INSTITUTE OF ENERGY
FOR SOUTH-EAST EUROPE

A STRATEGY FOR UNLOCKING GREECE'S HYDROCARBON POTENTIAL

An IENE Study Project

(M25)

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Executive Summary

A wide ranging debate concerning Greece's hydrocarbon deposits and potential production capabilities has been conducted over the last four to five years among petroleum geologists, engineers and energy economists while the government has made a moderate effort to restart hydrocarbon exploration. As it was expected the ongoing debate has raised huge expectations among politicians and the public at large of potentially enormous oil and gas reserves, which somehow remain stranded underground, and if properly explored and in case of discoveries, exploited they could generate billions of dollars of income and thus boost the deteriorating public finances and help the country not only to stave off bankruptcy but also make Greece and Greeks wealthy!

Of course the real situation concerning hydrocarbon resources in Greece is far off from this widely held popular belief according to which Greece is flash with oil and gas resources. Partly to dispel such misplaced and misleading view and partly to propose a realistic approach in unlocking the country's true hydrocarbon potential the present study has been undertaken.

While interest has been mounting by international companies for hydrocarbon exploration in the East Mediterranean, including Greece-albeit this interest has lately waned due to lower international oil prices-the government has been trying to identify oil and gas promising deposits by first initiating an ambitious seismic survey for a vast offshore area in Western Greece and South of Crete and then organising a series of "Open Door" type rounds and an international licensing round with mixed results so far. To an outside observer it is clear that a coherent and goal oriented long term strategy is lacking. So far such a strategy has been lacking as as a result of frequent government changes and consequent policy failures. This is why IENE, within its remit, took the initiative to prepare a detailed strategy oriented study, in short a "strategy for success" for developing Greece's dormant hydrocarbon potential.

The study contains twelve (12) chapters which between them cover the background on Greece's hydrocarbon exploration restart effort, an overview of Greece's existing oil and gas infrastructure and description of the country's petroleum geology. A review follows of the current concessions and their development outlook and the applicable legal framework. Then details are provided on the 1st International Licensing Round, conducted back in 1996/1997, and of the 2nd International Licensing Round, now in progress. The East Mediterranean and the Cyprus Connection is discussed at some length since Cyprus' successful hydrocarbon exploration efforts and the finding there of rich gas deposits has greatly encouraged Greece's successive governments in pursuing their efforts. The non-technical constraints of hydrocarbon exploration and production in Greece are discussed in detail since they have often acted, and still do, as great disincentives in achieving progress. Our understanding of Greece's actual hydrocarbon potential is absolutely key in our effort to formulate a successful strategy for exploration and production. Hence considerable attention was given in grouping data from 17 different oil and gas plays in different parts of the country and updating information concerning their proven, contingent and prospective reserves.

Chapter 11 deals exclusively with the analysis of the host of factors and components involved in strategy formulation. Four key factors are being considered: (a) Appraisal of Resources, (b) The Competitive Environment, (c) Setting Goals, (d) Effective Implementation. A "Strategic Fit" approach is followed in assessing the role and influence of those factors with government and industry acting as the two basic pillars which eventually act as prime movers in decision making and field action. A number of strategic options are considered prior to finalising and proposing a specific strategy.

The study concludes with IENE's proposal for a "ten-point" (10) Strategy for Success" for unlocking Greece's hydrocarbon potential with the following four premises underpinning this strategy:

(a) The need to further expand our knowledge and understanding of the country's hydrocarbon resources and further assess its overall petroleum potential

(b) The need to increase the country's proven hydrocarbon reserves

(c) The opening up of new exploration areas opting for quicker type procedures alongside with international licensing rounds (i.e. Expression of Interest, Open Door)

(d) Develop public awareness for oil and gas exploration

1. Background

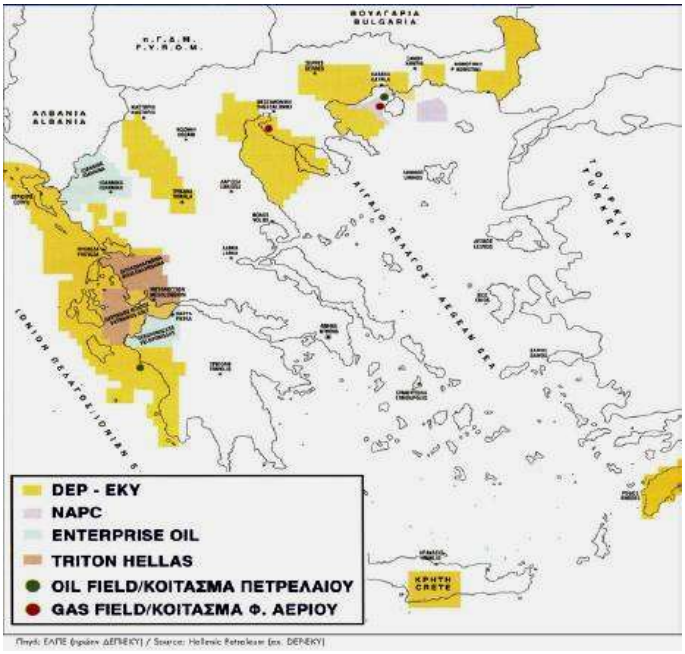
Over the last five years the Greek government has embarked on a reevaluation of the country's hydrocarbon potential while actively promoting exploration schemes of some of the more promising areas with proven hydrocarbon systems (see Fig. 1). These efforts culminated with the signing in May 2014 of three important concession agreements for areas in Western Greece- an offshore Katakolo, offshore Patraikos Gulf and onshore Ioaninna- following an "Open Door" type round which was launched in early 2012. In October 2014 the government launched a major international round for offshore areas in the Ionian Sea and south of Crete. Since then Greece had a government change following snap general elections on January 25, 2015. The new radical left coalition government led by the SYRIZA party has decided to continue with the previous government's plans for hydrocarbon exploration and development and has left unchanged the terms of the 2nd International Round, now in progress and due to close for bidding in mid July.

Figure 1. Oil Promising Areas in Greece (after Hellenic Petroleum)

The next few months will be critical though in determining the outlook of the new government's plans as far as implementation of the above round is concerned and progress in the award of licenses for three concessions in onshore in Western Greece following a Round, after expression of interest, earlier in the year which closed on February 6. There is no doubt that the degree of participation by reputable companies in the International Round, now in progress, will be a litmus test for the success

of this endeavour and will signal the return of Greece to the international oil and gas exploration scene.

Figure 2. Licensing Status in Greece 1997



Source: Hellenic Petroleum (ex DEP-EKY)

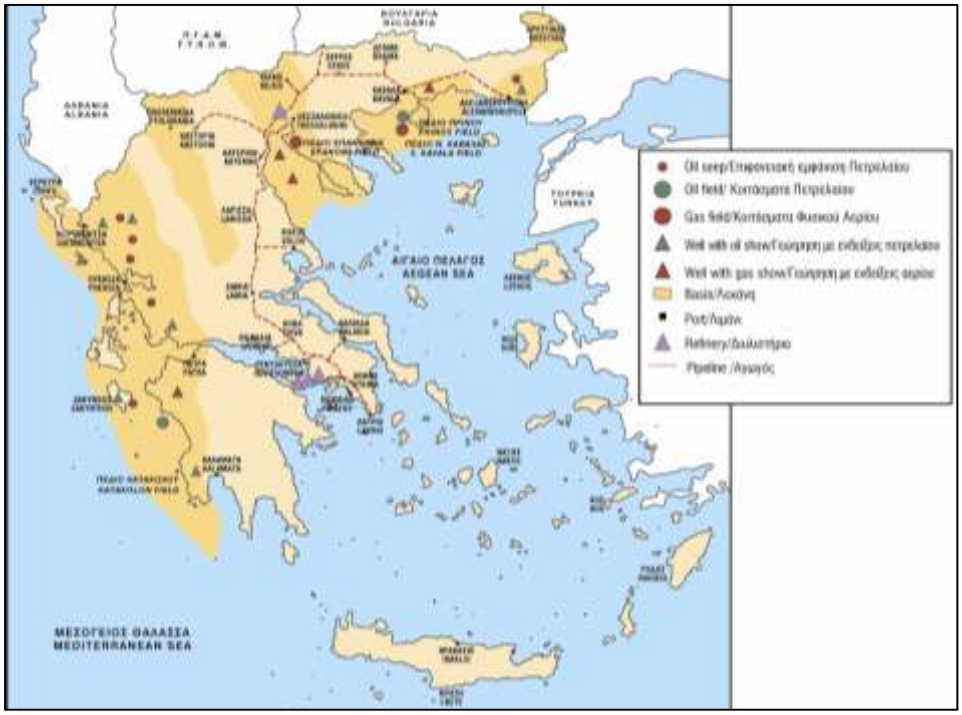
A 1st round was conducted by the now defunct National Oil Exploration Company (DEP-EKY) in 1997-1998. It is the consensus among professionals involved in the upstream sector that Greece should concentrate its efforts in (a) further assessing its overall oil and gas potential, (b) opening up of new exploration areas opting for quicker type procedures (i.e. Expression of Interest, Open Door) in addition to well planned international exploration rounds which normally take longer to prepare and launch and (c) developing public awareness for oil and gas exploration.

Greece has every reason to press ahead with the exploration of its hydrocarbon potential, estimated by various sources to be of the order of 4.0 bboe, for two basic reasons. The first has to do with the undisputable evidence for the existence of a series of oil and gas plays which are situated in different parts of the country both onshore and offshore. Some of these plays, and others likely to be discovered in their vicinity, could hold commercially exploitable reserves. The second reason for Greece's interest in developing its hydrocarbon potential has to do with the country's almost total reliance (99.5%)on oil and gas imports and hence the need, for reasons of energy security, to lessen somewhat its dependence on overseas suppliers.

Addressing the usual question of whether or not Greece has any reasonable exploration and production potential for H/C the answer is

empathically positive. This is because there are proven and active petroleum systems in the alpine and post-alpine basins of Western Greece, as well as, in the molassic and post-alpine tertiary basins of Eastern Greece, where source rocks, reservoirs, cap rocks, traps and proper geological and migration time co exist. The active hydrocarbon seeps and shows and hydrocarbon discoveries, found in both Western and Eastern Greece, attest to the existence of active hydrocarbon systems. Commercial exploitation of hydrocarbon accumulations in the Thracian Sea and in analogue systems to the ones of Greece, such as in Italy, Albania, Croatia, as well as discoveries in East Thrace in Turkey, all concur to a high hydrocarbon potential of similar sedimentary basins in Greece.

Figure 3. Sedimentary Basins in Greece under Exploration (1997)



Source: DEP-EKY

According to latest data provided by both companies and the government, Greece's proven hydrocarbon reserves amount to some 40.0 million boe. This is a far cry from the widely circulated but unsubstantiated estimates for billion of barrels of proven reserves to be found somewhere offshore south of Crete and in the Aegean. Only through active exploration and actual drilling programmes the Greek government, with the assistance of

the concessionaire companies, will be in a position to ascertain with a fair degree of certainty the country's proven reserves. But also through the oil companies will the country be able to increase its production from the present paultry amount of 2,000 bbd, which is produced at the Prinos concession in the Northern Aegean. The concessionaire company at Prinos, the Energean Oil & Gas company, in 2013 embarked on a five year oil exploration and production investment programme which aims to significantly increase oil production to 10.000 bbd by 2017-2018.

The non exclusive seismic work carried out in 2012-2013 by Norwegian company PGS in a vast offshore area in Western Greece and South of Crete has raised many hopes that certain parts of the explored terrain are rich with oil and gas deposits. That remains to be seen when actual exploration and drilling programmes will hopefully get under way from 2018 onwards. Meanwhile, the Greek state has to get on with the actual organisation and mobilisation of the new state entity, the Hellenic Hydrocarbon Management Company (EDEY) which is set to coordinate and supervise all upstream activities in Greece. EDEY is expected to contribute decisively in the preparation of a long term plan, for the exploration and the actual development of the country's oil and gas deposits. Hence, there is a clear need for the formulation of a long term strategy and how this could be adopted and implemented. The present study by IENE is a contribution towards this direction.

2. Overview of Greece's Existing Oil and Gas Infrastructure

Before discussing the hydrocarbon potential of Greece and the strategy for developing it, it is important to provide some essential background information on the country's existing oil and gas infrastructure. Should Greece be able to develop further its indigenous hydrocarbon resources the utilization of its present oil and gas infrastructure could prove a determining factor in maximizing the benefits of newly available oil and gas quantities. The transportation, storage and transshipment of such quantities could prove a major challenge. In this respect the extensive oil and infrastructure in Greece today would be of immense help in terms of providing readily available reception facilities but also in helping to minimize costs.

Greece's current infrastructure in the oil sector is not insignificant. With four fully operational refineries (see Table 1 and Fig. 4), Greece is a major exporter of refined products to most countries of SE Europe and the East Mediterranean.

Table 1. Greece's Operational Refineries

Ownership	Hellenic Petroleum	Hellenic Petroleum	Hellenic Petroleum	Motor Oil Hellas
Name	Aspropyrgos Refinery	Thessaloniki Refinery	Elefsis Refinery	Motor Oil Hellas
Location	Aspropyrgos	Thessaloniki	Elefsis	Agioi Theodoroi
Refinery Type	Cracking (FCC)	Hydrocrakcing	Hydroslamming	Hydrocracking, FCC
Nelson Complexity Index	9.7	6.9	11.3	-
Capacity Mt/year	7.5	4.5	5.0	4.5
Thousand bbl/d	148	93	100	180
Build	1958	1966	1972	1972

Source: IENE and companies

In 2009, total refining capacity stood at 425,000 bbl/d while today (2015) it stands at 521,000 bbl/d with almost 50% of its output exported. The refinery output in Greece covers the full range of refined oil products while the refineries are planning further increases of light product yields over the next years. Greece is totally self-sufficient in the production of lighter petroleum products, although some feedstock, heating oil, and lubricants are still imported. New units have been constructed or are under construction in the two Greek refinery groups in order to meet new product specifications and environmental standards. Most notably Hellenic Petroleum recently completed a 1.5 billion EUR modernization plan of its Elefsina refinery while Motoroil SA has also carried out extensive revamping and modernization of all its facilities over the last 5-6 years investing more than 1.0 billion euros.

Oil Storage

In order to meet IEA and EU requirements for energy reserves Greece has developed an extensive storage capacity base with several tank farms in different parts of the country including the major islands (i.e. Crete, Rhodes, Lesvos, Corfu). At the end of 2014, Greece possessed a total storage capacity of 59.7 million barrels (9.5 million cubic metres) used for industrial operations and mandatory industry stocks. Crude oil storage accounted for some 30% of the country's total storage capacity, roughly two-thirds of which was owned by Hellenic Petroleum at the end of 2009. The remaining portions were held by Motor Oil (21.8%), PPS (6.6%), BP Hellas (1.6%), Mamid Oil (1.6%), Shell Hellas (1.2%) and other smaller operators [1].

Pipelines and Other Transportation

There are two oil pipelines in Greece. The first, a 220-km, 16-inch crude pipeline with a capacity of 50 kb/d (2.5 Mt per year), links the Thessaloniki port with the Octa refinery in the Former Yugoslav Republic of Macedonia and is owned and operated by Hellenic Petroleum. The second, a 53-km, 10-inch JET A-1 pipeline with a capacity of 42 kb/d, connects the Aspropyrgos refinery with Athens International Airport at

Spata and is owned 50% by Hellenic Petroleum, 16% by Motor Oil Hellas, 17% by Athens Airport and 17% by Olympic Airlines. There are also pipelines connecting the Aspropyrgos refinery to nearby storage facilities owned by wholesale companies as well as to some military installations.

Figure 4. Map of Greece's Oil Refinery Infrastructure, 2010

Source: Energy Policies of IEA Countries, Greece 2011 Review, IEA

Nearly all inland transportation of crude oil and refined products is by road and ship. The exceptions are jet fuels to the Athens airport, to some wholesale storage facilities and military installations, which are supplied by pipeline, and deliveries by rail to power plants which are used for the bulk of retail oil transportation. Tank trucks have, however, been subject to a licence, and most of them are publicly owned. Restrictions in tank truck licensing and government-controlled transportation fees have barred oil companies from managing their businesses as efficiently as possible. In November 2009, the Council of State deemed these restrictions illegal. The situation will be remedied through enforcement of Law 3897/2010 whose Article 15 provides for a Joint Ministerial Decision to introduce framework conditions for private tank truck licensing.

There are ten oil terminals in Greece. Seven of them are located in the Attica area (Athens) and three in the Salonica area. Six oil terminals (Aspropyrgos, Elefsis, Thessaloniki, Aghioi Theodori, Pachi [Megara) and Agia Trias) can receive imported crude oils with four of them are located near the refineries [2].

Greece's Natural Gas System

The Greek natural gas system consists of a 512-km high-pressure main pipeline and 867 km high-pressure branch lines. The gas system has three entry points; the pipelines from Bulgaria and Turkey and the Revithoussa LNG terminal (see Figure 5). Gas storage is limited to the tanks at the LNG terminal.

Figure 5. Map of Greece's Natural Gas Infrastructure, 2010

Source: Energy Policies of IEA Countries, Greece 2011 Review, IEA

The two pipeline entry points to the Greek natural gas system have a total annual technical capacity of around 4.6 bcm. The 3.6 bcm entry point at Promachonas, near the town of Sidirokastro, on the Greek-Bulgarian border is used for delivering gas from Russia via Ukraine, Moldavia, Romania and Bulgaria. The 1 bcm entry point at Kipoi on the Greek-Turkish border allows Greece to import gas from Turkey and the Caspian region.

The Revithoussa LNG terminal has a technical capacity of 4.55 bcm, which brings Greece's total technical import capacity to 9.15 bcm per year total. Taking into consideration an assumed load factor for each entry point, the three entry points could manage a total of 6.4 bcm per year (annual demand in 2014 reached 3.8 bcm). Existing import infrastructure would

therefore allow for much higher internal demand. The high pressure gas network will continue to be expanded. Recent expansions include a 26-km line to a gas-fired power plant in Thisvi and a 72-km pipeline from Stefani to Aliveri. A latest project includes construction of a 151-km branch from Korinthos to the new gas-fired plant of PPC in Megalopoli. Responding to a growing demand for transmission capacity, DESFA has installed a natural gas compression terminal at Nea Mesimvria, near Thessaloniki. The first phase, scheduled to be operational in the first quarter of 2011, saw two 7.7-MW compressor units installed. If needed, a third 7.7-MW compressor will be installed later [3].

Greece is also involved in the following international gas pipeline projects:

- **Interconnector Turkey-Greece-Italy (ITGI)**

The ITGI project is part of the Southern European Corridor and is designed to transfer natural gas from the Caspian region (Azeri gas from Shah Deniz II). The ITGI system is composed of three parts: the 296-km Interconnector Turkey-Greece (ITG), in operation since 2007, a 570-km onshore pipeline from Komotini to Igoumenitsa on the northwestern coast, and a 212-km offshore pipeline to Italy. DESFA will construct the onshore pipeline as part of the Greek natural gas system. The offshore pipeline will be built by IGI Poseidon, a joint venture of Italy's Edison (50%) and DEPA (50%). The European Commission has granted the offshore interconnection a 25-year exemption from TPA rules for 8 bcm per year. Edison and DEPA signed a Memorandum of Understanding on transit through Turkey with BOTAŞ in June 2010. The project was planned to start operation at the earliest in 2015. The project has been put on hold (and could be activated any time that commercial conditions will allow) at this stage TAP pipeline was chosen (instead of ITGI) by the Shaz Deniz consortium for transporting early Caspian gas quantities to Europe.

- **Interconnector Greece-Bulgaria (IGB)**

The IGB will enable the Greek gas grid to link to the European market via subsequent Interconnector links between Bulgaria and Romania and beyond via the Romania- Hungary Interconnector and towards western

Balkans. The IGB is strongly connected with the Southern Corridor and the Interconnector Turkey-Greece (ITG).

With a transportation capacity of 3 to 5 bcm per year, the IGB pipeline will enable Bulgaria to diversify its supply routes by accessing sources from the Caspian area (e.g. Azerbaijan) through Greece. Bulgaria will also receive gas from the Revithoussa LNG terminal. The total investment is expected to reach EUR 180 million, and IGB is eligible for EUR 45 million from the European Energy Programme for Recovery.

A Memorandum of Understanding was signed in July 2009 between IGI Poseidon and the state-owned Bulgarian Energy Holding (BEH) to promote and undertake the construction of a 160-km gas pipeline from Komotini in Greece to Stara Zagora in Bulgaria. In March 2010, the companies formed an Asset Company which will build, own and operate the pipeline. Construction of the pipeline is stated to start in early 2016 with projected completion date in 2018.

The TAP Pipeline

The Trans Adriatic Pipeline (TAP) will transport Caspian natural gas to Europe with a major segment of its pipeline passing through Greece (see Fig. 6). Connecting with the Trans Anatolian Pipeline (TANAP) at the Greek-Turkish border, TAP will cross Northern Greece, Albania and the Adriatic Sea, before coming ashore in Southern Italy to connect to the Italian natural gas network. The project is currently in its implementation phase and is preparing for construction of the pipeline, which is planned to begin in 2016. Once built TAP will offer a direct transportation route opening up the vital Southern Gas Corridor, a 3500-kilometre long gas value chain stretching from the Caspian Sea to Europe.

Figure 6. TAP Pipeline Route

TAP's shareholders, major energy companies SOCAR, Statoil, BP, Fluxys, Enagás and Axpo, are experienced in delivering complex international projects. Environmental protection, corporate social responsibility and high safety practices are used in accordance with best industry practice. The pipeline's design has been developed in accordance with recognised national and international safety standards. The project is not dependent on public subsidies and will bring benefits to its host countries.

TAP chose the pipeline's route with great care as to ensure the best commercial and technical possibilities and cause minimum environmental and social impact. Approximately 870 kilometres in length, TAP's highest elevation will be 1,800 metres in the mountains of Albania while its lowest depth offshore will be 820 metres beneath the Adriatic Sea.

Anticipating future needs, TAP's developers integrated flexibility into the pipeline design to accommodate future gas volumes. TAP's initial capacity of 10 billion cubic metres (bcm) of gas per year is equivalent to the energy consumption of approximately seven million households in Europe. In future, the addition of two extra compressor stations could double throughput to more than 20 bcm as additional energy supplies come on stream in the wider Caspian region.

The pipeline will also have the so-called 'physical reverse flow' feature, allowing gas from Italy to be diverted to South East Europe if energy

supplies are disrupted or more pipeline capacity is required to bring additional gas into the region [4].

Gas Storage

At present there is no underground gas storage in Greece. The country's only storage facility is located at the Revithoussa LNG terminal. The terminal has two LNG tanks with a combined storage capacity of 130 000 m3 of LNG (80 mcm of natural gas), equalling eight days of average gas demand and five days of peak gas demand in 2009. Around 10 000 m3 of the storage is reserved for short-term balancing and security of supply purposes. DESFA is now constructing a third LNG tank at Revithoussa, with a capacity of 95 000 m3 of LNG (57 mcm of natural gas). The third LNG tank should be completed in 2016 and will increase the total storage capacity to 135 mcm, equalling 14 days of average gas demand and nine days of peak demand in 2009.

The government has plans for underground storage in the exhausted Kavala offshore gas field. A January 2011 study commissioned for the Ministry of Environment, Energy and Climate Change confirmed that it would be technically feasible to convert the Kavala field into a 1-bcm permanent storage facility. This capacity equals around 20 days of peak demand in 2009. The maximum drawdown capacity could reach 4 mcm per day for 90 days, equalling roughly 25% of peak daily demand and 40% of average demand in 2009. This underground installation would contribute to the security of supply at both national and regional levels after the completion of the reverse flow Interconnection Greece-Bulgaria (IGB) pipeline. The government is considering an international tender for the construction of the storage facility.

Liquefied Natural Gas (LNG)

Greece has one LNG import terminal which is located on the islet of Revythoussa (see Fig. 7) some 500 meters from the shore of Agia Triada, in the Pachi Gulf of Megara, 45 km west of Athens. Supplies are imported by DEPA under contract with Algeria's Sonatrach and also by private

Figure 7. The Revythoussa LNG Terminal

operators. The LNG is stored in two tanks, with a total capacity of 130,000 cubic meters.

Then, it is re-gasified in special installations and afterwards it supplies the National Natural Gas System.

Today, the Terminal has the capacity to accept and handle some 5.2 -5.3 billion m3 annually. More specifically, following an expansion of the infrastructure and upgrading of the facilities SMSR gasification capacity to 1,000 m3/h of LNG from 271 m3/h LNG previously and the peak gasification has increased its capacity to 1,250 m3/h from 500 m3/h LNG.

3. Greece's Hydrocarbon Resources

Introduction

Hydrocarbon (HC) exploration in Greece started way back in the 1898. A comprehensive review for the activity until 1977 has been undertaken by Monopolis (1977)[5][6] and until 2000 by Xenopoulos (2000) [7]. Early exploration focused on the abundant surface seepage oil in the region of Western Greece in areas like Zakynthos, Katakolo , Killini and Ioannina. Then, after decades, in 1970, it focused in the Thracean Sea (Prinos area) northeast of the country, in 1980s in western Greece at the Katakolon, Zakynthos, Epiros, Akarnania areas and further north in the Epanomi area and finally in 2000s again in Western Greece (see Table 2). Initial information shows that exploration results to date are not that encouraging since only one commercially viable field was discovered, in the Prinos area, while the small offshore and onshore oil and gas discoveries in Katakolon and the gas discovery in Epanomi have not yet been developed. It is worth mentioning that in Albania there are about 20 oil and gas fields while in Turkey there are more than 16 oil and gas fields in the Thrace basin and some in central and west Turkey.

Table 2. Exploration Activity in Greece

Exploration activity in Greece

WELLS					
INTERNATIONAL OIL COMPANIES	GREEK STATE + IFP	HELLENIC PETROLEUM	INTERNATIONAL OIL COMPANIES/ HELLENIC	PRINOS	TOTAL
1939-1974	1962-1967	1975-1995	1997-2002	1971-2009	
52	17	74 (*)	6	26	175 (**)

SEISMIC PROGRAMS (in KM)				
INTERNATIONAL OIL COMPANIES	HELLENIC PETROLEUM	INTERNATIONAL OIL COMPANIES/ HELLENIC	PRINOS	TOTAL
1939-1974	1975-2000	1997-2002	1971-2009	
12200	53550 + 1 3D	2100	7765 + 2 (3D)	75615

(**) 80% of the wells: off structure or very shallow depths, or with technical problems

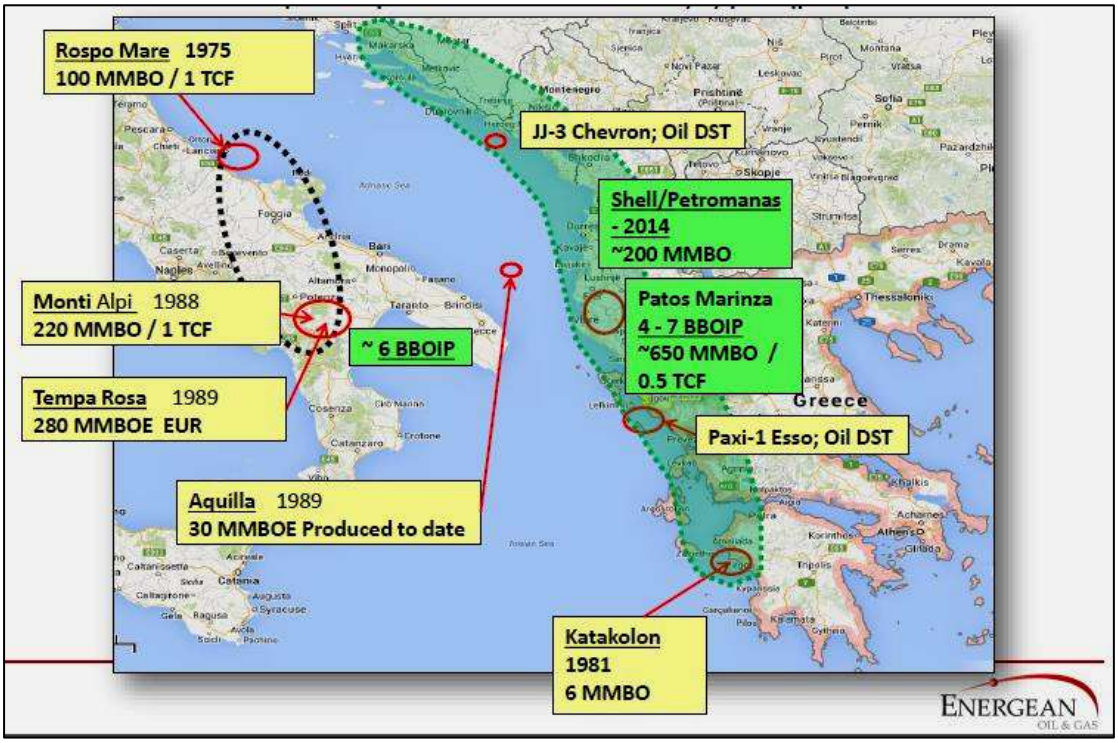
K. NIKOLAOU (2006)

New licensing agreements for three new concession areas were actually signed in May 2014 with Hellenic Petroleum SA leading the Patraikos Gulf consortium and Energean Oil & Gas the Katakolon and Ioannina ones.

Western Greece

The Greek Ionian and Preapulian zones should be an active oil or gas province since there are oil seeps distributed in various locations and this area is a continuation of the proven Albanian and Italian fields (Fig. 8).

Figure 8. Oil Plays in Western Greece, Albania and Italy



However, the only proven discoveries is the oil-gas field offshore Katakolon area and the asphalt field in Alykes on Zakynthos island. The field of Katakolon discovered in 1981, and the producing horizon is the Eocene- Upper/ Lower Cretaceous carbonates of a paleostructure, unconformably covered by clastic Neogene sediments with an estimated 30 million bbl oil in place and 6 to 8 million bbl recoverable oil. The Ionian zone is composed of Tertiary clastics, overlain thick Mesozoic carbonates which in turn overlain the Late Triassic evaporites. The Apulian Zone is

composed mainly with platform carbonates and slope carbonates in its foreland (see Fig.9).The general tectonic configuration is shown in Fig. 10.

Figure 9. Simplified Lithostratigraphic Columns with Main Reservoir & Source Rocks Intervals

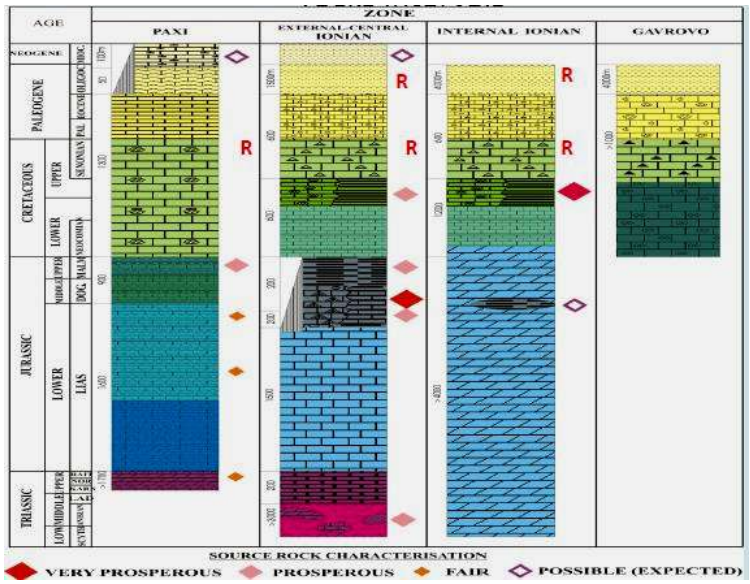
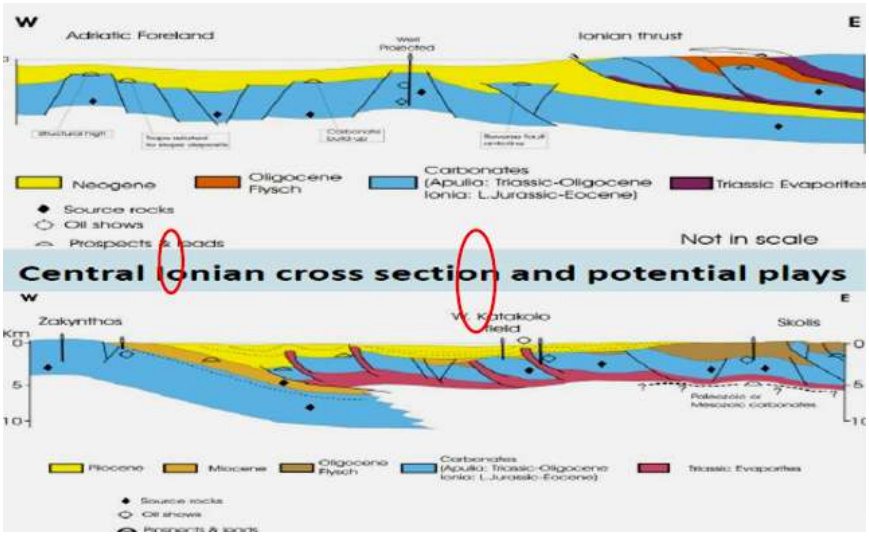


Figure 10. Ionian Sea: Geological Cross Sections with Play Concepts



Source: DEP-EKY

It is important to point out that so far all exploration wells have stopped in or never penetrated the Late Triassic evaporitic section which has never

been penetrated. Triassic evaporites consist of halite, gypsum, and anhydrite with interbedded dolomite and thin organic rich shales. The original thickness is uncertain but estimates raise it between 1800-2000m (IGRS, 1966, K. Nikolaou, 1986 and Mavromatidis, 2004) [8]. On top of this lie the carbonate successions of Pantokrator, platform dolomites and limestones which are more than 1500m thick (IGRS, 1966). Hence, the aim for future exploration and the potential for oil or gas discoveries should be in depths of more than 3.000m and up to 6.000m in case of exploration of targets below the Triassic evaporite or below the main thrusts. Exploration in Western Greece is encouraged by the existence of productive analogue structures in Albania and in Italy (see Fig. 11) but also the analogues of South Adriatic and North Ionian (Fig. 12). It is worth mentioning the Ballsh, Chacran, Patos- Maritza, Corishti, Delvina and other fields in Albania and Monti Alpi, Monti Crosso, Aquila, Medusa, Giove, Rospo etc. and in Italy (see Fig. 13). Ideal analogues for Western Greece are also the discoveries of West Katakolo (Fig. 14), and the Alykes asphalt field on Zakynthos island(Fig. 15). Positive indications are the abundant oil and gas seeps which are found in Western Greece (see Fig. 16).

Figure 11. H-C Fields in Italy and Albania

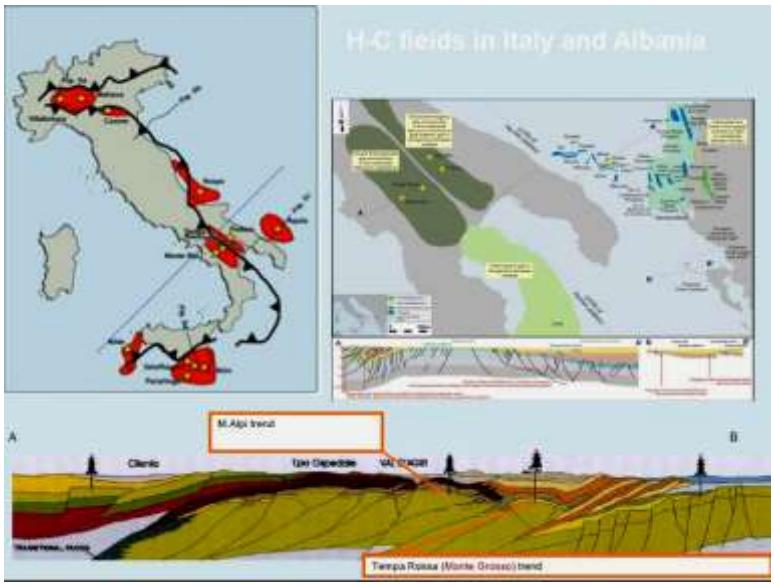


Figure 12. Analogues in South Adriatic and North Ionian

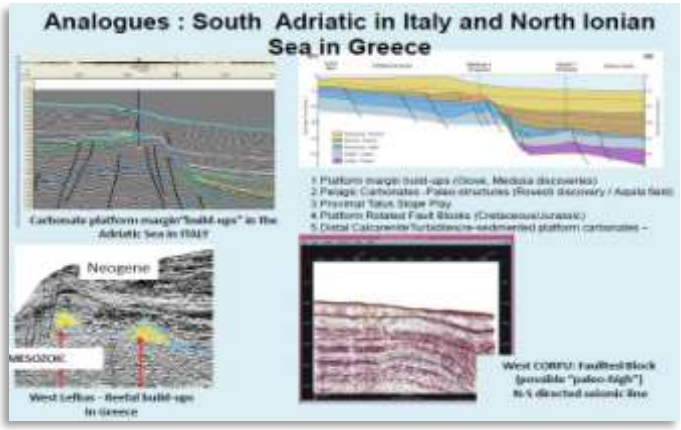


Figure 13.Albania Ballsh-Hekal Oil Fields

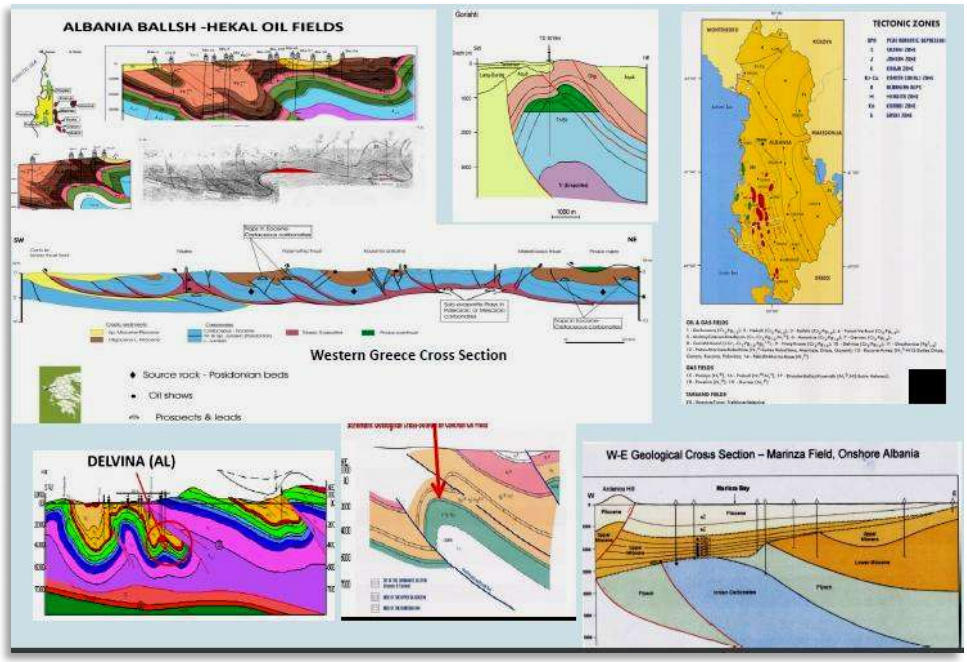
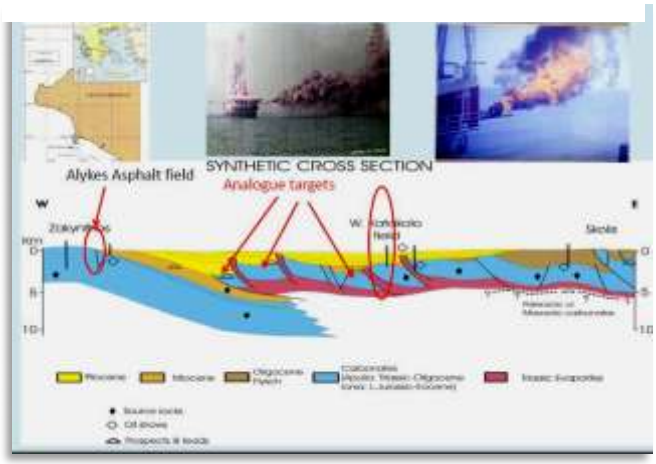
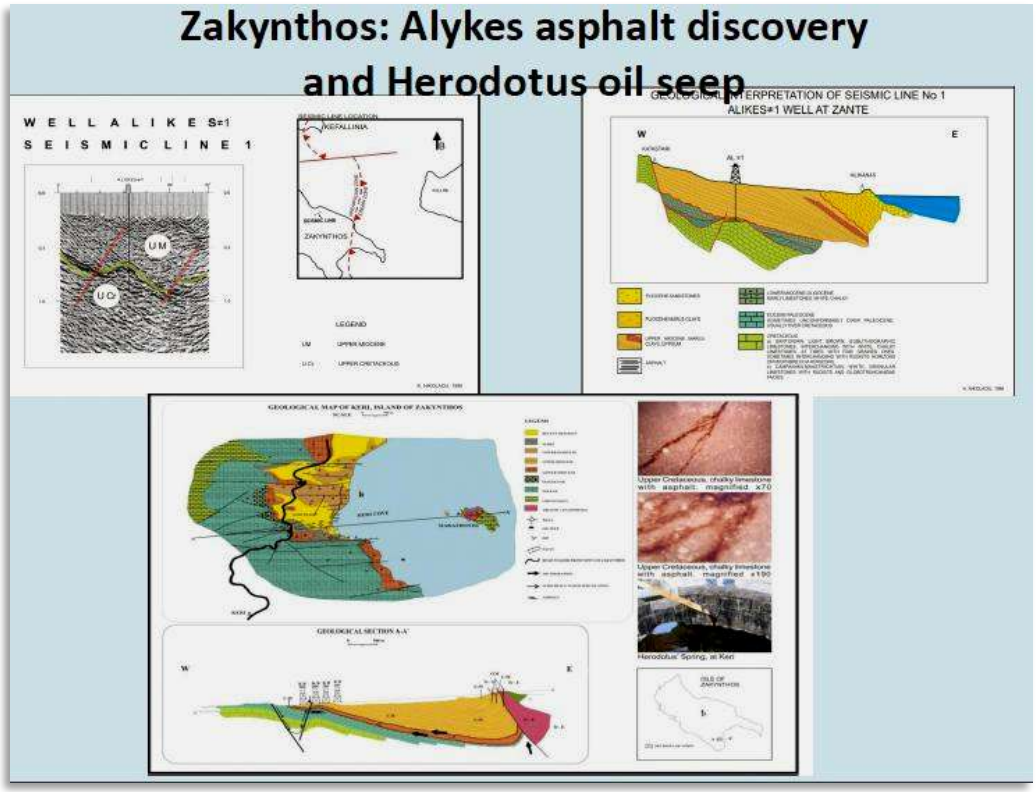


Figure 14. West Katakolon Discovery and Analogue Plays



Source: K. NIKOLAOU

Figure 15. Zakynthos: Alykes Asphalt Discovery and Herodotus Oil Seep



Source: K. NIKOLAOU

Exposed or shallowly buried carbonate anticlines are present throughout the Ionian zone. These carbonates, anticlines below the flysch, are expected to have low matrix porosity enhanced by fracturing during Tertiary compression [9].

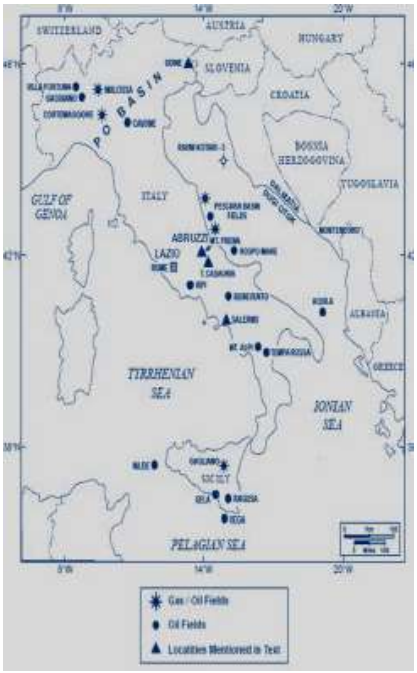
Figure 16. Oil & Gas Seeps in Western Greece

K.NIKOLAOU (1986)

In 1996, the Greek state oil company DEP-EKY (HP) announced for the first time after 1980 an international tender for six areas of Western Greece (three on land and three offshore), for a total coverage of 12,139 km^2 with the Katakolo field included in the tendering process. In 1997, the government

signed four areas for oil exploration and exploitation in four stretches near Ioannina, Eteloakarnania, West Patraikos Gulf and the Northwest Peloponnesos. Two of them were awarded to Enterprise Oil and the other two contracts in Aitoloakarnania and Gulf of Patraikos, to Triton Ltd. Enterprise Oil, in its two concessions carried out geophysical surveys which covered 700 km of seismic lines. The processing and interpretation of the seismic lines in the NWP has led to the determination of the position of two drilling sites at a depth of 2500m each, while for Ioannina has led to the determination of the position of one well for a target depth of about 4000m- 4500m. Triton Ltd. also carried out a broad programme of seismic lines on the land area of Aitoloakarnania which has led to the determination of the position of two prospects, one at Evinos at a depth of approximately 1500m and a second one in the Trifos area, at about the same depth. In the offshore of the Gulf of Patraikos, Triton Ltd. carried out a seismic survey of about 1000km, with 4000m streamers. The processing and interpretation of these tracings aimed at a targeted depth of 3000m- 4000m below sea level.

Figure 17. Active Oil Fields in Italy



By late 2001, all exploration and drilling activities ceased in an abrupt manner. Enterprise Oil drilled two wells in NWP, Artemis-1 and Apollo-1 in the year 2000, and one well, Demetra-1, in the Ioannina area, drilled in 2001. Artemis-1 is located on a thrusted rollover with a top seal of Oligocene flysch. The target was the Ionian carbonates underneath the flysch. The reservoir interval was prognosed to consist of fractured carbonates of Late Cretaceous to Eocene age (which are productive further up north in Albania). Drilling proceeded to a total depth of 2375m. The well encountered some oil shows and finally it was plugged and abandoned (P&A).

The Apollo-1 well was located in the Gavrovo Zone, within the Hellenide fold and thrust belt. The structure targeted by the Apollo-1 was a faulted fold, having the flysch as a seal rock. Only two key lithological intervals were present in the well, namely the Flysch and the Gavrovo carbonates, the latter comprising the reservoir. The Gavrovo carbonates have rarely been drilled in Greece. The reservoir interval was prognosed to consist of fractured platform carbonates. The well proceeded to a total depth of 1710m and was P&A.

The Demetra-1 well was drilled in 2001. The original target depth for Demetra-1 well was at 4000m aiming at penetrating the thick evaporitic section, never penetrated before, but this also did not materialize in this attempt. A dome structure was identified from reprocessed seismic profiles at that depth and the well was spudded and drilled over a period of five months and preceded with significant technical problems. However, it did not succeed in penetrating the evaporites with reports indicating that drillers had encountered unexpectedly high pressures, while still in the evaporitic section, which proved impossible to overcome, even after the unsuccessful attempt to sidetrack the well. These problems increased the drilling expenditure significantly and combined with the acquisition of the operator (Enterprise Oil) by Shell and prevailing low oil prices at the time, a shift of priorities of the new owner led to the decision for the well to be P&A.

In 2000, Triton Ltd. drilled two wells in Aitoloakarnania, named Trifos South-1 and Evinos-1. Triton Ltd. did not execute the agreed drilling programme in the Gulf of Patraikos due to company's management decision after the takeover by Amerada Hess following an unsuccessful attempt to farm out portions of the concession.

Trifos South-1 was planned to drill to a target of Ionian Zone basinal carbonates, sealed by Oligocene flysch or Triassic evaporites. This reservoir/seal interval was prognosed to be in a subthrust setting, overthrust by Triassic evaporites. However, during drilling these evaporites were found to be thicker and the well stopped within these evaporites at a depth of 1509 m with commitment depth for the well

being at 1500 m. This well failed to drill to the objective reservoir and failed to test the play. It was P&A (with minor oil and gas shows).

Evinos-1 was planned to drill Gavrovo Zone platform carbonates, sealed by Oligocene flysch. The well was drilled to the commitment depth of 1500m and stopped at 1508m. Minor gas shows and poor oil shows were encountered within the carbonates and the well was P&A. The most likely cause for dry hole was the absence of closure at the well location and the missing of source rock to charge the structure.

Even though the recent activity in western Greece has proven unsuccessful, the wealth of subsurface data that has been acquired with state of the art technology, never done before at such large depths, as in Demetra-1, should be made available for further exploration and analysis so that a better picture of Western Greece's subsurface geological setting is drawn and the causes of the unexpected high pressures to be determined. This will aid in the delineation of future attempts for oil exploration which should not cease.

Central Greece

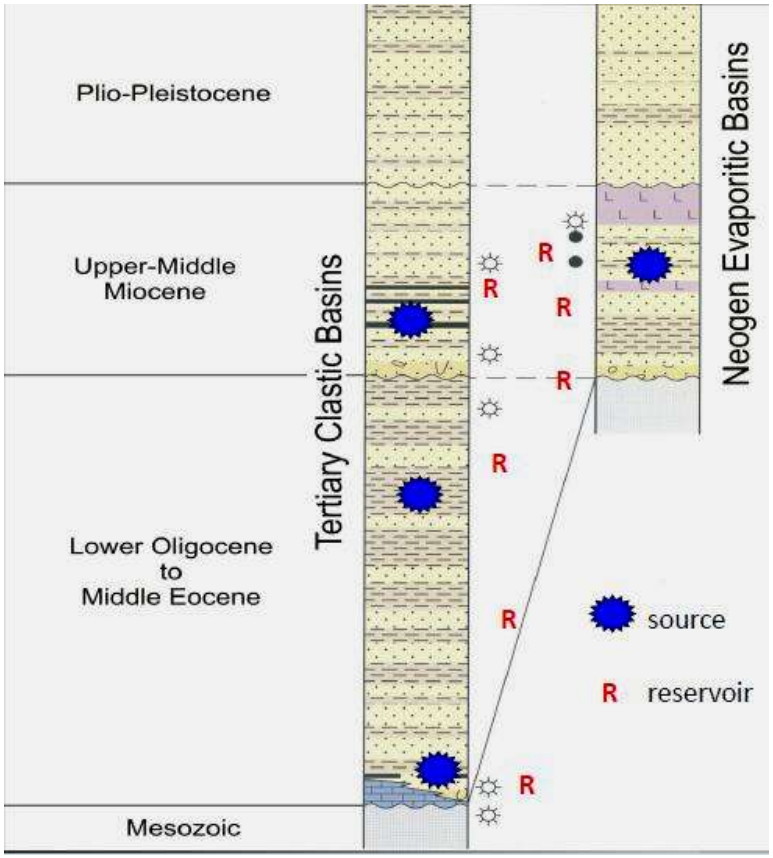
Central Greece is characterized by the Mesohellenic basin trends SSE-NNW which is 130km long and 40km wide and is located mostly in the district of Grevena . Two depocentres, more than 4200m and 3200m thick, have been recognized of Middle Eocene to Middle Miocene age, where submarine fans of sandstones and shales have accumulated unconformably over a sub pelagonian complex. Source rocks and possible stratigraphically trapped reservoirs have been identified by geological, geochemical and seismic analyses (DEP-EKY, Kontopoulos et al., 1999 [10] and Avramidis et al., 2002 [11]). (Indications from the area however show that the organic matter is mostly immature and thus the generation of gas is of biogenic origin is expected).

North and Eastern Greece

In eastern Greece exploration was oriented towards the tertiary basins in the post-orogenic Paleogene and younger Neogene basins. The main tectonic regime that controlled their evolution was extensional. The stratigraphy includes Eocene reefal limestones, thick Eocene to Oligocene marine clastic sediments, and Neogene marine and terrigenous deposits with extended Messinian evaporites (see Fig. 18).

Potential source rocks for gas and oil generation have been discovered in Eocene and Miocene sediments. Traps include rollover anticlines, growth faults, faulted blocks, and stratigraphic features in Eocene reefal limestones, Eocene Oligocene sandstones, and Neogene sands. Trapping ability also exists in fractured Mesozoic formations. Oil and gas may come from lateral migration from younger formations.

Figure 18. Stratigraphy and Source and Reservoir Rocks Position of Eastern Tertiary Basins

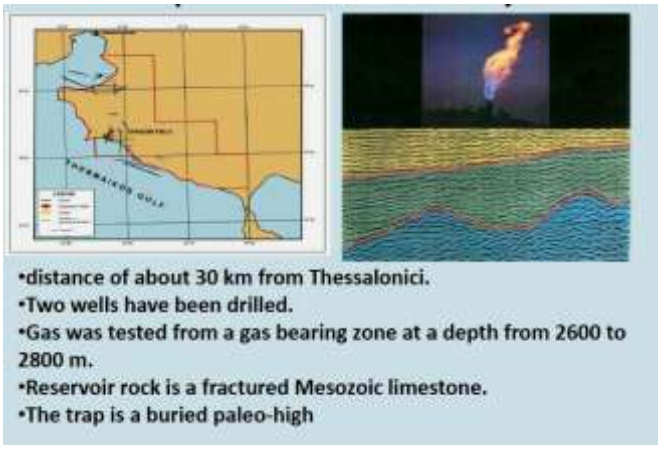


Source: Hellenic Petroleum

The Epanomi gas field was discovered in 1988 by DEP-EKY, with recoverable reserves of about 0.5 billion Nm3 of natural gas (DEP-EKY, Hellenic Petroleum). The structure is formed by the paleoerosional surface of Mesozoic limestones buried below Tertiary clastic sediments (Roussos & Marnelis, 1995). The field has not been exploited to date. Ideal analogues

for Eastern Greece are the discoveries of Prinos, South Kavala and Epanomi in Greece (see Fig. 19) and the discoveries in East Thrace in Turkey (see Fig. 20, 21).

Figure 19. Epanomi Gas Discoveries

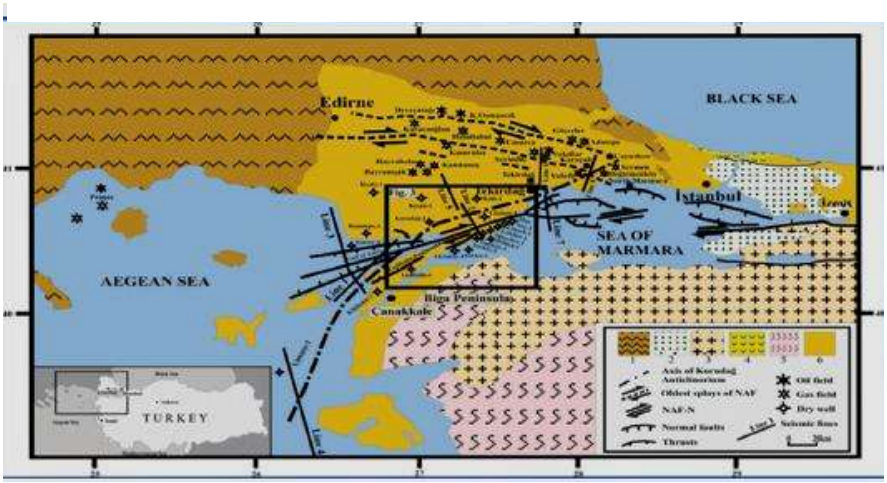


Source: DEP-EKY

Figure 20. Analogues in Eastern Thrace and Turkey

Source: K.NIKOLAOU

Figure 21. Oil & Gas Deposits in Turkish Thrace

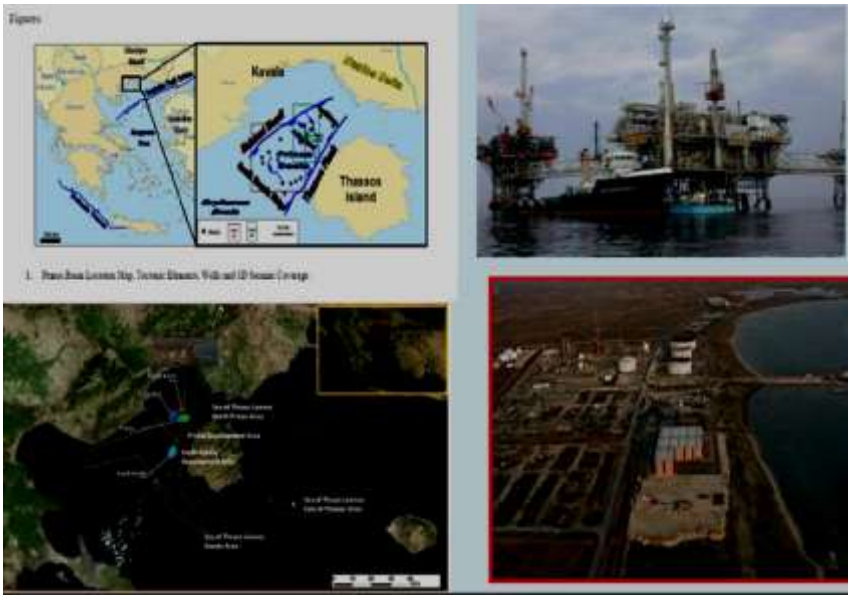


Source: K.NIKOLAOU

The Prinos Field

Miocene sands, capped by thick salt layers, form the Prinos reservoir and seal respectively, of Greece's only active producing field (see Fig. 22). Source rocks were considered to be marine shales of Middle Upper Miocene age. The Prinos structure is a graben bounded by NW-SE faults which dip towards the center of the basin. The South Kavala gas field and Prinos oil field were discovered by Oceanic co. in 1971 and 1973 and exploited by the North Aegean Petroleum Company (NAPC). Production terminated in 1993 for the South Kavala field and 1998 for the Prinos field. However, a new oil field, namely North Prinos, was discovered in 1994 by NAPC, and the Public Petroleum Corporation of Greece participating with a 35% interest. Maximum production was about 3,000 barrels per day in 1999. In 1998 NAPC withdrew completely from the region and operations were undertaken then by the newly formed Kavala Oil Co with majority shareholder the Eurotechniki SA company (67%) and with the workers union controlling the rest. In 2003 a new operator was appointed, Regal Petroleum which left in 2007 and with Energean Oil & Gas, the present operator, having taken control of the concession and in charge of all production and exploration operations since. Detailed information on the operation of the Prinos field and the exploration work conducted there is given is Chapter 4 of this report.

Figure 22. The Prinos- South Kavala Basin

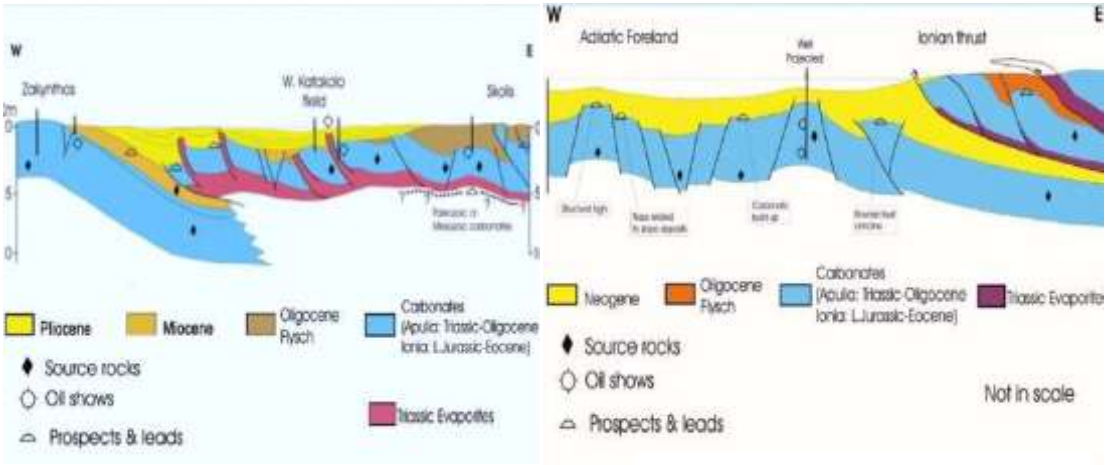


Source: Energean Oil & Gas

Discussion-Prospects

It is obvious that over the last 15 years and since the dissolution of the DEP-EKY, the state owned HC exploration company, there has been very little exploration effort in Greece and only very recently this discouraging situation looks set to change. The majority of the locations, drilled before 1960s, were selected mainly on the basis of surface geology with poor geophysical support. Geological surveys although locally controlled by some rather deep wells (> 3500m) have not yet been capable of providing a comprehensive and reliable picture of the relatively deep geological structure.

Figure 23. Adriatic and Ionian Sea Geology



Source: Hellenic Petroleum

However, in Western Greece there are basins with significant HC potential which merit exploration. Petroleum systems[(NB)] and all other requirements for hydrocarbon accumulations are satisfied in the Ionian and Apulian/Preapulian geotectonic zones. In this area there is significant amount of geological data. This part of the country has already attracted oil exploration interest since the early part of the last century and has been covered by detailed surface geological surveys including mapping of 1:50000. Western Greece is covered by northwest-southeast trending geotectonic units constituting the southern prolongation of the oil

[(NB)] Petroleum systems are the fundamental conditions to have hydrocarbons in an area and is the co-existence of source rocks (generating hydrocarbons), reservoir rocks (reserving h-c), sealing rocks (preventing the accumulations of h-c) traps (entrapping and storaging the h-c) and the proper geological history).

producing Albania and the Adriatic Sea. It can be safely stated that there is a great possibility for commercial production to be established in Western Greece which is an area characterized by proven petroleum systems, ideal and producing analogues in Albania and Italy, active oil seeps, asphalt saturated strata, repeated h-c shows in wells and thick dark coloured shaly or carbonate rocks rich in TOC, representing important source rock intervals (Rigakis, Rigakis-Karakitsios) [12].

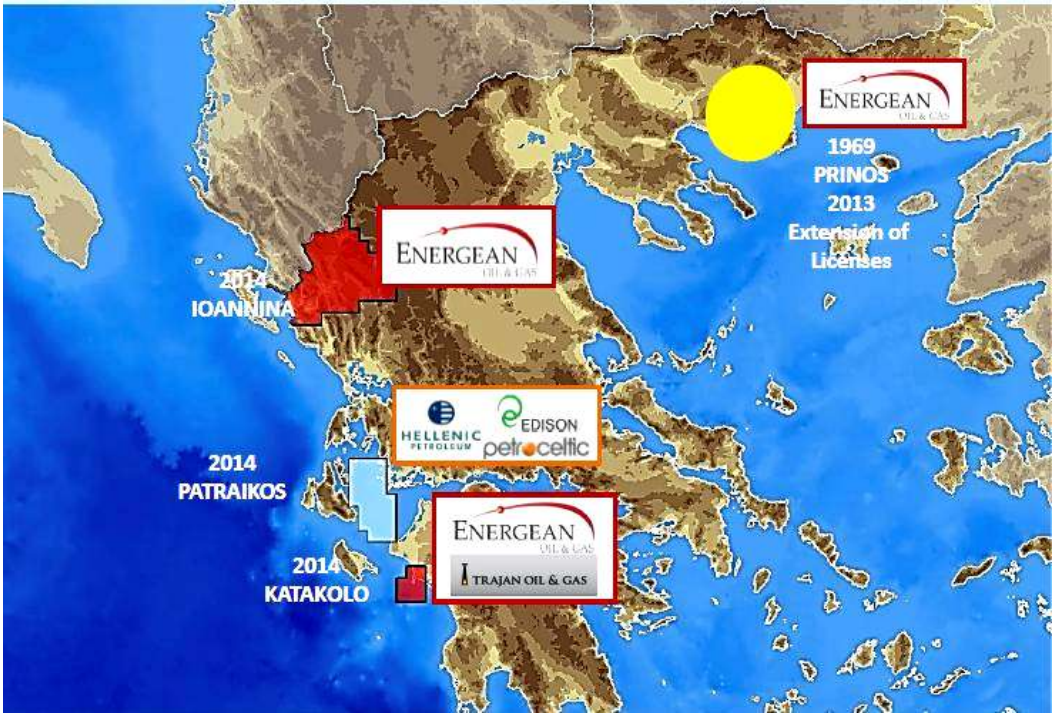
In Katakolon area, exploration has proven the existence of an oil field, in water depths of 260m, which now awaits exploitation. This shall proceed with new appraisal and development wells. While this task at the time of its discovery was deemed very risky and difficult and therefore not undertaken, now with the recent technological developments and breakthroughs in drilling technology, for deep well drilling, the field will be approached using an extended reach well, starting from the Cape Katakolon 3.5 km away.

The Messohelenic basin is considered to be a high risk area for HC exploration in which no commercial discoveries have yet been made. The Epanomi gas field is the ideal analogue to some neighbouring basins in the Aegean Sea. The onshore Thrace Basin, which is currently under intensive exploration activity in Turkey's side of the border, is the analogue to lead in exploration successes in the area of West Thrace in Greece. The Prinos field has also similar lithology with some Thrace Basin units and some claim that gas fields in the Marmara Sea in Turkey originated from the same sandstones as in the Prinos oilfield (Coskun, 2000)[13]. It should further be noted that Prinos is also analogue to some neighbouring basins in the Aegean Sea [14] [15].

4. Current Concessions and their Development Prospects

Today, we have four main hydrocarbon concession areas in Greece of which only one, the Prinos field in the Prinos- Kavala basin in northern Greece, is producing oil and has been in operation since 1981. The other three concession areas are located in Western Greece and were recently awarded to three consortia (May 2014) following a bidding and evaluation process which lasted 28 months. The petroleum systems (source rocks, reservoirs, seals, and migration/charging time) of these concession areas, i.e. the onshore Ioannina and the offshore Patraikos Gulf and Katakolon (see Fig. 24) are well documented from a geological viewpoint and extensive geological and geophysical data already exists from a previous round in 1997 and the legacy data of DEP/DEP-EKY. A description and the main characteristics of the above four (4) concessions are presented in a concise form as follows:

Figure 24. Active Lease Agreements in Greece (2014)



1. Prinos and surrounding fields

Production

The Prinos Oil Field is the main structure in the Prinos-Kavala basin, located offshore in the Gulf of Kavala. It covers an area of 4-5 km2, about 8 km north-west of the island of Thassos and 18 km south of the mainland of North Greece.

The solution gas contains about 40%-50% hydrogen sulfide. The reservoir is in a depth of 2500 to 2800 metres while the sea water depth in the area is around 30 metres. The field is separated in 4 main compartments, and in 12 different layers, with varied oil content. The field pressure ranges from 140 bars up to 400 bars, and the recovery of hydrocarbons is mainly achieved with the use of gas lift and water injection. The Prinos platform complex is located at the centre of the field.

The Prinos Field was discovered by the well Prinos-1, the third exploration well drilled in the area, at the end of 1973. The field was developed during the period 1974-1980, and crude oil production commenced in early 1981 at initial rates of 8,000 to 10,000 bopd. Production peaked at more than 27,500 bopd in 1985-1986, however it has steadily declined since then.

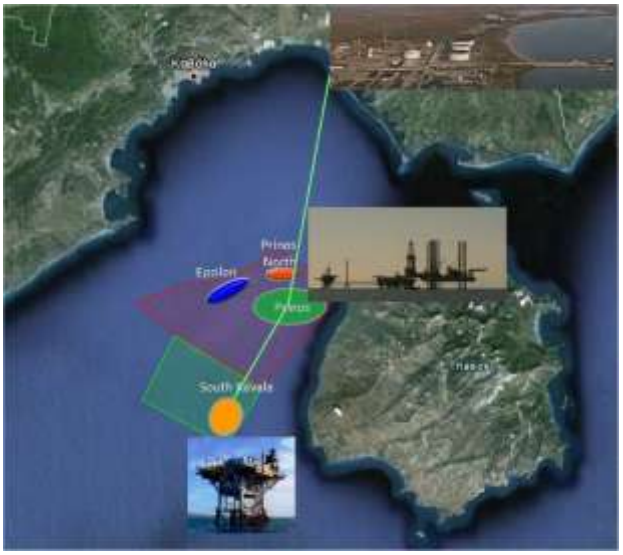
Since 2007, when Energean Oil & Gas [16] took over the concession from a previous operator it has invested €180 million and achieved a significant revival of the field. The first infill well, (PA-35) started production on February 2011, with an initial rate of 1,000 bbls daily. The cumulative production from PA-35 reached 320,000 barrels in August 2013.

Figure 25. New Prinos

On July 2013, Energean Oil & Gas started to implement a new investment programme, aiming to double the production from the field. One injection well (PB-23) was completed in September.2013, In order to increase the pressure in Prinos field, two months later an infill production well (PB-34) was completed. Production from Prinos has increased to more than 2,000 bbls/day during the first two months of 2014. It should be noted that Prinos 2P reserves were initially estimated at 60 million oil bbls, but the field has already produced almost 115 million bbls since 1981. This clearly shows the considerable potential that still exists for further production from the particular field.

Production Facilities

Figure 26. Prinos and Adjacent Fields



Development of the Prinos Field began in 1979 and involved the installation of a complex of platforms, underwater pipelines and onshore chemical facilities. The platform complex includes two 4-leg, 12 slot drilling platforms; Alpha and Beta, an unmanned gas production platform

Kappa, built for the exploitation of the South Kavala gas field, an 8 leg processing platform Delta which includes a three phase separation process, crude dehydration, oil pumping, sour gas dehydration, produced water treatment, water injection, sweet gas-lift, and other auxiliary facilities.

Crude oil is piped through an 18 km long 8" pipeline. The pipeline is connected to the onshore oil and gas processing facility denominated Sigma, where crude oil is subjected to the condensation process and sulphur is recovered and sold. Dehydrated gas is re-sent and re-inserted through a 12" sour gas line that is 18 km long. Sweet gas for fuel and gas lift is imported from the South Kavala field, located approximately 12 km south of Prinos, through a 6" sweet gas line.

Natural gas, NGL and liquid sulphur are also recovered during the processing procedures. Some natural gas is consumed as fuel gas and the balance is returned off-shore for gas lifting. NGL is blended with the finished crude oil, and liquid sulphur is recovered and sold to the nearby fertilizer plant.

South Kavala Gas Facilities- Kappa Platform

The South Kavala Gas field, an almost depleted gas field, is located offshore in the Gulf of Kavala and produces gas with more than 80% methane. The reservoir is located between two salt layers, at a depth of 1700 metres, and the sea depth in the area is about 51 metres.

The four leg platform, designated as Kappa, is 12 km southwest of the Prinos platforms, is the same design as Alpha and Beta platforms of the Prinos Platform Complex. It accommodates two wells and is compatible with drilling, workover and service rigs.

It is equipped with three-phase separation facilities, a gas booster compressor unit and a TEG gas dehydration unit. The platform has two deck levels; the lower deck contains a topsides completion system, a dehydration unit and the wellheads. The upper drilling deck has cabin

style quarters and diesel power generation facilities. The gas is dehydrated and then exported to the offshore oil production platform at Prinos, where the gas is used for fuel and gas lift.

Figure 27. Prinos Offshore Production Facilities

Source: Energean Oil & Gas

At present the gas well head operating pressure is 4 barg, while the gas leaves the platform and enters the 6" submarine pipeline at 12 barg and 30 degrees centigrade. Production consists of 60,000 nM3/day sweet dehydrated gas and 200 bpd gas condensate. Now the field is almost depleted.

Development

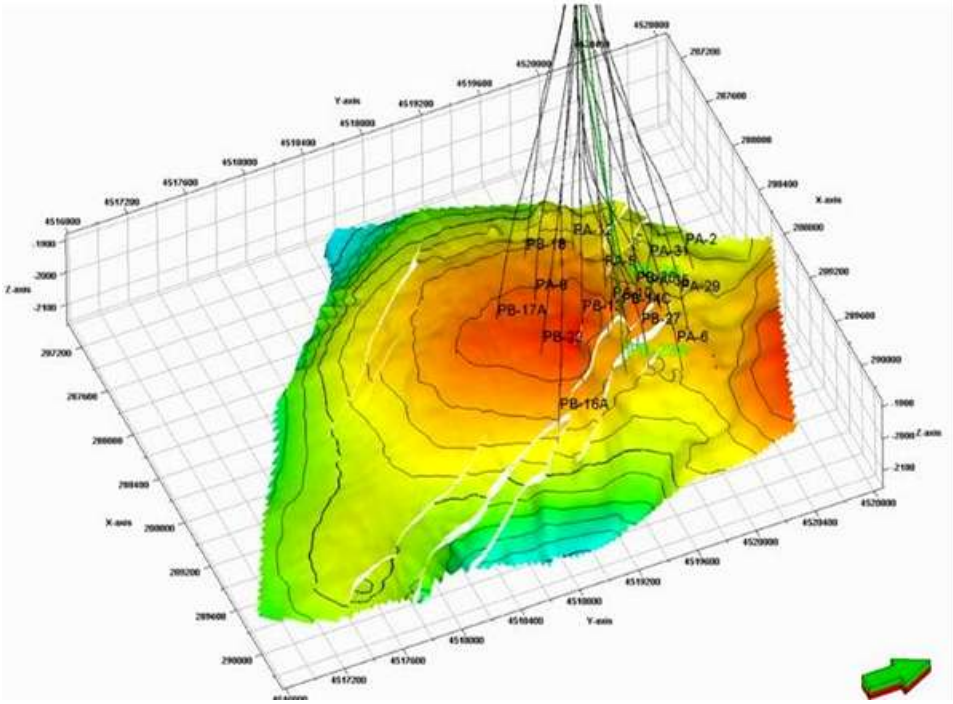
The Prinos Oil Field's new reservoir model as exemplified by "Energean Oil & Gas" confirms significant quantities of bypassed oil, which has also been confirmed by recent successful infill wells. Energean has recently completed the construction of a geo-cellular model of the Prinos reservoir and calculated a STOIIP totalling 344 MMstb, of which some 85 per cent is in the A1 and A2 sands (289 Prinos, 16 N. Prinos, 39 Epsilon).

The 2014-2016's investment programme, which is in excess of €200 million which commenced in late 2014 consists of the drilling of a further seven new production wells in Prinos, including one extended reach well to drain an area in the south east of the field, which was not previously developed. Four wells are also scheduled for workovers in 2014 to additionally perforate currently undrained sands. The execution of the aforementioned wells is expected to increase production by more than 3,500 bbls/day. Furthermore, small interventions & re-completions are expected to add more than 1,000 bopd. The remaining proved and probable reserves (2P) have been estimated at 30 mmboe.

The Zeta prospect is 1.75 km north of the Prinos Oil field, covering an area of 1.59 km2 (mid case). Zeta is a fault bounded structure below the Evaporitic sequence with good quality oil recovered on test. The Zeta discovery sits part way between Prinos and Prinos North. It was discovered in 1976 during the Prinos field delineation. Sweet oil (no H2S) was tested at rates of up to 1000bopd on the northern side of the main fault which separates Prinos from Prinos North. Clearly Zeta represents a separate accumulation from Prinos and Prinos North, both of which have very high H2S levels in the produced gas. STOIIP is estimated at 25.4 MMstb, while gross prospective oil resources at 3.9 MMstb.

The Alpha prospect is located to the east of Prinos North and to the north of Zeta, in another fault block defined from available 3D seismic data. Stratigraphically it belongs to the Pre-Evaporitic Sequence, in the same unit with Prinos Equivalent zone. Alpha is a fault bounded structure. Alpha has not been drilled, but its proximity to the Prinos North reservoir suggests similar rock characteristics, as well as the same OWC level and drive.The opportunity to explore Alpha will be considered once the Prinos North platform has been installed. STOIP is estimated at 17.57 to 21.18 MMstb, with Gross Oil prospective Resources at 6.74 MMstb.

Figure 28. Prinos Oil Field, Structural Map. The development wells are conventionally deviated in order to cover the entire anticlinic structure of the field

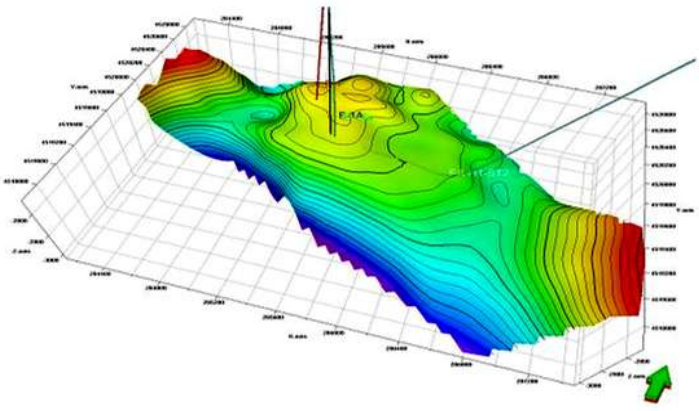


Source: Energean Oil & Gas

Epsilon

The Epsilon oil field is a satellite field within the Prinos – Kavala basin. It is located approximately 4.5 km west-northwest of the main Prinos Oil Field, covering an area of about 2.5km2. The exploration well E-1A discovered the field in 2001, followed by the E-1As side-track well, which was drilled down-dip along the structure. Energean Oil & Gas drilled an extended reach multi-lateral well, EA-H1, which was successfully completed in January 2010.

Figure 29. Epsilon Field, Structural Map. The exploration wells E-1, E-1A, e-1As, and the development well EA-H1 are illustrated on the map



Source: Energean Oil & Gas

The length of the well reached 5,297 m, with the more than 450 m horizontal section of each leg, being the longest well drilled in the Mediterranean to date. The well so far has produced 300,000bbls.

Energean has designed a full scale Field Development Plan for the Epsilon Field, in which a buoyant GMC tower, tied to Prinos platforms, will be used (Q1 '16).The 75 million euros investment programme consists of 2 appraisal wells and 4 injection -5 producers or 2 injection – 3 producers, subject to the result of the appraisals wells . Initial production rates and plateau are estimated at 3,000 bbls per day, and recoverable reserves are 14,2 mmboe while reserves in place are about 39 million bbls.

Prinos North

Prinos North Oil Field is one of the satellite fields within Prinos – Kavala Basin. It is located approximately 5 kms north of the Prinos Oil Field and about 18 km south-west of the mainland of North Greece. Prinos North Field was discovered in 1994, when PN-2 well was drilled in the area.

The field commenced production in mid-1996 at a rate of over 3,000 stb/d before a decline set in on water breakthrough in 1997. At the time of field shut-in in late 1998 the well was producing some 1,500 stb/d at a water cut of some 50 per cent. On the resumption of production the well continued declining to ca 300 stb/d at a water cut of some 80 per cent when it was closed in for side-track in 2004. Following the unsuccessful side-track in 2004, an extended reach well, PNA-H3, was successfully drilled by Energean in 2009, through a challenging operation due to the geological complexity of the targeted reservoir.

The new well reached a total depth of 4,370 m, with a 358 m horizontal section into the reservoir. The production started at initial rates of more than 1500bopd. The average oil production rate in 2014 was 220 stb/d at a water cut of some 80 per cent. The cumulative oil production is 3.9 MMstb.

In Prinos North, a new 40 million euros investment programme which consists of a GMC buoyant tower (Q3 2015) and the drilling of three wells in a new area, northwestern from the old reservoir, has been planned aiming at a production increase from the current 220 to 1,500 oil bbls per day.

The Prinos North platform is scheduled to be located approximately 3km northwest of the Prinos Delta processing facility. The Prinos North platform will receive crude from Epsilon, when the field commences production, which will then be mixed with the crude produced on Prinos North itself and transported through the 10" NPS flow line to Prinos Delta.

Three wells will be drilled during the first development phase of Prinos North, one into Prinos North itself, one into Zeta (appraisal) and a third either into Alpha or as a second Prinos North development well. Water injection and gas lift will be required as soon as the first well is brought into production. The drilling duration for the three Prinos North platforms is estimated to be approximate 40 days. North Prinos' recoverable reserves (2P) are estimated at 3,4mmbo.

2. Ioannina

Energean Oil & Gas, signed a License Agreement with the Greek State on May the 14th 2014, for hydrocarbon exploration and exploitation in the Ioannina block, onshore in Western Greece. Energean is the operator and holds an 80% interest, while the Canadian Petra Petroleum holds a 20% interest. Few months after the ratification of the agreement Petra petroleum farmed out its share to Energean Oil & Gas, which now holds 100% of the block.

The block is an under explored area (less than 1500 Km 2D, mostly old, seismic had been acquired and only one well drilled during the last 25 years) of 4,187 km2, which was previously awarded to Enterprise oil and was abandoned after their takeover by Shell in 1990. Resources in Demetra prospect (P50) had been estimated before drilling, in the range of 100 mmboe or 2 tcf gas, with significant upside potential.

Energean's investment programme at Ioannina during the 7-year exploration stage is estimated to reach €32 million, including acquisition of new seismic data and the drilling of 2 wells. The area has proven petroleum systems and great analogy with the proven and producing oil fields in Albania and Italy. The area is characterized by multiple play concepts, while shallow and deep exploration targets have been identified. Ioannina has a complex structural setting and geological regime (thrust fold belt) and extremely rough terrain. The main reservoir targets are fractured carbonates, below the Flysch formation, and deeper targets below the Triassic evaporates (Paleozoic or duplexes below the lower main thrust).

3. Patraikos Gulf

The Concession Area

Figure 30.W. Patraikos Lease

Source: Hellenic Petroleum

As part of its strategy Hellenic Petroleum, Greece's leading downstream oil company [17], participated in January 2012 in the Open Door process for the 3 areas in Western Greece where it focused its attention on the West Patraikos Gulf area. On May 14, 2014 exclusive E&P rights were awarded for the West Patraikos area to a business scheme led by Hellenic and comprising:

- Hellenic Petroleum (33.3%, operator)
- Edison International SpA (33.3%)
- Petroceltic Resources (33.3%)

A group of established, reputable and financially strong oil companies with vast experience and knowledge in the Adriatic and Ionian Seas will explore a sizeable offshore area in the West Patraikos Gulf (see Fig. 30). It should be noted that Hellenic Petroleum is not a newcomer in the area

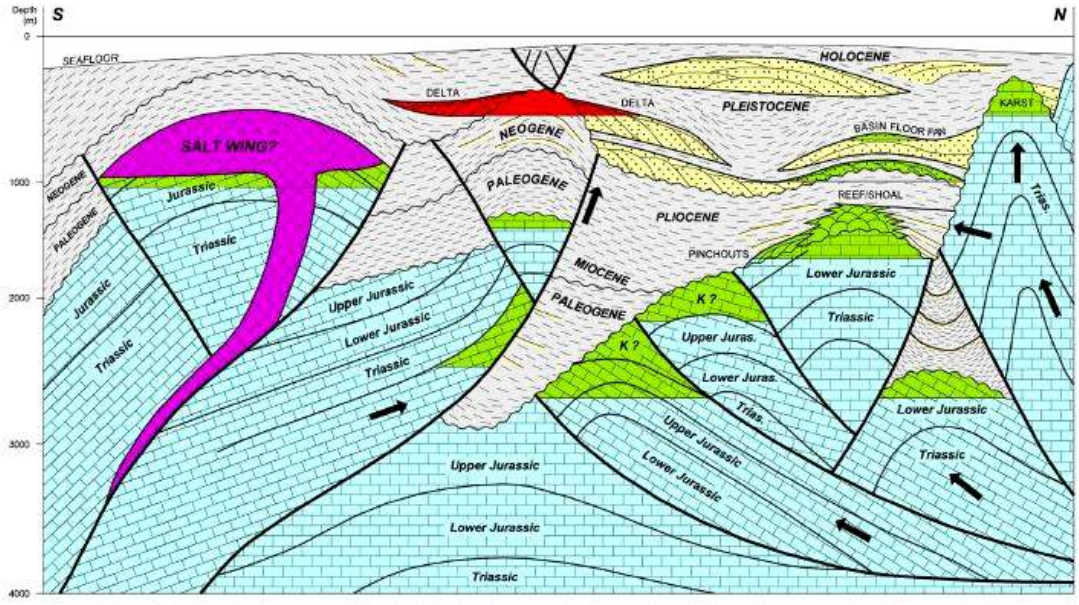
having carried out exploration works in the area before. During the period 1978 – 82, DEP, the ancestor of Hellenic, acting as operator it carried out geological and geophysical studies, and the overall results were encouraging for the area. Then, between 1998 and 2001 in association with Triton SA, as part of its participation in the 1st International Concession Round (see Chapter 6) carried out more seismic and geological studies. Unfortunately Triton decided to relinquish the block, due a change in this corporate strategy without drilling.

Today, Hellenic considers the West Patraikos Gulf as an oil promising area with complex geology, (see Fig. 31). Hellenic Petroleum and its partners' exploration strategy are determined to carry out extensive exploration in the entire concession area, so that by the end of the 8-year concession period they will know if there is oil or not in the block. The work programme comprises:

(a) Additional specially designed geological studies
(b) A high resolution 3D seismic survey of 800 sq.km.
(c) The drilling of 2-5 exploration wells

Hellenic, as operator, is currently fully engaged with the reprocessing and interpretation of the legacy seismic data so as to determine promising hydrocarbon plays. Following that it will proceed with the acquisition and interpretation of anew 3D seismic survey and 2D regional seimic lines that will be acquired by year end targeting to a detailed planning for the exploratory drilling programme.

Figure 31. An Outline of Play Concepts of Patraikos Gulf Area (Triton Co., 2000)



Hellenic Petroleum's Approach to E&P

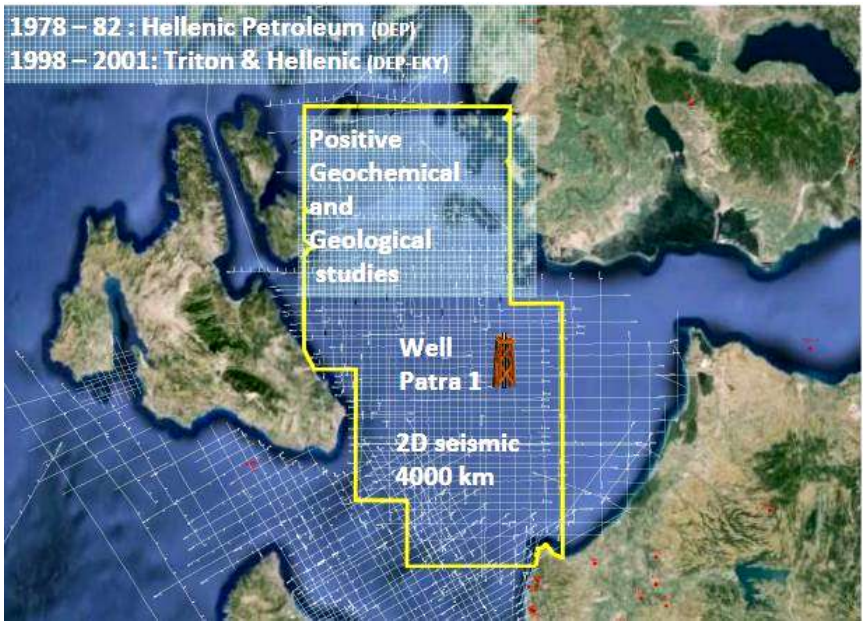
As part of its work for the Patraikos Gulf concession it is worth outlining Hellenic's view for the Greek E&P sector. Hellenic believes that Greece is offering today a number of distinct advantages:

- Attractive areas of exploration
- A new updated legal framework quite flexible for the investors
- A competitive fiscal regime (tax 25%- royalties 2-20%)

Hellenic Petroleum, being the leading oil company in Greece, finds itself in an advantageous position portraying certain unique features:

- A deep knowledge of the Greek geology
- Experience as an exploration operator in the past in 26 blocks in Greece
- Considerable international experience having participated in numerous JVs with other reputable international oil companies in Libya, Egypt, Albania and Montenegro, in exploration and participating in licensing rounds

Figure 32. Patraikos Gulf: Hellenic Petroleum's Past Exploration Activity



Source: Hellenic Petroleum

Today, Hellenic Petroleum is following closely the recent developments in the Greek upstream sector and is evaluating business opportunities. Hellenic's strategy for its E&P growth aims at increasing further the upstream contribution to the Group's value and growth by managing the existing assets portfolio in order to increase its value and also by acquiring interests in a portfolio of selected blocks. To this end Hellenic has submitted two offers for two onshore blocks in the current international round (Arta–Preveza and NW Peloponnese) while it is reviewing the available data and intends to participate in the upcoming licensing rounds in JVs with other oil companies.

As of late Hellenic is focusing homeland, capitalizing on the group's competitive advantages:

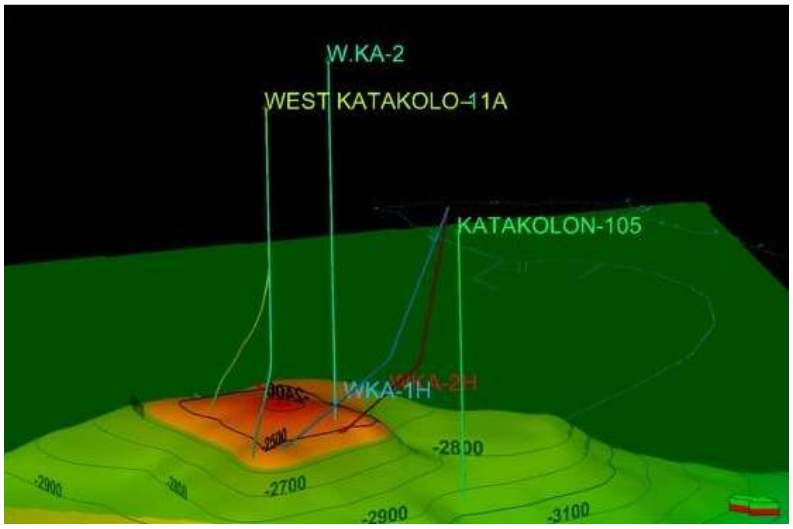
- the vast technical expertise in the Greek oil promising basins and
- the strong commercial position of the Group in the country's energy sector.

4. Katakolo

Energean, as operator in a consortium with Trajan Oil, has signed with the Greek State a License Agreement for hydrocarbon exploration and exploitation. The block is located in Western Peloponnese, covering 545 Km2, both in an offshore and an onshore area with 4-8 million oil barrels recoverable. The depth of the reservoir is estimated between 2,350-2,650m.

Energean is planning to develop the field with Extended Reach Drilling (ERD) starting from an onshore location, in a similar manner to the wells which Energean drilled in Prinos and East Magawish in Egypt. The investment programme for 5-year exploration stages will total €15 million, including the drilling of the 1st well, which is contingent upon seismic reprocessing results. W.KA-1 and W.KA -11A well (1981) tested gas and condensate in fractured Eocene and older carbonates.

Figure 33. Schematic of the Katakolo Oil Field



Source: Energean Oil & Gas

W.KA-2 well (1982) tested oil from two zones with flow rates 1,200–1,400 bbls/d. at 26-28 API. The solution gas contains 9% CO2, 6-8% H2S. The SKA≠1 and SKA≠1A wells (1981-82) reached the South Katakolon structure. Oil and gas shows from Triassic breccia were indicated. The West Katakolon reservoir is believed to be a dual porosity system (matrix, fractures and vugs), with an overlaying gas cap and an underlying aquifer.

5. The Legal Framework

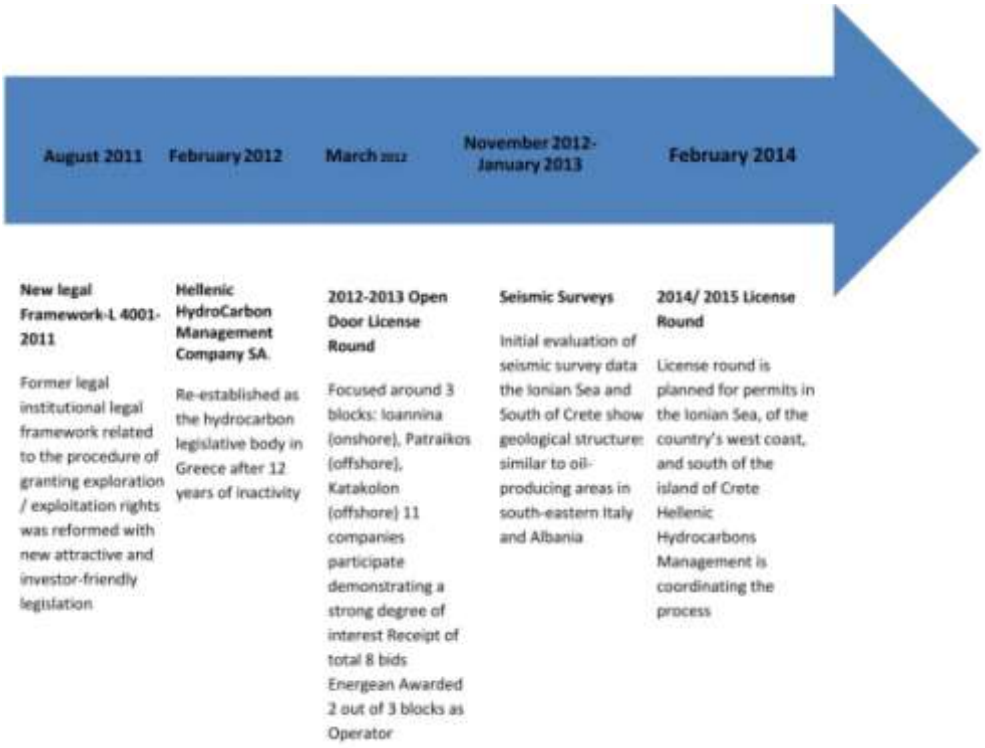
Greece has in place a very clear legal framework which governs all hydrocarbon related activities, from exploration to production. Current legislation offers an investment friendly framework and standard taxation rates, while bringing Greece in line with the more recent developments in the oil and gas industry.

Greece is committed to all relevant international protocols, agreements and EU legislation, actively encouraging best oil practices and adopting the 2013/30/EC Offshore Safety Directive. The protection of the touristic product and unique environmental heritage is a common goal to positively involve the local communities. Licenses are bound to follow the recommendations and comply with the results of Strategic Environmental Assessment (SEA) reports.

The research, exploration, and exploitation activities for hydrocarbons in Greece are mainly regulated by Law 2289/1995 (the "Hydrocarbons Law") [18], which transposed the EU legal regime (EU Directive 94/22/EC) into the Greek legislative framework. The Hydrocarbons Law was subsequently significantly revised by Law 4001/2011 (the "Energy Law"), which modernized and clarified the legal framework being in force since 1995 [19].

As a general principle and in accordance with the United Nations Convention on the Law of the Sea [20], as ratified by Law 2321/1995, the right to research, explore and produce hydrocarbons existing in onshore areas, sub lakes and submarine areas, where the Greek state has either sovereignty or sovereign rights, belongs exclusively to the Greek state and their exercise shall be for the benefit of the public. Following enactment of the Energy Law and by virtue of Presidential Decree 14/2012 the state company Hellenic Hydrocarbons Resource Management S.A. (HHRM S.A. or EDEY S.A. as per its Greek initials) was established to deal with certain matters relating to the management of the process of research, exploration and production of hydrocarbons.

Figure 34. Greece's Legal and Administration Framework and Licensing Round



Total Royalties	Average Daily Production
0%	Up to 2,500 bbls
3%	From 2,501 to 5,000 bbls
6%	From 5,001 to 10,000 bbls
10%	>10,001 bbls

HHRM S.A. is responsible for granting, on behalf of the state, the right to explore and produce hydrocarbons in accordance with the procedures specifically described in Law 2289/1995, modified by the law 4001/2011 and more particularly either (i) upon an invitation to tender; or (ii) upon an application by the interested party for an area not included in the invitation to tender; or (iii) with an open door invitation for the expression of interest.

The invitation to tender shall set out in detail the selection criteria and the competition points, which include the royalties offered by the interested parties escalating according to the production rates, the firm work programme, the depreciation escalation, the relinquishment of area, the

annual training support, and the signature and production bonuses. The declaration may also provide for a payment of an annual remuneration (surface fees) during the exploration and production stage which shall be set out per stremma (1,000m^2).

The state's rights of exploration and production of hydrocarbons are granted to third parties either (i) by the conclusion of a lease agreement; or (b) by the conclusion of a production sharing agreement, and in either case both the stages of exploration and production shall be provided for. Each agreement shall concern one or more adjacent onshore or offshore areas which shall together comprise the initial exploration area for the discovery of hydrocarbon deposits (the "Contract Area"). The Contract Area shall eventually be restricted to the area where commercially exploitable hydrocarbon deposits have been discovered (the "Production Area").

Under both agreements the contractor assumes the obligation to plan and perform the exploration and production of hydrocarbons and their by-products and has the exclusive right to do so. The contractor provides, at its own expense, the necessary technical equipment, materials, personnel and funds required for the performance of the project, and bears the entire financial risk in all events, particularly if no commercially exploitable deposit is discovered or if the profit made on the yield from a deposit is insufficient. The contractor manages the project, which shall be carried out in accordance with the international models for the exploration and production of hydrocarbons and pursuant to the work program and budget which has been approved by the employer or the lessor, as the case may be, and bears the risk throughout the entire term of the agreement.

Under the **production sharing agreement** in particular, in the event of the discovery and production of hydrocarbons, the contractor shall retain part of each calendar year's total production of hydrocarbons and by-products of each Production Area in order to cover the relevant expenses specified in the Law. The remainder of the production from the Production Area in question together is shared between the employer and the

contractor on the basis of a fixed and agreed upon percentage (ie, production sharing).

Under the **lease agreement**, in the event of the discovery of a commercially exploitable deposit, the contractor, by notification to the lessor, becomes lessee of the right of production of the deposit. As a result, it is obliged and entitled to produce hydrocarbons and their by-products and to market the same for his own benefit, either in their crude state or following the processing thereof, excluding refining, by paying to the lessor the rent and the relevant tax. The rent is due to the lessor under any circumstances, irrespective of whether the contractor realizes a profit or not. It is agreed that the rent will be paid in kind or in cash, at the lessor's option. In the first case, the rent shall be determined as a percentage of the quantity of hydrocarbons produced and in the second case as a percentage of their value, as provided under the agreement.

Both the lease agreement and the production sharing agreement may provide for the participation of the state in a joint venture with the contractor with regard to the exploration and the production stage. Such participation right of the state may not be exercised by HHRM S.A. The invitation to tender shall specify the percentage of the state's participation, if any; its participation percentage in the exploration and production expenses; its participation percentage in the allocation of the production; the legal entity through which the state will exercise its participation rights; the management of the joint venture; and any other necessary details.

Presidential decrees, which are issued following a proposal of the Minister of Environment, Energy and Climate Change specify in detail the terms and conditions of the agreements such as the contents and the timetable for the submission for approval of the exploration and production programmes and the expenditure budgets.

Under the agreements concluded, contractors may be natural persons and/or legal entities, acting singly or in a joint venture, provided they have the nationality of, in the case of a natural person, or are registered

in, in the case of a legal entity, a Member State of the European Union or a third party country having reciprocity. Following a recommendation by the Minister of Environment, Energy and Climate Change, the Council of Ministers may resolve to prohibit a person who is substantially controlled by a third country or by the citizens of a third country or, a joint venture in which such a person participates, from participating in the abovementioned procedures and from being granted a research license or from concluding lease agreements or production sharing agreements and from transferring rights granted under such agreements for reasons of national security. Following the conclusion of an agreement, the contractor may not be placed under the direct or indirect control of a foreign state which is not a Member State of the European Union, or under the direct or indirect control of a citizen of such a state without the prior approval of the Council of Ministers. The Council of Ministers will resolve whether or not to give such approval after receiving the opinion of the Minister of Environment, Energy and Climate Change. Breach of this provision shall result in the contractor forfeiting all his rights under the agreement following a resolution of the Council of Ministers to this effect.

The duration of the exploration stage shall be determined in the agreement, but may not exceed seven years for onshore areas and eight years for offshore areas, and starts with the entry into force of the agreement. Its term may be extended by up to one half of the initial period under specific circumstances. Concession schemes are royalty/tax based. The level of royalties is linked to specific tranches of R factor (ratio of gross cumulative revenue to cumulative costs) which are a biddable item. Other beddable items include firm work programme supported by a financial guarantee for the 1st exploration phase, depreciation escalation, relinquishment of area, annual training support, signature and production bonuses. The duration of the production stage may be extended for up to two five-year periods, upon a proposal by HHRM S.A., when it is shown that the original duration is not sufficient for the completion of the activities in question, with a renegotiation of the terms of the agreement and the signing of a new agreement, upon an application of the contractor which must be submitted before its expiration.

After a discovery is established the Exploration stage becomes 25 years with 5 + 5 years extension. Extensions can be granted under specific negotiated conditions. A state license authority (The Hellenic Hydrocarbons Recourse Management Company) has now taken over from the Ministry in handling all E & P matters.

The contractor shall be subject to a special income tax of 20%, as well as to a regional tax of 5%, without any other ordinary or extraordinary contribution, fee or other expenditure of any kind for the benefit of the state or of any third party. The tax shall be imposed on the net taxable income earned by the contractor's operations under each agreement.

Upon the expiration of the Production stage of each Exploration Area the same reverts, free and clear, to the state.

The use of real property which has been acquired and the ownership of moveable property, the value of which has been depreciated, shall be turned over to the lessor or the lessor or the employer ipso jure without the payment of any consideration.

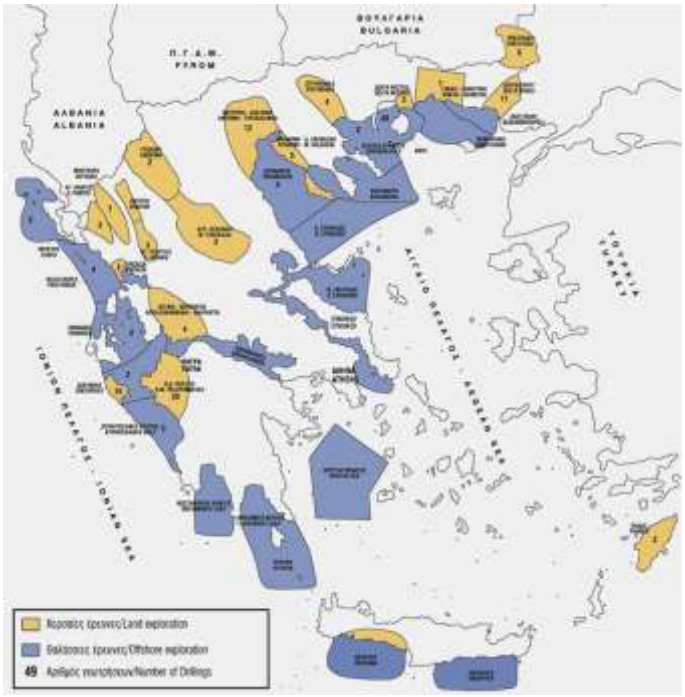
The above described legislation offers an investment friendly framework and standard taxation rates, while bringing Greece in line with the most recent developments and best practices in the oil & gas industry.

6. The 1st International Licensing Round

Greece remains one of the least unexplored countries of the Mediterranean region. Various factors, such as deep water and a difficult and complex geological basins, have in the past discouraged major exploration projects. Targets have been confined to relatively shallow depths, 100 to 1,000 m, while below 3,000m Greece remains virtually unexplored.

The most recent estimates on hydrocarbon potential point to targets, at a greater depth, which are considered a first priority. In Western Greece in particular, petroleum reserves might be very significant if they prove to be similar to that of the rest of the Peri-Adriatic basin, which has so far produced 4 billion barrels of petroleum equivalent. The western part of Greece occupies a third of this basins and up to now small quantities of hydrocarbons have been discovered.

Figure 35. Areas of H/C Exploration and Drillings



Source: DEP- EKY

If the generation of hydrocarbons is the same as in the rest of this region, and the deposits are similar, then a simple comparison shows that there

could be deposits of at least 2 billion barrels of hydrocarbon in Western Greece (US company TRITON reached the same conclusion in a recent study). Similar geological models have also been explored successfully in other parts of the world.

Because investments in oil exploration are by their nature high-risk, and at the same time high-return Greece's hydrocarbon legislation first introduced in 1995 facilitates the involvement of international companies by providing more favourable terms and greater profit margins. The Greek government, taking into account the geological complexity and the great business risks of these investments in exploration and production of hydrocarbons, in 1995 enacted Law 2289/95 of the exploration for and production of HC in Greece. This law is fully harmonized with the relevant directive of the European Union, and aims at creating a more competitive and favourable climate for attracting investors.

Consequently the Greek government went ahead with the organization of the 1st International Licensing Round by announcing in late 1995 an international Bidding Round for six regions in Western Greece(three onland and three offshore), with a total area of 12,138 km2.This called for a 12% participation by DEP-EKY as the state representative. Eight international oil companies expressed interest, and ten proposals were submitted for four regions [21].

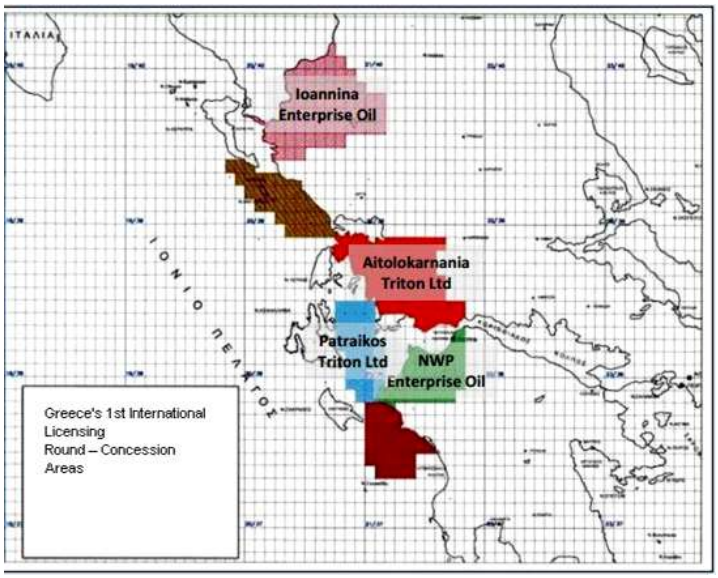
After evaluation and negotiations, in the summer of 1997, four leasing agreements were signed for four regions between the Greek State, represented by the DEP-EKY state company, and Enterprise Oil, Union Texas(now ARCO), MOL, and Triton Hellas (Map 3.4).

The following were the most important criteria for selection:

1. The proposed technical programme
2. The level of financial commitment
3. The duration of commitment for the exploration phase
4. The rate of relinquishment

The holding of the 1st International Round of Hydrocarbon Concessions in Greece created a favourable environment for investment between the Greek state and the international oil companies. This became immediately apparent from the great interest which was shown at the time of the announcement and the relevant presentations. Exploration activities in Western Greece at the time proceeded according to schedule and research data, such as seismic tracings, processing and interpretation, identified the drilling targets with the first drillings having taken in the second half of 2000.

Figure 36. Greece's 1st International Licensing Round – Concession Areas



Source: DEP- EKY

Large and promising areas still remain unexplored and a second International Round is now in progress (see Chapter 6).For the new regions which will emerge in the Central Greek Mediterranean region new targets have been set for exploration and development of hydrocarbons.

Some of the findings from the exploration carried out to date in Western Greece

Enterprise Oil, in its two concessions (Ioannina and the NW Peloponnese), carried out geophysical survey which covered 700km of seismic lines. The processing and interpretation of the seismic readings in the NW Peloponnese has led to the determination of the position of two drillings for a depth of 2,500 m. each. At the time the company believed that there were considerable prospects in the areas of Western Greece in which it worked.

Triton Hellas also carried out a broad programme of seismic surveys on the land area of Aitolokarnania which has led to the determination of the

position of two drillings, one at Trikorfo of Evinos at a depth of approximately 1,500 m, and a second one in the Tryfos area, at about the same depth.

Table 3. Basic Information on Greece's 1st International Round

Basic Information on Greece's 1st International Round					
Region	Area (in km2)	Company/ Joint Venture	Commitment of Prospecting Phases	Prospecting Investments (in USD)	Minimum Commitment (in USD)
Ioannina	4,200	Enterprise Oil 40% Union Texas 28% Mol 20% DEP-EKY 12%(now Acro)	6 Years	20 million	20 million
NW Peloponnese	2,025	Enterprise Oil 40% Union Texas 28%(now Acro) Mol 20% DEP-EKY 12%	4 Years	17 million	26 million
Aitolokarnania	3,650	Triton Hellas 88% DEP-EKY12%	2 Years	13,5 million	35 million
Gulf of Patra	2,100	Triton Hellas 88% DEP-EKY12%	4Years	13,5 million	26 million

Source: DEP- EKY

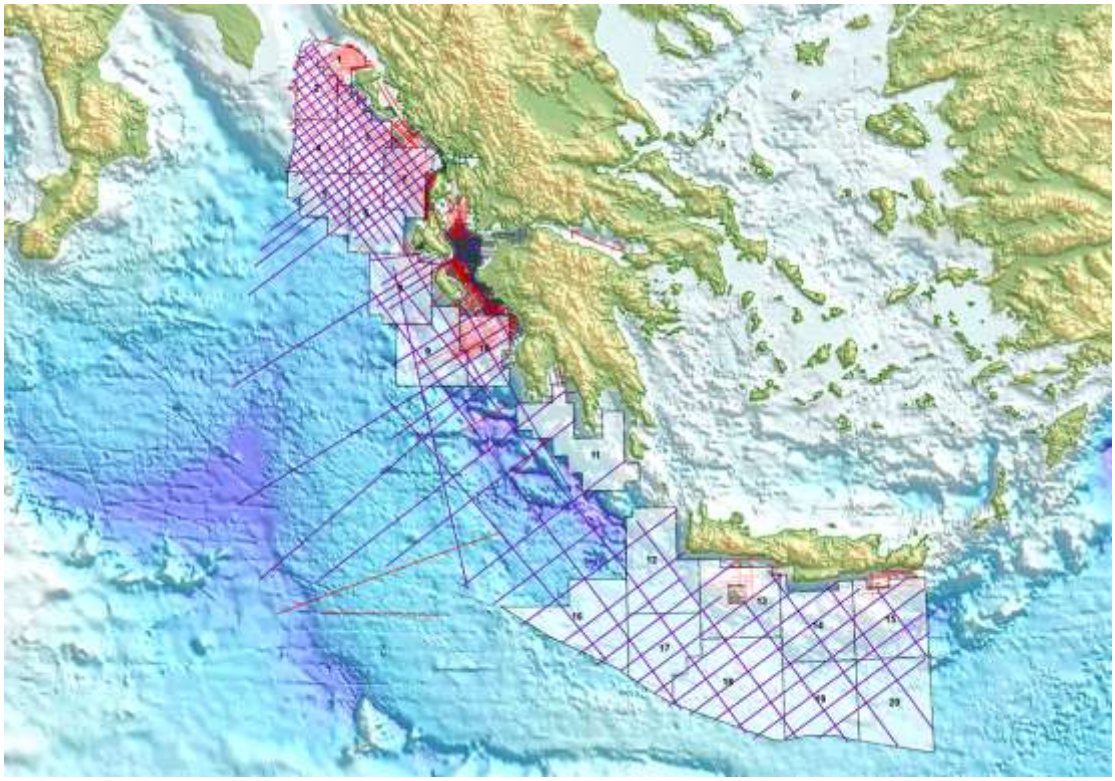
In the sea area of Western Part of the Gulf of Patras, Triton Hellas has carried out seismic surveys of 1,000 km, with 4,000m of streamers (long offsets method).The processing and interpretation of these programme led to the the determination of a drilling position, the targeted depth of which is 3,000 m below sea level.

It is to be noted that was the first time that systematic HC exploration was carried out in Greece following this first International Round and the four leasing contracts that were signed for Western Greece. Although these exploratory drillings proved largely unsuccessful, they have provided extensive and valuable information on the geology of Western Greece.

7. The 2nd International Licensing Round 2014/2015

In the second half of 2012 the Greek government decided to go ahead and organise a 2nd international licensing Round which would cover exclusively offshore areas in Western Greece and South of Crete [22]. Western Greece belongs to the Alpine Mediterranean Orogenic Belt (Dinarides, Albanides, Hellenides). The External Hellenides are part of this thrust and fold belt system.

Figure 37. Offshore Licensing Round Areas



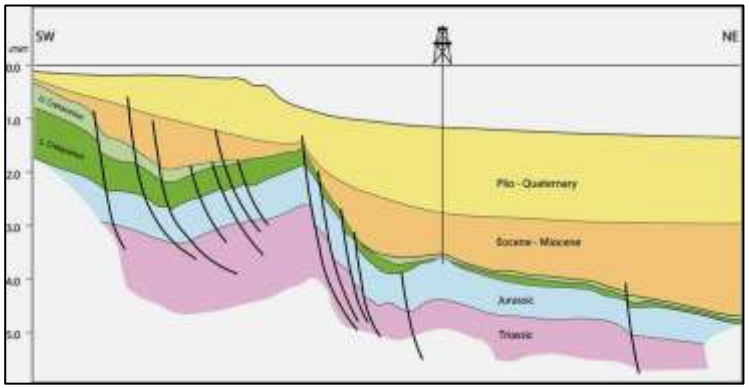
Source: DEP-EKY

Play types are controlled by thrust belt tectonics and related foreland basins stratigraphy in the NW and W part, while the Mediterranean ridge and the accretionary prisms of the Hellenic subduction zone are dominant features in the S and SW offshore Greece. The Ionian and Paxi zones to the NW and W Greece are the most promising for H/C with direct analogues to Albania and Italy. Offshore SW Peloponnesus and S. Crete are considered as frontier areas.

The island of Crete is an uplifted section of the Hellenic thrust belt, to the south of which the Hellenic trench and further the Hellenic accretionary wedge has been developed. Mud volcanoes and thermogenic gas emissions are indications for existing H/C potential. Extensive Messinian Evaporite formations provide evidence of good seal mechanism present in this potential oil and gas system.

In this latest round twenty (20) offshore blocks in offshore W. Greece and South of Crete are offered for tender (see map).Their acreage ranges from 1,800 to 9,500 sq Km. The total acreage is 101,000 sq Km. The Ionian and Paxi zones (regarded as the east Apulian margin) with working oil systems, create an eye-catching investment opportunity for oil and gas exploration and production. The area south of Crete, following latest evidence also presents some strong clues of promising opportunities for E & P.

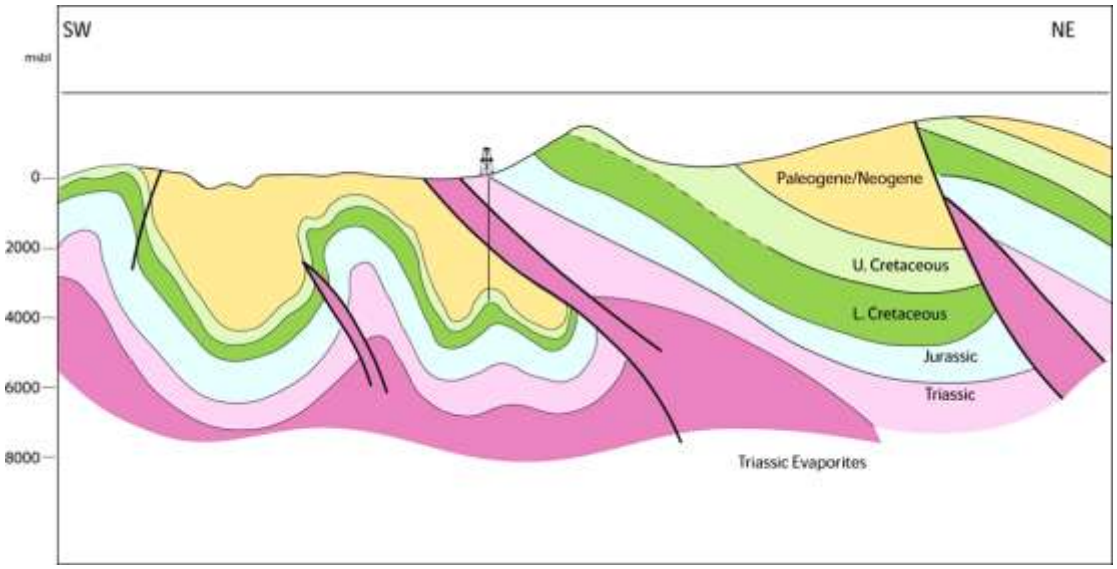
Figure 38. Italian Analogue, Apulian West, Aquila Field



Source: Ministry of Reconstruction, of Production, Environment & Energy

In preparation for this 2nd International Licensing Round non exclusive seismic surveys were carried out by Norwegian company PGS which were completed by the end of January 2014, creating 12, 500km of new data. That offshore seismic work was carried out in the Ionian Sea and South of Crete. Data was consequently transferred to the Greek Government and was first made available to interested companies in February 2014. According to PGS, *"A preliminary assessment of the data shows interesting geological structures bearing significant similarities to areas in neighbouring countries which already produce hydrocarbons"*.

Figure 39. Schematic cross section through the Delvina Discovery



Source: Ministry of Reconstruction, of Production, Environment & Energy

Current Oil & Gas Framework

The 1995 hydrocarbons law (Law 2289) that adopted EU directive 94/22/EC, was extensively modernized in 2011 and has been fully incorporated in Law 4001/2011. The new framework offers an investment friendly platform, incorporates developments and international best practices and introduced the competent state authority for upstream licensing (Hellenic Hydrocarbons Resources Management S.A. or HHRM SA). HHRM, which will be in charge for all licensing and supervision, will assume full function in the very near future. The adopted Concession scheme is royalty-tax based, with the R factor ranging from 2% to 20% and corporate tax rate at 20% plus 5% regional tax. Lease exploration agreements are up to 7 years for the onshore areas and up to 8 years for the offshore areas. Production agreements are 25 years long with optional 5 + 5 year long extensions. The oil and gas block tender procedures take the form of a Licensing Round, Open Door Invitation and Accepted Individual Initiative.

HSE Obligations

Greece is committed to all relevant international protocols, agreements and EU legislation, actively encouraging best oil practices and adopting the 2013/30/EC Off shore Safety Directive. The protection of touristic infrastructure and unique environmental and historical heritage is a common goal and fully involves the local communities.

The Licensing Round

The foreseen concession scheme is royalty/tax. Applicants must provide an entry fee, issue a reimbursable bid guarantee and purchase the relevant data package and interpretation report. All offers will be unconditional and remain valid for a period of 180 days after the application deadline. Where applicant is a consortium, each member shall hold at least 10% interest, shall nominate one member as operator and shall purchase individually the data package and interpretation report. Operators must have proven experience in deep and ultra deep waters and must have operated in environmentally sensitive areas. Companies based in tax haven states may not participate. An International Licensing round was officially launched by Greece in the 3rd quarter of 2014. Licenses will cover a maritime zone with a width of between 100kms and 400 kms.

The Greek government sent for publication an official notice of the Call to the EU Gazette at the end July 2014. The "Call for Tender'' was then published in the EU Gazette on November 17. The day of this publication heralds the start of the tender procedure and companies will have 180 days to the application deadline to prepare and submit the bids. Therefore bids were originally expected to be submitted by May 11, 2015. However, because of the negative international environment which resulted following the sharp drop of oil prices in late 2014 and early 2015, the Ministry of Energy decided to extend the submission date by full 2 months. Finally, bids must now were submitted on July 14, 2015. On Fig.40 one can see the areas offered in the 2nd International Round.

Figure 40. Greece Mega Project- 20 Offshore Blocks

Source: Ministry of Reconstruction, of Production, Environment & Energy

More info at http://www.ypeka.gr/Default.aspx?tabid=875&language=en-US.

Finally, as it has been reported in the press 3 bids were submitted. Until now there has not been any official announcement from the government about the bids and the bidders.

Available Data

The following is the available data to companies which will decide to participate in this bidding round:

- 12,347 km new 2D GeoStreamer GS Seismic data
- 12,347 km new Grav/Mag data
- 9,727 km reprocessed by PGS legacy seismic lines
- 13,015 km reconditioned by PGS legacy seismic lines
- Well data
- A comprehensive report about the geology, the petroleum systems and the petroleum potentials has been prepared by BFICIP and is available for the interested bidders

All above exploration data constitute the Greek Megaproject Database and is available for licensing through Petroleum Geo-Services (PGS).

8. The East Mediterranean and the Cyprus Connection

Introduction

Without doubt a key driver in Greece's renewed interest in oil and gas exploration was the progress achieved by Israel and the Republic of Cyprus in their efforts to develop their own hydrocarbon resources. Back in the early 2000's and encouraged by international developments in the international legal front but also by successes in deep sea oil and gas drilling, the government of Cyprus decided to look into the possibilities of prospecting for offshore hydrocarbons within its own Economic Exclusion Zone (EEZ). The government of Cyprus commenced its efforts by first defining the limits of its EEZ according to the provisions of the United Nations Convention on the Law of the Sea (UNCLOS of 1982) with Egypt, Lebanon, Israel.

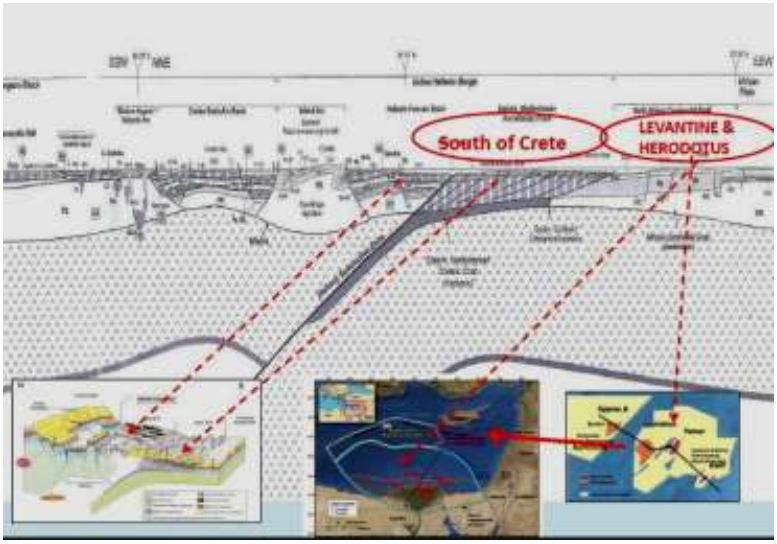
Cyprus is important to Greece as a paradigm in the hydrocarbon development front on three counts. Firstly, in terms of its proximity, being part of the same geographical setting. Secondly, on account of its geology since Greece and Cyprus share certain common geological formations such as the Hellenic Trench and the Mediterranean ridge. Thirdly, from an economic and geopolitical viewpoint Cyprus has showed the way of how a small country acting within the parameters of international conventions and EU's legal framework has managed to attract attention and investment from internationally acclaimed companies in order to explore and exploit its natural resources.

The Geology

Although geographically near there are marked differences between the geology of Greece and Cyprus both onshore and offshore. However, there are certain similarities to be found in the offshore South of Crete to those which exist in the East Mediterranean, mostly observed in the offshore areas of the Hellenic trench and the Mediterranean ridge.

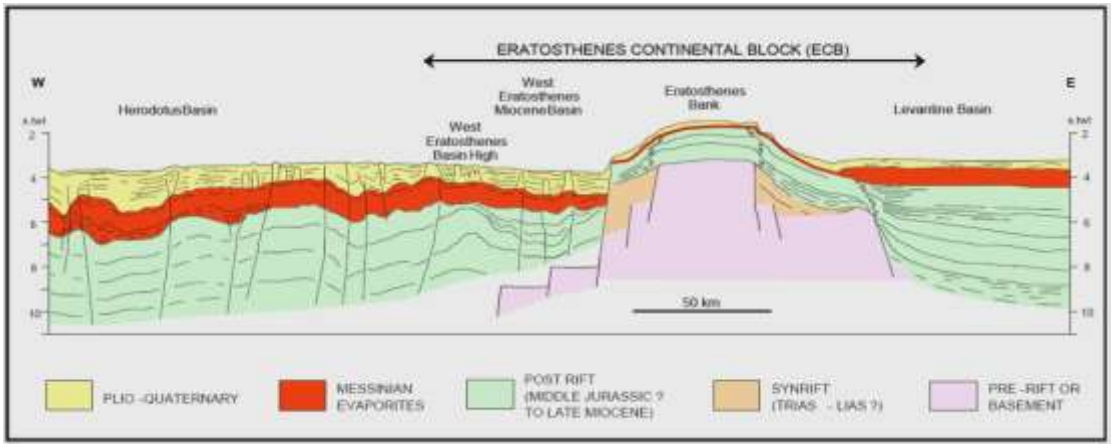
Earlier studies conducted by a variety of organizations and companies starting as early as 1938 up until 1987 had showed that a promising regional geological and geophysical setting existed in the offshore areas South and Southwest of the island of Cyprus [23] [24]. A great number and variety of "play concepts" for exploration associated to the different tectonic and stratigraphic domains had been identified. More specifically, an efficient regional seal of Messinian Evaporites, a very thick sedimentary basin (12-15 km), was apparent. This led researchers to believe that there were multiple possible clastics and carbonate reservoirs in the region which could open the way for big hydrocarbon discoveries in the region.

Figure 41. East Mediterranean and Plate Tectonics



K.NIKOLAOU

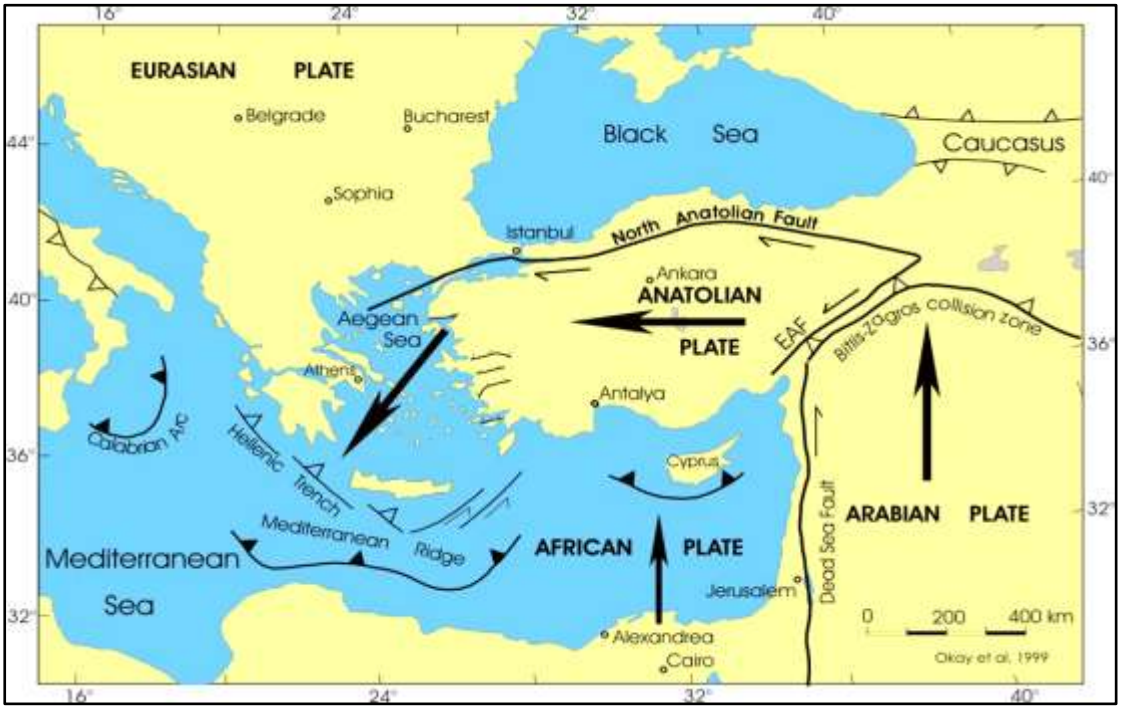
Figure 42. The Eratosthenes Continental Block (Beicip and Cyprus Energy Service)



The collision between the Arabian microplate and Eurasia which led to the separation between the Tethys and the Indian Ocean took place during middle Miocene. This process resulted in profound changes in the oceanic circulation patterns, which shifted global climates towards colder conditions. The Hellenic arc, which has a land-locked configuration, underwent a widespread extension for the last 20 Myr due to a slab roll-back process. In addition, the Hellenic Arc experienced a rapid rotation phase during the Pleistocene, with a counterclockwise component in its eastern portion and a clockwise trend in the western segment [25].

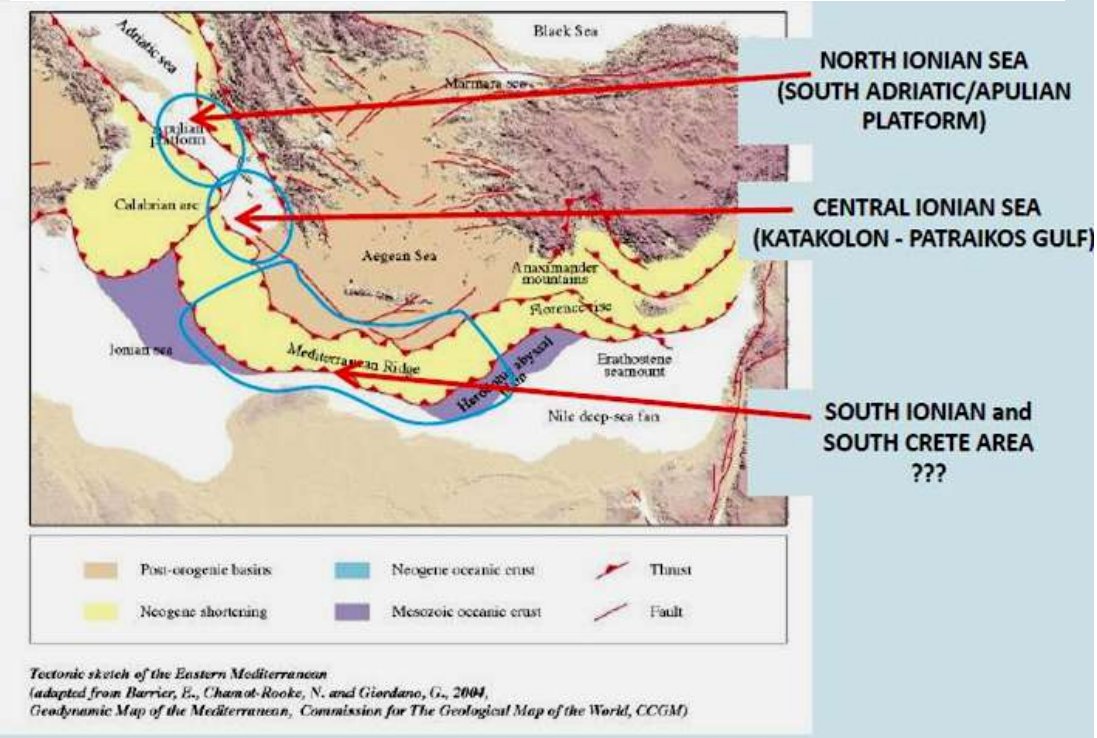
The eastern Mediterranean is a small ocean basin known for its unusual tectonic complexity. It includes a short segment of the convergence boundary between Africa and Eurasia. Subduction in this segment is along two very small arcs, the Hellenic and Cyprean arcs. In both arcs subduction has been documented using bathymetric, earthquake and other data. The Hellenic arc is associated with back-arc basin and volcanism, while the Cyprean arc is not.

Figure 43. The Eastern Mediterranean Sea Tectonics. (after Okay et al. 1999)



The bathymetric and seismic patterns in the eastern Mediterranean seem to be significantly more complex than in most simple "pacific type" subduction zones. This apparent complexity has resulted in numerous tectonic models for this region [26] [27].

Figure 44. Tectonic Sketch of Eastern Mediterranean



Modified by K. Nikolaou

Virtually all subduction arcs are characterized by a subduction trench, a single and mostly continuous ocean deep which marks the flexure of the descending oceanic lithosphere. In the eastern Mediterranean, however, the situation is markedly different. Subduction has been documented in this region, particularly in the Hellenic arc, yet a single continuous trench cannot be traced.

Figure 45. The Mediterranean Ridge, the Hellenic Trench and the Volcanic Arc.

Source:www.wikipedia.org

The Hellenic arc is characterized by multiple, parallel and en echelon ocean deeps which follow the arc; in addition, numerous short deeps which are perpendicular to the trend of the arc are also present. Separate elevated blocks appear to be the elements causing the fragmentation of the longer deeps parallel to the arc [28].

Generally, in the Hellenic arc, instead of one long subduction trench there are several deeps which could, probably, qualify as subduction trenches. This non-typical pattern is, probably, tectonically related and warrants an explanation. Several other bathymetric observations are of interest, For example, the different trenches are not equal in depth; in fact the outer, Strabo, trench is but a cleft in the ocean floor, whereas the one next to it, the Pliny trench, is much more distinct.

Equally important may be the observation of a halo of small and, in places, deep basins north of the subduction zone of the eastern Mediterranean. It could possibly be argued that some of these, particularly the shallow ones around Cyprus are equivalent to back-arc basins. The deep Finike and Rhodes basins, on the other hand, are much more difficult to account for [29].

Finally, the eastern Mediterranean includes a large number of elevated terranes particularly in the Ionian basin and the Hellenic arc complex. Some of the more distinct elevated terranes in the Ionian basin are the Medina Ridge, Medina Bank and the Cyrene, Epicharmos and Archimedes seamounts. Other prominent elevated terranes also appear within the Hellenic arc complex; however, whereas in the Ionian basin the elevated blocks are spread throughout the basin, in the Hellenic arc a large number

of blocks crowds a small area causing the complex pattern of bathymetric highs and lows.

The Cyprus Oil & Gas Regime

There are a number of international agreements governing the law of the sea as well as oil and gas activities to which Cyprus is a party. In 1988, Cyprus ratified the United Nations Convention on the Law of the Sea (UNCLOS) which defines the rights and responsibilities of states in their use of the world's oceans, establishing guidelines for businesses, the environment and the management of marine natural resources and regulating the territorial waters, contiguous zones and exclusive economic zones (EEZ) of states. Further to Cyprus ratifying UNCLOS, it passed a law defining and regulating its EEZ, the Declaration of the EEZ Law 2004. Cyprus' hydrocarbon legislative regime is therefore based on Cyprus' obligations under international law and European Union (EU) law.

Following ratification of the UNCLOS Cyprus has established its jurisdiction within its EEZ covering the following:

- the exploration, utilisation and management of all natural resources, the waters, the seabed and the soil under the seabed
- the production of energy
- the utilisation of man-made islands, installations and structures
- scientific research
- the protection of the environment

Consequently, agreements on the delimitation of the EEZ exist between Cyprus and respectively Egypt, Lebanon and Israel. In February 2003, Cyprus signed an EEZ delimitation agreement with Egypt, which has been ratified and has entered into force. In January 2007, Cyprus signed an EEZ delimitation agreement with Lebanon; however, this agreement has not been ratified and is therefore not currently in force. In December 2010, Cyprus signed a delimitation agreement with Israel. Although ratified and in force (since February 2011), the Cyprus-Israel agreement is disputed by Lebanon [30].

EU Law

As a member of the EU, Cyprus' oil and gas activities are governed by the applicable EU laws, including the Directive on the Conditions for Granting and Using Authorisations for the Exploration and Production of Hydrocarbons (Directive 94/22/EC of 30 May 1994). Directive 94/22/EC establishes a basis for rules to guarantee non-discriminatory access to the activities of prospecting, exploration and production of hydrocarbons. The directive sets out the framework for granting hydrocarbon-related authorisations, providing that the procedures must be introduced in a transparent manner based on objective, nondiscriminatory criteria.

At the same time, Directive 94/22/EC recognises that EU Member States have sovereign rights over the hydrocarbon resources within their territories and that as such, Member States have the right to determine the geographical areas in which the rights to prospect, explore for and produce hydrocarbons may be exercised and to authorise entities to exercise those rights. As such, EU Member States retain the right to make access to hydrocarbon activities and their exercise, subject to considerations of national security, public safety, public health, security of transport, protection of the environment, protection of biological resources, and the planned management of hydrocarbon resources or to the payment of a financial contribution or a contribution in hydrocarbons. Following the clarification and establishment of its international legal status Cyprus went ahead and introduced its own legal framework for hydrocarbon exploration and production.

Domestic Legislation

The most significant Cypriot domestic laws are the Hydrocarbons (Prospecting, Exploration and Exploitation) Law of 2007 (Law No. 4(I)/2007) (Hydrocarbons Law) and the Hydrocarbons (Prospecting, Exploration and Exploitation) Regulations of 2007 and 2009 (No. 51/2007 and No. 113/2009) (Hydrocarbons Regulations), which transpose Directive 94/22/EC into domestic law. Hydrocarbon activities are also subject to

generally applicable laws and regulations on health and safety and the protection of the environment.

Licensing Regime

The Hydrocarbons Law and the Hydrocarbons Regulations set out the criteria for the assessment of licence applications for prospecting, exploration and exploitation of hydrocarbons in Cyprus, including in its territorial waters, contiguous zone and EEZ. Cyprus has divided its exploration area into 13 exploration blocks, which fall under the control of the Ministry of Commerce, Industry and Tourism. Two types of licence may be granted in respect of the exploration blocks:

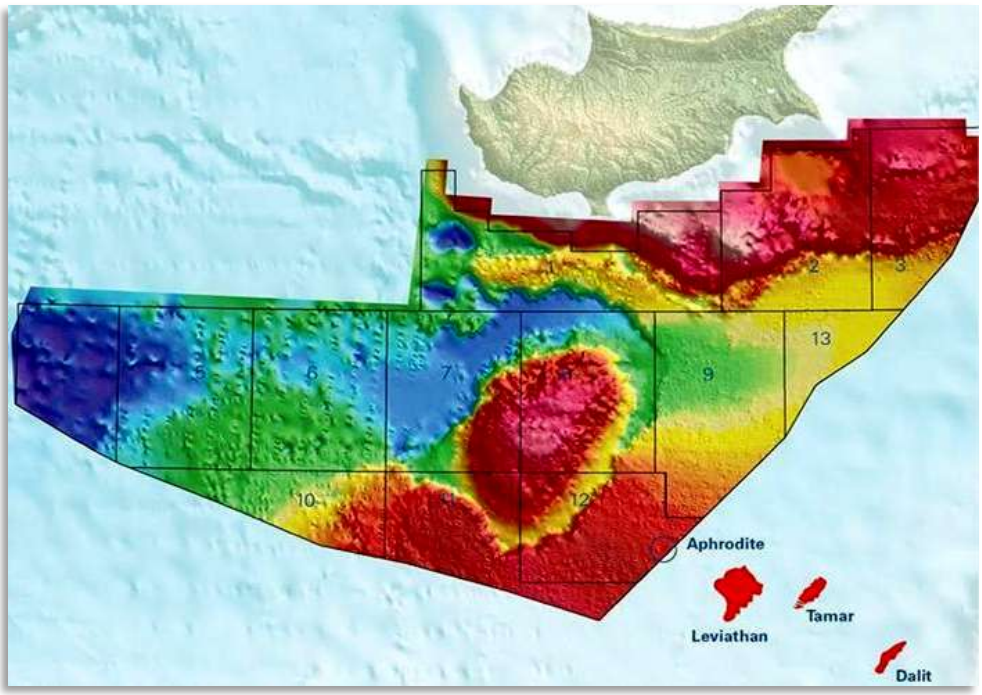
- a hydrocarbon prospecting licence
- a hydrocarbon exploration licence

Licensing Rounds

First licensing round

Cyprus' first licensing round was announced on 15 February 2007 and involved the granting of a hydrocarbon exploration licence and subsequent hydrocarbon exploitation licence for exploration block no. 12. The licence was granted to Noble Energy International Limited on the 24 October 2008 for an initial term of three years. Noble Energy completed its first exploratory drilling in Block 12 on 28 December 2011, Noble Energy announced that a well had hit a gas-bearing band about 310 feet thick. The company is stated results indicated that the area could hold 5-8 tcf of gas.

Figure 46. Hydrocarbon Exploration Licences



Source: MECIT, Cyprus

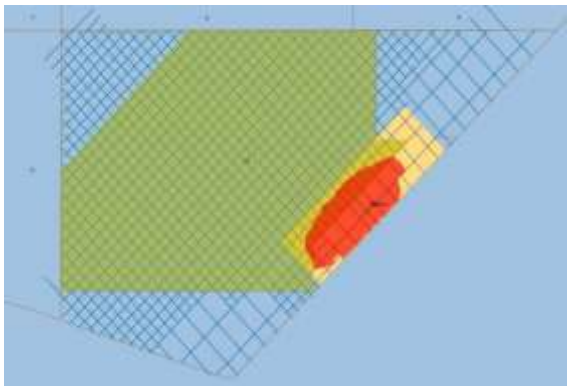
Second licensing round

An invitation for submission of applications for the second licensing round consisting of 12 offshore blocks was published in the Official Journal of the EU on 11 February 2012. The round consists of applications for hydrocarbon exploration licences and subsequent hydrocarbon exploitation licences for each of the 12 blocks. Based on publicly available information, the second licensing round blocks are, on average, approximately 4,000km2 and span an area from the Herodotus Basin in the west to the Levantine Basin in the east. As a result of the second licensing round PSC's were concluded with the uincorporated joint venture between ENI International BV and Korea Gas Corporation (KOGAS) JV in February of 2013 for blocks 2, 3 and 9 and with Total E&P Activities Petrolieres SA for blocks 10 and 11.

Hydrocarbon Activities in Offshore Cyprus, Findings and Reserve Estimates

A first exploratory well in Block 12 (Aphrodite) by Noble at the end of 2011 revealed some 7.0 tcf of gas deposits (initial announcement). Following further work and a second, appraisal well in 2013 natural gas deposits in Block 12 were reassessed to 4.5 tcf gross mean resources.

Figure 47. Hydrocarbon Activities Offshore Cyprus- Block 12



Source: MECIT, Cyprus

The smaller amount of available gas has forced Noble and the government of Cyprus to re-evaluate their strategy on the exploitation of the n.gas deposits. More recently an agreement on the exchange of data (seismic & well data, studies) was signed between Cyprus and Israel – Noble Energy to utilize and evaluate the well data from "Ishai" block (offshore Israel) while Noble is carrying out exploration activities [31].

Future Plans:

The government of Cyrpus and the companies which form part of the consortium which has the concession of the Block 12 have now jointly decided to move ahead with the commercial development of Aphrodite field. According to the development plan an FPSO unit will be established and situated above the field while one pipelines will run from the field to LNG plants in Egypt (200km away) and another one will connect the field with Cyprus in the area of Vassiliko, in order to feed the existing power plants. Consequently the Block 12 consortium is going ahead with:

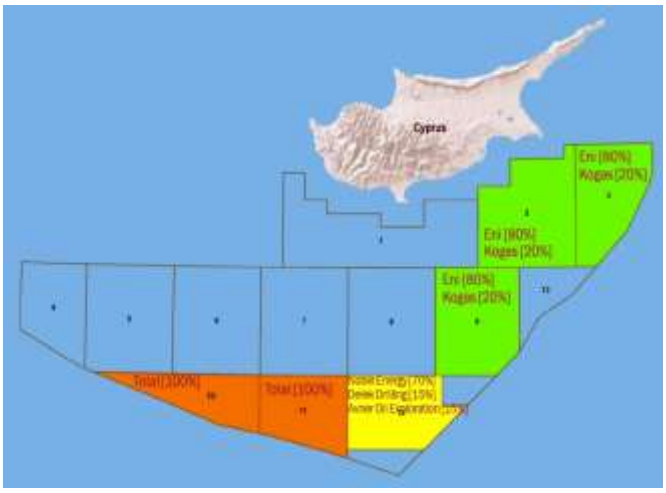
Figure 48. Drill Stem Test – Aphrodite Discovery

- A new exploration well by 2015-2016 in order to explore a new geological structure
- A second appraisal well for the "Aphrodite" gas discovery subject to the results of the evaluation of the data acquired in "Ishai"
- Data gathering for assessing further the commerciality of the gas discovery

Hydrocarbon Activities Offshore Cyprus in Blocks 2, 3, 9

As part of the 2nd Licensing Round large volumes of 2D & 3D seismic data were collected by the government prior to announcing the 2nd round. Four firm exploration wells and as many appraisal well(s) have been planned by the end of 2015. The 1st Exploration Well ("Onasagoras") of ENI, in Block 9, spudded at the end September 2014 by the drillship "Saipem 10000". The maximum depth reached by this exploration well is 6,000m at a water depth around 2,000m. The well was P & A (Plugged and Abandoned). The second exploration well followed with the name Amathousa. After reaching the targeted depth, this well was also declared dry and was P & A.

Figure 49. Hydrocarbon Activities in Offshore Cyprus

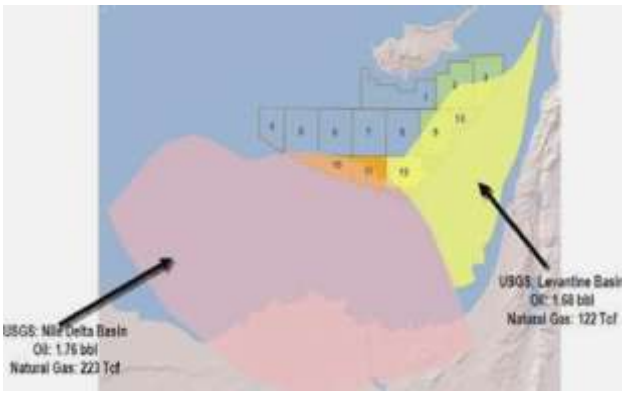


Source: MECIT, Cyprus

Hydrocarbon Prospects in the East Mediterranean

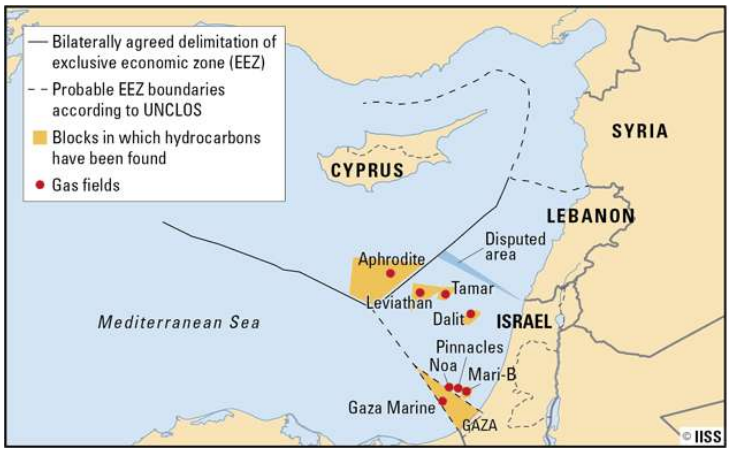
A USGS' Report shows that the Eastern Mediterranean region is a prospective and promising area with estimated significant amounts of undiscovered oil and gas. The assessments by USGS put the level of undiscovered oil and gas

Figure 50. Assessment of Resources in SE Mediterranean



resources in the Eastern Mediterranean to a total of 3.4 bil. bbl for oil and 345 tcf for natural gas in the Nile Delta, Herodotus basin and the Levantine basin.

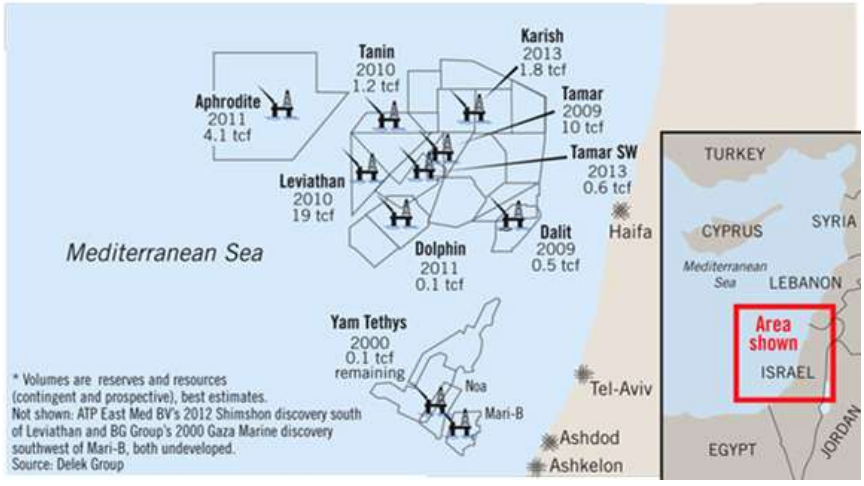
Figure 51. Eastern Mediterranean Gas Fields



Source: S. Kassinis

According to more recent estimates by Noble Energy, which is prospecting both in Israel and Cyprus, there are deep targets with Mesozoic plays with 3 bil. bbl (approximation of gross unrisked oil potential) for the Cyprus fields.

Figure 52. Basic Layout of East-Med Gas Fields



Source: S. Kassinis

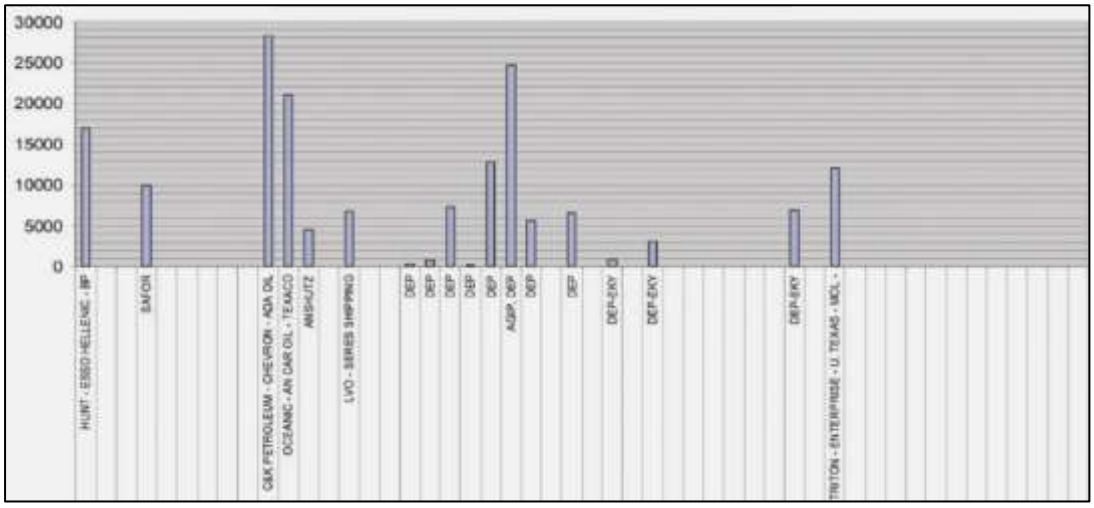
- Over the last six years a series of successful exploration wells offshore Israel has resulted in the discovery of approximately 35 tcf of gas resources
- Gas sales from Tamar (10 tcf) began in March 2013, just over four years from discovery. Tamar is currently covering a substantial part of Israel's domestic demand and is the main market for this field
- Currently, Negotiations are underway for:

    - 5 bcma of gas sales for 3 yrs to private customers in Egypt via the East Mediterranean Gas (EMG) pipeline
    - 4.5 bcma of gas sales for 15 yrs to Union Fenosa Gas for the LNG plant in Egypt
    - A total of 1.8 bcm for 15 years to Jordan

9. Non Technical Obstacles for Hydrocarbon Exploration and Production in Greece

If we are to take only a cursory look on the progress achieved so far in exploring the country's hydrocarbon resources over the last 45 years we can safely observe that there is little to show in terms of consistency in research efforts and subsequent discoveries, given the immense effort undertaken and money invested by tens of companies. Although there was no lack of interest by companies and individuals alike the way that the whole research and exploration process was conducted over the years by successive governments in Greece, leaves much to be desired. As it can clearly be seen in Figure 53 we have a situation of periods where intense effort was undertaken and which led to actual discoveries, followed by long periods of lull where nothing much happened [32]. These periods, coinciding with government inactivity and lack of interest were followed by some soul destroying administrative changes in the responsible state agencies. What ensued was a disastrous fall in morale and the departure of several brilliant petroleum engineers for abroad where they sought better luck and recognition.

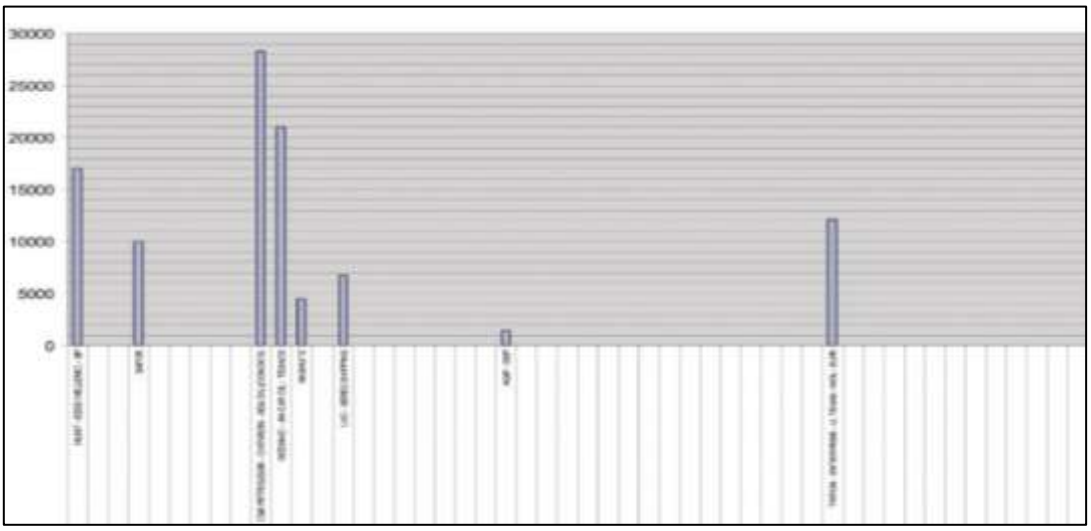
Figure 53. Concession Agreements Signed in Greece between 1960 and 2009



Source: Hellenic Petroleum/ K. Nikolaou

Put in a nutshell hydrocarbon exploration and production in Greece has been characterized by long periods of apathy and indifference interrupted by short periods of intense activity, as the governments at the time were adopting a jump start approach. Parallel to that we have a series of ill fated administrative changes with most serious the disbanding of Greece's Public Oil Company- Hydrocarbon Exploration and Research (DEP-EKY) in 1998 and its absorption by Hellenic Petroleum SA, a private company with state participation, whose bulk business was in refining and retailing.

Figure 54. Concession Agreements Signed with foreign companies between 1960-2009



Source: Hellenic Petroleum/ K. Nikolaou

Consequently, the momentum which had been built up in the 1980's and early 1990's was lost and all oil and gas exploration work in Greece ceased for more than 15 years. When the government of George Papandreou, which came to power in the fall of 2009, decided to re-start the hydrocarbon sector it faced very serious challenges mostly related to red tape, strong political opposition and trade union animosity built over years of neglect. The government at the time (2009-2012) and the Minister in charge- Mr. John Maniatis, who was then Deputy Minister of Environment and Energy- although convinced that the country should restart hydrocarbon exploration and formulate a new strategy adapted to the new global oil and gas environment: soon realized that it had to

overcome a very hostile political and business environment that was dead against Greece getting involved again in the upstream sector.

Two were the main opposition arguments at the time. The first was the self defeating statement which said that Greece is a country with no hydrocarbon deposits, since if she had any these would have been discovered long ago! A pedantic argument which failed to take into consideration the realities and the international practice of hydrocarbon research. The second argument was more serious as it treated prospective hydrocarbon exploration as an economic threat which could undermine Greece's substantial tourism sector.

The tourist argument appeared to be more convincing and influenced a large number of MP's, many of whom were elected in geographical areas with a strong tourism business. These MP's feared that hydrocarbon exploration activity would damage for good their constituencies "natural beauty" and hence act us a detriment for further tourism development. They were also expressing strong reservations on account of potential environmental damages from possible accidents (notwithstanding the fact that a large part of Greece's unique physical environment has permanently been destroyed by many years of uncontrolled building activity and the construction of aesthetically damaging structures scattered indiscriminately across landscapes of immense natural beauty). It is worth mentioning that in the Thassos island and Kavala area, (which attracts a fair amount of tourists each summer) where the offshore Prinos field is located, over a 35 year continuous period there has never been a single oil spilling or related accident. This excellent environmental record testifies to the fact that if proper care is taken and strict procedures are followed environmental damage can be avoided.

Another important area of constraint in re-starting hydrocarbon exploration was the considerable red tape encountered within the government machinery which prevented the adequate and timely re-organisation of the relevant government departments and agencies.

In this respect it is worth mentioning that it took two full years for the government to organise an international tender for non-exclusive seismic research offshore in Western Greece and South of Crete. Eventually bids were invited on February 6, 2012 and the survey by the successful contractor PGS of Norway was completed in the spring 2013. Then it took another 18 months for the government to announce the 1st International Round on November 11, 2014, thus missing a window of opportunity given the high prevailing international oil prices during that time (2010-2014).

Even worse in terms of the extraordinary long periods needed by the Greek government in carrying out basic functions within the hydrocarbon area of work was the case for the assessment of bids and eventual award of concession areas in the "Open Door" type of round. This round was publicly announced on March 3, 2012, bids were submitted on July 2, 2012 and it took the government a full two (2) years to assess the bids submitted by three consortia, and the final agreement concession documents to be agreed and signed between the government and the concessionaire companies.

It is quite obvious that with such long and cumbersome procedures the Greek state is at a considerable disadvantage, compared to other countries, when it comes to organising international licensing rounds for hydrocarbon exploration. It is the consensus among market participants and international observers that unless the Greek state streamlines its licensing and assessment procedures, in par with accepted practice in other countries, it will be extremely difficult to attract new entrants for hydrocarbon research and exploration.

In short it would be useful to recount the main non technical obstacles and constraints which have so far inhibited hydrocarbon exploration and production in Greece.

(a) A chronic negative sentiment by a large segment of the population which does not believe that Greece possess any oil and gas deposits

and is not convinced of the necessity for carrying out hydrocarbon exploration.

(b) There is widespread phobia by several local communities, mainly to be found in heavily developed tourist areas, that oil and gas exploration will ruin all or part of their region which because of its natural beauty and idyllic setting has proven as tourist magnet.

(c) Assorted environmental groups in different locations in the country expressing their "mild" displeasure (so far) to hydrocarbon exploration and production on account of possible damages to the environment from oil seepage and oil spills.

(d) There is considerable red tape and lack of resources within government departments and state agencies which inhibit the smooth functioning of administration with the result of unacceptably long delays in expediting the organisation of licensing rounds and the subsequent assessment of bids. The government's complete failure so far to organise and man the National Agency for Hydrocarbon Research, (set up by law in 2011) is a case in point.

(e) There appears to be a serious "disconnect" between the country's stated overall economic and energy policy goals and the profound needs for speeding up activities in the hydrocarbon sector as these are deemed to have a direct positive impact on economic development. Hence we have a situation where "lack of urgency" and "lack of prioritization" characterises the planning and administration of hydrocarbon exploration activities.

10. Estimating Greece's Hydrocarbon Potential

Over the last four to five years there has been an abundance of newspaper reports, conference presentations, and publications in learned journals, and Greek governments' announcements with widely differing estimates on Greece's hydrocarbon potential. According to some of these reports the exploitation of Greek hydrocarbons could produce between 200,000 and 1,000,000 barrels of oil, per day or even higher numbers while others refer to a specific gas potential of some 4.5 tcm, with Greece thus becoming a major gas supplier to Europe! Apparently most of these estimates are based purely on geological and seismic data and with widely differing interpretations.

The truth is that Greece has some very limited oil and gas discoveries to report over the last 45-50 years as shown in Figure 55.

Figure 55. Discovered Oil & Gas Fields in Greece

Source: Hellenic Petroleum

A summary of the past exploration activities is further presented in Figure 56 from where it is clearly deduced that Greece is one of the least explored countries in Europe.

Figure 56. Past Exploration Activities in Greece

Source: Hellenic Petroleum

The Institute of Energy for SE Europe (IENE) in an attempt to piece together a realistic and credible national energy policy carried out a comprehensive study and published a Working Paper on the subject in 2013 [33]. In the relevant section of this Working Paper IENE presented a detailed analysis of the existing for the exploitation of hydrocarbon deposits in Greece. An updated version of this analysis is to be found in Table 4 which includes some seventeen (17) oil and gas well identified prospects, discoveries and fields which have so far been identified with only few of them fully explored and only one under production (i.e. the Prinos field).

Table 4. Hydrocarbon Discoveries, Fields and Prospects in Greece

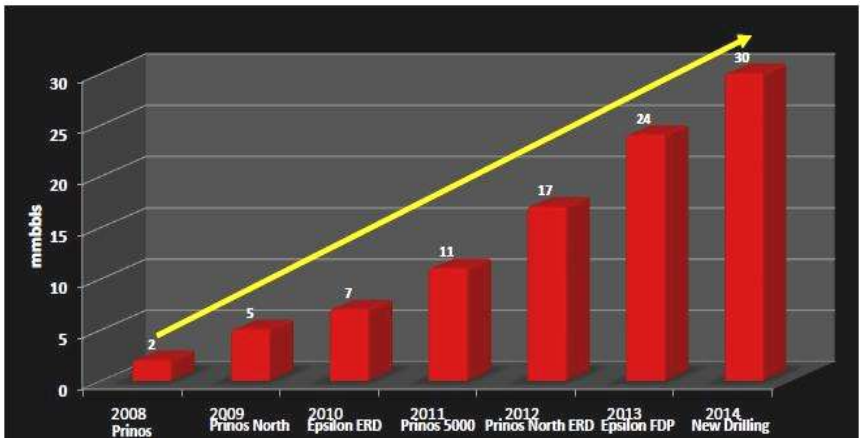
Field	Date	Company	Estimated reserves or resources (in million barrels)	Category
East Thassos I	1971	Oceanic-Colorado	350.0 In place	Contingent resources Heavy oil
East Thassos II	1971	Oceanic-Colorado	80.0 In place	Prospective resources
Babouras	1971 /72	Oceanic-Colorado	150.0 In place	Prospective resources
Stavros	1971 /72	Oceanic-Colorado	122.in place	Prospective resources
NikeI	1971 /72	Oceanic-Colorado	60.0 In place	Prospective resources
NikeII	1971 /72	Oceanic-Colorado	63.0 in place	Prospective resources
South Kavala (natural gas)	1972	Oceanic-Colorado	950.0 millionm^3 gas	Depleted Gas field
Amodes (heavyoil)	1972	Oceanic-Colorado	45.0	Contingent resources
Athos	1972	Oceanic-Colorado	45.0	Contingent resources
Prinos	1972 2015	Oceanic- Colorado Energean	60(1) 11,7	Proven recoverable Remaining recover.
West Katakolo	1982	DEP/EKY	4.0-8.0	Contingent resources
AlikesZakinthou	1984 /85	DEP/EKY	35.0(2)	Contingent resources Non recoverable
Epanomi (natural gas)	1987	DEP/EKY	450.0 million m^3 gas	Contingent resources
Prinos- North Prinos	2015	Energean	3,3	Remaining recoverable reserves
Patraikos Gulf	1998 /99	Enterprise Oil - Triton	-	Prospective
Ioannina Region	1998 /99	Enterprise Oil - Triton	-	Prospective
Prinos-Epsilon	2015	Energean	15.2 (39.0)	Recoverable reserves (in place)
Total recoverable reserves (proven)			30.2	
Total contingent reserves			94-98	
Total in place and prospective reserves			703	

(1) Some 116 million barrels of oil had been recovered by the end of 2014. Estimated original reserves in place: 290 mmbbl
(2) Asphalt contingent resource base has been found but considered to be non exploitable due to environmental and technical constraints

Source: IENE

Reviewing the data shown in this table it is becoming clear that the amount of proven recoverable reserves is surprising low and today stands at just less than 58 million STB of oil, while the total estimated prospective and contingent resources stand at just less than one (1.0) billion STB of oil. It should be further noted that the above estimates do not include any potential oil and gas plays in offshore Western Greece or South of Crete for which at this stage we cannot have any credible estimates.

Figure 57. The steady rise of proven reserves following well planned exploration programmes, in the main Prinos field from 2008 onwards i.e. from the time that Energean Oil & Gas undertook the management of the Concession [35]

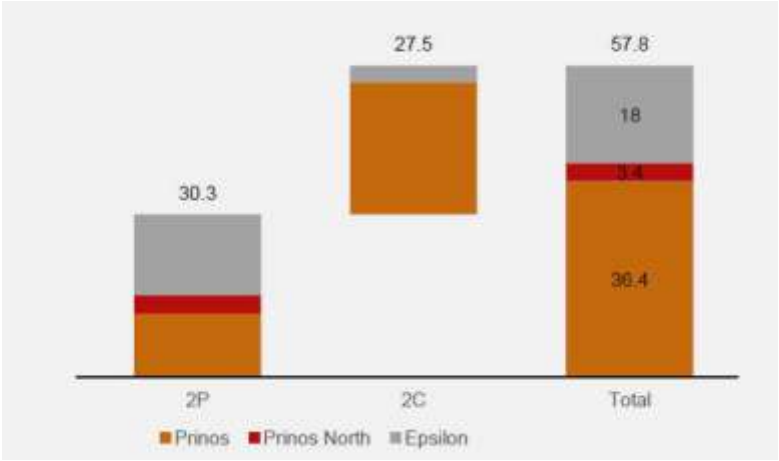


Source: Energean Oil & Gas

Some of the figures presented in Table 4 are based on data provided and analyzed following actual drilling operations. Some of these findings go back to the early 1970's where an extensive exploration programme was carried out by the Oceanic-Colorado consortium in offshore concessions to the south and to the east of the island of Thassos. Since then findings have been reported following a restricted number of exploratory drillings, without any follow up confirmation drillings, and hence, the data concerning the size of the deposits can only be reported as contingent resources [34].

We should also point out that indications for the existence of hydrocarbon deposits, based on oil seepage and undisputed geological evidence, concern some 200 different locations all over Greece and these can be found mainly in Epirus, Etoloakarnania, the island of Zante, in North West Peloponnese, in Central Greece, in Macedonia and in Thrace [36].

Figure 58. Prinos: Proven and Potential Reserves



Source: Energean Oil & Gas

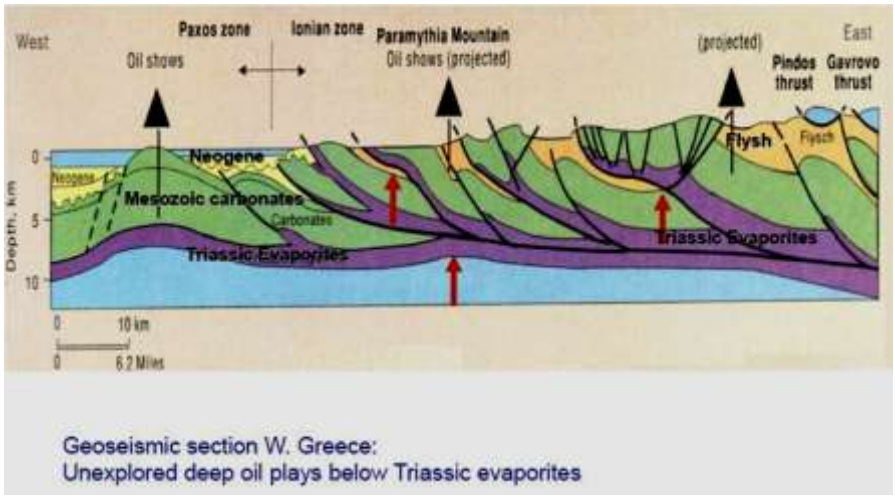
The overall picture that emerges concerning the hydrocarbon deposits in Greece so far is that there is moderate but promising hydrocarbon potential. Another observation is that the country has a number of confirmed hydrocarbon plays, widely dispersed in different parts of the country whose geology is rather complex, with deposits often found in difficult geological environment and in well hidden structures. In this sense a lot more exploration needs to be carried out both onshore and offshore in order to build an all round picture of the country's actual hydrocarbon potential.

The main oil and gas promising areas in Greece share a number of common characteristics: proved petroleum systems, both onshore and offshore; encouraging results of geochemical studies; numerous prospects and lead identified from seismic interpretation. We should also remind that the main common geological elements in most of these areas include:

(a) The external Hellenic Fold and Trust Belt (in West Greece)
(b) The post orogenic basins of Greece
(c) The Hellenic Trench- Mediterranean (offshore West Greece and South of Crete)

Indicatively, the unexplored deep oil plays below Triassic evaporites, to be found in Western Greece, are shown in sketch form in Figure 59.

Figure 59. Unexplored Deep Targets below Triassic



Source: DEP-EKY

11. A Strategy for Developing Greece's Hydrocarbon Resources

The Restart of Hydrocarbon Exploration and the Need for a National Strategy

As shown in Chapter 10, Greece at present possesses very limited proven reserves of oil while several promising oil and gas plays have been identified in various parts of the country both onshore and offshore and are reported as prospective resources. In this sense Greece's hydrocarbon potential appears a lot greater compared to its tiny current oil production of just 2,000 boe/d and to its equally restricted proven reserves. It is assumed that over the next 3 to 6 years the situation regarding actual oil and gas reserves will be progressively clarified as exploration drilling gets underway in the various concession areas in Western Greece but also from potential discoveries resulting from the 2nd International Licensing Round.

Over the last five years Greece made a determined effort to restart hydrocarbon exploration activities following a 15 year hiatus. The milestones in Greece's hydrocarbon exploration restart activity are shown in Fig. 60. From this chart it is evident that relevant activity has been accelerating over the past two years, while the previous government (in office between January 26- August 27, 2015) had stated that it will not discontinue the current programme which was established by the previous administration.

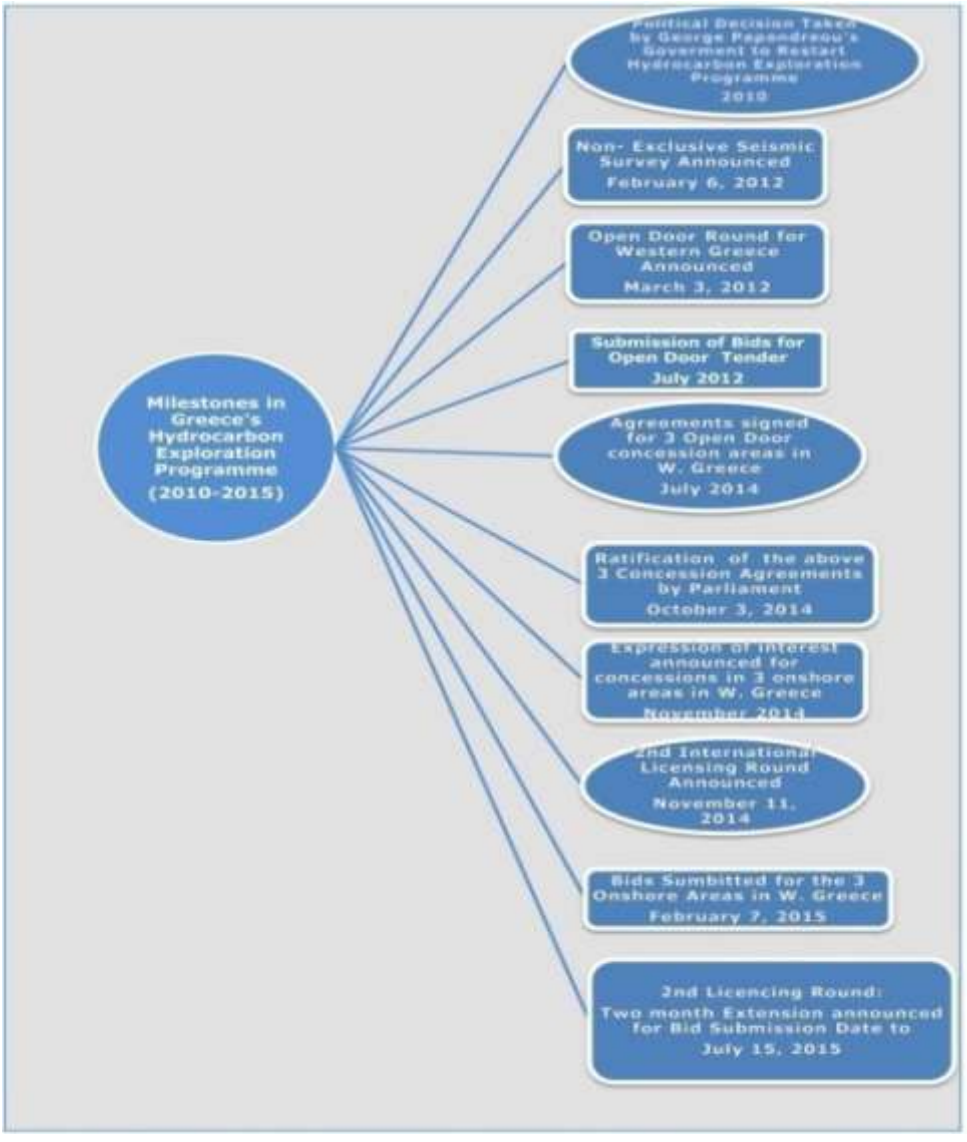
In view of the above positive developments and renewed international interest for oil and gas exploration in the East Mediterranean, as discussed in Chapter 8, it is becoming increasingly important to analyse and define a long term national strategy for unlocking Greece's not so insignificant hydrocarbon potential[1].

By definition strategy, as far as the economy and scientific progress is concerned, has to do with the long term however loosely this may be

[1] Any discovery of hydrocarbon reserves in deep offshore areas should be large enough to be commercial and therefore in these areas we expect huge discoveries.

defined[NB]. In our case, and in the case of hydrocarbon research internationally, this is usually in terms of 10, 15, 20 years or even longer. Our intent at this stage will be to analyse and describe the optimum path that needs to be taken in developing Greece's oil and gas deposits which are found in many different parts of the country.

Figure 60. Milestones in Greece's Hydrocarbon Exploration Restart



[NB] In its broadest sense, strategy is the means by which individuals or organizations achieve their objectives. Common to most definition is the notion that strategy is focused on achieving certain goals; that it involves allocating resources; and that it implies some consistency, integration or cohesiveness of decisions and actions.

As hydrocarbon reserves from a legal, administrative and exploratory point of view remain within the domain of government and national authorities, as they are considered to be national assets, and, as is the case in most countries it seems that the preparation and definition of a strategy should be the prerogative of government. However, at the same time one has to consider the existence of other stake holders such as local government, industry, professional associations and independent think tanks. In the case of IENE, which is a think tank among others, it is also speaking for industry as several of its corporate members are companies and organizations working in the upstream sector. In this context IENE has a vested interest to see that a well thought out strategy for the development of the hydrocarbon sector in Greece is in place and is being followed irrespective of the political forces in place. Obviously the question arises as to what this strategy should be.

Figure 61. The Unfolding of Licensing Rounds and Concession Activity in Greece 2014-2018

As can be seen from Fig. 61 there is a new dynamic trend in Greece's hydrocarbon exploration effort. Over the last 12 months new concession areas have been awarded in Western Greece while a new international round is in progress. International companies active in SE Mediterranean have lately expressed vivid interest to participate in new licensing round and "Open Door" type of calls as they believe that Greece may offer

promising exploration and production opportunities. In order to tap this interest a clearly defined strategy has to be formulated by the government and with the assistance of interested stake holders. In working and such a strategy one must take into consideration Greece's particular geopolitical setting (read the EEZ parameter) and a host of important components involved in this process.

The Role of EEZ in Hydrocarbon Exploration in Greece

There appears to be a widely held view that because Greece has so far failed to define and publicly proclaim its Economic Exclusion Zone (EEZ) as foreseen by UNCLOS[(NB)], hydrocarbon exploration activities in most offshore areas in the Aegean Sea but also south of Crete or in the Ionian Sea cannot progress satisfactorily. It is true that until recently successive Greek governments had failed to adopt, let alone implement, the provisions included in UNCLOS whereby a country with coastal areas can define its EEZ, up to 200 national miles offshore, and within these boundaries may exercise certain sovereign rights such as fishing, electricity generation from wind, tidal and ocean energy, and hydrocarbon exploration and production. Unlike Cyprus which has a widely extended open sea configuration all round the island, Greece's geography is constrained on account of its complex web of islands dispersed in the Aegean but also in Western Greece.

Also, in view of past episodes between Greece and Turkey in the Aegean in the late seventies, in 1987 and more recently in 1996, and following certain agreements signed between the two countries to abstain from hydrocarbon exploration activities beyond territorial waters in the Aegean sea area, Greece has purposely avoided to openly extend its EEZ as this could have been considered a provocative and hostile act, in the context of the above agreements. However, the situation in the south of Crete and Western Greece offshore areas is completely different and this is why Greece in announcing its 2nd International Licensing Round defined the exact boundaries of the various sea blocks on the basis of the provisions

[(NB)] UNCLOS- http://www.un.org/depts/los/convention_agreements/texts/unclos/unclos_e.pdf

of UNCLOS, with their outward perimeter lines extending as far south as that the median line allows, as is the case between Greece and Libya, and as far west or north as the case between Greece- Italy and Greece – Albania respectively. The exact co-ordinates of these boundaries were made public through the publication of the call for the Licensing Round in the official gazette of the European Union [37] but also by notification to the appropriate office at the United Nations in New York (see Fig. 62).

Figure 62. The Offshore Areas in West Greece and South of Crete which have been Designated for Hydrocarbon Exploration with Outward Limits Drawn according to UNCLOS Provisions

Source: Ministry of Reconstruction, of Production, Environment and Energy

Should the Greek government decide at a later date to open up further offshore areas for oil and gas exploration it is understood that a similar approach will be taken i.e. by first defining the EEZ boundaries relevant to the offshore areas in question, in accordance with the provisions of UNCLOS, and then drawing the boundaries of the offshore sea blocks to be included in forthcoming licensing rounds, to be publicly announced following the same procedure as the one followed in the 1st Licensing Round.

In the unlikely event that any claims are made by neighbouring countries or even disputes arise over Greece's decision to move ahead with international licensing rounds under the provisions of UNCLOS concerning EEZ and the exercise of its sovereign rights within it, the governments of the countries which will be contesting Greece's decision may file their complaints to the International Maritime Court in Hamburg, in Germany, which has been appointed by the United Nations to handle disputes arising from the interpretation and application of the UNCLOS. In order to carry out exploration and production activities the country in question needs to have delimitation of its border with neighbouring countries' continental shelf. In accordance with UNCLOS provisions hydrocarbon exploration could then be carried out within a 200 national miles zone.

The corollary of the above is that Greece, at this stage, is not obliged to declare openly and in advance its EEZ (partially or fully in the Aegean and in other sea areas) in order to move ahead with offshore hydrocarbon exploration activities. This can be done piecemeal, if necessary, on the strength of the particular conditions and circumstances arising from international licensing rounds and the geographical definition of concession areas. This does not mean to say that Greece should avoid to delineate its sea boundaries with neighbouring countries including Libya, Egypt, Cyprus, Turkey and Albania. On the contrary Greece should make every effort to determine its sea boundaries, on the basis of the UNCLOS provisions following bilateral negotiations with all above countries. It should be noted that such negotiations are already in progress with Egypt and Cyprus. With Italy sea boundaries had already been defined following a 1978 bilateral sea boundary treaty which was based on the median line concept as UCLOS was not in force at the time.

A Strategy for Success

Today in Greece we are faced with a situation where we know for certain that the county has certain limited but commercially exploitable hydrocarbon reserves while we suspect that it has a lot more to be discovered. This qualified guess is backed by some promising data.

Therefore the question arises as to what we should do. The companies' commercial instinct and national goals, as exemplified by the government, agree that we should go further. That means we should persevere in our efforts to discover and verify more actual deposits and plan for their exploitation. In other words we need a plan, or even better we need a strategy for success.

The transition from strategy as plan to strategy as direction raises the question of why firms and governments need strategy. Strategy assists the effective management of organizations (in our case the government), first, by enhancing the quality of decision making, second, by facilitating coordination, and, third, by focusing organizations on the pursuit of long-term goals [38].

More specifically, strategy improves decision making in several ways:

- It simplifies decision making by constraining the range of decision alternatives considered and acts as a heuristic- a rule of thumb that reduces the search required to find an acceptable solution to a decision problem
- The strategy-making process permits the knowledge of different individuals to be pooled and integrated
- It facilitates the use of analytic tools- the framework and techniques- which enable us to study and analyse complex situations

At this point we should observe that successful strategies share four common factors:

(i) The objective appraisal of resources

(ii)A profound understanding of the competitive environment

(iii) Setting goals which are consistent and long term

(iv) Effective implementation

Fig. 63 helps in illustrating this factor based approach to strategic thinking.

Figure 63. Common Elements in Successful Strategies

With the exception of (1) which we dealt with in some depth in Chapter 10 and we present below in summary, the other three factors are analysed and discussed in detail as follows:

(1) Estimation of Resources

In Chapter 10 we looked in detail at the present situation of Greece's hydrocarbon resources. These are characterized by a very small amount of proven reserves (less than 60 mboe) and limited prospective and contingent reserves. However, the fact is that several oil and gas plays have been identified in widely differing locations all over the country. The challenge therefore lies in our effort to explore these finds and determine the actual size and characteristics of deposits and reservoirs.

(2) The Competitive Environment

Understanding the competitive environment, having first acquired a firm understanding of our own resources and capabilities, comes a step closer in our goal for setting out a successful strategy. In our case the competitive environment is to be found in the activities and plans of other countries, in the international domain and especially in the East and South Mediterranean. Countries which also seek to attract international companies to carry out exploratory work and successfully built and operate the necessary production facilities. In this sense, it is important to identify Greece's competitive advantages in this sector which can be summarized as follows:

(i) Greece is a full member country of the European Union (since 1981) which means that its legal regime, tax status and banking network are fully harmonized with the EU governance

(ii) Greece has a well developed local oil industry, focused in refining and retailing but has also an equally important metal and light manufacturing industry which could support the construction and maintenance of oil production and support facilities, oil and gas pipelines, LNG terminals etc.

(iii) Greece has an extended network of shipping facilities covering a wide range of aspects from ship birthing, dry docking, ship building and ship repair, chartering, loading-unloading etc.

(iv) Greece has unique access to international shipping services and resources thanks to its global leadership in this key economic sector

(v) The country has a well educated workforce, with skilled and semi skilled workers, some of them in the oil and gas industry with many of them in their 30's, 40's and 50's

(vi) Greece's proximity to major European oil processing and trade centers is another distinct advantage

(3) Setting Goals

Following wide ranging consultation with both government and industry there appears to be a consensus on the long term goals which should be established along the following lines:

(i) The constant furthering of our knowledge and understanding of the country's hydrocarbon resources

(ii) Exploration programmes should be established and run on a continuing basis

(iii) Effective management and development of known oil and gas plays

(iv) Discovery of new oil and gas fields, appraisal drillings, and advancement with further exploratory and reservoir development programme

(v) Increase the size of proven resources

(vi) Increase of current production levels

(4) Effective Implementation

Implementation of the above goals can only be done through the existing organizational structure of the government i.e. the Hellenic Agency of Hydrocarbon Exploration (EDEY). This should be a well organised and well run body, accountable to the relevant government department (in our case the Ministry of Reconstruction, of Production, Environment and Energy) which will undertake to organise, coordinate and supervise all hydrocarbon related activities in the country.

The management of this body should be carefully selected so as to combine high standards with regard to professional qualifications, work expertise, professional integrity and good standing. The management must not be chosen on the basis of political criteria and politicians should refrain from pursuing frequent management changes. Senior management should be appointed with minimum five (5) year contracts.

Strategic Fit

Fundamental to our view of strategy as a link between the government and its external environment is the notion of strategic fit. This refers to the consistency of the government's strategy, first, with the external environment of the country and, second, with its internal environment, especially with its goals and values and resources and capabilities. A major reason for the decline and failure of some nations comes from their having a strategy that lacks consistency with either the internal or the external environment.

The concept of strategic fit also relates to the internal consistency among the different elements of a government's (or firm's) strategy. Effective strategies are ones where functional strategies and individual decisions are aligned with one another to create a consistent strategic position and direction of development. This notion of **internal fit** is central to Michael Porter's conceptualization of the government (or firm) as an **activity system**. Porter states that "Strategy is the creation of a unique and differentiated position involving a different set of activities". The key is how these activities fit together to form a consistent, mutually reinforcing system e.g. Ryanair's strategic position is as Europe's lowest-cost airline providing no-frills flights to budget-conscious travelers. This is achieved by a set of activities which fit together to support that positioning or Statoil's strategic position as Europe's biggest oil and gas producer [39].

The four elements of a successful strategy can further be recast in two groups the national or government, to be more precise, and the industry environment, with strategy forming a link between the two.

Figure 64. The Basic Framework: Strategy as a Link between the Government and its Environment

The government embodies goals and values (normally related to economic and foreign policy), resources and capabilities, structure, systems etc. while the industry covers the usual three elements of competitors, customers, suppliers and the technology base.

Strategy Components

In analyzing and describing a desirable strategy it is of the utmost importance to identify the set of components, some of which we have already covered, which play a key role in the shaping of the **factors** (as already described) which contribute to our strategic thinking. However, these components are not always recognised or understood in terms of the role they play. The following are some of these important components (as applied to Greek hydrocarbons) which normally influence the process of strategy formulation:

(a) Market Forces (local and international)
(b) National priorities and national differentiation in terms of resources and policies
(c) Greece's geographical position and geographical role
(d) Greece's location in relation to the international hydrocarbon value chain
(e) Local industry capabilities and infrastructures
(f) Country investment outlook and country risk
(g) Monetizing future oil and gas output

The above so called components, part of the strategic thinking process, interfere and often determine our main strategic factors i.e. resources, competitive environment, goal formulation and implementation. The role and influence of these components is crucial in our understanding of the main strategic factors, and how we may use them in determining our strategic options and consequently the laying out of specific strategies.

Strategy Options

In addition to the strategy related components one must take into consideration some broader developments and trends in a number of other key policy areas but also account for some important *socio-political and economic factors and public altitudes* which often affect the shaping of the above described strategy components and include the following:

- Energy and environmental policies
- National economic policy
- Foreign policy
- Local authority policies
- Local community attitudes
- Public opinion (national)

In view of the large number of parameters involved (which include strategy components and socio-political and economic factors) in strategy formulation it is evident that we may end up having more than one strategy options. In order to study these strategy options one must consider the above "components" and "factors" as well as the analysis of the country's competitive advantage and its particular strategic fit so as to observe interrelationships, advantages and disadvantages, strengths and weaknesses, opportunities and risks. In this sense we have some analytical tools at our disposal such as the famous SWOT analysis and the lesser known but more appropriate in our case *"Porter's National Diamond Approach"*.

The SWOT analysis presented in Figure 65 goes someway in showcasing Greece's relevant strengths and weaknesses when it comes to attracting international interest for hydrocarbon exploration. Right now (second half of 2015) there appears to be a different balance in place which predisposes towards a negative overall assessment. Should the political environment suddenly improve from a stability viewpoint, the analysis turns instantly positive as the relative strengths will outweigh the weaknesses.

Figure 65. A SWOT Analysis for Hydrocarbon Development in Greece

In order to analyse Greece's international competitive advantage we should also examine the dynamics through which resources and capabilities are developed. Porter's notion of competitive advantage [40] together with his concept of a *national diamond* framework offers a suitable analytical tool [41]. This framework (see Figure 66) identifies four key factors that determine a country's competitive advantage within a particular sector:

(a) Factor conditions

Whereas the conventional analysis of comparative advantage focuses on endowments of broad categories of resource, Porter emphasizes the role of highly specialized resources many of which are "home-grown" rather than "endowed"

(b) Related and supporting industries

One of Porter's most striking empirical findings is that national competitive strengths tend to be associated with "clusters" of industries

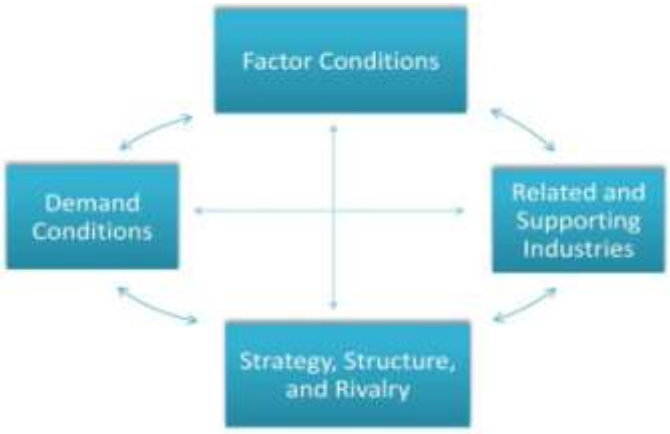
(c) Demand conditions

In the domestic market these provide the primary driver innovation and quality improvement

(d) Strategy, structure and rivalry

National competitive performance in particular sectors is inevitably related to the strategies and structures of firms in those industries. Porter puts particular emphasis on the role of intense domestic competition in driving innovation, efficiency and the upgrading of competitive advantage

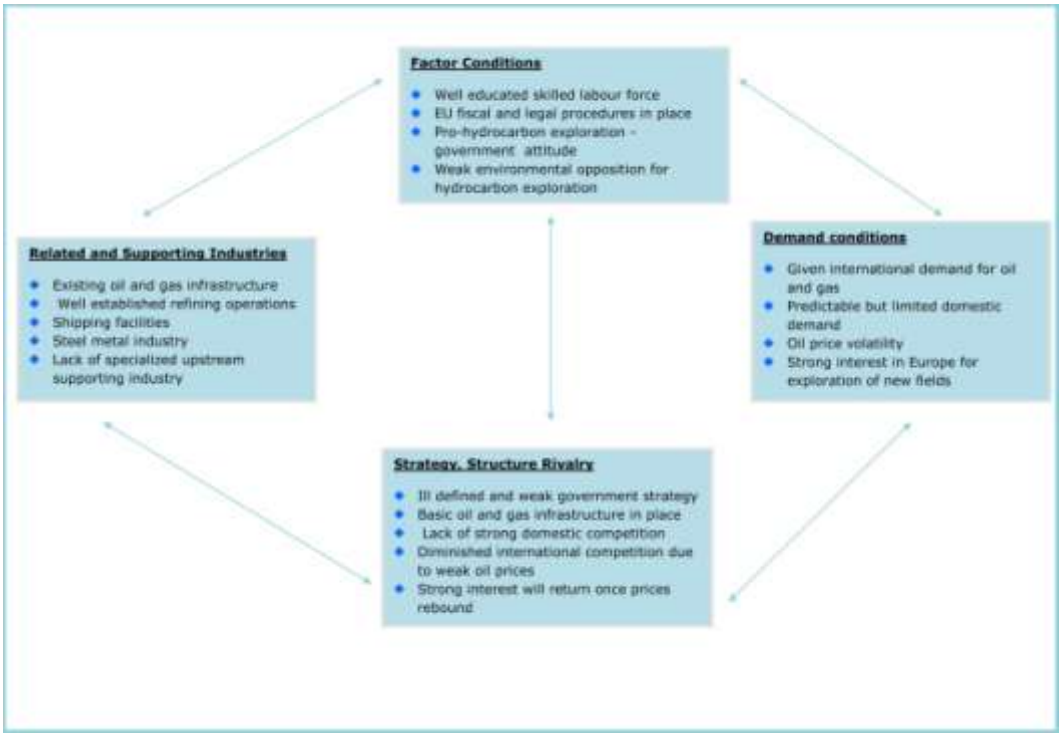
Figure 66.Porter's National Diamond Framework



Applying Porter's national diamond framework in the case of Greece's hydrocarbon exploration and production sector reveals some interesting facts especially if we substitute the "domestic market" element with the "international market" on the demand side. Whereas we have a positive environment in the two main areas (i.e. Factor Condition and Demand Conditions) we have a clear weakness on strategy and structure. Fortunately this can be corrected as it is a matter of policy rather than infrastructure, while the disadvantage in supporting industries, as Greece lacks a specialized upstream service sector, is more difficult to improve as Greece currently lacks a sizeable upstream activity, although such a service sector is not difficult to develop in view of the fact that Greece is home to an extensive metal industry. Overall we have a positive picture as the advantages outweigh by far the disadvantages, since many of them

can be rectified with E&P upstream type industries being established as demand for related services picks up.

Figure 67. Porter's National Diamond Framework as Applied to Hydrocarbon Exploration in Greece



As it is painfully obvious from the preceding analysis the shaping of a national strategy for unlocking Greece's hydrocarbon resources is rather more complex than the preparation of a carefully written essay. It requires the in depth evaluation of several factors related to both national and international conditions, but also political analysis at national and regional level and the ensuing country risk estimation. In addition one must familiarize himself with the prospective cash flows from hydrocarbon production and their implication in terms of economic policy and state finances. Furthermore Greece's competitive advantage in a regional and international context must be carefully assessed and factored in the formulation of a national strategy.

A Strategy Defined

Normally in most countries the formulation of energy strategy is considered a government prerogative with little input from opposition political parties or from industry and NGO's and even less contribution from the public. And although the formulation of a long term policy for developing Greece's hydrocarbon resources at first sight appears to be an exclusive government function, and at the highest level at that, the strategic importance of the subject at national level is such that warrants much broader input. Consequently there is room for an independent organisation like IENE to contribute in this process and present its views. In fact this is more than necessary at this time juncture as there currently appears to be serious lack of a coherent and targeted energy policy and well defined long term goals.

Having first consulted widely at both government and industry level, IENE, as a concerned stake holder and having carried out the detailed analysis presented in this study, is in a position to provide the broad outline of a much needed strategy. In short a proposed strategy for unlocking Greece's hydrocarbon deposits should take into consideration the following:

1. The need to further expand our knowledge and understanding of Greece's hydrocarbon resources
2. The need to increase the country's proven hydrocarbon reserves
3. To implement 1 & 2 an ongoing programme of exploratory activity, which should include regular concession rounds but also the relinquishing of research areas, must be established. In other words at all times there should be in place a continuous programme with a queue of prospective concession areas prepared and ready to be put in the market. This programme to include all three different types of call for tenders used so far:

(i) Open Door

(ii) Individual expressions of interest

(iii) International Licensing Rounds

4. To implement the above No. 3 item a permanent body or agency, within the state machinery, which will co-ordinate and supervise all exploration and production activity must be set up and function. The Hellenic Agency for Hydrocarbon Exploration (EDEY) already set up by the Ministry and Environment and Energy two years ago, (but not yet fully activated), is fully empowered and capable of undertaking this activity. However, every effort should be made to ensure the tenure of the management at the Agency in order to avoid frequent changes and interference by political forces which are counterproductive to the goals and mission of such a body

5. The need for a stable political environment cannot be over-emphasized as the change of ministers, even from within the same government, in adversly affects the ogranisation of licensing rounds and the evaluation procedure. This obliges companies to extend unnecessarily their time allocation for projects in Greece and as a result creates a rather unfavourable business environment as the withdrawal recently of several companies from exploration activity has showed

6. Hydrocarbon exploration and development must be included as a top priority in any government's political agenda. This is necessary as it is directly related to economic and foreign policy

7. The country needs to define and safeguard its sea boundaries within the provisions foreseen in Economic Exclusive Zones (EEZ) or continental shelf. The consequent exercise of sovereign rights, as foreseen by the various clauses of UNCLOS (Montego Bay, 1982), should be sought as part of the overall hydrocarbon exploration process

8. A "next generation" fund should be set up to take care of the potential state proceeds from oil and gas exploitation following the example of other oil producing countries i.e. Norway's Government Pension Fund (SPU). This shall be a professionally managed fund with a goal of increasing its value over the years and for supporting when necessary state pension and social welfare programmes
9. The development of local E + P expertise, both at professional and technician level, through the introduction of appropriately designed courses and on site training should be a permanent goal
10. The development of local E + P infrastructure in terms of access to exploration and production equipment, operation of a repair base and qualified services availability (i.e. laboratory equipment and personnel, IT services, accounting etc.) should be encouraged and facilitated

The above ten (10) points could provide the basis for exemplifying a more detailed step by step approach in strategy formulation as well as planning the necessary executive actions which need to be taken and implemented (some of them in parallel) within a specific timeframe.

Having presented the above broad strategy in outline form, the result of careful observation, extensive information retrieval and analysis, and broad consultations with government and industry, IENE aspires to contribute to the wider effort now being made by institutions and individuals to hammer out a realistic and effective national strategy for hydrocarbon development in Greece.

Perhaps more than many other areas of economic and business activity hydrocarbon exploration and the bringing of mature fields into production, requires careful long term planning, availability of human resources and access to ample capital resources in order to fully realize the potential of stranded assets, which is usually the case with hydrocarbons. In this sense a well defined strategy by the host country is of paramount importance.

12. Key Messages

1. Exploration and research work conducted over the last 40-50 years shows that Greece holds some promising oil and gas areas. Some of them are well defined while others need additional exploration in order to improve their potentiality. Only a small amount of hydrocarbon reserves are proven (less than 60.0 mbo) while the total prospective and contingent resources of the country amount to approximately one (1) billion STB of oil.

2. Current oil production from the Prinos oil field is minimal at 2.000 bb/d while this reservoir, which has been in operation since 1981, has yielded so far 116.0 million barrels of oil. A long term investment plan already in place by the field's operator (Energean Oil & Gas) aims at exploiting further the Prinos reservoir and surrounding secondary fields and increase production to 10.000 bb/d by 2016/2017.

3. Interest for the exploitation of the country's hydrocarbon reserves resurfaced only five years ago and since then successive governments made a determined effort to restart the exploration process. Already new concession areas in Western Greece have been awarded to two oil groups and an international licensing round (in progress) was launched in October 2014.

4. A common aspiration by government, industry and professionals is to gradually increase oil and gas production and so lessen somewhat the country's huge oil import dependence which today stands at 99.5%.

5. In view of Greece's attempted restart of oil and gas exploration and the strong interest expressed so far by international companies active in the East Mediterranean, (see also Cyprus, Israel) and emerging opportunities for investment in the region's hydrocarbon sector, it is becoming increasingly important to establish a long term national strategy for unlocking Greece's not so insignificant petroleum potential.

6. As there appears to be lack of a well defined national strategy for exploiting Greece's hydrocarbon resources, IENE within its remit, undertook the initiative to carry out the present study in order to

analyse in detail the various factors and parameters involved and formulate specific strategy proposals.

7. The present analysis has been based on a conservative estimation and re-evaluation of Greece's oil and gas reserves and the accounting of all different factors, and their components, which influence policy decisions and eventually strategy formulation. In this respect a number of strategic options have been considered.

8. The four main elements in the present analysis include: (i) Appraisal of resources, (ii)understanding the competitive environment, (iii) the setting of goals, (iv) effective implementation. Consequent to that is the "strategic fit" approach whereby strategy is considered as a link between government and its external environment, with the four above elements being recast in two groups, government and industry.

9. In examining the various strategy options available, IENE's evaluation has moved beyond a SWOT type analysis and has considered more advanced and resource related tools such as Porter's National Diamond Framework which fully considers the strategic fit approach. This has helped to assess the overall balance of prevailing conditions with reference to Greece which allow the establishment of successful strategies and their updating or redefinition when necessary.

10. IENE proposes a ten (10) point "Strategy for Success" for unlocking Greece's hydrocarbon potential with the following four premises underpinning this strategy:

a. The need to further expand our knowledge and understanding of the country's hydrocarbon resources and further assess its overall petroleum potential

b. The need to increase the country's proven hydrocarbon reserves

c. The opening up of new exploration areas opting for quicker type procedures alongside with international licensing rounds (i.e. Expression of Interest, Open Door)

d. Develop public awareness for oil and gas exploration

13. References

(1) For a good description of Greece's Oil and Gas Infrastructure, see IEA's "Energy Policies of IEA Countries", Greece, 2011 Review, IEA Paris, 2011

(2) Some of the detailed information on Greece's oil and gas infrastructure is given in "SE Europe Energy Outlook 2011", edited by Costis Stambolis and published by IENE, March 2011

(3) See Hellenic Gas Transmission Operator S.A., www.desfa.gr

(4) For a discussion of the various planned gas pipelines see IENE Research Note No. 3 "The Role of Greece as a Supply Route to Europe in view of the latest Gas Discoveries in the East Mediterranean" by Costis Stambolis and Nicholas Sofianos, December 2012, Athens, also IENE Study Project (M26) "The Vertical Corridor: From the Aegean to the Baltic", May 2015, Athens

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