

Research Notes: determining social, environmental and economic value

Impact of improving Air Quality on health conditions (e.g. Asthma, Dementia)

Livingston, G., Huntley, J., Sommerlad, A., Ames, D., Ballard, C., Banerjee, S., Brayne, C., Burns, A., Cohen-Mansfield, J., Cooper, C. and Costafreda, S.G., 2020. Dementia prevention, intervention, and care: 2020 report of the Lancet Commission. *The Lancet*, 396(10248), pp.413-446.
[https://doi.org/10.1016/S0140-6736\(20\)30367-6](https://doi.org/10.1016/S0140-6736(20)30367-6)

Summary: this study demonstrated significant evidence backing the addition of three additional factors for dementia to the original nine factors modelled by the 2017 Lancet Commission on dementia prevention, intervention, and care. Air pollution is one of the three additional factors.

- 12 factors for dementia: less education, hypertension, hearing impairment, smoking, obesity, depression, physical inactivity, diabetes, low social contact, excessive alcohol consumption, traumatic brain injury (TBI), and air pollution. "Together the 12 modifiable risk factors account for around 40% of worldwide dementias, which consequently could theoretically be prevented or delayed." (p.413)
- Summary of why air pollution is added as a risk factor: similarly to smoking (another risk factor), air pollution increases particulate matter which has vascular and toxic effects potentially resulting in cognitive impairment.
- Detailed explanation: 'Air pollution and particulate pollutants are associated with poor health outcomes, including those related to non-communicable diseases. Attention has turned to their potential effect on the brain. Animal models suggest airborne particulate pollutants accelerate neurodegenerative processes through cerebrovascular and cardiovascular disease, A β deposition, and amyloid precursor protein processing. Although the higher levels of dementia from air pollutants are still subject to the potential for residual confounding, the effects on animal models are evidence of physiological effects over and above those driven by life-course deprivation. High nitrogen dioxide (NO₂) concentration (>41.5 μ g/m³; adjusted HR 1.2, 95% CI 1.0–1.3), fine ambient particulate matter (PM)_{2.5} from traffic exhaust (1.1, 1.0–1.2) and PM_{2.5} from residential wood burning (HR=1.6, 95% CI 1.0–2.4 for a 1 μ g/m³ increase) are associated with increased dementia incidence. Traffic often produces NO₂ and PM_{2.5} and it is

hard to separate their effects, although evidence for additive effects of different pollutants exists. A systematic review of studies until 2018 including 13 longitudinal studies with 1–15 years follow-up of air pollutants exposure and incident dementia, found exposure to PM_{2.5}, NO₂, and carbon monoxide were all associated with increased dementia risk.²⁴ The attributable burden of dementia and excess death from PM_{2.5} in one large 10-year US study was particularly high in Black or African American individuals and socio-economically disadvantaged communities and related to particulate PM_{2.5} concentrations above the US guidelines.’ (p.425)

- Methodological note: meta-analysis of pollution data was not possible due to insufficient data. As such, data was taken from “the only study of all-cause air pollution with the outcome of all-cause dementia”, using a cohort from Canada ‘where pollutant concentrations are among the lowest in the world’. Given reliance on data from an area of low air pollution, the relative risk calculated is likely to be an underestimate.
- Results table (p.417):

	Relative risk for dementia (95% CI)	Risk factor prevalence	Communality	Unweighted PAF	Weighted PAF*
Early life (<45 years)					
Less education	1.6 (1.3–2.0)	40.0%	61.2%	19.4%	7.1%
Midlife (age 45–65 years)					
Hearing loss	1.9 (1.4–2.7)	31.7%	45.6%	22.2%	8.2%
TBI	1.8 (1.5–2.2)	12.1%	55.2%	9.2%	3.4%
Hypertension	1.6 (1.2–2.2)	8.9%	68.3%	5.1%	1.9%
Alcohol (>21 units/week)	1.2 (1.1–1.3)	11.8%	73.3%	2.1%	0.8%
Obesity (body-mass index ≥30)	1.6 (1.3–1.9)	3.4%	58.5%	2.0%	0.7%
Later life (age >65 years)					
Smoking	1.6 (1.2–2.2)	27.4%	62.3%	14.1%	5.2%
Depression	1.9 (1.6–2.3)	13.2%	69.8%	10.6%	3.9%
Social isolation	1.6 (1.3–1.9)	11.0%	28.1%	4.2%	3.5%
Physical inactivity	1.4 (1.2–1.7)	17.7%	55.2%	9.6%	1.6%
Diabetes	1.5 (1.3–1.8)	6.4%	71.4%	3.1%	1.1%
Air pollution	1.1 (1.1–1.1)	75.0%	13.3%	6.3%	2.3%

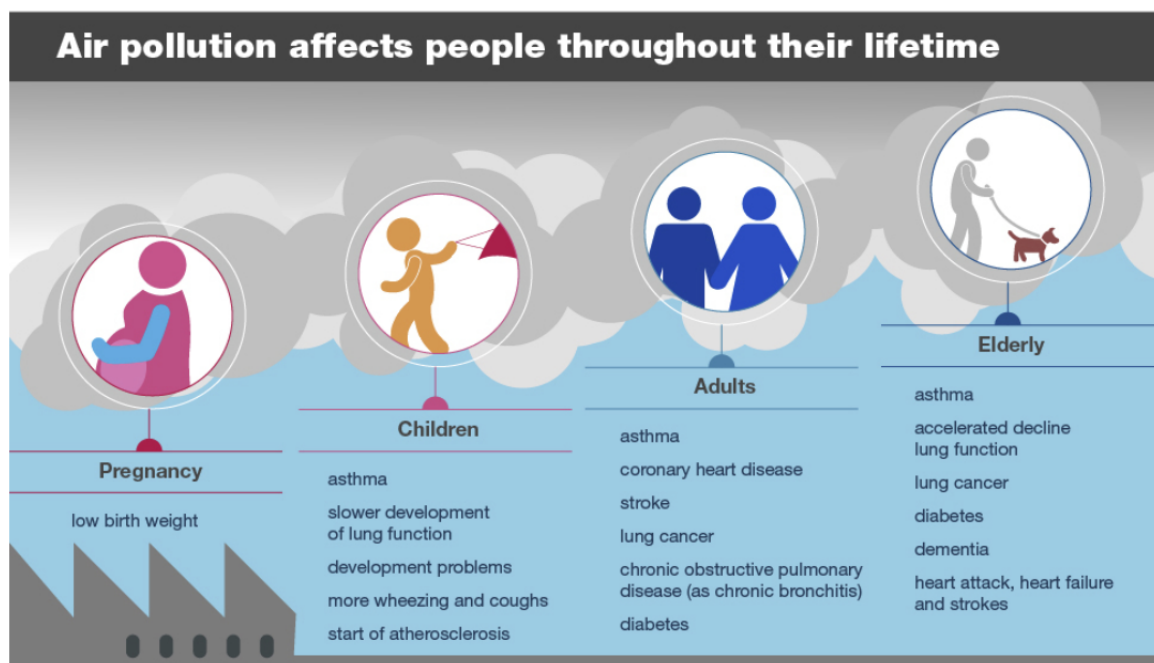
Data are relative risk (95% CI) or %. Overall weighted PAF=39.7%. PAF=population attributable fraction. TBI=traumatic brain injury. *Weighted PAF is the relative contribution of each risk factor to the overall PAF when adjusted for communality.

Table 1: PAF for 12 dementia risk factors

Public Health England (2020). Air pollution: applying All Our Health. Available via: <https://www.gov.uk/government/publications/air-pollution-applying-all-our-health/air-pollution-applying-all-our-health#:~:text=Air%20pollution%20can%20cause%20and,leading%20to%20reduced%20life%20expectancy>

Summary: air pollution is the largest environmental risk to public health in the UK. Annual mortality of human-made air pollution in the UK is between 28,000 - 36,000 deaths. Air pollution can worsen health in all individuals, with most pronounced effects on vulnerable populations.

- Costs: 'It is estimated that between 2017 and 2025 the total cost to the NHS and social care system of air pollutants (fine particulate matter and nitrogen dioxide), for which there is more robust evidence for an association, will be £1.6 billion.' (Source is a web page - no page numbers are available for referenced quotations throughout)
- Effects of long-term exposure: cause of chronic conditions such as cardiovascular and respiratory diseases as well as lung cancer, leading to reduced life expectancy.
- Effects of short-term exposure: effects on lung function, exacerbation of asthma, increases in respiratory and cardiovascular hospital admissions and mortality.
- Air pollutants with national emission reduction commitments: 'fine particulate matter (PM2.5), ammonia (NH3), nitrogen dioxide (NO2), sulphur dioxide (SO2), and non-methane volatile organic compounds (NMVOCs). Other ambient (outdoor) air pollutants include ozone and carbon monoxide (CO).'

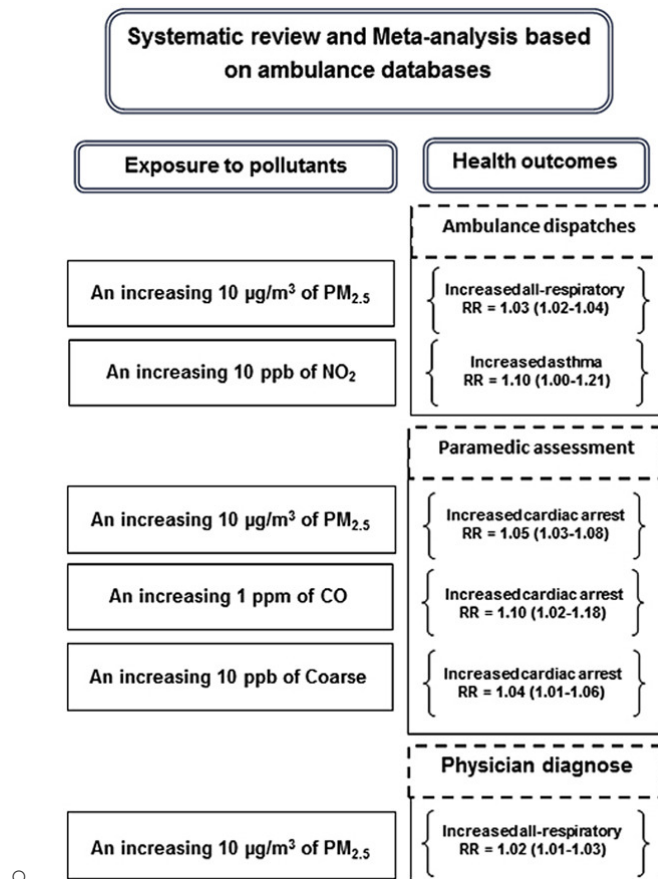


Tackling Air Pollution - Research Area - University of Birmingham. Home page available via: <https://www.birmingham.ac.uk/research/heroes/air-pollution.aspx>

This page links to a university research area. Samples of work authored by some of the academics and projects associated with the centres is outlined below. This is not exhaustive but provides an indication of research variety.

- West Midlands Air Quality Improvement Programme
<https://www.birmingham.ac.uk/schools/gees/research/projects/wm-air/index.aspx>
 - Air pollution in the West Midlands affects around 2.8 million people, reducing average life expectancy.
 - The Programme will provide improved understanding of pollution sources and levels in the region, and new capability to predict air quality, health and economic impacts of potential policy measures by up to 6 months.
- Singh, A., Bloss, W. and Pope, F., 2017. 60 years of UK visibility measurements. Atmospheric Chemistry and Physics. 17, pp.2085-2101. Available via:
[https://research.birmingham.ac.uk/portal/files/40640133/Singh_et_al_60_years_UK_visibility_measurements Atmospheric Chemistry Physics.pdf](https://research.birmingham.ac.uk/portal/files/40640133/Singh_et_al_60_years_UK_visibility_measurements_Atmospheric_Chemistry_Physics.pdf)
 - This paper explores the long term effects of air pollution on visibility (which has knock-on effects on human safety - e.g. low visibility can lead to increased road, rail and sea accidents).
 - It concludes that visibility has increased over time in the studied weather stations since the 1956 Clean Air Act. 'The improvements are greatest in urban areas and are attributed to reductions in aerosol particle loadings and decreases in atmospheric RH' (p.2098)
 - The research also identifies a sharp positive improvement (between 5-12%) in visibility on Sundays due to lower traffic. The immediacy of the benefit in lowered air pollution is noted as striking.
- Shehab, M.A. and Pope, F.D., 2019. Effects of short-term exposure to particulate matter air pollution on cognitive performance. Scientific reports, 9(1), pp.1-10. Available via:
[https://research.birmingham.ac.uk/portal/files/75450300/Shehab_Pope_2019_Effects_of_short_term_exposure Scientific Reports.pdf](https://research.birmingham.ac.uk/portal/files/75450300/Shehab_Pope_2019_Effects_of_short_term_exposure_Scientific_Reports.pdf)
 - This paper tested the effects of short-term exposure to particulate matter air pollution on cognitive performance. Participants were either exposed to indoor particulate matter from candle burning or outdoor particulate matter from commuting (30 mins) next to a major road (walking, cycling, bus or train).
 - Results of a Mini-Mental State Examination (MMSE) showed statistically significant cognitive decline in both experiments attributable to particulate matter exposure.

- Participants exposed to outdoor air pollution via roadside commuting also showed statistically significant short-term cognitive decline in automatic detection speed in selective attention tests.
- Sangkharat, K., Fisher, P., Thomas, G.N., Thornes, J. and Pope, F.D., 2019. The impact of air pollutants on ambulance dispatches: A systematic review and meta-analysis of acute effects. Environmental Pollution, 254, p.112769. Available via: <https://doi.org/10.1016/j.envpol.2019.06.065>
 - This paper conducted a systematic review and meta-analysis of the effects of ambient air pollution on ambulance dispatch data. It concludes that air pollution (as measured by PM_{2.5}, CO, NO₂ and coarse PM) was significantly associated with an increase in ambulance dispatch data, including those for cardiac arrest, all-respiratory, and asthma dispatches.
 - The graphical abstract is below:



European Society of Cardiology (2020). Study estimates exposure to air pollution increases COVID-19 deaths by 15% worldwide. Available via:
<https://www.escardio.org/The-ESC/Press-Office/Press-releases/study-estimates-exposure-to-air-pollution-increases-covid-19-deaths-by-15-world>

Summary: This is a press release describing the academic study linked below. The study is the first to estimate “the proportion of deaths from the coronavirus that could be attributed to the exacerbating effects of air pollution for every country in the world.”

The global estimate of COVID-19 deaths attributable to long-term exposure to air pollution is 15%. There is significant variation across regions: 'In Europe the proportion was about 19%, in North America it was 17%, and in East Asia about 27%.'

- Note: the study does not imply a direct cause/effect between air pollution and coronavirus morbidity; rather it establishes a relationship between the two factors. E.g. air pollution may aggravate comorbidities that increase COVID severity and therefore deaths.
- Explanation of the effects of air pollution: 'Prof. Münzel said: "When people inhale polluted air, the very small polluting particles, the PM_{2.5}, migrate from the lungs to the blood and blood vessels, causing inflammation and severe oxidative stress, which is an imbalance between free radicals and oxidants in the body that normally repair damage to cells. This causes damage to the inner lining of arteries, the endothelium, and leads to the narrowing and stiffening of the arteries. The COVID-19 virus also enters the body via the lungs, causing similar damage to blood vessels, and it is now considered to be an endothelial disease.'"
- The study also references previous work finding that air pollution can prolong the life and spread of infectious viruses in the air.
- Methodological note: air pollution data was collected at country rather than individual level, meaning it is more difficult to exclude confounding factors.
- Original research study: Regional and global contributions of air pollution to risk of death from COVID-19, by Andrea Pozzer et al. Cardiovascular Research. doi:[10.1093/cvr/cvaa288](https://doi.org/10.1093/cvr/cvaa288)

Fuel poverty and transport poverty

- UK policy currently lacks a concept of 'transport poverty', unlike the well-developed concept of 'fuel poverty' which has been recognised since the early 2010s. (e.g. see [Sustrans 2012](#)).
- Attention to interlinkage between transport and fuel poverty is now being addressed in the context of a 'just transition' to Net Zero across the linked energy vectors of electricity, heat and transport.

Mattioli, G., Lucas, K. and Marsden, G., 2017. Transport poverty and fuel poverty in the UK: From analogy to comparison. *Transport Policy*, 59, pp.93-105.

<https://doi.org/10.1016/j.tranpol.2017.07.007>

Summary: this paper compares similarities and differences between the concepts of transport poverty and fuel poverty, which have been historically siloed in the UK context. It highlights key differences between the concepts that will inform policy interventions in light of closer fuel/transport links under decarbonisation strategies.

- Fuel poverty:
 - Tends to focus on affordability of domestic energy, particularly heating.
 - Influenced by: household income, energy prices, energy efficiency.
 - Policy responses: income top-up (e.g. Winter Fuel Payment), pricing policies (Ofgem), energy efficiency grants.

- Impacts: ill-health, accelerated morbidity, housing damage (e.g. mould).
- Transport poverty:
 - Limited past focus, largely directed towards low mobility individuals and car-less households. (Affordability of transport, costs of motoring, and vulnerability to fuel price fluctuations are additional areas of transport poverty that have been less studied in the UK compared with other contexts).
 - Influenced by: more complex variable factors than domestic fuel poverty, e.g.: forced car dependency (e.g. due to planning decisions), lack of public transport or active travel infrastructure, car running and maintenance costs, fuel price fluctuations, lack of opportunity to learn to drive (etc).
 - Policy response: quite under-developed in the UK context. It is also more difficult to develop reliable measurement of transport poverty (such as % income spending) than for domestic energy poverty. The 'need' for travel is harder to define given diverse purposes (e.g. community, social, hospital appointments.)
 - Impacts: reduced social inclusion, reduced social capital and wellbeing (described to be seen as 'less pressing' than deaths from fuel poverty from a policy perspective). Also, there is a potential recursive relationship between income-generation and car ownership, with knock-on effects for other types of poverty.
- Two points of note:
 - Transport poverty plays out differently between urban and rural areas. There are also differences between urban areas which vary according to population distribution based on household income. This is different from fuel poverty, whereby households have a basic measurable level of warmth universally needed regardless of housing location.
 - Transport affordability is one of a broader set of transport policy issues that are hard to measure. By contrast, fuel poverty relies on a single metric.

Note - transport poverty debates in the context of decarbonisation can become focussed on electric vehicles. This requires careful consideration as it may inadvertently support car-focussed future planning to the exclusion e.g. of public transport or active travel.

FAIR project: Fuel and transport poverty in the UK's energy transition (FAIR). UK CREDS project homepage accessible via: <https://www.creds.ac.uk/fair/>

A notable new initiative examining fuel and transport poverty is the [FAIR project](https://www.creds.ac.uk/fair/), funded by the UK Centre for Research into Energy Demand Solutions (UK CREDS) from September 2019 - March 2022. The research involves a consortium of UK universities led by the University of Sussex. This research project will interview households and experts, and map regions prone to fuel and transport poverty across the UK. The

project aims to deepen understanding of who is most vulnerable to food and transport poverty and why; linking this with policy recommendations to support Net Zero ambitions in a fair manner. The project's first output was published in May 2020.

- Simcock N., Jenkins K., Mattioli G., Lacey-Barnacle M., Bouzarovski S., and Martiskainen M. (2020) Briefing: vulnerability to fuel and transport poverty. Available via:
<https://www.creds.ac.uk/wp-content/uploads/FAIR-vulnerability-briefing.pdf>
 - This briefing outlines groups vulnerable to fuel poverty, transport poverty, and both
 - Summary diagram (p.1)

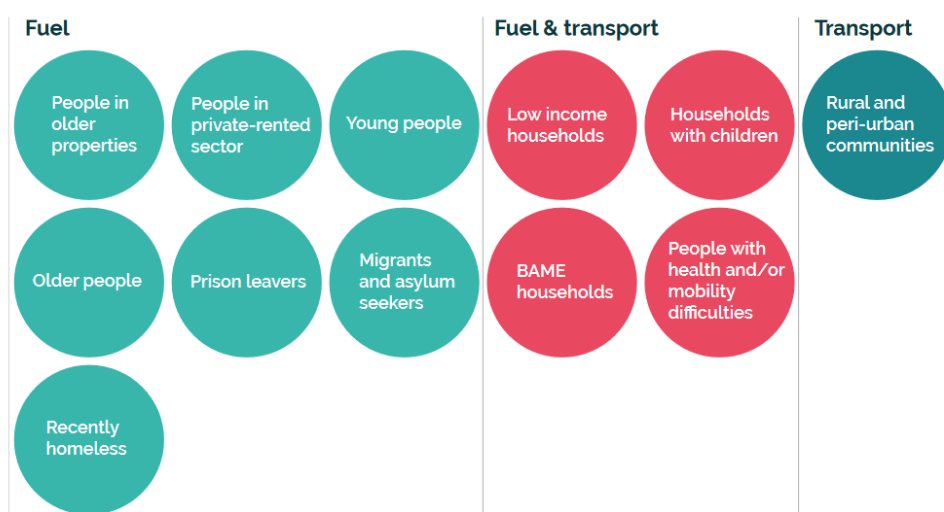


Figure 1: The groups of people vulnerable to fuel, fuel and transport, and transport poverty

- Definition of vulnerability - 3 components (p.2):
 - 'Exposure: the likelihood that a household will experience fuel and/or transport poverty
 - Sensitivity: the extent to which fuel and/or transport poverty will be harmful to the well-being of individuals or households
 - Adaptive capacity: the extent to which households are able to plan, adapt and respond to fuel and/or transport poverty'.
- Note: while transport and fuel poverty occurs both in rural and urban areas, the types of poverty experienced in different areas are qualitatively different.

Improvements to biodiversity linked to the decarbonisation of energy heat and transport

Luderer, G., Pehl, M., Arvesen, A., Gibon, T., Bodirsky, B.L., de Boer, H.S., Fricko, O., Hejazi, M., Humpenöder, F., Iyer, G. and Mima, S., 2019. Environmental co-benefits and adverse side-effects of alternative power sector decarbonization strategies. *Nature communications*, 10(1), pp.1-13. <https://doi.org/10.1038/s41467-019-13067-8>

Note: material included below focuses on ecosystem damage/biodiversity. There is also material on human health etc. that could be added in future if required.

Summary: the power sector has environmental impacts beyond carbon emissions. This paper uses life cycle assessment to analyse the environmental impacts of different technology choices ('scenarios') in power sector decarbonisation. Research finds that all decarbonisation pathways yield major environmental co-benefits, however different scenarios have different adverse effect profiles. Scenarios heavily reliant on bioenergy have the potential to cause significant ecosystem damage due to land requirements. Renewable (solar and wind pathways) generally yield better results in terms of reducing land use impact, ecotoxicity and water use.

- Impacts on ecosystem damage:
 - Potential impact channels: land occupation, land transformation, pollutant release resulting in terrestrial acidification, eutrophication and ecotoxicity impacts. (p.5)
 - Land occupation/transformation: research finds that scenarios reliant on bioenergy have the largest impact on land use, while renewable energy scenarios have the least.
 - '...all technologies feature life-cycle ecotoxicity impacts (Fig. 4d). However, on a per-MWh basis, these are greatest for fossil technologies (emissions during extraction), substantial for bioenergy (agrochemicals use for crops), and much smaller for wind and solar (Supplementary Fig. 2). As a consequence, ecotoxicity impacts in the NewRE decarbonization scenarios are around 30% lower than those in FullTech.' (p.5)
 - 'Electricity supply systems account for approximately 14% of global human water withdrawal: Most thermal power plants use water for cooling, while hydroelectric plants affect waterways through dams and water losses to evaporation and seeping' (p.5) - switch to renewable energy could significantly lower this water demand.

Sovacool, B.K., Hook, A., Martiskainen, M., Brock, A. and Turnheim, B., 2020. The decarbonisation divide: Contextualizing landscapes of low-carbon exploitation and toxicity in Africa. *Global Environmental Change*, 60, p.102028. <https://doi.org/10.1016/j.gloenvcha.2019.102028>

Summary: assessments of the benefit of renewable energy and electric mobility tend to be limited; ignoring downstream and upstream issues e.g. in mining or waste flows. The

paper posits that decarbonisation is creating 'two extremes where emerging low-carbon transitions in mobility and electricity are effectively implicated in toxic pollution, biodiversity loss, exacerbation of greater gender inequality, and exploitation' (p.1). They term this the 'decarbonisation divide' and argue that we must broaden the parameters of 'sustainability' used in our assessments of decarbonisation.

Problems:

- Downstream: e-waste is rising by approx. 8 million tonnes annually, of which only 20% is recycled (p.2). E-waste contains a number of components that are harmful to humans and the environment. It is also distributed unequally with lower-income countries being larger importers of this waste.
- Upstream: mining and manufacturing also have environmental side effects that are not evenly distributed.
- Justice: technologies relied upon for a digitalised, decarbonised future play into existing patterns of inequality and injustice - with consequences for gender, class and racial disparities.
- Material increases: "One study projected material stock increases between 2015 and 2060 for selected technologies, and the numbers are dizzying: there is an expected increase of 87,000% for battery electric vehicles, 1000% for wind power, and 3000% for solar PV power (Månberger and Stenqvist 2018)." (p.3)
- Mineral demand: batteries now form the largest demand for cobalt, overtaking consumer electronics in 2017 (p.3)
- Waste: 'While computer notebooks entail 3.5kgs of waste and televisions up to 25kgs of waste, a typical household solar energy system entails 80kgs of waste (Cucchiella et al. 2015)' (p.3). Lithium batteries are expected to become the greatest contributor to e-waste given the huge rise in demand for EVs and energy storage.

The study explores mining in the DRC and e-waste processing in Ghana as case studies looking at the impacts of the problems outlined above.

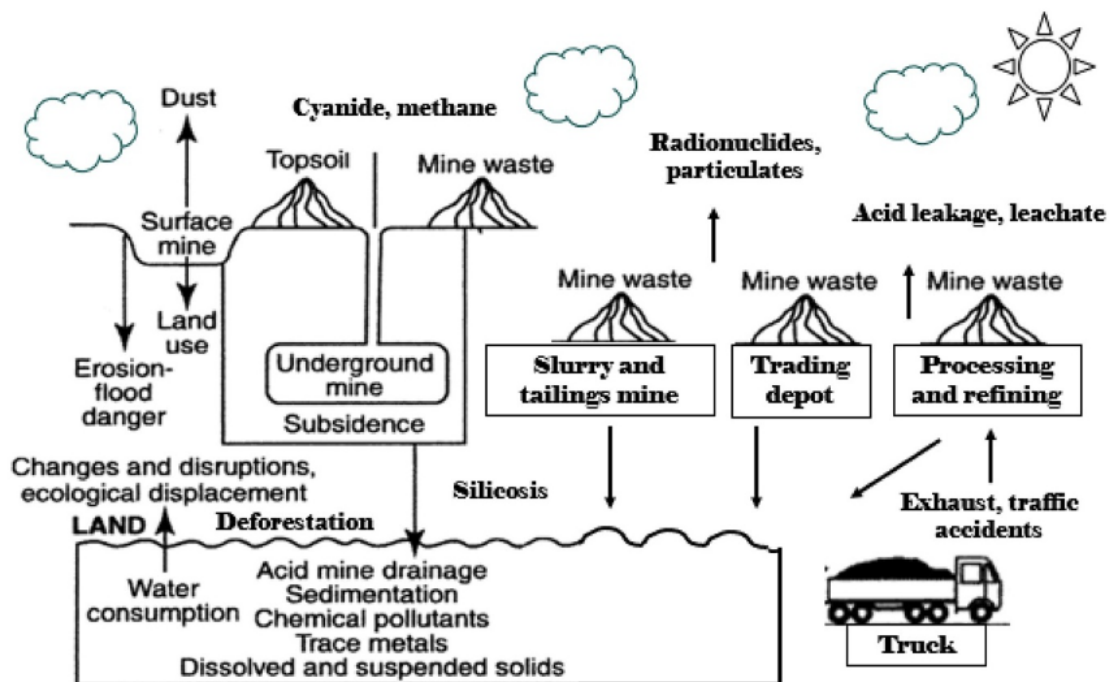


Fig. 6. Multifaceted externalities with cobalt mining in the DRC. Source: Authors.

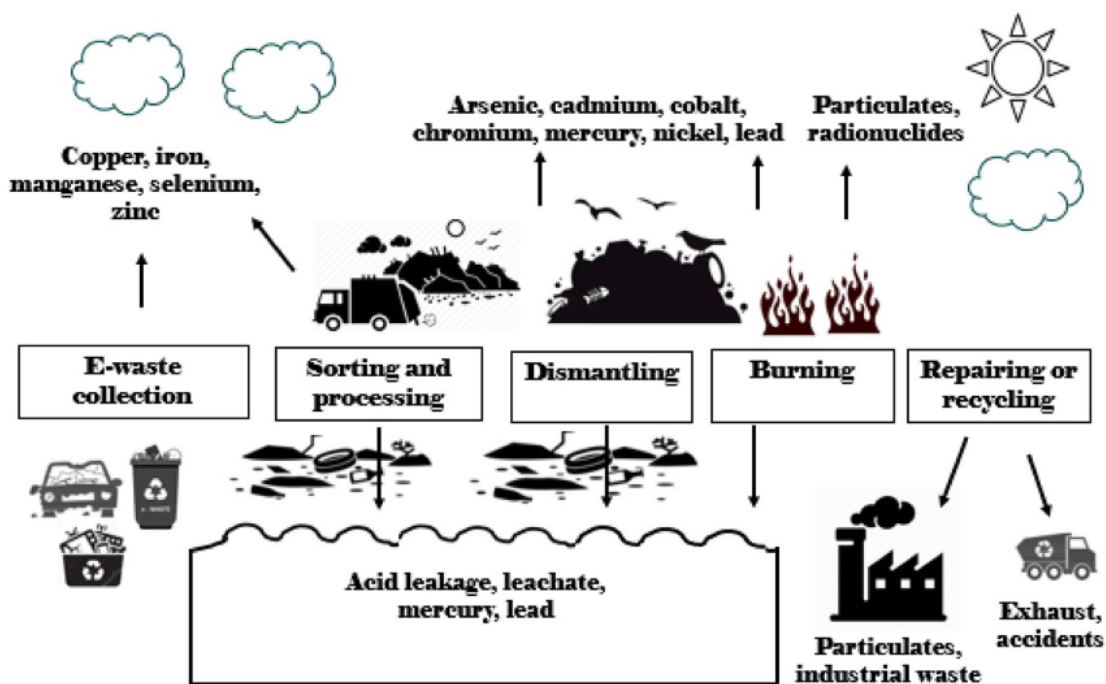


Fig. 7. Multifaceted externalities with e-waste processing in Ghana. Source: Authors.

Conclusion: while the clean energy transition tends to translate to cleaner air and environments in the Global North, this is often achieved by displacing negative social and environmental effects to Global South countries with active roles at either end of the supply chain.

Scottish Government (2020). Scottish Biodiversity Strategy: report to Parliament 2017 to 2019. Available via:

<https://www.gov.scot/publications/scottish-biodiversity-strategy-report-parliament-2017-2019/>

- This report only contains two items directly related to renewables. Both cite the importance of the marine environment in terms of developing renewable energy at sea. It includes the following: 'The Marine (Scotland) Act 2010 also introduced a specific duty to protect and enhance the marine environment and included measures to help boost economic investment and growth in sectors such as marine renewables.' (Section 8).
- Roles and sections relevant to local authorities:
 - Biodiversity reporting (p.12)
 - 'Local Biodiversity Action Partnerships (LBAPs) were established across Scotland in response to the first UK Biodiversity Action Plan in 1994 and they continue to play a critical role in bringing together local stakeholders including local authorities, environmental NGOs, communities and volunteers. These partnerships operate at a local level to raise awareness, and to organise projects and actions to conserve and enhance biodiversity around national and local priorities. The breadth of their work across Scotland is illustrated in a publication that accompanied a Scottish Parliament event celebrating 20 years of LBAP30 activity in 2016. However, with increasing pressure on local authority budgets there is a diminishing level of support for the LBAP officers who play a critical role in maintaining effective local biodiversity partnerships.' (p.15)
 - Developing Scotland's 'Natural Health Service' - four local authorities are involved in 'green health partnerships' to test an approach focusing on public health priorities around place, mental health, physical activities and tackling health inequalities. 'Early work has focused in mapping/facilitation and support for local green health interventions / opportunities as part of existing physical activity, mental health, social prescribing and lifestyle pathways and programmes. A range of communication projects inspiring the public to get their daily dose of nature have also been produced.' (p.30)

Scottish Government (2020): Combating biodiversity loss. Available via:

<https://www.gov.scot/news/combating-biodiversity-loss/>

- This announcement details plans to commission a Scottish Centre of Expertise in Biodiversity from 2022.
- The government is currently consulting on the [environment, natural resources and agriculture research draft strategy](#) (closes 14 December).
- Consultation document notes:

- Research strategy for 2022 - 2027: 48 million per year programme covering topics including: plant and animal health; sustainable food system and supply; human impacts on the environment; natural resources; and rural futures.
- New areas of focus and funding: air quality, land reform, circular economy and waste, large scale modelling.
- Two further cross-cutting focal areas: methods of data science and understanding behavioural change.
- Theme C: human impacts on the environment (relevant items only):
 - C1: climate change (aligned with Scottish climate change act 2019 and goal of net zero 2045)
 - C3: Land use - consideration of issues including forestry, agriculture, tourism, cultural heritage, biodiversity, carbon sequestration etc.
 - C5: large scale modelling - building a better understanding of interactions at landscape or sectoral scale & to understand interventions for greenhouse gas (GHG) reduction, nitrogen flow control and enhanced carbon sequestration.
 - C6: use of outdoors and green space: valuing nature, biodiversity and conservation, leisure and recreation, health
- Theme D: natural resources (relevant items only)
 - D1: air quality - 2015 Cleaner Air for Scotland Strategy is the main policy driver with six objectives related to transport, health, place-making, legislation and policy, communication, and climate change.
 - D4: biodiversity - notes linkage between climate and biodiversity crises. Resilience to climate change, pollution, new pests and pathogens. Contribution to mental and physical wellbeing. 'At the international level, the Convention on Biological Diversity (CBD) is currently developing the post-2020 Global Biodiversity Framework (GBF) as a stepping stone towards the 2050 Vision of "Living in harmony with nature".' (p.34)

Other

Welsh Government (2015). Wellbeing of future generations Act. Available via:
<https://www.wlga.wales/well-being-of-future-generations>

- The Act outlines a change to processes and decision-making in all areas of local government in Wales, introducing a longer-term view "which considers the social, economic, environmental and cultural impact of our actions on future generations."
- The Future Generations Report (2020) outlines progress made towards goals stated in the Act:

https://www.futuregenerations.wales/public_info/the-future-generations-report-2020/

- Chapter 5 reports on progress made towards decarbonisation and a vision of a Welsh low-carbon future:
 - Overall, emissions in Wales have fallen by 25% since the 1990 base year but they need to reduce dramatically in the next decade – the target is 45% by 2030.
 - ‘Our planning system will be carbon neutral and will also act as a mechanism to reduce carbon emissions through tree planting. Placemaking will improve people’s access to the natural environment, with high quality green infrastructure, which helps enhance biodiversity and improve resilience to floods and droughts.’ (p.5)
 - Regarding public perception of decarbonisation: ‘Concerns about climate change reached a record high in 2019 (85% in UK). Although people generally don’t relate to decarbonisation as a specific topic, they do relate to issues such as active/public transport, green energy, housing, biodiversity and air quality and are clearly concerned about these issues as well as wider environmental issues such as plastic pollution.’ (p.9)
 - ‘The main contributors to greenhouse gas emissions in Wales are the power and industry sectors.’ However, ‘Since 2010, renewable electricity generation in Wales has trebled. In 2018, renewable generators in Wales produced electricity equating to 50% of Wales’ use.’ (p.11)
 - The concept of a ‘just transition’ is used throughout the report. E.g. ‘Wales’ low carbon economy is currently estimated to consist of 9,000 businesses, employing 13,000 people and generating £2.4 billion turnover in 2016. Whilst there are opportunities - it is worth remembering the outcomes of previous ‘unjust transitions’, where shifts in the economic base of an area were not accompanied by protections for affected workers. The closure of the South Wales coalfields in the 1980s offers a stark example of the social costs that have followed for decades.’ (p.24)
- Welsh Government’s 2019 delivery plan for a low-carbon Wales: https://gov.wales/sites/default/files/publications/2019-06/low-carbon-delivery-plan_1.pdf

Neighbourhood data on living environments (2020). Available via:

<https://ocsi.uk/2020/10/26/neighbourhood-data-on-living-environments/>

- ‘The People and Nature Survey has found that since COVID-19 restrictions have been in place, 36% of adults reported spending more time in nature and 41% of

adults have reported that 'nature and wildlife is more important than ever to my wellbeing'.

- The rest of the article outlines datasets relevant to neighbourhood living environments available via Oxford Consultants for Social Inclusion (OSCI):
 - Addresses with outdoor space. Source: Ordnance Survey. Timepoint: April 2020
 - Green Space (active). Source: Consumer Data Research Centre. Timepoint: 2017
 - Households in fuel poverty. Source: BEIS. Timepoint: 2018
 - Indices of Deprivation 2019 Living Environment Rank. Source: Ministry of Housing Communities and Local Government.