

# THE THERMAL BLUEPRINT



Decarbonising Luxembourg's Heating  
Sector via Industrial Waste Heat

A Quantitative Analysis & Strategic Roadmap

## IMPORT RELIANT

**79.3%**

Space heating's share of residential energy, dominated entirely by imported natural gas and oil.

## UNTAPPED DOMESTIC SUPPLY SUPPLY

**6.81 PJ**

The annual technically recoverable waste heat actively dissipating from the southern steel basin.

## THE MACRO MATCH

**82.3%**

The equivalent share of the nation's total building thermal demand that this single waste stream could satisfy.

**The Fuel Tourism Anomaly:** Transport  
skews national per capita data.

**Residential Sector:** 15.2% of Total Final Consumption

**Services Sector:** 12.3% of Total Final Consumption

**When transport is contextualised, stationary  
sectors show a 44% efficiency gain since 2000.**

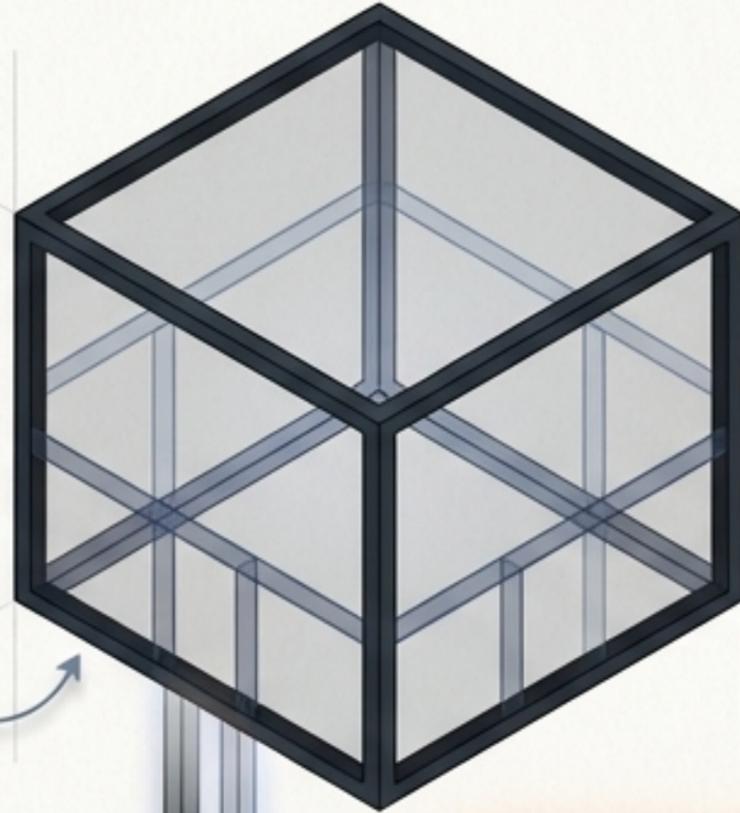
The baseline efficiency culture exists; the  
infrastructure to deliver clean heat does not.

## Residential

**5.55 PJ**  
Total Energy

Composition:  
79.3% Space Heating,  
15.1% Water Heating

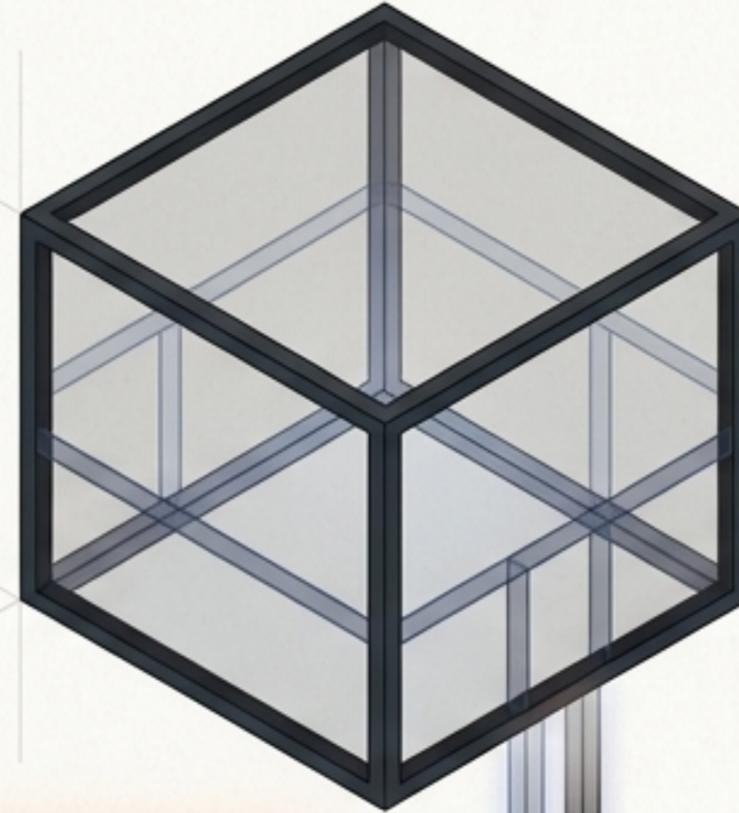
Vulnerability Note:  
Heavily reliant on  
gas (45.3%) and oil.



## Services/Tertiary

**5.44 PJ**  
Total Energy  
(Approx. 2.72 PJ for  
Thermal applications)

Composition:  
Gas (26%) and derived  
heat (7.7%)

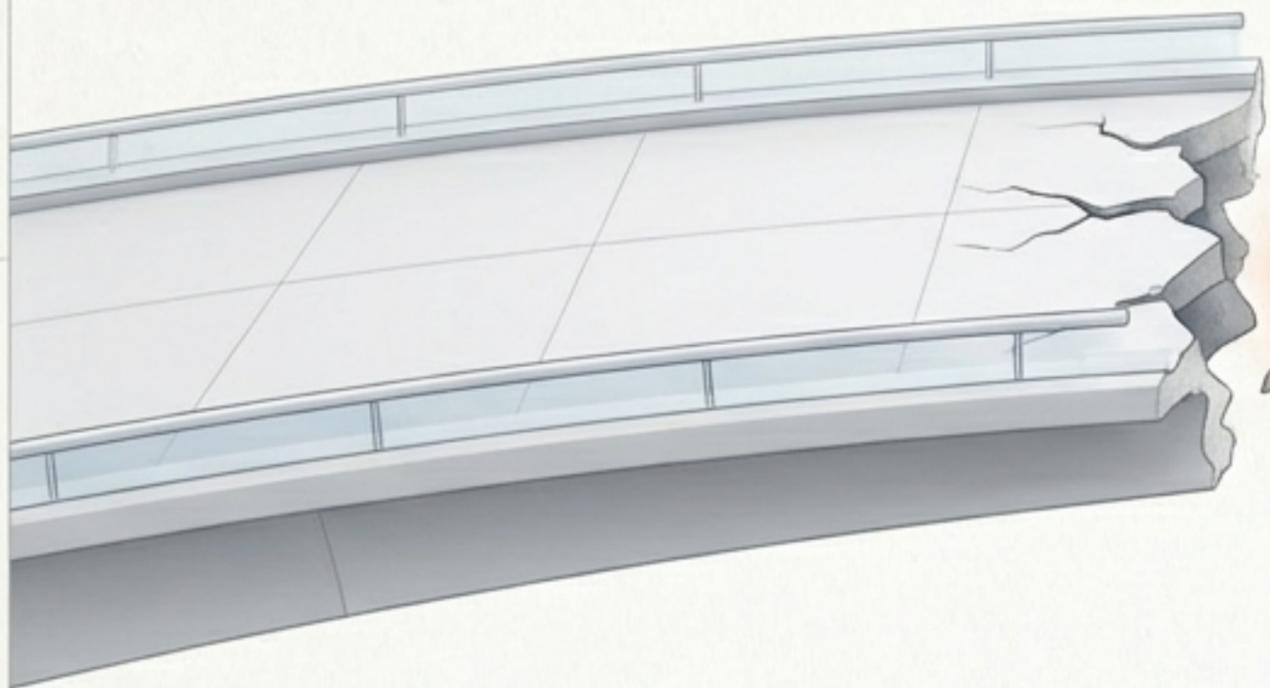


**TOTAL BUILDING  
THERMAL DEMAND:  
8.27 PJ**

Consumers are highly responsive to price signals: 2022 saw an 11% drop in gas usage and a 53% surge in biomass. The market is ready for a structural alternative.

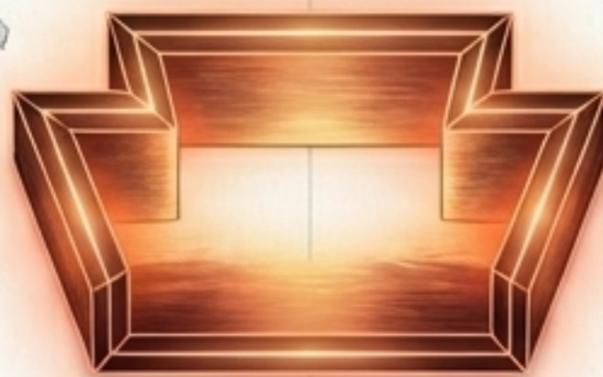
# Progressive EU/National Laws

Strongly incentivised local heat  
planning, dedicated national funding.



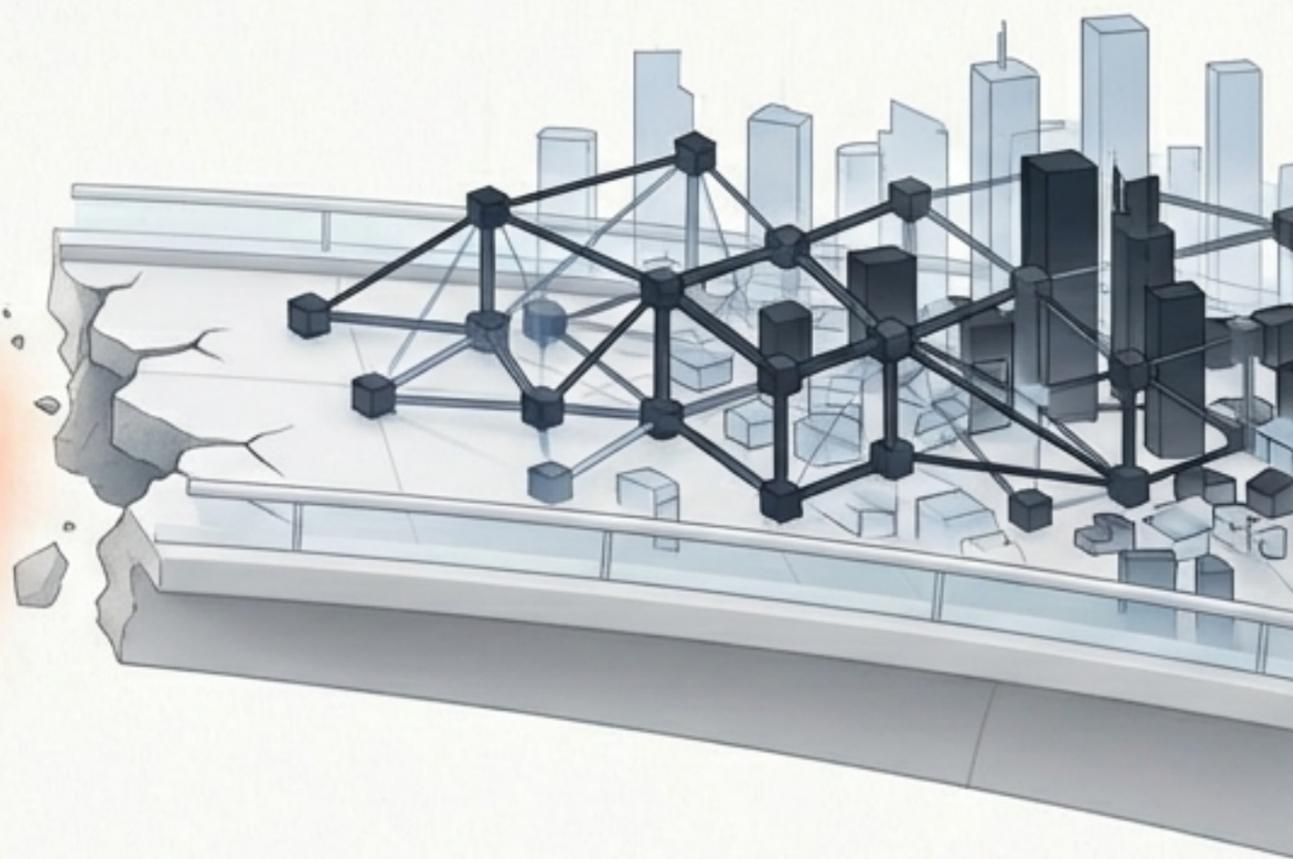
# <10%

Current District  
Heating Penetration.



The Large-Scale  
Anchor Heat Source.

# Concentrated End-User Demand

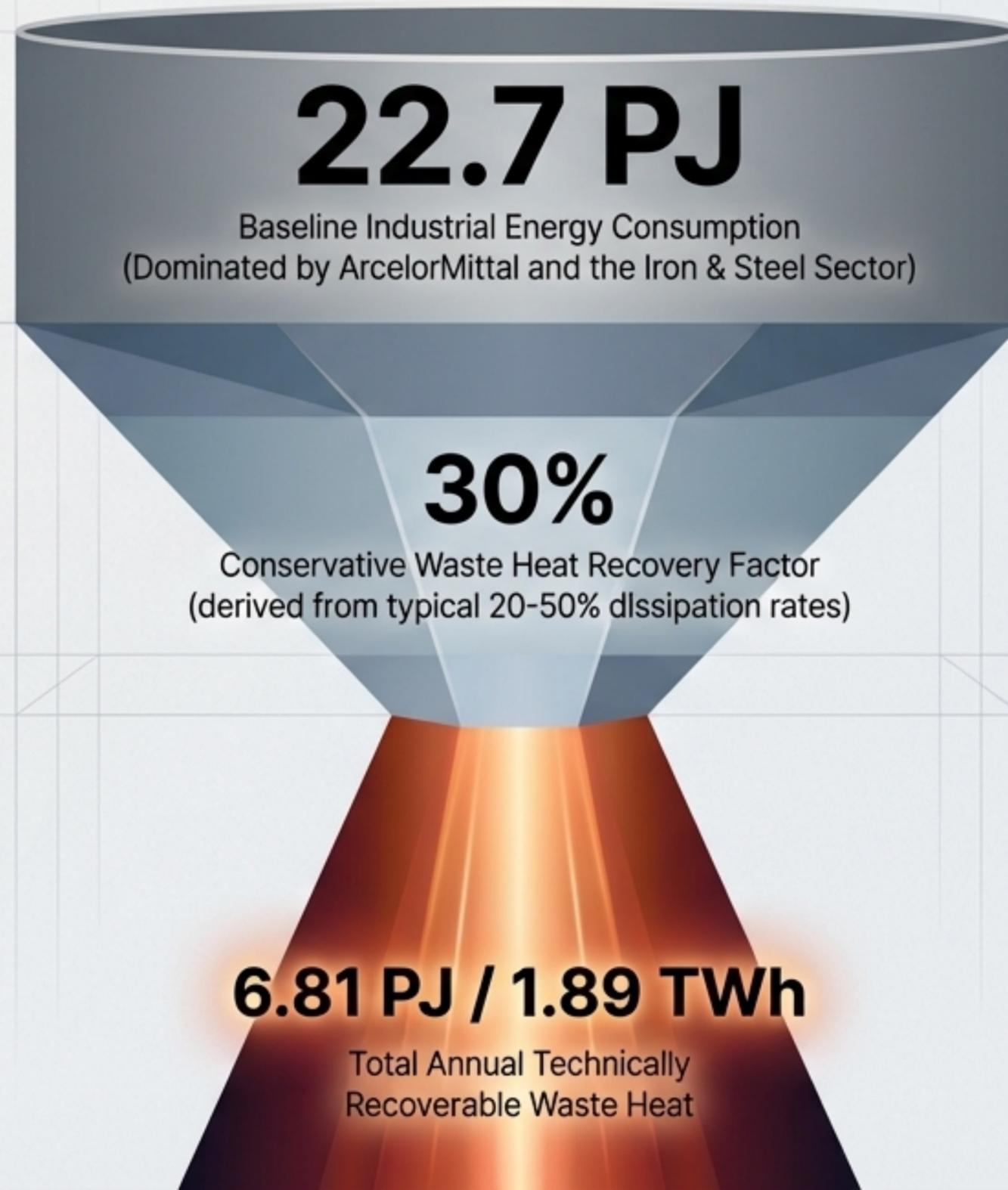


The **primary barrier** is not  
**political will** or **high-level  
finance**.

It is the **historical incumbency  
of the gas grid** and the  
the serond.

the perceived **absence of a  
massive, cost-effective  
domestic heat source**.

# The Thermal Extraction Funnel



This bottom-up calculation is validated by live pilot projects currently capturing **18 GWh/year (0.065 PJ)** into local networks

# GEOGRAPHIC ALIGNMENT



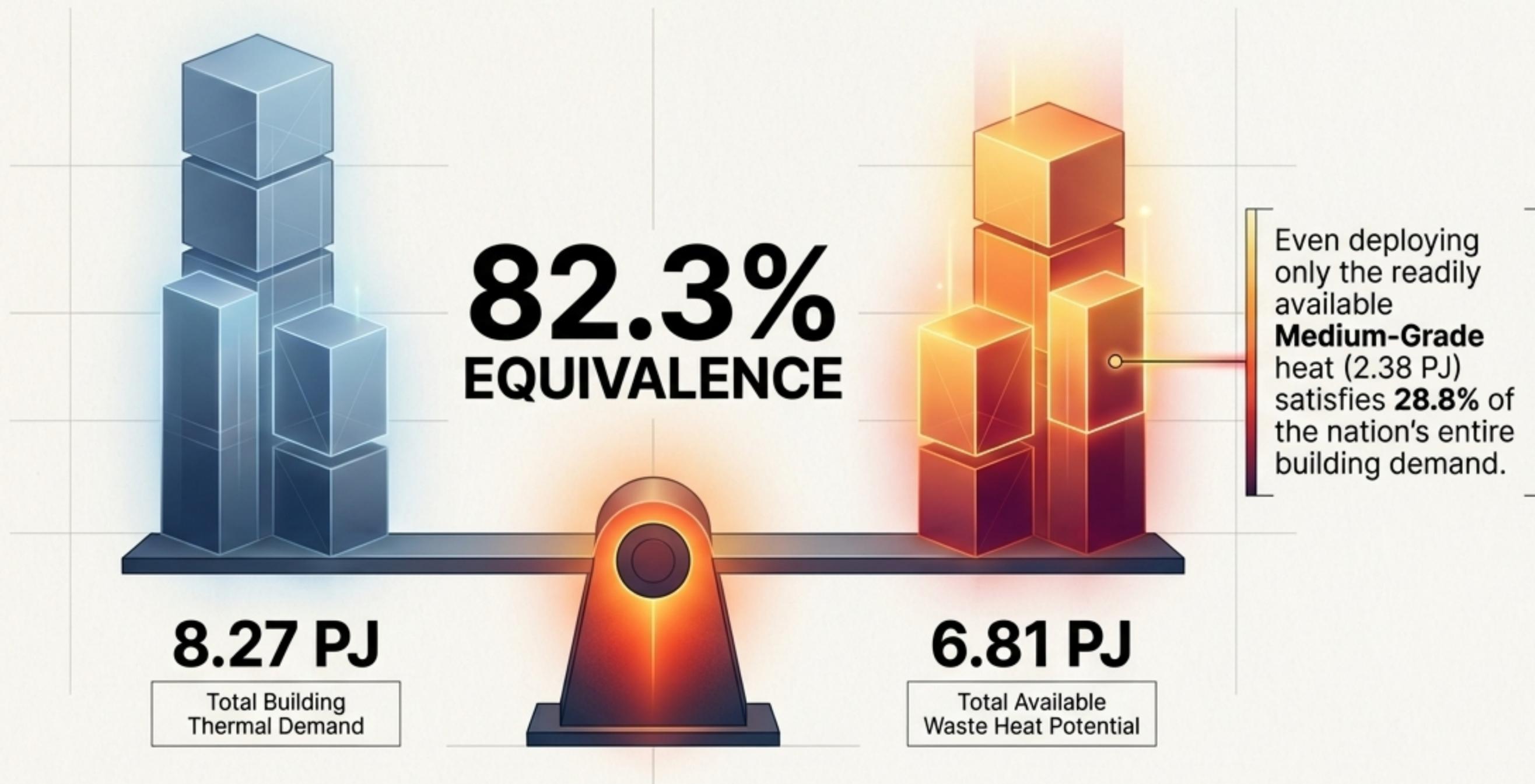
Luxembourg's primary source of waste heat is uniquely clustered in the 'Land of the Red Rocks.' Unlike dispersed industrial scenarios, this supply sits directly adjacent to areas of highest heat demand density, drastically reducing pipeline capital expenditure.

# THE QUALITY MATRIX

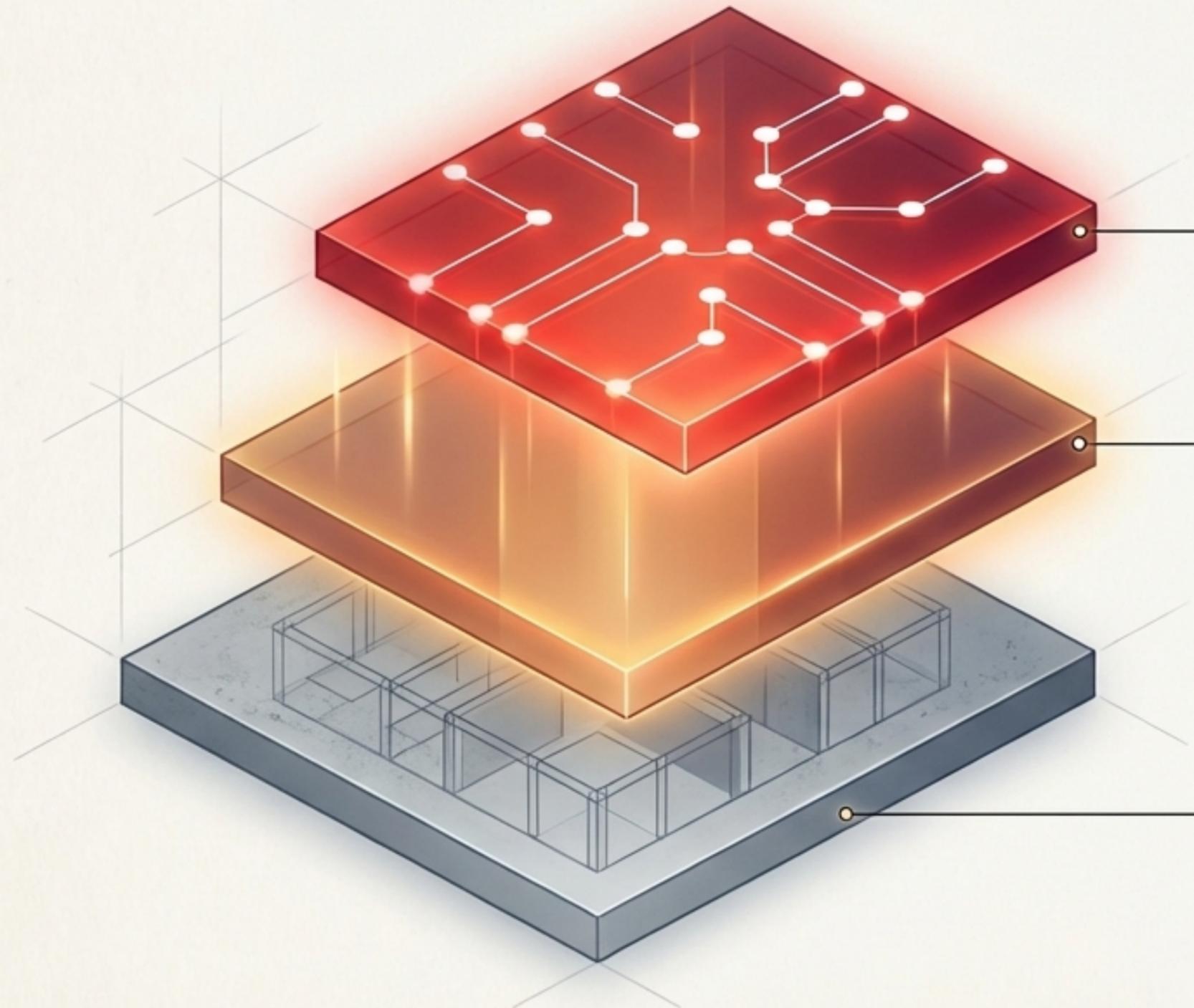
Low-Grade (<100°C)	Medium-Grade (100-400°C)	High-Grade (>400°C)
<b>1.71 PJ (25%)</b> Requires costly, energy-intensive large-scale heat pumps for upgrading.	<b>2.38 PJ (35%)</b> The Premium Resource. Ideally suited for direct injection into conventional district heating networks with zero temperature upgrading required. Lowest CapEx/OpEx.	<b>2.72 PJ (40%)</b> Highly versatile, suitable for internal industrial reuse or electricity generation.

Because steelmaking relies on extreme temperatures (>1,200°C), Luxembourg possesses an unusually high ratio of readily deployable Medium-Grade heat, bypassing the need for immediate, massive heat pump investments.

# THE 82% SCALE BALANCER



# THE SCENARIO IMPACT MATRIX



## SCENARIO 2 (LONG-TERM INTEGRATION)

**Action:** Add 1.71 PJ Low-Grade heat via high-efficiency heat pumps powered by domestic renewables.

**Total Displacement:** 4.09 PJ (Nearly 50% of national thermal demand).

**Abatement: >250,000 tonnes CO2 equivalent/year. Adds grid flexibility.**

## SCENARIO 1 (NEAR-TERM)

**Action:** Deploy 2.38 PJ Medium-Grade heat into southern district networks.

**Displacement:** Displaces ~1.43 PJ of gas, ~0.95 PJ of oil.

**Abatement: 130,000 – 150,000 tonnes CO2 equivalent/year.**

## THE STATUS QUO

Reliance on 3.0 Mtoe imports; volatile exposure to gas/oil pricing.

# THE INVESTMENT ROADMAP

1

## Spatial Heat Planning

**Action:** Mandate EED-aligned spatial studies to map priority DH zones and define specific anchor loads (hospitals, schools) in the southern municipalities.

## Mandatory Audits

**Action:** Upgrade the industrial Accord volontaire. Require investment-grade waste heat audits potential into defined project portfolios.

2

**Action:** Upgrade the industrial Accord volontaire. Require investment-grade waste heat audits for large consumers to transform notional potential into defined project portfolios.

3

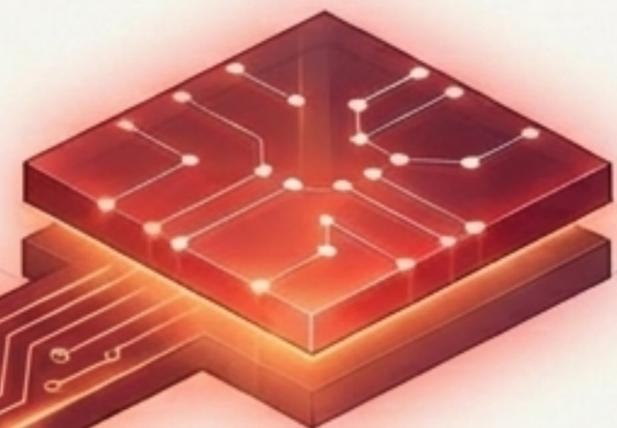
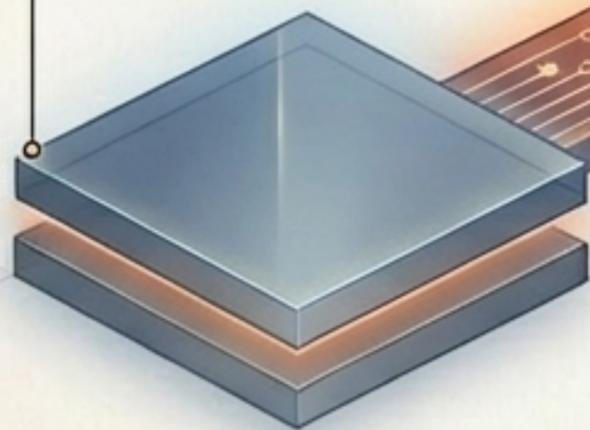
## State-Backed De-risking

**Action:** Establish a national waste-heat-to-grid infrastructure fund (mirroring the Danish model) offering low-interest loans to overcome the high DH CapEx barrier.

4

## CO2 Pricing Signals

**Action:** Progressively strengthen the national CO2 tax trajectory on heating fuels to permanently shift the economic advantage away from individual fossil boilers.





**Industrial waste heat is not a marginal environmental project. It is the cornerstone of a secure, sovereign, and decarbonised thermal energy system for Luxembourg.**

The geography aligns. The technology is proven. The supply matches the demand. The blueprint is ready for execution.