

01 DAIRY PROCESSING · SIMULTANEOUS HEATING & COOLING

₱100,000 a month back in your pocket. *From day one.*

A Philippine milk plant, chilling the raw milk and heating the pasteuriser from one Karnot platform — one electricity bill, no LPG boiler, financed by the bank, paid out of the saving. Modelled on a 20,000 L/day processor.

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WHY YOUR DAIRY PAYS FOR EVERY KILOWATT TWICE

The chiller dumps the milk's heat. The boiler buys it back. *Within metres of each other.*

Every milk plant runs **two opposing thermal jobs at the same time**: raw milk arrives warm and must reach 4 °C within 2 hours; the pasteuriser and the CIP loop want 65–85 °C all shift long. The same kilowatt-hour, paid for twice — once to Meralco to throw it away, once to the LPG man to buy it back.



Milk quality lives or dies at 4 °C

Grade-A milk must drop to **4 °C within 2 hours of reception** or bacterial count climbs and the batch degrades. Most PH plants do this with ageing R22 / R404A chillers at **COP ~2.5 and a Montreal Protocol phasedown clock** on the asset register. The chiller is both your quality bottleneck and your biggest electricity line.



The LPG boiler is optional — and nobody told you

HTST pasteurisation, CIP caustic and rinse loops, crate washing: roughly **11,400 kg of LPG a year on a 20,000 L/day plant (~₱968K)**. But the heat your milk gives up during chilling is the same heat your hot side needs — captured at the CO₂ gas cooler, **it covers the entire heating load. The boiler is retired, not replaced.**

THE ARCHITECTURE · ONE MACHINE, BOTH JOBS

Chill the milk. *Bank the heat. Retire the boiler.*

KARNOT DAIRY PLATFORM · MODELLED 20,000 L/DAY · SCALES 2,000 – 200,000 L/DAY

COLD SIDE · WHAT THE MILK NEEDS

Reception chilling · ice water · cold store

Raw milk 35→4 °C within 2 hours. **Ice-water loop feeds the pasteuriser cooling section.** Finished-product cold store 2–4 °C. All from iCOOL CO₂ at **COP 4.2 (Oak Ridge validated)** — 40% less electricity than the legacy chiller.



iCOOL CO₂ + iHEAT R290

The heat removed from the milk is delivered to the hot side. Nothing goes off the roof.



HOT SIDE · WHAT THE PLANT NEEDS

Pasteuriser · CIP · crate wash

HTST final-heater loop **75–80 °C** (72 °C hold). CIP caustic, acid, sanitiser 65–85 °C. Crate and churn washing 60 °C. Fed from **recovered milk heat** via the CO₂ gas cooler + iHEAT R290 top-up. **LPG: zero.**

ISTOR PCM · BOTH SIDES BUFFERED

Hot buffer decouples CIP demand from heat-pump runtime. **Cold buffer carries the cold store through a brownout — the milk survives the outage.**

90% REGENERATOR STAYS

Your HTST plate regenerator already does 90% of the lift. **We replace the utilities around it, not the pasteuriser.** No production-line surgery.

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THE FOUR BOXES YOU ACTUALLY NEED

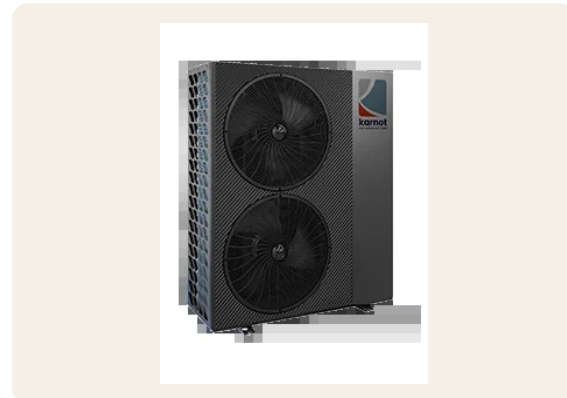
Four products. *One project. One commissioning team.*



iCOOL CO₂

Transcritical R744 · GWP 1 · food-safe A1

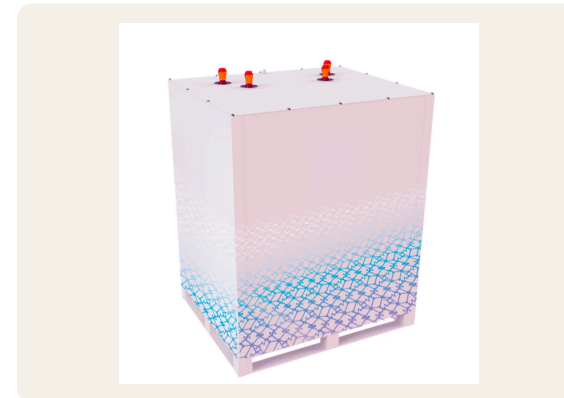
Milk chilling, ice water, cold store. **COP 4.2 at -5 °C** (Oak Ridge validated). Gas cooler delivers **75–90 °C hot water from the same cycle**. No ammonia exclusion zone, no R404A phasedown clock.



iHEAT R290

9.5–100 kW · COP 4.0+ · 60–85 °C

Hot-side top-up and standalone CIP duty. **Drop-in replacement for the LPG boiler**. Outdoor install, sealed 1.4 kg charge, EN 378 compliant. No flame, no flue, no boiler-room schedule.



iSTOR PCM

38 kWh · 8–12 hr backup

Thermal battery on both sides. **Hot:** CIP water ready on demand. **Cold:** the cold store rides through a PH brownout with zero compressor load. 1,500+ charge cycles.



iSAVE + iVOLT

IPMVP M&V + zero-export solar

iSAVE meters every duty — **monthly IPMVP Option B report to your CFO and your lender**. iVOLT zero-export solar cuts the remaining grid draw 30–50%. Dairy roofs are flat and big.

THE BILL · MODELLED 20,000 L/DAY PROCESSOR

₱2.76M thermal bill today. ~~₱1.07M~~ after. **-61%.**

ANNUAL FIGURE	TODAY · BOILER + OLD CHILLER	KARNOT PLATFORM	YOU STOP PAYING
Process heat (HTST + CIP + wash)	~11,400 kg LPG/yr	0 kg · recovered milk heat	₱968K/yr
Chilling + ice water + cold store	COP 2.5 · R404A	COP 4.2 · CO ₂	₱726K/yr
Scope 1 + refrigerant exposure	~34 t CO ₂ e + GWP 3,922	GWP 1 & 3 · natural	~70 tCO₂e/yr
Total investment (VAT-inc)	(already paid)	~₱2.0M	1.2 yr payback

Basis: 20,000 L/day, 360 day/yr. HTST 72 °C with 90% regeneration (the regenerator stays). LPG ₱85/kg at 82% boiler efficiency; Meralco GP ₱14/kWh. CAPEX includes iCOOL CO₂, iHEAT R290, 2× buffers, controls, commissioning, Permits-Managed Service LOW. **Your plant might be 5,000 L/day (÷4) or 100,000 L/day (×5) — the per-litre economics hold.** Excludes iVOLT solar (further 30–50% off the remainder).

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THE CASH FLOW · BANK-FINANCED

From day one. *Net of the loan payment.*

MONTH 1

₱100K

~₱141K monthly saving **minus** the green-loan payment (~₱40K). Net cash in pocket. Every month. From day one.

YEAR 1

₱1.2M

In your pocket while the loan is being repaid. **The kit has paid for itself in cash terms by month 15.**

YEAR 5

₱6.1M

Loan paid off. From now on you keep **every peso** of the ₱1.69M annual saving.

YEAR 15

₱23M

Total cash retained over the 15-year asset life vs keeping the boiler and the old chiller.

HOW YOU PAY FOR THE KIT · YOU DON'T, THE BANK DOES

Three banks. *One BOI Income Tax Holiday.* *Karnot files everything.*

DBP

Sustainable Energy Finance Programme (SEFP)

Agri-industrial priority — dairy qualifies. Covers heat pump + refrigeration + solar. 70–80% LTV. 5–10 year terms.

~6.5–8% p.a.

LandBank

Sustainable Energy Investment Loan (SEILP)

Path of least resistance for dairy cooperatives that already bank with LandBank. Agri-friendly underwriting.

~7% p.a.

BPI

Sustainable Development Finance (SDF)

Fastest decisions for established processors with a BPI relationship. ESG-aligned loan book.

~1–1.5% below SME

These are **loans**, not grants. The monthly saving covers the payment **3.5x over**. Plus **BOI Pioneer Income Tax Holiday under RA 11285** — food-security infrastructure qualifies. Karnot files **the loan, the BOI registration, the building permits and the monthly IPMVP M&V report your lender wants** as part of project scope.

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THE ENGINEERING BEHIND THE NUMBER · PINCH ANALYSIS

We don't guess the saving. *We calculate your thermodynamic minimum.*

NUMBER 1 · MINIMUM HEATING

 $Q_H \text{ min}$

The **absolute least boiler energy** your plant needs after maximum heat recovery. If your boiler burns more than this — and in every dairy we have surveyed, it does — **the difference is pure waste.**

NUMBER 2 · MINIMUM COOLING

 $Q_C \text{ min}$

The **absolute least chiller energy** required after recovery. Everything your chiller removes above this is heat you paid to make and then **paid again to throw away.**

NUMBER 3 · THE BOTTLENECK

 $\sim 35 \text{ }^\circ\text{C}$

The dairy pinch point. Above it: heat deficit. Below it: heat surplus. **A heat pump is the only utility that moves surplus heat from below the pinch to the deficit above it.** That is why the saving is 61%, not 15%.

Hot streams are income. Cold streams are expenses. Pinch analysis is the accountant that finds the maximum internal transfer before you go to the bank (boiler) or throw money away (chiller). *Plain-English guide: karnot.com/blog/idiots-guide-utility-pinch-analysis*

Three ways to chill milk. *Two of them have a clock running.*

LEGACY HFC · THE PHASEDOWN

3,922

GWP of R404A · Montreal Protocol clock

R22 / R404A chillers face **quota-driven service price rises every year**. The EU PFAS restriction names the HFC family explicitly. PH typically follows 6–8 years behind. **Every peso spent maintaining one is a peso spent on a dying asset.**

INDUSTRIAL AMMONIA · THE EXCLUSION ZONE

B2L

Toxic safety class · specialist compliance

NH₃ is efficient but **toxic** — **exclusion zones, specialist technicians, emergency response plans**, and an insurance loading. Sized for Magnolia-scale plants, not the 5,000–100,000 L/day processors that make up most of the PH industry.

KARNOT NATURAL · NO CLOCK, NO ZONE

GWP 1

CO₂ (R744) + propane (R290 · GWP 3)

CO₂ is food-safe, A1 class — the same gas in your carbonated products. R290 sits outdoors in a sealed 1.4 kg charge under EN 378. No phasedown, no exclusion zone, no insurance loading, **nothing on the asset register with a death date.**

SEC PFRS S2 climate disclosure: ~70 tCO₂e/yr avoided, audit-grade data from iSAVE, monthly.

WHAT HAPPENS NEXT

Four steps from this deck *to a retired boiler.*

- 1 Send us three things**
Daily milk intake (litres), 12 months of LPG + electricity bills, and your CIP schedule. That is all we need for the first model.
- 2 Level 1 Energy Survey + pinch study**
₱90K, one week of portable metering on your actual production data — **refunded in full when you proceed to install.** Output: your Q_{Hmin} , Q_{Cmin} and a sized system quote.
- 3 Bank + BOI paperwork — we file it**
DBP / LandBank / BPI green-loan application, BOI Pioneer ITH registration, building permits. You sign at the bank window, not before.
- 4 Install in 4–6 weeks · no production stoppage**
The regenerator and pasteuriser stay. We swap the utilities around them — commissioning across two scheduled CIP windows. Boiler retired on handover day.

GET YOUR PLANT'S NUMBERS

Send us your *daily intake, 12 months of bills and your CIP schedule.*

Stuart Cox · Founder & CEO

stuart.cox@karnot.com

+63 75 510 8922

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