



THE EVOLUTION OF THE DIGITAL WORLD is Driving Change for Renewable Energy

INCREASING PERFORMANCE AND OPTIMIZATION with Data & Technology

The evolution of the digital world has transformed the way we interact and go about our daily chores, from purchasing goods and services via smartphone apps, to networking via social media, so too, the power grid along with renewable energy is being transformed by digital technology. Whether it's solar panels on our rooftops or wind turbines on the horizon, electrons are flowing from different resources and data is collected and utilized in ways we could not have imagined just a decade ago.

The quantifiable data collected from a renewable energy plant can change the success or failure of the project. Industry terms such as **availability**, **faults** and **derates**, later defined, can prove this statement valid.

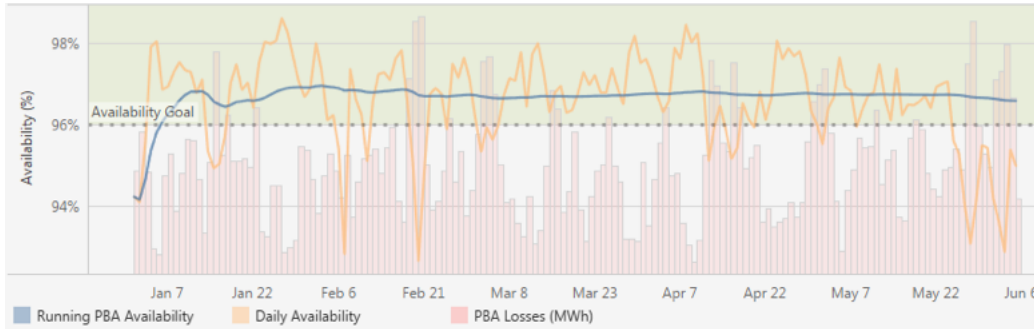
Engineers spend a significant amount of time utilizing big data from our digital world looking for areas of underperformance and solutions to bring projects sites up to full production. EDF Renewables uses its proprietary performance management tool TRUalytics™ for optimization and predictive modeling. To best show how an optimization tool works, let's look at **three scenarios as examples of increased performance attributed to TRUalytics**:



1. Availability

Availability is a key factor and attribute that can be quantified and measured.

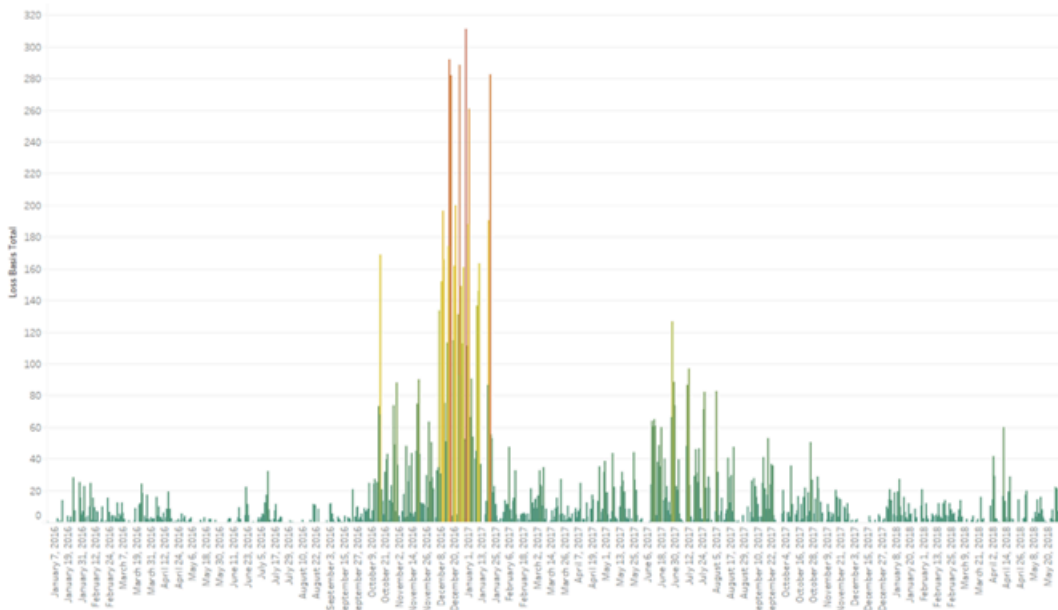
There are multiple types of availability calculations (production-based, time-based, etc.) that can be used to track contractual obligations for EDF Renewables or the original equipment manufacturer (OEM) still under warranty. The tracking of the availability is very important and can warrant liquidated damage payments. The following view tracks daily and running year-to-date production-based availability and can be filtered by fleet, OEM, operator, and region.



2. Faults

Faults are another key factor that can exist without notification and cost significant dollars.

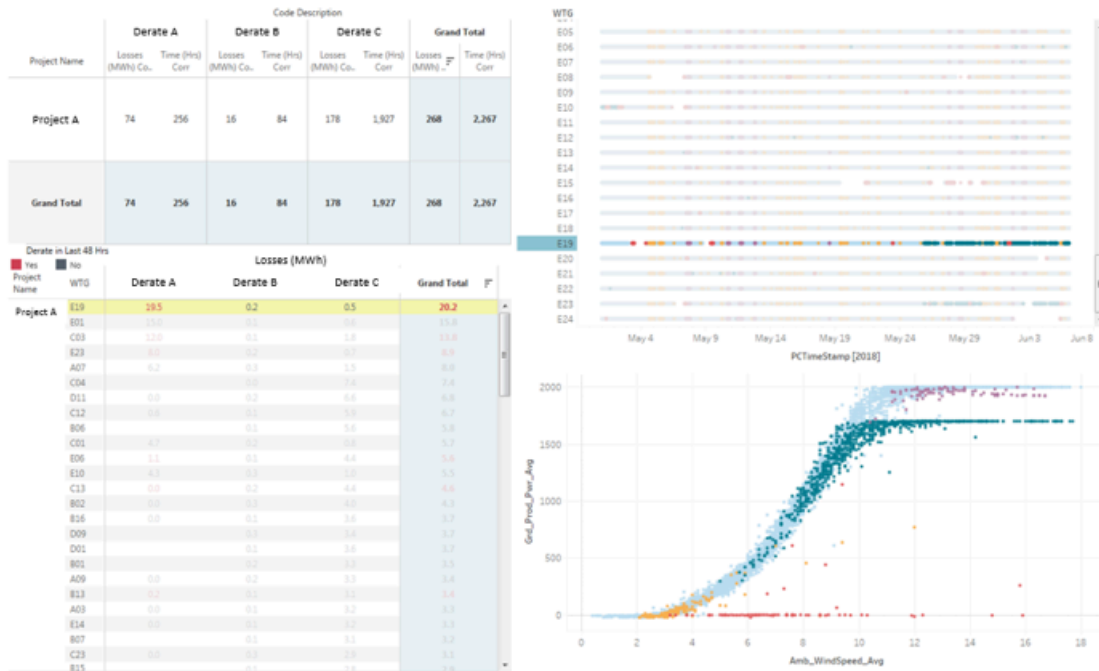
A particular fault on an OEM which started occurring fleet wide in late 2016 was analyzed by EDF Renewables Performance, Reliability and Engineering (PRE) group. The team performed a root cause analysis (RCA) and localized the issue to a thermostat on the gearbox. The thermostats were added to the inspection list and replaced, if necessary, during each 6 month maintenance procedure. Since this point, as shown below, the losses have dramatically decreased over time.



1. Derates

Derates by definition is a reduction in the power rating of a component or device.

PRE develops tools for sites under EDF Renewables control or OEM warranty. The sample below was created for a particular OEM where internal derates became an issue while still under warranty. The tool allows the engineer to see losses, timeline of derates, and current activity. This information is relayed to the OEM on site to investigate these derates. Losses due to internal derates have sharply decreased over the last 18 months.



Operations and maintenance teams are continually working these and other solutions to increase production and decrease the amount of time a turbine or solar panel is offline.

Maintaining comprehensive data is an advantageous tool. A complete record of service work and embedded service processes allows that expertise to be retained, repeated, and scaled across similar renewable sites thereby increasing the ROI. The grid is constantly evolving to ensure it can handle the technologies of the future. Constant monitoring of current technologies, like renewable plants, allows the grid to capture real-time data to continuously improve and prepare for what's to come.

Today, renewable resources are powering our lives. And technology and data analysis plays a significant role in performance and optimization of these power plants. The digital revolution is here and integral to the energy transition.



This piece was written by Joni Hamson, Senior Director of Origination, and EDF Renewables.

Joni brings over 30 years of experience in the electric energy industry. Joni started as an electrical engineer working for Minnesota Power in the late 80s and

entered the wholesale marketing and trading world in the 90s. Today, Joni originates long term renewable energy transactions to meet the needs of the regulated, unregulated, and corporate markets. Her focus is to bring value to both sides of the supplier-customer equation with renewable energy generation and market portfolios. Joni has held the Chair and President, Vice Chair and Vice President of the North American Energy Markets Association (NAEMA) and is currently serving as the Treasurer. She also participates on the Energy Tariff Committee. Joni has a B.S. in Electrical and Electronics Engineering degree from North Dakota State University. Joni and her husband Randy are empty nesters and live in Cushing, Minnesota.

ABOUT EDF RENEWABLES

EDF Renewables is a market leading independent power producer and service provider. Delivering **grid-scale power**: wind (onshore and offshore), solar photovoltaic, and storage projects; **distributed solutions**: solar, solar+storage, electrical vehicle charging and energy management; and **asset optimization**: technical, operational, and commercial skills to maximize performance of generating projects. EDF Renewables' North American portfolio consists of 10 GW of developed projects and 10 GW under service contracts. EDFR is a subsidiary of EDF Energies Nouvelles, the dedicated renewable energy affiliate of the EDF Group.



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