

11 COLD STORES & SUPERMARKETS · CO₂ REFRIGERATION

Stop leaking GWP 3,922. Stop paying to defrost. *Switch the cold to CO₂.*

For Philippine cold stores, frozen logistics and supermarkets still running R404A. One Karnot iCOOL CO₂ system runs every cold room, freezer and display case on GWP-1 natural refrigerant — and FLX Flex Defrost melts the frost with the heat your compressor already throws away, not an electric heater.

WHY EVERY HFC COLD STORE IN THE PHILIPPINES IS ON THE CLOCK

21%

Of cold-store energy wasted on electric defrost

FLX eliminates it · zero electric heaters
· ~9.25 kWh saved per defrost cycle

GWP 1

CO₂ vs R404A's 3,922

No PFAS, no Kigali phase-down, no Scope 1 leak bill at 15–25%/yr

<12 mo

Integrated retrofit payback

CO₂ + FLX + iVOLT solar · up to 60–80% off the electricity bill

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 energy and refrigerant saving covers the loan payment many times over, and a CO₂ conversion is **cold-chain food-security infrastructure** — most installs qualify for **BOI Pioneer status and Income Tax Holiday under RA 11285**. Karnot files the loan, the BOI paperwork and the LGU permit pack as part of project scope.

— FOUR PRESSURES SQUEEZING EVERY HFC COLD STORE AT ONCE

Your refrigerant is obsolete. Your defrost is wasteful. Both are fixable.

A Philippine cold store or supermarket spends **25–35% of revenue on electricity**, and a fifth of the refrigeration half of that is spent **melting frost with an electric heater — inside the room you are paying to keep cold**. Meanwhile R404A (GWP 3,922) leaks 15–25% of its charge a year, carries a PFAS classification, and is on the Kigali phase-down clock. CO₂ fixes the refrigerant; FLX fixes the defrost.



21% of your energy melts frost — with a heater, inside the cold room

Every evaporator coil ices up and must be defrosted **6–8 times a day**. Conventional electric defrost dumps ~10 kW of heat straight into the cold room, then the compressor works harder to pull it back out — a double penalty worth **21% of cold-store energy and a 5–10% COP hit**. Karnot FLX does it with zero electric heaters.



R404A is a GWP-3,922 liability with a phase-down clock

R404A is a **PFAS-classified HFC** that leaks 15–25% of charge a year — a growing Scope 1 bill under SEC PFRS S2 and a refrigerant whose price climbs as the Kigali phase-down bites. CO₂ (R744) is **GWP 1, food-safe, A1, and operates at positive pressure** so air and moisture (NCG) can't leak in and rob 5–15% efficiency. Nothing on the asset register with a death date.

— ONE CO₂ SYSTEM · COLD ON ONE SIDE, FREE HEAT ON THE OTHER

KARNOT ICOOL CO₂ PLATFORM · COLD STORE + SUPERMARKET · -25 TO +90 °C FROM ONE RACK

COLD SIDE · WHAT YOU KEEP COLD

Cold rooms · freezers · display cases

Chilled rooms +2 to +4 °C, frozen stores down to -25 °C, and every supermarket display case — all from **one transcritical CO₂ rack** instead of a patchwork of leaky R404A units. Permafrost PCM rides the cold store through a brownout.



ICOOL CO₂ + FLX

FLX banks the compressor's superheat and defrosts with it. The reject heat becomes free hot water.



HOT SIDE · THE FREE BONUS

Heat recovery · store hot water

The heat you reject is recovered at **the gas cooler at 75–90 °C** — deli and bakery hot water, staff showers, crate and floor wash-down, and reheat on the dehumidification coil that keeps supermarket aisles from fogging. One machine, two outputs.

— THE FOUR BOXES · ONE PROJECT

ICOOL CO₂

Transcritical R744 · GWP 1 · A1 food-safe

Medium- and low-temperature refrigeration, **6–350 kW**. Adiabatic gas cooler + parallel compression hold **COP 3.5–4.0 at 35 °C ambient**. Positive pressure throughout — no NCG ingress, no phase-down.

FLX Flex Defrost

Bio-PCM battery · patent-pending

Defrosts with **zero electric heaters**. Stores the CO₂ compressor's superheat in a coconut-derived PCM core — copper-foam-accelerated, ultrasonically agitated — and releases it on demand. **~9.25 kWh saved per cycle, <0.5 °C product swing**.

iSAVE

HACCP logging + IPMVP M&V

Real-time temperature logging, energy analytics, **HACCP compliance alerts** and SEC PFRS S2 carbon reporting. Proves the saving and the cold-chain integrity to your auditor every month.

iVOLT + Permafrost

Zero-export solar + cold PCM

Cold stores run 24/7 — ideal for solar. iVOLT zero-export PV charges **Permafrost cold PCM** in the day; the store rides the evening peak from stored cold. Another 30–50% off the bill.

— WHAT AN HFC COLD STORE PAYS TODAY · WHAT IT PAYS AFTER

Same cold rooms. **A refrigerant with no death date.**

PER COLD STORE / SUPERMARKET	TODAY · R404A + ELECTRIC DEFROST	KARNOT iCOOL CO ₂ + FLX	YOU STOP PAYING
Defrost energy	21% of cold-store energy	0 · FLX bio-PCM defrost	~9.25 kWh / cycle × 6–8/day
Refrigerant & Scope 1 exposure	R404A GWP 3,922 · leaks 15–25%/yr	CO ₂ GWP 1 · food-safe A1	PFAS + phase-down liability
NCG / head-pressure penalty	5–15% (air + moisture ingress)	0 · positive pressure throughout	5–15% compressor energy
Rejected heat	Dumped to atmosphere	Recovered 75–90 °C	Store hot water for free
Integrated retrofit (CO₂ + FLX + solar)	(legacy already paid)	Up to 60–80% off the bill	<12-month payback

*Basis: Philippine cold store / supermarket on R404A with electric defrost, paying full commercial tariff (Meralco GP ~₱14/kWh) at 25–35% of revenue on electricity. Defrost = 21% of refrigeration energy on conventional electric heaters, eliminated by FLX. NCG penalty per published cold-store studies. iCOOL CO₂ COP 3.5–4.0 at 35 °C ambient via adiabatic gas cooler + parallel compression. **Integrated 60–80% / sub-12-month figure assumes CO₂ + FLX + iVOLT zero-export solar + Permafrost on a 24/7 load.** Refrigeration-only retrofits pay back more conservatively. Book a free cold-store audit for your site's numbers.*

THE DIFFERENTIATOR · FLX FLEX DEFROST

Everyone sells you CO₂. **Only Karnot kills the defrost bill with it.**

Conventional refrigeration defrosts its coils with an **electric resistance heater** — ~10 kW, 6–8 times a day, dumping heat into the cold room and forcing the compressor to pull it back out. That is **21% of cold-store energy and a 5–10% COP penalty**, every day. FLX is a **bio-PCM thermal battery (patent-pending, Karnot provisional 2025)** that stores the superheat the CO₂ compressor already throws away — in a coconut-derived phase-change core, copper-foam-accelerated and ultrasonically agitated — and releases it on demand to melt the frost. **Zero electric heaters, the refrigerant never leaves cooling mode, ~9.25 kWh saved per defrost and under 0.5 °C product temperature swing.** It retrofits onto existing CO₂ systems or ships native in iCOOL.

— 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 cold-chain CAPEX*

DBP · SEFP

Sustainable Energy Finance Programme

Cold-chain & agri-industrial priority.
70–80% LTV · 5–10 yr · ~6.5–8% p.a.

LANDBANK · SEILP

Sustainable Energy Investment Loan

Natural route for agri-logistics and food-distribution cold stores already banking with LandBank · ~7% p.a.

BPI · SDF

Sustainable Development Finance

Fastest decisions for established supermarket and logistics groups · ~1–1.5% below standard SME rate

These are **loans**, not grants — covered many times over by the energy and refrigerant saving. Plus **BOI Pioneer Income Tax Holiday under RA 11285**: cold-chain is food-security infrastructure. Karnot files **the loan, the BOI registration, the LGU permit pack and the monthly IPMVP M&V + HACCP report your lender and your auditor want to see** as part of project scope.

WHY NATURAL REFRIGERANTS · THE COMPLIANCE ANGLE

CO₂ and propane. *No PFAS. No phase-down. No exclusion zone.*

Legacy cold-store refrigeration is either R404A / R507A (GWP up to 3,985, PFAS-classified, Kigali phase-down, service prices climbing every year) or industrial ammonia (toxic, exclusion zones, specialist compliance). Karnot iCOOL runs on CO₂ — GWP 1, A1 safety class, food-safe, the same gas in your carbonated drinks. iSTOR / Permafrost and the FLX core are coconut-based PCM, sourced from the next province. SEC PFRS S2 climate disclosure: the Scope 1 refrigerant line goes from GWP 3,922 x leak to a rounding error, audit-grade from iSAVE.

“ Everyone in refrigeration is now selling CO₂ — it is the obvious answer to the F-gas phase-down, and we install it too. What no one else has is the defrost fix. A cold store defrosts its coils six to eight times a day with an electric heater, inside the room it is paying to keep cold — twenty-one per cent of the energy, gone. FLX banks the heat the CO₂ compressor already throws away and defrosts with that instead. Future-proof refrigerant, and the defrost bill deleted. The maths is not subtle. ”

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