16 PROCESS INDUSTRY · HOT-EFFLUENT HEAT RECOVERY

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

A Philippine textile dyeing & finishing plant, recovering the heat from its hot effluent back into the incoming process water and the dye baths from one Karnot platform — one electricity bill, no boiler, financed by the bank, paid out of the saving. Scales across process plants.

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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 hot and is dumped to drain; meanwhile incoming process water arrives cold and must be heated from scratch. The same kilowatt-hour, paid for twice — once to the boiler to heat the water, once flushed away in the effluent you discard.

The hot effluent is your biggest wasted asset

Spent dye liquor and rinse water leave the machine at **50–80 °C and go straight to the drain** — thousands of litres a shift. 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 is the heat you buy back.

The boiler is mostly optional — and nobody told you

Dye baths, scouring, finishing, hot water: 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. **High-temp polyester (130 °C) keeps a small top-up; everything else, the boiler is retired, not replaced.**

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THE ARCHITECTURE · ONE MACHINE, BOTH JOBS

Recover the dye-bath heat. *Lift it. Retire the boiler.*

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 from iCOOL CO_2 at **COP 4.2** — and recovered straight into the hot side.

ICOOL CO_2 + IHEAT R290

Heat recovered from the hot effluent and 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 60–90 °C. Scouring, process hot water, drying. Fed from **recovered hot-effluent heat + recovered chiller heat** via the CO_2 gas cooler + iHEAT R290 high-temp lift to ~90 °C. **Boiler: only the polyester top-up.**

ISTOR PCM · BOTH SIDES BUFFERED

Hot buffer banks recovered effluent heat for the next dye batch. **Cold buffer carries process cooling through a brownout — production keeps running.**

THE DYE MACHINES STAY

Your jet dyeing, jigger and finishing lines don't change. **We replace the utilities around them, not the process line.** Commissioning across scheduled maintenance windows.

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THE FOUR BOXES YOU ACTUALLY NEED

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

iCOOL CO_2

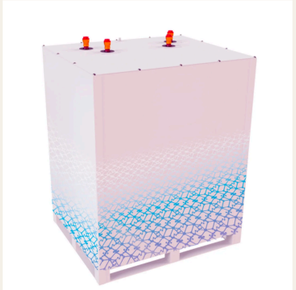
Transcritical R744 · GWP 1 · A1 safe

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+ · up to ~90 °C

Dye-bath, finishing and hot-water duty. **Drop-in replacement for the boiler.** High-temp R290 reaches up to ~90 °C. 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 effluent heat banked for the next dye batch. **Cold:** process cooling rides through a PH brownout with zero compressor load. 1,500+ charge cycles.

iSAVE + iVOLT

IPMVP M&V + zero-export solar

iSAVE meters every duty — **monthly IPMVP Option B report to your accountant and your lender**. iVOLT zero-export solar cuts the remaining grid draw 30–50%. Plant roofs are flat and big.

THE BILL · MODELLED TEXTILE DYEING & FINISHING PLANT

₱3.2M energy bill today. *₱1.2M after. −62%.*

ANNUAL FIGURE	TODAY · BOILER + OLD CHILLER	KARNOT PLATFORM	YOU STOP PAYING
Process heat (dye baths + finishing + hot water)	boiler (LPG/bunker)	iHEAT R290 + effluent recovery	**₱2.4M/yr**
Process cooling + recovered effluent heat	wasted hot effluent · COP 2.8	COP 4.2 CO_2 + recovery	**₱800K/yr**
Scope 1 + refrigerant exposure	~70 tCO_2e + GWP 3,922	GWP 1 & 3 · natural	**~80 tCO_2e/yr**
Total investment (VAT-inc)	**(already paid)**	**~₱3.0M**	**1.5 yr payback**

Basis: Philippine textile dyeing & finishing plant. Dye baths 60–90 °C, scouring, finishing, process hot water. Hot-effluent heat recovery feeds the heat pump; high-temp polyester dyeing (130 °C, pressurised) retains a small boiler top-up. 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, Permits-Managed Service. ***Process plants scale up and down — the per-batch economics hold.*** *Excludes iVOLT solar (further 30–50% off the remainder).*

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THE CASH FLOW · BANK-FINANCED

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

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

Banking ~₱1.4M a year after the loan payment. **The loan clears in year 7 — then you keep all of it.**

YEAR 15

₱26M

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

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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 and agri-linked processors 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 **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** as part of project scope.

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THE ENGINEERING BEHIND THE NUMBER · PINCH ANALYSIS

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

NUMBER 1 · MINIMUM HEATING

$Q_H min$

The **absolute least boiler energy** your plant needs after maximum heat recovery. If your boiler burns more than this — and in every dyehouse we have surveyed, it does — **the difference is pure waste**.

NUMBER 2 · MINIMUM COOLING

$Q_C min$

The **absolute least chiller energy** required after recovery. Everything your process chiller removes above this is heat you paid to make and then **paid again to throw away**.

NUMBER 3 · THE BOTTLENECK

~40 °C

The dyehouse 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 62%, 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/idiots-guide-utility-pinch-analysis*

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THE REFRIGERANT DECISION · PROCESS-SAFETY ANGLE

Three ways to cool a process plant. *Two of them have a clock running.*

LEGACY HFC · THE PHASEDOWN

3,922

GWP of R404A · F-gas phasedown clock

R404A / R134a process 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_3 is efficient but **toxic — exclusion zones, specialist technicians, emergency response plans**, and an insurance loading. Sized for heavy-industrial scale, not the mid-size process plants that make up the growing PH manufacturing base.

KARNOT NATURAL · NO CLOCK, NO ZONE

GWP 1

CO_2 (R744) + propane (R290 · GWP 3)

CO_2 is A1 class — non-toxic, non-flammable. R290 sits outdoors in a sealed 1.4 kg charge, designed to EN 378 (not ASHRAE 15). No phasedown, no exclusion zone, no insurance loading, **nothing on the asset register with a death date.**

SEC PFRS S2 climate disclosure: ***~80 tCO_2e/yr avoided, audit-grade data from iSAVE, monthly.***

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WHAT HAPPENS NEXT

Four steps from this deck *to a retired boiler.*

1 Send us three things

12 months of LPG / bunker + electricity bills, your dye-bath temperatures, and your production 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 production log — **refunded in full when you proceed to install**. Output: your $Q_H$min, $Q_C$min 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 no lost production

The dye machines stay. We swap the utilities around them — commissioning across scheduled maintenance windows. Boiler retired on handover day.

GET YOUR PLANT'S NUMBERS

Send us your *12 months of bills, dye-bath temperatures and production schedule.*

Stuart Cox · Founder & CEO
stuart.cox@karnot.com
+63 75 510 8922

karnot.com / applications / process-industry
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