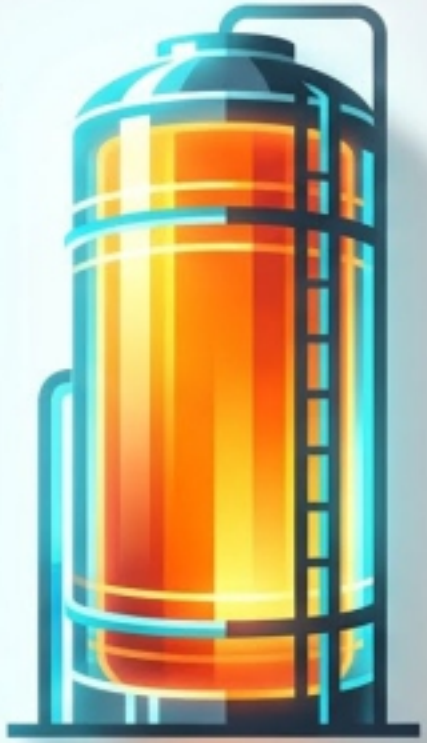
High-Temperature Thermal Storage

Engineering the Industrial Decarbonization Bridge.



A Research Study by DOMISTAT

A strategic overview of Sand, Salt, and Ceramic HTS deployment.

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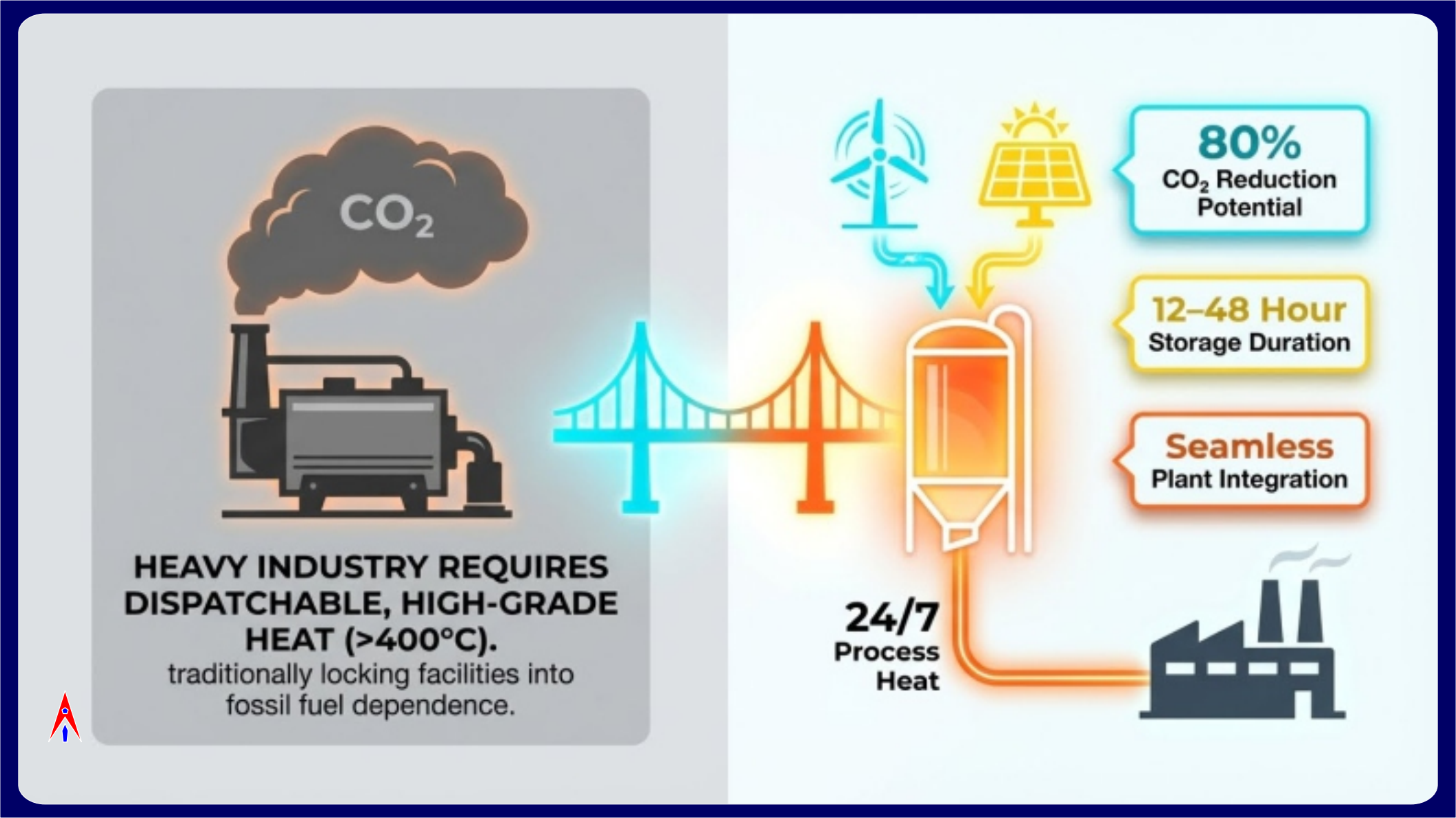

CO_2
HEAVY INDUSTRY REQUIRES DISPATCHABLE, HIGH-GRADE HEAT (>400°C).
traditionally locking facilities into fossil fuel dependence.
80%
CO_2 Reduction Potential
12–48 Hour
Storage Duration
Seamless
Plant Integration
24/7
Process Heat

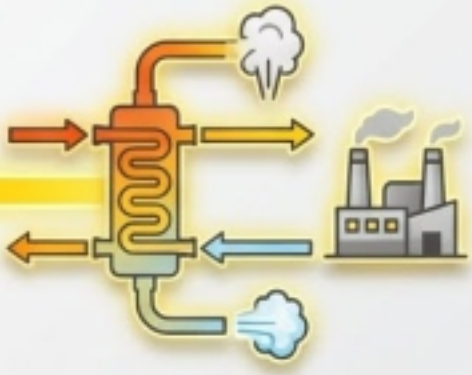
1. Charge

Intermittent renewable electricity powers highly efficient electrical resistance heaters, converting electrons into extreme thermal energy.

2. Store

Heat is captured in an insulated medium (sensible heat storage) with minimal thermal loss over multi-day durations.

3. Discharge



Hot media transfers heat through an exchanger to generate steam, drive air-Brayton cycles, or provide direct industrial process heat.

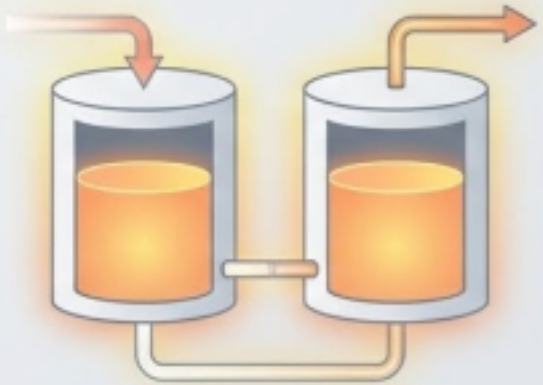
BASELINE STANDARD: MOLTEN SALT MEDIA

MAX TEMPERATURE	565°C
COST FACTOR	Moderate (~$0.10/kWh)
SAFETY	Non-toxic / Non-flammable (if operated within strict temperature limits)

HOW IT WORKS:
Nitrate or chloride salt mixtures are heated (290°C–565°C) and stored in insulated tanks as liquids.

EFFICIENCY:
85–95% round-trip thermal efficiency.

ADVANTAGE:
Commercially proven technology. The second most-used high-temp medium, widely deployed in Concentrating Solar Power (CSP) plants.



HIGH-SCALABILITY: SAND-BASED SYSTEMS

MAX TEMPERATURE	**1,000°C+**
COST FACTOR	Extremely Low (Target LCOS $0.05–$0.07/kWh; material cost ~$30/ton)
SAFETY	Completely inert, abundant, zero environmental toxicity

HOW IT WORKS:
Sand is heated to extreme temperatures via resistance heaters, retaining >95% of stored heat for at least five days.

ADVANTAGE:
No geological restrictions, zero phase-change management, and virtually no material degradation over decades of use.

STATUS:
Advancing from pilot to commercial-scale, with high potential for repurposing existing fossil fuel infrastructure.

THE ULTRA-HIGH TEMP FRONTIER: ADVANCED CERAMICS

MAX TEMPERATURE

1,500°C

COST FACTOR

Low (Highly cost-effective for extreme-efficiency systems)

SAFETY

Inert / Zero leakage risk (solid state)

HOW IT WORKS:

Solid-state ceramic materials (high-density magnesia, alumina) store sensible heat at extreme temperatures without ever undergoing a phase change. Match these capabilities to the thermal media comparisons.

ADVANTAGE:

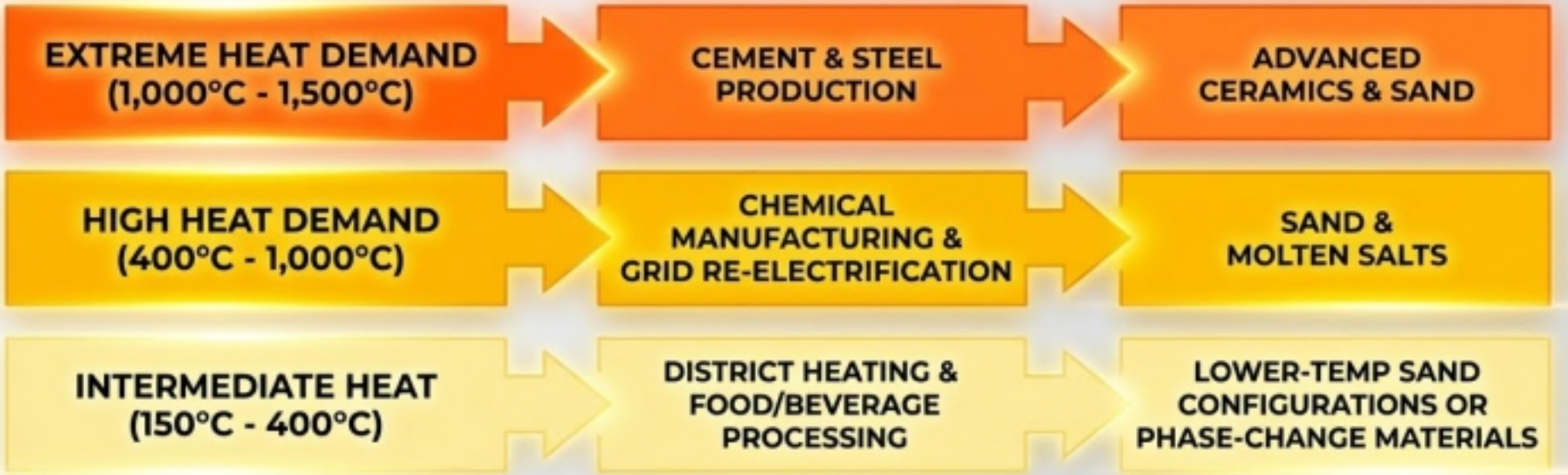
Exceptional temperature stability enables next-generation high-efficiency power cycles (like supercritical CO2). Requires only pressure isolation, avoiding complex high-temperature fluid management.

THERMAL MEDIA DIAGNOSTIC COMPARISON

MEDIUM	MAX TEMPERATURE °C	STORAGE COST FACTOR	TOXICITY/SAFETY
MOLTEN SALT	565°C Commercially Proven Baseline	Moderate (~$0.10/kWh)	Non-toxic within limits
SYNTHETIC SAND	1,000°C+ Maximum Scalability & Low Cost	Very Low (~$30/ton)	Inert/Abundant
SOLID CERAMIC	1,500°C Ultimate Temperature Capability	Low	Zero Leakage Risk

While molten salt remains the proven commercial standard, solid-state media (sand and ceramics) unlock the extreme temperatures required to fully decarbonize the heaviest industrial processes.

ALIGNING THE HEAT SOURCE TO THE HEAVY INDUSTRY



Economic drivers dictate that industrial facilities must match the storage medium precisely to their thermal threshold—replacing high-temp electric boilers with optimally engineered HTS.

THE FUTURE OF 24/7 CLEAN HEAT

“DECARBONIZING HEAVY INDUSTRY DOES NOT REQUIRE THEORETICAL CHEMISTRY—IT REQUIRES THE PRECISE APPLICATION OF ABUNDANT, HIGH-TEMPERATURE MATERIALS.”

COST PARITY

Utilizing ultra-cheap materials like sand ($30/ton) and ceramics drives LCOs below fossil fuel equivalents.

INFRASTRUCTURE AGNOSTIC

Solid-state sensible heat allows global deployment without the geological constraints of pumped hydro or CAES.

COMPLETE INTEGRATION

Repurposing existing fossil infrastructure with HTS silos creates a seamless bridge to 100% renewable process heat.