The Importance of Natural Gas in the Cypriot Energy Strategy between 2021-2030: Domestic and International Parameters

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Abstract

Natural gas will be introduced in 2022 to the Cypriot energy mix not through the monetization of the country's notable gas discoveries but through Liquefied Natural Gas (LNG) imports. This has constituted a major policy shift for the Republic of Cyprus (RoC) whose long-term impact on both the domestic energy system of the country and its gas export strategy has not been thoroughly analyzed. Will this shift be detrimental for the efforts of RoC to emerge as a major regional gas exporter to the EU? How will it affect the entirety of the country's energy strategy to 2030? Most articles do not assess the impact of that important policy shift on the country's gas export strategy and the resilience of its energy system. This article follows a holistic approach that explains the cross-sectoral impact of natural gas introduction in the Cypriot energy mix to 2030 including the RoC export plans.

The paper argues that natural gas will help to reduce the country's electricity generation cost and its Green House Gas Emissions (GHGE), while enabling the rapid expansion of its vast solar power potential allowing renewable electricity to double or even triple as a share of installed generation capacity by 2030, regardless of whether or when will the island state be interconnected with the electricity systems of its neighboring countries. Despite rising political tensions with Turkey, the Cypriot exploration program will carry on over the next two years in those parts of the Cypriot Exclusive Economic Zone (EEZ) where it matters most from a commercial point of view. The results of these exploration efforts will allow for a more accurate estimate of Cypriot net export capacity that could lead to a major revision of the country's existing gas export strategy that calls for the independent development of Aphrodite gas field and the exportation of its entire production to Egyptian LNG facilities via an underwater gas pipeline.

Keywords: Cyprus, Energy Strategy, Exclusive Economic Zone, Natural Gas Exports, Pipelines, LNG (Liquified Natural Gas)

Introduction

Since 2011 when the Aphrodite natural gas field was discovered offshoreCyprus, many articles have been written to analyze the challenges and opportunities for the monetization of the island's first ever natural gas discovery. Most of these analyses have focused on the geopolitical parameters of the Cyprus gas monetization options (Andoura & Koranyi, 2014, Giannakopoulos, 2016, Taehwan & Yoon, 2021)and the impact of that monetization on the Cyprus conflict (Stergiou & Karagianni, 2019) while others, fewer in number, have emphasized on the potential economic implications (Thrassou, Vrontis, Tsakiris, Hadjistassou 2016, Taliotis, Rogner, Ressl, Howells and Gardumi, 2017) of commercializing the island's offshore gas reserves.

This paper follows a holistic approach that assesses the importance of natural gas for the Cypriot Energy System and the long-term energy strategy of the RoC by analyzing *both* domestic and international challenges that affect not only the potential monetization of the RoC's offshore discoveries and the country's exports strategy, but also the effects of natural gas use on the overall optimization and resilience of the Cypriot Energy System, one of the most vulnerable in the EU.

The paper argues that the introduction of natural gas in the Cypriot Energy System will act as a positive catalyst for its modernization even if it is imported in the form of LNG and is de-linked from the monetization of the Aphrodite field or other less mature gas discoveries in the southern blocks of the Cyprus EEZ, like Glafkos, and Calypso, which can be entirely dedicated to exports.

Delaying the introduction of natural gas to the Cypriot Energy System in order to find enough gas in the Cypriot EEZ so as to build an export-oriented mega-project such as an onshore LNG exportation facility in the Vassilikos area, is no longer a viable option. It is a self-defeating option, especially since a fifteen-years long hiatus between the discovery (2011) and potential monetization (2026) of the Aphrodite field may even leave the field stranded if alternative export options currently being discussed, like a gas pipeline from Leviathan to Idku, are realized first.

This paper will fist illustrate the vulnerabilities and deficiencies of the Cypriot Energy System by analyzing the latest available market data, official energy statistics and official energy strategy documents which have been published by Cyprus's energy regulator (CERA),its electricity transmission system operator(DSMK) and the country's National Energy and Climate Plan (NECP) for 2021-2030.

This analysis will highlight the role that even imported natural gas can play as a major factor for reducing the island's cost of electricity generation and its overall GHGE (Green House Gas Emissions) and assess the government's decision to import LNG via a permanent Floating Separation and Regasification Unit (FSRU) terminal that is currently being constructed in the area of Vassilikos.

The paper argues that the utilization of natural gas in the Cypriot energy mix will expand the RoC's net export capacity thereby further incentivizing, despite Turkey's "gunboat diplomacy", IOC (International Oil Companies) to carry on with their exploration, appraisal and potential development of Cypriot offshore discoveries.

It will also analyze the maturity of each potential field with regards to its prospective monetization and assess the dynamics of future exploration in the Cypriot EEZ at the face of increasing Turkish opposition while evaluating the net export capacity of the RoC to 2030 according to a scenario based analysis.

It will conclude by examining the viability of RoC's current gas export strategy in light of recent developments in the Eastern Mediterranean and in particular the possibility of a new gas export pipeline that would link the Leviathan gas field with the Egyptian liquefaction plant in Idku (Wardany & Magdy, 2021), while offering an alternative policy path which is more likely to ensure the monetization of the island's gas reserves.

1. Natural Gas as a catalyst for the modernization of a vulnerable and isolated Energy System

With the exception of Lebanon and the Palestinian Authority, no other country in the Eastern Mediterranean, and certainly no other EU member-state, is in more dire need of introducing natural gas to its national energy mix than the RoC. The fact that Cyprus is the last EU member state with no natural gas or electricity interconnection whatsoever with any of its neighbors, not to mention the EU energy market, underlines the importance for the divided island republic to monetize its indigenous offshore reserves as soon as possible. Unfortunately for Cyprus a combination of political idleness unlucky drilling results and bureaucratic inertia, partly related to overoptimistic expectations regarding the resolution of the Cyprus Question between 2014-2017, has made it heretofore impossible for the RoC to monetize its 4,1 TCF (Trillion Cubic Feet) of proven and probable reserves in the Aphrodite field.

Indicative of the continuing impasse is the fact that Aphrodite was discovered back in 2011 and by the government's admission it is not expected to be monetized prior to 2025 or 2026. After almost a decade of "soul searching" on how to monetize the Aphrodite reserve that always included plans for a dedicated pipeline to Cyprus, which would have covered the island's domestic needs for several decades, the government was forced to indirectly acknowledge in 2019 that the Aphrodite field will be entirely reserved for exports to Egypt since the country's long-term natural gas needs would be covered by importing LNG for at least until 2030. The Vassilikos FSRU can satisfy the island's demand for decades, starting as early as 2022, four years before the expected beginning of production from Aphrodite. Monetizing its own natural gas reserves should have been a top priority for Cyprus for reasons of increasing its security of energy supply and reducing the levelized cost of its electricity generation and its associated GHGE (Tsangas, Zorpas, Jeguirim, and Limousy, 2018, Mirasgedis, Sarafidis, Georgopoulou, Lalas, and Papastavros, 2004)in what is arguably Europe's most vulnerable, least competitive, and most isolated energy system.

The Cypriot energy system is almost entirely dependent on imported oil products, which are sourced primarily from Israeli and Greek refineries, that amounted in 2019 to almost 95% of its Total Primary Energy Supply (TPES), 92,35% of its Final Energy Demand (FED), and 91,3% of its entire generated electricity capacity. More than 50% of the energy consumption in Cyprus is attributed to the transportation sector, around 20% to residential demand, 13% to the services sector and only 12% to industry and 2% to agriculture. In order to underline the level of Cypriot dependence on imported oil products one needs to note that even in the best-case scenario of the NECP to 2030, oil will still cover 53% of FED, even if all oil-fired electricity is eliminated and Renewable Energy Sources (RES) expand to the point of covering 51,3% of installed electricity capacity and 20,1% of Total Final Consumption (Cyprus' Integrated National Energy & Climate Plan, /CNECP, 2020, 196-198)

This structural overdependence on imported oil products did not appear enough to motivate successive Cypriot governments to introduce major policy reforms that would mitigate this risk despite the country's accession in the EU in 2004 and the despite the catastrophic Mari accident of 2011 that destroyed 60% of the RoC's installed electricity generation capacity (Zachariadis & Poullikkas, 2012). The accident resulted in four months of brown-outs throughout the island's free territories costing, by various estimates, the Cypriot economy anywhere between €1,2-3 billion amounting to a loss of 6% to 13% of its GDP at the time (Mullen, 2013). The cost of energy is highly sensitive to international oil price fluctuations in Cyprus which is consistently among the highest in Europe, representing around 8% of its GDP. Until 2004 the RoC did not even have a legal framework in place for the promotion of Renewable Energy Sources (RES) generation despite its large solar power potential (Zachariadis, 2007).It was not until 2010 that renewable electricity started to represent a statistically notable share of the country's installed electricity capacity.

Cyprus had no wind generated electricity until 2010 (Cyprus Energy Regulatory Authority/CERA, 2018, 58)and the latest available data by the Cypriot Electricity TSO (DSMK) for 2020, indicate that oil remains the dominant source of electricity generation representing 88,7% of total generation, something which is unique to Cyprus when compared with any other EU country, including Malta that introduced natural gas to its energy mix in 2017without having any indigenous natural gas reserves. This is one of the lowest rates of RES penetration in the European Union.*Cyprus was one of the few EU member states to miss by a notable margin its 2020 EU Energy strategy goals that called for a national target of 16% of RES as a share of the island's generated capacity by the end of 2020*. The DSKM data indicate that by the end of 2020, only 11,7% of the island's generated electricity emanated from RES, primarily from Solar PV and Wind Power which represented respectively 5,8% and 5% of the island's power generation (TSOC, 2020).

In its latest annual report CERA, the Cyprus Energy Regulatory Authority, projects an increase of around 25,5% in the country's installed electricity capacity to between1390-1440 MW by 2028 compared to 1130MW in 2019 (CERA, 2019, 58). The expansion will be primarily driven by a rapid increase in SPV (Solar Photovoltaics) projected to rise by almost 120MW to 2028 and the commissioning of the country's first independent thermal power producer (PEC-Power Energy Cyprus), the 262 Mega-Watt unit currently being constructed by CYFIELD in Vassilikos (Andreou, 2019a).

PEC is likely to replace after 2023 the older oil-fired power plant in Delekeia, which is expected to go into cold-reserve status as a back-up for the resilience and stability of the electricity market, which, according to CERA, may reach a peak demand of approximately 7600GWh (Gigawatt/Hours) by 2030.CERA projects that in order to cover the country's expected peak demand by 2030 a total installed generation capacity of 1600MW will be required, 200MW above the projected maximum installed capacity of 1400MW between 2025-2030. NECP's projection for 2030 is limited to 7100 GWh (CERA 2019, 58-59, CNECP, 58).The €200 million independent power plant was supposed to run on natural gas and its date of commissioning (March 2021), was initially planned synchronically with DEFA's (Public Natural Gas Co.) plans to start the operation of the islands first FSRU unit, although this is no longer possible since the FSRU will not be operational before mid-2022 at the earliest.

PEC has accordingly shifted its own schedule to begin its operation is what would be the most efficient (60% dispatchability rate) combined cycle gas fired power plant in Cyprus in the 1Q 2023 which may indicate an expectation of additional delays in the operationalization of the Vassilikos LNG import terminal (Manolis, 2021).In 2020 the Cypriot electricity system, in terms of actual generation share and wholesale market share, is respectively 94,79% and 100% dominated by the state-owned company AHK or EAC (Electricity Authority Co.) (CEFA, 2019, 55-56).EAC generated in 2019 4.846 Mega Watt hours (MWh) out of a total electricity generation of 5112 MWh during that same year. By 2030 CERA projects that the share of IPP (Independent Power Producers) will amount to around 65%-70% of the island's generated capacity, although the share of renewable electricity is unlikely to surpass 20% of installed capacity in the absence of any interconnectors, despite ambitious plans to link Cyprus with Egypt, Israel and Greece via respectively the EuroAsia and Euro Africa electricity cable projects (CERA 2018, 50-51).

On May 27, 2020EuroAsia Ltd submitted its application for a new Connect Europe Facility (CEF) grant with the support of both the Cypriot and Greek governments, despite the fact that the third leg of the original project, the underwater cable between Crete and Attica, will be constructed with Greek national funds. According to an estimate by the European Bank for Reconstruction and Development (EBRD), published as part of a loan granted from the EBRD to Cyprus in June 2020 for the construction of its first LNG import terminal, the EuroAsia project is more likely to be commissioned no sooner than 2025(European Bank for Reconstruction and Development/EBRD, 2020, 18) thirteen years after its original proposal, provided it secures a major grant from the CEF financial instrument, equal to as much as 30%-50% of its capital expenses within 2021 or 2022, given that the cable and its associated infrastructure will be constructed over a period of at least two years from the time the project takes its Final Investment Decision (FID).

Unless EuroAsia or even smaller less ambitious interconnectors are established with either Egypt or Israel (or both), Cyprus is very unlikely to be able to increase its renewable generation capacity to beyond 20% of its total installed capacity by 2030. It is notable that the Cypriot 2021-2030 National Energy & Climate Plan, contradicts CERA's estimates and appears more optimistic in predicting that even without any interconnectors, renewables could still make up to 30,3% of the island's installed electricity capacity by 2030 expanding to 51,3% in case the interconnectors are constructed (CNECP, 58).The differences between the NECP and CERA are that a) the NECP assumes that EuroAsia will be operational by 2023, something which is more likely to take place after 2025 and b) NECP's estimates may be overoptimistic on the future availability of batteries as ancillary back-ups for intermittent renewable electricity, especially since NECP did not model in its calculation the option of pumped-hydro storage (CNECP, 55-58).

CERA projected in its latest annual report that, including a 6hours storage option for SPV, all renewable electricity will barely surpass 20% of the island's total installed generation capacity by the end of this decade (CERA, 2019, 59).

Where both NECP and CERA would agree though, is the fact that these chronic delays in the island's electricity interconnectivity constitute a major deterrent for the unlocking of the RoC's solar power potential and further expedite the need for the gasification of the island's electricity mix in order to reduce the country's Green House Gas Emissions and its levelized cost of electricity generation.

In 2020 according to the then President and CEO of the Public Gas Company of Cyprus (DEFA), Symeon Kassianides, 800MW or 71% of the country's installed capacity is technically capable of operating with natural gas but has been burning fuel oil for decades (Kolonas, 2020)As the Cypriot NECP notes "The most important policy measure [to reduce GHGE] relevant to electricity production concerns the import and utilisation of natural gas" (CNECP, 25)According to the NECP the strategic goal of the RoC is to replace all of the island's current oil-fired thermal electricity, estimated at 5000GWhr, with natural gas within two years after the first LNG cargo arrives in the Vassilikos FSRU(CNECP, 28)

The first effort to introduce imported natural gas to achieve the same objectives dates back to November 2007, four years before the discovery of the Aphrodite field, when the government of Tassos Papadopoulos established DEFA. Since 2007,according to former Cypriot Energy Minister George Lakkotrypis, there have been three more attempts, 2009-2011, 2012-2013, 2014-2016 to introduce natural gas to the Cypriot energy system that ended all in failure (Xinhua, 2019). After decades of delays the good news is that within 2022/2023, natural gas will be finally introduced in the Cypriot energy system in the form of LNG that is expected to cover the needs of the island's domestic market for at least 10 years by importing up to 0,9 billion cubic meter/year (bcm/y) though a mix of long-term (0,6 bcm) and short-term (0,3 bcm) supply contracts.

The firth, and apparently successful attempt started in 2016 when the government decided to import natural gas to Cyprus in the form of LNG before 2020, thereby disassociating the gasification of the island's economy with the monetization of its indigenous offshore gas reserves. In June 2017 DEFA was authorized to develop the LNG "intermediate" solution by delinking the gas supply contract with the FSRU that would not be leased, as it was called for in all previous LNG import attempts but would now be acquired as a permanent fixture of the future national gas grid. DEFA would develop the FSRU as part of a larger consortium with EAC through a Special Purpose Vehicle, the Natural Gas Infrastructure Company or ETYFA that was established in April 2018. DEFA would control 70% of ETYFA's shares and EAC the remaining 30% by contributing €43 million towards the financing of the FSRU(CERA, 2019, 64-65).In January 2018, the government secured a €101,5 million CEF grant to build the Vassilikos FSRU as a Project of Common Interest on the basis of its significance as a permanent asset for the country's future security of supply.

Even if Cyprus were to eventually import natural gas through pipelines, a second entry point to its natural gas transportation system would still be necessary to enable supply diversification and improve the resilience of its future natural gas grid. The entire infrastructure that includes the retrofitted LNG tanker, the pipeline connecting the tanker to the onshore distribution network, the construction of other docking facilities and the onshore pipeline linking the terminal with EAC's Vassilikos power plant are expected to cost around €375 million, whereas its operational expenses over a 20years period may reach even beyond €200 million (CNECP, 2020, 143).

Given the isolation of the RoC from the EU natural gas system, and in accordance with the exceptions granted to emerging and isolated markets in the European natural gas Directive 2009/73/EC, the government through cabinet decision #87.469 of 5 June 2019 decided to grant DEFA monopolistic control as a natural gas supplier/trader over the emerging natural gas market of the island for a period of at least 10 years while also recognizing it, as a monopoly owner, developer and operator not only of the FSRU but also of the country's entire transmission and distribution system for a period of 30 years from the year CERA issues the relevant permits to DEFA which CERA issued in February 2021 (CERA 2019, 63-64).

The contracts for the construction of the FSRU were awarded on 13 December 2019 to a Sino-Greek-Norwegian consortium led by China's Petroleum Pipeline Engineering Co. & Metron S.A. During his address in the signing ceremonyfor the construction of the LNG import terminal, then Cypriot Energy Minister George Lakkotryp is announced that the introduction of LNG into his country's energy mix is expected to result to an average 25%-30% reduction in GHGE emissions and between 15%-25% decrease in the variable cost of electricity generation by 2025 when all of the country's oil-fired electricity power stations will be burning natural gas (Xinhua, 2019). Cyprus has one of the highest electricity prices in Europe, at approximately EUR 0.16 per kWh for non-households and EUR 0.22 kWh for households at end of 2019, the most expensive in the EUfor the first half of 2019 according to Eurostat (EBRD, 2020, 25-26)The FSRU's financial structure was completed in July 2020 through a combination of loans from European Financial Institutions and Cyprus government guarantees. On the 1st of May 2020, EAC decided after almost two years of internal debate to buy into ETYFA by committing to pay €43 million.

In June 2020, ETYFA also succeeded to secure a €150 million loan from the EIB with the RoC "underwriting" the entirety of the loan by issuing a government guarantee while in July 2020 it also secured an additional loan from EBRD for €80 million (Agapiou, 2020).

The Vassilikos FSRU was approved as a matter of priority by the EBRD Board due to its maturity, its CEF grand and PCI status, and its overall strategic significance for the island's energy security as a catalyst for sizeable CO2 reductions and as an enabler for higher RES penetration. As the decision document of the EBRD's Board notes in its justification for granting the loan to ETYFA "Cyprus' ambitious long-term goals for renewable energy penetration require flexible capacity to match intermittent wind and solar, a role for which gas-fired generation is well suited" (EBRD, 8). The decision also notes that "In Cyprus, CO2 emissions savings will represent more than 10% reduction in the national carbon emissions. The Bank's economic analysis values the emissions reductions at EUR 100 million annually on average"(EBRD, 8).

The FID on the Vassilikos FSRU was taken on July 9th 2020, when the construction work on the project officially begun. Kasssianides noted that the country's first infrastructure project will be commissioned by July 2022 (Kolonas).Due to complications related to the project's spatial permitting, its incomplete financial structure and the unavoidable COVID-19 restrictions on economic activity, DEFA's initial 4Q/2021-1Q/2022 deadline has been effectively pushed back to mid-2022 at the earliest, although it is more likely that the FSRU may start operation by the end of 2022.With regards to the supply side of the country's first LNG import contract, the first non-binding phase of DEFA's LNG supply tender was completed in September 2019 for a total of 0,9 bcm/a. In order to maximize its supply flexibility DEFA divided its call between a 0,6 bcm/y long-term contract valid between 3-5 years and a smaller 0,3 bcm/a contract that would be based on spot market prices.

Twenty-five major traders and LNG producers, including ENI, BP and Total, submitted non-binding offers and the pre-qualification process for their selection for both the long-term "LNG Sales and Purchase Agreement – SPA" and the spot Master's Sales Agreement contracts. Of the initial 25 offers, 19 were qualified to continue to the next round for both contracts and 5 only for the MSA (Financial Mirror, 2020). The second phase of the competition that includes the submission of binding offers was scheduled to take place in the first quarter of 2021 with the contacts signed within 2021.Ostensibly the decision to import LNG is only an intermediate solution until the Aphrodite reserve or other yet unconfirmed discoveries in the Cypriot EEZ such as Glafkos and Calypso are monetized.

Nevertheless, the size of the contacts currently under negotiation (0,9 bcm) and the size of the country's domestic demand for 2021-2030 which is rather optimistically estimated to peak at around 1,1bcm by 2030 (Taliotis, M. de Boncourt, K. Keramidas, 2015), indicate that it would be very difficult to generate, within this decade, any significant additional demand for gas, beyond the projected 0,9 bcm/y, in an economy of less than 900,000 people, especially if almost all of the country's thermal generation capacity shifts to natural gas over 2-3 years after the FSRU starts operating.

As we will discuss below this is not necessarily a negative development since it could maximize the availability of exports and generate more income for the RoC. If the predictions of the government and the EBRD about the value (circa €100 million) of net annual savings generated as a result of the gasification of the Cypriot electricity mix are confirmed, then the entire investment cost for the FSRU will be recaptured in less than four years, especially if oil prices increase above their record-low 2020 levels. The benefits though of the FSRU would last for decades, probably well into the 2040s regardless of when or whether the EuroAsia project will be realized.

2. Promise Unfulfilled: The unlocked potential of the Cyprus EEZ and its projected net export capability to 2030: From Aphrodite to Glafkos and beyond

The results of the first exploratory drilling (A-1) on the Aphrodite prospect in December 2011 that came up with an estimate of 7-10 TCF (Trillion Cubic Feet) of *in situ* reserves, were greeted by Cypriots with great enthusiasm. The success of the initial drilling followed three years of astonishing achievements for Noble and its Israeli partners in the Exclusive Economic Zone of Israel that had led to the discovery of Tamar and Leviathan. Aphrodite was considered by many as the "natural" continuum of these discoveries that would in turn herald the emergence of Cyprus as a major exporter of natural gas to Europe and beyond. Although, since December 2014 a series of unfortunate developments has abated the irrational exuberance of the early years of Cypriot exploration and despite the fact that there have been many attempts to link the freezing of the Cypriot exploratory program with the resolution of the Cyprus Question, the government of Nikos Anastasiades followed a pragmatic approach that has so far *disassociated* hydrocarbon developments from the prospects of resolving the Cypriot Question.

Repeated attempts to link the resolution of the Cypriot Question with unilateral Greek-Cypriot concessions over the division of future state profits from gas sales or the imposition of an immediate moratorium on all upstream activities in the Cypriot EEZ, but only in the areas claimed by the self-proclaimed "Turkish Republic of Northern Cyprus",as Turkey has proposed since 2012, (Erciyes, 2012)are both unbalanced and counter-productive.

They are unbalanced and counter-productive because the acceptance of a moratorium on the part of the GreekCypriots will *ipso facto* result to the *de facto* recognition of the illegal "TRNC" *as a co-decider over sovereign Cypriot policies in the absence of a solution* without simultaneously protecting the RoC from Turkey's illegal drillings in the part of its EEZ (and particularly Cyprus Offshore Blocks 1, 4, 5, 6, 7) that Ankara claims as overlapping with its own Continental Shelf claims (Karbuz, 2021)

More importantly, one needs to understand that what Turkey and the TRNC demand is not merely the unilateral termination of Greek Cypriot drillings, which will benefit none of the island's ethnic communities, but the right to approve or not approve the entire drilling program of the RoC. This is not a question of dividing future revenues within the context of a future federal budget. It is primarily a question of authority and legitimate competence over who has the sovereign right of decision. Granting an illegal entity, recognized by none other than Turkey, veto rights over its drilling program would be suicidal for the RoC from a legal point of view, more than anything else.Talking about splitting future revenues is at the very least premature for the simple reason that there will be no state revenues whatsoever to be divided before 2025/2026 at the earliest when production is expected to begin from the country's only proven gas field. It would also take several years before the state acquires a sizeable revenue stream from the exploitation of Aphrodite since under the initial cost gas phase of the field's development plan the majority of the gross revenue will be given, under the terms of any Profit-Sharing Agreement, to the developers in order to allow them to recapture their initial investment costs dated back to 2008 (Tsakiris, 2018).

Between 2008-2019 Noble, Delek and Shell have claimed close to $0,5 billion in deductible expenses from future profits. According to Aphrodite's FDP (Field Development Plan) announced in November 2019, the capital and operational expenses of the consortium's investment are expected to rise to a minimum of $8 billion for the duration of the field's life expectancy to 2043. This would translate to an average cost-gas phase of approximately 5-7 years depending on future oil and natural gas prices. Future net state profits were estimated at an average of $9,3 billion between 2025 and 2043. The $9,3 billion projection was made with a Brent price estimate of $70 in 2022 with a 2% increase rate and calculated natural gas quantities of 4.1 tcf. Then Energy Minister GeorgeLakkotryp is said that in all three scenarios with an oil price of $50, $70 and $80 per barrel respectively, Cyprus's revenue share is still over 50% of the abovementioned $9,3 billion (Stergiou & Karagianni, 113-114).

The theoretical revenues are sizeable but hardly constitute a game changer for the $21 billion Cypriot economy because they would be spread out over more than two decades. They are also theoretical until and unless an export monetization option is secured and the second appraisal well on Aphrodite is drilled sometime in 2022. Consequently, any significant future profits are still uncertain at this point in time and too far away into the future to have a direct political impact on present day negotiations to resolve the Cyprus Question (Adamides & Christou, 2016) this was true between 2015-2017 and remains true today. These revenues may start circa 2030/2031 and they were unlikely to affect the outcome of the intercommunal negotiations on the resolution of the Cyprus Question held in 2017 and will remain equally unlikely to have any tangible effect on the talks that are set to be resumed in Geneva in April 2021.

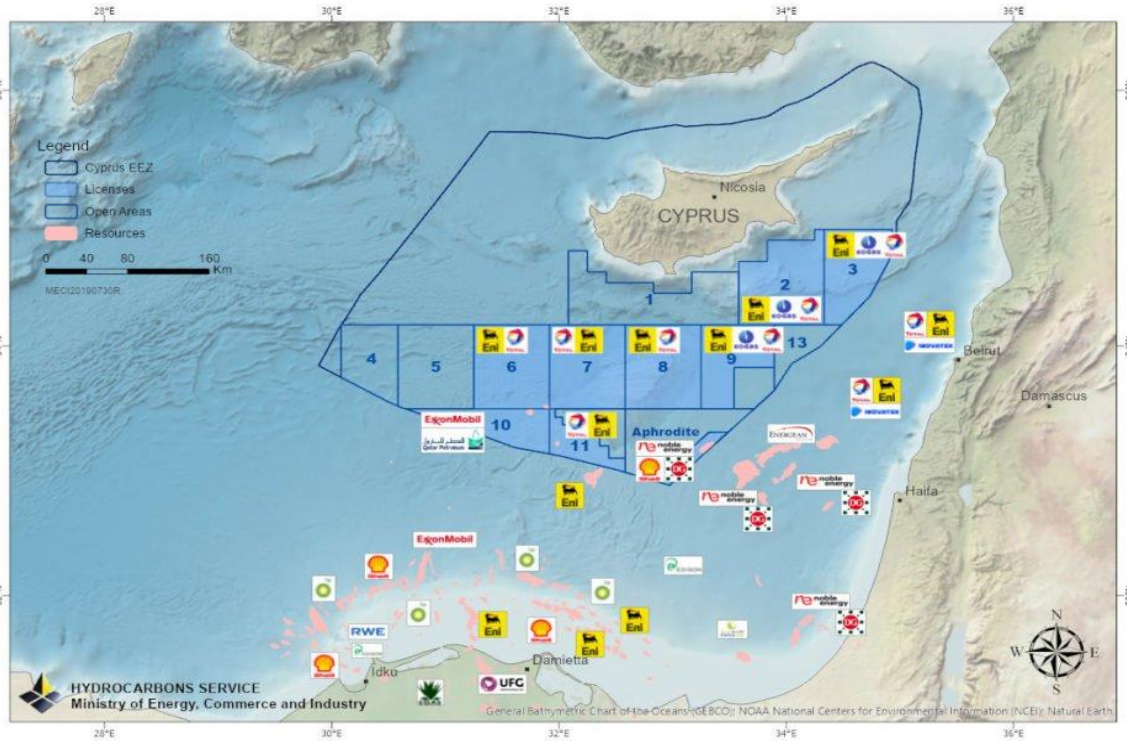
From a political point of view, what is more notable for the period between 2013, when Aphrodite's first appraisal well was drilled, and 2019, when Exxon made the Glafkos discovery, is the persistence of Nicosia to stick to its drilling program despite a series of disappointing failures and ever-increasing geopolitical adversities. These disappointments started with the appraisal well on Aphrodite that Noble and Delek drilled in September 2013 which limited the field's potential volumes to between 5-8 TCF with a mean 2P estimate of 6 TCF. In December 2014, the hopes of a major discovery on the Onasagoras prospect in Block 9 were disappointed when the ENI/Kogas exploration came up with a dry hole while in late January 2015 Total announced that it had not found enough evidence to support the cost of drilling an exploratory well in Block 10, where Exxon will discover Glafkos four years later. Moreover, ENI's second drilling on Block 9, the Amathousa well, also ended in failure in March 2015 leading to the re-evaluation of ENI's geological research model that effectively resulted to the withdrawal of ENI from the Cypriot EEZ until February 2018 (Tsakiris, 2017)

ENI's withdrawal effectively stopped all exploratory activities in the Cypriot EEZ and coincided with the election of Mr. Akinci in the leadership of the Turkish-Cypriot community and the restart of the intercommunal talks in April 2015 but there was never a direct causal link established between the two developments. No timetable for the return of ENI was announced for Block 9 which has yet to be drilled even today. When ENI did attempt to drill on Block 3 in February 2018 the Italian oil major and Nicosia were entirely unprepared for the predictable Turkish reaction that led to the cancelation of the so-called "Jellyfish" well (Kambas, 2018) and the essential freezing of all exploration activities in the northern part of the demarcated Cyprus EEZ to this day. Although is served Turkey's objectives in the northern blocks of the Cypriot EEZ, the "Jellyfish" incident had no paralyzing effect on exploration activities further south where the second major Cypriot gas field, was eventually discovered in 2019.

Had it not been for the discovery of Zohr in August 2015, Cyprus' offshore exploration efforts may have ended in abject failure regardless of what Turkey was able or prepared to do to stop it. By the admission of then Cypriot Energy Minister George Lakkotrypis, (Kambas, 2019)itwas Zohr's discovery that re-galvanized the interest of the International Oil Companies (IOC) in the Cypriot EEZ. Total remained in Block 11 and drilled another unsuccessful exploratory well in the Onisiforos target in September 2017. The results were disappointing in that the 11,2 billion cubic meters (bcm) discovery could not be autonomously developed, but they confirmed the existence of hydrocarbon reserves to the north of the Zohr discovery and around the underwater sea mountain of Eratosthenes. In April 2017 during its third licensing round the RoC tendered Block 8 to ENI, Block 6 to ENI/Total and Block 10 to a consortium made up from Exxon and Qatar Petroleum where Exxon is the operator and holds 60% of the special purpose vehicle.

Despite Turkey's claims that the northern part of Blocks 6 and 7 "belong" to its continental shelf and its warnings to the license holders that it would stop their drillings by force, ENI and Total drilled on the southern part of Block 6 in January 2018. Their drilling led to the discovery of the Calypso prospect which is believed to be extending to Block 7. There have been no official announcements regarding the size of Calypso (ENI, 2018)but it is believed to be -if confined to Block 6- a non-commercially exploitable reserve. In December 2018 exploration rights over Block 7 were awarded to the Total/ENI consortium opening the way for a new drilling campaign in 2020 that could have ascertained the size and potential extractability of the Calypso field, had it not been postponed due to the delays imposed on all economic activities by the COVID-19 pandemic.

Map 1: License Holders of Offshore Blocks in the Cypriot EEZ in 2021(Andreou, 2019b)

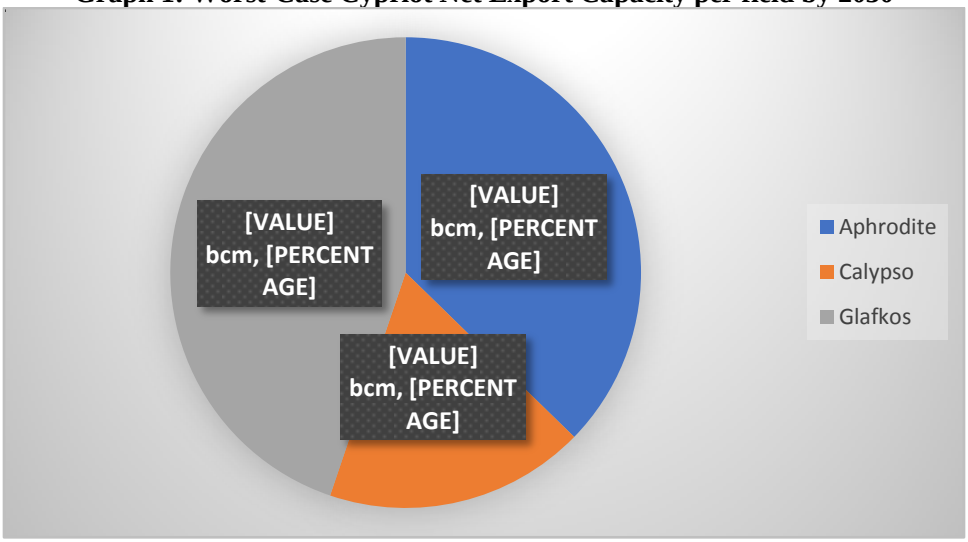


During the 2Q of 2020 Total/ENI planned for two new exploration wells in Blocks 6 (Cronos) and Block 7 (Calypso-2) that were interrupted by the pandemic restrictions and are rescheduled to take place with a delay of one year. In November 2018 Exxon commended drilling operations on its first of three targets in Block 10. It first well in Delphini completed in January 2019 was dry but the second target (Glafkos) which was drilled in February 2019 resulted in the RoC's second major discovery at a water depth of 2km (2063m). Glafkos' initial reserves estimate is between 5-8 TCF or (142-227 billion cubic meters) of *in situ* reserves (Exxon, 2019).In June 2020 Exxon planned to drill an appraisal well that would ascertain the field's size which has also been postponed due to COVID.

The Glafkos discovery is quite significant not only because it proves the hypothesis that Zhor-type fields exist inside the Cypriot EEZ thereby providing impetus for further exploration particularly in Blocks 6,7, 8, 9 and 10, but also because it can more than double the next export capacity of the RoC provided the appraisal well confirms even the lowest range estimate of circa 5 TCF (Henderson, 2019).The potential size of the field, its location, a mere 30km to the south of the Calypso discovery, and the unmatched technical and financial capability of Exxon, augur well for the field's prospective development that, if a viable export option such as the EastMed Gas Pipeline (EMGP) is found, can be monetized far quicker especially if compared to the continued "Odyssey" of Aphrodite's commercialization.

Despite the unavoidable delays in the continuation of the RoC's exploration program brought about as a result of the COVID-19 pandemic, the net export capacity of Cyprus remains notable although imperiled in the case of the Aphrodite field by excessive delays dating back to at least 2014 when the commercial viability of the field was declared. It would be challenging to make an accurate estimate of the size of the country's exportable gas volumes given the various uncertainties surrounding the development of the Aphrodite field which is still partially undefined in the absence of a second appraisal well. Since both Calypso and Glafkos have yet to be appraised, something that is expected to happen within 2021/2022, it would be more accurate to assess the net export capacity of Cyprus according to a worst-case and a best-case scenario. The worst-case scenario is based on the following three hypotheses: a) that the second appraisal drilling on Aphrodite fails, thereby ascertaining a *proven* reserve that is 50% less than the current reserves estimate. This would mean that the Aphrodite reserve drops from a 4,1 TCF to a 2,05 TCF (58,04 bcm) reserve, b) that the exploration drilling on the potential extension of Calypso to Block 7 fails, thereby making the field non-economically viable or limiting its size to around 1 TCF (28,3 bcm) and c) that the appraisal drilling on Glafkos also indicates a field that is half of its original estimate thereby limiting the field's *proven* reserves to 2,5 TCF (70,79 bcm).

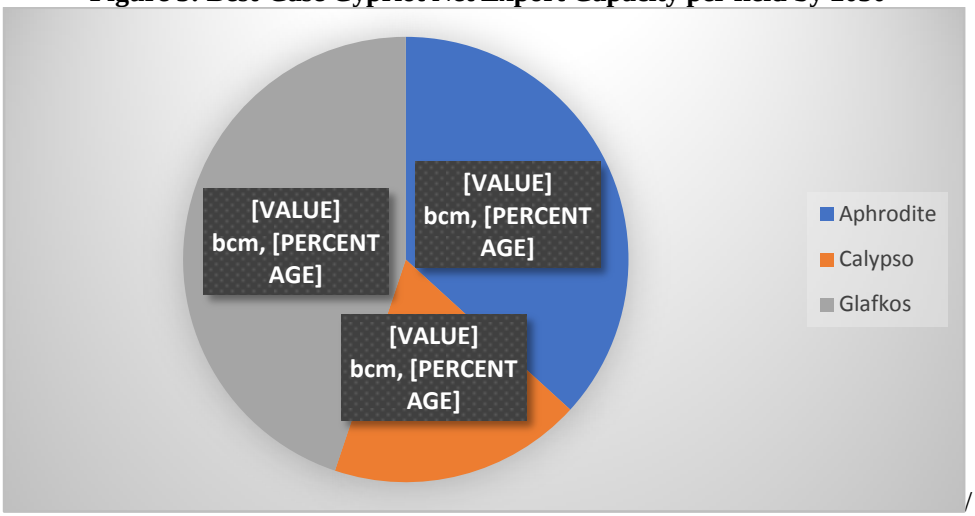
Graph 1: Worst-Case Cypriot Net Export Capacity per field by 2030



This worst-case scenario amounts to a cumulative export capacity of 5,55 TCF or 157,15bcm, which would not economically justify the development of an independent export infrastructure given the fact that the geographic distance between Aphrodite and Glafkos/Calypso does not economically justify the joined monetization of the two fields which are almost 400km apart. The best-case scenario for estimating the net export capacity of Cyprus is based on the following three hypotheses: a) that the 2022 second appraisal drilling in Aphrodite confirms as *proven* the existing estimate of 4,1 TCF, b) that the drilling of Eni/Total in Block 7 confirms at least a proven reserve equal to 50% of Aphrodite's size that is 2,05 TCF and c) that the appraisal drilling of Glafkos, which has been pushed forward by Exxon to 2022, (Stevenson, 2021) confirms even the lower end of its original estimate thereby ascertaining a field of 5 TCF.

This best-case scenario amounts to a cumulative export capacity of 11,15 TCF or 315,7 bcm. If, following the exploratory drilling in Block 7, Calypso is confirmed to be even a 2,05tcf field, then, given its proximity to Glafkos, a join monetization plan between the two fields may become the only viable way to make use of Calypso's export capacity. Such a joint monetization plan for Calypso and Glafkos is not illogical especially if the EMGP matures as an investment option over the next two-three years and slightly modifies its route in order to offer a viable monetization option to Total/ENI for Calypso and to Exxon/Qatar Petroleum for Glafkos.

Figure 3: Best-Case Cypriot Net Export Capacity per field by 2030



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According to the best-case scenario by the late 2020s the RoC can become a major exporter of both pipeline gas via the EastMed Gas Pipeline (EMGP) *and* a major exporter of LNG via Damietta or Idku in the order of 15,785 bcm/year over a 20-years period with Aphrodite's entire production capacity of 7 bcm/y going to Egyptian LNG facilities as envisioned in the Intergovernmental Agreement signed between Cyprus and Egypt in 2018. The remaining net exportable volumes or around 8,785 bcm/y from Calypso and Glafkos can either be committed to the EMGP, provided it is rerouted to cross through Block 10 of the Cypriot EEZ or -in case the EMGP fails- then the joined production of both fields can be dedicated in order to build a second Cypriot pipeline to the Egyptian gas grid.

3. Persistent Exportation Uncertainties and Alternative Options

As it has been already mentioned, the current Cypriot gas export strategy is founded around the exportation of Aphrodite's gas to Egypt via a dedicated underwater pipeline. Yet the path of "Aphrodite" to Egypt is not a path paved with roses. Even after the granting by the Cypriot government of the exploitation license for the develops of the field in November 2019, progress remains glacial and continues to be plagued by several uncertainties that may further delay its monetization or even render the field stranded for the following five reasons:

(i) A final *proven* reserve estimate for Aphrodite is still not available. Noble and Delek announced in November 2014 a 2P (50% probability) reserve estimate of 4,5 tcf by so notifying the Tel Aviv Stock Exchange (TASE). Former Cypriot Energy Minister George Lakkotryp is echoed Delek's TASE announcement during a public speech in Limassol on 7 November 2014. Yet the government of Cyprus did not announce its own final estimate of Aphrodite' proven reserves until November 2019 when it acknowledged that the reservoir is estimated at 4,1 TCF, (Cyprus News Agency, 2019a) with a 2P (50% probability) without still announcing its 1P (90% probability) estimates. The 2019 announcement was also almost 10% lower that the 2014 TASE estimate but no official explanation was given to explain this discrepancy.

In the case of a medium-small size field like Aphrodite, not knowing the 1P reserves will create uncertainties around the field's accurate estimate of exportable volumes something that will put into doubt its prospective monetization. Part of the reason why Nicosia mayhave been unable to publish its 1P estimate is the lack of a third drilling, named A-3, in the third geological compartment of the Aphrodite discovery which will provide an accurate estimate of the field's 1P reserves. According to the terms of the 2019 exploitation license the A-3 well should be drilled by May 2021 at the latest. As of March 2022, no date for the drilling of Aphrodite's second appraisal well has been announced which means that the contractual deadline has been lost. The final appreciation of Aphrodite's 1P reserves will also determine its eventual exportation route. If A-3 results in a dry hole, then Aphrodite will not be developed via an independent export pipeline. It will either become a minor supplement to the development and exportation of Leviathan's second phase of production or remain stranded.

(ii) although both the Egyptian-Cypriot Intergovernmental Agreement (IGA) of 2018 and Aphrodite's Field Development Plan approved in November 2019, recognize that Aphrodite's sole export destination is the Egyptian LNG facilities, there has been no tangible progress on the signing of a gas and sales purchasing agreement (GSPA) between the developers of Aphrodite and the operators of the Idku facility despite the fact that the largest shareholder of the Egyptian LNG facility is Shell, the same company which controls, as of November 2015 (Mainwaring, 2015)a 35% stake in the Aphrodite field. Despite persistent rumors about a "gentlemen's agreement" nothing has yet been signed or agreed upon.

Without a GSPA it is impossible for the developers of Aphrodite to take the Final Investment Decision (FID) there are supposed to take, according to the terms of their exploitation license by 2023 at the latest. If the 2023 deadline is missed due to the culpability of the license holder, then the government of Cyprus can theoretically even cancel the license and take over control of the development of the Aphrodite field.

Given the complexity of Aphrodite's compartmentalized reservoirs, the government and the license holder jointly estimated that from the date of the FID one would still need at least 36-42 months for first gas production, which may effectively move the expected beginning of monetization to 2026 or even latter. In June 2020Noble notified Nicosia that it was forced to "readjust", in other words to delay, the timetable of operations in Cyprus as a result of the financial impact of the pandemic on its investment spending program. In less than a month after Noble's notification to Nicosia, Chevron announced an agreement with Noble to buy the Texas-based oil/gas producer in a $13 billion takeover that was completed in October 2020 (Takahashi, 2020). The arrival of Chevron in the Eastern Mediterranean may be eventually beneficial for the RoC in the sense that Chevron has far larger financial capabilities than Noble, but in the short-term it is expected to cause further delays in the development of the field as Chevron is expected to go over a protracted period of internal review regarding the monetization of the various offshore assets it acquired from Noble in Cyprus and Israel.

(iii) another factor complicating the beginning of Aphrodite's production relates also to the absence of any tangible progress regarding the maturity of the offshore pipeline connecting the Aphrodite field with the Egyptian market which has been announced as the agreed-upon monetization option between the RoC and the license holder (Offshore Energy, 2019).So far, the talks between the RoC, the Egyptian government and companies engaged in the commercial side of a potential sale of Cypriot gas to Egypt appear to have been confined to estimating the cost of alternative export options with regards to the landfall point of the pipeline which is not defined in the IGA. On 31 July 2015, Enppi, the engineering subsidiary of the Egyptian national gas company (EGAS) completed a skeleton desk study of a pipeline that would connect Aphrodite with Idku that does not include either a Preliminary or a Detailed Marine Survey of the pipeline's potential route, which means that the estimated pipeline costs of $1-1,5 billion(Enterprise, 2019)may prove to be somewhat arbitrary when a detailed pre-FEED study on the project is eventually carried out.

Since the final ratification of the Cypriot-Egyptian IGA by both signatories in July 2019, there is still no detailed pre-FEED or FEED (Front End Engineering and Design) study completed yet, which would make it more challenging for the Aphrodite developers to take their FID when they do not have an accurate estimate of the cost of the pipeline. Who will pay for the pipeline is also not agreed on as part of the Aphrodite exploitation license. The paradox of Aphrodite's monetization lies in the fact that the complexity and the delays on its development persist, despite the fact that the sellersof Aphrodite's gas (Chevron, Shell, Delek) and its buyers(Shell, Egas) are almost identical with the potential pipeline developers (Chevron, Shell, Delek, Egas). Aphrodite is expected to produce first gas by 2026 starting with an initial output of 300 mmscfd (Phase 1) thereafter increasing to its maximum output of 800 mmscfd (Phase 2) at a total upstream cost of $3 billion for Phase 1 and an additional $2 billion for Phase 2, on condition, of course that the results of the A-3 well confirm a reserve estimate of 4,1 TCF (Cyprus News Agency, 2019b).

(iv) An additional factor of uncertainty that compounds the field's stagnation is the lack of an agreement with Israel over the potential joint monetization of the Aphrodite field which geologically partially extends into the Israeli EEZ. This in turn requires the prior signing of a Common Unitization Agreement with Tel Aviv that is long overdue with negotiations ongoing since 2012. Despite repeated statements by Cypriot officials that Nicosia will move forward with the monetization of the Aphrodite field regardless of whether a solution would be found on the issue, the reality is far more complex, since the Israeli government has the legal ability to demand arbitration procedures that can legally complicate or even block any progress on the field for years to come, practically stopping even the beginning of its development scheduled to start in 2023.Although there appears to be a significant level of confusion over the share of the Aphrodite field claimed by the Ishai developers, as Aphrodite is called in Israel, most estimates put the share of the volume under dispute to around 10% of the confirmed *in situ* reserve(Financial Mirror, 2021).

The size of the disputed reserve volume may not justify the level of the delay created as a result of the disagreement on how to resolve the dispute. The Cypriot government may have underestimated the resolve of the Israeli side to support the claims of the Ishai consortium, given Lebanese claims over the Alon Blocks regardless of the fact that there has been no gas discovery, as of yet, in the 854km^2 disputed maritime area that lies between Israel and Lebanon (Mizrahi& Oran, 2019). If Israel appeared to be making concessions to Cyprus over the division of future profits from a cross-border gas discovery this would have set a dangerous precedent for Israel if another cross-border field was discovered along its disputed maritime EEZ with Lebanon and the Palestinian Authority in Gaza.

In December 2019 Ehud Adiri, the Director General of the Israeli Energy Ministry sent a stern warning to the Cypriot government noting that "the State of Israel has not relinquished its share of the Aphrodite-Yishai natural gas reservoir and has no intention of doing so" while emphasizing that "that the development and exploitation of the Aphrodite-Yishai field by the licensees of both states must not commence prior to reaching an agreement between the governments of Israel and Cyprus" (Elliot, 2019).

Hopefully for the developers of the Aphrodite field after almost a decade since the beginning of the dispute in 2012 a recent agreement was reached between Tel Aviv and Nicosia on how to overcome the impasse over Aphrodite/Ishai that could lift one of the major impediments for the monetization of the field. On 10 March 2021 Israeli Energy Minister Yuval Steinitz and his Cypriot counterpart NatasaPilides decided to reach a compromise that according to Steinitz "will bring us closer to resolve the dispute over the Aphrodite-Yishai natural gas reservoir. My colleague Minister NatasaPilides and I have decided to give the energy companies on both sides a limited amount of time to negotiate the issue in order to reach an understanding that will bring an end to the ten-year dispute" (Government of Israel, 2021)

The agreement activates a 360-day deadline before the resolution of the dispute is reached via an intergovernmental agreement that will be imposed to both consortia holding exploration and exploitation rights over the Aphrodite and Ishai reservoirs. From 10 March 2021 and for a period of 180 days the two consortia will attempt to find a mutually agreed solution defining the share of Aphrodite's reservoir that indeed crosses into the Israeli EEZ and decide on the optimal method for compensating the Ishai license holders. If such an agreement is not reached, then an independent expert arbitrator that will try over a period of 180 days to bridge the differences between the two sides.

Any agreement jointly agreed by the two consortia either as a result of the expert's arbitration or as a result of their own volution will have to be ratified by the two governments. If the 360 days deadline passes, then Tel Aviv and Nicosia will decide the matter between them, although there is no deadline set in the March 2021 agreement on how quickly the two governments should reach their decision (Offshore Technology, 2021)It is clear though that, contrary to what was the position of the Cypriot government before 2021, an intergovernmental agreement with Israel is a precondition for the Aphrodite developers to take their FID and beginning even the development of the field which is scheduled to start in 2023.

(v) The potential resolution of the Ishai dispute though and the still pending A-3 appraisal well may be the most important challenges for the commercialization of Aphrodite's reserves from the ones mentioned above. Yet there is another unspoken challenge that relates to the commercial interests of Leviathan's developers, and in particular Chevron and Delek, who are also at the same time the principal shareholders (65%) of the Aphrodite consortium and who have treated Aphrodite as a sideshow to the monetization of the almost 18,89 TCF Leviathan field. Even if Aphrodite is confirmed as a 4,1 TCF field capable of producing a maximum net exportable volume of 7 bcm/y neither Chevron nor Delek are likely to prioritize its development over the development of Leviathan Phase 2 or build the $1-1,5 billion pipeline to the Egyptian natural gas system unless and until they first decide on how to best secure the exportation of Leviathan's second production phase that is expected to reach 9 bcm/y by 2025. This means that the FID on when to begin production and where to export the production of Leviathan Phase 2 will need to be taken from Chevron and Delek by 2023 at the latest.

For the Cypriot gas export strategy to be implemented as it stands, the 9 bcm/y of Leviathan's Phase 2 will have to be exported via the EMGP, not to Egypt, but to the markets of Italy and Southeastern Europe via Greece so that Chevron and Delek would decide to spend the 65% of the $5 billion necessary to produce Aphrodite's gas and part of $1-1,5 billion necessary to build the pipeline through which Cypriot gas would be exported to Egypt. Nevertheless, if Chevron and Delek decide to export Leviathan's Phase 2 to Egyptian liquefaction facilities via a new dedicated underwater pipeline from the Israeli field,as it was apparently discussed during the visit of Egyptian Petroleum Minister Tarek el-Molla to Jerusalem on 22 February 2021,(Times of Israel, 2021)then Chevron and Delek are highly unlikely to build two parallel pipelines, one for Leviathan and one for Aphrodite in order to reach the same market.

They are also highly unlikely to spend $5 billion to develop Aphrodite as an independent field despite the fact that it can be developed jointly with the second phase of Leviathan for the simple added reason that Aphrodite and Leviathan are only 20km apart. If Chevron and Delek decide to export Leviathan phase 2 to Egypt then the RoC would need to readjust its strategy so as to develop Aphrodite synchronically and jointly with Leviathan phase 2 and carry part of the financial load that would become necessary to construct one, not two, underwater pipelines in order for *both* Leviathan Phase 2 and Aphrodite to reach the Egyptian liquefaction facilities or join in the construction of the EMGP.

4. Conclusions

The decision of the Cypriot government in 2016 to disassociate the introduction of natural gas to the island's energy mix from the monetization of the Aphrodite reserve will ensure that by 2022 the Republic of Cyprus, one of Europe's largest natural gas reserves holders, will become a net gas importer.

This decision, although controversial, will have positive strategic ramifications for the EU's last isolated energy system, since it will enable the rapid replacement of the country's aging oil-fired electricity generation fleet with far more efficient natural gas fired units by 2025/2026. The rapid gasification of the country's electricity mix will significantly reduce one of the highest levelized cost of electricity generation in the EU, abate its GHGE, and allow for the expansion of the island's solar power PV generation to *at least* 30% of the country's installed generation capacity by 2030.

Despite increasing Turkish incursions in the demarcated Cypriot EEZ, which have frozen exploration efforts is some of the RoC's northern offshore blocks (Stevenson, 2020) the exploration program of the RoC is expected to continue in 2021/2022 in offshore blocks 6,7 and 10 where international oil companies have already made significant discoveries as well as in areas adjacent to the Egyptian and Israeli EEZ.The completion of exploratory/appraisal drillings in those areas is a precondition for a more accurate assessment of the net exportable capacity of the RoC, which will affect the feasibility of the country's existing export strategy as well as the fate of the EastMed Gas Pipeline. The expected drillings in offshore blocks 6,7, ad 10 may result in a worst case scenario that will leave the existing discoveries in Calypso and Glafkos stranded, unless they are linked to a rerouted EastMed Gas Pipeline export option.

In both scenarios analyzed above, the exportation of Cypriot gas to Egypt continues to face very serious challenges that may become insurmountable if the developers of the Leviathan gas field choose to export their second production phase of 9 bcm/yto Egyptian LNG facilities because that will displace Cypriot gas exports to these facilities which will be available *after* Leviathan Phase 2. In that case, even if Aphrodite's existing reserves estimate is finally confirmed by its second appraisal well that is expected in 2022, Aphrodite gas would be optimally developed from a commercial point of view under a joint monetization plan with Leviathan Phase 2 and through the same pipeline option, instead of being developed alone and being exported to Egypt through its own dedicated pipeline as it is currently planned by Nicosia.

Disclosure Statement

No conflict of interest

References

[1]S. Andoura, & D. Koranyi, *Energy in the Eastern Mediterranean: Promise of Peril?*,Egmont Institute, Academia Press, 2014, https://www.egmontinstitute.be/energy-in-the-eastern-mediterranean-promise-or-peril-2/

[2]A. Giannakopoulos, *Energy Cooperation and Security in the Eastern Mediterranean: A Seismic Shift towards Peace or Conflict?*, Tel Aviv University Press, 2016, https://dacenter.tau.ac.il/sites/abraham.tau.ac.il/files/Energy%20Cooperation%20and%20Security%20in%20the%20Eastern%20Mediterranean.pdf

[3]K.Taehwan. K., & S.S. Yoon, "Competition or Cooperation? The geopolitics of gas discovery in the Eastern Mediterranean Sea, *Energy Research & Social Science*, 74 (2021), 1-7, https://doi.org/10.1016/j.erss.2021.101983

[4]A.Stergiou, & M. Karagianni, *Does Energy Cause Ethnic War?: Eastern Mediterranean and Caspian Sea Natural Gas and Regional Conflicts*, Cambridge Scholars Publishing, 2019, 52-114

[5]A.Thrassou, D. Vrontis, T. Tsakiris, and C. Hadjistassou, "The Cyprus Oil & Gas Industry's Indirect Business Effects: A predictive real-time analysis", *Journal of Transnational Management*, 2021,(21), (3), 115-141, https://doi.org/10.1080/15475778.2016.1192915

[6]C.Taliotis, H. Rogner, S. Ressl, S., M. Howells, F. Gardumi, F. (2017), "Natural gas in Cyprus: The need for consolidated planning", *Energy Policy*, 107, 197–209, https://doi.org/10.1016/j.enpol.2017.04.047

[7]S. el-Wardany, S. & M. Magdy, "Israel and Egypt discuss natural gas pipeline link, *Bloomberg*, 22/02/2021, https://www.worldoil.com/news/2021/2/20/israel-and-egypt-discuss-natural-gas-pipeline-link

[8]Tsangas, M., Zorpas, A., Jeguirim, M, Limousy, L. (2018), "Cyprus Energy Resources and their potential to increase sustainability", *The 9th International Renewable Energy Congress (IREC 2018)*, pp.1-7, https://doi.org/10.1109/IREC.2018.8362480

[9]S.Mirasgedis, Y. Sarafidis, E. Georgopoulou, D.P. Lalas, C. Papastavros, (2004), "Mitigation policies for energy related greenhouse gas emissions in Cyprus: the potential role of natural gas imports", *Energy Policy*, 32, 1001–1011, https://doi.org/10.1016/S0301-4215(03)00048

[10]Republic of Cyprus, Ministry of Energy, Commerce and Industry, Cyprus' Integrated National Energy & Climate Plan, (NECP) 2020, 196-198, https://meci.gov.cy/en/useful-information/strategic-planning/cyprus-integrated-national-energy-and-climate-plan-for-the-period-2021-2030

[11]T.Zachariadis, & A. Poullikkas, (2012), "The costs of power outages: A case study from Cyprus", *Energy Policy* (51), 630–641, https://doi.org/10.1016/j.enpol.2012.09.015
[12]F. Mullen, "How much did the Mari Explosion Cost", *Financial Mirror,* August 19 (2013),https://www.financialmirror.com/2013/08/19/how-much-did-the-mari-explosion-cost/
[13]T.Zachariadis, "Energy Policy in Cyprus Outlook and Major Challenges", Cyprus Economic Policy Review, 2007, (1), 27-48, https://ucy.ac.cy/erc/documents/Zachariadis_vol1_no1_jun2007.pdf
[14]Republic of Cyprus, Cyprus Energy Regulatory Authority, *2018 Annual Review*, Nicosia, 2018, 47, https://tsoc.org.cy/files/ reports/annual-reports/CERA_Annual_Report_2018_gr.pdf#page=112
[15]Republic of Cyprus, Transmission System Operator of Cyprus, 2020, https://tsoc.org.cy/files/electrical-system/energy-generation records/renewable/RES_PENETRATION _2020_GR.pdf
[16]Republic of Cyprus, Cyprus Energy Regulatory Authority, *2019 Annual Review*, 2019, 58, https://tsoc.org.cy/files/ reports/annual-reports/CERA_Annual_Report_2019_gr.pdf#page=112
[17]E. Andreou, "Private power plant marks 'new era for energy sector", *Cyprus Mail*, February 16 (2019), https://cyprus-mail.com/2019/02/16/private-power-plant-marks-new-era-for-energy-sector/amp.
[18]Cyprus Energy Regulatory Authority, *2019 Annual Review,* 58-59
[19]Republic of Cyprus, National Energy and Climate Plan, 2020, 58
[20]C.Manolis, "PEC advances, EAC not yet", *Energypress,* March 7 (2021), https://energypress.gr/news/i-pec-prohorei-i-aik-akoma,
[21]Cyprus Energy Regulatory Authority, 2019 Annual Review, 55-56.
[22]Cyprus Energy Regulatory Authority, 2018 Annual Review, 50-51
[23]European Bank for Reconstruction and Development (EBRD), Cyprus: Cyprus FSRU, 2020, 18, https://www.ebrd.com/work-with-us/projects/psd/50634.html
[24]Republic of Cyprus, National Energy and Climate Plan, 2020, 58
[25]Republic of Cyprus, National Energy and Climate Plan, 2020, 55-58
[26]Cyprus Energy Regulatory Authority, 2019 Annual Review, 59
[27]C. Kolonas, "Cyprus today opens the gates to natural gas: interview of DEFA President and CEO Symeon Kassianides", *Euro2day*, July 9 (2020), https://www.euro2day.gr/specials/interviews/article/2032011/h-kypros-anoigei-shmera-tis-pyles-ths-sto-fysiko-a.html, (accessed 15/03/2021)
[28]Republic of Cyprus, National Energy and Climate Plan, 2020, 25
[29]Republic of Cyprus, National Energy and Climate Plan, 2020, 58
[30]Xinhua, "Cyprus, Chinese-led consortium sign contract for LNG terminal", *Xinhua,* December 13 (2019), http://www.xinhuanet.com/english/2019-12/14/c_138629509.htm
[31]Cyprus Energy Regulatory Authority, 2019 Annual Review, 64-65
[32]Republic of Cyprus, National Energy and Climate Plan, 2020, 143
[33]Cyprus Energy Regulatory Authority, 2019 Annual Review, 63-64
[34]Xinhua, "Cyprus, Chinese-led consortium sign contract for LNG terminal", *Xinhua,* December 13 (2019), http://www.xinhuanet.com/english/2019-12/14/c_138629509.htm
[35]European Bank for Reconstruction and Development (EBRD), Cyprus: Cyprus FSRU, 2020, 25-26, https://www.ebrd.com/work-with-us/projects/psd/50634.html
[36]G. Agapiou, "Cyprus gets EBRD and EU financing for natural gas", *Cyprus Mail,* August 3 (2020), https://cyprus-mail.com/2020/08/03/cyprus-gets-ebrd-and-eu-financing-for-natural-gas/
[37]European Bank for Reconstruction and Development (EBRD), Cyprus: Cyprus FSRU, 2020, 8, https://www.ebrd.com/work-with-us/projects/psd/50634.html
[38]Ibid
[39]C.Kolonas, op.cit.
[40]Financial Mirror, "Cyprus one step closer to importing LNG", *Financial Mirror*, December 22 (2020), https://www.financialmirror.com/2020/12/22/cyprus-one-step-closer-to-importing-lng
[41]C. Taliotis, M. de Boncourt, K. Keramidas, "East-Mediterranean Gas potential: Opportunities and Barriers", *Insight_E*, 2015, https://www.doi.org/10.5281/zenodo.32019, https://www.researchgate.net/publication/282768094_EastMediterranean_Gas_potential_Opportunities_and_Barriers

[42]Ç. Erciyes, Maritime Delimitation & Offshore Activities in the Eastern Mediterranean: Legal and Political Perspectives, paper presented at the TUROGE (Turkish Oil & Gas Exhibition) 2012, Ankara, March 21 (2012), http://www.mfa.gov.tr/site_media/html/maritime_delimitation.pdf

[43]S. Karbuz, Key Challenges Facing the Eastern Mediterranean: The Future of Regional Energy Development", Turkish Insight, (2021), 23(1), 115-138, https://www.doi.org/10.25253/99.2021231.9, https://www.insightturkey.com/article/key-challenges-facing-the-eastern-mediterranean-the-future-of-regional-energy-development

[44]T. Tsakiris, "The Importance of East Mediterranean Gas for EU Energy Security: The Role of Cyprus, Israel and Egypt", *Cyprus Review*, 2018, 30(1), 25-50, https://cyprusreview.org/index.php/cr/article/view/535

[45]Stergiou&Karagianni, 113-114

[46]C. Adamides& O. Christou, "Can Resolving the Cyprus [Question] hold the key to regional energy cooperation?", *Turkish Policy Quarterly*, 2016, 15 (2), 85-94, http://turkishpolicy.com/article/815/can-resolving-cyprus-hold-the-key-to-regional-energy-cooperation

[47]T.Tsakiris, "Cyprus's natural gas strategy: Geopolitical and economic preconditions", Mediterranean Quarterly, 2017, 28 (1), 29-57, https://doi.org/10.1215/10474552-3882786

[48]M.Kambas, "Standoff in high seas as Cyprus says Turkey blocks gas drill ship", Reuters, February 11 (2018), https://www.reuters.com/article/us-cyprus-natgas-turkey-ship-idUSKBN1FV0X5

[49]M.Kambas, "Cyprus gas search spurred on by Egypt find, says Cypriot minister", Reuters, May 12 (2017), https://www.reuters.com/article/us-cyprus-energy-minister-idUSKBN1881XC

[50]ENI, "Eni announces a gas discovery Offshore Cyprus", ENI, February 8 (2018), https://www.eni.com/en-IT/media/press-release/2018/02/eni-announces-a-gas-discovery-offshore-cyprus.html

[51]E. Andreou, "Dispute with Israel will not affect development of Aphrodite, minister says", *Cyprus Mail*, December 09 (2019), https://cyprus-mail.com/2019/12/09/dispute-with-israel-will-not-affect-development-of-aphrodite-minister-says/

[52]Exxon, "ExxonMobil makes natural gas discovery offshore Cyprus", Exxon, February 28 (2019), https://corporate.exxonmobil.com/News/Newsroom/News-releases/2019/0228_ExxonMobil-makes-natural-gas-discovery-offshore-Cyprus

[53]S. Henderson, "Cyprus Gas Discovery Could Be an East Mediterranean Game-Changer", Washington Institute for Near Eastern Policy, March 1 (2019), https://www.washingtoninstitute.org/policy-analysis/cyprus-gas-discovery-could-be-east-mediterranean-game-changer

[54]P. Stevenson, "Exxon Plans 2021 East Med Drilling", *Middle East Economic Survey*, April 2 (2021), https://www.mees.com/2021/4/2/oil-gas/exxon-plans-2021-east-med-drilling/d78e0e80-93ae-11eb-beab-a70e509a7569

[55]Cyprus News Agency, "Cyprus signs deal for offshore gas concession", *Kathimerini*, November 8 (2019), https://knews.kathimerini.com.cy/en/%20news/cyprus-grants-first-natural-gas-exploitation-license

[56]J. Mainwaring, "BG Group Buys a 35% Stake in Cyprus's Aphrodite Gas Field", *Rigzone*, November 23 (2015), https://www.rigzone.com/news/oil_gas/a/141752/bg_group_buys_a_35_stake_in_cypruss_aphrodite_gas_field/

[57]P. Takahashi, "Chevron completes $13B acquisition of Noble Energy", *Houston Chronicle*, October 5 (2020), https://www.houstonchronicle.com/business/energy/article/Chevron-13-billion-acquisition-Noble-Houston-Texas-15621496.php

[58]Offshore Energy, "Cyprus OKs Aphrodite development plan. Grants exploitation license", *Offshore Energy*, November 7 (2019), https://www.offshore-energy.biz/cyprus-oks-aphrodite-development-plan-grants-exploitation-license/

[59]Enterprise, "Egypt, Cyprus sign agreement on USD 1 bn gas pipeline", *Enterprise*, September 20 (2018),https://enterprise.press/stories/2018/09/20/egypt-cyprus-sign-agreement-on-usd-1-bn-gas-pipeline/

[60]Cyprus News Agency, "Cyprus signs deal for offshore gas concession", *Kathimerini*, November 8 (2019), https://knews.kathimerini.com.cy/en/%20news/cyprus-grants-first-natural-gas-exploitation-license

[61]Financial Mirror, "Cyprus, Israel agree on formula to end Aphrodite dispute", *Financial Mirror*, March 09 (2021), https://www.financialmirror.com/2021/03/09/cyprus-israel-agree-on-formula-over-aphrodite-dispute/

[62]Orna Mizrahi and Oded Eran, The Negotiations between Israel and Lebanon on the Maritime Border, *Institute for National Security Studies,* (2019), http://www.jstor.com/stable/resrep19479

[63]S. Elliot, "Cyprus gas field project still on despite Israeli claim: minister", *S&P Global Platts,* December 10 (2019), https://www.spglobal.com/platts/en/market-insights/latest-news/natural-gas/121019-cyprus-gas-field-project-still-on-despite-israeli-claim-minister

[64]Government of Israel, Ministry of Energy, "Minister Steinitz and his Cypriot counterpart reach agreement on the Aphrodite-Yishai's dispute", Press Release, March 10 (2021), Minister Steinitz and his Cypriot counterpart reach agreement on the Aphrodite-Yishai's dispute | Ministry of Energy (www.gov.il)

[65]Offshore Technology, "Israel and Cyprus agree to resolve dispute over Aphrodite gas field*", Offshore Technology*, March 10 (2021), https://www.offshore-technology.com/news/israel-cyprus-framework-aphrodite-field/

[66]Times of Israel (2021), "Israel to build new natural gas pipeline from its offshore rig direct to Egypt", *Times of Israel*, February 22 (2021), https://www.timesofisrael.com/israel-to-build-new-natural-gas-pipeline-from-its-offshore-rig-direct-to-egypt/

[67]P. Stevenson, "Can Cyprus Reboot Offshore Drilling Plans?" *Middle East Economic Survey*, December 24, (2020),https://www.mees.com/2020/12/24/oil-gas/can-cyprus-reboot-offshore-drilling-plans/377ebcd0-45e5-11eb-8e7a-dbb9b14889f9