

Developing a generic System Dynamics model for building stock transformation towards energy efficiency and low-carbon development

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Abstract Promoting the decarbonisation of buildings requires effective policy measures. An integral part of policy design is ex-ante evaluation of possible policy options and effects. System Dynamics, one of a range of potential modelling paradigms, emphasises the dynamic complexity arising from stock-and-flow structures, feedbacks, non-linearities and time lags of the system in question. It is therefore well placed to model building stock turnover dynamics and the associated energy use and carbon emissions, in order to conduct scenario analysis for policy evaluation. Previous efforts to employ System Dynamics models in buildings in various national contexts are found to have some common fundamental structural and behavioural limitations. We present an improved formulation that includes both building stock disaggregation and dynamics of energy-related retrofits. The model is characterised by greater transparency facilitating reproducibility and further improvements, high structural and functional flexibility for either extensions or reductions depending upon needs, and high generality and adaptability in diverse applications. It can be used as a stand-alone model or as part of a larger model for policy evaluation and scenario analysis exploring the transformation of building stock from improving energy efficiency and shifting towards low-carbon development.

Keywords building stock; System Dynamics; disaggregation; aging chain; energy retrofit

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