Decarbonising Bulgaria's Thermal Sector

The 7.44 TWh Industrial Waste Heat Opportunity

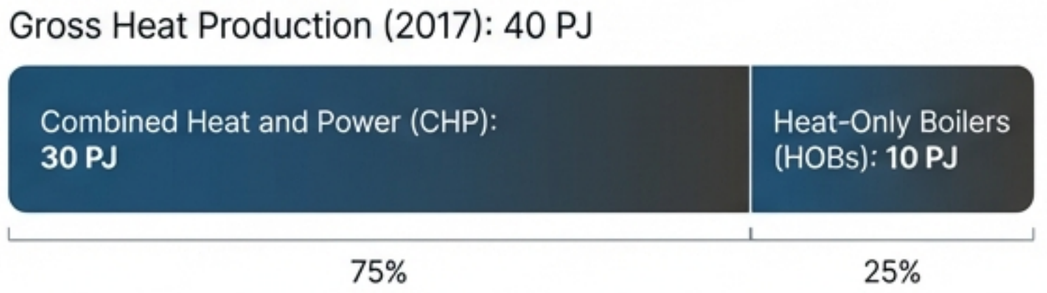
A quantitative pathway to **displace imported fossil fuels**, meet EED Article 25.6 mandates, and achieve 69% district heating coverage through circular energy recovery.

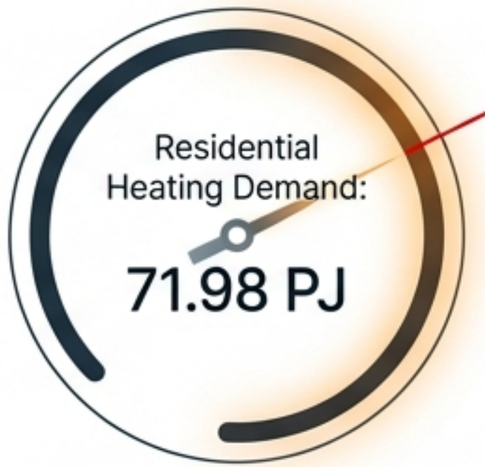
The Carbon Lock-In of Bulgarian Urban Heating

Bulgaria is the EU's most carbon-intensive economy.

Centralised heat production is inherently efficient but entirely dependent on imported natural gas and domestic coal.

The challenge is not replacing the 1,400 km district heating infrastructure, but substituting the fuel.

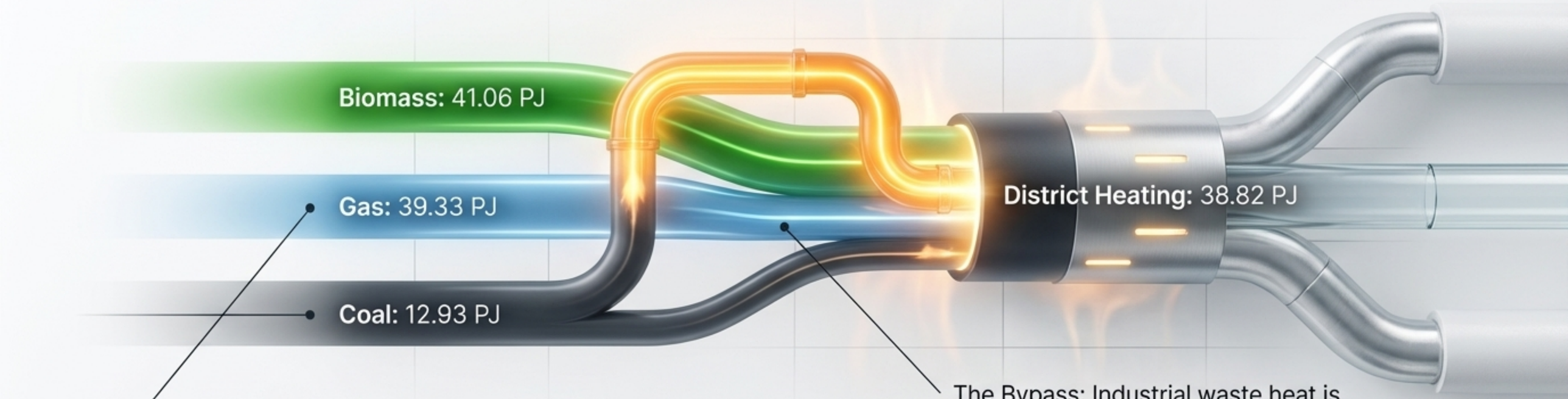




51.7% Direct Electricity Use

Tethers supposedly 'clean' home heating directly to carbon-intensive coal generation at the Maritsa basin, complicating the 2038 coal phase-out.

Mapping the Systemic Intervention Point



The Flaw: Every thermal conversion burns primary fuel and vents massive thermodynamic losses.

The Bypass: Industrial waste heat is post-conversion. Intercepting it allows the system to bypass primary combustion entirely, feeding directly into the 38.82 PJ District Heating node.

The Policy Deficit: EED Article 25.6 Compliance

The EU Mandate (Recast Energy Efficiency Directive)

- Obligatory local heating and cooling plans for municipalities >45,000 inhabitants.
- Mandatory mapping of local waste heat recovery potential.
- Deadline: September 2025.

EU Leaders (Germany, Denmark, Netherlands)

Status: Ready. Obligatory, integrated heat planning frameworks actively enforced.

Bulgaria's Status

Status: No legal framework in place.

Without a legal mechanism to compel mapping and integration, available industrial waste heat remains invisible to municipal energy planning, creating immediate compliance risk.

The Waste Heat Taxonomy: Quality and Application

High-Grade (>650°C)

Sources: Cement (rotary kilns), Steel (furnaces), Glass manufacturing.

Application: High-efficiency electricity generation; direct high-temperature process use.

Medium-Grade (250°C - 650°C)

Sources: Chemical & petrochemical processes, refineries, furnace exhaust.

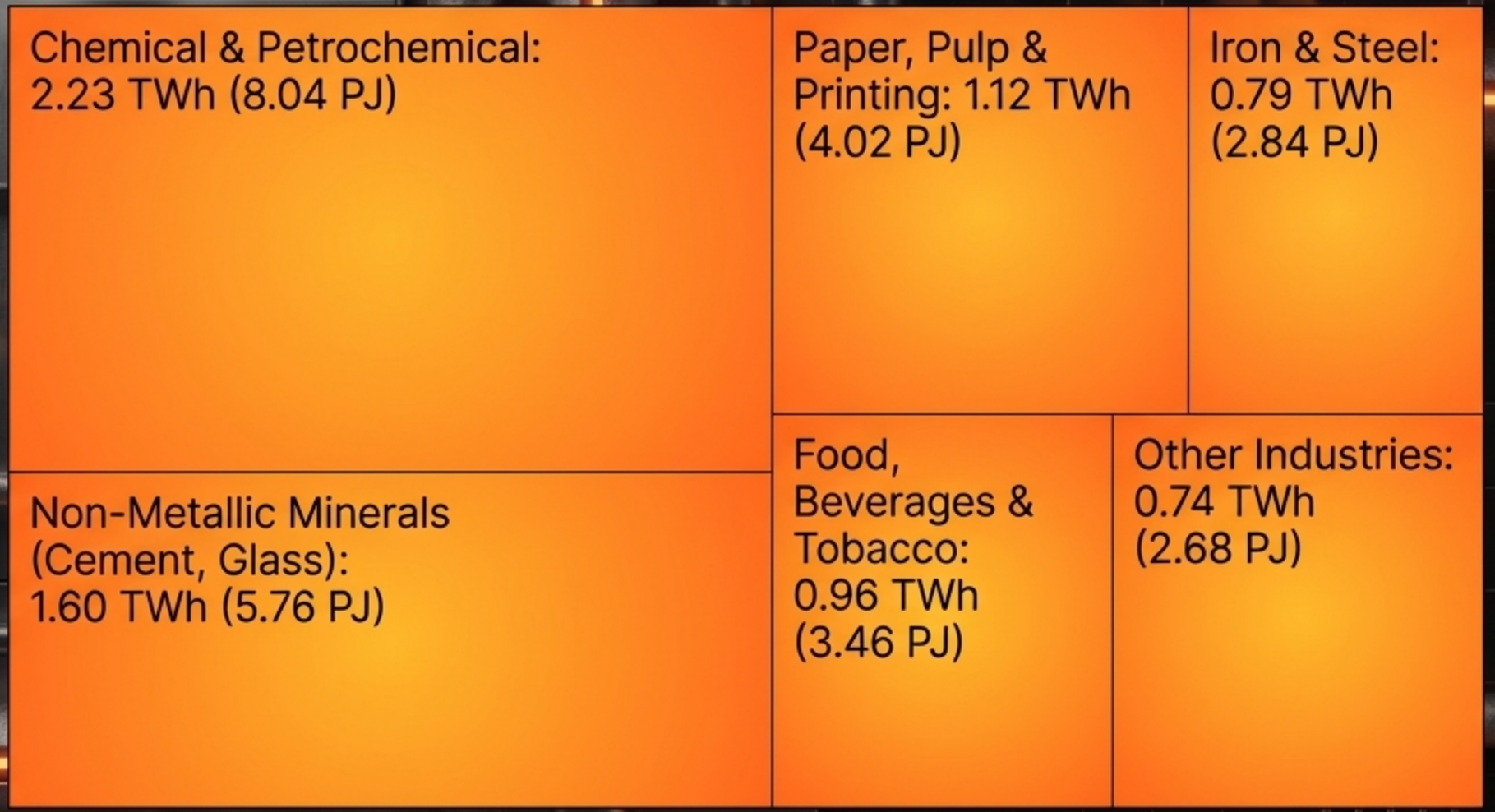
Application: Organic Rankine Cycle (ORC) electricity generation; conventional high-temperature district heating.

Low-Grade (<250°C)

Sources: Food & beverage, pulp & paper, process cooling circuits.

Application: 4th Generation District Heating (4GDH); upgrading via industrial-scale heat pumps.

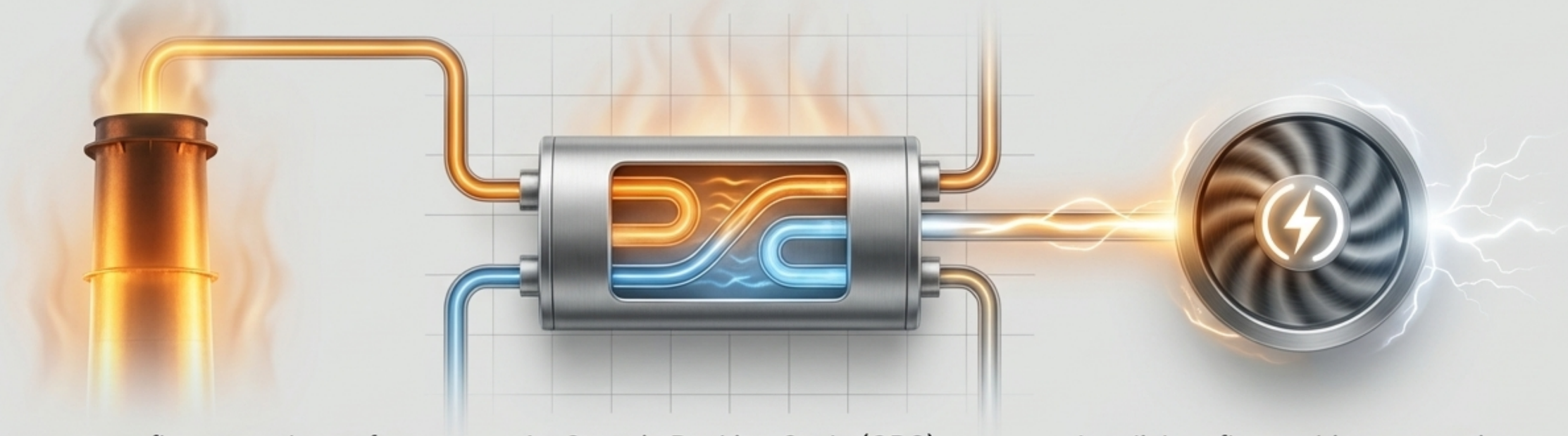
Quantifying the 7.44 TWh Domestic Resource



Methodology Callout

Baseline: 178.6 PJ Industrial Consumption. Applied a conservative 30% waste heat generation factor and a 50% technical recovery limit.

Technical Validation: The Şişecam Case Study



High-temperature flue gas exhaust from the Targovishte glass melting furnace.

An Organic Rankine Cycle (ORC) unit vaporising an organic fluid.

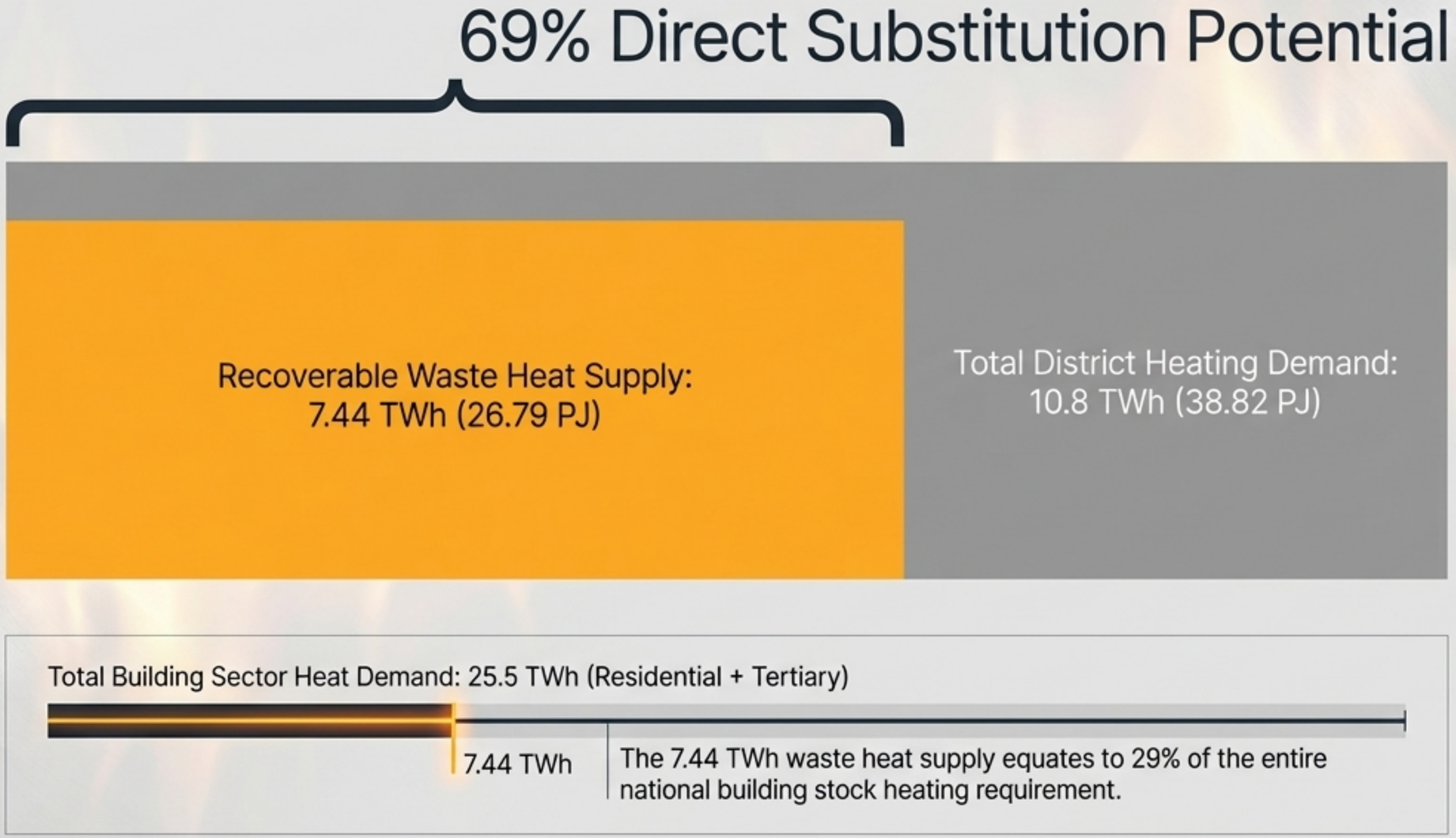
A radial outflow turbine generating 5 MWe of clean electricity.

Resource Proof: Large-scale, high-quality heat actively exists in Bulgarian heavy industry.

Technology Fit: Modern ORC systems function perfectly within local facility constraints.

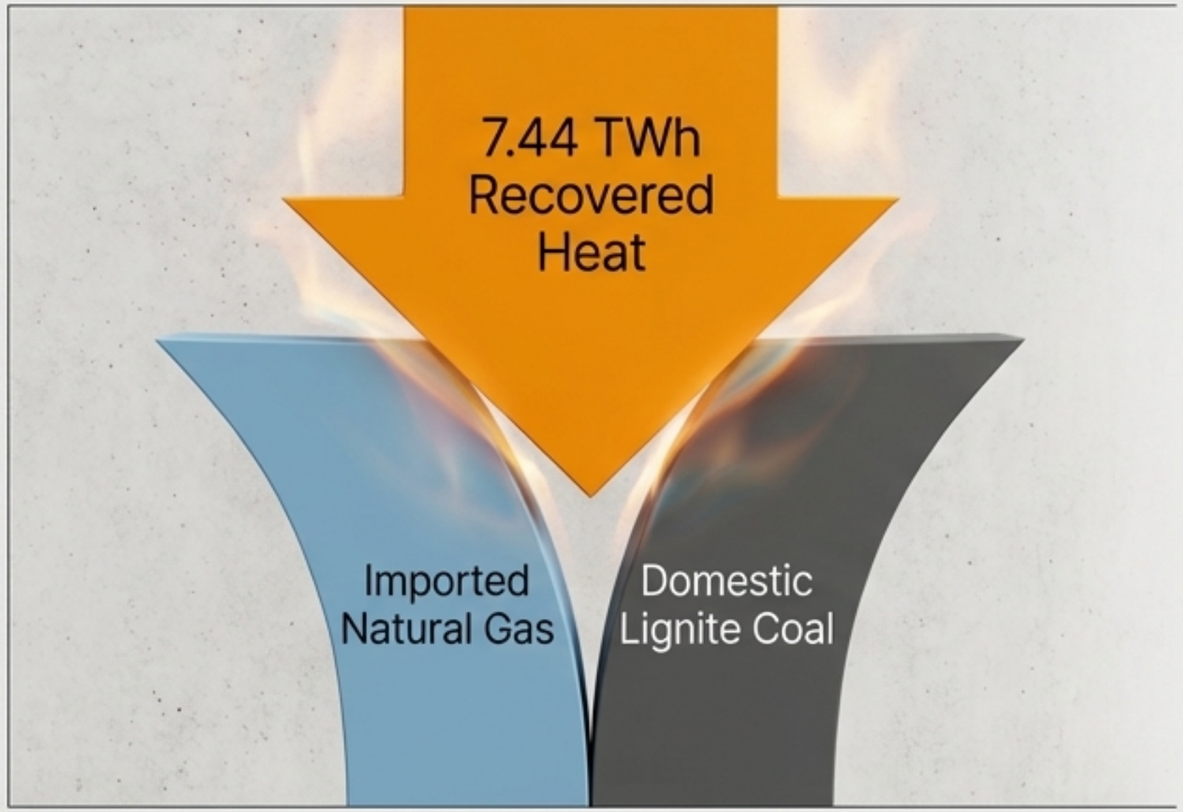
Commercial Bankability: Privately funded execution proves the compelling business case for energy efficiency and operational competitiveness.

The 69% Coverage Matrix



Strategic Synergies: Security and Decarbonisation

The Displacement Dynamic



The Strategic Outcomes

Immediate Decarbonisation

Eliminates CO_2 emissions at the source by stripping fossil fuels out of urban CHP networks.

Energy Security

Directly uncouples municipal heating costs from volatile international gas markets.

Avoiding Stranded Assets

Accelerates coal phase-out without locking the grid into a capital-intensive ‘coal-to-gas’ transitional infrastructure trap.

1

Action Pillar 1: Policy & Regulatory Framework

Transposition of EED Article 25.6

Immediate national legislation to establish binding local heating and cooling plans for municipalities over 45,000 inhabitants.

Mandatory Mapping

Establish a national methodology requiring local authorities to explicitly quantify industrial facilities and their thermal outputs.

‘Waste Heat First’ Principle

Enshrine a regulatory mandate requiring new large-scale energy projects to prove no viable local waste heat sources exist before securing permits for new fossil-fuelled generation.

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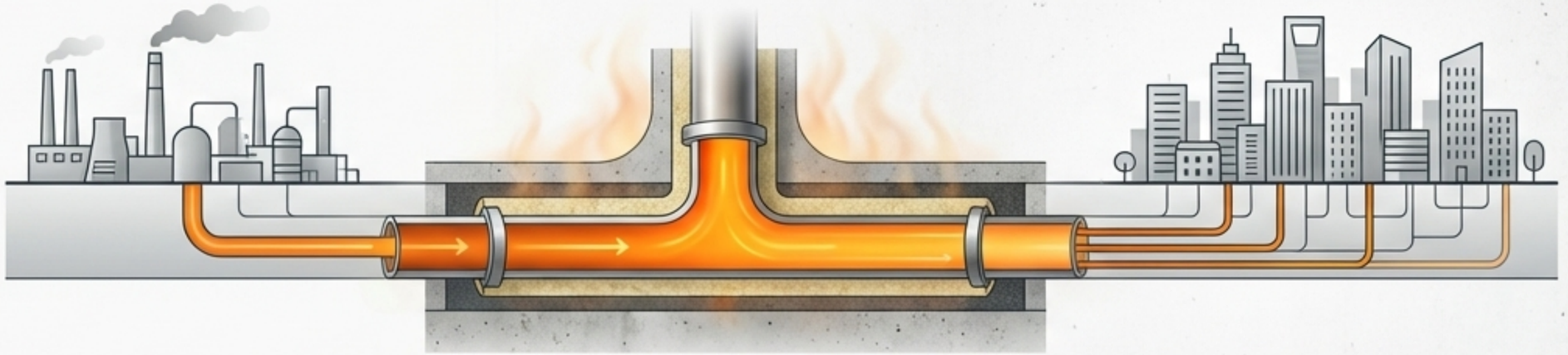
Action Pillar 2: Infrastructure Investment



Strategic Network Interconnection

Utilise the national heat atlas to prioritise 'anchor' projects, building from major industrial clusters (e.g., Devnya chemicals, Burgas refinery, Maritsa Iztok) directly to urban DH grids.

Transition to 4GDH

Modernise existing networks to operate at 50-60°C supply temperatures. Lower temperatures radically expand the viability of integrating low-grade, abundant industrial waste heat.

Large-Scale Thermal Storage

Deploy insulated buffer tanks to bridge the temporal gap between continuous industrial thermal output and variable urban morning/evening demand peaks.

3 Action Pillar 3: Financial Incentivisation

Funding Source: EU Modernisation Fund and related green transition mechanisms.

National Waste Heat Valorisation Fund

Instrument 1: Source De-risking

Capital grants targeted at industrial facilities to offset the upfront CAPEX of heat exchangers and ORC recovery units.

Instrument 2: Sink Financing

Low-interest, long-term debt facilities for district heating operators to finance the heavy civil engineering costs of pipeline interconnectors.

Instrument 3: Pipeline Development

Dedicated grants for technical feasibility studies to unlock the initial planning stages for joint industrial-municipal ventures.

Turning Industrial Waste into Urban Value

Valorising 7.44 TWh of waste heat is not a marginal efficiency project. It is the cornerstone of a circular thermal economy. It is the definitive mechanism to achieve Bulgaria's 45.5% renewable heating target by 2030, drastically reduce national carbon intensity, and secure long-term thermal affordability.