

03 PHARMACEUTICALS & LABS · SIMULTANEOUS HEATING & COOLING

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

For Philippine GMP pharmaceutical manufacturers and laboratories. The same machine that **cools and dehumidifies your cleanroom air heats your CIP loop, your purified water and your AHU reheat coil** — one electricity bill, no steam boiler running flat out, financed by the bank, paid for out of the saving. The heat your cleanroom AHU dumps to dehumidify IS the heat you pay the boiler to put straight back.

MODELLED MID-SIZE PHILIPPINE GMP FACILITY · CLEANROOM + CIP + COLD STORAGE

₱95K**In your pocket every month**

Saving minus the green-loan payment · from day one

2.2 yr**Cash payback**

~₱4.5M install vs ~₱2.0M/yr saving · -57% energy bill

75 t**CO₂ avoided every year**R404A retired · GWP 3,922 off the register · A1 pharma-safe CO₂**You pay nothing up front. *The bank does.***

DBP, LandBank and BPI all run **green-loan programmes** built for exactly this CAPEX — **~6.5–8% p.a., 5–10 year terms, 70–80% LTV**. The monthly saving (~₱167K) is larger than the monthly loan payment (~₱72K). **Cash flow goes UP from day one**. Karnot files the loan application, the BOI paperwork and the building permits as part of project scope. Most GMP-manufacturing installs qualify for **BOI Pioneer status and Income Tax Holiday under RA 11285**.

— WHY YOUR CLEANROOM PAYS FOR EVERY KILOWATT TWICE

The cleanroom 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 to 45–55% RH, then **REHEATS that same air back to a 20–22 °C setpoint** — cooling and heating in series, paid for separately. Meanwhile CIP and purified-water systems want 60–85 °C all shift long, and cold storage rejects condenser heat to the sky. Today the chiller dumps the dehumidification heat to a cooling tower, an electric coil reheats, and a steam boiler buys the process heat back. **The same kilowatt-hour, paid for twice.** A heat pump moves it across instead.



Cleanroom RH and temperature ARE your GMP licence — and your R404A chiller is the weak link

Cleanroom air must hold tight **RH and temperature bands for product stability and audit**, which means 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**. Karnot iCOOL CO₂ holds the same cooling and dehumidification duty at **COP 4.2 (Oak Ridge validated)** — and the heat it removes is the heat your reheat coil and CIP loop need.



The steam boiler is your biggest controllable cost — and most of it is optional

CIP caustic and acid loops, purified-water heating, process hot water and cleanroom reheat (60–85 °C) run a steam boiler at roughly **£2.1M/yr in LPG or diesel** on a mid-size facility. The heat recovered from cleanroom dehumidification and the cold-store condenser, captured at the iCOOL gas cooler, **covers the reheat, CIP and process-water load**. Only terminal sterilisation keeps a small electric steam top-up — we replace the utilities around the steriliser, not the sterilisation.

— ONE MACHINE · BOTH JOBS · ONE ELECTRICITY 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 duties from iCOOL CO₂ at COP 4.2 — with iSTOR PCM carrying the cold chain through brownouts.



iCOOL CO₂ + 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 and sanitiser loops 60–85 °C. Purified-water and process hot water heating. All fed from **recovered dehumidification + cold-store heat** via the iCOOL gas cooler + iHEAT R290 top-up. Boiler steam: only the steriliser.

— THE FOUR BOXES · ONE PROJECT

iCOOL CO₂

Transcritical R744 · GWP 1 · TRL 9

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. A1 food/pharma-safe — non-toxic, non-flammable.

iHEAT R290

9.5–100 kW · COP 4.0+

CIP, purified-water and reheat duty. **60–85 °C delivery** at PH ambient. Outdoor install, 1.4 kg sealed charge, EN 378 compliant. **Replaces the steam boiler for everything bar terminal sterilisation.**

iSTOR PCM

38 kWh · 8–12 hr backup

Thermal battery on both sides: **hot buffer banks recovered heat for CIP and reheat; cold buffer carries cold storage and cleanroom cooling through a brownout** with zero compressor load. N+1 redundancy — the batch and the cold chain survive the outage.

iSAVE + iVOLT

M&V + zero-export solar

iSAVE meters every duty — **audit-grade IPMVP M&V report monthly** for GMP, your lender and a BERDE Energy Efficiency credit. iVOLT zero-export solar on the plant roof cuts the remaining grid draw 30–50%.

— WHAT YOU PAY TODAY · WHAT YOU PAY AFTER

Mid-size GMP facility. *A real number on every batch.*

ANNUAL FIGURE · MID-SIZE GMP FACILITY	TODAY · BOILER + OLD CHILLER	KARNOT INTEGRATED PLATFORM	YOU STOP PAYING
Process heat (CIP + process + cleanroom reheat)	LPG/diesel steam boiler	iHEAT R290 + recovered cleanroom heat	₱1.6M/yr · only steriliser left
Cleanroom cooling + cold storage	COP 2.8 · R404A clock	COP 4.2 · CO ₂ GWP 1	₱680K/yr elec
Total energy bill (heat + cooling)	~₱3.5M/yr	~₱1.5M/yr	-57% / ~₱2.0M/yr
Scope 1 + refrigerant exposure	~65 tCO ₂ e + R404A GWP 3,922	R744 GWP 1 · R290 GWP 3	~75 tCO₂e/yr total
Total investment (VAT-inc)	(already paid)	~₱4.5M	2.2 yr cash payback

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 (we replace the utilities, not the sterilisation). Cold storage 2–8 °C plus ultra-low to -20...-80 °C on the cascade. LPG ₱85/kg at 82% boiler efficiency; Meralco GP ₱14/kWh. CAPEX includes iCOOL CO₂, iHEAT R290 (N+1 redundancy), hot + cold buffers, validation documentation, controls, commissioning and Permits-Managed Service. Scales with cleanroom area and batch volume — a smaller lab divides down, a multi-line plant multiplies up. Excludes iVOLT solar, which cuts the remaining ₱1.5M a further 30–50%.

— THE CASH FLOW · PLAIN AND DULL

<p>MONTH 1</p> <p>₱95K</p> <p>~₱167K monthly saving minus the green-loan payment (~₱72K). Net cash in pocket. Every month. From day one.</p>	<p>YEAR 1</p> <p>₱1.1M</p> <p>In your pocket while the loan is being repaid. The kit has paid for itself in cash terms inside year 3.</p>	<p>YEAR 5</p> <p>₱5.7M</p> <p>Loan paid off in year 7. Until then you bank ~₱1.1M a year after the loan payment.</p>	<p>YEAR 15</p> <p>₱22M</p> <p>Total cash retained over the 15-year asset life vs keeping the boiler and the old R404A chiller.</p>
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THE ENGINEERING BEHIND THE NUMBER · PINCH ANALYSIS

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

Pinch analysis maps every hot stream (cleanroom dehumidification heat that must leave, condenser heat from the cold store) against every cold stream (CIP, purified water and cleanroom reheat that must heat) and computes **Q_Hmin** and **Q_Cmin** — the absolute minimum heating and cooling your plant needs after maximum heat recovery. Everything above that minimum is waste. The pinch point in a GMP plant sits around 35 °C — and **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%. Read the plain-English guide: karnot.com/blog/idiots-guide-utility-pinch-analysis — or commission a Level 1 Energy Survey (₱90K, refunded on install) and we run the pinch study on your actual utility log.

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

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

Philippine green-loan programmes *built for pharma CAPEX*

DBP · SEFP

Sustainable Energy Finance Programme

Industrial energy-efficiency priority.
70–80% LTV · 5–10 yr · ~6.5–8% p.a.

LANDBANK · SEILP

Sustainable Energy Investment Loan

Strong fit for regional pharma and life-science plants already banking with LandBank · ~7% p.a.

BPI · SDF

Sustainable Development Finance

Fastest decisions for established manufacturers · ~1–1.5% below standard SME rate

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 your GMP auditor want to see** as part of project scope.

WHY NATURAL REFRIGERANTS · THE PHARMA-SAFETY ANGLE

CO₂ and propane. *No ammonia zone. No F-gas clock.*

Legacy pharma refrigeration is either R404A / R134a (GWP up to 3,922, F-gas phasedown, rising service prices) or industrial ammonia (toxic, B2L, exclusion zones, specialist compliance) — a non-starter next to a cleanroom. Karnot iCOOL runs on CO₂ — GWP 1, A1 safety class, food/pharma-safe, non-toxic and non-flammable. iHEAT runs on R290 outdoors with a sealed 1.4 kg charge under EN 378. Nothing on the asset register has a phasedown date, an exclusion zone, or an insurance loading — and IQ/OQ/PQ-ready documentation comes with the install. **SEC PFRS S2 climate disclosure: ~75 tCO₂e/yr avoided, audit-grade data from iSAVE.**

“ A GMP plant is the textbook case for simultaneous heating and cooling — the pinch analysis writes itself. The cleanroom must lose exactly the heat the reheat coil, the CIP loop and the purified water must gain, on the same shift. Today Philippine pharma manufacturers pay Meralco to chill the air, pay again to reheat it, and pay the boiler for process heat on top. One Karnot platform does all of it from one electricity bill: chill the cleanroom, bank the heat, cut the steam bill. ₱4.5M installed, ₱2.0M back every year, audit-grade M&V for the regulator, and the bank finances it against the saving. The maths is not subtle. ”

Stuart Cox · Founder & CEO · Karnot Energy Solutions Inc.