UNIVERSITY OF SURREY

Modelling Energy-Consuming Social Practices as Agents

Tina Balke, Thomas Roberts, Maria Xenitidou, Nigel Gilbert

Social Simulation Conference 2014

The WholeSEM Project

UNIVERSITY OF SURREY

- Whole Systems Energy Modelling Consortium
- Start: Effect. Oct 2013
- Duration: 4 year
- Funding Body: RCUK
- Partners: UCL, Imperial, Cambridge, Surrey

(Some) goals:

- Integrate whole energy systems modelling approaches across disciplinary boundaries.
- Build models on how energy demand co-evolves with changes in practice, supply, and policy.
- Conduct empirical research on energy practices to better understand their dynamics and influencing factors.

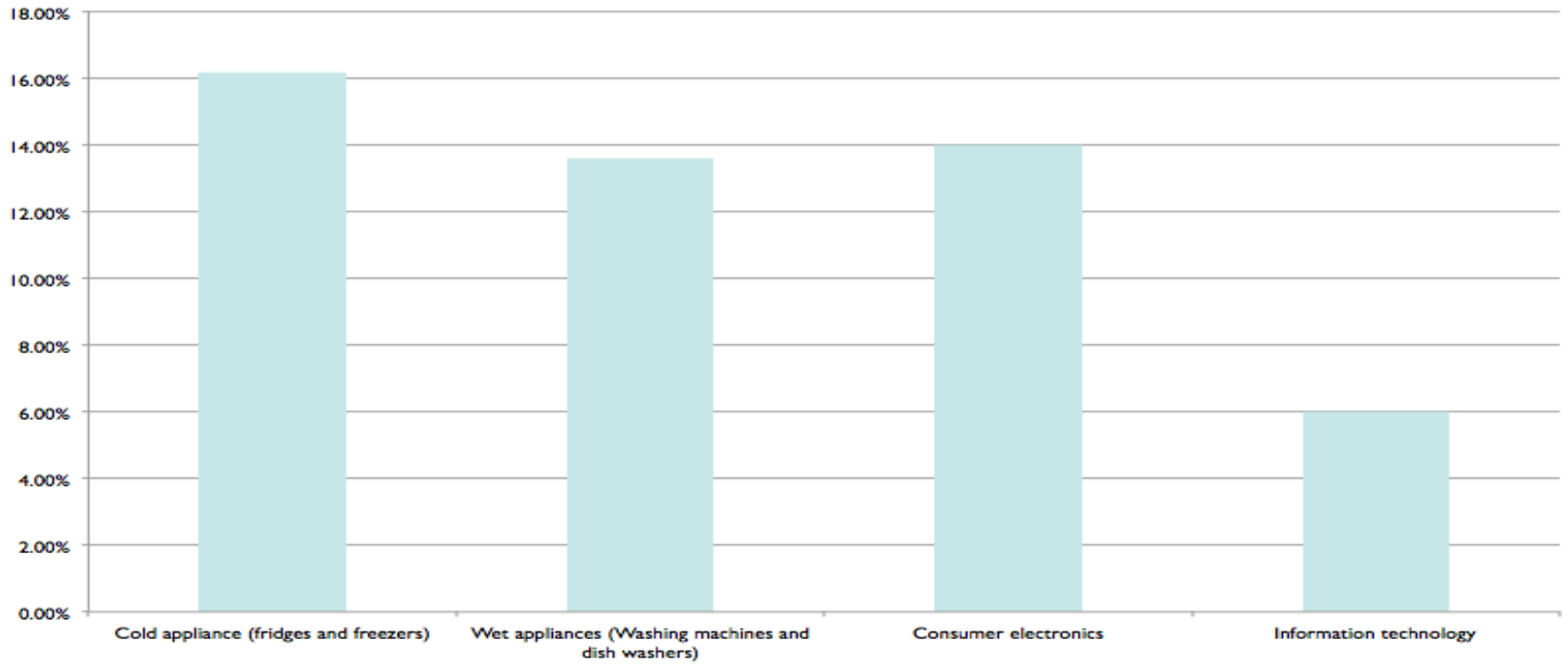
cress

Background

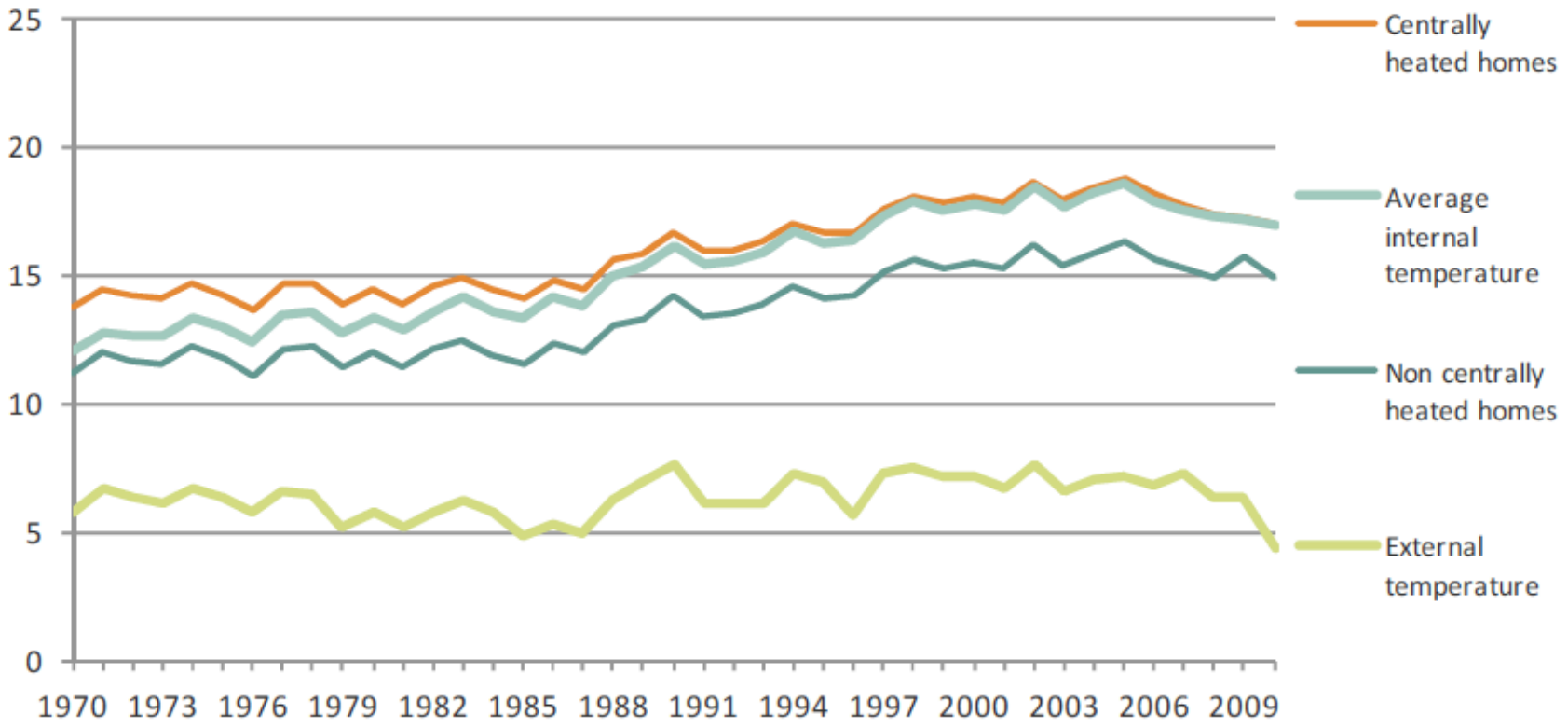
- Approximately one third of all energy consumed in the UK is used in domestic homes (DECC 2013).
- What energy is used for, and the amount that is used, has changed dramatically over the last 40 years.
- It could change in the future, towards lower overall demand, and/or lower peak demand.
- But we don't know how to influence this, because we have a poor understanding of what drives domestic energy demand.

Domestic Appliances

In 2010, 50% of energy was used to run appliances which were not commonly available in 1970:



Heating at Homes



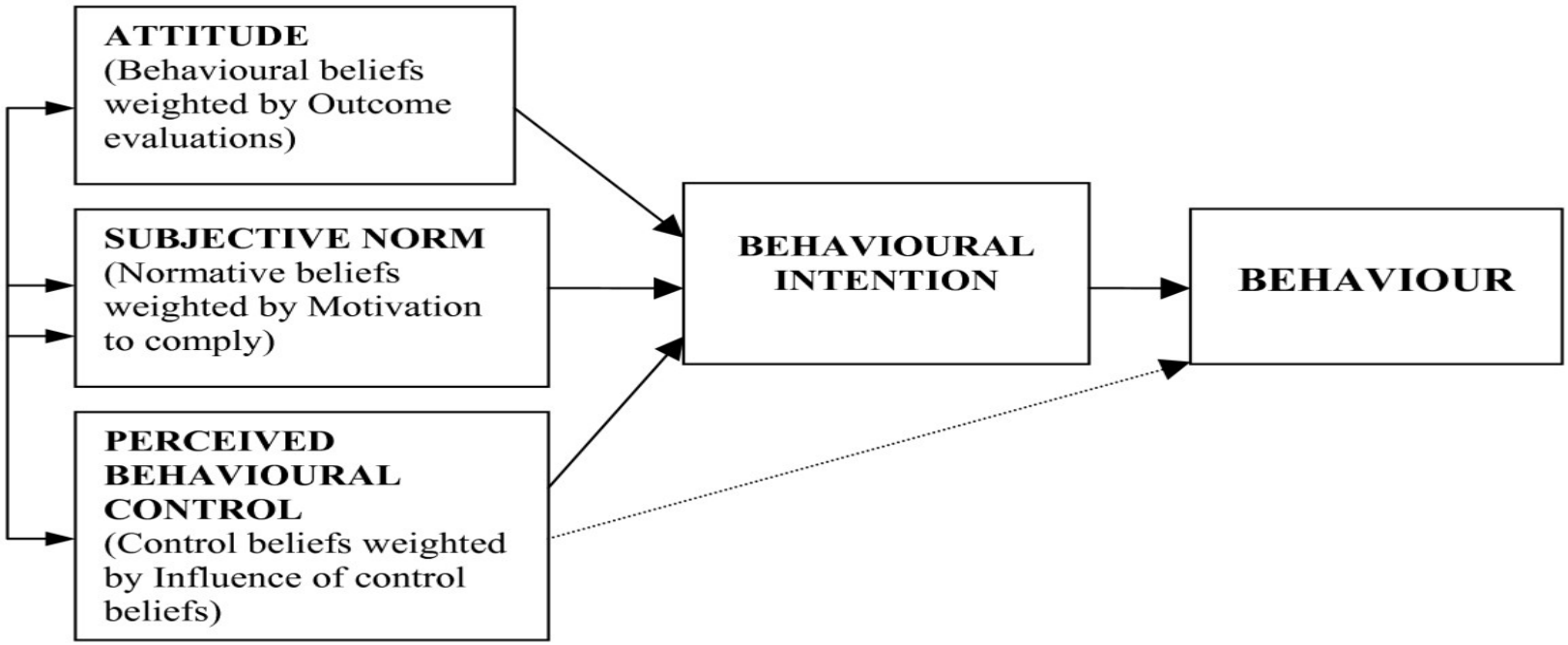
What we do know

- Domestic energy demand differs according to:
  - Size of household (how many adults, children, and their ages)
  - Size of home (ground area, number of rooms, tenure, type of accommodation)
  - Household income
  - Stage of life course (parents, working age, retired)
- But there is no or only modest correlations with:
  - 'green' attitudes
  - Education

Energy demand is only weakly related to cost

- Lots of evidence that energy demand is not price sensitive in a straightforward way
  - Low rate of supplier switching
  - Green deal not successful
- If energy cost decreases (e.g after installation of insulation, more efficient boilers etc.), there is a rebound effect
- Making energy use (and cost) visible is not very effective
  - Providing an energy monitor in the home has a limited and short term effects on usage
- So simple 'rational' economic models won't work

The standard psychological approach



Ajzen, I. (1991). The theory of planned behavior. Organizational Behavior and Human Decision Processes 50 (2), 179 – 211.

Attitudes → Behaviour → Change

An alternative approach: Social practices

Practices = A different way of thinking about everyday activities:

- Actions such as leaving the lights on, showering every day and turning the heating up are not seen as individual behaviours but as embedded within and occurring as part of social practices, such as:
  - Worries and concerns about security
  - Conventions about cleanliness
  - Conventions about appropriate dress in different settings

Social Practices

UNIVERSITY OF SURREY

Definition (Social (Energy) Practices)

In short, practice theory focuses on how *routines*, technologies, infrastructure, skills and meanings together constitute the many different *unnoticed* everyday uses of technologies in households, which result in the households' energy consumption (Gram-Hanssen, 2013).

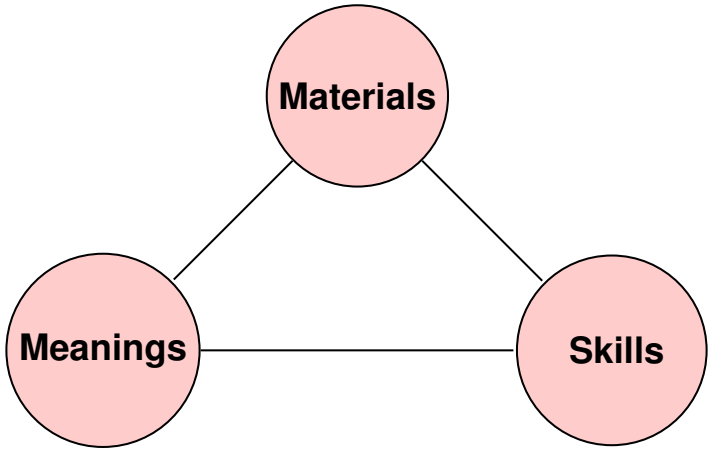
cress

Social Practices

UNIVERSITY OF SURREY

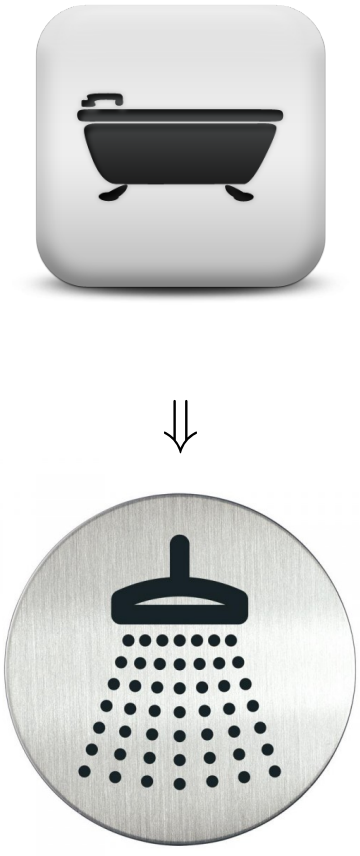
Definition (Social (Energy) Practices)

In short, practice theory focuses on how *routines*, technologies, infrastructure, skills and meanings together constitute the many different *unnoticed* everyday uses of technologies in households, which result in the households' energy consumption (Gram-Hanssen, 2013).



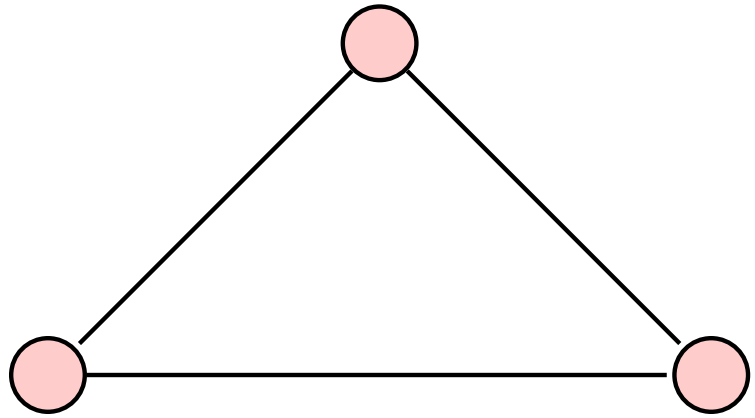
cress

Example



From baths to showers

Meaning: what it means to be clean



Materials: Showers, shower gel, frequent use shampoo

Competence: how to shower

Practice-as-Entity (Giddens 1984)

Giddens (1984):

- practices are recognisable entities that exist across time and space, that depend on inherently provisional integrations of elements, and that are enacted by cohorts of carriers
- practices are carried, sustained and transformed by cohorts of practitioners, but they also shape them
- practices emerge, persist and disappear

Modelling Social Practices

- Elements to be modelled and understood:
  - Life-cycle of & dynamics between practices depending on the practice elements
  - Context/environments that encourage or discourage practices
  - Interaction with carriers of practices (people performing practices)

Modelling Social Practices

- Elements to be modelled and understood:
  - Life-cycle of & dynamics between practices depending on the practice elements
  - Context/environments that encourage or discourage practices
  - Interaction with carriers of practices (people performing practices)

Modelling Social Practices

- Elements to be modelled and understood:
  - Life-cycle of & dynamics between practices depending on the practice elements
  - Context/environments that encourage or discourage practices
  - Interaction with carriers of practices (people performing practices)

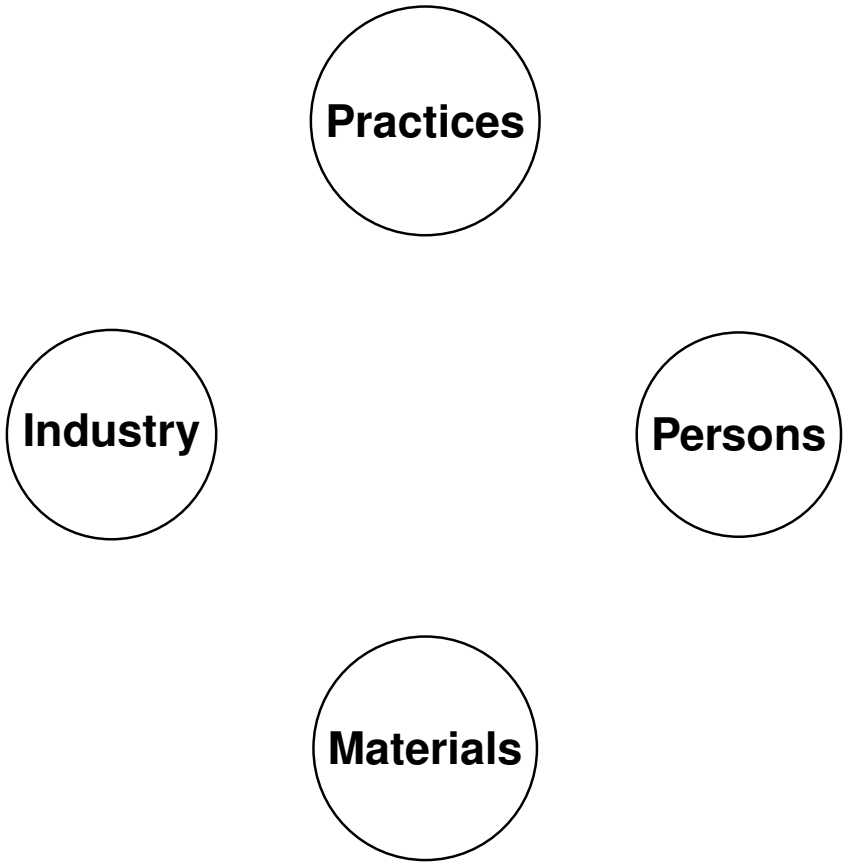
Modelling Social Practices

- Elements to be modelled and understood:
  - Life-cycle of & dynamics between practices depending on the practice elements
  - Context/environments that encourage or discourage practices
  - Interaction with carriers of practices (people performing practices)

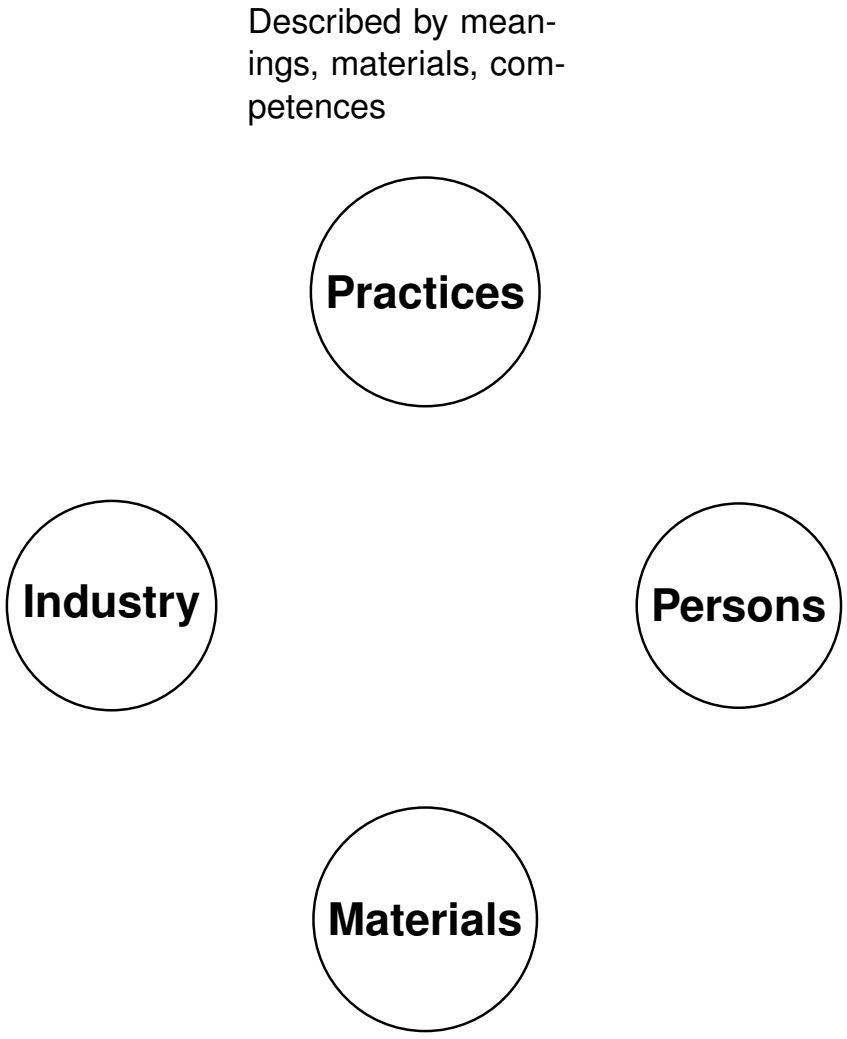
A Early Stage Demo

- focus on different instances of heating practice only
- insulation (Green Deal support) in the UK
- trial model using empirical data from literature and study conducted in Surrey

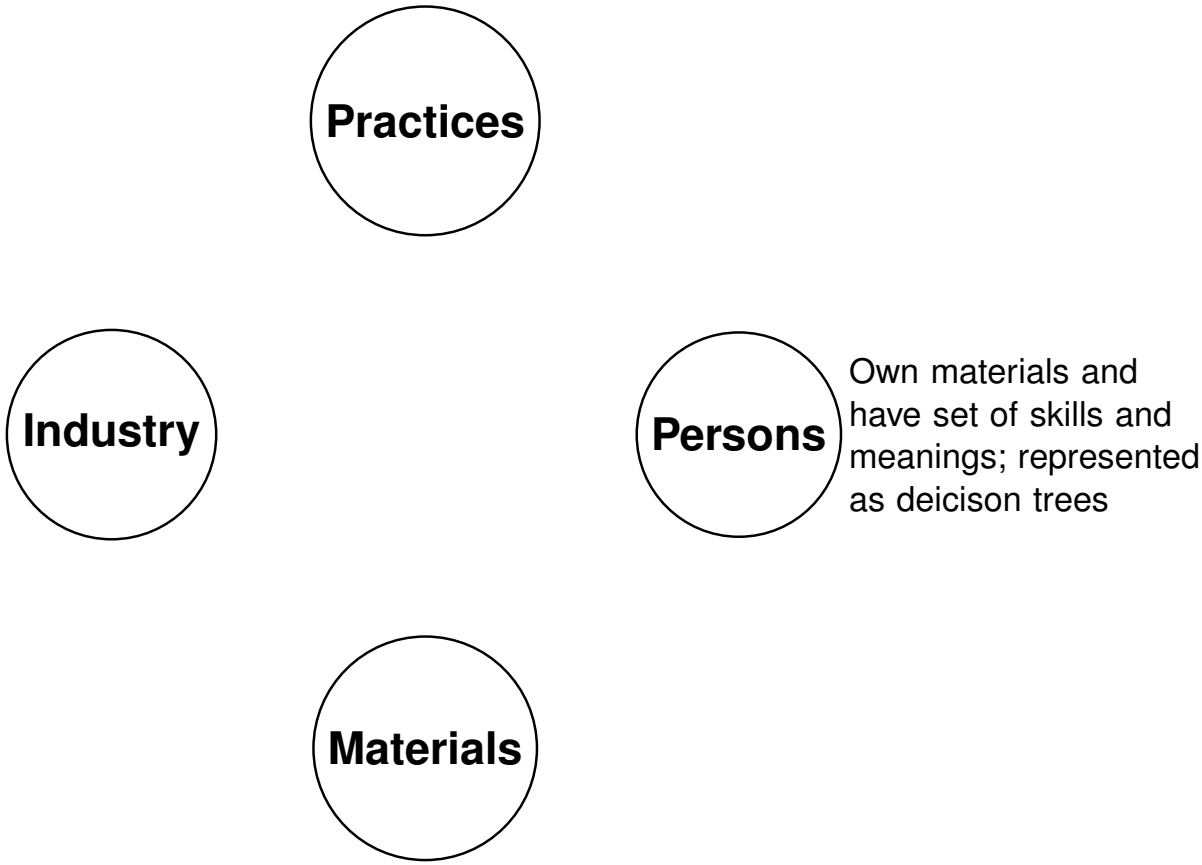
A Social Practice ABM



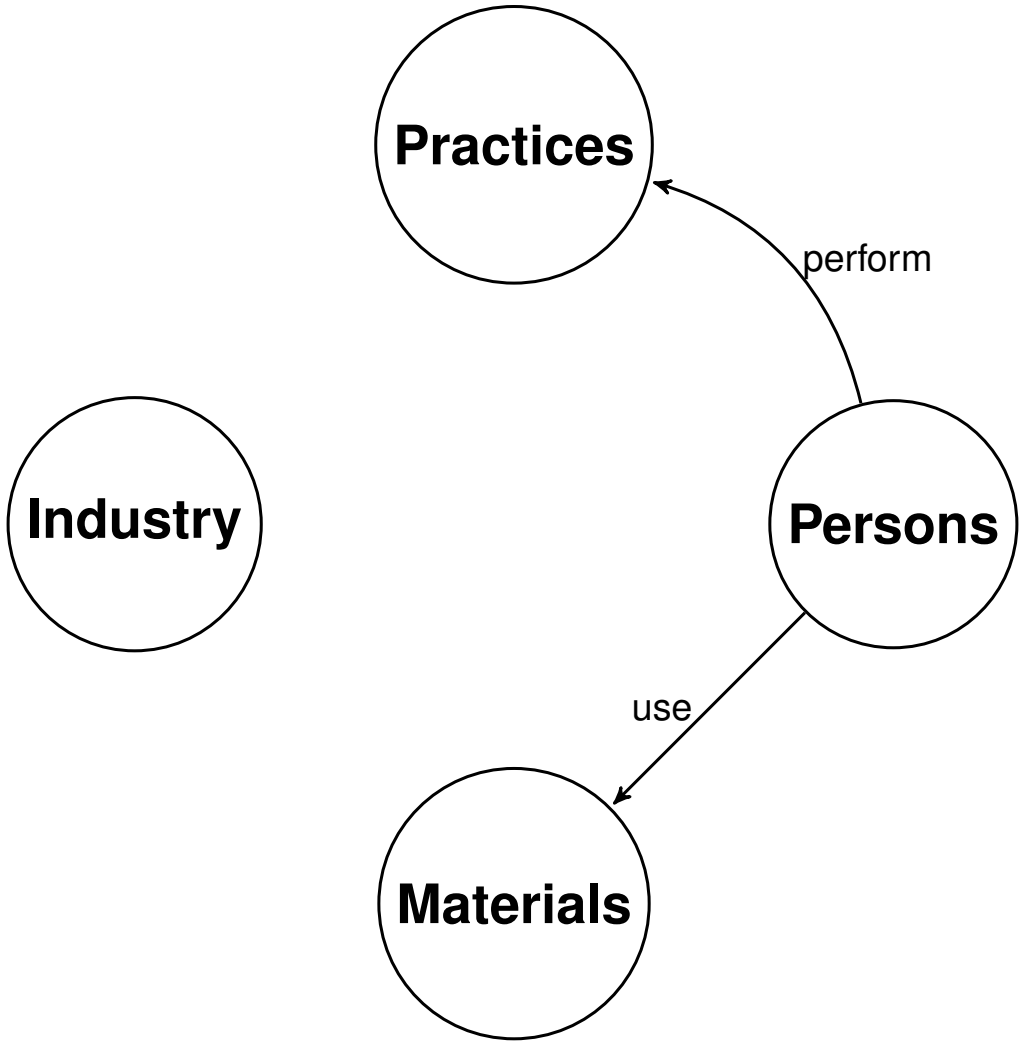
A Social Practice ABM



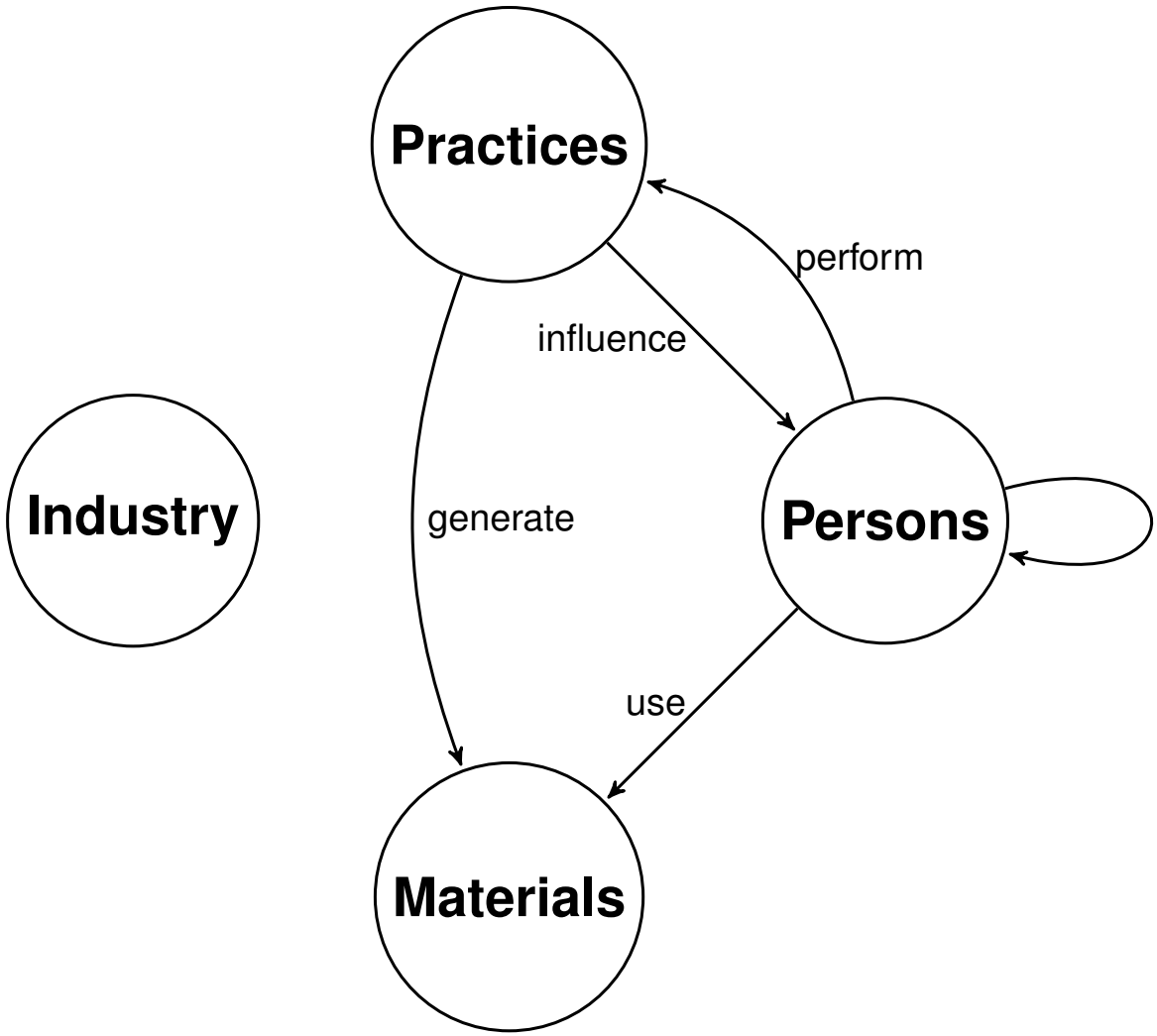
A Social Practice ABM



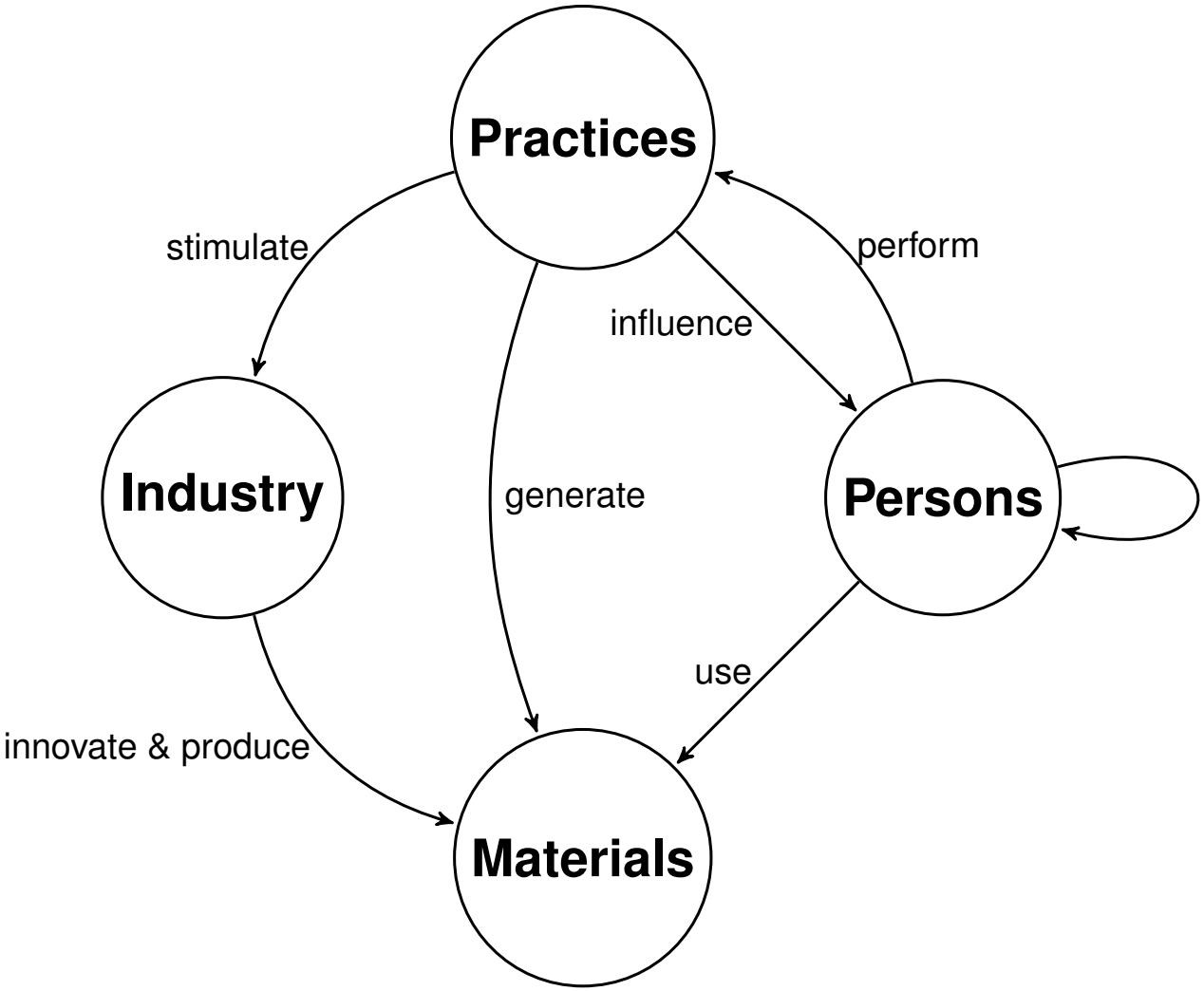
A Social Practice ABM



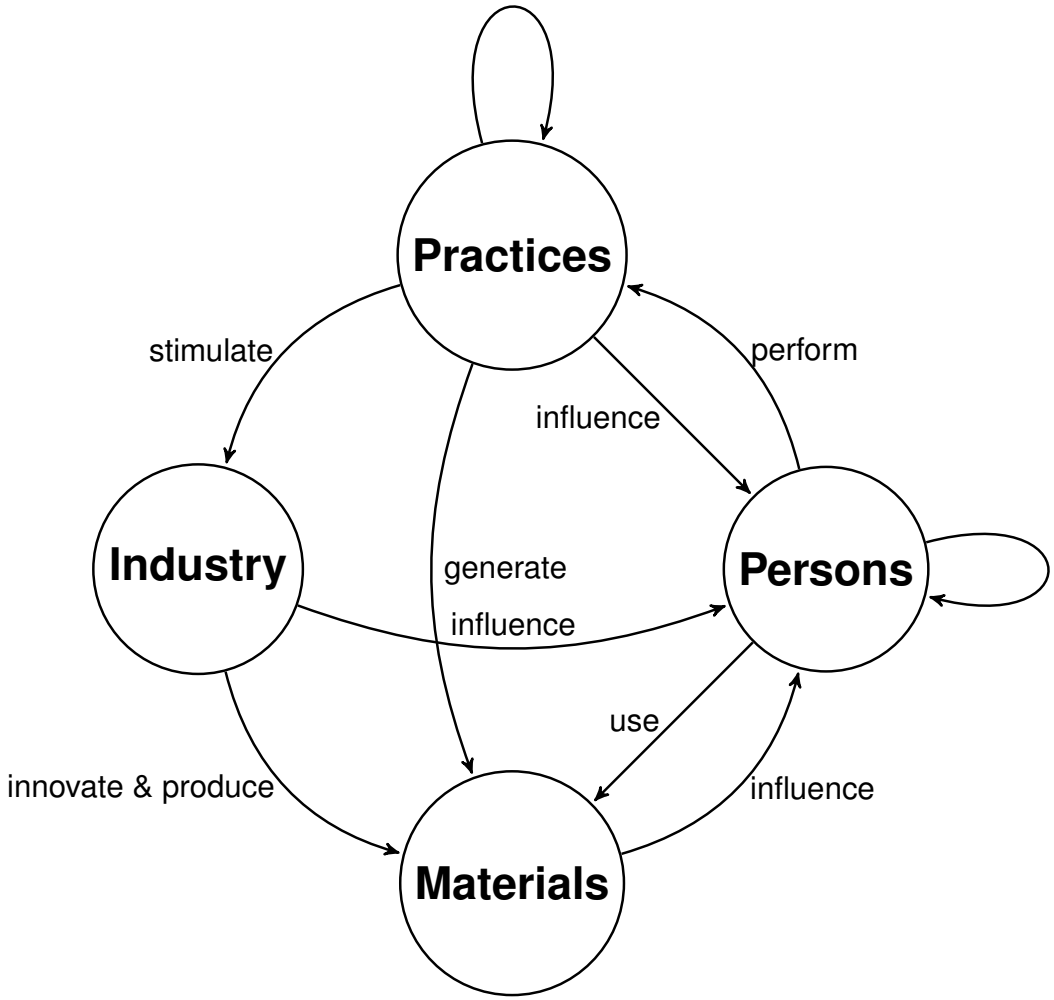
A Social Practice ABM



A Social Practice ABM



A Social Practice ABM



How to take this work forward?

- Collection of empirical data for model conceptualization (collaboration with ENLITEN project)
- Development of more sophisticated ABM showing interaction between practices
- Integration with other energy models (e.g. looking at both demand and supply and innovation)
- Interaction with stakeholders to determine in- and output interfaces

Job

UNIVERSITY OF SURREY

- The WholeSEM project has a two-year full-time post, with the possibility of extension, for a researcher to:
  - take the lead in developing agent-based models of household energy demand and of processes of innovation in the energy sector,
  - integrate these with other models of energy demand and innovation,
  - assist with the installation of energy monitoring in a sample of households to collect live data, and
  - link this work with other modelling activities in the consortium and internationally.
- Desirable technical skills for the post include:
  - knowledge of agent-based simulation,
  - programming in NetLogo,
  - object-oriented programming,
  - experience in using databases (e.g. MySQL),
  - a strong interest in and preferably some formal background in the social sciences.
- For informal discussions about the post, contact Nigel Gilbert (n.gilbert@surrey.ac.uk) or Tina Balke (t.balke@surrey.ac.uk)

cress

UNIVERSITY OF SURREY

Thank you for your attention
Any questions?

Centre for Research in **Social Simulation**

t.balke@surrey.ac.uk