Executive Summary

This study classifies retrofit pathways for heat-emitter systems in Vienna's existing housing stock by the required flow temperature (VLT) to enable efficient heat-pump (HP) operation in a planning-ready way. Only heat emission inside the dwellings is considered. Central generation and riser distribution are excluded.

A sample of 384 buildings served as the data basis for analyzing the current state of heat-emitter systems used in Vienna. Result: classic high-temperature radiators dominate (≈ 61%), followed by low-temperature radiators (≈ 17%), surface heating (≈ 12%), individual stoves (≈ 9%), and thermally activated building systems (≈ 2%). This implies a strong need to lower VLT to achieve HP readiness (1).

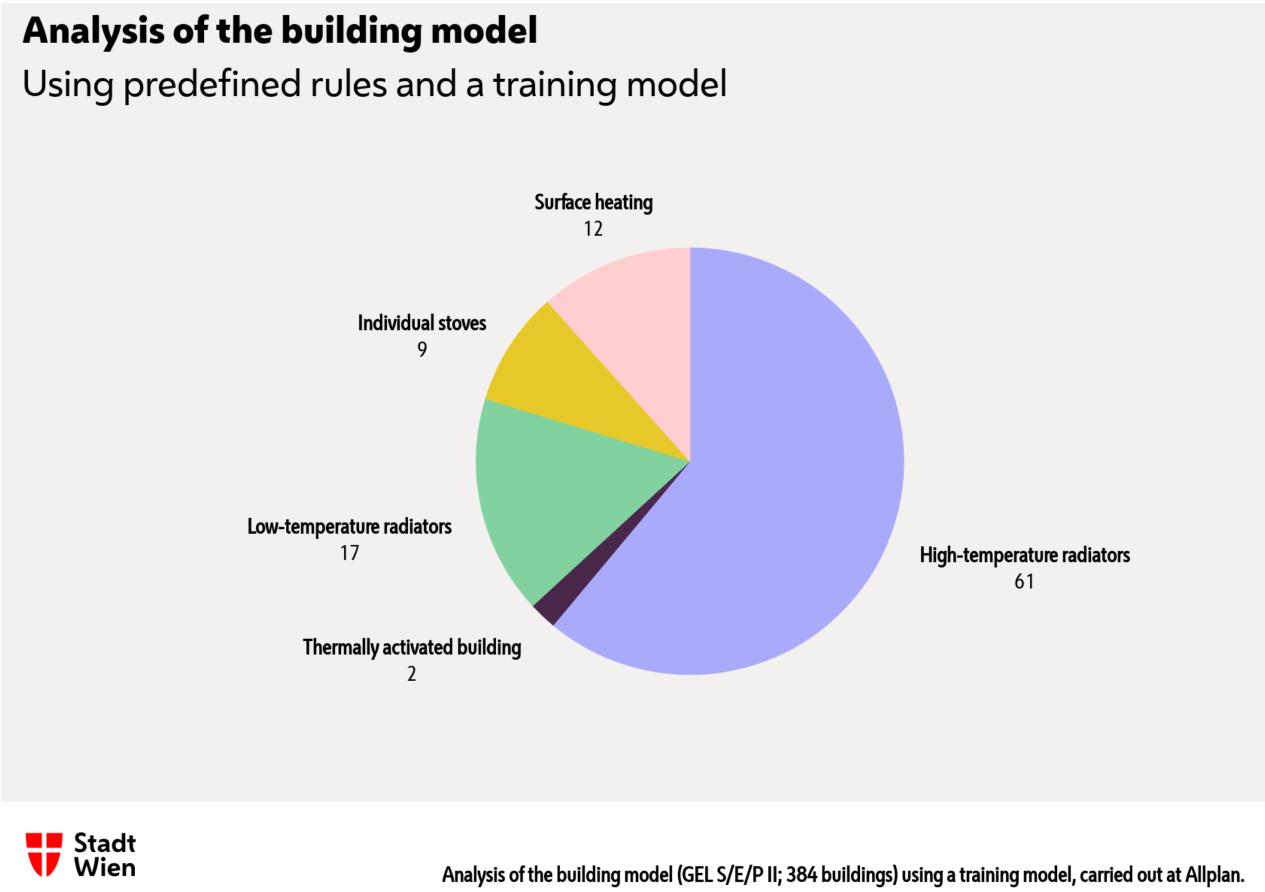

Figure 1: Analysis of the building model (GEL S/E/P II; 384 buildings) using predefined rules and a training model (created by author)

Low-temperature operation with a heat pump is specified as the benchmark. Target is a heating circuit at 35 - 45 °C VLT. Lower VLT increases COP/SCOP/JAZ and thus the seasonal efficiency. Prerequisites include proper hydraulic balancing, a suitable heating curve, controlled pumps, and, if required, separate domestic hot water (DHW) preparation. Table 1 links VLT bands with typical heat-emitter systems, heat-pump types, and efficiency ranges and serves as an operational benchmark for system selection.

Table 1: Relationship of system temperature (VLT), heat-pump type, and efficiency (SCOP/JAZ) with typical heat-emitter systems

VLT (system temperature)	Heat-pump type	SCOP	JAZ	Typical heat-emitter systems
30 - 35 °C	Air-to-water	3.5 - 4.5	2.8 - 3.6	Floor/wall heating
	Brine-to-water	4.0 - 5.0	3.4 - 4.2	
	Water-to-water	4.5 - 5.5	3.8 - 4.5	
35 - 55 °C	Air-to-water	2.8 - 3.5	2.3 - 2.8	Low-temperature radiators
	Brine-to-water	3.5 - 4.2	2.8 - 3.4	
	Water-to-water	4.0 - 4.8	3.2 - 3.8	
60 - 70 °C	All HP types (high-temp)	2.0 - 2.8	1.8 - 2.5	High-temperature radiators

The derivation of the measures is based on a controlled step test to determine the building-specific minimum required flow temperature; alternatively, the heating demand indicator is used as an approximation. A decision tree links this classification to strategy tables with clear options for each scope of intervention (no, minor, major interventions) and harmonised priorities.

This can be illustrated using a concrete example: for the initial situation “flow temperature 50 – 55 °C with radiators”, the decision tree identifies hydraulic balancing, flattening of the heating curve and variable-speed pump operation as the recommended measures without any structural interventions. Time schedules and electronic controllers are, in this case, assigned a medium priority. For more extensive interventions, the switch to low-temperature radiators and/or additional surface heating (wall/ceiling) is recommended as a priority option.

When the flow temperature is reduced, heat pump efficiency can be expected to increase significantly, low-temperature-ready systems in the existing stock become feasible, and a solid basis is created for planning, cost estimation and funding. Where appropriate, cooling is provided via fan coils or radiant surfaces. The report thus offers decision support ranging from quick operational optimisation through targeted interventions to comprehensive refurbishment, each with clear priorities and benchmarks for heat-pump integration.

In addition, dynamic simulation was used to analyse the impact of user behaviour and system condition. Specifically, realistic variants of ventilation, control and system condition were modelled for radiators, underfloor heating and fan-assisted radiators. Intermittent shock ventilation results in the lowest energy demand while maintaining comfortable PMV/PPD values. Permanent window-tilt ventilation, by contrast, increases the demand significantly. Raising the room setpoint temperature by 1 °C increases heating energy use by around 6 %. Covered heating surfaces (for example a couch in front of the radiator) reduce thermal comfort by up to 5 %, even though the amount of energy supplied hardly changes. Poorly vented radiators lead, at a flow temperature of 55 °C, to room underheating of 4 - 6 °C. This clearly shows that maintenance, proper venting and unobstructed air flow are critical prerequisites for low-temperature operation.