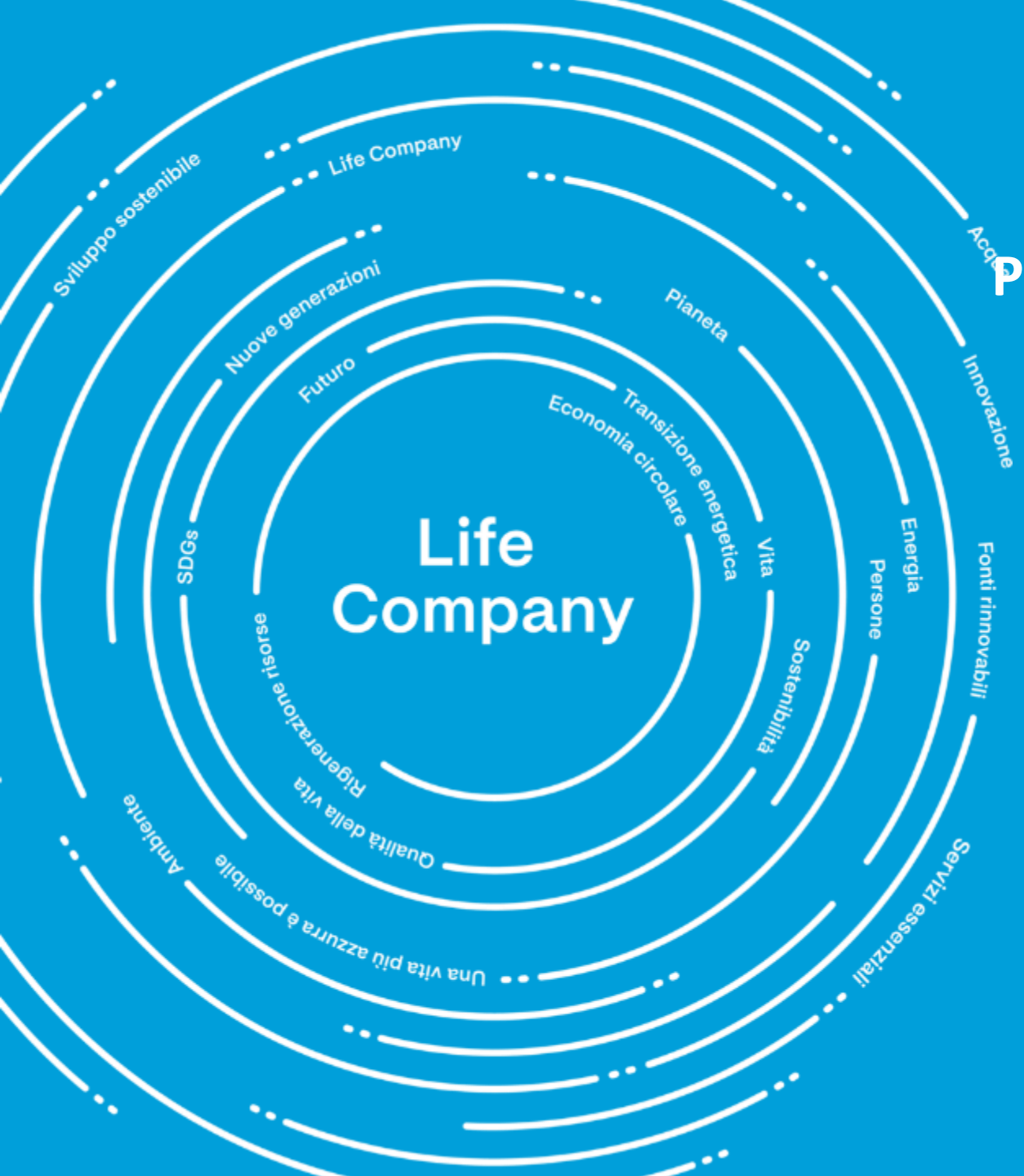
AVEVAWORLD

ACCELERATE INDUSTRIAL INTELLIGENCE



Predictive Analytics and PI Vision best way to share right data

A2A Calore & Servizi

Efficienza Impianti

Emanuele Taglieri

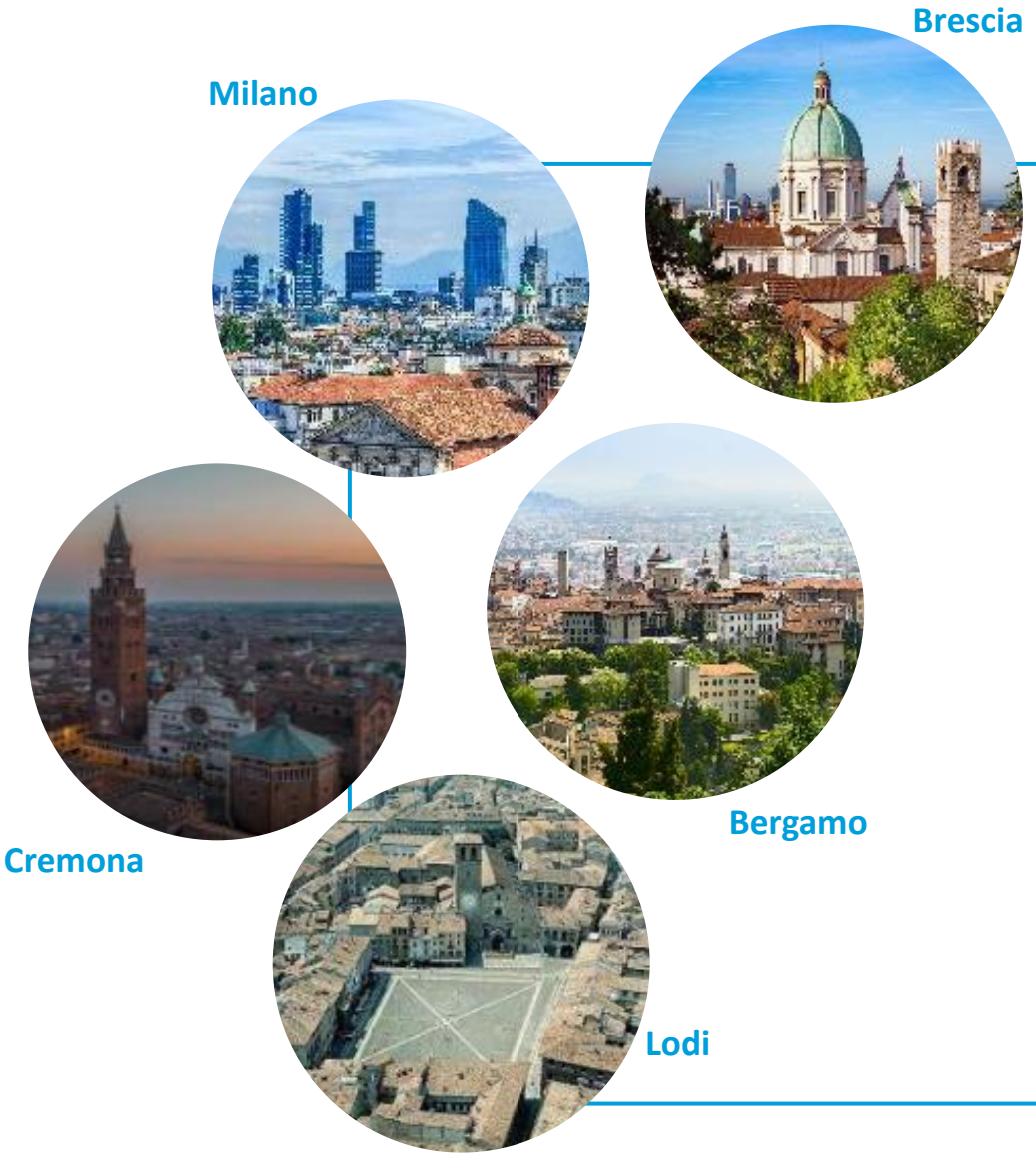
Giovanni Muscella

a2a LIFE COMPANY

Contents

A2A Calore & Servizi

A2A Calore e Servizi is a company of the A2A Group, a **leader in DHC in Italy**.
For over 50 years, we have designed DHC networks and delivered thermal and cooling energy production and operation services across the municipalities of Milan, Brescia, Bergamo, Cremona, and Lodi.



A2A Calore e Servizi is a member of Euroheat & Power and DHC – Technology Platform

AIRU associazione italiana riscaldamento urbano

EUROHEAT & POWER

DHC+ TECHNOLOGY PLATFORM

iDA ITALIAN DATACENTER ASSOCIATION

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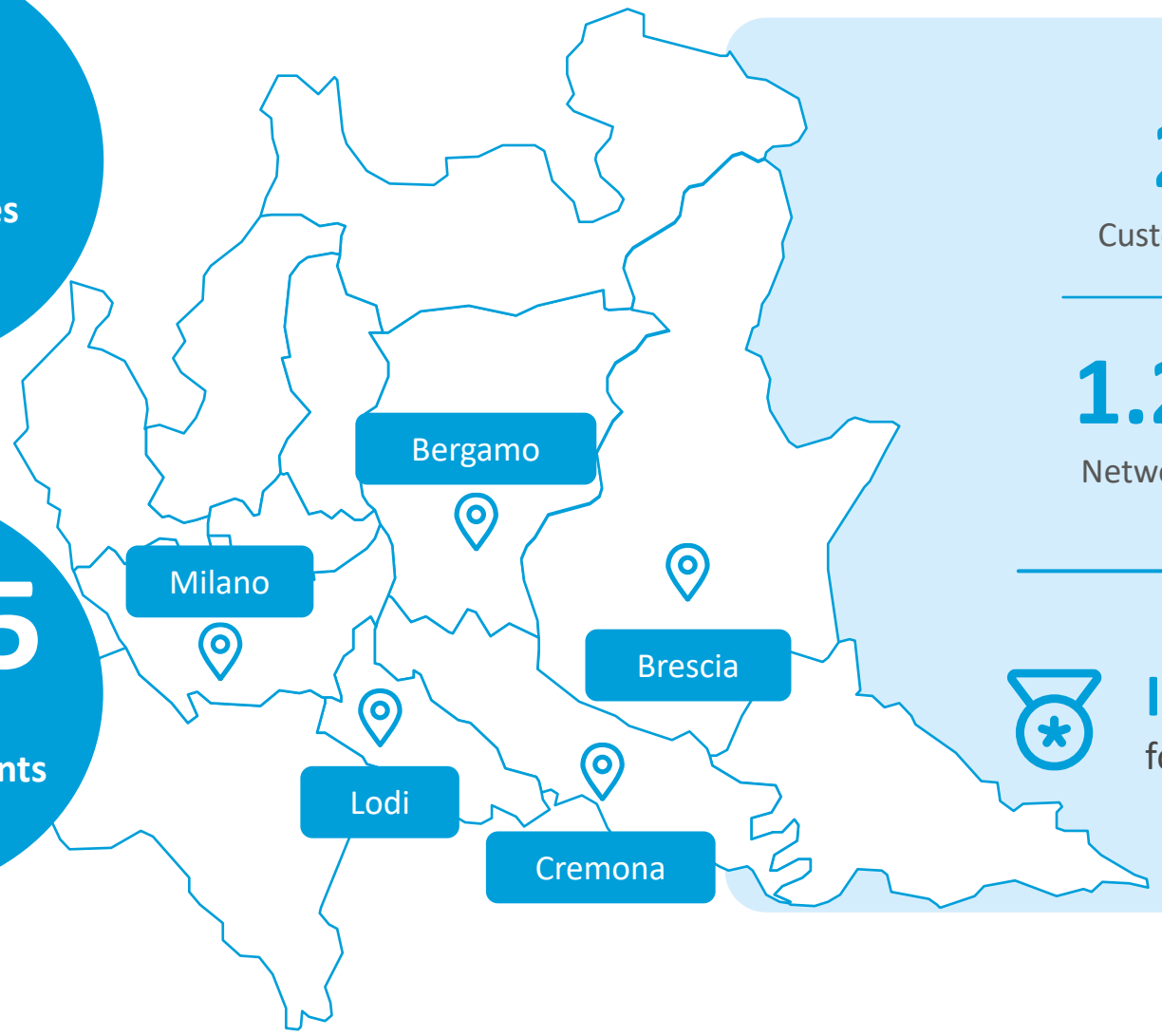
A2A Calore & Servizi

16
Municipalities served



More than 55
Thermal and cogeneration plants

26,7 k
Customers served

118 Mm³
Connected volume

1.294 km
Network expansion

492 k
Equivalent apartments served

Italian DHC market leader
for delivered heat and network lenght

3 TWh Distributed thermal power

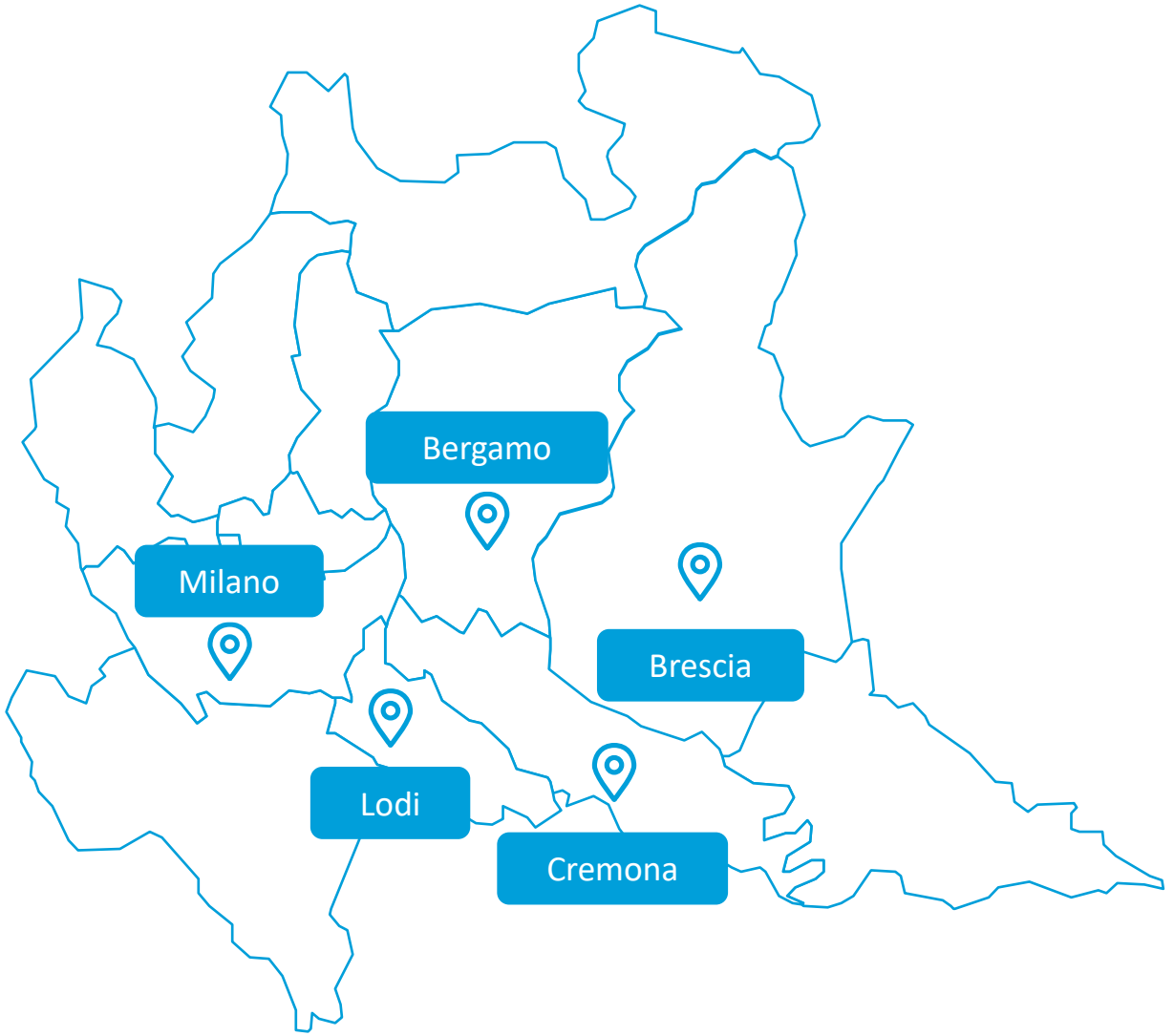
Dati al 31.12.2024

Plant Performance & Efficiency Department

Department objectives

Monitoring of KPI regarding:

- Thermal & electrical energy output
- Compliance with incentive PES thresholds to determine high efficiency CHP
- Predictive Maintenance for ensuring the efficiency of individual plant components



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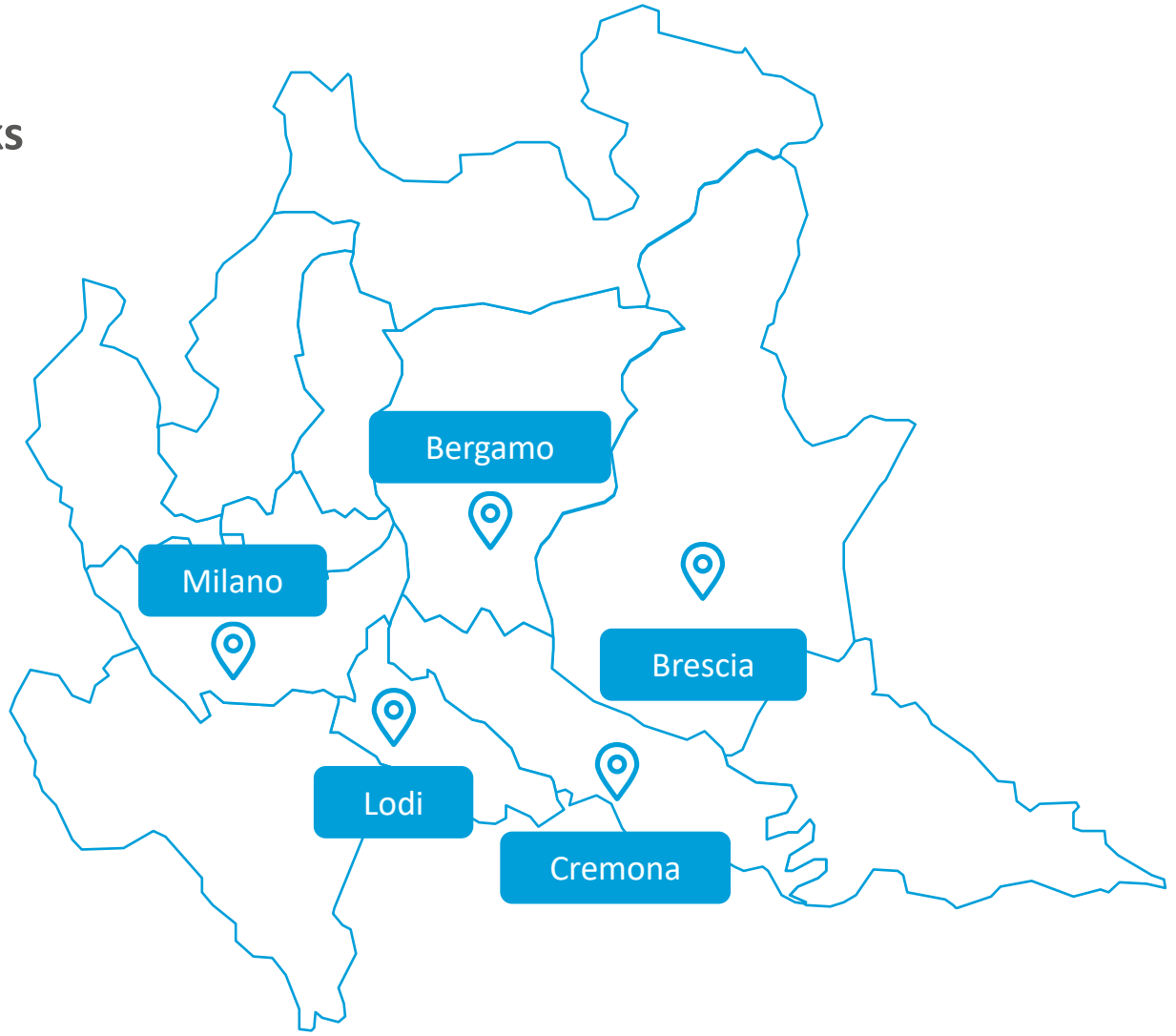
Plant Performance & Efficiency Department

Production plants and networks to be monitored

Monitoring of KPI regarding:

- 16 municipalities
- 18 DHC networks
- CHP including CCGT, GT, ICE.
- Heat only-plant supplying DHC with non cogeneration heat sources: geothermal heat pumps, condensing gas boilers.



Plant Performance & Efficiency Department

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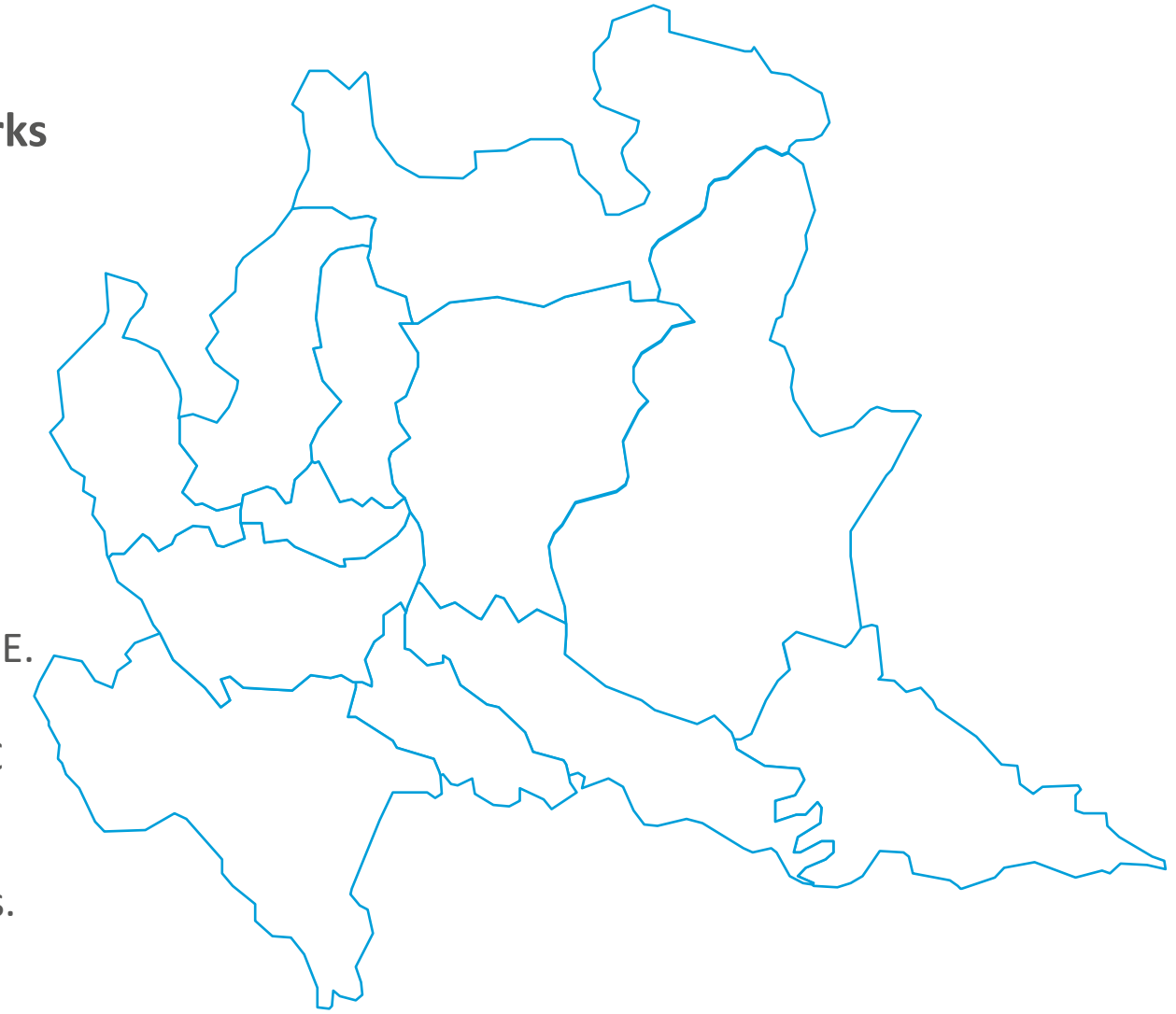

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Plant Performance & Efficiency Department

Production plants and networks to be monitored

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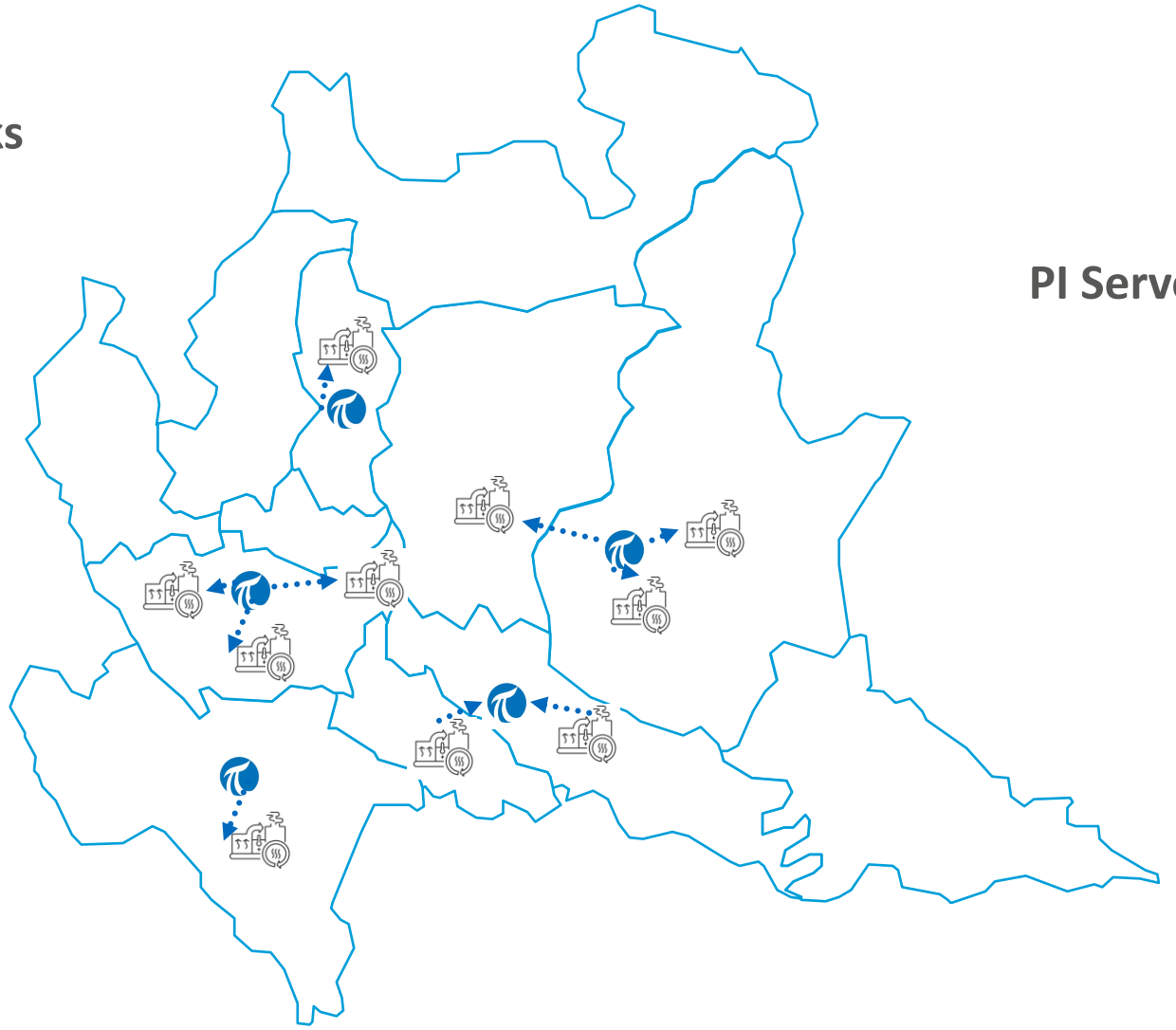
Plant Performance & Efficiency Department

Production plants and networks to be monitored

Process data flow between PI Servers and plants



PI Server

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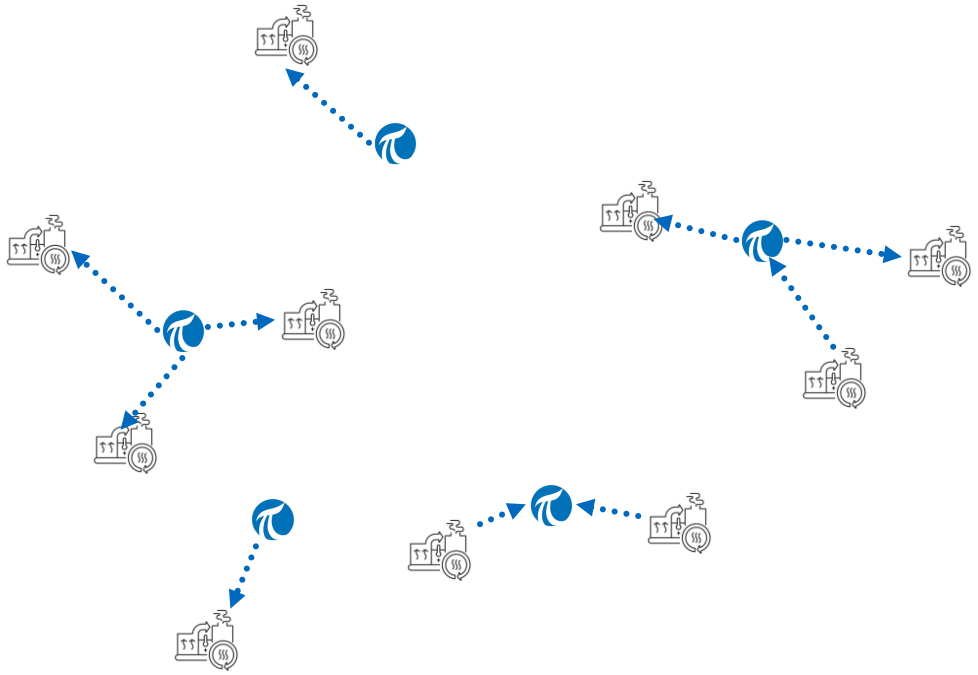
Plant Performance & Efficiency Department

Production plants and networks to be monitored

Process data flow between PI servers and plants

AVEVA PI Server



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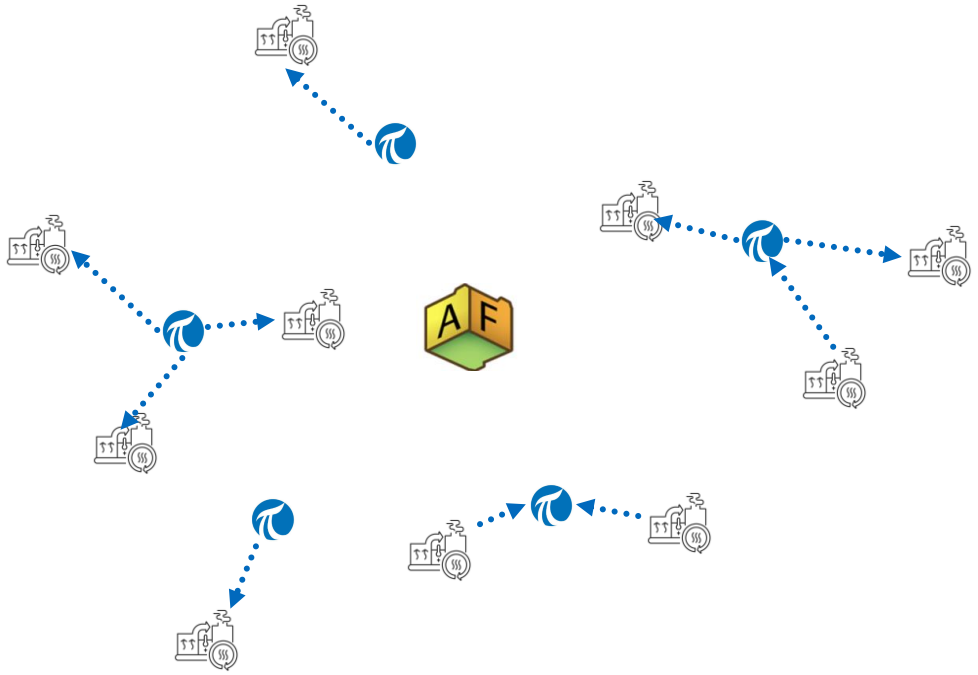
Plant Performance & Efficiency Department

Production plants and networks to be monitored

Aggregation of process data packages based on asset location and monitoring objectives.



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Asset Framework

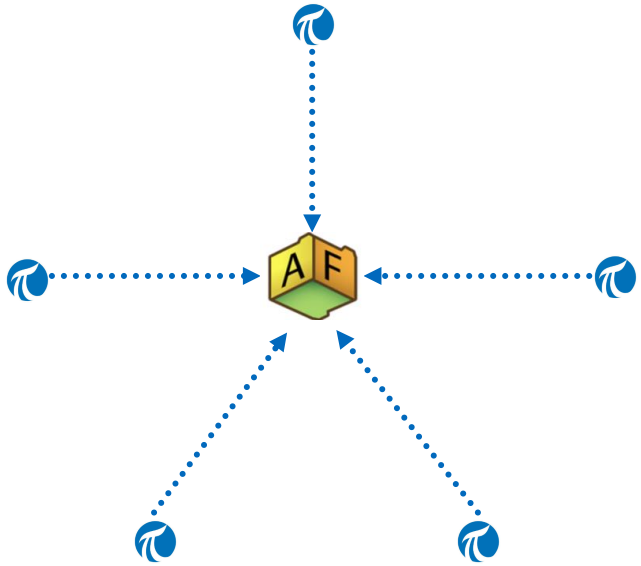
Plant Performance & Efficiency Department

AVEVA

Asset Framework

Production plants and networks to be monitored

Aggregation of process data packages based on asset location and monitoring objectives.



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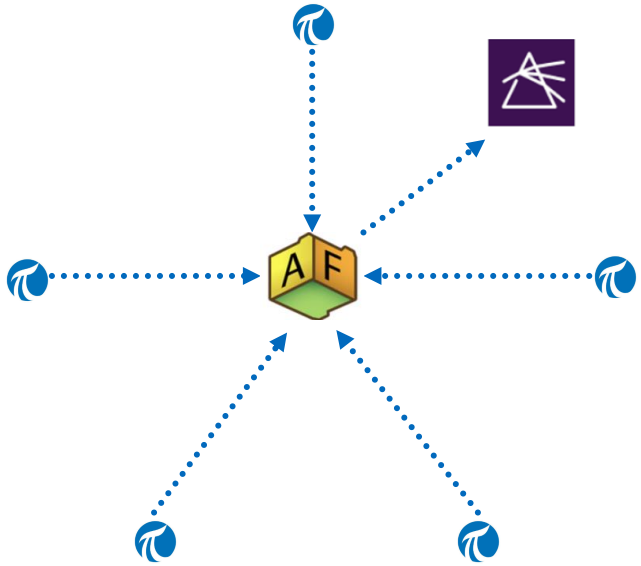
Predictive Analytics

Production plants and networks to be monitored

Aggregation of process data packages based on asset location and monitoring objectives.



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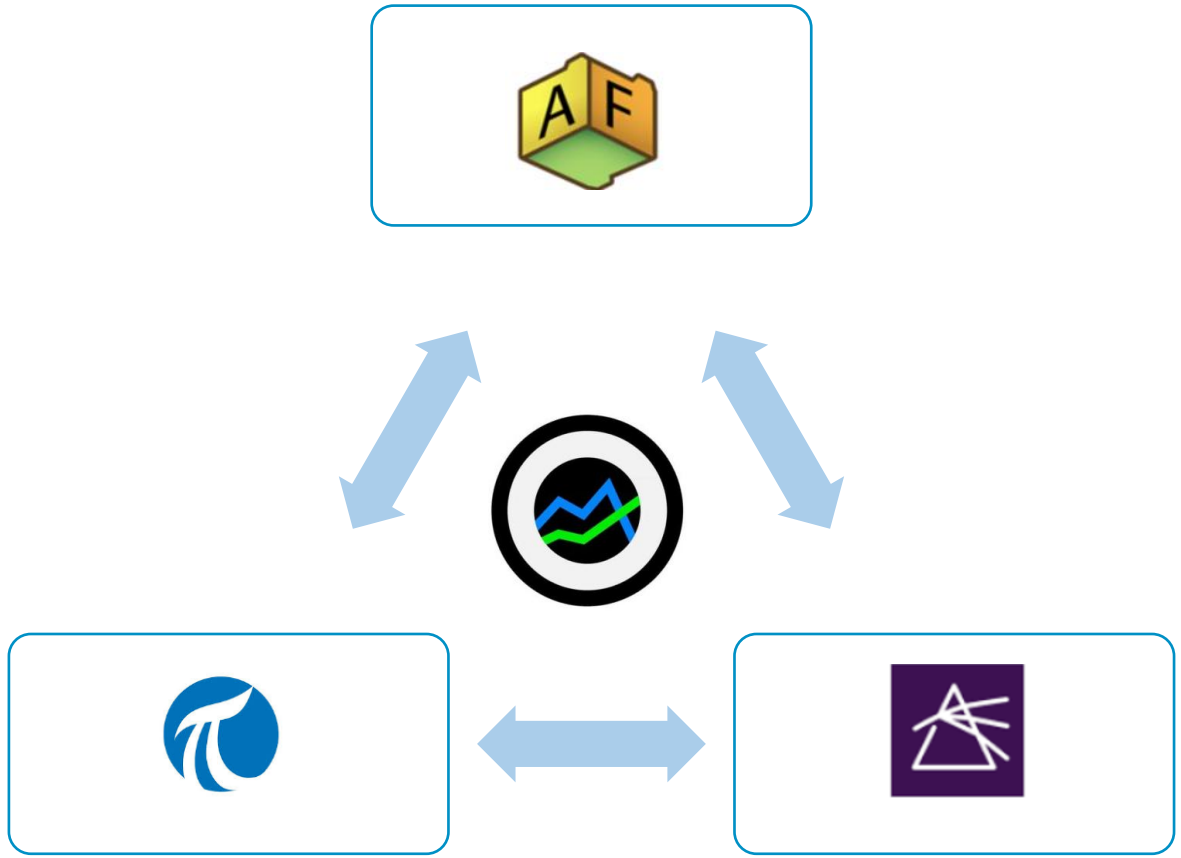
An Integrated Platform for Sharing and Exchanging Operational Data

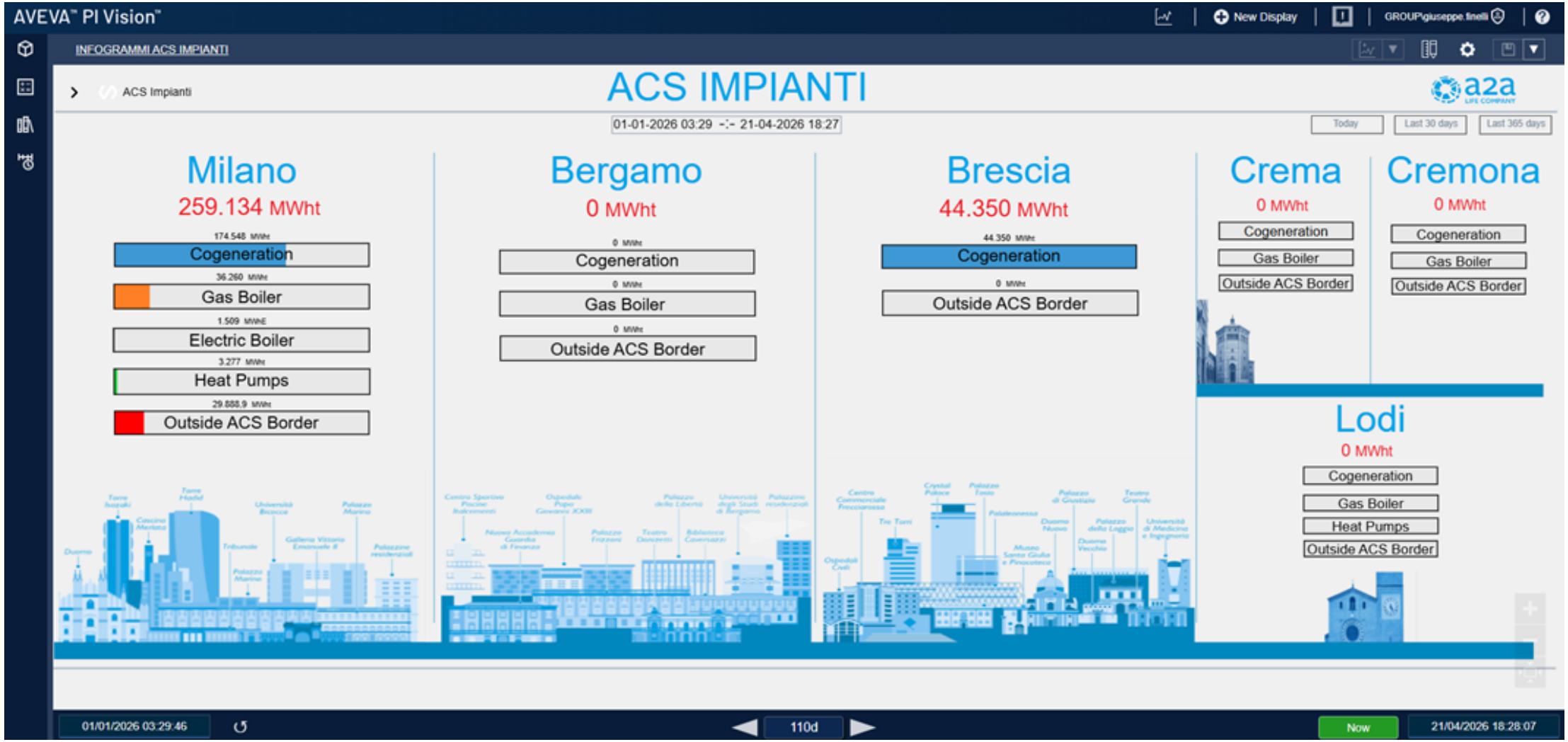
PI Vision as a unified dashboard platform

Bidirectional data flows:

- PI Server
- Asset Framework DB
- AVEVA Predictive Analytics

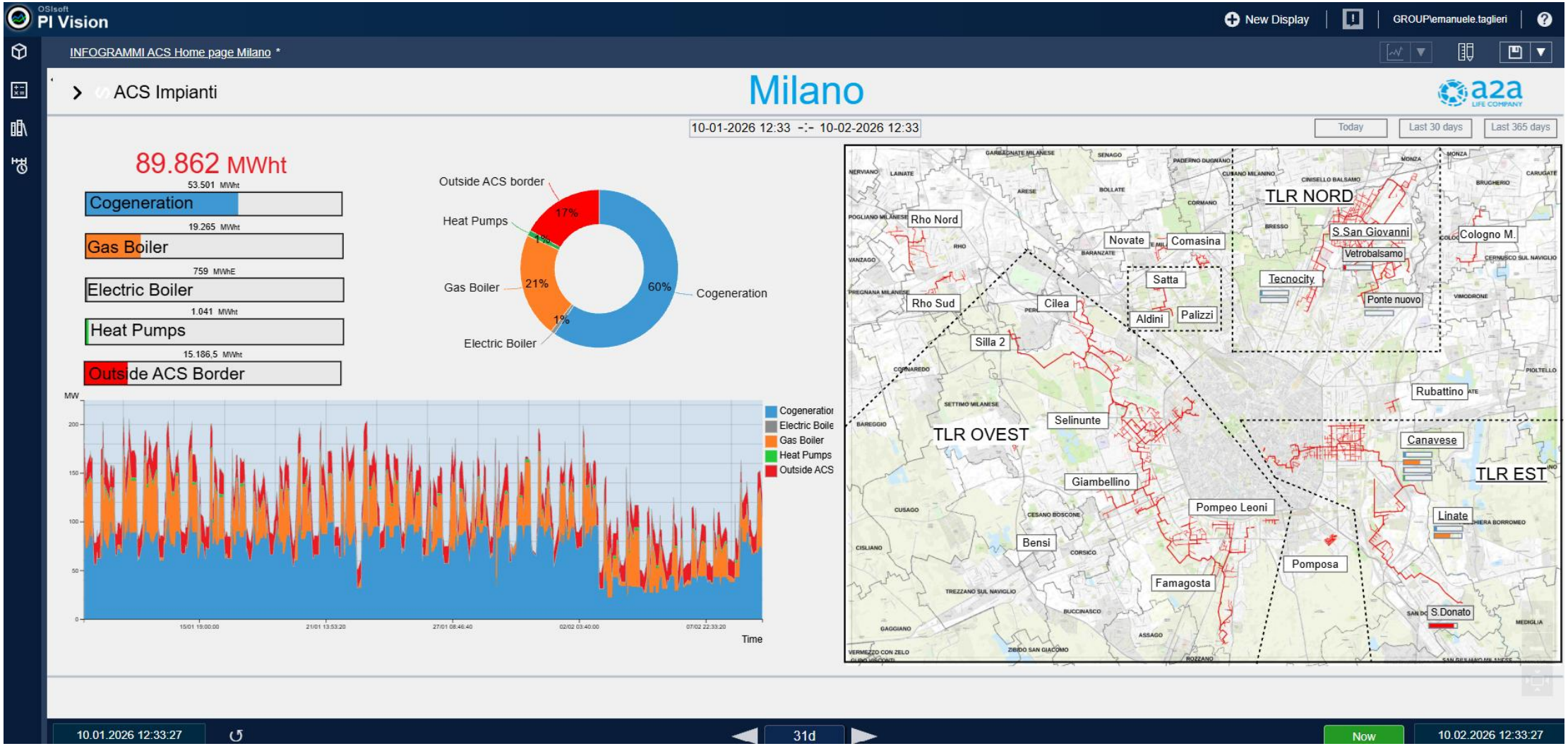


Our Concept - PI Vision for Integrated Data Sharing



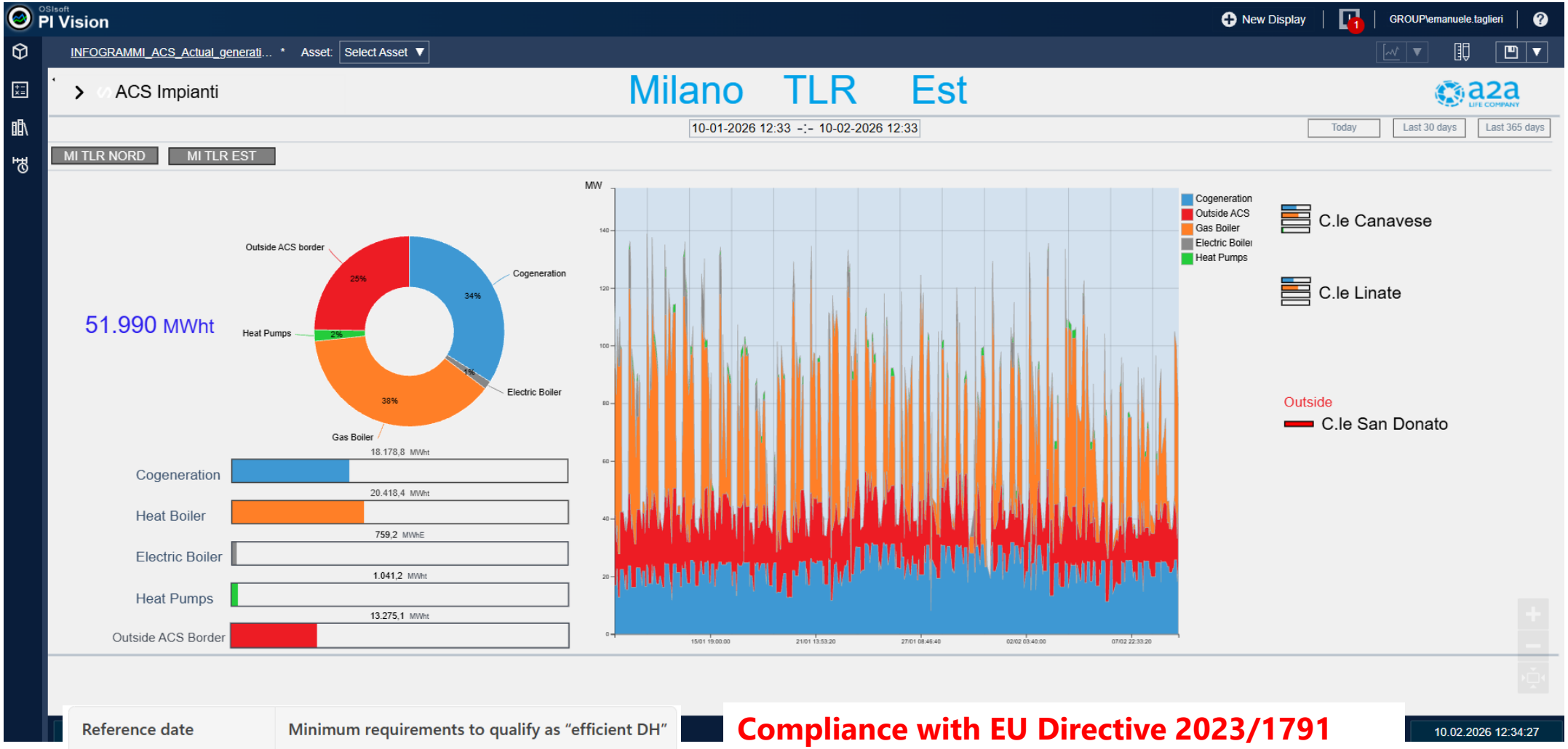
PI Vision dashboard – General overview DH networks in Milan area

Heat Production Mix Monitoring



PI Vision dashboard - Milano Est DH network

Heat Production Mix Monitoring



Reference date	Minimum requirements to qualify as "efficient DH"
from 1 January 2028	≥ 65% from RES / waste heat / CHP
from 1 January 2035	≥ 80%

Compliance with EU Directive 2023/1791 (energy efficiency in DH networks)

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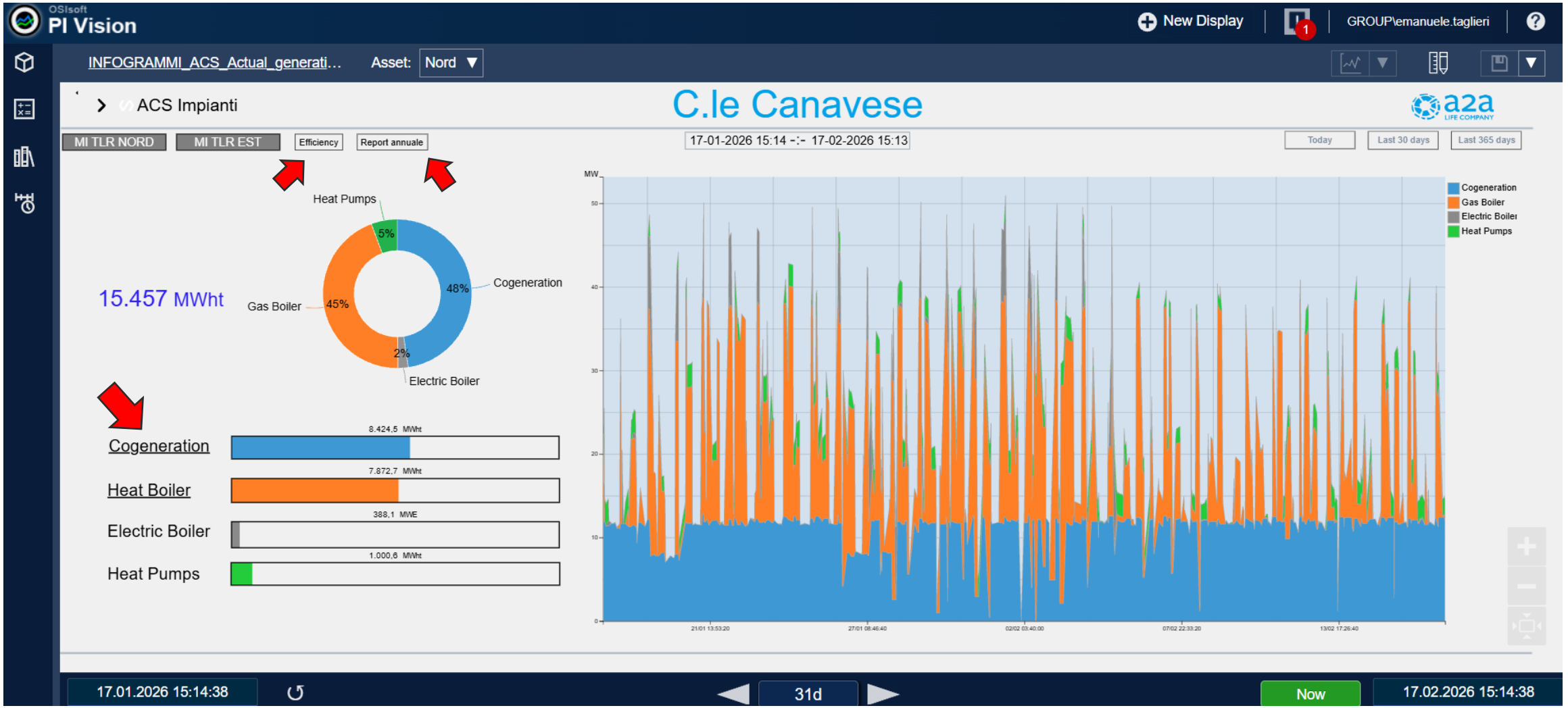
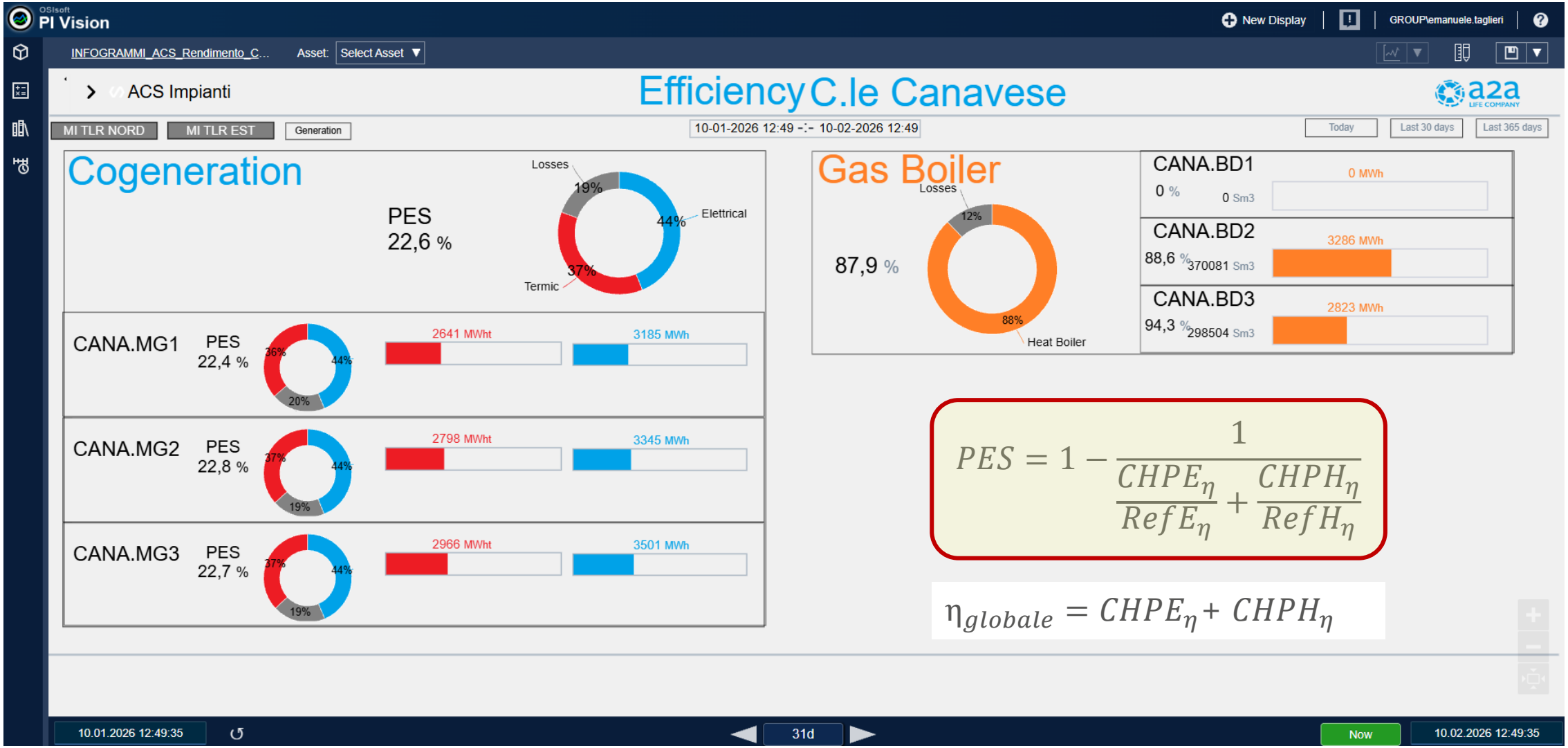
PI Vision dashboard - Milano Est - Canavese CHP

Cumulative Energy Production Overview, ICE, gas boilers, heat pumps



PI Vision dashboard - Milano Est - Canavese CHP

PES and energy efficiencies performance monitoring (ICE, gas boilers, heat pumps)



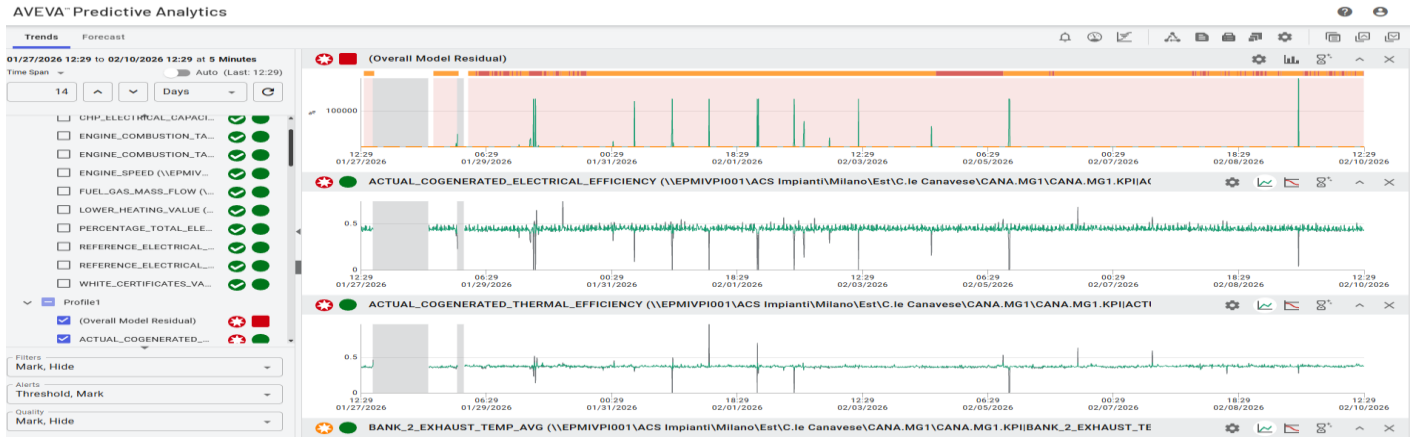
$$PES = 1 - \frac{1}{\frac{CHPE_\eta}{RefE_\eta} + \frac{CHPH_\eta}{RefH_\eta}}$$

$$\eta_{globale} = CHPE_\eta + CHPH_\eta$$

PI Vision - Milano Est - Canavese CHP

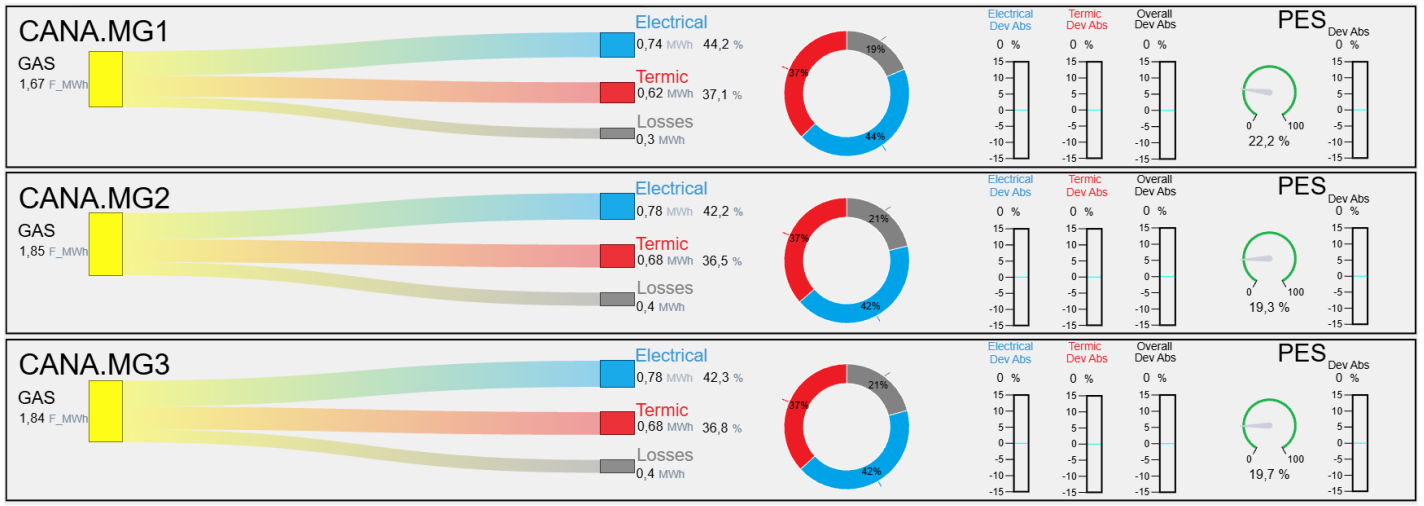
PI Vision Dashboard for Residual Visualization (Real time and Predicted)

AVEVA Predictive Analytics
Residual Visualization



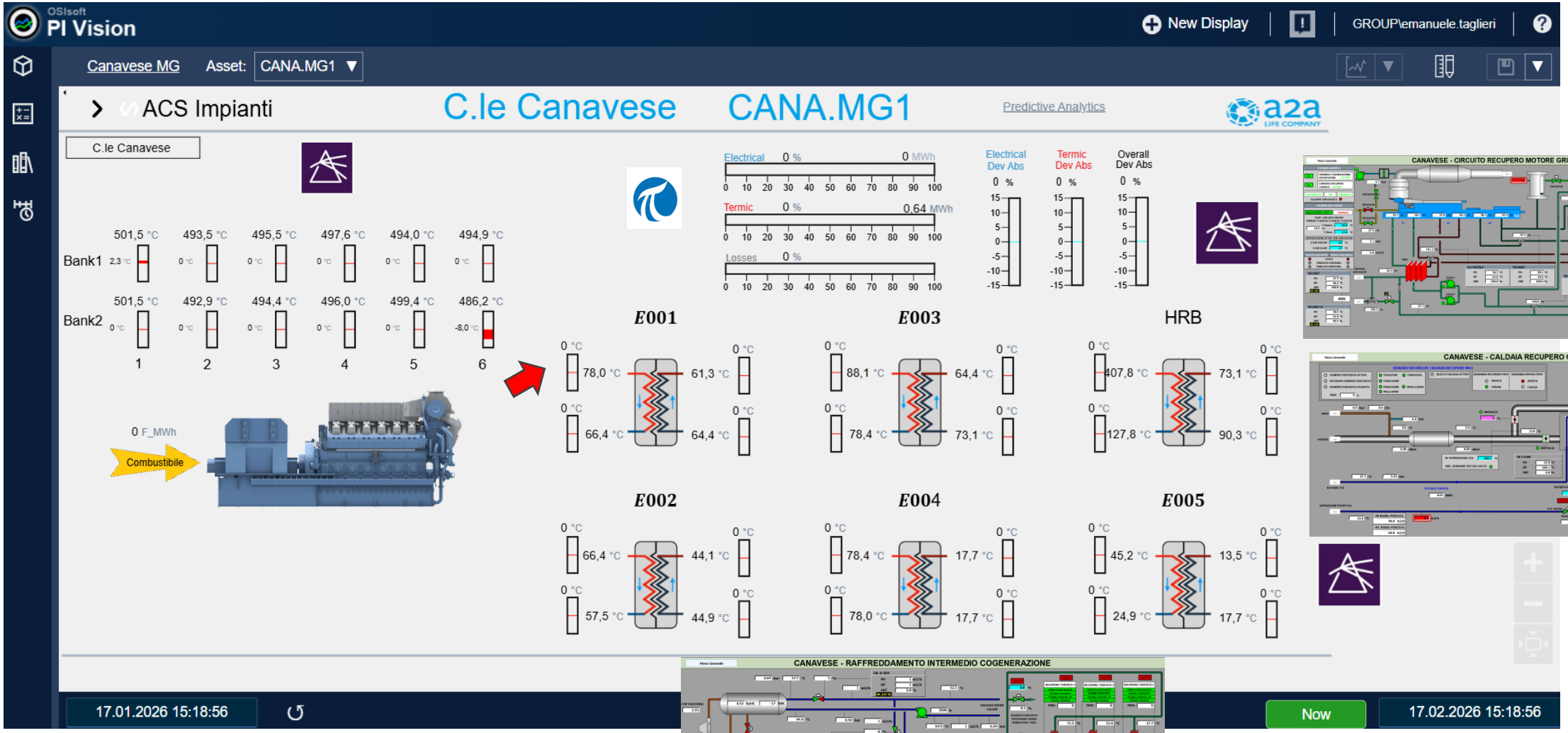
PI Vision
User-friendly Residual Visualization

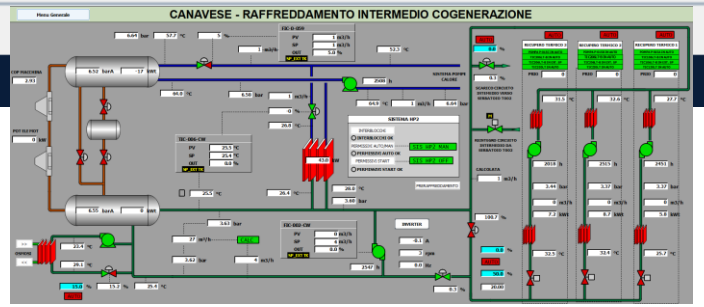
Real time comparison between actual and predicted performances



PI Vision maintenance dashboard - Milano Est - Canavese CHP

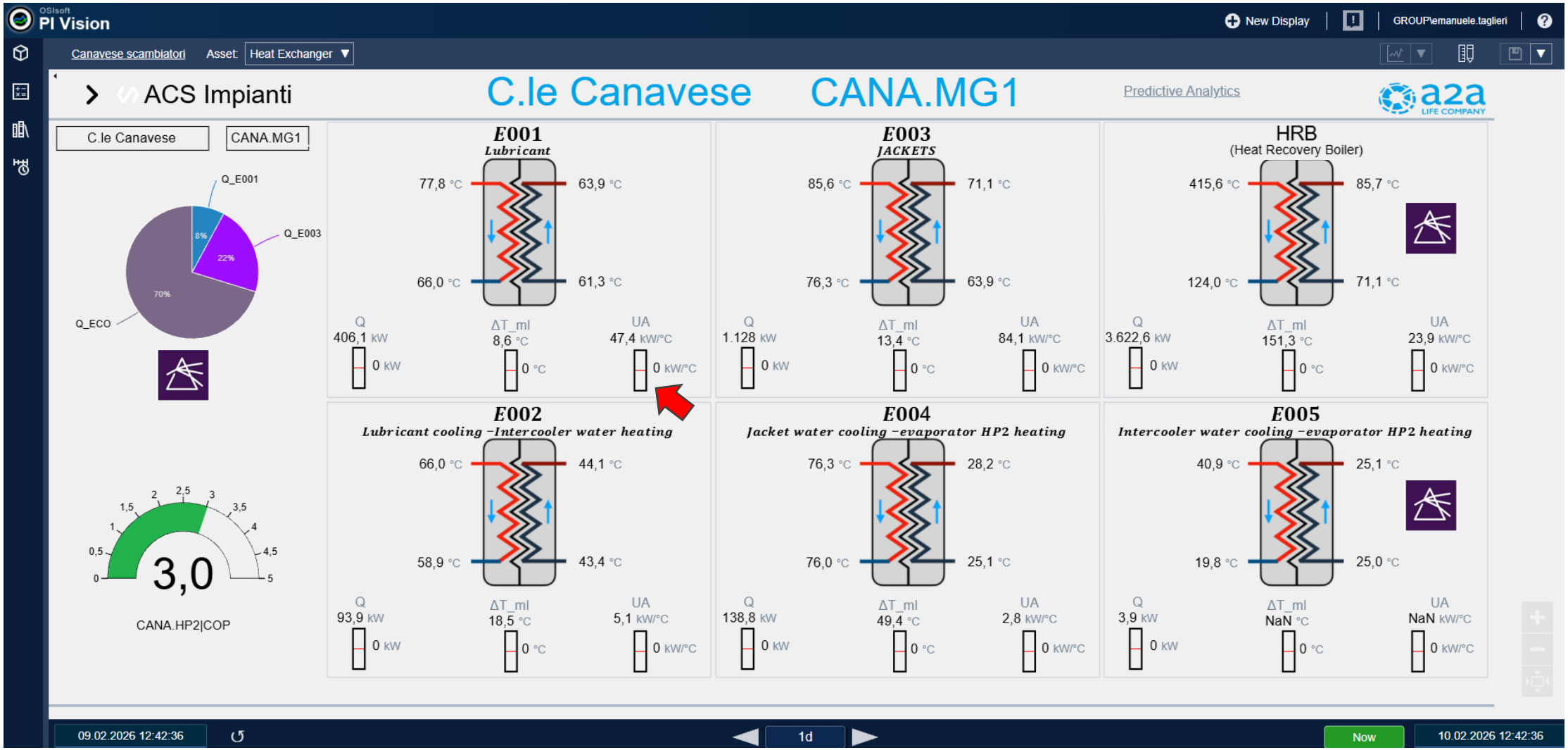
Residual Visualization (Real time and Predicted) for cylinders and heat exchangers





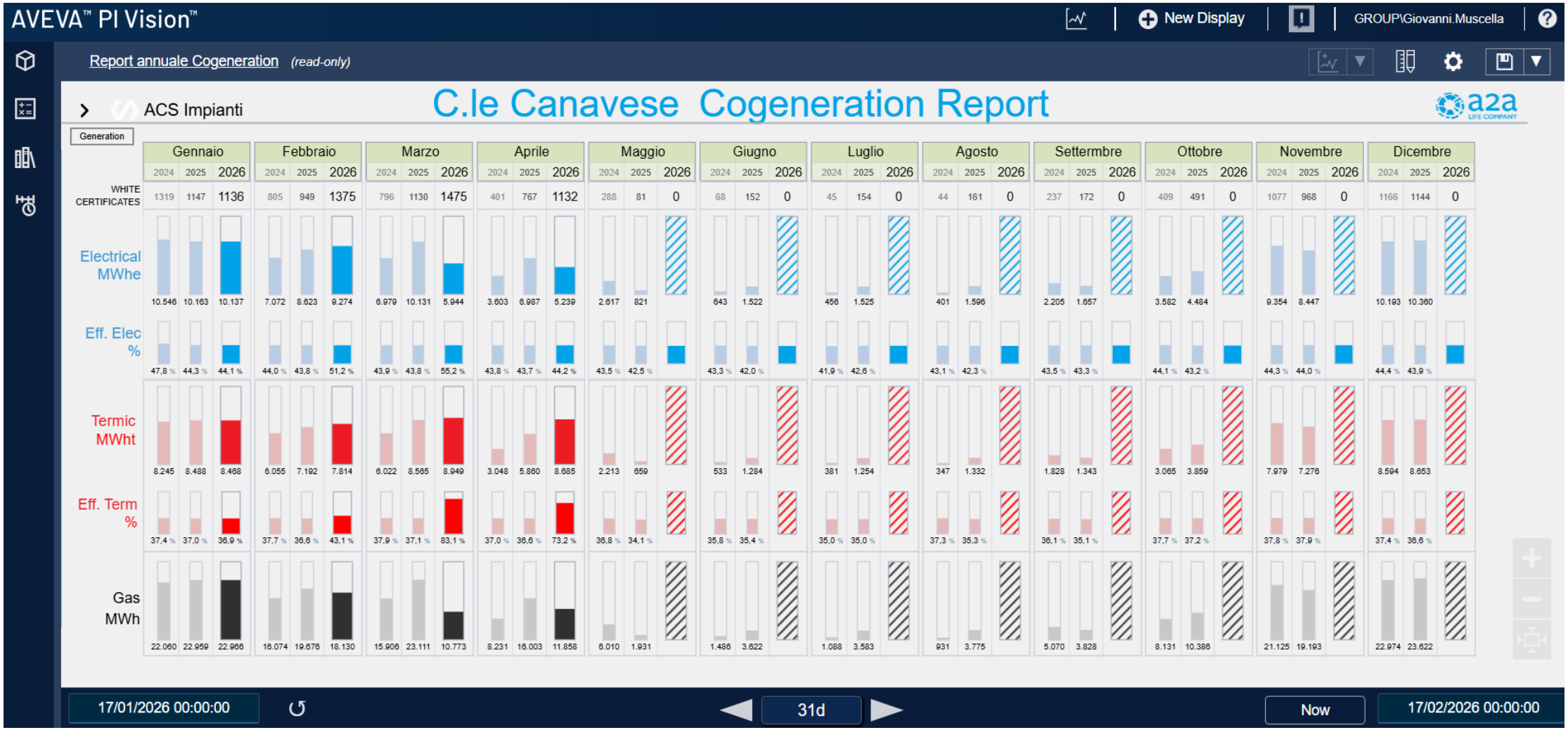
PI Vision maintenance dashboard - Milano Est - Canavese CHP & heat pump

ICE heat exchangers thermal efficiencies performance monitoring (residual analysis)



PI Vision performance dashboard - Milano Est - Canavese CHP

Monthly Energy Production and Efficiency Trends – YoY Comparison

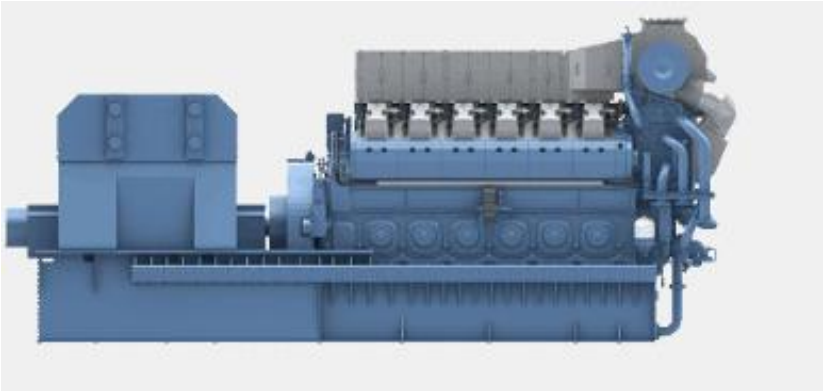


Milano Est - Canavese CHP MG1+2+3 – Economic impact of thermal efficiency

Dispatch priority based on impact of thermal efficiency on gross energy margin (fuel based).

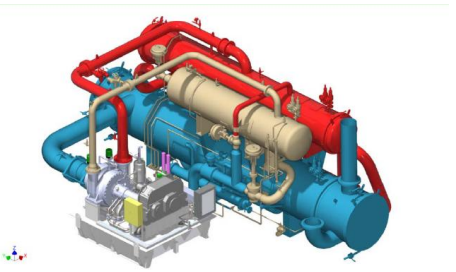
MG1+2+3 ICE: Variable economic input parameters

White certificates value [€/toe]	PUN [€/MWh,el]	TTF [€/MWh,t]	DH [€/MWh,t]
250	115	33,2	114,9



MG1+2+3 ICE: Variable economic output parameters

Electricity sales revenue [€/MWh,t]	Heat sales revenue [€/MWh,t]	Energy savings incentives revenue (White Certificates) [€/MWh,t]	Total revenues (energy sales + incentives) [€/MWh,t]	Natural Gas Cost [€/MWh,t]	Gross energy margin (fuel-based) [€/MWh,t]
137	115	25	277	90	186

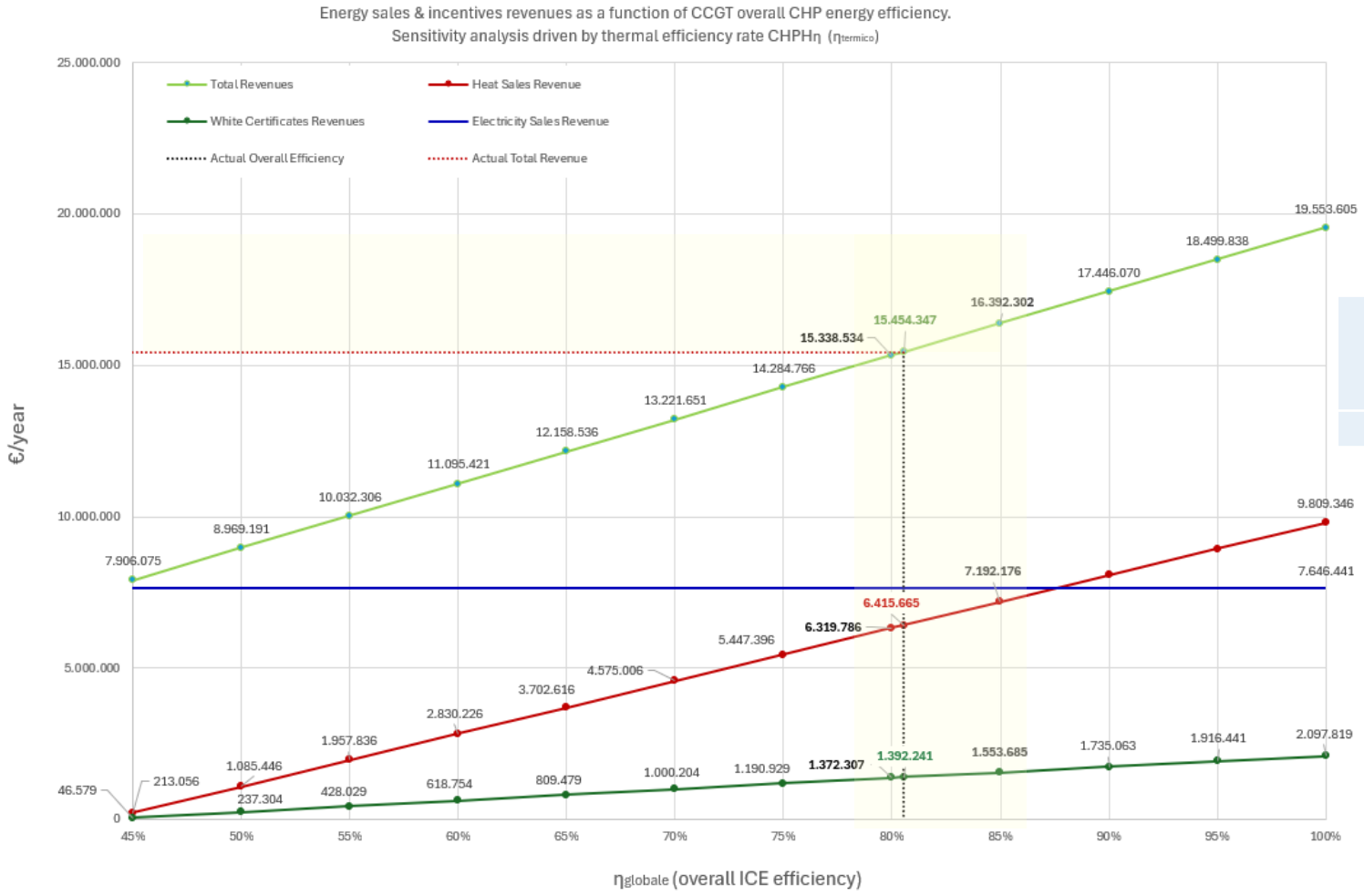


Definition of dispatch priority based on energy performance

	Natural Gas Cost [€/MWh,t]	Electricity sales revenue [€/MWh,el]	Electricity sales revenue (Lost electricity sales cost) [€/MWh,t]	Heat sales revenue [€/MWh,t]	Energy savings incentives (White Certificates) [€/MWh,t]	Total revenues (energy sales + incentives) [€/MWh,t]	Gross energy margin (fuel-based) [€/MWh,t]	Dispatch priority	Production gross margin loss due to CHP unavailability [€/MWh,t]
ICE	90	115	137	115	25	277	186	1	0
GAS-FIRED BOILER	37			115		115	78	2	-108
HEAT PUMP			-43	115		115	72	3	-114

Milano Est - Canavese CHP MG1+2+3 – Economic impact of thermal efficiency

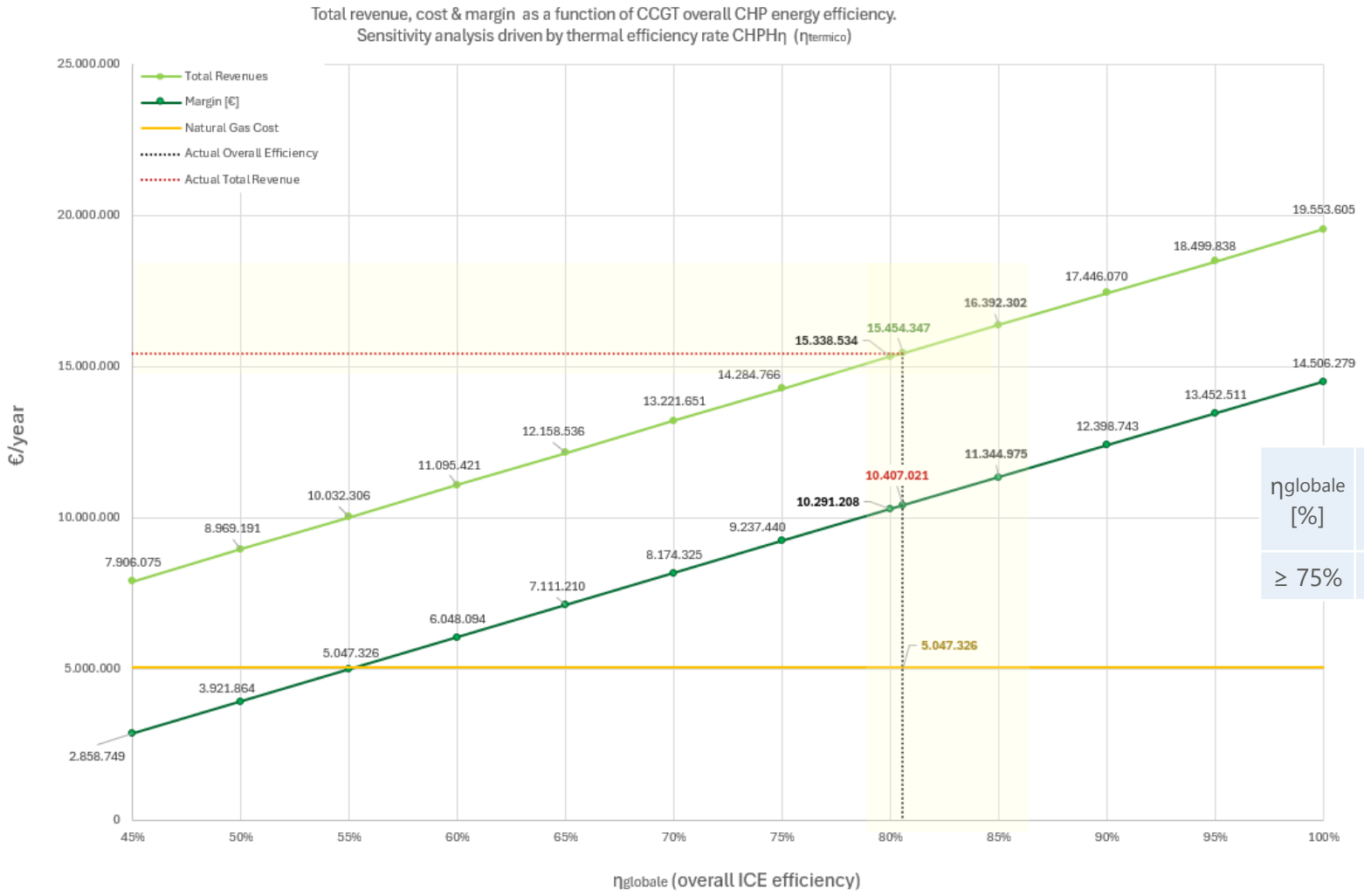
Revenues trends as a function of thermal efficiency



White certificates value [€/toe]	PUN [€/MWh,el]	TTF [€/MWh,t]	TLR [€/MWh,t]
250	115	33,2	114,9

ηglobale [%]	(ΔRISP/F)/Δηt [%]/[%]	**ΔTotal Margin for each Δηt=1% [k€]**	**Impact of Δηt=1% on Total Margin [%]**	ΔMargin Heat Sales for each Δηt=1% [k€]	ΔMargin Incentives (CB) for each Δηt=1% [k€]
≥ 75%	1,1	**211**	**2,0%**	174	36

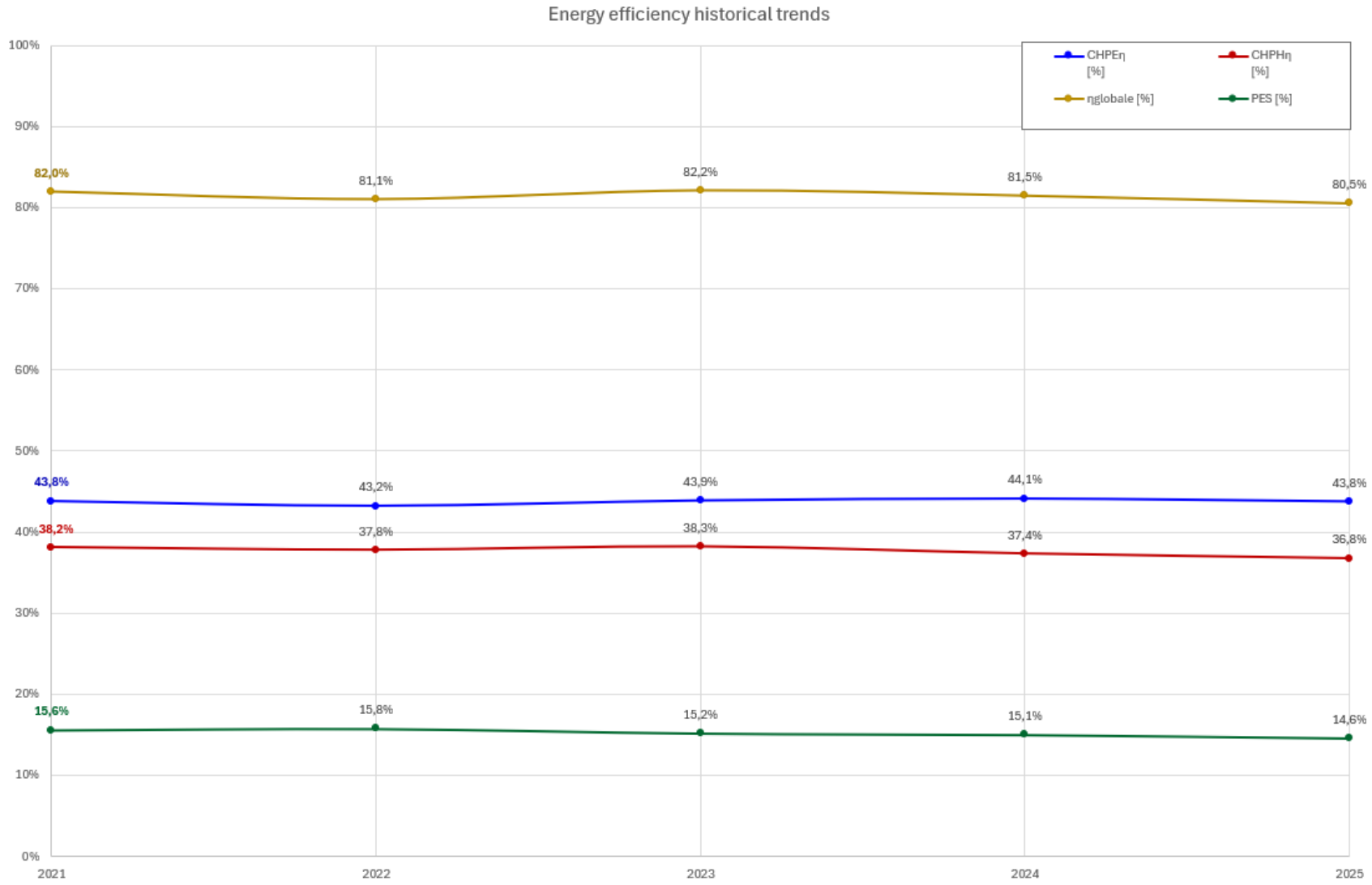
Canavese MG1+2+3 – Specific margin trend as a function of thermal efficiency



ηglobale [%]	ΔTotal Margin for each Δηt=1% [€/h]	ΔTotal Margin for each Δηt=1% [€/day (24h)]	**ΔTotal Margin for each Δηt=1% [k€/month (744h)]**
≥ 75%	48	1.150	**36**

ηglobale [%]	(ΔRISP/F)/Δηt [%]/[%]	**ΔTotal Margin for each Δηt=1% [k€]**	**Impact of Δηt=1% on Total Margin [%]**	ΔMargin Heat Sales for each Δηt=1% [k€]	ΔMargin Incentives (CB) for each Δηt=1% [k€]
≥ 75%	1,1	**211**	**2,0%**	174	36

Milano Est Canavese MG1+2+3 – Energy efficiency historical trends



	CHPEη [%]	CHPHη [%]
Max value	44,1%	**38,3%**
Min value	43,2%	36,8%
Deviation max 2021-2025	0,9%	**1,5%**
Last year value	43,8%	36,8%
Last year deviation	-0,35%	-0,60%
Deviation of last year value from the maximum	-0,35%	**-1,48%**
Estimated Gross Margin Loss [%]		**-3,0%**
Estimated Gross Margin Loss [€/MWh,t]		-5,6
Estimated Margin Loss [k€/year]		**-313**

Next step - Sesto Energia CCGT

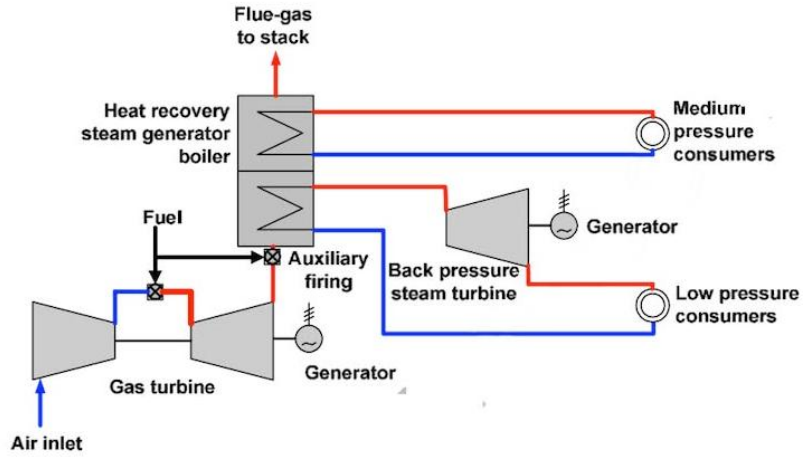
Definition of dispatch priority based on asset margin

Sesto Energia CCGT: Variable economic input parameters

White certificates value [€/toe]	PUN [€/MWh,el]	TTF [€/MWh,t]	TLR [€/MWh,t]
250	115	33,2	114,9

Sesto Energia CCGT: Variable economic output parameters

Electricity sales revenue [€/MWh,t]	Heat sales revenue [€/MWh,t]	Energy savings incentives revenue (White Certificates) [€/MWh,t]	Total revenues (energy sales + incentives) [€/MWh,t]	Natural Gas Cost [€/MWh,t]	Gross energy margin (fuel-based) [€/MWh,t]
107	115	16	238	85	153

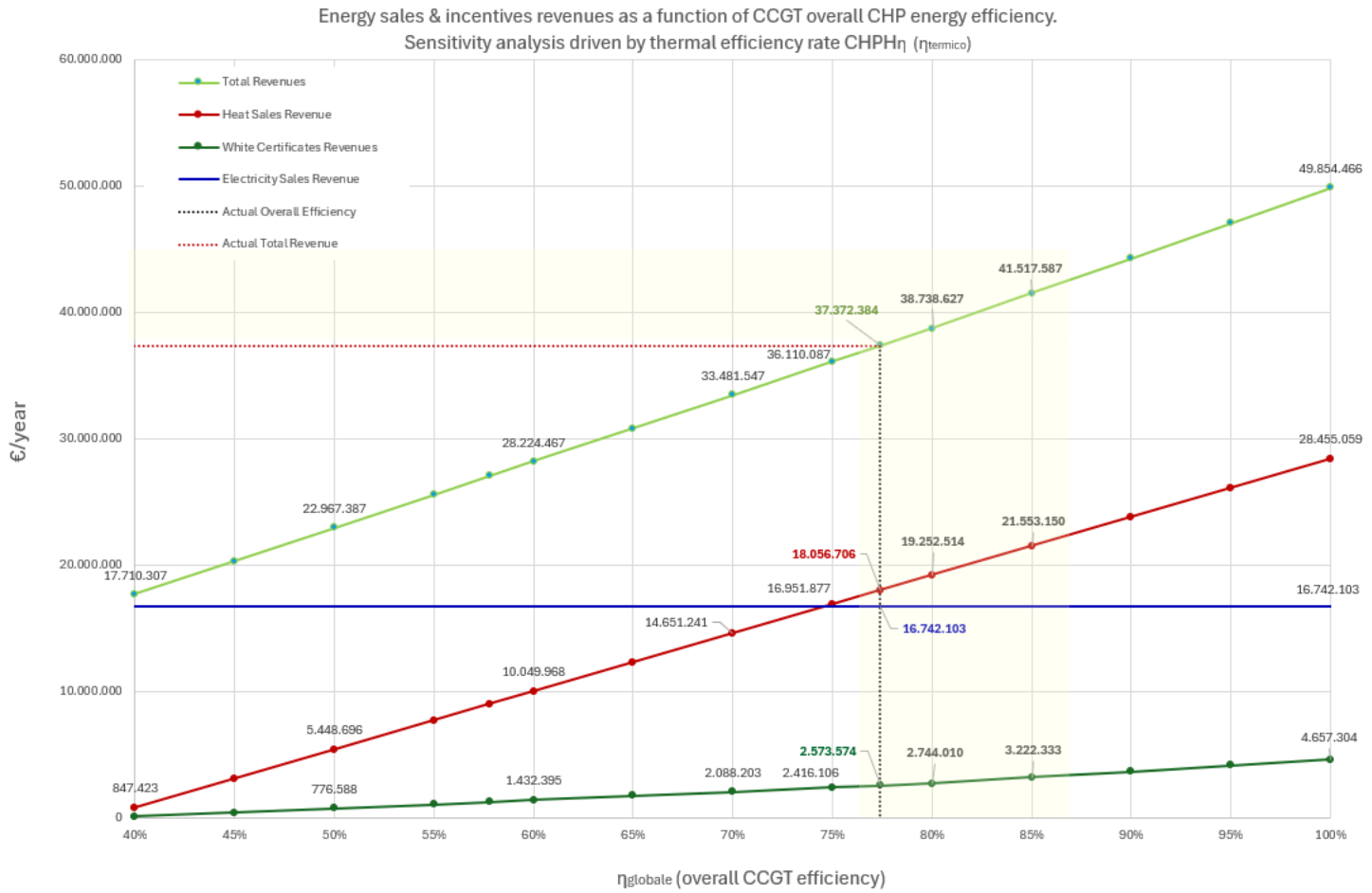


Definition of dispatch priority based on energy performance

	Natural Gas Cost [€/MWh,t]	Electricity sales revenue [€/MWh,el]	Electricity sales revenue (Lost electricity sales cost) [€/MWh,t]	Heat sales revenue [€/MWh,t]	Energy savings incentives (White Certificates) [€/MWh,t]	Total revenues (energy sales + incentives) [€/MWh,t]	Gross energy margin (fuel-based) [€/MWh,t]	Dispatch priority	Production gross margin loss due to CHP unavailability [€/MWh,t]
CCGT	85	115	107	115	16	238	153	1	0
GAS-FIRED BOILER	37			115		115	78	2	-75

Next step - CCGT Sesto Energia

Impact of thermal efficiency variations on margin



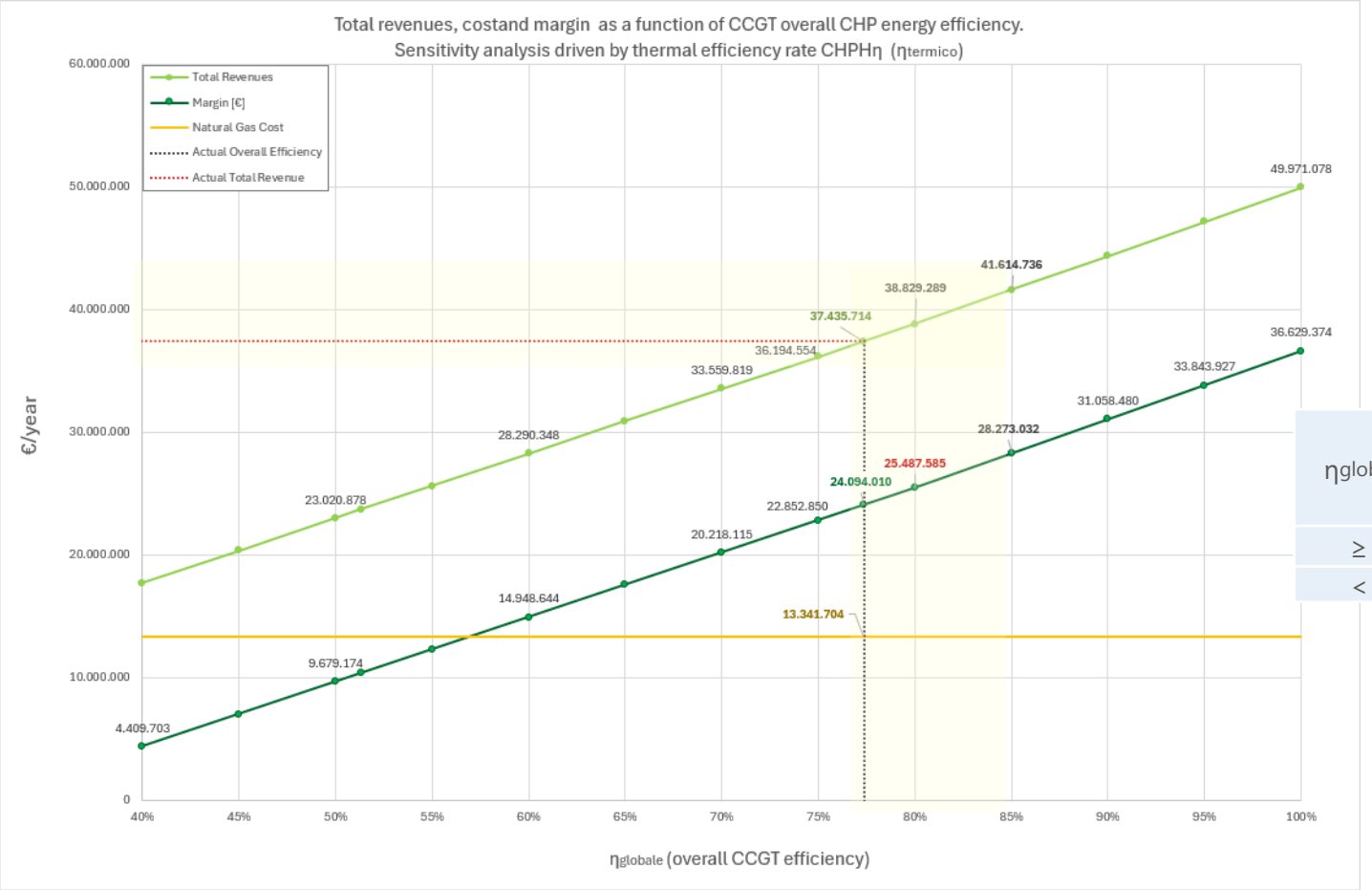
ηglobale [%]	(ΔRISP/F)/Δηt [%]/[%]	**ΔTotal Margin for each Δηt=1% [k€]**	Impact of Δηt=1% on Total Margin [%]	ΔMargin Heat Sales for each Δηt=1% [k€]	ΔMargin Incentives (CB) for each Δηt=1% [k€]
≥ 80%	1,1	556	2,2%	460	96
< 80%	0,8	**526**	2,2%	460	66

Variable economic input parameters

White certificates value [€/toe]	PUN [€/MWh,el]	TTF [€/MWh,t]	TLR [€/MWh,t]
250	115	33,2	114,9

Next step CCGT Sesto Energia

Specific margin trend as a function of thermal efficiency



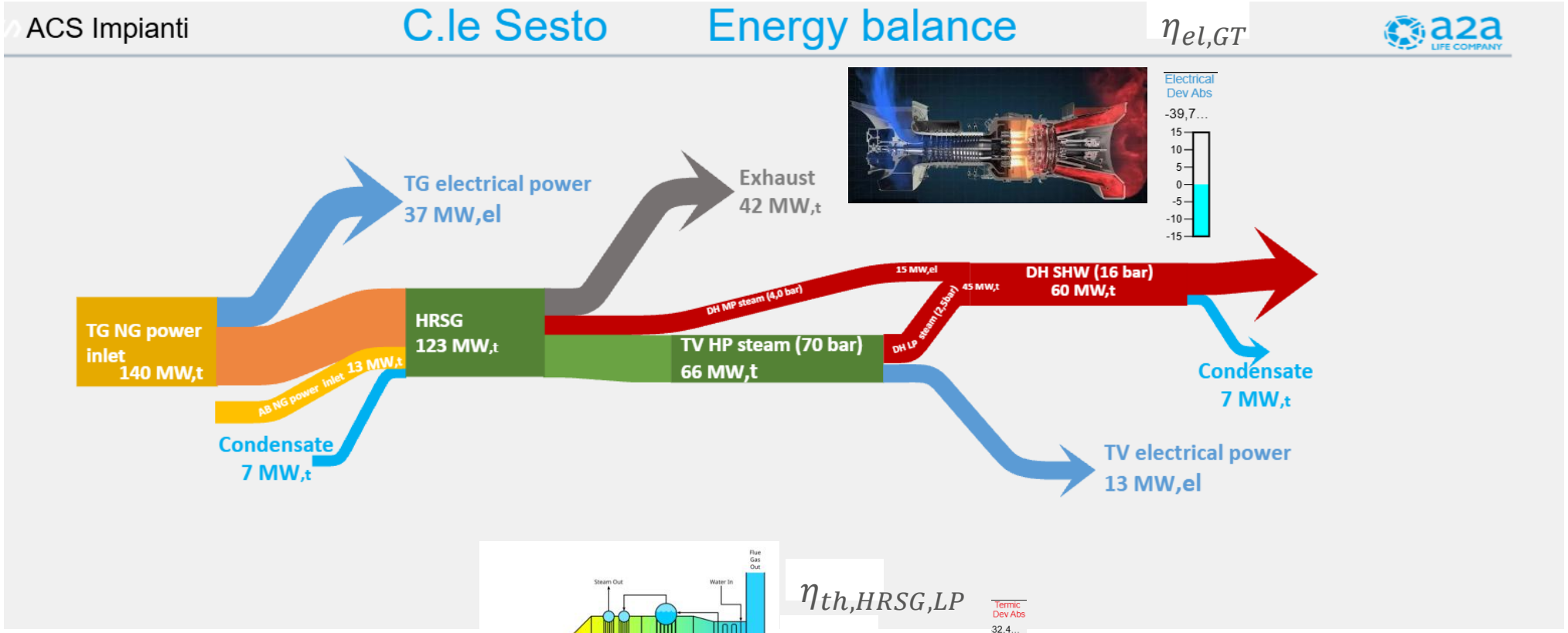
ηglobale [%]	ΔTotal Margin for each Δηt=1% [€/h]	ΔTotal Margin for each Δηt=1% [€/day (24h)]	**ΔTotal Margin for each Δηt=1% [k€/month (744h)]**
≥ 80%	163	3.904	121
< 80%	154	3.692	**114**

ηglobale [%]	(ΔRISP/F)/Δηt [%]/[%]	**ΔTotal Margin for each Δηt=1% [€/MWh,t]**	**Impact of Δηt=1% on Total Margin [%]**	ΔMargin Heat Sales for each Δηt=1% [€/MWh,t]	ΔMargin Incentives (CB) for each Δηt=1% [€/MWh,t]
≥ 80%	1,1%	3,3	2,2%	2,8	0,6
< 80%	0,8%	**3,3**	**2,2%**	2,9	0,4

Sesto Energia – Energy efficiency historical trends

	CHPEη [%]	CHPHη [%]
Max value	38,2%	**39,5%**
Min value	37,8%	39,2%
Deviation max historical	0,35%	0,3%
Last year value	37,8%	39,5%
Last year deviation	-0,35%	0,30%
Deviation of last year value from the minimum	-0,35%	0,30%
Estimated Margin Gain [%]		**0,66%**
Estimated Margin Loss [€/MWh,t]		1,0
Estimated Margin Gain [k€/year]		**160**

Next steps – CHP CCGT Performance Analysis – Case Sesto



$\eta_{el,GT}$

$\eta_{el,ST}$

$\eta_{th,HRSG,LP}$

$\eta_{th,HRSG,HP}$

$\eta_{th,HRSG}$

Summary & Conclusions

Achieved objectives:

This PI Vision dashboard concept addressed the following strategic objectives:

1. Sharing aggregated performance results by geographic area with **management**

2. Identification of asset inefficiencies across all DH and CHP assets with the information shared with **plant operational staff** to support timely corrective actions.

Next steps:

Progressive implementation of dashboards containing monitoring KPIs across the corporate plant portfolio.

Thank you for the attention

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