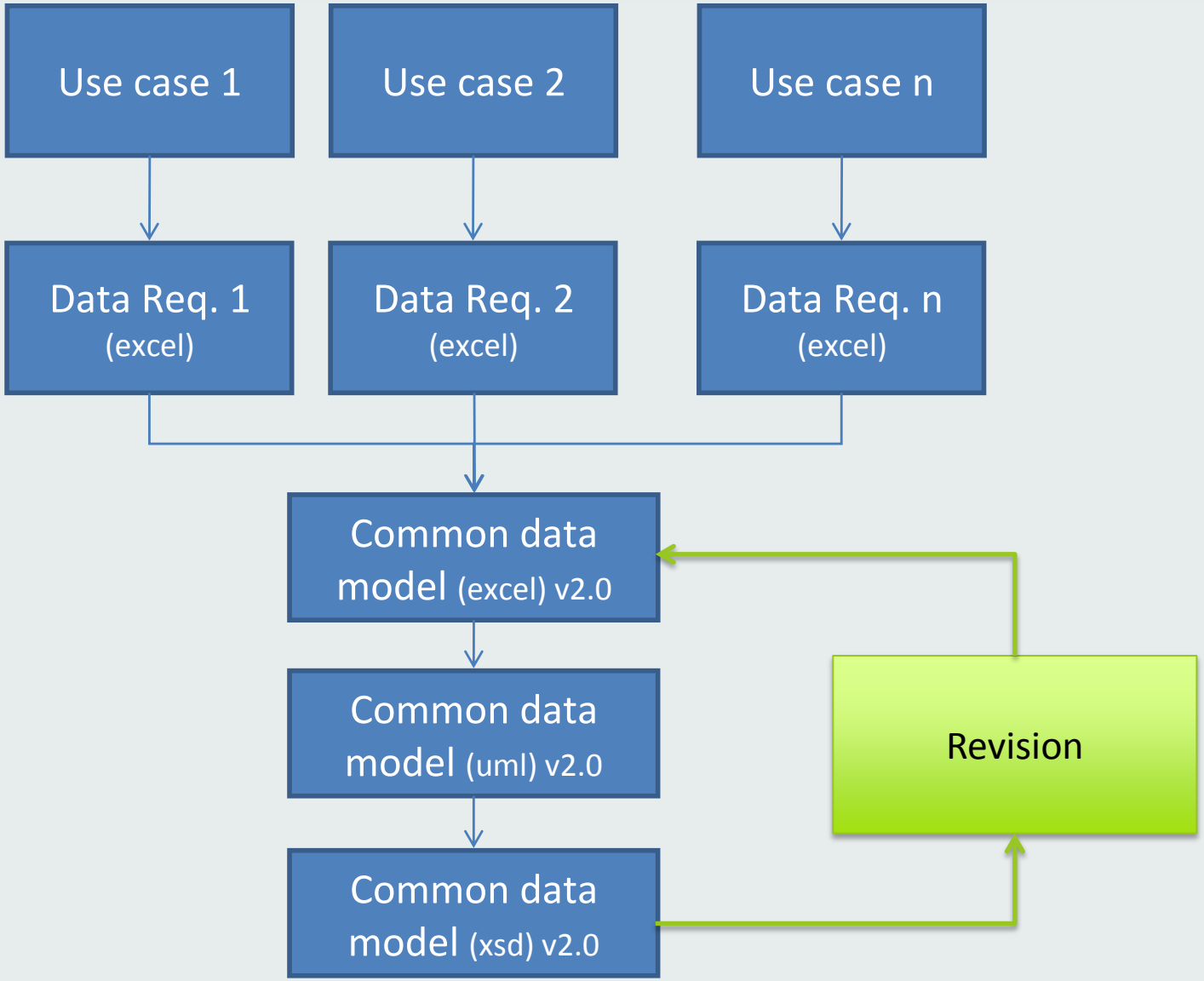
Urban Energy Workshop

The need for open and harmonized spatial data

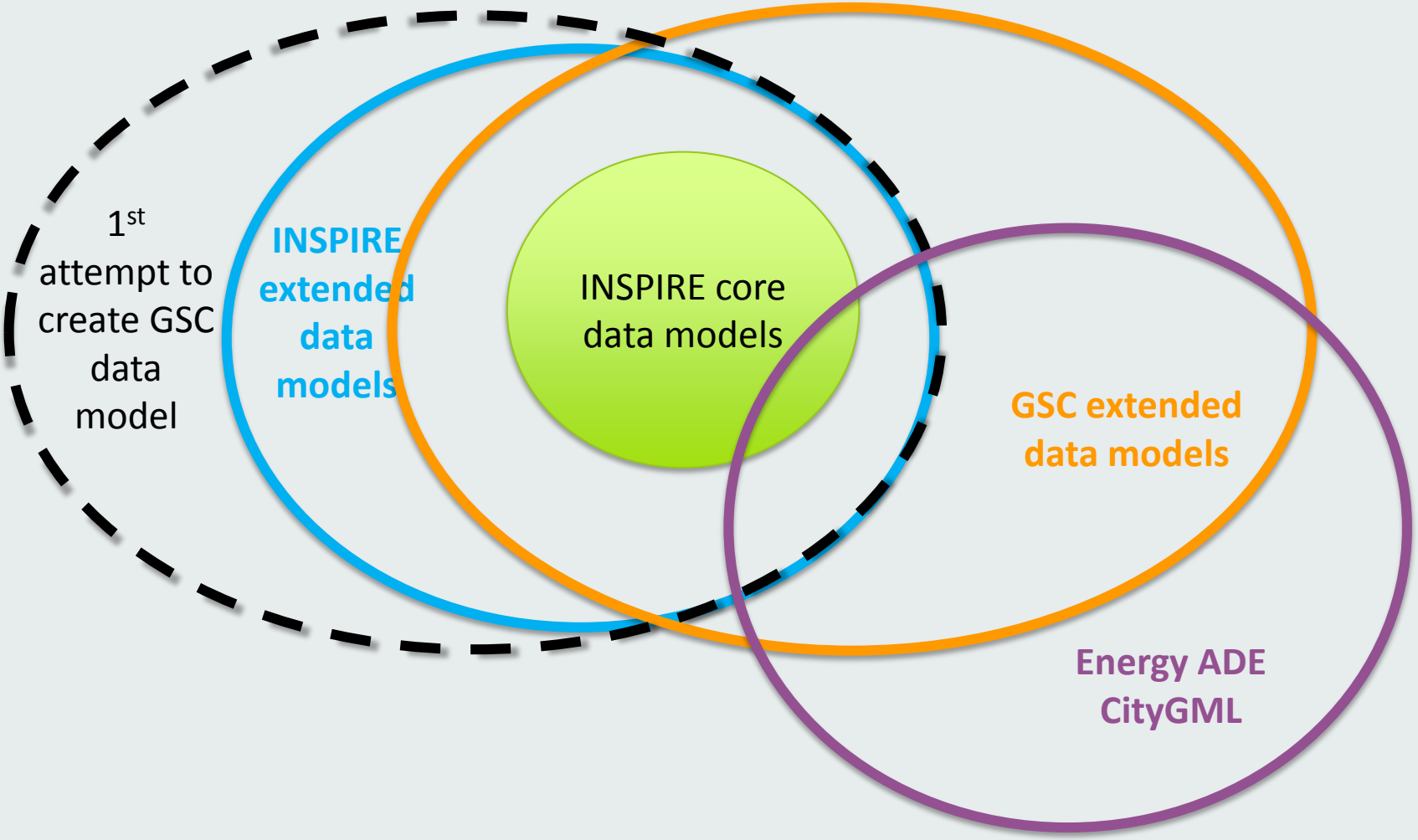
Giacomo Martirano
g.martirano@epsilon-italia.it

Summary

- Methodology for the production of the GSC data model
- INSPIRE DS extension approach
- An insight into the GSC data model


Use case 1
Use case 2
Use case n
Data Req. 1 (excel)
Data Req. 2 (excel)
Data Req. n (excel)
Common data model (excel) v2.0
Common data model (uml) v2.0
Common data model (xsd) v2.0
Revision

1. Create a template file in order to collect the pilots' data modelling requirements in a structured way.
2. Request each pilot to provide the list of attributes / information, the code list / code list values needed to run its use cases.
3. Align pilots' data modelling requirements
4. Compare data requirements so collected with the relevant INSPIRE Data Specifications
5. Provide an extension of the INSPIRE data models to take into account those elements included in pilots' data modelling requirements not covered by the INSPIRE Data Specifications.
6. Detailed procedures and instructions for the revision loop


1st attempt to create GSC data model
INSPIRE extended data models
INSPIRE core data models
GSC extended data models
Energy ADE CityGML

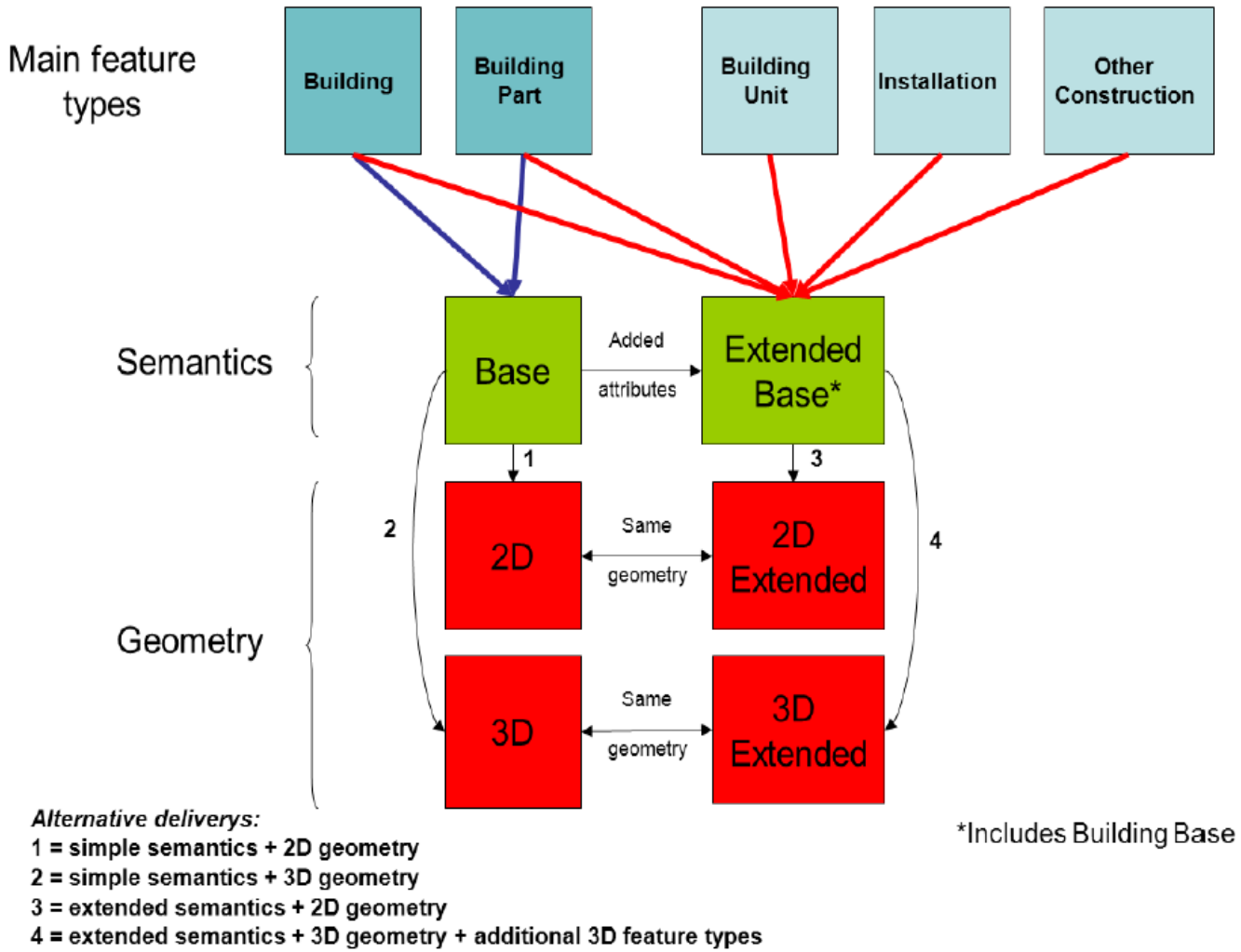
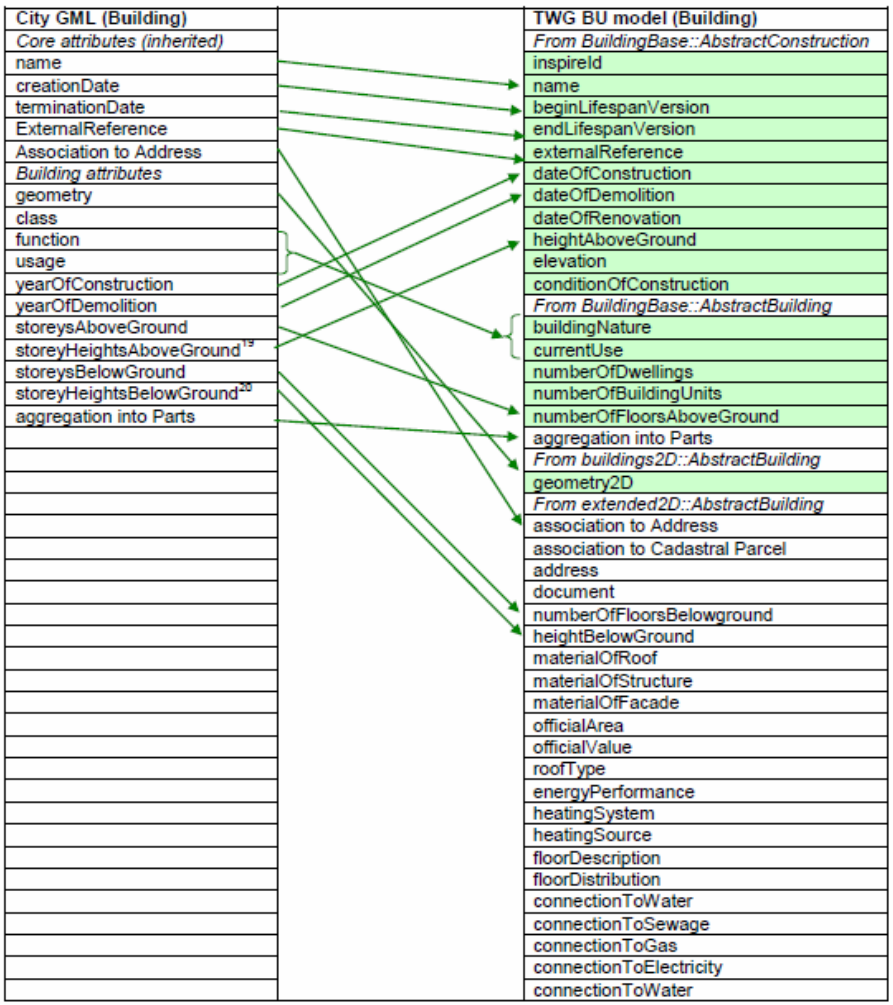


Figure 3: Content and structure of application schemas for theme Buildings

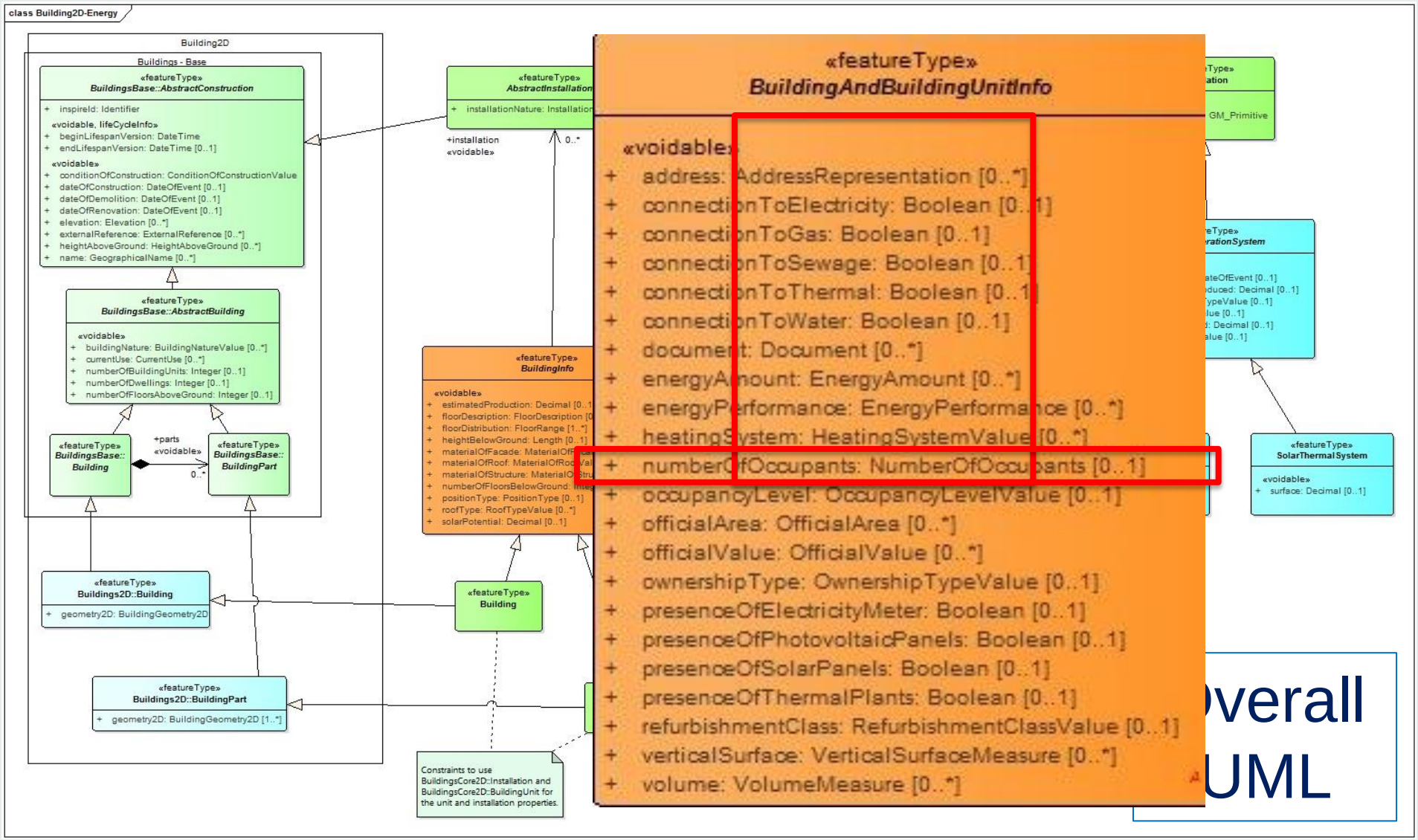
Feature types are represented in blue. Abstract application schemas are represented in green. Instanciable application schemas are represented in red.

Mapping between CityGML and INSPIRE BU model



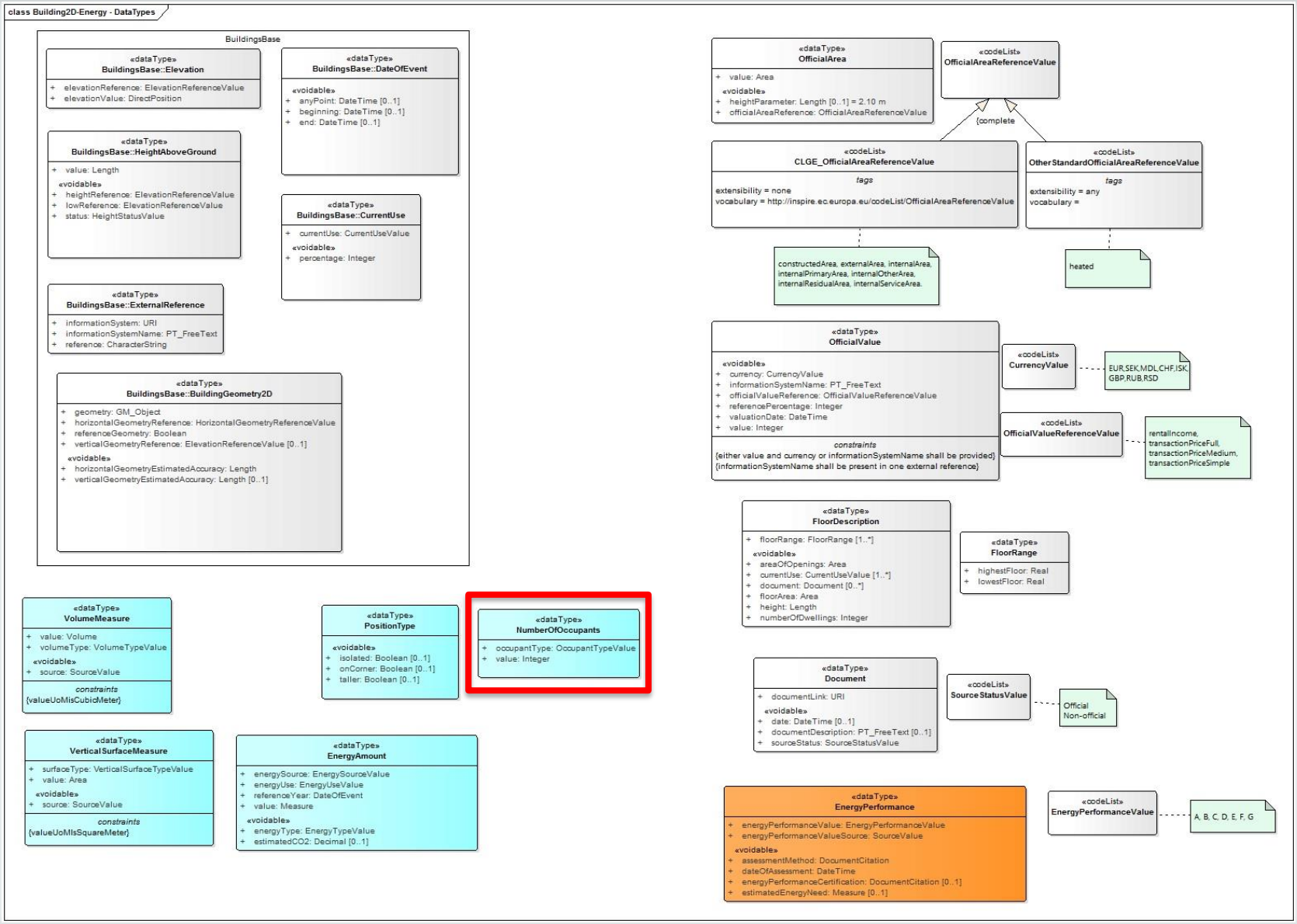
NOTE: attributes coloured in green are those coming from Core profiles

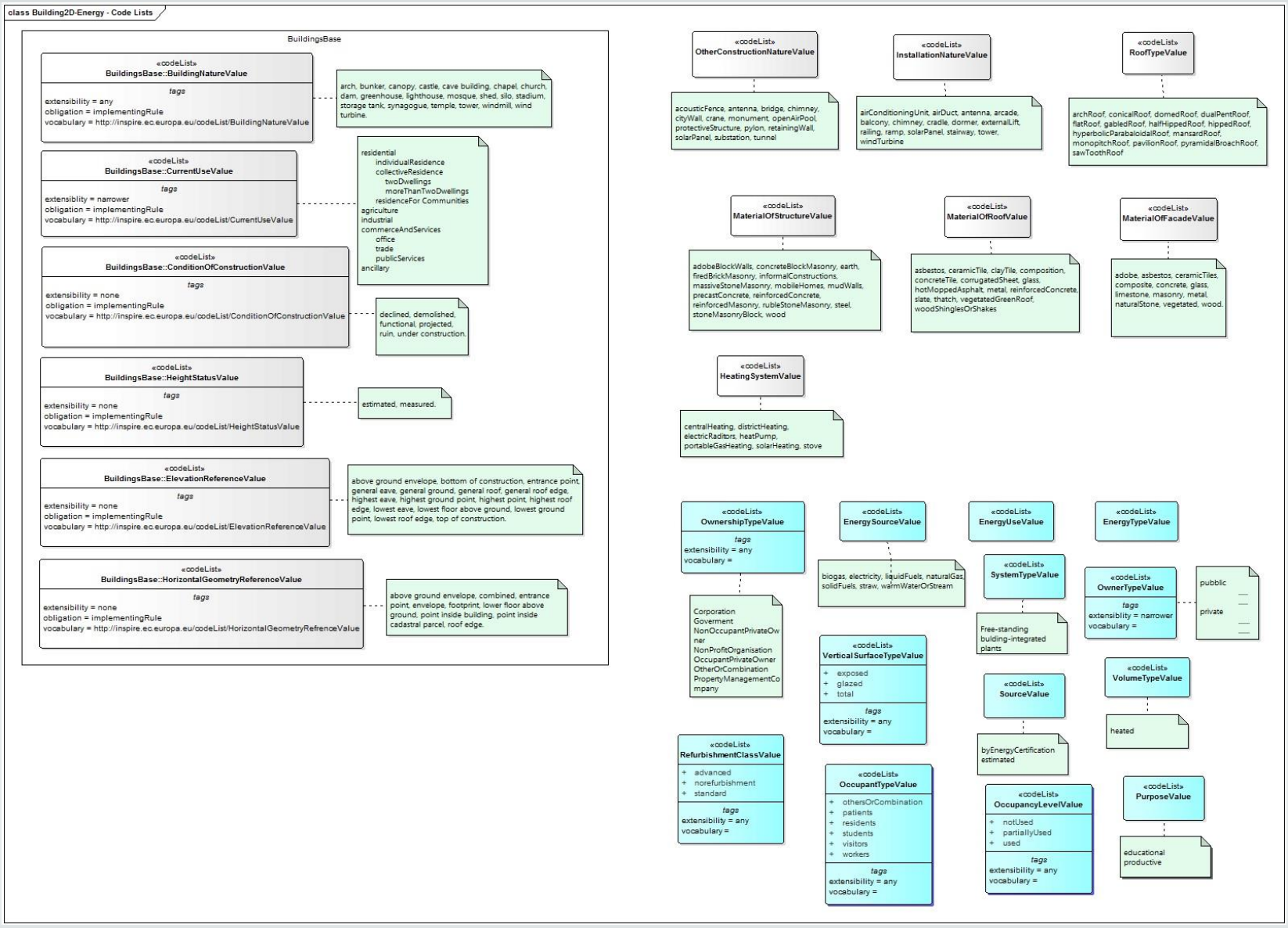
Pilot 01			Pilot 02				Pilot 03						
UC-GSCP01-01	UC-GSCP01-02	DATA LOGIC NAME (PILOT 1)	UC-GSCP02-01	UC-GSCP02-02	UC-GSCP02-03	DATA LOGIC NAME (PILOT 2)	DATA LOGIC NAME (PILOT 3)	DATA LOGIC NAME *	DESCRIPTION LOGIC NAME *	INPUT_OUTPUT DATA *	DATA TYPE *	INSPIRE Buildings	CityGML + Energy ADE
X (1, 2, 3, 4, 5, 6, 6bis, 7, 8)	X (1,2,3,4,7)	BuildingTerritory.Geometry 2D; BuildingUE.Geometry 2D	X	X	X	Building.Geometry 2D	Building.Geometry 2D; EconomicActivity.the_geom	**geometry2D**	footprint of the territorial building	INPUT	**Geometry**	**geometry2D**	**bldg:lod0FootPrint [data type]**
X (1, 2, 3, 4, 5, 6, 6bis, 7, 8)		BuildingUE.Name	X	X	X	Building.Name		**name**	Name of the building	INPUT	**Text**	**name (0..*)**	**gml:name [string]**
X (1, 2, 3, 4, 5, 6, 6bis, 7, 8)	X (1,2,3,4,7)	BuildingUE.Nature	X	X	X	Building.Nature	Building.Nature (__TEDIF)	**buildingNature**	Typology of the building	INPUT	**Code list**	**buildingNature (0..*)**	**bldg:function (0..*) [codelist] OR bldg:usage (0..*) [codelist]**
							Building.gid; UserBulding.gid;	**inspireId**		INPUT	**Number**		
X (1, 2, 3, 4, 5, 6, 6bis, 7, 8)		BuildingUE.Ownership						**ownership**	Ownership of the building	INPUT	**Code list**		
X (1, 2, 3, 4, 5, 6, 6bis, 7, 8)	X (1,2,3,4,7)	BuildingUE.Use(s)	X	X	X	Building.Use(s)	Building.currentUse (__TUTIL); EconomicActivity.tser	**currentUse**	Type of uses of the building (use classification based on the energy certification)	INPUT	**Code list**	**currentUse (0..*)**	**bldg:class (0..1) [codelist]**
X (1, 2, 3, 4, 5, 6, 6bis, 7, 8)	X (1,2,3,4,7)	BuildingUE.Address	X	X	X	Building.Postcode; Building.Neighborhood		**address**	Address building (Street, Civic, Civic sub)	INPUT	**Text**	**address (0..*)**	**bldg:address [data type]**
X (1, 2, 3, 4, 5, 6, 6bis, 7, 8)		BuildingUE.CostructionYear	X	X	X	Building.Construction period - begin; Building.Construction period - end	Building.__EPOCA; Building.UserYear	**dateOfConstruction**	Costruction Year of the building (if available or estimated)	INPUT	**Number**	**dateOfConstruction (0..1**	**bldg:yearOfConstruction (0..1) [YYYY]**
			X	X	X	Building.height; Building.height_statu		**heightAboveGround**	Total height of the building, in meters	INPUT		**heightAboveGround**	
X (1, 2, 3, 4, 5, 6, 6bis, 7, 8)	X (7)	BuildingUE.Volumes	X	X	X	Building.Total volumes		**volumes**	Volume of the building (by energy certification or estimated)	INPUT	**Number**		**ade:grossVolume (0..1) [double]**
X (1, 2, 3, 4, 5, 6, 6bis, 7, 8)	X (7)	BuildingUE.Surfaces						**surfaces**	Surface of the building (by energy certification or estimated)	INPUT	**Number**		**ade:ThermalBoundarySurface [data type]**
			X	X	X	Building.Elevation_value		**elevation**	Elevation of the ground compared to sea level at the point of the building	INPUT	**Number**	**elevation**	
			X	X	X	Building.Number of floors		**numberOfFloorsAboveGround**	Number of floors (attic excluded)	INPUT	**Number**	**numberOfFloorsAboveGround**	


class Building2D-Energy
Building2D
Buildings - Base
«featureType»
BuildingsBase::AbstractConstruction
+ inspireId: Identifier
«voidable, lifeCycleInfo»
+ beginLifespanVersion: DateTime
+ endLifespanVersion: DateTime [0..1]
«voidable»
+ conditionOfConstruction: ConditionOfConstructionValue
+ dateOfConstruction: DateOfEvent [0..1]
+ dateOfDemolition: DateOfEvent [0..1]
+ dateOfRenovation: DateOfEvent [0..1]
+ elevation: Elevation [0..*]
+ externalReference: ExternalReference [0..*]
+ heightAboveGround: HeightAboveGround [0..*]
+ name: GeographicalName [0..*]
«featureType»
BuildingsBase::AbstractBuilding
«voidable»
+ buildingNature: BuildingNatureValue [0..*]
+ currentUse: CurrentUse [0..*]
+ numberOfBuildingUnits: Integer [0..1]
+ numberOfDwellings: Integer [0..1]
+ numberOfFloorsAboveGround: Integer [0..1]
«featureType»
BuildingsBase::Building
+parts
«voidable»
0..*
«featureType»
BuildingsBase::BuildingPart
«featureType»
Buildings2D::Building
+ geometry2D: BuildingGeometry2D
«featureType»
Buildings2D::BuildingPart
+ geometry2D: BuildingGeometry2D [1..*]
«featureType»
AbstractInstallation
+ installationNature: Installation
+installation
«voidable»
0..*
«featureType»
BuildingInfo
«voidable»
+ estimatedProduction: Decimal [0..1]
+ floorDescription: FloorDescription [0
+ floorDistribution: FloorRange [1..*]
+ heightBelowGround: Length [0..1]
+ materialOfFacade: MaterialOfF
+ materialOfRoof: MaterialOfRoo
+ materialOfStructure: MaterialOfStru
+ numberOfFloorsBelowGround: Integ
+ positionType: PositionType [0..1]
+ roofType: RoofTypeValue [0..*]
+ solarPotential: Decimal [0..1]
«featureType»
Building
Constraints to use BuildingsCore2D::Installation and BuildingsCore2D::BuildingUnit for the unit and installation properties.
«featureType»
BuildingAndBuildingUnitInfo
«voidable»
+ address: AddressRepresentation [0..*]
+ connectionToElectricity: Boolean [0..1]
+ connectionToGas: Boolean [0..1]
+ connectionToSewage: Boolean [0..1]
+ connectionToThermal: Boolean [0..1]
+ connectionToWater: Boolean [0..1]
+ document: Document [0..*]
+ energyAmount: EnergyAmount [0..*]
+ energyPerformance: EnergyPerformance [0..*]
+ heatingSystem: HeatingSystemValue [0..*]
+ numberOfOccupants: NumberOfOccupants [0..1]
+ occupancyLevel: OccupancyLevelValue [0..1]
+ officialArea: OfficialArea [0..*]
+ officialValue: OfficialValue [0..*]
+ ownershipType: OwnershipTypeValue [0..1]
+ presenceOfElectricityMeter: Boolean [0..1]
+ presenceOfPhotovoltaicPanels: Boolean [0..1]
+ presenceOfSolarPanels: Boolean [0..1]
+ presenceOfThermalPlants: Boolean [0..1]
+ refurbishmentClass: RefurbishmentClassValue [0..1]
+ verticalSurface: VerticalSurfaceMeasure [0..*]
+ volume: VolumeMeasure [0..*]
GM_Primitive
«featureType»
SolarThermalSystem
«voidable»
+ surface: Decimal [0..1]

verall

UML


class Building2D-Energy - DataTypes
BuildingsBase
«dataType» BuildingsBase::Elevation
+ elevationReference: ElevationReferenceValue
+ elevationValue: DirectPosition
«dataType» BuildingsBase::DateOfEvent
«voidable»
+ anyPoint: DateTime [0..1]
+ beginning: DateTime [0..1]
+ end: DateTime [0..1]
«dataType» BuildingsBase::HeightAboveGround
+ value: Length
«voidable»
+ heightReference: ElevationReferenceValue
+ lowReference: ElevationReferenceValue
+ status: HeightStatusValue
«dataType» BuildingsBase::CurrentUse
+ currentUse: CurrentUseValue
«voidable»
+ percentage: Integer
«dataType» BuildingsBase::ExternalReference
+ informationSystem: URI
+ informationSystemName: PT_FreeText
+ reference: CharacterString
«dataType» BuildingsBase::BuildingGeometry2D
+ geometry: GM_Object
+ horizontalGeometryReference: HorizontalGeometryReferenceValue
+ referenceGeometry: Boolean
+ verticalGeometryReference: ElevationReferenceValue [0..1]
«voidable»
+ horizontalGeometryEstimatedAccuracy: Length
+ verticalGeometryEstimatedAccuracy: Length [0..1]
«dataType» OfficialArea
+ value: Area
«voidable»
+ heightParameter: Length [0..1] = 2.10 m
+ officialAreaReference: OfficialAreaReferenceValue
«codeList» OfficialAreaReferenceValue
{complete
«codeList» CLGE_OfficialAreaReferenceValue
tags
extensibility = none
vocabulary = http://inspire.ec.europa.eu/codeList/OfficialAreaReferenceValue
«codeList» OtherStandardOfficialAreaReferenceValue
tags
extensibility = any
vocabulary =
constructedArea, externalArea, internalArea, internalPrimaryArea, internalOtherArea, internalResidualArea, internalServiceArea.
heated
«dataType» OfficialValue
«voidable»
+ currency: CurrencyValue
+ informationSystemName: PT_FreeText
+ officialValueReference: OfficialValueReferenceValue
+ referencePercentage: Integer
+ valuationDate: DateTime
+ value: Integer
constraints
{either value and currency or informationSystemName shall be provided}
{informationSystemName shall be present in one external reference}
«codeList» CurrencyValue
EUR,SEK,MDL,CHF,ISK, GBP,RUB,RSD
«codeList» OfficialValueReferenceValue
rentalIncome, transactionPriceFull, transactionPriceMedium, transactionPriceSimple
«dataType» FloorDescription
+ floorRange: FloorRange [1..*]
«voidable»
+ areaOfOpenings: Area
+ currentUse: CurrentUseValue [1..*]
+ document: Document [0..*]
+ floorArea: Area
+ height: Length
+ numberOfDwellings: Integer
«dataType» FloorRange
+ highestFloor: Real
+ lowestFloor: Real
«dataType» VolumeMeasure
+ value: Volume
+ volumeType: VolumeTypeValue
«voidable»
+ source: SourceValue
constraints
{valueUoMisCubicMeter}
«dataType» PositionType
«voidable»
+ isolated: Boolean [0..1]
+ onCorner: Boolean [0..1]
+ taller: Boolean [0..1]
«dataType» NumberOfOccupants
+ occupantType: OccupantTypeValue
+ value: Integer
«dataType» Document
+ documentLink: URI
«voidable»
+ date: DateTime [0..1]
+ documentDescription: PT_FreeText [0..1]
+ sourceStatus: SourceStatusValue
«codeList» SourceStatusValue
Official
Non-official
«dataType» VerticalSurfaceMeasure
+ surfaceType: VerticalSurfaceTypeValue
+ value: Area
«voidable»
+ source: SourceValue
constraints
{valueUoMisSquareMeter}
«dataType» EnergyAmount
+ energySource: EnergySourceValue
+ energyUse: EnergyUseValue
+ referenceYear: DateOfEvent
+ value: Measure
«voidable»
+ energyType: EnergyTypeValue
+ estimatedCO2: Decimal [0..1]
«dataType» EnergyPerformance
+ energyPerformanceValue: EnergyPerformanceValue
+ energyPerformanceValueSource: SourceValue
«voidable»
+ assessmentMethod: DocumentCitation
+ dateOfAssessment: DateTime
+ energyPerformanceCertification: DocumentCitation [0..1]
+ estimatedEnergyNeed: Measure [0..1]
«codeList» EnergyPerformanceValue
A, B, C, D, E, F, G


class Building2D-Energy - Code Lists
BuildingsBase
«codeList» BuildingsBase::BuildingNatureValue
tags
extensibility = any
obligation = implementingRule
vocabulary = http://inspire.ec.europa.eu/codeList/BuildingNatureValue
arch, bunker, canopy, castle, cave building, chapel, church, dam, greenhouse, lighthouse, mosque, shed, silo, stadium, storage tank, synagogue, temple, tower, windmill, wind turbine.
«codeList» BuildingsBase::CurrentUseValue
tags
extensiblity = narrower
obligation = implementingRule
vocabulary = http://inspire.ec.europa.eu/codeList/CurrentUseValue
residential
individualResidence
collectiveResidence
twoDwellings
moreThanTwoDwellings
residenceFor Communities
agriculture
industrial
commerceAndServices
office
trade
publicServices
ancillary
«codeList» BuildingsBase::ConditionOfConstructionValue
tags
extensibility = none
obligation = implementingRule
vocabulary = http://inspire.ec.europa.eu/codeList/ConditionOfConstructionValue
declined, demolished, functional, projected, ruin, under construction.
«codeList» BuildingsBase::HeightStatusValue
tags
extensibility = none
obligation = implementingRule
vocabulary = http://inspire.ec.europa.eu/codeList/HeightStatusValue
estimated, measured.
«codeList» BuildingsBase::ElevationReferenceValue
tags
extensibility = none
obligation = implementingRule
vocabulary = http://inspire.ec.europa.eu/codeList/ElevationReferenceValue
above ground envelope, bottom of construction, entrance point, general eave, general ground, general roof, general roof edge, highest eave, highest ground point, highest point, highest roof edge, lowest eave, lowest floor above ground, lowest ground point, lowest roof edge, top of construction.
«codeList» BuildingsBase::HorizontalGeometryReferenceValue
tags
extensibility = none
obligation = implementingRule
vocabulary = http://inspire.ec.europa.eu/codeList/HorizontalGeometryRefrenceValue
above ground envelope, combined, entrance point, envelope, footprint, lower floor above ground, point inside building, point inside cadastral parcel, roof edge.
«codeList» OtherConstructionNatureValue
acousticFence, antenna, bridge, chimney, cityWall, crane, monument, openAirPool, protectiveStructure, pylon, retainingWall, solarPanel, substation, tunnel
«codeList» InstallationNatureValue
airConditioningUnit, airDuct, antenna, arcade, balcony, chimney, cradle, dormer, externalLift, railing, ramp, solarPanel, stairway, tower, windTurbine
«codeList» RoofTypeValue
archRoof, conicalRoof, domedRoof, dualPentRoof, flatRoof, gabledRoof, halfHippedRoof, hippedRoof, hyperbolicParabaloidalRoof, mansardRoof, monopitchRoof, pavilionRoof, pyramidalBroachRoof, sawToothRoof
«codeList» MaterialOfStructureValue
adobeBlockWalls, concreteBlockMasonry, earth, firedBrickMasonry, informalConstructions, massiveStoneMasonry, mobileHomes, mudWalls, precastConcrete, reinforcedConcrete, reinforcedMasonry, rubleStoneMasonry, steel, stoneMasonryBlock, wood
«codeList» MaterialOfRoofValue
asbestos, ceramicTile, clayTile, composition, concreteTile, corrugatedSheet, glass, hotMoppedAsphalt, metal, reinforcedConcrete, slate, thatch, vegetatedGreenRoof, woodShinglesOrShakes
«codeList» MaterialOfFacadeValue
adobe, asbestos, ceramicTiles, composite, concrete, glass, limestone, masonry, metal, naturalStone, vegetated, wood.
«codeList» HeatingSystemValue
centralHeating, districtHeating, electricRadiators, heatPump, portableGasHeating, solarHeating, stove
«codeList» OwnershipTypeValue
tags
extensibility = any
vocabulary =
Corporation
Goverment
NonOccupantPrivateOwner
NonProfitOrganisation
OccupantPrivateOwner
OtherOrCombination
PropertyManagementCompany
«codeList» EnergySourceValue
biogas, electricity, liquidFuels, naturalGas, solidFuels, straw, warmWaterOrStream
«codeList» EnergyUseValue
«codeList» EnergyTypeValue
«codeList» SystemTypeValue
Free-standing
buliding-integrated
plants
«codeList» OwnerTypeValue
tags
extensibility = narrower
vocabulary =
pubblic
private
«codeList» VerticalSurfaceTypeValue
+ exposed
+ glazed
+ total
tags
extensibility = any
vocabulary =
«codeList» SourceValue
byEnergyCertification
estimated
«codeList» VolumeTypeValue
heated
«codeList» RefurbishmentClassValue
+ advanced
+ norefurbishment
+ standard
tags
extensibility = any
vocabulary =
«codeList» OccupantTypeValue
+ othersOrCombination
+ patients
+ residents
+ students
+ visitors
+ workers
tags
extensibility = any
vocabulary =
«codeList» OccupancyLevelValue
+ notUsed
+ partiallyUsed
+ used
tags
extensibility = any
vocabulary =
«codeList» PurposeValue
educational
productive

Type New Type	Documentation	Attribute Association role New attribute	Attribute / Association role Documentation	Values / Enumerations	Multiplicity	Voidable / Non-Voidab	Pilot 01	Pilot 02	Pilot 03	NOTE by EP01+SGIS	Review by EPSIT
Building Supertypes: Building *BuildingAbstractBuildingAbstractConstructionBuildingInfo BuildingAndBuildingUnitInfo*	-- Name -- Building A Building is an enclosed construction above and/or underground, used or intended for the shelter of humans, animals or things or for the production of economic goods. A building refers to any structure permanently constructed or erected on its site.										
		beginLifespanVersion	-- Name -- Begin lifespan version Date and time at	DateTime	1	voidable					
		conditionOfConstruction	-- Name -- Condition of construction Status of the	ConditionOfConstructionValue	1	voidable					
		dateOfConstruction	-- Name -- Date of construction Date of	DateOfEvent	0..1	voidable	BuildingUE.ConstructionYear	Building.Construction period -	Building.__EPOCA;	Multiplicity [1]	This attribute is defined in the INSPIRE "Building2D"
		dateOfDemolition	-- Name -- Date of demolition Date of demolition	DateOfEvent	0..1	voidable					
		dateOfRenovation	-- Name -- Date of last major renovation Date of last	DateOfEvent	0..1	voidable					
		RefurbishmentClass									OK, it is a property of a "Building"/"BuildingPart" or
		elevation	-- Name -- Elevation Vertically-constrained	Elevation	0..*	voidable		Building.Elevation value			
		endLifespanVersion	-- Name -- End lifespan version Date and time at	DateTime	0..1	voidable					
		externalReference	-- Name -- External reference Reference to an external	ExternalReference	0..*	voidable					
		heightAboveGround	-- Name -- Height above ground Height above	HeightAboveGround	0..*	voidable		Building.height; Building.height_st		Multiplicity [1..*]	This attribute is defined in the INSPIRE "Building2D"
		inspireId	-- Name -- inspire id External object identifier of the	Identifier	1				Building.gid; UserBuilding.gi		
		name	-- Name -- Name Name of the construction EXAMPLES:	GeographicalName	0..*	voidable	BuildingUE.Name	Building.Name			
		buildingNature	-- Name -- Building nature Characteristic of the building that	BuildingNatureValue	0..*	voidable	BuildingUE.Nature	Building.Nature	Building.Nature (__TEDIF)		
		currentUse	-- Name -- Current use Activity hosted within the building	CurrentUse	0..*	voidable	BuildingUE.Use(s)	Building.Use(s)	Building.currentUse	Multiplicity [1..*]	This attribute is defined in the INSPIRE "Building2D"
		numberOfDwellings	-- Name -- Number of dwellings Number of	Integer	0..1	voidable					
		numberOfBuildingUnits	-- Name -- Number of building units Number of building	Integer	0..1	voidable		Building.Units			
		numberOfFloorsAboveGr	-- Name -- Number of floors above ground Number of	Integer	0..1	voidable		Building.Number of floors			
		parts	The building parts composing the Building A building may be a	BuildingPart	0..*	voidable					
		geometry2D	-- Name -- Geometry 2D 2D or 2.5D geometric	BuildingGeometry2D	1		BuildingTerritory Geometry	Building.Geometry 2D	Building.Geometry 2D;		
		connectionToElectricity	-- Name -- Connection to electricity An indication if	Boolean* TRUE* FALSE	0..1	voidable					
		connectionToGas	-- Name -- Connection to gas An indication if the building or	Boolean* TRUE* FALSE	0..1	voidable					
		connectionToSewage	-- Name -- Connection to sewage An indication if the	Boolean* TRUE* FALSE	0..1	voidable					
		connectionToWater	-- Name -- Connection to water An indication if the	Boolean* TRUE* FALSE	0..1	voidable					
		connectionToThermal		Boolean* TRUE* FALSE	0..1	voidable				NEW	OK - Could you please provide the
		document	-- Name -- Document Any document providing information	Document	0..*	voidable					
		energyPerformance	-- Name -- Energy performance The energy	EnergyPerformance	0..1	voidable				Multiplicity 0..*	OK

Generic workflow to transform datasets according to selected target schema requirements

- Import target/source schemas
- Import data
- Set mapping rules
- Export transformed data
- Validate transformed dataset

THANK YOU!

QUESTIONS?

Giacomo Martirano
g.martirano@epsilon-italia.it
www.geosmartcity-eu