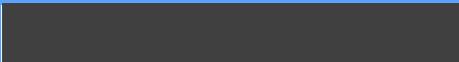


Rethinking fuel poverty as a complex problem:

From fabric first to folk first solutions

Dr Keith Baker

Built Environment Asset Management (BEAM) Centre, Glasgow Caledonian University, and the Energy Poverty Research initiative

T. 

E. keith.baker@gcu.ac.uk

W. www.energypovertyresearch.org

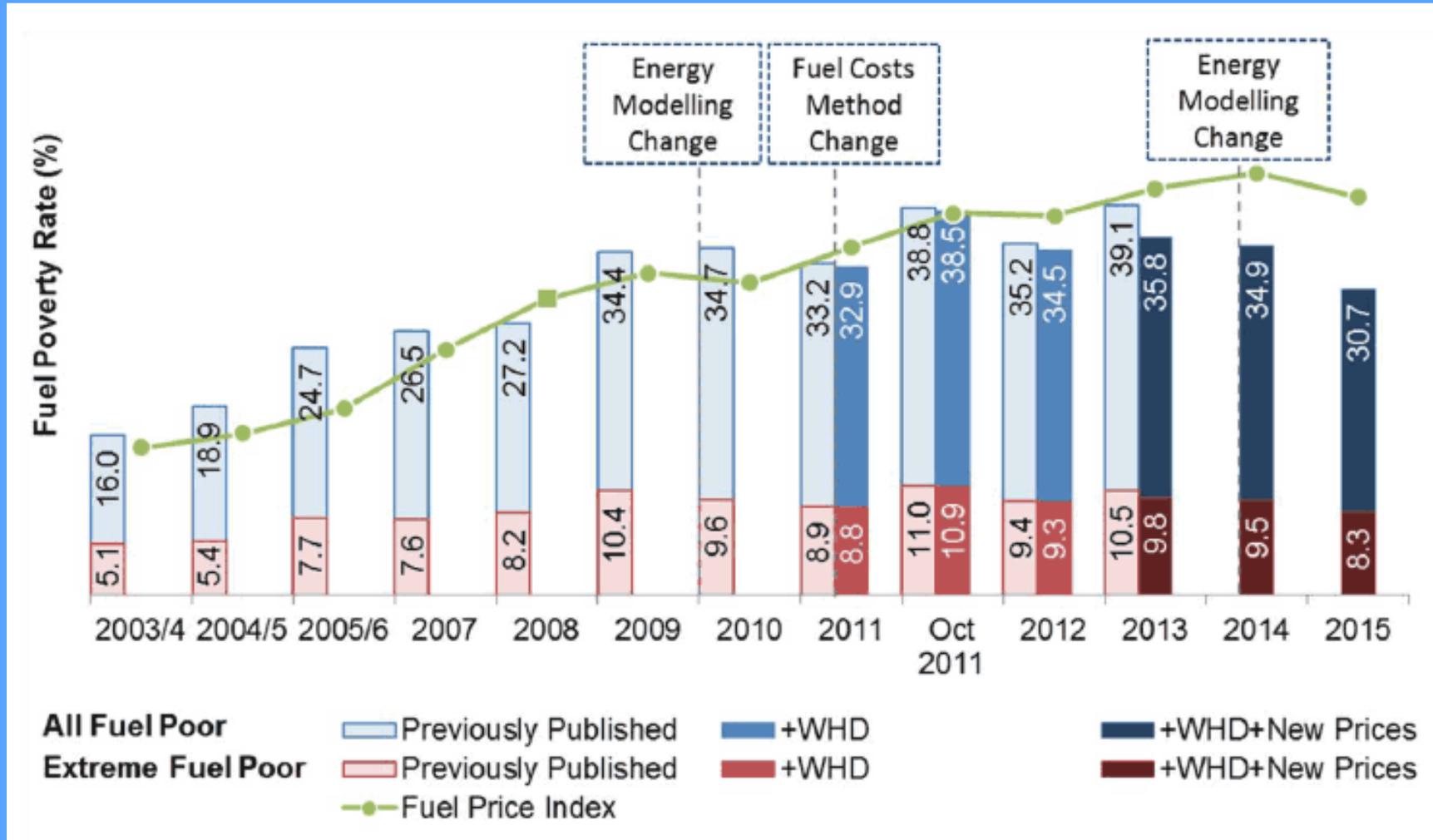
Twitter: @Stumpysheep

Outline

- **Defining fuel poverty**
- **Defining success**
- **What real data tells us (and doesn't)**
- **Key problems – data, regression, thresholds, boxes, and verbal overshadowing**
- **Rethinking fuel poverty as a complex problem**
- **From fabric first to folk first solutions**
- **Where do we go from here?**

Obligatory Fuel Poverty in Scotland slide

In 2016 ~649,000 Scottish households (~26.5%) were classified as living in fuel poverty



Source: Scottish House Condition Survey

Obligatory Defining Fuel Poverty slide

Scotland – to 2018

Boardman-based - a household is said to be fuel poor if it needs to spend more than 10% of its income on fuel to maintain an adequate level of warmth, either:

- Standard, where living rooms (Zone 1) are heated to 21°C and the rest of the dwelling (Zone 2) is heated to 18°C for 9 hours during weekdays and 16 hours on weekends
- Enhanced, where living rooms (Zone 1) are heated to 23°C and the rest of the dwelling (Zone 2) is heated to 18°C for 16 hours each day of the week

Wales and Northern Ireland – very similar to Scotland

England

Fuel poverty in England is measured by the Low Income High Costs definition [the 'Hills Definition'], which considers a household to be in fuel poverty if:

- Their income is below the poverty line (taking into account energy costs) and;
- Their energy costs are higher than is typical for their household type.

Little or no basis in building science – the less said the better!



INTERMISSION



Defining success?

Question:

What is the difference between a household spending 9.9% of their income on energy for heating and a household spending 10.1% of their income on energy for heating?

Defining success?

Question:

What is the difference between a household spending 9.9% of their income on energy for heating and a household spending 10.1% of their income on energy for heating?

Answer:

One is classified as fuel poor and the other isn't.

Defining success?

Question:

What does this tell us about how we should support these householders?

Defining success?

Question:

What does this tell us about how we should support these householders?

Answer:

Nothing.

Defining success?

Question:

What does this tell us about how we should support these householders?

Answer:

Nothing.

Question:

If you had £300 to spend on supporting one of these households which would you spend it on, and why?

Defining success?

Answer

Under current conditions if you were a service provider you would spend that £300 on the 'fuel poor' household because simply reducing the (modelled) proportion of their income spent on heating energy by a mere 0.2% would count as a 'success'.

And you'd probably spend it on energy efficiency solutions, not necessarily fuel poverty ones.

So! What should our definition of a 'successful' intervention be?



**KEEP
CALM
AND
HOLD THAT
THOUGHT**

Problems with the Scottish definition and metrics

- Use of the income domain of the Scottish Indices of Multiple Deprivation (SIMDs) as the main proxy for fuel poverty
- Energy / heating demands still calculated using the BREDEM 2012 (and the use of Energy Performance Certificates (EPCs) as a key policy driver)
- Underlying data is heavily abstracted (small sample sizes, small numbers of households in rural datazones, use of rdSAP, drive-by surveys, etc)
- Use of medians in reporting is not adequately representing the real distributions ('hidden geographies') of fuel poverty – fuel spend, and fuel poverty, are not normally distributed (heavily skewed, possibly bi-modal)
- The lack of an adjustment for the 'energy spend gap' between urban and rural households (and the lack of acceptance that this is greater than shown in current 'statistics')

Problems with the Heating Regime

- Good – but not perfect!
- Assumes the 'Zone 1 / Zone 2' assumption for modelling heating regimes is still valid – but this is now widely disputed in the UK (Baker, Rylatt & Lomas, 2008 – and many others!)
- Difficult to measure at scale, and so requires modelling (using BREDEM 2012) for reporting to Westminster / the EU
- Realistic? Achievable?

Health Warning!

The proscribed temperatures are targets that can be achieved under modelled conditions. Therefore reducing the minimum temperatures risks actual mean internal temperatures falling below 16°C and causing deleterious effects on building fabric and occupant health – condensation, dampness, mould growth, etc. Any revision of the definition must retain the current temperature targets.



New Scientist, 12th July 2014

The SIMDs and Rural Fuel Poverty

- The use of the SIMD income domain as a proxy for fuel poverty is disadvantaging people in rural Scotland.
- The use of large rural datazones with diverse populations and low population densities means that even the very small numbers of very high earners in rural areas significantly adjust the income datazone mean and median averages.
- Hence the proposed adoption of a Minimum Income Standards-based metric for income under the new Scottish definition of fuel poverty is a step in the right direction, but without a further adjustment for rurality the new definition will further exacerbate the influence of the urban / rural divide, and further disadvantage the fuel poor and otherwise vulnerable households in rural and island Scotland.

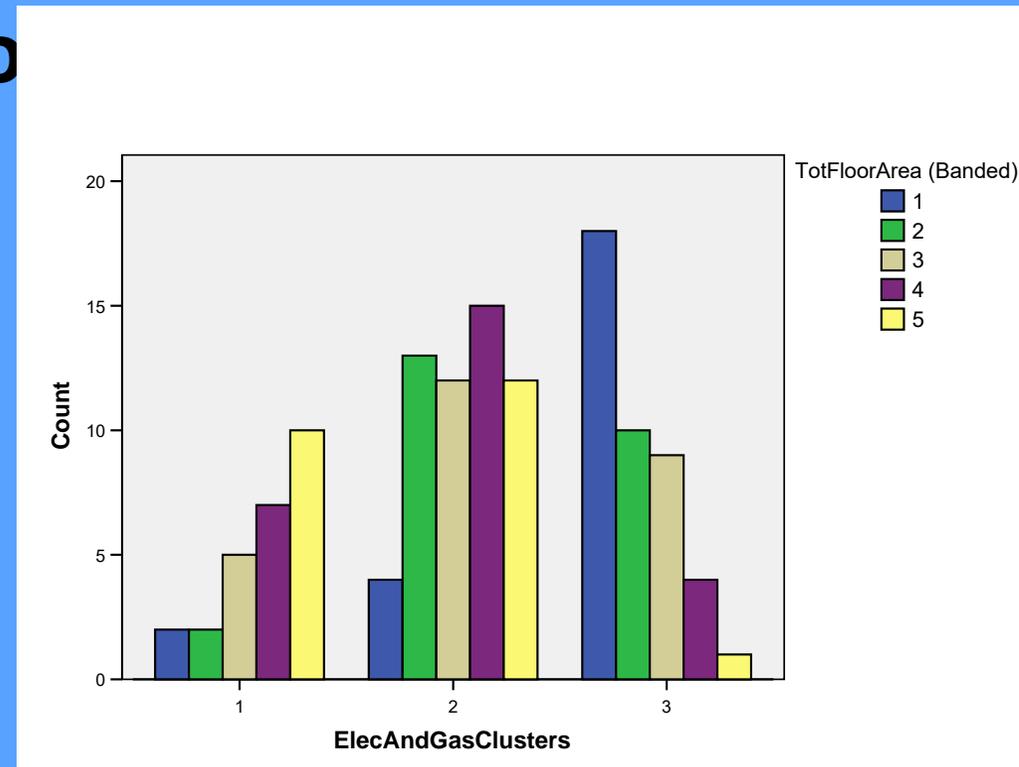
It's only a model!!!!



Using real data

- To date, 8 studies of socio-economic influences on household energy consumption / expenditure using real data have been conducted in the UK
 - We claim the first (Leicester and Sheffield), the first in Scotland (the Renfrewshire study), and the first to look specifically at the impact of the urban / rural divide (Proiseact Spéird).
 - The methodologies for all three studies were deliberately designed to avoid the need for additional data collection beyond that already available to central and local government, and (wherever possible) to eliminate the use of assumptions and proxy data.
 - Making greater use of real data is one of the recommendations made in the 2017 academic panel review of the fuel poverty definition commissioned by the Scottish Government. So far, it has been rejected.

What do

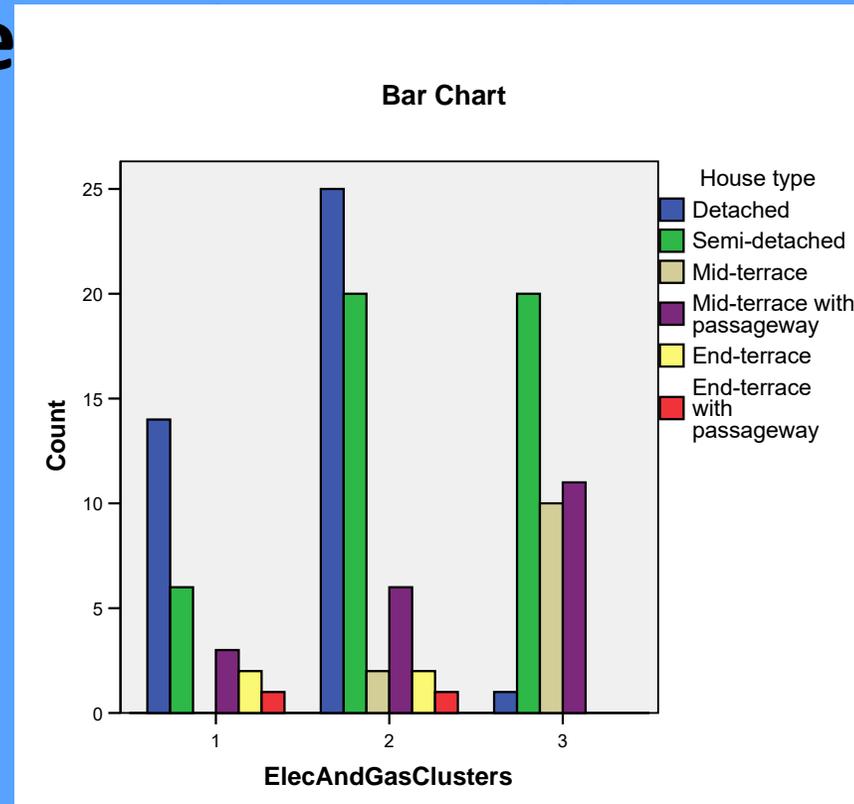


Total floor area is a strong predictor of energy consumption

Data for 154 households across three groups of homogenous (enough) dwellings in Leicester and Sheffield. The three clusters are statistically significant groups of high, medium and low energy users (note: in reverse order). In this study TFA (even grouped to 20% bands) was found to explain ~49% of the variation in energy consumption.

Source: Baker, K.J., 2007. Sustainable Cities: Determining indicators of domestic energy consumption. PhD thesis. Institute for Energy and Sustainable Development (IESD), De Montfort University, Leicester, UK.

What doe

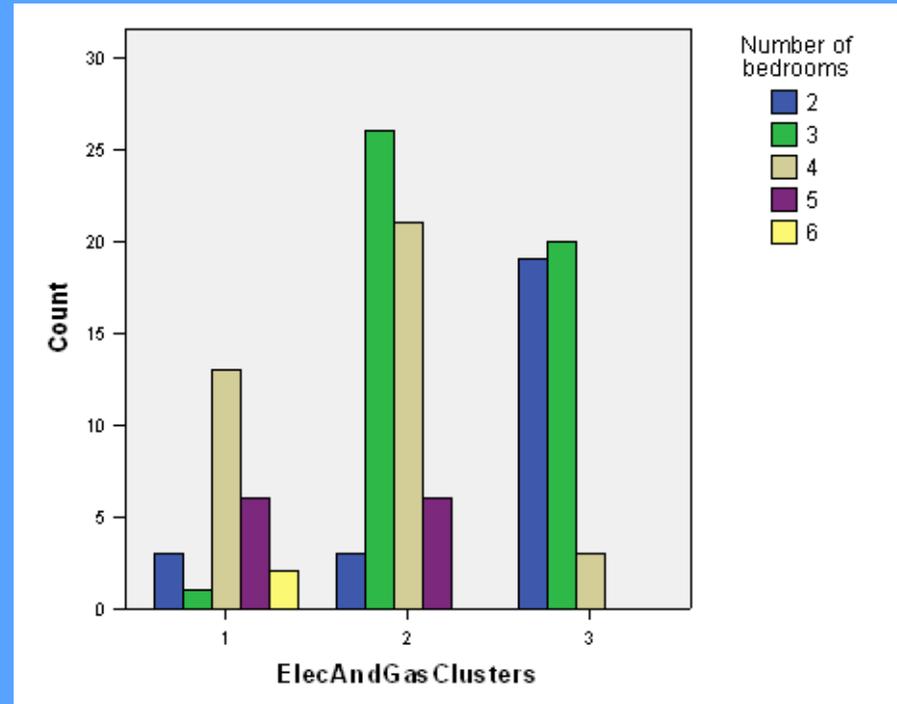


Built form is a poor(ish) predictor of energy consumption

Data for 154 households across three groups of homogenous (enough) dwellings in Leicester and Sheffield. The three clusters are statistically significant groups of high, medium and low energy users.

Source: Baker, K.J., 2007. Sustainable Cities: Determining indicators of domestic energy consumption. PhD thesis. Institute for Energy and Sustainable Development (IESD), De Montfort University, Leicester, UK.

What does real data tell us?

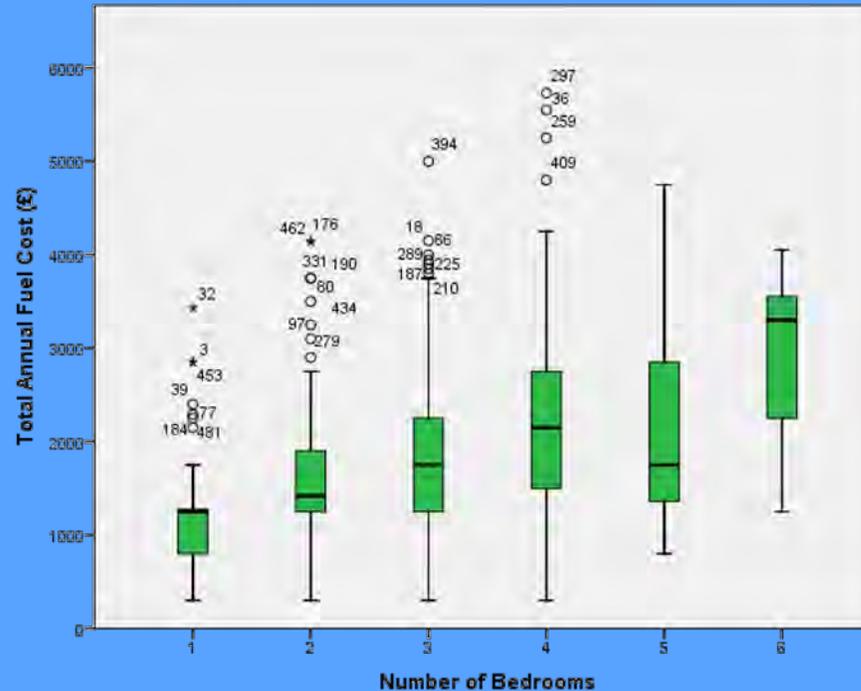


The number of bedrooms is a strong predictor of energy consumption - ?

For those same clusters there was a strong correlation between the number of bedrooms and household energy consumption – or at least that’s what we thought back in 2007.

Source: Baker, K.J., 2007. Sustainable Cities: Determining indicators of domestic energy consumption. PhD thesis. Institute for Energy and Sustainable Development (IESD), De Montfort University, Leicester, UK.

What does real data tell us?



The number of bedrooms is a *poor* predictor of energy consumption - ?

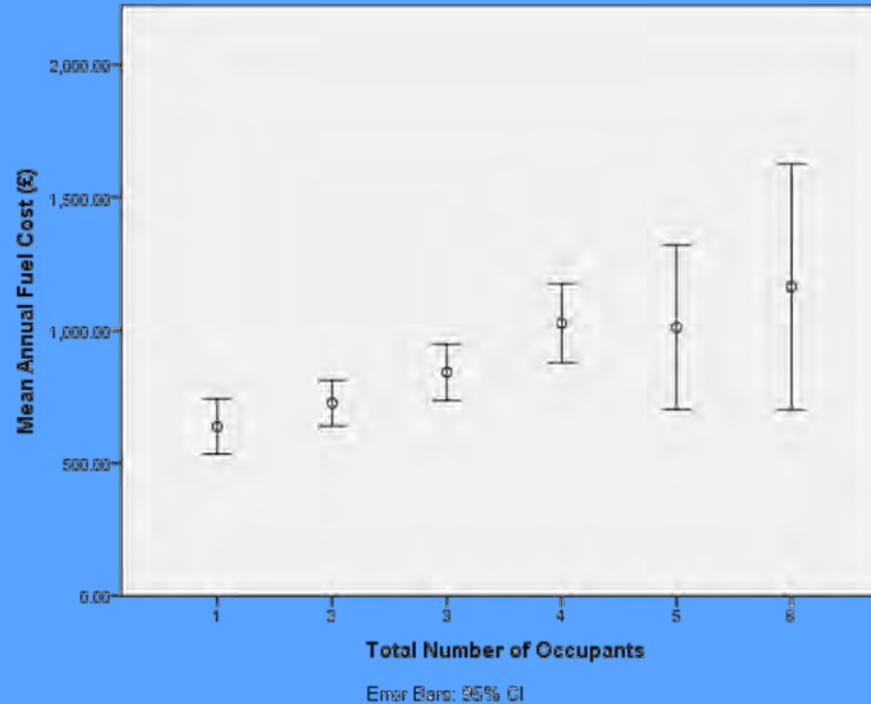
Proiseact Spéird - Data for total annual energy costs (all uses) for 515 households in heterogeneous dwellings in the Orkney Isles (mixed fuel – includes mains gas, main electricity, oil, LPG, coal, biomass, and some micro-renewables).

Interjection!

But the number of bedrooms is only a proxy for occupancy, and the Orkney households are highly heterogeneous, so if we use actual occupancy and normalise a load of the variables the correlation will be stronger, right?

Sorry....

What does real data tell us?

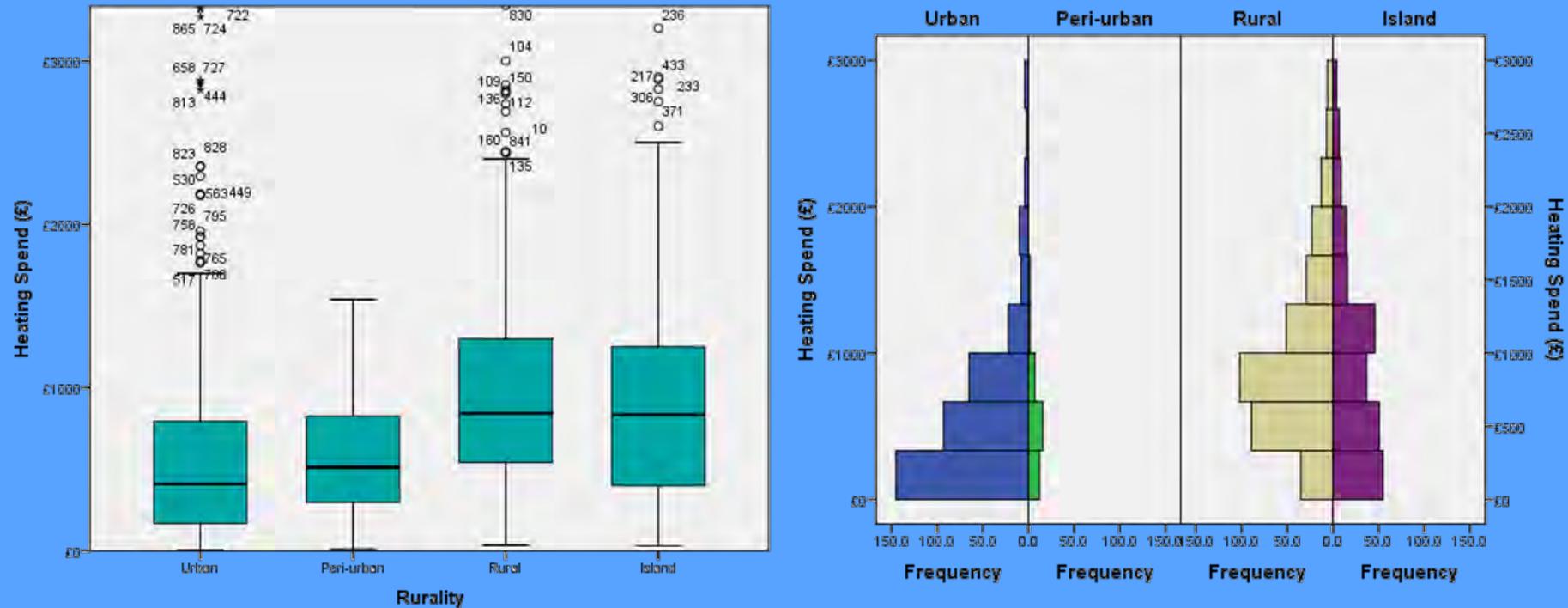


Occupancy is a *poor(ish)* predictor of energy consumption

Although commonly assumed to be a strong predictor of household energy consumption, an analysis of real heating cost data for a highly homogeneous group of dwellings illustrates the dangers of assuming correlation means causation.

Proiseact Spéird - Data for mean annual heating (only) fuel costs for 128 households in highly homogeneous dwellings near Portree, Skye (metered data, biomass DHS).

What does real data tell us?



Rural and island households not only spend significantly more on energy for heating, but the distributions of expenditure across the urban-rural divide are different too

Proiseact Spéird – Data on heating energy expenditure for 1,015 households across Aberdeenshire, Argyll and Bute, Lochaber, the Orkney Isles, Renfrewshire and Skye

Interjection!

Ah! But what about Energy Performance Certificates?

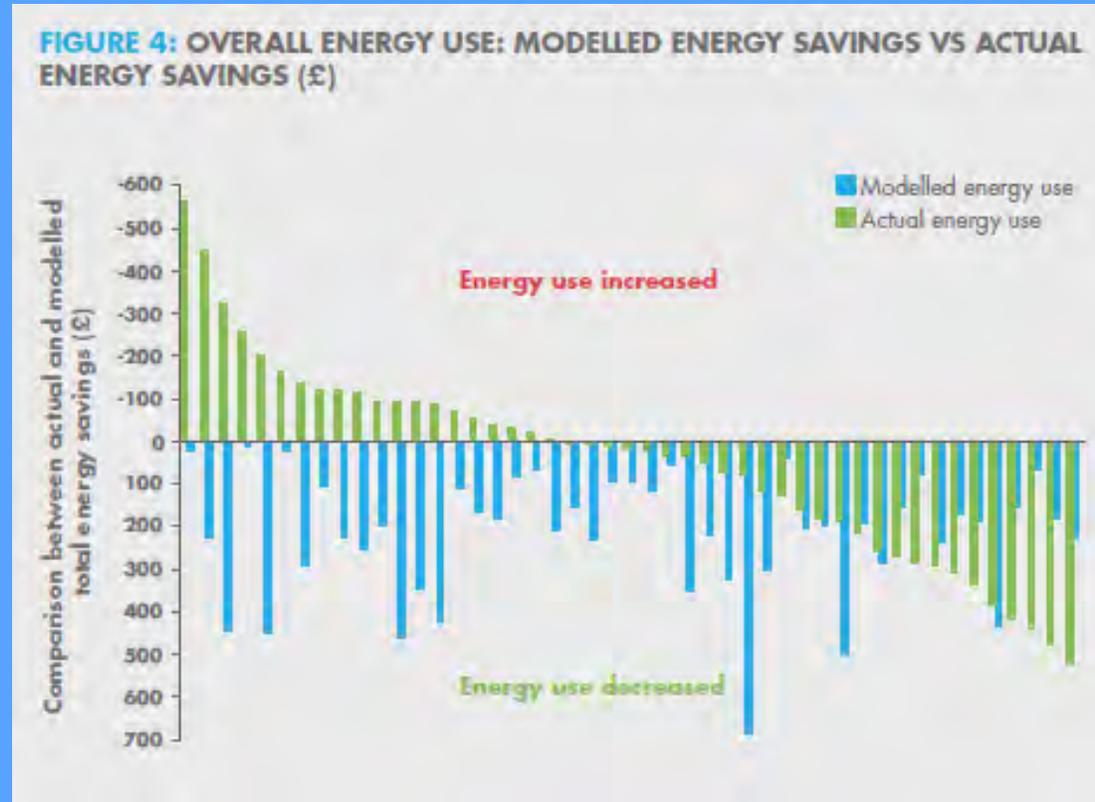
They're in the Scottish Government's Energy Efficiency Strategy, which aims to eliminate energy inefficiency as a driver for fuel poverty, so surely they must be a reasonable measure of success?

Sorry again....

Real data versus Energy Performance Certificates

“FutureFit has found that SAP is not an accurate modelling tool for existing homes”

Study based on 150 homes across England, metered energy data and monitored internal and external temperatures, pre and post-intervention.



Source: Jones Lang LaSalle, 2012. A Tale of Two Buildings: Are EPCs a true indicator of energy efficiency?. Better Buildings Partnership.

And that's just one of many reports.

Building scientists have been telling governments about the limitations of energy models for *decades....*

Are we having fun yet?



Real data – great fun for researchers, but not so much fun for policymakers

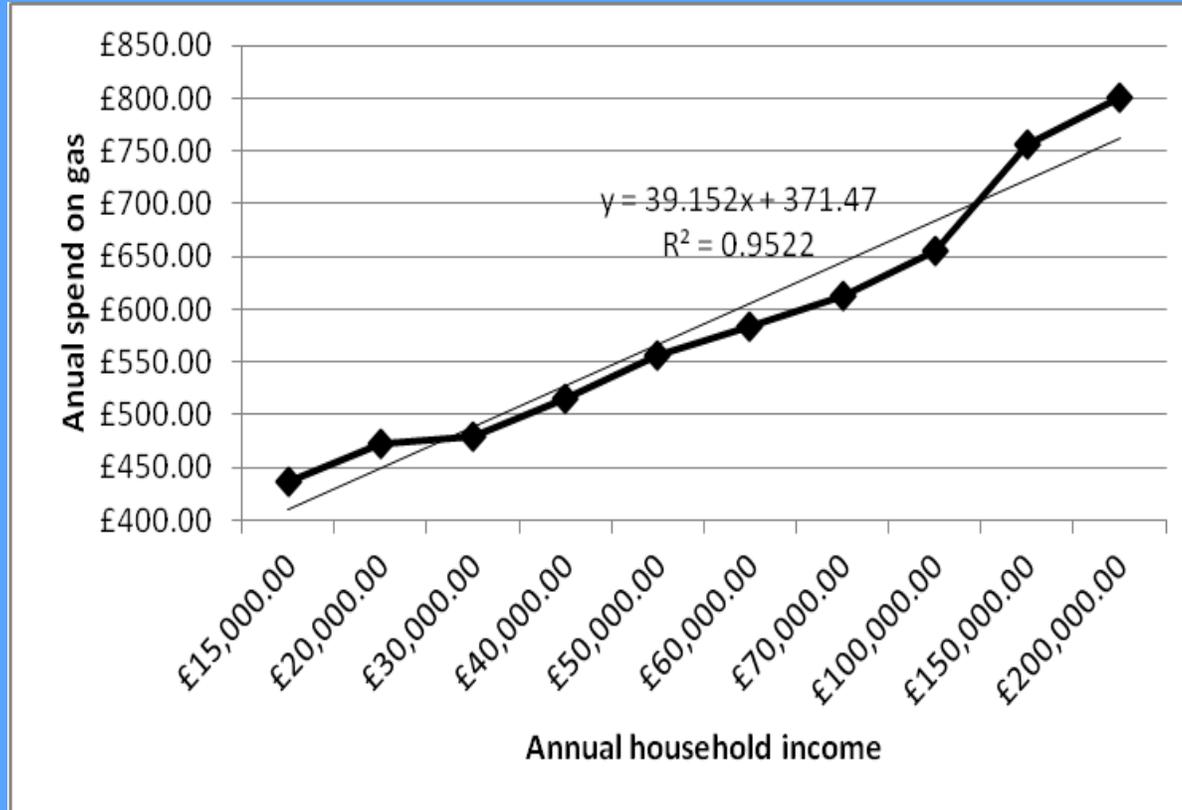
But it's not just the data that's the problem

Traditional quantitative social science-based approaches to policy making are failing the fuel poor and otherwise vulnerable

(Yes, that's a big statement)

Fundamentally, traditional social science views social reality as disorganised complexity. This justifies developing policies based on 'good enough' ($p = 0.00$) results and inferences from simplistic approaches. For example....

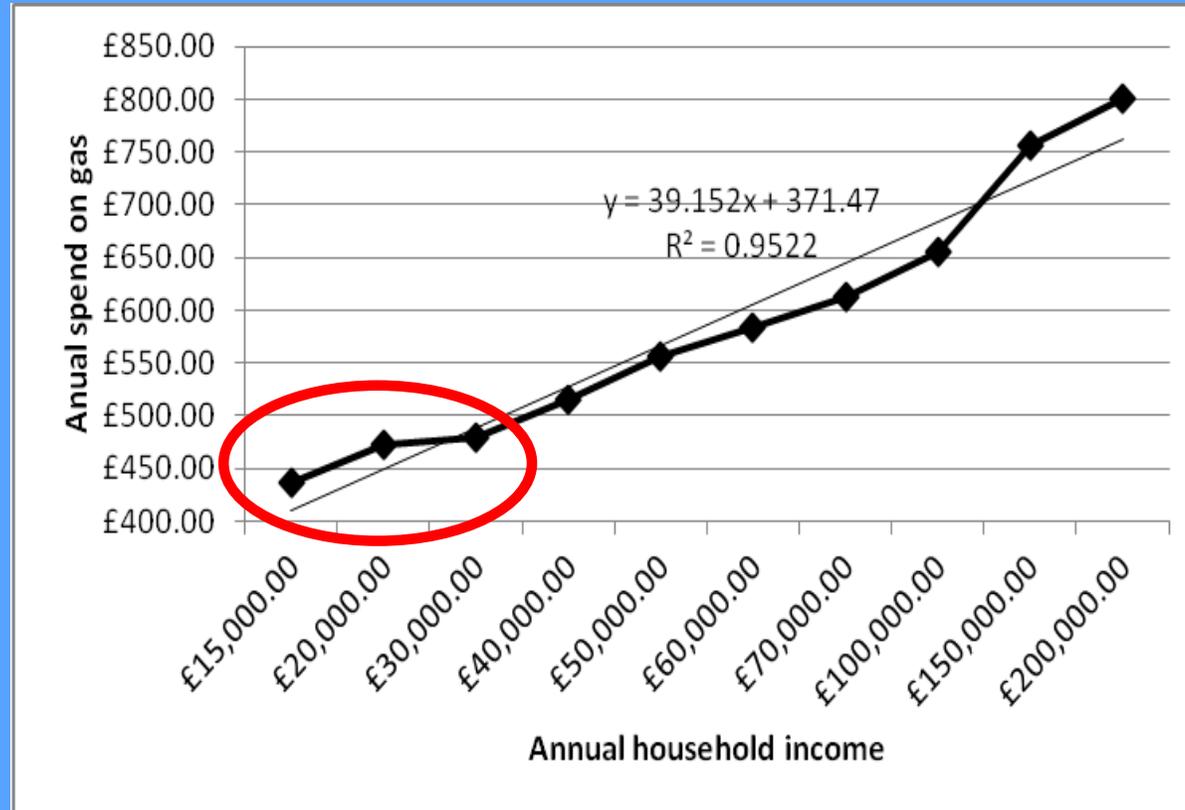
Regression Analysis



Policy-making for fuel poverty is currently based on the assumption that there is a linear relationship between household income and expenditure on heating....

Based on data from: DECC, 2015. National Energy Efficiency Data-Framework (NEED) table creator. Department for Energy and Climate Change, London, UK.

Regression Analysis



....but most people live down here.

Doesn't look so linear now does it?

Based on data from: DECC, 2015. National Energy Efficiency Data-Framework (NEED) table creator.
Department for Energy and Climate Change, London, UK.

The Problem of Boxes

A fundamental problem with conventional social science-led approaches

We currently address fuel poverty by using the large amounts of data we have to access to construct small numbers of household archetypes (boxes)

Then we design policy solutions to fit the boxes, rather than the needs of individual householders....

....and then we sit back and wonder why the schemes we design aren't reaching the most vulnerable

| Archetype | Count of HHs | N % | Mean annual electricity kWh | Mean annual gas kWh |
|--|-------------------|-------------|-----------------------------|---------------------|
| Non-mains gas HHs | | | | |
| Archetype 1: Low-income electrically-heated | 881,000 | 4% | 5,130 | - |
| Archetype 2: All other electrically-heated | 1,694,000 | 7% | 7,674 | - |
| Archetype 3: Low-income non-metered fuel-heated | 548,000 | 2% | 3,634 | - |
| Archetype 4: All other non-metered fuel-heated | 1,065,000 | 4% | 5,562 | - |
| Mains gas heated households | | | | |
| Archetype 5: Low-income, out-of-work single adults in small 1-bed social rented flats (London) | 948,000 | 4% | 2,018 | 8,553 |
| Archetype 6: Young working adults in rented flats (London) | 1,053,000 | 4% | 2,672 | 11,256 |
| Archetype 7: Low-income single adults (lone parents or elderly) in social rented houses | 1,221,000 | 5% | 2,474 | 11,515 |
| Archetype 8: Younger working families in medium-sized rented houses | 2,529,000 | 10% | 3,450 | 14,452 |
| Archetype 9: "Average" mains gas-heated households | 8,231,000 | 34% | 3,588 | 16,386 |
| Archetype 10: Wealthy working families in 3-4 bed semi's owned with mortgage | 2,339,000 | 10% | 4,767 | 20,202 |
| Archetype 11: Asset-rich, "empty-nesters" in detached houses in less urban areas | 2,494,000 | 10% | 4,184 | 20,557 |
| Archetype 12: Wealthy working families in larger detached houses in less urban areas | 1,528,000 | 6% | 5,608 | 25,200 |
| | 24,531,000 | 100% | 4,378 | 17,100 |

For example: Ofgem, 2012. Beyond Average Consumption.

Boxes and Verbal Overshadowing

Humans have an innate desire to find order in chaos – we like using boxes because they sift the chaos of reality into the pigeonholes provided by our pre-agreed words

But putting something in a pigeonhole means not putting it into others, by definition

For example, to describe someone as having two dogs is to focus on what the animals share – they're dogs – and to disregard the fact that they're a Sheltie and a springer-doodle; or old or young, excitable or placid; and this pigeonholing overwrites the previous memory

When words render experience, specific information is not just left out, it is deleted

(Source: Adapted from a Guardian interview with Nick Enfield, University of Sydney)



The Problem of Thresholds

Fuel poverty and energy efficiency schemes typically use blunt thresholds and 'passport benefits' to determine eligibility for support.

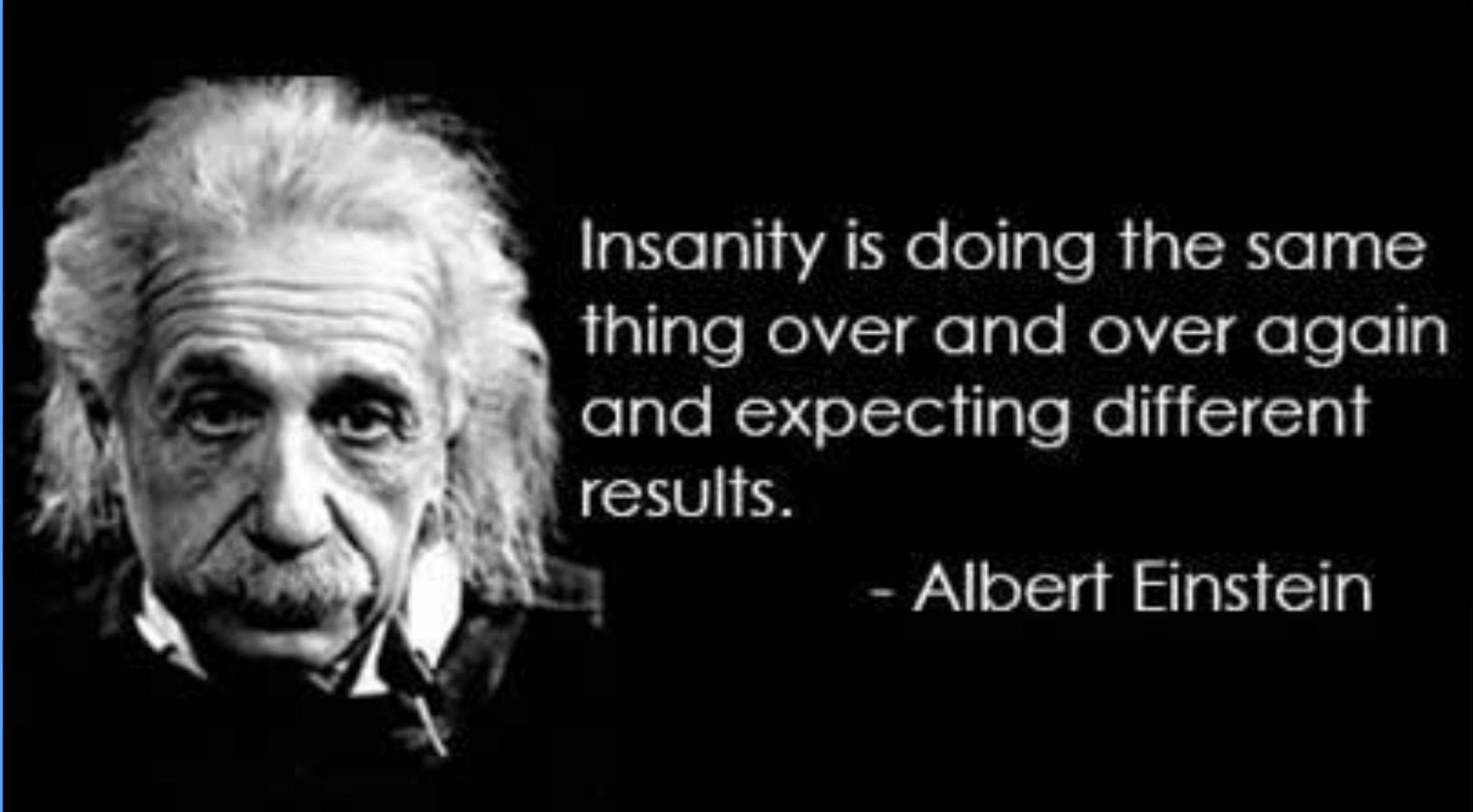
However, there are very few measures of dwelling and household characteristics that emerge as sufficiently significant to be fit-for-purpose for targeting fuel poor households.

A recent study of 1,595 households in Northern Ireland found that, in many instances, those households in most severe fuel poverty did not fit the criteria for energy efficiency upgrades, despite standing to benefit from significantly reduced fuel poverty.

Simply developing more, and more sensitive, metrics would still mean future schemes would be designed around blunt, threshold-based mechanisms for determining eligibility.

See: Walker, R., Liddell, C., McKenzie, P., Morris, C., & Lagdon, S., 2014. Fuel poverty in Northern Ireland: Humanizing the plight of vulnerable households. *Energy Research & Social Science*, 4 (2014), pp. 89–99.

Defining insanity



Founding statement of the Energy Poverty Research initiative

As academics and practitioners we share the view that in an energy rich nation it is not acceptable that such a large proportion of households suffer daily the deleterious effects of energy rationing, or that they are forced to manage debts just to maintain a reasonable modern standard of living.

We believe we have a duty to continually question our understanding of this modern societal inequality, and the methods and approaches we take to identifying and tackling it.

Rethinking Fuel Poverty as a Complex Problem

Complexity scientists view social reality as highly complex but fundamentally *organised*, and therefore it can be *conceptualised* (and modelled) as a complex system.

Yet our current conceptualisation of fuel poverty (even under the new definition) is defined only in technical and economic terms.

Essential reading: Castellani, B., 2014. Complexity and the failure of quantitative social science. Discover Society, November 2014. See: <https://discoversociety.org/2014/11/04/focus-complexity-and-the-failure-of-quantitative-social-science/>

Rethinking Fuel Poverty as a Complex Problem

“Fuel poverty is a highly complex social problem that is currently defined in technical and economic terms that prioritise energy performance measures as solutions. Yet considering the wider societal aspects of the condition demonstrates how adopting dynamic risk-based metrics can drive tailored and holistic folk-first outcomes.”

Source: Baker, K.J., Mould, R., & Restrict, S., 2018. **Rethink fuel poverty as a complex problem.** Nature Energy, 2nd July 2018. Available at: <https://rdcu.be/2j8E>

Redefining success

“An effective policy or intervention is one which not only serves to lift a household out of fuel poverty but which also serves to increase their resilience to the fuel poverty condition”.

Source: Baker, K.J., Mould, R., & Restrick, S., 2018. **Rethink fuel poverty as a complex problem.** Nature Energy, 2nd July 2018. Available at: <https://rdcu.be/2j8E>

Fuel Poverty as a Complex Policy Problem

Fuel poverty in Scotland is heavily mediated by a complex mix of environmental, social and economic factors, for example:

- Poorer households spend proportionately more of their income on keeping warm (*if they can afford to*).
- Homes in exposed, rural and island areas use proportionately more energy for heating, and often use more expensive fuels (e.g. LPG, oil), which may also generate proportionately more emissions.
- Even when multiple variables (higher fuel costs, etc) are normalised, rural homes spend more on heating through behavioural variations.
- Poorer households often live in poorly-maintained and poorly-insulated homes, which often leads to poorer health – e.g. children with asthma living in damp and mouldy homes.
- Vulnerable households and those with mental health problems are particularly at risk because they are less able to help themselves – difficulties with receiving information by phone, high drop out rates when signposted to other services, etc.
- Individual household behaviours can make them more or less vulnerable to fuel poverty - and we cannot assume that lifting a household out of fuel poverty will engender behaviour changes that will make them more resilient to it in the future (or that technical solutions are necessarily effective).

Behaviour as a Complex Policy Problem

“People say I make strange choices, but they’re not strange for me”

Johnny Depp

- Conventional policy approaches cannot cope with the problem that human behaviour is highly (possibly infinitely) complex.
- We can influence single behaviour changes (seatbelts, smoking, etc) using simple measures (taxation, enforcement, etc), but household energy behaviours result from highly complex influences, and this is even more pronounced amongst rural, island and vulnerable households.
- These influences include complex feedback loops, in which behaviours are mediating factors.
- Energy behaviours after an intervention are also influenced by the rebound and prebound effects.
- Before an intervention householders may be behaving in ways that make them more or less vulnerable to fuel poverty and its impacts, and we cannot assume that interventions will necessarily lead to them behaving in ways that make them less vulnerable or more resilient to fuel poverty.

The problem with human beings is that we’re human beings.

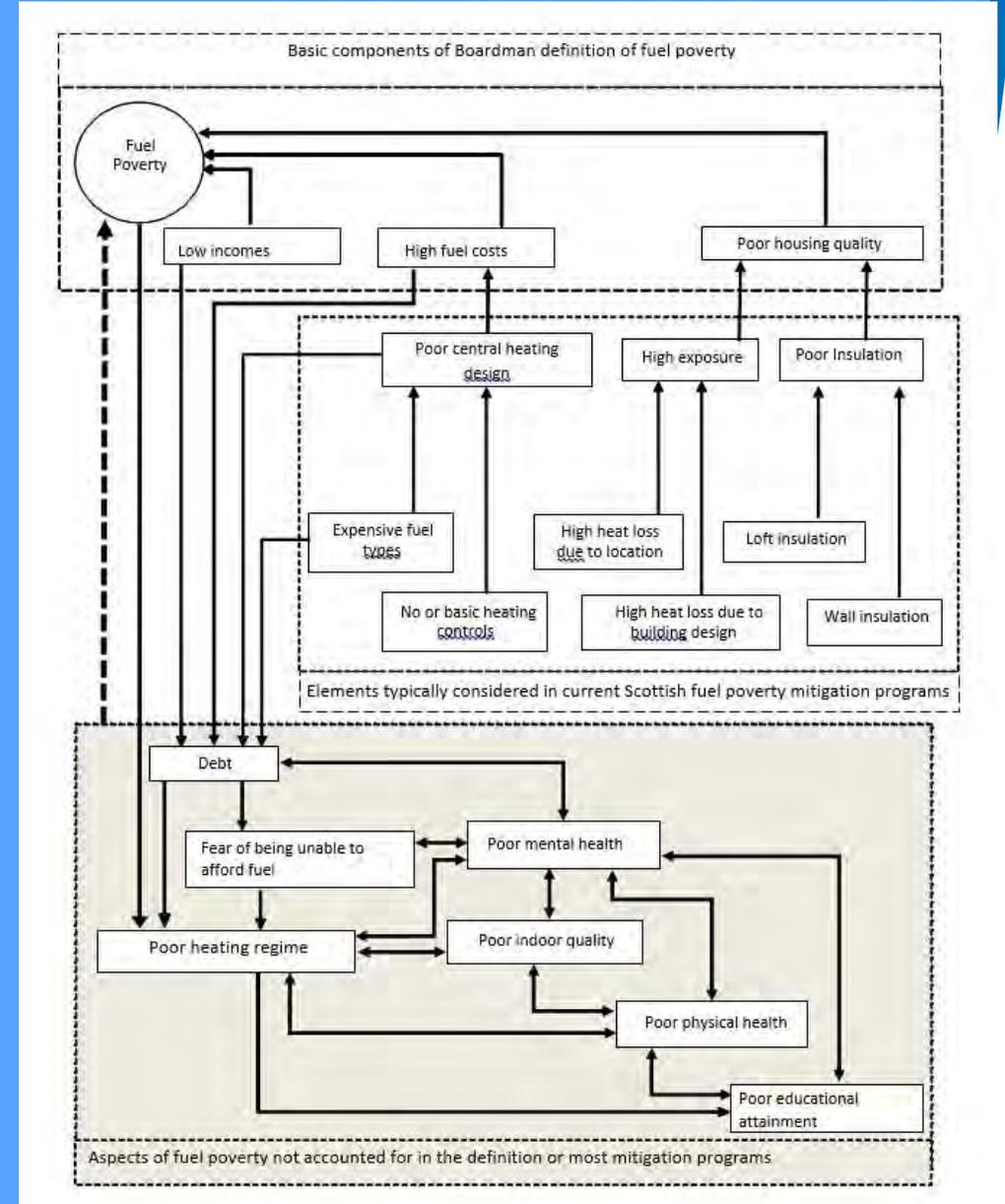
Reconceptualising Fuel Poverty as a Complex

Problem

Our research has shown how it is entirely possible, and socially desirable, to reconcile the Boardman-based ('10% of income') definition of fuel poverty with a wider complexity and risk-based assessment of householder vulnerability.

Source: Mould, R., & Baker, K.J., 2017. Documenting fuel poverty from the householders' perspective. *Energy Research & Social Science*, 31, (2017), pp.21–31.

Reproduced in: Baker, K.J., Mould, R., & Restrict, S., 2018. Rethink fuel poverty as a complex problem. *Nature Energy*, Nature Energy, 2nd July 2018. Available at: <https://rdcu.be/2j8E>



Fixing Fuel Poverty

Back to our original two households

- What might we now know about them?
- Which one would you now spend it on?
- What would you now spend it on? (Or might someone else be better placed to make that decision?)
- Who should deliver your solution?

Hold those thoughts for a little longer.

A Complexity science-based approach to Fixing Fuel Poverty

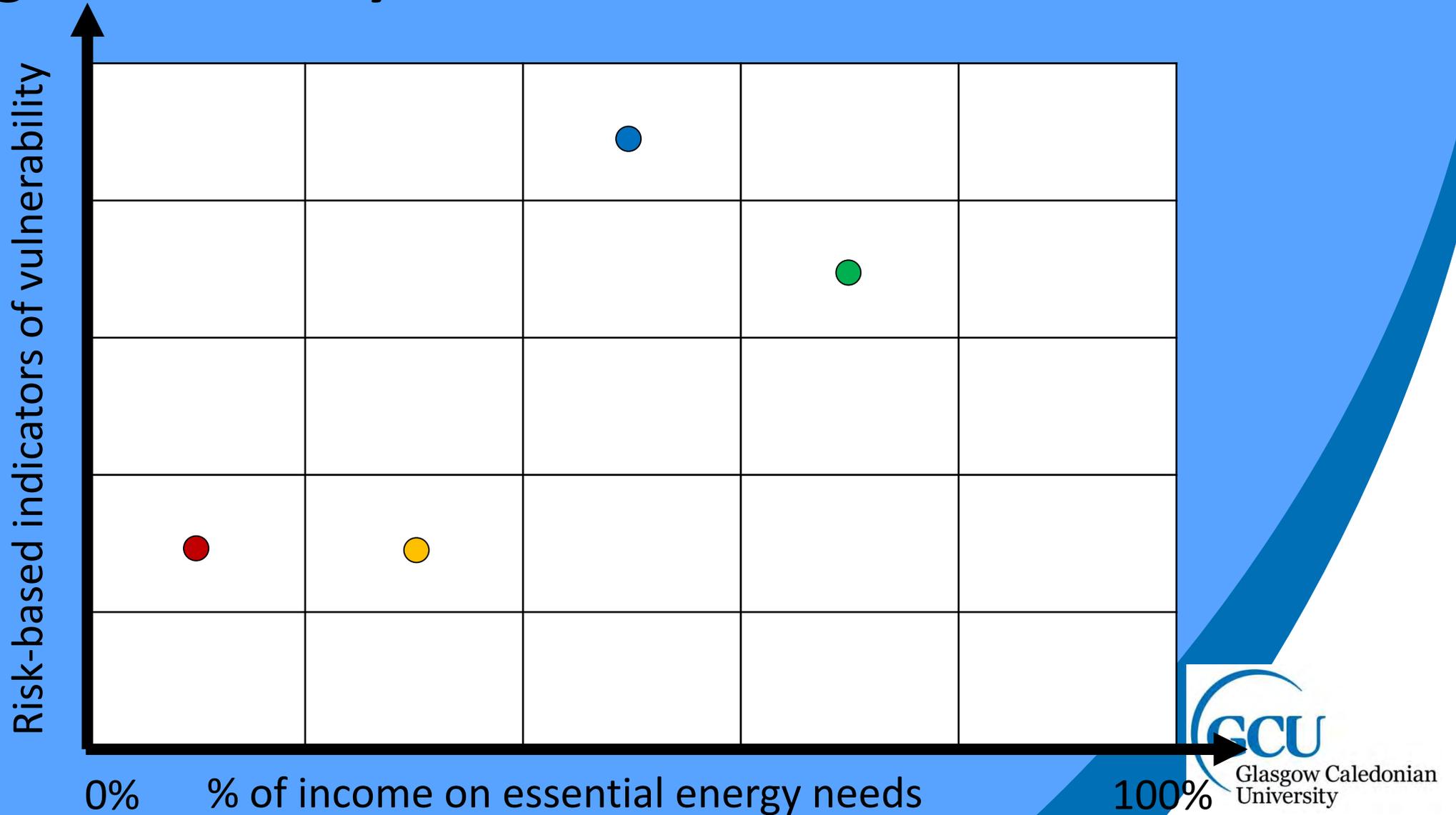
- What if we had a better way of making this decision?
- What if we could do away with thresholds and boxes?

A Complexity science-based approach to Fixing Fuel Poverty

First:

- Run a cluster analysis on (real) household energy consumption data and other indicators of fuel poverty and vulnerability (technical, social, economic, etc).
- Plot these household clusters in a risk-based matrix of % of income spent on essential energy needs versus indicators of vulnerability.

A Complexity science-based approach to Fixing Fuel Poverty

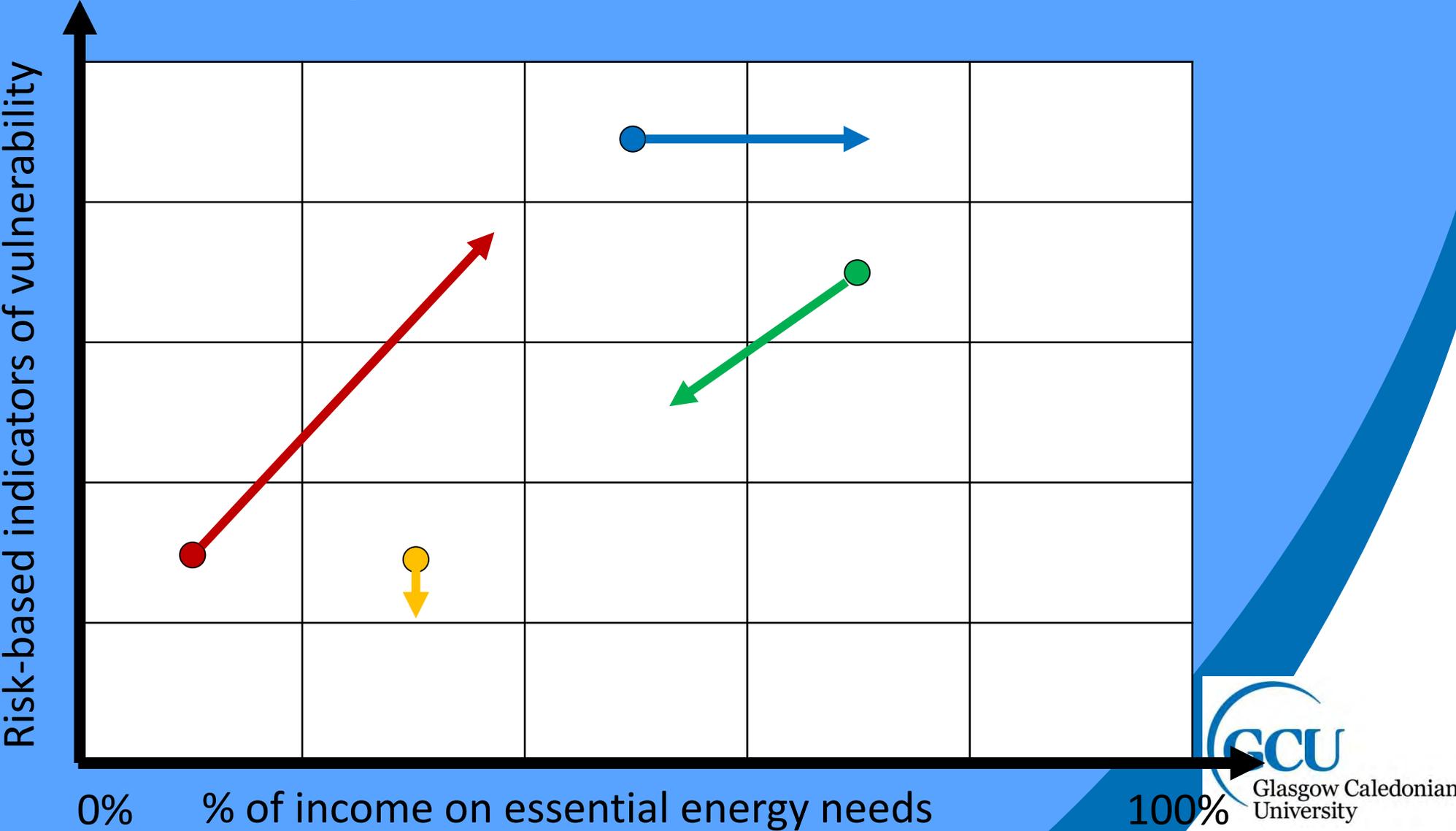


A Complexity science-based approach to Fixing Fuel Poverty

Then:

- Plot the trajectories / vectors of those householders / household clusters – direction and rate of change in % spent on energy, and change (and rate of change) in vulnerability.

A Complexity science-based approach to Fixing Fuel Poverty



A Complexity science-based approach to Fixing Fuel Poverty

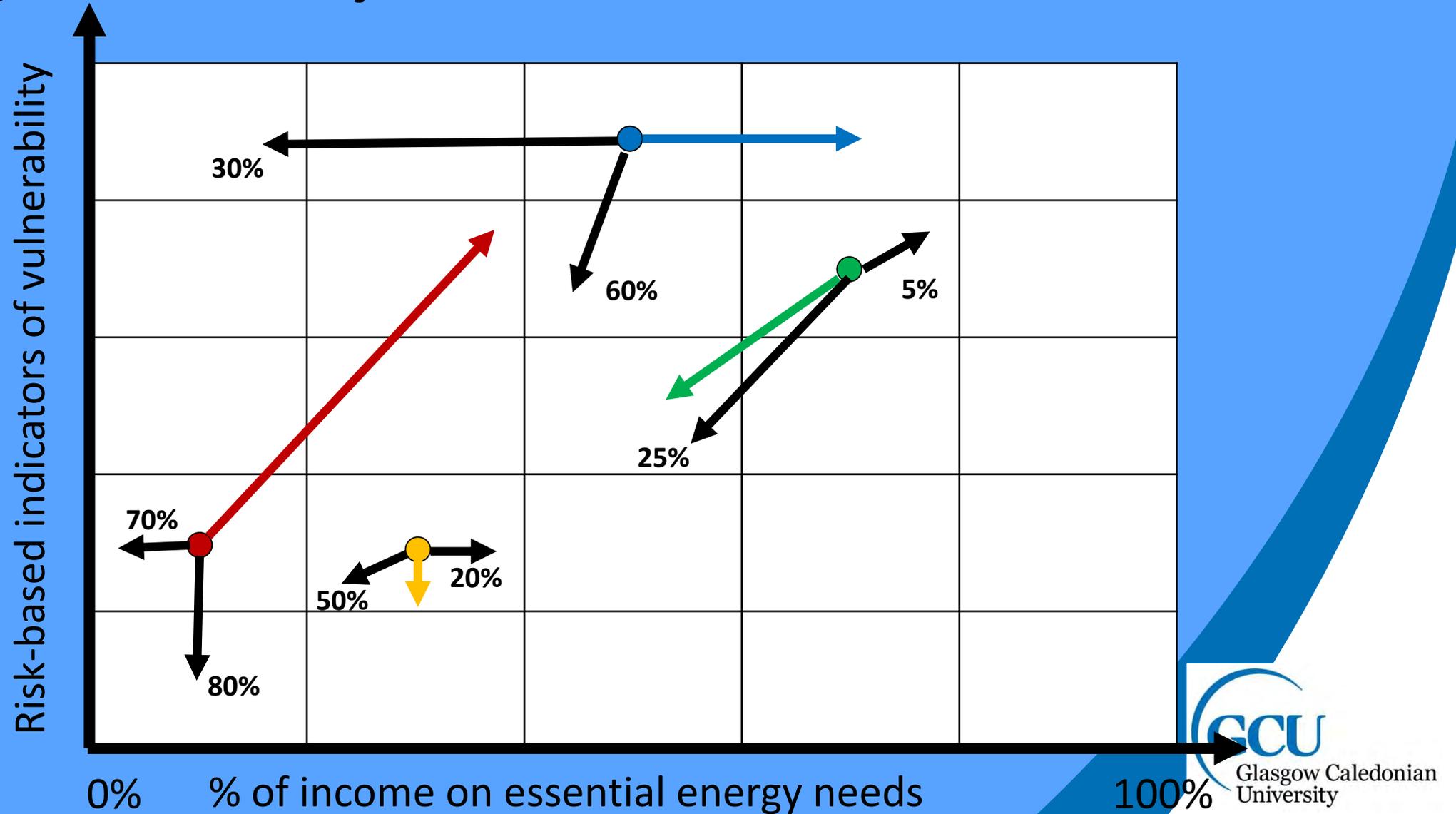
- What do we understand about these householders now?
- A household in the yellow cluster is in fuel poverty, but given a choice of the two, would we intervene in this household or a household in the red one?
- But there's more....

A Complexity science-based approach to Fixing Fuel Poverty

Finally:

- Using complexity modelling software (e.g. Complex-IT) we can assign different interventions, or groups of interventions (with associated costs) to each household (or household cluster) to determine the likely probability of the end point of each intervention.
- And from this we can determine both the effectiveness and cost effectiveness of each intervention for supporting each household to become less fuel poor **and** more resilient to fuel poverty and its impacts.

A Complexity science-based approach to Fixing Fuel Poverty



A Complexity science-based approach to Fixing Fuel Poverty

- Now what do we understand about these householders and how we might decide on how, or if, to intervene in each case?

Now what if we could do this at scale using data already being collected by government and support services? How would it change the ways we tackle fuel poverty?

Because we can do this – so why aren't we?

From fabric first to folk first solutions

By redefining what we want to achieve and reconceptualising fuel poverty as a complex social problem we reframe our understanding of the necessary solutions.

This reconceptualisation illustrates how adopting dynamic, risk-based metrics using data already being collected would improve the effectiveness (and cost-effectiveness) of targeting and delivering support to fuel poor and otherwise vulnerable householders.

But it's not just a matter of who receives what support....

Face-to-face folk first solutions

Through both quantitative and qualitative research we have found that the energy advice and support needs of fuel poor and otherwise vulnerable households are most effectively delivered face-to-face and in-home by 'trusted intermediaries' operating from services with strong local and social recognition. Specifically, these are local authorities, housing associations, Citizens Advice Bureaux, and community-based energy advocacy projects [1,2,3,4,5].

Based on a dataset of 2007 households in Renfrewshire we have found that minimum of 68% of 'client journeys' and 33% of individual actions required some form of face-to-face contact [5].

The benefits of providing empathetic, face-to-face and in-home support are much wider than simply tackling fuel poverty, yet our measures of 'success' fail to capture these benefits [3,4,5,6].

Face-to-face folk first solutions

Sources:

1. Maiden, T., Baker, K.J., & Faulk, A., 2016. Taking the Temperature: Review of Energy Efficiency and Fuel Poverty Programmes in Scotland. Report for Citizens Advice Scotland by CAG Consultants, Glasgow Caledonian University, and the Energy Agency.
2. Baker, K.J., Mould, R., & Restrict, S., 2016. Proiseact Spéird – The Spéird Project: Understanding influences on fuel poverty in rural and island Scotland. Final Report to the Eaga Charitable Trust. November 2016.
3. Mould, R., & Baker, K.J., 2017. Documenting fuel poverty from the householders' perspective. Energy Research & Social Science, 31, (2017), pp.21–31.
4. Baker, K.J., & Stewart, F., 2017. “Warm, friendly, reliable, and do what they say they do”: An Evaluation of South Seeds' Energy Advocacy Services. Glasgow Caledonian University & Dr Fraser Stewart, December 2017.
5. Baker, K.J., Mould, R., Stewart, F., Restrict, S., Melone, H., & Atterson, B., 2018. Never try and face the journey alone: Exploring the face-to-face advocacy needs of fuel poor and vulnerable householders. Journal paper for Energy Research and Social Science, under review.
6. Baker, K.J., Mould, R., & Restrict, S., 2018. Rethink fuel poverty as a complex problem. Nature Energy, Nature Energy, 2nd July 2018. Available at: <https://rdcu.be/2j8E>

Concluding Remarks

When we learn to understand fuel poverty as an emergent condition of a complex (but still fundamentally organised) system, we understand why and how to drive folk first solutions to those most in need.

We need to treat fuel poverty amongst the most vulnerable and isolated communities primarily as a welfare problem.

We need to make more, and better, use of real data that is already collected by frontline organisations (local authorities, housing associations, CABs, GPs and the NHS, etc).

We need to make more, and better, use of these frontline services for engaging and supporting the fuel poor, and for empowering individuals and communities to become more resilient to fuel poverty.

We need to design fuel poverty schemes around what householders need, not what we think we can deliver, and to build independent formal evaluation into the design and management of all fuel poverty schemes.

Most importantly, we need to stop putting householders in boxes and start treating them as individuals, not statistics.

Where do we go from here?

The Scottish Government has, so far, rejected two key recommendations from the academic panel review of the definition*: the need to make more and better use of real data; and the need for an adjustment for rurality. We have to reverse these two decisions.

Please consider adding your name to our open letter at:

<http://energypovertyresearch.blogspot.com/2018/06/open-letter-need-for-adjustment-for.html>

We also need to banish the myth that EPCs and other proxy data (including the HEED database) are valid drivers for policies for tackling fuel poverty.

We need a Scottish definition of vulnerability linked to the definition of fuel poverty.

And, fundamentally, we need to understand that there's no point in fixing fabric if we're not also fixing folk.

*Bramley, G., Fitzpatrick, S., Liddell, C., & Webb, J., 2017. A new definition of fuel poverty in Scotland: A review of recent evidence. Report for the Scottish Government.

Sources and Other Publications

Baker, K.J., Mould, R., & Restrict, S., 2018. **Rethink fuel poverty as a complex problem.** Nature Energy, Nature Energy, 2nd July 2018. Available at: <https://rdcu.be/2j8E>

Atterson, B., Restrict, S., Baker, K.J., Mould, R., Stewart, F., & Melone, H., 2018. **Down to the Wire: Research into support and advice services for households in Scotland reliant on electric heating.** Report for the Consumer Futures Unit, Citizens Advice Scotland.

Baker, K.J., Mould, R., Stewart, F., Restrict, S., Melone, H., & Atterson, B., 2018. **Never try and face the journey alone: Exploring the face-to-face advocacy needs of fuel poor and vulnerable householders.** Journal paper for Energy Research and Social Science, under review.

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