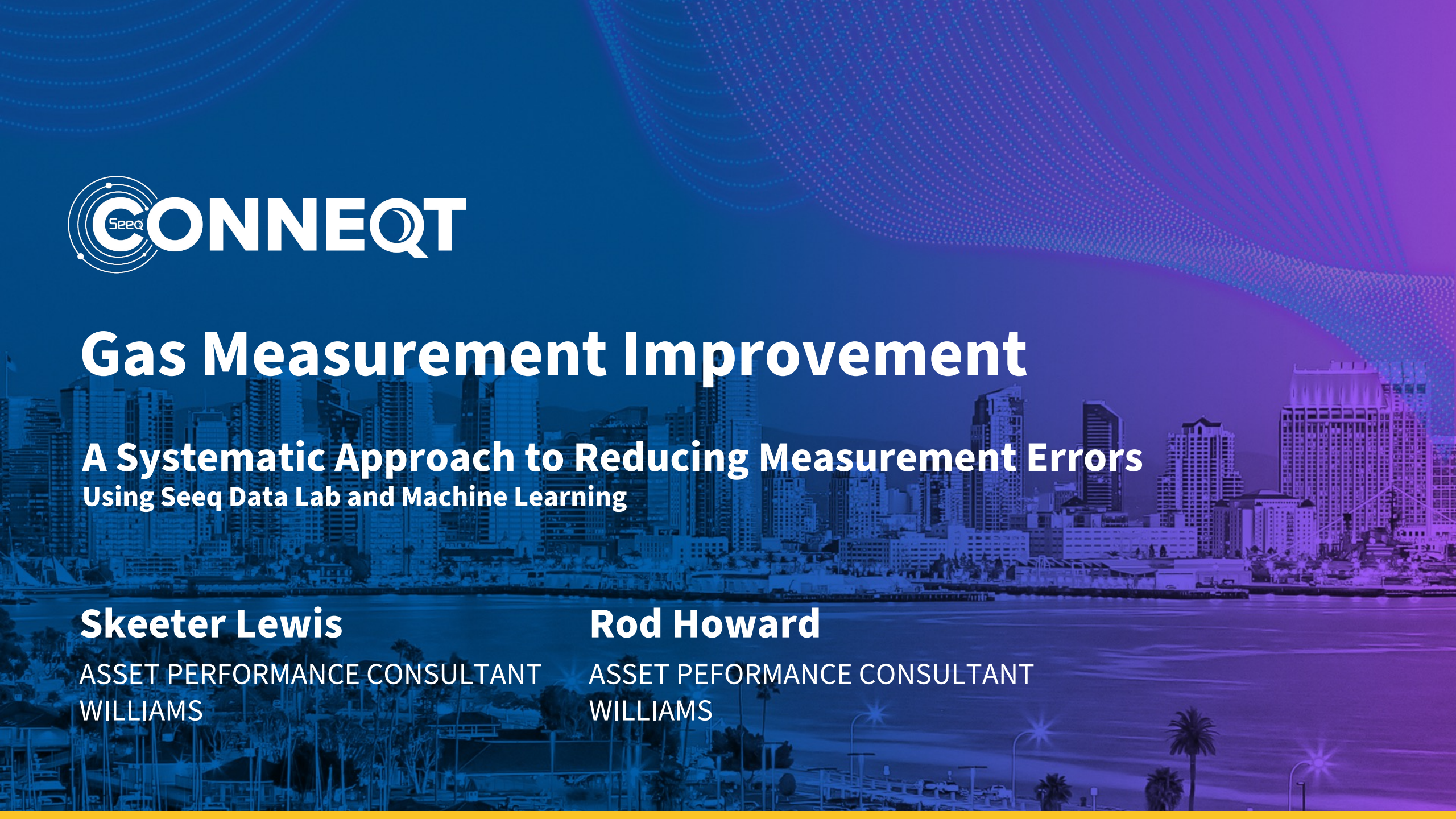


Gas Measurement Improvement

A Systematic Approach to Reducing Measurement Errors

Using Seeq Data Lab and Machine Learning

Skeeter Lewis
ASSET PERFORMANCE CONSULTANT
WILLIAMS

Rod Howard
ASSET PEFORMANCE CONSULTANT
WILLIAMS

About the Speakers

Skeeter Lewis

ASSET PERFORMANCE CONSULTANT

WILLIAMS

Rod Howard

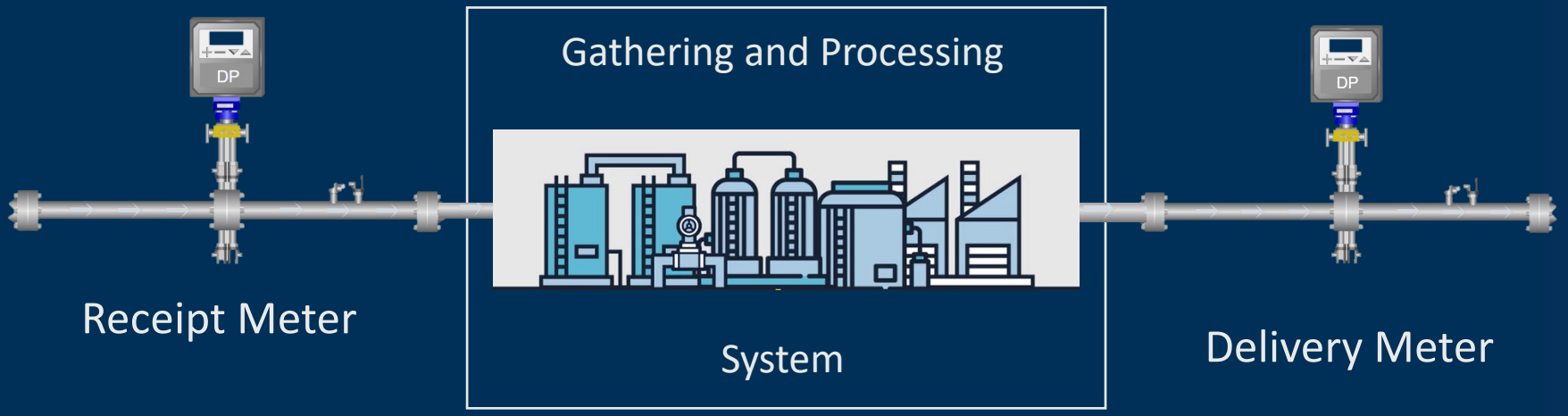
ASSET PERFORMANCE CONSULTANT

WILLIAMS

About Williams

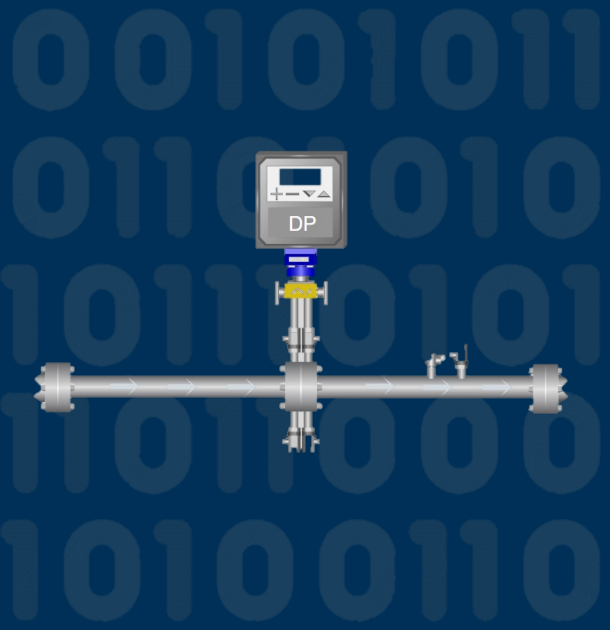
- Williams handles 30% of natural gas consumed in the US
- Handles gas used by 77 million homes and businesses
- Own and operate more than 32,000 miles of pipeline in 25 states
- Gas processing capacity of 7.4 bcf/d

Gas Measurement



Meter Conditions

FREEZE

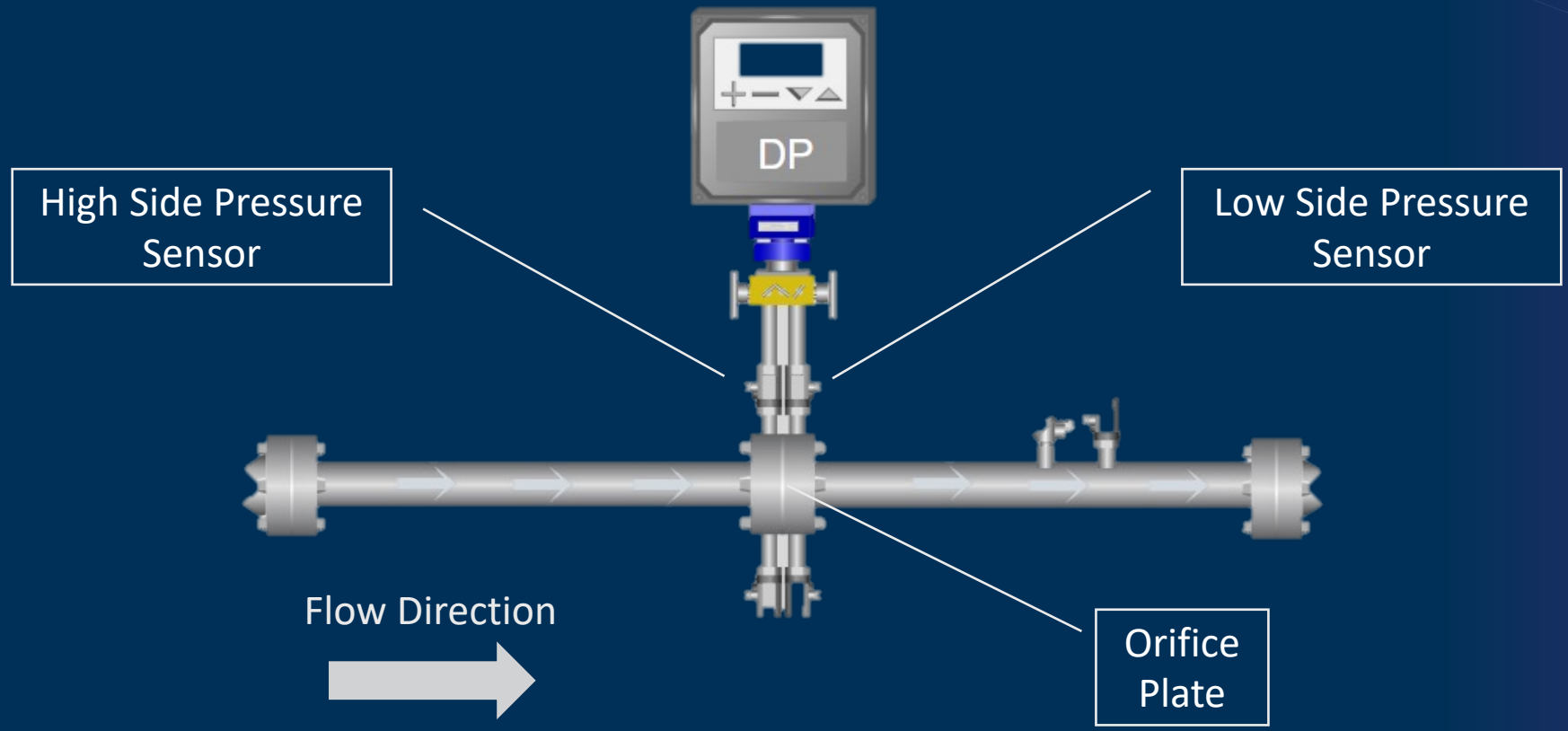


LIQUIDS

BACKFLOW

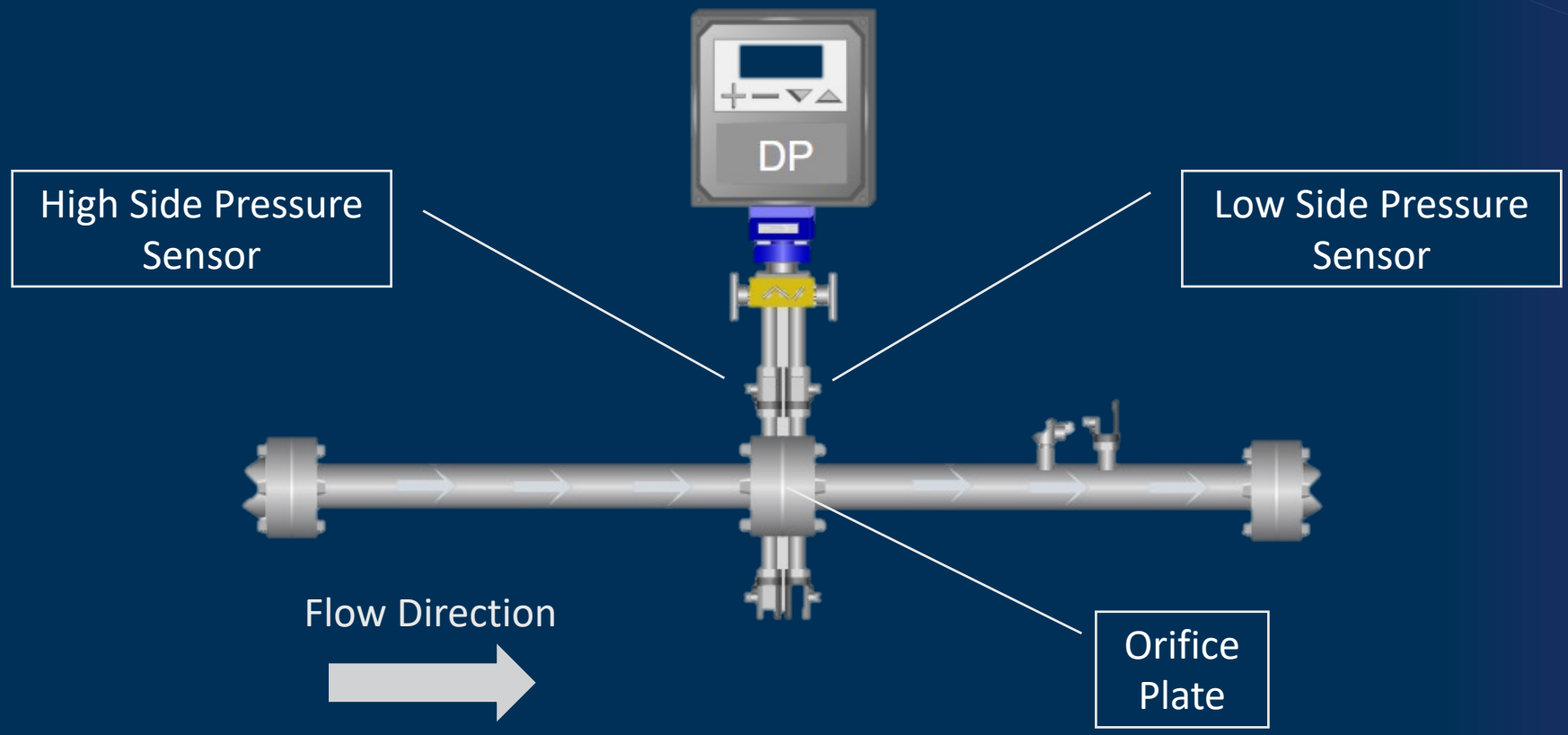
CALIBRATION

Meter Conditions

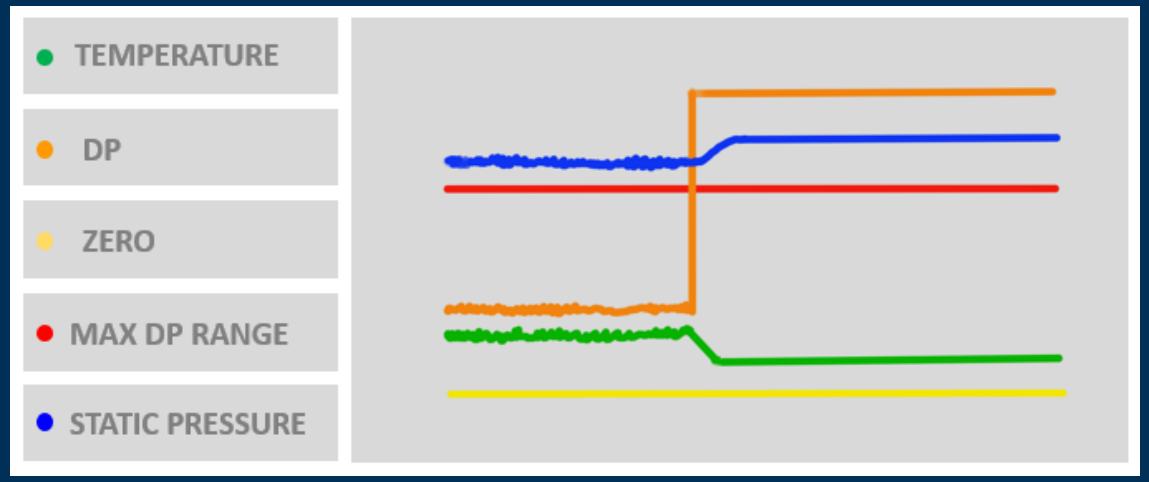


Orifice Plate

Meter Conditions

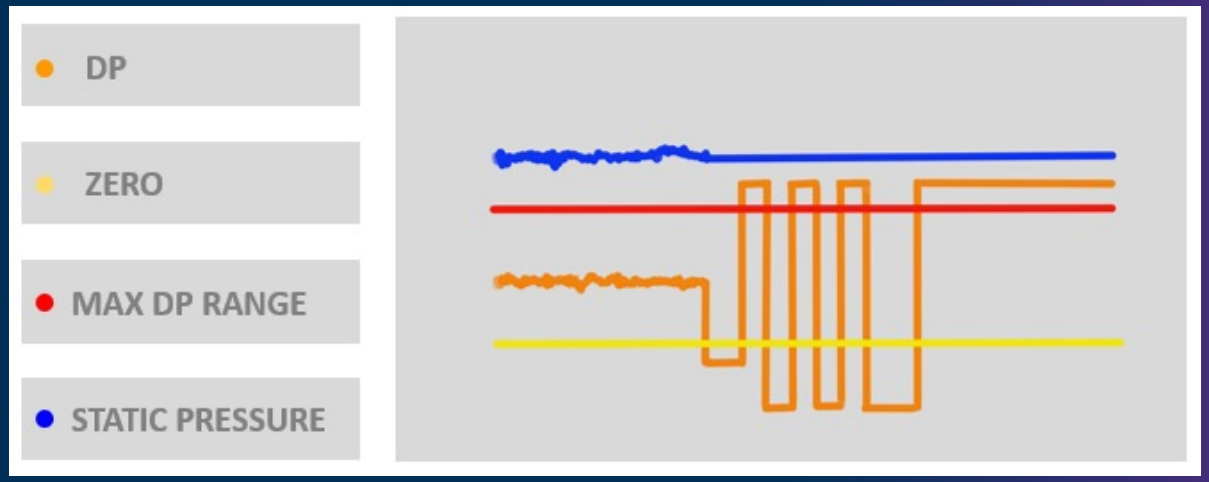


Freeze Defined by Trend Signatures



DP Over-range

Often indicative of a plate freeze



Unstable DP

Often indicative of a tube freeze

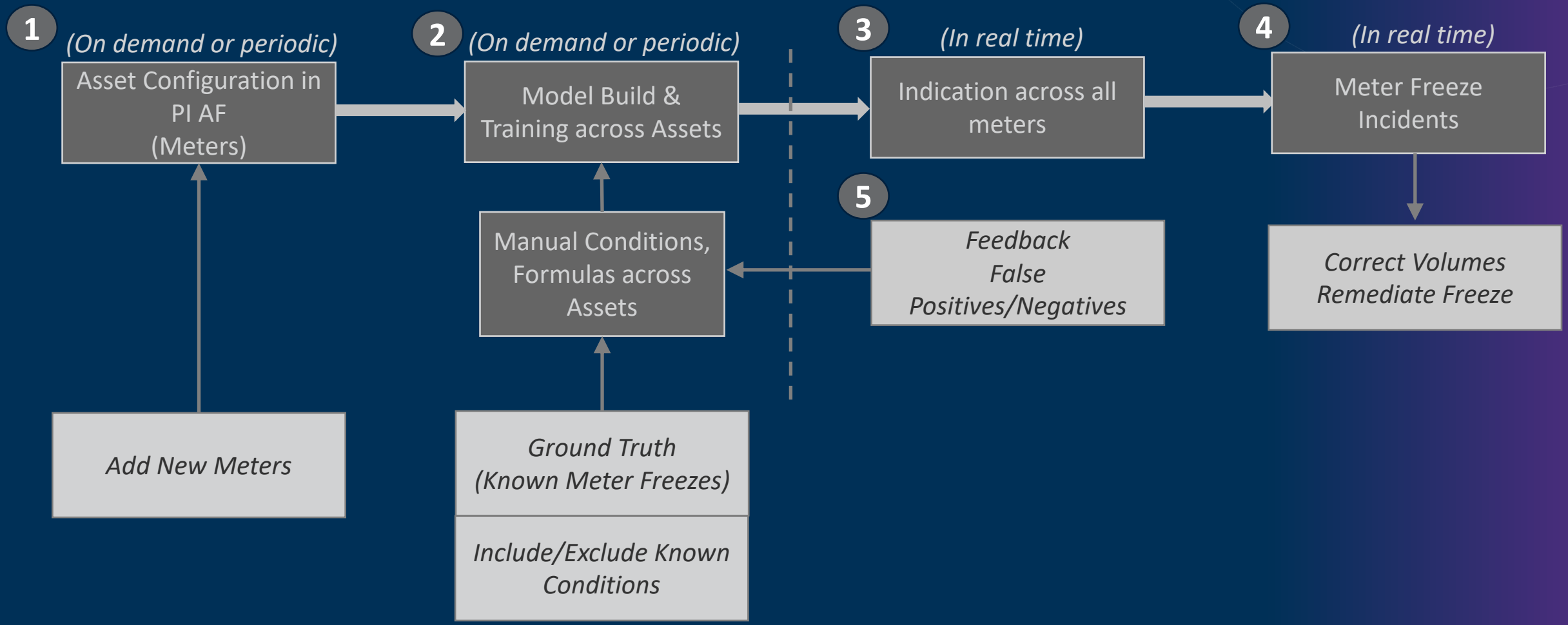
Program History

- Random Catch - Historical
- Started in 2015
  - Rules-based Approach
  - PI Vision Analytics
  - Seeq for Rule Development
- Formalized in 2019
  - SSRS Automated Reporting
  - PowerBI User Interface
- Advancement in 2023
  - Machine Learning
  - User Feedback

Machine Learning Approach

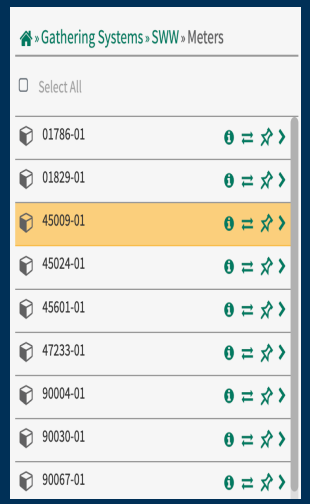
- Goal is to overcome limitations of rule-based approach
  - Fewer false positives and false negatives
  - Automated – less time required of analyst
  - Its easier to build an ML model than to develop highly-complex rules
  - Replace the review process with a model
  - Increase identification accuracy
- Goal is ***not*** to predict meter issues
  - Prediction not particularly useful
- Successful model developed in 2022/2023
  - Extensive assistance from Seeq customer success team in developing model
  - Confirmed the model is more accurate than the rules-based approach

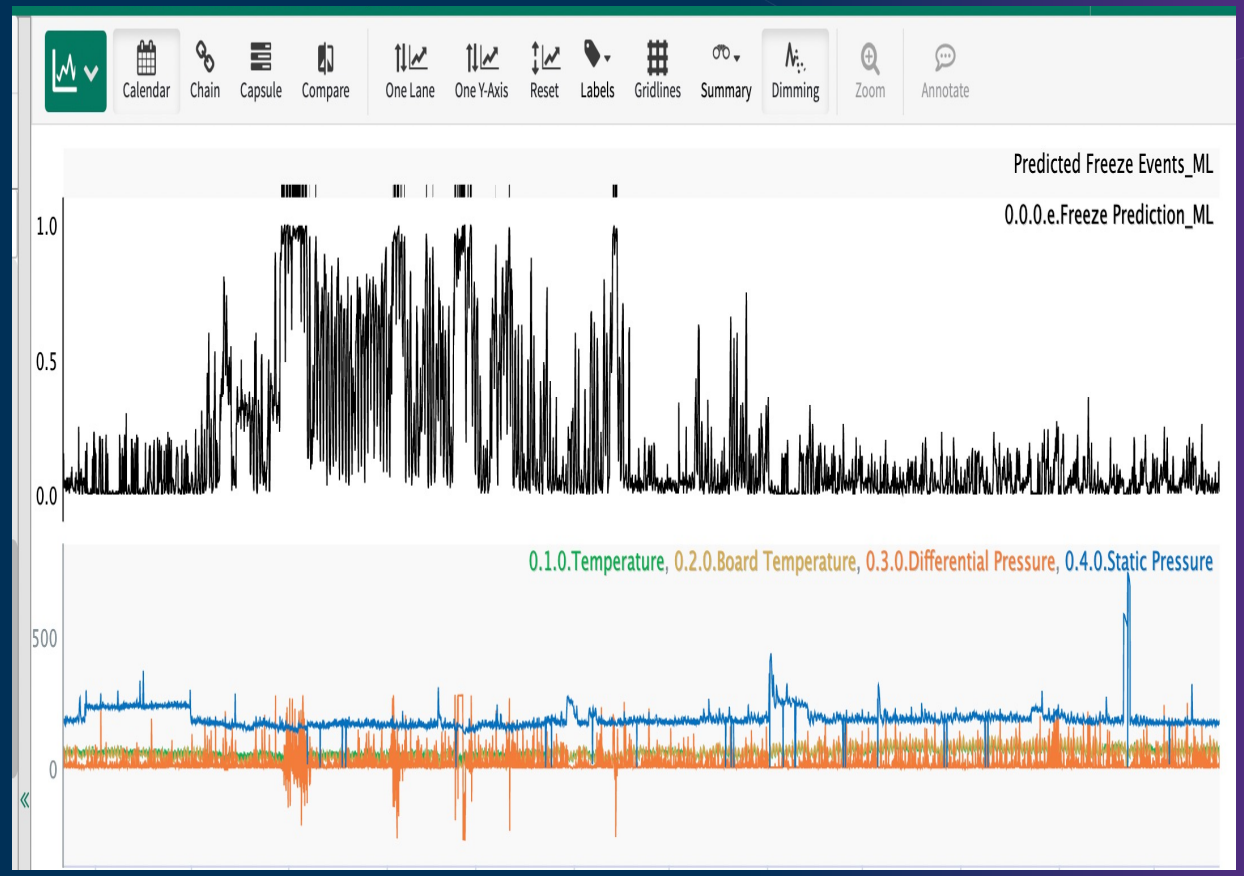
ML and Continuous Learning at Scale



Monitor by Exception at Scale

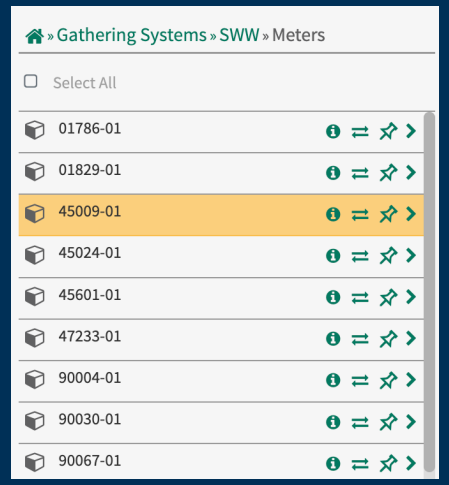
path	probability	event count	event capsules
Meters_ML >> WAM >> Meters >> 98011-01	0.7900000000000000	2	2
Meters_ML >> WAM >> Meters >> 94810-01	0.7900000000000000	1	1
Meters_ML >> WAM >> Meters >> 96170-01	0.7900000000000000	1	1
Meters_ML >> WAM >> Meters >> 94795-01	0.78375	8	2
Meters_ML >> WAM >> Meters >> 96817-01	0.78	1	1
Meters_ML >> WAM >> Meters >> 98213-01	0.7725	4	1
Meters_ML >> WAM >> Meters >> 98146-01	0.7710000000000000	10	3
Meters_ML >> WAM >> Meters >> 94538-01	0.77	3	2
Meters_ML >> WAM >> Meters >> 94763-01	0.77	1	1
Meters_ML >> WAM >> Meters >> 98474-01	0.7700000000000000	5	1
Meters_ML >> WAM >> Meters >> 94565-01	0.758	5	4
Meters_ML >> WAM >> Meters >> 94350-01	0.7528571428571430	14	1
Meters_ML >> WAM >> Meters >> 94733-01	0.75	5	2
Meters_ML >> WAM >> Meters >> 10432-01	0.7500000000000000	1	1
Meters_ML >> WAM >> Meters >> 96935-01	0.7500000000000000	1	1
Meters_ML >> WAM >> Meters >> 94636-01	0.7475	4	3
Meters_ML >> WAM >> Meters >> 94838-01	0.745	2	1
Meters_ML >> WAM >> Meters >> 94804-01	0.74	1	1
Meters_ML >> WAM >> Meters >> 94922-01	0.74	1	1
Meters_ML >> WAM >> Meters >> 98022-01	0.74	1	1
Meters_ML >> WAM >> Meters >> 10451-01	0.7327272727272730	11	2
Meters_ML >> WAM >> Meters >> 96256-01	0.7300000000000000	1	1
Meters_ML >> WAM >> Meters >> 98221-01	0.73	4	4
Meters_ML >> WAM >> Meters >> 94834-01	0.7271428571428570	14	1
Meters_ML >> WAM >> Meters >> 96586-01	0.726	5	3
Meters_ML >> WAM >> Meters >> 96379-01	0.7250000000000000	2	1



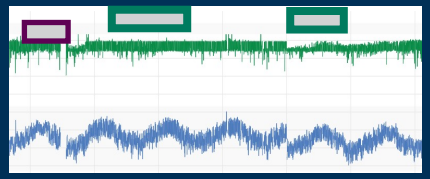


Solution Development

Access meter data from Seeq Workbench



Identify confirmed freeze events & normal operation



Provide Feedback & Retrain

Ad-hoc/Offline

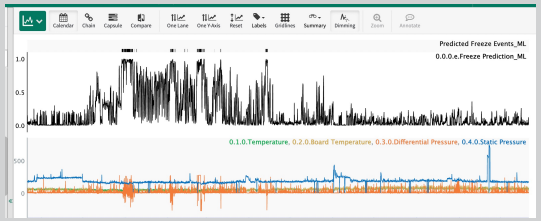
Build Seeq ML Model

Obtain instant insights

Provide Feedback

Operationalize

Real Time

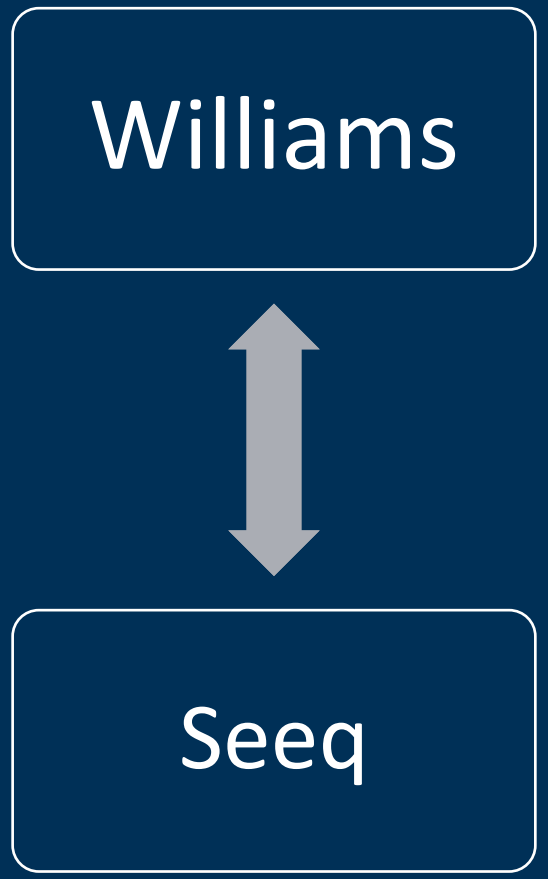


Identify Freeze Events

Publish to stakeholders

Engagement Model

Fast Iterations and End to End Management



Fast iterations

- Weekly discussion between Williams team (Skeeter) & Seeq team (Sepide, Andres, Ashwin)
- More frequent meetups during delivery weeks

Machine Learning Approach

- Next Step: Contain process entirely in Seeq
  - Identification
  - Analysis
  - Feedback

Impact

- Meter Errors
  - More likely to OVER-measure gas than under-measure
  - Appears as a loss when reconciling with customer
  - Gas must be replaced at Williams expense


Thank You
CONNEQT