WWF

POLICY BRIEF

2019

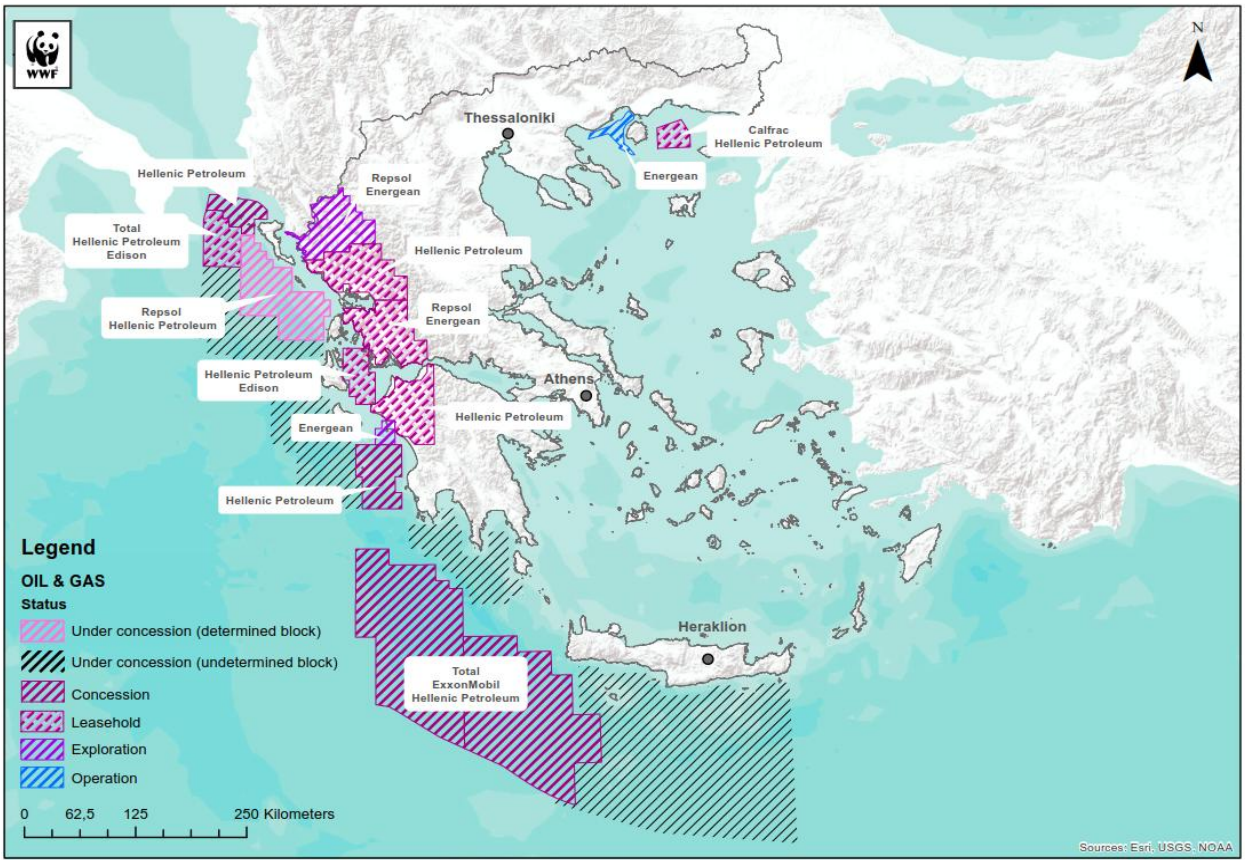
Economic impact study on the costs of oil and gas drilling in Greece

Summary: Economic impact study on the costs of oil and gas drilling in Greece

Background

Since 2012, successive Greek governments have granted a number of oil and gas concessions, which cover a large part of the Greek territory. Offshore concessions are cover a total surface area of 58,000 sq. km (72% of Greece's territorial waters), and onshore concessions account for a total surface area of 17,000 sq. km (13% of Greece's landmass)

Figure 1: **Map of concessions**



The economic, social and environmental risks associated with oil and gas drilling are well documented. Firstly, hydrocarbons are one of the most important drivers of climate change[1,2]. Secondly, it is widely admitted that oil and gas is a sunset industry, likely to globally generate trillions in stranded assets, a cost ultimately borne by investors and taxpayers, over the coming

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[1] Richard Heede (2014). Tracing anthropogenic carbon dioxide and methane emissions to fossil fuel and cement producers, 1854–2010. Climatic Change, Springer, vol. 122(1), pages 229-241, January.

[2] Masnadi, Mohammad S. & M. El-Houjeiri, Hassan & Schunack, Dominik & Li, Yunpo & Englander, Jacob & Badahdah, Alhassan & Monfort, Jean-Christophe & Anderson, James & J. Wallington, Timothy & Bergerson, Joule & Gordon, Deborah & Koomey, Jonathan & Przesmitzki, Steven & Azevedo, Inês & T. Bi, Xiaotao & E. Duffy, James & A. Heath, Garvin & A. Keoleian, Gregory & McGlade, Christophe & Brandt, Adam. (2018). Global carbon intensity of crude oil production. Science. 361. 851-853. 10.1126/science.aar6859.

decades[3,4]. Thirdly, oil and gas drilling, in particular offshore, is an extremely risky activity for marine ecosystems and coastal economies, as documented among others in the United Nation's World Oceans Assessment[5]. Beyond their environmental impacts, these activities can indeed trigger sizeable economic losses for tourism and fishing activities, or any activity relying directly or indirectly on healthy seas.

In Greece specifically, offshore oil and gas concessions overlap with critical marine ecosystems that are habitats for iconic species of global importance. Stretching from Corfu to Crete, they are also located in regions where tourism and fishing represent more than 50% of economic activity, and in some regions reach as high as 73%[6].

Despite extensive risks, the Greek state has failed to produce any systematic assessment on the impacts of oil and gas exploration and extraction activities on the economy, society and environment. Such an assessment is however a *sine qua non* for a transparent public debate on the expected benefits and costs from such activities, and for citizens and the state to make an informed decision on whether this is a worthwhile endeavor, or not.

This is why WWF-Greece commissioned one of the leading UK-based environmental economics consultancies, EFTEC, to develop a cost-benefit model, and produce an economic impact report on the costs involved with oil and gas extraction activities in Greece.

Objectives and scope of the study

The aim of this study is to provide an independent economic assessment to generate information on the impacts of hydrocarbon exploitation in the offshore concession areas of Greece. When making informed decisions, both the benefits and costs of an intervention should be considered. However, to date there is little sufficiently robust information on the amount of recoverable reserves of most concessions, rendering it impossible to measure the scale of revenues in any accurate and defensible way.

As such, this study addresses one side of the equation: it builds evidence on the potential costs of hydrocarbon exploitation to inform the decision-making process. While negative impacts result from both onshore and offshore oil and gas extraction, the current assessment focuses on offshore drilling only, due to the considerable differences in the cost typology of land-based ecosystems and economic activities.

Lastly, the present work is part of a wider modeling project. Beyond this report, EFTEC has developed an extensive cost-benefit model, which will enable comparing and contrasting expected revenues to expected costs, once the scale of recoverable reserves is known.

The assessment is developed around the analysis of four different scenarios which allows for the accounting of uncertainty through sensitivity testing of various parameters of the model. The scenarios represent a set of plausible future outcomes based on current evidence, but the model has been developed to be adjustable, should future understanding of potential impacts improve or more data become available.

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[3] Mark Jaccard & James Hoffele & Torsten Jaccard (2018). Global carbon budgets and the viability of new fossil fuel projects. Climatic Change, Springer, vol. 150(1), pages 15-28, September.

[4] Carbon Tracker (2018). Mind the Gap: the $1.6 trillion energy transition risk.

[5] United Nations (ed.) (2017) "Offshore Hydrocarbon Industries," in The First Global Integrated Marine Assessment: World Ocean Assessment I. Cambridge: Cambridge University Press, pp. 333–352. doi: 10.1017/9781108186148.024.

[6] Ικκος, Α, Κουτσος, Σ (2018) Η συμβολή του Τουρισμού στην ελληνική οικονομία το 2017, SETE Intelligence (Greece Tourism Confederation). https://sete.gr/media/10888/2018_symvolhtourismou-2017.pdf

The report covers the approach to modelling, the development of the scenarios, the results from the analysis and a discussion of their implications. The appendices contain research on the literature around the impacts of hydrocarbon exploitation and a description of the development of a cost-benefit analysis (CBA) model to assist the assessment.

Methodology

The analysis considers the development of hydrocarbon exploitation in Greece relative to the absence of such development. A 25-year time horizon (2019-2044) is applied, which was chosen after a review of both the EU Guide[26] (15-25 years for energy sector) and the licenses that the Greek Government has already issued (25 years).

The impacts assessed were chosen due to their materiality to the Greek economy, and depending on data availability. Most notably, the assessment does not account for an exhaustive set of negative impacts (e.g. loss of value to coastal real estate, loss of biodiversity). The modelled impacts are:

- Clean-up impact (direct costs), which represent the direct expenditure associated with clean-up and restoration activities due to spills.
- Tourism impact, expressed in loss of Gross Value Added (GVA), jobs, and tax revenue. Both direct and indirect impacts have been considered through the inclusion of economic multipliers. The loss of investment, in particular for the tourism sector, is not considered, which means the model underestimates potential costs.
- Fishing impact, which by and large replicates the methodology used for tourism impacts. It is highly likely that official statistics underestimate the size of, and impacts on, the fishing industry, as a large proportion of catches is largely underreported.
- Carbon impact (cost of emissions). The carbon impact refers to the carbon emissions associated with extraction activities *stricto sensu*, and not emissions associated with the consumption of the produced oil and gas. Including the latter would imply significant additional costs.

It is important to note that although the scope of the assessment is to focus on key economic impacts, the omission of both additional economic (such as impacts on real estate rents) and environmental impacts implies an underestimation of the negative impacts of hydrocarbon exploitation. This is especially the case as the "risks associated with the loss of biodiversity are not only ecological, moral and socio-cultural, they are also economic"[7]. A 2005 study, for example, estimated that the overall benefits delivered to Greece as a result of marine ecosystem services amount to more than 3 billion euros per annum, thereby highlighting the large scale of potential additional losses resulting from oil and gas extraction[8].

Having identified the impacts to be assessed in the model, a number of variables had to be considered to assess their monetary value, in particular the risk, and probabilities, of various sizes of oil spills. This variable is highly context dependent, and based on factors such as location,

[7] Mangos, A., Bassino, J-P. and D. Sauzade. (2010). The economic value of sustainable benefits rendered by the Mediterranean marine ecosystems. Valbonne: Plan Bleu.
[8] Mangos, A., Bassino, J-P. and D. Sauzade. (2010). *Op. cit.*

timing and receptors, and so was estimated using assumptions based on evidence from previous spills, and systematic reviews of US and EU authorities[9,10].

To analyze impacts over the assessment period, four scenarios were built. These reflect different possible combinations of future pathways for the Greek economy (including forecasts of e.g. tourism growth), and a range of combinations of assumptions used in the model, for instance regarding oil spill probabilities. In summary, scenarios 1-3 reflect the costs under scenarios of minor (7 barrels on average), medium-sized (210 barrels on average) and large (1600 barrels on average) oil spills at the production or transportation stages, while scenario 4 examines the possible impacts of a major, catastrophic oil spill (>=10,000 barrels).

Following standard appraisal practice, impacts occurring in future time periods are discounted, based on guidance set out in the EU Guide to cost-benefit analysis of investment projects. Results are consequently presented on a Prevent Value basis.

Headline results

Even when ignoring the possibilities of major oil spills, by accounting only for the probabilities of spills of up to 1600 barrels (scenarios 1-3), costs could reach 1.2 billion in total, over 25 years (Table 1). On the other hand, in a scenario of major, catastrophic spills (scenario 4) at some point in time over 25 years, the cumulative costs would reach 5.3 billion in present value terms (Table 1 excluding operational carbon costs), or €7.74 billion (about 4% of Greece's current GDP), in undiscounted terms.

In a scenario of major accidents, the largest losses are expected in tourism sector, and secondarily in the fishing sector. Losses to fishing and related sectors are more modest due to the smaller size of the sector. When expressed in percentage reduction terms, however, the sector could lose up to 17% of its income through direct (reduction of catches) or indirect (reputational damage) channels.

Expectedly, regions with large tourism sectors are expected to suffer the most in such a scenario. A single major oil spill in Crete, for example, could trigger one-off economic losses of approximately €2 billion (Table 2), while we estimate that more than 40,000 jobs would be lost (18% of the island's employment). Similarly, the Ionian Islands' could lose 1.7 billion of their income and 30% of their jobs lost, if a major oil spill occurred, with impacts expected to last for 1-3 years.

Table 1: Breakdown of costs by impact for Scenarios 1-4

Impact	Scenarios 1-3 estimated GVA cost (25-year assessment, PV)	Scenario 4 estimated GVA cost (25-year assessment, PV)
Clean-up	€27 million - €20 million	€34 million
Tourism	€436 million - €560 million	€5,047 million
Fishing	€12 million - €12 million	€183 million
Carbon	€407 million - €651 million	€679 million
TOTAL	**€881 million - €1,243 million**	**€5,943 million**

[9] Bureau of Ocean Energy Management & Bureau of Safety and Environmental Enforcement. (2016). 2016 Update of occurrence rates for offshore oil spills. Arlington: ABS Consulting Inc.
[10] European Commission. (2011). Impact assessment – Annex I accompanying the document 'Proposal for a regulation of the European Parliament and of the Council on safety of offshore oil and gas prospection, exploration and production activities.

Table 2: Breakdown of economic costs by region over the 25-year period

	Scenarios 1 to 3	**Scenario 4**
Eastern Macedonia and Thrace	€5 million - €8 million	€190 million
Crete	€218 million - €304 million	€2,161 million
Epirus	€52 million - €81 million	€218 million
Ionian Islands	€513 million - €735 million	€1,784 million
Peloponnese	€48 million - €75 million	€283 million
Western Greece	€36 million - €57 million	€161 million
Central Macedonia	€11 million - €16 million	€1,147 million
TOTAL	**€883 million – €1,275 million**	**€5,943 million**

Note: The costs shown above are presented in 2017 prices and have been calculated using a 4% discount rate.

Table 3: Breakdown of employment losses by region over the 25-year period

	Scenario 4 employment losses	**% of regional employment**
Eastern Macedonia and Thrace	3,856	2%
Crete	44,874	18%
Epirus	2,971	3%
Ionian Islands	24,844	30%
Peloponnese	4,217	2%
Western Greece	2,177	1%
Central Macedonia	25,323	4%
TOTAL (national)	**108,262**	**3%**

Overall, despite uncertainties and limitations, the findings emanating from this research suggest that oil drilling in the Greek seas could potentially have large, catastrophic impacts on local economies, Greece's regions, and the national economy at large.

If accounting for wider biodiversity and ecosystem services losses, impacts could be considerably higher than modeled through our analysis. According the US Environmental Protection Agency's BOSCEM (Basic Oil Spill Cost Estimation Model) factoring in the environmental costs of an oil spill can increase the total estimation of damages by 20%, on average[11].

In the case of major, catastrophic oil spills, losses to natural capital and biodiversity can increase total costs by a bigger margin. For example, the cost of biodiversity losses due to the Prestige oil spill was estimated to between €570 million €863.3 million[12,13], compared with an economic

[11] Kontovas CA, Psaraftis HN. 2008. Marine environment risk assessment: A survey on the disutility cost of oil spills. Paper presented at International Symposium on Ship Operations, Management and Economics (SNAME Greek Section), Athens, Greece.

[12] Loureiro, M. L. et al, (2007). Estimating the NonMarket Environmental Damages caused by the Prestige Oil Spill. IDEGA-Universidade Santiago de Compostela, working paper.

[13] Garza, M.D., Prada, A., Varela, M. and M.X. Vazquez Rodriguez. (2009). Indirect assessment of economic damages from the Prestige oil spill: consequences for liability and risk prevention. Disasters, 33(1), 95- 109. doi: 10.1111/j.0361-3666.2008.01064.x

damage estimated to €1.1 billion. Similarly, while the total damages of the Exxon-Valdez oil spill excluding environmental damages were estimated to $2.7 billion (USD 1989), environmental damages amounted to $2.8 billion[14]. In short, this evidence suggests that including losses to ecosystem services and natural capital could increase the costs of oil spills by 20% to 100%, depending on severity, size and location.

Implications: pain for no gain?

It is evident that the large, negative impacts of oil and gas drilling need to be balanced out against the potential positive contributions of oil and gas drilling to the Greek economy.

Although such a comparison is impossible as long as there is no certainty over recoverable reserves, indications from other countries are useful. Romania, for instance, is the 4th largest oil and gas producer in the EU, and it currently produces enough hydrocarbons to cover about 40% of its annual consumption. And yet, according to a Deloitte report, Romania's offshore oil and gas upstream sector contributes a modest 1.2% to GDP, even when accounting for indirect supply chain impacts[15]. A KPMG report reached a similar conclusion for Romania's onshore oil and gas activities[16]. Even if Greece held similar reserves, it is worth asking whether such orders of magnitude are worth the risk of inflicting an irreparable damage to Greece's natural capital and regional economies.

Further, any cost-benefit comparison needs to account for opportunity costs, i.e. the benefits Greece could harness by pushing for alternative energy investments. Indeed, international evidence suggests that the economic and employment footprints of renewable energy investments are considerable larger than the ones of hydrocarbons.

According to a World Bank report, each million dollars of investment in solar and wind power creates 13.5 FTE jobs in the US, compared to just 5.2 FTE jobs for each million invested in oil and gas extraction[17]. Similarly, an Oceana report suggests that offshore wind could create almost twice as many jobs than offshore oil and gas, in the US[18]. Finally, the influential ILO report *Greening with jobs* concludes that the number of jobs being created in renewable energy sectors is higher than jobs lost in fossil fuel activities[19].

Given Greece's urgency to reduce unemployment, investing in sectors with a higher employment footprint, such as renewable energies, would provide better value-for-money, while avoiding the potentially catastrophic risks involved with oil and gas extraction.

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[14] Carson, R.T., et al., (1992), A Contingent Valuation Study of Lost Passive Use Values Resulting From the Exxon Valdez Oil Spill. A Report to the Attorney General of the State of Alaska.

[15] Deloitte (2018), The contribution of Black Sea oil & gas projects to the development of the Romanian economy https://www2.deloitte.com/content/dam/Deloitte/ro/Documents/20180424_ImpRepRBSTA_ENG.PDF

[16] KPMG (2016), Impact of the onshore upstream oil and gas industry on the Romanian economy http://www.ropepca.ro/lib/foto/1459158395Impact%20of%20the%20onshore%20upstream%20oil%20and%20gas%20industry%20on%20the%20Romanian%20economy_20160222_en.pdf

[17] Bacon, R. Kojima, M. (2011). Issues in estimating the employment generated by energy sector activities. Washington DC: World Bank.

[18] Menaquale, A (2015). Offshore energy by the numbers: an economic analysis of offshore drilling and wind energy in the Atlantic. Oceana report. https://usa.oceana.org/sites/default/files/offshore_energy_by_the_numbers_report_final.pdf

[19] ILO. (2018). Employment and the role of workers and employers in a green economy. https://www.ilo.org/wesogreening/documents/WESO_Greening_EN_chap2_web.pdf

100

WWF is active in 6 continents and over 100 countries.

1961

WWF is founded in Switzerland.

1991

WWF office opens in Athens.

300

In Greece, we have implemented over 300 actions.

80%

of WWF Greece's actions are included in WWF's global priorities

5.000.000

More than 5,000,000 supporters globally-over 13,000 supporters in Greece.

1995

1995: WWF Greece's financial management is certified annually by independent auditors – all data are published in our annual report and website.

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