COMMERCIAL BAKERIES

Heat from the cooler. *Power for the proofer.*

Hot bread coming out of the oven needs cooling. The proofers need heating. Today's bakeries do both jobs **twice** — chillers dump heat to atmosphere, electric resistance heaters buy it back. The Karnot architecture — an iHEAT R290 reversible heat pump driving twin AHUs through iSTOR thermal storage — closes that loop. **Combined COP 6–8. ~70% off the thermal energy bill.**

APPLICATION

Commercial Bakeries

Brief 42 · Edition 1 · 2026

PUBLISHED BY

Karnot Energy Solutions

Pangasinan · Philippines

WHO WE ARE

The people behind *cleaner energy.*

We're **engineers, installers and problem-solvers** building natural-refrigerant technology that **cuts energy costs** and **protects the planet.**

OUR MISSION

Replace combustion. *Replace synthetics.*

Natural refrigerant systems that deliver **75% energy savings** — just as global regulations make them essential.

CO_2 · R290 · THE NEW STANDARD

SC

OUR FOUNDER

Stuart Cox *— Founder & CEO*

Stuart brings **decades of hands-on experience** designing and delivering natural-refrigerant systems for the world's most demanding industries.

He previously founded **Likido Ltd** in Edinburgh and successfully **exited via acquisition to Dalrada Corporation (OTCQB: DFCO) in 2020.** His systems were selected for technology assessment by the **U.S. Department of Energy** and **Oak Ridge National Laboratory.** In 2023 he moved to **Pangasinan, Philippines,** to build Karnot.

ZY

RESEARCH ADVISOR

Prof. Zhibin Yu *— Chair of Energy Engineering*

Chair of Energy Engineering and Lead of the Energy Research Cluster at a UK university. **Royal Society Industrial Fellow (2023–2027)** — placing senior academics inside industrial R&D to accelerate translation. Brings deep expertise in thermal-system modelling, heat-pump performance characterisation and natural-refrigerant cycle analysis.

AM

ENGINEERING ADVISOR

Andrew McCahey *— CEng MIMechE*

Chartered Mechanical Engineer (CEng) and Member of the Institution of Mechanical Engineers (MIMechE). Reviewing engineer on Karnot's **FLX phase-change-material module design**. Brings rigorous CIBSE/ASHRAE-grade design review and UK-standard mechanical-systems verification.

PART I — THE OPPORTUNITY

Your existing AC plant is on a *phasedown clock.*

Most warehouse split systems were specified with **R32 or R410A**. Both are now mid-phasedown under **DENR DAO 2021-31** (Kigali codified into PH law). Refrigerant prices have already risen 3–5× since 2022. Service-call recharge cost is now the largest line on most facility HVAC contracts.

01 — THE GAS

GWP 2,088

R410A traps **2,088×** more heat than CO_2. R32 (the "bridge" replacement) is 675. **Karnot R290 is 3.**

02 — THE PRICE

3–5× since 2022

Wholesale R410A price **up 3–5× in four years** as Kigali quotas tighten. Recharge cost now dominates HVAC OPEX. Insurance premiums on F-gas-equipped facilities rising too.

03 — THE DEADLINE

−80% by 2047

Under DAO 2021-31 the Philippines has committed to a **10% HFC cut by 2029, 30% by 2035, 50% by 2040, 80% by 2047**. Equipment installed today must outlive the gas inside it.

2024	2029	2035	2040	2047
FREEZE	−10%	−30%	−50%	−80%
PH hits HFC consumption ceiling	Virgin HFC supply tightens	R410A becomes a financial liability	Synthetic refrigerants near-eliminated	Final phase-down target

Sources: DENR DAO 2021-31 · UN Kigali Amendment Article 5 Group 1 · IIASA HFC Asia phasedown study

PART I — THE OPPORTUNITY (CONTINUED)

Why the legacy bakery setup *always wastes the same heat twice.*

Most commercial bakeries run **completely decoupled thermal systems**: a chiller for the cooling hall and an electric resistance heater for the proofers. The chiller throws heat away. The heater buys it back at **Meralco's punitive demand-charge rates**. Four ways the existing plant fails:

01 — ELECTRIC RESISTANCE PROOFING

COP 1.0. Demand charges punish you.

A standard proofing box at 40–46 °C / 80–90% RH is held with electric resistance heaters at **COP 1.0**. At Meralco's industrial GP rate of ~₱14/kWh blended, plus combined demand charges of **~₱700/kW**, a 100 kW resistance load costs ~₱22,400/day in energy alone — before the demand-charge spike on every peak draw.

MERALCO GP APRIL 2026 · ₱14.00–14.35/KWH BLENDED

02 — COOLING HALL OVERCOOLED

Crust ruined. Energy wasted.

The cooling hall HVAC needs to hold **20–25 °C / 60–70% RH**. Standard split AC overcools to dehumidify, then electric-reheats — illegal under **ASHRAE 90.1 §6.5.2.3**. Worse: above 70% RH the bread crust stays soggy, the loaf gums up the slicer, packaging traps moisture and mould begins inside the bag.

ASHRAE 90.1 · REHEAT EXCEPTION REQUIRES RECOVERED HEAT

03 — WASTED THERMAL ENERGY

The cooler dumps. The heater buys.

Hot bread comes out of the oven at **96 °C**. The cooling-hall chiller extracts that heat and rejects it to the atmosphere via a cooling tower. **Meanwhile**, the proofing electric heater consumes new electricity to make heat from scratch. The two systems never speak. The bakery pays for the same thermal energy twice.

ENERGY HIERARCHY VIOLATION · WASTE-HEAT RECOVERY AVAILABLE

04 — MOULD & PRODUCT LOSS

Aspergillus & Rhizopus in 48–96 hours.

The Philippine ambient is 28–35 °C / 70–85% RH year-round. If cooling-hall humidity drifts above 70% or bread is packaged before reaching the 32–43 °C target, condensation forms inside the polyethylene bag. **Aspergillus and Rhizopus colonies mature in 48–96 hours**, spoiling the entire batch and shortening shelf life by days.

BREAD MICROBIOLOGY LITERATURE · W·A > 0.80 = MOULD RISK

Sources: ASHRAE Handbook Refr. Ch. 41 (Bakery Products) · CIBSE Guide B2 · Meralco GP April 2026 schedule

PART I — WHAT IT ACTUALLY COSTS

A failed batch shows up at slicing. *A failed proof shows up at retail.*

Both proofing and cooling are **narrow-window biochemical processes**. The dough is alive in the proofer; the crumb is setting in the cooler. A 5 °F deviation in either window cascades into product loss the operator can't recover.

01 — PROOF BOX TOO HOT

Protease blowout. Premature collapse.

Yeast enzyme activity **doubles every 10 °C**. A mere 5 °F over the 40–46 °C target triggers a **30% jump in protease activity**, premature cell rupture, poor oven spring, and a complete loss of structural geometry. Low-scaling-weight buns are exponentially more sensitive — they fluid up, collapse on transfer, fail QC.

BAKERPEDIA · PROOFING BIOCHEMISTRY LITERATURE

02 — PROOF BOX TOO DRY

Crusting. Shaling. Dense buns.

If proofer humidity drops below 70%, moisture rapidly evaporates from the dough surface. A **dry, rigid skin** forms (industry term: shaling) that physically inhibits volumetric expansion. The result is dense, undersized buns with dull, irregular appearance — rejected at QC, not shipped, written off.

PROOFING TARGET: 80–90% RH · <70% RH = SHALING

03 — UNDERCOOLED AT PACKAGING

Slicer collapse. Mould inside the bag.

Bread sliced and bagged above 43 °C traps internal vapour. Inside the sealed polyethylene the vapour condenses, the surface water activity climbs > 0.80, and **Rhizopus or Penicillium colonies germinate within 48–96 hours**. Mechanically: undercooled crumb gums up the slicer, sidewalls collapse, line stops.

COOLING TARGET: 32–43 °C · W·A THRESHOLD 0.80

04 — OVERCOOLED AT PACKAGING

Brittle, dry, prematurely stale.

Forcing core temperature below 32 °C extracts too much moisture. The product becomes **brittle and crumbly**. Long-term staling (amylopectin retrogradation) accelerates — the loaf ages prematurely on the supermarket shelf, gets returned, gets discounted.

ASHRAE HANDBOOK REFR. CH. 41 · COOLING PROFILING

Sources: ASHRAE Handbook Refrigeration Ch. 41 (Bakery Products) · BAKERpedia bread cooling/proofing literature · Puratos packaged-bread microbiology

PART II — THE ANSWER

One heat pump. Two jobs.
Done at the same time.

The Karnot Simultaneous Heating & Cooling architecture: an **iHEAT R290 reversible heat pump** that *extracts heat from the cooling hall* and *delivers it to the proofing hall* simultaneously, buffered by **two iSTOR thermal batteries** (44 °C hot + 22 °C cold, patented PCM). The hot bread cools the dough. The dough heats itself.

HOW IT WORKS

- **Cooling AHU** at the cooling hall — extracts the **2–3% latent moisture** evaporating from hot bread, holds the room at 20–25 °C / 60–70% RH
- **Proofing AHU** at the proof box — delivers **40–46 °C / 80–90% RH** air, on a humidistat, with no temperature overshoot
- **iHEAT R290 reversible** sits between them — the heat extracted at the cooling AHU is upgraded by the compressor and *delivered straight to the proofing AHU*
- **Two iSTOR tanks** buffer the imbalance — when cooling demand exceeds proofing demand (or vice versa), the “other” tank carries the excess. Both AHUs see continuous, stable conditions.
- **Combined COP 6–8** — for every 1 kW of compressor input, the bakery gets ~3.5 kW of cooling AND ~4.5 kW of heating

THE TOPOLOGY · SHC LOOP

Combined COP 6.0–8.0+. The cooling and the heating are **the same kWh, used twice**.

PART II — WHAT KARNOT DELIVERS

From psychrometric audit to commissioning. *We run the project.*

A single contractor across the entire mechanical scope — survey, load calculation, design, installation, commissioning, performance verification.
One number to call. One throat to choke.

01 — AUDIT

Free site visit + ASHRAE block-load calc

One day on site with our engineers. Temperature/RH datalogging at multiple zone heights. Block-load calculation per ASHRAE Heat Balance Method (HBM). **Indicative pinch report and AHU + system sizing inside 14 days.** No procurement triggered.

FREE · NO OBLIGATION · 14-DAY TURNAROUND

02 — DESIGN

Mechanical package & compliance

Full AHU + iSTOR package — R290 plant sizing, PCM thermal storage modules, glycol distribution, BMS integration, structural review. **RA 11285 / DOE classification** support, EN 378 charge-limit verification, IPMVP Option B M&V plan included. BOI registration paperwork on request.

EN 378 · ASHRAE 90.1 · IPMVP · RA 11285

03 — INSTALL

Phased rollout · zero product disruption

Phased install warehouse-by-warehouse on a 12-month national programme. **The R290 heat pump sits outdoors** — no in-warehouse mechanical work and no flammable refrigerant inside the building envelope. **Witness-tested** per CIBSE Commissioning Code M.

SINGLE CONTRACTOR · 4 JURISDICTIONS

04 — SERVICE

Scheduled service & spare-parts depot

Quarterly service visits, refrigerant-leak inspection, performance audit. **PH-based parts depot** in Pangasinan — no 8-week air-freight wait for spares. **3-year warranty** on the heat-pump core. IPMVP-compliant sub-meter data feeds the M&V baseline.

ANNUAL SERVICE CONTRACT · 3-YEAR CORE WARRANTY

PRODUCT 01 · IHEAT

iHEAT — the reversible *R290 heat pump.*

The thermodynamic engine of the architecture — *one machine charges both iSTOR tanks*, hot or cold, on demand.

Reversible **R290 (propane)** air-source heat pump in a sealed monobloc, sited outside the warehouse envelope. **Heating COP 4.14–5.59. Cooling EER 3.51–4.16.** Reverses between heating and cooling modes to charge whichever iSTOR tank is depleted — the AHU never sees the reversal because the other tank carries the load. Full DC inverter, smart controller, A+++ class, ambient operating range −25 °C to +45 °C.

REFRIGERANT · CHARGE
R290 0.55 kg · GWP 3 · EN 378 outdoor

HEATING COP / COOLING EER
4.14–5.59 / 3.51–4.16

CAPACITY LINE-UP
9.5 → 105 kW · 9 R290 + 4 R744 models

REVERSAL
On demand charges either iSTOR tank

BUILT FOR

Warehouse climate control · tobacco product storage · pharmaceutical conditioning · paper & packaging stores · cleanroom anterooms. **Pairs with iSTOR** for continuous AHU operation through reversal cycles.

PRODUCT 02 · ISTOR

iSTOR — phase-change *thermal storage tanks.*

TWO TANKS · TWO TEMPERATURES

HOT TANK	COLD TANK
44 °C	22 °C
to AHU hot coil	to AHU cold coil

Patented PCM formulation — natural phase-change fluids, sourced in the Philippines. PH-manufactured tanks. No imported synthetic chemistry.

iSTOR PCM thermal storage

22 °C COLD TANK + 44 °C HOT TANK · NATURAL PCM · PH-BUILT

The reason the AHU never has to wait for the heat pump — *both temperatures are always available.*

Two iSTOR tanks sit in the loop — **a 22 °C cold tank and a 44 °C hot tank**, both filled with natural phase-change material sourced from PH suppliers. When the reversible R290 heat pump is making hot water for the AHU's hot coil, the **cold tank discharges into the cold coil**. When the heat pump reverses to make chilled water, the hot tank carries the heating load. The AHU sees continuous, stable conditions on both sides — the warehouse never sees the reversal.

HOT TANK · PHASE-CHANGE TEMP
44 °C patented PCM · feeds hot coil

COLD TANK · PHASE-CHANGE TEMP
22 °C patented PCM · feeds cold coil

STORAGE CAPACITY
33 → 80 kWh per tank · modular

SUPPLY CHAIN
PH-sourced natural fluids · BOI-eligible

BUILT FOR

Any Karnot installation that needs **continuous AHU operation through reversible heat-pump cycles** — warehouse climate control, hospital sterile storage, F&B process plant, pharma conditioning rooms. Drives the “no interruption” promise.

PRODUCT 05 · IVOLT

iVOLT — solar panels + inverter + Li-ION battery. *No more diesel generator.*

A complete electrical package — *solar panels, inverter, and lithium-ion battery* sized to power the AHU + iSTOR + iHEAT system through any grid event.

Warehouse roofs are some of the largest **under-utilised solar surfaces** in the country. iVOLT pairs a **roof-mounted PV array** with a **Karnot inverter** and a **LiFePO4 lithium-ion battery**, integrated directly with the iHEAT load. **Solar runs the day, the battery runs the night, the grid is the backup** — and the diesel generator goes off the OPEX line entirely. Aligns directly with corporate **Climate Transition Plan** targets on Scope 2 emissions reduction.

PV ARRAY
Roof-mount site-specific · sized to thermal load

INVERTER
Karnot grid-tied · battery-coupled

BATTERY
LiFePO4 Li-ION millisecond cutover · 20-yr life

DIESEL OFFSET
~600 L/wk per warehouse · ₱1.87M/yr saved

BUILT FOR

Warehouse fleets with large roof-area-per-thermal-load ratio · operators with formal Climate Transition Plans · facilities exposed to yellow/red Luzon grid alerts in dry season.

ROOFTOP REAL ESTATE · THE COP EFFECT

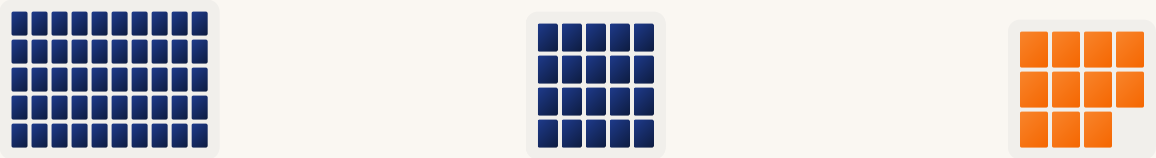
Same heat. *78% less electricity. ¼ the rooftop.*

To deliver **100 kWh/day of process heat**, an electric heater uses 100 kWh of grid power. A Karnot heat pump uses just **22 kWh — 78% less electricity for the same heat**. Fewer solar panels to power it. Lower bill. Lower carbon. Same hot water, same proofer, same process.

SOLAR FOOTPRINT · 100 KWH/DAY OF HEAT

Same heat. *¼ the rooftop.*

400 W panels needed to power the same daily heat load (PH 5 peak-sun hours).

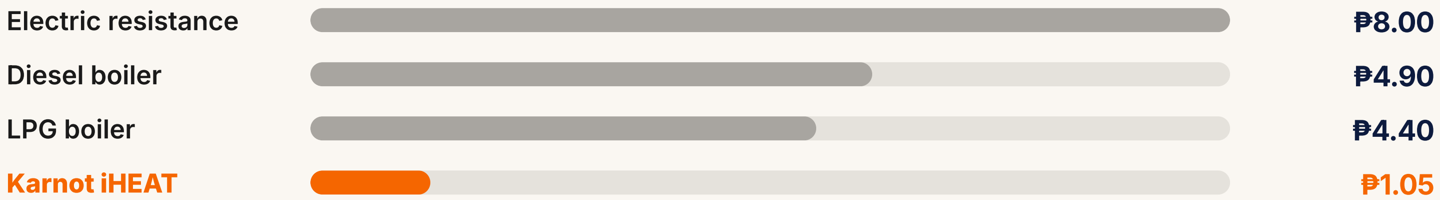


50	20	11
ELECTRIC RESISTANCE	OLDER HEAT PUMP	KARNOT IHEAT

COST OF HEAT · ₱ PER KWH DELIVERED

8× cheaper. *19× cleaner.*

Like-for-like cost to deliver one kWh of useful process heat.



COP 4.5 means a Karnot heat pump delivers **4.5 units of heat for every 1 unit of electricity it uses**. That's why the bill, the panels, and the carbon all shrink together.

~₱250K
ANNUAL SAVING · VS ELECTRIC RESISTANCE
On 100 kWh/day heat load · scales linearly with site demand

17.6 t
CO_2 AVOIDED · PER YEAR
PH grid factor 0.62 kg CO_2/kWh · DOE 2024

GWP 3
R290 WORKING FLUID
vs HFC-410A GWP 2,088 · no phasedown clock · Kigali-exempt

~78 m²
ROOFTOP AREA SAVED
39 fewer 400 W panels · room for iVOLT storage + battery

WORKED CASE · TYPICAL COMMERCIAL BAKERY

100 kW thermal load. *~70% off the bill.*

Modelled on a **typical mid-size commercial bakery** running a 100 kW combined thermal load (proofing box + DHW + cooling-hall reheat) for 16 hours/day, 6 days/week. Tariff: ₱14/kWh blended, plus combined demand charges of ~₱700/kW. Method: ASHRAE Refr. Handbook Ch. 41 + Meralco GP April 2026 schedule.

FIG. 01 · DAILY THERMAL-ENERGY COST (₱/DAY · 100 KW THERMAL · 16 H/DAY OPERATION)

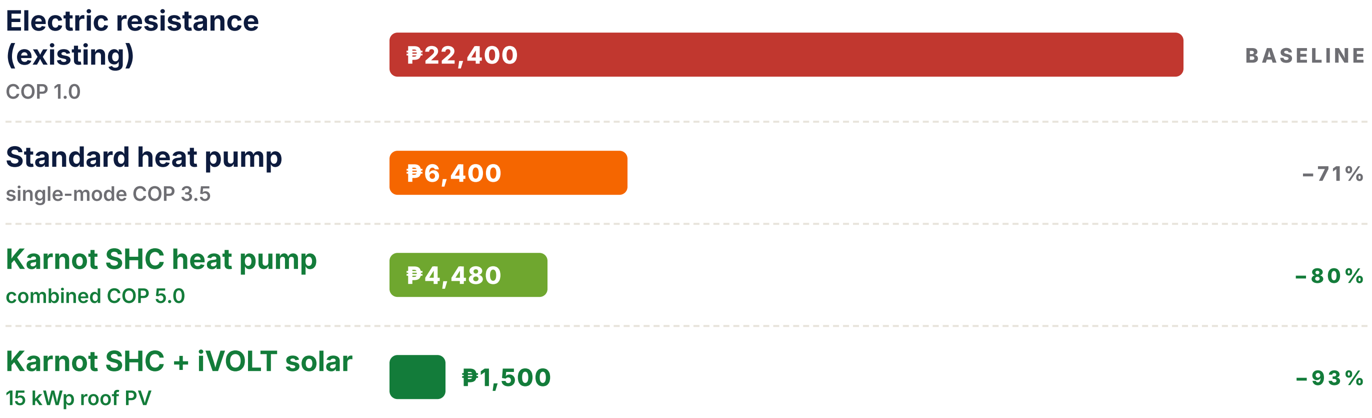
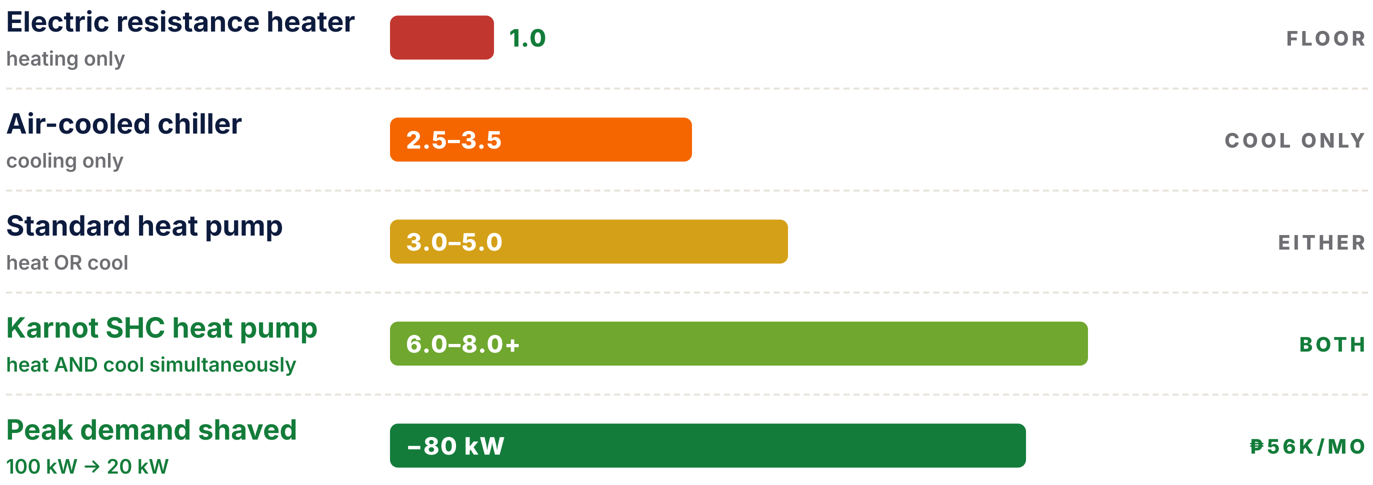


FIG. 02 · WHY SHC WINS ON COUPLED BAKERY LOADS (COMBINED COP COMPARISON · PER ASHRAE)



−80%
DAILY THERMAL ENERGY

₱6.5M
ANNUAL SAVING · HEATING SIDE ALONE

₱56K
DEMAND-CHARGE SAVING · MONTHLY

18–36 mo
PAYBACK · INDUSTRY F&B BENCHMARK

Sources: Meralco April 2026 GP rate schedule (₱8.39 generation + ₱700/kW demand) · ASHRAE Refr. Ch. 41 · Industry F&B heat-pump payback benchmark

COMPLIANCE & MEASUREMENT

Bakery-grade engineering. *Audit-ready savings.*

Bakery climate plant must satisfy **food-safety, refrigeration-safety, and energy-code** standards simultaneously. Karnot designs to ASHRAE, CIBSE, EN 378 and IPMVP from day one — and sub-meters the system so the energy savings are bankable for ESCO contracts and SEC sustainability disclosures.

01 — REFRIGERATION DESIGN

ASHRAE Refr. Handbook Ch. 41 + Ch. 23

Chapter 41 (**Bakery Products**) sizes the evaporator to handle the latent moisture released during bread cooling. Chapter 23 (**Refrigerated Facility Design**) governs vapour-barrier integrity inside proofing & cooling halls — critical for the Philippine wet season to prevent interstitial condensation and panel rot.

ASHRAE HANDBOOK REFRIGERATION · 2022 EDITION

02 — REFRIGERANT SAFETY

EN 378 / ASHRAE 15 / IEC 60335-2-89

R290 is highly flammable (A3) and direct-expansion charge limits in occupied spaces are strict. Karnot uses **indirect monoblock architecture** — the entire R290 circuit lives in a self-contained outdoor unit; only safe water/glycol enters the bakery building. Compliant up to **~80 kg charge** per IEC provisions.

IEC 60335-2-89 · INDIRECT MONOBLOCK = NO INDOOR R290

03 — AIR DISTRIBUTION & FOOD SAFETY

CIBSE Guide B2 · HEPA + positive pressure

CIBSE Guide B2 (**Ventilation & Ductwork**) governs airflow to the cooling halls — discharge velocity capped to prevent crust dehydration. HEPA filtration on supply air keeps Aspergillus and Rhizopus spores out. **Positive pressure** in the cooling hall blocks flour-dust infiltration from raw-ingredient zones.

CIBSE GUIDE B2 · POSITIVE PRESSURISATION MANDATE

04 — M&V + PH STATUTORY

IPMVP Option B · RA 11285 · BOI

Dedicated **kWh sub-meters** on the heat pump + continuous space T/RH datalogging. Mathematically isolates system boundaries and proves the combined COP — bankable for ESCO contracts and CECO reporting under **RA 11285**. **BOI fiscal incentive registration** may apply; final package case-by-case.

IPMVP VOL. 1 · RA 11285 · DOE-EUMB · BOI-SIPP

Standards basis: ASHRAE Handbooks · ASHRAE 90.1 / 62.1 / 15 · CIBSE Guides A/B2/B4 · EN 378 · IEC 60335-2-89 · IPMVP Vol. 1 · RA 11285

THE FREE TOOLS WE GIVE YOU

Run your own numbers. *No sign-up. No email gate.*

Six **live calculators** on karnot.com — built for the engineer, the CFO and the sustainability officer to use in the same conversation. Indicative output in under three minutes.

01 — RECOMMENDED FOR WAREHOUSES

Warehouse Dehumidification Sizer

m^2 + RH target + outdoor design in. Recommended Karnot DOAS unit size, projected litres/kWh, indicative payback period and CO_2 avoided per year.

karnot.com/applications/warehouse-climate-control-calculator

02 — COMPLIANCE

RA 11285 DOE Classification

Determines your facility's tier under the Energy Efficiency & Conservation Act. Triggers CECO/CEM appointment, mandatory audits and DEOS portal reporting.

karnot.com/compliance#doe

03 — CARBON

SEC PFRS S2 Carbon & F-Gas

Scope 1 + Scope 2 calculator including the F-gas refrigerant leak liability that most facility operators under-report. Built for SEC climate disclosures and corporate Climate Transition Plans.

karnot.com/compliance#sec-pfrs

04 — F-GAS RISK

Refrigerant Carbon Calculator

CO_2e impact of refrigerant leaks. R290 vs CO_2 vs R32 vs R410A vs R134a vs R404A. PFAS classification & Kigali phasedown timeline overlay.

karnot.com/engineering-hub/refrigerant-carbon

05 — PINCH

Pinch Analysis Tool

Identifies heat-recovery opportunities across the warehouse thermal load — process heat that can be recovered to reheat the dehumidifier supply air, eliminating waste.

karnot.com/engineering-hub/pinch-analysis

06 — RETROFIT ROI

Boiler / AC Retrofit ROI

Quick comparison: existing R410A split AC vs Karnot iHEAT-DOAS. Drops out a year-1 cost delta, 10-year NPV, and refrigerant-recharge avoidance — share-able single page.

karnot.com/engineering-hub/hot-water-opex

All six tools are free, no sign-up, indicative-grade. Final figures from on-site psychrometric audit.

THE COMMERCIAL MODEL

Capital purchase. *18–36-month payback per facility.*

Karnot equipment is sold outright with a **3-year warranty on the heat-pump core**. Energy-efficiency capex may qualify for **BOI incentives under RA 11285** — Karnot supports the registration paperwork. Per-facility payback figures from industry F&B benchmarks.

01 · PER-FACILITY PAYBACK

From day one, the bill drops.

SHC HEAT PUMP RETROFIT
18–36 mo
vs electric resistance + chiller baseline

+ IVOLT SOLAR BOLT-ON
+12 mo
further OPEX cut · grid-zero possible

HEAT-PUMP WARRANTY
3 yr
on the heat-pump core

ASSET LIFE
15–20 yr
no phasedown clock on R290

02 · PER-FACILITY ROLLOUT · ~6 MONTHS

Single contractor. Phased install.

Karnot delivers the whole stack — survey, design, BOI registration, install, commissioning, M&V — under one contract per facility. **Production runs through commissioning** — we install on the next planned shutdown, no lost batches.

- **Mo 1:** Site survey, ASHRAE Ch. 41 thermal-load model, BOI paperwork
- **Mo 2–3:** Mechanical design, twin-AHU package, hydronic loop layout, long-lead procurement
- **Mo 4–5:** Install iHEAT outdoor unit + iSTOR tanks + AHUs · commissioning · witness testing
- **Mo 6:** iVOLT solar (where roof permits) · IPMVP M&V baseline · handover

Specific BOI incentives subject to BOI approval — verify with your tax adviser before commitment.

NEXT STEP · A FREE PINCH STUDY

Thank you.
Now let's run your numbers.

Every Karnot project starts with a **pinch study** and a conversation. **Walk us through your plant room** — kitchens, laundry, pool plant, chillers — and we'll come back inside two weeks with an indicative system, payback under both commercial models, and the CO_2 you'd avoid. **No procurement triggered. No obligation.**

01 · FOUNDER & CEO

Stuart Cox

Direct line for site visits, pinch studies and bespoke quotes

stuart.cox@karnot.com

02 · THE COMPANY

Karnot Energy Solutions Inc.

SEC-registered · BOI-SIPP · Engineering · Compliance · Carbon · IP

karnot.com

03 · THE MARKETS

PH · UK · US · CA

Four jurisdictions · One stack · Built for the tropics · Shipping today

karnot.com/applications/warehouse-climate-control