# Data & Event Management at Scale

## Presented By: Matthew Brocklehurst

POWER FACTORS
DRIVE

# POWER FACTORS DRIVE

- SaaS company founded by power industry veterans
- Flagship Product Drive Platform
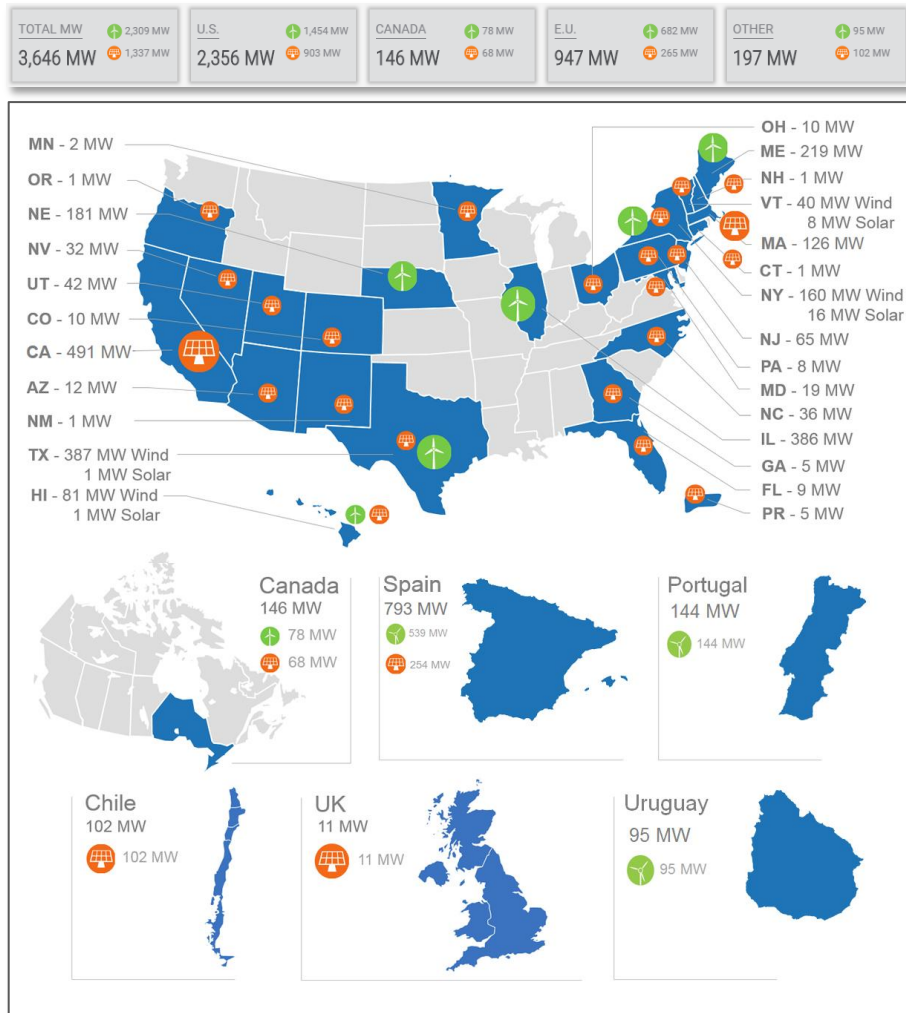- 90+ Industry experts
- 5 Continents
- 20GW+ Solar, Wind, Storage

# Challenge

# TerraForm POWER

- Owner-Operator Yield Co
- ~3600 MWs in NA/Europe
  - ~2500MWs in NA
  - Mixed Fleet of 500+ Solar & Wind sites
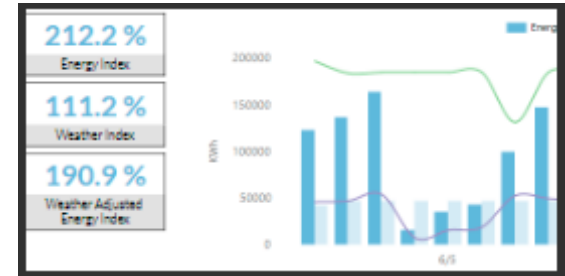
**Onboard this fleet in 3 months!**

| TOTAL MW | ↑ 2,309 MW ↓ 1,337 MW | U.S. | ↑ 1,454 MW ↓ 903 MW | CANADA | ↑ 78 MW ↓ 68 MW | E.U. | ↑ 682 MW ↓ 265 MW | OTHER | ↑ 95 MW ↓ 102 MW |
|---|---|---|---|---|---|---|---|---|---|
| 3,646 MW | | 2,356 MW | | 146 MW | | 947 MW | | 197 MW | |

MN - 2 MW
OR - 1 MW
NE - 181 MW
NV - 32 MW
UT - 42 MW
CO - 10 MW
CA - 491 MW
AZ - 12 MW
NM - 1 MW
TX - 387 MW Wind
     1 MW Solar
HI - 81 MW Wind
     1 MW Solar

OH - 10 MW
ME - 219 MW
NH - 1 MW
VT - 40 MW Wind
     8 MW Solar
MA - 126 MW
CT - 1 MW
NY - 160 MW Wind
     16 MW Solar
NJ - 65 MW
PA - 8 MW
MD - 19 MW
NC - 36 MW
IL - 386 MW
GA - 5 MW
FL - 9 MW
PR - 5 MW

Canada
146 MW
↑ 78 MW
↓ 68 MW

Spain
793 MW
↑ 539 MW
↓ 254 MW

Portugal
144 MW
↑ 144 MW

Chile
102 MW
↓ 102 MW

UK
11 MW
↓ 11 MW

Uruguay
95 MW
↑ 95 MW

# Technical Challenges



212.2 %
Energy Index

111.2 %
Weather Index

190.9 %
Weather Adjusted Energy Index

Accurate &
audited reporting

Generate Meaningful
Events & Integrate
with Field Service
Systems

Data Quality
Issues:-
Sensors/Comms
Failures & Meter
Rollovers

Deploy 500+
sites in 3 months

with various interfaces &
technologies


AICPA Service Organization Control Reports
AICPA
SERVICE ORGANIZATIONS
SOC
aicpa.org/soc
Formerly SAS 70 Reports

# Managed Service Requirements for Terraform

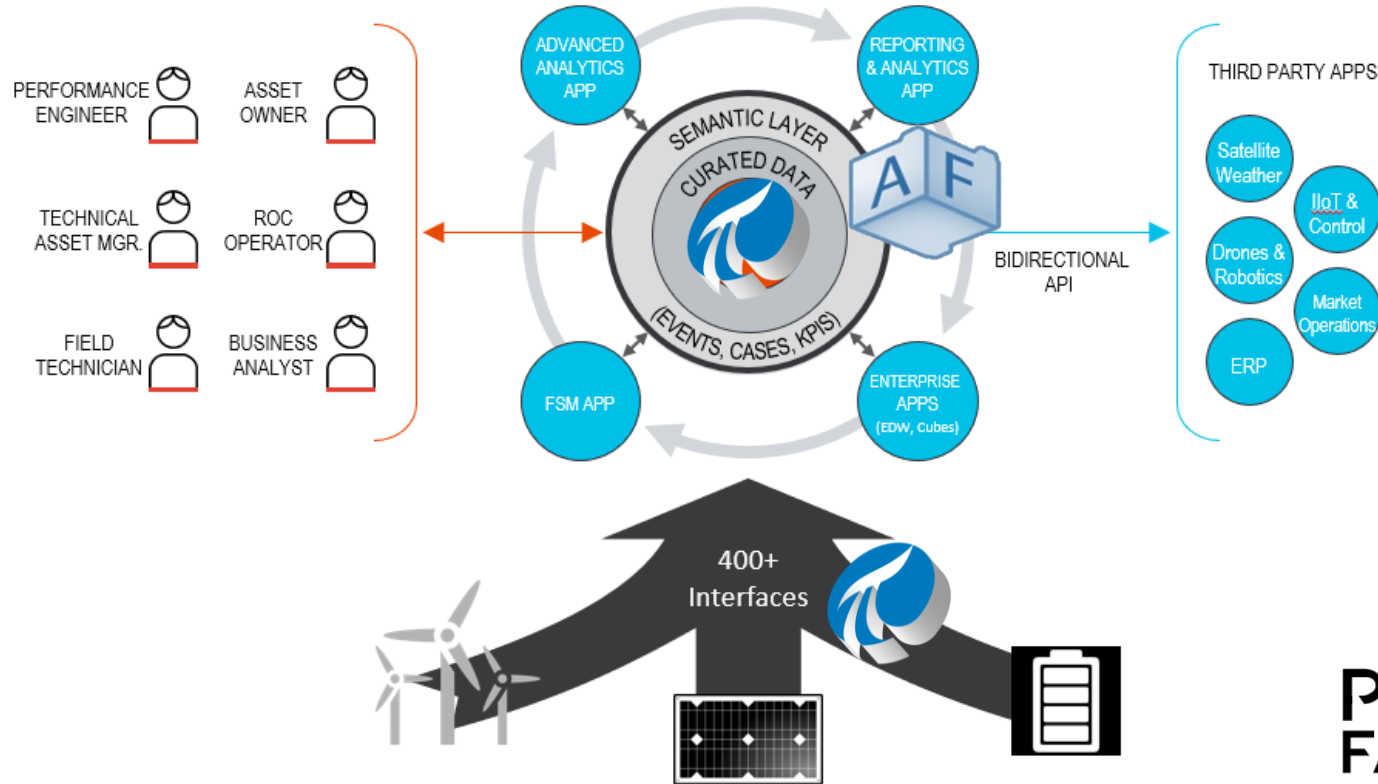| | | |
|---|---|---|
| 500+ Sites | Real-Time Data + Context | Data Curation |
| Event Management | Analytics | User Interface System of Engagement |
| Case Management | O&M - Work Management | Detailed Investor Reporting |

# Solution

# System of engagement for renewable energy

# Key Drivers

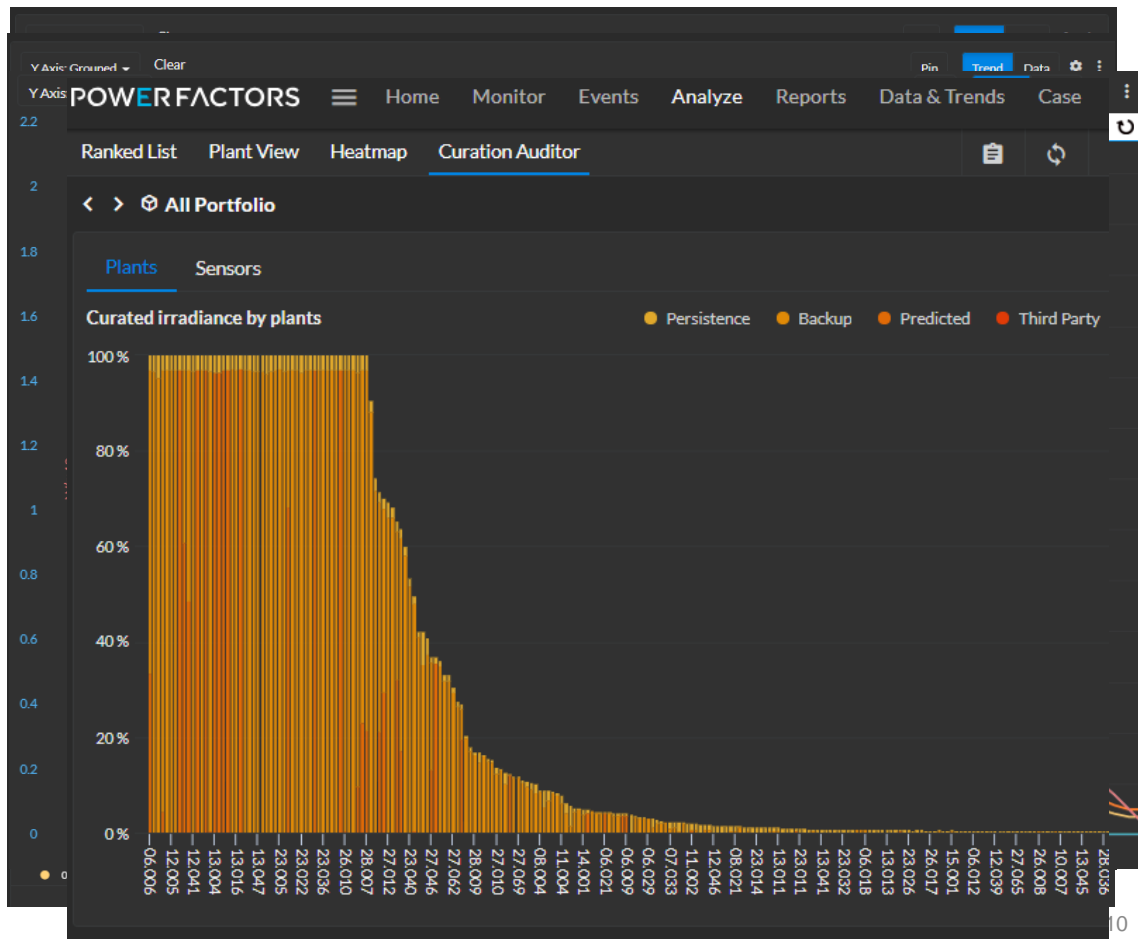| | |
|---|---|
| **Data & Quality Management** | • PI System, AF, Interfaces<br>• VEE Data Curation Engine |
| **Event Management** | • Event Genealogy<br>• Compression & Shelving |
| **Reporting Flexibility** | • Pre-Configured Reports<br>• Ad hoc Reporting with Full API |
| **Advanced Analytics** | • Integrated Analytics |
| **Auditable & Scalable** | • SOC 1 Audited (Type 2)<br>• OSIsoft PI, MS Azure, SalesForce |

# Data Curation @ Scale

- Advanced Rules to Validate & Estimate

- Quickly identified dozens of pyranometers needing replacement

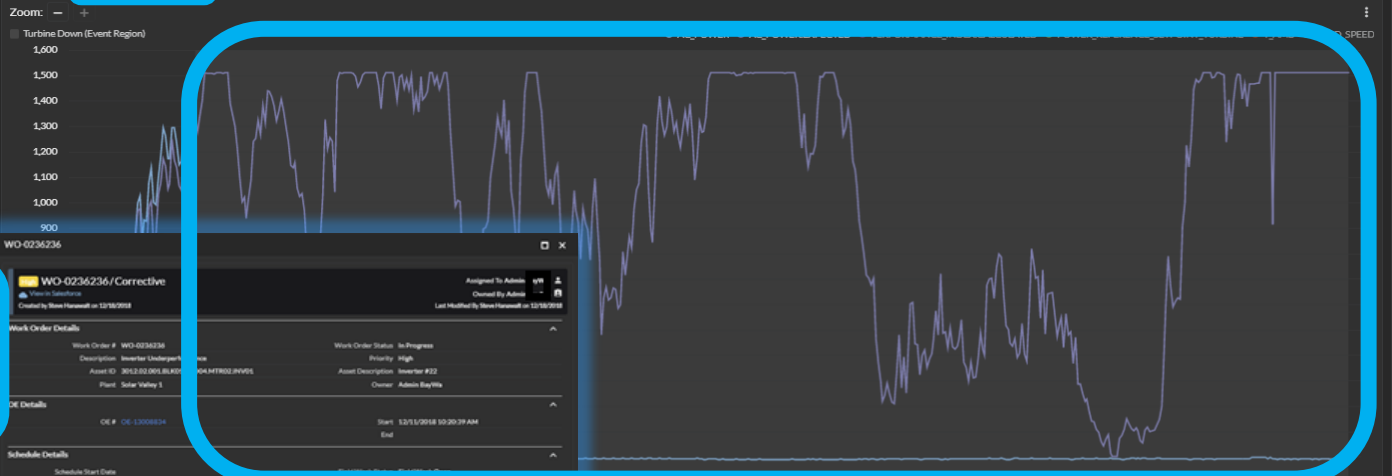- Maintained estimated reporting while under service

EG-0000007390

Overview | Knowledge Base

Edit Time  Split  Merge

| | |
|---|---|
| Status | Open |
| Ack. | UNACK |
| Event Time | |
| Event Code | 1156 - Repair |
| Asset | EWP01-28 |
| Start Time | 02/21/2019 8:30:00 AM |
| End Time | |
| Energy Loss kWh | 86,529.56 |
| Rate loss kWh/h | 1,042.68 |
| Work Order | |

| | |
|---|---|
| Controllable | Controllable |
| Responsibility | Manufacturer |
| Level 1 | Information Available |
| Level 2 | Non-Operative |
| Level 3 | Planned Corrective Action |
| Level 4 | Planned Corrective Action |
| Level 5 | Other Corrective Action |

Note
Matt Brocklehurst

Manufacturer scheduled repair

Zoom: — +

Turbine Down (Event Region)

1,600
1,500
1,400
1,300
1,200
1,100
1,000
900

WO-0236236

WO-0236236 / Corrective

View in Salesforce
Created by Steve Hanawalt on 12/18/2018

Assigned To Admin  bjW
Owned By Admin
Last Modified By Steve Hanawalt on 12/18/2018

Work Order Details

Work Order # WO-0236236
Description Inverter Underperformance
Asset ID 3012.02.005.BLK00A.MTR02.INV01
Plant Solar Valley 1

Work Order Status In Progress
Priority High
Asset Description Inverter #22
Owner Admin BayWa

OE Details

OE # OE-1300604

Start 12/11/2018 10:20:39 AM
End

Schedule Details

Schedule Start Date
Schedule Completion Date

Delay Details

Notes

Warranty Details

Warranty Claim No
Claim Status
RMA #

Claim Number
Claim Submission Date
Claim-Close Date

Work Order Notes

Problem Description Investigate and restore

Completion Notes

Down

PF120 - Turbine Down  ED-0000012199

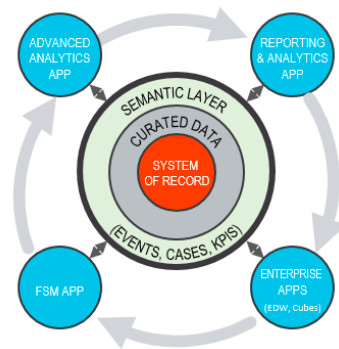| | |
|---|---|
| 1063 - Safety chain | |
| 1118 - Emergency stop nacelle / hub | |
| 1145 - Pitch control deviation axis 1 | |
| 1121 - Axis 1 fault pitch controller | |
| 1149 - Axis 2 fault pitch controller | |
| 1150 - Axis 3 fault pitch controller | |

1156 - Repair  ED-0000012214

16:00  20:00  0:00  4:00  8:00  12:00  16:00  20:00  0:00  4:00  8:00  12:00  16:00  20:00  0:00  4:00  8:00  12:00  16:00
03/21/2018        03/22/2018        03/23/2018        03/24/2018

All period

135 Events

Close

# POWER FACTORS DRIVE

## Data & Event Management at Scale

### CHALLENGE

A diverse fleet of non-homogenoues assets and aggressive onboarding schedule with public company filing requirements

- Disparate multi-OEM wind and solar plants

- Data quality

- Numerous, non-intelligent alarms

### SOLUTION

Drive System of Engagement with Data Quality, Event Management, & Reporting

- PI Historian, interfaces and AF for data collection and data management

- Power Factors Data Quality Engine, Event Manager

- Scalable, SOC compliant managed SaaS application

### RESULTS

Automation & business continuity to achieve operational performance and compliance objectives

- Quality data for 500+ power plants across wind and solar

- Manageable alarms for O&M (90% reduction)

- External stakeholder & SOX reporting requirements

# Speaker

- Matthew Brocklehurst
- CTO
- Power Factors
- [brock@pfdrive.com](mailto:brock@pfdrive.com)

# Questions?

Please wait for
the **microphone**

State your
**name & company**

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