Natural Gas
Smarter Power Today.

NCSL
San Antonio, Texas

Tommy Foltz
Petrohawk Energy Corporation
About ANGA

ANGA is dedicated to increasing the understanding of the environmental, economic and national security benefits of clean, abundant, reliable and affordable North American natural gas.
Why Natural Gas?

CLEAN

ABUNDANT

DOMESTIC

JOBS
The World Leader in Natural Gas

Gross Natural Gas Production 2009
(Billion Cubic Feet)

Source: EIA International Energy Statistics
http://www.eia.gov/cfapps/ipdbproject/IEDIndex3.cfm?tid=3&pid=3&aid=1
Abundant by Any Estimate

Estimates of U.S. Recoverable Natural Gas
(TCF – trillion cubic feet)

Sources:
ICF: As reported in BPC: http://www.bipartisancrificy.org/projects/energy/naturalgas (Task Force on Ensuring Stable Natural Gas Markets)
EIA: See http://www.eia.gov/analysis/studies/worldshalegas/
PGC: Potential Gas Committee’s Advance Summary and press release of its biennial assessment; see www.potentialgas.org
Stable Supplies = Stable Prices

- Price volatility has declined sharply, due to:
  - Prolific on-shore production of gas from shale
  - 70% increase in U.S. reserves
  - Vastly expanded pipeline distribution system

### Nat Gas vs. Coal Pricing Parity

- Source: Credit-Suisse, September 2010
Risks vs. Benefits

• All energy production comes with some risk.
  ─ Natural gas has a decades-long history of safety while producing more than a million wells.
  ─ No need to trade environmental protection for economic benefits, communities can and should have both.
  ─ ANGA members are committed to protecting our air, land and water while safely and responsibly developing this abundant domestic resource.
Responsible Production Means…

• Being a good neighbor
  ― Working in partnership with communities

• Transparency and access to information
  ― Companies are disclosing hydraulic fracturing chemicals through a registry run by state regulators

• Commitment to innovations
  ― New technologies to reduce environmental impacts

• Appropriate state and federal regulation
  ― Taking into account the unique geologic characteristics in each state
Production: The Power of Progress

• Smaller surface impact.
  — The average well site today is just 30% of the size of its 1970s counterpart—and today’s wells can access over 60 times more below-ground area.

• Fewer wells, more clean energy.
  — Half as many wells are needed to produce the same amount of clean energy as 20 years ago.

• Less waste.
  — We can retrieve the same amount of gas while producing 30% less waste than a decade ago.

• Fewer air emissions.
  — More efficient operations also means less energy consumption, and thus less air emissions, per unit of natural gas produced.
Horizontal Drilling

Traditional Wells

Horizontal Drilling
Hydraulic Fracturing

Multiple protective layers extend from surface to below aquifers.

Groundwater aquifers

Private well, about 500 feet deep
Public well, about 1,000 feet deep

Several layers of steel tubes encased in cement protect groundwater supplies

Protective steel casing encased in cement extends to shale depth

Depth from surface is typically more than a mile
Safety At the Surface

Multiple Layers of Groundwater Protection

Aquifer

Surface Casing Cement
Steel Surface Casing
Production Casing Cement
Steel Production Casing
Production Tubing
Frack Fluid Makeup

Water & Sand 99.5%

Additives - 0.5%
- Acid
- Friction Reducer
- Surfactant
- Gelling Agent
- Scale Inhibitor
- pH Adjusting Agent
- Breaker
- Crosslinker
- Iron Control
- Corrosion Inhibitor
- Antibacterial Agent
- Clay Stabilizer
Water Use

• A typical deep shale gas well stimulation = ~ 5 million gallons
  – A 1,000 megawatt coal-fired power plant in 8.5 hours
  – A 1,000 megawatt nuclear power plant in 4.5 hours
  – Six acres of corn in a season
  – Watering one golf course for a month

• Water used in extraction is only a small percentage of the total water-resource use in each shale gas area (typically between 0.1% and 0.8% of total water use by basin).
**Water Use Comparison**

**Gallons of Water Per MWh Electricity Generated**

- **Deep Shale Natural Gas Combined Cycle**
  - Avg. consumption for cooling: 204
  - Avg. consumption for fuel: 14

- **Integrated Gasification (from Coal) Combined Cycle**
  - Avg. consumption for cooling: 364
  - Avg. consumption for fuel: 34

- **Coal Steam Turbine**
  - Avg. consumption for cooling: 472
  - Avg. consumption for fuel: 52

- **Nuclear Steam Turbine**
  - Avg. consumption for cooling: 704
  - Avg. consumption for fuel: 114

- **Concentrating Solar**
  - Avg. consumption for cooling: 750
  - Avg. consumption for fuel: 0

*Source: Hightower 2008 (other than CHK data)*

*Average consumption for fuels; Chesapeake data*

*Note: Wind turbines and photovoltaic solar panels have negligible water demands*

*MWh = megawatt-hour*
Sufficient Federal Regulation

• The Clean Water Act regulates surface water discharges and storm-water runoff.

• The Clean Air Act sets rules for air emissions from engines, gas processing equipment and other sources associated with drilling and production activities.

• The Safe Drinking Water Act regulates the disposal of fluid waste deep underground (far below fresh water supplies and separated by approximately one mile of impermeable rock).

• The National Environmental Policy Act requires permits and environmental impact assessments for drilling on federal lands.

• The Occupational Safety and Health Act sets standards to help keep workers safe. These include requiring Material Safety Data Sheets be maintained and readily available onsite for any chemicals used by workers at that location.

• The Emergency Planning & Community Right-to-Know Act requires storage of regulated chemicals in certain quantities to be reported annually to local and state emergency responders.
Regulation At The State Level

- Interstate Oil and Gas Compact Commission
- Groundwater Protection Council
- AOGC Rule B-19
- Pennsylvania DEP Rule 78
“Colorado is a great example of oil and gas development balanced with extraordinary environmental values. State regulation covers every aspect of drilling, including hydraulic fracturing. Oil and gas companies’ best management practices and state regulation emphasize preventing groundwater contamination in the two most important areas: surface fluid management and well casing and cementing.”

Tisha Conoly Schuller, President & CEO
Colorado Oil & Gas Association

“State oil and gas regulations are adequately designed to directly protect water resources through the application of specific programmatic elements such as permitting, well construction, well plugging, and temporary abandonment requirements.”

National Ground Water Protection Council
May 2009

“We’re having compliance and no problems. It’s been well received by the industry and, I believe, the conservation groups.”

Tom Doll, superintendent,
Wyoming Oil and Gas Conservation Commission

“We should have regulation, but it's better to have people who are knowledgeable about it and can deal with various variations from state to state, rather than have the EPA use one size to fit all.”

Bob Anthony, Oklahoma Corporation Commission Chairman, in WaterWorld February 26, 2010
Voluntary Disclosure System

• FracFocus.org, created by GWPC and IOGCC
Safe and Responsible Development

• New ad campaign to continue efforts to educate about the industry’s innovative practices in place to safeguard local air, land and water
TRANSPORTATION
Choosing Natural Gas Vehicles

- Do we have enough natural gas?
- Will we have the infrastructure?
- What are the benefits?
- How much does it cost?
Cleaner for Vehicles

- Compared to gasoline or diesel, NGVs:
  - Reduce CO\textsubscript{2} emissions: 20-30%
  - Reduce CO emissions: 70-90%
  - Reduce NOx emissions: 75-95%
  - Reduce Particulate Matter emissions: 90%
  - Reduce VOC emissions: 89%
Our Dependence on Foreign Oil

• How much do we use?
  – 4,250,000,000 barrels imported in 2010

• How much does it cost?
  – $337,000,000,000 on imported oil in 2010
  – $1,091 for each person in America
  – In 2009, energy imports made up nearly 60% of our trade deficit

• Where does the money go?
  – Among the top countries we import from: Venezuela, Saudi Arabia, Nigeria, Russia, Algeria, Angola and Iraq
Nat Gas vs. Conventional Gasoline

On average, CNG costs 47% less than gasoline

Source: CNG prices captured in July 2011 by CNGPrices.com
Gas prices reflect city average on July 20 from GasBuddy.com
Growing Network for Refueling

Natural Gas Refueling Stations in the U.S.
(currently operating stations, as of May 2011)

- December 2006: 769
- December 2008: 816
- November 2010: 929
- May 2011: 941

Source: DOE, Alternative Fuels and Advanced Vehicles Data Center

102 new stations are in the planning or construction stages.
Infrastructure: Refueling Stations

Natural Gas Refueling Stations
(in operation as of 12/31/2010)

Source: http://www.afdc.energy.gov/afdc/fuels/stations.html
Opportunity: Heavy-Duty Vehicles

<table>
<thead>
<tr>
<th>Miles Traveled (average per year)</th>
<th>Fuel Economy (average mpg)</th>
<th>Fuel Consumed (average gallons per year)</th>
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<td>25,254</td>
<td>22.6</td>
<td>4,075</td>
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<td>10,951</td>
<td>18.1</td>
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<td>11,788</td>
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Source: EIA Annual Energy Review 2009
Benefits: Reducing GHG Emissions

**CO₂ Emissions From U.S. Vehicles**
(average per year)

Facts of the Road

• The 10 million trucks and buses operating in the U.S. constitute 4% of all road vehicles, but:
  — Consume 23% of highway fuel
  — Emit 28% of highway-related carbon dioxide

• Trucks alone or in combination with other transport modes manage the movement of:
  — About 84% of all goods shipped
  — Equal to about 2/3 of the nation’s GDP

Source: Gladstein, Neandross & Associates
Leading the Way

- NGVs in fleets across America.
  - About 16% of all transit buses in US
  - Waste trucks are fastest-growing segment
  - First CNG-powered fire trucks and ambulances are coming into the market
  - Medium trucks used by large fleets like USPS, UPS, AT&T, Comcast
Converting just one heavy-duty waste truck from diesel to natural gas…

… offers the emissions reduction equivalent of taking 325 cars off the road.
Replacing 3.5 million medium- and heavy-duty trucks and buses with CNG-powered counterparts by 2035 would save at least 1.2 million barrels of oil per day.
Los Angeles has America’s largest CNG bus fleet. More than 2,500 CNG buses comprise 99% of the overall fleet… …and express buses to the stadium make cheering for Dodger Blue a little more green.
Airports in Phoenix, Boston, Dallas and other cities are embracing clean ground transportation.
The Fresno Unified School District will soon have a total of 42 CNG-powered buses, supporting more than 9,000 students and covering 1.5 million miles each year.
Texas Example

- More ton miles of truck shipments in Texas than in any other state in the nation; traffic will increase significantly in the next 25 years (according to Federal Highway Administration)
- Tremendous truck traffic on interstate highways connecting major Texas metro areas located approx. 250 miles apart
- Texas is the single largest gas-producing state in the nation
- Result: Texas Clean Transportation Triangle project
Texas Clean Transportation Triangle

- Establish fueling infrastructure at regular intervals on interstate exists along I-35, I-10, and I-45 to service long-haul transportation vehicles
- Anchor stations in proximity to urban settings to act as hubs for more localized traffic
- 15 stations offering public LNG and CNG located at current retail facilities along the interstates
- Cooperative effort between natural gas producers, fleet customers and retail partners
Cleaner Air for Texas Cities

• The TCTT is expected to displace 2.1 million to 4.1 million gallons of diesel per year.
  — Over the expected 10-year vehicle life, this will translate into petroleum displacement of between 20.6 and 41.3 million gallons of diesel fuel per truck.

• Natural gas trucks deployed throughout the TCTT project will have an estimated
  — 90 percent fewer NOx and PM emissions than the estimated 5- to 7-year old diesel trucks they are replacing
  — 100 percent fewer SOx emissions
  — Up to 30 percent fewer GHG emissions
Funding Options

• The State of Texas is not being asked to foot the entire bill

• Working to ensure the burden is shared by a variety of funding sources, such as:
  – Public funding at the state and federal levels
  – Potential joint ventures with large fleet owners
  – Filling station chain owners
  – Investment firms
  – Natural gas producers
# Leading States With NGV Incentives

<table>
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<tr>
<th>Natural Gas Vehicle Count</th>
<th>Federal</th>
<th>California</th>
<th>Texas</th>
<th>Oklahoma</th>
<th>Oregon</th>
<th>Colorado</th>
<th>Louisiana</th>
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<td>117,074</td>
<td>37,745</td>
<td>11,454</td>
<td>2,719</td>
<td>1,645</td>
<td>972</td>
<td>378</td>
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| Natural Gas Station Count (Existing / Planned) | 930 / 75 | 246 / 12 | 37 / 3 | 59 / 5 | 5 / 0  | 25 / 5 | 7 / 3 |

| Infrastructure/Home Refuel | 30% up to $30,000 cap/ $1,000 Expiring: 12/31/11 | $1,000 Home Incentive | 75% of infrastructure Expiring: 01/01/14 | 35% of eligible costs for businesses | 50% of the cost of constructing an alternative fueling station | No current expiry |

| Vehicle Incentives | $2,000 rebate for the purchase of a NGV / $3,000 for the conversion | 50% of the incremental cost Expiring: 01/01/14 | 25% of the incremental cost or $750 for residents / 35% for businesses | 75% of incremental cost Expiring: 12/31/15 | 50% of the incremental cost, or 10% of the cost of the motor vehicle or up to $3,000 | No current expiry |

| Fuel Credits | $0.50 GGE Excise tax Credit | Paid through an annual flat-fee rate | Preferential NG Fuel rates | Deregulation of CNG as a Motor Fuel |

| Mandates | Acquisition Requirements | Acquisition Requirements | Acquisition Requirements | Acquisition Requirements | Acquisition Requirements | Acquisition Requirements |

| Funding | Grants / Loans | Grants / Loans | Grants / Loans | Infrastructure Loans | Loans | Loans |

Source: DOE AFDC