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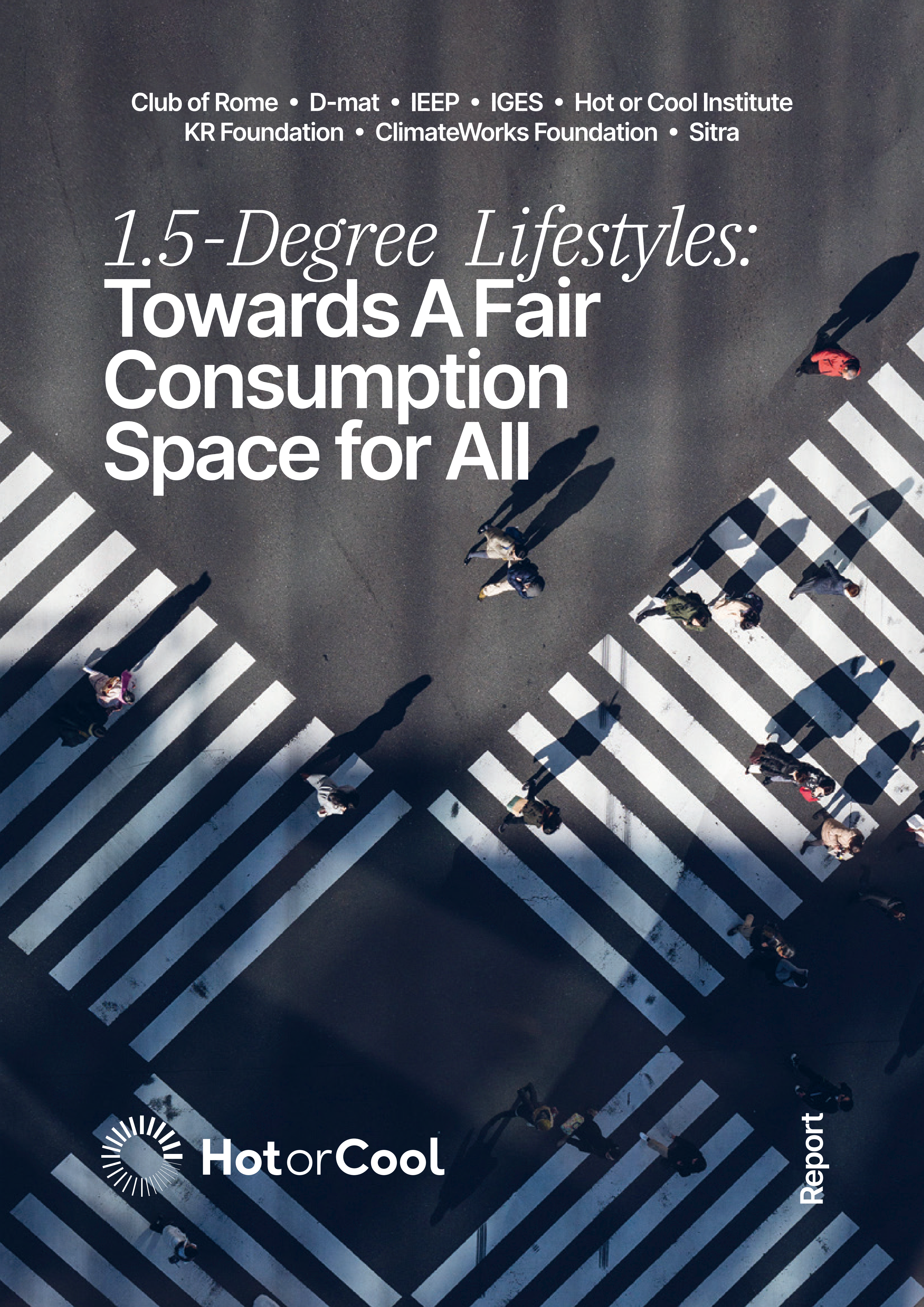
1.5-Degree Lifestyles: Towards A Fair Consumption Space for All



Hot or Cool

Report

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Abbreviations

10YFP	10-Year Framework of Programmes for Sustainable Consumption and Production
AR5	IPCC Fifth Assessment Report
BECCS	Bioenergy with carbon capture and storage
CBDR	Common but differentiated responsibilities and respective capabilities
CCS	Carbon capture and storage
CH4	Methane
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
DLE	Decent living energy
GDA	Guideline daily amount
GDP	Gross domestic product
GHG	Greenhouse gas
GLIO	Global link input-output
GNI	Gross national income
GTAP	Global Trade Analysis Project
HFCs	Hydrofluorocarbons
I/O	Input-output tables
IPCC	Intergovernmental Panel on Climate Change
LCA	Life cycle assessment
LCF	Lifestyle Carbon Footprint
LED	Low energy demand
LNG	Liquefied Natural Gas
LPG	Liquefied Petroleum Gas
LULUCF	Land use, land use change and forestry
NO2	Nitrous Oxide
OECD	Organisation for Economic Co-operation and Development
PCA	Personal carbon allowance
PCT	Personal carbon trading
PFCs	Perfluorocarbons
SDG	Sustainable Development Goal
SF6	Sulphur hexafluoride
SG	Social guarantee
SME	Small and Medium Size Enterprise
UBI	Universal basic income
UBS	Universal basic services
UN	United Nations
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change

Foreword

Since its establishment more than fifty years ago, the Club of Rome has drawn attention to the existence of ecological limits and alerted the world to the risks of transgressing those boundaries. The Club of Rome has regularly warned of the risks of multiple crises and tipping points. This is our reality today as we grapple with the multiple shocks across the globe, from the pandemic to the changing climate. Over these five decades, the Earth system´s limited capacity to assimilate rapid population growth and the direct greenhouse gas effects from ever increasing material consumption and wasteful lifestyles has emerged as one of the most pressing global challenges for human society. Despite strong and repeated warnings from the scientific community, numerous high-level gatherings and pledges, and a growing climate movement across the world, global emissions of climate-damaging gases are still on the rise.

With escalating impacts of climate change—such as the massive wildfires, record heat waves, and devastating floods we have witnessed recently—coupled with increasing biodiversity loss and ecosystem stress, the world is now at a critical juncture. The amount of greenhouse gases that can be emitted without pushing global warming above 1.5°C is now frustratingly small and humanity needs to consider carefully how to spend this limited "budget," which can rightly be seen as a global commons belonging to all of humanity.

The 1.5-Degree Lifestyles report makes a valuable contribution to the discussions on how to tackle climate change by drawing attention to the need for significant lifestyle changes, especially in high-income countries and among the wealthy. The need for lifestyle changes, although often acknowledged in theory, is still not well-reflected in government policies. On the contrary, many policies and infrastructure investments continue to enable and incentivise high-carbon behaviour and destructive consumption patterns. This report's conclusion that technological improvements in the emission-intensity of goods and services must be accompanied with major lifestyle changes towards reduced consumption is especially pertinent and should form the basis for emergency governmental plans of action.

We are in a planetary emergency and governments must act as such. Emergency plans of action must focus on the essential goal of curbing GHG emissions and immediately halt dangerous feedback loops between biodiversity loss and ecosystems destruction. By focusing on consumption, we can solve several problems at once, reducing our carbon emissions whilst regenerating our biodiversity stocks and safeguarding ecosystems. Since 1970, when the Club of Rome's seminal report, "The Limits to Growth" was written, the global extraction of materials grew from 27 billion tons a year to 92 billion tons by 2017. This is likely to double again by 2060, given current trends[1].

The bitter truth is that the use of natural resources cannot continue to increase year after year. It must level off quickly – and then contract. Otherwise, there is no possibility of managing the well-being of 9–10 billion people in the long run—perhaps more—within the planetary boundaries. The challenge is that this contraction must take place at the same time as both energy and material use in low-income countries increases. This is required for the peoples of these countries to acquire a decent standard of living. The inequality in the use of materials is flagrant today, with low-income countries using 2 tons of materials per capita in 2017 compared to

1 IRP (2019). Global Resources Outlook 2019: Natural Resources for the Future We Want. A Report of the International Resource Panel. United Nations Environment Programme. Nairobi, Kenya.

27 tons per capita in high-income countries. In fact, while the material footprints of low-income countries managed to drop from 2.5 to 2 tons per capita, those of high-income countries grew from 20 to 27 tons per capita.

The curve of material consumption corresponds well to the data we have over greenhouse gas emissions per capita. The richest 10% of the world population were responsible for 50% of the GHG pollution added to the atmosphere between 1990 and 2015. The richest one percent accounted for 15 percent of emissions during the same period.

The only transition, moving forward, is three-fold: first, a redistribution of material resources between rich and poor countries and between rich and poor people in all countries including clear restrictions on the material consumption of the rich part of the world's population. Second, a transition to a far more resource-efficient economy—from linear to circular and regenerative material flows—coupled with measures to deal with rebound effects. Finally, shifts in purchasing power towards a shared services-driven economy fostering collective well-being rather than continued individual material consumption.

What will be needed urgently is a value shift—replacing, or at least complementing, material consumption as the main objective in life. Instead, what's needed is a wellbeing economy that fosters true quality of life factors such as a purposeful life, health care, healthy ecosystems and a stable climate, safe conditions in the workplace, education, and access to and participation in cultural activities and family life. The pandemic has shown us how important the above true quality of life factors are, no matter where we live. Countless research has shown that the priority given in contemporary society to growth at all cost, to profitability, and material consumption has not materialized in greater collective well-being or individual happiness for most.

By putting forward the concept of a Fair Consumption Space for All, the report highlights the importance of justice and equity in the transition to a low-carbon society. With limited room for continued emissions—and, particularly, for increasing material footprints among the well-to-do—we need to consider both how to effectively meet basic needs everywhere and how to rein in excessive carbon-intensive consumption. It is no exaggeration to say that overcoming this dual challenge is the greatest task of our current generation. Taking on this task calls for responsible leadership and bold action at all levels but, if we succeed, will demonstrate that we can indeed be good ancestors to future generations.

If applied, the recommendations from the 1.5-Degree Lifestyles report will bring us back to a status of good ancestry. Some of the policy proposals herewith may be perceived as too far-reaching and intruding on privacy and the rights of the individual. But we are in a precarious situation. Carbon emissions must be brought to net zero in less than a few decades. This means we have to explore all possible means at our disposal and design the future we want to truly emerge from the current planetary emergency. The 1.5-Degree Lifestyles report is a bold attempt to do just that.

Sandrine Dixson-Declève
Co-President
Club of Rome

Anders Wijkman
Honorary President
Club of Rome

Executive Summary

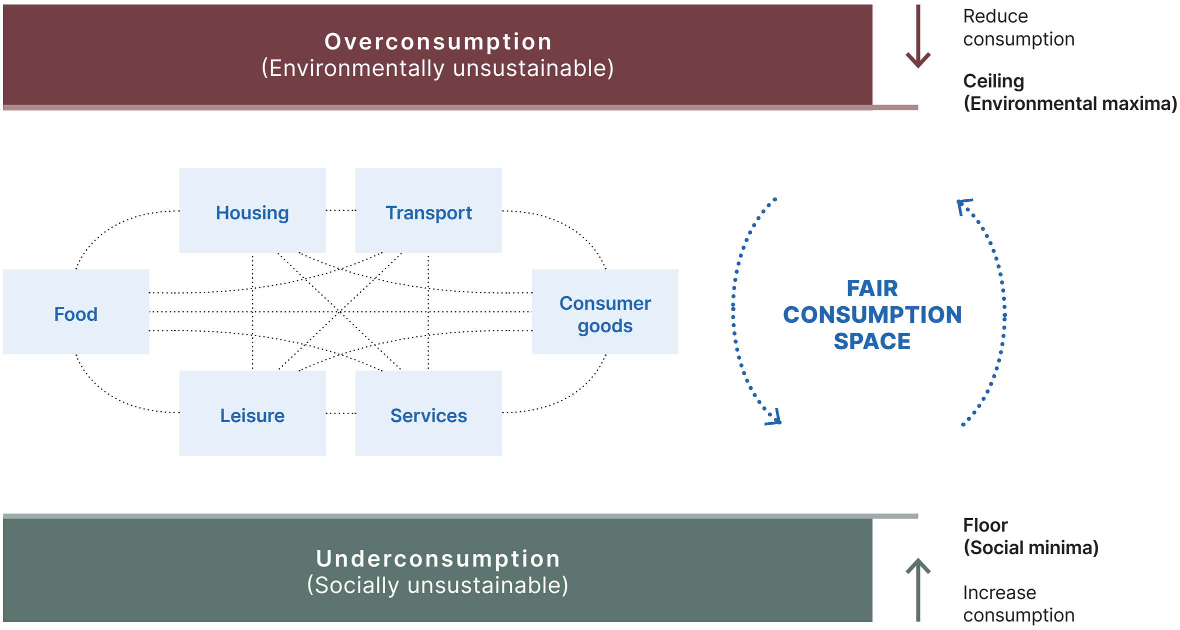
History of government commitments and failures on climate change shows that technological interventions and offsetting emissions, which is central to the net-zero strategy, has been teased for over three decades leading to the worsening state of affairs in which we now find ourselves—what the IPCC describes in its most recent report as "irreversible" damage to the environment, with worse to come unless we change course (IPCC 2021b). As this report demonstrates, changes in predominant lifestyles, especially in high-consuming societies, will determine whether we meet commitments in the Paris Agreement and avoid dire consequences of climate change. Overall reductions in levels of consumption must be achieved, while attending to growing social tensions.

An indictment of the current unsustainable economic development paradigm is the widening gap between the rich and the poor. The emissions share of the 10% richest, highest-emitting individuals ranges from 36-49% of the global total, while that of the poorest, lowest-emitting 50% of the world's population ranges from 7-15% of the total (UNEP 2020). There is observed inequality among countries, inequality within countries, inequality across races and between genders, and inequality across generations. And there are multiple expressions of inequality: of income, of health, of access to natural resources and public services, of participation in decision-making processes, for example, and notably in terms of inequality of carbon emissions. Calls for climate justice are already growing loud; these tensions will only get worse as competition heightens over diminishing resources and the remaining carbon budget to stay within sustainable limits.

The COVID-19 pandemic and the consequent unprecedented lockdown revealed what could happen if the world is caught in an unplanned transition. The deaths, restrictions on visiting friends and family, runs on necessities in shops, food shortages, and increased depression and anxiety, were just as shocking as the partial collapses in economic, health, security, and transportation systems that society had come to rely upon. By even the most conservative IPCC assessments, runaway temperature rise would produce a climate crisis several times the magnitude of the COVID pandemic. A planned transition (rather than a chaotic one as seen with the pandemic) to a society with sustainable lifestyles remains central to building a peaceful future in harmony with the ecological rhythm and balance of our planet.

Lifestyles embrace much more than just consumption patterns and behaviours. It includes non-economic aspects of our lives, such as caring for children or elderly parents, spending time with our friends, play, volunteering, or activism. All of these potentially affect, directly or indirectly, our wellbeing and our carbon footprint. Lifestyles are how we consume, and also how we relate to one another, what kind of neighbours, friends, citizens and parents we are, what kinds of values we nurture, and how we let those values drive our choices.

Figure A. A Fair Consumption Space for Sustainable Lifestyles



While generally overlooked in our pursuit of technological solutions to climate change, failing to shift the lifestyles of nearly eight billion human beings means we can never effectively reduce GHG emissions or successfully address our global climate crisis. This becomes especially complex, considering that the most impoverished populations will need to consume more, in order to achieve basic levels of wellbeing. Oxfam estimates that to reach the global average per capita emissions level by 2030 consistent with limiting global heating to 1.5°C, the per capita consumption emissions of the richest 10% of the global population should be reduced to about a tenth of their current level, while those of the poorest 50% could still increase by two to three times their current level (Oxfam 2020). Humanity will need to converge into "a fair consumption space" (See Figure A).

This report introduces the concept of a fair consumption space—an ecologically healthy perimeter that supports within it an equitable distribution of resources and opportunities for individuals and societies to fulfil their needs and achieve wellbeing. Within this space, there are a range of regenerative options (which this report details), but there are also clear demarcating limits to over- and underconsumption: with a cap in emissions, overconsumption by one person affects the prospects of another, and encroaches into another's consumption space, requiring collectively working toward a more equitable distribution of limited carbon budgets.

About this report

This report continues the science-based approach of linking concrete changes in lifestyles to measurable impacts on climate change in order to keep with the 1.5-degree aspirational target of the Paris Agreement on climate change. The 1.5-degree lifestyles approach examines GHG emissions and reduction potentials using consumption-based accounting, which covers both direct emissions in a country and embodied emissions of imported goods while excluding emissions embodied in exported goods. It analyses lifestyle carbon footprints of ten sample countries, representing high-, middle-, and low-income countries, and identifies hotspots, or consumption domains with the highest impact on the environment.

The report also fills the knowledge gap arising from most prevailing climate scenarios that underplay the potential contributions of lifestyle changes to climate change mitigation and focus entirely or mainly on developing new technologies and on changes in production. For each country in the report, the footprint gap between current and sustainable target levels are determined for the years 2030, 2040, and 2050. To bridge these gaps, options for reducing footprints in each country are introduced, estimating potential impacts from various adoption rates in each country. Finally, two scenarios are developed for each country, one focused on systems change and another on behaviour change, showing indicative pathways for achieving the 2030 target.

Targets and gaps

The results show massive gaps between current per capita footprints and targets; the lifestyle carbon footprint target for 2050 is exceeded in all countries analysed, requiring rapid and radical reductions. Estimates of current annual average lifestyle carbon footprints per person of countries analysed, as of 2019, are: Canada: 13.6 tCO_2e, Finland: 9.7, United Kingdom: 8.5, Japan: 8.1, China: 5.0, Turkey: 4.9, South Africa: 4.9, Brazil: 3.2, India: 3.0 and Indonesia: 2.2 tCO_2e (Figure C). In comparison, we need to aim for a lifestyle carbon footprint target of 0.7 tCO_2e by 2050, with intermediary targets of 2.5 and 1.4 tCO_2e by 2030 and 2040, respectively (Figure B). These targets are in line with the 1.5°C aspirational target of the Paris Agreement and for global peaking of GHG emissions as soon as possible without relying on the extensive use of negative emission technologies.

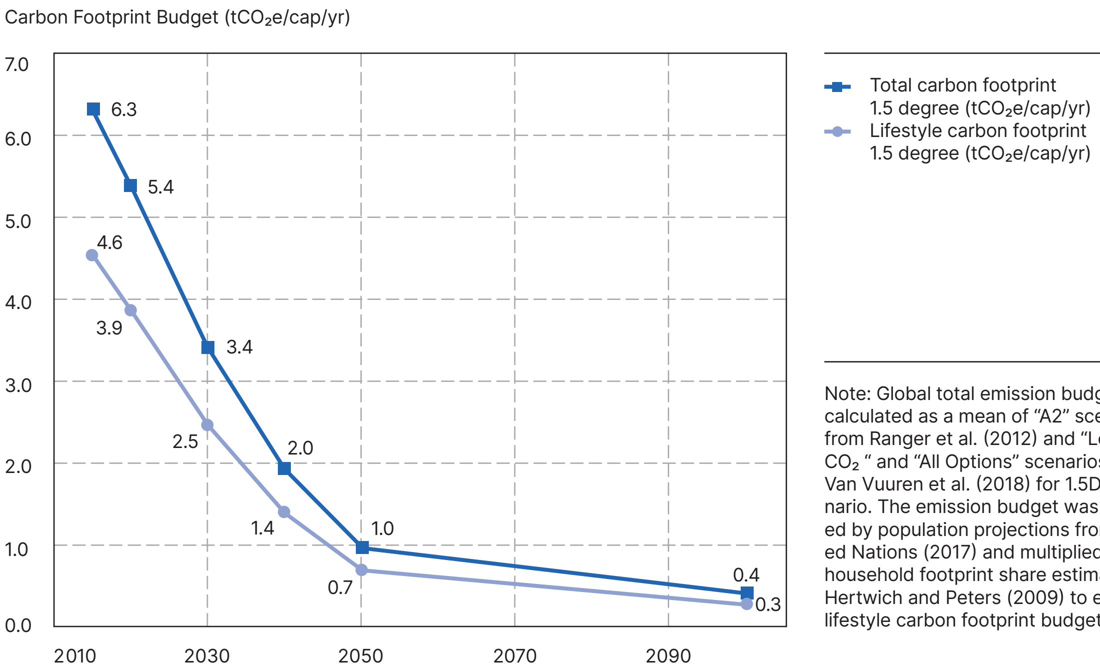
The footprint gaps between actual lifestyle and the targets show that footprints in high-income countries need to be reduced by 91–95% by 2050. Upper-middle income countries already need to reduce their footprints by 68–86% by 2050. Even lower-middle income countries need to reduce footprints by 76% in order to meet the 2050 target.

Hotspots

The report explores impacts of consumption in six domains: food; housing, personal transport; goods; leisure; and services, and uses these to aggregate total lifestyle carbon footprints and reveal hotspots in the ten surveyed countries. Focusing efforts to change lifestyles in relation to these domains would yield the most benefits; the three domains of food, housing, and personal transport tend to have the largest impact (approximately 79%) on total lifestyle carbon footprints.

Food consumption impacts show relatively similar footprints between the case countries (Figure D), with the exception of India and Indonesia where the overall meat consumption is notably lower than in the other countries. The reduction required in the footprint for food by 2030 ranges from 39% to 60% for all countries besides India and Indonesia where it is only 8%. In addition to meat, dairy products are a major contributor to footprints, especially in high-income countries, such as Canada and Finland. Different food cultures are reflected in the footprints as different consumption patterns between case countries: a primarily vegetarian diet in India shows the value of protecting this low-impact, healthy diet. Meat consumption by a Canadian (90 kg per year) is four times that eaten by a Japanese (40 kg

Figure B. Lifestyle carbon footprint budget comparable with 1.5°C target (without or with less use of negative emission technologies)



Note: Global total emission budget was calculated as a mean of "A2" scenario from Ranger et al. (2012) and "Low Non-CO_2" and "All Options" scenarios from Van Vuuren et al. (2018) for 1.5D Scenario. The emission budget was divided by population projections from United Nations (2017) and multiplied by the household footprint share estimated by Hertwich and Peters (2009) to estimate lifestyle carbon footprint budget.

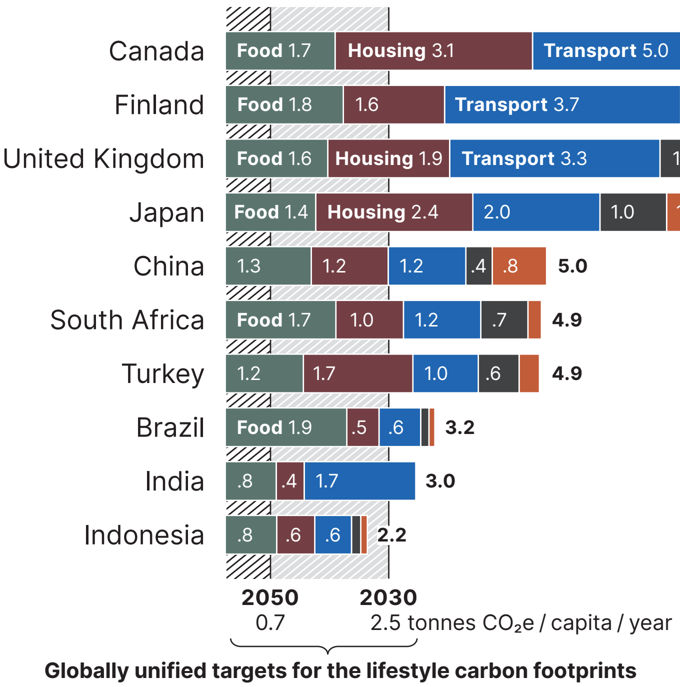
per year) with no discernible additional nutritional benefits for the Canadian.

In the **housing** domain, non-renewable grid electricity is an important source of lifestyle carbon footprints in all countries, as shown in Figure E. In addition, gas used for heating and cooking is another major contributor to the footprint of some countries, such as the United Kingdom, Japan, and Turkey. Large average living spaces and higher living standards are reflected as higher footprints in high-income countries. This is especially the case in Canada and Finland, where large living spaces together with long and cold winters are increasing the overall energy demand. Nevertheless, the housing footprint is notably higher in Canada due to relatively high consumption of carbon-intensive energy sources, such as natural gas. In Finland, a high share of the heating energy (the largest share of overall energy consumption) is based on district heating which has lower intensity due to the relatively high share of renewable energy sources. In Japan, overall energy demand is the lowest of the high-income countries studied but is mostly based on non-renewable energy sources, which is similar in the upper and lower middle-income countries studied.

Footprints for **personal transport** are highest in the high-income countries due to a high overall transport demand and a high share of car use and carbon-intensive air travel (Figure F). However, Japan has a high mobility demand but a notably higher share of public transport use than other high-income countries while India has a similar transport demand as Finland but motorcycles are responsible for the largest share of transport demand and footprint. In countries with a lower share of car use, transport demand is mainly focused on public transportation (bus and train), except in India and Indonesia, where motorcycles are the biggest contributor to both mobility demand and footprints. While Indonesia and Brazil would need to decrease the carbon footprints of personal transport for 2030 by 25% and 34%, respectively, all other countries require reductions in the range of 51% to 91%.

Footprints from **other domains** are strongly related with income levels, as shown in Figure G. In particular, leisure related footprints are the lowest in countries with the lowest average per capita spending, such as India and Indonesia. Consumer goods account for the greatest share of the footprint in most countries. Canada has a higher footprint compared to other countries, due to notably higher intensity for consumer goods and leisure related services. In middle-income countries the spending is focused on necessities, such as clothing and furniture/room coverings. The share of service-related footprints vary across countries and income groups.

Figure C. Carbon footprint and its breakdown between consumption domain and globally unified targets for the lifestyle carbon footprints.



Note: Average lifestyle carbon footprint of country estimated as of 2019. The horizontal lines indicate 1.5D lifestyle footprint targets for 2030 and 2050 (1.5 °C without/less use of CCS).

Figure D. Food-related carbon footprint (tCO_2e/cap/yr) and its breakdown between consumption components

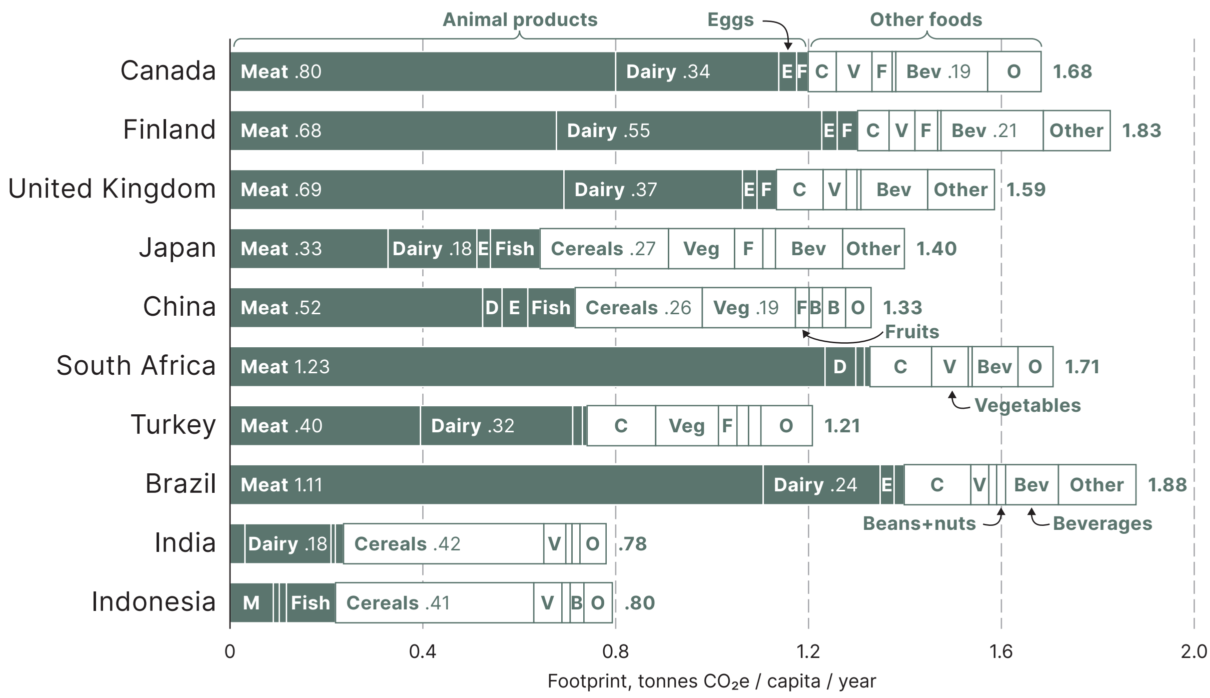
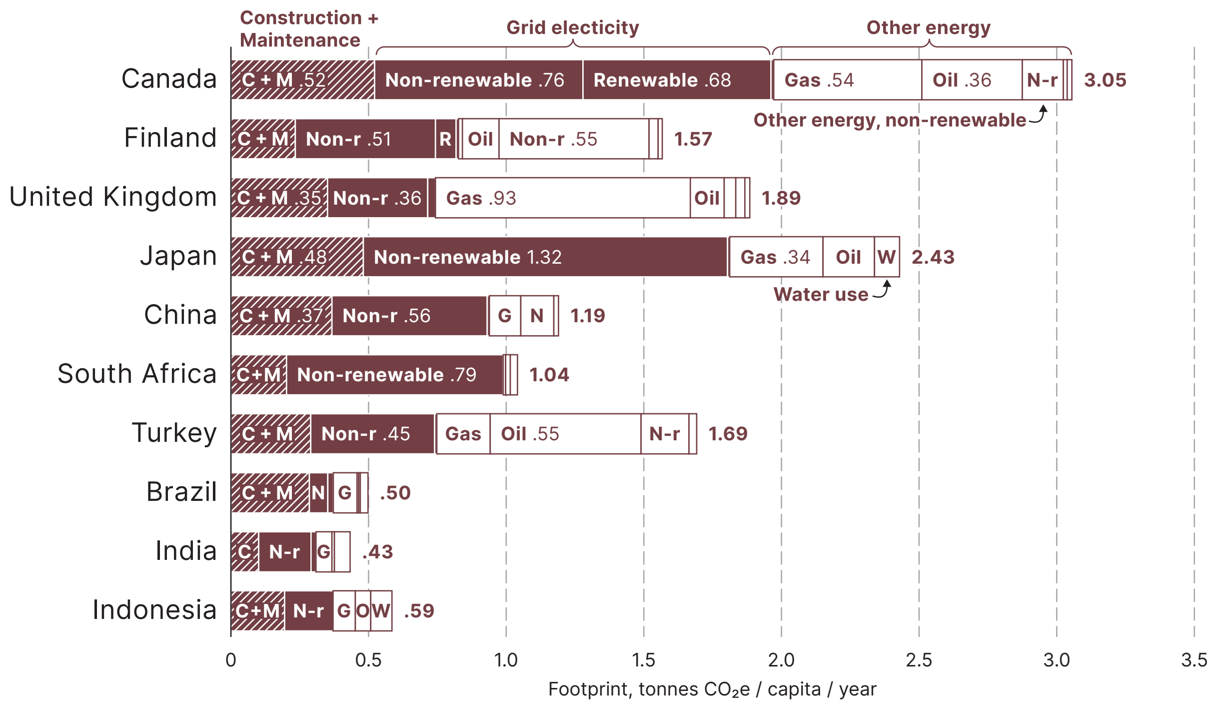
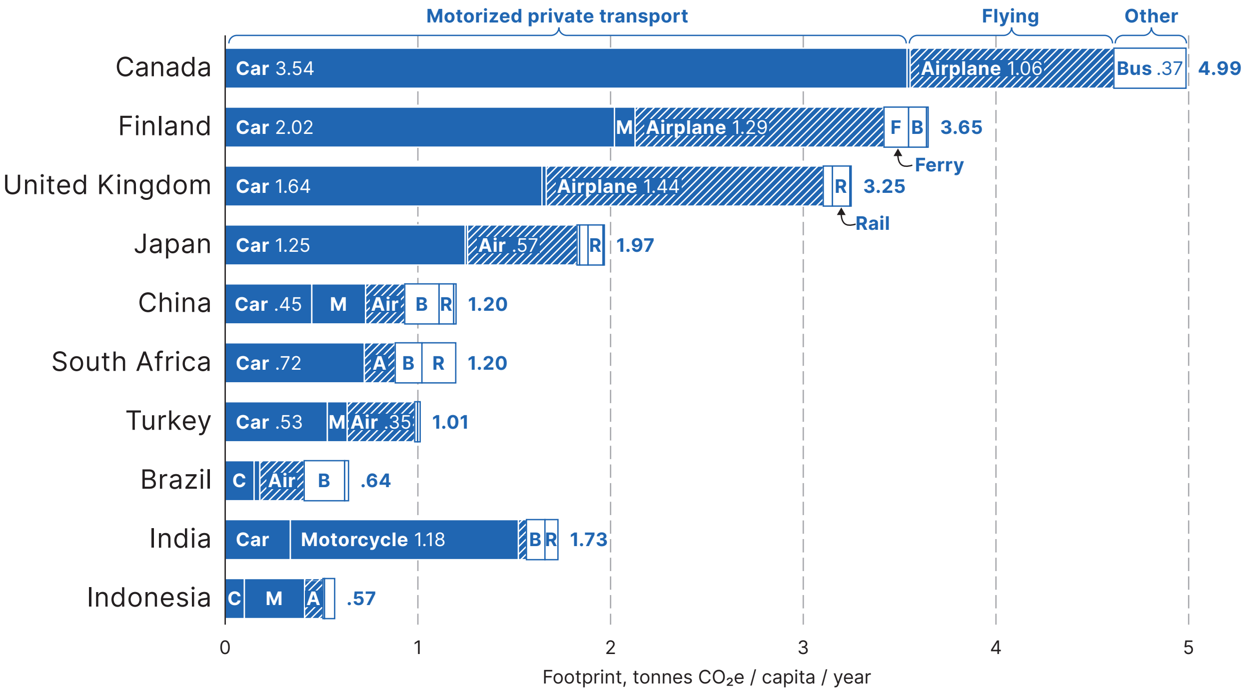


Figure E. Housing-related carbon footprint (tCO_2e/cap/yr) and its breakdown between consumption components



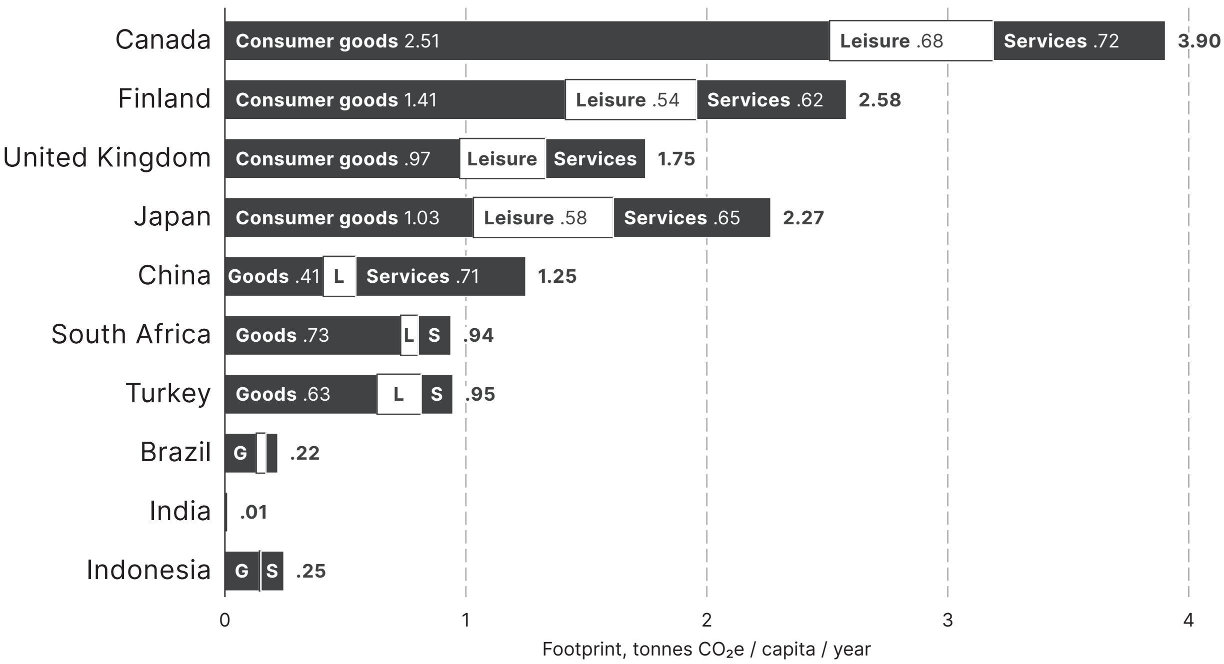
Note: Construction/maintenance covers emissions related to the living space (m2/person).

Figure F. Personal transport related carbon footprint (tCO_2e/cap/yr) and its breakdown between consumption components



Note: Rail covers bullet, long-distance and local trains, as well as trams and metros; other public transportation covers local modes of transportation, such as auto-rickshaw in India and bajaj (three-wheelers) in Indonesia.

Figure G. Consumer goods, leisure, and services related carbon footprint (tCO_2e/cap/yr) and its breakdown between consumption components



Options and scenarios

Practical solutions will require three parallel types of efforts: absolute reductions in high-impact consumption (such as flying and driving less); modal shifts towards more sustainable options (such as shifting from driving to public transport or biking); and efficiency improvements (such as shifting to electric cars), to use three examples from the transportation realm.

The options with large emission reduction potentials as revealed in this report are reducing car travel, air travel, meat consumption, and fossil-based energy usage. If these options are fully implemented they could reduce the footprint of each domain by a few hundred kg to over a ton annually. The magnitude of impacts would depend on adoption rates of actions by the public.

To present indicative pathways, this report analyses scenarios for which countries can meet the 2.5-ton target for 2030. For each country it presents two scenarios: one prioritizing systems change (adjusting carbon intensity of lifestyles options) and one prioritizing behaviour change (adjusting volume of consumption). Both intensity- and amount-adjusted carbon budget scenarios highlight the urgency of drastic lifestyle carbon footprint reductions in high-income countries, as the needed footprint reductions of 69–82% require almost full (at least 95%) adoption of low-carbon lifestyle options in all countries. Canada was an exception, as it is not able to meet the 2.5-ton target even with full adoption of the options applied in this report. Upper and lower-middle income countries also need lifestyle carbon footprint reductions of 23–50% by 2030, but pathways allow more freedom in terms of chosen actions and adoption rates, as well as the possibility of focusing on country-specific hotspots.

The results highlight the large potential lifestyle changes required across consumption domains in order to implement the Paris Agreement, and also imply it is not an either-or question of technology or lifestyles but rather both—improvements to the energy system and technology as well as shifts in consumption patterns are required to achieve the ambitious climate targets.

Policies

With a diminishing carbon budget amid impacts of climate change already being felt, growing social tension exacerbated by vast inequities in society, and a short timeline for action, we need every tool in the box, including options that may seem politically challenging. The report highlights a number of policy frameworks that may help society transition towards fair consumption within planetary boundaries. These recognise that significant lifestyle changes are, however, only possible if they occur within broader system change in the underlying economic and social conditions, and that the burden of change also includes communities, businesses and institutions, and government agencies.

Recommendations here deliberately focus on a few radical approaches that are not yet part of the mainstream climate discourse. This would hopefully broaden the discussions on how to deal with the escalating climate emergency in an equitable manner and within a short timeframe. The first approach is taking out the harmful consumption options, through choice editing. Choice editing is a traditional government approach that has been primarily applied through the filter of public safety, health, and security. However, in a climate emergency, governments need to incorporate and prioritise sustainability in their choice editing criteria. High impact options such as fossil-fuelled private jets and mega yachts, excessive meat consumption, and customer loyalty programs that encourage unnecessary frequent flying and stays in wasteful hotels need to be edited out, for example, while innovation for more sustainable alternatives would need to be edited in.

The second approach requires setting limits for environmentally harmful consumption and staying within those limits. The report asks the question of whether the time has come for carbon rationing. Rationing has been used in the past as a tool to regulate water shortages in times of droughts, and to ensure equitable availability of fuel and food when limited. Carbon rationing is relevant, since existing policies and programs are insufficient for meeting carbon reduction targets, and because it is a policy idea that meets calls for socially just action on climate change. However, rationing can be complex and controversial and it is so far not clear what mechanism could be used to implement carbon rationing. At the very least, thoughtful conversations among politicians and the public are needed, and so is some bold experimentation to implement such an approach.

The third set of policy approaches is intended to ensure a more equitable wellbeing society. One recommendation is to adopt a sufficiency approach to the design of policy and practical solutions. In contrast, and sometimes complementarily, to the dominant technology-driven efficiency approach with its open-ended incrementalism, sufficiency prioritises needs-provisioning with limits determined by the biophysical processes. A sufficiency approach will support a fair consumption space through a range of options for housing, personal transport, thermal comfort, and nutritional needs, for example, that are optimised for wellbeing within planetary boundaries. Another recommendation to ensure equity and guarantee access to basic needs for all, is to go beyond universal basic income and implement universal basic services (UBS). Meeting human needs through public services and other collective measures is more equitable, affordable, and sustainable than simply providing cash benefits to support individual market transactions. UBS are underscored by a social guarantee, which recognises that everyone has basic human needs that enable them to participate with dignity in society; equitable access is based on needs, not ability to pay. UBS, to be provided through a combination of individual effort, organisations, and government mandates, would be determined for each society. In the UK, for example, these include: health and social care, education, housing, childcare, digital access, and transport.

Thinking forward

The final section puts forward some ideas on research policy and practice to accelerate the transformation towards a low-carbon society and a stable climate. Akin to annual GDP projections, national governments should announce annual emissions reductions targets, and establish national carbon budgets. Sustainable Development Goal 12 on sustainable consumption and production is not sufficient on its own to carry the required global shifts in lifestyles. A midterm review of the SDGs needs to recognise its limits and boost the Goal through complementary programmes. One such programme is the 10-Year Framework of Programmes on sustainable consumption and production, which expires in 2022. The programme could be renewed and refocused on sustainable lifestyles and using a 1.5-degree lifestyles approach to boost SDG12 and link it to the Paris Agreement. More efforts also need to be put into creating visions that can inspire people and guide society towards a just and sustainable future. These visions should show opportunity, centre on wellbeing, and engage the youth population that is heavily affected by climate anxiety and that is destined to live with our success or failure to create a sustainable future.

Section I
A Budget for Living Within Limits

1 – Towards a Fair Consumption Space

1.1. The urgency of sustainable lifestyles

The future of our civilisation and its sustainability depend on resolving three key tensions that are already manifesting in increasingly disruptive ways across societies: a tension between limited natural resources and the continuous extraction to feed our growth appetites; a tension between the socio-economic system and inequalities in distribution that continue to exacerbate extremes of poverty and wealth; and a tension between the waste and pollution that we generate and the absorptive capacity of the planet (Akenji 2019). All three tensions derive from how society has been structured and how, at individual and collective levels, we define and pursue our needs and wants. Thus, far-reaching changes in how we live and consume are foundational to any attempts to address the sustainability challenge—in fact, as this report shows, sustainable lifestyles are both a driver as well as an objective of creating a peaceful future in harmony with the ecological rhythm and balance of our planet.

One of the most significant policy developments in recent years in this regard is on climate change mitigation; more than 100 countries have committed to achieving net-zero emissions goals by around mid-century in order to achieve the Paris Agreement on climate change (UNEP 2020). Local governments have also made decarbonization commitments, with more than 2,000 of them declaring a climate emergency (Climate Emergency Declaration 2021) and with a huge number promising climate neutrality (e.g., Eurocities 2019; Laine et al. 2020; Carbon Neutral Cities Alliance 2021). However, despite the importance and rapid mitigation potential of behaviour change, most policy approaches to climate change solutions have given it scant attention, choosing to focus instead on the application of technology (Creutzig et al. 2016). Little is being done to directly address the overconsuming lifestyles, even as the IPCC releases some of the strongest scientific assessments of the consequences of consumerism and growth-obsessed capitalism. Very few net-zero strategies are focused on the potential contributions of lifestyle changes and their implications on future ways of living. By relying heavily on unproven technologies and prioritising interventions that continue to sustain economic growth, net-zero strategies risk leaving citizens feeling disenfranchised.

While news of net-zero commitments is encouraging, the problem is accelerating faster than the solutions package being offered. Scenarios from integrated assessment models show that in most of the cost-optimal scenarios consistent with limiting global warming to 1.5°C, taking together global commitments thus far, net-zero greenhouse gas (GHG) emissions occur between 2060 and 2085; net-zero CO_2 emissions occur earlier than net-zero GHG emissions, between 2045 and 2060 for 1.5°C, on a global level (IPCC 2018). This is of course later than the IPCC stresses when net-zero emissions must have been stabilized. Keeping aside the debate on the varying interpretations of net-zero, UNEP warns that the litmus test of these net-zero announcements will be the extent to which they are reflected in near-term policy action and the extent to which they are genuine (UNEP 2020). History of government commitments and failures on climate change shows that offsetting emissions, which is central to the net-zero strategy, has been teased for over three decades, leading to the worsening state of affairs in which we now find ourselves—what the IPCC describes in its most recent report as "irreversible" damage to the environment (IPCC 2021b). This explains the widespread skepticism about net-zero commitments and calls for them to be carefully examined if their technology and market driven focus is not to lead to further excuses for postponing crucial climate decisions affecting consumption choice architecture, lifestyles, and inequalities.

In the two years since the publication of the first 1.5-degree lifestyles report (IGES et al. 2019), a number of dramatic local and global events have occurred, pressing home the message that unless lifestyles are addressed—that is, unless sustainable lifestyles move from a side topic to the centre of global frameworks on climate change, biodiversity, and resource scarcity—then social tensions and political disruptions will become a mainstay of the world as it grapples with the consequences of a fast-changing climate. The COVID-19 pandemic and the consequent unprecedented lockdown came as a foretaste to the very least of what could happen if the world is caught in an unplanned transition (Shan et al. 2020). The heartbreaking millions of deaths, inability to commune with loved ones, runs on basic necessities in shops, food shortages, and increased depression and anxiety were just as shocking as the partial collapses in economic, health, security, and transportation systems—systems that people had come to rely upon and trusted authorities responsible for them. Evidence of weakening public trust and disenfranchisement continues to be seen in protests around the world, including rejections of vaccines and basic prevention measures such as wearing masks. And yet, at the end of a terrible year with people having experienced the harshest restrictions in recent memory, the International Energy Agency reported just an 8% reduction in mean global CO_2 emissions (IEA 2020). And while that was the largest decline in annual emissions seen, it was far smaller than need be, especially considering the suffering endured. Worse still, a large majority of COVID-19 recovery plans are not "green;" government planning and spending, despite the rhetoric of "building back better," is trapped in the same problematic economic growth design that is causing these problems and threatening wellbeing and aspirations (O'Callaghan and Smith 2021). There is a huge amount of inertia in our economies, whether locked in fixed infrastructure, business interests, or simply unconscious patterns of behavior.

Contrary to pacifying commentary, impacts of climate change on lifestyles are not far off into some distant future; they are not only affecting vulnerable populations in developing countries; and impacts are not going to be gradual with advanced warnings. Rather, impacts of climate change on lifestyles are already being experienced today; they are occurring with increasing frequency and magnitude, and, although disproportionately affecting poorer countries, are also being experienced in highly industrialised and wealthy societies; and the manifestations are scattered and unpredictable. A number of recent sporadic heat waves and cold fronts and summer snows have left meteorologists baffled. One recent example of this is the heatwave that occured in Canada in June 2021. During this, Canada created and broke its temperature records for three straight days, reaching 49.6°C—with a consequence of over 100 deaths (BBC News 2021c); two months later, Europe logged its highest temperature in recorded history: 48.8°C on August 11, 2021 in Sicily, Italy (Weston and Watts 2021). Even with being prepared for wildfires, Australia witnessed mega-blazes across all states last summer, overpowering its firefighters and military support, with some professional firefighters losing their lives along with dozens of citizens and homes consumed by the fires (Shi et al. 2021). Nearly three billion animals were killed or displaced, and vegetation destroyed, in what was one of the worst wildfire disasters in its modern history (BBC News 2020). Keeping with the erratic patterns, Germany and parts of western Europe not familiar with natural disasters saw massive floods and landslides that swept away houses and killed over 200 people (Deutsche Welle 2021). These single events represent trends that have already been reported by IPCC's and other publications (IPCC 2021b).

Of growing concern is observed anxiety among a population that is especially prone to social disruptions and that is also arguably more vested in a sustainable future: youth. The climate crisis is precipitating new psychological conditions and worsening existing mental illnesses among young people. Referred to as eco-anxiety, climate distress, climate change anxiety, or climate anxiety, these terms describe anxiety related to the global climate crisis and the threat of environmental disaster. Natural disasters precipitated by climate change including hurricanes, heatwaves, wildfires, and floods can lead to direct psychological effects, such as increased rates of depression, anxiety, post-traumatic stress, and other mental health disorders (Wu et al. 2020). Younger people, compared to older adults, tend to report greater climate-related anxiety, possibly because younger people will be more likely to live through the climatic adversities in the decades to come. UNICEF's new Children's Climate Risk Index provides sobering data on how many children are currently exposed to a variety of climate and environmental hazards, shocks, and stresses: 820 million children (more than one-third of children globally) are currently highly exposed to heatwaves; 920 million children are currently highly exposed to water scarcity; 600 million children (more than a quarter of children globally) are currently highly exposed to vector-borne diseases, such as malaria and dengue, among others; 330 million children (one in seven children globally) are currently highly exposed to riverine flooding (UNICEF 2021). As impacts of climate change become more evident, the stability of systems that society has come to rely upon are also falling apart: predictable weather patterns, jobs and careers, pension schemes, eradicated diseases, stable communities, relative political and economic stability all seem to be at play (Clayton 2020). Climate-related anxiety also tends to be greater in people who deeply care for the environment. Levels of climate anxiety are likely to increase over time as increasingly more people are directly affected (Taylor 2020), and in all likelihood will increasingly drive political action. In March 2019 alone, an estimated 1.6 million school-aged protestors in 125 countries demanded action be taken to combat climate change (Wu et al. 2020).

The focus of this report is on lifestyles and climate change. Lifestyles embrace much more than just consumption patterns and behaviours. Lifestyles include non-economic aspects of our lives, such as caring for children or elderly parents, spending time with our friends, play, engaging in voluntary work, activism, or supporting a local campaign or political party. All of these potentially affect, directly or indirectly, our well-being and our carbon footprint. Lifestyles are how we consume, and also how we relate to one another, what kind of neighbours, friends, citizens, and parents we are, what kinds of values we nurture, and how we let those values drive our choices.

The UN Environment Programme defines a sustainable lifestyle as "a cluster of habits and patterns of behaviour embedded in a society and facilitated by institutions, norms and infrastructures that frame individual choice, in order to minimize the use of natural resources and generation of wastes, while supporting fairness and prosperity for all" (Akenji and Chen 2016).

As is the case with this report, focusing on lifestyles instead of just consumption implies considering non-economic aspects of our lives, as well as the role of factors outside the marketplace, and of policy, business, innovation, and other factors that enable or constrain adopting any consumption or lifestyle choice. A quantification of the impacts of aspects beyond consumption in terms of carbon emissions is, however, very difficult to obtain and often relies on strong assumptions and generalisations. For this reason, we focus on quantitative analysis of carbon footprints[1] for consumption, while maintaining a broader perspective on lifestyles through considering and discussing other factors, enablers, and co-benefits of lifestyle change.

1.2. Shrinking budget: the closing window for staying below 1.5 degrees

Opportunities for maintaining or improving comfortable ways of living are decreasing along with the shrinking budget to stay below a 1.5 °C increase in global temperature. The Intergovernmental Panel on Climate Change's Special Report (IPCC 2018) emphasised that an average warming of 1.5 °C should not be regarded as a "safe" climate target although the expected risks and negative impacts at this level are considerably lower than at 2 °C. The Special Report also reviewed the scientific literature on the remaining carbon budget—how much more CO_2 humanity can emit while still having a fair chance of meeting the agreed warming targets. It concluded that to have a 50% chance of limiting warming to 1.5°C, the world can emit 580–770 gigatons of CO_2 ($GtCO_2$) from the start of 2018. The range in values reflects different ways of calculating the pre-industrial global average temperature. For a likely chance (67%) of meeting the target, the remaining budget decreases to 420–570 $GtCO_2$, equivalent to around 10–14 years of current emissions.

Recent research has updated the IPCC's estimates of humanity's remaining carbon budget. A study published in early 2021 (Matthews et al. 2021) finds that the available 1.5°C budget has decreased to 230 $GtCO_2$ from 2020 onwards for a 67% chance of meeting the target, corresponding to around six years of global emissions. The corresponding budget for a 50% chance amounts to 440 $GtCO_2$ or around 11 years of global emissions, if they remain at current levels. The first part of the IPCC's 6th Assessment Report, which deals with the physics of climate change and was published in August 2021, largely confirms previous estimations of remaining carbon budgets for different warming targets and probabilities (IPCC 2021a). According to this latest assessment, starting from the beginning of 2020, the remaining carbon budget for a 50% likelihood of keeping warming to 1.5°C amounts to 500 $GtCO_2$.

With the carbon budget rapidly being spent, the unsustainability tensions are surfacing faster, and political and social justice issues are being exacerbated—straining debates on equity and fairness in the distribution of the remaining carbon budget in the process.

1 Carbon footprint refers not only to CO_2 but also other greenhouse gases. The report considers emissions of methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6), converted into CO_2-equivalents (CO_2e).

1.3. Worsening inequality

An indictment of the current unsustainable economic development paradigm is the clear narrative showing the ever growing gap between the rich and the poor, magnified by the perversity of the poor paying a higher price (literally and metaphorically) than the rich. There is inequality among countries, inequality within countries, inequality across races and between genders, and inequality across generations. And there are multiple expressions of inequality: of income, of health, of access to natural resources and public services, of participation in decision-making processes, for example, and notably in terms of inequality of carbon emissions. Calls for climate justice are already growing loud; these tensions will only get worse as competition heightens over the shrinking carbon budget to stay within sustainable limits. Equity is central to ensuring sustainable lifestyles.

Research shows a strong correlation between income and emissions, and a pattern of a highly unequal global distribution of consumption emissions between people of high and low income. The UNEP Emissions Gap Report 2020 (UNEP 2020) presents the following data to highlight the link between inequality and consumption. The emissions share of the 10% richest, highest-emitting individuals ranges from 36-49% of the global total, while that of the poorest, lowest-emitting 50% of the world's population ranges from 7-15% of the total. This disparity is particularly pronounced at the top of the global income scale—the emissions share of the top 1% highest income earners is greater than the total emissions of the bottom 50% combined—and may be twice as high, according to some estimates. Around half of the consumption emissions of the global top 10% and 1% are today associated with citizens of high-income countries, and most of the other half with citizens in middle income countries. Oxfam estimates that to reach the global average per capita emissions level by 2030 consistent with limiting global heating to 1.5°C, the per capita consumption emissions of the richest 10% of the global population should be reduced to about a tenth of their current level, while those of the poorest 50% could still increase by two to three times their current level (Oxfam 2020).

Yet this inequality trend is growing bigger. During the COVID-19 pandemic, billionaires and millionaires have gotten even richer while poverty has deepened among lower income groups (Parolin et al. 2020). This contrast was manifest in the United States, for example, when 40 million Americans filed for bankruptcy as billionaires saw their wealth rise by half a trillion dollars (Woods 2020). This disparity is present in both industrialised and developing countries, where a rich class is emerging with lifestyles similar to their Western counterparts. In India, for example, just 1% own 58% of the total wealth of the country (Oxfam 2017). The UN Food and Agriculture Organization estimates that global hunger increased to 811 million undernourished people worldwide in 2020, and the number of people living with food insecurity, a lack of year-round access to adequate food, rose by 318 million, to 2.38 billion (FAO et al. 2021). In Peru, a country that had made progress and halved poverty over the last two decades, national data shows that poverty jumped from 20% to 30% in a year (FAO et al. 2021). If not addressed, the effects of climate change will be far worse than the pandemic, and these inequalities and their impacts will get even more dramatic as provisioning systems, social safety nets, and natural capital all get compromised.

Analysis shows the unfortunate implications of this growing inequality of income for climate mitigation. Oxfam found that while the European Union's total consumption emissions fell between 1990 and 2015, income inequality in the EU increased, meaning that only the per capita emissions of low and middle income EU citizens actually declined in this period, while the per capita emissions of the richest 10% of EU citizens continued to increase. Oxfam observes that the richest 10% of EU citizens today have a per capita footprint over 10 times higher than the level needed by 2030 consistent with achieving the 1.5-degree target, while the footprint of the richest 1% is 30 times higher. By contrast the footprints of the poorest 50% of Europeans will need on average to be halved by 2030 (Oxfam 2020). Similar observations have been made for the lifestyle carbon footprints of the Japanese population (Koide et al. 2019).

Analysis in this report also highlights the deep inequalities at the heart of the climate crisis, in particular the inequalities between countries. For example, current per capita consumption emissions in Canada (14.2 tons CO_2e) are six times those in India (2.2 tons CO_2e). While it is broadly understood that Canada and similar countries need to drastically reduce consumption, countries such as India also already need to start cutting their emissions. Japan and Finland, for example, need to reduce lifestyle carbon footprints by about 90% by 2050; China, Brazil, and India need reductions of 86%, 78%, and 76%, respectively. These reductions need to be carried out by emerging economies while simultaneously getting hundreds of millions of people out of poverty. In addition, they are also dealing with droughts, hurricanes, fires, and other disasters—exacerbated by climate change. Although this report does not include further detail on the inequalities within those countries, it is nonetheless clear that a policy approach that does not reflect an equitable distribution of the carbon budget will only further embed social inequalities, undermine development opportunities for billions of people in lower income countries, and foment resistance to addressing climate change.

1.4. Defining a fair consumption space

This report asks the question: in order to stay within ecological limits, how do we distribute the remaining carbon budget in a fair manner that allows everyone equitable opportunities for a life of dignity, including future generations?

The longer we fail to curb carbon emissions, the smaller the global carbon budget gets, and the more challenging the remedial actions we must take. Competition over the remaining budget, if not carefully managed, will invite exercises of power and exacerbate tensions between those who have and those who have not. In a world of finite resources and planetary boundaries (including a tight carbon budget), in which everyone has needs and desires, a lack of balance in the system means that overconsumption by one group comes at the expense of opportunities by others to meet their own needs. Consumerism by some can only exist if others are deprived of their own livelihoods. Political economic analysis of the current economic climate points to the growing extremes in poverty and wealth being easily correlated to vast differences in power (Ravallion 2010; Oxfam 2015), as well as to impacts on the environment. Perversely, it is the poor, those at a power disadvantage and with limited agency, who experience the most dire impacts of climate change and unsustainability (IPCC 2012). But it is everyone who ultimately bears the consequences, as COVID-19 outbreaks and climate migration pressures have shown us. Thus, there is a need for a system that takes into account the limits of resources, the needs of everyone, and a balance in opportunities to meet those needs.

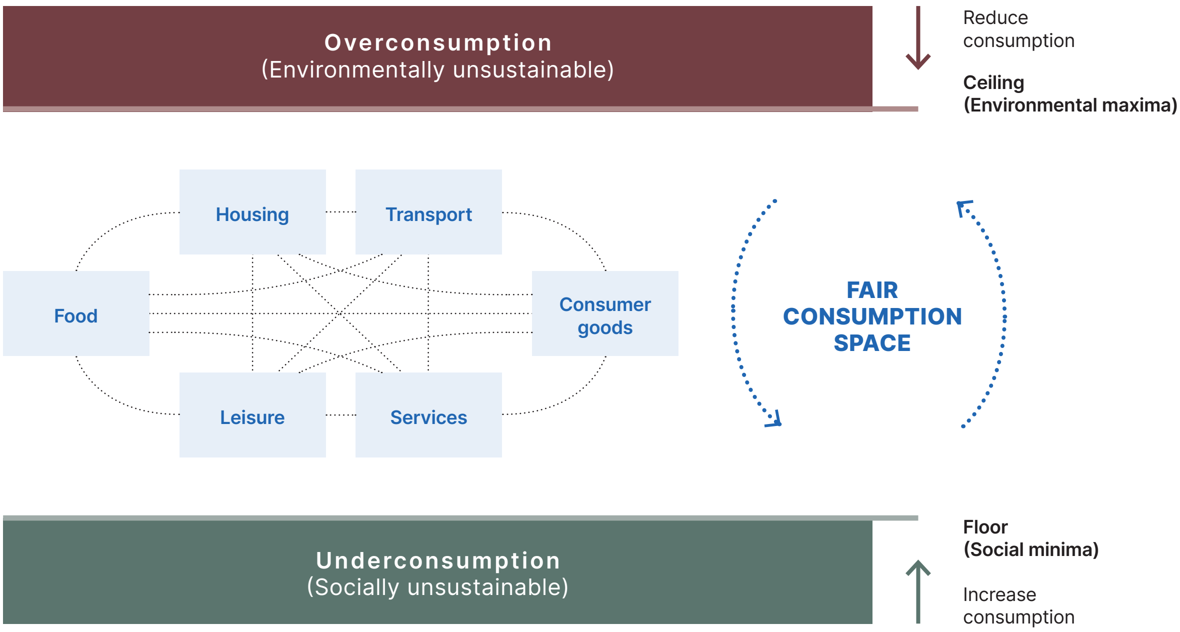
This report proposes identifying a fair consumption space: an ecologically healthy perimeter that supports within it an equitable distribution of resources and opportunities for individuals and societies to fulfil their needs and achieve wellbeing. This "space" constitutes a range of lifestyle options and consumption choices with different combinations of goods and services that can be exchanged, substituted, and adjusted over time as the ecological balance shifts. Such a space exists within a distributive system that equally allocates resources for everyone such that current and future generations have similar opportunities. *With a cap on resources, overconsumption by one person affects the prospects of another;* consuming beyond one's fair consumption space would cause deficit and thus encroach into another's space. If not balanced this would lead to ecological disequilibrium and social tensions.

This report asks the question: in order to stay within ecological limits, how do we distribute the remaining carbon budget in a fair manner that allows everyone equitable opportunities for a life of dignity, including future generations?

Achieving a fair consumption space is predicated on three principles: limits, equity, and wellbeing. The first is the need to stay within ecological limits, or one-planet living, as reflected in planetary boundaries. For this report, the limits are defined by the current carbon budget within which global temperature increases are likely to stay below 1.5 degrees. The second is equity, captured by the principle of ecological justice—including intragenerational and intergenerational justice—in access to resources and opportunities. It also asks the question, given that impacts of climate change are not limited to where the problems are caused, who benefits from actions that lead to continuing emissions and who suffers from the impacts. For this report, the global sustainable carbon budget is distributed equally among the global population[2] (see Methodology subchapter 2.2). The third is wellbeing. Carbon budget use within a fair consumption space should be optimised for the wellbeing of individuals and society rather than guided by economic growth. Within this space are not just reductions in consumption, but also innovation and regenerative measures.

2 The notion of fair distribution of efforts towards emissions reductions remains a point of discussion in UNFCCC negotiations—where they are sometimes referred to as "burden sharing" or "effort sharing"—and is steeped in politics. The UNFCCC uses a territorial-based accounting approach, which covers only direct emissions from domestic production activities within the geographical boundaries and offshore activities under the control of a country. However, to account for carbon leakage and place responsibility on consuming countries, this report uses consumption-based accounting, which covers household carbon footprints from domestic sources and emissions embodied in imported goods while excluding emissions embodied in exported goods. This allows calculations in this report to show the size of impact of households and individuals based on actual consumption. Furthermore, the equity debate in the UNFCCC is focused on who pays for emissions reductions, while from a lifestyle carbon footprint analysis the approach is that of whose direct or induced consumption is having the bigger impact—hence the more consumptive a lifestyle the higher the footprint, and the bigger the effort to reduce it to the globally unified target to stay under a 1.5°C increase in temperature.

Figure 1.1. A Fair Consumption Space for Sustainable Lifestyles



Based on Spangenberg (2014)

The concept of a fair consumption space is adapted from the 'environmental space,' coined in the early 1980s and related to the political economy of natural resource use (Opschoor 1987; Opschoor and Reijnders 1991). The 'environmental space' concept was proposed as an approach to address the limitation of various resources available for human consumption; it was applied to limit the use of oil, copper, natural gas, and biomass, necessary to guarantee the long-term availability of sufficient reserves to avoid that resource scarcity developing into a serious obstacle for economic development in the following century (Weterings and Opschoor 1992; Spangenberg 2002). It was later modified for the National Environmental Policy Plan of the Netherlands and used to describe external limits to private resource consumption due to climate change, the limited availability of wood and water, as well as issues of growing waste generation (Buitenkamp et al. 1992). For this, it estimated upper thresholds for car mobility, water and meat consumption, and so forth on a per capita basis.

In determining a per-capita environmental space, (Opschoor 1987), for example, estimated that a reduction of northern per-capita consumption by a factor of eight to ten was necessary. Already back in the 1990s, calculations showed that fossil-fuel and mineral-resource use needed reductions of about 90% in the over-consuming countries.[3] These studies form a basis for determining a per-capita fair consumption space.

The notion of establishing science-based limits and equitable distribution is central to setting a "space." Reconciling social and environmental criteria in sustainable lifestyles strategies requires a suitable conceptual framework, and an environmental space concept provides a suitable basis (Spangenberg 2014, 2002). The space is characterised by an upper limit to resource consumption (the ceiling) based on carrying capacity and equity arguments, and a lower limit (the floor) which is socially motivated and defines the minimum resource accessibility that permits people to lead a dignified life in society. Identifying fair consumption ceiling and floor values will set a fair consumption space. In this sense, setting the fair consumption space is akin to defining the "safe operating space" in the planetary boundaries (Steffen et al. 2015) literature as well in the

3 Friedrich Schmidt-Bleek (2008), for example, calculated that a worldwide per-capita consumption of non-renewable resources should be fewer than five to six tons per year (requiring a "Factor 10" increase in resource efficiency in industrialized countries like Germany); von Weizsacker et al. (2010) estimated "Factor 5" through 80% improvements in resource productivity.

so-called "doughnut economics" (Raworth 2017) that questions the conventional wisdom about unbounded, demand-led economic growth.

More recently, attempts to define fair consumption shares can be seen in the concept of "consumption corridors." Consumption corridors tie sustainable consumption and the good life to the right of the individual and the duty of governments. This concept recognises that people are entitled to have access to the necessary resources allowing them to satisfy their objective needs and live a good life, while governments have the duty to provide individuals with the necessary conditions to do so. In exercising these rights and duties, individuals and governments should use only amounts that allow others to also have similar access (Di Giulio and Fuchs 2014).

A fair consumption space therefore establishes a global or per-unit perimeter defined by resource limits, but also the absorptive and regenerative capacity of the planet. Figure 1.1 illustrates a fair consumption space. Within the space are consumption ranges with upper limits (i.e. ceiling) and lower limits (i.e. floor) for various resources. For this report, the rations are linked to emissions from high-impact domains of lifestyles such as food, housing, transportation, leisure, and consumer goods. Following calculations for this report, the fair consumption space should dynamically balance at 0.7 tCO_2e per person per year by 2050 in order to stay with the 1.5-degree temperature increase of the Paris Agreement.

The fair consumption space is about a balance of power among different actors in society, with rations per person determined through equitable distribution of the carbon budget and considerations of fundamental needs for wellbeing. With a clearly articulated space, there is a balance in which wants do not overpower needs; economic demands stay within environmental limits; and political platforms and policies do not exacerbate social disparities and ecological deficits. It is characterised by a rationing system that adjusts appetites equitably to periodic and physical constraints.

1.5. About the 1.5-degree lifestyles report

While changes in lifestyles have been widely recognised as part of a sustainable civilisation, it remained largely in the normative domain, with little quantifiable and systematic guidance of policy design and prioritisation of actions under specific climate regimes. The 1.5-degree lifestyles report was introduced as a science-based approach to link concrete changes in lifestyles to measurable impacts on climate change while keeping with the 1.5-degree aspirational target of the Paris Agreement on climate change. Changing lifestyles, especially by prioritising high-impact areas (such as food, personal transport, housing, consumer goods, leisure, and services), can bring about results relatively quickly, especially in consumption domains that are not locked into existing infrastructure (Moore 2013; Lettenmeier et al. 2017; Salo and Nissinen 2017).

Most scenarios for meeting climate targets are still hopeful on developing new technologies (including negative emissions technologies) and on changes in production (Rogelj et al. 2015; Rockström et al. 2017). This technology and production focus tends to underplay, if not ignore, both the contributions of lifestyle changes and impacts of how such technology developments and emerging business practices would impact lifestyles and society. While some pathway scenarios incorporating demand-side reduction measures have recently emerged (van Vuuren et al. 2018), these and other existing consumption-focused literature providing quantification of the mitigation potential of low-carbon lifestyles do not directly link reduction targets to pathways leading to achieving the temperature targets of the Paris Agreement (Vandenbergh et al. 2008; Dietz et al. 2009; Jones and Kammen 2011). This report and the approach taken fill a gap in the existing research by establishing global targets for lifestyle carbon footprints, examining current consumption patterns and their impacts on footprints, and evaluating potential reduction impacts of low-carbon lifestyle options.

The 1.5-degree lifestyles approach examines GHG emissions and reduction potentials using consumption-based accounting, instead of production-based accounting, which covers only direct emissions from domestic production activities within certain geographical boundaries. Consumption-based accounting covers both direct emissions in a country and embodied emissions of imported goods while excluding emissions embodied in exported goods. This accounts especially for the global impacts of high-consuming societies, and recognises that some communities still need to increase consumption to meet basic needs of their citizens.

The 1.5-degree lifestyles approach has been widely covered by the media, referenced by researcher organisations and think tanks, and has become very influential in policy discussions seeking to integrate lifestyles perspectives in climate policy. The Hot or Cool Institute has worked with partners to realise several results. The first report became the basis for the low-carbon lifestyles chapter of the United Nations Environment Programme Emissions Gap Report 2020 (UNEP 2020) and continues to inform the work of UNEP on sustainable lifestyles. It is providing knowledge input on the lifestyles component under the Global Opportunities for SDGs (GO4SDGs) (Green Growth 2020), funded by the government of Germany and led by UNEP. Recognizing the need for such an approach the European Commission has funded a multi-year research project consortium on "EU 1.5-Degree Lifestyles" under the Horizon

2020 scheme. In Finland, Sitra has adopted the 1.5-degree lifestyles approach to develop the "Shift-1.5 Method" (SITRA 2020) that has engaged almost a fifth of the country. The approach is also informing the philanthropic community's work on behaviour change, such as the Funders for Sustainable Living network, convened by the KR Foundation. It prompted the work and report by the Cambridge Sustainability Commission on Scaling Behaviour Change (Newell et al. n.d.). At the city level, ICLEI (the Local Governments for Sustainability network), the Institute for Global Environmental Strategies, and partners under the One-Planet network are analysing 1.5-degree urban lifestyle solutions in Kyoto, Yokohama, Cape Town, New Delhi, São Paulo and Nonthaburi. Similarly, C40, the network of the world's megacities committed to addressing climate change, is using the 1.5-degree lifestyles approach to support its work under the Thriving Cities Initiative.

This report builds on the first one published in 2019: "1.5-Degree Lifestyles: Targets and options for reducing lifestyle carbon footprints" (IGES et al. 2019). It presents a more refined methodology, updated data from countries in the first report, and extends detailed analysis to five additional countries. While the first report focused on establishing quantifiable global targets for sustainable lifestyles, this report goes further, introducing the need for a fair consumption space, and exploring choice editing, carbon rationing, and other strategies to achieve low-carbon lifestyles in an equitable manner.

A fair consumption space is predicated on three principles: consumption within ecological limits; equity and ecological justice; optimised for the wellbeing of individuals and society.

This report is divided into four sections. Section I provides a background, putting sustainable lifestyles in the context of the climate emergency and the need for a fair consumption space. It also introduces key concepts and methods used to determine proposed globally unified per capita targets for lifestyle carbon footprints from household consumption.

Section II presents detailed analysis of current average lifestyle carbon footprints of 10 countries: Canada, Finland, United Kingdom, Japan, China, Turkey, South Africa, Brazil, India, and Indonesia. These case countries were selected to capture a range of different consumption contexts, including capturing the differences between industrialised and industrialising countries. They are all members of the Group of Twenty (G20) countries, apart from Finland. As the report only covers these case countries, future studies can widen the selection to other countries by using the methodology, data sources, and results of estimation that are detailed in Annexes A to D[4]. The report estimates levels of physical consumption in each country, comparing them to global targets. For each country, it analyses low-carbon options for reducing lifestyle carbon footprints of households and calculates the carbon reduction potentials of identified options based on various adoption rates and country-specific contexts.

Section III looks at policy approaches to reconcile the tightening carbon emissions budget and vast inequalities and power dynamics manifesting in the sustainability transition. The section focuses on approaches that are less frequently discussed but which hold potential to break the worsening trends and to usher in effective solutions, as is required by the scale and urgency of the transitioning challenge. Examples include choice editing, carbon rationing, universal basic services, and sufficiency.

Section IV brings together and illustrates the several elements of this report: reducing current lifestyle carbon footprints through varying adoption rates of the solutions options introduced, in order to meet the 2030 target of 2.5-tons per person. For each country, it presents two scenarios: one with an emphasis on reducing intensity of supply options and a second with an emphasis on reducing consumption. In doing so it seeks to dispel the false dichotomy of systems changes versus behaviour change, and demonstrates the need for both to be orchestrated. The report ends with a final section, Section V, on recommendations for moving forward.

4 Annexes A,C and D published online only on the website of the Hot or Cool Institute: *hotorcool.org*

TEXT BOX A: Key features of the 1.5-degree lifestyles approach

Global carbon budget. The remaining carbon budget refers to the maximum amount of carbon dioxide equivalents that humanity can still emit while limiting global warming to a given target, such as 1.5°C. The longer mitigation action is delayed, the faster the budget is used up. The remaining carbon budget can be a powerful tool for communicating the urgency of climate mitigation.

Lifestyle carbon footprints. These are measures of GHG emissions directly and indirectly induced by an average household's consumption but excluding those from the public sector and capital investment. In principle, lifestyle carbon footprints are calculated by multiplying average annual consumption in physical units with life-cycle-based carbon intensities for a wide range of goods and services in case countries. For consumption areas where physical units cannot be easily expressed, such as for "leisure," consumer expenditures can be used. This consumption-based accounting approach ensures a clear focus on emissions attributable to lifestyles, and allocates emissions to specific goods and services consumed by households.

Hotspots. Lifestyle carbon footprints are analysed to identify "hotspots"—consumption areas with the highest climate impact. Identification of specific hotspots is made easier by the use of physical consumption units, such as distances travelled by car or vegetables eaten.

Equity-based reduction targets. To ensure that the temperature limits of the Paris Agreement are met, per capita targets are determined by distributing the remaining carbon budget on an equitable basis across the global population. (Targets for this report are set at 0.7tCO_2e by 2050, with intermediary targets of 2.5t in 2030 and 1.4t by 2040.) Establishing long-term per-capita carbon targets requires balancing GHG emissions and effects of sinks. Thus proposed per-capita carbon footprint targets dynamically shrink into the future as the total carbon budget shrinks—the longer action is delayed to stabilise and reduce emissions, the more rapidly the budget will shrink.

Low-carbon options. To support meeting 1.5-degree lifestyle targets, a number of low-carbon lifestyle options are drawn from the scientific literature and their emissions reduction potential is estimated. Options include both production-side efficiency improvements and consumption-side changes, grouped according to three key approaches: absolute consumption reductions, modal shift to alternative products or services, and efficiency improvements of current goods and services.

Adoption rates. Adoption rates are used to account for the varying extents to which a population changes to low-carbon options. They represent the share of the population implementing an option (e.g. 50% of population adopt a vegetarian diet) and/or the extent of implementation of the option (e.g. vegetarian diet implemented by 50%, i.e. half of one's meals are vegetarian). Estimated impacts and policy recommendations are calculated on the basis of partial or full implementation (or adoption) of each low-carbon lifestyle option.

TEXT BOX B: Lessons from research on enabling sustainable lifestyles

Changes in ways of living are a political hot-potato and can be psychologically daunting. Yet, with about two-thirds of global greenhouse gas emissions attributed to household consumption, sustainable lifestyles are integral to the solutions package required for a sustainable future (Capstick et al. 2020). Yet, practical and philosophical questions abound, as do misconceptions on the issue. Below are some key messages from this report, and culled from multidisciplinary research on transitioning to sustainable lifestyles.

1 **Green consumption is not the same as sustainable living.**
Sustainable living incorporates green consumption (Akenji 2014) where necessary, and extends to immaterial aspects of labour, love, and laughter, while being guided by equity in, and wellbeing of society. While green consumption and eco-labelled products might be better than conventional ones, buying too many of them leads to rebound effects (Hertwich 2008)—potentially erasing the environmental value.

In a sustainable lifestyles transition, we need to provide non-consumption and out-of-market options; and to protect lifestyles of communities already living well without consumerism.

2 **The environmental impacts of lifestyles mainly come from four domains: food, personal transport, housing, and consumer goods.**
Among these, as this report shows, eating meat, using fossil fuel cars, flying, and large and high energy-consuming houses are especially problematic.

Prioritising design, production, and consumption patterns in these domains will address about three-quarters of environmental impacts.

3 **There is no universal sustainable lifestyle—what is sustainable in one place may not be sustainable in another.**
If one must use a car, then an electric car in Iceland might make sense, where 100 percent of electricity comes from renewables, but not in India where electricity is primarily generated from coal.

Successful examples of sustainable lifestyle practices should be replicated and scaled in new places only after careful adaptation.

4 **The environmental impacts of lifestyles are not intentional but rather a consequence of people aspiring to fulfil needs or desires, and to function in society.**
Everyday practices of people are determined by social norms and values, and depend on systems and infrastructures around them (Shove 2012).

Change needs to focus on the choice architecture (Szaszi et al. 2018), social values and norms, physical infrastructure, provisioning systems.

5 **Increasing awareness does not necessarily lead to action.**
Knowledge of environmental impacts of consumption does not necessarily lead to changes in lifestyle. This knowledge-action or attitude-behaviour gap shows the limits of mere information campaigns (Terlau and Hirsch 2015).

Awareness is easily subordinated by lack of access or lock-in by prevailing options (Seto et al. 2016). In a sustainable society, the default options—the most widely available means of meeting needs—should already be made sustainable.

6 **The question of individual behaviour change versus systems change is a false dichotomy.**
Lifestyles choices are enabled and constrained by social norms and the physical environment or infrastructure (Sahakian and Steinberger 2011). And at the same time, history is full of heroes and communities that have come together to defy the odds.

It is important to differentiate between the factors that can be addressed at the individual level and those that are beyond individual control, and to recognise how the two are mutually reinforcing.

7 **Beyond the point of enabling basic needs and a life of dignity, having more money does not directly translate to more happiness.**
There is little evidence, especially in industrialised nations, to support the assumption that unending growth of gross domestic product beyond current levels translates to increases in wellbeing.

People's expressions of happiness correlate with the level of trust in the community, social ties, education, health, and meaningful employment (Helliwell et al. 2020); and these tend to be less consumerist.

8 **Inequality and perceived unfairness in society is a strong predictor of whether an intervention will fail or succeed.**
People will accept radical solutions if they are justified and everyone is perceived as bearing a fair share of responsibility (Gampfer 2014). Manifestations of social tension get stronger as disparity in socio-economic conditions between groups get wider (Cushman 1998).

Ensuring sustainable lifestyles will fail if efforts are not made to address the extremes of poverty and wealth in society.

9 **Lifestyles are not static; needs are a function of time and place.**
Individuals' needs and aspirations in life change as their personal situation, society, and the physical environment change. Different stages of life bring different perspectives.

Milestones and key transition moments in life—marriage, graduations, relocations, and births and deaths—offer heightened opportunities for reshaping lifestyles (Burningham and Venn 2017).

10 **Sustainable lifestyles are not all about reducing consumption.**
A central tenet of sustainable societies is not complete abstinence but consumption within regenerative capacity (Wahl 2018). Social evolution includes examination and creative adaptation towards new ways of meeting our needs.

Social innovations, social movements, and grassroots experiments are pivotal in opening up new avenues and engendering acceptability of sustainable solutions.

2 – Methods and Technical Notes

2.1. Consumption-based accounting and targets

The 1.5-degree lifestyles approach examines carbon footprints and reduction potentials using consumption-based accounting. This measure better reflects the emissions associated with a population's standard of living than production-based accounting (also referred to as territorial-based accounting) used in countries' official reporting to the UNFCCC. Production-based accounting covers only direct emissions from domestic production activities within the geographical boundaries and offshore activities under the control of a country, and does not consider emissions embodied in internationally traded goods (Boitier 2012; Moore 2013).

Conversely, consumption-based accounting (carbon footprinting) covers household carbon footprints from domestic sources and emissions embodied in imported goods while excluding emissions embodied in exported goods (Figure 2.1). This approach thus corrects for carbon leakage, where a shift from carbon-intensive domestic production to increased reliance on imports results in an apparent decarbonisation. In addition, when comparing countries' emissions in the context of international negotiations, consumption-based accounting does not burden industrialising countries with excessive emission commitments (Peters and Hertwich 2008). Compared to production-based accounting, it can be considered a better measure of the global climate impacts associated with individuals' consumption and lifestyles.

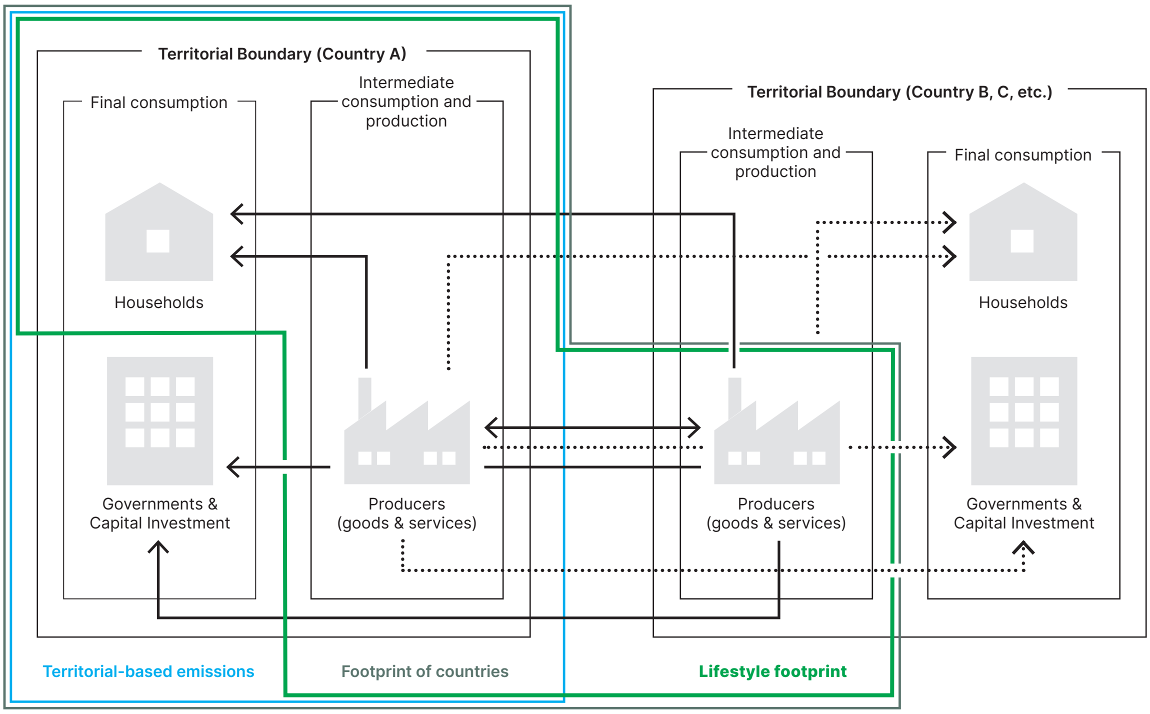
In this report, the term 'carbon footprint' refers not only to CO_2 but also other greenhouse gases, thus it is also sometimes referred to as 'greenhouse gas footprint.' The report considers emissions of methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulphur hexafluoride (SF_6), converted into CO_2-equivalents, as in most global carbon footprint analysis literature, including the UNEP Emissions Gap Report 2018 (UNEP 2018).

To date, studies of carbon footprints have mostly concerned the impacts of specific products, activities, and the final demand of countries. Research into household consumption over the past few decades (see Hertwich 2005; Tukker et al. 2010; Girod et al. 2014; Ivanova and Wood 2020) has generally been based on monetary estimations focused on typical domains; few studies have covered the broader perspective of lifestyles cutting across the typical domains (Schanes et al. 2016; Salo and Nissinen 2017) or looked at consumption patterns based on physical amounts, such as food intake, transport distance, and energy consumption (Barrett et al. 2002; Nissinen et al. 2007; Girod and De Haan 2010; Moore et al. 2013; Vita et al. 2020).

This report estimates carbon footprints associated with average lifestyles primarily based on physical consumption data and life cycle assessment data on the carbon intensity of goods and services. This approach, using physical consumption data rather than economic data on consumer spending, makes it easier to identify emission reduction opportunities through either changes in consumption modes (such as mode of transportation or type of fuel used) or reduction of physical consumption (such as distance travelled).

In addition to estimating current footprints, the report suggests future targets for such footprints and explores pathways towards those targets. Earlier studies have proposed per-capita carbon emission or footprint targets (Nykvist et al. 2013; Dao et al. 2015), but few have explored the role of lifestyles and lifestyle-related path-

Figure 2.1. Comparison of the boundary of GHG emission and footprint



Based on IGES et al. (2019)

ways (Girod et al. 2014). Building on these efforts, the report establishes per-capita, consumption-based targets of GHG emissions compatible with the Paris Agreement temperature goal of 1.5°C. (How footprint targets were determined is described in subchapter 2.3.) These targets can be seen as constituting a fair consumption space for all, determined through equitable distribution of the remaining global carbon budget for staying below 1.5-degree increase in warming. It therefore sets a shared direction for over-consuming and under-consuming populations—a global "contraction and convergence" (Meyer 2000) towards a shared prosperity within a "safe operating space for humanity" (Rockström et al. 2009).

2.2. Calculating bottom-up lifestyle footprints

Lifestyle carbon footprint calculations presented in this report include embedded and indirect emissions, i.e., those resulting from intermediate consumption during production induced by household final demand, but exclude direct and indirect emissions and footprints caused by public sector and capital investment (Figure 2.1). This accounting method reflects emissions that result from individual choices and the way they are enabled and constrained by the sociotechnical systems that households are part of (Akenji and Chen 2016). Some types of public spending contribute directly to citizens' wellbeing and can therefore moderate the need for private spending. This relationship between public and private provisioning and the implications for greenhouse gas emissions is not well reflected in the method used here. There are significant differences in public services among the countries studied so this limitation should be kept in mind when comparing countries. Some studies indicate that public spending can play a significant role in reducing overall energy consumption and therefore greenhouse gas emissions as well (e.g. Vogel et al. 2021).

The report covers ten countries: Brazil, Canada, China, Finland, India, Indonesia, Japan, South Africa, Turkey, and the United Kingdom. Nine of these countries are major G20 economies, selected to represent a range of income-levels and degrees of industrialisation. Finland is not a member of the G20, but was included since it was part of the 2019 1.5-Degree Study. These countries also differ significantly politically, culturally, and socially, which could highlight differences in both current lifestyles and potential changes.

For this report, countries are classified into three categories based on per capita gross national income (GNI) (United Nations 2020), listed here from highest to lowest:

→ High-income countries:
Finland, Canada, United Kingdom, and Japan

→ Upper-middle income countries:
China, Turkey, Brazil, South Africa, and Indonesia

→ Lower-middle income countries: India

2.2.1. Lifestyle carbon footprint estimation

The Organisation for Economic Co-operation and Development (OECD) defines household consumption as the "consumption of goods and services by households," and refers to their choices and actions that encompass the entire lifestyle: from selection to disposal of products and services (OECD 2002). This report classifies household resource consumption into six domains, based on previous studies: food, housing, personal transport, consumer goods, leisure, and services (Michaelis and Lorek 2004; Tukker et al. 2006; Kotakorpi et al. 2008; Seppälä et al. 2011; Lettenmeier et al. 2014). It uses a bottom-up approach, combining micro-level carbon footprint data with national statistical data for major consumption domains and items for three domains (food, housing, personal transport) (see Table 2.1). These calculations are based on physical units (e.g., weight of food, transport distance, and residential living area) rather than amounts of expenditure. The use of physical units makes it easier to analyse emission reduction actions to be taken at the household level. Current carbon footprints are calculated on a per-person annual basis, with 2019 as the reference year. In the absence of 2019 data, information from the latest year available was used. For a more detailed description of the used data sources, see Annex A.3.

The estimation covers "cradle-to-grave" emissions[5] over the whole life cycle of the goods and services consumed by households, including resource extraction, material processing, manufacturing, delivery, retail, use, and disposal, but excluding land use, land use change, and forestry (LULUCF). When available emissions data was based on different systems boundaries, supplementary data was used to expand the scope of the estimation wherever possible. The lifestyle footprints for each domain and major consumer articles were calculated by multiplying physical consumption data (amount per person per year) with life-cycle assessment (LCA) data (e.g. Wernet et al. 2016) on carbon intensities (emissions per unit) for the consumption domains of food, housing, and personal transport. For the other three domains (goods, leisure, and services), a top-down method, with data from multi-region input-output models, was used.

Footprints of single items were summed up by components (e.g. meat, cereals and vegetables) and further, components to domains (food, housing, personal transport, goods, services, and leisure) (Table 2.1.). For a more detailed description of the lifestyle carbon footprint calculations, see Annex A.

Table 2.1. Examples of the domain breakdown into components, sub-components and items

Domain	Component	Sub-components	Items
Food	Meat	Beef, lamb, chicken, other	Bovine meat, mutton & goat meat, poultry, pigmeat, edible offals, game meat
Housing	Grid-electricity	Renewable, non-renewable, nuclear	Hydropower, wind power, solar PV, natural gas, oil, coal, nuclear
Personal transport	Car	Conventional, flex fuel, gas, electric, hybrid	Petrol, diesel, ethanol, battery electric, plug-in hybrid
Other			
Consumer goods	Clothes		Wearing apparel, footwear
Leisure	Cultural		Creative, arts, culture, entertainment services
Services	Education		Public education, private education

5 Emissions created by products or activities from the beginning of their life cycles to their end or disposal.

2.2.2. Limitations

The data and methods used for this report have a number of limitations, which should be kept in mind when reading the findings. First, the bottom-up LCA data used in the analysis cover major domains but do not fully cover all activities in all domains. Second, since the amount of consumption was estimated using official statistics and other nation-level data, there is a possibility that different definitions and collection methods have been used, resulting in potential inconsistencies. The general quality of this data can also vary. Third, where data for the reference year (2019) was unavailable, statistics were drawn from the closest years for which data was available.

Other limitations related to data sources exist, such as differences in boundaries and assumptions of LCA-based carbon intensity data. Efforts were made to select data sources that are based on the boundary used for this report, but there may be slight differences in boundaries and assumptions or, in some cases, uncertainty due to insufficiently described data (poor quality metadata). Furthermore, country-specific data on carbon intensity was not always available. The report also assumed the intensity of imported products was the same as for domestic products.[6] Uncertainty in footprint estimation is a common issue, as even top-down I/O analysis-based estimations involve uncertainty due to model selection and sectoral aggregation, and models tend to have different results, in some cases significantly different (Arto et al. 2014; Owen et al. 2014; Steen-Olsen et al. 2014). For more details, see Tables A.2-A.21 in Annex A.

Considering these limitations, intensity data for specific items may not be fully comparable among countries. This report therefore mainly compares more aggregated consumption, footprint, and intensity at the component level or domain level. The purpose is to illustrate the overall pattern of GHG emissions driven by different lifestyles rather than the footprint of particular products or services.

Another limitation is that available data only allows analysing the lifestyle carbon footprints based on national averages. This hides the huge differences in lifestyles and carbon footprints that exist within all countries. There is a growing literature analysing greenhouse gas emissions from an equality perspective, which is highly complementary to the lifestyle carbon footprints approach (see subchapter 1.3). Finding ways to connect these analytical approaches is something to consider for future work.

6 Except for the top-down estimates based on the intensity data from the globally linked input-output (GLIO) model in Japan.

2.3. Remaining carbon budget and reduction targets

In this report, proposed targets for Paris-aligned lifestyle carbon footprints are based on emission budget pathways found in the literature. One key assumption that distinguishes different pathways estimations is the utilisation of human-made carbon sink technologies (or negative emission technologies). For this reason, both pathways that utilise negative emission technologies at large scale and those that only rely on such technologies to a very limited extent are included. Scenarios considered include those in the IPCC AR5 Scenario Database1, the United Nations Environment Programme Emissions Gap Report 2017 (UNEP 2017), as well as individual peer-reviewed papers in academic journals published after these reports. The scenarios used in this report were selected from the larger body of pathways, based on the following criteria:

- → Provides a pathway to keep the global average temperature increase below 2°C with at least 66% probability, or below 1.5°C with at least 50% probability.
- → Provides a quantified estimate of a carbon budget on a time scale up to year 2100, information on the type of model, and the baseline scenario.
- → Aims to limit atmospheric GHG concentration at 430–480 parts per million (ppm) CO_2e for 2°C target and 430–450 ppm CO_2e for 1.5°C target (in 2100).
- → Estimates a cumulative carbon budget at 350–950 GtCO2 for 2°C target and less than 350 $GtCO_2$ for 1.5°C target (2011–2100).
- → Covers CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6 gases in its estimation.
- → Explains the assumptions of "human carbon sink" utilisation (also known as negative emissions or CO_2 removal technologies).
- → If formulated before the year 2015, assumes a global climate policy commitment is secured in the near future to reduce GHG emissions and limit the increase in the global average temperature (as represented by the Paris Agreement).

For more details, see Annex A in the first 1.5 Degree Lifestyles Report (IGES et al. 2019).

One of the challenges of establishing long-term per capita carbon targets lies in the dynamics of GHG emissions and sinks. Proposing carbon budgets places limits on the amount of global emissions in order to stabilise the concentration of GHGs in the atmosphere; a number of published emission scenarios suggest pathways for reducing total emissions at the global level, such as in the UNEP Emissions Gap Report 2016 (UNEP 2016). The proposed per-capita carbon footprint targets in this report assume the targets will dynamically shrink over time, based on the selected emission scenarios.

In this report, the aim is to illustrate the per capita GHG footprint budget for the final consumption of households for the 1.5°C target under the Paris Agreement as a main scenario and also for the 2°C target for indicating a range of targets. There are few modeling studies specifically focused on the 1.5°C target; such studies are typically iterations of 2°C pathway assessments with more stringent mitigation measures. Hence, in 1.5°C scenarios, meeting the 2°C target is projected with higher probability.

The three scenarios used in the study are taken from literature sources that were publicly available at the time the previous 1.5 Degree Lifestyles report (IGES et al. 2019) was written. They are labelled the 1.5D, 1.5S, and 2S scenarios, reflecting the temperature targets they are consistent with and whether they require large-scale deployment of carbon sink technologies (S) or minimise the need for such technologies through widespread use of demand-side measures (D). The 1.5S and 2S scenarios are described in Table 2.2. Scenario 1.5D was calculated as the average of the three scenarios described in Table 2.3. More details about the methodology for screening emissions scenarios and details of each shortlisted scenario can be found in the first 1.5-Degree Lifestyles Report, in Annex A (IGES et al. 2019).

This report estimates carbon footprints associated with average lifestyles primarily based on physical consumption data and life cycle assessment data on the carbon intensity of goods and services. This approach, using physical consumption data rather than economic data on consumer spending, makes it easier to identify emission reduction opportunities through either changes in consumption modes (such as mode of transportation or type of fuel used) or reduction of physical consumption (such as distance travelled).

Table 2.2. Shortlisted scenarios with reliance on carbon sinks

Scenario	Description	Reference
1.5S: 1.5°C with Human Carbon Sinks Scenario	Pathway to the 2°C target with 75% probability and the 1.5°C target with 50% probability, considering the use of all sinks starting before year 2050	(Rockström et al. 2017)
2S: 2°C with Human Carbon Sink Scenario	Pathway to the 2°C target with more than 66% probability, considering the use of CCS technologies	(Rogelj et al. 2011)

Table 2.3. Shortlisted scenarios with demand-side measures

Scenario	Description	Reference
1.5D (a): 1.5°C with Demand-side Measure Scenario	Pathway to the 1.5°C target with 60% probability, without the use of CCS	"A2" scenario from (Ranger et al. 2012)
1.5D (b): 1.5°C with Demand-side Measure Scenario	Pathway to the 1.5°C target with stringent measures to reduce end-of-pipe emissions and non-CO_2 GHG emissions.	"Low Non CO_2" scenario from (van Vuuren et al. 2018)
1.5D (c): 1.5°C with Demand-side Measure Scenario	Pathway to the 1.5°C target with land sector sequestration, increased efficiency, renewable electricity, agricultural intensification, low non-CO_2 emissions, lifestyle changes, and low population growth.	"All Options" scenario from (van Vuuren et al. 2018)

2.3.1. Determining "fair" lifestyle carbon footprint targets

The principle of 'common but differentiated responsibilities and respective capabilities' (CBDR) lies at the heart of the UN Framework Convention on Climate Change (UNFCCC) and the Paris Agreement.[7] It implies that countries that have more responsibility for causing the climate crisis and more capacity to address it should reduce their emissions further and/or faster than those with less responsibility and capacity.

While the UNFCCC negotiations are conventionally based on national territorial rather than consumption-based emissions, the same basic equity principle should nonetheless apply to deriving 'fair' lifestyle emissions footprint targets, if they are to be widely considered as legitimate (particularly by the governments and citizens in lower income and less responsible countries).

A wide range of approaches have been proposed for operationalising the CBDR principle, based on different methods for determining the relative responsibilities and capabilities of different countries. One approach, in line with efforts to establish a fair consumption space, assumes that all countries began with an equal per capita fair share of the global carbon budget before the start of the industrial revolution. It then calculates the historic responsibility of all countries—based on their consumption-based emissions—for global emissions since this time, and identifies those (principally Northern, high-income) countries that have surpassed their equal per capita fair share allocation (termed 'debtors'), and those (principally Southern, lower-income) countries that remain within their allocation (termed 'creditors') (Hickel 2020).

In addition to these differentiated responsibilities, countries' differentiated capabilities can be seen, for ex-

7 See Article 3, paragraph 1 in the UNFCCC (United Nations 1992); and Article 2, paragraph 2 in the Paris Agreement (United Nations 2015).

ample, in the different levels of GDP/capita at which the citizens of different countries are required to peak and then reduce their emissions if the world is to avoid surpassing the remaining global carbon budget.[8]

Given that a minority of countries have already overused their allocation of the carbon budget—and reached globally high income levels in the process—the only 'fair' target for their citizens' lifestyle emissions today may logically be seen to be zero—or even negative. Indeed, the Civil Society Equity Review group, using an approach to calculate 'fair' mitigation efforts for all countries based on their responsibility and capability, derives substantially negative emissions targets for many countries (Climate Equity Reference Project 2015).[9]

But given the very significant social and environmental risks associated with negative emissions technology at scale (Anderson and Peters 2016), one practical means of operationalising this fair share approach is likely through a combination of deep emission reductions by such high-income, over-using countries in addition to the provision of financial, technological, and capacity-building support to lower-income countries to enable those countries to limit their emissions to less than their fair share. In practice, it could be reasonable to expect the citizens of high income countries that have over-used their allocation of the global carbon budget, to reduce their lifestyle footprints at least to the global average level needed by 2030 that is consistent with a 1.5°C global warming pathway, and in addition, provide significant financial and other types of support to enable lower income countries to do the same (Gore, forthcoming).

Therefore, global average per capita lifestyle footprints are used for all countries to illustrate the order of magnitude of reductions that are necessary, although this assumes that lower-income countries will be entitled to substantial financial and other forms of support in order to limit their citizens' footprints to this level.

2.3.2. National targets for footprint reduction

In this report, per-capita carbon footprint targets are assumed to be globally unified by 2030. Since climate change is a global scale phenomenon, the assumption is that everyone living in the same year in the world, regardless of age, location, and any other status, would have an identical carbon footprint target at the national average level. The approach partly adopts the concept of "contraction and convergence" proposed by (Meyer 2000), but with simplified assumptions. "Contraction and convergence" suggests that global greenhouse gas emissions should be reduced towards an equal per-capita level across countries in the long run, while assuming different pathways of the reduction from current per-capita emission levels towards the target for each region. This approach incorporates a combination of 'equality' and 'responsibility' equity principles (Höhne et al. 2013; van den Berg et al. 2019).

"Contraction and convergence" refers to the convergence of per-capita emissions of countries estimated based on territorial, production-based emissions. This is a different approach to this report, which focuses on the footprints of household consumption from a carbon budget point of view. Analyses for this report are aimed at estimating the average per capita lifestyle carbon footprint the inhabitants of the world can still afford while staying within the 1.5-degree aspirational target of the Paris Agreement with a certain probability. Such an estimation helps in understanding the lifestyle people can afford in the future, e.g. in 2030 and 2050. The implications on fairness from a consumption-based accounting perspective, as opposed to territorial based accounting, are twofold. First, historical emissions are not used as a basis for determining the carbon footprint of an average future lifestyle. Historical emissions are only accounted for insofar as they are reflected both in the sociotechnical context (e.g. roads, energy sources, food imports) that affects the intensity and volume of consumption and in the carbon budget we have left nowadays after all those historical emissions. Second, fairness from a lifestyles carbon footprint perspective also incorporates fairness for future generations; future generations should have the opportunity of living decent lives.

However, estimations in this report still use average current footprints of the countries studied, and do not directly focus on individuals and individual household footprints. The first reason is that countries provide the best (though sometimes far from good-enough) statistical basis for the bottom-up calculation of lifestyle carbon footprints. Second, countries are extremely relevant actors influencing the conditions under which lifestyles and their carbon footprints emerge. Third, each country has its own conditions and starting situation as a basis for pursuing 1.5-degree lifestyles. High-income countries may have more financial capability for facilitating the transition but they are also much more locked into unsustainable (infra)structures and consumption patterns. Middle- and lower-income countries may have

8 Presentation by Sivan Kartha to the UNFCCC plenary in 2012: (Davis 2012)

9 Note that the CSER approach (Climate Equity Reference Project 2015) calculates fair shares among countries not of the global carbon budget, but of the mitigation effort required to remain within the global carbon budget. Nonetheless the principle result—that some countries' fair shares require negative emissions, based on their high responsibility and capability—remains the same.

less financial capability but leap-frogging could help them jump directly into more sustainable lifestyles including technologies and infrastructures. Overall, average lifestyle carbon footprints by country provide a fairly good basis for illustrating, imagining, and implementing both the transition to 1.5-degree lifestyles and how to make decisions by governments, businesses, and individuals that facilitate this transition.

Rather than trying to precisely simulate reduction pathways for each country, per-capita targets are here calculated based on the mathematical means of the selected emission scenarios. In order to do this, the total GHG emission limit per year was divided by the estimated population of the reference year based on the median projection of the 2017 Revision of the World Population Prospects (United Nations 2017), thus the per-capita carbon footprint targets in this report use the formula below:

Per-capita annual carbon footprint target
= Annual global emission target / projected world population

To determine the share of national carbon footprints that is directly related to individual lifestyles, this report relies on the results of existing I/O analyses of multi-country carbon footprint estimates. Of these, Hertwich and Peters (2009) cover 73 countries and 14 aggregated regions for 2001 using the Global Trade Analysis Project (GTAP) database, giving an average share of carbon footprint by household consumption at the global level of 72%.[10] Another study, Ivanova et al. (2016), gives an estimate of 65%±7% (mean ± standard deviation). Although the latter study is more recent (based on 2007 data), it only considers 43 countries (EXIOBASE database) and is skewed towards the EU. The 72% was selected for this report and the lifestyle carbon footprint targets were calculated as follows:

Per-capita annual lifestyle carbon footprint target
= Per-capita annual carbon footprint target x 0.72

It should be noted that the above estimates are somewhat uncertain since they are based on the very few publicly available household footprint share calculations. Also, the assumed share in the present report is based on a mean of the countries included in the aforementioned study, which does not consider the variation among countries, due to their economic structure and the level of per-capita carbon footprints. Furthermore, the household footprint shares in this report are fixed towards the future, without assuming shifts over time in the allocation of carbon footprints between households, public sector, and capital investment.

This report proposes per-capita footprints targets for 2030, 2040, and 2050. However, the targets do not consider historical emissions, or climatic or other natural conditions of the countries concerned. Instead, the proposed targets are based on a simplified calculation using population projections and household footprint share, and thus do not consider dynamic aspects of modeling of consumer lifestyles and scenario analysis, which should be further researched in the future.

2.3.3. Reduction options and scenarios

In addition to calculating current lifestyle carbon footprints for the ten countries, the study also assessed the emission reduction impact of a wide range of options selected and analysed for each country (see Chapter 4). Options were identified through a literature review and selected to represent three categories of change: reduced physical consumption (called absolute reduction), shifted consumption to low-carbon alternatives (called modal shift), and reduced life cycle carbon intensity (called efficiency improvement). For each option, the amount of greenhouse gas emissions that could be saved was calculated for different adoption rates. Based on these results, for each country, a limited number of options were selected based on their calculated effectiveness in terms of reducing emissions.

The study also developed country-specific scenarios towards the intermediate emission target of 2.5tCO_2e per person per year (Chapter 6). For each country, two distinct scenarios were created—one relying to a greater extent on options that individual consumers have more direct influence over and the other focused on efficiency improvements in provisioning systems. In practice, all scenarios include a combination of these two approaches but the emphasis differs. Each scenario was established by combining a range of improvement options taken from those identified and assessed in Chapter 4, with varying assumptions on adoption rates, through an iterative process until the 2.5t target was met. In those calculations, care was taken to ensure that consumption amounts did not drop to unrealistic levels that could threaten health and wellbeing (i.e. the floor levels of the fair consumption space, see subchapter 1.4).

10 The remaining 28% is divided between government consumption (10%) and investments (18%) (Hertwich and Peters 2009). Examples of government consumption include road and infrastructure repairs and national defence; examples of investments include factories, transport equipment, and materials used for the future production of goods.

Section II

Hotspots and Options for Footprint Reductions

3 – Lifestyle Carbon Footprints

The focus of this report is on the daily activities of individuals determined by their lifestyle choices. To achieve this, the report uses the unit of lifestyle carbon footprints: GHG emissions both directly emitted and indirectly induced by household consumption, excluding those induced by government consumption and capital formation.[11] Through consumption-based accounting, and by excluding emissions from government expenditure and capital formation, lifestyle carbon footprints allow a strong focus on emissions resulting from deliberate individual choices and due to lock-in effects of sociotechnical systems, which inevitably constrain these choices (Akenji and Chen 2016).

Household resource consumption is classified into six domains, based on previous studies, e.g., Michaelis and Lorek (2004); Tukker et al. (2006); Kotakorpi et al. (2008); Seppälä et al. (2011); Lettenmeier et al. (2014), as follows:

Food: intake of all foodstuffs and beverages consumed at home and outside the home, e.g., meat, fish, dairy, cereal, vegetable and fruit, and alcohol and nonalcoholic beverages.[12]
Housing: housing infrastructure and supply of utilities, e.g., construction, maintenance, energy use, and water use.
Personal transport: use of owned transport equipment and transportation services for commuting, leisure, and other personal purposes, e.g., cars, motorbikes, public transport, air travel, and bicycles.[13]
Consumer goods: goods and materials purchased by households for personal use not covered by other domains, e.g., home appliances, clothes, furniture, daily consumer goods.[14]
Leisure: activities performed outside of the home, e.g., sports, culture, entertainment, and hotel services.
Services: services for personal purposes, e.g., insurance, communication and information, ceremonies, cleaning and public baths, and public services.[15]

The targets of lifestyle carbon footprints (carbon footprints from households) in the five shortlisted scenarios[16] (introduced in Chapter 2, Tables 2.2 and 2.3) are summarised in Figure 3.1–3.2. In terms of all GHGs, the ranges of the estimated lifestyle carbon footprint targets for 2030, 2040, and 2050 are respectively 3.2–2.5, 2.2–1.4, and 1.5–0.7 tCO_2e per capita (IGES et al. 2019). The ranges overlap due to different assumptions regarding negative emission technologies and temperature targets. The selection of targets between the lower and higher ends depends on assumed long-term availability

11 Examples of government consumption include road and infrastructure repairs and national defence; examples of capital formation include factories, transport equipment, and materials used for the future production of goods.

12 Direct emissions from cooking at home are included under housing, whereas emissions from operation of restaurants are included under leisure.

13 Emissions from business purpose trips are excluded here as they are included under respective domains of the products and services supplied.

14 Emissions from ingredients of food taken out of home are included in food, whereas direct emissions from leisure performed at home are included in housing.

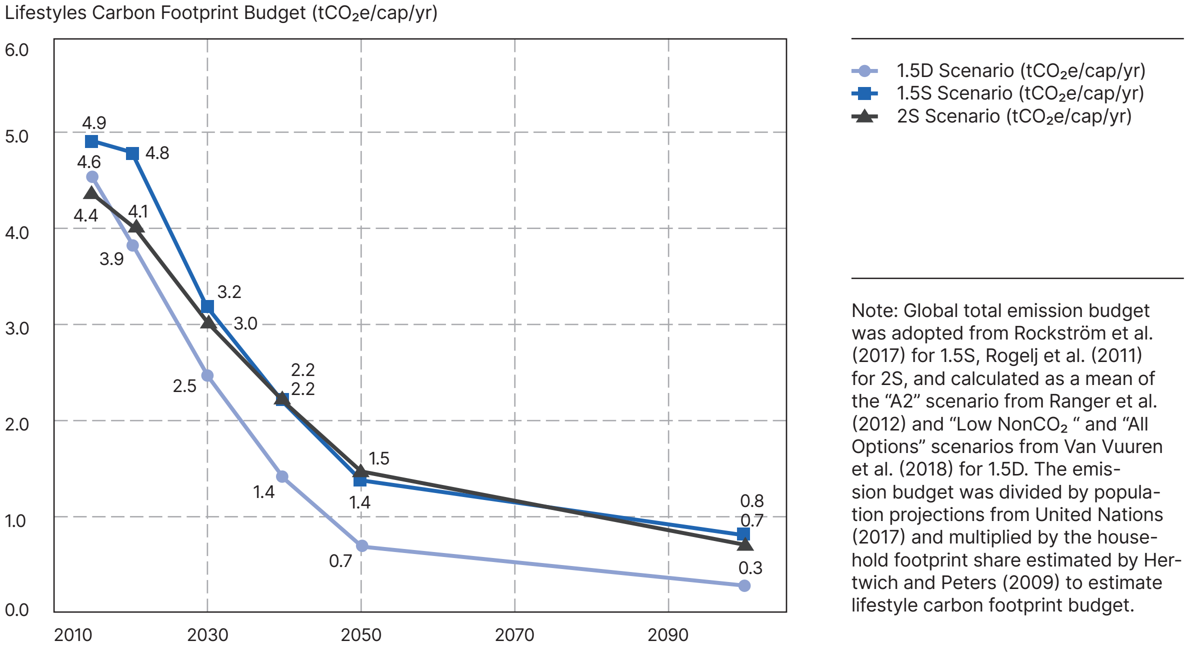
15 Public services covered by government expenditure are excluded from lifestyle carbon footprints.

16 Scenario 1.5D was calculated as the average of the three scenarios described in Table 2.2

of human carbon sinks or negative emissions technologies, such as BECCS, and the selection of the global average temperature targets, either 1.5°C or 2.0°C.

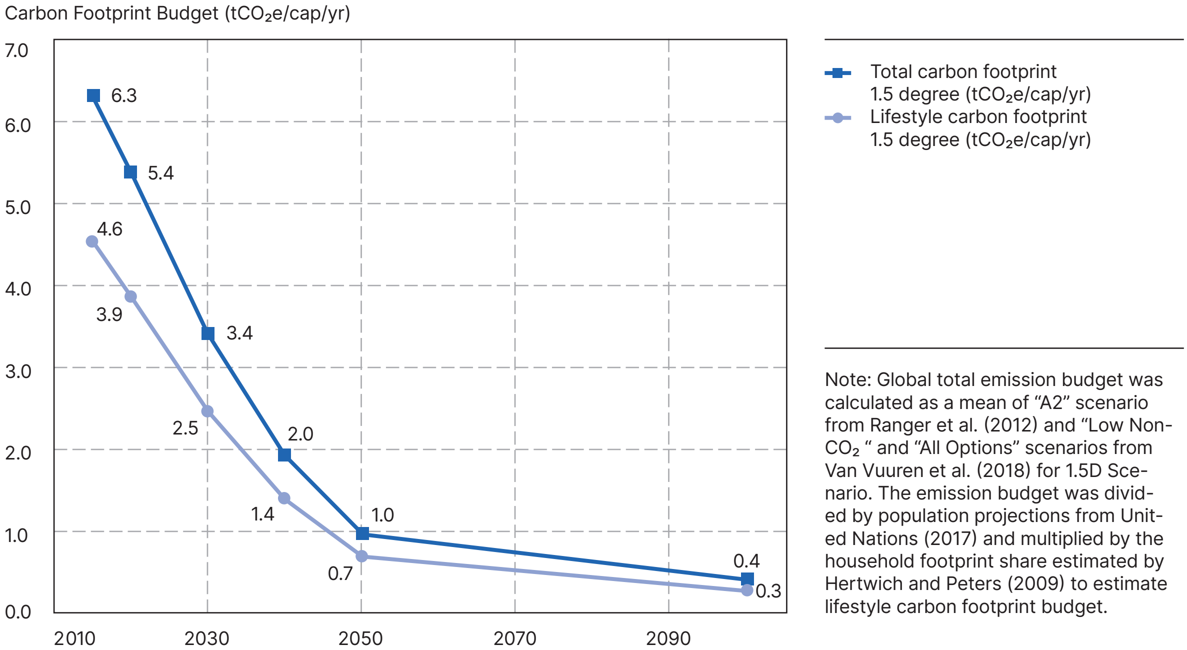
Based on our review of the emission scenarios, we need to aim for a lifestyle carbon footprints target of **0.7 tCO_2e by 2050, with proposed intermediary targets of 2.5 in 2030 and 1.4 tCO_2e by 2040.** These targets are in line with the 1.5°C aspirational target of the Paris Agreement and for global peaking of GHG emissions as soon as possible without relying on the extensive use of negative emission technologies.

Figure 3.1. Lifestyle carbon footprint budget from shortlisted mitigation pathways



Note: Global total emission budget was adopted from Rockström et al. (2017) for 1.5S, Rogelj et al. (2011) for 2S, and calculated as a mean of the "A2" scenario from Ranger et al. (2012) and "Low NonCO_2" and "All Options" scenarios from Van Vuuren et al. (2018) for 1.5D. The emission budget was divided by population projections from United Nations (2017) and multiplied by the household footprint share estimated by Hertwich and Peters (2009) to estimate lifestyle carbon footprint budget.

Figure 3.2. Lifestyle carbon footprint budget comparable with 1.5°C target (without or with less use of negative emission technologies)

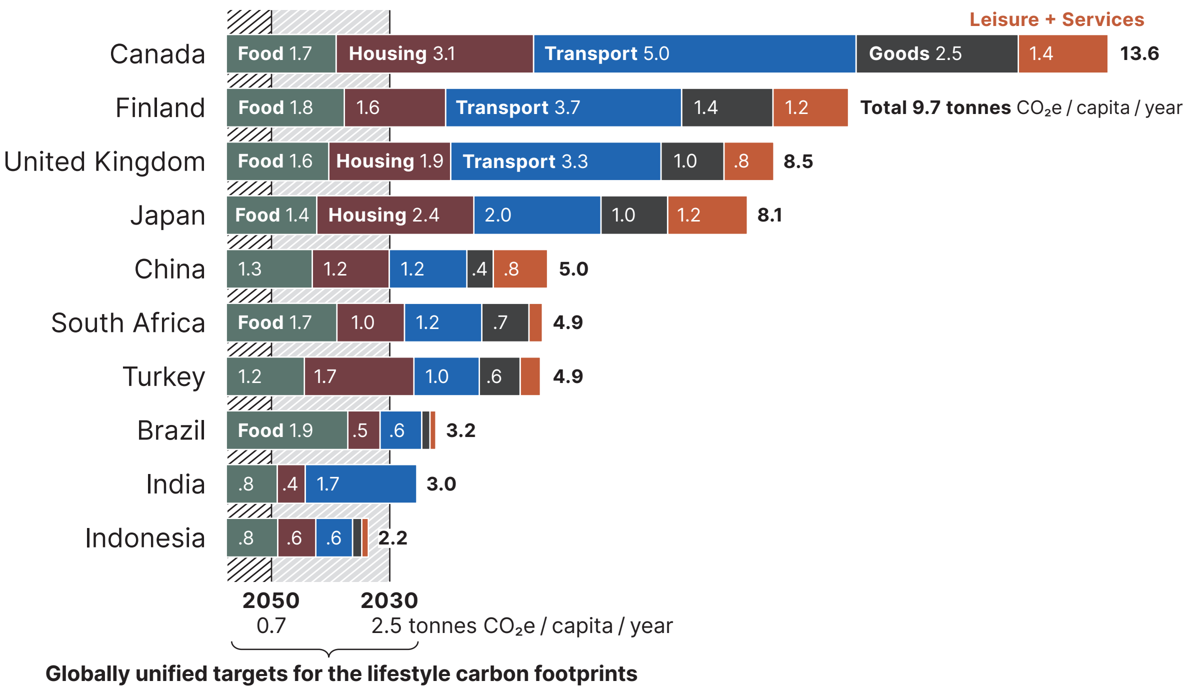


Note: Global total emission budget was calculated as a mean of "A2" scenario from Ranger et al. (2012) and "Low Non-CO_2" and "All Options" scenarios from Van Vuuren et al. (2018) for 1.5D Scenario. The emission budget was divided by population projections from United Nations (2017) and multiplied by the household footprint share estimated by Hertwich and Peters (2009) to estimate lifestyle carbon footprint budget.

3.1. Comparing lifestyle carbon footprints

Total average lifestyle carbon footprints vary notably between the countries analysed for this report—Canada has the highest at 13.6 tCO_2e per year, followed by Finland at 9.7, the United Kingdom at 8.5, Japan at 8.1, China at 5.0, South Africa and Turkey at 4.9, Brazil at 3.2, India at 3.0, and Indonesia at 2.2 tCO_2e. The results are visualized in Figure 3.3, which gives the total footprint and its breakdown into different components in tons CO_2e/cap/yr for each country. Compared with the carbon footprint target proposed for 2030 (2.5 tons per capita in terms of all GHGs), Canada, Finland, the United Kingdom, and Japan heavily exceed the targets; China, Turkey and South Africa overshoot moderately; and Brazil and India slightly. As a result, lifestyle carbon footprints need to drop by the following percentages by 2030: Canada 82%, Finland 74%, the United Kingdom 70%, Japan 69%, China 50%, South Africa 49%, Turkey 49%, Brazil 23%, and India 14%. Indonesia is already currently close to the target level set for 2030 (Table 3.1). The lifestyle footprint target for 2050 (0.7 tons per capita in terms of all GHGs) is exceeded in all case countries. Large footprint reductions of 95% and 93% are needed in Canada and Finland, respectively, 92% and 91% reductions are needed in the United Kingdom and Japan, and 86% reductions are needed in China, Turkey, and South Africa. Reductions are also needed in Brazil, India, and Indonesia of 78%, 76%, and 68%, respectively.

Figure. 3.3. Carbon footprint and its breakdown between consumption domain and globally unified targets for the lifestyle carbon footprints



Note: Average lifestyle carbon footprint of country estimated as of 2019. The horizontal lines indicate 1.5D footprint targets for 2030 and 2050 (1.5°C without/less use of negative emissions technologies).

Table 3.1. Current annual lifestyle carbon footprint per capita and reduction targets for case countries

Current annual lifestyle carbon footprint (tCO_2e/cap/year)										
Domain	**Canada**	**Finland**	**United Kingdom**	**Japan**	**China**	**South Africa**	**Turkey**	**Brazil**	**India**	**Indonesia**
Food	1.7	1.8	1.6	1.4	1.3	1.7	1.2	1.9	0.8	0.8
Housing	3.1	1.6	1.9	2.4	1.2	1.1	1.7	0.5	0.4	0.6
Transport	5.0	3.7	3.3	2.0	1.2	1.2	1.0	0.6	1.7	0.6
Goods	2.5	1.4	1.0	1.0	0.4	0.7	0.6	0.1	<0.1	0.1
Leisure & Services	1.4	1.2	0.8	1.2	0.8	0.2	0.3	0.1	<0.1	0.1
Total	**13.6**	**9.7**	**8.5**	**8.1**	**5.0**	**4.9**	**4.9**	**3.2**	**3.0**	**2.2**
Reduction targets for lifestyle carbon footprints										
2.5 tCO_2e/ person/ yr by2030	82%	74%	70%	69%	50%	49%	49%	23%	16%	
0.7 tCO_2e/ person/ yr by 2050	95%	93%	92%	91%	86%	86%	86%	78%	76%	68%

3.2. Overall patterns and analysis per economic grouping

This section elaborates country-specific results by comparing the overall patterns and hotspots of the average lifestyle carbon footprints per economic grouping. While differences in culture and infrastructure (Akenji et al. 2016; Akenji and Chen 2016) and availability of public services (Ottelin et al. 2018) shape lifestyle-related consumption patterns in countries, characteristics provide a clear point of comparison between countries, not only because related data is widely collected, but also because income levels correlate with levels of consumption and impacts of lifestyles (United Nations 2018). For country-specific data sources and details of estimation results, refer to Annex A.2 and B.

3.2.1. Food

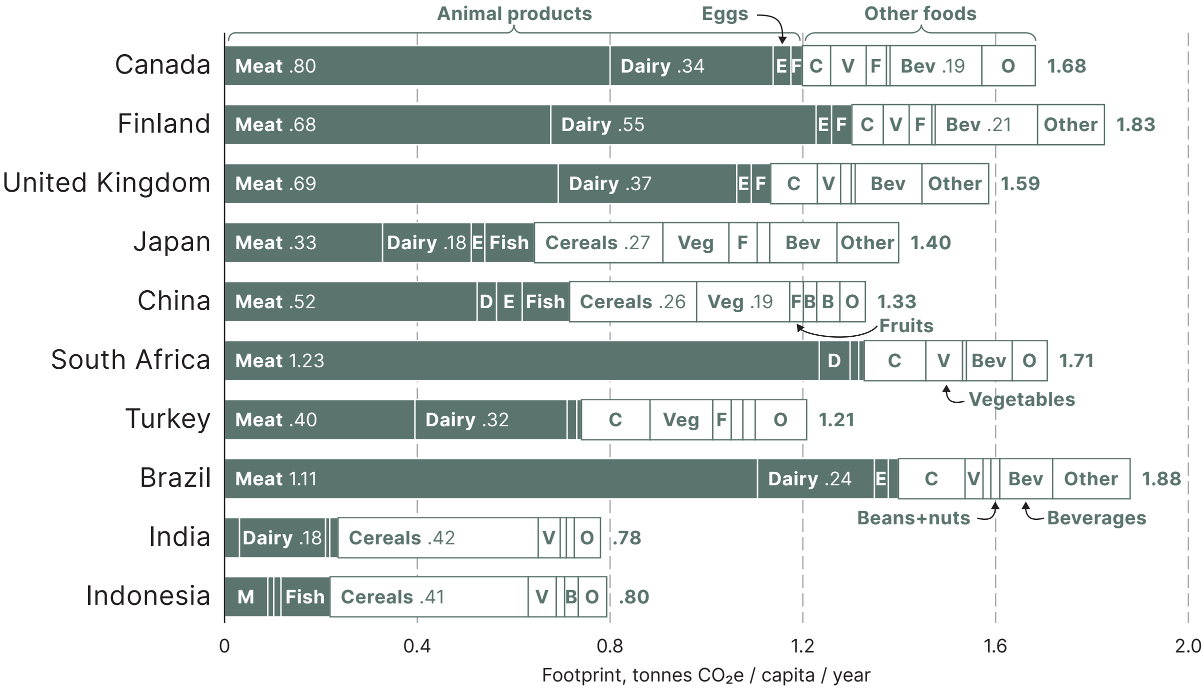
Overall the food domain is relatively similar in footprints between all case countries (Figure 3.4), except India and Indonesia where overall meat consumption is notably lower compared to other countries. In South Africa and Brazil, meat, especially beef, is reflected in the footprints due to relatively high consumption and notably higher carbon intensity compared to other countries. In addition to meat, dairy products are another major contributor to footprints, especially in high-income countries, such as Canada and Finland, due to high consumption of milk and carbon-intensive cheese.

Also different food cultures are reflected in the footprints as different consumption patterns between case countries: fish consumption is high in Japan, China, and Indonesia, whereas those countries have the lowest dairy consumption among all case countries; beans are eaten most in Japan, Turkey, India, and Indonesia, whereas meat consumption has the overall lowest share of the total food consumption in these case countries; high consumption of carbon-intensive rice reflects on the footprints in Japan, China, India and Indonesia.

In the **high-income countries**, meat consumption is the largest contributor to the average person's carbon footprint for food, varying across countries—from the 90 kg eaten in Canada to the 40 kg eaten in Japan, as shown in Figures 3.4 and 3.5. In Figure 3.5, the results are visualized using "skyline charts", which give the amount of consumption (x-axis) and the carbon intensity (y-axis) for the different components. The size of each rectangle thus expresses the component's carbon footprint, and the left-right order of the rectangles represents the highest-to-lowest footprint of components. In these charts, the average intensity and total consumption in each domain is indicated by dotted grey rectangles, and the 1.5-degree targets for 2030 and 2050 as red and blue rectangles, respectively. In the United Kingdom and Finland, most of the meat consumed is pork (31% and 39%, respectively) and chicken (38% and 33%, respectively). In Canada, half of the meat consumed is chicken (45%), yet, Canada has the highest beef consumption (28 kg) due to the overall high consumption of meat.

Dairy products are another significant contributor to the carbon footprint in Canada, Finland, and the United Kingdom. In Canada and Finland this is due to the large consumption of milk, carbon-intensive cheese, and other dairy products. In the United Kingdom, the total dairy

Figure. 3.4. Food-related carbon footprint (tCO_2e/cap/yr) and its breakdown between consumption components



consumption is only given in milk liters in the current data (Food and Agriculture Organization of the United Nations 2021). In Japan, dairy consumption is less than half of the other high-income countries, which could be due to cultural habits.

Other major contributors to food are cereals and beverages. Cereals have relatively high intensity in Japan due to rice consumption, which tends to have higher intensity than wheat and other cereals consumption. The share of beverages in the food footprint is explained in Finland by the relatively high consumption (10 kg/capita/year) of highly carbon-intensive coffee and in Canada and the United Kingdom by the relatively high consumption of relatively carbon-intensive alcohol products, such as beer. Beans are a relatively low-carbon and protein-rich food, but their consumption is very limited in high-income countries, with over 20 kg in Japan and less than 5 kg in Canada, Finland, and the United Kingdom.

In the **upper-middle income countries** the overall amount of food consumed is relatively similar to high-income countries.[17] The overall meat consumption is relatively similar to high-income countries: it varies from 104 kg in Brazil to 41 kg in Turkey. Indonesia is an exception where meat consumption is only 14 kg. Beef is responsible for the greatest share of the meat-related footprint due to it's high carbon intensity, especially in South Africa and Brazil. Yet, in Turkey, South Africa, Brazil, and Indonesia, most of the meat consumed is chicken (51%, 55%, 45%, and 52%, respectively). Indonesia has the highest fish consumption of all countries (45 kg) and it accounts for the second largest share (13%) of the country's total footprint, as it has relatively high intensity.

Cereals and vegetables often account for the largest share of total consumption but the related footprint for the most part remains small due to the notably lower carbon intensity. Share of total intake for cereals varies from 49% in Indonesia to 13% in Brazil, and for vegetables from 45% in China to 13% in Brazil. In China and Indonesia, cereals have a relatively high carbon footprint (20% and 52% of the food footprint), due to the high share of carbon-intensive rice consumption (In China 61% and in Indonesia 75% of the cereal consumption).

Dairy consumption varies a lot within middle income countries. Dairy plays only a minor role in the food carbon footprint in China, South Africa, and Indonesia (3%, 4% and 2%, respectively). In Turkey and Brazil total dairy consumption is close to that of high-income countries (179 kg and 142 kg, respectively). Dairy consumption is also trending upward in many countries (Food and Agriculture Organization of the United Nations 2021).

17 In comparison between the average intake of high-income, upper-middle income, and lower-middle income countries studied.

In India, the **lower-middle income country studied**, the total food consumption amount is the smallest compared to the high-income and upper-middle income countries studied. Most of the food consumed is plant-based (72%), as vegetarianism is a predominant diet. The main protein source together with beans and nuts are dairy products—the consumption of which is similar to high-income countries (approximately 110 kg). India has the highest consumption of beans and nuts (26 kg) among all countries.

Similar to Indonesia, only very little meat is consumed in India (less than 5 kg), of which more than half (54%) is chicken. Fish consumption is one of the lowest (only 7 kg), similar to Canada, Turkey, South Africa, and Brazil.

As indicated by the dotted rectangles in Figure 3.5, the food footprints of high-income countries need to be greatly reduced: by 47–60% by 2030 and by 75–81% by 2050. For upper-middle income countries, the food footprints need to be reduced by 7–61% by 2030 and 56–82% by 2050. For the lower-middle income country, India, the reduction required in the food footprint is 6% by 2030 and 56% by 2050. Yet, the estimated reduction required in food is below that of other domains as there is less variation in current footprints, reflecting that food is considered a necessity (see the first 1.5-Degree Lifestyles Report, Annex D (IGES et al. 2019) for more details). Shifting nutrition sources and reducing carbon intensity or physical consumption amounts where possible while satisfying nutritional requirements can contribute to reducing footprints.

Figure 3.5. A comparison of carbon footprints and their breakdown (food, in kgCO$_2$e/cap/year 2019) in higher-income countries (A) and upper and lower middle-income countries (B)

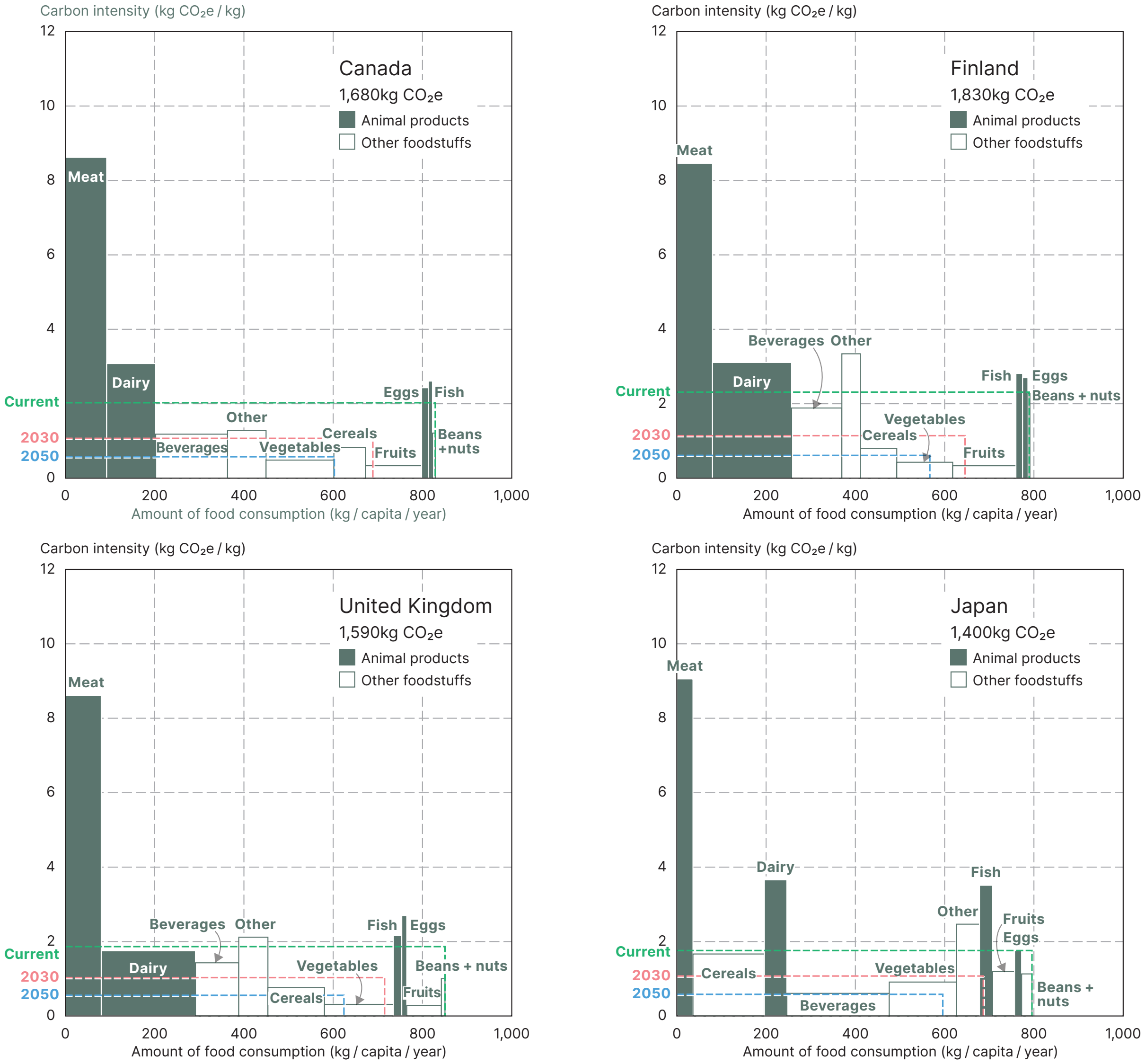
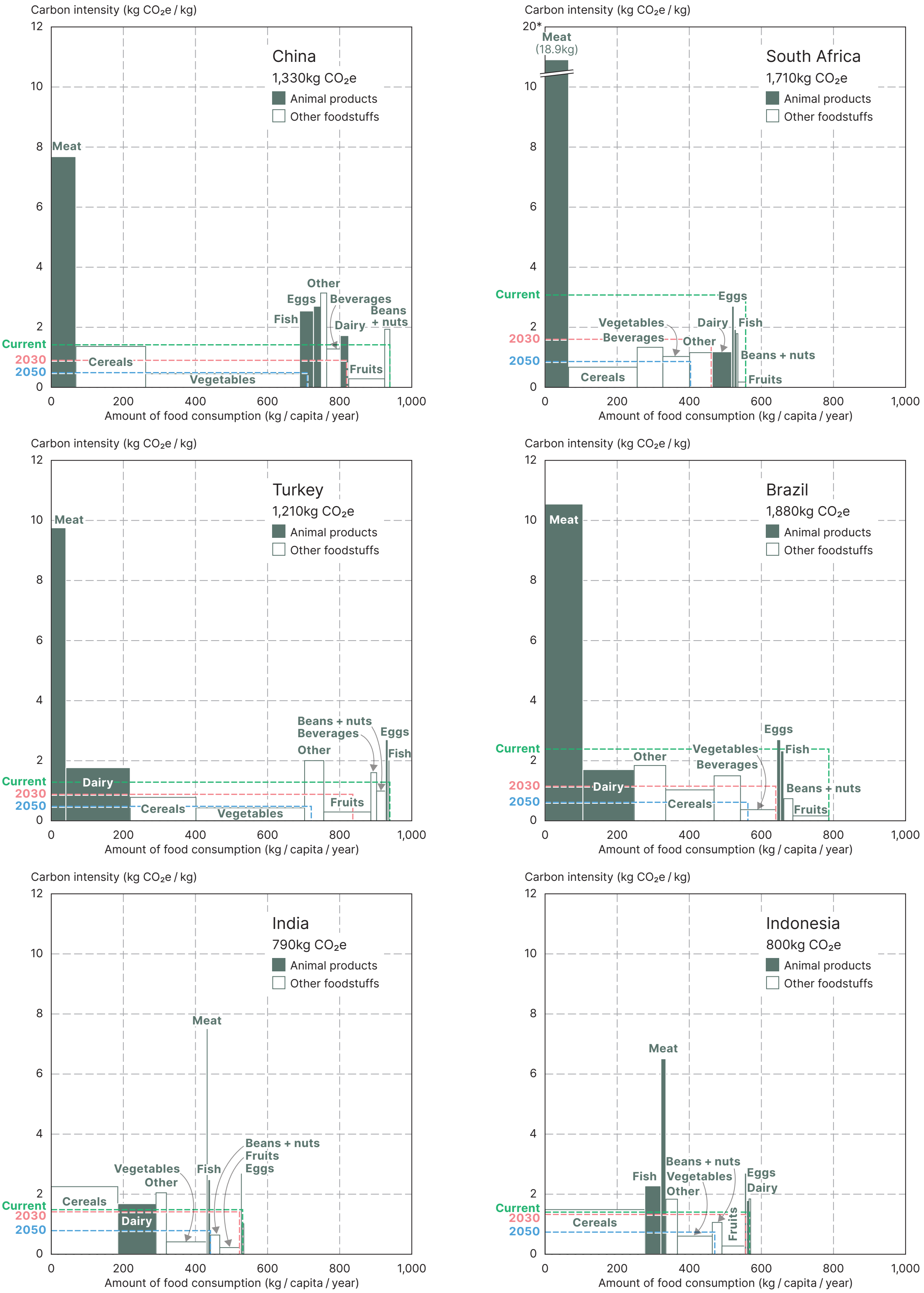


Figure 3.5. A comparison of carbon footprints and their breakdown (food, in kgCO_2e/cap/year 2019) in higher-income countries (A) and upper and lower middle-income countries (B)



* Different scale in y-axis compared to other countries.

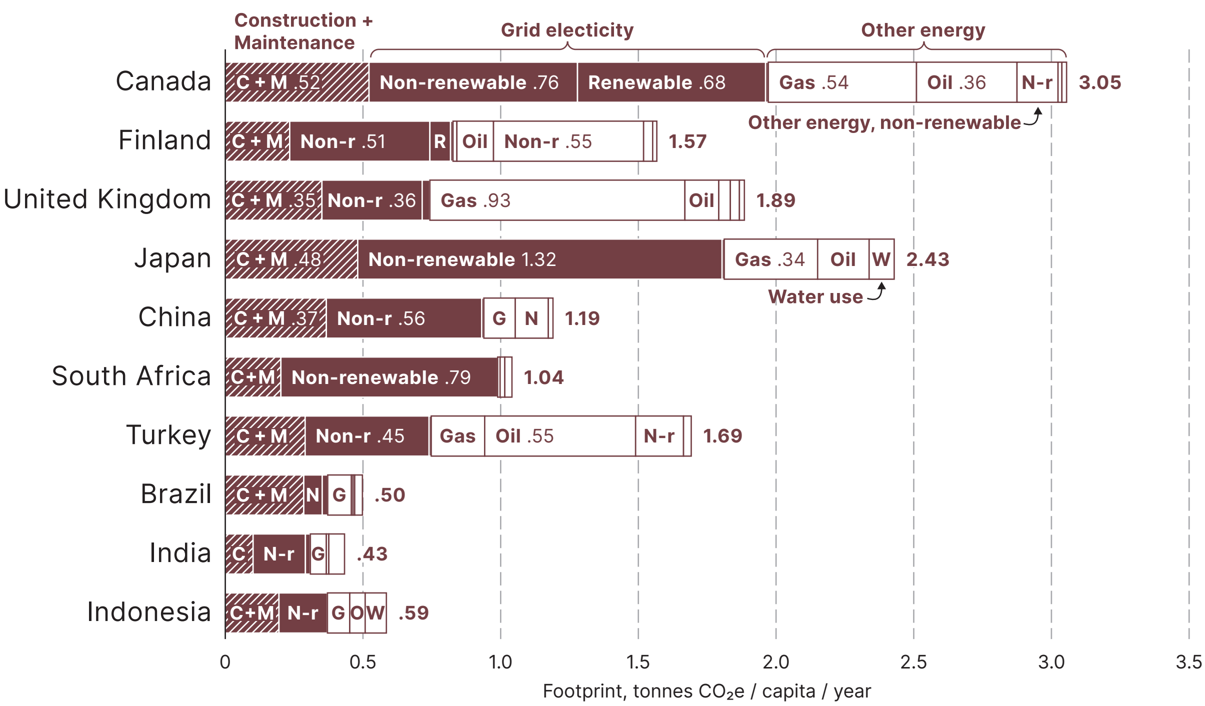
3.2.2. Housing

In the housing domain, non-renewable grid electricity is an important source of lifestyle carbon footprints in all countries, as shown in Figure 3.6. In addition, gas used for heating and cooking is another major contributor to the footprint for some countries, such as the United Kingdom, Japan, and Turkey. Large average living spaces and higher living standards are reflected as higher footprints in high-income countries. This is especially the case in Canada and Finland, where large living spaces together with long and cold winters increase the overall energy demand. Nevertheless, the housing footprint is notably higher in Canada due to relatively high consumption of carbon-intensive energy sources, such as natural gas. Also a high share of renewable grid energy is based on pumped hydropower, which has the highest carbon intensity compared to all other renewable energy sources. In Finland, a high share of the heating energy (the largest share of overall energy consumption) is based on district heating, which has lower intensity due to the relatively high share of renewable energy sources. In Japan, overall energy demand is the lowest of the high-income countries studied but is mostly based on non-renewable energy sources, which is similar in the upper and lower middle-income countries studied.

High-income countries have large living space per capita, varying from the United Kingdom's 39m² to Canada's 58m² per person, with construction and maintenance accounting for up to a fifth (from 15% for Finland up to 22% for the United Kingdom) of the footprint (see Figure 3.6). However, there are big differences in direct energy use (from Canada's 11,500 to Japan's 4,200 kWh) (see Figure 3.7), and energy use per living space (from Finland's 280 to Japan's 100 kWh per m²). This is partly because of the high energy demand for heating in Canada, Finland, and the United Kingdom—for indoor heating and water heating, 63–67% and 15–17%, respectively. In addition, 5% of the households' energy use is for sauna heating in Finland. Japan has a relatively high demand for hot water use of 29%, whereas indoor heating and cooling only account for, respectively, 22% and 2% of the home energy consumption (Agency for Natural Resources and Energy, Japan 2017).

Electrification of direct housing energy use with renewables can contribute to low-carbon lifestyles, but non-renewable electricity can be less efficient in comparison with non-electricity energy sources. Japan has the highest electrification rate of direct energy consumption in the housing domain among high-income countries, with 51% compared to lowest 22% in the United Kingdom. Typically, electricity-based room tem-

Figure 3.6. Housing-related carbon footprint (tCO_2e/cap/yr) and its breakdown between consumption components



Note: Construction/maintenance covers emissions related to the living space (m²/person).

perature control systems such as heat pumps have higher energy conversion efficiency at the household level. If fossil fuels are used to produce the grid electricity for home heating, it generally has higher carbon intensity than home-heating systems using non-renewable heating energy because the conversion efficiency of power plants is relatively low. Therefore, electrification of home energy sources should be promoted together with renewable-based grid electricity.

The carbon intensity of grid electricity in Canada, Finland, and the United Kingdom is about half that in Japan (0.15–0.31 vs 0.63 $kgCO_2e/kWh$), as a large share comes from renewables (37–65%), whereas 84% of Japan's electricity is generated from fossil fuel, over a third of which (39%) is coal. For Canada, over 90% of the renewable grid-electricity is hydropower and of that 40% is based on pumped hydropower, which has higher intensity compared to natural gas used for heat and power cogeneration. Thus, the average carbon intensity for Canadian grid electricity is twice as high compared to Finland and the United Kingdom yet only half of Japan's.

For non-electricity energy, Japanese homes typically use LPG and urban gas for heating and cooking, as well as kerosene for heating (49% of overall energy from housing). On the other hand, 48% of the energy used for room and water heating in Finnish homes is district heat, which has relatively low carbon intensity despite nearly half of it being non-renewable based,

Figure 3.7. A comparison of carbon footprints in higher-income countries (A) and upper and lower middle-income countries (B) (housing energy, in $kgCO_2e/cap/year$ 2019)

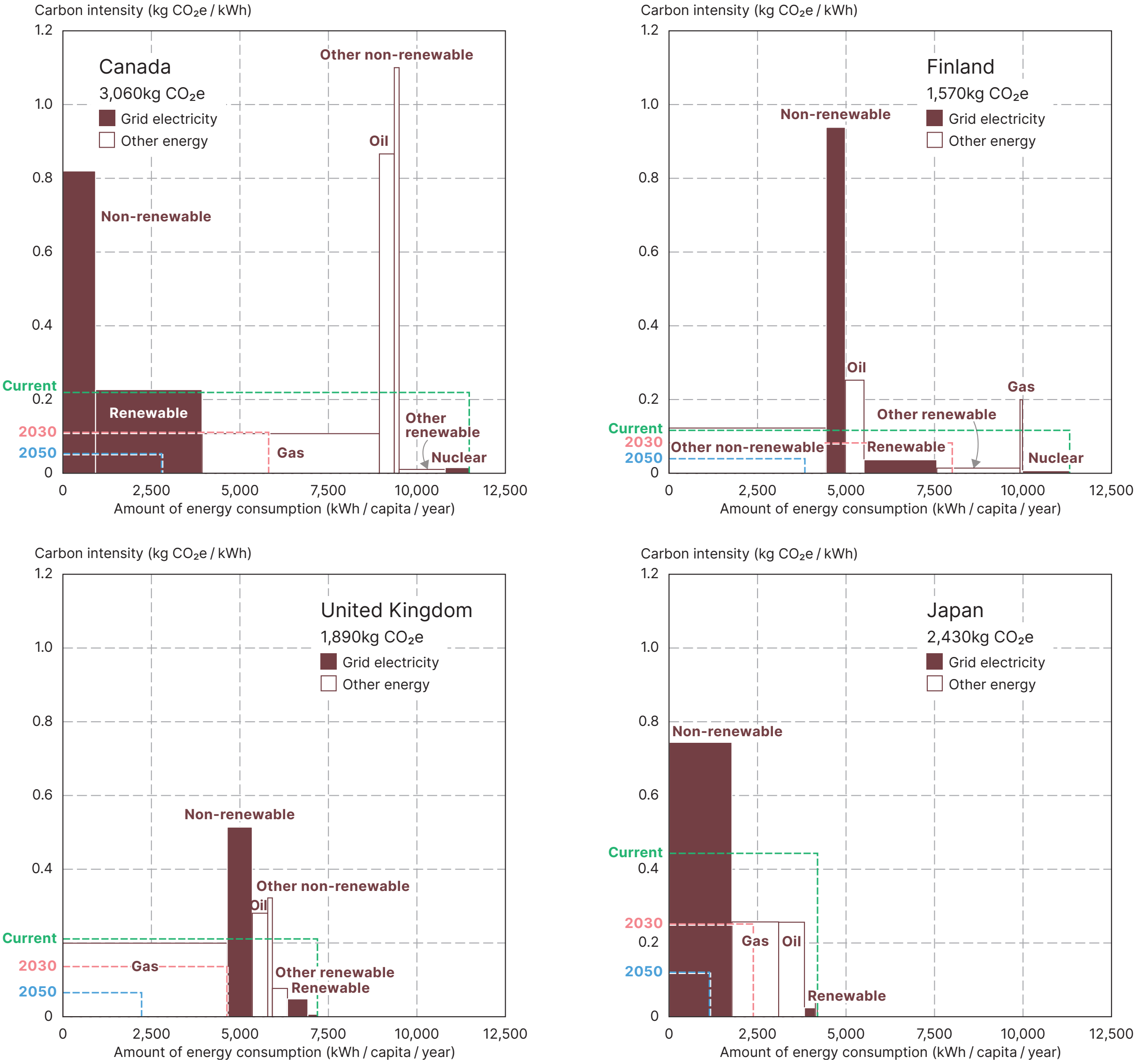
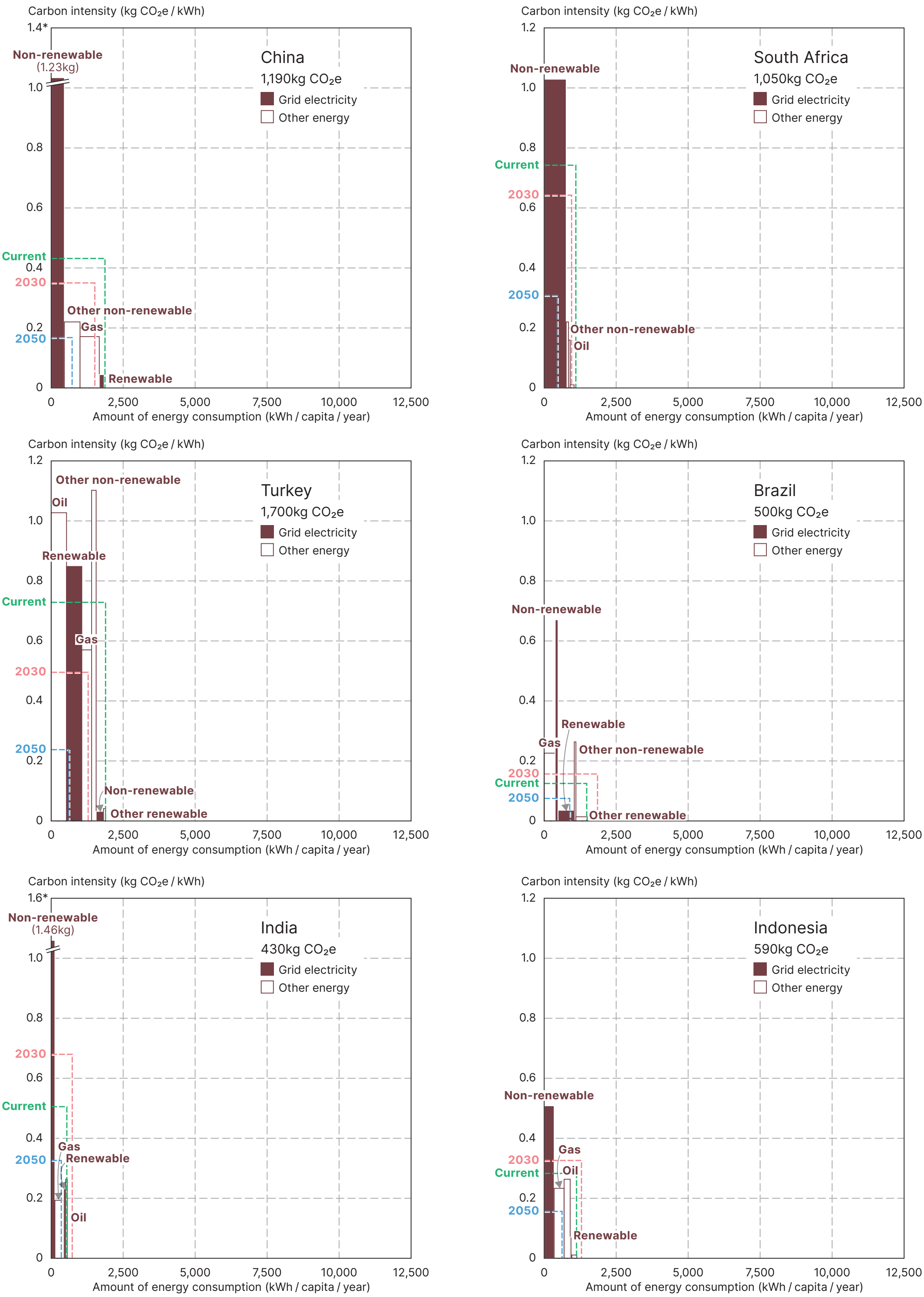


Figure 3.7. A comparison of carbon footprints in higher-income countries (A) and upper and lower middle-income countries (B) (housing energy, in kgCO$_2$e/cap/year 2019)



* Different scale in y-axis compared to other countries.

and 34% of the energy used for room, sauna, and water heating is from wood, which is classified as carbon neutral (except for indirect emissions such as transport and production). Canada and the United Kingdom rely heavily on natural gas as the main energy source for heating, but the intensity for natural gas is over a fifth lower compared to LPG and urban gas used in Japan. As a result, for direct housing energy use, the overall renewable share in Canada and Finland is higher than in the United Kingdom and Japan (38–39% vs. 14–8%).

For **upper-middle income countries**, overall housing footprints, size of living space and energy demand are mainly lower compared to high-income countries (500–1,700 kgCO_2e, 19–41m², 1,100–1,900kWh, respectively, see Figure 3.7), resulting in a lower average carbon intensity per living space (36 kgCO_2e/m²) compared to high-income countries (50 kgCO_2e/m²). The smaller living space per person is due to the higher average number of household members. The lower energy demand is due to less use of appliances and electricity and the lower heating demand is explained by the fact that the upper-middle income countries are situated in warmer regions of the world. Compared to Brazil's high share of renewables in total energy demand (65%), that of Turkey, China, South Africa, and Indonesia is much lower (17%, 9%, 14% and 12%, respectively) so that also the carbon intensity of grid electricity in these countries is significantly higher. In Brazil, 83% of grid electricity is renewables, mainly hydropower. On the contrary, grid electricity is generated mainly with coal and its derivatives in other middle income countries.

Housing footprints are one of the smallest among all countries in the **lower-middle income country**, India (430 kgCO_2e, see Figure 3.6). Living space per person is the smallest (10 m²) and the overall energy demand is one of the lowest (540 kWh) among all countries studied. A high share of the population living under poverty is reflected in an average living space (10 m²) that barely fulfills decent living standards (Rao and Min 2018). The low use of energy is explained by the rudimentary living conditions on average and lower heating demand owing to the climate.

Non-renewables, mainly coal and oil based energy sources, play a major role in energy generation (48% of grid electricity and 90% of non-electricity energy). Renewables used are mainly hydropower.

In relation to the 1.5-degree targets for 2030 and 2050, the carbon footprint reductions required in the high-income countries studied are 50–74% and 90–94%, respectively, which should be achieved either by reduced consumption or improved efficiency (see Figure 3.7). The reduction required in the middle-income countries' housing footprint is 25–54% by 2030 and 64–89% by 2050. For the lower-middle income country, footprint reductions in the housing domain are not needed by 2030, but the needed reduction for 2050 is 52%.

3.2.3. Personal transport

Personal transport related footprints are highest in high-income countries due to high overall transport demand and high share of car use and carbon-intensive air travel (Figure 3.8). Though Japan and India are an exception: Japan has a high mobility demand but a notably higher share of public transport use compared to other high-income countries; India has a transport demand similar to Finland but motorcycles are responsible for the largest share of transport demand and footprint. In countries with a lower share of car use, transport demand is mainly focused on public transportation (bus and train), except in India and Indonesia, where motorcycles are the biggest contributor to both mobility demand and footprints.

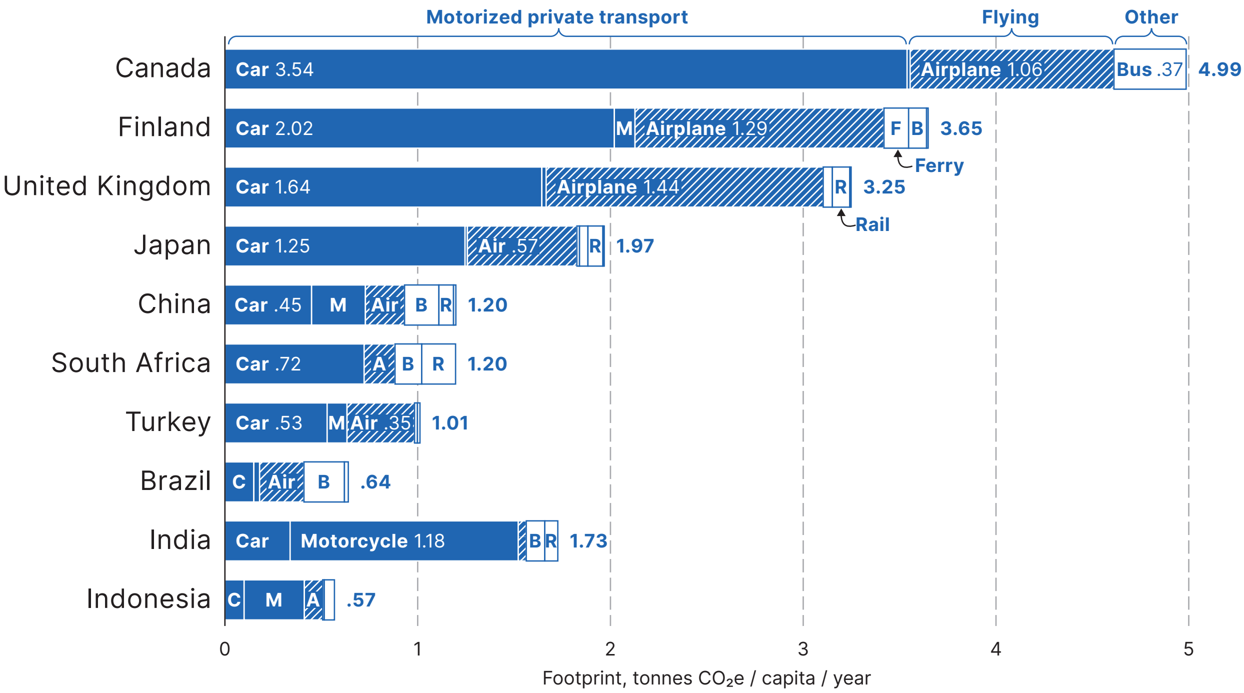
In **high-income countries**, the overall transport demand is higher compared to other countries, though India is an exception (see Figure 3.9). Canada has the highest transport demand at 22,200 km, compared with 17,500 km in Finland, 14,700 km in the United Kingdom and 11,000 km in Japan. Cars are the biggest contributor to the carbon footprint of personal transport in all the high-income countries studied. The modal share of cars varies a lot within high-income countries, from very high (70%) in Canada to moderate (46%) in Japan.

The carbon intensity of cars is slightly higher in Japan compared to other high-income countries, probably due to selection of intensity data, which is based on global averages for different car classes and fuel types for countries other than Japan.

Air travel is the second largest contributor to transportation footprints (see Figures 3.8 and 3.9), though the modal share might be lower compared to other modes of transportation. For example in the United Kingdom, flights induce 1,400 kgCO_2e/capita (44% of the transport footprint), while only accounting for 29% of transport demand. Flights contribute more to the carbon footprint than other modes of transportation due to the notably higher carbon-intensity of air travel.

Travelling by land-based public transportation varies a lot within the high-income countries. Japan has the highest rate of public transportation use (3,600 km or 33% of the total transport demand), compared to other countries (from 9% in Finland to 15% in Canada), partly reflecting the higher service coverage supported by high population density in Japan. Japan has a notably higher use of trains (28% of transport demand) compared to Canada's 0.5% and to the United Kingdom's 8%. The use of buses is almost reversed—highest in Canada with 15% and lowest in Japan and the United Kingdom

Figure 3.8. Transport related carbon footprint (tCO_2e/cap/yr) and its breakdown between consumption components

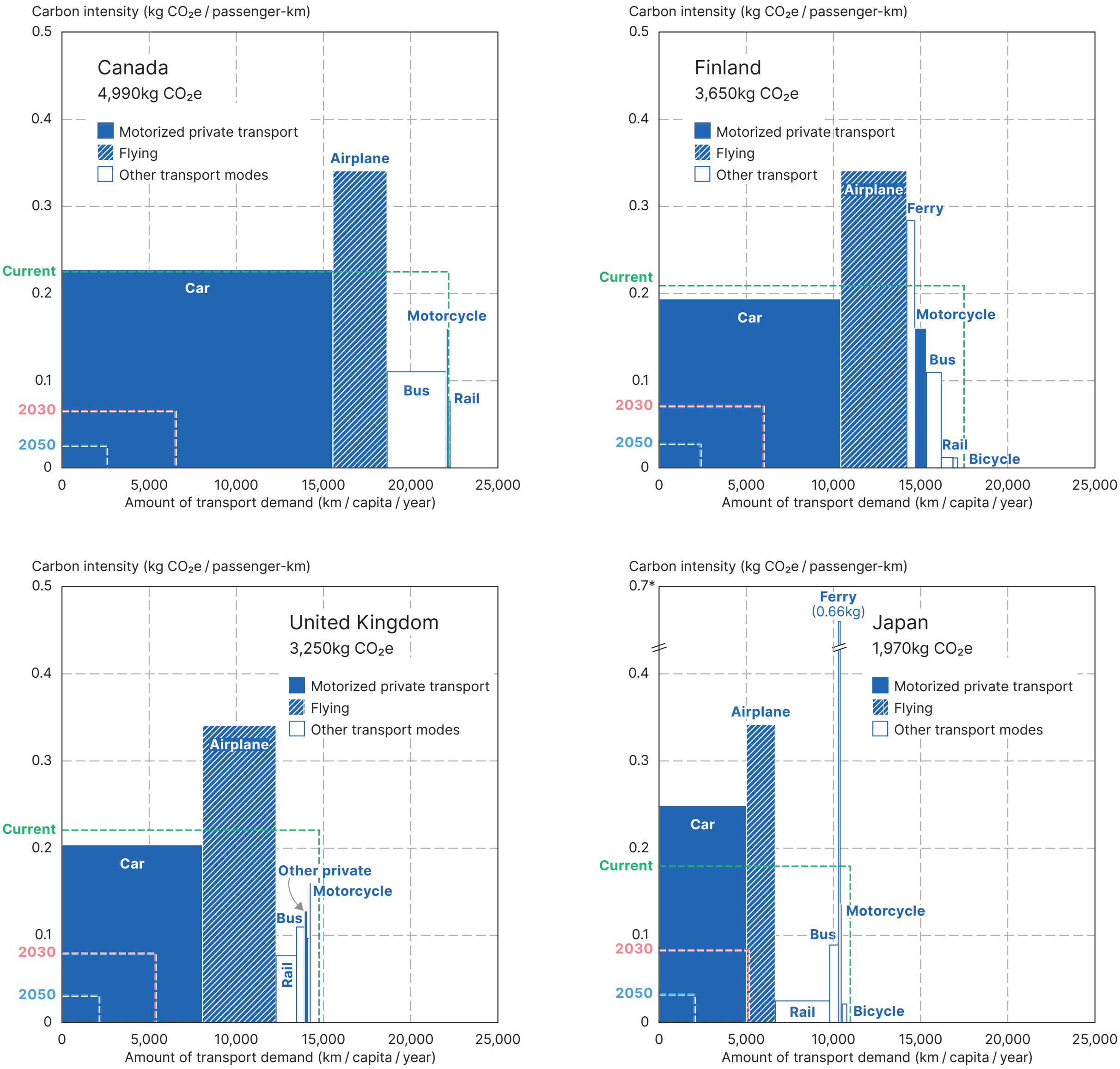


Note: Rail covers bullet, long-distance and local trains, as well as trams and metros; other public transportation covers local modes of transportation, such as auto-rickshaw in India and bajaj (three-wheelers) in Indonesia.

with 4% and 3%, respectively. The carbon-intensity of land-based public transportation is lowest in Finland due to the carbon-neutral policy of the national train service (VR Group Ltd. 2020). In Canada, a high share of the land-based public transportation is bus travel, which has notably higher carbon-intensity compared to train travel. Bicycles and walking account for a small share of the overall transport demand in high-income countries.

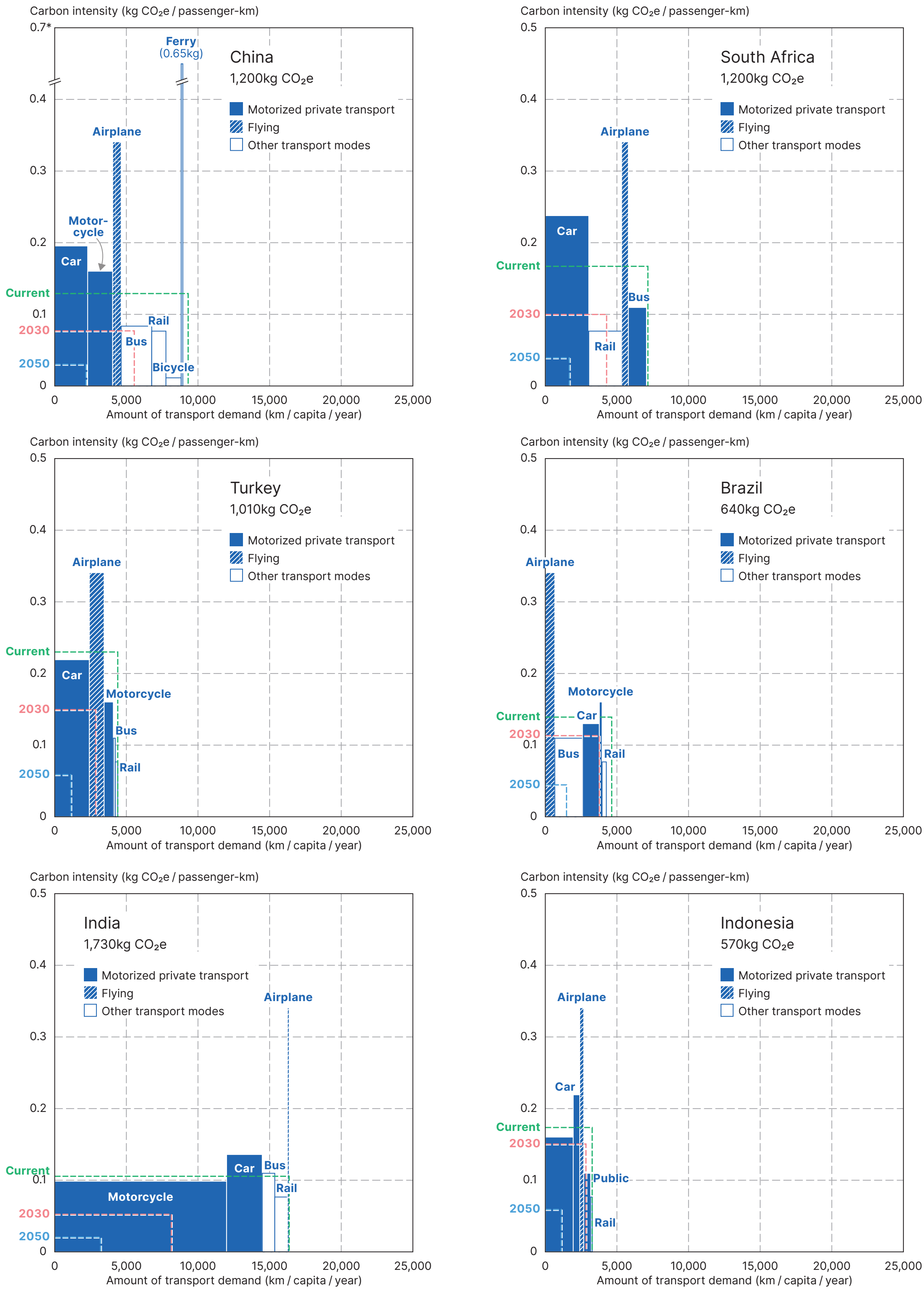
In the **upper-middle income countries** studied the average transport demand is only two-fifths of the demand of high-income countries (see Figure 3.9). China has the highest transport demand at 9,300 km, compared to 7,200 km in South Africa, 4,600 km in Brazil, 4,400 km in Turkey, and 3,300 km in Indonesia. Lower transport demand probably reflects lower consumption levels in upper-middle income countries compared to high-income countries. Of transport, cars are also the biggest contributor to the carbon footprint in the upper-middle income countries, except for Brazil and Indonesia, where it is buses and motorcycles, respectively. Modal share of cars are moderate, from 14% for Indonesia (460 km) to 55% for Turkey (2,400 km). Country-specific carbon intensities of cars are similar to high-income countries, except for Brazil where the car fleet is mainly flex fuel cars with lower carbon intensity compared to only fos-

Figure 3.9. A comparison of carbon footprints in higher-income countries (A) and upper and lower middle-income countries (B) and their breakdown (transport, in kgCO₂e/cap/year 2019)



* Different scale in y-axis compared to other countries.

Figure 3.9. A comparison of carbon footprints in higher-income countries (A) and upper and lower middle-income countries (B) and their breakdown (transport, in kgCO₂e/cap/year 2019)



* Different scale in y-axis compared to other countries.

sil fuel cars. The occupancy rate for cars in upper-middle income countries is similar to high-income countries though slightly lower, and the car fleet has a similar share of electric, hybrid, and alternative fuels using cars.

Air travel is the second largest contributor to the carbon footprint only in Turkey (see Figure 3.8), due to much higher transport demand for other modes of transportation in almost all upper-middle income countries. Land-based public transportation covers nearly half of the transport demand in China, South Africa, and Brazil (34%, 50%, and 48%, respectively). Turkey and Indonesia are an exception with a low share (7% and 18%, respectively) of public transportation. The share of trains of the total public transportation demand varies a lot among countries, from 13% in Brazil to 64% in South Africa. That also affects the carbon intensity of land-based public transportation, which is higher in countries with less train use. Motorcycles cover over half (55%) of the transport demand in Indonesia and nearly one-fifth in China and Turkey (19% and 15%, respectively), and although motorcycles have lower intensity than cars, it is still much higher than public transportation. In addition, other modes of public transportation cover altogether 15% of Indonesia's transport needs. High use of motorcycles and similar means of transportation probably reflects differences in cultural habits among the middle-income countries studied. Data for cycling and walking is inadequate and therefore their comparison within middle-income countries is not suitable.

In the **lower-middle income country**, India, overall demand for transport is similar to that of high-income countries (16,400 km in India, see Figure 3.8). Contrary to the countries of other income categories, motorcycles are responsible for the largest share of the transport footprint (68%) and transport demand (73%). Cars account for only 15% of the transport demand. Air travel is minor in transport demand, which probably reflects the role of air travel as a privilege of higher income classes, as over a fifth (22%) of the population live in poverty in India (World Bank Group 2020). Overall the share of public transportation is on a similar level with high-income countries (11%), but with the difference that other travel is not car-focused.

In relation to the 1.5-degree targets for 2030 and 2050, the reductions needed in high-income countries' personal transport are 78–91% and 97–99%, respectively (see Figure 3.9). For upper-middle income countries the needed reductions are 25–64% by 2030 and 88–95% by 2050. The lower-middle income country studied also needs to reduce its transport footprint greatly: by 75% by 2030 and 96% by 2050.

3.2.4. Other domain (consumer goods, leisure, and services)

Other domain footprints are strongly related with income levels, as shown in Figure 3.10. In particular, leisure related footprints are the lowest in countries with the lowest average per capita spending, such as India and Indonesia.

Consumer goods account for the greatest share of the footprint in most countries. Canada has a notably higher footprint compared to other countries, due in part to having the highest annual per capita spending but also due to notably higher spending on relatively high intensity consumer goods. In middle-income countries the spending is focused on necessities, such as clothing and furniture/room coverings.

The share of service-related footprints vary across countries and income groups. Although education and healthcare services are strongly subsidized by the government in Finland, the country has the highest service related footprint due to notably higher spending on finance/insurance related services.

The footprints of consumer goods, leisure, and services are highest in the **high-income countries** studied (see Figure 3.10), and the footprint varies among countries from Canada's highest footprint of 3,900 $kgCO_2e$ to the lowest of 1,700 $kgCO_2e$ in the United Kingdom. The spendings of high-income countries are also the highest among all case countries, and they vary from United Kingdom's pound equivalent[18] of 12,500 USD to Canada's dollar equivalent of 9,000 USD.

In Canada, Finland, the United Kingdom, and Japan consumer goods have the highest footprint, though the service domain has the greatest spendings. In the consumer goods domain, clothes have the highest spendings in all other countries, except in Japan, where clothes are the second highest after the category of other consumer goods (including jewelry, tobacco, and miscellaneous manufacturing products). In the service domain, finance and insurance-related services are clearly highlighted in all high-income countries. The leisure domain covers 17–26% of the summed up footprint and 12–29% of per capita spending in these three domains. Average carbon intensities for high-income countries are lowest for all three domains between case countries, possibly due to a higher share of renewables used for service production in industrialised countries compared to industrialising countries.

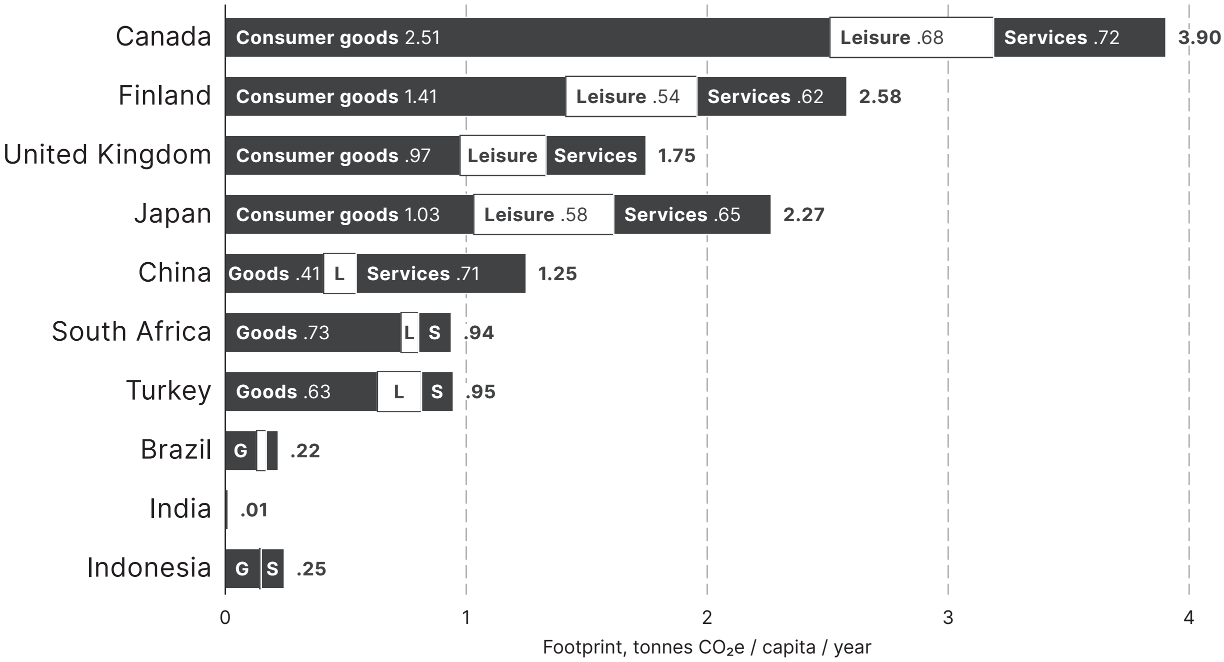
For **upper-middle income countries**, both the footprint and the spendings fall behind the high-income countries (see Figure 3.10). The average footprint is only one-fifth (19%: 720 $kgCO_2e$) and the per-capita consumer spending less than a tenth (8%: 1,100 USD) of high-income countries. Nevertheless, within upper-middle income countries, Indonesia has a notably lower footprint and per-capita consumer spending compared to other countries. In Turkey, South Africa, Brazil, and Indonesia, consumer goods account for the greatest footprint, as it covers over half (67%, 78%, 59% and 58%, respectively) of the summed up footprint of the three domains. In China, the highest are services (57%). Spending varies a lot among countries due to the different data quality and level of details available. Nevertheless, for China, South Africa, Brazil, and Indonesia a major part of the spending is targeted to services, though the use of different services vary between countries. In Turkey, consumer goods account for the greatest share of spendings, of which 67% is due to clothes and furniture/room coverings. Leisure is responsible for a minor part of spending in China, South Africa, Brazil, and Indonesia—only 6–28%—relatively similar to high-income countries.

For the **lower-middle income country**, India, the average footprint and spendings in these three domains are only a fraction compared to high-income countries (1%: 10 USD/capita) (see Figure 3.10). Although the summed up consumption of the three domains is distributed similarly in India and the upper-middle income countries—47% for consumer goods, 6% for leisure, and 47% for services—the overall consumption is vastly smaller. This is reflected in the footprint, which is only 15 $kgCO_2e$. It shows clearly that the average per-capita consumer spending is targeted to necessities, to clothes and footwear, education and welfare/medical services. Leisure-related annual consumption is less than 1 USD. Average carbon intensities for lower-middle income countries are the highest for all three domains, possibly due to a lower share of renewable energy sources used for product and service production and distribution.

In relation to the 1.5-degree targets for 2030 and 2050, the reductions needed in high-income countries' consumer goods, leisure, and services in total are 68–93% and 94–99%, respectively. For upper-middle income countries the needed reductions are 41–64% by 2030, except for Brazil and Indonesia where the footprints are already below the target, and 56–91% by 2050. The lower middle income country, India, has so far reached the 2030 and 2050 targets.

18 Country-specific currency converted into USD by using the average currency exchange rate for the year 2019. (X-Rates 2021)

Figure 3.10. Consumer goods, leisure, and services related carbon footprint (tCO_2e/cap/yr) and its breakdown between consumption components



4 – Options and Priorities for Shrinking Lifestyle Carbon Footprints

This chapter examines the reduction potentials of low-carbon lifestyle options towards meeting the 1.5-degree target, based on the estimates for current lifestyle footprints and proposed per-capita targets. Key approaches concerning low-carbon lifestyles are explained before evaluating country-specific impacts of low-carbon lifestyle options that could be applied.

4.1. Reduce, shift, improve

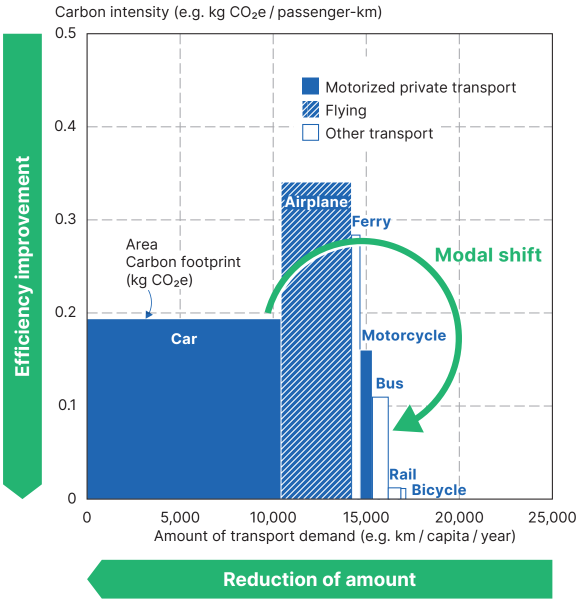
Analysis for this report estimates lifestyle carbon footprints based on the amount of consumption and the carbon intensity of the items. The report adopts three main approaches for reducing footprints: absolute reduction, modal shift, and efficiency improvement (Figure 4.1). These approaches are in line with analyses and recommendations from related literature (Vandenbergh et al. 2008; Jones and Kammen 2011).

I. Absolute reduction (Akenji et al. 2016) refers to reducing physical consumption of goods or services consumed, such as food, kilometers driven, energy use, or living space, as well as avoiding unsustainable options.

II. Modal shift (Nelldal and Andersson 2012) means changing from one consumption mode to a less carbon-intensive one, such as in adopting plant-based diets instead of eating excessive meat, using public transport instead of cars, or using renewable energy for electricity or heating instead of fossil fuels.

III. Efficiency improvement means decreasing emissions by replacing technologies with lower-carbon ones while not changing the amount consumed or used, such as in energy-efficient vehicles, appliances, or housing.

Figure 4.1. Key approaches for lifestyle carbon footprint reduction: absolute reduction, modal shift, and efficiency improvement



Source: IGES et al. (2019)

4.1.1. Rebound effects

When efficient products or environmentally sound behaviours are introduced, rebound effects need to be considered. Rebound effects refer to "the unintended consequences of actions by households to reduce their energy consumption and/or greenhouse gas (GHG) emissions" (Sorrell 2012). Rebound effects mean that efficiency improvements can be less effective than intended and can even increase total consumption and associated emissions (Schmidt-Bleek 1993). A review of the rebound effect of energy consumption concluded that direct rebound effects (rebound in the same consumption item) are expected to be up to 30%, while indirect and economy-wide rebound effects (rebound in other consumption items) can exceed 50% (Sorrell 2007). For example, introducing fuel-efficient cars might increase the total distance travelled by cars or the size of cars, which could potentially upset or even reverse the absolute amount of resource use or emissions. Rebound effects have also been considered in the context of other approaches including modal shift or absolute reduction (Buhl 2014; Ottelin et al. 2017). It is therefore important to examine cross-domain household behaviours to identify and try to address potential rebound effects.

Although theoretically, approaches such as the sharing economy can bring about significant synergies with low-carbon lifestyles, it also involves the possibility of rebound effects, depending on the options chosen (see Clausen et al. (2017) for potential negative effects). For example, car-sharing might increase the total distance of car use among citizens who were previously car-free, and increase car use especially outside rush-hours, thus potentially weakening demand for public transportation. Sharing options should not raise total carbon footprints by inducing additional demand or causing adverse shifts in consumption modes.

4.1.2. "Lock-in" effects

Another factor to consider when assessing the potential effectiveness of options for lifestyle changes is the "lock-in" effect (Sanne 2002; Akenji and Chen 2016). In facilitating low-carbon lifestyles, consideration of behavioural "lock-in" is important. While technological and institutional lock-in have been discussed in the context of blocking sustainable innovations (Unruh 2000; Foxon 2002), lock-in also applies to consumer choices and lifestyles in terms of products available on the market, infrastructure and public services, the consumer's community and social networks (Akenji and Chen 2016), as well as by economic framework conditions (Lorek and Spangenberg 2014). Consumers in the current society are to a certain degree locked-in by circumstances including work-and-spend lifestyles (Sanne 2002). Considering these challenges to behavioural change, there is a need also to improve production processes, improve the availability of low-carbon products or services by the private and public sectors, and bring about shifts in infrastructure as well as introduce national policies to enable the adoption of more low-carbon options and to phase-out carbon-intensive options. The shifts in lifestyles that are needed to meet the 1.5°C target thus need both systems and individual behaviour change (Akenji 2014). It remains with government and business and collaborative action by all stakeholders, especially those who are actively driving the current consumption modes.

4.2. Estimated impacts of low-carbon lifestyle options

In this report, the carbon footprint reduction of selected low-carbon lifestyle options were assessed for each country. The selected low-carbon options are based on a literature review presented in the first 1.5-Degree Lifestyles report, Annex E (IGES et al. 2019) and include both production and consumption side options; offering different point of views to reduction (absolute reduction, modal shift, efficiency improvement). The drastic reductions required to achieve the 2030 and 2050 targets (e.g. 60–82% by 2030 in high-income countries) highlight the need for high impact carbon reduction options.

Country-specific impacts of selected options were calculated based on data on physical consumption amount and carbon intensity (see Chapter 3). The reduction impacts were estimated based on the collected consumption and footprint data by changing the intensity and/or amount of relevant components depending on the nature of the options.

The percentage of the population changing their behaviour and the extent of change by each individual are critical, so both different adoption rates and depths of change are presented. "Full implementation" means that individuals fully implement a low-carbon option and realise the maximum reduction potential of that option. "Partial-adoption" means an option is partially adopted, either by individuals or by society. The "full implementation" practices of each option are defined as assumptions listed in Annex F in the first 1.5-Degree Lifestyles report (IGES et al. 2019) and the resulting maximum reduction potentials were estimated using LCA-based carbon footprint data by changing the carbon intensity and/or consumption amount of relevant components. Impacts from "partial-adoption" were estimated based on the following equation:

Partial adoption impacts
= full implementation impacts x adoption rate (%)

The results of the estimated carbon footprint reduction impacts for each country from full and partial implementation of options are summarised in Figures 4.2.–4.11. It should be noted that the selected low-carbon lifestyle options and their assumptions differ slightly among countries due to the applicability of options to local contexts and the availability of data.

In **high-income countries** the largest reduction potential of **500 to over 1,500 kg CO_2e/person/year** per option on average[19] are car-free private travel, reduction of international flights, vegan diet, electric car, vegetarian diet, renewable grid electricity, vehicle fuel efficiency improvement, renewable off-grid electricity, low-carbon protein instead of red meat, and renewable based heating and/or cooling.[20] Most options are based on a modal shift from carbon-intensive to other lower-intensity consumption modes, such as car to public transport, fossil fuel to renewable energy sources, and meat to vegetarian nutrition sources. High-impact efficiency improvement options, such as electric car and vehicle fuel efficiency improvements, are mainly found in the transport domain. The majority of the highest impact options are from the transport domain, while housing and food also offer major reduction potential through switching from non-renewables to renewable sources and through shifting dietary habits. In **upper-middle income** countries, the options exceeding the full potential of 500 kg per option on average[19] are vegan diet and low-carbon protein instead of red meat, making these the highest impact options. In **lower-middle income countries**, only living closer to the workplace (i.e. reducing commuting distance) exceeded 500 kg per option on average.[19]

Options with medium-high reduction potentials of **250 to 500 kg** *per option* on average[21] in **high-income countries** are living closer to the workplace, car-free commuting with electric bikes, ride sharing, smaller living space, hybrid car, car-free commuting with public transportation, closer weekend leisure, and efficiency improvement of home appliances. Options include modal shift, efficiency improvement, and absolute reduction, such as car-free commuting, ride sharing, and living closer to work, respectively. In **upper-middle income countries** the options exceeding the full potential of 250 kg per option on average[21] are vegetarian diets, renewable grid electricity, and renewable off-grid electricity. In **lower-middle income countries** the second largest potential per option on average[21] are vehicle fuel efficiency improvement, vegan diet, and vegetarian diet. In **middle income countries**, options are mainly based on modal shifts, such as switching from fossil to renewable energy sources and changing dietary habits.

Options with moderate impacts, **less than 250 kg** *per option* on average[22] in **high-income countries** are food production efficiency improvement, alternative dairy products, renting a guest room, telework, efficiency improvement of buildings, heat pump or air conditioner for temperature control[20], reduction of sweets and alcohol, reduction of domestic flights, household food loss reduction, saving hot water, lowering temperature at home and supply side food loss reduction, i.e., options based on efficiency improvement of production and products or absolute reduction of physical consumption amounts. In **middle-income** and **lower middle-income countries**, the majority of the options have an impact of less than 250 kg per option on average.[22]

When reading these findings, it's important to keep the limitations of this study in mind. First, the options analysed are not exhaustive but a selection based on available literature (see Annex E in the first 1.5-Degree Lifestyles report (IGES et al. 2019)). Second, the estimates are based on basic assumptions of changes in consumption amounts, modes, and/or carbon intensity, as well as the production side adopting the most ambitious company targets (see Annex C). Also, changes in energy systems, such as renewable electricity grid mix, were not systematically reflected in the estimation of every product and service but only as a specific option of direct energy use in the housing domain and as a general efficiency improvement in production in other domains (such energy system changes can be studied in future research). Last, this report does not consider the dynamic changes towards the future, such as interactions between demography, technology, economy, and consumption or comparisons with business-as-usual scenarios. The estimated impacts were calculated by altering amounts of consumption or carbon intensity of components based on the estimated footprints as of 2019, while the targets indicated for comparison relate to the future, such as 2030. A more comprehensive, dynamic modelling of future lifestyles is beyond the scope of this report.

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19 Estimated to have more than 500 kgCO_2e/capita/year reduction potential in full implementation as a mean of potentials. Descending order by estimated mean reduction potentials.

20 The assumption varies depending on whether the energy is used for heating or cooling purposes in each country.

21 Estimated to have more than 250 kgCO_2e/capita/year reduction potential in full implementation as a mean of potentials. Descending order by estimated mean reduction potentials.

22 Estimated to have less than 250 kgCO_2e/capita/year reduction potential in full implementation as a mean of potentials. Descending order by estimated mean reduction potentials.

Figure 4.2. A comparison of estimated per-capita carbon footprint reduction impacts (kgCO_2e/capita/year) of low-carbon lifestyle options (Canada)

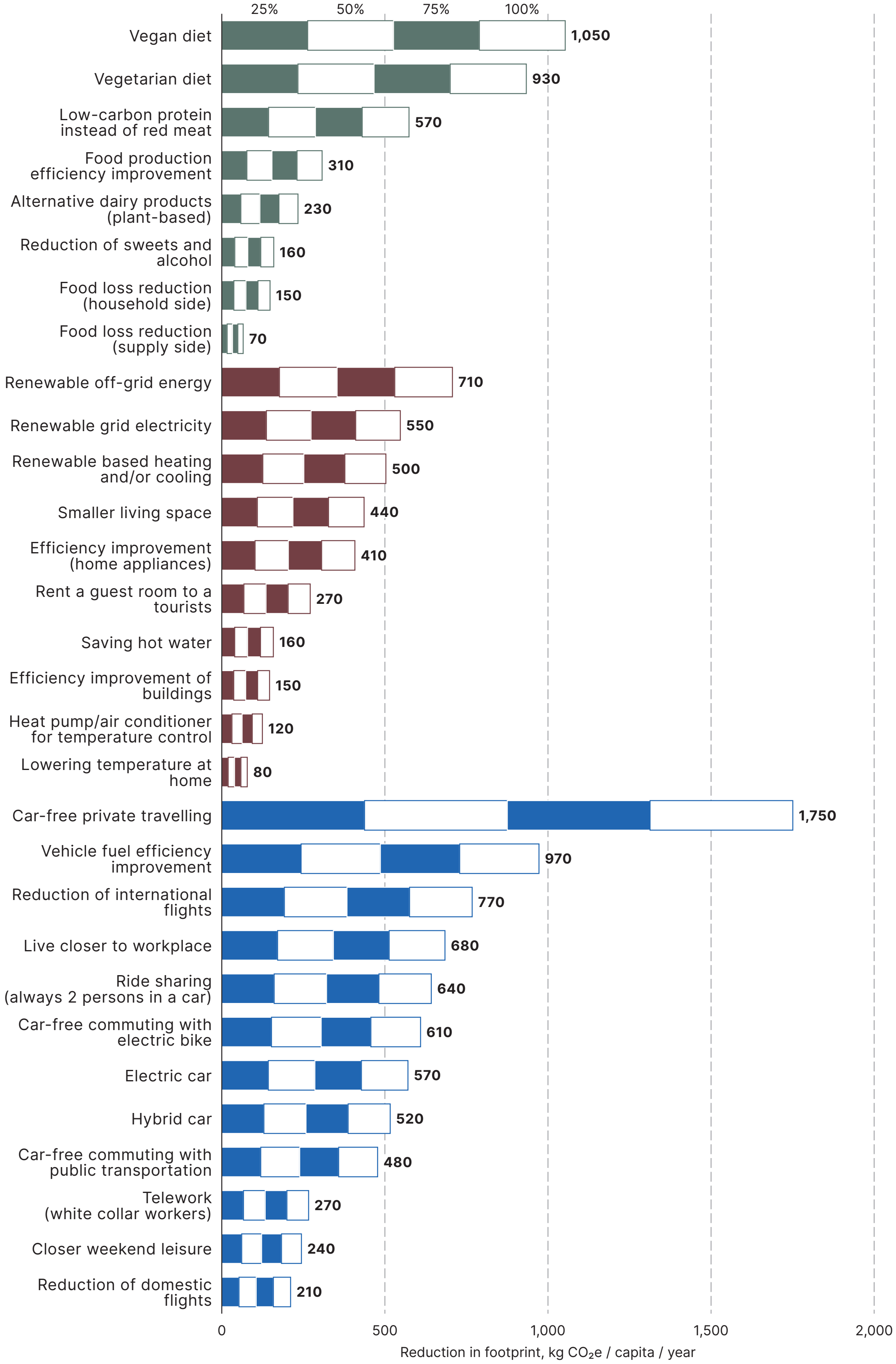


Figure 4.3. A comparison of estimated per-capita carbon footprint reduction impacts (kgCO$_2$e/capita/year) of low-carbon lifestyle options (Finland)

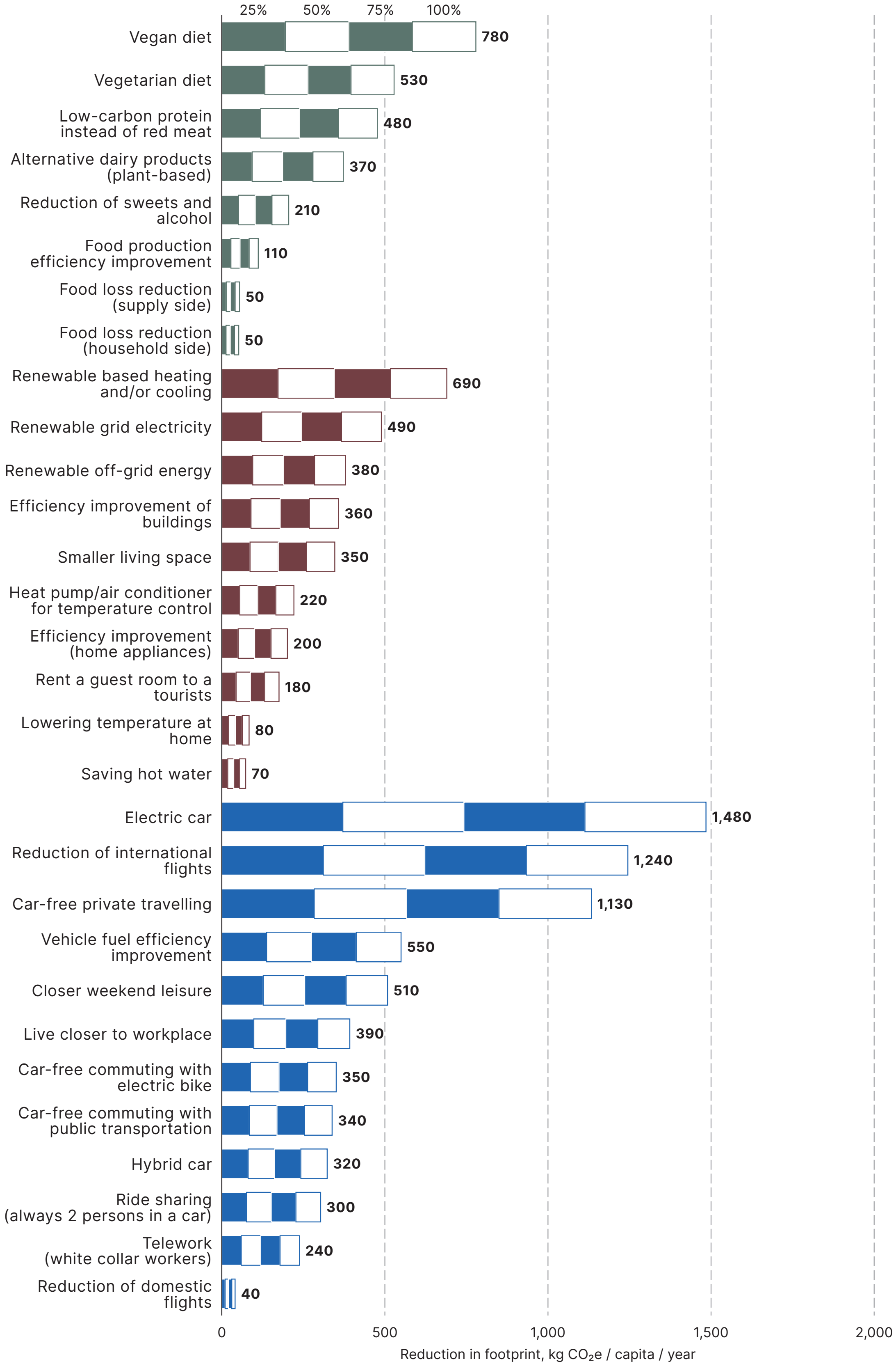


Figure 4.4. A comparison of estimated per-capita carbon footprint reduction impacts (kgCO_2e/capita/year) of low-carbon lifestyle options (United Kingdom)

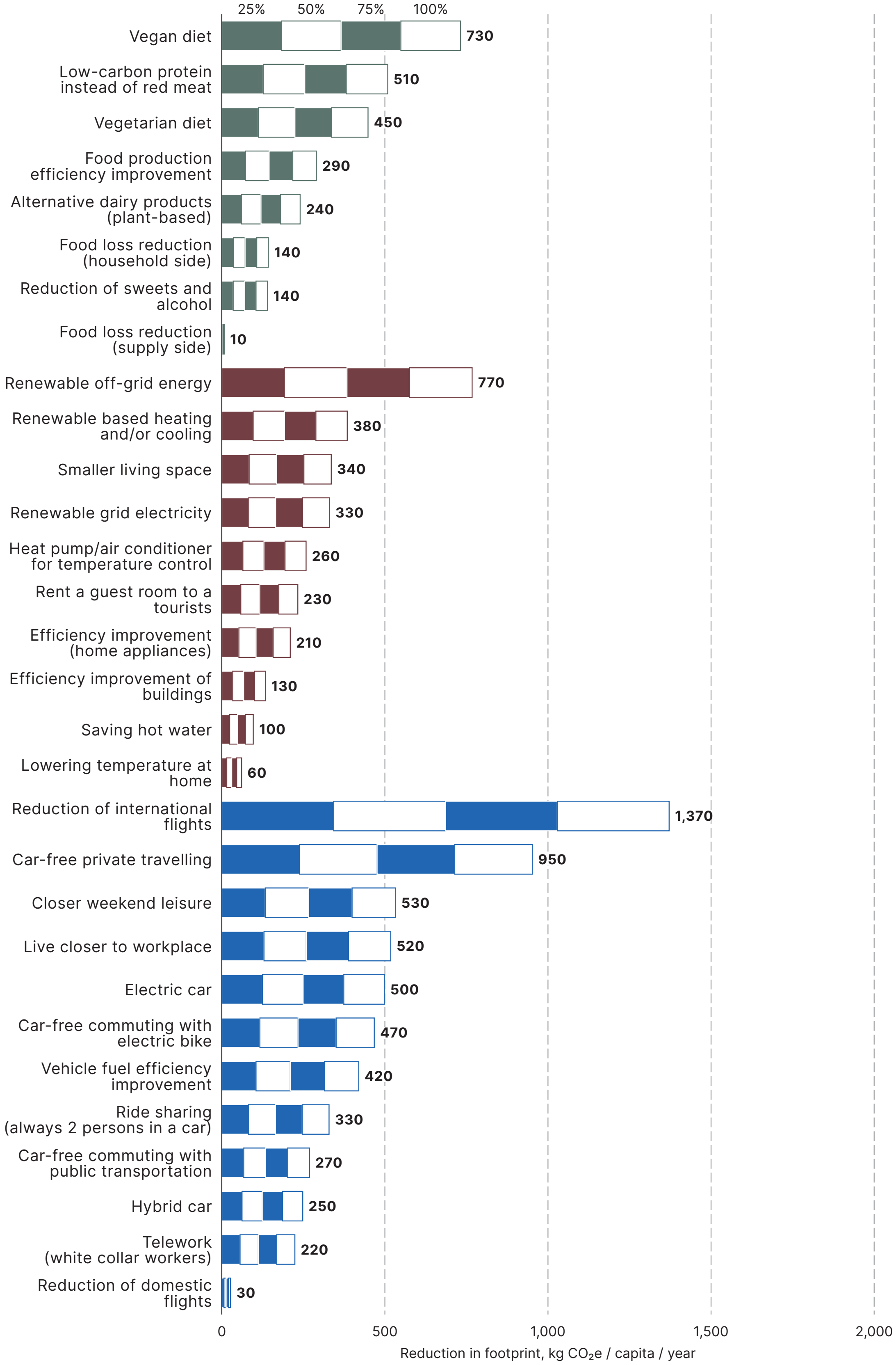


Figure 4.5. A comparison of estimated per-capita carbon footprint reduction impacts (kgCO_2e/capita/year) of low-carbon lifestyle options (Japan)

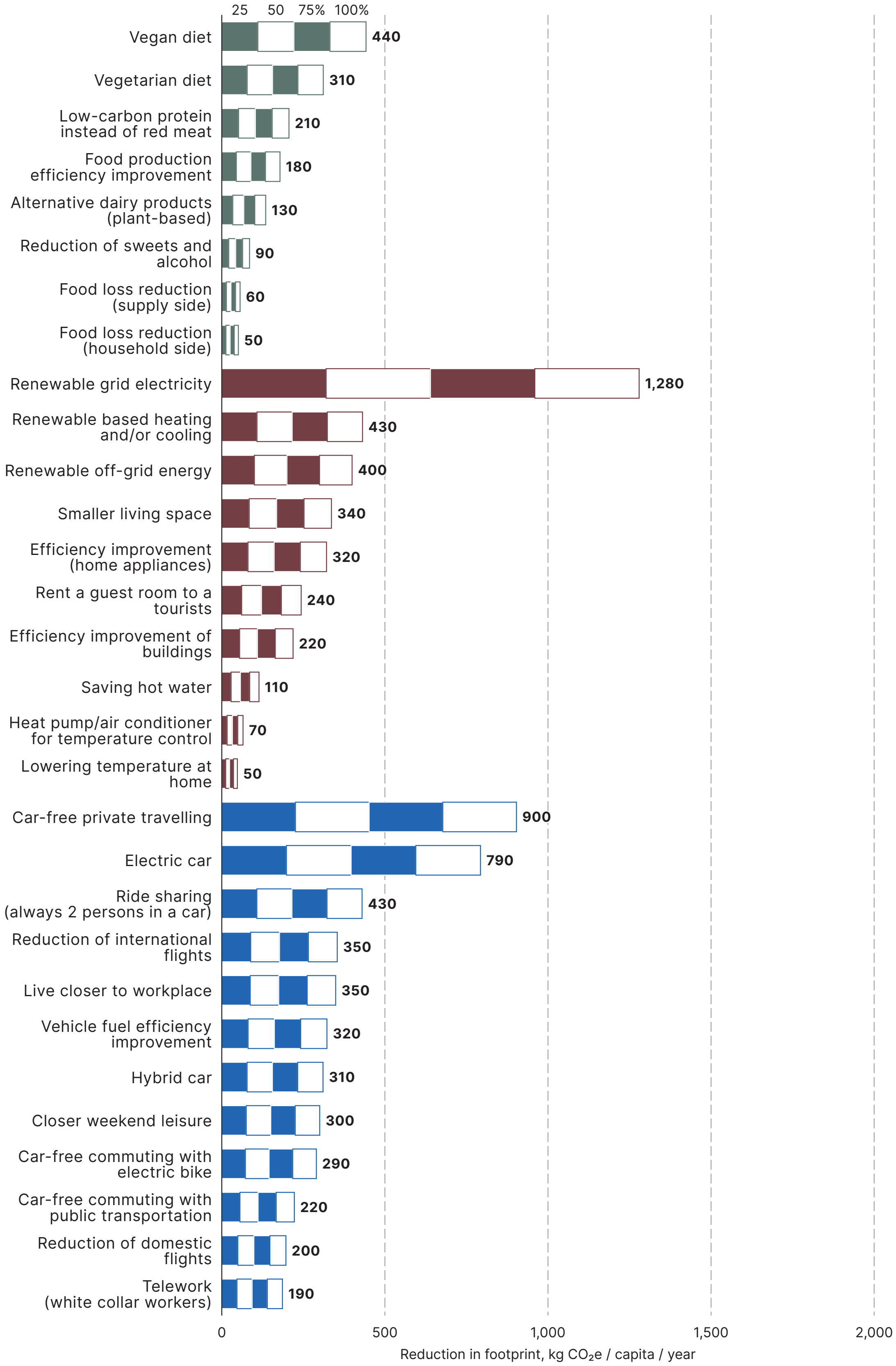


Figure 4.6. A comparison of estimated per-capita carbon footprint reduction impacts (kgCO$_2$e/capita/year) of low-carbon lifestyle options (China)

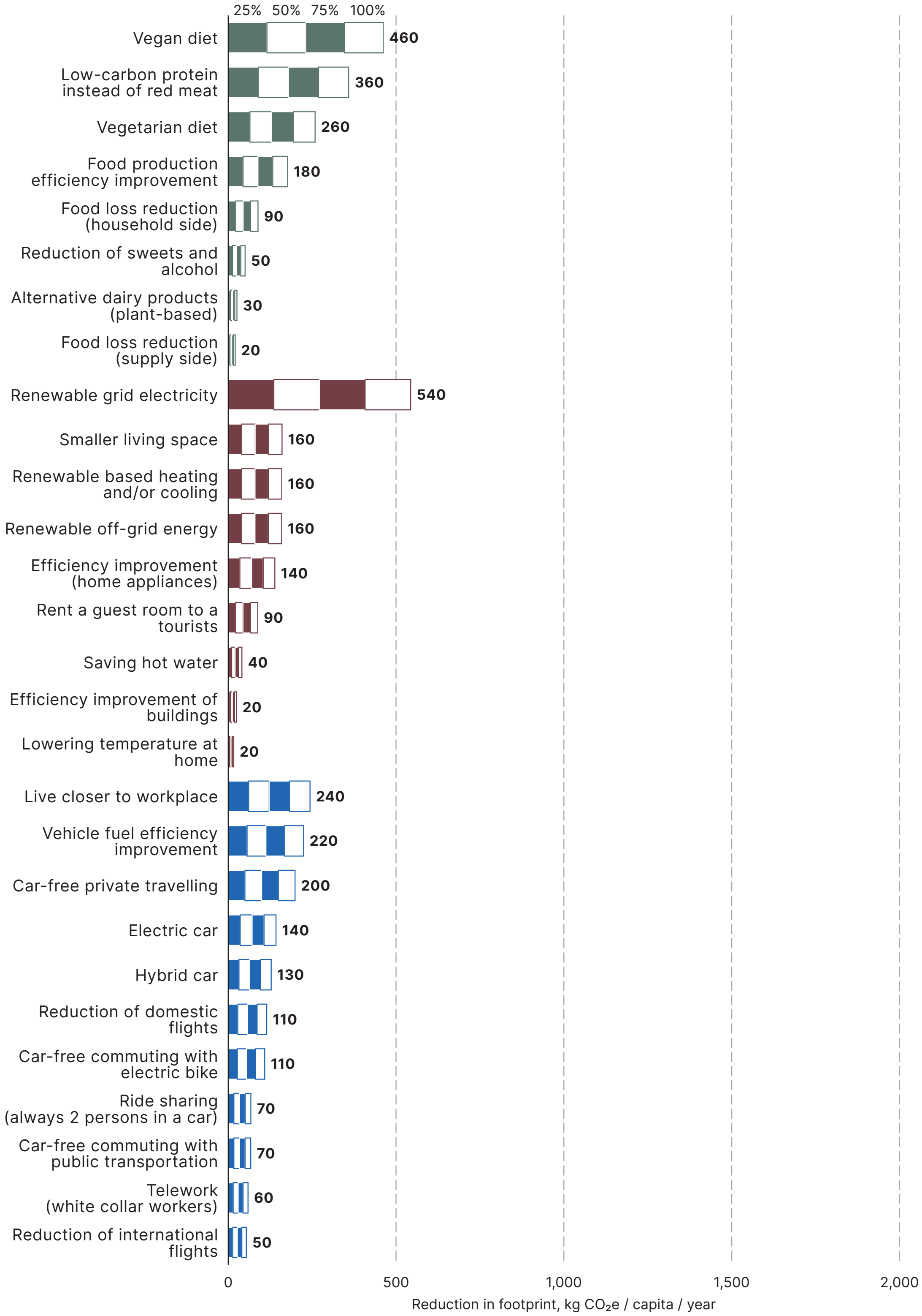


Figure 4.7. A comparison of estimated per-capita carbon footprint reduction impacts (kgCO$_2$e/capita/year) of low-carbon lifestyle options (South Africa)

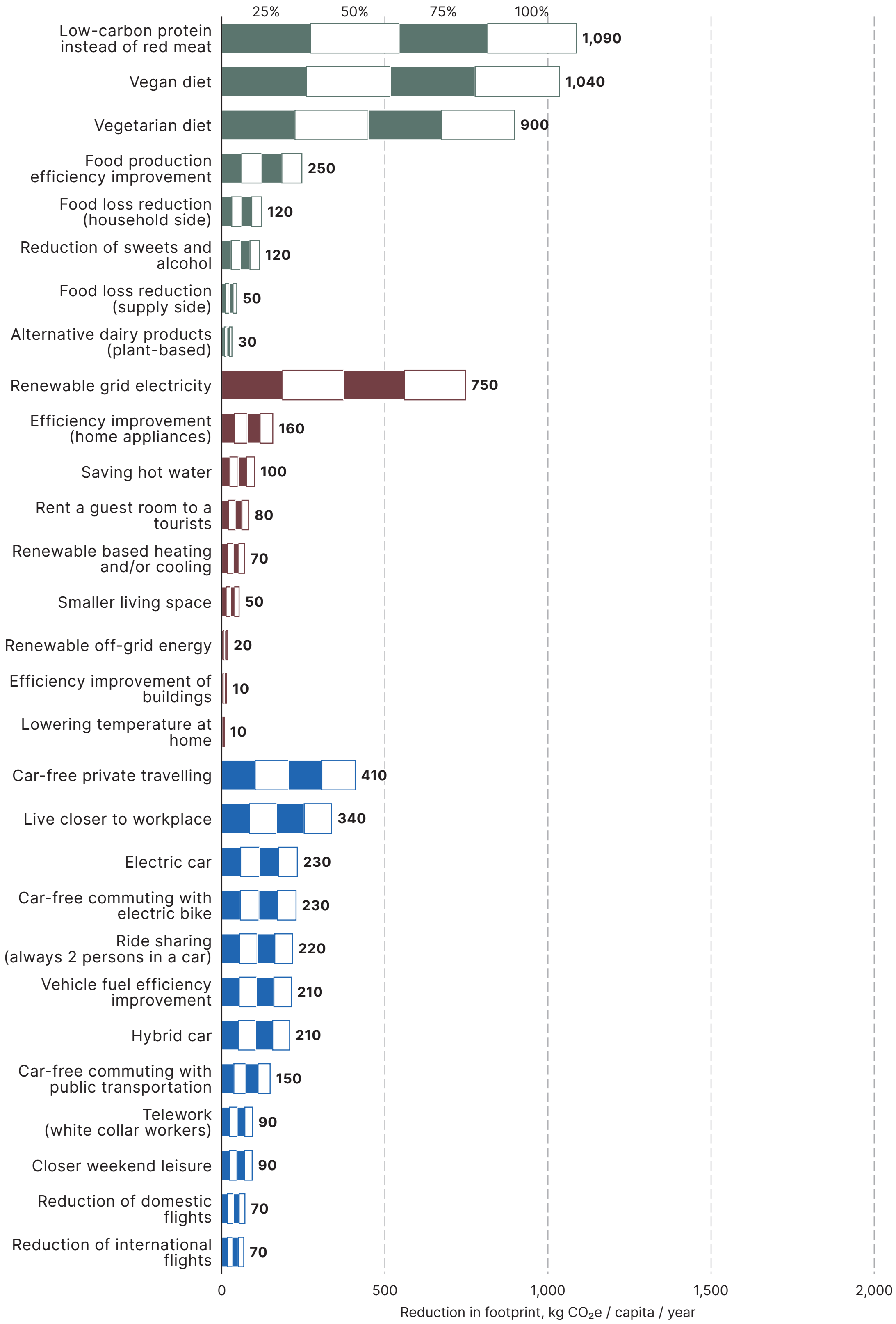


Figure 4.8. A comparison of estimated per-capita carbon footprint reduction impacts (kgCO_2e/capita/year) of low-carbon lifestyle options (Turkey)

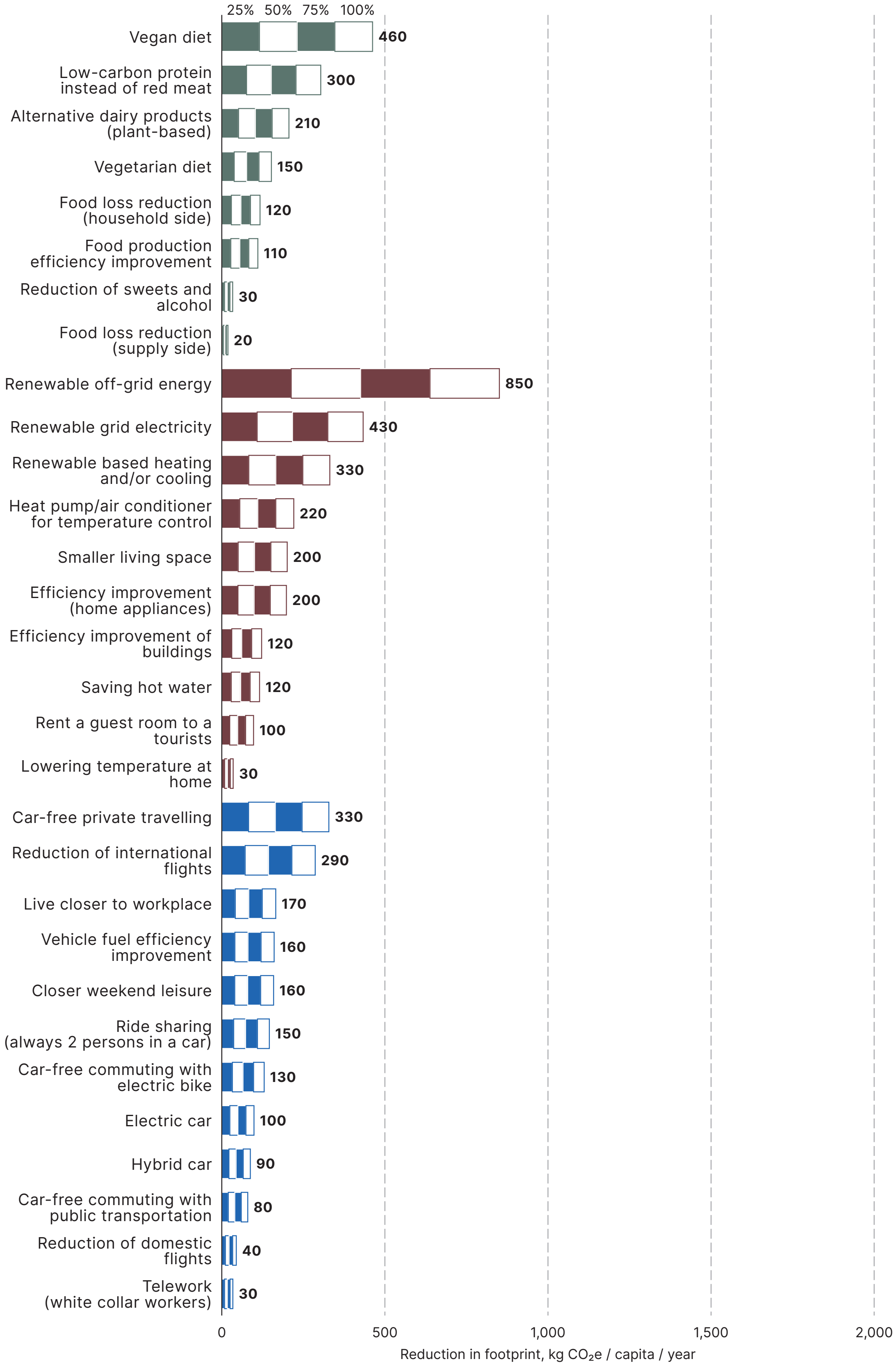


Figure 4.9. A comparison of estimated per-capita carbon footprint reduction impacts (kgCO₂e/capita/year) of low-carbon lifestyle options (Brazil)

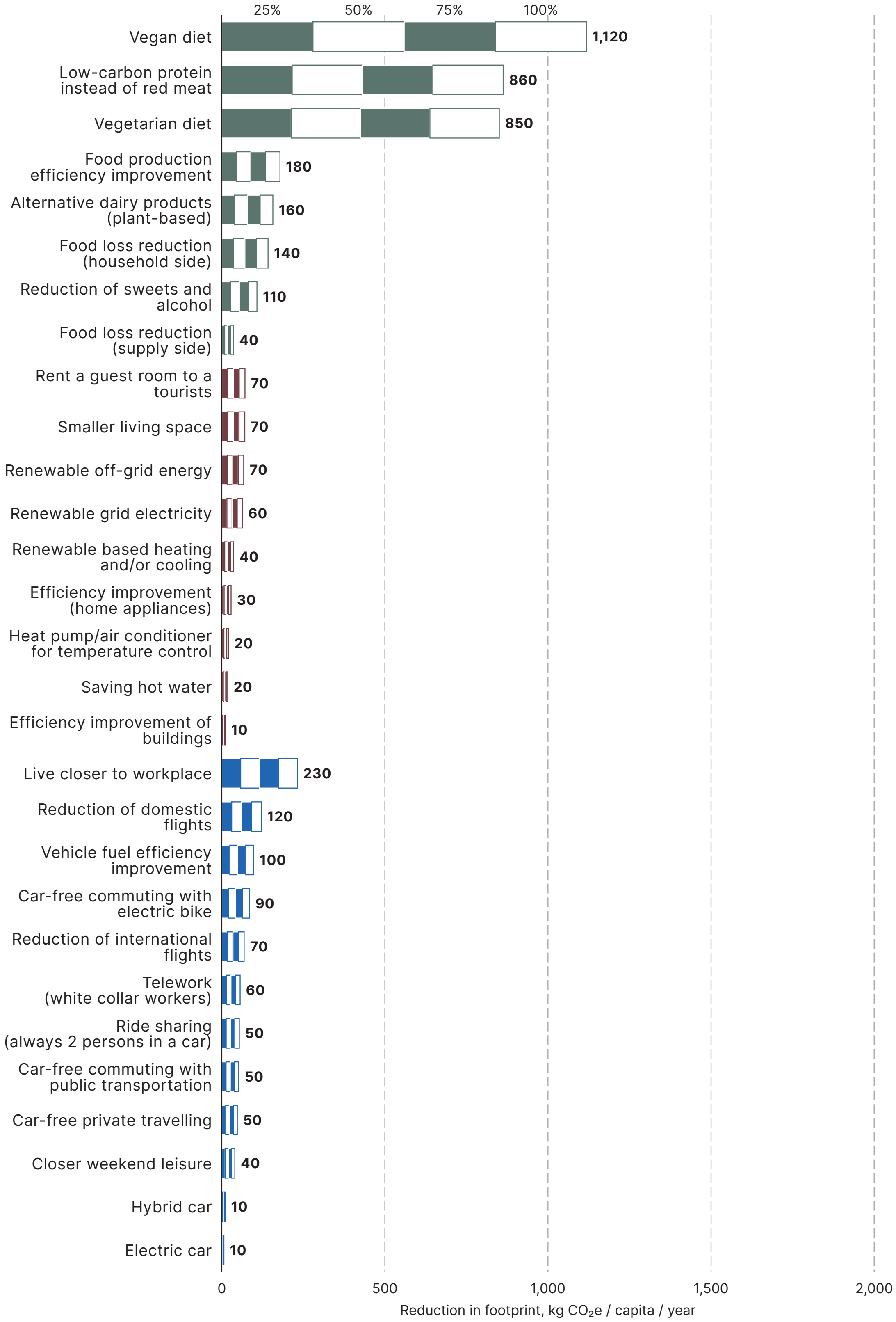


Figure 4.10. A comparison of estimated per-capita carbon footprint reduction impacts ($kgCO_2e$/capita/year) of low-carbon lifestyle options (India)

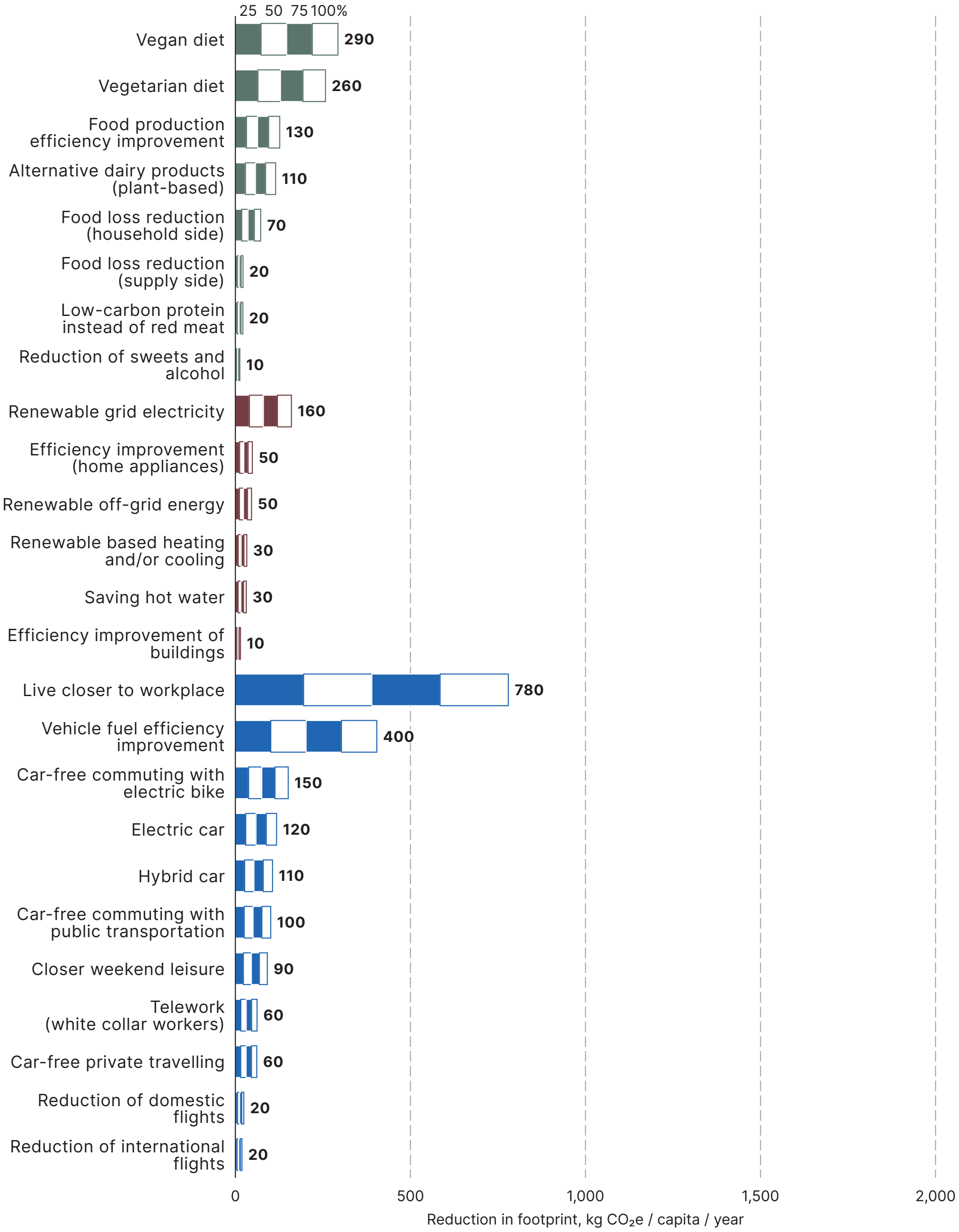
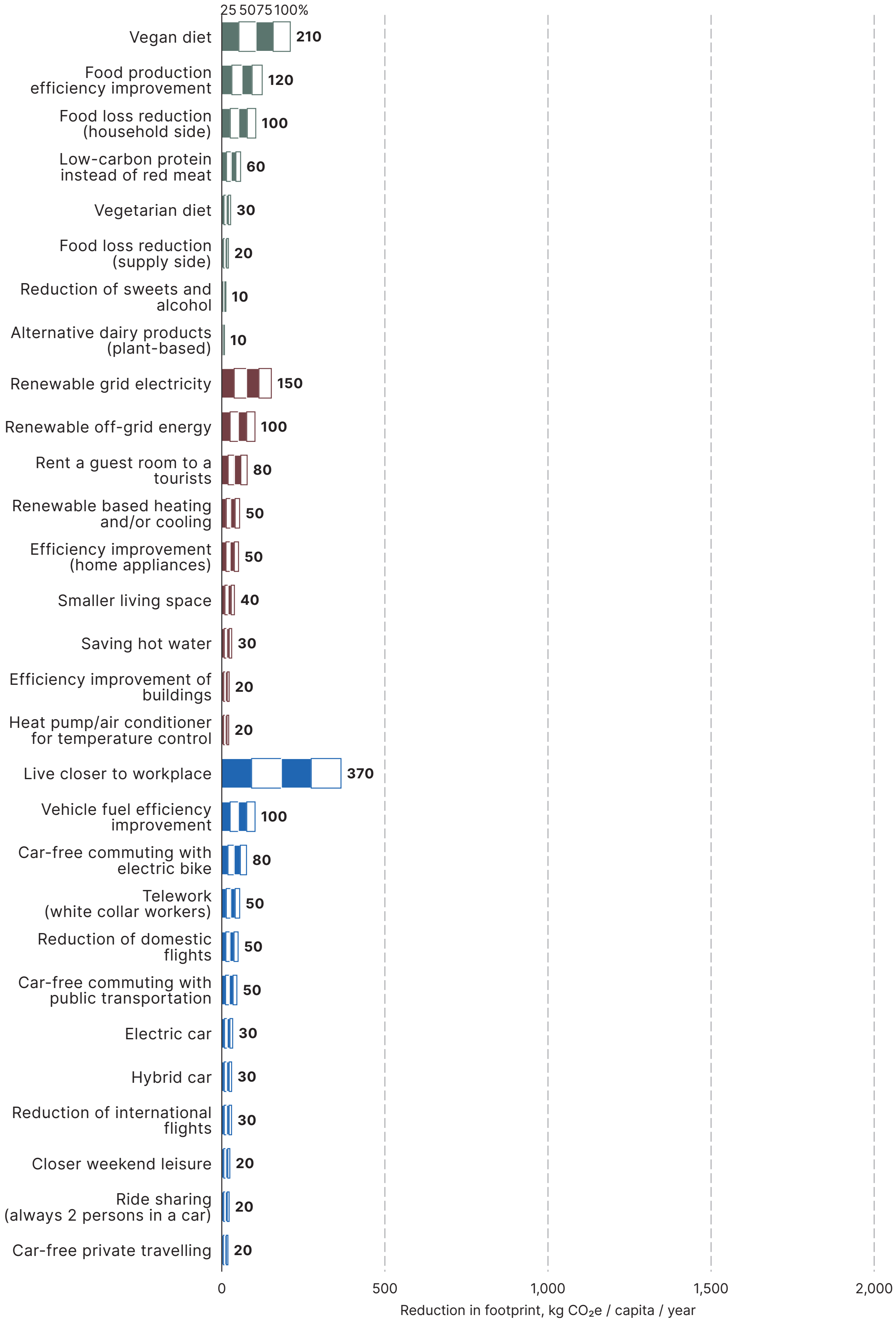


Figure 4.11. A comparison of estimated per-capita carbon footprint reduction impacts ($kgCO_2e$/capita/year) of low-carbon lifestyle options (Indonesia)



Section III Policy Approaches For a Fair Consumption Space

In a world with a limited and fast-shrinking global carbon budget, coupled with vast power and economic inequalities, how do we allocate the remaining carbon allowance in a manner that is fair while drastically decreasing our footprints in a limited timeframe to avoid irreversible ecological damage?

One of the conclusions of the IPCC assessment is that the world is now very close to the point where the Paris target of limiting heating to 1.5°C will get out of reach. Even under optimistic assumptions, a 50/50 chance of achieving the 1.5°C target requires global emissions to peak by the middle of the current decade—that is, 3–4 years from now—and to fall at unprecedented rates until reaching net zero around mid-century (IPCC 2021b). All IPCC scenarios that manage to limit heating to 1.5°C either employ the most drastic reductions, or they first overshoot 1.5°C and then rely on the massive deployment of negative emission technologies in the second half of this century, although there are no guarantees that such measures will work at scale.

What is happening to the planet as a result of continued emissions of greenhouse gases is unprecedented and this calls for unprecedented actions. Efforts made so far, which have been typically measured to protect economic growth and to avoid inconveniencing the polluting consumer class, have been woefully inadequate—hence the worsening trends. The rapidly changing climate and the increasing risks it generates have been called an emergency, even officially recognised as such (Climate Emergency Declaration 2021) by over 2,000 local governments in 34 countries (encompassing over one billion people), but it is not yet treated as such. The ongoing public health crisis caused by the COVID-19 pandemic offers an interesting comparison. In this case, many governments have taken quick and decisive actions despite the negative economic impacts of these policies.

In the following brief chapters, we highlight a number of perspectives and approaches that may help society transition towards a fair consumption space within planetary boundaries. For this, we invited some leading global thinkers and doers for contributions. We have chosen to focus on a few radical topics that are not yet part of the mainstream climate discourse. By doing so, we hope to broaden the discussions on how to deal with the escalating climate emergency in an equitable manner and within a short timeframe.

The approaches can be grouped in three sets of policy approaches: the first is removing carbon-intensive options from the market and driving social innovation, through choice editing (Chapter 5). The second requires setting limits for environmentally harmful consumption and staying within the remaining carbon budget. Tina Fawcett and Yael Parag (Chapter 8) discuss personal carbon allowances and ask if the time has come for carbon rationing. To not put all the weight on consumers, Joachim H. Spangenberg (Chapter 9) examines the role of international carbon allowances, institutions, and the global trade regime, and discusses the European Commission's planned Carbon Border Adjustment Mechanism and how it could avoid unfairly affecting low-income countries where cheap labour has been used to attract high intensity production facilities relocated from industrialised nations. The third set of policy approaches is intended to ensure a more equitable society (through a social guarantee including universal basic services, and adopting a sufficiency approach to address climate change). Anna Coote writes on universal basic services, going beyond universal basic income to ensure that meeting human needs through public services and other collective measures is more equitable, affordable, and sustainable than simply providing cash benefits to support individual market transactions (Chapter 6). Yamina Saheb explores how much is enough and contrasts a sufficiency approach with the current obsession with market solutions and technology efficiency (Chapter 7). Finally, Luca Coscieme highlights the co-benefits of a society living within a fair consumption space, drawing from the Wellbeing Economy Alliance (WEAll 2020) and linking 1.5-degree lifestyles to personal, community, and ecological wellbeing, as well as a stimulant for a wellbeing economy (Textbox E).

Some of these sections will be published subsequently in longer versions as part of a planned series of "Think Pieces" on rapid decarbonisation.

5 – Choice Editing: Taking Out the Harmful Consumption Options

Choice editing involves the use of specified criteria and set standards to filter out unsuitable options in the range of products and services being brought to the market. It is done by manufacturers and service-providers when they decide on product and service portfolios, as well as their designs. Business choice editing criteria is often based on, for example, profitability, available technology, or attractiveness. Brand owners choice edit what goods and quality to bring to different market segments; retailers choice edit what products they shelve for their customers in different zip codes (Gunn and Mont 2014; Kumar and Dholakia 2020). Governments also use choice editing to eliminate unsafe products or services, or to encourage development of safer alternatives, which may otherwise not be made available. Choice editing is effective because what is not available cannot be consumed. Consumption choice is a function of the options available on the market—or, in other words, a response to opportunities created by a combination of government policy (or lack thereof), decisions by manufacturers and service providers, and decisions by retailers on what to shelve.

Lifestyles impacts of climate change are accelerated by cultural norms that encourage consumerism, are driven by advertising, exacerbated by planned obsolescence, and are proliferating in a growth-driven macroeconomic context that depends on ever increasing private and public consumption. Some of the products flooding the market and contributing to climate change, arguably, neither have a function nor contribute to the wellbeing of consumers, their existence predicated on fulfilling a profit motive. Yet, in our current situation, with a highly constrained ecological budget and the need to shrink our footprint very quickly, we need to assess carefully what products use our scarce natural resources and what should be allowed to use up the very limited carbon allowance. One approach to addressing overconsumption is to limit excess; to ensure available options fit within a fair consumption space where everyone first has an opportunity to meet their fundamental human needs (Max-Neef 1991) within the planetary boundaries: hence choice editing.

Lifestyles impacts of climate change are accelerated by cultural norms that encourage consumerism, are driven by advertising, exacerbated by planned obsolescence, and are proliferating in a growth-driven macroeconomic context that depends on ever increasing private and public consumption.

5.1. History and common examples of choice editing

The UK Sustainable Consumption Roundtable, exploring how consumer choices could stay within environmental limits, concluded that given the complexity of consumption and considering the multiple influences on consumer decisions, it is not practical to place the burden of change on consumers alone. The Commission concluded that "the lead for ensuring environmental stewardship must lie higher up in the supply chain" (Sustainable Consumption Roundtable 2006). Among its recommendations is the need for choice editing.

Traditional government use of choice editing is common for public health and safety reasons. For example, in most European countries a consumer cannot simply walk into a shop and buy a pistol or hard drugs. These options have been edited out of the market due to concerns for safety. Smoking in public places is banned in several countries, and seatbelts are mandated for car drivers out of concerns for the public wellbeing. Subsidies and stimulus packages are allocated to encourage new businesses in order to edit in new markets and production opportunities. Choice editing is therefore not new, having been a strong basis for public policy. And in recent years, choice editing out of concern for environmental harm has been implemented, for example, banning leaded petrol and ozone-depleting chlorofluorocarbons (CFCs).

Awareness of the climate crisis has led to widening application of choice editing. The phasing out of incandescent light bulbs from domestic use in Australia, the European Union, and other countries are contemporary examples of governmental choice editing driven by sustainability concerns. Likewise, the ban on plastic shopping bags and other single use plastic packaging from supermarkets by several countries can be seen as steps towards choice-editing for packaging (Akenji et al. 2020). These are basic examples and not nearly enough in a climate emergency.

5.2. Mandate for sustainability choice editing

National governments have signed on to several policy frameworks with objectives and targets that require choice editing. The most recent report of the IPCC warns that human-induced climate change has already caused irreversible damage and that the further we delay action, the more entrenched the dramatic wildfires, floods, poor harvests, and physical illnesses we will witness. As these reports show, more than half of the contributing emissions can be reduced from changes in meat and cheese consumption, fossil-fuelled transportation, and changes in size and temperature of housing. The Convention on Biological Diversity has similar priority areas for biodiversity loss. And yet government action to meet their obligations under these frameworks largely skirt actions that would reduce consumerism, despite rising evidence of acceptability of radical but fair public policy to address sustainability issues. To a large extent this avoidance of choice editing has been due to the fear of the consumer class—the mostly overconsuming population that also doubles as voters.

The optics, especially in democratic or so-called free societies, of government intervention in private consumption choice is perceived as too costly for politicians and for economic growth. For this reason, Di Giulio and Fuchs (2014) approach the prospect of limiting unsustainable consumption choices by acknowledging the need for caution in assessing how it could be feasible—not only empirically but especially politically. The view that establishing consumption limits is against democratic governance and modern systems ensuring individual rights and freedoms is countered by di Giulio and Fuchs with two arguments that can be applied to choice editing and ensuring a fair consumption space. The first is that the pursuit of the common good is the responsibility of the political community—those mandated with governing. Governing includes the management of commons, which the atmosphere and most natural resources are considered to be. Thus the design and implementation of consumption limits is a way of guaranteeing the common good, especially when there is scarcity of said resources or risk that they may be severely (or "irreversibly" as put by the IPCC) damaged. The second argument is that since it is the task of the state to prevent discrimination and protect individuals against infringements on their freedom by others, the state has the right and the obligation to prevent individuals from consuming to such an extent that access to a sufficient quality and quantity of resources is denied to others. Given the significant asymmetries in power that exist in the market and in politics today, the need of exerting this right and obligation to protect freedoms is, in fact, particularly important (Di Giulio and Fuchs 2014). This is only reinforced by recent observations of unpredictable and dangerous weather events, and the message in the recent IPCC report highlighting the prohibitive consequences of global temperature rise above 1.5 degrees (IPCC 2021b).

Whereas traditional choice editing has primarily been through the filter of public safety, health, and security, in a climate emergency governments need to incorporate and prioritise sustainability in their choice editing criteria.

5.3. Implementing choice editing

There are several ways to implement choice editing, from removing the worst products, to making the least sustainable choices less attractive or more expensive, to shifting the context for making choices (i.e. changing the broader "choice architecture") (Maniates 2010).

Removing the worst products is best seen with programs like Japan's "Top Runner" energy efficient appliance program. Each year, the government rates major appliances for energy efficiency, and the top-rated appliances set the standard for future years, thus nudging the worst performing models out of the market. This essentially **creates a race to the top** as there is a clear incentive for companies to make models more efficient year after year. Thus it is not surprising that in the early 2000s, TVs, air conditioners, and refrigerators became 26, 68, and 56% more efficient, respectively (Inoue and Matsumoto 2019).

A second strategy is to make the least sustainable choices more expensive. Plastic bag taxes are a good example. Rather than banning, which draws consumer ire as well as industry lawsuits and work-arounds, taxing plastic bags can also reduce consumption significantly. The city of Chicago, for example, banned thin plastic bags in 2015 but allowed thicker plastic bags, which rather than reducing plastic bag usage significantly, led to retailers offering customers thicker plastic bags. In 2017, Chicago tried again, replacing the ban with a 7-cent tax, bringing plastic bag usage down from 82% per trip to 54% (Parbhoo et al. 2018). Gentler changes can also help people get used to a shifting choice architecture. As more people shift to reusable bags to avoid the tax, when taking the next step of banning plastic bags, citizens are more comfortable with this further edit, having already gotten used to cultural shifts, such as bringing their own reusable bags.

Third, and most broadly, governments and institutions can **shift the choice architecture**, such as when cafeterias remove trays, diners consume less food (Thiagarajah and Getty 2013), or how municipal governments, by building sidewalks and bike lanes and implementing traffic calming infrastructure (like speed bumps), can draw people from cars to more sustainable modes of transportation (Aldred and Goodman 2020). In order to reduce car traffic and to encourage walking, biking, or public transport use, London introduced the Congestion Charge, which vehicles must pay in order to drive within the charge zone in central London. In addition, vehicles that do not meet Ultra Low Emission Zone standards must pay an additional charge to drive in further restricted zones (Transport for London n.d.).

Perhaps one of the most effective, and subtlest forms of choice editing is to **alter the default options**. Limiting the use of public spaces for highways and car parking promotes innovation for more sustainable transport; revising local government zoning laws, size limits for housing construction, and raising the bar for minimum housing insulation standards defaults towards sustainable housing; raising ethical standards for animal farms and mandating reforestation and regeneration of lands previously allocated for cattle and pigs would encourage low-carbon and healthier diets.

Tiered pricing is also a great example of shifting choice architecture. By increasing prices according to usage, tiered pricing expands a basic level of access for all but ratchets down consumption as prices increase along with total usage. In Durban, South Africa, for example, the first 750 litres of water per month is free (recognizing that access to water is a basic human right). But as consumption increases, so does the price. The cost of the next 20,000 litres jumps dramatically, and beyond that the cost doubles again (Vital Water Graphics 2009). Tiered pricing could easily be expanded to electricity and heating fuels, which in turn could further incentivize efficiency upgrades and solar panel installations on homes.

It is not only governments that can implement significant choice edits. While businesses have mostly used choice editing to sell more products (such as cultivating planned obsolescence), companies can also design products to be longer-lasting, repairable, and, through everything from marketing and store design to shelf placement, can encourage more sustainable choices. Stores can even take a further step of only stocking sustainable goods, whether removing virgin paper products, selling only sustainably harvested forest products, or selling only sustainably sourced fishes, as many companies have now committed to do. Companies can also shift default options. For example, utilities can make renewable energy the default source of electricity for new customers, or investment companies can make a green portfolio the default, which leads customers to automatically opt for the more sustainable option (Maniates 2010).

Analyses in this report have shown that key areas where choice editing could have the most and quickest impact are food, private transport, and housing. Ultimately, considering that choice editing directly affects specific industries and product sales, it is rarely conflict-free. Choice editing strategically can help successfully navigate through the conflict, but not always avoid it. Therefore, if conflict is unavoidable, efforts to choice edit should be worthwhile. Thus, while mobilizing against plastic bags is useful, far greater impacts and quicker returns are to be seen in **severely restricting or outrightly banning high carbon-intensive consumerism**, especially where there are privatised benefits and distributed burden sharing. Private jets, mega yachts, fossil fuel investments and other domains where the polluter elite thrive while getting everyone else to pay the environmental price are examples (Textbox D). Common practices of the consumer class such as frequent flying (mileage) programs to accumulate and use miles for further flying, customer loyalty programs that encourage stays in wasteful hotels, etc., need to be seen in the context of their high climate impacts and banned (Carmichael 2019). Such a focus would have the additional advantage of not victimising low-income or sustainable groups that already have limited consumption and environmental impacts. And while outright bans may be challenging with the heavily resourced polluter elite, significant taxes on such unmitigated environmentally destructive consumption options could help rein this in.

As choice editing is an effective and proven strategy, it should be applied across key sectors and sub-sectors: number of houses owned, house sizes and insulation standards, electricity, water, and fuel usage, and so on. As Textbox C lists, there are many high-level transportation choice edits that are already being implemented to great effect.

TEXT BOX C: Examples of sustainability choice editing in transport

Phase out fossil fuel cars. A European Union proposal would ban the sale of new petrol and diesel cars from 2035 in order to address the climate crisis. The European Commission proposed a 55% cut in CO_2 emissions from cars by 2030 compared to 2021 levels (Carey and Steitz 2021). Carmaker Volkswagen has committed to stop selling combustion engine cars in Europe by 2030 (Reuters 2021).

Freeze all new road building projects. As a part of its plan to achieve net-zero carbon emissions by 2050 (Messenger 2021), the Welsh government announced in June 2021 a freeze on all new road projects. In Wales, 17% of emissions are from road vehicles. The government plans to redirect funding to public transport and maintaining current roads (BBC News 2021b).

Discourage private car use. The London Congestion Charge, which vehicles must pay in order to drive within the charge zone, reduces car traffic in central London, encourages walking, biking, and use of the public transport network. In addition, vehicles that do not meet Ultra Low Emission Zone standards must pay an additional charge to drive in further restricted zones (Transport for London n.d.).

Stop airport expansion. Plans to expand Bristol airport in the United Kingdom were rejected by councillors following concerns that it would exacerbate the climate emergency, damage the health of local people, and harm flora and fauna (Morris 2020). Similarly, in 2017 concerns that an additional runway at the Vienna airport would lead to an additional 1.79% annual increase in carbon emissions led a Austrian court to block expansion of the airport (Berwyn 2017).

Ban short haul flights. France has banned short-haul domestic flights—journeys that could be made under two-and-a-half hours—in a bid to reduce climate impacts from flying. Instead it would promote train travel, which is lower emissions per capita, as an alternative along those routes (BBC News 2021a). Similarly, Austrian Airlines replaced short domestic flights with increased train service after a government bailout (a good tool for implementing choice edits) required that it cut its carbon emissions and end flights that are under three hours and have a direct train connection (Halasz and Picheta 2020).

Keep oil in the ground. Governments of several countries, including New Zealand, Belize, Costa Rica, France, and Denmark have all enacted total or partial bans on oil and gas exploration. New Zealand has a ban on new offshore oil and gas exploration permits, and has established a "Just Transitions Unit" to support parts of the country most dependent on the oil and gas industry (SEI et al. 2019).

5.4. Assessments for choice editing

Choice editing at an economy-wide scale requires facilitation by governments and with the involvement of key stakeholders that recognise what is at stake, according to the (Sustainable Consumption Roundtable 2006). To ensure public acceptance, the objective of choice editing needs to be clearly understood, the process transparent (based on a widely recognised criteria such as a scientific approach) and be seen as fair. Developing a choice editing framework is beyond the scope of this report, however, for demonstration purposes, a number of logical and scientific assessment approaches are already widely available that can be used for a rigorous framework.

→ Impact and sustainability assessments ask the question of whether we can ecologically afford the option under consideration. It applies an under standing of biophysical capacity, including planetary boundaries, limits to resources, climate change from GHG emissions to set physical thresholds below which consumption should occur—the ceiling of a fair consumption space.

→ Needs and wellbeing assessments ask the question of whether products and services are necessary. Assessments can be useful to understand the utility of existing products and services, and distinguish products that satisfy needs (starting with fundamental human needs) versus wants. In a climate crisis, a luxury is any carbon emitting product or service that draws on the remaining limited carbon budget without a commensurate contribution to wellbeing or near-term opportunity for regeneration.

→ Social innovation stimulates development of alternative satisfiers of needs, or identification of options that could be modified to be more sustainable.

→ Cost assessments reveal whether alternative satisfiers are economically and socially affordable. Comparative costs reveal what it takes to introduce new product alternatives, modify existing options, or retire some obsolete or harmful products and services completely.

In promoting sustainable lifestyles, choice editing can be applied to edit-in desired options or to edit-out undesired ones. It can be used to edit-out unsustainable products and services (those that don't contribute to the wellbeing of environment and society—or which adversely affect them), overconsumption (consuming beyond the fair consumption space), superfluous consumption (which is neither sustainable nor unsustainable but provides no additional value and takes up resources or opportunities for others to satisfy their needs). Conversely, it can be used to edit-in sustainable alternatives to existing products or ways of meeting needs by stimulating innovation, or to ensure access to satisfiers of fundamental human needs and address under-consumption.

TEXT BOX D: The polluter elite: Recognising inequalities in consumption

Not all lifestyles contribute equally to climate change; in approaching solutions, it is important to recognise that in fact there is a "polluter elite" who hold greater individual responsibility now and historically (Kenner 2019). The polluter elite are extremely rich individuals whose net worth, lifestyle, and political influence mainly rest on wealth that is derived from investments in polluting activities. The 80 million richest people around the world are responsible for more greenhouse gas emissions from their consumption and their investments than the poorest four billion (Chancel and Piketty 2015; Oxfam 2015; Knight et al. 2017). (Their much larger carbon footprints tend to remain hidden by the political institutions' focus on territorial or averaging per-capita emissions.) For this reason, it is appropriate that environmental policies currently under consideration, such as carbon taxes and choice editing, target the richest in their consumption (particularly luxury transport) and investments (their portfolios invested in fossil fuels and agribusiness, which are likely to have much larger greenhouse gas emissions compared to their consumption).

In order to fund the war effort and post-war reconstruction after 1945, the UK government raised taxes on income, inheritance, and luxury goods. The top marginal income tax rate went up from 75% in 1938 to 98% in 1941, and it stayed at this level until 1952; the top inheritance tax rate went up from 50% in 1938 to 65% during the war, and it increased to 80% between 1949 and 1968 (Piketty 2014). Just as in the Second World War when those with the broadest shoulders were asked to contribute the most, in order to get the expected rapid decrease in lifestyles carbon footprints, climate policy must pay attention to asymmetries in power and ensure that actions address the richest while also avoiding disproportionate effects on the poor. If the richest continue their high carbon-intensive lifestyles (as some did when they flew in private jets during national lockdowns while the majority of the population did not leave where they lived) this undermines other efforts at wider behaviour change (Newell et al. n.d.).

Issues of who holds power and profits from the fossil fuel dominated status quo must be engaged with by those seeking to promote sustainable behaviour change (Akenji 2019). Perhaps the most important area and where the role of the polluter elite has been decisive is in their political influence. In addition to their own high carbon-intensive lifestyles, the polluter elite also hold more responsibility because as decision makers they approve lobbying of governments (funding lobbyists and direct donations to political parties) to block the transition away from fossil fuels (Kenner and Heede 2021). With their wealth and access to those in decision making positions, they have contributed to lock-in the consumption options of ordinary citizens to be dependent on fossil fuels e.g. diesel and petrol vehicles, plastic packaging, coal and gas for electricity, heating, and cooking. Whilst some lower-carbon consumption options exist, overall the polluter elite have broadly been successful in trapping consumers by shaping a socio-technical context of carbon-intensive lifestyles. For example, when people want to travel, often the most accessible option (and sometimes the cheapest) is to drive a petrol or diesel vehicle. One factor, of many, for this is because the polluter elite have historically lobbied governments for fossil fuel subsidies and to build infrastructure for the fossil fuel economy (and thus deprioritize low-carbon alternatives).

While many seek options of transforming to low carbon lifestyles, additional attention needs to be on the actors blocking systemic change and individual action. The fossil fuel based global economy we live in today has been built up over centuries of choices by a range of stakeholders. To undertake the necessary phase out of fossil fuel production and use economy-wide will require identifying, discussing, and taking on the power of the polluter elite, in particular their capacity to lobby and capture governments around the world.

6 – Universal Basic Services: Social Guarantee for a Fair Consumption Space

Public services and other collective measures to meet human needs have an important role to play in identifying and realising a fair consumption space and sustainable lifestyles. They represent a form of public consumption that can be controlled democratically rather than by market forces (Coote 2021). It has been noted (in Chapter 1) that sustainable lifestyles can be 'facilitated by institutions, norms and infrastructures that frame individual choice' and that attention should also be paid to 'non-economic aspects of our lives, as well as the role of factors outside the marketplace' including policy and innovation. Therefore ensuring universal basic services is an innovative and regenerative measure that can help to achieve fair and sustainable consumption within environmental limits.

Following is a brief summary of the case for universal basic services (UBS) as part of a Social Guarantee (SG) (The Social Guarantee n.d.) designed to ensure that every individual has access to life's essentials. The SG draws on experience of post-war welfare states, learning from their strengths and their weaknesses, and reimagines them for the 21st century. This brief piece also contributes to addressing a gap in the prevailing discourse about climate mitigation where social policy ought to be and show how social and environmental policies can be mutually reinforcing.

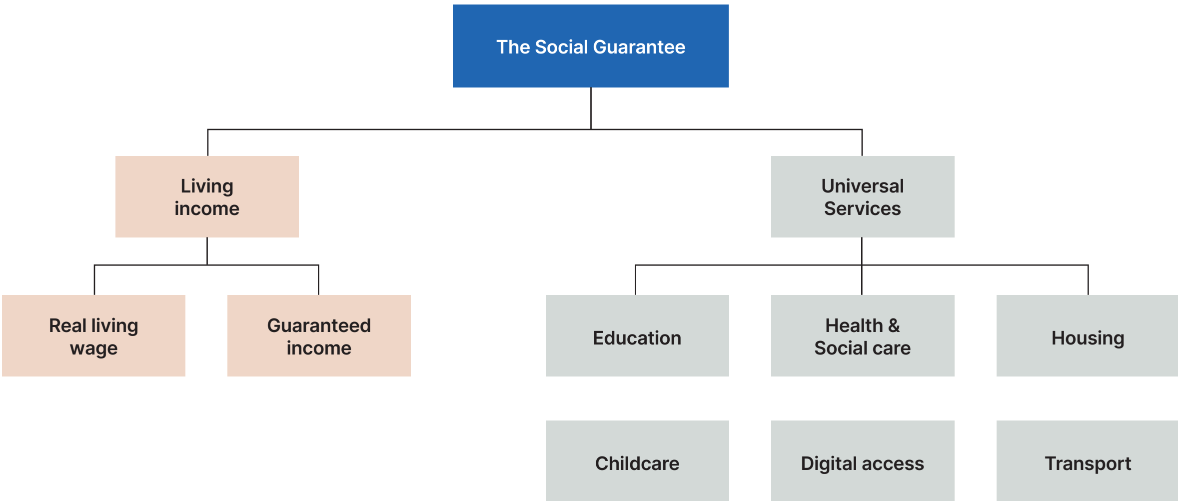
The concept of UBS was initially put forward as an alternative to universal basic income (UBI) as a better way of tackling poverty and inequality (Coote and Percy 2020; Institute for Global Prosperity 2017). The basic argument is that meeting human needs through public services and other collective measures is more equitable, affordable, and sustainable than simply providing cash benefits to support individual market transactions. Growing enthusiasm for UBI as a regular unconditional cash payment to all was seen as a threat to the collective ideal that inspired post-war welfare states—both fiscally (because anything other than a token UBI would be hugely expensive and divert funds from services) and ideologically (because UBI favours markets and individual autonomy over collective endeavour and social solidarity) (Coote and Yazici 2020). In 2021, proposals for a Social Guarantee (The Social Guarantee n.d.) brought together universal services with a fair income derived from a living wage and a guaranteed minimum income, as Figure 6.1 shows. The latter is designed to ensure that no one's income falls below an agreed level of sufficiency. It shares the primary goals of many UBI supporters but is infinitely more affordable and compatible with UBS.

6.1. Meeting human needs

The Social Guarantee is grounded in need theory, recognising that everyone shares the same set of basic human needs that enable them to participate in society. It is argued that every individual should have secure access to these essentials, regardless of income, location, or status.

Doyal and Gough identify participation, health, and critical autonomy as basic human needs (Doyal and Gough 1991). In a similar vein, Nussbaum describes three 'core' capabilities: of affiliation, bodily integrity, and practical reason (Nussbaum 2001). While such needs are universal across time and space, the practical means by which they are satisfied vary widely, as norms, resources, and expectations shift and change between generations and countries. But there are certain need satisfiers or 'intermediate needs' that are generic and enduring. They are listed by need theorists as water,

Figure 6.1. The Social Guarantee



Source: The Social Guarantee (n.d.)

nutrition, shelter, secure and non-threatening work, education, healthcare, security in childhood, significant primary relationships, physical and economic security, and a safe environment (Miller 2012). Added to the list more recently are access to motorised transport and to digital information and communications (Rao and Min 2018).

A key feature of this needs-based approach is that it recognises limits. While wants and preferences vary infinitely and can multiply exponentially, needs are satiable: there's a point beyond which more food, more work, or more security are no longer helpful and could even be harmful. Thus, sufficiency is integral to the process of meeting universal needs. The combination of these two concepts—universalism and sufficiency—is central to the Social Guarantee.

Generic need satisfiers provide a starting point for exploring the practical implications of the Social Guarantee. So far, the focus has been on education, healthcare, housing, transport and digital access, but it could well be extended to other necessities such as food, energy, and access to green spaces.

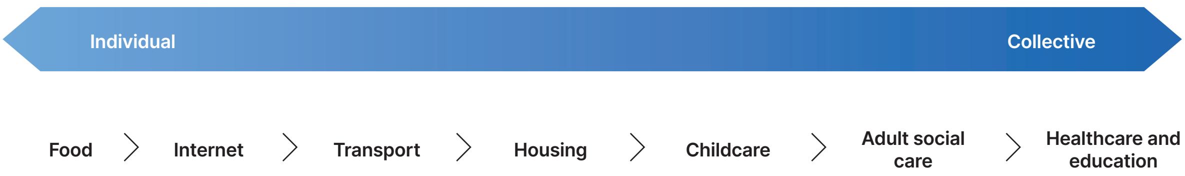
6.2. A normative framework

The Social Guarantee is best understood as a normative framework for policy and practice. Each area of need requires a customised approach. As Figure 6.2 indicates, some needs are typically met by individuals through direct market-based transactions while others can only be met for all by pooling resources and sharing responsibility. In all cases, collective measures—including taxation, investment, and regulation—are required to ensure that access to life's essentials is both universal and sufficient. And in all cases the same set of principles apply.

Accordingly, access to life's essentials is a universal right. Access is based on need, not ability to pay. Power in deciding how needs are met is devolved to the lowest appropriate level. Services are delivered by a range of organisations with different models of ownership and control, but all share a clear set of enforceable public interest obligations, which support collaboration and reinvestment over competition and profit extraction. There is meaningful participation in planning and delivering services by residents and service users, working in close partnership with professionals and other service workers, reflecting the model of co-production (Boyle et al. 2010). Service workers are entitled to fair pay, secure conditions, and high-quality training and career development. There are clear rules and procedures for establishing and enforcing entitlements. Last, but most important in this context, services and other collective measures to secure life's essentials are designed and delivered to promote and enable sufficiency within planetary boundaries.

Within this framework, state institutions are likely to provide some services directly—at national and local levels—where appropriate. Beyond that, they have certain key functions: to guarantee equality of access for individuals, between and within localities; to set and en-

Figure 6.2. Individual and collective means of securing life's essentials



force ethical and quality standards; to collect and invest the necessary funds, distributing them to maximise inclusion and fairness; to encourage and support diverse models of service provision and enforce providers' public interest obligations; and to coordinate activities across sectors to achieve optimal results.

It is proposed that key decisions—for example, about designing services and other measures, or about the order of priorities and pace of change—be made through a three-way democratic dialogue. This combines the experiential wisdom of lay residents with the codified knowledge of experts and the strategic and tactical insights of elected representatives. Citizens' juries and citizens' assemblies offer useful models that can be adjusted for decision-making at national and local levels, and across a range of political settings.

There are many examples from a wide range of countries that show how needs are being met collectively in ways that are fairer and more sustainable than where they are left to unfettered markets. It is impossible to do justice to them here, but details and further reading can be found inter alia in a briefing on 'Universal Quality Public Services' (Coote and Yazici 2020) published recently by Public Services International and on the Social Guarantee website (The Social Guarantee n.d.).

6.3. Investing in the social infrastructure

The costs of implementing the Social Guarantee will vary between areas of need as well as between countries. It will also depend on the scope and quality of measures that are introduced to secure life's essentials for all. Most OECD countries already spend significant amounts on healthcare, transport, and access to digital information. It has been estimated that the total additional annual expenditure required for the five areas of need on which the Social Guarantee is focused, if implemented all at once and provided universally, would be between 4 and 5% GDP in a typical OECD country.

To put this in perspective, both the UK and US governments increased public spending by more than 6% of GDP in 2008 to bail out private banks during the financial crisis and in 2020–21 the United States, Japan, Germany, Italy, and France all spent more that 20% of GDP on fiscal stimulus packages related to COVID-19 (Statista 2021b). These events are not directly comparable, but they do indicate that public spending can be more a matter of political imperative than applying rules of contemporary economics.

Further research is required to calculate the net costs of universal services alongside measures to secure a living income. This would take account not only of expenditure but also of potential savings, as well as returns on the investment in social infrastructure that the Social Guarantee entails. For example, there may be economies of scale where needs are met collectively rather than individually. Enabling people to co-produce—as far as possible —he ways in which their needs are met can bring uncommodified human resources into the process: this can not only enhance the wellbeing of the individuals concerned—provided they are adequately supported—but also improve the quality and scope of the services without a corresponding increase in the overall cost. In addition, collective action to meet needs can prevent harm that would otherwise require more costly 'downstream' interventions by public services—for example, decent childcare and housing for all who need it can improve wellbeing and reduce demands for healthcare services. An analysis conducted for 74 low and middle income countries found that increasing health expenditures by just $5 a person with a focus on preventative health measures could yield up to nine times that value in economic and social benefits including greater GDP growth and the prevention of needless deaths (Stenberg et al. 2014). No less important is the fact that public investment in universal services can generate considerable returns as discussed below.

Protagonists claim that implementing the Social Guarantee can bring substantial benefits in terms of equality, efficiency, solidarity, and sustainability. These claims are not definitive because the framework is new and untested, and there has so far been little opportunity for scrutiny and debate. There is nevertheless some evidence, drawn from studies of existing public services that support them.

6.3.1 Equality

Public services are known to reduce income inequalities by providing a virtual income or 'social wage', made up of in-kind benefits. For example, UK research has shown that a free childcare service would save a couple with two children more than £200 per week. This is worth much more to people in low income groups (Davis et al. 2020). A study of OECD countries suggests that poor people would have to spend three quarters of their income on essential services (Verbist et al. 2012). Table 6.1 shows in-kind benefits—of education, healthcare, social housing, ECEC (early childhood education and care), and elderly care—as a share of disposable income per quintile.

Table 6.1. In-kind benefits as a share of disposable income by quintile, average over 27 OECD countries

	Q1	Q2	Q3	Q4	Q5	Total
Education	30.6%	18.5%	14.2%	10.4%	5.6%	11.8%
Healthcare	34.9%	22.2%	15.8%	11.8%	7.2%	13.9%
Social housing	1.8%	0.7%	0.4%	0.2%	0.1%	0.4%
ECEC	4.5%	3.0%	2.4%	1.5%	0.8%	1.8%
Elderly care	4.0%	1.9%	0.7%	0.4%	0.2%	0.9%
Total	**75.8%**	**46.4%**	**33.5%**	**24.3%**	**13.7%**	**28.8%**

Source: Verbist et al. (2012)

The 75.8% share for the lowest income quintile compares with a 13.7% income share for the highest quintile. Indeed, the study shows that inequality in OECD countries is reduced by one-fifth when the measure is extended from money incomes to a combination of money and social income (Verbist et al. 2012). Without in-kind benefits, many individuals and families would be unable to meet their needs and flourish. They are important for all families, and especially for those on lower incomes, not only directly through the services they offer (education, care, housing), but also indirectly through their preventative effects as well as improving wellbeing and a sense of security. The sense of security is also a foundation for trust, which in turn is good for social interaction, democratic relations, and the economy at large. Those who can rely on getting an education, a decent home, and care when they need it are better protected over time against accumulating risks and vulnerabilities.

6.3.2. Efficiency

Measures of efficiency in the public sector are usually complex and contested. Public services have been accused of inefficiencies, to justify introducing market rules. But privatisation, competition between multiple providers, and customer choice for service users have largely failed to improve outputs let alone outcomes. These failings have been greatly exacerbated by public spending cuts.

Non-profit, collective forms of provision avoid inefficiencies that routinely arise from market processes: inflexible contracts, higher transaction costs, and moral hazards that are encountered when profit incentives combine with unequal knowledge in markets. A non-profit system does not need to extract funds to pay dividends to shareholders.

A 2016 study compared spending on healthcare and average life expectancy in OECD countries. It found the USA, which is a mainly market-based system, outspent the UK in 2014 by the equivalent of £6,311 ($8,000) per person, compared with £2,777 ($3,500, yet had an average life expectancy at birth of 78.8 years, compared with 81.4 in the UK (Office for National Statistics 2016).

Calculations of efficiency must take account of the multiple dimensions of value, the many ways in which value is experienced and how it accrues. This calls for social value analysis to take account of longer-term, indirect effects across social and environmental dimensions. As noted, expenditure on UBS can be seen as an investment in social infrastructure, which can be expected to yield significant returns over time.

Social Return on Investment (SROI) is one approach that has been adopted by the UK government, which formally requires public authorities to consider whether their procurement practices 'improve the economic, social and environmental well-being of the relevant area, and how, in conducting the process of procurement, it might act with a view to securing that improve-

ment' (Department for Digital, Culture, Media and Sport and Cabinet Office 2021). Bauwens has called for a major 'Value Shift:' instead of rewarding 'extractive' practices 'that enrich some at the expense of the others,' we should reward 'generative' practices that enrich the social and environmental resources to which they are applied (Bauwens and Niaros 2017). Building support for UBS will partly depend on redefining efficiency along these lines, by asking how far universal basic services lead to outcomes that renew local assets, safeguard planetary boundaries and nurture human flourishing.

6.3.3. Solidarity

The concepts of shared needs and collective responsibilities embody the idea of solidarity, and the Social Guarantee has potential to develop and strengthen it. Solidarity is taken to mean feelings of sympathy and responsibility between people that promote mutual support. It is an inclusive process, not just within well-acquainted groups but also, crucially, between people and groups who are 'strangers' to each other. It involves collective action towards shared objectives (Wilde 2013).

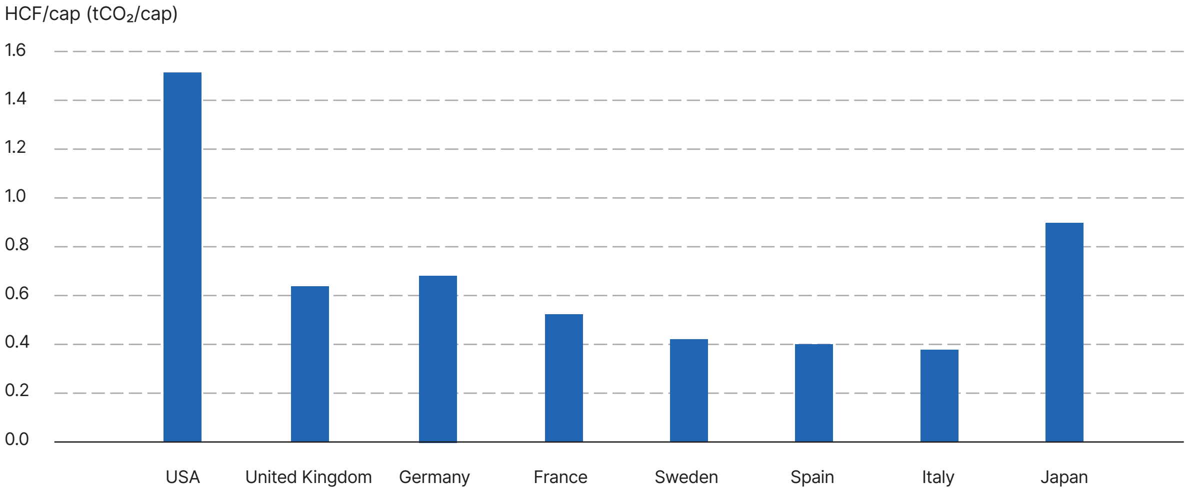
First, universal services can develop experience of shared needs and collective responsibility, which builds understanding of how people depend on each other and a commitment to retaining those interconnections. Second, where services bring people together from different social groups, they can provide opportunities for developing mutual sympathy and responsibility. Third, the combined effects of more and better services bring benefits to society as a whole and have a redistributive effect, reducing inequalities that otherwise create barriers to solidarity.

By contrast, there is a rich literature on the ways in which systems based on individualism, choice, and competition weaken the values of social citizenship and undermine solidarity (Jayasuriya 2006; Brodie 2007; Akenji 2019; Lynch and Kalaitzake 2020).

6.3.4. Sustainability

Sustainability involves, at its simplest, an inherent 'capacity for continuance', as Ekins observes: a sustainable system is one that can function in ways that continue to achieve its desired goals over time (Ekins 2014). Universal services have the potential to affect this capacity through prevention of harm, through economic stabilisation and through helping to mitigate climate change and the depletion of natural resources. The urgent ne-

Figure 6.3. Health carbon footprints per capita, selected countries, 2014



Source: Pichler et al. (2019)

cessity to move away from unsustainable economic, social, and environmental practices provides a new justification and impetus for extending universal services.

As noted, collectively provided services that help people to stay well and flourish are directly beneficial to individuals and society; they can also reduce demand for a range of services required to cope with problems that are otherwise likely to occur. For example, unemployment, anti-social behaviour, and many forms of crime, have roots in poverty and deprivation, which can be significantly reduced by a more generous 'social income'. By helping to maintain and improve social wellbeing, services can not only support the capacity of society to continue to flourish; they can also prevent harm and thereby mitigate the risk of services becoming overwhelmed by rising demand, enabling them to continue to function effectively (Gough 2013).

Where the economy is concerned, public services can help to stabilise fluctuations by generating relatively stable employment and providing security through meeting everyday needs. In these ways, they can act as a counter cyclical buffer, helping to offset the effects of market downturns and recession, contributing to the economy's 'capacity for continuance.'

A move towards more and better public services is considered likely to prove more environmentally sustainable than leaving the process of meeting needs to transactions in a market based system. There are three main reasons for this. First, the Social Guarantee framework focuses on sufficiency for all, rather than on satisfying wants and preferences, which can escalate without constraint. This helps to put a brake on excessive consumption that would otherwise threaten to breach planetary boundaries.

Second, by promoting collective action to pool resources and share risks so that everyone's needs are met, the Social Guarantee can play a part in changing attitudes to economic success—by favouring a concern for human wellbeing within planetary limits rather than simply focusing on GDP growth.

Third, provisioning systems that are democratically controlled with the purpose of serving the public interest have greater potential than market-based systems to promote sustainable consumption, as there is no built-in imperative to increase production and consumption. Through their networks of employees, service users, and suppliers, they can coordinate sustainable practices such as active travel, resource-efficient buildings and local food procurement, avoid duplication and waste, minimise excessive demand, and implement national strategies for reducing GHG emissions. Where governments issue guidance, public sector organisations are more likely to comply because they share public interest values. Where public bodies work with non-governmental partners or subcontractors, they can spread sustainable practices among a wider range of institutions.

There is evidence that collectively provided services have a smaller ecological footprint than privately funded alternatives. For example, the per capita carbon footprint of healthcare in the USA is two and a half times greater than in the UK and three and half times greater than in several European countries (see Figure 6.3).

Finally, public services can play a vital role in decarbonising the economy in a just way. For example, Green

New Deal programmes to retrofit the vast bulk of the housing stock will require public planning, finance, and management. They will be needed to ensure a 'just transition' to lower carbon living, rather than one that will load costs onto the poorest people and communities.

6.4. Conclusion

To conclude, the Social Guarantee is a principled framework that seeks explicitly to contribute to creating a fair consumption space in ways that are summarised briefly below.

First, the Social Guarantee puts collective (or public) consumption on the agenda, alongside individual (or private) consumption, as a site of efforts to achieve a sufficient social foundation for all, to avoid breaching planetary boundaries, and to constrain excessive—and unnecessary—consumption. It involves consumption through expenditures on goods and services by a wide range of social and public institutions at national and local levels. Hospitals, schools, and prisons are obvious examples.

Second, it aims to support a sufficient level of consumption for all through an enhanced 'social income'. It offers benefits in kind, according to need, not ability, to pay, that are intended to enable everyone to have secure access to life's essentials. This the most obvious and substantial way in which the Social Guarantee can contribute to maintaining the social foundation that constitutes the lower boundary of a fair consumption space for sustainable lifestyles.

Third, the Social Guarantee embodies an ethos of collective responsibility and a needs-based approach to human welfare, based on sufficiency. As such, it offers a robust framework for policy and practice that is closely aligned with the goal of living well within limits. It seeks to build solidarity and mutual support among people and groups in ways that cannot be achieved by systems based on market transactions alone. By encouraging an awareness of interdependence and developing practical experience of collective responsibility, it can help to create favourable conditions for society to play a pivotal role in imposing limits on individual freedom to consume more than is required to live a good life (Fuchs 2019).

Fourth, as noted above, the SG framework can influence provisioning systems so that they remain within ecological limits. Inherent in the framework is a stipulation that all organisations that receive public funds to provide universal services, providers subscribe to public interest obligations that include the requirement to cut emissions and safeguard natural resources. Also inherent is the national allocation of resources to local and regional authorities to ensure equal access to services between different areas and population groups. This offers a vehicle for shaping the practice of organisations involved in delivering services and for influencing consumption patterns of people using services. For example, a free bus service can discourage other, more energy intensive forms of travel; housing policies can be designed not only to create zero-carbon homes made from renewable materials, but also to encourage residents to change patterns of consumption and tread more lightly on the planet; childcare services can be organised and run in ways that raise awareness about sustainable consumption, and encourage and support it in practice.

Fifth, the UBS framework can help to constrain excessive consumption by changing incentives and redirecting resources. If collective provisioning became an acceptable—even popular—way to secure much of what is necessary to live well within limits, norms and expectations would shift, influencing what people want to buy, how much is considered 'enough' and awareness of the negative effects of accumulating too much stuff. Financing UBS requires higher taxation, unless debt rises. Even where a tax system is proportional rather than progressive, higher disposable incomes are likely to be brought below the level they would otherwise be, reducing luxury consumption (all else being equal). Comparing two countries, with high and low provision of public services but with similar total consumption, the extent and share of high-end consumption above any ceiling would be lower in the former country.

Finally, it is important to stress that the Social Guarantee is not a single policy lever but a proposed route for policy making across a range of different areas. That route is shaped by distinctive values, favouring collective action to meet shared needs now and in years to come. How far these proposals are able to fulfil their promise depends on how services are devised, organised and funded, where power lies, models of ownership, how people participate, conditions of eligibility, and how entitlements are realised. The Social Guarantee agenda can be introduced incrementally, but its ambitions go well beyond piecemeal reform. It is essentially about changing whole systems to achieve a sustainable future.

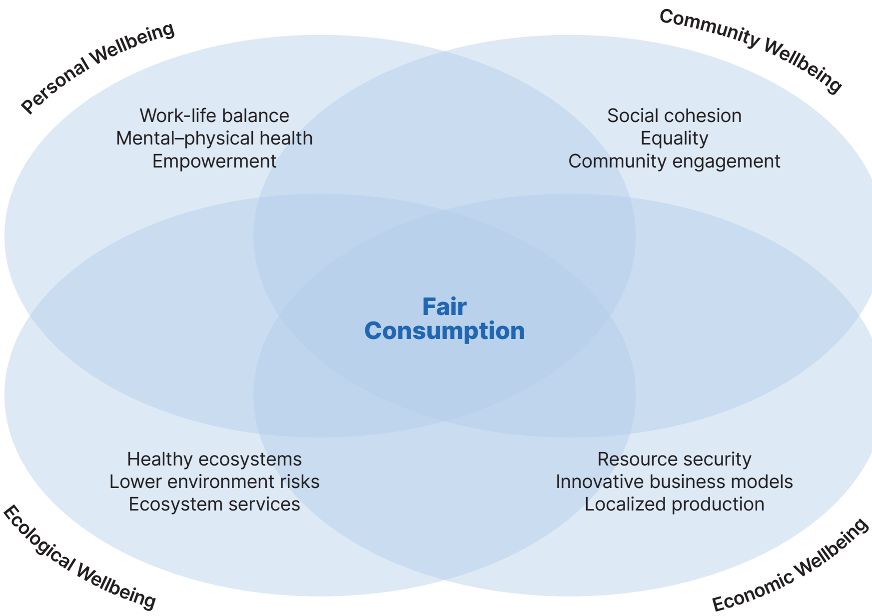
TEXT BOX E: Wellbeing: linking sustainable lifestyles, climate change, and health

Achieving the 1.5 °C target of the Paris Agreement and transitioning towards a fair consumption space will not only reduce the impacts and costs of climate change (IPCC 2018), it will also bring about improvements in quality of life including on physical and mental health, the quality of social relationships, interpersonal trust, work-life balance, empowerment, community engagement, and on many other levels.

Widespread adoption of 1.5-degree lifestyles requires an economy that prioritises human and ecological wellbeing over growth, and that recognizes, protects, and promotes the contributions of natural, social, and human capital to collective wellbeing. Achieving a fair consumption space for sustainable lifestyles means reducing both within- and between-countries inequalities by tackling over- as well as under-consumption. While, on the one hand sustainable lifestyles entail a radical change in the ways we satisfy our needs (Akenji 2019), on the other hand they entail consuming better, and living a healthier life in more equal societies that nurture participation, dignity, human connections, fairness, and ecological wellbeing.

Multiple Co-benefits

Figure E.1. Co-benefits of adopting 1.5-Degree Lifestyles



Achieving a fair consumption space could bring about a number of co-benefits in terms of increased personal, community, ecological, and economic wellbeing.

The quality of human relations and the living environment are both fundamental determinants of a person's health (European Environment Agency 2018). Continuous material growth and overconsumption are not only responsible for rising greenhouse gas emissions but also have detrimental impacts on social cohesion and psychological and physical wellness. Inequalities, psychological distress, anxiety, depression, narcissism, reduction of empathy, and other mental disorders are on the rise in modern societies (Friedli 2009; Botezat et al. 2017; Carod-Artal 2017; Macintyre et al. 2018). Growing inequalities have a negative bearing on personal and collective health outcomes, while greater equality affects many dimensions of wellbeing, from child development to life expectancy, from declining violence to improved social cohesion and interpersonal trust (Kasser 2003; Wilkinson and Pickett 2011). Care-based and trust-based activities, often voluntary, have a fundamental impact on societal wellbeing (Helliwell and Putnam 2004), and high levels of social capital are linked to collective action and more resilient societies.

Studies show how levels of physical health and life expectancy are lower in more economically unequal countries (De Vogli et al. 2005; Pickett and Wilkinson 2015). A meta-analysis of 29 studies, including about 60 million participants in total, found that people living in regions with high income inequality have an excess risk of premature mortality and poor self-rated health, with a 0.05 unit increase in the Gini coefficient linked to an 8% excess mortality risk (Kondo et al. 2009). In industrialised countries, reduction of income inequality was likely to be more effective in lowering infant mortality rates than further increases in Gross National Product per head would be (Hales et al. 1999).

There is an established link between economic inequality and rates of violence, property crime, and violent crime. For example, (Fajnzylber et al. 2002) show how a small permanent decrease in inequality—such as reducing inequality from the level found in Spain to that in Canada—would reduce homicides by 20% and lead to a 23% long-term reduction in robberies.

Countries with higher levels of income inequality tend to have lower levels of education and social mobility (Corak 2016). Lower scores in maths and reading are found in more unequal countries (Wilkinson and Pickett 2009).

Studies show that people in European countries with higher levels of inequality are less likely to help each other (Paskov and Dewilde 2012), and that higher income inequality is linked with lower levels of voter turnout (Geys 2006; Solt 2010, 2008), lower rates of social and civic participation, and lower political engagement (Lancee and Van de Werfhorst 2012).

Wellbeing benefits of fair consumption

A 1.5-degree world is a world with little or no space for inequality. Societies enabling, mainstreaming, and adopting 1.5-Degree Lifestyles within a fair consumption space can only do so in a context of reduced inequalities and increasing collective wellbeing. The co-benefits of 1.5-Degree Lifestyles are many.

Regarding food, the adoption of sustainable diets with reduced consumption of meat not only reduces personal carbon footprints, it is also healthier and linked to lower mortality rates, higher life expectancy, and lower risks of developing heart diseases and diabetes (Willett et al. 2019). For example, one study following more than 200,000 people from three different cohorts for up to 30 years, reported an increment of about 35 grams/day of red meat as associated with a significant 6% increase in risk of type 2 diabetes (Pan et al. 2011).

Regarding transport, reducing private transport in favour of shared, public, and more sustainable transport modes not only reduces carbon footprints, it also reduces air pollution and encourages active modes of transportation, such as cycling or walking, with numerous benefits for mental and physical health, reduced stress and anxiety, and which increase sense of place and social connectedness. For example, (Requia et al. 2018) estimated that PM 2.5 emissions during congestion periods in the Greater Toronto and Hamilton Area have an impact of 119 to 206 deaths per year. These findings are consistent with other existing studies in international literature (Levy et al. 2010; Zhang et al. 2011), and call for transitioning to more sustainable mobility options.

A better work-life balance, for example introducing a 4-day work week, has benefits in terms of better personal health, quality of work, it frees up time for family care and helps adopting healthy lifestyles, all of that while reducing carbon footprints (Knight et al. 2012; Kossek et al. 2014; Lunau et al. 2014). Shorter and less frequent commuting also leads to health benefits (Requia et al. 2018), lowering the demand for carbon-intensive healthcare products and services. Avoiding the stress and anxiety of a traffic jam is also good for mental health (Higgins et al. 2018), especially among women (Sandow et al. 2014).

Business innovation

Adopting 1.5-Degree Lifestyles also provides economic benefits through improved resource security and by opening business opportunities and redefining the role of consumers. Business opportunities emerge through the innovations that could serve as enablers for 1.5-Degree Lifestyles, such as peer-to-peer models, open-source software and hardware, 3D printing, block-chains, precision agriculture and decentralised community-based renewable energy systems (microgrids). Participatory models, where users play an active role in the design and manufacture of products and services, are also proving effective in helping developing countries to transition towards a more sustainable and wellbeing-centred way to meet some basic needs, for instance in the production of renewable energy. For example, by late 2014, an estimated 30% of the global cumulative installed capacity of PV in India was owned by private residents, “prosumers” both consuming and producing electricity (Martin and Jairaj 2016).

By localising and customising production and consumption, business innovation can promote shorter value chains and local empowerment, providing economic opportunities for multiple forms of entrepreneurs while reducing overproduction and waste of resources (Fioramonti 2020).

Finally, climate change mitigation through adopting 1.5-degree lifestyles contributes to tackling deforestation, habitat fragmentation and loss, and other concurrent causes of climate change, biodiversity loss, environmental degradation, and the emergence of pandemics (Jones et al. 2008; Faust et al. 2018; Gibb et al. 2020) and animal-borne infectious diseases such as Ebola (Redding et al. 2019). Climate change impacts ecosystems and ecological wellbeing, affecting crop and seafood production (Nelson et al. 2013), drinking water provision, ecosystems’ “protective” services from floods and coastal storms, as well as other key contributors of nature to our lives (Pörtner et al. 2021).

Overall, by activating policy, innovation, and other enablers for behavioural change, the 1.5°C target of the Paris Agreement can be potentially achieved (IGES et al. 2019). At the same time, a 1.5-Degree society in a fair consumption space would be one of increased personal, community, ecological, and economic wellbeing with reduced inequalities, better mental and physical health, functioning ecosystems, lower environmental risk, and higher resource, food, and water security.

7 – Sufficiency: How Much is Enough to Stay Below 1.5°C?

7.1. Understanding the sufficiency concept

Sufficiency is defined as a set of policy measures and daily practices that reduce the demand for energy, materials, land, water, and other natural resources, while delivering a decent living standard for all within the planetary boundaries (Shaheb, n.d.)—decent living standard being a set of essential material preconditions for human wellbeing, which includes housing, nutrition, basic amenities, healthcare, transportation, information, education, and public space (Rao et al. 2019).

Sufficiency is not a new concept, its root goes back to the Greek word *"sôphrosunè"*, which was translated in Latin to *"sobrietas"*, in a sense of *"enough"* (Cézard and Mourad 2019). The sufficiency concept was introduced to the sustainability policy debate by (Sachs 1993) and to academia by (Princen 2003). With the adoption of the Paris Agreement (United Nations 2015) and the collective failure in curbing global greenhouse gas emissions after three decades of climate mitigation policies (Stoddard et al. 2021), sufficiency is emerging as a climate mitigation strategy to compensate for the unsuccessful efforts of efficiency and limitations of individual behaviour agency in reducing energy demand and its related environmental impacts.

Sufficiency addresses how lifestyles can be sustainable within a fair consumption space. The remaining carbon budget, and its normative target for distributional equity, is the upper limit of sufficiency, while requirements for a decent living standard define the minimum level of sufficiency. By limiting the over and under demand for energy, materials, land, water, and other resources, sufficiency is likely to become, in the current decade, central to the global climate mitigation strategy (Shaheb n.d.). In fact, the untapped sufficiency potential will contribute to address the unprecedented and urgent transformation of the global economy and to limit the unequivocal role of human activities in global warming (IPCC 2021b).

Sufficiency is often conceptualised by contrast to efficiency. The latter is about the continuous short-term marginal technological improvements which allow doing more with less in relative terms without considering the planetary boundaries, while the former is about long-term actions driven by non-technological solutions (i.e. land use management), which consume less in absolute terms and are determined by the biophysical processes (Princen 2003). The focus of sufficiency is on human needs and the services required for human wellbeing (i.e., housing including thermal comfort, food, and personal transport) while the focus of efficiency is on human wants such as products and commodities (buildings, cars, appliances, and energy). In that sense, efficiency is a supply-side strategy while sufficiency is a demand-side one.

Sufficiency questions the current approach to climate change mitigation, such as the promise of the technological breakthrough over lifestyle changes, behavioural change of individuals over systemic change of the economy and the organisation of the society, the cost-benefit analysis over the biophysical reality of the planet, and the market-based instruments over redistributive ones (Akenji 2014). Moreover, sufficiency confronts the dominant discourse, which puts emphasis on trivial actions such as temperature set points and the over-reliance in the technological improvements driven by efficiency, which substitutes one technology with another and thus, increases the demand for materials and their related embodied energy and carbon. Unsurprisingly, sufficiency is perceived as controversial by the wealthiest consumers as it challenges their carbon-intensive lifestyles, requires changes in their consumption patterns and puts an indisputable cap in their consumption levels based on the remaining carbon budget to avoid the overshoot of the 1.5°C temperature target. Sufficiency, however, also includes ensuring that people have 'enough' not to suffer from underconsumption but takes into account that everyone has to have enough for a decent living standard.

Sufficiency principles include the moderation of the speed to enjoy life, the reduction of distances between suppliers and consumers to avoid the ecological breakdown, the limitation of trade to focus more on commons as well as the limitation of goods' ownership (Sachs 1993). Implementing sufficiency principles requires i) structural changes to moderate the demand for energy, materials, land, water, and other resources as well as ii) flexibility to allow for developing usership of services and for adapting the size and the use of goods and infrastructures to evolving human needs (NégaWatt 2003).

7.2. Sufficiency practices

As described in the section below, by considering an equal distribution of the remaining carbon budget for the 1.5°C temperature target as an upper limit, sufficiency requires a metamorphosis in the way human needs (i.e. housing, personal transport, and food) are fulfilled.

7.2.1. Food

Meat consumption and dairy products are the two major contributors to greenhouse gas (GHG) emissions identified in this report. Dietary changes will have a significant impact on limiting the overshoot of the 1.5°C target, especially in countries with carbon-intensive cuisines. Avoiding animal-based products in industrialised countries would reduce food related emissions by more than 50% (Hallström et al. 2015). However, policies have primarily focused on increasing production of organic food (which is also important) and not on reducing carbon-intensive food.

An integral food perspective, which includes prolonging the lifespan of food through better planning, purchasing, storing, cooking, and managing the leftovers is also among the strategies highlighted in the literature to reduce food waste and losses and consequently their related emissions (Roodhuyzen et al. 2017). At a global level, about one-third of food produced for human consumption is lost or wasted. This is equivalent to 1.3 billion tons per year. The highest food lost or wasted is observed in industrialised countries with an annual total of 95–115 kg/capita compared with 6–11 kg/capita in developing countries (Gustavsson et al. 2011).

7.2.2. Housing

The continuous increase of floor area per capita experienced in industrialised countries is a hidden driver of emissions from the built environment at the construction and the operation stage (Lamb et al. 2021). Applying sufficiency principles to housing requires putting a cap on the per-capita floor area. This cap could be achieved by downsizing dwellings through cohousing strategies by clustering apartments when existing buildings are renovated and by prioritising multi-family buildings over single-family homes in new developments or incentives to move 'empty nests' when household sizes are shrinking (Wilson and Boehland 2008; Stephan et al. 2013; Sandberg 2018). The cap on the per-capita floor area will have a direct impact in reducing the demand for materials in the construction phase and energy demand for heating, cooling, and lighting in the use phase (Heinonen and Junnila 2014). Less space also means fewer appliances and equipment and changing preferences towards smaller ones (Aro 2020).

Cohousing strategies provide users, in both new and existing buildings, a shared space (i.e, for laundry, offices, guest rooms, and dining rooms) to complement their private space, thus reducing per capita consumption of resources including energy, water, and electricity (Klocker et al. 2016), while offering social benefits such as limiting loneliness of elderly people and single parents (Riedy et al. 2019). Senior cooperative housing communities and ecovillages are considered among the cohousing examples to scale-up (Kuhnhenn et al. 2020).

Local authorities have an important role to play in the metamorphosis of housing by proposing communal spaces to be shared (Marckmann et al. 2012) through urban planning and land use policies (Newton et al. 2017). This can encourage intergenerational cohousing as well as interactions between people with different social backgrounds (Williams 2008) or spark the establishment of sufficiency consultancy services to citizens (Spangenberg and Lorek 2019). Progressive taxation based on a cap in the per-capita floor area is also needed to adapt the size of dwellings to households' needs (Murphy 2015; Cohen 2021).

7.2.3. Mobility

Over the last three decades of climate mitigation policies, emissions from mobility have increased in all countries (Lamb et al. 2021) driven by the expansion of the use of private cars due to urban sprawl, the lack of public transport, as well as the social and financial incentives to become a car owner. Sufficiency practices to reduce emissions from mobility include living car-free, ride sharing, reducing the travelled-distances, the weight of private cars, and speed limits (Bigo 2020). However, the focus of policies and research has been mainly on changing the behaviour of individuals through car sharing instead of ride sharing (Chen and Kockelman 2016) and on making mobility smarter (Marsden et al. 2014; Barr 2018). The contribution of structural changes to reducing emissions from mobility through new cycling and walking infrastructure, ride sharing, and safe and friendly public transport (Hasselqvist and Hesselgren 2019) are rather neglected in both policies and research.

Air travel and its related emissions have also increased in the last three decades (Gössling and Humpe 2020), especially with the increased offers for low-cost flights and leisure as well as the variety of frequent flyers' benefits. More recently, there has been an increasing focus on avoiding air travel with the flying shame movement. Using other modes of transportation and slowing travel to rediscover trips' enjoyment are among the sufficiency practices to reduce emissions from air travel, which are estimated at 1.6 tCO_2e/capita saved per roundtrip transatlantic flight (Wynes and Nicholas 2017).

Applying sufficiency principles to mobility requires framing mobility as a service to be provided within the limited per-capita carbon budget to avoid the overshoot of the 1.5°C temperature target. Urban planning and land use policies (Duffy 2009) play a major role in triggering or avoiding the daily travelled distances. High density, multi-functional areas, teleworking, as well as progressive taxation of frequent flyers and owners of multiple cars and private jets are among the sufficiency solutions to limit emissions from mobility.

Using other modes of transportation and slowing travel to rediscover trips' enjoyment are among the sufficiency practices to reduce emissions from air travel, which are estimated at 1.6 tCO_2e/capita saved per roundtrip transatlantic flight.

7.2.4. Other (consumer goods and services)

Similar strategies are suggested in the literature for products and goods (Freudenreich and Schaltegger 2020). Increasing the lifespan of products and goods by penalising planned obsolescence as well as moving from a linear use of materials and products to a circular one by reducing, reusing, recycling, and producing locally will reduce emissions from goods. Moving from ownership of products to usership of services (Grubler et al. 2018) as well as a slowing down their use (i.e. Slow fashion (Joyner Armstrong et al. 2016)) are also among the sufficiency practices to consider.

7.3. Sufficiency levels in climate mitigation scenarios aiming at 1.5°C temperature target

The contribution of sufficiency practices in mitigating climate change is hardly captured in global mitigation scenarios due to the underpinning modelling methodologies, which do not capture climate change uncertainties and irreversible changes. The most influential climate mitigation models are driven by i) the narrow techno-economic rationality (Wilson et al. 2020), ii) the technological over-optimism and reliance in unproven supply side solutions with high uncertainties (Larkin et al. 2018), iii) the price signal, iv) the cost-benefits modelling approach and v) irrational faith in the "free" market to mitigate climate change. These mathematical characterisations on which the most influential models are built are growth-based, leading to prioritising climate unfriendly actions such as creating and/or sustaining jobs in carbon-intensive industries considered cost-effective in the short-term. Overall, scenarios based on influential models do not capture the complexity and diversity of the long-term climate change damages, which are considered as externalities translated into social costs that can be internalised using carbon pricing to have the market correct its failures.

Since the adoption of the Paris agreement (United Nations 2015), new scenarios based on sufficiency principles are emerging. The Decent Living Energy (DLE) developed by (Millward-Hopkins et al. 2020) and the Low Energy Demand (LED) developed by Grubler et al. (2018) have pioneering innovative modelling approaches. The former is based on a bottom-up modelling approach while the latter combines both bottom-up and top-down modelling approaches. The LED scenario is the only known scenario delivering on the 1.5°C target without negative emissions (Grubler et al. 2018). Global final energy demand in LED by 2050 is estimated at 245 EJ, which is 40% less than in 2018. On the other hand, the DLE, with its radical demand-side changes driven by sufficiency principles, projects global final energy consumption to be at 149 EJ by 2050. Importantly, both scenarios assume a convergence between the global North and the global South in the fair consumption of space. However, the DLE scenario considers a much lower use of space for all (Table 7.1).

Table 7.1. Sufficiency levels in 2050 for selected services in scenarios based on the sufficiency principles

Well-being dimension	Sufficiency level per service required	Unit	Low-energy demand scenario (LED) (Grubler et al. 2018)	Decent Living Energy (DLE) scenario (Millward-Hopkins et al. 2020)
	Floor area per capita	m²/cap	30	15
	Housing energy demand in the use phase	GJ/cap	1.2–5	0.6–1.1
	Housing thermal comfort (Heating)	kWh/m²/yr	21	10.4–12.9
	Housing thermal comfort (cooling)	kWh/m²/yr	21	10.4–14.1
	Nutrition	GJ/cap/yr	NA	3.1–3.3
	Mobility services	passenger-km/cap	9,544–17,117	4,900–15,000

Models and scenarios play an incredibly important role in decision-making. Innovative modelling frameworks, such as the ones used for the LED and DLE scenarios, show that different pathways to decarbonise the global economy are possible. By considering the planetary boundaries, they both allow for a convergence and a fair consumption of space and use of resources between the global North and the Global South. The 1.5°C target requires an innovative modelling framework to break the existing silos inherited from the disciplinary specialism and the theoretical frameworks that have led to increasing emissions during the last three decades of intensive climate mitigation policies.

8 – Has the Time Come for Carbon Rationing?

8.1. Rationing: a socially just response to the climate crisis

New policies that address calls for climate justice and concerns about equity are needed. One policy approach that could resonate with these calls is carbon rationing. Personal carbon rationing[23] is a policy concept that aims to fairly reduce carbon emissions by targeting end-users and by focusing on the contribution of individuals' choices to global emissions. Carbon rationing also recognises individuals as citizens with a moral responsibility to contribute to protecting current and future generations from the climate crisis. It is based on the premise that climate change is a threat to society and therefore mitigation is a shared societal responsibility that should engage all members of society in a way that reflects their impact. It is both collective and individual, promoting society-wide and individual change, and making explicit links between global environmental limits and personal actions.

Carbon rationing is relevant for two main reasons: first, existing policies and programs are insufficient for meeting carbon reduction targets, and second because it meets calls for socially just action on climate change.

8.2. Carbon rationing as an idea

Rationing is usually introduced to control access to a scarce resource. It serves the double purpose of preventing overexploitation of the resource and ensuring that everyone has access to meet basic needs. 'Carbon rationing' is shorthand for rationing the right to emit carbon emissions where the scarce resource is the limited cumulative global greenhouse gas emissions budget if catastrophic climate change is to be avoided. The resource in this case is somewhat abstract, scientifically defined, and politically negotiated, and unconnected to people's everyday experiences. This makes it different from other rationing schemes in very important respects. However, the principles are the same, and there can be relevant lessons from historic and current rationing policies.

8.3. Contemporary and historical resource rationing

Rationing of individual access to services or resources is used in a variety of contemporary contexts, including road space rationing (Victoria Transport Public Institute n.d.) and water rationing (Enqvist and Ziervogel 2019). Rationing may be in response to a short-term emergency—either of shortage or unacceptable impacts of continued consumption—or as a longer-term policy. For example, 'load shedding' is a form of electricity rationing when power is cut to parts of the electricity grid for a limited time to avoid wide scale blackouts. This is used regularly in developing countries with inadequate electricity systems (Hashemi 2021), but also occasionally in industrialised countries, particularly in re-

23 Rationing individuals' carbon is an idea which has been discussed under a variety of names and different scheme designs: personal carbon trading, rations, allowances, budgets, quotas, individual carbon allowances, tradable energy quotas. The most common policy names in the academic literature are 'personal carbon allowances', PCA, and 'personal carbon trading', PCT. Here we use the language of rationing when referring to the general concept and PCA or PCT when referring to a specific policy.

Carbon rationing also recognises individuals as citizens with a moral responsibility to contribute to protecting current and future generations from the climate crisis.

sponse to extreme weather events (e.g. in Texas in 2021 in response to winter storm damage to the network (IEA 2021). Thus, rationing is part of the toolbox available to today's public policy makers but, for many it is more associated with experiences in the Second World War.

During the Second World War years (1939–1945), some degree of food control and rationing operated in almost every country in the world. The British food scheme, for example, rationed meat, cheese, fats, sugar, and preserves in fixed quantities per head. Additional schemes were superimposed on this common basis to meet particular needs, e.g. extra protein, vitamins, and minerals were provided to children of preschool age, and nursing and pregnant mothers (Burnett 1989). Food rationing in the UK, coupled with subsidies and price controls, promoted greater social equality, and consumption became more equal in contrast with the intense inequalities that existed previously. Despite difficulties, contemporary opinion polls showed that rationing and food control were on the whole popular and discontent was eclipsed by general satisfaction (Zweiniger-Bargielowska 2000).

Reflecting upon three years as UK Minister of Food during the Second World War, Lord Woolton believed that "the success of any rationing scheme depends, in the long run, on two things; the first is its justice and impartiality, and secondly—and perhaps the more important factor—on the general public acceptance of the correctness of its purpose and the fairness of its administration." The UK government took great pains to convince the public that rationing was necessary and temporary, explaining the economic case and invoking popular memory of the success of rationing during the previous war (Roodhouse 2017). The evidence is that the political and public acceptability of rationing policies is not determined solely by the policy design, its benefits and disbenefits, and its place within the broader policy landscape. It is also about how these are communicated and understood.

TEXT BOX F: Carbon rationing in the UK

Early carbon rationing research was predominantly carried out in the UK, and it is also the UK where the idea came closest to adoption by the government in 2007/08. However, despite initial high-level interest by the Environment Minister, after further government-commissioned research, it was declared to be an idea 'ahead of its time' (Defra 2008). Subsequent support from parliamentary committees and other influential bodies did not receive government interest in the idea (Fawcett and Parag 2010). There are different perspectives on why this was the case. The commissioned research certainly showed serious challenges with turning this idea into a policy—with high costs and concern about public acceptability of the idea being key barriers. However, it is also notable that at that time there were only a handful of published academic articles on personal carbon trading; there was almost no evidence base from which to examine the ideas as a potential policy. SImilarly, there was no significant civil society knowledge of or support for the idea. Arguably this idea had its moment in the political spotlight too soon in its development.

A recent study analyses carbon rationing policies using the multiple streams approach, which defines criteria that a policy proposal must meet to become part of the political agenda (Bothner 2021). It concludes that personal carbon trading will only move out of the 'policy primeval soup' when many researchers, practitioners, and politicians support the idea. A bright idea is not enough.

8.4. Policy design

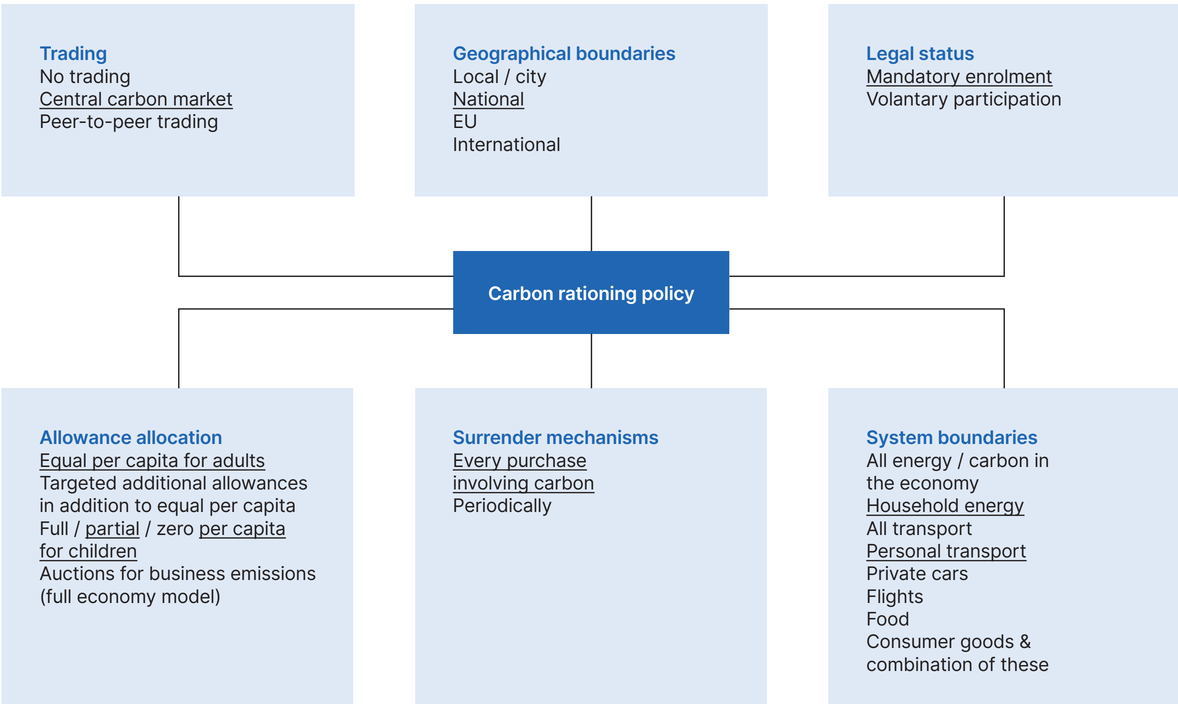
Several different policy proposals based on the idea of rationing or personal carbon trading have been explored. The policy design elements which attract most debate are the scheme boundaries, i.e. which economic sectors/activities are covered, how allowances are allocated (including whether an equal per capita allowance is fair), and whether trading in allowances is possible. Figure 8.1 illustrates key design decisions, which are combined to form a carbon rationing policy.

Other decisions not illustrated here include the monitoring and enforcement systems, obligations on various parties involved in the carbon system, what happens if the carbon price becomes unacceptably high—these issues are explored in Eyre (2010). Also important is the technology used to operate the policy (Fuso Nerini et al. 2021), lifetime of allowances and surrounding policies.

Critically important too is the rate at which personal allowances reduce over time—whether by a fixed percentage per year, fixed amount per year, or more slowly initially and then ramping up.

The combination of choices underlined in Figure 8.1 relate to a mandatory scheme, at a national level, with equal per capita allowances for adults and partial allowances for children, which covers household energy use and personal transport, and where allowances are tradable[24]. While many different combinations of scheme attributes can be chosen, we use this version of carbon rationing for illustration purposes, and call it personal carbon allowances (PCA). It is very similar to that proposed in the early literature on carbon rationing (Hillman and Fawcett 2004), and shares important characteristics with others proposed, trialled and studied, particularly the focus on direct uses of energy, the inclusion of trading, and equal per capita allowances.

Figure 8.1. Key design elements of a carbon rationing policy, underlined choices are those combined in a Personal Carbon Allowances policy



24 It is possible to have a carbon rationing system without personal carbon trading, or with limits to what can be traded. In this regard, one approach to a more socially just rationing system is having merit goods or base amounts of goods that cannot be traded. Given the potential for trading to prey on inequalities between the rich and the poor, perpetuated by unregulated markets, a mechanism for exchange would need to be carefully thought through for a successful carbon rationing approach.

To explain briefly these key design choices:

Focus on direct energy use: In 2018, 93% of global anthropogenic carbon was emitted from use of fossil fuel energy. In the same year, 76% of all greenhouse gases[25] was from fossil fuel energy (Climatewatch 2021). A significant share of emissions result from energy-use decisions made by individuals, such as electricity use, heating and cooling, as well as land and air travel choices. Most literature on personal carbon rationing proposes schemes covering direct uses of energy —either household energy and personal transport emissions, or just personal transport. It is considerably more difficult to create a system which includes embedded energy in terms of, for example, food, due to the difficulty of calculating accurate carbon footprints for such products.

Trading: With trading, those with low carbon footprints would have spare carbon units to sell, and those with high emissions would need to buy additional units when their allowance runs out. The high-polluter pays while the low-polluter is rewarded. Trading provides an economic incentive to reduce personal emissions, but, more importantly, it provides a mechanism for people to adjust to the impact of a fixed and reducing allowance (for more details see Text box G).

Equal per capita allowances: Simply, this is a demonstrably fair starting point for distributing access to this scarce resource, and a simple policy design. There are of course many arguments in principle and practice about definitions of fairness and the impact of policy designs on different groups (Starkey 2012). See Text box H for a discussion of winners and losers.

TEXT BOX G: Why trading?

The available evidence shows that carbon emissions from household energy plus transport energy vary hugely between individuals (by a factor of 12 in a small sample of 32 UK individuals (Fawcett 2005). Emissions depend on lifestyle choices, but also on geographical location, housing type and available heating fuels, amongst other parameters. The large variation in individual emissions is a key reason for the inclusion of trading.

If a rationing scheme had equal annual allowances and no trading either:

(a) approximately 40% of the population (with above average emissions) would have their energy use significantly restricted, immediately, to fit within their personal allowance

or

(b) the personal allowance would have to be set so high—to ensure most people could get the energy services they are accustomed to—that no significant savings would be made.

Trading is a mechanism to ensure both that the cap can be set at a level which delivers collective carbon savings and that people who cannot manage with their ration can purchase extra units. It also rewards those with a low carbon footprint, as they can earn money from selling spare allowances.

Trading is controversial, and there are many objections to it from both principled and practical standpoints.

25 This includes carbon dioxide, methane, nitrous oxide and F-gases.

These design choices can all be debated—and other researchers have proposed different policy designs. For example:

→ In the UK, electronic Tradable Energy Quotas (TEQs) were proposed, covering the whole economy and divided among individuals (40%) and other energy users (60%) (Fleming 2006);

→ In Ireland, Cap and Share (C&S) certificates covering the whole economy were proposed giving all adults emission certificates for an equal share of national emissions. Such certificates would be sold by individuals via banks and post offices to fossil fuel companies (Feasta 2008);

→ In California, household carbon trading was proposed for household energy, managed by the utilities (Niemeier et al. 2008).

TEXT BOX H: Winners and losers

Carbon rationing would create 'winners' and 'losers'—those with emissions higher than the ration amount would be losers, and those with lower emissions would be winners. People with low emissions could sell their spare ration on the carbon market. As people adjusted their consumption patterns in response to the ration, the distribution of winners and losers would change.

Vulnerable losers—those on lower incomes, facing significant extra costs under rationing, and without the capability to reduce their emissions—are of particular policy concern.

In parallel to carbon rationing, there would likely be additional support policies for vulnerable groups, to help them invest in/access lower carbon technologies or energy services. There could also be additional rations given to groups of concern—e.g. low income households living in rural areas, dependent on travelling long distances by car. However, raising the ration for some means that it is reduced for everyone else. It also effectively subsidises high carbon living, and should be a transitional measure for most groups, being phased out as low carbon options become more universally available.

8.5. Mechanisms of change

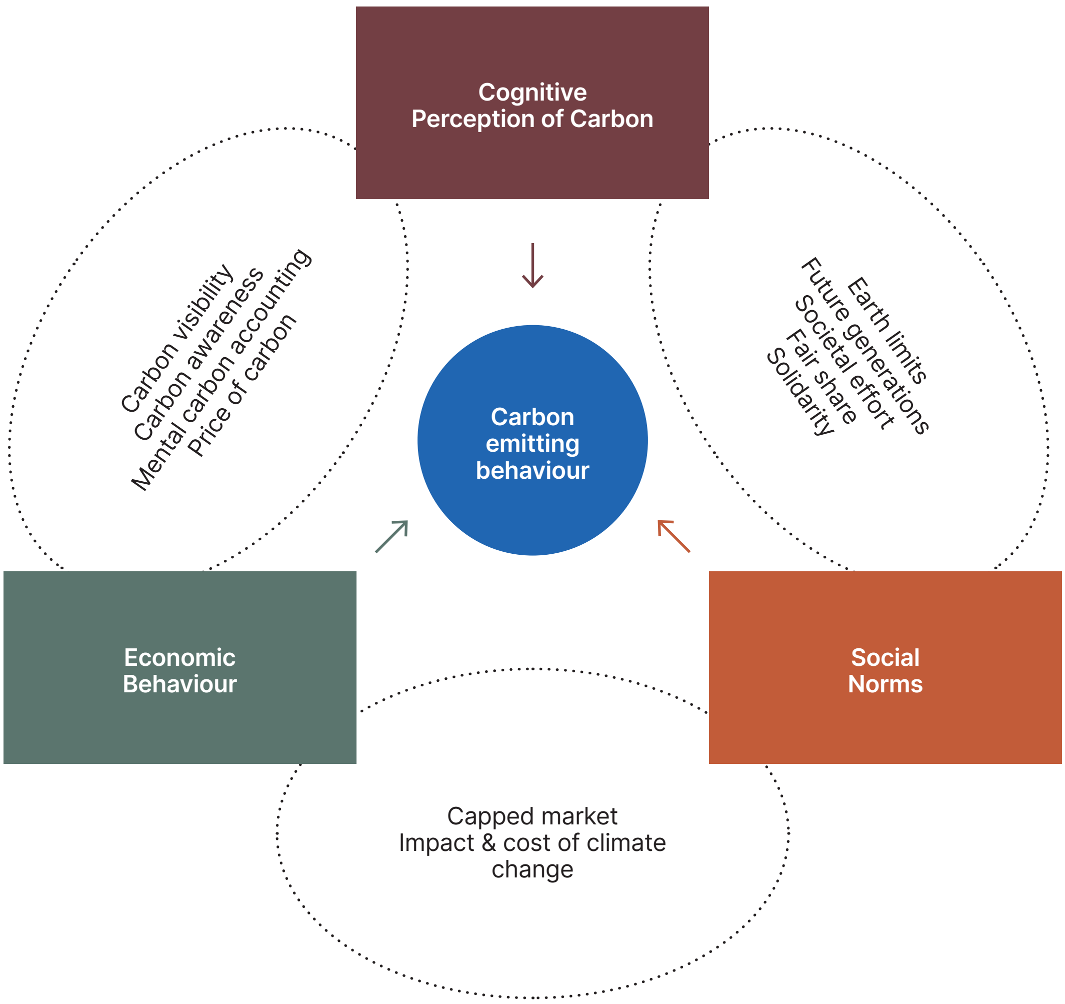
Rationing carbon is envisaged to influence individuals' carbon emitting behaviour through three interlinked and synergetic mechanisms: economic, cognitive, and normative (Parag et al. 2011). Figure 8.2 summarises the influence mechanisms.

Economic mechanism: the carbon price on personal emissions is likely to encourage people to prefer low over high carbon activities and goods, as the low carbon options will cost less. In addition, the introduction of a new virtual "carbon currency" and the shortage of carbon units created by the shrinking cap is likely to encourage mental carbon accounting and to promote economical use of carbon.

Cognitive mechanism: a PCA scheme is likely to engender new carbon and climate discussions and conversations in society, which in turn will increase carbon visibility and enhance individuals' awareness of their own impact on the climate. The cognitive process of linking actions and behavioural choices to consequences on climate is likely to encourage people to rethink high carbon emitting activities and prefer lower ones.

Normative mechanism: the underlying PCA premises of environmental limits, emissions fair shares, societal climate responsibility, and social solidarity are likely to create new social norms of what is socially acceptable behaviour and what is not. Because people tend to comply with prevailing social norms, it is envisaged that PCA will foster widespread low carbon lifestyles.

Figure 8.2. How PCA mechanisms could influence energy-use decisions and lead to low carbon choices



8.5.1. Trials

Personal carbon rationing has not been introduced anywhere on a mandatory basis. However, voluntary personal carbon rations, allowances, or budgets have been tested at various scales: locally through small 'carbon rationing action groups' (Howell 2012); in businesses, for employees (WSP 2021); across Norfolk Island, Australia in a health improvement and carbon reduction trial (Webb et al. 2014); and for transport at city-level in Finland (Kuokkanen et al. 2020).

The most recent trial is a personal carbon trading pilot in urban mobility in the city of Lahti, Finland. The aim is to incentivise citizens to reduce their mobility-related emissions through the means of a digital personal carbon trading (PCT) platform and mobile application. In addition, the aim is to improve citizens' carbon emission literacy and introduce a personal carbon trading approach to the wider public (Kuokkanen et al. 2020).

An earlier trial, the Norfolk Island Carbon/Health Evaluation Study (NICHE), occurred on Norfolk Island, 1,500 km off the coast of Australia from 2011. Hundreds of residents participated and there was an electronic carbon accounting system, feedback on carbon emissions, and rewards for participation. The research aims were to test attitudes to an incentive scheme for saving energy and reducing carbon footprints and to test the hypothesis that increasing people's environmental consciousness will have a positive impact on their health through better health behaviours (i.e., more exercise and healthy diet) (Webb et al. 2014; Webb and Egger 2014). Research on engagement with the Personal Carbon Monitoring System (PCMS) on Norfolk Island found significant pro-environmental changes in attitudes and behaviours towards the environment, carbon emissions, and climate change following the trial. Post-trial surveys also showed respondents believed most people would accept PCMS as a tool to improve the environment (Hendry 2019). Post-trial, there was an average 18% reduction in total household carbon emissions, from vehicle fuels (25% reduction) and electricity usage (12%). However, there was no reduction in body weight, one of the other hypothesised benefits of the intervention (Webb 2018).

8.5.2. Distributional effects

The distributional effects of carbon rationing depend on the design of the policy, the current distribution of personal carbon emissions, and the capacity of individuals and groups to respond to rationing and reduce their emissions. There is growing literature on how emissions vary by income and geography (e.g. Hargreaves et al. (2013); Kartha et al. (2020)). All the evidence suggests that carbon emissions go up with income, particularly transport emissions, and so lower income people will be 'winners' and higher income people 'losers' under a PCA policy design, on average.

Detailed distributional modelling of the effect of a PCA in 2006 in the UK showed that despite the overall progressiveness of an equal per adult carbon allowance allocation system, a significant number of low-income households would be made worse off by PCT (30% of households in the lowest three income deciles). However, compensatory mechanisms—targeted additional allowances and financial compensation—if combined could significantly reduce the number of low-income losers by about half (White and Thumim 2009). Debate about different scheme designs to make rationing more just continues (Burgess and Whitehead 2020)—but there are few if any significant recent modelling studies—meaning that detailed questions about the distributional effects of rationing cannot be answered with confidence.

8.5.3. Public and political support

From the start, there has been concern about whether carbon rationing would be publicly and politically acceptable. It runs contrary to the conventional wisdom about the extent to which governments can and should challenge personal consumption. When it was discussed in the UK in the late 2000s, PCA was perceived by policymakers as a political risk (Bird and Lockwood 2009). There are clear political risks in advocating any challenging or radical policies, particularly if they have never been implemented elsewhere and there is no previous policy experience to learn from. In fact, the empirical finding that most people in the UK had negative feelings towards PCT (Owen et al. 2008) helped put an end to political interest in the topic.

The evidence on public views towards PCT to date is mixed. In various empirical studies, the share of people who feel positively about PCT ranges between 25% and 77% (Guo et al. 2021; Bristow et al. 2010). This variation may in part be attributed to differences between more and less recent research, geographical, or methodological differences (Bothner 2021). Public acceptability has been examined with methods as diverse as surveys and questionnaires, focus groups, (semi-)structured interviews, and choice experiments based on participants' actual carbon footprints. On top of that, PCT is sometimes assessed on its own or compared with other carbon pricing mechanisms, such as a carbon tax or road pricing schemes. When confronted with alternatives, people tend to prefer PCT over these alternatives (Fawcett 2010). Public acceptance is generally higher when people think PCT is effective in reducing emissions, raises awareness for their individual carbon footprint, and when the scheme is perceived to be fair. The latter point often refers to the allocation of extra allowances to households with children, to individuals in the countryside with little access to public transportation, or to low-income households (Bristow et al. 2010). Moreover, acceptance is often linked with a higher level of education and environmental attitudes (Wadud and Chintakayala 2019; Stam and Gerdes 2021).

For those who reject PCT, concerns about implementation difficulties are key (von Knobelsdorff 2008). In addition, acceptability tends to be lower with lower understanding of the mechanism (Wallace et al. 2010). Maybe unsurprisingly, people who fly often, live in large houses, or generally have a high carbon footprint are less in favour of PCT than others (Larsson et al. 2020).

The overall message from this research is that the answer to the question of what the public thinks depends on the details of the rationing scheme, how it is explained, what it is compared with and which public is consulted.

Using deliberative processes to design and debate scheme rules could be a powerful way to build and ensure public acceptance. In Lahti, Finland in a trial of personal transport allowances, allowance allocation was determined with citizen engagement through surveys and workshops (Kuokkanen et al. 2020).

8.6. Comparison with a carbon tax

Key alternative approaches to personal rations are 'upstream' trading and carbon taxation. Upstream trading is where tradeable carbon caps are set high up the fossil fuel delivery chain, such as at the fossil fuel producers, energy utilities, or the energy retailer level. Carbon taxation could be implemented on fuels/energy sources at retail level, or higher up the delivery chain and then be passed down to household (or both). Economic evaluations from more than one decade ago indicated that introducing a personal carbon rationing mechanism would cost more and be more complex to implement than either upstream cap and trade or carbon taxation (Lockwood 2010; Sorrell 2010). However, in the last decade the huge advancements in data management capabilities and the penetration and availability of smartphones have dramatically reduced many of the implementation and management costs (Fuso Nerini et al. 2021).

Key comparisons between carbon rationing with taxation are set out very briefly (Table 8.1). Clearly there are pros and cons for each policy idea. For example, a carbon tax fits well with existing policy and economic paradigms that treat actors in society—companies and individuals alike—as economic entities. It encourages desirable behaviours by putting a price tag on undesirable ones, and encapsulates the polluter pays principle. Whereas PCA aims to influence behaviour also by altering individuals' perception of social responsibility and by encouraging citizens to adopt low carbon lifestyles.

Table 8.1. Comparison between a PCA scheme and a carbon tax

	Personal Carbon Allowance	Carbon Tax
Coverage	Depending on the design, could cover all direct and indirect personal emissions	Depending on the design, could cover all direct and indirect personal emissions
Influence mechanisms	Economic, cognitive, normative	Mainly economic
Allocation rule	Equal per capita	No allocation
Carbon visibility	Increases carbon visibility and encourages carbon budgeting	Increases carbon visibility
Price of carbon	Determined by shortage of units	Pre-set by government
Trading	Carbon units can be traded in the personal carbon market	No carbon market or carbon trading
Vulnerable groups	Additional policies needed to support vulnerable groups	Tax revenues could be recycled to support specific vulnerable groups
Social norm	Induces new carbon allowance social norm	Does not induce social norm
Public support	Unknown, likely to be influenced by communication and framing	Public tend to oppose new taxation
Policy certainty	Cap on emissions increases the certainty of achieving the policy targets	No carbon cap, and lower certainty of meeting policy targets
Administrative cost	Higher than taxation, as new administration and market structure need to be created	Lower than PCA, as the administration structure already exists
Policy risk	Risky, as there is no policy experience	Less risky, as taxation is familiar policy mechanism

Readers will make their own judgement on which arguments are most compelling. However, when thinking about carbon rationing or any new policy proposals, it is important not to fall into the trap of 'policy perfectionism.'[26] All policies have downsides as well as upsides. They must be judged on a variety of criteria, and considered in light of the status quo, which itself is far from perfect.

8.7. Next steps

Carbon rationing is an important idea, which has the potential to be developed into a powerful policy tool. There is some research and evidence showing how it could be implemented in practice and what the effects would be, but also much which is unknown. More research is needed—but, importantly, so are thoughtful conversations among politicians and with the public—not least to direct research to key issues of concern. Political and public engagement with and support for the idea is essential for it to be introduced (Fawcett and Parag 2010).

Further public and political discussions about rationing can begin immediately. Citizens assemblies have been shown to be a good venue for thoughtful responses from citizens to policies needed to address the climate crisis (Mellier and Wilson 2020). Local and national assemblies focused on debating the value anddesign of carbon rationing policies would be extremely valuable.

There is a significant research agenda to take rationing from a promising idea to a policy design with enough supporting data for an evidence-based decision to be made on its adoption. Because the detailed design of rationing determines its effects, this research needs to be nationally-specific, to take account of national priorities, the current distribution of carbon emissions and opportunities to reduce personal emissions, and the surrounding policy environment. Future research will need to include field trials of elements of carbon rationing including technology, communication and effects on behaviours and decision-making, and modelling of the impacts of different policy designs.

26 'Policy perfectionism' has been identified as one type of 'discourses of climate delay'—discourses that admit the existence of climate change, but justify inaction or inadequate efforts (Lamb et al. 2020).

9 – International Carbon Allowances in Achieving a Fair Consumption Space

9.1. Taxing or rationing

The distribution of scarce resources (and the right to emit is seriously limited) can in principle be handled in two different ways: through market-based mechanisms or with physical caps. Market-based options use taxes to increase efficiency to decouple economic activity from pollution—as in the green growth model. However, effective and efficient protection of global public goods requires collective political action to overcome the inability of private agents to capture any benefits, and hence the failure of market mechanisms (Nordhaus 2015). Furthermore, a plethora of studies have shown that a permanent decoupling sufficient to address the climate crisis has not occurred anywhere, and is unlikely to do so in the future (e.g. (Haberl et al. 2020; Pihl et al. 2021; Vadén et al. 2021).

Hence, only the option with physical caps seems to have the potential to be effective. This means to quantitatively limit the total emissions through legal, economic, and administrative means, regardless of to what extent this is compensated by efficiency improvements. Given the social insensitivity of markets (Wilkinson and Pickett 2011) and the increasing intra- and international polarisation of wealth (Piketty 2014), it is rather obvious that the social justice objective highlighted in the SDGs requires making this option operational (Ganzleben and Kazmierczak 2020; Xu et al. 2020).

This is where international carbon rationing comes in. Global carbon sinks are overwhelmingly public goods, which lack adequate legal protection. In particular, a fair allocation of the environmental space is nothing individuals or free markets can achieve—the required collective action must be initiated and coordinated by authorities (Martínez-Alier 2002; Bromley 2007). Hence a broader approach, with governments taking the lead, is needed to complement individual efforts.

Rationing is admittedly a controversial measure (often strongly opposed by those advocating market solutions and betting on efficiency gains), but can be effective also in the short run and is urgently needed to mitigate disaster and minimise global catastrophes—it is already too late to completely avoid large-scale disasters (Alcott 2010). The result would be a significant reduction in carbon-intensive consumption in affluent nations or trade blocs like the EU, where two-thirds of the global consumer class reside. Resistance by those benefiting from the status quo is to be expected, as one key result would be ending their current privileges (which they have enjoyed since the colonial era and have come to consider an entitlement) (Brand and Wissen 2017). However, ending overconsumption, that is consumption exceeding the planetary boundaries, is exactly what the climate, and sustainable development more generally, need right now.

9.2. Institutions for international rationing

This leads us to the question of how to distribute the scarce sink capacities of the planet. The climate system—like the atmosphere, space, or the deep sea—does not belong to anybody but can be considered the common heritage of humankind. And as according to the Universal Declaration of Human Rights all humans are born equal, they are entitled to an equitable share of this heritage. Consequently, fair sharing requires that the remaining carbon budget should be distributed amongst countries according to their population, based for example on the population projections for 2050 as the climate target year as these are the people, current and future, who will bear the burden of the climate crisis (Agarwal and Narain 1991). In a globalised, trade-intensive world, allowances must cover the carbon embedded in traded goods, leading to a carbon balance composed of domestic emissions and the net emissions embodied in trade to be accounted for, as using the quota allocated in the carbon sink rationing. The EU tradable permit system for CO_2 emissions, combined with the planned Carbon Border Adjustment Mechanism, already offer important building blocks for a carbon rationing regime.

Once the distribution of entitlements is allocated to countries on this basis, the next step is enforcing the resulting limitations on a national level. Staying within allocated limits cannot be left to individuals as even with willing citizens, many of the underlying factors that shape consumption patterns, such as public services and infrastructure investments, can only be addressed by governments.

However, any such move towards allocation of sink entitlements needs to be administered internationally. Individual countries or trading blocs can take initiatives, as they have done in the past. For instance, the EU Green Deal policy of combining more ambitious climate targets with a new Carbon Border Adjustment Mechanism has in essence established a Climate Club for its members. In such clubs, member states weigh the membership benefit against the decarbonisation efforts (and in the EU, the subsidies coming with them), and the otherwise more reluctant members go with the group (Nordhaus 2015).

Nonetheless, a full-scale global system for emission allowances would require a legal base in an international convention. It will take considerable time to negotiate and adopt a new convention and to make an international authority for carbon allocation operational.

9.3. International rationing and the global trade regime

Reducing consumption of carbon-intensive goods has knock-on effects as transporting, refining, transforming, delivering, and discarding materials are activities that consume a significant share of the total primary energy. In particular, the rare earth elements which require extremely high inputs of energy per ton of material in mining and refining would be permanently limited, with severe implications for the Green Growth strategies pursued by any governments, but also for decarbonisation and climate policy. According to the International Energy Agency, "today, the data shows a looming mismatch between the world's strengthened climate ambitions and the availability of critical minerals that are essential to realising those ambitions. [... For instance, a] typical electric car requires six times the mineral inputs of a conventional car, and an onshore wind plant requires nine times more mineral resources than a similarly sized gas-fired power plant." (IEA 2021).

Reducing energy consumption on a global scale, instead of only accelerating the switch from fossil to an ever increasing consumption of 'non-renewable-resources-based-renewable-energy' appears an important condition to make decarbonisation sustainable; rationing the consumption of resources beyond carbon sink access is an option still not sufficiently explored, but undoubtedly necessary, not least to guarantee the continued provision of carbon-free energy without breaking through the walls of environmental space and consumption corridors.

Legally an import-limiting regime, for the time being regulating trade based on the embedded carbon content, would probably be possible under the WTO regulations, as long as the standards set are non-discriminatory. However, the arbitration processes foreseen in most free trade agreements offer companies (foreign, or domestic through foreign subsidiaries) the opportunity to demand compensation for loss of expected revenues, caused by being hindered to continue polluting but lucrative activities (Kumm 2015; Marisi 2020). An international Convention would minimise this risk.

The ethical principle of the right to equitable shares of global carbon sinks has been the starting point of this argumentation. However, obviously the current situation is different, in and between nations. Hence an equitable allocation of rights will cause surplus entitlements for some, and shortcomings for other nations or blocs. Applying trade mechanisms established since the Kyoto Protocol and the Clean Development Mechanism (CDM) to these emission rights is a matter of political will, not of technical or legal difficulties. Countries with the highest per capita emissions, like some Gulf monarchies and other oil producing countries—Canada, Australia, the USA, Korea, Taiwan, the EU and even China—would have to try buying certificates from poorer countries (OECD n.d.). A Carbon Allocation Authority or trading platform could help here as well, as in bilateral negotiations the poor tend to sell cheap, not least due to arms twisting by powerful nations, and the risk for corruption where leaders agree to bad deals for private gain could be minimised. The current South-North monetary flows would be reverted, and the finances for strong sustainable development could be in sight at least. Simultaneously, such a regime would provide incentives for poorer countries not to pursue the usual emission intensive development path, as this would diminish the permit income. Open access to renewable energy and energy efficiency technology should be one element of what a carbon managing authority would have to offer to its clients.

9.4. Near term perspectives

International rationing—while strongly influencing prices through market mechanisms—does not generate revenue for the state or bloc introducing it, but border payments do so. The Carbon Border Adjustment Mechanism suggested by the European Commission will be charging imported goods according to the CO_2 emitted during their production, resulting in income for the public purse. The revenues will be partly needed to compensate exporters, but due to its negative trade balance in terms of embodied resources, a significant surplus income for the EU can be expected (Bruckner et al. 2012; Dorninger et al. 2021). Since the market stabilisation effect is reached by skimming off the price advantage resulting from less ambitious climate targets, the money is disposable, following politically set priorities. As long as the suggested, rationing-based permission trading system does not exist, the Border adjustment income is the most plausible stand-in for financing adjustment processes in countries affected by the new regime.

In particular, voices from the South have been criticising the planned Carbon Border Adjustment Mechanism as discriminatory to their exports, and indeed exporters with the lowest carbon productivity will be hit hardest—but that is a stimulus which is part of the overall approach (UNCTAD United Nations Conference on Trade and Development 2021). Hence the question should not be one of exemptions, weakening the performance of the incentives offered by the club, but how to support the transition to a low carbon production system in the Global South.

To answer this question, three groups of Southern exporters to the EU have to be distinguished:

→ For all agricultural goods, lowering carbon intensity can be achieved by employing agroecology measures, reducing fertiliser and pesticide use, and improving crop composition. As an important co-benefit, such a move would significantly reduce the pressures driving the loss of biodiversity (IPBES 2019) while creating jobs and improving the quality of water streams above and below ground. This way, a Carbon Border Adjustment would contribute to a series of SDGs simultaneously.

→ For those companies, which moved to the South to avoid increasingly strict regulations (compliance and hence pollution is much cheaper in many parts of the South) while exporting their products for in stance to Europe, it just means that the standards they tried to undercut will catch up with them. This would upend the abuse of the South as low-cost pollution location and production waste dump (Statista 2021a). This is not insignificant, as more than a third of the EU emission reductions has been achieved through relocation (Schütz et al. 2003), and with tightening rules more is to be expected without a Carbon Border Adjustment Mechanism.

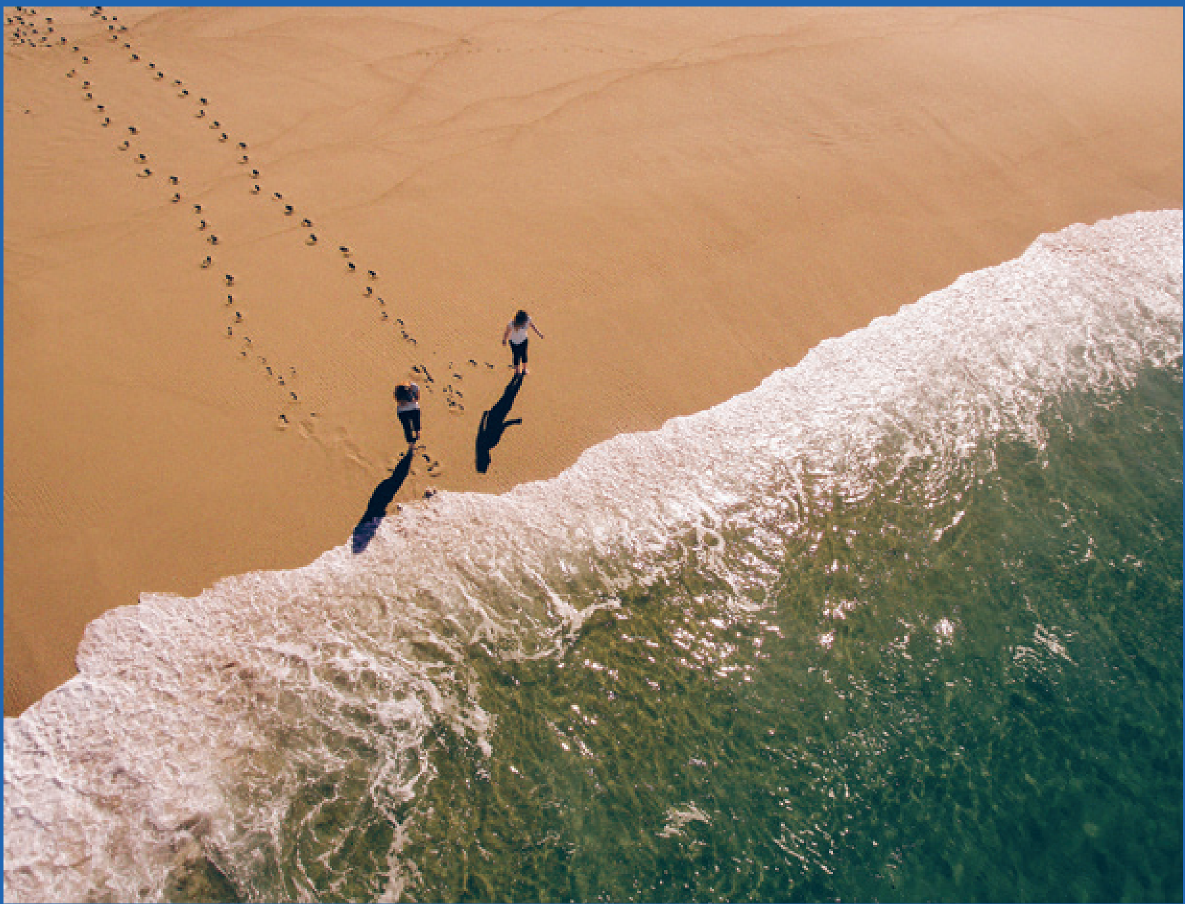
→ For small farmers trading through cooperatives, for small and medium size enterprises (SMEs) and other local businesses, support is necessary. Here the surplus income from the Carbon Border Adjustment Mechanism comes in handily—instead of using it as a windfall profit for the EU budget, a portion[27] should be spent on a Climate Adaptation Fund for production systems, in particular small holders and SMEs, helping them to keep step with the emerging EU legislation. Financing cooperation—including but not limited to technology transfer—would be an adequate and legitimising way of spending the funds.

9.5. Not letting the best become the enemy of the good

The jury is still out on what might be the best "how" to implement enforceable measures to make 1.5°C lifestyles, in all their diversity, the 'new normal' of the future citizen-consumer society. However, all pros and cons of different pathways must not distract from the need for rapid action to drive down emissions. The state of the natural world and the ongoing trends make quantitative limitations of resource consumption and carbon emissions an undeniable necessity, requiring a radical change of existing policies. The term "radical" is derived from the Latin "radix", meaning "root". Rationing is a rational approach to address the root causes of overconsumption, and turning the proposal into policy is one of the best instruments to address the climate crisis before it turns into a catastrophe.

27 Many of the strategies presented in this policy section could support each other in implementation. For example, revenue created by a border mechanism could also help fund universal basic services (UBS), reducing private consumption further as well as countering the effects of increasing costs of imported consumer goods.

Section IV
Scenarios for Living Within a Fair Consumption Space



10 – Need for Both Individual and System Change

This chapter elaborates selected low-carbon lifestyle options (introduced in Chapter 4) into carbon budget scenarios to meet targets at a country level (see Chapter 2). The carbon budget scenario brings together and illustrates the several elements of this report: the current level of average lifestyle carbon footprint, adoption rates for previously introduced options to meet the 2.5-ton target, differences and potentials of individual choices, but also the major role of policy making and recommendations to achieve the sustainable lifestyle carbon footprint target set for 2030.

As the remaining carbon budget is divided evenly between the inhabitants of different countries, developing carbon budget scenarios offers a tool to illustrate the fair consumption space. It demonstrates a combination of both the type and magnitude of actions that could be taken to bring lifestyle carbon footprints within planetary limits. Because allocation of the available carbon budget should be done in a fair manner, it highlights the duty of countries with currently higher average lifestyle carbon footprints to bear greater responsibility for pursuing a smaller average lifestyle footprint and getting the world to within sustainable limits. In addition to country level responsibility, *carbon budget scenarios stress the importance of enabling change at both individual behaviour and systems levels.* Finally, scenarios are not only about reductions; getting to, and thriving within a fair consumption space requires innovation for new ways of meeting needs in society and regeneration of existing measures to be compatible with wellbeing in a fair and equitable society within planetary limits.

The carbon budget scenarios—**consumption-focused and system-focused scenarios**—are based on the aggregated impacts of lifestyle options. Evaluating aggregated impacts is necessary because sums of estimated reduction impacts of individual options may not equal aggregated impacts due to overlaps and synergies between options. It is worth mentioning that many lifestyle options, as well as environmental initiatives in general, do not fall purely in one of the two categories (consumption-focused or system-focused), but represent both the amount and intensity aspect, along with other dimensions entirely. For example, car-free commuting with public transportation falls into both categories, as modal shift from car to public transportation is often an individual's choice, but it also requires systemic changes in infrastructure to enable large scale adoption at a societal level; the efficiency improvement of household appliances is often a manufacturer's choice, but a household can choose to use more efficient appliances, reducing its energy consumption. **Illustrating two scenarios per country allows for a comparison of the impacts and effectiveness of individual choices and systemic changes.** Nevertheless, as it is not realistic to assume that the consumption-focused scenarios would be enabled without systemic changes, intensity type options were included in the consumption-focused scenarios and amount type options into system-focused scenarios (with bolded interventions corresponding to their appropriate category).

Note that estimation of aggregated impacts does not consider rebound effects. Therefore, this estimation should be considered as slightly optimistic, as some of the gains from the options could be lost through re-spending of money and time. In addition, aggregated impacts of previously introduced options consider only food, housing, and personal transport. For consumer goods, the impacts of leisure and services are based solely on absolute reduction of consumption (average spending) and/or efficiency improvement (average carbon intensity), thus the footprints are decreasing pro-

portionally more compared to the three main domains (food, housing, and transport).

Scenarios here focus on the 2.5 tonCO_2e/capita/year target set for 2030. The year 2030 is mainly illustrative; a similar exercise could have been done for 2050—albeit with the higher risks that further delays in rapid reductions of carbon would pose considerably more challenges than already being experienced. The 2030 target is one of the easiest intermediary targets, and one that must be met if the climate emergency is to be addressed. Also, comparatively more realistic assumptions can be made of potential changes in society in the timeframe between now and 2030—making the scenarios more feasible.

Country specific scenarios, using adoption rates for selected aggregated options to meet the 2.5 ton-target set for 2030, are introduced in the Figures 6.1–6.9. See Annex D for more detailed descriptions of the scenarios.

10.1. Carbon budget scenarios

Both consumption-focused and system-focused scenarios show very ambitious adoption rates across all consumption domains for high-income countries to meet the 1.5-degree target, as seen in Figures 6.1–6.4. This highlights the urgency of drastic lifestyle carbon footprint reductions in high-income countries, as the needed footprint reductions of 69–82% require an almost full (at least 95%) adoption rate in all countries. Canada was an exception, as it is not able to meet the 2.5-ton target with any adoption rate and has 99% for both intensity and amount type options. **Upper- and lower-middle income countries** also need lifestyle carbon footprint reductions of 23–50% by 2030, although scenarios allow more freedom in terms of chosen actions and adoption rates, as well as the ability to focus on country-specific hotspots. In addition, a system-focused scenario turned out to be a more efficient way to meet the 1.5-degree target by 2030, as the adoption rate of intensity type options is notably lower for most of the countries in comparison to the consumption-focused scenario. This indicates high lock-in of e.g. energy related consumer choices, as many of the middle-income countries are still heavily relying on non-renewable energy sources in their energy generation. Indonesia is an exception as its current lifestyle footprint is already less than 2.5 tons CO_2e/capita/year.

As shown in the estimated carbon budget scenarios, the options listed in this report can satisfy this long-term target for most of the countries, but additional options including non-incremental changes in provisioning systems and lifestyles would be required. These results highlight the large potential lifestyle changes required across consumption domains in order to implement the Paris Agreement, and also imply it is not an either-or question of technology or lifestyles but rather both—improvements to the energy system and technology as well as shifts in consumption patterns are required to achieve the ambitious climate targets.

Note: scenarios for **Indonesia** are not discussed below due to the analysed target year being 2030 and the current per-capita footprints already being within the global target level.

Canada – The current target of 2.5-tons is not met with any adoption rate of options analysed for this report, even if it has 99% adoption for both intensity and amount type options, thus in practice leading to a single scenario. As well as having an urgent need for society-wide changes in consumption habits, countries with similar levels of consumption to Canada will need massive interventions in investments (including divestments) and significant political actions to reorient government planning to support households to meet their needs within comparable material levels to the rest of the world.

The largest reduction is focused on the transport domain, as the transport domain is one of the hot spots in Canada with high annual transport demand. Personal transport demand would need to decrease at least a third (31%: 6,900 km) from the current level and achieve the current intensity of an average electric car in Canada. Transport serves as a means to conduct meaningful daily activities such as work and study related commitments, social and leisure activities, shopping and other errands. Thus, the discussion on personal transport is not only about vehicles and fuels but on new ways to conduct these daily activities with fewer kilometers travelled.

Changes in the diet (e.g. vegan diet) and system-focused changes (e.g. more efficient food production) would lead to a dietary footprint of 370 kg (CO_2e/person/yr) or an 78% (1,300 kgCO_2e) reduction from the current level.

The overall housing footprint would need to decrease more than half, resulting in a footprint of 1,300 kg. The living space per person would need to drop from the current 58m² to at most 32m², and the energy consumption would need to drop 30% (3,400 kWh), resulting in an intensity of 0.16 kg/kWh, which would be close to the average carbon intensity of current hydropower-based electricity production.

For others (consumed goods, leisure, and services), both the intensity and the per-capita consumer spending would need to drop drastically.

Finland – Both scenarios require large scale improvements in consumption habits and systemic changes, as both the amount and intensity type options would need a 95% implementation. The lower adoption rate for supporting options[28] in the consumption-focused scenario highlights the effectiveness of amount based options and the role of individual choices to reach the 2030 target. Nevertheless, supporting options in both scenarios is still critical.

Similar to Canada, the largest reduction is focused on the transport domain in both scenarios, due to high annual transport demand. Transport demand would need to be halved (54%, or 8,100 km reduction), or the average carbon intensity should reach the current level of electric cars in Finland in the consumption- and system-focused scenarios, respectively. The average intensity is lower in the consumption-focused scenario, as high intensity flying reaches a nearly 100% reduction.

The housing-related footprint would need to drop dramatically in both consumption- and system-focused scenarios (62% and 76%, respectively), leading to at least a 34% (14 m²) reduction in living space and a minimum 41% (4,620 kWh) reduction in total energy consumption in the consumption-focused scenario. The average carbon intensity per kWh would need to reach the current level of an air heat pump (approximately 0.07 kg/kWh) in Finland in the system-focused scenario, together with the efficiency improvement of buildings and more efficient use of space (e.g renting a guest room, or using these as co-working spaces in residential areas to reduce need for additional office buildings).

Food-related footprints would decrease more effectively in the system-focused scenario, due to shifts towards low-carbon dietary habits, i.e. lower intensity of consumed food products. In addition, system-focused scenarios have higher adoption of supporting (non-intensity type) options compared to consumption-focused scenarios. (System-focused changes tend to be shifts towards plant-focus food production, which reduces the intensity of the food without total food consumption reductions by consumers.)

Similarly to Canada, both per-capita consumer spending and the carbon-intensity of products and services would need to drop considerably. System-focused scenarios indicate being more effective in footprint reduction due to higher improvement of carbon intensity of products and services, together with lower consumer spending.

United Kingdom – Similar to Finland, large-scale implementation is needed for both scenarios in order to meet the 1.5-degree target. Adoption rates for supporting options is lower compared to the previous countries as the overall lifestyle carbon footprint reduction requirement is lower.

As for the previous countries, the largest reductions are focused on transport, but also on the housing domain. In the consumption-focused scenario, transport

28 Intensity type options were included in the consumption-focused scenarios and amount type options in the system-focused scenarios.

demand would need to be reduced by 55% from the current level (8,200 km reduction) and in the system-focused scenario the reduction would need to be only 30% (4,300 km). In the system-focused scenario, the average carbon intensity should reach the current level of electric cars in the United Kingdom.

For housing, the living space and overall energy consumption would need to decrease from the current 39 m^2 to a maximum of 25 m^2 (37% smaller) and from the current 7,200 kWh to 5,200 kWh (a 28% decrease).

For food, intensity would need to drop at least 30%, which is achieved by heavy adoption of consumption-focused scenarios (95% adoption of amount type options and 30% adoption of intensity type options). The overall food consumption decreases approximately only 10% as most of the options focus on modal shifts of dietary habits, such as switching to a vegan diet.

Consumer goods, leisure, and services follow the same pattern as for Canada and Finland.

Japan – Typical to all high-income countries, Japan also needs large scale implementation for both scenarios. The adoption rate for supporting options is lower in the system-focused scenario (compared to the consumption-focused scenario), which indicates the effectiveness of intensity type options on decreasing the lifestyle carbon footprint, though the reduction impacts are focused on different domains in different scenarios.

In the consumption-based scenario, the highest reduction is focused on transport, which indicates large hot spots in the transport domain but also the role of consumer choices in reducing the transport related footprint. Mobility demand could drop 66% (7,200 km) in the consumption-focused scenario. As a contrast, transport demand would need to drop only 12% (1,300 km) if the average intensity of 0.09 $kgCO_2e$/km could be achieved, as shown in the system based scenario.

Housing related consumer choices, i.e. consumption-focused options, would reduce current living space 39% (15m^2) to 24m^2 and overall energy consumption by 22% (940 kWh). Similar to transport, fewer reducing actions would be needed if the average energy intensity of 0.18 $kgCO_2e$/kWh could be achieved with the system-focused scenario. In addition, system-focused scenarios account for a greater reduction in the housing domain due to the shift towards renewable energy sources, which addresses a hot spot in the housing-related footprint in Japan.

Similarly to Canada, both per-capita consumer spending and intensity of products and services would need to drop notably. The system-focused scenario is more effective in footprint reduction due to higher improvement of carbon intensity of products and services, together with lower per-capita consumer spending.

China – China, too, needs widespread adoption of options in both scenarios, but supporting options are already notably lower compared to high-income countries. This means that in consumption-focused scenarios households play a major role in enabling shifts towards a sustainable footprint, but the system-level changes are a more efficient way to achieve the 2030 target.

Mobility accounts for the largest reduction in the consumption-focused scenario. Overall transport-related footprints would be reduced 51% (610 $kgCO_2e$ reduction) by cutting transport demand by 21% (1,900 km) and by the radical reduction of high intensive modes of transportation, such as flying and car driving.

In the system-focused scenario a marked shift towards lower intensity modes of transportation and general efficiency improvement of transport would reduce the transport footprint by 31% (380 kg), and the average intensity would decrease to a level of an average train, without decreasing the overall transport demand.

Living space and overall energy consumption would need to decrease 31% (13m^2) and 14% (270 kWh) to meet the 2030 target in the consumption-focused scenario. In contrast, in the system-focused scenario, efficiency improvements (e.g. a pronounced shift towards renewable energy sources) would result in a more efficient way to reduce housing-related footprints (58%, or 770 kg reduction) as energy in China is generated mainly with non-renewable energy sources.

Turkey – Differences in the effectiveness of consumption- and system-focused scenarios are seen clearly in Turkey. Consumption-focused scenarios require nearly full adoption of amount type options, in comparison to 65% adoption of intensity type options in the system-focused scenario. This means that the ambitious 2030 footprint target would need higher engagement of households in the consumption-focused scenario to meet the 2030 target.

As with China, the hotspots and the highest impact reduction potentials are found in the transport and housing domain. High reduction of overall transport demand would result in a notably lower footprint (71%, or 580 $kgCO_2e$ reduction in the transport), but as mentioned above, would need high adoption of related options at the household level.

Overall, generation of grid electricity and other energy with renewable energy sources, which is enabled in the system-focused scenario, is the most effective way to move towards a sustainable housing footprint, providing a 60%, or 1,000 $kgCO_2e$ reduction.

In food, differences between the two scenarios are not as notable as for transport and housing. The nutrition footprint is already relatively low in Turkey due to lower consumption of meat and dairy (compared to high-income countries). The achieved footprint reduction in the consumption- and system-focused scenarios are 21% (250 kg) and 38% (460 kg), respectively. It should be noted once again that the adoption of consumption-focused options is lower compared to system-focused options, which indicates a more efficient scenario towards sustainable consumption.

South Africa – As compared to previous countries, the system-focused scenario offers an even more efficient way to achieve the 1.5-degree target by 2030 in South Africa. The adoption rate of intensity type options in the system-focused scenario is only 55%, compared to heavy adoption (90%) of amount type options in the consumption-focused scenario. This highlights the potential of system level changes, as many lifestyle options are locked-in due to current infrastructure (e.g. energy generation with non-renewables), thus making sustainable lifestyle primarily out of reach.

As with most of the studied countries, significant reduction of overall transportation demand (36%, or 2600 km) would decrease the footprint most efficiently (62%, or a 750 kg reduction), but would require considerable engagement at the household level (90% adoption of amount type options in the consumption-focused scenario).

In a system-focused scenario the highest reduction potential is in food. A shift towards plant-based diets would reduce food footprints by 57% (or 980 kg), as high intensity meat consumption is relatively high.

Brazil – Adoption rates for both amount and intensity type options are notably lower in Brazil, compared to previous countries, due to an overall lower reduction target from the current lifestyle carbon footprint. Nevertheless, the adoption rate for intensity type options is still 40% in the consumption-focused scenario, but only 25% for intensity type options in the system-focused scenario.

In both scenarios the highest reduction potential is in food, due to heavy consumption of high intensity meat products. Shifting towards plant-based diets in the system-focused scenario would result in a 32% lower food footprint and an overall reduction of the current footprint by 600 $kgCO_2e$.

Current living space and energy consumption are already relatively low (28m² and 1,500 kWh), compared to high-income countries. To achieve the 1.5-degree target by 2030, living space should be reduced by 10% and energy consumption by 6% in the consumption-focused scenario. Almost the same reduction impact could be achieved in the system-focused scenario by shifting towards renewable off-grid energy sources, replacing remaining non-renewable grid electricity sources with renewables, and using current living space more efficiently (improved efficiency of houses and appliances and sharing a space by renting a guest room).

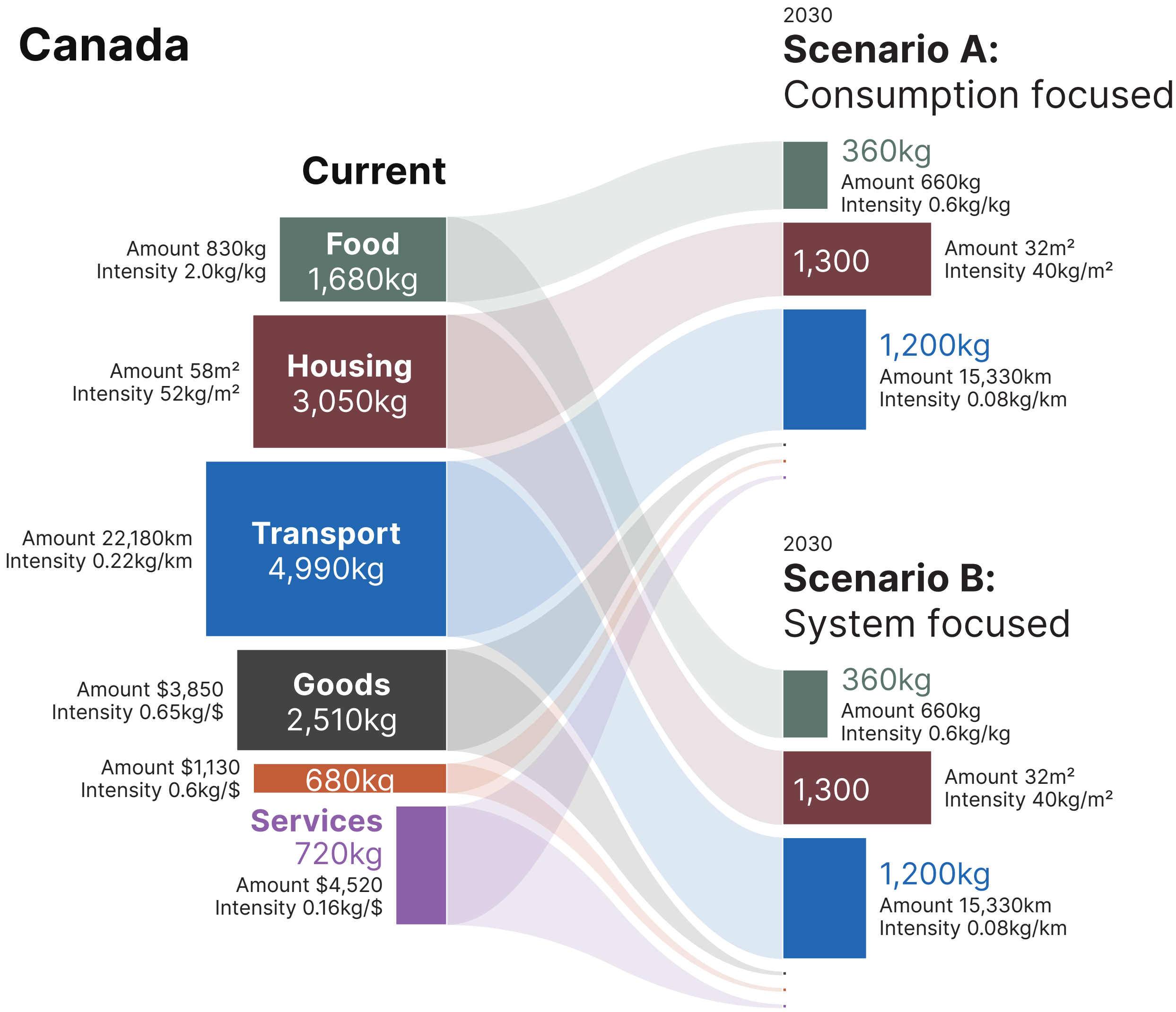
The mobility related footprint is currently relatively low due to the high share of flex fuel cars and public transportation. Nevertheless, high adoption of transport demand reducing options could reduce the transport footprint by 36% (or 240 kg) due to lower transportation distances travelled (24%, or 1,100 km). A more realistic way to support sustainable footprint levels would be to support a shift towards public transportation from car driving and/or introduction of hydrid and electric cars, as the share of non-white collar workers, i.e. people not able to remote work, is relatively high in Brazil (Lustig et al. 2020), compared to high-income countries.

India – With a notably lower footprint compared to high-income and upper-middle income countries, India is able to achieve the 1.5-degree target only with an adoption rate of 30% in both scenarios. In addition, mainly transport related options were selected, as this is clearly the hotspot of the country's current footprint.

Overall lower transport demand and use of cars in the consumption-focused scenario, together with shifting towards lower intensity modes of transportation in the system-focused scenario could offer an effective way of achieving a sustainable footprint level. It should be noted that, especially in the case of India, higher adoption of individual domain level options, instead of using the same adoption rate for all domains, could offer a more efficient and sustainable pathway towards the 2030 target.

A vegetarian diet is already the predominant diet in India and therefore shifts towards plant-based diets do not offer notable reductions to the current footprint, as long as the present situation is maintained. Housing footprints are already very low in India and the current living space is at the lower limit of a decent living standard. Therefore low-carbon lifestyle options mainly target system-focused options, such as shifting towards renewable energy sources, which are often beyond consumer choices and locked-in in the current infrastructure.

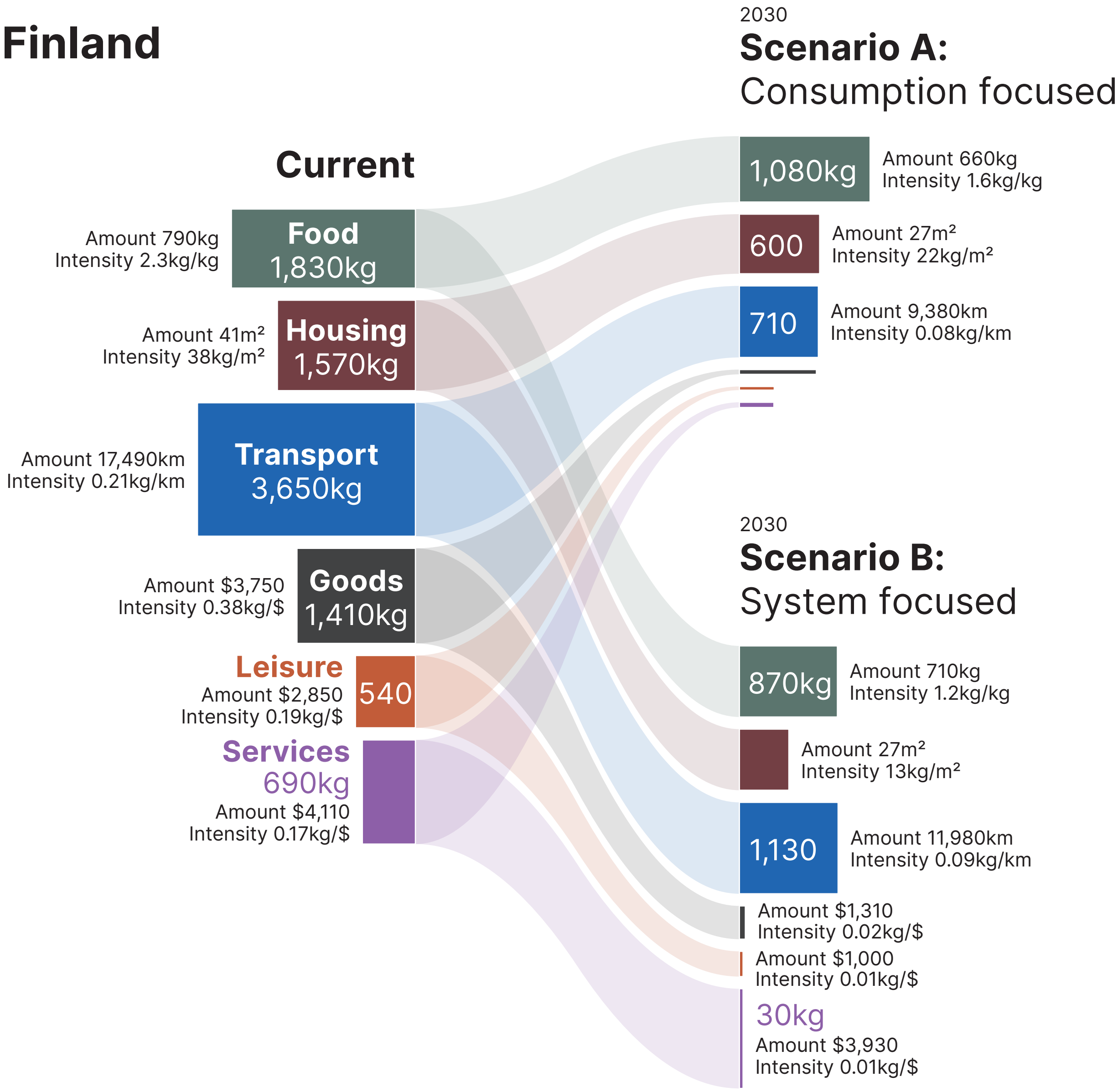
Figure 10.1. Current lifestyle carbon footprints and estimated consumption- and system-focused scenarios with needed adoption rates of selected low-carbon lifestyle options to meet the 1.5-degree target by 2030 (Canada)



Note: Coloured rectangles indicate the average lifestyle carbon footprints of each component. Height, width, and size of the area represent the physical amount of consumption, carbon intensity, and carbon footprints, respectively.

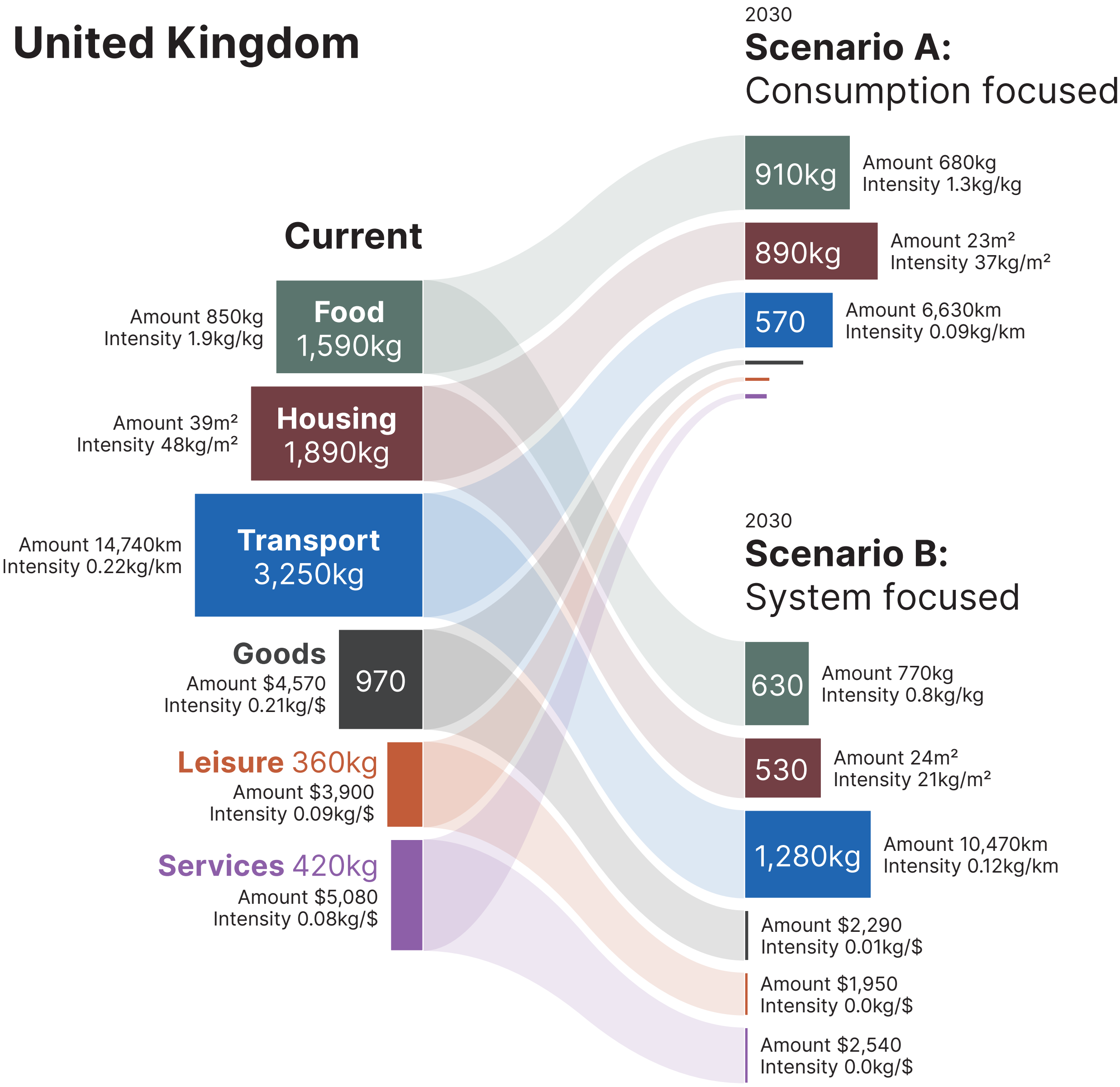
	Scenario A: "Consumption Focused"		Scenario B: "System Focused"	
Current Footprint ($kgCO_2e$/capita/year)		13,630		13,630
Options		**Adoption rate**		**Adoption rate**
	Consumption focused	99%	System focused	99%
	System focused	99%	Consumption focused	99%
Scenario based footprint ($kgCO_2e$/cap/yr)		2,870		2,870

Figure 10.2. Current lifestyle carbon footprints and estimated consumption- and system-focused scenarios with needed adoption rates of selected low-carbon lifestyle options to meet the 1.5-degree target by 2030 (Finland)



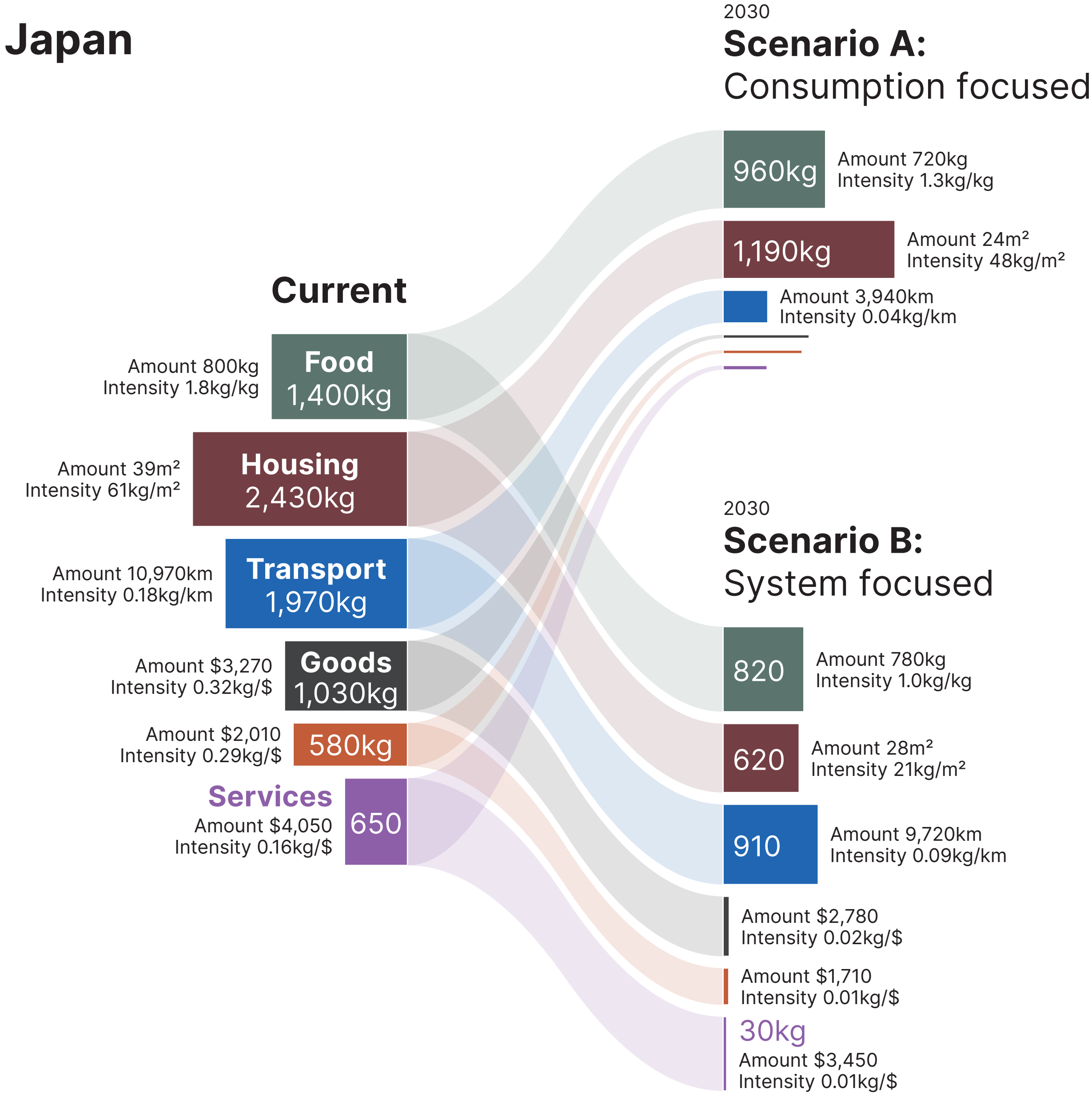
	Scenario A: "Consumption Focused"		Scenario B: "System Focused"	
Current Footprint (kgCO$_2$e/capita/year)		9,700		9,700
Options		**Adoption rate**		**Adoption rate**
	Consumption focused	95%	System focused	95%
	System focused	35%	Consumption focused	65%
Scenario based footprint (kgCO$_2$e/cap/yr)		2,480		2,450

Figure 10.3. Current lifestyle carbon footprints and estimated consumption- and system-focused scenarios with needed adoption rates of selected low-carbon lifestyle options to meet the 1.5-degree target by 2030 (United Kingdom)



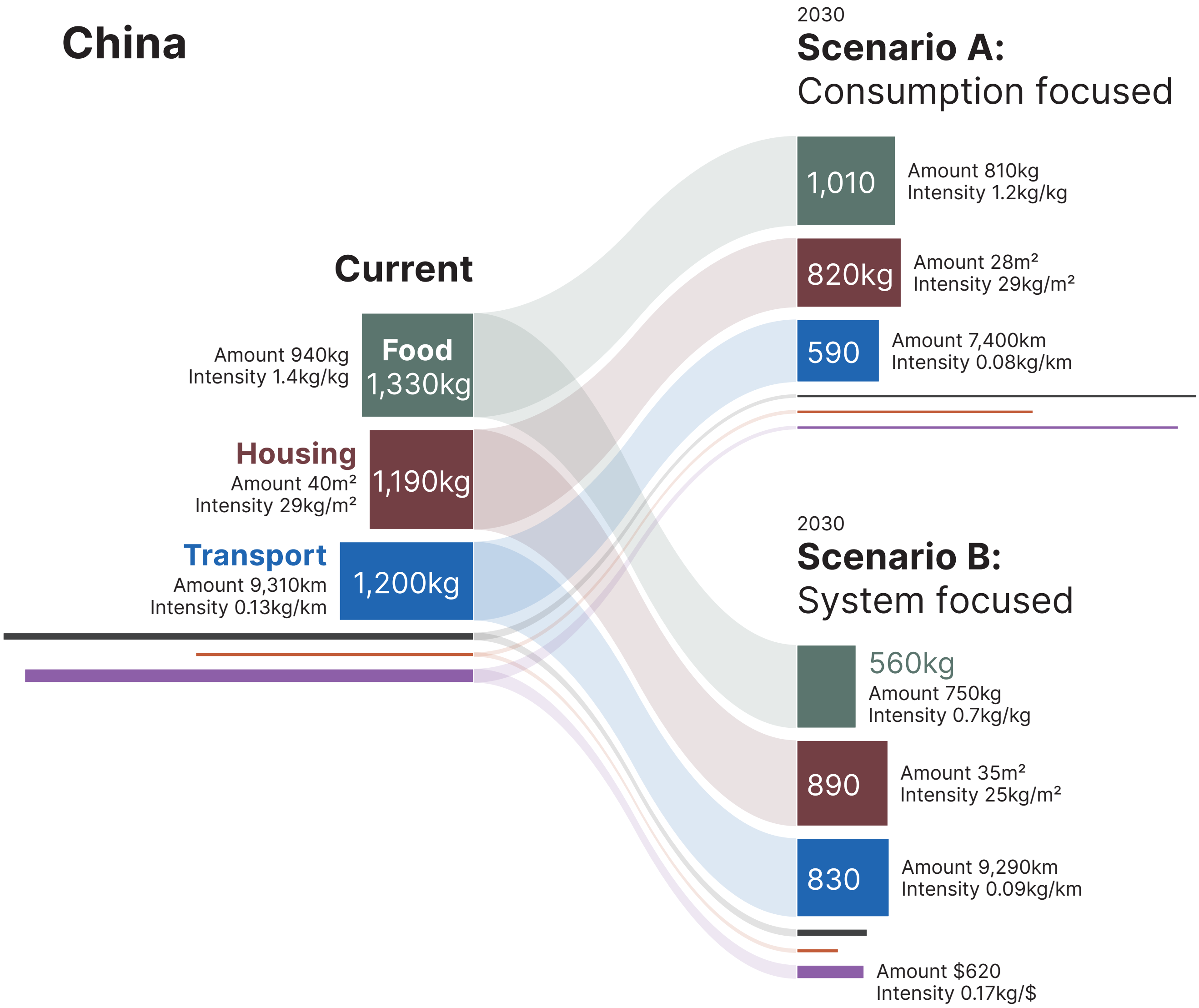
	Scenario A: "Consumption Focused"		Scenario B: "System Focused"	
Current Footprint (kgCO$_2$e/capita/year)		8,470		8,470
Options		**Adoption rate**		**Adoption rate**
	Consumption focused	95%	System focused	95%
	System focused	30%	Consumption focused	50%
Scenario based footprint (kgCO$_2$e/cap/yr)		2,430		2,490

Figure 10.4. Current lifestyle carbon footprints and estimated consumption- and system-focused scenarios with needed adoption rates of selected low-carbon lifestyle options to meet the 1.5-degree target by 2030 (Japan)



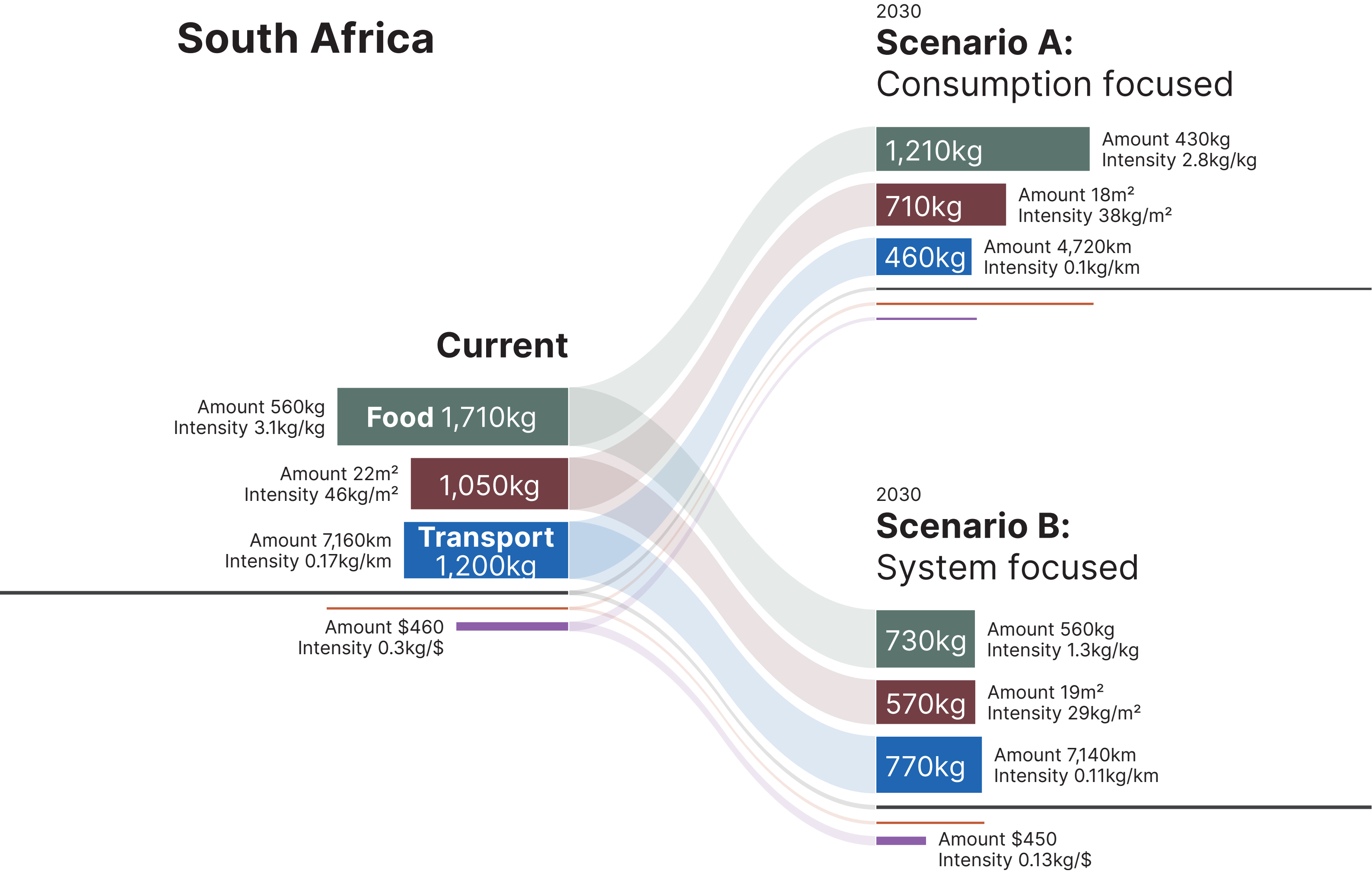
	Scenario A: "Consumption Focused"		Scenario B: "System Focused"	
Current Footprint (kgCO$_2$e/capita/year)		8,060		8,060
Options		**Adoption rate**		**Adoption rate**
	Consumption focused	95%	System focused	95%
	System focused	30%	Consumption focused	15%
Scenario based footprint (kgCO$_2$e/cap/yr)		2,400		2,450

Figure 10.5. Current lifestyle carbon footprints and estimated consumption- and system-focused scenarios with needed adoption rates of selected low-carbon lifestyle options to meet the 1.5-degree target by 2030 (China)



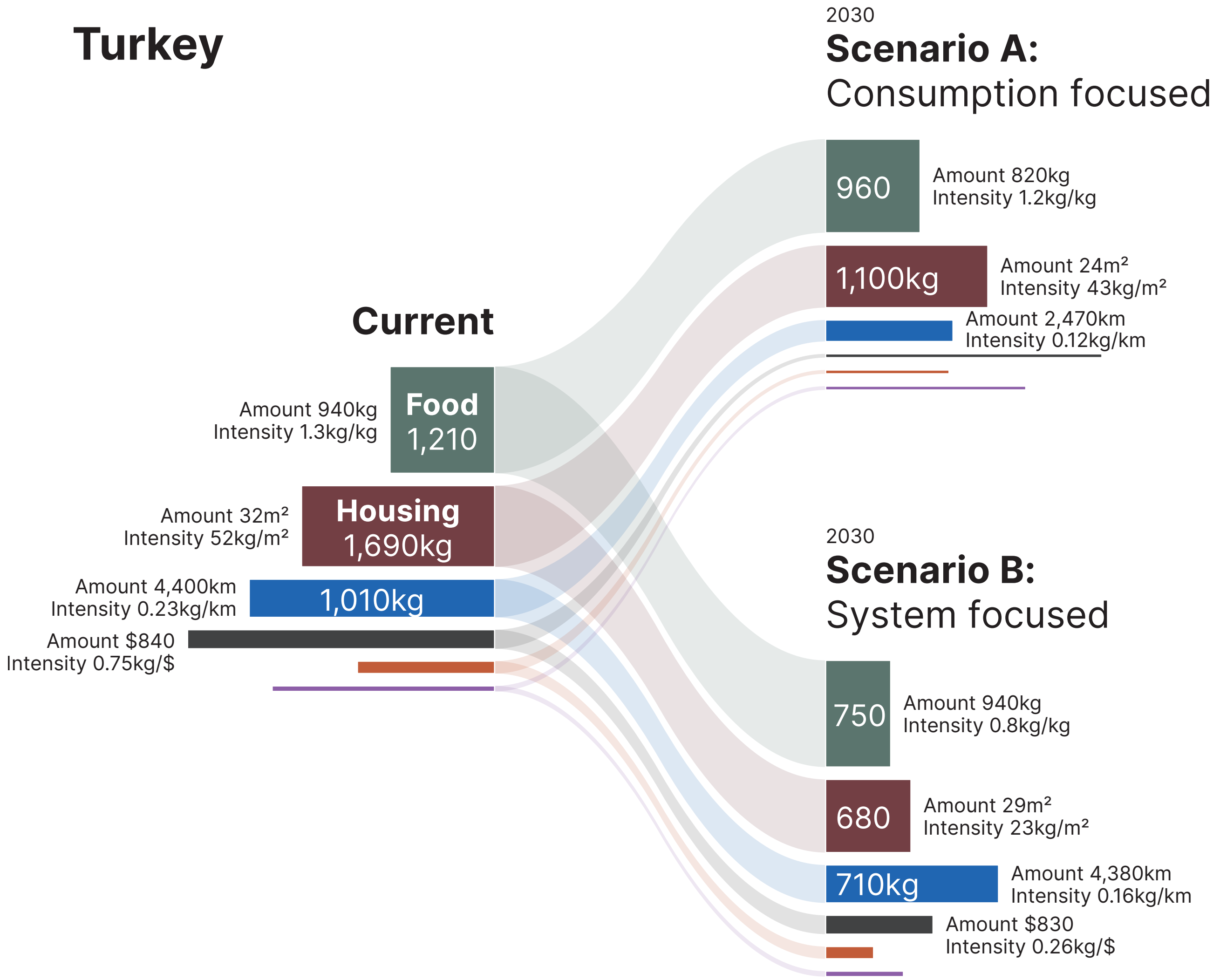
	Scenario A: "Consumption Focused"		Scenario B: "System Focused"	
Current Footprint (kgCO$_2$e/capita/year)		4,970		4,970
Options		**Adoption rate**		**Adoption rate**
	Consumption focused	95%	System focused	85%
	System focused	15%	Consumption focused	1%
Scenario based footprint (kgCO$_2$e/cap/yr)		2,470		2,460

Figure 10.6. Current lifestyle carbon footprints and estimated consumption- and system-focused scenarios with needed adoption rates of selected low-carbon lifestyle options to meet the 1.5-degree target by 2030 (South Africa)



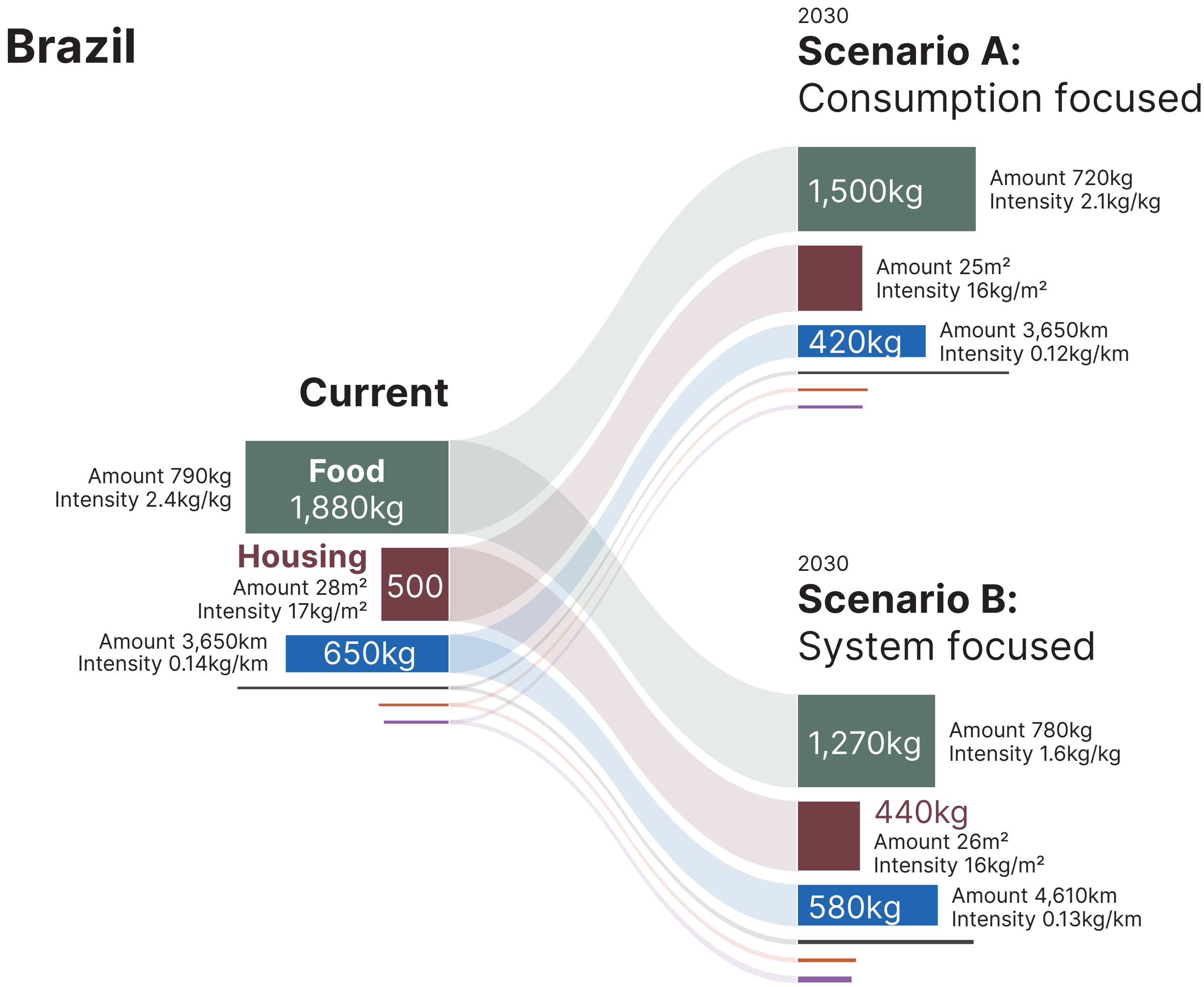
	Scenario A: "Consumption Focused"		Scenario B: "System Focused"	
Current Footprint (kgCO_2e/capita/year)		4,890		4,890
Options		**Adoption rate**		**Adoption rate**
	Consumption focused	90%	System focused	55%
	System focused	10%	Consumption focused	1%
Scenario based footprint (kgCO_2e/cap/yr)		2,470		2,490

Figure 10.7. Current lifestyle carbon footprints and estimated consumption- and system-focused scenarios with needed adoption rates of selected low-carbon lifestyle options to meet the 1.5-degree target by 2030 (Turkey)



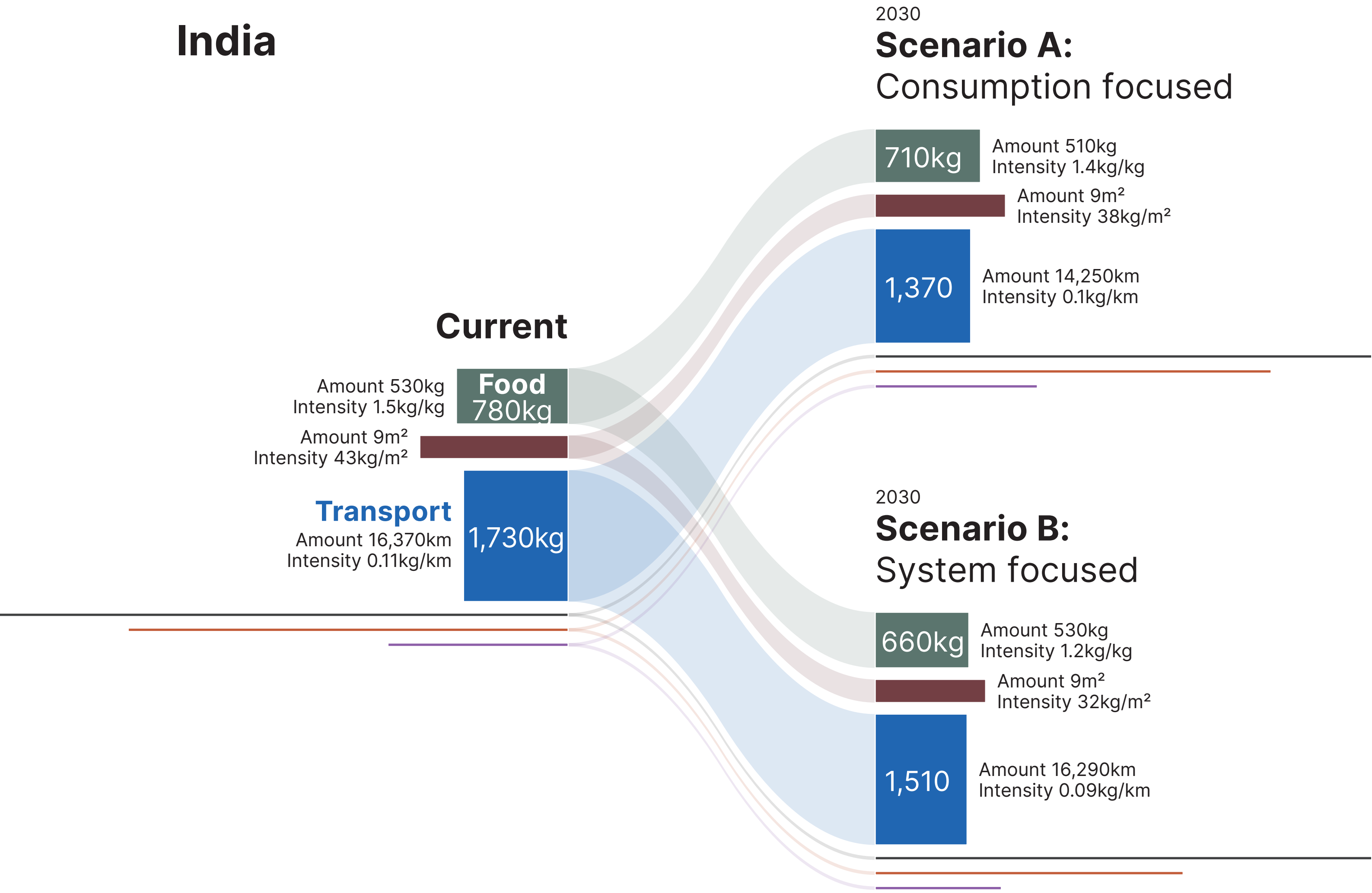
	Scenario A: "Consumption Focused"		Scenario B: "System Focused"	
Current Footprint (kgCO₂e/capita/year)		4,860		4,860
Options		**Adoption rate**		**Adoption rate**
	Consumption focused	90%	System focused	65%
	System focused	10%	Consumption focused	1%
Scenario based footprint (kgCO₂e/cap/yr)		2,430		2,470

Figure 10.8. Current lifestyle carbon footprints and estimated consumption- and system-focused scenarios with needed adoption rates of selected low-carbon lifestyle options to meet the 1.5-degree target by 2030 (Brazil)



	Scenario A: "Consumption Focused"		Scenario B: "System Focused"	
Current Footprint (kgCO$_2$e/capita/year)		3,240		3,240
Options		**Adoption rate**		**Adoption rate**
	Consumption focused	40%	System focused	25%
	System focused	10%	Consumption focused	1%
Scenario based footprint (kgCO$_2$e/cap/yr)		2,470		2,450

Figure 10.9. Current lifestyle carbon footprints and estimated consumption- and system-focused scenarios with needed adoption rates of selected low-carbon lifestyle options to meet the 1.5-degree target by 2030 (India)



	Scenario A: "Consumption Focused"		Scenario B: "System Focused"	
Current Footprint (kgCO₂e/capita/year)		2,960		2,960
Options		Adoption rate		Adoption rate
	Consumption focused	30%	System focused	30%
	System focused	10%	Consumption focused	1%
Scenario based footprint (kgCO₂e/cap/yr)		2,470		2,500

As a complement to their long-term national climate targets, national governments should establish annual emissions reduction targets, akin to annual GDP projections. These targets should be monitored and outcomes reported every year.

These targets further need to be tied to equity and achievement of shared wellbeing within the country. Unless there is a change of indicators by which governments measure success, there will be little change in government planning and investments.

Section V
The Way Forward

11 – Conclusions

11.1. Current lifestyle carbon footprints

The study highlights the huge differences in lifestyle-related greenhouse gas emissions that exist among the world's major economies. An average person in Canada, the country with the highest per-capita emissions among the economies studied, was found to have a lifestyle footprint six times larger than a person in Indonesia. The other high-income countries studied (Finland, Japan, and the UK) were found to have around 70% larger footprints than the three more prosperous middle-income countries included in the study (China, South Africa, and Turkey). These results confirm the well-known relationship where greenhouse gas emissions are strongly linked to per-capita national incomes.

However, there is also considerable variation in emissions among some of the high-income countries. Canada, which has a lifestyle carbon footprint around twice as large as Japan and the UK, is a case in point. This variation shows the significance of factors other than economic activity, such as population density, public investments, climate, and culture, in explaining the carbon intensity of lifestyles.

When looking at different domains of consumption, the footprints related to food are relatively similar for the ten countries studied, with the exception of India and Indonesia, where meat consumption is notably lower. In addition to meat, dairy products are a major contributor to footprints, especially in high-income countries, in particular in Canada and Finland. Different food cultures are reflected in the footprints, for example with respect to fish, dairy, beans, rice and meat consumption.

In the housing domain, non-renewable grid electricity is an important source of lifestyle carbon footprints in all countries. This shows the importance of changing the socio-technical context in order to support sustainable lifestyles. In addition, gas used for heating and cooking is another major contributor to the footprint for some countries, such as the United Kingdom, Japan, and Turkey. Large average living spaces contribute to the higher footprints of high-income countries. This is the case, especially in Canada and Finland, where large living spaces together with long and cold winters increase the overall energy demand.

Footprints for personal transport are highest in the high-income countries due to high overall transport demand and a high share of car use and carbon-intensive air travel. Japan, however, has a high mobility demand but a notably higher share of public transport use than other high-income countries. In countries with a lower share of car use, transport demand is mainly met through public transportation (bus and train), except in India and Indonesia, where motorcycles are the biggest contributor to both mobility demand and footprints.

11.2. Pathways to a fair consumption space

The study proposes a "fair consumption space" as a guiding principle for sustainability and the transition to a low-carbon society. This concept recognises the need to simultaneously address both underconsumption, which results in unmet human needs, poor health, and limited freedoms, and overconsumption, which harms planetary systems disproportionally. Based on this notion, the study establishes "contraction and convergence" pathways for countries' lifestyle carbon footprints.

Drawing from model scenarios used by the IPCC, the study sets mid-century global targets for lifestyle impacts. The lifestyle carbon footprints target to stay under a 1.5-degree increase in global temperature is 0.7 tCO_2e by 2050, with intermediary targets of 2.5 tCO_2e by 2030 and 1.4 tCO_2e by 2040. These targets are consistent with the goal to limit global warming to 1.5°C and derived from scenarios that require only limited deployment of negative emission technologies.

The pathway analysis focuses mainly on the intermediate target of 2.5 tCO_2e per person per year, which would need to be met around 2030. For high-income countries, this requires footprint reductions of 69–82%. Middle-income countries, such as China, South Africa, and Turkey, currently have lifestyle carbon footprints that are about twice as large as the 2030 target. Of the ten countries analysed, it is only Indonesia that has some limited room to grow footprints in the current decade. Even so, it is already above the 2050 target, and so emissions would need to peak and fall soon thereafter.

The study analyses the potential footprint reductions from a range of solutions options, for each of the target countries. The results show that there is a huge reduction potential, especially for high-income countries. In these countries, the largest reduction potentials (of 500 to over 1,500 kg CO_2e/person/year) are found in car-free private travelling/transport, reduction of international flights, vegan diet, electric car, vegetarian diet, renewable grid electricity, vehicle fuel efficiency improvement, renewable off-grid electricity, low-carbon protein instead of red meat, and renewable based heating and/or cooling. In the upper-middle income countries studied, the options with a potential to save more than 500 kg/person/year per option on average are vegan diet and low-carbon protein instead of red meat. In lower-middle income countries, only reducing commuting distances exceeded 500 kg per option.

Based on the assessment of options for reducing footprints, the study analyses how the 2.5t target for 2030 could be reached in each of the countries covered. For each country, two different scenarios for how to reach the 2.5t target were developed—one that relies more on supply-side solutions and one that builds more on changes in behaviour. A consistent finding across all countries is the need for both systems and behaviour change. Even with very ambitious assumptions on supply-side measures (reduced carbon intensity) there is still a need to also reduce and shift overall consumption patterns. This need is especially pronounced for high-income countries where drastic cuts are needed. Canada, which has by far the largest footprint among the countries studied, is not even able to meet the 2.5-ton target with the options considered in this report. Middle-income countries also need lifestyle carbon footprint reductions of 23–50% by 2030, but have more leeway in terms of what domains to focus on and what options to adopt.

The scenarios show that the low-carbon lifestyle options assessed in this report can meet the target for 2030 in most countries but this generally requires high adoption rates of several options in all consumption domains. Although the 2030 target can be met in different ways, the scenarios with more emphasis on supply-side measures were generally found to be more effective. This finding highlights the importance of rapid decarbonisation of products, production systems, and infrastructure—transformations that cannot be brought about by individual consumers but require collective action, including political decisions and effective public policies.

12 –Thinking Forward

According to the IPCC, the remaining carbon budget for limiting global heating to 1.5°C now corresponds to around ten years of emissions at the current level. This timeframe is reflected in the 2.5tCO_2e by 2030 target for lifestyle carbon footprints proposed in this study. Considering the glacial pace of international climate negotiations, the inadequate and wildly inconsistent policies put in place by governments, and the inertia of a civilization shaped for many decades by the availability of cheap high-density energy, ten years is a short period. Time is not on our side and it is easy to understand the growing frustration of climate activist movements.

This final section puts forward some ideas on how to accelerate the transformation towards a low-carbon society and a stable climate. Not all these ideas are derived directly from the footprints analyses presented in this report but have practical links. The ideas are not presented in any specific order.

1 As a complement to their long-term national climate targets, national governments should establish annual emissions reduction targets, akin to annual GDP projections. These targets should be monitored and outcomes reported every year. These targets further need to be tied to equity and achievement of shared wellbeing within the country. Unless there is a change of indicators by which governments measure success, there will be little change in government planning and investments.

2 Governments should also be more explicit in how much global heating they consider acceptable and more transparent in how they intend to contribute to this target. This could involve establishing national carbon budgets, revealing the amount of greenhouse gases that can be emitted during the remainder of the 21st century. Such budgets could also be used for citizens' climate dialogues where people are invited to discuss how to set priorities within a limited national emissions cap.

3 The world is sorely in need of visions that can inspire and guide us to a sustainable future civilization. Imagining sustainable futures is a powerful catalyst for transformative change and for co-creating desired worlds that respond to different identities and aspirations. Most campaigns currently emphasise reductions and familiar ways of living that will be lost, and not enough innovation, regeneration, and inspiration from the past. Visions need to show opportunities to meet needs differently through satisfiers that are less resource and carbon-intensive. The lived experiences of peoples and communities currently achieving high levels of wellbeing with rather modest carbon footprints could be shared much more widely. Visions should be based on sound science (e.g. assessments of resource constraints, carbon budgets, etc.), to avoid technology-driven utopias that disregard resource limits and human psychological wellbeing. In the process of visioning, youth panels on future lifestyles can help communicate the aspirations of the younger generations and identify what societal changes, for example in city planning, can help them turn hopes and dreams into reality.

4 In order to see the role of lifestyles in climate change, both as a driver of emissions and as part of solutions, policymakers and implementation programs need more analysis carried out using consumption-based accounting, of which the analyses presented

in this report are an example. Such measures better reflect the emissions associated with a population's standard of living than the production-based ones used in countries' official reporting. Consumption-based analyses should also be extended beyond climate impacts to cover other critical environmental issues, such as biodiversity loss, air and water pollution, and freshwater use. Improving the accuracy of consumption-based accounting requires better data, updated more frequently. More and better data on lifestyles and consumption patterns of different demographic groups, including of different socioeconomic strata, would be especially valuable for policy design. Ideally, efforts to strengthen data generation on lifestyles, consumption, and wellbeing should also be made at the international level to ensure the availability of data that are comparable across countries.

5 This report presents and discusses mostly country averages. However, literature shows that there are huge differences in lifestyle carbon footprints within countries. These different population groups should be addressed in further research in order to direct decisions and facilitate governance as effectively as possible. Analysis is also needed in-country and at more granular levels, e.g. cities and neighbourhoods/boroughs, inequalities within countries/cities, and reflecting unique lifestyle characteristics.

6 The process of collecting information and results from consumption-based accounting could provide an opportunity for public authorities to involve individuals and communities in participatory policy design, building legitimacy and acceptance to facilitate uptake and implementation of resulting policies and programs. Acting on the basis of such an approach would also reveal what households can do on their own in transforming lifestyles and where intervention is needed at a policy level.

7 Sustainable Development Goal (SDG) 12 on sustainable consumption and production is not sufficient on its own to carry the required global shift in lifestyles. The goal and its targets are an inadequate representation of sustainable lifestyles, the role of such ways of living in a sustainable society, and how the widespread adoption of such lifestyles could be promoted. The agreed indicators are weak, and mostly related to waste management and efficiency, which can be helpful but in no way guarantee sustainable outcomes. In addition, the relationships to other goals are poorly articulated and recent assessments find that SDG12 is among the goals where the least progress has been made. As the international policy community gears up for a midterm review of the SDGs, it will be essential to deal with this failure, and to mandate complementary programs that can boost SDG12.

8 One such complementary programme that could boost SDG12 is the UN mandated 10-Year Framework of Programmes for Sustainable Consumption and Production (10YFP) that is soon to expire. While implementation has had little visible impact, a renewed mandate, restructured governance, and more dedicated resources could provide opportunity for it to be refocused on lifestyles transition. Using a 1.5-degree lifestyles approach would also immediately link the renewed 10YFP to the Paris Agreement, a link that has been missing, as well as to SDGs addressing climate, inequality, and wellbeing.

9 An unprecedented amount of capacity development is needed in order to support a global transition to sustainable future societies. The scale and urgency of change described in this report and by others, such as the IPCC, cannot be addressed with current levels of capacity. Capacity building for future lifestyles will be needed, not just for individuals and households but also for businesses, government agencies, and institutions influencing socio-cultural norms and physical infrastructures that shape lifestyles. Capacity is needed: to reject familiar but unsustainable practices and institutions; to imagine alternatives to current consumerist lifestyles; to understand and accept policies and solutions that may seem radical but are needed; to learn new ways of meeting needs; to build practical life-skills for sustainable living; and to be proactive and innovative towards future directions.

10 Be brave! Each delay in taking meaningful action only increases the likelihood of a climate catastrophe, which would make even more drastic actions necessary. There is enough evidence of workable solutions, and additional opportunities for experiments with high-return potential in terms of climate mitigation, to get started right away.

The world is sorely in need of visions that can inspire and guide us to a sustainable future civilization. Imagining sustainable futures is a powerful catalyst for transformative change and for co-creating desired worlds that respond to different identities and aspirations. Most campaigns currently emphasise reductions and familiar ways of living that will be lost, and not enough innovation, regeneration, and inspiration – including from the past.

Visions need to show opportunities to meet needs differently – through satisfiers that are less resource and carbon-intensive. The lived experiences of peoples and communities currently achieving high levels of wellbeing with rather modest carbon footprints could be shared much more widely. Visions should be based on sound science (e.g. assessments of resource constraints, carbon budgets, etc.), to avoid technology-driven utopias that disregard resource limits and human psychological wellbeing. In the process of visioning, youth panels on future lifestyles can help communicate the aspirations of the younger generations and identify what societal changes can help them turn hopes and dreams into reality.

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Annex B. Country-specific Results

B.1. Country-specific lifestyle carbon footprints: major components and hotspots

Country-specific lifestyle carbon footprints are compared for the three domains—food, housing and personal transport—as they contribute the most (81±10%) to total lifestyle carbon footprints in countries studied. Other domains (consumer goods and leisure and services) generally account for a small proportion of the total lifestyle carbon footprint (10±5%, 8±6%, respectively), with Canada and Finland as an exception, and are compared for all countries but with less attention due to the limited data for some of the case countries and smaller impact on total lifestyle carbon footprint.

1. Food

Canada – The average Canadian has a food carbon footprint of 1,680 kg (CO_2e per year), of which meat products comprise 47%. The highest contributor to this is beef, which, despite contributing only one-third of the total meat consumption, has a high carbon intensity contributing 63% to the footprint of meat. Dairy products are the second highest contributor to the footprint (20%), mostly due to the high share of cheese and milk consumption. Beverages produce nearly a tenth (11%) of the footprint due to the relatively high total consumption (19% of the total food consumption in kilograms) of beverages and the relatively high carbon-intensity of coffee and beer. Consumption of cereals, vegetables, beans and nuts, fruits, and other food products account for nearly half (53%) of the physical amount of food consumed but the share of the total footprint is just 18%. On the contrary, animal products represent only one third of the physical amounts consumed but have a huge impact (79%) on the carbon footprint, much higher than plant-based foodstuffs.

Finland – The food carbon footprint of the average Finn is 1,830 kg (CO_2e per year). The composition of this footprint follows the same pattern as in Canada. For the Finns too, meat products account for over one third (37%) of the footprint due to the high carbon-intensity of meat. Beef consumption accounts for only a quarter (24%) of the total meat consumption compared to pork (39%) and chicken (33%), but the intensity for pork and chicken is notably lower. Another third (30%) of the footprint comes from dairy products due to the high consumption of cheese and milk (14% and 60% of the dairy consumption, respectively). Cheese especially has a high carbon intensity compared to other dairy products. Beverages represent a seventh of the footprint and total consumption (12% and 14%, respectively) due to the consumption of high intensity coffee and beer. The summed share of cereals, vegetables and fruits account for nearly half (44%) of the total consumption but they comprise 9% of the footprint. Similar to Canada, animal products have the highest impact on food carbon footprint despite the lower share of consumption.

United Kingdom – The average person's food footprint in the United Kingdom is 1,590 kg (CO_2e per year). Forty-four percent of the footprint is meat, due to consumption of high intensity beef, which contributes 60% of the meat footprint. Consumption of pork and other meat products and chicken is higher (38% and 35%, respectively), but carbon intensity for both is three to eight times lower compared to beef. Dairy consumption in the United Kingdom is high, and this contributes almost a quarter (23%) to the food footprint. Eggs and fish contribute only 2–3% of the food footprint, likewise the consumption amounts. Division between animal products and cereals, vegetables, beans and nuts, and fruits follows the same pattern as in Canada and Finland—consumption of plant-based products is much higher but the impact on the food footprint is notably lower compared to meat products.

Japan – The food carbon footprint of the average Japanese is 1,410 kg (CO_2e per year). For the Japanese too, meat products are a key contributor at nearly a quarter of this footprint (24%) due to their high carbon intensity, especially beef. Thirteen percent of the footprint is caused by dairy products, the carbon intensity of which highly varies (e.g., butter is 13 times higher than milk). Fish consumption causes 7% of the footprint, and has a relatively high intensity. Cereals represent nearly a fifth of the footprint, and beverages and vegetables a tenth each, but their carbon intensity is relatively low. The carbon intensity of cereals is higher in Japan because of the higher intensity of rice than other cereal crops. Alcoholic beverages are over six times more carbon-intense than non-alcoholic beverages. The intensity of "Others" is also relatively high due to processed or lightweight products such as oils and spices.

China – The average Chinese has an annual food footprint of 1,320 kg (CO_2e per year). Similar to the previous countries, the impact of meat consumption is high, at 39% of an average person's food footprint, with one-third (33%) of this caused by high intensity beef. Pork is responsible for the highest share (63%) of meat consumption, but with relatively lower carbon intensity the impact remains low. Cereals contribute a fifth (20%) to both footprint and consumption amount, due to the relatively high carbon intensity and consumption of rice. Although the share of vegetables of the total consumption amount is nearly half (46%), they only account for a seventh (14%) of the footprint, due to the low carbon intensity. Other plant-based products (beans and nuts, and fruits) account for 6%. Fish accounts for 8% of the food footprint and eggs even less (4%). Consumption of dairy products is very low, compared to previously introduced high-income countries and their share is only 3% of the footprint.

South Africa – The average South African has a food footprint of 1,700 kg (CO_2e per year). Again, animal-based products account for only a quarter (25%) of the total consumption but they contribute over three-quarters (77%) to the total footprint. Meat in particular contributes heavily to the food footprint (72%), due to the relatively high share of beef (30%) of the total meat consumption and notably carbon intensive livestock farming compared to other countries. Nevertheless, overall meat consumption per capita is relatively moderate (65 kg) compared to Canada (157 kg) and Finland (80 kg), for example. Over a third (35%) of the food consumption is cereals but they account for just 8% to the food footprint due to their low carbon intensity. Vegetables, beverages, and other products (such as oils) together account for more than a third (13%, 13% and 11%, respectively) of total consumption but their aggregate impact to the total food footprint is only 14%, due to the relatively low carbon intensity, especially compared to beef.

Turkey – The food carbon footprint for an average Turk is 1,220 kg (CO_2e per year). As for all industrialised countries above, meat consumption is responsible for the greatest share (33%) of the footprint. Total meat consumption is notably lower compared to previous countries but the share of beef in total meat consumption is higher, nearly half (45%). Also the share of chicken consumption is higher (51%) compared to previous countries, which is explained by the high share (99%) of Muslims (European Commission 2021) that refrain from eating pork. Dairy products have the second largest contribution to the footprint (26%). Cereals, vegetables, and other products all contribute approximately one-tenth each to the footprint (12%, 11% and 9%, respectively). Vegetables have the highest consumption amount (32%), but have one of the lowest carbon intensity together with fruits (less than 0.5 kgCO_2e/kg). Also consumption of beverages is very low, so beverages are responsible only for a fraction (2%) of the footprint.

Brazil – The food footprint of the average Brazilian is 1,890 kg (CO_2e per year). For the average Brazilian too, meat products contribute over a half (59%) to the food footprint, though their consumption accounts for below a sixth (13%) of the total consumption. Carbon intensity of beef is relatively higher in Brazil compared to most other countries due to high intensity livestock farming, similar to South Africa. Plant-based products account nearly half (46%) of the total consumption but only 12% of the footprint. Their carbon intensity is lower compared to many other countries, for instance due to the self-sufficient production of fruits and many vegetables (Paulo et al. n.d.). Dairy consumption accounts for 18% of the total consumption and the total amount is quite similar to Finland. Nevertheless, consumption data from Brazil does not distinguish whether consumed milk is used for cheese production or consumed as liquids. Therefore the carbon intensity for dairy products remains lower and the consumption amount higher as the data for the share of high intensity cheese consumption is not available.

India – The food footprint for an average Indian is one of the lowest, 790 kg (CO_2e per year). The overall smaller consumption and the composition of consumed food products differ from the previous countries. Consumption of animal based products account for only 23% of the total consumption and are mainly (92%) dairy products. Meat consumption is very low, only 4 kg per person. Different consumption habits of food products are due to religious reasons. Approximately 80% of the population are Hindus (Census India 2011) and eat mainly vegetarian food. Half of the food consumption is due to cereals and vegetables (34% and 21%, respectively). Cereals are responsible for over a half (54%) of the food footprint due to the high share of carbon-intensive rice consumption.

Indonesia – The average Indonesian has a food footprint of 800 kg (CO_2e per year). Consumption habits follow a similar pattern to India, low consumption of animal products and high share of cereals and vegetables in the diet. Animal-based products account for a third (28%) to the footprint but only one-sixth (12%) to the total consumption. Share of fish product consumption (7%) is one of the highest among the countries and it accounts for nearly a seventh (13%) to the food footprint. High consumption of high intensity rice is reflected in the footprint, as cereals account for more than half (52%) of the food footprint.

2. Housing

Canada – The average Canadian lives in housing with a floor space of 58 m² and uses 11,480 kWh of energy per year, which produces an annual footprint of 3,060 kgCO_2e and intensity of 52 kgCO_2e/m². Over four-fifths of a person's annual carbon footprint for housing is represented by direct energy consumption (83%), over half of which is other energy, meaning heating. Other energy is mainly (73%) from natural gas, followed by renewable sources (wood: 19%). High intensity oil products account for 6% of the other energy consumption but account for more than one third (34%) of the other energy footprint. Grid electricity is mainly (65%) from renewable sources (hydro, tidal, solar and wind power). Non-renewable grid electricity accounts for the higher share (53%) of the footprint due to the relatively high share (43%) of high intensity coal and petroleum (Government of Canada 2017).

Finland – The average Finn lives in housing with a floor space of 41 m² and uses 11,320 kWh of energy, which produces an annual footprint of 1,550 kgCO_2e and an intensity of 38 kgCO_2e/m². Heating demand is high due to the long winters and relatively large living space. Electricity accounts for two fifths (38%) of each person's annual housing footprint, including its use as a main heating source (46% of the electricity consumption). Half (52%) of the electricity production comes from renewable sources, such as hydro, wind and solar power and wood based biomass). District heating covers one-third (30%) of the heating demand and housing footprint. The fuels used for district heating production, from highest to lowest share, are wood and other biomass, coal, peat, natural gas, oil and waste (Official Statistics of Finland 2020d). Despite the relatively low share (15%) of peat used for district heating production, it is responsible for nearly two-fifths (39%) of the district heating emissions. The share of heat pumps is nearly a tenth (8%) of the total heating demand, but the footprint is relatively low due to the low intensity.

United Kingdom – The average person in the United Kingdom lives in housing with a floor space of 39 m² and uses 7,190 kWh of energy, which gives an annual footprint of 1,880 kgCO_2e and an intensity of 48 kgCO_2e/m². Four-fifths (80%) of the housing footprint is represented by direct energy consumption of which two thirds (66%) is natural gas. One-fifth (22%) of the direct energy consumption is grid electricity, of which 63% is produced with non-renewable sources (coal, oil, natural gas, and nuclear power). Non-renewable grid electricity accounts for 92% of the housing footprint.

Japan – The average Japanese lives in housing with a floor space of 40m² and uses 4,200 kWh energy per year, which results in an annual footprint of 2,430 kgCO_2e and an intensity of 61 kgCO_2e/m². Nearly four-fifths of a Japanese's annual carbon footprint is represented by direct energy consumption (77%), over half of which is electricity. Grid electricity is mainly (84%) from coal, oil and LNG, with hydropower and other renewables producing only 15% (Agency for Natural Resources and Energy, Japan 2018b). The direct energy supplied to households is comprised equally of electricity and other energy (mainly non-renewables, such as kerosene for heating, and LPG and city gas for cooking and heating), with only 8% from renewables.

China – The average Chinese has a housing floor space of 41 m² and uses 1,870 kWh of energy, which results in an annual footprint of 1,190 kgCO_2e and intensity of 29 kgCO_2e/m². Grid electricity consumption is responsible for the biggest share (48%) of the annual housing footprint. Twenty-six percent of the grid electricity is produced with renewable sources. Non-renewable sources are mainly fossil fuel-based (71%) and therefore are responsible for the greatest share (98%) of the grid electricity related footprint. Other energy sources used in households are only fossil fuel based—coal, natural gas, and LPG.

South Africa – The average South African lives in housing with a floor space of 23 m² and uses 1,100 kWh of energy, which results in an annual footprint of 1,050 kgCO_2e and intensity of 46 kgCO_2e/m². Three-quarters (76%) of the annual footprint comes from grid electricity consumption that is heavily non-renewable-based: 94% of the electricity-based footprint comes from coal. Overall, the energy demand in South Africa is lower compared to the previously introduced countries due to its southern location. Also half (50%) of the other energy consumption is based on non-renewable energy sources, such as coal and oil.

Turkey – The average Turk lives in housing with a floor space of 32 m² and uses 1,890 kWh of energy, which results in an annual footprint of 1,700 kgCO_2e and intensity of 52 kg(CO_2e/m². Four-fifths (80%) of a person's annual carbon footprint is represented by energy consumption, over half (54%) of which is other energy than grid electricity. These other energy sources are mainly (48%) oil products, 31% natural gas and 15% other non-renewable sources such as heat and waste-based energy. Just 6%) comes from renewable sources. Grid electricity is mainly (68%) from coal and natural gas. One-third is from renewables, which is mainly (61%) from hydropower.

Brazil – The average Brazilian lives in housing with a floor space of 28 m²—similar to South Africa—and uses 1,480 kWh of energy, which results in an annual footprint of 510 kgCO_2e and intensity of 18 kg(CO_2e/m². Over half (58%) of the moderate housing footprint results from the relatively carbon-intense living space. Both grid electricity and other energy consumption contribute approximately a fifth (18% and 20%, respectively) due to low overall consumption and high share of renewable energy. Over three-fifths (65%) of grid electricity is based on renewable hydropower and the overall share of renewables of grid electricity is 82%. Other energy consumption is divided quite evenly between renewable wood-based energy (49%) and natural gas (48%), though natural gas contributes 90% to the other energy related footprint.

India – The average Indian lives in housing with a floor space of 10 m² and uses 540 kWh of energy, which results in an annual footprint of 440 kgCO2e and intensity of 43 kgCO_2e/m². Nearly half (49%) of the footprint comes from grid electricity due to the high share of coal-based energy and other non-renewable sources. The total consumption of other energy forms is higher but the carbon intensity is lower compared to coal-based energy. LPG and natural gas are the main sources for other energy consumed by households.

Indonesia – The average Indonesian lives in housing with a floor space of 19 m² and uses 1,120 kWh of energy, which results in an annual footprint of 590 kgCO_2e and intensity of 31 kgCO_2e/m². The housing footprint is divided quite evenly between living space, grid electricity and other energy consumption (32%, 31% and 24%, respectively). Only 13% of the grid electricity comes from renewable sources, such as hydropower and geothermal sources. Also other energy relies heavily on non-renewable sources (77%), kerosene and LPG being the main energy sources in households.

3. Personal transport

Canada – For the average Canadian, transport contributes 35%, or 5,000 kg (CO_2e) of their annual carbon footprint, nearly three quarters of which is caused by heavy car use (15,500 km) and its high carbon intensity. Half (49%) of the car kilometers are travelled by light trucks (including light-duty vehicles, such as pickup trucks and minivans) and half (51%) by regular passenger cars. Canadians also travel a lot by bus (3,400 km, or 15% of the transport demand) and by air (3,100 km, or 14% of the transport demand). Bus transport comprises nearly all (99%) land-based public transport demand and has the highest carbon intensity of all public transportation modes. Air travel has the highest carbon intensity of all travel modes and it contributes the second highest share (21%) to the carbon footprint. Low intensity trains account for less than 1% of the transport demand.

Finland – For the average Finn, transport contributes a third (38%), or 3,650 kg (CO_2e) of their carbon footprint and they travel 17,500 km in a year. Half (55%) of the footprint results from heavy car use (10,400 km in a year) and 35% from air travel (3,800 km in a year), and their high carbon intensity. Land-based public transportation accounts for 12% (or 2,140 km) of the total transport demand—over half (56%) of which is bus, two-fifths trains (38%) and less than a tenth (7%) tram or metro. Passenger trains, trams, and metros run mainly on renewable energy (VR Group Ltd. 2020), which results in a very low intensity of 0.01 kgCO_2e per km. They also travel 690 km, or 1.9 km per day, on motorcycles, scooters, snowmobiles, quad bikes, and so on, and cycle and walk little (260 km and 350 km, respectively, or less than 1km per day for both).

United Kingdom – Average person's transport-related footprint in the United Kingdom is nearly two-fifths (38%, or 3,250 kgCO_2e) of the annual lifestyle carbon footprint. Half of the footprint is due to the high share of high intensity car and air travel (50% and 44%, respectively). Annual transport demand is 14,700 km per person, of which car travel comprises 55%, or 8,100 km, and air travel 29%, or 4,200 km. High carbon intensity of car transport is due to the high share of fossil-fuel use and low occupancy rate. The share of public transportation of the total transport demand is low, only 11% (1,700 km). Share of trains is 70% (1,200 km), of which

85% is surface rail and 15% is underground. Cycling accounts for only 90 km or 0.25 km a day and walking 490 km or 1.3 km a day.

Japan – For the average Japanese, transport contributes nearly a quarter, or 1,970 ($kgCO_2e$) of their carbon footprint and they travel 11,000 km a year, including walking. Nearly two-thirds of their transport footprint comes from cars, which, while representing less than half their annual km travelled (5,000 km), incurs a high carbon intensity, partly due to the low occupancy rate, high share of fossil-fuel use, and low use of electric vehicles. Taxis have even higher carbon intensity due to their relatively low occupancy rate. Air travel contributes a little over a third of the carbon footprint, which while less than cars adds up due to relatively long trips (approx. 600 km domestic, 1,000 km international) and high carbon intensity. Trains are also used a lot—3,100 of the 3,600 km land-based public transport demand (with the remainder being buses)—and have a very low carbon intensity of 0.02 kg per km. Cycling accounts for only 270 km, or 0.7 km a day.

China – For the average Chinese, transport contributes 1,200 kg (CO_2e), with a total annual transport demand of 9,300 km per person. Almost two fifth (37%) of the footprint is due to car use and nearly a quarter (23%) is due to the heavy use of motorcycles. The share of public transportation is 22%, over two-thirds (69%) of which is bus transport. Air travel is the third largest contributor to the footprint (17%). The transport demand for air travel (600 km) is notably lower than for car, motorcycle and public transportation (2,300 km, 1,700 km, 3,100 km, respectively).

South Africa – For the average South African, transport contributes a quarter (25%, or 1,200 $kgCO_2e$) to the total lifestyle carbon footprint. South Africans travel an average of 7,200 km a year, mainly by public transportation (50% of the annual demand) and by car (42%). Public transportation is divided between train and bus transport (65% and 35%, respectively). They both contribute approximately a sixth (15% and 12%, respectively) to the transport footprint. Cars account for 60% of the annual transport footprint due to high share of fossil fuel use and low occupancy rate. Air travel accounts for only 7% of transport demand.

Turkey – The average Turk has a transport footprint of 1,000 kg (CO_2e), half (52%) of which comes from cars, due to their low occupancy rate, low share of electric cars, and high transport demand (55%, or 2,400 km of the total transport demand). Air travel accounts for 35% of the annual footprint and 23% (1,000 km) of annual transport demand (4,400 km). Land-based public transportation contributes 7% (310 km) of annual transport demand. Instead, motorcycles account for 15% (640 km) of the annual transport demand and a tenth of the total annual transport footprint.

Brazil – For the average Brazilian, transport contributes 20%, or 640 kg (CO_2e) of their carbon footprint and they travel 4,600 km in a year. Land-based public transportation has the highest transport demand (48%, or 2,200 km), followed by cars (25%, or 1,200 km) and air travel (14%, or 670 km). Carbon-intensive flying contributes the highest share (36%) to the transport footprint, followed by bus (33%) due to the heavy use of bus transport. Cars account for only 23% of the transport footprint due to one of the highest share of flex fuel cars (Empresa de Pesquisa Energética - EPE 2013) within the case countries. Cycling accounts for only 20 km or 0.06 km a day and walking 360 km or 1.0 km a day.

India – Mobility contributes over a half (58%), or 1,730 kg (CO_2e) of a average person's footprint in India, due to the high transport demand (16,400 km) and high share of relatively carbon intense travel by motorcycle and car (73% and 15% of the total transport demand, respectively). Motorcycling (including two, three and four wheelers) produce over three-fifths (68%) and car driving one-fifth (20%) of the transport footprint. Use of public transportation is low, only a tenth (10%) of the transport demand.

Indonesia – For the average Indonesian, transport contributes a quarter (26%), or 570 kg (CO_2e) of their annual footprint. Transport demand is relatively low (3,300 km) and is mainly fulfilled by motorcycle (60%, or 2,000 km), followed by public transportation (18%, or 590 km) and car (14%, or 450 km). Motorcycling is also the greatest contributor to the transport footprint, as it covers over half (55%) of it. Both cars and airplanes contribute a fifth (18%) to the footprint due to their high carbon intensity.

4. Other domains (consumer goods, leisure, and services)

Canada – Consumer goods comprise 18% (2,510 $kgCO_2e$) of the annual lifestyle carbon footprint of the average Canadian. Clothes account for the greatest share (37%, 930 kg) of the consumer goods footprint, followed by furniture/room covering (17%) due to overall high consumer spending but also due to the highest carbon intensities (0.91 and 0.88 $kgCO_2e$/USD, respectively) among consumer goods. The average per-capita consumer spending for other goods, such as durable goods and jewelry covers 16% of the overall consumer goods related spendings, but the carbon intensity is nearly one-fifth smaller compared to clothes' carbon intensity.

Leisure services consumed outside the home account for 680 kg (CO_2e per capita), or 5% of the average person's lifestyle carbon footprint in Canada. Other leisure services, such as games of chance and pets, are the largest contributor at 55% (380 kgCO_2e) to the leisure related footprint.

Services account for 5% (720 kg) of the total lifestyle carbon footprint. Finance and insurance comprise over half of the services-related consumption and carbon footprint (62%).

Finland – The carbon footprint of consumer goods is 1,410 kg (CO_2e) for an average Finn, which is 15% of Finland's average lifestyle carbon footprint. Clothes and furniture/room covering account for the greatest shares (37% and 26%, respectively) of the consumer goods footprint, followed by other goods (18%, or 250 kg), electronics (11%, or 160 kg) and sanitation/medicine (7%, or 100 kg). Appliances are a minor contributor (2%, or 30 kg).

Leisure services account for 6% (540 kgCO_2e) of the lifestyle carbon footprint, of which over half (55%) comes from the hotels and restaurant services. Nearly one-fourth (23%) of the footprint is related to cultural services and 11% each to sport services and summer cottages (constructed space, electricity, and other energy consumption).

Services account for 690 kg (CO_2e), which is 7% of the average annual lifestyle carbon footprint. Welfare/medical and finance/insurance services, account for the greatest share (28% each) of the footprint and over half (29% and 28%, respectively) of total consumer spending. Other services, including such as postal and publishing services, account for 41% of the footprint, and 19% of total consumer spending.

Though the average per-capita spending for consumer goods is less than for services, the overall footprint is highest among all three domains, reflecting relatively high carbon intensity. The average carbon intensity of leisure and services are nearly half (0.17–0.21 kgCO_2e/USD) of the consumer goods related intensity (0.40 kgCO_2e/USD).

United Kingdom – Consumer goods, leisure, and services together account for 21% (1,750 kgCO_2e) of the average person's annual lifestyle carbon footprint. Average per-capita consumer spending is distributed quite evenly between all three domains: 34% for consumer goods, 29% for leisure, and 37% for services.

Of consumer goods, clothing is the largest contributor to this footprint at 360 kg, or 37%, followed by the other goods (including such as paints, paper products, rubber, plastic and metal products) at 260 kg, or 27%. Electronics and sanitation/medicine cover 17% and 14% respectively.

Leisure services cover 4% of the lifestyle carbon footprint. Nearly half (49%) of the leisure footprint is related to the high consumption of food and beverage serving services. Remaining footprint and consumption is distributed relatively evenly between cultural, sport, and other leisure services (14–22% and 11–18%, respectively).

The footprint of services is similar to leisure, as it accounts for 5% of the lifestyle carbon footprint. Thirty-five percent of the leisure footprint comes from the high consumption of other services (including such as veterinary, other personal and postal services), followed by finance/insurance (29%) and education and welfare/medical services (14% for each). Average per-capita consumer spending follows a similar pattern, reflecting relatively even carbon intensities within the service domain (0.09–0.11 kgCO_2e/USD). Overall, the carbon intensity of leisure and services are more than half (0.09–0.10 kgCO_2e/USD) of the consumer goods related intensity (0.23 kgCO_2e/USD).

Japan – Consumer goods account for 1,030 kg (CO_2e/capita), or 13% of the average person's lifestyle carbon footprint in Japan. Other goods (such as tobacco, jewelry, batteries, miscellaneous small household goods, and decoratives) is the largest contributor to footprint at 240 kg, or 23%, with clothing and electronics second at 220 kg and 200 kg, respectively. Home appliances and sanitation/medicine contribute 12% (or 120 kg for both) and furniture/room covering is responsible for only 4% of the footprint.

Leisure services consumed outside the home account for 580 kg (CO_2e/capita) of the lifestyle carbon footprint, with 43% coming from restaurants and 22% coming from hotels. The monetary equivalent carbon intensity for hotel and restaurant services, including the footprint induced from food ingredients, is approximately 0.35 kgCO_2e/USD, the highest among leisure items. Cultural services account for 22% (130 kg) of the footprint and the rest of the 70 kg footprint is accounted for by sports, and outdoor leisure including movies, theatre plays, sports facilities, and outdoor parks, which have relatively low carbon intensities per monetary value of under 0.27 kg per USD. Access to these leisure facilities is accounted for in the transport domain.

China – Detailed data or product lists concerning total amounts of individual products and services was not available for China. Lifestyle carbon footprint estimated for consumer goods, leisure, and services are based on average per-capita consumer spending of aggregated product/service groups by the National Bureau of Statistics of China (2020).

Consumer goods account for 8% (410 $kgCO_2e$) of the average Chinese's lifestyle carbon footprint. Consumer goods are divided between clothes and household goods, which contribute 61% and 39% to the footprint, respectively. The leisure related footprint is just 3% of the lifestyle carbon footprint and only includes cultural and recreational leisure services. Over half (58%) of the service related footprint is due to welfare/medical services. The rest is divided between other education and other services (20% and 23%, respectively). The average per-capita consumer spending of services follows the same pattern as the footprint: 47% to welfare/medical services, 31% to education, and 22% to other services.

South Africa – Consumer goods, leisure, and services together account for 19% (940 $kgCO_2e$) of the average person's annual carbon footprint. Despite the relatively small per-capita consumer spending, consumer goods have the highest impact on the footprint (15%) due to high average carbon intensity (3.17 $kgCO_2e$/USD) compared to leisure and services (0.63 $kgCO_2e$/USD and 0.29 $kgCO_2e$/USD, respectively). Clothing accounts for the largest share of the average per-capita consumer spending and carbon footprint (42% and 68%, respectively) in the domain of consumer goods.

Leisure accounts for only a fraction (1%) of the total footprint. Two-fifths (41%) of the leisure footprint is related to the consumption of cultural services. Services have the highest per-capita consumer spending but due to overall low carbon intensity services are responsible for only 3% of the lifestyle footprint.

Turkey – Consumer goods account for 630 kg (CO_2e), or 13% of the average person's annual carbon footprint. The average per-capita consumer spending of consumer goods is quite evenly divided between furniture/room covering (34%), other goods (33%), and clothes (32%). Furnishing/room covering has the highest carbon intensity (0.70 $kgCO_2e$/USD) and it accounts for the highest share (49%) of the consumer goods related footprint.

Leisure and services each account for less than tenth (6% and 3%, respectively) of the total carbon footprint. Over half (59%) of the leisure related consumption comes from hotels and restaurants and the rest (41%) from cultural services. Hotels and restaurant services have relatively higher carbon intensity and they account for 75% of the leisure footprint.

Welfare and medical services account for nearly half (45%) of the services footprint due to their high carbon intensity (0.53 $kgCO_2e$/USD) within the domain and relatively high share of the consumer spending (32% of the service related consumption).

Brazil – Consumer goods account for only 130 kg (CO_2e), or 4%, of the average person's annual carbon footprint. The average Brazilian spends 310 USD on consumer goods and the consumption is mainly focusing on electronics, other goods (such as paper products and pesticides), and clothes (32%, 30% and 14% of the total consumption, respectively). Electronics and other goods have a relatively low carbon intensity (0.40 and 0.33 $kgCO_2e$/USD, respectively), but due to their high consumption share they account for approximately a quarter (29% and 25%, respectively) of the footprint.

Leisure and other services account for only 3% of the annual footprint. The average per-capita consumer spending is relatively similar to consumer goods (280 and 410 USD, respectively), but the carbon intensity is much lower for leisure and services (0.14 $kgCO_2e$/USD and 0.12 $kgCO_2e$/USD, respectively), compared to consumer goods (0.42 $kgCO_2e$/USD). Cultural services contribute the largest share (77%) to the leisure footprint and other services, such as maintenance services for household appliances and public administration collective services (76%) to the services footprint.

India – Consumer goods, leisure, and services contribute less than one percent (0.5%) to the average person's annual lifestyle carbon footprint. The overall consumer spending in India is notably lower compared to most of the developed countries and the intensity per Indian rupee is very low. The consumer spending is mainly focused on clothes (52% of the consumer goods), entertainment services (100% of the leisure services) and welfare and medical services (42% of the services). In addition to low consumption, a small part of the consumer goods (2%) are secondhand items, which have a lower carbon intensity compared to those bought as new.

Indonesia – Similar to Brazil, consumer goods, leisure, and services account for only 11% of the average person's carbon footprint in Indonesia. The overall per-capita consumer spending is mainly focused on consumer goods (46% of total per-capita consumer spending) and services (48%). Durable goods and goods other than clothes are the main contributor (88%) to the consumer goods footprint, followed by clothing (12%). Nearly half (46%) of the service footprint comes from welfare and medical services, and education. Parties and ceremonies cover the entire leisure category, with an annual footprint of 10 kg (CO_2e).

B.2. Supplementary table of results

The detailed estimation results of lifestyle carbon footprints in case countries are given in Table B.1. (comparison among case countries) and Table B.2-11 (country-specific results).

Table B.1. Current annual lifestyle carbon footprint per capita in case countries

Domains	Canada		Finland		United Kingdom		Japan		China	
	CF (kg)	%	CF (kg)	%	CF (kg)	%	CF (kg)	%	CF (kg)	%
Food	1,680	12%	1,830	19%	1,590	19%	1,400	17%	1,330	27%
Housing	3,050	22%	1,570	16%	1,890	22%	2,430	30%	1,190	24%
Transport	4,990	37%	3,650	38%	3,250	38%	1,970	24%	1,200	24%
Total (3 domains)	**10,310**	**71%**	**7,050**	**73%**	**6,730**	**79%**	**5,800**	**72%**	**3,720**	**75%**
Consumer goods	2,510	18%	1,410	15%	970	11%	1,030	13%	410	8%
Total (4 domains)	**12,820**	**90%**	**8,460**	**87%**	**7,700**	**91%**	**6,830**	**85%**	**4,130**	**83%**
Other (leisure & services)	1,390	10%	1,240	13%	770	9%	1,230	15%	840	17%
Total (all domains)	**13,630**	**100%**	**9,700**	**100%**	**8,470**	**100%**	**8,060**	**100%**	**4,970**	**100%**

Domains	South Africa		Turkey		Brazil		India		Indonesia	
	CF (kg)	%	CF (kg)	%	CF (kg)	%	CF (kg)	%	CF (kg)	%
Food	1,710	35%	1,210	25%	1,880	58%	790	27%	800	36%
Housing	1,050	21%	1,690	35%	500	15%	430	15%	590	27%
Transport	1,200	24%	1,010	21%	640	20%	1,730	58%	570	26%
Total (3 domains)	**3,960**	**81%**	**3,910**	**80%**	**3,030**	**93%**	**2,950**	**100%**	**1,960**	**89%**
Consumer goods	730	15%	630	13%	130	4%	10	0.5%	140	6%
Total (4 domains)	4,690	96%	4,540	93%	3,160	97%	2,960	100%	2,100	95%
Other (leisure & services)	210	4%	320	7%	90	3%	3	0.1%	100	5%
Total (all domains)	**4,890**	**100%**	**4,860**	**100%**	**3,240**	**100%**	**2,960**	**100%**	**2,200**	**100%**

Table B.2. Current annual lifestyle carbon footprint per capita in Canada (rounded values)

Domains and components	CF (kg-CO_2e)	CF (%)	Amount (total)	Amount (%)
Food	**1,680**	**12%**	**830 kg**	
Cereals	60	3%	70 kg	9%
Vegetables (incl. potatoes)	70	4%	150 kg	18%
Beans/nuts	10	0.5%	10 kg	1%
Dairy	340	20%	110 kg	13%
Eggs	40	2%	20 kg	2%
Fish	20	1%	10 kg	1%
Meat	800	47%	90 kg	11%
Fruits	40	3%	130 kg	15%
Beverages	190	11%	160 kg	19%
Other	110	7%	90 kg	10%
Housing	**3,050**	**21%**	**58 m²**	
Construction/maintenance	520	17%	58 m²	
Electricity	1,450	47%	4,610 kWh	
Renewable grid electricity	680	47%	3,010 kWh	65%
Non-renewable grid electricity	760	52%	9,20 kWh	20%
Nuclear grid electricity	10	1%	680 kWh	15%
Other energy	1,070	35%	6,870 kWh	
Oil	360	34%	420 kWh	6%
Gas	540	51%	5,010 kWh	73%
Other (non-renewable)	150	14%	140 kWh	2%
Other (renewable)	10	1%	1,300 kWh	19%
Water consumption	20	1%	80 m³	
Transport	**4,990**	**35%**	**22,180 km**	
Airplane	1,060	21%	3,100 km	14%
Car	3,540	71%	15,540 km	70%
Train	5	0.1%	40 km	>0.5%
Bus	370	8%	3,390 km	15%
Motorcycle	20	>0.5%	100 km	>0.5%
Consumer goods	**2,510**	**18%**	**4,810 CAD**	
Appliances	390	16%	1,080 CAD	22%
Electronics	110	4%	400 CAD	8%
Furniture/room covering	430	17%	640 CAD	13%
Clothes	930	37%	1,350 CAD	28%
Sanitation/medicine	0	0.1%	20 CAD	>0.5%
Hobby	220	9%	550 CAD	11%
Other goods	410	16%	700 CAD	14%
Repair	30	1%	70 CAD	2%
Leisure	**680**	**5%**	**1,420 CAD**	
Hotels/travels	160	24%	360 CAD	26%
Cultural	40	6%	120 CAD	9%
Sports	100	15%	340 CAD	24%
Other leisure	380	55%	590 CAD	42%
Services	**730**	**5%**	**5,660 CAD**	
Education	20	3%	550 CAD	10%
Welfare/medical	110	15%	1,110 CAD	20%
Finance/insurance	450	62%	2,790 CAD	49%
Communication	70	9%	660 CAD	12%
Other services	80	11%	550 CAD	10%
Sub-total 3 domain	**9,720**	**71%**		
Goods	**2,510**	**18%**	**4,820 CAD**	
Leisure	**680**	**5%**	**1,420 CAD**	
Services	**720**	**5%**	**5,660 CAD**	
Grand Total (6 domains)	**13,630**	**100%**		

Table B.3. Current annual lifestyle carbon footprint per capita in Finland (rounded values)

Domains and components	CF (kg-CO_2e)	CF (%)	Amount (total)	Amount (%)
Food	**1,830**	**19%**	**790 kg**	
Cereals	70	4%	80 kg	10%
Vegetables (incl. potatoes)	50	3%	130 kg	16%
Beans/nuts	10	0.5%	3 kg	>0.5%
Dairy	550	30%	180 kg	22%
Eggs	30	2%	10 kg	2%
Fish	40	2%	15 kg	2%
Meat	680	37%	80 kg	10%
Fruits	50	3%	140 kg	18%
Beverages	210	12%	110 kg	14%
Other	140	8%	40 kg	5%
Housing	**1,570**	**16%**	**41 m²**	
Construction/maintenance	230	15%	41 m²	
Electricity	590	38%	3,930 kWh	
Renewable grid electricity	80	13%	2,060 kWh	52%
Non-renewable grid electricity	510	86%	540 kWh	14%
Nuclear grid electricity	10	2%	1,330 kWh	34%
Other energy	720	46%	7,380 kWh	
Oil	130	18%	530 kWh	7%
Gas	10	2%	70 kWh	1%
Other (Non-renewable)	540	75%	4,440 kWh	60%
Other (Renewable)	30	5%	2,350 kWh	32%
Water consumption	10	1%	40 m3	
Transport	**3,650**	**38%**	**17,490 km**	
Airplane	1,290	35%	3,790 km	22%
Car	2,020	55%	10,420 km	60%
Other private transportation	0	0%	20 km	0.1%
Train	10	>0.5%	680 km	4%
Bus	90	3%	850 km	5%
Ferry	130	3%	450 km	3%
Motorcycle	110	3%	670 km	4%
Bicycle	3	0.1%	260 km	2%
Walking	0	0%	350 km	2%
Consumer goods	**1,410**	**15%**	**3,180 €**	
Appliances	30	2%	90 €	3%
Electronics	160	11%	560 €	18%
Furniture/room covering	360	26%	580 €	18%
Clothes	520	37%	1040 €	33%
Sanitation/medicine	100	7%	280 €	9%
Other goods	250	17%	630 €	20%
Leisure	**540**	**6%**	**2,410 €**	
Hotels/travels	300	55%	1,670 €	69%
Cultural	130	23%	510 €	21%
Sports	60	11%	240 €	10%
Summer cottage	60	11%	5 m²	
Services	**690**	**7%**	**3,480 €**	
Education	30	4%	119 €	3%
Welfare/medical	190	28%	994 €	29%
Finance/insurance	200	28%	974 €	28%
Communication	90	13%	478 €	14%
Personal care	50	7%	257 €	7%
Other services	140	20%	658 €	19%
Sub-total 3 domain	**7,040**	**73%**		
Goods	**1,410**	**15%**	**3,180 €**	
Leisure	**540**	**6%**	**2,410 €**	
Services	**690**	**7%**	**3,480 €**	
Grand Total (6 domains)	**9,700**	**100%**		

Table B.4. Current annual lifestyle carbon footprint per capita in United Kingdom (rounded values)

Domains and components	CF (kg-CO²e)	CF (%)	Amount (total)	Amount (%)
Food	**1,590**	**19%**	**850 kg**	
Cereals	100	6%	130 kg	15%
Vegetables (incl. potatoes)	50	3%	150 kg	18%
Beans/nuts	10	1%	10 kg	1%
Dairy	370	23%	210 kg	25%
Eggs	30	2%	10 kg	1%
Fish	40	3%	20 kg	2%
Meat	690	44%	80 kg	9%
Fruits	20	1%	80 kg	9%
Beverages	140	9%	100 kg	11%
Other	140	9%	70 kg	8%
Housing	**1,890**	**22%**	**39 m²**	
Construction/maintenance	350	19%	39 m²	
Electricity	390	21%	1,550 kWh	
Renewable grid electricity	30	7%	580 kWh	37%
Non-renewable grid electricity	360	92%	710 kWh	46%
Nuclear grid electricity	2	0.5%	270 kWh	17%
Other energy	1,120	60%	5,640 kWh	
Oil	120	11%	440 kWh	8%
Gas	930	82%	4,640 kWh	82%
Other (non-renewable)	40	4%	130 kWh	2%
Other (renewable)	30	3%	430 kWh	8%
Water consumption	20	1%	50 m³	
Transport	**3,250**	**38%**	**14,740 km**	
Airplane	1,440	44%	4,220 km	29%
Car	1,640	51%	8,060 km	55%
Other private transportation	20	1%	170 km	1%
Train	90	3%	1,180 km	8%
Bus	50	1%	430 km	3%
Motorcycle	5	0.1%	30 km	>0.5%
Other public transportation	10	>0.5%	70 km	0.5%
Bicycle	1	>0.1%	90 km	1%
Walking	0	0%	490 km	3%
Consumer goods	**970**	**11%**	**3,290 £**	
Electronics	160	17%	610 £	19%
Furniture/room covering	60	6%	200 £	6%
Clothes	360	37%	1,210 £	37%
Sanitation/medicine	130	14%	450 £	14%
Other goods	260	27%	790 £	24%
Repair	5	>0.5%	30 £	1%
Leisure	**360**	**4%**	**2,810 £**	
Restaurants	180	49%	1,600 £	57%
Cultural	80	22%	390 £	14%
Sports	50	14%	510 £	18%
Other leisure	50	15%	320 £	11%
Services	**420**	**5%**	**3,660 £**	
Education	60	14%	390 £	11%
Welfare/medical	60	14%	490 £	13%
Finance/insurance	120	29%	1,160 £	32%
Communication	30	8%	290 £	8%
Other services	150	35%	1,320 £	36%
Sub-total 3 domain	**6,720**	**79%**		
Goods	**970**	**11%**	**3,290 £**	
Leisure	**360**	**4%**	**2,810 £**	
Services	**420**	**5%**	**3,660 £**	
Grand Total (6 domains)	**8,470**	**100%**		

Table B.5. Current annual lifestyle carbon footprint per capita in Japan (rounded values)

Domains and components	CF (kg-CO_2e)	CF (%)	Amount (total)	Amount (%)
Food	**1,400**	**17%**	**800 kg**	
Cereals	270	19%	160 kg	20%
Vegetables (incl. potatoes)	140	10%	150 kg	19%
Beans/nuts	30	2%	20 kg	3%
Dairy	180	13%	50 kg	6%
Eggs	30	2%	20 kg	2%
Fish	100	7%	30 kg	4 %
Meat	330	23%	40 kg	5%
Fruits	60	4%	50 kg	6%
Beverages	140	10%	230 kg	29%
Other	130	9%	50 kg	7%
Housing	**2,430**	**30%**	**40 m²**	
Construction/maintenance	480	20%	40 m²	
Electricity	1,330	55%	2,120 kWh	
Renewable grid electricity	10	1%	310 kWh	15%
Non-renewable grid electricity	1,320	99%	1,780 kWh	84%
Nuclear grid electricity	1.0	0.1%	40 kWh	2%
Other energy	530	22%	2,070 kWh	
Oil	190	35%	730 kWh	35%
Gas	340	64%	1,320 kWh	64%
Other (non-renewable)	0.6	0.1%	0 kWh	0.1%
Other (renewable)	1.5	>0.5%	20 kWh	1%
Water consumption	90	4%	212 m³	
Transport	**1,970**	**24%**	**10,970 km**	
Airplane	570	29%	1,660 km	15%
Car	1,250	63%	5,000 km	46%
Train	80	4%	3,120 km	28%
Bus	40	2%	490 km	4%
Ferry	10	1%	20 km	>0.5%
Motorcycle	10	1%	90 km	1%
Bicycle	10	>0.5%	270 km	2%
Walking	0	0%	310 km	3%
Consumer goods	**1,030**	**13%**	**3,590 00 JPY**	
Appliances	120	12%	380 00 JPY	11%
Electronics	200	20%	730 00 JPY	20%
Furniture/room covering	40	4%	140 00 JPY	4%
Clothes	220	21%	730 00 JPY	20%
Sanitation/medicine	120	12%	400 00 JPY	11%
Hobby	80	8%	320 00 JPY	9%
Other goods	240	23%	880 00 JPY	24%
Leisure	**580**	**7%**	**2,200 00 JPY**	
Restaurants	250	43%	940 00 JPY	43%
Hotels/travels	130	23%	420 00 JPY	19%
Cultural	130	22%	520 00 JPY	24%
Sports	30	4%	140 00 JPY	7%
Other leisure	40	8%	180 00 JPY	8%
Services	**650**	**8%**	**4,440 00 JPY**	
Education	110	17%	800 00 JPY	18%
Welfare/medical	130	20%	720 00 JPY	16%
Finance/insurance	80	12%	930 00 JPY	21%
Communication	90	14%	810 00 JPY	18%
Personal care	60	9%	310 00 JPY	7%
Other services	190	29%	870 00 JPY	20%
Sub-total 3 domain	**5,800**	**72%**		
Goods	**1,030**	**13%**	**3,590 00 JPY**	
Leisure	**580**	**7%**	**2,200 00 JPY**	
Services	**650**	**8%**	**4,440 00 JPY**	
Grand Total (6 domains)	**8,060**	**100%**		

Table B.6. Current annual lifestyle carbon footprint per capita in China (rounded values)

Domains and components	CF (kg-CO_2e)	CF (%)	Amount (total)	Amount (%)
Food	**1,330**	**27%**	**940 kg**	
Cereals	260	20%	190 kg	21%
Vegetables (incl. potatoes)	190	15%	430 kg	45%
Beans/nuts	30	2%	10 kg	2%
Dairy	40	3%	20 kg	2%
Eggs	50	4%	20 kg	2%
Fish	100	7%	40 kg	4%
Meat	520	39%	70 kg	7%
Fruits	30	2%	100 kg	11%
Beverages	50	4%	40 kg	4%
Other	50	4%	20 kg	2%
Housing	**1,190**	**24%**	**41 m²**	
Construction/maintenance	370	31%	41 m²	
Electricity	570	48%	650 kWh	
Renewable grid electricity	10	1%	170 kWh	26%
Non-renewable grid electricity	560	99%	460 kWh	70%
Nuclear grid electricity	0.3	0.1%	30 kWh	4%
Other energy	230	20%	1,210 kWh	
Gas	110	49%	670 kWh	55%
Other (non-renewable)	120	51%	550 kWh	45%
Water consumption	20	1%	55 m³	
Transport	**1,200**	**24%**	**9,310 km**	
Airplane	200	17%	600 km	6%
Car	450	37%	2,300 km	25%
Train	80	6%	990 km	11%
Bus	180	15%	2,130 km	23%
Motorcycle	280	23%	1,740 km	19%
Bicycle	10	1%	1,070 km	11%
Walking	0	0%	480 km	5%
Consumer goods	**410**	**8%**	**2,240 CNY**	
Clothes	250	61%	1,340 CNY	60%
Other goods	160	39%	900 CNY	40%
Leisure	**140**	**3%**	**1,260 CNY**	
Other leisure	140	100%	1,260 CNY	100%
Services	**710**	**14%**	**4,060 CNY**	
Education	140	19%	1,260 CNY	31%
Welfare/medical	410	58%	1,900 CNY	47%
Other services	160	23%	900 CNY	22%
Sub-total 3 domain	**3,720**	**75%**		
Goods	**410**	**8%**	**2,240 CNY**	
Leisure	**140**	**3%**	**1,260 CNY**	
Services	**710**	**14%**	**4,060 CNY**	
Grand Total (6 domains)	**4,970**	**100%**		

Table B.7. Current annual lifestyle carbon footprint per capita in South Africa (rounded values)

Domains and components		CF (kg-CO_2e)	CF (%)	Amount (total)	Amount (%)
Food		**1,700**	**35%**	**560 kg**	
Cereals		130	7%	190 kg	34%
Vegetables (incl. potatoes)		80	4%	70 kg	13%
Beans/nuts		10	0.5%	5 kg	1%
Dairy		60	4%	50 kg	10%
Eggs		20	1%	10 kg	1%
Fish		10	1%	10 kg	1%
Meat		1,230	72%	70 kg	12%
Fruits		5	>0.5%	20 kg	4%
Beverages		90	6%	70 kg	13%
Other		70	4%	60 kg	11%
Housing		**1,050**	**21%**	**23 m²**	
Construction/maintenance		200	19%	23 m²	
Electricity		790	75%	830 kWh	
	Renewable grid electricity	1	0.1%	20 kWh	2%
	Non-renewable grid electricity	790	100%	770 kWh	93%
	Nuclear grid electricity	>0.5	>0.01%	40 kWh	5%
Other energy		30	3%	270 kWh	
	Oil	10	33%	60 kWh	21%
	Gas	0.1	>0.5%	1 kWh	>0.5%
	Other (non-renewable)	20	61%	80 kWh	29%
	Other (renewable)	1.5	5%	140 kWh	50%
Water consumption		30	3%	90 m³	
Transport		**1,200**	**25%**	**7,160 km**	
Airplane		160	13%	470 km	7%
Car		720	60%	3,040 km	42%
Train		180	15%	2,290 km	32%
Bus		140	12%	1,260 km	18%
Walking		0	0%	100 km	1%
Consumer goods		**730**	**15%**	**3,320 ZAR**	
Appliances		10	1%	200 ZAR	6%
Furniture/room covering		80	11%	380 ZAR	11%
Clothes		510	70%	1500 ZAR	45%
Other goods		60	8%	250 ZAR	8%
Repair		70	9%	1000 ZAR	30%
Leisure		**70**	**1%**	**1,680 ZAR**	
Restaurants		10	16%	470 ZAR	28%
Hotels/travels		10	9%	240 ZAR	14%
Cultural		20	31%	540 ZAR	32%
Other leisure		30	44%	430 ZAR	25%
Services		**140**	**3%**	**6,710 ZAR**	
Education		19	14%	770 ZAR	11%
Welfare/medical		21	15%	280 ZAR	4%
Finance/insurance		14	11%	2,980 ZAR	44%
Communication		40	30%	1,060 ZAR	16%
Personal care		21	15%	600 ZAR	9%
Other services		20	15%	1,010 ZAR	15%
Sub-total 3 domain		**3,950**	**81%**		
Goods		**730**	**15%**	**3,320 ZAR**	
Leisure		**70**	**1%**	**1,680 ZAR**	
Services		**140**	**3%**	**6,710 ZAR**	
Grand Total (6 domains)		**4,890**	**100%**		

Table B.8. Current annual lifestyle carbon footprint per capita in Turkey (rounded values)

Domains and components	CF (kg-CO_2e)	CF (%)	Amount (total)	Amount (%)
Food	**1,210**	**25%**	**940 kg**	
Cereals	140	12%	180 kg	19%
Vegetables (incl. potatoes)	130	11%	300 kg	32%
Beans/nuts	20	2%	20 kg	3%
Dairy	320	26%	180 kg	19%
Eggs	20	2%	10 kg	1%
Fish	10	1%	5 kg	1%
Meat	400	33%	40 kg	4%
Fruits	40	3%	130 kg	14%
Beverages	30	2%	20 kg	2%
Other	110	9%	50 kg	6%
Housing	**1,690**	**35%**	**32 m^2**	
Construction/maintenance	290	17%	32 m^2	
Electricity	460	27%	790 kWh	
Renewable grid electricity	10	2%	250 kWh	32%
Non-renewable grid electricity	450	98%	530 kWh	68%
Other energy	920	54%	1,100 kWh	
Oil	550	60%	530 kWh	48%
Gas	190	21%	340 kWh	31%
Other (non-renewable)	170	19%	160 kWh	14%
Other (renewable)	3	0.5%	70 kWh	7%
Water consumption	30	2%	80 m^3	
Transport	**1,010**	**21%**	**4,400 km**	
Airplane	350	35%	1,030 km	23%
Car	530	52%	2,420 km	55%
Train	10	1%	170 km	4%
Bus	10	1%	140 km	3%
Motorcycle	100	10%	640 km	15%
Consumer goods	**630**	**13%**	**7,180 TRY**	
Furniture/room covering	310	49%	2,470 TRY	34%
Clothes	200	32%	2,310 TRY	32%
Other goods	120	20%	2,400 TRY	33%
Leisure	**180**	**4%**	**4,650 TRY**	
Hotels/travels[1]	110	61%	2,680 TRY	58%
Cultural	70	39%	1,970 TRY	42%
Services	**130**	**3%**	**2,070 TRY**	
Education	20	12%	490 TRY	24%
Welfare/medical	60	48%	670 TRY	32%
Communication	50	40%	910 TRY	44%
Sub-total 3 domain	**3,910**	**81%**		
Goods	**630**	**13%**	**7,180 TRY**	
Leisure	**180**	**4%**	**4,850 TRY**	
Services	**130**	**3%**	**2,070 TRY**	
Grand Total (6 domains)	**4,860**	**100%**		

1 Restaurants are included to hotels/travels.

Table B.9. Current annual lifestyle carbon footprint per capita in Brazil (rounded values)

Domains and components	CF (kg-CO_2e)	CF (%)	Amount (total)	Amount (%)
Food	**1,890**	**58%**	**790 kg**	
Cereals	140	7%	130 kg	17%
Vegetables (incl. potatoes)	40	2%	100 kg	13%
Beans/nuts	20	1%	30 kg	4%
Dairy	240	13%	140 kg	18%
Eggs	30	2%	10 kg	1%
Fish	20	1%	10 kg	1%
Meat	1,110	59%	100 kg	13%
Fruits	20	1%	100 kg	13%
Beverages	110	6%	70 kg	9%
Other	160	9%	90 kg	12%
Housing	**500**	**16%**	**28 m²**	
Construction/maintenance	290	58%	28 m²	
Electricity	90	18%	680 kWh	
Renewable grid electricity	20	23%	560 kWh	82%
Non-renewable grid electricity	70	81%	100 kWh	15%
Nuclear grid electricity	0.1	0.1%	20 kWh	3%
Other energy	100	20%	800 kWh	
Gas	90	92%	380 kWh	48%
Other (non-renewable)	10	10%	20 kWh	3%
Other (renewable)	10	10%	390 kWh	49%
Water consumption	30	6%	40 m³	
Transport	**640**	**20%**	**4,640 km**	
Airplane	230	36%	670 km	14%
Car	150	23%	1,180 km	25%
Train	20	3%	290 km	6%
Bus	210	33%	1,930 km	42%
Motorcycle	30	5%	190 km	4%
Bicycle	0.3	>0.1%	20 km	0.5%
Walking	0	0%	360 km	8%
Consumer goods	**130**	**4%**	**1,220 BRL**	
Appliances	10	8%	130 BRL	11%
Electronics	40	31%	390 BRL	32%
Furniture/room covering	10	8%	80 BRL	7%
Clothes	20	16%	170 BRL	14%
Sanitation/medicine	10	8%	80 BRL	7%
Other goods	30	24%	360 BRL	30%
Leisure	**40**	**1%**	**1,120 BRL**	
Hotels/travels	10	18%	200 BRL	18%
Cultural	30	82%	910 BRL	82%
Services	**50**	**2%**	**1,620 BRL**	
Education	7	12%	150 BRL	9%
Welfare/medical	1	2%	20 BRL	1%
Finance/insurance	1	1%	20 BRL	1%
Communication	4	7%	340 BRL	21%
Other services	40	77%	1,080 BRL	67%
Sub-total 3 domain	**3,020**	**93%**		
Goods	**130**	**4%**	**1,220 BRL**	
Leisure	**40**	**1%**	**1,120 BRL**	
Services	**50**	**2%**	**1,620 BRL**	
Grand Total (6 domains)	**3,240**	**100%**		

Table B.10. Current annual lifestyle carbon footprint per capita in India (rounded values)

Domains and components	CF (kg-CO_2e)	CF (%)	Amount (total)	Amount (%)
Food	**780**	**26%**	**530 kg**	
Cereals	420	53%	180 kg	35%
Vegetables (incl. potatoes)	50	6%	110 kg	21%
Beans/nuts	20	2%	30 kg	5%
Dairy	180	23%	110 kg	20%
Eggs	10	1%	3 kg	1%
Fish	20	2%	10 kg	1%
Meat	30	4%	4 kg	1%
Fruits	10	2%	60 kg	11%
Beverages	3	>0.5%	3 kg	1%
Other	50	7%	30 kg	5%
Housing	**440**	**15%**	**10 m²**	
Construction/maintenance	100	23%	10 m²	
Electricity	210	48%	210 kWh	
Renewable grid electricity	20	9%	80 kWh	37%
Non-renewable grid electricity	190	91%	130 kWh	62%
Nuclear grid electricity	>0.1	>0.1%	4 kWh	2%
Other energy	70	15%	330 kWh	
Oil	10	14%	30 kWh	10%
Gas	60	86%	300 kWh	90%
Water consumption	60	13%	40 m³	
Transport	**1,730**	**58%**	**16,370 km**	
Airplane	40	2%	120 km	1%
Car	340	20%	2,490 km	15%
Train	70	4%	880 km	5%
Bus	100	6%	880 km	5%
Motorcycle	1,180	69%	12,000 km	73%
Consumer goods	**10**	**>0.5%**	**320 INR**	
Appliances	2	18%	70 INR	23%
Clothes	7	55%	160 INR	50%
Sanitation/medicine	2	15%	30 INR	10%
Other goods	2	12%	50 INR	16%
Leisure	**1**	**>0.1%**	**40 INR**	
Cultural	1	100%	40 INR	100%
Services	**2**	**>0.1%**	**320 INR**	
Education	>0.5	8%	70 INR	21%
Welfare/medical	1	47%	130 INR	42%
Finance/insurance	>0.5	13%	40 INR	13%
Other services	0.6	31%	80 INR	24%
Sub-total 3 domain	**2,950**	**100%**		
Goods	**10**	**>0.5%**	**320 INR**	
Leisure	**1**	**>0.1%**	**40 INR**	
Services	**2**	**0.1%**	**320 INR**	
Grand Total (6 domains)	**2,960**	**100%**		

Table B.11. Current annual lifestyle carbon footprint per capita in Indonesia (rounded values)

Domains and components	CF (kg-CO_2e)	CF (%)	Amount (total)	Amount (%)
Food	**800**	**36%**	**570 kg**	
Cereals	410	52%	280 kg	49%
Vegetables (incl. potatoes)	60	7%	100 kg	17%
Beans/nuts	30	4%	30 kg	5%
Dairy	10	2%	10 kg	1%
Eggs	20	2%	10 kg	1%
Fish	100	13%	40 kg	8%
Meat	90	11%	10 kg	2%
Fruits	20	2%	60 kg	11%
Beverages	3	>0.5%	1 kg	>0.5%
Other	60	7%	30 kg	6%
Housing	**590**	**27%**	**19 m²**	
Construction/maintenance	190	33%	19 m²	
Electricity	180	30%	390 kWh	
Renewable grid electricity	3	2%	50 kWh	12%
Non-renewable grid electricity	180	98%	350 kWh	88%
Other energy	140	23%	730 kWh	
Oil	60	40%	210 kWh	29%
Gas	80	58%	350 kWh	47%
Other (renewable)	2	1%	170 kWh	24%
Water consumption	80	13%	50 m³	
Transport	**570**	**26%**	**3,270 km**	
Airplane	100	17%	280 km	9%
Car	100	18%	450 km	14%
Train	10	1%	110 km	3%
Motorcycle	310	55%	1,950 km	60%
Other public transportation	50	9%	480 km	15%
Consumer goods	**140**	**7%**	**2,000 000 IDR**	
Clothes	20	12%	420 000 IDR	21%
Non-organic waste	130	88%	1,570 000 IDR	79%
Leisure	**10**	**>0.5%**	**260 000 IDR**	
Other leisure	10	100%	260 000 IDR	100%
Services	**100**	**4%**	**2,080 000 IDR**	
Education	16	17%	430 000 IDR	21%
Welfare/medical	27	28%	360 000 IDR	17%
Finance/insurance	5	5%	420 000 IDR	20%
Other services	50	50%	870 000 IDR	42%
Sub-total 3 domain	**1,950**	**89%**		
Goods	**140**	**7%**	**2,000 000 IDR**	
Leisure	**10**	**>0.5%**	**260 000 IDR**	
Services	**100**	**4%**	**2,080 000 IDR**	
Grand Total (6 domains)	**2,200**	**100%**		

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ANNEX B

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This report uses a science-based approach to link concrete changes in lifestyles to measurable impacts on climate change in order to achieve the 1.5-degree aspirational target of the Paris Agreement on climate change. The report also fills the knowledge gap arising from most prevailing climate scenarios that underplay the potential contributions of lifestyle changes to climate change mitigation and focus on developing new technologies as well as on changes in production.

For each country in the report, the footprint gap between current and sustainable target levels are determined for the years 2030, 2040, and 2050. To bridge these emissions gaps, options for reducing footprints in each country are introduced, estimating potential impacts from various adoption rates in each country. The report introduces policies that could transform lifestyles and socio-technical systems in sustainable directions. Finally, two scenarios are developed for each country, one focused on systems change and another on behaviour change, showing indicative pathways for achieving footprint targets for 2030.

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