Natural Gas System Forecasting and Coordination Opportunities

Energy Systems Integration Group (ESIG)
2018 Forecasting Workshop

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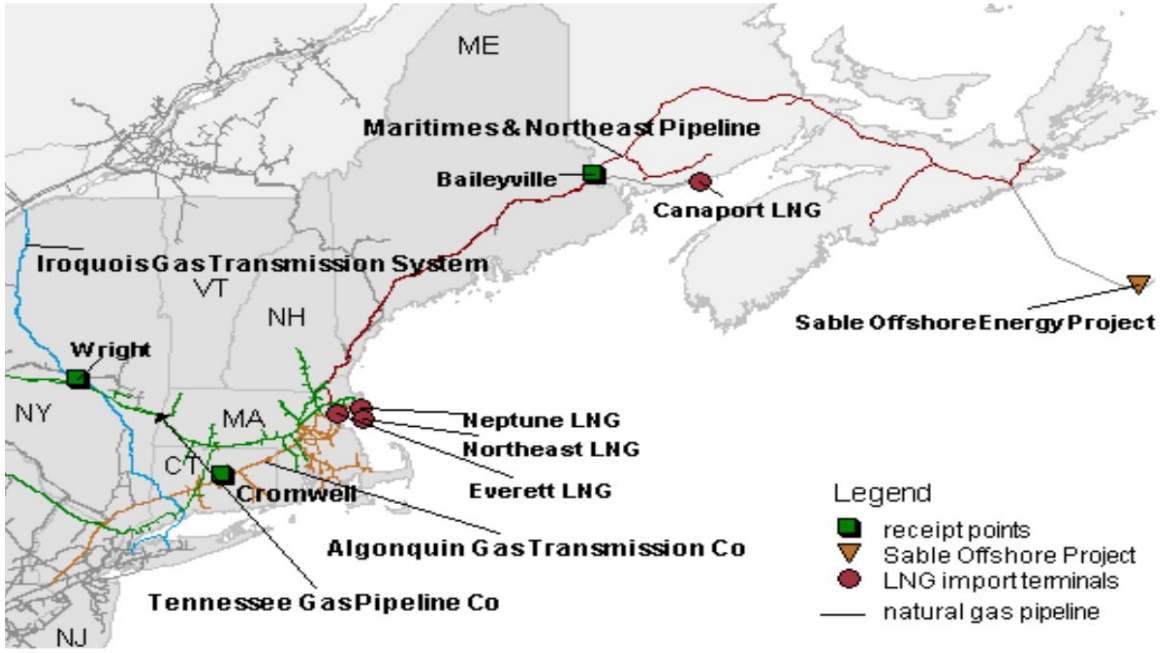
Background – Unique Issues

- **New England** natural gas issues are **unique** to our system
- PJM, California ISO and New York all have natural gas issues that are **unique to their systems**, presenting a different set of problems to their areas, such as:
  - No solution that is **one-size-fits-all**
  - Requires a **specific understanding** of each individual system
  - **Coordination** with pipeline operations is key

Background – Supply Capability

- New England is at the **end of the pipes** from the west
  - Algonquin (Enbridge)
  - Tennessee (Kinder Morgan)
  - Iroquois
  - Maritimes and Northeast (M&N) (Enbridge)
  - Portland Natural Gas Transmission System (PNGTS)



Source: U.S. Energy Information Administration based on Ventyx's Energy Velocity Suite

Terminology

- **MMBtu**: Million British Thermal Units
- 1 Dekatherm (Dth) = **1 MMBtu**
- **Bcf**: Billion Cubic Feet ≈ 1,000,000 MMBtu
  - Slightly more MMBtu per Bcf

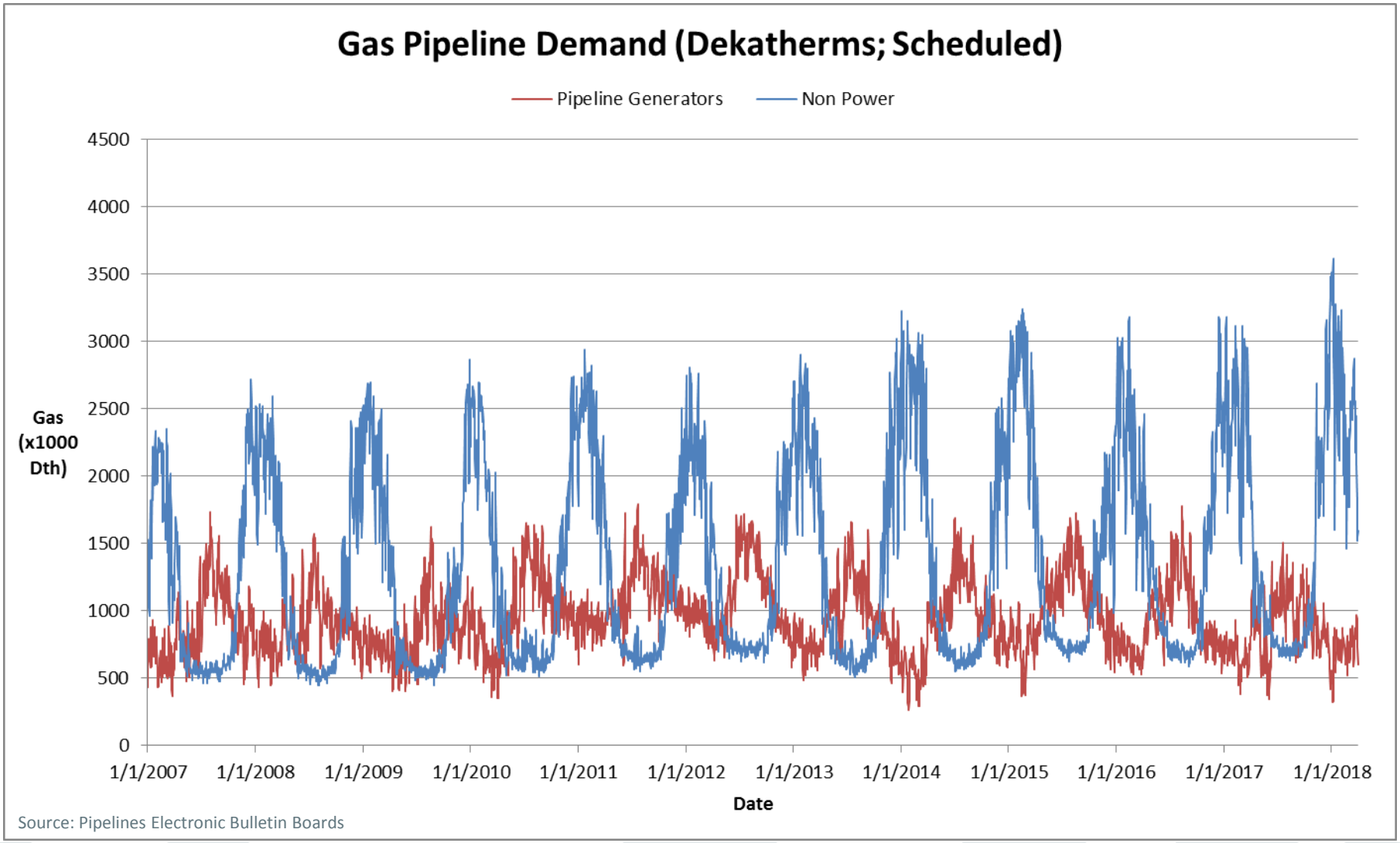
Background – Supply Capability

- LNG
  - **Canaport** and **Distrigas** LNG terminals in the east
    - About 13 Bcf total **storage** capability
    - Up to 1.8 Bcf per day **vaporization** capability (max)
  - **Peak shaving satellite facilities** (low pressure)
    - About 16 Bcf total **storage** capability
    - Up to 1.4 Bcf per day **vaporization** capability

Natural Gas Pipeline Demand – New England

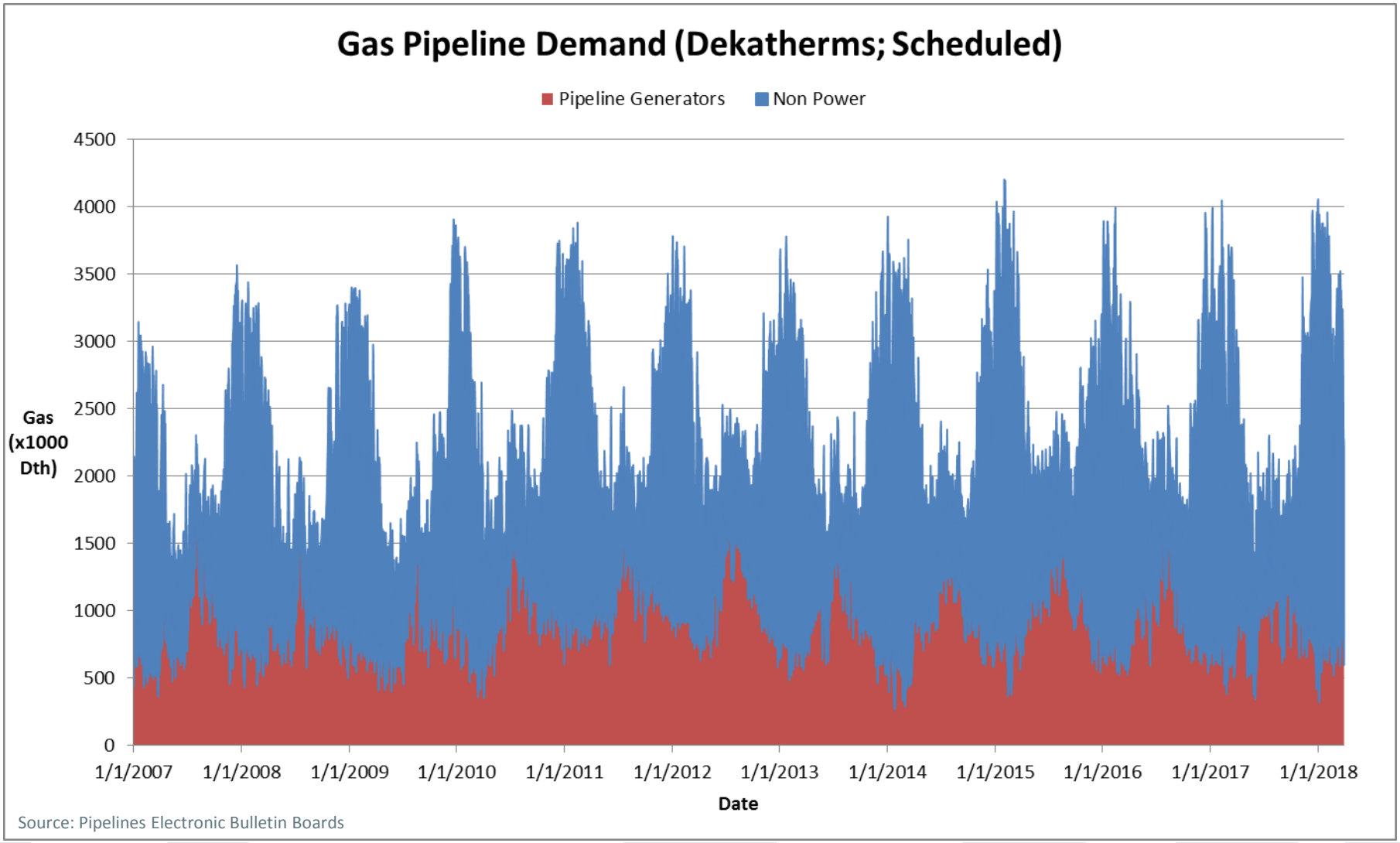
- Gas demands are **distributed proportional** to supply capability
  - System is mostly homogenous
- Pipeline operators **make every effort** to move as much gas through their systems as they can
- Local Distribution Companies (heating demand) hold almost all of the **firm gas transportation** to New England
  - Minimal firm gas transportation for New England generators
- Generators schedule gas by way of **Capacity Release**
  - Firm shippers release firm capacity for resale
  - Vastly different behavior in summer vs. winter months

Natural Gas Pipeline Demand
Comparing Power Generation to Non-Power



Source: Pipelines Electronic Bulletin Boards

Natural Gas Pipeline Demand
Concurrent Power and Non-Power Demands



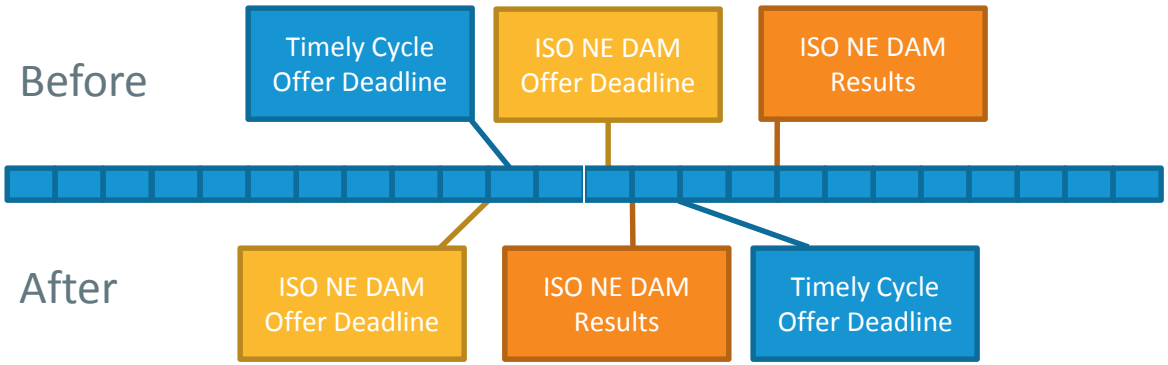
Source: Pipelines Electronic Bulletin Boards

Electric-Gas Coordination - Communication

- **Open communication** with the gas system operations personnel is my **most valuable tool** for Electric-Gas Coordination at ISO New England
  - **Direct communication** with the experts
  - **Routine coordination** helps both sides anticipate conditions
- Maintenance **coordination**
  - Better understanding from both sides of **expected conditions**
  - Potential for **rescheduling outages** as necessary
    - Improved efficiency
    - Reliable Operations
  - **Pre-summer meetings** to go over outages

Electric-Gas Coordination - Market Alignment

- Attempts to **move** the electric operating day and gas day
  - Neither day moved
- **Market timelines** did move (note: all times Eastern)
  - 4/1/2016: NAESB cycle **nomination deadlines moved**
    - Timely cycle deadline moved from 12:30 to 14:00
    - Evening cycle deadline stayed at 19:00
  - 5/24/2013: **New England Day Ahead Market moved**
    - Publishing DAM results moved from 16:00 to 13:30
    - DAM Offer deadline 10:00



Electric-Gas Coordination - Market Alignment, *cont.*

- **Hourly Re-offers** (ISO Market)
  - Generators can change **incremental prices** up to 30 min before hour
  - If they need to **switch** to more expensive fuel, reflected in offer
  - Commitments **lock in** no-load cost, startup cost

Capacity Analysis – Natural Gas Effects

- Power system **capacity analysis** requires accounting for gas that is unavailable due to supply limitations
  - This is different than forced outages, not as random
  - Function of gas supply capability and firm demand
  - Can be calculated beforehand and actions can be taken

GENERATING CAPACITY POSITION						
Total Capacity Supply Obligation (CSO)	30,038	30,038	30,038	30,038	30,038	30,038
Anticipated Cold Weather Outages	1,019	4,078	4,758	2,889	0	169
Other Generation Outages	2,409	2,070	2,280	1,950	1,905	2,159
Anticipated De-List MW Offered	1,010	1,010	1,010	1,010	1,010	1,010
Total Generation Available	27,620	24,900	24,010	26,209	29,143	28,720

Capacity Analysis – PV Effects

- Load is served by **most economic resources**, mostly in economic-merit order
- Behind-the-meter PV **reduces** the overall demand seen by the bulk power system
- Marginal fuel is the **first to be reduced** when load reduces
- Natural gas is **frequently** the marginal fuel
- As PV output **goes up**, natural gas demand for power generation **goes down**

Gas System Supply Capability

- Gas system **capability** is relatively static from day to day
  - **Based on** compressor capability and LNG vaporization rates
  - Affected by **outages**, planned or unplanned
    - Pipeline outages occur in the **non-winter months** (off-peak)
- Supply Capability is **publically available** information
  - Posted to Electronic Bulletin Boards
  - Requires some understanding of pipeline interconnection and operation
- Scheduled gas above / below **operational capacity**
  - (+) Operators can flow more gas than operational capacity
  - (-) No-notice service can be held in reserve

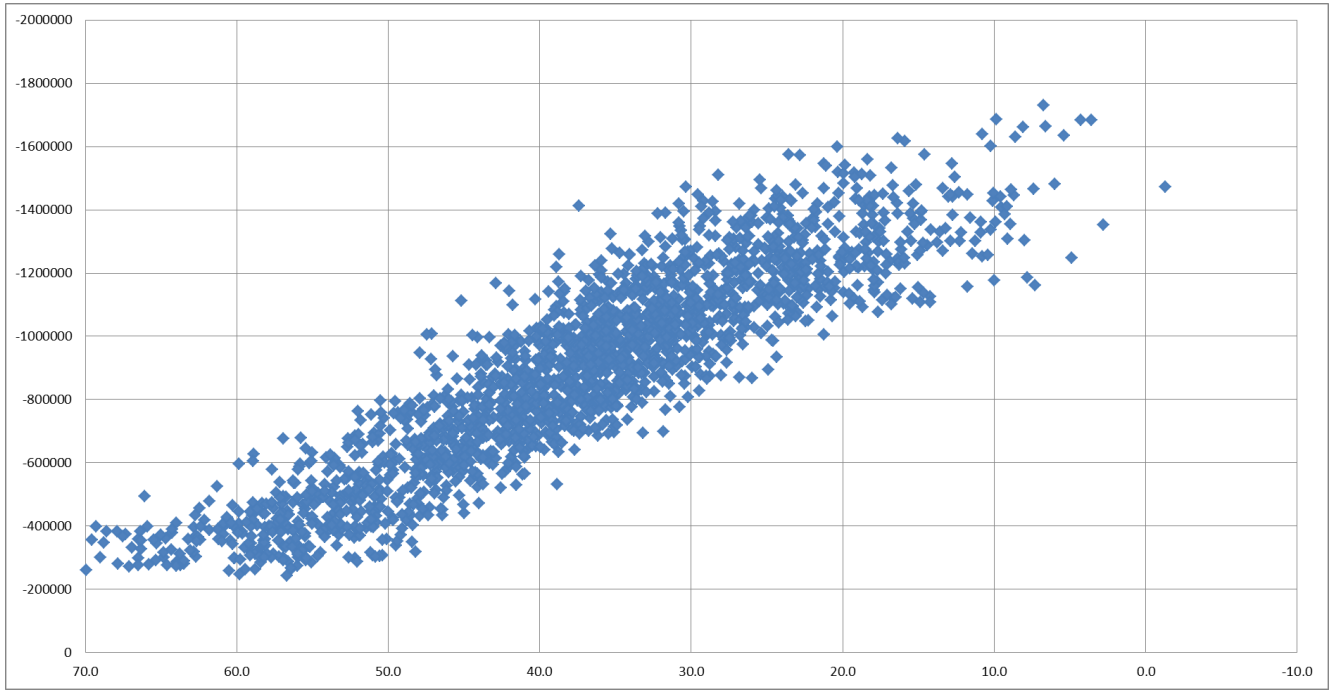
Forecasting Gas Demand

- Gas System Demand is a **function of temperature**

- **Available Information**
  - Weather data (primarily temperature)
  - Scheduled gas data from the Electronic Bulletin Boards
  - ISO New England does not have access to actual gas flow data
- **Linear or polynomial interpolation** for gas generator reductions
  - [Total gas system capability] – [heating demand]
  - Remainder for generation, converted to a MW value
  - Assuming dual fuel generators switch to oil when gas is scarce
- **Neural network** models and other approximations
  - Same as the load forecasting tools, trained with scheduled gas

Gas Forecasting

- Natural gas heating demand can be **estimated** as a function of temperature
  - Simple equations have been used by the ISO for the past several years
  - Good for approximation and situational awareness, not for operation



Limitations and Challenges

- Gas is scheduled on a **daily basis**
  - Gas day from 10 am to 10 am
  - Hourly flows may be restricted to 1/24, ratable take
  - Hourly flows may be flexible
    - Overall gas system demand
    - Initial pressure on pipeline, higher the better for high load days
- **Operational Flow Orders** (OFOs)
  - Pipeline operators issue OFOs to help manage pressure
  - Can be system wide or meter specific (usually system wide)
  - Apply penalty pricing for departing from scheduled gas
  - Same mechanism for excess supply as for excess demand

Future of Gas Forecasting?

- What **tools** can be utilized?
- What **information** is available?
- How much **precision** do we need – and can we get it?
- What **factors** drive natural gas demand?
  - We looked at temperature. What else matters?
  - How similar to power system electric demand is it?

Questions