Who are we?

Digitalisaton of lifestyles

low-carbon lifestyles

Charlie Wilson

- Energy Group Leader, ECI
- research on innovation, behaviour and policy in the field of energy and climate change mitigation

Maureen Agnew

- Applied climatologist, statistical downscaling and upscaling of data
- use of large-scale secondary social science data

Hazel Pettifor

- empirical quantitative social scientist
- research using large-scale social science data

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A Framework for Measuring and Modelling Low-Carbon Lifestyles

Hazel Pettifor, Maureen Agnew, Charlie Wilson

- This study had three main aims
  - Conceptual - To develop and test a universal framework for measuring low carbon lifestyles
  - Empirical - To measure heterogeneous lifestyle types across countries and cultures
  - Interpretive - To understand behavioural, cognitive and contextual variation across lifestyle types

Why a universal framework for low-carbon lifestyle?

Transition towards sustainable living requires lifestyle change [Lubowiecki-Vikuk et al 2021]

Multiple perspectives, multiple approaches

Inconsistencies across global energy models [van den Berg 2019]

Universal frameworks are proprietary

There is a need for a generalisable, open-access, transparent, representative framing of low-carbon lifestyle

Our conceptual approach

Aim : To develop and test a universal framework for measuring low carbon lifestyles

Contrasting perspectives contribute worthwhile insights for our framework

OVERVIEW

WIREs
ENERGY AND ENVIRONMENT   WILEY

Lifestyle, an integrative concept: Cross-disciplinary insights for low-carbon research

Maureen D. Agnew[1,2] | Hazel Pettifor[2] | Charlie Wilson[2]

Key insights from synthesis work

- Lifestyle consists of three interacting elements: cognitions, behaviour and context [Jamal et al 2016; Faiola et al 2019]

- Cognitions drive behaviour [Jain 2019]

- Shaping role of social and material environment [ONS 2017, Sinus 2018]

- Lifestyle is reflexive [Sinus 2018]

- Important synergies between health and low-carbon research [Cengiz and Torlak 2018]
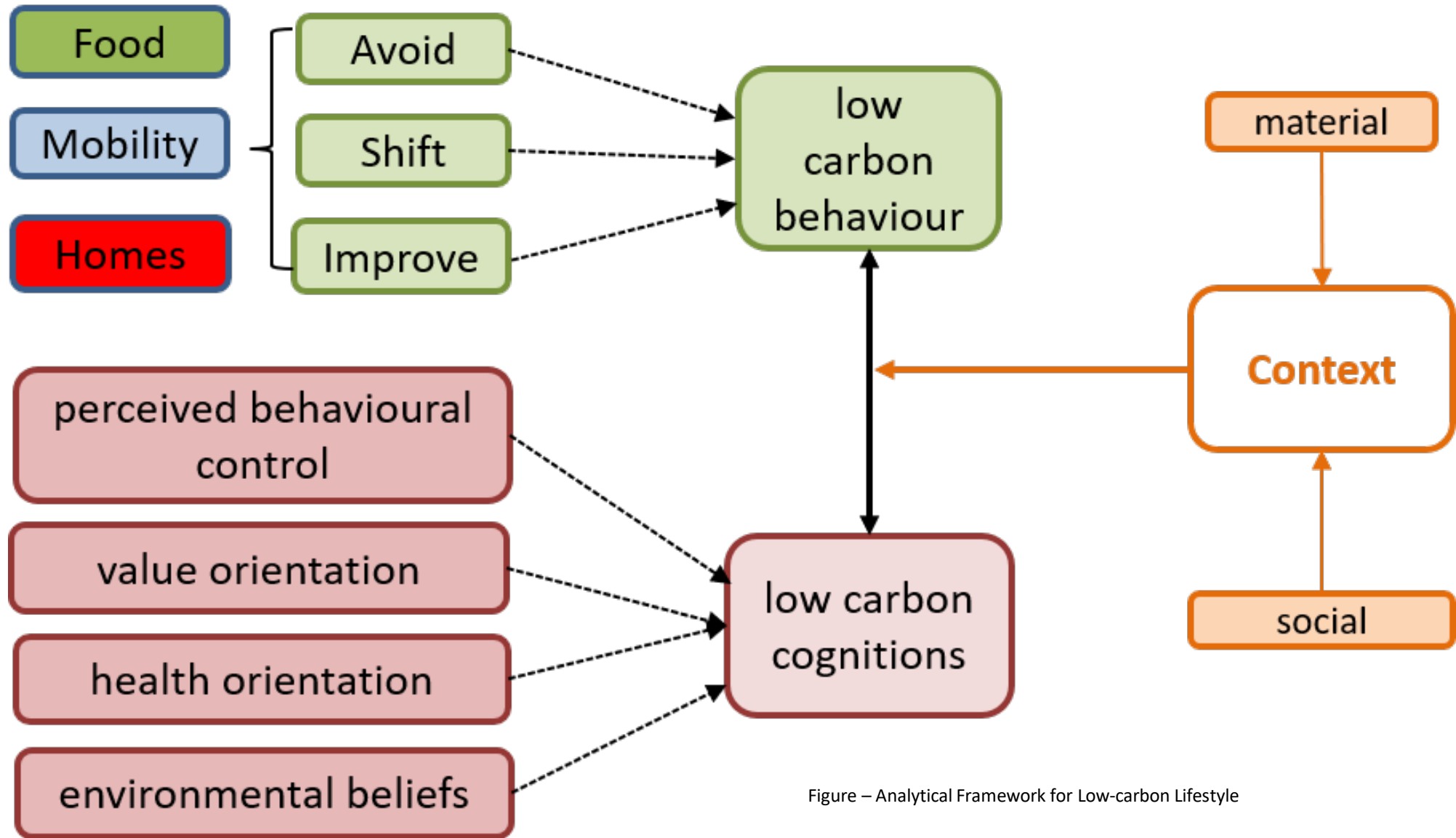
Figure – Analytical Framework for Low-carbon Lifestyle

We define lifestyle as '*the interplay between cognitions and behaviour in specific material and social contexts*'

Our empirical approach

Aim : To measure heterogeneous lifestyle types
across countries and cultures

Our empirical approach is quantitative and focuses on large scale social survey data

Which is ……

- Publicly available;

- Nationally representative;

- Randomly sampled (individuals and/or households);

- Valid measures of elements (and constructs) within our framework;

- Variables are measured within the same time frame;

- Four datasets met these criteria:
  - UK Understanding Society (2014-2018) (University of Essex)
  - China Family Panel Survey (2012-2016) (Institute of Social Science)
  - US General Household Survey (2006-2014) (University of Chicago)
  - Australian Household, Income and Labour Dynamics Survey (2012-2019) (University of Melbourne)

Each dataset provides measures of all elements and constructs within our framework

Data preparation results in single valid measures for each construct, using same scaling, reducing large sample sizes ready for analysis
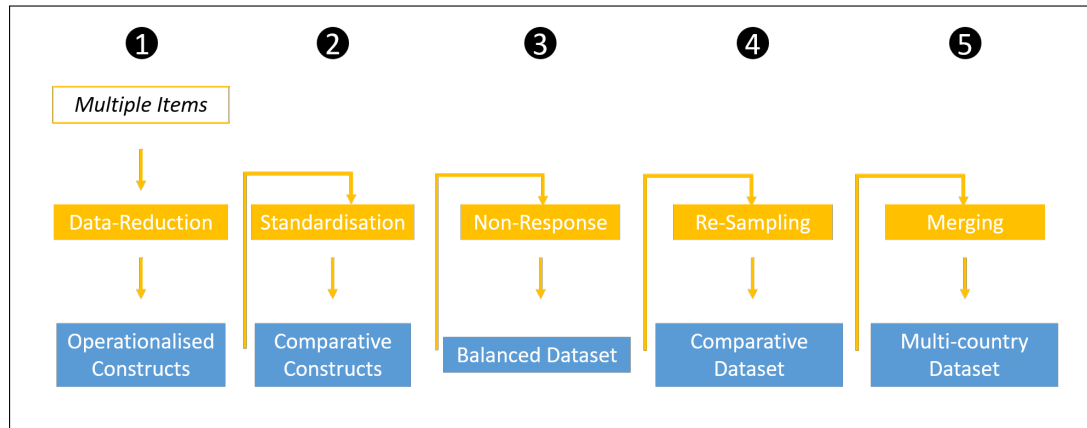

Figure – Steps to Data Preparation

Table – Representation of Analytical Framework

Construct	Valid items (N)			
	UK	China	US	Australia
Low-carbon Cognitions				
perceived behavioural control	12	2	2	5
value orientation	10	25	3	13
health orientation	10	11	8	13
environmental beliefs	15	1	5	4
total (n)	**42**	**39**	**18**	**35**
Low-carbon Behaviour				
mobility	5	9	1	2
food	7	6	3	5
homes	7	1	1	1
total (n)	**19**	**16**	**4**	**8**
Material Context				
affordability and wealth	2	2	2	2
living conditions	10	4	3	5
access to infrastructure	11	11	3	7
Social Context				
family and educational capital	5	5	5	5
social connectedness	1	5	1	1
Total (n)	**29**	**27**	**14**	**20**
Total (N)	**90**	**82**	**36**	**63**
Sample size	12,000	16,000	900	8,000
Reduced sample size	5,000	5,000	900	5,000

To preserve within country heterogeneity each dataset is prepared and analysed separately

Primary analytical approach identifies the clusters

hierarchical cluster analysis

$N_{Cluster}$ *= Low-carbon behaviour (mobility + homes + food) + low-carbon cognitions (perceived behavioural control + value orientation + health orientation + environmental beliefs)*

Secondary analytical approach characterises the lifestyle types

OLS and multinomial logistic regression other descriptive statistics to characterise the four lifestyle types

We apply ex-post the A-S-I framework
- Avoid behaviours (using car less) (avoid foods) (reduce heating)
- Shift behaviours (from car to public transport) (change diet) (shift to renewable electricity)
- Improve behaviours (from conventional to EV) (reduce food waste) (home generation)

	Mobility	**Food**	**Homes**
Avoid	*Reduce / avoid use of carbon intensive modes of transport* Fewer flights; Drive less (UK, CHN, USA, AUS)	*Avoid unsustainable goods* Avoid excess packaging Avoid products for environmental reasons (UK, USA)	*Reduce home energy consumption* Reduce heating controls; use less lighting (UK, USA, AUS)
Shift	*Shift from car to public transport / cycling / walking* Shift to public transport from car Walk short journeys (UK, CHN, AUS)	*Shift to a more sustainable healthy diet* Low meat diet (UK, CHN, USA, AUS)	*Shift to lower carbon source of fuel* cook using low-carbon fuel (electricity, biogas (CHN))
Improve	*Fuel-efficient vehicles / Electric vehicles* Car share; Own EV; Own E-bike (UK, CHN)	*Efficient use of food products / reduce waste* Recycled packaging; Take owns bags shopping (UK, USA)	*Micro-generation* Home has solar panels for water; heating; wind turbine (UK)

Figure – Categorisation of Behaviours across the A-S-I Framework

Based on the A-S-I framework (evaluated in Creutzig et al. (2022) and van den Berg et al. (2019)

Results

Aim: To understand behavioural, cognitive and contextual variation across lifestyle types

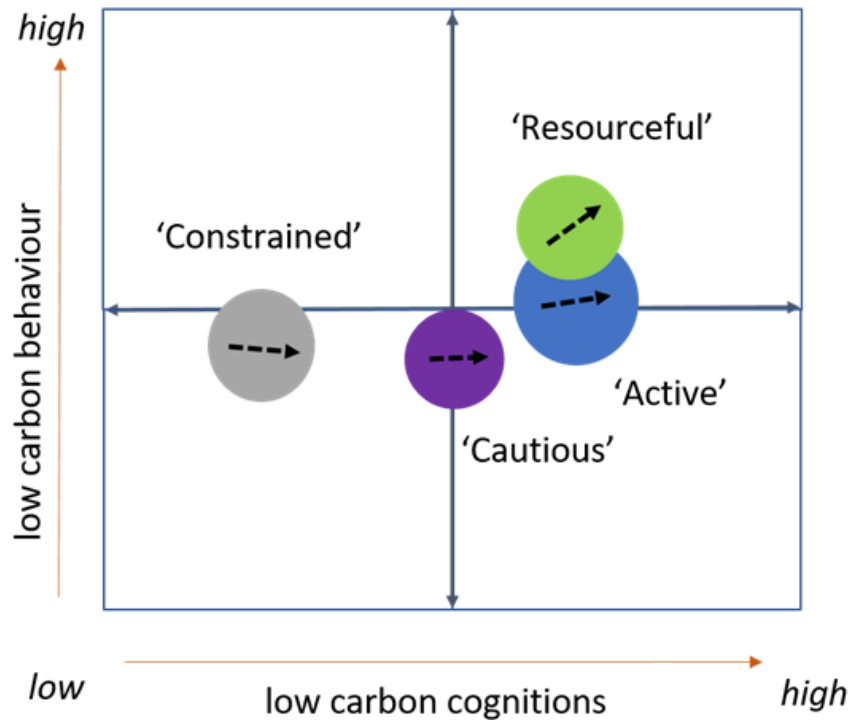Key findings 1: Four lifestyle types are clearly distinguished by their low-carbon cognitions, behaviours and contexts

Figure – Schematic Representation of Four Lifestyle Types

Table – Cognitive, Behavioural and Contextual Heterogeneity Across Lifestyle Types
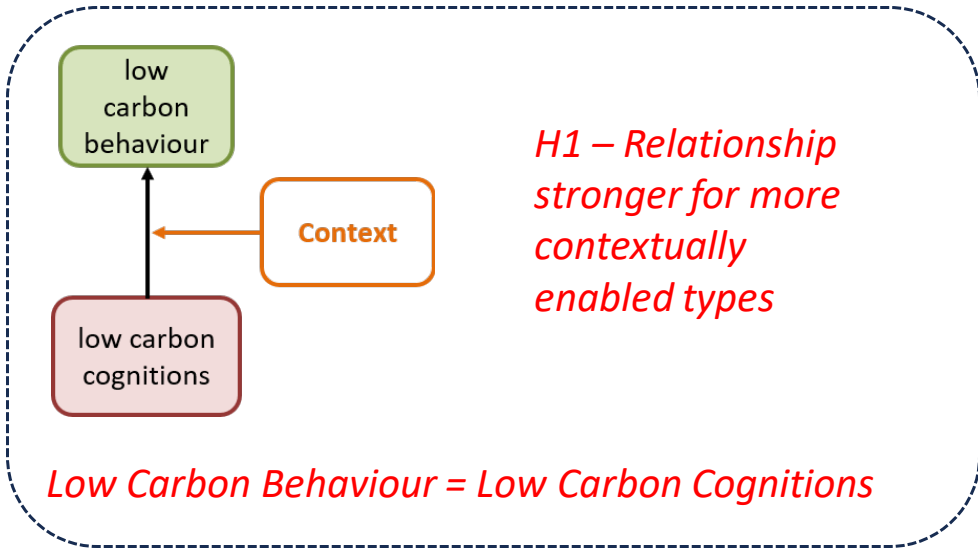
	Resourceful	Active	Constrained	Cautious
Sample size (n) [%]	3,592 [23%]	4,795 [30%]	4,259 [27%]	3,254 [20%]
Element 1				
Low-carbon Cognitions	▬	▬		
Constructs				
PBC				▬
Value orientation	▬			
Health orientation		▬		
Environmental beliefs	▬			
Element 2				
Low-carbon Behaviour	▬			
Constructs				
Avoid Mobility	▬	▬		
Avoid Food	▬			
Avoid Homes	▬	▬		
Shift Mobility	▬			
Shift Food	▬	▬		
Shift Homes	▬			
Improve Mobility	▬			
Improve Food	▬			
Improve Homes	▬			
Element 3				
Context	▬			▬
Income (US$)	▬			
Educated (% high education)				▬
Technology Savvy (% high)	▬			
Urban environment (%)	▬			
Supportive social networks (%)	▬			▬
Smaller household				▬
Younger		▬		

Key findings 2: Each lifestyle type is associated with different identifiers that vary across countries

We find small differences in the profiling of lifestyle types which emphasise differences in social and material contexts between countries

- There are differences in the size of groups across countries
  - In UK 'Constrained' types are the largest group
  - In China and Australia 'Active' types are the largest
  - In USA, 'Cautious' types are the largest groups
- The digital divide [Liu et al 2017]
  - All countries 'Resourceful' types are most 'technology savvy', 'Constrained' types the least
- Societal Structural divide [Delhey et al 2018]
  - In China all lifestyle types have strong social networks. In USA these are weak for all types.
- Economic divide and reforms [Huang et al 2021].
  - China has transitioned from socialist welfare housing system to one countries highest proportion of home-owners

Key findings 3: Low-carbon cognitions direct low-carbon behaviour, if context is 'enabling'

H1 – Relationship stronger for more contextually enabled types

Low Carbon Behaviour = Low Carbon Cognitions

'Resourceful' and 'Active' types are contextually 'enabled'. For them low-carbon behaviour is more strongly directed by low-carbon cognitions.

'Constrained' types faces many barriers to engagement
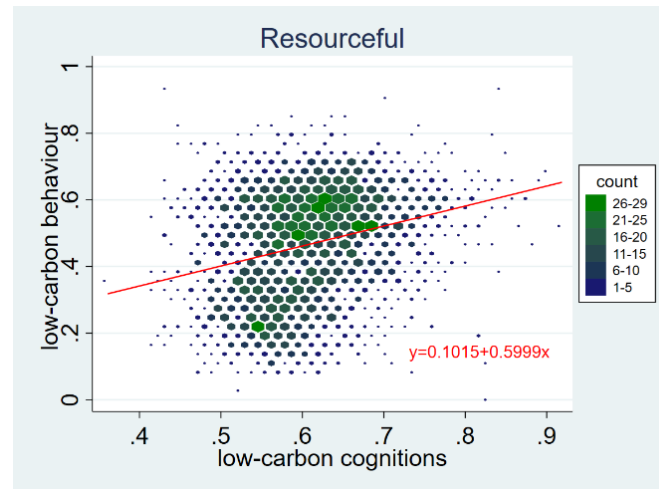'Cautious' types are 'enabled' but 'passive'

Figure – Scatterplot, Resourceful types with line of best fit
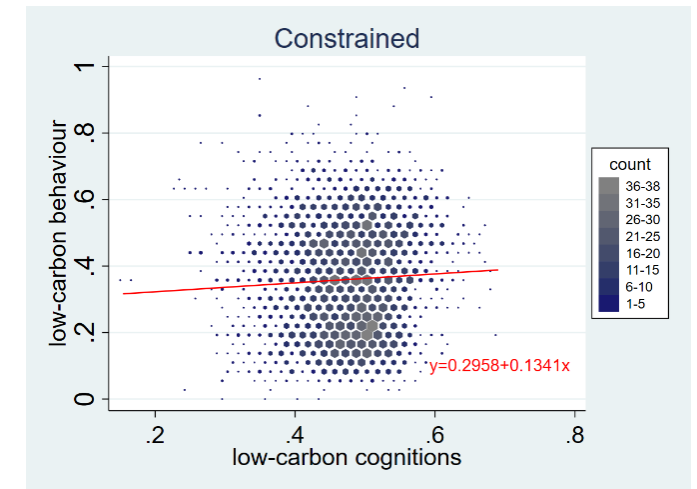
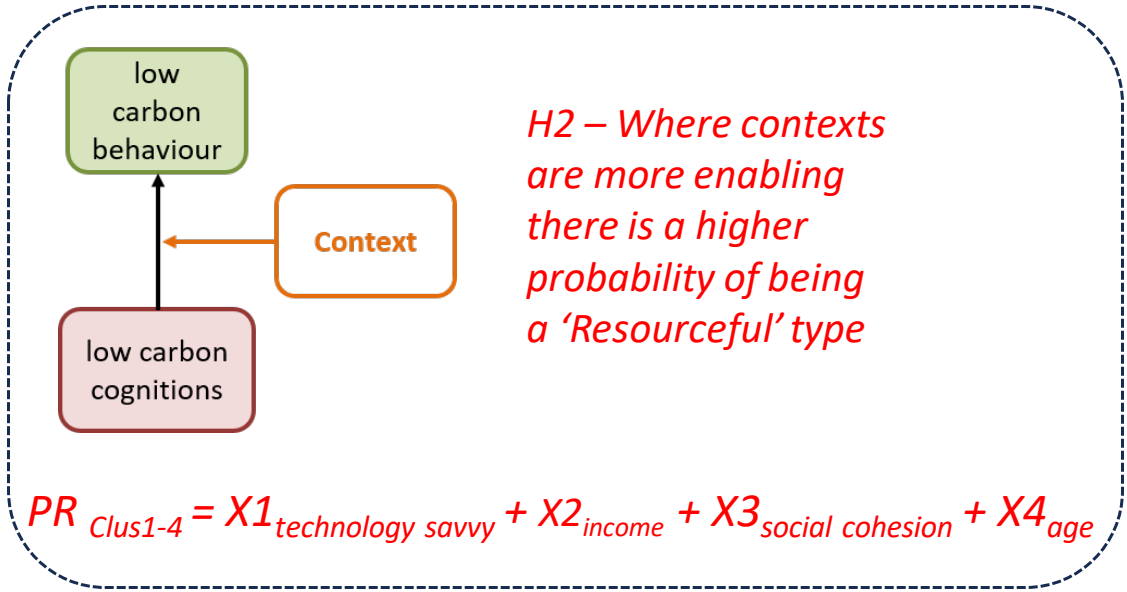Figure – Scatterplot, Constrained types with line of best fit
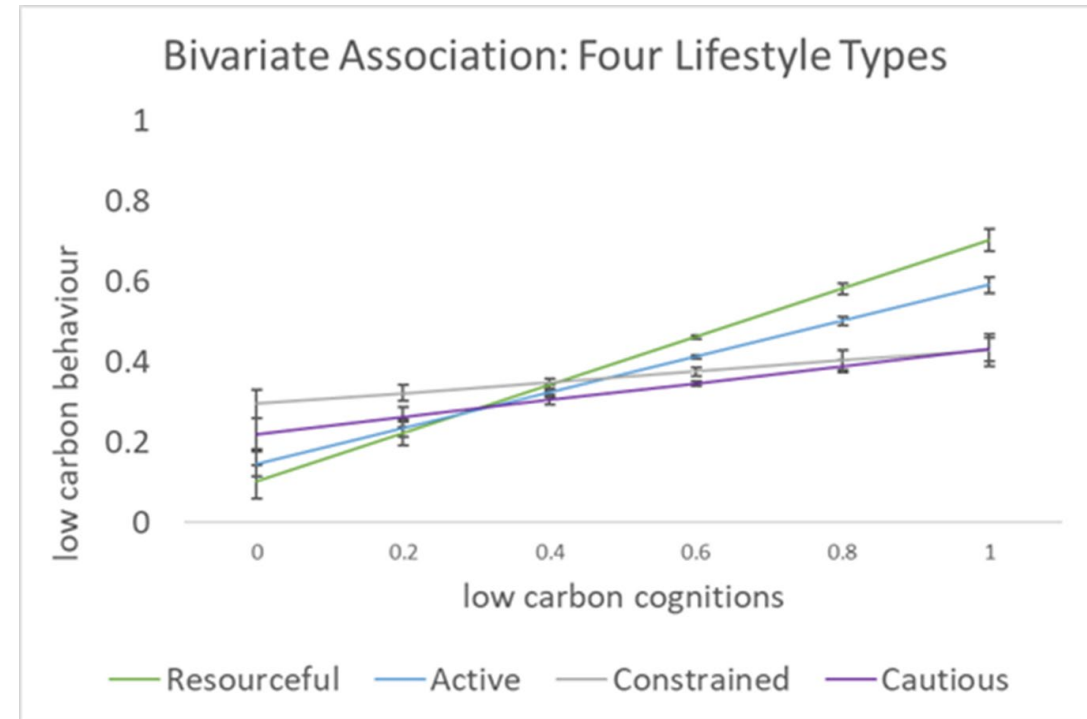
Figure – Bivariate association between cognitions and behaviour, four lifestyle types

Key finding 4 The opportunity to change lifestyle is shaped by context

Figure – change in probability of cluster membership based on access and use of digital products and services

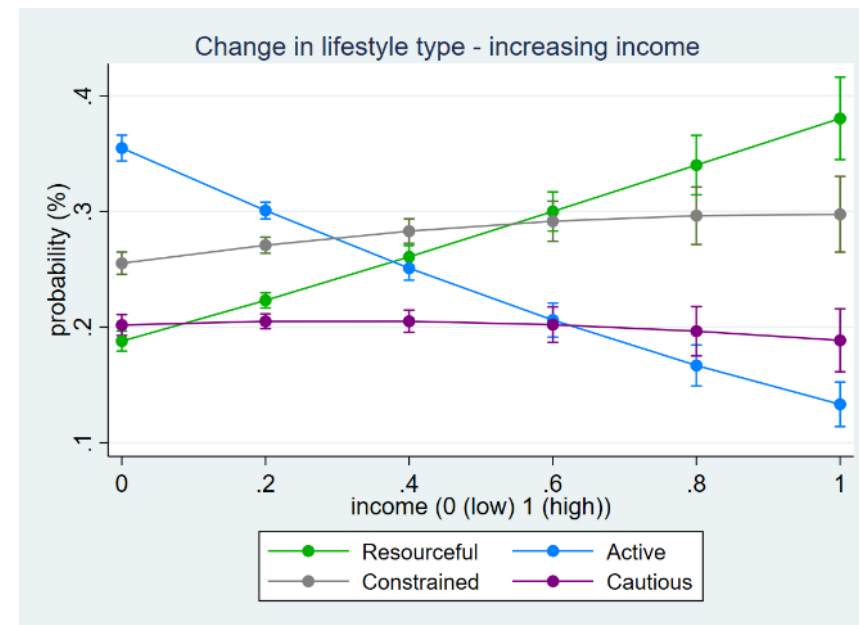*H2 – Where contexts are more enabling there is a higher probability of being a 'Resourceful' type*

$$PR_{Clus1-4} = X1_{technology\ savvy} + X2_{income} + X3_{social\ cohesion} + X4_{age}$$

low carbon behaviour

Context

low carbon cognitions

When socio-technical contexts become more enabling, there are large shifts towards 'Resourceful' and 'Active' lifestyle types

Most noticeable when more people have access to digital skills and related technology.
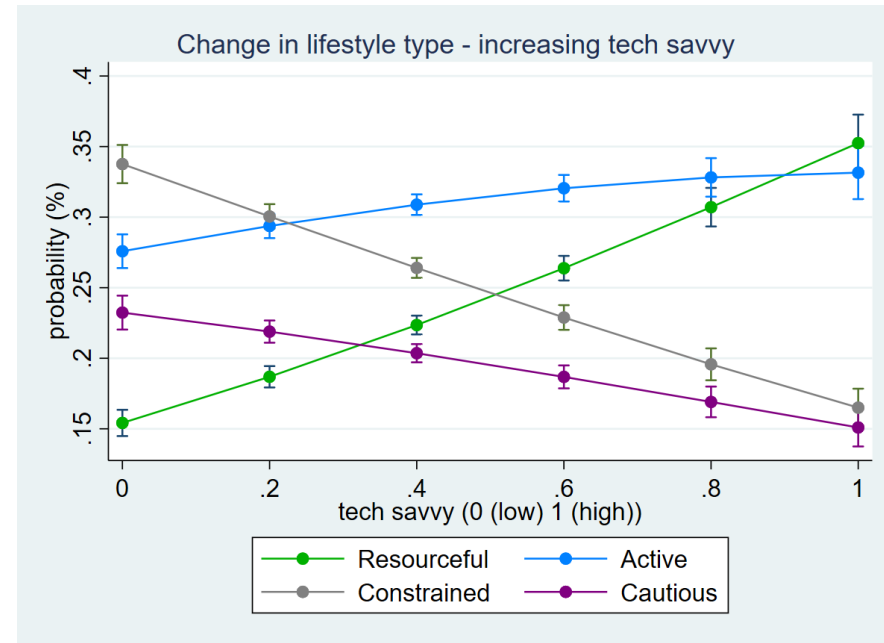

Figure – change in probability of cluster membership based on income

Discussion and Conclusion

A generalisable lifestyle framework is an important tool for understanding lifestyle contributions to climate change mitigation.

- Country representation, some regional representation
- Can be extrapolated to further regions using other global datasets

Transition towards low-carbon living involves an interplay between lifestyle elements

- Cognitions to strengthen pathways
- Behaviour to widen experiences across domains and behaviours (enhance consistency)
- Context to enable people to act on their cognitions

Inequality present major barriers to large-scale transitions to low-carbon future

- Address digital divide [Cullen 2001] (infrastructure, skills, access), links to social cohesion)
- Retain aspects of culture and tradition that can enrich perspectives in Global North

Insights for Government, and Modelling Communities

- Policy for specific archetypes to align diverse motivations with differing contexts.
- Simulate contribution of lifestyle change to global climate change mitigation

Endogenous Simulation of Low-Carbon Lifestyle Change in Global Climate Mitigation Pathways

Hazel Pettifor[1] (iD), Alessio Mastrucci[2] (iD), Charlie Wilson[1] (iD), Bas van Ruijven[3] (iD), Maureen Agnew[1] and Thomax Le Gallic[4]

- The main aim of this study was to demonstrate an approach to modelling low-carbon lifestyle and lifestyle change in global energy system models

- .. that was empirically based

Endogenous Simulation of Low-Carbon Lifestyle Change in Global Climate Mitigation Pathways
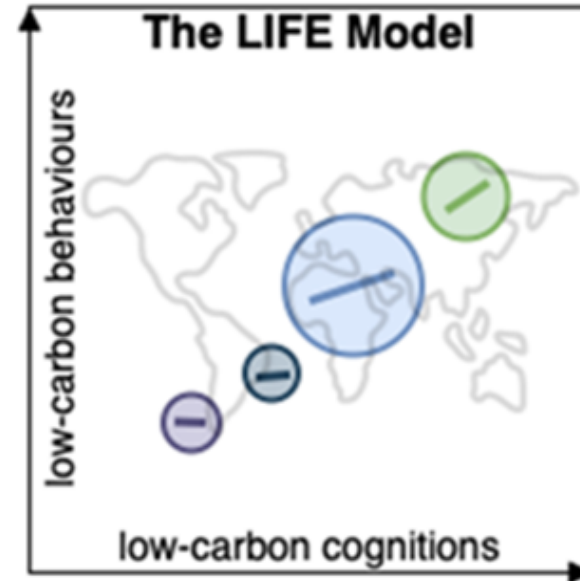
Hazel Pettifor, Alessio Mastrucci, Charlie Wilson, Maureen Agnew, et al

The LIFE Model

An empirically based, static model of low-carbon lifestyle

The Problem

- Lifestyle change is an integral and inevitable feature of a low-carbon future

- Integrated Assessment Models (IAMs) used to characterise mitigation pathways have a simplified representation of lifestyle that focuses on the impact

- To adequately represent lifestyles, they need to also capture the mechanisms of lifestyle change

- This is the aim of the LIFE model

The LIFE model - characterises four lifestyle types across cognitions, behaviour and context

Cognitions *are mental processes*

**Behaviours** *are physical (observable) activities, actions, improvements*

Context *is material or social*

Resourceful highly engaged

Active goal driven and healthy

Constrained contextual challenges

Cautious the means not the motivation

Mechanisms of lifestyle change

1. **Context-enabled** as incomes rise, or new skills are learnt

2. **Cognitively-driven** behaviour changes as values, beliefs and intentions change

3. **Behaviour-driven** cognitions change with as people become familiar and learn about behaviours that have changed

❶

❷

❸

Context-enabled
lifestyle change

Cognitively-driven
lifestyle change → low carbon
behaviour

low carbon
cognitions ← Behaviour-driven
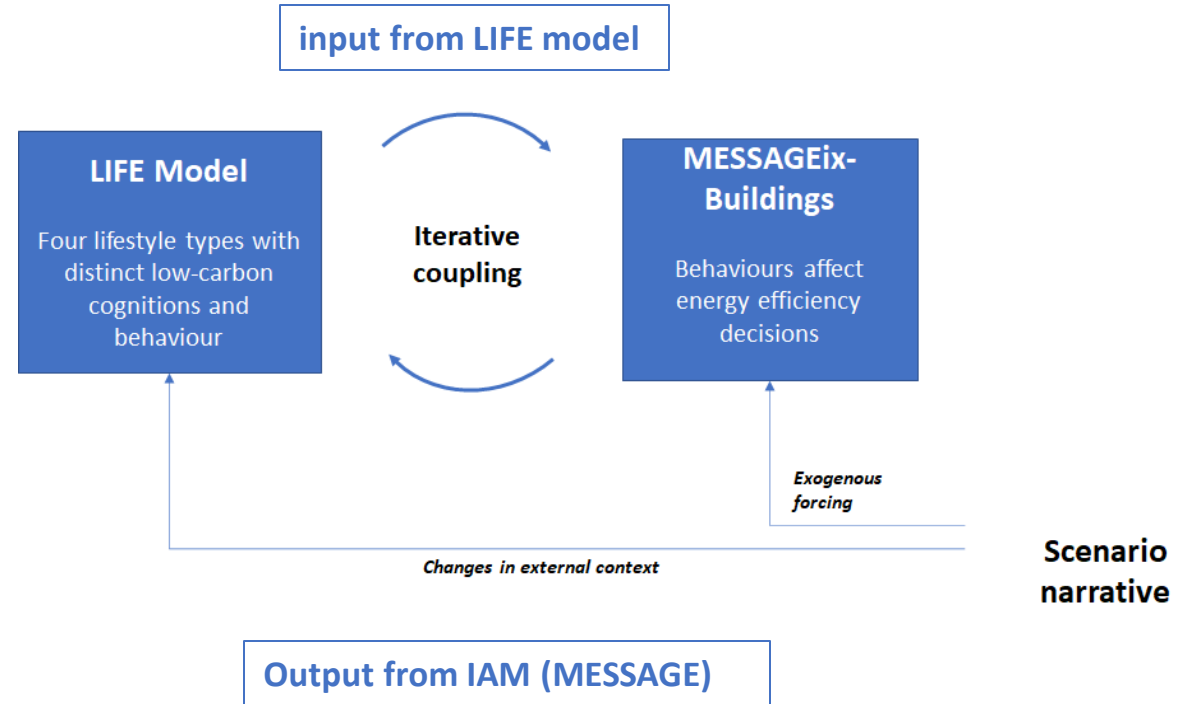lifestyle change
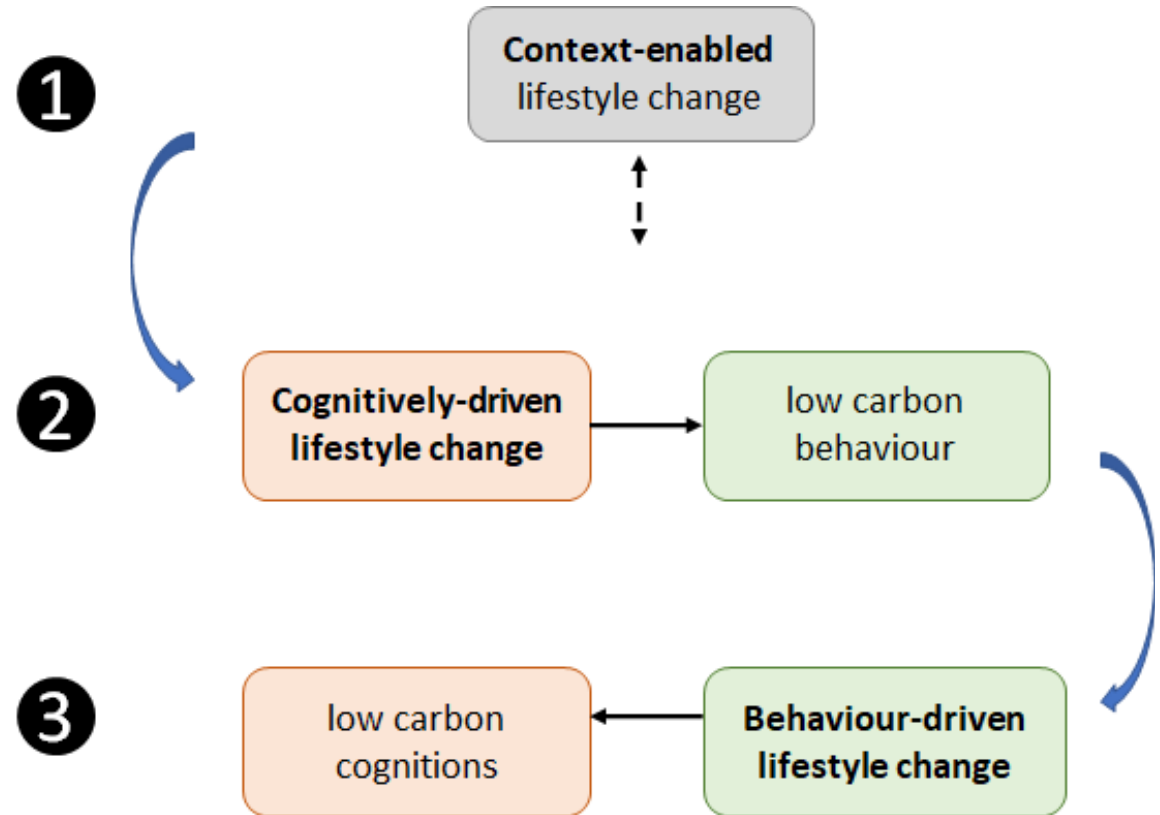
These are interconnected processes

The LIFE Model

Enables dynamic simulation of lifestyle change

Demonstration approach in MESSAGEix-Buildings

Demonstration:

Global residential space heating

Coupled framework:

- LIFE
- MESSAGEix-Buildings

Scenarios (SSP2 = business as usual)

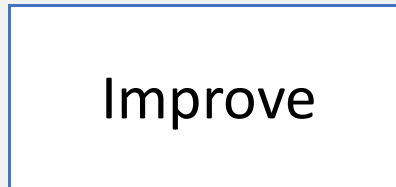| SSP2	SSP2 + LIFE	SSP2 + LIFE + Values
Baseline scenario No lifestyles differentiation	Heterogeneous low-carbon lifestyles	Strengthened drivers of low-carbon lifestyle change *Cognition - identity effect*

Interventions

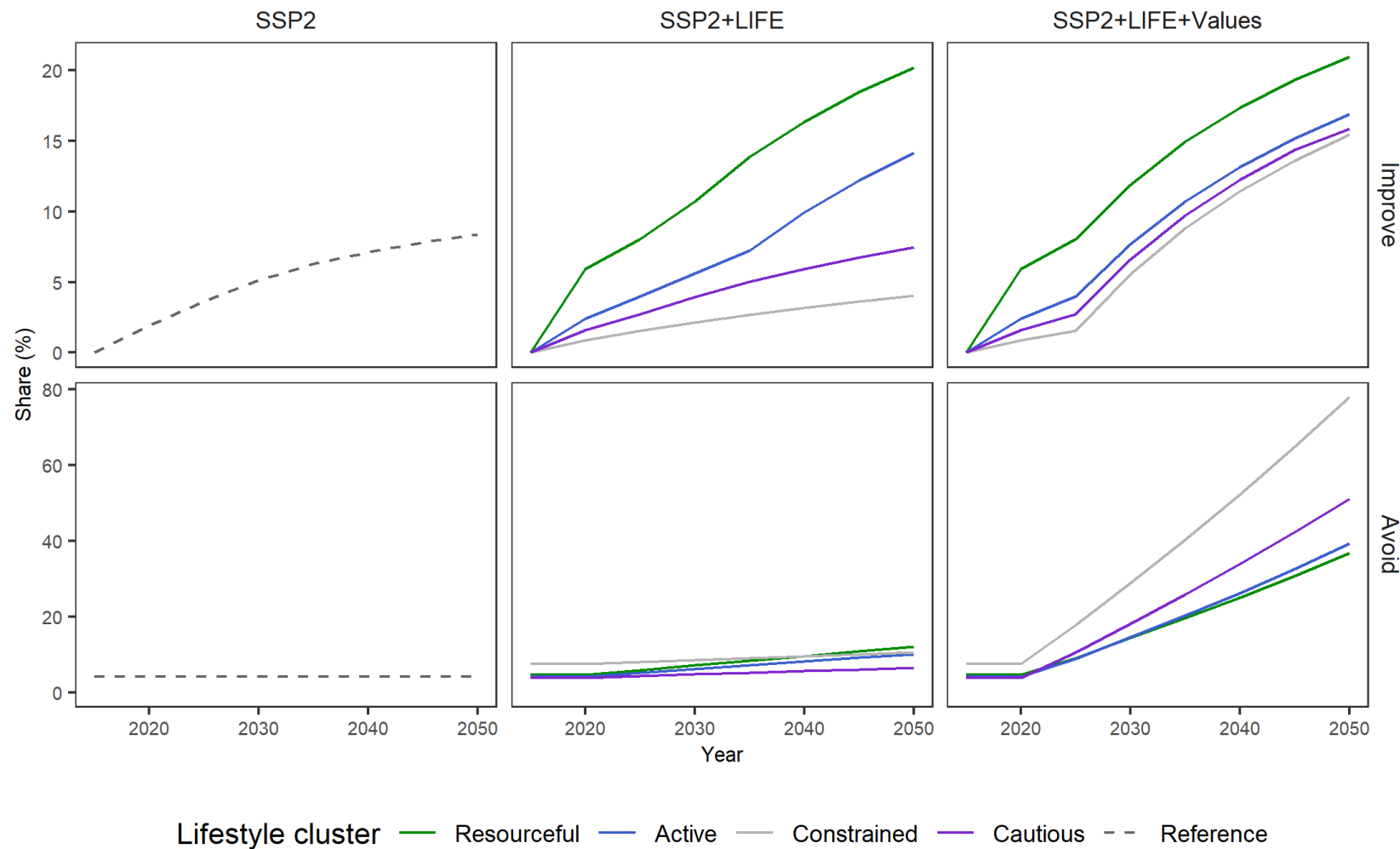| Improve	Avoid
Advanced renovation and new construction	Conservative heating temperature set-point
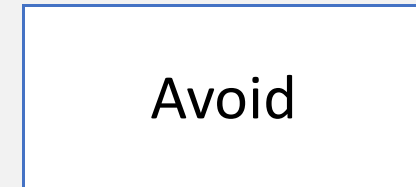
Results
Low-carbon Activities

- SSP2 + LIFE

Heterogeneity across the lifestyle types

Behaviour gap 'engaged' and 'dis-engaged' types

- SSP2+LIFE+Values

Strengthened cognitions closes this gap

Conclusion

Coupling the LIFE model and global IAMs:

- Simulate dynamic low-carbon lifestyle change

- Widen the potential 'tool-kit' of IAMs towards modelling social processes and the mechanisms of socially-oriented change