



UNIVERSITY of STRATHCLYDE
**INTERNATIONAL PUBLIC
POLICY INSTITUTE**

CENTRE FOR ENERGY POLICY

UCD workshop on Consumers, Economics and Energy Systems

17th October 2016

Rebound and energy demand

**Multiple benefits: economic expansion, household
incomes and economy-wide rebound**

**KAREN TURNER, CENTRE FOR ENERGY POLICY, UNIVERSITY OF STRATHCLYDE
WITH GIOELE FIGUS, ANTONIOS KATRIS AND PETER MCGREGOR**

EPSRC GRANT REF: EP/M00760X/1



FRASER OF ALLANDER INSTITUTE



**Centre on
Innovation
and Energy
Demand**



UNIVERSITY of STRATHCLYDE
**INTERNATIONAL PUBLIC
POLICY INSTITUTE**

CENTRE FOR ENERGY POLICY

EPSRC EUED project 'Energy saving innovations and economy-wide rebound effects'

<http://cied.ac.uk/research/impacts/energysavinginnovations>

Project partners: EUED CIED centre at Sussex and Fraser of Allander Institute; external collaborators on different WP



FRASER OF ALLANDER INSTITUTE



Modelling multiple outcomes and benefits

- Multi-sector economy-wide models
- Energy Saving Trust – input-output (IO) models to estimate ripple or multiplier effects in economic output and job creation resulting from investment in *making* energy efficiency improvements
- Scottish Government – wider use of IO models to consider multiplier effects of range of investments and demand changes
- Scot Govt. and HM Treasury – embed IO data in more sophisticated computable general equilibrium (CGE) models to consider fuller economic and fiscal implications of wider range of changes in economic conditions
- Our project – CGE modelling to consider
 - Productivity-led expansion of increased efficiency in industrial energy use
 - Demand-led expansion of increased efficiency in household energy use

Energy efficiency has lasting stimulatory effects

- September 16 - Scottish Government inclusion of investment in energy efficiency in post-Brexit economic stimulus package
- Initial focus – output and job creation triggered by building activity to make homes and public buildings more energy efficient
- Our research: further, and lasting, economic stimulus generated by what happens once increased efficiency takes effect
 - Increased disposable household income
 - Savings from lower energy bills can be spent on other things
 - Reallocation of spending changes composition of activity
 - Upward pressure on prices (depending on supply conditions)
 - Some winners and losers
 - But likely net gains at economy-wide/macroeconomic level



June 2015
Thematic Issue 49

**Exploring the Links
between Energy
Efficiency and
Resource Efficiency**

**Subscribe to free
weekly News Alert**

Source: 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.20
14.01.008.

European
Commission

Science for Environment Policy

Household energy efficiency could help boost the economy

Improving the energy efficiency of homes could have positive economy-wide impacts, recent UK research suggests. It would allow householders to spend the money they save on energy on other products and services. Although this additional demand and the associated production in non-energy sectors would partly offset the energy saved in the home, this 'rebound effect' does not completely outweigh the household energy savings.

This study explored the links between increased energy efficiency of UK households and the wider UK economy using 'general equilibrium' modelling. In particular, researchers investigated a potential 5% improvement in [energy](#) efficiency, which they assumed would occur as a result of technological improvements (e.g. more efficient appliances) that allow a household to continue operating at the same capacity, but using less energy.

Financial savings from this lower energy use will probably mean that householders use their appliances more than before, creating 'direct rebound effects'. This study also considered 'indirect rebound effects'. These occur because the cost savings allow householders to spend more money on goods and services other than energy. The energy used by other sectors that provide these goods and services can reduce the overall benefits of the initial improvement in household efficiency. To understand these rebound effects, the researchers assessed the energy usage of 21 economic sectors. These included four energy sectors (1. coal; 2. refined oil (and also nuclear fuel that goes to the electricity generation sector - analysed together with oil, as these two sectors were integrated in the study's source of data); 3. gas; 4. electricity) and 17 other sectors, including food, textiles/clothing and finance.

The model's results suggest that the 5% improvement would have positive effects on the national economy, because increased real income and spending on non-energy sectors has a greater economic impact than the same amount of spending on energy. The effects would

Energy efficiency and low income households

- Common focus of government support of energy efficiency actions
- Energy poverty dependent on energy prices, income level and state of property
- Direct rebound: if under-heating homes, direct rebound may reflect comfort-taking and provide a better picture of true demand levels

Multiple benefits argument

- Wider range of socio-economic benefits possible
- Including those linked to economic expansion and, thus, indirect and economy-wide rebound effects
- Problems/trade-offs implicit in needing policy to deliver on multiple outcomes - increasing energy efficiency, reducing carbon emissions, reducing fuel poverty.....all while delivering GDP growth

Question is it better to

- **Focus policy action/support on increasing energy efficiency in low income households?**
- **Or support increased energy efficiency in *all* households?**
- UK CGE modelling experiments to consider the type of general effects we may expect under either case
- 10% increase in efficiency in energy use for heating and lighting
- All households or just lowest income quintile
- Costless or funded through reallocation of government spending or increased tax (assume UK aim of balanced government budget)



Simple costless case first... All households

Lowest 20% only

Table 1. % change in key macroeconomic variables from a 10% costless increase in efficiency of household energy use (heating and lighting) - all households

	SR	LR
GDP	0.03	0.16
CPI	0.32	0.21
Investment	1.14	0.79
Unemployment rate	-0.82	-2.08
Employment	0.05	0.13
Nominal wage	0.42	0.45
Real wage	0.09	0.24
Import	0.70	0.58
Export	-0.49	-0.37
Total energy use	-0.67	-0.89
Household disposable income (after savings)	0.52	0.58
Household energy consumption	-1.66	-1.87
Household electricity, gas and coal consumption	-2.35	-2.62
Household rebound in electricity, gas and coal	76.53	73.82
Household total energy rebound	78.89	76.33
Economy wide rebound	69.86	59.68

Table 3. % change in key macroeconomic variables from a 10% costless increase in efficiency of household energy use (heating and lighting) - lowest quintile only

	SR	LR
GDP	0.00	0.02
CPI	0.03	0.01
Investment	0.15	0.11
Unemployment rate	0.04	-0.13
Employment	0.00	0.01
Nominal wage	0.02	0.03
Real wage	0.00	0.01
Import	0.07	0.05
Export	-0.04	-0.02
Total energy use	-0.09	-0.11
Household disposable income (after savings)	0.06	0.07
Household energy consumption	-0.22	-0.24
Household electricity, gas and coal consumption	-0.30	-0.33
Household rebound in electricity, gas and coal	79.03	76.71
Household total energy rebound	80.65	78.50
Economy wide rebound	71.94	63.91

Simple costless case first...



UNIVERSITY of STRATHCLYDE
**INTERNATIONAL PUBLIC
POLICY INSTITUTE**

CENTRE FOR ENERGY POLICY

All households

Table 2. % change in households income and energy expenditure

	HG1		HG2		HG3		HG4		HG5	
	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR
<i>Disposable income (after savings)</i>	0.70	0.70	0.60	0.63	0.54	0.60	0.51	0.60	0.43	0.52
<i>Electricity, gas and coal consumption</i>	-1.99	-2.31	-2.19	-2.49	-2.34	-2.61	-2.44	-2.68	-2.61	-2.86
<i>Share of disposable income spent on EGC</i>	-2.67	-2.99	-2.78	-3.10	-2.87	-3.19	-2.93	-3.26	-3.03	-3.36
<i>Household rebound in electricity, gas and coal</i>	80.11	76.85	78.07	75.08	76.59	73.87	75.61	73.24	73.90	71.43

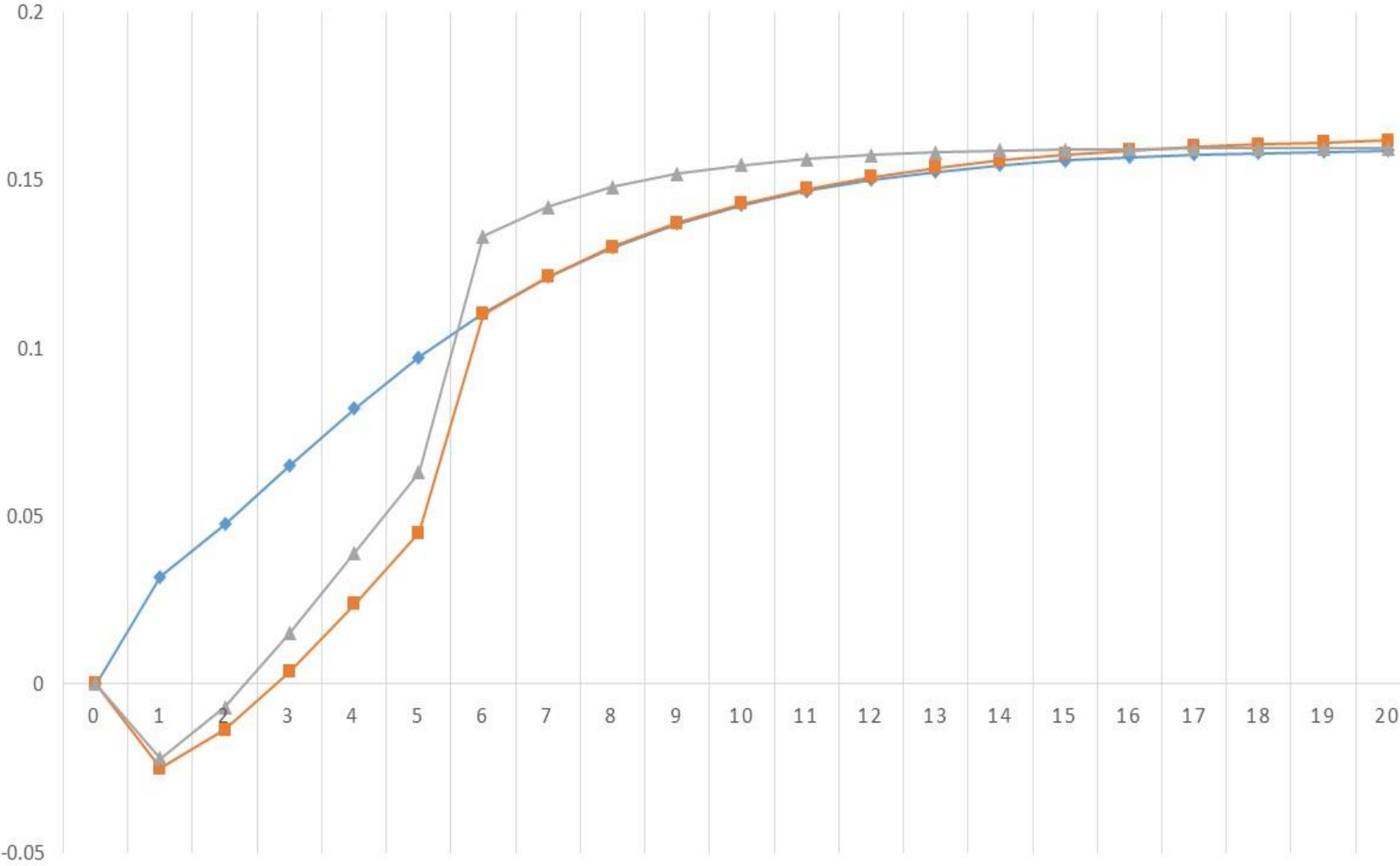
Lowest 20% only

Table 4. % change in household's group 1 income and energy expenditure

	HG1		HG2		HG3		HG4		HG5	
	SR	LR	SR	LR	SR	LR	SR	LR	SR	LR
<i>Disposable income (after savings)</i>	0.60	0.60	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01
<i>Electricity, gas and coal consumption</i>	-2.41	-2.45	0.05	0.01	0.05	0.02	0.05	0.02	0.05	0.03
<i>Share of disposable income spent on EGC</i>	-3.00	-3.04	0.04	0.00	0.04	0.00	0.04	0.00	0.04	0.00
<i>Household rebound in electricity, gas and coal</i>	75.86	75.47	-	-	-	-	-	-	-	-

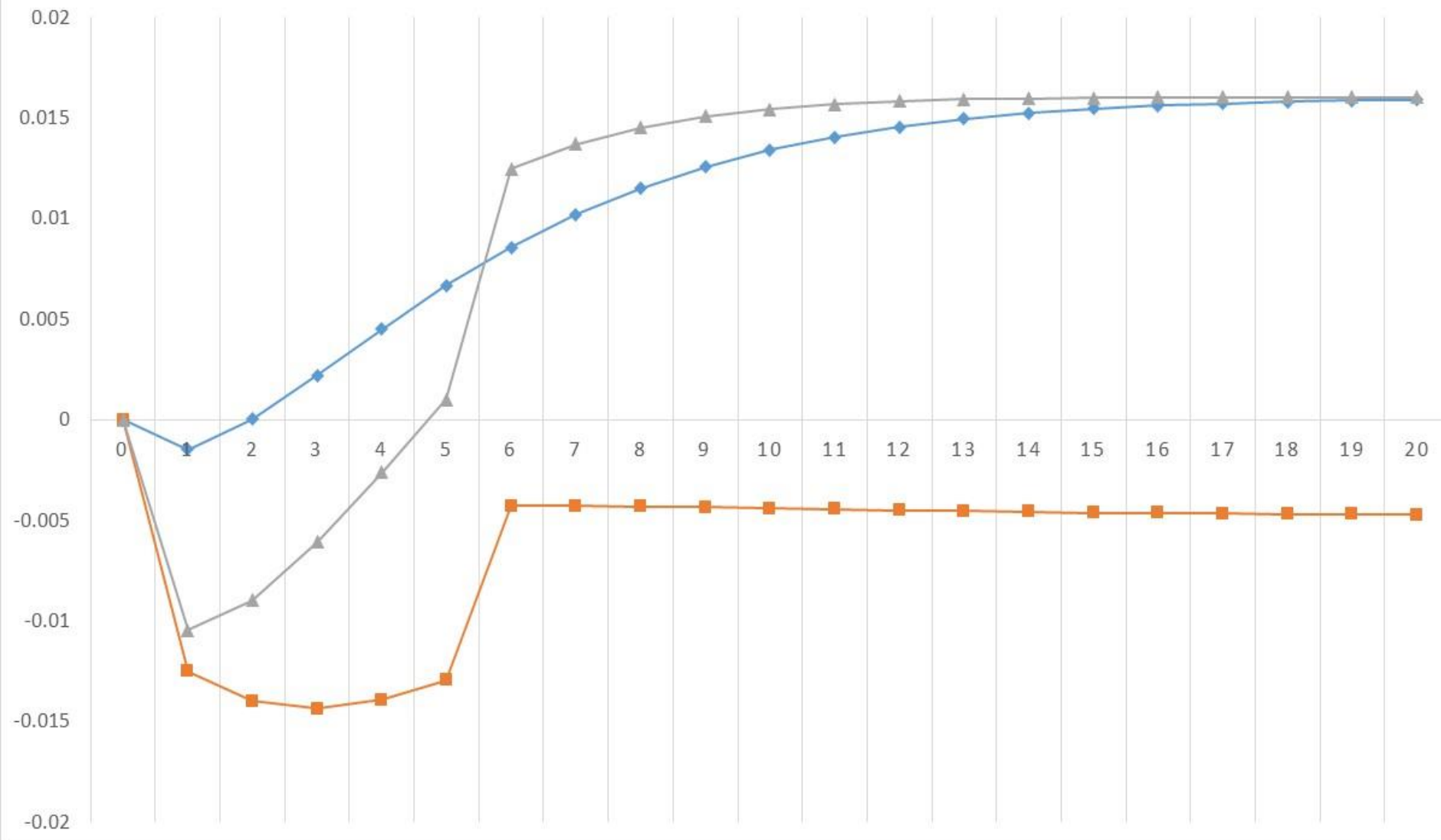
PERCENTAGE CHANGE IN GDP FROM A 10% INCREASE IN HOUSEHOLD
ENERGY EFFICIENCY (ALL HOUSEHOLDS)

Standard Tax Gov



PERCENTAGE CHANGE IN GDP FROM A 10% ENERGY EFFICIENCY INCREASE IN ONLY THE LOWEST HOUSEHOLD INCOME QUINTILE

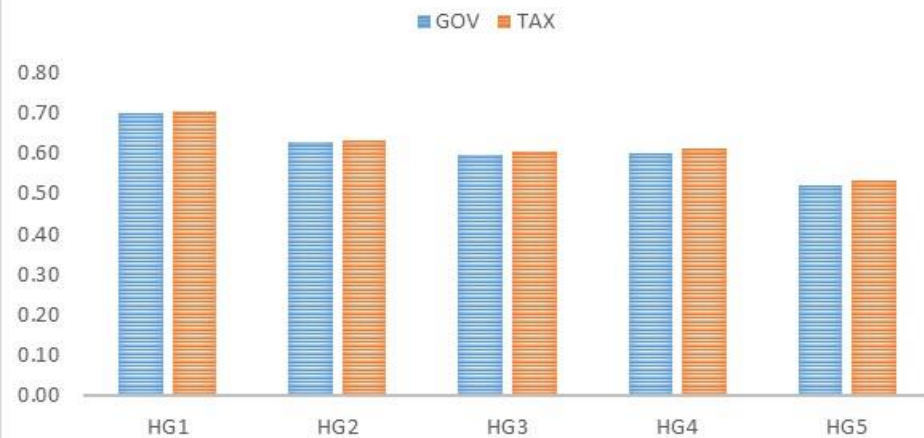
Standard Tax Gov



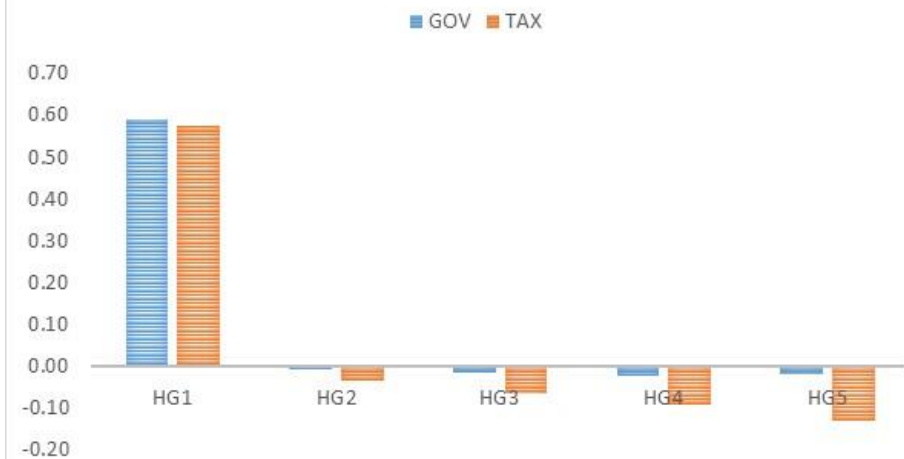
SHORT-RUN % CHANGE IN DISPOSABLE
INCOME - ALL HOUSEHOLD CASE



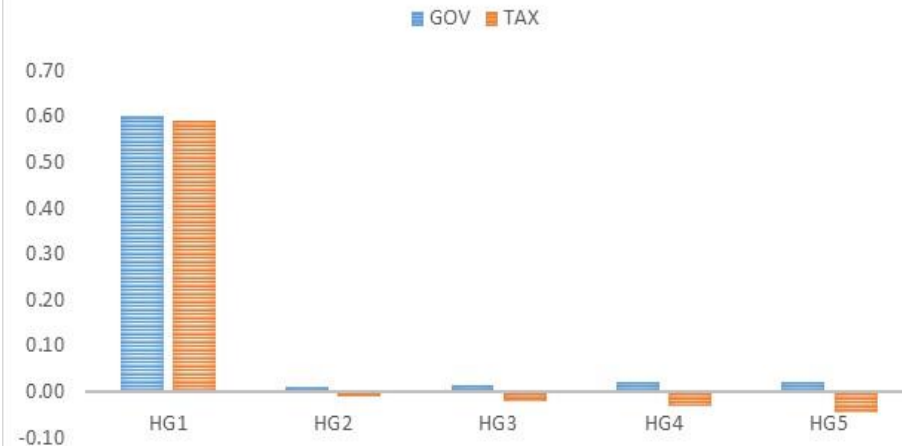
LONG-RUN % CHANGE IN DISPOSABLE
INCOME - ALL HOUSEHOLD CASE



SHORT-RUN % CHANGE IN DISPOSABLE
INCOME - LOWEST QUINTILE CASE



LONG-RUN % CHANGE IN DISPOSABLE INCOME
- LOWEST QUINTILE CASE



Conclusions?

- Government is committed to support of energy efficiency
- But has a wider set of required outcomes
- **Can't meet them all just by focussing only on low income homes**
- Potential for system approaches to increasing efficiency of all types of homes
- CGE model experiments show us the general effects of supporting increased energy efficiency – including impacts on incomes of and energy use by different types of households
- Demonstrating potential multiple economy-wide benefits can help government think longer term about how they can go about achieving these benefits

Specifically...

- How to trigger a change in the wider economy and get the private sector to pick up and play a role in delivering funding/investment required
- That, is drawing attention to the fact that there is a clear payback to investing in energy efficiency
- For government, multiple benefits of economic expansion provides justification for making energy efficiency a strategic national infrastructure investment priority