



ANALYSIS OF FUTURE OPTIONS FOR CONNECTICUT'S GASOLINE DISPENSING FACILITY (GDF) VAPOR CONTROL PROGRAM

SUPPORT FOR DEEP'S GDF VAPOR CONTROL TRANSFORMATION

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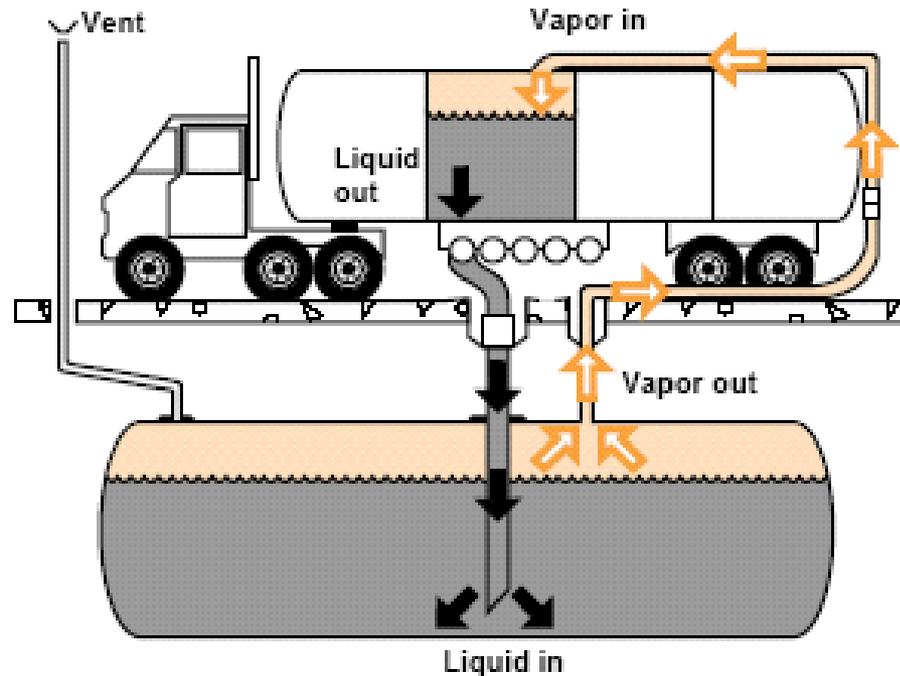
Objectives

- Determine widespread use (WSU)
 - Widespread use (WSU) occurs when on-board refueling vapor recovery (ORVR) systems provide the same benefits as Stage II systems.
 - After WSU occurs, EPA will allow CT to submit a SIP amendment to terminate its Stage II vapor recovery program.
- Estimate total costs and benefits of terminating or enhancing the Stage II programs
- Explore total costs and benefits of enhancing the Stage I program
- Review procedures for decommissioning Stage II systems

Overview of Controls for GDFs

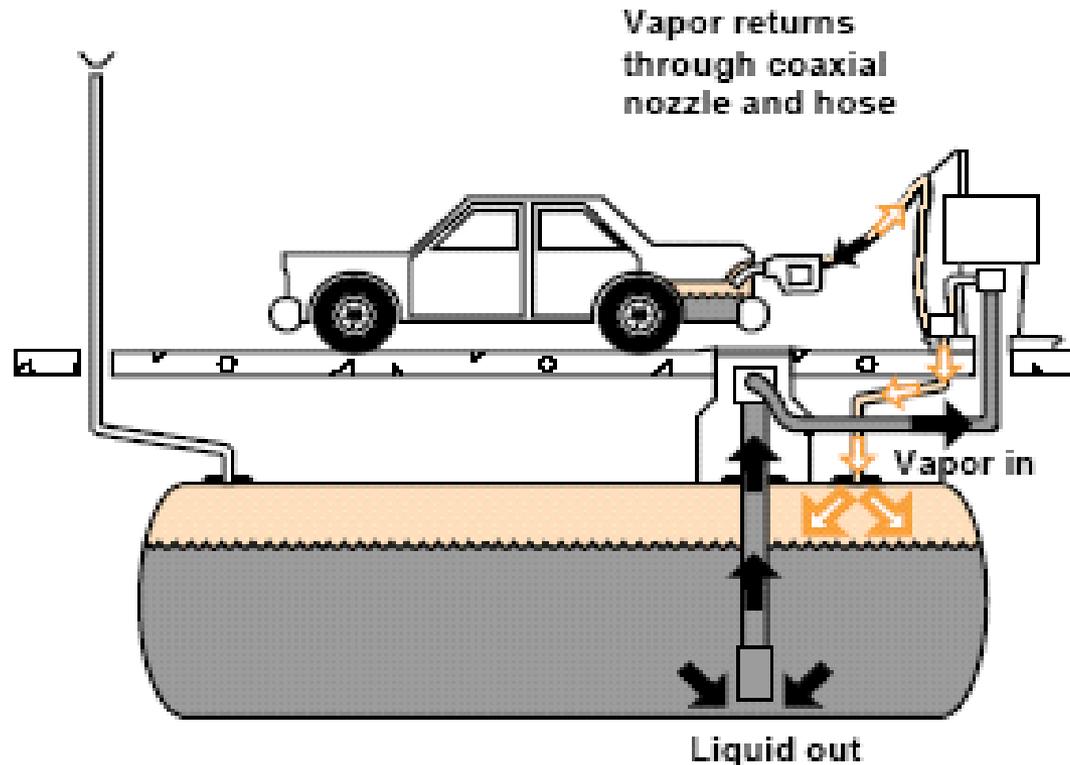
- **Stage I Controls:**
 - Controls vapor emissions when GDF tanks are filled.
- **Stage II Controls:**
 - Controls vapor emissions when vehicle tanks are filled.
 - Types of systems:
 - Balance: Bellows establish a seal around nozzle. Vapors in vehicle's tank displace fuel in GDF tank.
 - Vacuum assist: Vapors from the vehicle's tank are sucked into GDF tank through holes in the nozzle.
- **Onboard Refueling Vapor Recovery (ORVR) systems**

Gas Station with Stage I Vapor Recovery



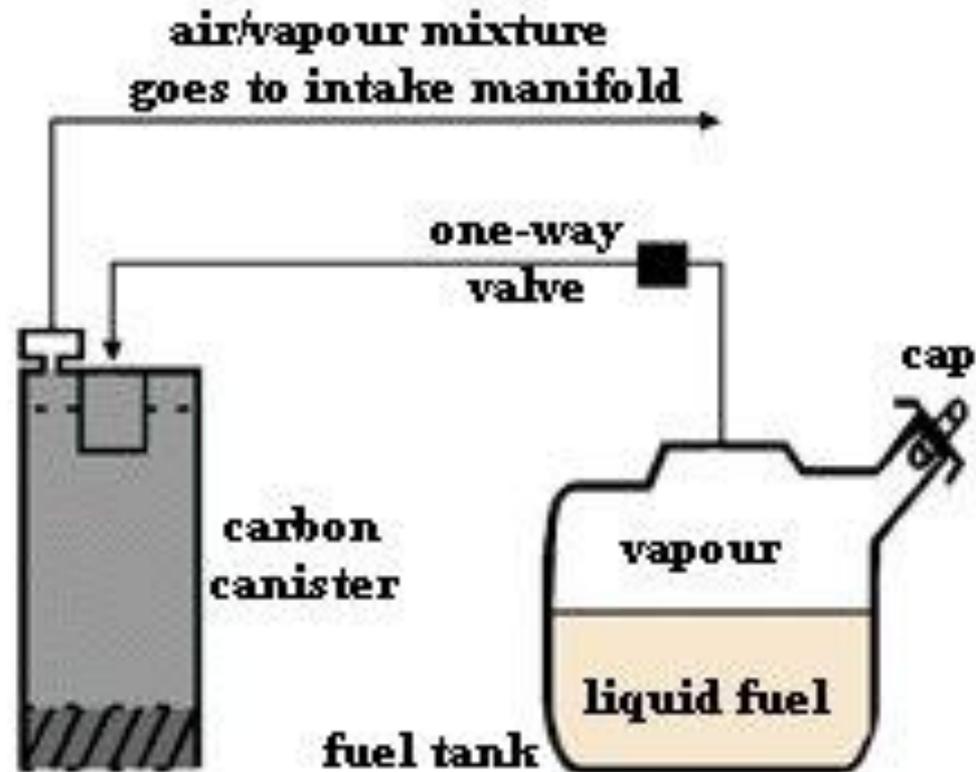
- Stage I – Deliveries
 - As fuel enters the GDF's Tank, vapors are returned to the tanker via a separate vapor connection.

Gas Station with Stage II Vapor Recovery



- Stage II – Vehicle Fueling
 - As fuel enters the vehicle tank, vapors are collected at the vehicle fill neck and returned to the GDF tank.

Onboard Refueling Vapor Recovery (ORVR) Systems



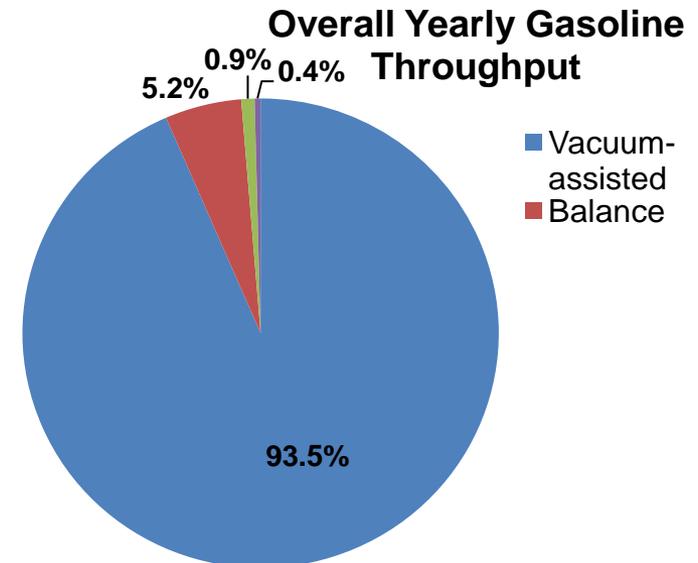
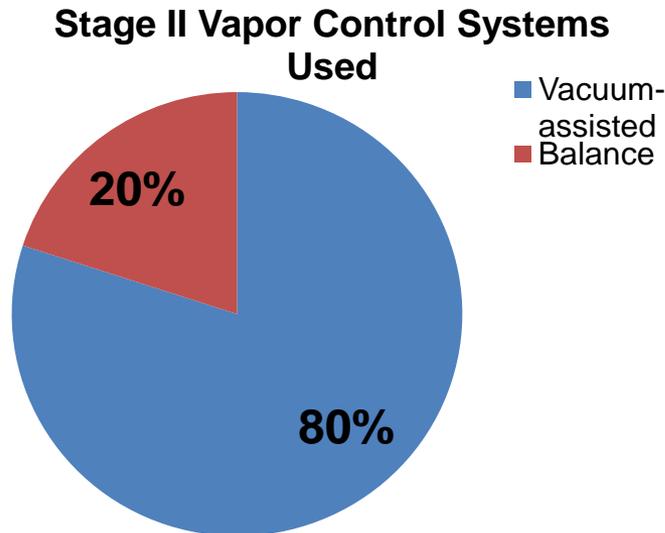
Incompatibility Between ORVR and Vacuum Assist Stage II Systems



- When cars equipped with ORVR systems are refueled with a vacuum assist system, fresh air is collected at vehicle fill neck and returned to the GDF tank.
- The returned air from fueling ORVR cars will be saturated by the fuel and grow in volume, resulting in excess vapor being emitted through the GDF tank vent pipe.
- These emissions are referred to as Incompatibility Excess Emissions, or IEE.
 - Reported IEE factors vary between 0.42 to 2.5 lb./1000 gal.

Summary of GDFs in CT

- To characterize GDFs in CT, Eastern Research Group (ERG) sent survey forms to all GDFs. 908 GDFs (43%) responded to the survey.
- Survey results indicate that about 80% of the GDFs use vacuum assist Stage II system; about 20% use balance systems. When gasoline throughput is considered, vacuum assist systems account for 94% of the throughput.
- Less than 1% of the gasoline is dispensed in facilities without Stage II vapor controls.



Widespread Use (WSU) Analysis

Effectiveness of Stage II systems



- As defined by EPA, WSU occurs when on-board refueling vapor recovery (ORVR) systems provide the same benefits as Stage II systems.
- Dependent on effectiveness of Stage II systems:
 - Data from CT and other states indicate systems often have leaks and other problems causing them to lose effectiveness.

CT	CT	MA	MA
Inspections conducted by DEP since Dec. 20, 2010	dKC-commissioned GDF tests performed 2-4 months after certification in 2011	Annual certification tests for 2001 through 2010	Additional tests conducted 120 days after initial certification
70% Failed	100% Failed	66%-82% Failed	56% Failed

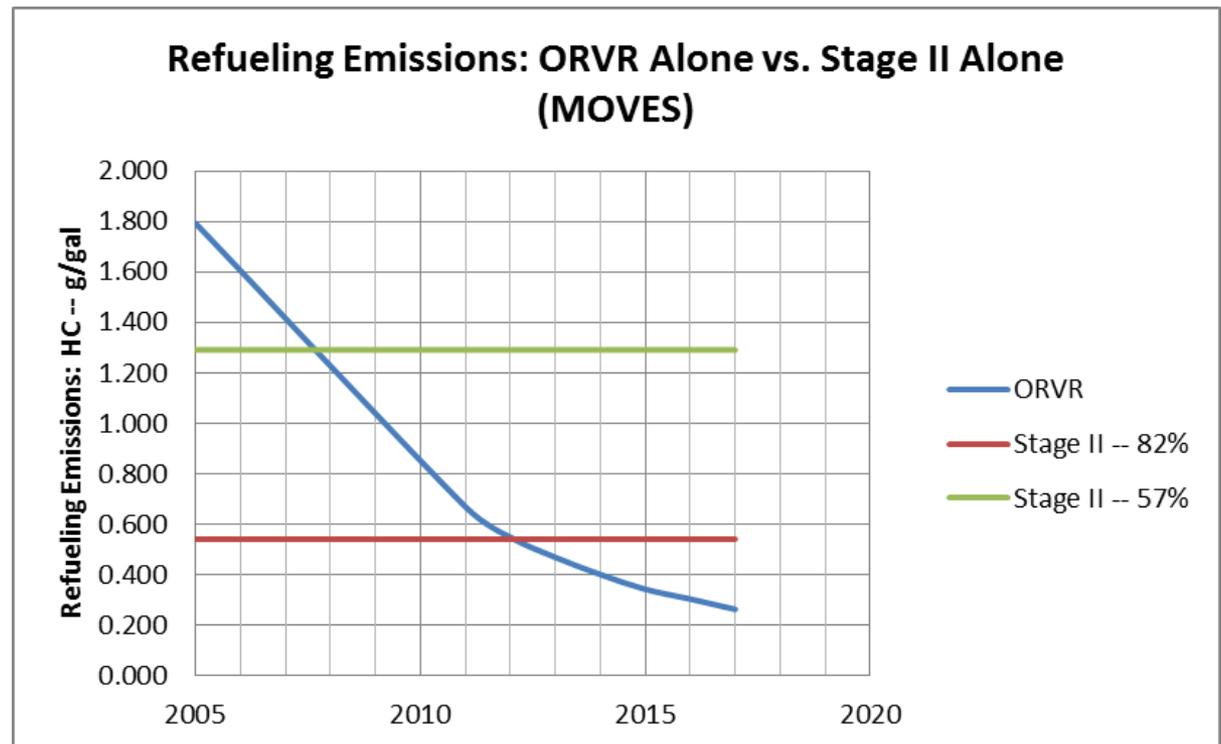
- From research conducted by NH, Stage II repairs last an average of 58 days.
 - Across all data, the most common failure is the pressure decay test.
- dKC used two estimates of Stage II effectiveness:
 - 82% - from CT's State Implementation Plan (SIP) (86% adjusted for Rule Penetration and Effectiveness).
 - 57% - incorporating findings from tests.

Widespread Use (WSU) Analysis

Estimated Dates



- Using EPA's current emission factor model, MOVES, to determine when emissions from Stage II systems alone equal emissions from ORVR alone.



57% Stage II efficiency:
2007-2008

82% Stage II efficiency:
July 2012

Widespread Use (WSU) Analysis

Implications of EPA's Proposed Rule



- On July 8, 2011, EPA published a Proposed Rule on WSU determination for Onboard Refueling Vapor Recovery (ORVR) systems.
 - In the absence of state specific analysis, EPA has set a WSU date of July 1, 2013.
- ORVR/Stage II Incompatibility
 - The proposed rule acknowledges the incompatibility between ORVR and vacuum assist Stage II systems.
 - States that continue with the Stage II requirement must upgrade to ORVR compatible systems.
- Maintain Environmental Benefit from non-ORVR vehicles
 - Ozone non-attainment areas must make up for any emission reductions lost by terminating Stage II programs.
 - CT must make up:

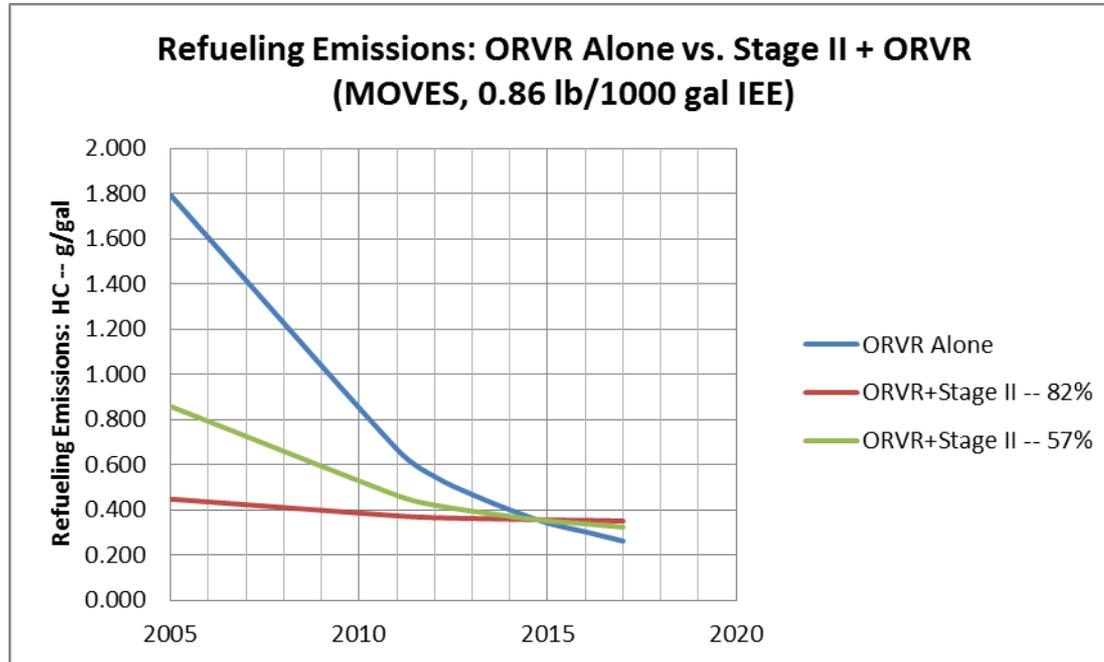
	In 2013 (tons/day)	In 2015 (tons/day)
Considering IEE	0.48	<i>None (Increases emissions)</i>
Not considering IEE	1.8	1.3

Review of GDF Options

- dKC reviewed several options for CT, focusing on:
 - Emission reductions
 - Implementation costs
- Emissions reductions proportional to gasoline consumption:
 - Statewide gasoline consumption in 2010: 1,514,621,566 gallons
- Options evaluated:
 - Decommission Stage II
 - Make Stage II compatible with ORVR systems
 - Adopt Stage II provisions of CA EVR program
 - Enhance Stage I: Require vapor leak monitoring systems
 - Enhance Stage I: Require tank pressure control systems

1 Decommission Stage II Program

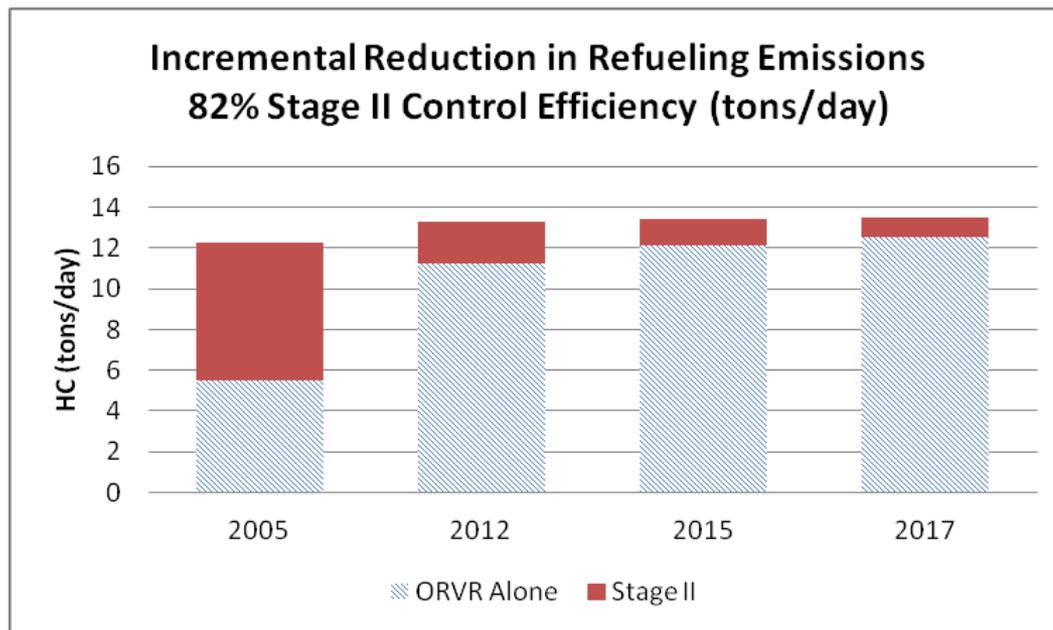
- Due to IEE, emissions will increase after 2015 with current Stage II controls.



Emissions Reductions 2015 (tons/day)	Costs (\$/yr.)	Cost Effectiveness (\$/ton)
82%: 0.063 57%: 0.044	<i>Decommissioning costs are lower than costs to maintain current Stage II systems.</i>	<i>Cost savings</i>

2 Make Current Stage II ORVR Compatible

- Upgrade to ORVR compatible nozzles
 - Eliminates IEE
 - Required for vacuum assist systems, which most GDFs in CT use
- By 2015, ORVR compatible Stage II systems have minimal benefits



2 Make Current Stage II ORVR Compatible

- Costs
 - Continue current Stage II:
 - Total annual cost: \$6,650,000
 - Upgrade to ORVR compatible nozzles:
 - \$2,000 to \$14,000 fixed cost/GDF
 - Total annual cost: \$3,800,000
 - Total annual cost: \$10.4 million

Emissions Reductions 2015 (tons/day)	Costs	Cost Effectiveness (\$/ton)
82%: 1.3 57%: 0.9	\$10.4 million/yr.	For 2015, including fuel savings: 82%: \$21,000 57%: \$31,000

3 Upgrade Stage II to CA EVR Requirements

- Implement a series of modules included in California’s Enhanced Vapor Recovery (CA EVR):
 - ORVR Compatibility
 - Tightened performance standards
 - In-station diagnostics
- 90% efficiency is assumed for CA EVR.

Emissions Reductions 2015 (tons/day)	Costs	Cost Effectiveness (\$/ton)
1.4	CA EVR Upgrade: \$30,000-\$53,000/GDF \$17.1 million/yr.	For 2015, including fuel savings: \$32,109

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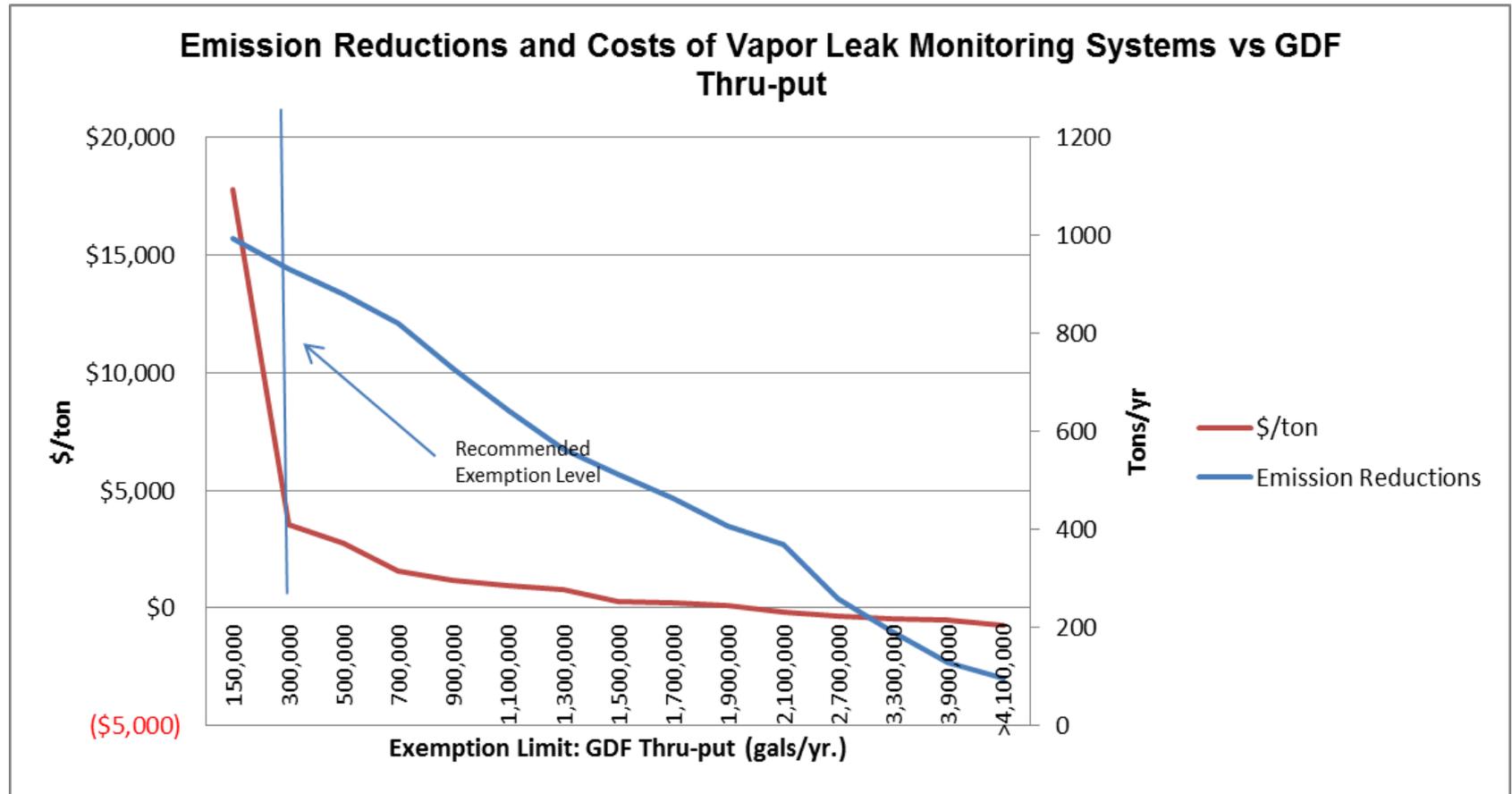
Enhance Stage I: GDF Vapor Leak Monitoring System



- Continuous monitoring of GDFs for vapor leaks
 - Parameters monitored:
 - Tank Pressure
 - Tank level
 - Dispensing activity
 - Ambient temperature and pressure
 - Reduces breathing losses and tank filling losses:
 - Inspections indicate Stage I efficiency is much lower than the 96% assumed in the SIP.
 - Control efficiencies for breathing losses assumed for Pressure Vacuum (P/V) valves are likely lower than the 90% assumed in CT's SIP.
 - Reduced State oversight costs:
 - Continuous monitoring systems and self-certification replaces periodic inspections.
- Exempting GDFs with less than 300,000 gal/year
 - Reduces emissions benefits by 7%, but reduces costs by 39%.

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Enhance Stage I: GDF Vapor Leak Monitoring System



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Enhance Stage I: GDF Vapor Leak Monitoring System



Emissions Reductions (tons/day)	Costs	Cost Effectiveness (\$/ton)
GDFs with 300,000+ gal/yr.: Only breathing losses: 1.1 Plus tank filling losses: 2.6	Fixed Cost: \$6,000/GDF Total cost for GDFs with 300,000+ gal/yr.: \$1,820,000/yr.	GDFs with 300,000+ gal/yr., including fuel savings: Only breathing losses: \$3,300 Plus tank filling losses: \$630

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Enhance Stage I: GDF Tank Pressure Control System

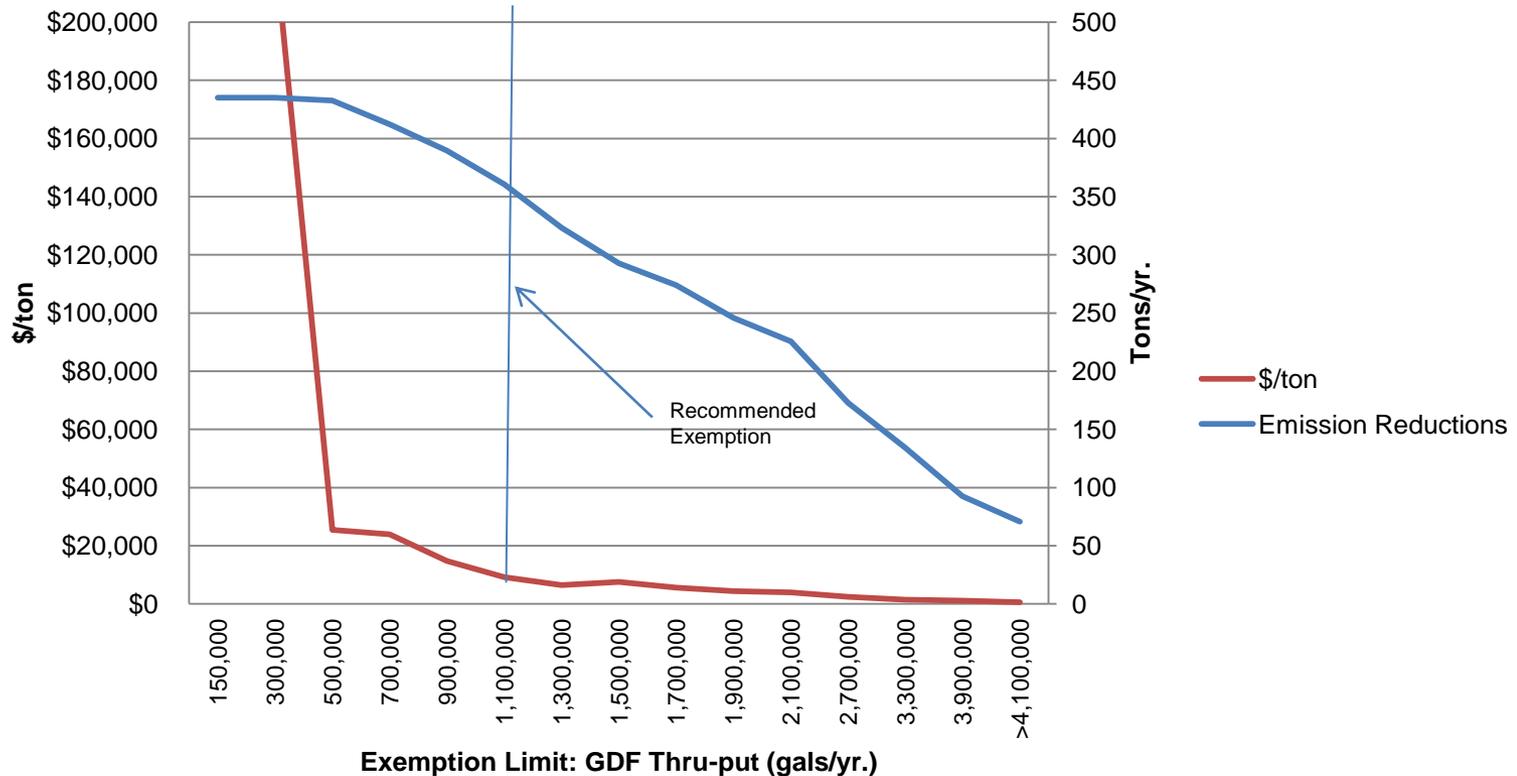


- Install vapor processors:
 - Reduces breathing losses
 - Maintains the tank pressure close to ambient to avoid fugitive emissions
- Benefits are proportional to gasoline throughput:
 - Exempting GDFs that dispense less than 1,100,000 gal/year, reduces emissions benefits by 16%, but reduces costs by 72%.

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Enhance Stage I: GDF Tank Pressure Control System

Emission Reductions and Costs of Pressure Management Systems vs. GDF Thru-put



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Enhance Stage I: GDF Tank Pressure Control System



Emissions Reductions (tons/day)	Costs	Cost Effectiveness (\$/ton)
GDFs with 1,100,000+ gal/yr.: 1.00	Fixed Cost: \$12,250/GDF GDFs with 1,100,000+ gal/yr.: \$1,830,000/yr.	GDFs 1,100,000+ gal/yr.: including fuel savings: \$3,800

Decommissioning Stage II

- Major components of Stage II vapor recovery systems:
 - Vapor recovery piping
 - Hanging hardware for dispenser
 - Dispenser decals for instructions and proper use
 - Vacuum pump
 - Liquid drop-out tank (if necessary)
- Piping can stay in place
 - If not accessible without excavation, piping can be sealed.
 - Upon next excavation at GDF, piping should be removed.
- Perform pressure decay test to ensure no leaks were created
- Next steps:
 - Get DEEP underground storage tank (UST) and EPA written approval of proposed plan.
 - Immediately exempt new or significantly modified GDFs.
 - Give priority to vacuum assist systems.
 - Require stations with more than 300,000 gallons per year to implement continuous vapor leak monitoring systems. GDFs below this throughput should continue periodic inspections for tank decay and P/V valve function.
- Reference
 - PEI RP 300 provides detailed steps on decommissioning Stage II systems.

Conclusions/Options

- Estimates of Emission Reductions and Cost Effectiveness of Stage I and Stage II Options

	OPTION	Emissions Reductions 2015 (tons/day)	Costs (\$/yr.)	Cost Effectiveness (\$/ton)
1	Decommission Stage II Program	82%: 0.063 57%: 0.044	<i>Decommission costs are less than costs to continue Stage II</i>	<i>Cost savings</i>
2	Make Current Stage II ORVR Compatible	82%: 1.28 57%: 0.89	\$10.4 million	82%: \$21,000 57%: \$31,000
3	Upgrade Stage II to CA EVR Requirements	90%: 1.40	\$17 million	\$32,000
4	Enhance Stage I: GDF Vapor Leak Monitoring System for GDFs > 300,000 gal/yr.	Only breathing losses: 1.1 Plus tank filling losses: 2.6	\$1.8 million	Only breathing losses: \$3,300 Plus tank filling losses: \$630
5	Enhance Stage I: GDF Tank Pressure Control System for GDFs > 1,100,000 gal/yr.	1.0	\$1.8 million	\$3,800

Conclusions/Options

- **WSU by summer 2012**
 - Some data indicates this has already occurred
 - Decommissioning Stage II reduces emissions after 2014
- **Enhancing Stage II systems is costly**
 - Make systems compatible with ORVR: \$21,000 to \$31,000 per ton
 - Adopting CA EVR enhancements: \$32,000 per ton
- **Options to enhance Stage I are most cost-effective**
 - Vapor leak monitoring systems on stations that dispense more than 300,000 gallons per year.
 - \$630 to \$3,300 per ton
 - Provides additional benefit by identifying leaks after Stage II decommission
 - Tank pressure control systems on GDFs that dispense more than 1,100,000 gallons/year improves cost effectiveness.
 - \$3,800 per ton

Next Steps

- Solicit and consider comments on draft report
- Form a workgroup to evaluate proposed options for Stage I enhancements (Ric Pirolli)
- Form a workgroup to evaluate decommissioning options and recommend a preferred approach (Bob Girard)