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# Comprehensive Assessment of the Potential for Efficient Heating and Cooling

## Report for Point C - Map of National Territory of Republic of Cyprus Showing Existing Heating and Cooling Demand Areas and Location of Existing and Planned Installations Generating Waste Heat and Cold

Report for Ministry of Energy Commerce and Industry (MECI) of the Republic of Cyprus

Report for MECI, Cyprus

ED 18485 | Issue number 2 | Date 9th August 2024

Customer:

Ministry of Energy, Commerce and Industry (MECI), Cyprus

Customer reference: YEEB/YE/04/2023

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9th August 2024

Ref: ED18485

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## 1.1 Introduction

Annex X of the Energy Efficiency Directive (EU) 2023/1791 requires that the comprehensive assessment of national heating and cooling potentials includes a map covering the entire national territory of the Republic of Cyprus. According to Annex X of the aforementioned directive, this map is to present the following information:

1. Heating and cooling demand areas following from the analysis of point 1, while using consistent criteria for focussing on energy dense areas in municipalities and conurbations
2. Existing heating and cooling supply points identified under point 2(b) and district heating transmission installations
3. Planned heating and cooling supply points of the type described under point 2(b) and identified new areas for the district heating and cooling.

In Sections 1.2 to 1.4, we set out our approach to satisfying these requirements. The results of our approach are presented in the Appendices in the form of extracts of the Heat Map.

The Heat Map developed is an interactive heat map and is available at the GIS Online account for MECI:

https://meci.maps.arcgis.com/apps/webappviewer/index.html?id=abe1fecb3c7b4ecc8fe451f8be14a001

## 1.2 Heating and Cooling Demand Areas

### 1.2.1 Introduction

As indicated in the Energy Efficiency Directive (EU) 2023/1791, heating and cooling demand areas are established following the "analysis of point 1". Point 1 in the context of this work are the results from Point A. In Point A, the demand for heating and cooling has been established for 2022, following the methodologies set out in the Point A report. In the Point A report, demand for heating and cooling was resolved into economic sectors (residential, service, industrial and agricultural) and end use (space heating, heating of sanitary hot water, space cooling and process cooling).

In order to meet the Directive's requirement to "focus on energy dense areas in municipalities and conurbations", it is necessary to present the heating and cooling demand from Point A in terms of density of demand (kWh/km$^2$), according to geographical location. In the heat map we present the Useful Energy (UE) demand, disaggregated according to sector and end use, expressed per km$^2$, as separate layers. Below we describe the method followed for determining the UE density across the different layers presented on the heat map.

### 1.2.2 Methodology

#### 1.2.2.1 Residential Space Heating, Cooling and SHW

The demand for UE across these three end uses is taken from the results in Point A, where UE is evaluated for three residential subsectors (Apartments, Row houses and Single houses).

The area for each of the three residential subsectors in each postcode is evaluated from a combination of census data (2011 and 2021[1]) and assumptions about the average floor area for the types of residential building observed in the 2011 census[2].

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[1] 2011 Census data tables <POP_CEN_11-LQ_GEO-EN-231215.xls> (2011 dwelling stock by type for each postcode), <POP_CEN_21-PRE_RESULTS-MUNCOM_COMP-EN-040823.xlsx> (2011 and 2021 dwelling stock by municipality with corresponding postcodes) and <<POP_CEN_11-POP_MUN_PC_STREET-081123.xlsx> (2011 population for each street showing postcode and municipality).

[2] Based on report <Report  Households.pdf>, table 4 mid age, provided by MECI by email on 08 December 2020.

To calculate the space heating UE for each residential subsector in each postcode; the total space heating UE of this subsector (from Point A) is divided by the total floor area for the subsector across Cyprus to calculate average UE per square metre, which is then multiplied by total floor area for the subsector in that postcode. The same approach is taken for space cooling and SHW.

The derived UE for space heating and cooling per residential subsector is further adjusted to account for climatic region[3]. This analysis observes four climatic regions: Semi mountainous, Mountainous, Low land and Coastal. There is assumed to be no demand for space cooling in residential buildings located in mountainous regions and only 70% of the space cooling demand in semi-mountainous region compared to coastal regions. A further adjustment is that the demand for space heating in mountainous regions is assumed to be 3 times that in the coastal and in semi-mountainous region 1.2 times that in the coastal region. There are no other adjustments in respect of climatic region, i.e. the demand for SWH is assumed not to vary with climatic region.

The total residential UE for each end use in each post code is then calculated by summing the UE for each subsector. The total UE is then divided by the total area in the post code to derive the residential UE density for each end use.

These UE densities are plotted on the heat map.

#### 1.2.2.2 Service Space Heating, Cooling and SHW

There are 8 subsectors established for the service sector, as presented in Point A. These are as follows: Airports, Catering, Healthcare, Hotels, Offices, Schools, Shopping and Other.

The total floor area for each of these subsectors in each post code is evaluated. There are a range of ways of doing this, depending on the primary data available. The derivation of floor area for these service subsectors is set out in detail below:

- **Airports** – Only 2 airports: Larnaka (Area = 100,000m$^2$) and Pafos (Area: 29,000 m$^2$)
- **Catering** – Area in postcode = No. catering sites in PC x Floor Area/Catering site (80 m$^2$/site)
- **Health care (Private)** – Area in PC = No beds in PC (deduced from no of rooms in 2023 and 2021 directories and no of beds in 2021 directory) x 119.8 m$^2$/bed
- **Health care (Public)** – Area in PC for 8 public hospitals was supplied to Ricardo by MECI (average 219m$^2$/bed)
- **Hotels** - Area in PC = No Hotel Rooms in PC x 50.5 m$^2$/Hotel Room
- **Offices** – Area in PC No. sites in PC x 150 m$^2$/site
- **Schools** – Area in PC supplied by MECI and covers private and public nursery, primary and secondary schools and tertiary education sites
- **Shopping** - Area in PC supplied by MECI and covers malls, shopping centres and other retail
- **Other Area** in PC supplied by MECI and covers sports buildings and other buildings

The total UE for each subsector for each end use (from Point A) is divided by the sum of floor area for each subsector for each end use across all PC in Cyprus, to provide a UE/ m$^2$. As with the residential sector this is adjusted to account for differences in the 4 climatic regions.

The UE for each end use for each subsector in each post code is then calculated by multiplying the floor area for the subsector in that post code by the UE/ m$^2$ for the end use (appropriate to the climatic region), to derive the UE for that end use in that post code. This UE is then aggregated across all service subsectors and divided by the total land area in the post code to derive the service sector UE density for each end use..

These UE densities are plotted on the heat map.

#### 1.2.2.3 Industry

For Industry (ETS); the Useful Energy (UE), for each grade of heat demand, is calculated separately based on Final Energy (FE), which is fuel consumption, for each of the 10 industrial sites (Vasiliko cement works and 9 ceramics factories) covered by EU ETS and broken down into low, medium and

[3] Based on report <Report  Households.pdf>, table 3, provided by MECI by email on 08 December 2020 and subsequent agreement with MECI to assume no cooling in mountainous areas.

high grade heat based on the same industrial report used to split the heat grades in Point A[4]. Only 6 of the 9 ceramics factories consumed fuel and thus generated heat in 2022 and therefore only the corresponding 6 postcodes show any industrial ETS heat density on the heat map. For modelling purposes, each of the ETS sites is modelled individually where the grade of heat is appropriate to the high efficiency technology being modelled.

For Industry (Non-ETS); the UE (heating and cooling) is determined by taking the FE for low, medium and high-grade heating or cooling for each industry sub-sector, (Point A), in the case of other minerals, subtracting the ETS FE for all ceramics sites (see above), to derive the FE for non-ETS other minerals industry, and calculating heat demand based on assumed heating or cooling efficiency.

In the same way as for the residential and services subsectors, the non-ETS UE is then geographically distributed across the PCs by taking the proportion of total national industrial floor area in each PC[5] in each climatic region and multiplying by the non-ETS UE to derive the industrial UE and UE density for each end use in each postcode.

#### 1.2.2.4 Agriculture

For Agriculture only heating is considered. There is no HW and cooling consumption. There are two subsectors, greenhouses and other agriculture. Total UE for Agriculture is taken from Point A. As with the above sectors, the UE established in Point A for each of the two subsectors is apportioned to each postcode based on total site floor area, accounting for differences in heating demand per square metre between climatic regions, divided by land area to calculate heat land density and mapped.

## 1.3 Existing Heating and Cooling Supply Points

### 1.3.1 Introduction

As indicated in the EED 2023/1791, heating and cooling supply points are to be established as "identified under point 2(b)". Point 2(b) in the context of this work are the results from Point B specifically relating to installations from which waste heat or cold could be recovered and act as potential supply points for meeting demand for heating and cooling elsewhere.

In Point B, and consistent with the EED 2023/1791, we have considered a range of installations from which waste heat and cold could be recovered, as follows:

**Thermal power generating installations with thermal input exceeding 50 MWth.**
We find that there are three such installations in the Republic of Cyprus. The waste heat that could be available from these installations has been calculated according to methodology explained in the Point B report and the potential availability of this heat has been mapped.

**Heat and power cogeneration installations with thermal input exceeding 20 MWth.**
As explained in the Point B report, there are no such installations in Cyprus.

**Waste incineration plants.** As discussed in the Point B report, there are no such plants and all in country waste generation and waste imports are consumed within the cement sector (see below).

**Renewable energy installations with a total thermal energy input in excess of 20 MWth.**
As discussed in the Point B report, there are no such installations in Cyprus

**Industrial installations with a total thermal input in excess of 20 MWth.**
As discussed in the Point B report, all such installations would be covered by EU ETS. EU ETS installations comprise the three thermal power generating installations (discussed above), 1 x cement installation and 9 x ceramics installations. The potential waste heat recoverable from the cement works was calculated according to the methodology described in the Point B report. Upon consultation with operators of large ceramics installations of the type covered by EU ETS in 2021, it

[4] Industrial information supplied by MECI <Copy of IndAnalysis_1015f-FINAL.xlsx> by email on 08 December 2020 12:48
[5] Industrial floor area per postcode was derived using GIS data sent by MECI from Department of Lands and Surveys by We Transfer on Fri 27/11/2020 11:04 and Mon 04/01/2021 08:11

was decided that all waste heat from the kiln is consumed for the drying of green product and that, therefore, there is no waste heat available form this source, so these were not mapped.

There are no existing district heating transmission installations in Cyprus to represent on the Heat Map.

Regarding the availability of waste heat from cooling installations, as discussed out in the Point B report, we conclude that there are no individual buildings with cooling demand large enough to produce waste heat on a scale that could make recovery and feeding into a DHC scheme feasible.

## 1.4 Planned Heating and Cooling Supply Points

Regarding potential supply points of waste cold, in the first instance the LNG plant under construction at Vasilikos Port could be viewed as a potential source, via recovery of coolth from the heat transfer medium used to vaporise the LNG. However, the Natural Gas Public Company is currently unable to confirm whether the regasification system will be open or closed loop. Consequently, the potential for this to act as a source of waste cold which could be tapped into cannot be evaluated at present.

There are no other planned potential heating and cooling supply point of the types detailed in Section 1.3.

# Appendices

Appendix 1 - Total Cooling Density for Republic of Cyprus

Appendix 2 - Total Heating Density for Republic of Cyprus (excl. Sanitary Hot Water)

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Appendix 10 - Location of Waste Heat Sources with Thermal Input >20MWth

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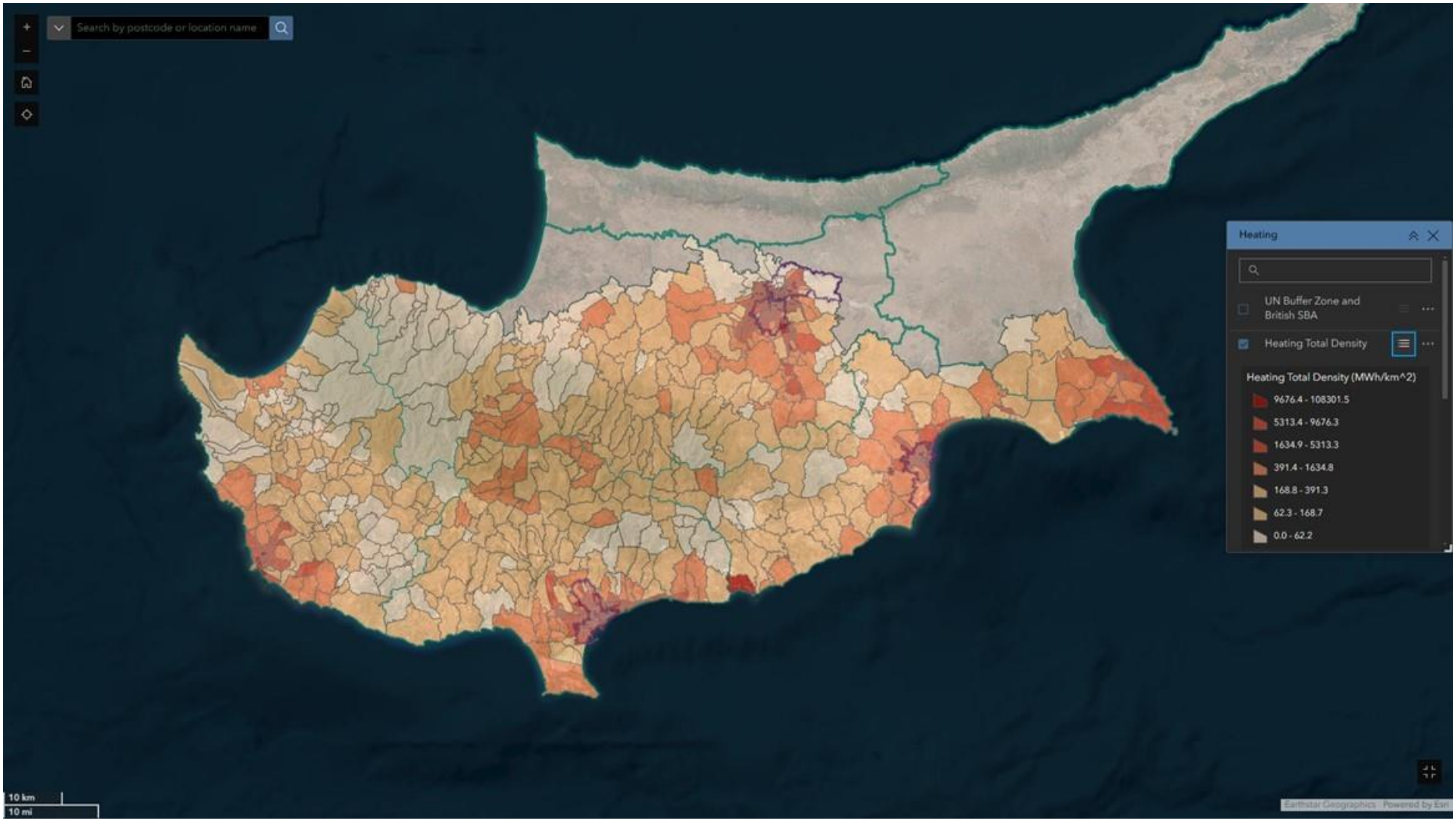

# Appendix 3- Total Residential Cooling Density for Republic of Cyprus

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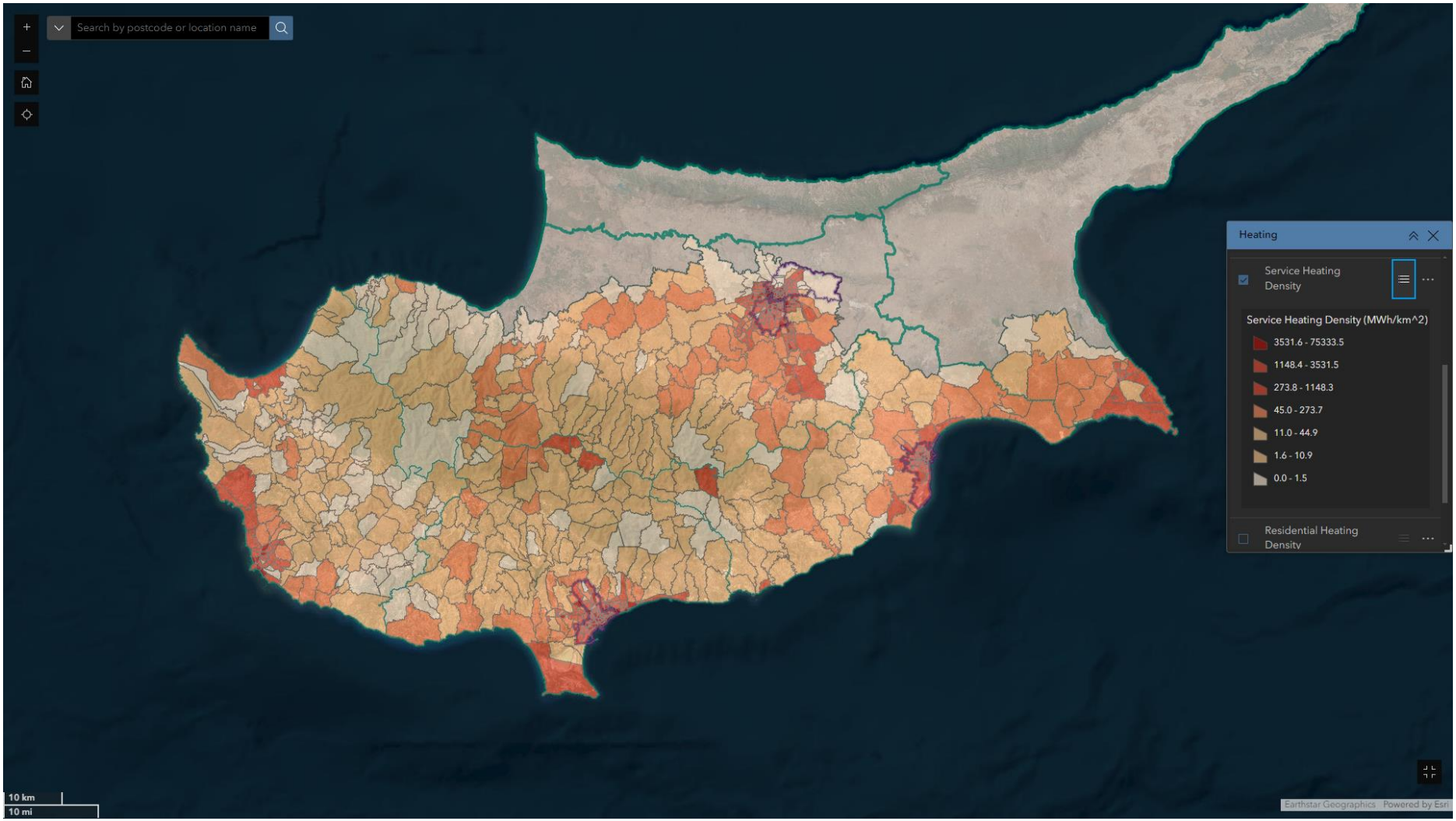

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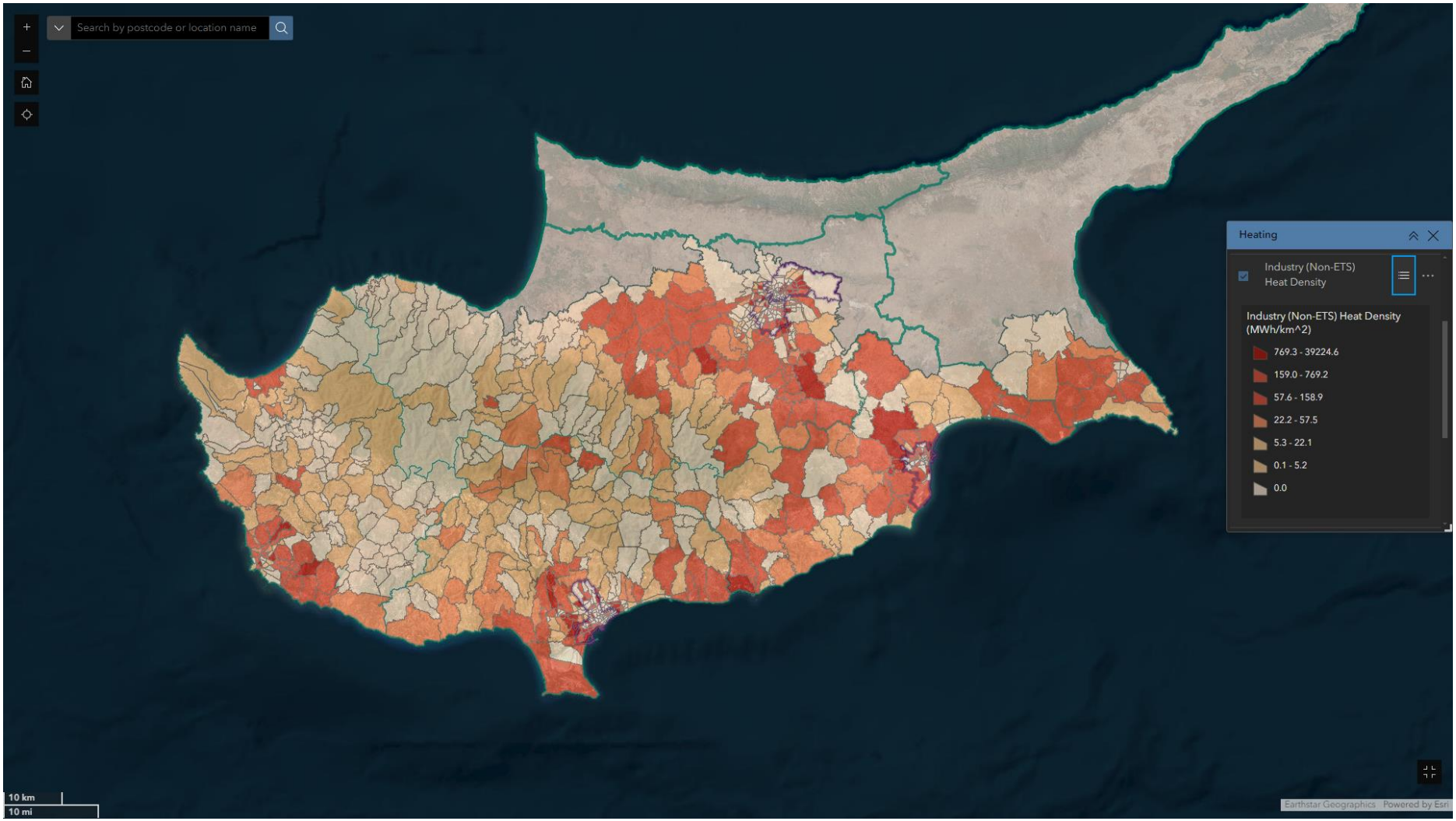

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