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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

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1.1 Introduction

Annex VIII of the Energy Efficiency Directive 2012/27/EU (EED) 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 the revised Annex VIII of the EED, set out in Commission Delegated Regulation (EU) 2019/826, 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 district heating transmission installations.

In Sections 1.2 to 1.4, we set out our approach to satisfying these requirements. The results of our approach are presented in Sections AA-BB 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 EED, 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 2018, 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 architypes (Apartments, Row houses and Single houses).

The area for each of the three residential architypes across the whole of Cyprus is evaluated from a combination of census data (2011) and assumptions about the average floor area for the types of residential building observed in the 2011 census.

To calculate the space heating UE for each residential architype, the total space heating UE of this architype (from Point A) is divided by the total floor area for the architype across Cyprus. The same approach is taken for space cooling and SHW.

The derived UE for space heating and cooling per residential architype is further adjusted to account for climatic region. 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 UE for each end use for each architype in each post code is then calculated by multiplying the floor area for the architype in that post code by the UE/m^2 for the end use, to derive the UE for that end use in that post code. This UE is then divided by the total area in the post code to derive and end use UE density for the architype under consideration.

These UE densities are plotted on the heat map.

A full list of the residential architypes and their heating, cooling and sanitary hot water consumptions is provided in Appendix 11.

1.2.2.2 Service Space Heating, Cooling and SHW

There are 8 architypes established for the service sector, one for each of the service subsectors presented in Point A. This means that service architypes are established 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 architypes 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 PC = No. catering sites in PC x Floor Area/Catering site (80 m^2)

Health care (Private) – Area in PC = No beds in PC x 130 m^2/bed

Health care (Public) – Area in PC for 8 public hospitals was supplied to Ricardo by MECI

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 architype for end use (from Point A) is divided by the sum of floor area for each architype for each end use across all PC in Cyprus, to provide a UE/ m^2.

The UE for each end use for each architype in each post code is then calculated by multiplying the floor area for the architype in that post code by the UE/ m^2 for the end use, to derive the UE for that end use in that post code. This UE is then divided by the total area in the post code to derive and end use UE density for the architype under consideration.

These UE densities are plotted on the heat map.

A full list of the service sector architypes and their heating, cooling and sanitary hot water consumptions is provided in Appendix 11.

1.2.2.3 Industry

For Industry (ETS), only process heating demand is considered. The process heat demand is calculated separately for each of the 9 industrial sites covered by EU ETS. Since the locations of these sites are known, these a plotted as point sources of heat demand in the heat map.

For Industry (Non-ETS)- The Industry (Non-ETS) UE (heating and cooling) is determined by taking the UE for all industry, split by sub-sector, (Point A) and removing the ETS UE (see above), to derive the UE for non-ETS industry, split by subsector.

The non-ETS UE is then geographically distributed across the PCs by taking the proportion of total national industrial floor area in each PC and multiplying by the non-ETS UE.

A full list of the non-EU ETS architypes and their heating and cooling (where applicable) consumptions is provided in Appendix 11. The consumptions for the EU ETS sites in not provided, as the demands are specific to these sites and providing them could be disclose information deemed confidential.

1.2.2.4 Agriculture

For Agriculture only heating is considered. There is no SHW and cooling consumption. Total UE for Agriculture is taken from Point A. Distribution across Cyprus PC is calculated by taking the proportion of total national agricultural floor area in each PC and multiplying by the Agriculture UE.

A full list of the agriculture sector architypes and their heating consumptions is provided in Appendix 11.

1.3 Existing Heating and Cooling Supply Points

1.3.1 Introduction

As indicated in the EED, 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, 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 8 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, it 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.

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)

Appendix 3 - Total Residential Cooling Density for Republic of Cyprus

Appendix 4 - Total Residential Heating Density for Republic of Cyprus (excl. Sanitary Hot Water)

Appendix 5 - Total Service Cooling Density for Republic of Cyprus

Appendix 6 - Total Service Heating Density for Republic of Cyprus

Appendix 7 - Total Industry Process Cooling Density for Republic of Cyprus

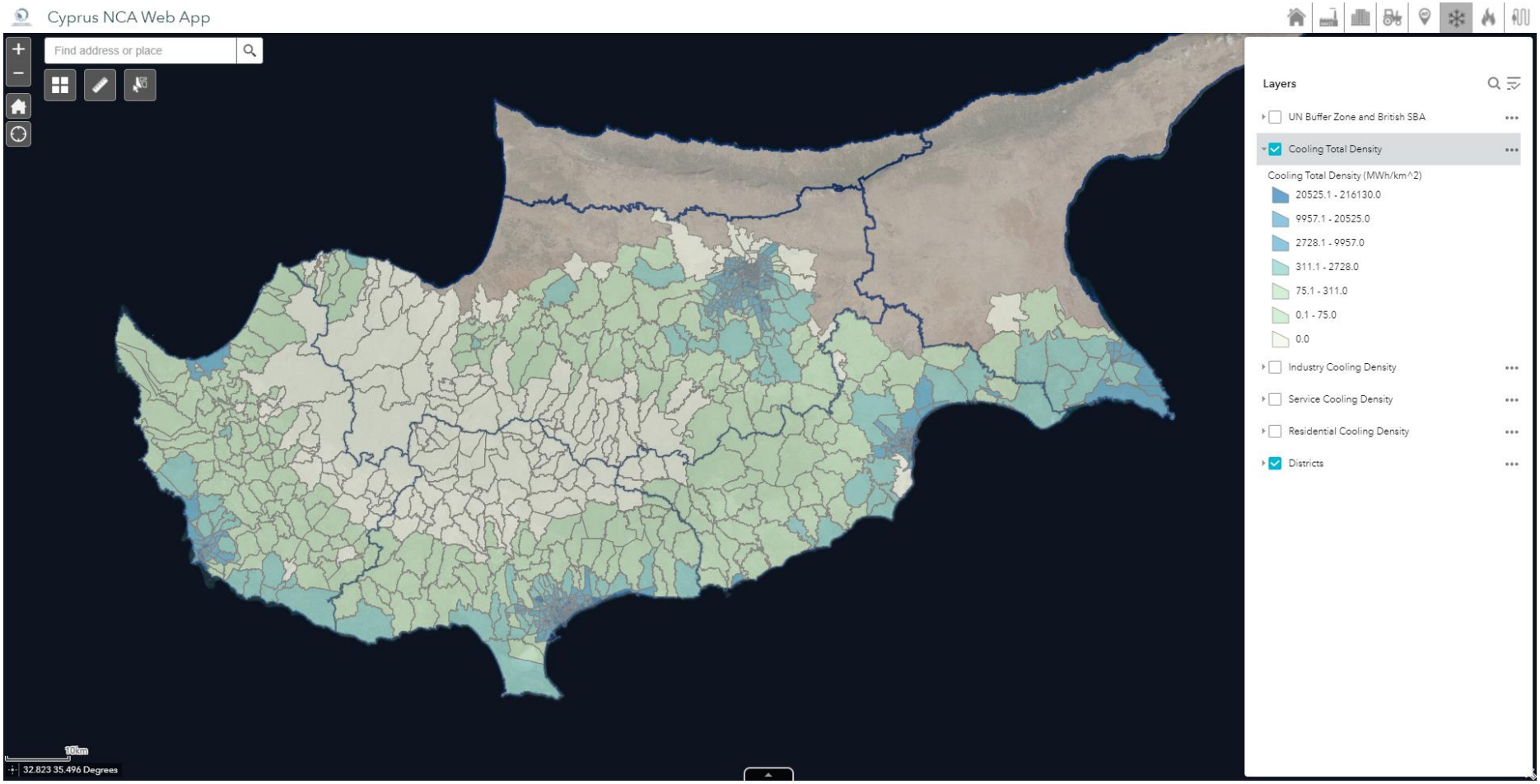
Appendix 8 - Total Industry (EU ETS) Heating Density for Republic of Cyprus

Appendix 9 - Total Industry (Non-EU ETS) Heating Density for Republic of Cyprus

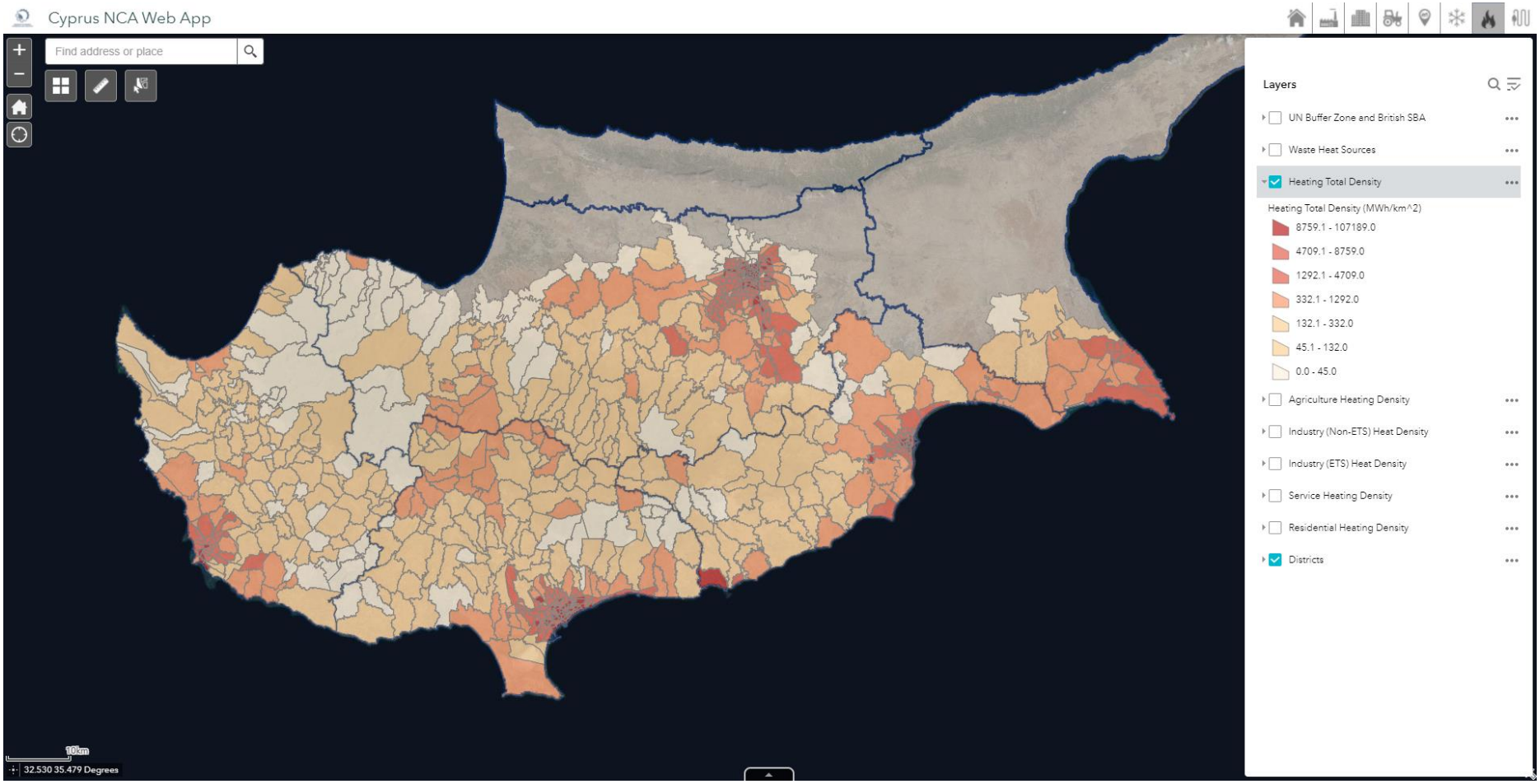
Appendix 10 - Location of Waste Heat Sources with Thermal Input >20MWth

Appendix 11 - Heating and Cooling Consumption for the Modelled Architypes

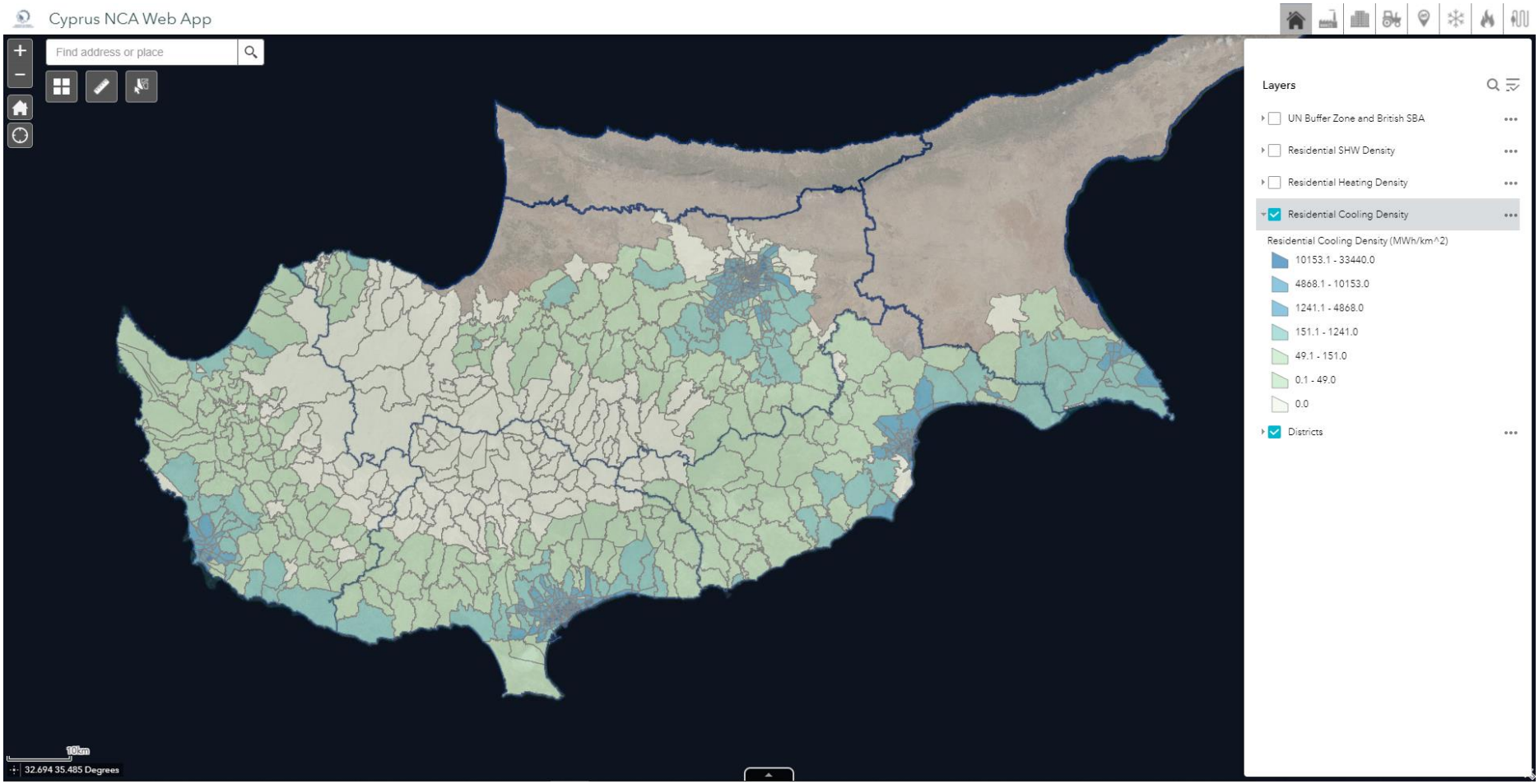
A1 Total Cooling Density for Republic of Cyprus



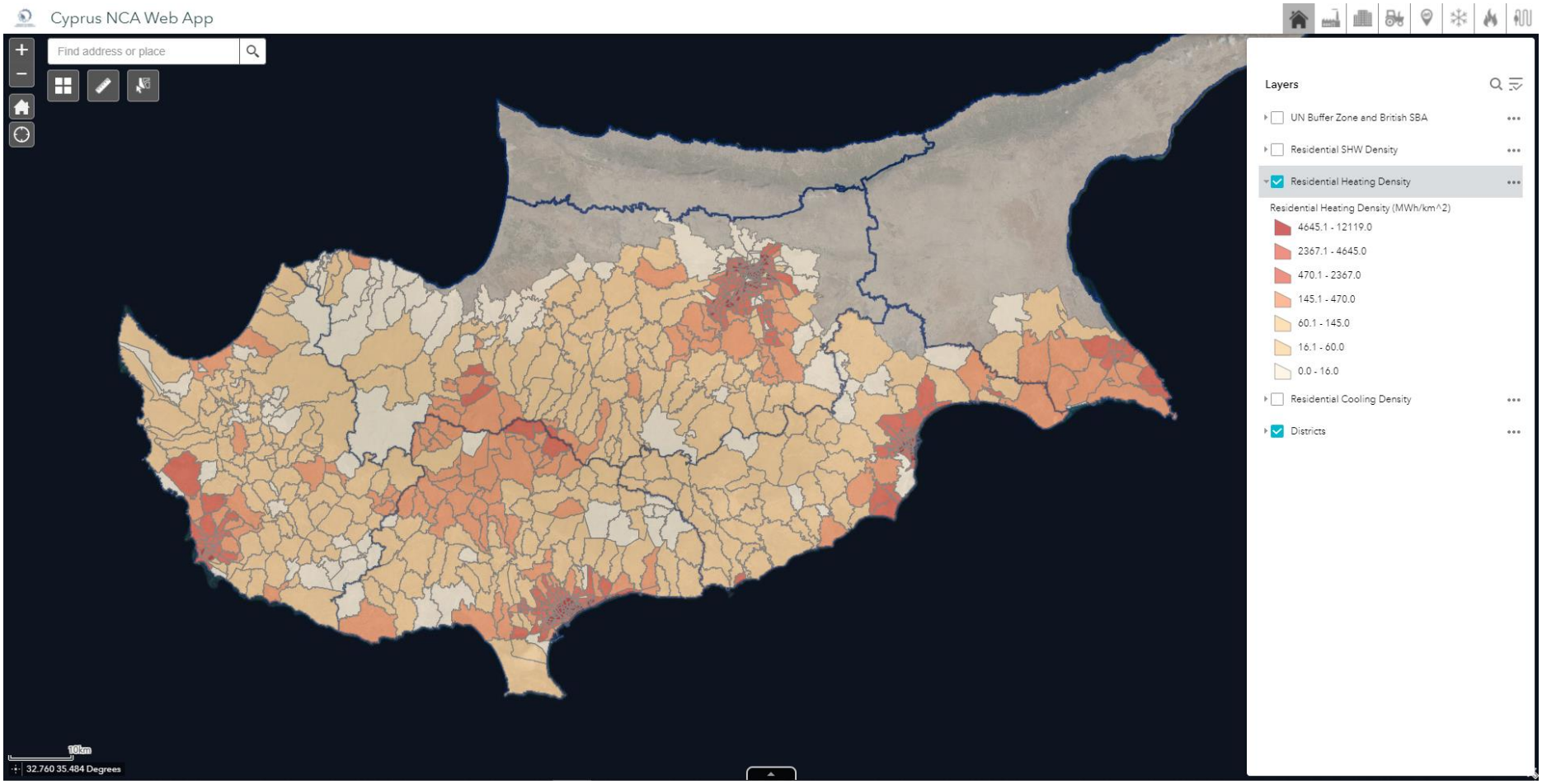
A2 Total Heating Density for Republic of Cyprus (excl. Sanitary Hot Water)



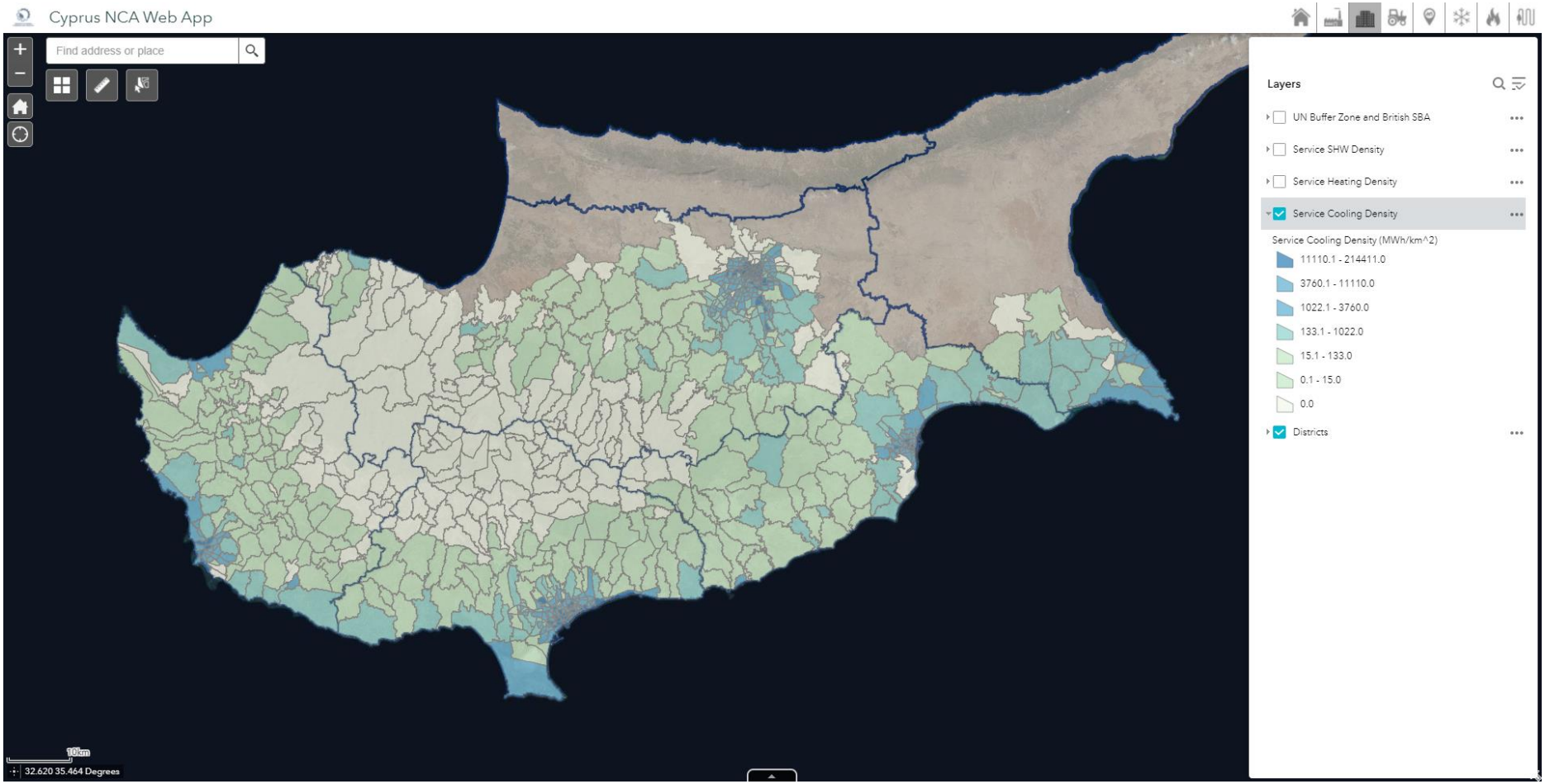
A3 Total Residential Cooling Density for Republic of Cyprus



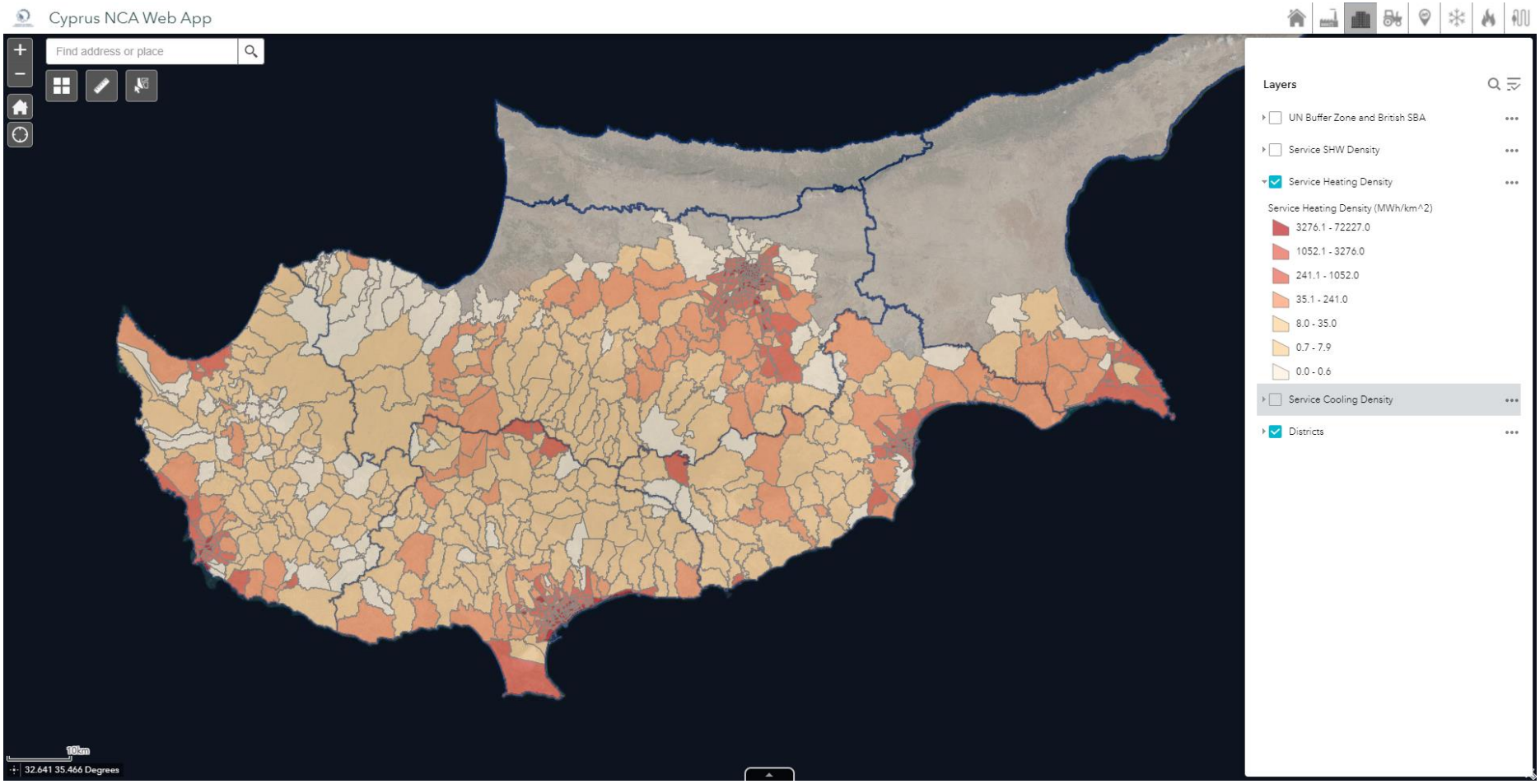
A4 Total Residential Heating Density for Republic of Cyprus (excl. Sanitary Hot Water)



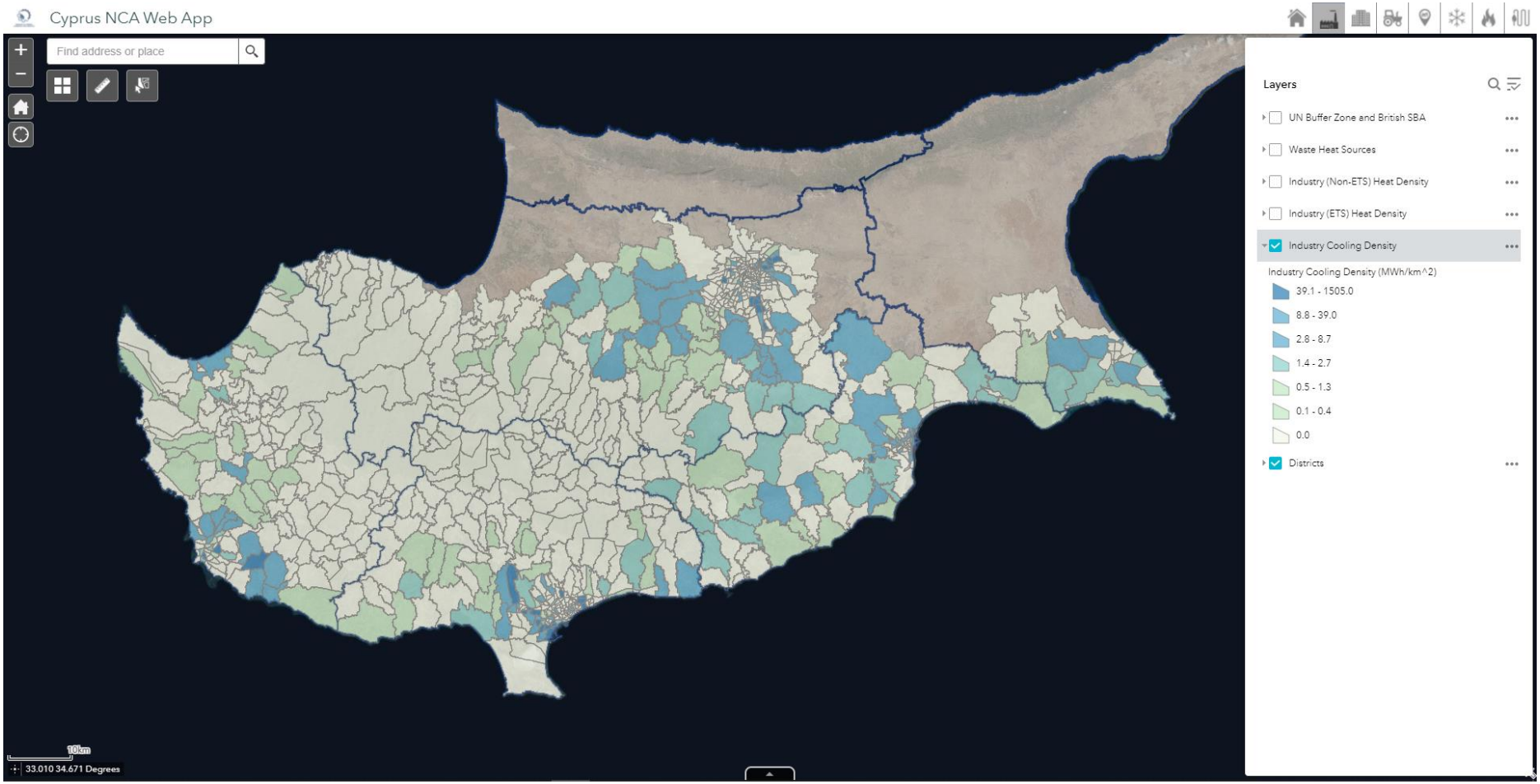
A5 Total Service Cooling Density for Republic of Cyprus



A6 Total Service Heating Density for Republic of Cyprus

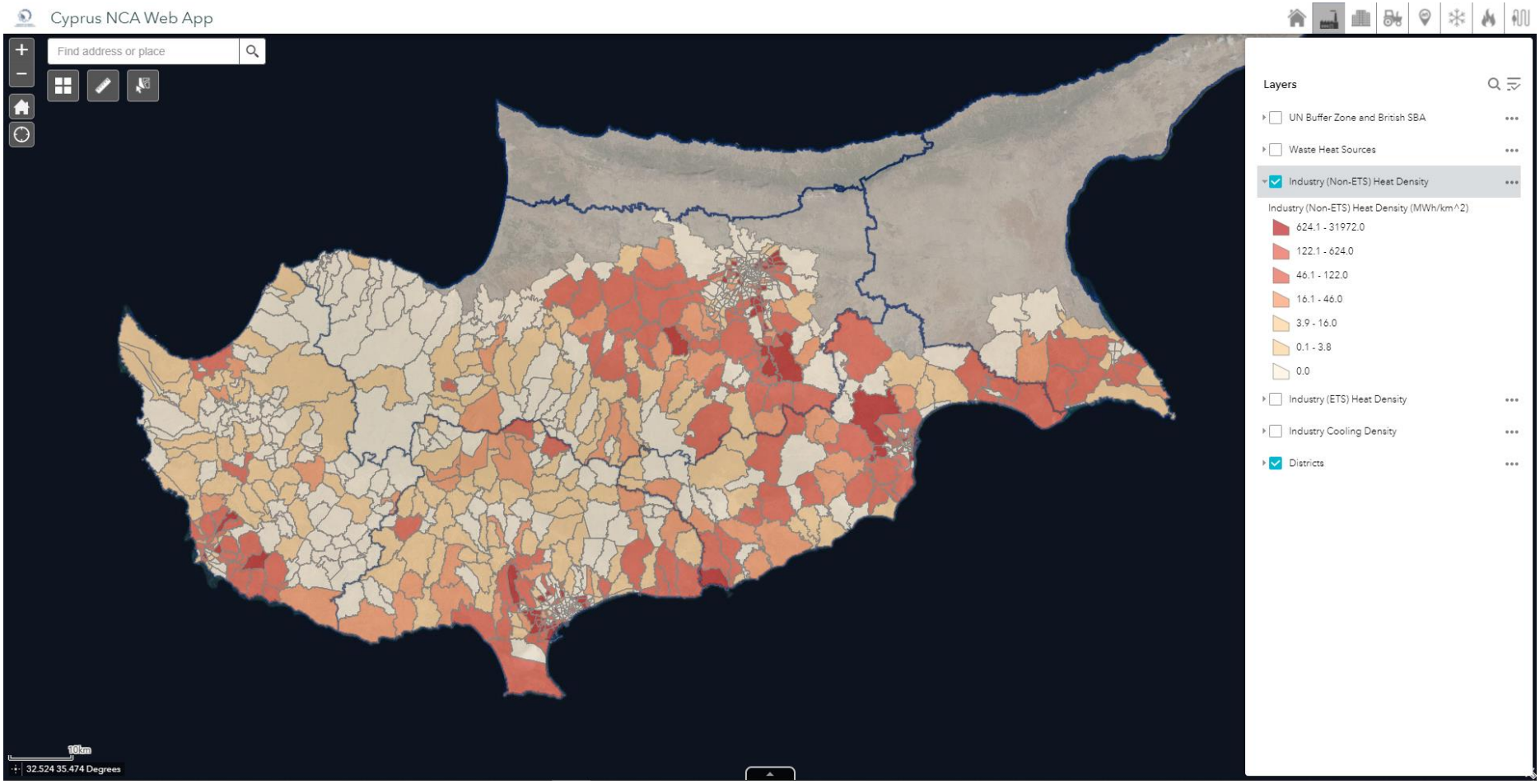


A7 Total Industry Process Cooling Density for Republic of Cyprus



A8 Total Industry (EU ETS) Heating Density for Republic of Cyprus

A9 Total Industry (Non-EU ETS) Heating Density for Republic of Cyprus



A10 Location of Waste Heat Sources with Thermal Input >20MWth

A11 Heating and Cooling Consumption for the Modelled Architypes

Heating and Cooling Consumption for Modelled Architypes (Coastal Areas)

Sector	Architype	Space/Process Heating Demand (MWh)	Cooling Demand (MWh)	SHW Demand (MWh)
Residential	Apartment	1,800	5,294	1,491
	Row house	2,735	3,700	1,791
	Single house	3,118	5,352	2,187
Service	Airports	4,026,040	12,381,824	536
	Restaurant	38,901	100,430	16,936
	Hospitals	409,006	1,234,242	565,103
	Hotels	264,626	1,428,646	138,851
	Offices	27,248	61,167	0
	Schools	56,525	140,486	11,998
	Shopping	5,545	28,613	21
	Other Services	67,162	215,355	25,104
Industrial (Non-EU ETS)	Chemicals	276,838	48,985	0
	Food and Drink	266,627	14,037	0
	Other Minerals	41,877	0	0
	Other Industry	33,618	0	0
Agriculture	Greenhouses	3,027	0	0
	Other Agriculture	3,027	0	0

Heating and Cooling Consumption for Modelled Architypes (Low Land Areas)

Sector	Architype	Space/Process Heating Demand (MWh)	Cooling Demand (MWh)	SHW Demand (MWh)
Residential	Apartment	1,807	5,314	1,497
	Row house	2,782	3,762	1,821
	Single house	3,118	5,352	2,187
Service	Airports	0	0	0
	Restaurant	38,901	100,430	16,936
	Hospitals	880,833	2,658,054	1,217,002
	Hotels	247,434	1,335,830	129,830
	Offices	27,248	61,167	0
	Schools	64,390	160,033	13,667
	Shopping	4,912	25,348	18
	Other Services	67,355	215,974	25,176
Industrial (Non-EU ETS)	Chemicals	386,661	68,418	
	Food and Drink	164,847	8,679	
	Other Minerals	19,009	0	
	Other Industry	27,648		0
Agriculture	Greenhouses	2,285	0	0
	Other Agriculture	2,285	0	0

Heating and Cooling Consumption for Modelled Architypes (Mountainous Areas)

Sector	Architype	Space/Process Heating Demand (MWh)	Cooling Demand (MWh)	SHW Demand (MWh)
Residential	Apartment	5,408	0	1,493
	Row house	7,789	0	1,699
	Single house	9,355	0	2,187
Service	Airports	0	0	0
	Restaurant	116,702	0	16,936
	Hospitals	2,063,030	0	950,128
	Hotels	162,844	0	28,482
	Offices	81,744	0	0
	Schools	74,154	0	5,246
	Shopping	16,050	0	20
	Other Services	198,020	0	24,672
Industrial (Non-EU ETS)	Chemicals	0	0	
	Food and Drink	99,377	0	
	Other Minerals	10,067	0	
	Other Industry	20,286		0
Agriculture	Greenhouses	2,438	0	0
	Other Agriculture	2,438	0	0

Heating and Cooling Consumption for Modelled Architypes (Semi--Mountainous Areas)

Sector	Architype	Space/Process Heating Demand (MWh)	Cooling Demand (MWh)	SHW Demand (MWh)
Residential	Apartment	2,149	3,688	1,484
	Row house	3,211	2,533	1,752
	Single house	3,742	3,746	2,187
Service	Airports	0	0	0
	Restaurant	46,681	70,301	16,936
	Hospitals	1,139,155	2,005,255	1,311,593
	Hotels	62,523	196,902	27,339
	Offices	32,698	42,817	0
	Schools	51,245	74,295	9,064
	Shopping	5,454	16,416	17
	Other Services	79,184	148,110	24,664
Industrial (Non-EU ETS)	Chemicals	323,432	40,061	
	Food and Drink	293,583	10,819	
	Other Minerals	24,369	0	
	Other Industry	46,462		0
Agriculture	Greenhouses	1,777	0	0
	Other Agriculture	1,777	0	0