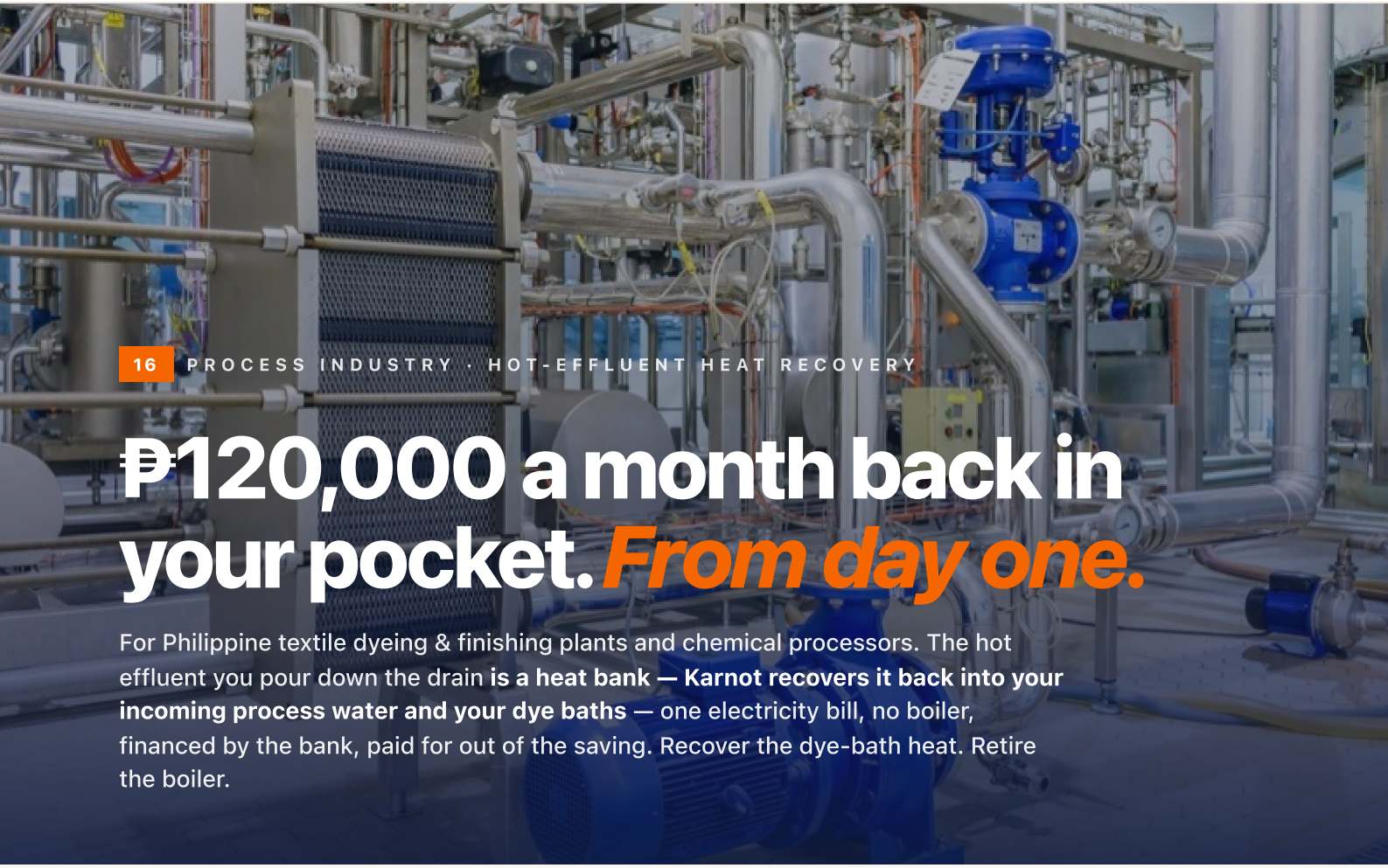

16 PROCESS INDUSTRY · HOT-EFFLUENT HEAT RECOVERY

₱120,000 a month back in your pocket. *From day one.*

For Philippine textile dyeing & finishing plants and chemical processors. The hot effluent you pour down the drain **is a heat bank — Karnot recovers it back into your incoming process water and your dye baths** — one electricity bill, no boiler, financed by the bank, paid for out of the saving. Recover the dye-bath heat. Retire the boiler.

MODELLED PHILIPPINE TEXTILE DYEING & FINISHING PLANT · DYE BATHS + FINISHING + PROCESS HOT WATER

₱120K

In your pocket every month

Saving minus the green-loan payment · from day one

1.5 yr

Cash payback

~₱3.0M install vs ~₱2.0M/yr saving · −62% energy bill

0

LPG/bunker deliveries from day one

Boiler retired · ~80 tCO_2e/yr avoided · no flame on site

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 (~₱48K). **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 process-manufacturing installs qualify for **BOI Pioneer status and Income Tax Holiday under RA 11285**.

WHY YOUR PLANT PAYS FOR EVERY KILOWATT TWICE

Your hot effluent is a heat bank. *You pour it down the drain.*

Every dyehouse runs **two opposing thermal jobs at once**: dye baths and finishing run at 60–90 °C, and the spent dye liquor leaves the machine hot and is dumped to drain — while incoming process water arrives cold and must be heated all over again. Today the boiler burns LPG or bunker fuel at ₱85/kg to heat that incoming water, and the process chiller throws its condenser heat into a cooling tower. **The same kilowatt-hour, paid for twice.** A heat pump moves it across instead: recover the dye-bath heat out of the effluent, recover the chiller heat into the hot-water load.

The hot effluent is your biggest wasted asset — and you flush it every batch

Spent dye liquor and rinse water leave the machine at **50–80 °C and go straight to the drain** — thousands of litres a shift carrying recoverable heat with them. Meanwhile incoming process water comes in cold and the boiler reheats it from scratch. A Karnot effluent heat-recovery exchanger feeds the heat pump, which **lifts that recovered heat back to dye-bath temperature** — the heat you dumped becomes the heat you buy back.

The boiler is your biggest controllable cost — and it's mostly optional

Dye baths (60–90 °C), scouring, finishing and process hot water burn roughly **₱2.4M of LPG / bunker a year** on a mid-size dyehouse. iHEAT R290 high-temp delivers **up to ~90 °C** from recovered effluent heat — covering cotton / reactive dyeing, finishing, scouring and hot water, the bulk of the load. High-temp polyester (130 °C, pressurised) keeps a small boiler top-up; everything else, the boiler is retired, not replaced.

ONE MACHINE · BOTH JOBS · ONE ELECTRICITY BILL

KARNOT PROCESS PLATFORM · TEXTILE DYEING & FINISHING MODELLED · SCALES ACROSS PROCESS PLANTS

COLD SIDE · WHAT THE PROCESS NEEDS

Process cooling · condenser cooling

Chilled water for process cooling and machine condenser duty. **The heat the chiller removes is captured, not thrown into a cooling tower.** All duties from iCOOL CO_2 at COP 4.2 — with iSTOR PCM carrying the cooling load through brownouts.

← **iCOOL CO_2 + iHEAT R290** →

Heat recovered from the hot effluent and from the process chiller is delivered to the dye-bath and hot-water load. Nothing goes to the drain or the cooling tower.

HOT SIDE · WHAT THE DYEHOUSE NEEDS

Dye baths · finishing · process hot water

Dye baths and finishing at 60–90 °C. Scouring, process hot water and drying. Fed from **recovered hot-effluent heat + recovered chiller heat** via the iCOOL gas cooler + iHEAT R290 high-temp lift to ~90 °C. Boiler: only the polyester 130 °C top-up.

THE FOUR BOXES · ONE PROJECT

iCOOL CO_2

Transcritical R744 · GWP 1 · TRL 9

Process cooling and condenser duty. **COP 4.2** at process temperatures. Gas cooler delivers **75–90 °C recovery** from the same cycle — straight into the dye-bath and hot-water load.

iHEAT R290

9.5–100 kW · COP 4.0+

Dye-bath, finishing and hot-water duty. **60–85 °C delivery; high-temp R290 reaches up to ~90 °C** at PH ambient. Outdoor install, 1.4 kg sealed charge, EN 378 compliant. **Drop-in replacement for the boiler.**

iSTOR PCM

38 kWh · 8–12 hr backup

Thermal battery on both sides: **hot buffer banks recovered effluent heat for the next dye batch; cold buffer carries process cooling through a brownout** with zero compressor load. Production keeps running.

iSAVE + iVOLT

M&V + zero-export solar

iSAVE meters every duty — **IPMVP Option B M&V report monthly** to your accountant and your lender. iVOLT zero-export solar on the plant roof cuts the remaining grid draw 30–50%.

WHAT YOU PAY TODAY · WHAT YOU PAY AFTER

A Philippine dyehouse. *A real number per batch.*

ANNUAL FIGURE · TEXTILE DYEING & FINISHING PLANT	TODAY · BOILER + OLD CHILLER	KARNOT INTEGRATED PLATFORM	YOU STOP PAYING
Process heat (dye baths + finishing + hot water)	boiler (LPG/bunker)	iHEAT R290 + effluent recovery	**₱2.4M/yr · stop paying**
Process cooling + recovered effluent heat	wasted hot effluent · COP 2.8	COP 4.2 CO_2 + recovery	**₱800K/yr**
Total energy bill (heat + cooling)	~₱3.2M/yr	~₱1.2M/yr	**–62% / ~₱2.0M/yr**
Scope 1 + refrigerant exposure	~70 tCO_2e + R404A GWP 3,922	R744 GWP 1 · R290 GWP 3	**~80 tCO_2e/yr avoided**
Total investment (VAT-inc)	**(already paid)**	**~₱3.0M**	**1.5 yr cash payback**

Basis: Philippine textile dyeing & finishing plant · dye baths 60–90 °C, scouring, finishing and process hot water. Hot-effluent heat recovery feeds the heat pump; high-temp polyester dyeing (130 °C, pressurised) retains a small boiler top-up — the heat pump fully covers cotton / reactive dyeing, finishing, scouring and hot water, the bulk of the load. LPG ₱85/kg at 82% boiler efficiency; Meralco GP ₱14/kWh. CAPEX includes iCOOL CO_2, iHEAT R290 high-temp, effluent heat-recovery exchanger, buffers, controls, commissioning and Permits-Managed Service. ***Process plants scale up and down — the per-batch economics hold.*** *Excludes iVOLT solar, which cuts the remaining ₱1.2M a further 30–50%.*

THE CASH FLOW · PLAIN AND DULL

MONTH 1

₱120K

~₱167K monthly saving **minus** the green-loan payment (~₱48K). Net cash in pocket. Every month. From day one.

YEAR 1

₱1.4M

In your pocket while the loan is being repaid. **The kit has paid for itself in cash terms by month 18.**

YEAR 5

₱7.2M

Loan paid off in year 7. Until then you bank ~₱1.4M a year **after** the loan payment.

YEAR 15

₱26M

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

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 (dye-bath effluent that must cool, process-chiller heat that must leave) against every cold stream (incoming process water and dye baths that must heat) and computes **$Q_H$min and $Q_C$min — the absolute minimum heating and cooling your plant needs** after maximum heat recovery. Everything above that minimum is waste. The pinch point in a dyehouse sits around 40 °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 62%, 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 production 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 process-industry 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 and agri-linked processors** 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 3.5× 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 wants to see** as part of project scope.

WHY NATURAL REFRIGERANTS · THE PROCESS-SAFETY ANGLE

CO_2 and propane. *No ammonia zone. No F-gas clock.*

Legacy process 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)**. Karnot iCOOL runs on CO_2 — **GWP 1, A1 safety class**. iHEAT runs on R290 outdoors with a sealed 1.4 kg charge under EN 378 — the design basis is EN 378, not ASHRAE 15. Nothing on the asset register has a phasedown date, an exclusion zone, or an insurance loading. **SEC PFRS S2 climate disclosure: ~80 tCO_2e/yr avoided, audit-grade data from iSAVE.**

> **"A dyehouse is the textbook case for hot-effluent heat recovery — the pinch analysis writes itself. The spent dye liquor must lose exactly the heat the incoming process water and the next dye bath must gain. Today Philippine processors flush that heat down the drain and pay the boiler to make it again. One Karnot platform does both jobs from one electricity bill: recover the dye-bath heat, lift it back to temperature with high-temp R290, retire the boiler. ₱3.0M installed, ₱2.0M back every year, and the bank finances it against the saving. The maths is not subtle."**
>
> **Stuart Cox · Founder & CEO · Karnot Energy Solutions Inc.**