



AVEVA PI WORLD

Enel Data Gathering Project

- PI Ready (by Design) Power Plant: the Plug & Play way
- Data Catalog: how to manage PI tags
- Data Availability Monitoring: Dashboard and Reporting

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The AVEVA logo is located in the bottom right corner, featuring the word 'AVEVA' in a white, bold, sans-serif font. The background behind the logo consists of abstract, glowing lines and dots in shades of blue, purple, and orange, creating a sense of motion and data flow.

AVEVA



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Who we are

Global Digital Solution in the Global Power Generation

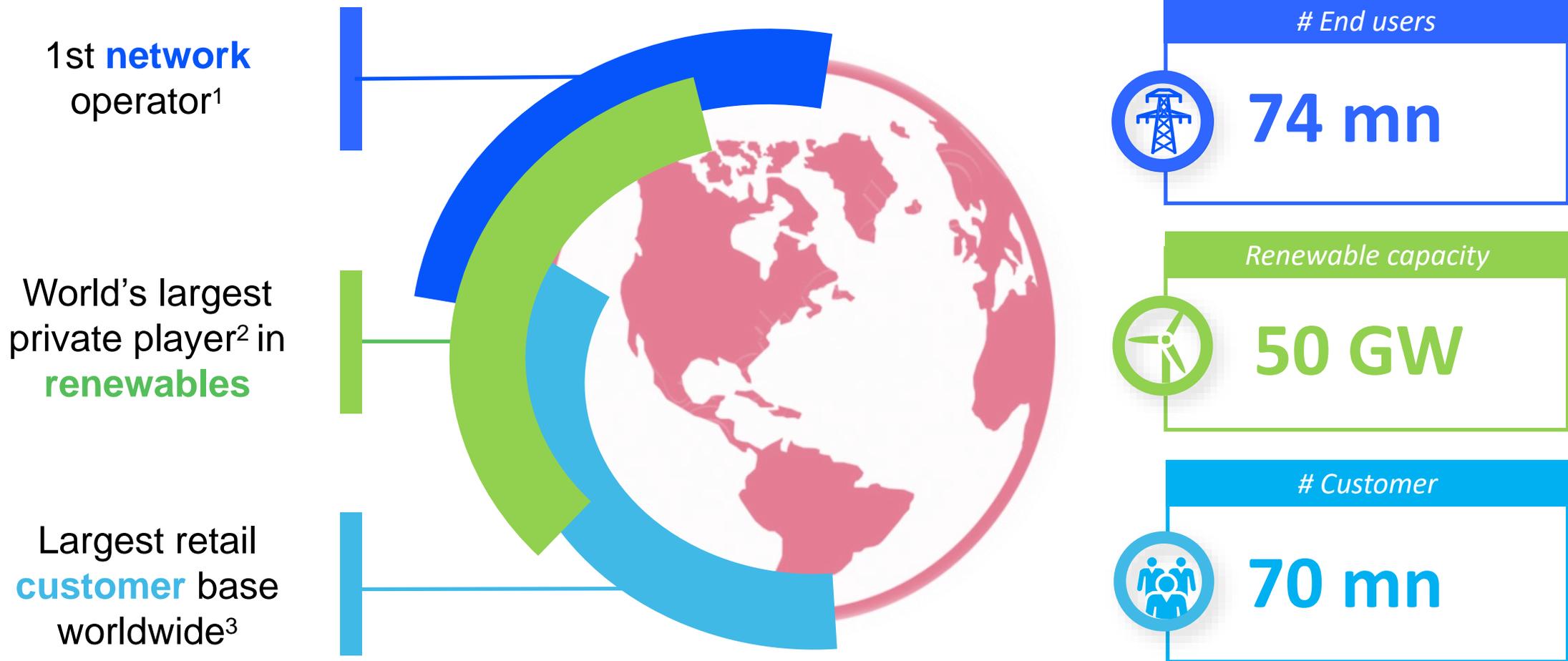
DIGITAL HUB: Plant Information Platforms



Open Power
for a brighter future

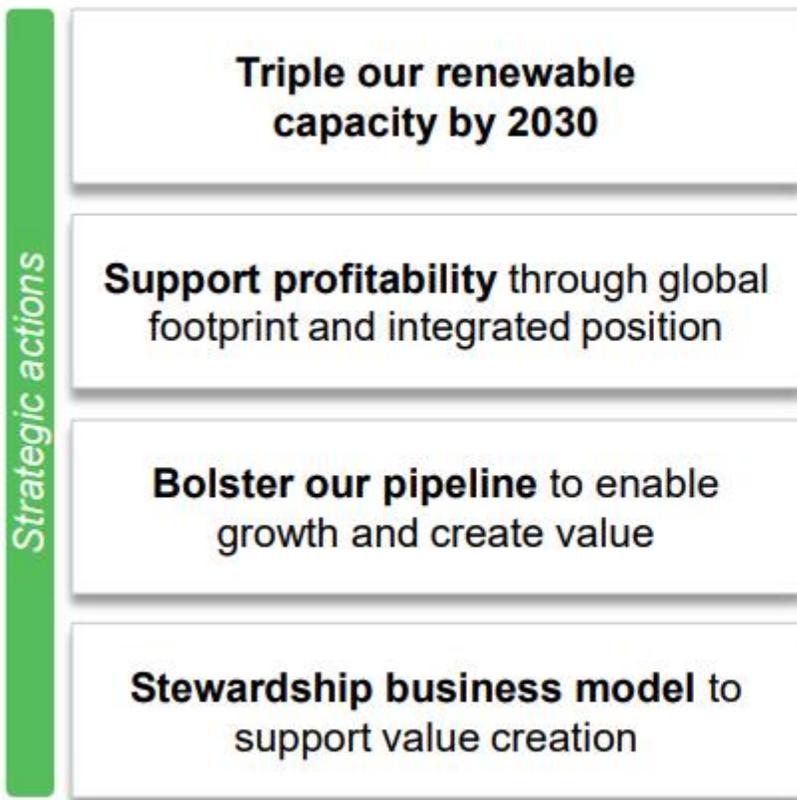
We empower sustainable progress

Enel's leadership in the new energy world

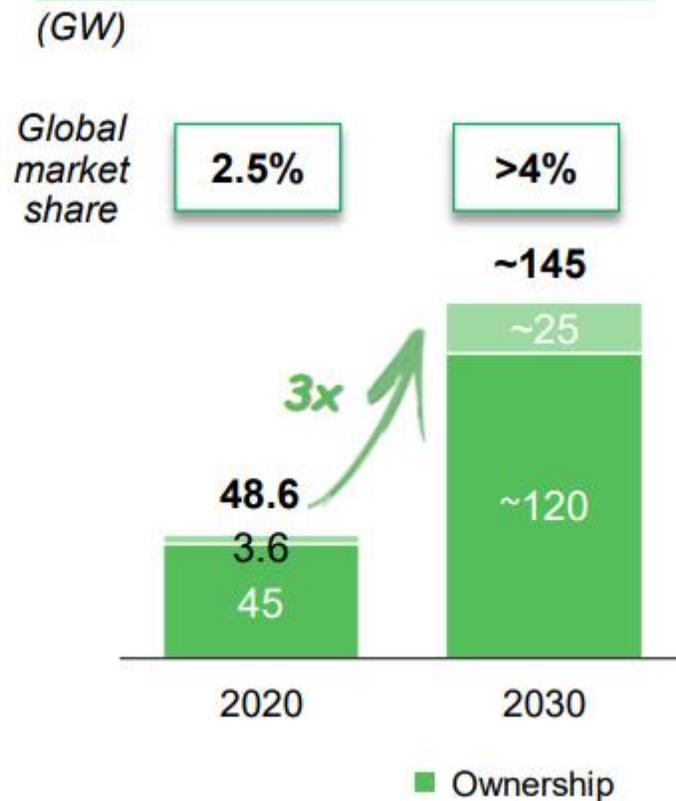


1. By number of users. Publicly owned operators not included
2. Includes managed capacity
3. Power and gas customers

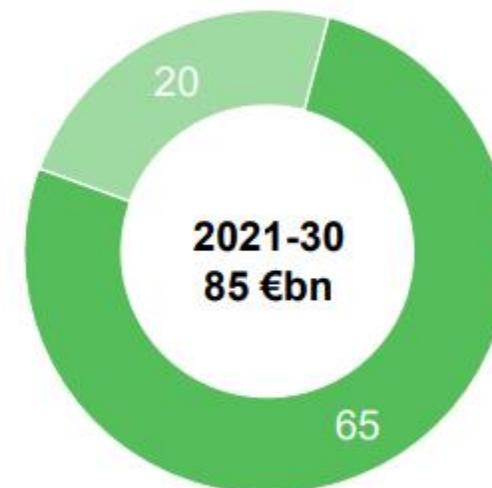
Renewables super major ...



3x RES capacity increase



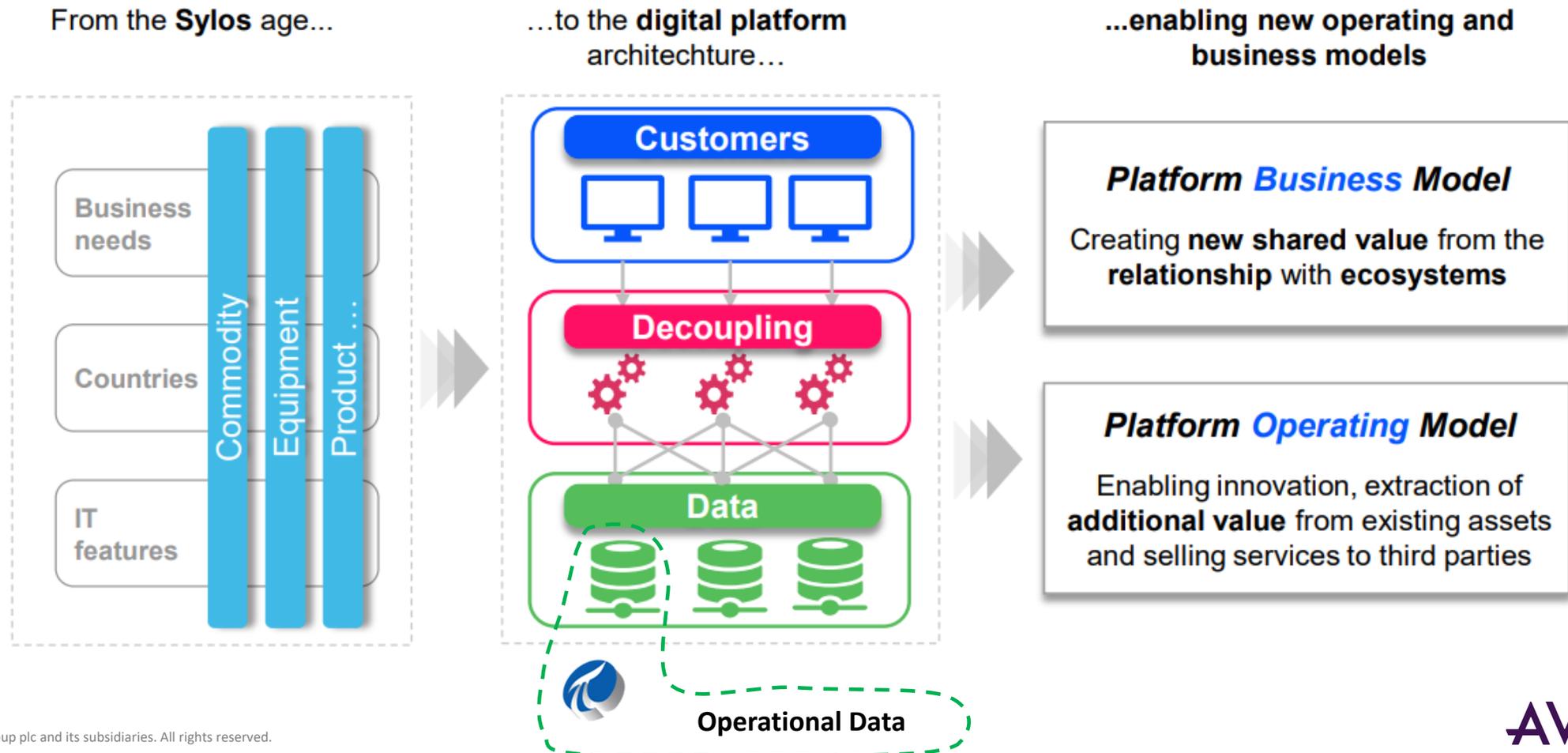
2021-30 catalyzed investments¹



1. Investments in storage of 5 €bn not included

Platformization

A New Development Model To Move Towards a Platform Company



Plant Data Gathering

PI represents main Enel worldwide Platform for data collection process directly from the plant, providing a structured BD to guarantee a high level of availability and quality of the data gathered

SUPPORTED PERIMETER



Global Applications



Local Applications

MAIN ACTIVITIES

Predictive Analysis

Performance Reporting

Big Data Analysis

Plant Monitoring System

Monitoring rooms

Plant Operations System

Data as key driver for advanced Analysis & Monitoring...

BUSINESS DECISION LEVEL
Data Driven Maintenance & Operational Efficiency Knowledge Sharing

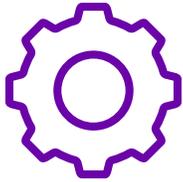
INTERMEDIATE LEVEL
PI concentrator

PLANT LEVEL
PI gateway

...at each level

PI Ready (by Design) Power Plant

PI Ready (by Design) Power Plant



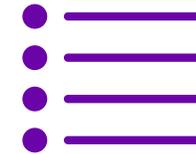
Challenge

- **Huge increase of new Power Plants** due to the long-term expansion plans of the company (average of additional 10GW per year until 2030)



Solution

- PI System Implementation during the **construction phase** of a new Power Plant
- Standard **pre-defined architecture** that can be replicated in each new plant with little effort

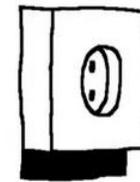
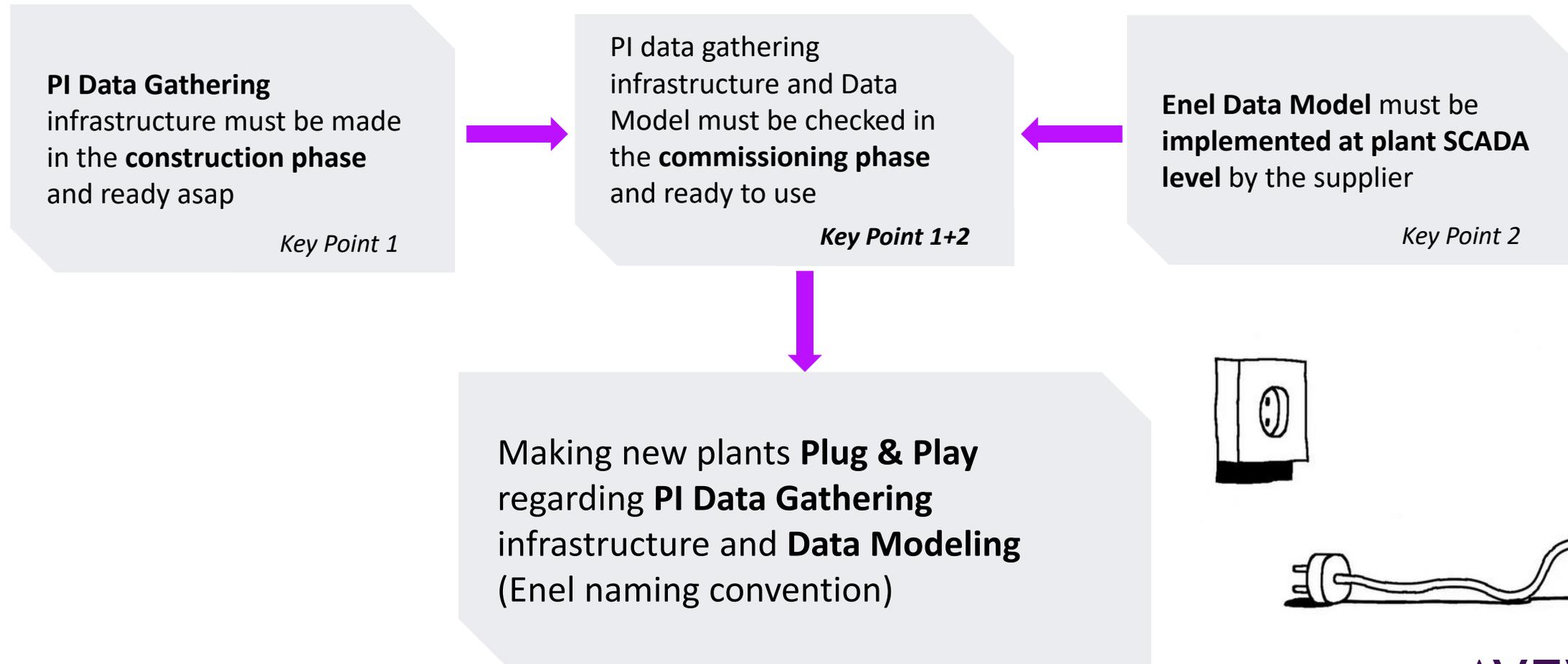


Benefits

- All the local and **global O&M processes are immediately applicable**
- **Real time and historical process data are immediately available and reliable**

Architecture

Our Goals



New process definition

Steps to achieve «PI-Ready By Design» goal

Definition of a new process with different Enel department

- ✓ **New technical specification for PI integration**
 - Hardware / software requirements
 - Standard architecture definition
 - Detailed installation and configuration steps
- ✓ **PI components test procedure** to be used during FAT to guarantee PI readiness at SCADA SAT
- ✓ **EDM application on SCADA to have PI tags ready to be used** immediately after their configuration for global processes

The image shows three overlapping document pages from an Enel technical specification. The top page is titled "TECHNICAL SPECIFICATIONS" and is page 1 of 24. The middle page is titled "PI integration through the" and is page 2 of 24. The bottom page is titled "INDEX" and is page 43 of 92. The bottom page contains a test procedure "14.6.3 T603 PI Node/ Plant SCADA interface Cold start after PI Node restart" with a diamond icon containing "01". The test procedure includes a clarification, a purpose, and pre-conditions.

14.6.3 T603
PI Node/ Plant SCADA interface Cold start after PI Node restart

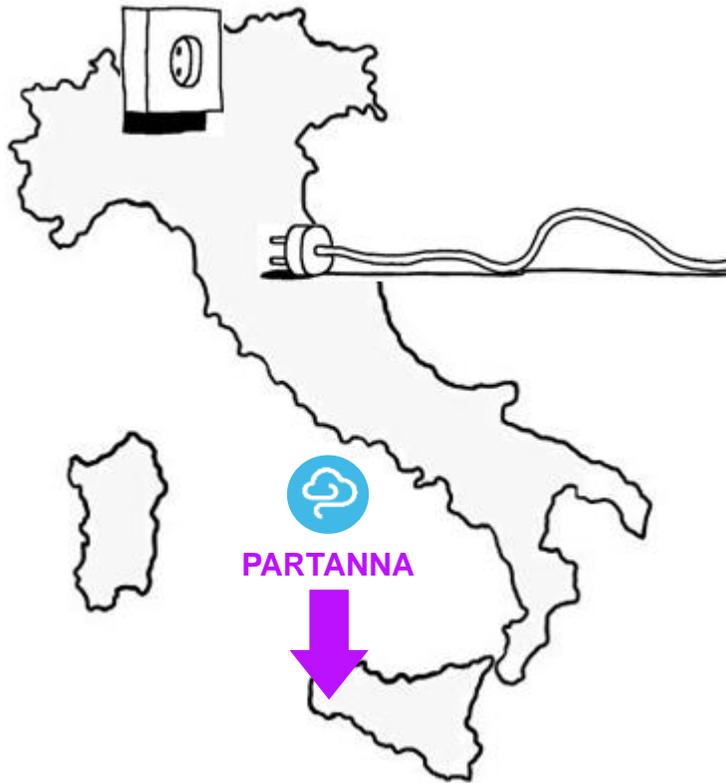
Clarification
The present test is to be done for both physical or virtual machines.
If PI Node is not supplied by the same Contractor who provides the Plant SCADA, this test can be skipped.
If the PI node runs on a virtual machine on the same server where SCADA runs, the power failure can be simulated with a stop of the PI node virtual instance.

Purpose:
To verify that the connection between the OPC UA server and the PI Node is totally recovered after the power on of the PI Node.

Pre-conditions:
Plant SCADA and OPC UA server are started and configured.
PI Node is powered on and correctly configured.
Before the failure simulation, check that the connection between the OPC UA server and the PI Node is working and systems are exchanging data

Plug & Play PI connection for the new power plants

Partanna Wind Power Plant experience



Characteristics:

Six 2,4 MW wind turbines, for a total power of 14,4 MW.

SCADA supplier SDI automation

5075 tags among Electrical substation and wind turbines

Virtual machine available for PI SW suite installation

Protocol used: OPC UA

Activities done (together the supplier and E&C):

- Firewall configuration
- PI SW (connector suit) installation and configuration
 - It used PI concentrator (archive and AF servers) dedicated to hub Europe (located in AWS Frankfurt)
- Data acquisition activation



AF structure for Partanna Power Plant

Automatic Database and AF configuration

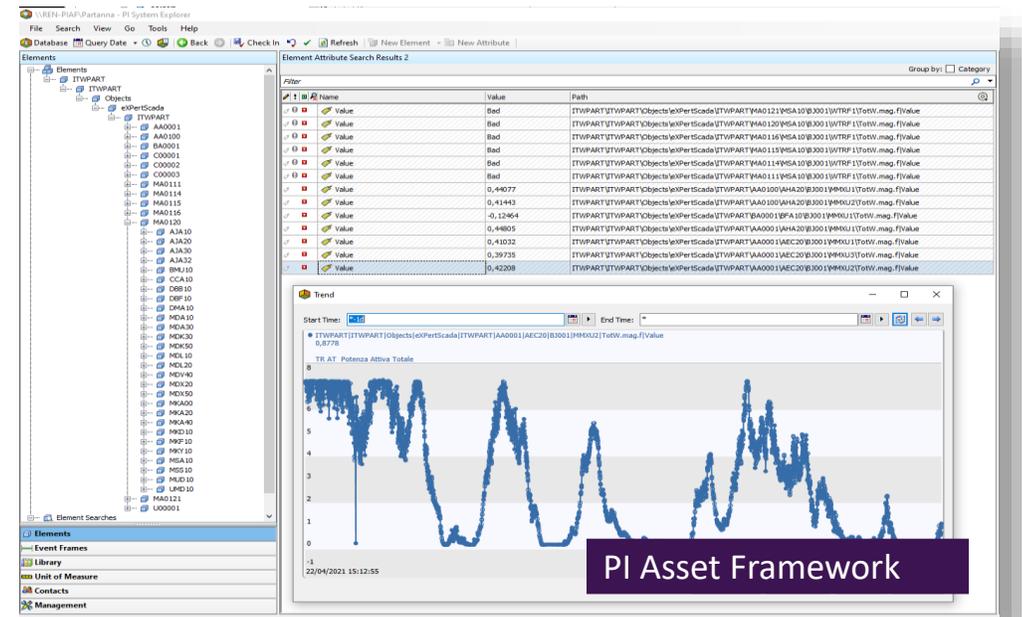
RESULTS:

- The **DB configuration** (tagname, descriptor, eng unit ...) has been done **completely automatically**
- The **AF hierarchy** has been done **completely automatically**

The naming convention and the hierarchy are inherited directly from the SCADA server through OPC UA connection

The **Data acquisition** of the information and the archiving in the PI server started automatically without any manual action after the PI connector configuration and activation

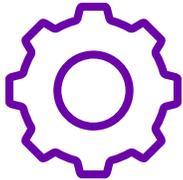
Selected(x)	Name	ObjectType	Description	engunits	archiv
x	ITWPART.AA0001.AEC20.BA001.CJA10.MMXU1.V.mag.f.Value	PIPoint	MP1 Voltage		
x	ITWPART.AA0001.AEC20.BA001.MMXU1.PNV.phsA.cVal.mag.f.Value	PIPoint	TR AT Tensione di fase Va - lato 150kV		
x	ITWPART.AA0001.AEC20.BA001.MMXU1.PNV.phsB.cVal.mag.f.Value	PIPoint	TR AT Tensione di fase Vb - lato 150kV		
x	ITWPART.AA0001.AEC20.BA001.MMXU1.PNV.phsC.cVal.mag.f.Value	PIPoint	TR AT Tensione di fase Vc - lato 150kV		
x	ITWPART.AA0001.AEC20.BA001.MMXU1.PPV.phsAB.cVal.mag.f.Value	PIPoint	TR AT Tensione Conatenata Vab - lato 150kV		
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x	ITWPART.AA0001.AEC20.BA001.MMXU2.PNV.phsA.cVal.mag.f.Value	PIPoint	TR AT Tensione di fase Va		
x	ITWPART.AA0001.AEC20.BA001.MMXU2.PNV.phsB.cVal.mag.f.Value	PIPoint	TR AT Tensione di fase Vb		
x	ITWPART.AA0001.AEC20.BA001.MMXU2.PNV.phsC.cVal.mag.f.Value	PIPoint	TR AT Tensione di fase Vc		
x	ITWPART.AA0001.AEC20.BA001.MMXU2.PPV.phsAB.cVal.mag.f.Value	PIPoint	TR AT Tensione Conatenata Vab		
x	ITWPART.AA0001.AEC20.BA001.MMXU2.PPV.phsBC.cVal.mag.f.Value	PIPoint	TR AT Tensione Conatenata Vbc		
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Automatic Data Catalog

AVEVA

The Automatic PI Data Catalog



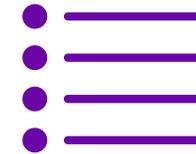
Challenge

- Be able to **quickly identify the PI tags associated with a specific power plant** within heterogeneous PI databases
- Have **statistics** about the **amount of power plants integrated in PI**



Solution

- Implement a custom tool that allows to **insert and read structured metadata about PI tags** in a central database
- Design the tool basing upon user habits, so that they can start using it in no time



Benefits

- Every user can **quickly identify the data they are looking for**, without the need to spend time on research or on communication
- The catalog also allows to have a **solid view of the power plants connected to PI at the global level**

Heterogeneity of Plant Data

- ENEL has been using **PI systems** for almost **20 years**
- Until some years ago, the management of the systems was fully delegated to local teams, each of which had:
 - Its own naming conventions for the tags, where a naming convention was applied
 - Significant differences in the nature of data coming from different sources
 - Its own data selection strategy
- **In years, PI Data Archive databases grew large without common standards for identifying one plant's data**
- As more and more applications used by Enel rely on PI Data – and they are often meant to cover the global fleet – a need for a central repository that maps the data related to each plant emerged. We called it the **PI data catalog**

Possible already-existing solutions for building a data catalog

- **Modeling all the available tags with AF**

PROS

Best integration with Data Archive

Best usability for third party applications

CONS

Time consuming (millions of tags)

Hard to model all the tags for each plant

- **Leverage on the already-deployed Enel Data Model**

PROS

No additional development needed

Tagnames become intrinsically clear

CONS

Renaming tags is tricky for some sources

Only most relevant tags usually mapped

A quicker and more universal method was needed!

The most used search criteria: the tag prefix

Adapting to user experience

The most common way currently used for identifying all the PI tags of a certain plant is their **prefix**.

Prefixes are marked by the data source, by the connector or in the tag configuration, in any case they are an easy way to group PI tags associated with a certain plant.

The Data Catalog was designed while thinking about tag prefixes, but it can seamlessly be used for tracking any **search criterion** accepted by PI tools.



The Data Catalog ingredients

How search criteria are...

- **...tracked: Powershell + OSISoft .NET libraries**

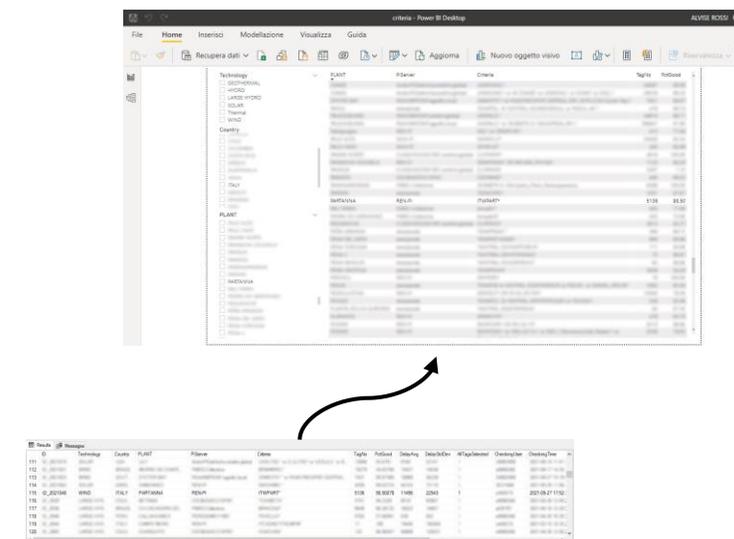
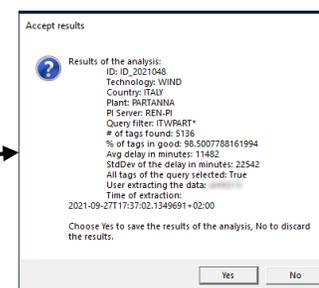
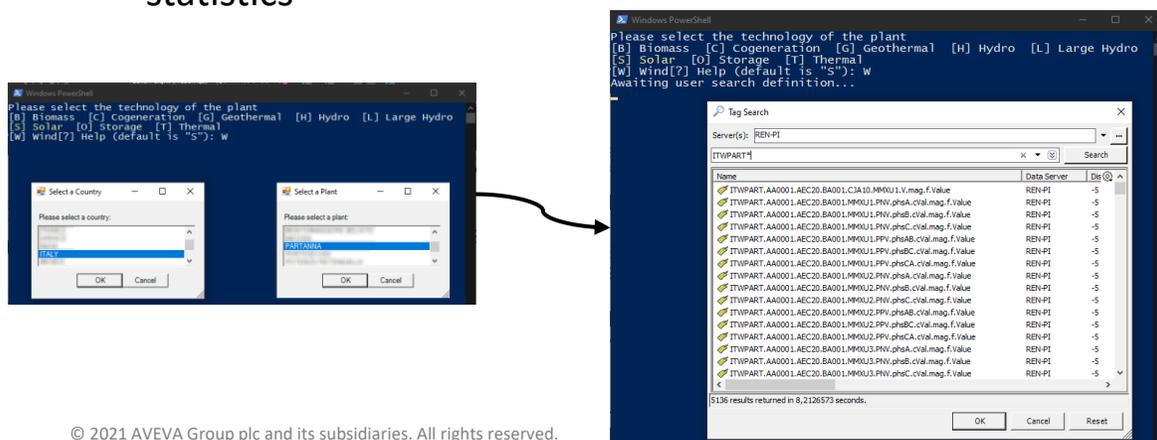
- Code written in Powershell – nothing to be installed on clients, easy interaction with the SQL Server DB
- AF User Interface library for tag search and selection: familiar to PI users
- AFSDK library for computing tag statistics

- **...stored: Microsoft SQL Server**

- Pre-loaded registry of all the ENEL plants to ensure data integrity when tracking PI tags related to a plant
- Easy management of logical access through corporate Active Directory, both from the tracking script and from the PowerBI dashboards

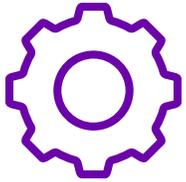
- **...shown: PowerBI**

- Built-in features to navigate the search criteria database
- Possibility to provide users with web-based access (TBD)



Data Availability Monitoring: Dashboard and Reporting

Data Availability Monitoring: Dashboard & Reporting



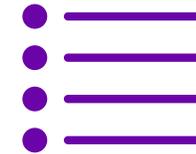
Challenge

- **Difficult understanding & visualizing the possible faults in the PI data collection** from the data sources
- High variety of tags per technology (Solar/Wind/Hydro/Thermo)



Solution

- Design an **AF database** to check if a list of **core tags** are updated and are reporting good quality values



Benefits

- **Global real-time data availability**
- **Historical statistics** available to look for possible improvements over time

Data Availability Monitoring: Reporting

Monitor the data-acquisition chain starting from the **single generation unit** (Solar or Wind plants) or the **single data source** (Hydro or Thermo plants) to the PI infrastructure. **Key tags to monitor for:**



Wind Technology

Active Power
Wind Speed



Hydro Technology

Up to 8 core tags selected by O&M for each data source



Solar Technology

Active Power
Total Energy
Irradiance reference
PV module temperature reference



Thermo Technology

Up to 8 core tags selected by O&M for each data source

Logic Implemented

Communication check between GU and PI concentrator

Verification of a subset of electrical tags:

Are these tag-values updated in the last 30 minutes?

YES

Communication works fine

NO → Some Core Tags in fault

*Field - Data Source
communication fault*



Field



Data Source

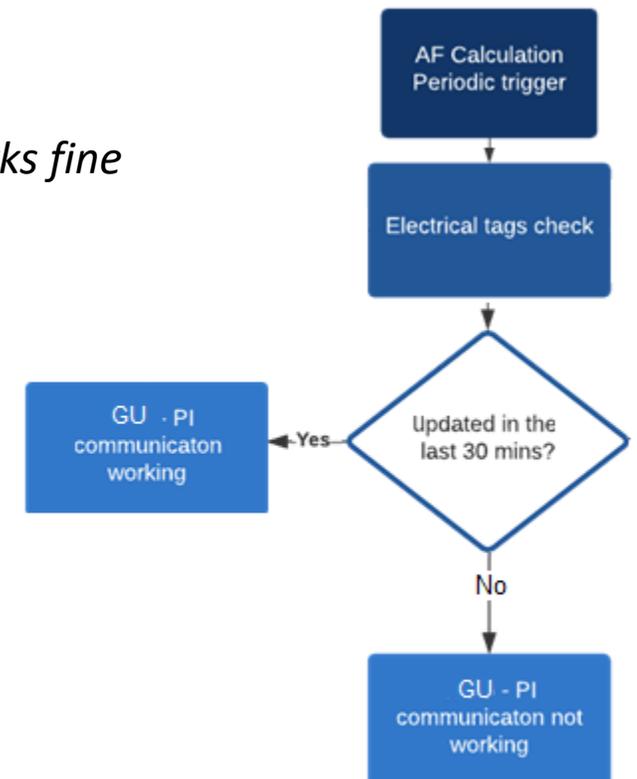
NO → ALL Core Tags in fault

*Data Source – PI
communication fault*



OSIsoft.

PI Infrastructure
(concentrator)



Data Availability Monitoring

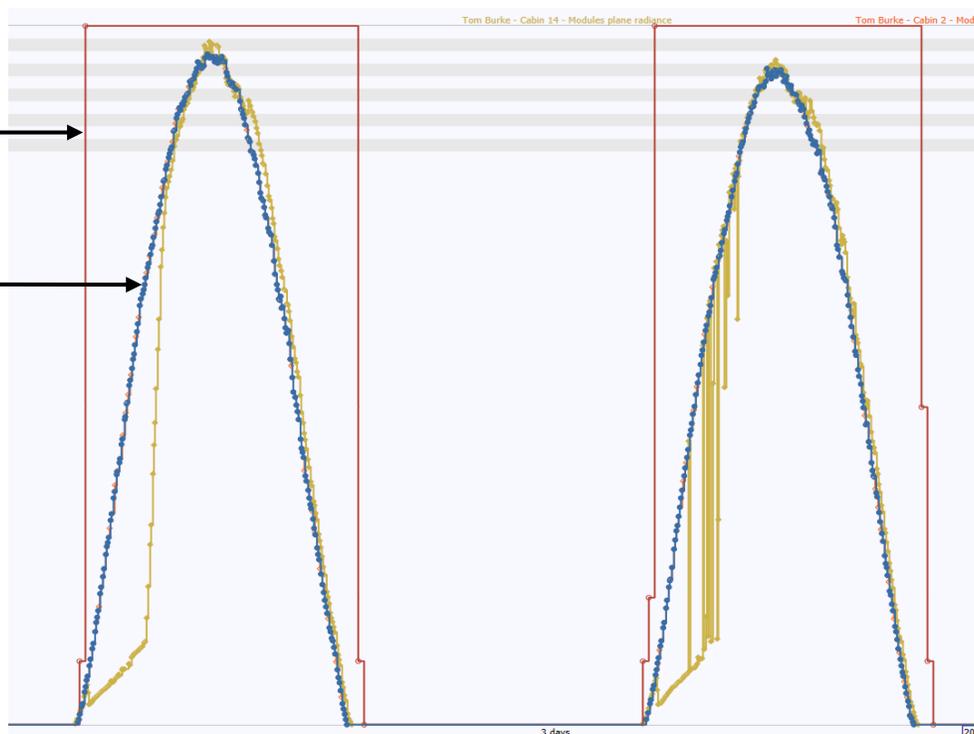
Solar Technology Case



For solar technology plants, we perform the **identification and analysis** of the Plant Production Phase through **pyranometers** to avoid data availability check during “no production” phase.

Production phase tag

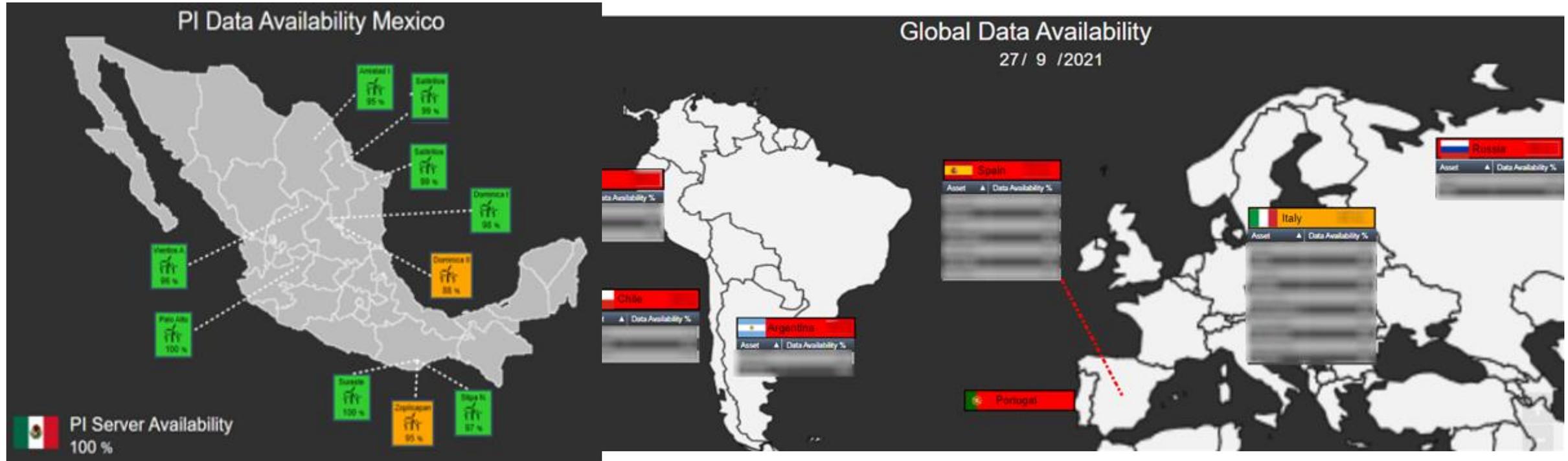
Pyranometers tag



Dashboard & Reporting

Daily Overview Report – Country Overview Report

PI Vision based



- Map with each plant reference
- Possibility to check trends of the data availability KPI
- WIND and SOLAR → Navigation through the displays to reach every generation unit information.
- TGX and HYDRO → Navigation through the displays to reach every data source information

DZIĘKUJĘ CI
 NGIYABONGA
 TEŞEKKÜR EDERİM
 DANKIE
 TERIMA KASIH
 СПАСИБО
 GRAZIE
 МАХАДСАНИД
 GO RAIBH MAITH AGAT
 БЛАГОДАРЯ
 GRACIAS
 ТИ БЛАГОДАРАМ
 TAK DANKE
 RAHMAT
 HATUR NUHUN
 PAKKA PÉR
 HATUR NUHUN
 PAXMAT САГА
 CÁM ƠN BẠN
 WAZVIITA
 謝謝
 ТАРΑΔΗ ΛΕΙΒΗ
 KEA LEBONA
 БАЯРЛАЛАА
 MISAOTRA ANAO
 WHAKAWHETAI KOE
 DANKON TANK TAPADH LEAT
 MATUR NUWUN
 ХВАЛА ВАМ
 MULŢUMESC
 고맙습니다
 GRAZIE
 شڪرا
 HVALA
 FAAFETAI
 ESKERRIK ASKO
 HVALA
 TEŞEKKÜR EDERİM
 OBRIGADO
 MERCİ
 DI OU MÈSI
 ĎAKUJEM
 EΥΧΑΡΙΣΤΩ
 GRATIAS TIBI
 MAHALO IĀ 'ŌE
 TAKK SKALDU HA
 ありがとうございます
 SIPAS JI WERE
 TERIMA KASIH
 UA TSAUG RAU KOJ
 ТИ БЛАГОДАРАМ
 СИПОС
 KÖSZÖNÖM
 GRACIES
 SALAMAT
 MAHADSANID
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 DANKJE
 AČIŪ
 SALAMAT
 GRAZZI
 PAKKA PÉR
 FALEMINDERIT

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ABOUT AVEVA

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