



The future of heating in Greece's lignite regions: Analysis of current planning & Sustainable alternatives

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Text

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Summary

The plan for the transition of the heating and district heating system of Greece's lignite regions to the post-lignite era was drafted in 2020 on purely political terms and was based entirely on fossil gas. Since then, geopolitical developments and radical changes in EU energy policy have rendered new gas infrastructure economically unsustainable. Nevertheless, the planning regarding the heating of the country's lignite regions has remained essentially unchanged and is still based on gas.

As a result, the citizens in these regions are currently at an impasse, as the government, local authorities and the Public Power Corporation (PPC) are unable to reach an agreement on how to split the substantial costs of implementing this solution.

In order to contribute constructively to solving this vital issue, the Green Tank has collected publicly available data to analyze the history and costs of the current, gas-based planning.

According to the findings of the analysis, the total cost of the planned sub-projects verges on €420 million. On the other hand, key sub-projects such as (a) the interconnection of Kozani's district heating system with the integrated district heating network; (b) the construction of the new gas CHP plant by PPC; and (c) the interconnection of Amyntaio's district heating system -budgeted at €176 million- are not yet underway; moreover, there are significant delays in projects under construction.

In addition to the high installation costs, the cost-benefit analysis for the city of Kozani shows that the operating costs of these systems will also escalate due to the dependence on fossil gas, which is both polluting and expensive; these costs will not only burden lignite regions' residents but all consumers across the country.

This is happening in Greece at a time when gas prices have not returned to pre-crisis levels and continue to fluctuate, and while Europe is accelerating its decoupling from fossil fuels, decidedly reducing funding dedicated to gas infrastructure. Particularly with regard to heating and district heating systems, solutions based on renewable energy sources should be endorsed, with Denmark, Latvia and Hungary already providing good examples; in fact, RES-based proposals have already been put forward to address district heating in Greece's lignite regions.

Against this background, our policy paper's conclusions and recommendations are as follows:

- With regard to the three cities that currently have district heating systems (Kozani; Ptolemaida; Amyntaio), the permanent solution should be based on **the optimal mix of RES technologies** (solar thermal systems; heat pumps; photovoltaics and electric boilers; locally produced biomass, geothermal systems; etc.) depending on each area's potential as well as on installation and operational costs.

- Kozani, in particular, will certainly require to implement a transitional solution, which can be based on electric boilers, provided that funding is available to cover the cost of purchasing electricity from the grid in a manner that does not impose an additional burden on the citizens of Kozani during the interim period until the implementation of the permanent solution.
- A **program along the lines of ‘Apollon’**, specifically addressing district heating, could bridge possible funding gaps that may arise following the technical and economic assessment of alternative solutions.
- The cities lacking a district heating system (Florina and Megalopolis) should opt for the **electrification of their heating systems via heat pumps**; the latter solution should be combined with energy upgrading of buildings and RES installations to cover electricity demand, either by individual households and businesses, or collectively using the framework of energy communities.
- With regard to resources, renewable energy solutions can be developed at a quick pace and are eligible for European funding, unlike gas. Lignite regions, in particular, are currently being offered numerous opportunities for investment in clean energy projects. For instance, approximately half of the **Just Development Transition Program’s** total resources of €1.6 billion (€1.4 billion for the lignite regions) have yet to be allocated. Moreover, the **revenues from the auctioning of emission allowances**, which have been channeled to the lignite regions since 2018, remain largely unused to date (€144.2 million for the period 2018-2023); the Regional Operational Programs (ROPs) of Western Macedonia and the Peloponnese represent yet another source of funding for clean energy solutions.

Therefore, it is both possible and necessary to radically redesign the heating system of Greece’s lignite regions. The political will of both government and local authorities constitutes, nonetheless, a prerequisite for any truly sustainable heating solution to be effectively implemented.

Introduction

A common aspect of several lignite and coal regions across Europe is that the heating needs of residents and local businesses are met by district heating systems, which are supplied by the thermal energy produced in lignite- and coal-fired power plants. Nonetheless, in recent years, as practically all EU countries have been phasing out solid fossil fuels, namely lignite and coal, these regions have had to make critical decisions on the manner in which their heating needs will be met in the post-coal era. In fact, the issue of heating forms an integral part of the wider Just Transition challenge in these regions, where the entire production model -including heating- has long been based on the extraction and combustion of lignite and coal.

In Greece, this issue concerns the five ‘lignite’ municipalities: four in Western Macedonia (Kozani, Eordea, Florina, & Amyntaio) and one in the Peloponnese (Megalopolis). Of these, three (Kozani, Eordea, & Amyntaio) already have district heating systems in operation. Following the 2019 announcement of the decision to phase out lignite in Greece by 2028 at the latest, an initial plan to meet the heating needs of these five cities was agreed in 2020 -at a purely political context- between the mayors and the Ministry of Environment and Energy (YPEN) and was based entirely on fossil gas¹. Despite recent geopolitical developments and policy changes in Europe having radically altered the prospects for using gas to meet heating needs, the original plan remains essentially unchanged.

This issue is currently at a critical juncture, with the timeframe narrowing and both local government representatives and the YPEN having to make final decisions. This policy paper aims to make a constructive contribution to this challenging process.

Initially, our paper presents the three district heating systems currently operating in Western Macedonia, along with the temporal evolution of the energy sources used for their supply, from the beginning of their operation to date. This is followed by a description of the current planning for the transition of the aforementioned five “lignite” cities’ heating systems to the post-lignite era, including data on installation and operation costs. Next, the international geopolitical developments and policy changes that have taken place since 2020 are analyzed, thus rendering the planned solution unsustainable from both an environmental and an economic point of view. Furthermore, this paper offers representative examples from different regions of Europe that have transformed their district heating systems to rely on clean energy sources for heat production, thus drastically reducing fossil fuel dependence. In addition, the main findings of an opinion survey conducted by prorata -on behalf of The Green Tank- in the lignite regions are presented. This survey examined the views of stakeholders on both the planned gas-based solution and the prospects for using renewable energy sources (RES) in conjunction with sustainable heating technologies. Finally, all the above are evaluated to draw conclusions and formulate recommendations.

¹ Ministry of Environment and Energy (YPEN). 11.12.2020. “Updated Master Plan for the Just Development Transition of the Lignite Areas” SDAM Coordinating Committee. <https://bit.ly/3XNs24H>.

District Heating to date

District heating systems have been operating in Kozani, Ptolemaida and Amyntaio, namely in three out of Greece's five 'lignite' cities. Florina and Megalopolis, the other two cities whose economies have also long been dominated by lignite mining and combustion, do not have a functional district heating network. The following is a brief description of the three district heating systems in Western Macedonia from the start of their operation to the present day.

Kozani

The district heating network of Kozani was constructed and is operated by the Municipal Water Supply and Sewerage Company of Kozani (DEYAK)², providing heating to the city of Kozani, as well as to the settlements of Nea Haravgi and the Active City Planning Zone. The network serves an area of approximately 2.5 million m² and 5,500 buildings; the total number of connected apartments amounts to 28,000. Consumers' heating needs verge on 247 GWh_{th} annually; however, due to losses, heat production exceeds 335 GWh_{th} each year (efficiency: ~73.7%).

Since it became operational in 1994 to date, the district heating system of Kozani has been supplied with thermal power by units III, IV and V of the Public Power Corporation's (PPC) Agios Dimitrios lignite plant; each unit has a capacity of 67 to 70 MW_{th}. A total thermal capacity of 137 MW_{th} is being supplied by two units, with the third unit acting as a reserve. In addition to the above, the company owns a 50 MW_{th} oil-fired boiler, which is used as a reserve for any deficit in the thermal load from the connected lignite-fired units.

Over the past winter (2023-2024), the price of district heating in Kozani was at 55.8 €/MWh_{th}³ following a 10% increase in December 2023⁴.

As of 2021 to date, only the district heating system of Kozani is still based on thermal energy production from lignite-fueled power plants.

Ptolemaida

District heating in Greece was first implemented in the city of Ptolemaida. The District Heating Municipal Company of Ptolemaida (DETIP)⁵, established in 1994, was the first purely municipal company in Greece in charge of providing the thermal energy required by a city.

Up to the winter of 2020-2021, the district heating network was supplied by PPC's lignite plants. Initially, in 1993, the network was supplied with 50 MW_{th} of thermal capacity by the Ptolemaida III lignite unit, which ceased operation in November 2014. In 2004, 25 MW_{th} were

² DEYAK - District Heating: <https://bit.ly/3TNpoL7>.

³ Including VAT 6%.

⁴ DEYAK, Decision No. 445/2023 "Tariffs for water supply, sewerage and district heating for the year 2024". Online Publication No.: ΨΑΨΦΟΡΥΑ-ΦΥ8.

⁵ DETIP - Short Presentation 2022: <https://bit.ly/3Bn5vEt>.

added from the Liptol lignite plant, which was, however, decommissioned in June 2013. In November 2012, district heating was connected to units III and IV of the Kardia lignite plant, which has a conventional thermal capacity of 100 MW_{th} and supplied the city with 80 MW_{th}. Thus, between 2014 and 2021, district heating was based on the latter two lignite units until they too were permanently retired in April and May 2021, respectively.

As of the winter of 2021-2022 to date, the district heating network is based on heat production via electricity coming from two electric boilers with a total capacity of 80 MW_{th}.

The DETIP network also includes a peak-reserve oil-fired boiler with a capacity of 25 MW_{th}, which has been in operation since 2002. In addition, in 2007 and 2016, accumulation tanks with a total capacity of 3,800m³ were installed to store thermal energy (225 MWh_{th}) in the form of hot water to be used when necessary.

Based on the DETIP's available data (2022), 4,330 buildings and 15,752 apartments/spaces with a total area of 1,772,011m² are connected to the district heating network. The system's annual thermal energy production approximates 230 GWh_{th}, while final consumption after losses amounts to nearly 170 GWh_{th} (efficiency: ~74%).

The price of district heating in Ptolemaida is the lowest in Western Macedonia and has remained stable since 2010 at 40 €/MWh_{th}³. Recently, DETIP proposed a very large increase to 63 €/MWh_{th} (+57.47%)⁶, based on the assumption that, as of next winter, the city's district heating would be provided by the Ptolemaida V lignite plant. The latter's costs were projected to increase by 200% compared to the average 2013-2021 price, thus increasing thermal energy rates by 17 €/MWh_{th}. Therefore, most of the proposed increase (74%) was intended to contain this expected rise in thermal energy costs. Nonetheless, the DHCP's proposal was rejected by the Municipal Board of Eordea.

Amyntaio

The district heating system of Amyntaio is the newest in the country's lignite regions. The Municipal District Heating Company of the Greater Amyntaio Area (DETEPA)⁷ was established in 1997, as an inter-municipal enterprise based on the cooperation of the Municipality of Amyntaio with the Communities of Levea and Filotas; DETEPA aimed at installing and operating a system using heat co-produced by the Amyntaio lignite power plant.

From 2005 up to the winter of 2020-2021, the district heating system was supplied with 25 MW_{th} of thermal capacity by the Amyntaio lignite plant. As in the case of Ptolemaida, this system also includes thermal energy storage tanks with a capacity of 1,200m³.

As of 2021, when the Amyntaio plant was decommissioned, the district heating system has been supplied by two combustion units with a total capacity of 30 MW_{th}, burning mainly biomass combined with smaller quantities of lignite. The thermal energy produced annually verges on 44 GWh_{th}, while final consumption after losses amounts to nearly 33 GWh_{th}

⁶ DETIP Announcement 13.12.2023. "Thermal energy unit price adjustment" <https://bit.ly/47SVR8u>.

⁷ DETEPA: <https://shorturl.at/gh41q>

(efficiency: ~74%). This thermal energy meets the heating needs of roughly 1680 residential, business and municipal buildings with a total heated surface area of around 363,000 m².

Over the past winter (2023-2024), the price of district heating in Amyntaio was at 63.6 €/MWh_{th}³. However, the municipality board decided⁸ to adjust the price at 74.2 €/MWh_{th}³ at the end of the winter (March '24) and for the next heating season.

The existing plan

The plan regarding the heating of Greece's five lignite cities was formulated in parallel with the planning for these cities' transition to the post-lignite era, in the context of the so-called "Master Plan" or Just Development Transition Plan (SDAM).

In default of any public debate or any comparative techno-economic analysis of different solutions, the plan for the future of heating in the five lignite cities was agreed upon by the Ministry, local authorities (mayors and governors), PPC and the Hellenic Gas Transmission System Operator S.A. (DESFA). Specifically, with regard to the three cities that have district heating systems (Kozani, Ptolemaida, Amyntaio), the plan was reflected in a Memorandum of Understanding and Strategic Cooperation, which was signed on 17.09.2020 by the Regional Governor of Western Macedonia; the Mayors of Kozani, Eordea, and Amyntaio; senior PPC and DESFA executives; and the Chairman of the SDAM Coordination Committee¹.

The original plan, which has remained largely unchanged to date, envisages the integration of the existing district heating networks and facilities under a new entity (Intermunicipal District Heating Company of Western Macedonia), foreseeing the development of an interconnecting network between the three cities and the establishment of a thermal hub. The latter would consist of the Ptolemaida V unit (140MW_{th}, with an estimated output of 300-400k MWh/year); a new fossil gas-fired High Efficiency Combined Heat and Power (CHP) plant (60MW_{th}, with an estimated output of 270-350k MWh/year); electric boilers (80MW_{th}, with an estimated output of 0-125k MWh/year); as well as an additional gas boiler (100MW_{th}, with an estimated output of 10-125k MWh/year). At the time, the SDAM draft provided for the Ptolemaida V lignite plant to be replaced after 2028 by a gas-fired combined cycle plant with a higher capacity (1000 MW vs. 660 MW). Therefore, the initial plan for meeting the thermal needs of the city of Ptolemaida was based on lignite until 2028 and, from then onwards, on gas.

With regard to the cities of Florina and Megalopolis, which do not have an operational district heating network, the plan provided that thermal needs be met by the development of a new gas distribution network -to be constructed by the end of 2023- and the free-of-charges installation of individual gas boilers.

⁸ Municipality of Amyntaio. 31.01.2024. Extract from the minutes of the 5/2024 meeting of the Municipal Council, Decision No. 42/2024, Subject: Approval of the decision of the DHCA BoD regarding the "Adjustment of the consumption fees for district heating". Online Publication No. Ψ97ΘΩΨΛ-8N8.

The plan also provided that the gas for the new district heating systems of Kozani, Eordea, and Amyntaio, as well as for the new gas distribution network in Florina would come from a new pipeline; the latter would start at Nea Mesimvria, bringing Azeri gas via the Trans Adriatic Pipeline (TAP) to Western Macedonia.

It is important to note that the Just Transition Fund Regulation governing the allocation of European resources to EU regions in transition prohibits the use of funds for any type of gas infrastructure; thus, the funding plan for the above infrastructure was based exclusively on the 2014-2020 Partnership Agreement (PA). However, due to significant delays beyond 31.12.2023, namely, the deadline for expenditure eligibility, the funding of projects -either in part or in whole- was extended into the new 2021-2027 PA.

The table below presents all sub-projects included in the above planning, along with their cost, funding source, and their -initially planned- construction duration; relevant decisions and announcements are also cited.

Table 1: Sub-projects planned for the transition of heating and district heating systems to the post-lignite era.

Project	Description	Source	Cost (€)	Duration
Supply of Ptolemaida's district heating system with thermal energy by Ptolemaida SES Unit V ⁹	<p>Sub-project 1: Interconnection pipeline between Ptolemaida's district heating system and PPC's new unit, 'Ptolemaida V'.</p> <p>Sub-project 2: Facilities for the interconnection of Ptolemaida's district heating system with PPC's new unit, 'Ptolemaida V'.</p> <p>Sub-project 3: Supply, installation and commissioning of equipment for the supply of 140 MW_{th} of thermal capacity by the Ptolemaida V plant to the district heating network - Stage 1.</p> <p>Sub-project 4: Archaeological costs.</p> <p>Sub-project 5: Supply, installation and commissioning of equipment for the supply of 140 MW_{th} thermal capacity by the Ptolemaida V plant to the district heating network -Stage 2; civil engineering works.</p> <p>Sub-project 6: Displacement costs.</p>	Transport Infrastructure, Environment, & Sustainable Development (YMEPERAA) 2014-2020 + Environment & Climate Change (PEKA) 2021-2027	18,273,059.86	25/11/2021-1/12/2023
Connection of Amyntaio's district heating system with Western Macedonia's integrated district heating network ¹⁰	Construction of a 14.5km-long transmission pipeline system and installation of the necessary "interconnection - reception" facilities, namely, pumping stations, exchangers, thermal energy storage tanks and other equipment for the interconnection of Amyntaio's district heating system with the integrated district heating network of Western Macedonia.	YMEPERAA 2021-2027	21,613,065.78	30/12/2022-31/12/2023
Connection of Kozani's district heating system with Western Macedonia's integrated district heating network ¹¹	<p>Sub-project 1: Transmission pipelines and interconnection of Kozani's district heating installation with the integrated district heating network of Western Macedonia.</p> <p>Sub-project 2: Modifications, construction of a new pumping station & accompanying infrastructure for the interconnection of Kozani's district heating with the integrated district heating network of Western Macedonia.</p> <p>Sub-project 3: Technical support.</p> <p>Sub-project 4: Archaeological services.</p> <p>Sub-project 5: Cost of expropriation/transit facilitation.</p>	PEKA 2021-2027	55,144,000	2/2/2024-31/12/2027
Gas-fueled CHP ¹²	Engineering, procurement and construction (EPC)/turn-key project for a High Efficiency Combined Heat and Power (CHP) plant with gas-fired internal combustion engines (ICE), with an effective thermal capacity of ≥ 65 MW _{th} at Kardias SES facilities.	PPC	99,200,000	7/2/2022: extended

⁹ Operational Program Transport Infrastructure, Environment and Sustainable Development "Supplying Ptolemaida District Heating with thermal energy by Ptolemaida SES Unit V: <https://bit.ly/3ZIF99R>.

¹⁰ Project summary «'Interconnection of the Amyntaio district heating system with the integrated district heating network of Western Macedonia». Online Publication No.: 9A0EOETA-Q2A. <https://bit.ly/3ZPCE5J>.

¹¹ Special Management Service for the programs: "Environment and Climate Change" and "Civil Protection". "Interconnection of the district heating system of Kozani with the integrated district heating network of Kozani-Ptolemaida-Amyntaio": <https://bit.ly/3TRxJ0q>.

¹² PPC. Directorate of Lignite Production Support Operations-196, Tender information. <https://bit.ly/4eMnvX0>.

Gas transmission pipeline across Western Macedonia¹³	The pipeline (~160km) and its branches will cross the Regions of Central Macedonia (Regional Units of Imathia & Pella) and Western Macedonia (Regional Units of Kozani & Florina), starting from Trikala, Imathia, and ending in Kardias, Kozani.	DESFA	163,000,000	23/2/2023 -
Development of low- and medium-pressure gas networks in the city of Florina¹⁴	Development of a ~50 km low pressure network and a ~52.5 km medium pressure network; 2 pressure measurement and regulation stations (M/R); and 178 connections for consumers of all categories. The number of connections may be higher and depends on the number of consumer requests.	OP Competitiveness, Entrepreneurship & Innovation (EPAnEK) 2014-2020 + European Regional Development Fund (ERDF)	21,155,857.24	29/10/2021-30/11/2023
Replacement of heating systems with gas systems in the city of Florina¹⁵	Sub-project 1: Replacement of existing heating systems (using oil or other solid conventional fuels) and installation of indoor gas systems in residential buildings in the city of Florina. Sub-project 2: Services for the reception and processing of requests, as well as for the certification of the technical and financial scope of the project in the city of Florina.	EPAnEK 2014-2020 + ERDF	19,992,000	1/2/2022-31/12/2023
Development of low- and medium-pressure natural gas networks in the city of Megalopolis¹⁶	Construction and operational installation of 1 integrated natural gas distribution network in the city of Megalopolis, as well as creation of administrative & other infrastructure necessary for its operation. This proposed network, exceeding 46 km (medium pressure network: 6,674 meters; low pressure network: 40,200 meters), will adequately and efficiently cover the entire city, supplying natural gas to approximately 3,500 households (number of consumer connections: 3,400 Gas Points).	EPAnEK 2014-2020 + ERDF	9,000,000	09/06/2021-31/12/2022
Replacement of heating systems with gas systems in the city of Megalopolis¹⁷	Sub-project 1: Replacement of existing heating systems (using oil, district heating or other solid conventional fuels) and installation of indoor gas systems in residential buildings in the city of Megalopolis. Sub-project 2: Services for the reception and processing of requests, as well as for the certification of the technical and financial scope of the project in the city of Megalopolis.	EPAnEK 2014-2020 + ERDF	11,995,200	1/1/2022-31/12/2023
Total			€ 419,373,182.9	

¹³ DESFA 23.02.2023. "Start of Construction Works on the Pipeline to Western Macedonia" <https://shorturl.at/9PZ8C>.

¹⁴ Special Secretariat for the Management of European Regional Development Fund and Cohesion Fund Programs - Special Management Service of the Competitiveness, Entrepreneurship & Innovation Operational Program: "Development of low and medium pressure natural gas networks in the city of Florina", "Competitiveness, Entrepreneurship & Innovation 2014-2020" Operational Program, MIS 5076663: <https://bit.ly/4gMFLh>.

¹⁵ Special Secretariat for the Management of European Regional Development Fund and Cohesion Fund Programs - Special Management Service of the Competitiveness, Entrepreneurship & Innovation Operational Program: "Replacement of heating systems with natural gas systems in the city of Florina", "Competitiveness, Entrepreneurship & Innovation 2014-2020" Operational Program, MIS 5154702: <https://bit.ly/3zGRX62>.

¹⁶ Special Secretariat for the Management of European Regional Development Fund and Cohesion Fund Programs - Special Management Service of the Competitiveness, Entrepreneurship & Innovation Operational Program: "Development of low and medium pressure natural gas networks in the city of Megalopolis", "Competitiveness, Entrepreneurship & Innovation 2014-2020" Operational Program, MIS 5085288: <https://bit.ly/3BAir9S>.

¹⁷ Special Secretariat for the Management of European Regional Development Fund and Cohesion Fund Programs - Special Management Service of the Competitiveness, Entrepreneurship & Innovation Operational Program: "Replacement of heating systems with natural gas systems in the city of Megalopolis", "Competitiveness, Entrepreneurship & Innovation 2014-2020" Operational Program, MIS 5154701: <https://bit.ly/4eFz3vT>.

This is an expensive plan; according to relevant decisions, notices and announcements, total installation costs verge on €420 million. Importantly, key sub-projects have yet to commence, as (a) the interconnection of Kozani's district heating system with the integrated district heating network; (b) the construction of the new gas CHP plant by PPC,; and (c) the interconnection of Amyntaio's district heating system with the integrated district heating network, at a total cost of approximately €176 million¹⁸. Moreover, the latest amendment (18 July 2024) regarding projects related to the supply of Ptolemaida's district heating system with thermal energy by the Ptolemaida V lignite plant, and their inclusion under the Environment and Climate Change program (PEKA) 2021-2027, reveals that a significant part of these projects remains incomplete.

Significant delays are noted in several projects under construction. In particular, the completion of the gas transmission pipeline in Western Macedonia, which was inaugurated in early 2023 by DESFA, has been postponed from late 2024¹⁹ to mid-2025²⁰. The new gas network in Florina is expected to be completed in December 2025²¹. In the Municipality of Megalopolis, the construction of 3,782 and 30,341 meters of, respectively, medium- and low-pressure pipelines has been completed; nonetheless, an additional 5,589 meters of low-pressure network are pending and expected to be constructed by 2027²².

In addition, besides the delays and high installation costs, there are strong indications that this plan's operating costs will also be excessive, because of its dependence on fossil gas - the latter being both polluting and expensive; these costs shall be borne by the citizens - and not just those residing in the lignite regions. According to the financial and cost-benefit analysis of the project entitled "Interconnection of Kozani's District Heating installation with the integrated Interconnected District Heating System of Western Macedonia", the cost of thermal energy for Kozani's consumers is expected to nearly double, from €52,64/MWh_{th} (current price) to €103/MWh_{th}. This is *'in order to ensure that, in the coming period, following the completion of the project, at least the revenues are balanced with the operating costs'*. As the analysis states, *'this figure is dynamic and may fluctuate due to: (a) changes in the estimated cost of purchasing thermal energy from PPC, which, in turn, is related to the cost of gas and carbon dioxide and (b) the share of energy sources in the system'*²³.

These dire estimates regarding the high cost of district heating based on the planned gas-centered solution constitute the main and persisting obstacle for the mayors of the three

¹⁸ The project for the interconnection of the Amyntaion district heating with the integrated district heating system of Western Macedonia was more expensive than the amount indicated in the YMEPERAA in which it was originally included. Specifically, €26.8 million including VAT (€21.61 million without) is the amount stated in the tender. The tendering procedure has not yet been completed. <https://bit.ly/4dvFOyS>.

¹⁹ Ypodomes.gr, 11.04.2024. "The new gas pipeline in Western Macedonia will be ready at the end of 2024", <https://bit.ly/3N8K4tm>.

²⁰ Ypodomes.gr, 09.09.2024. "New gas pipelines to Western Macedonia and Northern Macedonia to be launched in 2025", <https://bit.ly/4eKFqgL>.

²¹ Regional Development Plans. Development of low and medium pressure natural gas networks in the city of Florina: <https://erga.gov.gr/PRJ-02-24>.

²² Hengas. "HENGAS Gas Distribution Network Development Program for the period 2023-2027", <https://bit.ly/3N9L00y>.

²³ DEYAK. 17.11.2023. "Approval of the Financial Analysis and Cost Benefit Analysis of the project "Interconnection of the Kozani District Heating Installation with the integrated Interconnected District Heating System Kozani-Ptolemaida-Amyntaio" (Ref. No.: TΘ 0469/2023): <https://bit.ly/3N7yXkl>.

cities, the Regional Governor of Western Macedonia, the PPC and the leadership of the Ministry of Energy and Energy to reach an agreement. It is evident that the root of the problem lies in the choice of the specific fossil gas-based solution; nevertheless, there does not seem to be any discussion or consideration of any alternative, such as a solution based on clean energy, compliant with EU policy and ensuring long-term economic sustainability. Instead, according to the relevant reports, deliberations among local elected officials, the government and the PPC are focused on solving an extremely difficult -if not impossible- equation, namely, finding a middle ground among three different issues:

- a. the **current** debts of DETIP (at least €102 mil.²⁴) & DEYAK (almost €17 mil.²⁵) to PPC;
- b. the lowest possible **future** pricing of thermal energy produced by the gas-fired CHP for the citizens of the three cities; and
- c. avoiding a **future** financial loss for PPC, which will build and operate the gas-fired CHP plant, if an agreement is finally reached.

In order to cover the financial difference resulting from their attempt to reconcile the above disparate objectives, these stakeholders *seem to opt charging the entire country's electricity consumers*. Firstly, the government has amended the relevant law, and, as a result, electricity consumers across Greece will be more heavily burdened than thus far, so as to cover the CO₂ costs of the CHP plant²⁶. In addition, various proposals have been put forward to address the costs of this expensive solution via the 'Special Account for RES and CHP' or other state aids which, if implemented, will weigh on all citizens across the country²⁷.

Extending the operation of Ptolemaida V as a lignite plant beyond 2028 -exclusively to provide heating to the Municipality of Eordea- continues to turn up in the negotiations. However, this proposition is reportedly rejected by the PPC²⁸, which, in fact, recently announced the retirement of this plant in 2026²⁹.

International developments

The above planning to meet the heating needs in the lignite regions was drafted in early 2020, in the months following the decision to phase out lignite³⁰. Decisions, however, were

²⁴ According to the DHCP: "The cost of electricity from October 2021 to February 2024, amounts to €102.304.353"; DHCP. 23.08.2024 "Operating costs of electric boilers for Ptolemaida's district heating", Press release, <https://bit.ly/4eQUObt>.

²⁵ According to an extrajudicial document sent by PPC to DEYAK, DEYAK's outstanding debts to PPC for the supply of thermal energy and CO₂ emission costs amount to €16,926,807. Kozan.gr, 04.10.2024 "Breaking news: PPC sends an extrajudicial document to DEYAK, requesting the latter repays, within 30 days, overdue debts amounting to 16,926,807 euros, otherwise it will proceed to terminate the thermal energy supply contract and, by extension, disrupt district heating", <https://bit.ly/4gVSNgi>.

²⁶ Law No. 5106/2024, Article 106, paragraph 3, GG A 63/01.05.2024.

²⁷ energypress. 11.01.2024. "Kick-off for the construction of a new CHP plant by PPC for the district heating of Western Macedonia - Agreement reached yesterday at a meeting at the Ministry of Environment and Energy". <https://bit.ly/3zEqiCZ>

²⁸ e-ptolemeos. 30.08.2024. "'Triple liability' solution sought regarding the debts in district heating - The operation of 'Ptolemaida V' hinders the agreement between municipalities, PPC and the Ministry of Environment and Energy- The plan presented by the Regional Governor to the Municipality of Eordea", <https://bit.ly/4eFRrVr>.

²⁹ PPC, Capital Markets Day, London, 23.01.2024: <https://bit.ly/47T5lk9>.

³⁰ YPEN. 08.02.2020. "L. Hatzidakis presents 12 measures for immediate action regarding Western Macedonia", <https://bit.ly/3ZC2gmz>.

not based on any -at least published- comparative techno-economic analysis of different solutions. On the contrary, it appears that the selected gas-centered solution was agreed upon between the Ministry of Environment and Energy and the representatives of local authorities on purely political terms^{31,32}.

Skyrocketing prices

It is important to note that international developments since 2020 have radically changed the prospects for the use of gas. Indeed, the restart of the economy following the first wave of the coronavirus pandemic led to an increase in gas supply prices, which further escalated after Russia's invasion of Ukraine. Despite a partial deceleration in 2023, prices remain far from 2021 levels (prior to the post-pandemic economic recovery) and continue to show significant volatility and sensitivity to international geopolitical developments (Figure 1).

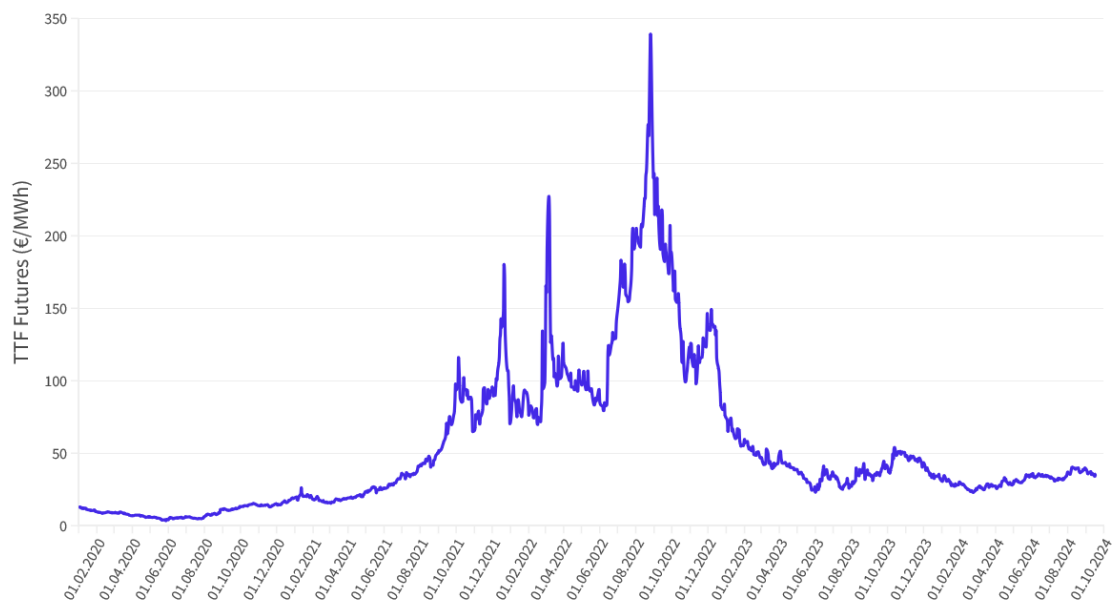


Figure 1: Temporal evolution of gas prices in the Dutch TTF.

RePowerEU: gas reduction and heat pumps

In addition to encouraging the surge in gas prices, Russia's invasion of Ukraine also had a far-reaching effect on EU energy policy. Shortly after the war started, the EU agreed on RePowerEU, a roadmap to decouple from Russian fossil fuels altogether by 2027. Specifically, RePowerEU foresees a massive reduction (-52%) in the consumption of gas -be it Russian or not- by 2030 compared to 2019. Given that the pre-war target for reducing overall gas use was nearly half (-29%) under the 'Fit for 55' package (2021), this new policy

³¹ euro2day.01.07.2020. "Hatzidakis: Agreement on district heating in Western Macedonia", <https://bit.ly/4exM89Z>.

³² Newmoney. 18.05.2020. "Uninterrupted operation of district heating in Megalopolis - Investments in the context of the lignite phase-out", <https://bit.ly/47Bgx4M>.

signals the EU's -unuttered but certain- abandonment of the view that gas should constitute a 'transitional fuel'³³.

In the same vein and acknowledging that the heating sector consumes large amounts of gas, RePowerEU emphasized the electrification of heating through heat pumps. In particular, it set a target of doubling the current rate of individual heat pump installation to reach a total of 10 million units by 2027³⁴. The EU is already on track to meet this target given that a total of 5.25 million heat pumps were installed in 2022 and 2023³⁵. Despite a slowdown in 2024 the European Heat Pump Association (EHPA) foresees the installation of an additional 1.5 million new heat pumps by the end of this year³⁶; therefore, halfway through the 2022-2027 period, the EU-27 has already met nearly 70% of this target. This ambition has been further reinforced in the process of setting the EU climate target for 2040, which foresees the installation of almost 60 and 80 million heat pumps by 2030 and 2035, respectively³⁷.

“Fit for 55”: EU Emissions Trading System (ETS) & Energy Efficiency Directive

RePowerEU has had a catalytic effect on the "Fit for 55" legislative package files that the three EU institutions had started working on in 2021; indeed, this new plan provided specific policies to achieve the EU-27's central 2030 climate target of reducing net emissions by at least 55% compared to 1990 levels.

Central to this package was the 'flagship' of the EU's climate policy, namely, the Emissions Trading System (ETS) Directive. The EU-27 acknowledged the great success of the ETS in reducing emissions in previous years -mainly in the electricity production sector- while at the same time identified the stagnation of emissions coming from buildings and road transport, which were not included in the ETS. Thus, a new ETS -the so-called ETS-2- was established exclusively for these two sectors. As in the case of the electricity sector, the implementation of the new ETS from 2027 onwards is expected to lead to an increase in the cost of fossil fuel-based heating.

This development concerns citizens and businesses that meet their heating needs via individual fossil fuel boilers (oil or gas or lignite). With regard to the lignite regions in particular, the operation of the ETS-2 from 2027 onwards will deeply impact the citizens of the two cities lacking a district heating system (Florina & Megalopolis), if the installation of gas boilers proceeds according to the plan agreed by the government and local authorities in 2020.

³³ E3G. 27.09.2023. «Gas in decline: benchmarking the EU's National Energy and Climate Plans»: <https://bit.ly/3ZU4Ft9>.

³⁴ European Commission. 18.05.2022. "REPowerEU", <https://shorturl.at/CbS93>

³⁵ European Commission. May 2024. "REPowerEU - 2 years on": <https://bit.ly/3ZBVZaA>.

³⁶ Telegraph, 27.09.2024. «Heat-pump sales plummet by almost 50pc across Europe»: <https://bit.ly/4epQ90h>.

³⁷ European Commission. 06.02.2024. SWD (2024) 63, Impact Assessment Report. Figure 44: <https://bit.ly/3zmuntv> & <https://bit.ly/3ZDYIAe>.

Nonetheless, the revised ETS Directive³⁸ will also greatly affect large district heating systems that are still based on fossil fuels. The amendments to the directive, finalized in 2023, are expected to significantly raise the price of emission allowances compared to current levels, which, in turn, will increase the cost of district heating supplied by large heat production or CHP plants; this is the case of the new gas-fired CHP plant which has been foreseen to meet the district heating needs (mainly) of the city of Kozani. Despite gas having much lower emissions per unit of energy produced compared to lignite -which currently supplies Kozani's district heating- the cost of energy production is also expected to surge for CHP plants due to the escalating allowance prices. The rise in the cost of purchasing CO₂ allowances is deemed certain; indicatively, the European Commission has instructed Member States to use the values presented in Table 2 to forecast the cost of emission allowances in their revised National Energy and Climate Plans (NECPs). Strikingly, in 2035 -merely 7 years into the aforementioned planned CHP plant's operation- the allowance price is expected to more than double compared to current levels and quadruple by 2040³⁹.

Table 2: The European Commission's forecast on the evolution of ETS emissions allowance prices, as reflected in Member States' NECPs.

Year	2025	2030	2035	2040	2045	2050
Allowance price (€/tCO ₂)	80	80	140	290	430	490

The gradual decoupling of district heating from fossil fuels and the shift to RES in the heating sector is also reflected in the Energy Efficiency Directive, which was revised as part of the "Fit for 55" package⁴⁰. More specifically, expanding the share of renewable energy in the supply of heating and cooling delivered to the grid constitutes a key target of this Directive. Among other provisions, by 2035 the total share of renewable energy and waste heat in a district heating and cooling system is required to be at least 35%. Clearly, the existing gas-based district heating plan for Western Macedonia is not in line with this provision.

Funding

The above policy changes in the heating sector are also reflected in the radically reduced eligibility of fossil fuel infrastructure to receive EU funding, especially in transition regions. In particular, the Just Transition Fund (JTF), which is intended to change the production model in lignite and other EU regions hosting carbon-intensive activities, completely excludes any *'investment related to the production, processing, transport, distribution, storage or combustion of fossil fuels'*. Instead, JTF resources may be used for *'investments in heat production, provided that the heat production installations are supplied exclusively by renewable energy sources'*⁴¹.

³⁸ Directive (EU) 2023/959 of the European Parliament and of the Council of 10 May 2023 amending Directive 2003/87/EC establishing a system for greenhouse gas emission allowance trading within the Union and Decision (EU) 2015/1814 concerning the establishment and operation of a market stability reserve for the Union greenhouse gas emission trading system <https://shorturl.at/pU64h>.

³⁹ 63.4 €/tCO₂ on 22 September 2024.

⁴⁰ Directive (EU) 2023/1791 of the European Parliament and of the Council of 13 September 2023 on energy efficiency and amending Regulation (EU) 2023/955 (recast): <https://shorturl.at/8U4ym>

⁴¹ Regulation (EU) 2021/1056 of the European Parliament and of the Council of 24 June 2021 establishing the Just Transition Fund, Article 9d, <https://shorturl.at/yVGMl>.

Furthermore, under the revised ETS Directive, 100% of the resources allocated to Member States from the auctioning of emission allowances are now required to fund climate actions; thus, they obviously cannot finance fossil fuel infrastructure. Additionally, the Modernization Fund, which is funded by ETS resources and aims at modernizing the energy infrastructure of the 13 economically weaker EU-27 Member States (including Greece), does not provide any support to fossil fuel-fired power plants. Instead, as in the case of the JTF, these resources can be invested in renewable energy projects for heating and cooling³⁸.

Good examples and sustainable alternatives

The use of RES in meeting heating needs either through individual heating systems or district heating is already widespread across Europe. Acknowledging the particular challenges faced by lignite regions in transitioning their district heating systems to the post-lignite era, the European Commission has published a guide on sustainable district heating systems, providing a number of good examples⁴².

Denmark

Denmark stands at the forefront of district heating, as almost 60% of the country's total building surface area is heated by district heating systems -a figure that is actually increasing. Based on the competent ministry's latest available data for 2024⁴³, 78% of the thermal energy supplying Denmark's district heating systems comes from RES; moreover, according to its most recent final NECP⁴⁴, the country has committed to restricting the thermal energy produced by fossil fuels to supply district heating systems to a maximum of 10% by 2030.

Salaspils, Latvia

Salaspils is an industrial town of 21,000 inhabitants in Latvia, 18 km away from the Latvian capital, with winter temperatures dropping below -20°C. The residents' thermal needs are met through a district heating system, which was long based on gas. In an effort to reduce its dependence on gas, in 2019, the municipal district heating company 'Salaspils Siltums'⁴⁵ integrated to the system a new 3 MW biomass boiler (using wood chips), equipped with a condenser for waste heat recovery, as well as an 8000m³ thermal energy storage tank and 12.8 MW solar thermal panels. Construction started in 2017 and was completed in two years. In addition, the company has assisted and continues to assist citizens improve the energy efficiency of their homes by using more technologically advanced solutions to control heat demand. As a result, both consumption and the carbon footprint of the heat production mix were reduced; moreover, thermal energy prices dropped compared to those of neighboring cities. Specifically, the thermal energy supplied by the municipal district heating company

⁴² European Commission. October 2023. "Toolkit: A technology overview and pathways towards decarbonization". <https://bit.ly/3zBALPk>

⁴³ Ministry of Climate, Energy and Utilities: Denmark's Energy and Climate Outlook 2024.

⁴⁴ Denmark's NECP, June 2024, p. 26: <https://bit.ly/4eztNcz>.

⁴⁵ Salaspils Siltums: <https://salaspilssiltums.lv/en/>.

in 2023 came from biomass (65%), solar thermal panels (16%), waste heat (13%), and, at a small share, fossil gas (6%), while the purchase price of thermal energy dropped by 12.7% compared to 2016.

Szeged, Hungary

Szeged, Hungary's third largest city, has for 40 years relied entirely on gas to provide district heating for its 162,000 inhabitants; this district heating system constituted the chief polluter in the region. In recent years, however, Szetav, the municipal district heating company⁴⁶, has tapped into the region's rich geothermal potential to minimize its dependence on Russian gas and the resulting pollution. The new geothermal system, which cost approximately €70 million (€22.5 million of which came from the EU's Cohesion Fund), provides heat and hot water to nearly half the city, 27,256 homes and 433 public buildings. This system constitutes one of the largest European geothermal energy installations dedicated to supplying a district heating system. As a result of the project, a total of nearly 20 million m³ of gas was replaced by 600,000 GJ of geothermal energy per year, reducing Szeged's annual GHG emissions by 35,000 tons (65%-68%) and improving air quality; moreover, supply was secured, while citizens were shielded from the gas price explosion which followed Russia's invasion of Ukraine in 2022⁴⁷.

Sustainable alternatives for district heating in W. Macedonia

WWF Greece has submitted two well-documented proposals for an environmentally and economically sustainable transition of Western Macedonia's district heating systems into the post-lignite era.

The first study (2016)⁴⁸ focused exclusively on district heating in the city of Ptolemaida. Taking into account the local RES potential, the following four different RES technologies were pre-selected and assessed: (a) Cogeneration of electricity and heat from biogas; (b) Thermal solar panels with seasonal heat storage and heat pumps; (c) Heat generation from biomass boilers; and (d) Combined production of heat and electricity (CHP) via the Organic Rankin Cycle (ORC) technology using biomass as a fuel. Six different scenarios combining the aforementioned RES technologies were then compared. The scenarios combining CHP-ORC, biogas and solar thermal systems were economically efficient without excessive biomass requirements and were therefore considered as optimal solutions.

The second study (2021)⁴⁹ included the city of Kozani in addition to Ptolemaida; it was assumed that the needs of the city of Amyntaio were sufficiently met by the then new biomass combustion plant, so no additional investment was deemed necessary. Good examples across Europe (Denmark, Germany, Slovakia, Romania) were studied, along with

⁴⁶ Szetav: <https://geotherm.szetav.hu/>.

⁴⁷ Think Geoenergy, 02.12.2022, "Geothermal in Szeged, Hungary has reduced heating bills": <https://bit.ly/3N3SjXK>.

⁴⁸ WWF Hellas. July 2016. "Alternatives to the district heating systems of Western Macedonia", <https://shorturl.at/nDG2D>.

⁴⁹ WWF Hellas - LDK Consultants, April 2021, "Regions and Municipalities for a Just Transition: Sustainable District Heating Solutions for Western Macedonia. Final Report" <https://shorturl.at/94mNN>.

more than 50 different scenarios entailing different energy mixes, such as biomass (under very strict conditions and in combination with local synergies), geothermal, biogas and solar heating with storage. Two main scenarios were then formulated, addressing the cost and energy demand issue at similar levels to the SDAM's gas-based proposal, while minimizing environmental impact, in an effort to promote the most sustainable and environmentally-friendly solution. The option satisfying all the above constraints was based on three technologies with different levels of participation, namely: (a) biomass at 60%; (b) solar heating with seasonal storage at 30%; and (c) geothermal systems at 10%. This solution was also assessed against the technical criteria of the EU's sustainable investment classification to be recommended as the optimal alternative to the SDAM scenario.

Citizens' views

Evidently, the citizens of the lignite regions are those directly affected by the choices made today by the government and local authorities regarding the future of heating and district heating in the post-lignite era. For this reason, The Green Tank, in cooperation with Prorata, conducted a telephone survey of 1000 individuals residing in the four lignite municipalities of Western Macedonia (Kozani, Eordea, Florina and Amyntaio)⁵⁰.

Responses reveal that few (23%) citizens are sufficiently aware of the aforementioned developments in European energy and climate policy, which render the prospects for gas bleak. However, a large majority acknowledge that the use of fossil gas is now expensive. Specifically, only 14% of citizens consider the planned fossil gas-based solution for the heating and district heating of the 4 cities in the Regional Units of Kozani and Florina to be reasonable. Exactly the same percentage assents that the fossil gas solution will lead to lower heating costs. On the contrary, 60% of the respondents believe that selecting this option will increase heating costs.

Interestingly, 68% of respondents believe that the municipal authorities of the four cities, in cooperation with the government, should reconsider the fossil gas-based solution designed in 2020.

Moreover, despite the fact that, for decades, the dominant production model in these regions has been based on lignite, citizens of the lignite municipalities express a positive attitude towards clean energy, as an increasing number of them are turning to RES to meet their energy needs.

Almost 1 in 2 respondents (48%) either already own a photovoltaic system (4%), are planning to get one regardless of funding (21%), or would proceed to install such systems if a subsidy were available (23%)⁵¹.

⁵⁰ The Green Tank - prorata. 09.07.2024 "The future of heating in lignite areas - A public poll in Western Macedonia", <https://shorturl.at/xAiv8>.

⁵¹ this 32% of 71% of respondents who answered in the previous question that they would not consider installing photovoltaic systems correspond to 23% of the total who would change their minds if subsidies were available.

Respondents are also positive towards sustainable forms of heating, such as heat pumps. More than 1 in 3 households (34%) are considering installing heat pumps as a solution to meet their heating needs.

Of the 53% who are not considering this option, approximately half (47%) cite the high cost of purchasing and installing heat pumps as the main deterrent; this barrier could be removed via adequate financial incentives or funding schemes.

The fact that heat pumps are recognized as a sustainable solution by households is illustrated by the finding that a greater number of households (33%) would currently choose heat pumps over gas-fueled boilers -or over neither solution (26%)- if a subsidy were available.

Conclusions and recommendations

International geopolitical developments, together with the far-reaching changes in the EU's energy and climate policy, especially after Russia's invasion of Ukraine, have rendered the choice of fossil gas as the main fuel for heating and district heating in lignite regions, unrealistic.

At the same time, the poll conducted by prorata on behalf of The Green Tank indicates that citizens in Western Macedonia favor a change of the existing gas-based plan drafted in 2020. In fact, they seem to increasingly seek long-term sustainable solutions based on the electrification of heating and the use of RES.

Sustainable heating and district heating solutions are already being implemented in several European cities, as illustrated in the review published by the European Commission and the brief description of examples herein. Therefore, at a time when European cities are decoupling their heating sector from fossil fuels, it is -to say the least- outdated to start implementing a heating plan based entirely on gas in Greece's lignite regions. In fact, the economic data of the initial plan, support this view. The installation costs are high and the operating costs are also expected to be elevated, as they will be heavily influenced by both unpredictable fluctuations in gas prices as well as rising emission allowance prices.

On the contrary, the favorable conditions created by the new EU legislation and the major advances in renewable energy technologies, together with their eligibility for EU funding, indicate that the long-term economic viability of a heating system built today can only be ensured if it is based on renewables.

It is therefore vital to radically redesign the heating system of Greece's lignite regions.

The cities without a functional district heating system (Florina and Megalopolis) should opt for the electrification of their heating system via heat pumps; the latter solution should be combined with energy upgrading of buildings and RES installations to meet electricity

demand, either by individual households and businesses, or collectively using the framework of energy communities.

With regard to the three cities that currently have district heating systems, the permanent solution should be based on the optimal mix of RES technologies (solar thermal systems; heat pumps; photovoltaics and electric boilers; locally produced biomass, geothermal systems; etc.) depending on each area's potential and on installation and operation costs. The optimal solution should be selected based on a comparative technical and economic analysis, carried out with transparency, and agreed on following substantial consultation with all stakeholders (district heating companies; institutes; universities; municipal and regional councils; civil society).

According to a prevailing view in the public debate, it is presumed that implementing any plan different from the existing gas-based one would take considerably longer; in fact, it is worth noting that, even if all issues related to the new gas CHP plant in Kardias were to be resolved immediately, the plant would start operating in 2028 at the earliest, provided that all accompanying sub-projects for the construction of substations and transmission and connection pipelines are completed by then. Therefore, Kozani in particular will certainly require implementing a transitional solution, which can be based on electric boilers⁵².

On the contrary, the implementation of the entire 'Apollon' program, which aims to meet 50% of the electricity needs across all 13 regions in Greece via photovoltaic systems, is expected to be completed in three years⁵³; in fact, as mentioned above, the installation of solar thermal systems to supply district heating in Salaspils, Latvia, only took two years.

Therefore, renewable energy solutions can be implemented at a quick pace, and even faster than the gas-based solution currently considered.

The implementation of truly sustainable heating solutions in lignite regions relies on the political will of both government and local authorities, as well as on obtaining the resources to finance the relevant investments. Particularly with regard to funding, Greece -and especially its lignite regions- is currently being offered numerous opportunities for investment in clean energy projects. For instance, approximately half of the Just Development Transition Program's total resources of €1.6 billion (€1.4 billion for the lignite regions) have yet to be allocated. Moreover, the revenues from the auctioning of emission allowances, which have been channeled to Greece's lignite regions since 2018, remain largely unused to date (€144.2 million for the period 2018-2023); the Regional Operational Programs (ROPs) of Western Macedonia and the Peloponnese represent yet another source of funding.

Beyond installation costs, a need for subsidies to support operating costs may arise from the technical-economic design of a RES-based solution; these subsidies could be addressed via

⁵² As in the case of Ptolemaida, electric boilers, which have very low costs and installation times, can constitute a transitional solution, provided that funds are obtained to cover the cost of purchasing electricity from the grid, without placing a burden on the citizens of Kozani for the period of time required until the implementation of the permanent solution.

⁵³ YPEN, 03.11.2023. "7 questions - answers regarding the 'Apollon' program" <https://bit.ly/3XFFtUd>.

a special program that will focus exclusively on district heating in Western Macedonia, much along the lines of the ‘Apollon’ program.

The citizens of the lignite regions have been sacrificing their quality of life for decades in order to support the country’s economic development. For this reason, citizens throughout Greece must now contribute financially (as well) to the irreversible transition of these regions to the post-lignite era. This financial support, however, cannot be granted to a gas-based solution that is both environmentally and economically unsustainable.

