

ARGONNE'S *NGINSIGHT* TOOL FOR ELECTRIC SECTOR RELIABILITY



ARGONNE NATIONAL LABORATORY

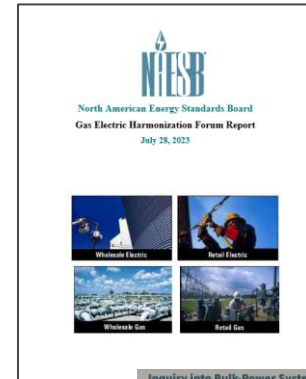
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Relevance of *NGInsight* Tool for Electric-Gas Sector Coordination and Communications

- Recommendations of North American Energy Standards Board (NAESB) report to “identify concrete actions (...) to improve the reliability of the natural gas infrastructure system necessary to support the Bulk Electric System”:

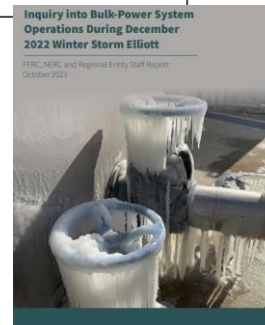
Recommendation 2: The FERC should take steps to facilitate the expansion of the Argonne National Laboratory NGInsight tool, with funding from a federal governmental agency, such as the Department of Energy, to improve situational awareness and communication between the natural gas pipeline system and Bulk Electric System operators. Access to and use of this tool should include appropriate security protocols and market protections.

Recommendation 3: The FERC should take steps to facilitate the expansion of the Argonne National Laboratory NGInsight tool, with funding from a federal governmental agency, such as the Department of Energy, to improve situational awareness and communication between owners and operators of natural gas production and processing facilities and Bulk Electric System operators. Such communication could include aggregated volume data or confirmed scheduled quantities for key upstream receipt points. Access to and use of the tool should include appropriate security protocols and market protections.



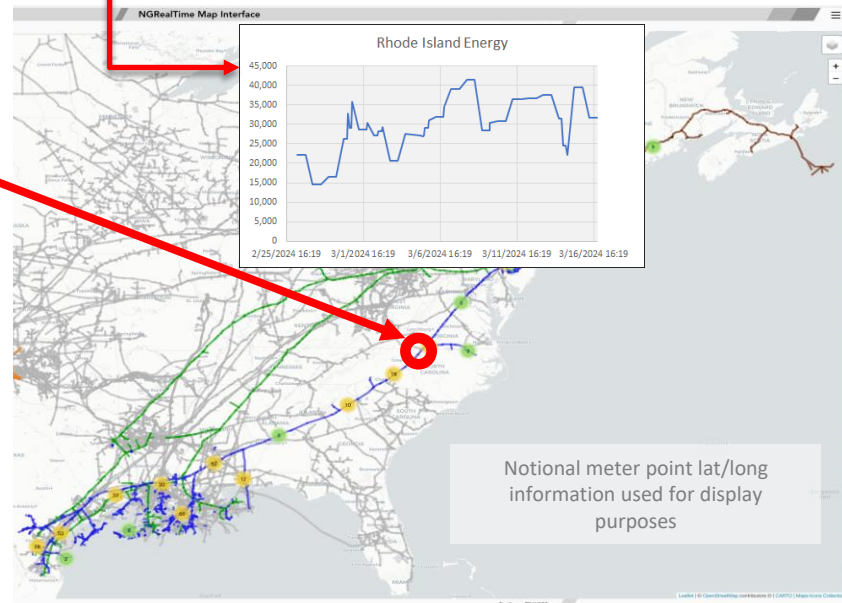
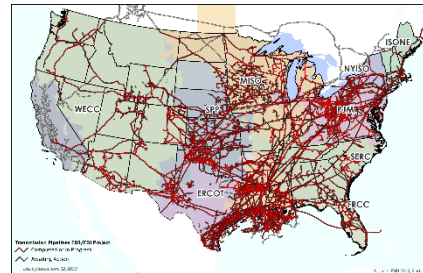
- FERC–NERC Final Report on Winter Storm Elliott supported these recommendations:

NAESB Report Recommendations 2 and 3 identified a potential tool that can be used to accomplish the desired information sharing—Argonne National Laboratory’s *NGInsight* Tool.³¹⁵ The tool makes it possible to identify the potential impact of weather or other critical events on overall natural gas supply.³¹⁶

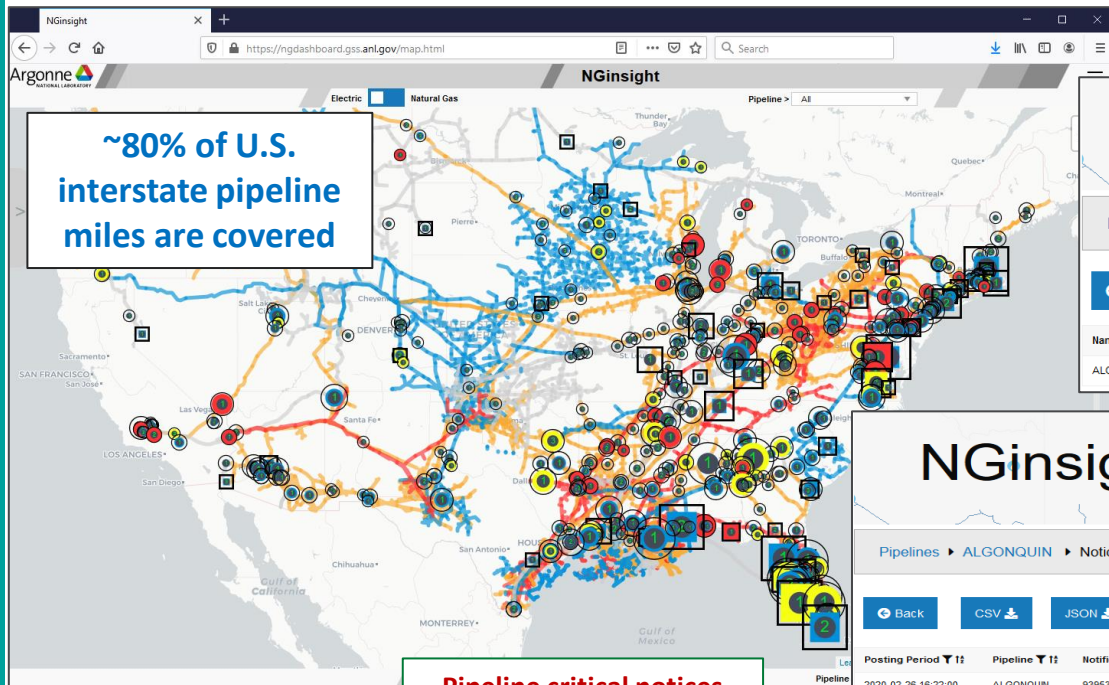


Near-Real-Time Natural Gas Interstate Pipeline Data

- Argonne-developed *NGInsight* viewer:
 - Natural gas supply for gas-fired generators.
 - Interruptible vs. firm MW capacity served.
 - Dual-fuel vs. single-fuel plants; single connect vs. multiple connect.
 - Ranked critical notices.
 - Rankings customized for individual user organizations.
 - Outreach to electric and gas industry companies including EIA, EIPC, ISO-NE, NY-ISO, PJM, AGA, and INGAA for testing.



NGinsight Assimilates Near-Real-Time Gas Data



Map Display

Pipeline critical notices flagged during 2021 Texas cold snap

Reports Display

NGinsight Reports

Pipelines ▸ ALGONQUIN

[Back](#) [Locations](#) [History](#) [Posting](#) [Notices](#)

Name ▼ 1: ALGONQUIN

NGinsight Reports

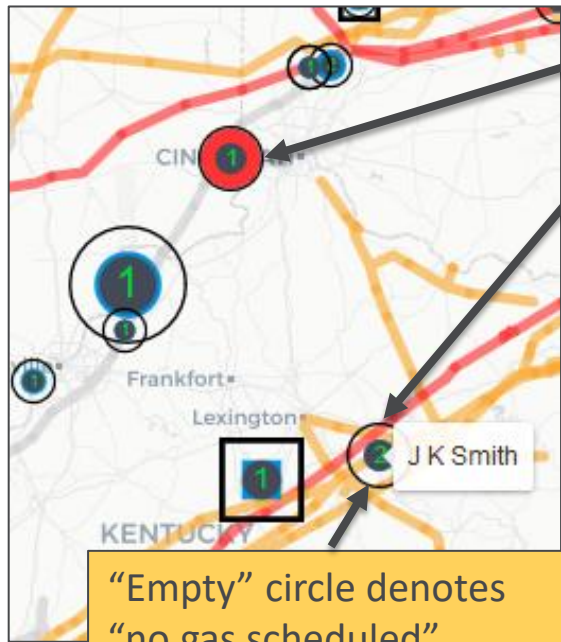
Pipelines ▸ ALGONQUIN ▸ Notices

[Back](#) [CSV](#) [JSON](#) From: 02/20/2020 To: mm/dd/yyyy [Filter](#)

Posting Period ▼ 1:	Pipeline ▼ 1:	Notification ID ▼ 1:	Is Critical ▼ 1:	Subject ▼ 1: +	User Rating ▼ 1:
2020-02-26 16:22:00	ALGONQUIN	93953	N	AGT PLANNED OUTAGES PRESENTATION / WEBCAST - TUESDAY, MARCH 3, 2020 +	-
2020-02-26 15:34:00	ALGONQUIN	93947	Y	AGT Pipeline Conditions for 2/27/2020 +	-
2020-02-26 15:28:00					-
2020-02-26 11:48:00					-
2020-02-26 11:36:00					-

Currently, receiving up to 6,500 notices per month (or about 80,000 per year)

NGINSIGHT Shows Which Generators Could Have Multiple Natural Gas Supply Points



“1” → only one meter point provides gas supply

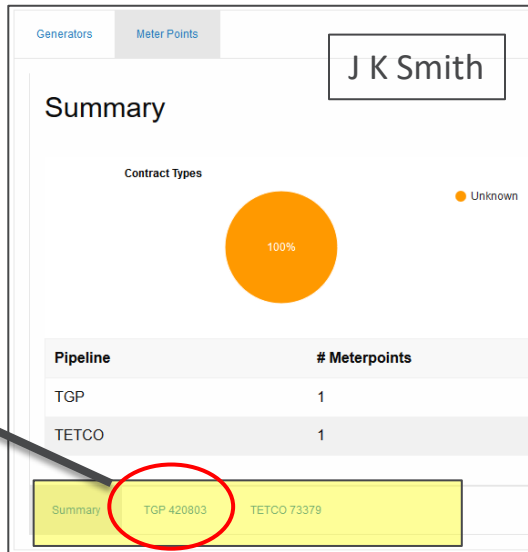
“2” → two meter points provide gas supply

“Empty” circle denotes “no gas scheduled”

Daily Gas Nominations

Pipeline	TGP
Meterpoint	420803
Name	EWTFWR/TGP JK Smith SALES CLARK
Entity	MQ
Longitude	
Latitude	

Effective	Posting	Cycle	TSQ	OAC	DC	DoF	QT	I
2020-02-27 09:00:00	2020-02-26 21:45:00	EVE	0	274611	274611	D	DPQ	N
2020-02-26 09:00:00	2020-02-26 21:45:00	ID3	0	274611	274611	D	DPQ	N



Number within icon denotes the number of meter points that provide NG fuel to the generating plant.

Machine learning - North American Energy Resiliency Model (NAERM)

Notices - Critical Notices

EDI - X12 format



INFORMATIONAL POSTINGS

> Notices

Critical

Notice Type	Posted Date/Time	Notice Effective Date/Time	Notice End Date/Time	Notice Identifier	Subject
Maint	06/17/2019 08:08:19 CDT	06/17/2019 08:08:19 CDT		9758865	2019 Major Construction and Maintenance Projects
OFO	06/17/2019 06:57:55 CDT	06/17/2019 09:00:00 CDT		9758789	Terminate Operational Flow Order Imbalance

Notice 9758789 - Google Chrome

Not secure | www.1line.williams.com/1Line/wgp/download?delvid=9758789&hfn

```
ISA*00*                *00*                *01*007933021        *01*624 49968
*191003*2055*U*00304*000005137*0*P*^~GS*TX*007933021SWNT*624449968SWNT*201910*2055*5137*X*00
3040~ST*864*0001~BMG*00*10010788~DTM*007*****DTS*20191003152526~DTM*145*****DTS*201910031525
26~N1*SJ**1*007933021~REF*QV*Y~REF*F8*10000975~REF*ME*5~MIT*2*2019 Major Construction and
Maintenance Projects~MSG~Maint~MSG~Please be advised that Transco's 2019 Major Construction and
construction and maintenance schedule for projects that are currently planned for 2019 has
been updated and can be accessed on the 1Line portal. The link to the updated
schedule will also be available on the 1Line portal under the operational information
provide dates for the 2019 schedule. Updates are subject to change. Transco will
updated information is available. So of interruptible transportation
impact will depend on operating conditions. Activity is expected to affect the
information will be posted prior to the 2019 Maintenance Schedule link.~SE*1
```

TSP: 007932908
TSP Name: Texas Eastern Transmission, LP
Critical Desc: Critical notice
Notice Eff Date/Time: 01/06/2014 08:46:12 AM
Notice End Date/Time: 01/31/2014 09:00:00 AM
Notice ID: 42065
Notice Stat Desc: Supersede
Notice Type: Capacity Constraint
Post Date/Time: 01/06/2014 08:46:12 AM
Prior Notice: 41977
Reqd Rsp Desc: No response required
Rsp Date/Time:
Subject: TE Imbalance and FERC Order 698 Warning Update

Notice Text:
Due to the continued cold weather and high demand throughout the TE system, TE requires all delivery point operators to keep actual daily takes out of the system less than or equal to scheduled quantities regardless of their cumulative imbalance position. All receipt point operators are required to keep actual daily receipts into the system greater than or equal to scheduled quantities regardless of their cumulative imbalance position.

TE may issue action alerts and/or OFOs as permitted in Section 4.3 of its General Term & Conditions of its FERC Gas Tariff against any shipper, point operator or TABS party failing to adhere to this critical notice.

In addition, TE requires all Power Plant Operators to provide information mandated by FERC Order No. 698. Information required includes the hourly consumption profile of directly connected power generation facilities.

Shipper and point operators are reminded of the importance of monitoring TE's postings during this period of heavy demand on the system.

Customers are advised that capacity may become available as the nomination and confirmation process continues throughout the day.

Please contact your Operations Account Manager if you have any questions.

TRANSCONTINENTAL GAS PIPE LINE COMPANY, LLC

Critical: Y
Notice Eff Date: 06/17/2019
Notice Eff Time: 09:00:00 CDT
Notice End Date:
Notice End Time:
Notice ID: 9758789
Notice Stat Desc: Initiate
Notice Type Desc: OFO
Post Date: 06/17/2019
Post Time: 06:57:55 CDT
Prior Notices: 0
Reqd Rsp Desc: No response required
Rsp Date:
Rsp Time:
TSP: 007933021
TSP Name: TRANSCONTINENTAL GAS PIPE LINE COMPANY, LLC

Notice Text:

Subject: Terminate Operational Flow Order - Imbalance

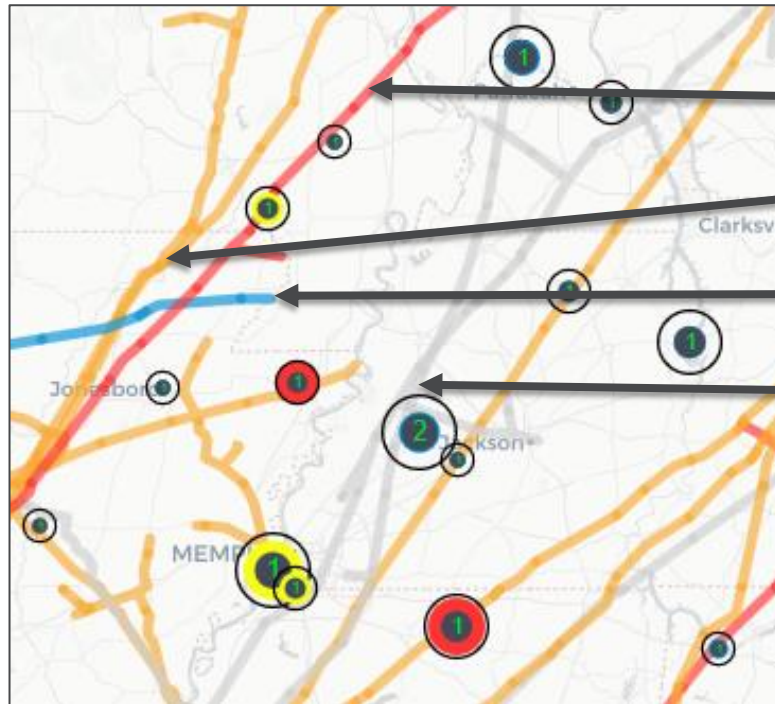
The Operational Flow Order - Imbalance (OFO) currently in effect on the Transco system in Zones 4, 5 and 6 will be terminated effective with the start of gas day Monday, June 17, 2019 at 9:00 AM CDT.

Circumstances leading to the issuance of the OFO are expected to improve; however, Transco has limited flexibility to manage imbalances and strongly encourages all shippers to manage their system requirements to ensure a concurrent balance of receipts and deliveries daily.

Additional information on Operational Flow Orders and Operational Controls can be found at this link: http://www.1line.williams.com/Transco/files/training/Critical_Day.pdf

If you have any questions, please call your Customer or Transportation Service Representative.

NGINSIGHT Shows What Pipeline Notices Should Be Examined More Closely Today



Red: Severity 5 Notices – Most Important

Orange: Severity 4 Notices – Important

Blue: Severity 1-3 Notices – Advisory

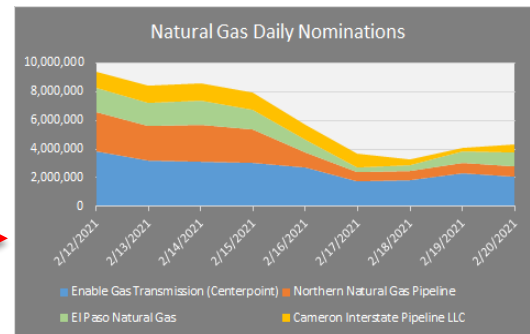
Grey: No notices posted

The tool currently rank notices 1 through 5, with 5 being the “most important” requiring the user to contact the pipeline for further information. The tool uses Machine Learning and Natural Language processing algorithms to support this task. It accounts for terms such as “OFO”, force majeure, etc. provided by individual users.

Pipeline color denotes potential relevance and severity of real-time notices.

Natural Gas Production Data

- EBB data can be used to determine scheduled volumes (not actual flow) of natural gas production as a function of State, county, and pipeline:
 - Can be used to identify future reductions in natural gas supply due to extreme weather, etc.
- Pipeline nomination data provides the type for each receipt point:
 - Helps determine which receipt point is associated with a “Gas Processing Plant” or “Gathering System Interconnect”.
 - Argonne has compiled list of pipelines connected to each processing plant (see example below).
- Comparing scheduled volumes from one cycle to the prior could provide indicator that production is experiencing issues during extreme weather, etc. (information at key points would be helpful)



EBB Receipt Point Descriptions	
CITYGATE	R
COMPRESSOR	R
END USER	R
GAS PROCESSING PLANT	R
GATHERING SYSTEM INTERCONNECT	R
INTERSTATE INTERCONNECT	R
INTRASTATE INTERCONNECT	R
LNG TERMINAL	R
MEXICO BORDER	R
PARK AND LOAN	R
POOL POINT	R
STORAGE	R
THROUGHPUT METER	R

EXAMPLES OF NATURAL GAS PROCESSING PLANTS CONNECTED TO MULTIPLE GAS PIPELINES									
NAME	STATE	COUNTY	Plant Capacity	Meter Station Name1	Pipeline1	Meter Station Name2	Pipeline2	Meter Station Name3	Pipeline3
MOBILE BAY GAS PLANT (MOBILE BAY PROCESSING)	AL	MOBILE	300.0	16706 - DUKE - MOBILE BAY (R)	Gulf South Pipeline Company, LP	15915 - DEFS Mobile Bay (R)	Gulfstream Natural Gas System, L.L.C.	75008 - MBPP Inlet Primary (X)	Dauphin Island Gathering
WILLIAMS MOBILE BAY GAS PLANT	AL	MOBILE	690.0	16714 - WILLIAMS FLD SERVICE - MOBILE BAY (R)	Gulf South Pipeline Company, LP	15922 - Williams Mobile Bay (R)	Gulfstream Natural Gas System, L.L.C.	24265 - MOBILE BAY PLT WFS MP 123.1 (R)	Transcontinental Gas Pipe Line Company, LLC
YELLOWHAMMER GAS PLANT	AL	MOBILE	200.0	16719 - SHELL-YELLOWHAMMER - MOBILE BAY (R)	Gulf South Pipeline Company, LP	17794 - YELLOWHAMMER M3560 MP 122.859 (R)	Transcontinental Gas Pipe Line Company, LLC	N/A	N/A
BADGER WASH GAS PLANT	CO	MESA	N/A	4890 - BADGER WASH RECEIPT (R)	Northwest Pipeline Corporation	4889 - BADGER WASH DELIVERY (D)	Northwest Pipeline Corporation	N/A	N/A

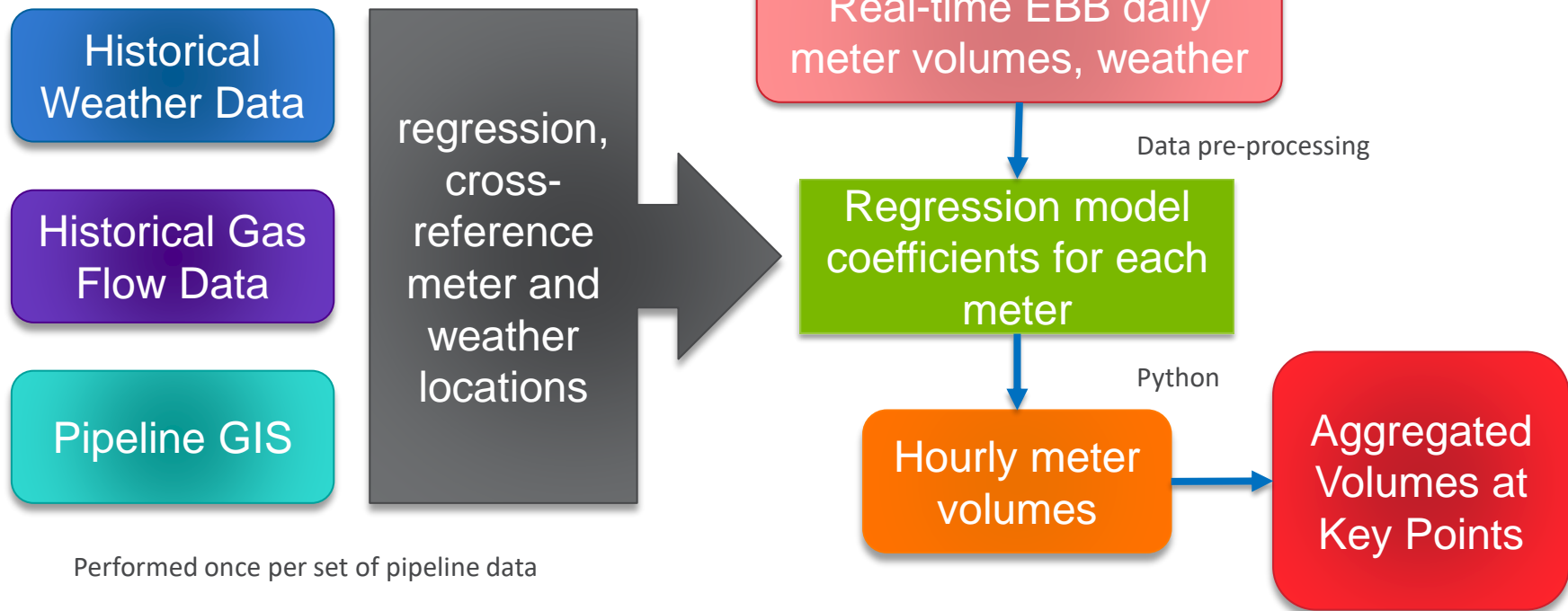
Possible Concept – Estimating Future Gas Pipeline Flows at Key Locations using AI/ML Techniques

Comparing published gas nomination flows versus predicted values to provide early warning in the event of extreme weather

- Hourly gas flows are known to depend on weather and human factors
 - Different customers (residential, commercial, generation) display unique and nonlinear hourly gas demands
- Multi-year weather data includes geolocated temperature, solar, precipitation
- We can **model** hourly gas flows using historical daily flows and weather
- We can **predict** hourly gas flows using past or **future** weather data
- Data sources:
 - Historical US geolocated hourly validated climate data (NOAA, $>10^6$ records)
 - Historical US daily meter volumes (*NGinsight*, $>10^6$ records)
 - Meter locations US ($>10^5$ records)

PREDICTING TRANSIENT METER FLOW DATA

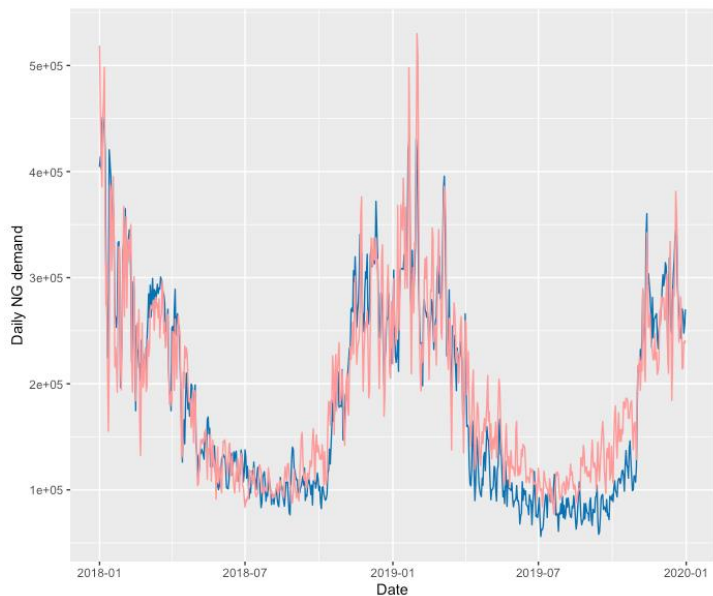
Conceptual data workflow



PREDICTING TRANSIENT METER FLOW DATA (2)

Single meter regression model results using AI/ML techniques

Daily volume actual vs predicted



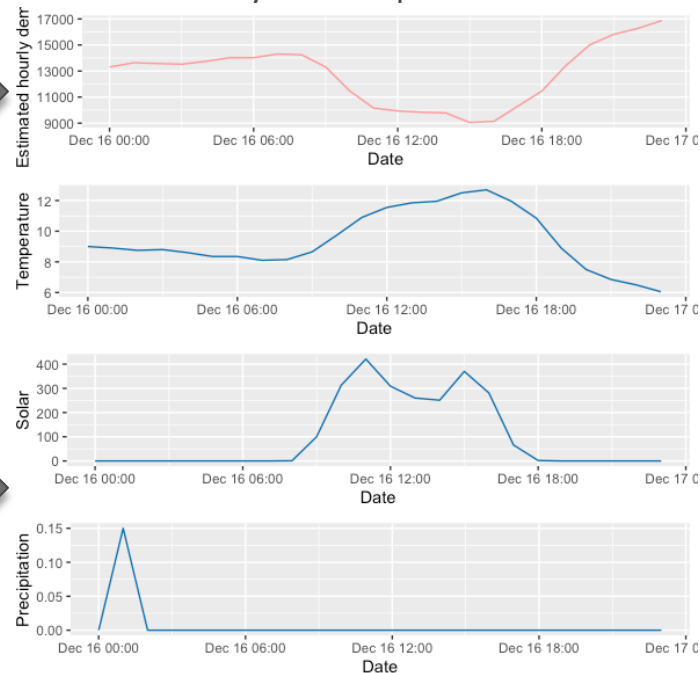
Regression
model
output

colour

- Actual
- Predictions - Best

geolocated
weather
data (input)

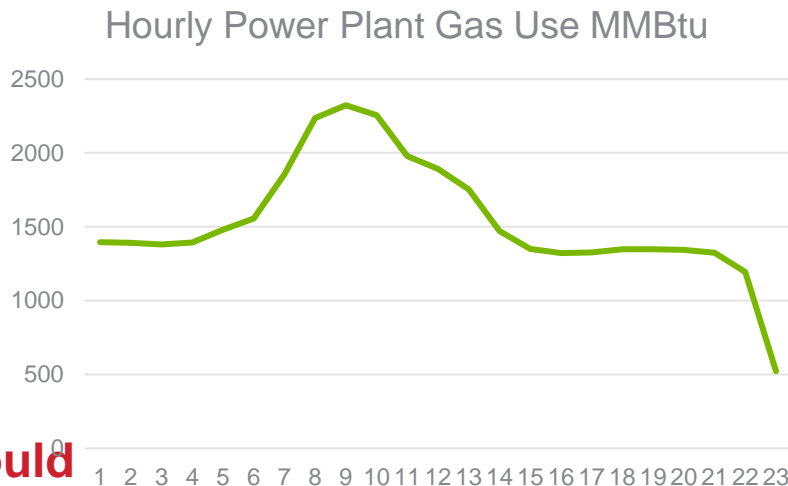
Hourly volume predicted



PREDICTING POWER PLANT DEMANDS

Historical plant hourly gas demands from public EPA emissions data

- Highly correlated to EP load (heat rate)
- Poor correlation to weather
 - Higher temps drive EP demand, but nonlinear response
 - Peaking plants don't correlate
 - Regional vs local weather effects
- Lots of missing data
- **For future predictions, electric sector would have to provide the hourly EP load profiles to estimate future pipeline flows at key locations.**



Current and Proposed Tool Capabilities

CURRENT STATUS:

- **Provides near-real-time gas-electric situational awareness to >75% of U.S. interstate and offshore gas transmission pipelines:**
 - Gas volumes as a function of pipeline cycle (minimum of five times per day).
 - Unsubscribed capacity available for additional available supply:
 - Nominated gas supply to directly-connected gas-fired electric generators.
- **Current and future gas pipeline conditions:**
 - Critical updates (outages, restrictions).
- **Machine-learning-based ranking of critical notices to identify those most-significant to individual tool users.**
- **Incorporates outside feeds such as weather alerts, major wildfires, hurricanes, etc.:**
 - Provides situational awareness during hurricanes, extreme cold weather, etc.

PROPOSED ENHANCEMENTS:

- **Build out remaining 25% of gas interstate pipelines:**
 - Contact and sign new EDI access agreements for remaining gas interstate pipelines.
 - Conduct EBB web scraping for pipelines and storage areas without EDI.
- **Include EBB data from intrastate pipelines (e.g., in California and Texas):**
 - Collect nomination and notice data from LDCs such as SoCalGas, PG&E, etc. who provide EBB data via the web.
- **Provide near-real-time information on natural gas production:**
 - Each cycle's scheduled nominations would be compared with prior cycles to identify potential supply issues.
- **Predict pipeline flows at key locations:**
 - Compare predicted values with future nominations to identify possible gas supply issues

THANK YOU VERY MUCH FOR YOUR TIME AND CONSIDERATION!

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