Producer Partner Reported Opportunities

Lessons Learned
from Natural Gas STAR

Producers Technology Transfer Workshop

ExxonMobil Production Company,
American Petroleum Institute and
EPA's Natural Gas STAR Program

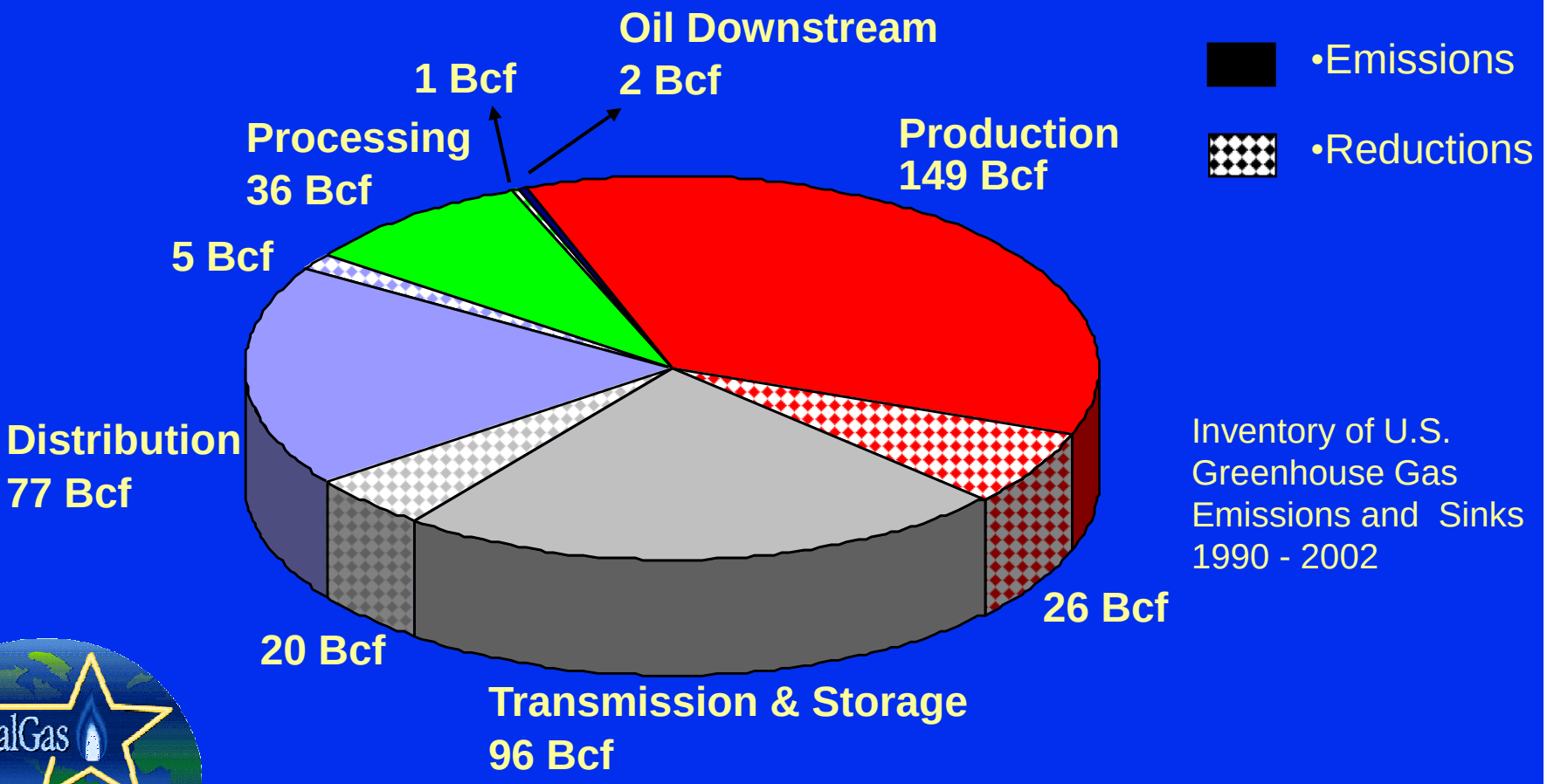
September 21, 2004

Partner Reported Opportunity Overview: Agenda

- Production Sector Emissions
- Top Partner Reported Opportunities (PROs)
- Potential Emission Savings from Other Opportunities
- Discussion Questions

Natural Gas and Petroleum Industry Emissions

- Production sector responsible for largest portion of emissions



Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990 - 2002

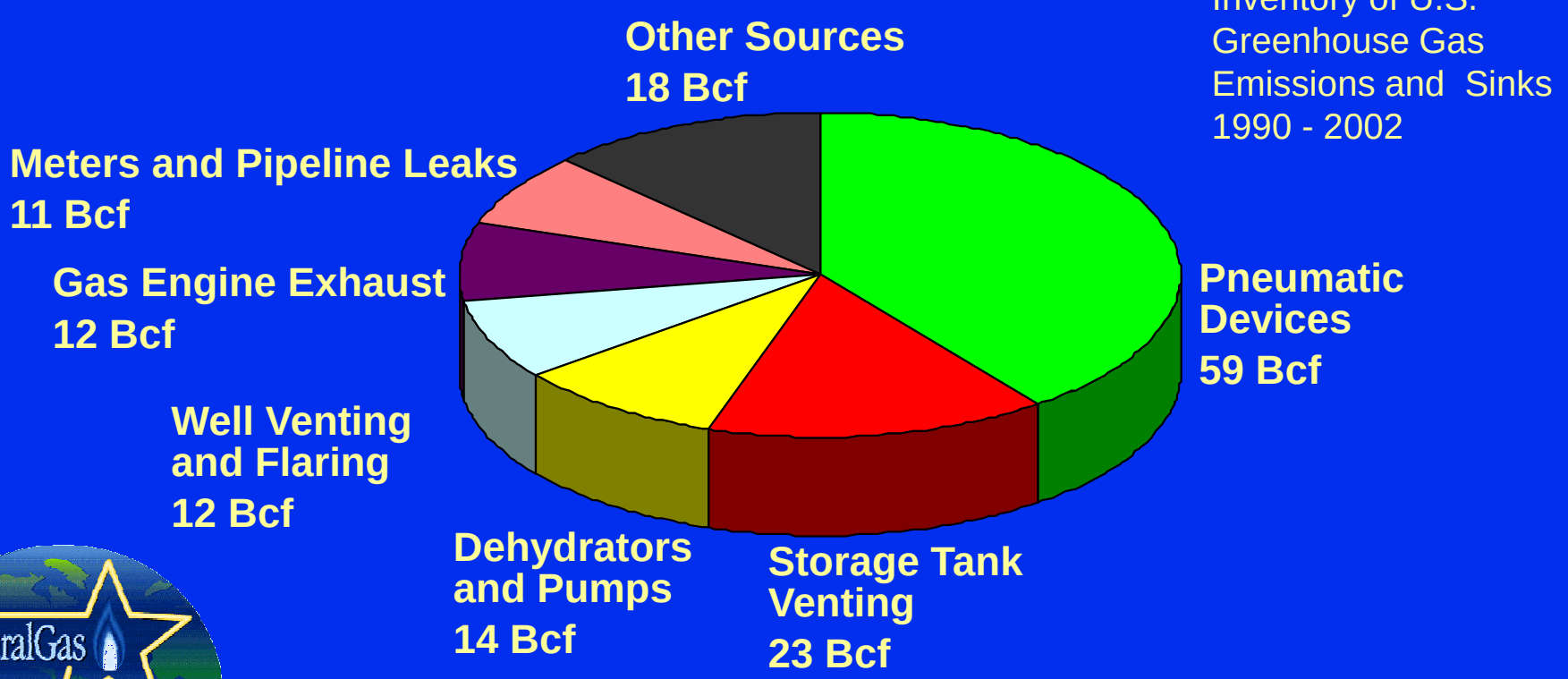
NaturalGas
EPA POLLUTION PREVENTER

Reducing Emissions, Increasing Efficiency, Maximizing Profits

Oil and Gas Production Sector Emissions

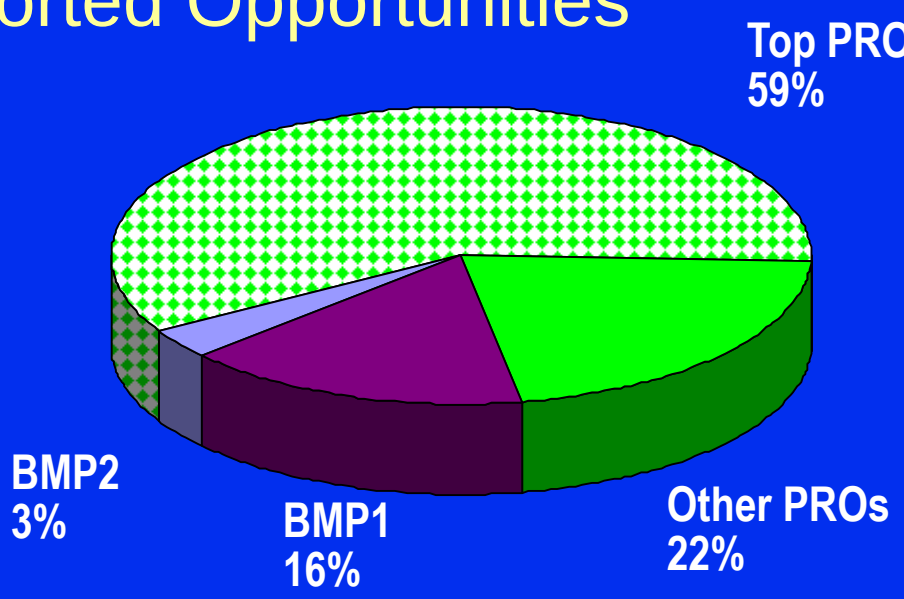
- The production sector has several large methane emission sources that can be targeted for reductions

Inventory of U.S. Greenhouse Gas Emissions and Sinks 1990 - 2002



Best Management Practices (BMP)

- 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**



Highly Implemented PROs

- The Gas STAR program has identified 39 PROs that are applicable to the production sector
- Nine "top" PROs:
  - **PROs most reported by production Gas STAR partners**
  - **All target major emissions sources**
  - **Responsible for over 2/3 of PRO emissions reductions**

Top PROs

Rank	Top PROs	Payback	Methane Savings
1	Install Instrument Air Systems	<1 yr	20,000 Mcf/yr
2	Install Plunger Lifts	<1 yr	>4,700 Mcf/yr
3	Pipe Glycol Dehydrator to Vapor Recovery Unit	<1 yr	3,300 Mcf/yr
4	Convert Gas-Driven Chemical Pumps to Instrument Air	<1 yr	2,500 Mcf/yr
5	Eliminate Unnecessary Equipment and/or Systems	<1 yr	2,000 Mcf/yr
6	Install Vapor Recovery Units	1-3 yr	>4,900 Mcf/yr
7	Consolidate Crude Oil Production and Water Tank Storage	1-3 yr	4,200 Mcf/yr
8	Install Electric Compressors	>10 yr	6,440 Mcf/yr
9	Install Flares	None	2,000 Mcf/yr

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

Top PROs Currently Reported

Partner Reported Opportunities	ExxonMobil Corp.	ChevronTexaco	Burlington Resources Inc.	Marathon	Kerr-McGee Corp.	Devon	Methane Savings per Application
Compressors/Engines							
Install Electric Compressors		x				x	6,440 Mcf/yr
Dehydrators							
Convert Gas-Driven Chemical Pumps to Instrument Air	x	x		x	x		2,500 Mcf/yr
Pipe Glycol Dehydrator to Vapor Recovery Unit		x	x			x	3,300 Mcf/yr
Wells							
Install Plunger Lifts	x		x	x		x	4,700 Mcf/yr

Top PROs Currently Reported Cont.

Partner Reported Opportunities	ExxonMobil Corp.	ChevronTexaco	Burlington Resources Inc.	Marathon	Kerr-McGee Corp.	Devon	Methane Savings per Application
Pneumatics/Controls							
Install Instrument Air Systems	x	x		x	x		20,000 Mcf/yr
Tanks							
Consolidate Crude Oil Production and Water Tank Storage	x			x			4,200 Mcf/yr
Install Vapor Recovery Units	x	x	x	x	x	x	4,900 Mcf/yr
Other							
Install Flares	x	x	x	x	x	x	2,000 Mcf/yr
Eliminate Unnecessary Equipment and/or Systems	x	x		x	x	x	2,000 Mcf/yr

Implementation of Top PROs

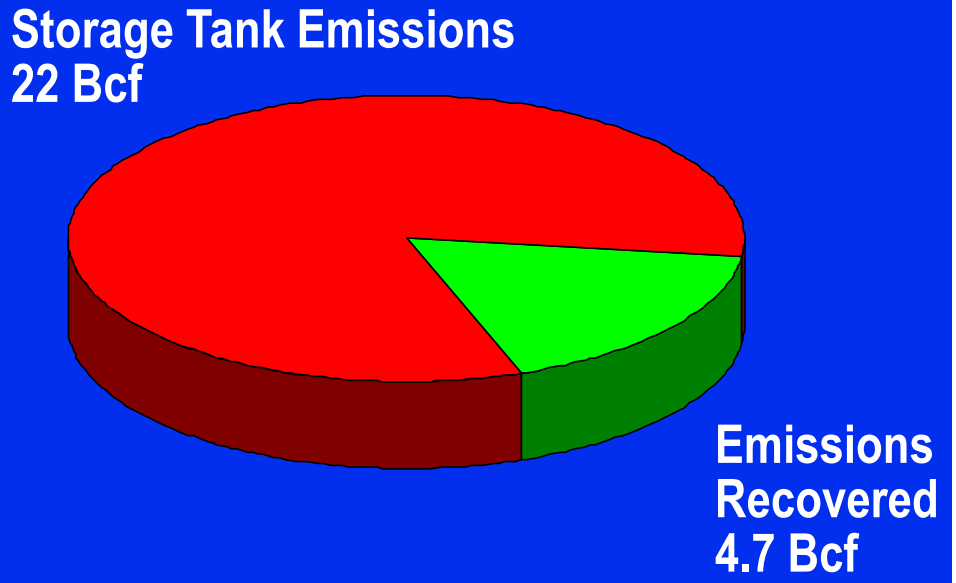
- These PROs have been proven to reduce emissions economically
- Top PROs target the largest sources of methane emissions in the production sector
- Room for a great deal of further emissions reductions

Emissions Targeted by Top PROs

- BMPs and top PROs target over 75% of production sector emissions but have only reduced emissions by 20%
- 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**

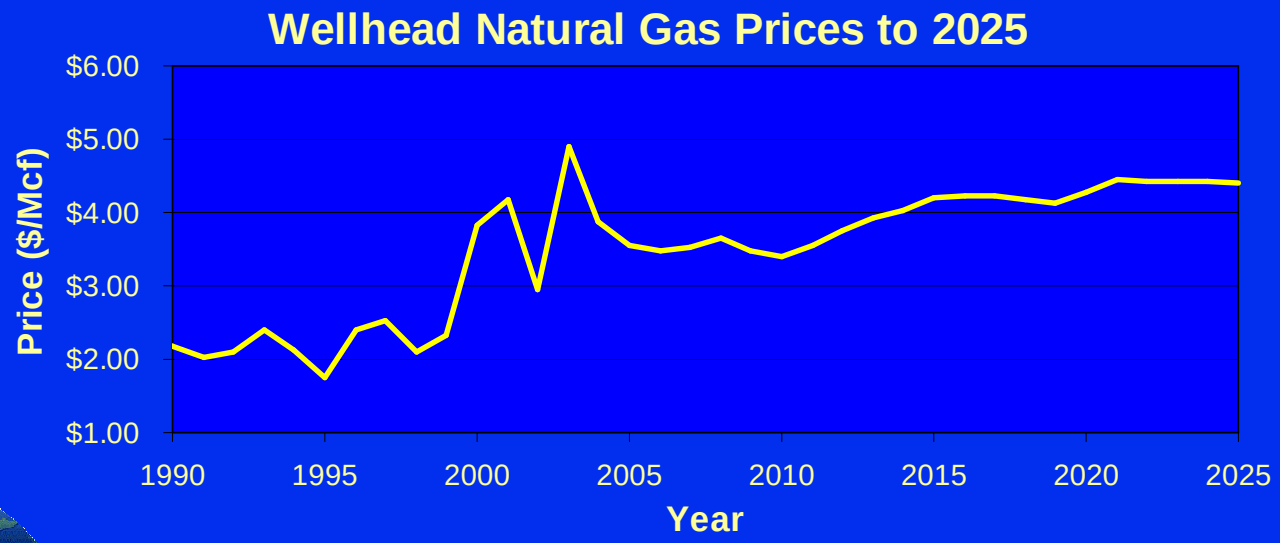
Installing Vapor Recovery Units

- Only 18% of emissions from crude oil storage tanks were recovered in 2002
- Lessons Learned studies show that vapor recovery units save 5,000 to 100,000 Mcf/yr per application
- Installing vapor recovery units may have room for more savings in emissions and money



Gas Price 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



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	$ 4.00
Gas Saved (Mcf/yr)	8,700	8,700	8,700
Annual Savings ($/yr)	$ 17,400	$ 26,100	$ 34,800
Installed Cost	$ 29,250	$ 29,250	$ 29,250
Operating Cost	$ 6,000	$ 6,000	$ 6,000
Payback Period (years)	2.6	1.5	1.0

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 (years)	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 currently documents 39 PROs applicable to the production sector
  - **7 Compressor/Engine related**
  - **5 Dehydrator related**
  - **3 Pneumatics/Controls related**
  - **4 Pipeline related**
  - **4 Tank related**
  - **5 Valve related**
  - **7 Well related**
  - **4 Miscellaneous**

Other PROs with High Potential Savings

Rank	PROs	Payback	Methane Savings
1	Install Compressors to Capture Casinghead Gas	<1 yr	32850 Mcf/yr
2	Rerouting of Glycol Skimmer Gas	<1 yr	7600 Mcf/yr
3	Connect Casing to Vapor Recovery Unit	<1 yr	7300 Mcf/yr
4	Inspect & Repair Compressor Station Blowdown Valves	<1 yr	2000 Mcf/yr
5	Use Ultrasound to Identify Leaks	<1 yr	2000 Mcf/yr

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

New PROs in Development

- Install an additional phase of separation to recover gas from separators
- Route gas to a portable desiccant dehydrator during glycol dehydrator maintenance
- Recover gas produced during rich gas field pigging operations
- Zero emissions glycol dehydrator

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?