# Responding to the greatest challenge of our time: climate change co-benefits and maladaptation

Good morning everyone and thank you for the invitation to address you all and set the context for what I am sure will be a very productive day. Last night's discussion went from bus shelters and potholes to attribution pathways of how climate changes health and complex exposure pathways, climate impact screening and an in-depth look at Healthy Streets and what are our local options for making Cork's streets less polluted and congested. One thing is for certain, Cork has the potential to be a world leading Green and Healthy City.

My talk today will deal with how we best respond to the greatest challenge of our time with consideration of health co-benefits and the threat of maladaptation.

## Health in all Policies

Many of you are likely familiar with the concept of Health in all Policies, developed by the World Health Organization. As defined directly in the Helsinki statement: "Health in all Policies is an approach to public policies across sectors that systematically take into account the health implications of decisions, **seeks synergies**, and avoids harmful health impacts to improve population health and health equity". It has its justification in the societal goal of "health for all" which the WHO recognises is crucial for sustainable development.

According to the Helsinki statement: "Policies made in all sectors can have a profound effect on population health and health equity". And yet we need to recognise that often health and equity do not take precedence over other domestic and international priorities and policy objectives. If health is truly a pre-requisite for sustainable development, then the whole of government should engage with health, and this requires political will through a Health in all Policies approach.

## Health & Climate Change in all Policies

According to the Universal Declaration of Human Rights: "everyone has the right to a standard of living adequate for the health and wellbeing of themselves and of their family". It is not a far leap to argue that a standard of living adequate for health and wellbeing includes an environment that is not degraded, exploited or polluted.

Basic human rights are being threatened by anthropogenic climate change. During the 1950s, carbon dioxide in the atmosphere was recorded at just over 300 parts per million, 70 years later we are now over 400 parts per million. There have never been atmospheric $CO_2$ levels this high in the history of the planet[1]. We have polluted the atmosphere to such an extent that we are changing the earth's climate. We have entered into a new geological epoch where humanity is now the dominant force of change on the planet and environmental health is threatened.

This means that climate change is now the greatest societal challenge of our time. It is outrageous that *our climate* has been said to pose a greater threat than global terrorism and is projected to force over 100 million people into extreme poverty by 2030 if we sit back and do nothing (Haines & Ebi, 2019). The frustrating part is that we have brought this upon ourselves and the infuriating part is that we *know* how to fix it. We know that tackling the problem cannot be done by one country alone so, in Ireland, how could we even leave this monumental catastrophic challenge to one government

[1] US National Oceanic Atmospheric and Administration

department alone? Arguably a safe climate and environment is a pre-requisite for achieving any of the other sustainable development goals given their interconnectedness, especially with health and equity. Given the complexities and intricacies of attribution pathways of climate change and poor health and wellbeing I believe that it does not make sense to advocate simply for a Health in All Policies approach but rather that a Health and Climate Change in All Policies approach is needed.

The Paris Agreement is a political commitment to hold the increase in global average temperature to well below 2°C above pre-industrial levels and preferably making great efforts to limit temperature increase to below 1.5°C through nationally determined contributions. However, even if all countries adhere to their contributions, the world will likely still warm by 3°C by 2100. Thus, to keep below 2°C, contributions actually need to triple[2] (UNEP, 2018).

We often hear that climate change is happening at an unprecedented rate, it has become a term so over-used that for many of us, I feel, it has lost its meaning. Allow me to contextualise this from a recent report by the World Meteorological Organization. Global temperature has risen by 1.1°C in the last 170 years and by 0.2°C in the last 4 years. I mentioned that $CO_2$ levels were over 400 parts per million and we are polluting the air at an alarming rate with 1.97 parts per million of $CO_2$ released into the atmosphere between 2017 and 2018. Projections from 1993 put sea-level rise at 3.2mm per year but in the last five years, that has accelerated to 5mm per year. It is not only our air that is heating but our oceans too with 2018 displaying the highest ocean heat content values ever recorded. Emissions have increased the acidity of the oceans by 26% from the industrial revolution threatening ecosystems struggling to sustain life. Extreme events are also happening at an unprecedented rate. The extreme event that has been the deadliest meteorological hazard for the past four years: heatwaves (WMO, 2019). The extreme event that has been the costliest: tropical cyclones (WMO, 2019)[3].

It is painfully clear - we need to adapt. And we need to adapt quicker than ever before ultimately because our health depends on it.

Co-Benefits

A core principle of the Health in All Policies approach is to seek synergies. So, what if by responding to the environmental crisis that is climate change, we simultaneously improve health? To do so, it is essential that we invest in climate change adaptation and mitigation with co-benefits for health. Major pathways of this include: transport; food and energy.

Consider the environmental and health co-benefits of promoting active transport such as walking or cycling in place of driving cars. By walking instead of driving there would be lower use of fossil fuels and subsequent decreased greenhouse gas emissions. With less air pollution at the micro-environment level the urban heat island effect might diminish. These positive environmental benefits of replacing driving with walking will result in improved health benefits as well, possibly lowering rates of obesity, cardiovascular disease and improving mental health. Global, cost:benefit analyses indicate that with a 7% investment in cleaner air, 3 million premature deaths might be avoided by 2040 (Haines, 2017). Additionally, although no analysis has been conducted for Ireland, if city dwellers in Wales and

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[2] According to the current policy and NDC scenarios, global emissions are not estimated to peak by 2030, let alone by 2020. The current NDCs are estimated to lower global emissions in 2030 by up to 6 GtCO2 e compared to a continuation of current policies. As the emissions gap assessment shows, this original level of ambition needs to be roughly tripled for the 2°C scenario and increased around fivefold for the 1.5°C scenario. And the 3°C rise is based on pathways of current NDCs.

[3] The 2017 Atlantic hurricane season was one of the most devastating on record, with more than US$ 125 billion in losses associated with Hurricane Harvey alone. In the Indian Ocean, in March and April 2019, unprecedented and devastating back-to-back tropical cyclones hit Mozambique.

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England used active transport as much as the population of Copenhagen, then the NHS could see a reduction of about £17 billion over 20 years due to predicted reductions in Type 2 diabetes, dementia, ischemic heart disease, cerebrovascular disease and cancer even after adjusting for the possible increases in road traffic accidents (Jarrett et al. 2012).

Another example is of our diets, eating a diet rich in plant-based protein sources, fruits, vegetables, wholegrains, nuts and legumes with less animal-sourced protein is good for health given that many cultures over consume certain food groups such as red meat, starchy vegetables and eggs. Aside from over-consumption in general being a risk factor for obesity, over-consumption of certain foods can increase the risk of non-communicable diseases such as cancer, heart disease and Type 2 Diabetes. Unhealthy diets now pose a greater risk to morbidity and mortality than unsafe sex, alcohol, drug and tobacco use combined. Globally, eating a healthy diet could prevent approximately 11 million adult deaths per year. Scientists have proposed eating a "planetary health diet" which is good for health and will also keep the planet thriving within planetary boundaries (Willet et al., 2019). This means constraining food production-related greenhouse gas emissions, nitrogen and phosphorus pollution, biodiversity loss, using less water and less land. It is important to acknowledge the environmental burden of every piece of food on your plate and recognise that agriculture occupies about 40% of land globally. One recommendation of the planetary health diet is to reduce animal-sources of protein. Particularly as our bodies require only 0.8g of protein per kilogram of bodyweight. So, a healthy, moderately active individual weighing 70kg physiologically only requires 56g protein per day. Compared to any other food group, animal products and their feed demonstrate the largest proportion of greenhouse gas emissions[4]. That is not to say that production of other foods are without emissions[5] but a transition to a diet rich in plant-based protein does show a high mitigation potential, particularly in the face of a growing population estimated to be 10 billion people by 2050.

Another example of a health co-benefit for climate change adaptation is that of increasing urban green space which is inherently good for the environment through carbon sequestration and is good for health as green space may reduce the urban heat island effect, reduce noise pollution, and has been shown to improve self-reported health status and mental health (IPCC, 2014, pg 738).

It pains me that the economic argument even needs to be made for environmental and health benefits nonetheless, studies have shown that the global cost for investing in climate change mitigation strategies to keep countries in accordance with their Paris Agreement contributions would be comfortably offset by the savings in healthcare costs associated **with air pollution-related disease alone**[6] (Markandya et al. 2018). But I believe that it is not a matter of economics, it is a matter of basic human rights, equity, moral responsibility and respect for our natural environment.

[4] 0.8g protein per kg | Vit B12 absent from planetary health diet | cooked & prepared | processed meat = group 1 carcinogen | pescatarian & Mediterranean diet = lowest risk usually | depends what you replace your meat with | biology of animal | land for animal & feed | consumption red meat has been linked to CVD | precision technology farming | vegetarian/vegan diets = risk haemorrhagic stroke link | dairy is allowed

[5] Whilst there is much in the way that can be done of technology, particularly precision farming, for growing plant-based foods, there is little that can be done to counter the physiological process of ruminant animals thus by reducing excessive meat consumption there is a reduction in emissions such as methane, a potent GHG and a precursor for tropospheric ozone production, as well as less land and environmental resources are needed for the animal grazing and feed production.

[6] Our study is a comprehensive assessment of the global and regional implications of climate change mitigation in terms of (ambient) air pollution in the coming decades. The results show that, in all the scenarios, global health co-benefits are greater than the mitigation cost of achieving the target. The ratio of health co-benefit to

Maladaptation

At this stage of the speech when I have inspired everyone to jump into environmental action that elicits co-benefits for human health, it is also my duty here to present the flipside. That is ensuring that strategies implemented in the short-term do not result in unintentional co-harms or maladaptation in the long-term, leading to increased vulnerability to climate-risks, and a wasting of financial resources thereby having the opposite outcome of its original intention. This might seem an obvious point but allow me to provide some case study examples.

Planting 66 billion trees in China. How could this possibly be a bad idea from the world's largest GHG emitter contributing 27% to global GHG emissions (WRI, 2019)? And I would not say that it necessarily is a bad idea either, but trees have been planted in China's Gobi Desert in an attempt to limit the threat of a spreading desertification. The maladaptation? Non-native trees[7] were planted which are incredibly water-intensive and with projections of increased frequency of drought and temperature rise, the trees may be using up valuable water, worsening water scarcity and ultimately increasing vulnerability for those in the region. Further to this there have been reports of farmers cutting down native trees to be paid to plant non-native trees on the government-funded program (Hua et al., 2018).

Another lesson can be learnt from renewable energy technology which is a popular mitigation option as producing more energy from renewable sources such as solar, wind and wave technology will result in less fossil fuel use and subsequent GHG emissions, improving outdoor air quality which is good for cardiorespiratory health and lower rates of cancer. But what is often missing from the analysis is the life cycle impacts of energy technologies. We are all well aware of the adverse environmental and health impacts of coal, oil and gas on climate change, freshwater ecotoxicity and particulate formation and that renewable energy technologies such as solar and wind have virtually no GHGs associated. However, renewables are likely to have a great impact on metal and mineral depletion levels such as manganese and copper with solar requiring probably the most land occupation compared to other primary sources of energy (Berrill et al. 2016)[8]. Indeed, you may have heard reports on sulphur hexafluoride or $SF_6$, a GHG with a global warming potential 23,000 times that of $CO_2$ and an atmospheric lifetime of 3,200 years making it an extremely potent and persistent GHG[9]. SF6[10] is useful as an electrical insulator, and with the rapid growth of renewable energy sources feeding into electrical grids[11], the use of this gas has become more frequent. But leaks in these system can lead to SF6 escaping into the atmosphere and recent studies show a rise in SF6 leaks for the year 2015 was

mitigation cost ranges between 1·4 and 2·45. The staged approach, CER (constant emission ratios), is the most efficient burden sharing approach in terms of net cost.

[7] Shrubs should have been planted instead as lower water requirements and perhaps with those of economic value such as herbs (Hua et al., 2018)

[8] Yet scientists are adamant that the adverse environmental impacts of wind and solar, including the possible need for transmission grid extensions and energy storage, do not outweigh their benefits to addressing climate change (Berrill et al. 2016).

[9] 1,000 years if lifespan of CO2 (Solomon et al., 2010)

[10] The use of $SF_6$ has been banned from applications where a suitable alternative can be provided and is classified as a regulated fluorinated greenhouse gas by both the EU and the UK [2,3]. $SF_6$ is also listed in the United Nation's Kyoto [5] and Paris agreements [6] as a gas deemed to have a high global warming impact and emissions, and, therefore, should be reduced. However, this has not been an easy task and, in the market at present, there is no alternative to $SF_6$ that could directly replace it while fulfilling all its dielectric and interruption properties. (Widger & Haddad, 2018)

[11] https://www.bbc.com/news/science-environment-49567197

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equivalent to 258,000 tonnes of $CO_2$ being released into the environment for Great Britain alone (Widger & Haddad, 2018).

Another example: electric vehicles. Ireland's Climate Action Plan of 2019 aims to increase the number of EVs to approximately 1 million by 2030[12] in an attempt to drastically reduce transportation emissions. Whilst the promotion of EVs is a popular choice globally, at the production end, scientists have estimated that the global warming potential of EV production compared to conventional car production may be doubled[13] and if the power source for the EVs is coal then the global warming potential of EVs actually increases compared to conventional vehicles (Hawkins et al., 2012). So, it is imperative that the power source is non-fossil fuel dependent. The impact of the vehicle supply chain on environmental health must also be analysed concerning human toxicity[14], freshwater eco-toxicity and eutrophication as well as metal depletion (Hawkins et al., 2012).

Maladaptation can be analysed in many other examples, such as in an attempt to improve energy efficiency of homes through improved insulation, residents might be at risk of increased exposure to household air pollution, mould or heat stress if adequate ventilation is not considered in the design and building phase (Haines et al. 2009). From my own experience during the 2018 drought in Cape Town, residents were encouraged to re-use their greywater as a water saving measure. The downside of this was that there was very little risk communication accompanying this recommendation and the chance of infection was high given that greywater usually contains bacteria, viruses and parasites.

No-regrets

Does the threat of maladaptation prevent us from responding urgently to the climate crisis? No, but it does encourage us to conduct as thorough as possible review of potential anticipated adverse outcomes with deep reflection during initial phases to put adequate planning or safety measures in place before implementing policy[15]. For example, before encouraging more public bicycle sharing, should we be advocating for increased road safety for bike users, provision of helmets, improved cycle ways etc. Perhaps not all of these "precautions" are financially possible or feasible, but the anticipation of the risks should be dealt with as far as possible before implementation.

And this is where the precautionary principle is a useful framework to consult[16]. This framework can be applied to many situations that have an element of uncertainty. From the global scientific field, there are four guiding principles of the precautionary framework when applied to climate change adaptation with minimal risk of maladaptation (Hallegatte, 2009)

[12] https://www.dccae.gov.ie/en-ie/climate-action/publications/Pages/Climate-Action-Plan.aspx

[13] In contrast with ICEVs, almost half of an EV's life cycle GWP is associated with its production. We estimate the GWP from EV production to be 87 to 95 grams carbon dioxide equivalent per kilometer (g CO2-eq/km), which is roughly twice the 43 g CO2-eq/km associated with ICEV production. Battery production contributes 35% to 41% of the EV production phase GWP, whereas the electric engine contributes 7% to 8%. Other powertrain components, notably inverters and the passive battery cooling system with their high aluminum content, contribute 16% to 18% of the embodied GWP of EVs.

[14] particularly the production chain of copper and nickel

[15] Health Impact Assessment and Environmental Impact Assessments do occur, usually after the design phase. We propose looking at what is good for health & the environment at the initial ideas/design stage.

[16] Other potentially useful frameworks would be the Pathways Framework and the Assessment Framework (Magnan et al. 2016)

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1. No regrets - strategies should be developed and implemented with no regrets such that even in the face of uncertainty to the extent of climate change, these strategies would still yield benefits to society for example fixing water leaks or improving the public health system.
2. Reversible - strategies that are reversible and ideally flexible might also help avoid maladaptation such as insurance schemes or, deciding not to increase urbanisation in an area vulnerable to flooding - a decision that can be easily reversed.
3. Safety margin – strategies should have a safety margin such as being pessimistic in planning for example estimating larger capacity for drainage systems which would be useful in times of extreme flood or accommodate an increasing population.
4. Soft strategies – these are non-engineering strategies such as policies, early warning systems or financial tools[17]. Adopting soft strategies, however, does not always protect from maladaptation. Consider that in a poorly designed carbon tax system, a poorer household may spend a greater proportion of their income on fuel thereby spending more of that income on tax (ESRI, 2018), or they might not even be able to afford fuel when cold snaps occur thereby seeing no net improvement in their vulnerability status.

Conclusion

There is the argument that it impossible to anticipate all iterations of potential maladaptation and that ultimately some degree of maladaptation is inevitable (Magnan et al. 2016). This may be true, and most strategies will come with both positives and negatives, but the overall picture should be taken into account, balancing the positives, the negatives, and the consequences of inaction.

Responding to and planning for climate change requires thorough investigation and planning to design strategies with health co-benefits at the outset that avoid the risk of maladaptation.

We are the first generation to recognise anthropogenic climate change. It is therefore our duty to take action.

[17] Often these are also reversible

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References


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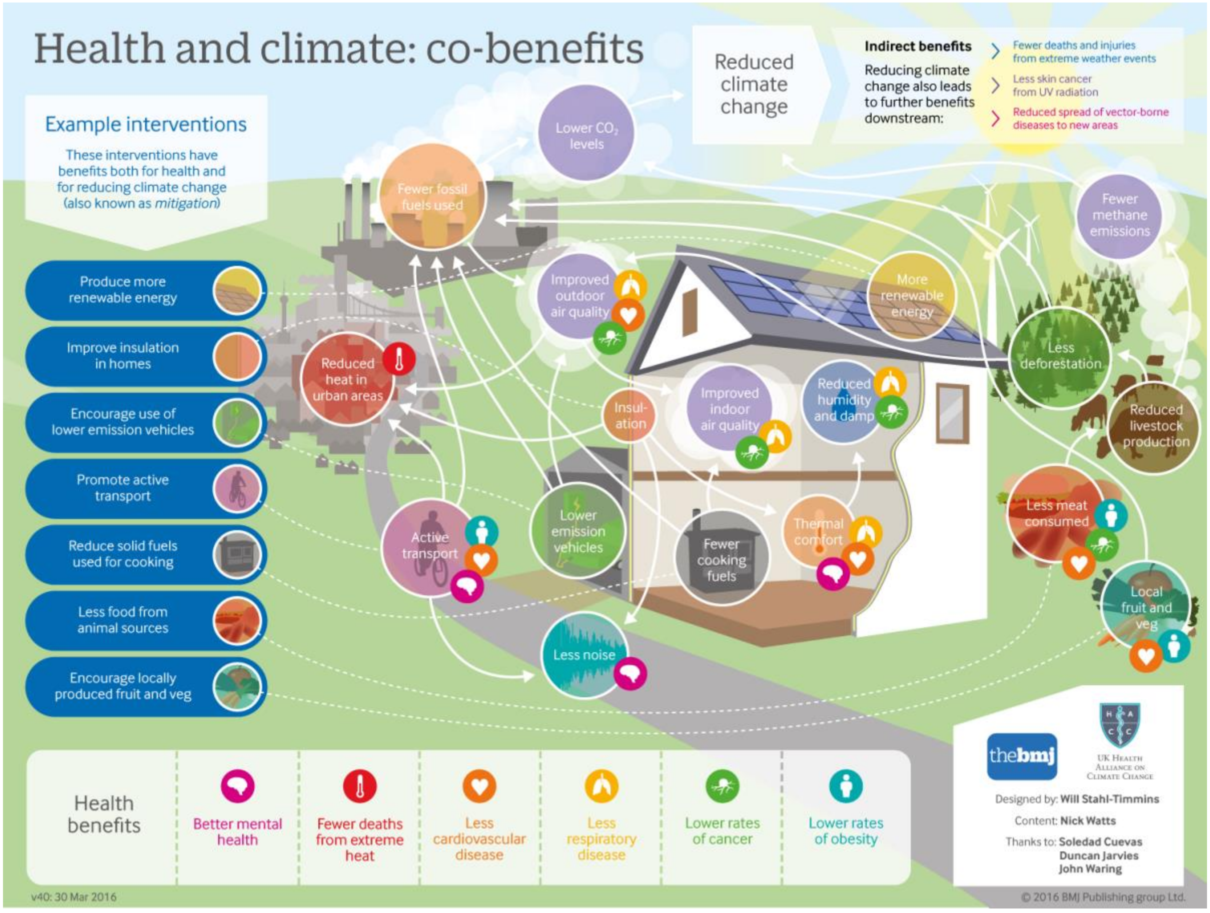
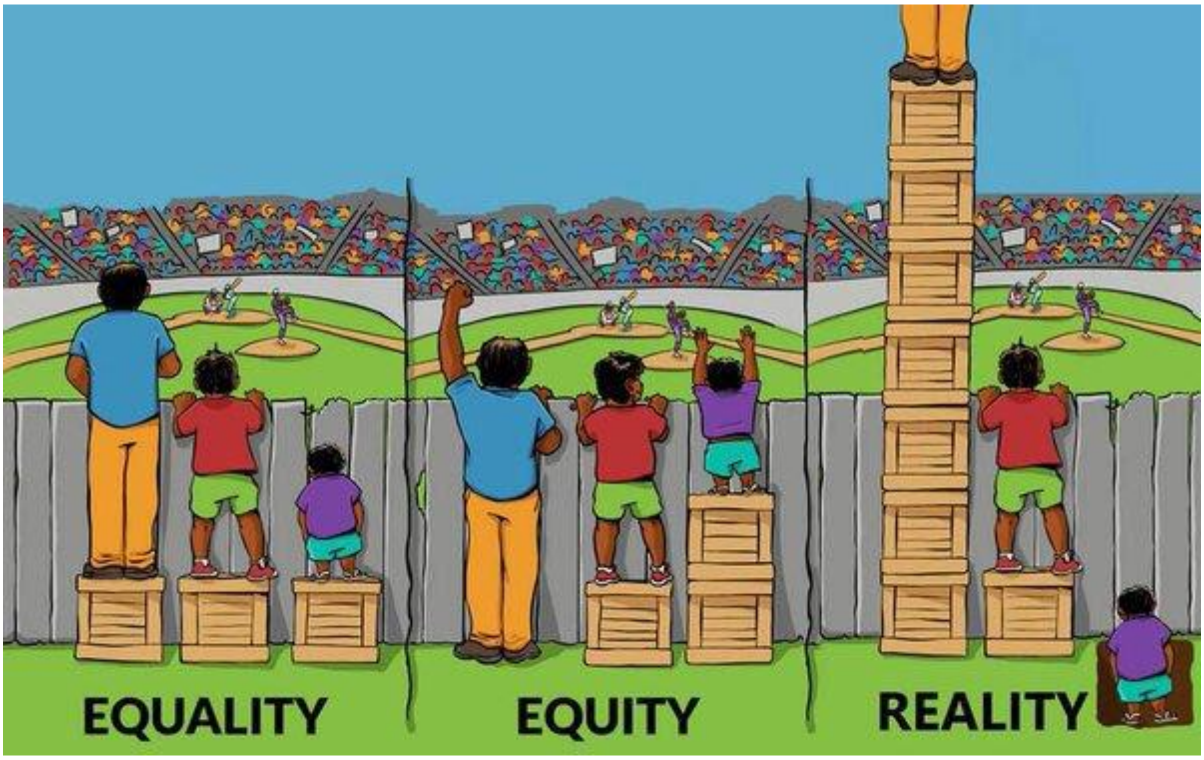
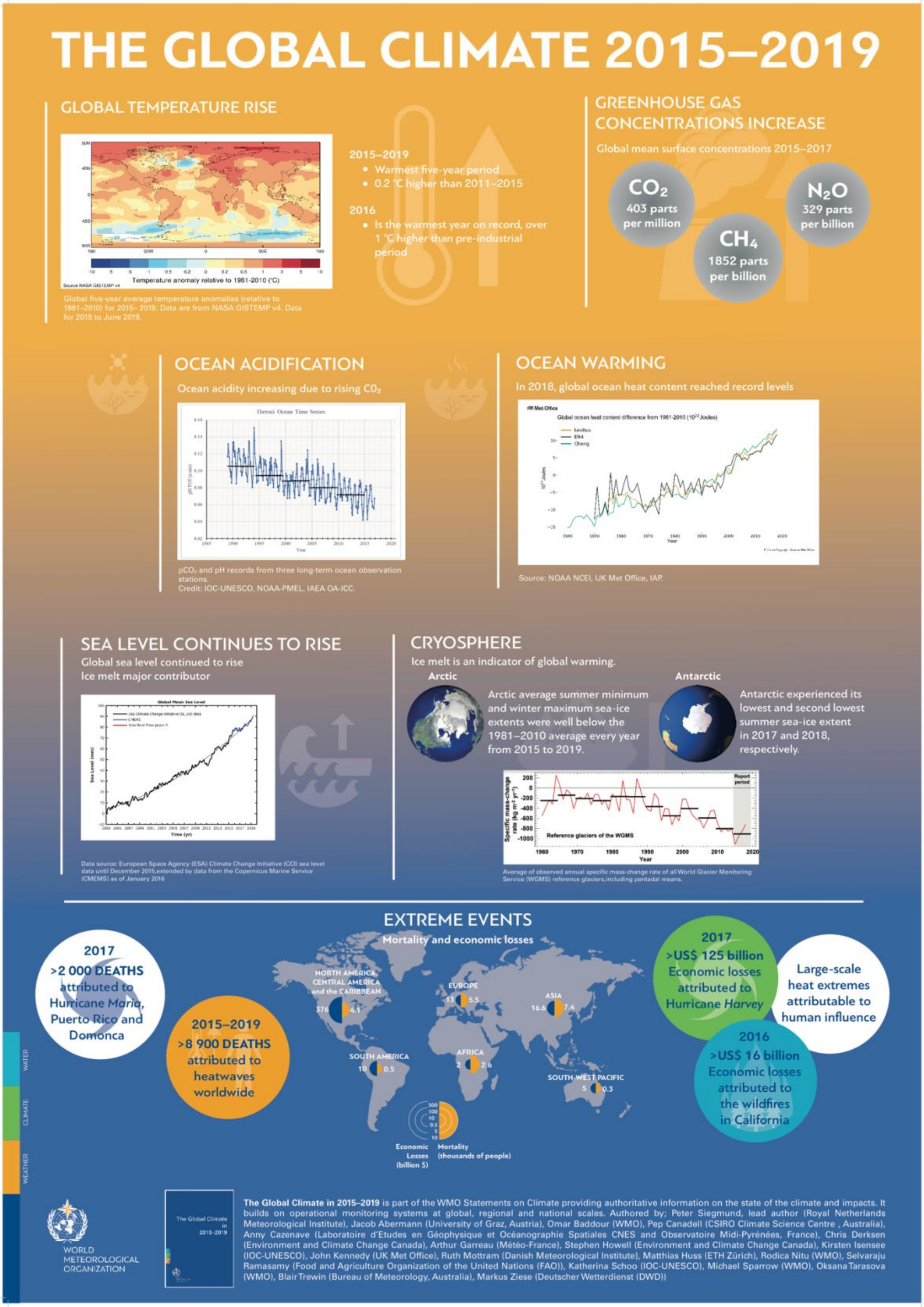
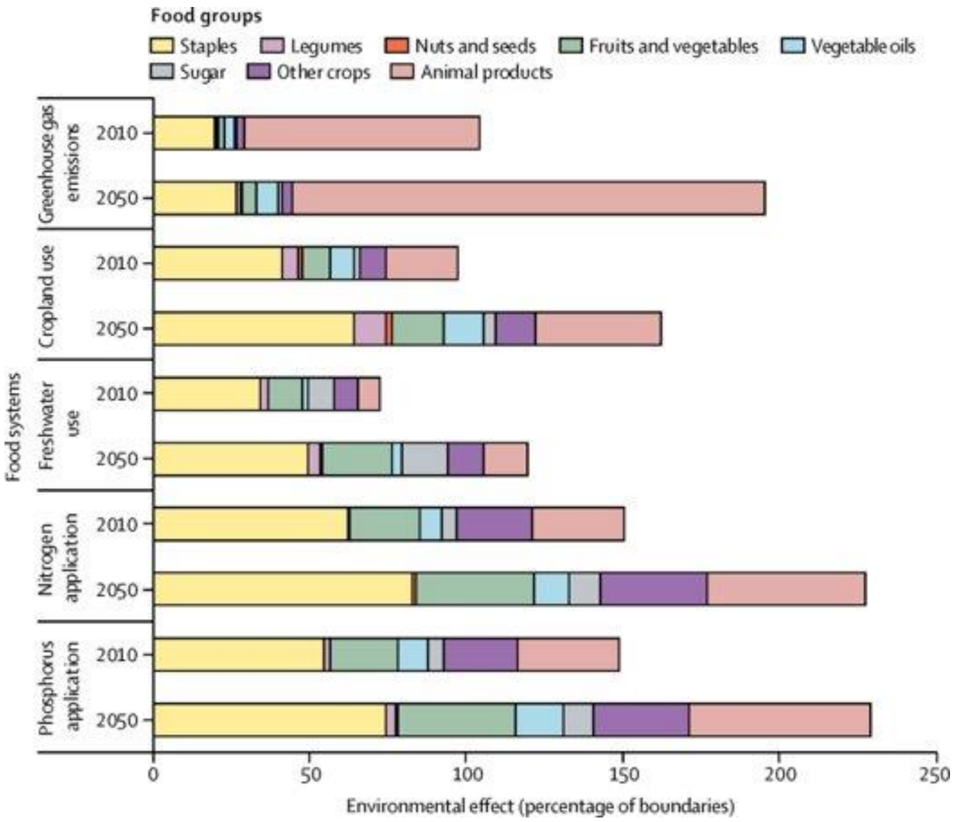
- https://apps.who.int/iris/bitstream/handle/10665/112636/9789241506908_eng.pdf;jsessionid=DEB1C24C9EEEC27BDF6668B0D29D0E07?sequence=1
- https://www.un.org/en/universal-declaration-human-rights/
- Health co-benefits of climate action https://www.thelancet.com/journals/lanplh/article/PIIS2542-5196(17)30003-7/fulltext
- https://www.bmj.com/campaign/climate-change

BMJ: The UK Health Alliance on Climate Change (link)


EQUALITY
EQUITY
REALITY


THE GLOBAL CLIMATE 2015–2019
GLOBAL TEMPERATURE RISE
Temperature anomaly relative to 1981-2010 (°C)
Source NASA GISTEMP v4
Global five-year average temperature anomalies (relative to 1981–2010) for 2015– 2019. Data are from NASA GISTEMP v4. Data for 2019 to June 2019.
2015–2019
• Warmest five-year period
• 0.2 °C higher than 2011–2015
2016
• Is the warmest year on record, over 1 °C higher than pre-industrial period
GREENHOUSE GAS CONCENTRATIONS INCREASE
Global mean surface concentrations 2015–2017
CO2 403 parts per million
CH4 1852 parts per billion
N2O 329 parts per billion
OCEAN ACIDIFICATION
Ocean acidity increasing due to rising C02
Hawaii Ocean Time Series
pCO2 and pH records from three long-term ocean observation stations.
Credit: IOC-UNESCO, NOAA-PMEL, IAEA OA-ICC.
OCEAN WARMING
In 2018, global ocean heat content reached record levels
Met Office
Global ocean heat content difference from 1981-2010 (10^22 Joules)
Levitus
EN4
Cheng
Year
Source: NOAA NCEI, UK Met Office, IAP.
SEA LEVEL CONTINUES TO RISE
Global sea level continued to rise
Ice melt major contributor
Global Mean Sea Level
Sea Level (mm)
Time (yr)
Data source: European Space Agency (ESA) Climate Change Initiative (CCI) sea level data until December 2015,extended by data from the Copernicus Marine Service (CMEMS) as of January 2016
CRYOSPHERE
Ice melt is an indicator of global warming.
Arctic
Arctic average summer minimum and winter maximum sea-ice extents were well below the 1981–2010 average every year from 2015 to 2019.
Antarctic
Antarctic experienced its lowest and second lowest summer sea-ice extent in 2017 and 2018, respectively.
Specific mass-change rate (kg m-2 yr-1)
Reference glaciers of the WGMS
Report period
Year
Average of observed annual specific mass-change rate of all World Glacier Monitoring Service (WGMS) reference glaciers,including pentadal means.
EXTREME EVENTS
Mortality and economic losses
2017
>2 000 DEATHS
attributed to Hurricane Maria, Puerto Rico and Domonca
2015–2019
>8 900 DEATHS
attributed to heatwaves worldwide
NORTH AMERICA, CENTRAL AMERICA and the CARIBBEAN 376 4.1
EUROPE 13 5.5
ASIA 16.6 7.4
SOUTH AMERICA 10 0.5
AFRICA 2 2.6
SOUTH-WEST PACIFIC 5 0.3
Economic Losses (billion $)
Mortality (thousands of people)
2017
>US$ 125 billion
Economic losses attributed to Hurricane Harvey
Large-scale heat extremes attributable to human influence
2016
>US$ 16 billion
Economic losses attributed to the wildfires in California
WATER
CLIMATE
WEATHER
WORLD METEOROLOGICAL ORGANIZATION
The Global Climate in 2015–2019
The Global Climate in 2015–2019 is part of the WMO Statements on Climate providing authoritative information on the state of the climate and impacts. It builds on operational monitoring systems at global, regional and national scales. Authored by; Peter Siegmund, lead author (Royal Netherlands Meteorological Institute), Jacob Abermann (University of Graz, Austria), Omar Baddour (WMO), Pep Canadell (CSIRO Climate Science Centre , Australia), Anny Cazenave (Laboratoire d'Etudes en Géophysique et Océanographie Spatiales CNES and Observatoire Midi-Pyrénées, France), Chris Derksen (Environment and Climate Change Canada), Arthur Garreau (Météo-France), Stephen Howell (Environment and Climate Change Canada), Kirsten Isensee (IOC-UNESCO), John Kennedy (UK Met Office), Ruth Mottram (Danish Meteorological Institute), Matthias Huss (ETH Zürich), Rodica Nitu (WMO), Selvaraju Ramasamy (Food and Agriculture Organization of the United Nations (FAO)), Katherina Schoo (IOC-UNESCO), Michael Sparrow (WMO), Oksana Tarasova (WMO), Blair Trewin (Bureau of Meteorology, Australia), Markus Ziese (Deutscher Wetterdienst (DWD))

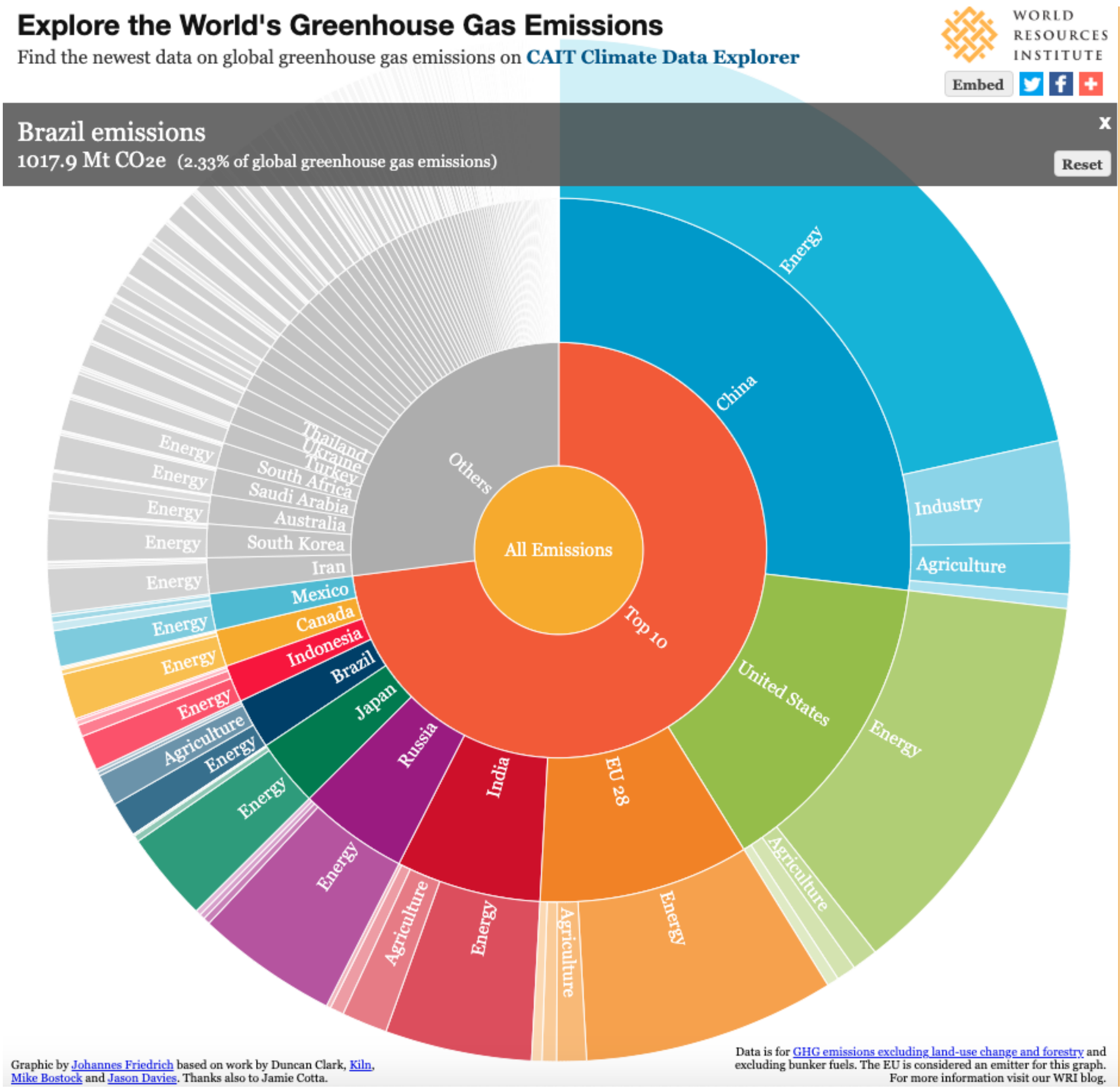



Willett et al. (2019) Lancet

# Achieving planetary health diets

| Actions | Description |
|---|---|
| **Dietary shift**<br>Planetary health diet | Planetary health diet – as outlined in Table 1. |
| **Halve waste**<br>Reduced food loss and waste | Food losses and waste reduced by half, in line with SDG target 12.3. |
| **PROD**<br>Improved production practices<br>Standard level of ambition | Closing yield gaps to about 75%; rebalancing N and P application; improving water management; implementation of agricultural mitigation options; and land is expanded first into secondary habitat and then to intact forests to minimize impacts on biodiversity. |
| **PROD+**<br>Improved production practices<br>High level of ambition | Closing yield gaps to 90%; a 30% increase in N use efficiency and 50% recycling rates of P; phase-out of first-generation biofuels; implementation of available bottom-up options for mitigating GHG emissions; and optimizing land-use across regions to minimize impacts on biodiversity. |

Willett et al. (2019) Lancet


Explore the World's Greenhouse Gas Emissions
Find the newest data on global greenhouse gas emissions on CAIT Climate Data Explorer
WORLD RESOURCES INSTITUTE
Embed
Brazil emissions
1017.9 Mt CO2e (2.33% of global greenhouse gas emissions)
Reset
All Emissions
Top 10
Others
China
Energy
Industry
Agriculture
United States
Energy
Agriculture
EU 28
Energy
Agriculture
India
Energy
Agriculture
Russia
Energy
Japan
Energy
Brazil
Energy
Agriculture
Indonesia
Energy
Canada
Energy
Mexico
Energy
Iran
Energy
South Korea
Energy
Australia
Energy
Saudi Arabia
Energy
South Africa
Energy
Turkey
Ukraine
Thailand
Graphic by Johannes Friedrich based on work by Duncan Clark, Kiln, Mike Bostock and Jason Davies. Thanks also to Jamie Cotta.
Data is for GHG emissions excluding land-use change and forestry and excluding bunker fuels. The EU is considered an emitter for this graph. For more information visit our WRI blog.

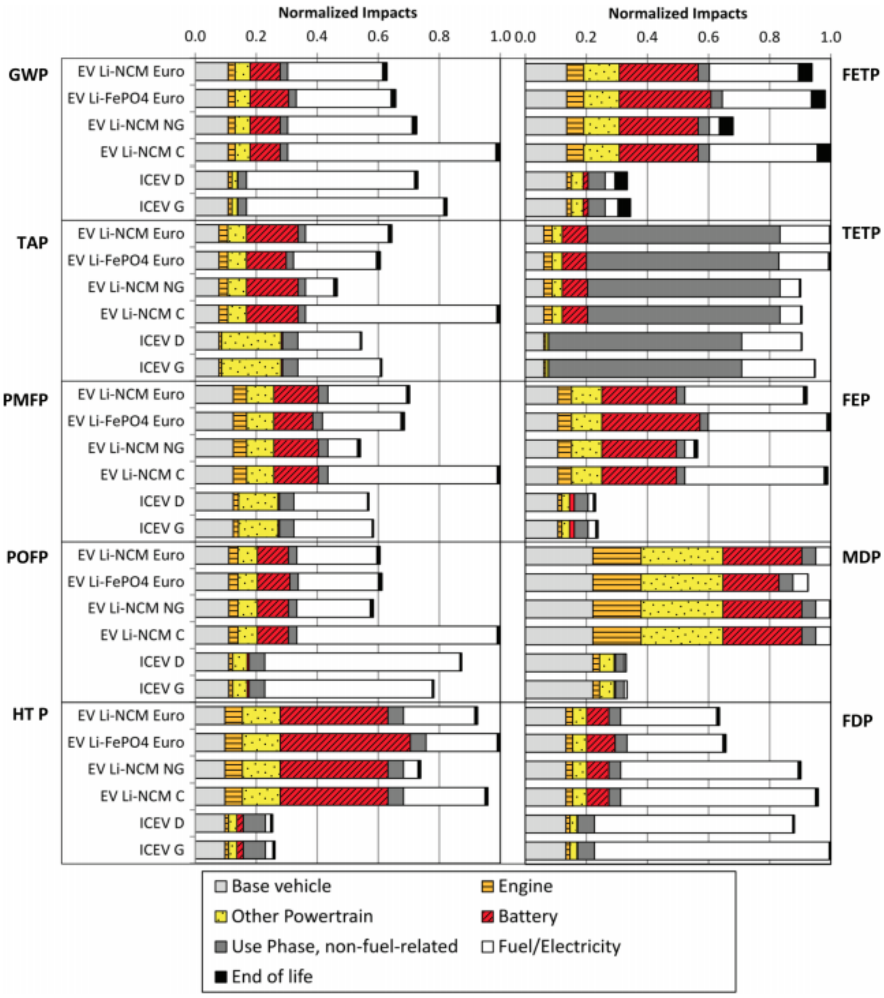



**Figure 1** Normalized impacts of vehicle production. Results for each impact category have been normalized to the largest total impact. Global warming (GWP), terrestrial acidification (TAP), particulate matter formation (PMFP), photochemical oxidation formation (POFP), human toxicity (HTP), freshwater eco-toxicity (FETP), terrestrial eco-toxicity (TETP), freshwater eutrophication (FEP), mineral resource depletion (MDP), fossil resource depletion (FDP), internal combustion engine vehicle (ICEV), electric vehicle (EV), lithium iron phosphate ($LiFePO_4$), lithium nickel cobalt manganese (LiNCM), coal (C), natural gas (NG), European electricity mix (Euro).