Real Time Digital Oilfield

a game changer in Upstream asset management

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AGENDA

1. Project Scope
2. PI Asset Connection: eDOF
3. eDOF Integrated Architetture
4. Field Application & Results
5. Conclusions & Further Developments

About ENI

> 30 000 people

Active in 67 Countries

€ 7.9 bln capex

Innovation in renewables

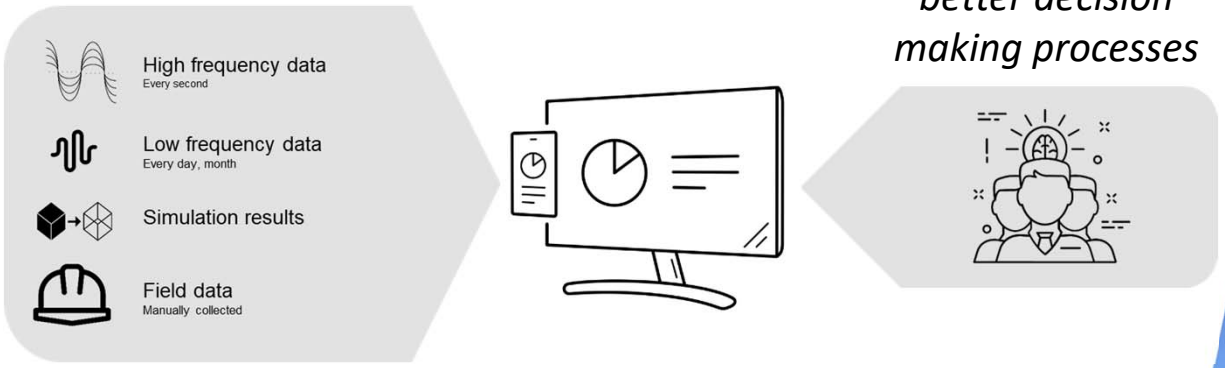
Exploration & Production

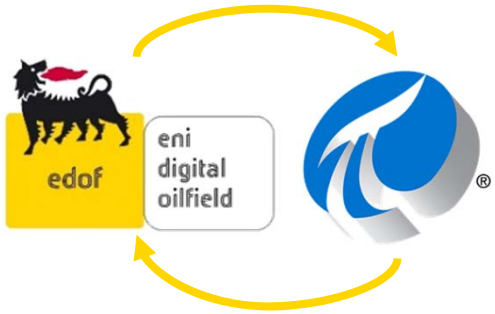
Gas & Power

Decarbonisation: embedded in our strategy

Refining & Marketing & Chemicals

Scope of the Project

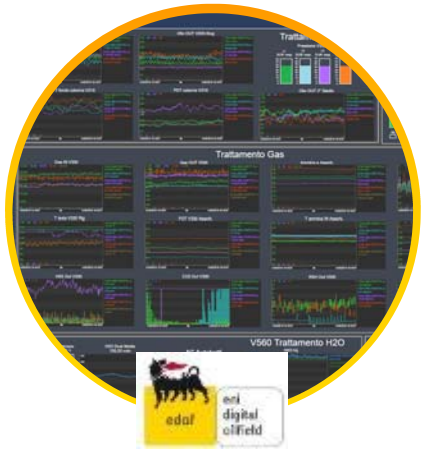




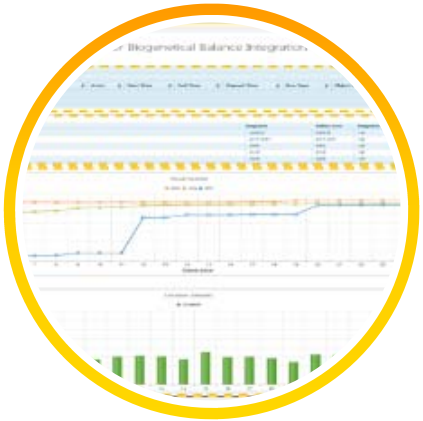
Advanced Digital Oilfield

It's a mature technology adopted by O&G Industry with various names and targets.
Eni on-line solutions is named ***eDOF*** *and is integrated with PI tools maximizing the support to asset management and Operations in real-time*

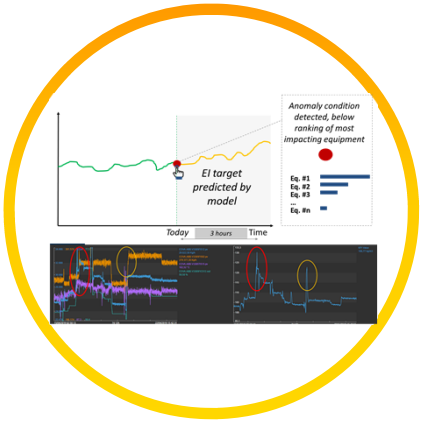
Scope of the Project



1. Monitoring



2. Optimization



3. Prediction and prescription

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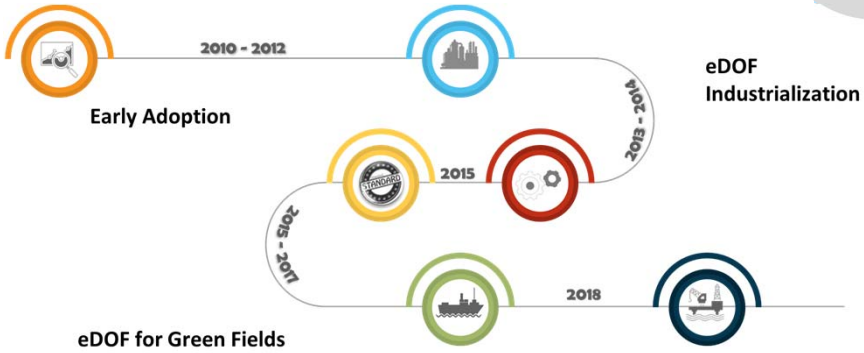
Eni Digital Oilfield: eDOF

eni standard configuration is named **e-DOF**

- ✓ The solution is based on the configuration of **state-of-the art** off-the-shelf components
- ✓ All the design, implementation and deployment activities are performed by a team of highly specialized **eni people**, both from IT and business disciplines, thus incorporating eni Intellectual Property.
- ✓ eDOF is actually acquiring/calculating more than $350*10^6$ values every day, with an average frequency of 20 sec.
- ✓ Real time data , KPIs and OWs, advanced simulations , modelling , predictive tools, analytics are integrated in the framework to enable asset production optimization and better decision making
- ✓ Flexible visualization pages are developed in order to provide to provide all the information to management, engineers and site teams, enhancing their impact on field operations, monitoring, troubleshooting and optimization activities

eDOF Highlights

- *The digital transformation plays a key role in the data analysis for a continuous and efficient management of the subsurface and of the process plants*
- *The eDOF (**E**ni **D**igital **O**il **F**ield) system, allows the collection of signals coming from all the deployed sensors, in order to have a complete monitoring of the overall Asset, from wells and reservoir to point of sale of products.*



- **High and Low frequency data** are fundamental for the comprehension of the behavior of subsurface and topside processes.
- eDOF is developed leveraging on a **strong synergy** between business and ICT depts.
- eDOF is the **main enabler** of the digital transformation in Eni

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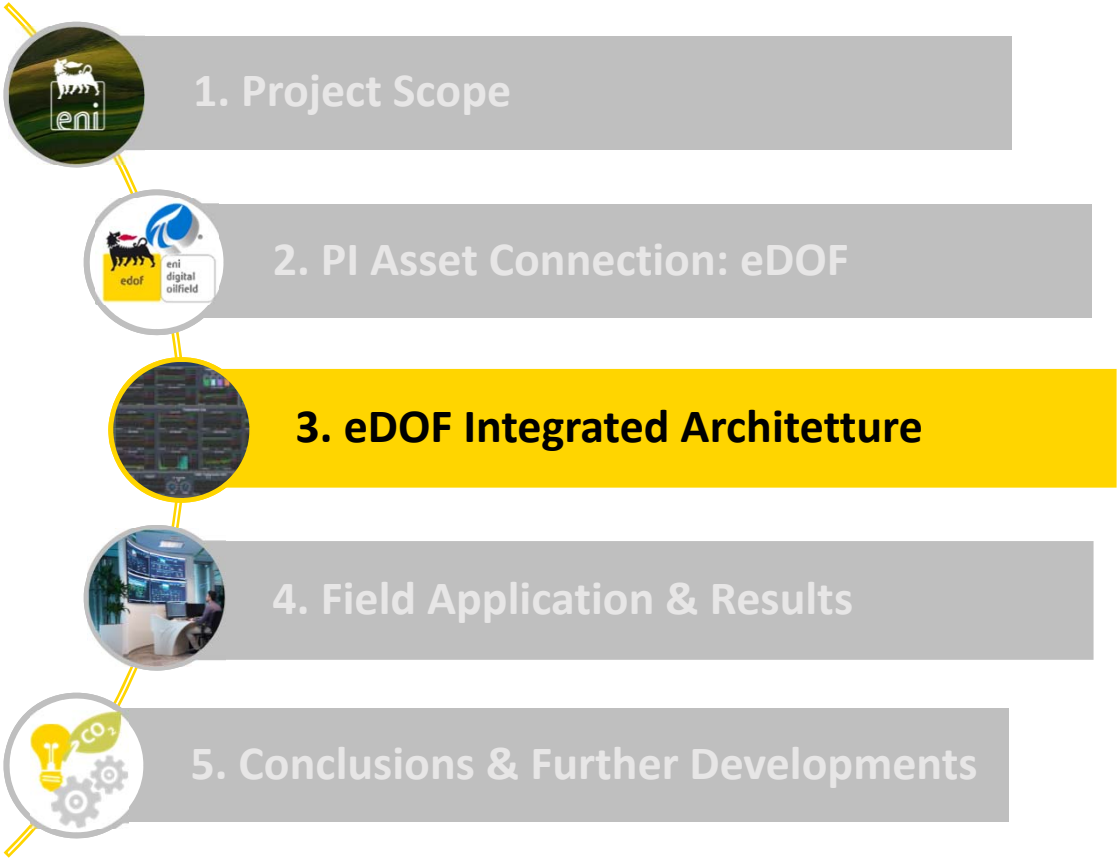
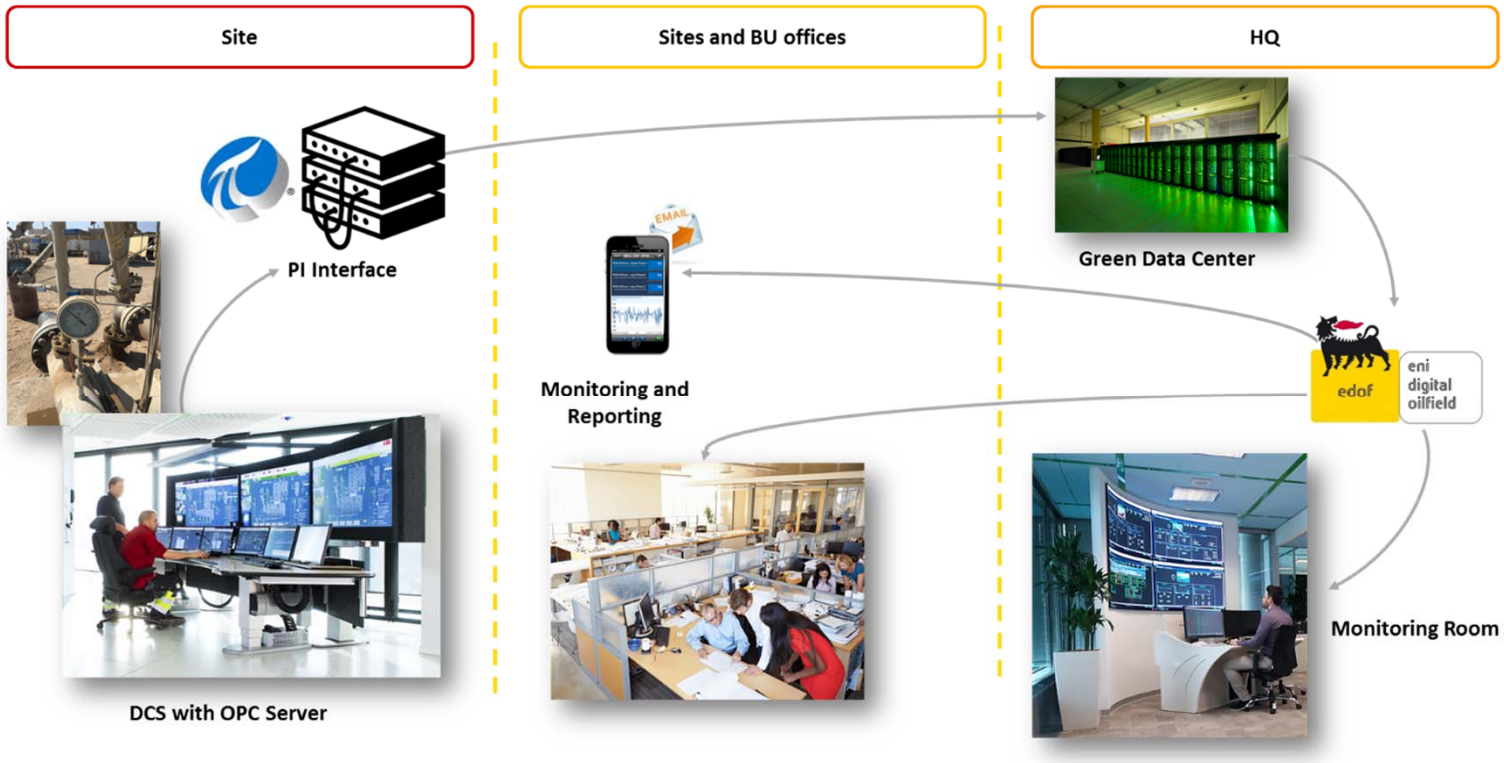


Standard eDOF Infrastructure



Data from the asset are historicized at HQ Green Data Center

Development of the system from HQ in tight collaboration with BU engineers

Full support from Eni HQ

Green Data Center

TOP 6 most powerful super computer in the world (HPC5)

1 MW power produced by the GDC's solar panels

14 GWh the Green Data Center's annual energy consumption

6000 ton CO2 avoided every year

70 million billion calculations a second, done with minimal environmental impact (HCP5+HPC4)

52 million billion mathematical operations per second (HPC5)

2,25 MW HPC5's energy consumption in full operation

eDOF features: AF central role

Data export to other applications

Data collected in PI DA are available for specific studies: they can be used to feed - directly or after processing - third party applications such as Prosper, HYSYS, GAP, Big Data Architecute or other simulation/optimization tools.

Individual Analysis in Excel

Individual analyses and provision of customized reports are facilitated through PI Datalink software that allows real time data gathering, analyzing and reporting leveraging on MS Excel computational, graphic and formatting capabilities.

Mobile Dashboards & Notifications

Leveraging on PI Vision support for mobile browsers and customized views for small screen devices, eDOF allows to access important process information from any device and from anywhere, providing specific alerts, notifications or workflows to selected GU staff via SMS or email to notify signs of abnormal conditions.

Remote HMI Displays

eDOF does not provide automated control but exploits the same data used in the control room, storing it with context and structure. Data collected via eDOF can be consumed immediately for monitoring purposes or on a longer term loop for simulation and optimization purposes.

KPI Dashboards

Raw data are elaborated in KPI, Operating Window and Integrity OW through application of international standards.
These are monitoring tools used to evaluate how well an equipment
is performing compared to normal condition and to bring focus on critical asset integrity aspects.

Real-Time analysis

Discipline engineers can have fast access to live information and can provide realtime support to opertion teams, even from HQ. Self-service dashboarding is helping to move towards more proactive operation management as engineers are more aware of the overall behavior of the Asset.

Production Advanced Monitorig

KPI

Easy variables correlation
Continuous monitoring
Field production optimization
Operating issues prevention

Correct

Warning

Out of specific

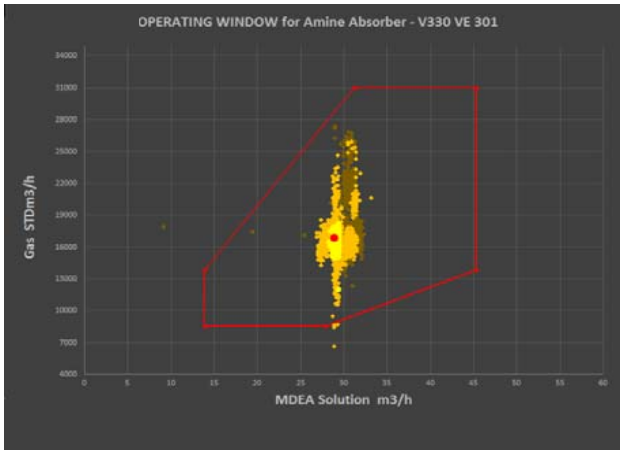
KPI's are defined for:

- Process
- Maintenance
- Asset Integrity
- Energy Efficiency

If a warning appears on eDOF, an alert mail will be sent

Operating Windows

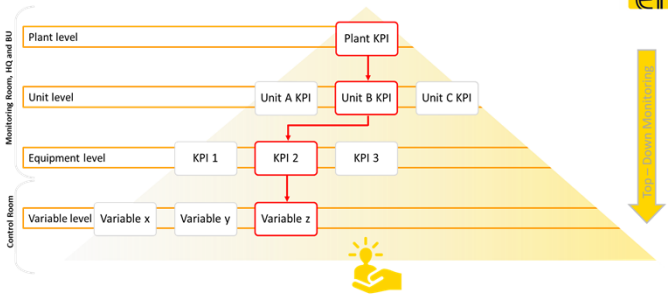
Process equipment (Trayed Columns, Compressors)
Flow Assurance (piping, network)

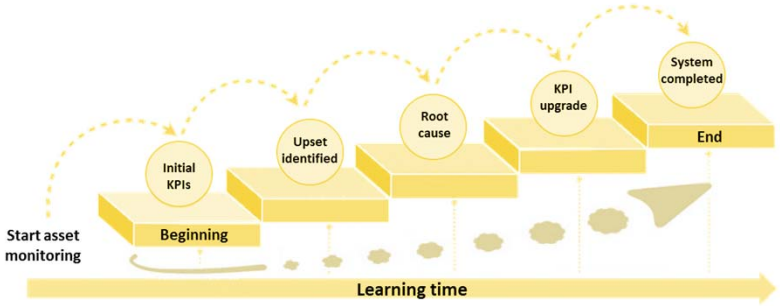


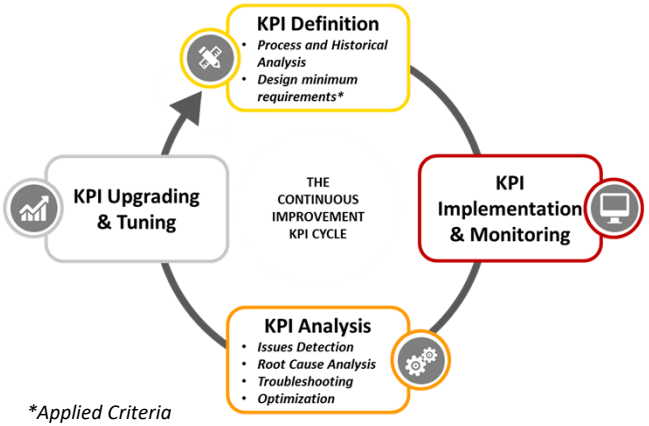
Direct way to show equipment operability area
OW defined by Project and Industrial Standards
Real-time app for troubleshooting & debottlenecking

What is a KPI?

- Define correlations of different variables, KPI, to simplify equipment performance and integrity evaluation allowing continuous monitoring
- Optimizing field production
- Prevent and troubleshoot operating issues







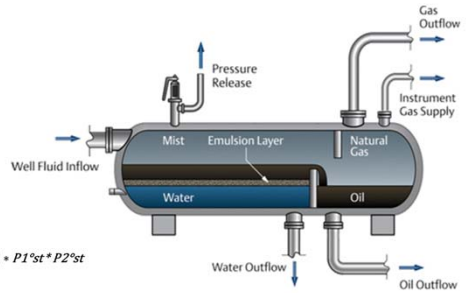
KPI Example - Separation unit

Process Variables: Flow-rate, Pressure, Temperature, Levels, Fluid characteristics

KPI:

- *Water\Oil droplet diameter 1° and 2° St* $KPI_{Dp} = \frac{Droplet\ diameter}{Target\ droplet\ diameter}$
- *Nozzles noises 1° and 2° St* $KPI_{nozzle} = \frac{\rho v^2}{\rho v^2\ specific}$

$$KPI\ Separation\ unit = (f1\ Dp\ H2O\ 1°st + f2\ Dp\ H2O\ 2°\ st) * P1°st * P2°st$$

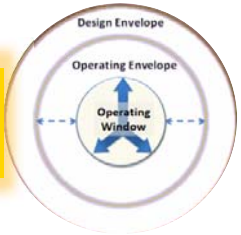


**Applied Criteria*

- *10009.HTP.PRC.PRG – Process design minimum requirement*
- *GPSA – Gas processors suppliers association*
- *API RP 584 – Integrity operating windows*
- *API RP 14E – Erosional velocityAPI*
- API RP750 – Management of Process Hazard
- *API 581 – Risk Based Inspection*

What is a OW?

Operating Windows (OWs) are bounded systems function of key process parameters in which operations will result in correct and acceptable equipment performance.



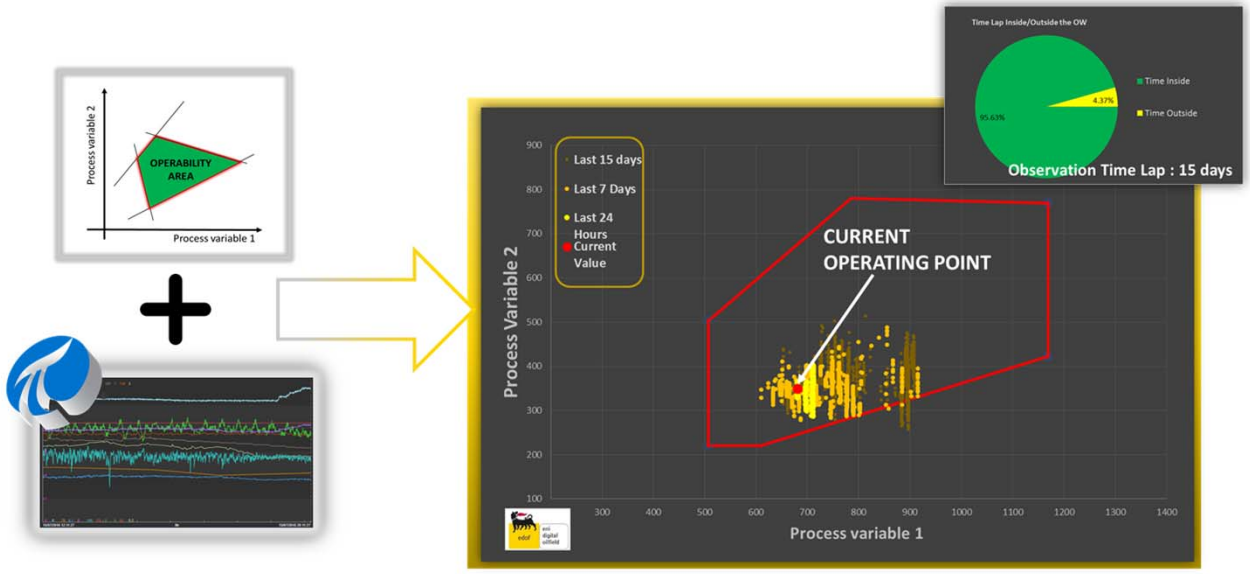
- *Possibility to monitor the **operability range** of a single equipment*
- ***Real time** application with online time data for **troubleshooting** and **debottlenecking** operations*

Advantages:

- **Simple** and **direct way** to visualize the range of operability of the equipment
- Possibility to visualize **more info** in a single graph
- Representative for **single equipment**

Design requirement:

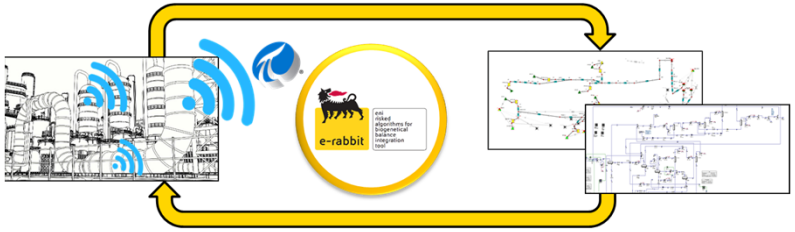
- Necessity to condense all the influencing parameters in two variables

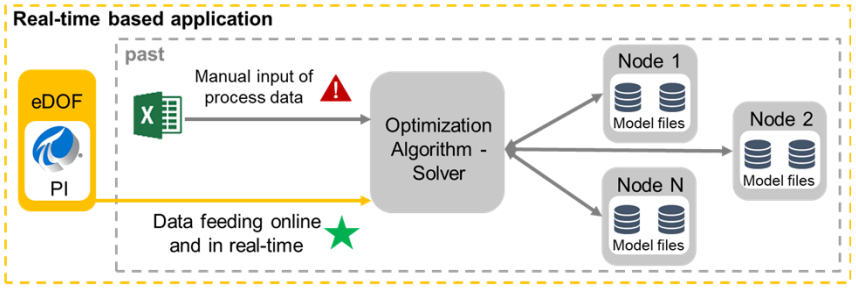


Advanced Tools

Real-Time Asset Modeling

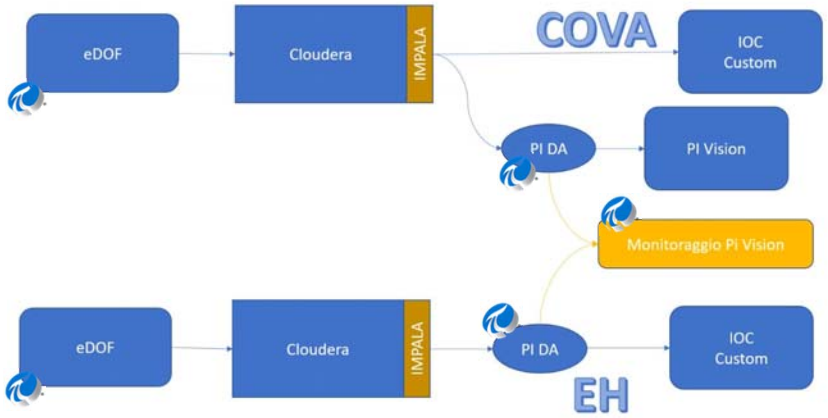
Build integrated production system models fed by real-time data and able to:
represent field operating conditions
monitor & optimize asset performances





Advanced Analytics

Prediction and prescription of actions in order to mitigate critical upsets or out off spec through the process.
Huge amount of data to be managed.



How ENI train a model from PI System data

1.) Explore source data to identify relevant time series	• Data science teams have complete access to all data, PI AF template attributes, calculations, KPI's, summary information, event frames etc
2.) Ingest only relevant time series into Big Data environment	• No need to perform utopic complete PI data ingestion into data lake • Only relevant PI Data updated every 5 minutes… • Reduced and efficient workload on PI server
3.) Start modelling with data from big data storage	• Common & official data sets are sourced through PI AF to all A.I. models • Data scientists work in the same environment as used for data discovery • Results exposed to dashboards and Operations Teams via PI AF & PI Vision

Time to do steps 1,2 & 3 with PI AF same as time for just step 1 with raw historian data…a Data Infrastructure approach hugely accelerates Data Science and makes results more successful!

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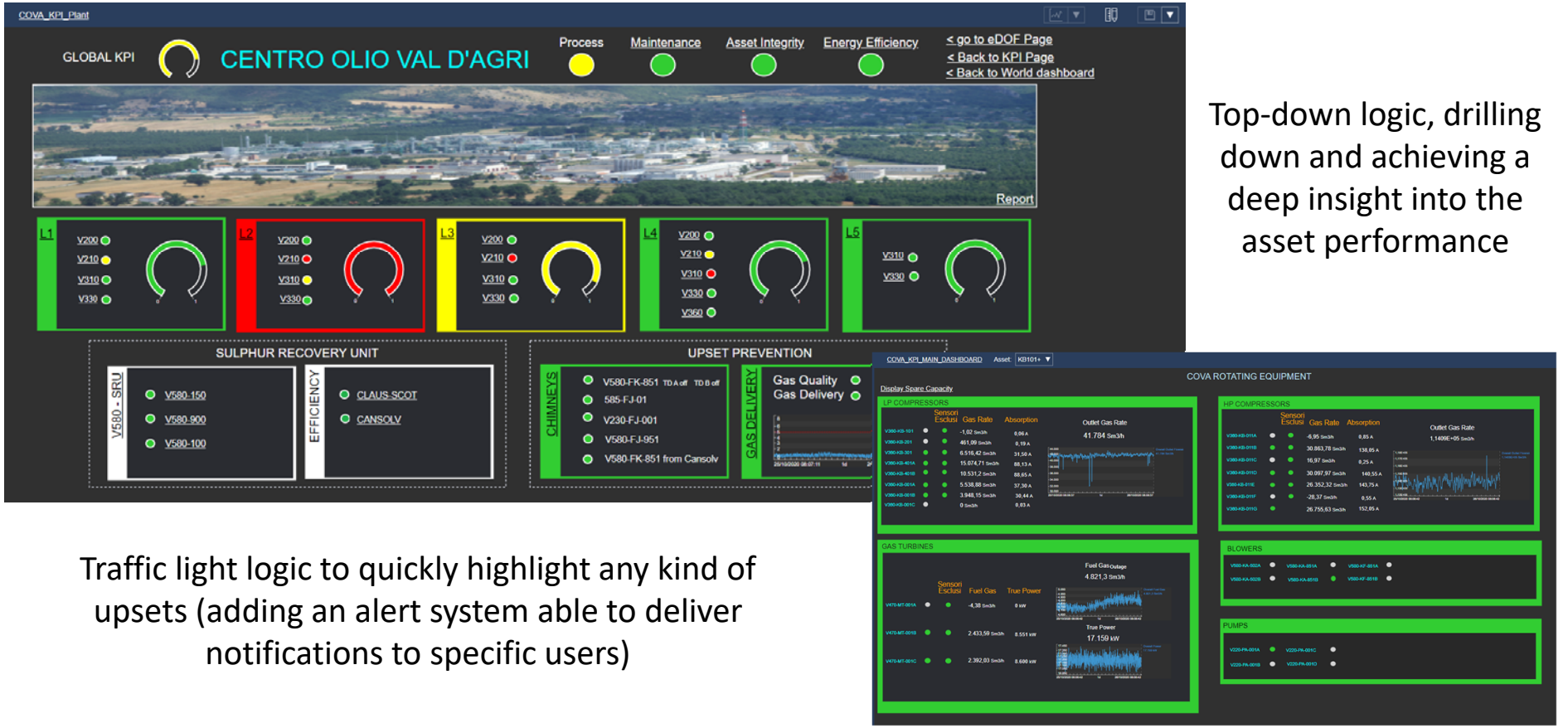
Green Data Center



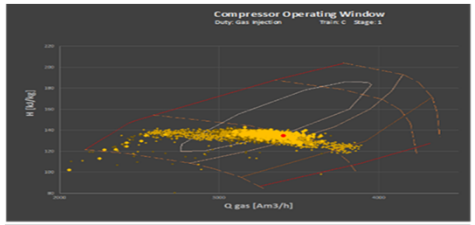
Top-down logic, drilling down and achieving a deep insight into the asset performance

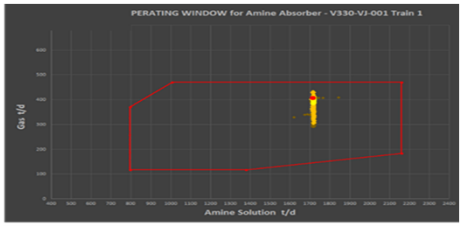
Traffic light logic to quickly highlight any kind of upsets (adding an alert system able to deliver notifications to specific users)

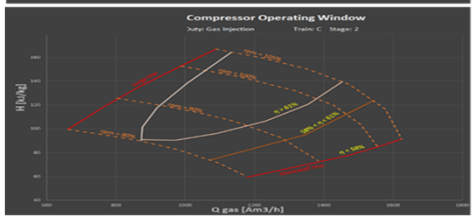
Production OW - Overview

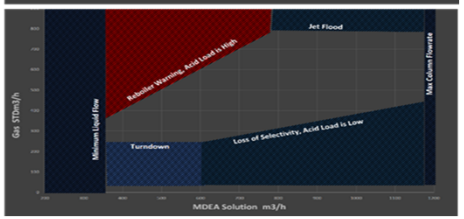
Equipment

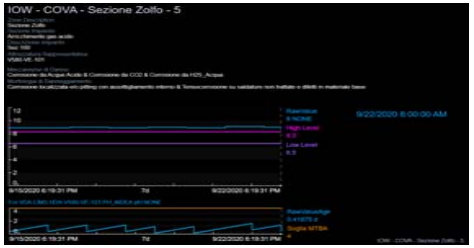
Centrifugal compressors/trayed column/Asset Integrity





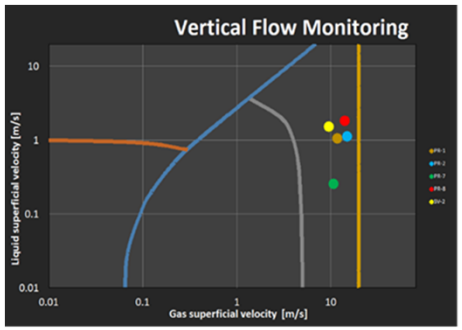


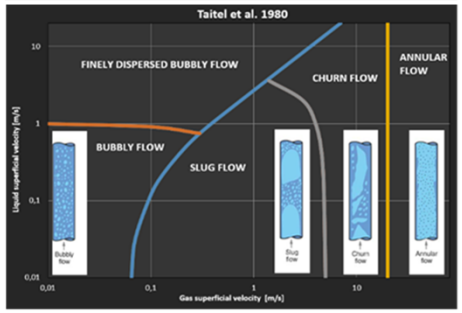




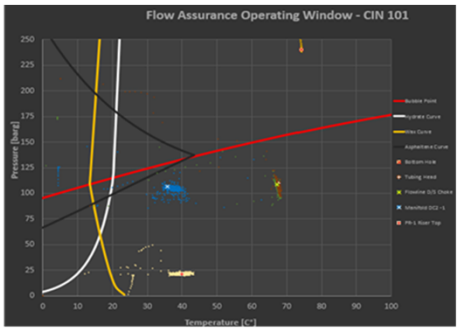
Flow Assurance

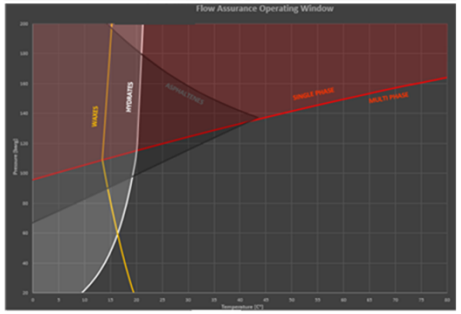
Flow pattern analysis





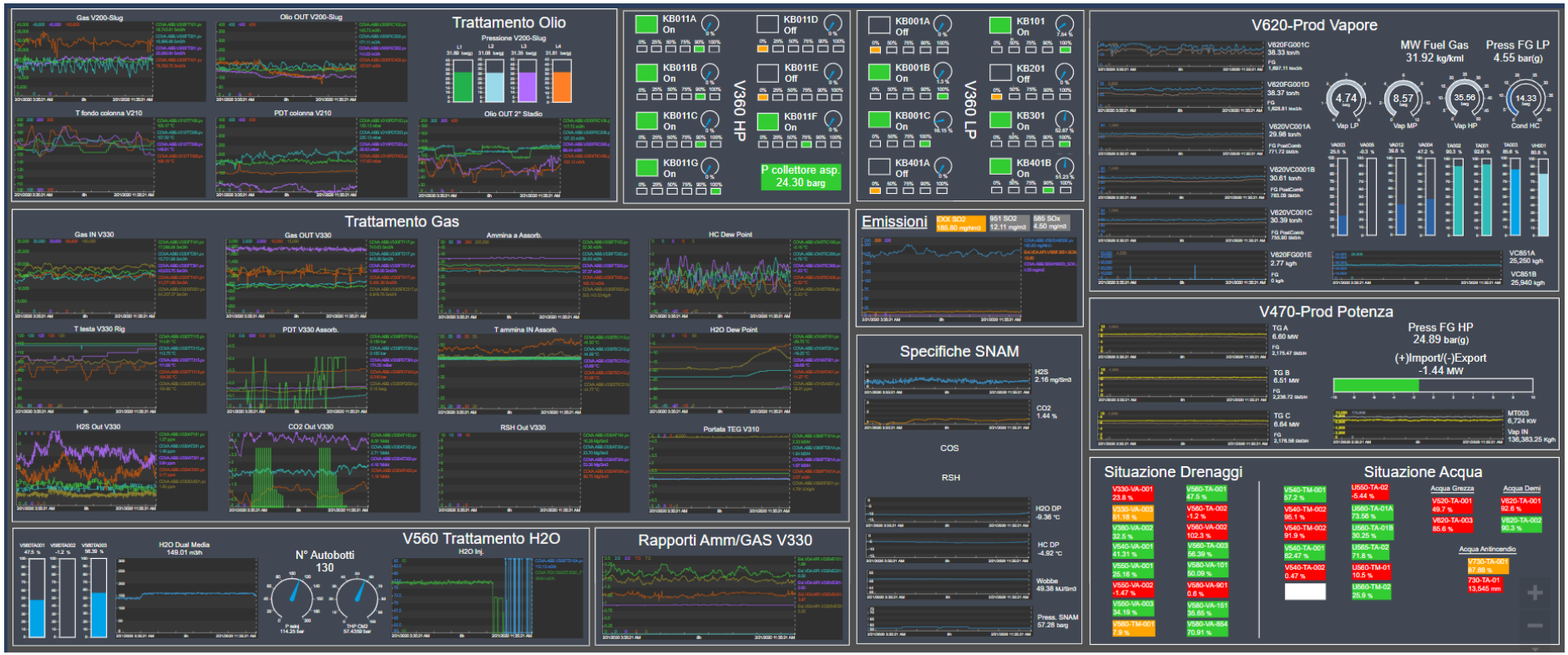
Solids formation





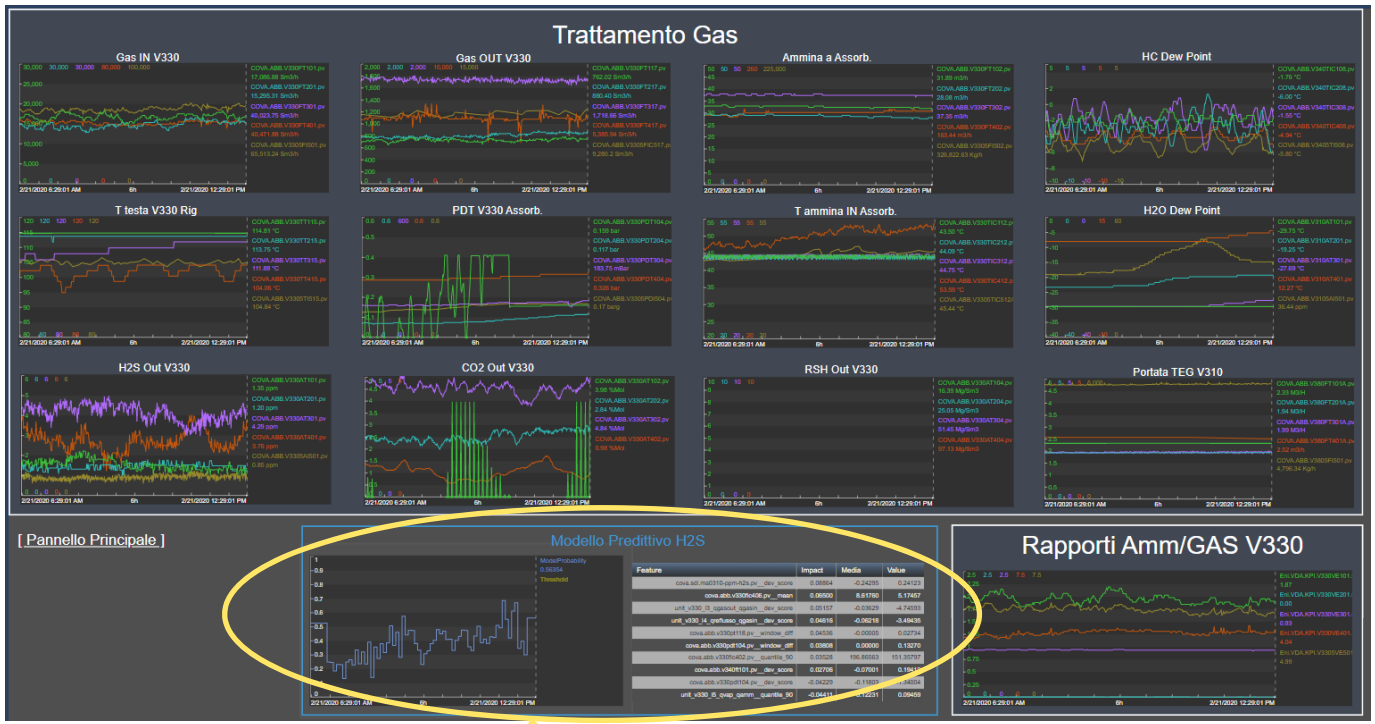
PI VISION Display for & from End Users

Nickname: «the monster»



All what a Control Room Operator need to have at his fingertips: around 230 Pi-Points on this Pi Display

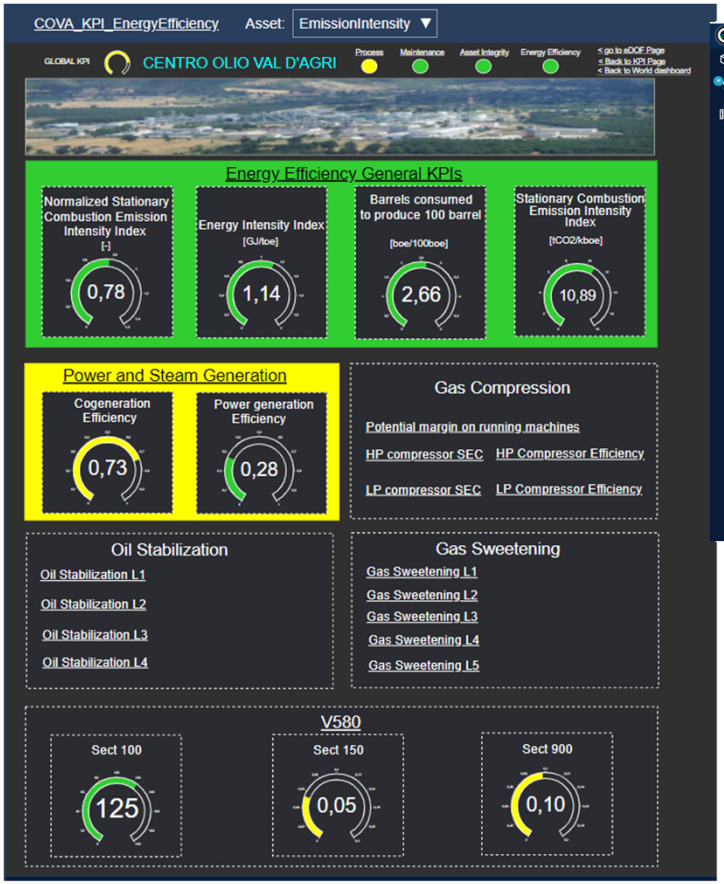
Implementation of advanced analytics subset

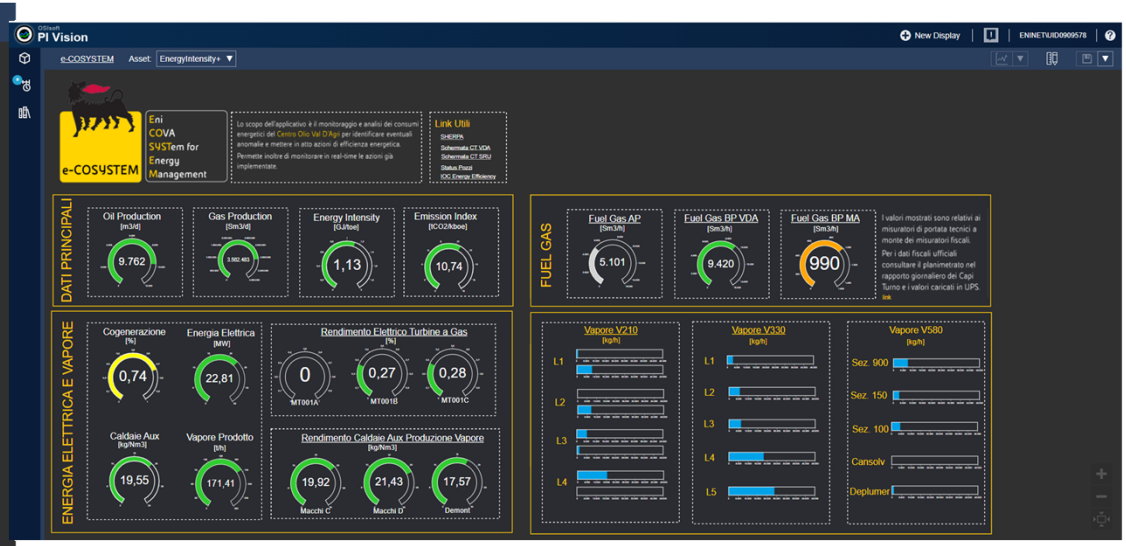


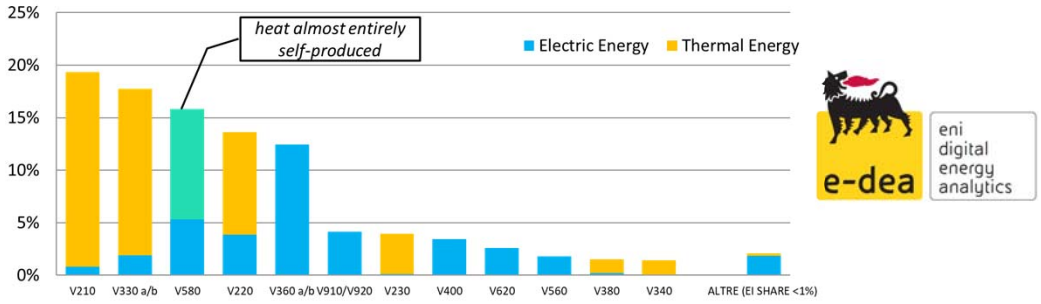
Additional Information from a Predictive Model based on advanced analytics

Subset of «the monster» focusing on specific parameters and including big data predictions focusing on a section of the process and adding actions to mitigate upsets

Focus on Energy Efficiency

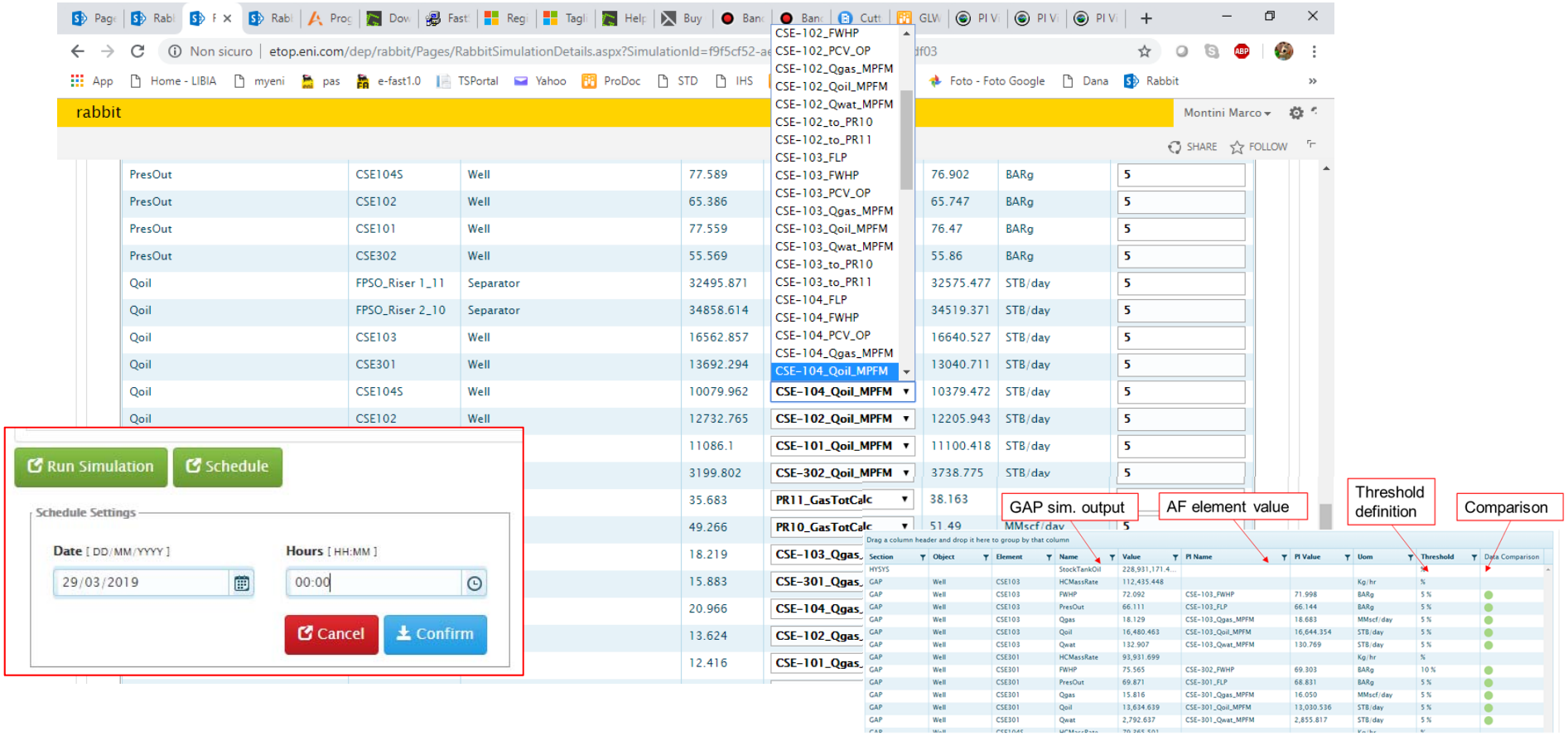






e-dea eni digital energy analytics

On-line Modeling



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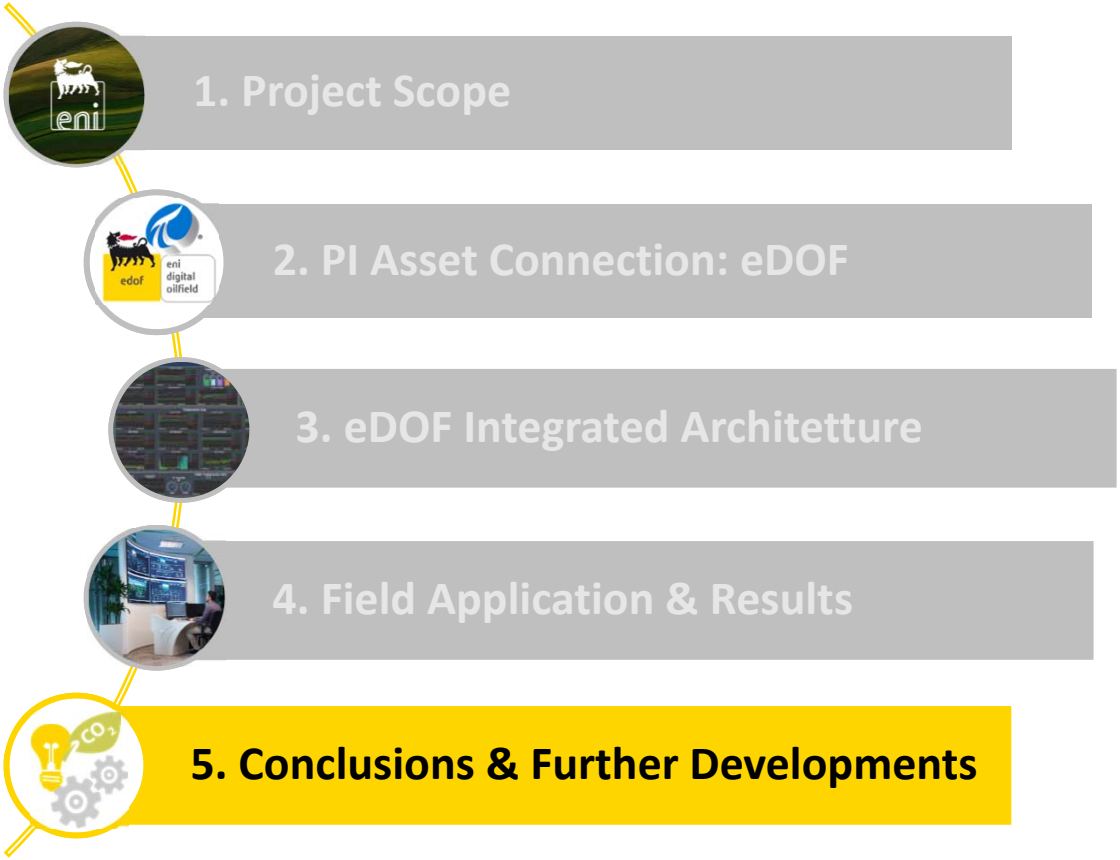


Key Enabling Factors

1. Integration

2. Flexibility

3. Data availability

Accelerating ‘Time to Value’ with OSIsoft PI

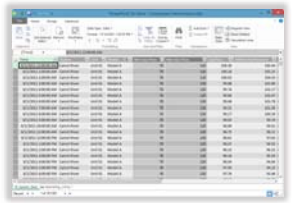
Meaningful, Structured and Contextualised data …always available

All pre-processing standardised

Everything Consistent & Centrally Managed

Reliable and Quality Data

Months Become Minutes!!! Greater success & accelerated ‘Time to Value’



Focused Tabular Data

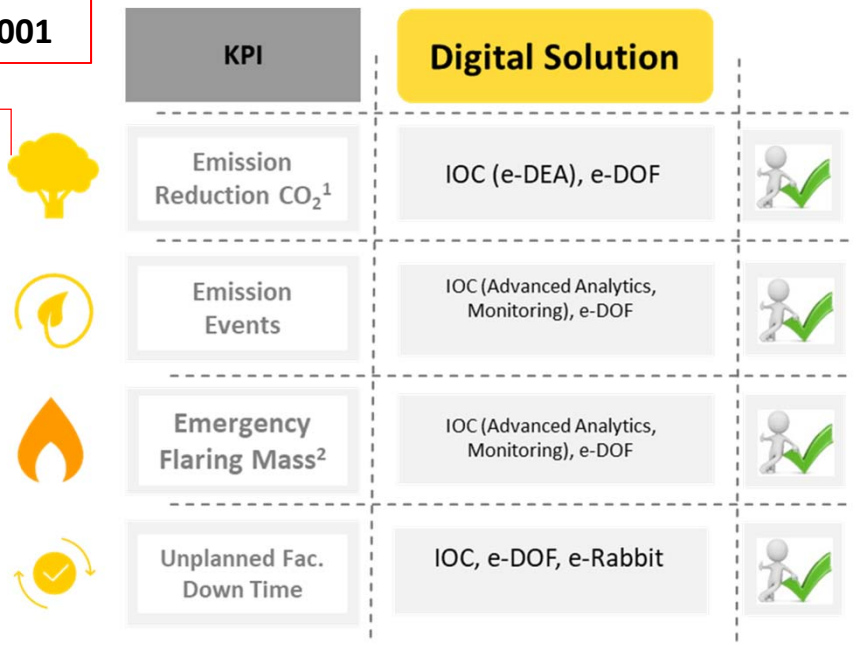
Eni Digital

edof

eni digital oilfield

Field Macro Results

Certification ISO 50001



1 - CO2 from Stationary combustion – net of plant SD on 2016-2017
2 - Flaring Events > 5000kg/h

"The mix of production specialists know-how, together with the power and flexibility offered by the new digital tools and Osisoft solution allow to maximize processes efficiency.

It is now possible to anticipate process upsets, asset integrity issues or deviation from plant optimized parameters

The user friendly interface, the tools accuracy and the collaborative digital environment created are the key of the results achieved"

- Site Operation team -

It is fundamental to highlight that the **field macro trends** are a results of **several factors**: operators **sensibility** improvement, **digital tools**, reinforcement of **operators team**, **change** management


THANK YOU
OSIsoft.