Solar-Thermal Ice Systems — Scale-Up Pricing

10, 20 & 50-Panel Arrays — Cost Amortized Straight-Line Over 25 Years (No Financing / No Interest)

MTD refrigeration-in-a-box: 5-panel UV thermal array on an elevated canopy frame above a modified ISO shipping container (illustrative rendering)

MTD's ammonia-absorption ice system runs on solar heat alone — no compressor, no inverter, no refrigeration-scale battery. The array is modular: the same design scales from a 5-panel reference unit up to 10, 20, or 50 panels, with installed cost per ton of annual ice capacity falling as scale increases. Figures below simply divide each system's total installed cost evenly across a 25-year service life — a straight-line amortization with no loan, no interest, and no financing assumptions.

25-Year Straight-Line Amortized Pricing

Array Size	Installed Cost	Annual Ice Output (t/yr)	Avg. Daily Output (t/day)	Amortized Annual Cost	Amortized Monthly Cost	Cost per Ton of Ice, Amortized
10 Panels	$416,448	807.1	2.21	$16,658	$1,388	**$20.64**
20 Panels	$715,552	1,614.2	4.42	$28,622	$2,385	**$17.73**
50 Panels	$1,472,990	4,035.6	11.06	$58,920	$4,910	**$14.60**

Amortized cost = total installed system cost ÷ 25 years (annual) or ÷ 300 (monthly). No interest, financing fees, or loan terms are applied — this is a straight-line depreciation of the equipment cost only. Source: Modern Thermal Design internal engineering sizing model, September 2026 (MTD Ice Sizing Worksheet, "Scale-Up & Amortization" sheet).

Why Cost per Ton Falls as You Scale

$365	$14.60	0%
per ton/yr capacity	amortized $/ton	output degradation
installed cost at 50 panels	at 50 panels, 25-yr	assumed over 25 years
vs. $602/ton at 5-panel scale	straight-line, no interest	— unlike PV (see below)

UV Solar Thermal Never Degrades — Unlike PV

Modern PV panels lose roughly 0.5–0.7% of rated output every year, cumulating to an estimated 13–20% loss by year 25 — why 25-year PV warranties typically only guarantee 80–87% of original output (NREL; Energy Solutions, 2026). That decline comes from semiconductor-level wear inside the PV cell itself. MTD's evacuated-tube UV thermal collectors have no PV cell to degrade, aging instead through discrete, field-repairable wear (tube vacuum loss, coating degradation) with a 15–25+ year typical service life (SRCC OG-100 durability testing). This sheet assumes 0% output degradation over the full 25-year term — a PV-electric competitor's output and $/ton economics erode every year, plus a costly battery/inverter replacement around year 10–15 that the MTD thermal array does not require.

Why Thermal Needs Far Less Solar Field

Matching this array's output with a PV-battery-electric system takes far more collector area. A representative 19.8 kWp PV-electric plant (36 × 550 W panels) needs about 93 m² (1,001 ft²) of bare module area — roughly 150 m² (1,600 ft²) once racking and row spacing are installed — versus just 13 m² (140 ft²) for MTD's 5-panel thermal array, about 1/7th the collector footprint, because driving the absorption cycle directly with solar heat is far more area-efficient than first converting sunlight to electricity.

93 m²	13 m²
PV-electric panel area	MTD thermal panel area
36 × 550 W (~19.8 kWp), 1,001 ft²	5-panel array, 140 ft² — 1/7th the space

For scale: a PV-battery-electric system of equivalent output (illustrative rendering) — the elevated panel canopy alone covers roughly 7× the collector area of MTD's thermal array

Standard 550 W module dimensions (2,278 × 1,134 mm) per LONGi datasheet; installed PV footprint assumes a 60% ground-coverage ratio for row-to-row spacing at low fixed tilt. Sources: LONGi 550 W datasheet, https://www.todoensolar.com/LONGI-550W-Solar-Panel-with-great-power-and-efficiency — Maysun Solar, "Solar Panel Dimensions," https://www.maysunsolar.com/blog-what-are-the-standard-sizes-of-solar-photovoltaic-panels/.

Optional Upgrade: Efficiency Optimization + Thermal Storage

Bank solar heat during peak sun and discharge it after sunset to extend the daily ice-making cycle by 2 hours — 9 to 11 hrs — without adding a single panel. Combined with optimistic-case cycle-efficiency performance, this lifts full-array output 63% over baseline on the same 5-panel reference array: 1.11 to 1.80 metric tons/day (403.6 to 657.6 metric tons/year). The upgrade adds one insulated ≈1,150-gallon thermal storage tank with an internal finned HTF coil, charged to 350°F and discharged down to a 250°F floor, plus a bulk mineral heat-transfer oil charge sized to that swing. The system runs on free solar heat, not purchased fuel or grid power — the only real purchased-equivalent input is the ~20 W dedicated PV/battery valve-automation package.

+63%	+2 hrs/day	$27,534
more daily ice output	extended operating hours	added installed cost
1.11 → 1.80 t/day, same 5-panel array	9 → 11 hrs via banked solar heat	insulated tank + oil charge, 5-panel scale

Added cost reflects one insulated storage tank (≈$12,350) plus a 1,112-gallon bulk thermal-storage oil charge (≈$15,184 at $13.65/gal). Storage sizing scales with array size for 10/20/50-panel systems; figures above are for the 5-panel reference array. Source: Modern Thermal Design internal engineering sizing model, September 2026 (MTD Ice Sizing Worksheet, "Output-Boosting Levers" and "Thermal Storage Tank Sizing" sections; HTF properties per Eastman Therminol 66 Technical Data Sheet, https://www.eastman.com/content/dam/eastman/corporate/en/literature/t/tf8695a.pdf).

UV Thermal Collector — Efficiency

95%
collector efficiency
solar radiation → usable heat in the
HTF loop; ~5% optical/thermal losses

Collector Efficiency = Usable Heat Out ÷ Incident Solar Radiation

Collector: ~95% of incident solar radiation converted to usable heat in the HTF loop (~5% optical/thermal losses)

MTD's evacuated-tube collectors are themselves highly efficient — approximately 95% of incident solar radiation reaches the HTF loop as usable heat, with only ~5% lost to optical/thermal losses at the collector (reflection, glazing transmission, tube heat loss). Since ammonia-absorption ice-making draws no fuel or grid electricity for the cooling cycle itself, the only real purchased-equivalent input is the ~20 W PV/battery valve-automation package. Source: Modern Thermal Design internal engineering sizing model, September 2026 (MTD Ice Sizing Worksheet, heat-input and collector-efficiency assumptions).

Philippine Incentives — RA 9513 Renewable Energy Act

The Philippines' own Renewable Energy Act of 2008 (RA 9513) is a strong fit for this system: DOE guidance confirms these incentives cover both power and non-power applications — including solar-thermal process heat like this ammonia-absorption cycle, once certified as a DOE RE Developer (typically via a Philippine-registered entity, cooperative, or JV partner).

7 Years	10 Years	0% VAT
Income Tax Holiday	Duty-Free Equipment Import	On Local Project Purchases
10%	**50%**	**100%**
Corporate Tax Rate After ITH	Missionary Electrification Cash Incentive	Tax Credit, Domestic Equipment/Services

Outer-island barangays (Tawi-Tawi, Basilan, Sulu, and similar unserved coastal sites) — this system's target market — are exactly the "missionary" areas the electrification cash incentive was designed for. Note: U.S. federal solar tax credits do not apply to this system — they're limited to electricity-generating property used within the United States; this is a Philippine-sited, solar-thermal (non-electric) system.

Which Incentives Directly Cut Capex?

Only three of the incentives above reduce the project's upfront capital cost directly — the rest reduce ongoing income or property tax instead. Duty-free importation and VAT zero-rating remove taxes normally baked into the landed/installed cost; the domestic-content tax credit gives the same benefit for locally sourced balance-of-system materials and labor.

0–5%	12%	12–17.6%
Import Duty Waived	VAT Waived	Combined Capex Avoided
on RE machinery & equipment (10 yrs)	on landed cost + local purchases	vs. a non-incentivized cost baseline

12% applies if the underlying import duty is already 0%; up to 17.6% if a 5% duty would otherwise apply, since duty and VAT compound (cost × (1 + duty%) × 1.12, all waived). Requires DOE certification as an RE Developer, typically held by a Philippine-registered entity. Source: The Mills Global, "Renewable Energy Equipment Importation in the Philippines," https://themillsglobal.com/articles/renewable-energy-equipment-import-philippines.

SOURCES: NREL, "Photovoltaic Degradation Rates — An Analytical Review," https://docs.nrel.gov/docs/fy12osti/51664.pdf — Energy Solutions, "Solar Panel Degradation Rates 2026," https://energy-solutions.co/articles/sub/solar-panel-degradation-rates-2026 — Ingener.by, "Evacuated Tube Solar Collectors," https://ingener.by/specialty-applications-testing/specialty-hvac-applications/service-water-heating-domestic-hot-water/water-heater-types/solar-water-heating/evacuated-tube-collectors/ — Ingener.by, "Flat Plate vs Evacuated Tube Solar Collectors," https://ingener.by/specialty-applications-testing/specialty-hvac-applications/service-water-heating-domestic-hot-water/solar-water-heating/flat-plate-vs-evacuated-tube/. Volume discounts of 5/10/15% and a 0.75 cost-capacity exponent applied at 10/20/50-panel tiers; budgetary estimates, final pricing subject to site engineering.
PH INCENTIVES SOURCES: Philippine DOE, "RE Developers," https://doe.gov.ph/re-developers — PwC Philippines, "Is investing in renewable energy a power move?," https://www.pwc.com/ph/en/tax/tax-publications/taxwise-or-otherwise/2024/is-investing-in-renewable-energy-a-power-move.html — agcprime, "Philippine Renewable Energy Act: Tax Incentives," https://agcprime.com/blog/renewable-energy-act-incentives-philippines. Subject to DOE certification and change; consult a Philippine tax advisor.

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