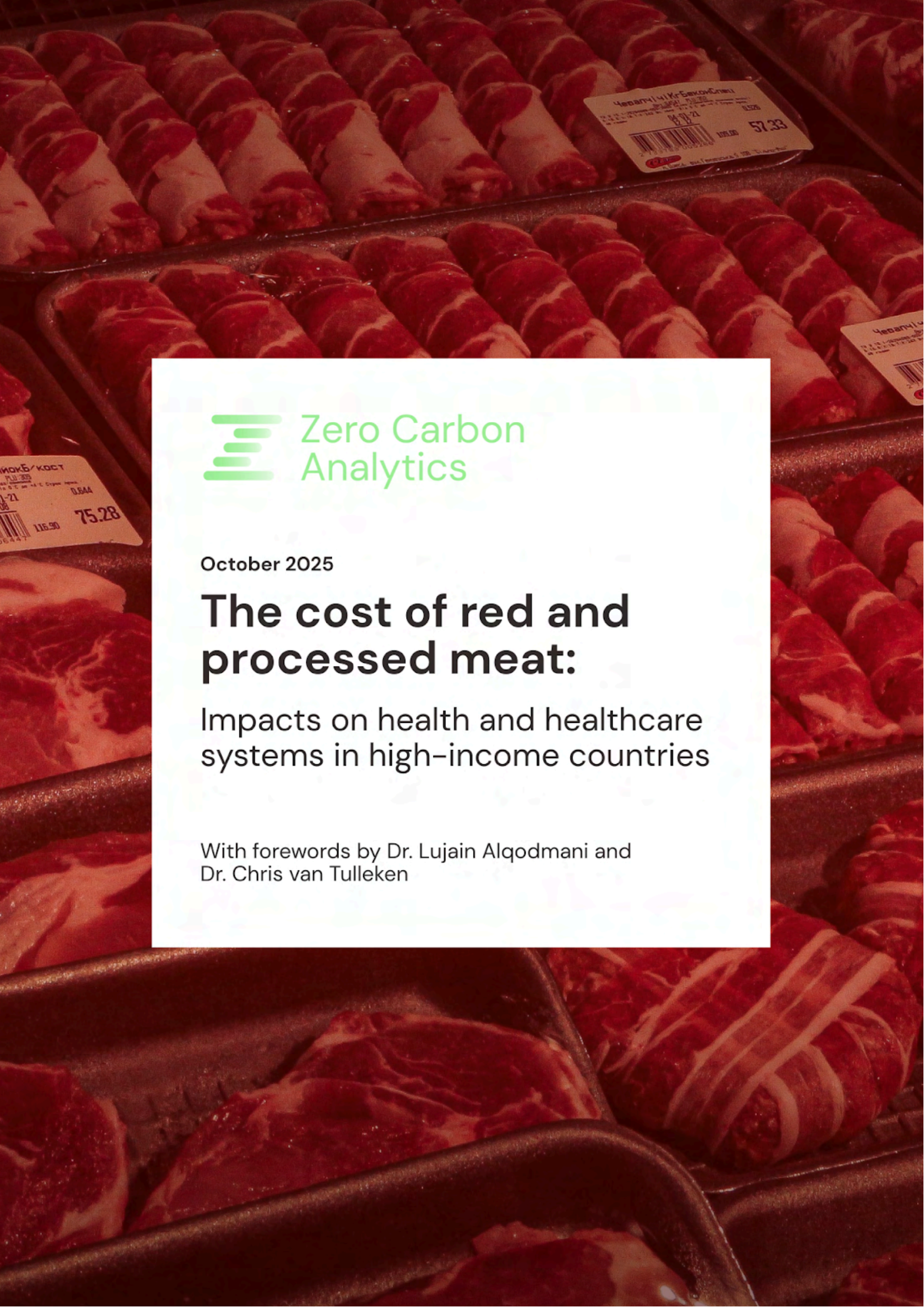

Zero Carbon Analytics

October 2025

The cost of red and processed meat:

Impacts on health and healthcare systems in high-income countries

With forewords by Dr. Lujain Alqodmani and Dr. Chris van Tulleken

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Forewords

From Dr Lujain Alqodmani

Health Professional Networks Lead at Health Care Without Harm

As healthcare professionals we are driven by a single mission, to save lives and improve the health of people. Over the years, we have seen fierce debate and meaningful policy change on threats to human health such as tobacco, alcohol, sugar and salt. Yet meat consumption has remained unchecked, despite red meat alone causing 334,000 deaths and accounting for 9.63 million years of healthy life lost in 2021.

This is a health crisis sweeping across high-consuming and high-income countries. Europe accounts for 14 of the 20 nations with the highest years of life lost to red meat. Nine of these are in Eastern Europe, where diets high in meat are driving alarming rates of premature death and preventable illness.

This report should be the wake-up call that health professionals cannot ignore. It sets out the grave consequences and economic costs of overconsumption. Processed meat fuels a preventable disease burden dominated by diabetes and kidney disease. Red meat is a major driver of cancer. When you look at the overall health picture, between 2010 and 2021, the global health burden linked to red meat nearly doubled, rising by about 44%.

The economic cost is just as shocking. In the United States, cutting red meat intake by one-third could save USD 12.5 billion every year. Germany could save up to USD 1.9 billion. France could save just over USD 1 billion. The United Kingdom could save USD 902 million. These are not abstract figures. They represent nurses, medicines and hospital beds that could be freed up when health systems are already stretched to breaking point.

It has been my life's work to champion healthy diets for all that protect both people and the planet. Historically, the call to cut red meat is framed mainly as an environmental issue. While that is true, and intrinsically linked to human health, we cannot ignore the

direct damage that meat overconsumption is causing to our bodies and to the healthcare systems already stretched to their limits.

This research must be a turning point. It shows clearly why we need stronger oversight of an industry that has gone unchecked for far too long. We need policies that make healthy choices easier and promote diets rich in fruits, vegetables and wholegrains as the norm, not the exception. With global meat consumption still on the rise, this is not an attack on meat itself. It is a call to rein in dangerous overconsumption before it exacts an even greater toll on our health, our health services and our planet.

Dr Lujain Alqodmani

From Dr Chris Van Tulleken

Professor of Global Health and Infection, UCL

Our diets are broken, or rather they have been broken, ironically by the very industry that feeds us, an industry which leverages financial power and political influence to resist all efforts to create healthy, equitable food environments. And so, poor diet is now the leading cause of early death globally, a source of terrible suffering for children and adults, and an unsustainable stress on already fragile healthcare systems.

Processed meat is a huge part of this problem.

Controversies abound in nutrition science, and yet there is near consensus that processed meat is one of the most harmful food groups for both human and planetary health.

The health consequences are undeniable. Processed meat consumption is linked to increased risks of many diseases, but especially type 2 diabetes, cardiovascular disease and cancer. The World Health Organization classifies processed meat as carcinogenic to humans. Despite this, consumption has risen by more than 150% per person since 1990.

In 2021, processed meat was linked to 295,000 deaths and the loss of 10.4 million years of healthy life worldwide due to preventable disease. Eating just 50 grams a day, or the equivalent of an average hot dog, raises the risk of colorectal cancer by 26% and diabetes by 30%. Experts state there is no safe level of consumption.

And yet, to date, the power of the industrial meat industry has gone largely unchecked. Lobbying and misleading marketing have enabled companies to have a dangerous influence on national dietary guidelines and what ends up on our plates. The result is rising disease, spiralling healthcare costs, and a preventable burden on society.

Public health has been here before. Tobacco, alcohol, salt and sugar all required regulatory action once the evidence was clear. Processed meat belongs in the same category. Fiscal measures, marketing restrictions and clearer labelling are proven tools that governments can and must deploy.

High-income countries pay a high economic and social cost for processed meat consumption, using precious funds that are needed elsewhere. As meat consumption rises globally, middle- and lower-income countries face health costs that will be utterly unmanageable.

The good news is that manageable dietary changes, aligned with existing health guidelines, would deliver significant benefits. This research is crystal clear that prevention is better than treatment. Not only for those who would avoid years of illness and premature death, but also for health budgets that are already under immense strain.

At the moment, public money is being used to pay the externalised costs of processed meat giants. This is a crisis which is morally, socially and economically intolerable. The solutions are as clear as the problem, but will require immense political courage and public support to bring about.

Chris Van Tulleken

Dr Chris Van Tulleken

Summary

The cost of consuming red and processed meat

A wealth of evidence directly links the consumption of red and processed meat to an increased risk of chronic diseases, including type II diabetes, cardiovascular disease and cancer. In 2021 alone, processed meat consumption was responsible for 295,000 deaths and 10.4 million years of healthy life lost globally, while red meat caused 334,000 deaths and 9.63 million years of healthy life lost.

Yet despite the well-established risks to our health, global meat consumption has risen steadily, with people eating nearly 20% more meat in 2022 than in 2002. The populations of wealthier nations eat more meat per person on average, though middle-income countries are anticipated to drive increased meat demand in the near future.

In addition to loss of life and years of well-being, the preventable disease burden caused by eating meat represents a significant economic strain on societies. The estimated health-related costs of consuming red and processed meat hit USD 285 billion globally in 2020. This demand on national healthcare budgets comes at a time of a global economic slowdown: declines in government health spending have been reported across all country income groups.

What ZCA found

Against this landscape, ZCA undertook a fresh analysis of the latest and most comprehensive data from the Global Burden of Disease study to estimate where reduced red and processed meat consumption could yield the greatest health and economic returns. To do this, we:

- Identified which countries are spending the most per year of healthy life lost from high consumption of red and processed meat. These represent high-priority candidates for shifting to a preventative healthcare approach.
- Assessed how preventable diseases caused by consuming red and processed meat are straining countries' healthcare resources.
- Quantified the trade-offs. The findings suggest how much funding could be redirected to other health challenges by refocusing resources on upstream dietary interventions.

Wealthy countries suffer the greatest disease burden

Using disability-adjusted life years (DALYs) – a standard global metric that sums years of life lost to premature death and years lived with disability to quantify disease burden from risk factors such as diet – ZCA's analysis found that countries with high meat consumption, concentrated in Europe, North America, Oceania and parts of Asia, carry a disproportionate share of the global disease burden from red and processed meat. Across all countries, higher GDP per capita is associated with greater meat-attributable DALYs.

ZCA found that the highest disease burden from processed meat-rich diets is concentrated in Europe and North America, which together dominate the top rankings by premature deaths and years lived with chronic, disabling conditions. By contrast, the highest red-meat burden is more geographically dispersed across Europe, North America, Asia and Oceania.

For countries with high disease burden rates, ZCA compared per-capita health spending with disease burden from red and processed meat – giving us the average healthcare spend per year of healthy life lost – to identify where dietary prevention would yield the biggest returns. European countries, as well as the US, Canada, Australia, Japan and Singapore, are candidates for prevention strategies that could reduce disease burden and free up healthcare resources.

Big spenders

ZCA also found that some high-income countries, such as Switzerland, Germany, Norway, Japan and Australia, achieve better health outcomes than expected, considering their high levels of red and processed meat consumption. ZCA estimated that this advantage comes at a substantial cost: Switzerland, for instance, may be spending up to USD 99,000 to avert one DALY from processed meat.

These countries may be spending heavily on treating and managing preventable diseases, rather than investing in preventative measures, such as dietary change. This indicates a critical trade-off whereby, at great cost, robust health systems can moderate, but cannot eliminate, this preventable disease burden.

What's next?

ZCA's analysis found that shifting focus from treatment to prevention would offer a more cost-effective solution. Fiscal and social policies, like those successfully applied

to sugar and salt, provide a proven model for this shift. For example, a 30% reduction in the disease burden from processed meat in the US could save USD 21 billion annually, which is equivalent to funding the salaries of 247,000 nurses. Similarly, in Germany, the same reduction could save USD 2.2 billion annually, enough to fund almost 36,500 nurses.

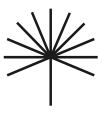
Reducing the amount of red and processed meat in our diets is the most reliable way to curb the disease burden caused by meat consumption. This could, in turn, allow a redirection of healthcare spending from treatment to prevention that would yield significant human health and fiscal returns. Strong precedents further highlight the cost-effectiveness of a focus on prevention over treatment: in the US, a salt reduction policy was estimated to cost USD 332 per DALY averted, while treatment with statins cost USD 37,000 per DALY averted.

This health-focused report is the first in a series of Zero Carbon Analytics (ZCA) research papers exploring the economic, environmental and social costs of the modern livestock industry. Future reports will focus on emissions, water use, and water and air pollution. Sign up for our newsletter to receive updates on ZCA research and analysis.

Key points

- Global meat consumption has risen steadily despite increasingly well-established evidence of chronic health risks, with people eating almost 20% more meat in 2022 than in 2002.
- A new ZCA assessment found that wealthy countries in Asia, Europe, North America and Oceania consume high amounts of red and processed meat and face a substantial disease burden as a result, despite having well-resourced healthcare systems. European countries in particular are facing significant premature mortality and years of life spent with chronic, disabling conditions, particularly from processed meat.
- These countries present strong opportunities for introducing primary prevention - such as reduced meat consumption – to decrease the disease burden and save costs related to disease treatment and management.
- Some countries in Europe (Denmark, Germany, Norway, Switzerland and others), Oceania (Australia and New Zealand) and Asia (Japan, Singapore and South Korea) achieve better health outcomes despite similar or higher meat consumption than their peers. However, this superior performance comes at a substantial cost: these countries spend up to USD 99,000 per healthy year of life preserved through their healthcare systems.
- Prioritising prevention by reducing red and processed meat consumption could achieve comparable or better health outcomes at far lower cost, freeing resources for other health priorities. Fiscal policies such as those successfully applied to sugar or salt (e.g. taxes, marketing restrictions) offer proven models for this shift.
- In all these high-income, high-consumption countries, preventative dietary interventions could limit the healthcare impacts of red and processed meat, generating resources that could be redirected to other healthcare priorities. For example:
    - Reducing the disease burden caused by processed meat by 30% could free up USD 21 billion annually in healthcare spending in the US, USD 2.2 billion in Germany, USD 1.4 billion in the UK and just under USD 1 billion in France.
    - This is enough to cover the annual salaries of over 247,000 nurses in the US, 31,000 nurses in the UK, 36,500 nurses in Germany and 21,000 nurses in France.

- Even modest dietary change could reduce the disease burden of processed meat. For the UK, we estimate that a 30% reduction in the disease burden from processed meat is roughly equal to two fewer sausages per person per week. A 2024 study of the US estimates that if adults ate six fewer rashers of bacon a week, there would be 350,000 fewer cases of type 2 diabetes, 92,500 fewer instances of cardiovascular disease, and over 53,000 fewer occurrences of colorectal cancer over a 10-year period.



1. Global context

Meat consumption and human health

Chronic diseases[1] including cancer, diabetes, chronic respiratory diseases and cardiovascular diseases are our greatest global health challenge, responsible for 74% of all deaths worldwide. Yet up to 15 million premature deaths and many years of illness could be prevented by dietary changes.[2]

A growing body of scientific evidence shows that the consumption of red and processed meat is significantly linked to increased risk of disease, particularly type II diabetes, cardiovascular disease and cancer. The World Health Organization's (WHO) International Agency for Research on Cancer (IARC) ranks substances by the strength of the evidence linking them to cancer; it places processed meat in Group 1 ('carcinogenic to humans'), and red meat in Group 2A ('probably carcinogenic to humans').

Systematic reviews – the gold standard of evidence synthesis – have confirmed that processed meat, even in small amounts, poses a substantial health risk: consuming just 50g more processed meat per day, or the equivalent of an average hot dog, raises the risk of gastric cancer by 72%. A 2025 analysis using a stringent 'Burden of Proof' methodology[3] found that consuming just 50g of processed meat a day is linked to a 30% increase in the risk of type II diabetes and a 26% increase in the risk of colorectal cancer. The authors warn that their analysis suggests that there is no 'safe' level of processed meat consumption with respect to these chronic conditions.

A growing pattern of consumption

However, despite well-established health risks, meat consumption has steadily increased globally over the last half-century, with people eating almost 20% more meat in 2022 compared to 2002. The global per-head consumption of both red meat and processed meat (such as sausages, bacon and deli meats) increased significantly between 1990 and 2018, by 88.1% and 152.8%, respectively. In the same period, people ate, on average, 0.5 to 1.2 more servings of meat per week.

[1] Also referred to as noncommunicable diseases (NCDs)
[2] If the Planetary Health Diet (PHD), also known as the EAT-Lancet reference diet, is followed.
[3] The Burden of Proof method grades health risks on a 1-5 star scale, checking if studies agree and correcting for errors or bias in the research.

The populations of wealthier nations eat more meat per person on average, and middle-income countries are projected to largely drive a 2% increase in global demand over the next decade.

Meat consumption and healthcare systems

In addition to human suffering and loss caused by consuming red and processed meat, the preventable disease burden[4] takes a substantial economic toll on societies worldwide. Globally, the health-related costs of red and processed meat consumption were estimated to have reached USD 285 billion in 2020, based on direct medical costs (such as hospital care and medications) and indirect costs (such as loss of productivity and informal care).

These costs come at a time of a global economic slowdown: in 2025, worldwide growth is projected to wane to just 2.3%. The World Bank estimates that average global growth in the 2020s will be at the weakest pace for any decade since the 1960s. With declines in government health spending recently reported across all country income groups, Zero Carbon Analytics (ZCA) assessed the available data to:

- Identify high-priority countries for preventative healthcare – those which are spending a lot to treat the disease burden from red and processed meat consumption (measured in lives cut short and years lived with disability)
- Estimate the potential healthcare savings if nations shifted investment from treatment of the disease burden to upstream dietary interventions.

[4] A consideration of 'disease burden' covers the full impact of a health issue on a population, including overall effect of illness, disability and death; it is often measured using 'disability-adjusted life years' (DALYs) - see Box 1 for definition.

2. The disease burden of consuming red and processed meat

The Global Burden of Disease (GBD) study is the largest global health study based on real-world data. The GBD estimated that, in 2021 alone, suboptimal diets – such as those characterised by eating too many highly processed, salty or sweetened foods or too few whole-grains, fibre, fruits and vegetables[5] – were responsible for 178 million disability-adjusted life years (DALYs, see Box 1) and 7.22 million deaths among adults over the age of 25. Poor diets were also linked to a 17.9% increase in the number of DALYs between 2010 and 2021.

Box 1. Measuring the burden of disease

'Disability-adjusted life years' (DALYs) were collaboratively developed by WHO, the World Bank and Harvard School of Public Health as a measure to compare the burden of disease across countries. One DALY represents one lost year of healthy life, whether due to premature death or years lived with disease or disability. DALYs can be broken down into:

- 'Years of life lost' (YLLs) – which represents the years of life lost due to premature death
- 'Years lived with disability' (YLDs) – which represents the years lived in less than optimal health due to disease or disability.

These metrics can be used to prioritise health interventions based on their potential to reduce overall disease burden.

The consumption of red and processed meat is among the dietary risk factors considered by the GBD study's exacting methodology,[6] which accounts for variation in

[5] Suboptimal diets are defined by the aggregation of all GBD-defined dietary 'risk factors', including low intakes of whole grains, fruit, fibre, legumes, nuts and seeds, seafood omega-3 fatty acids, omega-6 polyunsaturated fatty acids, vegetables, milk and calcium; and high intakes of sodium, trans fatty acids, red meat, processed meat and sugar-sweetened beverages, which are causally associated with an increased probability of disease.

[6] The 2021 GBD study uses rigorous systematic reviews and Burden of Proof methodology, using advanced statistical methods to combine data from over 54,000 sources, estimating health risks such as those from red and processed meat consumption. It calculates how much disease could be avoided if exposure to risks were reduced to optimal levels, while automatically adjusting for differences in study quality and confounding factors (e.g. age, smoking and socio-economic status). Although observational data alone can't prove causation, the GBD strengthens its estimates by using systematic reviews of the

non-diet risks (such as air pollution and healthcare access). Reporting on the year 2021, the data shows that:

- Processed meat (such as bacon, sausages and deli meats) caused 295,000 deaths globally and 10.4 million years of healthy life lost
- Red meat (such as beef, lamb and pork) caused 334,000 deaths and 9.63 million years of healthy life lost.

Both types of meat have negative effects on health. For processed meat, diabetes and kidney diseases dominate the disease burden, followed by cardiovascular diseases and cancers; for red meat, cancers are the largest element of the disease burden, with diabetes and kidney diseases contributing less. Red meat shows negative DALYs for cardiovascular diseases, as the risk of heart disease is balanced out by some protection against strokes. The global net health impact of both types of meat increased substantially between 2010 and 2021, according to the GBD study, with processed meat DALYs rising 17.5% and red meat DALYs almost doubling, to 44.4%.

Like drinking alcohol, smoking and other lifestyle risks, eating red and processed meat increases the likelihood of preventable disease that can be moderated by a mix of behavioural change measures, such as diets which substitute meat with high-quality plant protein, and policy interventions, such as risk-aware marketing and labelling. Prioritising policies aimed at preventing common chronic diseases is essential to easing the burden on overstretched healthcare systems.

Mapping the disease burden

ZCA's assessment of GBD data looked at how the disease burden from red and processed meat presents across different country income levels.[7] A clear pattern emerged: higher GDP per capita tends to mean a higher disease burden from red and processed meat. High-income countries[8] with the greatest meat-attributable disease burden in Asia, North America, Europe and Oceania are therefore the priority targets that we focus on in this analysis for preventative dietary interventions (see Figure 1).

best available evidence and accounting for uncertainty. Separately, the Burden of Proof method evaluates the strength of this evidence on a 1-5 star scale, providing an additional check on how reliable the risk estimates are. Together, these approaches give policymakers robust evidence about which dietary risks require action.

[7] By assessing if GDP per capita is correlated with diet-related disease burden.

[8] High-income (or wealthy) countries are defined according to World Bank income levels for 2021.

Fig. 1

A closer analysis of the top 20 countries with the highest total per-capita red and processed meat disease burden[9] looked at whether this was driven by non-fatal illness (measured by years lived with disability, or YLD) or premature death (years of life lost, or YLL). High YLDs suggest that people are living with chronic, disabling conditions, while high YLLs suggest that diseases are proving fatal.[10]

Globally, Europe accounts for 14 of the top 20 countries with the most YLLs due to red meat consumption; nine of these are in Eastern Europe (see Figure 2a). In those countries, red meat consumption is driving substantially greater premature mortality.

The countries with the highest number of years lived with disability (YLDs) attributable to consuming red meat are slightly more geographically dispersed, with nine of the top 20 countries located in Europe and the remainder spread across North America,

[9] We used total DALYs to quantify the absolute global burden of diet-related diseases, as this reflects the real-world impact on populations. A country with more elderly residents will naturally have higher total DALYs.

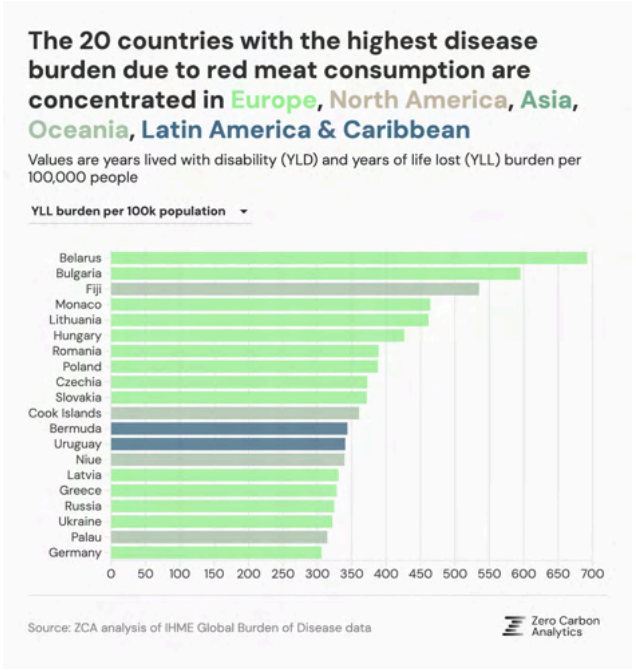
[10] Figures for red and processed meat are presented separately and should not be summed because some disease cases overlap.

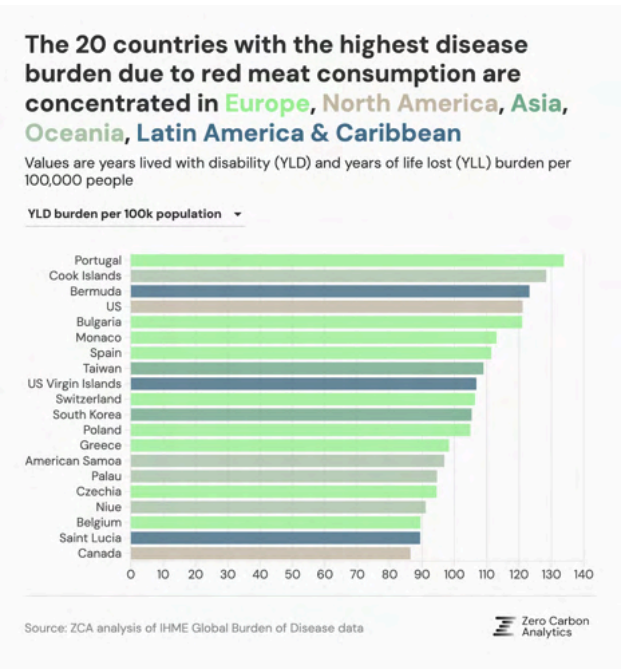
Oceania and Asia (see Figure 2b). In these countries, red meat consumption is driving up the number of people living with chronic illness.

The premature mortality burden of consuming processed meat is even more concentrated in Europe: 18 of the top 20 countries for YLLs attributable to processed meat are European, joined by the US and Greenland[11] (see Figure 3a).

The non-fatal YLD burden for processed meat is also predominantly European, accounting for 16 of the top 20 countries (see Figure 3b). Non-European countries in the top 20 are the US (which has the highest YLD burden), Japan, South Korea and Canada.[12]

Figs. 2a-b

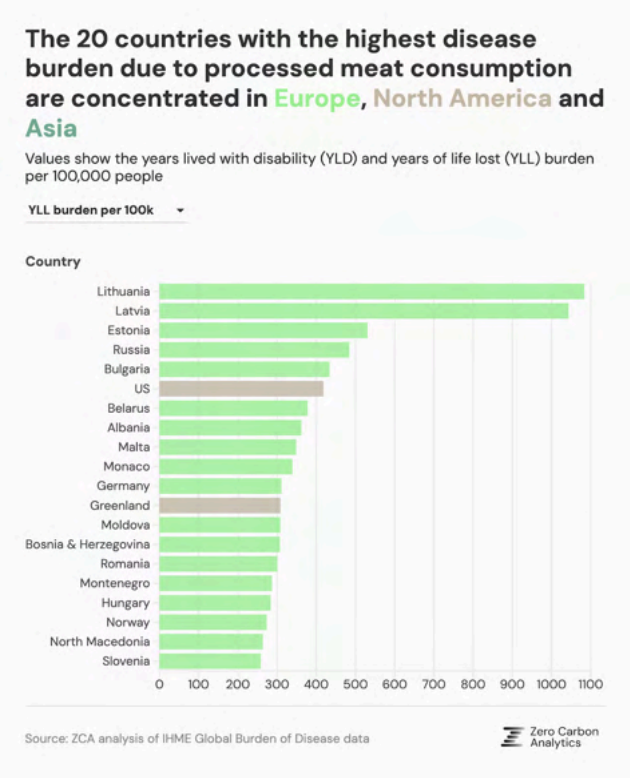


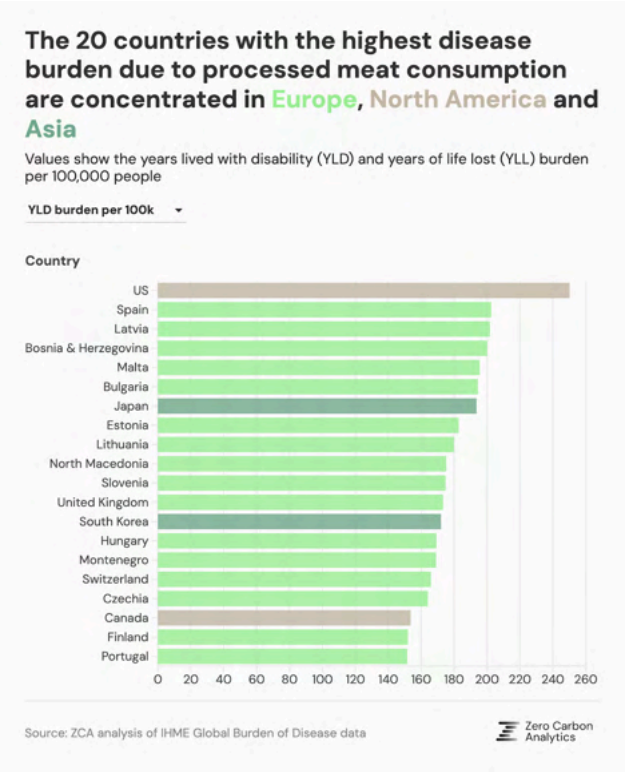


[11] Geographically in North America. Consistent with the GBD database, we use UN regional classifications for country assignments.

[12] We acknowledge that disease burden values are national averages and may therefore mask important within-country differences.

Figs. 3a-b


The 20 countries with the highest disease burden due to processed meat consumption are concentrated in Europe, North America and Asia
Values show the years lived with disability (YLD) and years of life lost (YLL) burden per 100,000 people
YLL burden per 100k
Country
Lithuania
Latvia
Estonia
Russia
Bulgaria
US
Belarus
Albania
Malta
Monaco
Germany
Greenland
Moldova
Bosnia & Herzegovina
Romania
Montenegro
Hungary
Norway
North Macedonia
Slovenia
0 100 200 300 400 500 600 700 800 900 1000 1100
Source: ZCA analysis of IHME Global Burden of Disease data
Zero Carbon Analytics


The 20 countries with the highest disease burden due to processed meat consumption are concentrated in Europe, North America and Asia
Values show the years lived with disability (YLD) and years of life lost (YLL) burden per 100,000 people
YLD burden per 100k
Country
US
Spain
Latvia
Bosnia & Herzegovina
Malta
Bulgaria
Japan
Estonia
Lithuania
North Macedonia
Slovenia
United Kingdom
South Korea
Hungary
Montenegro
Switzerland
Czechia
Canada
Finland
Portugal
0 20 40 60 80 100 120 140 160 180 200 220 240 260
Source: ZCA analysis of IHME Global Burden of Disease data
Zero Carbon Analytics

3. Reducing meat consumption as a strategic public health investment

Identifying high-priority targets for dietary intervention

Beyond identifying countries with a substantial disease burden caused by the consumption of red and processed meat, effective intervention strategies require that we understand which national healthcare systems are investing the greatest resources in the treatment and management of preventable conditions.

To pinpoint the countries where dietary prevention could yield the greatest economic and health returns, we compared per-capita health expenditure against disability-adjusted life years (DALYs) per 100,000 people[13] from consuming red and processed meat. To enable fair comparison across countries, we calculated the 'dollar per DALY', or in simple terms, the average healthcare spend per year of healthy life lost to disability or premature death.[14]

Unlike comparisons of absolute spending figures, which would simply identify wealthy healthcare systems, the 'dollar per DALY' is a relative measure which reveals those countries that are spending heavily **per unit** of disease caused by meat consumption.[15] A high number indicates countries that are **incurring large healthcare costs relative to the disease burden**, and so stand to save the most from upstream dietary measures that help prevent disease.[16]

Countries with the highest dollar per DALY values for red meat are again clustered in Europe, which accounts for 14 of the top 20 (see Figure 4a). Switzerland tops the list,

[13] Age-standardised DALYs account for demographic effects by statistically weighting all populations to have the same age structure, thereby removing the 'background noise' of natural age-related disease. When using DALYs in the context of health expenditure analysis, we use age-standardised rates to reveal whether diet-related disease outcomes are better or worse than expected given a country's population's age structure. This allows us to isolate the impact of healthcare quality and prevention programmes from inherent ageing effects.

[14] Calculated by dividing each country's health expenditure per capita by its disease burden attributable to red and processed meat consumption (age-standardised DALYs per 100,000 people).

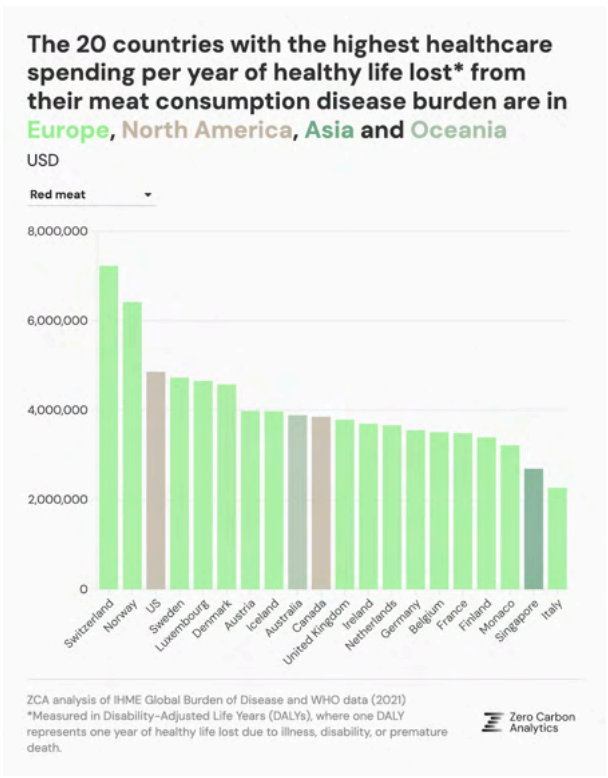
[15] We filtered for countries with substantial disease burden (above the median DALY rate for each meat type) and then calculated the dollar per DALY. By filtering for substantial disease burden first, we ensured our dollar-per-DALY calculations identified countries with both significant health problems AND high healthcare spending – the combination needed for prevention strategies to yield substantial health and economic returns.

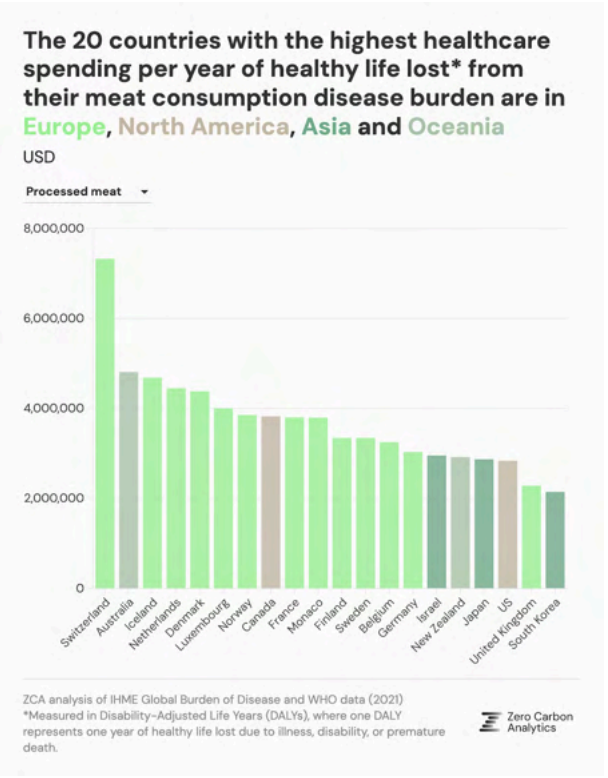
[16] We are using total health expenditure per capita, not spending specifically on diseases caused by consuming red and processed meat. The implicit assumption is that countries spending more overall are also spending proportionally more on these diseases.

followed by Norway and the US; from there, European countries dominate, with Australia, Canada and Singapore being the only other non-European outliers. We found that similar countries have the highest dollar per DALY values for processed meat (see Figure 4b), with Switzerland again leading a Europe-dominated list.

All of the countries shown in Figures 4a and 4b are strong candidates for dietary prevention strategies that could simultaneously reduce the disease burden and free up stretched healthcare resources.

Figs. 4a-b





The cost of countering the disease burden of meat consumption

Next, we looked at which of the countries identified as a potential intervention target are achieving better health outcomes than expected, despite their populations having similar levels of dietary risk from eating meat.[17]

A number of European countries, plus Australia, New Zealand and South Korea, showed better-than-expected health outcomes with respect to their red meat consumption. Several European countries, Australia and Singapore showed better health outcomes with respect to processed meat consumption.

The outcomes achieved by these 'outliers' could have several explanations, including population genetics, lifestyle factors or differences in food quality. However, the consistent pattern we found across diverse high-income nations – from Switzerland to Singapore – suggests that systemic advantages account for at least part of the reason for better health outcomes. These advantages include robust healthcare systems capable of mitigating (but not eliminating) dietary risks.

However, the better-than-expected health outcomes come at a significant opportunity cost: these countries may be **spending heavily to manage preventable disease, rather than investing in prevention to avoid it altogether** (see Figures 5a and b).

To quantify the potential cost of this 'treatment-over-prevention' approach (see Box 2), we estimated how much these outlier countries spend per unit of disease burden from meat consumption – i.e. per year of healthy life lost that they avoid through healthcare investment.[18]

[17] That is, despite eating similar amounts of meat at levels considered to be risky by the GBD study methodology. To do this, we used the summary exposure value (SEV), which measures population-level exposure to dietary risk on a 0-100% scale, accounting for both average consumption levels and the distribution of high-risk consumption patterns within populations: in other words, a high SEV indicates both high overall meat consumption and widespread consumption of meat at levels that pose health risks across the population. If two countries have the same SEV, they have similar levels of risky meat consumption patterns across their populations. Therefore, when countries with the same SEV have different DALY burdens, the country with higher DALYs is experiencing worse health outcomes from the same level of meat exposure risk. This regression analysis follows established methods for linking SEV to health outcomes, such as in studies of population-level risk factors.

[18] We estimated healthcare spending per avoided DALY by: (1) calculating the proportion of total disease burden from meat consumption, (2) applying this proportion to total healthcare expenditure per capita to estimate healthcare spending on the disease burden caused by meat consumption, and (3) dividing by avoided DALYs per capita (regression residuals). Least-squares regression estimates how much disease burden would be expected at each exposure level across all countries. Countries with negative residuals have fewer DALYs than expected, suggesting better health outcomes than average. We found

Box 2. Identifying the 'treatment-over-prevention' effect

We asked: *What does it cost a country to maintain better-than-expected health outcomes than its meat consumption would lead us to expect?*

Step 1. Benchmark the disease burden

- We compared meat consumption patterns against health outcomes (DALYs) across all countries
- Using regression analysis,* we found the typical relationship between these two variables
- This gave us a benchmark: for a given level of meat consumption, what disease burden would typically be expected?

Step 2: Identify overperforming countries

- We identified those countries with far fewer diet-related diseases than their meat consumption predicts by comparing their actual DALYs to the expected DALYs
- These countries 'beat the disease burden odds' given their meat intake
- We asked: What does it cost to offset this specific dietary risk?

Step 3: Quantify the economic tradeoff

- We calculated the 'spend per avoided DALY' for the countries that beat the disease burden odds
- This gave us the healthcare dollars needed to avert one year of healthy life lost – a reflection of the economic burden to maintain better-than-expected health outcomes
- Countries with high 'spend per avoided DALY' represent opportunities for preventive interventions to achieve similar health outcomes more cost-effectively.

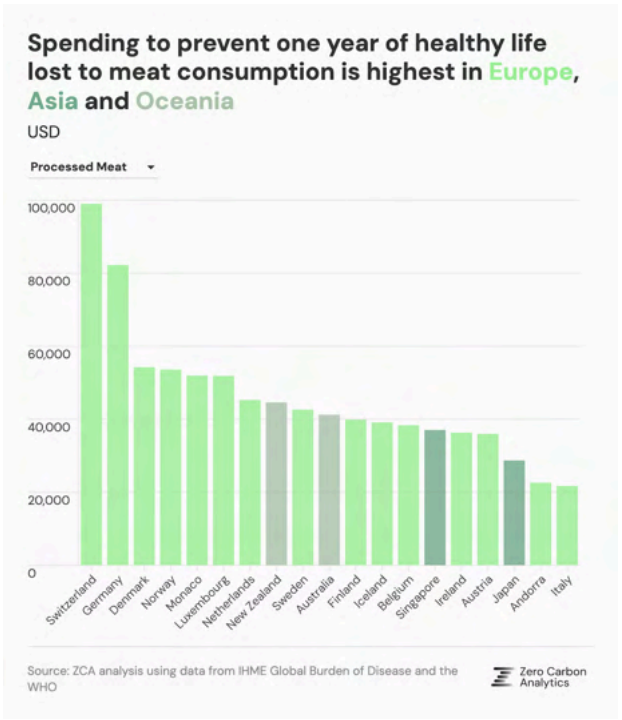
*Regression analysis finds the typical relationship between two things. Here, it tells us the expected disease burden for each level of meat consumption, allowing us to spot which countries do better or worse than the norm.

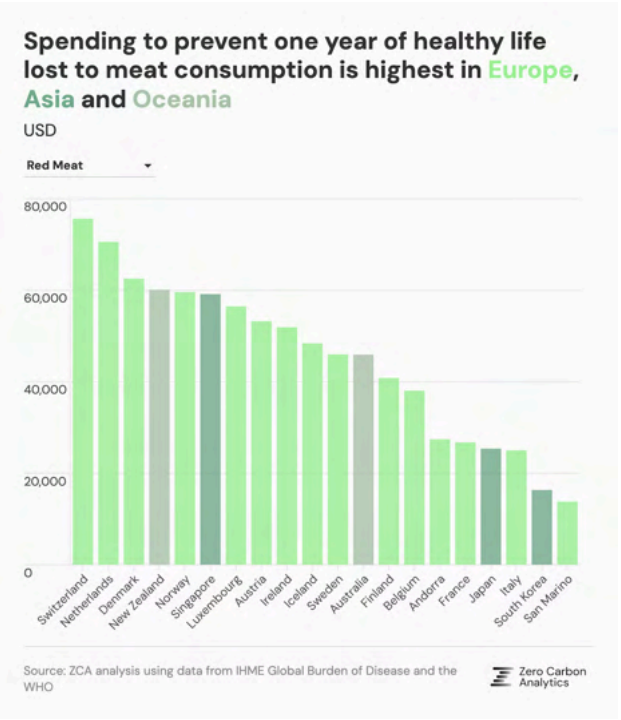
positive associations between exposure to red and processed meat and age-standardised disease burden (DALYs per 100,000). For red meat, the regression model indicated that each one-point increase in SEV was associated with a 4.4 increase in DALYs ($\beta = 4.40$, $p < 0.001$, $R^2 = 0.39$). For processed meat, the association was stronger, with each additional SEV point linked to a 4.6 increase in DALYs ($\beta = 4.60$, $p < 0.001$, $R^2 = 0.50$). Finally, we identified the 30% of countries with the most negative residuals as over-performers, indicating better-than-expected health outcomes potentially due to stronger healthcare systems.

This 'spend per avoided DALY' quantifies the economic burden associated with maintaining better-than-expected outcomes in these countries.[19] While not solely attributable to healthcare spending, this metric reflects the real-world cost of their current approach to managing diseases caused by eating meat – whether through treatment, social policies, or other systemic advantages.[20]

The countries with the highest spend per avoided DALY for processed meat are Switzerland – spending up to USD 99,000 to avert one DALY – followed by several European countries including Germany, Denmark and Norway, as well as New Zealand, Australia, Singapore and Japan (see Figure 5a). For red meat, Switzerland also has the highest spend at USD 76,000 to avert one DALY, followed again by several European countries such as the Netherlands, Denmark and Norway, alongside New Zealand, Singapore, Australia, Japan and South Korea (see Figure 5b).

Figs. 5a-b





The spending associated with each avoided DALY highlights a missed opportunity to achieve similar or greater health gains through prevention, at far lower cost.[21]

[19] Even though we've scaled the total health budget to the share of disease caused by meat, the number is still only an approximate estimate of what it costs to avoid one DALY caused by meat consumption, not an exact record of money actually spent on care for the meat consumption disease burden.
[20] This metric identifies where preventive measures could yield the greatest economic and health returns, though it does not prove that treatment-focused spending is the sole driver of outcomes.
[21] These high 'spend per avoided DALY' figures reflect a well-established economic pattern in healthcare systems: healthcare spending and health outcomes follow a pattern of diminishing returns, in that

This highlights a critical policy trade-off: while these well-resourced healthcare systems may successfully minimise their disease burden attributable to meat consumption, they do so at substantial cost.

Norway – one of the top countries in terms of spend per avoided DALY – spends 20% above the EU average on health per capita, and also has the highest spending on long-term care in Europe, implying the country invests heavily in managing chronic conditions.[22] A prevention-oriented approach, including dietary interventions to reduce red and processed meat consumption, could free up healthcare resources for other pressing health priorities.

This is a trend among European nations: the share of total EU health expenditure dedicated to prevention between 2014 and 2019 was less than 3%, rising to 6% in 2021 on the back of the Covid-19 pandemic. Switzerland, Norway, Iceland, Sweden and France, which have some of the highest spends per averted DALY for the meat-attributable disease burden, spend only 4% or less of their total healthcare budgets on preventive healthcare.[23] This 'treatment-over-prevention' approach is further evidenced by recent research showing that only five of 20 high-income European countries selected by the study have national policies on primary prevention in hospitals,[24] with just Ireland and the UK allocating additional funding for such initiatives. This suggests these healthcare systems are missing opportunities to integrate prevention into routine healthcare delivery.

Prevention is also an apt response for countries with lower healthcare spending that also suffer from a high disease burden due to meat consumption, such as Latvia, Lithuania and some other Baltic European countries (see Figures 2 and 3). Latvian and Lithuanian healthcare spending per capita is lower than many of their European counterparts; both countries suffer significantly worse health outcomes than expected, given that their levels of meat consumption are similar to other European nations. This renders **prevention at least equally critical** for these less wealthy countries: with fewer resources dedicated to treatment, avoiding disease burden through dietary changes represents a viable and cost-effective strategy.

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additional health gains become progressively more expensive as spending increases. Our high 'spend per avoided DALY' countries may be operating in this high-cost, low-marginal-benefit zone, explaining why they must invest substantial resources to achieve each additional unit of meat disease burden avoided.

[22] This spending is also mostly from public funds – suggesting it's a public policy decision to invest heavily in treatment rather than prevention.

[23] Defined as "any measure that aims to avoid or reduce the number or severity of injuries and diseases, their sequelae and complications".

[24] Defined in the study as "actions that aim to avoid diseases from occurring. Examples are providing information on the harmful effects of smoking, alcohol consumption or unhealthy diets, or providing information on how to prevent cancer, cardiovascular or respiratory diseases".

In sharp contrast to the pattern we observed in Europe, high healthcare spending in the US has not alleviated the worse-than-expected health outcomes, given its meat consumption. This suggests that total healthcare spending alone cannot compensate for weak dietary policies and systemic healthcare gaps,[25] and reinforces the argument that prevention-oriented approaches - including dietary interventions to reduce meat consumption - will likely offer a more sustainable path to better health outcomes.

While our analysis reveals strong associations between healthcare spending and health outcomes, we cannot establish direct causation. Countries achieving better outcomes at high cost may benefit from multiple advantages, including but not limited to: healthcare system quality, population health behaviours, food safety regulations, genetic factors, and broader social determinants of health. However, our results emphasise that robust health systems moderate, but cannot eliminate, disease burdens caused by meat consumption. Reducing meat consumption is a surer path to curb disease burdens caused by diet.

Putting savings back into burdened healthcare systems

As a final step in our analysis, we translated what a reduced meat disease burden would look like in terms of potential cost savings to healthcare systems in some of the countries that are devoting significant resources to managing and treating preventable diseases.

To do this, we calculated the proportion of each country's total disease burden attributable to processed meat consumption, then applied this proportion to their healthcare expenditure.[26] We then did the same for red meat consumption.

We present two illustrative prevention scenarios (a 10% and a 30% reduction in the disease burden caused by eating processed and red meat, respectively), based on proportional reductions to demonstrate the range of potential savings. While actual dose-response relationships may be non-linear, these scenarios provide useful planning estimates for policymakers considering prevention investments.[27]

These figures represent the healthcare resources that could theoretically be redirected to other health priorities if dietary interventions successfully reduced the instances of diseases caused by consuming processed and red meat. To put this into

[25] The US 'health disadvantage' is a paradoxical phenomenon where US citizens experience worse health outcomes compared to other high-income countries and is largely rooted in structural and systemic failures that create unhealthy environments while denying care.

[26] We assume healthcare costs are proportional to disease burden.

[27] Evidence suggests non-linear dose-response relationships, with risk plateauing at high consumption levels, making these conservative estimates assuming linear relationships.

context, in the US, a 30% reduction in processed meat intake is equivalent to every citizen eating six fewer rashers of bacon per week,[28] or in the UK, eating two fewer sausages a week.[29]

In the US alone, reducing the red meat disease burden by 30% could save up to USD 12.5 billion annually. Reducing the country's processed meat disease burden by 30% could save USD 21 billion annually – potentially funding at least 247,000 hospital nurses.[30] Redirecting even a fraction of the treatment-focused spending toward dietary prevention could achieve outsized health and fiscal returns. In Figures 6-9, below, we show the potential healthcare savings and funded nurse salaries for Australia, Canada and relevant countries in Europe.

There is substantial evidence to support improved economic and health outcomes with primary prevention (measures that prevent disease from occurring, like healthy diets and exercise) over secondary prevention (which aims to detect or manage disease early to halt progression, such as screening) and tertiary interventions (which treat established disease to reduce complications, including surgery or chronic disease management). See Box 3.

Box 3. Cost-effectiveness of primary prevention

Primary, diet-focused prevention often delivers far greater health gains per dollar than secondary prevention (screening or treatment), particularly for diet-related chronic diseases such as cardiovascular disease and colorectal cancer. The examples below, spanning the US, UK, EU and Australia, show population dietary policies (e.g. salt and sugar reduction) achieving large health impacts at very low cost or net savings, while screening and pharmaceutical treatment typically cost far more per unit of health gained.

[28] A reduction of 8.7 grams per day per person.

[29] We calculated the processed meat reduction for a 30% DALY decrease using GBD 2021 UK adult exposure data and published all-cause mortality risk (RR=1.15 per 50g; Wang et al., 2016). Assuming log-linear dose-response and DALYs proportional to excess risk, we solved for intake reduction. Linear dose-response analysis (specifically, log-linear) is standard practice for estimating associations between dietary exposures and health outcomes in nutritional epidemiology. This is a first-order proxy for policy communication, not a full burden-of-disease calculation. Authoritative dietary guidelines should use the complete GBD comparative risk assessment methodology.

[30] We estimated each country's total health expenditure as population × per-capita health expenditure, then allocated this total by the processed or red-meat share of overall disease burden (processed or red-meat DALYs divided by all-cause DALYs) to approximate spending on conditions caused by consuming processed or red meat. Potential savings under illustrative prevention scenarios were calculated as 10% and 30% of this allocated amount. The implicit assumption is that spending is proportional to DALY shares across causes.

A 2000 study found that screening for colorectal cancer – one of the biggest cancer risks posed by meat consumption – reduced mortality by 80% but cost USD 232,000[31] per life-year gained. This demonstrates that secondary prevention (e.g. screening) is a costly intervention compared to a primary prevention like dietary change.

In the US, a salt reduction policy aimed at preventing heart disease was estimated to cost USD 332 per DALY averted, while treatment with statins – a common secondary prevention pharmaceutical for heart disease – costs USD 37,000 per DALY averted. In the UK, a small reduction in daily salt intake was predicted to prevent over 30,000 cases of cardiovascular disease and more than 4000 deaths over 10 years, saving over GBP 80,000 per year.

In Australia, mandating the WHO sodium benchmarks for packaged foods is projected to save ~AUD 223 million over 10 years, avert ~2,743 cardiovascular disease-related deaths and ~43,971 cardiovascular events, and gain ~11,174 health-adjusted life years (HALYs) – a measure combining the quantity and quality of life into a single indicator of population health – remaining cost-effective over a population's lifetime.

Another study found that implementing US National Salt and Sugar Reduction Initiative targets could prevent about 2.5 million cardiovascular events, nearly half a million cardiovascular disease deaths and 750,000 diabetes cases over a lifetime, while saving USD 160 billion in societal costs. The policy would become cost-effective within six years.

Inspired by successful interventions targeting other foods with high disease burdens, Portugal introduced taxes on sweetened beverages in 2017, generating EUR 80 million in the first year, which was invested directly into the state-funded healthcare system. The tax achieved a 7% reduction in beverage sales and, more importantly for public health, prompted widespread industry reform to reduce sugar content across existing products.

A modelling study of England's Soft Drinks Industry Levy (SDIL) projected that reductions in sugar from soft drinks could prevent ~64,100 instances of children and adolescents being classified as overweight or obese in the first 10 years after implementation.

[31]This value has been adjusted for inflation to 2024 USD based on a medical price inflation rate of 150%.

A large US modelling study found that giving "produce prescriptions" (free or discounted fruit and vegetables plus nutrition support) to 6.5 million adults with diabetes and food insecurity would prevent about 292,000 heart events and add roughly 260,000 years of healthy life over 25 years. The programme would be highly cost-effective (~USD 18,000 per healthy year gained) and close to cost-neutral from a broader societal view, with benefits showing as early as 5-10 years after implementation.

An EU review of front-of-pack nutrition labels found that Nutri-Score – which scores nutritional quality by penalising energy, sugars, saturated fat and sodium while crediting fibre, protein and fruit/veg/nuts – could avert ~2 million chronic disease cases (2023–2050), reduce annual healthcare spending by 0.05% and improve productivity, gaining 10.6 full-time equivalent workers per 100,000 working-age people.

Fig. 6

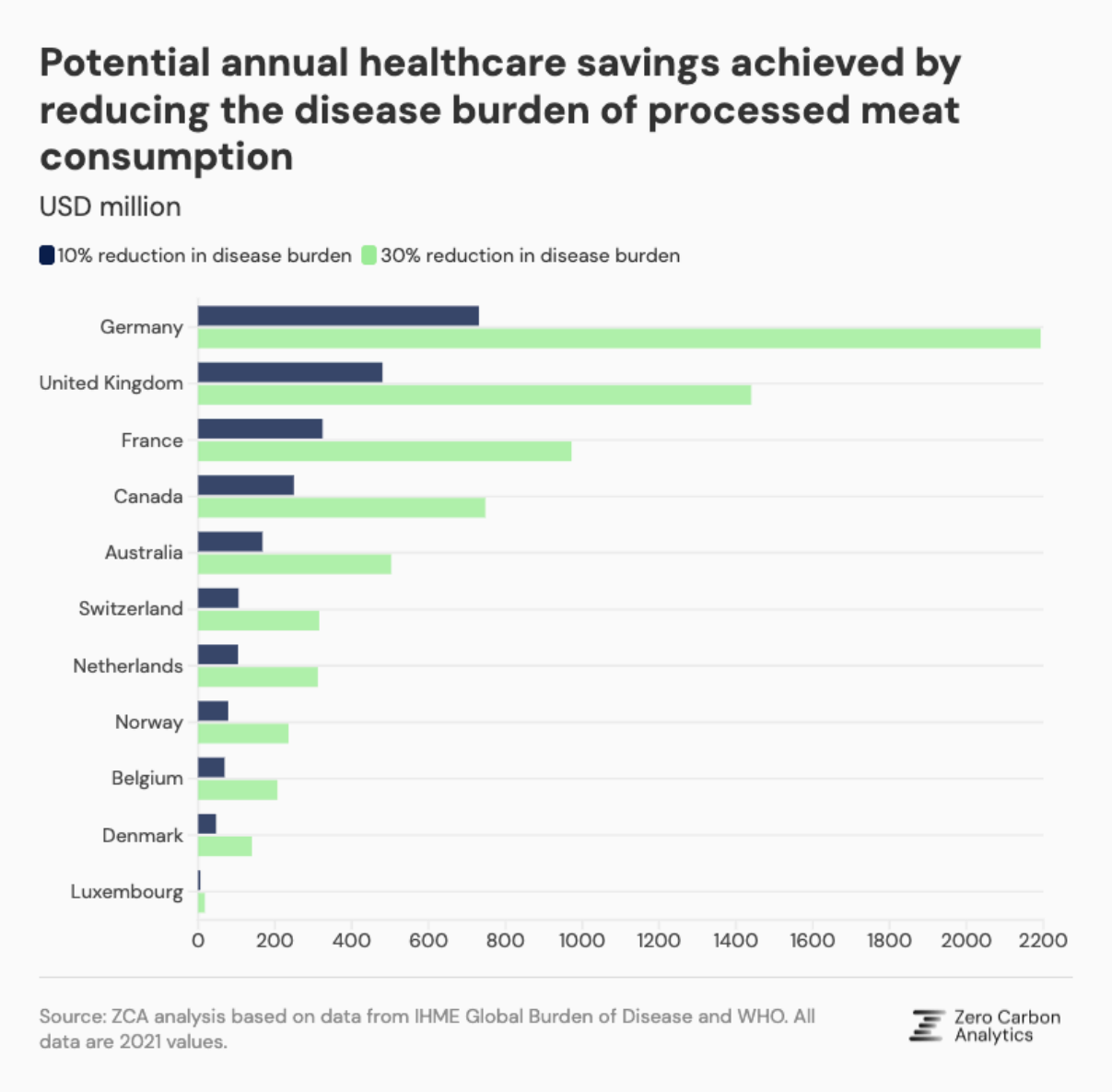

Potential annual healthcare savings achieved by reducing the disease burden of processed meat consumption
USD million
10% reduction in disease burden
30% reduction in disease burden
Germany
United Kingdom
France
Canada
Australia
Switzerland
Netherlands
Norway
Belgium
Denmark
Luxembourg
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
Source: ZCA analysis based on data from IHME Global Burden of Disease and WHO. All data are 2021 values.
Zero Carbon Analytics

Fig. 7

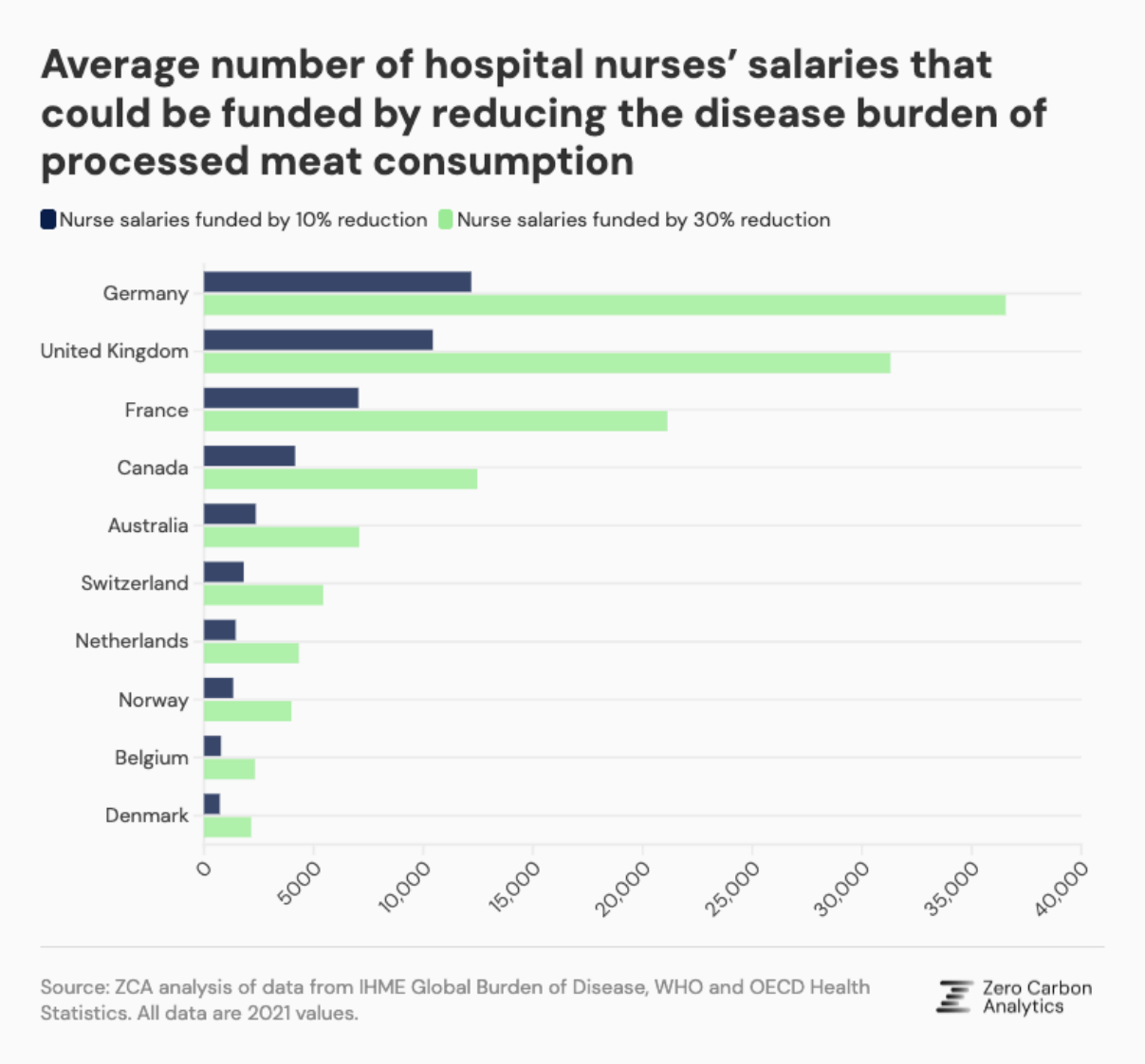

Average number of hospital nurses' salaries that could be funded by reducing the disease burden of processed meat consumption
Nurse salaries funded by 10% reduction
Nurse salaries funded by 30% reduction
Germany
United Kingdom
France
Canada
Australia
Switzerland
Netherlands
Norway
Belgium
Denmark
0
5000
10,000
15,000
20,000
25,000
30,000
35,000
40,000
Source: ZCA analysis of data from IHME Global Burden of Disease, WHO and OECD Health Statistics. All data are 2021 values.
Zero Carbon Analytics

Fig. 8

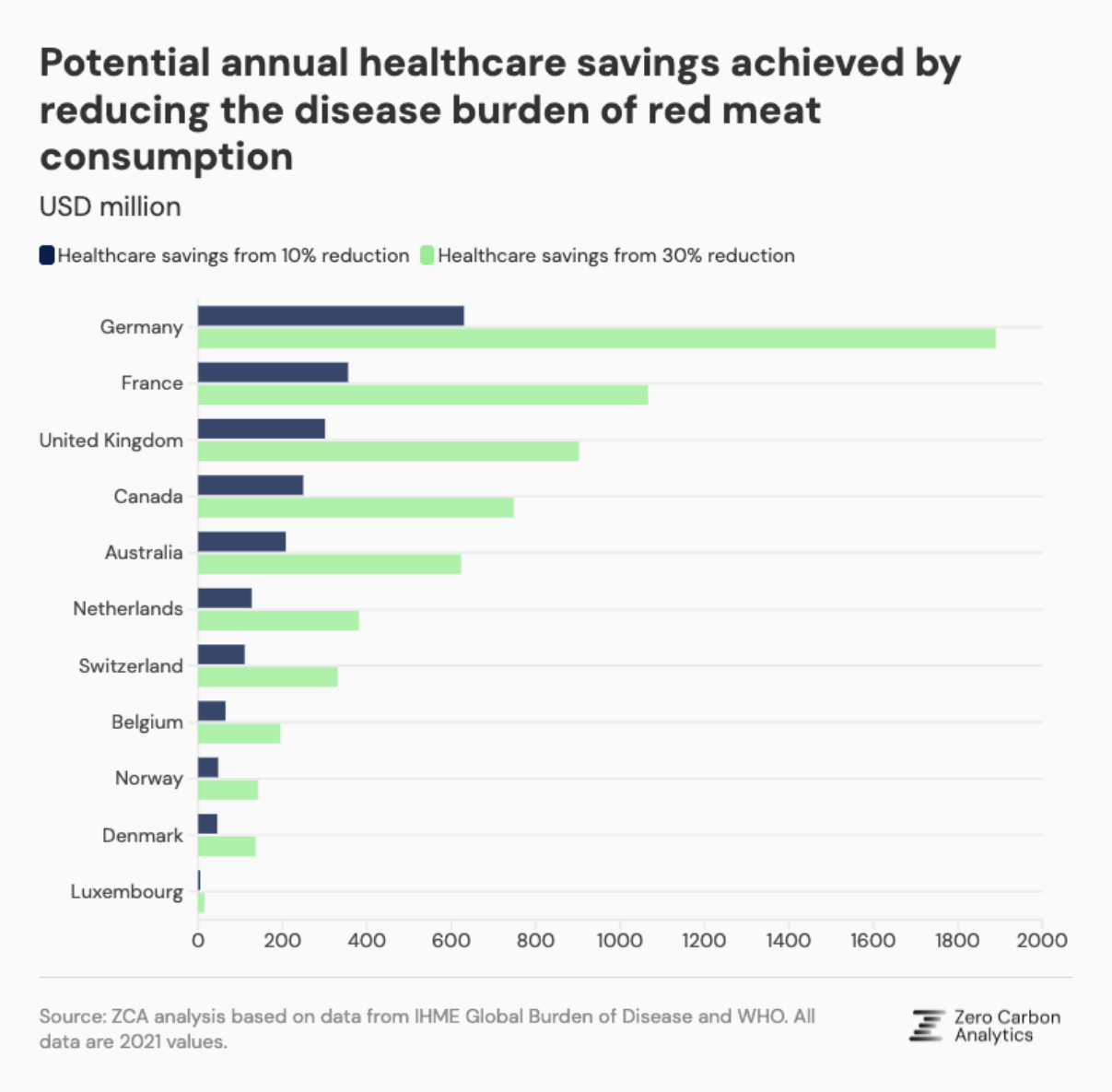
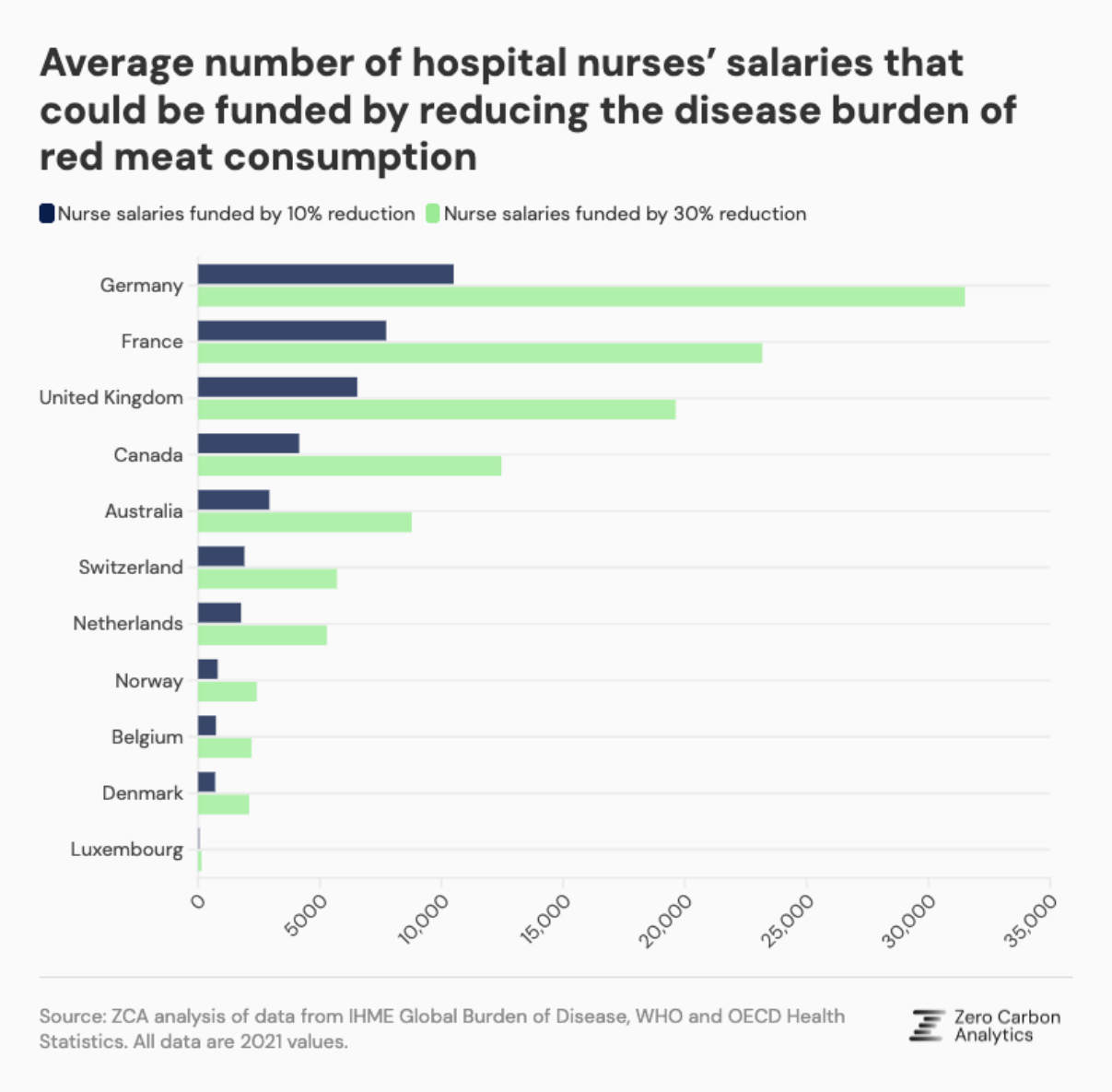

Potential annual healthcare savings achieved by reducing the disease burden of red meat consumption
USD million
Healthcare savings from 10% reduction
Healthcare savings from 30% reduction
Germany
France
United Kingdom
Canada
Australia
Netherlands
Switzerland
Belgium
Norway
Denmark
Luxembourg
0
200
400
600
800
1000
1200
1400
1600
1800
2000
Source: ZCA analysis based on data from IHME Global Burden of Disease and WHO. All data are 2021 values.
Zero Carbon Analytics

Fig. 9



Policy change prevents disease and premature death

There is mounting evidence that targeted policies and interventions are needed to reduce the disease burden caused by consuming red and processed meat. In Europe, chronic diseases are responsible for 90% of deaths and 85% of years lived with disability, a large proportion of which are avoidable with behaviour change, such as diet.

Research shows that reducing red and processed meat intake is a highly effective public health intervention: in the US, reducing red and processed meat consumption

by just 30% could prevent over one million cases of type II diabetes, almost 400,000 cardiovascular events, over 84,000 colorectal cancers and more than 60,000 deaths over 10 years. Comparable benefits could be achieved in Europe, where processed meat causes more than 1.8 million DALYs a year. Research shows that completely replacing processed meat with legumes could avert approximately 20% of that disease burden. Another study found that placing warning labels on processed meat in the US could prevent over 100,000 cases of cancer and add 660,000 quality-adjusted life years – years of life lived in perfect health – with USD 1.3 billion in healthcare cost savings.

In the Netherlands, following national dietary guidelines – particularly reducing processed meat and increasing fruit intake – could substantially cut the future burden of preventable diseases and death, including around 20% fewer new cases of diabetes and coronary heart disease in 2050. Similar studies from the Nordic and Baltic countries link dietary habits, including the reduction of processed meat, with large gains in life expectancy.

Research from the Netherlands finds that healthcare systems currently subsidise the health costs of meat overconsumption,[32] rather than consumers paying the true cost of their dietary choices. Diseases caused by consuming meat were estimated to cost Dutch society EUR 0.65 billion annually through healthcare systems and insurance premiums. If these health costs were instead added to meat prices at the point of purchase, red meat would cost EUR 7.50 more per kilogram and processed meat EUR 4.30 more per kilogram - reflecting the true health costs that society currently absorbs.[33] If the environmental toll of meat production were also considered, these values would roughly double.

These findings support the European Commission's call for fiscal policies to tax processed meat, restrict marketing to children, and align national dietary guidelines with the Planetary Health Diet, which recommends limiting red and processed meat to no more than 0-3 servings per week. This could cut the disease burden of meat consumption by 8% in Sweden and nearly 7% in France – significant reductions at the national scale.[34]

[32] 'Overconsumption' was defined as any intake of processed meat; for red meat, 'the assumption for overconsumption is based on an advice of about a quarter of current consumption.'

[33] This is a conservative estimate, which does not include the health costs associated with meat production, such as infectious animal diseases, nitrogen emissions and particulate matter. The costs of the loss of work associated with illness have also not been taken into account, as have health problems caused by poor preparation of meat.

[34] Despite the growing evidence and rising pressure to reduce red and processed meat consumption for health and climate reasons, meat industry actors deploy well-established framing strategies (such as disputing evidence and reassuring consumers) designed to deflect regulatory action and preserve

Taken together, these studies underscore the high returns – both health-related and financial – of investing in dietary prevention policies aimed at reducing red and processed meat consumption.

market share. These globally-applied tactics mirror those used by other industries that are proven to harm human health, such as tobacco and fossil fuels, and present a substantial barrier to the adoption of evidence-based food policy.