Modelling Human Behaviour in Climate Mitigation Scenarios

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IEA Workshop on:

The role of 'behavioural aspects'

for reaching net zero emissions by 2050

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International Institute for Applied Systems Analysis
IIASA
Tyndall Centre for Climate Change Research
SILCI Social Influence and *disruptive* Low Carbon Innovations
erc European Research Council
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Social and behavioural change is critical for net-zero, and ubiquitous in the ‘real’ world.

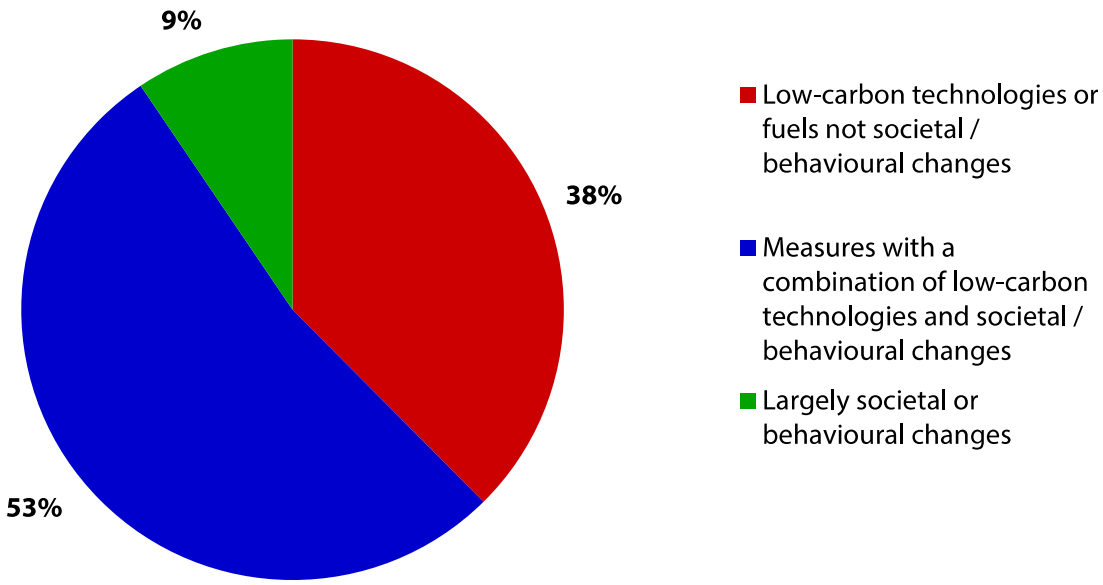

Figure 5.6 in UK CCC (2019). *Net Zero: The UK's contribution to stopping global warming*. London, UK, UK Committee on Climate Change.

There are different ways of representing or simulating behaviour in models.

	implicit (part of a more general phenomenon)	**explicit** (discrete, identifiable phenomena or processes)
exogenous (externally specified)		
endogenous (internally generated)		

Mundaca, L., D. Ürge-Vorsatz and C. Wilson (2019). "Demand-side approaches for limiting global warming to 1.5 °C." *Energy Efficiency* 12(2): 343-362.

Models handle some behavioural phenomena quite well: e.g., income & price responsiveness.

	implicit (part of a more general phenomenon)	**explicit** (discrete, identifiable phenomena or processes)
exogenous (externally specified)	scenario narrative translated into general modelling approach *e.g., energy service demand is a function of GDP growth*	
endogenous (internally generated)	behavioural phenomenon codified without resolving specific causal mechanism *e.g., price elasticity*	

Mundaca, L., D. Ürge-Vorsatz and C. Wilson (2019). "Demand-side approaches for limiting global warming to 1.5 °C." *Energy Efficiency* 12(2): 343-362.

Non-economic behavioural phenomena are *not* typically well represented in models.

	implicit (part of a more general phenomenon)	**explicit** (discrete, identifiable phenomena or processes)
exogenous (externally specified)		scenario narrative translated into behavioural assumptions or parameters *e.g., 'consumption options', Low Energy Demand scenario*
endogenous (internally generated)		specific behavioural process represented causally in model parameters or relationships *e.g., social influence and learning*

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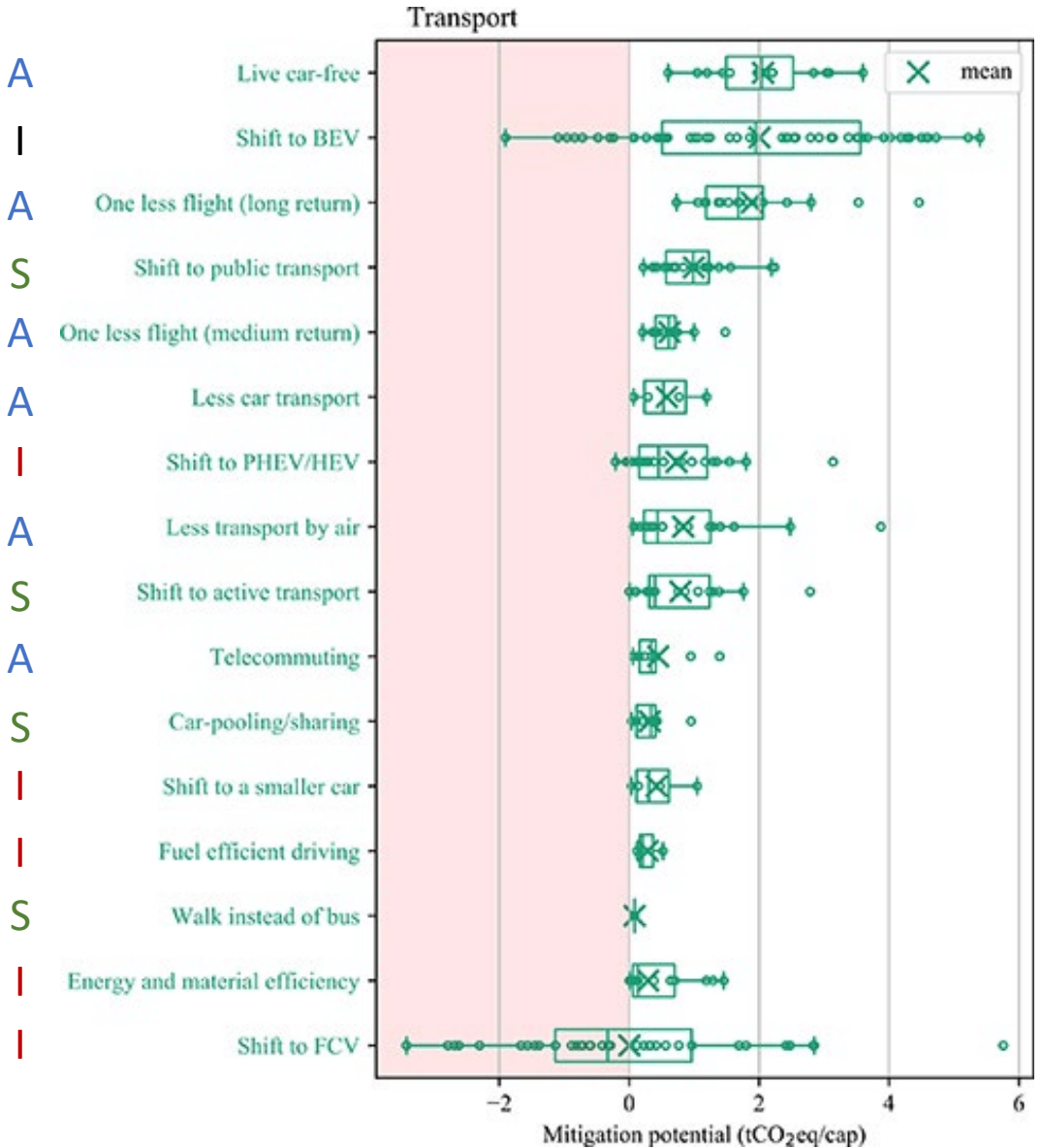
Modelling ‘behaviour change’ can be reduced to changes in *A*, but *S* and *I* are also important.

Activity =
total amount ‘consumed’
e.g., less °C, less meat, fewer p-km

Structure =
mix of different forms of activity
e.g., mixed use buildings, modal shift

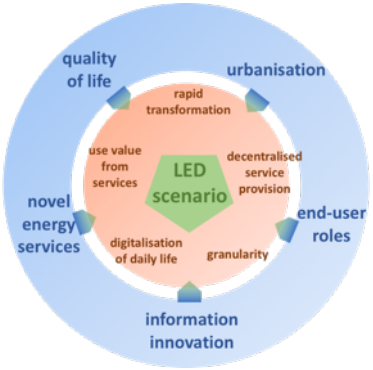
Intensity =
efficiency of each form of activity
e.g., heat pumps, line drying, EVs



Ivanova et al. (2020). "Quantifying the potential for climate change mitigation of consumption options." *Environmental Research Letters* 15(9): 093001.

*A*ctivity – *S*tructure - */*ntensity decompositions are useful for translating behaviour into models.

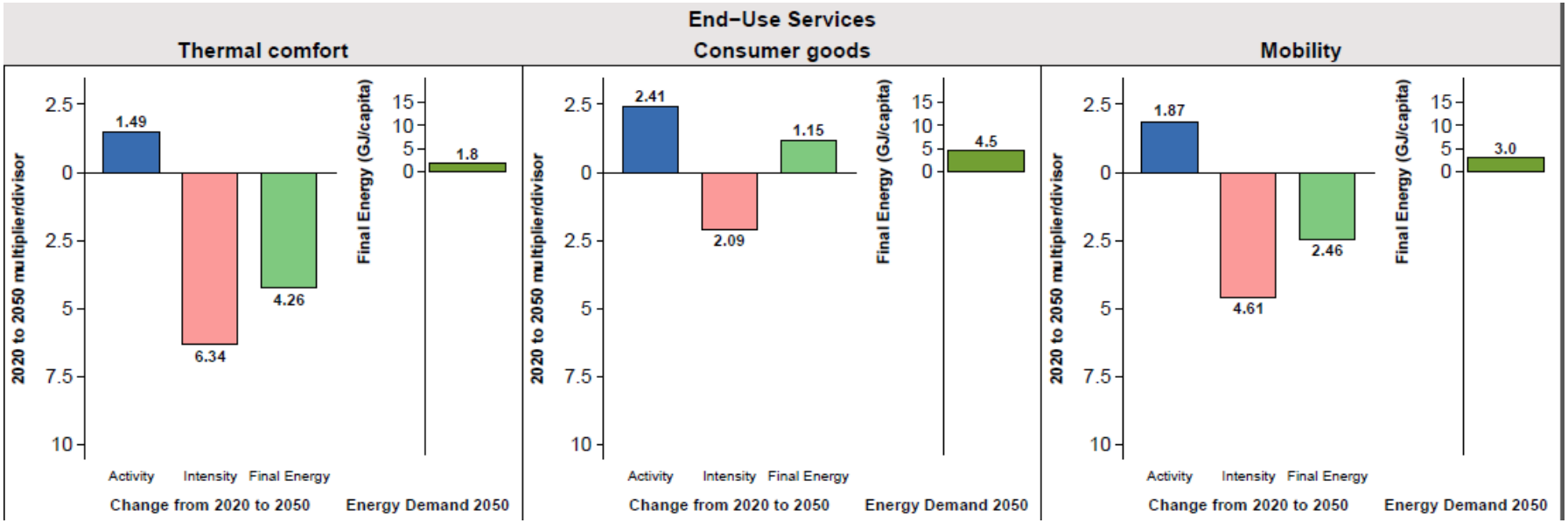
scenario narratives to 2050 in global 'Low Energy Demand' scenario:



increase in *A*ctivity
- more demand for useful services (esp. Global South)

changes in *S*tructure
- new forms of service
- improved 'service' efficiency

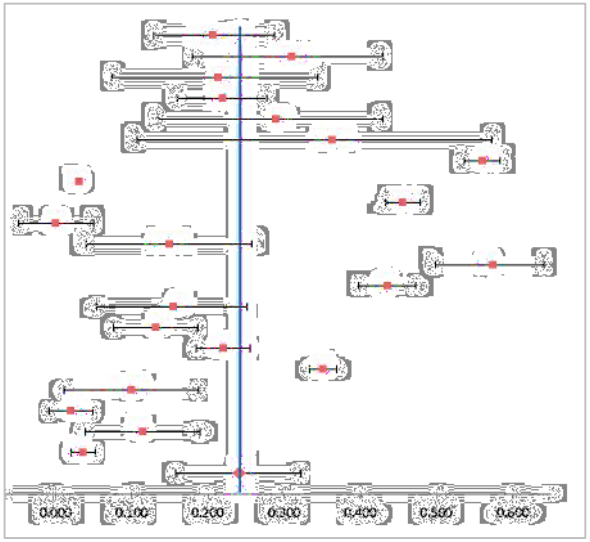
reduction in */*ntensity
- improved conversion efficiency
- avoided losses



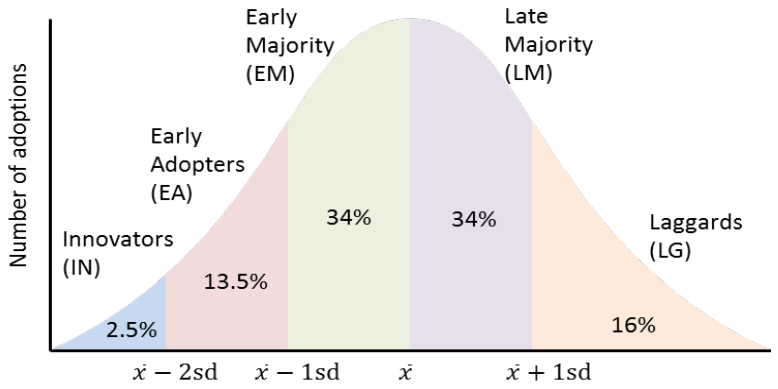
Grubler, Wilson et al. (2018). "A Low Energy Demand Scenario for Meeting the 1.5oC Target and Sustainable Development Goals without Negative Emission Technologies." *Nature Energy* 3: 515-527.

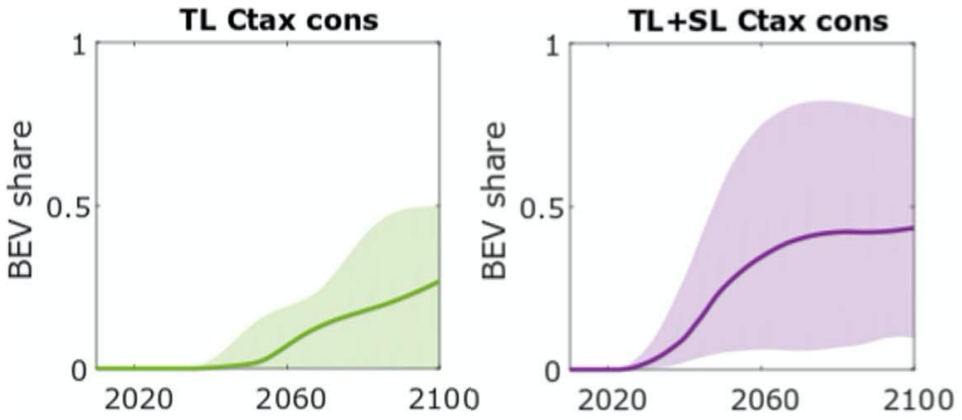
As well as behavioural change, important social and behavioural processes can be modelled.

uptake rates?



diffusion is a social process (Rogers 2003)





meta-analysis of 20+ empirical studies of **social influence on vehicle choice**

Pettifor et al. (2017). "Social influence in the global diffusion of alternative fuel vehicles – A meta-analysis." *Journal of Transport Geography* 62: 247-261.

social learning (SL) parameterised alongside technological learning (TL) in global modelling

Edelenbosch et al. (2018). "Interactions between social learning and technological learning in electric vehicle futures." *Environmental Research Letters* 13(12): 124004.

More explicit representation of behaviour in models is possible, useful, and policy-relevant.

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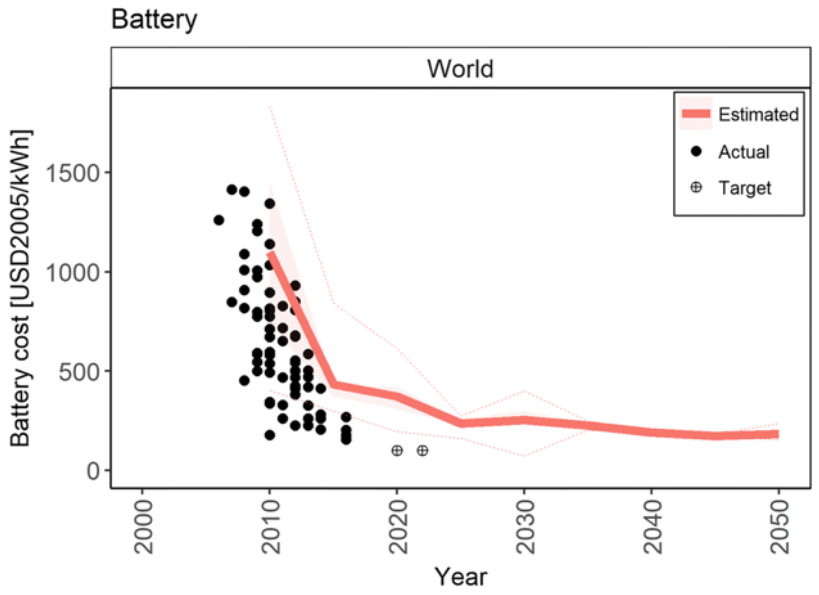
More explicit representation of behaviour in models is possible, useful, and policy-relevant.

Social and behavioural change can - and should - be captured in scenario narratives for achieving net-zero, then ...

… *either* translated into modelling assumptions,

… *or* internalised as parameters and relationships within models.

'*Behaviour is uncertain and there's insufficient empirical evidence*' are not strong enough reasons to avoid trying!



Shiraki, H. and M. Sugiyama (2020). "Back to the basic: toward improvement of technoeconomic representation in integrated assessment models." *Climatic Change* 162(1): 13-24