Burns & McDonnell

Waste to Energy Projects in Kansas and Beyond

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Burns & McDonnell

Works 2010
Annual Conference
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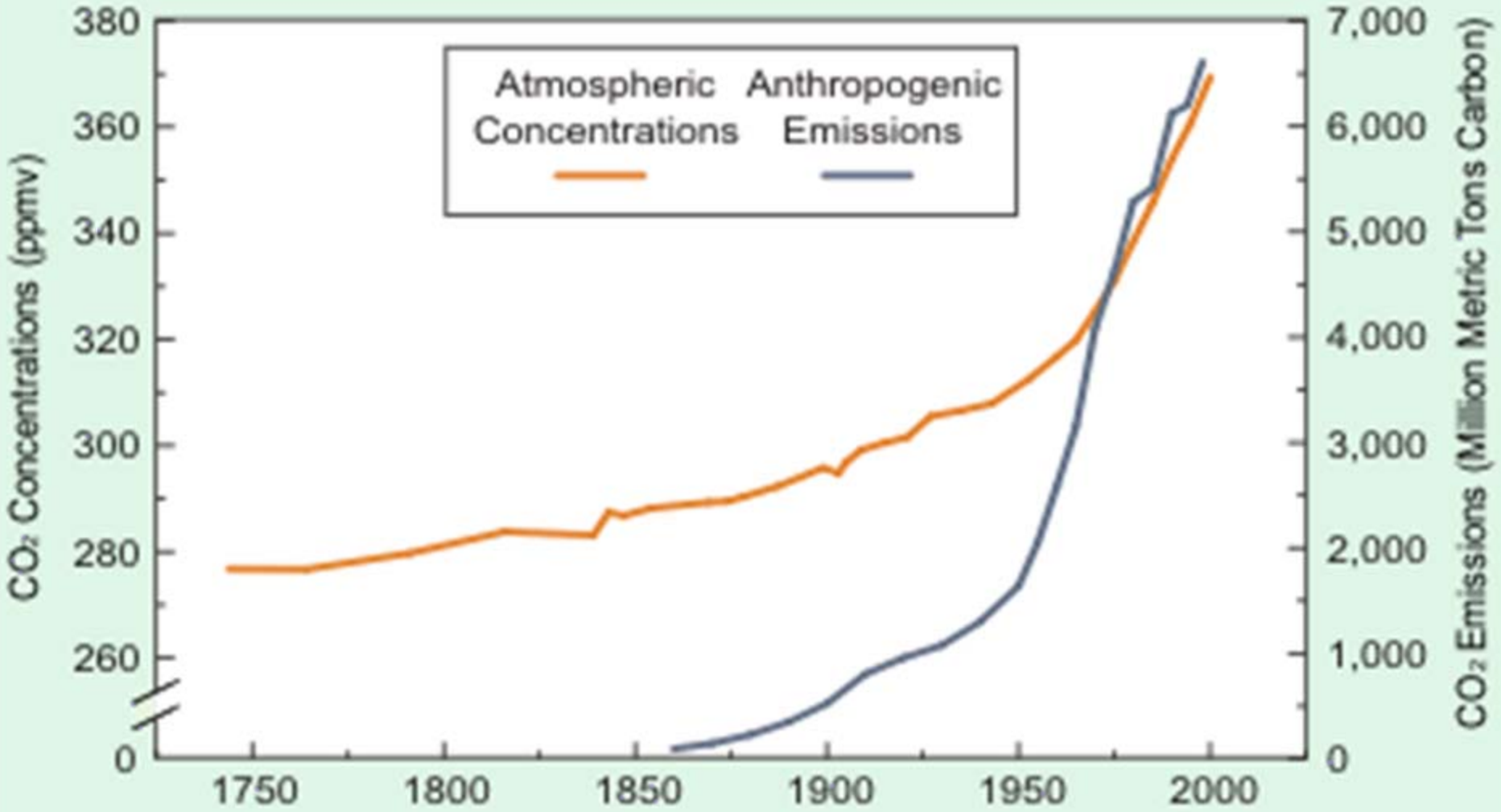
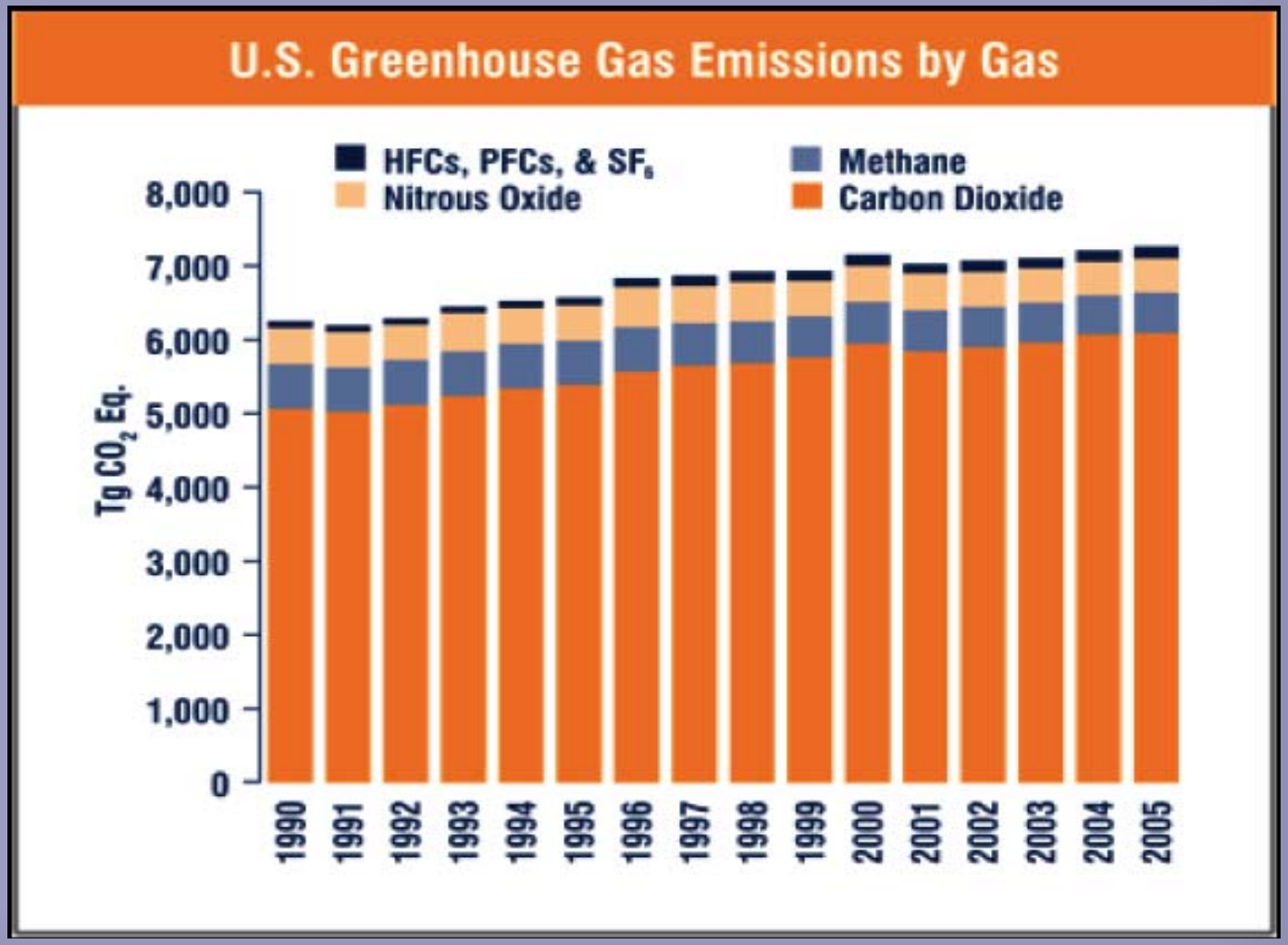
CO_2 Concentrations vs. Emissions



Source: Oak Ridge National Laboratory, Carbon Dioxide Information Analysis Center, http://cdiac.esd.oml.gov/.

The Trend is Real

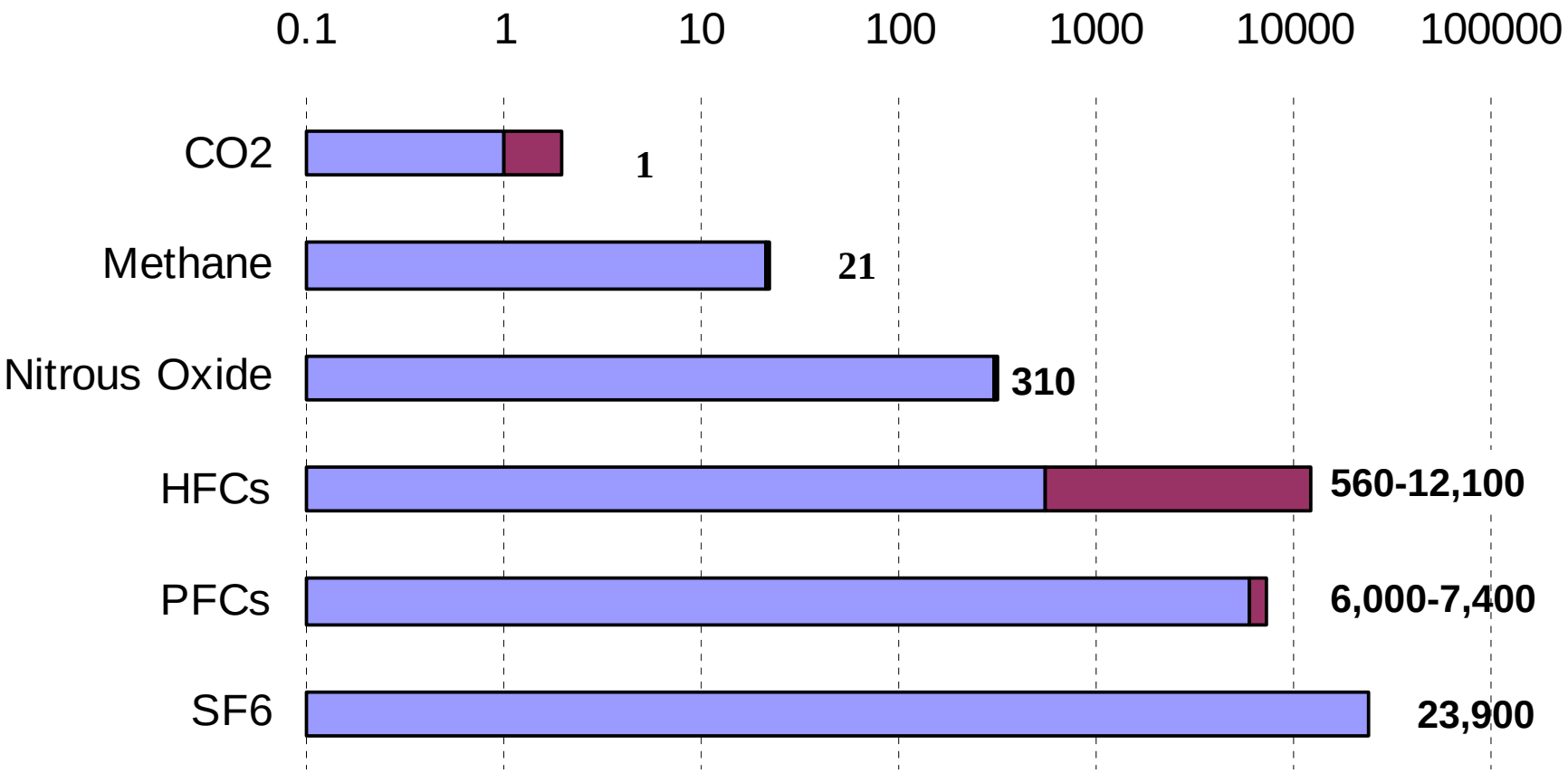


Reference: Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990-2005, USEPA #430-R-07-002

Primary Greenhouse Gases

- Carbon dioxide, CO_2
- Methane, CH_4
- Nitrous Oxide, N_2O
- Hydrofluorocarbons (HFCs) and Chlorofluorocarbons (CFCs) (covers 13 chemicals)
- Perfluorocarbons, PFCs (covers 7 chemicals)
- Sulfur Hexafluoride, SF_6

Global Warming Potential of Constituents



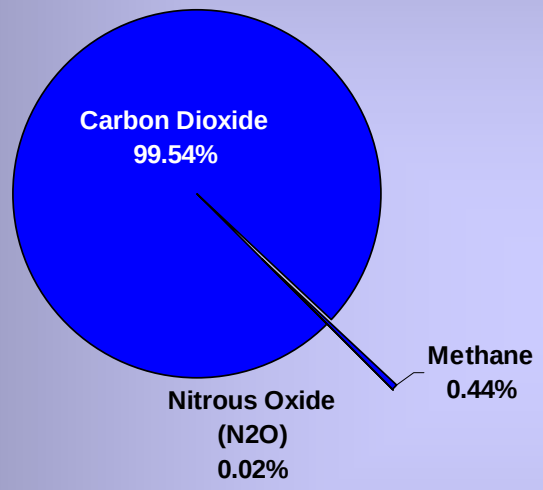
These Gases from Landfills Contribute to GHG/Global Warming

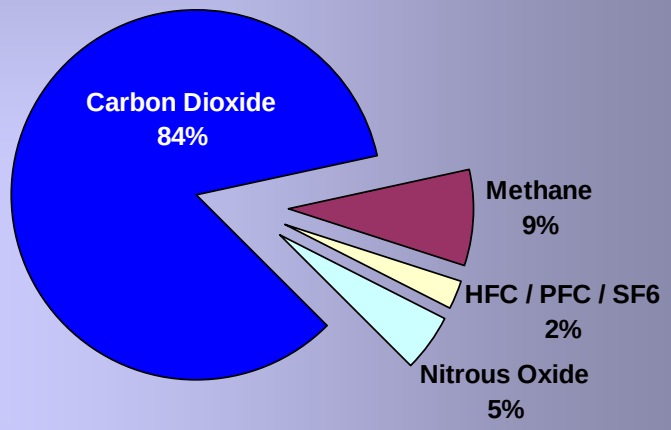
- CO_2
- CH_4
- N_2O
- O_3
- Water Vapor

GHG/Global Warming

- **CH_4 is the second largest contributing factor of GHG after CO_2**
- **CH_4 in atmosphere has increased by 150% since 1750**

U.S. CO_2 and CO_2e Emissions





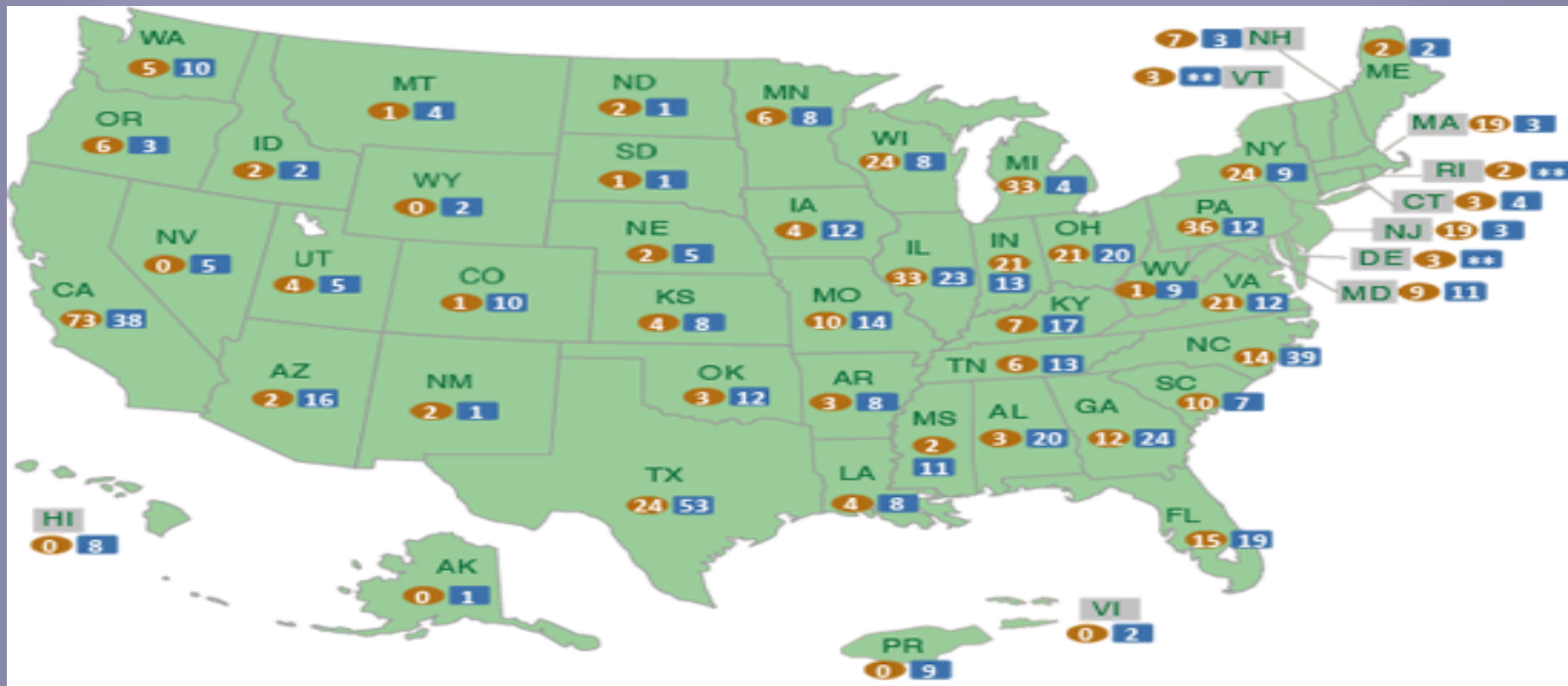
CO2 "Raw Values

CO2 Equivalents

Bringing it Home to Landfills

- **34% percent of man made methane from landfills**
- **Landfills #1 source of man made CH_4**
- **1000 cfm landfill project > 100,000 tons/yr. of CO_2**

LFG to Energy Projects and Candidate Landfills



Nationwide Summary

509 OPERATIONAL Projects (1,563 MW and 304 mmscfd)

~530 CANDIDATE Landfills (1,170 MW or 600 mmscfd, 13.5 MMTCE Potential)

OPERATIONAL PROJECTS

CANDIDATE LANDFILLS*

* Landfill is accepting waste or has been closed for 5 years or less has at least 1 mmtons of waste and does not have an operational/under construction LFGE project; or is designated based on actual interest/planning.

These data are from LMOP's database as of December 16, 2009.

** LMOP does not have any information on candidate landfills in this state.

History of LFG Utilization Industry (in US and Missouri)

First Project 1974	1999	2005	2007	2008	2009
Operational Projects	294	380	435	495	509
Electricity	75%	70%	68%	67%	67%
Direct Use	25%	20%	20%	20%	20%
Other	5%	10%	11%	12%	13%
(High BTU/Cogen/fuel-cells, etc.)					
Remaining Potential	400	601	550	520	530
(In Kansas)				7	8

Source: USEPA: Landfill Methane Outreach Program, www.epa.gov/lmop/index.htm

Most Common Methods for LFG Utilization

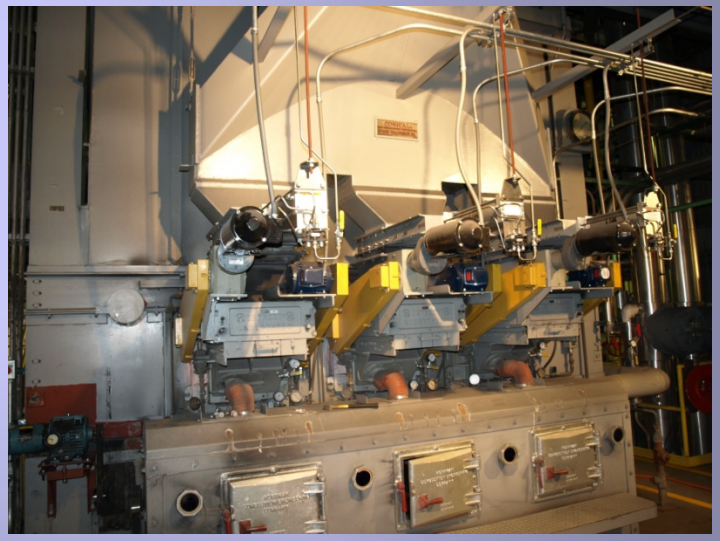
Electricity

- **Typical projects range from 100 kW – 10 MW (microturbines, reciprocating engines)**
- **Large projects upwards of 50 MW (steam cycle power plant)**

Most Common Methods for LFG Utilization (Continued)

Direct Use

- **LFG can be utilized in medium Btu applications, where LFG is fired as a heat source. Firing boilers, kilns, infrared heaters, CNG.**



- **LFG can be utilized for High-Btu applications as well. The LFG is treated to remove impurities in the gas and the end result is a pipeline quality gas.**

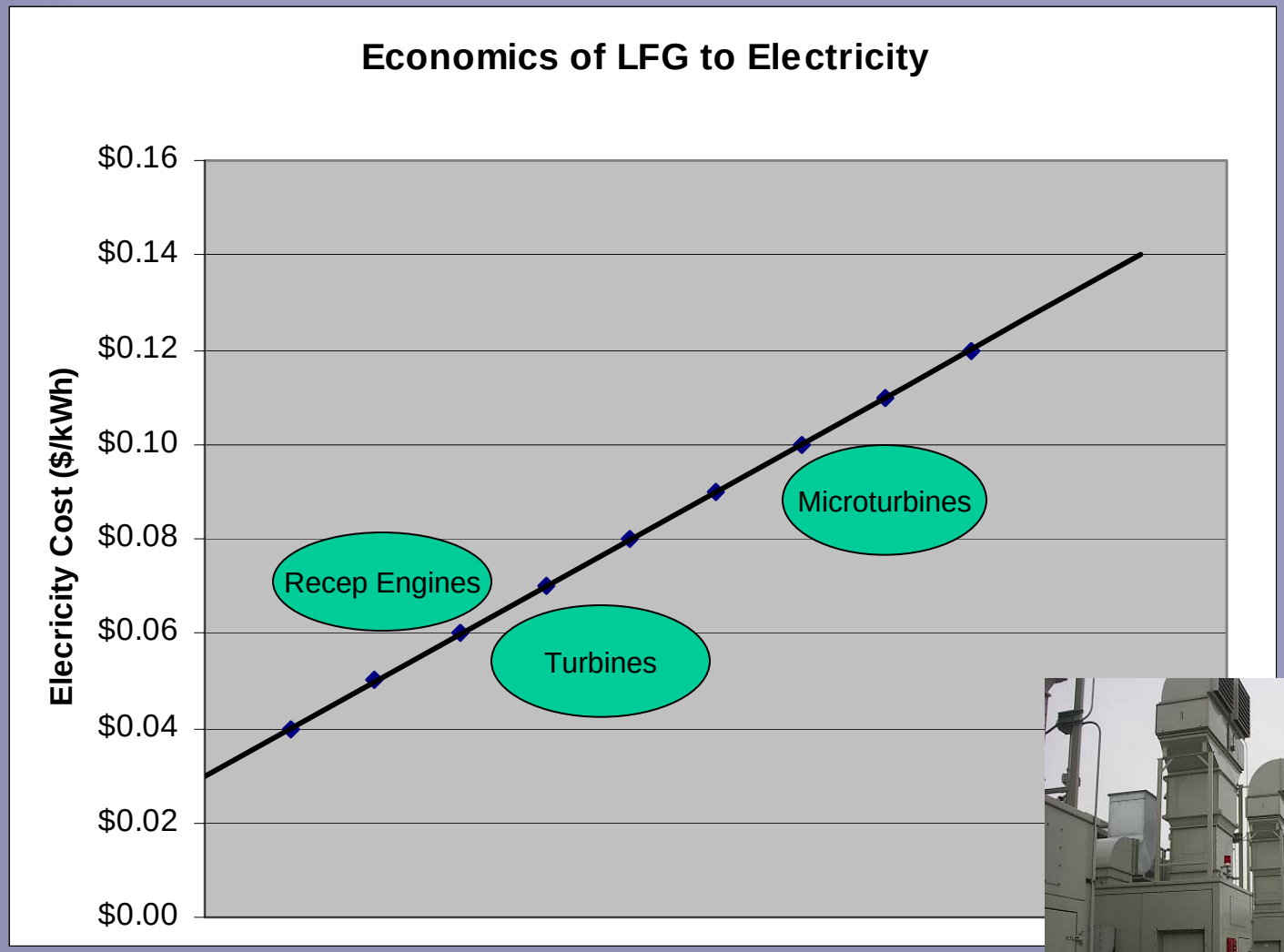
Most Common Methods for LFG Utilization (Continued)

Other (CHP, High Btu, Fuel Cell)

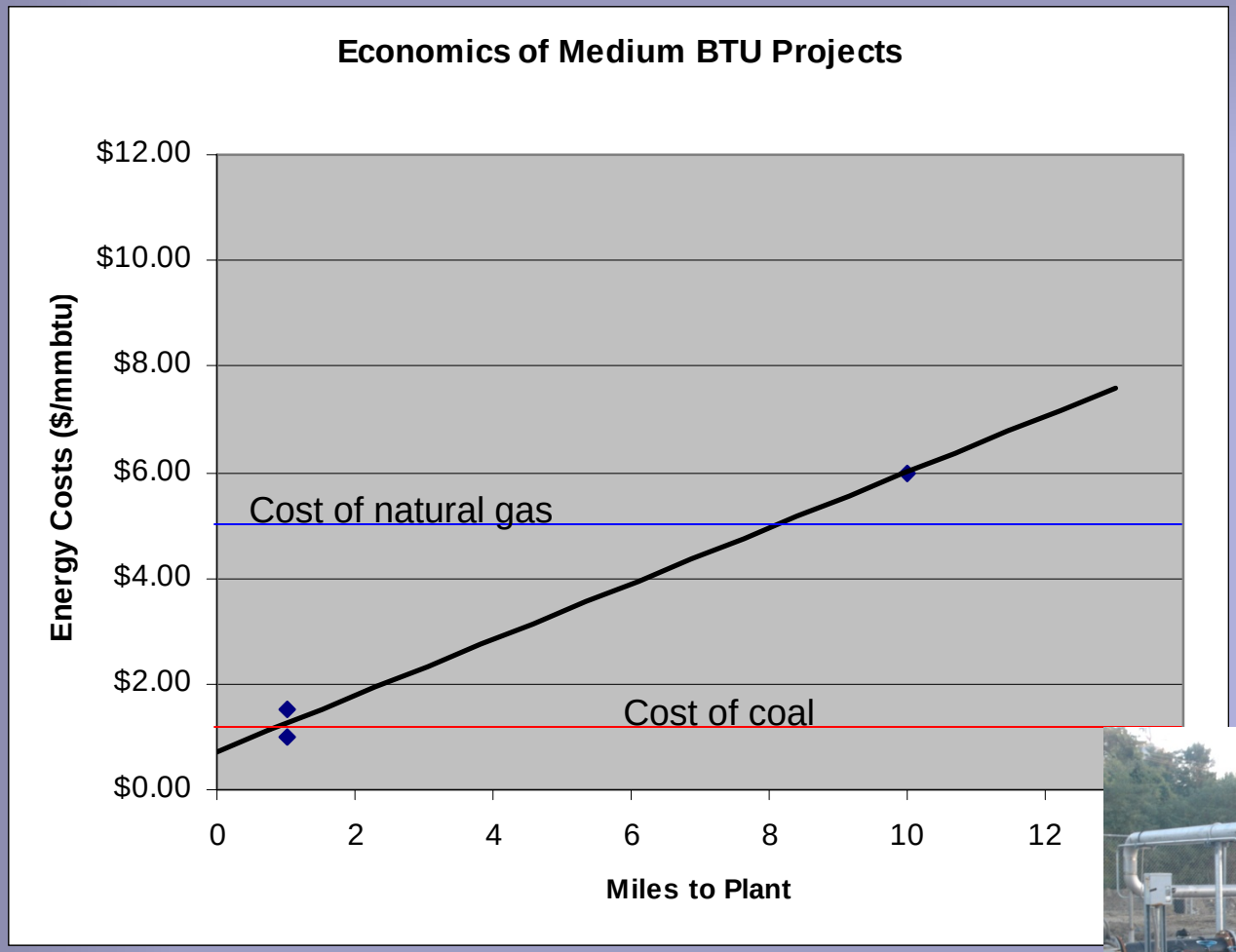
- **Fuel Cell – use LFG as process fuel source.**
- **Utilize waste heat for brewery process. 1 MW capacity.**

Sierra Nevada Brewery

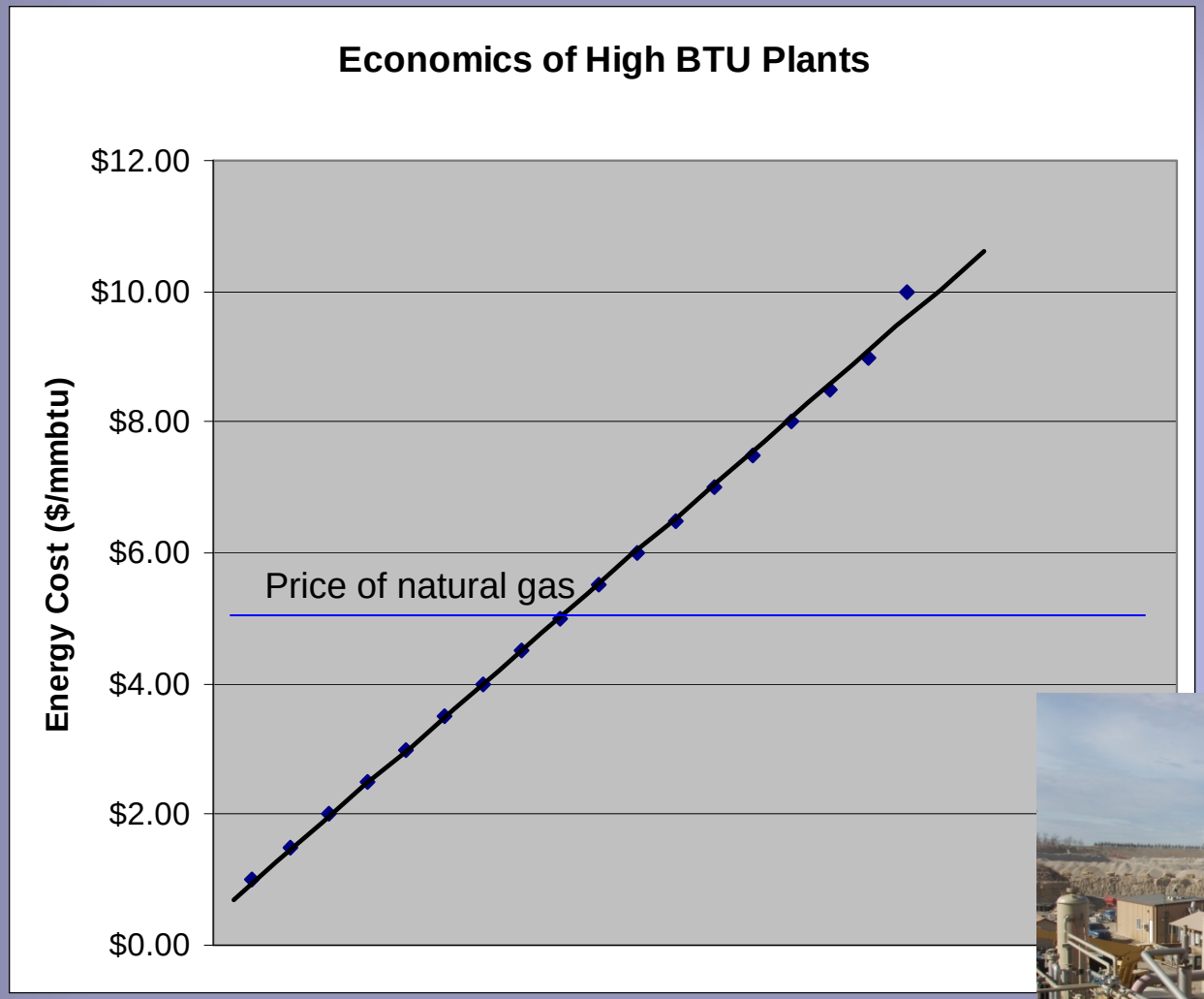
LFG Economics – LFG to E



LFG Economics – Medium BTU



LFG Economics – High BTU



Key Definitions

- A Carbon Offset represents a reduction, avoidance, or destruction of greenhouse gas emissions. Although there are six primary categories of greenhouse gases, carbon offsets are measured in metric tons of carbon dioxide-equivalent (CO2e). One carbon offset represents the reduction of one metric ton of carbon dioxide, or its equivalent in other greenhouse gases.

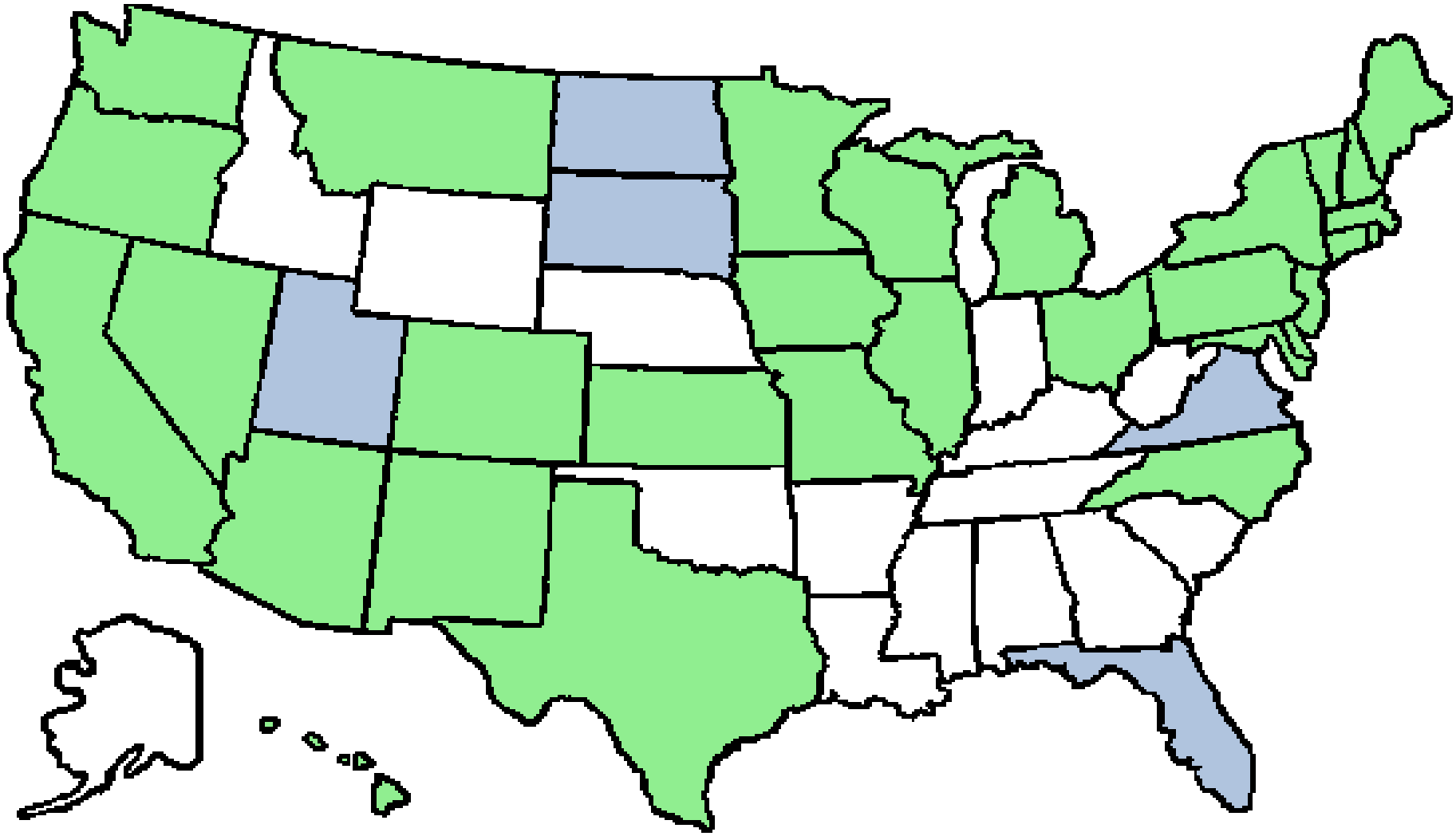
- Renewable Energy Credits (RECs) are tradable commodities that represent that 1 MWh was generated from a renewable energy source. RECs can be either regulatory driven where Renewable Portfolio Standards (RPS) are established or voluntary.

- Additionality describes the fact that a carbon dioxide reduction project would not have occurred had it not been for concern for the mitigation of climate change. Different ways of assessing additionality:
  - Regulatory
  - Financial
  - Business-As-Usual
  - Timing Test

Carbon Credit Protocol Comparison

- Climate Action Reserve (CAR) / CCAR
  - Online date: 2001 (only have until November 2009 to submit project)
  - “New” projects must be submitted within 6 months of coming online
  - Must exceed a performance standard test and a regulatory additionality test
- Chicago Climate Exchange (CCX)
  - Online date: 1999
  - Protocol does not account for displaced grid electricity, but you can claim these credits under a separate protocol
  - Regulatory additionality
- Voluntary Carbon Standard (VCS)
  - Online date: 2002
  - Includes electricity generation, flaring or gas being distributed through a network
  - Most common used test is the Project Test - includes financial, regulatory and beyond business-as-usual additionality

35 States now have Mandatory RPS or Renewable Goals



Mandatory RPS

State Renewable Goal

Missouri and Kansas have Recently Adopted RPS

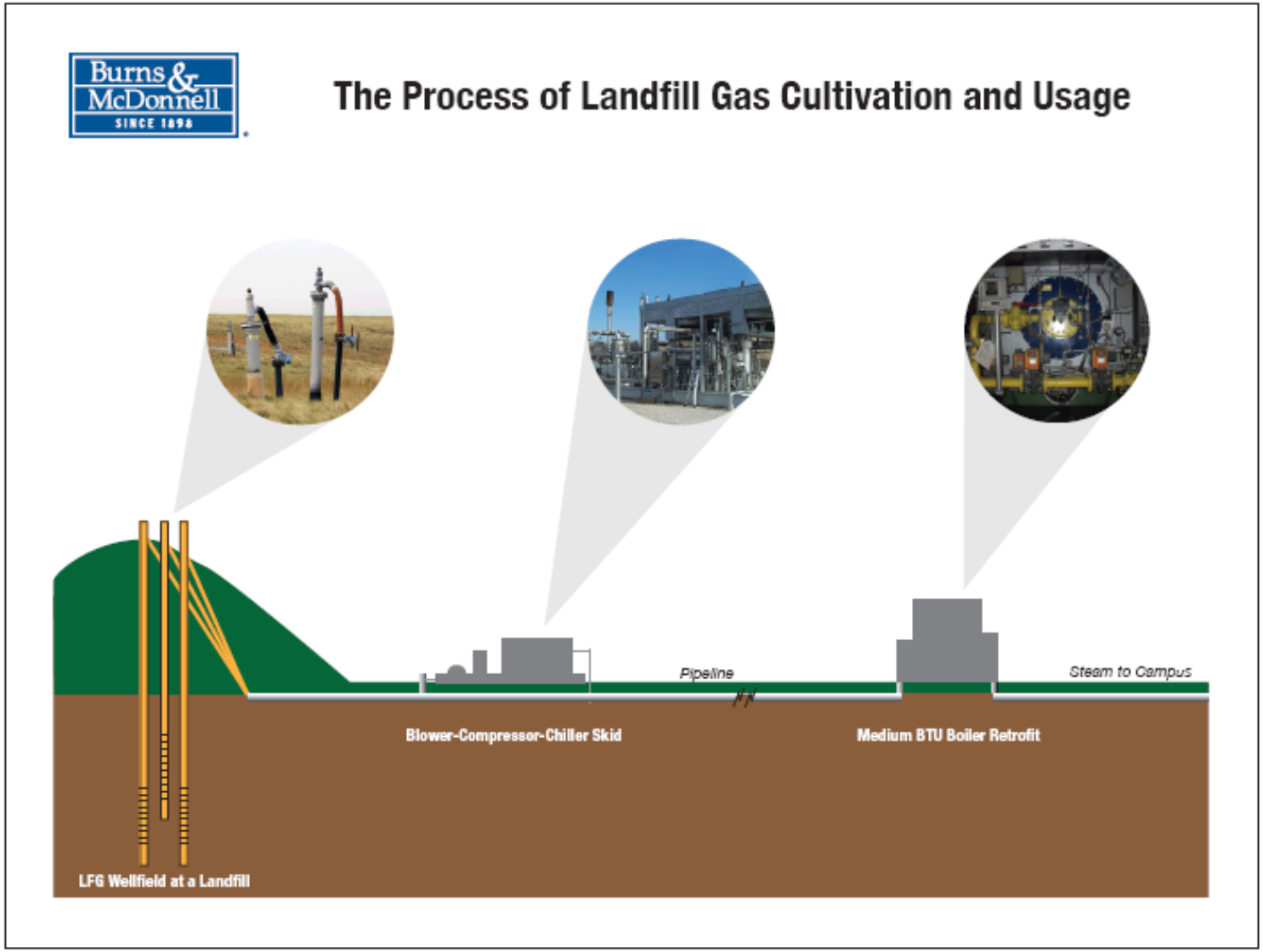
- On May 22, 2009, Kansas Governor Mark Parkinson signed into law the Senate Substitute for H.B. 2369, which includes a renewable energy standard, net metering provisions, and various other energy efficiency and energy-related provisions. The Renewable Energy Standard mandates that utilities (excluding municipal utilities) obtain 10 percent of their energy from renewable sources by 2011, 15 percent by 2016, and 20 percent by 2020. Renewable sources include wind, solar thermal and solar photovoltaic, various biomass sources, methane from landfills or wastewater treatment facilities, existing hydropower and new hydropower of 10 megawatts or less, and fuel cells using hydrogen produced from renewable sources.

- On November 4, 2008, Missouri voters approved the Missouri Clean Energy Initiative, creating the nation's third state Renewable Portfolio Standard (RPS) to be adopted by ballot initiative. Currently, 29 states and the District of Columbia have established mandatory RPSs. Most state RPSs have been adopted through legislation or executive order. The proposal requires that investor-owned utilities increase renewable electricity generation to two percent of total output by 2011, five percent by 2014, 10 percent by 2018, and 15 percent by 2021. Two percent of generation must come from solar energy; the remainder may come from other renewable sources including landfill gas, wind, biomass, and hydroelectric power. In order to protect rate-payers, utilities are prevented from increasing power prices more than one percent.

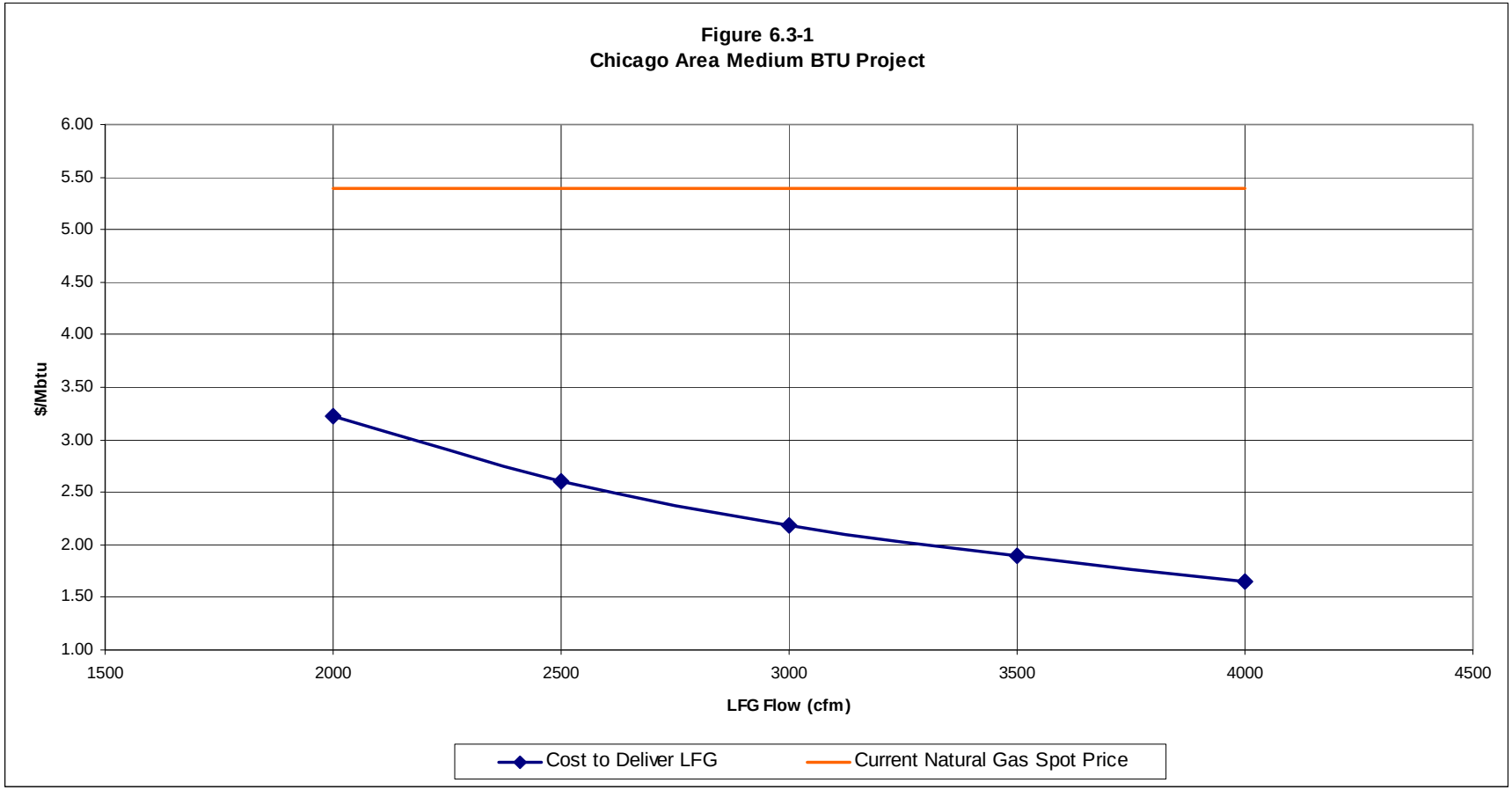
  The Clean Energy Initiative ramps up the goals set forward in S.B. 54 enacted in Missouri in 2007, which calls on utilities to make a "good-faith effort" to generate 11 percent of electricity from renewable sources by 2021.

  Source: http://www.pewclimate.org/what_s_being_done/in_the_states/rps.cfm

The Process of Landfill Gas Cultivation and Usage



Chicago Area Medium BTU Project

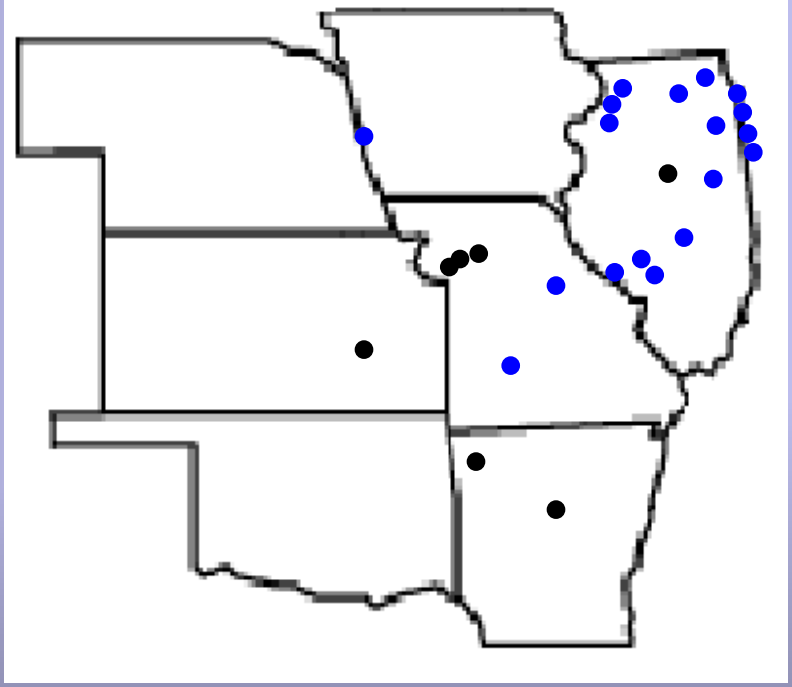


Midwest Sites

- **Livingston Landfill, Pontiac, IL** **Turbines**
- **Rumble Landfill, Sugar Creek, MO** **Direct Energy Use**
- **Forest View Landfill, Kansas City, KS** **Direct Thermal**
- **Allen County, Kansas** **Direct Thermal**
- **Johnson County Landfill, Shawnee, KS** **High Btu Gas**

Existing Sites in Our Region

- Recently completed projects
- Other sites in region



Livingston Landfill, Pontiac, Illinois
Gas Developer: RTC

Permitted for 400 acres. Current footprint 200 acres.

- **LFG Recovery: 3,000 scfm**
  - **Collection System**
    - **150 wells currently**
    - **Compressor intake**

  LFGTE Plant

    - **Three 4.8 MW Solar turbines**

3 Taurus Solar Turbines

Taurus Solar Turbines with Compressors

Rumble Landfill, Sugar Creek, Missouri
Owner: Waste Management

- **LFG Recovery 900 cfm**
  - **Collection System**
    - **20 vertical wells**
    - **20 hp blower**
  - **Transmission System**
    - **60 hp compressor**
    - **2,000 feet of 10-inch pipeline**
  - **End User: Lafarge Cement Plant**

60 hp Compressor

Forest View Landfill, Kansas City, KS
Developer: Unified Government

- **LFG Recovery: 30 scfm**
  - **Delivery System**
    - **200 cfm, 40 in compressor**
    - **1,000 linear foot of 4-inch pipe**

Filter, Regulator, Control Valve, and Pressure Switch

Allen County, Kansas

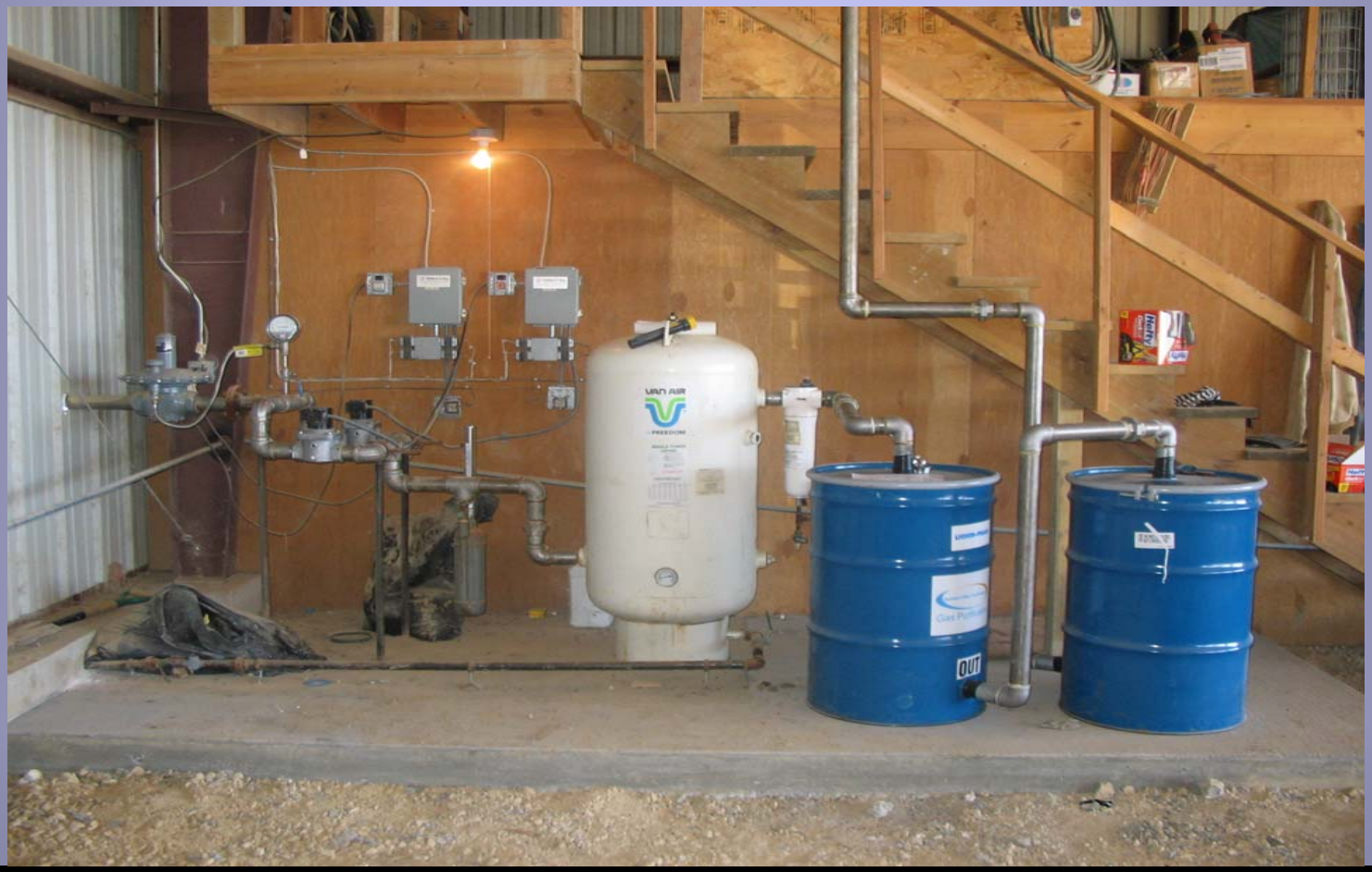
- 8 heaters heating 6,000 sq ft garage installed in 2005.

Allen County, Kansas

- 80,000 btu/hr Infared heater
- Utilize 30 cfm of lfg
- Additional lfg available

Allen County, Kansas

- Activated carbon added to process train in 2006

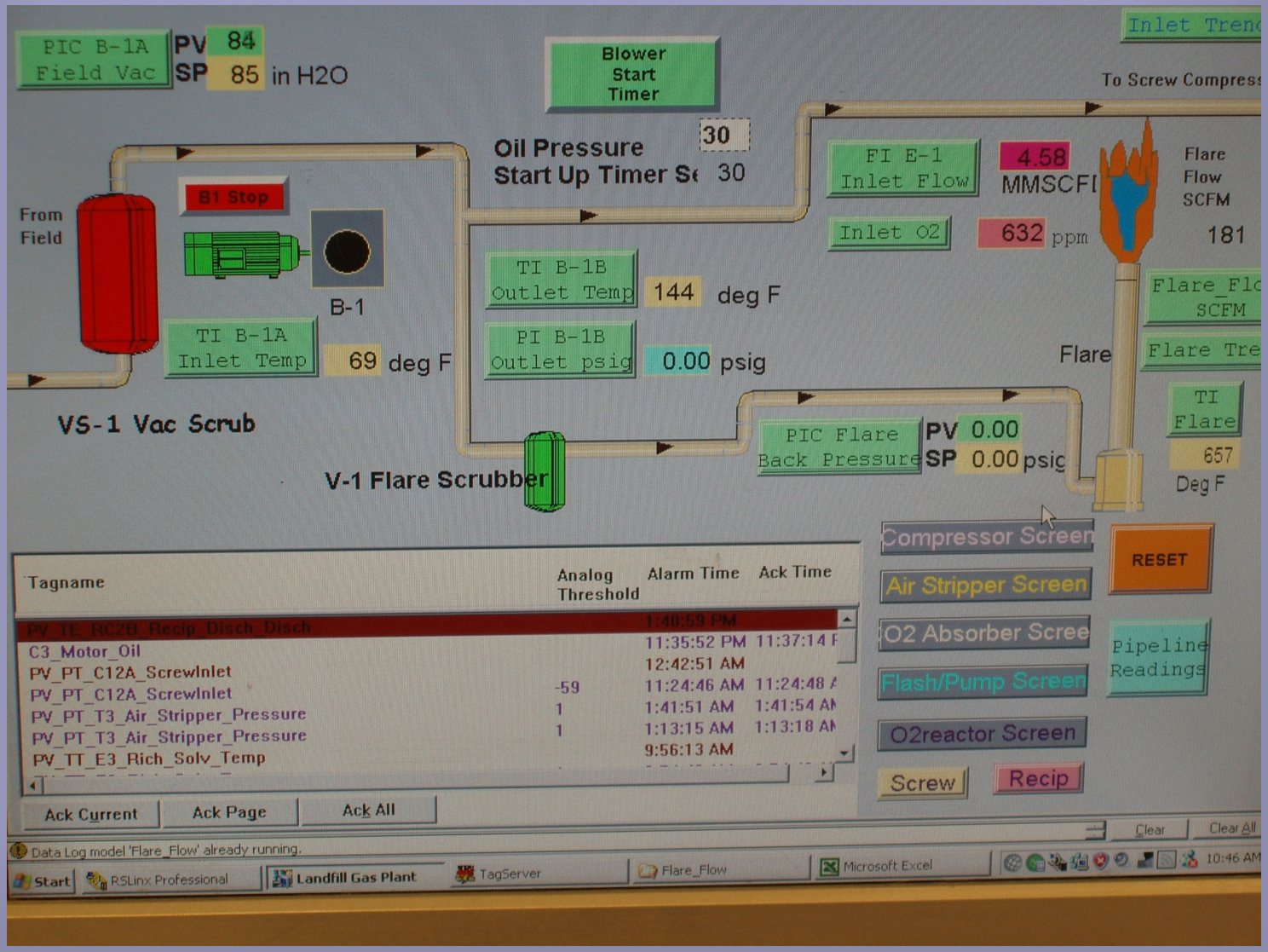


Johnson County Landfill, Shawnee, Kansas

- **LFG Recovery 4,000 scfm currently**
  - **Collection System**
    - **150 wells**
    - **Blower, screw compressor, reciprocal compressor**
  - **High Btu processing plant**
    - **H2S removal**
    - **VOC removal**
    - **O2 removal to < 50 ppm by catalytic converter**
    - **Activated carbon polishing**
    - **960 mmbtu gas output**
  - **End User: Aquila Natural Gas Pipeline**

6,250 cfm LFG Processing Plant, Johnson County, Kansas

Process Control Screens



H_2S, VOC and O_2 Stripping Towers

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Thanks for Attending.
Have a Great Day.