

CASE STUDY

Socioeconomic and environmental impact of exploitation of hydrocarbons in maritime areas: The case of Greece

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Abstract: The exploration and exploitation of hydrocarbons in a maritime area have considerable social, economic and environmental impact. Despite the relevance of the topic, accurate analyses on the exact social and environmental impact of the extraction of hydrocarbons are sparse. Companies-shareholders are mainly concerned about the profit deriving from such kind of activities, while national leaders are mainly concerned about their national constituencies, since they preside over national economies and pursue national interests. On the other side, NGO's are mainly focused on the downsides of natural resources development. Taking into account some characteristic examples of extraction and monetisation of hydrocarbons discovered in maritime areas similar to Greece, the paper tries to identify their impact in the specific circumstances of Greece and to contribute the highly topical discussion about the utility of development of hydrocarbons resources in Greece.

Keywords: Hydrocarbons, offshore drilling, fossil fuels, hydrocarbons resources, Greece

1 Introduction

Exploration and exploitation of hydrocarbons are subjects of a constant evolution both in technological and institutional terms. Both activities are of extremely complex nature and hence their success is subject to many and diverse factors. The exploitation of offshore hydrocarbons essentially differs from the onshore activities. The challenges for oil and gas offshore exploration are more significant than onshore. As a rule, offshore drillings refers to a mechanical process where a well is drilled through the seabed, often to a depth exceeding 2000 meters, i.e. mostly in a remote and harsh environment. Therefore, the operational costs required for offshore exploration are more expensive than onshore. The environmental impact of offshore explorations might be bigger, while the social impact is in the most cases less than in onshore schemes. The provisions needed to drill onshore wells are somewhat more accessible than offshore. Examples of onshore works are onshore refineries and boreholes. However, the advantage of an offshore rig is that the structure can be moved because of the use of floating platforms such as Floating Production Storage and Offloading and Tension Leg Platform. Moreover, in offshore activities, exploration and exploitation are carried out using fixed offshore platforms (jacket, jack-up) or floating [1].

Consequently, the analysis firstly attempts a comparative analysis of the socioeconomic and environmental impact of offshore resources development globally, focusing on areas that feature similarities with the Eastern Mediterranean (Aegean and Ionian Sea), i.e. a semi-closed Sea with a fragile ecosystem. Then it moves to the discussion about the utility of exploration and extraction of hydrocarbons in Greek maritime areas in light of the current energy crisis and Greece's specific institutional and geopolitical features.

2 Socioeconomic and environmental impact of offshore resources development: a comparative analysis

Offshore oil and natural gas activities usually engulf several stages. The exploration process normally begins with a review of existing geological and geophysical data about potential reservoirs, it continues with a marine seismic survey and ends with drilling. Should a company decide that it wants to proceed to oil and natural gas production, the next step is development that can last from five to 10 years, depending on the size of the project. Once all of the accessible

oil and natural gas reserves in a field have been produced, the project should be decommissioned, meaning that wells are plugged and abandoned, infrastructure is removed and the site is cleared.

These multifaceted activities have a considerable socioeconomic impact that needs to be assessed at many levels and over a long period of time. Their basic aspects, which in some cases are identical with onshore exploration activities, are:

(1) Increase of public expenditure that, in turn, can boost social welfare benefits, infrastructure projects and so on. There are multiple layers of profits-based rent extraction mechanisms such as special profits taxes, windfall profits taxes, oil and gas production sharing, and/or corporate income taxes. Profits-based mechanisms which include mostly taxes and production sharing costs are the most common features found in license agreements or PSCs (Production Sharing Contracts) [2]. The most common concept is the “state take” as it is defined below:

$$\text{Government Take}(\%) = \frac{\text{Total Government Revenues Gross}}{\text{Gross Revenues} - \text{Total Costs}} \times 100$$

Where: Total Government Revenues = All revenues from royalties, taxes, production sharing, and government equity participation (full-cycle). Gross Revenues = All revenues from the sale of hydrocarbons (full-cycle) and Total Costs = All capital costs and operating costs (full-cycle).

In practice, sharing the rents equitably is difficult. Foreign participation is necessary when there is not the required technical expertise, skilled labour and financial resources to explore and exploit the resources. The formula foreign firms work is simple: recouping their costs, make a normal profit and self-insuring for projects which might prove barren. With asymmetric information and transfer pricing, however, the foreign firm may present the accounts so that cost recovery appears to take longer than in reality. If the state fails to specify social, politically sensitive matters, environmental or work safety obligations or to hold the partner responsible for other negative externalities, then the partner is not obligated to spend money on these matters [3].

(2) Increase in the demand of labour (While natural gas and oil industry’s effect on total employment has been registered in the most cases, the level of jobs supported by an energy sub-sector is a fundamentally different kind of statistic than estimates of changes in jobs resulting from changes in investments or policies in the energy sector. Data are scarce and there are large uncertainties with published numbers, so that point estimates should be treated with caution.) due to the direct production activities, exploration and drilling, the construction of facilities and infrastructure, extraction and distribution (supply chain). In addition to permanent drilling personnel working on the rig, in connection with the actual operation of the rig a large number of maintenance and service functions are normally put out to tender, for example: painting the rig, security, maintenance of electrical installations, catering services, medical services, offshore nursing services, laundry and supply of work clothes, sea and air transport to and from the rig, maintenance of main generator, maintenance of turbine, single anchor loading, chemical supplies, gas supply, maintenance of lifeboats/rafts, servicing cranes, repair and maintenance of valves, compressors and pumps, rig inspection, preparation of local storage facilities. Furthermore, the capital investment by the oil and natural gas industry might have an indirect impact on jobs and the labour income. In the case of Greenland, for example, hydrocarbons development generated a need for sailors, divers, metal workers, electricians, harbour and logistics personnel, IT specialists, hotel and catering staff, engineers, geologists, office staff, builders, pilots, steward(esse)s, airport personnel etc [4].

(3) Finally, household spending of labour and proprietor’s income earned either directly or indirectly from the oil and natural gas industry’s spending generate the so-called induced impact on jobs. To meet the demand for goods and services from an industry, purchases are made in other industries. These purchases in turn spark still more purchases by the industry’s suppliers, and so on. Additionally, employees and business owners make personal purchases out of the additional income that is generated by this process, sending more new demands rippling through the economy. Additional economic impact was generated by shareholder spending out of dividends received from oil and natural gas companies. The jobs, labour income (including wages and salaries and benefits as well as proprietors’ income), and value added supported by this cycle of spending. For example, it is estimated that in 2015 in the USA the oil and natural gas industry directly provided 2.8 million jobs for American workers, paid 289.6 billion dollars in wages, salaries and fringe benefits and proprietors’ income, and generated 602.6 billion dollars in GDP. It also has supported 10.3 million full- and part-time jobs through direct employment and indirect support to other sectors, because for every direct natural gas and oil job, an additional 2.7 jobs are supported elsewhere in the economy. These jobs made up 5.6 percent of the nation’s total employment, while the overall economic impact as a result of wages, taxes, capital investments and support to other industries reached 6 percent of the US GDP [5].

Revenues emanating from monetisation of hydrocarbon are not income in the traditional sense but arise from “tapping” the national wealth. Therefore, many countries (Saudi Arabia

in 1971, Norway in the early 1990s, the Republic of Cyprus in 2019 et. al.) have created revenue funds (Sovereign Wealth Funds) as a mechanism to balance the impact of volatility on the economy in the event that the economy is exposed to significant cyclical fluctuations and in order to distribute the wealth between generations and prevent the emergence either of Dutch disease or the so-called “rentier state”. Notably, the concept of the ‘rentier state’ has been introduced by Hossein Mahdavy to define a state that receives on a regular basis substantial amounts of external economic rents that “paradoxically”, in the end turn out to have negative economic and political consequences for the well-being of the state. The main reasons for that lies on the fact that the state budget becomes more and more dependent on the revenues from natural resources sold on foreign markets with prices determined by external conditions and not on taxes. As the state is largely freed from the need to levy domestic taxes, institutional capacity remains weak despite over-blown administration. In such resource-rich countries success in the natural resource industry determines success in society, and control over the resource industry determines political power. The lack of democratic traditions makes the distribution of income intransparent, fuelling corruption and huge social disparities [6].

Those funds’ real effect on inflation, broad money volatility and price volatility is depended on whether the appropriate fiscal policies and institutional capacities are in place. The rapid and widespread emergence of the sovereign wealth fund industry (meanwhile estimated to some trillion dollars) has been one of the most important developments in international finance and resource economics in the past decades, although they did not always avoided the occurrence of the rentier state phenomenon [7, 8].

The fate of the Caspian countries is a striking example of the emergence of so-called rentier state phenomenon despite the establishment of Wealth Sovereign Funds. Until 2008 Kazakhstan’s oil industry experienced a boom favoured by the high world market prices, which had as a result that fuel accounted for 70% of all merchandise exports and the country’s gross domestic product rose on average by 8% per year. However, from this oil boom only a small portion of the Kazakh population benefited. Apart from the fact that the oil industry did not create many jobs and suppressed the development of other economy sectors, the big income from the export of the natural resources brought about the so-called rentier state phenomenon. The violent protests at the beginning of 2022 in Kazakhstan have shown that the current model of governance has angered millions of people who missed out when the resources pie was shared out and exposed decades of inequality, injustice, and corruption [9–11].

High revenues from gas did not spare Turkmenistan from the repercussions caused by the over-reliance on external rents than taxes, preparing the soil also in this case for the emergence of a ‘rentier state’. This, in turn, obliterated the need for the government to seek public support and legitimation for spending. The lack of checks on executive power further undermined the weak democratic system. The country’s large gas rents were largely spent on prestige projects in support of a personality cult or disappeared into foreign bank accounts. Populist measures to provide free or low-cost basic needs were provided at the government’s pleasure without granting to the residents property rights or security of supply of power, heating or plumbed water. In the absence of the possibility to raise money from the financial markets, the attempts at increasing productive capacity or diversification of the economy also turned out to be inefficient [3].

Azerbaijan also set up a sovereign wealth fund (SOFAZ) in late 1999 in order to avoid income volatility, to achieve intergenerational equity, to transform resource wealth into more productive assets as well as to be able to finance social projects. While SOFAZ has gradually become the leading part of the country’s public finance system, its contribution to long-run economic development is still questionable: transparency applies only to the income side of Azerbaijan’s oil fund while the expenditure side remains opaque. Despite development of the oil and gas sector, the other sectors of the economy remained undeveloped and fragile. Given that the oil and gas industry were only responsible for less than 2 % of employment in Azerbaijan, while agriculture employs nearly 50% of the country, the contribution of the natural resources’ monetisation on the labour market has been very unsatisfactory [12].

On the environmental level, offshore drilling is mostly linked to pollution caused by accidents and oil spills that, in turn, entail not only environmental degradation but also socio-economic impacts on recreational and tourist activities such as fisheries, mariculture, but also on power plants, shipping, salt production or seawater desalination, and seafood industry for the years that follow. The oil spill in the Gulf of Mexico is the most representative example [13].

It is true that the energy companies are endeavoured to implement mitigation measures such as: Observers onboard for the monitoring of marine mammals and specialists for passive acoustic monitoring; Use of the lowest possible power for the sound source, Minimisation of acoustic waves propagation in the water; Adoption of the ramping up method; Implementation of an exclusion zone; Constant monitoring by sight and by instruments in order to make sure no

marine mammals will be in the area before and during the survey *et al.* [14].

However, in many cases, oil and hazardous and noxious substances products get released at sea affecting the environment in many ways: with chemical toxicity giving rise to lethal or sub-lethal effects or causing impairment of cellular functions; ecological changes, primarily the loss of key organisms from a community and the takeover of habitats by opportunistic species; indirect effects, such as the loss of habitat or shelter and the consequent elimination of ecologically important species. The nature and duration of the effects of an oil spill depend on a wide range of factors such as the quantity and the type of spill, its chemical characteristic and its behaviour in the marine environment, the location of spill in terms of ambient conditions, physical and ecological characteristics, the season and the prevalent weather conditions [15].

The case of Caspian Sea is more representative for the environmental hazards the offshore drilling might entail and of inordinate importance for this study, because the Caspian Sea has much in common with the Mediterranean Sea that is a semi-closed sea. The Caspian Sea, bordered by Azerbaijan, Iran, Kazakhstan, Russia and Turkmenistan, is a unique ecological system with rich natural resources, which include mineral, biological, agroclimatic, balneological, and recreational components. It is also the world's largest inland body of water, about the size of Japan. Intensive oil and gas development in the Caspian region resulted in extensive air, water and land pollution, wildlife and plant degradation, exhaustion of natural resources, ecosystem disturbance, desertification and considerable losses in biological and landscape diversity. Moreover, the pollution, along with declining water levels due to climate change, has posed a severe threat to many species and the future of the sea itself at risk. The UN Environment Programme has drawn attention to the fact that the Caspian "suffers from an enormous burden of pollution from oil extraction and refining, offshore oil fields, radioactive wastes from nuclear power plants and huge volumes of untreated sewage and industrial waste introduced mainly by the Volga River". Environmental damage has exceeded revenues from exploitation of natural resources. Negative environmental changes seem to have caused growth of human morbidity and mortality. Life-rate in the Caspian littoral states is lower for 15-20 years than in developed countries. Some areas have become dead zones, and the Caspian shelf mainly loses its validity as a place for spawning of the Caspian Sea fishes. The fishing activities, the famous country's caviar industry, are also undermined [16, 17].

In Nigeria, where oil earnings (over 80 per cent of Nigeria's wealth) go to only one per cent of the population, development of hydrocarbons has also brought about a complete and senseless desecration of the environment especially in the oil sector (the case of the Niger Delta is still a case at hand), loss of indigenous occupation among local communities, corrupt practices and rural to urban migration in search of perceived oil related white-collar jobs among others [18].

Regarding the Mediterranean Sea, international environmental organisations have repeatedly called attention to the significant accidents caused by offshore activities that could have long term adverse consequences for the fragile ecosystems and biodiversity of the Mediterranean Sea due to its enclosed nature and special hydrodynamics as well as negative consequences on the economies of the Mediterranean countries especially for tourism and fisheries [19].

As most of the exploration of hydrocarbons in the Eastern Mediterranean is meanwhile focused on natural gas, it is worth mentioning that natural gas' releases into the sea, can have severe environmental consequences. Although a part of natural gas can evaporate off, another significant portion dissolves in the water and is highly toxic to marine life, especially when they happen near shore, in shallow waters or in areas with slow water circulation, as it happens to be in the Mediterranean. As it has been pointed out, during drilling and extraction of gas deposits from the sea floor, releases of gas into the marine environment are inevitable. Gas is dumped into the sea mixed in with produced water, may leak from pipelines, tankers and underwater storage tanks, or may be released during catastrophic well blowouts, explosions and smaller accidental spills. Spills and blowouts occur due to drilling equipment failure, corrosion of pipelines, human error, earthquakes, ice, storms, shipping accidents etc [20].

Other experts [21] accept indeed that natural gas is a "lesser evil" option compared to other fossil fuels but they still pinpoint the environmental damages of the drilling and extraction, transportation as well as burning and consumption of natural gas: drilling a well can affect wildlife and land use and lead local ecosystems to collapse by breaking migration patterns, polluting rivers and streams, causing erosion of dirt and pollutants. Laying pipelines to transport the gas from the wells to natural gas power plants is also a polluting process, since it can cause habitat fragmentation and cross key areas from the perspective of nature. Gas leaks from pipes can cause big environmental trouble in the groundwater levels (and even on the surface). Burning and consumption of natural gas is more environmentally friendly than fossil fuel because it burns cleaner (50 to 60 percent less carbon dioxide than regular oil or coal-fired power plants). However, it also emits greenhouse gases with a lower life cycle into the atmosphere, while combustion also releases methane and lowers air quality.

3 The Greek case

In the wake of the devastating economic crisis that inflicted Greece from 2010 onwards, the possibility of discovery of oil and gas has unleashed an unprecedented hydrocarbon frenzy within the Greek society, featuring future oil and gas revenues as the spearhead of the long-desired economic recovery. Indeed, many experienced energy experts have argued that drilling for oil and natural gas reserves in Greece may not only increase the country's revenues, create new job opportunities and technological innovations but also end its dependence on oil and gas imports, on which it spends billions of euros each year [22].

Greece is a country heavily dependent on hydrocarbons and reliant on Russian gas for nearly 40% of its annual energy consumption of about six billion cubic metres. Despite efforts of diversification of the energy mix, natural gas continues to support the country's power production at a growing rate, while the fuel's share in the area of industrial and domestic consumption is also expanding. Since the overwhelming majority of the hydrocarbons used in the Greek energy market is imported, the discoveries of gas reserves in the Southeast Mediterranean excited Greece's interest in exploration of gas.

Against this background and given that the investment needed to bring the deposits into production is huge, the Greek government granted licences for exploration and exploitation of hydrocarbons to Greek and foreign companies (French, American, Spanish) in various continental and maritime parts of its territory. During the period 2014-2019 Parliament ratified 11 lease agreements for concession of exploration and operation rights. According to the official announcements, the concessions in the northern Ionian Sea and mainland Western Greece were expected to yield crude oil deposits, with natural gas appearing further south, as indicated by the results of drilling in the past decades.

Climate change and EU energy policies (the so-called European Green Deal envisaging total decarbonisation by 2050) forced the new government to adopt a new course towards hydrocarbons. Climate change is a particularly pressing threat for the Mediterranean and is shared by all states of this region, irrespective of their present socio-economic or political standing [23].

In December 2019, the Greek government announced a very ambitious National Plan for Energy and Climate in order to abide by the European Green Deal and the ambitious EU-energy transition goals for total decarbonisation by 2050, indicating at the same time that it is not interested in going ahead with the development of hydrocarbons resources. Exploration activities in the unexplored reserves south of Crete and in the Ionian Sea, were mostly suspended.

The 2021-2022 energy crisis, however, revived interest in hydrocarbons. In April 2022, the Greek government made an U-turn in its hitherto energy policy and announced its intention to accelerate efforts to explore and exploit potential oil and gas reserves, as it seeks to form a key part of a Europe-wide effort to reduce dependence on Russian natural gas and oil [24].

The research is set to focus on six on- and offshore areas in Western Greece and west of Crete in the southern Aegean Greece aims to conclude a first round of all seismic research by March 2023. In the Ionian Sea and Kyparissiakos Gulf block, the licenses have been granted to Energean and Hellenic Petroleum companies. The most promising blocks south of the coast of Crete, awarded to a consortium made up of Total, ExxonMobil and HELPE. The foreign companies Total and ExxonMobil, however, remained indifferent to the calls of the Greek government. Total already announced its decision to withdraw from two hydrocarbon exploration blocks near Crete – the block of Western Crete and that of Southwest Crete – after the completion of surveys in those areas. The company remains committed to developing renewable energy sources in Greece and will continue its activity in the country via its local subsidiary TotalEnergies Marketing Hellas [25].

The Greek Society is deeply divided about this issue. Proponents of the development of hydrocarbons believe that Greece is about to reap a windfall and this opportunity should not be missed. In their view, domestic production is vital as Russian hydrocarbons cannot be replaced via the tight global LNG and pipeline markets. Whilst European economies are desperately in need of increased oil and gas supply in the short-term, suppliers will be focused on longer-term contracts to de-risk upstream development [26].

According to estimations of experts who argue in favour of hydrocarbons development, geological formations and geometric structures in the southern Ionian Sea and especially in offshore regions of Southwest and Western Crete seem to resemble the Zohr field in Egypt, the fields of Aphrodite, Calypso, Glafkos and the geological structures of Onesiphoros in Cyprus or the Leviathan in Israel. According to some estimations, there are reasonable indications that at least 30 targets of Zohr-type deposits are located within the Greek territory amounting to about 20 billion barrels of oil equivalent. The potential value of Greece's natural gas reserves

could exceed €250 billion and support the process of replacing coal with Greek natural gas in the whole region, transforming Greece from being an exporter of petroleum products and an importer of crude and natural gas to a producer of hydrocarbons and an exporter of natural gas. These quantities could also, according to the same estimates, accelerate the transition to a more sustainable low-emission energy system. They could render Greece to a producer of Blue Hydrogen, enabling the country to play a leading role in the European energy transition plan [27–29].

The example Norway is representative for this. Successive Norwegian governments accomplished indeed a responsible management of natural endowment that has essentially helped the country to move fast towards its goal of transition to green energy and to create a more environmental friendly energy mix. While Norway is one of the richest countries in fossil fuel reserves and production, approximately 96% of electricity is generated by hydropower [30, 31].

On the same trajectory, it has been argued that hydrocarbon exploration will become imperative in the next years, since Greece is set to eliminate lignite (the main energy fuel in Greece) completely by 2028, as a major indigenous fuel. Reduction in carbon dependency is strongly associated with the controlled conservation of traditional energy sources due to their high energy efficiency compared to the alternatives. For this reason, as lignite is being withdrawn, the argument goes, Greece should within the next few years, make every effort to produce natural gas from its own reserves so that it can gradually cover most, or even all, of its consumption (5-8 BCM / year) [32].

Some energy experts believe that not only Greece but the whole Eastern Mediterranean region subsumes into the category of regions in which the transition process to the green economy and climate cooperation is linked to the natural gas as transitional fuel in the objective to attain long-term decarbonisation energy and climate goals. Since the East Med countries lack significant nuclear capacity, are heavily reliant on gas consumption and have significant quantities of natural gas (though some of them are still assumed), gas should remain an important energy source to back up intermittent renewables and replace more polluting oil and coal in the medium term [33].

Proponents of the exploration of hydrocarbons in Greece usually refer to the small producing oil fields in Prinos and North Prinos (120 million oil barrels since 1980) together with a neighbouring natural gas field in South Kavala in Northern Greece. The largest part of the basin is located offshore between the island of Thassos and the opposite mainland to the west. Only the North-Eastern portion of it lies onshore in the Delta Nestos plain. It is true that the companies that won the tender have been operating there since the 1970s with no accidents and no leaks of oil into the sea. Moreover, the oil and gas production in the area did not result in significant atmospheric emissions, taking into account the progress made in the efforts to reduce emissions and protect the environment, through the use of emission control technologies and the continuous monitoring and assessment of atmospheric emissions and local air quality [34, 35].

Another argument, the supporters of hydrocarbons development in Greece have come up is the guarantees for environmental protection provided by the existing hydrocarbons laws. The Hydrocarbons Law, which is Law No. 2289/1995, amended by Law No.4001/2011 is the basic legal instrument that sets the regulatory framework for the exploration and exploitation of hydrocarbons in Greece in addition in addition to the general environmental legislation provided by national and EU law. Various Greek laws have incorporated the general principles that form the cornerstone of the European framework, such as the ‘polluter pays’ principle as well as all directives and regulations relating to the protection of the environment in the field of hydrocarbons, such as Directive 2013/30 / EU on Offshore Safety [36].

Environmental organisations and local groups are opposed to the plans for extraction of new oil and gas. Many energy experts are heavily questioning the overall economic utility of the extraction of hydrocarbons in Greece due to the potential environmental hazards in first place. They warn of costs associated with oil and gas extraction, which may lead to economic loss, since the overwhelming majority of tourism and recreation activities take place near the coast. The economic impacts of an oil spill on industries connected to the marine environment, *e.g.* the fishing and tourism industries is also linked to the environmental impact on commercially viable species and the aesthetic impacts of an oil spill. In this respect, they argue that any profits from the oil exploration activities will largely be reaped by the hydrocarbon companies, whereas the benefits to citizens will be minimal, as oil and gas will remain at the same prices set by international stock exchanges [37].

They argue that the planned extraction of hydrocarbon deposits poses a dramatic risk of irreversible ecological and socio-economic disaster both within the marine regions and productive land zones where explorations are designed to take place, as well as for the country as a whole. Incidents can occur at various steps of the production process, including transportation of products by ships and the extraction process itself, for example from damaged installations

resulting from explosions. According to the same argumentation, the reserves to be exploited are relatively small, however the drilling is of particular concern, given the large depth associated with the offshore fields as well as the seismic activity in the area, resulting in a logistically and technically challenging operation. Inevitably those activities will increase the environmental impacts with different characteristics: direct and indirect, short and long term, temporary and permanent, singular and cumulative [38].

Regarding the possibility of Greece turning to a Rentier State as those described above, there it should be mentioned the following: Despite similarities with rentier states of developing areas of the world, Greece is not a typical rentier state. Rent situations do not predominate in the Greek economy, rather characterised by a large service sector. However, as it has been aptly pointed out [39], thanks to generous EU subsidies, and the possibility of borrowing at low interest rates as a result of its EU-zone membership, Greece became a semi-rentier state. Consequently, the country's budget and trade deficits and sovereign debts ballooned during the 2000s. This, in turn, led to the emergence of some phenomena typifying notorious rentier states: widespread tax evasion, emboldening of a powerful economic oligarchy, able to enforce rules that favoured them et. al. Taking into account these uncontested facts and the general clientelistic political and economic framework of the Greek economy and society [40], one should feel justified to wonder whether external rents emanating from hydrocarbons could ever be used to boost sustainable development or to cover temporary consumption purposes benefiting certain interest groups.

Probably the most convincing argument of the opponent of the exploration and production of hydrocarbons in Greece is associated with the impact of the climate crisis that is already heavy in Greece. The Mediterranean basin is perceived to be particularly vulnerable to the interconnected challenges stemming from climate change and environmental degradation. Reasons for concern include sea-level rise related risks, land and marine biodiversity losses, risks related to drought, wildfire, alterations of water cycle, endangered food production, health risks in both urban and rural settlements from heat and altered disease vectors. Temperatures are going up 20% faster than the global average and this is already having real and serious consequences across the basin with sea level rises expected to exceed one metre by 2100, impacting one third of the population in the region [41].

The UN Intergovernmental Panel on Climate Change has labelled the region as a 'climate change hotspot' expecting the warming across the Mediterranean to be about 20 percent higher than global averages in the decades to come, as the region is hit with devastating heatwaves, which in turn trigger water shortages, loss of biodiversity and risks to food production. According to the report an increase of 10-20 days per year of maximum daily temperature exceeding 35°C, a typical, critical threshold for crop productivity and analogous increase in agricultural, ecological and hydrological droughts is expected, by the mid-century, in the Mediterranean areas. Moreover, streamflow droughts and fire weather conditions are projected to become more severe and persistent in the region [42].

Last but not least, development of offshore hydrocarbons in the Aegean might entail serious geopolitical tensions between Greece and Turkey. When an offshore unit is located in the exclusive economic zone (EEZ) is considered to be a "ship" and the flag state would have exclusive jurisdiction over it; but if it is considered to be an "installation", the exclusive jurisdiction is on the coastal state [43].

The provisions of the United Nations Convention on the Law of the Sea (UNCLOS) provide for a more or less clear legal regime for installations and structures in the exclusive economic zone (Article 60) in which the coastal State shall have the exclusive right to construct and to authorize and regulate the construction, operation and use of installations and structures for various purposes. The coastal State shall have exclusive jurisdiction over such installations and structures. The coastal State may, where necessary, establish reasonable safety zones around such artificial islands, installations and structures in which it may take appropriate measures to ensure the safety of navigation. The breadth of the safety zones shall be determined by the coastal State, taking into account applicable international standards. Such zones shall be designed to ensure that they are reasonably related to the nature and shall not exceed a distance of 500 metres around them, measured from each point of their outer edge, except as authorized by generally accepted international standards or as recommended by the competent international organization. Turkey however is one of 16 states that has not signed the convention. Greece maintains that UNCLOS has codified customary law that binds non-signatory states as well. Turkey, on the contrary believes that the treaty is binding only for the signatory states (*res inter alios acta*). Notably, Greece and Turkey have not delimited either their Continental Shelves or their EEZs in the Aegean. Furthermore, Turkey believes that the maritime boundaries in the Aegean are not clearly defined [44].

History has shown that in the case of interstate hostilities, offshore units become targets

of attacks (cf. the 19 October 1987 attack on the Iranian R-7 and R-4 offshore oil platforms in Reshadat and the 18 April 1988 attack on Iranian offshore). Safeguarding such installations from external threats are logistically and administratively very challenging requiring the transport of men, weapons, ammunition and equipment around a wide geographic area in time [43].

4 Conclusions

International experience has manifested a variety of socioeconomic and environmental results of exploration and production of hydrocarbons in maritime areas, positive and negative. The extant literature has focused mainly on how the monetisation of hydrocarbons affects the economy. Areas of interest are whether economic exploitation of hydrocarbons diversifies the structure of the economy, stimulates employment and guarantees long-term energy security. The interest of the researchers has also attracted whether revenues from exploitation of hydrocarbons resources have turned out to be a curse, causing unrepairable harm to the environment, impeding growth, igniting internal or cross-boundaries clashes, attracting foreign interventions, deepening existing conflicts and undermining the creation of a stable representative, pluralistic, democratic system. In this respect, the institutional factor, *e.g.* transparency, the quality of democracy and the political institutions are predominant. On the environmental level, it can be argued that offshore drilling is in most of the cases associated with pollution and environmental degradation, especially in closed seas or in semi-closed areas like the Mediterranean Sea.

Taking all these into consideration in combination with indisputable ongoing climate crisis that is expected to hit Eastern Mediterranean very hard in the foreseeable future, it can be concluded that the exploration and production of hydrocarbons in Greece has for sure many positive aspects, especially in times of energy prices crises. It appears, however, to be in general a very risky undertaking. The semi-closed nature of the Mediterranean Sea, the clientelistic character of the Greek political system and the risk of environmental degradation in a country whose tourism industry accounts for about 20% of its GDP, raises serious doubts on the overall utility of the development of hydrocarbons despite the legal guarantees and the previous experience in the Prinos fields. After all, the production in Prinos began in 1980 when the mankind was not aware of the repercussions of major accidents and the climate change and essentially there was no alternative to the hydrocarbons, as it is the case today with the renewables for the development of which Greece has vast possibilities (sun, wind, water, *et al.*).

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References

- [1] PWYP Indonesia. Understanding the Onshore and Offshore Schemes in the Upstream Oil and Gas Industry, 2021.
<https://pwypindonesia.org>
- [2] Agalliu I, Montero A, Adams S, *et al.* Comparative Analysis of the Federal Oil and Gas Fiscal Systems: Gulf of Mexico International Comparison. Study for U.S. Department of the Interior Bureau of Ocean Energy Management, Bureau of Safety and Environmental Enforcement, Bureau of Land Management, 2018.
<https://www.boem.gov>
- [3] Pomfret R. Resource management and transition in Central Asia, Azerbaijan and Mongolia. *Journal of Asian Economics*, 2012, **23**: 146-156.
<https://doi.org/10.1016/j.asieco.2011.08.004>
- [4] The Greenland home rule government Bureau of Minerals and Petroleum, 2004, Report on socio-economic aspects of hydrocarbon exploration and exploitation in Greenland.
- [5] American Petroleum Institute, 2017, Impacts of the Natural Gas and Oil Industry on the US Economy in 2015, Report, 2019.
<http://www.api.org>
- [6] Mahdavy H. The Pattern and Problems of Economic Development in Rentier States: The Case of Iran, in *Studies in the Economic History of the Middle East*. M.A. Cook, Oxford, Oxford University Press, 1970, 428-467.

- [7] Van den Bremer T, Van der Ploeg F and Wills S. The Elephant in the Ground: Managing Oil And Sovereign Wealth, *European Economic Review*, 2016, **82**: 113-131.
<https://doi.org/10.1016/j.eurocorev.2015.10.005>
- [8] Tsani S. Natural resources, governance and institutional quality: The role of resource funds. *Resources Policy*, 2013, **38**(2): 181-195.
<https://doi.org/10.1016/j.resourpol.2012.11.001>
- [9] Azhgaliyeva D. The effect of fiscal policy on oil revenue fund: The case of Kazakhstan, *Journal of Eurasian studies*, 2014, **5**(2): 157-183.
<https://doi.org/10.1016/j.euras.2014.05.001>
- [10] Dossym S and Tolganay U. The protests in Zhanaozen and the Kazakh oil sector: Conflicting interests in a rentier state. *Journal of Eurasian Studies*, 2015, **6**(2): 122-129.
<https://doi.org/10.1016/j.euras.2015.03.005>
- [11] Gabuev A and Umarov T. Turmoil in Kazakhstan Heralds the End of the Nazarbayev Era, *Carnegie*, 2022.
<https://carnegiemoscow.org>
- [12] Zulfigarova F and Neuenkircha M. The impact of oil price changes on selected macroeconomic indicators in Azerbaijan. *Economic Systems*, 2020, **44**(4): 100814.
<https://doi.org/10.1016/j.ecosys.2020.100814>
- [13] Romo-Curiel AE, Ramírez-Mendoza Z, Fajardo-Yamamoto A, *et al.* Assessing the exposure risk of large pelagic fish to oil spills scenarios in the deep waters of the Gulf of Mexico. *Marine Pollution Bulletin*, 2022, **176**: 113434.
<https://doi.org/10.1016/j.marpolbul.2022.113434>
- [14] Spinos S. Environmental protection for offshore activities of hydrocarbon exploration and production, in *Hydrocarbon exploration and production in Greece and the role of the Hellenic Hydrocarbons Resources Management*, SA, C. Oikonomopoulos. Ebook published by the Hellenic Hydrocarbons Resources Management, 2019, 67-72.
- [15] REMPEC, 2021. Mediterranean Action Plan. Fourteenth Meeting of the Focal Points of the Regional Marine Pollution Emergency Response Centre for the Mediterranean Sea, 31 May - 2 June 2021.
<https://www.rempec.org/en>
- [16] Palasciano A. Seals, caviar and oil: Caspian Sea faces pollution threat, 2020.
<https://phys.org/news>
- [17] Jafari N. Review of pollution sources and controls in Caspian Sea region. *Journal of Ecology and the Natural Environment*, 2010, **2**(2): 25-29.
<https://www.academicjournals.org/jene>
- [18] Agbaeze EK and Ukoha K. Oil a Blessing or a Curse: The Nigerian Experience. *European Journal of Social Sciences*, 2018, **56**(3): 262-270.
<http://www.europeanjournalofsocialsciences.com>
- [19] United Nations Environment Programme. Mediterranean Action Plan, 1st Offshore Protocol Working Group Meeting Valletta, Malta, 13-14 June 2013.
<https://www.rempec.org/en>
- [20] Novaczek I. Impact of Natural Gas in the Marine Environment. *Watershed Sentinel*, 2021.
<https://watershedsentinel.ca>
- [21] Net Group. Natural gas environmental impact: problems and benefits, 2021.
<https://group.met.com/en>
- [22] Mezartasoglou D, Stambolis C, Perellis A, *et al.* The Greek Energy Sector - Annual Report 2020. Institute of Energy for SE Europe (IENE), 2021.
<https://www.iene.eu>
- [23] Dessì A, Fattibene D and Fusco F. Mediterranean Transitions: The Challenge of Sustainable Development', in *Climate change and sustainability: Mediterranean perspectives*, A. Dessì, D. Fattibene, F. Fusco, Rome: Rome Edizioni Nuova Cultura for Istituto Affari Internazionali, 2021.
- [24] Kathimerini. Speeding up hydrocarbons research, 2022.
<https://www.ekathimerini.com/economy>
- [25] Total withdraws from two hydrocarbon blocks off Crete.
<https://www.ekathimerini.com/economy>
- [26] Rigas M. The multi-faceted value of energy security - opinion, *Jerusalem Post* April 12, 2022.
<https://www.jpost.com/business-and-innovation>
- [27] Athens Academy. Summary of the conclusions of the Workshop on the energy self-reliance of Greece in the context of the European Energy Policy, 2021.
<http://www.academyofathens.gr/el>
- [28] Institute of Energy for South-East Europe - IENE. Report on Economic and Geopolitical Benefits of Hydrocarbon Exploitation in Greece (in Greek), 2022.
<https://www.iene.gr/articlefiles>
- [29] Foskolos A. O amithitos energeiakos thisauros pou krivei I elliniki AOZ. The vast energy treasure hidden in the Greek EEZ, *SLPRESS*, 2022.
<https://slpress.gr/oikonomia>
- [30] Hemmings P. Norway's economy: maintaining a successful business sector in a changing world, *OECD Working papers*, No. 1459, OECD Publishing, Paris, 2018.
- [31] Aslani A, Hamlehदार M and Saeedi R. Robustness of Norway Economy and Energy Supply/Demand. *International Journal of Green Computing*, 2017, **8**(2): 1-19.
<https://doi.org/10.4018/IJGC.2017070101>

- [32] Oikonomopoulos K. 2020 (ed.), Hydrocarbon Exploration in Greece: The role of Hellenic Hydrocarbons Resources Management, Hellenic Hydrocarbons Resources Management SA Study, 2021. <https://www.greekhydrocarbons.gr>
- [33] Franza L. Greening the Mediterranean: Pathways for Sustainable Energy and Climate Cooperation, Climate change and sustainability: Mediterranean perspectives, A. Dessì, D. Fattibene, F. Fusco, Rome: Rome Edizioni Nuova Cultura for Istituto Affari Internazionali, 2021, 113-135.
- [34] Proedrou P and Papaconstantinou M. Primus Basin - A Model For Oil Exploration. Bulletin of the Geological Society of Greece, 2004, **36**(1): 327-333. <https://doi.org/10.12681/bgsg.16675>
- [35] Papailias G and Mavroidis I. Atmospheric Emissions from Oil and Gas Extraction and Production in Greece. Atmosphere, 2018, **9**: 152. <https://doi.org/10.3390/atmos9040152>
- [36] Arvanitis D. Environmental protection in Greece, in Hydrocarbon exploration and production in Greece and the role of the Hellenic Hydrocarbons Resources Management SA C. Oikonomopoulos, Ebook published by the Hellenic Hydrocarbons Resources Management, 2019, 41-44.
- [37] Archipelagos Institute of Marine Conservation 2019, Potential hydrocarbon exploration in Greece, will Blue or Black Growth be the choice? Report, 2021. <http://archipelago.gr/en>
- [38] Kuyer J, Hard S, Cherch F, *et al.* Economic impacts of the exploitation of hydrocarbons in Greece. An analysis for World Wide Fund for Nature (WWF), 2021. <https://contentarchive.wwf.gr>
- [39] Huliaras A and Sotiropoulos D. The crisis in Greece: The semi-rentier state hypothesis', Hellenic Observatory Papers on Greece and Southeast Europe, No.120, 2022. <https://eprints.lse.ac.uk>
- [40] Stergiou A. Staatsverständnis und Klientelismus in Griechenland, in (eds.), Die Krise in Griechenland, U.-D. Klemm, W. Schultheiß, Frankfurt and New York: Der Campus Verlag, 2015, 111-125.
- [41] WWF Mediterranean Marine Initiative, 2021, The climate change effect in the Mediterranean. Six stories from an overheating sea, 2021. <https://wwfeu.awsassets.panda.org>
- [42] United Nations: Intergovernmental panel on climate change 2021 full report. Final Government Distribution, chapter 12, pages 67-70, 2021. <https://www.ipcc.ch/report>
- [43] Argyriou I and Christeas D. An analysis of the types, threats and security measures of offshore drilling facilities. The legal status of offshore installations, is one of the most difficult areas in international law. Nmiotc Maritime Interdiction Journal, 2015, **10**: 6-12.
- [44] Davutoglu A. The Strategic Depth. Turkey's International Position (In Greek). Athens: Piotita Publisher, 2010.