SSTC-DWTC

Global change and sustainable development

A SIMULATION MODEL TO EVALUATE THE CO_2 – EMISSION REDUCTION POSSIBILITIES OF COMBINATIONS OF ENERGY SAVING MEASURES.

Executive Summary

A. Verbruggen, D. Goetghebuer

Universiteit Antwerpen, STEM, Kleine Kauwenberg 12, 2000 Antwerpen
Institut Wallon, Bd. Frère Orban 4, B-5000 Namur,

The study of the energy saving potential in the residential sector starts, at least in the ‘bottom-up’ approach we have decided to follow, from an estimate of the technically feasible saving. This estimate in turn depends on an accurate estimation of the ‘thermal quality’ of the existing housing stock. Until now, this estimation was based on a rather rudimentary approximation of the distribution of K-values over the housing stock. The first contribution of the current research project therefore consisted in improving this approximation. To achieve this, a statistical relationship, based on the available data, was estimated between housing characteristics and their measured K-value. This relationship was subsequently used to calculate the average K-value for houses of a specified type and age category, using a representative sample of Flemish houses. The obtained K-value distribution then served as an input to compute the average energy demand for each housing category, by means of the stationary heat balance model. Finally, the technical saving potential could be estimated by calculating the effect of a maximal saving effort (maximum insulation and maximum boiler efficiency) on the average energy use.

The technical saving potential is the upper limit of the technico-economic potential. The latter is defined as the amount of energy saved as a result of the implementation of all measures with a unit annual conservation life-cycle cost below the prevailing energy price. The saving potential of a set of conservation measures is traditionally determined by using ‘energy conservation supply curves’, representing the cumulated amount of conserved energy as a function of their unit costs, ordered from least to highest cost. While the resulting step-functions provide a relatively easy way to estimate the technico-economic potential, they have a number of well-known disadvantages. The most important ones are the presumed sequential implementation of the measures, and the assumption of 'single point' average unit costs. In real world situations, it is rather more probable that energy saving measures will be implemented, at least partially, simultaneously, as a result of the fact that unit conservation costs will be distributed over a range of values. This observation implies that due consideration ought to be given to possible interaction effects between measures, another aspect of real-world situations that is hard to incorporate in the classical model. The second contribution of the current project has been to replace the traditional step-functions by a model allowing to introduce saving measures simultaneously, and in which interaction can be taken into account. The model is based on the logistic distribution, and the resulting cumulative energy savings function is called the 'Logistic Conservation Supply Curve' (LCSC).

Using this LCSC model, the CO_2 emission reduction potential in 2000 was estimated to be close to 2200 kTon per year, or approximately 16% of the annual residential emission for space heating. This reduction potential was computed in a 'business as usual' scenario, assuming no additional government intervention takes place. It respresents the economically feasible energy saving in the existing housing stock and the newly built houses. It should be stressed however, that this figure is a savings potential, which may not correspond to actual energy saving behaviour.

The model has been used to estimate the additional savings that could (potentially) be achieved when additional stimuli are provided by government policy measures. A distinction was made between measures pertaining to the existing dwellings, and those for newly built houses. For the existing housing stock, the effect of the following measures was calculated: a 10% energy tax, a 10% insulation subsidy, and a budget-neutral combination of both measures. The latter appears to be a promising policy: our simulation results indicate that a moderate energy tax (5%) could generate substantial energy savings, provided that the extra tax income is used to stimulate energy saving behaviour through investment subsidies (a 20% subsidy on efficient boilers and wall insulation). These measures do not seem to be equally effective for new houses, where they should be supplemented by measures in the domain of urban planning (a reduction of the share of 'open space' single-family dwellings). This combination has a reduction potential comparable to a strict (and enforceable) K50 insulation norm.

The essential conclusion of our research is that a policy of combined and mutually reinforcing financial stimuli is probably the most succesful strategy to achieve the desired control of CO_2 emission. Moreover, this policy should focus on improving the quality of the older houses, which are a substantial part of the total stock, and whose energy efficiency is well below the efficiency of their more recent counterparts.