Southwestern Energy®

SWN Gas Capture Case Study and Methane Emission Initiatives

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Areas of operation

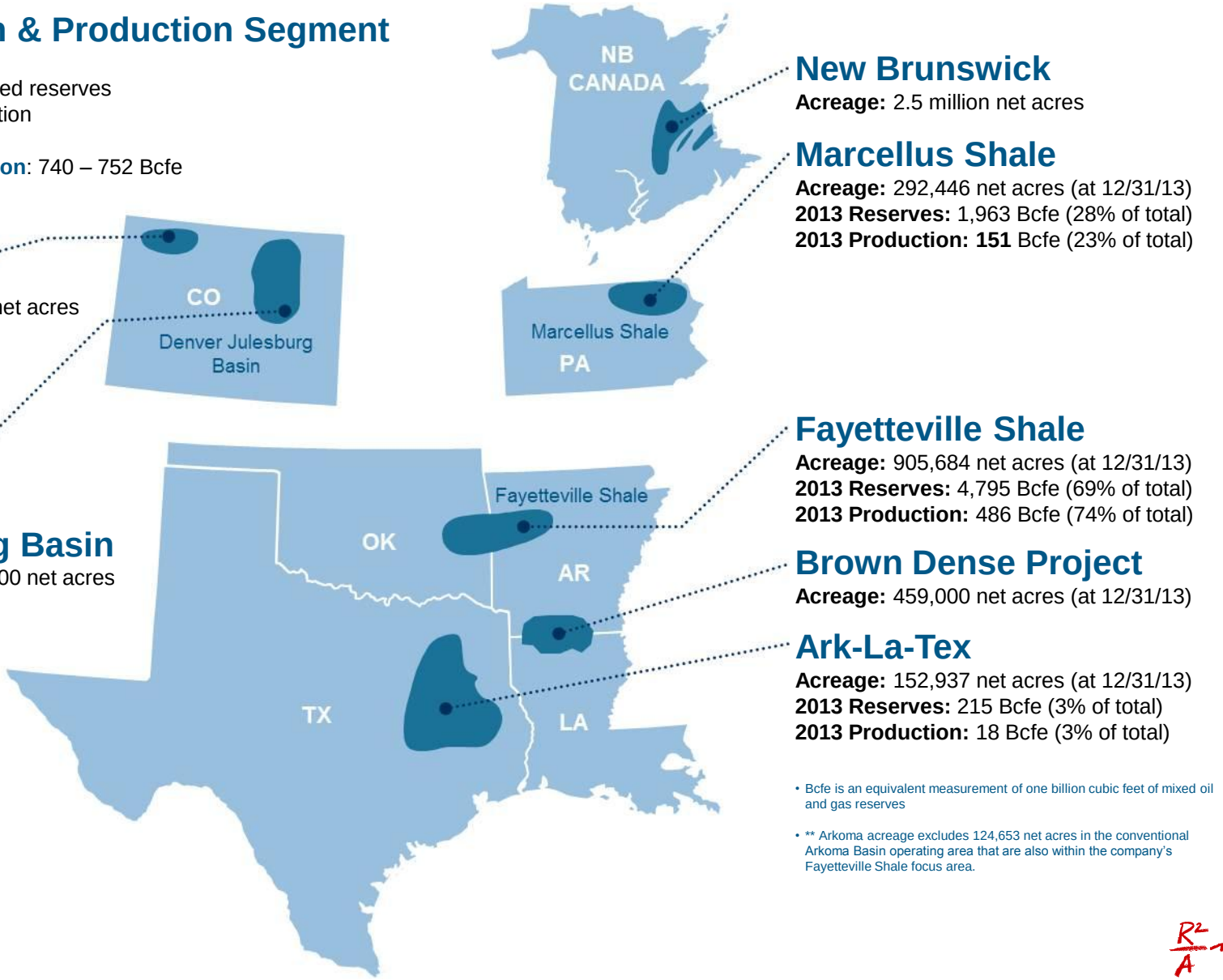
Exploration & Production Segment

2013
6,976 Bcfe* of proved reserves
657 Bcfe of production

2014 est. production: 740 – 752 Bcfe

Sand Wash Basin
Acreage: 313,000 net acres

Denver Julesburg Basin
Acreage: 302,000 net acres



New Brunswick
Acreage: 2.5 million net acres

Marcellus Shale
Acreage: 292,446 net acres (at 12/31/13)
2013 Reserves: 1,963 Bcfe (28% of total)
2013 Production: 151 Bcfe (23% of total)

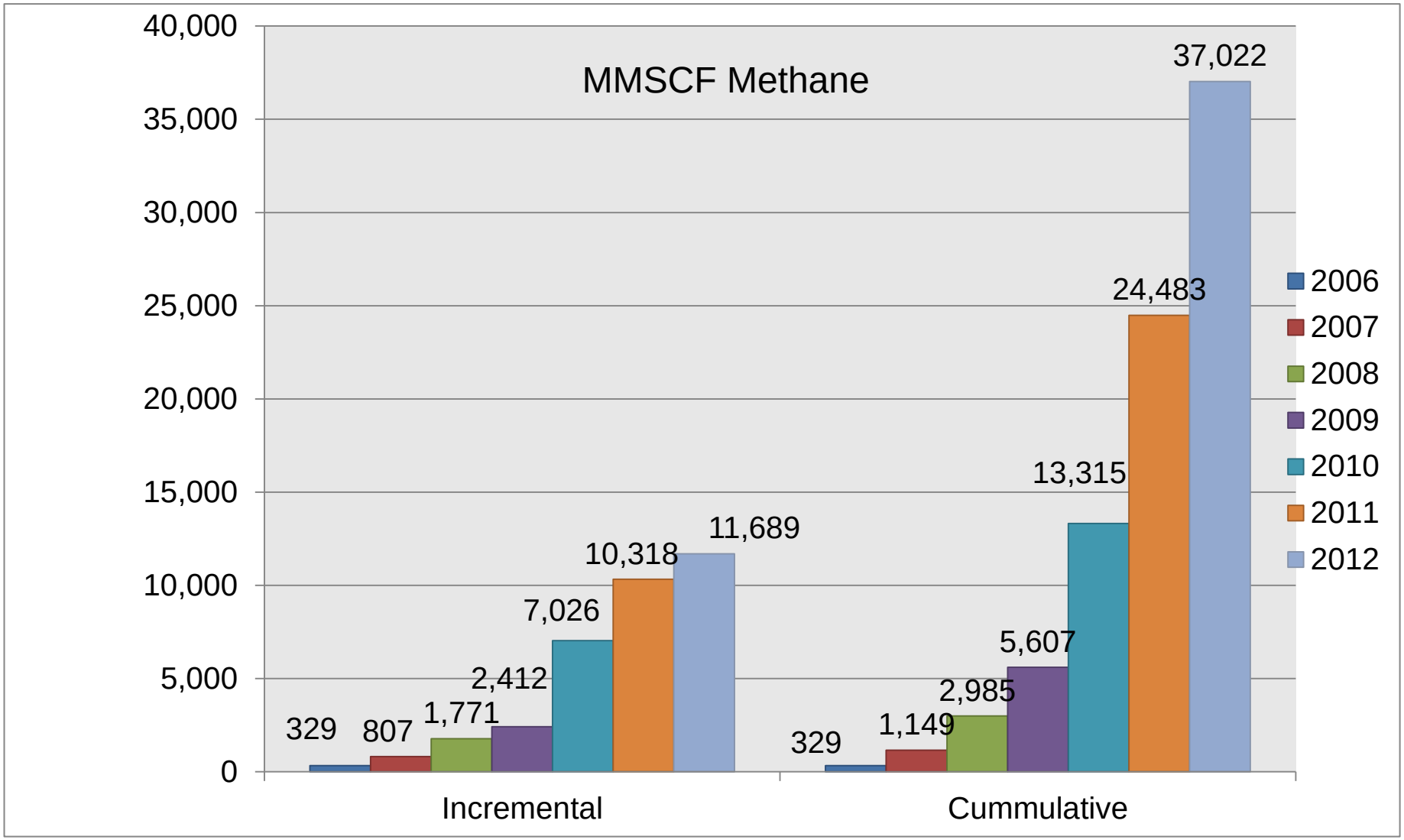
Fayetteville Shale
Acreage: 905,684 net acres (at 12/31/13)
2013 Reserves: 4,795 Bcfe (69% of total)
2013 Production: 486 Bcfe (74% of total)

Brown Dense Project
Acreage: 459,000 net acres (at 12/31/13)

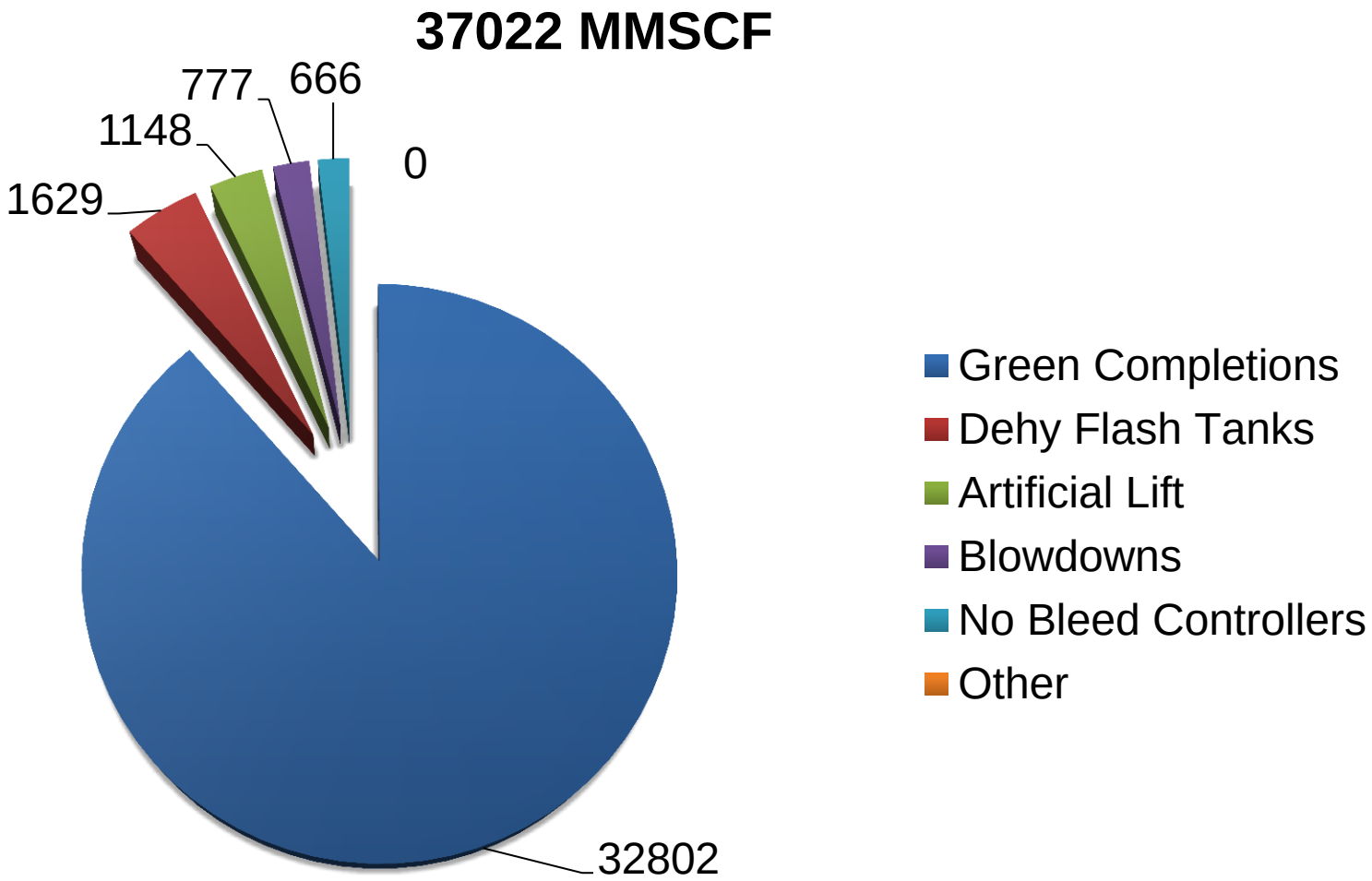
Ark-La-Tex
Acreage: 152,937 net acres (at 12/31/13)
2013 Reserves: 215 Bcfe (3% of total)
2013 Production: 18 Bcfe (3% of total)

- Bcfe is an equivalent measurement of one billion cubic feet of mixed oil and gas reserves
- ** Arkoma acreage excludes 124,653 net acres in the conventional Arkoma Basin operating area that are also within the company's Fayetteville Shale focus area.

SWN EPA Natural Gas STAR
Incremental and Cumulative Methane Reductions



SWN Cumulative Reported Reductions



SWN Fayetteville Gas Capture – Case Study

SWN Gas Capture: History - Background

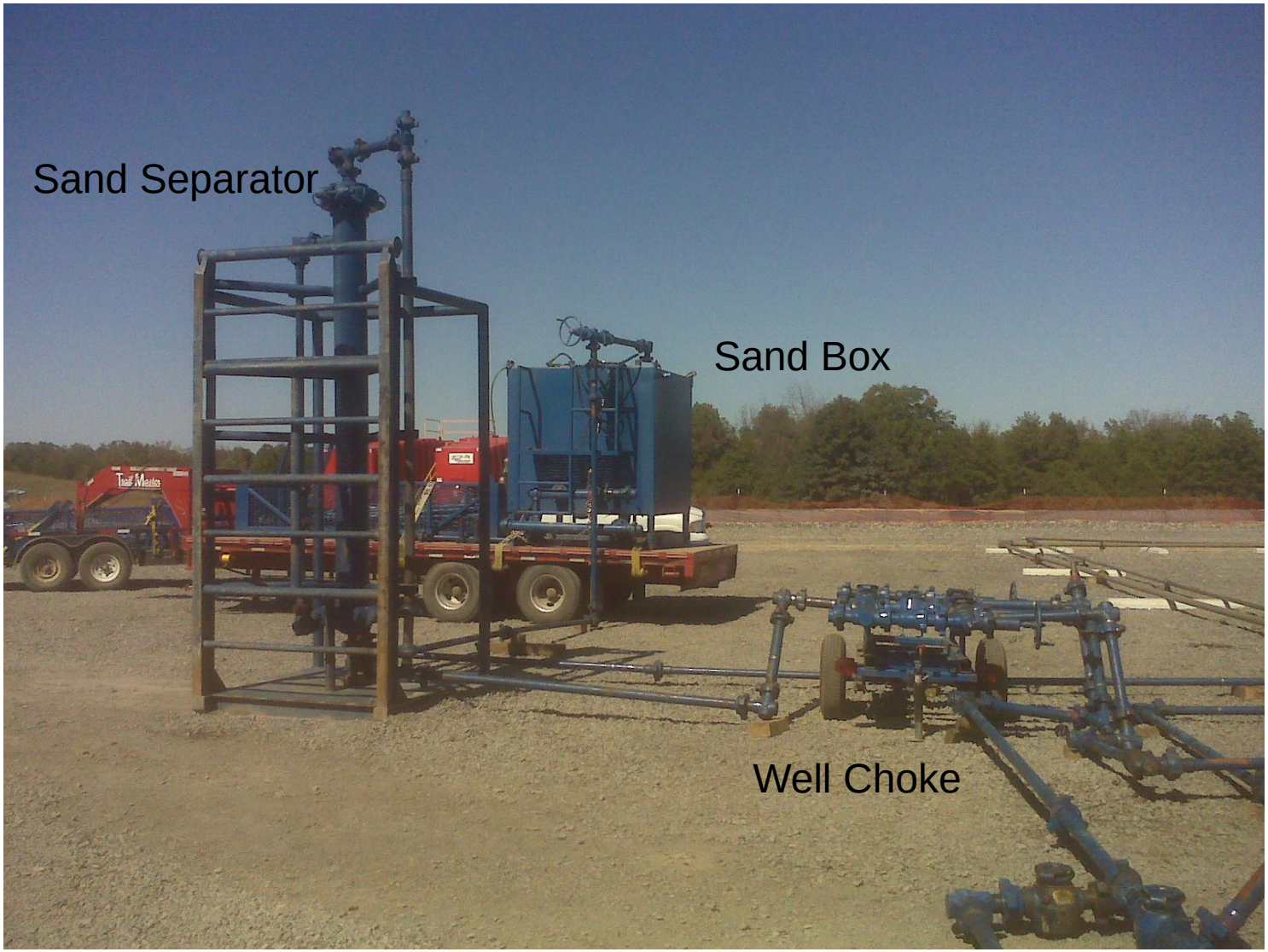
- **Fayetteville Shale Gas**
- **Pre 2010:** Wells vented until tubing flow could be established.
- **September 2009**: Study concluded 16 MMCF is vented during an average flowback.
- **December 2009**: Completion program changed. Tubing run immediately after frac plug drill out, no casing flowback.
- **December 2009**: Flowback scheme "modified" to allow selling gas via the casing/tubing annulus.
- **January 2010**: Separators upgraded, allowing for 2000+ bwpd capability, "modified" flowback in full use.
- **January 2010**: First "Gas Capture" well was executed.
- **April 2010**: Completed 19th full "Gas Capture" operation.
- **September 2010:** Completed the 100th full "Gas Capture" operation.
- **October Forward:** Expanded "Gas Capture" to recompletions or "Ventless Restoration.

SWN “Gas Capture”

SWN Gas Capture - Portable Compressor

- Portable Caterpillar 3406
- 200-300 MCF Gas Compressed
- 8-12 Hours
- Target 2000 psi

SWN Gas Capture -Sand Separator and Sand Box



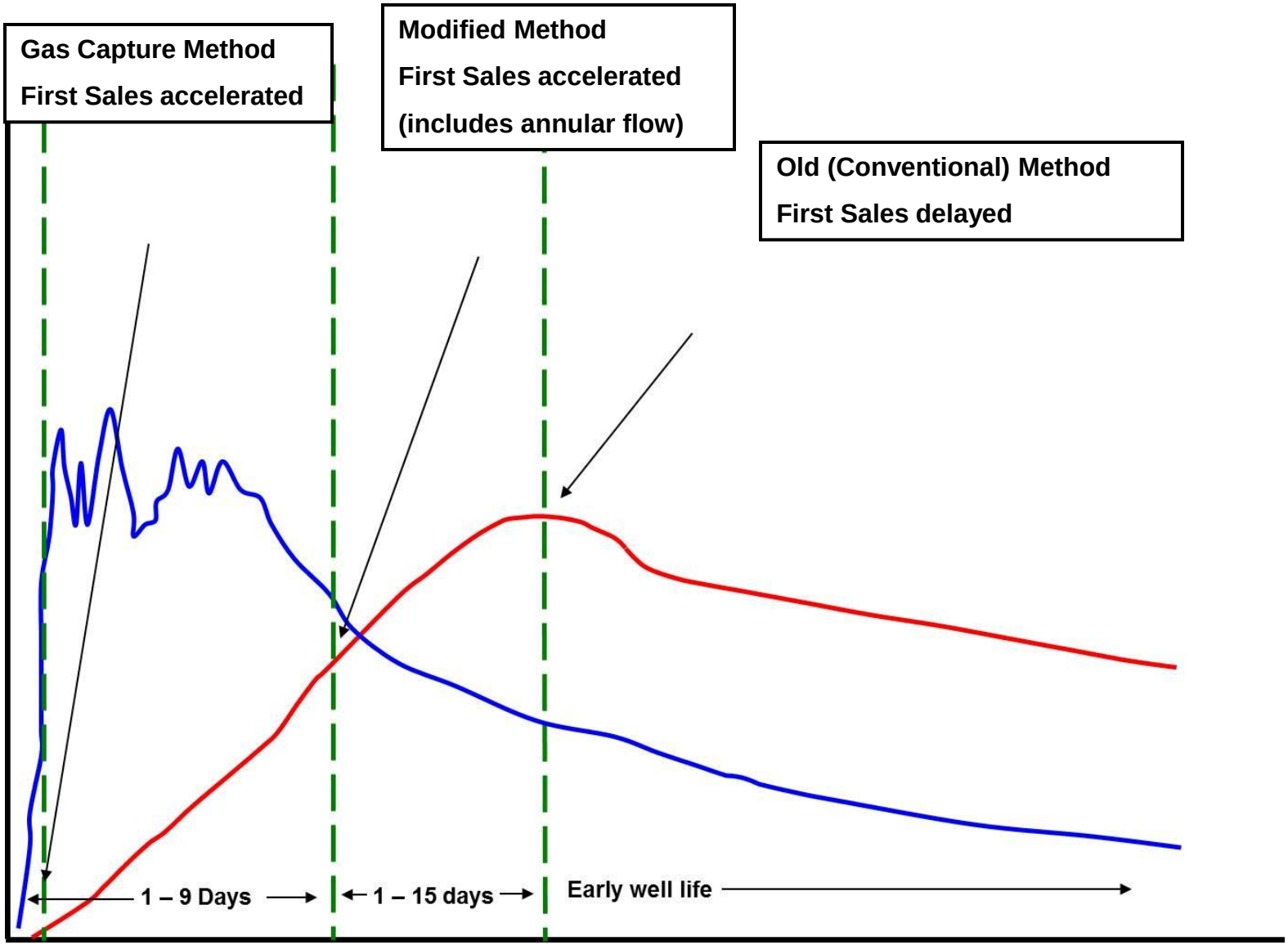
SWN Gas Capture - Fat Boy Separators

SWN Gas Capture - Flowback Water to Frac Tank

SWN Gas Capture - Water Recovery/Recycling

SWN Gas Capture – Gas Straight to Sales

Flowback Type Curve (Post Drill-Out)



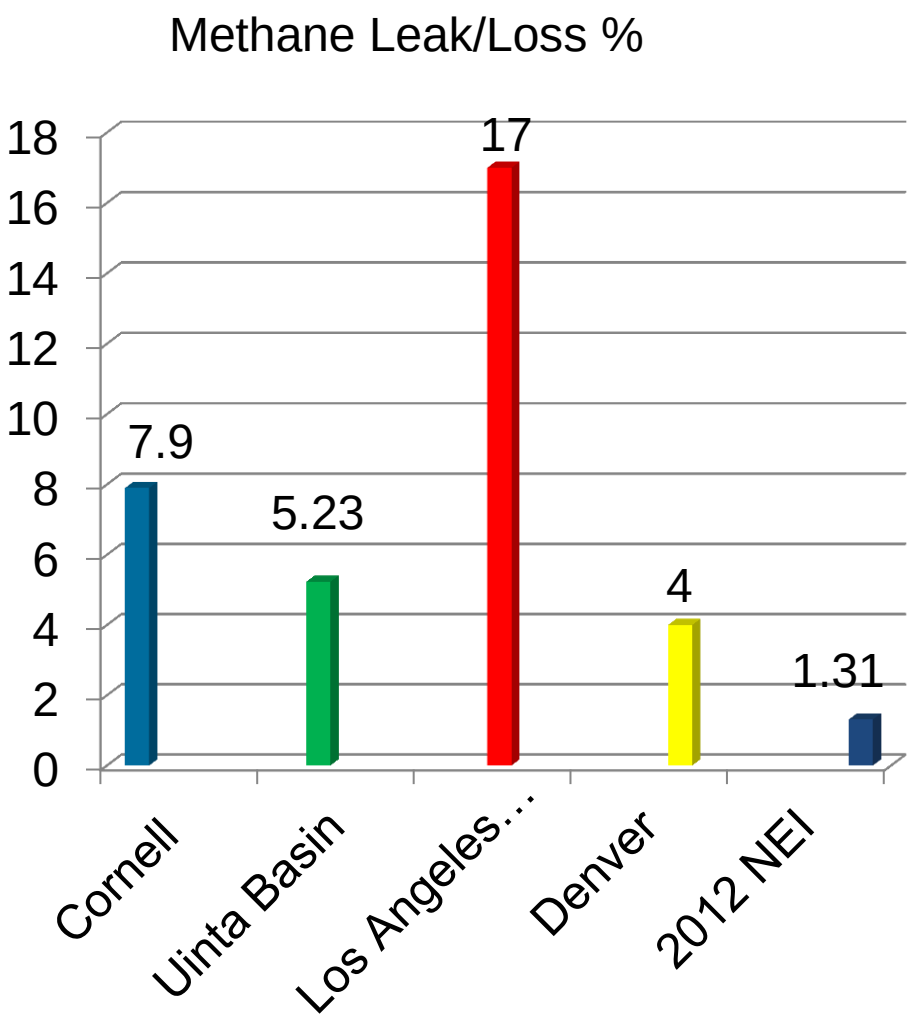
SWN Gas Capture – Fayetteville vs Marcellus

- Fayetteville
  - Low pressure reservoir
    - Need for gas compression/injection
  - Low sales line pressure~65 psi
- Marcellus
  - High pressure reservoir
  - High sale line pressure >500 psi
  - Installing additional compression to lower line pressure
- 32.8 BCF Reported Reductions

SWN Methane Emission Initiatives

SWN Methane Measurement Study Participation

- Need for more accurate and factual methane emissions data
  - Limited or no methane emissions measurements for industry
  - Outdated emissions factors (GRI 1996).
  - EPA and NEI estimates vary in order of magnitude due to changes in assumptions
- Better understanding of methane emissions and sources
- Demonstrate that natural gas is natural fuel of choice



Production Methane Measurement Study

Production Sector Measurement – Project Takeaways

- Project Highlights:
  - Successful collaboration between participants resulting in better understanding of emissions
  - Identified the need for additional studies
  - Identified opportunities for SWN to pursue regarding emission reduction/product recovery
    - Catalyst for SWN LDAR initiative

Gathering and Processing Methane Measurement Study

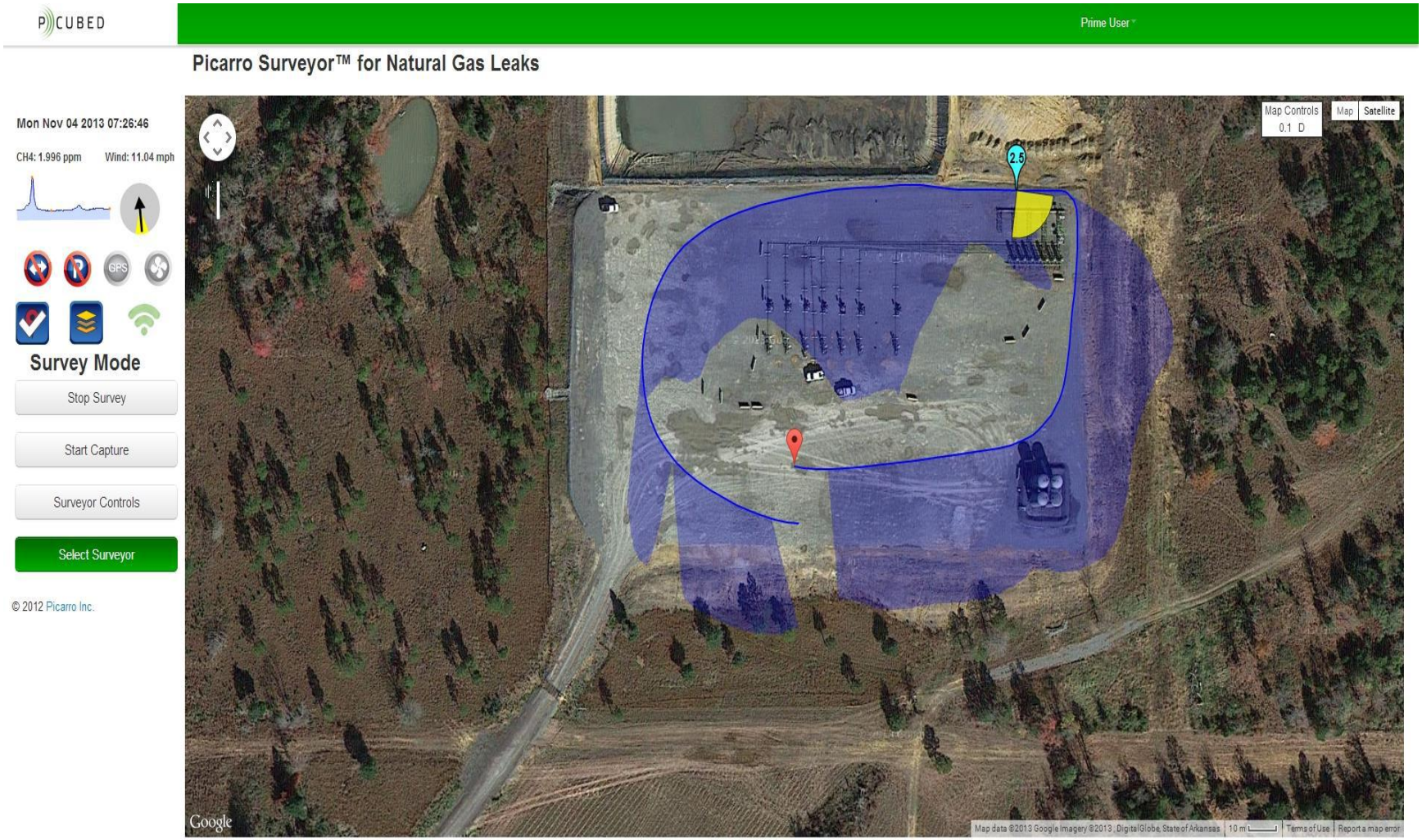
Research

- EDF “Bottom-Up” series
  - Phase 2 Production Sector
  - Pneumatics and Liquids Unloading
    - Emissions characterized by a “fat-tail” distribution
  - Processing Sector
- EDF “Methane Detectors Challenge”
  - Apache, BG, Hess, Noble and SWN participating with EDF to identify and catalyze next-generation methane monitoring technologies
  - Southwest Research Institute
- DOE/Penn State Marcellus Study
  - Specifically identified in President’s Climate Action Plan. 2 year, $2 mm project funded by DOE and led by Penn State
  - Currently a top-down study design
    - SWN has been participating in an industry group across the value chain helping with the study design
  - Additional data and financial support may be needed for establishing more accurate measurements
- Joint Institute for Strategic Energy Analysis D-J Reconciliation Study of “top-down” and “bottom-up” methane measurements

SWN Picarro Evaluation

- SWN project to compare Picarro monitoring with “direct measurement” (FLIR and HiFlow) to assess viability.
- Field measurements conducted November 4-8, 2013 in Fayetteville operations.

SWN Well Example



Picarro Evaluation Summary

1. **Survey ~20 well pads with Picarro Surveyor technology and FLIR camera to determine if the well pads had methane leaks or not**
   - –Surveyed 21 wells pads and 3 drill sites in ~17 hrs
2. **Execute a simulated leak to directly compare the Picarro Scanner and high flow instrument leak measurements**
   - –Picarro Scanner and high flow instrument measurements agree
3. **Quantify the leaks at 5-6 well sites using both the Picarro Scanner technique and high flow instrument operated by Dexter.**
   - –Due to limited road access and wind direction, only 2 well pads were measured with the Scanner technique
   - –Only 1 well pad leak was measured by both the Plume Scanner (59.8 SCFH) and high flow instrument (79.2 SCFH)
   - –We can estimate the leak rates of all pads surveyed using both high flow instrument and Picarro Scanner measurements

Main Results:

- •19% of well pads were *not leaking*
- •77% of leaks rates are less than 10 SCFH (standard cubic feet per hour)
- •Direct comparison with a simulated leak show that Picarro Surveyor agree with Dexter's high flow instrument

Picarro Surveyor

Preliminary Advantages

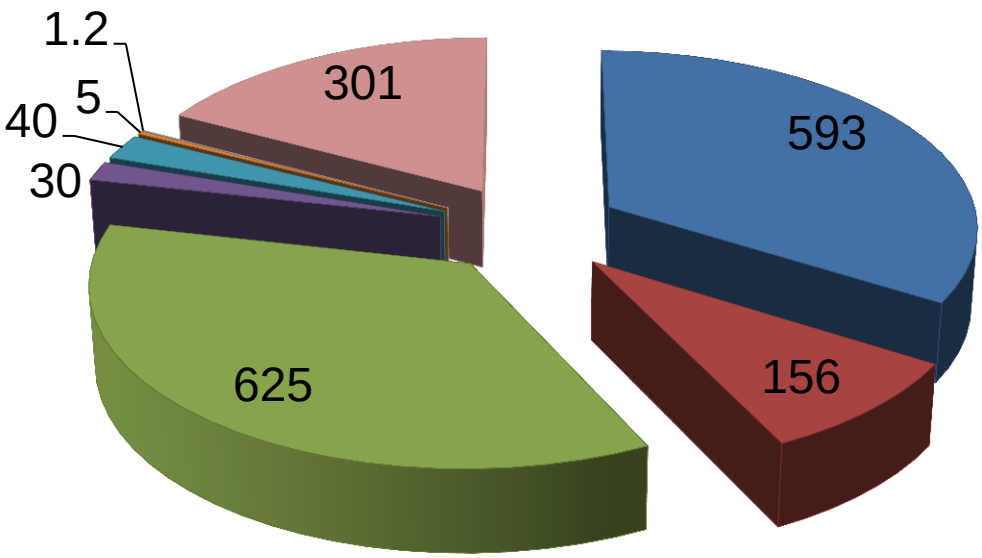
- Quick measurement time (approximately five minutes, vs. 15-20 minutes per pad for FLIR and high volume samples).
- Ease of data storage.
- Concentrations can be plotted on Google map in real time.
- Low concentration detection level (ppb vs. 10,000 ppm for FLIR)
- High distance detection ability (100 ft vs. 20 ft. for FLIR)
- Ability to visualize what has been “sniffed” on i-Pad.

Preliminary Disadvantages

- Inability to distinguish exact source of leak.
- Requires wind speed between 3.5-20 mph to determine “Flow rate” (scf/hr)
- “Pressurized Releases” may impact measurement accuracy
- Requires mounting a sensor on the front of the vehicle and an anemometer on the roof.
- Not currently accepted by EPA as an acceptable alternative to a standard LDAR method.
- Equipment reliability is unknown.

SWN Methane “Opportunities”

SWN 2013 Subpart W = 1751 MMSCF



- **Pneumatic Devices**
- **Pneumatic Pumps**
- **Liquids Unloadings**
- Completion/Workovers
- Tanks
- Well Testing
- Compressors
- **Equipment Leaks**

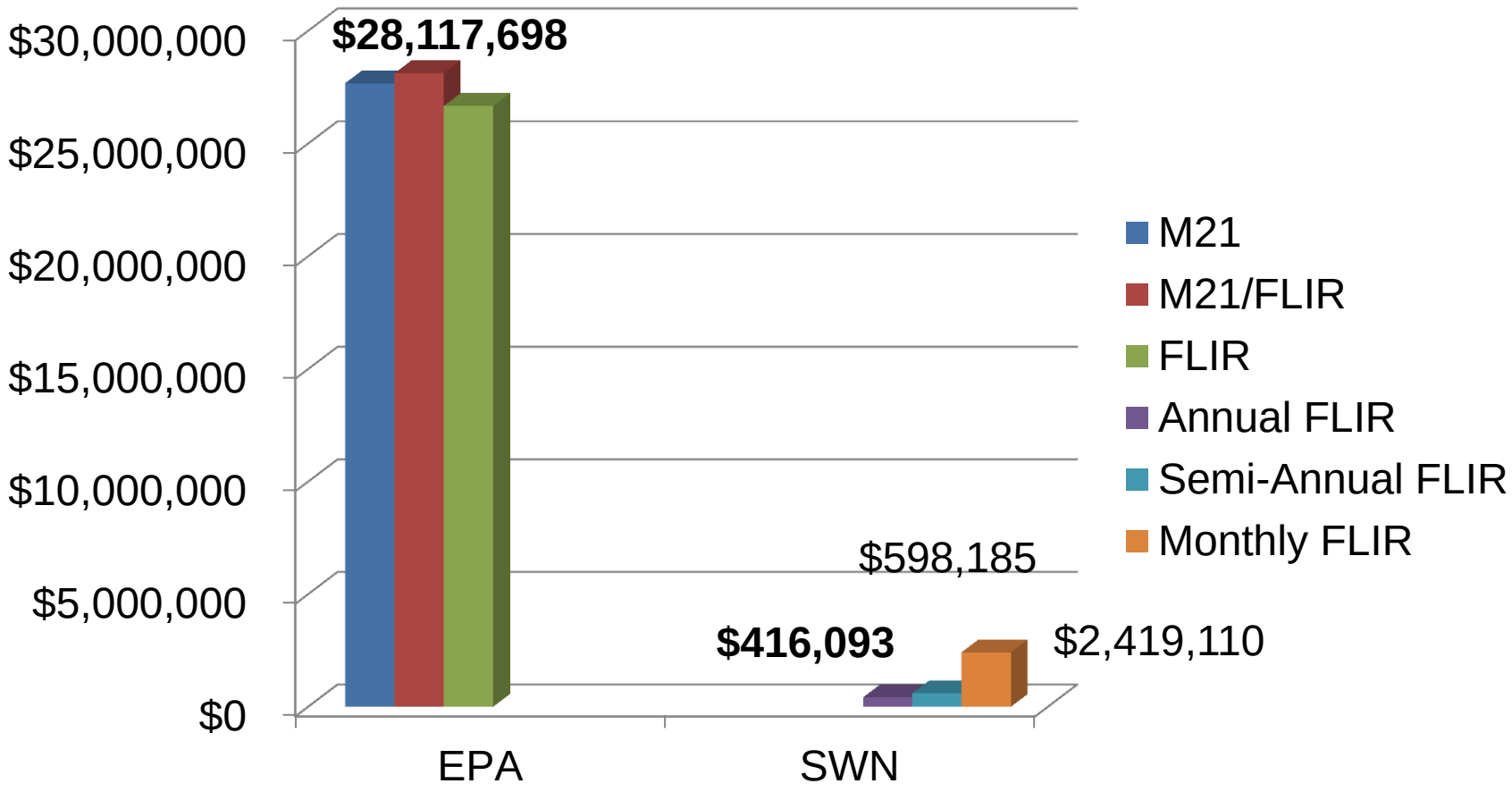
SWN SMART LDAR

Equipment Leaks
Gas Loss and Emissions

		GHGRR	UT/EDF	OOOO	GHGRR	UT/EDF	OOOO
Region	Wells	MMSCF	MMSCF	MMSCF	TPY	TPY	TPY
Appalachia	71	7.12	2.38	9.1	150.6	48	188.6
E. Texas	408	28.26	13.72	52.1	598.1	74.4	1084
Arkoma	3407	265.29	115	435	5615	2304	9049
Louisiana	4	.15	.14	.5	3.2	2.45	10.6
Totals	3890	301	131	498	6367	2557	10332

GHGMRR is SWN's Subchapter W reported emissions for 2012
UT/EDF uses the national average of 0.064 scf/min/well
OOOO uses the 13.28 tpy estimate for a site with 5 wells

EPA and SWN LDAR Implementation Cost Estimates



SWN LDAR Program

- SWN Leak Detection and Repair (LDAR) Program
  - Identify and repair equipment leaks.
    - 6 out of 7 new wells in Pennsylvania identified with leaking components
    - 7 out of 16 well sites observed in UT study identified with leaking components
  - Product recovery, natural resource conservation, environmental stewardship, and safety benefits.
  - Regulatory requirement in Pennsylvania and Colorado, voluntary in other SWN operating areas.
- Phase 1 – Implemented “new well” leak detection program for Fayetteville Shale – 4Q2013.
  - 216 Wells
  - 44 Leaking components
- Phase 2 – Company-wide implementation 2014.

SWN Methane Emissions Reduction Projects

Fuel Cell

SWM Methane Reduction Projects

Pressure Actuated Liquids Unloading

Thermostat Actuated Chemical Addition

SWN Diesel-Natural Gas Rigs

Moving Forward

- Future Opportunities
  - No bleed pneumatics
  - Solar Powered pumps
  - Thermostat controllers
  - Liquids Unloading
  - Storage Tanks < 6 tpy
  - Gas capture of blowdowns
  - Diesel/Gas Drill Rigs
  - Diesel/Gas Frac Spreads (Completions pumps)
  - Directed Inspection/Maintenance
  - Fuel cells for power generation (air compressors)
  - Reciprocating compressors at well pad
  - Fleet and vehicle conversions to CNG

Natural Gas Supply Chain Coalition

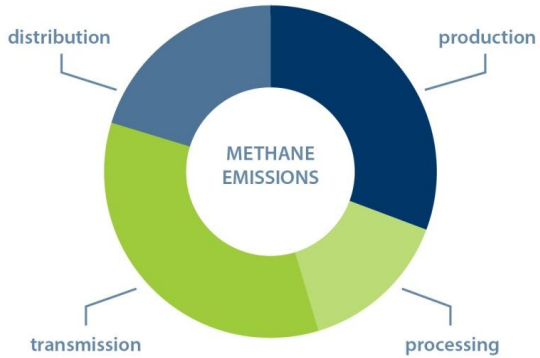
Southwestern Energy®

ONE
OUR NATION'S ENERGY
FUTURE

AIR

OUR GOAL

Enhance the energy delivery efficiency of the natural gas supply chain by limiting energy waste and by achieving a methane "leak/loss rate" of no more than one percent.



EPA Natural Gas STAR “Gold” Program

Where is the Platinum Program?