D5.8 Implementation Plan Kifissia

30/09/2022

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Topic: LC-SC3-SCC-1-2018-2019-2020: Smart Cities and Communities

Deliverable administration

No & name	**D5.8 Implementation plan Kifissia**				
Status	Released	**Due**	M36	**Date**	22-09-30
Author(s)	KFS, FHG				
Description of the related task and the deliverable. Extract from DoA	**T5.3Fellow City Replication Strategy (FHG) M1–24** The objective of this task is to provide an evidence base and in-depth understanding for key systems in the SPARCS Fellow Cities as basis for the development of long-term visions, smart city strategies and the development of locally adapted interventions in the area of positive energy blocks. To this end, Fraunhofer IAO, supported by VTT, will adapt and apply the joint assessment framework as outlined in WP2, T2.1 to each FC within the course of the first 18 months. Subtask 5.3.1 Fellow Cities profile development: A targeted data collection process will take place with different municipal actors from all FCs providing their data inputs into the data repository. The comparison of city-level indicators with corresponding benchmarks and action fields will allow to draft a profile for each city, highlighting the quantifiable sustainability performance in selected sectors (energy, emissions, transportation, buildings) and the current strengths and weaknesses around acting towards a low carbon transformation of the city system. The profile will become the background for an individual smart city strategy and urban transformation plan, as well as the baseline for monitoring progress in the city and for deriving actions and measures in an integrated way (linking governance, strategies and technologies). Subtask 5.3.2 Onsite assessment in Fellow cities: A one-week onsite assessment will be conducted in all FCs consisting of ca. 25 -30 interviews with key local actors and workshops with different urban stakeholders. This will allow the identification and systematization of city specific framework conditions and provide the basis for adapting the packaged solutions to the local conditions. The outcomes of subtask 5.3.2 will consist in ca. 10 – 15 early-stage project outlines per city that are based on the packaged solutions and the Lighthouse City interventions. They will then be related back to the results of the assessment (subtask 5.3.1) in order to prioritize activities and design an early-stage roadmap of interconnected projects on the level of technology / infrastructure, strategy and governance. The results of subtask 5.3.2 will be compiled into a local implementation plan and provided as deliverable (one deliverable per FC: D5.4 – D5.8)				
Participants	FHG, VTT, KFS				
Comments					

V	Date	Authors	Description
0.1	09.04.2020	FHG	Draft before assessment of data
0.2	19.05.2022	KFS	Draft document submission to FHG
0.3	19.09.2022	BABLE	Reviewing
0.4	27.09.2022	WP leader	Deliverable checked by WP leader and released to the Coordinator and the Quality Manager for quality check and subsequent submission to the EC.
1	30.09.2022	VTT	Coordinator submits the deliverable to the EC

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Dissemination level		
PU	Public	X
CO	Confidential, only for members of the consortium (including the Commission Services)	

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About SPARCS

Sustainable energy Positive & zero cARbon CommunitieS demonstrates and validates technically and socioeconomically viable and replicable, innovative solutions for rolling out smart, integrated positive energy systems for the transition to a citizen centred zero carbon & resource efficient economy. SPARCS facilitates the participation of buildings to the energy market enabling new services and a virtual power plant concept, creating Virtual Positive Energy communities as energy democratic playground (positive energy districts can exchange energy with energy entities located outside the district). Seven cities will demonstrate 100+ actions turning buildings, blocks, and districts into energy prosumers. Impacts span economic growth, improved quality of life, and environmental benefits towards the EC policy framework for climate and energy, the SET plan and UN Sustainable Development goals. SPARCS co-creation brings together citizens, companies, research organizations, city planning and decision making entities, transforming cities to carbon-free inclusive communities. Lighthouse cities Espoo (FI) and Leipzig (DE) implement large demonstrations. Fellow cities Reykjavik (IS), Maia (PT), Lviv (UA), Kifissia (EL) and Kladno (CZ) prepare replication with hands-on feasibility studies. SPARCS identifies bankable actions to accelerate market uptake, pioneers innovative, exploitable governance and business models boosting the transformation processes, joint procurement procedures and citizen engaging mechanisms in an overarching city planning instrument toward the bold City Vision 2050. SPARCS engages 30 partners from 8 EU Member States (FI, DE, PT, CY, EL, BE, CZ, IT) and 2 non-EU countries (UA, IS), representing key stakeholders within the value chain of urban challenges and smart, sustainable cities bringing together three distinct but also overlapping knowledge areas: (i) City Energy Systems, (ii) ICT and Interoperability, (iii) Business Innovation and Market Knowledge.

Partners

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EXECUTIVE SUMMARY

SPARCS's objective is to support European cities in transforming into Sustainable energy Positive & zero cARbon CommunitieS by creating innovative solutions and citizen-centric ecosystems that are equipped to bring about meaningful change. Keys factors of SPARCS solutions include technologies for energy positivity in districts and building, energy storage, e- mobility, flexible grid management as well as stakeholders and citizens engagement.

The current deliverable is part of task 5.3 (Fellow City Replication Strategy), aimed at providing an evidence-based and in-depth understanding for key systems in the SPARCS Fellow Cities–the City of Kifissia specifically, as basis for the development of long-term visions, smart city strategies and of locally adapted interventions regarding positive energy blocks.

The Implementation plan provides a baseline profile of the City of Kifissia and several early-stage project ideas, that are based on interventions in Lighthouse Cities and the packaged solutions. The baseline profile highlights quantifiable sustainability performance of the city, its strengths and weaknesses around carbon transformation.

The methodology followed is the Morgenstadt assessment framework and more specifically its City Lab Methodology for sustainable urban development, based on the qualitative and quantitative analysis of the city of Kifissia.

The profile of the city and its municipal units is outlined, providing valuable information about the environment within which the activities will be implemented. Subsequently, the vision of Kifissia is expressed, which is "to become a carbon neutral city with the use of Renewable Energy Systems, energy efficient buildings; to transform urban areas improving social and economic well-being of the citizens; to establish circular economy and efficient waste management; to use alternative modes of transportation and to establish an environmental mindset with highly engaged citizens."

To this end, several strategic plans were developed and are summarized in the current deliverable. Specifically, the city's mobility indicators were analysed, to assist in the development of the mobility sector in Kifissia. Strategic plans regarding energy consumption (provided by the Municipality of Kifissia and other strategic partners) were studied and analysed to form the basis of the city's profile. Kifissia has also created a sustainable urban mobility plan, which aims to upgrade public spaces and the urban environment, leading to the improvement of the residents' quality of life. These plans are supported by an information action plan that will disseminate the objectives of the city's Sustainable Energy Action Plan.

Finally, the on-site assessment was implemented, during which, a total of 29 project ideas were developed, inspired by the implementations in the Lighthouse cities in SPARCS. These project ideas were the result of interviews with representatives from several city departments including deputy mayor of technical department, deputy mayor of environment and recycling and the Mayor of Kifissia. A stakeholders' workshop and an innovation workshop followed, leading to the selection of six project ideas, including three mobility solutions (bike sharing, municipal e-buses, super blocks), two energy solutions (energy community, energy refurbishment of private houses) and a circular economy solution (waste to energy plant).

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3. INTRODUCTION

The city of Kifissia, being a small-sized municipality within the region of Attica, where Athens, the capital of Greece is also situated, holds the ambition to become a carbon neutral city with the use of Renewable Energy Systems and energy efficient buildings, to transform urban areas and improve social and economic well-being of the citizens; to establish circular economy and efficient waste management; use alternative modes of transportation and to establish an environmental mindset with highly engaged citizens.

The current implementation plan demonstrates a step-by-step process for developing the city of Kifissia's profile, starting with targeted data collection and the comparison of city-level indicators with corresponding benchmarks and action fields that will identify the quantifiable sustainability performance in selected sectors, and the current strengths and weaknesses concerning the low carbon transformation of the city's system.

A City Lab Methodology for sustainable urban development was applied, consisting of a virtual onsite assessment, interviews, and a City Lab Innovation Workshop, which concluded with the proposal of 6 project ideas for further development after local and internal discussions.

3.1 Purpose and target group

Kifissia seeks further support in achieving its goals within the context of both energy and mobility. Within SPARCS and as part of the replication activities in the project, Fraunhofer IAO, with its Morgenstadt Initiative, and in strategic cooperation with the Municipality of Kifissia, studied the areas for improvement and success, which became the basis for the Implementation Plan. The aim was to develop a roadmap of solutions for the city in tackling key focus areas such as: promoting environmental protection and sustainable urban development, enhancing the competitiveness of the local economy, and reinforcing social cohesion. The report was undertaken in collaboration with the Municipality of Kifissia. The results presented here include an integrated set of innovative projects, which shall support the municipal goal of carbon neutrality by the year 2030. They aim to further improve Kifissia's status as a municipality within Greece and help it to achieve its long-term visions of environmental sustainability and establish itself as a lighthouse example in the East Mediterranean basin.

3.2 Contributions of partners

The revision of the assessment framework prepared by Fraunhofer, was performed by SPI and Suite5. The data collection of indicators and action fields was carried out by the Municipality of Kifissia. Likewise, Kifissia has revised this report and contributed with feedback to the assessment carried out by Fraunhofer.

3.3 Relations to other activities

This report is linked with the overall SPARCS City Vision 2050 in Work Package 1, the Monitoring and Impact Assessment in Work Package 2 and the Replication Potential of SPARCS projects and frameworks in Work Package 5. Additionally, the replication in

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Follower Cities within Work Package 5 is connected to the demo projects in Lighthouse Cities in Work Package 3 and 4.

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4. METHODOLOGY CITY LAB

The basis for the in-depth analysis of Kifissia is the Morgenstadt assessment framework and more specifically its City Lab Methodology for sustainable urban development. The model was developed in the course of the "Morgenstadt: City Insights" joint research project in which ten Fraunhofer Research Institutes have pooled their expertise with a further 37 partners from municipal governments and industry to offer cities wide-ranging support for sustainable city development. The project was established in 2011 and the methods since then have been undergoing continuous adaptation and refinement (Fraunhofer IAO, 2022; Radecki, 2019).

In order to achieve an in-depth understanding of the sustainability performance of cities both qualitatively and quantitatively, the Morgenstadt Model is structured into three levels of analysis:

1. Key performance indicators (quantitative analysis)
2. Action fields (qualitative analysis)
3. Impact factors (qualitative analysis)

To create the current report, the relevant indicators and action fields from the Morgenstadt Model, developed in 2011 by the Morgenstadt Initiative led by Fraunhofer IAO together with the University of Stuttgart, were applied. The analysis of this information shows a status quo inventory of Kifissia and addresses the following question: "What is the sustainability performance of the city?". Additionally, it assesses the type of data being measured and available at the city level to provide a well-rounded understanding of the city's sustainability within the energy sector and other related sectors. This understanding of the city's challenges, plans and opportunities create a common ground as the foundation for the co-creation and design activities described below.

The third level of analysis utilizes impact factors to identify the city-specific drivers and barriers which are determined by unique historic, cultural, economic, climatic, and morphological characteristics. Impact factors thus extend the general model and adjust it to the needs of each city, providing for an objective performance profile while laying out the basis for an individual sustainability roadmap.

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4.1 City Lab process

The process in the setting of City Lab is divided into four main steps, as illustrated in Figure 1 below.

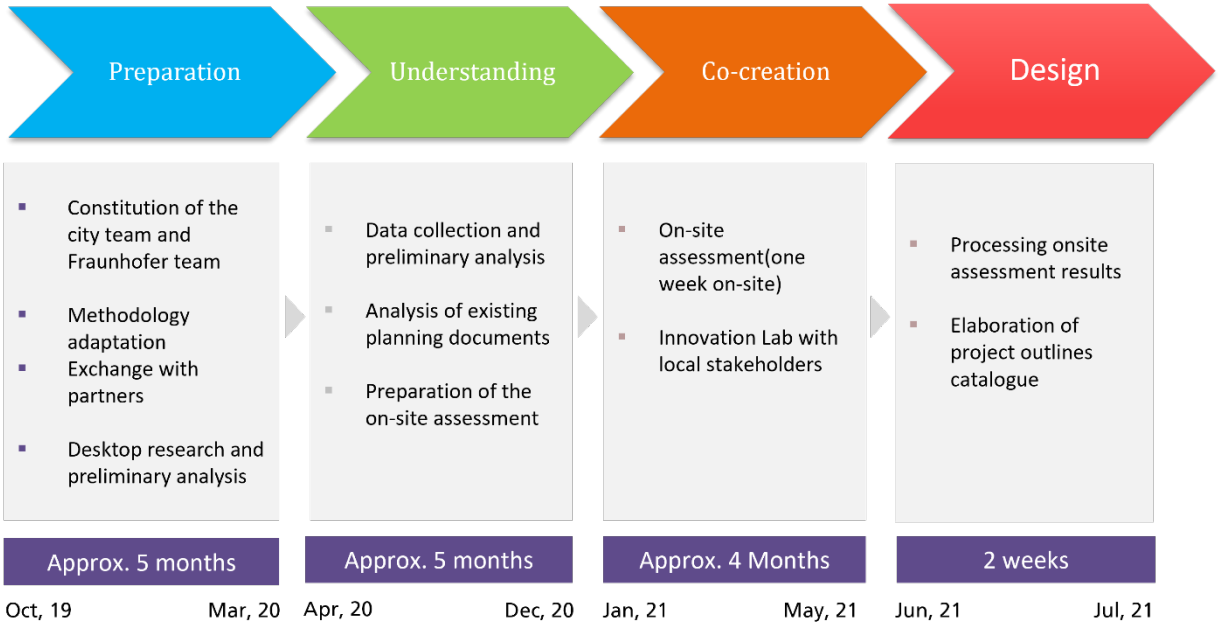

Figure 1: Structure of the City Lab process in Kifissia

The first phase of the development of the City Lab comprised the overall preparation and with it, the constitution of the local team in Kifissia as well as the assessment team from the Fraunhofer side. The city team of Kifissia is composed of:

- Stavros Zapantis, Deputy Mayor of development, energy and social planning
- Artemis Giavasoglou, SPARCS project manager
- Menia Hatzikou, Business analyst
- Katerina Nikolaou, Marketing manager
- Kleopatra Kalampoka, RES expert

Fraunhofer Team:

- Marielisa Padilla, researcher project manager, Urban Governance Innovation
- Reef Qubailat, research assistant, Urban Governance Innovation

The **understanding phase** consisted of the analysis of strategic documents relevant to the energy sector and the initial data collection. It also included the initiation of data collection through online research and desktop analysis. Existing strategic papers and plans of the city were inquired and studied by the Fraunhofer assessment team. Data collection of the indicators and action fields is described in more detailed in Chapters 5, 6 and 7. Gaps in the information and data collected were identified, discussed, and cleared with the local team via several conference calls. Preparations with regards to content (such as the formulation of research questions for the onsite assessment) and organization for the onsite assessment were also included.

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This was taken forward in the **co-creation** phase during the onsite assessment, which was dedicated to formulating project ideas together with local experts and the local team in Kifissia. As the efforts in these activities are part of the replication work package within the project, the developed measures were inspired, among others, by the projects implemented in the Lighthouse Cities.

The data collected in the aforementioned phases and onsite results, especially the outputs of the interviews and workshop, was then compiled during the **design phase**. This culminated in the final version of the implementation plan; it includes concrete project ideas based on the interventions taking place in the Lighthouse Cities within the SPARCS project.

4.2 The Morgenstadt Framework in the SPARCS project

Since the SPARCS project is focused on energy and related mobility impacts, a carefully considered selection of indicators and action fields from the original framework related to these sectors was carried out. SPARCS partners leading activities related to the replication strategy such as SPI, VERD and CiviESCo gave feedback on the updated/shortened model. A second round of filtering further refined the framework before it was sent to the city for the respective data collection. Alongside this effort, benchmarks were updated, and a scoring system was developed to evaluate the city for international comparison. This framework is divided into the following two levels of analysis.

Assessment of indicators: Measuring the current status quo of urban systems and showing the sustainable performance of the city with a focus on the energy sector (quantitative assessment). They were also tailored to cover the most important aspects of such city categories as mobility, society, economy, ICT, and environment. Out of the initial list of more than 100 Morgenstadt indicators (Radecki, 2019), 62 were selected for this purpose.

Assessment of action fields: Analysis indicates how the city addresses sustainability and which activities it is focused on. It gives an overview of relevant fields of actions and related sub-aspects. In total, 35 action fields consisting of 118 'yes/no'-type questions to understand municipal challenges, select priority areas and identify key activities were defined. The adaptation of the existing framework tailored the action fields and questions to the SPARCS objectives. After that, each question was linked to an evaluation factor, which has been designed such that each action field could receive up to a maximum of 10 points if completely developed or implemented. The grading system has been developed to emphasize important fields including the use of renewable energy and heat sources, intelligent traffic management, promotion of multimodal transport and building stock refurbishment.

- ICT: These action fields address ICT specifically in the areas of data and governance, with applications in traffic management and participatory government. Intelligent traffic management allows for the public transit system as well as individualised transit solutions to respond to evolving conditions and for the city to use historical data to study the cost effectiveness of investments in infrastructure or new mobility solutions.
- Governance: These action fields include the topics of municipal strategy and planning, organisation and structure, and regulations and incentives. They can be loosely divided into concrete measures and structural action fields, with the first sections providing insight into the city's long-term vision and goals and the political stability necessary to implement them. The structure and networks for sustainability-related policy management, innovation and reporting are assessed as the necessary

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predecessors for effective policy. Then, a few more specific action fields survey the existence of municipal level policies in place for transportation, air quality, and buildings. These areas provide a concrete starting point for the city in case of a lack of such measures.

- Transport and Mobility: These action fields survey infrastructure for soft mobility such as pedestrian and cycling modes and the corresponding uptake. Studying the linkages between soft mobility and the pricing and infrastructure for public transit, the questions assess the intermodality and vehicle-sharing availability. E-mobility prioritization and visibility through policies and charging infrastructure as well as traditional automotive decreasing measures through policies related to emissions, parking, tolls, and charging, e.g., in congested zones, are addressed. Finally, questions relating to urban freight assess a key component of traffic, the optimisation of which represents a significant environmental impact factor.
- Energy: These action fields assess municipal energy generation and distribution with respect to renewables share, networks for intersectoral resource sharing and the existence of district heating as well as its sources. As citizens are a crucial part of the energy transition, questions also focus on educational outreach to promote efficient consumption, the use of smart grids and meters and distributed energy generation.
- Building transformation: These action fields seek to understand the development of the various fields for building performance in the municipality, beginning with refurbishment of pre-existing stock. Questions regarding regulations for construction, demolition, and materials recycling technologies as well as the recognition of national and international certifications and standards aim to assess impact potential for pre-existing transformative processes. Finally, the level of use of new technologies related to energy and building performance represents the cutting edge of building transformation and indicates a city's ongoing investment into this area.

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The sum of all assessment levels allows the research team to obtain an understanding of **the baseline sustainability city profile,** which is the current performance of the city in energy and closely linked key areas, assisting in the development of coherent strategies. The process simultaneously respects the impact factors of the city that are conditioned by external pressures, socio-cultural dynamics, geography, and historical pre-determinations, among others. Moreover, a standardised data assessment throughout the whole evaluation process helps to identify critical challenges and opportunities, which are crucial for the development of project outlines and the roadmap. The assessment process is outlined in the following graph in Figure 2:

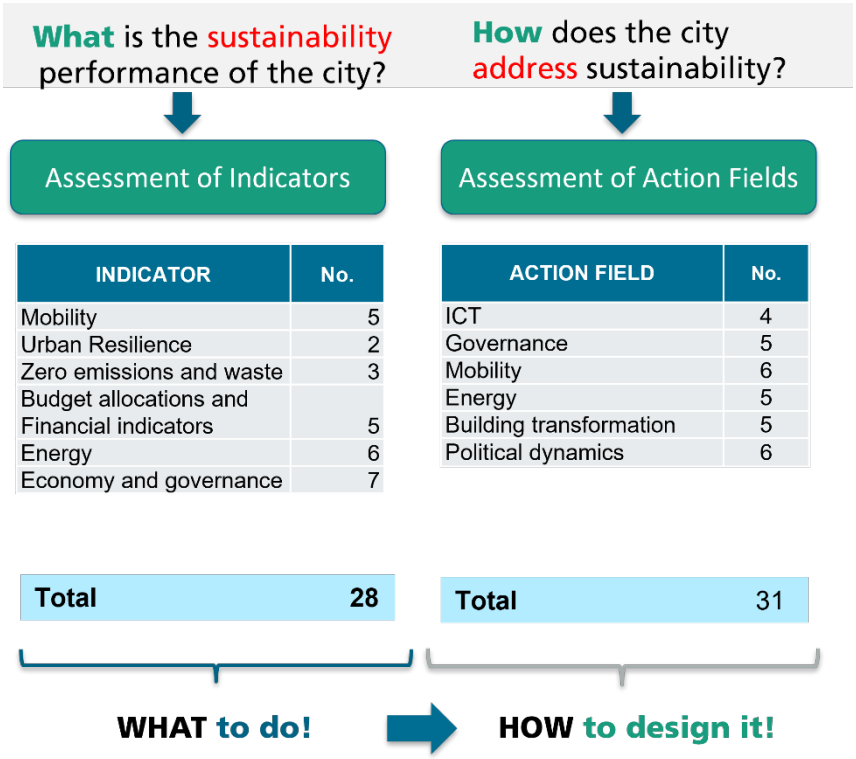

Figure 2: City Lab assessment framework for Kifissia

5. CITY PROFILE KIFISSIA

5.1 Greece

Greece, officially known as the Hellenic Republic, is a European country located on the Mediterranean in the south-eastern part of Europe. It is situated in the far south of the Balkan Peninsula with the longest coastline in Europe (see Figure 3). Greece is composed of two main Peninsulas and over 1400 islands in the Aegean and the Ionian seas (Nationsonline.org, 2022). It is a member of the United Nations (UN), the European Union (EU), including the Euro Zone and the Schengen Area, the North Atlantic Treaty Organization (NATO), the Organization for Economic Cooperation and Development (OECD), the World Trade Organization (WTO).

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Figure *3*: Map of Greece

(Encyclopaedia Britannica, 2022)

Greece is considered a country of very high human development according to the Human Development Index (HDI) of United Nations (UNDP, 2020). The country, according to the recent census of 2021, is populated by 10,432,481 people spreading over its area of about 132 km^2. About two thirds of the Greek population live in urban areas. The most populated region in Greece is Attika with 3,792,469 inhabitants, where the capital city of Athens is located with 637,798 inhabitants. Major cities include Thessaloniki with 317,774 inhabitants, Patra, 211,593 inhabitants, and Heraklion with 177,064 inhabitants (Hellenic Statistical Authority, 2022).

Greece has a capitalist economy while the public sector accounts for 40% of GDP. It has a GDP per capita of less than 40% below the European Union (EU) average while Luxembourg and Ireland recorded a 177% and 120% respectively above the EU average (Eurostat, 2022). The main economic sectors in Greece are agriculture, construction, shipping and especially tourism which provides 18% of GDP. More than 50% of the Greek industry is in the Greater Athens area. Immigrants make up nearly 20% of the work force, mainly in agricultural and

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unskilled jobs (Central Intelligence Agency, 2022).

The Structure of the Greek energy market showed high dependence on fossil fuels, yet a low degree of Renewable Energy Sources (RES) in the local energy grid. In the last decade, Greece has been working on the development of RES as one of the major energy policy lines by implementing comprehensive energy sector reforms to drive decarbonization and foster competitive markets. The government is focused on a just and affordable energy transition that benefits all citizens. Greece has set targets to reduce greenhouse gas emissions by more than 56% by 2030 compared to 2005 and have a climate neutral economy by 2050. Most coal fired generation will be phased out by 2023 and 5 billion Euros has been committed to assist impacted communities. Auctions are driving strong deployment of solar PV parks and onshore wind farms. The government is implementing reforms to standardize and simplify licensing procedures for renewable projects and is investigating options for offshore wind. There are also projects for interconnections and renewables to decarbonize electricity on Greek islands (IEA, 2021).

Greece's final integrated national energy and climate plan (NECP) sets a 2030 target for greenhouse gas (GHG) emissions not covered by the EU Emissions Trading System (non-ETS) of -16% compared to 2005, in line with the Effort Sharing Regulation (ESR). The final plan states that Greece is committed to proportionally support the European objective of climate neutrality by 2050, consistent with its national long-term strategy. Specifically, the long-term strategy sets out a GHG reduction target of about 95% by 2050 compared with 1990 (for the 1.5^{o}C target scenario) or of about 85% (for the 2^{o}C target scenario). It also sets the target for renewable share in power generation at above 95%.

Greece's renewable energy contribution to the EU target for 2030 is 35% of gross final energy consumption without cooling from heat pumps (Figure 4) (Hellenic Republic, Ministry of the Environment and Energy, 2019). This is more ambitious than the contribution of 31% specified on the draft NECP and well above the minimum share resulting from the formula in Annex II of the Governance Regulation 2. This increased ambition is linked to the planned increase in the renewable energy share in the electricity, heating and cooling sectors.

For energy efficiency, Greece specified that it would achieve energy consumption levels of 20.6 Mtoe for primary energy consumption and 16.5 Mtoe for final energy consumption. The energy efficiency first principle is applied, acknowledging the overall importance of energy efficiency goals and considering energy efficiency policies as a horizontal priority throughout the NECP. The final NECP provides further information on the energy efficiency of buildings including a plan to renovate 600.000 homes by 2030 (Hellenic Republic, Ministry of the Environment and Energy, 2019).

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	National targets and contributions	Latest available data	2020	2030	Assessment of 2030 ambition level
GHG	Binding target for greenhouse gas emissions compared to 2005 under the Effort Sharing Regulation (ESR) (%)	-28 (2017)	-4	-16	As in ESR, total GHG target implies higher reductions
	National target/contribution for renewable energy: Share of energy from renewable sources in gross final consumption of energy (%)	18 (2018)	18 (target)	35	Sufficiently ambitious (32% is the result of the formula)
	National contribution for energy efficiency:				
	Primary energy consumption (Mtoe)	22.64 (2018)	22.68	20.55	Modest
	Final energy consumption (Mtoe)	16 (2018)	16.93	16.51	Low
	Level of electricity interconnectivity (%)	10%	13	21	N.A

Figure 4: Greece's objectives, targets and contributions

(European Commission, 2020)

In its plan, Greece set objectives for energy security, aiming to ensure security of supply and the further development of the internal energy market. These two objectives are strongly interlinked and include a new market design, market coupling with neighboring countries, interconnection of islands, new gas infrastructure projects as well as a new gas trading platform. Some of the objectives lack quantification and or time frames.

Greece aims to reach an electricity interconnectivity target of 21% by 2030 and to expand its cross-border infrastructure with neighboring countries for both electricity and gas to this end. Under the plan, this target should already be met by 2025.

National objectives and funding targets related to research, innovation and competitiveness are established to support the development of technologies for the achievement of the overall energy targets by 2030. Research and innovation(R&I) activities specifically relate to the improvement of the energy efficiency of buildings, while research and innovation (R&I) actions focus on renewables technologies. The plan indicates energy networks, digitalization and development of smart grids as priority areas for R&I. Actions on energy storage are also planned.

Accumulated investment to attain the plan's objectives is estimated at around 43.8 billion Euros over 10 years. Overall investment figures are given per policy area, but the split between public and private funding is not specified for different sectors. Greece has provided estimates of the budgetary impacts for some of the planned policies and measures, in

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particular under the energy efficiency and renewable energy, and to a lesser extent, the R&I dimension of the plan. The plan lacks an analysis of the gap between the investment needs and available sources of financing.

A detailed list of energy subsidies, especially for fossil fuels, is missing from the plan, although a qualitative discussion on subsidies is provided. Significant energy subsidies have been identified in recent Commission analyses on energy subsidies. A list of actions undertaken and planned to phase out fossil fuels subsidies is not included, although the intention to reduce or phase these out has been expressed in the plan.

The plan provides information on the interactions with air quality and air emissions policy by mentioning quantitative obligations to reduce national emissions of certain air pollutants under Directive (EU) 2016/2284. It also presents the circular economy as a core element in Greece's development strategy, integrated into sectors like construction, waste management, urban planning and bioeconomy. The plan acknowledges the synergies between circular economy and GHG emissions reductions, but without quantification. Further quantification efforts of the impact of circular economy on decarbonization would be welcome in future plans, in line with the most recent scientific evidence (Hellenic Republic, Ministry of the Environment and Energy, 2019).

The NECP succinctly describes the synergies between climate policies and biodiversity. Future updates would benefit from further reflection on the interactions with carbon sinks and biodiversity, especially when referring to the increased use of bioenergy and the sustainable supply of biomass.

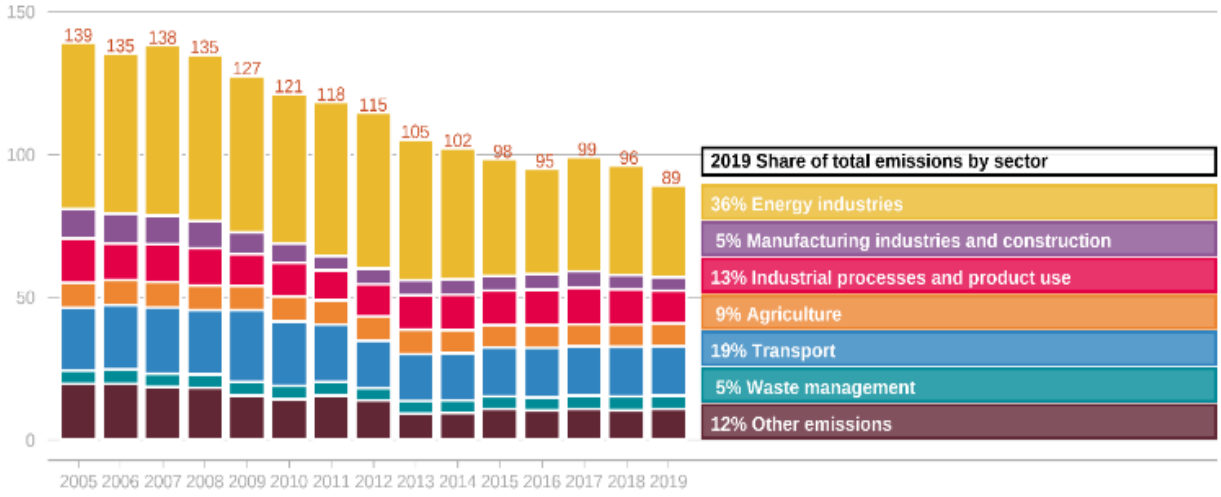

Figure *5*: Total GHG emissions by sector ($MtCO_2e$)

(European Parliament, 2021)

The plan considers the just and fair transition aspects and provides information on the social, employment and skills impact of transition to a carbon-neutral economy. For example, Greece will develop transition plans for Western Macedonia and Megalopolis that are both dependent on lignite and will be affected by its phase-out. Employment impacts in the energy sector have been considered. The overall jobs impact of the transition is projected to be positive, thanks to the creation of over 60,000 jobs by expanding renewable energy sources and implementing energy-saving measures and policies.

On energy poverty, Greece reports the number of households affected, and planned measures to reduce energy poverty. According to the plan, 23% of the population was unable to heat

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their household sufficiently in 2017. For vulnerable consumers, this share was 41%.

There are several examples of good practices in Greece's final NECP, especially "the early and full decommissioning of lignite-fired generation linked to an increase in renewable resources and enhancing energy efficiency measures"

According to the NECP, the year 2023 will see the closure of all currently operating lignite-fired power plants, while those still under construction will have until 2028 to close or adapt to new fuel sources. Emissions from energy industries fell by almost 45% in the 2005-2019 period, reducing their share of total emissions by close to 14%. The biggest emissions reduction was in the manufacturing industries and construction sector, which reduces its share of total emissions over the period from 7.4% to 5.3%. This translates into a 54% reduction in emissions since 2005 or 5.5 $MtCo_2e$. The sectors with the lowest emissions reductions between 2005-2019 were agriculture and transport (13% and 21% respectively). Emissions linked to waste management increased by 0.4%. In combination, these sectors' share of total emissions grew from 25.6% in 2005 to 33.5% in 2019 (Figure 5) (Hellenic Republic, Ministry of the Environment and Energy, 2019)

5.2 Kifissia—A Role Model for Small-sized Municipalities

The municipality of Kifissia since 2011, consists of three Municipal Units: Kifissia, Nea Erythrea and Ekali shown in Figure 6. It is a green suburb located 12km northeast of the Greek capital Athens (see Figure 7), with many parks and tree-lined streets, museums, lot of high value architectural historical buildings, a busy commercial area, and an important industrial area across the highway.

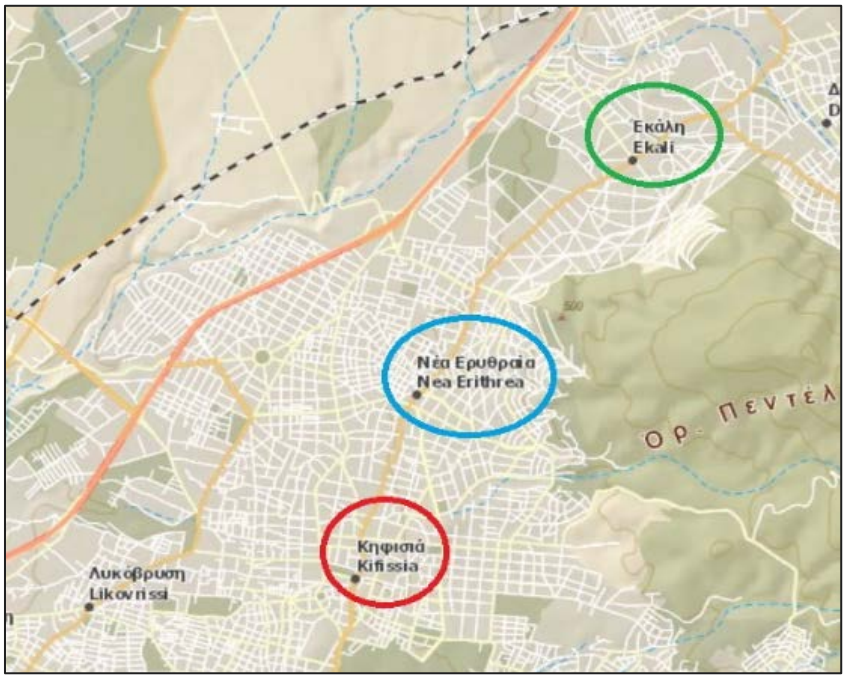

Figure *6*: Location of Kifissia, Nea Erythrea and Ekali (*Google Maps)*

Although, Kifissia has turned into a city bustling with business and professional activities of all kinds, it still maintains its residential character with low building density and gardens. This modern city has held on to its tradition in accordance with its development and made itself one of the most prominent cities in Athens.

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Nea Erythrea, municipal unit which occupies an area of 6,500 acres has recently demonstrated a significant engagement with the development of cultural and social activities as well as with the construction of infrastructure and utilities, while the municipal unit of Ekali, occupying an area of 4,400 acres, is characterized mostly by residential use with high standard architecture and large areas of greenery. The main features of the area are the low building factor, the large percentage of private and municipal green, but also the excellent street plan which consists of a mixture of circular and straight roads interrupted by roundabouts and squares (The Municipality of Kifissia, 2022).

The municipality as whole has an area of 36,804 hectares with 72.860 inhabitants according to the latest population census (Hellenic Statistical Authority, 2022).

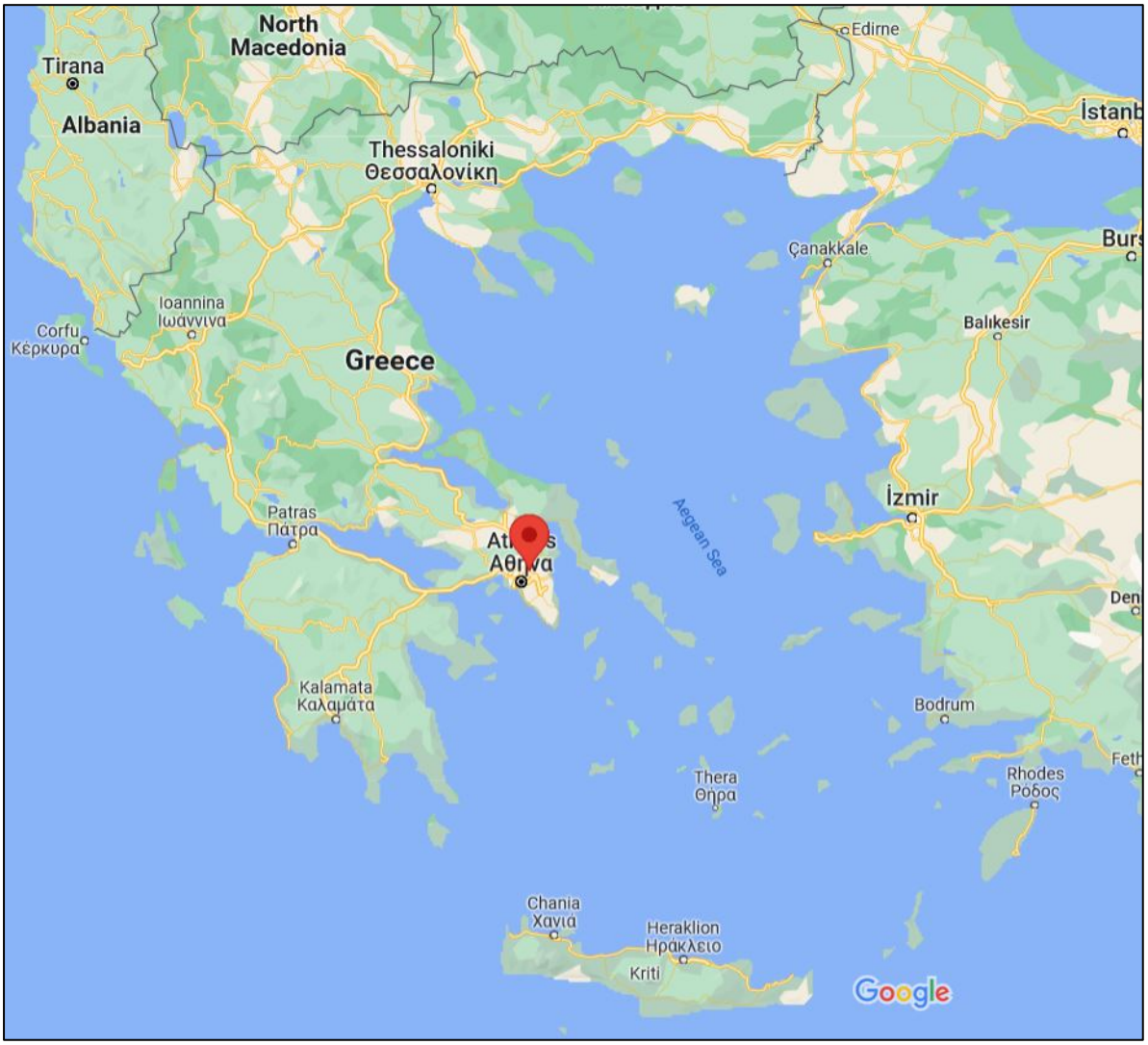

Figure 7: Kifissia's location within Greece

(*Google Maps)*

The climate of the Municipality is Mediterranean and according to Koppen's classification "Csa - marine with a distinct dry and very hot place". According to Koppen's climate classification, the Mediterranean climate is characterized by hot, dry summers and cool, wet winters and is divided into the Csa and Csb subtypes. Greece belongs to the Csa subtype, i.e.,

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the temperature of warmest month is greater than or equal to 10°C and temperature of coldest month is less than 18°C but greater than -3°C (letter symbol C), the precipitation in driest month of summer half of the year is less than 30mm and less than one-third of the wettest month of the winter half (letter symbol s) and the temperature of warmest month is 22°C or above (letter symbol a). Due to the effects of climate change in the Mediterranean basin and especially in Greece, the absolute maximum temperature is 45°C, while the absolute minimum temperature is -5,8°C. December is the rainiest month. The maximum rainfall height reaches 69.1 mm. The hottest month is July and the coldest is January (Encyclopedia Britannica, 2022).

The Municipality of Kifissia according to the categorization of the Greek Law 3661/2008 on Measures to reduce energy consumption in buildings and other provisions and the Energy Efficiency Regulation of Buildings belongs to the climatic zone B.

According to the Technical Guidelines of the Technical Chamber of Greece, Greece is divided into four climatic zones based on Heating Degree Days (HDD) index, which describes the need for heating energy requirements of buildings (see Figure 8). Greece in order to meet the EU's requirements of a nearly zero energy building (NZEB) and reduce energy consumption in buildings has to take into consideration the four climatic zones in combination with the building shell characteristics, the electro-mechanical installations and the RES technologies (Tecnhnical Chamber of Greece, 2017).

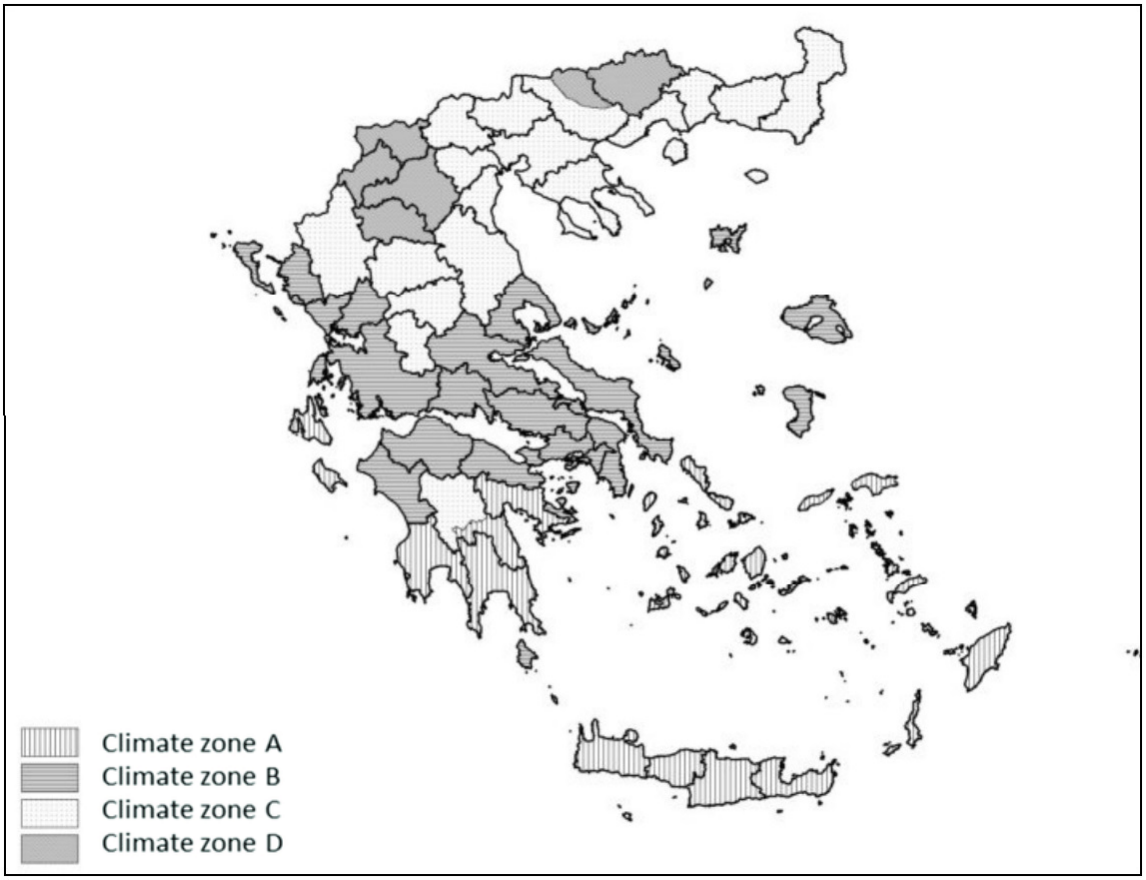

Figure *8*: Climate zones of Greece

(Tecnhnical Chamber of Greece, 2017)

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The Municipality of Kifissia intends to achieve and exceed the European Union's 40% CO_2 reduction target by 2030 by implementing the below actions: create specialized and stable jobs that are not subject to relocation, create healthier environment and quality of life, improve economic competitiveness and reinforce greater energy independence (The Municipality of Kifissia, 2017). Table 1 shows a summary of important data about Kifissia.

Table *1*: Data table of Municipality of Kifissia

(Hellenic Statistical Authority, 2022)

City	Kifissia
Population	72,860
Area	36.804 km^2
Density	1,979 persons/km^2
Main Economic Pillars	Tourism, Finance
Main Emissions Sources	Private buildings & mobility

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6. SMART CITY VISION

For the purpose of the city vision 2050 workshop and report, several actions took place with the collaboration of local SPARCS team, main stakeholders and the Municipality.

Prior to the workshop, open discussions were initiated in order to enhance the input during the workshop. The city invited the citizens to a virtual open discussion about the vision of the city in order to better understand their views and opinions, and give everyone the opportunity to speak and feel a part of the city vision. Similarly, an invitation was sent to the members of the city council for a virtual open discussion in order to discuss their view on the city vision and make all opinions and concerns included in the process. We also tried to involve the younger citizens by asking elementary students to draw their vision of the future city. We used the drawings by putting them up on a wall during the city vision workshop as an inspiration for the participants.

Figure 9: Photo from City Vision workshop

The workshop was implemented based on the methodology provided, and then adapted to local conditions and restrictions due to covid 19, it lasted two days, within the premises of the Municipality (see Figure 9). Fourteen participants from local associations and organizations, the technical department of the Municipality, citizens of Kifissia, national association of architects and several experts all with different backgrounds and knowledge, participated in the workshop.

The key strategic areas addressed were Mobility, Energy Consumption of Buildings, Green energy, Urban planning, Digital city, Citizen awareness and engagement, all of which were decided by local task force, based on the current situation and needs of the city.

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The workshop was divided in five exercises: the first exercise "Trip to the Future" was introduced, along with relaxing music to help the participants get in the mood and at the end of the exercise the participants shared their reflection with their group.

Status Quo was the second exercise where experts presented the key facts of the current situation in the strategic areas - An example is shown in Figure 10. Then, the participants in groups discussed what we are leaving behind and what we are taking with us.

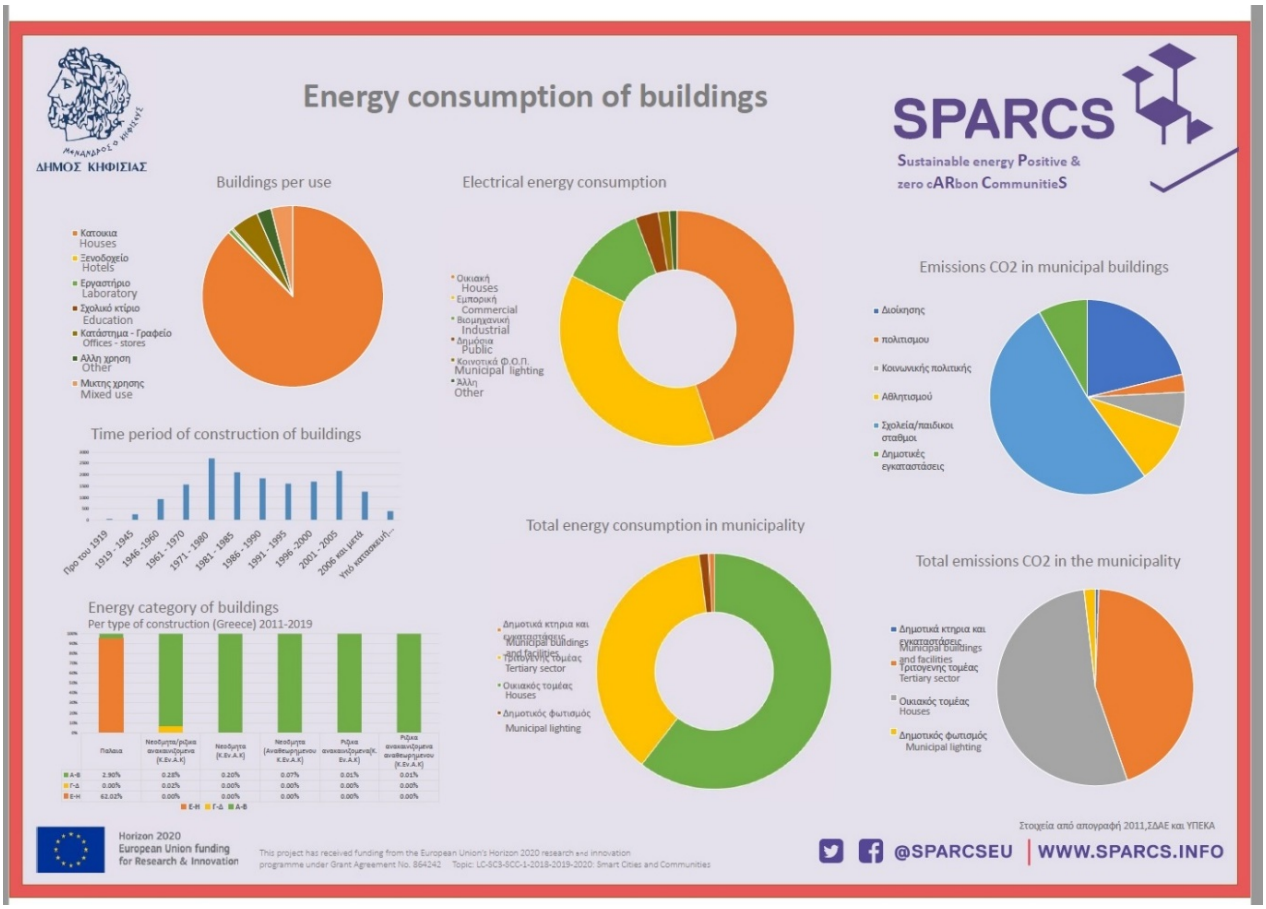

Figure 10: Example of status quo poster

Trends Gallery, the trends posters were placed on the walls and were available throughout the workshop to the participants. At the end of Day 1, we distributed the same posters in A4 printouts, so the participants could take them home and read them through for next day's exercises.

Headlines from the future followed, all groups worked together to identify the front page of the local newspaper in 2050, what will Kifissia have achieved?

Finally, the fifth exercise included the vision statements. The groups were assigned specific strategic pillars to work with and transform the headlines to visions statements.

The result of the city vision workshop is the creation of a draft roadmap for the future actions planning.

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7. SMART CITY INITIATIVES

The vision of Kifissia is to become a carbon neutral city with the use of Renewable Energy Systems (RES), energy efficient buildings; to transform urban areas improving social and economic well-being of the citizens; to establish circular economy and efficient waste management; use alternative modes of transportation and to establish an environmental mindset with highly engaged citizens.

In line with the future vision, the Municipality of Kifissia has several ongoing smart city initiatives, addressing energy transition within the key strategic areas of the city.

Feasibility study for energy upgrades of Municipal school buildings is underway and some of them have already got appropriate funding (from local funding schemes-2021) for energy refurbishment. In addition, other municipal buildings, as well as tertiary buildings and residential buildings energy upgrades are planned to take place until 2030. Measures include Replacement of diesel heating systems, building shell upgrades, replacement of office equipment with ''Energy Star'' labelled appliances, replacement of old windows and other energy efficient solutions, exchanging half of the air conditioning systems with energy efficient units, replacing boiler-based water heaters with solar thermal systems, changing behavior of the occupants, adding local RES systems.

Kifissia plans to reduce energy consumption of public lighting by replacing the existing streetlights with LED lights. This project started in 2020 and is ongoing on an area-by-area basis. Additional funding is being examined.

The Municipality has established many digital ways of communication and e-services like electronic submission of requests for everyday issues of the citizens and live streaming of city council meetings.

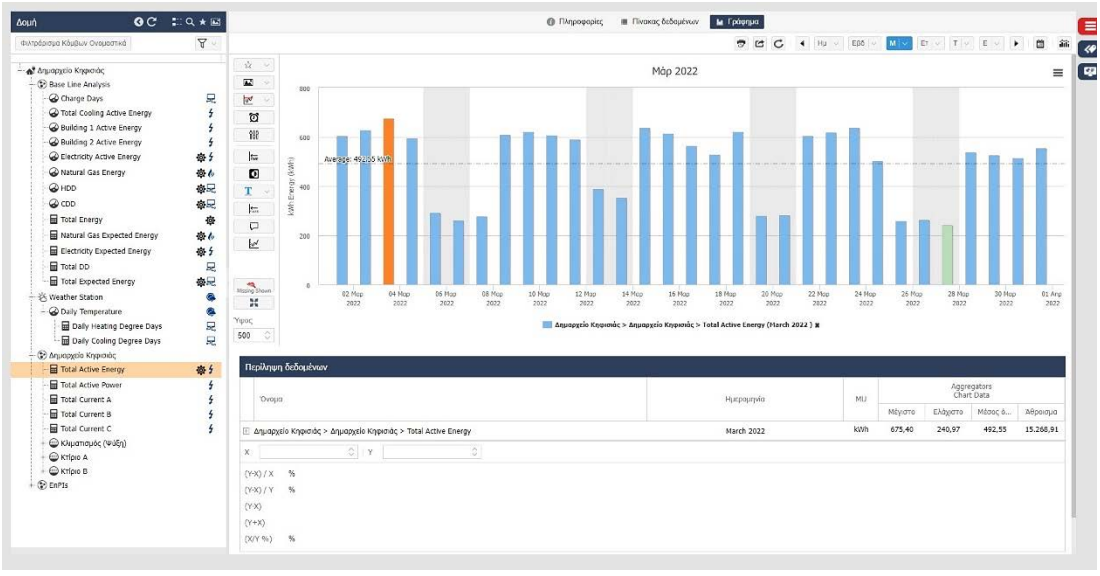

Figure 11: Electrical energy consumption for city hall, March 2022. Screenshot of the "Sense One IoT Monitoring Platform"

With the help of local ICT contractor Kifissia has installed the cloud-based "Sense One IoT Monitoring Platform" in order to remotely monitor electrical energy consumption in three municipal buildings - the technical department building and city halls in Kifissia and Nea

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Erythrea. The platform provides information on real time electrical energy consumption and reports for previous time periods, for each of the three buildings as shown in Figure 11.

In addition, the system provides daily temperature monitoring, from the station based in city hall in Kifissia and exports tables and graphs for heating and cooling degree-days (see Figure 12).

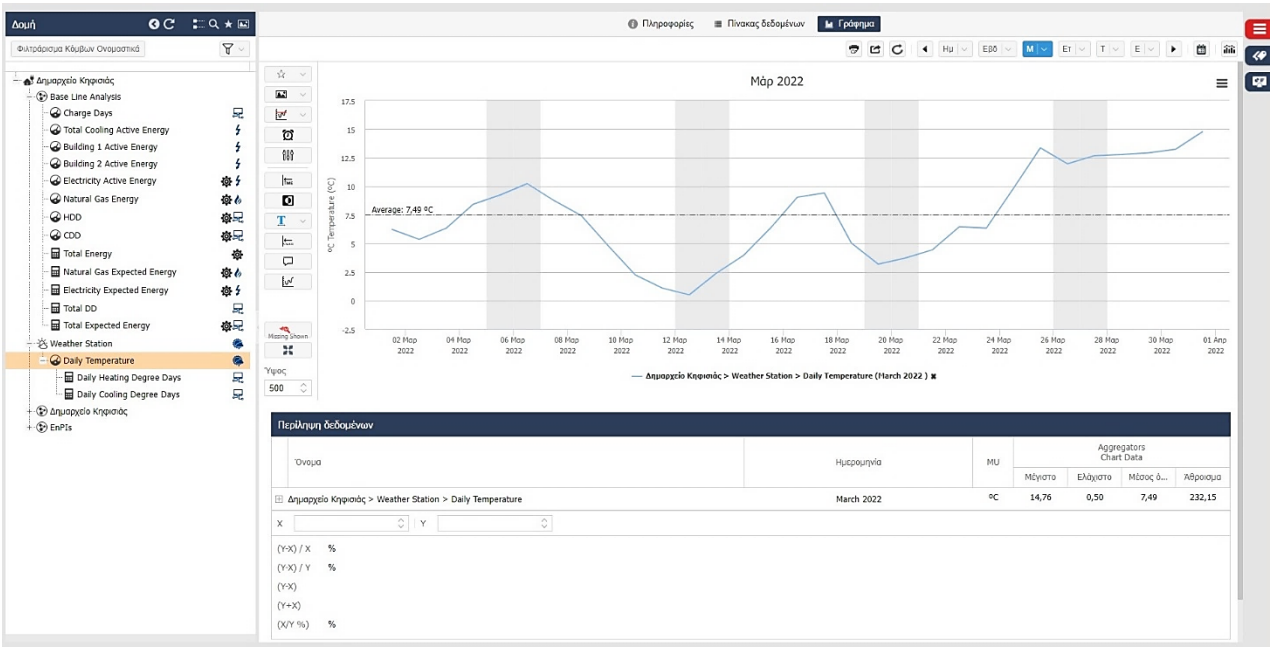

Figure 12: Daily temperatures, March 2022. Screenshot of the "Sense One IoT Monitoring Platform"

A parking system with smart signs that informed citizens about available parking spaces was installed in 2016. The pilot programme, funded by "Green Fund" of the Ministry of environment and Energy, was applied to 140 parking spaces in the area of Nea Erythrea, but the results were poor, and the System does not operate in full scale nowadays.

Preparations for applying for an ISO 50001" Energy management system" certification is ongoing within the municipality. Date of conclusion is not yet available.

Furthermore, the municipality plans to be more engaged in the field of Green Procurement Practices, since a new legislative act, government gazette sheet n. 466/8-2-2021, for the Promotion of Green Public Procurement sets obligatory targets for green procurement practices in 10 areas/products (including photocopy paper, electric and electronic equipment etc.) (Hellenic Republic, Ministry of Development & Investments, 2021)

Ongoing studies and business plan are being held regarding the formation of an Energy Community with the participation of the Municipality and citizens. The plan includes the creation of a photovoltaic plant for the needs of the community members who can profit from the energy produced via virtual net metering.

An e-bike sharing system is also under study. Potential areas for the implementation were selected, technical aspects are being identified, funding options and business models are being examined. This will be the first sharing system for the Municipality of Kifissia. E-bikes for the users with mobility difficulties are also included in the study.

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Another smart city initiative that is under implementation is the creation of an open pilot monitoring system where new features could be added soon, to create a general smart city control room. Initially the system will include environmental sensors for monitoring air quality and sensors for safeguard major green areas of the city monitoring humidity, water leakages and potential fires. The vision is that this pilot monitoring system will be the first step of a complete city monitoring system with smart features enabling urban management, energy efficiency and improve quality of life of the citizens.

Finally, involvement and engagement of the citizens is crucial in order to inspire commitment, change behavior and create an environmental mindset. The Municipality of Kifissia has initiated many actions towards that goal, including open consultations, workshops, open talks, dissemination through social media and newspapers, participation in sustainable activities and actions and involving younger citizens and students from local schools.

7.1 Strategic plans

Kifissia plans to carry out interventions in the following areas: municipal, tertiary and residential buildings, at the core of it are public lighting and transportation.

The city has adopted Sustainable Energy Action Plan (SEAP) in 2015 through which the municipality of Kifissia had identified appropriate and tailor-made activities to be implemented by 2020 and 2030 for safeguarding the natural environment, promoting energy-friendly urban development and ensuring quality of life. The vision of the Municipality of Kifissia is to enhance the competitiveness of the local economy, reinforce social cohesion and promote environmental protection through a variety of measures and intervention areas identified in the SEAP. 40% of CO_2 reduction is the key core objective that the city of Kifissia tries to achieve until 2030 (SPARCS, 2019).

The Sustainable Urban Mobility Plan has been concluded for the Municipality, with helpful information and suggestions for possible future actions that can be included in the roadmap process towards the city vision. In addition, an EV charging plan is ongoing for establishing the first 71 municipal charging stations within the territory of the Municipality, facilitating and promoting the use of electric vehicles.

A local action plan for waste management has been issued, to promote circular economy in the context of the "Zero Waste Society", using innovative standards, technologies & management methods. This study was delivered by Economic Environment & Sustainable Development Research Unit of the National Technical University of Athens. In 2021, the Municipality of Kifissia approved the updated “Local waste management plan” aligned with current legislation and regulations, for a period of five years with a forecast of yearly update. This Waste Management Plan describes the specific actions that have to take place, in order to move towards a Zero Waste Municipality, including waste prevention and recycling measures for the years 2022 – 2025 (The Municipality of Kifissia, 2021a).

The local solid waste management plan focuses on five areas - Analysis and evaluation of current status of management of municipal solid waste; the incorporation of new institutional management developments; adapting planning objectives to municipal level; having new actions based on promoting prevention, reuse and sorting at source; and investment and management cost analysis of the actions.

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In 2010 the Greek law 3852 "New architecture of local Government and decentralized administration – Kallikratis programme", introduced the role of developing Operational programs within Greek municipalities. The new Operational program of Kifissia was issued in 2019 and includes the four-year plan for the Municipality. The plan consists of infrastructure developments and local investments as well as improving actions of current operation of municipal services (The Municipality of Kifissia, 2019).

In general, the Municipality adopts the provisions of the national laws and directives including National Climate Change Adaptation Strategy (NASCC), drafted in 2016 and setting the basis for the specification of adaptation policies and actions for the 13 administrative regions of Greece, National Energy and Climate Plan (NECP) drafted in 2019 and the long-term strategy for the year 2050.

Recent laws issued include revised regulations for building energy efficiency, use of geothermal energy, energy communities with the use of virtual net metering and the criteria for the installation of photovoltaic plants.

Specifically, the Greek law 4414/2016 added new support regime for electricity generation plants from Renewable Energy Sources, for cogeneration of Electricity and High Efficiency Heat as well as Provisions for legal and functional separation for the supply and distribution sector within the natural gas market.

The Greek law 4513/2018 "Energy Communities and other provisions" clarifies issues such as the purpose of an energy community, their potential members, their scope of activity and the requirements for their development.

The Greek law 4843/2021 incorporates the EU directive 2018/2002 of the European parliament regarding energy efficiency in building sector and the support of renewable energy sources.

The Greek law 4710/2020 regarding the promotion of electric mobility, including provisions for charging infrastructure within Greek municipalities

The recently issued Greek law 4951/2022 regarding the modernization of the permit process for the development of renewable energy sources, as well as production and storage of electric power and other provisions for energy and environmental protection.

7.2 Indicators and Action Fields Analysis

The municipality owns less than one percent of the building stock within its premises. This results in a red rating in the correspondent indicator and accounts to a limited decision-making autonomy in the building sector. Municipal assets would be free from the need to provide profits and can be used for the pursuit of other policy goals, especially sustainability measures and experimentation with alternative energy policy. Since most of the building stock is privately owned, there is a great need for interacting and co-working with the building owners. Most of the real estate owners are the residents themselves thus a need for inclusion of the population is advised. With the projects developed through SPARCS, the municipality actively engages with its citizenry (see Chapter 8). Innovative ideas to provide carbon-neutral e-mobility solutions, a project to promote alternative ways of transportation to the car like (e-)cycling and the energy efficient refurbishment in private homes that serve as role model for other inhabitants were thought up. All of these solutions try to include the citizens in the climate-neutral development of the municipality.

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Table 2: Sample Economy and Governance Indicators for Kifissia

Indicator description	City Value	Green	Yellow	Red
Buildings owned by the city as % of total building stock	<1 %	> 35	15 - 35	< 15
Percentage of homes owned by residents	99%	> 79.3	59.3 - 79.3	< 59.3
Air quality Index *Considers eight pollutants (PM10, PM2.5, NO2, SO2, CO, O3, NH3 and Pb) in a 24-hourly averaging period. National Ambient Air Quality Standards are applied. Categories: Good – Fair - Severe*	Fair	Good	Fair	Severe
Green Space Intensity *Calculated as Hectares of permanent green space per 100,000 city residents*	140	>50	20-50	<20

The air quality index of the closest measuring station Lykovrisi, which is approximately 2.5km from Kifissia's city centre shows a similar, urban surrounding. It was therefore used as proxy for deriving the air quality index of the municipality of Kifissia. The index, considering a 24-hours average of eight pollutants, shows an overall rating of "fair". Details of the pollutants yield following results: Inhalable coarse particles: particulate matter with a diameter of 2.5µm or less ($PM_{2.5}$) concentration of 15 µg/m^3, Particulate matter with a diameter of 10µm PM_{10} concentration of 27 µg/m^3; Nitrogen dioxide from combustion engines NO_2 concentration 20 µg/m^3; Ozone O_3 concentration 64µg/m^3. These values are all below the permissible exposure limits defined by the European Environmental Agency (EEA). Still, these values can be improved through e.g., the increase of inner-city green spaces, the limitation of combustion engine use and private cars or the limitation of traffic in general. Also here, the municipality has already developed ways to improve mode of transportation by e.g., a project for the uptake of electric buses in its public transport network (see Chapter 8). To provide accurate data, show possible effects of the envisaged projects and possibly inform its citizens, the city can establish an air quality measuring station.

The Green Space Intensity indicator shows up as green, surpassing average baseline comparison values of other cities. This is mainly due to a larger forest area within the municipality's premises (see Fig. 14). The inhabitants of Kifissia actively make use of this extended green space as the municipality notes. For nearby air quality amelioration, carbon sequestration or leisure activities, the existence of the forest and the function it provides has to be highlighted in the indicator assessment. Still, as noted above, extending inner city green areas can work towards an improvement of the air quality index (see Tab. 2).

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8. ENERGY PROFILE KIFISSIA

Strategic plans provided by the Municipality of Kifissia and other strategic partners were studied and analysed to form the basis of this city profile.

In 2019, 315,804 building energy performance certificates were issued, covering almost 31,546,583m² of existing building stock within Greece. The majority of the existing buildings resulted in the lowest energy performance classification E-G, while only the 5.96% were classified in category A or B as shown by the pie chart in Figure 13. Ranking percentage in each category is almost the same as 2018 (Department of Energy Inspection, 2020)

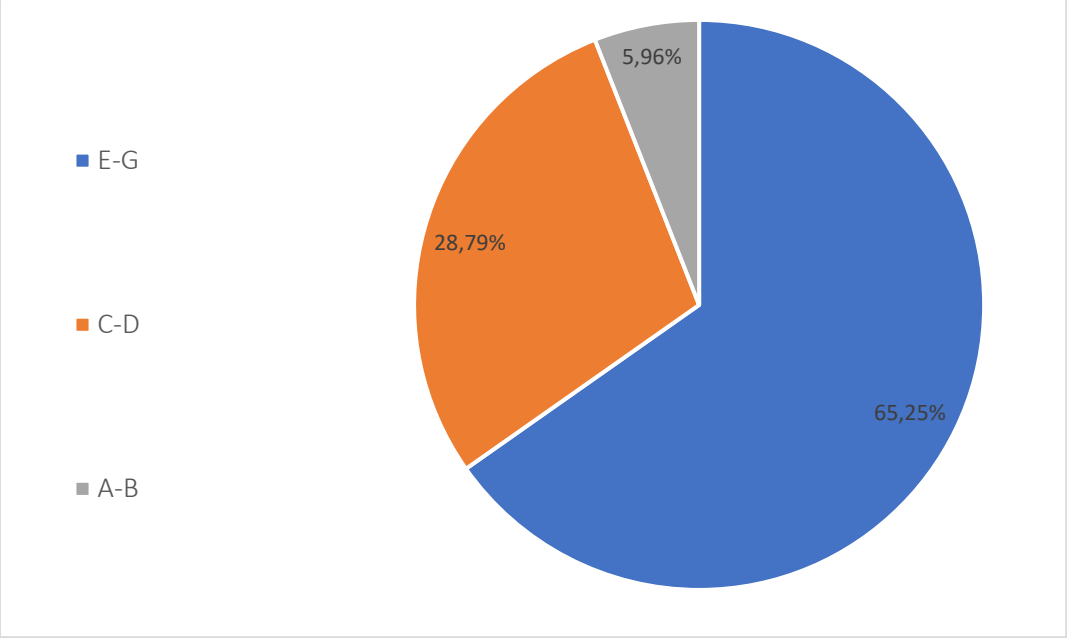

Figure 13: Building's energy certification per energy class issued in 2019 within Greece

According to the initial analysis from the available data for the status quo of the city, private buildings are one of the two most energy demanding and CO_2 emitting areas within the city. The majority of the buildings were constructed before energy regulations were issued, in 2010 and belong in a low energy efficiency classification. Existing buildings are mainly private, mainly houses as shown in Figure 14, and buildings within the tertiary sector, while municipal buildings count for less than 1% of the building stock within the city (The Municipality of Kifissia, 2017).

The Municipality has performed energy inspections and issued Energy Performance Certificates (EPC) for many municipal school buildings. The EPC are being issued under the directive 2010/31/EU for energy performance of buildings and according to the national energy performance building regulation issued in 2010 and the technical instructions, revised in 2017. EPCs can be issued only by certified energy inspectors on the registry of the Ministry of Environment and Energy. The majority of the EPCs issued categorizes municipal school buildings in a low energy performance of class D, E or F.

In addition to the EPCs, the municipality has initiated inspections of the heating systems of 30 municipal buildings in order to have a more detailed analysis of the energy status of the

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buildings, and to select the most efficient energy refurbishment actions. The reports of the inspections will include energy performance of the system as well as suggestions and proposals for energy upgrades or adjustments and repairs needed.

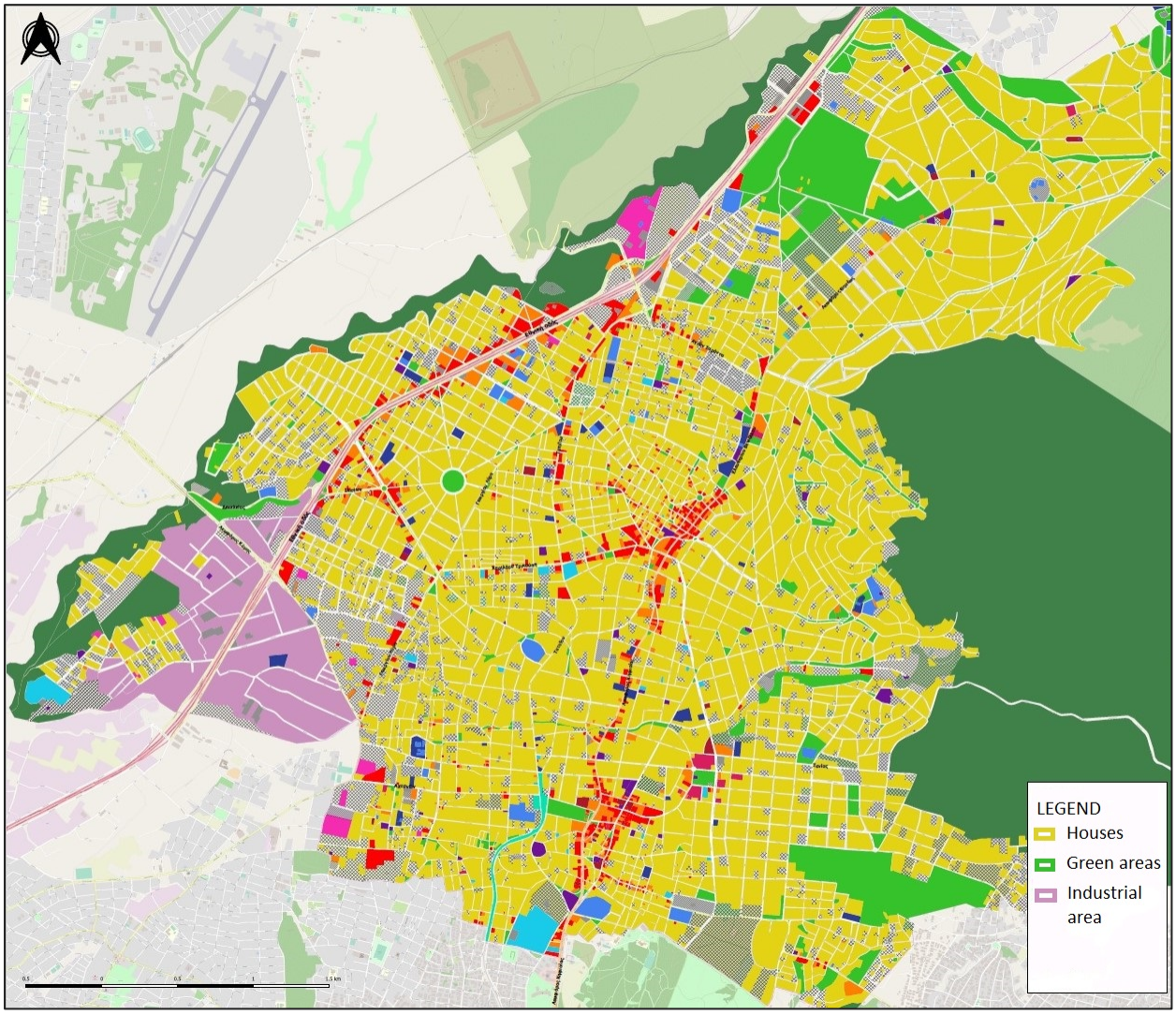

Figure 14: Land use in Kifissia- houses shown in yellow

The main source of energy for households is petrol or gas for heating and mainly electricity from the network for cooling. Several solar panels are used in households, primarily for water heating (The Municipality of Kifissia, 2017).

There is a very low rate of energy refurbishment in existing buildings caused mainly by financial issues. Existing funding options from local schemes can be applied only to a very small percentage of the buildings. Installation of RES like photovoltaic or solar panels on the roof of apartment buildings can be challenging due to differences in opinion or financial status of the co-owners.

In Kifissia, the use of roof tile is usually mandatory by urban and architectural regulations and in many cases, this could cause technical problems in installing solar panels. Getting the best orientation for enhancing produced solar energy is challenging also when inclined roof tiles are in place.

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According to the data available and for the reference year 2015, energy produced by renewable energy systems within the Municipality is 9,364MWh while total energy consumption, for the same year is 1,135,730MWh (The Municipality of Kifissia, 2017).

8.1 Strategic plans and Goals

The Municipality of Kifissia joined the Covenant of Mayors initiative in 2015 and adopted SEAP in 2017. Through the SEAP, the municipality identifies objectives and appropriate activities to implement till 2030 for safeguarding natural environment, promoting energy – friendly urban development and ensuring quality of life.

The calculated emissions within the city, for the reference year 2015, are 630,087 tons of CO_2/year. The goals of the SEAP include reduction of 40% of CO_2 emissions by 2030. In addition, proposed actions are targeting to also improve social and economic state, creating a healthier environment and a better quality of life for dwellers (The Municipality of Kifissia, 2017).

Proposed interventions regarding municipal buildings, include energy uprating of building's cell, upgrading heating and cooling systems as well as existing lighting. A renewable energy system, like photovoltaic or solar panels and a building energy management system will contribute to the desired goal.

Figure 15 shows that Houses, tertiary buildings and private transportation are the most energy demanding sectors within the municipality. The 2030 goal of the SEAP is to achieve a 40% reduction of the CO2 emissions and a 32% energy saving by 2030, compared to reference year 2005 (The Municipality of Kifissia, 2017).

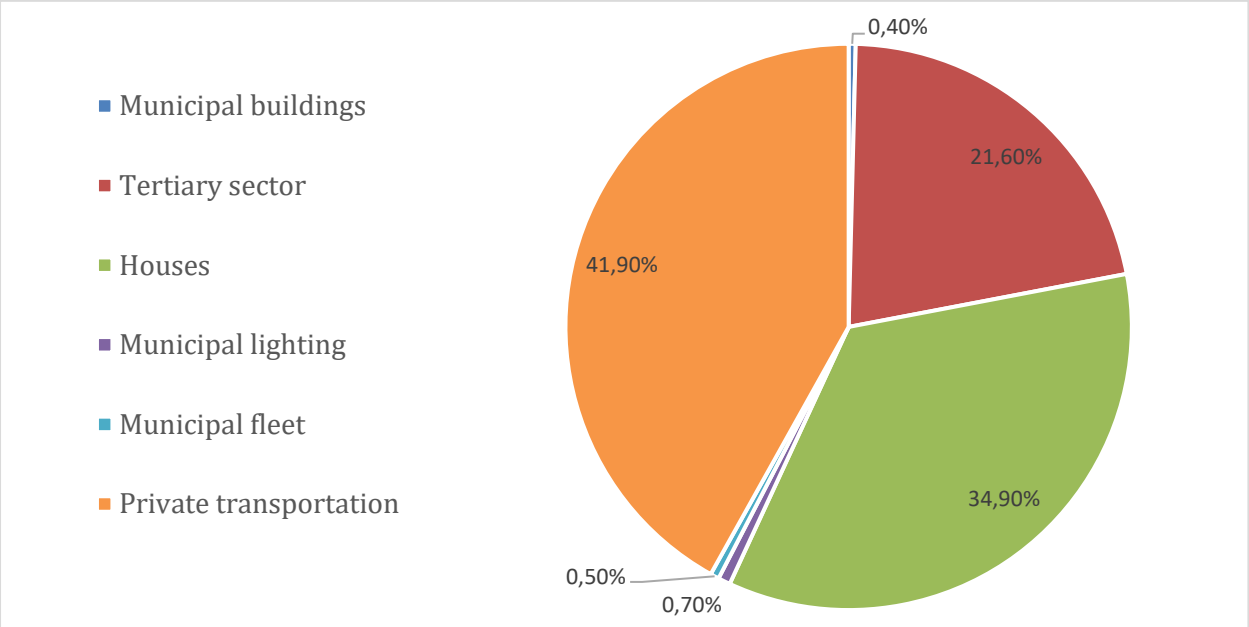

Figure *15*: Total energy consumption in Kifissia in different areas

(The Municipality of Kifissia, 2017)

In order to address the energy demanding private sector, buildings and transportation, the Municipality issued a dissemination and information plan of the SEAP in 2018. The plan is targeting three main axes: habits of consumer, technology available and legal restrictions.

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The dissemination and information action plan proposes different actions for disseminating the objectives of SEAP. Actions include use of media newspapers, radio and tv as well as social media and digital means of communication. In addition, face to face or online informative events, workshops, seminars and presentations are to be organized in order to reach and engage as many citizens and local organizations as possible.

Municipal Operational program 2019-2023 sets the adoption of a sustainable energy management and reduction of CO_2 emissions as primary goals of the city. Main objectives also include energy savings studies for buildings, digital transformation and actions for raising citizens' awareness and engagement.

The National Climate Change Adaptation Plan (NASCC) drafted in 2016 sets out the general objectives and implementation tools for the adaptation strategy in line with the EU directives. The objective of the NASCC is to contribute to the resilience against climate change impacts and set the basis for the specification of adaptation policies and actions for the 13 administrative regions of Greece. This Plan was revised in 2019 (Hellenic Republic, Ministry of the Environment and Energy, 2019) and in December 2021 Greece introduced a new Climate Law in a consultation process, in order to address new goals according to the latest EU Climate Change guidelines. The final text is expected to be published in 2022.

The share of renewable energy in gross final energy consumption was 7.2% in 2004, and increased to 19.6% in 2019 (Figure 16), which amounts to average percentage in the EU, while the country is aiming for a 35% share in gross final energy consumption by 2030 (Hellenic Republic, Ministry of the Environment and Energy, 2019). In addition, the objectives for 2030, according to revised and more ambitious NECP 2019 is to reduce GHG by more than 42% compared to emissions in 1990 and more than 56% compared to emission in 2005. The objective of the government strategy and the programme called lignite phase-out, is to put a complete end to the use of lignite in power generation by 2028 (Hellenic Republic, Ministry of the Environment and Energy, 2019).

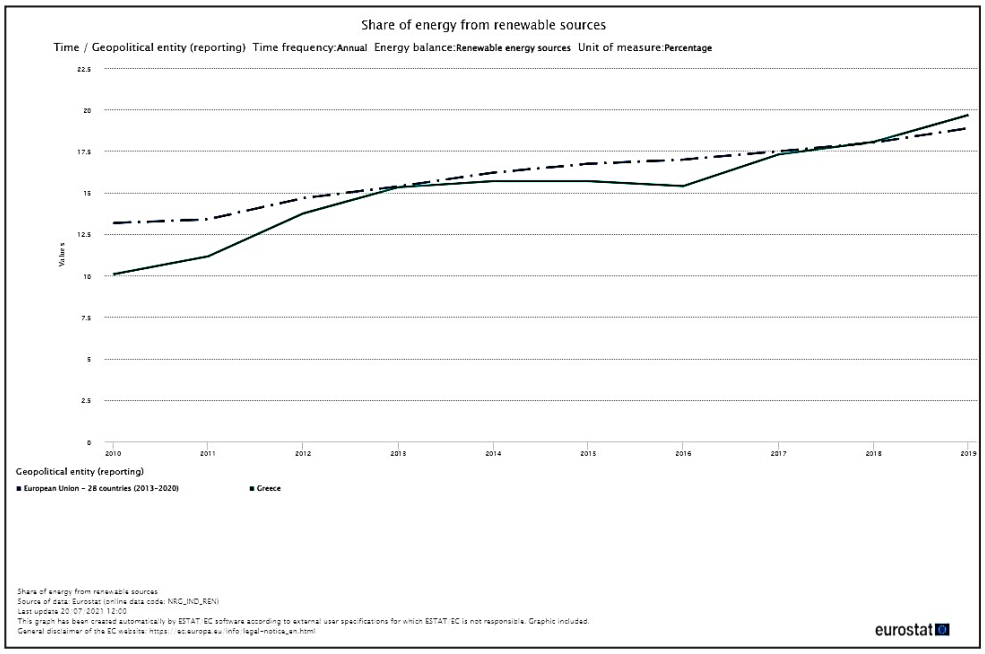

Figure 16: Share of energy from RES

(Eurostat, 2021)

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National objectives and targets include also promoting the improvement of buildings energy efficiency, increase the share of RES, bioclimatic design in urban planning, actions on energy security, energy market and innovation.

The use of e-vehicles is also being promoted by setting a minimum number of chargers in buildings but also in public areas within the municipalities.

The government's strategy includes legal and financial incentives as tools for supporting Renewable Energy Technology (RET) investments (Hellenic Republic, Ministry of the Environment and Energy, 2019) .

Greece accounted for 2.4% of total EU GHG emissions in 2019, this is a 36% decrease from 2005, in a higher pace than the EU average, while increasing the share of energy from renewable sources (see Figure 17).

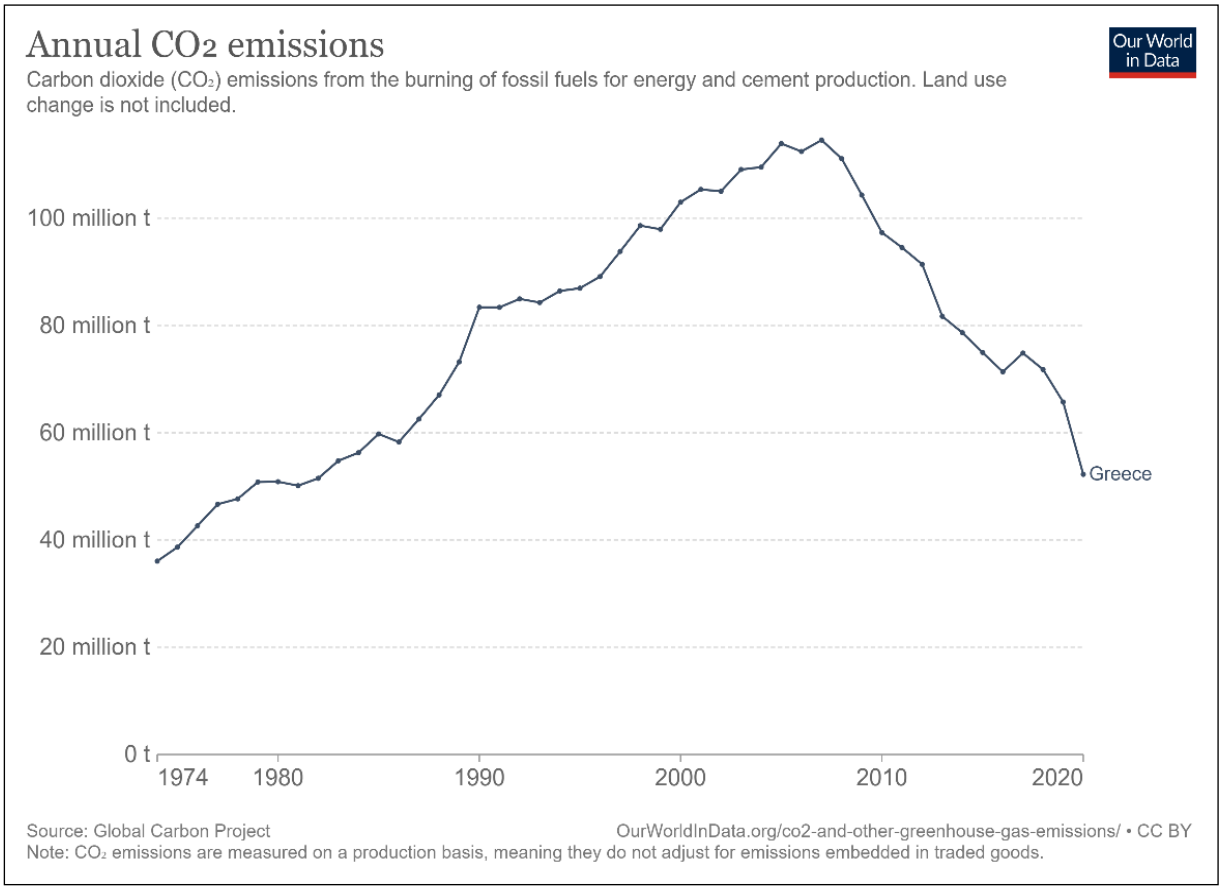

Figure *17*: Annual GHG emissions of Greece

(Hannah Ritchie et al., 2020)

In 2019, The Greek Ministry of Environment and Energy (MEEN) prepared the long-term strategy for the year 2050, and was submitted by Greek Government, to the European Commission after public consultations in early 2020. The long-term strategy was developed complementary and in addition to the National Plan for Energy and Climate, which is the main strategic plan for implementation action in the field of energy and climate (Hellenic Republic, Ministry of the Environment and Energy, 2020).

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8.2 Indicators and Action Fields Analysis

Kifissia, as well as all urban areas in Greece, had in July 2022 an average residential electricity supply cost of about 0.245€/kWh, while extra charges and taxes were 0.185 €/kWh, Regarding gas prices, an average value is 0.125€ /kWh (*PPC*, 2022). Naturally, both prices vary regionally and depend on the retailer as they offer different contracts to their customers. The cities' inhabitants have slightly less electricity consumption of 6.24 MWh/year than in northern European countries, placing it within the middle "yellow" range benchmark of total electricity consumption. However, the city's household electricity consumption indicator is shown to be as high as 7.49 MWh/household/year. This value places the city within the "red" benchmark for exceeding 5 MWh/household/year.

A Review of the energy related action fields and indicators show that no share of the energy demand is delivered by district heating system which is because the city has not yet implemented any centralized energy supply networks. Therefore, an opportunity for development and improvement becomes apparent in this area. Connecting smart grid technologies and the possibility of using renewables for the energy production is mainly where the city falls behind. However, the assessment of the related action fields indicates that the city is already, partially and in some ways, working on promoting the use of renewable energies as well as running a program to inform and educate citizens on energy efficiency and user behaviour.

As further steps to be adopted by the city for upgrading the city's performance in this regard, an investment plan for modernizing public buildings and infrastructures might be developed as well as working towards optimizing the city's the energy use of buildings and infrastructures using sensors and other management tools.

Table 3: Sample energy indicators for Kifissia[1]

Indicator description	City Value	Green	Yellow	Red
Total energy use of the city per cap (MWh/a/cap)	15.93 MWh/a/cap	< 15	15 - 20	> 20
Total electrical energy use per cap (kWh/a/cap)	6244KWh	< 3000	3000 - 7000	> 7000
Electricity consumption per household (kWh/household/year)	7490KWh	1,500–3,500	900–1,500; 3,500–5,000	< 900 or > 5,000
Average electricity price for private consumers (€/kWh)	0.46	< 0.21	0.21 - 0.35	> 0.35
Average price for natural gas for private consumer	0.055	< 0.055	0.055 - 0.07	> 0.07

[1] Data collected in 2020, revisions are advised due to recent developments

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9. MOBILITY PROFILE KIFISSIA

The Municipality of Kifissia (Municipalities Kifissia, NeaErythrea and Ekali) is characterised by residential areas, industrial areas, forest areas and areas of other uses such as hospitals and museums. Kifissia is connected to the broader region through the highway Ethniki Odos Anthinon-Lamias, Leoforos Kifissias and Thiseos together with their connecting roads, which attract most motorised movements as shown in Figure 18. The highway itself has a length of 3.7km within the municipality of Kifissia and 2.5km within Nea Erythrea. In the municipality, there is a significant number of junctions, which cause delays, where service for pedestrians is deficient and the separation or intersection of traffic streams is harming a smooth flow or where users have vision problems in the intersection (The Municipality of Kifissia, 2021b).

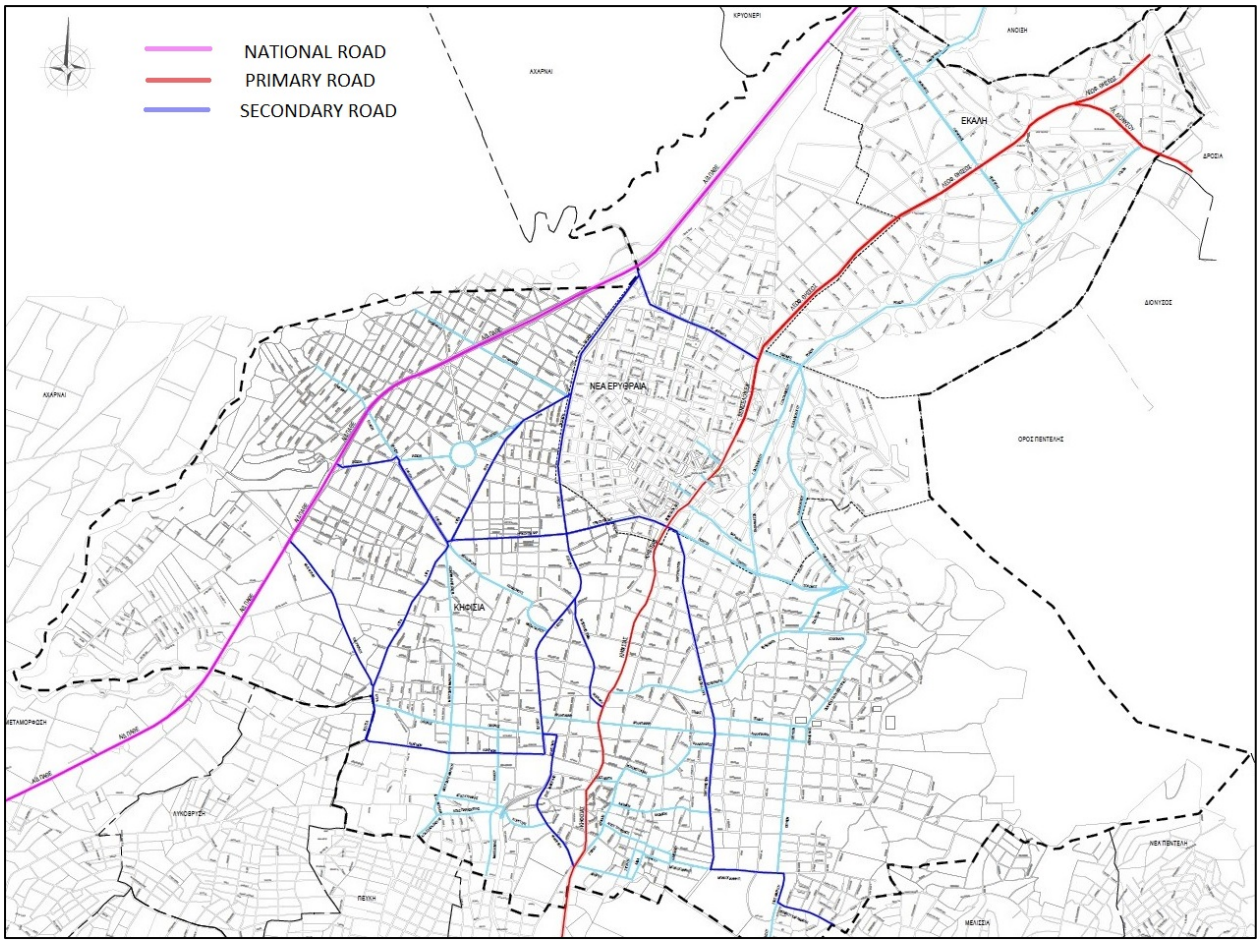

Figure *18*: Main Road network of Municipality of Kifissia

(The Municipality of Kifissia, 2021b)

The green metro line (line1) from Athens arrives in Kifissia, which is the terminal station the municipality of Kifissia and has two stops within the city – one is located in the centre of Kifissia and the other one at the border with the adjacent municipality Maroussi. The ride from the centre of Athens to Kifissia takes around 30 minutes with this connection.

The metro line 1 is the oldest from the 3 lines of Athens metro, connecting Kifissia to Piraeus passing through 24 stations, within approximately 50 minutes.

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An indicative passenger traffic rate for the terminal station in Kifissia for the period of 1/10/2019 - 31/10/2019 is 317,802 persons boarding and 292,480 persons disembarking (Athens Urban Transport Organisation, 2019).

The city is also connected with the rest of Attica and the adjacent municipalities via bus lines. Additionally, the borough is well served with a total of 21 bus lines running through all three municipal units.

Public bus transportation within the city is operated by the Road transportation SA (OSY SA), which is coordinated and controlled by Athens Urban Transport Organization (OASA SA) under the supervision of the Ministry of Development, Competitiveness, Infrastructure Transport and Networks, while metro lines are operated by Urban Rail Transport SA. There was no Municipal public transportation system until the time of writing this plan.

According to the analysis of the questionnaires stated in the 1st phase of the SUMP, the main mode of transportation for citizens of the Municipality is private vehicle, and accounts for 72% while walking is preferred from 12% of the people and bicycling only from 4% of the inhabitants (The Municipality of Kifissia, 2021b).

In the same document, it is reported that the major problems that citizens are facing during transportations is lack of parking spaces, public transport routes are not frequent enough, walking is not comfortable and there is poor road quality.

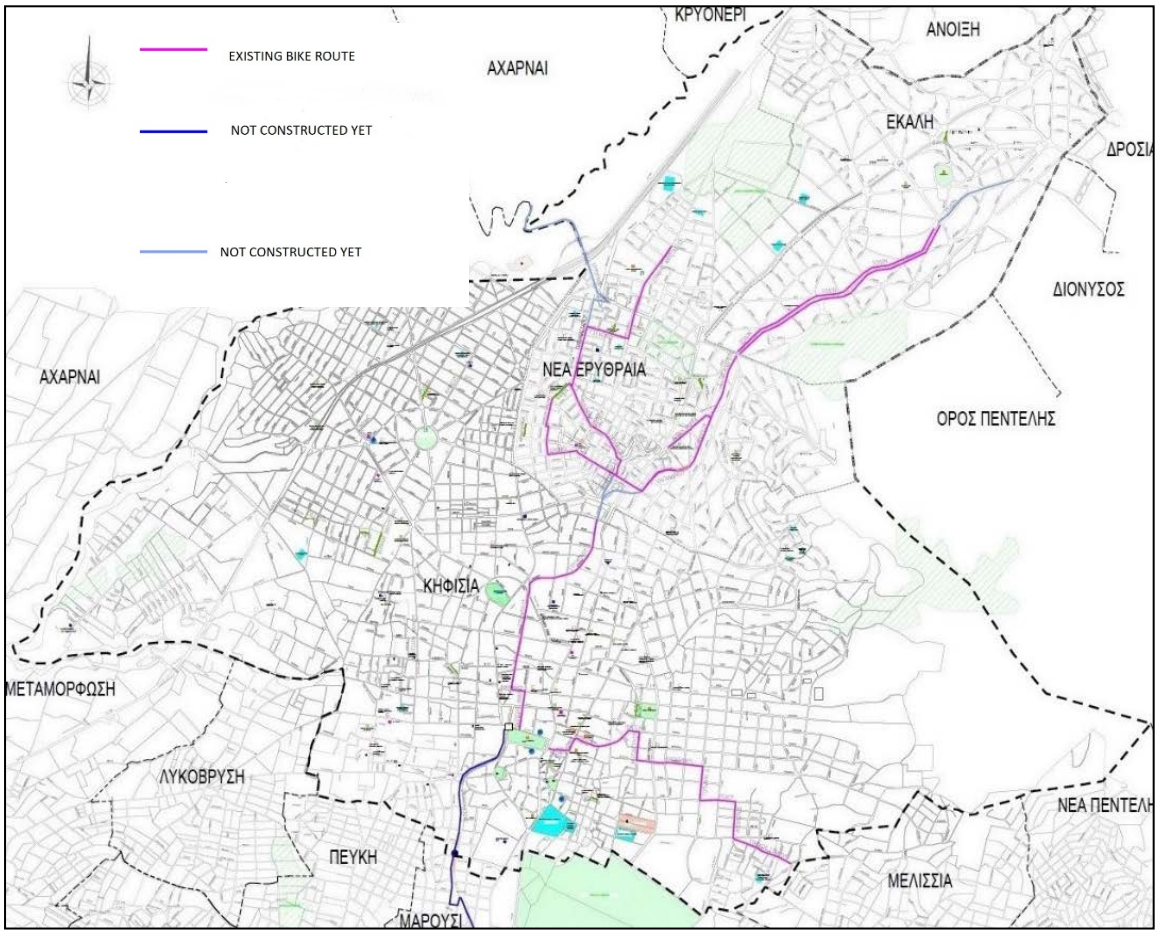

Figure 19: Kifissia's existing bike routes

(The Municipality of Kifissia, 2021b)

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There is a controlled parking system in the area of the commercial center of Kifissia with parking spaces and in the center of Nea Erythrea with 180 parking spaces, including spaces reserved for citizens and visitors). Park and Ride in the area close to the terminal station of line 1 can be very challenging.

The average value of walkability is 5.7 with highest 69.57, (50-69 medium walkability, 70-89 high walkability) this big difference is due to the large areas within the municipality that are not urban space, and they score 0 (The Municipality of Kifissia, 2021b).

Electric vehicles (EV) are not commonly used within city and there are no public EV charging stations at the moment, while the most common fuel used for vehicles, privates as well as municipal, is still diesel and petrol

The municipality has a bicycle network with a total length of 6 km in Nea Erythrea, 5 km in Kifissia and 3.7km within the municipal unit of Ekali, constructed between the years 2009-2010 (Figure 19).

Mobility is the second most energy demanding area within the Municipality and Figure 20 shows that private transportation accounts for most of it.

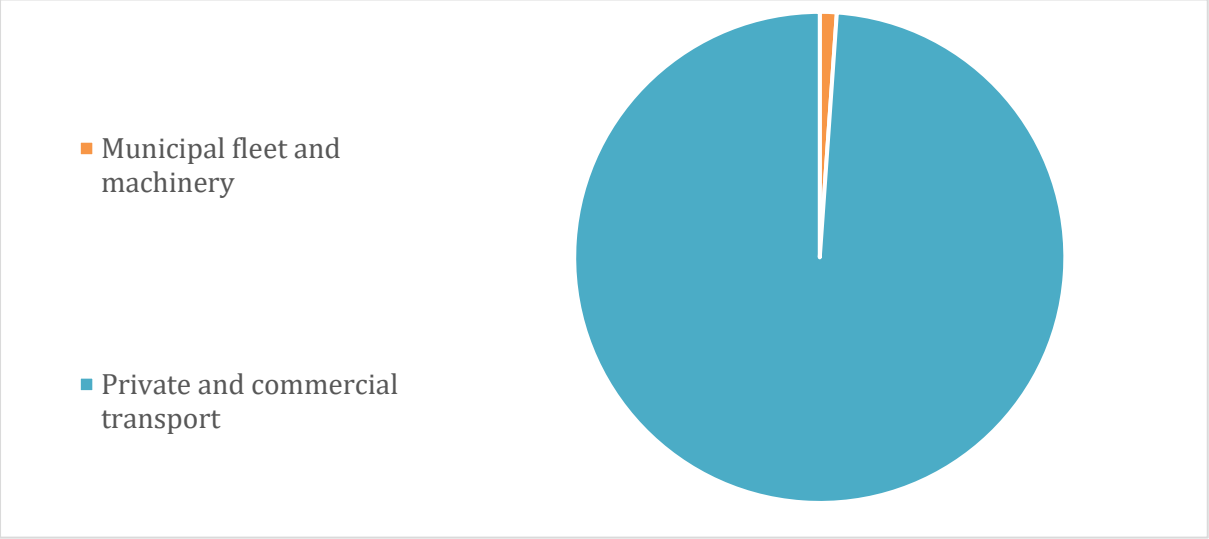

Figure *20*: Energy consumption of mobility (MWh)

(The Municipality of Kifissia, 2017)

Regarding municipal fleet, garbage trucks (waste collection vehicles) and dump trucks are the most energy consuming and CO_2 emitting vehicles. Garbage trucks that are 24% of the vehicle fleet and account for 40% of the energy consumption and CO_2 emissions. Dump trucks are 12% of the vehicle fleet and account for 14% of the energy consumption and CO_2 emissions (The Municipality of Kifissia, 2017).

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9.1 Strategic plans and goals

The municipality of Kifissia is considering residential mobility directly linked to the operability of urban space, quality of life and access to activities in the city and therefore wants to provide sufficient service. Municipality of Kifissia has created a sustainable urban mobility plan using the SUMP model, which is the concept the European Commission (EC) encourages cities and towns to use when creating a mobility plan. Kifissia wants to upgrade the urban environment through reorganising and improving the urban mobility infrastructures, strengthening the accessibility of the city centre, reducing the noise pollution in residential areas, increasing the use of public transport and active mobility modes, while reducing the use of private vehicles. Furthermore, Kifissia aims to reduce energy consumption and associated greenhouse gas emissions of the transport sector. The efficient use of new technologies shall help to manage the mobility flow and inform citizens. Kifissia also wants to ensure safe and inclusive transportation, also for persons with reduced mobility or disabilities, and wants to strengthen the inclusive and democratic decision making processes relating to mobility within the city.

The SUMP sought to tackle urban mobility as a field intersecting traffic, urban, environmental, economic and social issues, as well as elaborate tools and approaches on participatory planning. In this sense the SUMP treats issues of urban mobility in relation to land use, urban green, organization of finance activities, urban infrastructure, and the everyday needs of residents, workers and visitors. Note that the specialized nature of studies required the following: specific equipment (e.g., equipment for measurement of traffic volume); the requirement for license B class and above the basic category 10; and the requirement for study groups with extensive experience in drafting controlled studies.

The Sustainable Urban Mobility Plan of Kifissia was approved in April 2021 by the city council. During the four phases of the plan, participatory actions included open, face to face consultation; an idea submission platform; and online consultation. Additionally, questionnaires were used to identify habits, needs and problems of the citizens. Through this participatory procedure, the interaction between decision makers and citizens was promoted, targeting commonly accepted solutions.

The main goals of SUMP are to upgrade public spaces and urban environment by reorganizing urban mobility, promoting sustainable modes of transportation, minimizing the use of private vehicles, and reducing energy consumption and greenhouse gas emissions (The Municipality of Kifissia, 2021b).

Aligned with the goals of SUMP, as well as the project ideas and the outcomes from the innovation workshop, the first vehicle sharing system of the Municipality is under study. This will be a bike and e-bike sharing system with docking stations around the city's area. The location of the docking stations will be finalized, taking into consideration the future municipal bike route extension, as well as the metropolitan network of bike route proposed in the new Master plan of Athens. The proposed network of bike routes connects the Municipality of Kifissia with Faliro, in the southern part of Attika, through a 27 km ride.

National law 4710/2020 "promotion of e-mobility and other provisions" sets, among other specifications and regulatory issues, the minimum number of charging stations for municipalities in 1 per 1000 citizens. Aligning with this recent law, a plan for the first municipal e-vehicles charging stations has been approved (LEVER - ΣΥΜΒΟΥΛΟΙ

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ΑΝΑΠΤΥΞΗΣ Α.Ε., 2022). The plan aims to facilitate and promote the use of e-vehicles, thus reducing the dependence on mineral fuels and therefore CO_2 emissions.

The installation of the chargers is going to be implemented in three phases. First phase includes 54 charging stations in central commercial areas.In the second phase, 44 extra stations will be added in public squares and residential areas of the city. Finally in phase 3, 18 complementary charging stations will be added in the city (see Figure 21) (LEVER - ΣΥΜΒΟΥΛΟΙ ΑΝΑΠΤΥΞΗΣ Α.Ε., 2022).

There are currently 14 charging stations within city's limits (LEVER - ΣΥΜΒΟΥΛΟΙ ΑΝΑΠΤΥΞΗΣ Α.Ε., 2022). Lack of available charging stations are one of the limitations when considering using an e-vehicle, and the above-mentioned plan attempts to address this problem.

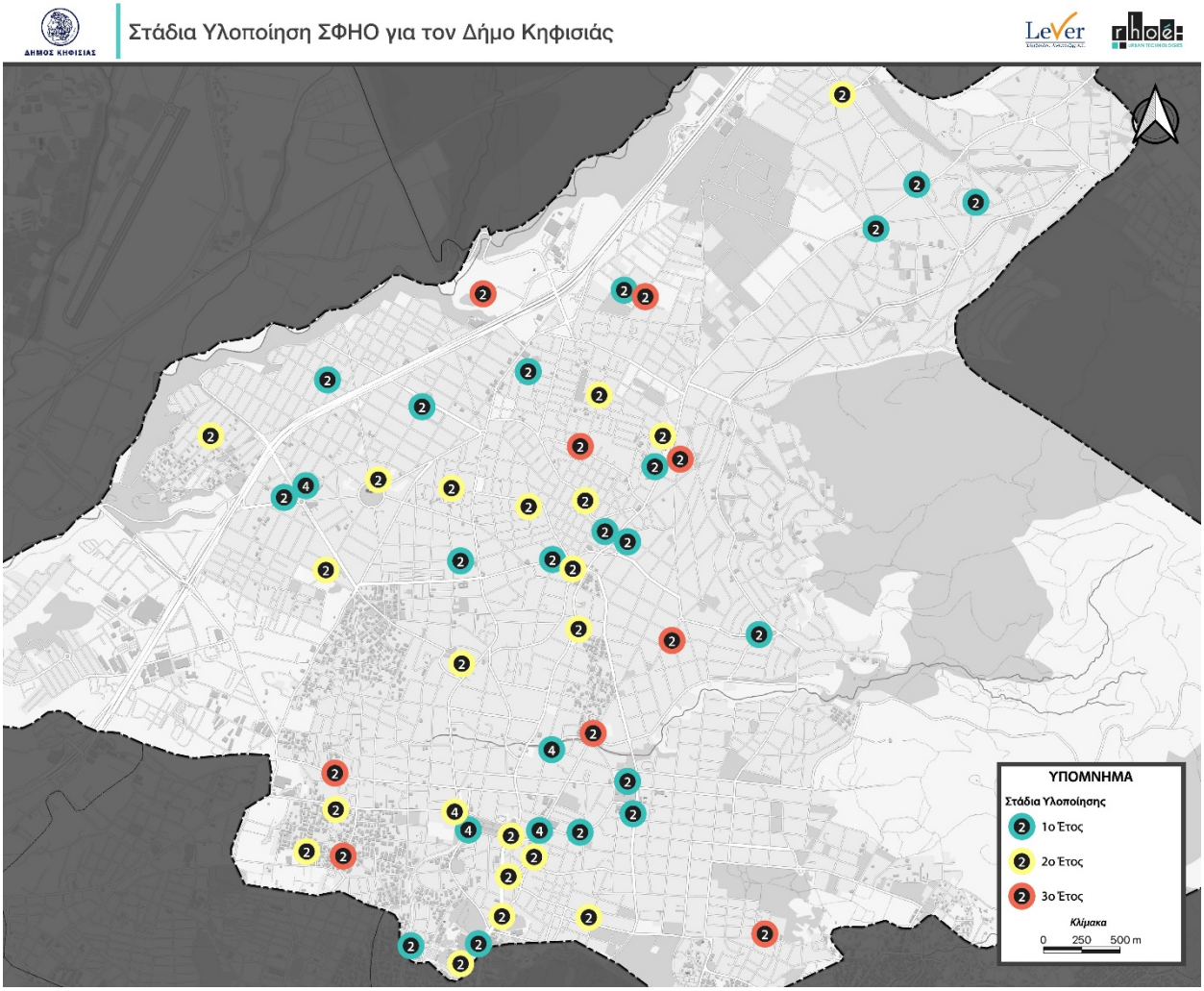

Figure *21*: Phases of charger installation implementation

(LEVER - ΣΥΜΒΟΥΛΟΙ ΑΝΑΠΤΥΞΗΣ Α.Ε., 2022)

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9.2 Indicators and Action Fields Analysis

The city's indicators reveal a rather underdeveloped bicycle infrastructure. In Kifissia, only 14.3 Kilometer of bicycle path is available per 100,000inhabitants. This value is significantly below the "red" zone benchmark at 35 km/100,000 inhabitants. Examining the modal split of a city is a very important indicator for assessing the condition of its mobility sector. Since the modal split values of the different transportation modes is not collected for Kifissia, it is challenging to provide an overview of the mobility performance in the city. However, by reviewing the action fields for Kifissia, it is possible to identify some focus areas and highlight recommendations that can be adopted by the city to better develop the mobility sector.

It is evident that prime focus must be geared towards enhancing and promoting active mobility, E-mobility, and mobility sharing systems. Incentives for purchasing electric vehicles (EVs)and including them in the city's municipal fleet are possible steps to reinforce E-mobility within the city. As Kifissia is already actively identifying and resolving danger areas and spots for cyclists, establishing a mobility plan where pedestrian and cycling movements are the core, is an essential action for transforming the state of mobility. Furthermore, committing to a systematic approach towards decreasing the number of cars through less car parking spaces and streets to provide more public green spaces would be advisable.

Table 4: Sample mobility indicators for Kifissia

Indicator description	City Value	Green	Yellow	Red
Water (%)	0%	> 17	1 - 17	< 1
Share of electric vehicles in local transportation as percentage of total number of vehicles registered (%)	0.0020%	< 5	1 - 5	> 1
Average age of fleet in use (years)	15	< 6	6 - 12	> 12
Kilometers of bicycle path per 100,000 population (km/100,000 inhabitants)	14.3km	> 90	35-90	< 35

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10. PROJECT IDEAS FOR THE TRANSFORMATION OF KIFISSIA

10.1 Virtual Onsite assessment

During the on-site assessment, a total of 29 project ideas (see Table 5) were developed together with the interviewees and during the internal co-creation sessions with the local team. These project ideas were inspired by the implementations in the Lighthouse cities in SPARCS. The onsite assessment was held online due to covid-19 restrictions, organized by local and FHG team during February and March 2021. A total of 10 interviews took place, involving representatives from many city departments including the deputy mayor of technical department of environment and recycling as well as the Mayor of the Municipality. The interviews were held in English, a member of the local team acted as a translator when needed.

Table 5: List of Project ideas

Governance	
1	Creating a Renewable Energy task force
2	Intersectoral Department for Innovation
3	Intersectoral communication
Mobility	
4	Bike sharing system
5	Mobility Hub
6	Electric Buses
7	City wide bike route
8	Smart parking system
9	Kifissia Super Blocks
10	Kifissia Green Corridors
11	Kifissia Park and Rides
Citizen Engagement / Environmental Awareness	
12	Energy efficiency awareness campaign
13	Municipal program to promote energy refurbishment
14	Info kiosks
Energy	
15	Energy community
16	Energy refurbishment of private houses -demo block
17	Creation of PV power plant-virtual net metering

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18	Energy refurbishment in Municipal buildings
19	local (small) hydroelectric power generator
ICT	
20	City wide flora and fauna monitoring system
21	Exchange program for data governance and platform
22	Cameras/sensors for traffic control and environmental data
23	Water consumption management
24	Fire control / civil protection management
Circular economy	
25	Expert training in waste management and circular economy
26	Waste to energy plant
27	Composting project
28	Used cooking oil recycling program
29	Electrification of waste management fleet

10.2 Project filtering

The project filtering was done by the local SPARCS team under the advice and suggestion of representatives of the Municipality. The criteria for the final selection of the six project ideas that were discussed during the workshop, included the need to hear stakeholders' opinion, political support, availability of resources needed to be implemented and limitations of current laws and regulations.

The project ideas filtering was finalized according to the main issues facing the city. The final innovative solutions can help in addressing the two most energy demanding areas - houses and mobility. In addition, the most demanding project idea that sets high goals was introduced, so as to get initial feedback from the participants. Some of the project ideas regarding mobility are also mentioned in the recently approved sustainable urban mobility plan.

10.3 Innovation workshop

On 11/5/2021 an innovation workshop was organized for presenting, verifying, discussing and further developing the existing ideas. The workshop was done virtually, due to covid-19 restrictions.

Twelve participants and members of the SPARCS local group joined the workshop. The participants came from different backgrounds and with different work experiences, in order to have a variety of opinions and more inclusive knowledge of stakeholder's ideas. Representatives from the Municipality, citizens, engineers and experts in mobility and urban planning joined the workshop.

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Given the limited time available on the innovation workshop, 6 out of the 29 solutions were selected by city representatives and the City Lab team, to be discussed in detail on the day of the workshop. The selected project ideas were:

- Bike sharing system
- Municipal E-buses
- Super blocks
- Energy community
- Waste to energy plant
- Energy refurbishment of private houses

The above-mentioned solutions include topics of high interest for the city and would be of immediate benefit of the citizens, focusing on the two most energy consuming areas: houses and mobility. The construction of an energy plant is a very ambition plan that cannot be implemented by the city alone, but needs to be planned in a regional level.

As an introduction, the City Lab methodology was presented. It was followed by the presentation of the preliminary results and the 6 developed ideas. The participants were divided into 3 groups, according to either their expertise or area of interest or both for a detailed discussion on a specific project package. Three members from the local SPARCS team acted as a moderator, assigning a work group and two project ideas to each of them. A pre workshop rehearsal had been organized, between members of local team, in order to decide final agenda, resolve organizational and technical issues and assign participants and project ideas.

The discussion was used to validate and further develop the projects regarding the needed components, the strategic stakeholders, next steps, possible financing options, and others. For this, templates were designed and distributed and explained to the moderators in advance. Two project ideas were assigned to each group for further discussion during two sessions of 75 minutes each. Finally, the results of the discussion and the filled templates were presented in the plenum in the form of a marketplace with a short 3-minute pitch.

The workshop was held in Greek, final posters were filled out and translated in English after the workshop by the local team. Figure 22 gives an example of the final poster from the event.

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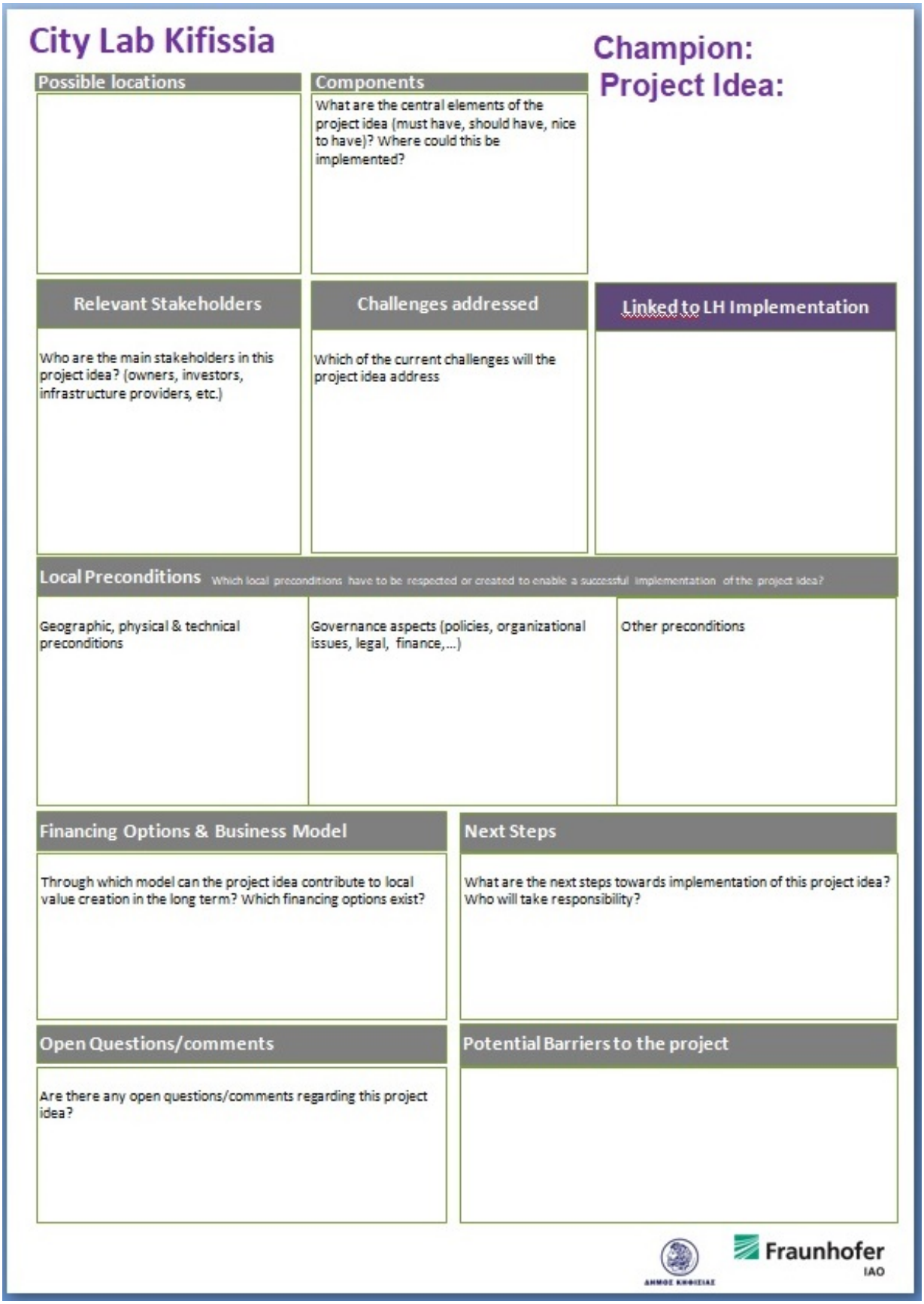

Figure 22: Example of final poster

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10.4 Project ideas for Kifissia

The six project ideas included three mobility solutions, two energy solutions and a circular economy solution as shown in the figures below.

Mobility, solution 1: Bike sharing system

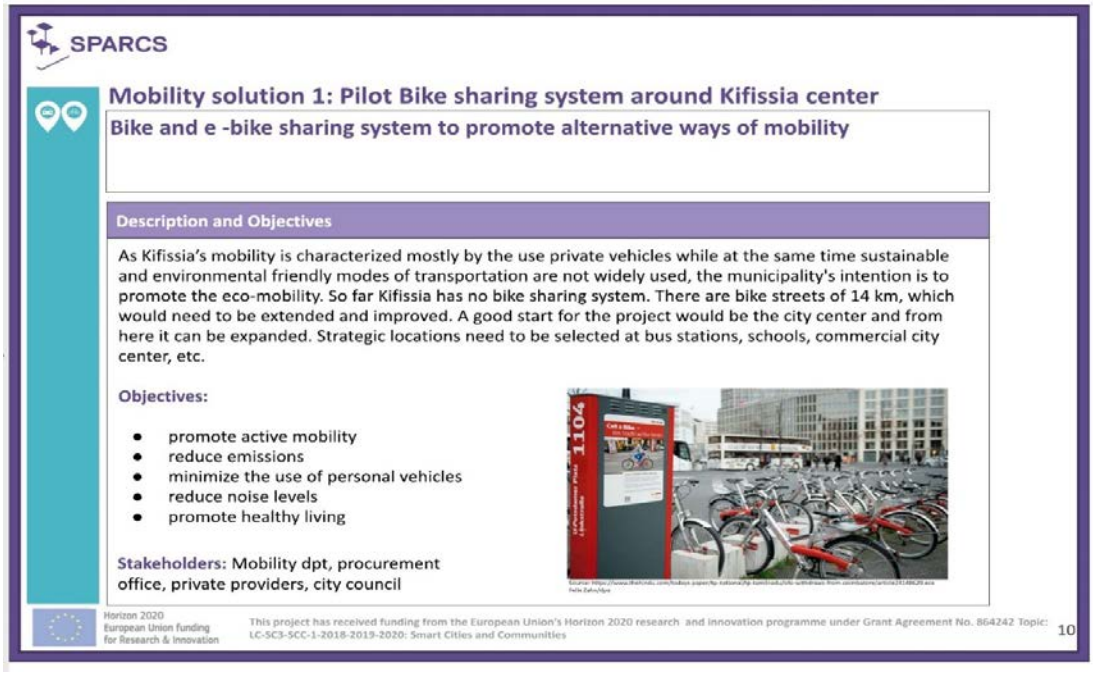

Figure 23: Presentation of bike sharing idea

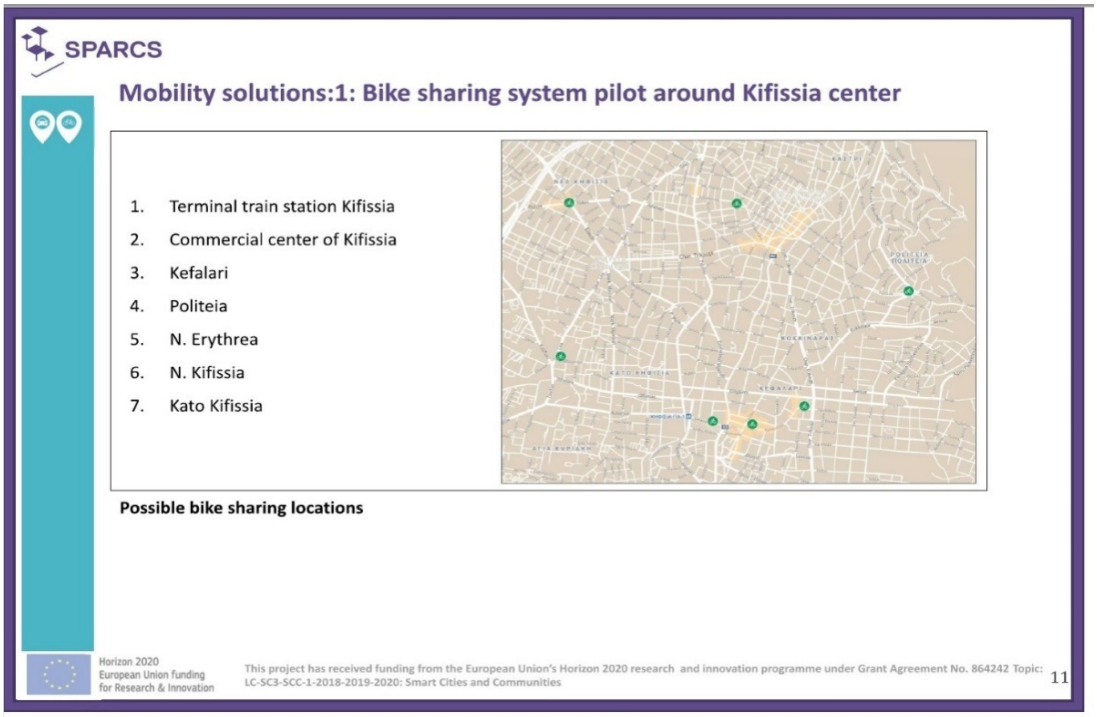

Figure 24: Presentation of dock stations possible locations

Mobility, solution 2: Municipal E-Buses

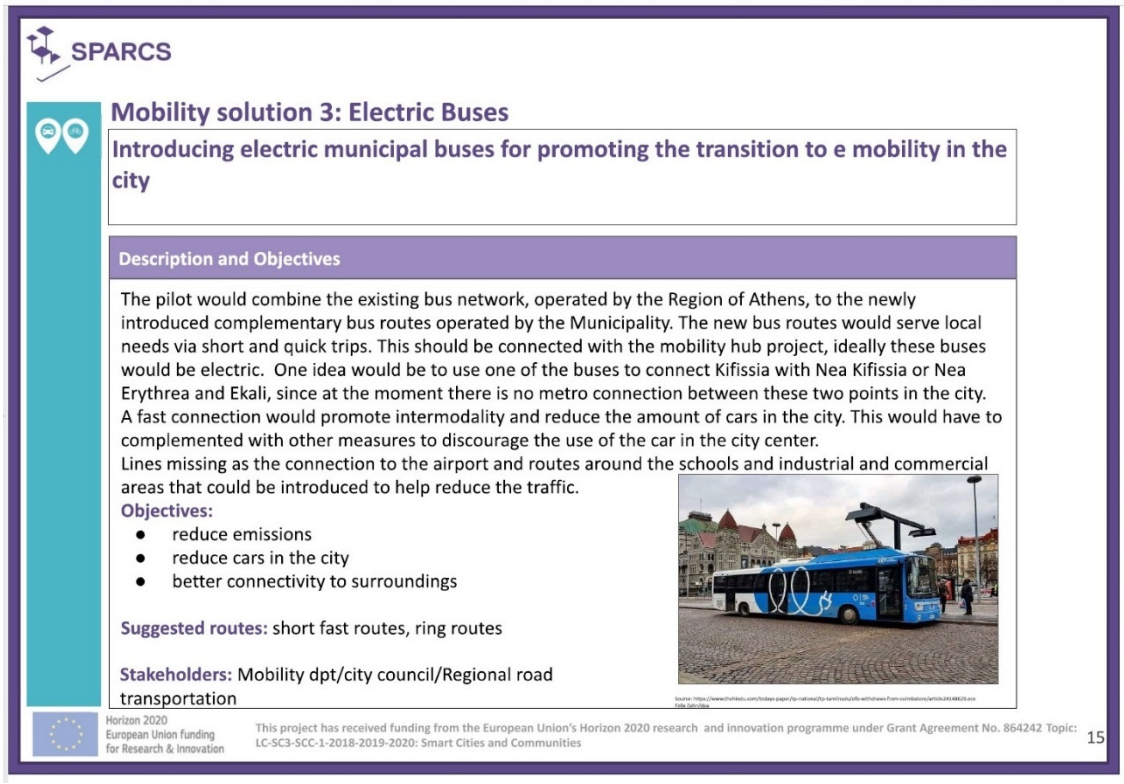

Figure 25: Presentation of E-buses project idea

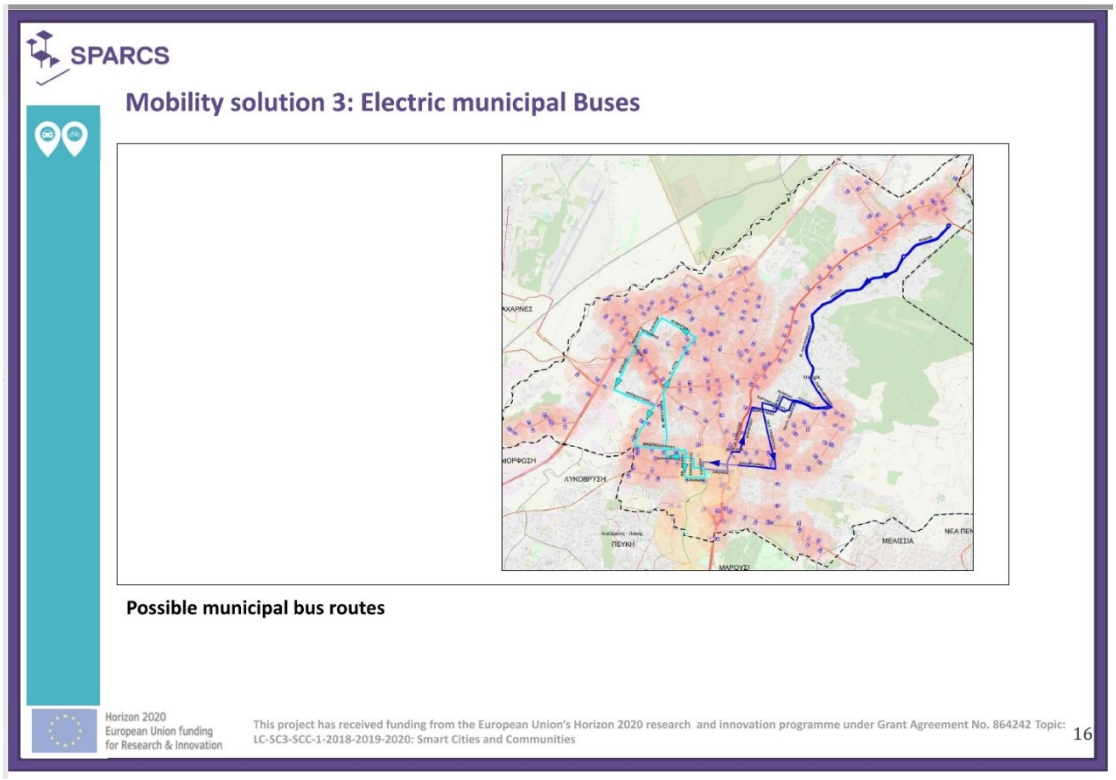

Figure 26: Presentation of E-buses possible routes from SUMP (The Municipality of Kifissia, 2021b)

Mobility, solution 3: Super blocks

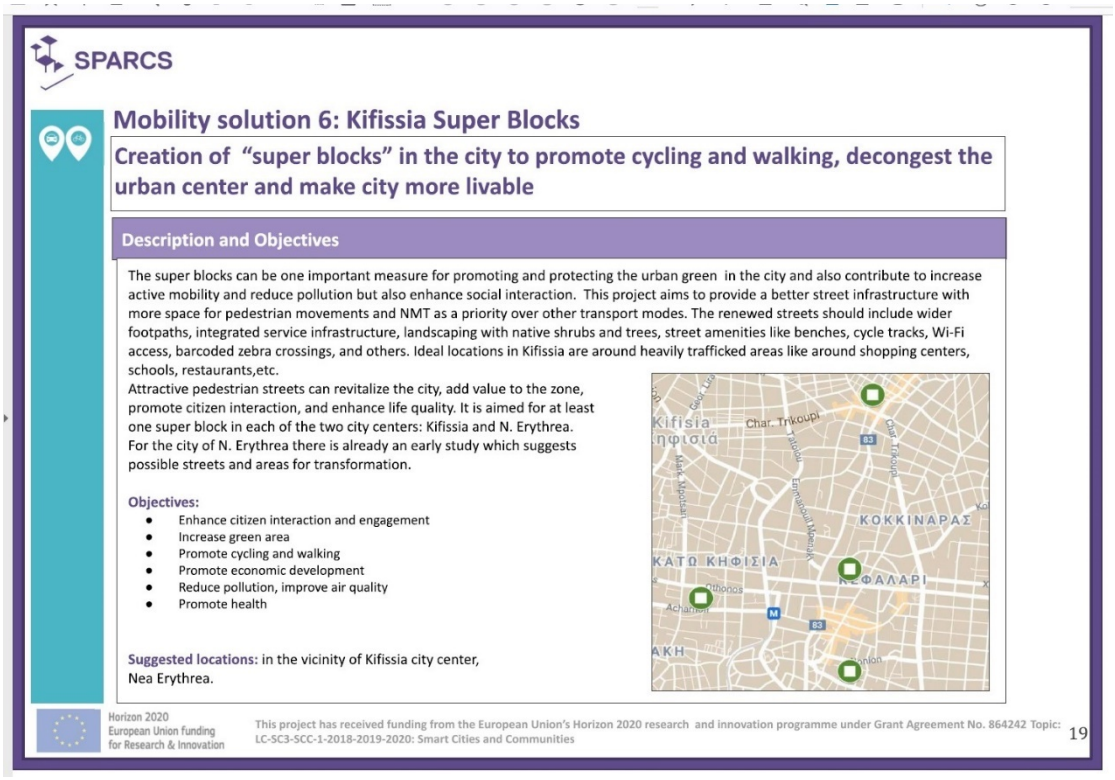

Figure 27: Presentation of Super Blocks project idea

Energy, solution 4: Energy community

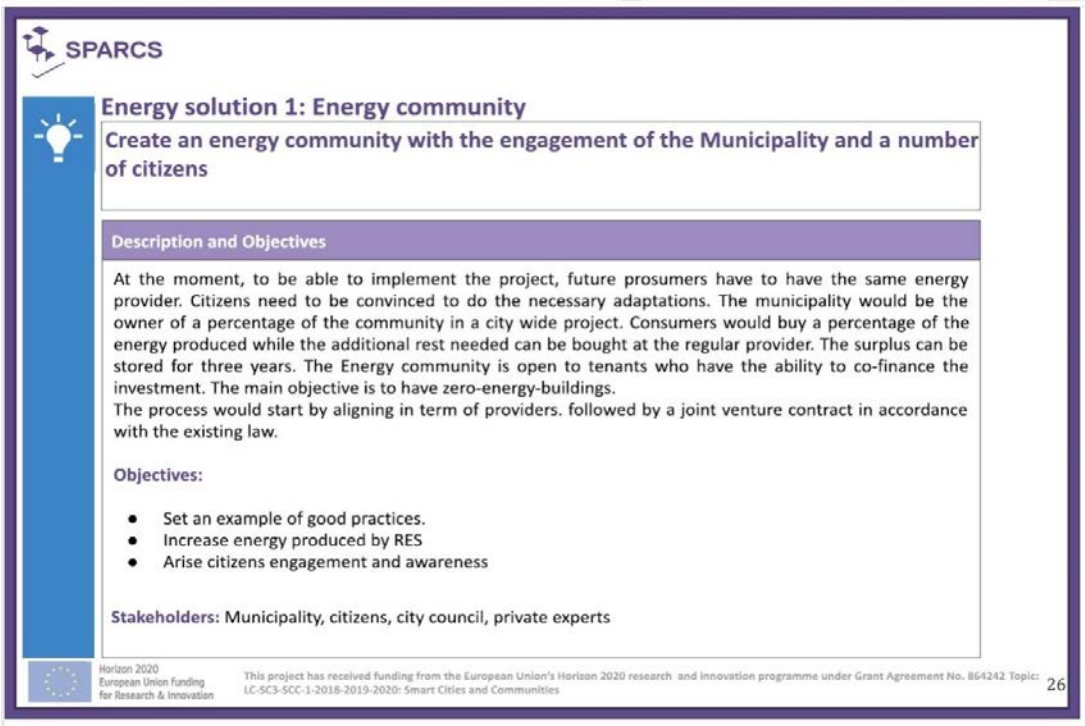

Figure 28: Presentation of Energy community project idea

Energy, solution 5: Energy refurbishment of private houses

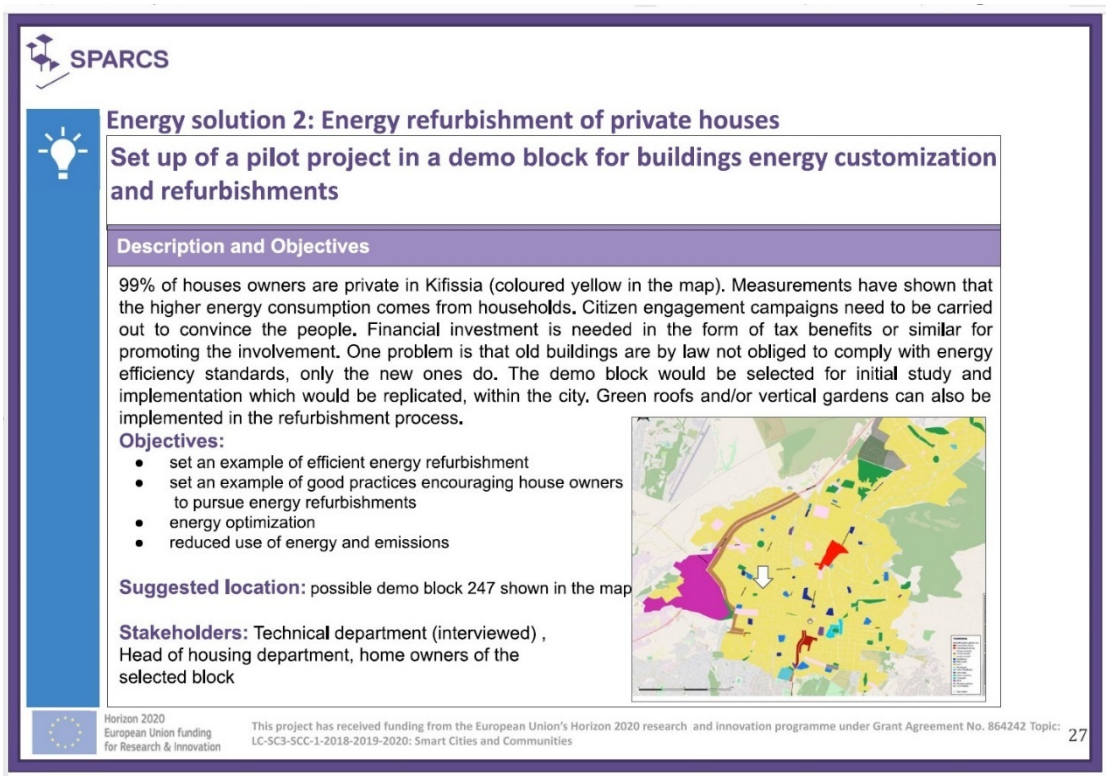

Figure 29: Presentation of Energy refurbishment of private houses project idea

Circular economy, solution 6: Waste to energy plant

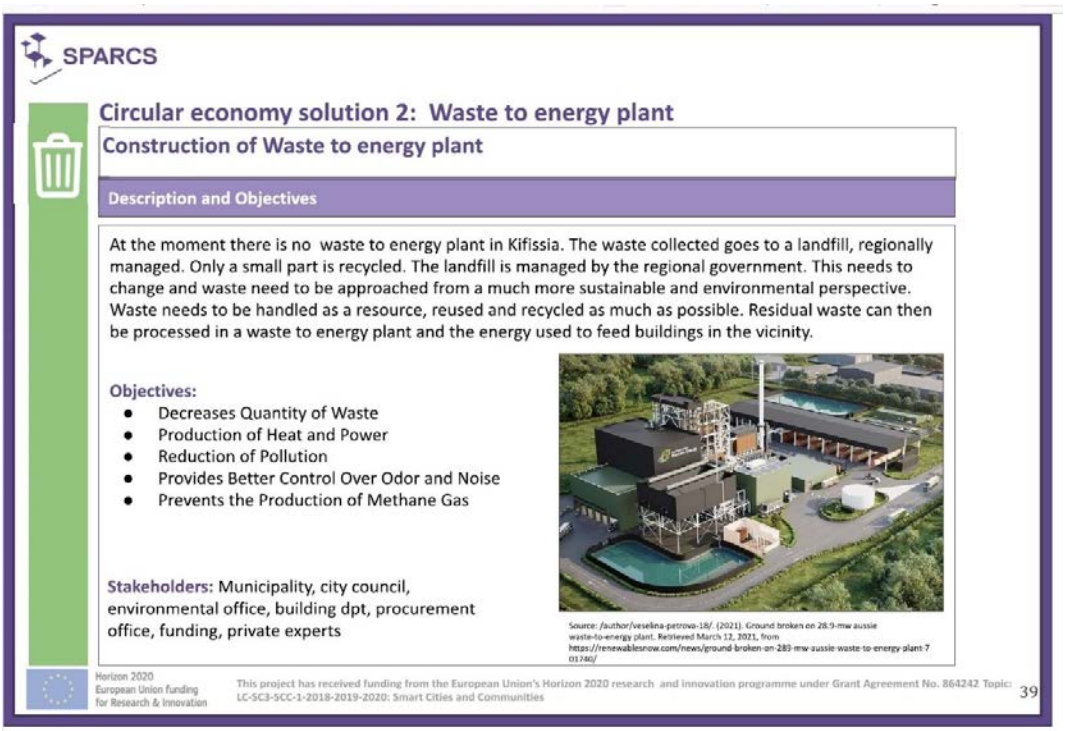

Figure 30: Presentation of Waste to energy plant project idea

Although the idea for the Waste to Energy Plant was discussed during the event, it must be noted that the realization of such a project is not an easy case, because the legislative framework puts some constraints. Waste treatment facilities are planned in the higher regional level, thus such a proposal must be discussed and approved by the Prefecture and the Attica Waste Management Association, which must carry out the waste management of the whole Attica Region including 66 Municipalities. The Municipalities themselves are responsible for the collection, source separation and light treatment of waste such as green waste.

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11. CONCLUSIONS

The current Implementation Plan of the city of Kifissia has been the outcome of a well-designed process, based on the City Lab methodology and in particular on the Morgenstadt Framework.

The activities undertaken, including the on-site assessment and the data collection process, the cooperation among the various municipal departments, the SPARCS partners and the stakeholders, provided an invaluable opportunity to better understand the city, to express its vision and to select six project ideas towards the implementation of mobility, energy and circular economy solutions.

11.1 Summary of achievements

The expression of the city's Smart Vision has been among the main achievements since it will serve as a strategic plan for success. It can act as a guide when involved parties encounter challenges and it can motivate them to work towards the achievement of the set sustainability goals.

Since Kifissia is officially classified as a municipality within the bigger agglomeration of Athens rather than an independent city, the ability to precisely assess many of its related action fields and indicators is a complex process, mainly due to the absence of certain information on the municipal level. However, within SPARCS, the municipality has worked towards the specification and assessment of certain mobility indicators that are specific to the city of Kifissia rather than Athens in general.

Another important achievement is the participation of various municipal departments in the implementation of the current deliverable, providing useful information and insight from various viewpoints within the municipality. Specifically, a total of 10 interviews took place in the virtual on-site assessment, with representatives from the technical department, the departments of environment and recycling, as well as the Mayor of the Municipality.

The participation of key stakeholders, such as the citizens of Kifissia is also one of the main achievements. Their involvement in the development of the project ideas will contribute to the relevant projects' success since the citizens will support their implementation and they will benefit from the projects' results.

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11.2 Impacts

The implementation plan, aligned with the key strategic areas, is an important instrument and holds the opportunity of aligning the city on a common mission to achieve carbon neutrality and energy positivity in the shortest possible time.

The development process, the on-site assessment and the City Lab Innovation Workshop, worked towards getting the attention and support of the relevant key stakeholders for the achievement of the project's goals and the determination of smart city project ideas, including three mobility solutions, two energy solutions and a circular economy solution.

Table 6: SWOT analysis for Kifissia

Strengths	Weaknesses
Existing strategic documents (SEAP, SUMP, General Urban Plan, Waste Management Plan)	Lack of intersectoral collaboration
Ambition to become more sustainable	Lack of personnel experience
Existing public amenities	Technical implementation expertise
Good weather facilitates promotion of alternative modes of transportation	Existing building stock is energy demanding and CO_2 emitting
Existing office for planning, monitoring, implementation and resource utilization	Low rate of energy refurbishment of existing building
Support of the Municipal Administration	Low rate of RES
Openness for innovation	Lack of data availability
	Administrative time-consuming procedures
Opportunities	**Threats**
Funding opportunities - local or EU	Bureaucracy
Networking and knowledge exchange	Financial issues
Access to best practices	Limitations of current legislation
Stakeholder engagement	Citizen's acceptance
Enhance local resources	Behavioral and existing mindset change
	Availability of areas for RES installation

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11.3 Other conclusions and lessons learnt

The activities undertaken for the development of the Implementation Plan for Kifissia, combined all the essential aspects of sustainability and focused on the community role and the importance of having a structured communication strategy to engage and inspire all the key actors in the field.

The communication and cooperation among various municipal departments has been made feasible even when it seems impossible, given the constraints posed by the pandemic. All participants showed great interest in SPARCS, expressing that it offered a great opportunity for Kifissia to set and work towards the achievement of specific sustainability goals.

The opportunity provided through SPARCS to get familiar with methodologies and solutions implemented in other cities has been of great importance for the development of the implementation plan in the city of Kifissia. The interventions in Lighthouse Cities have been inspirational for the Municipality and will contribute greatly to the achievement of its long-term visions of environmental sustainability, hopefully establishing Kifissia as a future Lighthouse City.

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12. ACRONYMS AND TERMS

SPARCS	Sustainable energy Positive and zero cARbon Communities
RES	Renewable Energy Sources
SEAP	Sustainable Energy Action Plan
ICT	Information Communication Technologies
ISO	International Organization for Standardization
ESCI	Emerging and Sustainable Cities Initiative
IADB	Inter-American Development Bank
WB	World Bank
OECD	Organization for Economic Cooperation and Development
UN	United Nations
EU	European Union
NATO	North Atlantic Treaty Organization
WTO	World Trade Organization
HDI	Human Development Index
UNDP	United Nations Development Programme
GDP	Gross Domestic Product
CIA	Central Intelligence Agency
PV	Photovoltaics
IEA	International Energy Agency
NECP	National Energy and Climate Plan
GHG	Greenhouse Gas
EU ETS	EU Emissions Trading System
ESR	Effort Sharing Regulation
R&I	Research and Innovation
EV	Electric vehicle
NASCC	National Climate Change Adaptation Strategy
EPC	Energy Performance Certificate
RET	Renewable Energy Technology
EC	European Commission
SUMP	Sustainable Urban Mobility Plan

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13. LIST OF TABLES

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