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Socioeconomic, urban morphology, microclimate, land surface temperature and vegetation data

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Data Article

Spatializing household energy consumption in the Netherlands: Socioeconomic, urban morphology, microclimate, land surface temperature and vegetation data

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A B S T R A C T

Household energy consumption (HEC) is affected by a variety of determinants. In addition to the level of HEC in 2612 residential zones in the Netherlands (the so-called wijk) in 2014, this dataset provides a geographically-referenced data of 11 determinants of HEC on: (1) socioeconomic characteristics - namely income per capita, household size, population density; (2) urban morphology —namely buildings' surface to volume ratio, building age; (3) microclimate factors —namely number of summer days, number of frost days, humidity, wind speed at 10 m height; (4) land surface temperature; (5) normalized difference vegetation index (NDVI). The dataset is initially prepared for an analysis titled as “Land surface temperature and households' energy consumption: who is affected and where?” [1].

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Specifications Table

Subject	Energy (General)
Specific subject area	Household energy consumption
Type of data	GIS data (ESRI shapefile), text file
How data were acquired	The raw data are extracted from different sources and analysed by ArcGIS Pro software.
Data format	Raw and analysed
Parameters for data collection	The data on the energy consumption and the 11 determinants is collected from a variety of data sources, analysed, and ultimately aggregated at the scale of residential zones. The final dataset include all the areas in which all data sources has been available.
Description of data collection	The basic data is collected from open-to-public, geographically-referenced Dutch, European, and international —namely NASA, datasets.
Data source location	The Netherlands (latitude 52.1326° N, and longitude 5.2913° E)
Data accessibility	With the article
Related research article	Mashhoodi, B., Stead, D. and van Timmeren, A., 2020. Land surface temperature and households' energy consumption: Who is affected and where? Applied Geography, 114, p.102125 [1].

Value of the Data

- The data helps providing a multidimensional set of geographically-referenced determinants of household energy consumption in the Netherlands.
- Researchers in the field of household energy consumption, energy poverty and energy transition could benefit from the dataset.
- The dataset could be employed to develop further insights over energy poverty, energy transition, heatwave vulnerability and environmental assessments in the Netherlands.
- The data is geographically-references, which allow for spatial analysis of household energy consumption. Additionally, it brings data from a variety of Dutch, European, and international —namely NASA, into a single datasets.

1. Data

1.1. Dataset aggregate at the scale of Dutch residential zones

The main dataset is consisted of the data on households' energy consumption (HEC) per capita and 11 determinants of HEC aggregated at the scale of residential zones of the Netherlands —the so-called wijk, institutional boundaries defined by central bureau of statistics in the Netherlands (CBS). Table 1 represents the code used for different types of data in the dataset. (Find the descriptive statistics of the data in Ref. [1]).

The variables included in the dataset are:

1. Annual energy consumption per capita in Mega Joule, accounting for gas and electricity provided by energy grids combined (Find the map in Ref. [1]);
2. Income per capita, accounting for average annual disposable income per capita, in 1000 euros;
3. Household size, accounting for average number of individuals in a household;
4. Population density, representing the number of registered inhabitants per square kilometre of the residential zones;
5. Median building age, accounting for the median age of the buildings;
6. Surface to volume ratio of buildings, accounting for the ratio of sum of the areas of buildings' outer walls and roofs to their volume;
7. Number of summer days, the days in which the maximum temperature exceed 25° Celsius in 2014;
8. Number of frost days, the days in which the minimum temperature is below zero degrees Celsius in 2014;

Table 1
The column titled as "Code" refers to the name of the variables in the GIS database.

	Code
HEC	HEC
Income	INC
Household size	HHS
Population densityv	PD
Building age	BA
Surface to volume ratio	STV
Number of summer days	SDAY
Number of frost days	FDAY
Humidity (%)	HM
Wind speed	WS
LST	LST
NDVI	NDVI

9. Relative humidity at the height of 150 cm;
10. Wind speed at the height of 10 m;
11. Average annual land surface temperature, accounting for average of 12 satellite images representing average LST of 8 days (Find the map in Ref. [1]);
12. Annual average NDVI, accounting for average value of 12 monthly satellite images.

1.2. Raw datasets

The dataset represented in the previous section is prepared on the basis of five sets of raw data - which are presented in this section.

1.2.1. Energy consumption and socioeconomic characteristics

The first raw dataset is CBS Wijk-en-buurtkaart 2014, providing the basic socioeconomic data on income per capita, household size and population density. The dataset provides data on population, number of dwellings, and gas and electricity consumption per dwellings, which has been used for calculation of HEC [2].

1.2.2. Urban morphology and building age

The second raw dataset provides geographically-referenced data on the geometry and the height of the buildings in the Netherlands in format of polygons – 3D BAG [3]. The 3D BAG dataset also provide data on the construction year of the buildings, which is used for calculation of median building age in the residential zones. Given the sheer-size of the 3d BAG dataset in format of polygons, the data is converted into two raster files, one representing the height of the buildings (titled as Buildings_DEM), and one representing age of the buildings (titled as Buildings_Age).

1.2.3. Microclimate

The third dataset is consisted of the observations of air temperature, humidity and wind speed at the height of 10 m at the 28 meteorological stations of the Royal Netherlands Meteorological Institute (KNMI) [4]. In order to calculate wind speed, an estimation of roughness length classification is carried out based on CORINE land-cover database, 2012 [5].

1.2.4. Land surface temperature

The raw dataset used for calculation of average annual land surface temperature (LST) is consisted of twelve MODIS/Terra Land Surface Temperature/Emissivity 8-Day L3 Global 1km SIN Grid V006 (MOD11A2) data [6], each image representing average daily LST of 8 days in 2014. The images are selected according to three criteria: (i) roughly equal temporal intervals between the date of consequent images – one image per month accounting for LST of 8 days; (ii) coverage of all study areas, i.e. residential zones of the Netherlands; (iii) being of high quality, as assessed by Quality Assurance band of MODIS data. (Find the detailed dates and the descriptive statistics of the 12 satellite images at [1].)

1.2.5. Normalized difference vegetation index

The data on average annual normalized difference vegetation index (NDVI) is calculated based on the average value of twelve monthly MODIS/Terra Vegetation Indices Monthly L3 Global 1km SIN Grid V006 [6].

2. Experimental design, materials, and methods

GIS analysis of the sheer-size dataset on the buildings in the Netherlands, 3D BAG, is an operational challenge. In order to calculate surface to volume ratio of the buildings in residential zones, the dataset is converted to a raster file, with resolution of 15m × 15 m excluding the buildings less than 3 m height, and used as the digital elevation model (DEM) Dutch buildings. Using ArcGIS "Focal Flow" toolset, the DEM is used to identify the outer surfaces of the buildings and to calculate the ratio. The DEM could be further used for calculation of solar radiation and aerodynamic roughness length in the Netherlands (see Refs. [7,8]). Combined with the dataset on urban morphology and building age, the DEM file could further be employed for analysis of energy poverty in the Dutch neighbourhoods (see Ref. [9]).

The data on the microclimate are retrieved from the 28 meteorological stations of the Royal Netherlands Meteorological Institute (KNMI) using the interpolation methods put forward by the KNMI scientific research team [10]. The Number of summer days and Number of frost days are retrieved based on the universal kriging interpolation of the stations' observations, with external drift of log distance to the shore. Relative Humidity is retrieved by conducting an ordinary kriging interpolation of stations' observation, with an exponential variogram. Wind-speed at 10-m height is calculated based on two-layer model of the planetary boundary layer interpolation (for a detailed description see Ref. [11]). Aerodynamic roughness length values are calculated based on CORINE land-cover database ([5]European Environment Agency, 2016) using classification methods of Silvia et al. [12].

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Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.dib.2020.105118.

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