Cassandra

ARG-BLC1 / Industrial partner brief

Industrial cooling. Clearer decisions.

Turn operating measurements into understandable engineering evidence.

A clearer view of performance. A stronger basis for action.

ARG-BLC1 brings temperature, pressure, flow and electrical input into a reviewed engineering context. It helps teams examine changing efficiency, investigate unusual component behaviour and evaluate forecasts against later measurements.

Understand performance

Compare efficiency under relevant load and environmental conditions, rather than treating every change as a fault.

Focus the investigation

See the measurements behind an indicator, the plausible explanations and the next checks that could distinguish them.

Evaluate improvement

Review forecast error, data coverage and a simple reference before accepting a new model or operating conclusion.

The workflow

- **Observe**
- **Interpret**
- **Predict**
- **Verify**
- **Review**

Current scope: engineering pilot and decision support for equipment profiles that have been assessed. Customer deployment, diagnostic performance and benefits require asset-specific validation. HET-B1 for heating systems is under development.

From measurements to meaning.

A useful analysis starts with the right signals, their definitions and the conditions in which the machine is operating.

Signal group	Typical parameters	What it supports
Water or process temperatures	Evaporator inlet / outlet; condenser inlet / outlet, °C	Temperature difference and heat-transfer context.
Refrigerant pressures	Evaporator and condenser, bar with gauge / absolute basis declared	Pressure-related operating conditions; saturation context for the correct refrigerant.
Flow	Evaporator flow, m^3/h; other flows if reported	Cooling calculation and low-flow investigation. Verify fluid composition.
Electrical input	Power, kW; period energy, kWh; auxiliaries separately when available	Efficiency denominator, loading and meter-boundary checks.
Cooling output	Reported cooling power / energy, or a labelled water-side estimate	Useful cooling delivered; compare output and input over matching periods.
Compressor and site context	Individual compressor power, pump state, ambient temperature; other status signals if available	Operating state and changing conditions. Do not infer missing channels as measurements.

Efficiency needs a clear boundary.

Period cooling EER = total cooling energy / total electrical energy.
Both energies use the same period and agreed meter boundary. In kW/kW convention, EER is a dimensionless ratio; cooling COP can use the same ratio. Heat-recovery COP has a different useful-heat boundary and must be identified separately.

When cooling energy is not measured, a water-side estimate can use flow, inlet / outlet temperature difference and verified fluid properties. Estimated and measured quantities remain distinguishable. Period efficiency is an energy-weighted ratio, not the simple average of row-by-row ratios.

First check the evidence.

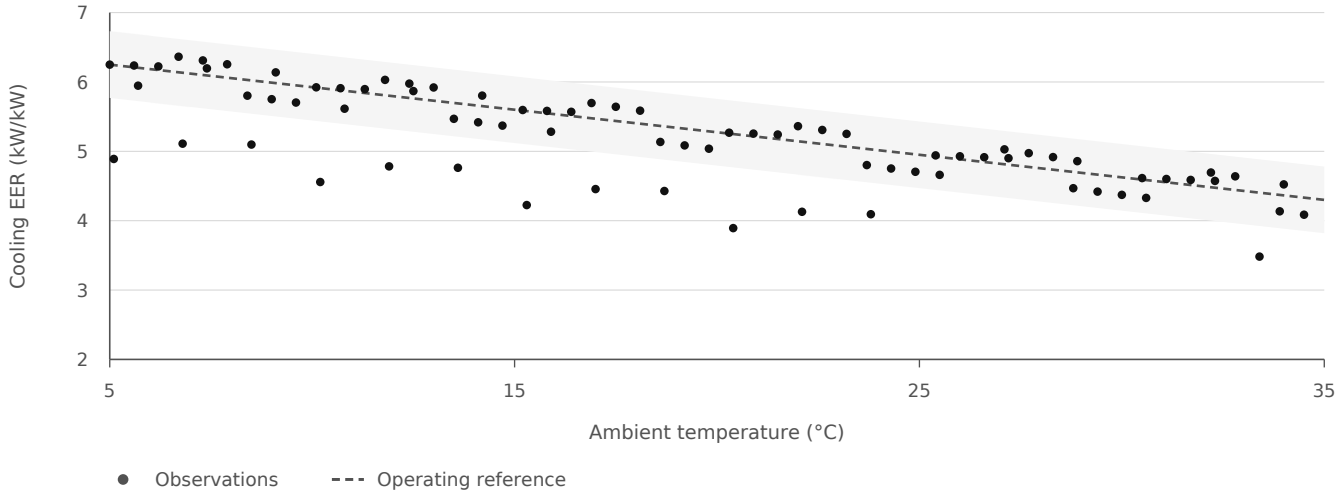
Units, timestamps, gaps, invalid values and operating state are assessed before interpretation. Required channels depend on the equipment profile and analysis. Missing inputs can make a result unavailable; they are not invented to complete a chart.

See efficiency in context.

Trends show when performance changes. Relationship plots help establish whether load or operating conditions could explain the change.

ILLUSTRATIVE EXAMPLE - NOT PLANT DATA OR A VALIDATED RESULT

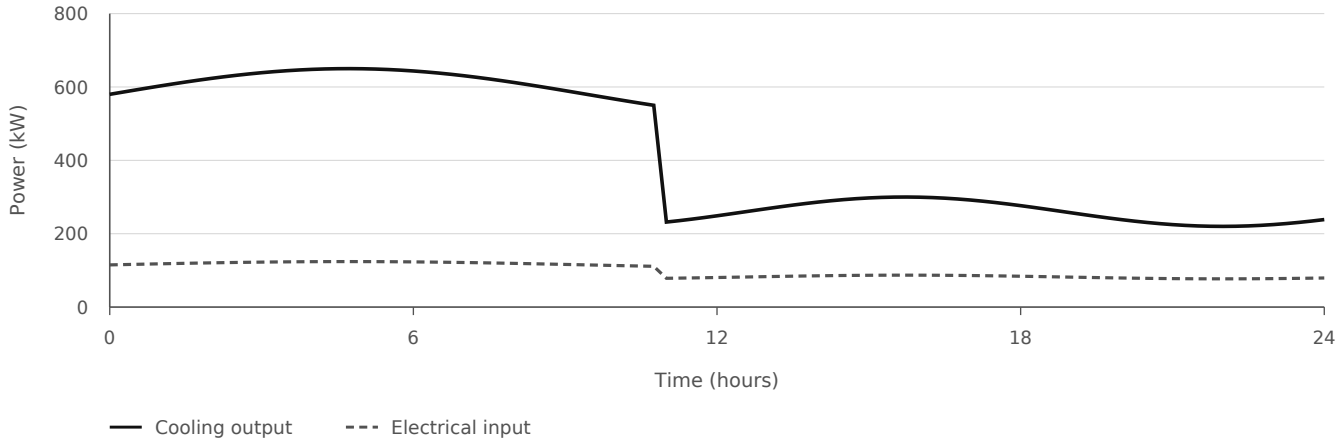
Efficiency against ambient temperature



How the plot is read

Points below the comparable operating reference prompt investigation. Check load, water temperatures, flow and the electrical boundary before attributing the difference to the machine. This illustrative band is not a manufacturer limit.

Cooling output and electrical input over time



What the change could mean

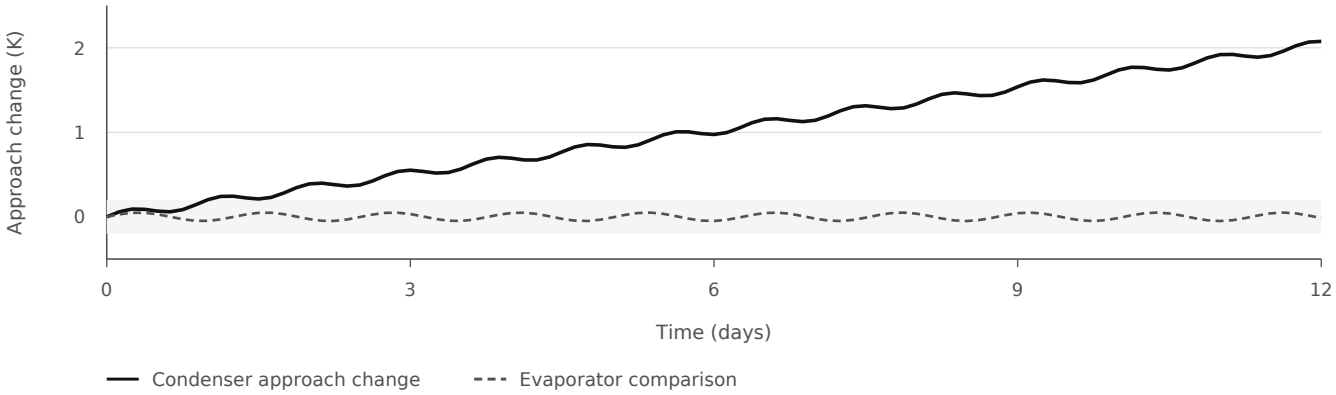
In this example, cooling demand falls more than electrical input. The ratio therefore falls, without proving a component defect. Low load, cycling and auxiliary demand are possible explanations to check. Invalid or near-zero input must not produce a misleading efficiency value.

Investigate the component.

An indicator becomes useful when the supporting signals, alternative explanations and recommended engineering checks are visible together.

ILLUSTRATIVE EXAMPLE - NOT PLANT DATA OR A VALIDATED RESULT

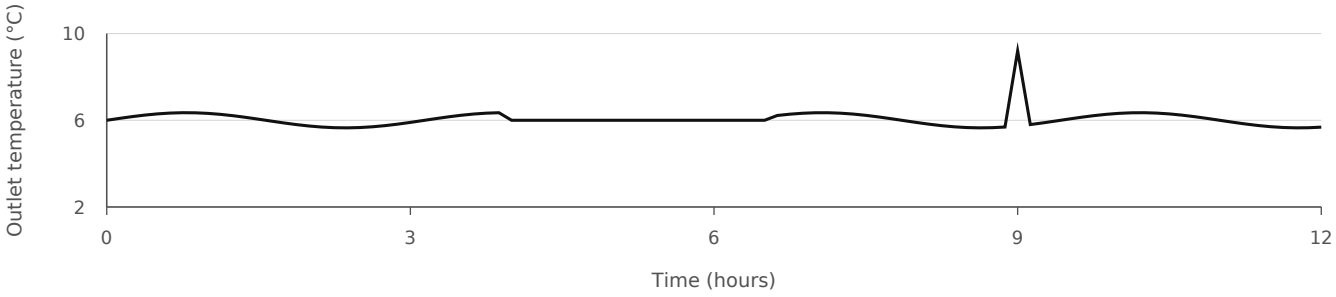
Heat-exchanger approach against a reviewed reference



Evidence before a fouling conclusion

Rising condenser approach at comparable load and flow suggests poorer heat transfer. Check fouling, coolant conditions, low flow and sensor error together. The water-cooled example uses condensing saturation temperature minus leaving condenser-water temperature.

Sensor behaviour can change the interpretation



A flat line or spike is a reason to check the signal.

Stable operation can produce a constant signal; spikes can be measurement issues. Check other channels before inferring a component fault.

Further investigations, when the required signals exist

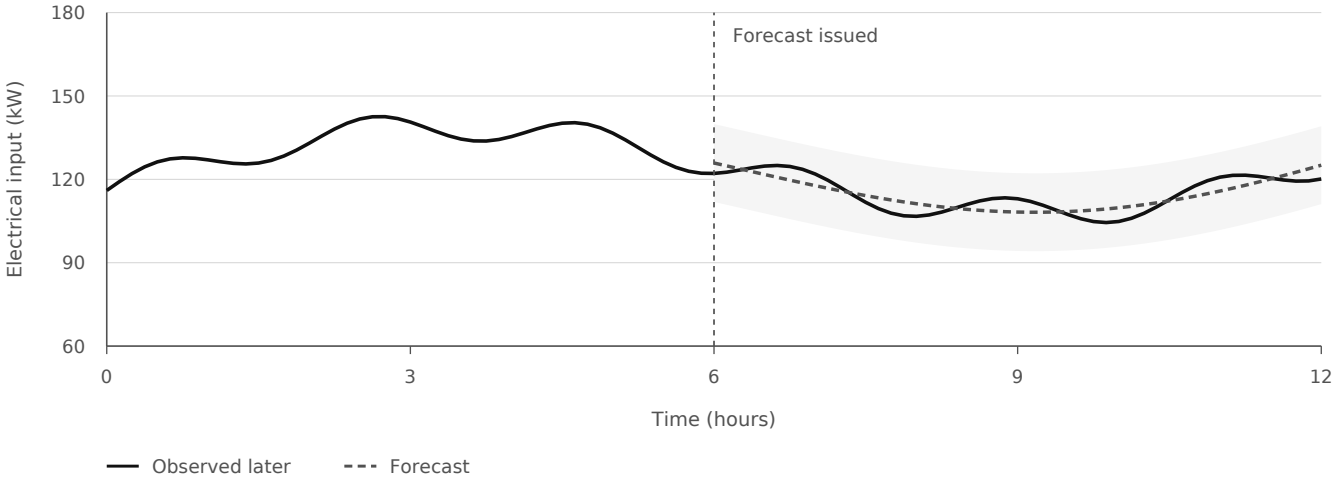
Evaporator: approach, flow and water temperatures for heat-transfer or freezing-risk review.
Compressors: compare individual electrical loading at matched conditions; unequal power alone does not establish failure.
Refrigerant-related behaviour: combine pressure and temperature evidence; pressure decline alone does not establish a leak.
Limits: use reviewed, equipment-specific references. No universal threshold or exact physical-failure date is implied.

Forecast. Observe. Verify.

Predictions support planning only when their errors, coverage and useful operating range can be checked against what actually happened.

ILLUSTRATIVE EXAMPLE - NOT PLANT DATA OR A VALIDATED RESULT

Predicted and observed electrical input



Illustrative retrospective view: the observations after the dividing line became known later. The shaded band illustrates uncertainty; it is not a calibrated interval or a promised accuracy level.

What is reported	How it helps the customer
Matched-period error	**RMSE** describes error on the target's own scale. Read it alongside a simple reference forecast.
Explained variation	**R^2** compares squared error with target variation. It can be negative, and is undefined for a constant target.
Coverage and conditions	See how many predictions matched valid observations, which periods were excluded and whether the operating regime changed.
Clear engineering commentary	State what changed, which signals support it, what else could explain it and what check is recommended next.

A practical reporting view

A pilot can combine these plots with data-quality findings and traceable assessment notes. Available views depend on the signals and analysis configured for that asset.

Measured scores come later. A forecast has no measured R^2 or RMSE until matching observations arrive. Forecast horizon and acceptance criteria are agreed for the application; neither an accuracy target nor a failure date is guaranteed.

Start with one asset. Agree the evidence.

A focused pilot turns a broad capability discussion into a practical, reviewable engineering evaluation.

Pilot stage	What we agree
Define the equipment and the question	Confirm machine type, refrigerant, process fluid and metering boundary. Agree the engineering question and intended use.
Review history and establish a reference	Validate signal definitions, timestamps and coverage. Establish a reviewed operating reference and identify any additional measurements needed.
Evaluate on later, separate evidence	Compare forecasts with later observations and a baseline. Use technician-reviewed events to assess fault findings, missed events and false alarms.
Review the result before expanding	Accept or reject against agreed criteria. Retain prior versions and require authorization before an operational release.

What a partner can evaluate

A defined parameter set, a transparent quality review, relevant graphs with explanations, forecast comparisons on held-out periods and a clear account of what still needs confirmation.

Trust has practical boundaries.

This public overview contains no customer telemetry, equipment access or proprietary implementation details. Data access, retention, permissions, security review and recovery arrangements must be agreed for each deployment.

ARG-BLC1 supports engineers. It does not repair equipment, issue automatic commands or replace certified safety protection. Compatibility and field accuracy require separate validation. Improvements require evidence and human approval.

Explore a pilot evaluation.

Project Cassandra / ARG-BLC1
Public overview: black-axiom.amin244863.chatgpt.site

Document v1.0. English edition. Charts are original illustrative examples, not customer measurements, validated fault events or performance results. Actual scope and deliverables are agreed for each pilot.