



## Strathprints Institutional Repository

**Turner, Karen and Riddoch, Fiona and Figus, Gioele (2016) How Improving Household Efficiency Could Boost the Scottish Economy. [Report] ,**

This version is available at <http://strathprints.strath.ac.uk/57955/>

**Strathprints** is designed to allow users to access the research output of the University of Strathclyde. Unless otherwise explicitly stated on the manuscript, Copyright © and Moral Rights for the papers on this site are retained by the individual authors and/or other copyright owners. Please check the manuscript for details of any other licences that may have been applied. You may not engage in further distribution of the material for any profitmaking activities or any commercial gain. You may freely distribute both the url (<http://strathprints.strath.ac.uk/>) and the content of this paper for research or private study, educational, or not-for-profit purposes without prior permission or charge.

Any correspondence concerning this service should be sent to Strathprints administrator: [strathprints@strath.ac.uk](mailto:strathprints@strath.ac.uk)



UNIVERSITY of STRATHCLYDE  
**INTERNATIONAL PUBLIC  
POLICY INSTITUTE**

**CENTRE FOR ENERGY POLICY**

---

## **How improving household efficiency could boost the Scottish economy**



**Karen Turner, Fiona Riddoch and Gioele Figus**  
Centre for Energy Policy

---

**Making a difference to policy outcomes locally, nationally and globally**

---

**POLICY BRIEF**

---

The views expressed herein are those of the author  
and not necessarily those of the  
**International Public Policy Institute (IPPI)**,  
University of Strathclyde.

---

# How improving household energy efficiency could boost the Scottish economy

Karen Turner, Fiona Riddoch and Gioele Figus, Centre for Energy Policy, International Public Policy Institute, University of Strathclyde

---

## Acknowledgement

The authors acknowledge the support of the EPSRC (Grant ref: EP/M00760X/1) and the ESRC (Grant ref: RES-061-25-0010; PhD studentship ref: 1562665), and of ClimateXChange, the Scottish Government-funded Centre for Expertise in Climate Change. Please note that the opinions in the paper are the sole responsibility of the authors, and not necessarily those of ClimateXChange or the Scottish Government.

---

## Executive Summary.

While European governments continue to invest in energy efficiency as a key tool of energy and climate policy, there is increased interest in the broader economic benefits of energy efficiency in a social and economic context. Recent studies show that, beyond the direct effects on energy use and spending, multiple positive impacts of energy efficiency improvements exist in the wider economy as a whole. Gross Domestic Product (GDP) increases linked to household efficiency enhancements could well be an outcome of both implementing and realising energy efficiency measures.

A team from the Centre for Energy Policy (CEP) and Fraser of Allander Institute (FAI) at the University of Strathclyde have used modelling and simulation to explore the economy wide impacts of energy efficiency improvements in households.<sup>1</sup> A clear, long lasting stimulus to the economy is triggered by improving the energy efficiency of homes; this is because the disposable income of householders increases as a result of saving money on energy bills. The team used modelling to trace the economic impact of this disposable income increase. The simulation suggested that a spending-

---

<sup>1</sup> Lecca, P., McGregor, P. G., Swales, J. K., & Turner, K. (2014). The added value from a general equilibrium analysis of increased efficiency in household energy use. *Ecological Economics*. 100, 51–62. Doi:10.1016/j.ecolecon.2014.01.008.

led GDP boost can be triggered and could have wider impacts in employment and public budgets. Associated with the increased economic activity will be an increase in energy use that tends to reduce the ultimate level of energy savings from an energy efficiency action. Such an effect is called “rebound”. However, by encouraging spending in low carbon products and services, the erosion of energy savings could be minimised.

Simulating the impacts of single energy efficiency measures on the economy as a whole provides policy-relevant insights:

- 1) There are potential multiple benefits which result from a policy initiative improving energy efficiency in domestic buildings. At the household level, these benefits include the positive impact of increased household disposable income as well as the better recognised comfort and health benefits.
- 2) Where low income has held the amount of energy used for heating in a household uncomfortably low, a rational economic response for the household is to heat more rooms or heat spaces to a comfortable temperature. While this may undermine the original intent of energy saving, it will improve household well-being and produce a positive economic stimulus. From an energy policy perspective it is “right sizing” of energy demand, revealing the true demand which must be met.
- 3) Modelling suggests that there is a set of positive longer-term macro-economic effects that accompany energy efficiency improvements in households. This includes increased GDP when money saved on energy bills is spent on other activities and goods in the UK and Scottish economies.

Energy policy development could benefit from:

- Anticipating, at the planning stage, that there will be a level of rebound from energy efficiency measures.
- Exploring options, through projects and demonstrations, to link packages of energy efficiency actions such that the released disposable income can be absorbed in low energy intensity goods and services.

## 1. Looking at energy efficiency measures through economy-wide modelling

Improved energy efficiency is part of the ‘energy and climate tool kit’ of governments across Europe as they address their energy and climate objectives. Successful energy efficiency measures contribute to:

- reducing energy demand leading to lower energy imports and increased energy security
- reducing the energy required across the economy and so lowering CO<sub>2</sub> emissions
- reducing the physical energy required to deliver energy services thereby increasing affordability.

The International Energy Agency (IEA) has developed a ‘multiple benefits view’ of energy efficiency which focuses on the point that the benefits of improved energy efficiency are not limited to energy/emissions savings, security and affordability; rather they extend to a range of potential economic and social benefits including positive GDP impact, employment and public budgets, reduced (energy and absolute) poverty and improved health of the population<sup>2</sup>.

In making these arguments, the IEA is not referring to only the activity and employment triggered by initial investments to enable energy efficiency improvements; they are referring to the impacts of improved energy efficiency itself that potentially delivers a greater and longer lasting stimulus to household incomes and the wider economy.

The case for a sustained multiple benefits outcome from energy efficiency policy is supported by the findings of research conducted by the Centre for Energy Policy (CEP) and Fraser of Allander Institute (FAI) at the University of Strathclyde over the last decade.<sup>3</sup> This research has used multi-sector ‘general equilibrium’ or CGE models (of the type adopted by both the Scottish and UK governments for a range of policy analyses) to consider the economy-wide impacts of both domestic and industrial energy efficiency.

---

<sup>2</sup> IEA (2014). Capturing the Multiple Benefits of Energy Efficiency, OECD/IEA, Paris.

<sup>3</sup> The main current project is an EPSRC End-Use Energy Demand project titled ‘Energy Saving Innovations and Economy-Wide Rebound Effects’. EPSRC Grant Reference EP/M00760X/1. See the project web-site at <http://cied.ac.uk/research/impacts/energysavinginnovations>.

One element of this work explored the economy-wide response to a 5% household energy efficiency improvement that occurs across the board in UK households following technical improvements to buildings efficiency, appliances, and heating systems. This improvement would enable households to operate as normal while using less energy, with the savings being, in effect, an increase in disposable income. The research simulates the various potential outcomes if households decide to spend the money they save on either buying energy or buying other products and services.

The research indicates that, over time, a 5% national energy efficiency improvement in household energy use may generate a boost to national GDP of around 0.10%, with other related economic benefits (Figure 1 refers). Indeed in provisional work for Scotland, results suggest that the boost to economic activity could be greater, given more flexible labour market conditions (i.e. the possibility of migration of workers within the UK economy).<sup>4</sup>

Figure 1. The Impacts of a 5% improvement in efficiency in UK household energy use

The CEP research considered a situation where all UK households became 5% more efficient simultaneously and traced the impacts of that single change throughout the economy over a 30 year period.

The findings point to positive and lasting economic outcomes from such an energy policy initiative, suggesting that, over the longer-term, a 5% energy saving in households could translate to a 0.10% improvement in GDP. In addition, results suggest that total household consumption of goods and services would increase by 0.25% in value and national investment by 0.10%. There could also be a corresponding 0.40% fall in unemployment rates and average wage increases of 0.07%.

However, the findings also suggest rebound in energy use, both in the household sector (which falls by around only 1.6%) and in the industries benefiting from increased demand; the findings also suggest a net drop in industrial energy use of around 0.2% due to the transfer of demand from energy supply to other (less energy-intensive) sectors.

For more details, see a summary of the findings prepared for the [European Commission Science for Environment Policy](#) (p.12).<sup>5</sup>

<sup>4</sup> Provisional Scottish results are reported in a CEP occasional paper, which can be downloaded at <http://strathprints.strath.ac.uk/56449/>.

<sup>5</sup> Also available to download via the EPSRC project web-site at <http://cied.ac.uk/files/file.php?name=household-energy-efficiency-could-help-boost-economy-49si7-en.pdf&site=440>.

The team is currently conducting work to consider how energy efficiency improvements in any given household income group will, via the resulting economic expansion, have income benefits for other, and potentially all, households. In particular, they are focussing on how low-income households may benefit both from support to improve their own energy efficiency and from any efficiency improvements in other household groups. These kind of income benefits which would occur from efficiency improvements in all household sectors are likely to have expansionary effects that raise living standards across the wider economy.

## **2. The concept of rebound effects in absolute energy savings**

The improvement in energy efficiency which allows households to operate as normal while using less energy, thereby increasing household disposable income, is also contributing to the energy savings target of governments, within their energy and climate strategy. Spending the disposable income will result in some off-setting energy use associated with production of any additional energy, goods or services purchased and the resulting economic expansion. In simulating a range of different household purchasing responses, the research shows that this macro-economic rebound effect can cause an erosion of around 60% in the original energy saving over the long term. This could be a challenge for target-driven energy policies such as energy and climate objectives, where there is a risk of overestimating the energy savings which can be expected from a given energy efficiency action. When creating policy, both the responses it may trigger and the wider impacts of potential rebound pressures need to be considered from the outset.

In research on fuel poverty, a key issue is that in the absence of improved energy efficiency, low income households, including those spending more than 10% or even 20% (extreme fuel poverty) of their income on energy, may well be limiting the time of use or the overall temperature of heating in their homes to minimise cost. In 2014, these represented 35% of households in Scotland<sup>6</sup> and 10.6% in England.<sup>78</sup> Efficiency

---

<sup>6</sup> <http://www.gov.scot/Topics/Statistics/Browse/Housing-Regeneration/TrendFuelPoverty>

<sup>7</sup> [https://www.gov.uk/government/uploads/system/uploads/attachment\\_data/file/540034/Annual\\_Fuel\\_Poverty\\_Statistics\\_Report\\_2016\\_-\\_revised.pdf](https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/540034/Annual_Fuel_Poverty_Statistics_Report_2016_-_revised.pdf)

<sup>8</sup> It needs to be noticed that Scotland and England measure fuel poverty using two different indicators <http://sticerd.lse.ac.uk/dps/case/cr/CASereport72.pdf>



improvements in, for example, building insulation, heating systems and appliances, allow these households to adjust their comfort level in a controlled way and to use the money saved to achieve a normal level of comfort. Such adjustments are likely to bring not just direct comfort benefit but also health and wider social benefits. Moreover, the wider economic benefits of the efficiency improvement will act to reinforce and strengthen this outcome.

### **3. Implications of economic rebound for policy makers working on energy efficiency and energy savings measures.**

The outcomes of macro economic simulations of national energy efficiency measures suggests that multiple policy benefits could be expected and should be considered in the design of such measures:

- Policy makers should take into consideration the likely economic rebound effect in setting targeted energy outcomes for energy efficiency actions. In addition, in evaluating the likely societal impacts of an energy efficiency measure, potential positive economic, health and social effects should be taken into account.
- Where the amount of energy used for heating has been held uncomfortably low before energy efficiency measures have been applied, some direct household rebound in additional energy use is likely. This adjustment could be considered as “right- sizing” demand: that is, reducing the uncertainty in demand planning for policy makers.
- Higher income households that spend a smaller share of their income on energy are likely to rebound less in direct energy use but potentially benefit and spend more as the economy expands. This implies a need to: 1) understand better the complexities of indirect and economy-wide rebound due to spending reallocation and economic expansion and 2) potential variation in the targeting of energy efficiency measures in different economic sectors.

- With better understanding of potential rebound effects, energy policy makers might consider developing packages of energy efficiency measures that encourage rebound into areas of lower total energy use (e.g. public rather than private transport) hence minimising rebound in energy and CO<sup>2</sup>.<sup>9</sup>

### **Conclusion: how to treat rebound in policy discussions**

The Centre for Energy Policy research highlights several potential positive impacts of national household energy efficiency initiatives, at both household and economy-wide levels.

In particular, the economy-wide perspective highlights that there are advantages both in terms of reduced energy costs and greater disposable income when household energy efficiency improves. There are also positive economy-wide impacts of the energy rebound of any spending of the resulting increased disposable income. It is appropriate therefore when planning for and assessing the results of energy efficiency actions that the potential wider range of positive economic impacts be taken into account.

---

<sup>9</sup> Turner K., Figus G., Lecca P., Swales K., (2016) "Reducing Rebound Without Sacrificing Macroeconomic Benefits of Increased Energy Efficiency?", The Energy Forum, [Page 31](#), <http://www.iaee.org/en/publications/newsletterdl.aspx?id=353>

### **About the authors:**

**Karen Turner** is Director of the Centre for Energy Policy (CEP), International Public Policy Institute (IPPI), University of Strathclyde.

**Fiona Riddoch** is Senior Knowledge Exchange Fellow, Centre for Energy Policy, International Public Policy Institute (IPPI), University of Strathclyde.

**Gioele Figus** is a PhD student, Centre for Energy Policy (CEP), International Public Policy Institute (IPPI), University of Strathclyde.

### **Contact details:**

#### **Karen Turner**

Director, Centre for Energy Policy  
University of Strathclyde

e: [karen.turner@strath.ac.uk](mailto:karen.turner@strath.ac.uk)

t: 0141 548 3198

#### **International Public Policy Institute (IPPI)**

McCance Building, Room 4.26  
University of Strathclyde  
16 Richmond Street  
Glasgow G1 1XQ

t: +44 (0) 141 548 3865

e: [ippi-info@strath.ac.uk](mailto:ippi-info@strath.ac.uk)

#### **The International Public Policy Institute**

IPPI focuses on global policy challenges in energy, future cities, health, economic development, government and public sector policy, education and social policy. IPPI draws on expertise from across the Humanities and Social Sciences, Strathclyde Business School, Science and Engineering and takes an inter-disciplinary approach to public policy challenges.



the place of useful learning

[www.strath.ac.uk/research/internationalpublicpolicyinstitute](http://www.strath.ac.uk/research/internationalpublicpolicyinstitute)

[ippi-info@strath.ac.uk](mailto:ippi-info@strath.ac.uk)

University of Strathclyde Glasgow G1 1XQ

The University of Strathclyde is a charitable body,  
registered in Scotland, with registration number SC015263