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Estimating Lifetimes and Stock Turnover Dynamics of Urban Residential Buildings in China

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Abstract Building lifetime and stock turnover are both key determinants in modelling building energy and carbon. However in China, aside from anecdotal claims that urban residential buildings are generally short-lived, there are no recent official statistics, and empirical data are extremely limited. We present a system dynamics model where survival analysis is used to characterise the dynamic interplay between new construction, aging, and demolition of residential buildings in urban China. The uncertainties associated with building lifetime were represented using a Weibull distribution, whose shape and scale parameters were calibrated based on official statistics on floor area up to 2006. The calibrated Weibull lifetime distribution allowed us to estimate the dynamic stock turnover of Chinese urban residential buildings for 2007 to 2017. We find that the average lifetime of urban residential buildings was around 34 years, and the overall residential stock size reached 23.7 billion m^2 in 2017. The resultant age-specific sub-stocks provide a baseline for the overall stock, which—along with the calibrated Weibull lifetime distribution—can be used in further modelling and for analysis of policies to reduce the whole-life embodied and operational energy and CO_2 emissions in Chinese residential buildings.

Keywords building stock; survival analysis; lifetime distribution; system dynamics

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