Briefing, November 2024

PAYING THE PRICE

The economic impacts of six extreme weather events in 2024, compared against the potential revenue from a Climate Damages Tax on seven major oil and gas companies.

INTRODUCTION

2024 has been marked by a surge of extreme weather events, leaving a trail of destruction across communities globally. From the destructive forces of Hurricanes Helene and Milton to the unexpected flooding in the ordinarily dry Sahara Desert, the increased severity and intensity of these extreme weather events have underscored the lack of preparedness to face looming disasters.

The numbers can never tell the full story; lives, homes, cultures and hope for the future cannot be quantified in money alone. Yet when communities need to rebuild, families heal, and businesses recover, there are bills to be paid. Who should pay? This is fundamentally an issue of climate justice. For years, oil and gas corporations have deliberately misled the public while delaying the transition away from fossil fuels. Communities that now face severe climate impacts and disasters are left to bear the economic, social and emotional costs.

This briefing juxtaposes the costs and scale of losses to countries arising from a sample of six recent climate-change-induced extreme weather events (Part 1) with the huge profits accrued by international oil and gas companies and estimates of the companies' potential to pay Climate Damages Tax (Sharma and Hillman, 2024) (Part 2).

The briefing employs the Climate Damages Tax proposal by Stamp Out Poverty as a potential part of the solution. This proposal advocates taxing international oil and gas companies (IOCs) that have been central to driving the climate crisis, such as ExxonMobil, Shell, TotalEnergies, BP, Chevron, Equinor and Eni. It gives illustrative examples to show how this tax on the CO_2e embedded within the fossil fuels they extract (estimates calculated from their reported production volumes) would help meet these public and socialised costs while making the polluters pay.

This briefing contributes to the growing civil society call for long term tax on fossil fuel extraction, with year-on-year increases, combined with taxes on excess profits and other levies.

PART 1. ECONOMIC AND OTHER COSTS OF EXTREME WEATHER EVENTS

For this briefing, Greenpeace International selected six extreme weather events occurring in 2024 from a shortlist of 17 such events covered by the media. Selection required each event to have a clear climate change attribution. We sought at least one instance of three main weather event types (hurricane/typhoon/storm, heatwave/fire/drought, heavy rain/flood/landslides), at least three cases from the Global South, sufficiently authoritative cost estimates and sizable losses for countries concerned.[1] See Table 1.

Table 1. Selected extreme weather events, 2024, dates and estimated cost

Event/countries	Date	Estimated cost
1. Hurricane Beryl, US Gulf states, Caribbean and Mexico	June and July 2024	At least $6.6bn
2. Hurricane Helene, southeastern USA	September 2024	At least $13bn
3. Heatwave, India	May and June 2024	At least $25bn
4. Floods in Rio Grande do Sul, Brazil	April and May 2024	At least $17.4bn
5. Typhoon Carina/Gaemi, Philippines, China Mainland, Taiwan, North Korea	July 2024	At least $2.49bn
6. Floods, Kenya	March to May 2024	$79mn
Total		**At least $64.6bn**

Details concerning each weather event follow below.

Data limitations and related points

- Cost estimates for the featured extreme weather events are indicative and far from definitive.
- These estimates represent only a sample of total annual costs worldwide of one-off extreme weather events and of cumulative climate change loss and damage borne by people and communities, including erosion of agricultural productivity in many regions.
- The World Meteorological Organization (2023) puts the total economic cost of climate change from 1970 to 2021 as 'US$4.3 trillion and rising'.
- Cost estimates are often hard to find and/or imprecise, especially for countries and regions in the Global South, where disaster data collection, reporting, and recovery

infrastructure and resources are usually more limited than in the North. This makes comparisons between weather events and affected countries difficult.

- All insurance-based loss data is highly likely to underestimate the true costs by omitting uninsured losses.
- Significant costs transcend or are below the radar of many if not most monetary estimates: loss of life, physical and psycho-social health impairment, cultural damage (affecting both material culture and intangible socio-cultural goods), unreported damage to homes and personal property, loss of school and work days (work days are included in some estimates but not in others), effects on social cohesion and community resilience, and costs of permanent displacement and migration as some traditional nature-based livelihoods cease to be financially viable.
- Numbers of deaths in the Global South, particularly in remote regions, can be heavily disputed.
- Relatively low cost estimates for loss and damage in the South are likely to reflect the lack of insurance cover, the lack of high-money-value infrastructure and more reliance on the undervalued informal economy.
- Much larger estimated monetary losses in the North may also belie the greater severity of damage to human lives and wellbeing in the South, where economies are smaller in monetary terms, more people rely on ecosystem survival resources (which are often uncosted), and there is less capacity to recover.
- Poor communities in poor countries, with precarious nature-dependent livelihoods and often makeshift housing, suffer most.

1. Hurricane Beryl, US Gulf states, Caribbean and Mexico (June and July 2024)

Scattered debris on the island of Petite Martinique, Grenada, in the aftermath of Hurricane Beryl | © *OSV News/Reuters/Arthur Daniel*

General description: Hurricane Beryl, the earliest Category 5 hurricane ever recorded, with 165mph winds, affected Barbados, Saint Lucia, Saint Vincent, Grenada, Jamaica, the Cayman Islands and other Caribbean islands, Mexico, and the US Gulf Coast (Gopalan, 2024; Weather Channel, 2024).

Climate change attribution: 'Hurricane Beryl's extreme winds in Jamaica were nearly twice as likely due to climate change' (Grantham Institute, 2024).

Estimated cost and scope of losses:

- USA: At least **$6bn** (National Oceanic and Atmospheric Administration, 2024): damage to homes and infrastructure; job and wage losses; supply chain interruptions; power outages; flight delays and cancellations; government clean-up (AccuWeather, 2024).
- Caribbean region: **$510mn**: demolition of buildings; infrastructure damage; disruption of agriculture and fisheries; loss of incomes (IFRC, 2024; Jackson, 2024; Karen Clark & Co., 2024). For example:
  - Grenada and its dependencies: $440mn:[2] destruction of homes, farms, schools and other buildings, mangrove forests, water infrastructure, electricity grids and fishing sector; roads impassable; power outages (Cotterill and Harris, 2024; Hernandez and Franklin, 2024; OCHA, 2024; Reuters, 2024).
  - Jamaica: At least $76mn,[3] very likely more: destruction of food crops and farm infrastructure (especially coconut and banana plantations and poultry sector) at $64mn; damage to housing and public health sector buildings (at least $12mn) and to other buildings, roads and electricity power lines (Mathison, 2024; Myers, 2024; ReliefWeb, 2024b).
- Mexico: **$90mn** (Jackson, 2024; Karen Clark & Co., 2024).[4]
- Total estimated cost: At least **$6.6bn**.

Fatalities and other non-costed aspects and issues: At least 36 deaths occurred region-wide, as did psycho-social trauma (Lozano and Stengle, 2024; Smith, 2024). In Jamaica, severe impacts on small poultry farmers, many of them single women, had implications for children's school fees (Mathison, 2024). In the Caribbean, 'stronger storms lead to longer recovery periods, which can increase governments' public debt as they borrow at high interest rates from multilateral institutions to rebuild after the storm has passed' (Mowla, 2024).

Previous such events: According to Swiss Re (2024), 'the US economy loses almost 0.4% of GDP ($97bn)' to floods, tropical cyclones and severe thunderstorms annually. In Jamaica climate hazards affected over 2 million people (out of a total population of 2.6mn) between 1980 and 2022, causing total adjusted damage of $5.4bn (ACAPS, 2024a). Beryl was potentially 'one of Jamaica's top-three most damaging hurricanes in history, along with Hurricane Gilbert of 1988 ($2.5bn in inflation-adjusted damage) and Hurricane Ivan of 2004 ($920mn)' (Masters and Henson, 2024a).

2. Hurricane Helene, southeastern USA (September 2024)

Hurricane Milton's aftermath on west coast beaches in Florida. The destroyed roof of Tropicana Field following Hurricane Milton is visible in the aerial view of the stadium |
© *Tim Aubry / Greenpeace*

General description: Emerging from the northwestern Caribbean Sea, Hurricane Helene rapidly intensified and hit southeastern US states (Florida, Georgia, South Carolina, North Carolina, Virginia, Tennessee) as a Category 4 hurricane in late September 2024, with storm surges and widespread flooding (Danielle, 2024; Ramirez, Barber and Chinn, 2024; Shapiro *et al.*, 2024). The USA's deadliest mainland hurricane since Katrina in 2005 (Masters and Henson, 2024b), it was followed within two weeks by Hurricane Milton in early October (Drenon and FitzGerald, 2024).

Climate change attribution: 'Climate change key driver of catastrophic impacts of Hurricane Helene' (World Weather Attribution, 2024c).

Estimated cost and scope of losses: At least **$13bn** (Moody's, 2024):[5,6] power outages requiring electricity infrastructure repair or rebuild; widespread flooding; many households without clean water; communication disruptions; highways destroyed; damaged bridges and railway tracks; mudslides on to homes and other property damage; business disruption and rural communities cut off (Williams and Bernard, 2024; Wolfe *et al.,* 2024).

Fatalities and other non-costed aspects and issues: More than 230 deaths occurred (Shapiro *et al.,* 2024). Much flood-related damage was not covered by insurance (Rajbhandari, 2024a).

Previous such events: According to Swiss Re (2024), 'the US economy loses almost 0.4% of GDP $97bn)' to floods, tropical cyclones and severe thunderstorms annually. Helene followed less than three months after Hurricane Beryl (see weather event (i) above).

3. Heatwave, India (May and June 2024)

Residents collect water from a tanker during high temperatures in New Delhi, India, on Thursday 30 May 2024 | © *Prakash Singh | Bloomberg | Getty Images*

General description: India had its longest recorded heatwave, with temperatures reaching 49.9°C or 50°C in New Delhi (Dash and Mehta, 2024; Mukherjee, 2024).

Climate change attribution: 'Climate change made the deadly heatwaves that hit millions of highly vulnerable people across Asia more frequent and extreme' (World Weather Attribution, 2024d).

Estimated cost and scope of losses: At least **$25bn**,[7] affecting all economic sectors where heat exposure is significant, including through water shortages and lost hydropower generation; electricity blackouts and higher power consumption for cooling; lost outdoor working hours; crop failure; livestock loss; damage to fresh produce (food losses up to $13bn) (Pearce and Ware, 2024; Press Trust of India, 2024; Woetzel *et al.,* 2020).

Fatalities and other non-costed aspects and issues: Hundreds of deaths occurred (likely underreported), including at least 192 among homeless people in Delhi during 11–19 June (Dalal, 2024; Mitra and Magramo, 2024). Severe heat impacts disproportionately on low-income workers in high-risk sectors (such as construction, agriculture, sanitation) and gig workers, through illness and loss of livelihoods. This then impacts their households. It also especially harms women and girls because of their burden of unpaid domestic labour (including providing care for heat-related illness), their relative poverty and low pay compared to men, and their greater vulnerability to health risks and to gender-based violence (Climate Resilience Center, 2024; Press Trust of India, 2024).

Previous such events: India's 2024 heatwave was the third consecutive summer of such events (Ghosh, 2024).

4. Floods in Rio Grande do Sul, Brazil (April and May 2024)

Devastation in Arroio do Meio, Rio Grande do Sul, Brazil | © *Fernanda Ligabue / Greenpeace*

General description: Unprecedented rainfall and widespread floods impacted on Brazil's southern state of Rio Grande do Sul State, including the state capital Porto Alegre (Aon, 2024b).

Climate change attribution: 'Climate change, El Niño and infrastructure failures behind massive floods in southern Brazil' (World Weather Attribution, 2024a).

Estimated cost and scope of losses: At least **$17.4bn** (Brasil Participativo, 2024)[8] in federal aid to Rio Grande do Sul State to cover 'a wide range of impacts, from infrastructure damage to the displacement of families, the disruption of livelihoods, and the destruction of crops and livestock – all of which have had profound economic and social repercussions' (Climate Department, 2024).

Fatalities and other non-costed aspects and issues: 183 deaths were reported (Climate Department, 2024), including from waterborne disease, with hundreds of thousands displaced (Pearce and Ware, 2024). Infrastructure failure and underinvestment in flood protection measures contributed to the impacts (Aon, 2024b).

Previous such events: Brazil suffered losses from major drought in 2022–23 ($2.5bn), as well as from flooding (several billion USD) in 2023 (Aon, 2024a). '[M]ore than 28.8 million people in Brazil were affected by disasters related to rain, floods and landslides between 2017 and 2022. In just one year, these disasters cost over BRL 105bn ($20.4bn) from public coffers' (Fontes, 2024).

5. Typhoon Carina/Gaemi, Philippines, China Mainland, Taiwan and North Korea (July 2024)

Typhoon Gaemi and southwest monsoon impacts in Quezon City, Philippines | © *Noel Celis / Greenpeace*

General description: Typhoon Gaemi, named Super Typhoon Carina in the Philippines, with winds of up to 191km per hour and intensified rainfall, passed close by the Philippines and made landfall in Taiwan and eastern China Mainland over a week-long period, causing severe flooding and landslides (Climate Centre, 2024; NCDR Taiwan, 2024; Ong, Wang and Serapio, 2024; ReliefWeb, 2024d).

Climate change attribution: 'Climate change increased Typhoon Gaemi's wind speeds and rainfall, with devastating impacts across the western Pacific region' (World Weather Attribution, 2024b).

Estimated cost and scope of losses (combined with effects of southwest monsoon):

- Philippines: At least $185mn (National Disaster Risk Reduction and Management Council/NDRRMC, 2024):[9] damage (including by flooding) to houses, agriculture, fisheries, factories, warehouses and retail outlets, irrigation, and other infrastructure and assets (ACAPS, 2024b; AHA Center, 2024; NDRRMC, 2024). Costs potentially billions of USD (Kaufman, 2024).
- China Mainland: $2bn (Ministry of Emergency Management, 2024):[10] including damage from flash flooding and landslides, damaged farmland, roads, homes and communication facilities, river dyke failures and power outages; 312,000 people displaced (Insurance Asia, 2024; Ministry of Emergency Management, 2024).
- Taiwan: At least $308mn (NCDR, 2024):[11] including agricultural and infrastructure

damage affecting homes, schools and other buildings, roads, railways, water supplies, drainage systems and other infrastructure (Lai and Wu, 2024; Ministry of Interior, 2024; Nakhiengchanh, 2024; NCDR, 2024; Ong, Wang and Sullivan, 2024).

- Total estimated cost: At least **$2.49bn**.

Fatalities and other non-costed aspects and issues: At least 48 deaths were reported in the Philippines (NDRRMC, 2024), 96 in China Mainland (Ministry of Emergency Management, 2024) and 11 in Taiwan, with hundreds injured (Executive Yuan, 2024; Focus Taiwan, 2024). North Korean fatalities are unknown. The Philippines' central government and over 100 cities and municipalities in the country declared a state of calamity (ACAPs, 2024b; JBA, 2024).

Previous such events: Swiss Re (2024) states the Philippines 'loses 3% of GDP (USD 12 billion)' to floods, tropical cyclones and severe storms annually and is exposed to 'hazard intensification'. The Asian Development Bank Institute says extreme weather events cost the Philippines about $1.2bn annually between 2000 and 2016 (Jha *et al.,* 2024). China Mainland, according to Swiss Re (2024), loses 0.22% of GDP and Taiwan 0.21% to such events each year. Extreme weather damage in China Mainland is reported as costing 'nearly $30 billion' in 2023 (Iyer, 2024). Typhoon Doksuri/Egay (July–August 2023) reportedly cost the Philippines, China Mainland, Taiwan and Vietnam combined $25bn (Xue, 2024).

6. Floods, Kenya (March to May 2024)

Floods in Homa Bay County, Kenya | © *Caleb Mbuvi / Greenpeace*

General description: East Africa experienced severe flooding due to exceptionally heavy rainfall in April, with Kenyan weather stations recording about five times more rain than average (WTW, 2024). Cyclones Hidaya and Laly then hit the region in May, making the flooding the 'worst in memory' (Center for Disaster Philanthropy, 2024; Economist, 2024).

Climate change attribution: 'Kenya: Impacts of climatic shocks on communities' (ReliefWeb, 2024c); 'Brought on by climate change, El Niño and a positive Indian Ocean Dipole, extreme rain caused flooding, landslides and destruction' (Mbiyozo and Owino, 2024).

Estimated cost and scope of losses: Emergency response and reconstruction costs of about **$79mn** (Mwere, 2024)[12] for damage to water infrastructure (pipelines, dams, embankments), homes, food production (livestock, crops, fishing), roads, airports, businesses, schools, health facilities, plus cost of waterborne disease (Economist, 2024; Pearce and Ware, 2024; ReliefWeb, 2024a); more than 293,000 people displaced (Mbiyozo and Owino, 2024).

Fatalities and other non-costed aspects and issues: At least 300 deaths occurred (Mbiyozo and Owino, 2024). Impacts were heavy on the urban poor living in informal settlements (WTW, 2024) and on the school system (Elimu Bora Working Group, 2024). There are 'huge challenges of under-resourced governments across Africa that are grappling with the impact of changing weather patterns and rapid urbanisation' (Schipani and Pilling, 2024). The Kenyan government is 'already struggling to meet revenue targets due to a slowdown in economic performance' (Njagi, 2024a).

Previous such events: Flooding in Kenya in 2023 cost the country 'millions' (Aon, 2024a). After flooding in 2018 the Kenyan government 'had to allocate an extra $120mn (24% of the budget in the previous year) for repairs and maintenance of road infrastructure' (Njagi, 2024b).

PART 2. INTERNATIONAL OIL COMPANY PROFITS AND ESTIMATES FOR CLIMATE DAMAGES TAX

Profits (adjusted earnings)

Seven of the world's largest publicly traded oil and gas companies[13] declared the following adjusted earnings for 2023:[14]

ExxonMobil (USA): $38.6bn

Shell (UK): $28.3bn

Chevron (USA): $24.7bn

TotalEnergies (France): $23.2bn

BP (UK): $13.8bn

Equinor (Norway): $10.4bn

Eni (Italy): $9.2bn (EUR 8.3bn)[15]

Total combined adjusted earnings 2023 (seven selected IOCs): $148.2bn.

Application of Climate Damages Tax (CDT) to address extreme weather loss and damage

Stamp Out Poverty has established in *The Climate Damages Tax: A guide to what it is and how it works* (Sharma and Hillman, 2024) the case for volume-based CDT levied on the volumes of oil and gas that international oil and gas companies (IOCs)[16] extract – in addition to other forms of taxation on IOCs, including significantly higher profit taxes; and with similar taxes on coal-extracting companies.

CDT would be 'a fee on the extraction of each tonne of coal, barrel of oil or cubic metre of gas, calculated at a consistent rate based on how much CO2e [carbon dioxide equivalent] is embedded within the fossil fuel' (Sharma and Hillman, 2024, p.7). Oil and gas emit CO2e at different rates when combusted.

SOP research with Global Witness has found that home government collection of volume-based CDT is feasible, with many countries already collecting volume-based revenue from oil and gas producers.

The following estimates illustrate how much money CDT at $5/tonne of CO2e ($5/t CO2e) could raise from the seven selected IOCs based on their reported annual oil and gas production in 2023.

For the rationale for starting with a low CDT rate of $5/t CO2e, versus a far higher rate closer to the 'social cost of carbon', see Sharma and Hillman (2024, Annex 2). As we indicate in the illustrative projections below, we envisage an annual $5/tonne increase in CDT plus annual inflation increase, as Sharma and Hillman (2024) recommend.

Here we model a straightforward approach for estimating CDT based on the oil and gas production volumes IOCs report annually. The method uses two simple International Energy Agency (IEA, 2023) formulas to estimate CO2e greenhouse gas (GHG) emissions per barrel of oil equivalent (boe) of oil and per boe of natural gas (recognising the two fuels' different CO2e intensity) and covers Scope 1, 2 and 3 emissions.

The Greenhouse Gas Protocol Corporate Accounting and Reporting Standard (World Resources Institute and World Business Council for Sustainable Development, 2024, p.25) classifies companies' GHG emissions into Scope 1 ('[d]irect GHG emissions [that] occur from sources that are owned or controlled by the company'); Scope 2 ('GHG emissions from the generation of purchased electricity consumed by the company'); and Scope 3 ('a consequence of the activities of the company … from sources not owned or controlled by the company … [including] extraction and production of purchased materials; transportation of purchased fuels; and use of sold products and services').

Table 2 illustrates how much CDT each of the seven featured IOCs would pay annually over three years, based on their reported production volumes in 2023, assuming each company reduced its CO2e emissions by 10% annually, and assuming CDT increased by $5/tonne plus 2% inflation annually.

Table 2. IOCs' potential CDT obligations, years 1 to 3 ($bn)

IOC	2023 adjusted earnings ($bn)	Year 1: CDT at $5/t CO2e ($bn)	Year 2: CDT at $10.10/t CO2e ($bn)	Year 3: CDT at $15.30/t CO2e ($bn)
ExxonMobil	38.6	3.19	5.80	7.90
Shell	28.3	2.30	4.18	5.70
Chevron	24.7	2.54	4.61	6.29
TotalEnergies	23.2	2.06	3.74	5.10
BP	13.8	1.88	3.41	4.65
Equinor	10.4	1.72	3.12	4.25
Eni	9.2	1.34	2.43	3.32
Total	**148.20**	**15.02**	**27.30**	**37.22**

Details for each company and further illustrative projections follow below. For additional calculation details, see the annex on methodology.[17]

ExxonMobil: 2023 adjusted earnings $38.6bn

2023 reported daily production volumes: oil (total liquids inc. nat. gas liquids) 2.45mn barrels oil equivalent (Mboe); natural gas 1.29 Mboe[18]

Annual production: 894.25 Mboe oil/year; 471.43 Mboe gas/year[19]

Equivalent emissions:

Oil: 894.25 Mboe x 510kg CO2e/boe ÷ 1,000[20] = 456.07 Mt CO2e

Gas: 471.43 Mboe x 385kg CO2e/boe ÷ 1,000[21] = 181.50 Mt CO2e

Total estimated 2023 Scope 1–3 emissions: 456.07 + 181.50 = 637.57 Mt CO2e

CDT at $5/tonne CO2e: 637.57 Mt x $5 = **$3.19bn**

Shell: 2023 adjusted earnings $28.3bn

2023 reported daily production volumes: oil (crude oil & liquid nat. gas + synthetic crude oil) 1.50 Mboe; natural gas 1.29 Mboe[22]

Annual production: 548.23 Mboe oil/year; 469.03 Mboe gas/year[23]

Equivalent emissions:[24]

Oil: 548.23 Mboe x 510kg CO2e/boe ÷ 1,000 = 279.60 Mt CO2e

Gas: 469.03 Mboe x 385kg CO2e/boe ÷ 1,000 = 180.57 Mt CO2e

Total estimated 2023 Scope 1–3 emissions: 279.60 + 180.57 = 460.17 Mt CO2e

CDT at $5/tonne CO2e: 460.17 Mt x $5 = **$2.30bn**

Chevron: 2023 adjusted earnings $24.7bn

2023 reported daily production volumes: oil 1.48 Mboe; natural gas (inc. nat. gas liquids) 1.62 Mboe[25]

Annual production: 547.50 Mboe oil/year; 592.24 Mboe gas/year[26]

Equivalent emissions:[27]

Oil: 547.50 Mboe x 510kg CO_2e/boe ÷ 1,000 = 279.23 Mt CO_2e

Gas: 592.24 Mboe x 385kg CO_2e/boe ÷ 1,000 = 228.01 Mt CO_2e

Total estimated 2023 Scope 1–3 emissions: 279.23 + 228.01 = 507.24 Mt CO_2e

CDT at $5/tonne CO_2e: 507.24 Mt x $5 = **$2.54bn**

TotalEnergies: 2023 adjusted earnings $23.2bn

2023 reported daily production volumes: oil 1.39 Mboe; natural gas (inc. condensates & nat. gas liquids) 1.09 Mboe[28]

Annual production: 507.35 Mboe oil/year; 397.85 Mboe gas/year[29]

Equivalent emissions:[30]

Oil: 507.35 Mboe x 510kg CO_2e/boe ÷ 1,000 = 258.75 Mt CO_2e

Gas: 397.85 Mboe x 385 kg CO_2e/boe ÷ 1,000 = 153.17 Mt CO_2e

Total estimated 2023 Scope 1–3 emissions: 258.75 + 153.17 = 411.92 Mt CO_2e

CDT at $5/tonne CO_2e: 411.92 Mt x $5 = **$2.06bn**

BP: 2023 adjusted earnings $13.8bn

2023 reported daily production volumes: oil (liquids) 1.12 Mboe; natural gas 1.19 Mboe[31]

Annual production: 406.98 Mboe oil/year; 435.69 Mboe gas/year[32]

Equivalent emissions:[33]

Oil: 406.98 Mboe x 510 kg CO_2e/boe ÷ 1,000 = 207.56 Mt CO_2e

Gas: 435.69 Mboe x 385 kg CO_2e/boe ÷ 1,000 = 167.74 Mt CO_2e

Total estimated 2023 Scope 1–3 emissions: 207.56 + 167.74 = 375.30 Mt CO_2e

CDT at $5/tonne CO_2e: 374.37 Mt x $5 = **$1.88bn**

Equinor: 2023 adjusted earnings $10.4bn

2023 reported daily production volumes: oil (liquids) 1.11 Mboe; natural gas 0.97 Mboe[34]

Annual production: 405.88 Mboe oil/year; 354.05 Mboe gas/year[35]

Equivalent emissions:[36]

Oil: 405.88 Mboe x 510 kg CO_2e/boe ÷ 1,000 = 207.00 Mt CO_2e

Gas: 354.05 Mboe x 385 kg CO2e/boe ÷ 1,000 = 136.31 Mt CO2e

Total estimated 2023 Scope 1–3 emissions: 206.63 + 136.31 = 343.31 Mt CO2e

CDT at $5/tonne CO2e: 342.94 Mt x $5 = **$1.72bn**

Eni: 2023 adjusted earnings $9.2bn (EUR 8.3bn)

2023 reported daily production volumes: oil (liquid production) 0.77 Mboe; natural gas 0.89 Mboe[37]

Annual production: 281.05 Mboe oil/year; 323.13 Mboe gas/year[38]

Equivalent emissions:[39]

Oil: 281.05 Mboe x 510kg CO2e/boe ÷ 1,000 = 143.34 Mt CO2e

Gas: 323.13 Mboe x 385kg CO2e/boe ÷ 1,000 = 124.40 Mt CO2e

Total estimated 2023 Scope 1–3 emissions: 143.34 + 124.40 = 267.74 Mt CO2e

CDT at $5/tonne CO2e: 267.74 Mt x $5 = **$1.34bn**

Total CO2e emissions (seven selected IOCs) based on reported production volumes: 3,003.24 Mt CO2e

Total CDT (seven selected IOCs) at $5/tonne CO2e payable on 2023 reported production volumes: $15.02bn (3,003.24 Mt x $5)

Illustrative projections

The following year, assuming an annual $5/tonne increase in CDT plus annual inflation increase, as Sharma and Hillman (2024, pp.24, 28) recommend – here we use 2% – and assuming the seven IOCs report a combined reduction in production volumes over the year that results in a combined 10% fall in Scope 1–3 CO2e emissions from 3,003.24 to 2,702.92 Mt, their combined CDT would total **$27.30bn** (2,702.92 x $10.10/boe).

The third year, assuming a further annual $5/tonne increase in CDT and a further 2% inflation increase, and assuming the seven IOCs report a further combined reduction in production volumes over the year that results in a further combined 10% fall in Scope 1–3 CO2e emissions from 2,702.92 to 2,432.63 Mt, their CDT would total **$37.22bn** (2,432.63 x $15.30/boe).

Data limitations

- Minor differences are due to rounding.
- IOCs vary in their disaggregation of oil and gas: ExxonMobil (2024) and Shell (2024) state they include natural gas liquids in their oil/liquids production figures; Chevron (2024) states it includes natural gas liquids in its gas figure; and the other IOCs are less explicit.
- Different IOCs use different factors to convert cu ft gas into boe: ExxonMobil (2024)

and Chevron (2024) convert at 0.167, Shell (2024) and BP (2024) at 0.172, and Eni (2024) at 0.191(see annex on methodology).[40]

- BP (2024) states its production figures are net of royalties (presumably paid in kind); the other IOCs in this group do not, although Equinor (2024, p.48), distinguishes between 'entitlement', 'equity' and 'liftings' production' (the latter may include royalties in kind), giving slightly different totals for each type.
- As far as we can tell, none of the above three factors have a major effect on IOC data comparability for present purposes.
- The method does not account for the varying carbon intensity of oil and gas production, which 'varies by country, with the US producing half the emissions per barrel as Norway' (Boren, 2022).

SUMMARY TABLES: WEATHER EVENTS COSTS AND CLIMATE DAMAGES TAX

Table 3. Estimated costs of 2024 extreme weather events featured in this briefing

Extreme weather event	Estimated cost/ losses ($bn)
1. Hurricane Beryl, US Gulf states, Caribbean, Mexico (June and July 2024)	6.6
2. Hurricane Helene, USA (September 2024)	13.0
3. Heatwave, India (May and June 2024)	25.0
4. Floods in Brazil (April and May 2024)	17.4
5. Typhoon Carina/Gaemi, Philippines, China Mainland, Taiwan, N. Korea (July 2024)	2.5
6. Floods, Kenya (March to May 2024)	0.08
Total	**64.560**

Note to Table 3: Minor differences in cost totals etc. in this briefing are due to rounding.

Table 4. IOCs' potential CDT obligations and cumulative totals, years 1 to 6 ($bn)

IOC	Year 1 ($bn)		Year 2 ($bn)		Year 3 ($bn)		Year 4 ($bn)		Year 5 ($bn)		Year 6 ($bn)	
	CDT $5/t CO2e	Cumu-lative total	CDT $10.10/t CO2e	Cumu-lative total	CDT $15.30/t CO2e	Cumu-lative total	CDT $20.61/t CO2e	Cumu-lative total	CDT $26.02/t CO2e	Cumu-lative total	CDT $31.54/t CO2e	Cumu-lative total
ExxonMobil	3.19	3.19	5.80	8.98	7.90	16.88	9.58	26.46	10.88	37.35	11.87	49.22
Shell	2.30	2.30	4.18	6.48	5.70	12.19	6.91	19.10	7.86	26.96	8.57	35.53
Chevron	2.54	2.54	4.61	7.15	6.29	13.43	7.62	21.05	8.66	29.71	9.45	39.16
TotalEnergies	2.06	2.06	3.74	5.80	5.10	10.91	6.19	17.10	7.03	24.13	7.67	31.80
BP	1.88	1.88	3.41	5.29	4.65	9.94	5.64	15.58	6.41	21.98	6.99	28.97
Equinor	1.72	1.72	3.12	4.84	4.25	9.09	5.16	14.25	5.86	20.11	6.39	26.50
Eni	1.34	1.34	2.43	3.77	3.32	7.09	4.02	11.11	4.57	15.68	4.99	20.67
Total	**15.02**	**15.02**	**27.30**	**42.32**	**37.22**	**79.53**	**45.12**	**124.66**	**51.27**	**175.93**	**55.93**	**231.86**

Notes to Table 4: The table shows that, over six years, assuming each of the seven IOCs reduces their CO2e emissions by 10% annually, and assuming the CDT rate increases by $5/t plus 2% inflation annually, the seven IOCs would pay a combined total of $231.86bn CDT. Minor differences in totals etc. in this briefing are due to rounding.

ANNEX: METHODOLOGY

Methodology for Part 1: Economic and other costs of extreme weather events

- Figures are in USD unless stated otherwise.
- Currency conversions use historical rates at www.exchange-rates.org.
- Country 2023 GDP data are from World Bank (2024), except for Taiwan (no current World Bank data) where we used Statista (2024); Caribbean region 2023 GDP is from the International Monetary Fund (IMF, 2024).
- None of the cost estimate sources mention a cost on lives lost.
- A spreadsheet of country cost v GDP data and workings is available from Greenpeace on request.

1. Hurricane Beryl

- US Gulf states: $6bn is the official National Oceanic and Atmospheric Administration (2024) cost figure and represents about 0.02% of the USA's 2023 GDP of $27.4trn (World Bank, 2024).
- Caribbean region: Estimate (henceforth 'est.') $510mn from Jackson (2024, citing weather catastrophe modellers Karen Clark & Co., 2024) represents about 0.41% of the Caribbean's 2023 GDP of $125.11bn (IMF, 2024).
- Grenada and dependencies: Damage of 'a third of the country's GDP'/'up to a third of economy' (Cotterill and Harris, 2024; Reuters, 2024; both quote the Grenadian Prime Minister). Grenada's 2023 GDP was $1.32bn (World Bank, 2024), of which one-third (33.33%) = about $440mn.
- Jamaica: Est. $76mn combines $64mn to rebuild agriculture sector (Mathison, 2024, quoting Agriculture Minister on 'close to [JMD] 10 billion' = $64mn converted at rate at date of report [www.exchange-rates.org]) + $12mn infrastructure damage including hospitals and health sector (ReliefWeb, 2024b). $76mn represents about 0.39% of Jamaica's 2023 GDP of $19.42 bn (World Bank, 2024). No estimates have been identified for other economic sectors; hence this is likely a significant underestimate.
- Mexico: Est. $90mn (Jackson, 2024, citing weather catastrophe modellers Karen Clark & Co., 2024) represents about 0.005% of Mexico's 2023 GDP of $1.79trn (World Bank, 2024).

2. Hurricane Helene

- In the absence of a NOAA figure (see Hurricane Beryl above), we used analysts Moody's (2024) 'best estimate' of $11bn in private market insured losses plus $2bn+ losses to the National Flood Insurance Program. $13bn ($11bn + $2bn) represents 0.05% of the USA's 2023 GDP of $27.4trn (World Bank, 2024). Uninsured losses may reach $30bn (Egan, 2024).
- For Hurricanes Helene and Milton combined, Moody's (2024) estimated private market insured losses alone to 'exceed $35bn'.

3. Heatwave, India

- Est. extrapolated from Woetzel *et al.*'s (2020) projection of 2.5–4.5 percent of GDP, or $150–250bn annual, risk to India's GDP from direct impacts of climate-change-induced heat and humidity extremes by 2030, implying potentially up to $2.5trn in losses over 10 years (cited in Press Trust of India, 2024). McKinsey Global Institute (2024) clarified that Woetzel *et al.*'s (2020) $150–250bn 'refers to an annual number' based on a 'higher-emission scenario' that 'enables us to assess physical risk in the absence of further decarbonization … [and] to understand the magnitude of the challenge … [without] factor[ing in] any specific adaptation measures'.
- We interpret McKinsey's (Woetzel *et al.,* 2020; McKinsey Global Institute, 2024) numbers conservatively, assuming no more than $25bn damage from the 2024 heatwave.
- Est. $25bn represents about 0.7% of India's 2023 GDP of $3.55trn (World Bank, 2024).

4. Floods, Rio Grande do Sul, Brazil

- Total value of federal emergency aid to Rio Grande do Sul State as at 10 September 2024 BRL 98.7bn (Brasil Participativo, 2024, confirmed by Climate Department, 2024): BRL 98.7bn converts at rate at date of report (www.exchange-rates.org) to $17.4bn.
- Climate Department (2024) said total figure omits many private donations, broader economic losses still being assessed and significant resources mobilised by Rio Grande do Sul State.
- Est. $17.4bn represents 0.8% of Brazil's 2023 GDP of $2.17trn (World Bank, 2024).

5. Typhoon Carina/Gaemi

- Philippines: Composite est. $185mn compiled from government's (National Disaster Risk Reduction and Management Council/NDRRMC, 2024) platform: housing, PHP 3.66mn; infrastructure, PHP 5,982.23mn; agriculture, PHP 4,386.28mn; other assets, PHP 0.12mn; total = PHP 10,372.29mn; converted at rate at date of report (www.exchange-rates.org). The Philippines' 2023 GDP was $437bn (World Bank, 2024), of which $185mn represents 0.04%.
- China Mainland: Est. $2bn (Ministry of Emergency Management, 2024); conversion of CNY 14.4 bn at date of report (www.exchange-rates.org); $2bn represents about 0.01% of China's 2023 GDP of $17.79trn (World Bank, 2024).
- Taiwan: Est. $308mn converted from TWD 9.79bn at date of (NCDR 2024) at date of report (www.exchange-rates.org). $308mn represents about 0.04% of Taiwan's 2023 GDP of $755.1bn (Statista, 2024).
- Total estimated cost of at least $2.52 bn comprises Philippines $185mn + China Mainland $2bn + Taiwan $331mn.

6. Floods, Kenya

- Est. $79mn = government emergency response budget (Mwere, 2024), converted at date of report from KES 10.6bn (www.exchange-rates.org). $79mn = 0.07% of Kenya's 2023 GDP of $107.4bn (World Bank, 2024).

Data limitations for Part 1 and related points (these points are also included in Part 1 of the main text above)

- Cost estimates for the featured extreme weather events are indicative and far from definitive.
- These estimates represent only a sample of total annual costs worldwide of one-off extreme weather events and of cumulative climate change loss and damage borne by people and communities, including gradual loss of agricultural productivity in many regions.
- The World Meteorological Organization (2023) puts the total economic cost of climate change from 1970 to 2021 as 'US$4.3trn and rising'.
- Cost estimates are often hard to find and/or imprecise, especially for countries and regions in the Global South, where disaster data collection, reporting and recovery infrastructure and resources are usually more limited than in the North. This makes comparisons between weather events and affected countries difficult.
- All insurance-based loss data is highly likely to underestimate the true costs by omitting uninsured losses.
- Significant costs transcend or are below the radar of many, if not most, monetary estimates: loss of life, physical and psycho-social health impairment, cultural damage (affecting both material culture and intangible socio-cultural goods), unreported damage to homes and personal property, loss of school and work days (work days are included in some estimates but not in others), effects on social cohesion and community resilience, and costs of permanent displacement and migration as some traditional nature-based livelihoods cease to be financially viable.
- Numbers of deaths in the Global South, particularly in remote regions, can be heavily disputed.
- Relatively low cost estimates for loss and damage in the South are likely to reflect the lack of insurance cover, the lack of high-money-value infrastructure and more reliance on the undervalued informal economy.
- Much larger estimated monetary losses in the North may also belie the greater severity of damage to human lives and wellbeing in the South, where economies are smaller in monetary terms, more people rely on ecosystem survival resources (which are often uncosted), and there is less capacity to recover.
- Poor communities in poor countries, with precarious nature-dependent livelihoods and often makeshift housing, suffer most.

Methodology for Part 2: IOCs' profits and application of Climate Damages Tax (CDT) to address extreme weather loss and damage

A spreadsheet of IOC production volumes, CO_2e emissions, and CDT data and workings is available from Greenpeace on request.

IOC selection and adjusted earnings

- Selection of international oil and gas companies (IOCs) for inclusion in Part 2 comprises seven US and Western European IOCs listed among the world's largest publicly traded oil and gas companies by revenue (CompaniesMarketCap, 2024): ExxonMobil, Shell, Chevron, TotalEnergies, BP, Equinor and Eni (rankings vary depending on the last quarter's published results).
- We omit three of the largest IOCs – Saudi Aramco, Sinopec and PetroChina (all non-Western) – and others such as Phillips, Marathon and Valero (all USA) for geographical balance. Hence the seven featured are a sample, although including arguably the most prominent Western IOCs.
- We use Greenpeace adjusted earnings (or equivalent) data for 2023 extracted from companies' published annual results; adjusted earnings = profits + increases in loss reserves + new business + deficiency reserves + deferred tax liabilities + capital gains (Investopedia, 2023).

Calculating CDT at $5/tonne CO_2e for the selected IOCs based on their reported 2023 oil and gas production

- The method uses IOCs' disaggregated reporting in their annual reports on 2023 of their daily oil production in millions of barrels of oil equivalent (Mboe) and their daily gas production (in Mboe or in billion cubic feet/bn cu ft).
- Where IOCs report gas production in bn cu ft, we convert this to Mboe using each IOC's conversion factor stated in their annual report: 6,000 cu ft gas/boe = factor 0.167 (i.e. 1 ÷ 6) for ExxonMobil (2024, p.14)[41] and Chevron (2024, p.116); 5,800 cu ft gas/boe = factor 0.172 (1 ÷ 5.8) for Shell (2024, p.33, table, note [B]) and BP (2024, p.378); 5,232 cu ft gas/boe = factor 0.191 (1 ÷ 5.23) for Eni (2024 p.54, note (c)). As far as we can tell, variances in the conversion factors IOCs use do not significantly affect IOC data comparability for present purposes.
- Conversion from bn cu ft does not arise with TotalEnergies (2024) or Equinor (2024), which both report daily gas production in boe.
- All the featured IOCs report daily production; we convert this to annual production separately for oil and gas at x 365.[42]
- For each company, we then estimate annual CO_2e emissions in kg separately for oil and gas using two simple formulas derived from IEA (2023) estimates of 'full lifecycle' CO_2e emissions per boe of oil and per boe of gas.[43]
- The two IEA-derived formulas are 510kg CO_2e/boe for oil and 385kg CO_2e/boe for gas, reflecting the fact that Scope 1–3 (upstream and downstream, from production to final combustion) CO_2e emissions are larger for 1 boe than for 1 boe gas (IEA, 2023).
- We combine for each IOC the separately estimated CO_2e emissions figures for their

annual oil and gas production into a single total annual CO2e emissions figure.
- We then multiply each IOC's total annual CO2e emissions by $5/tonne of CO2e to calculate the annual CDT payable in year 1.
- Together with total CDT payable by the seven IOCs combined, we also include illustrative projections for a second and a third year's combined total CDT based on simple assumptions of annual emissions reductions (due mainly to assumed declining production) and a $5 annual increase in the CDT rate plus an annual 2% inflation increase.[44]

Data limitations for Part 2 (these points are also included in Part 2 of the main text above)

- Minor differences are due to rounding.
- IOCs vary in their disaggregation of oil and gas: ExxonMobil (2024) and Shell (2024) state they include natural gas liquids in their oil/liquids production figures; Chevron (2024) states it includes natural gas liquids in its gas figure; the other IOCs are less explicit. This variance is likely to have minor effects on the calculation of emissions, which we have not sought to resolve.
- Different IOCs use different factors to convert cu ft gas into boe as described above.
- BP (2024, p.38), states its production figures are net of royalties (presumably paid in kind); the other IOCs in this group do not, although Equinor (2024, p.48), distinguishes between 'entitlement', 'equity' and 'liftings' production' (the latter may include royalties in kind), giving slightly different totals for each type.
- As far as we can tell, none of the above three factors has a major effect on IOC data comparability for present purposes.
- The method and estimates do not account for the varying carbon intensity of oil and gas production, which 'varies by country, with the US producing half the emissions per barrel as Norway' (Boren, 2022).
- We initially looked into using IOCs' own reported emissions in their annual and/or sustainability/climate reports as the basis for estimating CDT payable. However, we chose on balance our production-volume-based method due to several limitations in the companies' emissions data:
    - While all IOCs' state that their reported Scope 1, 2 and 3 emissions are 'estimates', those for Scope 3 tend to be less precise.
    - Scope 3 reporting involves 15 categories of which most IOCs researched to date appear to report only on category 11 ('use of sold products').
    - Because Scope 3 emissions are far from straightforward to estimate, we decided, for the purpose of these illustrative examples, to use the standardised volume-based method as described.
    - The CDT proposal is based ultimately on quantities extracted. But because oil emits more CO2e in production and in consumption than gas, we have calculated CO2e emissions differently for each fuel.

ACRONYMS AND ABBREVIATIONS

bn	billion
boe	barrels of oil equivalent
BRL	Brazilian real
CDT	Carbon Damages Tax
CNY	Chinese yuan
CO2e	carbon dioxide equivalent
cu ft	cubic feet
est.	estimate(d)
GDP	gross domestic product
GHG	greenhouse gas
EUR	European Union euro
IEA	International Energy Agency
IFRC	International Federation of Red Cross and Red Crescent Societies
IMF	International Monetary Fund
IOCs	international oil and gas companies[45]
JMD	Jamaican dollar
KES	Kenyan shillings
kg	kilogrammes
Mboe	millions of barrels of oil equivalent
mn	million
Mt	million tonnes
NCDR	National Science and Technology Center for Disaster Reduction
NDRRMC	National Disaster Risk Reduction and Management Council
NOAA	National Oceanic and Atmospheric Administration
OCHA	UN Office for Coordination of Humanitarian Affairs
PHP	Philippine peso
SOP	Stamp Out Poverty
t	tonne
trn	trillion
TWD	Taiwan dollar
USD	US dollar

ENDNOTES

1. All figures are in USD. Country 2023 GDP figures are from the World Bank (2024) Open Data platform, except for Taiwan, for which the World Bank provides no current statistics, so we used Statista (2024). None of the cost estimates appear to include a cost on lives lost. A spreadsheet of country cost v. GDP data and other workings is available from Greenpeace International on request.

2. Grenada's 2023 GDP was $1.32bn (World Bank, 2024), of which one-third would be about $440mn. Grenada's dependencies Carriacou and Petite Martinique were especially hard hit (Hernandez and Franklin, 2024).

3. Jamaica's 2023 GDP was $19.42bn (World Bank, 2024), of which $76mn represents about 0.39%.

4. Mexico's 2023 GDP was $1.79trn (World Bank, 2024), of which $90mn represents about 0.005%.

5. The USA's 2023 GDP was $27.4trn (World Bank, 2024), of which $13bn represents about 0.05%. Weather data company AccuWeather estimated far higher costs of up to $160bn (Danielle, 2024).

6. Hurricane Milton less than two weeks later was estimated as resulting in insured losses up to $50bn (Rajbhandari, 2024b).

7. For how we arrived at this estimate, see the annex on methodology. India's 2023 GDP was $3.55tn (World Bank, 2024), of which $25bn represents about 0.7%.

8. This represents the total value of federal emergency aid to Rio Grande do Sul State (BRL 98.7bn converted at rate at date of report (www.exchange-rates.org). Brazil's 2023 GDP was $2.17trn (World Bank, 2024), of which $17.4bn represents about 0.8%. This figure omits many private donations, broader economic losses still being assessed and significant resources mobilised by Rio Grande do Sul State (Climate Department, 2024). Other damage and/or reconstruction/relief cost estimates vary from $2.45bn (Aon, 2024b) up to $33.5bn to rebuild infrastructure damage (Bateleur, 2024; BRL 176bn converted at rate at date of report [www.exchange-rates.org]).

9. USD figure converted from totalled sectoral PHP costs at rate at date of report (www.exchange-rates.org). The Philippines' 2023 GDP was $437bn (World Bank, 2024), of which $185mn represents 0.04%.

10. Conversion of CNY 14.4bn at rate at date of report (www.exchange-rates.org). China's 2023 GDP was $17.79trn (World Bank, 2024), of which $2 bn represents about 0.01%.

11. Taiwan's 2023 GDP was $755.1bn (Statista, 2024), of which $308 mn represents about 0.04%. Losses potentially as high as $50bn (Ong, Wang and Sullivan, 2024).

12. KES 10.6bn converted to $79mn at rate at date of report (www.exchange-rates.org). Kenya's 2023 GDP was $107.4bn (World Bank, 2024), of which $79mn represents about 0.07%.

13. CompaniesMarketCap, 2024. Our sample omits Saudi Aramco, Sinopec, PetroChina, Phillips, Marathon, Valero and others. Of the seven companies featured, Eni is one-third owned by the Italian state, Equinor 67% by the Norwegian state and Total about 1% by the French state; the others featured are entirely non-state-owned.

14. Greenpeace adjusted earnings (or equivalent) data for 2023 extracted from companies' published annual results; adjusted earnings = profits + increases in loss reserves + new business + deficiency reserves + deferred tax liabilities + capital gains (Investopedia, 2023).

15. Eni, 2024: EUR 8.3bn converted at 29 Dec. 2023 (www.exchange-rates.org), the last working day of calendar year 2023, the period Eni's annual report covers.

16. As we note above, we u se the widely recognised acronym ‘IOC’ fully aware that these are petroleum (i.e. oil and gas) producers: ‘[A]s a technical term, petroleum also includes natural gas and … bitumen, which is found in tar sands’ (Britannica, no date).

17. A spreadsheet showing company production volumes, emissions and CDT payment workings is available from Greenpeace on request.

18. ExxonMobil, 2024, p.12; gas converted from mn cu ft using Exxon’s factor 0.167 (6,000 cu ft/boe): ibid., p.14.

19. Calculated as daily boe volume x 365. Petroleum Office (no date) recommends using 365.24.

20. IEA, 2023, p.9 including note 3: ‘105 kg CO_2-eq is emitted on average for each barrel of oil produced [broadly, Scope 1 and 2 emissions]: this is 20% of the full lifecycle emissions intensity of oil’ and ‘today’s global average array of oil products produced from a barrel of oil equivalent (boe) results in 405kg CO_2 when combusted’ (Scope 3 emissions).

21. IEA, 2023, p.9 including note 3 ‘Scope 1 and 2 emissions from natural gas are 65kg CO_2-eq per barrel of oil equivalent (boe) produced, 15% of the full lifecycle emissions of natural gas’ and ‘Natural gas combustion [Scope 3 emissions] results in 320kg CO_2 per boe’.

22. Shell, 2024, p.33; Shell converts cu ft natural gas @5,800 cu ft/boe = factor 0.172; ibid., p.33 table note [B].

23. Calculated as for ExxonMobil – see relevant note and annex on methodology.

24. Calculated as for ExxonMobil – see relevant note and annex on methodology.

25. Chevron, 2024, p.xxi; gas converted from mn cu ft using Chevron’s factor 0.167 (6,000 cu ft/boe): ibid., p.116.

26. Calculated as for ExxonMobil – see relevant note and annex on methodology.

27. Calculated as for ExxonMobil – see relevant note and annex on methodology.

28. TotalEnergies, 2024, p.71.

29. Calculated as for ExxonMobil – see relevant note and annex on methodology.

30. Calculated as for ExxonMobil – see relevant note and annex on methodology.

31. BP, 2024, p.38 ('net of royalties'); gas converted from mn cu ft using BP’s factor 0.172 (5,800 cu ft/boe): ibid., p.378.

32. Calculated as for ExxonMobil – see relevant note and annex on methodology.

33. Calculated as for ExxonMobil – see relevant note and annex on methodology.

34. Equinor, 2024, p.48 (‘equity production’).

35. Calculated as for ExxonMobil – see relevant note and annex on methodology.

36. Calculated as for ExxonMobil – see relevant note and annex on methodology.

37. Eni, 2024, pp.53–54; gas converted from mn cu ft using Eni’s factor 0.191 (5,232 cu ft/boe): ibid., p.54 note (c).

38. Calculated as for ExxonMobil – see relevant note and annex on methodology.

39. Calculated as for ExxonMobil – see relevant note and annex on methodology.

40. A spreadsheet of IOC production volumes, CO_2e emissions and CDT workings data is available on request from Greenpeace.

41. ExxonMobil, 2024, p.14: 'six million cubic feet [of gas] per one thousand barrels'; so 1 bn cu ft gas: 166,660 boe (1bn ÷ 6mn = 166.66) = 0.167 Mboe (rounded).

42. Petroleum Office (no date) recommends using x 365.24, but we have used the more straightforward x 365.

43. For the IEA-derived formulas, see IEA, 2023, p.9 including note 3: for oil – '105 kg CO_2-eq is emitted on average for each barrel of oil produced [Scope 1 and 2 emissions]: this is 20% of the full lifecycle emissions intensity of oil'; full life cycle includes Scope 3 emissions: 'today's global average array of oil products produced from a barrel of oil equivalent (boe) results in 405 kg CO_2 when combusted'; for gas – 'Scope 1 and 2 emissions from natural gas are 65kg CO_2-eq per barrel of oil equivalent (boe) produced, 15% of the full lifecycle emissions of natural gas' and 'Natural gas combustion [Scope 3] results in 320kg CO_2 per boe'.

44. Assumptions based on Sharma and Hillman, 2024, pp.24, 27, 28. Here we assume annual inflation at 2%.

45. We use the widely recognised acronym 'IOC' fully aware that these are *petroleum* (i.e. oil *and gas*) producers: '[A]s a technical term, petroleum also includes natural gas and ... bitumen, which is found in tar sands' (Britannica, no date).

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