Wind Farm Performance Monitoring

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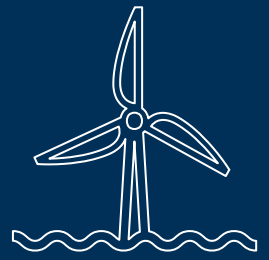
RWE CLEAN ENERGY

RWE Clean Energy at a Glance

8 GW of operating assets

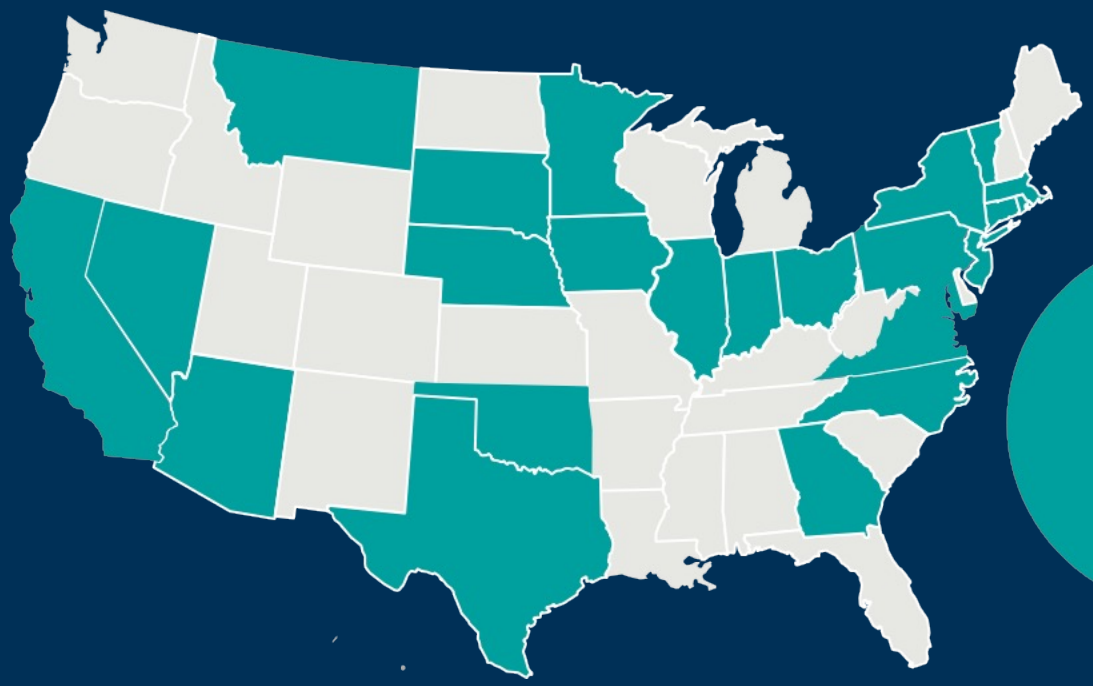
~1,500 employees in the U.S.

+24 GW development pipeline



~3.9 GW secured offshore wind development capacities

RWE Clean Energy's renewables platform



~8 GW

Project Summary

CHALLENGE

RWE needed a way to score, visualize, and assess asset performance

SOLUTION

An interactive report to easily identify sites experiencing issues by scoring sites during curtailment

RESULTS

Reduction of time to discover events
Estimate cost impact of control issues
Prioritization of vendor outreach

Wind Farm Real-Time Operations

Generation: Turbines generate real power

Transmission: Limits must be respected

Grid: Balance of load and generation

Result: Real power MW basepoint

Wind Farm Curtailment

Outside of curtailment:

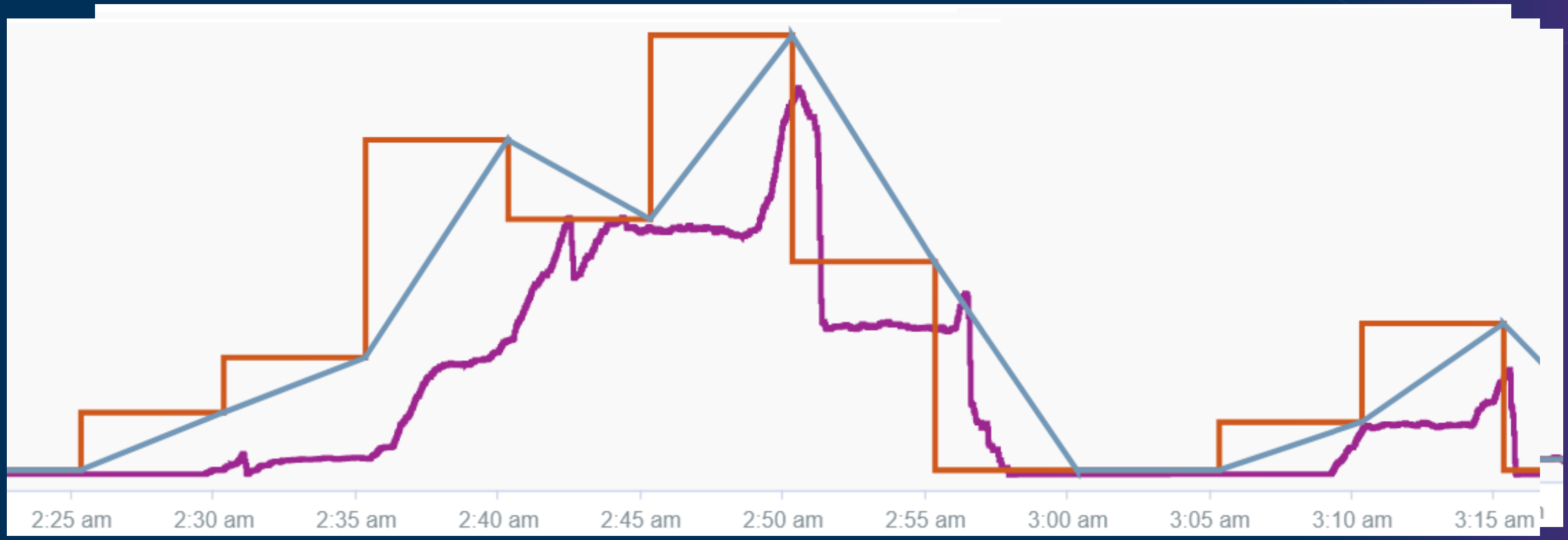
Wind sites can generate as many MW as possible without constraints from the grid operator

During curtailment*:

Wind sites are expected to follow grid operator basepoints that are dispatched every five minutes

*scoring happens during curtailment

Performance During Curtailment

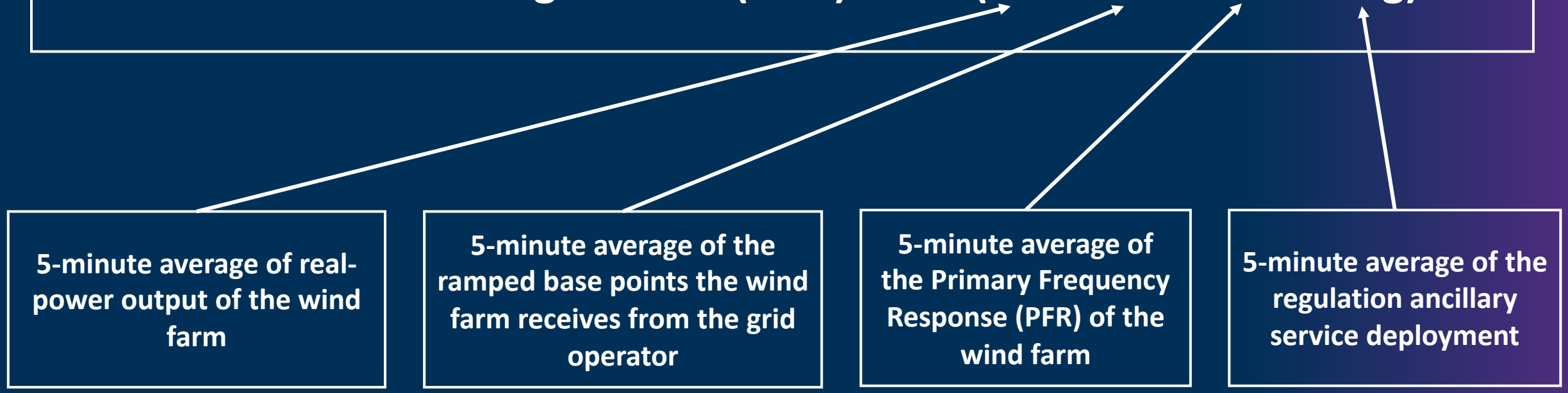


Expected Output (MW)
Actual Output (MW)
Grid Operator Basepoint (MW)

Project Background

- Focus: RWE's Texas wind farms
- Goal: Replicate an estimate of grid operator scoring metrics to internally evaluate wind farm performance
- Methodology: Score units on their ability to follow basepoints, ancillary service energy deployments, and respond to frequency events
- Results:
  - Before: RWE had a reactive approach to post real-time performance monitoring and would wait for grid operators to run reports and do outreach regarding poor performance
  - Current: This project will enable RWE to have a proactive approach regarding performance monitoring

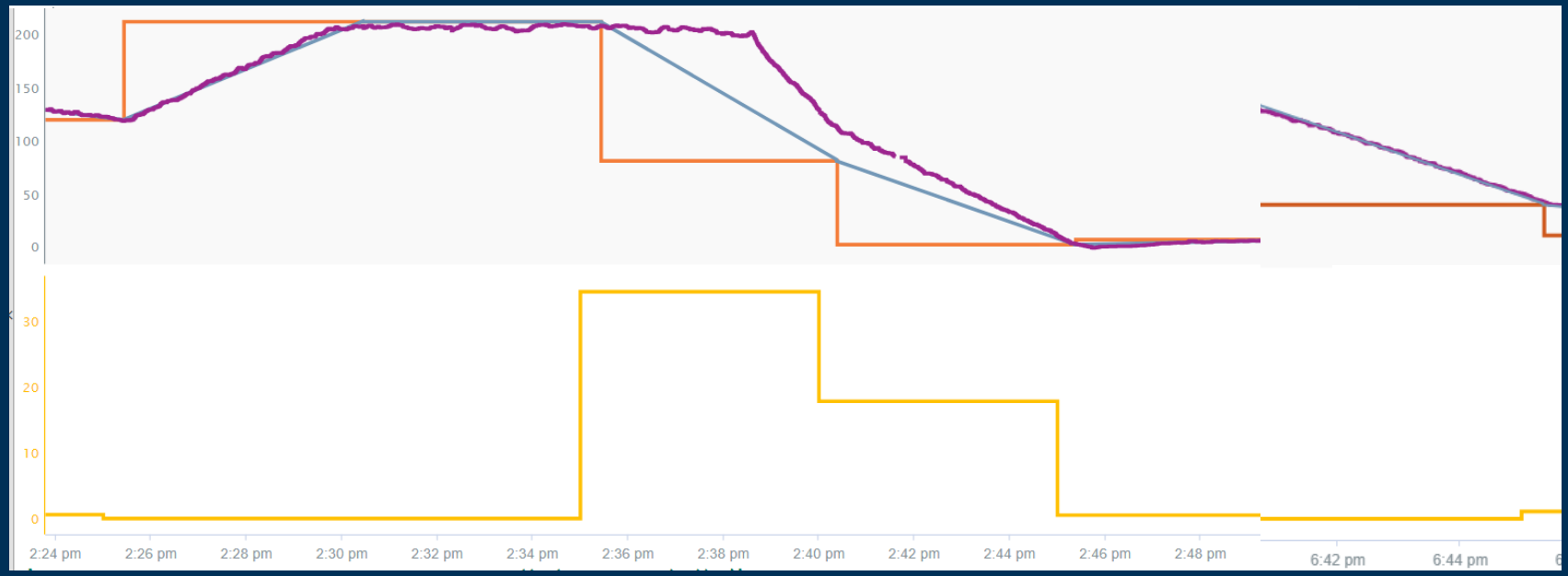
Performance Scoring Metric* (MW) = ABS(Gen – BP – PFR – Reg)



*Lower score = more ideal performance

Project Results

- Interactive report to easily identify sites experiencing issues scoring five-minute periods of curtailment



- Usage of PI Asset Framework and Seeq allows the report to be scaled across the sites in the fleet with the same tree structure

CONNEQT

Project Results

	MW Score
Apr 5, 2023 8:00 PM	14.777
Apr 5, 2023 8:10 PM	50.376
Apr 5, 2023 8:15 PM	58.714
Apr 5, 2023 8:20 PM	27
Apr 5, 2023 10:25 PM	36.408
Apr 5, 2023 11:50 PM	11.963
Apr 6, 2023 1:55 AM	9.2167
Apr 6, 2023 8:00 AM	8.8871
Apr 6, 2023 8:15 AM	11.22
Apr 6, 2023 8:35 AM	12.181

Name	Count
Score > 20 MW	7
Score > 10 MW	22
Score > 8 MW	28
Curtailment 5 Minute Periods	238

Project Roadblocks

Grid Operators have data that RWE, as a resource owner, doesn’t have access and insight into

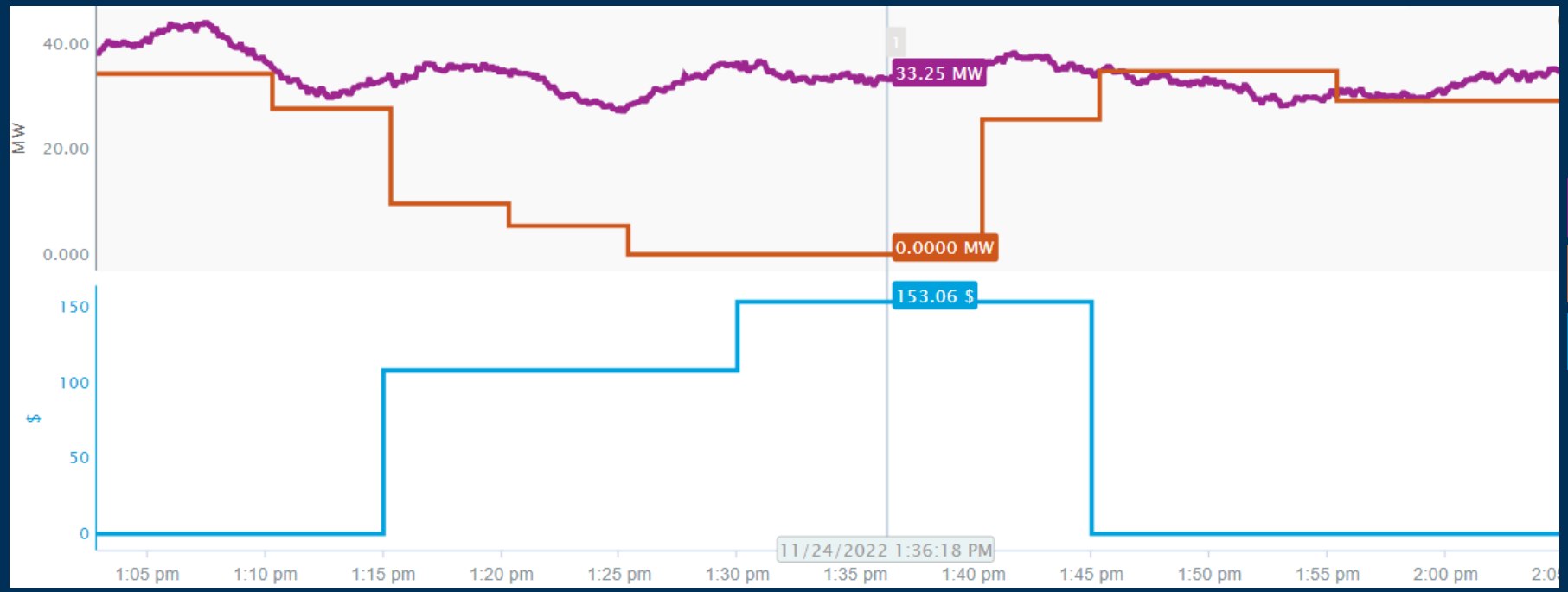
Need to create new signals that aggregate and average other data

Data may have gaps due to storage errors, mapping errors, or communication issues

Business Impact

Cost estimations

- Under generating – lost cost of power agreements and real-time prices
- Over generating – cost of basepoint deviation charges



Business Impact

Time savings

Streamlined identifying sites and time periods of concern (20+ hours pp)

Outreach Prioritization

Increased effectiveness of vendor engagement (5+ hours pp)

Compliance

Increased compliance with grid operator and internal standards

Next Steps

Data Lab application to enhance report availability across the organization

Expand report across the fleet to other interconnections and asset types

Continue to identify performance issues and reach out to vendors


Thank you
SeeQ
CONNEQT