Extended data

Table S1: Constituents of wellbeing and their relationship to SDGs.

Well-being dimension	SDG	Potential metric
Food	2 ZERO HUNGER	access to sufficient and safe nutrition
Water	6 CLEAN WATER AND SANITATION	access to adequate and clean drinking water
Air	7 AFFORDABLE AND CLEAN ENERGY; 11 SUSTAINABLE CITIES AND COMMUNITIES	exposure to dangerous concentrations; pollutants both indoor and outdoor
Health	3 GOOD HEALTH AND WELL-BEING	access to health services; physical and mental health ; obesity
Sanitation	6 CLEAN WATER AND SANITATION	access to adequate sanitation; waste and sewage management
Energy	7 AFFORDABLE AND CLEAN ENERGY	ability to attain a socially and materially necessitated level of energy services (often related to access to electricity) ; access to affordable, reliable and sustainable fuels (electricity); renewable and clean electricity
Shelter	11 SUSTAINABLE CITIES AND COMMUNITIES	access to accommodation ; affordable housing market
Mobility	11 SUSTAINABLE CITIES AND COMMUNITIES	ability to access key other services physically in a safe and affordable manner; access to safe walking and cycling infrastructures, and to public transport
Education	4 QUALITY EDUCATION	education for all ; access to education and material ; knowledge and information
Communication		ability to make human connections with and without personal meetings; access to information and entertainment
Social protection	1 NO POVERTY; 2 ZERO HUNGER; 8 DECENT WORK AND ECONOMIC GROWTH; 10 REDUCED INEQUALITIES	community, social insurance, social assistance, and labor markets that enhance people's capacity to manage economic and social risks, e.g. unemployment, exclusion, sickness, disability and old age.
Participation	16 PEACE, JUSTICE AND STRONG INSTITUTIONS; 5 GENDER EQUALITY; 10 REDUCED INEQUALITIES	democratic rights (voting, association, etc.)
Personal Security	16 PEACE, JUSTICE AND STRONG INSTITUTIONS; 5 GENDER EQUALITY	exposed to homicide, crime, war/state violence
Social cohesion	16 PEACE, JUSTICE AND STRONG INSTITUTIONS; 10 REDUCED INEQUALITIES	social trust; bottom-up initiatives; reduce inequality; sense of usefulness
Political stability	16 PEACE, JUSTICE AND STRONG INSTITUTIONS; 11 SUSTAINABLE CITIES AND COMMUNITIES	trust in politicians; good governance; quality of governance
Economic stability	8 DECENT WORK AND ECONOMIC GROWTH	not having to fear unexpected expenses; access to jobs
Economic supply side effects	8 DECENT WORK AND ECONOMIC GROWTH; 12 RESPONSIBLE CONSUMPTION AND PRODUCTION	upstream effects of demand-side measures on upstream production systems (e.g.: compact cities make reduce demand for cars, increase demand for shared mobility)
Material provision	9 INDUSTRY, INNOVATION AND INFRASTRUCTURE; 12 RESPONSIBLE CONSUMPTION AND PRODUCTION	ability to access wellbeing services which are derived from materials; provision of adequate industrial capacity; access to infrastructure

Table S2: Demand-side mitigation strategies and potentials over sectors- Extended version

Sector	Gt CO_2 in 2050	Mitigation strategy	Changes in CO_2	Sources
Building	**8.8**	**Avoid: Sufficiency of energy and resources** (include Compact city and Nature based solution from Urban sector) *Passive building design, energy saving practices (including passive management and flexibility over time), low carbon building materials, green/blue surfaces, circular and sharing economy*	10-40% **[median: 25%]**	IEA 2020[1]; Ürge-Vorsatz et al. 2020[2]; Niamir et al. 2020[3]; Ahl et al. 2019[4]; IGES et al. 2019[5]; van der Grijp et al. 2019[6]; ECF 2018[7]; Galassi & Madlener 2018[8]; Rakha et al. 2018[9]; Sköld et al. 2018[10]; Talele et al. 2018[11]; Valencia et al. 2018[12]; Ala-Mantila et al. 2017[13]; Alders 2017[14]; Chang et al. 2017[15]; Kusumadewi & Limmeechokchai 2017[16]; Hansen and Hauge 2017[17]; Sanguinetti et al. 2017[18]; Sun and Hong 2017[19]; Darby et al. 2016[20]; Hasegawa 2016[21]; Taniguchi et al. 2016[22]; Virage-énergie 2016[23]; Singh 2016[24]; Dong et al. 2015[25]; Rafsanjani et al. 2015[26]; Ayoub et al. 2014[27]; Cao et al. 2014[28]; Fell et al. 2014[29]; Brown et al. 2013[30]; Tokuda et al. 2013[31]; van Den Wymelenberg 2012[32]; Volochovic et al. 2012[33]
		Shift: Improve access and switch to renewables *On-site renewables, micro-grids, switch to lower carbon fuels and electrification for space heating, cooling, cooking, hot water and electrical uses*	30-70% **[median: 50%]**	IEA 2020[1]; Niamir et al. 2020[34]; Mastrucci & Rao 2019[35]; González-Mahecha et al. 2019[36]; IGES et al. 2019[5]; Langevin et al. 2019[37]; ECF 2018[7]; Economidou et al. 2018[38]; Peñaloza et al. 2018[39]; Giraudet et al. 2018[40]; Mata et al. 2018[41]; Oluleye et al. 2018[42]; Braulio-Gonzalo and Bovea 2017[43]; Iten et al. 2017[44]; Purohit and Höglund-Isaksson 2017[45]; Sharma et al. 2017[46]; Oluleye & Smith 2016[47]; Purohit et al. 2016[48]; Timilsina et al. 2016[49]; Virage-énergie 2016[23]; Wittchen et al, 2016[50]; Novikova et al. 2015[51]; Markandya et al. 2015[52]; Markewitz et al. 2015[53]; Ürge-Vorsatz et al. 2014[54]; Bettgenhäuser &Hidalgo 2013[55]; Dolman et al. 2012[56]
		Improve: Efficiency *Improved building envelope, improved building technical systems (for HVAC, cooking and electrical uses), smart home and digitalization, efficient appliances, control systems, clean cooking*	50-95% **[median: 70%]**	IEA 2020[1]; Mata et al. 2020[57]; IGES et al. 2019[5]; Ellsworth-Krebs et al. 2019[58]; ECF 2018[7]; Oluleye et al. 2018[42]; Braulio-Gonzalo & Bovea, 2017[43]; Purohit and Höglund-Isaksson 2017[45]; Sharma et al. 2017[46]; ; Oluleye & Smith 2016; Purohit et al. 2016[48]; Ruparathna et al. 2016[59]; Timilsina et al. 2016[49]; Virage-énergie 2016[23]; Wittchen et al, 2016[50]; Novikova et al. 2015[51]; Bettgenhäuser and Hidalgo 2013[55]
Food	**18**	**Avoid: Food waste** *Food waste prevention: improved information ('best before dates'); adequate portion sized (HORECA); food sharing programs. Food waste recycling: use of food waste as animal feed (including insects);*	8-25% **[median: 15%]**	Poore and Nemecek, 2018[60]; Schanes et al. 2018[61]; Gunders & Bloom 2017[62], Makov et al 2020[63]

		improved collection & composting, anaerobic digestion.		
		Avoid: Over-consumption *Information campaigns; adequate portion sized (HORECA); marketing restrictions on energy-dense food; taxes on energy dense and/or luxury protein foods; choice architecture instruments*	n/a	Smith et al. 2013[64]
		Shift: Animal free protein *Green procurement; food-based dietary guidelines; food labels; educational campaigns; subsudies/taxes; voluntary sustainabilty standards; R&I on improved on nutritional and agronomic characteristics of plant proteins; regulations on novel foods*	18%-87% **[median: 40%]**	Semba et al. 2020[65]; Springmann et al. 2018[66]; Willett et al. 2019[67]; Parodi et al. 2018[68]; Springmann et al. 2016[69]; Aleksandrowicz et al., 2016[70]; IPCC SRCCL, 2019[71]
Land Transport	**9.5**	**Avoid: Teleworking** *Teleworking or telecommuters partially or entirely replace their out-of-home work activities by working at home or at locations close to home. In general, telecommuting offers more flexibility to workers by relaxing the temporal and spatial work-related constraints. In addition IOT represents use of behavior data to nugde commuting behavior; school travel behavior and transforming shopping travel behavior*	0-10% **[median: 1%]**	Brand et al. 2020[72]; Creutzig et al. 2016[73]; Ivanova et al. 2020[74]; Riggs 2020[75]
		Avoid: Walking and Cycling *Supported by compact highly accessible city design and safe infrastructures for pedestrians and cyclists.*	10-30% **[median: 15%]**	Brand et al. 2020[72]; Creutzig et al. 2016[73]
		Shift: Shared economy and digitalization *Pooled shared mobility with high occupancy and micro-mobility with high lifetime of vehicle stock; convenient rail-based public transit; supported by urban design and transit-oriented development resulting in reduced travel distances; logistic optimization in last-mile freight.*	from -50% to +50% **[median: 0%]**	ITF, 2020[76,77]; ITF, 2017[78,79]; Creutzig et al. 2016[73]; ITF, 2016[80]

		Improve: Evs *Electric Vehicles when charged with the electricity generated from medium decarbonized power system (IEA stated policies); Behavior change programs on the socio-economic structures that impede adoption of EV's; the urban structures that enable reduced car dependence and how EV's can assist grids; and the synergies between emerging technologies and shared economy to maximizing the greater benefit of EVs*	20-75% **[median: 50%]**	EEA, 2018[81]; Hill et al 2019[82]; Lutsey 2015; Plötz et al 2017[83]; Khalili et al 2019[84]
Industry	**15.8 Gt CO2**	**Avoid: Materials efficient services** *Materials-efficient service provision involves avoided material demand through dematerialization, the sharing economy, materials-efficient designs, and yield improvements in manufacturing. For example, researchers calculate that if beam designs were optimized to suit their use instead of their production cost, weight of up to 30 per cent could be saved. Opportunities to reduce metal requirement through lightweight design was assessed by Carruth et al. (2011) who found that 25% to 30% of metal can be saved across five case study products: construction beams, reinforcement bar, car body and crash structures, food cans and deep-sea oil and gas pipelines.*	5%-22% **[median: 13%]**	IEA 2020[1,85]; Grubler et al. 2018[86]; Allwood and Cullen, 2015[87]; Carruth et al., 2011[88]
		Avoid: Lifespan extension *Designing products so that their lifetime can be extended through repair, refurshing, and remanufacturing. For example, Cooper et al (2014) estiamtes that approximately 40% of annual demand for steel worldwide is used to replace products that have failed. Standardisation, modularity and functional segregation can help extending the lifespan of steel in products and therefore present a*	3%-7% **[median: 5%]**	IEA 2020[1,85]; Cooper et al. 2014[89]

		significant opportunity to reduce demand and carbon dioxide emissions from steel production. Similar appraoch are possible with other emission intensive materials.		
		Shift: Reuse and recycling *Increasing the re-usability and recyclability of product's components and materials once these products are at the end of their life. For example, old cars are dismantled to be re-used for reparing cars that can be repaired and most of the old components that cannot be re-used are recycles in scrap metals. / CE covers: avoid material use by reuse; shift from primary to recycled materials.*	4%-7% **[median: 5%]**	IEA 2020[1,85]; Ellen MacArthur Foundation, 2019[90]; IEA 2019[91]; Material Economics 2018[92]
		Improve: Energy Efficiency *Reducing the need for energy consumption through the installation of new efficient technologies and through systems and operating practices that contribute to reduce energy needs (ex: Energy Management System practices).*	25%-28% **[median: 26%]**	IEA 2020[1,85]; Material Economics 2018[92]
Urban (not included in aggregate potential analysis to avoid double counting)		**Compact city** *Urban planning interventions for increasing density*	4-25% **[median: 12%]**	Creutzig et al. 2016[73]; Borck and Brueckner 2016
		Circular and shared economy *Shared spaces and facilitites: energy co-ops, group purchasing, libraries, repair cafes, food production and consumption; food sharing; . Circular economy: urban industrial ecology; Consumer actions at reducing waste, recycling. Shared spaces and shared mobility not included here due to overlap with buildings and transport; Improved diets and no excessive consumption*	30-60% **[median: 50%]**	Cantzler et al 2020[93]

		Systems approach *A comprehensive climate change city plan- climate change actions embedded in urban plans. Innovation in urban institutional structure; promote regenerative culture, behaviour, anddesign innovative financing, stronger science policy linkages. Nexus approaches' that trace linkages between water, food and energy systems ; integrated strategies for energy-material reduction through urban industrial ecology; formal and informal governance arrangements for green and built infrastructure. Local energy generation- renewables; waste to energy; reverse auctions*	n/a	
		Nature based solution *All urban scale green spaces/interventions including networks of parks and open spaces, green corridors, planted and indigenous trees, and original grassland and woodlands, protection of urban nature (e.g., forests and wetlands), urban agriculture, and water-sensitive designs well as possible street level design interventions that incorporate vegetation.*	0-10% **[median: 5%]**	Culwick and Bobbins, 2016
Aviation	1.8	**Avoid: flights** *Aviation is of low economic value and demand is highly sensitive to prices. A carbon price of aviation fuel of $400/tCO$_2$ would have demand for aviation in 2050.*	0-47% **[median: 40%]**	IATA 2020[94]; Schäfer et al. 2019[95]; Gossling et al (in review)
Shipping	1.9	**Avoid: Reduce demand and slow steaming** *Shifting supply chains, lower demand for consumption goods, and slow steaming of ships would reduce shipping demand substantially.*	40%-60% **[median: 47%]**	Bouman et al 2017[96], McKinnon 2020[97], ITF, 2018[98]

		Shift: modal shift to train *Shift from ships to long-distance train (especially across the Eurasian continent) reduces GHG emissions, but not more than 1% of expected emissions.*	0%-1% **[median: 1%]**	ITF, 2018[98]
		Improve: Design and power system *Independent of fuels (supply) better hull design and improved propulsion system can make ships highly more efficient*	30%-50% **[median: 40%]**	Bouman et al 2017[96], McKinnon 2020[97], ITF, 2018[98]

Guide through Table S3-7

(dark green)	High positive impact [+3]
(medium green)	Medium positive impact [+2]
(light green)	Low positive impact [+1]
(yellow)	Overall Neutral
	No impact
(light red)	Low negative impact [-1]
(red)	Medium negative impact [-2]
▤▤▤	Level of evidence {limited, medium, robust}
☺☺☺	Level of agreement {low, medium, high}
★★★★★	Level of confidence {very low, low, medium, high, and very high}

Table S3: Human wellbeing and demand-side mitigation strategies in building sector

	Sufficiency	Efficiency	Lower carbon and renewable energy
Food	**[+1]** ▤ ☺☺☺ ★★★ Energy sufficiency measures result in lower energy bills and reduce the "heat or eat" dilemma[99,100].	**[+2]** ▤ ☺ ★ Improved cook stoves provide better food security and reduced risk of fuel shortage in developing countries. Under real-world conditions, these impacts may be limited as the households use these stoves irregularly and inappropriately[101,102]. Energy efficiency measures result in lower energy bills and avoiding the "heat or eat" dilemma[99,100].	**[+2/-1]** ▤▤ ☺☺ ★★★ Improving energy access enhances agricultural productivity and improves food security. On the other hand, increased bioenergy production may restrict the available land for food production[86,103–106].

Water	**[+2]** ▤▤ ☺☺☺ ★★★★ Reduced energy demand due to sufficiency measures can lead to reduced requirements on energy supply and the associated water consumption[103,107,108].	**[+2]** ▤▤ ☺☺☺ ★★★★ Reduced energy demand due to efficiency measures can lead to reduced requirements on energy supply and the associated water consumption[103,107,108].	**[+2/-1]** ▤▤ ☺☺☺ ★★★★ An upscaling of RES usually results in reduced water demand for thermal cooling at energy production facilities. Improved access to electricity is necessary to treat water at homes. In some situations the switch to bioenergy could increase water use compared to existing conditions [103,107–111].
Air	**[+2]** ▤▤▤ ☺☺☺ ★★★★★ Air quality improvements due to reduced direct and indirect emissions associated with sufficiency measures[112–116].	**[+3/-1]** ▤▤▤ ☺☺☺ ★★★★ Air quality improvements (indoor and outdoor) due to reduced direct and indirect emissions associated with energy efficiency measures, including improved cook stoves[3,102,102,112–115,117–119]. Energy efficiency interventions with inadequate ventilation or use of improper materials may have negative impacts on indoor air quality[120,121].	**[+3]** ▤▤▤ ☺☺☺ ★★★★★ Fuel switching to RES and improvements in energy access would eliminate major sources (both direct and indirect) of poor air quality (indoor and outdoor)[112–115,122–124].
Health	**[+3]** ▤▤▤ ☺☺☺ ★★★★★ A consequence of better indoor and ambient air quality, energy/fuel poverty alleviation and elimination of the heat island effect. Efficiency measures with inadequate ventilation may lead to the sick building syndrome symptoms[86,99,100,112–115,120–122,125–131].	**[+3/-1]** ▤▤▤ ☺☺☺ ★★★★★ A consequence of better indoor and ambient air quality, energy/fuel poverty alleviation and elimination of the heat island effect. Efficiency measures with inadequate ventilation may lead to the sick building syndrome symptoms[86,99,100,112–115,120–122,125–131].	**[+3]** ▤▤▤ ☺☺☺ ★★★★★ A consequence of better indoor and ambient air quality, energy/fuel poverty alleviation, and elimination of the heat island effect[5,18,29,35–3786,99,100,112–115,120–122,125–131].
Sanitation	**[+1]** ▤ ☺ ★ A consequence of improved conditions and smaller dwellings[130].	**[+1]** ▤ ☺ ★ A consequence improved dwelling conditions[130].	
Energy	**[+3]** ▤▤▤ ☺☺☺ ★★★★ Energy/fuel poverty alleviation in both developed and developing countries[86,115,126,130,132–135] (EC 2016).	**[+3]** ▤▤▤ ☺☺☺ ★★★★ Energy/fuel poverty alleviation in both developed and developing countries[86,115,126,130,132–135] (EC 2016).	**[+3]** ▤▤▤ ☺☺☺ ★★★★ Energy/fuel poverty alleviation in both developed and developing countries[86,115,126,130,132–135] (EC 2016).

Shelter		**[+2]** ▤▤▤ ☺☺ ★★★★ Buildings with high energy efficiency and/or green features are sold/rented at higher prices than conventional, low energy efficient houses[136–150] (Högberg, 2013; EC, 2016).	**[+1]** ▤▤ ☺ ★★★ Buildings with green features are sold/rented at higher prices than conventional, low energy efficient houses[136–150] (Högberg, 2013; EC, 2016).
Mobility			**[+1]** ▤▤ ☺☺☺ ★★★ Helpful if in-situ production of RES combined with charging electric two, three and four wheelers at home [103,151,152].
Education		**[+1]** ▤▤ ☺☺☺ ★★★ Energy efficiency measures result in reducing the school absenteeism due to better indoor environmental conditions. Also, energy poverty alleviation increases the available space at home for reading[99,153,154].	**[+1]** ▤▤ ☺☺☺ ★★★ Improved access to clean electricity and fuels enables people living in poor developing countries to read, while it is also associated with greater school attendance by children[103,106,128,155].
Communication		**[+1]** ▤▤ ☺☺☺ ★★★ Better indoor conditions, such as reduced exposure to cold, damp and mould in winter period, avoiding high temperatures in summer, reduced indoor pollution, etc., achieved through energy efficiency interventions can enable residents to avoid social isolation and improve social cohesion. Also, they can reduce stress related to chronic discomfort and high bills, fear of falling into debt, and a sense of lacking control, which are potential drivers of further social isolation[99,126,156,157] (Wilson et al. 2016).	**[+2]** ▤▤ ☺☺☺ ★★★ Improved access to clean electricity and fuels in developing countries results in substantial timesaving for women and children, increasing the time for rest and communication[122,158,159]. Adoption of distributed generation and smart grids helps in communication infrastructure expansion[160,161] (ENISA 2015).
Social protection			

Participation		**[+1]** ▤▤ ☺☺☺ ★★★★ When lower energy use gives occupants more control, their wellbeing increases[162]. Stakeholder engagement is a key success factor in urban energy efficiency initiatives[163].	**[+1]** ▤▤ ☺☺ ★★★ RES projects are an opportunity for inclusion and participation of citizens, indigenous communities with different mechanisms (co-ownership, procurement, investments, knowledge transfer, professionalization), often leading to increased positive synergies for both the project and participants[164] (Salman, 2016; Koch and Christ, 2018).
Personal Security		**[+1]** ▤ ☺☺ ★★★ Building retrofits are associated with lower crime[99].	**[+1]** ▤▤ ☺☺☺ ★★★ Improved access to electric lighting can improve safety (particularly for women and children)[103] (Burnes and Sammad, 2018; Alston and Jacobson, 2018).
Social cohesion	**[+2]** ▤▤▤ ☺☺ ★★★ Sufficiency measures lead to reduced energy expenditures that further lead to poverty reduction[103,115,130,135].	**[+2/-1]** ▤▤ ☺☺☺ ★★★ Efficiency measures lead to reduced energy expenditures that further lead to poverty reduction. The distributional costs of some mitigation policies may reduce the disposable income of the poor[99,103,115,129,135,165].	**[+2/-1]** ▤▤ ☺☺☺ ★★★★ Access to RES will largely help alleviate poverty in developing countries as the productive time of women and children will increase, new activities can be developed, etc. The distributional costs of some mitigation policies may reduce the disposable income of the poor[101,103,119,135,155,165].
Political stability			

Economic stability	**[+2]** ▤▤▤ ☺☺☺ ★★★★ Through lower energy prices due to the reduced energy demand, positive direct macroeconomic effects (GDP, employment, public budgets) and fostering innovation [103,115,133,135,166].	**[+2]** ▤▤▤ ☺☺☺ ★★★★★ Through lower energy prices due to the reduced energy demand, positive direct macroeconomic effects (GDP, employment, public budgets) and fostering innovation[103,115,129,130,133,135,166].	**[+2/-1]** ▤▤▤ ☺☺☺ ★★★★★ Through lower energy prices due to the reduced energy demand, positive direct macroeconomic effects (GDP, employment , public budgets), improved energy access and fostering innovation[103,115,130,133,135,166]. Recognized risks of increased RES include higher peaks and congestions in low price-hours, difficulties in designing electricity tariffs and potential instability in the entire electricity system (Mata el al, 2020).
Material provision	**[+2]** ▤▤ ☺☺☺ ★★★★ Reduced consumption of natural resources, namely metal ores, minerals, etc[115,167–169] (EC 2016).	**[+2/-1]** ▤▤ ☺☺☺ ★★★★ Reduced consumption of natural resources, namely metal ores, minerals, etc[115,167–169] (EC 2016). Negative impacts (increased use of materials) from increased penetration of new efficient appliances[157].	**[+2]** ▤▤ ☺☺☺ ★★★★ Reduced consumption of natural resources, namely metal ores, minerals, etc[115,167–169] (EC 2016).
Economic supply side effects	**[-2]** ▤▤ ☺☺☺ ★★★ Negative macroeconomic effects in upstream sectors due to reduced energy demand [103,115,129,133,135,166].	**[+2/-2]** ▤▤ ☺☺☺ ★★★ Positive and negative macroeconomic effects in upstream sectors due to the realization of the energy efficiency measures[103,115,129,133,135,166].	**[+2/-2]** ▤▤ ☺☺☺ ★★★ Positive and negative macroeconomic effects in upstream sectors due to the promotion of RES and clean energy fuels[103,115,129,133,135,166].

Table S4: Human wellbeing and demand-side mitigation strategies in food sector

	Food waste	Reduce over-consumption	Animal free protein
Food	**[+1]** ▤ ☺ ★★ Reducing food loss and waste increases food availability and can potentially increase food security; though distributional problems need to be overcome as well[71,170–173]. There is a high agreement and evidence that reducing food loss and waste in the agrifood sector is crucial for climate mitigation and wellbeing particularly in the developed world. Roughly, 20-40% of food that is produced is estimated to be lost to waste before it reaches the market or wasted by households[174,175] (Godfray et al. 2012). The energy embodied in wasted food is estimated at ~36 EJ/yr and during 2010–2016 the global food loss and waste was 8–10% of total GHG emissions (Mbow et al. 2019).	**[+1]** ▤ ☺ ★ The, technical mitigation potential of dietary changes by 2050 range from 2.7–6.4 GtCO2-eq yr-1 for different diets, part of which to be achieved through reduced overconsumption, and the rest mainly through reduced consumption of animal source food. The economic potential of such solutions is lower, ranging from 1.8–3.4 GtCO2-eq yr-1 at prices of 20–100 USD tCO2, with caloric costs up to 190 kcal per person per day (Mbow et al. 2019). Similar to reduced food waste, additional food available through reduced over-consumption can contribute to reducing food insecurity, if distributional challenges are addressed.	**[+1]** ▤▤ ☺☺ ★★★
Water	**[+2]** ▤▤▤ ☺☺☺ ★★★★ reducing food waste reduces embodied water losses[171,176] and water pollution	**[+1/-1]** ▤ ☺ ★ Depends on substitution effects; policies targeting reduction of over-consumption focus on high-caloric foods[177,178]. These are often combined in food-based dietary recommendations (FBDGs) with recommendations to increased consumption of low-caloric (and healthier) products[179,180]. Though the impact on climate, water and air pollutants should reflected in ‘healthy sustainable diets[181], these are often not yet considered in national FBDGs[182], thus the effect of reduction of over-consumption remains inconclusive.	**[+2]** ▤▤ ☺☺☺ ★★★★ Higher blue and green water footprints of animal source food as compared to plant based food allow significant reduction of water use[183], e.g. for vegan diets and diets consuming low-food chain products[70,184].
Air	**[+2]** ▤▤▤ ☺☺☺ ★★★★ reduced food demand avoids emissions of air and water pollutants in food production, transport, processing, distribution and waste managment[176,185].	**[+1/-1]** ▤ ☺ ★ see water.	**[+3]** ▤▤▤ ☺☺☺ ★★★★★ Livestock products are responsible for most agricultural NH3 and CH4 emissions; precursors of PM2.5 and tropospheric ozone[186–188].

Health	**[+2]** ▤ ☺☺ ★★★ Food waste increases risk of contamination with pathogenic microorganisms; there is a trade-off between through better food planning (=reducing health risk) and avoiding food waste by wasting less/eating more (in most cases neutral to health, might in some cases have negative health effect); indirect health effect reduced air and water pollution through avoided food supply & waste management[189].	**[+3]** ▤▤▤ ☺☺☺ ★★★★ Over-consumption is one of the major cause of the obesity pandemic and of non-communicable diseases[190,191]. Reducing US food overconsumption, especially meat, would lead to both health and environmental benefits[192]. In the US, healthy food choices -- higher fruit and vegetable consumption -- are positively correlated with wellbeing[193,194].	**[+3]** ▤▤▤ ☺☺ ★★★ Healthy diets are characterized by low consumption of meat, in particular red meat, with increased consumption of nuts, fruits, vegetables and legumes; however, the changes needed differ greatly by region[174,195]. Furthermore, livestock systems are associated with occurrence of Antimicrobial resistance[196,197]; and the potential risk of zoonotic diseases[198].
Sanitation	**[+1]** ▤ ☺ ★★ Food waste increases risk of contamination with pathogenic microorganisms[199,200].	**[+1]** ▤ ☺ ★★ Reducing junk foods and overconsumption would have positive impacts on Australia's environmental footprint and reduce waste[201].	**[+1]** ▤▤ ☺ ★ Reduce diary and animal industry residues.
Energy	**[+1]** ▤▤▤ ☺☺☺ ★★★★ Reduced energy needs in food supply, preparation & waste management[176,202].	**[+1/-1]** ▤ ☺ ★ see water.	
Shelter			
Mobility	**[+1]** ▤▤ ☺☺ ★★★ Less transport of food both within supply chain and for shopping end users.	**[+1/-1]** ▤ ☺ ★ see water.	

Education			
Communication	**[+1]** ▤ ☺☺ ★★ Food sharing is proposed as a measure to reduce food waste[63,203,204] and requires communication.		**[-1]** ▤▤▤ ☺ ★★★ information on how to 'use' animal free diets (recipes, what is healthy) not equally available (in the transition period); guidance on healthy plant-based diets largely missing[182].
Social protection	**[-1/+1]** ▤▤▤ ☺☺ ★★★ Food banks & donations to reduce food waste are an important social protection measure in some countries. On the negative side, this does reflect austerity measures and the on-going breakdown of social security nets[205–208].	**[+2]** ▤▤▤ ☺☺☺ ★★★★★ Reducing US food overconsumption, especially meat, would lead to both health and environmental benefits[192]. In the US, healthy food choices -- higher fruit and vegetable consumption -- are positively correlated with wellbeing[193,194]. Reducing junk foods and overconsumption would have positive impacts on Australia's environmental footprint[201].	**[+3]** ▤▤▤ ☺☺☺ ★★★★★ Sustainable vegetarian diets are better for both human health and planetary health[209,210]. Meat increases the risks of chronic ill health, colorectal cancer and cardiovascular disease[211]. Improved health helps people to manage their socio-economic risks; conversely, non-communicable diseases harm social protection[212–216].
Participation	**[+1]** ▤▤ ☺☺☺ ★★★★ Reducing food waste in the US requires attention to specific contexts, social and behavioural factors, motivations, values, skills and preferences[217]. Reducing food waste can link to wellbeing, inclusiveness, and urban resilience[218]. In Singapore, ecologies of participation help explain transition motivations[219].	**[+2]** ▤▤▤ ☺☺☺ ★★★★ Community-led interventions to reduce over-consumption and other health inequities can increase local control and socio-political impetus for improvements[220]. Traditional and community food systems also promise health (obesity-reduction), environmental, economic and social benefits[221,222]. Dietary norms are strongly influenced by social context[223].	**[+1]** ▤▤▤ ☺☺ ★★★★ Interest in meat-free diets is socially-mediated and is growing quickly[224]. Diet shifts away from meat maybe understood as politicized and related to social identity[225,226] and as reflecting moral judgement[227,228]. In the US, vegans face social stigma[229].
Personal Security			

Social cohesion	**[+1]** 🗏 ☺ ★ Food sharing arrangements (e.g. food banks, soup kitchens) can be actively designed to improve social cohesion, and are one strategy to reduce food waste.		**[-1]** 🗏 ☺ ★ Dietary shift requires a transformation of society - today large resistance against it; 'healthy food' as status symbol in the transition period; social divides around alternative diets could be exploited.
Political stability	**[+1]** 🗏 ☺ ★ indirect positive effects if positive impact on food security are realized.	**[0/+1]** 🗏 ☺ ★ unclear/slightly positive outlook; reducing overconsumption is likely opposed by vested interests in the food sector, leading to conflict; but successful reductions would tackle several underlying social problems, such as obesity and social class divisions.	**[+1]** 🗏 ☺ ★ unclear/slightly positive outlook; reducing overconsumption is likely opposed by vested interests in the food sector, leading to conflict; but successful reductions would tackle several underlying social problems, such as obesity and social class divisions.
Economic stability	**[+1]** 🗏 ☺ ★★ Depending on the cost of food waste reduction, household income can increase (less purchases) or slightly decrease[230]. Indirect savings through environmental and health benefits[189].		**[+2/0]** 🗏 ☺ ★ Shifted demand could also increase demand for new products with possibly high profit margins.
Material provision			
Economic supply side effects	**[-1]** 🗏🗏🗏 ☺☺ ★★★ Reduced demand for food might lead to a reduced demand for agricultural supply[230]; however there might be opportunities for smart packaging or food processing industries valorising food waste[231,232].	**[+1/-2]** 🗏 ☺ ★ Reduced over-consumption might lead to a substitution effect with increased consumption of healthier products that partly compensates for reduced demand, or consumption of re-formulated products[177,233].	**[-2]** 🗏 ☺ ★ Cattle and meat industry will witness a decrease in demand. Opportunity to produce higher value low-carbon meat.

Table S5: Human wellbeing and demand-side mitigation strategies in land transport sector

	Teleworking & online education system	**Non-motorized transport**	**Shared mobility**	**Evs**
Food	**[+1]** ▤▤ ☺ ★★ Food service delivery mediated through mobile applications have increased rapidly globally between 2015-2020. Most major countries have at least one major Online Provider for food delivery showing unyielding growth rates (Statista,2019).This may be tampering with family values, dine-out culture, case in India (Shentil et al 2020). Built environment plays significant role connected with eating behavior and practice[234].	**[+2]** ▤▤ ☺ ★★ Active travel and healthy diets tend to cluster[235,236]. The causal mechanism is not clear[237].	**[+1]** ▤▤ ☺ ★★ Food availability, food security by crowd-shipping services; see Le (2019) Sharing economy introduces new dynamics into the food service transaction and the food-service market change has implications for restaurants and the workforce[238].	**[+1]** ▤▤ ☺☺ ★★★ Pedelec's expand mobility options for those with low and medium fitness. Increased physical activity in turn is statistically correlated with healthier diets [235,236].
Water		**[+1]** ▤ ☺ ★★ Walking and use of non-motorized transport to fetch water a public health problem for many, especially women, in the poor regions[239]. Alternative decentralized water treatment systems is a means of achieving rapid health gains among vulnerable populations in rapidly growing urban and peri-urban slums[240].		
Air	**[+3]** ▤▤▤ ☺☺☺ ★★★★ Same as health. Reduced transportation needs -> reduced congestion and emissions. Teleworking improve traffic condition and air quality[241].	**[+1]** ▤▤▤ ☺☺☺ ★★★★★ Reduced congestion and emissions[242]. NMT solely give small CO2 emission reduction[243–245]. Combination with shared mobility/sharing system will improve air quality (PM 2.5) and public health[246].	**[+3]** ▤▤ ☺☺☺ ★★★ Considerable emissions reductions and hence air quality improvements possible (see following tabs), but some potential for rebound effect as latent mobility demand increases. Tirachini, 2019	**[+2]** ▤▤▤ ☺☺☺ ★★★★ Potential to eliminate particulate emissions from combustion (but not brakes, tire wear)[247,248].

Health	**[+2]** ▤▤▤ ☺☺☺ ★★★★ It has mix influence: "+2" for reduce commuting and (mico) trips > reduce emissions > increase public health; while "-1" for tendency of less physical activity which increase prevalence for cardiovascular diseases and obesity. Video formats are key requirements for COVID-19 and health provisioning[249].	**[+3]** ▤▤▤ ☺☺☺ ★★★★★ increase physical activity > increase health level while less air pollution, better quality of life[250,251]; Combination of cycling & shared mobility/sharing system (bike sharing) will improve air quality (PM 2.5) and public health[246].	**[+2]** ▤▤▤ ☺☺☺ ★★★★ Considerably reduce emissions via less energy consumption, therefore increase public health. While it could have a negative impact on physical activity (e.g. less walking). In combination with EVs or Autonomous Vehicle will improve public health[252].	**[+1]** ▤▤▤ ☺☺☺ ★★★★ It very much depends on the implementation, the impact could be +1 or +2 (in combination with other policies). Nature Conservation and Nuclear Safety (BMU) report; Buekers et al. (2014); Requia et al. (2018); House et al. (2019). Combination with Shared Mobility (Ride Sharing, Ride Splitting) will improve public health[252].
Sanitation				**[+1]** ▤▤▤ ☺☺☺ ★★★★ Sanitation vehicles with electric drive train reduce noise pollution in early morning hours, in addition to reducing GHG emissions[253].
Energy	**[+2]** ▤▤▤ ☺☺☺ ★★★★ Walking is highly energy efficient. Improving Non-motorized transport facilities will increase modal share of NMT and reduce fuel consumption and GHG emissions. Combination of NMT infrastructures together with improvement of Public Transport System will give maximum benefits for modal share, energy consumption and GHG emissions[254].	**[+2]** ▤▤▤ ☺☺☺ ★★★★ Walking is highly energy efficient. Improving Non-motorized transport facilities will increase modal share of NMT and reduce fuel consumption and GHG emissions. Combination of NMT infrastructures together with improvement of Public Transport System will give maximum benefits for modal share, energy consumption and GHG emissions[254].	**[+1]** ▤▤▤ ☺☺☺ ★★★ Shared cycling, shared e-scooters and shared pooled mobility are more energy efficient than ICEs. Ride sourcing (Uber, Lyft) are more energy intensive than ICEs[77] (ITF, 2020).	**[+3]** ▤▤▤ ☺☺☺ ★★★★ Much more energy efficient that ICEs, key opportunity to reduce primary energy while keeping useful energy constant[86,255]
Shelter	**[+1]** ▤ ☺ ★★ Potential to de-link housing competition from job availability in dense urban areas, hence increasing affordability/access to shelter, but no known studies			

Mobility	**[+2]**	▤▤▤	☺☺☺	★★★★	**[+3]**	▤▤▤	☺☺☺	★★★★★	**[+2]**	▤▤▤	☺☺☺	★★★★	**[+2]**	▤▤▤	☺☺☺	★★★★
	Energy reduction from less travel, including less congestion and less stress on roads[256,257]. Overall savings are significant but modest. Accessibility gain to work (convenience, time savings). Travel time saved for more pleasurable activities.				Walking is an active mode of travel. Improving space use in terms of mode choice. A large number of car trips are less than 5 km and could be easily replaced by NMT (cycling), cycling use much less space than car and cyclists tend to be happier than other transport users[258]. Combination with sharing system (bike sharing) and electric-bike can remove barrier of elderly people for cycling longer distance and rides uphill[259]. Combination with improvement of public transport facilities will bring maximum benefit on the mobility (access to public transport & safety issues)[254].				Shared mobility offers notable convenience effects[260–262].				Another mobility option; higher air quality for traffic participants. Combined with Autonomous vehicle and shared mobility will increase the impact[260–262].			
Education	**[-1]**	▤	☺	★★★	**[+1]**	▤▤▤	☺☺☺	★★★★								
	An experiment of university students indicates that live education leads to slightly larger average test scores than online education[263,264].				all behavioural changes relates to education. The walkability could improve safety issue of school travel. Safe Route to School (SRTS) to promote active school travel (AST) through the improvement of infrastructure and non-infrastructures was common and famous[265]. The other example of intervention, walking school bus (WSB), was a promising intervention in short and long term in urban low-income elementary school students[266].											

Communication	**[+2]** ▤▤ ☺☺☺ ★★★★ Facilitate interaction with distant communities and long-distance family interactions[267].	**[+3]** ▤▤ ☺☺ ★★★ Perceived walkability is positively related to neighbourhood social environment but neighbourhood socio-economic factors should be considered in walkability studies[268]. Walking enables more face to face contact than for example car driving	**[+1]** ▤▤ ☺☺ ★★★ Shared mobility as a way to also share information and values[269].	
Social protection	**[+1]** ▤▤ ☺☺ ★★★★ IoT and digital commons represent key platforms for information (also eco-chambers of information) exchange, offer an open marked of alternatives for consumption e.g. (consumer) assisting decisions in the private and public spheres, and create new spaces for social and political interaction[270,271].	**[+1]** ▤▤▤ ☺☺ ★★★★ Urban street reclaiming for non-motorized transport can make cities safer for children[272], and has high potential for health-promoting transport in less-developed countries[273,274]. However, due to policy failures, most victims of road accidents are non-motorized transport users[275–277].	**[+2]** ▤▤ ☺☺ ★★★ Shared mobility can fill gaps and extend the reach of public transport to connect low-income people with jobs and other opportunities[278] and increase quality of life for seniors[279]. Shared mobility may reduce and shorten trips and increase efficiency[280] as well as user control[281].	**[+3]** ▤▤▤ ☺☺☺ ★★★★★ The widespread adoption of EVs has the potential to substantially reduce greenhouse gas and other emissions, plus associated health impacts and damages[282,283].
Participation	**[+2]** ▤▤ ☺☺☺ ★★★★ On daily basis less interaction with office mates however, Teleworkers able to develop greater social support relationships with some other teleworkers, while at the same time allowing them to distance themselves from negative work relationships[284].	**[+1]** ▤ ☺ ★★ Walkable design solutions and hence require participation and may also foster it. Majority of pedestrians, cyclists, public transit and even car users would prefer a redistribution of road space and investment in favour of active transport.	**[+1]** ▤ ☺☺ ★★★ Private car sharing require and foster local participation.	**[+2]** ▤ ☺☺ ★★★ Demands for decentralized renewable energy systems controlled at the local level are emerging in democratic energy transition politics[285,286]. EV adoption in the US is linked to progressive political identity[287]. Energy transitions follow paths driven by policies, technology development, and markets[288].
Personal Security	**[-1/+1]** ▤▤ ☺☺ ★★★★ Teleworking leads to reduced number of car crashes[289]. Teleworkers are less aware of ergonomic and health safety issues compared to office workers[290].	**[+2]** ▤▤▤ ☺☺☺ ★★★★ Safety and Security are important aspect on the decision to walk or not[291–293].	**[-1/+1]** ▤▤▤ ☺☺☺ ★★★ Platform security is a concern[294], particularly in the case of ridesourcing[295]. Shared pooled mobility is comparatively safe, and shared cycling is also safe from assault. Increases road safety by taking cars from the roads[296].	

Social cohesion	**[+2]** ▤▤ ☺☺☺ ★★★★ Reduced demand for cars. Teleworking may have positive implications on productivity of creative tasks but negative implications on productivity of dull tasks[297,298].	**[+2]** ▤▤▤ ☺☺ ★★★ More social cohesion in more walkable neighborhoods[299] (Wood et al 2009).	**[-1/+1]** ▤▤▤ ☺☺☺ ★★★★ Local shared mobility can help to build and sustain communities[269], but in many cases also create instability due to competition with regular taxis or regular paratransit drivers[276].	
Political stability	**[+2]** ▤▤ ☺☺ ★★★ Data sovereignty and data protection and security, as well as inclusivity, accessibility, net neutrality, resilience and robustness of digital and digitalized infrastructures are key requirements. // Inequality of internet service provision will make teleworking possible for some types of work. Equal and affordable access to internet services will define political possibilities.	**[+2]** ▤▤ ☺ ★★ Same as social cohesion	**[-1]** ▤▤▤ ☺☺☺ ★★★★ Shared mobility is seen as force of disruption in the automobile industry, possibly associated with slowdown in vehicle sales growth[300]. Even as overall revenue grows[300], tomorrows highly paid jobs will differ from today's, making the speed of change a relevant issue. Potential conflicts with regular taxis or paratransit drivers in developing countries[276].	
Economic stability	**[+2]** ▤▤▤ ☺☺☺ ★★★ Spatial and social-group-specific differences in access to digital services (internet), differences in skills for dealing with ICT ,for the spread of telecommuting and for receiving economic benefits of digitalization[301,302].	**[+2]** ▤ ☺☺ ★★★ Active travel infrastructure is associated, in most cases, with increased local business activities[303–305].	**[+2]** ▤▤▤ ☺☺☺ ★★★★ Large additional economic service-oriented turnover expected[300].	**[+2]** ▤▤▤ ☺☺☺ ★★★★ Similar to the concept of #M4.
Material provision			**[+2]** ▤▤ ☺☺☺ ★★★★ Material demand reduction[86,306–308].	**[-1]** ▤ ☺ ★★ Material for EVs are heavier and more carbon intensive[306–309,309–312].

Economic supply side effects	**[+1]** ▤▤▤ ☺☺☺ ★★★★	**[+1]** ▤▤ ☺☺ ★★★	**[-2]** ▤▤▤ ☺☺☺ ★★★★★	**[+1]** ▤▤ ☺☺ ★★★
	spatial and social-group-specific differences in access to digital services (internet), differences in skills for dealing with ICT ,for the spread of telecommuting and for receiving economic benefits of digitalization [301,302].	Walking increases creativity and improve productivity[313]; less car dependence may reduce monetary turnover for repairing and providing for new streets and automobile infrastructure	Reduced demand for private cars, may have negative impact on the existing public transport system[260,314].	Although the adoption of electric vehicles are accelerating, it may not be clear that purchasing an electric vehicle is advantageous from an economic or environmental perspective[315]; diesel and ICE engines are more labor intensive than electric engines.

Table S6: Human wellbeing and demand-side mitigation strategies in urban sector

	Compact city	Circular and shared economy	Systems approach in urban policy and practice	Nature based solutions
Food	**[+2/-1]** ▤ ☺☺ ★★★	**[+2]** ▤▤▤ ☺☺☺ ★★★★	**[+1]** ▤ ☺☺ ★★★	**[+2]** ▤ ☺☺ ★★★
	Mix effects. land use and land availability perspective; protecting agricultural land (which also has positive impact on food security and E stability) (+2) / increase transport (in contrast to local production) (-1) ; Creutzig (2016), Wake (2019), Azunre et al (2019), Yuan (2019), Anabtawi (2018), Gu et al (2019)	Community gardens that support sustainable food production and consumption, urban food sharing including sharing seeds, redistribution of food to the needy, food banks, shared kitchens, shared dining deliver substantial environmental benefits including avoided foodwaste to landfills (Munz and Cohen, 2016) (Davies & Legg, 2018)	Integrating urban agriculture can improve food access and security[316] ; Bisello (2018); Integrating rural land use optimization, changing urban dietary structure, and reduce food waste in cities can all contribute to overall food security Gu et al (2019) / land use mix, connectivity, and accessibility > IPCC-AR5-Ch12	Sustainable urban agriculture can enhance local food production[317] Petit-Boix (2018); Pauliuk (2018). Green infrastructure help biodiversity restoration and thus help pollinator health, contributing to longer term food security (Hall et al 2017).
Water	**[+1]** ▤ ☺ ★★	**[+1]** ▤ ☺☺ ★★★	**[+2]** ▤▤ ☺☺☺ ★★★	**[+1/-1]** ▤▤▤ ☺☺☺ ★★★★★
	Compact urban form that limits urban expansion in combination with both behavioural and structural shifts for reducing water demand, including rainwater harvesting, can reduce energy usage for water demands and CO_2 emissions as well as the water stress of urban areas on 24 local and/or distant reservoirs (James et al. 2018; Lam et al. 2018; Xu et al. 2018a). Negligible effect of densification on residential water demand[318].	Likely large potential for rainwater harvesting via building design , as well as low water use devices and behaviours.. A circular economy approach for water could enable efficient use of water and enhance the city's water security[319]. (Slys, 2009)	Similar to food, potential to integrate "water-energy-food" nexus in urban sites[320] the nexus approach allows for simultaneous planning to reduce energy and water footprint[321] (Wang and Chen, 2017) Urbanization and urban air pollution both found to exacerbate heavy rainfall and thus flood risk in cities. Therefore, urban water management need to be considered through a systems approach considering these interlinkages[322].	Water-energy-food nexus. E.g. integrating food production with rainwater harvesting / waste water flows / water recycling schemes on shared urban spaces such as rooftops, parks[323,324] UNESCO, 2018); Lwasa et al. 2015. Support storm water management[325] (Mcphearson et al., 2015); Urban blue infrastructure enhances water quality and security; trade-off with choice of tree species especially in water scarce cities; Sponge city initiative in China reduces urban flood risk (Chan et al 2018)

Air	**[+2/-1]**	▤▤	☺☺ ☺	★★★	**[+2]**	▤▤	☺☺ ☺	★★★	**[+2]**	▤	☺☺ ☺	★★★	**[+3/-1]**	▤▤▤	☺☺ ☺	★★★★
	There is evidence of improved air quality avoided deaths from reduced air pollution, especially when accompanied by appropriate transit policies[326–328]. However, some studies show low or no clear impact of compact urban development on air quality[329,330]; Compactness if not accompanied by transit can add to congestion and poor air quality				Considerable emissions reductions and hence air quality improvements possible (see following tabs), but some potential for rebound effect as latent mobility demand increases Tirachini, 2019.				Same as health - integrated urban planning supporting air quality; Co-benefits between climate mitigation and air pollution reduction[25]. Systemic (district) solutions to heating and cooling needs, as well as logistic needs can reduce overall air pollution[54,331].				Urban tree planting can provide significant air quality benefits[332–334] (De la Sota et al. 2019). Choice of species matters- some species could produce wind dispersed pollen and gases that cause photochemical reactions[335,336].Through reduced urban heat island effect, urban green surfaces also reduce photochemical smog. incl. ozone concentration[337].			
Health	**[+3/-1]**	▤▤▤	☺☺ ☺	★★★ ★	**[+2]**	▤▤	☺☺	★★★	**[+3]**	▤	☺☺	★★★	**[+3]**	▤▤▤	☺☺ ☺	★★★★ ★
	Compact cities that support a modal shift away from private motor vehicles towards walking, cycling, and low-emission public transport[326]. This modal shift to active transport secured cleaner air, benefitting public health Savacool (2020); Newman (1989); Creutzig (2016); Urge (2018) Woodcock (2009); Balbus (2014). Trade-offs include the marginal health costs of transport air pollution[338] , noise stress (Madza Adli, 2017).				Health impact via less outdoor air pollution and improved indoor environmental conditions (Savacool, 2020); combine ICT, e-mobility could create sustainable urban spaces, thus a better quality of life including health and social cohesion (EU SCIS project, 2017); energy retrofit on urban regeneration mentioned in several project reports[339] (Bisello (2018). Indirectly from avoided air pollution and noise from manufacturing and construction. Health benefits from shared urban food systems[340]; Significant reduction in energy use and material usage > air pollutant emissions reduction and therefore increase public health (Urge (2018)); increase leisure and social quality times; health benefits from improved diets (Christis et al., 2019)				Sustainable positive health outcomes in the urban context require a systems approach that integrates perspectives from urban planning > Bai (2016); Roux (2015); Tozan (2015); Bai (2012); Urge (2018); A better access to healthier food, improved air quality and waste management				Space for more physical activity for urban residents (Raymond et al., 2017). Health benefits including reduced cardiovascular morbidity, improved mental health[341,342], higher birth weight (within 100 m)[343] and from reduced air pollution and access to green spaces[344,345] (Bellamy et al., 2017). Overall, urban greenery has significant impact on increased life expectancy (Jonker et al 2014)			
Sanitation	**[+1]**	▤	☺	★★					**[+1]**	▤	☺☺	★★★	**[+1]**	▤▤	☺☺ ☺	★★★
									by designing and operation of infrastructure to secure sanitation, control infiltration and storm water runoff; Circular economy unlocks a rich cycle of biological, and renewable, resources that can be used and reused continuously which usually being lost and often causing harm.				nature-based sanitation solutions can be implemented into wastewater treatment facilities (UNESCO 2018)			

			Circular Sanitation Economy could significantly speed up the pace of change and the scale needed to achieve SDG 6: Universal access to adequate and equitable sanitation and hygiene; The safe management of Toilet Resources is critical to creating sustainable and resilient sanitation systems for all[346].	
Energy	**[+3/-1]** ▤▤▤ ☺☺☺ ★★★★★ Energy use from housing and mobility is reduced in more compact cities (Borck and Brueckner, 2016; Creutzig, 2014; Creutzig et al, 2015) fewer emissions from transport due to shorter distances may be counteracted with more urban heat island effect. Supports integration of renewables; high density development reduces energy for piped water and sanitation infrastructure but increases energy consumption for pumping water to high rise buildings[347]; compact cities could increase the urban heat island effect[348].	**[+3]** ▤▤ ☺☺☺ ★★★ Energy co-ops can enhance the generation and use of renewable energy in cities[349], Sharing economy as a business model for energy storage (Lombardi and schwabe 2017).	**[+3]** ▤ ☺☺☺ ★★★ Local production of renewable energy[350] Kaamen and Suntar (2016). Joint car and bike sharing significantly reduces energy consumption and needs (Becker et al, 2020). Considerable reducing in energy use for building construction by material use reduction (Lucon et al 2014). Occupant's behaviour can save up to 10-25% of energy consumption in residential buildings, and 5-30% in commercial buildings (Zhang et al 2018).	**[+3]** ▤▤ ☺☺ ★★★ Reduced urban heat island effect from urban greenery as well as building shading by green walls, roofs, can result in significantly reduced cooling energy consumption[351]. Dense urban greenery can reduce night-time urban cooling and thus heating needs in heating season[352] (Simpson 1998).
Shelter	**[-1]** ▤▤▤ ☺☺☺ ★★★★★ Densification projects can be detrimental for housing affordability, as urban regeneration (e.g. establishing walkable districts, constructing dense urban apartments) is often associated with gentrification[353–355]; Higher land values and housing costs[356].	**[+2/-1]** ▤ ☺ ★★★ Shared spaces/low income housing provide affordable shelter. Trade-off: Shared hostels impacted local hotel industry[357,358]. Prioritising retrofits rather than new urban construction, reusing construction materials, especially cement, in building and infrastructure construction is fundamental to a circular economy[2,359].	**[+2]** ▤ ☺☺ ★★★ Integrated buildings design / urban policy may improve shelter quality, but could be detrimental for affordability. Reductions in building cost/material use potentially increasing affordability, access (Lucon et al 2014).	**[+1/-1]** ▤ ☺☺ ★★★ In coastal areas, natural mangroves can act as bioshields protecting residential property (Feagin et al., 2010)

Mobility	**[+3]** ▤▤▤ ☺☺☺ ★★★★★	**[+3]** ▤▤▤ ☺☺☺ ★★★★★	**[+3]** ▤ ☺☺ ★★★	**[+1]** ▤▤ ☺☺ ★★★
	Compact cities a) reduce the distance needed to drive; b) enable modal shift to public transit (require high ridership) and cycling (requires shorter distances). They may also increase congestion (unclear results)[338] (Creutzig, 2014). Denser, mixed use, and compact environments can provide benefits and offset effects of VMT and energy consumption, but also found that 12 such built environments can offset such benefits due to the fact that congestion often occurs in denser 13 urban areas. The study also found that population density and mixed use have only limited effects on 14 commuting trip distance, but for non-commuting trips, mixed use and street connectivity are associated 15 with shorter VMT Ding et al. (2017a).	Shared mobility (ride sharing) is among the most promising urban strategies to address congestion, parking challenges, frees up road space for more safe bicycle infrastructure[79,80]. Shared vehicle (without ride sharing) use makes mobility more flexible without having to rely on available parking and being tied to vehicle location. Simultaneously, it saves substantial embodied emissions through reduced needs for automobiles and parking infrastructures.	Joint car and bike sharing significantly reduces energy consumption and needs (Becker et al, 2020) and improves transport efficiency[360].	Shaded pathways can enhance shift to walking and cycling[361].
Education	**[+1]** ▤▤ ☺☺☺ ★★★★★	**[+1]** ▤ ☺☺☺ ★★★★		**[+2]** ▤▤ ☺☺☺ ★★★★
	Compact cities increase access to the schools and educational facilities[362].	Participants in food exchange programme gained new knowledge[340]; community school gardens integrated into school curricula can deliver education and health benefits to children[363]. Widespread use of shared mobility substantially increases the inclusivity of cities, including access to education[80].		Schools, universities and urban forests can enhance knowledge regarding nature, ecosystems functions and biodiversity[364–366].

Communication	**[+1/-1]**	▤▤	☺☺	★★★	**[+1]**	▤▤	☺☺☺	★★★★	**[+1]**	▤	☺	★★				
	Mixed effects. Design of public spaces is important (Raman, 2010)				Shared housing (e.g. shared kitchens), improves communication between neighbours, or co-inhabitants, though design issues, and the predisposition of inhabitants are important (Baum, 1986). People with dementia benefit from shared living arrangements. Shared urban spaces enhance virtual and physical communication among urban communities[340]. Widespread use of shared mobility substantially increases the inclusivity of cities, including communication among its citizens, ability to form communities[80]				A systems approach can translate into improved communication at urban level, e.g. via urban-scale smart mobility systems that improve accessibility also for the disadvantaged (De, Sikarwar and Kumar, 2018). RE integration with smart city systems can enhance the potential of ICT. Food and appliances sharing system build on social group communication, both requiring this and fostering it.							
Social protection	**[+2]**	▤▤	☺	★★	**[+1]**	▤	☺☺	★★★	**[-1]**	▤	☺	★★	**[+2]**	▤	☺☺☺	★★
	Potentially greater access to amenities supporting social protection (health, education, green spaces, community spaces). These benefits could potentially also be offset by the gentrification and commercialisation of dense urban areas. References unknown. Safer urban environments (OECD, 2018) Streets that have kiosks, shops, etc. , more frequently found in compact cities, have "eyes on the street", and thus provide an element of the building of social capital (Jacobs, 2016)				Food sharing and re-distribution to the needy can enhance food security and act as a social protection strategy[340,367,368]. Widespread use of shared mobility substantially increases the inclusivity of cities, including the access to services and infrastructures to build community and social services[80].				Ambitious mitigation and adaptation plans could benefit private interests resulting in adverse effects on the urban poor Chu 2016; Mehta et al. 2019				Nature based solutions offer opportunities for greater interaction; spaces for shared activities, events, etc, improve societal health and well-being[324] (Bellamy et al., 2017)			

Participation	**[+1]** ▤ ☺ ★★ The built environment (walkability) has a small but significant positive effect on social capital (Wood et al., 2009) (see also social cohesion)	**[+1]** ▤ ☺☺☺ ★★★ Systems approach that engages public participation and developed solutions can enhance participation (Bai et al.,2018) Widespread use of shared mobility substantially increases the inclusivity of cities, including access to active participation opportunities[80].	**[+1]** ▤ ☺☺ ★★★ Participation itself can realize system-wide solution, such as well-designed cable car systems in Medellin[369].	**[+3]** ▤ ☺ ★★ Many solutions are bottom-up (participatory)[324,370,371].
Personal Security	**[+1]** ▤▤ ☺☺☺ ★★★★ Compact and dense cities could enhance citizens safety[356]; Compact and optimally designed cities enhance energy efficiency, and through this alleviate poverty[372].	**[+2]** ▤ ☺☺☺ ★★★★ Sustainable urban planning, particularly with nature-based solutions has a positive impact and contributes to urban resilience, human well-being, economic stability and physical security > H2020 report (2015) ; it also address the societal challenges of climate change, natural disasters, food and water security, human health and well-being, and economic and social development > Bush (2019); Cohen-Shacham (2016); EC (2015)	**[+2]** ▤ ☺ ★ The system approach in urban planning and policies have a direct influence on spatial segregation of society and in the perception of urban security by citizens. Therefore enhance citizens and sources security, for example by creating safe and healthy places, urban crime and violence reduces > Saaty (2017)	**[+1]** ▤ ☺ ★★★ In pandemics such as in COVID19, urban parks can provide access to safe exercise and safe leisure such as walking with pets or meeting friends[373].
Social cohesion	**[+1]** ▤▤ ☺☺☺ ★★★★★ Access to recreation, amenities, education, jobs and opportunities for social interaction. Dense cities have small networks but stronger ties (Raman, 2010)	**[+1]** ▤ ☺☺ ★★ Shared spaces for interaction such as libraries, recycling cafes, community gardens and shared public spaces can offer opportunities for bringing communities together (Munz and Cohen, 2016). Many solutions are bottom-up and improve cohesion; sense of belonging main motivation to participate in sharing economy (Hawlitschek et al, 2016). Widespread use of shared mobility substantially increases the inclusivity of cities, including social cohesion[80].	**[+1]** ▤ ☺ ★★ By involving, in different ways, more people in the management and decision making about green spaces additional, more socio-cultural benefits can be unlocked (Andersson, 2018) See also communication and participation	**[+2/-2]** ▤▤ ☺☺☺ ★★★ Synergy: provide spaces for social engagement; improve well-being (Bellamy et al, 2017) greening strategies, upgrading and urban revitalization as primarily market-driven endeavours targeting middle class and higher income groups sometimes at the expense of less privileged residents. Rise in property prices could lead to further gentrification (Raymond et al., 2017) (Hasse et al., 2017); uneven distribution of costs and benefits (Bush & Doyon, 2019)

Political stability					**[+1]**	▤	☺	★★								
					Similar link to social cohesion - sharing economy fostering social cohesion and hence political stability											
Economic stability	**[+1]**	▤▤	☺☺☺	★★★★	**[+2]**	▤	☺	★★	**[+1]**	▤	☺☺	★★	**[+3]**	▤▤	☺☺☺	★★★★
	Compact cities can foster regional economic growth, affect its economic activities. Improved productivity, better access to jobs through reduced travel distances[356]. Higher densities and close proximity of a larger population would mean that local businesses become more viable (Jenks, 2019, and enabled higher levels of energy efficiency help alleviate poverty[372].				Economic benefit for those receiving the redistributed food. Green jobs from urban start-ups, avoided costs[340]. Local economic opportunities through urban start-ups ((Munz and Cohen, 2016). Not enough evidence to show these benefits will be sustained				System approach poses an ability to deal with large number of interacting variables and relations. > direct and indirect positive impacts > address disaster risk reduction, urban poverty reduction and urban resilience > enhance economic stability. Systems approach entails creating demand and opportunities for entrepreneurship and business and civil society engagement[316]; this strategy can address a variety of societal challenges in sustainable ways, with the potential to contribute to green growth, 'future-proofing' society, fostering citizen well-being, providing business opportunities > H2020 report (2015)				has high positive impact on economic stability; see Ghisellini er al (2016), Esposito et al (2017), Esposito et al (2018), Tomey et al (2016) , ...			
Material provision	**[+1]**	▤	☺	★★	**[+3]**	▤	☺☺☺	★★★	**[+3]**	▤▤▤	☺☺☺	★★★★★	**[+1]**	▤	☺	★★
	Compact cities use land and resources efficiently (Fertner and Große 2016) but there isn't enough evidence on material use				Reduced material needs from higher recycling and reuse[374] (Cohen & Munoz, 2016)(Kumar and Baskar 2015) ; Urban organic waste can be recycled and reused in many urban applications, including as fertilisers[375].				Integrated and efficient infrastructure reduces material from avoided infrastructure and better efficiency ; Policy on green procurement and changing industrial development policy may change the type and quantity of material provision as well as GHG emission of the city[376,377].				Urban parks, gardens, green infrastructure can provide bio-based materials for various uses, including wood for construction, firewood, compost for fertilisation, etc[375].			

Economic supply side effects	**[+1/-2]**	🗎	☺☺	★★★	**[-1]**	🗎🗎	☺☺☺	★★★★	**[+2/-2]**	🗎	☺☺	★★	**[+1]**	🗎	☺☺	★★
	Reduced demand for cars. Makes public transport viable; positive and negative effects on real estate sector; typically compact cities are productive for street-level business and in particular for service-oriented domains where in-person meetings are important (law, notary services, etc.)[378–381]; Improves labour productivity[54]				Reduced demand for primary material input (at the urban scale, net effects positive because recycling is more labour and technology intensive). Retrofitting rather than new construction has substantial net positive impacts on employment (Urge-Vorsatz et al 2010)				Impacts on centralised energy supply but higher opportunities for integrating renewables[316].				NBS may provide new opportunities for landscape planners and implementing agencies[324,351,370].			

Table S7: Human wellbeing and demand-side mitigation strategies in industry sector

	Using less material by design	Product life extension	Energy Efficiency	Circular economy
Food	[+2] ▤ ☺☺ ★★ More material efficient design of packaging > less waste food; more efficient fertilizer application > more food production (per unit of material)[86].	[+2] ▤ ☺☺ ★★ Extending the life of food products, through better packaging, refrigeration, genetic improvement > increased provision of food. Can cause increases in food loss and wastes and energy consumption in for storage/refrigeration[86].	[+2] ▤ ☺☺ ★★ Increased energy efficiency in food processing supply chains, increase food production (per energy input) [382,383].	[+2] ▤▤ ☺☺ ★★★ More circular material and food systems (i.e. recycled packing, composting of food) > improved system provision of food[86].
Water	[+2] ▤▤ ☺☺ ★★★ More material efficient design of water infrastructure > increased access to water (per unit of material) [86].	[+2] ▤▤ ☺☺ ★★★ Long-life water infrastructure > increased access to water[86].	[+2] ▤▤ ☺☺ ★★★ Increased energy efficiency in pumping and treating of water > increased water access[86].	[+2] ▤▤ ☺☺ ★★★ Increased reuse/recycling/cascading of water (to avoid single use) > recyclable bottles > recycled water infrastructure > improved more water provision[86].
Air	[+3] ▤▤ ☺☺ ★★★ Less overall material demand > reduced industrial non-GHG emissions > air quality improvements[86].	[+3] ▤▤ ☺☺ ★★★ Less overall material demand > reduced industrial non-GHG emissions > air quality improvements[86].	[+3] ▤▤ ☺☺ ★★★ More energy efficient material production > reduced industrial non-GHG emissions > air quality improvements[86].	[+3] ▤▤ ☺☺ ★★★ More circular material systems > less overall material demand > reduced industrial non-GHG emissions > air quality improvements[86].
Health	[+2] ▤ ☺☺ ★★ More materially efficient of medical equipment and consumables > increased health provision (per unit of material) [86].	[+2] ▤ ☺☺ ★★ Longer life medical product design > increased health provision (per unit material)[86].	[+1] ▤ ☺☺ ★★ More energy efficient production of medical equipment and services > increased health provision[86].	[+1] ▤ ☺☺ ★★ More circular materials systems for medical equipment and services > increased health provision (per unit of material) [86].

Sanitation	**[+2]** ▤▤ ☺☺ ★★★ More materially efficient design of sanitation infrastructure > increased access to sanitation (per unit of material) [86].	**[+2]** ▤▤ ☺☺ ★★★ Longer life sanitation infrastructure > increased access to sanitation (per unit of material) [86].	**[+2]** ▤▤ ☺☺ ★★★ More energy efficient sanitation infrastructure > increased access to sanitation[86].	**[+2]** ▤▤ ☺☺ ★★★ More recovery of nutrients from sewage > recycling of sanitation infrastructure > increased access to sanitation (per unit of material) [86].
Energy	**[+3]** ▤▤ ☺☺ ★★★★ More efficient designs > less materials > less industrial energy required > increased energy access (per unit of material)[86,87,306,308].	**[+3]** ▤▤ ☺☺ ★★★★ Longer life energy designs > less materials > less industrial energy required > increased energy access (per unit of material[86,87,306,308].	**[+3]** ▤▤ ☺☺ ★★★★ Improved efficiency of energy system > more services delivered (per input of energy) > increased energy access[86,87,306,308,384,385].	**[+3]** ▤▤ ☺☺ ★★★★ More circular material systems > less materials > less industrial energy required > increased energy access (per unit of material)[86,386,387].
Shelter	**[+2]** ▤▤ ☺☺ ★★★★ Better, more material efficient design of shelters > more shelter provision (per unit of material)[86,87,306–308].	**[+2]** ▤▤ ☺☺ ★★★★ Longer lasting shelters > more shelter provision (per unit of material)[86,87,306–308].	**[+2]** ▤▤ ☺☺ ★★★★ More energy efficient manufacture of shelter > more shelter provision (per unit of material)[86].	**[+2]** ▤▤ ☺☺ ★★★★ More circular material systems for shelters > more shelter provision (per unit of material)[86,307].
Mobility	**[+2]** ▤▤▤ ☺☺ ★★★★ Lightweight vehicles > more mobility (per fuel use and unit materials) [86,87,306–308].	**[+2]** ▤▤▤ ☺☺ ★★★★ Longer life vehicles > more mobility (per unit material) [86,87,306–308].	**[+2]** ▤▤▤ ☺☺ ★★★★ More energy efficient manufacture of vehicles and mobility infrastructure > increased mobility provision[86].	**[+2]** ▤▤▤ ☺☺ ★★★★ More circular material systems > more mobility (per unit material)[86,307].
Education	**[+1]** ▤ ☺☺ ★★ Less materials used to deliver education infrastructure and buildings > increase education facilities (per material use) [86].	**[+1]** ▤ ☺☺ ★★ Less materials used to deliver education infrastructure and buildings > increase education facilities (per material use)[86].	**[+1]** ▤ ☺☺ ★★ Less energy used to deliver education infrastructure and buildings > increase education facilities[86].	**[+1]** ▤ ☺☺ ★★ More circular materials systems > reuse of materials in education buildings > increase education facilities (per material use)[86].

Communication	[+2] ▤▤ ☺☺ ★★★ Less materials used in communication infrastructure > increased rollout of communication (per material use)[86].	[+2] ▤▤ ☺☺ ★★★ Longer life communication infrastructure > increased rollout of communication (per material use)[86].	[+2] ▤▤ ☺☺ ★★★ More energy efficient manufacture of communication infrastructure > increased rollout of communication[86].	[+2] ▤▤ ☺☺ ★★★ Increased reuse and recycling of materials used in communication infrastructure > increased rollout of communication (per material use) [86].
Social protection	[+1] ▤ ☺☺ ★★ Better product design > increased sales > more social protection[86].	[+1] ▤ ☺☺ ★★ Longer life, higher quality products > more profits > more social protection[86].	[+2] ▤▤▤ ☺☺☺ ★★★★ Energy efficiency has human health benefits, and these are greater for low-income people[86,153,388,389].	[+1] ▤ ☺☺ ★★ More circular product designs > increased sales > more social protection[86].
Participation	[+1] ▤ ☺☺ ★★★ Mix results: While public acceptability is high for resource-efficient products. In practice, findings for electronic devices also showed strong preferences for products with the highest perceived quality, which are more resource intensive by design[390,391].	[-1] ▤▤▤ ☺☺☺ ★★★★ Extended producer responsibility and buy-backs tend not to be popular with consumers or producers; policy packages are proposed as a way to address this[86,392–395] (Yoon and Jang 2006).	[+2] ▤▤ ☺☺ ★★★ Energy democracy movements advance the transition away from fossil fuels, which democratically link social justice with energy innovation through a mix of policies[396–398].	[+1] ▤▤ ☺☺ ★★★ Circular fashion, based on participatory eco/re-design and consumer meaning-making in expanded value-creation and sharing, is proposed as a way to reduce material throughput in clothing[399]. In electronics and other sectors too, consumers are ready for product take-back, design for disassembly, Extended Producer Responsibility, and remanufacturing[86,400–402].
Personal Security	[+1] ▤ ☺☺ ★★ Increased material efficiency > reducing energy demand, reducing the emissions and other environmental impacts of industry, therefore increases national resource security[86] (Allwood et al, 2013).	[+1] ▤ ☺☺ ★★ Extended lifecycle of materials > enhanced resource security[86].	[+1] ▤ ☺☺ ★★ Energy efficient production of materials > enhanced resource security	[+2] ▤ ☺☺ ★★ Increased circularity of materials > enhanced resource security[86].

Social cohesion	**[+1]** ▤ ☺☺ ★★ Participatory design of products > better match to consumer needs[86].	**[+1]** ▤ ☺☺ ★★ Participatory design of products > better match to consumer needs[86].		**[+1]** ▤ ☺☺ ★★ Participatory design of products > better match to consumer needs[86].
Political stability	**[+1]** ▤ ☺☺ ★★ material efficiency > reducing energy demand, reducing the emissions and other environmental impacts of industry, therefore increases national resource security[86] (Allwood et al, 2013, IEA report)	**[+1]** ▤ ☺☺ ★★ Extended lifecycle of materials > enhanced resource security[86].	**[+1]** ▤ ☺☺ ★★ Energy efficient production of materials > enhanced resource security[86].	
Economic stability	**[+2]** ▤▤ ☺☺ ★★★ Better product design > competitive advantages > more sales[86,403] (Bleischwitz, 2010).	**[+2]** ▤▤ ☺☺ ★★★ Better product design > competitive advangtages > more sales[5] (Bleischwitz, 2010).	**[+2]** ▤▤ ☺☺ ★★★ More energy efficient production of materials and manufacturer of products > competitive advangtages > more sales[5].	**[+2]** ▤▤ ☺☺ ★★★ More circular product designs > competitive advangtages > more sales[5].
Material provision	**[+3]** ▤ ☺☺ ★★ Better, material efficient designs > increased provision of services derived from materials[86,87,87,88,306–308,404,405].	**[+3]** ▤ ☺☺ ★★ Better, longer life product designs > increased provision of services derived from materials[86,306,308,87,307,406,405,404].	**[+2]** ▤ ☺☺ ★★ Energy efficiency and material efficiency are interrelated in industrial plants, often inversely[86,384,385,407,408].	**[+3]** ▤ ☺☺ ★★ Better, more circular product designs > increased provision of services derived from materials[86,386,387,404,405,409–413].

Economic supply side effects	**[-2]**	📄	☺☺	★★	**[-2]**	📄	☺☺	★★	**[-2]**	📄	☺☺	★★	**[-2]**	📄	☺☺	★★
	Reduced demand for primary energy > loss in rents of resource owners; reduced demand of energy intensive products > loss in demand for some incumbent industry and related perception bias (status quo, loss aversion) hindering changes in business models. For medium-term positive effects see > economic stability[86,403].				Reduced demand for primary energy > loss in rents of resource owners; reduced demand of energy intensive products > loss in demand for some incumbent industry and related perception bias (status quo, loss aversion) hindering changes in business models. For medium-term positive effects see > economic stability[86,403].				Reduced demand for primary energy > loss in rents of resource owners; reduced demand of energy intensive products > loss in demand for some incumbent industry and related perception bias (status quo, loss aversion) hindering changes in business models. For medium-term positive effects see > economic stability[86,403].				Reduced demand for primary energy > loss in rents of resource owners; reduced demand of energy intensive products > loss in demand for some incumbent industry and related perception bias (status quo, loss aversion) hindering changes in business models. For medium-term positive effects see > economic stability[86,403].			

SI References

1. IEA. *World Energy Outlook 2020*. https://www.iea.org/reports/world-energy-outlook-2020 (2020).
2. Ürge-Vorsatz, D. *et al.* Advances toward a net-zero global building sector. *Annual Review of Environment and Resources* **45**, 227–269 (2020).
3. Niamir, L. *et al.* Assessing the macroeconomic impacts of individual behavioral changes on carbon emissions. *Climatic Change* **158**, 141–160 (2020).
4. Ahl, A., Accawi, G., Hudey, B., Lapsa, M. & Nichols, T. Occupant behavior for energy conservation in commercial buildings: Lessons learned from competition at the Oak Ridge National Laboratory. *Sustainability (Switzerland)* **11**, (2019).
5. Institute for Global Environmental Strategies, Aalto University & D-mat ltd. *1.5-Degree Lifestyles: Targets and Options for Reducing Lifestyle Carbon Footprints*. https://www.iges.or.jp/en/publication_documents/pub/technicalreport/en/6719/15_Degree_Lifestyles_MainReport.pdf (2019).
6. van der Grijp, N. *et al.* Demonstration projects of Nearly Zero Energy Buildings: Lessons from end-user experiences in Amsterdam, Helsingborg, and Lyon. *Energy Research and Social Science* **49**, 10–15 (2019).
7. ECF. *Net Zero by 2050: from whether to how*. https://europeanclimate.org/wp-content/uploads/2019/11/09-18-net-zero-by-2050-from-whether-to-how.pdf (2018).
8. Galassi, V. & Madlener, R. Shall I open the window? Policy implications of thermal-comfort adjustment practices in residential buildings. *ENERGY POLICY* **119**, 518+-518+ (2018).
9. Rakha, T., Chen, Y. & Reinhart, C. Do Office Buildings `Save’ Energy in the United States Due To Daylight Saving Time (Dst)? a 50-State Simulation-Based Study. *2018 Building Performance Analysis Conference and Simbuild* 21–28 (2018).
10. Sköld, B. *et al.* Household preferences to reduce their greenhouse gas footprint: A comparative study from four European cities. *Sustainability (Switzerland)* **10**, 1–16 (2018).

11. Talele, S. *et al.* Energy modeling and data structure framework for Sustainable Human-Building Ecosystems (SHBE) — a review. *Frontiers in Energy* **12**, 314–332 (2018).
12. Valencia, M., Villacreses, S., Benitez, D. S., Velasco, A. & Ochoa-Herrera, V. Towards a Sustainable Energy-Efficient Future at Universities, Universidad San Francisco de Quito Case Study, Phase I. in *2018 IEEE ANDESCON* (ed. Callejas, J.) (IEEE, 2018).
13. Ala-Mantila, S., Ottelin, J., Heinonen, J. & Junnila, S. Reprint of: To each their own? The greenhouse gas impacts of intra-household sharing in different urban zones. *Journal of Cleaner Production* **163**, S79–S90 (2017).
14. Alders, E. E. Adaptive heating, ventilation and solar shading for dwellings. *Architectural Science Review* **60**, 150–166 (2017).
15. Chang, C., Zhu, N. & Shang, J. The study of occupant behavior analysis of Inner Mongolia in regard to heating energy consumption. *Procedia Engineering* **205**, 915–922 (2017).
16. Kusumadewi, T. V. & Limmeechokchai, B. CO2 Mitigation in Residential Sector in Indonesia and Thailand: Potential of Renewable Energy and Energy Efficiency. *Energy Procedia* **138**, 955–960 (2017).
17. Hansen, M. & Hauge, B. Prosumers and smart grid technologies in Denmark: developing user competences in smart grid households. *Energy Efficiency* **10**, 1215–1234 (2017).
18. Sanguinetti, A., Pritoni, M., Salmon, K., Meier, A. & Morejohn, J. Upscaling participatory thermal sensing: Lessons from an interdisciplinary case study at University of California for improving campus efficiency and comfort. *Energy Research and Social Science* **32**, 44–54 (2017).
19. Sun, K. & Hong, T. A simulation approach to estimate energy savings potential of occupant behavior measures. *Energy and Buildings* **136**, 43–62 (2017).
20. Darby, H., Elmualim, A., Clements-Croome, D., Yearley, T. & Box, W. Influence of occupants' behaviour on energy and carbon emission reduction in a higher education building in the UK. *Intelligent Buildings International* **8**, 157–175 (2016).

21. Hasegawa, K. Stimation on the effect of CO_2 reduction through the action of cool share and warm share in Akita city. *AIJ Journal of Technology and Design* **22**, 1–4 (2016).
22. Taniguchi, A. *et al.* Estimation of the contribution of the residential sector to summer peak demand reduction in Japan using an energy end-use simulation model. *Energy and Buildings* **112**, 80–92 (2016).
23. Virage-énergie Nord-Pas de Calais. *Mieux vivre en Nord-Pas de Calais*. http://www.virage-energie.org/wp-content/uploads/2016/01/Virage-%C3%A9nergie-NPdC_Rapport-complet-%C3%A9tude-mieux-vivre_mars2016-1.pdf (2016).
24. Singh, S. Seasonal evaluation of adaptive use of controls in multi-storied apartments: A field study in composite climate of north India. *International Journal of Sustainable Built Environment* **5**, 83–98 (2016).
25. Dong, B., Li, Z. & McFadden, G. An investigation on energy-related occupancy behavior for low-income residential buildings. *Science and Technology for the Built Environment* **21**, 892–901 (2015).
26. Rafsanjani, H., Ahn, C. & Alahmad, M. A Review of Approaches for Sensing, Understanding, and Improving Occupancy-Related Energy-Use Behaviors in Commercial Buildings. *Energies* **8**, 10996–11029 (2015).
27. Ayoub, N., Musharavati, F., Pokharel, S. & Gabbar, H. A. Energy consumption and conservation practices in Qatar - A case study of a hotel building. *Energy and Buildings* **84**, 55–69 (2014).
28. Cao, B., Zhu, Y., Li, M. & Ouyang, Q. Individual and district heating: A comparison of residential heating modes with an analysis of adaptive thermal comfort. *Energy and Buildings* **78**, 17–24 (2014).
29. Fell, M. J., Shipworth, D., Huebner, G. M. & Elwell, C. A. Exploring perceived control in domestic electricity demand-side response. *Technology Analysis and Strategic Management* **26**, 1118–1130 (2014).

30. Brown, Z., Johnstone, N., Hascic, I., Vong, L. & Barascud, F. Testing the effect of defaults on the thermostat settings of OECD employees. *ENERGY ECONOMICS* **39**, 128–134 (2013).

31. Tokuda, K., Matsumoto, S. & Nakamura, M. Implementing a mobile application for spontaneous peak shaving of home electricity. *International Conference on Wireless and Mobile Computing, Networking and Communications* 273–278 (2013) doi:10.1109/WiMOB.2013.6673372.

32. Van Den Wymelenberg, K. Patterns of occupant interaction with window blinds: A literature review. *Energy and Buildings* **51**, 165–176 (2012).

33. Volochovic, A., Simanaviciene, Z. & Streimikiene, D. Šiltnamio Efektą Sukeliančių Dujų Emisijų Mažinimas Dėl Elgsenos Pokyčių Lietuvos Namų Ūkiuose. *Engineering Economics* **23**, 242–249 (2012).

34. Niamir, L., Ivanova, O. & Filatova, T. Economy-wide impacts of behavioral climate change mitigation: Linking agent-based and computable general equilibrium models. *Environmental Modelling & Software* **134**, 104839 (2020).

35. Mastrucci, A. & Rao, N. D. Bridging India's housing gap: lowering costs and CO2 emissions. *Building Research and Information* **47**, 8–23 (2019).

36. González-Mahecha, R. E. *et al.* Greenhouse gas mitigation potential and abatement costs in the Brazilian residential sector. *Energy and Buildings* **184**, 19–33 (2019).

37. Langevin, J., Harris, C. B. & Reyna, J. L. Assessing the Potential to Reduce U.S. Building CO2 Emissions 80% by 2050. *Joule* **3**, 2403–2424 (2019).

38. Economidou, M., Zangheri, P., Müller, A. & Kranzl, L. Financing the Renovation of the Cypriot Building Stock: An Assessment of the Energy Saving Potential of Different Policy Scenarios Based on the Invert/EE-Lab Model. *Energies* **11**, 3071–3071 (2018).

39. Peñaloza, D., Erlandsson, M., Berlin, J., Wålinder, M. & Falk, A. Future scenarios for climate mitigation of new construction in Sweden: Effects of different technological pathways. *Journal of Cleaner Production* **187**, 1025–1035 (2018).

40. Giraudet, L. *et al.* Long-term efficiency and distributional impacts of energy saving policies in the French residential sector To cite this version : HAL Id : hal-01890642 Long-term efficiency and distributional impacts of energy saving policies. (2018).
41. Mata, É., Kalagasidis, A. S. & Johnsson, F. Contributions of building retrofitting in five member states to EU targets for energy savings. *Renewable and Sustainable Energy Reviews* **93**, 759–774 (2018).
42. Oluleye, G., Allison, J., Kelly, N. & Hawkes, A. A Multi-period Mixed Integer Linear Program for Assessing the Benefits of Power to Heat Storage in a Dwelling Energy System. *Computer Aided Chemical Engineering* **43**, 1451–1456 (2018).
43. Braulio-Gonzalo, M. & Bovea, M. D. Environmental and cost performance of building's envelope insulation materials to reduce energy demand: Thickness optimisation. *Energy and Buildings* **150**, 527–545 (2017).
44. Iten R., J. M., Catenazzi G, Reiter U. ,. Wunderlich A. ,. Sigrist D. *Auswirkungen eines subsidiären Verbots fossiler Heizungen*. (2017).
45. Purohit, P. & Höglund-Isaksson, L. Global emissions of fluorinated greenhouse gases 2005-2050 with abatement potentials and costs. *Atmospheric Chemistry and Physics* **17**, 2795–2816 (2017).
46. Sharma, M., Chaturvedi, V. & Purohit, P. Long-term carbon dioxide and hydrofluorocarbon emissions from commercial space cooling and refrigeration in India: a detailed analysis within an integrated assessment modelling framework. *Climatic Change* **143**, 503–517 (2017).
47. Oluleye, G. & Smith, R. A mixed integer linear programming model for integrating thermodynamic cycles for waste heat exploitation in process sites. *Applied Energy* **178**, 434–453 (2016).
48. Purohit, P., Bertok, I., Chaturvedi, V. & Sharma, M. Scenario Analysis for HFC Emissions in India : Mitigation potential and costs. (2016).

49. Timilsina, G., Sikharulidze, A., Karapoghosya, E. & Shatvoryan, S. How Do We Prioritize the GHG Mitigation Options ? Development of a Marginal Abatement Cost Curve for the Building Sector in Armenia and Georgia. (2016).

50. Wittchen, K. B., Kragh, J. & Søren, A. *Potential heat savings during ongoing renovations of buildings until 2050*. 76 (2016).

51. Novikova, A. *et al.* The typology of the residential building stock in Albania and the modelling of its low-carbon transformation. 136–136 (2015).

52. Markandya, A., Labandeira, X. & Ramos, A. Policy instruments to foster energy efficiency. *Green Energy and Technology* **164**, 93–110 (2015).

53. Markewitz, P., Hansen, P., Kuckshinrichs, W. & Hake, J. F. Strategies for a low carbon building stock in Germany.

54. Ürge-Vorsatz, D., Herrero, S. T., Dubash, N. K. & Lecocq, F. Measuring the Co-Benefits of Climate Change Mitigation. *Annu. Rev. Environ. Resour.* **39**, 549–582 (2014).

55. Kjell Bettgenhäuser and Andoni Hidalgo. Integrated assessment modelling for building sectors – a technical, economic and ecological analysis for Germany and the EU until 2050. in *ECEEE 2013 SUMMER STUDY PROCEEDINGS– RETHINK, RENEW, RESTART* 1365–1376 (2013).

56. Dolman, E., Abu-Ebid, M. and Stambaugh, J. Decarbonising heat in buildings: 2030–2050. 2030–2050 (2012).

57. Mata, É. *et al.* A map of roadmaps for zero and low energy and carbon buildings worldwide. *Environ. Res. Lett.* **15**, 113003 (2020).

58. Ellsworth-Krebs, K., Reid, L. & Hunter, C. J. Home Comfort and "Peak Household": Implications for Energy Demand. *Housing, Theory and Society* **0**, 1–20 (2019).

59. Ruparathna, R., Hewage, K. & Sadiq, R. Improving the energy efficiency of the existing building stock: A critical review of commercial and institutional buildings. *Renewable and Sustainable Energy Reviews* **53**, 1032–1045 (2016).

60. Poore, J. & Nemecek, T. Reducing food's environmental impacts through producers and consumers. *Science* **360**, 987–992 (2018).

61. Schanes, K., Dobernig, K. & Gözet, B. Food waste matters-A systematic review of household food waste practices and their policy implications. *Journal of Cleaner Production* **182**, 978–991 (2018).

62. Gunders, D. & Bloom, J. Wasted: How America is losing up to 40 percent of its food from farm to fork to landfill. (2017).

63. Makov, T., Shepon, A., Krones, J., Gupta, C. & Chertow, M. Social and environmental analysis of food waste abatement via the peer-to-peer sharing economy. *Nature Communications* **11**, (2020).

64. Smith, P. *et al.* How much land-based greenhouse gas mitigation can be achieved without compromising food security and environmental goals? *Global Change Biology* **19**, 2285–2302 (2013).

65. Semba, R. D. *et al.* Adoption of the 'planetary health diet' has different impacts on countries' greenhouse gas emissions. *Nature Food* **1**, 481–484 (2020).

66. Springmann, M. *et al.* Health and nutritional aspects of sustainable diet strategies and their association with environmental impacts: a global modelling analysis with country-level detail. *The Lancet Planetary Health* **2**, e451–e461 (2018).

67. Willett, W. *et al.* Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. *The Lancet* **393**, 447–492 (2019).

68. Parodi, A. *et al.* The potential of future foods for sustainable and healthy diets. *Nature Sustainability* **1**, 782–789 (2018).

69. Springmann, M., Godfray, H. C. J., Rayner, M. & Scarborough, P. Analysis and valuation of the health and climate change cobenefits of dietary change. *PNAS* **113**, 4146–4151 (2016).

70. Aleksandrowicz, L., Green, R., Joy, E. J. M., Smith, P. & Haines, A. The impacts of dietary change on greenhouse gas emissions, land use, water use, and health: A systematic review. *PLoS ONE* **11**, 1–16 (2016).

71. Shukla, P. R. *et al.* IPCC, 2019: Climate Change and Land: an IPCC special report on climate change, desertification, land degradation, sustainable land management, food security, and greenhouse gas fluxes in terrestrial ecosystems.

72. Brand, C., Dons, E. & Anaya-Boig. The climate change mitigation effects of active travel. (2020) doi:10.21203/rs.3.rs-39219/v1.

73. Creutzig, F. *et al.* Beyond technology: demand-side solutions for climate change mitigation. *Annual Review of Environment and Resources* **41**, 173–198 (2016).

74. Ivanova, D. *et al.* Quantifying the potential for climate change mitigation of consumption options. *Environ. Res. Lett.* **15**, 093001 (2020).

75. Riggs, W. *Telework and Sustainable Travel During the COVID-19 Era*. https://papers.ssrn.com/abstract=3638885 (2020) doi:10.2139/ssrn.3638885.

76. ITF. *Shared Mobility Simulations for Lyon*. https://www.itf-oecd.org/shared-mobility-simulations-lyon (2020).

77. ITF. *Good to Go? Assessing the Environmental Performance of New Mobility*. https://www.itf-oecd.org/good-go-assessing-environmental-performance-new-mobility (2020).

78. ITF. *Transition to Shared Mobility*. https://www.itf-oecd.org/transition-shared-mobility (2017).

79. ITF. *shared-mobility-simulations-helsinki.pdf*. https://www.itf-oecd.org/sites/default/files/docs/shared-mobility-simulations-helsinki.pdf (2017).

80. ITF. *Shared Mobility: Innovation for Liveable Cities*. https://www.itf-oecd.org/shared-mobility-innovation-liveable-cities (2016).

81. Hampshire, K., German, R., Pridmore, A. & Fons, J. Electric vehicles from life cycle and circular economy perspectives. *Version* **2**, 25 (2018).

82. Hill, G., Heidrich, O., Creutzig, F. & Blythe, P. The role of electric vehicles in near-term mitigation pathways and achieving the UK's carbon budget. *Applied Energy* **251**, 113111 (2019).

83. Plötz, P., Funke, S. A., Jochem, P. & Wietschel, M. CO 2 mitigation potential of plug-in hybrid electric vehicles larger than expected. *Scientific reports* **7**, 1–6 (2017).

84. Khalili, S., Rantanen, E., Bogdanov, D. & Breyer, C. Global Transportation Demand Development with Impacts on the Energy Demand and Greenhouse Gas Emissions in a Climate-Constrained World. *Energies* **12**, 3870 (2019).

85. IEA. *Tracking Industry 2020*. https://www.iea.org/reports/tracking-industry-2020 (2020).

86. Grubler, A. *et al.* A low energy demand scenario for meeting the 1.5 °C target and sustainable development goals without negative emission technologies. *Nat Energy* **3**, 515–527 (2018).

87. Allwood & Cullen, J. *Sustainable Materials: with both eyes open*. (2012).

88. Carruth, M. A., Allwood, J. M. & Moynihan, M. C. The technical potential for reducing metal requirements through lightweight product design. *Resources, Conservation and Recycling* **57**, 48–60 (2011).

89. Cooper, D. R., Skelton, A. C. H., Moynihan, M. C. & Allwood, J. M. Component level strategies for exploiting the lifespan of steel in products. *Resources, Conservation and Recycling* **84**, 24–34 (2014).

90. Ellen MacArthur Foundation. *Completing the Picture: How the Circular Economy Tackles Climate Change*. https://www.ellenmacarthurfoundation.org/assets/downloads/Completing_The_Picture_How_The_Circular_Economy-_Tackles_Climate_Change_V3_26_September.pdf (2019).

91. IEA. *Material efficiency in clean energy transitions – Analysis*. https://www.iea.org/reports/material-efficiency-in-clean-energy-transitions (2019).

92. Material Economics. *The Circular Economy - a Powerful Force for Climate Mitigation*. https://materialeconomics.com/publications/the-circular-economy-a-powerful-force-for-climate-mitigation-1 (2018).

93. Cantzler, J. *et al.* Saving resources and the climate? A systematic review of the circular economy and its mitigation potential. *Environ. Res. Lett.* **15**, 123001 (2020).

94. IATA. *IATA Annual Review 2020*. 56 (2020).

95. Schäfer, A. W. *et al.* Technological, economic and environmental prospects of all-electric aircraft. *Nature Energy* **4**, 160–166 (2019).

96. Bouman, E. A., Lindstad, E., Rialland, A. I. & Strømman, A. H. State-of-the-art technologies, measures, and potential for reducing GHG emissions from shipping–a review. *Transportation Research Part D: Transport and Environment* **52**, 408–421 (2017).

97. McKinnon, A. *Decarbonizing logistics: Distributing goods in a low carbon world*. (Kogan Page Publishers, 2018).

98. Ronan. Decarbonising Maritime Transport. *ITF* https://www.itf-oecd.org/decarbonising-maritime-transport (2018).

99. Payne, J., Downy, F. & Weatherall, D. Capturing the "multiple benefits" of energy efficiency in practice: the UK example. 10.

100. Tonn, B., Rose, E. & Hawkins, B. Evaluation of the U.S. department of energy's weatherization assistance program: Impact results. *Energy Policy* **118**, 279–290 (2018).

101. Berrueta, V. M., Serrano-Medrano, M., García-Bustamante, C., Astier, M. & Masera, O. R. Promoting sustainable local development of rural communities and mitigating climate change: the case of Mexico's Patsari improved cookstove project. *Climatic Change* **140**, 63–77 (2017).

102. Hanna, R., Duflo, E. & Greenstone, M. Up in Smoke: The Influence of Household Behavior on the Long-Run Impact of Improved Cooking Stoves. *American Economic Journal: Economic Policy* **8**, 80–114 (2016).

103. McCollum, D. L. *et al.* Connecting the sustainable development goals by their energy inter-linkages. *Environ. Res. Lett.* **13**, 033006 (2018).

104. Hasegawa, T. *et al.* Consequence of Climate Mitigation on the Risk of Hunger. *Environ. Sci. Technol.* **49**, 7245–7253 (2015).

105. Sola, P., Ochieng, C., Yila, J. & Iiyama, M. Links between energy access and food security in sub Saharan Africa: an exploratory review. *Food Sec.* **8**, 635–642 (2016).

106. Torero, M. The Impact of Rural Electrification: Challenges and Ways Forward. *Revue d'économie du développement* **23**, 49 (2015).

107. Holland, R. A. *et al.* Global impacts of energy demand on the freshwater resources of nations. *Proc Natl Acad Sci USA* **112**, E6707–E6716 (2015).

108. Fricko, O. *et al.* Energy sector water use implications of a 2 °C climate policy. *Environ. Res. Lett.* **11**, 034011 (2016).

109. Rao, N. D. & Pachauri, S. Energy access and living standards: some observations on recent trends. *Environ. Res. Lett.* **12**, 025011 (2017).

110. Hejazi, M. I. *et al.* 21st century United States emissions mitigation could increase water stress more than the climate change it is mitigating. *Proc Natl Acad Sci USA* **112**, 10635–10640 (2015).

111. Song, Y. *et al.* The Interplay Between Bioenergy Grass Production and Water Resources in the United States of America. *Environ. Sci. Technol.* **50**, 3010–3019 (2016).

112. MacNaughton, P. *et al.* Energy savings, emission reductions, and health co-benefits of the green building movement. *J Expo Sci Environ Epidemiol* **28**, 307–318 (2018).

113. Levy, J. I. *et al.* Carbon reductions and health co-benefits from US residential energy efficiency measures. *Environ. Res. Lett.* **11**, 034017 (2016).

114. Balaban, O. & Puppim de Oliveira, J. A. Sustainable buildings for healthier cities: assessing the co-benefits of green buildings in Japan. *Journal of Cleaner Production* **163**, S68–S78 (2017).

115. Thema, J., Thomas, S., Chatterjee, S., Bouzarovski, S. & Mzavanadze, N. More than energy savings: quantifying the multiple impacts of energy efficiency in Europe. 10.

116. Vardoulakis, S. *et al.* Impact of climate change on the domestic indoor environment and associated health risks in the UK. *Environment International* **85**, 299–313 (2015).

117. García-Frapolli, E. *et al.* Beyond fuelwood savings: Valuing the economic benefits of introducing improved biomass cookstoves in the Purépecha region of Mexico. *Ecological Economics* **69**, 2598–2605 (2010).

118. Aunan, K. *et al.* Upgrading to cleaner household stoves and reducing chronic obstructive pulmonary disease among women in rural China — A cost-benefit analysis. *Energy for Sustainable Development* **17**, 489–496 (2013).

119. Jeuland, M., Tan Soo, J.-S. & Shindell, D. The need for policies to reduce the costs of cleaner cooking in low income settings: Implications from systematic analysis of costs and benefits. *Energy Policy* **121**, 275–285 (2018).

120. Wierzbicka, A. *et al.* Healthy Indoor Environments: The Need for a Holistic Approach. *IJERPH* **15**, 1874 (2018).

121. Cedeño-Laurent, J. G. *et al.* Building Evidence for Health: Green Buildings, Current Science, and Future Challenges. *Annu. Rev. Public Health* **39**, 291–308 (2018).

122. Rosenthal, J., Quinn, A., Grieshop, A. P., Pillarisetti, A. & Glass, R. I. Clean cooking and the SDGs: Integrated analytical approaches to guide energy interventions for health and environment goals. *Energy for Sustainable Development* **42**, 152–159 (2018).

123. Steenland, K. *et al.* Modeling the potential health benefits of lower household air pollution after a hypothetical liquified petroleum gas (LPG) cookstove intervention. *Environment International* **111**, 71–79 (2018).

124. Goldemberg, J., Martinez-Gomez, J., Sagar, A. & Smith, K. R. Household air pollution, health, and climate change: cleaning the air. *Environ. Res. Lett.* **13**, 030201 (2018).

125. Mzavanadze, N. Quantifying energy povertyrelated health impacts of energy efficiency. 66 (2018).

126. Liddell, C. & Guiney, C. Living in a cold and damp home: frameworks for understanding impacts on mental well-being. *Public Health* **129**, 191–199 (2015).

127. Willand, N., Ridley, I. & Maller, C. Towards explaining the health impacts of residential energy efficiency interventions – A realist review. Part 1: Pathways. *Social Science & Medicine* **133**, 191–201 (2015).

128. Burney, J., Alaofè, H., Naylor, R. & Taren, D. Impact of a rural solar electrification project on the level and structure of women's empowerment. *Environ. Res. Lett.* **12**, 095007 (2017).

129. Saheb, Y., Shnapp, S. & Johnson, C. The Zero Energy concept: making the whole greater than the sum of the parts to meet the Paris Climate Agreement's objectives. *Current Opinion in Environmental Sustainability* **30**, 138–150 (2018).

130. Saheb, Y., Ossenbrink, H., Szabo, S., Bódis, K. & Panev, S. Energy transition of Europe's building stock. Implications for EU 2030. Sustainable Development Goals. *Annales des Mines - Responsabilité et environnement* **N° 90**, 62 (2018).

131. Van de Ven, D.-J. *et al.* Integrated policy assessment and optimisation over multiple sustainable development goals in Eastern Africa. *Environ. Res. Lett.* **14**, 094001 (2019).

132. Mastrucci, A., Byers, E., Pachauri, S. & Rao, N. D. Improving the SDG energy poverty targets: Residential cooling needs in the Global South. *Energy and Buildings* **186**, 405–415 (2019).

133. Alawneh, R., Ghazali, F., Ali, H. & Asif, M. A new index for assessing the contribution of energy efficiency in LEED 2009 certified green buildings to achieving UN sustainable development goals in Jordan. *International Journal of Green Energy* **16**, 490–499 (2019).

134. Thomson, H., Snell, C. & Bouzarovski, S. Health, Well-Being and Energy Poverty in Europe: A Comparative Study of 32 European Countries. *IJERPH* **14**, 584 (2017).

135. Ürge-Vorsatz, D. *et al.* Measuring multiple impacts of low-carbon energy options in a green economy context. *Applied Energy* **179**, 1409–1426 (2016).

136. Tajani, F. *et al.* Energy retrofit assessment through automated valuation models: An Italian case study. in 020045 (2018). doi:10.1063/1.5045451.

137. de Ayala, A., Galarraga, I. & Spadaro, J. V. The price of energy efficiency in the Spanish housing market. *Energy Policy* **94**, 16–24 (2016).

138. Marmolejo-Duarte, C. & Chen, A. The Uneven Price Impact of Energy Efficiency Ratings on Housing Segments and Implications for Public Policy and Private Markets. *Sustainability* **11**, 372 (2019).

139. Kahn, M. E. & Kok, N. The capitalization of green labels in the California housing market. *Regional Science and Urban Economics* **47**, 25–34 (2014).

140. Fuerst, F., McAllister, P., Nanda, A. & Wyatt, P. Does energy efficiency matter to home-buyers? An investigation of EPC ratings and transaction prices in England. *Energy Economics* **48**, 145–156 (2015).

141. Cajias, M., Fuerst, F. & Bienert, S. Tearing down the information barrier: the price impacts of energy efficiency ratings for buildings in the German rental market. *Energy Research & Social Science* **47**, 177–191 (2019).

142. Hyland, M., Lyons, R. C. & Lyons, S. The value of domestic building energy efficiency — evidence from Ireland. *Energy Economics* **40**, 943–952 (2013).

143. Davis, P. T., McCord, J. A., McCord, M. & Haran, M. Modelling the effect of energy performance certificate rating on property value in the Belfast housing market. *Int J of Hous Markts and Analy* **8**, 292–317 (2015).

144. Jensen, O. M., Hansen, A. R. & Kragh, J. Market response to the public display of energy performance rating at property sales. *Energy Policy* **93**, 229–235 (2016).

145. Fuerst, F., Oikarinen, E. & Harjunen, O. Green signalling effects in the market for energy-efficient residential buildings. *Applied Energy* **180**, 560–571 (2016).

146. Cadena, A. & Thomson, T. A. An Empirical Assessment of the Value of Green in Residential Real Estate. 9.

147. Brounen, D. & Kok, N. On the economics of energy labels in the housing market. *Journal of Environmental Economics and Management* **62**, 166–179 (2011).

148. Deng, Y., Li, Z. & Quigley, J. M. Economic returns to energy-efficient investments in the housing market: Evidence from Singapore. *Regional Science and Urban Economics* **42**, 506–515 (2012).

149. Zheng, S., Wu, J., Kahn, M. E. & Deng, Y. The nascent market for “green” real estate in Beijing. *European Economic Review* **56**, 974–984 (2012).

150. Koirala, B. S., Bohara, A. K. & Berrens, R. P. Estimating the net implicit price of energy efficient building codes on U.S. households. *Energy Policy* **73**, 667–675 (2014).

151. Venugopal, P. *et al.* Roadway to self-healing highways with integrated wireless electric vehicle charging and sustainable energy harvesting technologies. *Applied Energy* **212**, 1226–1239 (2018).

152. Liu, L., Kong, F., Liu, X., Peng, Y. & Wang, Q. A review on electric vehicles interacting with renewable energy in smart grid. *Renewable and Sustainable Energy Reviews* **51**, 648–661 (2015).

153. Maidment, C. D., Jones, C. R., Webb, T. L., Hathway, E. A. & Gilbertson, J. M. The impact of household energy efficiency measures on health: A meta-analysis. *Energy Policy* **65**, 583–593 (2014).

154. Ortiz, M. A., Kurvers, S. R. & Bluyssen, P. M. A review of comfort, health, and energy use: Understanding daily energy use and wellbeing for the development of a new approach to study comfort. *Energy and Buildings* **152**, 323–335 (2017).

155. Rao, N. D., Agarwal, A. & Wood, D. IMPACTS OF SMALL-SCALE ELECTRICITY SYSTEMS. 66.

156. Howden-Chapman, P. *et al.* Tackling cold housing and fuel poverty in New Zealand: A review of policies, research, and health impacts. *Energy Policy* **49**, 134–142 (2012).

157. Smith, A. C. *et al.* Health and environmental co-benefits and conflicts of actions to meet UK carbon targets. *Climate Policy* **16**, 253–283 (2016).

158. Galán-Marín, C., Rivera-Gómez, C. & García-Martínez, A. Embodied energy of conventional load-bearing walls versus natural stabilized earth blocks. *Energy and Buildings* **97**, 146–154 (2015).

159. Mehetre, S. A., Panwar, N. L., Sharma, D. & Kumar, H. Improved biomass cookstoves for sustainable development: A review. *Renewable and Sustainable Energy Reviews* **73**, 672–687 (2017).

160. Camarinha-Matos, L. M. Collaborative smart grids – A survey on trends. *Renewable and Sustainable Energy Reviews* **65**, 283–294 (2016).

161. Baimel, D., Tapuchi, S. & Baimel, N. Smart Grid Communication Technologies. *JPEE* **04**, 1–8 (2016).

162. Steemers, K. & Manchanda, S. Energy efficient design and occupant well-being: Case studies in the UK and India. *Building and Environment* **45**, 270–278 (2010).

163. Trencher, G., Takagi, T., Ryuichi, H. & Sprigings, Z. *Urban Efficiency: A Global Survey of Building Energy Efficiency Policies in Cities Contents*. (2014).

164. Gladu, J. Indigenous participation in renewables and the four directions of sustainability. *Corporate Knights* https://www.corporateknights.com/channels/leadership/indigenous-participation-renewables-four-directions-sustainability-15797747/ (2020).

165. Cameron, C. *et al.* Policy trade-offs between climate mitigation and clean cook-stove access in South Asia. *Nat Energy* **1**, 15010 (2016).

166. Mirasgedis, S., Tourkolias, C., Pavlakis, E. & Diakoulaki, D. A methodological framework for assessing the employment effects associated with energy efficiency interventions in buildings. *Energy and Buildings* **82**, 275–286 (2014).

167. Teubler, J., Kiefer, S. & Bienge, K. Methodology and quantification of Resource impacts from energy efficiency in Europe. 109 (2018).

168. Huang, C., Han, J. & Chen, W. Changing patterns and determinants of infrastructures' material stocks in Chinese cities. (2017) doi:10.1016/J.RESCONREC.2016.06.014.

169. Heeren, N. & Hellweg, S. Tracking Construction Material over Space and Time: Prospective and Geo-referenced Modeling of Building Stocks and Construction Material Flows. *Journal of Industrial Ecology* **23**, 253–267 (2019).

170. FAO. *Global food losses and food waste: extent, causes and prevention. Study conducted for the International Congress SAVE FOOD! at Interpack2011 Düsseldorf, Germany*. (Food and Agriculture Organization of the United Nations, 2011).

171. FAO. *The State of Food and Agriculture 2019. Moving forward on food loss and waste reduction*. (2019).

172. Alexander, P. *et al.* Losses, inefficiencies and waste in the global food system. *Agricultural Systems* **153**, 190–200 (2017).

173. Verma, M. van den B., de Vreede, L., Achterbosch, T. & Rutten, M. M. Consumers discard a lot more food than widely believed: Estimates of global food waste using an energy gap approach and affluence elasticity of food waste. *PLOS ONE* **15**, e0228369 (2020).

174. Springmann, M. *et al.* Health and nutritional aspects of sustainable diet strategies and their association with environmental impacts: a global modelling analysis with country-level detail. *The Lancet Planetary Health* **2**, e451–e461 (2018).

175. Gustavsson, J., Cederberg, C. & Sonesson, U. *Global food losses and food waste*. 38 http://www.fao.org/fileadmin/user_upload/suistainability/pdf/Global_Food_Losses_and_Food_Waste.pdf (2011).

176. Muth, M. K. *et al.* A systems approach to assessing environmental and economic effects of food loss and waste interventions in the United States. *Science of the Total Environment* **685**, 1240–1254 (2019).

177. Temme, E. H. M. *et al.* Demand-Side Food Policies for Public and Planetary Health. *Sustainability* **12**, 5924 (2020).

178. Park, H. & Yu, S. Policy review: Implication of tax on sugar-sweetened beverages for reducing obesity and improving heart health. *Health Policy and Technology* **8**, 92–95 (2019).

179. Springmann, M. *et al.* The healthiness and sustainability of national and global food based dietary guidelines: modelling study. *BMJ* **370**, (2020).

180. Herforth, A. *et al.* A Global Review of Food-Based Dietary Guidelines. *Adv Nutr* **10**, 590–605 (2019).

181. FAO and WHO. *Sustainable healthy diets: Guiding principles*. (FAO and WHO, 2019). doi:10.4060/CA6640ENAlso Available in:Chinese Spanish French Russian.

182. Costa Leite, J., Caldeira, S., Watzl, B. & Wollgast, J. Healthy low nitrogen footprint diets. *Global Food Security* **24**, 100342 (2020).

183. Hoekstra, A. Y. The hidden water resource use behind meat and dairy. *Animal Frontiers* **2**, 3–8 (2012).

184. Kim, B. F. *et al.* Country-specific dietary shifts to mitigate climate and water crises. *Global Environmental Change* 101926 (2019) doi:10.1016/j.gloenvcha.2019.05.010.

185. Vanham, D., Bouraoui, F., Leip, A., Grizzetti, B. & Bidoglio, G. Lost water and nitrogen resources due to EU consumer food waste. *Environmental Research Letters* **10**, 84008 (2015).

186. Leip, A. *et al.* Impacts of European livestock production: nitrogen, sulphur, phosphorus and greenhouse gas emissions, land-use, water eutrophication and biodiversity. *Environmental Research Letters* **10**, 115004 (2015).

187. Sutton, M. A. *et al. Nitrogen - Grasping the Challenge. A Manifesto for Science-in-Action through the International Nitrogen Management System. Summary Report*. (Centre for Ecology & Hydrology, 2019).

188. Westhoek, H. *et al.* Food choices, health and environment: Effects of cutting Europe’s meat and dairy intake. *Global Environmental Change* **26**, 196–205 (2014).

189. FAO. *Food Wastage Footprint: Fool cost-accounting*. *Food and Agriculture Organization of the United Nations (FAO)* (2014). doi:ISBN 978-92-5-107752-8.

190. GBD 2017 Diet Collaborators. Health effects of dietary risks in 195 countries, 1990–2017: a systematic analysis for the Global Burden of Disease Study 2017. *The Lancet* **393**, 1958–1972 (2019).

191. Swinburn, B. A. *et al.* The Global Syndemic of Obesity, Undernutrition, and Climate Change: The Lancet Commission report. *The Lancet* **393**, 791–846 (2019).

192. Cafaro, P. J., Primack, R. B. & Zimdahl, R. L. The Fat of the Land: Linking American Food Overconsumption, Obesity, and Biodiversity Loss. *J Agric Environ Ethics* **19**, 541–561 (2006).

193. Wahl, D. R. *et al.* Healthy food choices are happy food choices: Evidence from a real life sample using smartphone based assessments. *Sci Rep* **7**, (2017).

194. Holder, M. D. The Contribution of Food Consumption to Well-Being. *ANM* **74**, 44–52 (2019).

195. Willett, W. *et al.* Food in the Anthropocene: the EAT–Lancet Commission on healthy diets from sustainable food systems. *The Lancet* **393**, 447–492 (2019).

196. Lomazzi, M., Moore, M., Johnson, A., Balasegaram, M. & Borisch, B. Antimicrobial resistance – moving forward? *BMC Public Health* **19**, 858 (2019).

197. Tang, K. L. *et al.* Restricting the use of antibiotics in food-producing animals and its associations with antibiotic resistance in food-producing animals and human beings: a systematic review and meta-analysis. *The Lancet Planetary Health* **1**, e316–e327 (2017).

198. Environment, U. N. Preventing the next pandemic - Zoonotic diseases and how to break the chain of transmission. *UNEP - UN Environment Programme* http://www.unenvironment.org/resources/report/preventing-future-zoonotic-disease-outbreaks-protecting-environment-animals-and (2020).

199. Gerba, C. P., Tamimi, A. H., Pettigrew, C., Weisbrod, A. V. & Rajagopalan, V. Sources of microbial pathogens in municipal solid waste landfills in the United States of America: *Waste Management & Research* (2011) doi:10.1177/0734242X10397968.

200. Gao, Y. *et al.* Global trends and future prospects of e-waste research: a bibliometric analysis. *Environ Sci Pollut Res* **26**, 17809–17820 (2019).

201. CSIRO. Reducing the environmental impact of your diet. https://www.csiro.au/en/Research/BF/Areas/Nutrition-and-health/Public-health-and-wellbeing/Case-studies/Environmental-impact-of-diets.

202. Vågsholm, I., Arzoomand, N. S. & Boqvist, S. Food Security, Safety, and Sustainability—Getting the Trade-Offs Right. *Front. Sustain. Food Syst.* **4**, (2020).

203. Morone, P., Falcone, P. M., Imbert, E. & Morone, A. Does food sharing lead to food waste reduction? An experimental analysis to assess challenges and opportunities of a new consumption model. *Journal of Cleaner Production* **185**, 749–760 (2018).

204. Falcone, P. M. & Imbert, E. Bringing a Sharing Economy Approach into the Food Sector: The Potential of Food Sharing for Reducing Food Waste. in *Food Waste Reduction and Valorisation* 197–214 (Springer International Publishing, 2017). doi:10.1007/978-3-319-50088-1_10.

205. Riches, G. Food banks and food security: Welfare reform, human rights and social policy. Lessons from Canada? *Social Policy and Administration* **36**, 648–663 (2002).

206. May, J., Williams, A., Cloke, P. & Cherry, L. Welfare Convergence, Bureaucracy, and Moral Distancing at the Food Bank. *Antipode* **51**, 1251–1275 (2019).

207. Pollard, C. M. & Booth, S. Food insecurity and hunger in rich countries—it is time for action against inequality. *International Journal of Environmental Research and Public Health* **16**, (2019).

208. Bergström, P., Malefors, C., Strid, I., Hanssen, O. J. & Eriksson, M. Sustainability assessment of food redistribution initiatives in Sweden. *Resources* **9**, 1–27 (2020).

209. Fresán, U. & Sabaté, J. Vegetarian Diets: Planetary Health and Its Alignment with Human Health. *Adv Nutr* **10**, S380–S388 (2019).

210. Marsh, A. A. *et al.* Reduced amygdala-orbitofrontal connectivity during moral judgments in youths with disruptive behavior disorders and psychopathic traits. *Psychiatry Res* **194**, 279–286 (2011).

211. Godfray, H. C. J. *et al.* Meat consumption, health, and the environment. *Science* **361**, (2018).

212. Nikolić, S., Mojović, L., Rakin, M., Pejin, D. & Pejin, J. Utilization of microwave and ultrasound pretreatments in the production of bioethanol from corn. *Clean Techn Environ Policy* **13**, 587–594 (2011).

213. Qiu, M., Jessani, N. & Bennett, S. Identifying health policy and systems research priorities for the sustainable development goals: social protection for health. *International Journal for Equity in Health* **17**, 155 (2018).
214. Mwai, D. & Muriithi, M. Economic Effects of Non-Communicable Diseases on Household Income in Kenya: A Comparative Analysis Perspective. *Public Health Research* **6**, 83–90 (2016).
215. Spray, A. L. *Leveraging Social Protection Programs for Improved Nutrition*. (World Bank, 2016). doi:10.1596/25337.
216. Thakur, J., Prinja, S., Garg, C. C., Mendis, S. & Menabde, N. Social and Economic Implications of Noncommunicable diseases in India. *Indian J Community Med* **36**, S13–S22 (2011).
217. Thyberg, K. & Tonjes, D. Drivers of Food Wastage and their Implications for Sustainable Policy Development. *Technology & Society Faculty Publications* (2016) doi:dx.doi.org/10.1016/j.resconrec.2015.11.016.
218. Phongpipatkul, M. & Wongwatcharapaiboon, J. *The impact of food waste initiatives on urban resilience, well-being and inclusiveness*. (2019).
219. Rut, M., Davies, A. R. & Ng, H. Participating in food waste transitions: exploring surplus food redistribution in Singapore through the ecologies of participation framework. *Journal of Environmental Policy & Planning* **0**, 1–14 (2020).
220. Davey, R. C., Hurst, G. L., Smith, G. R., Grogan, S. C. & Kurth, J. The impact and process of a community-led intervention on reducing environmental inequalities related to physical activity and healthy eating - a pilot study. *BMC Public Health* **11**, 697 (2011).
221. O'Kane, G. What is the real cost of our food? Implications for the environment, society and public health nutrition. *Public Health Nutr* **15**, 268–276 (2012).
222. Johns, T., Powell, B., Maundu, P. & Eyzaguirre, P. B. Agricultural biodiversity as a link between traditional food systems and contemporary development, social integrity and ecological health. *Journal of the Science of Food and Agriculture* **93**, 3433–3442 (2013).

223. Higgs, S. & Thomas, J. Social influences on eating. *Current Opinion in Behavioral Sciences* **9**, 1–6 (2016).

224. Asano, Y. M. & Biermann, G. Rising adoption and retention of meat-free diets in online recipe data. *Nature Sustainability* **2**, 621–627 (2019).

225. Chuck, C., Fernandes, S. A. & Hyers, L. L. Awakening to the politics of food: Politicized diet as social identity. *Appetite* **107**, 425–436 (2016).

226. Veser, P., Taylor, K. & Singer, S. Diet, authoritarianism, social dominance orientation, and predisposition to prejudice : Results of a German survey. *British Food Journal* **117**, 1949–1960 (2015).

227. Rosenfeld, M. J., Thomas, R. J. & Hausen, S. Disintermediating your friends: How online dating in the United States displaces other ways of meeting. *PNAS* **116**, 17753–17758 (2019).

228. Plante, C. N., Rosenfeld, D. L., Plante, M. & Reysen, S. The role of social identity motivation in dietary attitudes and behaviors among vegetarians. *Appetite* **141**, 104307 (2019).

229. Markowski, K. L. & Roxburgh, S. "If I became a vegan, my family and friends would hate me:" Anticipating vegan stigma as a barrier to plant-based diets. *Appetite* **135**, 1–9 (2019).

230. Philippidis, G., Sartori, M., Ferrari, E. & M'Barek, R. Waste not, want not: A bio-economic impact assessment of household food waste reductions in the EU. *Resources, Conservation and Recycling* **146**, 514–522 (2019).

231. Wohner, B., Pauer, E., Heinrich, V. & Tacker, M. Packaging-related food losses and waste: An overview of drivers and issues. *Sustainability (Switzerland)* **11**, (2019).

232. Müller, P. & Schmid, M. Intelligent packaging in the food sector: A brief overview. *Foods* **8**, (2019).

233. Garnett, E. E., Balmford, A., Sandbrook, C., Pilling, M. A. & Marteau, T. M. Impact of increasing vegetarian availability on meal selection and sales in cafeterias. *PNAS* **116**, 20923–20929 (2019).

234. Mattioli, G. & Anable, J. Gross polluters for food shopping travel: An activity-based typology. *Travel Behaviour and Society* **6**, 19–31 (2017).

235. Tormo, M. J. *et al.* Physical sports activity during leisure time and dietary intake of foods and nutrients in a large Spanish cohort. *Int J Sport Nutr Exerc Metab* **13**, 47–64 (2003).

236. de Nazelle, A. *et al.* Improving health through policies that promote active travel: a review of evidence to support integrated health impact assessment. *Environ Int* **37**, 766–777 (2011).

237. Carrus, G., Pirchio, S. & Mastandrea, S. Social-Cultural Processes and Urban Affordances for Healthy and Sustainable Food Consumption. *Front. Psychol.* **9**, (2018).

238. Furunes, T. & Mkono, M. Service-delivery success and failure under the sharing economy. *Int J Contemp Hospitality Mngt* IJCHM-06-2018-0532 (2019) doi:10.1108/IJCHM-06-2018-0532.

239. Sorenson, S. B., Morssink, C. & Campos, P. A. Safe access to safe water in low income countries: Water fetching in current times. *Social Science & Medicine* **72**, 1522–1526 (2011).

240. Ali, S. I. Alternatives for safe water provision in urban and peri-urban slums. *J Water Health* **8**, 720–734 (2010).

241. Giovanis, E. The relationship between teleworking, traffic and air pollution. *Atmospheric Pollution Research* **9**, 1–14 (2018).

242. Shafray, E. & Kim, S. A Study of Walkable Spaces with Natural Elements for Urban Regeneration: A Focus on Cases in Seoul, South Korea. *Sustainability* **9**, 587 (2017).

243. Brand, C., Goodman, A. & Ogilvie, D. Evaluating the impacts of new walking and cycling infrastructure on carbon dioxide emissions from motorized travel: A controlled longitudinal study. *Applied Energy* **128**, 284–295 (2014).

244. Keall, M. D., Shaw, C., Chapman, R. & Howden-Chapman, P. Reductions in carbon dioxide emissions from an intervention to promote cycling and walking: A case study from New Zealand. *Transportation Research Part D: Transport and Environment* **65**, 687–696 (2018).

245. Hino, K., Taniguchi, A., Hanazato, M. & Takagi, D. Modal Shift from Cars and Promotion of Walking by Providing Pedometers in Yokohama City, Japan. *International Journal of Environmental Research and Public Health* **16**, 2144 (2019).

246. Otero, I., Nieuwenhuijsen, M. J. & Rojas-Rueda, D. Health impacts of bike sharing systems in Europe. *Environment International* **115**, 387–394 (2018).

247. Schnell, J. L. *et al.* Air quality impacts from the electrification of light-duty passenger vehicles in the United States. *Atmospheric Environment* **208**, 95–102 (2019).

248. Tessum, C. W., Hill, J. D. & Marshall, J. D. Life cycle air quality impacts of conventional and alternative light-duty transportation in the United States. *Proc Natl Acad Sci USA* **111**, 18490–18495 (2014).

249. Smith, A. C. *et al.* Telehealth for global emergencies: Implications for coronavirus disease 2019 (COVID-19). *J Telemed Telecare* **26**, 309–313 (2020).

250. Mueller, N. *et al.* Health impact assessment of cycling network expansions in European cities. *Preventive Medicine* **109**, 62–70 (2018).

251. Stankov, I. *et al.* A systematic review of empirical and simulation studies evaluating the health impact of transportation interventions. *Environmental Research* **186**, 109519 (2020).

252. Rojas-Rueda, D., Nieuwenhuijsen, M. J., Khreis, H. & Frumkin, H. Autonomous Vehicles and Public Health. *Annu. Rev. Public Health* **41**, 329–345 (2020).

253. Hammer, M. S., Swinburn, T. K. & Neitzel, R. L. Environmental noise pollution in the United States: developing an effective public health response. *Environ Health Perspect* **122**, 115–119 (2014).

254. Tiwari, G., Jain, D. & Ramachandra Rao, K. Impact of public transport and non-motorized transport infrastructure on travel mode shares, energy, emissions and safety: Case of Indian cities. *Transportation Research Part D: Transport and Environment* **44**, 277–291 (2016).

255. Michaelides, E. E. Thermodynamics and energy usage of electric vehicles. *Energy Conversion and Management* **203**, 112246 (2020).

256. Hook, A., Court, V., Sovacool, B. K. & Sorrell, S. A systematic review of the energy and climate impacts of teleworking. *Environ. Res. Lett.* **15**, 093003 (2020).
257. Shabanpour, R., Golshani, N., Tayarani, M., Auld, J. & Mohammadian, A. (Kouros). Analysis of telecommuting behavior and impacts on travel demand and the environment. *Transportation Research Part D: Transport and Environment* **62**, 563–576 (2018).
258. Martin, A., Goryakin, Y. & Suhrcke, M. Does active commuting improve psychological wellbeing? Longitudinal evidence from eighteen waves of the British Household Panel Survey. *Preventive Medicine* **69**, 296–303 (2014).
259. Nieuwenhuijsen, M. J. Urban and transport planning pathways to carbon neutral, liveable and healthy cities; A review of the current evidence. *Environment International* **140**, 105661 (2020).
260. Nugroho, S. B., Zusman, E. & Nakano, R. Explaining the spread of online taxi services in Semarang, Bogor and Bandung, Indonesia; a discrete choice analysis. *Travel Behaviour and Society* **20**, 358–369 (2020).
261. Becker, H., Balac, M., Ciari, F. & Axhausen, K. W. Assessing the welfare impacts of Shared Mobility and Mobility as a Service (MaaS). *Transportation Research Part A: Policy and Practice* **131**, 228–243 (2020).
262. Suatmadi, A. Y., Creutzig, F. & Otto, I. M. On-demand motorcycle taxis improve mobility, not sustainability. *Case Studies on Transport Policy* **7**, (2019).
263. Figlio, D., Rush, M. & Yin, L. Is It Live or Is It Internet? Experimental Estimates of the Effects of Online Instruction on Student Learning. *Journal of Labor Economics* **31**, 763–784 (2013).
264. Protopsaltis, S. *Does Online Education Live Up to Its Promise? A Look at the Evidence and Implications for Federal Policy*. (2019).
265. Stewart, O. Findings from Research on Active Transportation to School and Implications for Safe Routes to School Programs: *Journal of Planning Literature* (2010) doi:10.1177/0885412210385911.

266. Mendoza, J. A., Levinger, D. D. & Johnston, B. D. Pilot evaluation of a walking school bus program in a low-income, urban community. *BMC Public Health* **9**, 122 (2009).

267. Abel, S., Machin, T. & Brownlow, C. Social media, rituals, and long-distance family relationship maintenance: A mixed-methods systematic review. *New Media & Society* 1461444820958717 (2020) doi:10.1177/1461444820958717.

268. Jun, H.-J. & Hur, M. The relationship between walkability and neighborhood social environment: The importance of physical and perceived walkability. *Applied Geography* **62**, 115–124 (2015).

269. Haerewa, N., Stephenson, J. & Hopkins, D. Shared mobility in a Māori community. *Kōtuitui: New Zealand Journal of Social Sciences Online* **13**, 233–245 (2018).

270. Kostakis, V., Latoufis, K., Liarokapis, M. & Bauwens, M. The convergence of digital commons with local manufacturing from a degrowth perspective: Two illustrative cases. *Journal of Cleaner Production* **197**, 1684–1693 (2018).

271. Rotta, M. J. R., Sell, D., dos Santos Pacheco, R. C. & Yigitcanlar, T. Digital Commons and Citizen Coproduction in Smart Cities: Assessment of Brazilian Municipal E-Government Platforms. *Energies* **12**, 2813 (2019).

272. Fotel, T. Marginalized or Empowered? Street Reclaiming Strategies and the Situated Politics of Children's Mobilities. *Geography Compass* **3**, 1267–1280 (2009).

273. Ahmed, M. M. A. W. & Monem, N. A. E. Sustainable and green transportation for better quality of life case study greater Cairo – Egypt. *HBRC Journal* **16**, 17–37 (2020).

274. Tulu, G. S., Hadgu, M. & Tarekegn, A. G. Bicycling in Addis Ababa, Ethiopia: Opportunities and challenges. *Journal of Sustainable Development of Transport and Logistics* **4**, 50–59 (2019).

275. Mittal, N. & Sarin, S. Safety issues in non-motorized transport in India. *Journal of traffic medicine* **27**, 37–48 (1999).

276. Machado, C. A. S., De Salles Hue, N. P. M., Berssaneti, F. T. & Quintanilha, J. A. An Overview of Shared Mobility. *Sustainability* **10**, 4342 (2018).

277. Valero, C. F. F. & Puerta, C. P. Identification of the Main Risk Factors for Vulnerable Non-motorized Users in the City of Manizales and its Relationship with the Quality of Road Infrastructure. *Procedia - Social and Behavioral Sciences* **162**, 359–367 (2014).

278. Kodransky, M. & Lewenstein, G. *Can Shared Mobility Help Low-Income People Access Opportunity?* https://www.livingcities.org/resources/284-can-shared-mobility-help-low-income-people-access-opportunity (2014).

279. Levasseur, M. *et al.* Importance of proximity to resources, social support, transportation and neighborhood security for mobility and social participation in older adults: results from a scoping study. *BMC Public Health* **15**, 503 (2015).

280. Le Vine, S., Adamou, O. & Polak, J. Predicting new forms of activity/mobility patterns enabled by shared-mobility services through a needs-based stated-response method: Case study of grocery shopping. *Transport Policy* **32**, 60–68 (2014).

281. Mattia, G., Guglielmetti Mugion, R. & Principato, L. Shared mobility as a driver for sustainable consumptions: The intention to re-use free-floating car sharing. *Journal of Cleaner Production* **237**, 117404 (2019).

282. Peters, D. R., Schnell, J. L., Kinney, P. L., Naik, V. & Horton, D. E. Public Health and Climate Benefits and Trade-Offs of U.S. Vehicle Electrification. *GeoHealth* **4**, e2020GH000275 (2020).

283. Requia, W. J., Mohamed, M., Higgins, C. D., Arain, A. & Ferguson, M. How clean are electric vehicles? Evidence-based review of the effects of electric mobility on air pollutants, greenhouse gas emissions and human health. *Atmospheric Environment* **185**, 64–77 (2018).

284. Collins, A. M., Hislop, D. & Cartwright, S. Social support in the workplace between teleworkers, office-based colleagues and supervisors. *New Technology, Work and Employment* **31**, 161–175 (2016).

285. de Wit, D. Power Over Power: The Politics of Energy Transition. (UC Santa Cruz, 2020).

286. Dotzer, L. J. Governing sustainable mobility : modes of governance in infrastructure development for electric vehicles. http://essay.utwente.nl/82372/ (2020).

287. Sintov, N. D., Abou-Ghalioum, V. & White, L. V. The partisan politics of low-carbon transport: Why democrats are more likely to adopt electric vehicles than Republicans in the United States. *Energy Research & Social Science* **68**, 101576 (2020).

288. Kulmer, V. & Seebauer, S. Beyond the s-shape: Identifying and explaining turning points in market diffusion of low-carbon technologies. 51.

289. Pirdavani, A., Bellemans, T., Brijs, T., Kochan, B. & Wets, G. Assessing the road safety impacts of a teleworking policy by means of geographically weighted regression method. *Journal of Transport Geography* **39**, 96–110 (2014).

290. Von Bergen, C. W. Safety and Workers' Compensation Considerations in Telework. *Regional Business Review* **27**, (2008).

291. Nugroho, S. B., Zusman, E. & Nakano, R. Pedestrianisation Programs and Its Impacts on the Willingness to Increase Walking Distance in Indonesian Cities. The case of Bandung City and Bogor City, Indonesia. *undefined* /paper/Pedestrianisation-Programs-and-Its-Impacts-on-the-Nugroho-Zusman/acf4b6f6a3d14c63bd99c4e29ebf5616e2f2e8b0 (2018).

292. Fyhri, A., Hof, T., Simonova, Z., Jong, M. de & TNO Defensie en Veiligheid. The Influence of Perceived Safety and Security on Walking. (2010).

293. Loukaitou-Sideris, A. Is it Safe to Walk?1 Neighborhood Safety and Security Considerations and Their Effects on Walking. *Journal of Planning Literature* **20**, 219–232 (2006).

294. National Academies of Sciences, Engineering, and Medicine. *Between Public and Private Mobility: Examining the Rise of Technology-Enabled Transportation Services*. (2016). doi:10.17226/21875.

295. Ye, Q., Chen, X., Ozbay, K. & Wang, Y. How People View and Respond to Special Events in Shared Mobility: Case Study of Two Didi Safety Incidents via Sina Weibo. 3229–3240 (2020) doi:10.1061/9780784482933.278.

296. Dia, H. & Javanshour, F. Autonomous Shared Mobility-On-Demand: Melbourne Pilot Simulation Study. *Transportation Research Procedia* **22**, 285–296 (2017).

297. Glenn Dutcher, E. The effects of telecommuting on productivity: An experimental examination. The role of dull and creative tasks. *Journal of Economic Behavior & Organization* **84**, 355–363 (2012).

298. Society, I. for a B.-E., Bosua, R., Gloet, M., Kurnia, S. & Mendoza, A. *Telework, Productivity and Wellbeing*. (IBES, 2012).

299. van den Berg, P., Sharmeen, F. & Weijs-Perrée, M. On the subjective quality of social Interactions: Influence of neighborhood walkability, social cohesion and mobility choices. *Transportation Research Part A: Policy and Practice* **106**, 309–319 (2017).

300. Springer India-New Delhi. Automotive Revolution & Perspective Towards 2030. *Auto Tech Rev* **5**, 20–25 (2016).

301. Cruz-Jesus, F., Oliveira, T. & Bacao, F. The Global Digital Divide: Evidence and Drivers. *Journal of Global Information Management (JGIM)* www.igi-global.com/article/the-global-digital-divide/201005 (2018).

302. WBGU. *Towards our Common Digital Future*. https://www.wbgu.de/en/publications/publication/towards-our-common-digital-future#section-downloads (2019).

303. Rowe, K. Measuring the Economic Impact of Bicycle Facilities on Neighborhood Business Districts. in (2013).

304. Goodno, M., McNeil, N., Parks, J. & Dock, S. Evaluation of Innovative Bicycle Facilities in Washington, D.C.: Pennsylvania Avenue Median Lanes and 15th Street Cycle Track. *Transportation Research Record* **2387**, 139–148 (2013).

305. Poirier, J. A. Bicycle Lanes and Business Success: A San Francisco Examination. *Transportation Research Record* **2672**, 47–57 (2018).

306. Allwood, J. M., Ashby, M. F., Gutowski, T. G. & Worrell, E. Material efficiency: A white paper. *Resources, Conservation and Recycling* **55**, 362–381 (2011).

307. Hertwich, E. G. *et al.* Material efficiency strategies to reducing greenhouse gas emissions associated with buildings, vehicles, and electronics—a review. *Environ. Res. Lett.* **14**, 043004 (2019).

308. Allwood, J. M., Cullen, J. M. & Milford, R. L. Options for Achieving a 50% Cut in Industrial Carbon Emissions by 2050. *Environ. Sci. Technol.* **44**, 1888–1894 (2010).

309. Dunn, J. B., Gaines, L., Kelly, J. C., James, C. & Gallagher, K. G. The significance of Li-ion batteries in electric vehicle life-cycle energy and emissions and recycling's role in its reduction. *Energy Environ. Sci.* **8**, 158–168 (2014).

310. Cox, B., Mutel, C. L., Bauer, C., Mendoza Beltran, A. & van Vuuren, D. P. Uncertain Environmental Footprint of Current and Future Battery Electric Vehicles. *Environ. Sci. Technol.* **52**, 4989–4995 (2018).

311. Hawkins, T. R., Singh, B., Majeau-Bettez, G. & Strømman, A. H. Comparative Environmental Life Cycle Assessment of Conventional and Electric Vehicles. *Journal of Industrial Ecology* **17**, 53–64 (2013).

312. Cabrera Serrenho, A. & Allwood, J. M. Material Stock Demographics: Cars in Great Britain. *Environ. Sci. Technol.* **50**, 3002–3009 (2016).

313. Oppezzo, M. & Schwartz, D. L. Give your ideas some legs: The positive effect of walking on creative thinking. *Journal of Experimental Psychology: Learning, Memory, and Cognition* **40**, 1142–1152 (2014).

314. Shaheen, S. & Cohen, A. Mobility on demand (MOD) and mobility as a service (MaaS): early understanding of shared mobility impacts and public transit partnerships. in *Demand for Emerging Transportation Systems* 37–59 (Elsevier, 2020). doi:10.1016/B978-0-12-815018-4.00003-6.

315. Kennedy, D. & Philbin, S. P. Techno-economic analysis of the adoption of electric vehicles. *Front. Eng. Manag.* **6**, 538–550 (2019).

316. Bai, X. *et al.* Defining and advancing a systems approach for sustainable cities. *Current Opinion in Environmental Sustainability* **23**, 69–78 (2016).

317. Cole, M. B., Augustin, M. A., Robertson, M. J. & Manners, J. M. The science of food security. *npj Science of Food* **2**, 14 (2018).

318. Ghavidelfar, S., Shamseldin, A. Y. & Melville, B. W. Future implications of urban intensification on residential water demand. *Journal of Environmental Planning and Management* **60**, 1809–1824 (2017).

319. Voulvoulis, N. Water reuse from a circular economy perspective and potential risks from an unregulated approach. *Current Opinion in Environmental Science and Health* **2**, 32–45 (2018).

320. Toboso-Chavero, S. *et al.* Towards Productive Cities Environmental Assessment of the Food-Energy-Water Nexus of the Urban Roof Mosaic. **23**, (2018).

321. Engström, R. E. *et al.* Connecting the resource nexus to basic urban service provision – with a focus on water-energy interactions in New York City. *Sustainable Cities and Society* **31**, 83–94 (2017).

322. Shi, P. *et al.* Urbanization and air quality as major drivers of altered spatiotemporal patterns of heavy rainfall in China. *Landscape Ecology* **32**, 1723–1738 (2017).

323. Toboso-Chavero, S. *et al.* Towards Productive Cities: Environmental Assessment of the Food-Energy-Water Nexus of the Urban Roof Mosaic. *Journal of Industrial Ecology* **23**, 767–780 (2019).

324. Raymond, C. M. *et al.* A framework for assessing and implementing the co-benefits of nature-based solutions in urban areas. *Environmental Science and Policy* **77**, 15–24 (2017).

325. Wamsler, C. & Pauleit, S. Making headway in climate policy mainstreaming and ecosystem-based adaptation: two pioneering countries, different pathways, one goal. *Climatic Change* **137**, 71–87 (2016).

326. Stevenson, M. *et al.* Land use, transport, and population health: estimating the health benefits of compact cities. *The Lancet* **388**, 2925–2935 (2016).

327. Hankey, S. & Marshall, J. D. Urban Form, Air Pollution, and Health. *Current environmental health reports* **4**, 491–503 (2017).

328. Ramaswami, A. *et al.* Urban cross-sector actions for carbon mitigation with local health co-benefits in China. *Nature Climate Change* **7**, 736–742 (2017).

329. Cho, H. S. & Choi, M. J. Effects of compact Urban development on air pollution: Empirical evidence from Korea. *Sustainability (Switzerland)* **6**, 5968–5982 (2014).

330. Rodrigues, P. F. *et al.* Health economic assessment of a shift to active transport. *Environmental Pollution* **258**, 113745 (2020).

331. von Stechow, C. *et al.* Integrating Global Climate Change Mitigation Goals with Other Sustainability Objectives: A Synthesis. *Annu. Rev. Environ. Resour.* **40**, 363–394 (2015).

332. Scholz, T., Hof, A. & Schmitt, T. Cooling Effects and Regulating Ecosystem Services Provided by Urban Trees—Novel Analysis Approaches Using Urban Tree Cadastre Data. *Sustainability* **10**, 712–712 (2018).

333. Nowak, D. J., Hirabayashi, S., Doyle, M., McGovern, M. & Pasher, J. Air pollution removal by urban forests in Canada and its effect on air quality and human health. *Urban Forestry and Urban Greening* **29**, 40–48 (2018).

334. Sicard, P. *et al.* Should we see urban trees as effective solutions to reduce increasing ozone levels in cities? *Environmental Pollution* **243**, 163–176 (2018).

335. Grote, R. *et al.* Functional traits of urban trees: air pollution mitigation potential. *Frontiers in Ecology and the Environment* **14**, 543–550 (2016).

336. Eisenman, T. S. *et al.* Landscape and Urban Planning Urban trees , air quality , and asthma : An interdisciplinary review. *Landscape and Urban Planning* **187**, 47–59 (2019).

337. Fallmann, J., Forkel, R. & Emeis, S. Secondary effects of urban heat island mitigation measures on air quality. *Atmospheric Environment* **125**, 199–211 (2016).

338. Lohrey, S. & Creutzig, F. A 'sustainability window' of urban form. *Transportation Research Part D: Transport and Environment* **45**, 96–111 (2016).

339. Creutzig, F. *et al.* Beyond Technology: Demand-Side Solutions for Climate Change Mitigation. *Annual Review of Environment and Resources* **41**, 173–198 (2016).

340. Davies, A. R. & Legg, R. Fare sharing: interrogating the nexus of ICT, urban food sharing, and sustainability. *Food, Culture & Society* **21**, 233–254 (2018).

341. Vujcic, M. *et al.* Nature based solution for improving mental health and well-being in urban areas. *Environmental Research* **158**, 385–392 (2017).

342. van den Bosch, M. & Ode Sang. Urban natural environments as nature-based solutions for improved public health – A systematic review of reviews. *Environmental Research* **158**, 373–384 (2017).

343. Dzhambov, A. M., Dimitrova, D. D. & Dimitrakova, E. D. Association between residential greenness and birth weight: Systematic review and meta-analysis. *Urban Forestry & Urban Greening* **13**, 621–629 (2014).

344. Panno, A., Carrus, G., Lafortezza, R., Mariani, L. & Sanesi, G. Nature-based solutions to promote human resilience and wellbeing in cities during increasingly hot summers. *Environmental Research* **159**, 249–256 (2017).

345. Pedersen Zari, M., Kiddle, G. L., Blaschke, P., Gawler, S. & Loubser, D. Utilising nature-based solutions to increase resilience in Pacific Ocean Cities. *Ecosystem Services* **38**, 100968–100968 (2019).

346. Moya, B., Parker, A. & Sakrabani, R. Challenges to the use of fertilisers derived from human excreta: The case of vegetable exports from Kenya to Europe and influence of certification systems. *Food Policy* **85**, 72–78 (2019).

347. Zhang, Q. *et al.* Urbanization impacts on greenhouse gas (GHG) emissions of the water infrastructure in China: Trade-offs among sustainable development goals (SDGs). *Journal of Cleaner Production* **232**, 474–486 (2019).

348. Pearsall, H. Staying cool in the compact city: Vacant land and urban heating in Philadelphia, Pennsylvania. *Applied Geography* **79**, 84–92 (2017).

349. Hufen, J. A. M. & Koppenjan, J. F. M. Local renewable energy cooperatives: revolution in disguise? *Energy, Sustainability and Society* **5**, 18–18 (2015).

350. Bagheri, M., Shirzadi, N., Bazdar, E. & Kennedy, C. A. Optimal planning of hybrid renewable energy infrastructure for urban sustainability: Green Vancouver. *Renewable and Sustainable Energy Reviews* **95**, 254–264 (2018).

351. Faivre, N., Fritz, M., Freitas, T., de Boissezon, B. & Vandewoestijne, S. Nature-Based Solutions in the EU: Innovating with nature to address social, economic and environmental challenges. *Environmental Research* **159**, 509–518 (2017).

352. Aboelata, A. & Sodoudi, S. Evaluating the effect of trees on UHI mitigation and reduction of energy usage in different built up areas in Cairo. *Building and Environment* **168**, 106490–106490 (2020).

353. Quastel, N., Moos, M. & Lynch, N. Sustainability-As-Density and the Return of the Social: The Case of Vancouver, British Columbia. *Urban Geography* **33**, 1055–1084 (2012).

354. Rosol, M. Social mixing through densification? The struggle over the Little Mountain public housing complex in Vancouver. *DIE ERDE – Journal of the Geographical Society of Berlin* **146**, 151–164 (2015).

355. Clark, T. A. Metropolitan density, energy efficiency and carbon emissions: Multi-attribute tradeoffs and their policy implications. *Energy Policy* **53**, 413–428 (2013).

356. Peiró-Palomino, J. & Picazo-Tadeo, A. J. OECD: One or many? Ranking countries with a composite well-being indicator. *Social Indicators Research* **139**, 847–869 (2018).

357. Marckmann, B., Gram-Hanssen, K. & Christensen, T. H. Sustainable Living and Co-Housing: Evidence from a Case Study of Eco-Villages. *Built Environment* **38**, 413–429 (2012).

358. Lidewij. Digital Library Of The Commons. in *Practicing the Commons: Self-Governance, Cooperation and Institutional Change* (2017).

359. Bai, X. *et al.* Six research priorities for cities and climate change. *Nature* **555**, 23–25 (2018).

360. Luo, H., Zhao, F., Chen, W. Q. & Cai, H. Optimizing bike sharing systems from the life cycle greenhouse gas emissions perspective. *Transportation Research Part C: Emerging Technologies* **117**, (2020).

361. Langenheim, N., White, M., Tapper, N., Livesley, S. J. & Ramirez-Lovering, D. Right tree, right place, right time: A visual-functional design approach to select and place trees for optimal shade benefit to commuting pedestrians. *Sustainable Cities and Society* **52**, 101816 (2020).

362. Spiess, K. & Wrohlich, K. Does distance determine who attends a university in Germany? *Economics of Education Review* **29**, 470–479 (2010).

363. Guitart, D. A., Pickering, C. M. & Byrne, J. A. Color me healthy: Food diversity in school community gardens in two rapidly urbanising australian cities. *Health and Place* **26**, 110–117 (2014).

364. Sat Gungor, B., Chen, J., Wu, S., Zhou, P. & Shirkey, G. Does Plant Knowledge within Urban Forests and Parks Directly Influence Visitor Pro-Environmental Behaviors. *Forests* **9**, 171–171 (2018).

365. Sampaio, M. B., De La Fuente, M. F., Albuquerque, U. P., da Silva Souto, A. & Schiel, N. Contact with urban forests greatly enhances children's knowledge of faunal diversity. *Urban Forestry & Urban Greening* **30**, 56–61 (2018).

366. Hunter-Doniger, T. Seeing the forest through the trees: at the intersection of Forest Kindergartens and art-based environmental education. *Journal of Adventure Education and Outdoor Learning* 1–13 (2020) doi:10.1080/14729679.2020.1771388.

367. Loh, P. & Agyeman, J. Urban food sharing and the emerging Boston food solidarity economy. *Geoforum* **99**, 213–222 (2019).

368. Davies, A. R. *et al.* Making visible: Interrogating the performance of food sharing across 100 urban areas. *Geoforum* **86**, 136–149 (2017).

369. Milan, B. F. & Creutzig, F. Lifting peripheral fortunes: Upgrading transit improves spatial, income and gender equity in Medellin. *Cities* **70**, 122–134 (2017).

370. Frantzeskaki, N. Seven lessons for planning nature-based solutions in cities. *Environmental Science & Policy* **93**, 101–111 (2019).

371. van der Jagt, A. P. N. *et al.* Cultivating nature-based solutions: The governance of communal urban gardens in the European Union. *Environmental Research* **159**, 264–275 (2017).

372. Pachauri, S., Ürge-Vorsatz, D. & LaBelle, M. Synergies between Energy Efficiency and Energy Access Policies and Strategies. *Global Policy* **3**, 187–197 (2012).

373. Xie, J., Luo, S., Furuya, K. & Sun, D. Urban Parks as Green Buffers During the COVID-19 Pandemic. *Sustainability* **12**, 6751 (2020).

374. Cabeza, L. F. *et al.* Affordable construction towards sustainable buildings: review on embodied energy in building materials. *Current Opinion in Environmental Sustainability* **5**, 229–236 (2013).

375. Adhikari, B. K., Trémier, A., Martinez, J. & Barrington, S. Home and community composting for on-site treatment of urban organic waste: perspective for Europe and Canada: *Waste Management & Research* (2010) doi:10.1177/0734242X10373801.

376. Zhu, Q., Geng, Y. & Sarkis, J. Motivating green public procurement in China: An individual level perspective. *Journal of Environmental Management* **126**, 85–95 (2013).

377. Peng, Y. & Bai, X. Experimenting towards a low-carbon city: Policy evolution and nested structure of innovation. *Journal of Cleaner Production* **174**, 201–212 (2018).

378. Newman, P., Kosonen, L. & Kenworthy, J. Theory of urban fabrics: planning the walking, transit/public transport and automobile/motor car cities for reduced car dependency. *Town Planning Review* **87**, 429–458 (2016).

379. Bibri, S. E., Krogstie, J. & Kärrholm, M. Compact city planning and development: Emerging practices and strategies for achieving the goals of sustainability. *Developments in the Built Environment* **4**, 100021–100021 (2020).

380. Mouratidis, K. Compact city, urban sprawl, and subjective well-being. *Cities* **92**, 261–272 (2019).

381. Kotulla, T., Denstadli, J. M., Oust, A. & Beusker, E. What Does It Take to Make the Compact City Liveable for Wider Groups? Identifying Key Neighbourhood and Dwelling Features. *Sustainability* **11**, 3480–3480 (2019).

382. Ramos, S. *et al.* 1 - Cleaner production strategies for the food industry. in *The Interaction of Food Industry and Environment* (ed. Galanakis, C.) 1–34 (Academic Press, 2020). doi:10.1016/B978-0-12-816449-5.00001-1.

383. Xu, Y. & Szmerekovsky, J. System dynamic modeling of energy savings in the US food industry. *Journal of Cleaner Production* **165**, 13–26 (2017).

384. Gonzalez Hernandez, A., Lupton, R. C., Williams, C. & Cullen, J. M. Control data, Sankey diagrams, and exergy: Assessing the resource efficiency of industrial plants. *Applied Energy* **218**, 232–245 (2018).

385. Hernandez, A. G. & Cullen, J. M. Exergy: A universal metric for measuring resource efficiency to address industrial decarbonisation. *Sustainable Production and Consumption* **20**, 151–164 (2019).

386. Cullen, J. M. Circular Economy: Theoretical Benchmark or Perpetual Motion Machine? *Journal of Industrial Ecology* **21**, 483–486 (2017).

387. Gutowski, T. G., Sahni, S., Boustani, A. & Graves, S. C. Remanufacturing and Energy Savings. *Environ. Sci. Technol.* **45**, 4540–4547 (2011).

388. Buonocore, J. J., Lambert, K. F., Burtraw, D., Sekar, S. & Driscoll, C. T. An Analysis of Costs and Health Co-Benefits for a U.S. Power Plant Carbon Standard. *PLOS ONE* **11**, e0156308 (2016).

389. Roulet, C.-A. *et al.* Multicriteria analysis of health, comfort and energy efficiency in buildings. *Building Research & Information* **34**, 475–482 (2006).

390. Cherry, C., Scott, K., Barrett, J. & Pidgeon, N. Public acceptance of resource-efficiency strategies to mitigate climate change. *Nature Climate Change* **8**, 1007–1012 (2018).

391. Kasulaitis, B. V., Babbitt, C. W. & Krock, A. K. Dematerialization and the Circular Economy: Comparing Strategies to Reduce Material Impacts of the Consumer Electronic Product Ecosystem. *Journal of Industrial Ecology* **23**, 119–132 (2019).

392. Quinn, L. & Sinclair, A. J. Policy challenges to implementing extended producer responsibility for packaging. *Canadian Public Administration* **49**, 60–79 (2006).

393. Nahman, A. Extended producer responsibility for packaging waste in South Africa: Current approaches and lessons learned. *Resources, Conservation and Recycling* **54**, 155–162 (2010).

394. Wang, H. *et al.* Operating models and development trends in the extended producer responsibility system for waste electrical and electronic equipment. *Resources, Conservation and Recycling* **127**, 159–167 (2017).

395. Leclerc, S. H. & Badami, M. G. Extended producer responsibility for E-waste management: Policy drivers and challenges. *Journal of Cleaner Production* **251**, 119657 (2020).

396. Burke, M. J. & Stephens, J. C. Energy democracy: Goals and policy instruments for sociotechnical transitions. *Energy Research & Social Science* **33**, 35–48 (2017).

397. Burke, M. J. & Stephens, J. C. Political power and renewable energy futures: A critical review. *Energy Research & Social Science* **35**, 78–93 (2018).

398. Stephens, J. C., Burke, M. J., Gibian, B., Jordi, E. & Watts, R. Operationalizing Energy Democracy: Challenges and Opportunities in Vermont's Renewable Energy Transformation. *Front. Commun.* **3**, (2018).

399. Hussain, T., Kuzmina, K. & Santamaria, L. Re-tail: exploratory design for the marketplace of a circular economy. (2020).

400. Fang, Y.-T. & Rau, H. Optimal Consumer Electronics Product Take-Back Time with Consideration of Consumer Value. *Sustainability* **9**, 385 (2017).

401. Cole, M. B., Augustin, M. A., Robertson, M. J. & Manners, J. M. The science of food security. *npj Science of Food* **2**, 14–14 (2018).

402. Tozanlı, Ö., Kongar, E. & Gupta, S. M. Evaluation of Waste Electronic Product Trade-in Strategies in Predictive Twin Disassembly Systems in the Era of Blockchain. *Sustainability* **12**, 5416 (2020).

403. Allen, G., Clift, R., Davidson, J. F. & Stahel, W. R. The service economy: 'wealth without resource consumption'? *Philosophical Transactions of the Royal Society of London. Series A: Mathematical, Physical and Engineering Sciences* **355**, 1309–1319 (1997).

404. Cullen, J. M. & Allwood, J. M. Mapping the Global Flow of Aluminum: From Liquid Aluminum to End-Use Goods. *Environ. Sci. Technol.* **47**, 3057–3064 (2013).

405. Cullen, J. M., Allwood, J. M. & Bambach, M. D. Mapping the Global Flow of Steel: From Steelmaking to End-Use Goods. *Environ. Sci. Technol.* **46**, 13048–13055 (2012).

406. Cooper, D. R. & Gutowski, T. G. The Environmental Impacts of Reuse: A Review. *Journal of Industrial Ecology* **21**, 38–56 (2017).

407. Hernandez, A. G., Cooper-Searle, S., Skelton, A. C. H. & Cullen, J. M. Leveraging material efficiency as an energy and climate instrument for heavy industries in the EU. *Energy Policy* **120**, 533–549 (2018).

408. Levi, P. G. & Cullen, J. M. Mapping Global Flows of Chemicals: From Fossil Fuel Feedstocks to Chemical Products. *Environ. Sci. Technol.* **52**, 1725–1734 (2018).

409. Densley Tingley, D., Cooper, S. & Cullen, J. Understanding and overcoming the barriers to structural steel reuse, a UK perspective. *Journal of Cleaner Production* **148**, 642–652 (2017).

410. Pongiglione, M. & Calderini, C. Material savings through structural steel reuse: A case study in Genoa. *Resources, Conservation and Recycling* **86**, 87–92 (2014).

411. Fraj, A. B. & Idir, R. Concrete based on recycled aggregates – Recycling and environmental analysis: A case study of paris' region. *Construction and Building Materials* **157**, 952–964 (2017).

412. Gallego-Schmid, A., Chen, H.-M., Sharmina, M. & Mendoza, J. M. F. Links between circular economy and climate change mitigation in the built environment. *Journal of Cleaner Production* **260**, 121115 (2020).

413. Gutowski, T., Cooper, D. & Sahni, S. Why we use more materials. *Philosophical Transactions of the Royal Society A: Mathematical, Physical and Engineering Sciences* **375**, 20160368 (2017).