SILCI

Social Influence and Low-Carbon Innovations: Synthesis Report

31 May 2021

SILCI project: silci.org

Tyndall°Centre for Climate Change Research

erc European Research Council

Starting Grant #678799

Please cite as: Wilson, C., E. Cassar, L. Kerr, H. Pettifor, E. Vrain and M. Wilson (2021) Social Influence and Low-Carbon Innovations: Synthesis Report. SILCI project. Norwich, UK. 31 May 2021.

0.1

Consumer innovations can help tackle climate change. Social influence helps them spread.

Science

Granular technologies to accelerate decarbonization
C. Wilson, A. Grubler, N. Bento, S. Healey, S. De Stercke and C. Zimm

Science **368** (6486), 36-39.
DOI: 10.1126/science.aaz8060

Environmental Innovation and Societal Transitions 38 (2021) 82–97
Contents lists available at ScienceDirect
Environmental Innovation and Societal Transitions
journal homepage: www.elsevier.com/locate/eist
ELSEVIER

Research article
Social networks and communication behaviour underlying smart home adoption in the UK
Emilie Vrain *, Charlie Wilson

Renewable and Sustainable Energy Reviews 130 (2020) 109954
Contents lists available at ScienceDirect
Renewable and Sustainable Energy Reviews
journal homepage: http://www.elsevier.com/locate/rser
ELSEVIER

Low carbon innovations for mobility, food, homes and energy: A synthesis of consumer attributes
Hazel Pettifor[a,*], Charlie Wilson[a,b]

Energy Efficiency
https://doi.org/10.1007/s12053-018-9679-8
CrossMark
ORIGINAL ARTICLE
The potential contribution of disruptive low-carbon innovations to 1.5 °C climate mitigation
Charlie Wilson · Hazel Pettifor · Emma Cassar · Laurie Kerr · Mark Wilson

ANNUAL REVIEWS
Annual Review of Environment and Resources
Potential Climate Benefits of Digital Consumer Innovations
Charlie Wilson,[1,2] Laurie Kerr,[1] Frances Sprei,[3] Emilie Vrain,[1] and Mark Wilson[1]

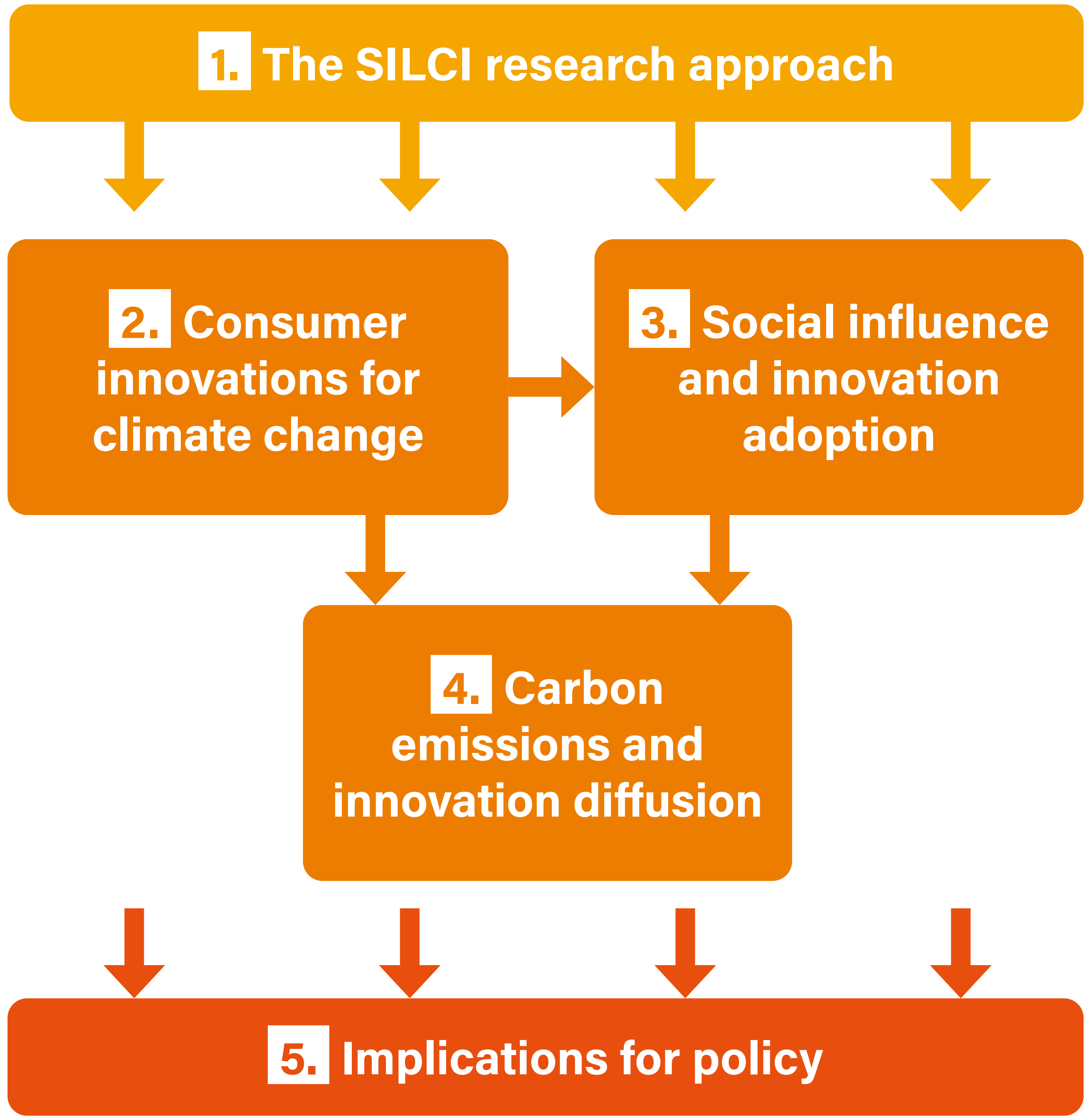
WHAT WE DID

- We were funded for 4.5 years by the European Research Council (#678799) to investigate the role of social influence on low-carbon consumer innovations.
- We collected data using surveys, market studies, interviews, focus groups, workshops, choice experiments, historical archives, and systematic literature review.
- We analysed data using perceptual mapping, thematic coding, statistical models, simulation models, and scenario analysis.

WHAT WE FOUND

- Looking **broadly** across consumer innovations in different domains, we found good evidence of significant contributions to emission reductions and strong evidence of the pervasive importance of social influence.
- Looking **deeply** at particular consumer innovations for mobility, food and homes, we identified specific challenges as well as opportunities … for people, policy and the planet.

0.2 Here's how we've organised this synthesis report of our findings.



IN THIS REPORT

- We summarise all our main findings, grouped into three themes:
  - consumer innovations for climate change
  - social influence and innovation adoption
  - carbon emissions and innovation diffusion
- We also begin by outlining our research approach, and we conclude with the implications of our findings for policy.
- Throughout we provide links to all our outputs. These are freely available for download on our website (**silci.org**).

IN THE APPENDIX TO THIS REPORT

- We list all our outputs and provide links to our publicly-archived data sources.
- We provide summaries of our methods and data.

*** COVID-19.**

The pandemic struck in the final year of our project. Lockdown restrictions have clearly impacted our research topic. We adapted our final rounds of data collection to measure these impacts. We report our findings in relevant parts of this report. But we have intentionally avoided Covid19 dominating this report, as much of our analysis was completed before March 2020.

SECTION 1.

Our research approach in the SILCI project.

CONTENTS

1.1

The 'Diffusion of Innovations' framework has four elements: adopters, interaction, networks, attributes.

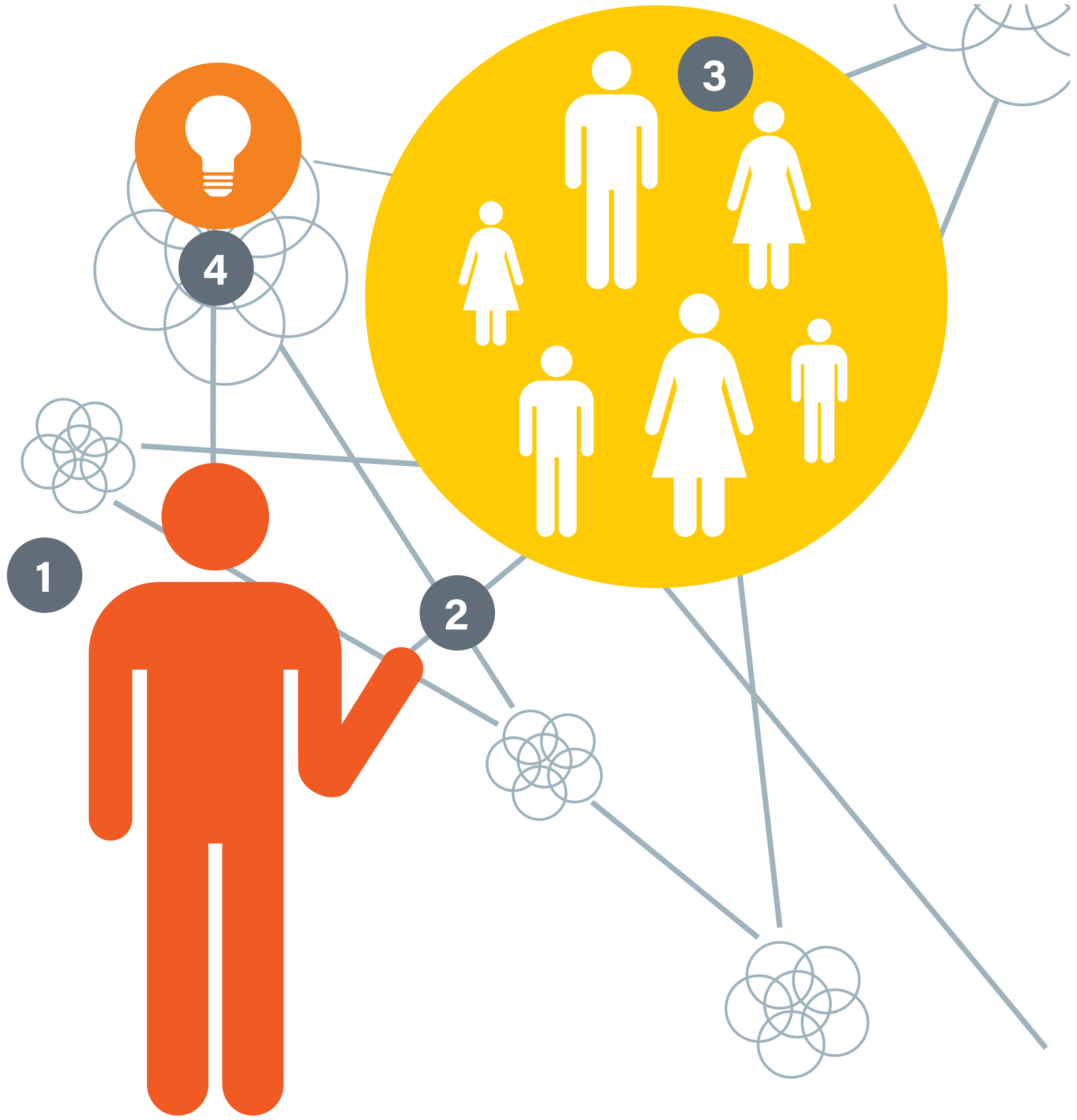


Figure: *Key elements of the Diffusion of Innovations framework, based on Rogers (2004).*

WHAT WE DID

- We used the Diffusion of Innovations framework by Everett Rogers. This defines diffusion as "communication over time about an innovation among members of a social system."
- Diffusion of Innovations identifies the four main elements that explain how and why innovations spread:
  1. *adopter heterogeneity* – people vary in their propensity to try out new ways of doing things;
  2. *interpersonal transmission* – people exchange information about their experiences which gives other people confidence to try out new things;
  3. *social networks of interaction* – people have networks of trusted social contacts with whom they interact and exchange information;
  4. *innovation attributes* – certain characteristics of innovations are appealing to would-be adopters.
- We focused our data collection and analysis on these four elements to understand how and why low-carbon innovations are being adopted by consumers.

LINK TO SILCI OUTPUTS:

Journal Articles: Vrain & Wilson (2021) *Environmental Innovation and Societal Transitions.* Vrain et al. (under review).

Talks: Wilson (2020) *Oxford Energy Network.*

SILCI

1.2 We researched 16 low-carbon consumer innovations for transport, food, homes and energy.

Domain	Label	Low-Carbon Innovation	Definition	Example
Mobility (or Transport)	T1	**Car clubs (US = carsharing)**	A membership-based service offering short-term rental of vehicles	Zipcar
	T2	**Peer-to-peer carsharing**	Networks of car owners making their vehicles available to others for short-term rental	Turo
	T3	**Liftsharing (US = ridesharing)**	Networks connecting passengers and drivers for shared car journeys or commutes	Liftshare
	T4	**Shared ride-hailing (or taxi-buses)**	Cars or minivans with multiple passengers on similar routes, booked on short notice via apps	UberPool
	T5	**Mobility-as-a-service**	App-based scheduling, booking, and payment platform for multiple transport modes	Whim
	T6	**Electric vehicles**	Vehicles with electric motor propulsion and a battery that is recharged from external sources	Nissan Leaf
	T7	**E-bikes**	Bicycles with an electric motor and battery for assisting with pedalling up to limited speeds	Gocycle
Food	F1	**Online food hubs**	Buy food for delivery directly from multiple local producers (= digital farmers' markets)	Open Food Network
	F2	**Meal kits (or recipe boxes)**	Home deliveries of fresh produce pre-portioned for cooking specific recipes	Hello Fresh
	F3	**11th hour apps**	Food outlets advertise surplus fresh food at reduced prices	Too Good to Go
Home	H1	**Smart heating systems**	Monitoring, automation, adaptive learning, and control (via app) of heating	Nest
	H2	**Smart lighting**	Customization and control (via app) of lighting	Philips Hue
	H3	**Smart home appliances**	Automation and control (via app or by utilities) of white goods and other large appliances	Samsung Smart Fridge
Energy	E1	**Generation with storage**	Electricity generated domestically stored in a battery system to maximize own-consumption	Tesla Powerwall
	E2	**Peer-to-peer electricity trading**	Networks of households for trading surplus electricity generated domestically	Brooklyn Microgrid
	E3	**Electric vehicle-to-grid**	Allowing bidirectional flows of energy between the grid and batteries of electric vehicles	DriveElectric V2G

1.3

Our set of 16 low-carbon consumer innovations have diverse characteristics.

Domain	Label	Low-Carbon Innovation	Market Share*	Product or Service	Digital	UK Coverage	Infrastructure Dependence
Mobility (or Transport)	T1	Car clubs (US = carsharing)	<1%	service	platform	national	limited (dedicated parking)
	T2	Peer-to-peer carsharing	<1%	service	platform	national	no
	T3	Liftsharing (US = ridesharing)	<1%	service	(platform)	national	no
	T4	Shared ride-hailing (or taxi-buses)	<0.1%	service	platform	some cities	no
	T5	Mobility-as-a-service	<0.1%	service	platform	some city trials	limited (co-located modes)
	T6	Electric vehicles	<1%	product	(navigation)	national	high (charging)
	T7	E-bikes	~2%	product	no	national	limited (home charging)
Food	F1	Online food hubs	<0.1%	service	ordering	some areas	no
	F2	Meal kits (or recipe boxes)	<0.1%	service	ordering	national	no
	F3	11th hour apps	<1%	service	platform	national	no
Home	H1	Smart heating systems	~6%	product	controls	national	no
	H2	Smart lighting	~5%	product	controls	national	no
	H3	Smart home appliances	<1%	product	controls	national	no
Energy	E1	Generation with storage	<0.1%	product	energy management	national	limited (grid connections)
	E2	Peer-to-peer electricity trading	<0.1%	service	platform	some city trials	limited (grid connections)
	E3	Electric vehicle-to-grid	<0.1%	service	grid integration	some areas	limited (grid connections)

* estimated from available data

1.4

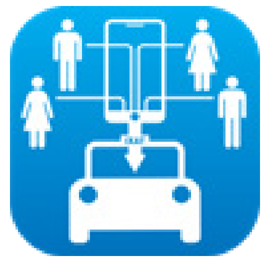
We designed an app icon for each of the low-carbon innovations we studied.

Mobility


T1 Car clubs
(US = carsharing)


T2 Peer-to-peer carsharing


T3 Liftsharing
(US = ridesharing)


T4 Shared ride-hailing
(or taxi-buses)


T5 Mobility-as-a-service


T6 Electric vehicles


T7 E-bikes

Food


F1 Online food hubs


F2 Meal kits
(or recipe boxes)


F3 11th hour apps

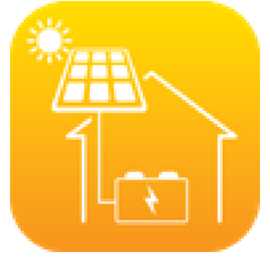
Home

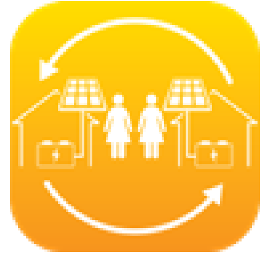

H1 Smart heating systems

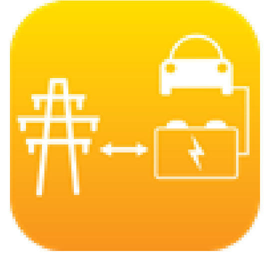

H2 Smart lighting


H3 Smart home appliances

Energy


E1 Generation with storage


E2 Peer-to-peer electricity
trading


E3 Electric vehicle-to-grid

1.5 Low-carbon consumer innovations reduce the energy required to provide useful services.

The figure on the next page represents the entire global provisioning system through which energy and material resources are extracted from nature and used to provide services as part of daily life at home and on the move.

Supply chains lead from resource extraction *(far right of Figure)* through a succession of conversion steps *(middle of Figure)* until the final provision of services like lighting, washing, heating, cooking and getting around *(left of Figure)*.

This use of natural resources – particularly fossil fuels, and land for agriculture – is also responsible for global greenhouse gas emissions *(shown by CO_2 bubbles)*.

In a second version of the figure, we've added the low-carbon consumer innovations in our sample (except for the ones related to food which we couldn't fit on!).

By design, these innovations are close to or at the point of final consumption. This defines the focus of the SILCI project and our interest in low-carbon consumer innovations.

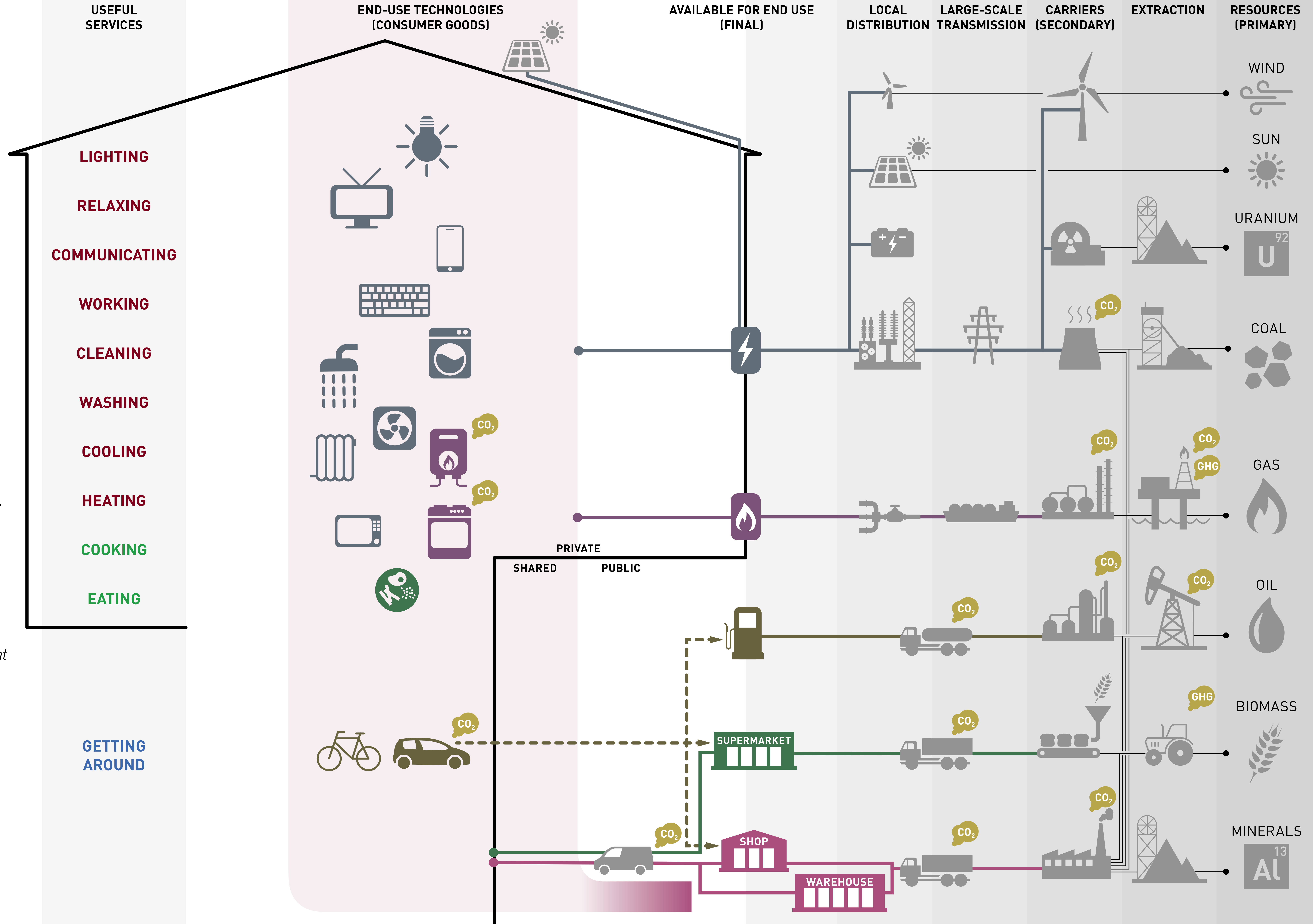


Figure: *Supply chains lead from resource extraction (far right) through a succession of conversion steps (middle) to the final provision of services like lighting, washing, heating, cooking and getting around (left). The use of natural resources also leads to greenhouse gas emissions (CO_2 and GHG bubbles).*

Source: *Wilson et al. (2020) Annual Review of Environment and Resources.*

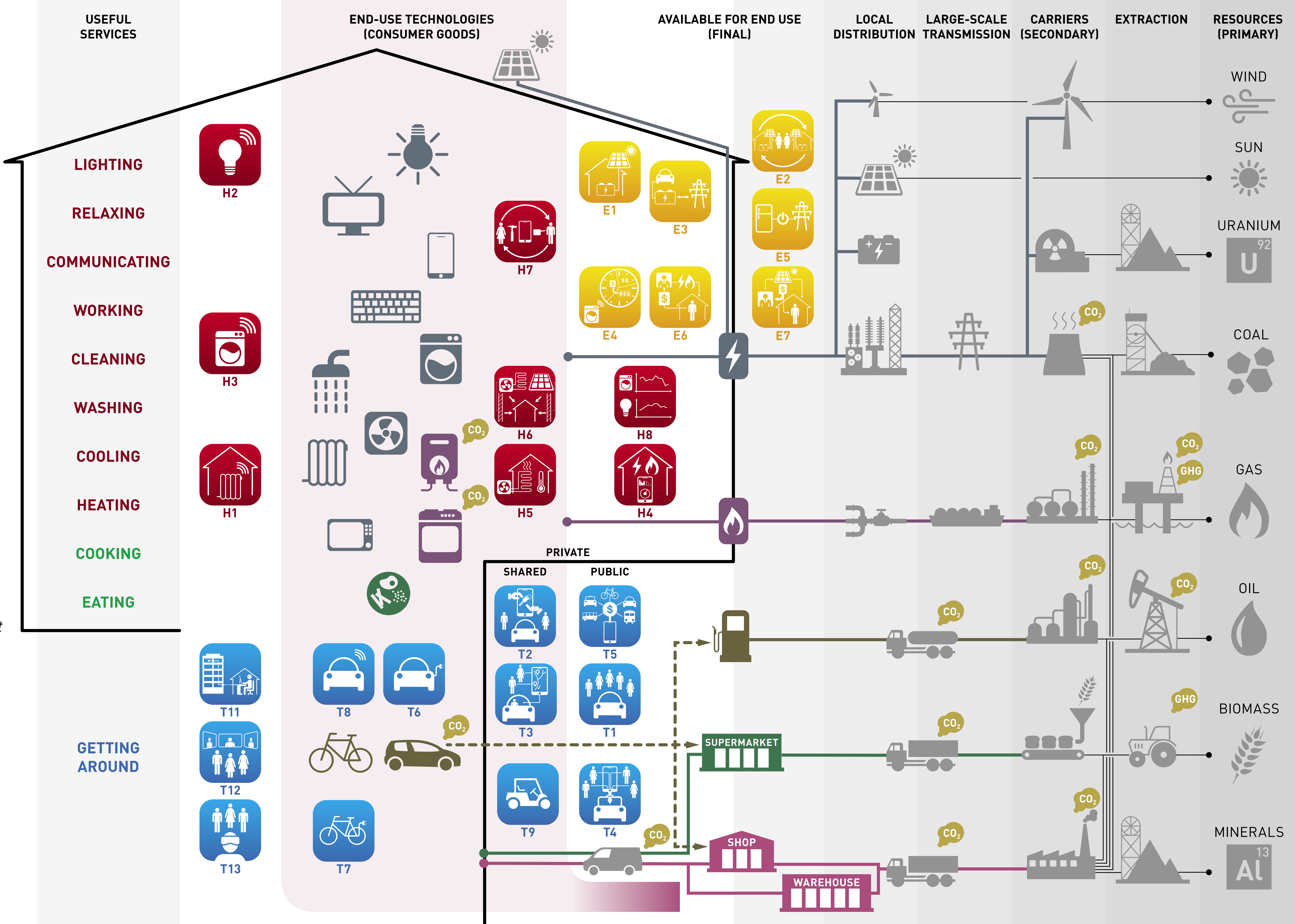


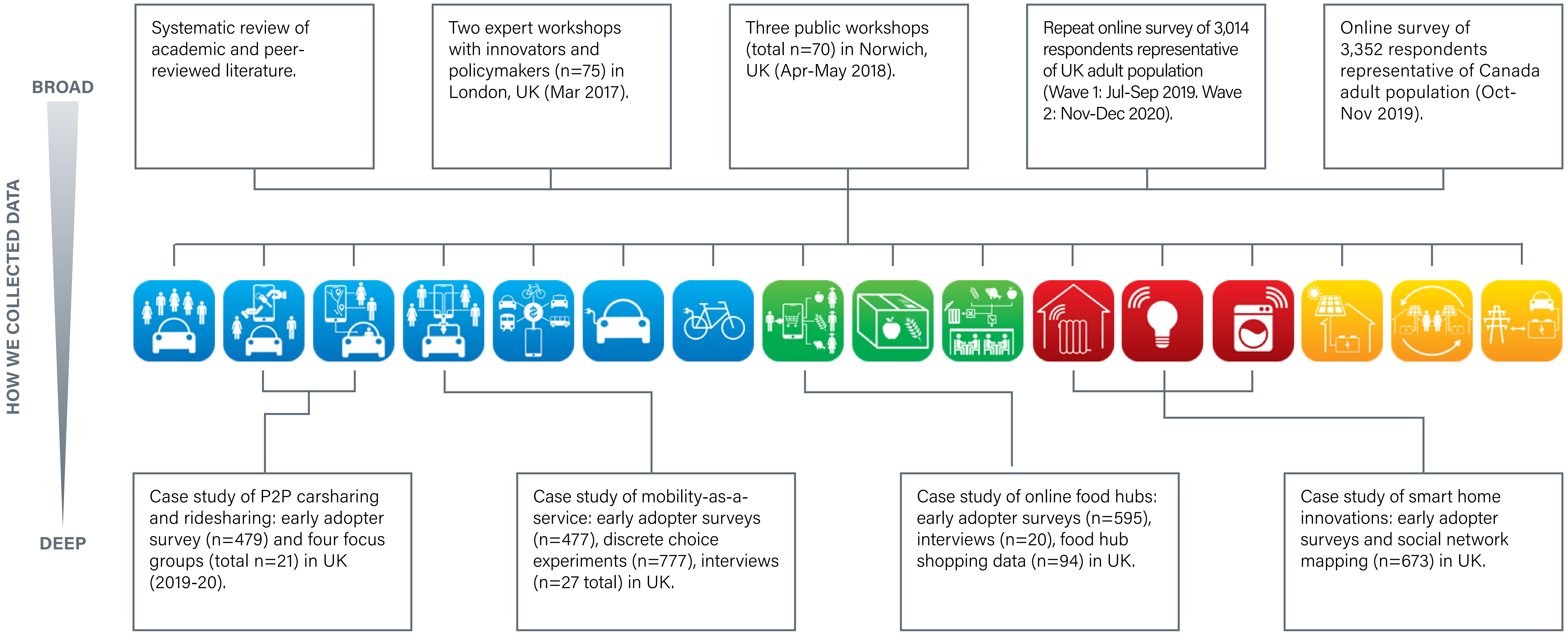
Figure: *The global provisioning system for useful services as part of daily life including app icons for the low-carbon consumer innovations for mobility, homes and energy studied in the SILCI project.*

Source: *Wilson et al. (2020) Annual Review of Environment and Resources.*

SILCI

1.6

We combine broad analysis *across innovations* and deep contextual analysis *within innovation* cases.



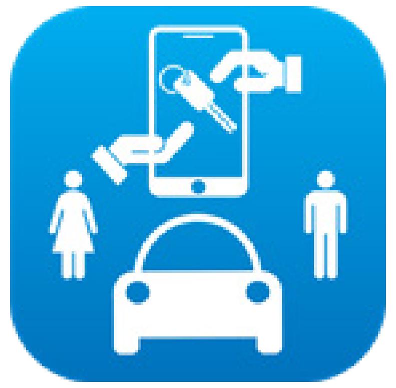
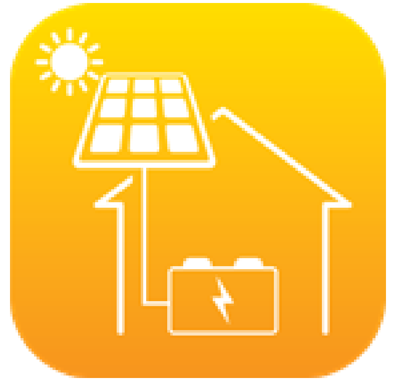
SECTION 2.

Consumer innovations for climate change.

CONTENTS

SILCI

2.1 Low-carbon consumer innovations offer alternatives to mainstream consumption practices.

consumption domain	**MOBILITY**	**FOOD**	**HOMES**	**ENERGY**
example of a low-carbon consumer innovation	 peer-to-peer carsharing	 online food hubs	 smart heating systems	 storing own-generated electricity
which challenges ...				
mainstream consumption practice	driving own vehicle with low occupancy	doing large food shops in supermarkets	manually controlling appliances	exporting surplus own-generated electricity to grid

LINK TO SILCI OUTPUTS:

Journal articles: Wilson et al. (2019) *Energy Efficiency.* Wilson et al. (2020) *Annual Review of Environment and Resources.*

Reports: Wilson & Pettifor (2017) *BEIS.*

2.2 Consumer innovations may be 'disruptive,' but this is not a widely agreed upon term.

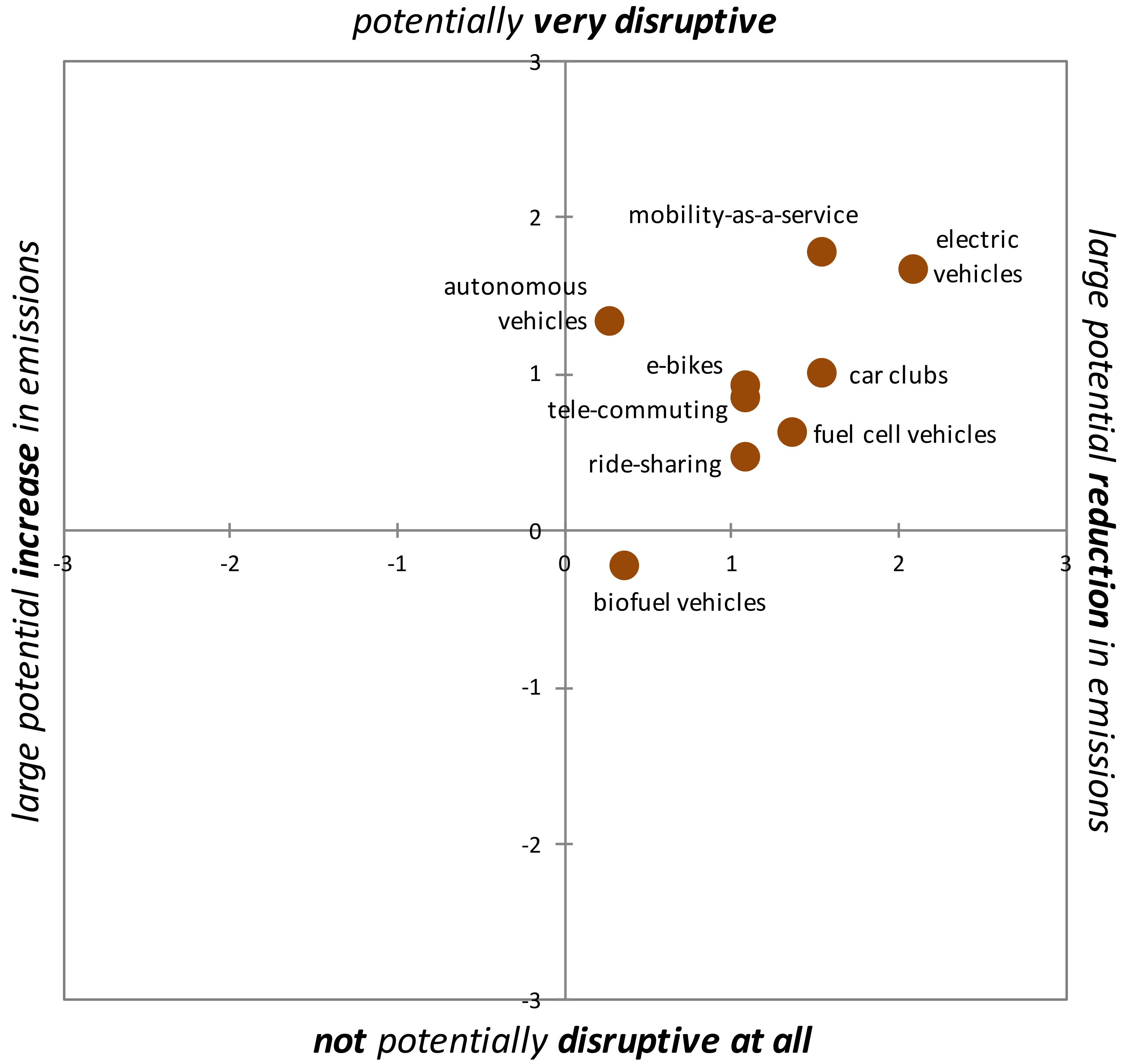


***Figure:** We asked workshop participants to rate the disruptiveness and low-carbon potential of a range of innovations, shown here for the mobility domain.*

***Source:** Wilson et al. (2019) Energy Efficiency.*

WHAT WE DID

- We convened two expert workshops to explore disruptive innovation concepts and their relevance to climate change.
- We invited 10 author teams to contribute contrasting perspectives on disruptive innovation which we edited together in a journal special issue.

WHAT WE FOUND

- Business leaders and entrepreneurs see low-carbon innovation as inherently disruptive. This also includes high-end manufacturers like Tesla and Apple (see *Figure*).
- Researchers critique disruption innovation concepts for narrowly emphasising discrete technologies or business models. They argue disruption is systemic and political.
- Clayton Christensen's definition of 'disruptive innovation' to mean low-cost goods and services appealing to marginalised consumers has limited relevance for climate change.
- However disruptive innovation does usefully emphasise novel consumer value propositions for stimulating adoption.

LINK TO SILCI OUTPUTS:

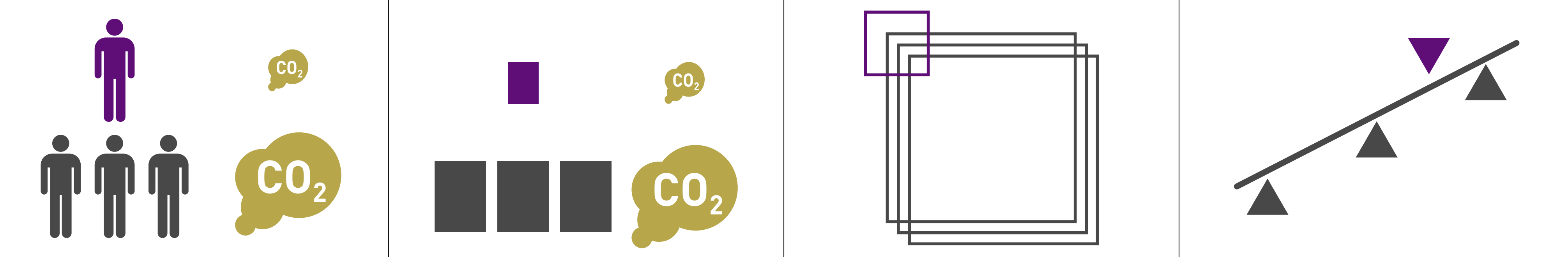
Journal Articles: Wilson & Tyfield (2018) *Energy Research & Social Science.* Wilson (2018) *Energy Research & Social Science.* Wilson et al. (2019) *Energy Efficiency.*

Conference Papers: Wilson (2017) *ECEEE Summer Study.*

Reports: Wilson (2017) *Workshop Synthesis Report.*

2.3

Disrupting consumption practices can have broader knock-on effects on firms, markets, regulations.



	First-order disruption →		Second-order disruption →	
Novel value propositions Mainstream goods & services	Consumption practices	Firms & markets	Regulatory frameworks	Norms & infrastructure
Mobility	Owning & driving petrol or diesel vehicles with low occupancy	Automakers, dealers	Revenue-raising taxation	Parking, transit & ownership norms
Food	Doing big (meaty) food shops	Supermarkets & centralised suppliers	Food safety	Land use, high streets & shopping norms
Homes	Manually controlling devices whenever needed	Small renovation firms, non-digital competences	Data, privacy & consumer protection	Wireless & phone networks, boundaries of home
Energy	Using grid-supplied energy whenever needed	Centralised utilities	Grid access & market participation	Distribution networks & energy use norms

Figure: *Innovations with appealing attributes that offer novel value propositions to consumers can challenge mainstream consumption practices and service providers. Interactions between these 'first-order disruptions' can lead to wider 'second-order disruptions' to regulatory, physical, and social contexts.*

Source: *Wilson et al. (2020) Annual Review of Environment and Resources.*

WHAT WE FOUND

- Challenges to consumption practices from innovations clustering and interacting at the consumer level can have wider 'second-order' disruption effects (see *Figure*).
- As an example, mobility innovations such as shared, electric, autonomous vehicles offer novel attributes to consumers but can also impact urban form, social exclusion, and working practices as well as the automotive industry.

LINK TO SILCI OUTPUTS:

Journal Articles: Wilson et al. (2020) *Annual Review of Environment and Resources.*

Conference Papers: Wilson (2019) *APPAM Conference.*

2.4

'Non-core' attributes differentiate low-carbon innovations from the mainstream and attract adopters.

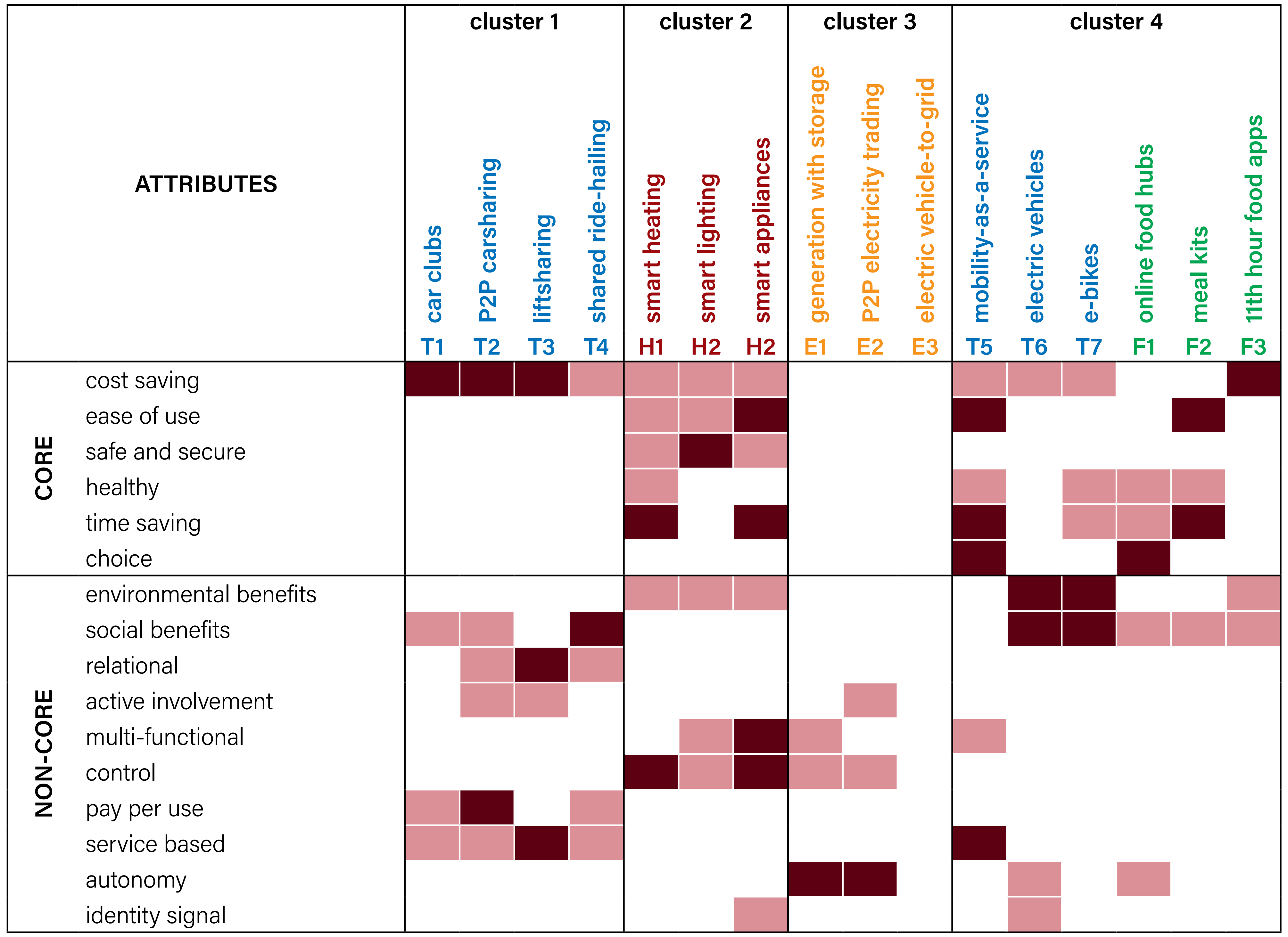


Figure: *We mapped a range of innovations against a common set of core and non-core attributes, then grouped innovations with similar consumer appeal using cluster analysis. Colour coding:* ***dark red*** *= high appeal,* *light red* *= modest appeal.*

Source: *Pettifor & Wilson (2020) Renewable & Sustainable Energy Reviews.*

WHAT WE DID

- We reviewed over 170 studies on low-carbon innovations from marketing and consumer behaviour perspectives.
- We analysed how the innovations were marketed by service providers and how they were perceived by prospective users.

WHAT WE FOUND

- The value proposition of many different low-carbon innovations comprises a shared set of core and non-core attributes (see *Figure*).
- Core attributes are necessary for adoption. Examples include cost-effectiveness and ease of use. Mainstream goods and services have strong core attributes that are hard to compete against.
- Non-core attributes are 'value added', differentiating innovations and stimulating adoption. They vary by domain: e.g., relationships and the environment for food innovations; versatility and control for homes innovations.
- Many innovations are currently positioned to appeal to a distinctive but limited 'low-carbon' consumer segment.
- Innovations for managing energy in homes have the weakest consumer appeal on core attributes, meaning current growth potential is limited.

LINK TO SILCI OUTPUTS:

Journal Articles: Pettifor & Wilson (2020) *Renewable & Sustainable Energy Reviews.*

Talks: Pettifor (2019) *Global Sustainability Institute.*

SILCI

The current appeal of low-carbon innovations is strongest for public functional and symbolic attributes.

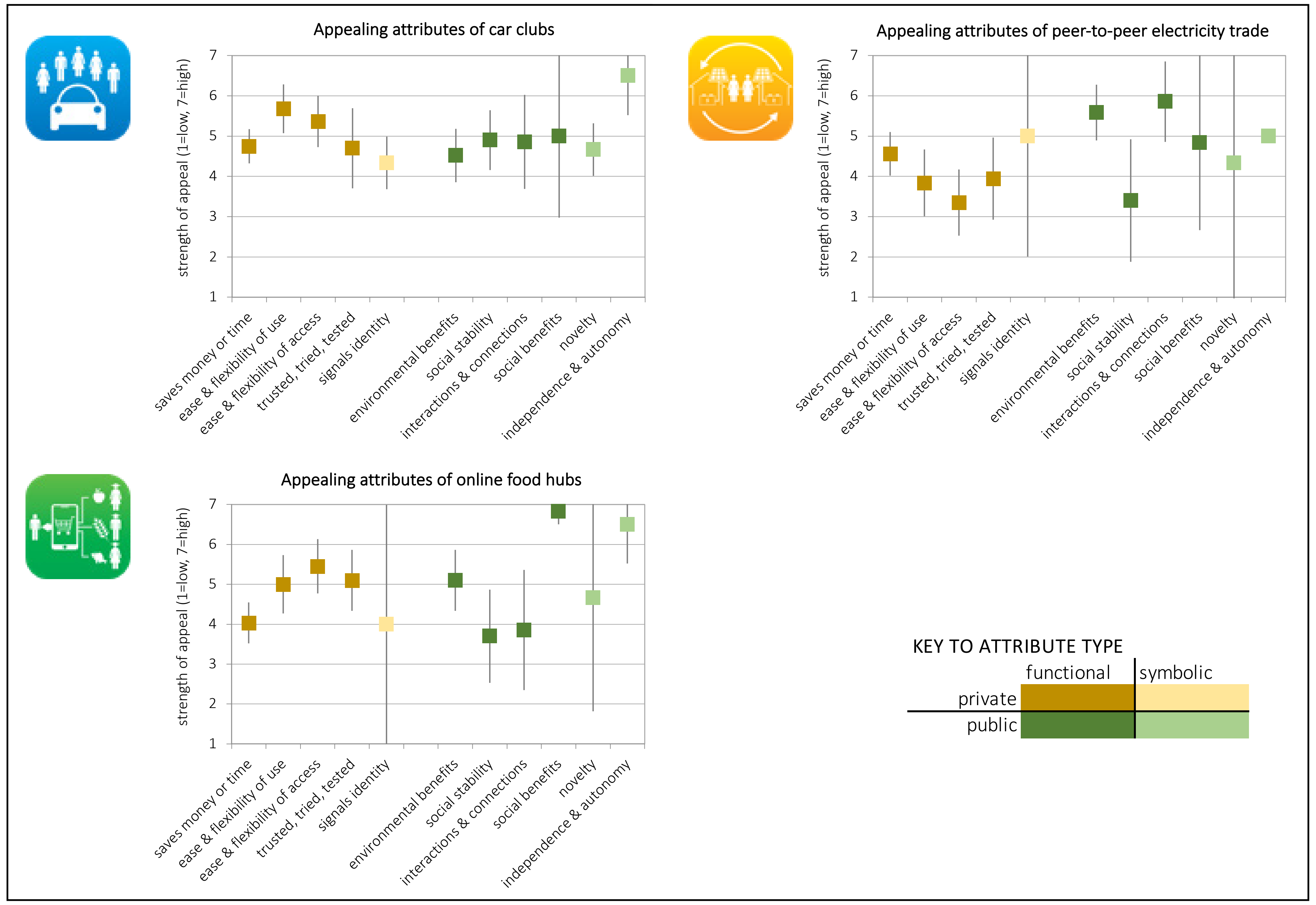


***Figure:** We mapped the strength of consumer appeal against private vs. public attributes and functional vs. symbolic attributes.*

***Source:** Pettifor et al. (2020). Energy Research & Social Science.*

WHAT WE DID

- We held a series of public workshops in Norwich (UK) to elicit detailed perceptions of 12 low-carbon innovations in mobility, food, homes and energy domains.
- We used repertory grid analysis to distinguish private attributes (benefitting users) from public attributes (benefitting society), and functional attributes (what it does) from symbolic attributes (what it represents).

WHAT WE FOUND

- Low-carbon innovations have relatively weak appeal on the private functional attributes valued by mainstream consumers (e.g., save money or time, ease of use). But they do have strong appeal on public functional and symbolic attributes including a range of social, relational, and environmental benefits (see *Figure*).
- As examples, mobility innovations like car clubs provide autonomy and independence (including from owning and maintaining a car). Energy innovations like P2P electricity trading foster connections and social benefits. Food innovations like online food hubs are appealing as they support local businesses and build community.

LINK TO SILCI OUTPUTS:

Journal Articles: Pettifor et al. (2020) *Energy Research & Social Science.*

Talks: Pettifor (2019) *International Conference in Environmental Psychology.* Wilson, C. & M. Wilson (2019) *Pint of Science.*

2.6 Innovation case studies reveal specific attributes of appeal in food and mobility domains.

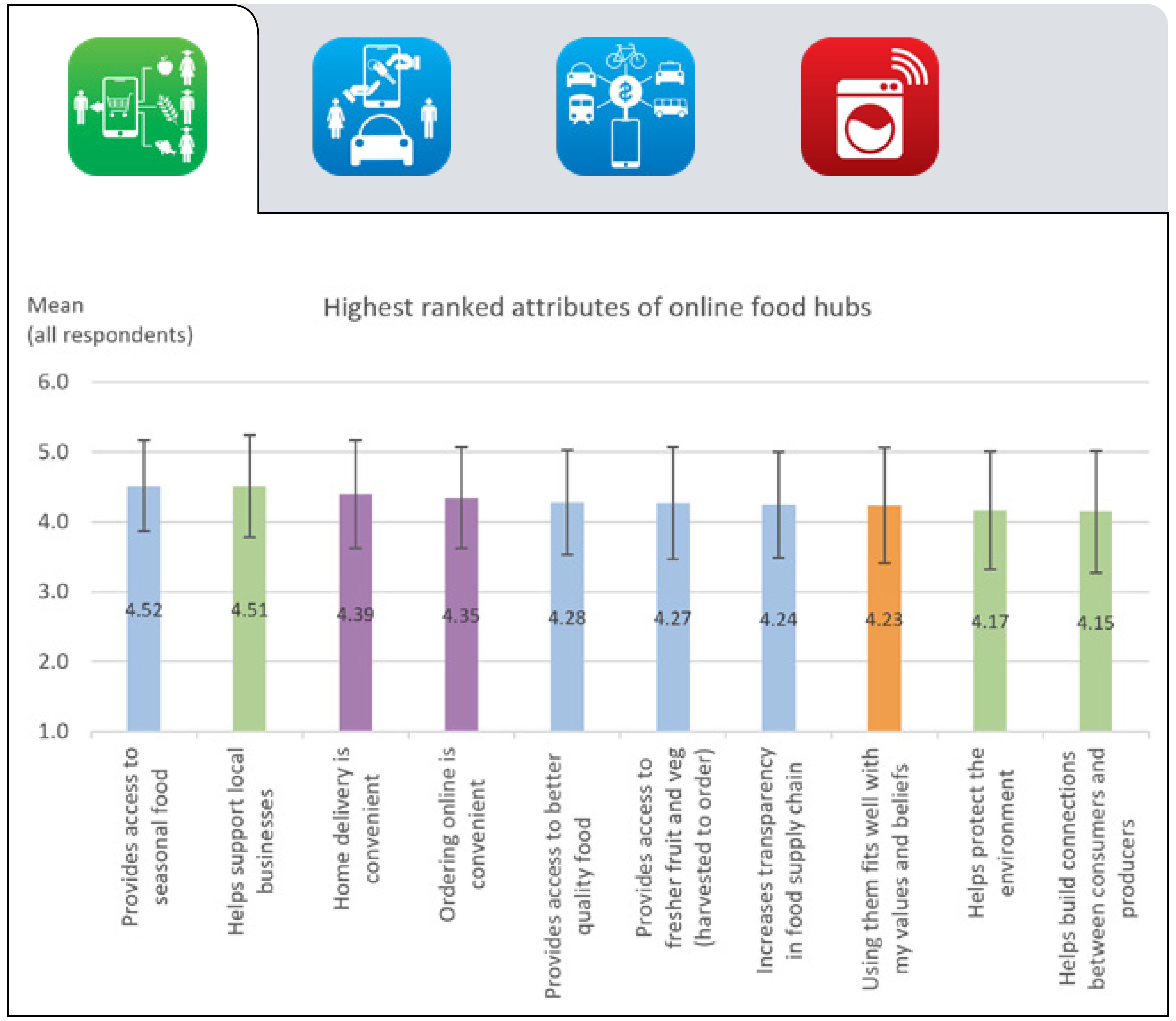


***Figure:** The appeal of online food hubs to early adopters: mean scores on a range of attributes. Error bars show 95% confidence intervals. Colour coding: blue = food quality; green = environmental and societal benefits; purple = convenience; orange = identity.*

WHAT WE DID:

- In each of our four innovation case studies (see *Icons*), we analysed which attributes appealed to early adopters and compared these with non-adopters to isolate the attributes influential on adoption.

WHAT WE FOUND:

- For online food hubs, we found diverse appeal across private functional benefits like the convenience of online ordering, public benefits like supporting local businesses, and symbolic benefits like consistency with self-identity and values (see *Figure*).
- For peer-to-peer mobility, we found commuters valued the social aspects of ridesharing, but financial benefits were more important.
- For mobility-as-a-service, we found both university students and employees in the workplace alike valued short travel times and quick interchanges between modes, as well as affordability.
- For smart home technologies, we found value for money and controllability were the main attributes communicated in social interactions.
- These insights reinforce our broad findings on the importance of core attributes, and the distinctiveness of non-core attributes in attracting would-be adopters to low-carbon innovations.

LINK TO SILCI OUTPUTS:

Conference Posters: Wilson, M. (2021) *Climate Exp0.*

Talks: Wilson, M. (2019) *RGS Conference.* Cassar (2020) *BECC Conference.* Vrain (2019) *European Conference on Social Networks.*

SILCI

2.7 Innovations can be rejected after adoption if users' experience of innovation attributes falls short.

	Discontinuers (treatment group)			Remain adopters (control group 1)			Remain non-adopters (control group 2)		
	Wave 1	Wave 2	Difference [SD]	Wave 1	Wave 2	Difference [SD]	Wave 1	Wave 2	Difference [SD]
Social influences[a]									
Word of mouth (WOM)	3.08	2.60	**-0.48 [1.51]****	2.92	3.00	0.08 [1.56]	1.9	2.03	**0.13 [1.46]****
Electronic WOM	2.54	2.32	**-0.23 [1.55]***	2.05	2.11	0.05 [1.54]	1.65	1.70	0.05 [1.39]
Social norms	2.23	2.24	0.01 [1.57]	2.04	2.24	**0.21 [1.56]***	1.57	1.71	0.14 [1.38]**
Neighbourhood effect	2.72	2.48	**-0.24 [1.58]***	2.66	2.68	0.02 [1.64]	1.73	1.77	0.04 [1.46]

[a]Paired t-test result, $^{*}p \leq 0.05$, $^{**}p \leq 0.01$

Table: *Changes in the strength of social influence on innovation adoption from late 2019 (Wave 1) to late 2020 (Wave 2) in three groups of respondents: 'Discontinuers' who have rejected an innovation once adopted, 'Remain adopters' whose status as an adopter is unchanged over the previous year, and 'Remain non-adopters' whose status as a non-adopter is unchanged over the previous year. These two 'Remain' groups provide a reference point or control group for analysis of the 'Discontinuers' who reported the largest drop in social influence over the previous year.*

Source: *Vrain et al. (in progress).*

WHAT WE DID

- We recontacted our UK survey respondents a year after their initial responses (from late 2019 to late 2020). We asked them if their adoption status had changed for any of the 16 low-carbon consumer innovations in our sample.
- We focused our analysis on why some respondents reported having discontinued their use of an innovation.

WHAT WE FOUND

- We found innovation attributes best explained discontinuance, particularly if respondents had found innovations to offer lower relative advantage and lower compatibility than originally perceived.
- We also found a lack of positive social influence was associated with discontinuance (see *Table*), for example, if information is spread through social networks on the weak acceptability or usefulness of an innovation. (We discuss social influence in more detail in the next section of this report).
- In contrast, we did not find that discontinuance was explained either by the personal characteristics of the discontinuer (e.g., lack of relevant skills) or by contextual conditions (e.g., Covid-19).

LINK TO SILCI OUTPUTS:

Journal Articles: Vrain et al. (in progress).

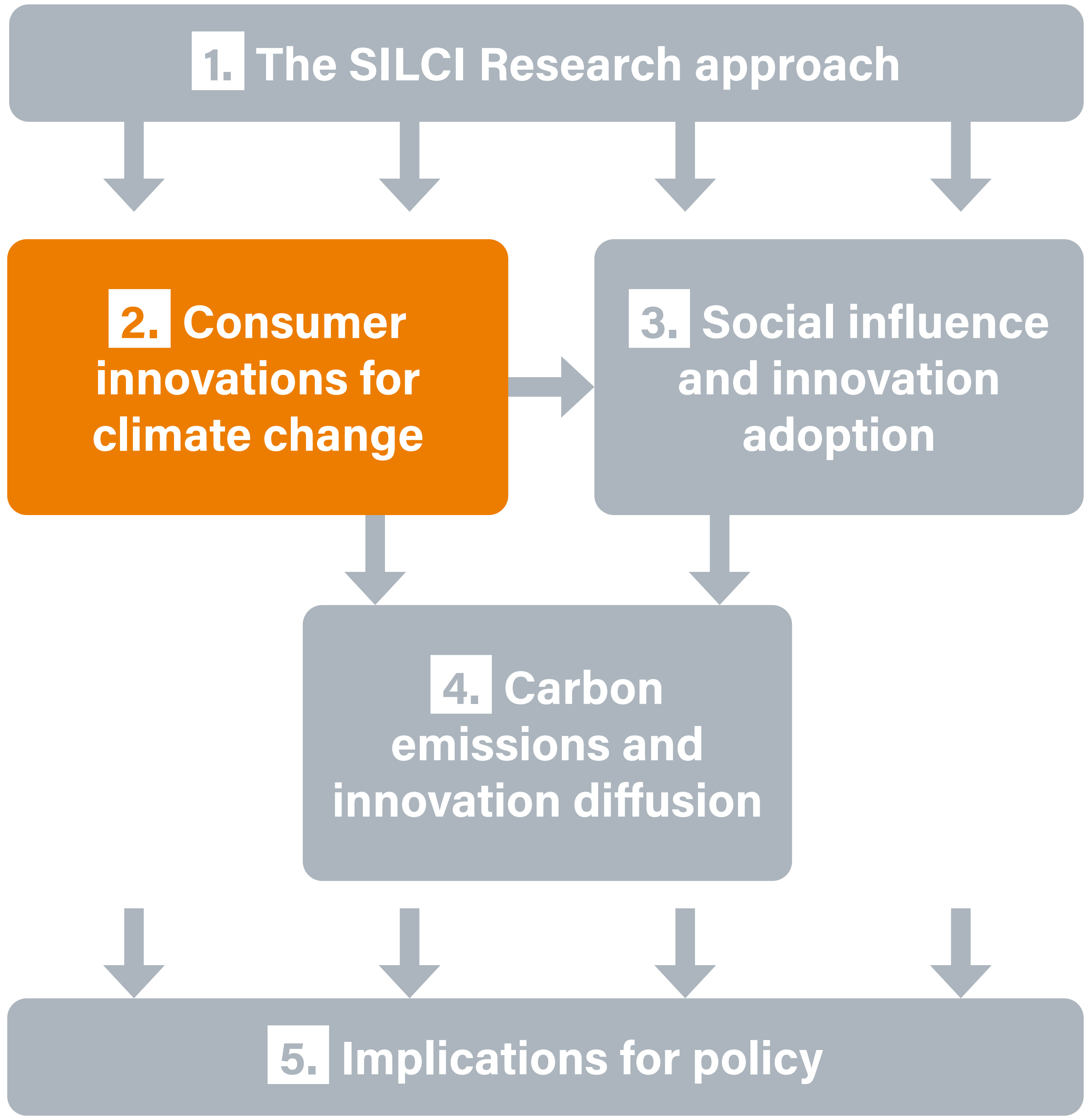
Blogs: Vrain (2021) *UK Energy Research Centre.*

Talks: Wilson (2021) *Tyndall Centre for Climate Change Research.*

2.8

SECTION 2. SUMMARY OF FINDINGS.

Consumer innovations for climate change.



A range of new goods and services, many of them digital, offer alternatives to carbon-intensive consumption practices in mobility, food, homes and energy domains.

The current consumer appeal of these low-carbon innovations is strong on 'value-added' features, particularly those with public and symbolic benefits for society and the environment.

But to enter the mainstream, low-carbon innovations also need to compete on the basics including affordability, ease of use, and lifestyle compatibility.

The importance of appealing innovation attributes for adoption is mirrored in rejection. If the experience of certain attributes – particularly relative advantage and compatibility – is underwhelming compared to pre-adoption expectations, then adopters will discontinue use. Diffusion of Innovations works in reverse too!

SILCI

SECTION 3.

Innovation adoption and the role of social influence.

CONTENTS

3.1 Early adopters of low-carbon consumer innovations stand out from the crowd.

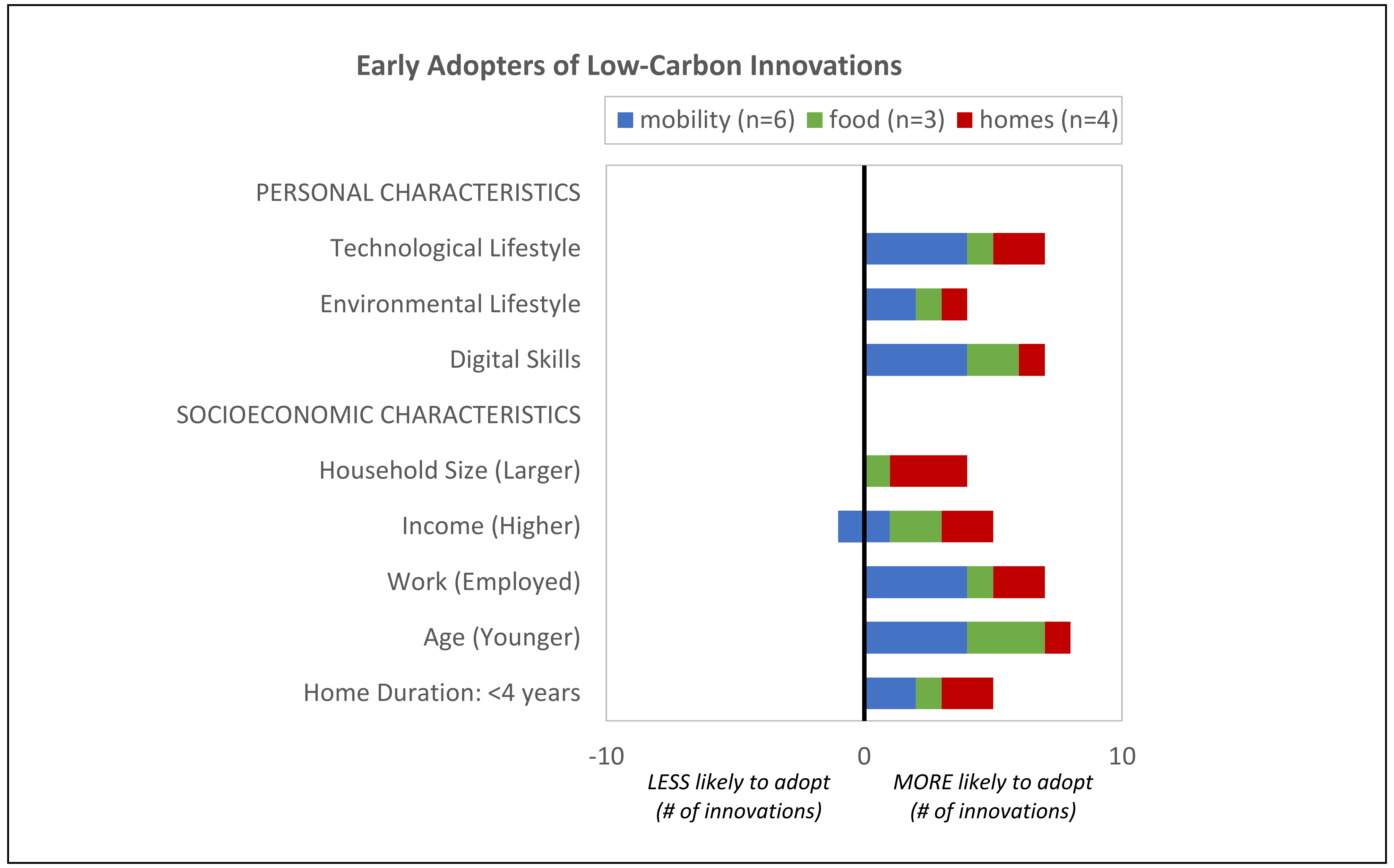


Figure: *Distinctive characteristics of early adopters (compared to non-adopters), across 13 low-carbon consumer innovations.*

Source: *Wilson & Andrews (in progress).*

WHAT WE DID

- We conducted online surveys of nationally-representative samples in the UK (n=3014) and Canada (n=3352) to collect data from both adopters and non-adopters of 16 low-carbon consumer innovations.
- By comparing early adopters with non-adopters, we could isolate which characteristics of early adopters are distinctive, giving our findings strong internal validity (or robustness).
- We built statistical 'logit' models to identify significant predictors of adoption (as opposed to non-adoption).

WHAT WE FOUND

- Generalising across different low-carbon innovations, we found early adopters to be younger, more likely to be in employment, higher income, living in multi-person households, and having more recently moved home.
- We also found early adopters were more likely to have either more technological lifestyles, or more environmental lifestyles, or both. They also had higher digital skills.
- These findings are generalisable across mobility, food, and homes domains (see *Figure*).

LINK TO SILCI OUTPUTS:

Journal Articles: Wilson & Andrews (in progress).

Talks: Wilson (2020) *Oxford Energy Network.* Wilson (2021) *Tyndall Centre for Climate Change Research.*

3.2 Early adopters are themselves heterogeneous, varying in their values, skills, and lifestyles.

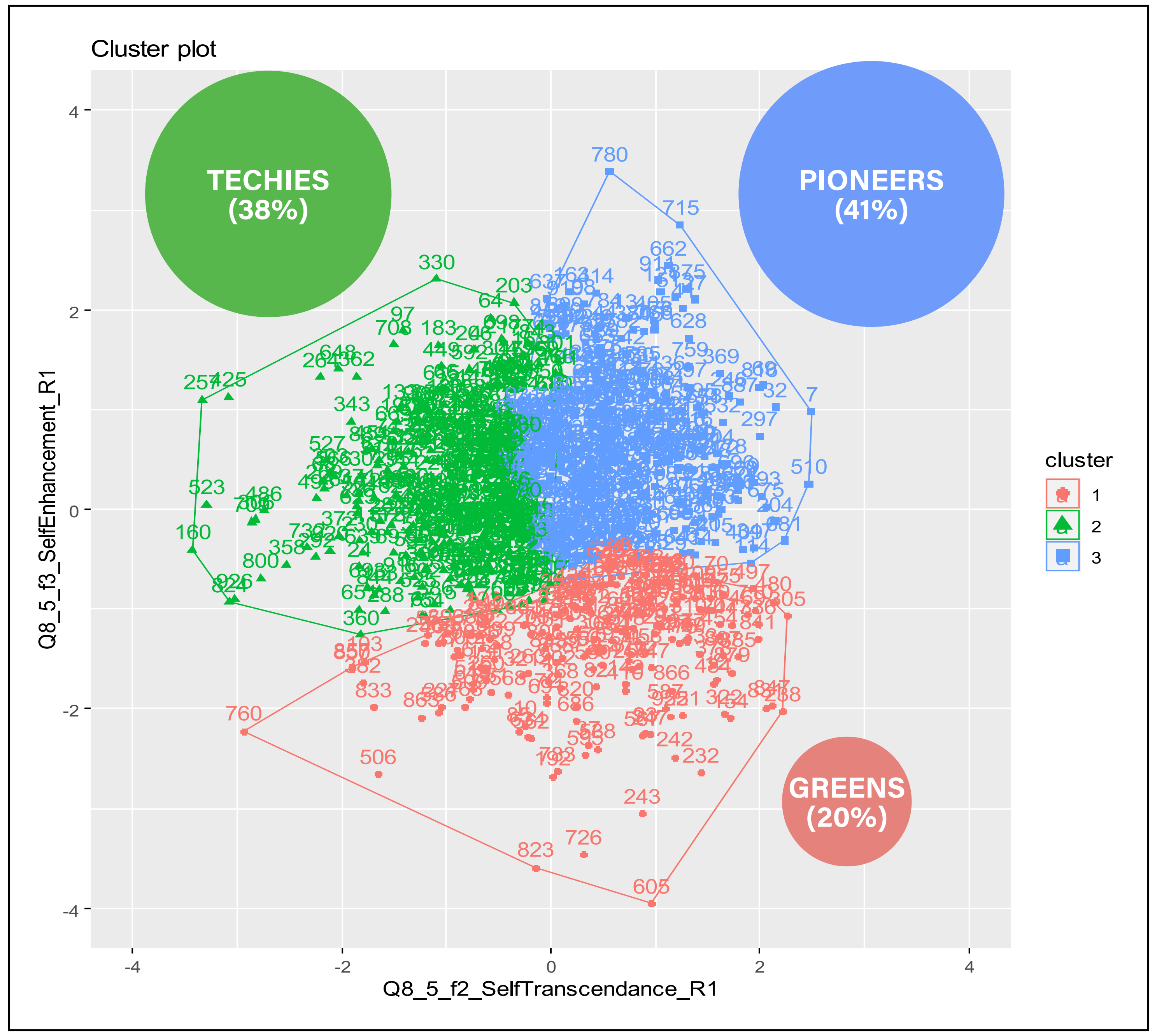


Figure: *We mapped each early adopter onto a 2x2 space defined by self-enhancement values (authority, influence, wealth) and self-transcendence values (social justice, peace, nature). We ran cluster analysis to identify three subgroups with distinctive characteristics.*

Source: *Wilson & Andrews (in progress).*

WHAT WE DID

- We used cluster analysis to identify distinct subgroups among the early adopters of 16 low-carbon consumer innovations.
- We also did a detailed case study of shared mobility innovations using early adopter surveys and focus groups.

WHAT WE FOUND

- Generalising across different low-carbon innovations, we found three distinct clusters of early adopters (see *Figure*):
  - techies (38% of sample) who have egoistic values, more technological lifestyles, and higher digital skills;
  - greens (20%) who have biospheric values and more environmental lifestyles;
  - pioneers (41%) who combine the characteristics of both techies and green, and are opinion leaders to boot!
- This implies a mismatch between the innovations' environmental market positioning, and the more tech-minded early adopters.
- Looking more in depth at lift-sharing and P2P car-sharing, we found other dimensions of variation, particularly trust (in others or in digital platforms) and usage characteristics (frequent or occasional, peer-user or peer-provider).

LINK TO SILCI OUTPUTS:

Journal Articles: Wilson & Andrews (in progress).

Talks: Wilson (2020) *Oxford Energy Network.* Kerr (2020) *NEST Conference.*

3.3

Social influence from adopters to non-adopters explains the spread of low-carbon innovations.

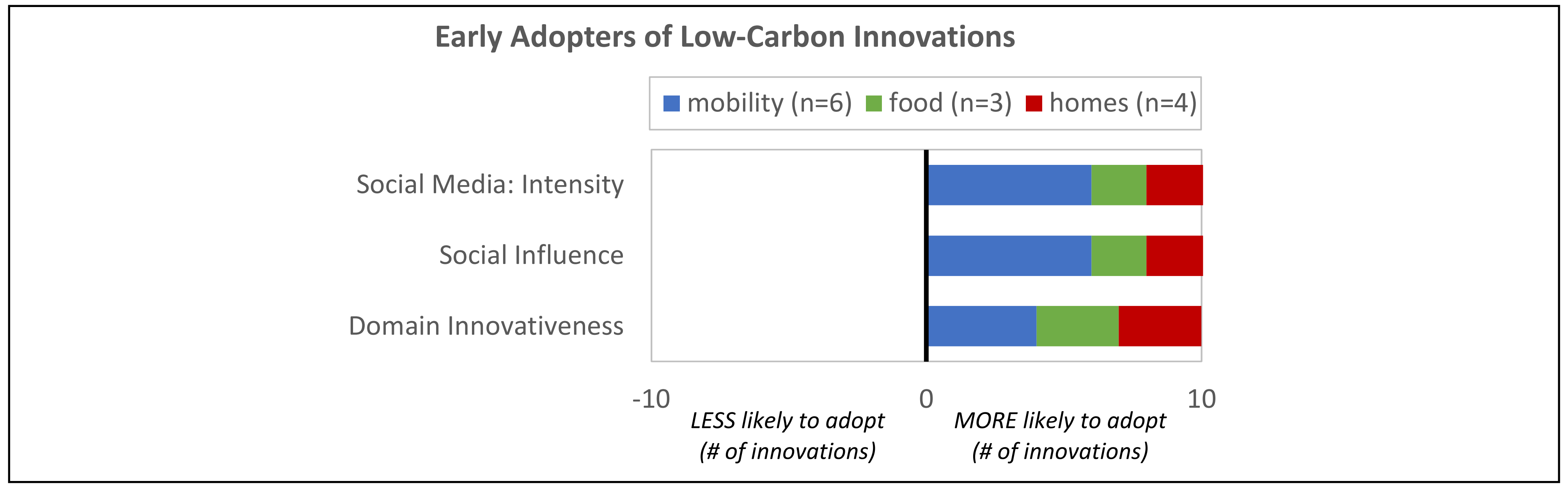


Figure: *Distinctive characteristics of early adopters (compared to non-adopters), across 13 low-carbon consumer innovations.*

Hypothesis: Early adopters of smart home technologies ...	*Test Result*
... actively seek information	*Confirmed*
... have a high degree of opinion leadership for smart home technologies	*Confirmed*
... are active social media users	*Confirmed*
... communicate about smart home tech with a high density of people	*Confirmed*
... communicate about smart home tech with a high density of weak ties	*Rejected*
... communicate about functional aspects of smart home tech	*Confirmed*
Hypothesis: Non-adopters of smart home technologies ...	***Test Result***
... use interpersonal communication as an important source of information	*Confirmed*
... are connected to early adopters for interpersonal sources of information	*Rejected*

Table: *Hypotheses explaining the potential role of social influence on early adoption of smart home technologies, and test results in our smart homes case study.*

Source: *Vrain & Wilson (2021). Environmental Innovation and Societal Transitions.*

WHAT WE DID

- We asked respondents in our large UK and Canada surveys whether they had talked to or been influenced by others about innovations. We also asked if they had spread information as an opinion leader, as this indicates 'domain innovativeness.'
- We also did a detailed case study of smart home innovations (heating, lighting, appliances) in which we tested social influence effects in more depth. We incorporated these into statistical 'logit' models to identify the significant predictors of adoption (as opposed to non-adoption).

WHAT WE FOUND

- Generalising across different low-carbon innovations, we found social influence and domain innovativeness were consistent predictors of adoption (see *Figure*). Using diverse social media platforms was also important as a proxy for digital opinion leadership.
- Looking more in depth at smart home innovations, we confirmed that adopters are not only more active information seekers, but also opinion leaders influencing others (see *Table*).

LINK TO SILCI OUTPUTS:

Journal Articles: Vrain & Wilson (2021) *Environmental Innovations and Societal Transitions.* Wilson & Andrews (in progress).

Talks: Vrain (2020) *Sunbelt Conference.* Vrain (2020) *BECC Conference.*

3.4 Social networks shape who is exchanging information with whom about what.

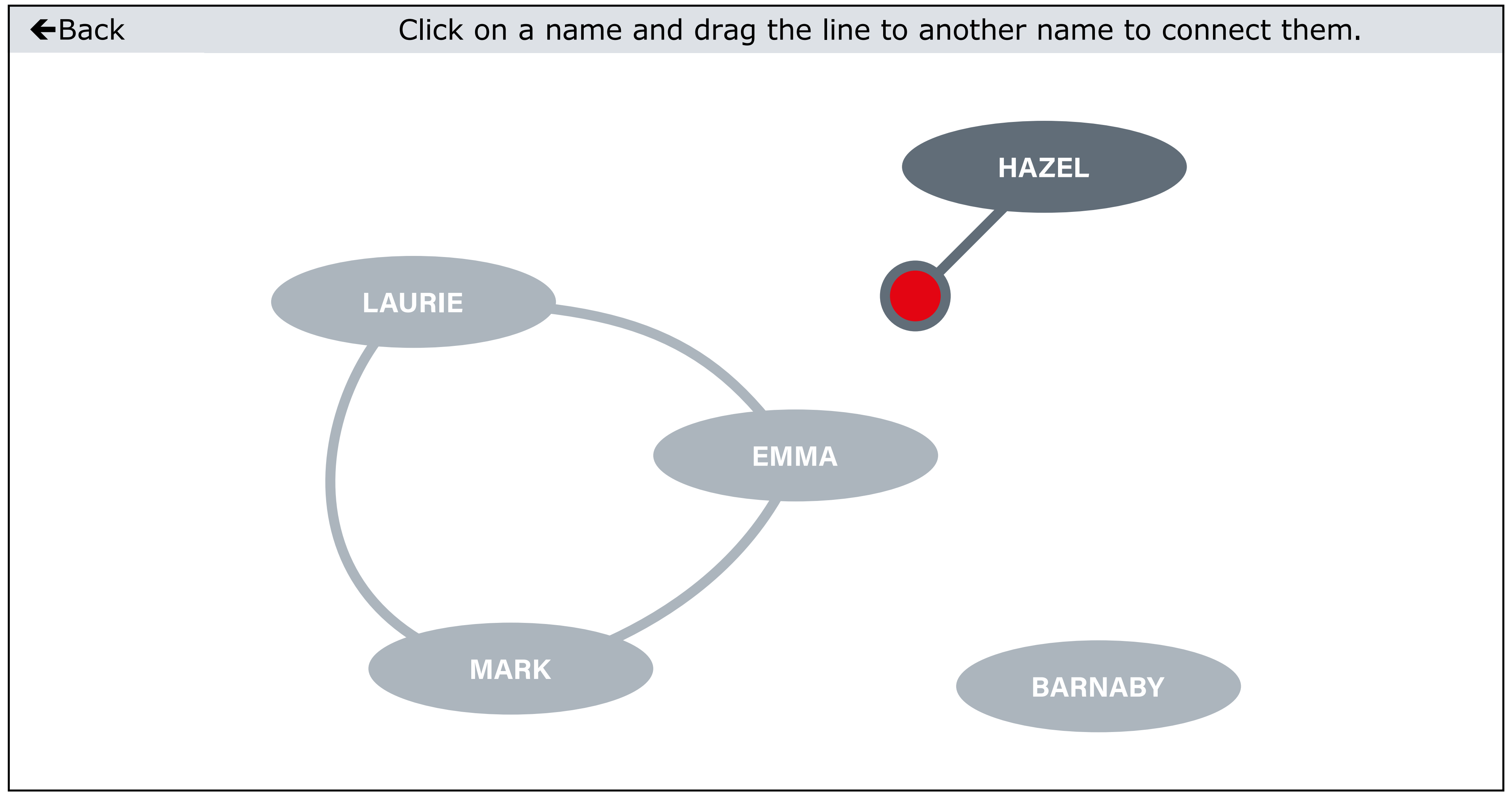


Figure: *A survey tool we used to map how information about smart home technologies flowed through social networks.*

Source: *Vrain & Wilson (2021). Environmental Innovation and Societal Transitions.*

WHAT WE DID

- We asked respondents in our large UK and Canada surveys about how large, how diverse, and how cliquey their social networks were.
- In our detailed case study of smart home technologies, we also mapped respondents' networks specifically with respect to information exchange about the innovations (see *Figure*).

WHAT WE FOUND

- Generalising across different low-carbon innovations, we didn't find evidence that people's social networks in general influenced adoption. This is not surprising as low-carbon innovations are not the only topic of conversation among friends!
- Looking more in depth at social networks specific to smart home technologies, we found evidence that social network structure is slowing down diffusion.
- Non-adopters shape their opinions of smart home technologies by talking to and learning from others. But non-adopters knew relatively few early adopters, reducing their exposure to first-hand experience and knowledge. This creates an interpersonal communication 'chasm.'

LINK TO SILCI OUTPUTS:

Journal Articles: Vrain & Wilson (2021) *Environmental Innovations and Societal Transitions.*

Talks: Vrain (2019) *European Conference on Social Networks.* Vrain (2020) *Sunbelt Conference.*

3.5 Electronic word-of-mouth is an important type of social influence, particularly for digital innovations.

	n=1144	
Variables	**p-value**	**Exp(B)**
Word-of-mouth	.001*	1.542
Electronic word-of-mouth	.001*	3.307
Social norms	.001*	1.605
Neighbourhood effect	.764	.965
Pseudo R^2	0.52	
Correctly classifies % of cases	79.5%	
* p<.01		

Table: *Binary logistic regression ('logit') model testing the effect of four types of social influence on propensity to adopt 16 low-carbon consumer innovations. Three of four types are significant predictors (at 99% significance level), with electronic word-of-mouth consistently having the strongest effect. Exp(B) shows variable coefficients as odds ratios.*

Source: *Vrain et al. (under review) Energy Policy.*

WHAT WE DID

- In our large UK survey, we asked respondents about 4 types of social influence: word-of-mouth, electronic word-of-mouth (social media, blogs, review sites), neighbourhood effects, and social norms.
- We also did a detailed case study of online food hubs to examine specific local conditions under which social influence occurred.

WHAT WE FOUND

- Generalising across different low-carbon innovations, we found electronic word-of-mouth was consistently the strongest type of social influence on non-adopters (see *Table*). Social norms and neighbourhood effects were also important for visible innovations such as electric vehicles or rooftop solar.
- Looking more in depth at online food hubs as a place-specific innovation, we found non-adopters' initial exposure was most commonly through electronic word-of-mouth. Community networks were also important for word-of-mouth effects, particularly in rural areas where innovation activity is more visible.
- This creates a risk of adoption 'echo chambers' if social networks are cliquey. As one interviewee put it: *"a lot of people in our circle already use the local food hub so we're preaching to the converted".*

LINK TO SILCI OUTPUTS:

Journal Articles: Vrain et al. (under review) *Energy Policy.*

Conference Papers and Posters: Vrain (2021) *BEHAVE Conference.* Wilson, M. (2021) *Climate Exp0.*

3.6 Geography and proximity can strengthen social influence effects if innovation adoption is visible.

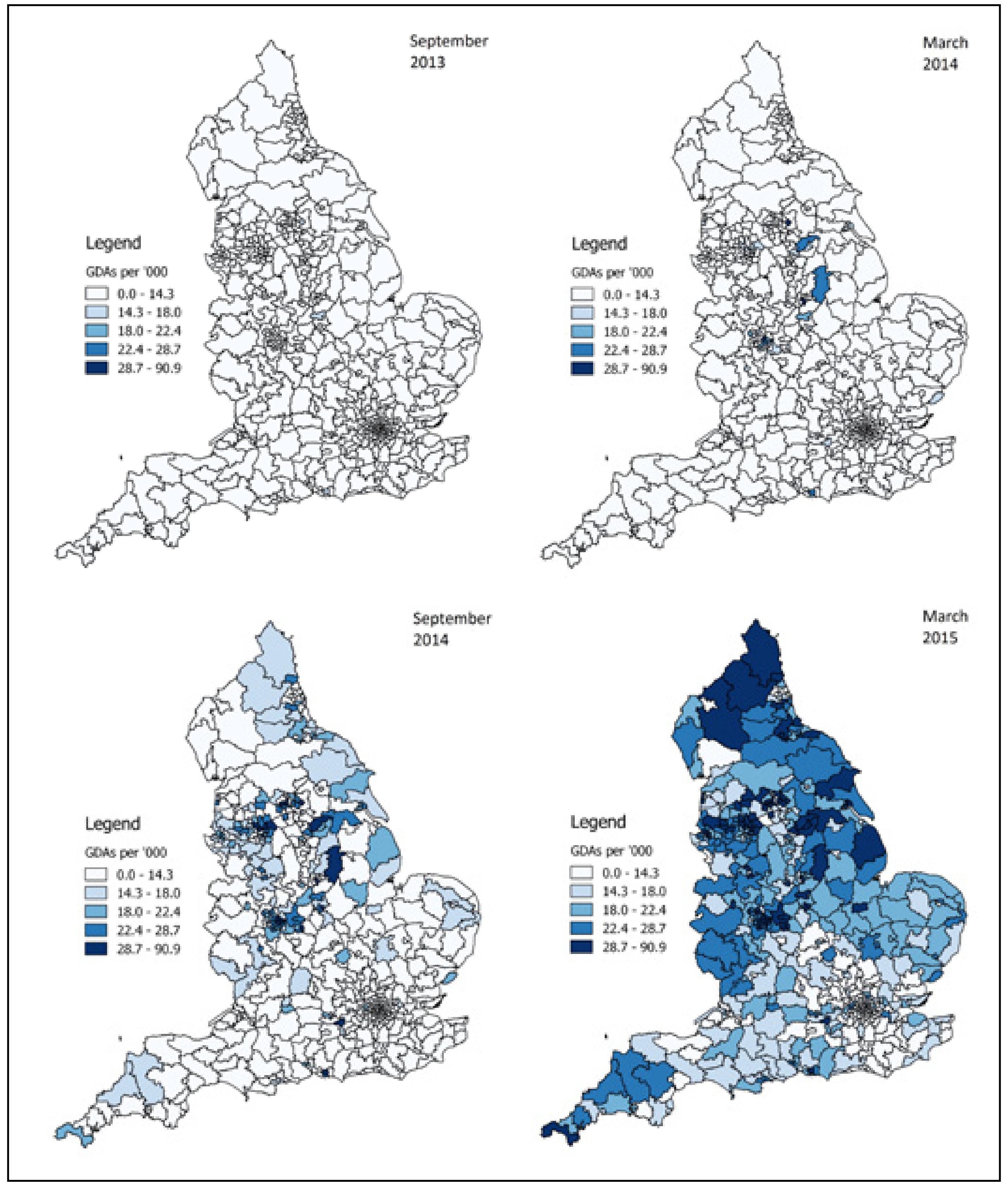


Figure: *The spatial diffusion of 'Green Deal Assessments' or home energy-efficiency assessments in the UK from March 2014 – June 2015.*

Source: *Morton et al. (2018) Energy Policy.*

WHAT WE DID

- In a study led by Craig Morton at Loughborough University we analysed the diffusion of home energy-efficiency assessments over both time and space (see *Figure*). We tested for spatial clustering as an indicator of neighbourhood effects (a type of social influence).
- We used a similar approach in a separate study to test for spatial clustering of local energy projects involving both consumer innovations as well as energy network investments.

WHAT WE FOUND

- A range of local conditions relating to energy, socioeconomics, infrastructure, and institutions, explain the spatial variation in how energy innovations diffuse.
- Accounting for these local conditions, we also found home energy-efficiency innovations were spatially clustered: seeing others adopt innovations locally helps reduce perceived risks among would-be adopters, and so stimulates more adoption in nearby areas.
- In contrast, we didn't find evidence of spatial clustering for more complex local energy projects. These are less visible or 'salient' for consumers as they mainly affect energy infrastructure, so neighbourhood effects as a type of social influence are weaker.

LINK TO SILCI OUTPUTS:

Journal Articles: Morton et al. (2018) *Energy Policy.* Arvanitopoulos et al. (in review).

Conference Papers: Morton et al. (2017) *ECEEE.*

SILCI

Adopter characteristics, innovation attributes, and social influence all help predict adoption.

Independent Variables	car clubs T1	P2P carsharing T2	liftsharing T3	shared ride-hailing T4	electric vehicles T6	e-bikes T7	online food hubs F1	meal kits F2	11th hour food apps F3	smart homes H1	smart lighting H2	smart appliances H3
SOCIODEMOGRAPHICS CHARACTERISTICS												
Household Income (Low)	-	-	-	2.09	-	-	0.08	0.41	-	-	-	-
OTHER ADOPTER CHARACTERISTICS												
Digital Skills: Apps (4 items)	13.98	-	-	3.93	-	-	-	39.48	-	-	-	-
Technological Lifestyle Activities (5 items)	-	-	1.76	-	-	-	-	-	-	-	2.45	2.86
INNOVATION ATTRIBUTES												
Relative Advantage	-	-	2.12	1.52	-	-	-	-	-	2.61	-	3.01
Compatibility	-	5.57	1.87	-	-	2.74	-	-	-	-	4.55	-
INFORMATION FLOWS												
Domain Innovativeness (3 items)	2.79	21.49	-	-	-	4.17	3.71	-	5.38	2.36	4.45	2.50
Social Influence (8 items)	2.34	-	-	1.50	10.63	-	-	-	-	-	-	-
SOCIAL NETWORK STRUCTURE												
Social Media Intensity (# types * hrs online)	-	-	-	-	1.10	-	-	-	-	1.14	-	1.34
CONTEXTUAL FACTORS												
[+ travel, food, homes control variables]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]	[-]
MODEL FIT												
Total n (n adpoters)	176 (74)	114 (24)	164(81)	176 (84)	166 (53)	100 (45)	99 (11)	159 (74)	165 (68)	136 (73)	186 (88)	115 (54)
pseudo R^2	**0.56**	**0.66**	**0.34**	**0.17**	**0.50**	**0.49**	**0.31**	**0.41**	**0.35**	**0.41**	**0.62**	**0.50**

Table: *Logit models predicting innovation adoption, showing only variables significant for two or more innovations. Numbers show odds ratios, with >1 meaning adoption is more likely, and <1 meaning adoption is less likely. Colour shading also distinguishes positive effects **(green)** from negative effects (orange). Pseudo R^2 shows goodness of fit, with R^2>0.3 considered good.*

Source: *Wilson & Andrews (in progress).*

WHAT WE DID

- We used our large UK and Canada surveys to build statistical models predicting innovation adoption, drawing on all the different variables we measured.

WHAT WE FOUND

- Generalising across different low-carbon innovations, we found social influence effects and the position of adopters as influencers in social networks to be the most consistent predictors of innovation adoption. This is consistent with the 'Diffusion of Innovations' framework.
- Adopters also favour innovations whose attributes offer advantages over current practices and are compatible with current lifestyles and beliefs.
- Digital skills and use of different social media platforms as part of technologically-minded lifestyles also help explain adoption.

LINK TO SILCI OUTPUTS:

Journal Articles: Wilson & Andrews (in progress)

Talks: Wilson (2020) *Sunbelt Conference.*

3.8 Covid-19 restrictions have shrunk our social networks and impacted low-carbon mobility innovations.

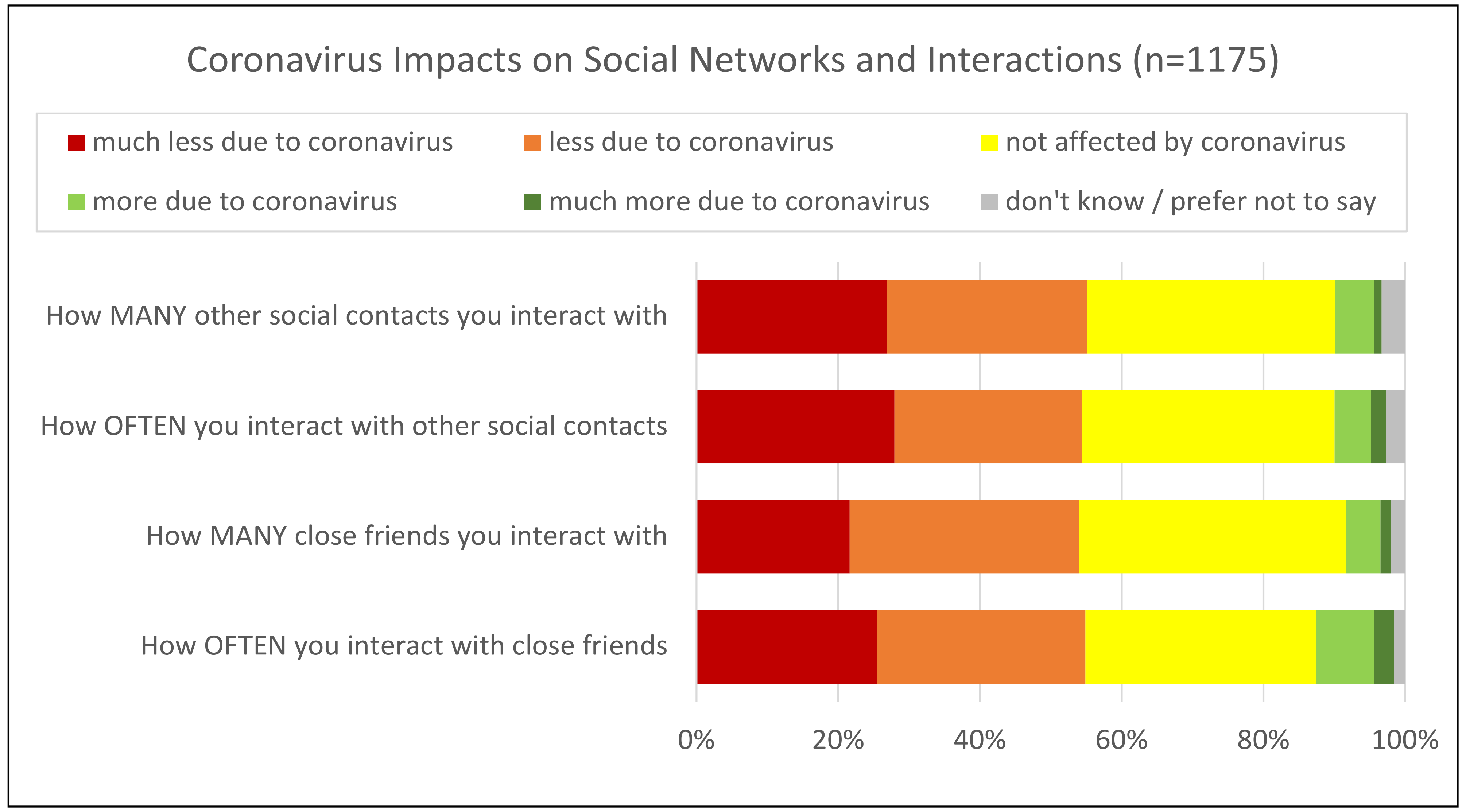


Figure: *Impact of coronavirus on social interactions with close friends and other social contacts, using data from Wave 2 of UK survey (n=1175).*

Source: *Vrain (2021) UK Energy Research Centre.*

LINK TO SILCI OUTPUTS:

Journal Articles: Vrain et al. (in progress).

Reports: Wilson, M (2021) *Open Food Network.*

Talks: Kerr (2021) *International Workshop on Sharing Economy.* Wilson (2021) *Tyndall Centre for Climate Change Research.*

Blogs: Vrain (2021) *UK Energy Research Centre.*

WHAT WE DID

- We recontacted our UK survey respondents during the pandemic (Wave 2, late 2020) and compared their responses to what they told us pre-pandemic (Wave 1, late 2019).
- We also monitored adoption behaviour in our case studies on online food hubs and on shared mobility innovations.

WHAT WE FOUND

- Use of most low-carbon mobility innovations among existing adopters fell sharply, with the exception of e-bikes and peer-to-peer car-sharing (seen as safer than public transport). In contrast, use of some food innovations (like online food hubs) rose slightly.
- Non-adopters' intentions to adopt innovations in the next 12 months follow a similar pattern: shared transport modes were badly hit.
- The pandemic also impacted interpersonal communication as a mechanism of social influence. Over 50% of respondents said they had been interacting with fewer people and less frequently. This shrinking of social networks applies equally to close friends and family as it does to more distant social contacts.
- This decline in interpersonal communication was partially offset by an increase in time spent on social media. In the specific case of online food hubs, early adopters helped spread information through electronic word-of-mouth about the benefits of online food provisioning during lockdown.

3.9 The spatial diffusion of low-carbon innovations has important implications for physical infrastructure.

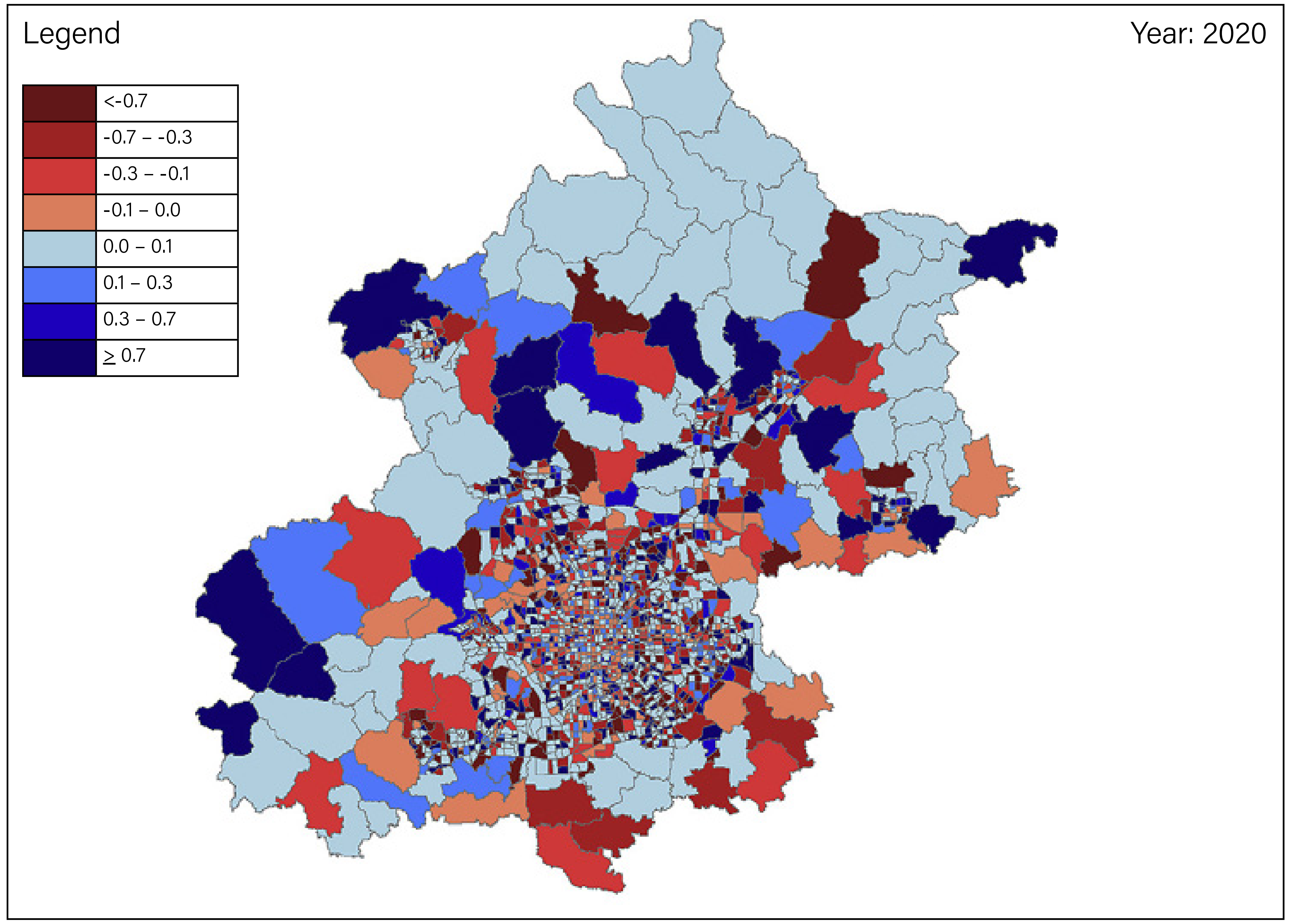


Figure: *Additional demands placed on local electricity networks from electric vehicle (EV) charging during evening peak hours based on residential location of EV adopters in Beijing.*

Source: *Zhuge et al (2020) Journal of Clean Production.*

WHAT WE DID

- SILCI team member, Chengxiang Zhuge, used an urban-scale agent-based simulation model to explore the effect of social influence on the spatial diffusion of low-carbon innovations.
- Agent-based models explicitly represent how different types of people move around, interact, and influence each other within a spatially-explicit environment – like a city.
- Calibrating the model to spatial and behavioural data collected in Beijing, China, allowed Chengxiang and his colleagues to run robust simulations of innovation diffusion under real-world conditions.

WHAT WE FOUND

- Innovation adoption has implications for physical infrastructure in specific places. In Beijing, for example, financial incentives for electric vehicles are appealing to adopters whose residential locations create local needs for on-street charging infrastructure (see *Figure*).
- Also in Beijing, water and energy use in different neighbourhoods is concentrated at certain periods during the day. Travel activity for work, leisure or retail helps reveal these characteristic spatial patterns. This enables smart planning of urban infrastructure supplying transport, energy, and water, to ensure needs are met in different locations.

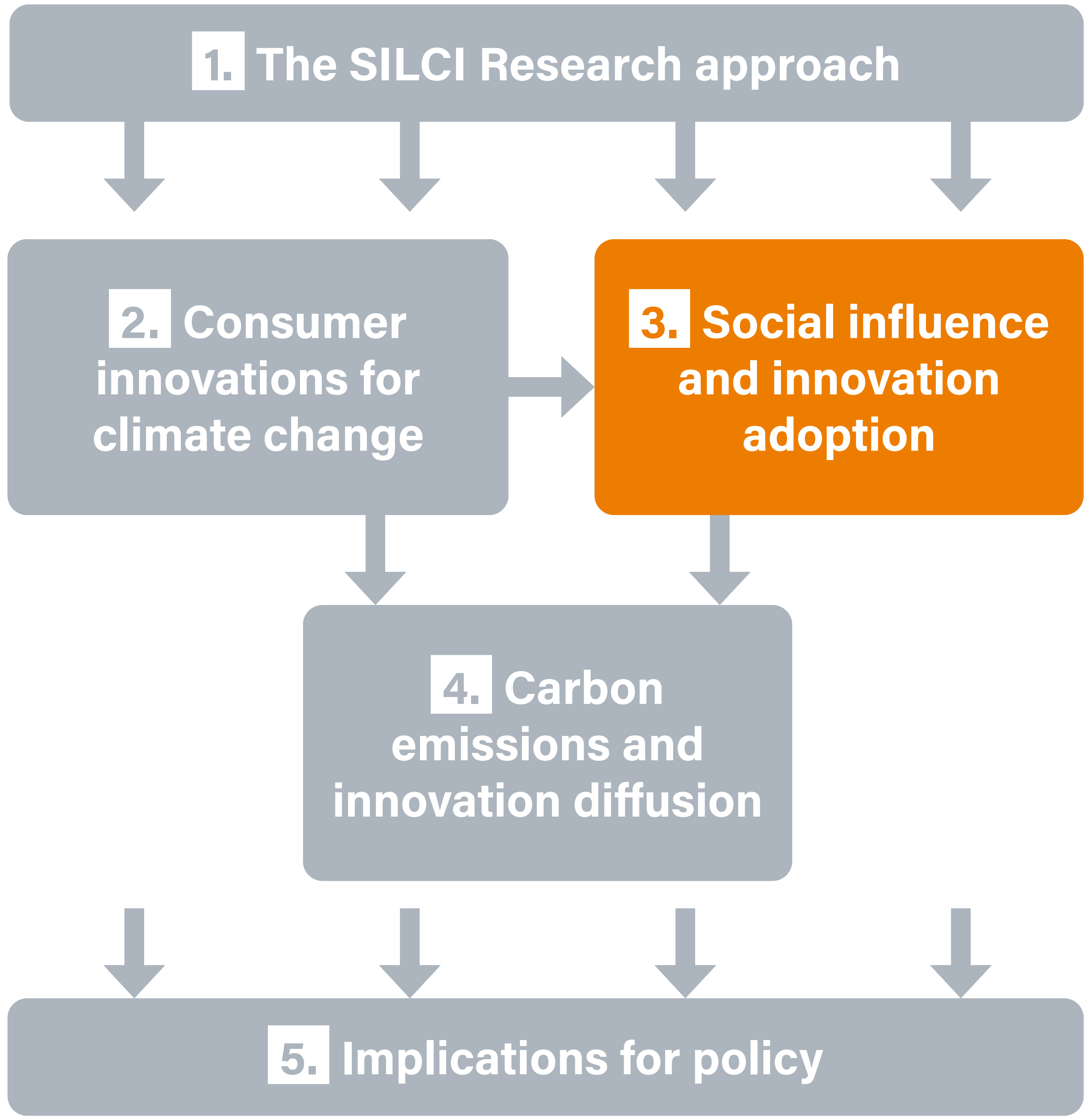
LINK TO SILCI OUTPUTS:

Journal Articles: Zhuge et al. (2020) *Science of the Total Environment.* Zhuge et al. (2020) *Journal of Cleaner Production.* Zhuge et al. (2020) *Energy Policy.* Zhuge et al. (2021) *Transportation.*

3.10

SECTION 3. SUMMARY OF FINDINGS.

Innovation adoption and the role of social influence.



For low-carbon consumer innovations, early adopters are highly distinctive with both environmental and/or technological values, skills, and lifestyles.

We found strong support for Diffusion of Innovations with its emphasis on social influence mechanisms for spreading information to reduce perceived risks and uncertainties. Digital communication through electronic word-of-mouth has the strongest effect on the propensity of non-adopters to adopt.

Social influence and the role played by early adopters in social networks are consistent predictors of innovation adoption. But adoption 'echo chambers' restrict innovation flows if early adopters exchange information only with other like-minded early adopters.

Covid-19 related restrictions have shrunk our social networks. Resulting reductions in social influence will slow down adoption rates. Increased social media use during the pandemic has only partially offset this effect.

SECTION 4.

Impact of innovation diffusion on carbon emissions.

CONTENTS

4.1 There is good evidence that consumer innovations can help reduce carbon emissions.

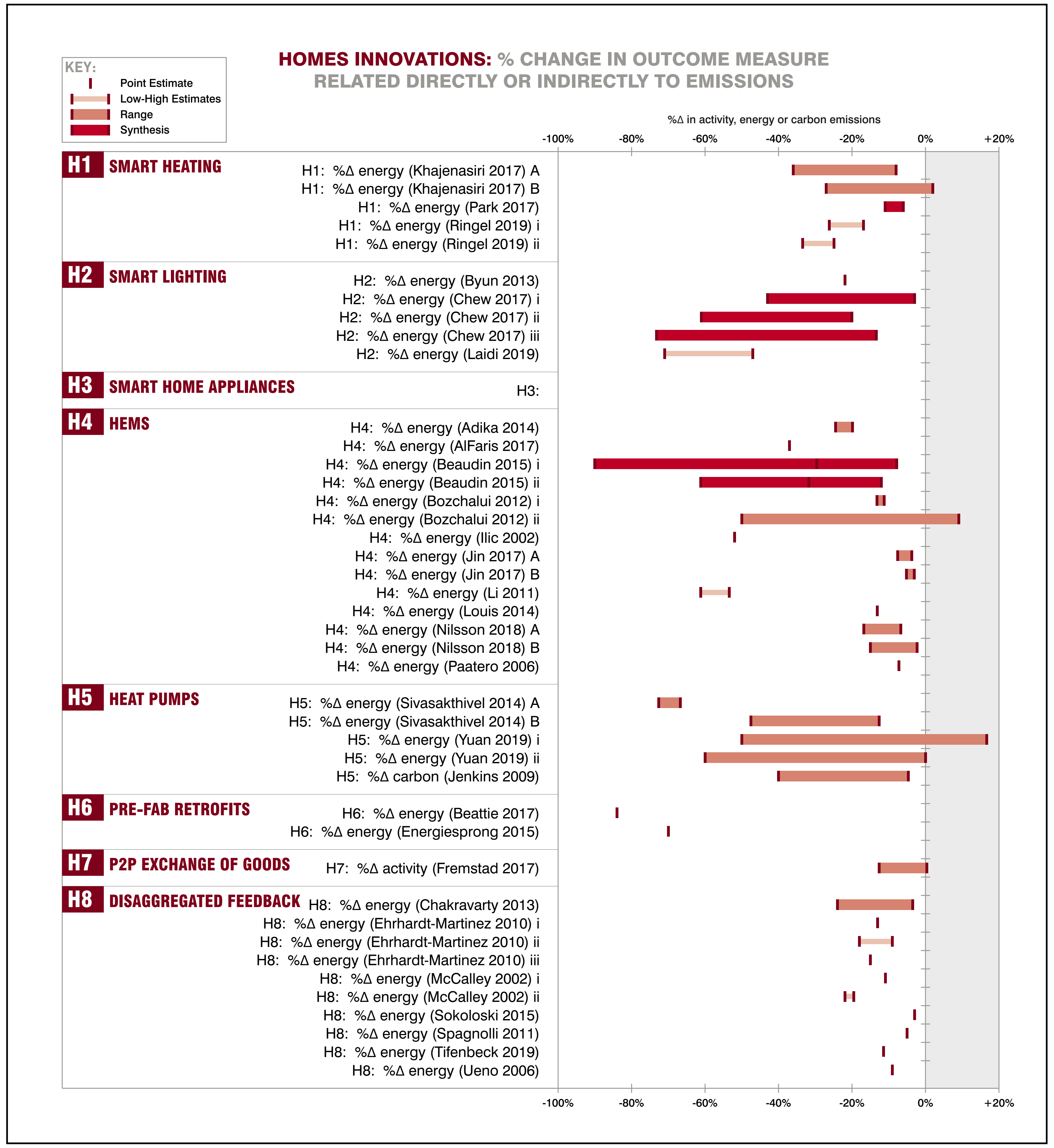


***Figure:** % changes in activity, energy or carbon emissions from the adoption and use of 8 consumer innovations in the home, based on published studies. HEMS = home energy management systems.*

***Source:** Wilson et al. (2020). Annual Review of Environment and Resources.*

WHAT WE DID

- We collected data from 187 studies assessing the emissions impact of 26 low-carbon consumer innovations.
- We extracted robust quantitative estimates from 94 of these studies. We standardised these data as % changes in activity, energy or carbon emissions relative to a without-innovation baseline.

WHAT WE FOUND

- Despite wide variation across studies of very different designs, we found consistent evidence of potential emission reduction benefits across mobility, food and homes innovations (see *Figure* for homes as an example).
- However, emission reductions are not a given. A small number of studies reported substitution or rebound effects through which innovation use leads to increased emissions.

LINK TO SILCI OUTPUTS:

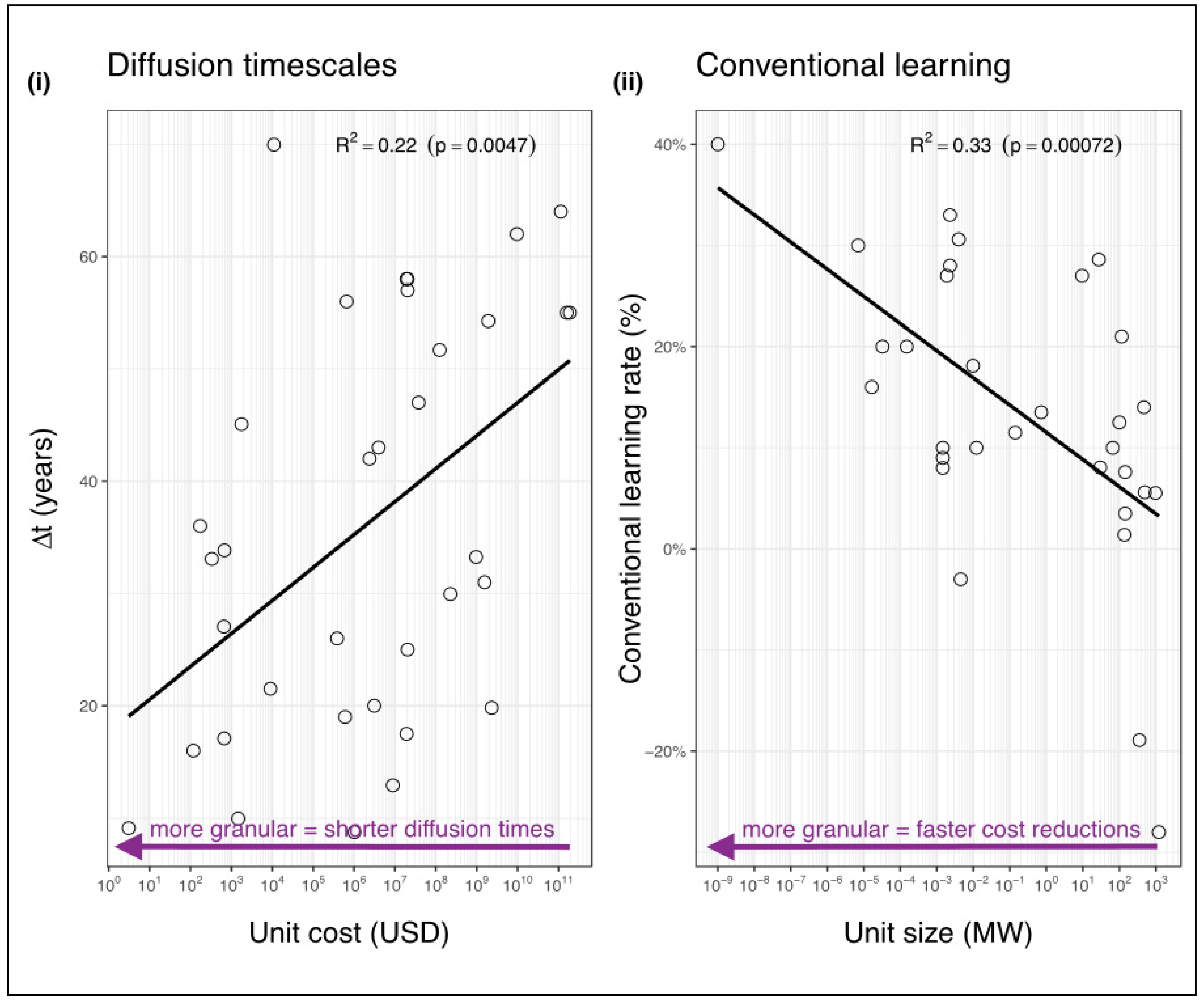
Journal Articles: Wilson et al. (2019) *Energy Efficiency.* Wilson et al. (2020) *Annual Review of Environment and Resources.*

Talks: Wilson (2020) *Mission Innovation.* Wilson (2020) *Central European University.*

4.2 Consumer innovations have many advantages for decarbonisation like speed, jobs, and accessibility.

Figure: *Both panels show how the size of energy-related innovations (x-axis) has historically been related to how rapidly they have diffused (y-axis, left panel) and how rapidly they have improved in cost and performance (y-axis, right panel). Δt (years) is the diffusion time, with shorter Δt showing more rapid diffusion. Learning rate (%) is the cost reduction per doubling of experience. Smaller-scale more 'granular' innovations have diffused over more compressed timescales (left panel) in part due to faster performance improvement trajectories (right panel).*

Source: *Wilson et al. (2020) Science.*



WHAT WE DID

- Collaborating with researchers at the International Institute for Applied Systems Analysis (IIASA) in Austria, we collected historical data on 83 energy technologies over a range of performance criteria.
- We compared smaller-scale 'granular' technologies – including many consumer innovations – against larger-scale 'lumpy' technologies and infrastructures that tend to dominate thinking on climate solutions.

WHAT WE FOUND

- More granular technologies are associated with faster diffusion and more rapid cost improvements (see *Figure*).
- More granular technologies also provide more equitable access to benefits, create more jobs, and yield higher social returns on innovation investments.
- Applying these historical insights to future decarbonisation, we found that the types of consumer innovations analysed in the SILCI project have many advantages.

LINK TO SILCI OUTPUTS:

Journal Articles: Wilson et al. (2020) *Science.*

Talks: Wilson (2018) *David Suzuki Foundation.* Wilson (2020) *International Forum on Long-Term Energy Scenarios.*

4.3 Innovative ways of providing useful services play a critical role in limiting global warming to 1.5°C.

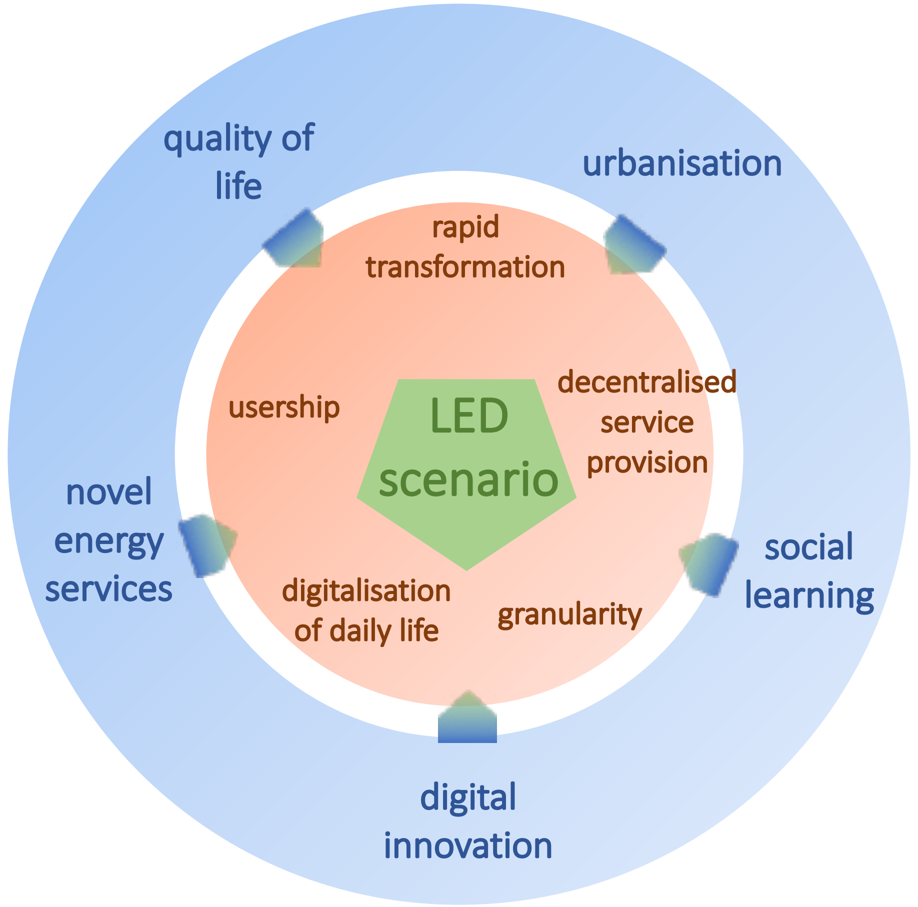


Figure: The main elements of the global low energy demand (LED) scenario narrative. Outer ring shows global 'mega-trends.' Inner ring shows more specific drivers of change for the supply and use of energy.

Source: *Grubler et al. (2018) Nature Energy*

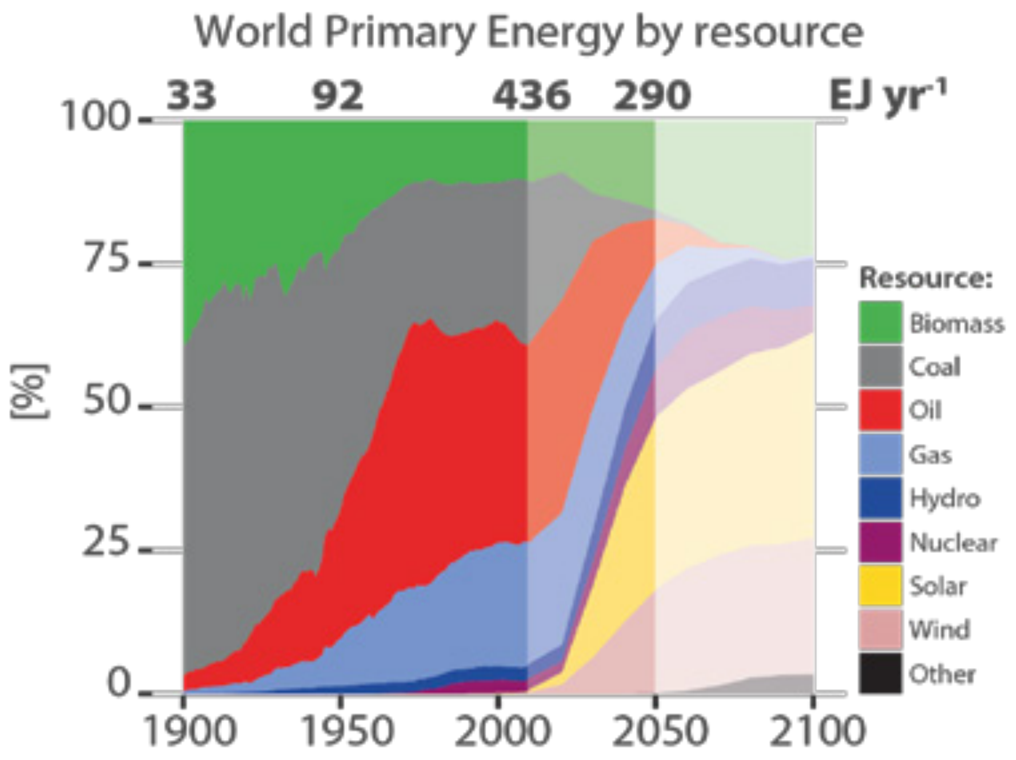


Figure: *A 40% reduction in energy demand from 2020 to 2050 in the global LED scenario enables rapid phase out of fossil fuels and renewable transformation of the energy supply.*

Source: *Grubler et al. (2018) Nature Energy*

WHAT WE DID

- We participated in a major scenario modelling study led by Arnulf Grubler and colleagues at IIASA. We helped map out a low energy demand (LED) pathway to deliver on the Paris Climate Agreement's ambition: no more than 1.5°C warming.

WHAT WE FOUND

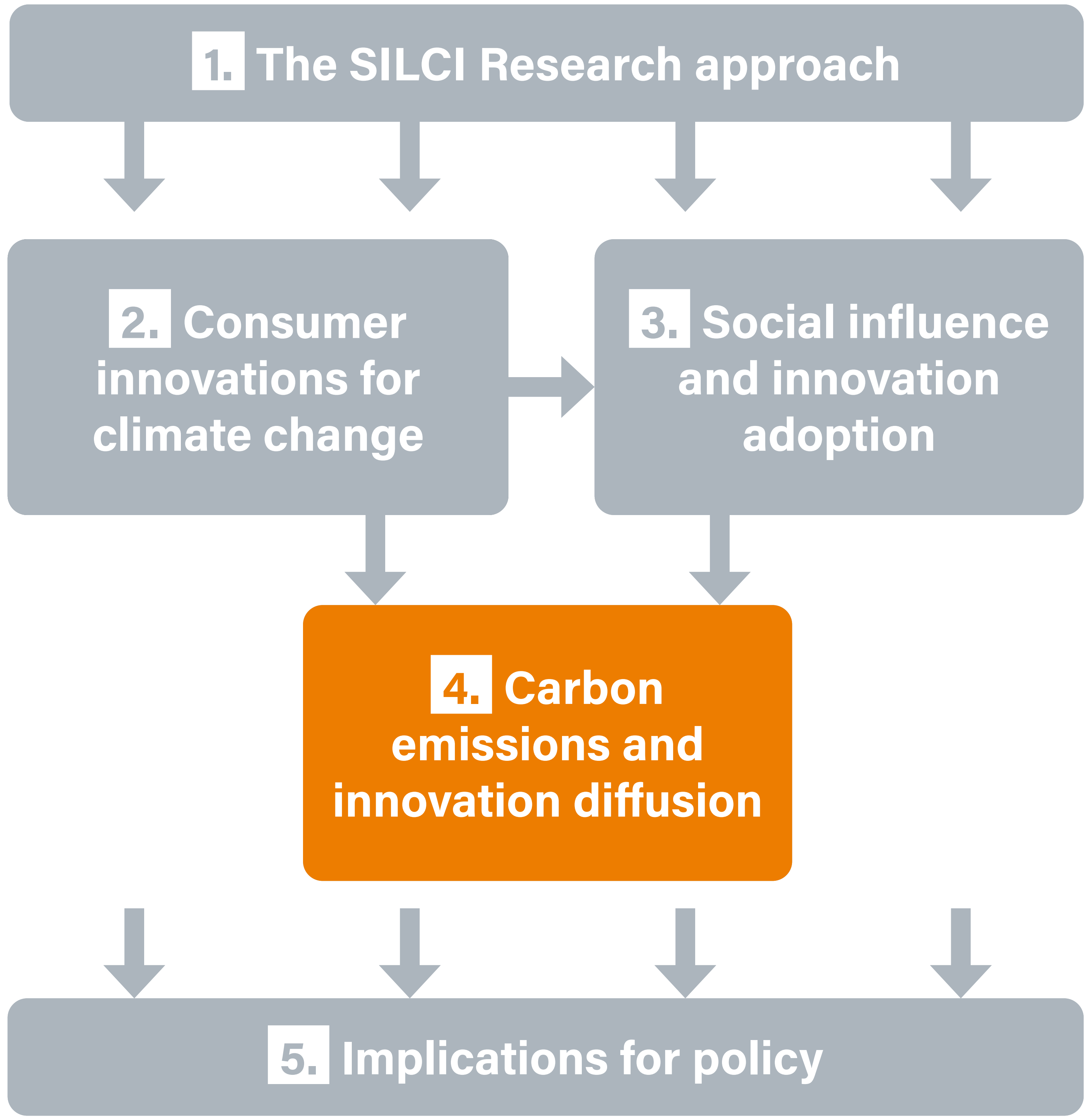
- Digitalisation, new forms of consumption, innovative service provision, and a shift from owning stuff to using services, are all major elements of a future LED world (see upper *Figure*).
- Low-carbon consumer innovations that help change the way we consume energy and resources in turn enable rapid decarbonisation of the energy supply (see lower *Figure*).
- Examples include shared mobility to increase vehicle occupancy, smart charging of electric vehicles to help manage renewable power grids, smart home technologies to provide demand flexibility, and local food systems to reduce supply chain emissions.
- These are all innovations we've studied in depth in the SILCI project!

LINK TO SILCI OUTPUTS:

Journal Articles: Grubler et al. (2018) *Nature Energy.*

Talks: Wilson (2017) *Climate Lab.* Wilson (2018) *International Energy Agency.* Wilson (2019) *Energy Transitions Conference.*

Impact of innovation diffusion on carbon emissions.



Low-carbon consumer innovations offer alternative forms of mobility, food provisioning, and home energy management. By reducing energy needed for daily activities, these innovations are an essential part of efforts to tackle climate change.

Consumer innovations can result in energy use going up as well as down. Using innovations profligately or more intensely is a risk that needs careful monitoring and management.

Smaller-scale innovations that change how energy and resources are used by consumers also have numerous benefits: they spread faster, they are lower risk, they improve quicker, they're more fairly distributed, they create more jobs.

Scenario modelling shows the clear promise of a global future in which low-carbon consumer innovations, particularly digital ones, are effectively harnessed for helping to limit global warming. Reducing global energy demand by 40% over the next three decades keeps the 1.5°C target in sight, and has numerous benefits for UN Sustainable Development Goals.

SILCI

SECTION 5.

Insights for policy on accelerating diffusion.

CONTENTS

5.1 Countries with declining carbon emissions also have declining energy demand... with help from policy.

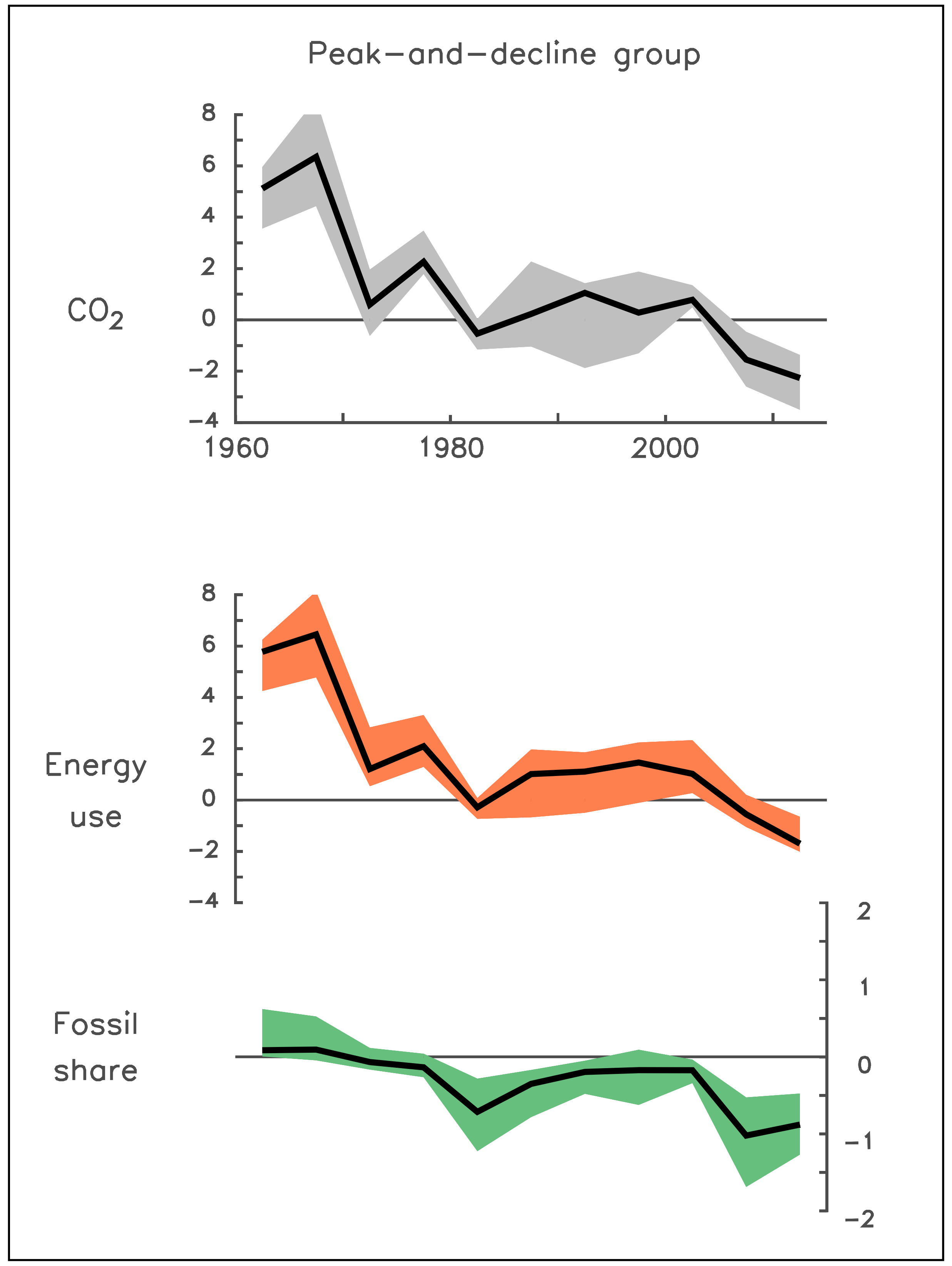


Figure: *Annual % changes in CO_2 (top), energy use (middle), and fossil fuel share of the energy mix (bottom) in 18 countries that have peaked-and-declined their CO_2 emissions over the period 2005-2015.*

Source: *Le Quéré et al. (2019 Nature Climate Change.*

WHAT WE DID

- We collaborated in a study of the 18 developed economies that had successfully peaked and declined their carbon emissions. The study was led by Corinne Le Quéré and colleagues at the Global Carbon Project.

WHAT WE FOUND

- Declining carbon emissions are mainly due to renewable energy displacing fossil fuels (accountable for 47% of the decline), and to decreases in energy use in transport, buildings, and industry (36%) (see *Figure*). In countries where emissions are still rising, increases in energy use accounts for over 75% of the increase in carbon emissions. How we use energy is important!
- The 18 'peak-and-decline' countries had more climate policies tackling both energy supply and energy demand. More energy efficiency policies are associated with larger decreases in energy use.
- In separate work led by David McCollum at IIASA, we found that scenario modelling of climate mitigation pathways fails to fully explore the transformative potential of demand-side action. Our global low energy demand (LED) scenario, covered earlier in this report, is the exception that proves the rule!

LINK TO SILCI OUTPUTS:

Journal Articles: Le Quéré et al. (2019) *Nature Climate Change.* McCollum et al. (2020) *Nature Energy.*

Talks: Wilson (2019) *Energy Transitions Conference.*

5.2 Many demand-side policies have proved effective at reducing energy demand and carbon emissions.

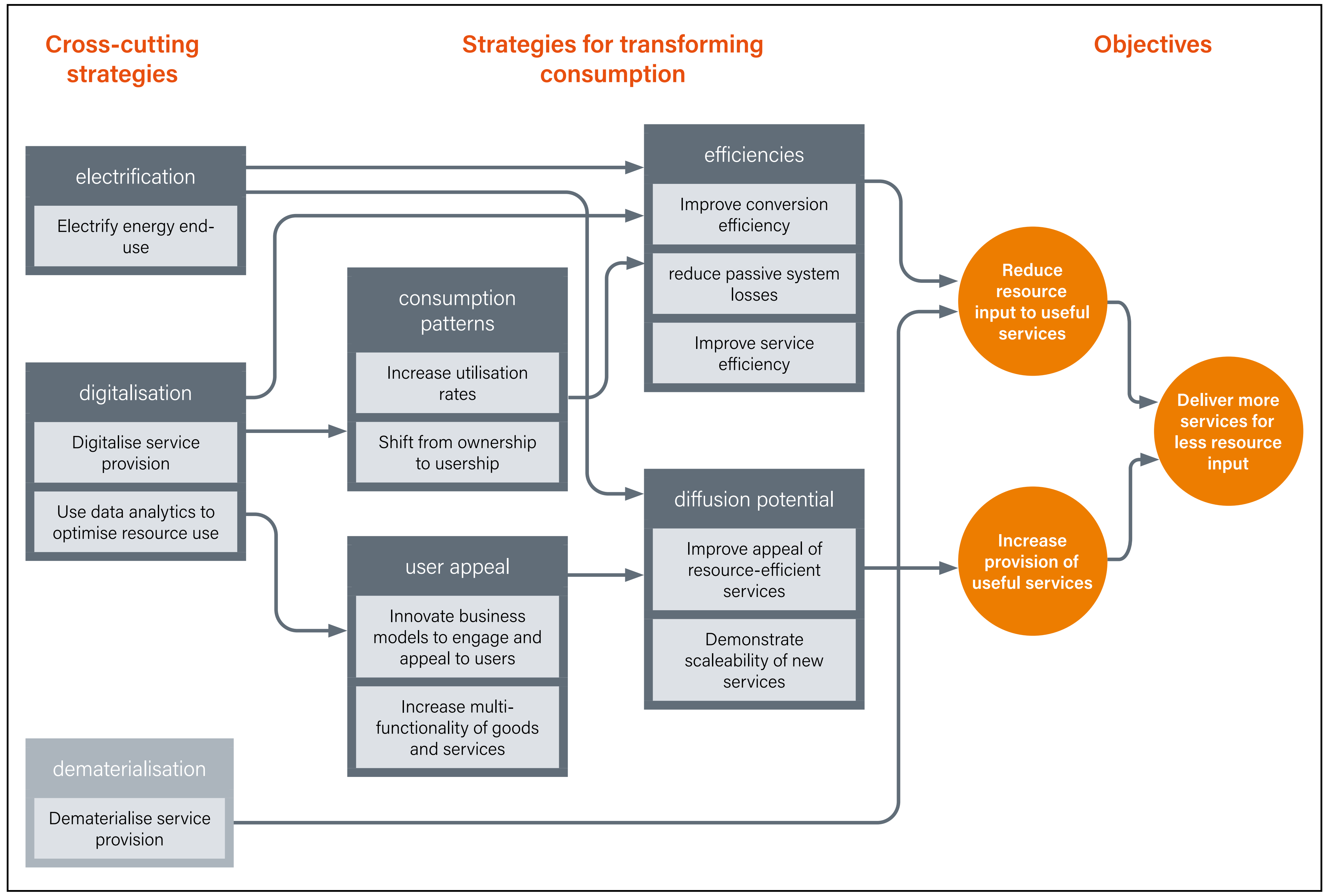


Figure: *Influence diagram showing how six strategies can transform energy demand by reducing the resources required to provide energy services.*

Source: *Wilson (2019) Mission Innovation Net Zero Compatibility Initiative.*

WHAT WE DID

- We collaborated with Luis Mundaca and Diana Ürge-Vorsatz to edit a journal Special Issue on demand-side approaches for tackling climate change. We identified numerous effective policies for transforming energy services and energy demand.
- In separate work, we scoured the evidence to find policies consistent with our global low energy demand (LED) scenario.

WHAT WE FOUND

- Demand-side policies are many and varied. They include sectoral emission targets, building codes, energy performance standards, behavioural interventions, carbon pricing. Mixes or portfolios of demand-side policies tend to work the best.
- More specific policies for transforming energy demand can be grouped within six major strategies (see *Figure*): electrification, functional convergence (single devices with multiple uses), accessing services rather than owning goods, higher utilisation rates, efficient energy conversion, and user-oriented innovation.
- The low-carbon consumer innovations studied in the SILCI project tick many of these boxes!

LINK TO SILCI OUTPUTS:

Journal Articles: Mundaca et al. (2019) *Energy Efficiency.*

Conference Papers: Wilson et al. (2019) *ECEEE.*

Reports: Wilson (2019) *Mission Innovation Net Zero Compatibility Initiative.*

5.3 Regulatory frameworks need to open up space for disruption by low-carbon consumer innovations.

test and learn	demonstrate and trial innovations in protected market niches to enable policy learning while limiting disruptive impacts
leave no-one behind	engage with 'losers' of disruptive processes to reduce resistance to change and ensure more equitable distribution of transitional benefits and costs
nurture diversity	ensure diversity of disruptive innovators, processes, goods and services to avoid premature lock-in to a new form of incumbency
tie incentives to emission reductions	direct market activity to incentivise disruptive consumer innovations which contribute to public policy goals for emission reductions.

Table: *Regulatory strategies for de-risking the introduction of potentially disruptive consumer innovations.*

Source: *Wilson (2019) APPAM Conference.*

WHAT WE DID:

- We surveyed the literature on disruptive innovation and reviewed how it was dealt with by policy and regulation.

WHAT WE FOUND:

- There are four conditions under which policy should intervene to steer low-carbon consumer innovations towards societal goals:

  1. Innovation adoption leads to emission reductions.
  2. Alternatives to mainstream consumption practices improve wellbeing, welfare, or other social objectives.
  3. There is risk of adverse collective impacts on consumers' or workers' rights (e.g., misuse of data).
  4. There is strong overlap with strategic research and innovation objectives for long-term decarbonisation.

- Policy and regulation controls the market access of low-carbon consumer innovations, from shared mobility in cities to households in electricity markets. Regulatory frameworks designed to ensure system reliability can create barriers to change.

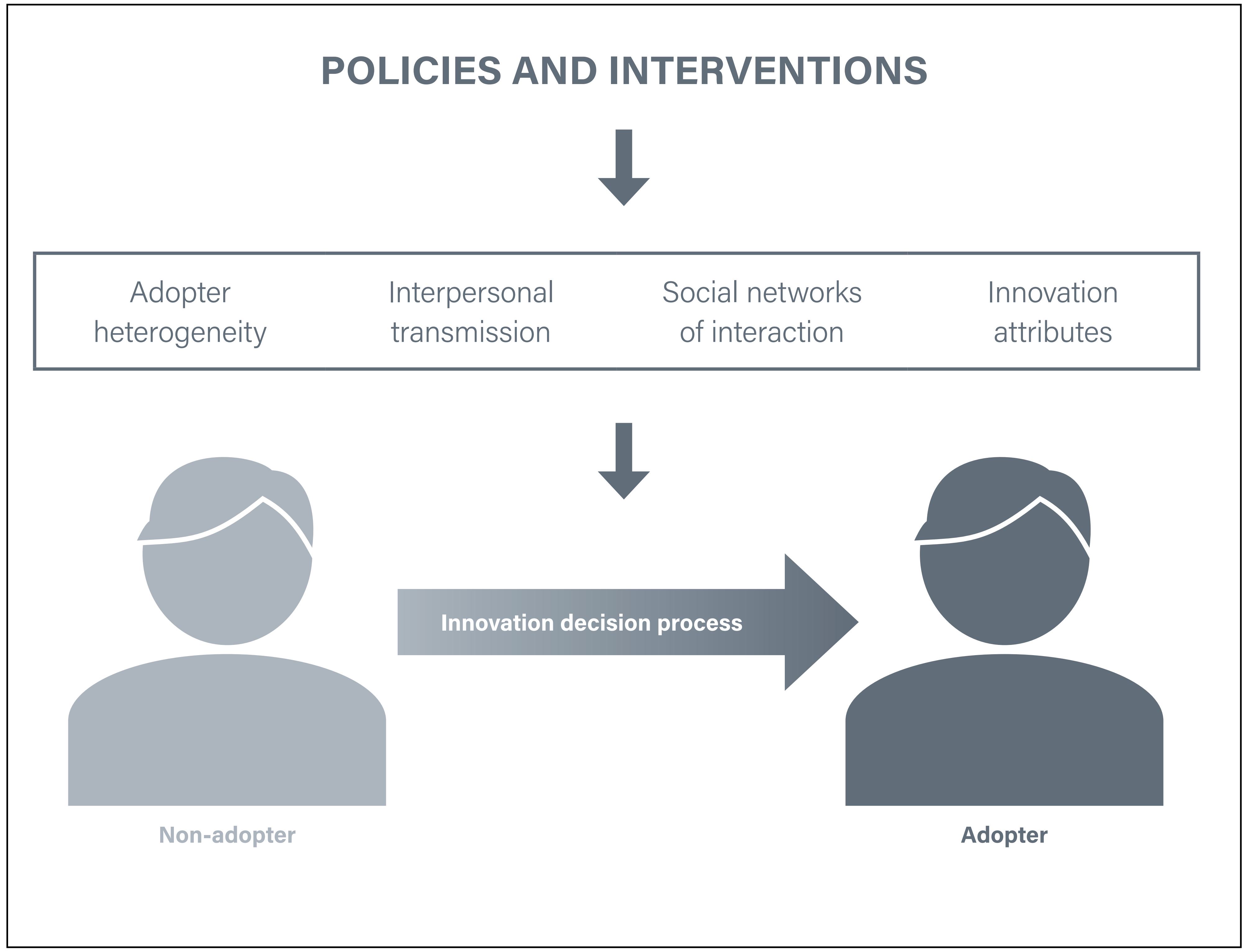
- Policymakers and regulators can pursue different strategies for steering potentially disruptive consumer innovations toward societal goals (see *Table*). Experimentation and learning is key.

LINK TO SILCI OUTPUTS:

Journal Articles: Wilson et al. (2020) *Annual Review of Environment and Resources.*

Conference Papers: Wilson et al. (2019) *APPAM Conference.*

5.4 Policies and interventions can support the social influence mechanisms behind innovation adoption.



WHAT WE DID:

- We surveyed the literature on social influence and diffusion relevant to low-carbon innovations in general, and to our case study innovations specifically.
- We identified effective interventions and policy strategies, and how they could adapt to our study context.

WHAT WE FOUND:

- Policy can help boost digital skills, access to digital infrastructure, trust in digital platforms, and appropriate use of data. This supports electronic word-of-mouth as a form of social influence on low-carbon innovation adoption.
- Policy can help communicate, label, make salient, and otherwise raise the visibility of low-carbon innovations. This supports observing or being aware of early adopters' activity as an important form of social influence.
- Policy can concentrate incentives in early-adopting areas, stimulating neighbourhood effects that accelerate local deployment. Polices aiming for more uniformity may be fairer, but less effective as they work against natural variation in local conditions enabling adoption.

LINK TO SILCI OUTPUTS:

Journal Articles: Vrain & Wilson (2021) *Environmental Innovations and Societal Transitions.* Vrain et al. (in review) *Energy Policy.*

Talks: Vrain (2020) *BECC Conference.*

5.5 Innovation case studies reveal specific conditions for supporting adoption.

Photo Credit: ShareNow @Unsplash.

WHAT WE DID:

- In each of our innovation case studies, we analysed contextual conditions enabling or constraining innovation adoption. We then identified policy strategies for overcoming barriers and stimulating rapid uptake.

WHAT WE FOUND:

- For ridesharing, particularly among commuters, we found workplace schemes and sustainable travel policies would help establish supportive social norms around shared mobility while also improving its appeal relative to private vehicle use (e.g., by limiting parking spaces at work).
- For mobility-as-a-service, particularly among young adults transitioning from university to employment, we found both carrot measures (e.g., affordable monthly subscriptions) and stick measures (e.g., restricted car use in city centres) could sustain use of public and shared modes.
- For online food hubs, we found support and incentives could help food hubs set up in new areas, particularly if large institutions like schools, councils or hospitals could act as 'anchor' customers to then help build the local network.

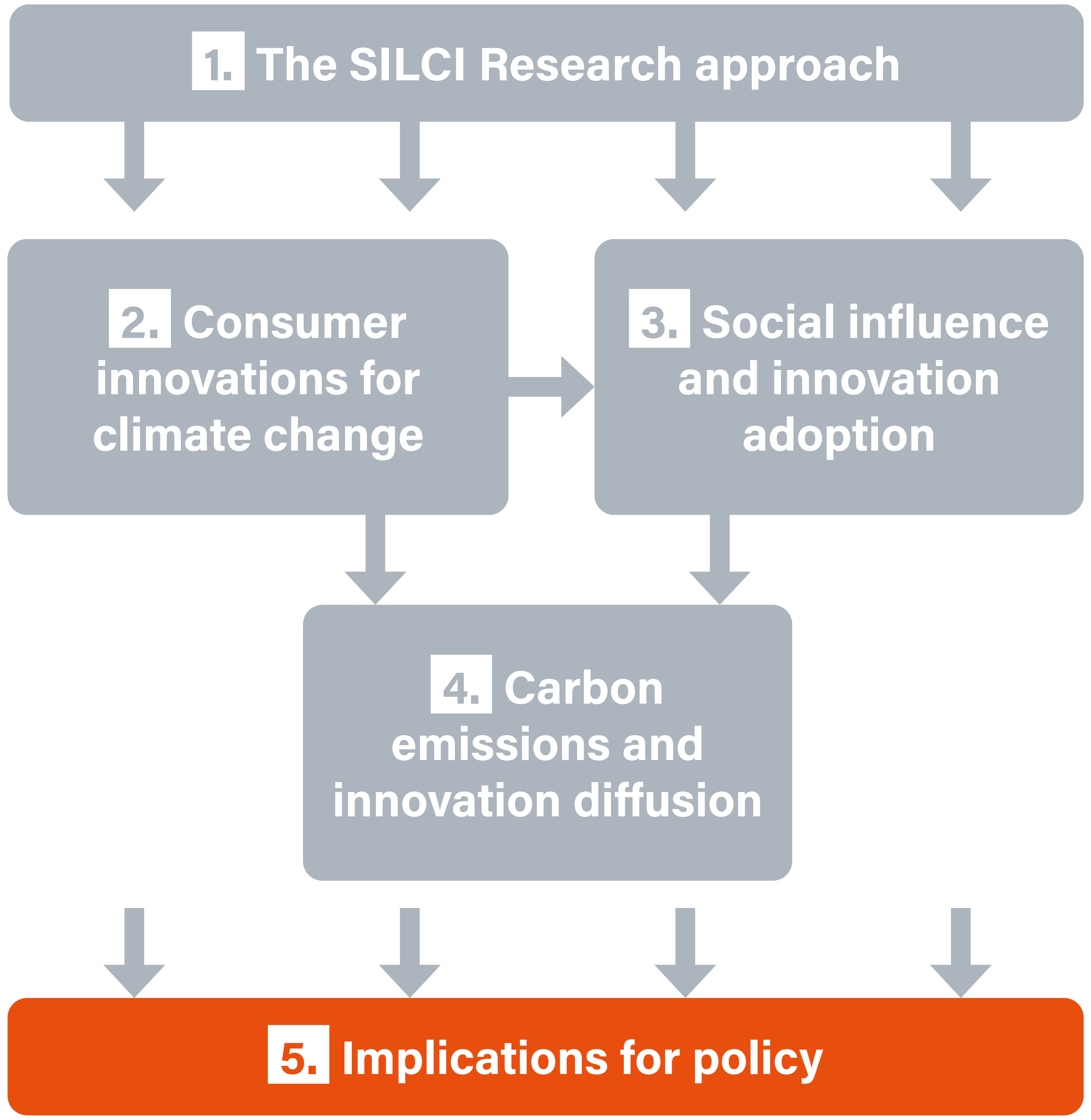
LINK TO SILCI OUTPUTS:

Journal Articles: Vrain & Wilson (2021) *Environmental Innovations and Societal Transitions.* Vrain et al. (in review) *Energy Policy.*

Conference Papers and Posters: Wilson (2019) *APPAM.* Cassar (2021) *Climate Exp0.* Kerr (2021) *Climate Exp0.* Wilson, M. (2021) *Climate Exp0.*

SILCI

Insights for policy on accelerating diffusion.



Consumption activity related to mobility, food, homes, and energy accounts for 75% of global carbon emissions. There are many proven strategies available to policymakers for testing, learning, nurturing, and regulating in order to amplify the emission reduction benefits of low-carbon consumer innovations.

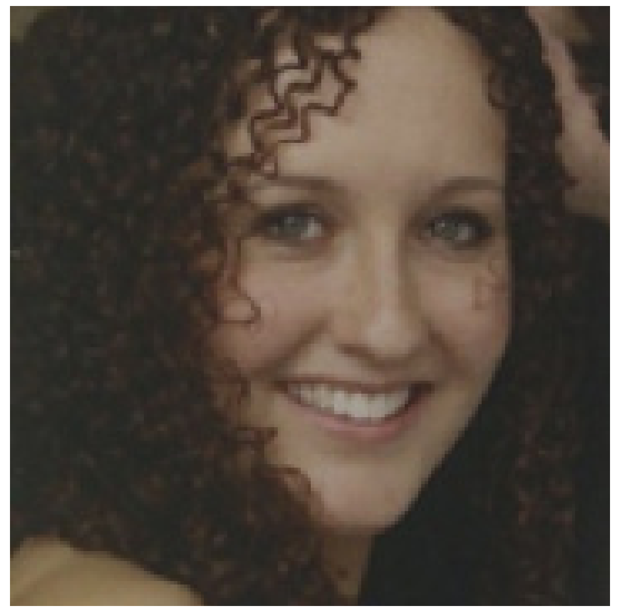
Policies and interventions for tapping into the social influence mechanisms that drive innovation diffusion are widely used in fields like agriculture and public health... but are not widely used to tackle climate change.

Many of these policy strategies are generalisable, such as early adopter incentives to drive down costs and perceive risks. Other strategies are innovation-specific such as workplace schemes to support sustainable travel.

In the absence of strategic direction to steer consumer innovations towards societal goals, there is a clear risk of ever-rising emissions. This is particularly the case for digital innovations appearing at breakneck speed.

Get in touch! For further information on anything you've read in this report, please let us know by contacting...

CHARLIE WILSON
emission impacts and overall project
charlie.wilson@uea.ac.uk



EMILIE VRAIN
social influence and smart home technologies
e.vrain@uea.ac.uk

LAURIE KERR
carsharing and ridesharing
l.kerr@uea.ac.uk

MARK WILSON
online food hubs
mark.wilson@uea.ac.uk

EMMA CASSAR
mobility-as-a-service
e.cassar@uea.ac.uk

HAZEL PETTIFOR
innovation attributes
h.pettifor@uea.ac.uk

+ BARNABY ANDREWS
survey data analysis and logit models

+ THEO ARVANITOPOULOS
spatial diffusion analysis

And for all this and more, go to silci.org

SILCI team picnic with former member Tony Zhu

SILCI

CONTENTS

SILCI

Outputs referenced in this report: Journal articles.

Grubler, A., C. Wilson et al. (2018). "A low energy demand scenario for meeting the 1.5°C target and Sustainable Development Goals without negative emission technologies." *Nature Energy* https://doi.org/10.1038/s41560-018-0172-6

McCollum, D.L., A. Gambhir, J. Rogelj & C. Wilson (2020). "Energy modellers should explore extremes more systematically in scenarios." *Nature Energy* 5(2): 104-107. https://doi.org/10.1038/s41560-020-0555-3

Morton, C., C. Wilson & J. Anable (2018). "The diffusion of domestic energy efficiency policies: A spatial perspective." *Energy Policy* 114: 77-88. https://doi.org/10.1016/j.enpol.2017.11.057

Mundaca, L., D. Ürge-Vorsatz & C. Wilson (2019). "Demand-side approaches for limiting global warming to 1.5°C." *Energy Efficiency* 12(2): 343-362. https://doi.org/10.1007/s12053-018-9722-9

Pettifor, H., C. Wilson, S. Bogelein, E. Cassar, L. Kerr & M. Wilson (2020). "Are low-carbon innovations appealing? A typology of functional, symbolic, private and societal attributes". *Energy Research & Social Science* 64. https://doi.org/10.1016/j.erss.2019.101422

Pettifor, H. & C. Wilson (2020). "Low carbon innovations for mobility, food, homes and energy: A synthesis of consumer attributes." *Renewable & Sustainable Energy Reviews* 130: 109954. https://doi.org/10.1016/j.rser.2020.109954

Quéré, C.L., J.I. Korsbakken, C. Wilson et al. (2019). "Drivers of declining CO2 emissions in 18 developed economies." *Nature Climate Change* 9: 213–217. https://doi.org/10.1038/s41558-019-0419-7

Vrain, E. & C. Wilson (2021). "Social networks and communication behaviour underlying smart home adoption in the UK." *Environmental Innovation and Societal Transitions* 38: 82-97. https://doi.org/10.1016/j.eist.2020.11.003

Wilson, C. (2018). "Disruptive low-carbon innovations." *Energy Research & Social Science* 37: 216-223. https://doi.org/10.1016/j.erss.2017.10.053

Wilson, C. & D. Tyfield (2018). "Critical perspectives on disruptive innovation and energy transformation." *Energy Research & Social Science* 37: 211-215. https://doi.org/10.1016/j.erss.2017.10.032

Wilson, C., H. Pettifor, E. Cassar, L. Kerr & M. Wilson (2019). "The potential contribution of disruptive low-carbon innovations to 1.5 °C climate mitigation." *Energy Efficiency* 12(2): 423-440. https://doi.org/10.1007/s12053-018-9679-8

Wilson, C., A. Grubler, N. Bento, S. De Stercke & C. Zimm. (2020). "Granular technologies to accelerate decarbonization." *Science* 368(6486): 36-39. https://doi.org/10.1126/science.aaz8060

Wilson, C., L. Kerr, F. Sprei, E. Vrain & M. Wilson (2020). "Potential climate benefits of digital consumer innovations." *Annual Review of Environment and Resources* 45: 113-144. https://doi.org/10.1146/annurev-environ-012320-082424

Zhuge, C., M. Yu, C. Wang, Y. Cui & Y. Liu (2020). "An agent-based spatiotemporal integrated approach to simulating in-home water and related energy use behaviour: A test case of Beijing, China." *Science of The Total Environment* 708: 135086. https://doi.org/10.1016/j.scitotenv.2019.135086

Zhuge, C., B. Wei, C. Shao, C. Dong, M. Meng & J. Zhang (2020). "The potential influence of cost-related factors on the adoption of electric vehicle: An integrated micro-simulation approach." *Journal of Cleaner Production* 250: 119479. https://doi.org/10.1016/j.jclepro.2019.119479

Zhuge, C., B. Wei, C. Shao, Y. Shan & C. Dong (2020). "The role of the license plate lottery policy in the adoption of Electric Vehicles: A case study of Beijing." *Energy Policy* 139: 111328. https://doi.org/10.1016/j.enpol.2020.111328

Zhuge, C., M. Bithell, C. Shao, X. Li & J. Gao (2021). "An improvement in MATSim computing time for large-scale travel behaviour microsimulation." *Transportation* 48(1): 193-214. https://doi.org/10.1007/s11116-019-10048-0

Under review / in progress

Arvanitopoulos T., C. Wilson & S. Ferrini (under review). "Local conditions for the decentralisation of energy systems".

Vrain, E., C. Wilson, L. Kerr & M. Wilson (under review). "Social influence in the adoption of digital consumer innovations for climate change." *Energy Policy*.

Vrain, E., Wilson, C. & B. Andrews (in progress). "Rejection of innovations: The discontinuance of low carbon digital products and services."

Wilson, C. & B. Andrews (in progress). "Digital consumer innovations for climate change."

All pre-prints available for download: silci.org/outputs

SILCI

Outputs referenced in this report: Conference papers and posters.

Cassar, E. (2021). "University graduates choice of commute as they transition into the workplace: potential for Mobility as a Service". *Climate Exp0.* UK and Italian Universities Network Conference on Climate Change. online. 17-21 May 2021.

Kerr, L. (2021). "Assessing the role of trust in the adoption of peer-to-peer mobility innovations as a pathway to reduce CO2 emissions". Poster presentation. *Climate Exp0.* UK and Italian Universities Network Conference on Climate Change. online. 17-21 May 2021.

Morton, C., C. Wilson & J. Anable (2017). "A spatial perspective on the transition towards low carbon homes: Evidence from the Green Deal." *European Council for an Energy Efficient Economy (ECEEE) Summer Study on Buildings.* Hyeres, France. 29 May - 2 June 2017.

Pettifor, H. & C. Wilson (2019). "Appealing attributes of low-carbon innovations". Poster presentation. *World Social Marketing Conference.* Edinburgh, UK. 5-6 June 2019.

Vrain, E. (2021). "Social influence in the adoption of digital consumer innovations for climate change". *6th European Conference on Energy Efficiency and Behaviour Change (BEHAVE).* online. 21-23 April 2021.

Vrain, E. (2021). "The role of social influence in the adoption of low carbon digital innovations". Poster presentation. *Climate Exp0.* UK and Italian Universities Network Conference on Climate Change. online. 17-21 May 2021.

Wilson, C. (2017). "Disruptive low carbon innovations". *European Council for an Energy Efficient Economy (ECEEE) Summer Study.* Hyeres, France. 29 May - 2 June 2017.

Wilson, C., N. Bento, B. Boza-Kiss & A. Grubler (2019). "Near-term actions for transforming energy-service efficiency to limit global warming to 1.5°C." *European Council for an Energy Efficient Economy (ECEEE) Summer Study on Buildings.* Hyeres, France. 3-8 June 2019.

Wilson, C. (2019). "Should public policy support disruptive consumer innovations for climate change?" *Association for Public Policy Analysis and Management (APPAM) International Conference.* Barcelona, Spain. 30-31 July 2019.

Wilson, M. (2021). "Online food hubs: platforms which re-localise, reconnect and reduce". Poster presentation. *Climate Exp0.* UK and Italian Universities Network Conference on Climate Change. online. 17-21 May 2021.

All outputs available for download: silci.org/outputs

I.iii

Outputs referenced in this report: Reports and blogs.

Reports

Wilson, C. (2017). “Disruptive Low Carbon Innovation Workshops: Synthesis Report”. *Tyndall Centre for Climate Change and Future Earth.* Norwich, UK. May 2017. http://silci.org/key-insights-from-workshops-on-disruptive-low-carbon-innovations/

Wilson, C. & H. Pettifor (2017). "Disruptive Low-Carbon Innovations." *Report for UK Department for Business, Energy and Industrial Strategy (BEIS).* Tyndall Centre for Climate Change. Norwich, UK. August 2017.

Wilson, C. (2019). "1.5°C Compatibility Pathfinder Framework". *Mission Innovation Net Zero Compatibility Initiative.* Stockholm, Sweden. November 2019. https://www.misolutionframework.net/

Wilson, M. (2021). “The shopping behaviour of online food hub customers.” *Report for the Open Food Network.* January 2021.

Blogs

Vrain, E. (2021). "Coronavirus and digital solutions for climate change." *UK Energy Research Centre (UKERC).* 1 July 2021. https://ukerc.ac.uk/news/coronavirus-and-digital-solutions-for-climate-change/

All outputs available for download: silci.org/outputs

SILCI

Outputs referenced in this report: Talks.

Cassar, E. (2020). "Preference for Mobility as a Service using a stated choice experiment". *Behaviour, Energy, and Climate Change (BECC) Conference.* online. 7-10 December 2020.

Kerr, L. (2020). "Who shares and why? Assessing the diffusion potential of peer-to-peer mobility innovations." *NEST Conference.* online. 7 May 2020.

Kerr, L. (2021). "Who shares and why? Assessing the role of trust in the adoption of P2P mobility innovations." *International Workshop on the Sharing Economy.* online. 24 February 2021.

Pettifor, H. (2018). "The attributes of low carbon innovations?". *Global Sustainability Institute, Anglia Ruskin University.* Cambridge, UK. December 2018.

Pettifor, H. (2019). "The appealing attributes of low carbon innovations". *International Conference in Environmental Psychology.* Plymouth, UK. 4-6 September 2019.

Vrain, E. (2019). "Ever talked about smart homes, car sharing platforms or digital farmers markets?". *4th European Conference on Social Networks.* Zurich, Switzerland. September 2019.

Vrain, E. (2020). "Crossing the chasm for low carbon innovations: Smart home case study". *Sunbelt Conference of the International Network for Social Network Analysis (INSNA).* online. 13-17 July 2020.

Vrain, E. (2020) "Social influence in the adoption of low carbon digital innovations". *Behaviour, Energy and Climate Change Conference (BECC).* online. 7-10 December 2020.

Wilson, C. (2017). "Thinking differently to limit warming to 1.5°C." *Climate Lab, University College Cork.* Cork, Ireland. May 2017.

Wilson, C. (2018). "The transformative potential of consumer innovations for 1.5°C climate stabilisation". *David Suzuki Foundation.* Vancouver, Canada. August 2018.

Wilson, C. (2018). "Transforming energy demand to meet the 1.5°C target and Sustainable Development Goals without relying on negative emission technologies". *International Energy Agency.* Paris, France. November 2018.

Wilson, C. (2018). "Transforming energy demand to limit global warming to 1.5°C". *Central European University.* Budapest, Hungary. December 2018.

Wilson, C. (2019). "Transforming energy services to limit warming to 1.5°C". *Energy Transitions Conference.* Trondheim, Norway. March 2019.

Wilson, C. (2020). "Digital and distributed technologies in clean energy transitions". International Forum on Long-Term Energy Scenarios for the Clean Energy Transition. *International Renewable Energy Agency (IRENA) Clean Energy Ministerial Meeting.* online. March 2020.

Wilson, C. (2020). "Social influence on the adoption of digital consumer innovations with potential climate benefits". *Sunbelt Conference of the International Network for Social Network Analysis (INSNA).* online. 13-17 July 2020.

Wilson, C. (2020). "Distributed innovation strategies for a 1.5°C compatible future". *Net Zero Compatibility Initiative: Mission Innovation Clean Energy Ministerial.* online. 21 September 2020.

Wilson, C. (2020). "How do new things spread? The diffusion of digital low-carbon innovations". *Oxford Energy Network.* online. 3 November 2020.

Wilson, C. (2021). "Is a digital future also a low carbon future?". *UEA London Live Public Lecture.* online. 18 March 2021. https://www.youtube.com/watch?v=sELkqAzBG1c

Wilson, C. (2021). "How do new things spread? The diffusion of digital low-carbon innovations". *Tyndall Centre for Climate Change Research.* online. 5 May 2021.

Wilson, C. & M. Wilson (2019). "Can new consumer goods and services help tackle climate change?". *Pint of Science.* Norwich, UK. 21 May 2019.

Wilson, M. (2019). "Who uses food apps and why? An exploration of their disruptive potential". *Royal Geographical Society (RGS) Annual Conference 2019.* London, UK. 28 Aug 2019.

All outputs available for download: silci.org/outputs

Additional outputs (not referenced in this report): Organising events, conference papers and posters.

Throughout this report, we have referenced our journal articles, conference papers and posters, and selected talks. We have also engaged widely with stakeholders, publics, and policymakers throughout the project. Our funding support from the European Research Council (ERC) has also enabled us to organise, host, and participate in a wide range of events.

SILCI project team: CW = Charlie Wilson, HP = Hazel Pettifor, EV = Emilie Vrain, EC = Emma Cassar, LK = Laurie Kerr, MW = Mark Wilson

Events that we organised and ran as part of our research or to disseminate our research findings:

2017: Two expert workshops on disruptive innovations supported by UK Science and Innovation Network and Future Earth (n=75), London, UK [CW, HP]. Workshop on disruptive innovations at ECEEE Conference (n=15), Hyeres, France [CW].

2018: Three public workshops on innovation attributes (n=70), Norwich, UK [HP, CW, EC, LK, MW]. Dialogue session on disruptive innovation at International Sustainability Conference (n=40), Manchester, UK [CW]. Expert workshop on rethinking energy demand organised with IIASA and RITE, (n=30), Nara, Japan [CW].

2019: Public engagement event on Shifting Mindsets as part of Norwich Science Festival (n=100), Norwich, UK [EV, CW, EC, LK, MW]. Organising committee for Oxford Conference on Achieving Net-Zero Emissions, (n=200), Oxford, UK [CW]. Organising committee for the Symposium on Opportunities to Strengthen Climate Action, (n=50), Potsdam, Germany [CW].

2020: Workshop on online food hubs at Open Food Network annual gathering, Birmingham, UK [MW].

2021: Organising committee and Mitigation Solutions lead for Climate Exp0, CoP26 Universities Network Conference on Climate Change, (n=5000), online [CW].

Conference posters and papers we've presented:

2018: University of East Anglia Postgraduate Education Conference [LK].

2019: International Conference in Environmental Psychology [HP]. UKERC Whole Systems Networking Fund Final Conference [EV].

2021: Climate Exp0 [EV + EC + MW]. Transition 2021 [EV].

All outputs available for download: silci.org/outputs

II.ii Additional outputs (not referenced in this report): Talks for academic and other audiences.

Throughout this report, we have referenced our journal articles, conference papers and posters, and selected talks. We have also engaged widely with stakeholders, publics, and policymakers throughout the project. Our funding support from the European Research Council (ERC) has also enabled us to organise, host, and participate in a wide range of events.

SILCI project team: CW = Charlie Wilson, HP = Hazel Pettifor, EV = Emilie Vrain, EC = Emma Cassar, LK = Laurie Kerr, MW = Mark Wilson

Talks we've given at conferences, workshops, seminars and symposia to mainly academic audiences:

2016: Environmental Change Institute, University of Oxford [CW].

2017: ESRC Seminar Series on Green Innovation, Open University [CW]. Tyndall Centre for Climate Change Research [CW]. European Council for an Energy Efficient Economy (ECEEE) Summer Study [CW]:

2018: Science Policy Research Unit, University of Sussex [CW]. International Sustainability Transitions Conference [CW]. Centre International de Recherche sur l'Environnement et le Développement (CIRED) [CW]. University of Regina [CW]. University of British Columbia [CW]. RITE-IIASA Expert Workshop on Rethinking Energy Demand [CW]. Central European University [CW]. Tyndall Centre for Climate Change Research [HP]. Global Sustainability Institute, Anglia Ruskin University [HP]. International Workshop on Systems Innovations towards Sustainable Agriculture [MW].

2019: Energy Transitions Workshop on Smart Cities [CW]. CESI-ClimateXChange Workshop on Interdisciplinarity and Whole Systems Analysis [CW]. British Institute of Energy Economics [CW]. Researcher summit at University of East Anglia [EV]. Université Toulouse-Jean Jaurès [EV]. Tyndall Centre for Climate Change Research [EV + EC]. European Conference on Social Networks [EV]. CEEDA Symposium [LK]. NEST Conference [EC + LK]. International Workshop on the Sharing Economy [LK]. Royal Geographical Society Annual Conference [MW].

2020: IIASA-RITE Expert Dialogue on Energy Demand, Innovation and Technological Solutions [CW]. Sunbelt Conference of the International Network for Social Network Analysis [EV + CW]. Behaviour, Energy and Climate Change BECC Conference [EV + EC]. Tyndall Centre for Climate Change Research [EC + MW]. NEST Conference [LK]. CEEDA Conference [MW].

2021: European Conference on Energy Efficiency and Behaviour Change (BEHAVE) [EV]. European Council for an Energy Efficient Economy ECEEE Summer Study [EC]. International Workshop on the Sharing Economy [LK].

Talks we've given or panels we've been part of to mainly non-academic audiences:

2018: Fossil Free Sweden [CW]. Japanese Electric Power Research Institute (CRIPEI) [CW]. International Energy Agency [CW]. Transport Research Arena TRA Conference [EC]. Norwich Science Festival [EC].

2019: UK Committee on Climate Change [CW]. Bloomberg New Energy Finance Summit [CW]. Swedish Environmental Protection Agency [CW]. Norwich Science Festival [LK]. Pint of Science [MW].

2020: St Gallen Forum for Management of Renewable Energies [CW]. Norwich Science Festival [LK]. Pint of Science [LK]. London Transport Museum [LK].

2021: International Energy Agency Expert Workshop on Reaching Net-Zero Emissions [CW]. International Forum on Long-Term Scenarios for the Clean Energy Transition [CW]. Swiss Federal Office of Energy [CW]. Mission Innovation Clean Energy Ministerial event on Net-Zero Compatibility Initiative [CW].

All outputs available for download: silci.org/outputs

II.iii Additional outputs (not referenced in this report): Other events, media.

Throughout this report, we have referenced our journal articles, conference papers and posters, and selected talks. We have also engaged widely with stakeholders, publics, and policymakers throughout the project. Our funding support from the European Research Council (ERC) has also enabled us to organise, host, and participate in a wide range of events.

SILCI project team: CW = Charlie Wilson, HP = Hazel Pettifor, EV = Emilie Vrain, EC = Emma Cassar, LK = Laurie Kerr, MW = Mark Wilson

Other events we've attended and participated in:

2018: Exponential Climate Action for Cities Workshop [CW + LK]. Pathways after Paris Symposium, Dept. of Business, Energy and Industrial Strategy [CW]. Learning on Climate Solutions Workshop [CW]. Sunbelt Conference of the International Network for Social Network Analysis [EV]. Mobility of the Future Conference [EC]. UCL Energy Seminar [EC]. IET and ITS UK Behavioural Science in Transport Event [EC]. Oxford Real Farming Conference [MW].

2019: Royal Society Workshop on Digital Technology for the Planet [CW]. International Energy Agency (IEA) Expert Roundtable on Energy Technology Innovation Policy [CW]. Future of Transport, BT Innovations [HP]. Expert Workshop on Social Innovation and Lifestyles [HP]. World Social Marketing Conference [HP]. Smart IoT Conference [EV]. Smart Home Expo [EV]. Recherche froncophone sur les graphes et les réseaux sociaux [EV]. CEEDA Symposium [LK]. Oxford Real Farming Conference [MW].

2020: CREDS Energy Demand Research Conference [EV]. Oxford Real Farming Conference [MW].

2021: International Energy Agency Workshop on Methodologies for Quantifying Climate Impacts of Digitalisation [CW]. Oxford Real Farming Conference [MW].

Media, blogs, stakeholder engagement we've written or been interviewed for:

2018: 'Energy efficiency policy,' Blog for CIED-SPRU [CW]. 'Low energy demand futures,' Various media interviews for WIRED, Carbon Brief, L'Echo, Canadian Broadcasting Corporation [CW]. Podcast interview for Energy Transitions Show [CW]. 'Multi-modality,' Times of Malta [EC].

2019: 'Peak-and-decline emissions,' Blog for The Conversation [CW]. 'Low-carbon travel,' Adresseavisen [CW]. 'Food hubs and climate change,' Open Food Network [MW].

2020: EU Cordis 'Results Pack' on 'Frontier Research for the Green Deal' [CW]. Science Media Centre briefing on Reaching Net Zero [CW]. Interview for Swiss Radio und Fernsehen [CW]. Interview for BBC News Online [CW+EV]. 'Small-scale solutions,' Blog for The Conversation [CW]. Podcast interview for Tyndall Talks [CW]. 'Harnessing social networks,' Blog for Tyndall Centre [EV]. Reports on 'Use of online food hubs,' Open Food Network [MW]. 'Datasets on consumer appeal, Open Food Network [MW].

2021: 'Social networks for net-zero,' Blog for UKERC [EV]. 'Coronavirus impacts on low-carbon innovations,' Blog for UKERC [EV].

All outputs available for download: silci.org/outputs

II.iv

Additional outputs (not referenced in this report): Training, other achievements.

Throughout this report, we have referenced our journal articles, conference papers and posters, and selected talks. We have also engaged widely with stakeholders, publics, and policymakers throughout the project. Our funding support from the European Research Council (ERC) has also enabled us to organise, host, and participate in a wide range of events.

SILCI project team: CW = Charlie Wilson, HP = Hazel Pettifor, EV = Emilie Vrain, EC = Emma Cassar, LK = Laurie Kerr, MW = Mark Wilson

External (non-UEA) training courses and skills development we've learnt from:

2016: Visiting research fellow, Environmental Change Institute [CW].

2017: On 'blog and news article writing,' The Conversation [CW]. On 'social network analysis,' University of Essex Summer School [CW].

2018: Visiting research fellow, Science-Policy Research Unit [CW]. On 'systematic reviews,' Mercator Climate Change Institute [CW]. On 'social network analysis,' International Network for Social Network Analysis [EV]. On 'sustainable food provision,' European Society for Rural Sociology [MW].

2019: On 'survey data analysis,' University of Essex Summer School [LK + MW].

2020: On 'behavioural modelling,' Newcastle University [EC]. On 'cities in climate transformations,' University of Bergen Summer School [LK].

Other achievements related to the SILCI project that we're proud of!

2017: Guest editor of *Special Issue of Energy Research & Social Science* on 'Disruptive Low-Carbon Innovation' [CW].

2018: Guest editor of *Special Issue of Energy Efficiency* on 'Demand-side Strategies for Limiting Warming to 1.5°C' [CW]. Co-chair of Summer School on 'Modelling Energy Demand and Lifestyles for Climate Change Mitigation,' Centre International de Recherche sur l'Environnement et le Développement (CIRED) [CW]. Expert reviewer of Exponential Climate Action Roadmap [CW]. Supervision of MSc project, Utrecht University [HP].

2019: Contributing Author to IPCC 6th Assessment Report Working Group III on Climate Change Mitigation [CW]. Expert reviewer of Future Earth's 10 New Insights in Climate Science [CW]. Supervision of MSc project, Utrecht University [HP]. Supervision of BSc project, University of East Anglia [HP]. 2nd prize in 3MP competition at Researcher Summit, University of East Anglia [EV]. In top 30 women in energy research invited to IVUGER funding retreat [EV].

2020: Expert reviewer of Mission Innovation 2.0 Strategy, World Energy Outlook (IEA), Energy Technology Perspectives (IEA), IPCC 6th Assessment Report [CW].

And last, but very definitely not least …

2021-22: PhD thesis on mobility-as-a-service [EC]. PhD thesis on shared mobility [LK]. PhD thesis on online food hubs [MW].

All outputs available for download: silci.org/outputs

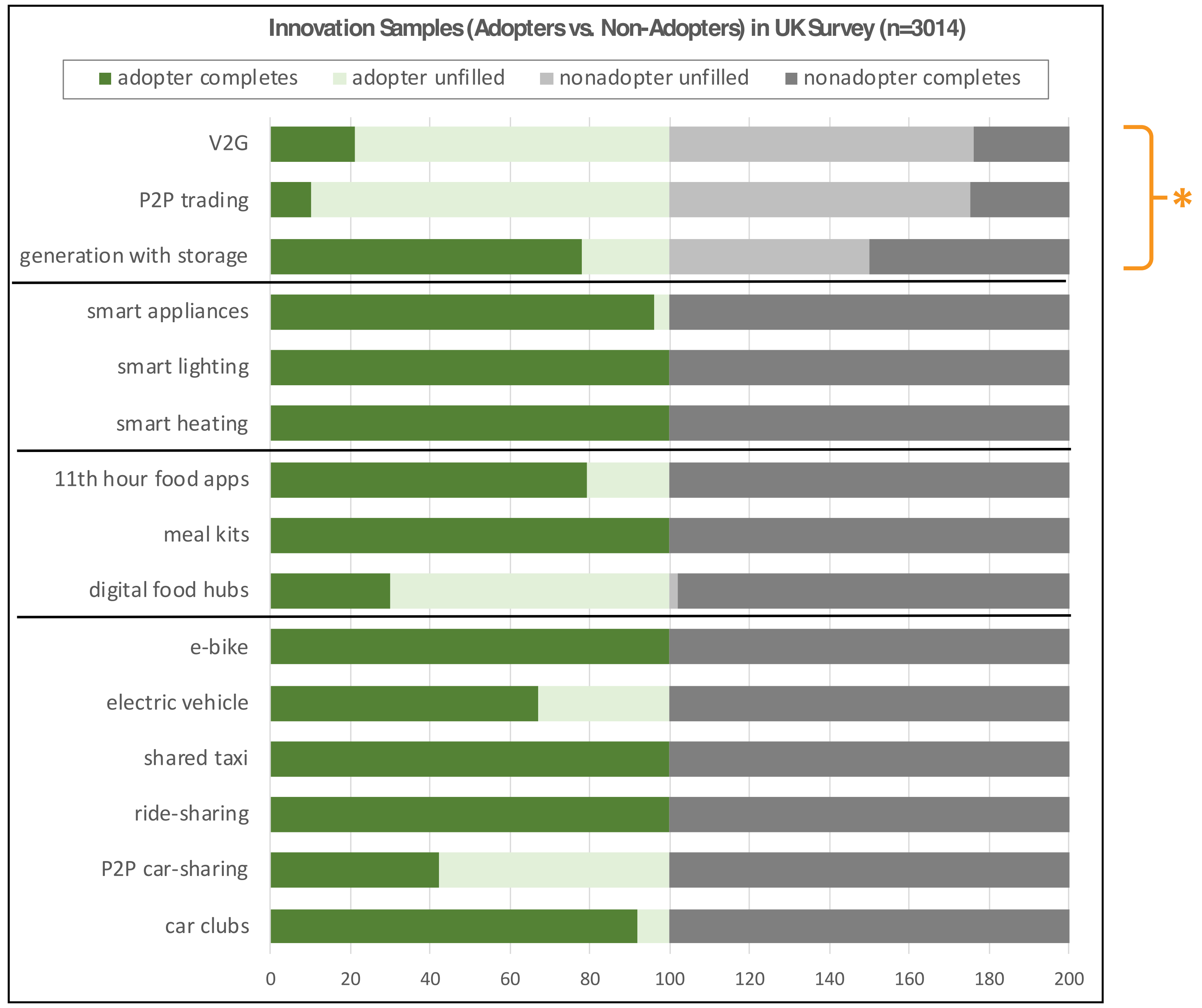
III.i Data: UK and Canada surveys.

SILCI

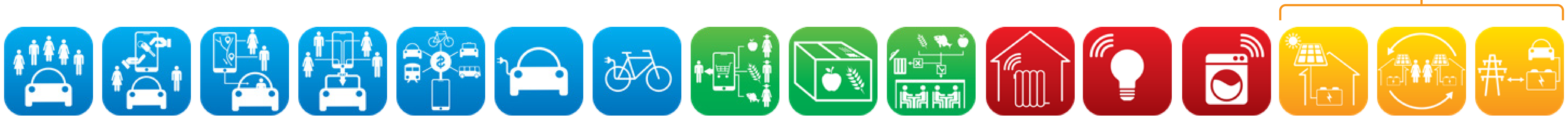
Online survey sample sizes:
n=3,014 (UK) + n=3,352 (Canada)

Sampling periods:
Wave 1 (UK): 2 Jul - 3 Sep 2019
Wave 1 (CAN): 11 Oct – 14 Nov 2019
Wave 2 (UK): 23 Nov – 20 Dec 2020

Sampling design for comparative analysis of multiple innovations:
quotas per innovation of
~100 adopters
~100 non-adopters (who are nonetheless aware of innovations)



* combined into a 4th homes innovation as low sample sizes



III.ii Data accessibility.

We are fully committed to making our datasets publicly accessible whenever possible, subject to the informed consent of our research participants.

Our anonymised survey datasets are available on the ReShare repository of the UK Data Archive:

https://reshare.ukdataservice.ac.uk/854723/

https://reshare.ukdataservice.ac.uk/855005/

Our innovation case study datasets will also be available, also on the ReShare repository, in late 2021 - early 2022 as we publish our final set of journal articles.