

Producer and Processor Partner Reported Opportunities

**Lessons Learned
from Natural Gas STAR**



Producers Technology Transfer Workshop

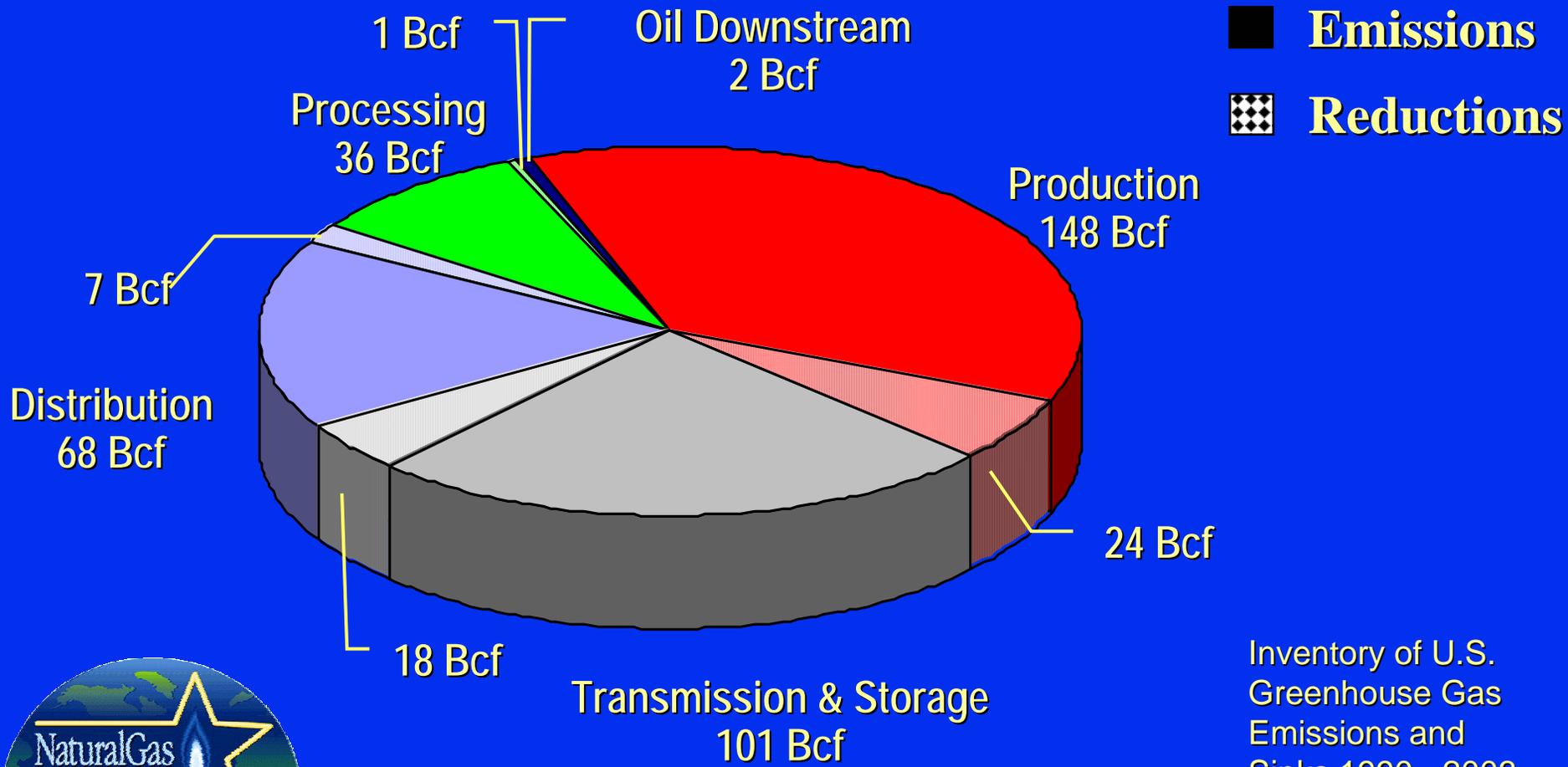
**Marathon Oil and
EPA's Natural Gas STAR Program
Houston, TX
October 26, 2005**

Producer and Processor Partner Reported Opportunities : Agenda

- ★ Production Sector Emissions
- ★ Processing Sector Emissions
- ★ Top Partner Reported Opportunities (PROs)
- ★ Gas Prices and Methane Savings
- ★ Other Opportunities
- ★ Discussion Questions



Methane Losses from the Natural Gas Industry

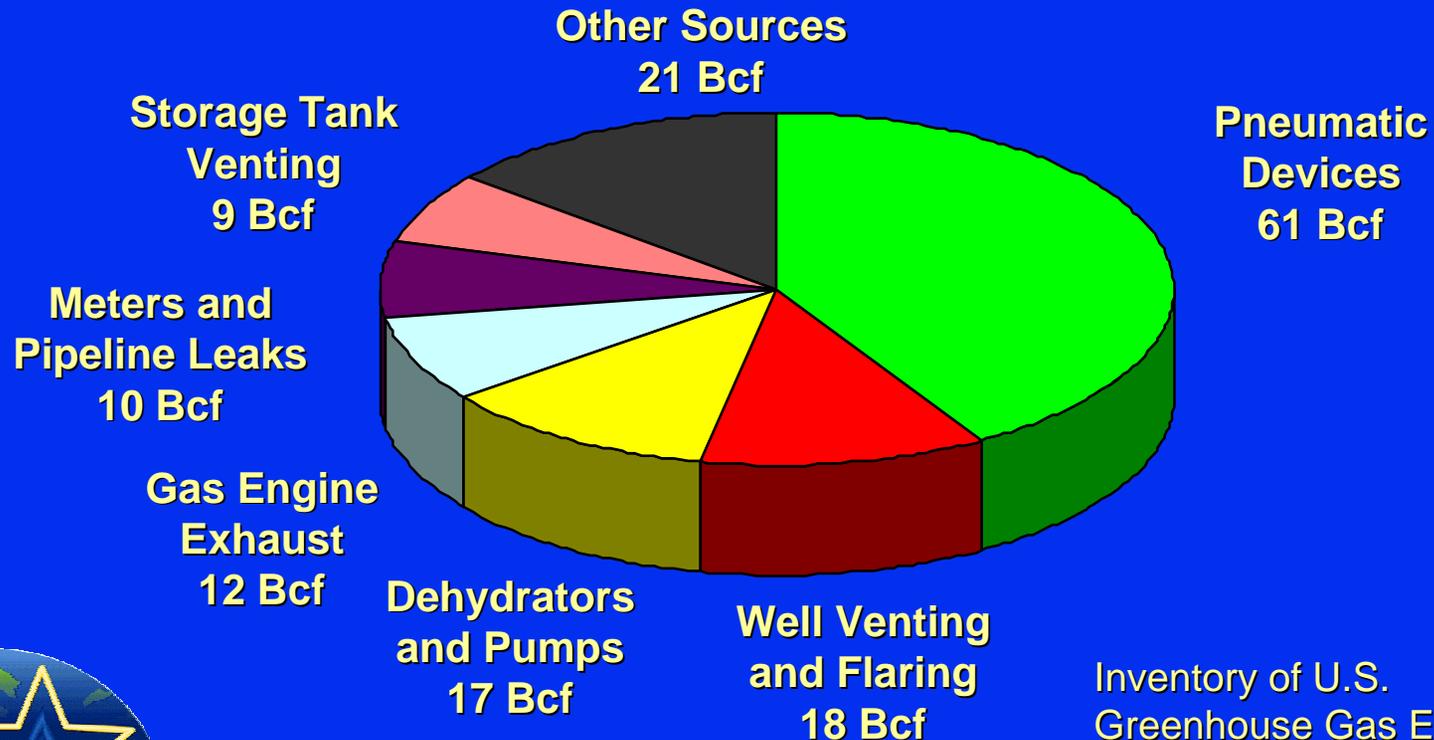


Inventory of U.S.
Greenhouse Gas
Emissions and
Sinks 1990 - 2003



Production Sector Emissions

- ★ The production sector has several large methane emission sources that can be targeted for reductions



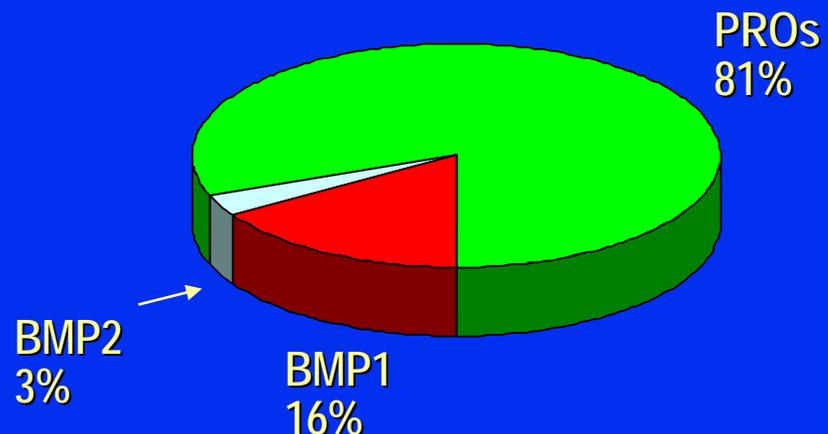
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Producer Best Management Practices (BMPs)

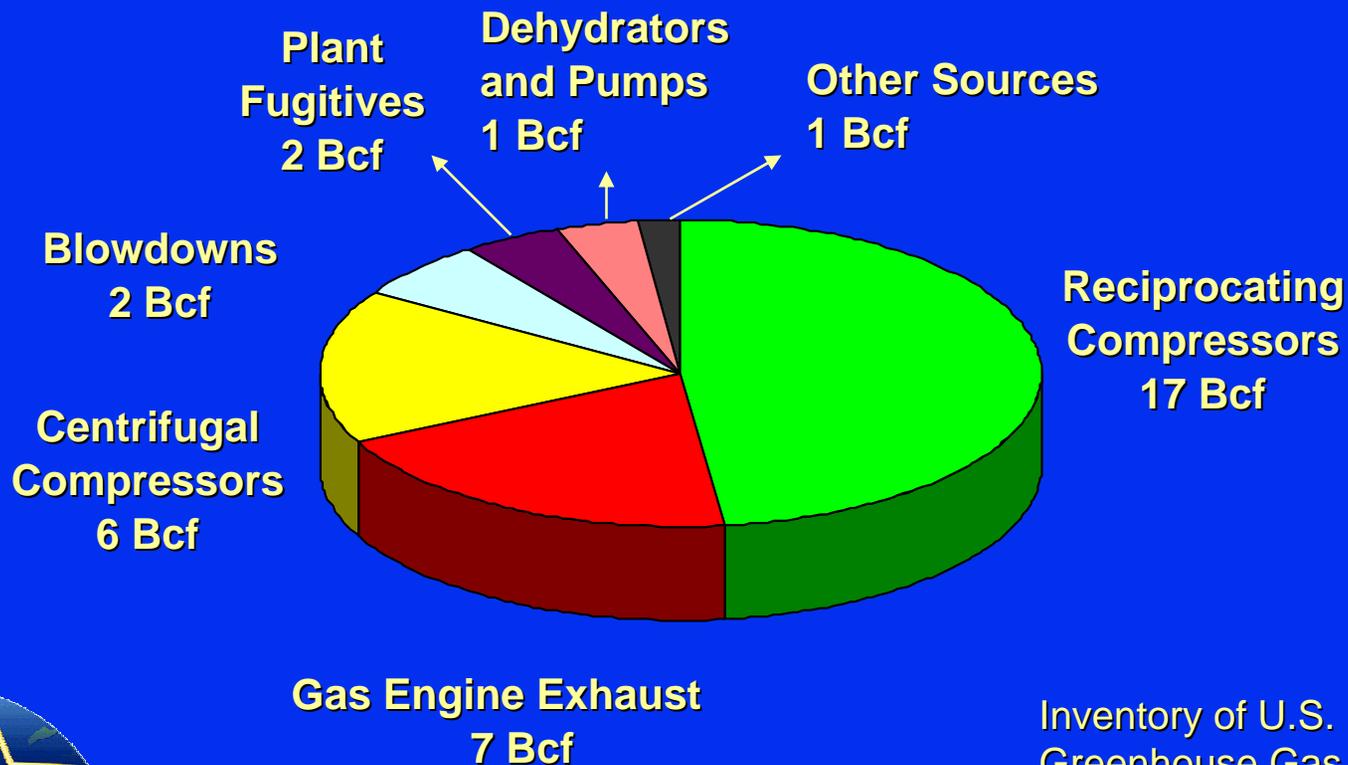
- ★ BMP 1: Identify and replace high bleed pneumatic devices
- ★ BMP 2: Install flash tank separators on glycol dehydrators
- ★ BMP 3: Partner Reported Opportunities (PROs)

◆ 81% of production sector reductions came from PROs



Processing Sector Emissions

- ★ The processing sector emits less methane, but still has several large emission sources



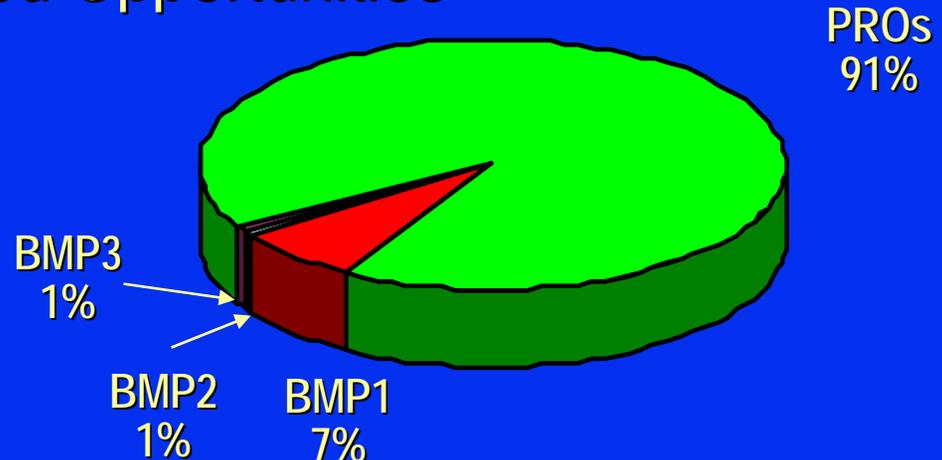
Inventory of U.S.
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Processor Best Management Practices

- ★ BMP 1: Replace gas pneumatics with instrument air systems
- ★ BMP 2: Install flash tank separators on glycol dehydrators
- ★ BMP 3: Directed Inspection and Maintenance at Gas Plants and Booster Stations
- ★ BMP 4: Partner Reported Opportunities

◆ **91% of processing sector reductions came from PROs**



Highly Implemented PROs

- ★ The Gas STAR program has identified
 - ◆ 42 production sector PROs
 - ◆ 29 processing sector PROs
- ★ Ten “top” PROs from each sector:
 - ◆ PROs most reported by Gas STAR partners in production and processing sectors
 - ◆ All target major emissions sources
 - ◆ Responsible for over 65% of all emission reductions in the production and processing sectors



Production and Processing Top PROs

Top PROs	Sector		Payback	Methane Savings
	Production	Processing		
Install flares	X	X	None	2,000 Mcf/yr
Install vapor recovery units	X	X	1-3 yr	4,900 Mcf/yr
Install plunger lifts	X		<1 yr	4,700 Mcf/yr
Install instrument air systems	X		<1 yr	20,000 Mcf/yr
Eliminate unnecessary equipment and/or systems	X	X	<1 yr	2,000 Mcf/yr
Perform green completions	X		1-3 yr	7,000 Mcf/yr
Conduct leak surveys	X		1-3 yr	4,000 Mcf/yr
Install electric compressors	X	X	>10 yr	6,440 Mcf/yr
Consolidate crude oil production and water storage tanks	X		1-3 yr	4,200 Mcf/yr
Alter blowdown piping	X		1-3 yr	1,000 Mcf/yr
Use hot taps for in-service pipeline connections		X	1-3 yr	24,400 Mcf/yr
Redesign blowdown systems and alter ESD practices		X	1-3 yr	2,000 Mcf/yr
Rerouting of glycol skimmer gas		X	<1 yr	7,600 Mcf/yr
Shut down compressors		X	<1 yr	5,000 Mcf/yr
Replace gas starters with air		X	<1 yr	1,300 Mcf/yr
Replace glycol dehydration units with methanol injection		X	<1 yr	800 Mcf/yr



Production Top PROs

- ★ Determine which top PROs are not currently implemented at your company
- ★ Revisit economics of top PROs using current gas price

Partner Reported Opportunities	Methane Savings in 2004 (Mcf)
Install flares	2,231,586
Install vapor recovery units (VRUs)	4,187,078
Install plunger lifts	4,441,645
Install instrument air systems	410,214
Eliminate unnecessary equipment and/or systems	327,896
Perform green completions	6,497,087
Conduct leak surveys	14,081
Install electric compressors	116,947
Consolidate crude oil production and water storage tanks	709,404
Alter blowdown piping	198,419



Production Top PROs Currently Reported

Partner Reported Opportunities	BP	ExxonMobil	ConocoPhillips	Devon Energy	Marathon
Install flares	X	X	X		X X
Install vapor recovery units (VRUs)	X	X	X		X X
Install plunger lifts		X		X	X X
Install instrument air systems		X	X		X
Eliminate unnecessary equipment and/or systems	X	X	X	X	X
Perform green completions	X			X	X
Conduct leak surveys		X	X	X	X
Install electric compressors			X		X X
Consolidate crude oil production and water storage tanks		X			X
Alter blowdown piping			X		



Processing Top PROs

- ☆ Determine which top PROs are not currently implemented at your company
- ☆ Revisit economics of top PROs using current gas price

Partner Reported Opportunities	Methane Savings in 2004 (Mcf)
Install flares	78,878
Use hot taps for in-service pipeline connections	36,008
Install vapor recovery units (VRUs)	3,796
Redesign blowdown systems and alter ESD practices	2,310
Eliminate unnecessary equipment or systems	354,167
Install electric compressors	45,743
Rerouting of glycol skimmer gas	9,512
Shut down compressors	10,850
Replace gas starters with air	9,982
Replace glycol dehydration units with methanol injection	79,244



Processing Top PROs Currently Reported

Partner Reported Opportunities	Company				
	Enterprise (GulfTerra)	Western Gas Pioneer	Enbridge Energy	Dynegy	
Install flares	X	X	X		
Use hot taps for in-service pipeline connections	X	X		X	
Install vapor recovery units (VRUs)			X		
Redesign blowdown systems and alter ESD practices	X		X	X	
Eliminate unnecessary equipment or systems	X	X			
Install electric compressors	X				X
Rerouting of glycol skimmer gas		X	X		
Shut down compressors			X		
Replace gas starters with air			X	X	
Replace glycol dehydration units with methanol injection		X			



Implementation of Top PROs

- ★ These PROs have been proven to reduce emissions economically
- ★ Top PROs target the largest sources of methane emissions in the production sector
- ★ Room for a great deal of further emissions reductions



Emissions Targeted by Top PROs

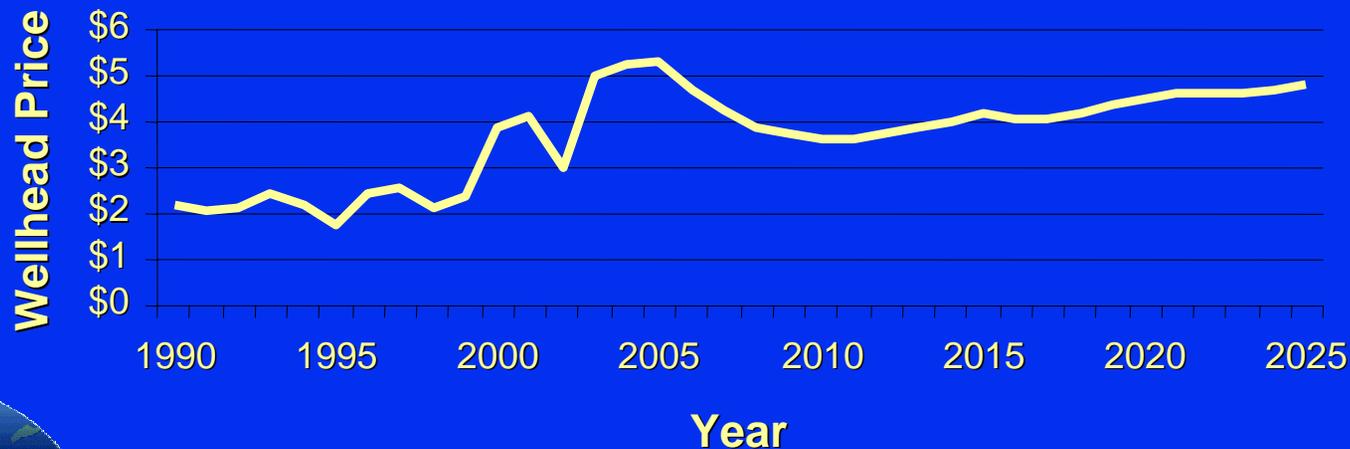
- ★ BMPs and top PROs target over 75% of production and processing sector emissions
- ★ This means:
 - ◆ Partners that report PROs recognize major sources of methane losses and are taking steps to mitigate emissions
 - ◆ Partners not practicing all BMPs and top PROs may have further opportunities for methane savings



Gas Prices and Methane Savings

- ☆ Economics of implementing new PROs change with gas price
- ☆ PRO fact sheets use nominal gas price of \$3/Mcf
- ☆ Many PROs were reported when gas price <\$2

Natural Gas Wellhead Price to 2025



EIA Annual Energy Outlook with Projections to 2025. <http://www.eia.doe.gov/oiaf/aeo/gas.html>



Economics of Vapor Recovery Units

- ★ Installing a 50 Mcf/day vapor recovery unit (VRU) will save about 8,700 Mcf/yr of saleable gas
 - ◆ **Costs associated with the VRU include a \$19,500 capital investment with 50% for installation and \$6,000/yr operating and maintenance**

Gas Price (\$/Mcf)	\$ 2.00	\$ 3.00	\$ 5.00
Gas Saved (Mcf/yr)	8,700	8,700	8,700
Annual Savings (\$/yr)	\$ 17,400	\$ 26,100	\$ 43,500
Installed Cost	\$ 29,250	\$ 29,250	\$ 29,250
Operating Cost	\$ 6,000	\$ 6,000	\$ 6,000
Payback Period (yr)	2.6	1.5	0.8



Install Pressurized Storage of Condensate

- ★ This PRO is reported to save 7,000 Mcf/yr but requires high capital investment for pressurized transport vehicles
- ★ A partner estimated the capital cost at \$37,500 with an annual operating cost of \$2,500
- ★ The decision to implement this PRO depends upon current gas prices



Economics of Pressurized Condensate

Gas Price (\$/Mcf)	\$ 2.00	\$ 3.00	\$ 5.00
Gas Saved (Mcf/yr)	7,000	7,000	7,000
Annual Savings (\$/yr)	\$ 14,000	\$ 21,000	\$ 35,000
Installed Cost	\$ 37,500	\$ 37,500	\$ 37,500
Operating Cost	\$ 2,500	\$ 2,500	\$ 2,500
Payback Period (yr)	3.3	2.0	1.2

- ★ High gas prices make the economics of implementing this PRO much more attractive
- ★ Efforts to reduce emissions should be intensified when gas prices are high and capital investments pay back quickly



Other Opportunities

The Gas STAR Program has the following PRO Fact Sheets available

Production

- ★ 8 Compressor
- ★ 6 Dehydrator
- ★ 2 Pneumatics/Controls
- ★ 3 Pipelines
- ★ 5 Tanks
- ★ 6 Valves
- ★ 9 Wells
- ★ 3 Other

Processing

- ★ 9 Compressor
- ★ 5 Dehydrator
- ★ 2 Pneumatics/Controls
- ★ 2 Pipelines
- ★ 3 Tanks
- ★ 6 Valves
- ★ 2 Other



Other PROs with High Potential Savings

PRO	Sector		Payback	Methane Savings
	Production	Processing		
Nitrogen Rejection Unit Optimization		x	<1 yr	200,000
Install Compressor to Capture Casinghead Gas	x		<1 yr	32,850
Zero Emissions Dehydrators	x	x	<1 yr	31,400
Connect Casing to Vapor Recovery Unit	x		<1 yr	7,300
Inspect & Repair Compressor Station Blowdown Valves	x	x	<1 yr	2,000
Use Ultrasound to Identify Leaks	x	x	<1 yr	2,000

- ★ Partners implementing all top PROs have further opportunities for emissions reductions
- ★ These PROs reduce emissions and with higher gas prices pay back more quickly



Discussion Questions

- ★ Do you find any of the top PROs to be economically unattractive?
- ★ How do you take into account the price of gas when examining which PROs to implement?
- ★ What are some of the other issues that are preventing you from implementing these practices?

