EXPLORING THE EFFECTS OF GREEN ENERGY ECONOMY POLICIES FOR TRANSFORMING THE SWEDISH BUILDING STOCK

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(1) Overview

Sweden is often recognised as a country with an effective record associated with energy efficiency policies. While this assertion may hold for certain end-use sectors, there is a great deal of uncertainty about the performance of policies in the building sector. First, ex-ante evaluations of energy efficiency policies targeting the national residential sector are rather scarce and the few ones have been undertaken using general modelling tools (e.g. Nordic-MARKAL model). This approach has been criticised not only by researchers but also by policy makers, who are becoming more and more be frustrated because the same modeling tool is used to answer any type of policy question. Analysts and policy makers alike are in clear need of an improved policy evaluation model that specifically targets the residential sector and allows for suitable modelling and relatively lower uncertainty levels. Second, ex-post evaluations of energy efficiency policies addressing the building sector are also rare and based on outdated statistical data (collected in the decade between 1983 and 1993). In fact, and aware of this critical problem, the government recently decided to carry out a study about the actual technical status of the building stock. The National Board of Housing Building and Planning (Boverket) undertook the assignment for developing up-to-date and adequate statistics (the so-called BETSI project). The work is still in progress it remains to be seen the richness, usefulness, uncertainty and availability of the data, in particular for those outside Boverket. Thirdly, since the global financial crisis in 2008-2009, several policies to stimulate the construction sector and radically develop a much greener building stock have been discussed (e.g. zero net energy building). Again, one can discern strong policy hopes but uncertainty and ambiguity about policy expected policy impacts –let alone the lack of tools to perform such an evaluation.

Based on the above, one can safely say that the performance of energy efficiency policies as applied to the Swedish building sector is still highly uncertain or simply unknown until today. Taking into account the uncertainty and lack of knowledge in this area, the paper at hand provides both an ex-ante and also an ex-post assessment of energy efficiency policies. For the latter, we evaluate whether existing and new energy efficiency policies have (or not) the potential to trigger a radical change in the building sector, taking the single- and two-household residential building segment as a case study.

(2) Methods

To achieve the purpose mentioned above, two different modeling tools were used/developed. First, building energy performance analyses were carried out with eQuest, which is considered as one of the most sophisticated building energy use simulators on the market. eQuest allowed to estimate disaggregated energy values associated with current and potential future technological configurations in the Swedish single- and two-household residential sector.

Second, we developed the EEB_Sweden v1.0 simulation tool to quantitatively represent and simulate the Swedish residential sector, and to generate and evaluate different energy efficiency policy scenarios (2010-2050). The EEB_Sweden v1.0 model is highly-rich bottom-up simulation model. Two alternative baselines and four policy scenarios were simulated with the implemented in order to comprehend, ex-ante, how and to what extent future patterns in energy consumption in buildings is affected by specific measures that could be adopted by policy makers.

(3) Results

In the context of existing policies, an ‘Energy Price Increase’ scenario (combined with existing policies) does not reduce energy consumption when compared to the two baselines. Overall, our results seem to be modest. The main reason for this may be the behavioural component that is included in our framework, rather than technical and financial aspects. These results suggest that overall, decision-makers are much less sensitive to price increases (i.e. inelastic energy use consumption). This is consistent with ex-post policy evaluation studies of the Swedish residential sector, which suggest there have been marginal and incremental efficiency improvements since the 1970s.

Regarding the ‘Net Zero Energy Building’ scenario, on-site solar electricity starts to play a significant role and solar PV is the technology with the highest growth rate. Compared to baselines #1 and #2, this scenario delivers efficiency improvements in the range of 35% and 33% by 2050, respectively. Most efficiency improvements come from space heating.

Finally, the ‘Building System Incentives’ scenario sees a radical transformation of the sector. Compared to the two baselines, it leads to a vast reduction in primary energy consumption. Less carbon-intensive fuels (such as electricity) replace natural gas and LPG. After 2025, natural gas and LPG only make a minor contribution to the fuel

mix and fuel oil and kerosene are no longer used. Space heating is now heavily “serviced” by highly efficient building envelop (i.e. wall/roof/floor insulation and triple glazing). Compared to the two baselines, this scenario reduces energy consumption per dwelling in the order of 63% and 65% by 2050. As a whole, we find that homeowners respond much better to policy instruments when designed in a more comprehensive way. In particular, micro-economic decisions for radical technological change are better driven when aggressive whole-building policies are introduced, in particular when energy intensity targets are introduced (e.g. 50-75 kWh/m^2/yr).

(4) Conclusions

This paper investigates present and future energy consumption in the Swedish single- and two-household residential sector by first creating comprehensive building models picturing the current stock, then analysing their energy performance and finally simulating the evolution of energy consumption under different policy regimes. Our ex-post results seem to be consistent with newly developed statistics rather than (old) official data. In turn, results reveal that much more ambitious policies need to be implemented if a radical transformation of the building stock is wanted, as only incremental progress can be seen for the past 20 years. For radical transformation of the building stock, results suggest that the standard approach of using isolated or technology-targeted policy instruments do not work. On the contrary, preliminary results strongly suggest that micro-economic decisions (capital decisions in particular) are more effectively affected when ambitious whole building policies are combined with energy (or carbon) pricing.