

Projected climate loss and damages from new UK oil and gas fields unequivocally show their destruction of economic value globally

Luke Hatton

l.hatton23@imperial.ac.uk

Imperial College London <https://orcid.org/0000-0002-1813-4467>

Research Article

Keywords: oil and gas, climate change impacts, climate damages, loss and damage, environmental impacts

Posted Date: August 18th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-10724670/v1>

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Additional Declarations: The authors declare no competing interests.

ARTICLE TYPE

Crossmark

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RECEIVED
dd Month Year

REVISED
dd Month Year

ACCEPTED
dd Month Year

PUBLISHED
dd Month Year

Luke Hatton^{1,2,*}

¹ Centre for Environmental Policy, Imperial College London, London, UK.

² Columbia Centre on Sustainable Investments, Columbia University, New York, USA.

* **E-mail:** l.hatton23@imperial.ac.uk

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Abstract

Modelled future emissions pathways compliant with limiting global temperature rises to 1.5C show the need to avoid expansion of oil and gas supply. However, several countries are examining reversals to previous bans on the licensing of new projects, driven in some cases by energy security concerns as well as the prospects of job creation and economic growth. Despite growing evidence on the economic loss and damage caused by carbon emissions, regulatory assessments for licensing typically treat the economic and environmental aspects separately. Using peer-reviewed estimates of cumulative climate loss and damages to 2100 from future emissions, we quantify the future destruction of economic value from the Rosebank and Jackdaw oil and gas fields in the UK. We estimate that their approval is likely to lead to future damages of at least £170bn – £483 bn over their lifetime, 6 – 17 times the economic value they will generate for the UK (£28.7bn). We invert this calculation to show that only 5.9% of their future climate damages need to be felt by the UK to for them to destroy more value nationally than they create. Drawing on the existing literature on the UK's exposure to climate risks, we discuss that this a not infeasible scenario. Amidst repeated droughts, wildfires and record temperatures in 2026, we conclude on the importance of not approving new oil and gas fields in the UK and beyond.

Introduction

Mitigating the worst impacts of climate change will require a large-scale transition away from the use of fossil fuels in the global energy system. Despite strong public support¹, international commitments² and rapid falls in the cost of clean energy technologies such as solar PV³, global emissions from the combustion of fossil fuels have continued to grow (excluding the disruption in 2020 caused by Covid-19)⁴. Reducing fossil fuel consumption will require the rapid scaling up of clean energy sources, but current deployment is off-track to meet the target of tripling global renewable capacity by 2030 that is needed for Paris-aligned mitigation pathways⁵.

Replacing fossil fuel consumption under market-based systems requires clean energy sources to continue to fall in relative price, absent large-scale subsidisation. This means that fossil fuels will need to become more expensive over time, either through supply constraints or carbon pricing. However, if the supply of fossil fuels stays constant as demand falls, this will lead to falling prices (all other things held constant) and a boost in their competitiveness. Leaving “unburnable” fossil fuel reserves in the ground⁶ is largely regarded as key to staying with the target of limiting global temperature rises well below 2C, as global fossil reserves contain much more carbon than can be emitted to comply with these pathways⁷. The International Energy Agency has stated that achieving net zero emissions globally by 2050 will mean that no new oil, gas or coal fields can be approved, beyond existing committed projects⁸.

Despite these warnings and the economic risks of reliance on volatile oil and gas markets that recent energy crises have highlighted⁹, upstream oil and gas exploration and development has continued. Investment in fossil supply projects has remained at levels around USD 1 trillion per annum globally since 2022¹⁰ with expectations of a global oil and gas oversupply before the closure of the Strait of

Hormuz following the U.S. and Israeli attack on Iran. Changing (geo)political landscapes have also reversed or brought into question previous commitments to no new oil and gas supply projects in countries including the US¹¹, UK¹² and France¹³. This is despite the evidence that over 60% of oil and gas reserves must remain unextractable to limit temperature rises to 1.5C^{14,15}, one of the factors contributing to growing recognition of the impossibility of reaching the 1.5C emissions target without overshoot¹⁶.

Drivers for exploring exceptions to licensing bans (UK, France) or full rollback (USA) following previous bans have largely been focused on how production could improve energy security. Concerns about job losses from the transition and potential economic growth driven by new projects have also played a role. For example, the UK developer Adura has claimed that the Rosebank and Jackdaw oil and gas fields with licenses currently under review will make “a material contribution to UK energy security” and generate “more than 3,500 jobs at peak construction” with “880 high-quality jobs throughout production”¹⁷. Considerations around jobs and energy affordability have been central to the UK government’s promise of a “pragmatic approach” to North Sea oil and gas¹⁸, despite warnings that it will do nothing to address energy security or affordability¹⁹.

Regulatory assessments for the licensing of new oil and gas projects largely treat greenhouse gas emissions caused by the downstream consumption of oil and gas as externalities separate to the project. This is despite evidence of the high damages caused by greenhouse gas emissions^{20,21} and the inclusion of the economic value from reductions in greenhouse gas emissions in policy appraisal by many countries^{22,23}. Estimation of the social cost of carbon (the damages per tonne of carbon dioxide) have become an important metric for these appraisals, with evidence into the suitable level(s) growing in recent years^{20,21}. For example, using an open-source model Rennert et al. 2022 found that, 3.6 times higher than the US government’s previous value of 51 USD/t used for policy evaluation²⁴. Burke et al. 2026 in a more recent study used empirical data on the relationship between temperature rises and economic output to show that one tonne of CO₂ emitted in 1990 caused USD 40-530 in damages up to 2020, with estimates of an additional USD500-5700 in damages up till 2100²⁰.

Values for the social cost of carbon have been used to develop estimates of the damages from emissions from oil and gas companies^{20,25}, but have not yet been leveraged at the project level to inform future licenses. Here, using the case studies of the Jackdaw and Rosebank oilfields currently under review in the UK due to their potential scope 3 emissions, we quantify the loss and damages caused by their future oil and gas production based on historical relationships between temperature rises and economic growth. We find that even under the most conservative estimates, their damages reach £170bn, five times more than the estimated £28.7bn they will generate for the UK economy. Under less conservative assumptions, their damages reach up to 17 times the economic value they create (£483bn). If just 5.9% of the damages they cause are focused on the UK (a not unrealistic value given its exposure to climate physical and financial risks), their approval will destroy more economic value nationally than it creates even before accounting for the future impacts of sea level rises, extreme weather and climate-related mortality. With expert opinions already showing that their approval is unlikely to boost the UK’s energy security or reduce domestic energy bills¹⁹, these findings indicate the need to rethink how the approval of new oil and gas fields are assessed to avoid net destruction of economic value globally.

Method

Oil and gas production

Oil and gas production profiles for Jackdaw and Rosebank were taken directly from Shell (Jackdaw) and Adura and Equinor’s (Rosebank) Environmental Statements²⁶ and Scope 3 Emissions Assessments^{27,28}. These were developed in response to the request from the Offshore Petroleum Regulator for Environment and Decommissioning for emissions and production profiles for three cases (P10, P50, P90)²⁷. Here, we use the P50 (likely production) and P10 (max production) scenarios. For Rosebank, only the production profile for the high oil case production profile (P10) is presented in the Environmental Statement²⁶. To reconstruct the P50 production profile, we scale the P10 production profile by the ratio of the reported emissions between P50 and the P10 profile in the Scope 3 assessment²⁷. This translates to a 30.12% lower production per annum in the P50 case²⁷. We note that the assumption of an equal distribution of production over time may introduce an inaccuracy in our model for the Rosebank P50 case but is necessary in the absence of better data.

Emissions

Greenhouse gas emissions from the development of Jackdaw and Rosebank can be categorised into three scopes in line with standard emissions accounting: (1) Direct emissions from sources owned by the developers (2) Indirect emissions from the generation of purchases electricity, steam, heating or cooling and (3) All other emissions upstream and downstream of the field, including from the combustion of the oil and gas produced by the field. Estimates of the Scope 1 and 2 emissions were taken directly from the Environmental Statements for Jackdaw and Rosebank for the P10 and P50 scenarios (Jackdaw) and the central estimate for Rosebank²⁶. For the P50 case, the Scope 1 and 2 emissions were estimated at 661,406 tCO₂e (Jackdaw) and 4,543,176 tCO₂e (Rosebank). To estimate the Scope 3 emissions, product emissions factors were multiplied by the production profiles to give the yearly total emissions, in line with the reported assessments to the OPRED^{27,28}.

Quantifying loss and damages from carbon emissions

Evaluating the loss and damages caused by the emission of a unit of carbon dioxide (or other greenhouse gas emissions) requires modelling the subsequent stream of future damages during its lifetime in the atmosphere. This in turn requires evaluating the (non-linear) relationship between temperature and economic output from an emissions pulse, relative to a baseline scenario. Using the estimates of the loss and damages for a marginal unit of emissions between 1990-2020 from Burke et al. 2026²⁰, we extract estimates of the cumulative damages between 2021-2100 and the corresponding social cost of carbon. Estimates are provided for a range of discount rates (determining how future damages are converted to present terms), which we extract for the 1.5%, 2%, 3% and 5% assumptions. For all social costs of carbon, we initially convert from 2020 US dollar terms to 2025 US dollar and British pounds terms using inflation and exchange rates from the IMF's World Economic Outlook 2026²⁹. Initial estimates for the social cost of carbon for a marginal unit of carbon dioxide emitted in 2025 are shown in **Table 1**.

Table 1. Estimates of the social cost of carbon from a unit of carbon dioxide, based on Burke et al. 2026¹³. Using the timeseries of accumulated damages between 2021-2100 with year of emission, the total damages for carbon dioxide emissions in 2020 are converted into 2025 US dollar and GBP terms using inflation and exchange rates from the IMF World Economic Outlook 2026.

Damages accumulated 2021-2100 (USD/t), under different discount rates				
Discount rate	1.5%	2%	3%	5%
2020 USD	1298	1013	636	283
2025 USD	1538	1200	754	355
2025 GBP	1167	911	572	254

We note that this assumes the damages from 1 Gt pulse of carbon dioxide are the same in 2020 and 2025, despite increased aggregate concentrations of greenhouse gas emissions in the atmosphere⁴. Assuming the damages are the same in 2025 dollar terms does not account for the non-linear relationship between emissions and warming, an uncertainty that we explored here. We develop a scenario for how the social cost of carbon for emissions in year (t) changes over time using Equation (2), which uses a real growth rate (g) of 0-2% i.e. with all values reported in 2025 USD/GBP terms.

$$SC - CO_{2,t} = SC - CO_{2,2020} \cdot (1 + g)^{t-2020} \quad (1)$$

We use the social cost of carbon estimates under a discount rate of 1.5%, close to the 1.4% used by the Stern Review³⁰ and in line with the 1.5% used by the UK Treasury for projects and interventions that can have substantial effects on systemic risks to society³¹ (which we argue would be the case for the scale and risks associated with climate change³²). For sensitivity purposes, we use social cost of carbon numbers under a 3% discount rate (in line with the UK Treasury Green Book standard guidance³¹) and a higher 5% discount rate (closer to and exceeding the higher value of 4.25% used in the DICE model by

Nordhaus³³). We note that both of these assumptions are not fully in line with the full UK Treasury Green Book guidance which recommends declining term structures for the discount rate used for project appraisals, with different values for the first 30 years, subsequent 45 and 50 years (respectively)³¹.

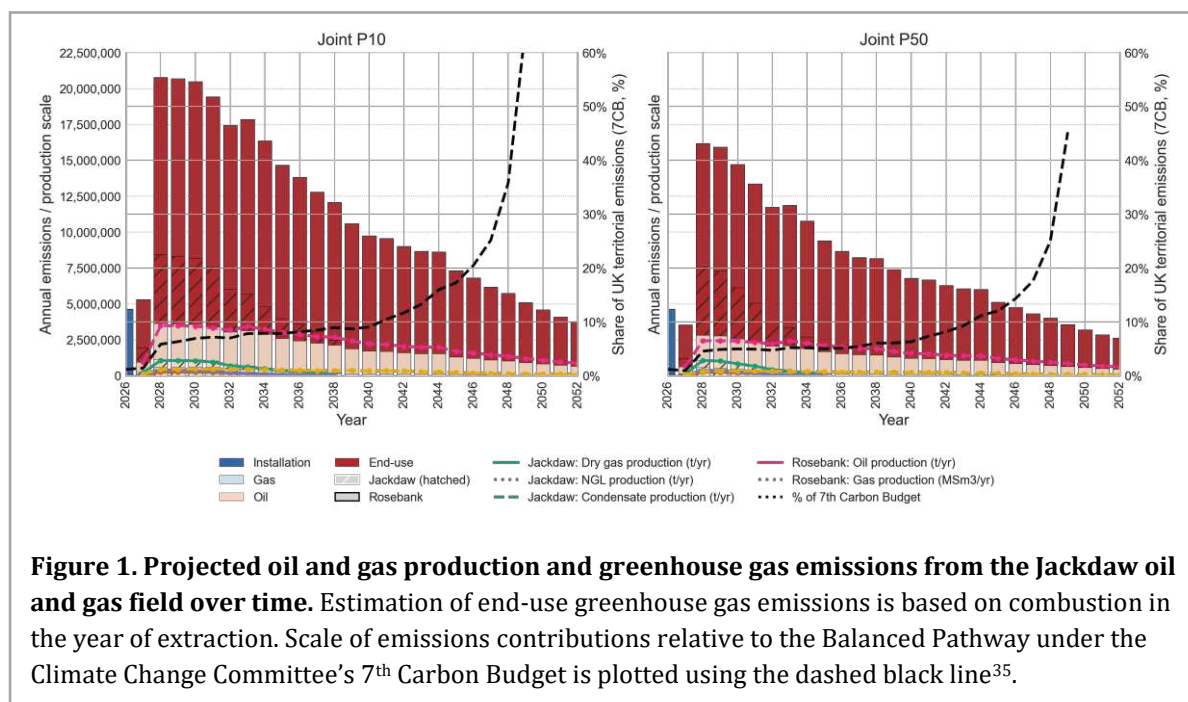
Estimates for the social cost of carbon under each discount rate for each year are then used in Equation (2) to estimate the total damage caused by the lifetime emissions from Rosebank and Jackdaw, where E_t is the total emissions in year (t) until the end of life (L) and $SC-CO_{2,t}$ is the social cost of carbon emissions in year (t).

$$L + D = \sum_{t=2025}^{n=L} SC - CO_{2,t} \cdot E_t \quad (2)$$

We note here that our estimates are likely to be conservative, due to the effects of three assumptions in our modelling framework (i) the assumed growth rates for the social cost of carbon over time, which will not fully reflect the non-linearities between future emissions and the risk of future tipping points, (ii) the fact that damages beyond 2100 are not considered and (iii) the damage function used to relate emissions and loss & damage in Burke et al. 2026 only relates temperature change to GDP growth. For the latter, future impacts from extreme weather, damage to health or impacts from future sea level rises are not considered. As such, in line with Burke et al. 2026, we note that the estimates presented here “will understate the total damages, perhaps substantially”²⁰.

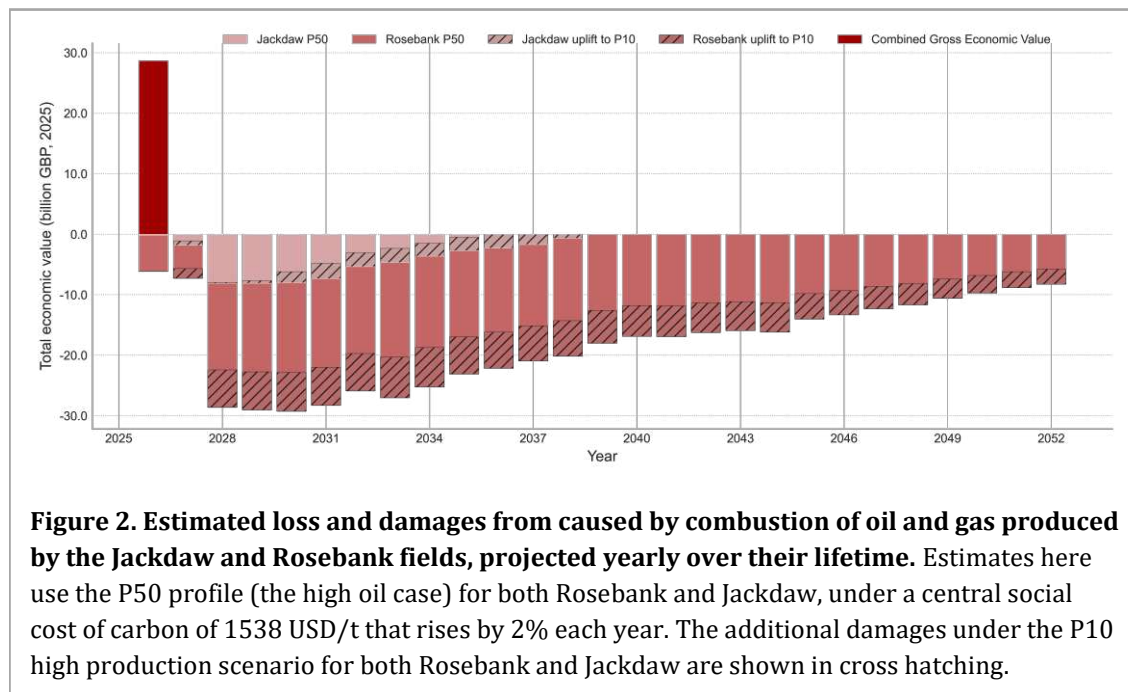
Results

Emissions profiles for Jackdaw and Rosebank are illustrated in **Figure 1**, based on reporting in their Environmental Statements and Scope 3 Emissions assessments for the P10 and P50 production profiles. Under the P10 (high) production profiles, the total emissions associated with Rosebank and Jackdaw reaches nearly 300 million tonnes of CO₂e over their lifetimes, equal to 81% of the UK’s total territorial emissions in 2025³⁴. For the P50 case, this is slightly lower at 208 million tonnes of CO₂e (57% of the UK’s total territorial emissions). Emissions peak with extraction in the early years of operation, reaching around 21 million tonnes of CO₂e in 2030, equivalent to an additional 2-3% of the 68% emissions reduction that the UK has committed to by 2030³⁵.



As the oil and gas produced from Rosebank and Jackdaw will largely be sold on international markets, the emissions from their combustion (“Scope 3”) will not show up in the UK’s domestic reporting. In Jackdaw and Rosebank, scope 3 emissions account for around 90% of the total emissions. Compared to

the Climate Change Committee’s Balanced Pathway (an independent recommendation for how to meet the UK’s legally binding emissions commitments), emissions start at less than 2% of territorial emissions but rise to reach nearly 10% of the UK’s emissions in early 2040 as its territorial emissions fall in line with its legally binding targets.



Socioeconomic assessments of the economic value generated by Rosebank and Jackdaw have been a central point of evidence used by their developers to push for their approval¹⁷, with estimates of £24.1bn³⁶ (Rosebank) and £4.6bn (Jackdaw)¹⁷ over their lifetime. However, these assessments do not reflect future climate-related loss and damages from the emissions from combustion of oil and gas produced by Rosebank and Jackdaw. These are only reported in the scope 3 assessments provided to the regulator and were a central reason why their licensing is currently under review. Using the estimate of USD 1538/tCO₂ under a 1.5% discount rate, **Figure 2** quantifies the loss and damages from the combustion of oil and gas products from Rosebank and Jackdaw across their lifetime. We find that total loss and damages reach £483 billion, more than seventeen times the economic value they will collectively generate for the UK (£28.7bn). This is likely to be an underestimate, as discussed in the Methods, as it does not account for future damages from extreme weather, sea-level rises and climate-related mortality.

Projected loss and damages are sensitive to the discount rate and how the marginal damages from future emissions change over time. The latter depends heavily on the future baseline scenario²⁰, whilst the former is highly debated amongst economists and policymakers³⁷. For completeness, we recalculate the loss and damages from Rosebank and Jackdaw using a range of assumptions for the social cost of carbon (754 USD/t – 1538 USD/t) and its evolution over time (0-2%) in **Figure 3**. Total economic damages from Rosebank and Jackdaw exceed the value generated for the UK by a factor of 5.9 – 16.8x, with the upper estimate reaching around £483bn in damages against the £28.7bn generated for the UK. In other words, this means that only 5.9% of the total global losses from climate change caused by emissions from Jackdaw and Rosebank need to be focused on the UK for it to wipe out more value nationally than they create. For reference, the UK’s share of loss and damages from climate change between 1990-2020 was estimated at 1.6%²⁰, though this is only on the basis of the relationship between GDP growth and historical temperature rises. Accounting for the UK’s exposure to climate impacts³², vulnerability to heat-related mortality^{38,39}, and the concentration of climate-related financial risks (including future asset stranding⁴⁰) make higher shares from damages associated with Jackdaw and Rosebank’s emissions entirely feasible.

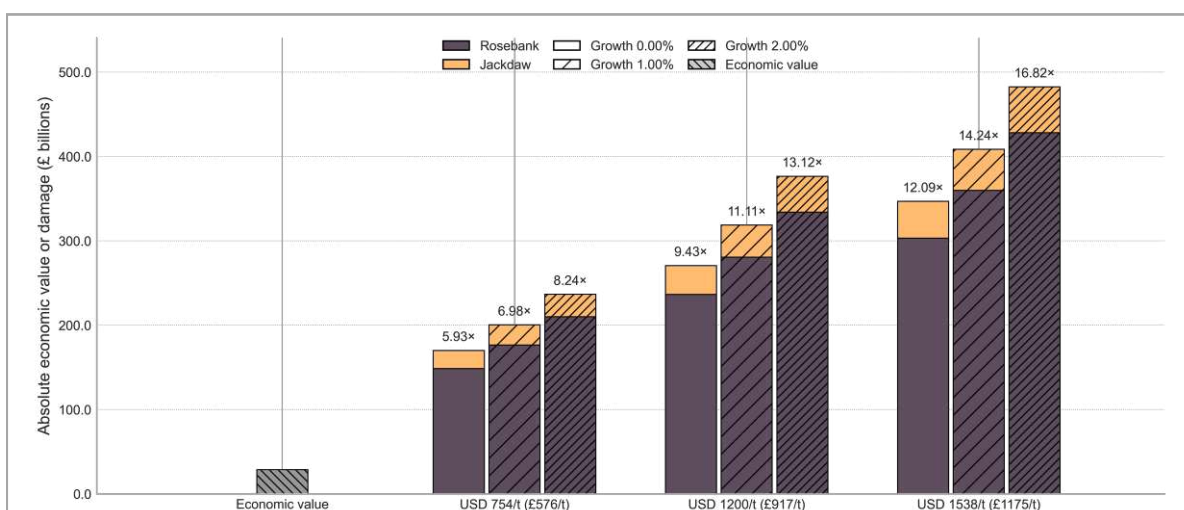


Figure 3. Estimates of the total damages caused by the Jackdaw and Rosebank fields, compared to estimates of the gross economic value that they will generate for the UK. Estimates are developed across social costs of carbon under three discount rates (1.5%, 3%, 5%, corresponding to USD 754/t, USD 1200/t and USD 1538/t) and three growth rates for the social cost of carbon over time (0-2%).

Discussion

Limiting global temperature rises to “well below 2C” on pre-industrial temperatures will require a substantial portion of global fossil fuel reserves to remain in the ground^{6,7}, higher still if 1.5C is pursued^{14,15}. Despite strong evidence that new oil and gas projects are incompatible with these goal⁸, some governments have begun to examine exceptions or reversals of previous commitments to bans on new projects. Evidence provided to regulators for new projects have kept separate the environmental and economic assessments for new projects, but new approaches that quantify the loss and damages caused by a marginal emission of carbon dioxide²⁰ can bridge this gap and estimate total future damages associated with their contributions to global emissions. To date, this has only been conducted at a corporate level in the literature²⁵. Here, using the Jackdaw and Rosebank oil and gas fields in the UK (which at the time of writing are awaiting a regulatory decision based largely on their future emissions), we show that their approval could lead to £170bn – £483bn in future damages globally. This will destroy 5.9 – 16.8 times the £28.7bn that the projects will collectively generate for the UK economy.

Estimates of the damages from Rosebank and Jackdaw developed here are likely conservative, as the social cost of carbon estimates used from Burke et al. 2026 do not account for climate-related mortality, impacts from sea-level rises or future damages from extreme weather. Emissions from the combustion of oil and gas from Rosebank and Jackdaw are also likely to have higher social costs of carbon than we model, as they start production in the early 2030s when the marginal damage per tonne of carbon dioxide is likely to be higher. In effect, their approval would reflect an extremely inefficient extraction of economic value from future generations and vulnerable countries most exposed to future climate loss and damages. The primary beneficiaries of this economic extraction will be the developers and their shareholders (for Rosebank the developers are Shell, Equinor and Ithaca Energy, whilst for Jackdaw this is Shell). For Shell and Ithaca Energy, their shares are owned by institutional investors, investment funds and public investors (with no single owner). For Equinor, 67% of its shares are owned by the Norwegian state (with the remaining shares owned by a range of investors). In all cases, the returns from Jackdaw and Rosebank are likely to accrue to those already well-off by many measures. For example, Semieniuk et al. 2024 found that the record profits accrued by oil and gas companies amidst the 2022 oil and gas crisis resulted in 51% of profits going to the wealthiest 1% in the U.S.⁴¹, whilst Norway has 7th highest GDP per capita in the world²⁹.

Economic loss and damages are likely to be focused on already vulnerable individuals, social groups and countries with more limited capacity to cope with climate impacts, in line with the distribution of the effects of future climate change. Due to uncertainties around climate system responses and the future baseline emissions profile, it is difficult to quantify the exact geographic breakdown of future damages from their emissions. Estimates of historical damages in Burke et al. 2026 from the impact of temperature rises on growth found the largest aggregate damages to be focused in the USA, E.U and China²⁰, though this is largely due to the size of their economies. Relative damages (i.e. on a percentage basis) were found to be largest in low-income countries²⁰, in line with findings from other studies⁴². For highly vulnerable countries such as the Small Island Developing States, even climate impacts under 1.5C of warming are likely to be catastrophic⁴³. Low- and middle-income countries are also already exposed to the impacts of extreme weather, including tropical cyclones⁴⁴.

The UK is also not immune to the effects of climate change, as the summer of 2026 has shown. The evaluation in Burke et al. 2026 found that the UK had accounted for 1.6% of all damages between 1990-2020, lower than its share of world GDP²⁹. However, this does not account for the effects of extreme weather, sea-level rises or climate-related financial risks (all of which the UK is exposed to³²). Wildfires, heatwaves and drought in the summer 2026 have been estimated to cost the UK £4.4bn in loss output⁴⁵, with projections of cumulative economic losses of £25.6bn by 2030⁴⁵. Our results show that only 5.9% of the future damages from Rosebank and Jackdaw's emissions need to be focused on the UK for it to wipe out the £28.7bn that they will generate for the UK (an entirely feasible share based on the UK's share of global GDP and exposure to climate change). Their approval could thus lead to a net negative impact on the UK economy over their lifetime, worsening the UK's economic impacts from climate change³².

Beyond economics, there is also a strong moral and legal case for the UK to retain its commitments to the ban on new oil and gas fields⁴⁶. Based on its historical cumulative emissions, the UK (as well as other high-income countries) has profited from its overuse of the global carbon budget⁴⁷, with common but differentiated responsibility under the Paris Agreement underlining its need to contribute more to global mitigation efforts⁴⁸. The ICJ's ruling in 2025 declared that nation-states have a binding legal duty to prevent climate harm, with failure to do so potentially constituting an internationally wrongful act⁴⁹. Their approval could also send misleading signals to the global stage at a time when support for climate change is shifting under geopolitical pressures, potentially deterring more ambitious action from other countries.

Conclusion

Our results show that the UK's approval of the Rosebank and Jackdaw oil and gas fields may destroy at least 6- 17 times more in economic value than they deliver for the UK, based solely on the effect of temperature rises on global economic growth. Accounting for the effect of their emissions on extreme weather, sea-level rises and climate-related mortality will increase the projected economic damages from their emissions, perhaps substantially²⁰. Only 5.9% of their future damages need to be focused on the UK for them to destroy more economic value than they create, which under the rising frequency of extreme weather and the UK's vulnerability to climate impacts³² does not seem infeasible.

Investment tax reliefs for new oil and gas fields mean that the UK government will effectively provide a subsidy of over 80% of the development costs for Rosebank and Jackdaw⁵⁰. A large body of literature has highlighted alternative policy routes to improving energy security and reducing bills in the UK^{51,52}. Displacing natural gas from the UK's energy system will be central to reducing bills (as it currently sets the price over 90% of the time⁵³) as well as improving energy security (by reducing dependency on LNG imports through its replacement with domestic renewables). These avenues are likely to be more effective without the risk of substantial climate damages, unlike the approval of Jackdaw and Rosebank, which will increase emissions whilst doing little to boost energy security or reduce energy bills¹⁹.

Under their P10 production profiles, Jackdaw and Rosebank would add nearly 300 million tonnes of carbon dioxide to global cumulative emissions, independent of national accounting. Using social cost of carbon estimates ranging from USD 734 – 1538/tCO₂ and growth rates of 0-2%, climate damages from Rosebank and Jackdaw outweigh their projected economic value by factors ranging up to 16.8. Some politicians have labelled the approval of Rosebank and Jackdaw to be "climate vandalism"; our results provide quantitative context for that debate without applying normative judgements on terminology.

The “pragmatic”¹⁸ decision on licensing is ultimately a policy choice, which our results aim to inform by quantifying economic trade-offs and climate damages under a range of assumptions and uncertainties.

Acknowledgements

The authors wish to acknowledge the value of the social costs of carbon estimates developed by Marshall Burke, Mustafa Zahid, Noah Diffenbaugh and Solomon Hsiang in their article “*Quantifying climate loss and damage consistent with a social cost of carbon*”, which the modelling in this article leans upon. All errors remain their own.

Data Availability

The data that support the findings of this study and code used to generate the results and visualisations are openly available at the following DOI: 10.5281/zenodo.21970349

Code Availability

The code used to generate the results and visualisations are openly available at the following DOI: 10.5281/zenodo.21970349

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