



# ADDRESSING FOOD-RELATED CONSUMPTION -BASED EMISSIONS IN C40 CITIES

IN FOCUS

# Table of contents

<b>1. Impact of food</b>	<b>12</b>
<b>2. Consumption interventions to reduce food-related emissions</b>	<b>16</b>
2.1 Targets for food consumption	19
2.2 Differentiated consumption targets	26
2.3 Savings from food interventions	30
<b>3. Benefits of addressing food-related emissions</b>	<b>32</b>
3.1 Benefits associated with dietary changes	35
3.2 Benefits associated with avoided food waste	39
<b>4. Creating change through collaboration</b>	<b>42</b>
4.1 Key stakeholders	44
4.2 Cities' role in catalysing stakeholder action	46
4.3 Spotlight: How businesses are leading the way in reducing meat consumption?	51
<b>5. Summary</b>	<b>54</b>

# Acknowledgements

## PROJECT TEAM

### • C40

Tom Bailey  
Markus Berensson  
Rachel Huxley

### • Arup

Ben Smith  
Kristian Steele  
Christina Lumsden  
Christopher Pountney  
Stephanie Robson  
Ewan Frost-Pennington  
Ethan Monaghan-Pisano  
Francesca Poli  
Anna Lawson  
Maria Sunyer Pinya  
Jaspreet Singh  
Ben Ashby

### • University of Leeds

John Barrett  
Andrew Gouldson  
Joel Millward-Hopkins  
Anne Owen

## THIRD PARTY REVIEWERS

Klaus Hubacek, University of Maryland  
Emma Stewart, World Resources Institute

## SPECIALIST INPUT

### • C40

Mark Watts, Kevin Austin, Shannon Lawrence, Andrea Fernández, Michael Doust, Josh Alpert, Josh Harris, Emily Morris, Sophie Bedcecarré Ernst, Donna Hume, Zachary Tofias, Stefania Amato, Ricardo Cepeda-Márquez, Kathrin Zeller, Zoe Sprigings, Paul Cartwright, Caroline Watson, Anna Beech, Milag San Jose-Ballesteros, David Miller, Laura Jay, Stelios Diakoulakis, Hastings Chikoko, Pengfei Xie, Divyaprakash Vyas, Daniel Robinson, Caterina Sarfatti, Julia Lipton, Charlotte Breen

### • Arup

Will Cavendish, Carol Lemmens, Alexander Jan, Stephen Cook, Richard Boyd, Orlando Gibbons, Michael Muller, Christine McHugh, Tim Armitage, Joe Wheelwright, Emily Woodason, Giacomo Magnani, Erato Panayiotou, Allen Hogben, Jack Clarke, Simon Hart, Andrew Lawrence

### • Other organisations

Miranda Schnitger (Ellen MacArthur Foundation), Maja Johannsen (Ellen MacArthur Foundation), Richard Waites (World Resources Institute), Graham Earl (Ecolyse), Arianna Nicoletti (Future Fashion Forward e.V), John Dulac (International Energy Agency), Thibaut Abergel (International Energy Agency), Tiffany Vaas (International Energy Agency), Mikael Linnander (EAT Forum), Dabo Guan (University of East Anglia), Julian Hill-Landolt (World Business Council For Sustainable Development)

# Acronyms

Abbreviation	Full term
<b>BECC</b>	Bio-energy Carbon Capture and Storage
<b>CBE</b>	Consumption-Based Emissions
<b>CCS</b>	Carbon Capture and Storage
<b>D2020</b>	Deadline 2020
<b>EEIO</b>	Environmentally Extended Input-Output Model
<b>ETS</b>	Emissions Trading Scheme
<b>EU</b>	European Union
<b>EV</b>	Electric Vehicle
<b>GDP</b>	Gross Domestic Product
<b>GHG</b>	Greenhouse Gas
<b>GPC</b>	Global Protocol for Community-Scale Greenhouse Gas Inventories
<b>GTAP</b>	Global Trade Analysis Project
<b>IEA</b>	International Energy Agency
<b>IPCC</b>	Intergovernmental Panel on Climate Change
<b>OECD</b>	Organisation for Economic Co-operation and Development
<b>NDCs</b>	Nationally Determined Contribution
<b>UN</b>	United Nations

# Key terms

Term	Description
<b>Ambitious target</b>	Target level of ambition for consumption interventions that is more 'ambitious', based on a future vision of resource-efficient production and extensive changes in consumer choices. This level was typically informed by expert judgement rather than existing research.
<b>Aviation</b>	Consumption category covering full supply chain emissions associated with the operation of planes due to city residents' personal flights. This category excludes the embodied emissions of planes and associated equipment.
<b>Bio-energy carbon capture and storage</b>	Carbon capture and storage (CCS) is a set of technologies that can keep CO <sub>2</sub> from entering into the atmosphere, typically from sources with concentrated and high CO <sub>2</sub> emissions such as power plants or industrial processes. Bio-energy with CCS (BECCS) is a potential greenhouse gas mitigation technology which removes CO <sub>2</sub> from the atmosphere by combining bio-energy (energy from biomass) use with geological capture and storage.
<b>Buildings and infrastructure</b>	Consumption category encompassing full supply chain emissions from the construction of new buildings and infrastructure as well other works associated with refurbishment, retrofit etc. It excludes operational emissions during a building's lifetime. The methodology for determining a city's buildings and infrastructure emissions is based on downscaling expenditure at a national level to the associated urban population on a pro-rata basis. This is based on the assumption that new construction benefits the national population irrespective of where people live.
<b>City residents</b>	Refers to residents living within a city, i.e. excluding visitors.
<b>Clean production</b>	The sequence of processes involved in the production of a commodity are associated with low emissions.
<b>Clothing and textiles</b>	Consumption category encompassing full supply chain emissions from all apparel, footwear and other textile products (e.g. rugs, curtains, bedding, fabric) purchased by city residents.
<b>Consumption-based emissions</b>	Consumption-based GHG accounting is an alternative to the production-based approach to measuring city GHG emissions. It focuses on the consumption of goods and services (such as food, clothing, electronic equipment) by residents of a city, and GHG emissions are reported by consumption category rather than GHG emission source category. For the purposes of this report, the PAS 2070 methodology was adopted.

<b>Consumption category</b>	Category of products and services covered by consumption-based emissions. These are aggregated categories based on EEIO model categories.
<b>Consumption intervention</b>	A change in production or consumption that in most cases leads to a direct reduction in consumption-based emissions. One example would be a reduction in vehicle ownership.
<b>Deadline 2020</b>	Deadline 2020 is a routemap for achieving the Paris Agreement, which outlines the pace, scale and prioritisation of actions needed by C40 member cities to reduce their production-based emissions over the next five years and beyond. The report was delivered through a collaboration between Arup and C40.
<b>Electronics and household appliances</b>	Consumption category encompassing full supply chain emissions from electronics (e.g. smart phones and laptops) and household appliances (e.g. refrigerator, toaster, microwave) purchased by city residents.
<b>Environmentally Extended Input-Output Model (EEIO)</b>	This model provides environmental indices associated with financial flows. For the purposes of this report, the Environmentally Extended Input-Output Model was used to analyse spending from households and government, and business capital expenditure, based on financial flow data from national and regional economic accounts. It estimates GHG emissions using average GHG emission factors for each consumption category depending on where the goods and services consumed in a city are produced.
<b>Food</b>	Consumption category referring to full supply chain emissions from all products for human consumption, including beverages and tobacco.
<b>Global Trade Analysis Project</b>	The Global Trade Analysis Project is one of several multi-regional input-output models available and was chosen for producing the C40 cities consumption-based emissions inventories due to its global reach.
<b>Greenhouse Protocol for Community-scale Greenhouse Gas Inventories</b>	The World Resources Institute, C40 and Local Governments for Sustainability (ICLEI) have partnered to create a GHG protocol standard for cities known as the Global Protocol for Community-Scale Greenhouse Gas Emission Inventories. This establishes a methodology for city GHG emissions reporting based on the production-based emissions accounting framework.
<b>GHG budget</b>	The quantity of GHG emissions that can be emitted in total over a defined period of time defined by the probability of avoiding a specific global average temperature increase.
<b>Nationally Determined Contribution</b>	A commitment made by each signatory country to the Paris Agreement outlining the climate action it will take to contribute towards the agreement's aims.
<b>On-site (emissions)</b>	Emissions occurring on the site of a specific industry e.g. emissions from on-site agricultural facilities.

<b>Planetary boundary</b>	A boundary that provides a safe operating space for humanity within which it is possible to continue to thrive in a long-term perspective.
<b>Production-based emissions</b>	An approach to producing emissions inventories that focuses on activities occurring within a boundary as opposed to a population's consumption within that boundary. This methodology was developed by the Intergovernmental Panel on Climate Change for national emissions reporting. Note the terms production-based emissions and production emissions are used interchangeably within this report.
<b>Private transport</b>	Consumption category referring to full supply chain emissions associated with privately owned transport modes primarily private vehicles. In this case, it covers embodied emissions of vehicles as well as operational emissions in running vehicles.
<b>Progressive target</b>	Target level of ambition for consumption interventions determined through research on currently available technologies and evidence of feasibility for progressive changes in consumer choices (e.g. historic evidence of consumer habit change or alignment with other consumer priorities such as health).
<b>Rest of Nation</b>	Term used to refer to source emissions of a city's consumption-based emissions that occur within that city's host nation.
<b>Rest of World</b>	Term used to refer to source emissions of a city's consumption-based emissions that occur outside that city and its host nation's borders. Note this does not preclude the emissions occurring within one of the C40 cities where these relate to a different city.
<b>Supply chain</b>	The sequence of processes involved in the production and distribution of a commodity.
<b>Urban stakeholders</b>	The broader group of stakeholders, such as city governments, businesses and residents, whose decisions contribute to the emissions intensity of an economy. For example, building contractors' use of cement is arguably a consumer choice that ultimately leads to emissions associated with construction.

# Key findings

**Food is the biggest source of urban consumption-based emissions for C40 cities in 2017, at 582MtCO<sub>2</sub>e per year, representing 13% of the total. Food-related emissions could increase by 38% by 2050 under a no further climate action scenario.**

## EMISSIONS SOURCES

60% of food emissions are agricultural, 16% relate to electricity-use, 9% relate to fossil-fuel production and 5% for transportation.

## FOOD TYPES

Consumption of animal-based food represents roughly 75% of food emissions, against 25% from consumption of plant-based foods.

The food sector offers a big emissions savings potential between 2017-2050 (51% progressive targets; 60% ambitious targets). Food is therefore a target area for urban climate interventions, with example interventions being (in order of impact):

## MOVE TO A PLANT-BASED DIET

By far the biggest opportunity for savings.

- Aim for 16kg of meat per person per year down from C40 average of 58kg by 2030. This includes 1.3kg beef, when currently the average citizen from East Asia consumes 13kg a year.
- A target of 90kg dairy per person per year, down from C40 average of 106kg, or around 220kg in Europe.
- Meat and dairy will need to reach even lower levels to achieve the most ambitious emissions reduction potential.

## EAT HEALTHY QUANTITIES

A target of an average 2,500 kcal per person per day.

## AVOID WASTE

Reducing household food waste (50% progressive target; 100% ambitious target) and supply chain waste (50% progressive target; 75% ambitious target).

These actions would have wide ranging benefits in cities. Eating less red meat and more vegetables and fruits could save 170 thousand deaths per year in C40 cities, equivalent to \$600 billion, based on the economic value of life. Reducing dairy intake could save 19 billion m<sup>3</sup> of freshwater per year.

There is no time to wait for action. No one actor can prevent climate breakdown at this stage. All action is needed from all actors, government, business, cities, civil society & citizens. For example on increasing plant based diets, each has a role:

- **City governments** have a prominent role overseeing urban food environment (availability and affordability), procurers, regulators, waste managers, conveners, and educators.

- **Citizens** have a key role, as they have the ability to alter diets and reduce meat consumption. In most cases, it is ultimately individual consumers who decide what food that they buy and eat, but life is made much easier if those options are affordable and readily available. The role of citizens is also different depending on region and often income, with higher wealth cities globally tending to have higher carbon diets.

- **Businesses** action, through farming, product development and marketing, is necessary for individuals to increase consumption of plant-based foods.

- **Civil society** groups play a supporting role by influencing consumers, producers and policymakers to adopt and support plant-based diets.

- **National governments** can support the increased consumption of plant-based foods through legislation, guidelines and procurement.



---

# Introduction

---

**C40, Arup and the University of Leeds have collaborated on research and analysis to better understand consumption-based emissions in cities, to explore their scale and to consider what cities can do to reduce them.**

---

The research sets out a series of future scenarios to show how consumption-based emissions in C40 cities may evolve if no action is taken, if limited action is taken, or if ambitious action is taken. It evaluates previously untapped opportunities for emissions reductions across six key consumption categories:

- Food;
- Buildings and infrastructure;
- Private transport;
- Aviation;
- Clothing and textiles; and
- Electronics and household appliances.

The study has explored the climate mitigation potential of interventions in these key consumption categories as well as the wider benefits of taking climate action. A stakeholder mapping framework has also been developed to highlight key actors and create a structure for catalysing action. The overall results across consumption categories are presented in the project's headline report *The Future of Urban Consumption in a 1.5°C World* (2019).

***It evaluates previously untapped opportunities for emissions reductions across six key consumption categories:***

- ***Food;***
- ***Buildings and infrastructure;***
- ***Private transport;***
- ***Aviation;***
- ***Clothing and textiles;***
- ***Electronics and household appliances.***

The purpose of this “In Focus” report is to present further details on food-related consumption-based emissions across C40 cities, and ultimately, highlight what cities can do to reduce these emissions. Opportunities for climate action have been considered in light of disparate levels of food-related consumption across the C40 network and the report provides pathways to achieve equitable consumption by 2030. The potential benefits of climate actions for different regions were also analysed. The highest impact intervention – reducing meat consumption – has been used to illustrate which stakeholders are most instrumental in facilitating change.

This report confirms that urgent action is needed from all actors – governments, businesses, cities, civil society & citizens. It is a call to mayors and urban policymakers to reflect on how their city development plans can help reduce food-related emissions while delivering multiple benefits for residents. However, reducing food-related consumption is a shared responsibility. While mayors can play an important role as leaders and convenors in this effort, there must be collaboration across all sectors of society in order to achieve a healthier and more sustainable future.

***This report confirms that urgent action is needed from all actors – governments, businesses, cities, civil society & citizens. It is a call to mayors and urban policymakers to reflect on how their city development plans can help reduce food-related emissions while delivering multiple benefits for residents. However, reducing food-related consumption is a shared responsibility.***

The method, evidence base, and limitations of this research are published in a method report.

We invite all stakeholders – including city administrations, NGOs, civil society, business and private citizens – to read and review the Method Report, and provide comments and recommendations for improvement, as well as links to other relevant work and data.

All documents associated with this research project can be found on

<https://www.c40.org/research>



# 1 Impact of food

**In 2017, emissions associated with the consumption of food in C40 cities were estimated to account for 13% of total consumption-based emissions across C40 cities.<sup>1</sup>**

Figure 1 shows the breakdown of cumulative food-related consumption-based emissions by source between 2017 and 2050, assuming that countries deliver on their nationally determined contributions (NDC), as set out in the Paris Agreement, and C40 cities deliver on their Deadline 2020 commitments.<sup>2</sup>

The data shows that consumption of animal-based food represents roughly 75% of food-related emissions, versus 25% from plant-based foods. The most significant source emissions are on-site emissions from agricultural facilities, representing just under 60% of emissions. These are relatively evenly split between emissions from growing crops (34%) and rearing livestock (25%). However, up to 65% of the emissions associated with animal-based products stem from on-site emissions in crop production.<sup>3</sup>

Electricity generation (16%) and on-site emissions from fossil fuel extraction (9%) are significant sources of emissions that stem from electricity and fossil fuel use across the food supply chain. Notably, on-site emissions associated with chemicals production are responsible for 7% of food-related emissions. This type of emissions can be associated with fertiliser production, packaging and any other chemicals utilised by the food industry. Lastly, land transportation emissions in the food supply chain make up only 5% of total cumulative emissions.

<sup>1</sup> Note that land-use change emissions (for example, those associated with deforestation) are not accounted for in this report, as these types of emissions are not reported as part of consumption-based emissions inventories. The exclusion of land-use change emissions results in an underestimation of the impact of food-related consumption-based emissions and its impacts on climate change.

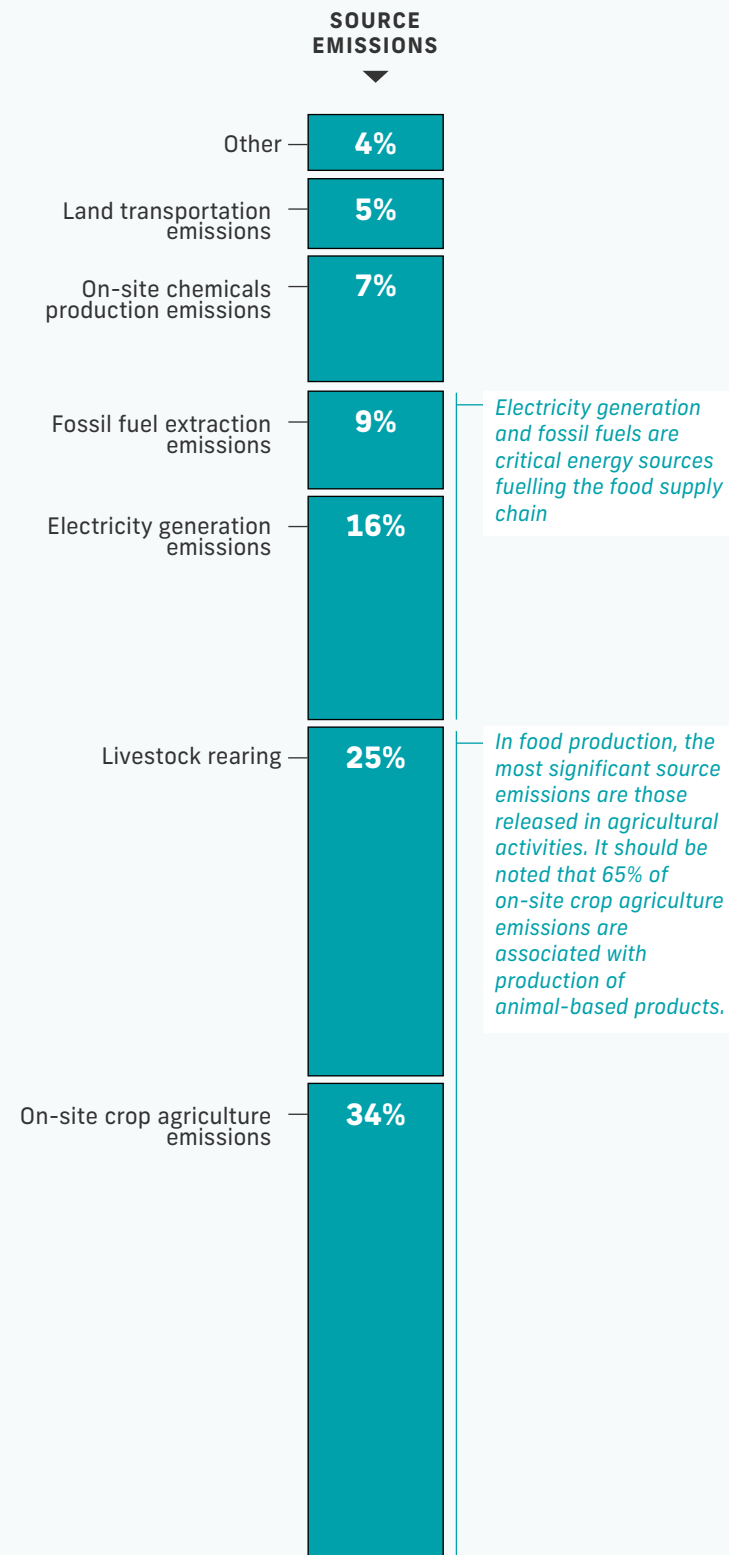
<sup>2</sup> For further information on the scenarios, see The Future of Urban Consumption in a 1.5°C World.

<sup>3</sup> Source emission category: on-site crop agriculture.



**fig.1**

Source emissions of food products from 2017-2050 under an NDC scenario.



If there is no further climate action within the food sector, it has been estimated that the emissions impacts from farming, food production, processing, transportation and waste will increase by 38% as the world's urban population grows and average incomes rise between 2017-2050.

These effects will be lessened if national governments deliver on their NDCs. Through the delivery of current NDCs, which imply improved farming practices and a limited shift away from eating carbon-intensive foods – specifically meat; emissions from food consumption could be 9% lower in 2050 than 2017 levels. However, this 9% reduction is not sufficient to reduce emissions in line with a 1.5°C trajectory and hence additional action on food-related consumption-based emissions in C40 cities is necessary.

**If there is no further climate action within the food sector, it has been estimated that the emissions impacts from farming, food production, processing, transportation and waste will increase by**

**38%**



# 2

## Consumption interventions to reduce food-related emissions

Cities are centres of consumption and by changing the types of food that urban residents eat, as well as reducing food waste, there is a significant opportunity to reduce consumption-based emissions.

It is widely proven that animal products such as meat and dairy are associated with increased levels of emissions compared to plant-based sources of equivalent nutrition. Within animal-based food, broad distinctions can be seen between different types of meat and their relative impact on GHG emissions. Red meat, and beef in particular, is associated with far higher emissions than the rearing of poultry, for example (Food and Agriculture Organization of the United Nations, 2019). However, global trends show that consumption of beef is declining, while overall meat consumption (poultry and pork) continues to grow (OECD Data, 2018). This is particularly the case in some of the highest future-emitting regions of the C40 network, such as East Asia, where beef consumption is generally stagnating while poultry consumption increases.

A recent report from the EAT-Lancet Commission on Food, Planet, Health suggests a reference diet for sustainable food systems that will also improve health outcomes. The EAT-Lancet report calls for an increase in consumption of plant-based foods alongside a shift away from both red and white meats, as well as sugar. It states that plant-based foods '*cause fewer adverse environmental effects per unit weight, per serving, per unit of energy or per protein weight than animal source foods*'. This study has based the progressive targets for meat consumption on early achievement of the EAT-Lancet commission targets in order to support delivery of C40 cities' 1.5°C compliant GHG budget.

Within animal-based foods, broad distinctions can be made between the impact of different types of meat and their relative impact on GHG emissions.

Food waste in terms of surplus edible food that is not consumed because it is lost or wasted, both through the supply chain and by the end-consumer, is another key source of emissions for the sector, given that emissions arise in the production, transportation, distribution and, finally, disposal of that food.<sup>4</sup> Avoiding waste in the first place should therefore avoid the emissions associated with this over-production. Causes of waste include logistical issues and poor storage, handling during transportation, aesthetic preferences as well as purchasing and meal-planning decisions. Packaging solutions can increase product protection and shelf-life and consequently reduce levels of food waste, but unnecessary packaging, particularly using materials that are difficult to recycle, is increasingly problematic as a waste issue in its own right (Ellen MacArthur Foundation, 2017).

In addition to reducing the emissions associated with food production, the research team behind this report evaluated the impact of changes in packaging in response to the recent concerns around the impact of plastic on the environment. The use and disposal of packaging is particularly important in the food sector, due to the higher frequency with which packaged products are consumed (i.e. commonly as single use and often on a daily basis by consumers).

<sup>4</sup> It is recognised that many cities are engaged in managing disposal of edible and inedible foods (also commonly referred to as food waste). The focus of this study is on minimising the impact of primary production as a means to have a greater impact on emissions reduction.

Ways of reducing the impact of food packaging on GHG emissions largely fall into either reducing the overall amount of raw materials used in food packaging or by switching to lower-carbon materials. While innovations such as bio-plastics and compostable packaging materials are emerging, there are complex issues associated with these new materials, and GHG emission benefits are still unclear and have yet to be realised.

**Food waste in terms of surplus edible food that is not consumed because it is lost or wasted, both through the supply chain and by the end-consumer, is another key source of emissions for the sector, given that emissions arise in the production, transportation, distribution and, finally, disposal of that food.**<sup>4</sup>

**Avoiding waste in the first place should therefore avoid the emissions associated with this over-production.**

## 2.1

# Targets for food consumption

Based on the opportunities presented above, two target levels were established for five consumption interventions in order to reduce food-related emissions. These targets are set out in detail in Table 1, and if implemented fully would support C40 cities to align with a 1.5°C target trajectory on consumption-based emissions.

The first target level is based on research into the opportunities for greater resource efficiency and behavioural change. It is based on current technology coupled with 'progressive' changes in consumer choice. The second target level is more 'ambitious' and is based on a future vision of resource-efficient production and extensive changes in consumer choice.

This report does not advocate for the wholesale adoption of these more ambitious targets in C40 cities; rather, the purpose of their inclusion is to provide a set of reference points that cities, and other actors, can reflect on when considering different emission-reduction interventions and long-term urban visions.



Tab.1

Interventions to reduce consumption-based emissions from food.

INTERVENTION	DIETARY CHANGE (this option is characterised by three forms of intervention)	
2017 AVERAGE IN C40 CITIES	58 kg of meat per person per year	106 kg dairy per person per year
PROGRESSIVE TARGET	16 kg of meat per person per year	90 kg dairy per person per year (or derivative equivalent) <sup>5</sup>
AMBITIOUS TARGET	0 meat consumption	0 dairy consumption
WHY AND HOW?	<p><b>Rationale</b></p> <p>Livestock farming for meat is highly carbon-intensive compared to most other types of agriculture. Globally, meat consumption has been increasing steadily over time. C40 cities now consume on average over 58kg of meat per person each year, with some as high as 127kg. This equates to more than three portions of meat a day.</p> <p>Alternatively, plant-based sources of protein are associated with lower levels of emissions and require a smaller amount of water and land to provide the same amount of protein.</p> <p>Reducing meat consumption, in particular red and processed meats, has also been linked to health benefits and lower mortality and disease risks (see Section 3).</p> <p>Recent research including a study by EAT-Lancet Commission has indicated that meat consumption amounting to 300g per week (equivalent to approximately 16 kg per year) is optimal, for health and planetary goals (Greenpeace, 2018; EAT-Lancet Commission, 2019).</p> <p>The per-person targets adopted in this study work for different types of meat and align with EAT-Lancet:</p> <ul style="list-style-type: none"> <li>• Beef and lamb: 50g per week</li> <li>• Pork: 50g per week</li> <li>• Chicken and other poultry: 200g per week</li> </ul> <p><b>Ambitious potential</b></p> <p>There are several reasons why it could be considered unrealistic to expect that everyone stop eating meat completely. However, health experts agree that a meat-free diet can be suitable for essentially anyone (British Dietetic Association, 2017). Therefore, as an ambitious target, zero meat consumption has been applied.</p>	<p><b>Rationale</b></p> <p>While meat products are known to be the most carbon-intensive of animal products generally, dairy production has considerable impacts on emissions and the environment.</p> <p>Cows demand the greatest amount of space, feed, and water of all common livestock animals, and they produce higher levels of greenhouse gases through enteric fermentation, which generates methane. Even as intensive rearing and selective breeding of cattle have increased yields, growth in demand for milk-based products has increased the impacts from dairy farming.</p> <p>A target to reduce dairy consumption to 90kg milk per person per year (equivalent to ~250g a day) is based on a sustainable diet as defined by EAT-Lancet (EAT Lancet Commission, 2019).</p> <p><b>Ambitious potential</b></p> <p>Dairy is not essential to a healthy human diet with suitable plant-based alternatives to calcium. Indeed, approximately 65% of the global population has a reduced ability to digest lactose after infancy (US National Library of Medicine, 2019). Therefore, as an ambitious target, zero dairy consumption has been applied.</p>

2,660 kcal per person per day
2,500 kcal per person per day
2,500 kcal per person per day
<p><b>Rationale</b></p> <p>Obesity and overweightness are growing problems in cities across the world. The global obesity epidemic is not limited to developed or wealthy countries, and often co-exists with undernutrition (World Health Organisation, 2003). While the required calorie intake at an individual level will vary based on factors such as physiology, activity levels, condition and lifestyle, the average recommended daily calorie intake at a population level is 2,500 kcal (EAT-Lancet Commission, 2019). However, calories can represent very different levels of nutrition depending on where they come from. While simple over-consumption of food is an issue in some places, there continues to be issues around food access and security, even in the wealthiest nations. For example, over 11% of households in the USA are estimated to have faced food insecurity during 2017 (United States Department of Agriculture, 2017). The shift towards a healthy diet involves eating better, more nutritious food, as well as keeping overall calorie intake within the recommended guidelines.</p> <p>The dietary change profile selected as a target for this study involves rebalancing existing consumption profiles towards an optimum intake across food groups, aligned with this calorie target.</p>

<sup>5</sup>This target includes dairy derivatives such as cheese in terms of raw-milk equivalent; for example it takes roughly ten times the amount of milk to make a specified quantity of cheese (Fox, Patrick. F.; McSweeney, Paul. L.H.; Cogan, 2000), so this target could also be expressed as either 250g of milk or 25g of cheese.



INTERVENTION	FOOD - REDUCE HOUSEHOLD WASTE
2017 AVERAGE IN C40 CITIES	<b>\$251</b> per capita (representative of cities for which household food waste target is applicable)
PROGRESSIVE TARGET	<b>50%</b> reduction in household waste
AMBITIOUS TARGET	<b>0</b> household waste
WHY AND HOW?	<p><b>Rationale</b></p> <p>Food waste from households impacts emissions in two ways; firstly, in terms of the emissions generated in producing the food, and secondly in disposal. In the worst-case scenarios, household food waste is dumped, generating methane. In better situations, separated food waste collections are sent to industrial composting or anaerobic digestion plants.</p> <p>The focus for this study is on reducing the impact of household food waste on the entire food supply chain by reducing the volume of food that is wasted at a household level in the first place, rather than by improving the method of disposal/waste management. There is still a very important role for efforts that divert food waste from landfill.</p> <p>The target for food waste aligns with the United Nations Sustainable Development Goal (SDG) 12 which aims to halve per capita global food waste at the retail and consumer levels by 2030.</p> <p>For the purposes of calculating the average reduction in food expenditure, European levels of household food waste (10% to 16% depending on food group) was used as the baseline level of food waste in high income cities.</p> <p><b>Ambitious potential</b></p> <p>Household food waste in the context of this report means all edible food waste that is thrown away or disposed of at a household level. It does not include non-edible food waste such as tea bags, or non-edible parts of vegetables, fruits and animals (e.g. bones, orange peel, stones from fruit, etc), also called food scraps.</p> <p>Therefore, it is theoretically possible to achieve an absolute reduction with a target of zero household waste where all edible parts of all food purchased are either eaten or donated.</p>

INTERVENTION	FOOD - AVOID SUPPLY CHAIN WASTE
2017 AVERAGE IN C40 CITIES	<b>183</b> per person per year
PROGRESSIVE TARGET	<b>50%</b> reduction in supply chain food waste
AMBITIOUS TARGET	<b>75%</b> reduction in supply chain food waste
WHY AND HOW?	<p><b>Rationale</b></p> <p>Food waste across the supply chain is food loss and waste that occurs during all the stages of the food lifecycle before consumption. It includes agricultural production, post-harvesting handling and storage, processing and distribution. This waste can occur because of several failures in the system including inefficiencies in logistics or inadequate infrastructure, strict standardisation of aesthetics, lack of technology, insufficient skills, knowledge and management capacity of supply chain actors, and limited access to markets as well as events such as natural disasters.</p> <p>Supply chain waste makes up between 60% and 95% of total food waste depending on the region. Its impact on emissions is, as for household food waste, through both the emissions involved in producing the food that is lost and wasted, alongside the emissions associated with waste management and disposal.</p> <p>However, when considered in terms of relative % of overall food loss and waste, supply chain loss and waste tends to represent a higher proportion of overall food loss and waste in less developed parts of the world. This is likely due to less waste at the consumer level, as well as the fact that these regions commonly have less advanced logistics, packaging and storage solutions that often result in higher levels of supply chain food loss.</p> <p>A goal of 50% reduction in supply chain food waste and losses is based on the UN SDG and Food and Agriculture Organization (FAO) target for retail and consumer food waste (United Nations, no date).</p> <p><b>Ambitious potential</b></p> <p>The ambitious target for reduction in supply chain food loss and waste is based on estimations of the maximum achievable reduction in supply chain food waste (Springmann et al., 2018).</p>

INTERVENTION	FOOD PACKAGING - MATERIAL EFFICIENCY
2017 AVERAGE IN C40 CITIES	n/a
PROGRESSIVE TARGET	<b>19%</b> reduction in materials used in packaging
AMBITIOUS TARGET	<b>38%</b> reduction in materials used in packaging
WHY AND HOW?	<p><b>Rationale</b></p> <p>Many existing food packaging designs have the potential to be modified to use less material in production through using thinner materials, optimising the geometric properties of the packaging or by eliminating unnecessary components.</p> <p>Several existing options have been shown to reduce the materials required in standard packaging by 10-60% (Waste &amp; Resources Action Programme (WRAP), 2013). The target for reducing quantity of materials used in food packaging was based on the average reduction in materials across 12 different case studies of existing packaging alternatives.</p> <p><b>Ambitious potential</b></p> <p>New designs and developments in packaging technology continue to provide opportunities for material efficiency and it is likely that material efficiency could further increase. There is no evidence to suggest what the potential might be, but given that some design options can achieve a 60% reduction currently, an ambitious target of double the progressive target has been adopted.</p>

INTERVENTION	FOOD PACKAGING - RECYCLE PACKAGING
2017 AVERAGE IN C40 CITIES	<b>14%</b> of plastic packaging made from recycled material
PROGRESSIVE TARGET	<b>50%</b> of plastic packaging made from recycled material
AMBITIOUS TARGET	<i>No different to standard target</i>
WHY AND HOW?	<p><b>Rationale</b></p> <p>Recycled plastic saves approximately 81% of the emissions associated with virgin material manufacturing. The ambition for 50% of plastic to be recycled per packaging is based on assumption that each recycled unit feeds back into the packaging industry at least once. Current levels of recycling in packaging are at 14% (Ellen MacArthur Foundation, 2017).</p>

## LOCAL AND REGIONAL CONSIDERATIONS

While food is an important contributor to consumption-based emissions, there are complex issues around food production and consumption, the associated impacts on human health and the environment, and societal and cultural contexts that vary locally and regionally.

### Food access and insecurity

Access to food is still inconsistent across the world. Many cities have neighbourhoods that are characterised as “food deserts” where it is difficult to obtain affordable or good-quality fresh food. Other cities have neighbourhoods that form “food swamps”, where the only available food is less healthy and highly processed. Addressing food insecurity and ensuring all citizens have access to healthy, safe and sustainable foods, while minimising increases in emissions, is a priority of this research.

### Food and health

What constitutes a healthy diet will vary according to individual physiological characteristics as well as availability and provenance of different types of food amongst other factors. The guidelines by which the targets in this section have been developed are based on a global analysis, and do not represent a prescriptive diet for every individual. Rather, they represent broad aims for how consumption needs to change at a city scale to reduce emissions in line with a 1.5°C trajectory.

### Production systems

Different food production systems can make a considerable difference to the quantum of GHG emissions associated with food product output (as well as other environmental impacts such as water demand, land-use change and fertiliser use) of the food produced. For example, well managed livestock grazing systems in some cases can support soil carbon sequestration (Tara et al., 2017). This also applies to the choices of food substitutes when reducing meat consumption, and different plant protein sources (e.g. nuts and legumes) have different emissions intensities associated with their production. Notwithstanding this, on the whole such choices are less significant than the difference between meat and plant-based protein.

These issues were researched as part of this study and are further examined in the accompanying Method Report.

## 2.2

# Differentiated consumption targets

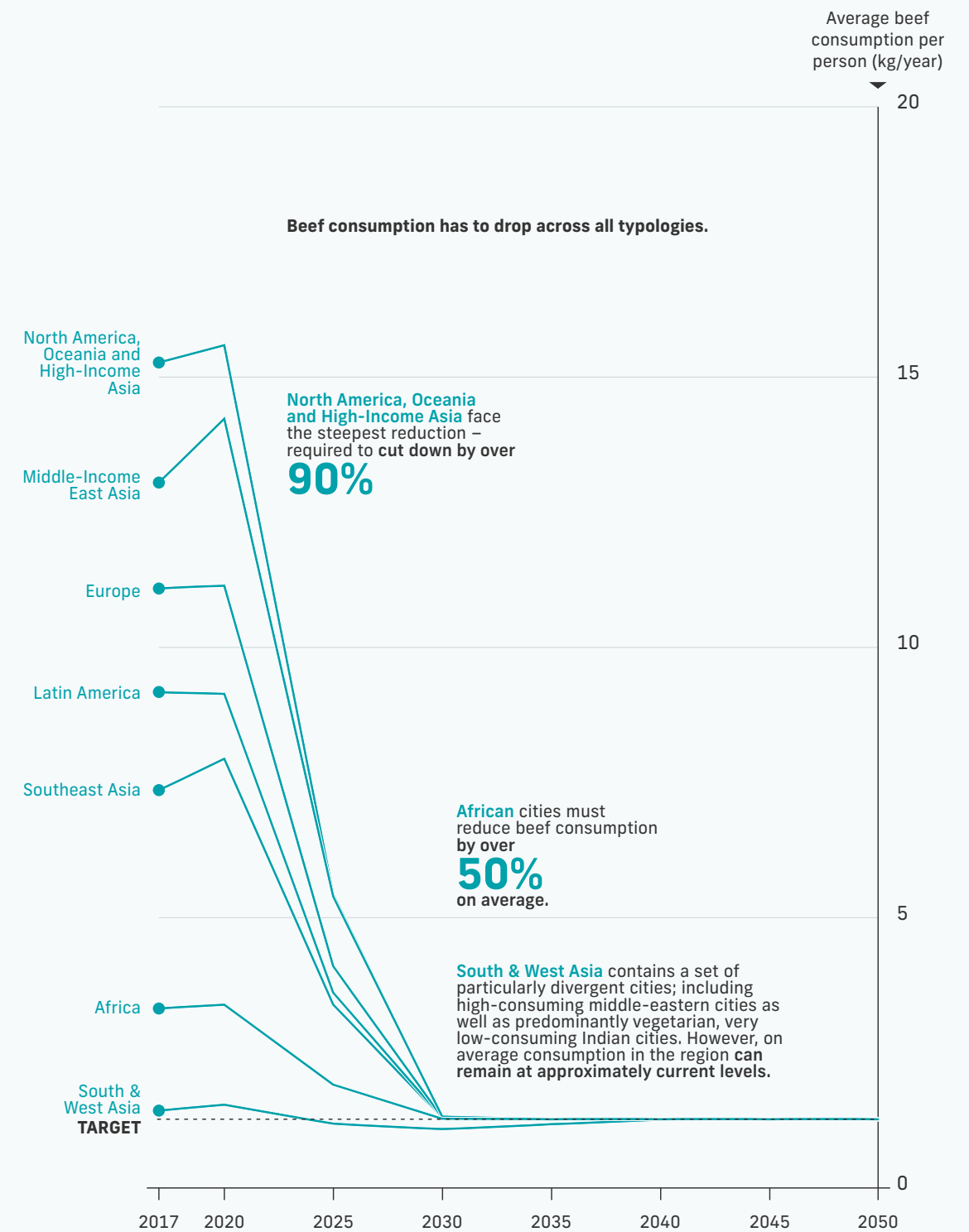
Levels of food consumption, diet patterns, and food waste volumes vary across C40 cities. This means that the scale of change to reduce food-related emissions differs between city typologies.

From the graphs below (Figure 1, Figure 2 and Figure 3), it is clear that if food-related emissions for C40 cities are to decrease in line with their progressive targets, then cities in the global north along with rapidly growing economies in Asia, need to make more significant and faster changes to their food consumption than cities in some parts of the global south.

**It is clear that if food-related emissions for C40 cities are to decrease in line with their progressive targets (described in preceding section), then cities in the global north along with rapidly growing economies in Asia, need to make more significant and faster changes to their food consumption than cities in some parts of the global south.**

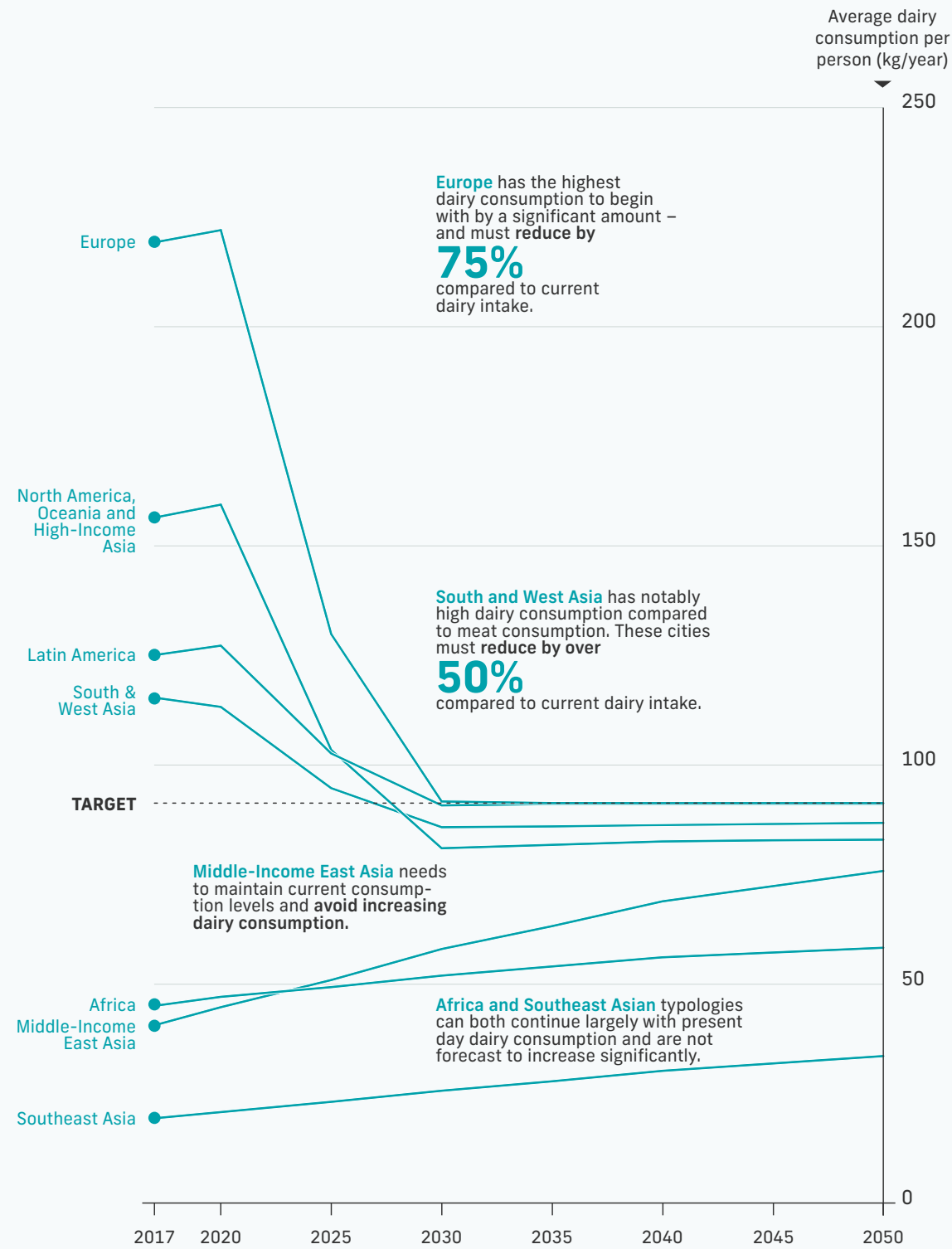
fig.2

Dietary change in beef consumption per typology towards a progressive target of 1.3kg per person per year (which equates to 25g per week). The overall progressive target for meat consumption in general is 16kg per person per year, equating to 300g per week.

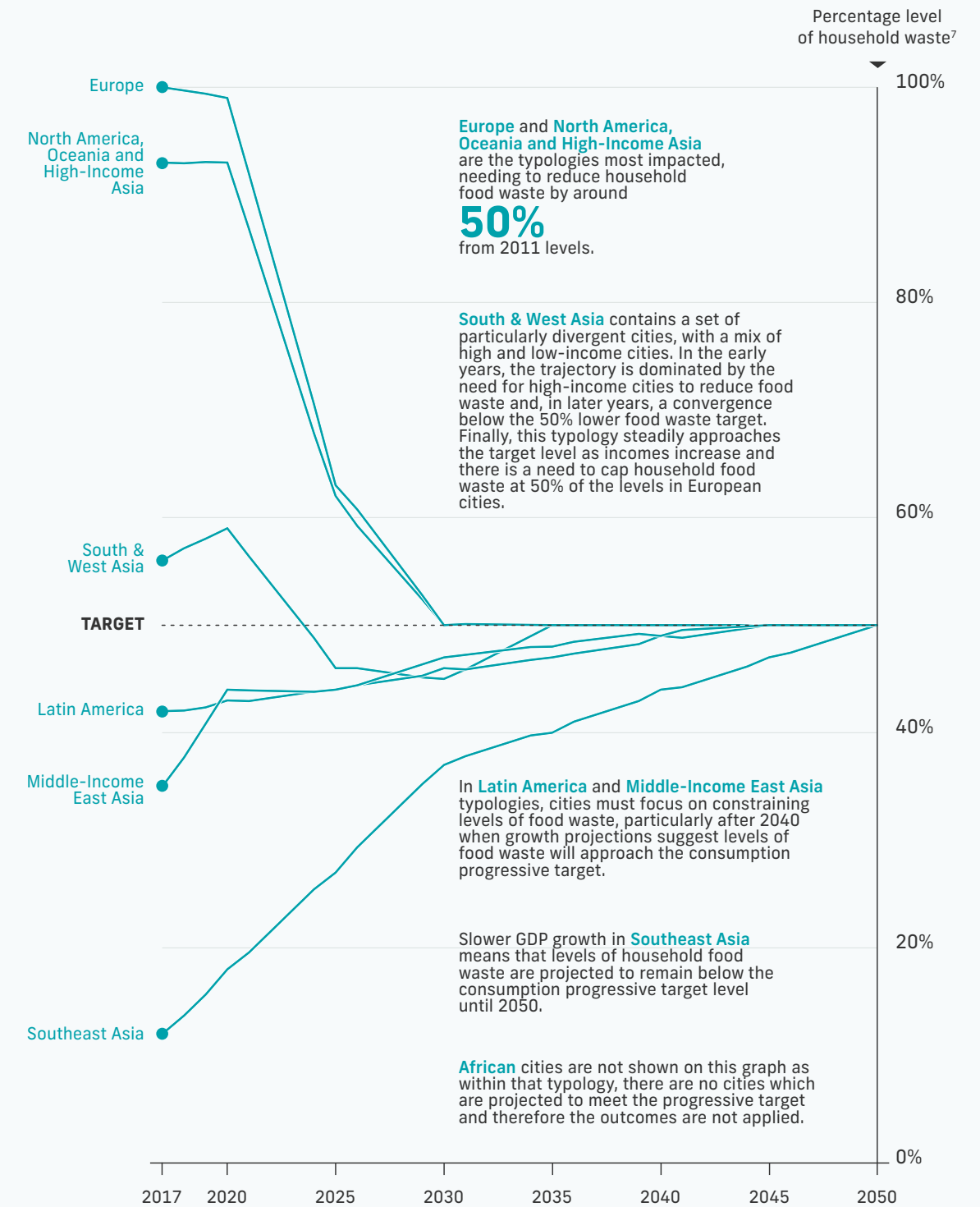




**fig.3**  
Dietary change in dairy per typology towards progressive target of 90 kg per year per person.



**fig.4**  
Change in household food waste per city typology targeting the progressive target of a 50% reduction.<sup>6</sup>



<sup>6</sup> This figure includes only those cities for which the household food waste progressive target is applicable (now or in the future), in total 62 out of 96 cities.  
<sup>7</sup> The level of household waste was set at 100% for all cities where household waste is non-negligible. The average household waste percentage reflects the fact that typologies may include cities where household food waste does or does not occur.

## 2.3

# Savings from food interventions

If C40 cities change their food consumption habits in line with the identified intervention targets, the category's emissions could be cut by 51-60% by 2050, depending on target level (Figure 5).

The adoption of ambitious targets would enable an additional 9% reduction.

Out of all consumption interventions, adopting dietary change offers the greatest potential for emissions reductions. This change is characterised by a healthy diet with lower meat and dairy intake, which contribute 60% of emissions reductions (43% and 17%, respectively). The remainder is likely associated with reduced calorie intake as well as the recommended alternatives to animal-based products.<sup>8</sup>

Additionally, avoiding household food waste and supply chain food waste would reduce current food-related emissions by 10% and 5%, respectively. Changes in packaging would have a comparatively small impact on emissions reductions (<1%).<sup>9</sup>

<sup>8</sup> See Method Report for further details on the method for developing the approach for applying the dietary change targets.

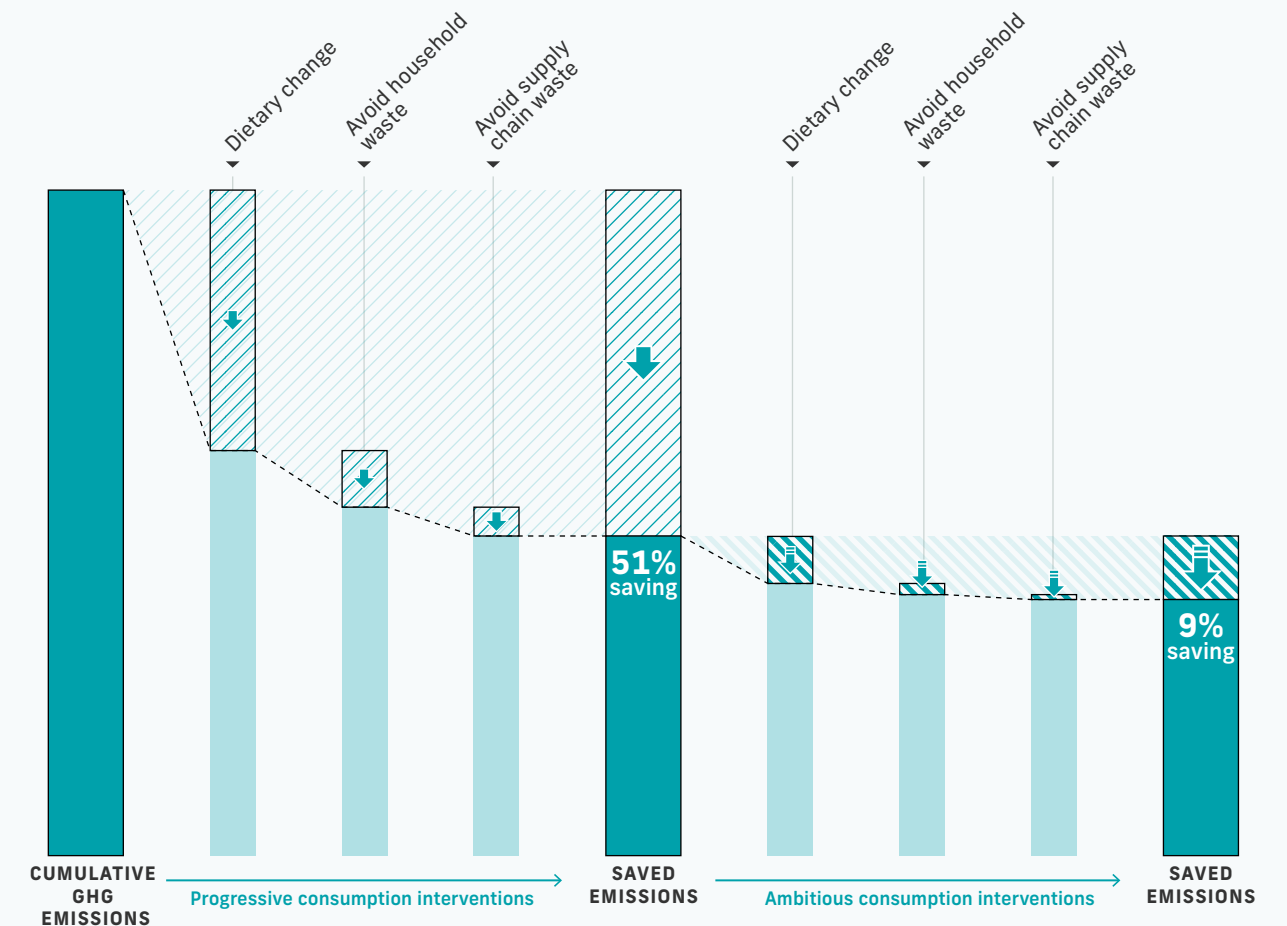
<sup>9</sup> The impact of packaging-related interventions was not included in The Future of Urban Consumption in a 1.5°C World Headline Report given their negligible impact on emissions.

# 60%

**This change is characterised by a healthy diet with lower meat and dairy intake, which contribute 60% of emissions reductions (43% and 17%, respectively). The remainder is likely associated with reduced calorie intake as well as the recommended alternatives to animal-based products.<sup>7</sup>**

fig.5

Food emission reductions broken down by consumption intervention and target ambition.





# 3 Benefits of addressing food-related emissions

Climate change is often seen as competing with a range of other pressing issues, such as lack of affordable housing, poverty, unemployment, and poor health.

Without a holistic and persuasive case for climate action that articulates how addressing climate change can simultaneously address other priorities, it will be challenging for city governments to attract the required support for ambitious climate policies. By looking at the wider benefits associated with delivering the proposed consumption interventions, this report supports cities in building the case for taking action.

The changes that need to be made to current consumption patterns can in some cases seem dramatic, but residents, businesses and government all stand to gain if they are achieved in the right way.

This section presents the quantified benefits associated with delivering the highest impact food consumption interventions according to progressive targets.<sup>10</sup> If C40 cities delivered consumption interventions in line with ambitious targets, the benefits would be greater still.

*The changes that need to be made to current consumption patterns can in some cases seem dramatic, but residents, businesses and government all stand to gain if they are achieved in the right way.*

<sup>10</sup> These benefits are calculated using available data that is representative of current consumption. As such, the reported year for data may vary between different benefits (typically 2011 and 2013). This approach was adopted to improve accuracy of results.

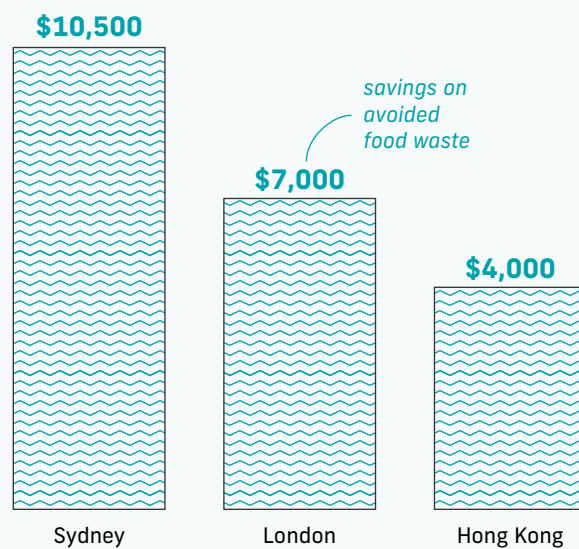


## KEY BENEFITS OF FOOD-RELATED INTERVENTIONS

- ✓ Healthier city residents
- ✓ Longer life expectancy
- ✓ Reduced deforestation
- ✓ Freshwater resource and pollution savings
- ✓ Personal financial savings
- ✓ Global economic savings

By avoiding **household food waste**, over a 20 year period, city residents in C40 cities **could save** on average

# \$5,500



Avoided food waste in the supply chain would save

# \$25 billion

globally per year



Eating less red meat and more vegetables and fruits could save

# 170,000

deaths per year in C40 cities, equivalent to \$600 billion based on the economic value of life.

Reducing dairy intake could save



# 19

billion m<sup>3</sup> of freshwater per year

# 460

billion m<sup>2</sup> of land per year (equivalent to the size of Spain or 32 billion trees)

## 3.1

## Benefits associated with dietary changes

Reducing meat and dairy consumption while increasing vegetable and fruit intake is not only necessary to reduce GHG emissions, but would be a major benefit for human health.

In the 21st century, obesity is a major public health issue with rates rising in almost all countries, while the poorest countries of the world are still battling under-nourishment (EAT-Lancet Commission, 2019). Over-consumption of red meat and under-consumption of fruits and vegetables are associated with numerous chronic and potentially fatal illnesses such as coronary heart disease (CHD), stroke, cancer and type-2 diabetes.

In C40 cities, over 110,000 annual deaths could be avoided due to a reduction in red meat consumption in line with the minimum target assessed as part of this study. An additional 60,000 deaths could be avoided by increasing vegetable and fruit intake compared with current consumption levels. This translates to over \$600 billion associated savings based on the economic valuation of life.<sup>11</sup>

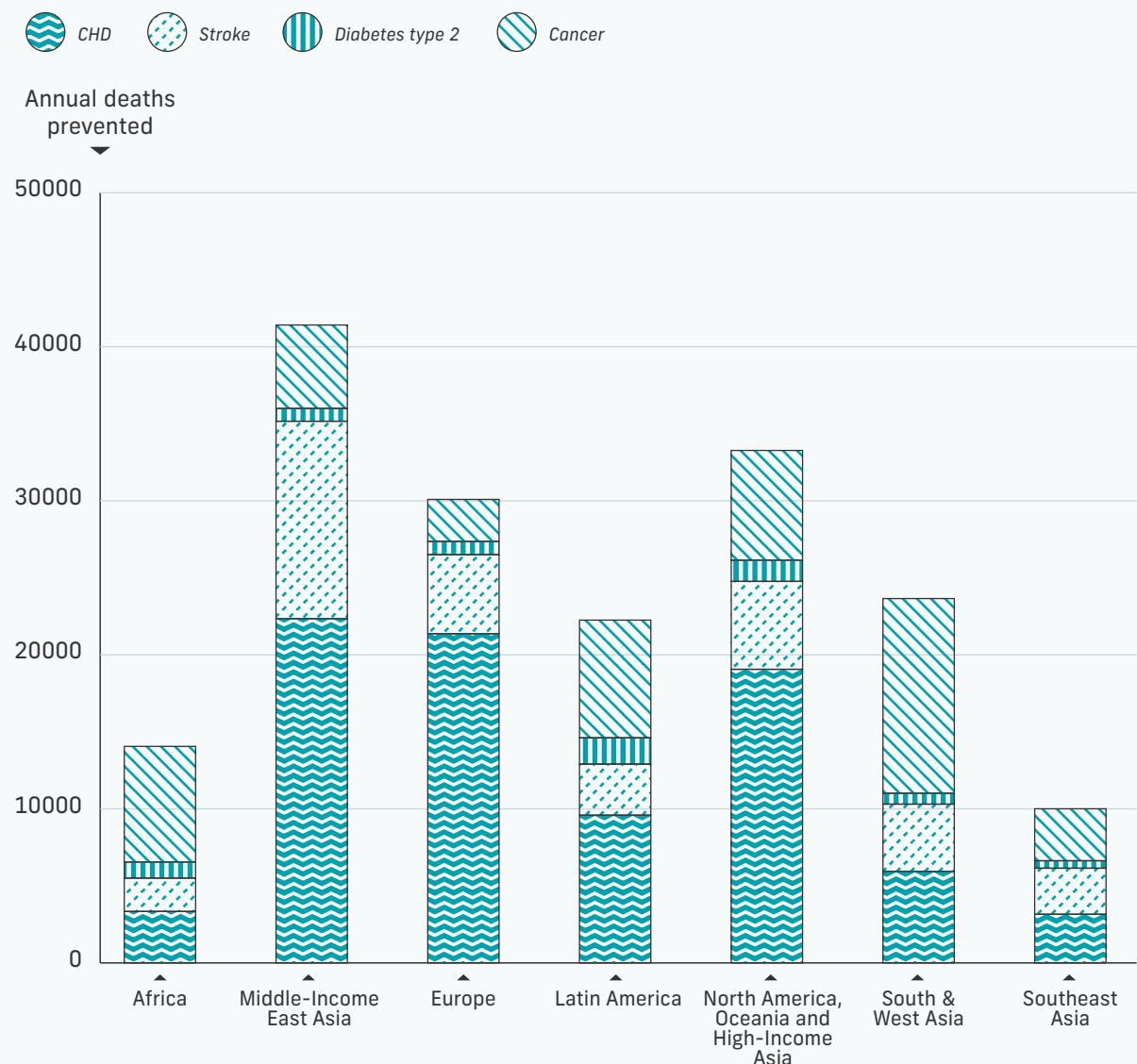
<sup>11</sup> All benefits of dietary changes were calculated against reported consumption in 2011.

With regard to regional distribution of health benefits, North America, middle-income East Asia, Europe and Latin America receive the greatest benefits in absolute terms, representing 73% of the deaths prevented, as indicated in Figure 2. Decreased consumption of meat has a higher impact on cities in developed countries in terms of deaths prevented per capita, while increased consumption of fruit and vegetables has a higher impact on cities in developing countries.

# 73%

With regard to regional distribution of health benefits, North America, middle-income East Asia, Europe and Latin America receive the greatest benefits in absolute terms, representing 73% of the deaths prevented

**fig.6**  
Annual deaths prevented from increased consumption of fruits and vegetables and decreased consumption of red meat according to progressive targets.



Food production, particularly meat and dairy production, has major impacts on other resources, notably freshwater and land. For example, a reduction in dairy intake in line with the progressive target for dietary shift in C40 cities recommended by this study could reduce water consumption by 19 billion m<sup>3</sup> and release 460

billion m<sup>2</sup> of land. In the context of a growing global population, the release of land would most likely imply reduced deforestation, safeguarding invaluable ecosystems for other species as well as sequestering carbon.<sup>12</sup> In a given year, the world's forests absorb as much as 30% of global CO<sub>2</sub> emissions (Luyssaert, 2014).

Figure 7 and Figure 8 show the regional distribution of environmental benefits from the targeted dairy reductions. Dietary changes away from dairy would benefit European cities the most, however they would also be significant across other regions with high dairy consumption such as Latin America, North America, Oceania and high-income Asia as well South & West Asia (see Figure 3 for consumption levels).

<sup>12</sup> Note that within this study, the emissions associated with land use change and resulting savings associated with consumption interventions were not quantified because these are not included within the consumption-based emissions inventories which form the basis of the analysis.

**fig.7**  
Reduction in freshwater use from substituting dairy for plant-based alternatives according to progressive targets.

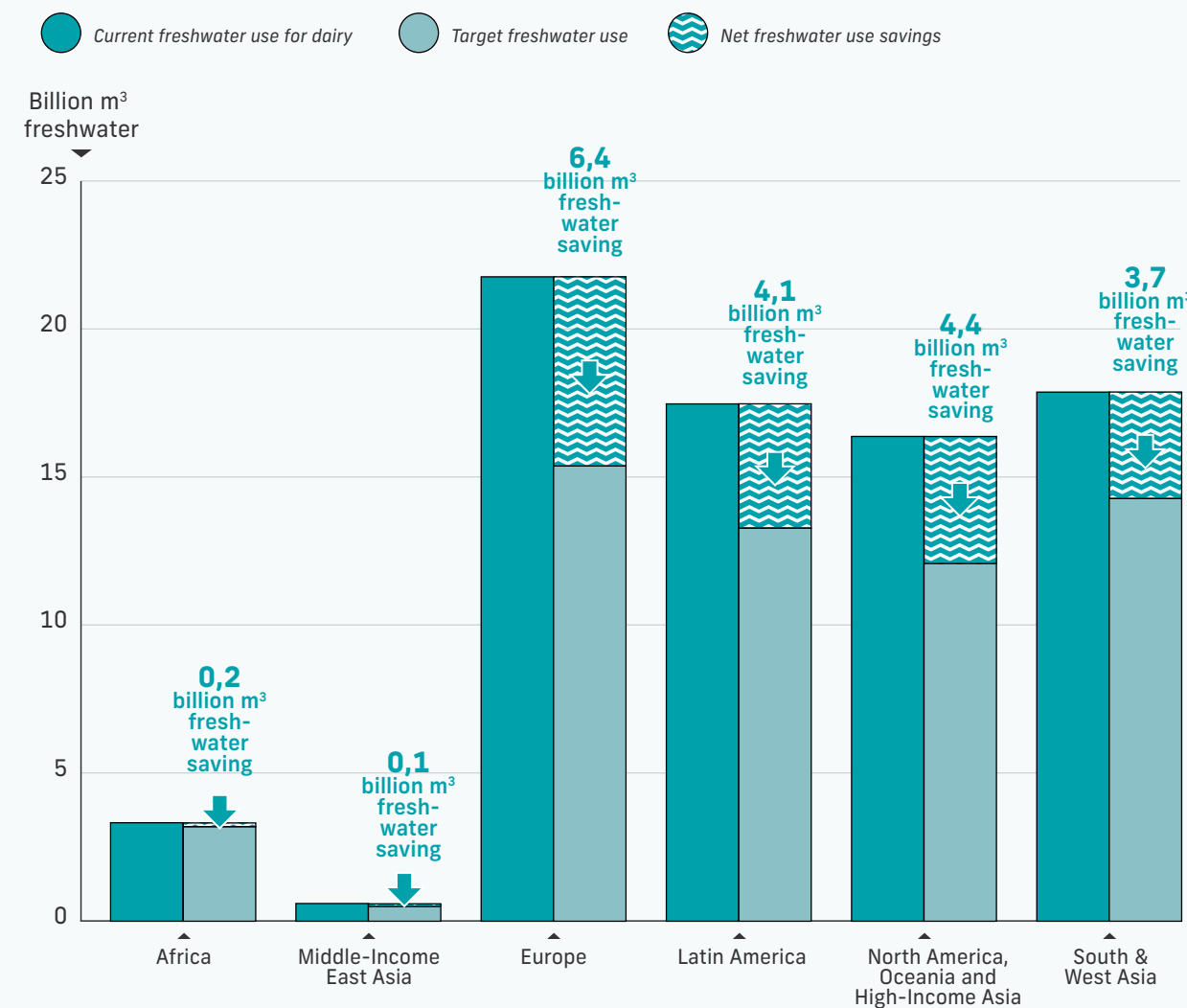
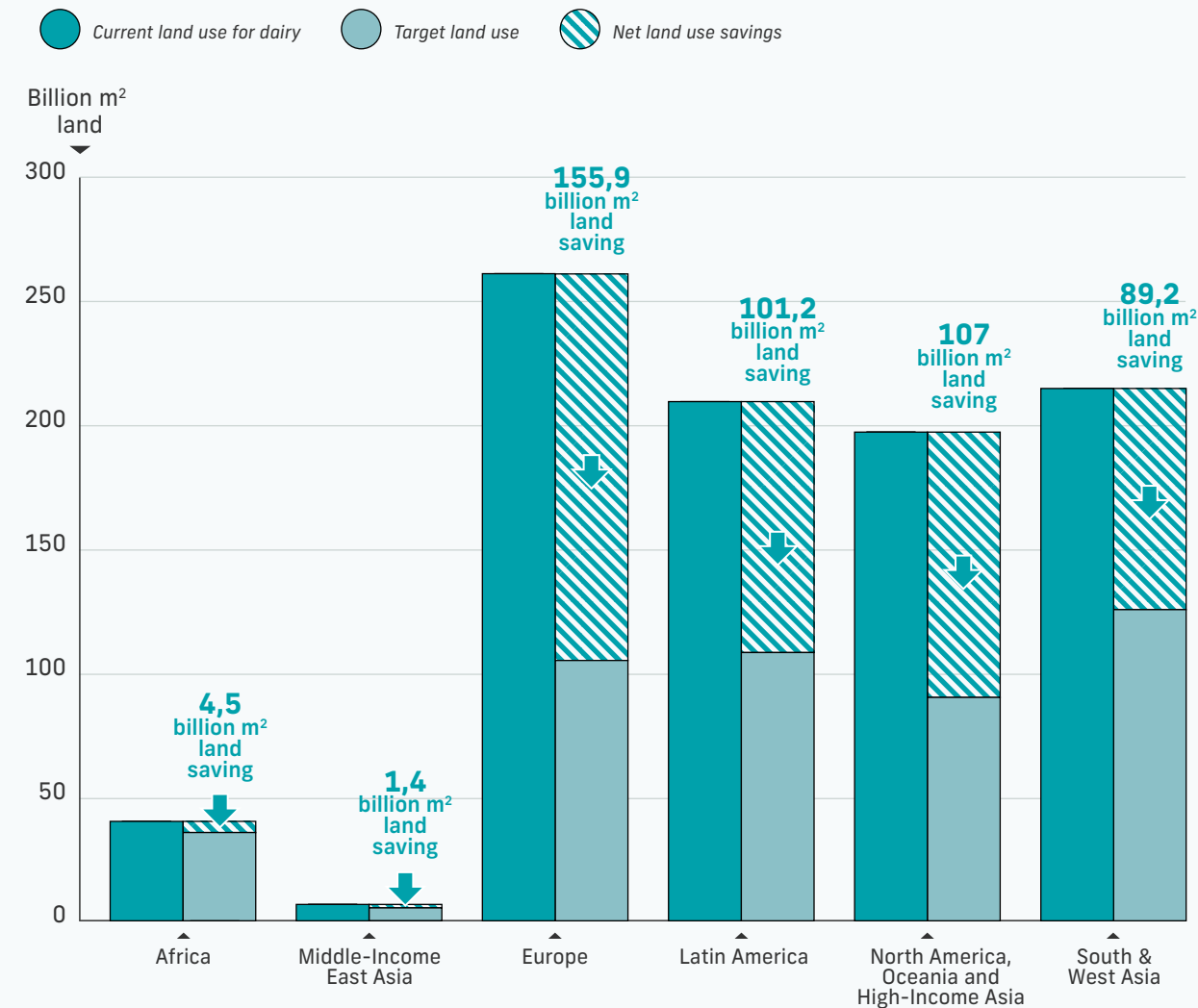


fig.8

Reduction in land use from substituting dairy for plant-based alternatives according to progressive targets.



## 3.2

## Benefits associated with avoided food waste

Improved consumption habits can have immediate benefits for personal financial budgets. Reducing household food waste, for instance, is a money-saving as well as an emission-saving opportunity.

Citizens of C40 cities with higher levels of household food waste could see an average saving in their annual food bills of 7%, or \$112 per capita. This typically represents 0.5% of total household expenditure. If cities were to eliminate 100% of household food waste, they would avoid the full cost associated with household food waste and would save \$224 per capita per week.<sup>13</sup>

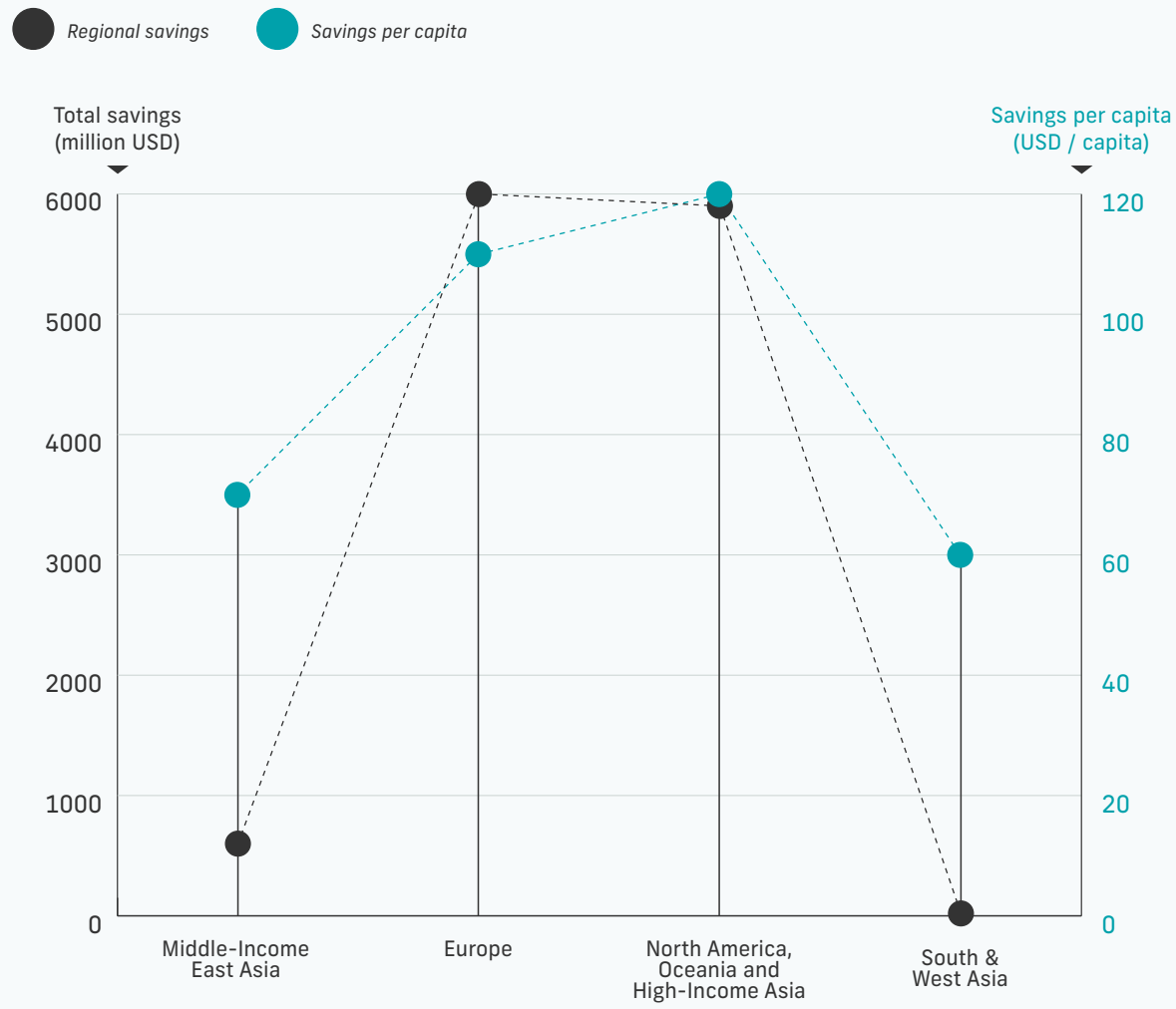
<sup>13</sup> Note that expenditure was not corrected for purchasing power parity such that the value of money (in equivalent goods) will vary per city. The average expenditure saving is provided for illustration purposes only.  
<sup>14</sup> There are differences in where in the supply chain the food loss occurs e.g. storage and handling or retail.

At a macro-economic level, food loss and wastage is a major burden, causing unnecessary loss of economic value. Avoiding 50% of supply chain loss destined for consumption in C40 cities, in line with the target set out in Table 1, could mean avoiding the loss of over 32 billion kg of food, equivalent to \$25 billion in economic costs per year. These economic savings are more evenly distributed across regions given that supply chain loss affects most economies.<sup>14</sup> Cities in middle-income East Asia would see the most significant economic benefits in avoided total losses as they represent a large share of the total population of the C40 cities (23% of the total population) as well as higher than average losses within their supply chain (177 kg / capita in middle-income East Asia, compared to an average of 150 kg / capita across the other regions).

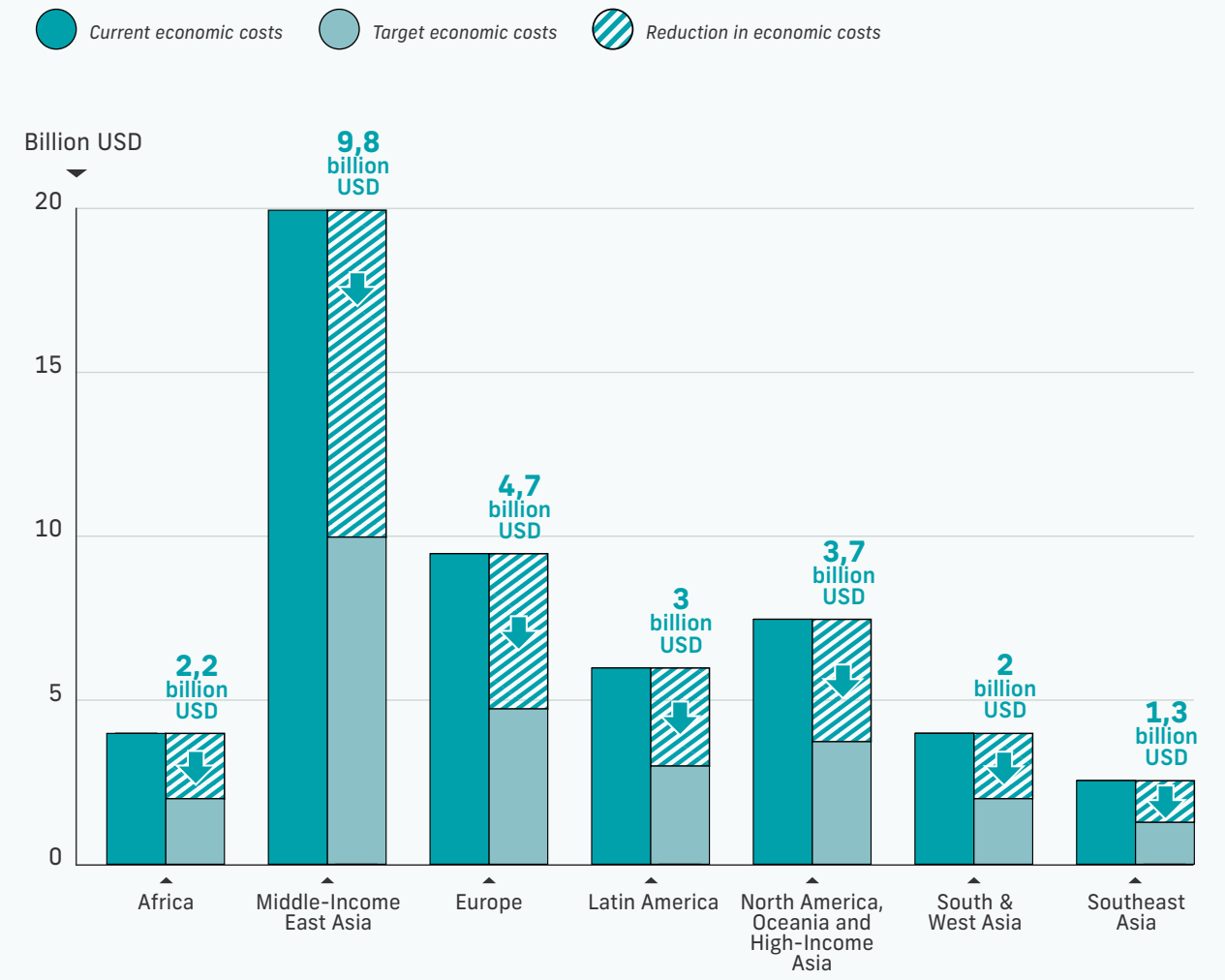
Figure 9 highlights that expenditure savings mainly accrue to cities in developed economies in the Global North. This relates to where household waste occurs, as shown in Figure 4.



**fig.9**  
Household expenditure savings from avoiding household waste.



**fig.10**  
Reduction in economic costs from reduction in food losses and waste within the supply chain.



# 4

## Creating change through collaboration

After determining consumption targets for food, the next step is to consider how these changes can be delivered and identify the key stakeholders that can influence change.

A framework was produced which can be used to assess the relative power, influence and capacity of different stakeholders to act on any given intervention.

The stakeholder framework is structured around five generalised groups of key stakeholders that are involved in making decisions which impact consumption-based emissions of cities. These groups are:

- Individuals
- Business
- Civil society
- National governments
- City governments

Further sub-division of specific roles within each group is shown in Figure 11 –stakeholder power scoring was carried out at this level and is illustrated by the colours of the graph. Details on the basis of the scoring are contained in the accompanying method report.

The following sections illustrate the results of the scoring framework with regard to the most impactful of the food consumption dietary change interventions, namely reducing meat intake.

**The dietary change intervention was selected for application of the framework as it is the most impactful intervention globally on consumption-based emissions relating to food.**

4.1

# Key stakeholders

Individuals consumers are identified as the most influential group when it comes to reducing meat consumption. However, these behaviour changes are not possible without a significant supporting role from government, business and civil society to make the low carbon choice easier.

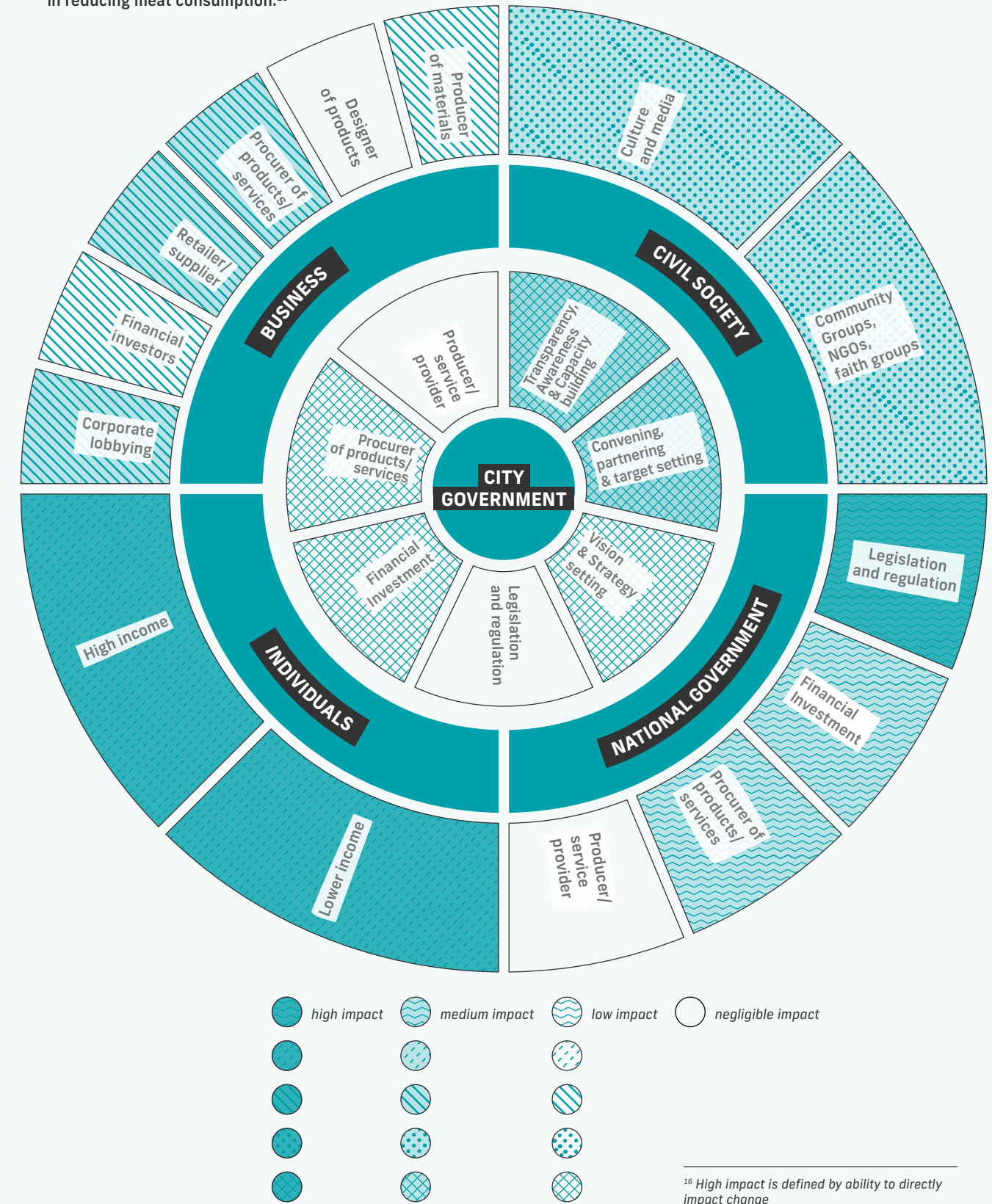
Though evidence suggests that plant-based diets are cheaper than the traditional alternative<sup>15</sup>, finding affordable, healthy and sustainable food can be a challenge for lower-income individuals. Addressing issues around equity and barriers to food access is therefore central to ensuring that a switch to a healthy, sustainable diet is possible at the scale we needed.

**Issues around food access and equity are therefore central to ensuring that a healthy, sustainable diet is accessible for all; however evidence suggests that plant-based diets are cheaper than the traditional alternative.**

<sup>15</sup> (M. Berners-Lee, 2012)

fig.11

Stakeholder mapping framework highlight with high, medium, low and negligible impact potential in reducing meat consumption.<sup>16</sup>





## 4.2

# Cities' role in catalysing stakeholder action

Table 2 summarises the types of action that can be taken by each stakeholder group and is based on the same research used to develop the power scoring framework in Figure 11. The different sub-divisions are discussed and each section also contains a specific focus on the role that cities can play to collaborate with each stakeholder group to catalyse action.

Tab.2

Stakeholder assessment of actions relating to dietary change intervention.

<b>INDIVIDUALS</b> <ul style="list-style-type: none"> <li>• Individuals (high income)</li> <li>• Individuals (low income)</li> </ul>	<i>With sufficient access to healthy and sustainable alternatives, individuals have the ability to alter diets and reduce meat consumption.</i>
Examples of individual actions	<p>There is growing evidence of consumer action to reduce meat consumption. As much as 30% of the U.S. population now call themselves 'flexitarians', for example, meaning that they are actively eating more plant-based foods (Gervis, 2018). In the UK, there are an estimated 600,000 vegans, which is a 400% increase compared to four years ago (Smithers, 2018). Veganuary – a movement where participants adopt a meat free diet for the month of January – has seen participant numbers double each year since it started five years ago. In total, 250,000 people in 193 countries signed up in 2019.</p>
How can cities collaborate with individuals?	<p>Mayors often have access to <b>advertising space</b> and/or direct access to media outlets or influencers. Mayors can <b>support campaigns directed at individuals</b> in their cities, advocating for people to make lifestyle changes, including dietary choices which are better for the planet. Mayors can help <b>inform their residents</b> on what a low-carbon diet looks like. Stockholm modelled this by distributing a cookbook with "climate smart" recipes to all its residents as a part of an information campaign (Stockholms stad, 2019). Mayors can also <b>buy and serve</b> more plant-based options in city-operated institutions such as public schools, kindergartens, hospitals. London's recent move to ban junk food advertising on its public transport network is a perfect example of a city's ability to influence the public (Greater London Authority, 2018).</p>

<b>BUSINESSES</b> <ul style="list-style-type: none"> <li>• Producers</li> <li>• Product designers</li> <li>• Retailers</li> <li>• Investors</li> <li>• Lobbyists</li> </ul>	<i>Businesses action, through farming, product development, marketing and pricing, is necessary for individuals to sufficiently reduce their meat consumption.</i>
Examples of business actions	Farmers and food producers respond to changing consumer demand, and pioneering food producers can provide consumers with new options based on consumer interest in sustainable alternatives. This could be plant-based hamburgers that mimic the texture of beef or sausages that mix animal products and plant-based alternatives to reduce the meat content (Express, 2017). Retailers can adjust supermarket or website designs, such as introducing vegan sections, to promote meat-free alternatives (The Times, 2018). Additionally, retailers can offer “climate smart” low-carbon recipes as inspiration (ICA, 2019) or use new technology, such as household smart devices to give customers live feedback about their dietary choices. On the supply side, businesses can nudge employers to eat less meat by reducing or removing meat within the premises that they own or manage, such as canteens or food courts, or by not allowing employees to expense meat-based meals (Peters, 2017; Tyler, 2018; Wolfson, 2018).
How can cities collaborate with business?	Mayors have a unique role as <b>convener</b> s. A mayor can typically convene representatives from all stages of the food supply chain to work together on a response to dietary change. Mayors can <b>engage retailers and restaurants</b> to promote reduced-meat diets and meal options. City government can engage businesses on what foods they offer at their employment sites in order to prioritise healthy plant-based food. This could be championed in parallel with a broader environmental agenda that mayors are discussing with business leaders (e.g. energy efficiency, skills, climate smart investment). Mayors can, in some cases, <b>institute new taxes</b> on food and beverages, exemplified by Philadelphia’s beverage tax on drinks with sugar-based sweeteners that is levied on registered distributors (City of Philadelphia, 2019). Mayors can also increase the availability of healthy plant-based foods by supporting healthy supermarkets and corner stores in ‘food deserts’ and ‘food swamps’, or support projects that align with their vision and strategy.

<b>CIVIL SOCIETY</b> <ul style="list-style-type: none"> <li>• Community groups/ NGOs/Faith groups etc.</li> <li>• Media and culture</li> </ul>	<i>Civil society groups play a supporting role by influencing consumers, producers and policymakers to adopt and support plant-based diets.</i>
Examples of civil society actions	There are many campaign groups and advocates around the world that are working to promote plant-based diets. One prominent campaign is Meat Free Monday, which raises awareness by promoting one meat free day per week (The Meat Free Monday Foundation, 2019). There are also high-profile individuals supporting this agenda including musicians, actors, athletes, politicians and climate change champions such as Beyoncé, Christiana Figueres and Greta Thunberg (Barr, 2018; Veganuary, 2018; Axios, 2019). Furthermore, mainstream media, celebrity chefs, cooking shows, movies, documentaries, articles and books continuously shape values and set food trends as well as inform the public on the pros and cons of dietary decisions.
How can cities collaborate with civil society?	Cities often work together with civil society to raise awareness and build capacity. Mayors can <b>directly fund planning or outreach work</b> which is led by external stakeholders. This line of work can be extended to raise awareness about sustainable diets and reduced meat consumption. The food agenda connects to a number of other policy areas and mayors can consider where co-benefits might be delivered. For example, looking at all civil society-run shelters that serve food, or where social prescriptions are supported, the mayor could encourage referrals to community food growing schemes and go further to providing relevant dissemination materials to the partner organisations running these foods growing schemes.

<p><b>NATIONAL GOVERNMENT</b></p> <ul style="list-style-type: none"> <li>• Producer</li> <li>• Procurer</li> <li>• Legislator/Regulator</li> <li>• Investor</li> </ul>	<p><i>National governments can support the reduction of meat consumption through legislation, taxes and procurement.</i></p>
<p>Examples of national government actions</p>	<p>Using its ability to legislate or tax, national governments can redesign dietary guidelines and reconsider business support schemes accordingly (Bloomberg Philanthropies, 2019).</p>
<p>How can cities collaborate with national government?</p>	<p>Mayors can <b>lobby central government</b> on several fronts. City government can change its public procurement processes and challenge national government to follow suit. Mayors can advocate for a stronger <b>focus on preventative health within the health</b> sector or make an environmental case for reduced meat consumption to national environmental agencies. Mayors can develop a food vision or strategy for their city and suggest that the national government does the same for the country at large. A city food strategy can cover a broad range of issues (e.g. reducing food waste, improving health, cost and inclusivity). A strategy can support interventions that align with an ambition to reduce meat consumption, increase healthy and sustainable food distribution, and can allocate space for urban, plant-based agriculture, etc.</p>

### 4.3

## Spotlight: How businesses are leading the way in reducing meat consumption?

Over the past few years, the availability and variety of meat alternatives and plant-based options in grocery stores and restaurants has grown noticeably. Certain cities, as centres of new social trends, are leading the charge.

The extent of meat-free culinary exploits within a city help market it as an interesting and creative destination. Tel Aviv, Bristol, Ghent and Berlin have all at some point been branded as the vegan or vegetarian capital of the world, with many other cities featuring on 'top 10' lists of vegan-friendly cities.

Within cities, more consumer choice supports an increasing interest and move towards vegetarian, vegan and 'flexitarian' diets. Depending on preference, urban consumers can pick from an increasing number of food products that are designed to include less meat, such as the 'Love Meat & Veg' range from UK retailer Sainsbury's, the 'Flexilicious' products from ABP Food Group or the entirely plant-based

'Impossible Foods' burgers that are being sold in restaurants and fast food chains such as Burger King or White Castle.

Businesses benefit from a growing interest in plant-based alternatives as well and can reach new consumer groups, strengthening a company's profile. In 2019 Gregg's, a UK-based bakery chain, released a vegan version of their classic (non-vegan) sausage roll to coincide with the 'Veganuary' movement. Gregg's gained recognition as a surprising vegan actor, upsetting 'traditionalist' influencers and handling the resulting social media controversy adeptly. In the end, demand for the vegan sausage rolls far surpassed the company's expectations – many stores ran out of the product and the story gained traction across the UK.

Employers also play an important role in changing behaviours. Business objectives relating to sustainability and corporate social responsibility have taken an increasingly important role in board and shareholder decisions, and supporting sustainable dietary choices through catering and procurement choices is a key opportunity to lead the way. For example, WeWork, a global shared workspace provider headquartered in the US, has taken an executive decision to only serve plant-based foods in its offices and not reimburse expenses for meals that include meat.

The World Resources Institute demonstrates integrity with its sustainable catering and events policy which ensures that only vegetarian and vegan food is procured for events using their funding. In other places, local governments and schools have been leading actors, showing how meat consumption can be reduced within their own premises.

**Businesses benefit from a growing interest in plant-based alternatives as well and can reach new consumer groups, strengthening a company's profile. In 2019 Gregg's, a UK-based bakery chain, released a vegan version of their classic (non-vegan) sausage roll to coincide with the 'Veganuary' movement. Gregg's gained recognition as a surprising vegan actor, upsetting 'traditionalist' influencers and handling the resulting social media controversy adeptly. In the end, demand for the vegan sausage rolls far surpassed the company's expectations – many stores ran out of the product and the story gained traction across the UK.**



# 5 Summary

**Food is one of the largest contributing categories to the consumption-based emissions of C40 cities, representing 13% of the total in 2017.**

Rising income combined with increasing consumption of higher-carbon foods such as meat mean that without concerted efforts, emissions will continue to rise. According to our analysis, emissions could increase by 38% if no further climate action is taken. These effects can be greatly reduced by delivering current NDCs and Deadline 2020 commitments, which imply improved farming practices and a limited shift in carbon intensive meat consumption such that emissions from food consumption would be 9% lower in 2050 than in 2017. However, this reduction is not sufficient to reduce emissions in line with a 1.5°C trajectory.

This report adds to the body of evidence showing that dietary changes and avoiding waste are critical interventions to reduce food-related emissions. These solutions can be implemented immediately, with important benefits both to individual health as well as wider society and the environment. If C40 cities change their food consumption habits in line with the identified interventions to their maximum potential, the category's emissions could be cut by 60% by 2050.

FOOD CATEGORY INTERVENTIONS	GHG EMISSION REDUCTION POTENTIAL
<ul style="list-style-type: none"> <li>• lowering intake of meat and dairy</li> <li>• eating in line with health recommendations</li> <li>• avoid household waste</li> <li>• avoid supply chain waste</li> </ul>	<b>60%</b>



Adopting a new diet has the greatest potential for emissions savings of all the consumption interventions considered in this study. This change is characterised by a healthy diet with lower meat and dairy intake contributing, 60% of the emissions reduction (43% and 17% respectively). The remainder is associated with reduced calorie intake and the consumption of alternatives to animal-based products.

Additionally, avoiding household food waste and supply chain waste would reduce current food-related emissions by 10% and 5%, respectively. Changes in packaging were also considered. However, these would have a comparatively small impact on emissions reductions at <1%.

The level of change required varies significantly across C40 cities. This is due to a number of factors, including the composition of diets and the prevalence of different types of food waste (namely cities in higher-income nations have a propensity for higher household food waste versus those in lower- and middle-income nations).

The changes that need to be made to current consumption patterns can in some cases seem dramatic, but residents, businesses and governments stand to gain if they are achieved. Although this project's analysis has been undertaken primarily with emissions reduction in mind, consumption interventions will also have wider benefits for urban residents in terms of health and personal finance.

The most impactful changes investigated in this study are most readily achieved by individual consumers, provided that they have easy access to affordable, sustainable and healthy food options. Changing dietary patterns will undoubtedly be challenging, given significant cultural attachments to specific types of food; and government, business and civil society will have a strong supporting role in making low-carbon choices the consumer preference.

**This report adds to the body of evidence showing that dietary changes and avoiding waste are critical interventions to reduce food related emissions. These solutions can be implemented immediately, with important benefits both to individual health as well as wider society and the environment. If C40 cities change their food consumption habits in line with the identified interventions to their maximum potential, the category's emissions could be cut by 2050 by**

**60%**

# Bibliography

- American Nutrition Association (2019) USDA defines food deserts. Available at: <http://americannutritionassociation.org/newsletter/usda-defines-food-deserts>
- Axios (2019) 'Cory Booker could be the first vegan president', Axios, February. Available at: <https://www.axios.com/cory-booker-vegan-2020-presidential-election-197455ad-7045-42d5-9082-1e12f029cc6a.html>.
- Barr, S. (2018) 'BEYONCÉ ANNOUNCES VEGAN DIET IN PREPARATION FOR COACHELLA', Independent, 5 March. Available at: <https://www.independent.co.uk/life-style/food-and-drink/beyonce-vegan-coachella-festival-headlining-instagram-nutrition-meal-planner-a8240231.html>.
- Bloomberg Philanthropies (2019) TASK FORCE ON FISCAL POLICY FOR HEALTH. Available at: <https://www.bloomberg.org/program/public-health/task-force-fiscal-policy-health/#overview> (Accessed: 25 February 2019).
- British Dietetic Association (2017) Press release: 'British Dietetic Association confirms well-planned vegan diets can support healthy living in people of all ages', British Dietetic Association news archive. Available at: <https://www.bda.uk.com/news/view?id=179> (Accessed: 27 February 2019).
- City of Philadelphia (2019) Philadelphia Beverage Tax. Available at: <https://www.phila.gov/services/payments-assistance-taxes/business-taxes/philadelphia-beverage-tax/> (Accessed: 25 February 2019).
- EAT Lancet Commission (2019) Healthy Diets for Sustainable Food Systems. Available at: [https://eatforum.org/content/uploads/2019/01/EAT-Lancet\\_Commission\\_Summary\\_Report.pdf](https://eatforum.org/content/uploads/2019/01/EAT-Lancet_Commission_Summary_Report.pdf).
- Ellen MacArthur Foundation (2017) The New Plastics Economy: Catalysing Action. Available at: [https://www.ellenmacarthurfoundation.org/assets/downloads/New-Plastics-Economy\\_Catalysing-Action\\_13-1-17.pdf](https://www.ellenmacarthurfoundation.org/assets/downloads/New-Plastics-Economy_Catalysing-Action_13-1-17.pdf).
- Express (2017) 'Sausages launched that are a mix of meat and vegetables', 10 January. Available at: <https://www.express.co.uk/life-style/food/752293/Flexi-sausage-vegetables-meat-combination-Asda>.
- Food and Agriculture Organization of the United Nations (2013) Food Wastage Footprint Impacts on Natural Resources: Technical Report. Available at: <http://www.fao.org/3/i3347e/i3347e.pdf>.
- Food and Agriculture Organization of the United Nations (2019) Global Livestock Environmental Assessment Model (GLEAM) 2.0 - Assessment of greenhouse gas emissions and mitigation potential: Results. Available at: <http://www.fao.org/gleam/results/en/>.

- Fox, Patrick. F; McSweeney, Paul. L.H.; Cogan, T. M. (2000) Fundamentals of Cheese Science. Springer Science & Business Media. Available at: [https://books.google.co.uk/books?id=-oRp5VCVTQQC&pg=PA171&lpg=PA171&dq=typical+cheese+yield&source=bl&ots=P1t1Azk8iw&sig=ACfU3U1JdU8spjK4A23RrF\\_7opSy-xOXg&hl=en&sa=X&ved=2ahUKEwjii\\_nwiLLiAhXCUhUIHQxeB8o4ChDoATAGegQICRAB#v=onepage&q=typical cheese yield&f=false](https://books.google.co.uk/books?id=-oRp5VCVTQQC&pg=PA171&lpg=PA171&dq=typical+cheese+yield&source=bl&ots=P1t1Azk8iw&sig=ACfU3U1JdU8spjK4A23RrF_7opSy-xOXg&hl=en&sa=X&ved=2ahUKEwjii_nwiLLiAhXCUhUIHQxeB8o4ChDoATAGegQICRAB#v=onepage&q=typical%20cheese%20yield&f=false).
- Gervis, Z. (2018) 'One third of Americans consider themselves "flexitarian"', New York Post, 26 October. Available at: <https://nypost.com/2018/10/26/one-third-of-americans-consider-themselves-flexitarian/>.
- Greater London Authority (2018) Mayor confirms ban on junk food advertising on transport network. Available at: <https://www.london.gov.uk/press-releases/mayoral/ban-on-junk-food-advertising-on-transport-network-0> (Accessed: 25 February 2019).
- Greenpeace (2018) Less is More: Reducing Meat and Dairy for a Healthier Life and Planet. Available at: <https://www.greenpeace.org/international/publication/15093/less-is-more/>.
- ICA (2019) Recept: Klimatsmart. Available at: <https://www.ica.se/recept/klimatsmart/> (Accessed: 25 February 2019).
- OECD Data (2018) Meat consumption data. Available at: <https://data.oecd.org/agroutput/meat-consumption.htm>.
- Peters, A. (2017) 'Google's Quest To Develop A Plant-Based "Power Dish" More Popular Than Meat', Fast Company, July. Available at: <https://www.fastcompany.com/40443479/googles-quest-to-develop-a-plant-based-power-dish-more-popular-than-meat>.
- Smithers, R. (2018) 'Third of Britons have stopped or reduced eating meat - report', The Guardian, 1 November. Available at: <https://www.theguardian.com/business/2018/nov/01/third-of-britons-have-stopped-or-reduced-meat-eating-vegan-vegetarian-report>.
- Springmann, M. et al. (2018) 'Options for keeping the food system within environmental limits', Nature, 562(7728), pp. 519–525. doi: 10.1038/s41586-018-0594-0.
- Stockholms stad (2019) Det smarta köket ('The smart kitchen'). Available at: <https://www.stockholm.se/ByggBo/Leva-Miljovanligt/Det-smarta-koket/> (Accessed: 25 February 2019).
- Tara, H. G. et al. (2017) Grazed and confused? Summary. Available at: [https://www.fcrn.org.uk/sites/default/files/project-files/fcrn\\_gnc\\_report.pdf](https://www.fcrn.org.uk/sites/default/files/project-files/fcrn_gnc_report.pdf).
- The Meat Free Monday Foundation (2019) Meat Free Mondays. Available at: <https://www.meatfreemondays.com/about/> (Accessed: 25 February 2019).
- The Times (2018) 'Waitrose vegan section is Britain's first', 7 June. Available at: <https://www.thetimes.co.uk/article/waitrose-vegan-section-is-britains-first-3c6mwr86g>.
- Turner, D. A., Williams, I. D. and Kemp, S. (2015) 'Greenhouse gas emission factors for recycling of source-segregated waste materials', Resources, Conservation and Recycling. Elsevier, 105, pp. 186–197. doi: 10.1016/J.RESCONREC.2015.10.026.



- 
- Tyler, J. (2018) 'IKEA has a new vegan hot dog that's taking off with customers — here's what it tastes like', Business Insider, October. Available at: <https://www.businessinsider.com/ikea-follows-costco-vegan-food-court-menu-item-2018-10?r=US&IR=T>.
  - United Nations (no date) Sustainable Development Goals: Goal 12: Ensure sustainable consumption and production patterns. Available at: <https://www.un.org/sustainabledevelopment/sustainable-consumption-production> (Accessed: 27 February 2019).
  - United States Department of Agriculture (2017) Household Food Security in the United States in 2017. Available at: <https://www.ers.usda.gov/publications/pub-details/?pubid=90022> (Accessed: 27 February 2019).
  - US National Library of Medicine (2019) 'Lactose Intolerance'. Available at: <https://ghr.nlm.nih.gov/condition/lactose-intolerance#statistics>.
  - Veganuary (2018) Vegan people: sports. Available at: [https://veganuary.com/people\\_categories/sports-people/](https://veganuary.com/people_categories/sports-people/) (Accessed: 25 February 2019).
  - Waste & Resources Action Programme (WRAP) (2013) Courtauld Commitment 2: Signatory Case Studies. Available at: [http://www.wrap.org.uk/sites/files/wrap/CC2 case studies - Dec 2013.pdf](http://www.wrap.org.uk/sites/files/wrap/CC2_case_studies_-_Dec_2013.pdf).
  - Wolfson, S. (2018) 'WeWork will no longer serve meat at events or expense meals with it', The Guardian, 18 July. Available at: <https://www.theguardian.com/environment/2018/jul/13/wework-meat-events-expense-ban>.
  - World Health Organisation (2003) Controlling the global obesity epidemic. Available at: <https://www.who.int/nutrition/topics/obesity/en/> (Accessed: 27 February 2019).
- 

*June 2019 ©C40 Cities, Arup & University of Leeds.*

This report has been co-created and co-delivered by C40, Arup and University of Leeds with funding from Arup, University of Leeds and Citi Foundation.

Design by Datcha

Images

©getty/123ducu, ©getty/ake1150sb, ©getty/ansonmiao, ©getty/aoldman, ©getty/CostinT, ©getty/fotofermer, ©getty/frytka, ©getty/lifede, ©getty/littleny, ©getty/Krafla, ©getty/Michael Kulmar, ©getty/PPAMPicture, ©getty/serts, ©getty/Mikhail Strogalev