



April 29, 2014

# Natural Gas Resiliency

**American Gas Association**



Natural Gas Systems:

## Pipeline Infrastructure

2.4 million miles natural gas pipelines

- Transmission: 300,000 miles
  - Natural gas “highways” - Mostly steel, larger diameter, higher pressure
- Distribution: 2.1 million miles
  - Natural gas “main and side street” - Different materials, smaller diameter, lower pressure
- All buried 3'+ below ground
- Operates 24/7

Compare: 2.7 million miles paved roads



## **Resilient & Reliable: *Have you ever had a natural gas outage?***

- \$19 billion annual spend to maintain safety & reliability, increasing resiliency
- Highly regulated: Federal + state
- Most issues are local events with little impact to supply or customers
  - Most disruptions due to 3<sup>rd</sup> party damage
  - System has capacity to absorb issues
    - Some ability to re-route gas
    - Can go from 70 Bcf to 139 Bcf in 1 day

# Potential Vulnerabilities

Worked with DOE, other agencies & independently to analyze potential vulnerabilities:

- Physical security threat analysis
- Cybersecurity threat analysis
- Identification of critical infrastructure
- Identification of pipeline integrity threats and mitigation measures
- Sector specific security plans

Have identified four potential vulnerabilities...

# 1. Significant Natural Disasters



- Hurricanes
- Earthquakes
- Floods
- Landslides
- Other significant natural disasters

Must have enough force to move pipelines several feet underground



## 2. Lack of Supply

- Interstate transmission line out of service due to natural disaster, integrity or other issue
  - Can re-route natural gas to other transmission lines to supply an area, if the lines exist + can hold additional capacity
- Lack of storage
  - Natural gas expands/contracts, which means it can be stored or liquefied for future use
  - Lack of storage or storage sites far from where supply is needed can reduce the system resiliency
- Too much demand & not enough pipelines to support the demand

### 3. Physical or Cyber Attack

- Infrastructure is mostly buried
- Network highly diversified, which mitigates widespread compromise from a cyber attack
- Multiple backups/redundancies to keep product flowing (many due to regulations)
- Sector specific plans to improve resiliency

***Security Metrics:  
The Oil & Natural  
Gas Sector  
Coordinating  
Council, to which  
DOE is the Sector  
Specific Agency,  
has collected  
metrics for physical  
and cybersecurity.  
May also want to  
consider how  
quickly actionable  
info is shared by  
gov't***

## 4. Natural Gas & Electric Interdependencies

- Electric generation consumes ~40% of all gas used
- As electric generation from natural gas rises, electric system resiliency will increasingly depend on how well electric markets provide the right economic signals for natural gas companies to invest in infrastructure needed to serve gas-fired generators.
- Recent natural gas and electric price volatility suggests a strong need for more natural gas infrastructure to support electric generation in certain areas (e.g., Northeast, New England).





A close-up photograph of a gas burner with a bright blue flame. The burner is dark and metallic, and the flame is a vibrant blue, indicating a clean burn. The background is dark and out of focus.

## Ways to increase resiliency

- System expansion
- Storage expansion or storage closer to supply needs
- Review regional electricity markets for how well they support gas infrastructure investment needed to serve gas-fired electric generation in the region
- Distributed generation, combined heat and power

# Combined Heat and Power Technologies

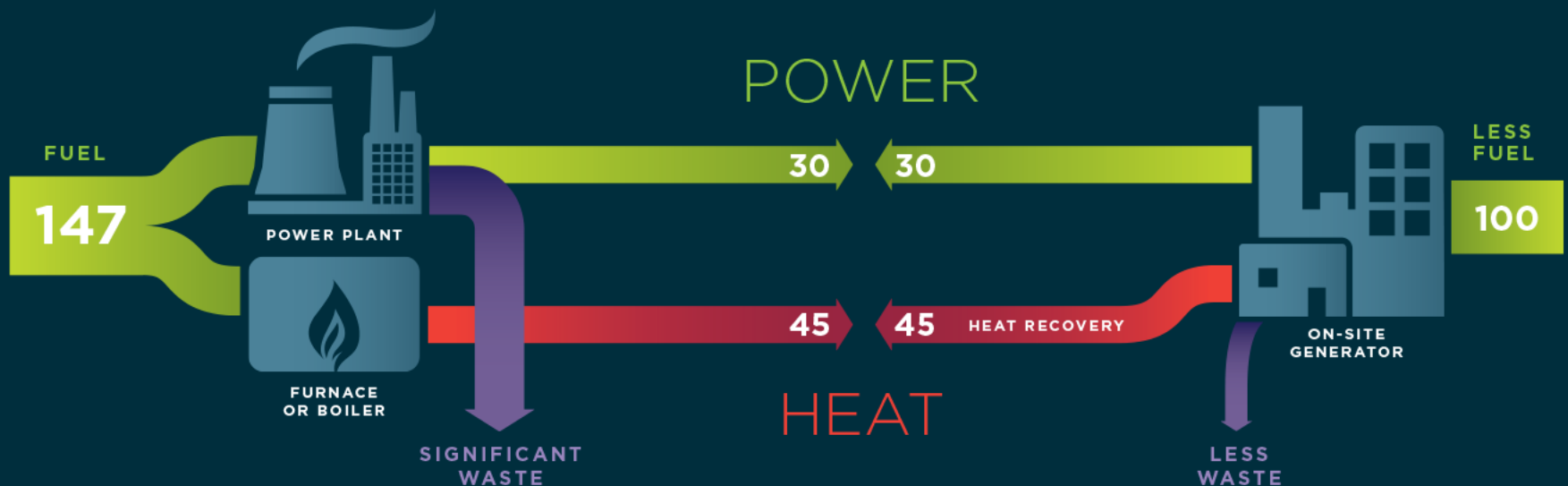
The use of natural gas for CHP applications allows for new electricity generation to meet current and future demand at costs up to 50% less than traditional forms of delivered new base load electricity.

## Separate Production of Electricity and Heat

TOTAL EFFICIENCY: **51%**

## Combined Heat and Power Systems (CHP)

TOTAL EFFICIENCY: **75%**



# Potential Resiliency Metrics

- Customer outages per customers served
- Duration of customer outages per customers served
- Variance in regional gas and electric prices
- Security Metrics: Physical and cybersecurity metrics identified by the Oil & Natural Gas Sector Coordinating Council



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