



AVEVAWORLD
PARIS

SM|ENERGY

Utilizing AVEVA™ PI System™ for Enhanced Methane Detection The Bridger Project

October 14, 2024

NYSE: SM

WEB: sm-energy.com

Who Are We?

» THE PRESENTERS



Tia Eberline

B.S. Chemical Engineering
Systems Engineering
Ph.D. Candidate

IT Supervisor – Technical & Business
Applications at SM Energy

PI Admin – 8 Years

Industries: Oil and Gas, Specialty Chemicals,
Pulp and Paper, Pharmaceuticals



Devin Schmidt

B.S. Business Administration
Masters of Business
Administration

IT Supervisor – Field Applications and
Production Services at SM Energy

Application Owner (ie. PI) – 4 Years

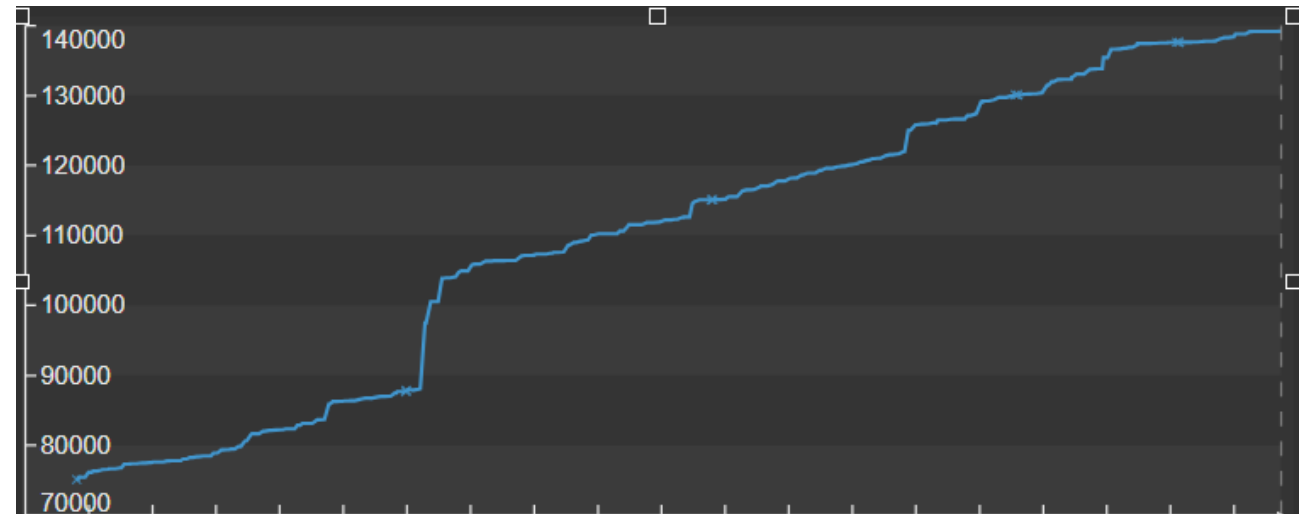
Industries: Oil and Gas, Banking

System Overview

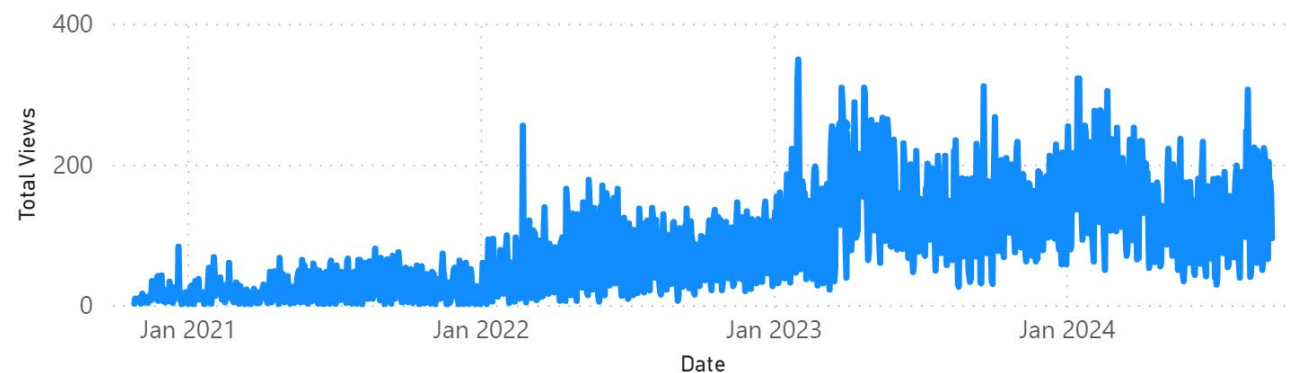
» A BRIEF HISTORY

- **Full PI Install in 2020**
 - ~ 30,000 PI Points
 - Permian-Focused
 - 30 Vision Displays
- **5x in Size from 2022-2024**
 - ~ 150,000 PI Points
 - Analytics & Event Frames
 - Added Inputs/Outputs
 - 405 Vision Displays
- **Aiming for Full Build-Out**
 - New Permian Instrumentation
 - STX & Acquired Assets
 - Additional Analytics

PI Point Growth

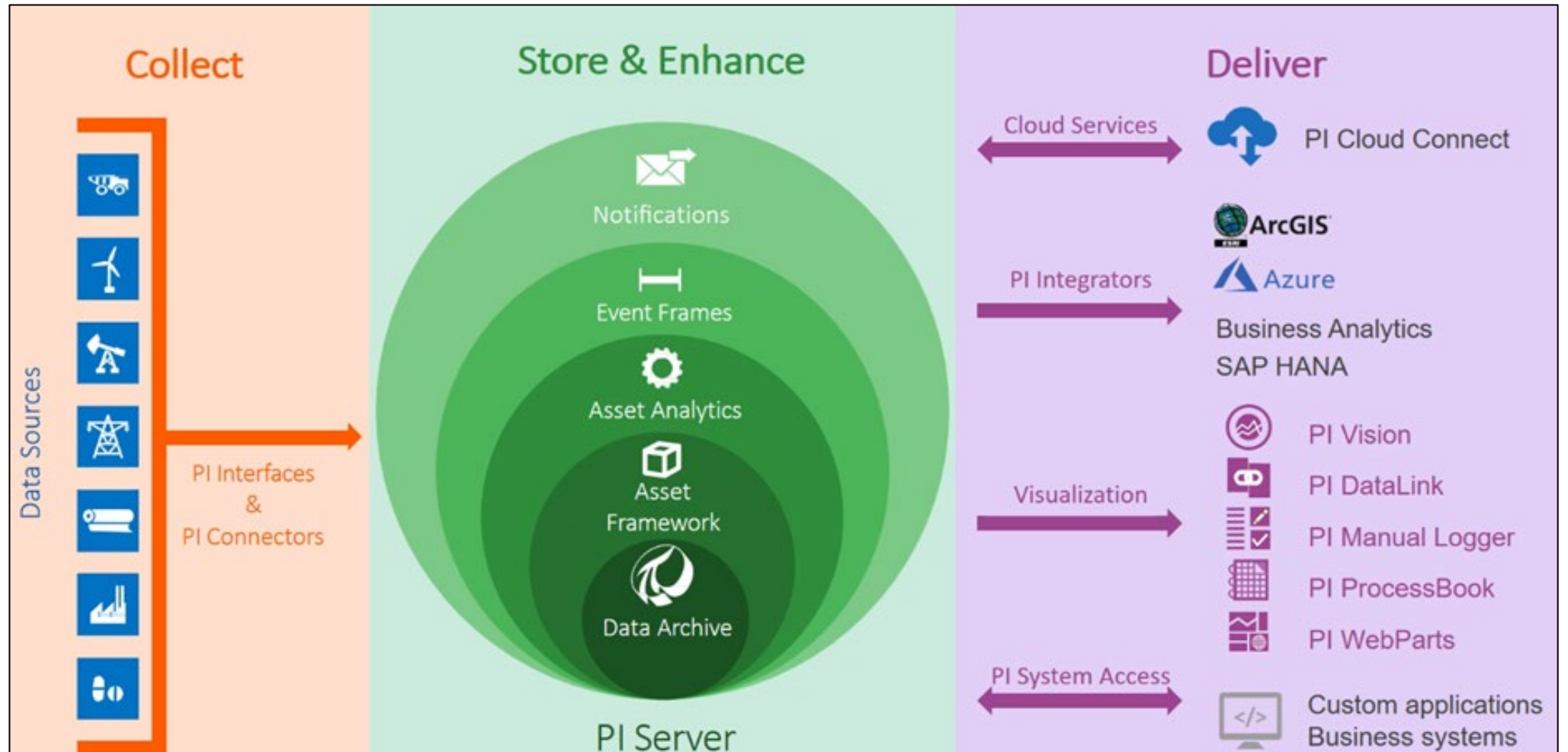


Total Views by Day



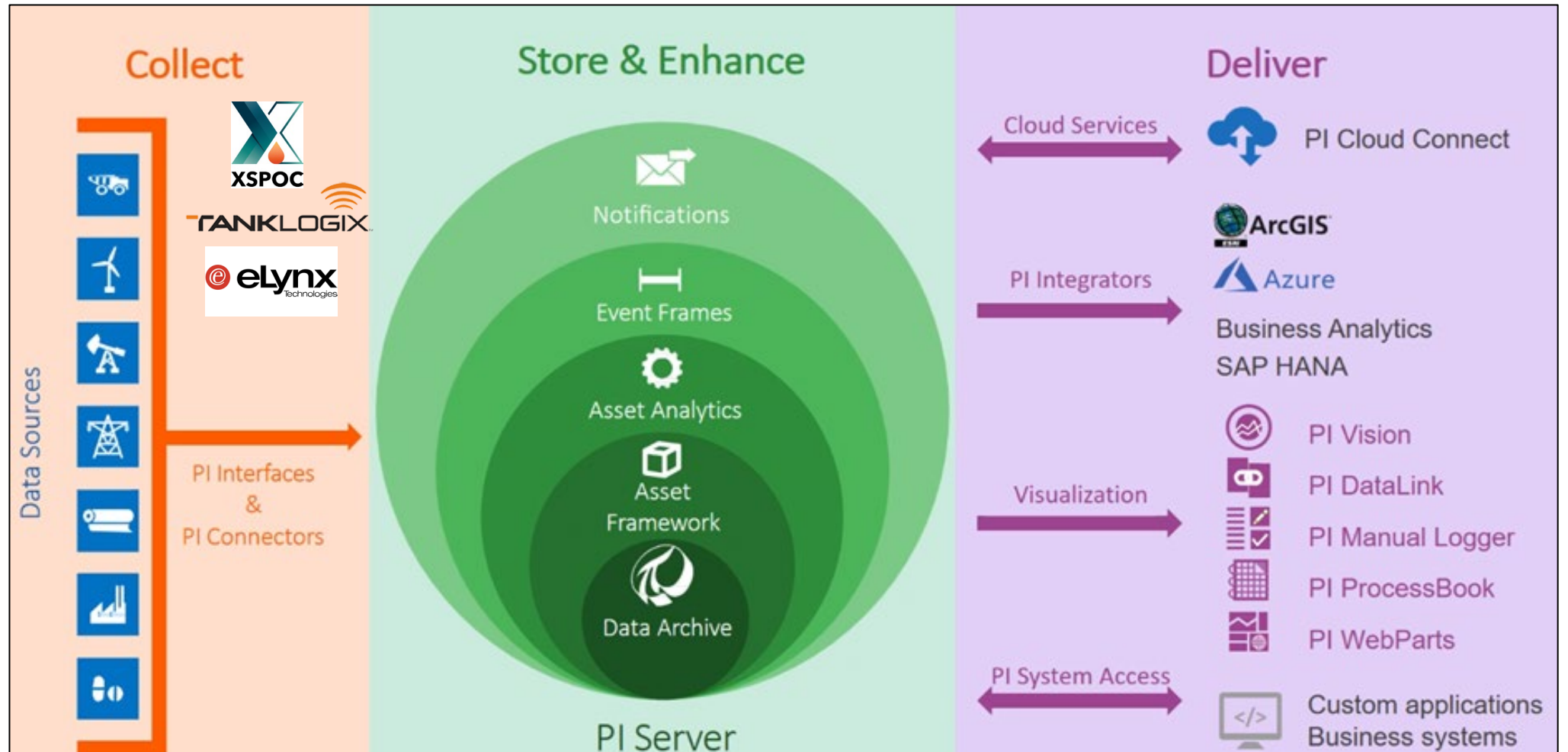
System Overview

» PI AT A GLANCE



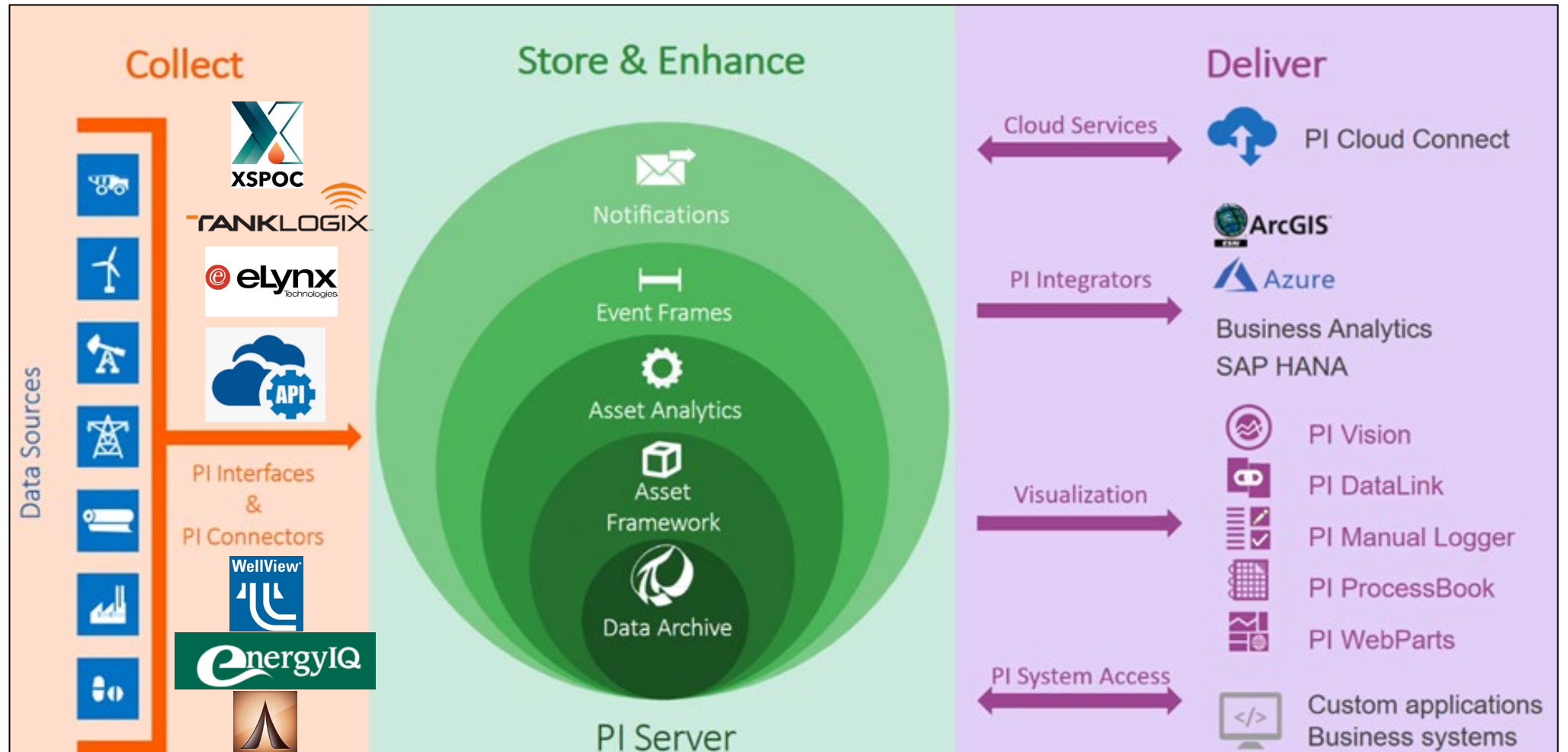
System Overview

» PI AT SM ENERGY



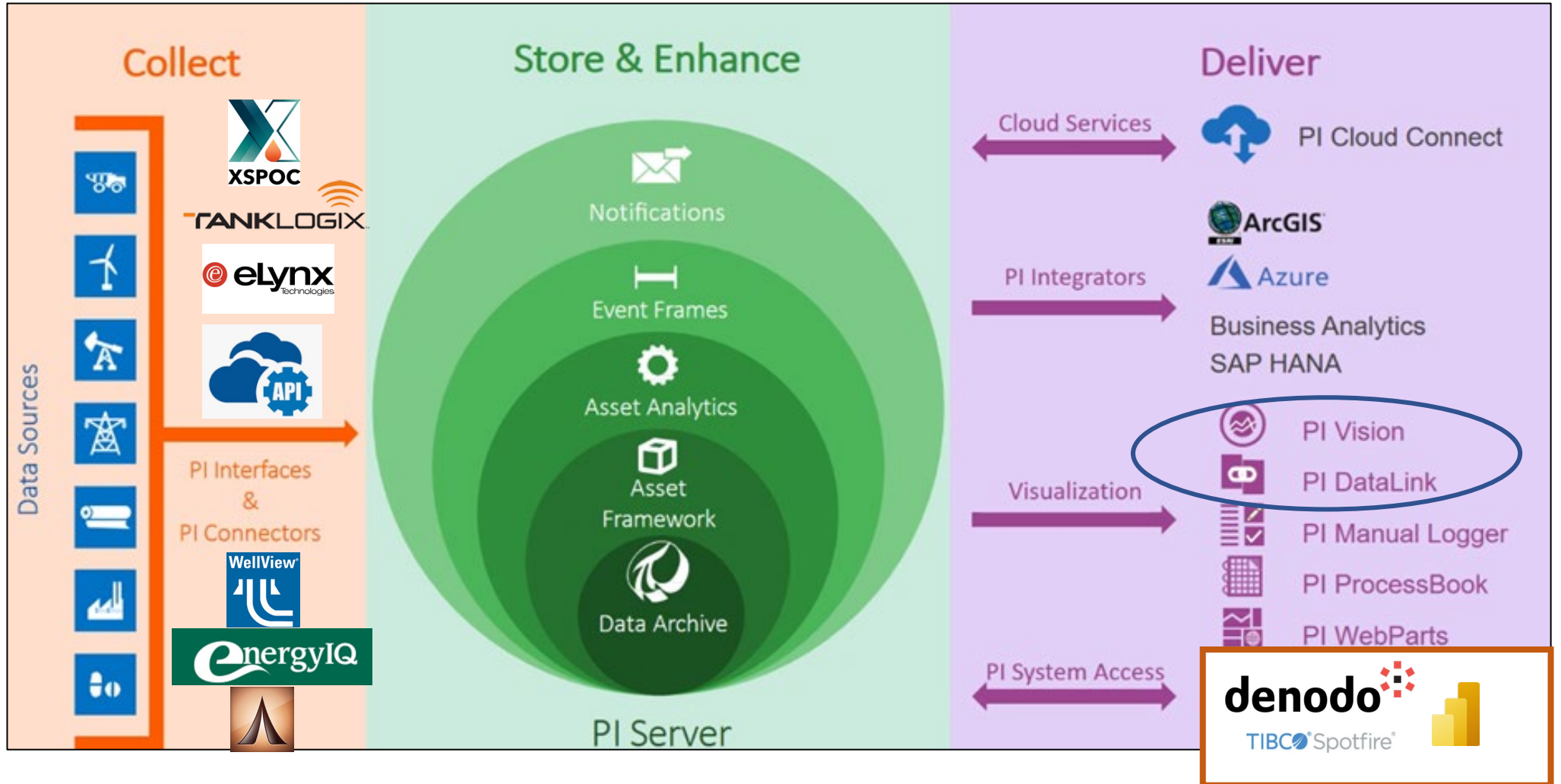
System Overview

» PI AT SM ENERGY



System Overview

» PI AT SM ENERGY



System Overview

» CONNECTORS AND INTERFACES

- **UFL Connector**
 - 7 Instances
 - API Response
 - .csv Output
 - ~70,000 PI Points
 - 1-15 Minute Frequency



System Overview

» CONNECTORS AND INTERFACES

- **UFL Connector**
 - 7 Instances
 - API Response
 - .csv Output
 - ~70,000 PI Points
 - 1-15 Minute Frequency
- **RDBMS Interfaces**
 - 3 Interfaces
 - 14 Custom Queries
 - ~35,000 PI Points
 - 2-15 Minute Frequency



System Overview

» CONNECTORS AND INTERFACES

- **UFL Connector**
 - 7 Instances
 - API Response
 - .csv Output
 - ~70,000 PI Points
 - 1-15 Minute Frequency
- **RDBMS Interfaces**
 - 3 Interfaces
 - 14 Custom Queries
 - ~35,000 PI Points
 - 2-15 Minute Frequency
- **Analysis Tags**
 - ~ 40,000 PI Points



The Bridger Project

» PAST-LIFE PROCESS

- **Manual Leak and Emissions Detection**
 - Monthly Facility Inspections
 - Routine LDAR Reviews Facility by Facility
- **Delays and Lag**
- **Resource Heavy**
- **Heavy Data Mining**
 - Multiple Sources
 - Non-Normalized Time Series
- **No Exposure to Key Facility Data**
 - Intuitive Data Mapping Non-Existent



The Bridger Project

» GOALS

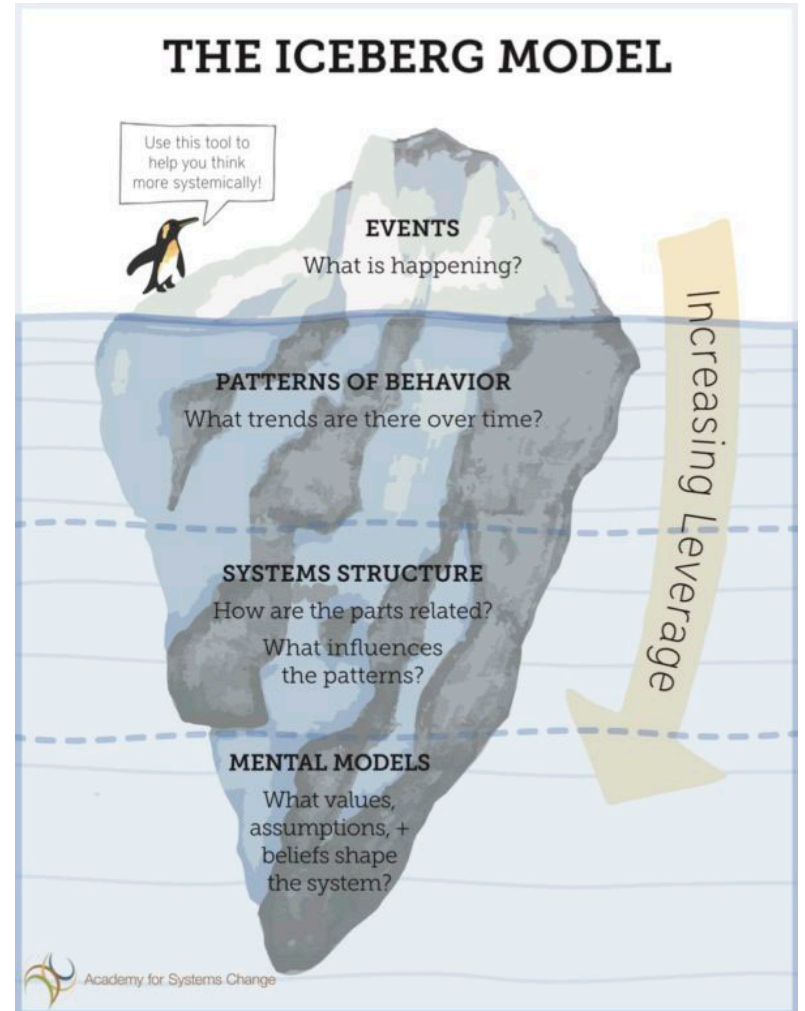
- **Monthly Drone Flyovers of Midland Basin Facilities**
 - Continuous Evaluation of Frequency
- **Faster Leak Detection**
 - Holistic View vs. Facility by Facility
- **Less Manual Intervention**
 - Ground Inspections
 - Data Mining
- **Proactive Leak Determination w/ PI**
 - Potential Root Cause Analysis
 - Compared to Delayed Reactive Maintenance



The Bridger Project

» CHALLENGES

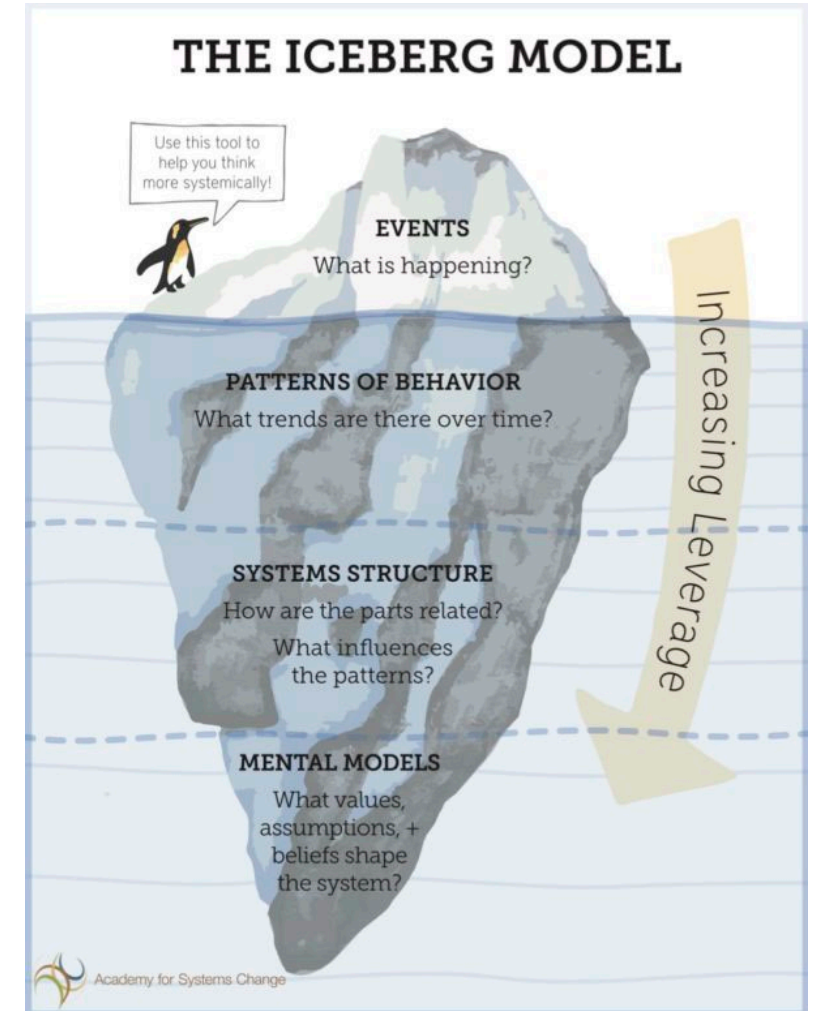
- **Getting Drone Flyover Dates and +/- 7 days in PI**
 - Working w/ 3rd Party
 - Explicitly Noting Each



The Bridger Project

» CHALLENGES

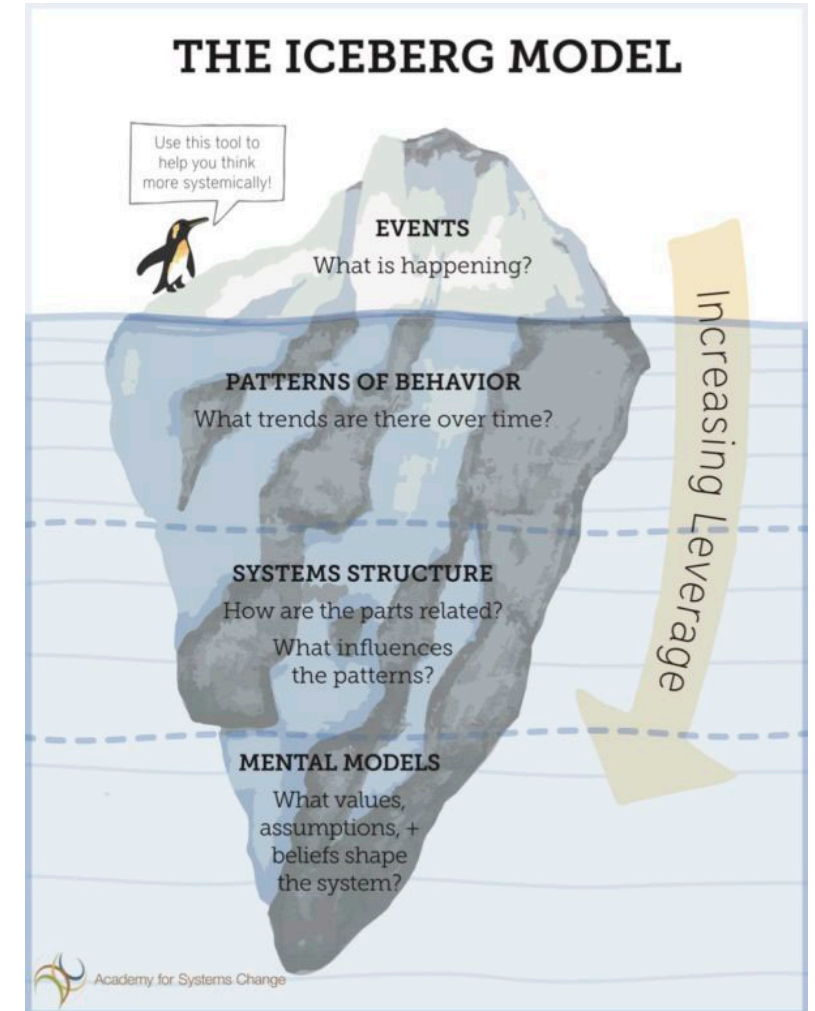
- **Getting Drone Flyover Dates and +/- 7 days in PI**
 - Working w/ 3rd Party
 - Explicitly Noting Each
- **Automatic Event Frame Backfills**
 - *Flyover Dates Provided Afterwards*
 - *Needed for Retroactive Analyses*



The Bridger Project

» CHALLENGES

- **Getting Drone Flyover Dates and +/- 7 days in PI**
 - Working w/ 3rd Party
 - Explicitly Noting Each
- **Automatic Event Frame Backfills**
 - *Flyover Dates Provided Afterwards*
 - *Needed for Retroactive Analyses*
- **Exposure to BI Tools**
 - Record Count
 - Display Effectiveness



The Bridger Project

» RESULTS & BENEFITS

- Full Automation
 - FTP w/ Flyover Dates to GIS Table
 - GIS Table Linked to PI Table
 - PI Table to Corrected Dates Analyses
 - Corrected Dates to Backfilled Event Frames
 - Event Frames to PI View
 - PI View to BI Tools

| Bridger Flyover Dates | | |
|-----------------------|------------------------|-----------------------|
| reportnumber | flyoverstartdate | flyoverenddate |
| SME0002 | 8/3/2022 7:28:16 PM | 8/10/2022 2:41:52 PM |
| SME0003 | 8/7/2022 12:34:01 PM | 8/10/2022 1:56:01 PM |
| SME0004 | 9/10/2022 12:52:16 PM | 9/13/2022 2:16:08 PM |
| SME0005 | 10/10/2022 6:35:55 PM | 10/12/2022 5:11:53 PM |
| SME0006 | 11/9/2022 2:16:21 PM | 11/11/2022 1:39:23 PM |
| SME0007 | 12/14/2022 1:30:30 PM | 12/15/2022 2:51:30 PM |
| SME0008 | 1/16/2023 2:03:25 PM | 1/25/2023 3:13:55 PM |
| SME0009 | 2/19/2023 1:46:52 PM | 2/21/2023 5:26:06 PM |
| SME0010 | 3/20/2023 1:07:18 PM | 3/23/2023 4:05:56 PM |
| SME0011 | 4/19/2023 1:32:04 PM | 4/22/2023 1:45:57 PM |
| SME0012 | 5/21/2023 11:51:24 ... | 5/24/2023 7:20:09 PM |
| SME0013 | 6/22/2023 3:25:55 PM | 6/27/2023 12:50:04 PM |
| SME0014 | 7/19/2023 12:03:43 PM | 7/21/2023 1:22:23 PM |
| SME0015 | 8/21/2023 12:15:47 PM | 8/24/2023 1:13:09 PM |
| SME0016 | 9/25/2023 12:29:33 PM | 9/28/2023 2:41:11 PM |
| SME0017 | 11/21/2023 1:41:37 PM | 12/1/2023 9:49:32 PM |
| SME0018 | 1/22/2024 6:58:58 PM | 1/29/2024 3:58:16 PM |
| SME0019 | 3/11/2024 1:07:01 PM | 3/14/2024 3:58:55 PM |

The screenshot shows the Permian software interface for configuring an analysis. The main configuration area includes:

- Name:** Corrected Flyover Dates +-7 Days
- Description:** (empty)
- Categories:** Backfill;Bridger;BridgerAnalytics2
- Analysis Type:** Expression (selected), Rollup, Event Frame Generation, SQC

The **Variables** table is as follows:

| Name | Expression | Output Attribute | Map |
|---------------|--|----------------------|-----|
| vNow | '*' | Map | ⊗ |
| vMin | 'Minimum Flyover Date Raw' | Map | ⊗ |
| vMax | 'Maximum Flyover Date Raw' | Map | ⊗ |
| v7Days | 7 * 24 * 60 * 60 | Map | ⊗ |
| vMin7 | //3601 to account for daylight savings tim Bod(vMin - v7Days + 3601) | Map | ⊗ |
| vMax7 | //3601 to account for daylight savings tim Bod(vMax + v7Days + 3601) | Map | ⊗ |
| vMinTimestamp | If (vNow <= (vMax7) and vNow >= (vMin7)) then vMin else NoOutput() | Minimum Flyover Date | ⊗ |
| vMaxTimestamp | If (vNow <= (vMax7) and vNow >= (vMin7)) then vMax | Maximum Flyover Date | ⊗ |

Scheduling: Event-Triggered (selected), Periodic

Trigger on: Minimum Flyover Date Raw

Output time stamp override: vMin7

Functions: A list of functions is shown, with 'Abs(number x)' selected. The description for Abs is: "Return the absolute value of an integer or real number. Example: Abs(-2.2) [Returns 2.2]"

The Bridger Project

» RESULTS & BENEFITS

- Event Frame Generation Including +/- 7 days of the Flyover Utilizing Custom Automatic Backfill Solution
 - Applied to all Wells, Oil Tanks, Water Tanks, Flares, and VRU's

The screenshot displays two software windows. The left window is the 'Configuration Editor' for 'SmeEventFrameBackfillService.exe.config'. It shows various configuration keys and their values, such as 'PiSystem', 'AfDatabase' (SM Energy Production), 'ServiceAccountEnabled' (True), 'CheckIntervalMinutes' (180), and 'Simulate' (False). The right window is 'Event Frame Search 4', which shows a list of event frames with columns for Name, Duration, Start Time, End Time, Description, and Category. The list includes numerous entries for different wells and VRUs, such as 'Lumbergh VRU800 Bridger Flyover' and 'Maverick VRU800 Bridger Flyover', all with a duration of 21:00:00 and start/end times around 1/15/2024 and 2/5/2024.

Configuration Editor

Configuration File: C:\Install\EventFrameBackfillService_22.18.4\SmeEventFrameBackfillService.exe.config

| Setting Key | Setting Value |
|----------------------------|----------------------|
| PiSystem | |
| AfDatabase | SM Energy Production |
| ServiceAccountEnabled | True |
| ServiceAccountUsername | |
| ServiceAccountPassword | |
| CheckIntervalMinutes | 180 |
| BackfillElementCategory | BridgerRoot |
| AnalyticCategory | BridgerAnalytics |
| EventFrameAnalyticCategory | BridgerEventFrames |
| FlyOverTableCategory | BridgerTable |
| Simulate | False |

Configuration file SmeEventFrameBackfillService.exe.config loaded

Event Frame Search 4

| Name | Duration | Start Time | End Time | Description | Category |
|---|----------|-----------------------|----------------------|---------------|----------|
| Lumbergh VRU800 Bridger Flyover 01-22-2024 | 21:00:00 | 1/15/2024 12:00:00 AM | 2/5/2024 12:00:00 AM | Backfill;B... | Noi |
| Maverick VRU800 Bridger Flyover 01-22-2024 | 21:00:00 | 1/15/2024 12:00:00 AM | 2/5/2024 12:00:00 AM | Backfill;B... | Noi |
| Fletch VRU800 Bridger Flyover 01-22-2024 | 21:00:00 | 1/15/2024 12:00:00 AM | 2/5/2024 12:00:00 AM | Backfill;B... | Noi |
| Guitar North 17 VRU801 Bridger Flyover 01-22-2024 | 21:00:00 | 1/15/2024 12:00:00 AM | 2/5/2024 12:00:00 AM | Backfill;B... | Noi |
| Merlin VRU801 Bridger Flyover 01-22-2024 | 21:00:00 | 1/15/2024 12:00:00 AM | 2/5/2024 12:00:00 AM | Backfill;B... | Noi |
| Lassard VRU801 Bridger Flyover 01-22-2024 | 21:00:00 | 1/15/2024 12:00:00 AM | 2/5/2024 12:00:00 AM | Backfill;B... | Noi |
| McFly VRU800 Bridger Flyover 01-22-2024 | 21:00:00 | 1/15/2024 12:00:00 AM | 2/5/2024 12:00:00 AM | Backfill;B... | Noi |
| Guitar North 17 VRU800 Bridger Flyover 01-22-2024 | 21:00:00 | 1/15/2024 12:00:00 AM | 2/5/2024 12:00:00 AM | Backfill;B... | Noi |
| Guitar North 26-2 VRU801 Bridger Flyover 01-22-2024 | 21:00:00 | 1/15/2024 12:00:00 AM | 2/5/2024 12:00:00 AM | Backfill;B... | Noi |
| Merlin VRU800 Bridger Flyover 01-22-2024 | 21:00:00 | 1/15/2024 12:00:00 AM | 2/5/2024 12:00:00 AM | Backfill;B... | Noi |
| Griswold VRU800 Bridger Flyover 01-22-2024 | 21:00:00 | 1/15/2024 12:00:00 AM | 2/5/2024 12:00:00 AM | Backfill;B... | Noi |
| Flenderson VRU800 Bridger Flyover 01-22-2024 | 21:00:00 | 1/15/2024 12:00:00 AM | 2/5/2024 12:00:00 AM | Backfill;B... | Noi |
| Jester VRU801 Bridger Flyover 01-22-2024 | 21:00:00 | 1/15/2024 12:00:00 AM | 2/5/2024 12:00:00 AM | Backfill;B... | Noi |
| Maximus VRU801 Bridger Flyover 01-22-2024 | 21:00:00 | 1/15/2024 12:00:00 AM | 2/5/2024 12:00:00 AM | Backfill;B... | Noi |
| Iceman VRU800 Bridger Flyover 01-22-2024 | 21:00:00 | 1/15/2024 12:00:00 AM | 2/5/2024 12:00:00 AM | Backfill;B... | Noi |
| Smalls VRU801 Bridger Flyover 01-22-2024 | 21:00:00 | 1/15/2024 12:00:00 AM | 2/5/2024 12:00:00 AM | Backfill;B... | Noi |
| Miyagi VRU800 Bridger Flyover 01-22-2024 | 21:00:00 | 1/15/2024 12:00:00 AM | 2/5/2024 12:00:00 AM | Backfill;B... | Noi |
| Maximus VRU800 Bridger Flyover 01-22-2024 | 21:00:00 | 1/15/2024 12:00:00 AM | 2/5/2024 12:00:00 AM | Backfill;B... | Noi |
| Top Gun VRU800 Bridger Flyover 01-22-2024 | 21:00:00 | 1/15/2024 12:00:00 AM | 2/5/2024 12:00:00 AM | Backfill;B... | Noi |
| Jester VRU800 Bridger Flyover 01-22-2024 | 21:00:00 | 1/15/2024 12:00:00 AM | 2/5/2024 12:00:00 AM | Backfill;B... | Noi |
| Costanza VRU801 Bridger Flyover 01-22-2024 | 21:00:00 | 1/15/2024 12:00:00 AM | 2/5/2024 12:00:00 AM | Backfill;B... | Noi |
| Jessup VRU800 Bridger Flyover 01-22-2024 | 21:00:00 | 1/15/2024 12:00:00 AM | 2/5/2024 12:00:00 AM | Backfill;B... | Noi |
| Battery 33 VRU800 Bridger Flyover 01-22-2024 | 21:00:00 | 1/15/2024 12:00:00 AM | 2/5/2024 12:00:00 AM | Backfill;B... | Noi |

The Bridger Project

» RESULTS & BENEFITS

- Rolling 1-year View of All Event Frames (+/- 7 Days of Flyover) at 15 min. Frequency
 - ~ 20 Million Records

```
SELECT ef.Name as [EFName]
,s.[Asset Name] as VRU_Master_Template
,s.Timestamp
,s.[AVM Stop ID] as AVM_Stop_ID
,s.[AVM Stop Name] as AVM_Stop_Name
,s.[Compressor Alarm Message] as Compressor_Alarm_Message
,s.[Compressor Status] as Compressor_Status
,s.Downtime
,s.[Facility Name] as Facility_Name
,s.[Facility Site Number] as Facility_Site_Number
,s.[Fault Time] as Fault_Time
,s.[Maximum Flyover Date] as Maximum_Flyover_Date
,s.[Mechanical Availability] as Mechanical_Availability
,s.[Minimum Flyover Date] as Minimum_Flyover_Date
,s.[Off Time] as Off_Time
,s.[Production Area] as Production_Area
,s.Route
,s.Runtime
,s.[Total Available Time] as Total_Available_Time
,s.[Vendor Name] as Vendor_Name
,s.[Ventline KO Pressure] as Ventline_KO_Pressure
,s.[VRU Number] as VRU_Number
FROM
(
    SELECT ID, Name, Template, StartTime, EndTime
    FROM [Master].[EventFrame].[EventFrame]
    WHERE Template = N'Bridger Flyover VRU'
) ef
CROSS APPLY [Samples].[Queries].[Bridger Flyover VRU_GetSampledValues]
(
    ef.ID, --Event Frame ID
    ef.StartTime, --Start Time
    ef.EndTime, --End Time
    '15m' --Time Step
) s
```

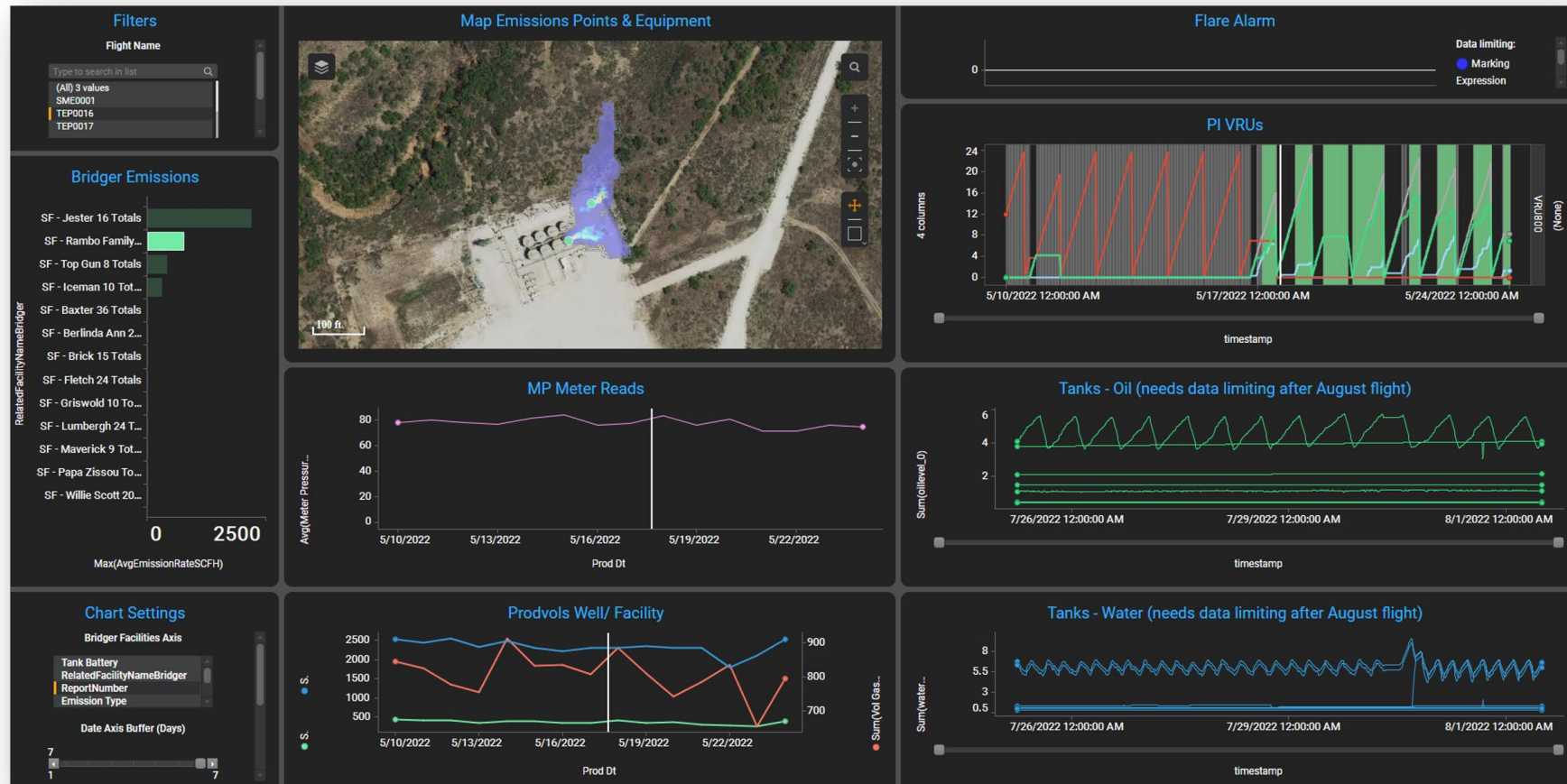
```
SELECT TOP 100 *
FROM [Prod].[Queries].[BridgerFlyoverVRU]
```

| | Maximum_Flyover_Date | Mechanical_Availability | Minimum_Flyover_Date | Off_Time | Production_Area | Route | Runtime | Total_Available_Time | Vendor_Name | Ventline_KO_Pressure | VRU_Number |
|----|-------------------------|-------------------------|-------------------------|----------|-----------------|--------|---------|----------------------|-------------|----------------------|------------|
| 1 | 2023-07-21 00:00:00.000 | 0 | 2023-07-19 00:00:00.000 | 0 | RR Area 3 | Merlin | 18 | 18 | Aereon | 3.67532525450008 | VRU800 |
| 2 | 2023-07-21 00:00:00.000 | 0 | 2023-07-19 00:00:00.000 | 0 | RR Area 3 | Merlin | 18.25 | 18.25 | Aereon | 4.02125552448533 | VRU800 |
| 3 | 2023-07-21 00:00:00.000 | 0 | 2023-07-19 00:00:00.000 | 0 | RR Area 3 | Merlin | 18.5 | 18.5 | Aereon | 4.62081634854878 | VRU800 |
| 4 | 2023-07-21 00:00:00.000 | 0 | 2023-07-19 00:00:00.000 | 0 | RR Area 3 | Merlin | 18.75 | 18.75 | Aereon | 5.03758537890747 | VRU800 |
| 5 | 2023-07-21 00:00:00.000 | 0 | 2023-07-19 00:00:00.000 | 0 | RR Area 3 | Merlin | 19 | 19 | Aereon | 4.66411473178695 | VRU800 |
| 6 | 2023-07-21 00:00:00.000 | 0 | 2023-07-19 00:00:00.000 | 0 | RR Area 3 | Merlin | 19.25 | 19.25 | Aereon | 4.24744244243877 | VRU800 |
| 7 | 2023-07-21 00:00:00.000 | 0 | 2023-07-19 00:00:00.000 | 0 | RR Area 3 | Merlin | 19.5 | 19.5 | Aereon | 4.44078788015841 | VRU800 |
| 8 | 2023-07-21 00:00:00.000 | 0 | 2023-07-19 00:00:00.000 | 0 | RR Area 3 | Merlin | 19.75 | 19.75 | Aereon | 4.79954313442367 | VRU800 |
| 9 | 2023-07-21 00:00:00.000 | 0 | 2023-07-19 00:00:00.000 | 0 | RR Area 3 | Merlin | 20 | 20 | Aereon | 4.6915333045216 | VRU800 |
| 10 | 2023-07-21 00:00:00.000 | 0 | 2023-07-19 00:00:00.000 | 0 | RR Area 3 | Merlin | 20.25 | 20.25 | Aereon | 4.85985580918298 | VRU800 |
| 11 | 2023-07-21 00:00:00.000 | 0 | 2023-07-19 00:00:00.000 | 0 | RR Area 3 | Merlin | 20.5 | 20.5 | Aereon | 5.02931374526773 | VRU800 |
| 12 | 2023-07-21 00:00:00.000 | 0 | 2023-07-19 00:00:00.000 | 0 | RR Area 3 | Merlin | 20.75 | 20.75 | Aereon | 4.87189012824194 | VRU800 |
| 13 | 2023-07-21 00:00:00.000 | 0 | 2023-07-19 00:00:00.000 | 0 | RR Area 3 | Merlin | 21 | 21 | Aereon | 4.8650951328383 | VRU800 |
| 14 | 2023-07-21 00:00:00.000 | 0 | 2023-07-19 00:00:00.000 | 0 | RR Area 3 | Merlin | 21.25 | 21.25 | Aereon | 4.23434581548772 | VRU800 |
| 15 | 2023-07-21 00:00:00.000 | 0 | 2023-07-19 00:00:00.000 | 0 | RR Area 3 | Merlin | 21.5 | 21.5 | Aereon | 3.67100180483274 | VRU800 |
| 16 | 2023-07-21 00:00:00.000 | 0 | 2023-07-19 00:00:00.000 | 0 | RR Area 3 | Merlin | 21.75 | 21.75 | Aereon | 4.28305340350931 | VRU800 |
| 17 | 2023-07-21 00:00:00.000 | 0 | 2023-07-19 00:00:00.000 | 0 | RR Area 3 | Merlin | 22 | 22 | Aereon | 4.61697341285533 | VRU800 |
| 18 | 2023-07-21 00:00:00.000 | 0 | 2023-07-19 00:00:00.000 | 0 | RR Area 3 | Merlin | 22.25 | 22.25 | Aereon | 4.95089342220134 | VRU800 |
| 19 | 2023-07-21 00:00:00.000 | 0 | 2023-07-19 00:00:00.000 | 0 | RR Area 3 | Merlin | 22.5 | 22.5 | Aereon | 5.08629229150906 | VRU800 |
| 20 | 2023-07-21 00:00:00.000 | 0 | 2023-07-19 00:00:00.000 | 0 | RR Area 3 | Merlin | 22.75 | 22.75 | Aereon | 5.01085408978215 | VRU800 |
| 21 | 2023-07-21 00:00:00.000 | 0 | 2023-07-19 00:00:00.000 | 0 | RR Area 3 | Merlin | 23 | 23 | Aereon | 4.86765117732715 | VRU800 |
| 22 | 2023-07-21 00:00:00.000 | 0 | 2023-07-19 00:00:00.000 | 0 | RR Area 3 | Merlin | 23.25 | 23.25 | Aereon | 4.18278665219973 | VRU800 |
| 23 | 2023-07-21 00:00:00.000 | 0 | 2023-07-19 00:00:00.000 | 0 | RR Area 3 | Merlin | 23.5 | 23.5 | Aereon | 3.73186015674488 | VRU800 |
| 24 | 2023-07-21 00:00:00.000 | 0 | 2023-07-19 00:00:00.000 | 0 | RR Area 3 | Merlin | 23.75 | 23.75 | Aereon | 4.23223398193829 | VRU800 |

The Bridger Project

» RESULTS & BENEFITS

- Birds Eye View Resulted in 25% Faster Leak Detection w/ 10% Fewer Manual Surveys



What Else?

» CONTINUED GROWTH OF COMPLEX ANALYSES

- **Compressor Analyses**
 - Daily Operation & Preventative Maintenance
- **Critical Asset 1-Second Data**
 - To Provide Insight Around Highest Producing Assets
- **Spatial Alarming**
 - Paired w/ ESRI to Streamline Field Operations





Q&A