The Open University

Low and zero carbon solutions

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Sustainable Innovation: Building and construction technologies,
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Open University design and environment courses

- T172 Working with our environment: technology for a sustainable future

- T211 Design and designing

- T206 Power for a sustainable future

- T307 Innovation: designing a sustainable future

Climate change: UK policy

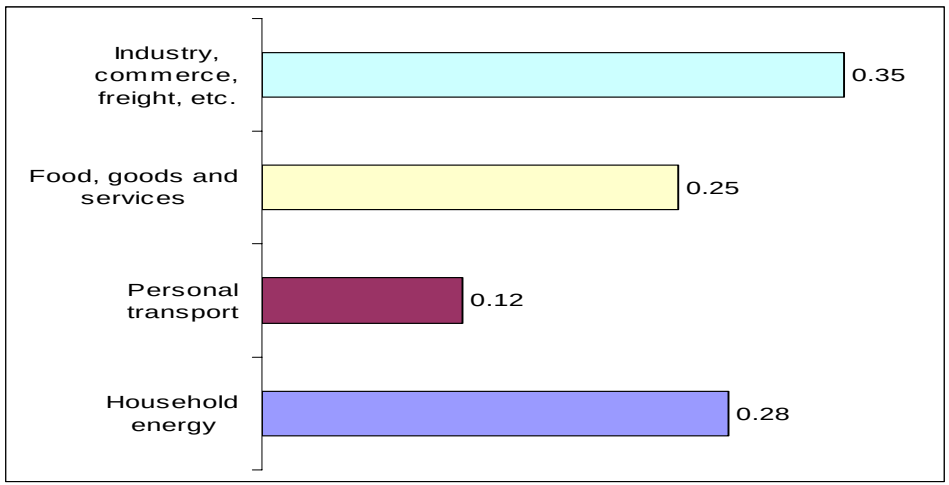
Government targets (from 1990 levels)

- 60% reduction in CO_2 emissions by 2050
- 20% reduction in CO_2 emissions by 2010

Kyoto Protocol requirement

- 12.5% reduction in greenhouse gas emissions between 2008 and 2012

Household carbon emissions: UK



Strategies for household carbon reduction

- Technical:

  Low and zero carbon (LZC) technologies –

  25 million existing UK homes,

  200,000 new UK homes/year

- Social:

  Behavioural and lifestyle change

  Consume less energy

  Use LZC technologies to reduce emissions

Low and zero carbon technologies 1

LZC buildings

- Insulation
  (loft, walls, floors, windows)

- Air tightness

  Draught-proofing;
  Active ventilation/heat recovery

- Passive solar design.

Low and zero carbon technologies 2

Low carbon products

Heating systems
(condensing boilers + heating controls, wood stoves, micro-CHP, heat pumps, etc.)

- Lights
  (CFLs, LEDs)

- Appliances
  (fridges, washing machines, TVs, computers, etc.)

Low and zero carbon technologies 3

LZC energy supply

- Grid supplied
  (renewables e.g. wind; nuclear)
- Local network
- (e.g. Woking private wire, community CHP)
- Household generation
  (e.g. solar water heating, solar PV, micro-wind)

People-centred eco-design:

Consumer adoption and use of low and zero carbon products and systems

- Why consumers do (and don't) adopt energy efficient products and renewable energy systems
- Consumers' experiences of using these products and systems
- Ideas for improving the products and systems to make them more user-friendly and desirable

Adopting LZC products does not guarantee reduced carbon emissions

- Depends on people using LZC products/systems effectively
- Depends on minimising rebound effects
- Provided people don't trade up to more powerful products
- Provided people don't use energy saving to buy new energy-consuming products

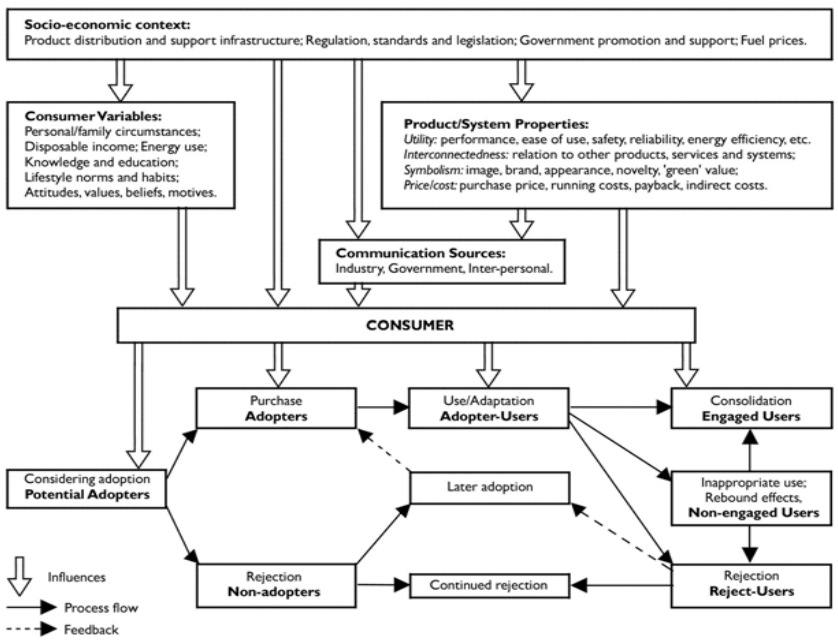
Key influences on consumer adoption and use of LZC products & systems

- Socio-economic context
- Fuel prices; subsidies; regulations

- Consumer variables
- Income; personal circumstances; attitudes

- Communication sources
- Official; interpersonal

- Product/system properties
- Price; Utility; interconnectedness; symbolism



People centred eco-design: methods

- In-depth telephone interviews with consumers who adopted – or considered but rejected – established energy efficiency measures (e.g. insulation, heating controls, low energy lamps) and solar water heating.

- On-line survey of consumers who adopted – or considered but rejected – established energy efficient products and innovative micro-generation systems (e.g. micro-wind turbines, photovoltaic roofs).

People centred eco-design: results

- Shared drivers for consumer adoption of LZC technologies:
  - Reducing fuel bills and/or saving energy
    (especially in the context of rising fuel prices)
  - Environmental concern
    (especially nature conservation and climate change)
- Barriers vary for different products and systems

Established energy efficient products 1:
loft insulation 250-300mm thick

- **Barriers to adoption**
- Loss of loft storage space (37% non-adopters)
- Clearing loft ready for installation (33% non-adopters)
- Irritant mineral wool fibres in insulation (6% non-adopters)
- **Benefits in use**
- Warmer home (58%)
- Lower fuel bills/energy consumption (30%)
- **Problems in use**
- Irritant mineral wool fibres in insulation (19%)
- **Improvement ideas/innovations**
- More user/environmentally-friendly insulation materials (76% adopters)
- Thinner/less bulky insulation materials (60% adopters)
- Systems for storage above insulation (39% adopters)

Established energy efficient products 2:
Heating controls – timer-programmer/TRVs

- **Barriers to adoption**
- Too much trouble to install - TRVs (47% non-adopters)
- Fuel savings not worth cost – programmers (26% non-adopters)
- **Benefits in use**
- Lower fuel bills/energy consumption (40%)
- Warmer home (32%)
- **Problems in use**
- Difficult to read controls/displays (11%)
- Difficult to understand/ know how to use to save energy (9%)
- **Improvement ideas/innovations**
- More ergonomic/inclusively designed controls (56% adopters)
- Controls that provide feedback on energy/money used or saved (53% adopters)
- Automated controls to optimise comfort/energy use (51% adopters)

Established energy efficient products 3:
Energy efficient lighting

- Barriers to adoption
- Large size and ugliness of CFLs (42% non-adopters)
- Incompatibility with existing fittings and/or dimmers (33% non-adopters)
- Harsh light quality (33% non-adopters)
- Benefits
- Lower energy consumption (32%)
- Problems in use
- Leave lights switched on longer (11%)
- Improvement ideas/innovations
- CFLs that fit existing lamps and light fittings (72% adopters)
- CFLs that can be dimmed (55% adopters)

Renewable energy/micro-generation systems 1:
Solar water heating

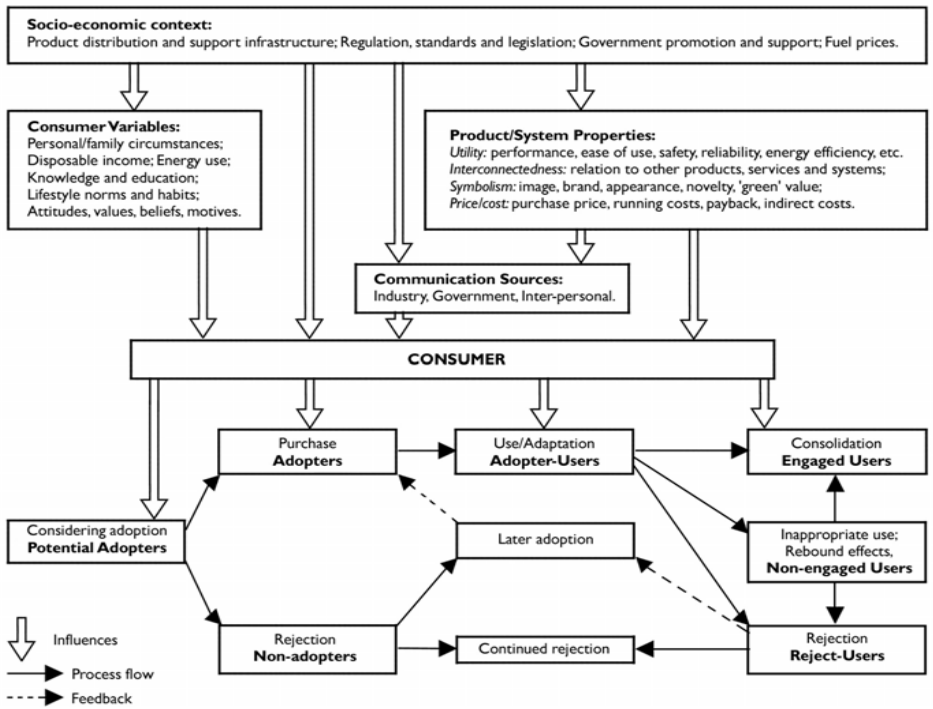
- Barriers to adoption
- Capital cost (73% non-adopters)
- Payback given uncertain reliability and life-time (36 % non-adopters)
- Benefits
- Pleasure at using solar heated water (65%)
- Lower fuel bills/energy consumption (approx. 50%)
- Problems in use
- Incompatibility with washing machine/dishwasher (31%)
- Improvement ideas/innovations
- Roof integrated systems (69% adopters)
- User feedback on money/energy saved (56% adopters)
- Packaged system e.g. condensing boiler + solar WH (48 % adopters)
- Financed by energy supplier, payback via fuel bills (44% adopters)

Renewable energy/micro-generation systems 2:
Photovoltaic roofs, Micro-wind turbines

- Barriers to adoption
- Capital cost (53% micro-wind; 85% PV non-adopters)
- Payback of cost in fuel savings (40% PV non-adopters)
- Planning permission (37% micro-wind non-adopters)
- Benefits
- Pleasure at generating own electricity (31% PV; 11% micro-wind adopters)
- Improvement ideas/innovations
- Building integrated systems (50% micro-wind adopters)
- User feedback on money/energy saved (56% PV; 33% micro-wind adopters)
- Financed by energy supplier, payback via fuel bills (31% PV; 39% micro-wind adopters)

Key influences on adoption and effective use of LZC products and systems

- Product/system properties
- utility; interconnectedness; symbolism
- Price
- capital cost; payback
- Socio-economic context
- Government support; fuel prices; subsidies; regulation; etc.
- Consumer variables
- income; family circumstances; attitudes, etc.



Carbon Connections – micro-generation

- OU project with Energy Saving Trust for technical and user evaluation of micro-generation systems (Scoping study funded)

- Focus:
- Solar WH; Ground source heat pumps; Biomass stoves/boilers
- Sample: LCBP applicants/adopters (managed by EST)

- Aims:

  Drivers and barriers to adoption of these micro-gen technologies
  Existing knowledge on performance of these micro-gen technologies
  Technical and user evaluation of one of these micro-gen technologies
  Knowledge transfer to industry of ideas for improving these micro- gen technologies

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