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Virtual Pipeline: The key enabler of Natural Gas penetration in off-grid areas

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I hereby declare that the work submitted is mine and that where I have made use of another's work, I have attributed the source(s) according to the Regulations set in the Student's Handbook.

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Abstract

The aim of this dissertation is to go through the Virtual Gas Pipeline activity as the key enabler for the penetration of Natural Gas, even in the most remote off-grid areas. The first topic under examination will be the scope of utilizing the Virtual Pipeline and the various cases resulting in its attractive, feasible, and cost-efficient implementation for the supply of End Consumers located in remote areas that are not physically connected with the Natural Gas Distribution Network, compared to the construction of a physical Natural Gas pipeline (medium or low pressure).

One of the main topics of this work will be the detailed analysis of the Regulatory framework that governs the activity of the Virtual Pipeline in our country. The decisions of the Regulatory Authority that determine the operation of the Virtual Pipelines, the duration of validity, the rights and obligations of the involved parties (Operators, contractors, tenders, maximum price), and the Regulator's intervention will be presented. The management of the respective costs and their recovery will be thoroughly analyzed in accordance with the provisions of the Natural Gas Distribution Network Tariff Regulation (operating costs, regulated revenue) and the impact of their socialization (i.e., equal allocation to the end consumer base), to the final charges will also be examined.

In the same context, alternative ways to utilize the respective equipment will also be addressed, for the assurance of uninterrupted supply of the Network, that constitutes one of the major obligations of the DSO, both in accordance with the applicable Regulatory Framework (Natural Gas Distribution Network Operation Code) and the Energy Law in general.

Furthermore, a technically oriented introduction, regarding the various technologies used for transportation in the context of the Virtual Pipeline, such as compressed and liquefied Natural Gas, equipment utilization, mechanisms involved, and the operation of the Virtual Pipeline in general, is going to be presented. Moreover, the inclusion of projects in the Development Programs of domestic DSOs, for the supply of certain areas throughout the Country utilizing Virtual Pipelines, will be presented. The major topic that will be analyzed in this section is the technology expected to be used in each case (area).

Concluding, the activity of the Virtual Pipeline from the point of view of European Energy Law will be analyzed in accordance with the respective gas directive and gas regulation included in the 3rd energy package. An effort will be made to clarify the provisions and the legislators' recital as of the inclusion of this activity in the respective legislation. In the same context, the "nature" of the Virtual Pipeline activity from the point of view of competition policy, whether as a monopolistic or competitive activity, will be examined, and issues such as ensuring transparency and impartiality,

equal third-party access in the Network, equal treatment of users, eligibility, and protection of end consumers from abusive practices will be considered.

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Introduction

According to the provisions of national and European law, the activity of Natural Gas Distribution¹ is exercised under a regulated regime, with legal and functional unbundling², from any energy activity of Transmission, Production, and Supply of Natural Gas. In this context, these energy activities and the return received by the Gas Distribution System Operators³ for the provision of their services are regulated, i.e., they are provided for by the Regulatory framework and monitored by the Energy Regulatory Authority (RAE)⁴.

From the first moment of the arrival of Natural Gas in Greece and the supply of the first big cities, End consumers' ⁵ file requests for the connection to the Natural Gas Distribution Network and supply of areas⁶ that are far (long distance) from the active Distribution Network. The feasibility study for the supply of these areas has to take into account techno-economic criteria, while ensuring a fair return on investments but also reasonable distribution charges to the End consumers. As connecting these remote areas usually requires the construction of a 19-bar medium pressure steel gas pipeline (high capital expenses), Natural Gas DSOs have begun to consider alternatives to supply those areas by developing remote Networks.⁷

According to European best practices, the initial supply of these areas with compressed or liquefied Natural Gas (CNG/LNG)⁸ is considered, and when Natural Gas penetration is achieved and the connection becomes cost-efficient, a remote area can be connected by expanding the physical Network.

The main concept of this activity lies on a multidimensional process where quantities of Natural Gas are extracted from an existing Network, then compressed to 200 bar (CNG) or liquefied at -160 degrees of Celsius (LNG) and transported through the road Network by trucks and trailers in high-pressure cylinders or by the sea with special vessels equipped with suitable tanks to keep the fuel in its liquid form. In the final stage, the compressed / liquefied Natural Gas is decompressed / re-gasified in decompression or regasification facilities, after which a Natural Gas transmission or distribution network is developed to supply the End Consumers.

1 See Art. 2 par. 5 of Directive 2009/73/EC and Art. 2 par. 2 of Law 4001/2011

2 See Art. 26 par. 1,2,3 Directive 2009/73/EC and Art. 80 par. 5 of Law 4001/2011

3 See Art. 2 par. 6 of Directive 2009/73/EC and Art. 2 par. 1 of Law 4001/2011

4 See Art. 3 of Law 4001/2011

5 See Art. 2 par. 1 subpar. (ist) of Law 4001/2011

6 See Art. 2 par. 2. of Law 4001/2011

⁷ See Miguel Edgar Morales Udaeta, Jonathas Luiz de Oliveira Bernal, Luiz Claudio Ribeiro Galvão and José Aquiles Baesso Grimoni, Natural Gas Virtual-Pipeline for Alternative Energy Distribution, 2012

⁸ See Xiuli Wang, Michael Economides, Advanced Natural Gas Engineering 1st Edition, September 1, 2009

As the construction of a Natural Gas Distribution Network presupposes economic sustainability and efficiency, if these conditions for the interconnection of remote areas with a physical pipeline are not met, the development of remote Distribution Networks is able, under certain conditions, to meet the demand for a transitional period in these areas, until the expansion of the physical Network is feasible.

In other words, the Virtual Pipeline replaces the Natural Gas physical pipelines, where the expansion of the physical Network would disproportionately burden the Distribution Network usage tariff⁹, due to the initially low distributed quantities of Natural Gas, compared to the high cost of the investment. ¹⁰Thus, it became necessary to establish the respective framework with the aim of:

- Supplying remote areas and meeting the consumers' demand
- Increasing the penetration of Natural Gas
- Ensuring reasonable distribution tariffs

Until 2018, there was no regulation in Greek legislation on the supply of remote Networks. Until the establishment of the framework, CNG activity existed only at a theoretical level, under the previous monopoly regime of the gas market (vertically integrated undertakings¹¹). The respective Regulatory framework was established in 2018 for a 3-year period. The Ministry of the Environment and Energy set up a competent Technical Committee, with the participation of Natural Gas Operators for the preparation of a Draft Technical Regulation for Compressed Natural Gas Decompression Installations. After the completion of public consultation held by the Ministry and the European Commission, the *“Technical Regulation of Compressed Natural Gas Decompression Installations and Auxiliary Devices”* (OGG 1809/B'/21.05.2018) was issued. In addition, following a relevant suggestion of the Operators and the related public consultation, the RAE issued the Decision 643 / 02.08.2018 (OGG 3334/B'/10.08.2018) on the *“Framework for the Development of Remote Natural Gas using Compressed/ Liquefied Natural Gas”*.

⁹ See Art. 88 par. 4 of Law 4001/2011

¹⁰See *Th. Panagos*, Virtual Gas Pipeline: New Challenges in the Gas Regulatory Framework, *Journal Business Law*, 2020

¹¹See Art. 2 par. 2 sub. par. ie of Law 4001/2011

CHAPTER I

A. RAE Decision 643 / 2018 – Framework for the development of Remote Networks using Compressed / Liquefied Natural Gas

RAE Decision 643/2018 formulates, for the first time, the Regulatory framework for the supply of remote areas with Compressed Natural Gas. The decision provided for three separate cases:

- The development of CNG Virtual Pipeline in a Licensed geographical area, ¹²where a developed Natural Gas Distribution Network already exists and where the Remote Network is understood as a virtual extension of the existing Network. The boundaries of the geographical area concern areas (Distribution Networks), as described in the decisions approving the Distribution Tariffs (same Regulated Asset Base¹³).
- Supply of Natural Gas in geographical regions where there is no existing Distribution Network, and thus, the development of a Virtual Pipeline is out of the question. Therefore, the Operator has the obligation to ensure equal access of the Distribution Users to the decompressor.
- The direct supply to an individual consumer.

The recital of RAE's decision highlights exactly the importance of the development of remote Networks. According to the Natural Gas Distribution Network Operation Code, the Operator is obliged to develop the Network in the geographical Areas of its License based on a 5-year development plan, ¹⁴ which is updated annually and is implemented upon Regulatory approval. For the purpose of the Development Program drafting, the DSO calculates the impact of each of the planned Network expansion projects on the average distribution charge for the use of the Natural Gas Distribution Network, during the evaluation period of the projects.¹⁵ This charge is proportional to the cost of capital investment for the construction of the new project and conversely proportional to the projected consumption of Natural Gas from the new consumer connections that will emerge. In this context, the economic efficiency depends both on the distance of the Network (as longer extensions presuppose higher investment costs) that will be constructed from the existing Network in conjunction with

¹² See Art. 2 par. 27 of the Natural Gas Distribution Network Operation Code (OGG B' 3726/12.08.2021)

¹³ See Art. 5 of the Natural Gas Distribution Network Tariff Regulation (OGG B' 3727/12.08.2021)

¹⁴ See Art. 80 par. 10 of the Law 4001/2011

¹⁵ See Art. 12 of the Natural Gas Distribution Network Tariff Regulation (OGG B '3727 / 12.08.2021)

the number of new connections, the consumer category of each connection, and the forecasted gas demand per consumer category¹⁶.

In order to maximize the penetration in the population and to allow more consumers to switch to the use of Natural Gas, the Regulatory Authority for Energy considered that the DSO could consider the construction of a remote (non-interconnected) Network for the connection of areas, even in cases where the direct connection with the physical pipeline is not technically possible or is, temporarily, economically unfeasible. Without this feature, the Operator would deny access to the Distribution Network on the grounds of lack of capacity (according to the Natural Gas Distribution Network Operation Code) for the consumers in the remote off-grid area, and these consumers would have to wait until the Distribution Network was expanded sufficiently, so that the implementation of the project for their connection would become cost-effective. In this context, the Authority provided that the Operator can propose the development of remote Networks that will be supplied with compressed or liquefied Natural Gas through CNG decompression or LNG regasification facilities. After that, the remote Distribution Network is developed for the supply of more than a single delivery point¹⁷. The Operators' proposal for the inclusion of remote Distribution Networks in the 5-year development plans is accompanied by a cost-benefit analysis for the deployment of these Networks, demonstrating that the implementation of the virtual Network is more cost-efficient than the connection with a physical pipeline.

According to the provisions of the Natural Gas Distribution Network Operation Code, the CNG decompression or LNG regasification facilities are considered part of the Natural Gas Infrastructure (owned by the DSO), while the decompression or regasification activities are included in the Basic Distribution Activity of the Operator. The rest of the activities (compression, transportation of CNG/LNG with means) are not part of the Basic Distribution Activity, and their performance does not require a license for energy activity in accordance with the Natural Gas Licensing Regulation. Thus, these competitive activities are carried out by independent legal entities (third parties) on the basis of an open tender for the provision of the compression and transportation services to the DSO. However, RAE has still sufficient regulatory intervention, as the terms and conditions of the tender, ¹⁸as well as the maximum price per kWh or per km¹⁹, are subject to Regulatory approval and are determined by a decision of the RAE, upon the proposal of the DSO.

¹⁶See Art.14 of the Natural Gas Distribution Network Tariff Regulation (OGG B '3727 / 12.08.2021)

¹⁷See Art. 9 par 4,5,6 of the of the Natural Gas Distribution Network Operation Code (OGG B '3726/12.08.2021)

¹⁸See RAE Decision 822/2018 (OGG B' 4298/27.09.2018), the terms and criteria of the tender for the CNG Virtual Pipeline Services were approved.

¹⁹See RAE Decision 821/2018 (OGG B' 4298/27.09.2018), the maximum price per kWh for the Compressed Natural Gas Virtual Pipeline service for the year 2018

A1. Virtual Gas Pipeline – Development of Remote Networks in areas with an existing Natural Gas Distribution Network

The supply of remote Networks via Virtual Pipeline can be carried out exclusively in geographical areas where an interconnected²⁰ Network already exists. In this context, the Virtual Pipeline is considered as the virtual continuation of the Natural Gas Distribution Network (connecting the existing Network with the remote Network), and as such, its operation is under the responsibility of the DSO. In the case of Virtual Pipeline, similarly to the physical Network, the DSO has the possession but not the ownership of the Natural Gas²¹ during the distribution procedure.

As a virtual continuation of the Natural Gas Distribution Network, the CNG decompression or LNG regasification facilities do not constitute an Entry Point ²²of a Natural Gas Distribution Network, based on the definition provided by the Natural Gas Distribution Network Operation Code. On the contrary, as mentioned above, they are considered as part of the existing Network operated by the competent DSO in its Licensed Area. In the same context, the compression facilities (although they are managed by a third party) -when used to compress Natural Gas for the provision of the Virtual Pipeline services- , are not considered as Delivery Points as defined in the respective Code. The Natural Gas quantity that exits the Network is measured in the Compressor, solely to serve the Virtual Pipeline service and not to directly supply a delivery point (End Consumer), while its transportation to the decompression station simulates the route it would follow in case it was distributed through a Natural pipeline. In this way, in order to serve a delivery point located in a remote Network, Distribution Users ²³(Retail Market Supply Companies) only need to deliver the quantities of Natural Gas that will be consumed by the delivery points in their register, at an Entry point of the existing interconnected Distribution Network, in accordance with the usual practice for Delivery Points connected to the existing active Physical Network.

The Regulator's provision for integration of the Virtual Pipeline Operation in the Basic Activity of the DSO is in line with the DSO's general obligations, i.e., to ensure equal and non-discriminatory access of Distribution Users to the Natural Gas Distribution Network and the eligibility of the End Consumers²⁴. In addition to transparency and impartiality, the DSO as an entity (by nature) can and must ensure the Security of Supply, the safe, smooth, and uninterrupted operation of the Natural Gas Distribution Network²⁵, the continuous flow and appropriate measurements of the

²⁰ See Art. 2 par. 8 of the of the Natural Gas Distribution Network Operation Code (OGG B '3726/12.08.2021)

²¹ See Art. 10 of the of the Natural Gas Distribution Network Operation Code (OGG B '3726/12.08.2021)

²² See Art. 9 par 1,2,3 of the of the Natural Gas Distribution Network Operation Code (OGG B '3726/12.08.2021)

²³ See Art. 2 par 36 of the of the Natural Gas Distribution Network Operation Code (OGG B '3726/12.08.2021)

²⁴ See Art. 82 of Law 4001/2011 as amended by art.5 of Law 4336/2015

²⁵ See Art. 60 of the of the Natural Gas Distribution Network Operation Code (OGG B '3726/12.08.2021)

circulated quantities, and the quality standards ²⁶of the Natural Gas injected into the Remote Networks (with the same properties of that of the interconnected Network). The uninterrupted supply of the decompression facilities is ensured by monitoring the delivery of the quantities of Natural Gas consumed in the remote Networks. The DSO prepares daily, weekly, and monthly gas demand forecasts for each remote Network. For the preparation of forecasts, historical data on the evolution of the number of consumers, and assumptions about the consumption also based on the weather characteristics and climate effect (temperature), are taken into account.

With regards to the uninterrupted supply of the remote Network, the RAE may impose additional conditions on the DSO to enhance the Security of Supply in remote areas, such as the construction of a second decompression station (to provide an alternative / adequate route of supply) or the installation of a redundancy power generator for the continuous operation of the decompressor in case of emergency incidents. Moreover, the DSO is obliged to monitor, record, and report to the RAE, any losses of Natural Gas during the procedure of compression – transportation and decompression.

A2. Supply of Remote Networks in areas where there is no Natural Gas - Direct Access to the decompressor

In case the DSO wishes to supply a remote Network in a geographical area of its License, where there is no interconnected Network in its possession (no RAB established), it can propose the supply with direct access of the Network Users (Supply Companies) to the decompression or regasification facilities. In this case, the compression and transportation services do not fall under the responsibility of the Operator. The Network Users are in charge of performing those activities and delivering the quantities of Natural Gas (needed for the consumers' demand-response) to the remote Network.

However, to ensure functionality, the DSO must propose, and the Regulator has to approve or provide clear and transparent rules for equal and non-discriminatory access of the Distribution Users (Supply Companies) to the decompression or regasification stations. Especially for CNG supply, it is common practice (for technical and spatial reasons) to connect one truck at a time to supply the remote Network. Without those rules (unloading time window), it will be practically impossible to determine the order of priority, based on which users will proceed to delivering the quantities of Natural Gas to the decompression station. Additionally, as the DSO is not in charge of the process of compression and transportation, it still has to take actions to safeguard the quality specifications of the Natural Gas injected in the remote Network

²⁶See Chapter 8 of the of the Natural Gas Distribution Network Operation Code (OGG B '3726/12.08.2021)

as well as the Security of Supply to the End consumers. This can be done by developing emergency storage facilities (extra costs for equipment) in the decompression or regasification station, to facilitate the whole process of delivery – decompression and injection in the Network, but the procedure entails extra costs for the DSO.

This method does not help to differentiate the market, as only the Distribution Users who have access to compression and transportation means will be able to delivery natural gas to the decompressor and thus, to practically gain access to the delivery points of the remote Network.

A3. Supply of Individual and Industrial End Consumers with CNG

The framework in question also provided for the supply of Natural Gas to a non-interconnected (individual) delivery point. The case of compression and transportation of Natural Gas for its delivery to an individual End Consumer is not subject to the Distribution activity, and it does not fall in the scope of the responsibilities of the Natural Gas Distribution Network Operators. On the contrary, it is a competitive activity in its entirety, and it can be exercised exclusively by legal entities that are holders of a Gas Supply License (suppliers) in accordance with the provisions of the Natural Gas Supply Code (OGG B' 1969/1.6.2018), the Natural Gas Licensing Regulation (OGG B' 3430/17.8.2018) and the Law 4001/2011 as amended and in force.

To date, the supply of individual or industrial end consumers has not been widely developed in Greece, despite the fact that many interested energy-consuming Industrial Consumers could benefit from its implementation.

B. RAE Decision 633/2021 – Amendment of RAE decision 643/2018 – Provision for Virtual Interconnection

With the RAE Decision 633/2021 (OGG B' 4271/16.09.2021), the RAE Decision 643/2018 *“Framework for the Development of Remote Natural Gas using Compressed / Liquefied Natural Gas”* was amended and the validity of the framework was extended until the end of the year 2022.

With this amendment, the Regulatory Authority - taking into account the growing tendency of the DSOs to include in their Development Programs, proposals for the construction of remote Networks in their Licensed Areas, and to facilitate the increase of Natural Gas penetration throughout the country - envisaged an additional way of supplying remote Networks, the so called *“virtual interconnection”*.

We should highlight that in the case of Virtual Pipeline, the compression procedure should take place in a Compressor connected to an existing Natural Gas

Distribution Network, which is located in the same geographical area (same RAB) as the downstream remote Network. The virtual interconnection is similar to the Virtual Pipeline but allows a remote Distribution Network to be supplied with Natural Gas that was compressed from another Network (Transmission, Distribution or LNG truck loading). As in the case of Virtual Pipeline, the activity falls within the scope of the responsibility of the DSO, that is obliged to ensure the cost-effectiveness of the project, equal access and treatment of Users and End Consumers, and Security of Supply to the Remote Network. Compression and transportation services are provided to the DSO of the Downstream Remote Network by a 3rd party legal entity on the basis of an open tender, the terms of which as well as the maximum price per kWh and per kilometer are introduced by the DSO and are subject to Regulatory Approval.

However, as the whole process involves two completely separate Networks, it deviates from that of the Virtual Pipeline. As the gas is compressed in an upstream Network to be transported to a remote Distribution Network located on a different geographical area (different RAB) (on behalf of Network users), the compression point is considered as a delivery point (from the point of view of the Upstream DSO), similarly to any delivery point at which Natural Gas quantities exit the upstream Network. In the same context, the decompression or regasification stations of the downstream remote Network are considered as Entry Points in the sense referred to by the Natural Gas Distribution Network Operation Code. That is similar to the case of the metering and reducing interconnection stations of the National Natural Gas Transmission System or any Independent Transmission System²⁷ with the Distribution Network, where distribution users deliver, through the NNGS, the quantities of Natural Gas they intend to distribute to the delivery points that they serve, according to their End customer register.²⁸

The DSO of the upstream Network measures the quantities that exit the Network in the Compressor. As the compression and transportation services are performed by a third party on behalf of the downstream Network Operator, and in order for the upstream DSO to be able to charge the gas distribution activity, up to the point of the Compressor, the downstream DSO provides the allocation ²⁹of the distributed Natural Gas quantities to the delivery points of the distribution users. For this purpose, the upstream and downstream DSOs enter into an interconnected systems agreement ³⁰(similar to that between the Transmission System Operator and any DSO) which describes, in detail, the interoperability between the Operators, the exchange of the required information, and the relevant timeframes.

²⁷ See art.2 of Law 4001/2011

²⁸ See Art. 2 par. 8 of the of the Natural Gas Distribution Network Operation Code (OGG B '3726/12.08.2021)

²⁹ See Art. 43 and 44 of the of the Natural Gas Distribution Network Operation Code (OGG B '3726/12.08.2021)

³⁰ See Art. 2 par. 30 of the of the Natural Gas Distribution Network Operation Code (OGG B '3726/12.08.2021)

With the virtual interconnection, a framework is established (although more complicated than of the Virtual Pipeline) to enable areas under the responsibility of other Operators, to be directly supplied by compressing gas from the already operating compression facilities without incurring new investments and costs that would be borne by consumers.

We have to underline that according to RAE's decisions: The construction of Remote Networks is deemed as a transitional solution (intermediate penetration stage) to accelerate and financially facilitate the development of the Distribution Network, until they are connected through a physical pipeline to the existing Network, unless it is not technically feasible or cost-effective. In any case, their supply scheme described hereby is transitional.

CHAPTER II

A. DSO's Cost recovery – Required Revenue & Distribution Tariffs

Since the complete gas market liberalization in Greece back in 2018, when all consumers became eligible, the revenue of the DSO for the provision of services of the basic distribution activity is based on the EU best practice of the regulated required revenue³¹. The Tariffs based on which distribution users are invoiced, and then End Consumers are charged, are calculated according to the Natural Gas Distribution Network Tariff Regulation (OGG B' 3727/12.08.2021). The DSO calculates and submits for approval to RAE, the tariff drafts for each consumer category based on the above methodology. The calculation of the required revenue involves a complicated function, and various parameters are taken into account. The basic elements are:

- The return on the Regulated Asset Base (based on WACC³²) plus
- The depreciation on RAB plus
- The Operating Expenses of the Operator for the provision of the basic distribution activity

The DSO's Capital Expenditures are added to the Regulated Asset Base, and the depreciation of the assets is deducted. Depreciation of RAB is usually calculated until the expiration of the license. Operating Expenses include, inter alia, the cost of DSO personnel, the cost of operation and maintenance activities of the Network, the cost of

³¹ See Art. 4 of the Natural Gas Distribution Network Tariff Regulation (OGG B' 3727/12.08.2021)

³² See Art. 6 of the Natural Gas Distribution Network Tariff Regulation (OGG B' 3727/12.08.2021)

the metering service, the cost of the service of the Virtual Pipeline as well as other general expenses for the operation of the Company performing the duties and responsibilities of the DSO.

The required revenue is recovered from the End Consumers through socialization (tariffs) based on their consumption, while the charging rates (€/MWh) depend on the category of each consumer, based on a certain consumption threshold (Household, commercial, industrial, CNG station), and they are collected by the Distribution Users through the bills paid by the End Consumers.

The billing³³ to the Distribution Users is conducted by the Natural Gas Distribution Network Operator in accordance with the provisions of the Natural Gas Operation Code, based on the tariffs approved by RAE.

The final price of Natural Gas that is billed to the End Consumer derives, as a rule, from the sum of:

- the Regulated Transmission Charge (For the use of the Natural Gas Transmission System)
- the Regulated Distribution Charge (For the use of the Natural Gas Distribution System)
- and the Competitive Supply Charge

The billing of the End Consumers is carried out by the Distribution Users, according to the provisions of the Supply Code.

As already described in the previous section, the DSO, during the annual submission of the updated 5-year Development Plan to RAE, may propose the development of remote Networks by submitting a relevant cost-benefit analysis demonstrating the project's feasibility on the basis of technical and economic criteria, provided that the criterion of financial efficiency according to article 12 of the Tariff Regulation is observed. The proposal includes the method of supplying the remote Network, while the CBA is prepared based on assumptions according to the maximum unit price per kWh and per kilometer approved by RAE, the investments of the DSO, as well as the forecasted demand for Natural Gas.

The cost to be recovered by the DSOs for the development of remote Networks depends on the supply method implemented. Regarding the Virtual Pipeline, the costs are divided into two main components:

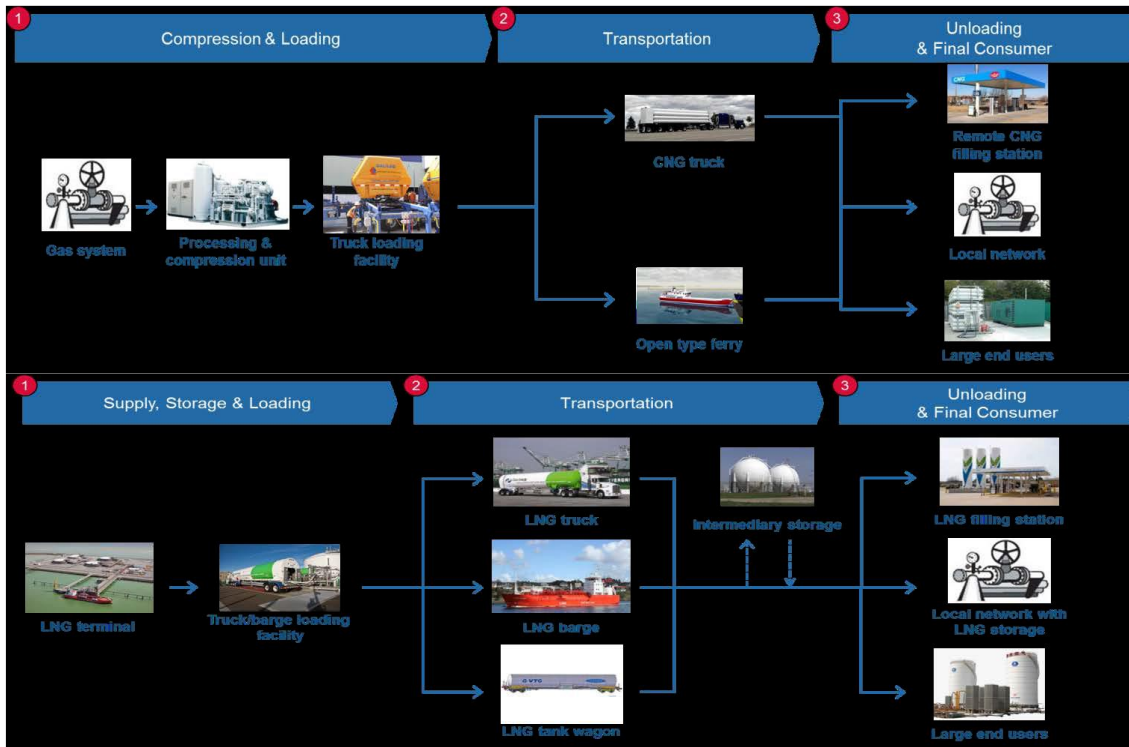
³³ See Art. 73 of the of the Natural Gas Distribution Network Operation Code (OGG B '3726/12.08.2021)

- The capital investments implemented by the DSO for the construction of the decompression station and the construction of the remote low-pressure Network.
- The Operating Expenses related to the supply method, namely the compression and transportation services.

Like all standard Network Capital Expenditures, the DSO's investments for the construction of the decompression station are included in the Regulated Asset Base of the DSO and are depreciated as described above. Regarding operational expenses, these are included in the required revenue of the DSO as Operating Expenses, while their amount depends on the total quantities of Natural Gas that circulate through every remote Network. In this way, as the required revenue of the Operator is socialized to all End consumers in a specific geographical area (Specific RAB), all consumers pay the same distribution tariff, whether they are connected to the existing interconnected Network or to the remote Network, which is supplied by a Virtual Pipeline.

Conversely, in the case of the supply of a remote Network with direct access of the Users to the Compressor, the End Consumer pays the distribution tariff, both for the use of the Network up to the compression point and for the use of the remote Network up to the final delivery point. In addition, as the DSO is not involved in the compression and transportation process, the respective cost of the service is included in the retail market price by the suppliers operating with direct access to the decompressor, to serve their End consumers.

Respectively, for the virtual interconnection and based on the data of the previous chapter, the Distribution User will be required to pay the distribution tariff for the gas distribution service up to the Compressor, to the upstream DSO, and the distribution tariff for gas distribution service, to the downstream Network DSO, while the operating expenses of the services for the compression and transportation will be included in the required revenue of the downstream DSO.



[ACER workshop on the launch of updated Gas Target Model](#)

CHAPTER III

A. The development of remote Networks in Greece

From 2018 until today, only one Natural Gas Distribution Network Operator has utilized the CNG technology to supply remote Networks in Greece. EDA THESS, which is the exclusive Gas DSO for the Regional Unit of Thessaloniki and the Region of Thessaly, took advantage of its high expertise, developed the Virtual Pipeline and supplied the remote areas with Natural Gas. About 4 years ago, the Company installed the first CNG stations in the country, which today amount to 16. By the end of 2020, the Company has been supplying the following areas, by utilizing the Virtual Pipeline and the CNG technology³⁴:

Distribution Network of Thessaloniki

- Municipality of Lagadas – 2 CNG Decompression Stations
- Municipality of Chalkidona (Koufalia Area) – 2 CNG Decompression Stations

³⁴ See Approval of the Development Program of the Company under the trade name “Gas Distribution Company Thessaloniki-Thessaly Societe Anonyme” for the Distribution Network of Thessaloniki and Thessaly for the period 2021-2025 (OGG B’ 5999/31.12.2020)

- Municipality of Delta (Chalastra Area) – 1 CNG Decompression Station *

*Chalastra Area has already been connected to the active distribution network, as its connection with the physical pipeline gradually became cost-efficient due to the growing demand of consumers for natural gas.

Distribution Network of Thessaly

- Municipality of Tyrnavos (Tyrnavos Area) – 1 CNG Decompression Station
- Municipality of Tyrnavos (Ampelonas Area) - 1 CNG Decompression Station
- Municipality of Elassona - 2 CNG Decompression Stations
- Municipality of Meteora - 1 CNG Decompression Station
- Municipality of Palamas - 1 CNG Decompression Station
- Municipality of Agia - 1 CNG Decompression Station
- Municipality of Pyli - 1 CNG Decompression Station
- Municipality of Mouzaki - 1 CNG Decompression Station
- Municipality of Tempi - 1 CNG Decompression Station

Moreover, according to the Company's 5-year approved Development Program, the connection of the following areas with CNG Virtual Pipeline is planned:

- Stavros Area in the Municipality for the Year 2021
- Falani Area in Larissa Municipality for the Year 2022
- Farkadona Municipality for the Year 2022
- Asprovalta and Vrasna areas of Volvi Municipality for the Year 2023
- Sohos and Zagliveri areas of Lagada Municipality for the Year 2024

It should be noted that in its approval Decision, the Regulatory Authority did not approve the construction of remote networks for the areas of Asprovalta, Sochos and Zagliveri, the development of which was proposed for the first time in the Development Program of the DSO. The reason of the rejection was that the framework of decision 643/2018 that had been adopted for a transitional period of 3 years, was close to expiration. In the respective decision's recital, the RAE - in view of the increasing tendency of DSOs such as EDA THESS and DEDA to propose the development of remote networks- considered that the revision of the framework (which was transitionally implemented) is necessary, in order to determine integrated and objective criteria, on the basis of which the development of Remote Networks and the terms of provision of this service to Customers will be regulated in line to services of general economic

interest. For that reason, the Authority expressed its intention to include the Virtual Pipeline (by CNG or LNG) in the Public Service Obligations, according to article 55 of Law 4001/2011, in order to enable consumers living in areas where there are currently no pipeline networks at all, to gain access to Natural Gas.

With regards to the rest of the country, where natural gas penetration is almost zero in terms of domestic consumption, DEDA plans ³⁵to expand the network in almost 36 cities and has already included many remote networks in its Development Program for the next 5 year. DEDA intends to supply the remote areas by utilizing both CNG and LNG technology. The construction of CNG decompression stations is planned for the following cities:

- Municipality of Delphi (City of Amfissa)
- Municipality of Karpenisi
- Municipality of Veria
- Municipality of Pella (City of Giannitsa)
- Municipality of Orestiada
- Municipality of Greverna

While the Construction of land LNG regasification Units is planned to supply the following cities:

- Municipality of Patras
- Municipality of Agrinio
- Municipality of Pyrgos
- Municipality of Ioannina
- Municipality of Arta
- Municipality of Preveza
- Municipality of Igoumenitsa

We should highlight that the issuance of RAEs' decision 633/2021 and the provision of "virtual interconnection" facilitate the supply of DEDAs remote networks. As the distribution network hasn't expanded in these areas yet, huge investments would be required from 3rd parties, due to lack of compression stations in the areas of DEDAs License. With the provision of "virtual interconnection", DEDA can bring CNG from the already existing compression facilities located in the License Areas of another DSO or even the TSO.

³⁵ See Approval of the Development Program of the company under the trade name "Public Company of Gas Distribution Networks Société Anonyme" (DEDA) for the Distribution Network of the Rest of Greece for the period 2021-2025.

With regards to LNG technology³⁶, its use for the handling and importing large quantities of natural gas from the upstream wholesale market by vessel tankers and eventually for its injection into the National Natural Gas System of DESFA (Revythousa Terminal), is widespread. However, this technology is still at a theoretical level in terms of its land transport and the supply of land gas storage and regasification stations. The Ministry has already set up a committee to develop the relevant technical regulation, the establishment of which is expected by the end of 2022. This point will be a milestone for the development of land satellite gas regasification stations for the supply of Virtual Pipelines. To this direction, DESFA has included small-scale LNG loading ramps for trucks.³⁷

B. The role of Natural Gas in Energy Transition

The recent series of legislative packages and amendments launched by the EC for the reduction of emissions by 55% by 2030 – the so called «fit for 55³⁸» - and the taxonomy for sustainable investments “EU Taxonomy Regulation³⁹” are on the right direction for the achievement of the energy transition targets. In this direction, The National Energy and Climate Plan clearly supports policies and measures with regards to the gas infrastructure, to achieve the national contribution to the EU targets for 2030. A key priority is to promote natural gas in specific sectors’ final consumption to replace the use of petroleum products. At the same time, ambitious goals for the decarbonization of the economy have been specified in the National Energy and Climate Plan:

- Reduction of total emissions until 2030 by at least 42% compared to 1990
- Share of RES in gross final energy consumption to reach at least 35% until 2030.
 - At least 60% in the final consumption of electricity
 - Over 40% for heating and cooling
 - More than 14% in the transport sector

³⁶ See Pramod Paliwal, Sudhir Yadav, Natural Gas Transmission and Distribution Business 1st Edition, 21 February 2019

³⁷ See Approval of the National Gas System Development Program (NSGF) for the period 2021-2030 (OGG B' 1392/08.04.2021)

³⁸ See On 14 July 2021 the Commission presented the first series of adopted files under the 'Fit for 55' package. The package contains legislative proposals to revise the entire EU 2030 climate and energy framework, including the legislation on effort sharing, land use and forestry, renewable energy, energy efficiency, emission standards for new cars and vans, and the Energy Taxation Directive

³⁹ See Sustainable finance taxonomy - Regulation (EU) 2020/852

Natural gas came to Greece only in the year 2000, too late compared to the other EU members. So, the first step is to phase out heavy oil from the industries and oil from domestic heating. This is the objective behind the ambitious development programs that are scheduled for the expansion of the distribution networks in the whole Country for the next five years. The first and realistic step is to increase the penetration of natural gas and to replace polluting fuels. Given the low penetration in most areas of Greece and the geographical dispersion, the development of remote networks utilizing CNG and LNG technology is expected to significantly contribute to this end.

The next step is the gradual decarbonization of the networks with the future injection of biomethane. Biomethane, having almost identical characteristics to natural gas, can be mixed both in existing networks and in compressed or liquefied natural gas infrastructure (Bio-CNG, Bio-LNG), even at contents close to 100%. In this way, it can directly contribute to the further reduction of emissions, taking advantage of the penetration of the mixture through the development of Virtual Pipelines in remote networks. Currently, there is no biomethane production in Greece. However, there is a significant biogas potential and current production, which in Greece is only utilized for power generation. In our Country, there are many plants producing agricultural and farming wastes that can support the production and injection of biomethane in the Distribution Networks in the near future.

In this regard, it is imperative to stay neutral toward all technical solutions available for the penetration of RES and the reduction of pollutants in buildings. For example, in domestic heating, natural gas appliances used by end-consumers are not necessarily more polluting than electric appliances.

In simple words, it depends on how pollutant is the energy mix that feeds power generation. Natural gas heating appliances must be fully supported in EU Taxonomy, as they:

- directly contribute to reducing greenhouse gas emissions in domestic heating (replacing more polluting conventional fuels).
- can operate with renewable (low or zero carbon) gases (Biomethane / Bio-CNG, Bio-LNG) in the future, and this will enable the penetration of RES in buildings and the total decarbonization of the final energy consumption

Moreover, it is important to understand the necessity of natural gas as a transitional fuel, in sectors where coal is prevailing e.g. power generation. There is a predictable electric power demand variation during the day driven by the consumers' need. On the other hand, due to the increasing penetration of Renewable Energy Sources, the supply pattern is rapidly changing. In many countries, and especially in

Greece, this transition is challenging, as power generation has always been relying on lignite. Challenges mainly concern technical issues, such as:

- dealing with the volatility and seasonality of RES production
- frequency and voltage regulation and balancing

Investments in infrastructure to integrate flexible gas-fired power plants are safeguarding the reliability and the stability of the system and the security of supply during the transitional period. Therefore, the European Commission approach should identify natural gas as the main transition fuel and treat gas infrastructure investments accordingly, in the framework of the European Taxonomy Regulation.

In order to achieve the targets set in the Paris Agreement and the European Green Deal⁴⁰ until 2030 and 2050, the proposed legislative and regulatory packages must be robust and support the ongoing and necessary transition towards a climate-neutral economy. It is crucial to support all forms of "green" energy and fully utilize all available infrastructure to achieve climate neutrality. Projects such as infrastructure that connects renewable and decarbonized gas production units to existing gas grids and installations that inject biomethane and hydrogen into the distribution networks, should be included as "Taxonomy compliant" investments, even if initially fed with natural gas. The reason is that this kind of investments will enable the initial transition from highly-emitting fossil fuels to natural gas and the accelerated greening of the gas system.

C. The role of CNG and LNG in Decarbonizing the Transport Sector

Natural Gas and the respective infrastructure also play an important role towards the decarbonization of the hard-to-abate transport sector by fueling vehicles with CNG and vessels with LNG. To highlight the strategic importance of decarbonizing the transport sector using natural gas and renewable gases on mobility, we should consider that, based on a well-to-wheel approach, a gas-powered light vehicle with a fuel mix of 60% natural gas and 40% biomethane is estimated to have 57% less emissions than a gasoline vehicle, and if the same vehicle is fuelled with 100% biomethane, it will emit 3% of the CO₂ emitted by a petrol vehicle, while compared to an electric vehicle, carbon performances are similar.⁴¹

Although, the use of bio-NGVs has direct benefits in Greenhouse gas targets set by the European Commission, the recently proposed CO₂ regulation for cars and vans in

⁴⁰ See The European Green Deal, Brussels, 11.12.2019 COM(2019) 640 final

⁴¹ See Frontier Economics, CO₂ Emission Abatement Costs of Gas Mobility and other road transport options, Report for NGVA Europe, 2021

Fit-For-55 package does not promote the sales of new Internal Combustion Engine vehicles after 2035. The currently implemented tailpipe (exhaust) approach, which is being used to categorize the vehicles as zero emissions or low emissions up to 50gr CO₂/km, measures only part of the emissions produced. In fact, life cycle emissions from a Battery electric vehicle depends on the electricity mix of each country. Battery Electric Vehicles - even if the charging electricity is 100% RES - would still end up with a positive emission footprint due to the construction of the respective RES plant feeding the vehicle battery. On the other hand, pure bio-CNG/LNG vehicles are emitting almost zero total emissions (manufacturing emissions included). Consequently, calculations should include the full-cycle and manufacturing process emissions, in order to optimise sustainable investment decisions to focus on reducing the greenhouse gas emissions.

The revised Alternative Fuel Infrastructure Directive, which is proposed to be a mandatory regulation for each country, foresees that there will be an appropriate amount of (bio) LNG refuelling infrastructure in road and maritime.

As long as this is not a quantitative target (such as electric charging stations per kilometre), it could lead to halt LNG infrastructure development and lead the member states to focus and incentivize electric charging and hydrogen infrastructure. Bio-LNG infrastructure should have binding targets in order to trigger investments in the sector.

In Greece, natural gas infrastructure is developing rapidly. However, CNG technology arrived in the country much later compared to other Member States, while in the transport sector it is currently experiencing rapid growth, especially in areas where natural gas has penetrated significantly.

In particular, by 2018 CNG progressive vehicle registrations amounted only to 920 and 11 refueling stations were deployed across the country. After this milestone year and thanks to the broader introduction of CNG technology, the market of CNG vehicles increased sharply. The registrations of new vehicles increased by 374% during the last 3 years -reaching 4360 progressively- while refuelling stations doubled to 24.⁴²

In light of the above, there has to be a coordinated effort to develop CNG, LNG, hydrogen and electric charging infrastructure with the most efficient way and in a timeline that recognizes the maturity of each option. The challenge is to rapidly decarbonize the transport sector while avoiding -at the same time- leading the citizens to forced choices of electric vehicles, which may be unaffordable

⁴² See <https://www.eafo.eu/>

CHAPTER IV

A. The legal framework in the Internal Gas Market

Law 4001/2011 (OGG' A' 179 / 22.8.2011) defined the legal aspects for the energy markets of electricity and Natural Gas and replaced Law 3428/2005 in order to incorporate the provisions of the "*Third Energy Package*" for the complete energy market liberalization, including the provisions of Gas Directive 2009/73/EC and Regulations (EC) 715/2009 (Gas Regulation) and 713/2009 (ACER Establishment). One of the basic amendments that followed and reformed the legal framework regarding the Distribution Activity as provided in Law 4001/2001, was the issuance of Law 4336/2015, which defined the obligation for legal and operational unbundling of the gas distribution companies and the separation of the competitive activities from the monopolistic ones of a previous Vertically Integrated Undertaking (VIU). More specifically, Law 4336/2015, with the provisions of Directives 2003/55/EC and 2009/73/EC, defined the conditions and the procedures for the complete liberalization of the internal gas market and set an exact timeline according to which the definition of "eligible customer" would begin to be in force for all End Consumer categories.

A1. The Virtual Pipeline from a Legal Point of View

After the provision of the unbundling of activities in Gas Directive 2009/73/EU, the internal gas market is a fully open market with well-defined separate stages, that is the wholesale market, transmission, distribution and retail supply of natural gas to the End Consumers. As many Network Operators are former VIUs, one of the main principles is to secure fair and non-discriminatory access to the Network for the Distribution Users and End Consumers in accordance with the rules of the Third Energy Package.⁴³

In relation to the operation and the scope of Virtual Gas Pipeline activity as described in the previous sections, we can conclude that its purpose is identical to the purpose of the DSO activity (to meet the consumers' reasonable demand) and as such, it is included in its basic activities. Even if the transport activity, for which third parties are designated in a public tender by the DSO, is purely of a competitive-commercial nature, as long as it serves the supply of the remote gas Distribution Network and thus the provision of consumers' access to natural gas and security of supply, it reflects the point

⁴³ See Th. Panagos, Handbook of Energy Law Second Edition, Thessaloniki 2018

of view of the European Energy Law. ⁴⁴Although the term is not foreseen in the European Legislation for the natural gas internal market, it performs the same activities as the physical Network and facilitates the accomplishment of the objectives of the DSO's basic activity. As the European legislator does not explicitly prohibit the activity of Virtual Pipeline and does not exclude the Operator from the construction of a secondary gas Network, we can conclude that the Virtual Pipeline activity is not contrary to the legislative framework in terms of the distribution activity, since it is performed to cover consumers' reasonable demand.

According to the Gas Directive 2009/73/EU that defines the unbundling of activities in the liberalized market, the separation of the competitive activities from the monopolistic ones, the Virtual Pipeline activity, being part of the main activity of a DSO, is not linked to the supply activity. The supply activity is carried out under fully competitive terms within the gas market and following the procedure of the DSO that serves the off-grid areas via Virtual Pipeline.

As in force, the operation of Virtual Pipeline in CNG technology is under the responsibility of the competent DSO which operates in a regulated market and with a regulated tariff. The transportation process of CNG is a competitive activity for which third parties mediate to transport the gas from the Compressor to the decompressor and, in essence, supports the DSOs activity to serve the off-grid customers via CNG in a secondary gas Network.

In a liberalized market, competition is the main goal and any abusive behavior would not be tolerated, as inconsistent with the scope of the EU legislation. In case of a Virtual Pipeline Activity without regulation and supervision on costs and prices per kwh, the suppliers could, under certain circumstances (immature market), act as dominant players in the market and demonstrate monopolistic or oligopolistic behavior by manipulating and determining high prices for the service. This, apart from delaying market growth, would result in all the characteristics that are opposed to the objectives of EU legislation (consumer protection, energy efficiency, Security of Supply).

A2. The purpose of the Virtual Gas Pipeline as a Regulated Activity

The benefits of Natural Gas are well known, both for reasons of environmental protection and because of the savings it provides in domestic use but also in commercial and industrial consumers. The accelerated use of Natural Gas contributes significantly to the achievement of the State's goals, as described in the National Energy and Climate Plan ⁴⁵for the rapid decarbonization of the country's economy, as it is the cleanest

⁴⁴ See Aspasia Aligizaki, Energy Policy and the Law of EU, Sakkoulas Editions 2018

⁴⁵ See National Energy and Climate Plan (OGG B' 4893/31.12.2019)

conventional form of energy, with reduced greenhouse gas emissions and multiple environmental benefits. In addition, it creates a favorable environment for competitiveness and an overall positive growth footprint.

The Virtual Pipeline copies and ensures - as the main responsibility of the Operator - the continuous flow and safe distribution of Natural Gas using specially designed vehicles and cylinders in remote areas where End Consumers are not served by the physical Network.

The purpose of the Virtual Gas Pipeline and the physical Natural Network is identical. It includes the circulation of Natural Gas quantities and delivery to the End Consumers and - especially in the case of the Virtual Pipeline - the circulation of Natural Gas from the compression station to the decompression facilities and then to the delivery points, resulting in the greatest possible penetration and use of Natural Gas.

It should be noted that in the case of Virtual Pipeline, the transportation of compressed Natural Gas from the location of the Compressor to the decompression station facilities and, has no longer not a purely competitive (commercial) character and is considered as part of the general regulated Distribution activity of the Operator, provided that this handling is carried out to supply a local secondary Distribution Network (remote Network) by the physical Network. This is because, from a functional point of view, the purpose of the gas transportation serves - as part of the Virtual Pipeline -, the supply of a Remote Natural Gas Distribution Network, the ownership and management of which belongs to the competent DSO, and it does not constitute an economic activity related to the competitive supply activity. Therefore, the economic and social purpose of the Virtual Pipeline would not be able to be fulfilled without this transportation.

The operation of the Virtual Gas Pipeline should not be confused with the activity of the Gas Supply. As in the physical Distribution Network, the commercial-supply activity in the Remote Network, which is “connected” with a Virtual Pipeline, is carried out on fully competitive terms, and the Retail Market Suppliers have equal access in the context of the free market.

The Virtual Pipeline does not adversely affect the Supply activity. On the contrary, it favors it, as it strengthens the competition between the Users of the Distribution Network and intensifies their economic activity due to the expansion of the relevant market and the delivery of quantities of Natural Gas to more End Consumers. Moreover, the possibility of supplying remote Networks through virtual interconnection is expected to further contribute to this direction.⁴⁶ The End Consumers of the Virtual Network supplied with Virtual Pipelines have the possibility to freely choose their retail suppliers that are active in the retail gas market, after its liberalization. By placing the virtual gas pipeline activity in a regulated context, no distinction is made between the

⁴⁶ See Th. Panagos, Virtual Gas Pipeline: New Challenges in the Gas Regulatory Framework, Journal Business Law, 2020

End Consumers, whether they are connected to the physical Network or to the virtual one, because all End Consumers pay the same regulated charge for the Basic Distribution Activity.

In addition to the main role of CNG as an alternative form of Natural Gas for the development of Virtual Pipelines, the use of compressed Natural Gas technology enhances the smooth and uninterrupted operation of the Natural Gas Distribution Network. The DSO can apply the CNG technology, in cases of planned cuts for maintenance reasons, emergency incidents or even crisis events, to ensure the continuous supply of Natural Gas. This is achieved through portable storage units and portable decompression stations, which enable the alternative temporary supply with Natural Gas, of Networks or installations which under normal conditions are supplied by pipelines.

B. Equal & Non-Discriminatory Access

Third-Party Access (TPA) ⁴⁷regime stemming from the European Energy legislation has been a central element of the liberalization of the Greek gas market and it allows the entities to have access and utilize the gas facilities on equal terms and conditions.

The objective is to foster healthy competition among the market players, thus ensuring supply efficiency, and strengthening the energy security. TPA provisions have an impact, particularly in the gas supply market, by introducing competition, breaking the incumbent's monopoly, while facilitating price reduction.

From their perspective, Member States should receive every necessary measure to ensure the implementation of a system of TPA to the transmission and distribution systems, based on published tariffs and shall ensure that those tariffs are approved by the National Regulatory Authorities (NRAs), before entering into force).

Virtual Pipeline activity, as part of the main activity of DSO, is subject to TPA. The DSO should grant any third person with an established legitimate interest access to the Remote Network or direct access to the decompressor and regasification facilities -that are utilized to facilitate the Remote Networks activity. Otherwise, suppliers or/and end consumers could demonstrate anti-competitive or abusive behaviors undermining the right to TPA. The Operators' facility - in this case the decompression or regasification

⁴⁷ See Art. 32 of Directive 2009/73/EC and Art. 2 par. 2 of Law 4001/2011

stations - must be technically accessible. As mentioned above, TPA regime entails the application of fair, non-discriminatory, and transparent tariffs for TPA framework.

C. State Aid Regime

The Treaty, generally, prohibits State aid unless it facilitates the development of certain economic activities or of certain economic areas, where such aid does not adversely affect trading conditions to an extent contrary to the common interest⁴⁸. To ensure that this prohibition is observed, and exemptions are applied equally across the European Union, the European Commission is in charge of ensuring that State aid complies with EU rules. According to the Treaty provisions, the aid measure is necessary to meet the stipulations in article 107 TFEU and obviously to avoid the distortion of competition by favouring certain undertakings or the production of certain goods within the internal market. In particular, analysing the provisions of article 107 (3 (c)) TFEU, the aid measure must pursue an objective of common interest in a mandatory and proportionate way to be compatible with the internal market⁴⁹. The EC then examines whether the distortions of competition and the effect on trade are limited, so that the overall balance of the measure is positive. In this respect, protocol No 26 of the TFEU defines the concept of SGEIs (Services of General Economic Interest). SGEIs are services of economic nature that deliver outcomes to the overall public interest under conditions defined by the State, and they impose a public service obligation on the providers.

Considering the relevant provisions of the EU legislation and taking into consideration that the activity of supplying Remote Networks (Virtual Pipeline) is a complementary activity to the distribution sector, which satisfies the purpose of the DSO, and an economically feasible solution that contributes to the economic efficiency, we can ⁵⁰highlight that: the Virtual Pipeline Activity can be determined as an economic activity compatible with the provisions of Article 107 (3(c))⁵¹ TFEU. Furthermore, it is certain that the Virtual Pipeline activity under the responsibility of the DSO does not impose anti-competitive practices in pricing or barriers to the access to the network for any consumer, but it certainly prevents the exercise of manipulative behaviors. Lastly, Virtual Pipeline cannot be considered as having a negative footprint on the supply

⁴⁸ As per art. 106 (2) TFEU: "Undertakings entrusted with the operation of services of general economic interest or having the character of a revenue-producing monopoly shall be subject to the rules contained in the Treaties, in particular to the rules on competition, in so far as the application of such rules does not obstruct the performance, in law or in fact, of the particular tasks assigned to them. The development of trade must not be affected to such an extent as would be contrary to the interests of the Union".

⁴⁹ See Michalis D. Chrisomallis-P.Argalias, *European Legislation for Energy*, Sakkoulas Editions, 2021

⁵⁰ See. Th. Panagos, *Virtual Gas Pipeline: New Challenges in the Gas Regulatory Framework*, *Journal Business Law*

⁵¹ As per art. 107 (1), (3 (c)) "1.Save as otherwise provided in the Treaties, any aid granted by a member State or through State resources in any form whatsoever which distorts or threatens to distort competition

activity or manipulative impact on trading conditions but on the contrary, it helps the expansion of this activity.

Conclusions

The activity of the Virtual Pipeline enabled the penetration of Natural Gas in areas where the construction of a Natural pipeline presents difficulties for technical and financial reasons. It led to the lifting of the energy exclusion of remote areas and the expansion of the Energy Map of the Country. The Virtual Pipeline is not just an extension of the physical Network. It is the result of the intention and commitment of the DSO to undertake any action in order to achieve maximum penetration of Natural Gas. The Virtual Pipeline has enabled DSOs to meet the reasonable demands of more and more consumers mitigating energy poverty, while contributing to the environmental protection and energy efficiency, promoting the achievement of National and European objectives as a whole.

The operation of the Virtual Pipeline ensures equal access and homogeneity in the quality of the Natural Gas and in the charges for all consumers, whether they are connected through a Virtual Pipeline or through the existing physical Network.

The author of the present Dissertation, firmly supports that the activity of the Virtual Pipeline and the development of the Virtual Networks (as a transitional solution), should remain in the competence of the Operators, under the regulatory supervision of the Energy Regulatory Authority. The role of Distribution Network Operators should be strengthened in the context of coordination, interoperability between the DSOs and the joint planning of infrastructure development in the country with the NNGS operator, in order to allow the development of more compression points and more remote networks to supply the End Consumers.

Bibliography

Th. Panagos, Virtual Gas Pipeline: New Challenges in the Gas Regulatory Framework, Journal Business Law, 2020

Theodore Panagos, Handbook of Energy Law second edition, Thessaloniki [2018]

Xiuli Wang, Michael Economides, Advanced Natural Gas Engineering 1st Edition, 2009

Miguel Edgar Morales Udaeta, Jonathas Luiz de Oliveira Bernal, Luiz Claudio Ribeiro Galvão and José Aquiles Baesso Grimoni, Natural Gas Virtual-Pipeline for Alternative Energy Distribution, 2012

Aspasia Aligizaki, Energy Policy and the Law of EU, Sakkoulas Editions, 2018

Pramod Paliwal, Sudhir Yadav, Natural Gas Transmission and Distribution Business 1st Edition, 2019

See Frontier Economics, CO2 Emission Abatement Costs of Gas Mobility and other road transport options, Report for NGVA Europe, 2021

Michalis D. Chrisomallis-P.Argalias, European Legislation for Energy, Sakkoulas Editions 2021

CEER, Study on the Future Role of Gas from a Regulatory Perspective, 6 March 2018

CEER, Regulatory Challenges for a Sustainable Gas Sector, 22 March 2019

CEER, How to Foster LNG Markets in Europe, 24 July 2019

ACER, European Gas Target Model review and update, January 2015

ACER, ACER workshop on the launch of updated the Gas Target Mode, January 2015

IEA, The Role of Gas in Today's Energy Transitions 2019

IENE, The crucial role of natural gas in the transformation of the Greek energy market, Athens, March 2019

Websites

www.rae.gr

<https://www.acer.europa.eu/>

<https://www.ceer.eu/web/portal/welcome>

[https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en,](https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en)

https://ec.europa.eu/info/index_en

See <https://www.eafo.eu/>

<https://www.enxgroup.gr/>

<https://www.edathess.gr/>

<https://deda.gr/>

<https://energypress.gr/>

<https://www.iene.gr/>

<https://www.haee.gr/>

Appendix

Law 4001/2011 (OGG A' 179/22.08.2011) "On the operation of Energy and Natural Gas Markets, for Research, Production and Hydrocarbon Transport Networks and other regulations" as amended in Force

Natural Gas Licensing Regulation (OGG B' 3430/17.08.2018)

Distribution Networks Operation Code (OGG B' 3726/12.08.2021)

Basic Distribution Activity Tariff Regulation (OGG B' 3727/12.08.2021)

RAE Decision 643/2018 (OGG B' 3334/10.08.2018) framework for the development of Remote Distribution Networks using Compressed/Liquefied Natural Gas

RAE Decision 822/2018 (OGG B' 4298/27.09.2018) terms and criteria of the tender for the CNG Virtual Pipeline Services

RAE Decision 443/2019 (OGG B' 2945/16.07.2019) amendment of RAE Decision 822/2018 on the tender for the CNG Virtual Pipeline Service

RAE Decision 442/2019 (OGG B' 2792/19.07.2019) determination of the maximum price per kWh for the CNG service for the year 2018

RAE Decision 1427/2020 (OGG B' 4920/09.11.2020) determination of the maximum price as of 01.11.2020 per kWh for the Compressed Natural Gas Virtual Pipeline service

RAE Decision 633/2021 (OGG B' 4271/16.09.2021) amendment of the RAE Decision 643/2018 on the framework for the development of Remote Distribution Networks using Compressed/Liquefied Natural Gas

Directive 2009/73/EC of the European Parliament and of the Council of 13 July 2009 concerning common rules for the internal market in natural gas and repealing Directive 2003/55/EC ("Gas Directive").

Regulation (EC) No 715/2009 of the European Parliament and of the Council of 13 July 2009 on conditions for access to the natural gas transmission networks and repealing Regulation (EC) No 775/2005 ("Gas Regulation").

Regulation (EU) No 852/2020 of the European Parliament and of the Council of 18 June 2020 on the establishment of a framework to facilitate sustainable investment, and amending Regulation

Regulation (EC) No 713/2009 of the European Parliament and of the Council of 13 July 2009 establishing an Agency for the Cooperation of Energy Regulators ("ACER Regulation").

National Energy and Climate Plan (OGG B' 4893/31.12.2019)