

# ₱95,000 a month back in your pocket. *From day one.*

A Philippine GMP facility, cooling and dehumidifying the cleanroom while heating the reheat coil, the CIP loop and the purified water from one Karnot platform — one electricity bill, no steam boiler running flat out, financed by the bank, paid out of the saving. Modelled on a mid-size GMP plant.

## KARNOT

WHY YOUR CLEANROOM PAYS FOR EVERY KILOWATT TWICE

# The AHU cools the air to dry it. Then reheats it.

## *You pay twice on the same coil.*

A GMP plant runs **two opposing thermal jobs at once**: the cleanroom AHU chills supply air below dew point to strip humidity, then reheats it back to a 20–22 °C setpoint; meanwhile CIP and purified water want 60–85 °C and cold storage rejects condenser heat. The same kilowatt-hour, paid for twice — once to Meralco to chill and dump it, once to the boiler to put it straight back.



### Cleanroom RH and temperature ARE your GMP licence

Cleanroom air must hold tight **RH and temperature bands** for product stability and audit — deep dehumidification then reheat. Most PH GMP plants run an ageing **R404A chiller at COP ~2.8 with an F-gas phasedown clock** on the asset register. The chiller is both your compliance tool and your biggest electricity line.



### The steam boiler is mostly optional — and nobody told you

CIP, purified water, process hot water and cleanroom reheat run a steam boiler at roughly **₱2.1M/yr in LPG or diesel**. But the heat your cleanroom dehumidification gives up is the same heat your hot side needs — captured at the CO<sub>2</sub> gas cooler, **it covers reheat, CIP and process water. Only terminal sterilisation keeps a small electric steam top-up.**

THE ARCHITECTURE · ONE MACHINE, BOTH JOBS

# Chill the cleanroom. *Bank the heat.* *Cut the steam bill.*

KARNOT PHARMA PLATFORM · MID-SIZE GMP FACILITY MODELLED · SCALES WITH CLEANROOM AREA + BATCH VOLUME

## COLD SIDE · WHAT GMP NEEDS

### Cleanroom dehumidification · process · cold chain

Cleanroom AHUs cool below dew point to 45–55% RH. Process cooling, cold storage 2–8 °C, ultra-low to –20...–80 °C on the cascade. All from iCOOL CO<sub>2</sub> at **COP 4.2 (Oak Ridge validated)** — 40% less electricity than the legacy R404A chiller.



## iCOOL CO<sub>2</sub> + iHEAT R290

*The heat pulled out of the cleanroom air and the cold store is delivered to the hot side. Nothing goes to the cooling tower.*



## HOT SIDE · WHAT THE PLANT NEEDS

### Cleanroom reheat · CIP · purified water

Cleanroom AHU reheat to 20–22 °C setpoint. CIP caustic, acid, sanitiser 60–85 °C. Purified-water and process hot water heating. Fed from **recovered dehumidification + cold-store heat** via the CO<sub>2</sub> gas cooler + iHEAT R290 top-up. **Boiler steam: only the steriliser.**

## ISTOR PCM · BOTH SIDES BUFFERED

Hot buffer banks recovered heat for CIP and reheat. **Cold buffer carries cold storage and cleanroom cooling through a brownout — the batch and the cold chain survive the outage.**

## THE STERILISER STAYS

Your autoclaves, fillers and cleanroom kit don't change. **We replace the utilities around the steriliser, not the sterilisation.** N+1 redundancy with validated, IQ/OQ/PQ-ready documentation.

## KARNOT

THE FOUR BOXES YOU ACTUALLY NEED

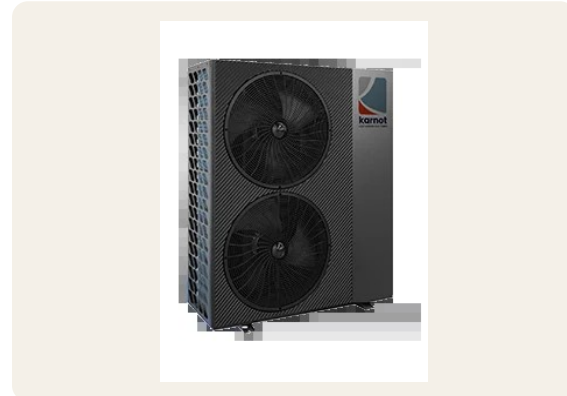
# Four products. *One project. One commissioning team.*



## iCOOL CO<sub>2</sub>

Transcritical R744 · GWP 1 · pharma-safe A1

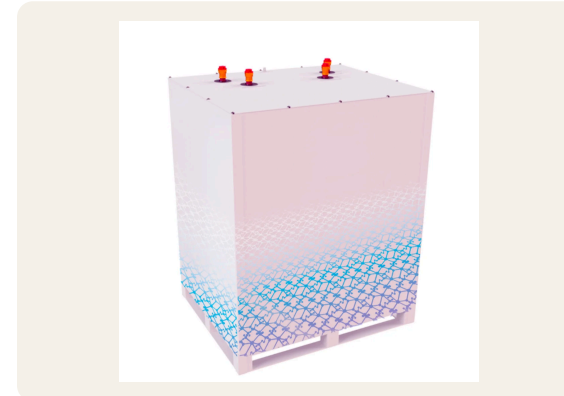
Cleanroom dehumidification, process and cold chain. **COP 4.2 at -5 °C** (Oak Ridge validated). Gas cooler delivers **75–90 °C hot water from the same cycle**. Non-toxic, non-flammable.



## iHEAT R290

9.5–100 kW · COP 4.0+ · 60–85 °C

CIP, purified-water and reheat duty. **Replaces the steam boiler for everything bar terminal sterilisation**. Outdoor install, sealed 1.4 kg charge, EN 378 compliant. No flame, no flue.



## iSTOR PCM

38 kWh · 8–12 hr backup

Thermal battery on both sides. **Hot:** recovered heat banked for CIP and reheat. **Cold:** cold storage and cleanroom rides through a PH brownout with zero compressor load. N+1, 1,500+ cycles.



## iSAVE + iVOLT

IPMVP M&V + zero-export solar

iSAVE meters every duty — **audit-grade IPMVP report monthly for GMP, your lender and a BERDE EE credit**. iVOLT zero-export solar cuts the remaining grid draw 30–50%. Plant roofs are flat and big.

## THE BILL · MODELLED MID-SIZE GMP FACILITY

# ₱3.5M energy bill today. ~~₱3.5M~~ **₱1.5M after. -57%.**

ANNUAL FIGURE	TODAY · BOILER + OLD CHILLER	KARNOT PLATFORM	YOU STOP PAYING
Process heat (CIP + process + cleanroom reheat)	LPG/diesel steam boiler	iHEAT R290 + recovered heat	<b>₱1.6M/yr</b>
Cleanroom cooling + cold storage	COP 2.8 · R404A	COP 4.2 · CO <sub>2</sub>	<b>₱680K/yr</b>
Scope 1 + refrigerant exposure	~65 t CO <sub>2</sub> e + GWP 3,922	GWP 1 & 3 · natural	<b>~75 tCO<sub>2</sub>e/yr</b>
<b>Total investment (VAT-inc)</b>	<b>(already paid)</b>	<b>~₱4.5M</b>	<b>2.2 yr payback</b>

*Basis: mid-size GMP facility. Cleanroom cool-and-reheat AHUs holding 45–55% RH; CIP + process hot water 60–85 °C; autoclave / SIP at 121 °C retains a small electric steam top-up. Cold storage 2–8 °C plus ultra-low to –20...–80 °C cascade. LPG ₱85/kg at 82% boiler efficiency; Meralco GP ₱14/kWh. CAPEX includes iCOOL CO<sub>2</sub>, iHEAT R290 (N+1), hot + cold buffers, validation documentation, controls, commissioning, Permits-Managed Service. **Scales with cleanroom area and batch volume — a smaller lab divides down, a multi-line plant multiplies up.** Excludes iVOLT solar (further 30–50% off the remainder).*

## KARNOT

THE CASH FLOW · BANK-FINANCED

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

MONTH 1

**₱ 95K**

~₱167K monthly saving **minus** the green-loan payment (~₱72K). Net cash in pocket. Every month. From day one.

YEAR 1

**₱ 1.1M**

In your pocket while the loan is being repaid. **The kit has paid for itself in cash terms inside year 3.**

YEAR 5

**₱ 5.7M**

Banking ~₱1.1M a year after the loan payment. **The loan clears in year 7 — then you keep all of it.**

YEAR 15

**₱ 22M**

Total cash retained over the 15-year asset life vs keeping the boiler and the old R404A 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)

Industrial energy-efficiency priority. Covers heat pump + refrigeration + solar. 70–80% LTV. 5–10 year terms.

**~6.5–8% p.a.**

## LandBank

### Sustainable Energy Investment Loan (SEILP)

Strong fit for regional pharma and life-science plants already banking with LandBank. Friendly underwriting.

**~7% p.a.**

## BPI

### Sustainable Development Finance (SDF)

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

**~1–1.5% below SME**

These are **loans**, not grants. The monthly saving covers the payment **2.3x over**. Plus **BOI Pioneer Income Tax Holiday under RA 11285** — energy-efficient manufacturing qualifies. Karnot files **the loan, the BOI registration, the building permits and the monthly IPMVP M&V report your lender and GMP auditor want** as part of project scope.

# 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 GMP plant 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 dehumidification heat you paid to make and then **paid again to throw away.**

## NUMBER 3 · THE BOTTLENECK

# ~35 °C

The GMP plant 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 57%, 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/idiot-s-guide-utility-pinch-analysis](https://karnot.com/blog/idiot-s-guide-utility-pinch-analysis)*

# Three ways to chill a GMP plant. *Two of them have a clock running.*

## LEGACY HFC · THE PHASEDOWN

# 3,922

GWP of R404A · F-gas phasedown clock

R404A / R134a 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

NH<sub>3</sub> is efficient but **toxic** — **exclusion zones, specialist technicians, emergency response plans**, and an insurance loading. A non-starter next to a cleanroom or a cold chain holding finished product.

## KARNOT NATURAL · NO CLOCK, NO ZONE

# GWP 1

CO<sub>2</sub> (R744) + propane (R290 · GWP 3)

**CO<sub>2</sub> is food/pharma-safe, A1 class — non-toxic and non-flammable.** 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 — and IQ/OQ/PQ-ready documentation.**

**SEC PFRS S2 climate disclosure: ~75 tCO<sub>2</sub>e/yr avoided, audit-grade data from iSAVE, monthly.**

## WHAT HAPPENS NEXT

# Four steps from this deck *to a cut steam bill.*

## 1 Send us three things

Cleanroom area and batch volumes, 12 months of LPG/diesel + electricity bills, and your CIP + cold-chain 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 utility log — **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 with N+1 redundancy · validated

The steriliser stays. We swap the utilities around it — IQ/OQ/PQ-ready documentation, commissioning around scheduled shutdowns. Audit-grade M&V from handover day.

## GET YOUR PLANT'S NUMBERS

Send us your *cleanroom area, 12 months of bills and your CIP schedule.*

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