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Public acceptance of resource efficiency strategies to mitigate climate change

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Supplementary Note 1

Consumption and production-based accounting

Greenhouse gas (GHG) emissions can be accounted for in different ways[1]. Currently the UNFCCC measures emissions geographically by territories, counting GHGs produced within a country's territory, hence excluding international aviation and shipping from all countries (these are included as a memo in UNFCCC inventories). A production-based inventory takes an economic definition and assigns emissions associated with production units and residents belonging to a country, whereas a consumption-based approach measures emissions associated with the consumption of goods and services consumed in a country (i.e. associated with the expenditure of a country's residents). Consumption emissions are equal to production emissions minus emissions embodied in exports to be consumed abroad plus emissions embodied in imports to meet final consumption. Emissions assigned to households from a territorial perspective include only the operational emissions produced directly to heat homes and drive cars. From a consumption perspective, all the emissions embodied in goods and services consumed by households are allocated to them, in addition to direct emissions from heating and private travel.

A UK comparison

While the UK officially reports its climate targets from a territorial perspective, many studies compare production and consumption-based emissions, finding that industrialised countries like the UK embody more emissions in their consumption than is produced within their territories or from their resident institutional units[1-5]. In the region of 50% of GHGs associated with UK consumption are emitted within the UK, with the remaining half emitted outside the UK[4,6,7]. The UK imports materials and products increasingly from industrialised countries like China, which tend to have been produced with a more coal-intensive energy mix, to satisfy their consumer demand[8]. This trend is representative of similarly industrialised countries[8-10].

Focusing on household emissions, 151 MtCO2e were directly emitted from private transport and home heating in 2015. In this sense, household emissions include private car travel, which is often attributed to transport, not the residential sector, in accounting measures. Hence, this value will be higher than those reported as the UK residential sector in UK GHG emissions national statistics. 151 MtCO2e is 17% of the UK's consumption-based footprint and 26% of its territorial footprint. From a consumption perspective, all the emissions embodied in goods and services consumed by households are allocated to them, which contribute around 80% of the UK's consumption emissions account. The remaining 20% is embodied in public procurement and large capital infrastructures.

In this paper we have focused on emissions embodied in carbon intensive non-consumable materials and goods common to households: clothing, footwear and textiles; packaging; vehicle manufacture; electronics and appliances; furniture; leisure equipment; and construction (buildings and transport infrastructure). Collectively they embody around 13% (75 MtCO2e) of emissions satisfying household demand, albeit the majority of these, over 80%, are emitted along manufacturing supply chains outside the UK.

Supplementary Note 2

Strategy allocation and avoiding double counting

Demand for some products, such as cars can be reduced across all strategies, e.g., cars can be redesigned (using less metal), can be used more intensively (through car clubs), or can be used longer before replacement (see Supplementary Data 1). Our case studies suggest a maximum technical potential of 45% steel reductions and 25% aluminium reductions are possible without material/alloy changes to cars sold to UK consumers [11], with 10% metal savings in each in the low adoption case. Whilst evidence on reducing car use through car clubs is limited, UK studies have found reductions in car ownership of 1 in 6 across its members[12]; we assume maximum adoption rates of 10% of households (going beyond best practice), retaining the current 1% adoption in the low adoption case. For longevity, we assume household cars remain in use for 1-3 years longer than the average 13 year lifespan, for between 33% (low adoption) and 100% (high adoption) of UK car owners. The analysis only includes emissions savings from manufacturing and does not include operational emissions savings, although clearly lighter cars reduce operational emissions too[13]. If we were to run each scenario individually and sum the emissions savings together we would overestimate reductions across cars. Using a lightweight car for longer saves less than using a conventional car for longer. Therefore, when calculating the overall savings we combine the changes to calculate the effect of a combination of measures.

Supplementary Note 3

Motivations for consumption-based accounting

The international imbalance of traded emissions raises important policy issues as to whether high consuming countries should take on higher mitigation targets to reflect emissions embodied in their final consumption[14]. This socio-economic inequity among countries is the premise of the UNFCCC's common but differentiated responsibility and respective capabilities (CBDR-RC) as a means to allocate responsibility for climate mitigation to countries. While there are a number of equity based attribution principles given in the literature[15-19], there are studies that suggest a country's climate targets should be adjusted to include net traded emissions[20-22]. Afionis, et al. [23] present the case for consumption-based accounting, suggesting that this approach is more just, increases the scope of emissions reductions, and encourages cleaner production processes. They provide examples of policies that could address consumption within todays political framework, including trade mechanisms, performance standards for embodied emissions (covered in more detail in Scott, et al. [24]), reducing consumption of goods and services, consumer information and awareness, and public procurement.

Afionis, et al. [23] and Scott and Barrett [20] demonstrate how consumption could unlock new opportunities for climate policy innovation and demand-side mitigation measures. For example, reducing food waste by households has shown to reduce emissions to comparable levels as low carbon energy investments in Bristol city in the UK[25]. Further studies have shown the mitigation potential of demand-side measures from a consumption-accounting perspective[26-30].

There are a number of advantages for redesigning and using products for longer. Scott, et al. [24] present evidence showing that further gains in energy efficiency are limited as energy is a major cost factor and has already driven energy efficiency improvements. Material efficiency along supply chains therefore offers new avenues for emissions reductions and this is demonstrated in the UK construction sector where companies have reported up to 40% reductions in embodied carbon combined with a 25% cost saving in just a few years[31]. In addition, demand-reduction can circumvent high costs, risks and uncertainty involved in unproven carbon capture and storage (CCS) technologies[32], which could raise producer prices much higher than estimated carbon prices in the EU ETS, in the cement sector for example[33].

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Supplementary Methods 1 - Deliberative workshop protocol

Day 1

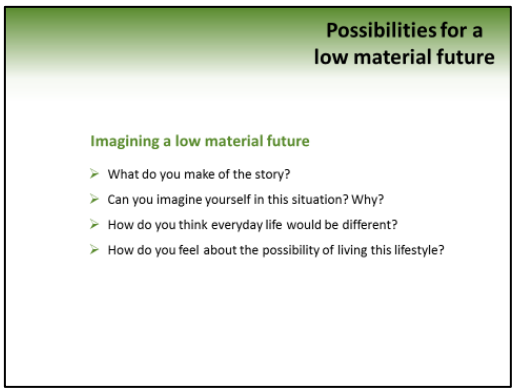
Time	Length	Task		
10:00	20	*Coffee and Consent*		
10:20	10	*Welcome and Introductions*		
10.30	20	**Presentation 1 – Changing consumption** (10-12 minutes)		
10.50	50	**Task 1 – Biographies of consumption**		
11.40	10	*Comfort break*		
11.50	30	**Presentation 2 – Challenging consumption**		
12.20	40	*Lunch*		
1.00	30	**World Café Scenario 1**	**World Café Scenario 2**	**World Café Scenario 3**
1.30	30	**World Café Scenario 4**	**World Café Scenario 5**	**World Café Scenario 6**
2.00	15	*Comfort break*		
2.15	30	**World Café Scenario 2**	**World Café Scenario 3**	**World Café Scenario 1**
2.45	30	**World Café Scenario 5**	**World Café Scenario 6**	**World Café Scenario 4**
3.15	30	**Presentation 3 – Climate change and embodied energy**		
3.45	15	*Debrief and homework activity explanation*		

Day 2

Time	Length	Task
10:00	20	*Coffee and welcome*
10.20	20	**Poster activity – Strategies for a Low Material Future**
10.40	20	**Group discussion 3 – Strategies for a Low Material Future**
11.00	45	**Task 3 – Photo task**
11. 45	45	**Task 4 – Writing a product obituary**
12.30	45	*Lunch*
1.15	30	**Task 5 – Create your future**
1.45	15	**Group discussion 4 – Achieving a low material future**
2.00	15	*Debrief*

World Café – low material scenarios

(Day 1 - 1.00-3.15)



- Ok thank you. So I'd like to just quickly explain how afternoon sessions are going to work. We are now going to explore each of the categories we talked about before lunch in more detail. We'll be working in small groups again and will each get to talk about 4 of the low material strategies in detail. For each strategy we have a detailed scenario of what it might be like to live in a future. This takes the form of a story of what everyday life might be like in the future for people like you. So what we want you to is just try and imagine yourself in this world, put yourself into the story and think about what you might think or feel in that situation. Obviously each story is about a different person at a different stage of their lives. This may not fit your circumstances exactly, but please bear with us and try to imagine yourself in this situation, even if perhaps you don't have children or are not yet retried etc. Think of what it might be like for you, in your everyday life to live in this way.

Topic prompts for scenarios

- Scenario 1: Rethinking Products – product longevity; modular/repairable products; different materials; virtual products; hardware upgrades; 3D printing
- Scenario 2: Rethinking Business – repair of products; extended producer responsibility; return schemes; upgrading products; product monitoring and data
- Scenario 3: Rethinking Ownership – contract for service (home); car leasing; procurement contracts; closed loop services
- Scenario 4: Rethinking Community – sharing economy; online trading/sharing; community sharing/trading; community currency; repair networks and training; library of things
- Scenario 5: Rethinking Waste – packaging materials biodegradable/recyclable; waste collections or pay per weight; electronics and product collection schemes/centres/costs; urban mining
- Scenario 6: Rethinking Lifestyles – home/flexible working; intensive use of space; small/shared living space; reduced product ownership; VAT/tax/quotas for material use; automatic cars; holidays in UK

Poster activity – Strategies for a Low Material Future

(Day 2 – 10.20-10.40)

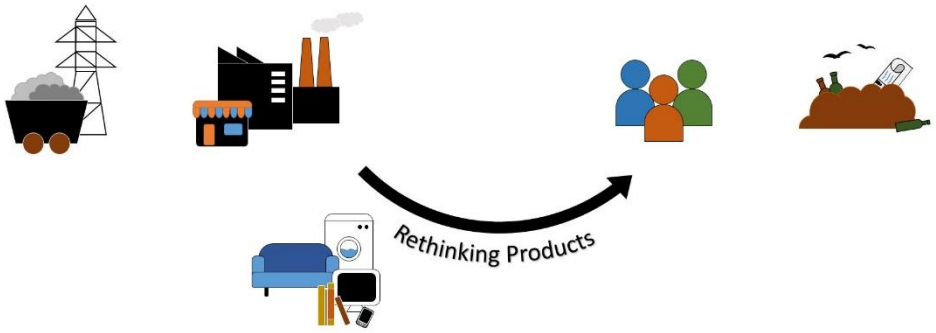
- So to start us off today, and help everyone remember the different low material products, services and lifestyle choices we talked about last week, we'd like everyone to take a look at the posters we've put up on the wall. There is a poster for each of the 6 futures we talked about last week. We've given everyone some stickers, so what we'd like you to do is have a wonder round and use them to show how positive (or not) you feel about each of the options are to you. So green for positive (acceptance/approval), yellow for neutral and red for negative (unacceptable/disapprove). You're free to chat if you want to, but this is a chance for you to have a think about it and note you own personal opinion. Later on we'll be a similar activity in groups.

Supplementary Methods 2 - Scenario materials

Scenario 1 – Rethinking Products

After retiring 6 months ago, you wake up slowly and enjoy your coffee over a leisurely breakfast. You put some eggs on and slice the bread for the toaster, but for some reason when you try and use it, it won't push down. You open up the back to see if you can find out what's wrong – one of the plastic levers has snapped! Oh well, at least it isn't an electronic fault, if you download the part specification from the manufacturers website you should be able to get a replacement printed at the library this afternoon. Over breakfast you watch the national news and catch up with what's going on locally from your tablet computer. All media is digital now and you make the most out of online services to keep up to date with the news, stream music and films, and interact with friends and wider society. Just like the VHS tapes you used back in the day, DVDs are very out of date now and only dedicated collectors keep any at home. Even books are mostly digital – you still enjoy visiting the library and borrowing a classic book from their collection, but few new books, whatever the genre, are no longer printed nowadays. On the way into town, you reflect on how much the things you own have changed in your lifetime. One way or another, they tend to last much longer now, whether that's through simple design, or through modular and replaceable parts. Most of the materials that are used are also recycled now, from the plastics that make up appliances and products, to the recycled steel in the new modern buildings that have been flying up all around the town. You take out your phone to check for messages and are pleased when you think how long it has lasted in comparison to the old fashioned phones of your youth – after 5 years, two upgrades and one repair, it's still working fine! You reach the library and head over to ask the staff to print you out a new part for your broken toaster, it will only take 10 minutes or so. Hopefully soon you'll be able to use the machines yourself. You've signed up for an evening course to learn how to use the 3D printers they operate. 3D printing has become a key part of modern life now and you don't want to be left behind – apparently you can even print a house, if you have a larger enough printer! Many people, including your son, now have a small 3D printer in their own home – and those that don't make use of communal printers such as those at the library. The course will teach you how to download, manipulate and 3D print existing designs, allowing you to produce spare parts for broken products, as well as small items for your home. It's second nature for your grandchildren's generation, so it's about time you learnt how to harness this new technology.

Rethinking Products



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Examples

1) Redesigning products

The Agency of Design proved you can redesign products in a number of ways to increase product lifetimes and prevent the need to replace them so often.

Here the toaster is redesigned in three different ways:

Durable toaster

Design for longevity

A durable toaster with few moving parts. Designed not to break.

Disassembled toaster

Design for disassembly

A toaster designed to be easily disassembled for reuse and recycling.

Modular toaster

Modular design

A toaster designed to be modular for easy replacement of broken parts.

Company logo

Ethical mobile phone

Company logo

Modular mobile phone

2) Design for social values

Redesigning the smart phone to:

- Conflict free minerals
- Design for longevity
- Modular design for repair/upgrade
- Take back of old/broken phones

3) 3D printing

3D printer

Company logo

How it works:

1) Product designs created on computer
2) Designs sent to the 3D printer
3) Printed by building up layers of plastic (or other material) to correct shape

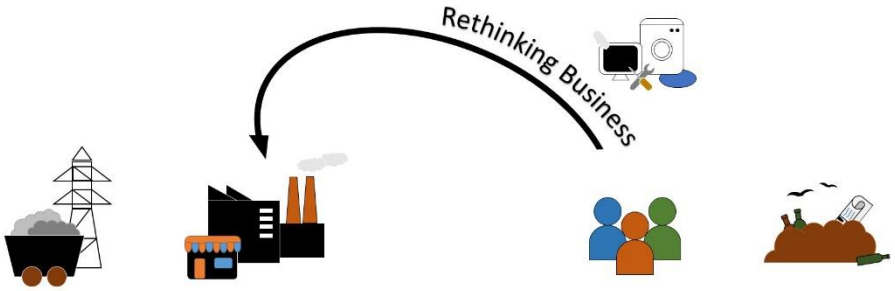
Possible benefits:

1) Allows for design/customisation of products
2) Allows local production of products
3) Allows easy production of replacement parts

Scenario 2 – Rethinking Business

Nursing a slightly sore head from the night before, you slowly ready yourself for the day ahead – at least you don't have any lectures to attend this morning! You can't stay in bed though, as you've got a few things to sort out before you go to class and revision to do. You grab your bag, your laptop and your notes and head into town – meeting a friend for lunch was a good plan and you'll compare notes for your upcoming exams. On the way past, you pop into the store where you bought your laptop last year. Annoyingly, it's has been on the blink for a while now, and you can't live without it at this point in the semester – hopefully the technician will be able to have a look at it within the next few days! It's great that all products now extended warranty that requires the manufacturer to repair and maintain it over its whole lifetime, as well as reuse or recycle the components once it eventually stops working! Ultimate responsibility for products is now with producers and retailers, and you wonder why this wasn't always the case. It is a bit of a hassle though, waiting while they try and work out what's wrong. You meet your friend and wander around the shops for a while before settling on a place to eat. As you walk past your favourite fashion store, you remember you need to drop off some old clothes you don't want anymore. You reach the counter and pull out a small bundle of slightly battered clothes, you wish they'd last longer, but at least you can return them to the shop for recycling – it's amazing to think that old clothes and shoes can now be remanufactured to create a whole new outfit! As you eat, you notice the adverts flash across screens outside the café, there's a new upgrade available for your phone that updates the camera module, so you don't need to buy a different model. These kind of upgrades are now included in your contract, so maybe you'll look into it at the weekend. After lunch, you finally arrive at the university and settle down for an afternoon of lectures. You've been studying sustainable design now for the last two years and you can't wait to put some of your ideas into practice once you graduate. Over the summer you'll be on placement with a company that manufactures and maintains the engines for aeroplanes. You've read a lot about how they've designed the high quality engines to be long-lasting and repairable and how they track each engine's location and condition so that they can make the most efficient use of their time and resources, recalling them for service, repair and upgrade as required. They definitely take responsibility for their product and provide a good service as well. It will be a steep learning curve, but hopefully a great boost to your career!

Rethinking Business



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Examples

1) Maintenance and repair

Businesses provide repair and maintenance services for all products they sell. Some companies already provide this service e.g., Patagonia's outdoor wear.

New repair businesses could thrive increasing repair of existing products.

Repair company graphic

Electrical repair

Repairable clothing

2) Incentivised return

Businesses provide incentives to consumers to return products that they no longer require (for whatever reason). Service is already available in some high street stores.

Company logo

Company logo

Company logo

3) Remanufacturing

Used products and materials are returned to the manufacturer who restores/repairs/recycles the materials to their original standard.

This process has already been trialled for popular sports brands but has not yet taken off mainstream.

Company logo

Diagram showing clothing remanufacturing process

4) Extended warranty

All products now come with product lifetime guarantees, which ensure that businesses and manufacturers guarantee the repair of faulty parts or products and the responsibility for remanufacture/recycling of a product at the end of its life

Durable washing machine advert

Scenario 3 – Rethinking Ownership

You wake up suddenly at the sound of your alarm. You've got a big day ahead at work, but first you need to get everyone out of bed, cook a quick family breakfast, and put the washing on! As everyone else gets ready around you, you scoop up the bundles of clothes that have been unhelpfully deposited throughout the house and stuff them into the washing machine. You choose the programme and set the timer, but for some reason nothing is happening – today of all days! You grab your tablet computer and search for the contact details of your supplier. Found them. You'll give them a ring in your lunch break and ask them to pop round ASAP to find out what's gone wrong. To be fair, inconvenient as it is, this is the first time the machine has broken down in the 3 years since you started the contract, and £15/month is a pretty good deal, with installation, service and repair, and washing detergent are all included. Plus you'd never be able to afford this high quality model outright. You make sure the kids are ready for school, and are grateful that you live near enough for them to walk, while your partner can cycle to work. With your job taking you all over the county, public transport isn't really an option, but your salary includes an allowance for travel. Owning your own car is quite uncommon nowadays – instead you opt to 'lease' an electric car. It's renting, but not like the old days! As you drive through the countryside, you remember the email alert reminding you that your second annual service is due and that in 1 years' time you can either renew the contract or return the car. You contemplate upgrading to a different model, but you're pretty pleased with the stylish, aerodynamic look of this car and the 300 mile range is plenty for your needs. You stop in at a local charging station – it only takes a few minutes – and as you swipe your phone against the reader, you are thankful that the electricity that powers the car is also included within the contract. You make it to your destination, just in time for your first meeting. Your company has recently been contracted to manufacture and manage the office environment for all Local Authority buildings. You describe how you will provide all required office furnishings, from flooring and lighting, to furnishing such as desks, chairs and seating areas, and how you will monitor and maintain these as part of the contract, as well as making any adjustments should any of their needs change. The executives are satisfied with the use of recycled materials and most importantly, that the system is 'closed-loop', meaning that once products are damaged or unwanted, they will be refurbished back to an as new standard and reused, either here or elsewhere. You're pleased to see the Local Government is leading by example on this one – maybe one day homes will all be furnished this way too!

Rethinking Ownership

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Examples

1) Washing as a service

Bundles is a Dutch company that provide you with a high quality and resource efficient washing machine on a pay per wash contract.

- Flat fee per month for a set number of washes.
- Includes installation, service, repair, detergent, upgrade.

Stills from "How it works" animation

Company logo

Washing service pricing plans

2) Printing as a service

HP provide a pay monthly printing service. You still buy the printer, but pay flat fee to print a specific number of pages per month.

Ink levels in the printer are monitored so that new ink can be provided before the cartridges run out.

Company logo

Printing service "How it works" and pricing plans

3) Transport as a service

Riversimple will aim to provide an inclusive mobility service on a contract basis, but will retain ownership of the car itself.

Example contract – 3 year duration; pay monthly instalments; car, service, MOT, insurance, fuel all included.

Car – innovative design that is light and aerodynamic; durable materials like carbon fibre; runs on hydrogen fuel.

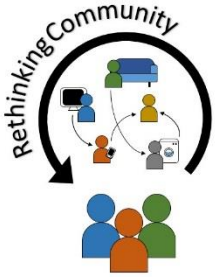
Company logo

Transport service car advert

Scenario 4 – Rethinking Community

Mornings are always hectic in your house. With three kids to look after, you only work part time now, and you're glad of the extra time to take care of all those small chores which keep the family home running smoothly! Once your partner and two eldest children leave the house, you write a list and get going. With your youngest nearly 18 months old now, he's growing like a weed and it's time to go through the drawers again and get rid of some of the clothes that are a little on the small side – no point having them cluttering up the house. You carefully select some of the nicer, less worn items to photograph and add to your online trading account. Other people can make use of things that you no longer need, and you can make a little money in the process! You enjoy a coffee and take twenty minutes to quickly scan through a few other popular websites that let you buy, sell or swap common household items and clothing – some things are even being given away for free! Later on, you sort through the remaining baby clothes, separating them into two piles, one for the local swap shop and one that's only fit for recycling. You bag up the first pile, grab the pushchair and head for the local community centre. The centre is now a hub of activity, with people from all over the neighbourhood making use of the many services it offers, as well as the chance to catch up with neighbours and friends in the café. You drop off the bag of clothes with the staff, who quickly process it and add 5 credits to your community 'ResourceBank' account. You'll need these credits later on – either to buy items from the swap shop or to buy the time of other local residents who have skills and equipment that you don't. It was great to get help with a leaking pipe last week – much better than calling an expensive plumber. You notice a poster for the Hackspace and Repair Café on the wall and remember that your teenage daughter will be late home this evening. For months now, she's been attending weekly workshops that bring creative people together to share ideas and experiment with repairing and upcycling old products. It's becoming a common hobby now amongst her friends and you're glad she's learning new skills in the process. On the way back you pop in at the library. You've always loved looking through the shelves for a good read, but this time you're here to make use of their new service – the Library of Things. All sorts of things are now available to borrow, including DIY and garden tools, kitchen appliances, luggage and electronics. You pick up a power drill (and a smoothie maker for the kids), and sign them out before heading home. You'll be pleased to finally get that new mirror up on the wall, and it's great you didn't have to shell out for an expensive drill in the process.

Rethinking Community



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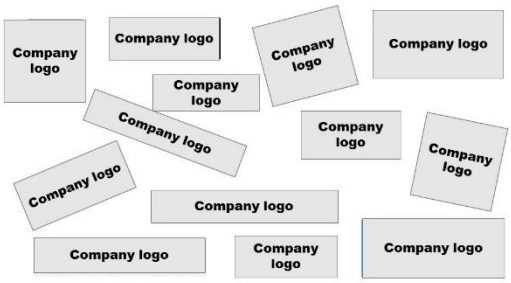
Examples

1) Peer to peer trading

Peer to peer selling, renting, swapping, lending and giving.

Expansion of well known businesses that help citizens trade products (e.g., eBay and Freecycle) and services (e.g., UBER and Airbnb) avoiding the need for purchase of new products and services.



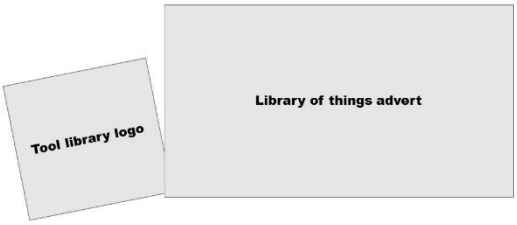
2) Community skills and education

Initiatives to give people new skills and encourage them to repair and upcycle their products. Includes:

- Drop in centres. The Restart project runs drop in sessions on specific products and more general repair skills.
- Hackspaces. Spaces for people to come together to create innovative new ideas and products.
- Repair education iFixit provides online tutorials to repair many common products.

3) Community sharing

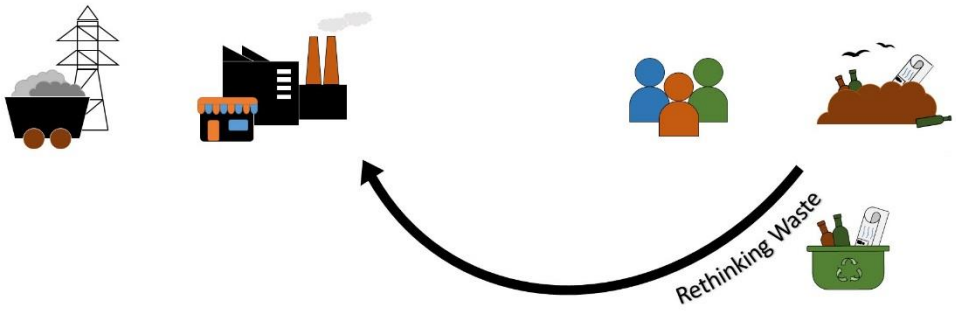
Centralised community schemes to help people avoid purchasing unnecessary new products through the pooling of local resources. This idea of a community library of products could take a physical form, e.g., the Library of Things or the Toronto Tool Library, or be an online database loaning items from different locations.



Scenario 5 – Rethinking Waste

A rumbling sound moving down the street wakes you at 7am – at least you remembered to put the bins out last night so this time you don't have to run downstairs in your dressing gown! You head downstairs and after a quick cup of tea, start making breakfast (and lunches) for the family. You notice how different packaging is now compared to when you were younger – the rules around packaging have been steadily tightening over the last decade – for one thing there's a lot less of it. With standardised plastics, cellophane and tetra packs it's rare now that you can't recycle the small amount of packaging you do end up with. Which is a good job too, because since they started charging by the kilogram for the left over rubbish that each household produces you want your black bin to stay as empty as possible! Once everyone's left you take a shower and relax whilst you wait in for a parcel to be delivered. Once it arrives, you notice that instead of using polystyrene, they are now using a new type of biodegradable packaging to protect products during transport – apparently it's made of mushrooms! If you lived in the city you would dispose of it in the food waste collection that all councils now have to provide, but since everyone in the countryside has their own compost bin you just pop outside and leave it to rot down – it's great that packaging can now be turned into plant food for your veg patch. You need to pop out this afternoon, but before you go, you remember to nip online and request a recycling collection for your broken hairdryer and a few other bits and pieces – things have changed now that everyone is personally responsible for the correct disposal of all their waste! You select the 'Small Electrical Appliances' category and pay the small charge, as at least this saves you a trip to the local Reuse, Repair and Recycling Centre. You grab your bag and head out of the house – don't want to miss the bus. You enjoy the view as the bus winds its way through the countryside, and as you pass the entrance to the old landfill site you wonder what treasures are being unearthed today. It must be a hard job working on the urban mine, but it's surprising how much of what used to be considered waste can now be recovered and reused! As you reach the city you wonder what uses all the different materials are being put to – pretty much everything has a second life now, as clothes, toys, washing machines, kettles, carpets, sofas, cars, and even buildings!

Rethinking Waste



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Examples

1) Eco-friendly packaging

Packaging is kept to a minimum for all products.

Innovative new packaging materials become available, such as the Ecovative biodegradable packaging produced from mushrooms.

Biodegradable packaging

Company logo

Biodegradable packaging

2) Urban mining

A significant amount of resources have been buried in landfill sites, including valuable metals and plastics, as well as many whole items that could be refurbished. It might be possible to excavate these resources to recover them for safe use and recycling.

Photo: e-waste

Photo: landfill

3) Household waste and recycling

Changes to the way we collect and treat our household waste. Suggestions include:

1) Pay-per-kilo collection for non-recyclable waste
2) Kerbside collection of all products for recycling, such as small electronics and appliances.
3) Expanded household waste centres to include reuse and repurposing of items

Recycling centre leaflet

Photo: recycling bags

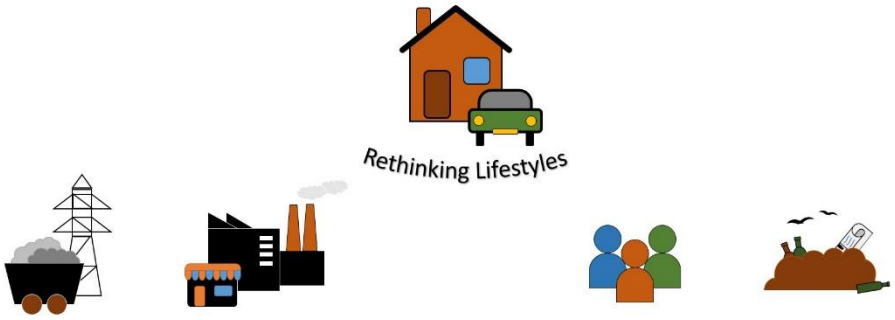
Photo: Kerbside recycling collection

Photo: Household recycling centres

Scenario 6 – Rethinking Lifestyles

You wake up slowly, the flexible working hours of your new job mean you don't have to rush to get up in the mornings, or commute across the city to work every day. You work from home most days, only heading into the office for big meetings that can't be held over video-conference. Space is used much more intensively nowadays – although come to think of it, it doesn't really make sense for offices to be empty all night, whilst homes are empty all day. You live alone in a small one bed flat, but you aren't lonely. There is plenty of communal space in your apartment block, including a social room with fully equipped kitchen and roof gardens. There is also an office hub on the top floor that provides hot desks and office equipment – you make a mental note to pop up there later on to use the printer and to get out of the flat. After a few hours, you visit the communal kitchen for a bite of lunch with some of your neighbours, you do have a small kitchenette in your flat, but what's the point of cooking just for one. When you were a child everyone had every new gadget on the market – most people own a lot fewer things now. After work, you wander through town on the way to meet your partner. You need to pick up a few things for your upcoming holiday, including a new set of headphones. You carefully consider which set to choose – the prices of different items have changed a lot since VAT was abolished in favour of a tax on material use – products that make use of renewable or recycled materials are now a lot cheaper. You think of your sister, who is currently living abroad, and wonder how she's managing. Where she lives, every person gets a fixed allowance of material goods each year and must stay within that limit – last month she had to save her allowance carefully to be able to send you a birthday present. You hop into a cab that takes you the rest of the way – they're all driverless now, so no one to chat to, but at least there aren't traffic jams now that few people own a car. Once you arrive, you greet your partner, and the six members of their extended family that share the house. You quickly get stuck in to planning the last details of your trip to Cornwall – you'll take the train and stay in a large shared cottage that overlooks the sea. The land is owned by a farmer who rents it out in exchange for help on the farm. You just can't wait to get out of the city. Your partner's parents are excited too, but over dinner they tell stories of the exotic destinations they visited in their youth. Travel to Europe via train or ferry is still relatively common, but flying for pleasure is a rare treat for most people now. The world is quite a different place now from when they grew up.

Rethinking Lifestyles



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Examples

1) Use existing resources more efficiently

Our cars are parked 95% of the time. Equally, whilst we are at work our homes are empty, and the reverse is true during the night. Could we:

Housing: move towards more flexible living and working arrangements, including home working and community hubs.

Transport: make greater use of public transport and car clubs. A fleet of dial up autonomous vehicles has also been suggested that could pick you up and take you wherever you want to go.

Photo: low carbon home

Photo: bike sharing

Photo: electric car charging

Photo: electric car charging

2) Taxes or personal budgets

Carbon credit card

Carbon label

The way we pay for materials and products could change. We could either:

Tax materials: instead of paying VAT on products and services we could pay taxes on the basis of material use.

Personal materials allowances: alternatively, each citizen/business could be granted an annual allowance of material goods and services which they could use as they chose.

3) Reducing use of materials

A different approach to reduce materials use finally option would be for individuals to simply use less i.e., buying fewer products or a smaller home. You could also share you home with a greater number of people, live nearer to work or travel less for holidays.

Carbon footprint advert

Supplementary Table 1

Table 1. Summary of demographics for deliberative workshops.

		Cardiff 1	Cardiff 2	Bristol 1	Bristol 2	Total
No. Participants		11	13	13	14	**51**
Gender profile	Female	4	8	7	8	**27**
	Male	7	5	6	6	**24**
Age	20-29	0	3	5	4	**12**
	30-39	3	3	0	2	**8**
	40-49	4	1	1	2	**8**
	50-59	2	2	2	1	**7**
	60-69	2	1	3	2	**8**
	70+	0	3	2	3	**8**
Socio-economic status	A	N/a	0	N/a	0	**0**
	B	N/a	8	N/a	4	**12**
	C1	N/a	7	N/a	10	**17**
	C2	4	N/a	4	N/a	**8**
	D	2	N/a	4	N/a	**6**
	E	5	N/a	5	N/a	**10**