

# Forensic Analysis for Optimal PV Asset Performance

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Black & Veatch Management Consulting



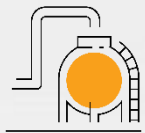


# Black & Veatch Today

## Core Markets



Power



Oil & Gas



Water



Financial



Telecom



Emerging  
Markets



**120+**  
Offices



**8,000+**  
Professionals

**\$3B**

2020 Revenue

Founded  
**1915**

Projects on



**6** Continents

One of the largest employee-owned companies in the U.S.

with

The size and experience to achieve your goals

**7,000**

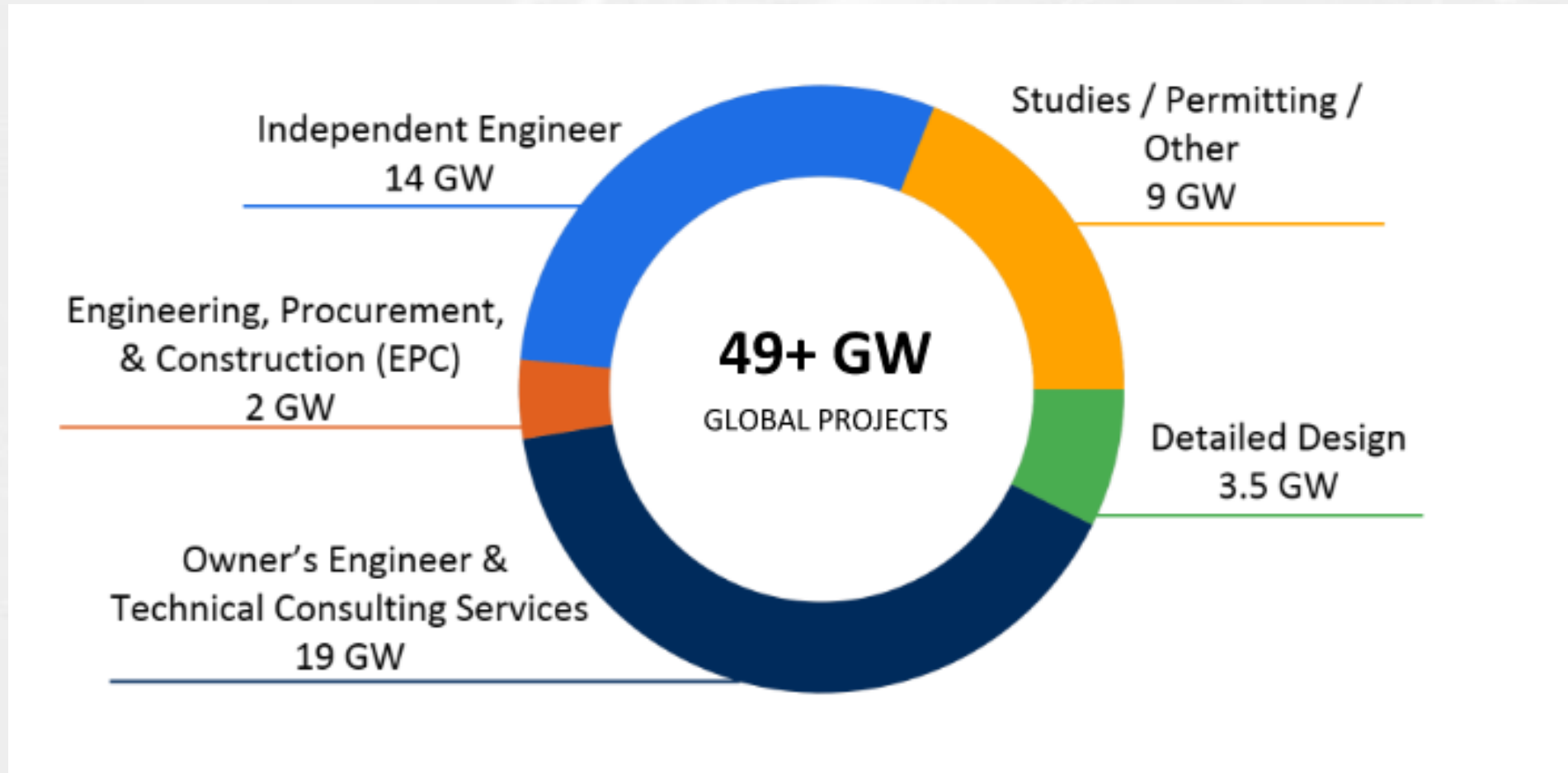


Active Projects  
Worldwide

## Our Purpose

To be a trusted source of integrated strategy, process and technology solutions to global critical human infrastructure needs.

# Black & Veatch's PV experience



# PV System Performance

- Most PV systems meet their performance estimates.
- However, system underperformance is a concern:
  - We are aware of underperformance in several client portfolios.
  - kWh Analytics, a leading solar risk management company in the United States, reported in its 2021 Solar Risk Assessment that over 12% of the assets analyzed chronically underperformed their P99 estimates.

# Some Causes of Underperformance

- extreme weather events, e.g. hail, snow, wind, wildfires
- higher-than expected:
  - equipment downtime, particularly inverters.
  - system performance degradation
- overly optimistic irradiance assumptions
- losses due to:
  - Inaccurate soiling estimates
  - sub-hourly inverter clipping
  - tracker alignment accuracy
  - tracker wind stow.
  - uneven terrain

# Forensic Analysis

- Forensic analysis is a detailed investigation to establish the root causes of PV system underperformance and develop an action plan to improve performance.
- Not all asset owners and operators have the resources to perform forensic analysis.
- Black & Veatch and RETC have the experience and resources to provide in-depth forensic analysis services.

# Addressing system underperformance

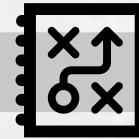
## Analysis

- Equipment performance
- Inverter clipping
- Irradiance
- Plant performance history
- Soiling
- System degradation
- Terrain
- Weather events



## Action Plan

- Establish root causes of underperformance
- Identify remediation measures
- Estimate costs
- Perform cost-benefit analysis
- Develop implementation schedule
- Place warranty and insurance claims



## Field Forensics

- Cable inspections
- EL Imaging
- IR Imaging
- IV Curve Tracing
- Inverter Inspection
- Lab testing (if required)
- String Testing
- Tracker Performance

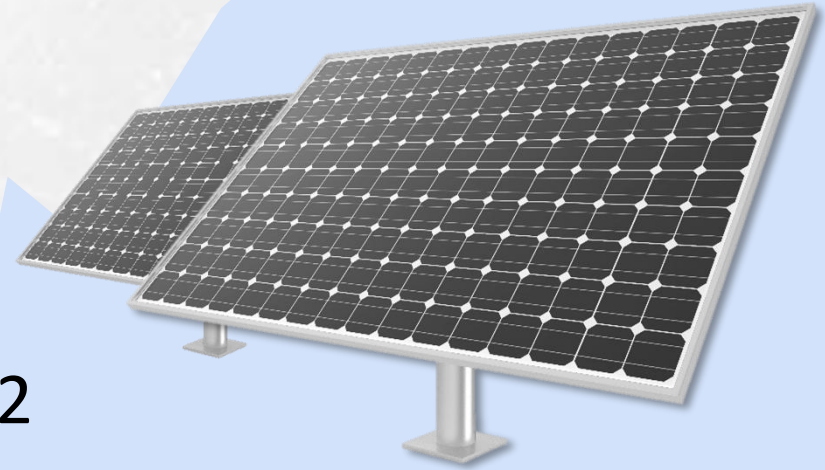
## Solution Engineering

- Engineer technical solution to prevent recurrence of underperformance
- Update risk management plan



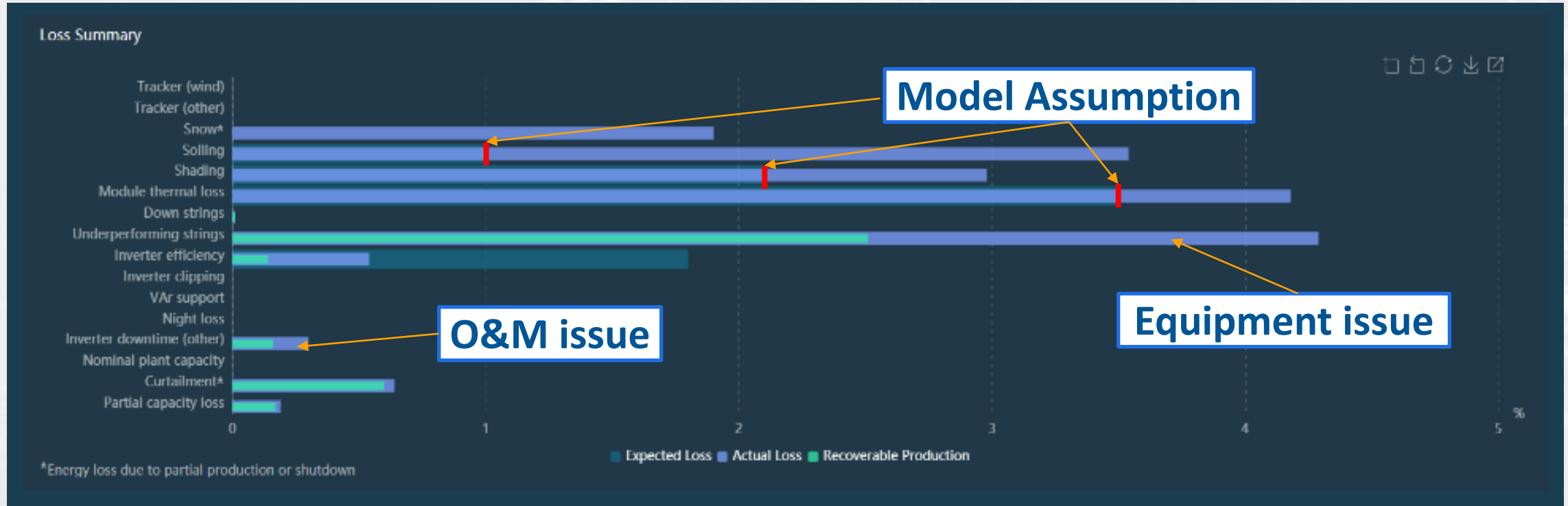
# Sample Site

- Location: Kentucky, USA
- Site capacity: 14MWp
- Inverter: Free Sun FS1050 CU
- PV Modules: Jinko Solar JKM315P-72

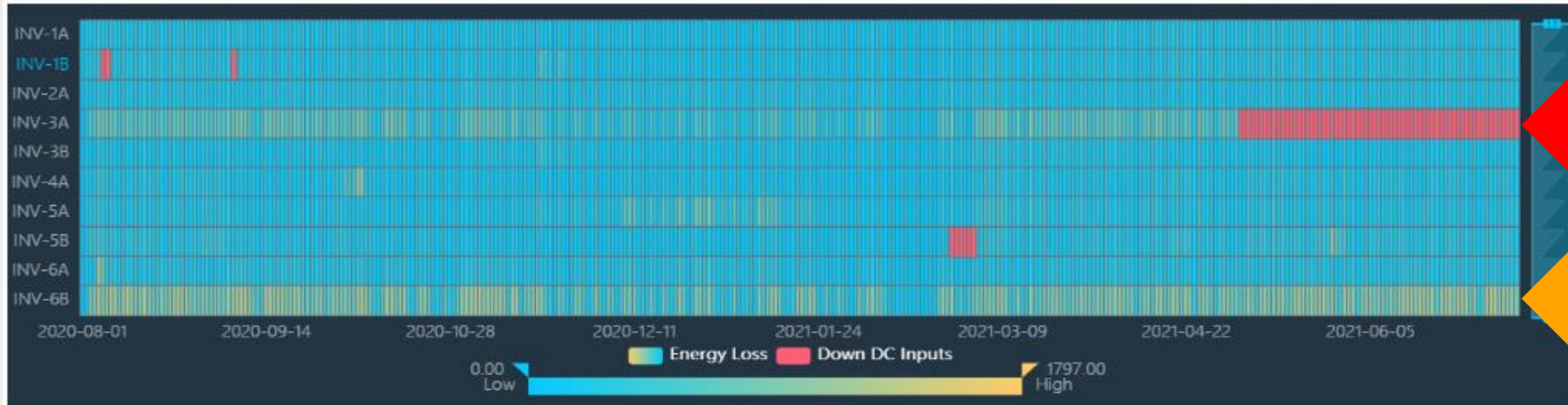




# Loss Summary (Sample)

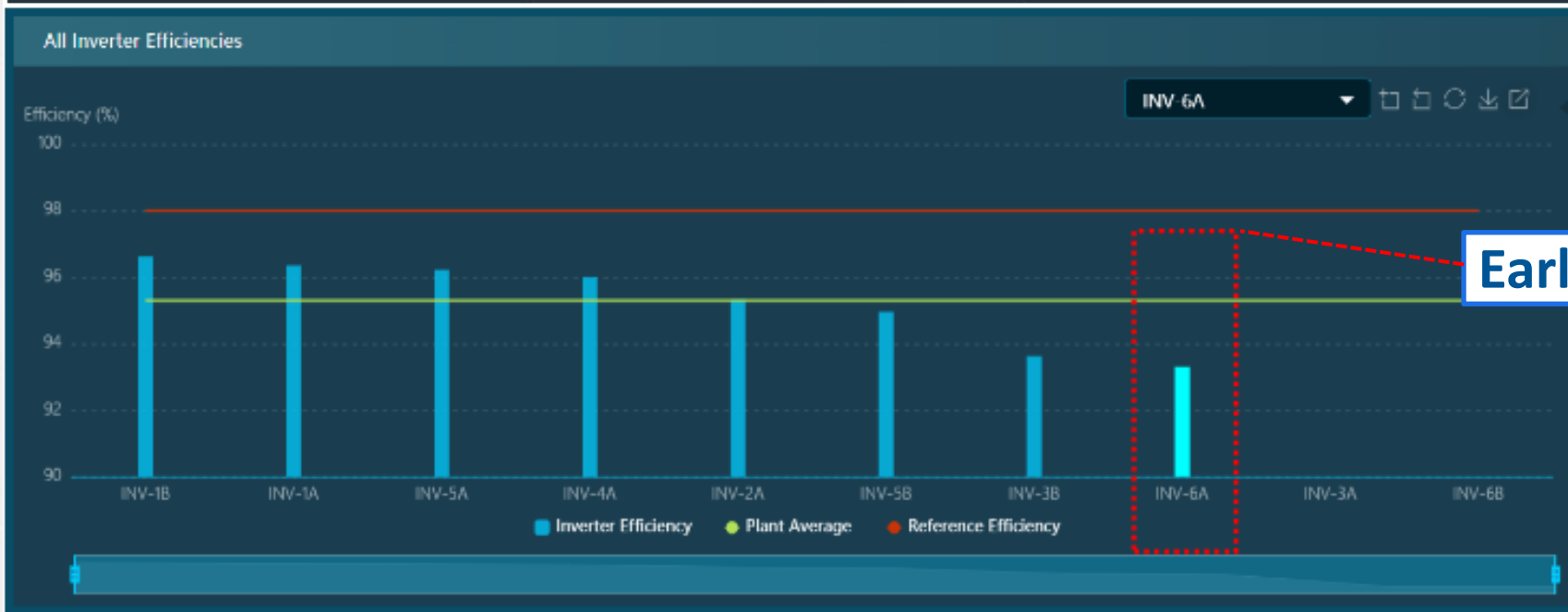


Source: Envision Digital International Pte. Ltd. Enight Solar™ Performance Analytics



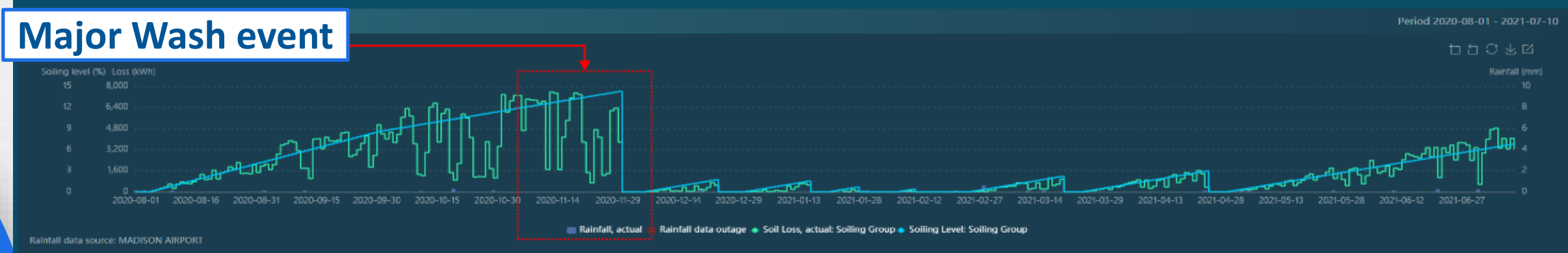
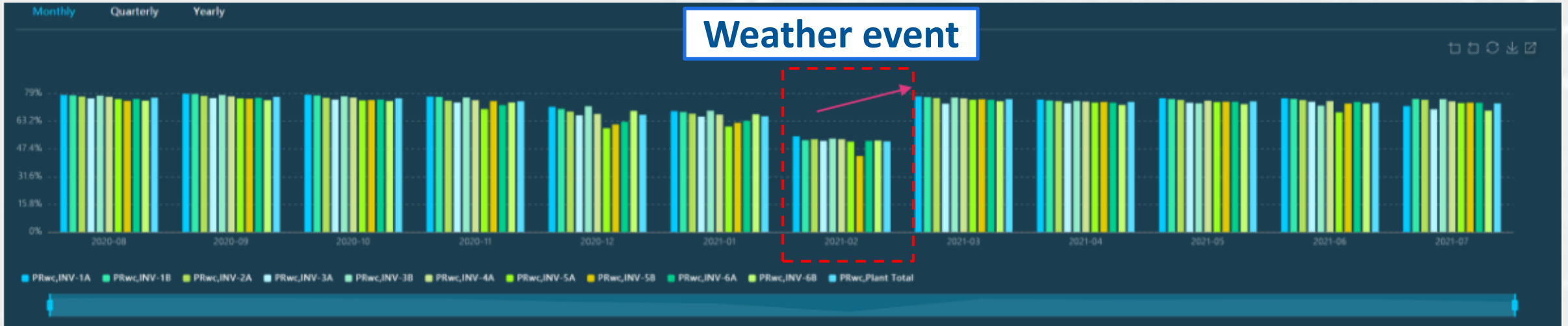
Issue

Risk



Early identification

Source: Envision Digital International Pte. Ltd. Enight Solar™ Performance Analytics



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# BUILDING A WORLD OF DIFFERENCE

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