Supplementary Note

What's under the poster
The poster reports stock-level outputs. This note documents the modelling choices upstream of those numbers.

CEA 4.0 — why this tool

City Energy Analyst (CEA) is an open-source urban building energy modelling platform [Fonseca et al., 2016]. It resolves per-building hourly (8,760 h) end-use demand from geometry, archetypes, weather, and occupancy, using a low-order RC thermal model. We chose CEA because the study question requires a tool that handles a large heterogeneous building stock at hourly resolution and exposes the operational parameters needed for metered-data calibration.

Scenario rationale — a policy ladder

Scenarios are not arbitrary efficiency increments. Each rung mirrors a measure group already present in Korean municipal decarbonisation plans (Dongdaemun-gu basic plan, 2024), letting the analysis isolate where savings concentrate, what is lost when measures are bundled, and at which grid-decarbonisation point electrification overtakes envelope-only action.

Scenario	Narrative
S0 — Calibrated baseline	2024 metered stock; reference for all measure-driven changes.
S1 — Shallow ret rofit	Mirrors the standard light BRP bundle subsidised by Korean municipalities. Tests whether ro utine equipment upgrades alone close the near-term gap.
S2 — Deep retrof it	Envelope brought to current Korean code — the upper bound of demand-side action without fuel switching. Isolates how far envelope alone can go.
S3 — Electrified retrofit	Heating and DHW shifted from gas to ASHP on top of S2, aligned with the national NDC. T ests when grid decarbonisation lets electrification overtake envelope-only retrofit.
± PV (rooftop)	A separable supply-side overlay on S2 / S3, matching the municipal rooftop-PV subsidy prog ramme. Allows the PV credit to be evaluated independently of demand-side measures.

Calibration

Ten unobserved operational parameters (occupant and equipment densities, DHW use, setpoints, heating operation factor, infiltration, etc.) were tuned against 2024 monthly metered electricity and gas, then transferred to the un-metered remainder by use-class regression. All scenarios reuse the same calibrated parameter set; only measure-specific inputs differ.

Climate baselines

Present uses Seoul TMYx; future uses a morphed near-future EPW driven by SSP2-4.5 monthly change signals. The pair represents two fixed external-condition combinations for comparison, not a probabilistic climate ensemble.

Rooftop PV

PV is computed as hourly direct self-consumption (max(GRID − PV, 0)) on flat-roof geometry — storage and feed-in are out of scope. The 70 % roof-coverage cap is applied as a downstream scalar so 50 % and 30 % sensitivities are obtained without re-running the simulation.