STRATEGIC ASSET BRIEFING

The 5,200
The 5,200 Terawatt-Hour Question

Monetising Waste Heat and De-risking the Global Nuclear Fleet

The Heat Vault Company | 2025

The low-carbon baseload champion.

2,602 TWh

Electricity generated by the global fleet in 2023

2.1 Billion

Tonnes of CO_2 avoided, surpassing the annual emissions of almost every nation

81.5%

Average global capacity factor, proving unparalleled grid reliability

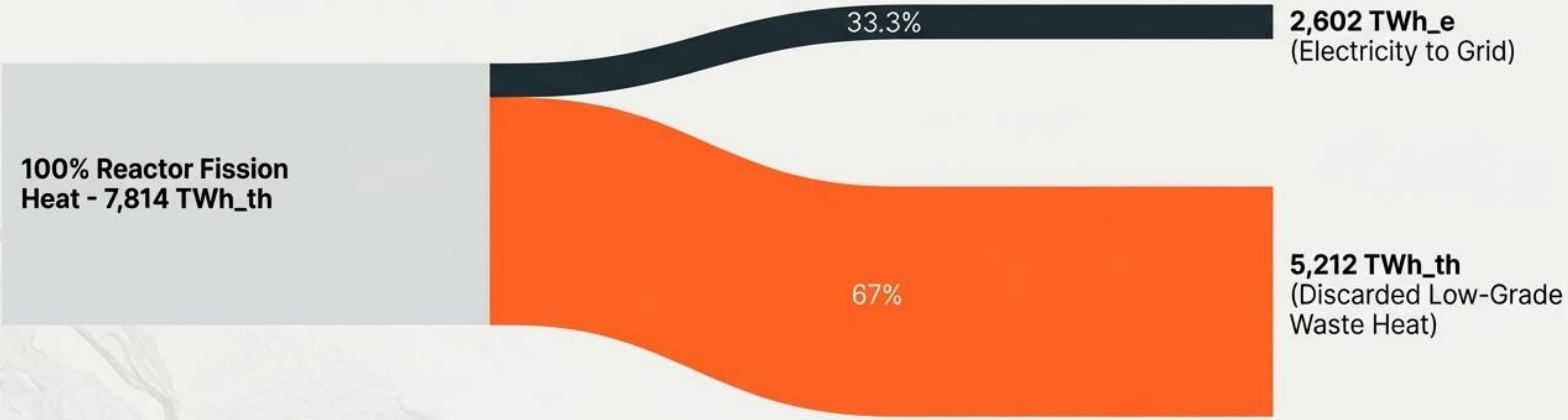
Nuclear power provides a quarter of all global low-carbon electricity.
But its primary output isn’t electricity.

The Inherent Thermal Paradox

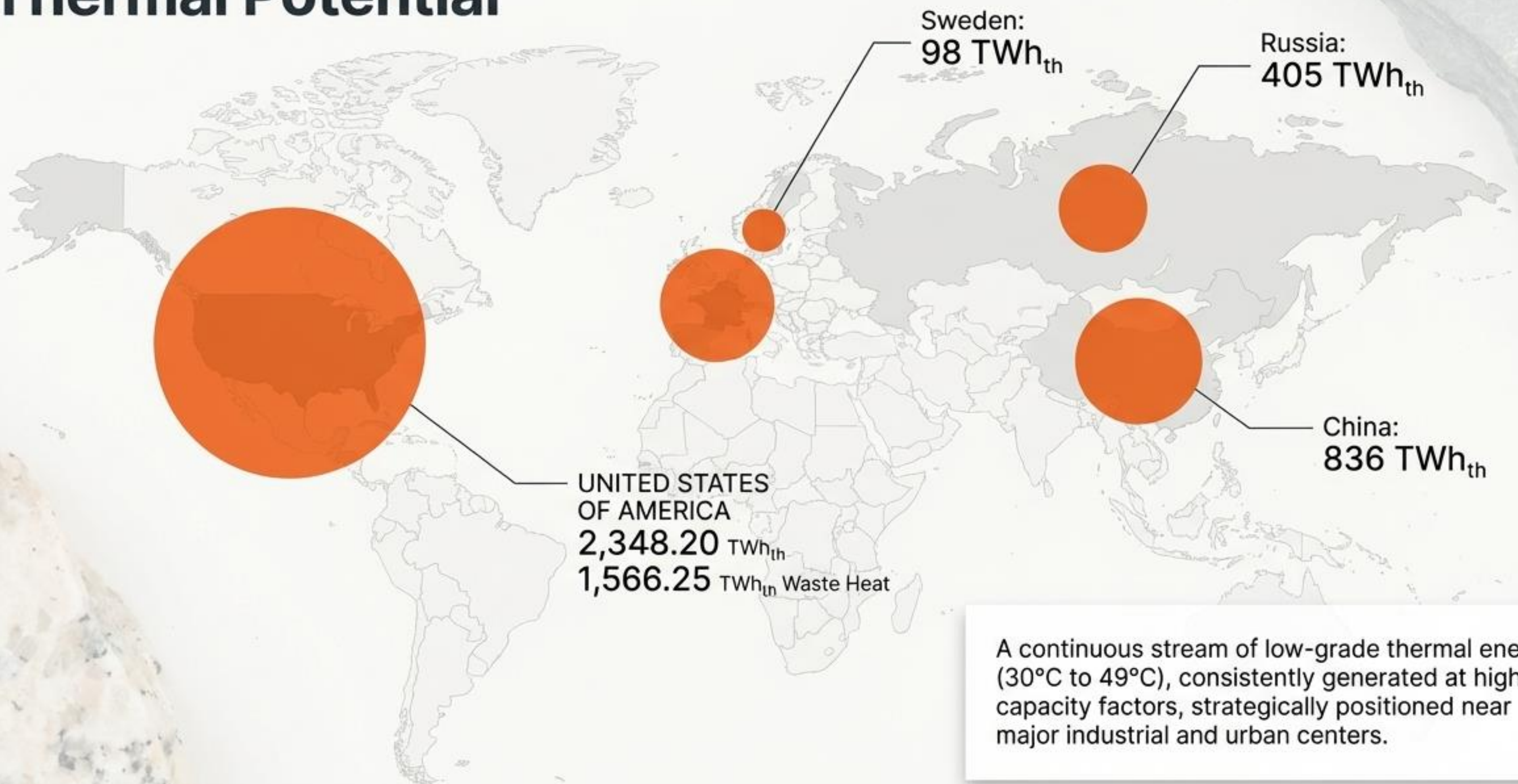
Bounded by the 2nd Law of Thermodynamics and the Rankine steam cycle, Light Water Reactors achieve a **maximum net thermal efficiency of ~33%.**

For every megawatt of electricity sold, two megawatts of thermal energy are perpetually discharged into the environment.

This is not a design flaw. It is a 5,200 TWh unmonetised resource.



The Geographic Concentration of Thermal Potential



A continuous stream of low-grade thermal energy (30°C to 49°C), consistently generated at high capacity factors, strategically positioned near major industrial and urban centers.

The Burden of Dissipation: Current Thermal Management

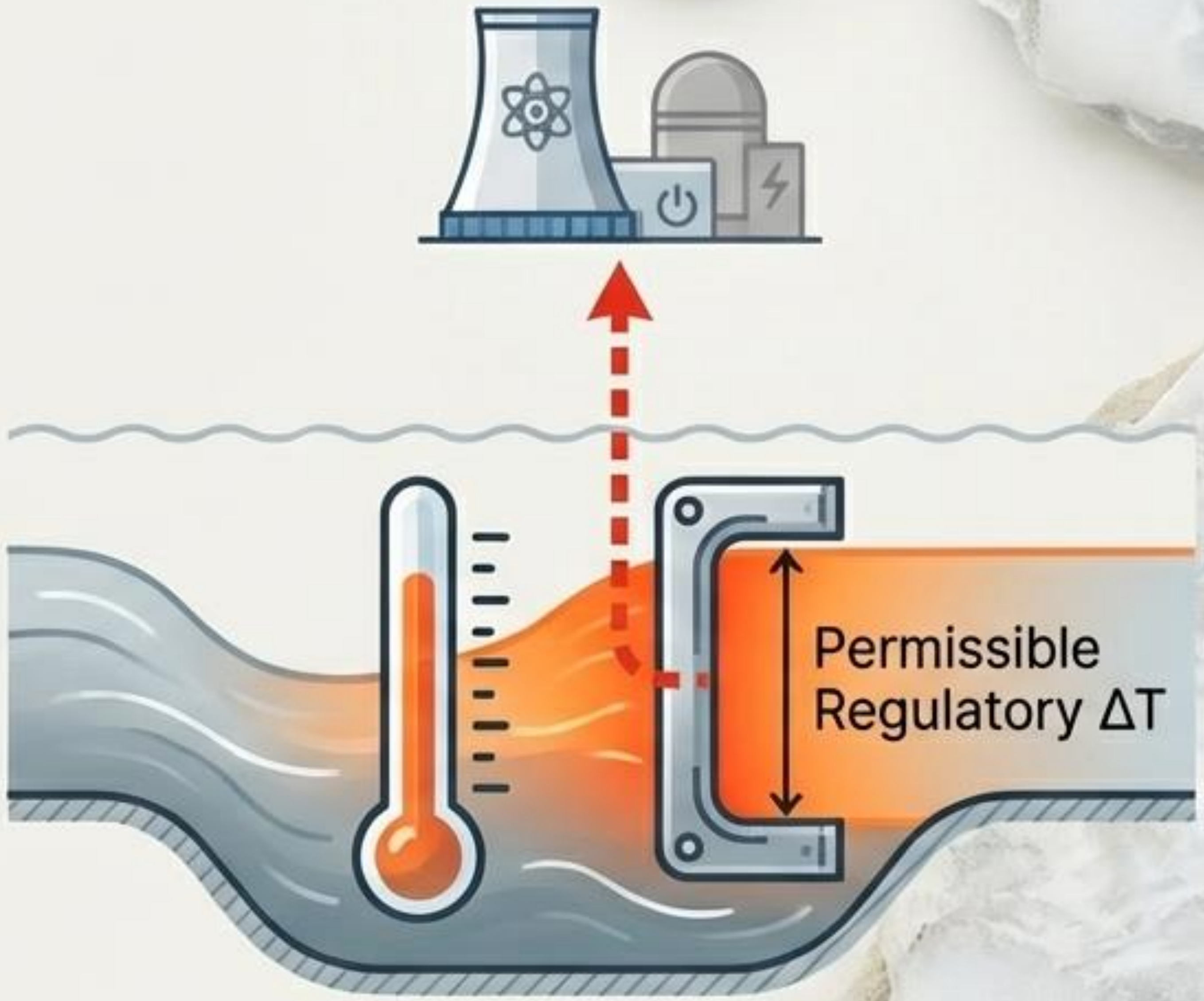
	Once-Through Cooling	Recirculating Cooling
Water Withdrawal Volume	Extreme: 25k-60k gal/MWh	Low
Net Water Consumption	Low: water returned	High: 600-800 gal/MWh evaporated
Primary Climate Vulnerability	Rising ambient river temperatures & strict ΔT limits	High ambient air temperature & humidity diminishing evaporative efficiency

Unlike fossil plants that exhaust 15% of heat via flue gas, nuclear must discharge ~100% of its waste heat into water-based systems, magnifying climate vulnerability.

The Defensive Crisis: The Climate Squeeze

Environmental regulations strictly cap the maximum temperature of discharged water to protect aquatic ecosystems. As climate change drives ambient river temperatures higher, the plant's thermal margin evaporates.

To avoid breaching limits, operators must curtail power or shut down—invariably during summer heatwaves when wholesale electricity prices and demand peak.



Financial Reality: In 2022, a combination of **climate factors and corrosion forced a historic 24% decline in France's nuclear output**, resulting in an estimated **€18.5 billion EBITDA negative** impact for EDF.

From Dual-Crisis to Dual-Asset

Offensive Failure: Leaving 5,200 TWh of unmonetised value on the table.

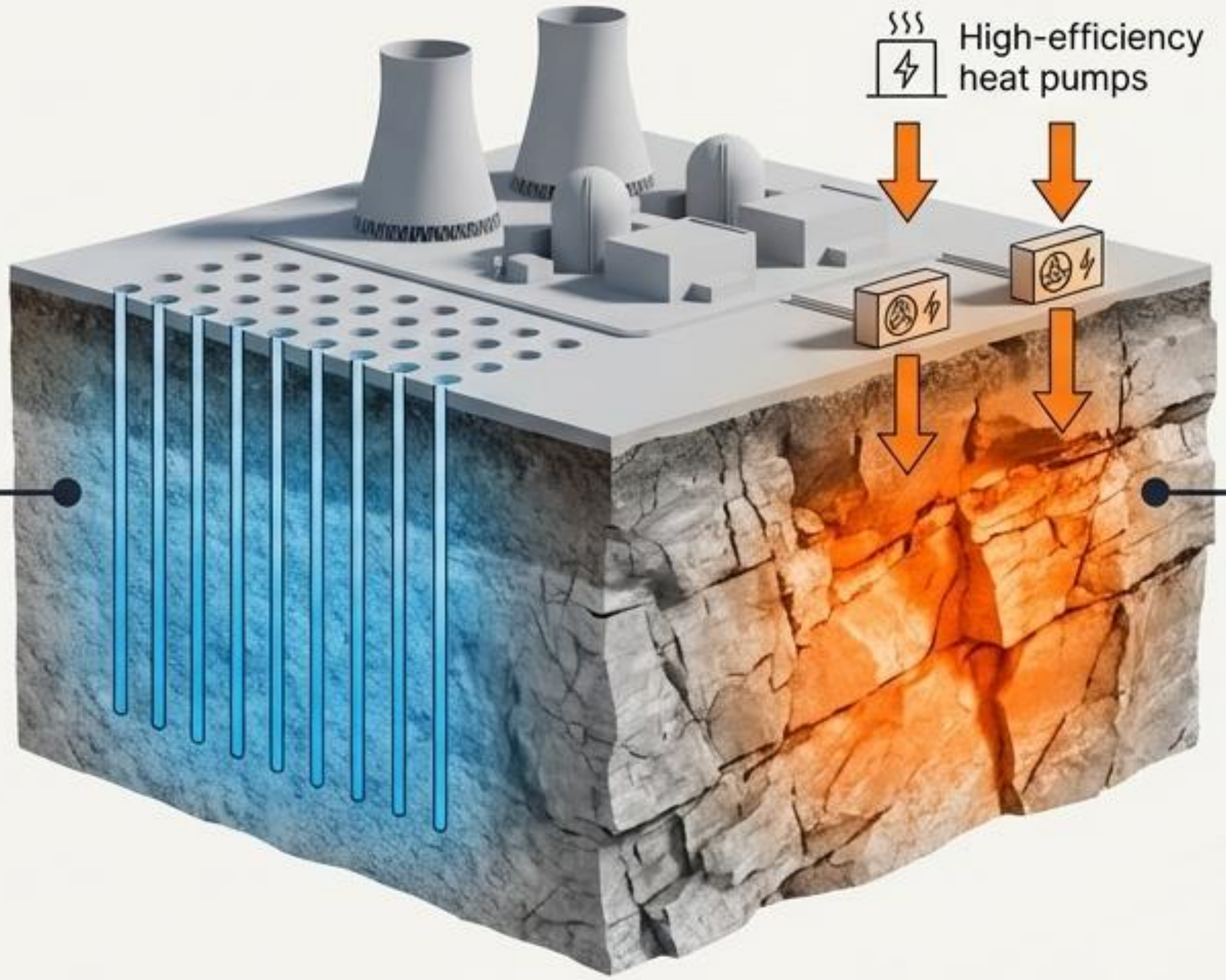
Defensive Failure: Losing highly profitable electricity generation to environmental volatility.

We require a technological intervention capable of decoupling a reactor's operations from its environment.

A massive thermal buffer to capture the heat (Offense) and guarantee the cold (Defense).

The Subterranean Thermal Intervention

The Cold Vault:
Subterranean cold storage creating artificial permafrost in water-saturated ground.



The Heat Vault:
Gigawatt-hour to Terawatt-hour scale underground thermal energy storage (UTES) in natural rock.

Core Concept: Utilising the earth's natural geological insulation to store massive volumes of thermal energy with minimal degradation over weeks, months, or seasons.

Technical & Economic Specifications

Dimension	The Heat Vault	The Cold Vault
Core Principle	UTES in natural rock formations	Artificial permafrost via borehole networks
Storage Scale	GWh to TWh (20 GWh to 600+ GWh projects)	Massive subterranean cold volumes
Operating Temp	Wide input range; 80°C+ output for DH	-5°C to -70°C (capable of -210°C)
Efficiency	92% storage / 98% heat efficiency	Minimal loss due to geological insulation
Primary Nuclear Application	Offensive: Capturing ~67% waste heat for monetisation	Defensive: Climate-independent cooling to eliminate thermal curtailments

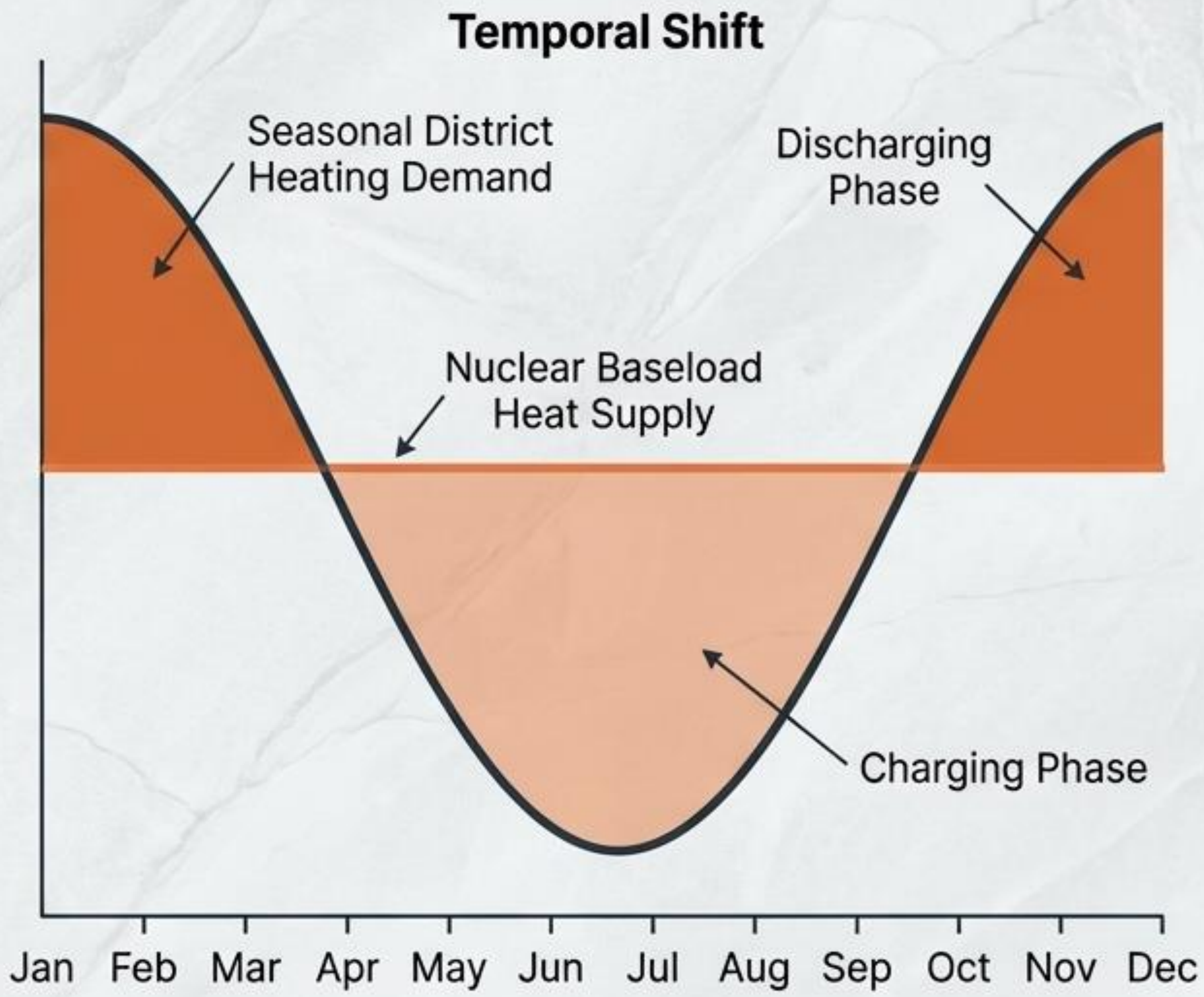
Bridging the Mismatch: The Swedish Case Study

The Inefficiency: Sweden discards 90 TWh of nuclear waste heat annually into the sea—nearly double the country's entire 50 TWh District Heating (DH) demand.

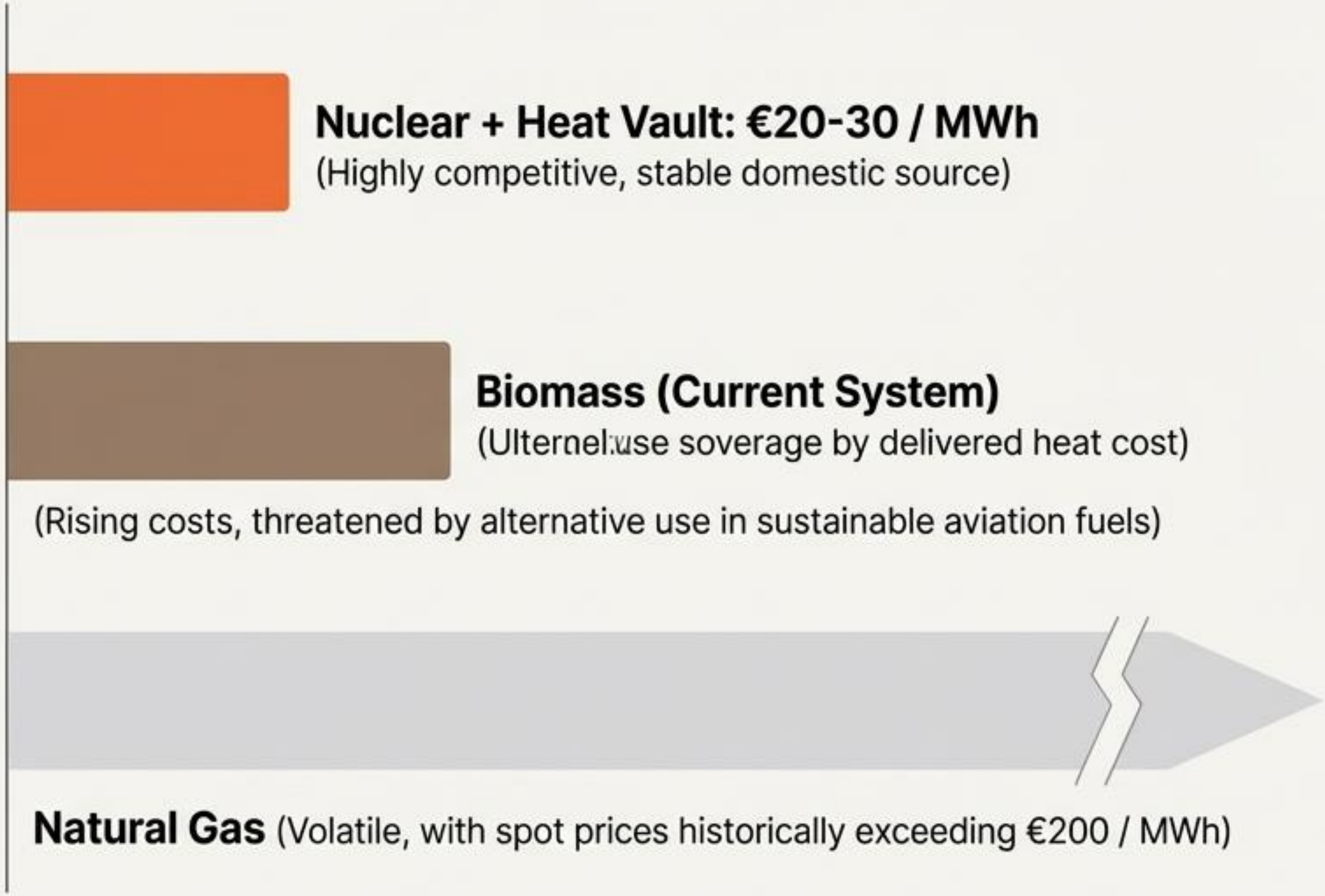
The Barrier: Direct connection is impossible. Nuclear produces constant baseload heat; municipal demand peaks violently in winter.

The Vault Solution: The Heat Vault acts as a seasonal buffer.
Summer: Low-grade heat (30-40°C) is upgraded via heat pumps (80-95°C) and injected into rock.

Winter: Stored baseload heat is extracted directly into the DH network.



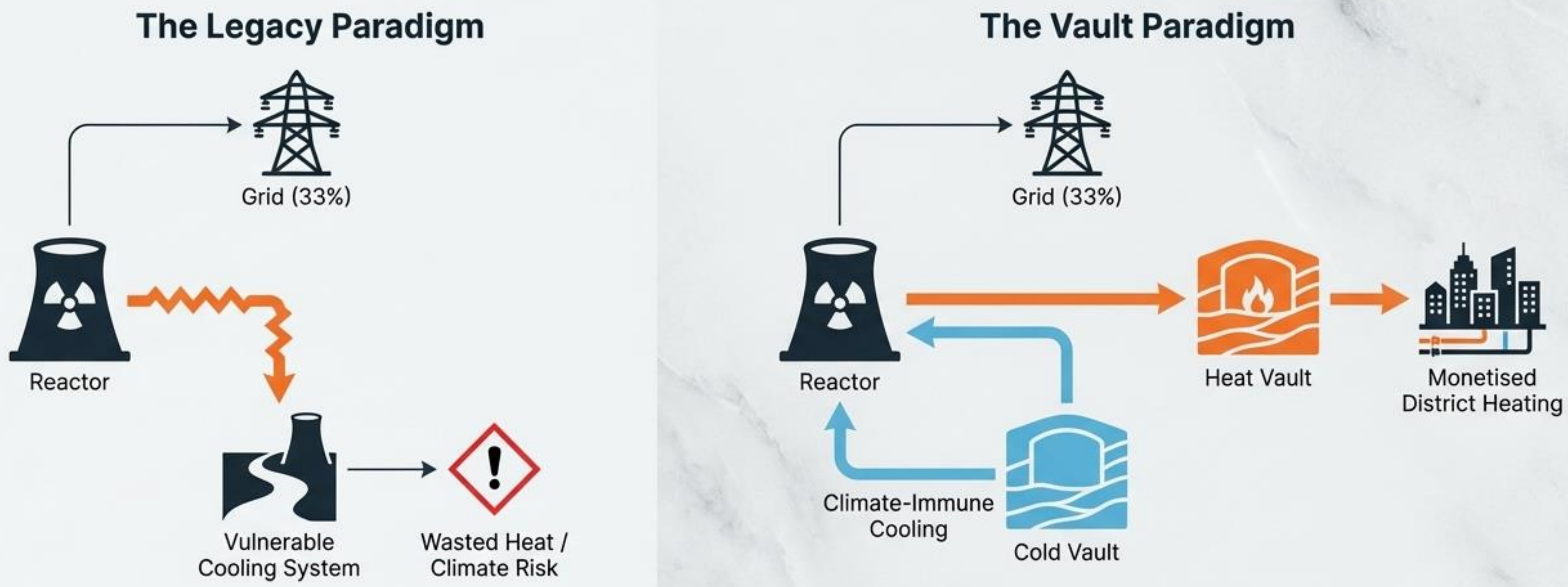
The Economic Imperative of Heat Integration



CAPEX/LCOS: Heat Vault technology projects a CAPEX of $<\$1/\text{kWh}_{th}$ and an LCOS of $<$USD¢1/kWh.

Strategic Outcome: Diversifies Sweden's heating away from biomass/imported waste, enhancing sovereign energy security while eliminating a 90 TWh market failure.

The Integrated Energy Hub



Core Synthesis: By deploying subterranean thermal storage, a nuclear plant transitions from a thermally inefficient, climate-vulnerable electricity generator into a fully decoupled, resilient cogeneration hub. We eliminate environmental curtailment risks while doubling the monetisable energy output.

De-risking the Two-Terawatt-Hour Future

Over 20 nations have pledged to triple global nuclear capacity by 2050 to achieve net-zero targets. Building these multi-billion-pound assets using legacy cooling architectures exposes them directly to compounding climate volatility.

Strategic management of waste heat is no longer a peripheral environmental issue. Integrated thermal storage—The Heat (represented in matte Thermal Orange) and Cold (represented in crisp Glacial Blue) Vaults—is the definitive strategy for ensuring the next generation of nuclear power is physically resilient, highly efficient, and economically bankable.