Hall 8/8-516
Thursday, 10th October 2024 - 15:00

CHILLVENTA

Chillventa Specialist Forums 2024
CSG Forum

CONNECTING EXPERTS.

New Technology in light of F-Gas 3.0

CENTRO STUDI GALILEO

Forum Agenda

- **Marco Buoni**, CSG – Technical Director| *Presentation of the* ***International Special Issue 2024*** *and moderation of the event*
- **Joachim Dallinger**, Epta Deutschland, Country Marketing Manager| *"The Future of Refrigeration: the EPTA vision for an Innovative and Sustainable approach to the industry"*
- **Gianluca Lillo** , General Gas Kryon, R&D Project Engineer | *"Internet Of Things for Commercial Refrigeration: the case study"*

Q&A time *at the end of the presentations*

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Presentation of the International Special Issue 2024

Marco Buoni
CSG – Technical Director

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International Special Issue – ISI 2024 : Empowering RACHP Workforce for the Future Transition

- Joint pubblication ***UNEP, IIR, AREA, CSG*** under the auspices of ***Italian Ministry for Environment and Energy Safety***
  - ***10° edition***: published since 2006
- Topic: strengthening the RACHP workforce for the future challenges of the sector
- Forewords by the Italian Minister of Env. , UNEP, IIR & CSG
- ***24 sector-specific articles*** about current exploitable and available technologies
- Contributions from global associations, institutions, (AREA, AHRI, ASHRAE, ISHRAE, EPEE, FAIAR, U-3ARC, …)
- Distributed at International Events (MOP, COP, Chillventa, etc)

Topics

- New European, American and global regulation to phase down or out HFCs; EU's F-Gas regulation,
- Achieving energy efficiency through refrigerant and cooling transition; preparations for Kigali Implementation Plans (KIPs),
- Global Cooling Pledge, MEPS (Minimum Energy Performance Standards), National Cooling Plans,
- Start of HFCs phase down in Art. 5 Countries,
- Low-GWP RAC technologies for high ambient temperature regions,
- Low-GWP and energy efficient refrigeration and air conditioning technology,
- Refrigeration and air conditioning standards and codes,
- Illegal trade in ozone depleting and high global warming refrigerants,
- Heat pumps,
- Women in RAC.

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Thank you for your attention

Marco Buoni
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The Future of Refrigeration: the EPTA vision for an Innovative and Sustainable approach to the industry

Joachim Dallinger
Epta Deutschland,
Country Marketing Manager

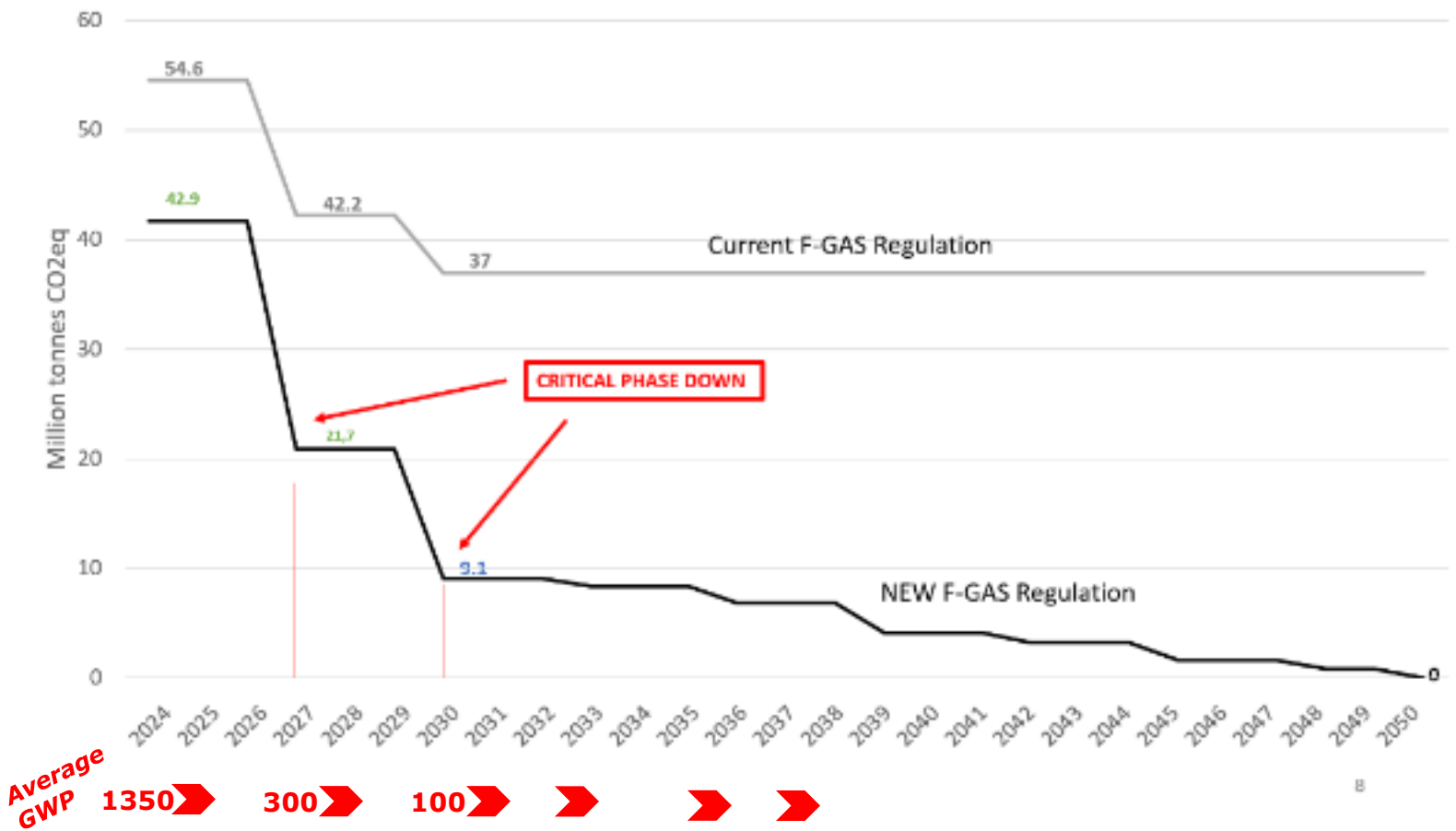
Epta

REGULATION (EU) 2024/573

F-GAS REGULATION REVISION:
INDUSTRY WANTS MORE AMBITION

THE PHASE DOWN OF QUOTAS

The new F-Gas introduces for the first time the **complete elimination** of the consumption of hydrofluorocarbons (HFCs) by 2050



Years	Maximum Quantity in tonnes CO_2 equivalent
2025 – 2026	***42 874 410***
2027 – 2029	***21 665 691***
2030 – 2032	9 132 097
2033 – 2035	8 445 713
2036 – 2038	6 782 265
2039 – 2041	6 136 732
2042 – 2044	5 491 199
2045 – 2047	4 845 666
2048 – ***2049***	4 200 133
2050 onwards	***0***

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REFRIGERATION PRODUCT PROHIBITIONS

Domestic refrigeration : GWP<150 from 2015; Stop F-gas from 2025

Refrigerators and freezers for commercial use (self-contained) : GWP<150 from 2025

Multipack centralised refrigeration systems for commercial use with a rated capacity of 40 kW or more : GWP<150 from 2022

All stationary refrigeration equipment : GWP<150 from 2030

All the traditional HFCs (R448A, R449A, R134a, etc.) prohibited in 2030

Only NATURAL REFRIGERANTS and A2L (midly flammable) remain

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SERVICING WITH F-GASES

Servicing or maintenance : The use of F-gases with

- GWP≥750 for stationary refrigeration equipment from 1 January 2032
- GWP≥2500 for air-conditioning equipment and heat pumps from 1 January 2026

is prohibited, with an exemption for reclaimed or recycled.

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THE PFAS ISSUE

Per- and polyfluoroalkyl substances (PFAS) are a group of approx. 10.000 man-made chemicals that are used in a variety of industries due to their sealing, temperature and pressure resistance, low friction properties.

"Forever chemicals" are very persistent in the environment and in the human body – meaning they don't break down and they can accumulate over time.

The majority of F-gases are or degrade in PFAS as well as their potential breakdown product called TFA (Trifluoracid) - few exceptions (R32, R152a, R23, R1132)

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DRIVERS FOR THE CHOICE OF THE REFRIGERANT OPTIONS

1. Investment cost

Life-cycle cost for the consumer (upfront and running costs)

2. Standards & Legislation

S&L includes bans, taxes and voluntary agreements

3. Complexity

Complexity of manufacturing and operating the product

4. Risk Awareness

Perceived and actual risk of using the product

5. Market Readiness

Market competence in safe adoption of the new technologies

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NATURAL REFRIGERANTS

100% of Epta's solutions portfolio with natural refrigeration

Integral solution
with natural refrigerant and best in class energy performance

Plug-in with natural refrigerant specifically designed for F&B segment

Remote CO_2 cabinet
with proprietary full glass door design

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RAC Genius Pro Internet of Things for Commercial Refrigeration: the Case Study

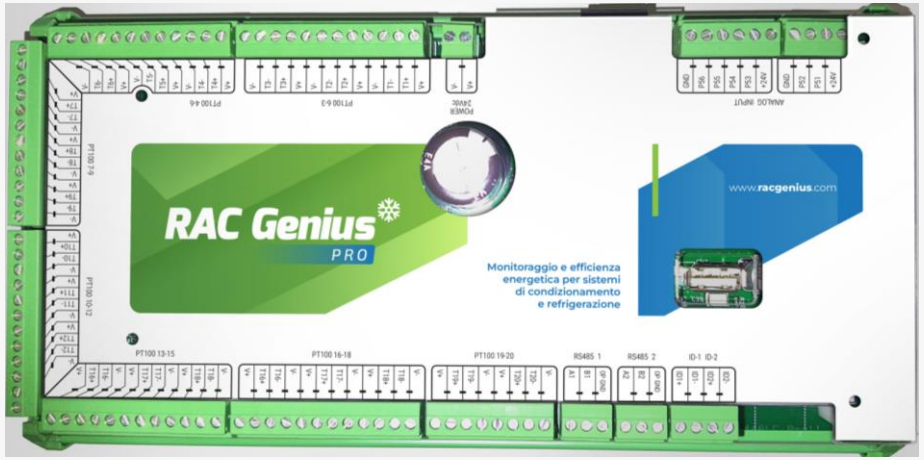
Gianluca Lillo
General Gas Kryon, R&D Project Engineer

GeneralGas PASSIONATELY COOL

KRYON B-BRAZE G-TEC

Description

Rac Genius Pro is a hardware and software system that measures and **enhances the performance** of HVAC-R system through the I.o.T. technology. It monitors operational parameters, evaluates efficiency, and provides recommendations for adjustments to improve performance, achieve **energy savings**, and **reduce environmental impact**.



How's made

- Switchboard with advanced electronic control board – internet connected
- Cloud web service for remote and real-time monitoring of the plant
- High-precision measuring transducers: Temperature – Pressure - Power meter

Key advantages

The Rac Genius Pro **plant monitoring** system offers real-time measurement and control of critical parameters such as temperatures, pressure levels, and energy consumption. It continuously evaluates system performance, tracks important parameters, **detects deviations**, suggests **energy optimization** strategies, **recommends maintenance** actions, and reduces operational costs while improving sustainability and system reliability.

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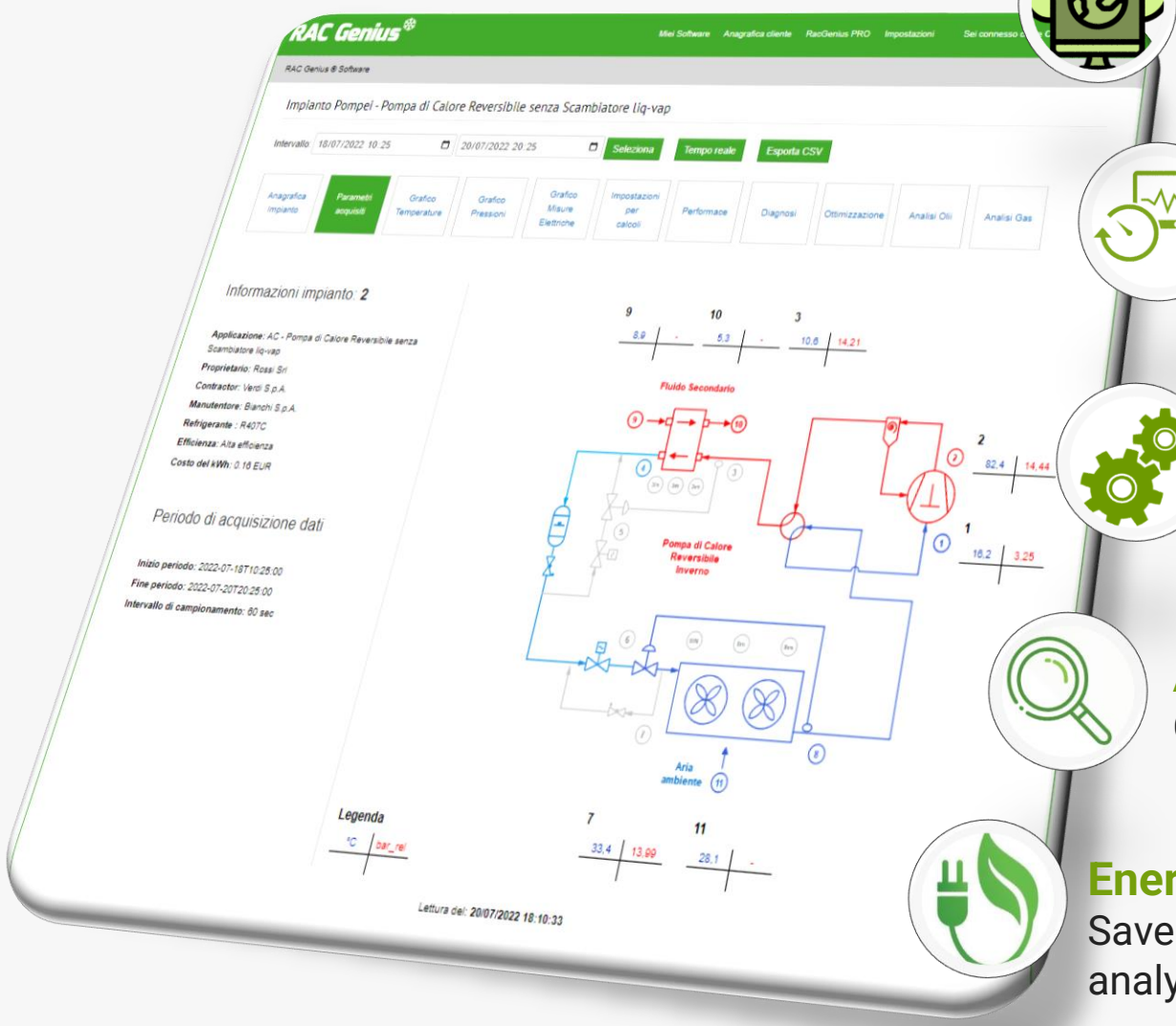
Main features



Remote access

Control your plant wherever you are, via our web portal

Real-time monitoring

Monitor your system's performance in real-time

Non-invasive installation

No need to hold on the system for installation

Advanced diagnosis

Quickly find the causes of any malfunctions

Energy optimization

Save energy and money with real-time performance analysis

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R.G. Pro: Supermarket installation essentials

Temperature sensors

A 4-wire RTD temperature sensor compensates for wire resistance, providing **precise measurements** for **long cable runs**. Insulated with Magnesium Oxide, it ensures **reliability in harsh environments**.

Temperature sensors are installed in crucial locations: suction line; discharge of each compressor; condenser outlet; outside ambient

Pressure sensors

Piezoresistive sensors, 4-20 mA output signal. Provides reliable pressure readings. Pressure sensors are installed on the low and high pressure sides.

Current transformers

A 333 mV secondary output CT measures AC by converting high primary current to a lower voltage signal. It has an accessible core for easy installation without circuit disconnection. Connected to an energy meter, it accurately measures energy consumption in residential, commercial, and industrial settings.

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Rac Genis Pro & Solstice L40X in the Supermarket

Components List:

Temperature transducers: MT line

➢ n. 7 pt100 A class 4 wires (2 suction, 2 discharge, 1 receiver discharge, 1 condenser

discharge, 1 outside ambient)

Pressure transducers

➢ n. 2 rated 0 - 40 barg (low and high pressure side)

Current transformers:

➢ n. 3 for each compressor + n. 3 for whole power plant current → a total of 9 CT

The MT & LT Arneg plant main features

✓ Condensers: Modine model EGK 912EL4B4, 54 kW capacity, rated @ 50 °C (mid temp), PED group 1

✓ LT rack: n. 1 Bitzer model 4DES-5Y, tot capacity 5 kW, rated @ -35 / + 50°C (mid temp)

✓ MT Rack: n. 2 Frascold model Q7-36.1Y, tot capacity 32 kW rated @ -10 / + 50°C (mid temp)

✓ Electronic control: Dixell

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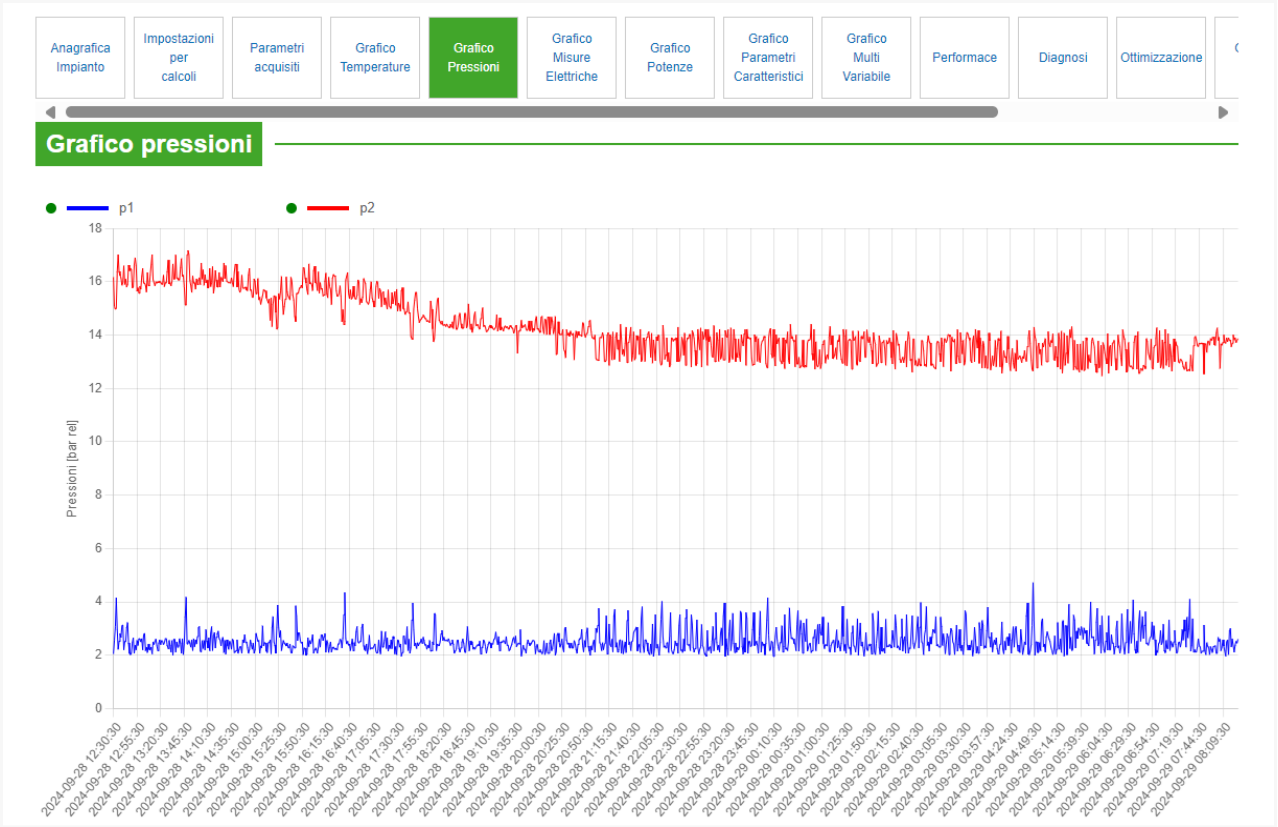
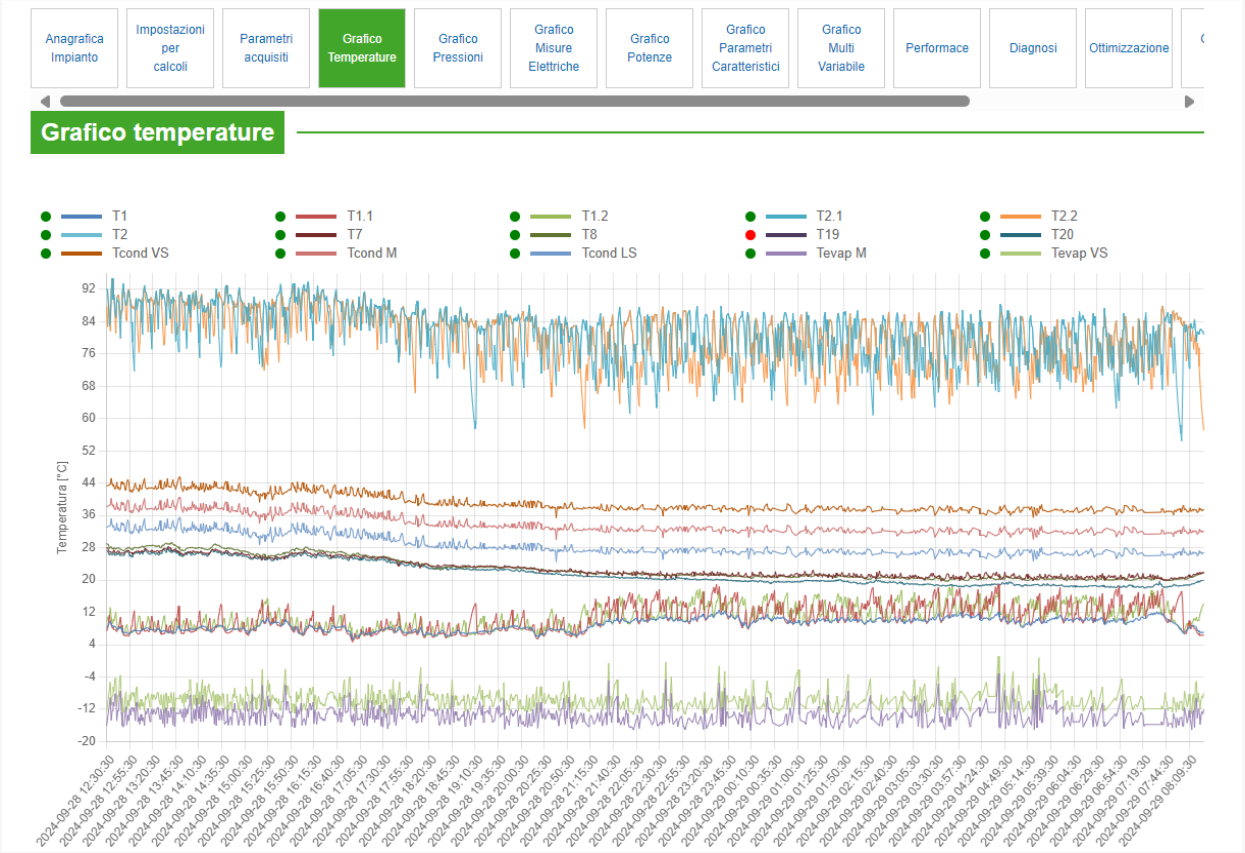
Stripcharts: Temperatures & Pressures

Continuously monitoring the pressures and temperatures on the key points of the system can build a base of datas that can be analyzed by the A.I. algorithm developed in the Cloud server. Stripcharts will be available for long time for further analysis





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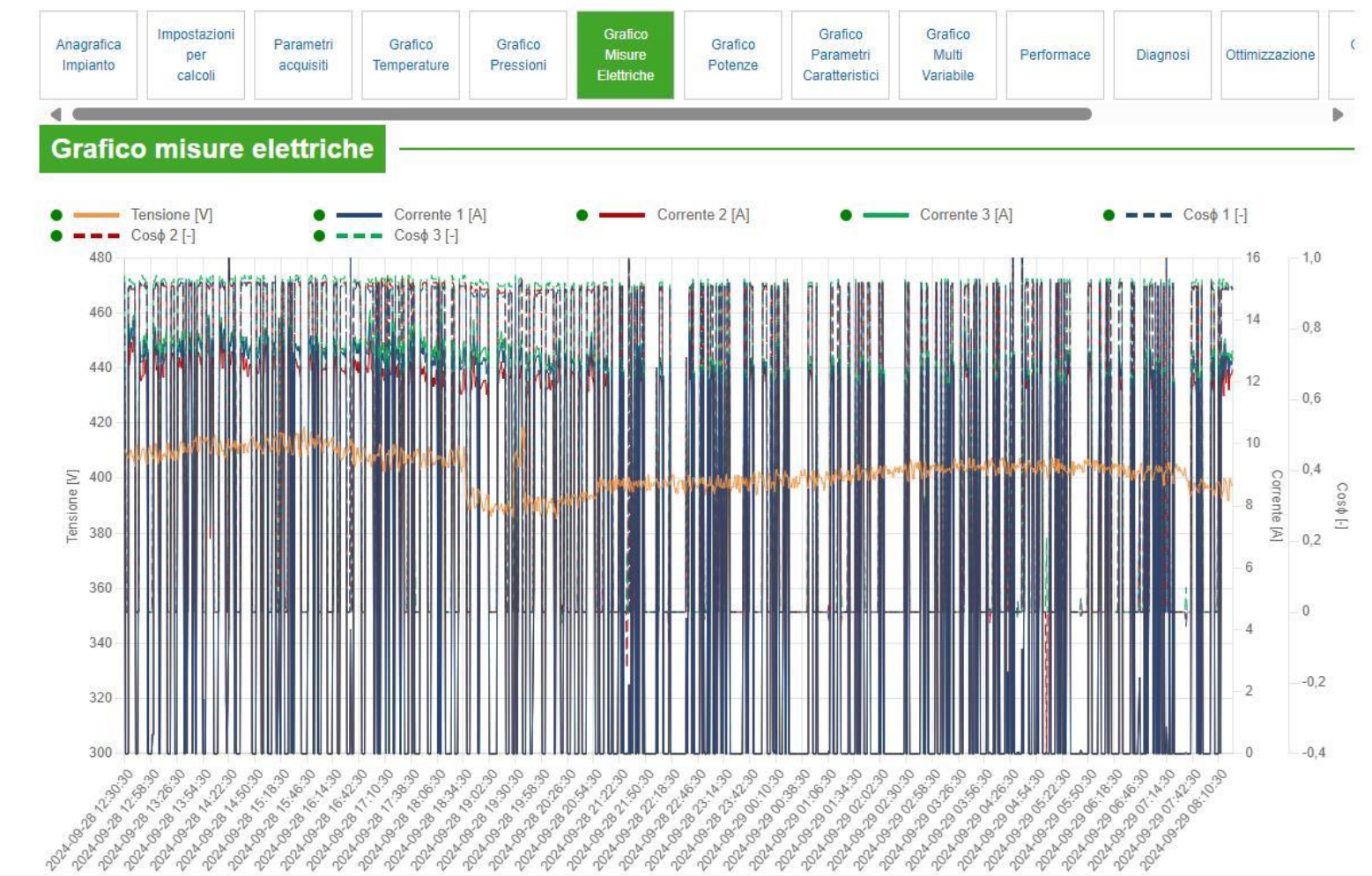
Stripcharts: Currents and Voltages



Measured quantities

- System supply voltage
- Current drawn by the individual phases
- Phase shift angle of the individual phases

Quick detection of the phase shift in the feed

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Plant Analysis– Performance Summaries

- Analysis of on/off times
- Analysis of the operating time at steady state
- Summary of thermal/electrical energies in the analysis period
- Evaluation of the average thermal/electrical power in the analysis period
- COP Assessment
- Calculation of average evaporation/condensation temperatures
- Calculation of average DTs
- Subcooling calculation
- Calculation of overheating
- Compressor efficiency calculation

4. Parametri di funzionamento *This values are only exemplary, not referred to specific application

	Valori misurati			Valori limiti	
	Medio	MIN	MAX	MIN*	MAX*
T evaporazione [°C]:	-13,5	-17,2	-4,7		-8,0
T condensazione [°C]:	34,5	30,0	39,4		
T aria ambiente [°C]:	23,2	18,2	27,1		
ΔT condensatore [°C]:	11,3				10,0
Sottoraffreddamento [°C]:	5,3	2,2	7,9	2,0	5,0
Surriscaldamento passivo [°C]:	11,5	5,2	16,7		10,0
Glide evaporatore [°C]:	7,6				
Glide condensatore [°C]:	10,5				
Portata totale massica media del compressore [kg/h]:	590	123	1.410		
Portata massica media del compressore 1 [kg/h]:	486	0	1.079		
Portata massica media del compressore 2 [kg/h]:	494	0	994		
Efficienza isoentropica compressione [%]:	66,2%	53,7%	87,6%		
Efficienza isoentropica compr 1 [%]:	69,8%	56,8%	159,2%		
Efficienza isoentropica compr 2 [%]:	70,4%	55,9%	117,4%		

1. Durata periodo di analisi *This values are only exemplary, not referred to specific application

	Periodo di analisi		
	sec	ore	%
Durata periodo di analisi:	71.520	19,87	
Durata compressore ON:	50.460	14,02	71%
Durata compressore OFF:	21.060	5,85	29%
Durata compressore a regime nel periodo ON:	26.040	7,23	52%
Durata compressore a regime nel periodo di analisi:			36%

Comparison with optimal values
Out-of-range alerts

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Plant Analysis– Diagnosis & Optimization

- Database with the main causes of malfunction:
  - Charge Level
  - Thermostatic valve condition
  - Suction insulation
  - Heat exchanger status
  - Undersized heat exchangers

Real-time diagnosis of possible malfunctions

Maintenance Intervention Suggestion

Energy Optimization Index

*This values are only exemplary, not referred to specific application

Diagnosi

Possibile malfunzionamento	Durata malfunzionamento (h)	Durata malfunzionamento (% sul tempo a regime)		Azione suggerita
Circuito Sottocaricato:	0,00	0%		
Circuito Sovracaricato:	3,90	54%	Possibile	Scaricare il circuito
Coibentazione tubazione aspirazione non sufficiente:	5,47	76%	Possibile	Aumentare la coibentazione della tubazione di aspirazione
Efficienza volumetrica del compressore scarsa:	3,90	54%	Possibile	Sostituire il compressore (nel caso in cui il surriscaldamento utile sia maggiore del valore massimo accettabile)
Presenza aria nel circuito:	3,90	54%	Possibile	Sostituire la carica di refrigerante con Refrigerante di buona qualità (nel caso in cui il surriscaldamento utile sia minore del valore minimo accettabile)
Condensatore sporco:	7,12	98%	Possibile	Pulire il condensatore
Condensatore sottodimensionato:	7,12	98%	Possibile	Sostituire il condensatore

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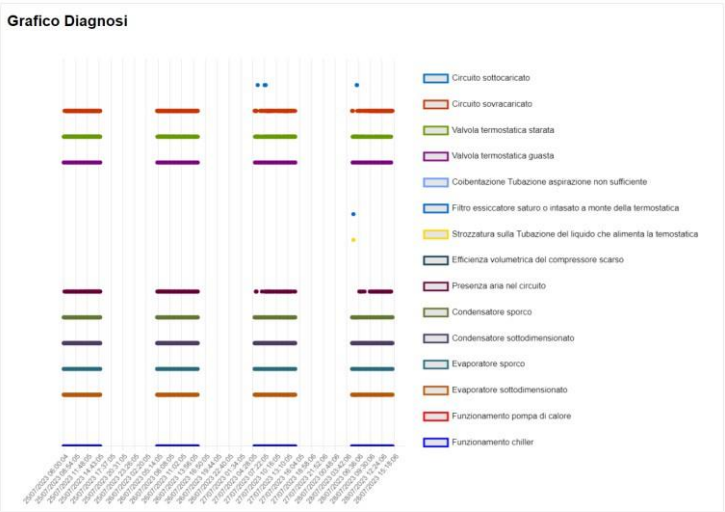

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Scelta parametri da ottimizzare

☐ Sottoraffreddamento ☐ Surriscaldamento utile ☐ Surriscaldamento passivo ☑ ΔT Evaporatore ☑ ΔT Condensatore ☐ Rendimento compressore

Ottimizzazione chiller

Parametri da ottimizzare	Funzionamento attuale	Ottimizzazione Globale	ΔT condensatore	ΔT evaporatore	Sottoraffred.	Surr. utile	Surr. passivo	Compressore	Ottimizzazione Utente	Ciclo Teorico
Temperatura media dell'aria ambiente [°C]:	26,3	26,3	26,3	26,3	26,3	26,3	26,3	26,3	26,3	26,3
Temperatura di condensazione [°C]:	42,1	34,3	34,3	42,1	42,1	42,1	42,1	42,1	34,3	34,3
ΔT condensatore [°C]:	15,8	8,0	8,0	15,8	15,8	15,8	15,8	15,8	8,0	8,0
Temperatura media del fluido secondario [°C]:	11,1	11,1	11,1	11,1	11,1	11,1	11,1	11,1	11,1	11,1
Temperatura di evaporazione [°C]:	2,0	6,1	2,0	6,1	2,0	2,0	2,0	2,0	6,1	6,1
ΔT evaporatore [°C]:	9,1	5,0	9,1	5,0	9,1	9,1	9,1	9,1	5,0	5,0
Sottoraffreddamento [°C]:	4,3	3,0	4,3	4,3	3,0	4,3	4,3	4,3	4,3	3,0
Surrisc. Utile [°C]:	2,9	5,5	2,9	2,9	2,9	5,5	2,9	2,9	2,9	5,0
Surrisc. Passivo [°C]:	-0,3	4,0	-0,3	-0,3	-0,3	-0,3	4,0	-0,3	-0,3	0,0
Rendimento compressore [%]:	70,82	75,00	70,82	70,82	70,82	70,82	70,82	75,00	70,82	100,00

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COP_rafr:	3,79	5,80	4,84	4,35	3,74	3,79	3,70	4,02	5,68	7,91
Energia elettrica assorbita dal compressore [kWh]:	390,27	255,30	305,64	340,25	395,24	390,49	400,23	368,53	260,47	187,11
Potenza elettrica assorbita dal compressore [kW]:	12,39	8,10	9,70	10,80	12,55	12,40	12,71	11,70	8,27	5,94
Costo energia elettrica assorbita dal compressore [€]:	62,44 €	40,85 €	48,90 €	54,44 €	63,24 €	62,48 €	64,04 €	58,96 €	41,68 €	29,94 €
Risparmio economico nel periodo di analisi [€]:	€	21,59 €	13,54 €	8,00 €	-0,79 €	-0,03 €	-1,59 €	3,48 €	20,77 €	0,00 €
Risparmio economico orario [€/ora]:	€	0,69 €	0,43 €	0,25 €	-0,03 €	-0,00 €	-0,05 €	0,11 €	0,66 €	1,03 €
Risparmio economico annuo [€]:	€	6.005,30 €	3.765,50 €	2.225,77 €	-220,96 €	-9,62 €	-443,19 €	967,53 €	5.775,27 €	9.039,77 €
Indice di Ottimizzazione Energetica [%]:	47,1 %	100,0 %	80,3 %	66,7 %	45,2 %	47,1 %	43,2 %	55,7 %	98,0 %	126,7 %
Potenza di Riscaldamento generata al Condensatore [kW]:	56,09	65,88	58,69	64,18	55,49	56,18	56,24	55,40	67,05	63,29
Potenza di Raffreddamento generata all'Evaporatore [kW]:	46,98	58,07	51,28	55,29	46,39	47,00	45,89	46,98	60,15	59,35
Variazione % della durata del funzionamento dell compressore/i [%]:	119,1 %	100,0 %	111,7 %	104,8 %	120,1 %	119,1 %	121,0 %	119,1 %	96,4 %	97,8 %

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Grazie per l'attenzione!

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