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SEMANCO

Deliverable 3.3 Guidelines for Structuring Contextual Data

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EXECUTIVE SUMMARY

Introduction

Deliverable 3.3, developed within Work Package 3 *Energy data modelling* summarises the work done and the results achieved in Task 3.3 *Structuring contextual data according to standards*, which had the main objective of semantically modelling the contextual data of the SEMANCO case studies according to different kinds of standards and literary references. Task 3.3 is the prosecution of the work done in Task 3.2 – *Structuring available data according to energy standards*, as it applies the same procedure used to structure the energy data and described in Deliverable 3.2 – *Guidelines for Structuring Energy Data*.

Deliverable 3.3 deals with the following issues:

- The identification of the categories of data to be semantically modelled according to a precise structure and definition of the categories included in the contextual data group.
- The analysis of standards and references for energy-related data modelling.
- The creation of the *Standard Tables* for the contextual data.
- The interconnections between the *Standard Tables* on the energy data (D3.2) and the *Standard Tables* on the contextual data, and the identification of the different territorial scales to which the *Standard Tables* are applied.

Deliverable 3.3 is the result of the collaborative work done in Task 3.3. The following project partners have been involved: POLITO, FUNITEC, UoT, CIMNE and HAS. Deliverable 3.3 has been elaborated by POLITO, which is the leader both of Task 3.3 and of the entire WP3.

Task 3.3, together with Task 3.2, provide a fundamental contribution to the development of the Use Case methodology, which is the core of the development of SEMANCO. Deliverable 3.2 and Deliverable 3.3 provide the guidelines to semantically model the input and outputs concerning energy data and energy-related data sets in the Activities which conform the Use Cases.

The main results of Tasks 3.2 and 3.3 are the *Standard Tables* in which the energy data and the contextual data, respectively, are structured and defined according to standards. In turn the *Standard Tables* serve as input for the specification of the Energy Model, a formally specified ontology (i.e. in OWL), that plays the central role in the work of the *Semantic Energy Information Framework* (SEIF) being developed in WP4, Task 4.2.

Classification of contextual data

The data categories defined in Deliverable 3.1 *Report on the Accessible Energy Data* were divided into two groups: the “energy data”, semantically modelled in D3.2 and the “energy-related data” or “contextual data”, semantically modelled in the present deliverable. The following data categories belong to the “contextual data” group: “Energy cost data”, “Environmental data”, “Legislative constraints”, “Geographical data”, “Land and buildings registry data”, “Urban Planning data”, “Socio-economic data” and “Demographic data”. The contextual data are necessary to carry out energy and environmental analyses on a specific area at different scales, by providing additional information on energy costs, land use, socio-economic and demographic aspects, etc.

Structure of contextual data

Analysis of standards and literature on contextual data modelling

The “**Energy cost data**” category includes data that can be grouped in “energy cost”, or more generally “running cost” data, and “investment cost” data. The “running cost” mainly refers to

the cost of the consumed energy and the cost of building operation and maintenance related to energy. The “investment cost” on the other hand refers to interventions of new construction or refurbishment actions on the existing building stock, linked to both the building envelope and the technical building systems. The analysis of concepts referred to “running cost” and “investment cost”, together with the related definitions, are provided by the international technical standard EN 15459 - *Energy performance of buildings - Economic evaluation procedure for energy systems in buildings*, 2007.

The “**Environmental data**” category takes into account all the data that refer to the principal air pollutants in the urban area: PM₁₀, PM_{2,5}, sulphur dioxide (SO₂), nitrogen oxides (NO and NO₂), carbon monoxide (CO), ozone (O₃), lead (Pb). The Directive 2008/50/EC on ambient air quality and cleaner air for Europe provides some definitions, related both to air pollutants and pollutant concentration. Other references on environmental data concepts are some international standards related to the measurement of the air pollutants concentration, such as EN 12341:1998 (on PM₁₀), EN 14907:2005 (on PM_{2,5}), EN 14212:2012 (on sulphur dioxide), EN 14211:2012 (on nitrogen dioxide and nitrogen monoxide), EN 14626:2012 (on carbon monoxide), EN 14625:2012 (on ozone), EN 14902:2005 (on lead).

The “**Legislative constraints**” are energy performance requirements fixed by the legislation to be applied to new constructions or existing buildings. The “Legislative constraints” usually refer to some data belonging to other data categories, for instance to “Energy data” or “Building technical data”. An important reference is the European Directive 2010/31/EU which specifies the application of minimum requirements to new buildings, to existing buildings subject to major renovation, to building elements when they are retrofitted or replaced, and to technical building systems whenever they are installed, replaced or upgraded. Other important references on energy performance requirements are the European Directive 2012/27/EU on energy efficiency and the European Directive 2009/28/EC on the promotion of energy from renewable sources.

The ontological modelling of data related to the “Legislative constraints” has been performed taking into account some guidelines provided by the international standard EN 15217 - *Energy performance of buildings - Methods for expressing energy performance and for energy certification of buildings*, 2007. This standard defines different types of energy performance requirements (overall and specific) and indicators for different types of buildings, as well as the parameters (related to climate, building function, energy carrier, building size, ventilation rate and illumination level) which can affect the requirements and the reference values used for classifying the energy performance of buildings.

The “**Geographical data**” are provided in SEMANCO through the “Geographic Information System” (GIS). The GIS is a system designed to capture, store, manipulate, analyse, manage and present all types of geographical data. A spatial database will inform the SEIF (*Semantic Energy Information Framework*) about geometric and topological data.

References on this topic are the European Directive 2007/2/EC and its related technical guidelines. . The Directive concerns the establishment of an “Infrastructure for Spatial Information in the European Community (INSPIRE)” focusing on the creation of metadata for the spatial data sets and services. An important role in INSPIRE, building data specification, is played by CityGML, a common model for the representation and the exchange of 3D city models, focusing on the semantics of objects and its structures (aggregations, relations).

Some complementary geographic data (numerical, text) are instead provided by the *Standard Tables* and semantically structured. These data include, for instance, some geographical coordinates, like the latitude, the longitude, the height above sea level, etc.

The “**Urban planning data**” have been modelled together with the “**Land registry data**”, because according to Koh (2001), the data for urban planning traditionally come from the

land registry's land category. The "Statement on the Cadastre" (1994) of the International Federation of Surveyors (FIG, 1994) has been taken as a reference. The document provides a classification of land information, determining the principal attributes of land, such as: *land parcels* (land location, land surface), *land tenure* (land tenure), *land value* (land quality, land type, land buildability, land economic value). The urban planning data are generally related to the *land use*, which has been considered another attribute of the land. Different classifications of the land use have been considered, taking as a reference the "Land-Based Classification Standards (LBCS Standards)" (2001) provided by the American Planning Association. The model extends the notion of classifying land uses by refining traditional categories into multiple dimensions, such as activities, functions, building types, site development character, and ownership constraints.

A reference classification of the "**Socio-economic data**" and the "**Demographic data**" is provided by the United Nations Statistics Division, under the section "Demographic and social topics", and by the UK – Office for National Statistics. In the ontological modelling of data, due to the strict relation of these topics, the two categories of data have been considered in the same structure. Two different topics have been analysed: the *population* (related to a high territorial scale), that includes data on size, density, gender, age, origin, language, etc., the *housing* (related to the building scale), that includes data on tenure, price, etc. In addition, both these topics include the following information, each referring to a different scale: households and families, economic activity, income and poverty, learning and education.

As regards the economic activity, a reference data structure is provided by the International Labour Organisation (ILO), that published the "International Standard Classification of Occupation (ISCO)" (2008), a classification structure for organising information about labour and jobs. Information about the modelling of the learning and education topic is provided by the "International Standard Classification of Education (ISCED)" (2011), a classification structure for organising information related to education and training maintained by the United Nations Educational, Scientific and Cultural Organisation (UNESCO).

Elaboration of the *Standard Tables* on contextual data

The energy-related data or contextual data have been semantically modelled according to the standard references and following the same procedure described in Deliverable 3.2 *Guidelines for Structuring Energy Data*, through the elaboration of the *Standard Tables*, which are a set of semantically structured concepts, including objects, attributes and standard definitions, provided in Excel sheets (see D3.2 – section 3.2). As for the energy data, some *Mapping Tables* have also been created for the contextual data (see D3.2 – section 4).

For each data category a single *Standard Table* is generally provided. An exception is done for the "Land and buildings registry data" and the "Urban planning data" for which a single *Standard Table* has been created for the concept "land". Another exception is represented by the "Socio-economic data" in which the *housing* data (for the building scale) and the *population* data (for a scale higher than the building one) are modelled in two different *Standard Tables*, because they convey a different information due to the different territorial level of analysis.

All the *Standard Tables* on contextual data are reported in Appendix A.

Contextualisation of the *Standard Tables* on territorial scales

In order to perform an ontological modelling of contextual data, it is necessary to refer each contextual data category and, consequently its related *Standard Tables*, to a well-defined area, i.e. to a different scale of application. In fact according to the Use Case methodology, "the Use Case brings together information about actors, policies and Activities to fulfil a goal at a particular scale (micro, meso, and macro)" (see Deliverable 1.8 – *Project Methodology*).

The *Standard Tables* elaborated both in Task 3.2 and Task 3.3 have been referred to a specific

area (i.e. country, region, municipality, neighbourhood, building). For that purpose a particular *Standard Table* named “TERRITORY” has been added. This sheet includes the concepts of “region”, “municipality”, “neighbourhood” and “building” with their attributes expressed through a link to the reference *Standard Tables*.

Conclusions

Deliverable 3.3 contributes to the development of SEMANTCO because it provides guidelines for structuring and semantically modelling contextual data following the methodology already presented in Deliverable 3.2 (Task 3.2) which are necessary for the development of the ontologies. Some standards and literary references are presented as the main sources for carrying out the ontological work as regards the energy-related data. The *Standard Tables*, in which the contextual data are structured and semantically modelled, are provided. The way to connect all the *Standard Tables* and to refer them to different territorial scales constitutes a true application of semantics which is not constrained to buildings but it embraces the urban scale as well.

Task 3.3 and Deliverable 3.3, together with the previous Task 3.2 and Deliverable 3.2 contribute to the creation of a standard energy model for the *Semantic Energy Information Framework* (SEIF) being developed in Work Package 4. The *Standard Tables* are an input for the development of the formally specified ontology which is being created using the *Ontology Editor* developed in Task 4.2.

The proposed methodology of data collection and structure is innovative both in the use and application of the references and in the elaboration of the *Standard Tables*. As the data structure and definitions come from different sources, new references on contextual data could be taken into account in the continuation of the project. Also the *Standard Tables* in Appendix A should not be considered completed. More data fields for each category will be added as required by the project development.

1 INTRODUCTION

1.1 Purpose and target group

Four interrelated components (Figure 1) are taken into account in the SEMANTCO project in order to develop and integrate ICT tools to reduce CO₂ emissions:

1. Supporting access to distributed and heterogeneous sources of energy data and energy-related data, and analysis of these sources.
2. Semantic modelling of energy data, according to EU energy and ontological standards.
3. Integrated tools, that access and update the semantically modelled data, based on new and existing IT solutions for decision making in the development of CO₂ reduction strategies.
4. Requirements analysis to ensure that the tools and CO₂ reduction strategies developed address real world problems, within the SEMANTCO demonstration cases and throughout the EU.

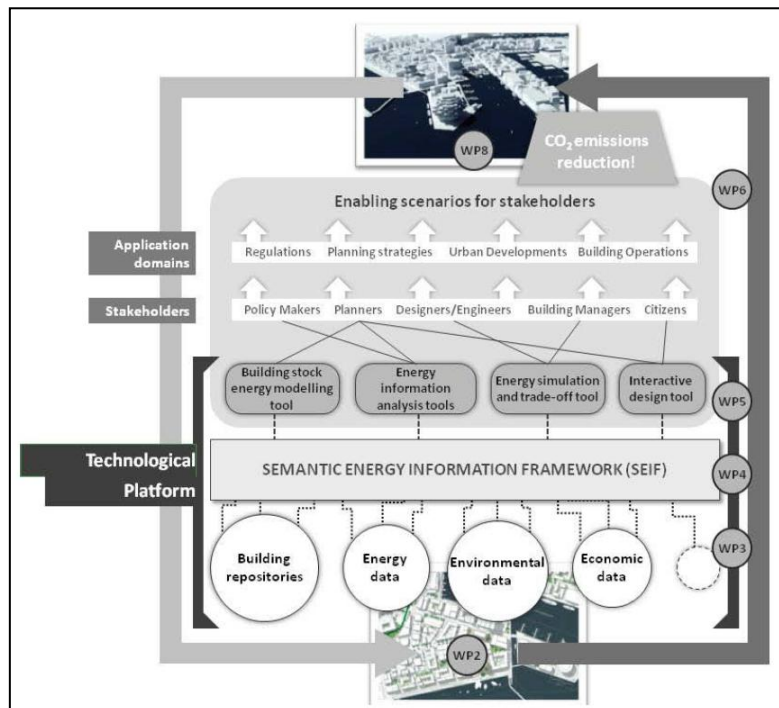


Figure 1. Methodological approach of SEMANTCO¹

The present project deliverable, D3.3 – *Guidelines for structuring contextual data*, has been developed within Work Package 3 (WP3) – *Energy data modelling* – of the SEMANTCO project. WP3 concerns both the first and the second component of the previous list and is composed of the following four tasks:

- Task 3.1 – *Providing access to distributed energy data repositories.*
- Task 3.2 – *Structuring available data according to energy standards.*
- Task 3.3 – *Structuring contextual data according to standards.*
- Task 3.4 – *Ontology Repository and Data migration to OWL format.*
- Task 3.5 – *Enhancing data available to the SEIF.*

¹ Annex I- *Description of the Work*, Part B, p. 3.

In particular, Deliverable 3.3 summarises the work done and the results achieved in Task 3.3, which had the main objective of semantically modelling the contextual data, also named energy-related data, according to different kinds of standards and literary references. Task 3.3 is the prosecution of the work done in Task 3.2, as it applies the same methodology used to structure the energy data.

The processed data were provided by Task 2.1 – *Case study design*, in which the available data from the three case studies analysed in SEMANCO – Manresa (Spain), Newcastle-upon-Tyne (United Kingdom) and North Harbour (Denmark) – were collected and then listed in Deliverable 2.1 – *Report of the case studies and analysis*. In Task 3.1, the data were analysed and classified according to a standard categorisation, fixing the terminology and the definitions and including them in Deliverable 3.1 – *Report on the Accessible Energy Data*.

Task 3.1 had a key role as connection node between Task 2.1 and Tasks 3.2 and 3.3. In fact, Tasks 3.2 and 3.3 provide the ontological modelling of data identified in Task 2.1 using the terminology defined in Task 3.1.

Both Task 3.2 and Task 3.3 concern the data modelling but Task 3.2 is about the energy data (i.e. energy systems, energy quantities and boundary conditions), while Task 3.3 is concerned with the energy-related data or contextual data. Deliverable 3.2 – *Guidelines for Structuring Energy Data* (submitted in month 15) contains the guidelines for structuring data on energy systems, energy quantities and boundary conditions, while the present project deliverable provides the guidelines for structuring energy-related data.

The methodology followed to semantically model the available data was described in detail in Deliverable 3.2. According to this methodology, the data referred to energy systems, energy quantities and boundary conditions were structured in the *Standard Tables*, as the main result of the ontological modelling process in Task 3.2. The same procedure has been applied for structuring the contextual data in Task 3.3, through the use of the *Standard Tables* as well.

In addition, in Task 3.3 all the *Standard Tables* have been contextualised in different areas (e.g. region, municipality, neighbourhood, building) and taken into account in SEMANCO for the three case studies. Each of these areas can be referred to a different scale (macro scale for region or municipality, meso scale for neighbourhood, micro scale for building), according to Deliverable 2.1.

Deliverable 3.3 deals with the following issues:

- The identification of the categories of data to be semantically modelled according to a precise structure and definition of the categories included in the contextual data group.
- The analysis of standards and references for energy-related data modelling.
- The creation of the *Standard Tables* for the contextual data.
- The interconnections between the *Standard Tables* on the energy data (D3.2) and the *Standard Tables* on the contextual data, and the identification of the different territorial scales to which the *Standard Tables* are applied.

The *Standard Tables* concerning contextual data are reported in Appendix A.

1.2 Contribution of partners

The present project deliverable is the result of the collaborative work done in Task 3.3. The following project partners have been involved: POLITO, FUNITEC, UoT, CIMNE and HAS. Deliverable 3.3 has been elaborated by POLITO, which is the leader both of Task 3.3 and of the entire WP3.

The information on data has been provided by the partners responsible for the case studies: RAMBOLL for North Harbour (Denmark), NEA and UoT for Newcastle-upon-Tyne (United

Kingdom), and CIMNE and FORUM for Manresa (Spain).

The semantic modelling of data (*Standard Tables*) has been developed with the support of HAS and FUNITEC.

Detailed reviews of the deliverable were conducted by Leandro Madrazo (FUNITEC) and Xavi Cipriano (CIMNE) and German Nemirowskij (HAS), and the final version of the deliverable was proofread by Nina Dunlavy (NEA).

1.3 Relations to other activities in the project

The development of the ontology, on which the semantic modelling of data is founded, is the basis for the creation of the SEIF in WP4 - *Semantic Energy Information Framework*. The SEIF facilitates access to distributed energy data for the tools developed in WP5 – *Integrated tools*. The semantic framework creates the required bridge between different domains, contents and applications.

As described in Deliverable 1.8 - *Project Methodology*, ontologies are the core of the SEMANTCO project. Building an ontology requires the integration of vocabularies originating from different domains and used in different data sources, tools, by different user groups and stakeholders. The process of building an ontology therefore requires a multiple view approach of the different dimensions of the project development in order that the different perspectives involved can be integrated. To facilitate the integration of the different areas of the project, a methodology based on Use Cases has been adopted.

A Use Case is the bond connecting the tasks carried out in the different WPs, e.g. development of tools and integration of data sources. It also provides the bridge between the WPs and the demonstration scenarios. Each Use Case is composed of a network of Activities which need to be performed to fulfil the goal of the Use Case. Some of the Activities are shared by several Use Cases.

The role of WP 3 – *Energy Data Modelling* in the Use Case methodology involves the following activities:

- The identification of input data to fulfil the Activity goal in the Use Case (T3.1).
- The check of the technical accessibility of data sources (T3.1) to develop the Ontology Repository (T3.4).
- The semantic modelling of energy data (T3.2) and energy-related data (T3.3) according to standards.

In particular, the role of Task 3.3 (and previously of Task 3.2) in the Use Case methodology is shown in Figure 2.

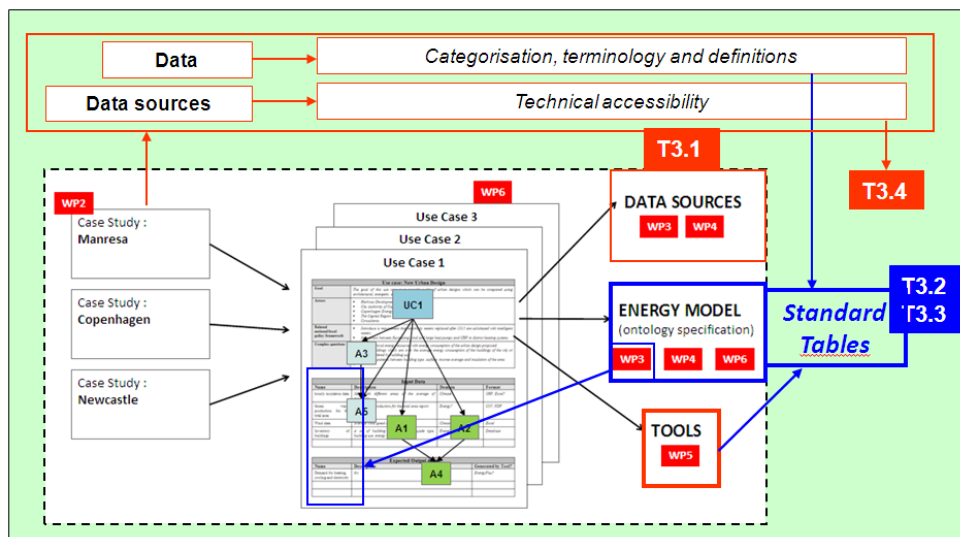


Figure 2. Role of Tasks 3.2 and 3.3 in the Use Case methodology

Tasks 3.2 and 3.3 represent a fundamental contribution to the development of the Use Case methodology, which is the core of the development of SEMANTCO. Deliverable 3.2 and Deliverable 3.3 provide the guidelines to semantically model the input and outputs concerning energy data and energy-related data sets in the Activities which conform the Use Cases.

The main results of Tasks 3.2 and 3.3 are the *Standard Tables* in which the energy data and the contextual data, respectively, are structured and defined according to standards. The description of the Activities refers to the *Standard Tables* (see Figure 3), which are developed from the data identified in WP2 – *Case studies* and classified in Task 3.1 (see Figure 2).

Also the input data of tools, in addition to those of the case studies, need to be structured; and for this reason, WP5 – *Integrated tools* is connected to Tasks 3.2 and 3.3 (see Figure 2).

In turn *Standard Tables* serve as input for the specification of the Energy Model, a formally specified ontology (i.e. in OWL), that plays the central role in the work of the *Semantic Energy Information Framework* (SEIF) being developed in WP4, Task 4.2 (Figure 2).

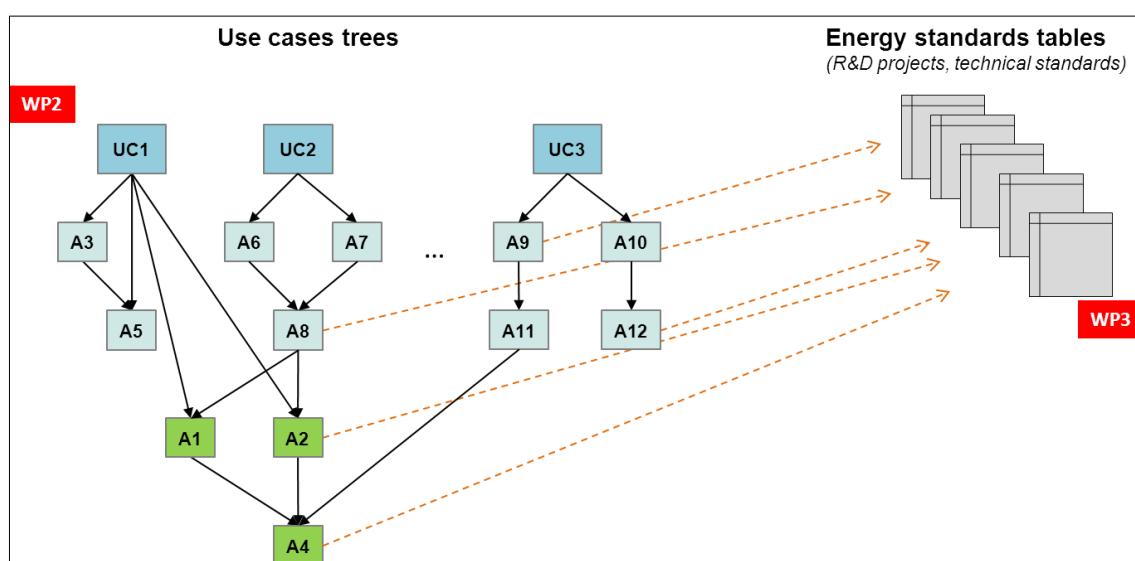


Figure 3. Relationship between Activities and Standard Tables (Tasks 3.2 – 3.3)

In addition, there is a strict link between the *Standard Tables* and the indicators defined in Task 2.2 *Strategies and indicators for data modelling and data analysis*. The “fund-flow model” described in Del. 2.2 refers to fund categories (e.g. land uses and time use) that should be applied to input flows (e.g. energy, materials) in order to get output flows (e.g. added value, CO₂ emissions). The fund categories are strongly linked to the contextual data. Depending on the structure of these data and their availability as well, the number and the way of calculating indicators could change. According to the list of indicators in Del. 2.2 (section 2.4.2.2.6 and Appendix A), the *Standard Tables* provide the structure of the indicators, of the data necessary to calculate the indicators (input data) and of the parameters used to normalise them (i.e. to express intensive quantities).

Deliverable 3.3, as the main result of the work done in Task 3.3, has been developed in parallel with other SEMANTCO deliverables due in month 18, such as:

- Deliverable 3.4 – *Ontology repository with migrated data*
- Deliverable 4.2 – *Semantic Energy Model*
- Deliverable 4.3 – *User interfaces for domain experts interacting with SEIF*
- Deliverable 6.1 – *Stakeholder requirements analysis*

2 CLASSIFICATION OF CONTEXTUAL DATA

Because of the different origins and the wide number of data necessary to develop an energy and environmental analysis at different scales, it was necessary to first collect data from case studies and then classify them into categories. This work was performed in Task 3.1. The data categories defined in Deliverable 3.1 – *Report on the Accessible Energy Data* are summarised in Table 1 with a brief description and some examples of data included in each category.

Table 1. Categories of data defined in D3.1

Category	Description	Example of data
ENERGY DATA	This category includes data referring to energy quantities.	Auxiliary energy, CO ₂ emission coefficient, CO ₂ emissions, delivered energy, energy demand (or energy required), energy supply, exported energy, final energy (or energy used), primary energy, produced renewable thermal/electric power/energy, RES coverage, etc.
ENERGY COST DATA	This category includes both energy cost and investment cost. The energy cost expresses the cost of each energy carrier and includes the cost of the consumed energy, the cost of the energy savings due to retrofit actions on the existing building stock and the cost of the produced/exported energy. The investment cost may refer to new constructions or to energy refurbishment actions.	Energy cost, investment cost, etc.
CLIMATIC DATA	This category includes the datasets that define the climatic conditions of a given geographical area.	Air temperature, diffuse solar irradiance, direct solar irradiance, global solar irradiance, gust wind speed, mixing ratio, total rainfall, reference wind speed, relative humidity, solar declination, solar irradiance, solar irradiation, water vapour pressure, wind direction, wind speed, etc.
ENVIRONMENTAL DATA	This category includes all the data that refer to the principal air pollutants in the urban area.	Total suspended particulate matter, sulphur dioxide, nitrogen dioxide, carbon monoxide, ozone, lead, etc.
BUILDING TECHNICAL DATA	This category includes data on building and its technical systems. It can be subdivided in several sub-categories, due to the wide range of data covered: <i>building general data, building external surroundings, building geometry, building construction, technical building systems.</i>	Building age, building typology, conservation state, building use, crowding index, occupancy profile, percentage of occupation, indoor air temperature (space heating), indoor air temperature (cooling), air exchange rate, internal heat gains, ground ρ -value, ground α -value, external obstructions, floor area, volume, height, orientation, thermal envelope area, number of complete storeys, number of apartments, shape factor, compactness ratio, building coordinates, type of <component>, number of <components>, <component> orientation, <component> adjoining space, <component> dimensions, <component> area, <component> percentage, <component> thickness, <component> U-value, type of system, type of subsystem, thermal/electrical power installed, efficiency, energy source, energy carrier, etc.

Category	Description	Example of data
LEGISLATIVE CONSTRAINTS	This category includes the data concerning legislative requirements to be applied to new constructions or to the refurbishment of existing buildings.	[The legislative constraints refer to some quantities and parameters already described in the “energy data” and “building technical data” categories].
GEOGRAPHICAL DATA	This category refers to data included in the “Geographic Information System” (GIS). The delivered information by the GIS is usually classified in: <i>geometric data, topologic data, informative data.</i>	[Due to the different nature of the information provided by the GIS and the high quantity of data delivered by the system, the geographical data for each case study of SEMANCO are provided and classified through an identification code, which summarises different types of data].
LAND AND BUILDINGS REGISTRY DATA	This category includes the data referring to the cadastre, for different scales or levels of analysis. The land registry data can be divided into the following sub-categories: <i>land parcels, land tenure, land value.</i> The registry data of buildings is considered a parallel category of the land registry data.	<i>Land registry data:</i> location, boundaries, coordinates, total surface, built surface, property rights, ownership, leases, property regime, land quality, land classification, economic value, tax value, value of improvements, etc. <i>Buildings registry data:</i> number of buildings, cadastral reference, cadastral area, cadastral rooms, graphic information, owner, etc.
URBAN PLANNING DATA	Traditionally the data for urban planning came from the land register’s land category or the building register’s major usage. However, urban land data also consider, for instance, the land use (e.g. building land, or no-building land) and the area of activity data.	Land use, area of activity, planned buildings, planned communication ways, planned public facilities and utilities, etc.
SOCIO-ECONOMIC DATA	This category includes overall basic social and economic data. The following sub-categories can be considered: <i>housing, families and households, economic activity, income and poverty.</i>	Occupancy status, number of rooms, number of occupants, type of ownership, property price, social rented, private rented, rental, rental free, number of nuclear families, size of nuclear family, type of nuclear family, number of households, size of household, type of household, employment, unemployment, occupations, earnings, hours worked, income, poverty, etc.
DEMOGRAPHIC DATA	This category includes overall basic data on population characteristics. The following sub-categories can be considered: <i>population, learning and education.</i>	Size, gender, age, birth date, density, origin, nationality, religion, language, learning level, education level, etc.

According to what is stated in Deliverable 3.2, in order to perform the subsequent data mining processes on the semantically modelled data, the information in Table 1 needs to be supplemented with additional information, namely, data types and units of measure for all data items. For these purposes, the data categories described in Table 1 need to be further classified into these two groups:

- Energy systems, energy quantities and boundary conditions data (defined generally as “energy data” in Deliverable 3.2), which were analysed in Deliverable 3.2.
- Energy-related data or contextual data, which are analysed in the following sections of the present deliverable.

The former group includes data that are essential to perform an energy and environmental analysis, while the latter group includes data that are related to energy but are not indispensable for carrying out an energy analysis. However, the energy-related data are necessary to contextualise the analysis (i.e. a precise territory is investigated) and to

characterise such context at different scales with additional information on energy costs, land use, socio-economic and demographic aspects, etc.

The categories of data that belong to each group are illustrated in Table 2, with a specification on the Task/Deliverable in which the data of each category are semantically modelled.

Table 2. Categories of data semantically modelled

Category	Group		Task/Deliverable
	Data on energy systems, energy quantities and boundary conditions	Energy related data or Contextual data	
ENERGY DATA	x		T3.2/D3.2
ENERGY COST DATA		x	T3.3/D3.3
CLIMATIC DATA	x		T3.2/D3.2
ENVIRONMENTAL DATA		x	T3.3/D3.3
BUILDING TECHNICAL DATA	x		T3.2/D3.2
LEGISLATIVE CONSTRAINTS		x	T3.3/D3.3
GEOGRAPHICAL DATA		x	T3.3/D3.3
LAND AND BUILDINGS REGISTRY DATA		x	T3.3/D3.3
URBAN PLANNING DATA		x	T3.3/D3.3
SOCIO-ECONOMIC DATA		x	T3.3/D3.3
DEMOGRAPHIC DATA		x	T3.3/D3.3

3 STRUCTURE OF CONTEXTUAL DATA

3.1 Analysis of standards and literature on contextual data modelling

3.1.1 Energy cost data

According to Deliverable 3.1 – *Report on the Accessible Energy Data*, the “Energy cost data” category includes data that can be grouped in “energy cost”, or more generally “running cost” data, and “investment cost” data. The “running cost” mainly refers to the cost of the consumed energy and the cost of building operation and maintenance related to energy. The “investment cost” on the other hand refers to interventions of new construction or refurbishment actions on the existing building stock, linked to both the building envelope and the technical building systems.

The analysis of the concepts referred to as “running cost” and “investment cost”, together with the related definitions, is provided by the international technical standard EN 15459 - *Energy performance of buildings - Economic evaluation procedure for energy systems in buildings*, 2007. This standard offers a calculation method for the economical issues of heating systems and other technical systems that are involved in the energy demand and energy consumption of the building.

The main items of the standard are the definitions and the structure of the types of costs, even those that shall be taken into account for calculation of the economical efficiency of saving options in buildings (e.g. insulation, better performing generators and distribution systems, efficient lighting, renewable sources, combined heat and power). For instance, the definitions of the following terms are provided in EN 15459: costs, initial investment costs, running costs, maintenance costs, operational costs, energy costs, added costs, replacement costs, annual costs, inflation rate, discount rate, market interest rate, real interest rate, annuity factor, price development (for energy, for human operation, for products, for maintenance, for added costs), lifespan, present value factor, design payback period of the building, starting year, calculation period, residual value, present value, nominal value, global cost, annuity cost.

The organisation of the various types of costs according to the standard EN 15459 is illustrated in Figure 4. These data have been considered in the ontological modelling.

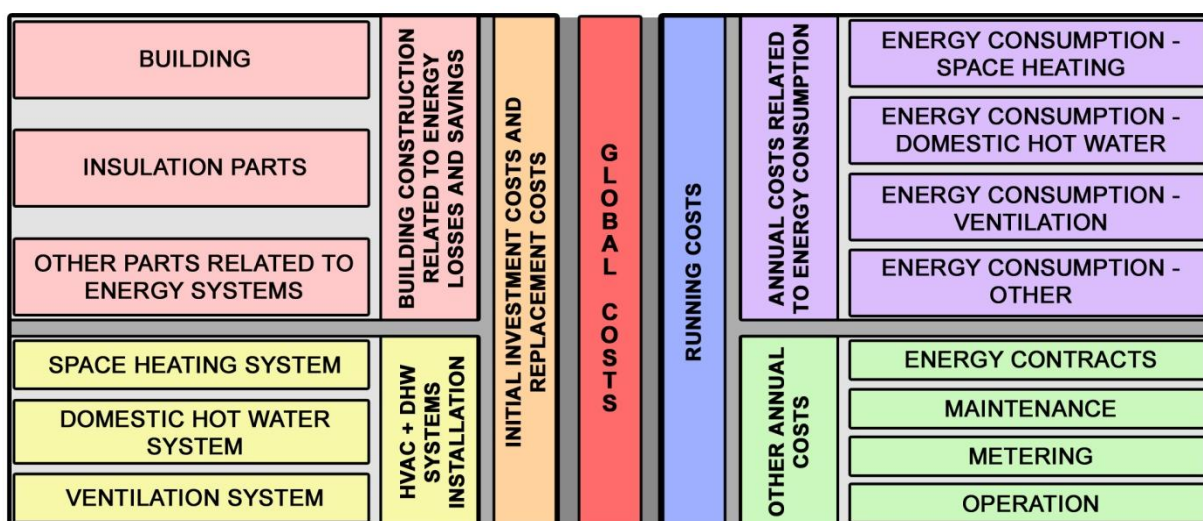


Figure 4. Types of costs according to EN 15459

3.1.2 Environmental data

The “Environmental data” category takes into account all the data that refers to the principal air pollutants in the urban area. As stated by Daly & Zanetti (2007), six principal pollutants can be included in this data category. They are “criteria” pollutants regulated by the United States Environmental Protection Agency (US-EPA) and by most countries in the world. The six principal air pollutants are the following ones:

- Total suspended particulate matter (TSP), with additional subcategories of particles smaller than 10 µm in diameter (PM₁₀), and particles smaller than 2,5 µm in diameter (PM_{2,5}).
- Sulphur dioxide (SO₂).
- Nitrogen oxides (NO and NO₂).
- Carbon monoxide (CO).
- Ozone (O₃).
- Lead (Pb).

The same environmental pollutants are taken into account by the European Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe. This Directive lays down measures aimed at the following:

- Defining and establishing objectives for ambient air quality designed to avoid, prevent or reduce harmful effects on human health and the environment as a whole.
- Assessing the ambient air quality in Member States on the basis of common methods and criteria.
- Obtaining information on ambient air quality in order to help combat air pollution and nuisance and to monitor long-term trends and improvements resulting from national and community measures.
- Maintaining air quality where it is good and improving it in other cases.
- Promoting increased cooperation between the Member States in reducing air pollution.

The Directive 2008/50/EC provides definition of air pollutants, such as PM₁₀, PM_{2,5}, oxides of nitrogen, volatile organic compounds (VOC), and definitions of pollutant concentration, such as level, limit value, critical level, margin of tolerance, target value, long-term objective, upper assessment threshold, lower assessment threshold, average exposure indicator. These are all attributes necessary to structure and model environmental data.

Other references on environmental data concepts are some international standards related to the measurement of the air pollutants concentration. They are the following ones:

- EN 12341:1998 – *Air quality. Determination of the PM₁₀ fraction of suspended particulate matter. Reference method and field test procedure to demonstrate reference equivalence of measurement methods.*
- EN 14907:2005 – *Ambient air quality. Standard gravimetric measurement method for the determination of the PM_{2,5} mass fraction of suspended particulate matter.*
- EN 14212:2012 – *Ambient air quality. Standard method for the measurement of the concentration of sulphur dioxide by ultraviolet fluorescence.*
- EN 14211:2012 – *Ambient air quality. Standard method for the measurement of the concentration of nitrogen dioxide and nitrogen monoxide by chemiluminescence.*
- EN 14626:2012 – *Ambient air quality. Standard method for the measurement of the concentration of carbon monoxide by non-dispersive infrared spectroscopy.*

- EN 14625:2012 – *Ambient air quality. Standard method for the measurement of the concentration of ozone by ultraviolet photometry.*
- EN 14902:2005 – *Ambient air quality. Standard method for the measurement of Pb, Cd, As and Ni in the PM₁₀ fraction of suspended particulate matter.*

3.1.3 Legislative constraints

The “Legislative constraints” are energy performance requirements fixed by the legislation to be applied to new constructions or existing buildings. The “Legislative constraints” usually refer to some data belonging to other data categories, for instance to the “Energy data” category, or “Building technical data” category, etc.

The main reference of contemporary legislative constraints in the field of building energy efficiency is the European Directive 2010/31/EU of the European Parliament and of the Council of 19 May 2010 on the energy performance of buildings. This Directive lays down requirements in relation to:

- The application of minimum requirements of the energy performance of new buildings and new building units.
- The application of minimum requirements of the energy performance of:
 - o existing buildings, building units and building elements that are subject to major renovation.
 - o building elements that form part of the building envelope and that have a significant impact on the energy performance of the building envelope when they are retrofitted or replaced.
 - o technical building systems whenever they are installed, replaced or upgraded.

Another important reference on this subject is the European Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency. The Directive establishes a common framework of measures for the promotion of energy efficiency within the Union in order to ensure the achievement of the Union’s 2020 20 % headline target on energy efficiency and to pave the way for further energy efficiency improvements beyond that date.

The promotion of the use of energy from renewable sources is the object of the European Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009. This Directive establishes a common framework for the promotion of energy from renewable sources. It sets mandatory national targets for the overall share of energy from renewable sources in gross final consumption of energy and for the share of energy from renewable sources in transport.

According to these Directives, the energy performance requirements and the reference values to comply with the European objectives are established by each Member State through their own legislative dispositions.

Guidelines to express overall indicators of energy performance of buildings, to express energy requirements for the design of new buildings or renovation of existing buildings, and to define reference values are specified by the international standard EN 15217 - *Energy performance of buildings - Methods for expressing energy performance and for energy certification of buildings*, 2007. This standard provides the concept of “energy performance indicators” that may be represented by the following:

- Primary energy (usually divided by the conditioned net floor area of the building or by the conditioned gross volume).
- CO₂ emissions.

- Net delivered energy weighted by any other parameter defined by national energy policy (e.g. delivered energy, primary energy or cost).

This overall indicator may be complemented by other indicators, for example thermal performance of the building envelope.

Two main types of energy performance requirements are defined by the standard:

- overall energy performance requirements (e.g. the primary energy as indicator),
- specific requirements based on:
 - o energy use for one specific purpose (e.g. heating, domestic hot water, cooling, lighting, ventilation),
 - o energy need for heating, domestic hot water and cooling,
 - o characteristics of the building itself or of its technical building systems considered as a whole (e.g. heat transfer coefficient of the building envelope, heating, domestic hot water or cooling system efficiency),
 - o characteristics of the building envelope or technical building systems components (e.g. thermal transmittance of walls, efficiency of boilers, insulation of heating and hot water pipes, lighting power density, specific fan power).

The indicators used may be different for a new building, a renovation of an existing building, an extension to an existing building, or different types of buildings.

The requirements may be written so as to modify (e.g. reduce, neutralise, correct or normalise) the impact of some parameters, i.e. the reference values to comply with are provided in function of different parameters, such as:

- The climate, to adapt the level of technologies requested to the climate.
- The building function, to adapt the requirements to the different designs, uses and feasible technologies.
- The energy carrier, for national energy policy regarding the possible use of different energy sources (e.g. gas/electricity), or to take into account the availability of specific energy sources in specific locations.
- The building size and/or the shape, to avoid unduly onerous requirements on detached houses and too low requirements on large compact buildings, and to adapt the requirements to buildings with different sizes and shapes.
- The ventilation rate, to prevent too costly requirements for buildings or uses which require a high ventilation rate.
- The illumination level, to prevent too costly requirements for buildings or uses which require a high illumination level.

All these aspects (type of requirement/indicator and reference parameter) have been taken into account for the ontological modelling of data related to the “Legislative constraints”.

3.1.4 Geographical data

The information on “Geographical data” is provided in SEMANTCO through the “Geographic Information System” (GIS). The GIS is a system designed to capture, store, manipulate, analyse, manage and present all types of geographical data.

References on spatial information are the European Directive 2007/2/EC and its related technical guidelines currently in publication. . The Directive concerns the establishment of an “Infrastructure for Spatial Information in the European Community (INSPIRE)” focusing on

the creation of metadata for the spatial data sets and services.

An important role in INSPIRE, building data specification, is played by CityGML, a common model for the representation and the exchange of 3D city models, focusing on the semantics of objects and its structures (aggregations, relations). CityGML defines the geometry, semantics and appearance of topographic objects in urban or rural regions. These objects are divided into thematic modules: the building module, the vegetation module, the transportation module, the water body module, the city furniture module and the digital terrain model module.

In SEMANTCO, a spatial database will inform the SEIF (*Semantic Energy Information Framework*) about geometric and topological data. The former group is related to the cartographic representation of the objects, such as the shape (point, line, polygon), the size and location. The latter group is related to the mutual relations between objects (connection, adjacency, inclusion, etc.).

Other complementary geographic data (numerical, text) are associated with each object. Some of them are provided by the *Standard Tables* and semantically structured. These data include, for instance, the latitude, the longitude, the height above sea level, etc. They have not been applied to the building scale but to a higher territorial level. The geographic information on the building is instead provided by the GIS.

3.1.5 Land and buildings registry data and urban planning data

In order to perform the semantic modelling of land data, the “Statement on the Cadastre” (1994) of the International Federation of Surveyors (FIG) has been taken as a reference. The document provides a classification of land information, determining the principal attributes of land, such as:

- *land parcels* → land location, land surface
- *land tenure* → land tenure
- *land value* → land quality, land type (i.e. urban land, rural land), land buildability, land economic value

It was decided to model the data on urban planning together with the land registry data because according to Koh (2001), the data for urban planning traditionally come from the land registry’s land category. Therefore, as the urban planning data are generally related to the land use, the land use can be considered an attribute of the land.

The land use might have different classifications. In this regard, the American Planning Association provides the “Land-Based Classification Standards (LBCS Standards)” (2001), a consistent model for classifying land uses based on their characteristics. The model extends the notion of classifying land uses by refining traditional categories into multiple dimensions, such as activities, functions, building types, site development character, and ownership constraints. Each dimension has its own set of categories and subcategories for classifying land uses.

According to the “Land-Based Classification Standards”, land use can be classified into:

- *Activity*: it refers to the actual use of land based on its observable characteristics. It describes what actually takes place in physical or observable terms (e.g. farming, shopping, manufacturing, vehicular movement, etc.). An office activity, for example, refers only to the physical activity on the premises, which could apply equally to a law firm, a non-profit institution, a court house, a corporate office, or any other office use. Similarly, residential uses in single-family dwellings, multifamily structures, manufactured houses, or any other type of building, would all be classified as residential activity.

- *Function*: it refers to the economic function or type of establishment using the land. Every land use can be characterised by the type of establishment it serves. Land use terms, such as agricultural, commercial, industrial etc., relate to establishments. The type of economic function served by the land use gets classified in this dimension; it is independent of actual activity on the land. Establishments can have a variety of activities on their premises, yet serve a single function. For example, two parcels are said to be in the same functional category if they serve the same establishment, even if one is an office building and the other is a factory.
- *Structure*: it refers to the type of structure or building on the land. Land use terms embody a structural or building characteristic, which indicates the utility of the space (in a building) or land (when there is no building). Land use terms, such as single-family house, office building, warehouse, hospital building, or highway, also describe structural characteristics. Although many activities and functions are closely associated with certain structures, it is not always so. Many buildings are often adapted for uses other than its original use. For instance, a single-family residential structure may be used as an office.
- *Site development character*: it refers to the overall physical development character of the land. It describes “what is on the land” in general physical terms. For most land uses, it is simply expressed in terms of whether the site is developed or not. But not all sites without observable development can be treated as undeveloped. Land uses, such as parks and open spaces, which often have a complex mix of activities, functions and structures on them, need categories independent of other dimensions. This dimension uses categories that describe the overall site development characteristics.
- *Ownership*: it refers to the relationship between the use and its land rights. Since the function of most land uses is either public or private and not both, distinguishing ownership characteristics seems obvious. However, relying solely on the functional character may obscure such uses as private parks, public theatres, private stadiums, private prisons, and mixed public and private ownership. Moreover, easements and similar legal devices also limit or constrain land-use activities and functions. This dimension allows classifying such ownership characteristics more accurately.

All these land use dimensions have been taken into account in the ontological modelling.

3.1.6 Socio-economic data and demographic data

A reference classification of the socio-economic and demographic data is provided by the United Nation Statistics Division, under the section “Demographic and social topics”, and by the UK – Office for National Statistics. In the ontological modelling of data, due to the strict relation of these topics, the two categories of data have been considered in the same structure.

The information on demography and social aspects might be referred to differently in relation to an area (such as, a region, a municipality, etc.) or to a building (with reference to the housing aspects).

In this regard, two different topics have been analysed:

- the *population* (related to a territory), that includes data on size, density, gender, age, origin, language, etc.
- the *housing* (related to a building), that includes data on tenure, price, etc.

In addition, both these topics include the following information, each referring to a different scale:

- households and families.
- economic activity.

- income and poverty.
- learning and education.

As regards the economic activity, a reference data structure is provided by the International Labour Organisation (ILO), that published the “International Standard Classification of Occupation (ISCO)” (2008), a classification structure for organising information on labour and jobs. It is part of the international family of economic and social classifications of the United Nations. The ILO describes the purpose of the ISCO classification as “a tool for organising jobs into a clearly defined set of groups according to the tasks and duties undertaken in the job. It is intended for use in statistical applications and in a variety of client oriented applications”.

Information about the modelling of the learning and education topic is provided by the “International Standard Classification of Education (ISCED)” (2011), a classification structure for organising information on education and training maintained by the United Nations Educational, Scientific and Cultural Organisation (UNESCO). It is part of the international family of economic and social classifications of the United Nations. The ISCED was designed in the early 1970s to serve as an instrument suitable for assembling, compiling and presenting statistics of education both within individual countries and internationally.

3.2 Elaboration of the *Standard Tables* on contextual data

The energy-related data or contextual data have been semantically modelled according to the standard references and following the same procedure described in Deliverable 3.2 – *Guidelines for Structuring Energy Data*, through the elaboration of the *Standard Tables*. The *Standard Tables* are a set of semantically structured concepts, including objects, attributes and standard definitions, provided in Excel sheets (see D3.2 – section 3.2).

As for the energy data, some *Mapping Tables* have also been created for the contextual data. They allow to keep a correspondence between the input data deriving from the data sources or from the tools of the case studies and the data names in the *Standard Tables*. These tables are also useful for enabling multiple users to collaborate in the definition and maintenance of the ontology (see D3.2 – section 4).

In Deliverable 3.2 a strict connection was established between the *Standard Tables* and the related data categories, i.e. for each data category (e.g. “Climatic data”, “Energy data”, “Building technical data”) a related *Standard Table* was created (e.g. “climate”, “energy quantities”, “building”, etc.) in the form of an Excel sheet. In the case of contextual data categories, a *Standard Table* does not necessarily coincide with a single data category. This is because the concepts related to a territorial context might have attributes belonging to different data categories. For instance, the “Land and buildings registry data” and the “Urban planning data” are both categories that provide the properties of the concept “land” and a single *Standard Table* is sufficient to model this concept with those properties.

In addition, the same category of data might provide different information in relation to the area size (e.g. building, municipality, region, etc.). The “Socio-economic data” category is an example of this. In fact, both the *housing* data (for the building scale) and the *population* data (for a scale higher than the building one) belong to the same category but convey a different information due to the different level of analysis. In this case two different *Standard Tables* are provided.

Besides the *Standard Tables* created for the contextual data categories (taking into account the issues described above), one further *Standard Table* has been elaborated in order to connect all the Excel sheets to the area object of analysis (see section 4).

All the *Standard Tables* on contextual data are reported in Appendix A.

4 CONTEXTUALISATION OF THE STANDARD TABLES ON TERRITORIAL SCALES

In order to perform an ontological modelling of contextual data, it is necessary to lead each contextual data category and, consequently its related *Standard Tables*, to a well-defined area, i.e. to a different scale of application. In fact according to the Use Case methodology, “the Use Case brings together information about actors, policies and Activities to fulfil a goal at a particular scale (micro, meso, and macro)” (see Deliverable 1.8 – *Project Methodology*). At the same time, the *Standard Tables* created in Deliverable 3.2 also need to be connected to the different areas, so that the contextualisation of energy systems, energy quantities and boundary conditions is guaranteed.

The categories of data, analysed in Deliverable 3.1 – *Report on the Accessible Energy Data* and then structured semantically in Deliverable 3.2 and in the present deliverable, are illustrated in Figure 5 and listed in Table 3 with reference to the different areas to which the categories might be applied (i.e. country, region, municipality, neighbourhood, building).

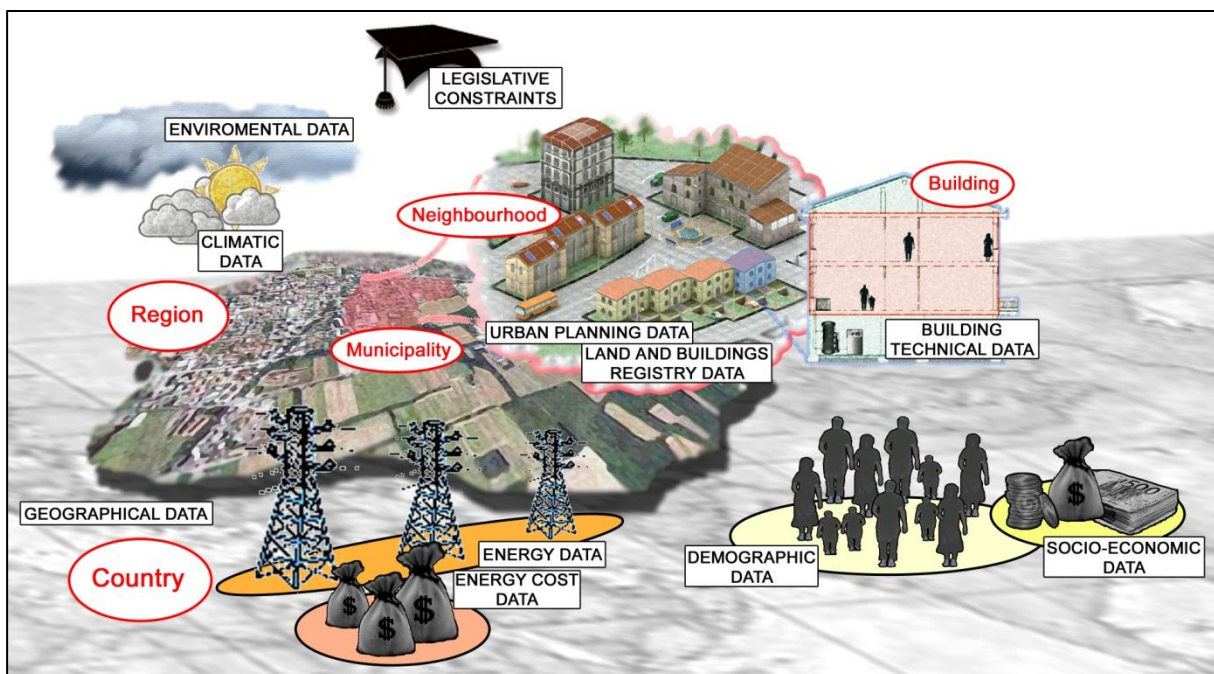


Figure 5. Categories of data and areas

Table 3. Application level of the categories of data

DATA CATEGORY (D3.1)	AREAS AND RELATED SCALES				
	COUNTRY (macro)	REGION (macro)	MUNICIPALITY (macro)	NEIGHBOURHOOD (meso)	BUILDING (micro)
<i>Energy data</i>	x	x	x	x	x
<i>Energy cost data</i>	x	x	x	x	x
<i>Climatic data</i>		x	x		
<i>Environmental data</i>	x	x	x	x	
<i>Building technical data</i>					x
<i>Legislative constraints</i>	x	x	x	x	x
<i>Geographical data</i>	x	x	x		
<i>Land and buildings registry data</i>				x	x
<i>Urban planning data</i>				x	
<i>Socio-economic data</i>	x	x	x	x	x
<i>Demographic data</i>	x	x	x	x	x

The *Standard Tables* elaborated both in D3.2 and in D3.3 have been referred in Task 3.3 to a specific area. The correspondence is reported in the Table 4 listing, for each data category, the related *Standard Tables* (through the Excel sheets' names) and the areas of application.

To that purpose a particular *Standard Table* Excel sheet named "TERRITORY" has been added. This sheet includes the concepts of "region", "municipality", "neighbourhood" and "building" with their attributes expressed through a link to the reference *Standard Tables*.

Table 4. Correspondence between data categories, Standard Tables (Excel sheets) and areas

DATA CATEGORY (D3.1)	STANDARD TABLE (ref. Excel sheets)	KIND OF AREA			
		Region	Munic.	Neighb.	Building
Energy data	"energy_quantities"	x	x	x	x
Energy cost data	"cost_related_to_energy"	x	x	x	x
Climatic data	"local_climate"		x		
	"climate"	x			
Environmental data	"pollution"	x	x	x	
Building technical data	"building"				x
	"b_use"				x
	"cs_geometry"				x
	"cs_envelope"				x
	"cs_internal_partitions"				x
	"cs_occupancy"				x
	"cs_indoor_air_temperature"				x
	"cs_ventilation"				x
	"cs_internal_heat_gains"				x
	"building_system"				x
	"energy_generator"				x
Legislative constraints	"requirement_related_to_energy"	x	x	x	x
Geographical data	"geographic_coordinate"	x	x		
Land and buildings registry data	"land"			x	
	"building"				x
Urban planning data	"land"			x	

Socio-economic data	"housing"				X
	"population"	X	X	X	
Demographic data	"housing"				X
	"population"	X	X	X	
-	"TERRITORY"	-	-	-	-

The connections between the *Standard Tables* are illustrated in Figure 6.

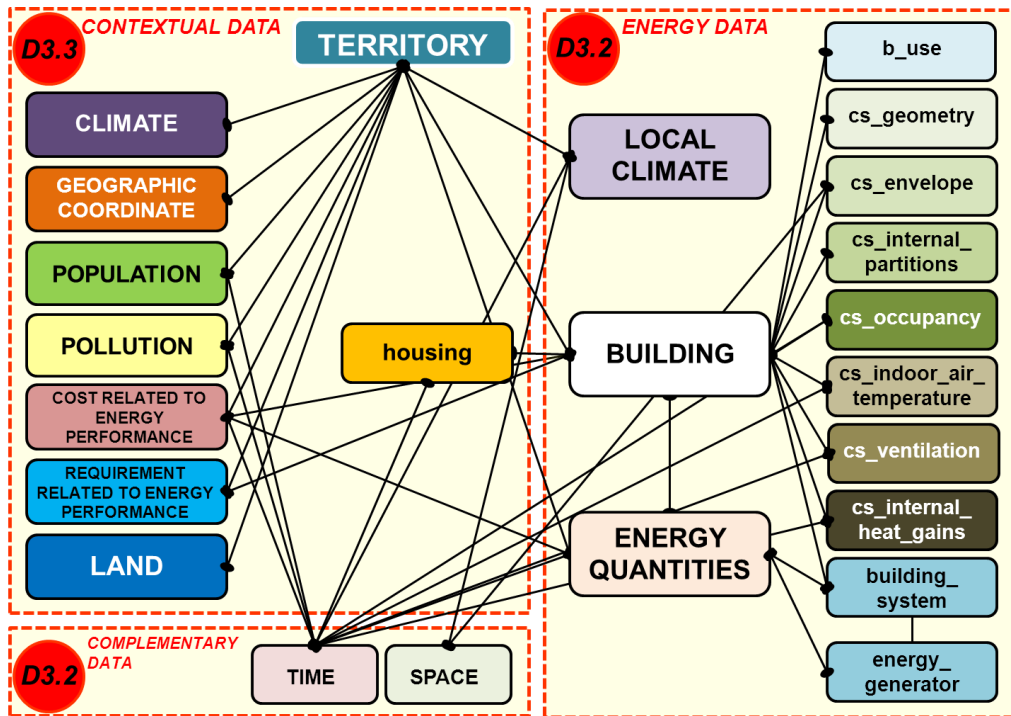


Figure 6. Connections among the Standard Table Excel sheets

5 CONCLUSIONS

5.1 Contribution to overall picture

The present deliverable, carried out in Task 3.3 of Work Package 3, contributes to the development of SEMANTCO insofar as:

- It presents guidelines for structuring and semantically modelling contextual data following the methodology already presented in Deliverable 3.2 (Task 3.2), in order to allow the building of ontologies as the core of the SEMANTCO project. Some standards and literary references are presented as the main sources for carrying out the ontological work as regards the energy-related data.
- It provides the *Standard Tables* for structuring and modelling the contextual data and the way to connect all the *Standard Tables* and to refer them to different territorial scales, as required in the Use Case methodology.

5.2 Impact on other WPs and Tasks

Task 3.3 and Deliverable 3.3, together with the previous Task 3.2 and Deliverable 3.2, have the following impacts on the other WPs and tasks of SEMANTCO:

- They contribute to create a standard energy model, i.e. the ontology building the heart of the *Semantic Energy Information Framework* (SEIF) being developed in Work Package 4. The *Standard Tables* are an input for the development of the formally specified ontology using the *Ontology Editor* being developed in Task 4.2.
- The standard energy model is also the basis for the application of the mapping tools developed in Task 4.1 and applied in Task 4.5 whose aim is to convert relational data to RDF and to integrate heterogeneously structured data sources to SEIF.
- The creation of the *Standard Tables* has contributed to the harmonisation and enhancement of the previously defined Use Cases and Activities.

5.3 Contribution to demonstration

The contribution of Task 3.3 and the present deliverable to the demonstration scenarios (see also Deliverable 8.1 – *Implementation Plan*) is directly linked to the Use Case methodology. Task 3.3 gives completion to WP3 as regards the semantic modelling of data, which started with Task 3.2.

As the work conducted in Tasks 3.2 and 3.3 is mainly focused on the semantic modelling of data, the further impact of this task in the demonstration concerns:

- The elaboration of the *Standard Tables*, structuring both the “data names” of the Activity forms of the Use cases and the input data from tools to be used in the SEMANTCO platform (WP5).
- The elaboration of the mapping tables to keep a link between the original data names in the data sources/tools and the data names of Deliverable 3.1 and the ontology, following the procedure explained in Deliverable 3.2.

5.4 Other conclusions and lessons learned

The present deliverable provides guidelines for structuring energy-related data through the application of rules, terminology, concept relationships that are derived from different standards. The proposed methodology of data collection and structure is innovative both in the use and application of the references and in the elaboration of the *Standard Tables*.

This work gives a substantial contribution to semantics, because new specific fields on energy topics are now available to be implemented in the ontology world. In this regard, the ongoing publication guidelines on Directive 2007/2/EC (INSPIRE) will be taken into account in the prosecution of the project, in order to include in the ontology more data fields on spatial information.

Task 3.3 and Deliverable 3.3, whose objective is modelling data related to context, allowed to lead all the developed *Standard Tables* (of both D3.2 and D3.3) to a specific area, and so they contribute to give a real application of semantics, not only related to the building concept but also to the urban scale.

As the data structure and definitions come from different sources, new references on contextual data could be taken into account in the continuation of the project. Also the *Standard Tables* in Appendix A should not be considered exhaustive. More data fields could be added for each category if new data need to be structured.

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7 GLOSSARY

Contextual data

Data related to energy and characterising a context. These data are not indispensable for carrying out an energy analysis, but to contextualise the analysis on a specific territory (including different territorial scales) by adding specific information. Examples of contextual data are energy cost data, environmental data, legislative constraints, geographical data, land and buildings registry data, urban planning data, socio-economic data, demographic data.

Energy data

Data related to energy systems, energy quantities and boundary conditions. These data are necessary to perform energy and environmental analyses. Examples of energy data are energy consumptions and energy savings, CO₂ emissions, climatic data, building technical data.

Standard table

Set of semantically structured concepts, including objects, attributes and standard definitions.

8 APPENDICES

APPENDIX A. Standard Tables on contextual data

The *Standard Tables* on contextual data or energy-related data created for the demonstration scenarios is illustrated from Table A1 to Table A10.

Table A1. Standard Table named “TERRITORY”

Name/Acronym		Corresponding Name in D3.1	Description	Reference	Type of data	Unit	Reference to other sheets
Territory		-	a geographical domain	-	string	-	-
is	Country	-	a territory of a nation or state	-	string	-	-
is	Region	-	an administrative division of a country	-	string	-	-
is	Municipality	-	a political unit, such as a city, town, or village, incorporated for local self-government	-	string	-	-
is	Neighbourhood	-	a geographically localised community within a larger city, town or suburb	-	string	-	-
has	Territorial_Information	-	-	-	-	-	-
Country		-	a territory of a nation or state	-	string	-	-
has	Region	-	an administrative division of a country	-	string	-	-
	has	Climate	climate that defines areas of size up to 200 km linear extension	-	-	-	"climate"
	has	Municipality	a political unit, such as a city, town, or village, incorporated for local self-government	-	string	-	-
	has	Local_Climate	climate that defines areas of size up to 10 km linear extension	-	-	-	"local_climate"
	has	Neighbourhood	a geographically localised community within a larger city, town or suburb	-	string	-	-
	has	Land	a topographically or functionally distinct tract	-	-	-	"land"
	has	Building	construction as a whole, including its envelope and all technical building systems, for which energy is used to condition the indoor climate, to provide domestic hot water and illumination and other services related to the use of the building	EN 15603	-	-	"building"

Name/Acronym		Corresponding Name in D3.1	Description	Reference	Type of data	Unit	Reference to other sheets
Territorial_Information		-	-	-	-	-	-
<i>has</i>	Geographic_Coordinate	-	coordinate describing geographical location	-	-	-	"geographic_coordinate"
<i>has</i>	Population	-	the body of inhabitants of a place	-	-	-	"population"
<i>has</i>	Pollution	-	substances present in ambient air and likely to have harmful effects on human health and/or the environment as a whole	Directive 2008/50/EC*	-	-	"pollution"
<i>has</i>	Cost_Related_To_Energy_Performance	-	cost that shall be taken into account for calculation of the cost effectiveness of energy efficiency measures in buildings	EN 15459	-	-	"cost_related_to_energy"
<i>has</i>	Energy_Consumption_And_Energy_Saving_Related_To_Building_Services	-	energy referred to building services	-	-	-	"energy_quantities"
<i>has</i>	Energy_Indicator	-	indicator of building energy performance	-	-	-	"energy_quantities"
<i>has</i>	Requirement_Related_To_Energy_Performance	-	minimum level of energy performance that is to be achieved to obtain a right or an advantage: e.g. right to build, lower interest rate, quality label	EN 15217*	-	-	"requirement_related_to_energy"

Table A2. Standard Table named "geographic_coordinate"

Name/Acronym		Corresponding Name in D3.1	Description	Reference	Type of data	Unit	Reference to other sheets
Geographic_Coordinate		-	coordinate describing geographical location	-	-	-	-
<i>has</i>	Latitude	<i>latitude</i> [new]	the angular distance north or south of the earth's equator, measured in degrees along a meridian, as on a map or globe	-	real	°	-
<i>has</i>	Longitude	<i>longitude</i> [new]	angular distance on the earth's surface, measured east or west from the prime meridian at Greenwich, England, to the meridian passing through a position, expressed in degrees (or hours), minutes, and seconds	-	real	°	-
<i>has</i>	Height_Above_Sea_Level	<i>height above sea level</i> [new]	the elevation (on the ground) or altitude (in the air) of an object, relative to the average sea level datum	-	real	m	-

Table A3. Standard Table named “population”

Name/Acronym		Corresponding Name in D3.1	Description	Reference	Type of data	Unit	Reference to other sheets
Population		-	the body of inhabitants of a place	-	-	-	-
has	Population_Size	size	number of inhabitants	-	integer	-	-
	has Gender	gender	-	-	string	-	-
	is Male	-	-	-	string	-	-
	is Female	-	-	-	string	-	-
	has Education_Level	education level	level of education	-	string	-	-
	is Early_Childhood_Education	-	initial stage of organised instruction, designed primarily to introduce very young children to a school-type environment and to develop their cognitive, physical, social and emotional skills	UNESCO - ISCED	string	-	-
	is Primary_Education	-	normally starting between the ages of 5-7, designed to give a sound basic education in reading, writing and mathematics along with an elementary understanding of other subjects	UNESCO - ISCED	string	-	-
	is Lower_Secondary_Education	-	designed to complete basic education, usually on a more subject-oriented pattern. It builds upon the learning outcomes from primary education and aims to lay the foundation for lifelong learning and human development	UNESCO - ISCED	string	-	-
	is Upper_Secondary_Education	-	more specialised education typically beginning at age 15 or 16 years and/or completes secondary education in preparation for tertiary education, or to provide skills relevant to employment, or both	UNESCO - ISCED	string	-	-
	is Post-Secondary_Non-Tertiary_Education	-	programmes that straddle the boundary between upper- and post-secondary education from an international point of view	UNESCO - ISCED	string	-	-
	is Short-Cycle_Tertiary_Education	-	first stage of tertiary education. Programmes that are practically oriented/ occupationally specific and are mainly designed for participants to acquire the practical skills and know-how needed for employment in a particular occupation or trade or class of occupations or trades, the successful completion of which usually provides the participants with a labour-market relevant qualification	UNESCO - ISCED	string	-	-
	is Bachelor_Or_Equivalent	-	first stage of tertiary education. Programmes that are largely theoretically based and are intended to provide sufficient qualifications for gaining entry into advanced research programmes and professions with high skills requirements	UNESCO - ISCED	string	-	-

Name/Acronym		Corresponding Name in D3.1	Description	Reference	Type of data	Unit	Reference to other sheets	
	<i>is</i>	Master_Or_Equivalent	-	programmes that are largely theoretically based and are intended to provide sufficient qualifications for gaining entry into advanced research programmes and professions with high skills requirements	UNESCO - ISCED	string	-	
	<i>is</i>	Doctoral_Or_Equivalent	-	second stage of tertiary education (leading to an advanced research qualification)	UNESCO - ISCED	string	-	
	<i>has</i>	Occupation	<i>occupations</i>	labour or job	-	string	-	
	<i>is</i>	Manager	-	chief executives, senior officials, legislators; administrative and commercial managers; production and specialised services managers; hospitality, retail and other services managers	ILO - ISCO	string	-	
	<i>is</i>	Professional	-	science and engineering professionals; health professionals; teaching professionals; business and administration professionals; information and communications technology professionals; legal, social and cultural professionals	ILO - ISCO	string	-	
	<i>is</i>	Technician_And_Associate_Professional	-	science and engineering associate professionals; health associate professionals; business and administration associate professionals; legal, social, cultural and related associate professionals; information and communications technicians	ILO - ISCO	string	-	
	<i>is</i>	Clerical_Support_Worker	-	general and keyboard clerks; customer services clerks; numerical and material recording clerks; other clerical support workers	ILO - ISCO	string	-	
	<i>is</i>	Service_And_Sales_Worker	-	personal service workers; sales workers; personal care workers; protective services workers	ILO - ISCO	string	-	
	<i>is</i>	Skilled_Agricultural_Forestry_Fishery_Worker	-	market-oriented skilled agricultural workers; market oriented skilled forestry, fishery and hunting workers; subsistence farmers, fishers, hunters and gatherers	ILO - ISCO	string	-	
	<i>is</i>	Craft_And_Related_Trades_Worker	-	building and related trades workers, excluding electricians; metal, machinery and related trades workers; handcraft and printing workers; electrical and electronic trade workers; food processing, wood working, garment and other craft and related trades workers	ILO - ISCO	string	-	
	<i>is</i>	Plant_And_Machine_Operator_And_Assembler	-	stationary plant and machine operators; assemblers; drivers and mobile plant operators	ILO - ISCO	string	-	
	<i>is</i>	Elementary_Occupation	-	cleaners and helpers; agricultural, forestry and fishery labourers; labourers in mining, construction, manufacturing and transport; food preparation assistants; street and related sales and service workers; refuse workers and other elementary workers	ILO - ISCO	string	-	
	<i>is</i>	Armed_Forces_Occupation	-	commissioned armed forces officers; non-commissioned armed forces officers; armed forces occupations, other ranks	ILO - ISCO	string	-	
	<i>is</i>	Unemployed	<i>unemployment</i>	without labour or job	-	string	-	
<i>has</i>	Population_Density		<i>density</i>	number of inhabitants per unit area	-	real	km ⁻²	-
<i>has</i>	Population_Main_Origin		<i>origin</i>	-	-	string	-	-

Name/Acronym		Corresponding Name in D3.1	Description	Reference	Type of data	Unit	Reference to other sheets
has	Population_Main_Language	language	-	-	string	-	-
has	Population_Number_Of_Buildings	number of buildings [new]	-	-	integer	-	-
has	Population_Number_Of_Households	number of households	-	-	integer	-	-
	is	Population_Number_Of_Households_Total	-	-	integer	-	-
	is	Population_Number_Of_Households_In_Fuel_Poverty	-	-	integer	-	-
has	Population_Percentage_Households_In_Fuel_Poverty	-	-	-	real	-	-
has	Population_Number_Of_Nuclear_Families	number of nuclear families	-	-	integer	-	-
has	Population_Mean_Income	income	-	-	real	EUR ...	-
	has	Duration	-	time interval to which the value refers	string	-	"TIME"

Table A4. Standard Table named "pollution"

Name/Acronym		Corresponding Name in D3.1	Description	Reference	Type of data	Unit	Reference to other sheets
Pollution		-	substances present in ambient air and likely to have harmful effects on human health and/or the environment as a whole	Directive 2008/50/EC*	-	-	-
has	Pollutant	-	type of substance present in ambient air and likely to have harmful effects on human health and/or the environment as a whole	Directive 2008/50/EC*	-	-	-
	is	Total_Suspended_Particiulate_Matter_PM_10	total suspended particulate matter - PM10 particulate matter which passes through a size-selective inlet with a 50% efficiency cut-off at 10 µm aerodynamic diameter. Particulate matter can exist in solid or liquid form, and includes smoke, dust, aerosols, metallic oxides, and pollen. Sources of PM include combustion, factories, construction, demolition, agricultural activities, motor vehicles, and wood burning	Directive 2008/50/EC EN 12341	string	-	-
	is	Total_Suspended_Particiulate_Matter_PM_2.5	total suspended particulate matter - PM2.5 particulate matter which passes through a size-selective inlet with a 50% efficiency cut-off at 2,5 µm aerodynamic diameter. Particulate matter can exist in solid or liquid form, and includes smoke, dust, aerosols, metallic oxides, and pollen. Sources of PM include combustion, factories, construction, demolition, agricultural activities, motor vehicles, and wood burning	Directive 2008/50/EC EN 14907	string	-	-

Name/Acronym		Corresponding Name in D3.1	Description	Reference	Type of data	Unit	Reference to other sheets	
	<i>is</i>	Sulphur_Dioxide	<i>sulphur dioxide</i>	the compound is colourless, but has a suffocating, pungent odour. The primary source of SO ₂ is the combustion of sulphur-containing fuels (e.g. oil and coal)	-	string	-	
	<i>is</i>	Nitrogen_Oxides	<i>nitrogen oxides</i>	it is a reddish-brown gas with a sharp odour. The primary source of this gas is vehicle traffic, and it plays a role in the formation of tropospheric ozone	-	string	-	
	<i>is</i>	Carbon_Monoxide	<i>carbon monoxide</i>	it is a odourless, colourless gas formed from the incomplete combustion of fuels. The largest source of CO today is motor vehicles	-	string	-	
	<i>is</i>	Ozone	<i>ozone</i>	tropospheric ("low-level") ozone is a secondary pollutant formed when sunlight causes photochemical reactions involving NO _x and VOCs. Automobiles are the largest source of VOCs necessary for these reactions	-	string	-	
	<i>is</i>	Lead	<i>lead</i>	the largest source of Pb in the atmosphere has been from leaded gasoline combustion, but with the gradual elimination worldwide of lead in gasoline, air Pb levels have decreased considerably. Other airborne sources include combustion of solid waste, coal, and oils, emissions from iron and steel production and lead smelters, and tobacco smoke	-	string	-	
	<i>has</i>	Pollutant_Level	-	the concentration of a pollutant in ambient air or the deposition thereof on surfaces in a given time	Directive 2008/50/EC	real	ppmv mg/m ³ µg/m ³	-
	<i>has</i>	Pollutant_Limit_Value	-	a level fixed on the basis of scientific knowledge, with the aim of avoiding, preventing or reducing harmful effects on human health and/or the environment as a whole, to be attained within a given period and not to be exceeded once attained	Directive 2008/50/EC	real	ppmv mg/m ³ µg/m ³	-
	<i>has</i>	Pollutant_Margin_Of_Tolerance	-	the percentage of the limit value by which that value may be exceeded subject to certain conditions	Directive 2008/50/EC	real	%	-
	<i>has</i>	Pollutant_Critical_Level	-	a level fixed on the basis of scientific knowledge, above which direct adverse effects may occur on some receptors, such as trees, other plants or natural ecosystems but not on humans	Directive 2008/50/EC	real	ppmv mg/m ³ µg/m ³	-
	<i>has</i>	Pollutant_Target_Value	-	a level fixed with the aim of avoiding, preventing or reducing harmful effects on human health and/or the environment as a whole, to be attained where possible over a given period	Directive 2008/50/EC	real	ppmv mg/m ³ µg/m ³	-
	<i>has</i>	Pollutant_Long_Term_Objective	-	a level to be attained in the long term, save where not achievable through proportionate measures, with the aim of providing effective protection of human health and the environment	Directive 2008/50/EC	real	ppmv mg/m ³ µg/m ³	-
	<i>has</i>	Pollutant_Upper_Assessment_Threshold	-	a level below which a combination of fixed measurements and modelling techniques and/or indicative measurements may be used to assess ambient air quality	Directive 2008/50/EC	real	ppmv mg/m ³ µg/m ³	-

Name/Acronym		Corresponding Name in D3.1	Description	Reference	Type of data	Unit	Reference to other sheets
has	Pollutant_Lower_Assessment_Threshold	-	a level below which modelling or objective-estimation techniques alone may be used to assess ambient air quality	Directive 2008/50/EC	real	ppmv mg/m ³ µg/m ³	-
has	Pollutant_Average_Exposure_Indicator	-	an average level determined on the basis of measurements at urban background locations throughout the territory of a Member State and which reflects population exposure. It is used to calculate the national exposure reduction target and the exposure concentration obligation	Directive 2008/50/EC	real	ppmv mg/m ³ µg/m ³	-
has	Time_Processing_Type	-	type of time processing for the determination of the value	-	string	-	"TIME"
has	Duration	-	time interval to which the value refers	-	string	-	"TIME"

Table A5. Standard Table named "cost_related_to_energy"

Name/Acronym		Corresponding Name in D3.1	Description	Reference	Type of data	Unit	Reference to other sheets
Cost_Related_To_Energy_Performance		-	cost that shall be taken into account for calculation of the cost effectiveness of energy efficiency measures in buildings	EN 15459	-	-	-
has	Initial_Investment_Cost	investment cost	cost to be considered when the building (or a specified equipment) is delivered to the customer, ready to use. This cost include design, purchase of systems and components, connection to suppliers, installation and commissioning process. The initial investment cost is the cost presented to the customer	EN 15459	real	EUR ...	-
is	Initial_Investment_Cost_New_Building	-	initial investment cost for a new building	-	real	EUR ...	-
is	Initial_Investment_Cost_Refurbished_Building	-	initial investment cost for a refurbished building	-	real	EUR ...	-
has	Wall_Cost	-	-	-	logic	-	-
has	Wall_Lifespan	-	expected lifetime (number of years) for the wall	EN 15459*	integer	-	-
has	Wall_Added_Insulation_Cost	-	-	-	logic	-	-
has	Wall_Added_Insulation_Lifespan	-	expected lifetime (number of years) for the wall insulation	EN 15459*	integer	-	-
has	Roof_Cost	-	-	-	logic	-	-
has	Roof_Lifespan	-	expected lifetime (number of years) for the roof	EN 15459*	integer	-	-

Name/Acronym		Corresponding Name in D3.1	Description	Reference	Type of data	Unit	Reference to other sheets
has	Roof_Added_Insulation_Cost	-	-	-	logic	-	-
has	Roof_Added_Insulation_Lifespan	-	expected lifetime (number of years) for the roof insulation	EN 15459*	integer	-	-
has	Window_Cost	-	-	-	logic	-	-
has	Window_Lifespan	-	expected lifetime (number of years) for the window	EN 15459*	integer	-	-
has	Skylight_Cost	-	-	-	logic	-	-
has	Skylight_Lifespan	-	expected lifetime (number of years) for the skylight	EN 15459*	integer	-	-
has	Ceiling_Cost	-	-	-	logic	-	-
has	Ceiling_Lifespan	-	expected lifetime (number of years) for the ceiling	EN 15459*	integer	-	-
has	Ceiling_Added_Insulation_Cost	-	-	-	logic	-	-
has	Ceiling_Added_Insulation_Lifespan	-	expected lifetime (number of years) for the ceiling insulation	EN 15459*	integer	-	-
has	Floor_Added_Insulation_Cost	-	-	-	logic	-	-
has	Floor_Added_Insulation_Lifespan	-	expected lifetime (number of years) for the floor insulation	EN 15459*	integer	-	-
has	Space_Heating_System_Cost	-	-	-	logic	-	-
has	Space_Heating_System_Lifespan	-	expected lifetime (number of years) for the space heating system	EN 15459*	integer	-	-
has	Space_Cooling_System_Cost	-	-	-	logic	-	-
has	Space_Cooling_System_Lifespan	-	expected lifetime (number of years) for the space cooling system	EN 15459*	integer	-	-
has	Domestic_Hot_Water_System_Cost	-	-	-	logic	-	-
has	Domestic_Hot_Water_System_Lifespan	-	expected lifetime (number of years) for the domestic hot water system	EN 15459*	integer	-	-
has	Ventilation_System_Cost	-	-	-	logic	-	-
has	Ventilation_System_Lifespan	-	expected lifetime (number of years) for the ventilation system	EN 15459*	integer	-	-
has	Lighting_System_Cost	-	-	-	logic	-	-
has	Lighting_System_Lifespan	-	expected lifetime (number of years) for the lighting system	EN 15459*	integer	-	-
has	Energy_Generator_Cost	-	-	-	logic	-	-
has	Energy_Generator_Lifespan	-	expected lifetime (number of years) for the energy generator	EN 15459*	integer	-	-

Name/Acronym		Corresponding Name in D3.1	Description	Reference	Type of data	Unit	Reference to other sheets	
	has	Period	-	time to which the value refers	-	string	-	"TIME"
	has	Running_Cost	running cost [new]	cost comprising maintenance cost, operational cost, energy cost and added cost	EN 15459	real	EUR ...	-
	has	Maintenance_Cost	maintenance cost [new]	annual cost for measures for preserving and restoring the desired quality of the installation. This includes annual cost for inspection, cleaning, adjustments, repair under preventive maintenance, consumable items	EN 15459	real	EUR ...	-
	has	Operational_Cost	operational cost [new]	annual cost for operators	EN 15459	real	EUR ...	-
	has	Energy_Cost	energy cost	annual cost for energy and standing charges for energy (and other consumables as well as costs). It includes contracts for energy delivered	EN 15459	real	EUR ...	-
	has	Energy_Carrier	energy carrier	substance or phenomenon that can be used to produce mechanical work or heat or to operate chemical or physical processes	ISO TR 16344 ISO 13600	string	-	"energy_quantities"
	has	Energy_Service	energy services	related to the services provided by the technical building systems and by appliances to provide the indoor climate condition, illumination and other services related to the use of the building	UNI TR 16344* EN 15603*	string	-	"energy_quantities"
	has	Added_Cost	added cost [new]	annual cost for insurance, other standing charges, taxes (including environmental taxes for energy). Subsidies for renewable energy delivered or produced locally are considered as benefits or cost reductions	EN 15459	real	EUR ...	-
	has	Duration	-	time interval to which the value refers	-	string	-	"TIME"
	has	Component_Replacement_Cost	replacement cost [new]	cost comprising periodic costs to replace a component	EN 15459*	real	EUR ...	-
	has	Wall_Replacement_Cost	-	-	-	logic	-	-
	has	Roof_Replacement_Cost	-	-	-	logic	-	-
	has	Window_Replacement_Cost	-	-	-	logic	-	-
	has	Skylight_Replacement_Cost	-	-	-	logic	-	-
	has	Ceiling_Replacement_Cost	-	-	-	logic	-	-
	has	Space_Heating_System_Replacement_Cost	-	-	-	logic	-	-
	has	Space_Cooling_System_Replacement_Cost	-	-	-	logic	-	-
	has	Domestic_Hot_Water_System_Replacement_Cost	-	-	-	logic	-	-
	has	Ventilation_System_Replacement_Cost	-	-	-	logic	-	-
	has	Lighting_System_Replacement_Cost	-	-	-	logic	-	-
	has	Energy_Generator_Replacement_Cost	-	-	-	logic	-	-

Name/Acronym		Corresponding Name in D3.1	Description	Reference	Type of data	Unit	Reference to other sheets		
	has	Period	-	time to which the value refers	-	string	-	"TIME"	
	has	Cost_Indicator	-	-	-	-	-	-	
	is	Global_Cost	global cost [new]	sum of the present value of all costs (referred to the starting year) including investment cost	EN 15459	real	EUR ...	-	
	is	Payback_Time_Period	payback time [new]	the period of time (years) required for the return on an investment to "repay" the sum of the original investment	-	integer	-	-	
	has	Inflation_Rate	inflation rate [new]	annual depreciation of the currency	EN 15459	real	%	-	
	has	Discount_Rate	discount rate [new]	definite value for comparison of the value of money at different times	EN 15459	real	%	-	
	has	Market_Interest_Rate	market interest rate [new]	interest rate agreed by lender	EN 15459	real	%	-	
	has	Real_Interest_Rate	real interest rate [new]	market interest rate adjusted according to inflation rate	EN 15459	real	%	-	
	has	Price_Development_Rate	price development [new]	rate of development of the prices	EN 15459	real	%	-	
		is	Price_Development_Rate_For_Energy	-	rate of development of the price for energy	EN 15459	real	%	-
		is	Price_Development_Rate_For_Human_Operation	-	rate of development of the price for human operation	EN 15459	real	%	-
		is	Price_Development_Rate_For_Products	-	rate of development of the price for products	EN 15459	real	%	-
		is	Price_Development_Rate_For_Maintenance	-	rate of development of the price for maintenance	EN 15459	real	%	-
		is	Development_Rate_Of_Added_Costs	-	rate of development of added costs	EN 15459	real	%	-
	has	Period	-	time to which the value refers	-	string	-	"TIME"	

Table A6. Standard Table named “*requirement_related_to_energy*”

Name/Acronym		Corresponding Name in D3.1	Description	Reference	Type of data	Unit	Reference to other sheets	
Requirement_Related_To_Energy_Performance		-	minimum level of energy performance that is to be achieved to obtain a right or an advantage: e.g. right to build, lower interest rate, quality label	EN 15217*	-	-	-	
is	Overall_Energy_Performance_Requirement	<i>overall energy performance requirement</i> [new]	a limit value of the overall energy performance indicator	EN 15217*	real	J Wh kWh/m ²	-	
	is	Primary_Energy_Requirement	<i>primary energy requirement</i> [new]	EN 15217*	real	J Wh kWh/m ²	-	
	has	Energy_Service	<i>energy services</i>	UNI TR 16344* EN 15603*	string	-	"energy_quantities"	
is	Specific_Energy_Performance_Requirement		<i>specific energy performance requirement</i> [new]	EN 15217*	real	J Wh kWh/m ²	-	
	is	Requirement_Related_To_Building_Services	-	a limit value of a specific energy performance requirement related to building and services	-	-	-	
		is	Delivered_Energy_Requirement	<i>delivered energy requirement</i> [new]	EN 15217*	real	J Wh kWh/m ²	-
		is	Energy_Need_Requirement	<i>energy need requirement</i> [new]	ISO TR 16344* EN 15603*	real	J Wh kWh/m ²	-
		is	Technical_Building_System_Average_Efficiency_Requirement	<i>technical building system average efficiency requirement</i> [new]	EN 15217* EN 15316-1*	real	-	-
		has	Energy_Service	<i>energy services</i>	UNI TR 16344* EN 15603*	string	-	"energy_quantities"
	is	Requirement_Related_To_Building_Envelope		-	limit value of a specific energy performance requirement related to characteristics of the building itself considered as a whole, or to characteristics of the building envelope components	EN 15217*	-	-
		is	Building_Envelope_Heat_Transfer_Coefficient_Requirement	<i>building envelope heat transfer coefficient requirement</i> [new]	EN 15217*	real	W/K	-

Name/Acronym		Corresponding Name in D3.1	Description	Reference	Type of data	Unit	Reference to other sheets	
	is	Wall_U-value_Requirement	wall U-value requirement [new]	limit value of the thermal transmittance of the wall	-	real	W/(m ² K)	-
	is	Window_U-value_Requirement	window U-value requirement [new]	limit value of the thermal transmittance of the window	-	real	W/(m ² K)	-
	is	Window_Glass_U-value_Requirement	window glass U-value requirement [new]	limit value of the thermal transmittance of the window glass	-	real	W/(m ² K)	-
	is	Window_Glass_g-value_Requirement	window glass g-value requirement [new]	limit value of the total solar energy transmittance coefficient of the window glass	-	real	-	-
	is	Roof_U-value_Requirement	roof U-value requirement [new]	limit value of the thermal transmittance of the roof	-	real	W/(m ² K)	-
	is	Skylight_U-value_Requirement	skylight U-value requirement [new]	limit value of the thermal transmittance of the skylight	-	real	W/(m ² K)	-
	is	Skylight_Glass_U-value_Requirement	skylight glass U-value requirement [new]	limit value of the thermal transmittance of the skylight glass	-	real	W/(m ² K)	-
	is	Skylight_Glass_g-value_Requirement	skylight glass g-value requirement [new]	limit value of the total solar energy transmittance coefficient of the skylight glass	-	real	-	-
	is	Ceiling_U-value_Requirement	ceiling U-value requirement [new]	limit value of the thermal transmittance of the ceiling	-	real	W/(m ² K)	-
	is	Bottom_Floor_U-value_Requirement	bottom floor U-value requirement [new]	limit value of the thermal transmittance of the bottom floor	-	real	W/(m ² K)	-
	is	Requirement_Related_To_Technical_Building_System	-	limit value of a specific energy performance requirement related to characteristics of the technical building systems considered as a whole, or to characteristics of the technical building systems components	-	-	-	-
	is	Technical_Building_System_Efficiency_Requirement	technical building system efficiency requirement [new]	limit value of the global efficiency of the technical equipment for heating, cooling, ventilation, domestic hot water, lighting and electricity production	EN 15217* EN 15316-1*	real	-	-
	is	Energy_Generator_Efficiency_Requirement	energy generator efficiency requirement [new]	limit value of the efficiency of the energy generator	-	real	-	-
	has	Energy_Service	energy services	related to the services provided by the technical building systems and by appliances to provide the indoor climate condition, illumination and other services related to the use of the building	UNI TR 16344* EN 15603*	string	-	"energy_quantities"
has		Neutralising_Parameter	-	parameter whose impact on the requirement should be modified (e.g. reduced, neutralised, corrected or normalised)	EN 15217*	-	-	-
	is	Heating_Degree_Days	heating degree days [new]	the summation, extended to the entire heating season, of the difference between a reference internal temperature (taking into account the internal and the solar heat gains) and a mean daily outside temperature	-	real	-	"local_climate"
	is	Shape_Factor	shape factor	ratio between the thermal envelope area and the conditioned floor area	EN 15217	real	-	"cs_geometry"
	is	Building_Use	building use	use of the building	-	string	-	"b_use"
	is	Energy_Carrier	energy carrier	substance or phenomenon that can be used to produce mechanical work or heat or to operate chemical or physical processes	ISO TR 16344 ISO 13600	string	-	"energy_quantities"
	is	Energy_Source	energy source	source from which useful energy can be extracted or recovered either directly or by means of a conversion or transformation process	ISO TR 16344	string	-	"energy_quantities"

Table A7. Standard Table named “climate”

Name/Acronym		Corresponding Name in D3.1	Description	Reference	Type of data	Unit	Reference to other sheets
Climate		-	climate that defines areas of size up to 200 km linear extension	-	-	-	-
is	Alpine	-	Alpine climate is the average weather (climate) for a region above the tree line. This climate is also referred to as mountain climate or highland climate	-	string	-	-
is	Oceanic	-	Oceanic climate (also known as Marine, West Coast and Maritime) is the climate typical of the west coasts at the middle latitudes of most continents, and generally features warm, but not hot summers and cool, but not cold winters, and a relatively narrow annual temperature range	-	string	-	-
is	Mediterranean	-	Mediterranean climate is the climate typical of the lands in the Mediterranean Basin, and is a particular variety of subtropical climate. The climate is characterized by warm to hot, dry summers and mild to cool, wet winters	-	string	-	-
is	Continental	-	Continental climate is a climate characterized by important annual variation in temperature due to the lack of significant bodies of water nearby. Often winter temperature is cold enough to support a fixed period of snow each year, and relatively moderate precipitation occurring mostly in summer	-	string	-	-
is	Temperate	-	Temperate climate is characterised by changes between summer and winter generally relatively moderate, rather than extreme hot or cold	-	string	-	-
is	Wet_Winter_Dry_Summer	-	Climate characterised by wet winter and dry summer	-	string	-	-
is	Dry_Winter_Wet_Summer	-	Climate characterised by dry winter and wet summer	-	string	-	-

Table A8. Standard Table named "land"

Name/Acronym		Corresponding Name in D3.1	Description	Reference	Type of data	Unit	Reference to other sheets
Land		-	a topographically or functionally distinct tract	-	-	-	-
has	Land_ID	-	the name (ID) of the land	-	string	-	-
has	Land_Location	<i>land parcels - coordinates</i>	the physical location of the land	-	-	-	-
	has	X-Coordinate	-	-	real	-	-
	has	Y-Coordinate	-	-	real	-	-
has	Land_Surface_Total	<i>land parcels - surface [new]</i>	total land parcel	FIG - "Statement on the Cadastre"	-	-	-
	has	Land_Surface_Built	<i>land parcels - built surface</i>	-	real	m ²	-
		is	Land_Surface	-	real	m ²	-
	has	Land_Surface_Non-Built	<i>land parcels - non-built surface [new]</i>	-	real	m ²	-
		is	Land_Surface	-	real	m ²	-
has	Land_Tenure	<i>land tenure</i>	land tenure is concerned with the rights, restrictions, and responsibilities people have with respect to the land	FIG - "Statement on the Cadastre"	string	-	-
	is	Leased_Land	<i>land tenure - leased land [new]</i>	FIG - "Statement on the Cadastre"	string	-	-
	is	Owned_Land	<i>land tenure - owned land [new]</i>	FIG - "Statement on the Cadastre"	string	-	-
has	Land_Type	<i>land type [new]</i>	type of land according to its location	-	string	-	-
	is	Rural_Land	<i>land type - rural land [new]</i>	-	string	-	-
	is	Urban_Land	<i>land type - urban land [new]</i>	-	string	-	-
has	Land_Buildability	<i>land buildability [new]</i>	classification of the land by buildability	-	string	-	-
	is	Building_Land	<i>land buildability - building land [new]</i>	-	string	-	-
	is	Non-Building_Land	<i>land buildability - non-building land [new]</i>	-	string	-	-
has	Land_Quality	<i>land quality</i>	quality of the land	FIG - "Statement on the Cadastre"	string	-	-
	is	Degraded_Land	-	-	string	-	-
	is	Urban_Land_In_Urban_Area	-	-	string	-	-

Name/Acronym		Corresponding Name in D3.1	Description	Reference	Type of data	Unit	Reference to other sheets
	is	Urban_Land_In_Periphery	-	-	-	string	-
	is	Land_Reserved_For_Urban_Development_In_Urban_Area	-	-	-	string	-
	is	Land_Reserved_For_Urban_Development_In_Periphery	-	-	-	string	-
	is	Excavated_Soil_Exploited_In_Place	-	-	-	string	-
has		Land_Economic_Value	land economic value	economic value of the land	FIG - "Statement on the Cadastre"	real	EUR ...
has		Land_Use_By_Activity	land use - activity [new]	the actual use of land based on its observable characteristics	LBCS Standards	string	-
	is	Residential_Activity	-	activities that occur in all types of residential uses, structures, ownership characteristics, or the character of the development	LBCS Standards	string	-
	is	Shopping_Business_Trade_Activity	-	all uses that are business related (retail, office, commercial, and industrial activities)	LBCS Standards	string	-
	is	Industrial_Manufacturing_Waste-Related_Activity	-	all manufacturing, assembly, warehouse, and waste management activities	LBCS Standards	string	-
	is	Social_Institutional_Infrastructure-Related_Activity	-	all institutional activities	LBCS Standards	string	-
	is	Travel_Movement_Activity	-	activities associated with all modes of transportation	LBCS Standards	string	-
	is	Mass_Assembly_Of_People	-	activities associated with mass assembly of people for either transportation, spectator sports, entertainment, or other social and institutional reasons	LBCS Standards	string	-
	is	Leisure_Activity	-	all forms of leisure activities	LBCS Standards	string	-
	is	Natural_Resources-Related_Activity	-	activities including farming, tilling, plowing, harvesting, pasturing, grazing, logging, etc.	LBCS Standards	string	-
	is	No_Human_Activity_Or_Unclassifiable_Activity	-	areas of no habitation (e.g. desert areas)	LBCS Standards	string	-
has		Land_Use_By_Economic_Function	land use - economic function [new]	economic function or type of establishment using the land. The type of economic function is independent of actual activity on the land	LBCS Standards	string	-
	is	Residence_Or_Accommodation_Function	-	all establishments offering residence or accommodation, such as homes, apartments, housing for the elderly, and hotels	LBCS Standards	string	-
	is	General_Sales_Or_Services	-	the vast majority of establishments typically associated with the commercial land use	LBCS Standards	string	-
	is	Manufacturing_And_Wholesale_Trade	-	manufacturing establishments with distinct production processes related to material inputs, production equipment, and employee skills	LBCS Standards	string	-
	is	Transportation_Communication_Information_And_Uilities	-	transportation, communication and utilities for essential facilities	LBCS Standards	string	-
	is	Arts_Entertainment_And_Ricreation	-	establishments operating facilities or providing services for a variety of cultural, entertainment and recreational functions	LBCS Standards	string	-
	is	Education_PublicAdmin_HealthCare	-	it includes educational services, government functions, establishments for public safety, establishments for health care at all levels, religious institutions, death care services, nonprofit organisations	LBCS Standards	string	-

Name/Acronym		Corresponding Name in D3.1	Description	Reference	Type of data	Unit	Reference to other sheets
is	Construction-Related_Business	-	these establishments either build buildings or structures, or perform additions, alterations, reconstructions, installations, and repairs. They may also provide building demolition or wrecking services	LBCS Standards	string	-	-
is	Mining_And_Extraction_Establishment	-	these establishments extract natural mineral solids, liquid minerals, and gases	LBCS Standards	string	-	-
is	Agriculture_Forestry_Fishing_And_Hunting	-	these establishments grow crops, raise animals, harvest timber, and harvest fish and other animals from a farm, ranch, or their natural habitats	LBCS Standards	string	-	-
has	Land_Use_By_Ownership_Constraints	land use - ownership constraints [new]	relationship between the use and its land rights	LBCS Standards	string	-	-
is	No_Constraints_Private_Ownership	-	private proerty without legal constraints to ownership	LBCS Standards	string	-	-
is	Some_Constraints_Easements_Or_Other_Use_Restrictions	-	subordinate conditions to the owner or the user of the property	LBCS Standards	string	-	-
is	Limited_Restrictions_Leased_And_Other_Tenancy_Restrictions	-	refers to a contract between the owner (lessee) and the tenant (lessor) of the property to convey the owner's rights to the lessor	LBCS Standards	string	-	-
is	Public_Restrictions_Local_State_And_Federal_Ownership	-	refers to the public entity that the property belongs to, or the public entity responsible for the property. Public entities are agencies from local, regional, state, or federal governments	LBCS Standards	string	-	-
is	Other_Public_Use_Restrictions_Regional_Special_Districts	-	refers to the public entity that the property belongs to, or the public entity responsible for the property. Public entities are regional government, port authorities, tribal lands	LBCS Standards	string	-	-
is	Nonprofit_Ownership_Restrictions	-	nontaxable entities (e.g. nonprofit educational, nonprofit philanthropic, nonprofit religious, etc.)	LBCS Standards	string	-	-
is	Joint_Ownership_Character_Public_Entities	-	includes all forms of public and nonprofit ownership	LBCS Standards	string	-	-
is	Joint_Ownership_Character_Public_Private_Nonprofit	-	a catch-all category for any combination of ownership	LBCS Standards	string	-	-
is	Not_Applicable	-	-	LBCS Standards	string	-	-
has	Land_Use_By_Site_Development	land use - site development [new]	the overall physical development character of the land	LBCS Standards	string	-	-
is	Site_In_Natural_State	-	areas normally referred to as vacant or open space	LBCS Standards	string	-	-
is	Developing_Site	-	sites that are under construction or otherwise in transition to becoming developed sites	LBCS Standards	string	-	-
is	Developed_Site_Crops_Grazing_Forestry	-	site is not in natural state	LBCS Standards	string	-	-
is	Developed_Site_No_Buildings_And_No_Structures	-	site is not in natural state, but it is used for a variety of purposes, such as outdoor storage, parking, and whole host of other functions and activities	LBCS Standards	string	-	-
is	Developed_Site_Non-Building_Structures	-	site is not in natural state or in crop or other resource use, but is fuctional nevertheless	LBCS Standards	string	-	-
is	Developed_Site_With_Buildings	-	developed sites with buildings, irrespective of their size or configuration	LBCS Standards	string	-	-
is	Developed_Site_With_Parks	-	state, national or local parks and recreational sites	LBCS Standards	string	-	-
is	Not_Applicable	-	-	LBCS Standards	string	-	-

Name/Acronym		Corresponding Name in D3.1	Description	Reference	Type of data	Unit	Reference to other sheets
	<i>is</i>	Unclassifiable_Site_Development_Character	-	site development characteristics that cannot be grouped	LBCS Standards	string	-
	<i>has</i>	Land_Use_By_Type_Of_Structure	<i>land use - type of structure [new]</i>	structure refers to the type of structure or building on the land	LBCS Standards	string	-
	<i>is</i>	Residential_Building	-	all buildings built for residential purposes	LBCS Standards	string	-
	<i>is</i>	Commercial_Building_And_Other_Specialised_Structures	-	category for structure types with not sufficient detail available (e.g. office or bank building, store or shop building, office or store building with residence on top, office building over storefronts, malls, shopping centers, collection of shops, industrial buildings and structures, warehouse or storage facility)	LBCS Standards	string	-
	<i>is</i>	Public_Assembly_Structure	-	structures related to public safety, transportation and emergency management. It includes theater, indoor games facility, sport stadium or arena, exhibition, convention, conference structure, churches, synagogues, temples, mosques, capitol buildings, covered or partially covered atriums and public enclosures, other community structures, passenger assembly	LBCS Standards	string	-
	<i>is</i>	Institutional_Or_Community_Facility	-	structures like medical facility, school or university buildings, library building, museum, exhibition or similar, public safety-related facility, jails, penitentiaries, detention centers and other correctional facilities, cemetery, monument, tombstone, mausoleum, etc.	LBCS Standards	string	-
	<i>is</i>	Transportation-Related_Facility	-	linear or network feature, automobile parking facilities, bus stop shelter, bus or truck maintenance facility, water transportation or marine related, air and space transportation facility, railroad facility	LBCS Standards	string	-
	<i>is</i>	Utility_And_Other_Nonbuilding_Structures	-	utility structures on right-of-way, water-supply-related facility, sewer and waste-related facility, gas or electric power generation facility, communication towers, environmental monitoring station, sign or billboard, etc.	LBCS Standards	string	-
	<i>is</i>	Specialised_Military_Structure	-	military and defense establishments	LBCS Standards	string	-
	<i>is</i>	Shed_Farm_Building_Or_Agricultural_Facility	-	all agricultural structures	LBCS Standards	string	-
	<i>is</i>	No_Structure	-	unclassifiable structure (e.g. subsurface structures)	LBCS Standards	string	-

Table A9. Standard Table named “housing”

Name/Acronym		Corresponding Name in D3.1	Description	Reference	Type of data	Unit	Reference to other sheets
Housing		-	dwelling tenure and households	-	-	-	-
has	Housing_Tenure	-	type of housing tenure	-	-	-	-
	is Rent	-	right to occupy or use the property of another through the payment, usually of an amount fixed by contract, at specified intervals	-	string	-	-
	is Social_Rent	<i>social rented</i>	social rent	-	string	-	-
	is Social_Rent_From_Social_Housing	-	rent coming from a social housing	-	string	-	-
	is Social_Rent_From_Local_Authority	-	rent coming from a local authority	-	string	-	-
	is Social_Rent_From_Other	-	rent coming from a not specified origin	-	string	-	-
	is Private_Rent	<i>private rented</i>	private rent	-	string	-	-
	is Private_Rent_General	-	general private rent	-	string	-	-
	is Private_Rent_From_Landlord_Or_Letting_Agency	-	rent coming from a landlord or a letting agency	-	string	-	-
	is Private_Rent_From_Employer_Of_Household_Member	-	rent coming from the employer of a household member	-	string	-	-
	is Private_Rent_From_Relative_Or_Friend_Of_Household_Member	-	rent coming from a relative or friend of a household member	-	string	-	-
	is Private_Rent_Other	-	other type of private rent	-	string	-	-
	is Rental_Free	<i>rental free</i>	without rental	-	string	-	-
	has Rental	<i>rental</i>	amount paid or collected as rent	-	real	EUR ...	-
	has Duration	-	time interval to which the value refers	-	string	-	"TIME"
	is Ownership	<i>type of ownership</i>	legal right to the possession of a thing	-	string	-	-
	is Ownership_Outright	-	outright ownership	-	string	-	-
	is Ownership_With_Mortgage_Or_Loan	-	ownership with a mortgage or loan	-	string	-	-
	is Shared_Ownership	-	shared ownership	-	string	-	-
has	Housing_Price	<i>property price</i>	price of the property	-	real	EUR ...	-
has	Household	-	one person living alone; or a group of people (not necessarily related) living at the same address who share cooking facilities and share a living room or sitting room or dining area	UK - Office for National Statistics	-	-	-
	has Household_Size	<i>size of household</i>	number of household members	-	integer	-	-
	is Household_Size_Global	-	total number of households	-	integer	-	-
	is Household_Size_Male	-	number of male households	-	integer	-	-
	is Household_Size_Female	-	number of female households	-	integer	-	-
	has Household_Type	<i>type of household</i>	type of household	-	string	-	-
	is One_Person_Household	-	one person household	UK - Office for National Statistics	string	-	-
	is One_Person_Household_Male	-	-	UK - Office for National Statistics	string	-	-
	is One_Person_Household_Female	-	-	UK - Office for National Statistics	string	-	-

Name/Acronym		Corresponding Name in D3.1	Description	Reference	Type of data	Unit	Reference to other sheets
	<i>is</i> Married_Couple_Household_With_Dependent_Children	-	household of a married couple with dependent children	UK - Office for National Statistics	string	-	-
	<i>is</i> Married_Couple_Household_No_Dependent_Children	-	household of a married couple without dependent children	UK - Office for National Statistics	string	-	-
	<i>is</i> Same_Sex_Civil_Partnership_Couple_Household_With_Dependent_Children	-	household of a same sex civil partnership couple with dependent children	UK - Office for National Statistics	string	-	-
	<i>is</i> Same_Sex_Civil_Partnership_Couple_Household_No_Dependent_Children	-	household of a same sex civil partnership couple without dependent children	UK - Office for National Statistics	string	-	-
	<i>is</i> Cohabiting_Couple_Household_With_Dependent_Children	-	household of a cohabiting couple with dependent children	UK - Office for National Statistics	string	-	-
	<i>is</i> Cohabiting_Couple_Household_No_Dependent_Children	-	household of a cohabiting couple without dependent children	UK - Office for National Statistics	string	-	-
	<i>is</i> Lone_Parent_Household_With_Dependent_Children	-	household of a lone parent with dependent children	UK - Office for National Statistics	string	-	-
	<i>is</i> Lone_Parent_Household_No_Dependent_Children	-	household of a lone parent without dependent children	UK - Office for National Statistics	string	-	-
	<i>is</i> Multi-Person_Household_All_Full_Time_Students	-	household of multi-persons like full time students	UK - Office for National Statistics	string	-	-
	<i>is</i> Multi-Person_Household_Other	-	not specified type of household	UK - Office for National Statistics	string	-	-
	<i>has</i> Household_Origin_Country	<i>origin</i>	origin of the household	-	string	-	-
	<i>has</i> Household_Nationality	<i>nationality</i>	nationality of the household	-	string	-	-
	<i>has</i> Household_Language	<i>language</i>	language of the household	-	string	-	-
	<i>has</i> Household_Member	-	-	-	-	-	-
	<i>has</i> Household_Member_Name	-	name of a household member	-	string	-	-
	<i>has</i> Household_Member_Age	<i>age</i>	age of a household member	-	integer	-	-
	<i>has</i> Education_Level	<i>education level</i>	level of education	-	string	-	"population"
	<i>has</i> Occupation	<i>occupations</i>	labour or job	-	string	-	"population"
	<i>has</i> Household_Income	<i>income</i>	income of the household	-	real	EUR ...	-
	<i>has</i> Duration	-	time interval to which the value refers	-	string	-	"TIME"
	<i>has</i> Household_Benefit	<i>benefit [new]</i>	benefit of the household	-	string	-	-
	<i>is</i> Housing_Benefit	-	housing benefit	-	string	-	-
	<i>is</i> Income_Support	-	income support	-	string	-	-
	<i>is</i> Job_Seekers_Allowance	-	job seekers allowance	-	string	-	-
	<i>is</i> Pension_Credit	-	pension credit	-	string	-	-
	<i>is</i> Child_Benefit	-	child benefit	-	string	-	-
	<i>has</i> Household_Fuel_Poverty	<i>fuel poverty</i>	-	-	logic	-	-

Table A10. Extract of the Standard Table named “building” [contextual data]

Name/Acronym		Corresponding Name in D3.1	Description	Reference	Type of data	Unit	Reference to other sheets
Building		-	construction as a whole, including its envelope and all technical building systems, for which energy is used to condition the indoor climate, to provide domestic hot water and illumination and other services related to the use of the building	EN 15603	-	-	-
has	Building_Cadastral_Data	-	cadastral data of the building	-	-	-	-
	has Cadastral_Reference	<i>cadastral reference</i>	-	-	-	-	-
	has Number_Of_Cadastral_Rooms	<i>cadastral rooms</i>	-	-	integer	-	-
	has Cadastral_Area	<i>cadastral area</i>	-	-	real	m ²	-
has	Housing	-	dwelling tenure and households	-	-	-	"housing"
has	Cost_Related_To_Energy_Performance	-	cost that shall be taken into account for calculation of the cost effectiveness of energy efficiency measures in buildings	EN 15459	-	-	"cost_related_to_energy"
has	Requirement_Related_To_Energy_Performance	-	minimum level of energy performance that is to be achieved to obtain a right or an advantage: e.g. right to build, lower interest rate, quality label	EN 15217*	-	-	"requirement_related_to_energy"