

# Eastern Interconnection Planning Collaborative's (EIPC) Gas -Electric System Interface Study



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*Target 3 Results - Natural Gas and Electric System Contingency Analysis*

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# Gas-Electric System Interface Study

## Target 3

### Natural Gas and Electric System Contingency Analysis

March 3, 2015

**LEVITAN & ASSOCIATES, INC.**  
MARKET DESIGN, ECONOMICS AND POWER SYSTEMS

# Acknowledgement and Disclaimer

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### Acknowledgement:

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# Agenda

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- ◆ Introduction
- ◆ Research Objectives
- ◆ Method and Models
- ◆ ISO-NE Results
- ◆ Mitigation Measures
- ◆ Milestone Schedule
- ◆ Appendix

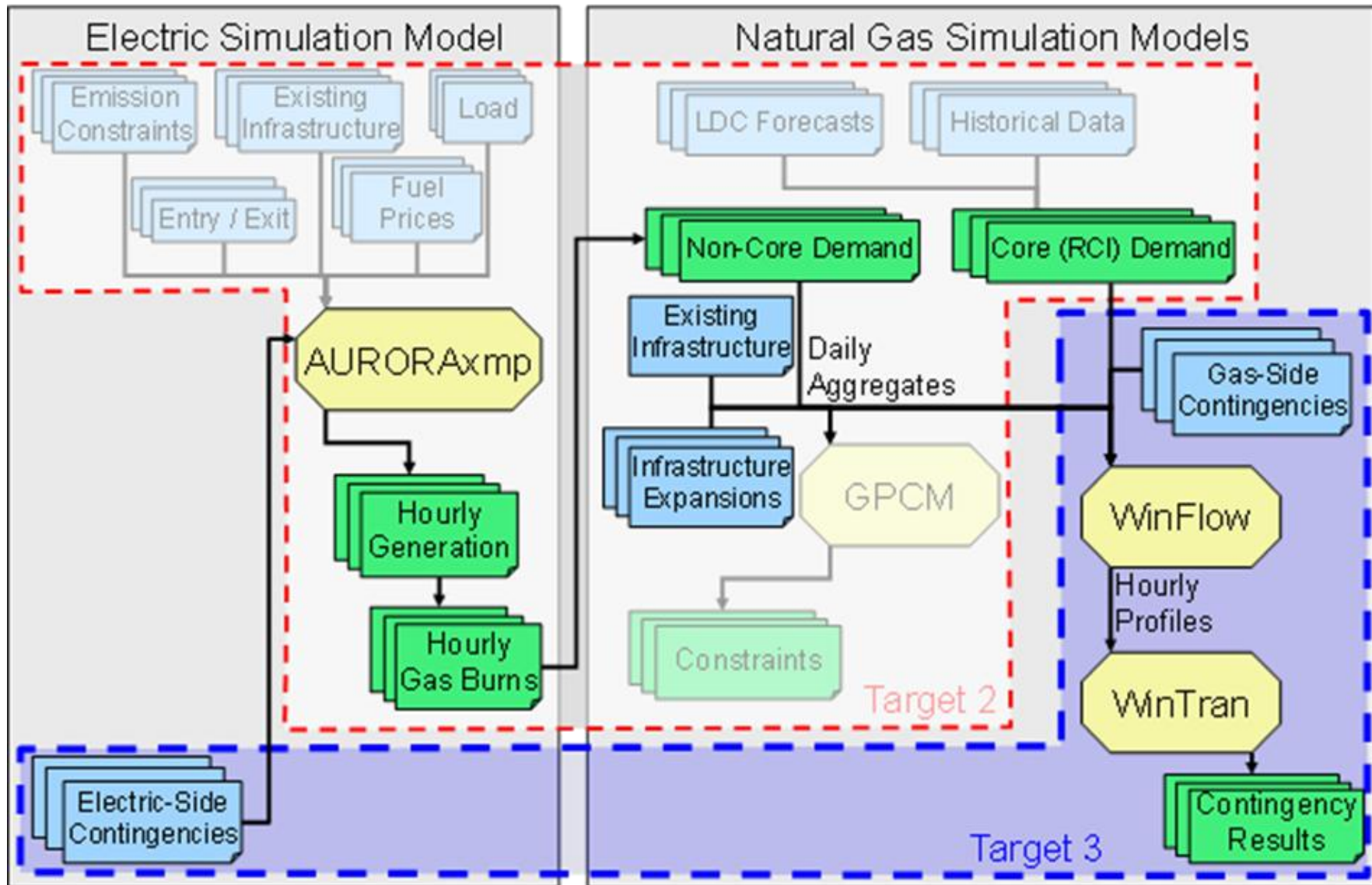
# Target 3 Primary Research Objectives

1. Test the resiliency of the consolidated network of pipeline and storage facilities when gas or electric equipment failures are postulated in the vicinity of gas-fired generators in each PPA
2. Identify operational measures that can mitigate the adverse impacts of gas- and electric-side contingencies, including market initiatives

# Key Terms

- ◆ RGDS or R – Reference Gas Demand Scenario
  - Modeled for 2018 and 2023
  - Winter and summer peak days
- ◆ HGDS or H – High Gas Demand Scenario
  - Modeled for 2018 only
  - Winter and summer peak days
- ◆ S0 – “Sensitivity 0” incorporates existing and planned system resources in the Study Region known by April, 2014
- ◆ WinFlow – Steady-state pipeline hydraulic model
- ◆ WinTran – Transient pipeline hydraulic model
- ◆ Affected Generation – Generation that may not be fueled by natural gas due to pipeline and/or LDC infrastructure constraints following a contingency

# Target 3 Model Components



# Target 3 Approach

- ◆ Select pipeline segments across the Study Region that exhibited congestion effects based on Target 2 results
- ◆ Identify 2-5 gas-side contingencies and 3-8 electric-side contingencies in each of six PPAs
  - Gas-side contingencies include compressor outages, pipeline ruptures, and loss of major storage deliverability
  - Electric-side contingencies include loss of transmission and major generator(s)
  - IESO contingencies modeled by TransCanada and the LDCs
- ◆ Pre- and post-contingency hourly gas use profiles derived from AURORAxmp chronological production cost model based on RGDS and HGDS



# Target 3 Approach (cont'd)

- ◆ Sub-hourly ramping profiles developed for each gas-fired technology type
- ◆ Prior to any contingency, utilize baseline pressure and flow within the PPA-specific consolidated pipeline model(s) to determine whether the full fuel quantities are deliverable
- ◆ Apply WinTran (transient flow) model to the consolidated pipeline model to quantify over the next 24 post-contingency hours:
  - Affected generation (GWh or MWh)
  - Time-to-trip interval, *i.e.*, insufficient pressure to sustain scheduled operation on gas

# Structure of the Target 3 Report

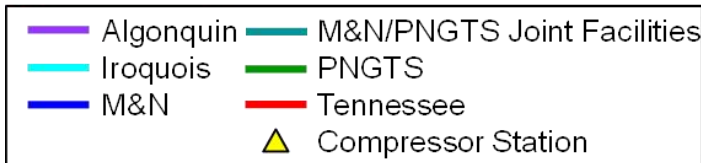
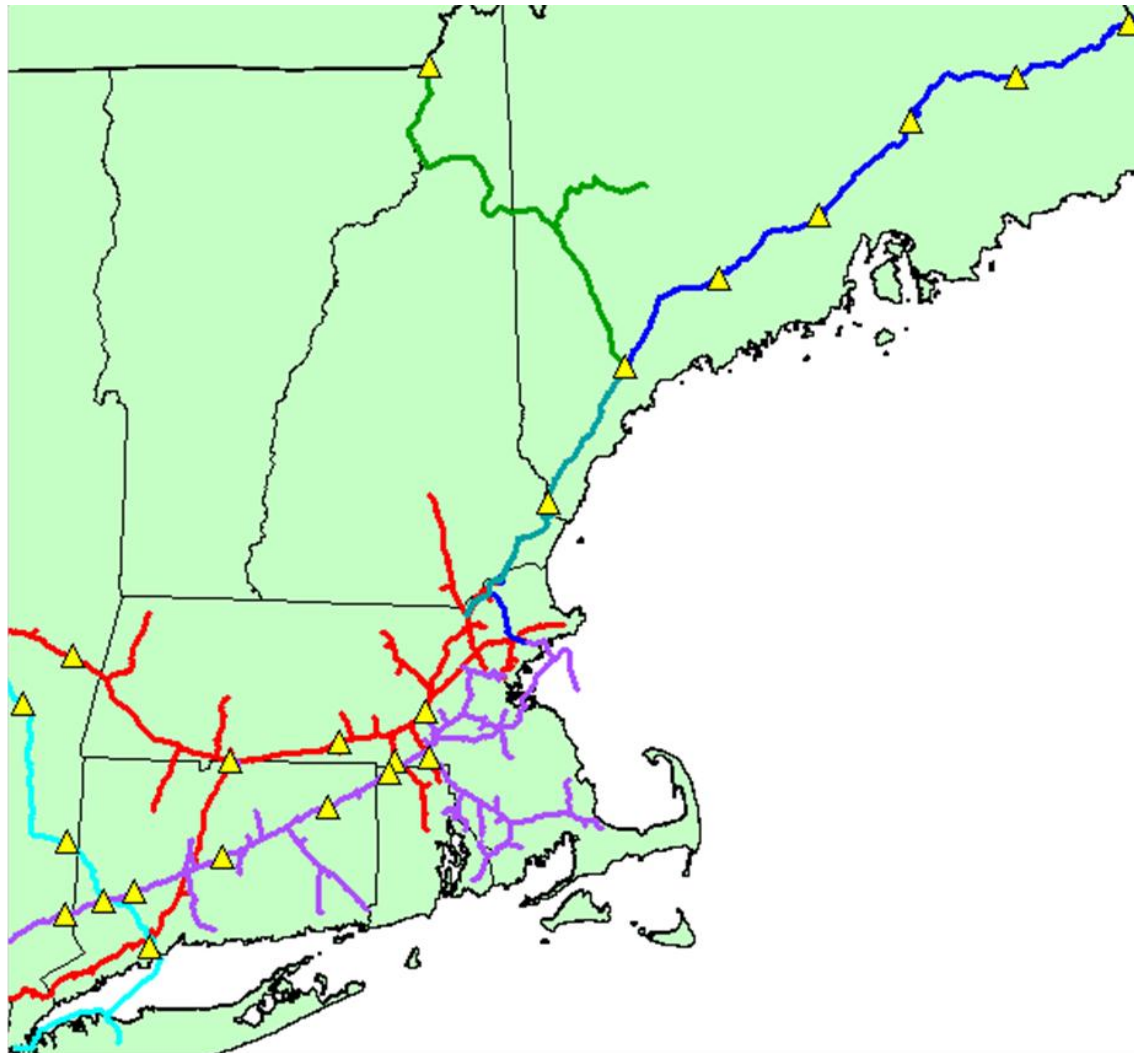
## ◆ Report

- Modeling description and assumptions
- Baseline hydraulic model results
- Gas-side contingency analysis
- Electric-side contingency analysis
- Mitigation measures to alleviate contingency impacts

## ◆ Appendices

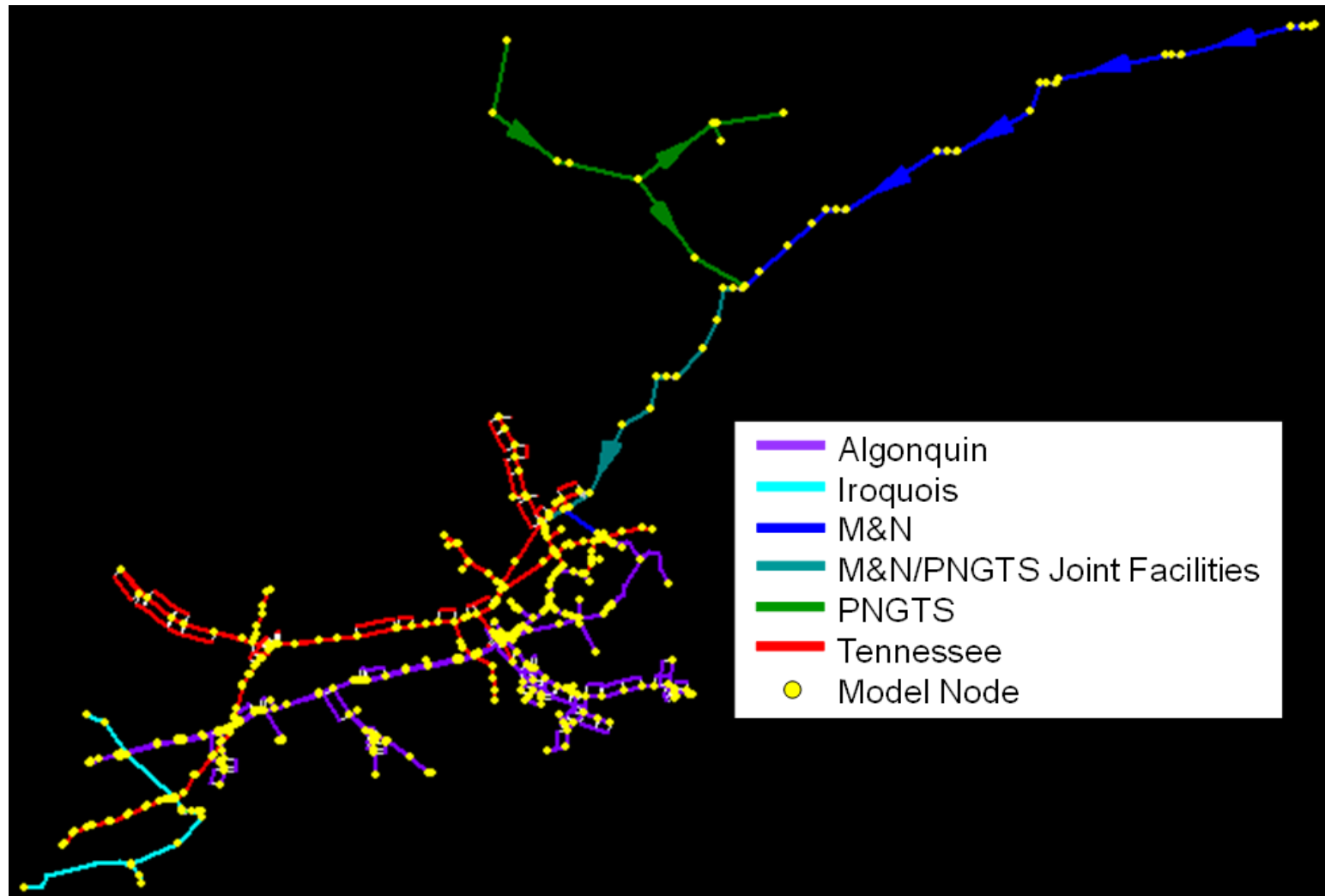
- Results for selected LDCs in PJM and NYISO as well as IESO (province wide)

# ISO-NE Gas Pipeline Map



# Consolidated ISO-NE Pipeline Model

Target 3 Results



# Target 3 Representative Results

# Baseline Results – RGDS Winter 2018

PPA	Scheduled Gas (MDth)	Scheduled Energy (MWh)	Scheduled Energy with Undeliverable Gas (MWh)	Scheduled Energy with Undeliverable Gas (%)
ISO-NE	1,136	156,821	19,979 (gas only) 489 (dual fuel)	13
MISO	1,874	257,301	26,655 (gas only) 21,352 (dual fuel)	19
NYISO	637	86,428	5,238 (gas only) 6,980 (dual fuel)	14
PJM	2,607	352,687	10,707 (gas only) 13,322 (dual fuel)	7
TVA	1,187	169,348	0 (gas only) 0 (dual fuel)	0

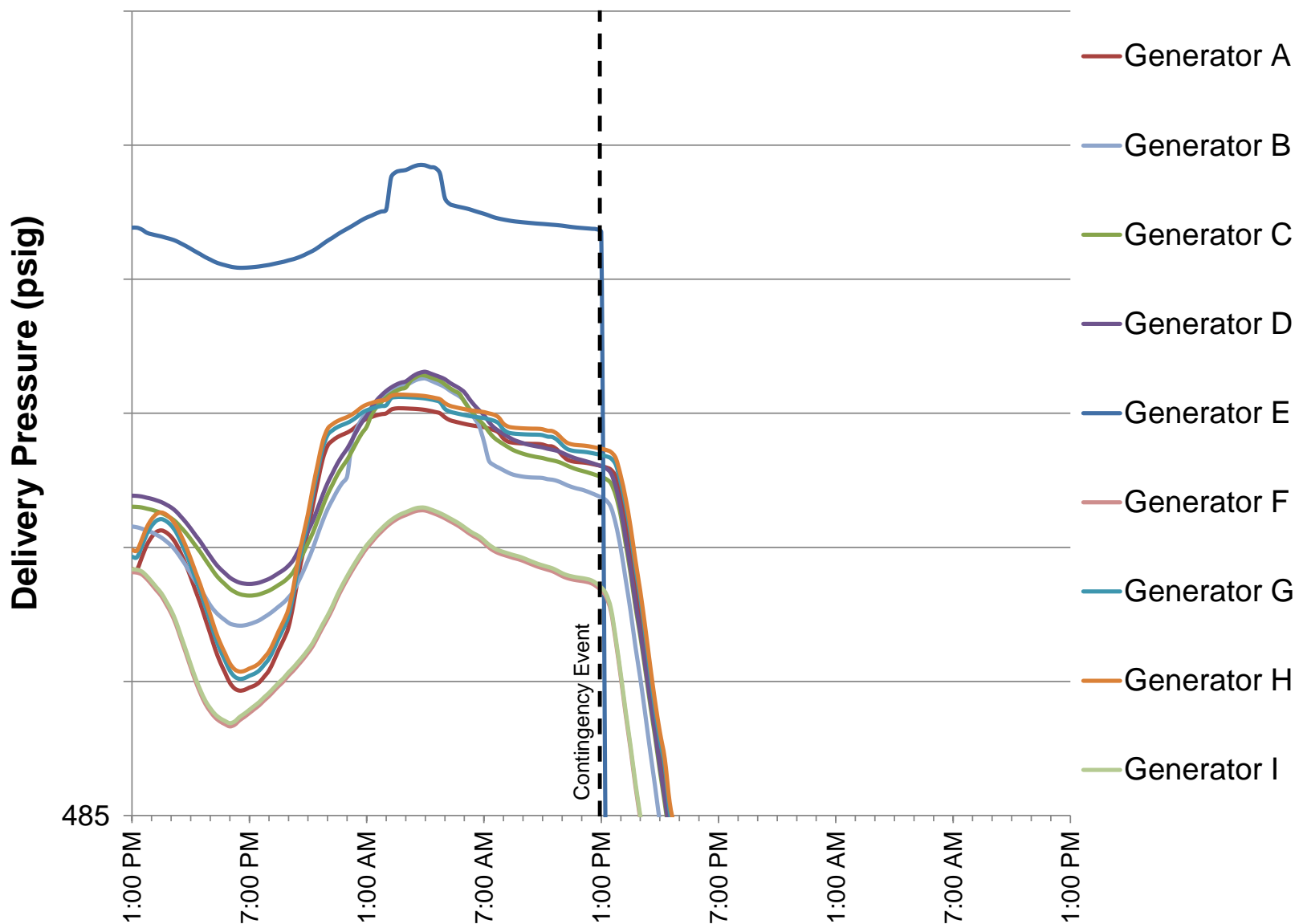
*Note: Results include only the footprint included in each PPA's hydraulic model*

# Baseline Results – RGDS Summer 2018

PPA	Scheduled Gas (MDth)	Scheduled Energy (MWh)	Scheduled Energy with Undeliverable Gas (MWh)	Scheduled Energy with Undeliverable Gas (%)
ISO-NE	2,286	281,745	5,905 (gas only) 40,469 (dual fuel)	16
MISO	2,744	358,026	12,254 (gas only) 6,471 (dual fuel)	5
NYISO	1,133	138,542	1 (gas only) 13,999 (dual fuel)	10
PJM	7,827	1,014,709	44,317 (gas only) 63,070 (dual fuel)	11
TVA	1,147	161,209	0 (gas only) 0 (dual fuel)	0

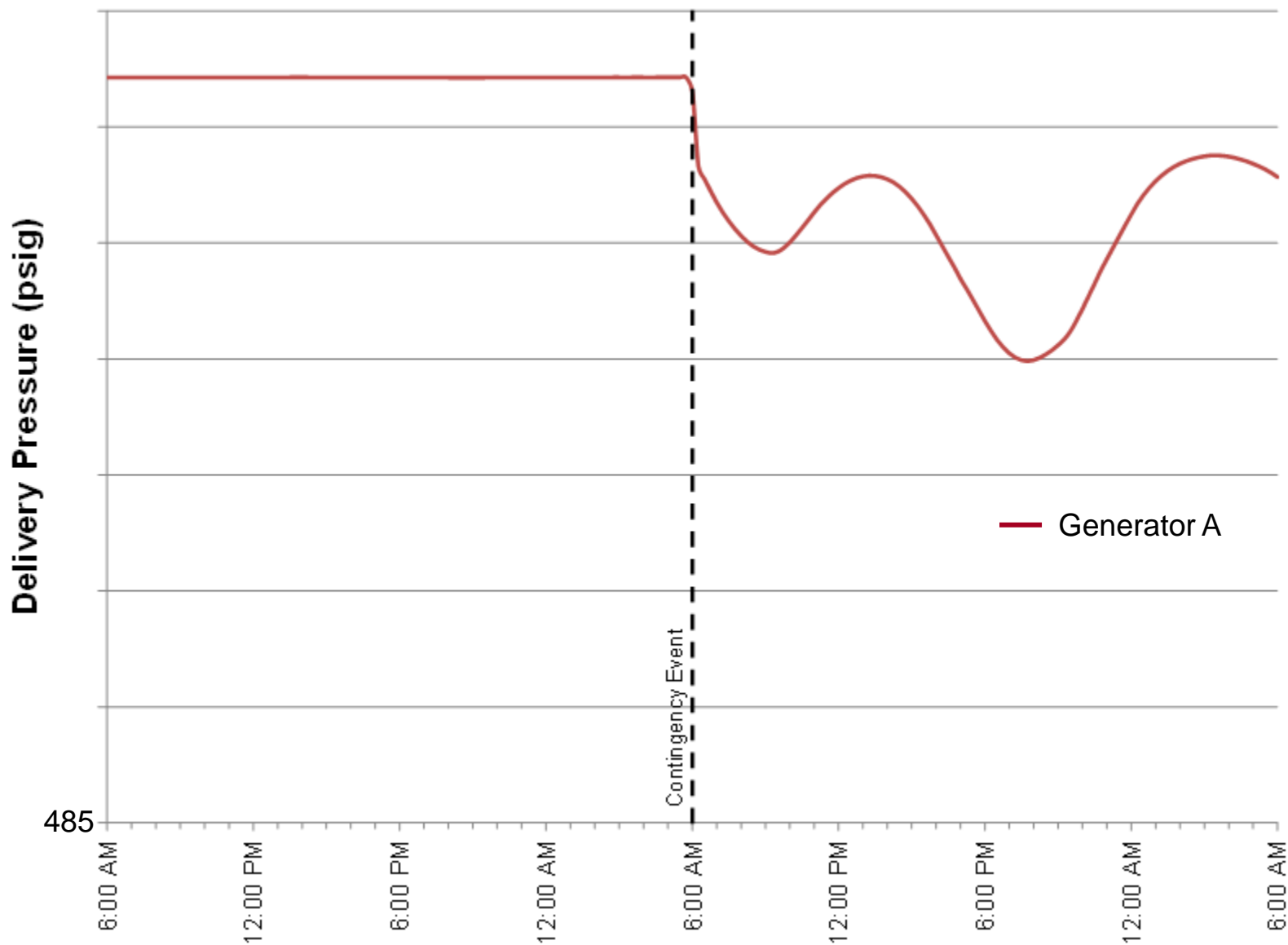
*Note: Results include only the footprint included in each PPA's hydraulic model*

# Example Transient Model Results (1)

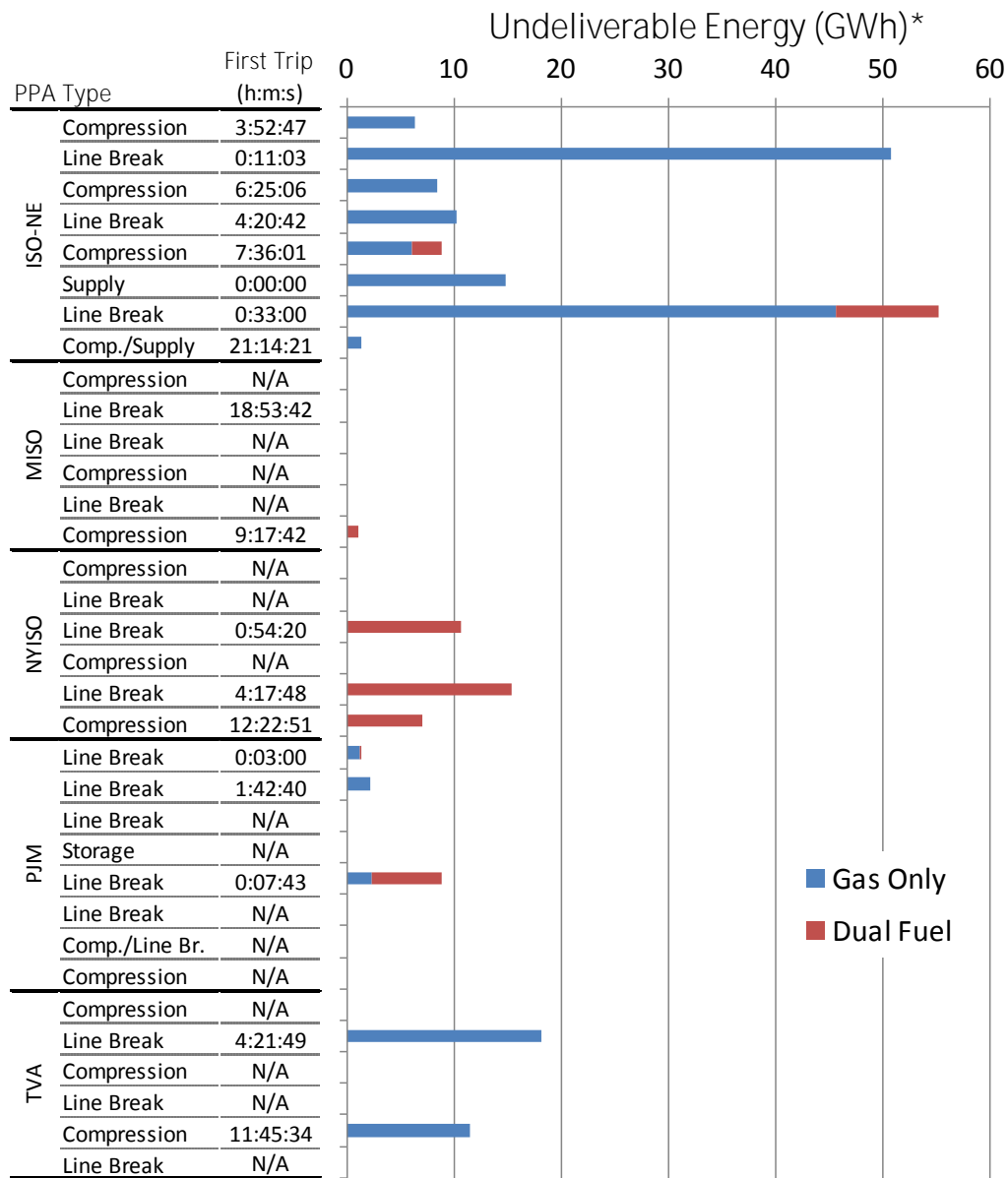




# Example Transient Model Results (2)



# Results of Gas-Side Contingencies – Winter 2018



\* Scheduled energy with undeliverable gas

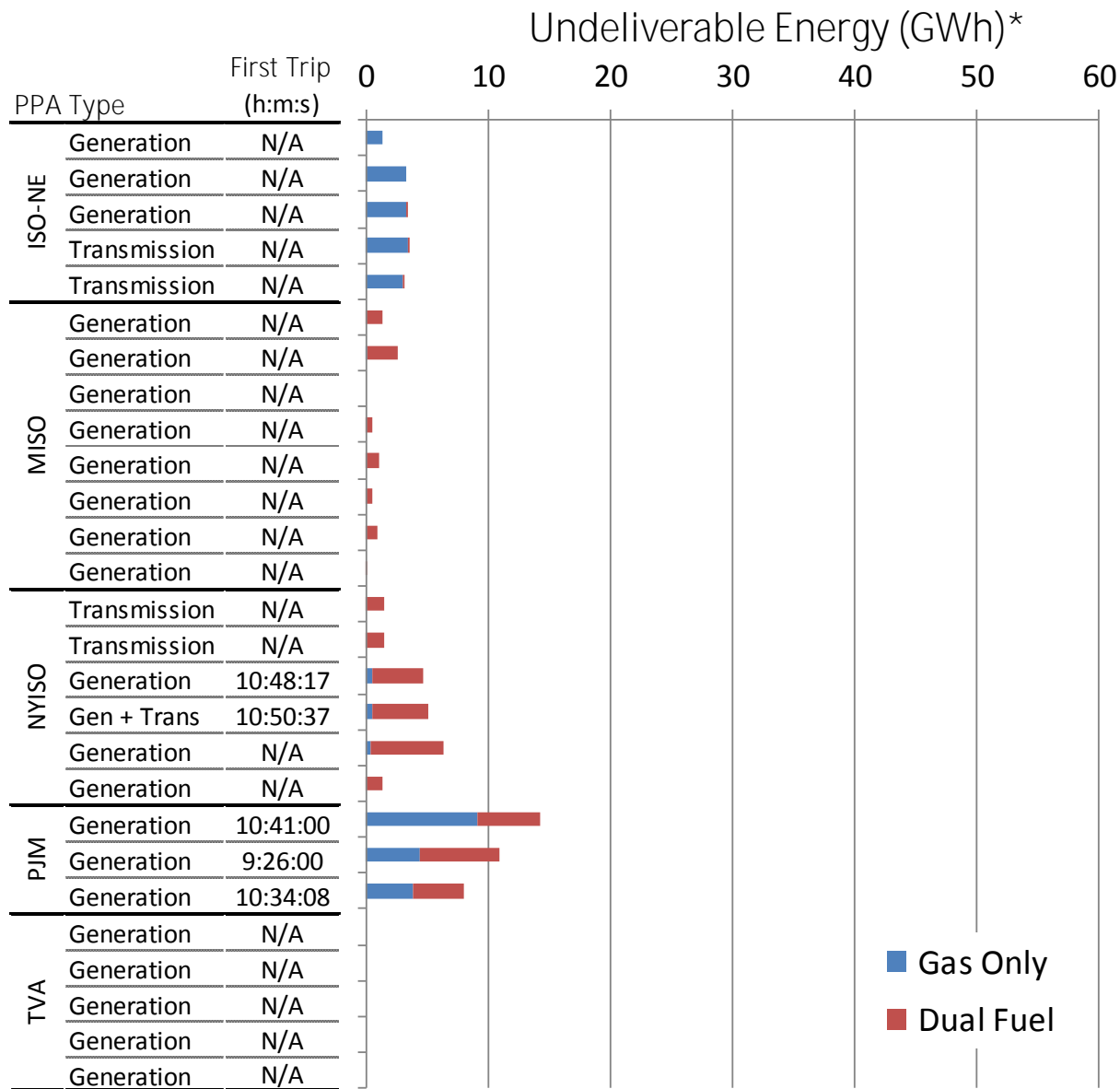
# Results of Gas-Side Contingencies – Winter 2018

- ◆ Severity of the contingency event impacts characterized by short time-to-trip intervals and large quantity of affected generation
- ◆ ISO-NE exhibited most severe impacts
  - Most affected generation not dual fuel capable
- ◆ PJM (MAAC area) and NYISO (Lower Hudson Valley and downstate) exhibited isolated pockets of affected generation
  - Substantial portion of affected generation is dual fuel capable
- ◆ MISO (North/Central), PJM (rest of RTO), TVA, IESO have less affected generation
  - Consolidated pipeline network and storage facilities provides resiliency

# Results of Gas-Side Contingencies – Summer 2018

- ◆ Outside of ISO-NE and the EMAAC and SWMAAC parts of PJM, network of pipeline and storage infrastructure results in negligible affected generation
- ◆ In ISO-NE, pipeline pressure limitations potentially constrain availability of gas-fired units
  - Redispatch of other units and other electric system operator actions can mitigate impacts
- ◆ Results are assumptions based, many of which were defined in Q2-2014

# Results of Electric-Side Contingencies – Winter 2018



\* Scheduled energy with undeliverable gas

# Results of Electric-Side Contingencies

- ◆ For RGDS Winter 2018, results show
  - Affected generation in ISO-NE, NYISO and PJM happens many hours after the event
  - Dual-fuel capable units in MAAC portion of PJM and NYISO lessen impacts
  - Negligible affected generation in MISO, none in TVA

# Contingency Mitigation

- ◆ Intrinsic – Operator actions included as part of the model solutions
  - Use of line-pack
  - Increased interconnect flows from neighboring pipelines
  - Increased utilization of spare horsepower from downstream compression stations
  - Reversal-of-flow across key pipeline segments
- ◆ Extrinsic – Considered in the analysis, but not included in the model solutions
  - Communication initiatives among the PPAs, pipelines and/or LDCs
  - Select pipeline tariff innovations
  - Continued efforts to promote harmonization of gas day and electric day scheduling procedures

# Target 3 Production Schedule

- ◆ Proposed key milestones

- Final draft report to DOE: Early April 2015

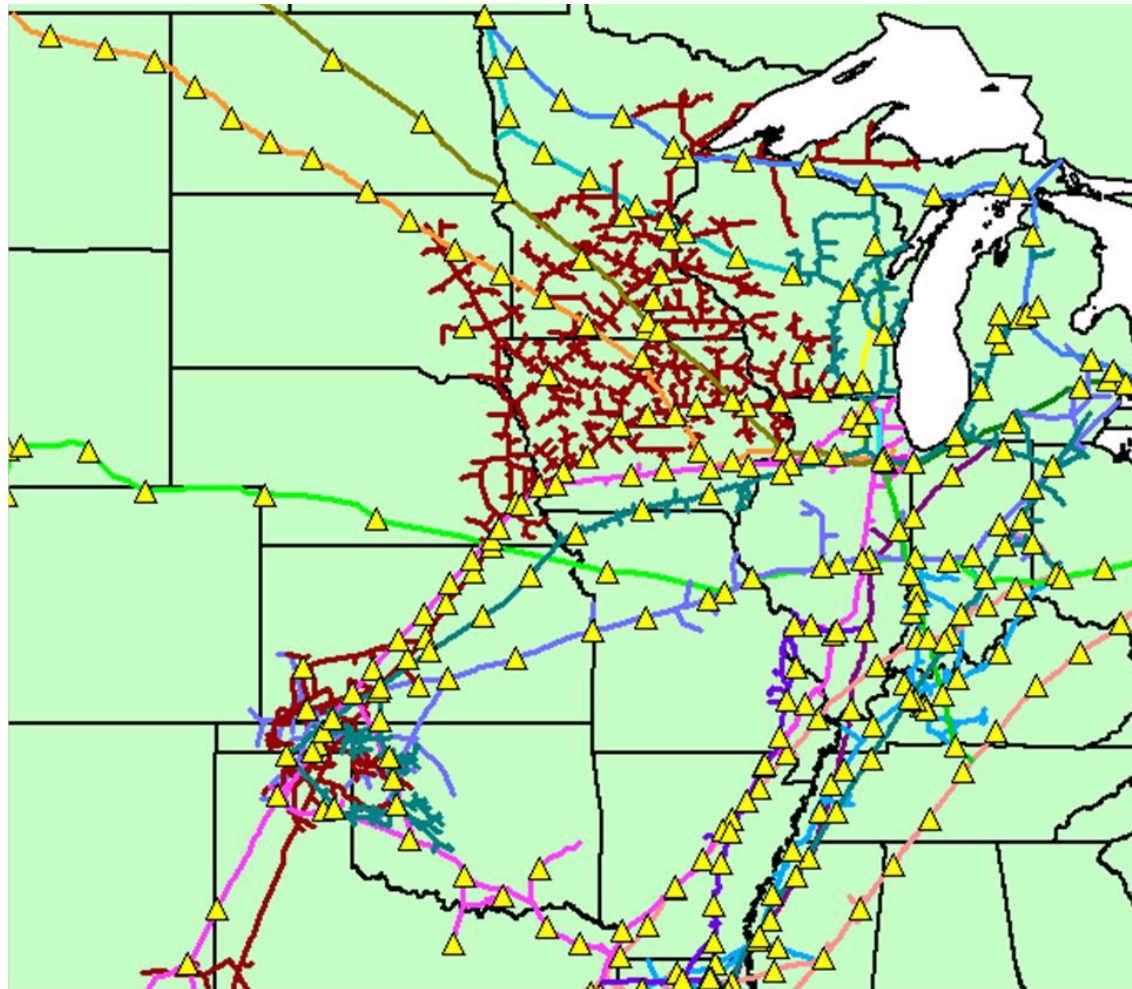


# Appendix

# Appendix – Other PPA Maps & Models

- ◆ MISO
- ◆ NYISO
- ◆ PJM
- ◆ TVA

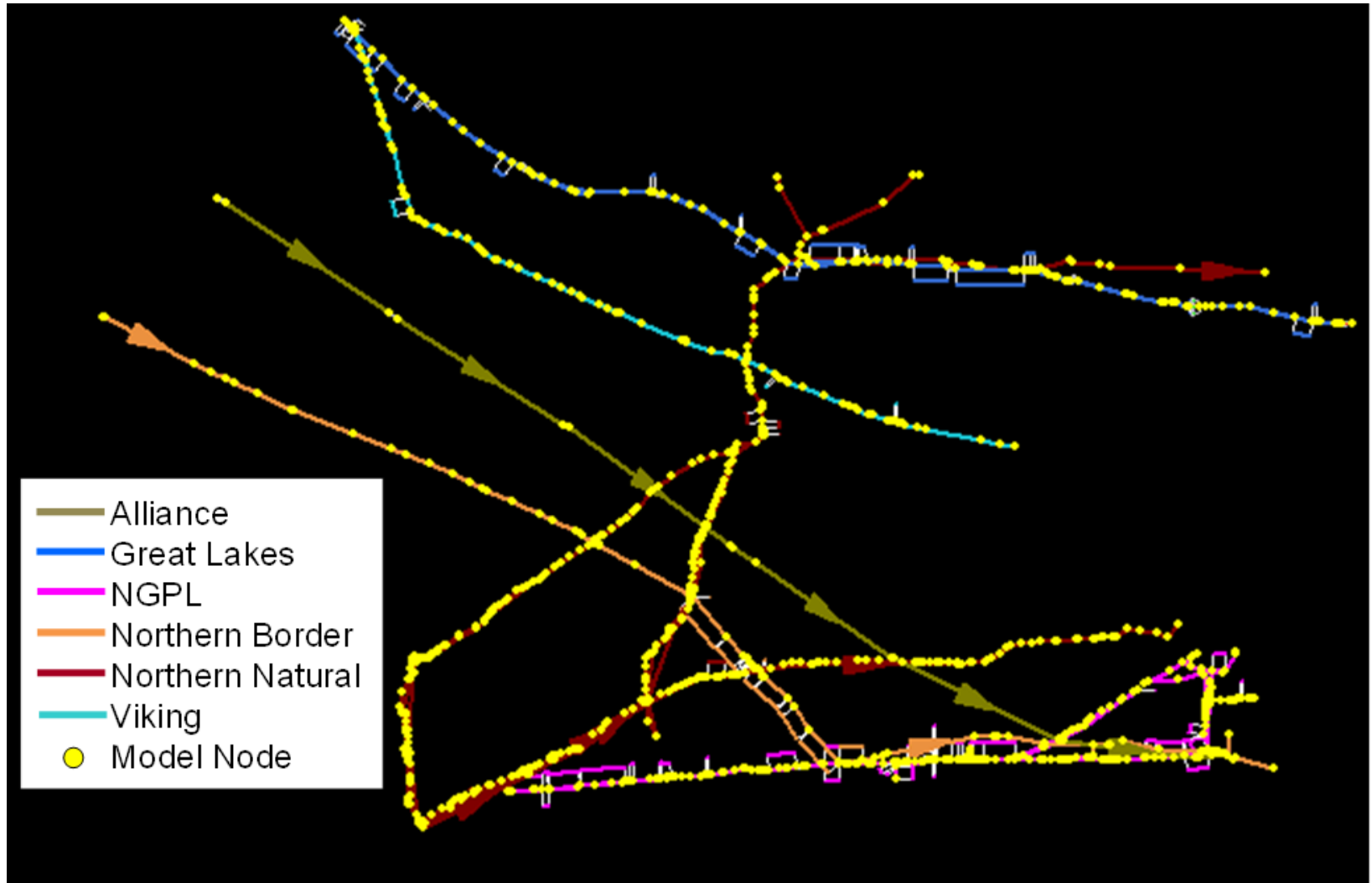
# MISO Gas Pipeline Map



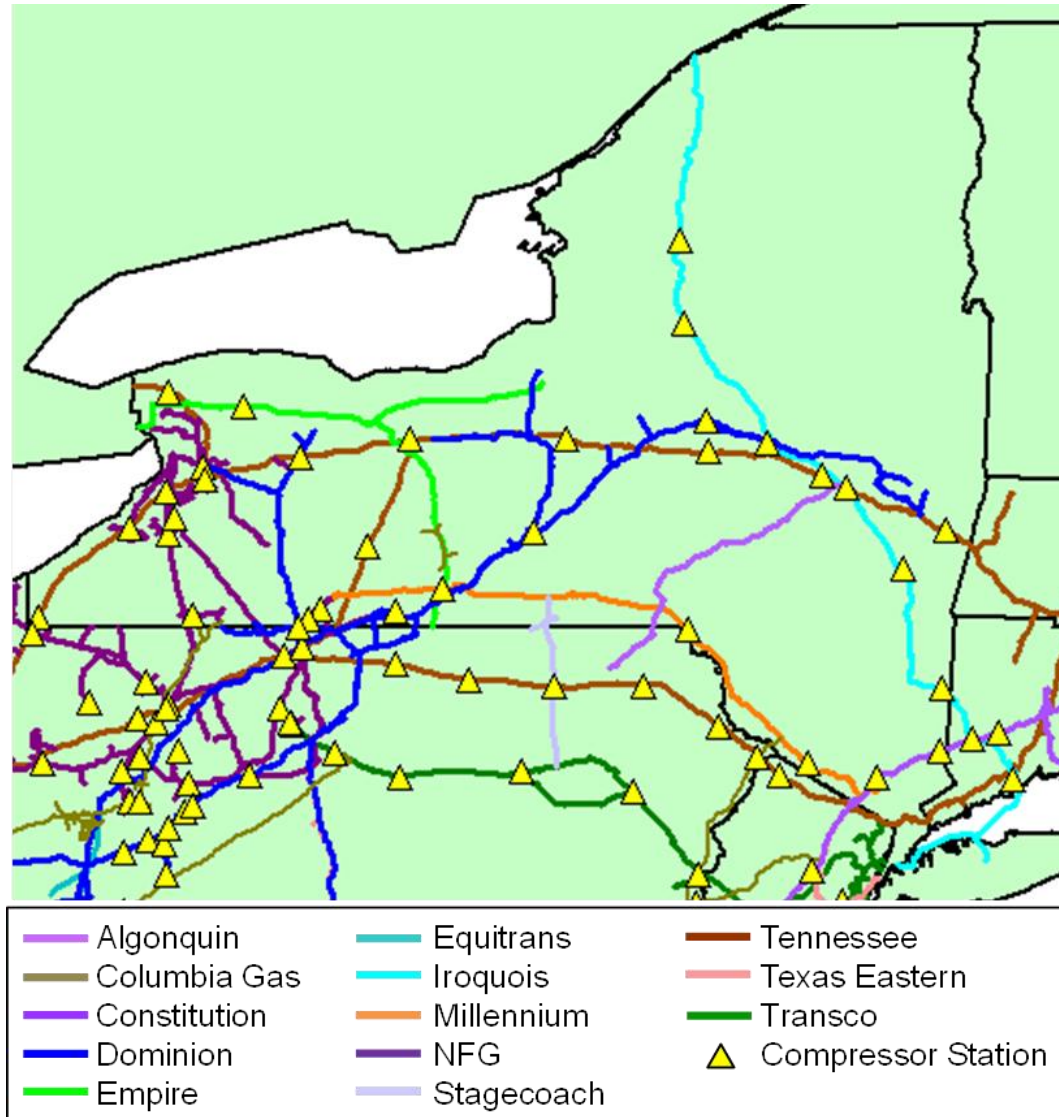
— Alliance	— NGPL	— Texas Gas
— ANR	— Northern Border	— Trunkline
— Great Lakes	— Northern Natural	— Vector
— Guardian	— Panhandle Eastern	— Viking
— Midwestern	— Rockies Express	▲ Compressor Station
— Mississippi River	— Texas Eastern	

# Consolidated MISO Pipeline Model: MN and IA

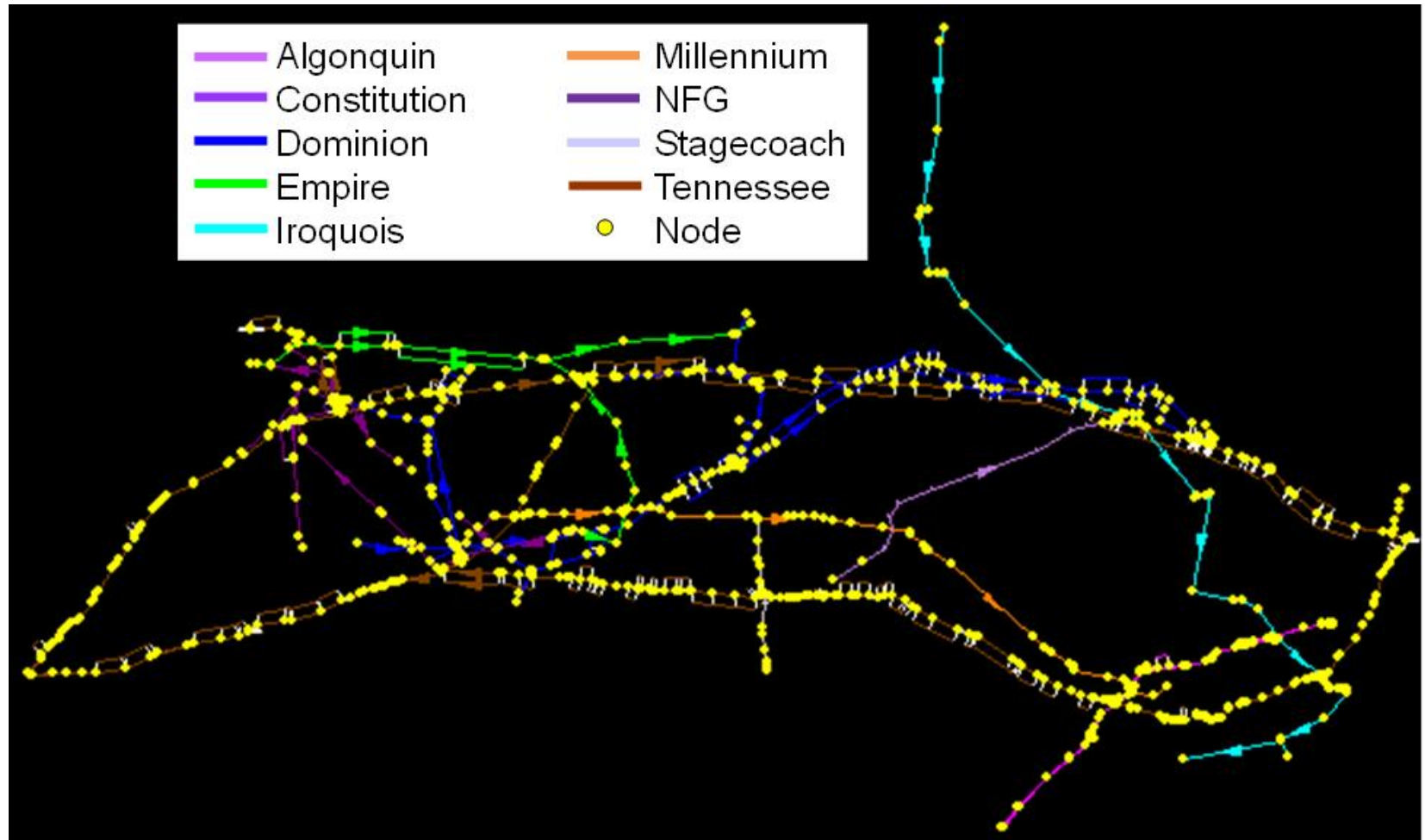
Target 3 Results



# NYISO Gas Pipeline Map

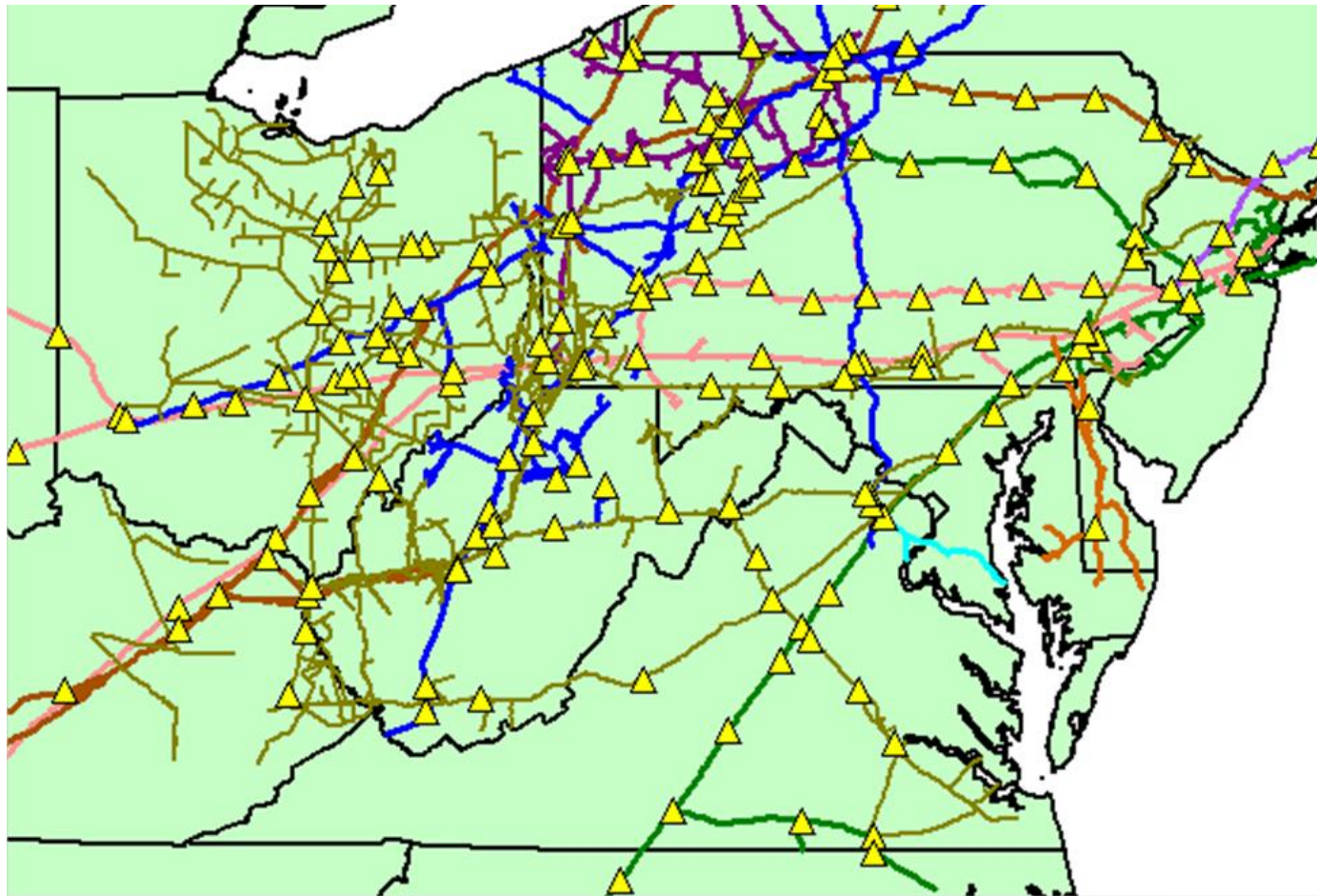


# Consolidated NYISO Pipeline Model



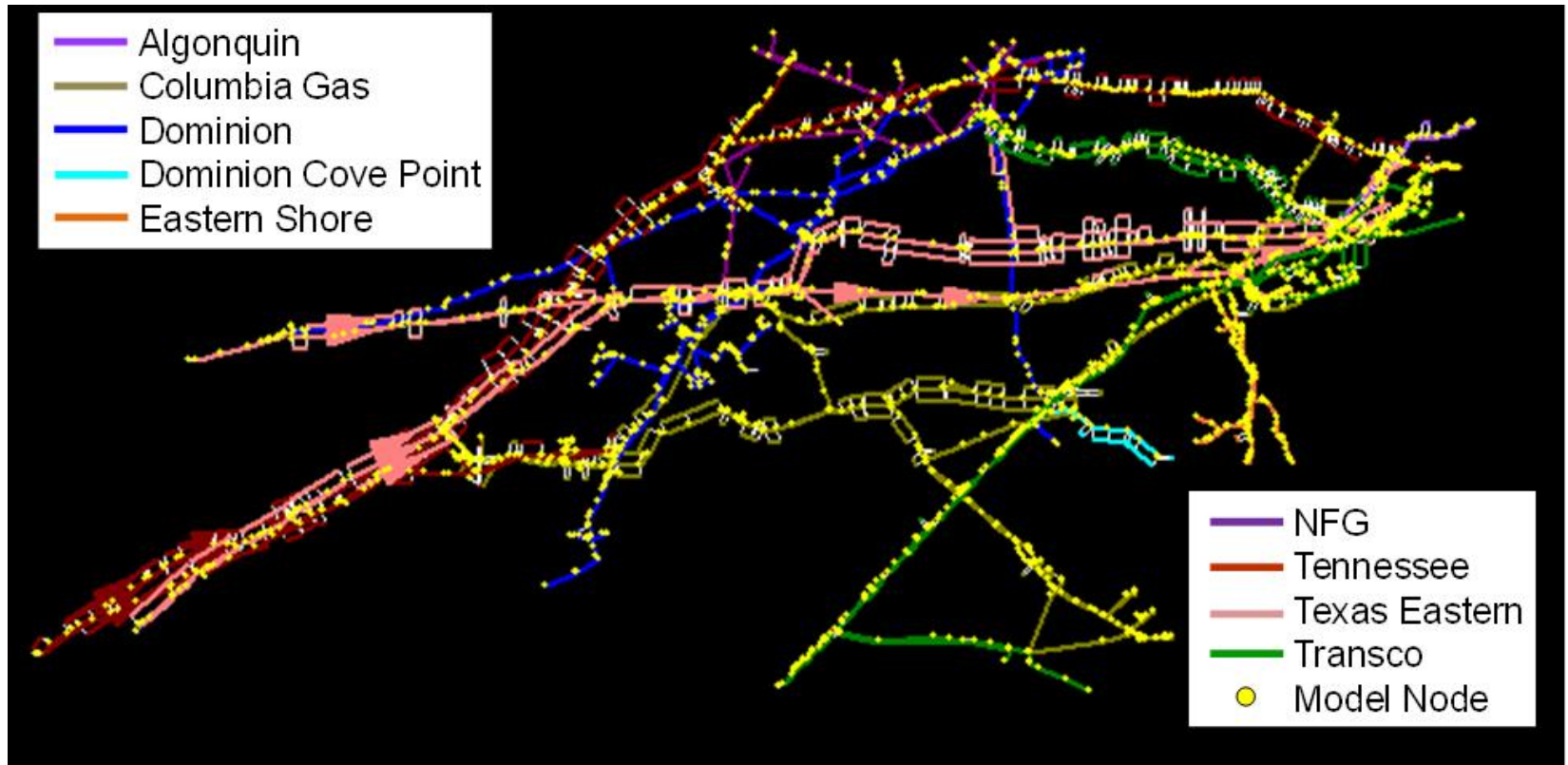


# PJM Pipeline Map



Algonquin	Eastern Shore	Texas Eastern
Columbia Gas	NFG	Transco
Dominion	Tennessee	Compressor Station
Dominion Cove Point		

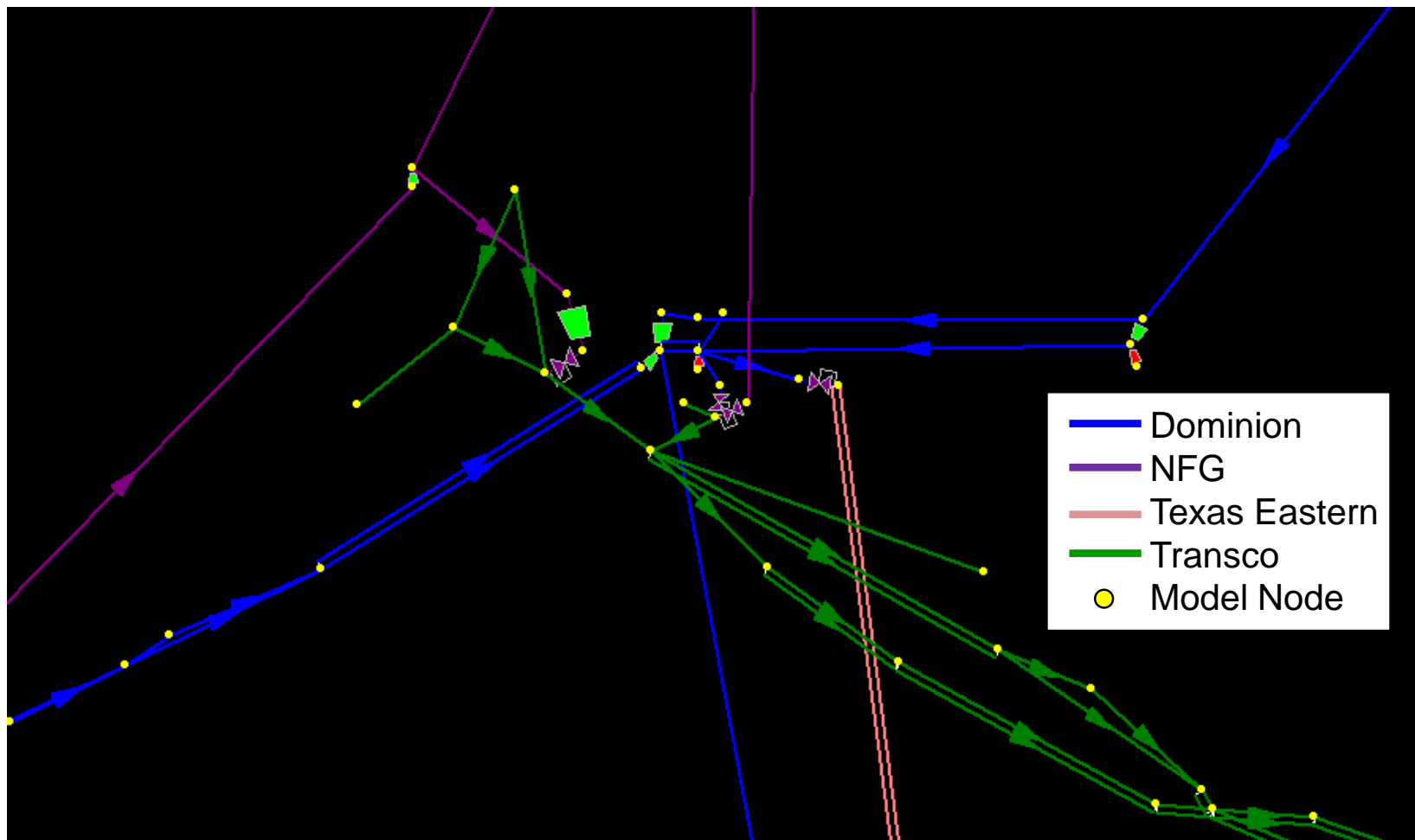
# PJM Consolidated Pipeline Model



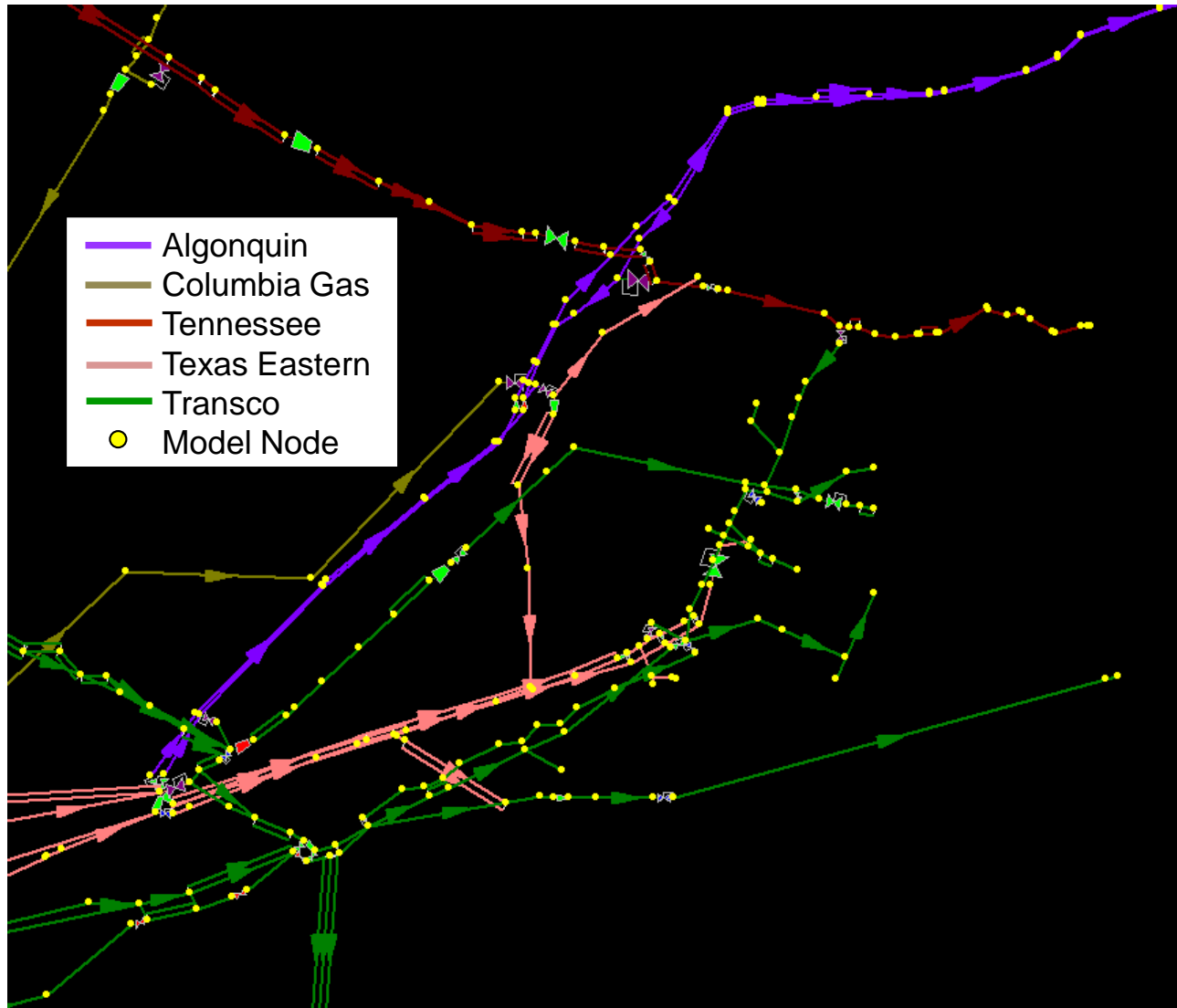


# Leidy Storage Area

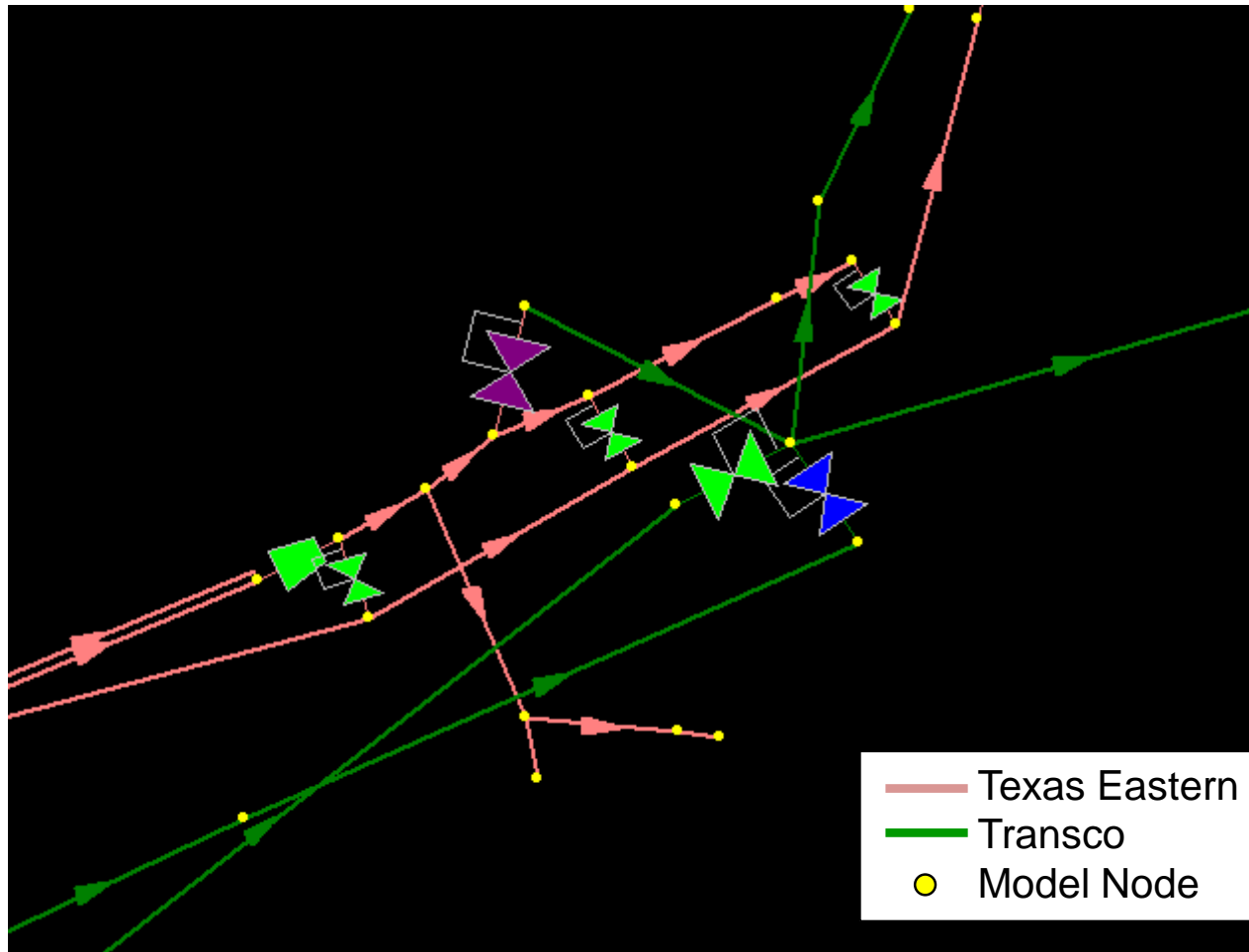
Target 3 Results



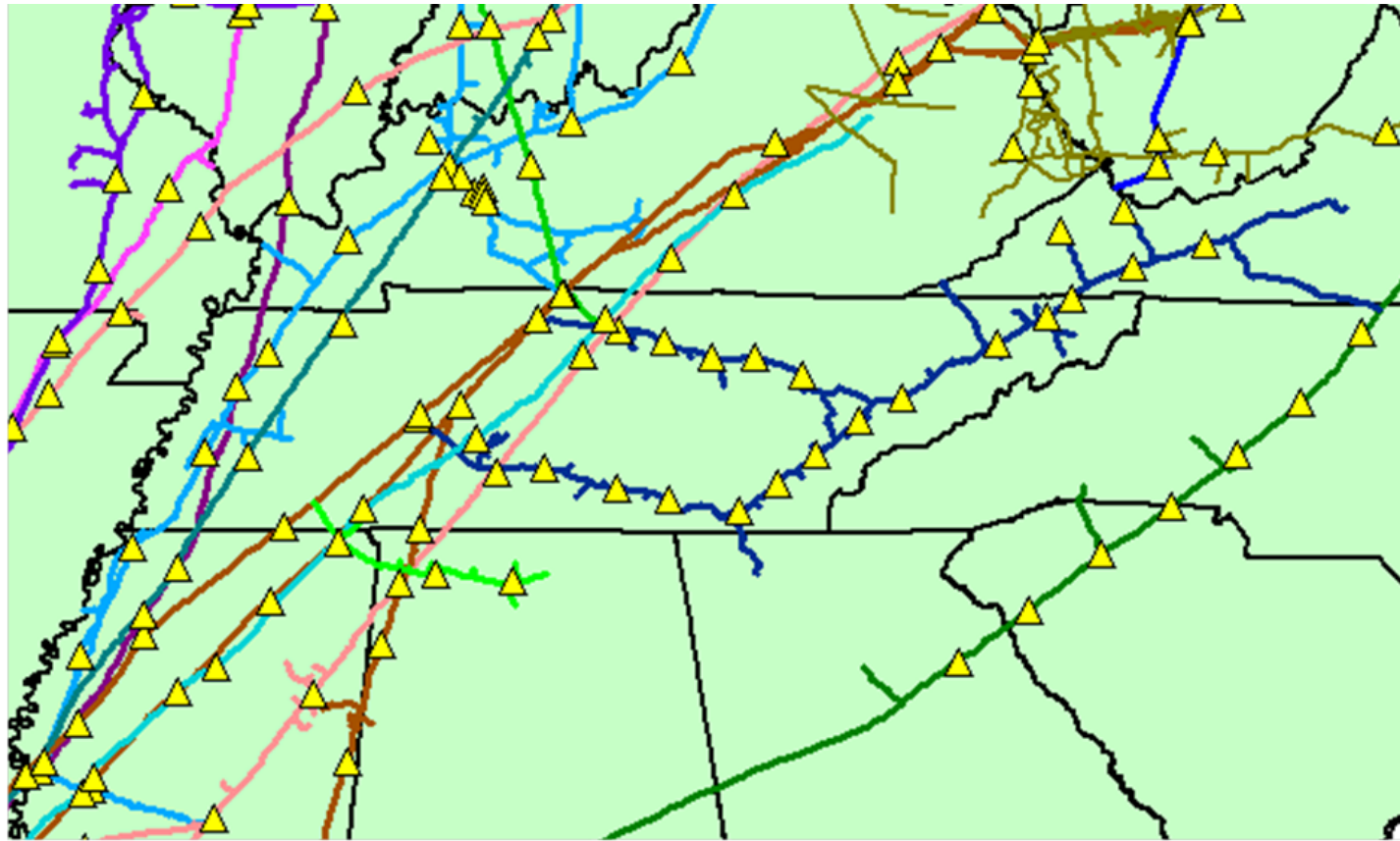
# Northern New Jersey



# Linden



# TVA Pipeline Map



AlaTenn	East Tennessee	Texas Eastern
ANR	Midwestern	Texas Gas
Columbia Gas	Mississippi River	Transco
Columbia Gulf	NGPL	Trunkline
Dominion	Tennessee	Compressor Station

# TVA Consolidated Pipeline Model

