Energy ADE Occupancy Modules

Activities, Request of changes for the Energy ADE v0.7

Working Group Organization

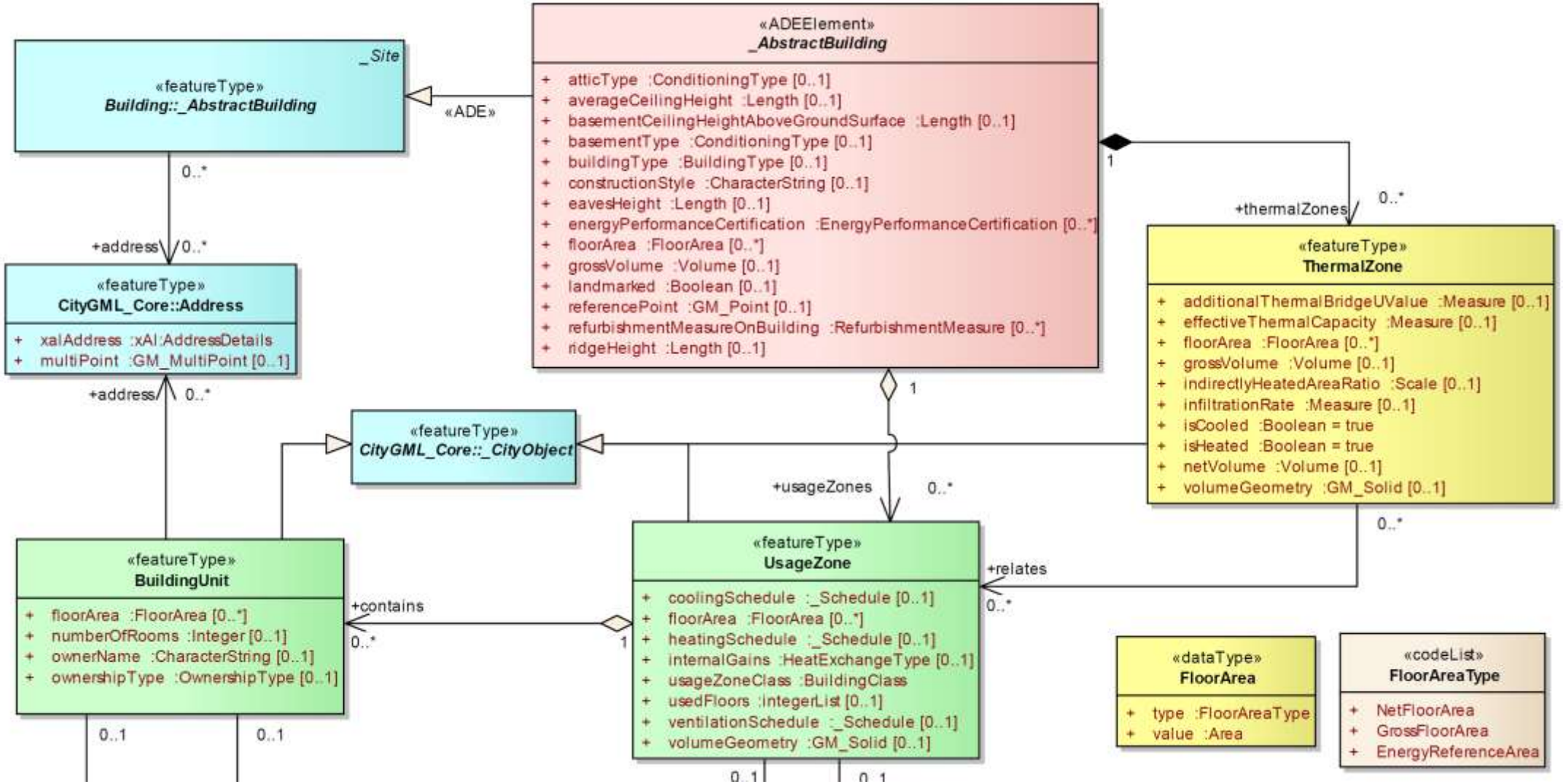
- As the occupant behaviour is a **key issue** for building and systems energy consumption, the aim of this WG is to investigate **questions related to occupancy, ownership or system scheduling**.

- As other WG, the ADE modules related to Occupancy present **many dependencies** and need common modelling decisions (e.g. with the Core or Energy systems WG).

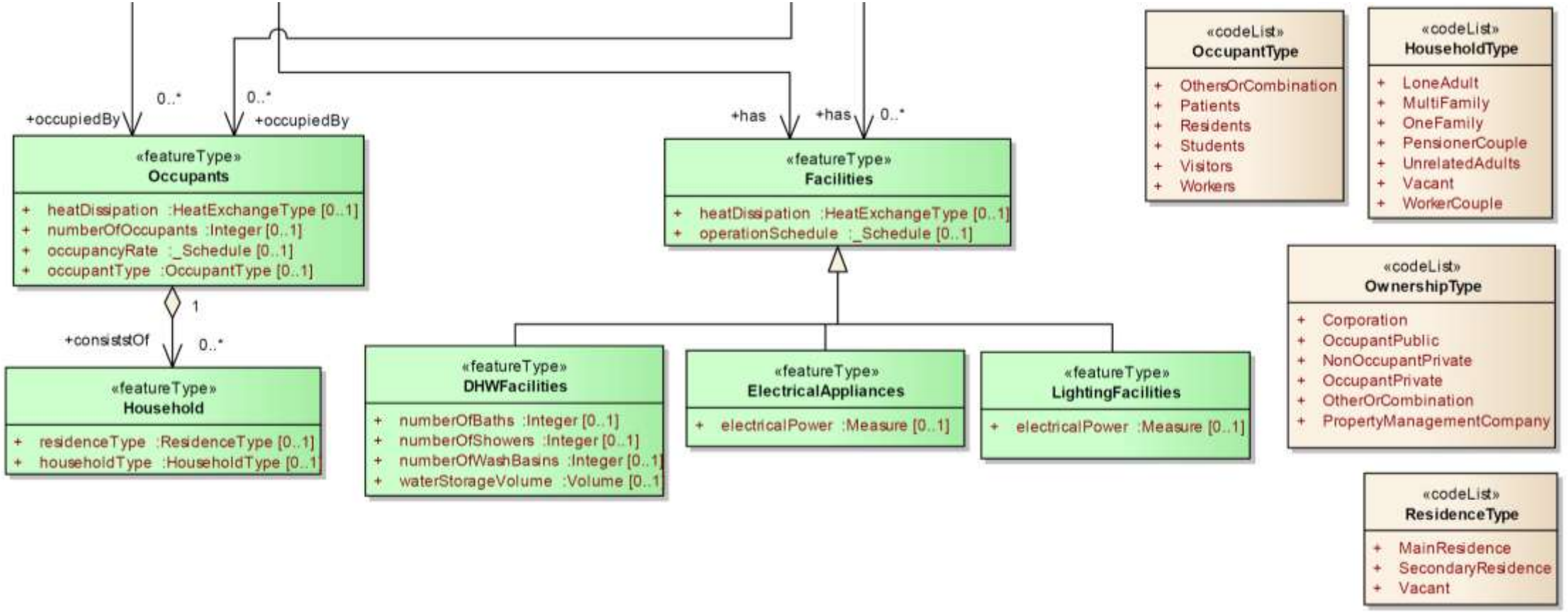
Working Group Organization

- From the guidelines:
  - The Occupancy Module contains the detailed characterization of the building usage, it means the **people** and the **facilities**.
  - It is related to the rest of the ADE Energy and CityGML model through the class **UsageZone**.
  - One building may have **several UsageZone**.
  - Due to the type of information it allows to store, the Occupancy Module may be used also for **multi-field analysis** (socio-economics, demographics etc.).

Main modules – UML overview



Main modules – UML overview



CityGML Energy ADE

Activities over the last 6 months

- 6 participants
- 4 online-conferences
- GitHub
  - 3 requests of change for ADE v0.7
  - 6 open issues
  - Contribution to guidelines with XML examples & illustrations (to be improved)
- CityGML test dataset and time series related to occupancy
- Ongoing documentation of the ADE v0.7
- Links with INSPIRE for codelists management

General feedbacks on ADE v0.6 and future

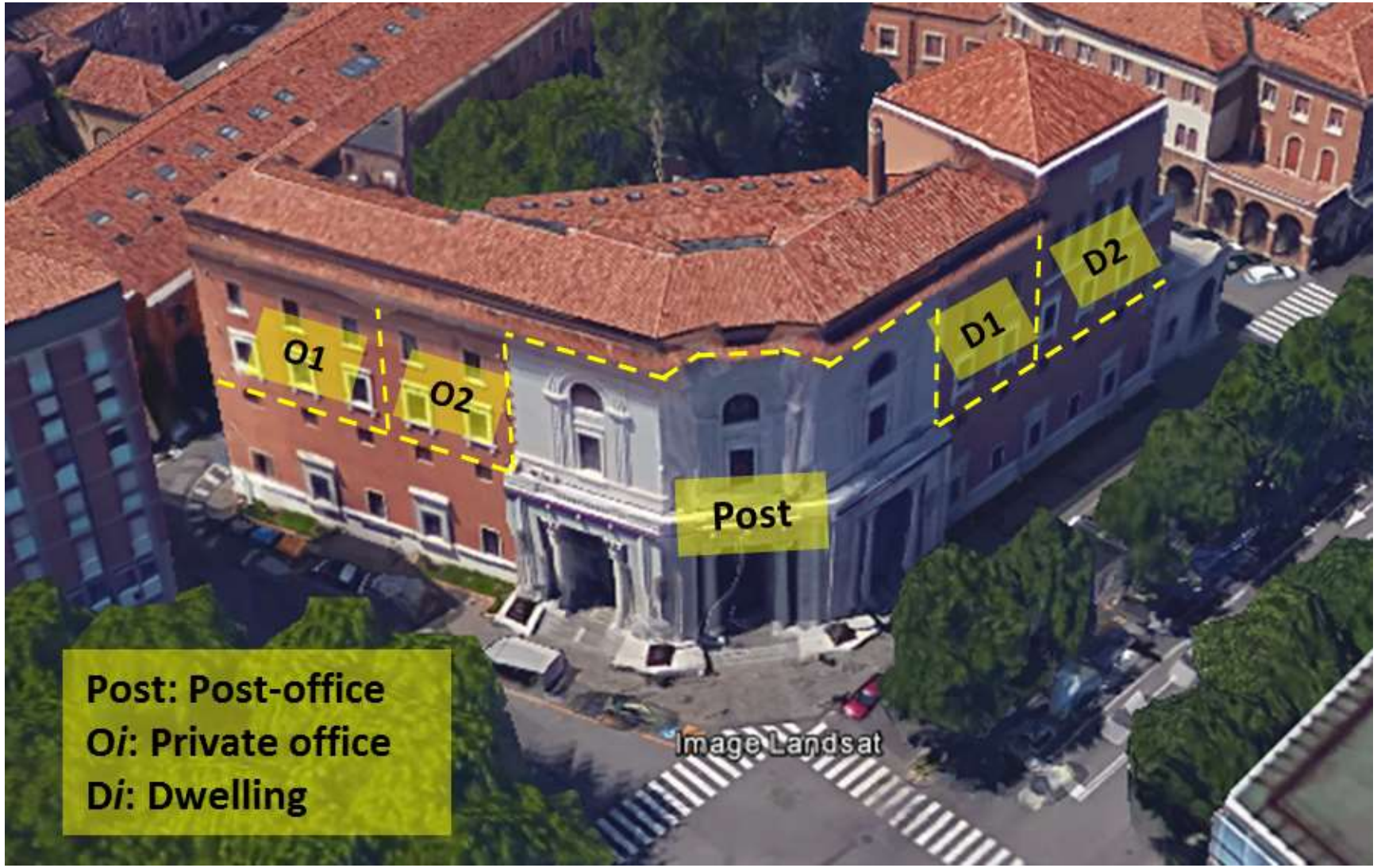
- Some links with other WGs have to be further strengthen (e.g. Energy Systems WG)
- SQL implementation of Energy ADE (3D CityDB or others)
- Reuse as far as possible existing material

Publicly available codelists (INSPIRE, ELF, GeoSmartCity)

Hong, T.; D'Oca, S.; Turner, W. J. & Taylor-Lange, S. C. (2015)
An ontology to represent energy-related occupant behavior in buildings. Part I: Introduction to the DNAs framework Building and Environment , 92 , 764 – 777

SEMANCO project ontology (http://semanco-project.eu/ontology.htm)

Occupancy example



Occupancy example

- The previous picture shows a mixed-use building corresponding to a single Building entity in a CityGML model file (with several real addresses).
- It consists in 3 different usage zones:
  - post office covering the whole ground floor and the part of the first floor just above the main entrance ("Post")
  - private office on the first floor at the left of the main entrance
  - dwelling on the first floor in the opposite side of the building
- Both UsageZone of type **companyOffice** and **residential** have two BuildingUnit, corresponding to different private offices ("O1" and "O2"), respectively different dwellings ("D1" and "D2").

Occupancy example

CityGML Energy ADE

```
41  <bldg:boundedBy>
58  <bldg:boundedBy>
75  <bldg:boundedBy>
92  <bldg:boundedBy>
109 <bldg:boundedBy>
126 <bldg:boundedBy>
143 <bldg:address>
152 <energy:EnergyDemand>
153   <energy:endUse>ElectricalAppliances</energy:endUse>
154   <energy:energyAmount>
155     <energy:IrregularTimeSeries>
156       <energy:variableProperties>
157         <energy:TimeValuesProperties>
158           <energy:acquisitionMethod>Measured with digital meters</energy:acquisitionMethod>
159           <energy:interpolationType>AverageInSucceedingInterval</energy:interpolationType>
160         </energy:TimeValuesProperties>
161       </energy:variableProperties>
162       <energy:uom uom="kWh"/>
163       <energy:contains>
164         <energy:MeasurementPoint>
165           <energy:time>2010-12-31</energy:time>
166           <energy:value>18291.0</energy:value>
167         </energy:MeasurementPoint>
168       </energy:contains>
169     </energy:IrregularTimeSeries>
170   </energy:energyAmount>
171 </energy:EnergyDemand>
172 <energy:EnergyDemand>
```

EnergyAmount at building level only with actual data from national tax agency

Occupancy example

CityGML Energy ADE

```
192  <energy:EnergyDemand>
212  <energy:EnergyDemand>
232  <energy:EnergyDemand>
252  <energy:EnergyDemand>
272  <energy:EnergyDemand>
273    <energy:endUse>SpaceHeating</energy:endUse>
274    <energy:energyAmount>
275      <energy:IrregularTimeSeries>
276        <energy:variableProperties>
277          <energy:TimeValuesProperties>
278            <energy:acquisitionMethod>Measured with analogic gas meters</energy:acquisitionM
279            <energy:interpolationType>AverageInSucceedingInterval</energy:interpolationType>
280          </energy:TimeValuesProperties>
281        </energy:variableProperties>
282        <energy:uom uom="m^3"/>
283        <energy:contains>
284          <energy:MeasurementPoint>
285            <energy:time>2012-12-31</energy:time>
286            <energy:value>691.0</energy:value>
287          </energy:MeasurementPoint>
288        </energy:contains>
289      </energy:IrregularTimeSeries>
290    </energy:energyAmount>
291  </energy:EnergyDemand>
292  <energy:EnergyDemand>
312  <energy:energyPerformanceCertification>
318  <energy:usageZone>
352  <energy:usageZone>
```

EnergyAmount at building level only with actual data from national tax agency

Occupancy example

CityGML Energy ADE

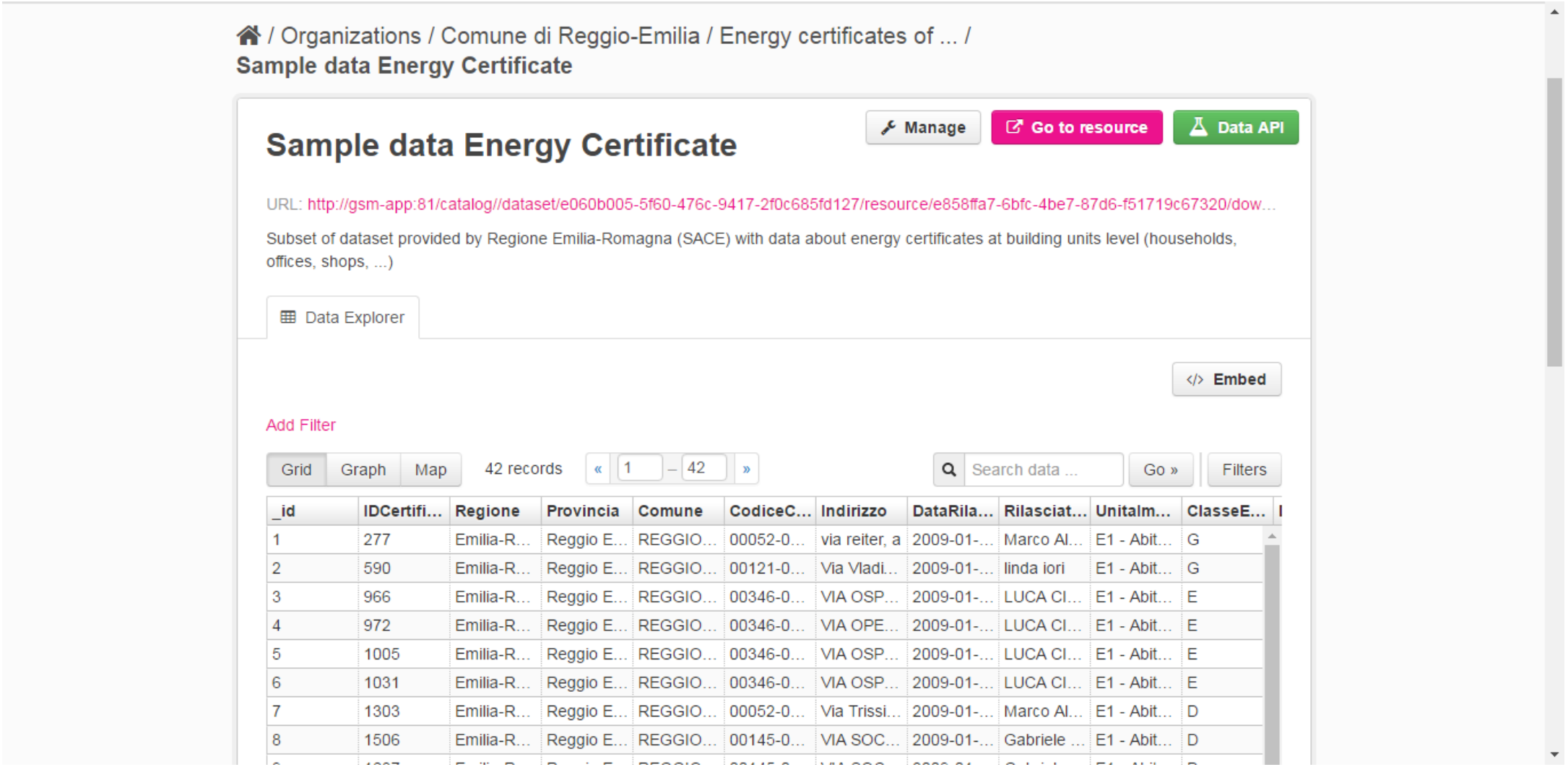
```
415   <energy:averageInternalGains>
424   <energy:contains>
425     <energy:BuildingUnit gml:id="H223_123-456-88">
426       <energy:floorArea>
427         <energy:FloorArea>
428           <energy:type>NetFloorArea</energy:type>
429           <energy:value uom="m^2">120</energy:value>
430         </energy:FloorArea>
431       </energy:floorArea>
432       <energy:energyPerformanceCertification>
433         <energy:EnergyPerformanceCertification>
434           <energy:certificationRating>E</energy:certificationRating>
435           <energy:certificationName>Regional law 7/2014 (Regione Emilia-F magna) implementing 2010/31/UE
436           <energy:certificationId>00052-00013-2012</energy:certificationId
437         </energy:EnergyPerformanceCertification>
438       </energy:energyPerformanceCertification>
439     </energy:BuildingUnit>
440   </energy:contains>
441   <energy:contains>
458   <energy:occupiedBy>
459 <!-- For residential the number of residents are sourced by the municipal register of popu
    included in this usage zone (residential) -->
460       <energy:Occupants>
461         <energy:numberOfOccupants>7</energy:numberOfOccupants>
462         <energy:occupantType codeSpace="http://hub.geosmartcity.eu/registry/codelist/OccupantTypeValue/Occupa                ts</
    energy:occupantType>
463       </energy:Occupants>
464   </energy:occupiedBy>
```

EnergyPerformanceCertification at building unit level with actual data from regional register

numberOfOccupants at buildingUnit level with actual data from municipal register

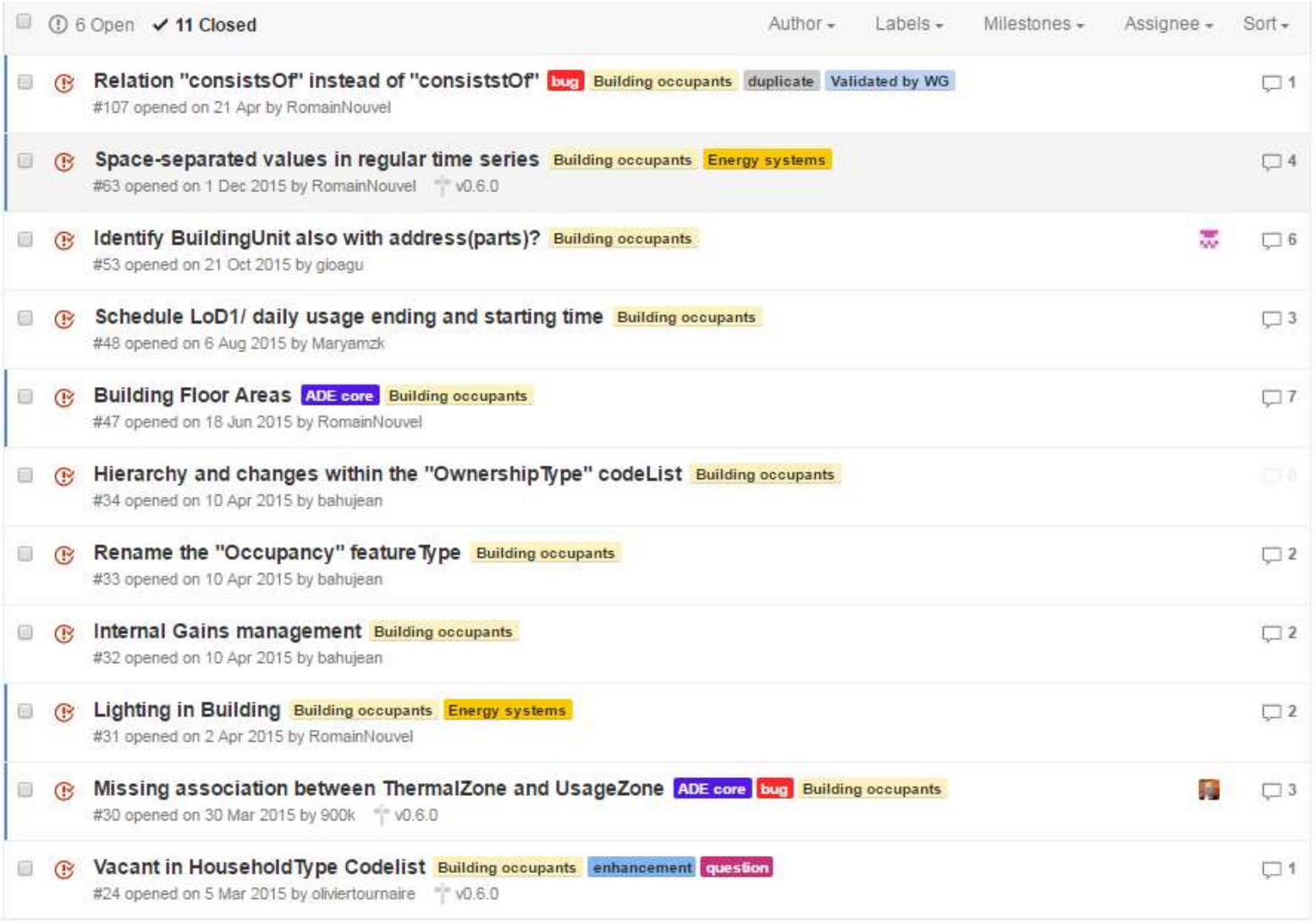
Data sources – Energy Performance Certificates

CityGML Energy ADE



Closed issues

CityGML Energy ADE



Open issues

CityGML Energy ADE

6 Open ✓ 11 Closed — Author — Labels — Milestones — Assignee — Sort

Rename relations *usageZones* and *thermalZones* ADE core · Building occupants · Validated by TC · Validated by WG — 4
#94 opened on 29 Mar by JoachimBenner

Relation ThermalZone --> UsageZone ADE core · Building occupants · Validated by TC · Validated by WG — 5
#93 opened on 29 Mar by JoachimBenner

Little BUG in Energy ADE 0.6 due to typo bug · Building occupants · Validated by TC · Validated by WG — 6
#85 opened on 4 Feb by gioagu · v0.6.1

InternalGains / HeatDissipation Building occupants · question · Validated by TC · Validated by WG — 3
#82 opened on 2 Feb by RomainNouvel

Add attribute "EnergyPerformanceCertification" also in class BuildingUnit — 3
ADE core · Building occupants · Validated by TC · Validated by WG
#76 opened on 12 Jan by gioagu · v0.7.0

Name/Rename of attribute usageZoneClass ADE core · Building occupants · question · Validated by TC · Validated by WG — 11
#75 opened on 12 Jan by gioagu · v0.7.0

Issue#93
ThermalZone <-> UsageZone

In ADE v0.6 :

- ThermalZone [0..*] → [0..*] UsageZone

Problems / needed clarifications

- Are both [0..*] cardinalities useful?
- What happens if 1 ThermalZone is related to several UsageZone?
- What happens if several ThermalZone are related to 1 UsageZone?

Issue#93
ThermalZone <-> UsageZone

- What happens if 1 ThermalZone is related to several UsageZone?
  - Used in simplified tools with monozone building model
  - ThermalZone is then not „isotherm“
  - Occupants and Facilities of UsageZone are summed up
  - Usage conditions of the single usage zone are averaged (weighted by (mandatory) floor area) for building simulation
- What happens if several ThermalZone are related to 1 UsageZone?
  - How to „split“ occupants, Facilities, and their internal gains?
  - single UsageZone may be defined for each ThermalZone instead

[ThermalZone redefinition]

[FloorArea mandatory]

[Not useful]

Proposition ADE v0.7 : ThermalZone [0..1] → [0..*] UsageZone

Open Issue#76

Add attribute "EnergyPerformanceCertification" also in class BuildingUnit

ADE v0.6

- No attribute related to energy performance **certification** (EPC or EPBD such as the DPE in France) and **labels** (e.g., BREEAM in the UK, LEED in the US, PassivHaus in Germany or HQE in France).

Example of CodeList related to energy performance from the GeoSmartCity project

Label
A
A+
B
B-
C
D
E
F
G

http://hub.geosmartcity.eu/registry/codelist/EnergyPerformanceValue/

Issue

- Add the attribute “energyPerformanceCertification” (Type: EnergyPerformanceCertification, cardinality 0..*) to the object “Building” or “BuildingUnit”.
- *Should this attribute be also at other scales (district)?*
- *Should we differenciate certification and labels?*

Open Issue#75
Name/Rename of attribute usageZoneClass

ADE v0.6

- Need to rename the attribute “usageZoneClass” to “usageZoneType”, in order to stay coherent to BuildingType, OccupantsType, atticType, …

Issue

- The attribute “usageZoneType” is to be valued with codelist
- The values should be based on existing codelists or new ones
- INSPIRE or other registries are already available out there

Code lists management

ADE v0.6
(current)

- https://github.com/cstb/citygml-energy/tree/master/xsd/Codelists

INSPIRE

- http://inspire.ec.europa.eu/codelist/

ELF project

- http://www.locationframework.eu/codelist/

ADE v0.7
(proposal)

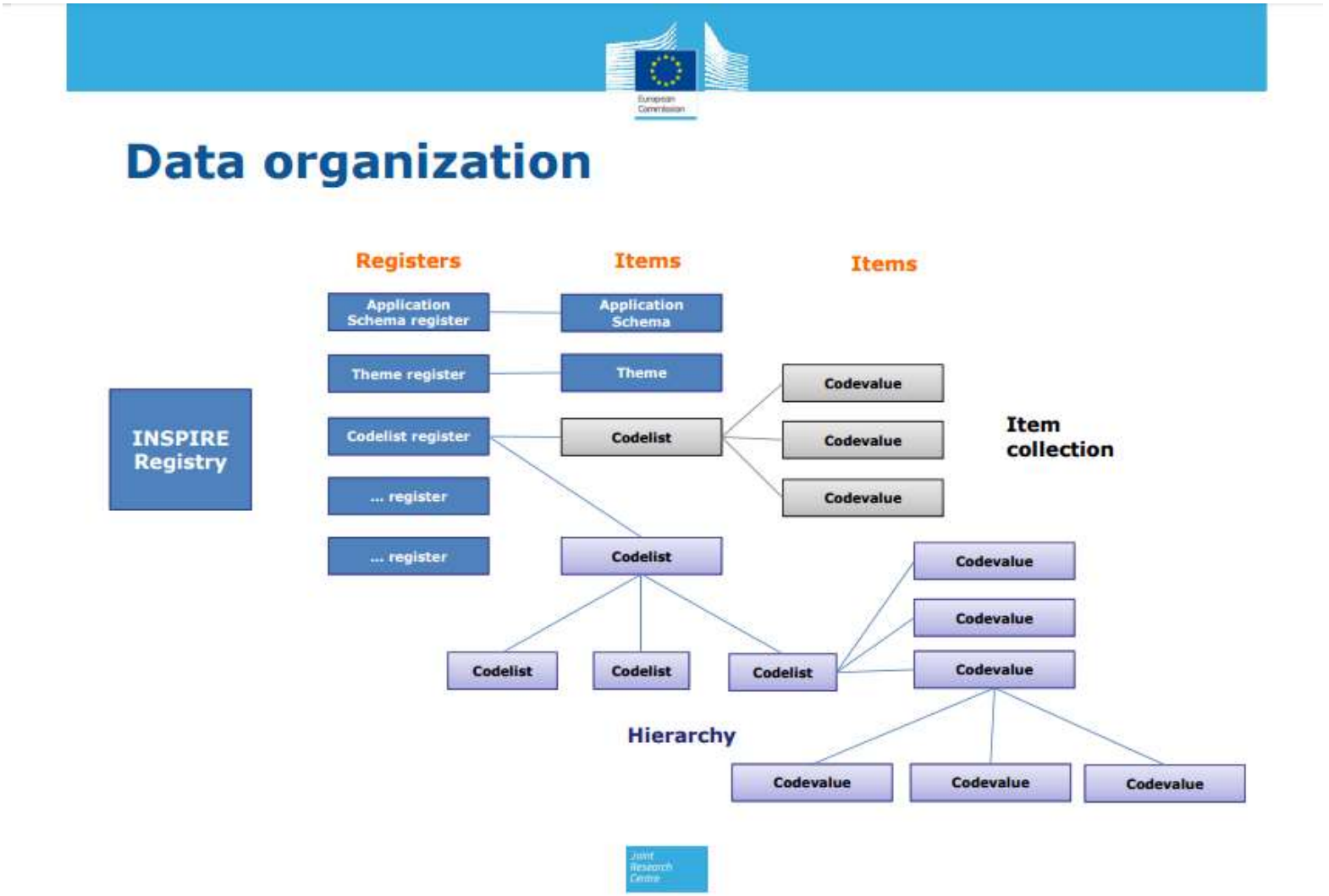
http://hub.geosmartcity.eu/registry/codelist/

Management of:

- Extension of existing INSPIRE codelists
- New codelists

Code lists management

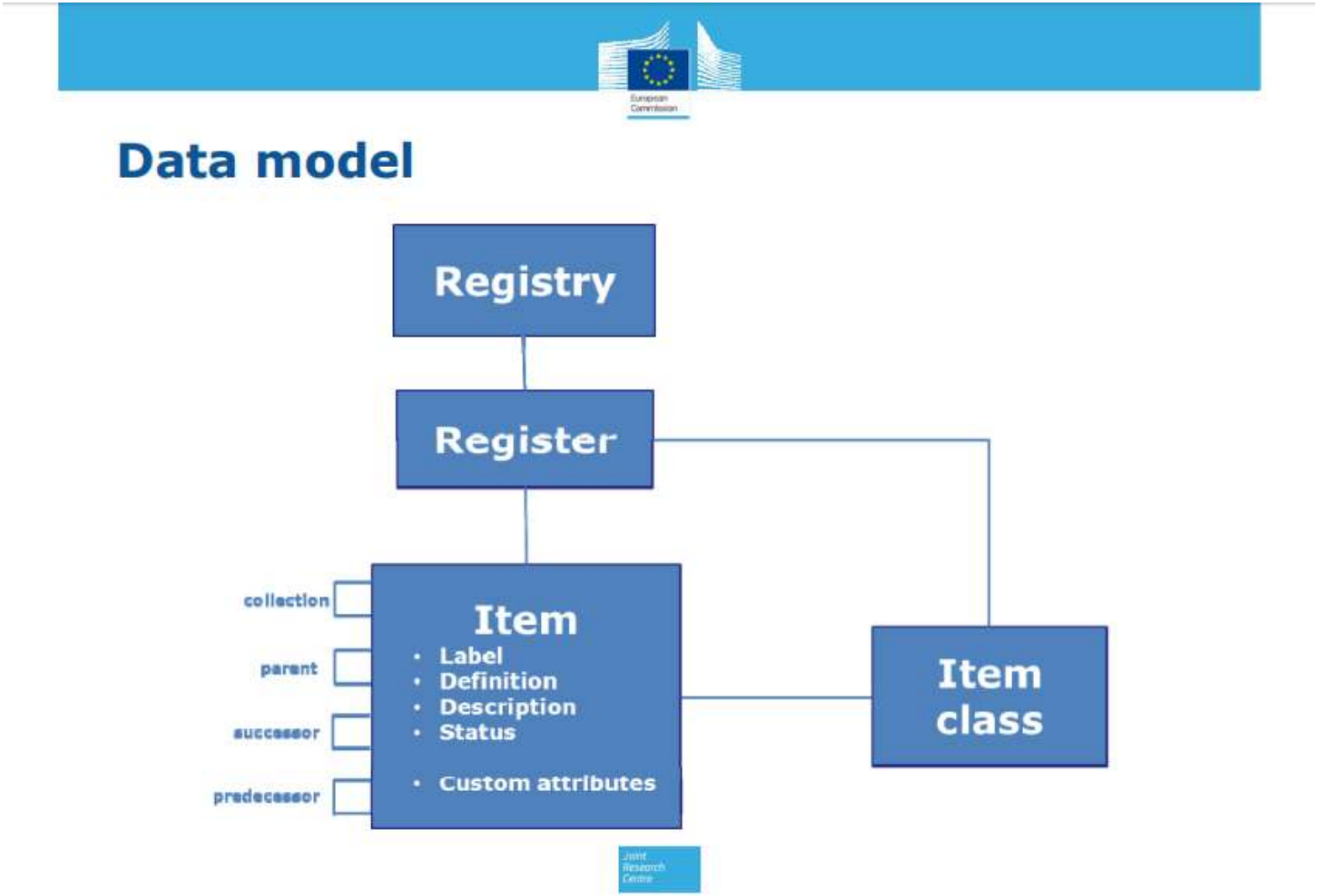
INSPIRE Registry



source: http://inspire.ec.europa.eu/events/conferences/inspire_2014/pdfs/19.06_5_11.00_Michael_Lutz.pdf

Code lists management

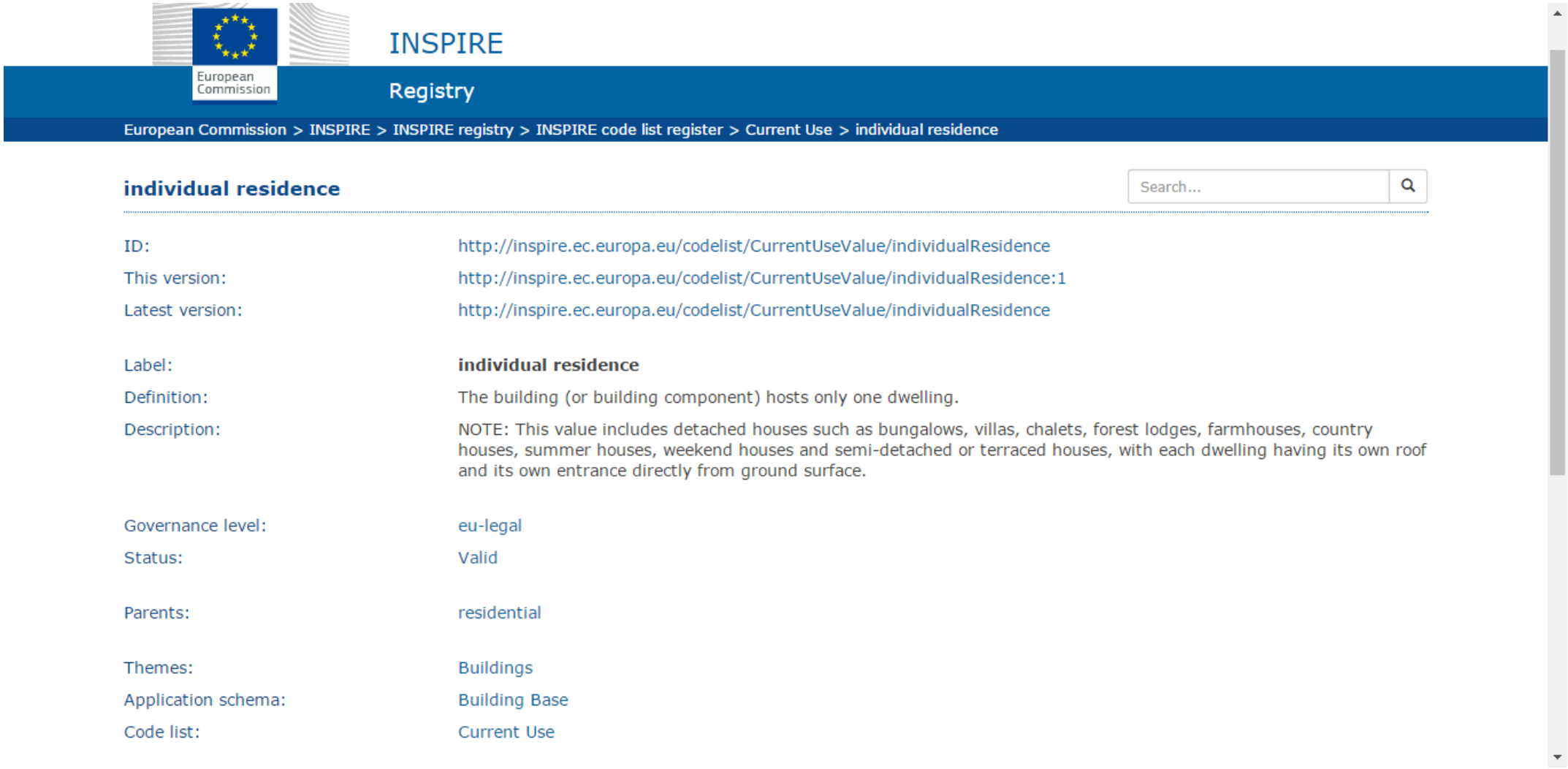
INSPIRE Registry



source: http://inspire.ec.europa.eu/events/conferences/inspire_2014/pdfs/19.06_5_11.00_Michael_Lutz.pdf

Code lists management

INSPIRE Registry



source: http://inspire.ec.europa.eu/codelist/CurrentUseValue/individualResidence

Code lists management

INSPIRE Registry

This XML file does not appear to have any style information associated with it. The document tree is shown below.


```
▼<RE_RegisterItem xmlns:gmd="http://www.isotc211.org/2005/gmd" xmlns:gco="http://www.isotc211.org/2005/gco" xmlns:xlink="http://www.w3.org/1999/xlink"
 xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns="http://www.isotc211.org/2005/grg" xsi:schemaLocation="http://www.isotc211.org/2005/grg
 http://standards.iso.org/iso/19135/-2/reg/1.0/registration.xsd">
   <itemIdentifier gco:nilReason="inapplicable"/>
  ▼<name>
     <gco:CharacterString>individual residence</gco:CharacterString>
   </name>
  ▼<status>
     <RE_ItemStatus>valid</RE_ItemStatus>
   </status>
  ▼<definition>
   ▼<gco:CharacterString>
       The building (or building component) hosts only one dwelling.
     </gco:CharacterString>
   </definition>
  ▼<description>
   ▼<gco:CharacterString>
       NOTE: This value includes detached houses such as bungalows, villas, chalets, forest lodges, farmhouses, country houses, summer houses, weekend houses and semi-detached or terraced
       houses, with each dwelling having its own roof and its own entrance directly from ground surface.
     </gco:CharacterString>
   </description>
   <additionInformation xlink:href="http://inspire.ec.europa.eu/codelist/CurrentUseValue/individualResidence"/>
  ▼<itemClass>
   ▼<RE_ItemClass>
    ▼<name>
       <gco:CharacterString>CodeListValue</gco:CharacterString>
     </name>
     <technicalStandard gco:nilReason="inapplicable"/>
     <alternativeNames gco:nilReason="inapplicable"/>
     <describedItem gco:nilReason="inapplicable"/>
   </RE_ItemClass>
  </itemClass>
</RE_RegisterItem>
```


source: http://inspire.ec.europa.eu/codelist/CurrentUseValue/individualResidence/individualResidence.en.iso19135xml

Code lists management

INSPIRE Registry

Use of ISO 19135 Standard for Item Registration

Submitted by richardsont on Tue, 02/04/2013 - 12:35pm

Challenge: Persistent resolvable identifiers

Category: Data

This responses suggest the use of BS EN ISO 1935:2007 to develop a Government Registry of Registers for the storage and maintenance of concepts such as codes and identifiers. Although developed for Geographic Information concepts the standard can be applied to other concepts and has a number of implementations which provide useful input.

▼ **User need approach**

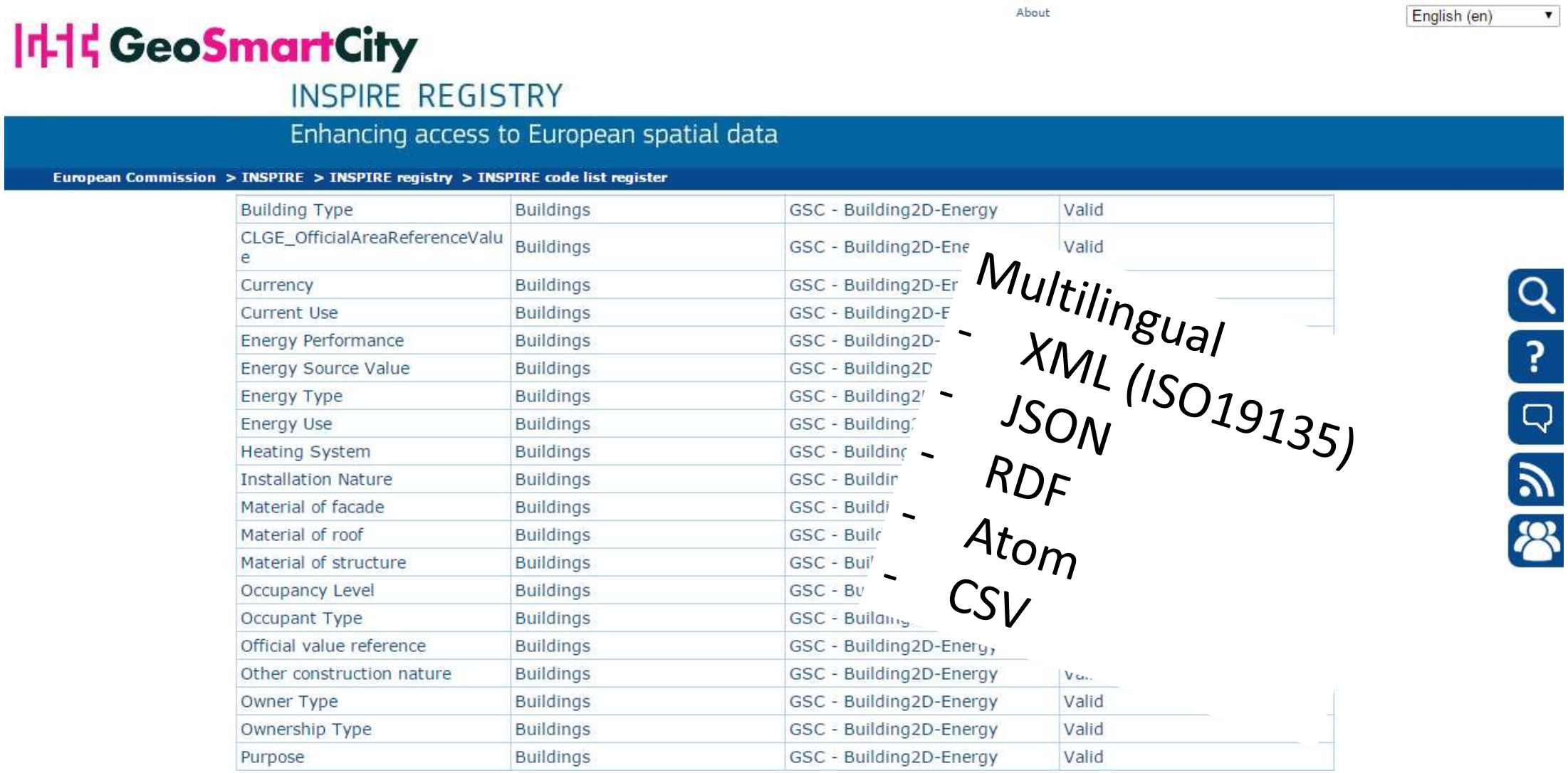
The standard provides the model for a register or series of registers for the registration of concepts. This includes version information and allows for supersession, retirement etc this would directly address the user need for a manageable location where codes and identifiers can be maintained. The registers can be linked from URIs and have search functions. Specifications or datasets using the registers would refer back to them.

▼ **Functional needs**

Being a web based registry means that persistent URIs can be used to reference back to items. a series of control bodies and register managers ensure that the distributed maintenance of items can be achieved. This also ensures that duplication is avoided. The concepts of retirement and supersession are used so that new items can relate to the item they replace. The IHO example provided includes some instances of this.

source: https://standards.data.gov.uk/proposal/use-iso-19135-standard-item-registration

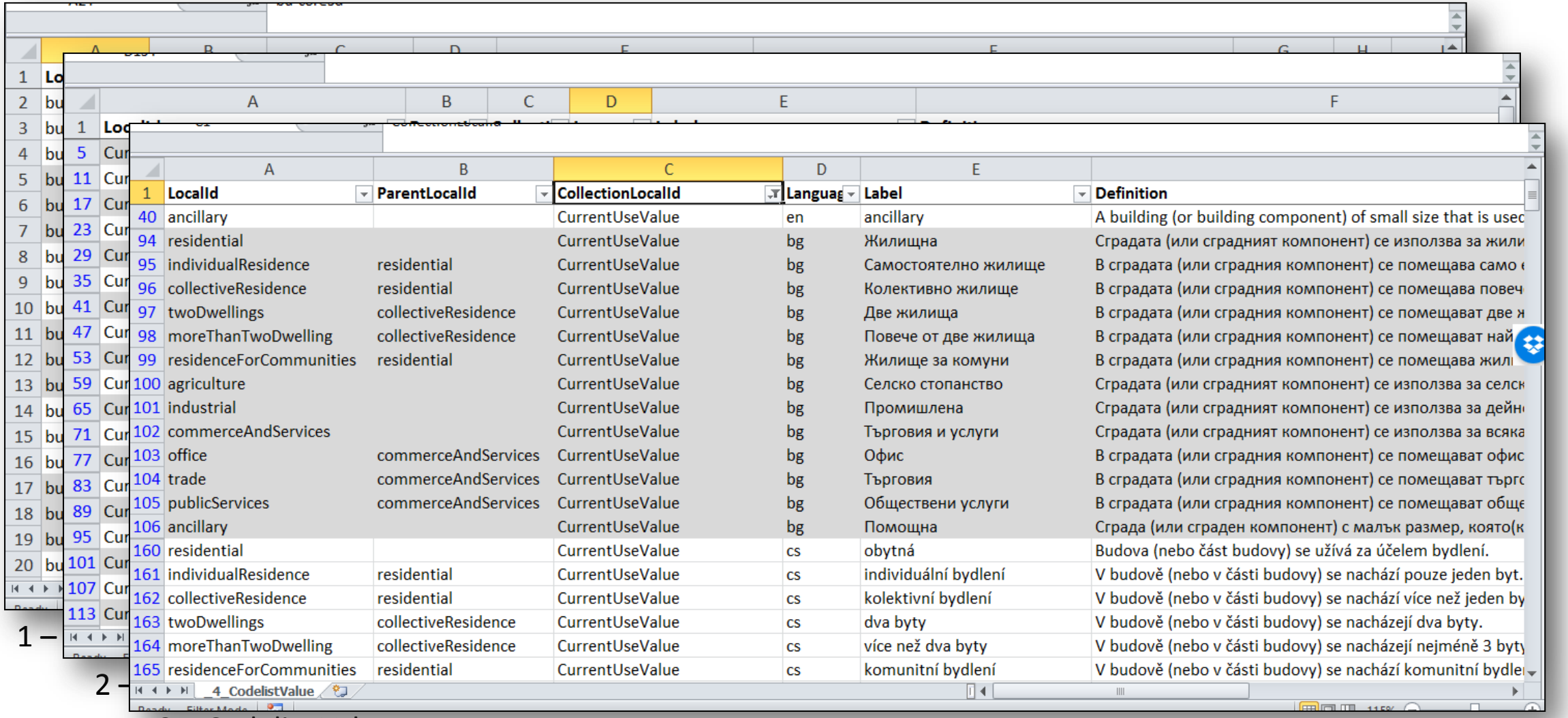
Extended and new codelists



Building Type	Buildings	GSC - Building2D-Energy	Valid
CLGE_OfficialAreaReferenceValue	Buildings	GSC - Building2D-Ene	Valid
Currency	Buildings	GSC - Building2D-Er	
Current Use	Buildings	GSC - Building2D-E	
Energy Performance	Buildings	GSC - Building2D-	
Energy Source Value	Buildings	GSC - Building2D	
Energy Type	Buildings	GSC - Building2	
Energy Use	Buildings	GSC - Building	
Heating System	Buildings	GSC - Buildin	
Installation Nature	Buildings	GSC - Buildi	
Material of facade	Buildings	GSC - Build	
Material of roof	Buildings	GSC - Bui	
Material of structure	Buildings	GSC - Bu	
Occupancy Level	Buildings	GSC - Buildi	
Occupant Type	Buildings	GSC - Building2D-Energy	
Official value reference	Buildings	GSC - Building2D-Energy	
Other construction nature	Buildings	GSC - Building2D-Energy	Valid
Owner Type	Buildings	GSC - Building2D-Energy	Valid
Ownership Type	Buildings	GSC - Building2D-Energy	Valid
Purpose	Buildings	GSC - Building2D-Energy	Valid

Extended and new codelists

CityGML Energy ADE



1 –

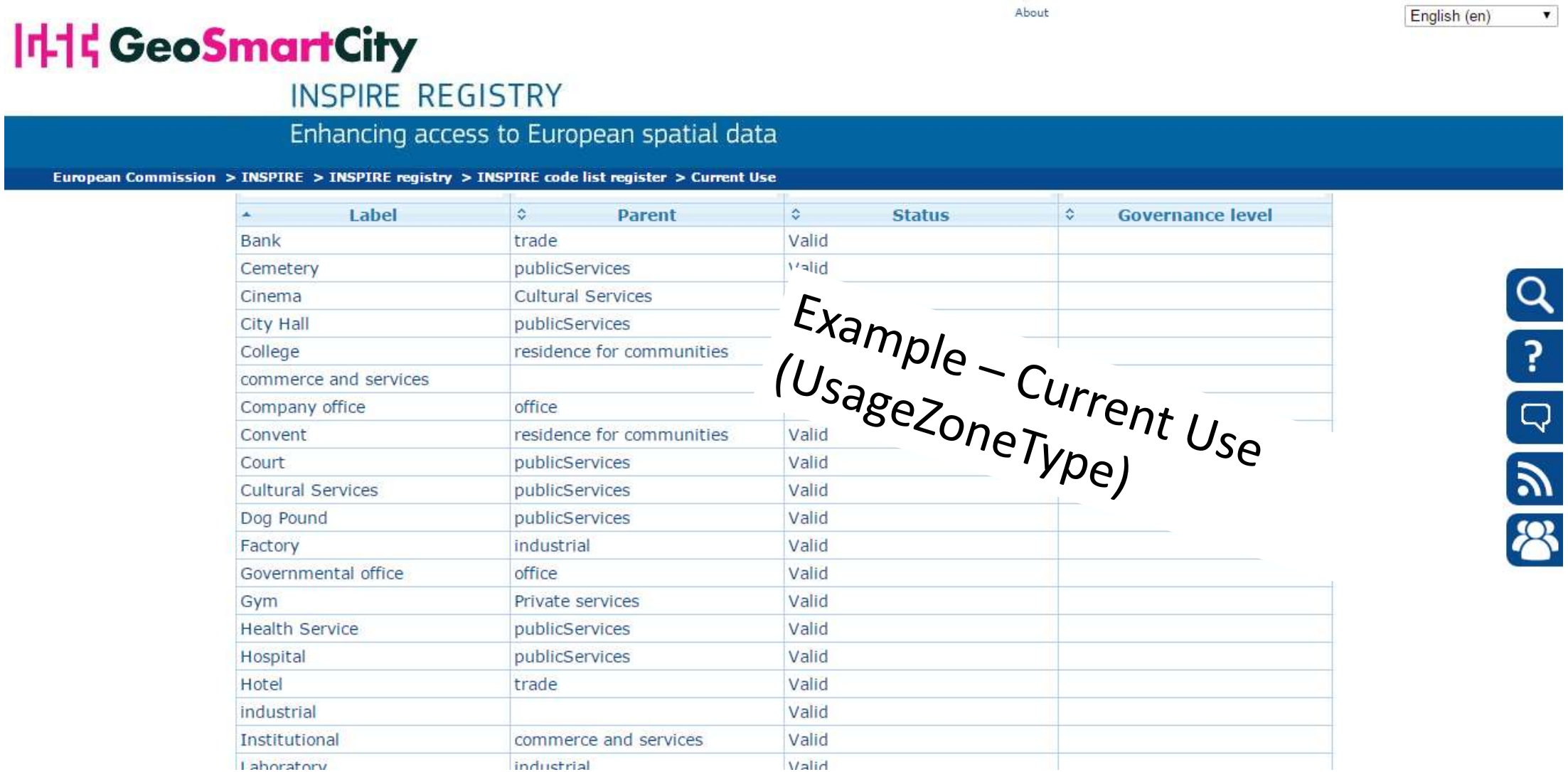
2 –

3 – Codelist Values

	A	B	C	D	E	F
1	LocalId	ParentLocalId	CollectionLocalId	Languag	Label	Definition
40	ancillary		CurrentUseValue	en	ancillary	A building (or building component) of small size that is usec
94	residential		CurrentUseValue	bg	Жилищна	Сградата (или сградният компонент) се използва за жили
95	individualResidence	residential	CurrentUseValue	bg	Самостоятелно жилище	В сградата (или сградния компонент) се помещава само е
96	collectiveResidence	residential	CurrentUseValue	bg	Колективно жилище	В сградата (или сградния компонент) се помещава повеч
97	twoDwellings	collectiveResidence	CurrentUseValue	bg	Две жилища	В сградата (или сградния компонент) се помещават две ж
98	moreThanTwoDwelling	collectiveResidence	CurrentUseValue	bg	Повече от две жилища	В сградата (или сградния компонент) се помещават най
99	residenceForCommunities	residential	CurrentUseValue	bg	Жилище за комуни	В сградата (или сградния компонент) се помещава жил
100	agriculture		CurrentUseValue	bg	Селско стопанство	Сградата (или сградният компонент) се използва за селск
101	industrial		CurrentUseValue	bg	Промишлена	Сградата (или сградният компонент) се използва за дейн
102	commerceAndServices		CurrentUseValue	bg	Търговия и услуги	Сградата (или сградният компонент) се използва за всяка
103	office	commerceAndServices	CurrentUseValue	bg	Офис	В сградата (или сградния компонент) се помещават офис
104	trade	commerceAndServices	CurrentUseValue	bg	Търговия	В сградата (или сградния компонент) се помещават търго
105	publicServices	commerceAndServices	CurrentUseValue	bg	Обществени услуги	В сградата (или сградния компонент) се помещават обще
106	ancillary		CurrentUseValue	bg	Помощна	Сграда (или сграден компонент) с малък размер, който(к
160	residential		CurrentUseValue	cs	obytná	Budova (nebo část budovy) se užívá za účelem bydlení.
161	individualResidence	residential	CurrentUseValue	cs	individuální bydlení	V budově (nebo v části budovy) se nachází pouze jeden byt.
162	collectiveResidence	residential	CurrentUseValue	cs	kolektivní bydlení	V budově (nebo v části budovy) se nachází více než jeden by
163	twoDwellings	collectiveResidence	CurrentUseValue	cs	dva byty	V budově (nebo v části budovy) se nacházejí dva byty.
164	moreThanTwoDwelling	collectiveResidence	CurrentUseValue	cs	více než dva byty	V budově (nebo v části budovy) se nacházejí nejméně 3 byty
165	residenceForCommunities	residential	CurrentUseValue	cs	komunitní bydlení	V budově (nebo v části budovy) se nachází komunitní bydle

_4_CodelistValue

Extended and new codelists



About

English (en)

GeoSmartCity

INSPIRE REGISTRY

Enhancing access to European spatial data

European Commission > INSPIRE > INSPIRE registry > INSPIRE code list register > Current Use

Label	Parent	Status	Governance level
Bank	trade	Valid	
Cemetery	publicServices	Valid	
Cinema	Cultural Services		
City Hall	publicServices		
College	residence for communities		
commerce and services			
Company office	office		
Convent	residence for communities	Valid	
Court	publicServices	Valid	
Cultural Services	publicServices	Valid	
Dog Pound	publicServices	Valid	
Factory	industrial	Valid	
Governmental office	office	Valid	
Gym	Private services	Valid	
Health Service	publicServices	Valid	
Hospital	publicServices	Valid	
Hotel	trade	Valid	
industrial		Valid	
Institutional	commerce and services	Valid	
Laboratory	industrial	Valid	

Example – Current Use (UsageZoneType)