Blueprint report 5.3.2: Confirming the energy effectiveness of proposed dwelling upgrades.

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This work stream is developing a state-of-the-art simulation-base procedure to confirm the efficacy of a proposed dwelling upgrade#. Where the impact across a range of indicators relating to energy use, indoor environmental conditions and environmental emissions are deemed unacceptable, exploratory simulations may be undertaken in support of upgrade package refinement.

To ensure that the simulations are realistic vis-à-vis the reality, high resolution dwelling models are constructed for representative dwellings in an estate. As summarised in Figure 1, these models comprise descriptions of 3D form, construction material properties, internal fittings & furnishings, heating system & hot water components, solar thermal/PV panels, the low voltage electrical network, control system components, air & moisture flow paths, room contaminant sources, and occupant behaviour.

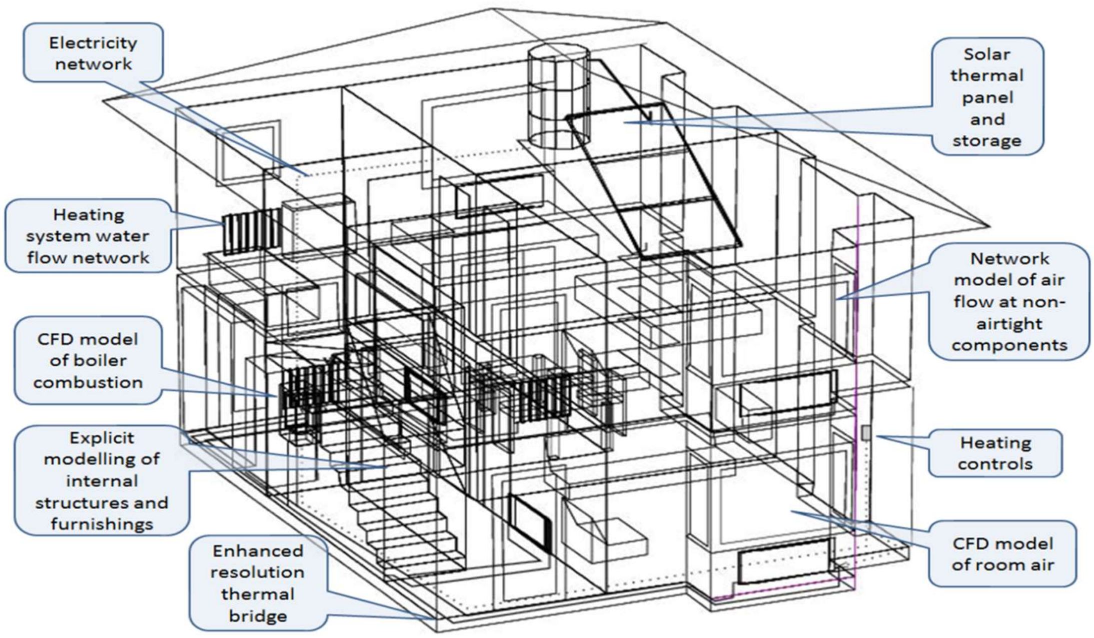

Figure 1: Aspects active in a high resolution model of a dwelling.

The required information is collated from sources such as construction drawings, manufacturers' data, site visits and the building standards prevailing at the time of dwelling construction. It may be expected that the future evolution of the BIM standard will simplify this data collection activity.

The simulation outcomes provide the spatial and temporal distribution of performance aspects such as those depicted in the examples of Figure 2. Within the procedure, these data are automatically probed (spatially and temporally) and the outcomes compared with agreed

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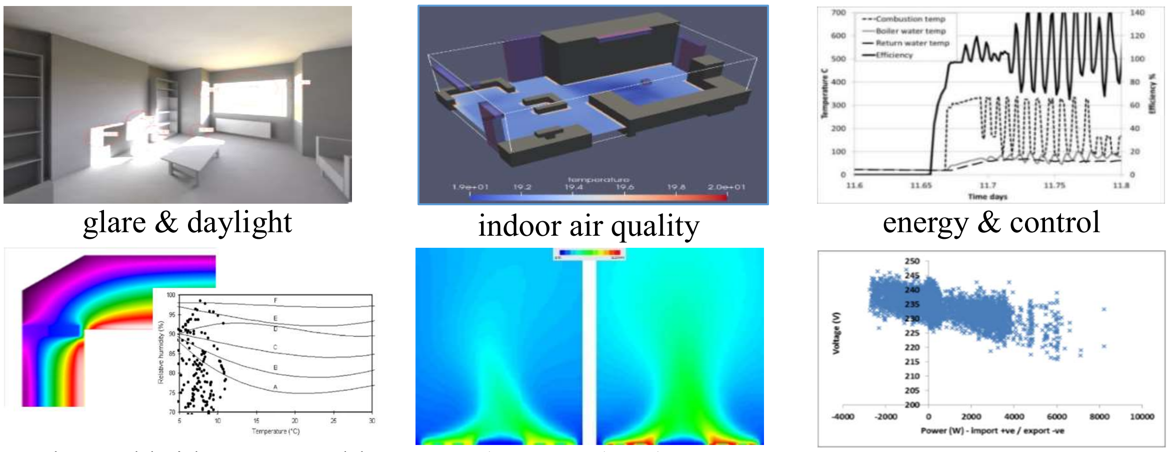
This work is based on the open source ESP-r system, which was initially developed with European Commission support.

standards of performance to confirm overall acceptability. The approach enables performance assessments under a spectrum of weather influences and occupant behaviours and supports upgrade adaptation to suit specific cases.



glare & daylight | indoor air quality | energy & control

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Figure 2 – Spatial/ temporal performance data from a dwelling simulation.

Within the project to date, the procedure has been applied to 3 typical dwelling types (terraced, semi-detached and apartment) when located in different climate zones; and to a showcase dwelling owned by the Domijn Housing Cooperation in Enschede in the Netherlands. Table 1, for example, gives the impact on the space heating demand of the semi-detached archetype at different locations and for progressive upgrade levels.

Table 1: Semi-detached dwelling, space heating demand (kWh/m^2.y).

	Amsterdam	Glasgow	Oslo
Pre-upgrade	121 ± 2.6	125 ± 3.2	170 ± 3.7
+ construction upgrade	60 ± 1.8	63 ± 2.5	80 ± 2.4
+ airtightness & MVHR	36 ± 0.8	42 ± 1.3	52 ± 1.4
+ underfloor insulation	8 ± 0.9	9 ± 1.3	20 ± 1.2

The deliverables from the project will include information on the data required to construct high resolution simulation models, an automated procedure for the simulation processing of models to confirm upgrade efficacy, and the results from performance assessments of the project's showcase dwellings.