

Reducing Methane Emissions During Completion Operations



**2007 Natural Gas STAR
Production Technology Transfer
Workshop**

**Glenwood Springs, CO
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Reducing Methane Emissions during Completion Operations

Williams Production RMT – Piceance Basin Operations



Agenda

- 🔥 Objectives
- 🔥 Piceance Basin Well Completion Process Description
- 🔥 Equipment Needed
- 🔥 Economics
- 🔥 Conclusion

Objectives:

- 🔥 Virtually eliminate venting of natural gas produced during new well completions.
- 🔥 Capture produced gas and deliver to sales.
- 🔥 Meter produced gas for revenue distributions.
- 🔥 Ensure safety of personnel during entire process.

Piceance Basin Well Completions

- 🔥 Williams Fork Formation – low permeability, tight, lenticular sandstone
- 🔥 10-acre Spacing
- 🔥 Wells drilled to depths of 6,500 ft to 9,000 ft.
- 🔥 Reservoir pressures as high as 4000 psi.
- 🔥 Fracture stimulation required to make wells economical.
- 🔥 Typically fracture stimulate 5 to 6 separate stages per well.

Piceance Basin Well Completions

- 🔥 Perforate casing prior to Stage 1 – makes fracture stimulation possible
- 🔥 Fracture Stimulate Stage 1. Flowback until next step.
- 🔥 Shut in well. Set flow-through casing plug to isolate next stage to be fracture stimulated.
- 🔥 REPEAT for each stage (avg. 5 to 6 stages/well)
- 🔥 Well continues to produce through the flow-through plugs until a workover rig is available to drill out the plugs.
- 🔥 Stimulation fluids and gas are produced while plugs are drilled out.

Sand Flowback Problems

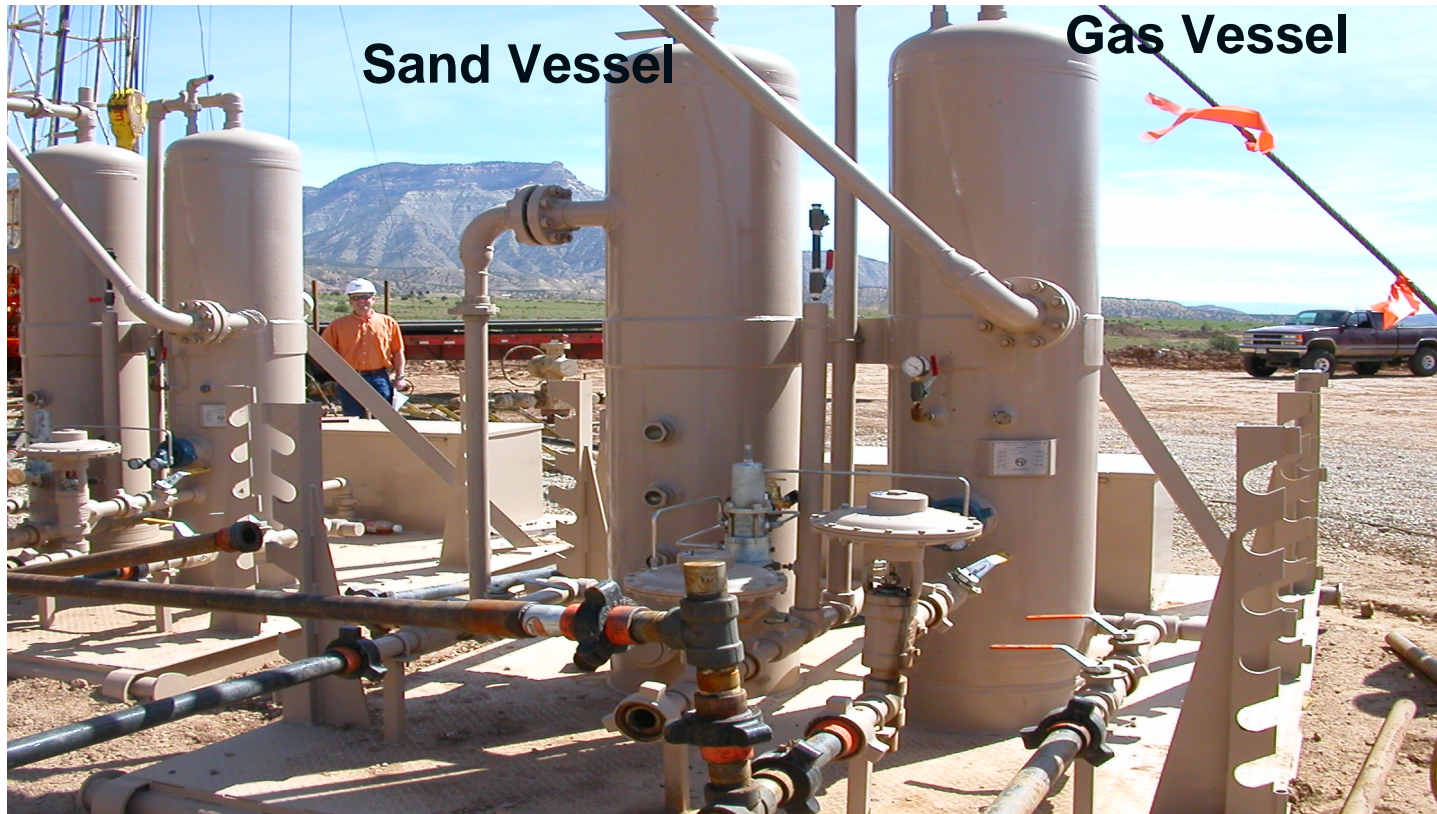


WASHOUT

Green Completions

- 🔥 Technology used to recover gas would otherwise be vented or flared during the completion phase of natural gas well.
- 🔥 Williams designed equipment to handle high pressure, high rate flowback fluids so as to safely handle and to sell the natural gas produced during flowback period.
- 🔥 Flowback equipment is used to separate sand, water and gas during initial flowback.

Flowback Unit



Flowback Unit - Operation

- 🔥 Sand Vessel separates sand from flowback liquids.
- 🔥 Sand is dumped to reserve pit. Gas and Liquids dump to the Gas Vessel.



Flowback Unit - Operation

- Gas Vessel separates gas from water used for fracture stimulation.
 - Gas routed to sales line through the production equipment to insure proper metering.
- Water dumps to holding tanks
 - Water is recycled and reused for subsequent fracture stimulation jobs.
- Flowback Unit vessels operate at 275 to 300 psi.



Risks

Safety – Primary Concern

- ⚡ High pressure gas, liquids and sand can erode steel pipe.
- ⚡ To mitigate safety concerns:
 - ⚡ Pipe, Fittings and Vessels use high strength metal
 - ⚡ Flowback Units are monitored 24/7.

Simultaneous Operations



Drilling

Completion

Drillout

Production

Risks

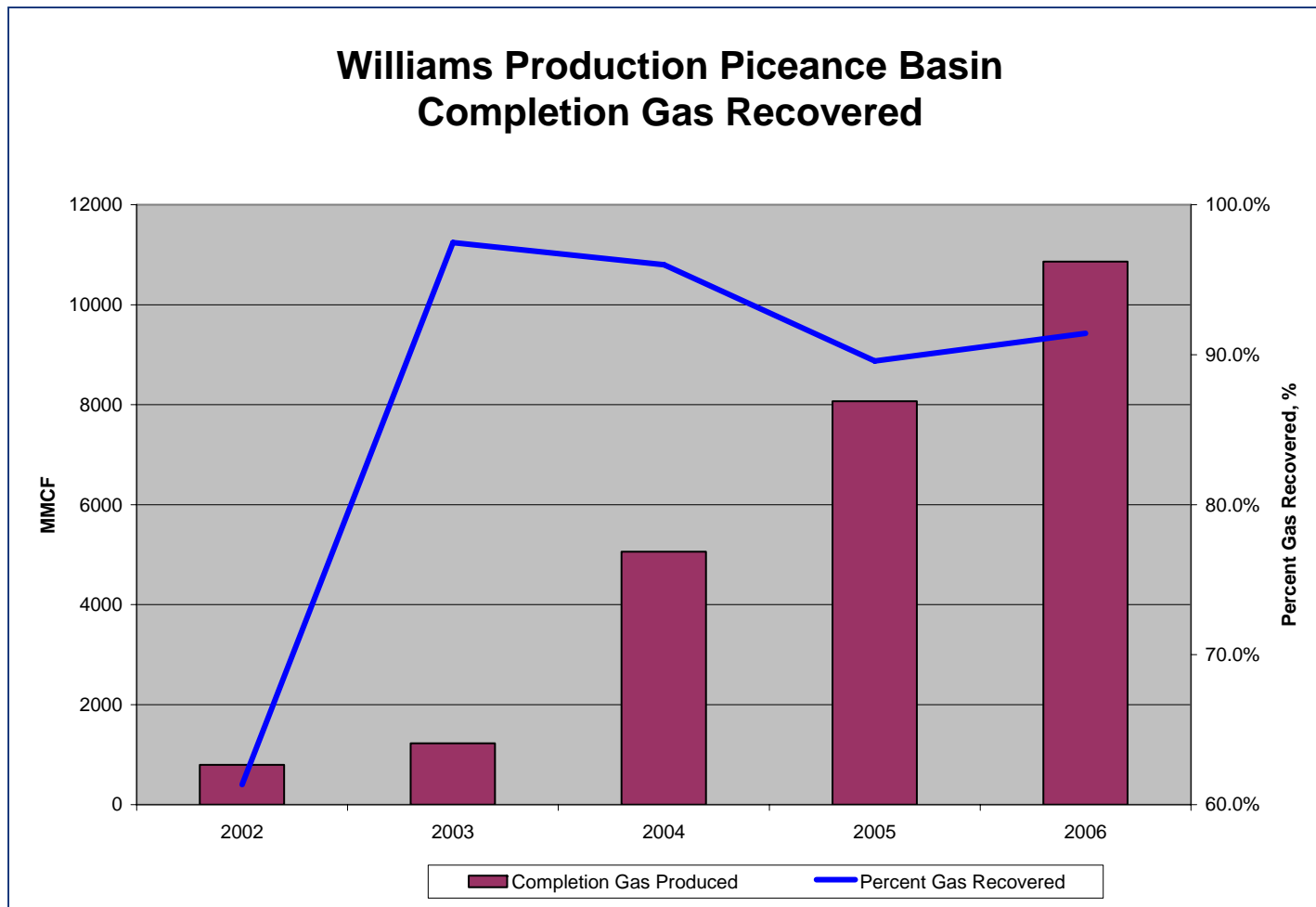
Operations & Reservoir Risks

- 🔥 Fluids pumped downhole must be recovered as quickly as possible
- 🔥 Wellbore damage by fluids can diminish production
- 🔥 Flowing fluids to flowback skid results in decreased flowback rates because of high backpressure (versus no backpressure when venting)

Economics – Volume Recovered

Year	Total Number of Well Spuds	No. of Spuds Not Completed or Completed Without Flowback	Actual Number of Flowback Completions	Actual Completion Gas Generated (MMCF)	Actual Completion Gas Vented/Flared (MMCF)	Flowback Gas Recovered (MMCF)	Flowback Gas Recovered (%)
2002	75	29	46	794	307	487	61.3%
2003	78	2	76	1227	31	1196	97.5%
2004	251	10	241	5060	202	4858	96.0%
2005	307	32	275	8070	841	7229	89.6%
2006	466	40	426	10863	932	9931	91.4%
Totals	1177	113	1064	26014	2313	23701	91.1%

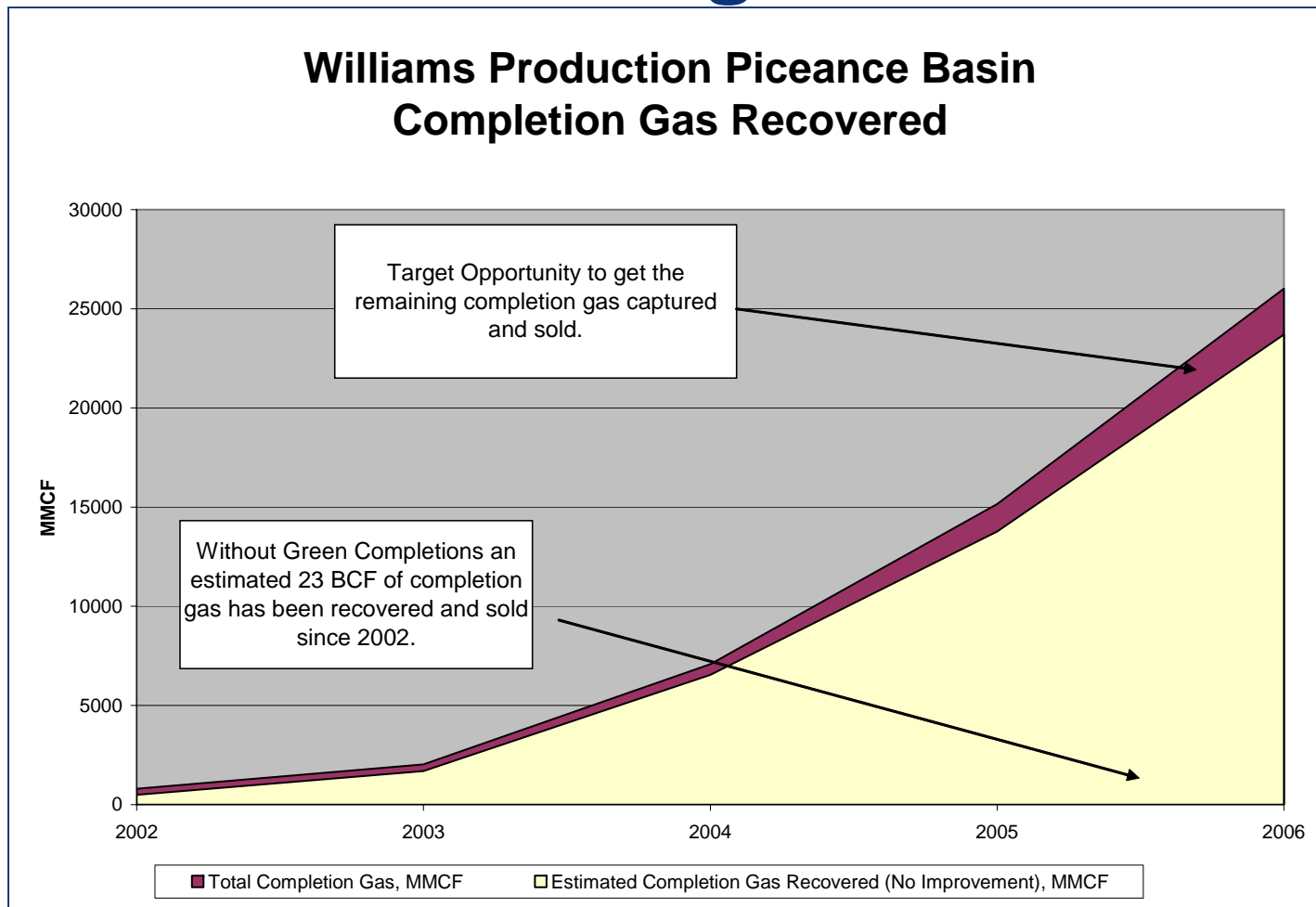
Economics – Volume Recovered



Economics – Savings Realized

Flowback Revenue/Cost Analysis			
Year	Total Revenue (MM\$)	Recovery Cost	Net Savings
		(M\$)	(MM\$)
2002	1.75	0.22	1.53
2003	7.20	0.90	6.30
2004	36.46	2.85	33.61
2005	48.73	4.85	43.88
2006	64.99	8.59	56.40
Totals	159.13	17.41	141.72

Economics – Savings Realized



Capturing Gas During Drillouts

- Typically gas is vented/flared during drillout procedure
- Solution: modular flowback packaged unit (Weatherford or Pure Energy)
- Example drillout:
 - 3,000-psi shut-in pressure
 - 1,400-psi drawdown while drilling
 - 8-12 hours for plug drill out time
 - 5,000 -15,000 MCF venting each drillout



Conclusion

- 🔥 Reduces methane emissions, a potent Green House Gas (GHG)
- 🔥 Well completion type location and existing infrastructure determine viability of Green Completion Technologies
- 🔥 Produced water and stimulation fluids from green completions are recycled
- 🔥 Reduces emissions, noise and citizen complaints associated with venting or flaring
- 🔥 Increases Economic Value Added

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