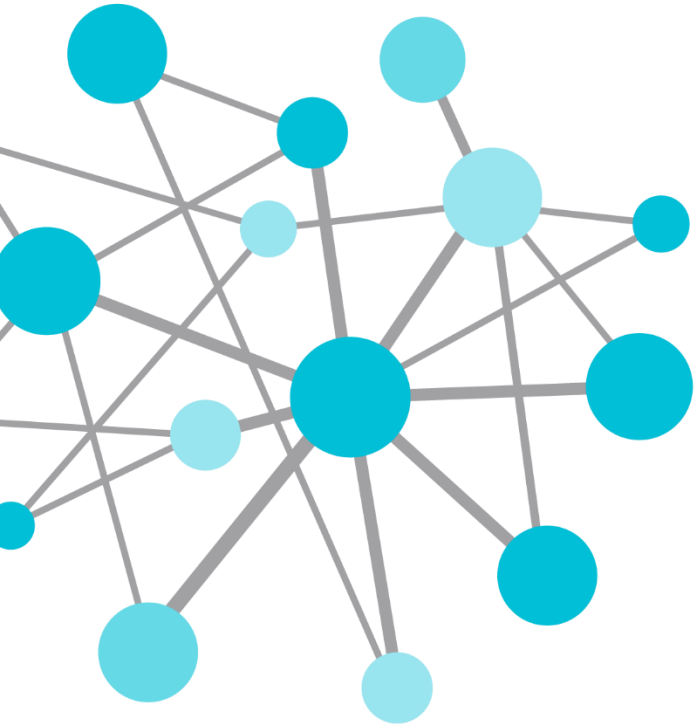


Wind **E**nergy **M**anagement **S**ystem

Powered by PI System Infrastructure

Presented by **Sérgio Pereira**
Nuno Ferreira

Agenda

1. EDP Renewables and CGI Presentations
2. Background
3. Architecture
4. Challenge
5. Problems
6. Solutions
7. Results & Benefits
8. Conclusions

EDP Renewables

EDP Renewables (Euronext: EDPR) is a leading, global renewable energy company devoted to value creation, innovation and sustainability. The company operates in markets around the globe and is continuously expanding its business to new regions, making the commitment to lead in each market as well as create value for its stakeholders and shareholders.

EDPR is committed to operational excellence through high-quality assets and attractive markets which provide highly attractive possibilities, principally due to their growth prospects and stable regulatory structure that permit profit generation.

CGI is a global end-to-end IT and business process services leader

High-end business and IT consulting

69,000 professionals, 85% shareholders*

10,000 clients across the globe

System integration, IT and business process outsourcing

400 offices, 40 countries around the world

Client satisfaction: 9.1/10

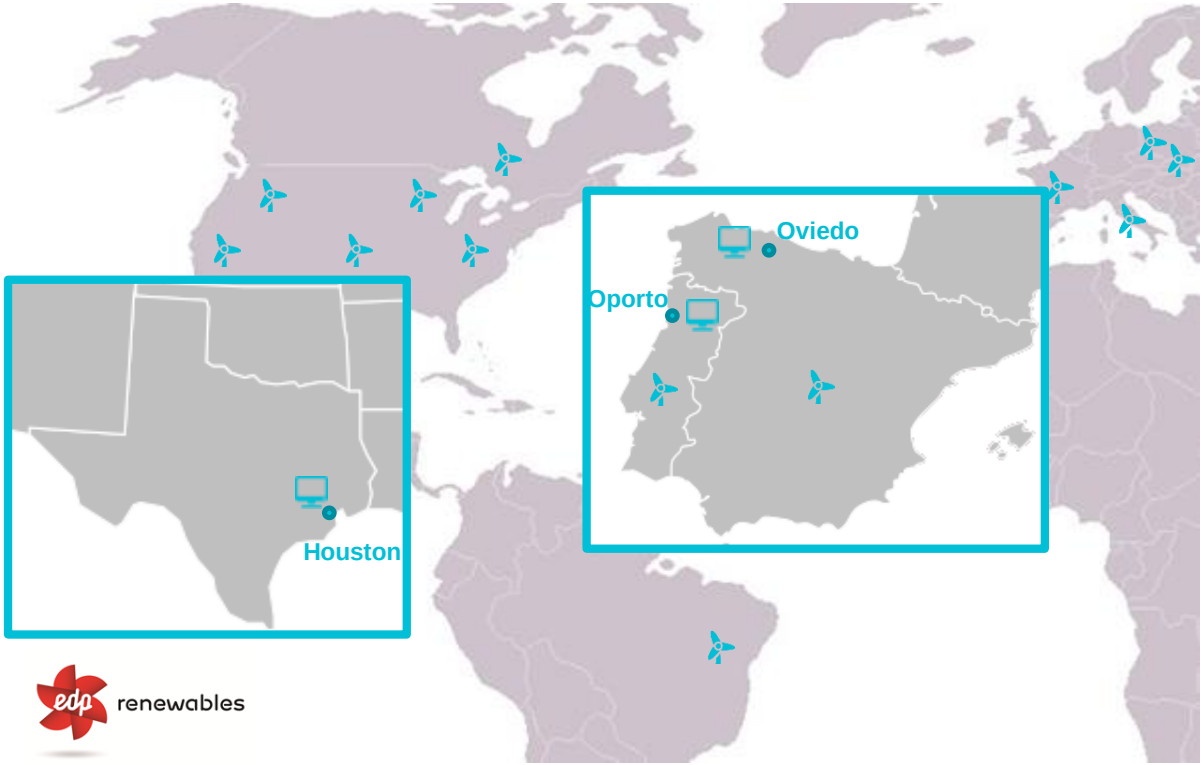
100+ mission-critical IP-based solutions

$10B annualized revenue

World's 5th largest independent IT and BPS firm

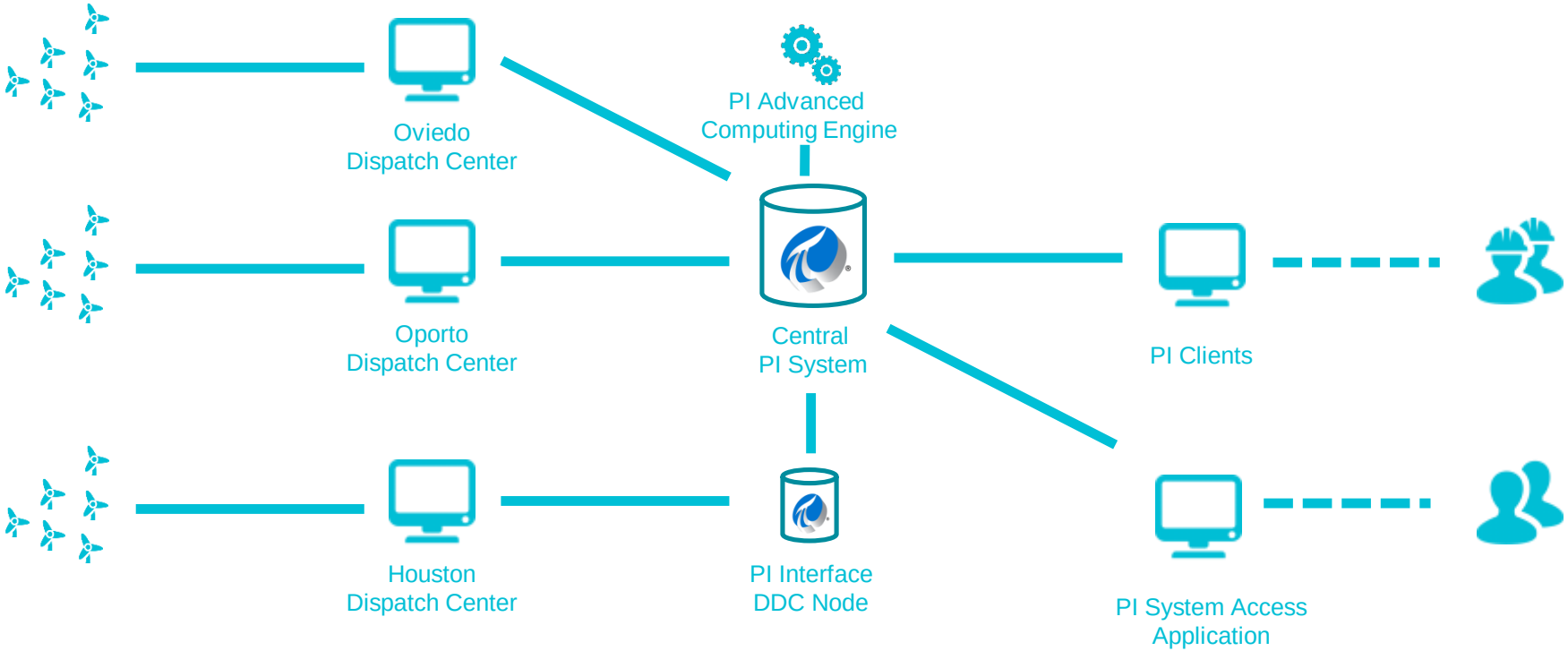
* Before Logica

Wind Energy Management System - Background



- 270 wind farms
- 6050 wind turbines
- 2 continents
- 10 countries
- 13 turbine suppliers
- 41 turbine models
- Oporto Dispatch Center
- Oviedo Dispatch Center
- Houston Dispatch Center

Wind Energy Management System - Architecture



270 wind farms **3 Dispatch Centers** **3,6 M tags**

Challenge

How to improve the availability reporting accuracy and, at the same time, help reduce downtimes?

Problems

1. Mixing apples and potatoes (availability inputs)
2. The supplier's numbers (availability calculation)
3. Turbines are stopped – so what? (measuring impacts)
4. Bad data is no good, no data is worse (data quality)

Problem 1 – Mixing apples and potatoes

There is a global definition for turbine availability…

$$\text{Availability:} \quad \frac{\text{Time when a Turbine is Available}}{\text{Total Operation Time}}$$

… but different turbine suppliers use different inputs

Which inputs drive Turbine Availability?

Supplier A: Generating Status.

Supplier B: Connection Status

Supplier C: Restriction Status

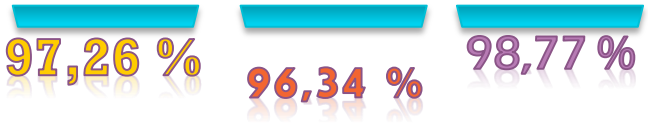
Problem 2 – The supplier's numbers

Suppliers throw in their turbine availability numbers…

95,86 % 96,34 % 97,26 %

98,77 % 99,56 %

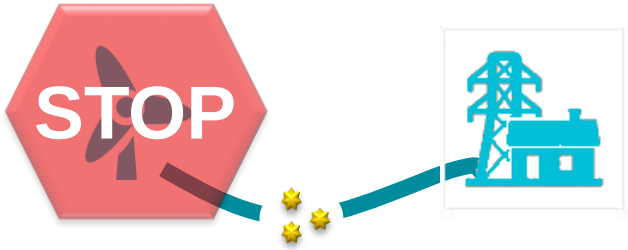
… but they can't be compared or used to determine a global value

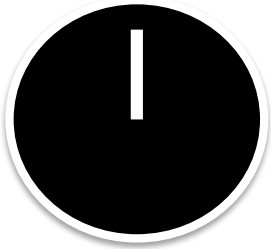


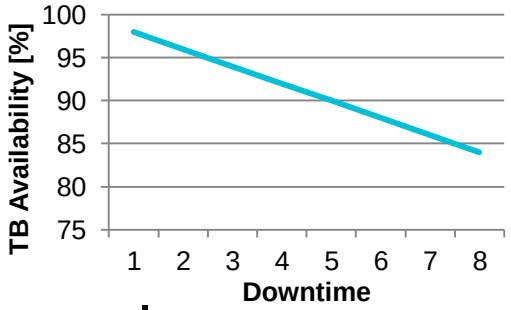
97,26 % + 96,34 % + 98,77 % = ?

Problem 3 – Turbines are stopped – so what?

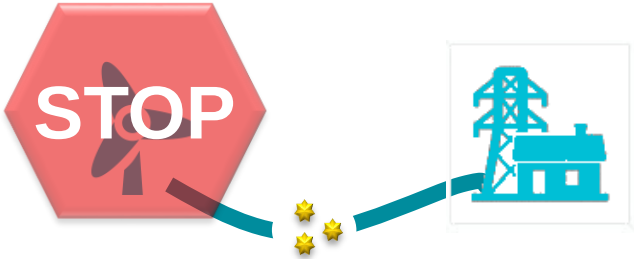
Time-based availability accounts for downtime…

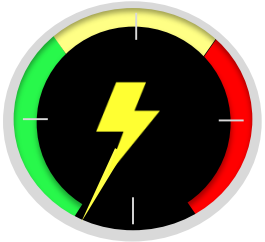






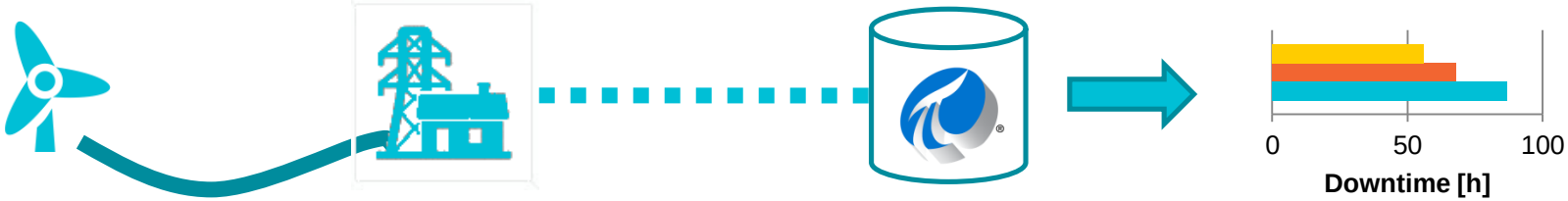
… but does not give information on energy losses.



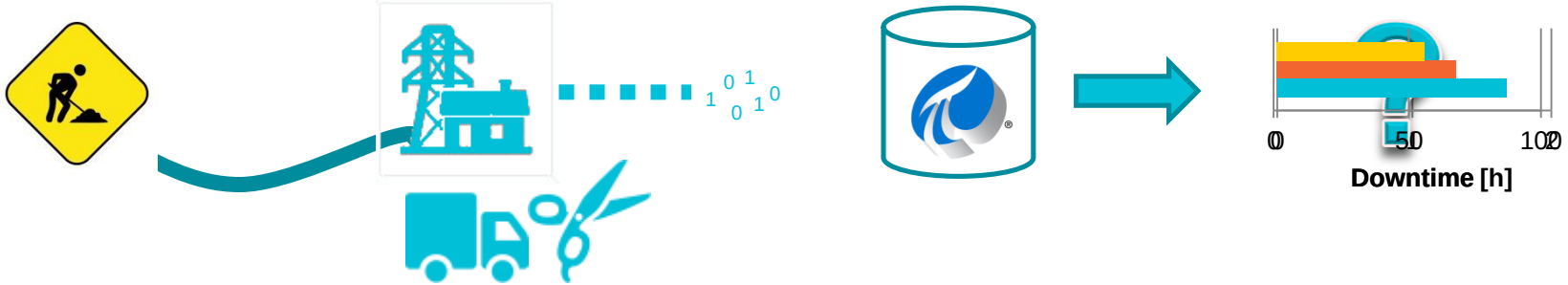


Problem 4 – Bad data is no good, no data is worse

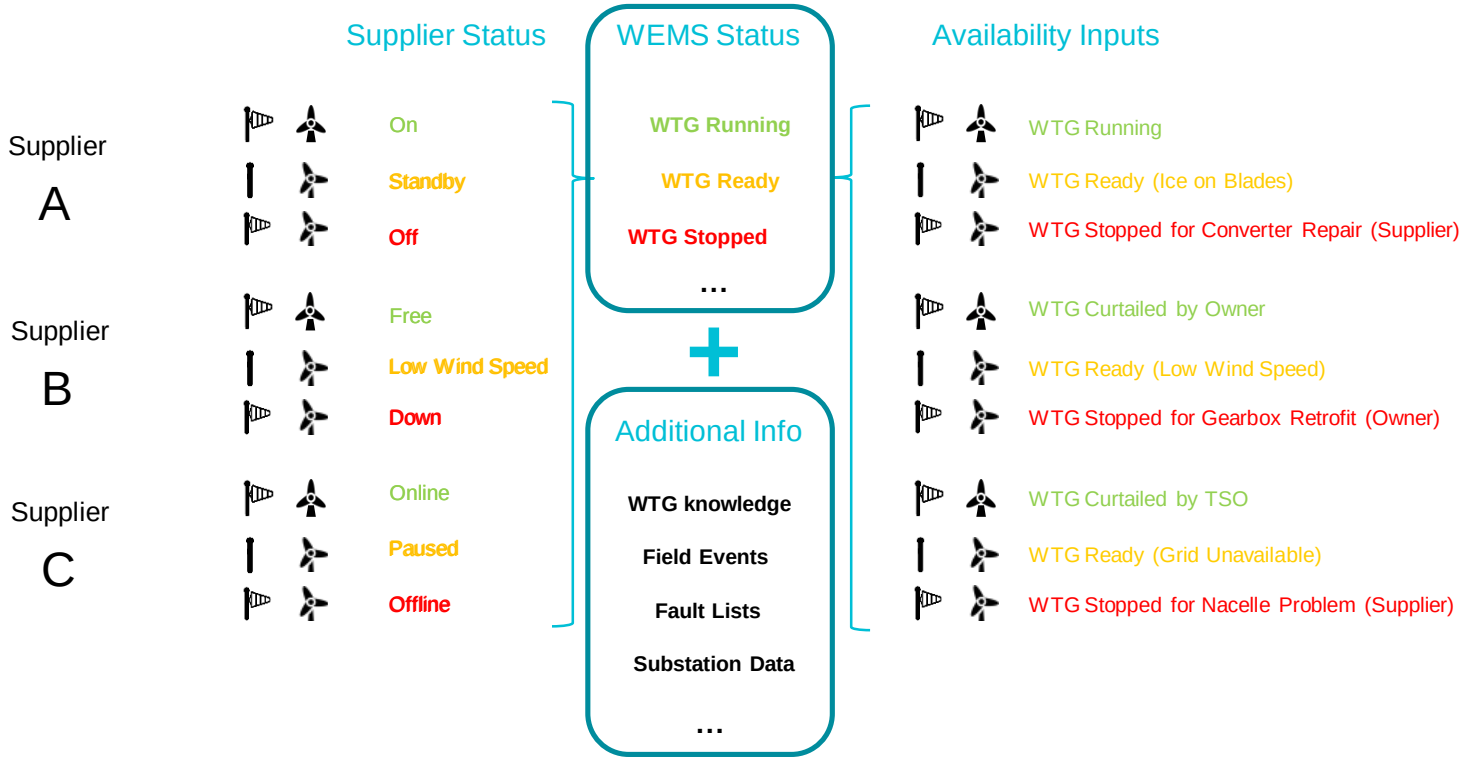
Good field data is crucial for availability calculations…



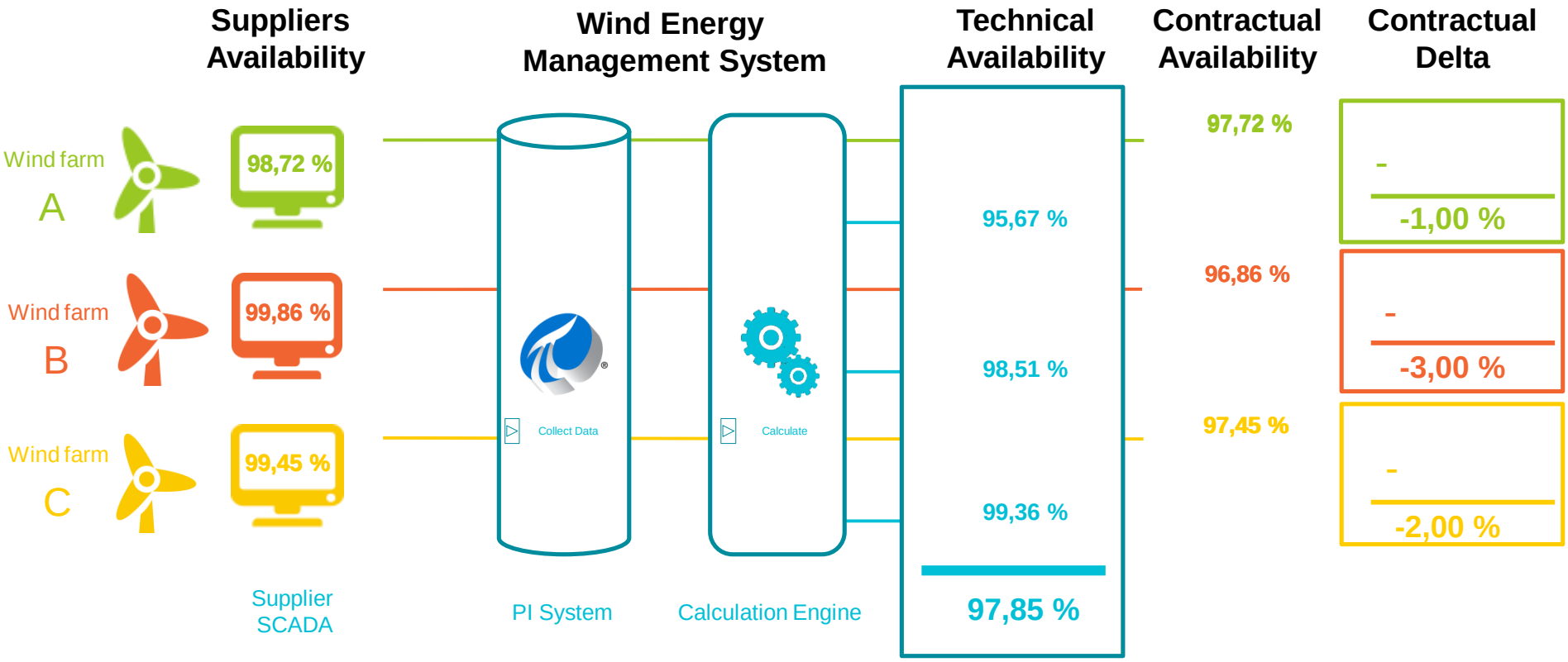
… but often data is lost due to maintenance operations



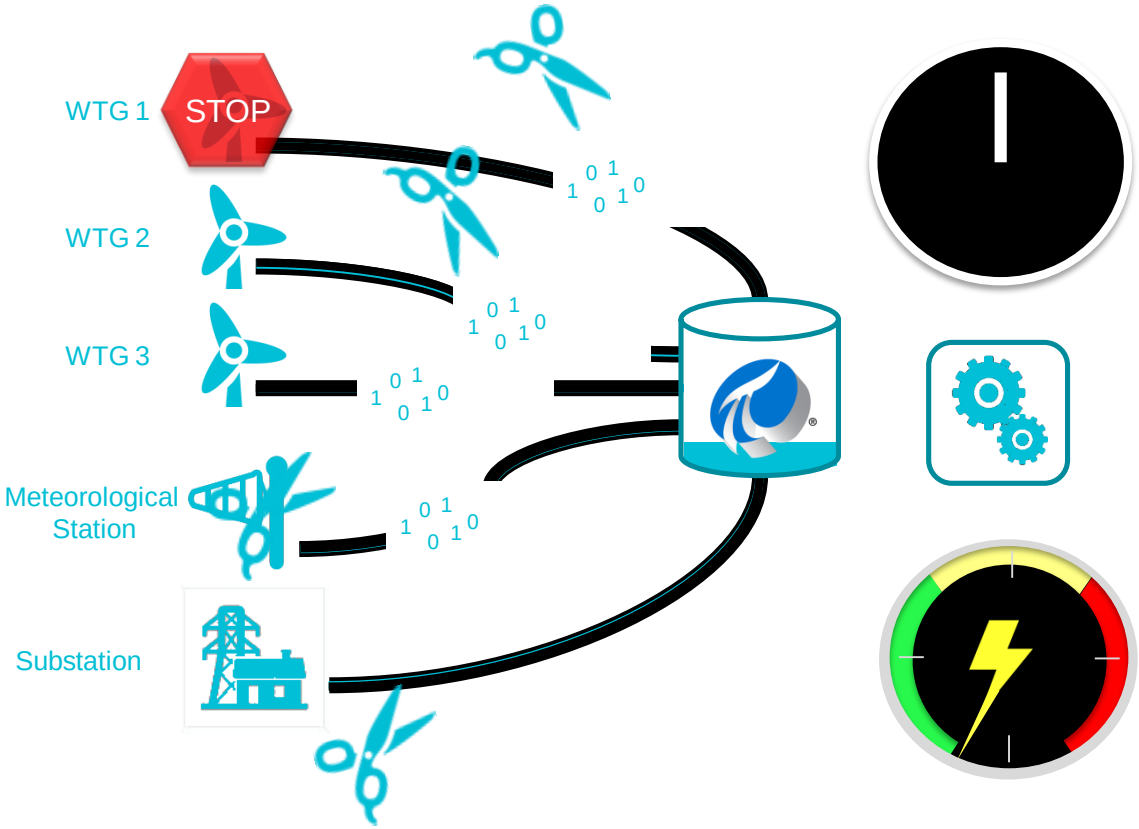
Solution 1 – Build global, normalized availability inputs

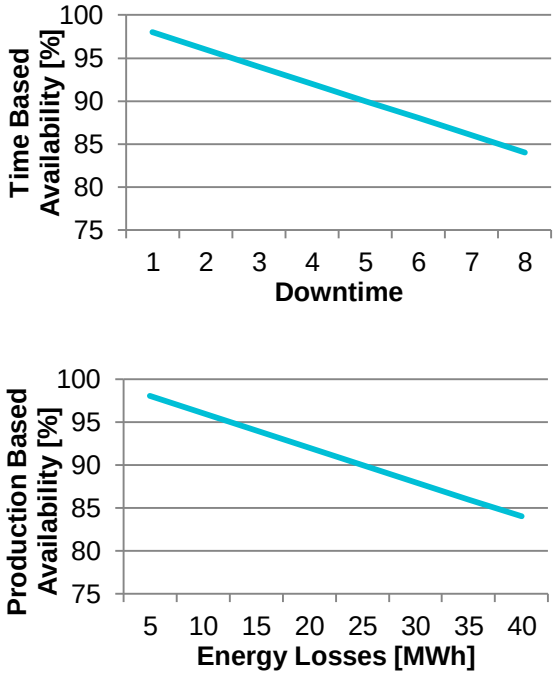


Solution 2 – Measure different availability concepts

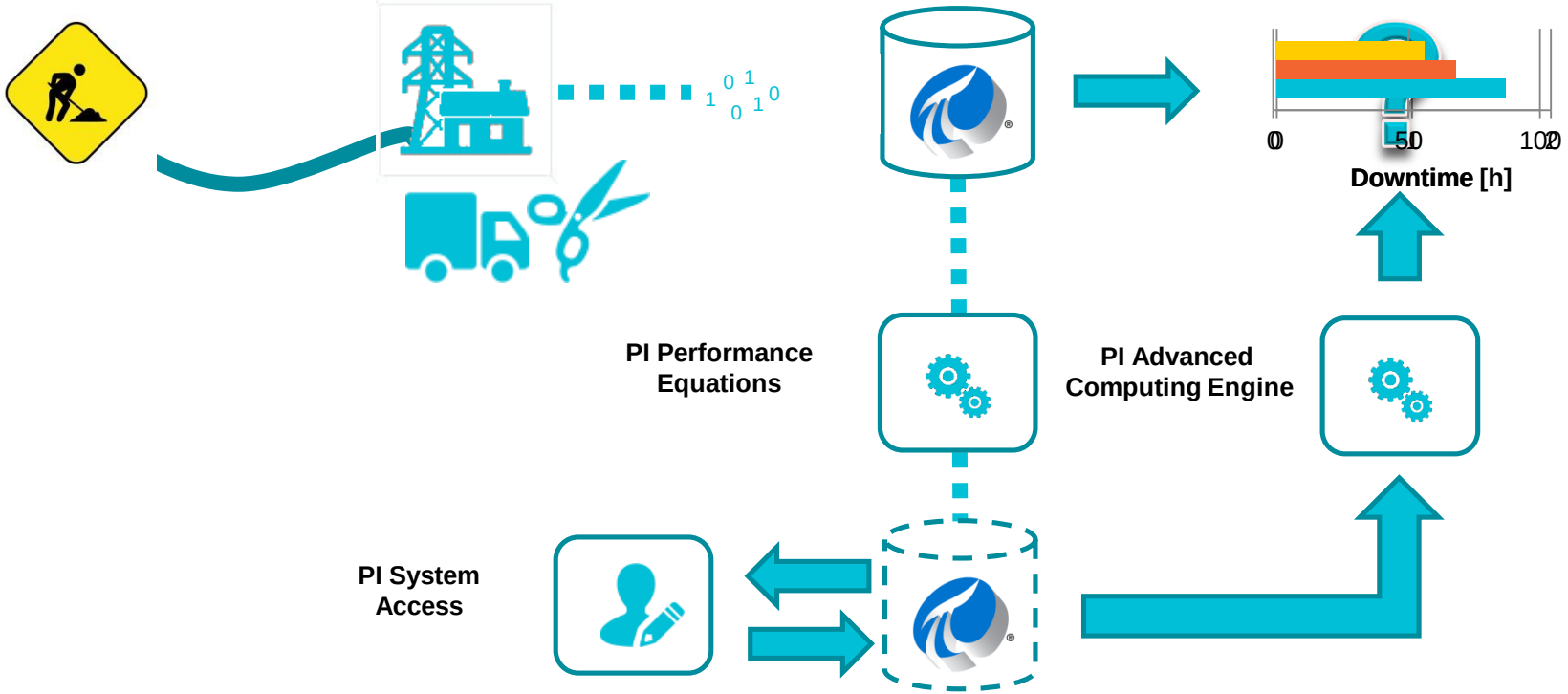


Solution 3 – Use all available sources for calculations





Solution 4 – Let users play a role in data improvement



Results & Benefits

Reliability

Results are calculated on independent data, collected directly from the field

Veracity

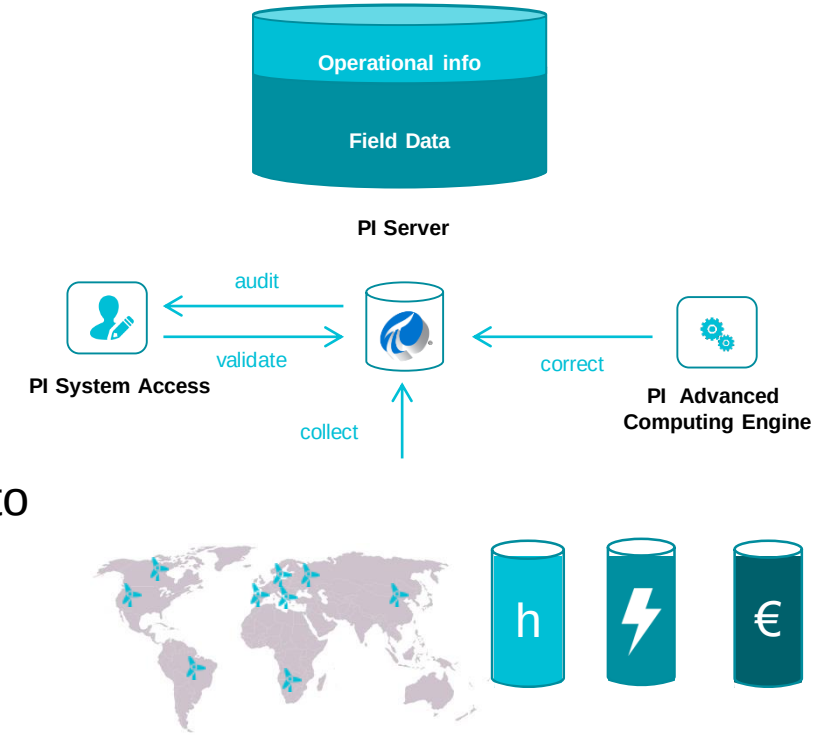
Automatic correction and manual validation increase the accuracy of availability results

Profitability

Better prioritization of improvement actions, towards a decrease of downtimes and increase of revenues

Conclusions

- PI Server: field data repository and direct source of operational information
- PI Advanced Computing Engine and PI System Access as enablers of a Data Governance strategy
- Benefits in availability are proportional to the size of the renewable assets portfolio



WEMS - Information and tools to optimize the management of EDP-Renewables assets

- Setting a **single platform** to manage EDP Renewables' portfolio
- Integrated operation and performance management in **real time**
- **Centralized operation** of wind turbine generators, lines and substations, complying with grid operators requirements
- Costs and Operational **risks reduction**
- **Increasing** renewable assets **availability** and **reducing downtimes**.

edp renewables

Business Challenge

- Improve availability **reporting accuracy**
- Reduce wind turbine **downtimes**

Solution

- **Comprehensive** real-time data collection using the PI System
- A **mix** between automatic data processing and distributed manual inputs

Results and Benefits

- **Reliability** – results are based on data brought straight from the field
- **Veracity** – more accurate values after manual correction
- **Revenues** – better definition, prioritization and return of improvement actions

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- Consultant Coordinator
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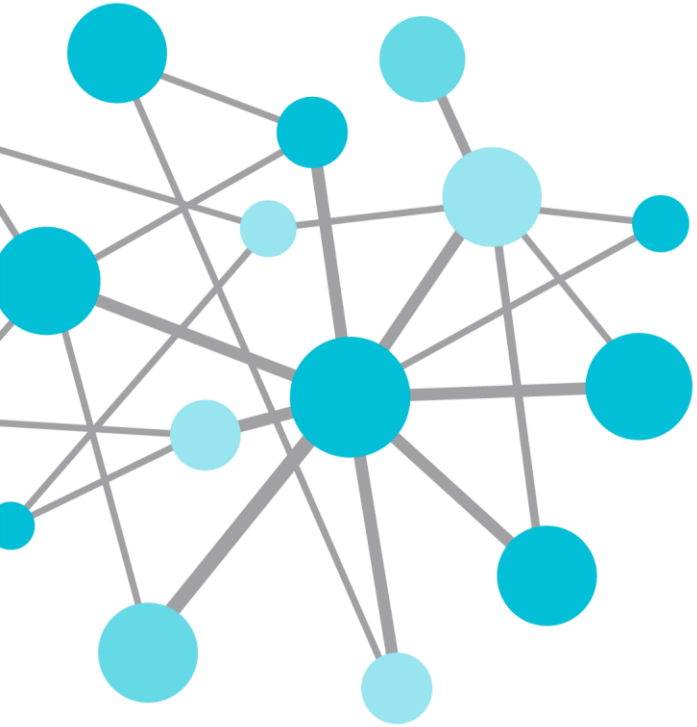
Questions

Please wait for the **microphone** before asking your questions

State your **name & company**



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