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Exploring the Links between Energy Efficiency and Resource Efficiency

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Contact: julien.bourrelle@ntnu.no; julien.bourrelle@monda.no

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Overcoming the tendency of those living in energy efficient buildings to use more energy

Zero Energy Buildings (ZEBs) are a viable means to reduce global energy demand, a new study suggests. However, in response to the drop in energy costs for the household due to better energy efficiency, people may begin to consume more energy than they otherwise would. These so-called 'rebound effects' can undermine emissions reductions, the study says, and it proposes approaches that could lessen these impacts.

ZEBs are gaining policy support in the EU as a means to reduce CO_2 emissions. The buildings have high energy efficiency and aim to offset any remaining emissions from the everyday running of the ZEBs together with those created by the construction by generating or investing in renewable energy. This can be done on site if the building is situated in an appropriate place, for example by fitting roof solar panels on a house that receives plenty of sunlight, or by investing in renewable energy that is generated off-site.

Although improving the energy efficiency of households is a popular approach to reduce emissions, rebound effects can undermine the savings made. These effects occur because better efficiency reduces the cost of energy in a household, hence increasing people's income inducing them to consume more, including more energy. This can be through using energy within the house itself, purchasing other services or goods that consume energy or investing the saved money which is then re-spent by financial institutions in activities that increase energy use.

In the past, rebound effects in ZEBs have been neglected in the calculation of the energy balance but they should be considered, the study says, when making policy decisions in this area. The study plotted non-renewable energy usage for the different building stages, such as manufacture of materials, construction and demolition, against the cost of these stages. This was done for both ZEBs and conventional buildings in a northern heating-dominated climate and the comparison allowed an analysis of money available from ZEBs to potentially re-spend on energy.

The research identified three major ways to influence rebound effects in ZEBs:

Feed-in-tariffs: Many EU countries encourage the generation of renewable energy with tariffs that pay people for the renewable energy they 'feed in' to the national grid. High feed-in-tariffs will encourage renewable generation early on but, if they are too advantageous, ZEB owners will be able to offset their emissions, pay off the cost of the building and still earn from renewable generation. This will mean they will have money to spare to potentially consume more household energy or engage in energy consuming activities, such as air travel. As such, advantageous feed-in-tariffs should be limited to the technology adoption phase in ZEBs to encourage investment in renewable energy technology. Once owners are 'earning' money from the ZEB then tariffs could be lessened to reduce their spending. This reduction must not be so severe that it discourages people from initially investing in ZEBS.

Choice of effective renewable energy: Rebound effects can be dampened through adopting the most effective renewable supply option, i.e. producing the most energy for least cost. For example, for ZEBS in the northern climate, investing in wind power is likely to be more effective than installing photovoltaic systems. The rebound effects on energy use are dampened because, with more effective renewable energy, the ZEB feeds back more energy into the grid than is used to construct the building, giving it a negative energy balance. So, although there may be some re-spend of cost savings on energy-consuming activities, the ZEB has an energy credit which it can use before the impact of any rebound effect kicks in, therefore acting as a form of buffer against the rebound effect. This approach is especially effective when combined with incentives to spend extra cost savings in renewable energy.

Controlling energy prices: Rebound effects can be reduced through energy prices, for example if prices for non-renewable fuels are increased while incentives for renewables are improved, this can encourage greater re-spend of cost savings in the renewables sector.

Both the building sector and policymakers need to be aware of possible rebound effects associated with ZEBs. More research is needed to quantify these effects so they can be included within the energy balance of ZEBs and clarify the real emissions savings.