TODAY'S EMISSIONS, TOMORROW'S DEATHS:

HOW EUROPE'S MAJOR OIL AND GAS COMPANIES ARE PUTTING LIVES AT RISK.

Greenpeace Netherlands, December 2023

CONTENTS

INTRODUCTION

Fossil fuels are the main source of global anthropogenic carbon emissions and therefore the main driver of the escalating climate crisis.[1] These emissions cause global heating, resulting in more frequent and more intense extreme weather events like heat waves, droughts, storms and typhoons - which are increasingly endangering human lives.

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Due to the global scale of its direct and indirect damage to people's lives and health, the World Health Organization (WHO) has identified the climate crisis as the greatest human health challenge and a risk that seriously threatens all aspects of society.[2] According to the World Meteorological Organisation (WMO), extreme weather has already caused the deaths of 2 million people and $4.3 trillion in economic damage over the past half a century, with people in the Global South suffering most.[3] According to the IPCC's Sixth Assessment Report, approximately 3.3 to 3.6 billion people live in regions that are highly vulnerable to climate change.[4] People in Global Majority[5] countries and people with limited access to resources and rights, and suffering from discrimination, are the most vulnerable to the deadly impacts of the climate crisis.[6]

1 *IPCC, 2023. Summary for Policymakers. In: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, pp. 1-34, doi: 10.59327/IPCC/AR6-9789291691647.001*

2 *World Health Organisation, 2018. COP 24 Special Report Health & Climate Change p.10.*

3 *World Meteorological Organisation, 2023. Atlas of Mortality and Economic Losses from Weather, Climate and Water-related Hazards.https://wmo.int/resources/publications/atlas-of-mortality-and-economic-losses-from-weather-climate-and-water-related-hazards-1970-2021*

4 *IPCC, 2023: Summary for Policymakers. In: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, pp. 1-34, doi: 10.59327/IPCC/AR6-9789291691647.001*

5 *People of the Global Majority is a "collective term that speaks to and encourages non-White persons as belonging to the majority in the globe, referring to people who are racialized as Black, African, Asian, Brown, dual-heritage, indigenous to the Global South and/or racialized as 'ethnic minorities'. These groups currently represent approximately 80% of the world's population." https://ilpa.org.uk/people-of-the-global-majority/*

6 *IPCC, 2023. Summary for Policymakers. In: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, pp. 1-34, doi: 10.59327/IPCC/AR6-9789291691647.001*

Of course, deaths and public health impacts resulting from the actions of the fossil fuel industry are not limited to those driven by global heating. Many forms of environmental pollution share fossil fuels as a common cause. Fossil fuel related air pollution is estimated to be responsible for millions of premature deaths annually.[7] There is strong evidence that the pollution from fossil fuels is contributing to mortality both today and in the long-term.

Heatwaves are amongst the deadliest extreme weather events for humans, with thousands of people dying from heat-related causes each year, according to the WMO.[8] Several studies on the impacts of the climate crisis have covered the health consequences directly associated with unusual variation in outdoor temperature, predicting an increase in heat-related mortality, and a concomitant decrease in cold-related mortality.[9] As the fossil-fuelled climate crisis escalates, heat-related deaths are expected to increase, outweighing any benefit from fewer cold extremes.[10,11] Projections using the Mortality Cost of Carbon (MCC) research by R. Daniel Bressler, and following a future climate scenario where global temperatures increase 4.1 °C, suggest 83 million temperature-related excess deaths from climate change could occur by 2100.[12]

Climate impacts arising today are the result of accumulated carbon emissions that have occurred in the past.[13] Every metric ton of carbon emitted today will contribute to heating our planet and is therefore set to contribute to impacts into the future. The link between fossil fuels and the climate crisis is well established, as is the relationship between human-caused climate change and an increase in extreme weather events. Research to develop methods to project future harms caused by today's carbon emissions has advanced significantly over recent years. A recent synthesis of independent studies estimating future human death tolls from climate change found converging evidence for the "1,000-ton rule". This 'order-of-magnitude estimate' suggests that one person will die prematurely every time 1,000 tons of carbon are burned.[14]

Of all damages caused to humans by the escalating climate crisis, the loss of life is clearly the most severe. Estimating the part likely to be played by fossil fuel-related carbon emissions in contributing to premature human deaths through the impacts of increased temperatures alone, while only one of the implications of the climate crisis, is nonetheless therefore an important endeavor, and helps in fully grasping the oftentimes abstract impacts of the climate crisis. Referring to deaths, illness and injury, philosopher John Nolt explained[15],

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7 Vohra, K., Vodonos, A., Schwartz, J., Marais, E.A., Sulprizio, M.P. and Mickley, L.J., 2021. Global mortality from outdoor fine particle pollution generated by fossil fuel combustion: Results from GEOS-Chem. Environmental research, 195, p.110754.

8 World Meteorological Organization, 2023. Exceptional heat and rain, wildfires and floods mark summer of extremes, https://public.wmo.int/en/media/news/exceptional-heat-and-rain-wildfires-and-floods-mark-summer-of-extremes

9 Gasparrini, A., Guo, Y., Sera, F., Vicedo-Cabrera, A.M., Huber, V., Tong, S., Coelho, M.D.S.Z.S., Saldiva, P.H.N., Lavigne, E., Correa, P.M. and Ortega, N.V., 2017. Projections of temperature-related excess mortality under climate change scenarios. The Lancet Planetary Health, 1(9), pp.e360-e367.

10 IPCC, 2023: Summary for Policymakers. In: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, pp. 1-34, doi: 10.59327/IPCC/AR6-9789291691647.001

11 K.R., A.Woodward, D. Campbell-Lendrum, D.D. Chadee, Y. Honda, Q. Liu, J.M. Olwoch, B. Revich, and R. Sauerborn, 2014. Human health: impacts, adaptation, and co-benefits. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel,A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L.White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 709-754.

12 Bressler, R.D., 2021. The mortality cost of carbon. Nature communications, 12(1), p.4467. https://www.nature.com/articles/s41467-021-24487-w

13 IPCC, 2021. Climate Change 2021: The Physical Science Basis, the Working Group I contribution to the Sixth Assessment Report, Cambridge University Press, Cambridge, UK.

14 Pearce, J.; Parncutt, R. (2023). Quantifying Global Greenhouse Gas Emissions in Human Deaths to Guide Energy Policy. Energies 2023, 16(16), 6074

15 Nolt, J., 2015. Casualties as a moral measure of climate change. Climatic Change 130, 347–358. https://doi.org/10.1007/s10584-014-1131-2

> “Climate change will cause large numbers of casualties, perhaps extending over thousands of years. Casualties have a clear moral significance that economic and other technical measures of harm tend to mask. They are, moreover, universally understood, whereas other measures of harm are not. (...) Such estimates would have wide margins of error, but they would add substantially to humanity’s grasp of the moral costs of particular greenhouse gas emissions.”
>
> *John Nolt, 2015*

The purpose of this report is to apply one of these methodologies, the Mortality Cost of Carbon, to the self-reported 2022 greenhouse gas emissions of nine major European oil and gas companies, in order to explore the implications of those emissions in relation to projected human deaths caused by global heating.

SCOPE OF THIS STUDY

This report uses statistical methods to project the future excess deaths that might occur before the end of this century as a result of fossil fuel companies’ greenhouse gas emissions occurring today. The purpose of this research is to understand and illustrate the extent to which future climate change-related deaths are attributable to current and ongoing carbon emissions relating to fossil fuel companies.

The companies included in this study are nine oil and gas companies headquartered in Europe: Shell, TotalEnergies, BP, Equinor, Eni, Repsol, OMV, Orlen, and Wintershall Dea. All of these companies are active internationally and most of them cover the entire value chain from oil and gas production to the end consumer, for example, via petrol station networks. The differences in size of these are of course enormous.

The mortality estimate is calculated based on the companies’ self-reported 2022 greenhouse gas emissions and applying the Mortality Cost of Carbon method developed by R. Daniel Bressler and further discussed below.[16]

16 Bressler, R.D., 2021. The mortality cost of carbon. Nature communications, 12(1), p.4467. https://www.nature.com/articles/s41467-021-24487-w

The results of this calculation are expected to be conservative (i.e. to underestimate true impacts) for three principal reasons:

Firstly, the calculation relies on the companies' self-reported greenhouse gas emissions data for the year 2022. Depending on the carbon accounting approach, the companies' greenhouse gas emissions could be higher than what the companies self-reported. For example, in 2022, Greenpeace France published a report challenging TotalEnergies' carbon accounting. According to the estimated calculations, the company's 2019 carbon emissions could actually be close to four times higher than those that TotalEnergies has published.[17] The presentation of company data and the use of the companies' own reported data for this research does not imply that Greenpeace accepts the validity of these values. Greenpeace has not independently audited or verified these data and independent emission datasets are not yet available for recent years.

Second, the Mortality Cost of Carbon only looks at temperature-related excess deaths, meaning premature deaths caused directly by heat and cold exposure. Deaths that might occur as a result of other future climate impacts like typhoons, forest fires, infectious disease, or drought are not included, neither are those related to air pollution or other contemporary hazards that result from the production and use of fossil fuels.

Third, the projection of future climate change, from which the mortality estimate is calculated, is produced using a conservative future greenhouse gas emissions scenario. The emissions scenario used is comparable with the IPCC's representative concentration pathway 2.6 (RCP 2.6)[18] and results in 2.4 °C of warming by 2100. Larger numbers of premature deaths per ton of carbon emitted would be expected under scenarios leading to higher global temperatures.

For these reasons, the true number of premature deaths attributable to the greenhouse gas emissions of the nine oil and gas companies could be larger. Nevertheless , the projected death toll arising from the level of emissions reported by the companies listed is shocking.

17 Greenpeace France, 2022. Bilan carbone de TotalEnergies: Le compte n'y est pas. https://www.greenpeace.fr/espace-presse/rapport-bilan-carbone-de-totalenergies-le-compte-ny-est-pas-la-major-serait-responsable-de-pres-de-quatre-fois-plus-demissions-de-gaz-a-effet-de-serre-que-ce-quelle-dec/

18 Representative Concentration Pathways (RCPs) are predefined scenarios that describe example future changes in the emission and concentration of greenhouse gasses. Four RCPs are used in IPCC climate assessment reports. RCP 2.6 used here is the scenario with the earliest peak in greenhouse gas emissions and least disturbance of the climate system.

THE MORTALITY COST OF CARBON CALCULATION

Integrated Assessment Models are routinely used to assess the impact of climate change in economic terms. They use 'damage functions' to relate emissions or warming to projected climate costs, frequently presenting the costs in dollars. These economic terms suggest that losses, whether they are human deaths, species extinctions, or damage from extreme weather events, can be directly replaced by economic growth elsewhere. Valuing deaths in this way is complex and morally highly controversial.[19 20 21]

The Mortality Cost of Carbon (MCC)[22] develops an approach that measures the impact of climate change in terms of human mortality, rather than economic impacts like Integrated Assessment Models. This human framing emphasizes that human lives lost due to anthropogenic climate change cannot simply be replaced by economic gains elsewhere.

The MCC estimates the number of deaths caused by one additional metric ton of CO_2. Specifically, a MCC calculation with the base year set at 2020 estimates the number of temperature-related excess deaths which will take place globally between 2020 to 2100, caused by the emission of one additional metric ton of carbon dioxide-equivalent in 2020. Excess deaths are deaths attributable to climate impacts that occur prematurely relative to a counterfactual scenario in which the greenhouse gas emission did not occur.

The MCC is calculated in an Integrated Assessment Model called DICE-EMR. DICE-EMR uses a simplified climate model and a mortality damage-function to link temperature change to future premature deaths. Here, DICE-EMR's 'optimal emissions' scenario is used.

19 Bressler, R.D. & Heale, G., 2022. Valuing Excess Deaths Caused by Climate Change. National Bureau of Economic Research. Working Paper 30648. DOI 10.3386/w30648
20 Gambhir, A.; Butnar, I.; Li, P.-H.; Smith, P.; Strachan, N. A Review of Criticisms of Integrated Assessment Models and Proposed Approaches to Address These, through the Lens of BECCS. Energies 2019, 12, 1747. https://doi.org/10.3390/en12091747
21 Thompson, E., 2022. Escape from Model Land: How mathematical models can lead us astray and what we can do about it. Basic Books.
22 Bressler, R.D., 2021. The mortality cost of carbon. Nature communications, 12(1), p.4467.
23 Bressler, R.D., 2021. The mortality cost of carbon. Nature communications, 12(1), p.4467.

This scenario is similar to the IPCC's representative concentration pathway 2.6 (RCP 2.6) and results in 2.4 °C of warming by 2100. DICE-EMR's baseline emissions scenario, not used in this study, results in 4.1 °C of warming by 2100. Had the baseline emission scenario been used, a larger number of premature deaths would be projected per ton of carbon emissions.

The mortality cost-function was developed from a systematic research synthesis of studies that project the global number of excess deaths, or the increase in the mortality rate, for specific warming scenarios. Only temperature-related mortality is considered, so the resulting mortality damage function relates future temperature change to mortality. Other causes of mortality linked to fossil fuel use, including those related to climate or exposure to air pollution, for example, are not included, meaning the mortality damage function is likely to provide a conservative estimate of mortality linked to fossil fuel use.

When the mortality cost-function is applied within the Integrated Assessment Model using the 'optimal emissions' scenario, it estimates that adding 9,318 metric tons of CO_2 into the atmosphere during 2020 will cause one excess death globally between 2020-2100. For higher emission tonnages, the number of tonnes that would lead to 1 excess death is reduced. This is because the model uses a nonlinear function to relate emissions to premature mortality.

In this way, the future excess deaths until 2100 that could be attributed to carbon emissions are estimated using the CO_2e emissions for the nine European oil and gas companies. Two DICE-EMR simulations are compared. These are:

- a Base simulation which includes CO_2e emissions following the DICE-EMR 'optimal emissions' scenario, similar to RCP 2.6, and
- a Base - Marginal Emissions simulation, where marginal emissions equivalent to each oil and gas company's 2022 emissions are removed.

The experiment only changes emission in the model year 2020, which is the closest model time step to the year 2022, emissions in subsequent years are unchanged. The global number of temperature-related excess deaths resulting from the change in emission is estimated by comparing mortality estimates for each scenario.

UNCERTAINTY AND LIMITATIONS OF MORTALITY COST OF CARBON

It is not possible to project with absolute certainty how our climate will change or the impacts it will have. Thus, carbon mortality estimates are reliant on assumptions about emissions, climate dynamics and human responses to future climates. The results we present are based on the central estimates of each projection.

Sources of uncertainty in the MCC methodology implemented here include those relating to the future evolution of the climate, those resulting from the mortality damage function, and propagation of these uncertainties in each step of the calculation. Uncertainties in emissions data are discussed in section 4.

Limitations of the method relating to future climates stem from the climate model and emission scenario used. As with all IAMs, the DICE-EMR model has a highly simplified representation of the climate system. Only one future climate scenario is investigated here, the DICE-EMR optimal emissions scenario. This scenario is similar to the IPCC's RCP 2.6. Future climates may not follow this concentration pathway, but the pathway selected here is the most conservative of those readily available in DICE-EMR.

Limitations of the method relating to the mortality calculation include:

- that only temperature-related deaths are considered,

Deaths that might occur as a result of other future climate impacts are not included; neither are those related to air pollution or other contemporary hazards that result from the production and use of fossil fuels.

- the MCC is in units of excess deaths, not lost life years,

The MCC is expressed in terms of 'excess deaths' I.e., all premature deaths are counted the same regardless of the age at death. The model does not estimate the lost life years.

- and assumptions made in the construction of the mortality damage function.

The mortality damage function combines data from previous studies, each of which have some uncertainty. The shape of the mortality cost-function, and hence the mortality projections it makes, are dependent on how the previous studies and their uncertainties are combined.

A recent comparison of different approaches that estimate future mortality resulting from carbon emissions found that because the MCC only considers temperature-related deaths, it is therefore consistent but conservative when compared with the other independent methodologies.[24] Given the inherent uncertainty in future projections of mortality, this work has adopted a highly conservative approach.

24 Pearce, J.M. and Parncutt, R., 2023. Quantifying Global Greenhouse Gas Emissions in Human Deaths to Guide Energy Policy. Energies, 16(16), p.6074.

THE COMPANIES' GREENHOUSE GAS EMISSIONS DATA

The mortality calculation uses estimated annual emissions of carbon dioxide equivalent (CO_2e) for each company. The approach used for data selection is to use recent and comparable data, as published by the companies themselves. Data are selected from 2022, the most recent year available and estimates are taken from the companies own reports.

Included are the companies' own reported data for scope 1, scope 2 and scope 3 category 11. The GHG Protocol Corporate Accounting and Reporting Standard classifies a company's GHG emissions into three 'scopes'[25]: "Scope 1 emissions are direct emissions from owned or controlled sources. Scope 2 emissions are indirect emissions from the generation of purchased energy. Scope 3 emissions are all indirect emissions (not included in scope 2) that occur in the value chain of the reporting company, including both upstream and downstream emissions."

Scope 1

records the carbon emissions that are directly caused by the company's activities. These include, for example, emissions caused by diesel engines or turbines during the extraction or transport of oil and gas; or methane emissions (converted into CO_2 equivalents = CO_2e) released during the extraction of oil and gas at the well site; or the very high emissions associated with the operation of oil refineries.

Scope 2

captures the carbon emissions that the company makes indirectly generated by the company's suppliers. In particular, this includes the CO_2 emissions from the power plants that supply the electricity needed by the oil company, and much more.

Scope 3

covers emissions both directly or indirectly related to the use of the products sold and is therefore the most difficult to measure. Inconsistency between reporting methods is not uncommon. Scope 3 category 11 emissions include emissions from the use of goods and services sold by the reporting company, and include the scope 1 and scope 2 emissions of end users (both consumers and business customers) of the company's products. This includes, in particular, emissions from end users, e.g. when motorists burn fuel purchased from an oil company in their vehicle's engine. Some companies, such as BP, focus on emissions resulting from the use of the oil and gas products they have produced themselves (net share). TotalEnergies uses a mixed approach that, depending on the product, uses either the quantity produced or the quantity sold to calculate emissions. Scope 3 emissions are the most controversial and most difficult to calculate and establish. At the same time scope 3 emissions are the highest in the "life cycle" of fossil fuels, because most carbon is released into the atmosphere when oil and gas are burnt.

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25 Wbcsd, W.R.I., 2004. The greenhouse gas protocol. A corporate accounting and reporting standard, Rev. ed. Washington, DC, Conches-Geneva. https://ghgprotocol.org/sites/default/files/standards/ghg-protocol-revised.pdf

All nine companies included in this research report scope 1, scope 2 and scope 3 category 11 emissions with the exception of BP. Instead of reporting scope 3 category 11 emissions, BP introduces the category "emissions from carbon of own upstream production" in their reports which only covers part of the emissions that the other five companies report under scope 3 category 11.

The presentation of company data and the use of the companies' own reported data for this research does not imply that Greenpeace accepts the validity of these values. Greenpeace has not independently audited or verified these data and standardized, independent emission datasets for all of the nine companies such as the Carbon Majors Report from the Climate Accountability Institute[26] are not yet available for recent years.

Given that all companies estimate and report their carbon emissions differently, the carbon emissions data extracted from the companies' reports and used for this calculation is only comparable to a very limited degree. By using self-reported carbon emissions, we risk that companies who underestimate or inaccurately report their carbon emissions are portrayed more favorably than they actually are in comparison with other companies.

In 2022, Greenpeace France published a report challenging TotalEnergies' carbon accounting. According to the estimated calculations, the company's 2019 carbon emissions could actually be close to four times higher than those that TotalEnergies has published.[27] This report is the subject of a SLAPP[28] by TotalEnergies against Greenpeace France, with TotalEnergies demanding that Greenpeace France's report and any mention of it be deleted.[29]

Existing independent emission datasets provide inter-comparable numbers, for example the Climate Accountability Institute's Carbon Majors Database. However, the emissions data are not usually available for the most recent years.

In order to provide an estimate of future deaths resulting from last year's carbon emissions, and to use numbers over which the companies cannot quibble, the companies' own reported greenhouse gas emissions data for 2022 are used for this calculation.

26 https://climateaccountability.org/carbon-majors/

27 Greenpeace France, 2022. Bilan carbone de TotalEnergies: Le compte n'y est pas. https://www.greenpeace.fr/espace-presse/rapport-bilan-carbone-de-totalenergies-le-compte-ny-est-pas-la-major-serait-responsable-de-pres-de-quatre-fois-plus-demissions-de-gaz-a-effet-de-serre-que-ce-quelle-dec/

28 SLAPP is an acronym for a Strategic Lawsuit Against Public Participation. SLAPPs are civil lawsuits that are brought by powerful organisations or individuals to deter public protest, in order to syphon economic resources from the defendants. This type of lawsuit is a well-known corporate strategy to stifle any criticism and protest, and is often based on unfounded accusations. See: European Centre for Press and Media Freedom: https://www.ecpmf.eu/slapp-the-background-of-strategic-lawsuits-against-public-participation/

29 Greenpeace France, 2023. Justice : TotalEnergies tente de museler Greenpeace. Press Release. https://www.greenpeace.fr/espace-presse/justice-totalenergies-tente-de-museler-greenpeace

Table 1. Greenhouse gas emissions reported by oil and gas companies in 2022 ($MtCO_2e$)

Company	Year	Scope 1	Scope 2	Scope 3 Category 11 (Use of sold products)	“Emissions from carbon of own upstream production”	Combined emissions
		$MtCO_2e$	$MtCO_2e$	$MtCO_2e$	$MtCO_2e$	$MtCO_2e$
Shell[30 31]	2022	51.0	7.0	910.0		968.0
TotalEnergies [32 33 34]	2022	51.0	5.0	381.0		437.0
BP[35 36 37]	2022	33.9	1.6		306.7	342.2
Equinor[38]	2022	11.4	2.5	243.0		256.9
Eni[39]	2022	39.4	0.8	164.0		204.2
Repsol[40]	2022	15.7	0.4	182.0		198.1
OMV[41]	2022	11.7	0.9	99.4		112.0
Orlen[42]	2022	21.1	1.6	87.7		110.4
Wintershall Dea[43]	2022	1.9	0.01	76.00		77.9
Combined total	2022					2706.7

(Source: company reports, rounded figures; references per company see footnotes)

30 *Shell, 2023. Sustainability Report 2022.* https://reports.shell.com/sustainability-report/2022/
31 *Shell, 2023. Annual Report and Accounts 2022.* https://reports.shell.com/annual-report/2022/
32 *TotalEnergies, 2023. ESG Databook 2022 (XLSX).* https://totalenergies.com/investors/esg
33 *TotalEnergies, 2023. Universal Registration Document 2022.* https://totalenergies.com/investors/esg
34 *TotalEnergies, 2023. Sustainability & Climate 2023 Progress Report.* https://totalenergies.com/investors/esg
35 *BP, 2023: ESG Datasheet 2022.* https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/sustainability/group-reports/bp-esg-datasheet-2022.pdf
36 *BP, 2023. Sustainability Report 2022.* https://www.bp.com/en/global/corporate/sustainability.html
37 *BP, 2023. Net Zero Ambition Progress Update.* https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/investors/bp-net-zero-progress-update-2023.pdf
38 *Equinor, 2023. 2022 Integrated Annual Report.* https://www.equinor.com/investors/annual-reports
39 *Eni, 2023. Annual Report 2022.* https://www.eni.com/assets/documents/eng/reports/2022/Annual-Report-2022.pdf
40 *Repsol, 2023. Repsol Group Integrated Management Report 2022.* https://www.repsol.com/content/dam/repsol-corporate/en_gb/accionistas-e-inversores/resultados/2022/q4/integrated-management-report-2022.pdf
41 *OMV, 2023. Sustainability Report 2022. Non-Financial Report.* https://reports.omv.com/en/sustainability-report/2022/
42 *Orlen Group, 2022. Greenhouse Gas Emissions Statement.* https://www.orlen.pl/content/dam/internet/orlen/pl/en/sustainable-development/our-emissions/GREENHOUSE%20GAS%20EMISSIONS.pdf
43 *Wintershall Dea, 2023. Energy in transition. Sustainability Report 2022.* https://wintershalldea.com/sites/default/files/media/files/20220321_WD_SR2022_EN_Interaktiv.pdf

RESULTS OF THE CALCULATION

Projected temperature-related excess deaths resulting from emissions equivalent to the self-reported 2022 CO_2e emissions of Shell, TotalEnergies, BP, Equinor, Eni, Repsol, OMV, Orlen, and Wintershall Dea are presented in Table 2 and Figure 1. The calculations in table 2 and figure 1 have been confirmed by R. Daniel Bressler and are in line with the Mortality Cost of Carbon.

Table 2. Self-reported CO_2e emissions for the year 2022 for a selection of European oil and gas majors and projected mortality estimates derived from those emission values using the Mortality Cost of Carbon metric

Company	2022 Emissions (Mt CO_2e)	Cumulative temperature-related excess deaths 2100 (MCC) projected from such emissions
Shell	968.0	130,000
TotalEnergies	437.0	57,000
BP	342.2*	45,000*
Equinor	256.9	34,000
Eni	204.2	27,000
Repsol	198.1	26,000
OMV	112.0	15,000
Orlen	110.4	15,000
Wintershall Dea	77.91	10,000
Combined total	2706,7	360,000**

* Instead of reporting scope 3 category 11 emissions, BP introduces the category “emissions from carbon of own upstream production” in their reports which only covers part of the emissions that the other five companies report under scope 3 category 11.
** This is the sum of cumulative temperature-related excess deaths by 2100 projected using emissions equivalent to those from each company, rounded to 2 significant figures.

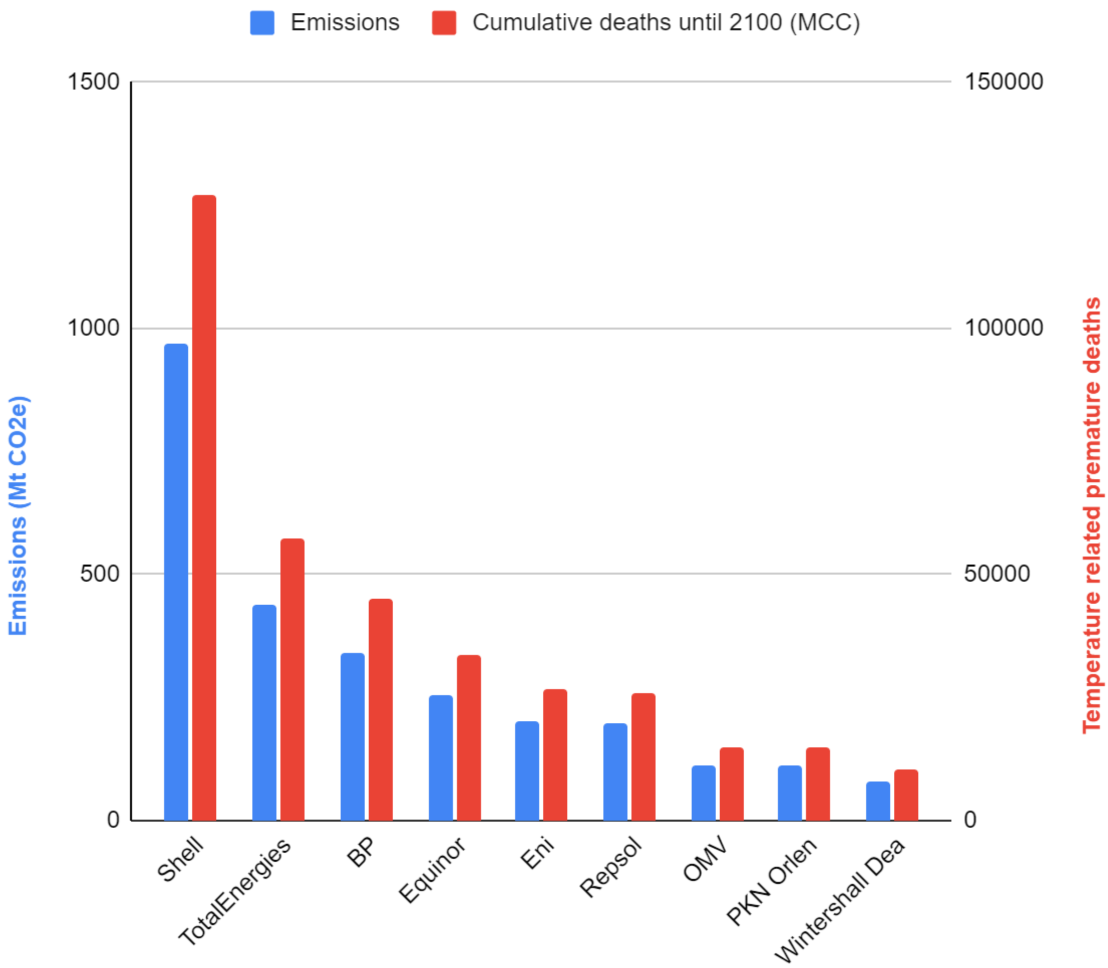

Figure 1. Self-reported CO_2e emissions for the year 2022 for a selection of European oil and gas majors (blue) and projected mortality estimates until 2100 derived from those emission values (red) using the Mortality Cost of Carbon metric

KEY FINDINGS AND CONCLUSIONS

Emissions from fossil fuels are a main driver of the climate crisis. The climate crisis is already having deadly impacts around the world, which are disproportionately impacting people, communities and entire countries that have contributed the least to global emissions.

The Mortality Cost of Carbon method was applied to the 2022 self-reported greenhouse gas emissions of nine major European oil and gas companies. It projects that emissions of CO_2e equivalent to that produced by these companies in 2022 alone collectively cause 360,000 expected temperature-related premature deaths by the end of the century (2100) compared to a scenario where those emissions did not occur.

The true estimated number of premature human deaths attributable to the greenhouse gas emissions of the nine oil and gas companies could be higher than what has been presented in this study due to three reasons:

Firstly, the calculation relies on the companies' self-reported greenhouse gas emissions data for the year 2022. Depending on the carbon accounting approach, the companies' greenhouse gas emissions could be higher than what the companies self-reported. Second, the MCC does not cover premature deaths as a result of other future climate impacts or those related to air pollution or other contemporary hazards that result from the production and use of fossil fuels. And third, the MCC uses a conservative future greenhouse gas emissions scenario.

Every metric ton of carbon emitted today, will have deadly consequences for decades to come. Rapidly reducing carbon emissions and phasing-out all fossil fuels is therefore truly a matter of life and death. According to Bressler, limiting global warming to 2.4 °C degrees - the 'optimal' emissions path developed in his MCC research and underlying also the calculations in this study - could save 74 million lives over the course of the twenty-first century compared to the scenario of 4.1 °C degrees global heating used as Bressler's starting point that could lead to an estimated 83 million temperature-related excess deaths by 2100.[44] Limiting global heating to 1.5 °C can be expected to significantly further reduce the number of temperature-related excess deaths.

By fueling the climate crisis, fossil fuel companies are already today responsible for deadly climate impacts. These deadly activities need to be stopped as soon as possible and fossil fuel companies need to be held accountable for the excess deaths caused by their emissions.

The science is clear: In order to limit global heating to 1.5 °C degrees and stop the climate crisis from escalating further, fossil fuel use must be reduced immediately and substantially.[45] We must end the era of fossil fuels, starting by abandoning all new fossil fuel extraction projects that create dangerous carbon lock-ins[46] and are incompatible with limiting global heating to 1.5 °C.[47]

The Mortality Cost of Carbon (MCC) uses estimates of future emission scenarios to project climate and mortality impacts of today's emissions. No one knows for sure how the climate will change in the coming decades; this will depend on political decisions and actual carbon emissions.

It is in our power to stop the climate crisis from further escalating. It is in our power to end the era of fossil fuels. And it is in our power to protect present and future generations from deaths attributable to the emissions of the reckless fossil fuel industry.

APPENDIX 1

The DICE-EMR model in 'Optimised' configuration including the calculations presented in this document can be viewed as a Microsoft Excel file HERE.

44 *Bressler, R.D., 2021. The mortality cost of carbon. Nature communications, 12(1), p.4.*

45 *IPCC, 2023: Summary for Policymakers. In: Climate Change 2023: Synthesis Report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H. Lee and J. Romero (eds.)]. IPCC, Geneva, Switzerland, pp. 1-34, doi: 10.59327/IPCC/AR6-9789291691647.001*

46 *The term "carbon lock-in" is used to describe economies which through a path-dependent process driven by technological, institutional and social factors become locked into fossil-fuel based technological systems that perpetuate fossil fuel based-infrastructures in spite of their known environmental externalities and the apparent existence of cost-neutral, or even cost-effective, remedies. See: Unruh, G.C., 2000. Understanding carbon lock-in. Energy Policy, Volume 28, Issue 12, pp. 817-830. https://doi.org/10.1016/S0301-4215(00)00070-7*

47 *IISD, 2022. Navigating Energy Transitions: Mapping the road to 1.5°C. https://www.iisd.org/publications/report/navigating-energy-transitions*