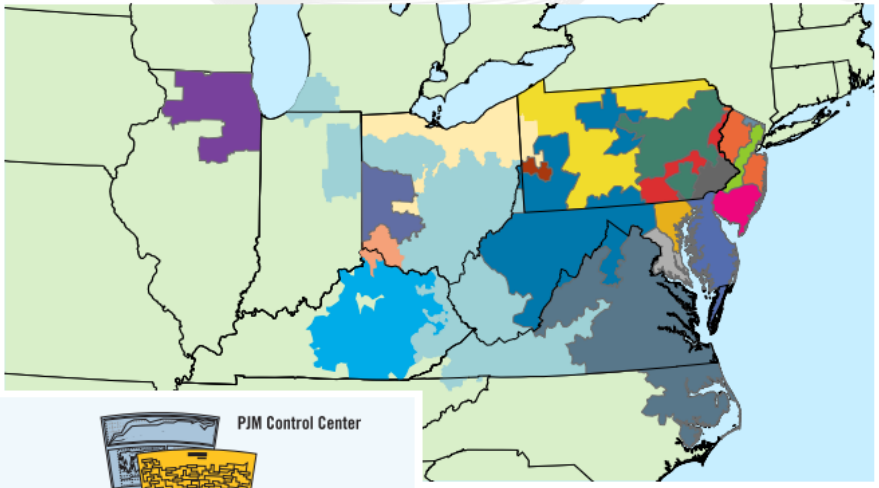
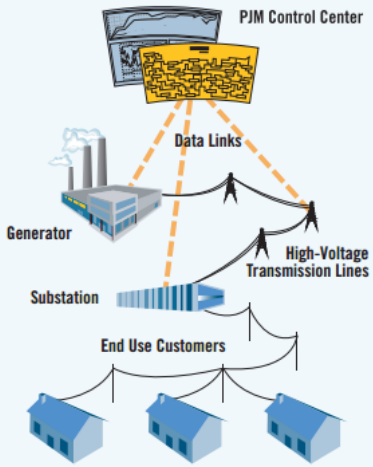
Power Generation: Natural Gas Role

Frank Koza
Exec Dir, Infrastructure Planning
PJM Interconnection LLC

Presentation to Ohio Gas Assn.
July 23, 2013

PJM Overview





Keeping the Lights On

We're sometimes called air traffic controllers of the power grid. PJM monitors and coordinates more than 1,376 electric generators and 62,566 miles of high-voltage transmission lines. Just like air traffic controllers, we don't own the equipment we direct. Others own the power lines and power plants.

Power generators, utilities and power marketers coordinate their operations through PJM. Doing so makes major electric outages less likely to occur and reduces power costs.

PJM Interconnection coordinates the movement of electricity in all or parts of 13 states and the District of Columbia. We work quietly behind the scenes. Our job is to ensure there is enough electricity for the 61 million people in our region.

Key Statistics	PJM Today
Millions of people served	61
Miles of transmission lines	62,556
2012 generation capacity in MW	183,604
Square miles of territory	243,417
Area served	13 states + D.C.

20130601

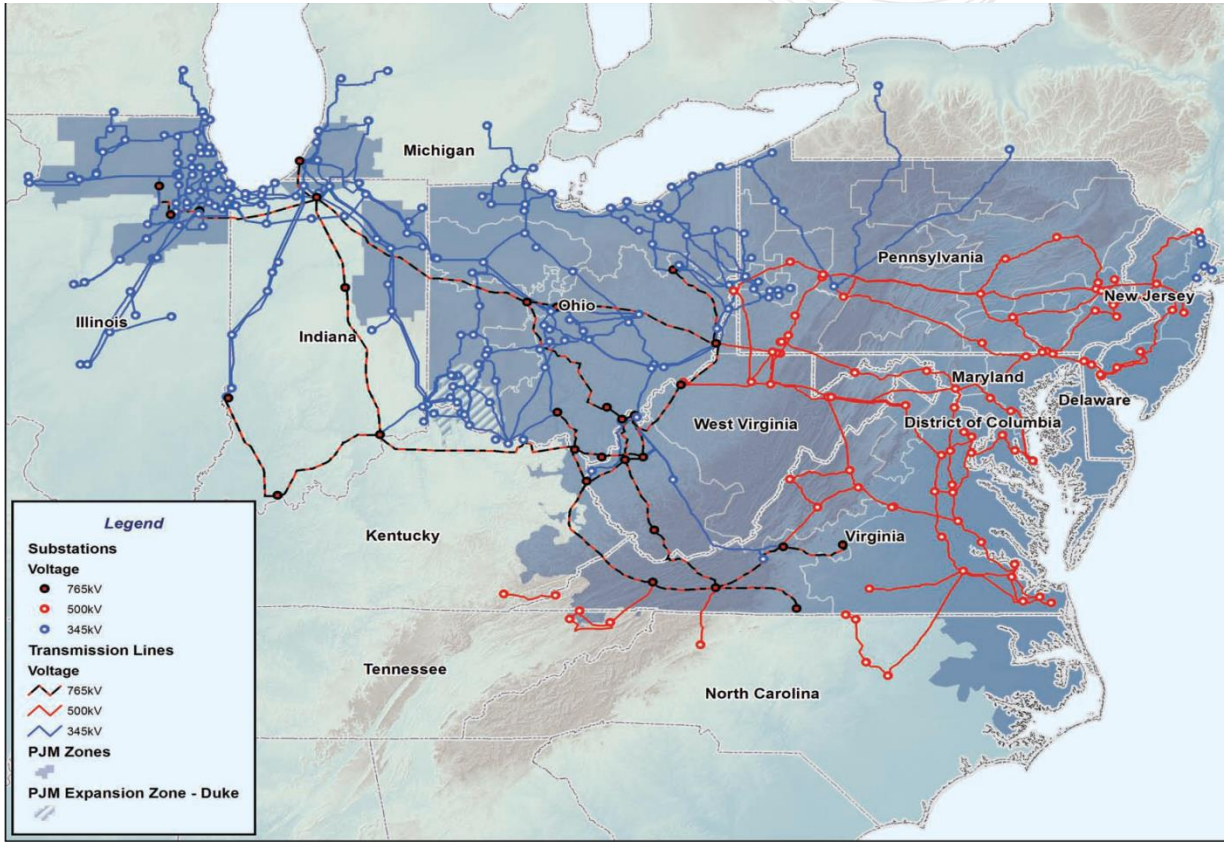
Similarities

- Operate commodity transportation businesses, regulated by FERC with FERC-approved tariffs
- Operate interconnected transmission networks
- Sell firm and interruptible (non-firm) transportation service, but our non-LDC customers generally won't buy firm service because of its cost

Differences

- Electric transmission is built in anticipation of demand growth (not firm service contracts)
- ISOs also run centralized energy markets, in addition to providing transmission service and have geographical exclusivity (same with non-market utilities)
- ISOs don’t own the transmission assets and are not responsible for maintenance (but individual utilities do)

Electric System Operations 101

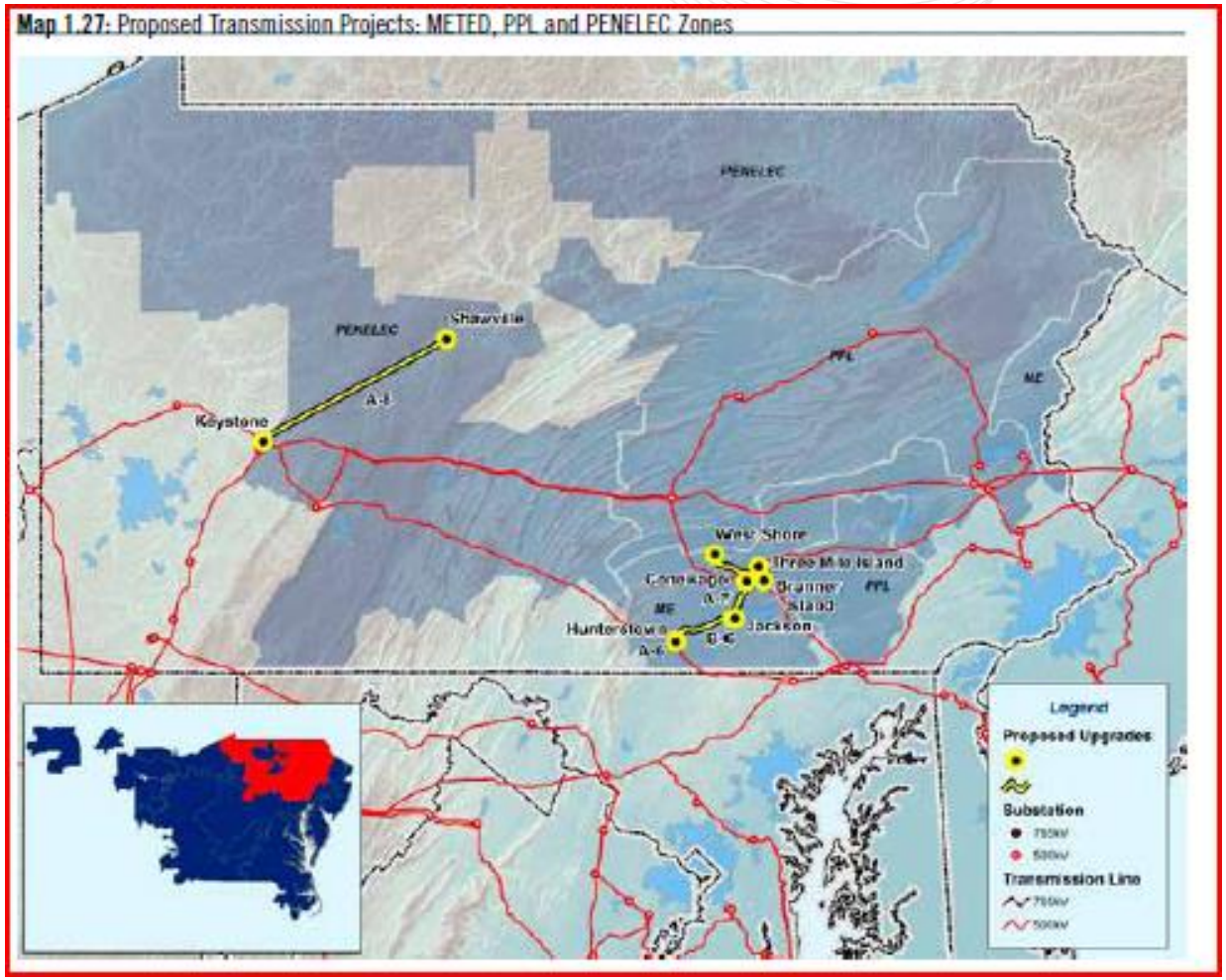


- Highly interconnected – internally and externally
- Open Ties—no "flow control"
- Flow managed by adjusting generator output (at the "wellhead")
- Voltage (="pressure") is important and needs to be boosted in places
- Network is operated in N-1 state at all times

At all times…

1. Generation and demand must balance and 2. Lines must be operated within limits

Regional Plan for Facility Enhancements



Result: A regional plan for enhancements to permit all reliability criteria to be met at peak load.

Different than gas:

--No open season

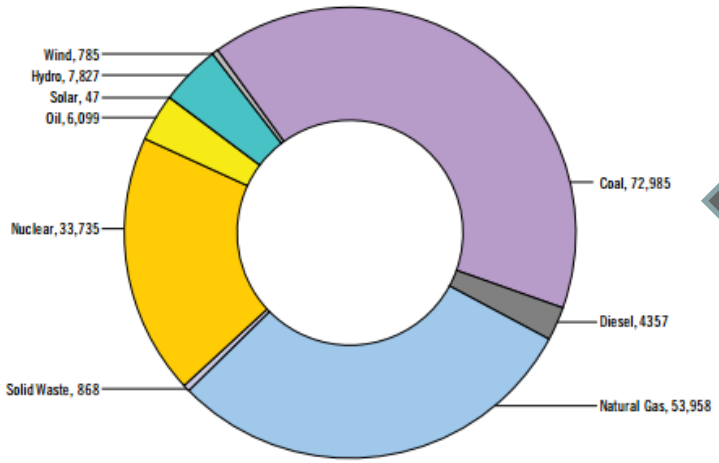
--No FERC Approval

--Project costs borne by the transmission service customers (e.g. LDCs)

--Generator interconnection costs borne by the generator

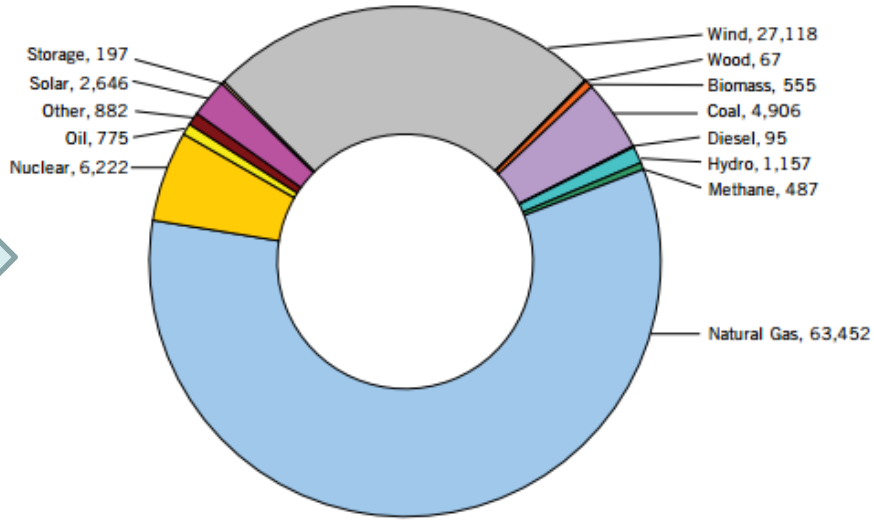
PJM Generation Fleet is Changing

Figure 3.2: Fuel Mix - Existing PJM Installed Generating Capacity (MW, December 31, 2012)



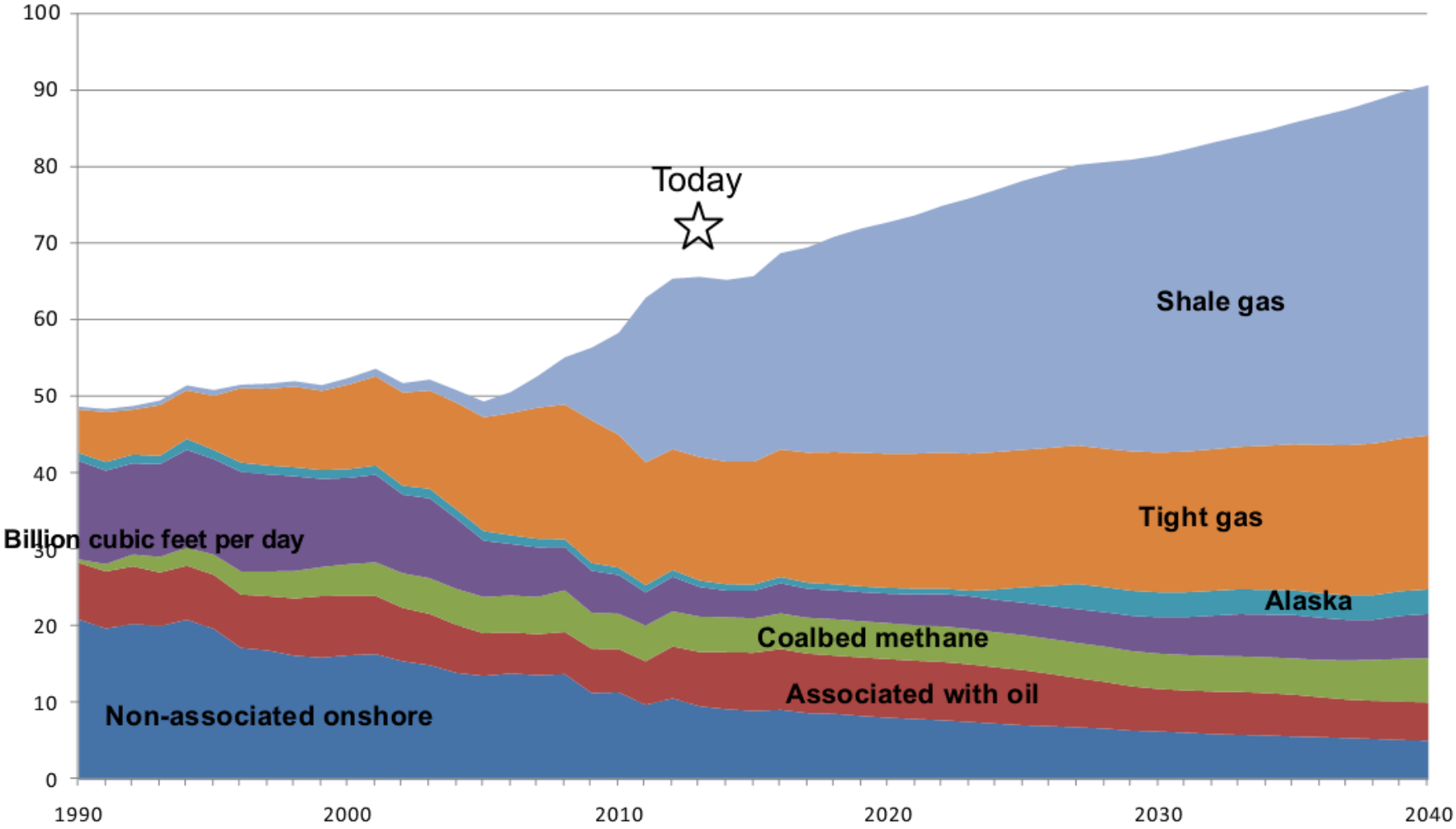
Now – Coal is ~45% of installed capacity; with gas ~20%

Figure 3.3: Fuel Mix – All Queued Generation Interconnection Requests Since 1999 (MW, Nameplate Energy, December 31, 2012)

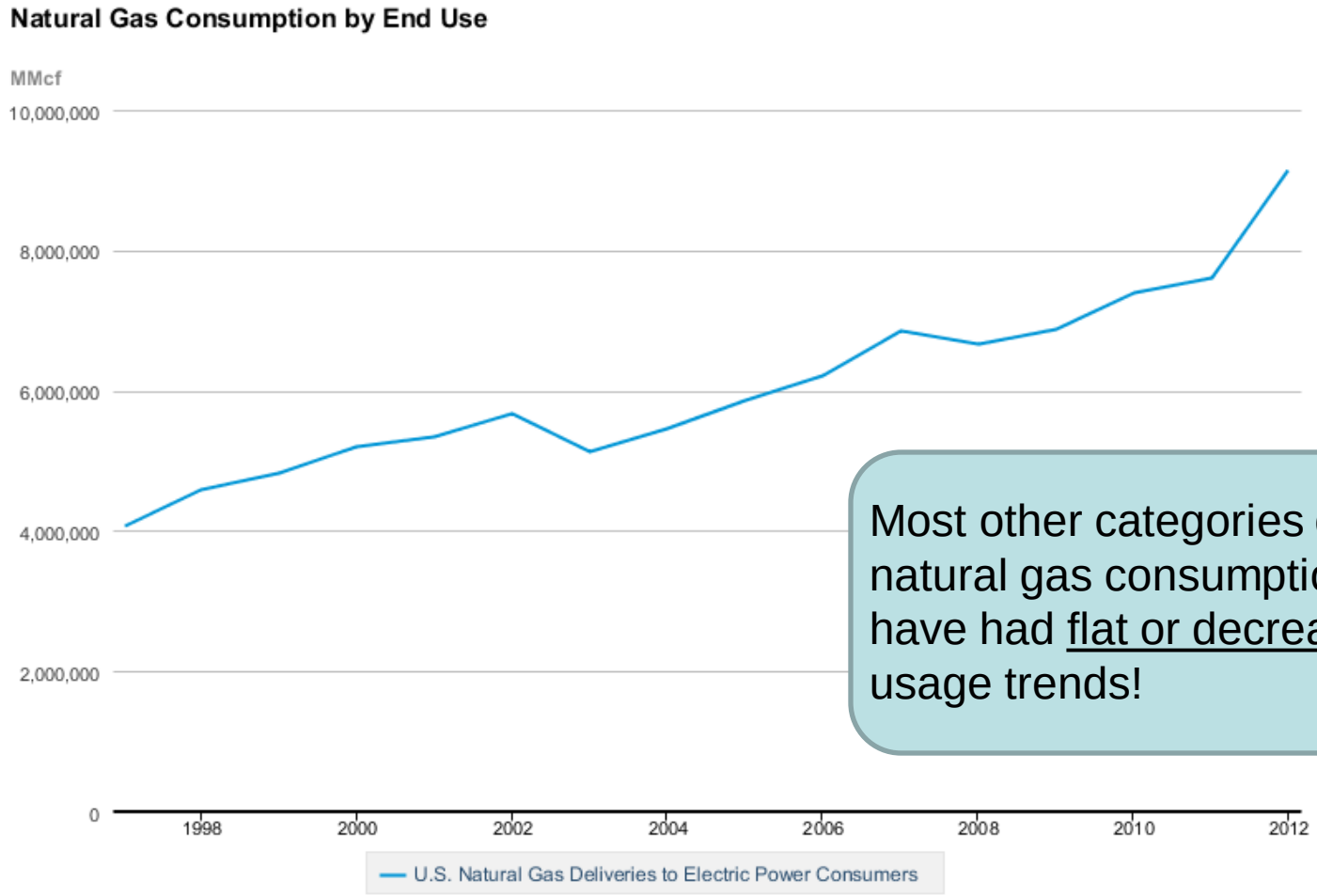


Future – Majority of proposed projects are gas-fired

SHALE GAS!


100
90
80
70
60
50
40
30
20
10
0
Billion cubic feet per day
Today
Shale gas
Tight gas
Alaska
Coalbed methane
Associated with oil
Non-associated onshore
1990
2000
2010
2020
2030
2040

Increasing Power Generation Natural Gas Consumption

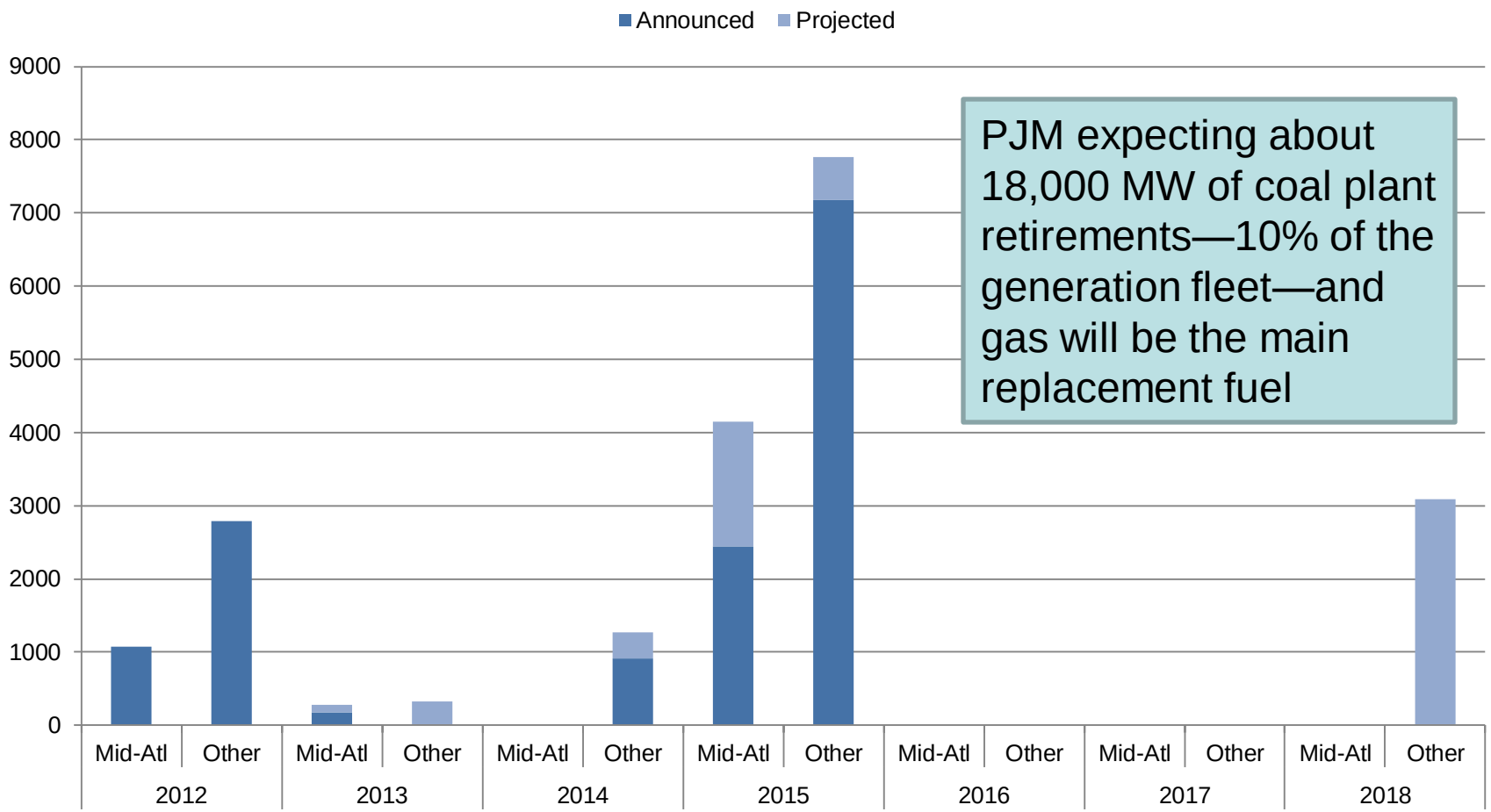


Most other categories of natural gas consumption have had flat or decreasing usage trends!

eia Source: U.S. Energy Information Administration

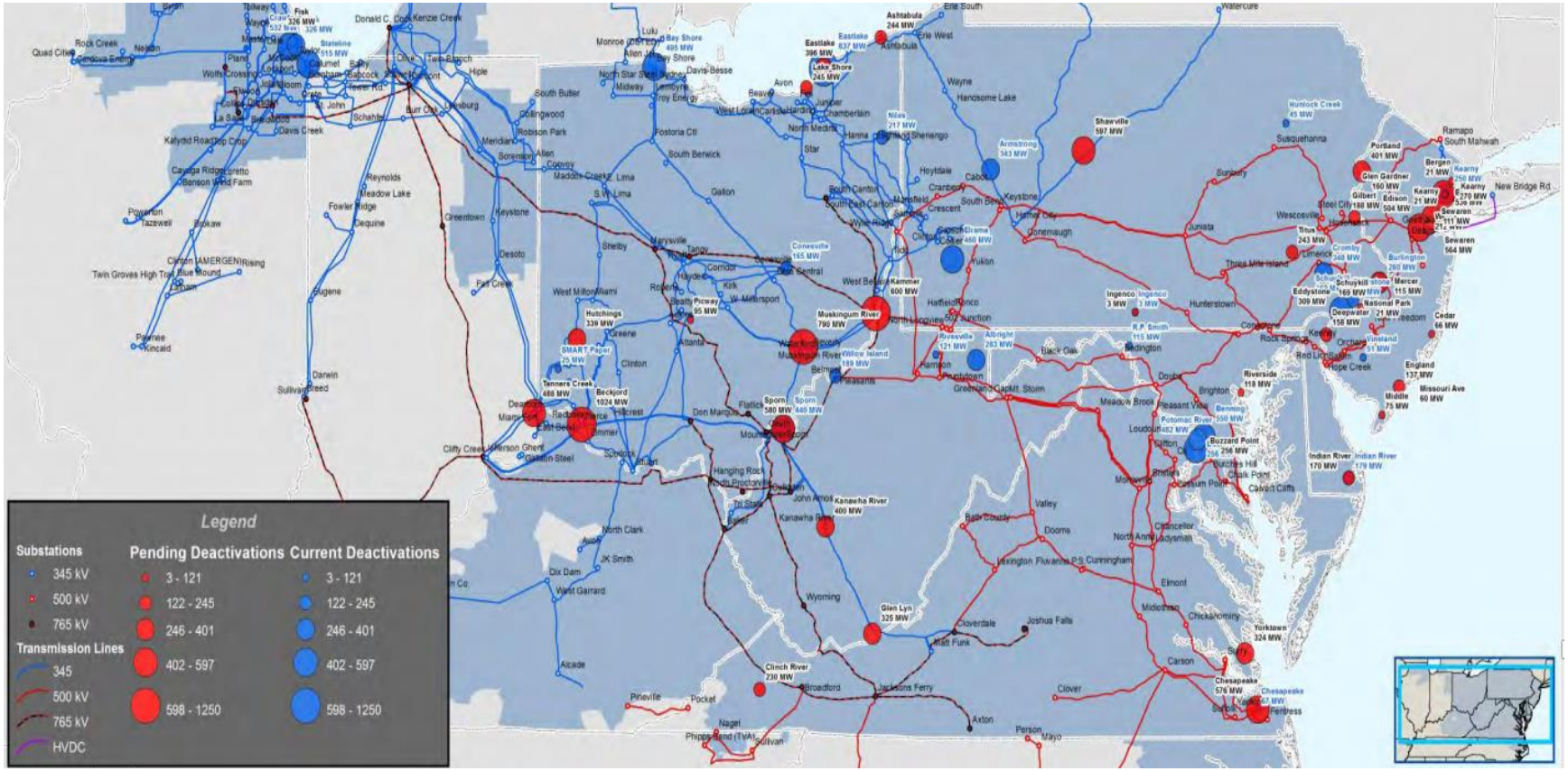
"The Other Shoe" Is About To Drop

EPA Rules!



PJM expecting about 18,000 MW of coal plant retirements—10% of the generation fleet—and gas will be the main replacement fuel

Map Version of Generator Retirements



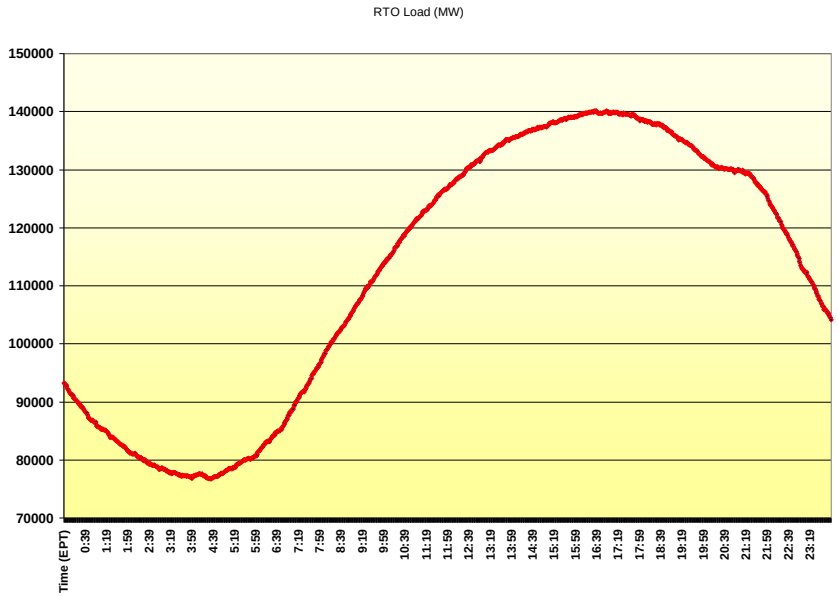
We’re Not Your Ideal Customer!

Power generation gas use does not fit neatly into the gas contractual construct

- Electricity demand, like gas demand, fluctuates and is subject to steep ramps, especially in winter
- Increased wind and other intermittent resources don’t help
- Fastest starting generation resources, generally are gas-fired combustion turbines which can go to full output in about 10 minutes or less

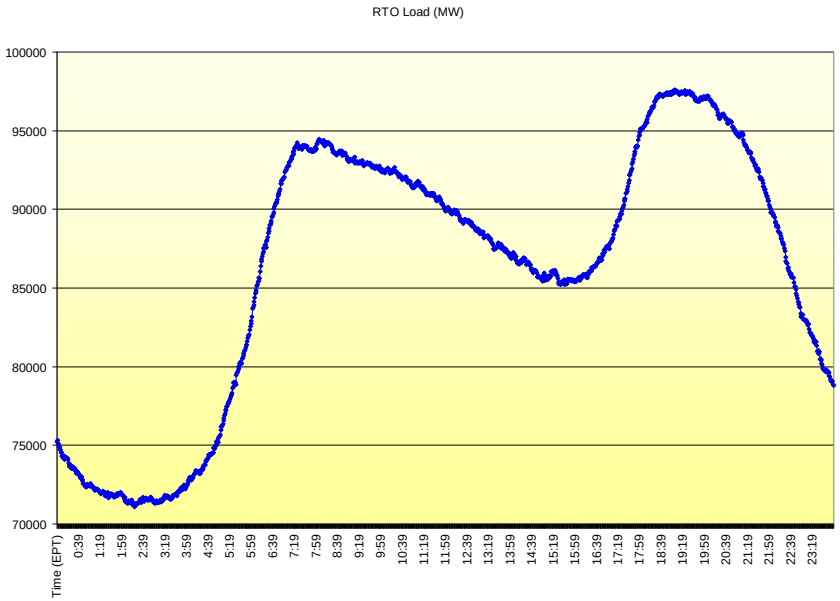
How Does It Work?—Load Variability

Summer Load Shape



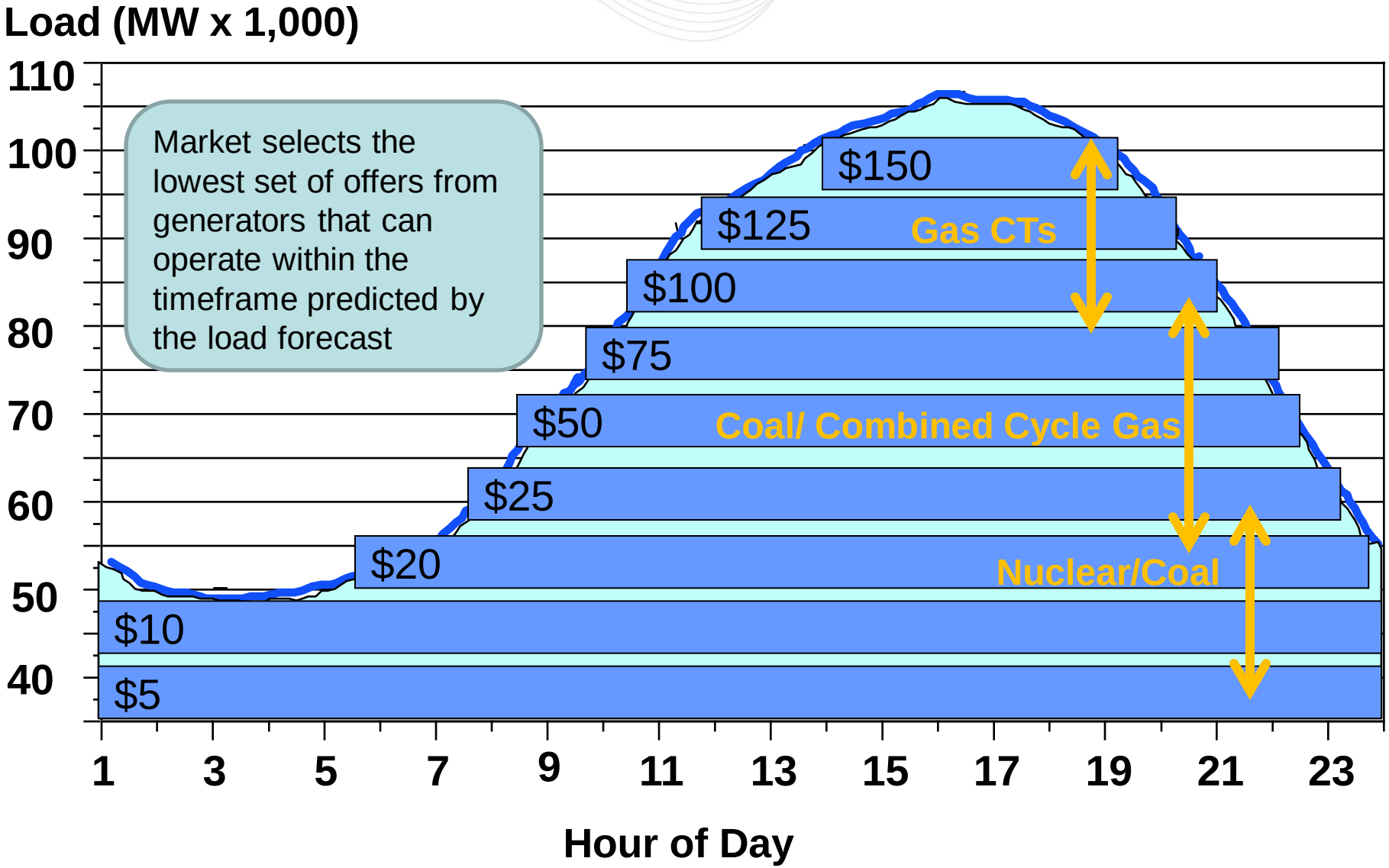
Slow, gradual increase in load throughout the day. Gas-fired units can be more carefully planned and sequentially brought into service.

Winter Load Shape

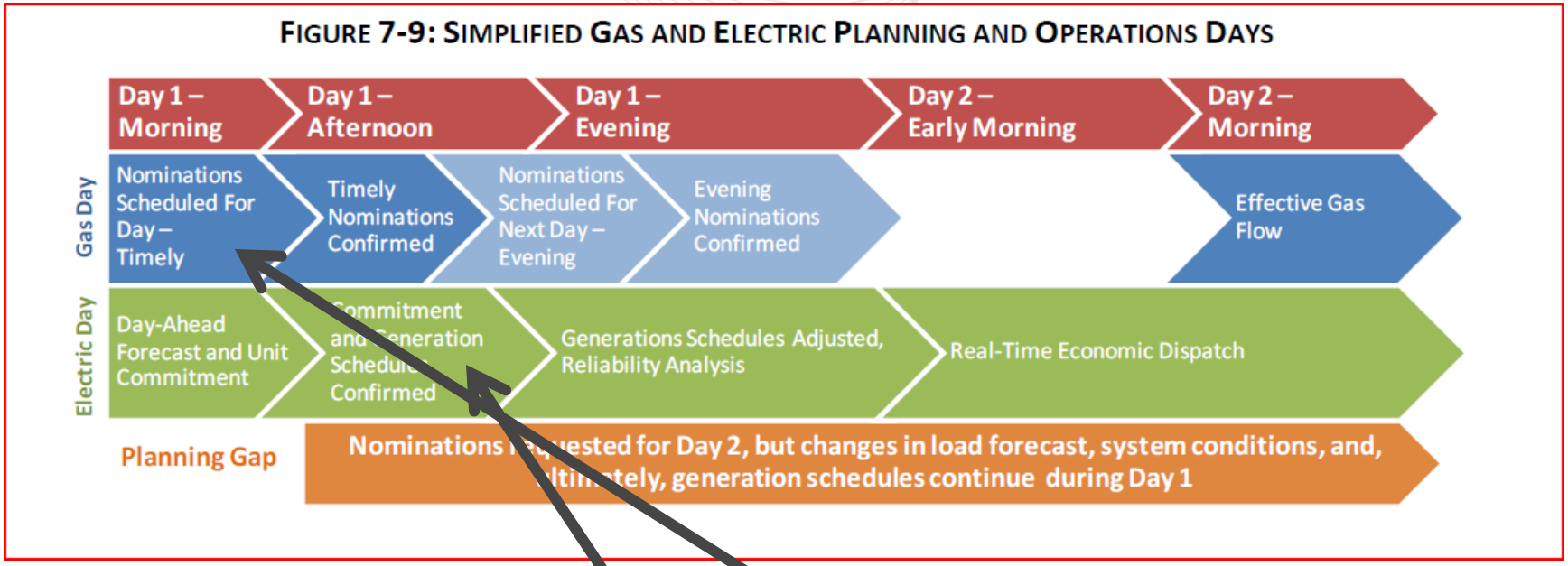


Very steep load pickup (5AM-8AM) in the morning, followed by an immediate stop and gradual decline during the day and a second pick up in the evening

How Does It Work? -- Market Operations



Gas Day vs. Electric Day



Issue: Timely gas nominations are due at 10AM the day before (Day 1); electric "awards" are made at 4PM the day before (Day 1) = 6 hours later; actual gas flow occurs starting at 10AM on Day 2

Source: NERC report on Gas Electric Interdependency

Addressing the Issue

- Improved Communication and Data Exchange
  - Give Gas Control a fighting chance to anticipate what we are going to do!

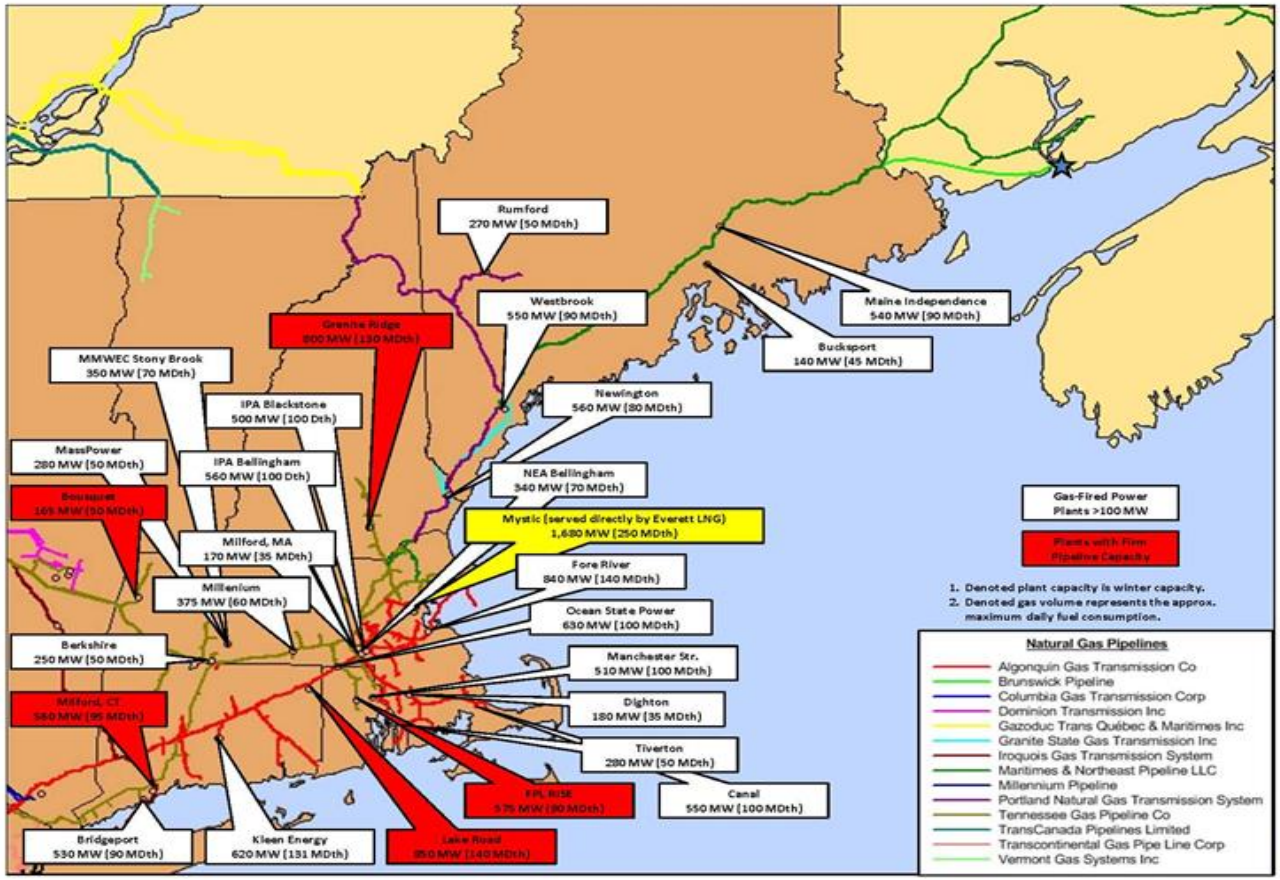
		Daily MW Assignment																							
UNITID	UNITLONGNAME	HE1	HE2	HE3	HE4	HE5	HE6	HE7	HE8	HE9	HE10	HE11	HE12	HE13	HE14	HE15	HE16	HE17	HE18	HE19	HE20	HE21	HE22	HE23	HE24
96032101	VP LADYSMYTH 1 CT	0	0	0	0	0	0	0	167	165	163	161	159	159	157	156	156	155	156	158	160	162	164	166	0
96032102	VP LADYSMYTH 2 CT	0	0	0	0	0	0	0	167	165	163	161	159	159	157	156	156	155	156	158	160	162	164	166	0
96032103	VP LADYSMYTH 3 CT	0	0	0	0	0	0	0	174	173	171	169	167	167	165	164	164	163	165	166	168	170	172	173	0
96032104	VP LADYSMYTH 4 CT	0	0	0	0	0	0	0	174	173	171	169	167	167	165	164	164	163	165	166	168	170	172	173	0
96032105	VP LADYSMYTH 5 CT	0	0	0	0	0	0	0	173	172	170	168	167	166	165	164	164	163	164	166	167	169	171	172	0
96062101	VP REMINGTON 1 CT	0	0	0	0	0	0	0	165	164	162	161	159	158	157	156	156	155	156	157	159	161	163	164	0
96062102	VP REMINGTON 2 CT	0	0	0	0	0	0	0	164	162	161	159	157	156	155	154	154	153	155	156	158	159	161	163	0
96062103	VP REMINGTON 3 CT	0	0	0	0	0	0	0	164	163	161	159	157	157	156	154	154	154	155	156	158	160	162	163	0
96062104	VP REMINGTON 4 CT	0	0	0	0	0	0	0	164	163	161	159	157	157	156	154	154	154	155	156	158	160	161	163	0
96090103	VP CHESTERFIELD 3	0	35.7	35.6	35.6	35.6	35.7	35.8	35.9	35.9	36	45.9	67.1	78.2	85.3	85.3	97.5	97.5	89.2	68.7	51.4	45.1	46.6	35.9	35.8
96090105	VP CHESTERFIELD 5	250.9	250.8	250.7	240	240	240	240	240	240	240	240	240	240	240	240	240	240	240	330	330	330	330	251	250.9
96090106	VP CHESTERFIELD 6	375.9	375.7	375.7	375.6	375.6	375.7	375.8	375.9	375.9	384.8	507.9	660.3	675	675	675	675	675	675	675	552.5	507.9	513.8	375.9	375.9
96090107	VP CHESTERFIELD 7CC	198	199	200	200	201	200	200	199	197	196	195	194	193	192	191	191	191	192	193	194	195	197	198	198
96280101	VP BELLAMEADE 1	257.2	245.3	188.8	174	178	248	255.8	258.8	260.8	264	262	261	261	260	263	263	258	259	260	262	263	264	260.6	256.9
96472101	VP CHESTERF LANDF	0	0	0	0	0	0	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	0	0

Addressing the Issue

- The Market Will Provide Necessary Gas Infrastructure Additions
  - Shippers will need to effectively use the secondary capacity release market at times, if relying on interruptible service
  - Suppliers and generators may need to team up in open season processes to ensure delivery under peak conditions

Prevalence of Interruptible Delivery Service

New England Gas-fired Power Generation (>100 MW)



Majority of power plants are using interruptible gas transmission service!

Addressing the Issue—Electric Side

- Placing limits on the use of quick starting generation
  - Recognition by the electric system operators that gas is a just-in-time fuel system that can only provide limited response in real time (how much for how long on each pipeline?)
  - Need for additional dual fuel capability
  - Use of hydro/pumped storage assets as other than economic energy providers (hydro assets are optimized to river use for run-of-river; pumped storage assets are optimized as energy providers)

Addressing the Issue—Gas Side

- Gas Demand Response
  - Are there gas consumers that would be willing to interrupt processes in the peak hours?
  - Ideal electric demand responder: Industrial gas producer—Large electricity consumer at a single site, can shut down quickly, and come back quickly with minimal impact to the process– are there equivalents in the gas business?

Getting Beyond the “Firm vs. Interruptible” Debate

- Low gas prices are changing the basic dispatch of the system
  - Combined-cycle plants are running like base load plants (>80% capacity factor)
  - Low capacity factor units are still there and needed to handle the occasional high load or forced outage situation (<5% capacity factor)

Getting Beyond the "Firm vs. Interruptible" Debate

- At high capacity factors, the costs of firm and interruptible delivery service start to converge

	Firm (FT-1)	Interruptible (IT-1)
Reservation ($10.91/dth/mo)	$3,257,402	
Usage (FT-$0.09/dth, IT-$0.45/dth)	$681,783	$3,282,848
TOTAL	$3,939,186	$3,282,848
or	**$3.20/MWh**	**$2.67/MWh**
If electricity is $50/MWH, then gas transportation is	6.4% of energy offer	5.3% of energy offer

So, high capacity factor units can begin to "afford" firm service, but the low capacity factor units cannot!

The Real Issue

- To what degree can the gas pipeline system supply the occasional instantaneous start-up of electric generators to deal with high loads (somewhat predictable) and forced outages (completely random)?
- As a customer of the gas industry, the electric generator is analogous to wind generators or electric arc furnaces for the electric industry
  - Can be intermittent and minimally predictable at times

The Answer!

- Trust that the gas industry market forces will add capacity as needed, based on the existing paradigm
  - In areas where there is high reliance on gas, e.g. New England, require firm gas service or dual fuel capability for a substantial portion of the capacity (ISO-determined)
- Develop understanding on both sides of the limitations that exist
  - How much instantaneous capacity is available on each pipeline?
  - Share operational information to minimize surprises

Summary

- Power generation is a “double edged sword” for the gas business
  - Largest growth market
  - Potential to cause problems in operations
- Working together, we can minimize the operational problems
  - Awareness of the limitations on each side
  - Increased real time communications across the aisle
  - Use of the demand side resources on each side