

# Using USM diagnostics for cloud based performance management and issue detection - at Gasunie

Case studies from field situations analyzed with MECADA by DNV

Robert Kruithof (Gasunie GTS) & Lennart van Luijk (DNV)



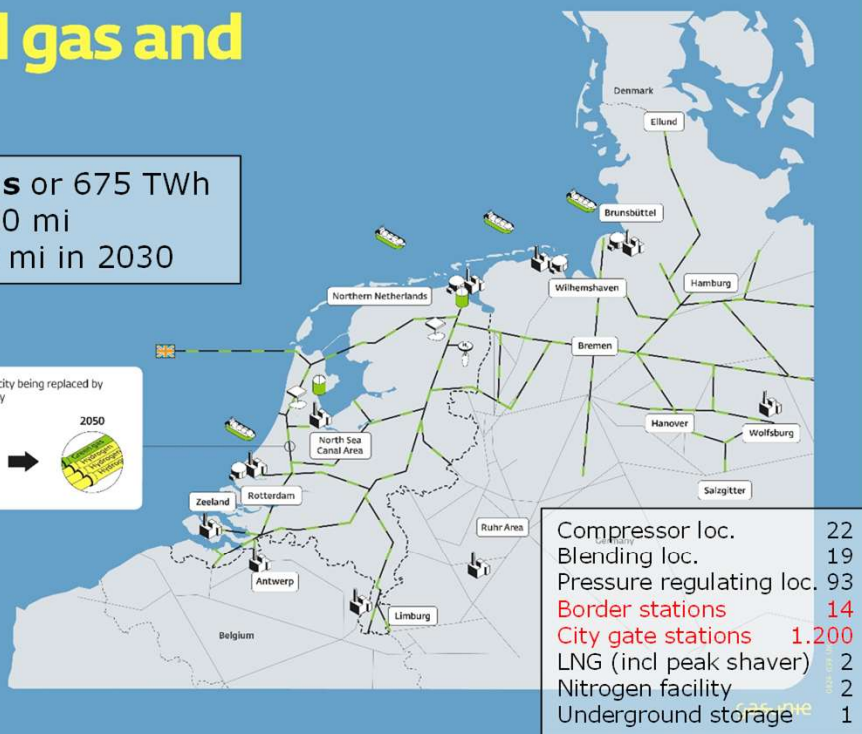
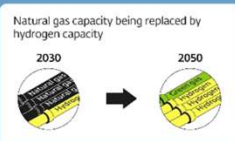
## Introduction Gasunie: The Dutch (GTS) and German (GUD) network

### Network natural gas and green gas 2030

Volume in 2025: **2200 bcf gas** or 675 TWh  
Length NG transport grid: 9300 mi  
Length H2 transport grid: 750 mi in 2030

#### Legend

- Network natural gas and green gas
- Installation green gas
- Industry cluster
- Storage (empty gas fields)
- Storage (cavern)
- Import
- Import terminal



|                          |       |
|--------------------------|-------|
| Compressor loc.          | 22    |
| Blending loc.            | 19    |
| Pressure regulating loc. | 93    |
| Border stations          | 14    |
| City gate stations       | 1.200 |
| LNG (incl peak shaver)   | 2     |
| Nitrogen facility        | 2     |
| Underground storage      | 1     |

National TSO statutory task (Gas Act) for network management:

Gas measurement accounting system

- Measures volume, energy and gas composition for invoicing purposes

Supply measurement data to the market

- Near real-time online

The quality of the measurement process:

- Accuracy, reliability and timeliness
- Processing of measurement data (**metering** and allocation)
- Final accounting data



## Routing & Processing of measuring data



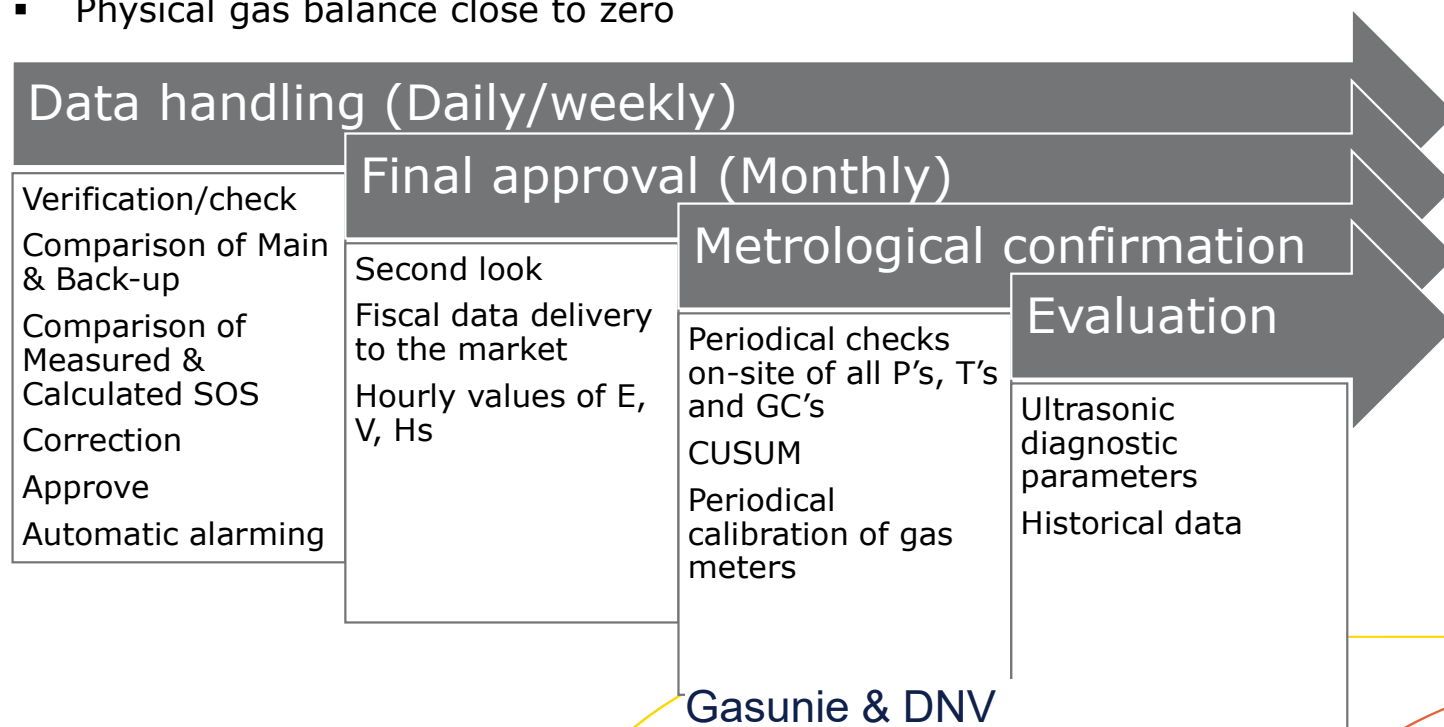
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| Hs(E/Vn) (H) | Hs(E/Vn) (B) | OLC_HSFC (H) | Vb (H) | Vb (B) | Vn (H) | Vn (B) | OLC_VN (H) | E (H)    | E (B)    |
|--------------|--------------|--------------|--------|--------|--------|--------|------------|----------|----------|
| 37.047       | 37.055       | 0.02         | 1077   | 1080   | 61246  | 61395  | -0.12      | 2268.957 | 2275.017 |
| 37.062       | 37.054       | 0.02         | 910    | 911    | 52024  | 52072  | -0.12      | 1928.088 | 1929.473 |
| 37.070       | 37.045       | 0.02         | 976    | 977    | 56035  | 56075  | -0.12      | 2077.217 | 2077.290 |
| 37.068       | 37.064       | 0.02         | 1021   | 1022   | 58900  | 58929  | -0.12      | 2183.276 | 2184.139 |
| 37.057       | 37.053       | 0.02         | 1023   | 1024   | 59242  | 59270  | -0.05      | 2195.297 | 2196.106 |
| 37.047       | 37.047       | 0.02         | 1005   | 1006   | 58352  | 58385  | -0.05      | 2161.749 | 2163.016 |
| 37.062       | 37.052       | 0.02         | 1012   | 1013   | 58806  | 58838  | -0.05      | 2179.490 | 2180.079 |
| 37.064       | 37.052       | 0.02         | 1014   | 1015   | 59024  | 59054  | -0.05      | 2187.644 | 2188.067 |
| 37.048       | 37.059       | -0.02        | 1000   | 1002   | 58343  | 58395  | -0.07      | 2161.482 | 2164.075 |
| 37.050       | 37.050       | -0.02        | 999    | 1000   | 58329  | 58384  | -0.07      | 2161.128 | 2163.120 |
| 37.051       | 37.056       | -0.02        | 1002   | 1002   | 58496  | 58529  | -0.07      | 2167.313 | 2168.870 |
| 37.050       | 37.058       | -0.02        | 1008   | 1009   | 58855  | 58891  | -0.07      | 2180.573 | 2182.422 |
| 37.053       | 37.035       | -0.01        | 976    | 981    | 57025  | 57272  | -0.09      | 2112.923 | 2121.060 |
| 37.033       | 37.039       | -0.01        | 969    | 970    | 56550  | 56598  | -0.09      | 2094.246 | 2096.360 |

Gasunie & DNV

## Metering practices and goals

- Domestic Delivery stations → Comply Dutch Gas Act; Energy Uncertainty 1%
- Border stations → Comply ENTSG (2015/703); Energy Uncertainty 0.75%
- Pursuit of zero systematic error by CUSUM technique (ISO 7870)
- Physical gas balance close to zero



## Focus on cross-border stations with USM pay meter (and optional check meter USM or Turbine)

- 2016-2020: Gasunie & DNV piloted SonicView in Excel
  - First insights in continuous data with trends and full history
  - Quickly overloaded after a few years of 15min data for several stations was available
- 2020-current: DNV MECADA for USM
  - Cloud platform for continuous data
  - Gasunie USM recalibration intervals have been extended from 5 to 8 years, under the condition that the diagnostics of the US-meters are closely monitored
  - With the older USM (>20 years), monitoring the US diagnostics is helpful to maximize the operational lifetime in a prudent way
  - Early servicing or removal of USM when showing issues



WHEN TRUST MATTERS

# Case studies with DNV MECADA cloud platform

CEESI USM Conference San Antonio, 09 June 2026

Lennart van Luijk – Principal Flow Metering Specialist & Data Scientist

09 June 2026

# DNV's approach to USM performance management

- DNV is a **truly independent 3<sup>rd</sup> party**, not associated with any vendor
- Decades of Flow Metering field & lab experience (2 decades myself, wider team has more)
- Cloud based platform MECADA for continuous updates, supports all brands and types of USM
- 3-monthly sessions for analysis of meters performance, either quick or in-depth
  - Proven long term flow metering expertise, field experience and lab testing of disturbances (*liquids in flow, acoustic valve noise, blocked flow conditioners, pulsations, etc*)
- Possibilities for follow-up
  - Consultancy to remediate issues
  - Recalculation advice
  - Full station audit, physical or remotely
  - Mediation between parties



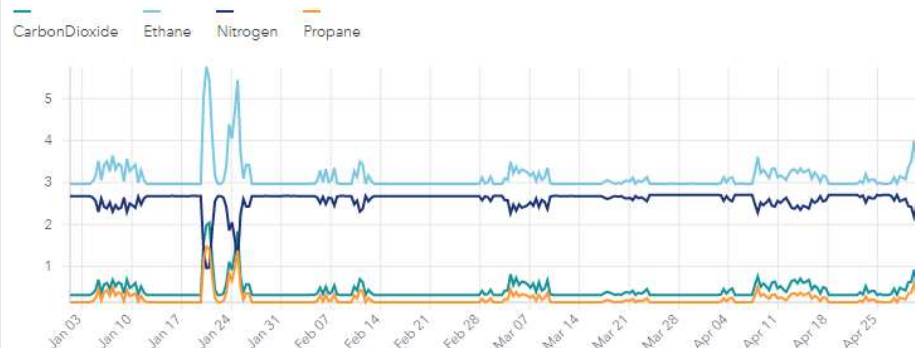


# Speed of Sound online comparison and GC tracking

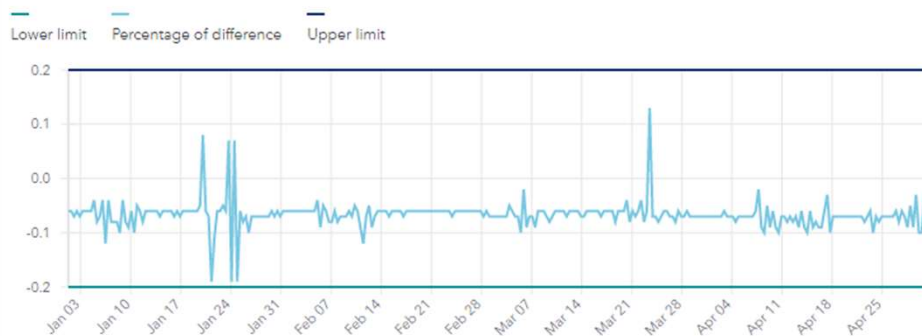
Speed of Sound comparison - Measured vs. Calculated *i*



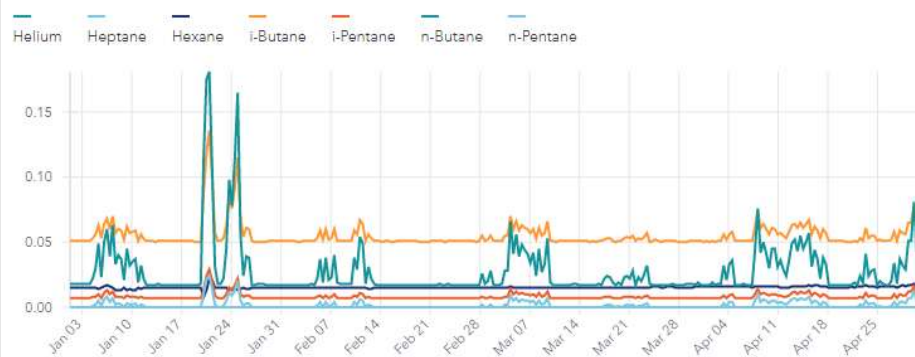
Gas Composition - High Range *i*



Speed of Sound comparison: Difference between Measured vs. Calculated SoS *i*



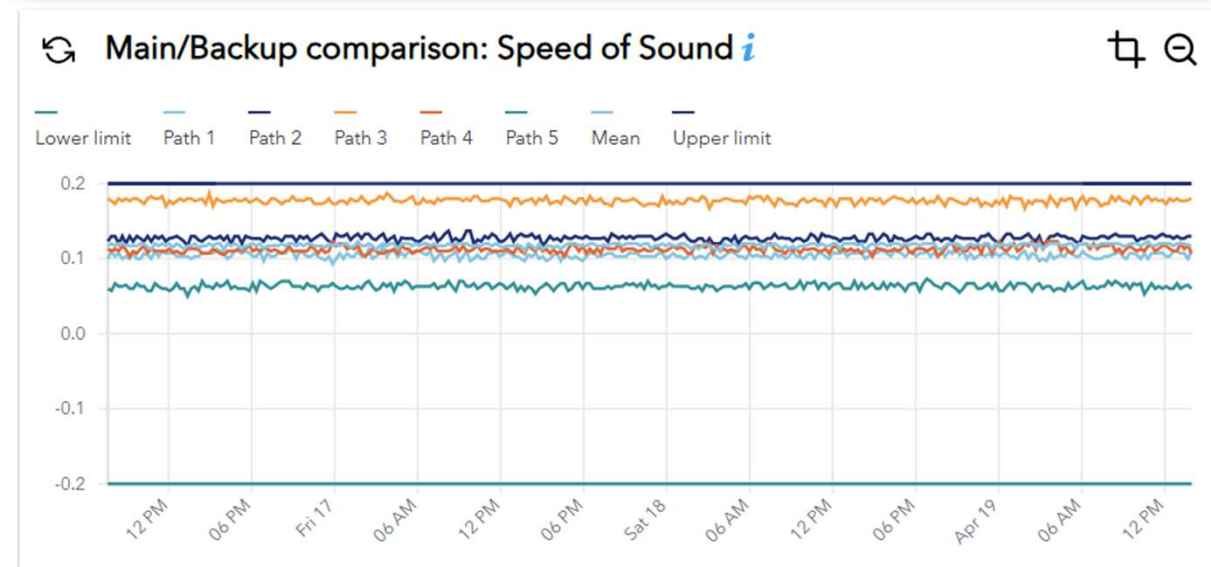
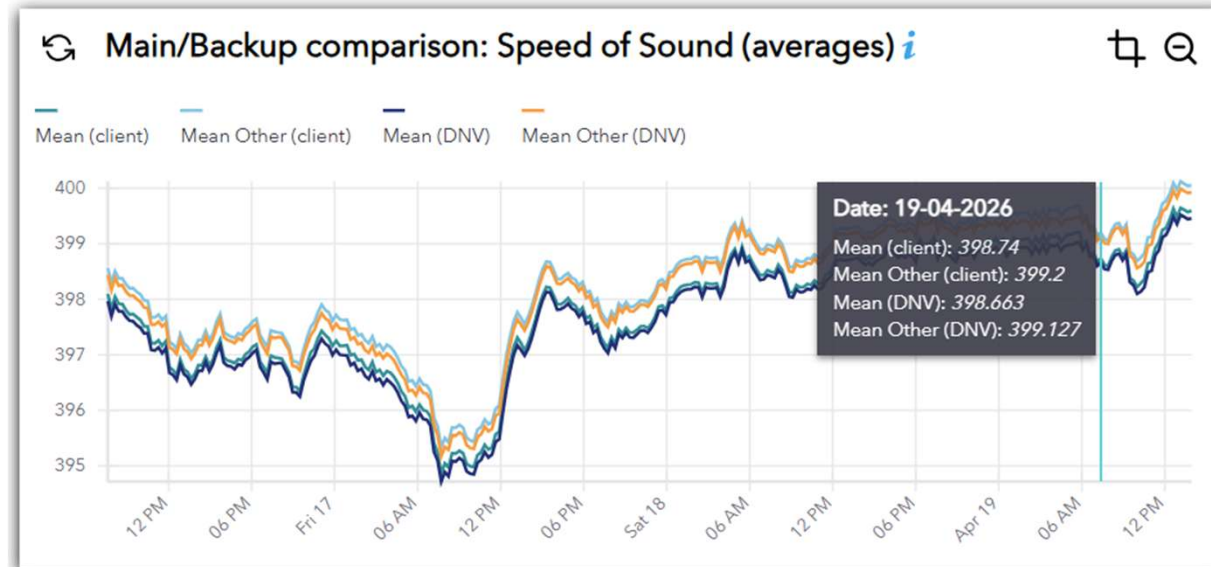
Gas Composition - Medium Range *i*





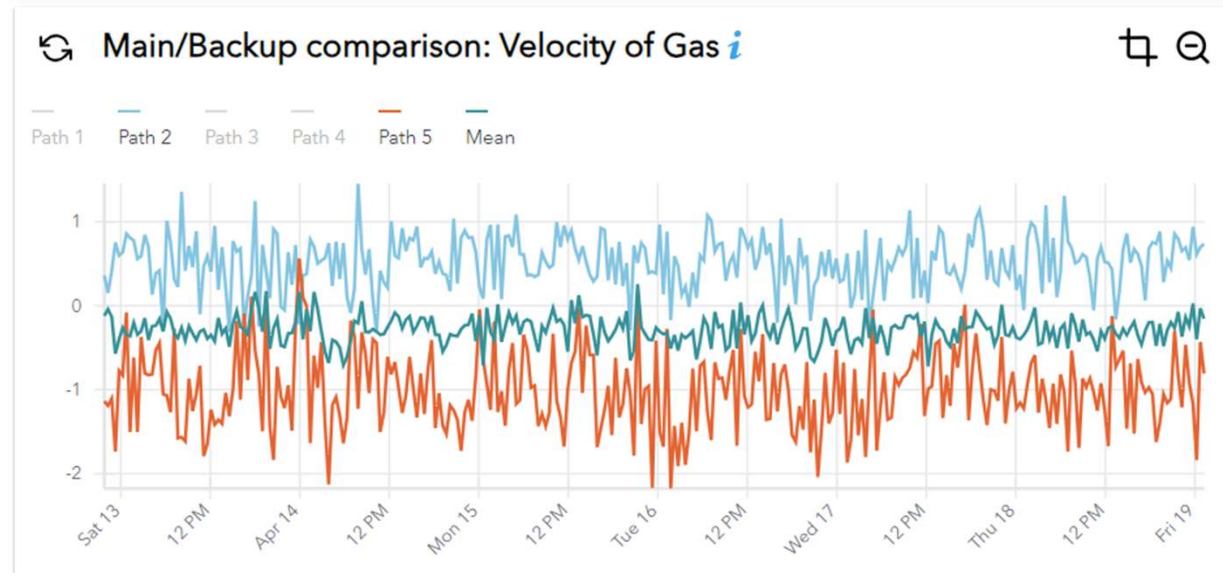
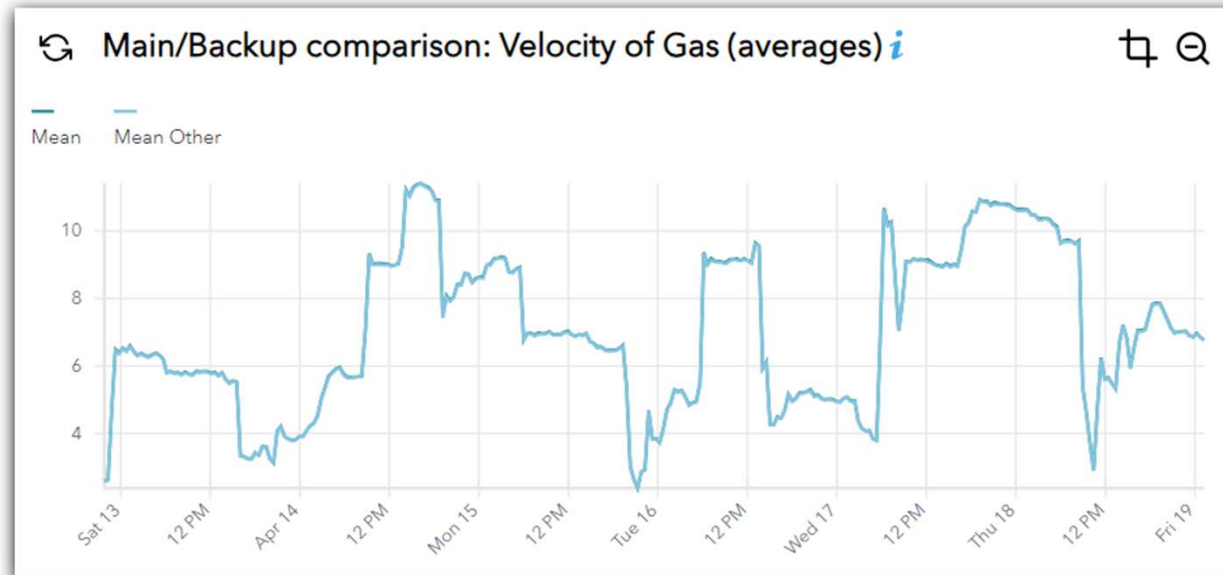
# Main vs. Backup: Speed of sound

- Comparison of two meters, per path
  - Two meter heads on 1 body
  - Two separate meters: pay / check
- Speed of sound should **not differ**, in case of equal P & T.
- Comparison of:
  - Mean value (by meter)
  - Mean value (by DNV)
  - Per-path value
  - And previous chart: mean (meter) vs. calculated



# Main vs. Backup: Velocity of gas

- Comparison of two meters, per path
  - Two meter heads on 1 body
  - Two separate meters: pay / check
- Velocity of gas **mean** should not differ
- **No difference** per path in case of same meter types
- **Consistent difference** in case of different meter types
- Comparison of:
  - Mean value (by meter)
  - Per-path value

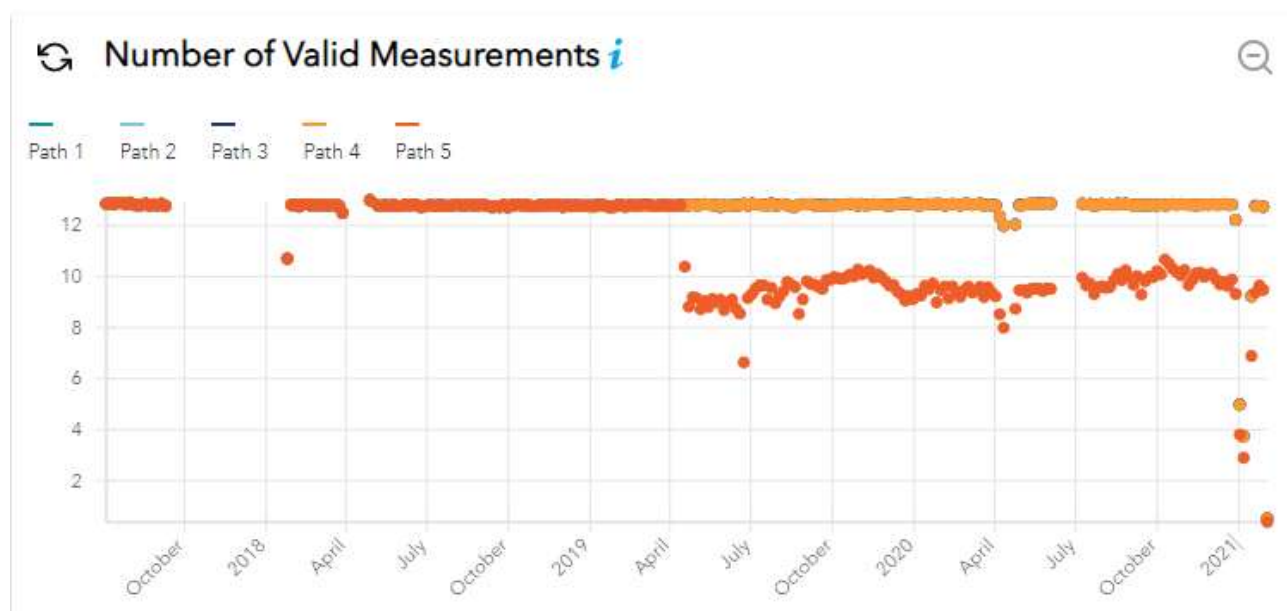


# Case Study 1: 5-Path Meter with Path 5 failure

- A 5 path meter develops issues on path 5 starting in **May 2019**
- Meter fails due to defective paths 4 and 5 **early 2021**

- Early warning August 2019
- In field service

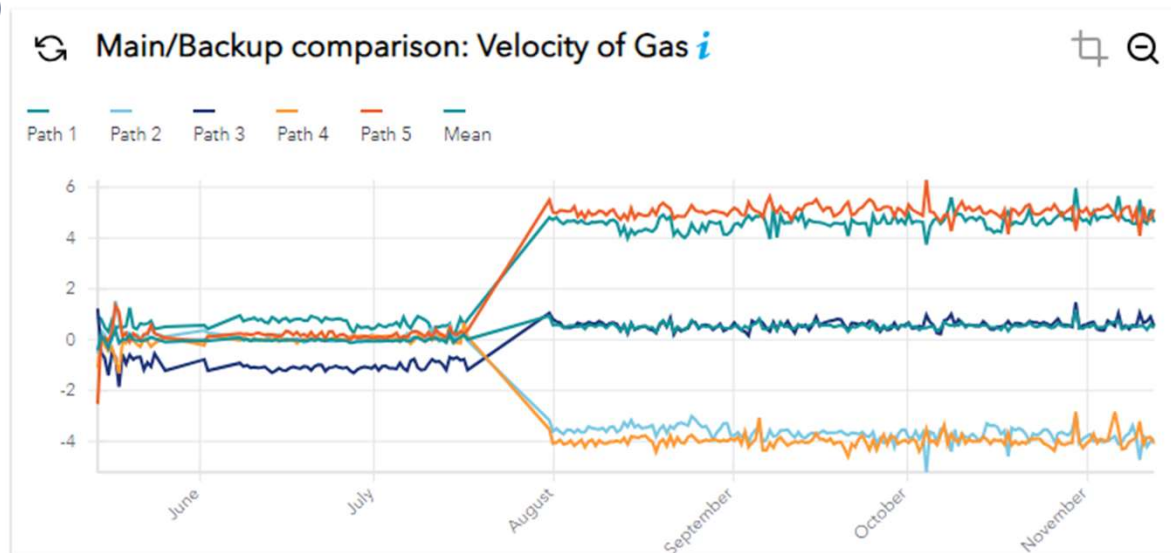
- Spare meter ready
- Limited downtime



## Case Study 2: Main / Backup meters and a very long thermowell

- Pay & Check meters in series, should measure the same on each path (same meter type)
- Online comparison of main / backup shows average flow rate difference of up to 0.5%
- Per path up to 5% difference (see chart)

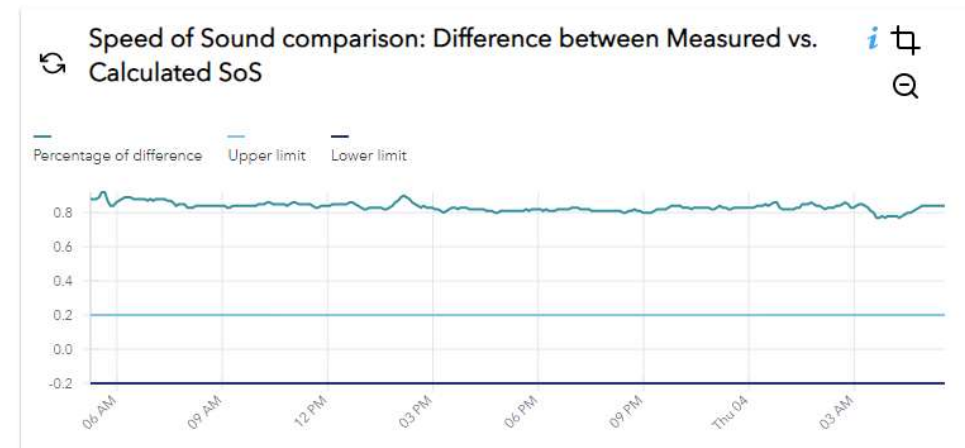
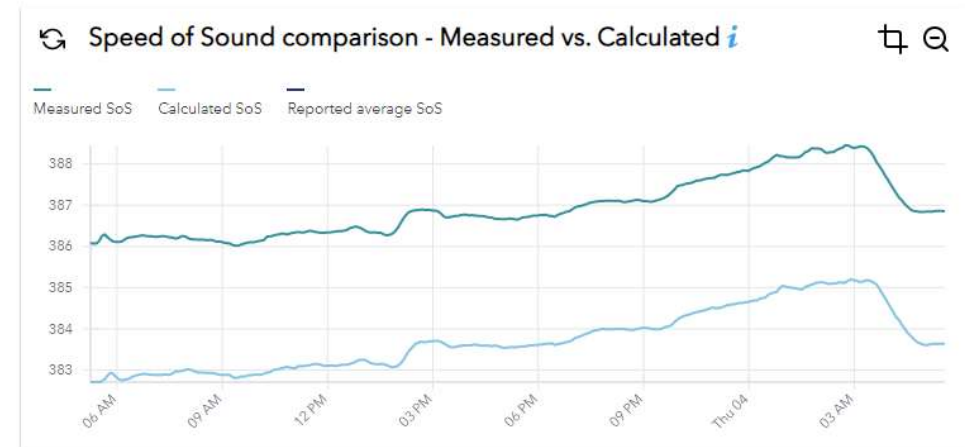
- Field check of installation
- Very long thermowells found, inserted to 70% of diameter (instead of 30%)
- Replaced thermowells by correct length
- Online comparison returned to normal





# Case Study 3a: SoS comparison indicates meter error

- Data from 2 meters shows measured SoS has the same pattern as the calculated SoS
- Meter 1 Offset present of 3m/s == **9.8 ft/sec** at about 385m/s SoS == **1263 ft/sec**, or about 0.8% consistently.
- Meter 2 smaller offset: about 0.3%
- Pattern of SoS is the same, so no random noise in the meter, but software or calibration related
- Meters were taken out and recalibrated, with FWME (Flow Weighted Mean Error) of:
  - **Meter 1 had calibration FWME of +1.66%**
  - **Meter 2 had calibration FWME of +0.66%**



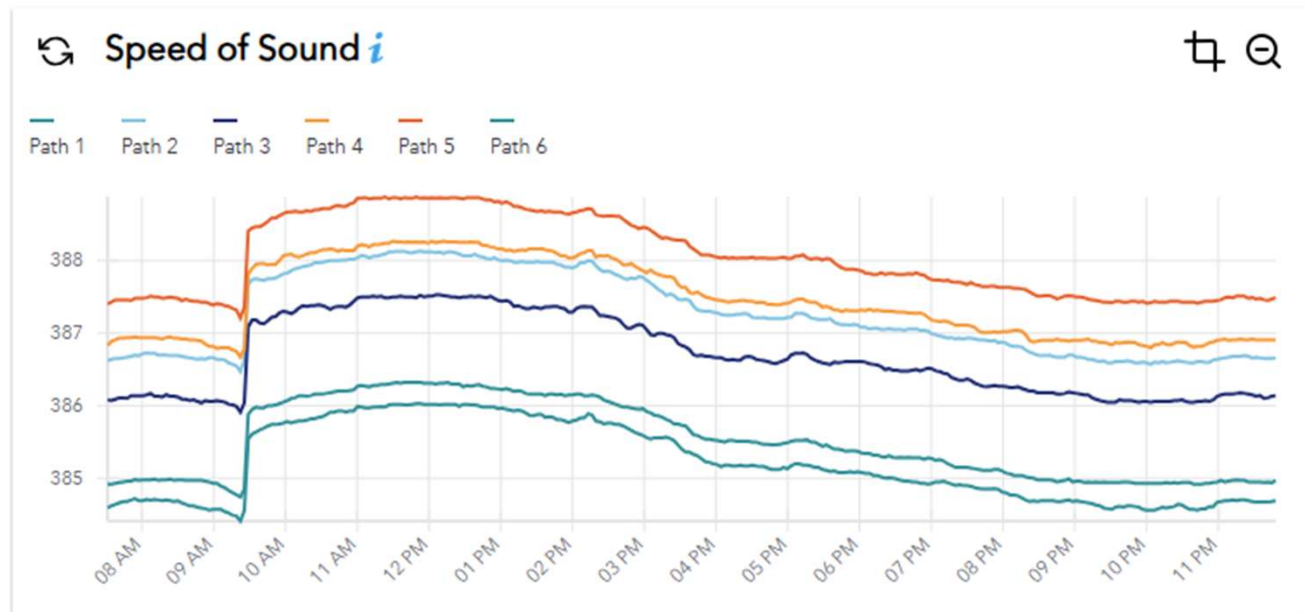
# Case Study 3b: SoS paths ratio indicates meter error

- Variation paths 1-6 SoS for Meter 1: up to 1.4 m/s (0.4%) == 4.6 ft/sec
- Variation paths 1-6 SoS for Meter 2: up to 4.0 m/s (1.0%) == 13.1 ft/sec
- ISO 17089-1:2019 section 8.7.1: Alarm when >0.3% which is 1.15 m/s == 3.8 ft/sec

- Good (<0.2%)  
< 2.5 ft/sec

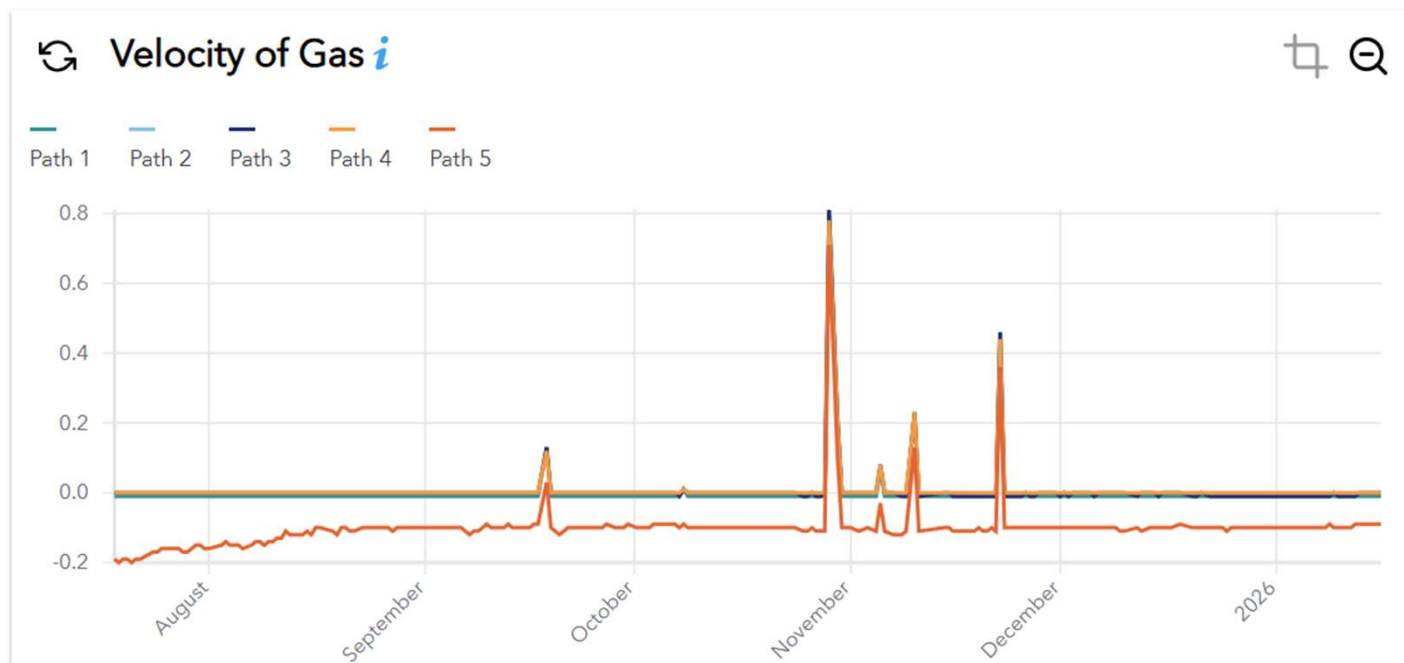
- Warning  
< 4 ft/sec

- Alarm (>0.3%)  
> 4 ft/sec



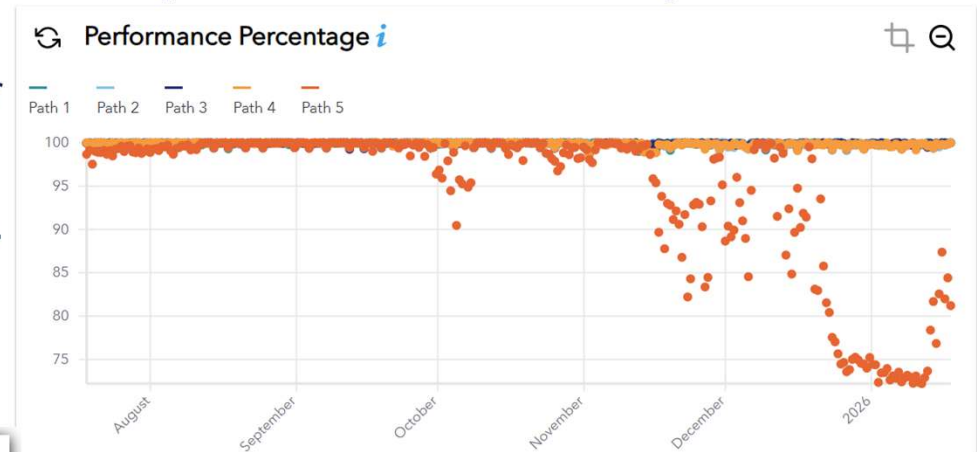
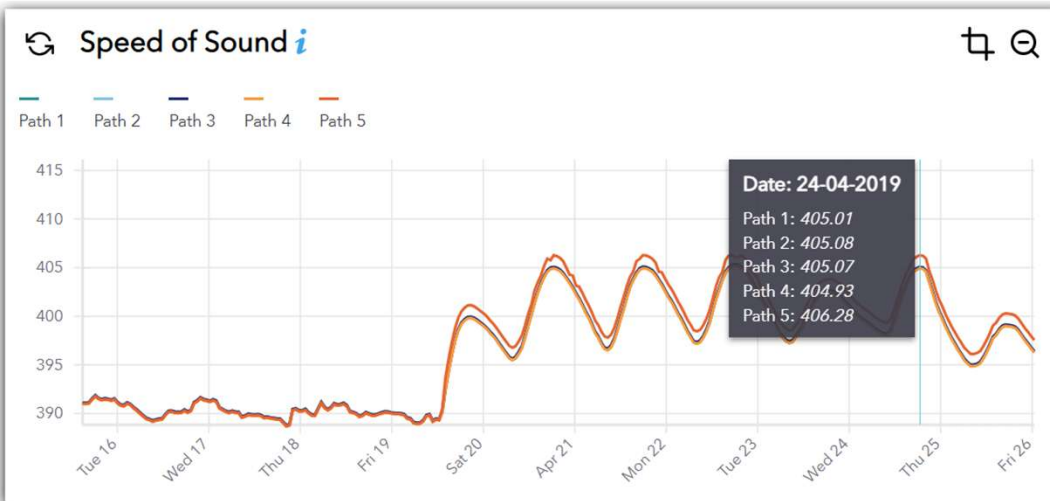
# Case Study 4a: Malfunctions on path 5 sensor pair

- 5-Path meter where several charts show issues on path 5, not flow related
- Velocity of gas per path: Path 5 is off for at least last 6 months



# Case Study 4b: Malfunctions on path 5 sensor pair

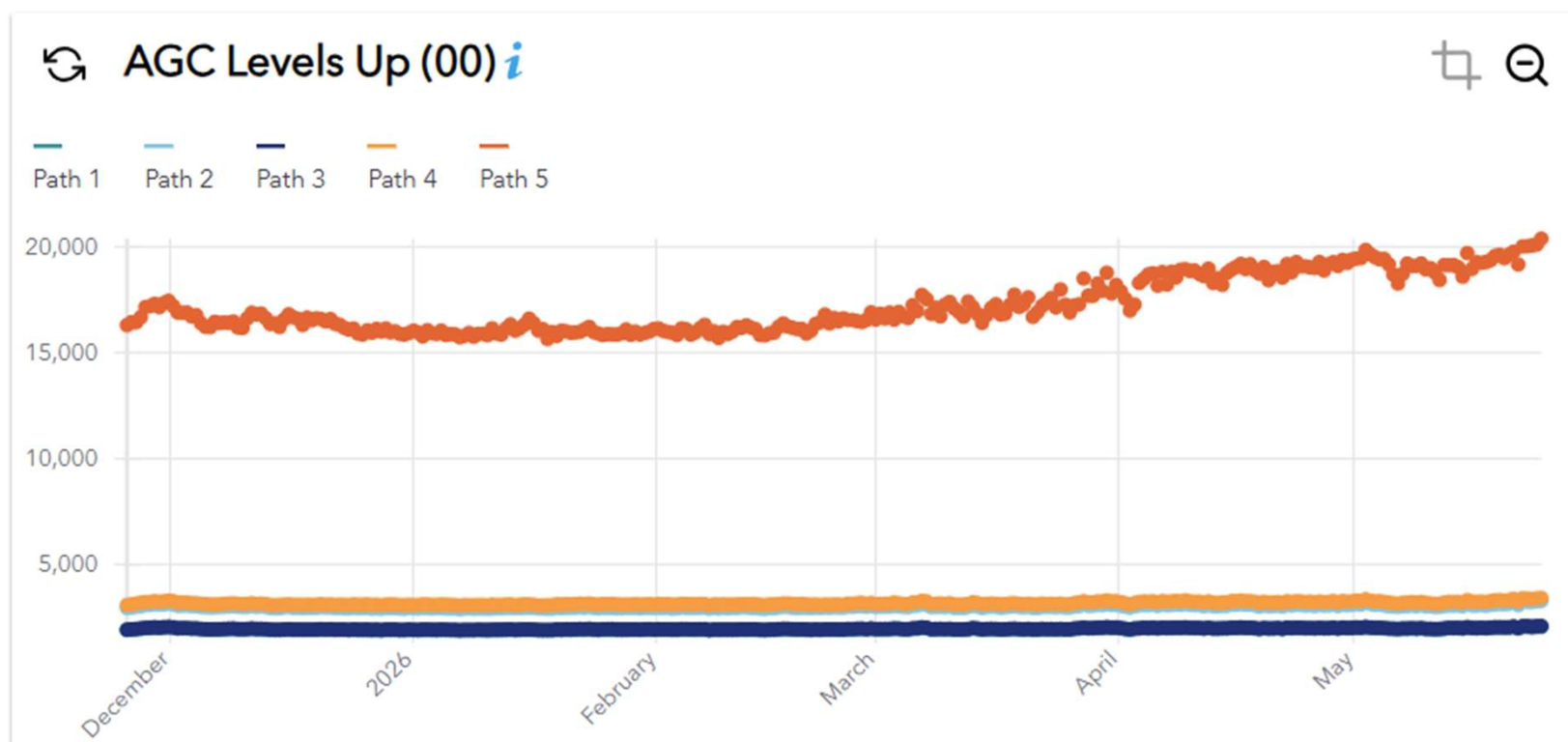
- Performance percentage dropping since October as well: increasing amount of issues
- AGC Levels also higher than the other paths 1-4.
- History: issues started April-2019 but meter now degrading further (end of 2025)





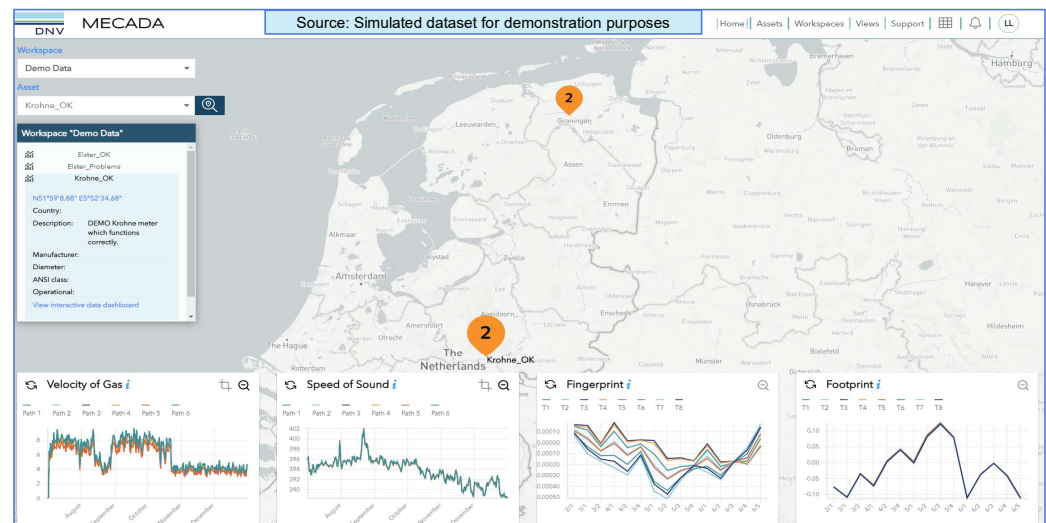
# Case Study 4c: Malfunctions on path 5 sensor pair

- Latest data: AGC Levels trending higher since start of 2026



# Key takeaways

- Long term trending of performance to detect slow degradation as well
- Continuous data is essential, because sample checks of ‘traffic light’ values only show an instant
- Checks during zero-flow situations have limited usefulness (AGC, SNR, not much more)
  - Gas is not homogeneous in the line, i.e. top temperature may be higher than bottom, etc.
- Historical charts show behaviour over time, reveal hickups, and periods of interest
- Comparison of values for different brands of meters has advantages, because you’re comparing independent measurements (different path configurations)



# Curious? Let's have a chat!

Robert Kruithof (Gasunie) – Metering Specialist  
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