

An aerial photograph of a large industrial facility, likely a steel mill or refinery, taken at dusk. The sky is a deep blue, and the plant's lights are beginning to glow. Several tall smokestacks are visible, with one in the foreground emitting a large plume of orange and red thermal energy, represented by concentric contour lines. The overall scene conveys a sense of industrial activity and energy production.

# The Untapped Thermal Resource

Integrating 352 TWh of Industrial Waste Heat  
to Solve Germany's Wärmewende

A National Strategic Playbook

**Stromwende  
(Electricity Transition)**



**Wärmewende  
(Heat Transition)**



**The heating sector is the primary bottleneck in Germany's national decarbonisation effort. Total thermal demand remains massive at 197.2 TWh/year.**

**100,000 MW**



Decentralised  
Fossil Boilers

A 3.3-to-1 ratio  
favouring individual,  
fossil-fuelled systems.

**30,000 MW**



District Heating  
Infrastructure

Residential fuel mix remains dominated by Natural Gas (38.6%) and Oil (19.5%), meeting over 58% of household thermal needs.



Using  $1,000^{\circ}\text{C}$  natural gas to heat a living room to  $20^{\circ}\text{C}$ .

**Massive Exergy Destruction**



Upgrading  $40^{\circ}\text{C}$  waste heat with a heat pump for  $50^{\circ}\text{C}$  space heating.

**Thermodynamic Efficiency**

**We must transition from a paradigm of high-temperature combustion to one of low-temperature heat transfer.**



**Energy Efficiency Act (EnEfG)**

Forces industry to quantify and report unavoidable waste heat.

**Heat Planning Act**

Mandates municipalities to zone for and build district heating to absorb local heat.

**Plattform für Abwärme (PFA)**

The national registry mapping thermal streams (Quantity, Temp, Time).

A self-reinforcing cycle of mandated supply meeting mandated demand.

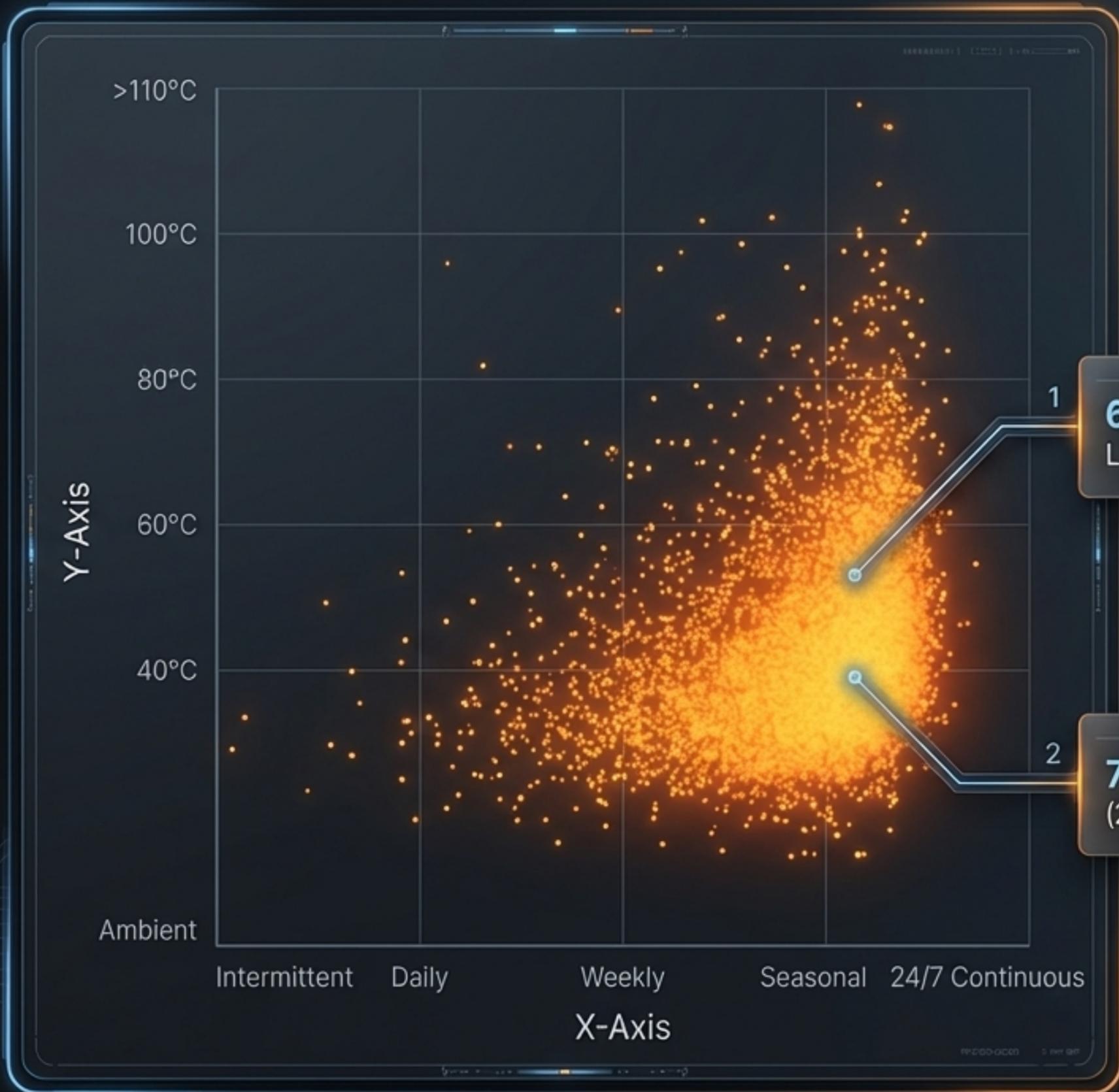
# 352 TWh / year

28,100+ Individual  
Waste Heat Streams

3,751 Reporting  
Companies

Bottom-up, geo-located  
data  
(Upgraded from the previous  
125 TWh theoretical estimate)

This is no longer a theoretical projection. It is a legally mandated, catalogued, and actionable inventory of national energy assets.



## Strategic Imperative

The dominance of **sub-60°C heat** dictates the technology pathway:

The **widespread deployment of large-scale industrial heat pumps** is an **absolute engineering necessity**, directly linking the Wärmewende to the Stromwende.

## Traditional Heavy Industry



- **Metal Production & Processing** (54% of NRW potential)
- Glass, Stone, Earth (17%)
- Chemical & Petrochemical (11%)

## New Energy Anchors



- **Data Centres:** Over 3,000 facilities with stringent new reuse mandates under EnEFG.
- **Green Hydrogen Electrolysis:** Highly exothermic; projected 0.63 TWh/yr in NRW alone by 2030.

**Industrial site selection has changed. Proximity to a municipal heat sink is now a core economic viability metric for new facilities.**

# Supply vs. Demand

Thermal Architecture

## Macro Scale

Total Potential (352.7 TWh)

Supply

352.7 TWh

Total National H&C Demand (197.2 TWh)

Demand

197.2 TWh

Ratio

1.79 : 1

## Baseload Scale

Continuous Potential (255.3 TWh)

Supply

255.3 TWh

Estimated District Heating Demand (~39.4 TWh)

~39.4 TWh

Ratio

6.48 : 1

## Residential Scale

Low-Grade Potential (244.1 TWh)

Supply

244.1 TWh

Total Residential Demand (60.7 TWh)

60.7 TWh

Ratio

4.02 : 1

### **The Supply Hurdle**

244 TWh of low-grade (<60°C) waste heat requiring massive heat pump deployment.



### **The Demand Match**

60 TWh of low-grade residential space heating demand currently powered by imported gas

**Germany does not have a clean energy generation problem. It has a thermal logistics problem.**

The 244 TWh slice of low-grade heat perfectly matches and dwarfs the 60 TWh residential requirement. The strategic outlook must pivot from "finding new energy" to "connecting existing systems."

# The Mandate: Heat Planning Act & The Solution

## THE MANDATE

2030

Heat Planning Act requires 30% renewable/waste heat by 2030 (necessitating 30-40 TWh)

2040

Mandate increases to 80%.

## THE SOLUTION

Medium/High-grade waste heat (>60°C) provides 109 TWh—**three times** the 2030 requirement, ready for direct integration.

## THE ECONOMIC DE-RISKING

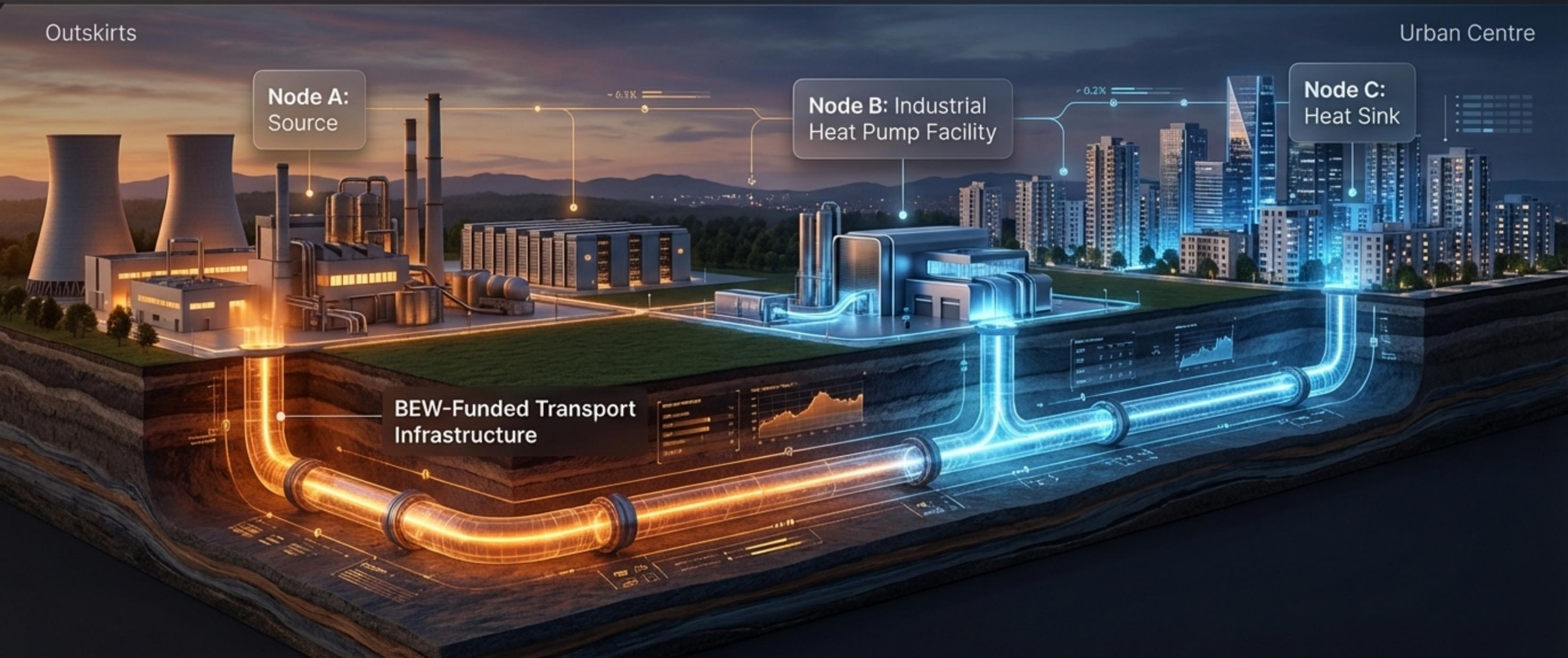
Expanding DH networks **requires ~€24 billion by 2030**. Long-term off-take agreements with local industrial plants replace volatile global gas prices with stable domestic co-products, making multi-billion-euro pipeline investments financially viable.

# The Spatial Integration Schematic

Thermal Architecture style

Outskirts

Urban Centre



Bridging the physical gap between industrial parks and urban residential zones is the primary logistical barrier.

# Barrier-to-Solution

## Spatial Mismatch

### Barrier

Industrial sources and urban sinks are geographically separated.



### Solution

#### Corridor Planning

Municipal heat plans must mandate and protect strategic pipeline routes in urban development.

## Economic Viability

### Barrier

High CapEx for pipelines and large-scale heat pumps.



### Solution

#### BEW Funding

Federal support for Efficient Heat Networks bridges the viability gap and de-risks private capital.

## Technical & Contractual Complexity

### Barrier

Aligning operational cycles of factories with public utilities.

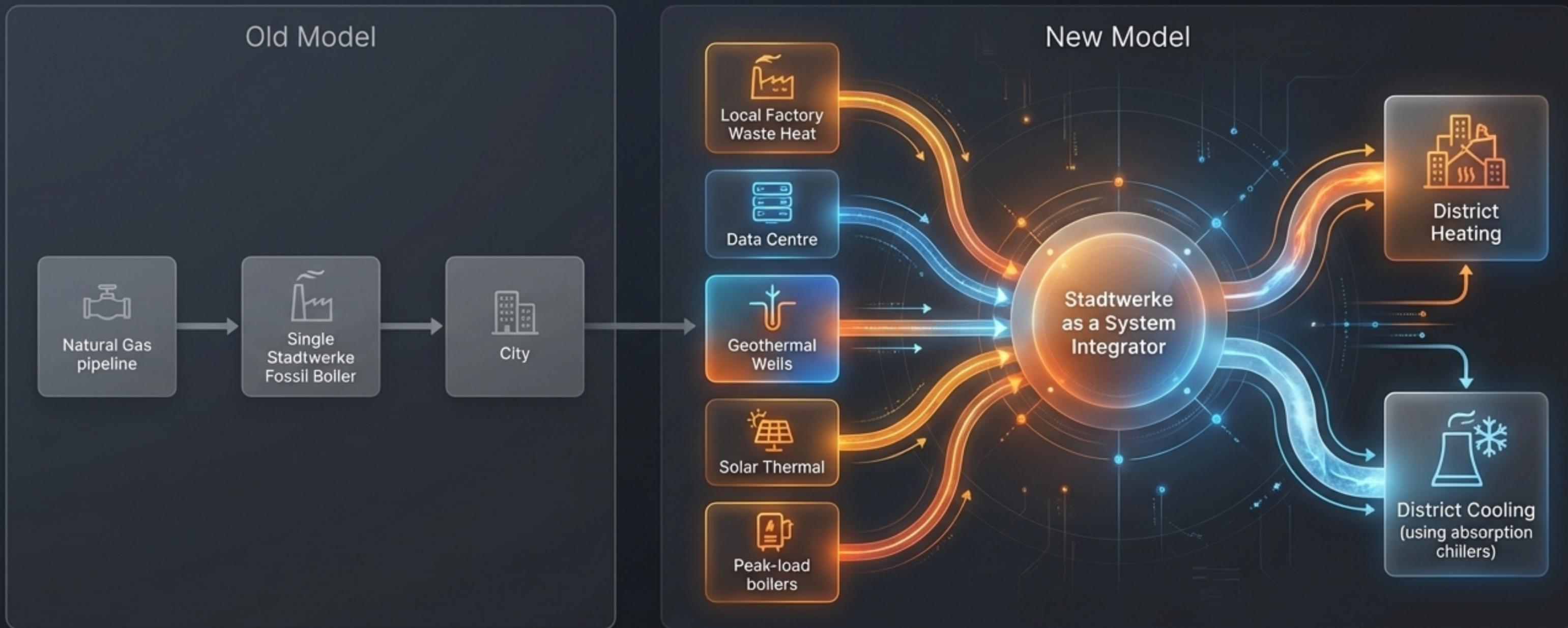


### Solution

#### Standardised Offtake Agreements

Developing model 15-20 year contracts to reduce legal friction between sellers and buyers.

# The New Heat Economy



Utilities are evolving from simple commodity burners into sophisticated thermal portfolio managers operating a Heat-as-a-Service economy.

# The energy is already here. The mandate is set.

## Treat Heat as an Asset:

Industry must view thermal co-products not as regulatory burdens, but as long-term revenue streams.

## Design for Symbiosis:

All new data centres and hydrogen hubs must integrate heat export into initial site selection.

## Build the Corridors:

Municipalities must use PFA data today to zone and build the physical pipelines of tomorrow.

**352 TWh awaits integration. The Wärmewende is a logistical challenge we can build our way out of.**