CONSISTENT COST CURVES FOR IDENTIFICATION OF OPTIMAL ENERGY SAVINGS ACROSS INDUSTRY AND RESIDENTIAL SECTORS

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Overview

Energy savings are a key element in reaching ambitious climate targets and may contribute to increased productivity as well. For identification of the most attractive saving options cost curves for savings are constructed illustrating potentials of savings with associated costs. In optimisation modelling these cost options are then compared with the cost of producing energy and all savings with negative costs and cost below the cost of producing the energy including the associated externality costs are expected to be implemented.

There are however several methodological issues associated with constructing and applying the cost curves in modelling:

- Cost curves do not have the same cost interpretation across economic subsectors and end-use technologies (investment cost for equipment varies – including/excluding installation – adaptation costs – indirect production costs)
- The time issue of when the costs are incurred and savings (difference in discount rates both private and social)
- The issue of marginal investment in a case of replacement anyway or a full investment in the energy saving technology
- Implementation costs (and probability of investment) differs across sectors
- Cost saving options are not additive - meaning that marginal energy savings from one option depends on what other options implemented

We address the importance of these issues and illustrate with Danish cases how large the difference in savings cost curves can be if different methodologies are used. For example, the difference between marginal investment costs in residential heating of a more efficient building element (windows) in a larger renovation project compared to the costs of just replacing the windows. This is done based on some of the results from Zvingilaite & Klinge Jacobsen 2016. We compare to the results found for residential savings in Giraudet et. al. 2012 and Amstalden et. al. 2007. For our case the resulting savings potential below a given level of costs can be up to a factor of 5 times larger if only the marginal cost measure is used. For national energy plan strategies this results in much more emphasis on energy savings, than renewable energy expansion as a way to achieve fossil fuel reductions if it is possible to implement all heating savings with their marginal costs.

As saving potentials are not additive for savings in a specific end-use entity it is difficult to compare savings in one sector comprising many options together and single options in another sector. We illustrate that a saving option in one sector (eg a more efficient pump) would be difficult to compare with the savings from replacing an entire production line in a factory with a more efficient one. If the average cost of the two are compared then probably the efficient pump would be preferred due to low costs compared to the full production line. This would leave out the elements of the production line where independent savings investments might have cost that are just as low as for the pump. We argue that comparing across sectors should be carried out with similar sets of savings options (small individual replacements in each sector, and comparable larger technology switches in each sector).

Methods

We begin by outlining the different methodologies that typically are used for identifying the costs of saving energy in different sectors and exemplified by Danish sectoral saving potentials and associated cost curves. Residential heat savings with rich detail and a lot of potentials in various categories of buildings are compared to residential electricity savings associated with marginal investment in more efficient appliances when it is being replaced anyway.

Then we compare these cost curves to cost curves for two Danish industries investment in a few key end-use technologies (high saving potential) and describe the consequences for cost efficient saving allocation to industrial subsectors and the residential sector. We quantify the difference in average savings costs for the two sectors if the results were to be used for allocating savings obligation (see use in EU in Bertoldi et. al. 2010) to the sectors.

Results

Preliminary results for the heating sector indicate that the size of saving potential is very large compared to the other sectors, but that this is partly due to including a larger set of options in residential heat saving than in the industrial savings. The higher cost industrial saving options are to some degree not included in the industrial cost curves due to less knowledge (focus) on the high cost part of the potentials. This may lead to underestimating the industrial energy saving options in scenario analysis where fossil fuel or emission reduction targets are set very high. Such results could lead to too high emphasis on the expensive part of heat savings compared to medium range cost options in industry. We suggest that the industrial saving cost curves should include the higher cost options even though the uncertainty on these costs are larger than for the residential sector.

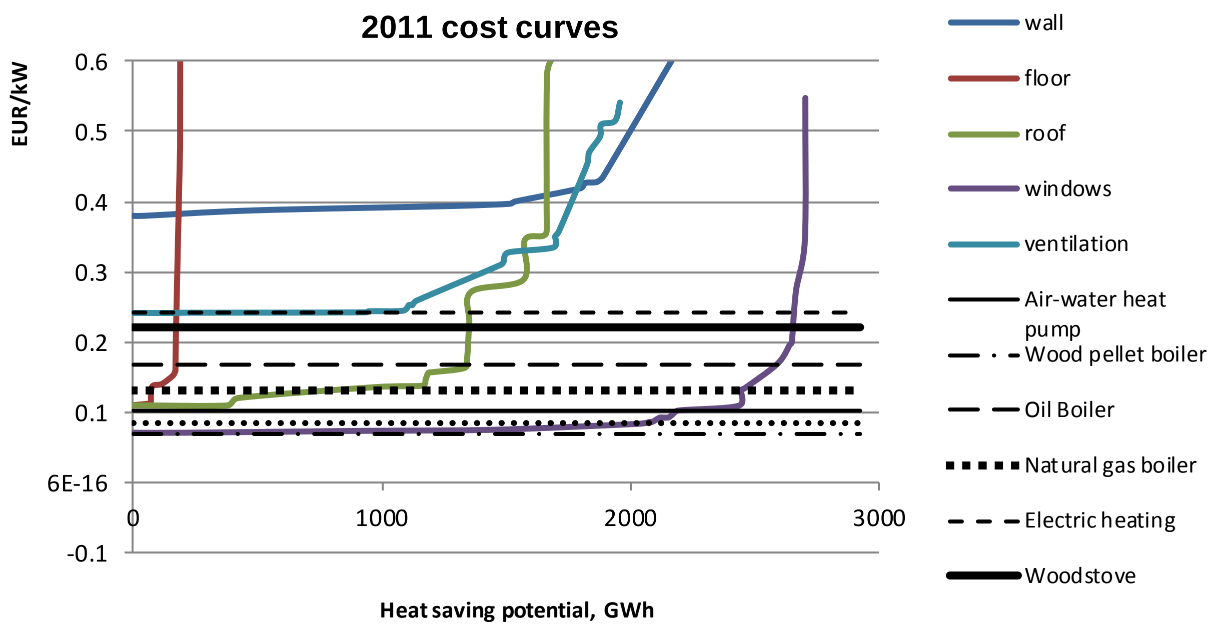

Figure 1 Example of residential sector marginal cost curves for heat savings in DK and heating supply costs

Conclusions

Cost curves for savings are constructed based on different methodologies for varies economic sectors and end-use technologies. That may distort the picture for where the most cost efficient energy savings options are to be found. As input in energy system optimisation models these cost curves could lead to in-optimal allocation of saving targets or obligations in sectors when ambitious economy-wide saving targets are analysed.

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