 | 11.16 | 11.25 | 11.34 | 11.43 |

The cumulative cash flow for this model is presented below:




For the inputs noted in the ELM; the fuel savings from operation of the PERMEATOR are shown to be about 2.2 gallons of fuel per 1,000 gallons of fuel dispensed. It should be noted that this volumetric savings rate corresponds to a mass savings rate of about 10 lb. of hydrocarbons per 1,000 gallons; a figure significantly higher than the previous figure of 5.20 and 2.60 lb./1,000 gallons used in the Conservative IEE calculation for base year 2013 in our spreadsheet. In practice, we note agreement within 10 to 15% between actual measured results and predicted values with the ARID ELM.

For a typical site with throughput of 150,000 gallons per month, an approximate 3-year payback is seen with an after-tax internal rate of return of 29%. For the interval 2013 – 2022, just over 103 tons of emissions are avoided while fuel savings of $76,500 are accumulated **from a single GDF**. These economics are for the capital equipment sale of ARID's PERMEATOR. An installed cost of $40,000 is used in this analysis.

ARID offers Permeator under two options: (1) Capital Equipment Purchase, or (2) Shared Savings Arrangement. With the capital purchase option, the one-off list price of the Permeator is $37,000, which includes a 3-year warranty on parts & labor. Under the shared savings arrangement, the Permeator is supplied at zero cost, and the customer makes monthly payments equal to 50% of the saved fuel value. In this manner, even GDF with relatively small to medium throughput can take advantage of the fuel savings and emissions reduction benefits of PERMEATOR. The GDF owner/operator can pay for the

equipment on a monthly basis; using saved fuel to fund the payment, while leaving additional funds left over for profit.

The comments below are supplemented by the spreadsheets, reports and additional comments submitted to Ms. Eileen Hiney via email on 14 August 2012.

Specific Comments on the ERG Report, **"Air Program Support for Stage I and Stage II Programs in Massachusetts"**, 16 July 2012

Page 3-4; *"Because…ARID's estimates have not been independently verified, ERG did not use their IEE factors in our analysis".* The ARID IEE factors were generated by a third-party study conducted at a GDF located in Florida; with oversight from Florida DEP, the Palm Beach County Health Department, and the United States EPA, Research Triangle Park. This study is referenced in the EPA's February 7, 2006 Options Paper, entitled, "Stage II Vapor Recovery Systems – Options Paper". The specific ARID reference can be found on pages 132 thru 135.

Page 3-9; Summary

- *"ORVR systems alone will result in the same reductions as Stage II systems alone around July 2013".* We disagree with this statement, since we explained the key distinction between refueling emissions and total emissions; where the total emissions = refueling emissions + vent emissions + fugitive emissions. Our CHART2, shows refueling emissions from ORVR systems equaling refueling emissions from Stage II systems around year 2016. However, the intersection of these refueling emissions curves does not impact the total emissions curves as seen in our CHART6 and CHART7.

- When the case of Stage II enhancement with a vent processor is considered; the ARID data show that the optimum option for emissions reductions is the combination of Stage II, ORVR and vent processor. ARID has measured IEE factors much higher than the ERG reported figure of 0.86 lb./1,000 gallons. The cost effectiveness of Stage II controls, when used in conjunction with ORVR and a vapor processor are favorable through all time periods with ever increasing ORVR penetration rates.

Page 4-3; section 4.1.2 Vapor Leak Monitoring Systems. The ARIDAS (ARID Data Acquisition System) gear was used by the State of NH in their study to assess storage tank vapor leakages (This report is referenced on page 4-7 of the ERG Report). The ARID equipment was used throughout the New England winter months with no operational problems. The ERG report failed to mention the use of this equipment for the NH study. In addition, ARID has a PERMEATOR vapor processor system installed in the

state of MA (Danvers, MA). This unit has been operating error free for over two years. ARID is pleased to share operating data from this unit with state of MA DEP.

Page 4-10; Section 4.2.3 Require Pressure Management System (Emissions Processors)
Pressure/Vacuum or P/V valves do not reduce vent losses from gasoline storage tanks. The P/V valve will simply allow pressure to increase up to the threshold or cracking pressure of the P/V valve; as such, fugitive losses (which are a direct function of storage tank pressure) will increase. Please reference Appendix 2, "Federal Way Study".

Page 4-11; ARID Technologies Summary. The ARID data reports emissions reductions from both vent and fugitive emissions from the gasoline storage tank. Our data does not assume that GDF's do not have P/V valves; our data (and supporting studies) show clearly that the presence of the P/V valve simply increases fugitive emissions (while at the same time decreasing vent emissions); where the total emissions (Vent + Fugitive) remain essentially constant. The figure listed of 4.5 lb./1,000 gallons represents the emissions reduction from a non-Stage II site. ARID's ELM (Evaporative Loss Model) also is suited to predicting emissions reductions from Stage II sites with inputs of A/L ratio, fuel RVP, fuel temperature, gasoline throughput, ORVR penetration, and altitude of the GDF. ARID has equipment available to monitor and measure vent losses at GDF, and we volunteer our equipment and insights to State of MA, CT, NY and other States seeking to make measurements of these parameters.

We did not receive an opportunity to clarify any questions by the ERG report author on any of our inputs. It seems that other vendors engaged in direct, personal communication with Mr. Klausmeier, but ARID was not afforded this courtesy.

Page 4-13; Costs for Continuous Monitoring for Vapor Leaks

ARID mentioned previously the ARIDAS system. This unit has been proven in the New England environment and is robust. Fixed Cost/GDF is about $4,750. It should be noted that the PERMEATOR system (ARID's vapor processor) includes the ARIDAS gear.

Page 5-1; Environmental Justice Communities

The ORVR population data shown for EJ (73%) vs. non EJ (77%) communities does not appear very meaningful since the derivation of these figures appears very complex and relied upon so-called Inspection Center data. Readers will need more data to fully understand the source of the ORVR data. The key point is that non Stage II and non-ORVR refueling activities will directly expose the motorist (and nearby people) to VOC's and HAP's from gasoline vapor. These vapors will be ingested and inhaled with significant adverse health effects. These adverse health effects could be avoided with the continued use of Stage II, where the adverse impacts of IEE are mitigated with the use of a vapor processor.

**Summary**

By understating and overlooking Storage Tank Emissions, the dKC / ERG Study derives flawed conclusions on the impact of removing Stage II vapor recovery from GDF's. In this analysis, ARID describes two types of IEE (Incompatibility Excess Emissions); IEE, version 1 are related to the storage tank emissions generated from air ingestion during simultaneous operation of Stage II vacuum assisted vapor recovery systems and ORVR equipped vehicles. IEE, version 2 refers to the storage tank emissions generated from air ingestion through vent lines as the storage tanks quickly develop negative pressures during the non-Stage II refueling of automobiles.

When properly accounted for, the IEE emissions dominate the refueling emissions. Even when ARID applies deeply discounted values for actual third-party quantified IEE emissions, the scenario which shows the most effective emissions reductions involves the continued use of Stage II, ORVR and a vapor processor used to mitigate the IEE emissions. If Stage II is removed, the IEE, version 2 emissions will far exceed the ORVR only refueling emissions as seen in Tab11: TPY to lb. per 1,000 gal (***4.5 lb./1000 gal vs. range of 1.18 lb./1,000 gal in year 2013, down to 0.165 lb./1,000 gal in year 2022***).

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. Overlooked in past studies and analyses on this topic are three key elements: 1.) The proper quantification and accounting for the IEE 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 impact of using active processors to enhance Stage II by managing storage tank pressure and significantly reducing IEE. The IEE should be quantified at a State of MA GDF using simple, direct measurement techniques. The adverse health impacts should be further studied with a more accurate determination of ORVR vs. non-ORVR vehicle population in EJ Communities. The consultant analysis should be expanded to include the impact of vapor processors to enhance Stage II operation.

The brief 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 through capital equipment purchase or shared savings arrangement*

The aggregate benefits for the State of MA GDF operators include $24 million per year in fuel savings while at the same time reducing emissions of volatile organic compounds and air toxics by 15,000 tons per year.

**Further Note**

ARID does not seek a regulatory mandate or requirement for Massachusetts GDF to use an active processor such as Permeator. However, we do believe that MA GDF owners and operators should be made fully aware of viable options. Even if the compelling benefits of the State-of-the-Art approach using Stage II/ORVR/and Active Processors are ignored by US EPA and the State of Massachusetts; ARID believes that individual GDF owners and operators should be free to continue to use Stage II, ORVR and an active processor.

We read with interest the section in the Federal Register that addresses SIP Revision; specifically the section 110 (l) requirements as well as the Clean Air Act Section 116; where States remain free to choose to implement Stage II programs in any area. Perhaps States that continue to use Stage II, in conjunction with a vapor processor will qualify for special state-of-the-art, or MACT status.

This qualification could trigger financial incentives to the GDF owner/operator such as reduced taxes on motor vehicle fuel and/or a subsidy to help cover the capital and installation expenses of installing vapor processor hardware. Moreover, the State may also qualify for various financial incentives while at the same time earning emissions reductions in their SIP. It seems reasonable to reward the proactive States and GDF owner/operators who employ a state-of-the-art approach to reduce emissions above and beyond mandated levels. On the one hand, they will earn an attractive return by paying back their capital investment with saved fuel, but on the other hand, an extra incentive can help ensure that Stage II systems are not incorrectly removed in “knee-jerk” reaction by the majority of the GDF owner/operators.

As an added benefit to regulatory agencies, the efforts expended by the GDF owner/operator will be much stronger and more focused if their “good housekeeping” practices earn them the opportunity to realize an economic benefit – in other words; why ensure leak integrity of your vapor piping system, if you know the losses are constantly occurring through the p/v valve? However, if the GDF owner/operator installs and maintains Stage II technology along with a vapor processor; they have a strong financial incentive to make sure all systems on the forecourt are properly operating and that the associated piping system remains leak free.

We hope our technical comments and critical review of the Klausmeier report will help MA DEP and USEPA to better understand the key technical issues related to IEE Storage Tank emissions generated by the interaction of Stage II and ORVR operations at GDF’s. With this knowledge in-hand, we hope that regulatory agencies can craft a thoughtful, science-based approach to reduce GDF hydrocarbon emissions in the optimum manner. We hope that engineering principles will be the primary driver in the Stage II vapor recovery debate. In the past, unfortunately, politics has been the primary driver. We also hope that State and Federal EPA personnel will step forward with the individual courage and conviction to make decisions based on the facts, even if such decisions are not supported by broader political

agendas. Perhaps political people who have thus far influenced the Stage II debate will be open-minded enough to consider new information, which they have previously overlooked.

To that end, ARID stands ready to assist this effort in an objective way.

**Respectfully submitted,**

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