The European Commission's science and knowledge service

Joint Research Centre

Geospatial solutions for a location-enabled society

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Giacomo Martirano (external consultant)

Genova (IT), 15 February 2017
GeoSmartCity Final Conference

European Commission

Outline

- **Geospatial technologies fuel the *data economy***
- **The role of INSPIRE**
- **ISA/ISA^2 Programme, EULF and ELISE**
- **Overview of EULF Pilots (Transport and Marine)**
- **The EULF Energy Pilot**
  - Pilot overview
  - Overview of Use Case 1
  - INSPIRE core schemas extension
  - Re3gistry implementation
  - Data transformation
  - Data validation
  - Data publication
  - Data use
  - Next steps

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Geospatial technologies fuel the *data economy*

Technologies accelerating the use of location intelligence

Accelerator	'Smart' devices	Sensors	Cloud storage	Machine learning	Remote imagery	BIM/CAD/GIS integration	IPv6 technology
Impact	Mobile devices that can detect location, direction and movement, enabling context-based interaction between government and citizens	Sensors provide constant data collection about our physical and natural infrastructure, offering a vibrant picture of trends across a range of data sources	Cloud-based storage allows for the collection, scaling and processing of vast amounts of location data, and enables geo-data sharing	By 'learning' from historical spatial data, computer algorithms can scan new data to identify anomalies and patterns that yield predictive insight	A blend of commercial and government satellites, planes and drones provide a near real-time picture of the changing conditions on the Earth's surface	The integration of Building Information Modeling, Computer Aided Design and Geographic Information Systems enables analysis inside and outside of structures	Internet Protocol Version 6 will expand the number of unique addresses on the Internet, improving geolocation
Today	Geotagged tweets and text messages are used to connect with citizens	Cities can monitor and track air quality to inform better regulations	Agencies share geo-data on a common platform	Law enforcement can create predictive models for violent crimes	Imagery provides awareness about events like natural disasters, migration patterns and foreign conflicts	Site planners and inspectors use GIS and building specifications to perform more uniform evaluations	Road signs, utilities and other infrastructure are connected to the Internet
Tomorrow	Government uses geofencing to push information to individuals based on location	Government can trace contaminated food to its source immediately, and even predict an outbreak	Real-time data from millions of sources are securely available anywhere, anytime	Unstructured social data becomes instant insight for policy makers	More granular imagery allows for remote monitoring of public infrastructure to predict future needs	Directions continue seamlessly from outdoors to inside buildings	Emergency managers rapidly assess damage using data points from thousands of inanimate objects

Graphic: Deloitte University Press | DUPress.com

http://government-2020.dupress.com/driver/geospatial-technology//

Deloitte.

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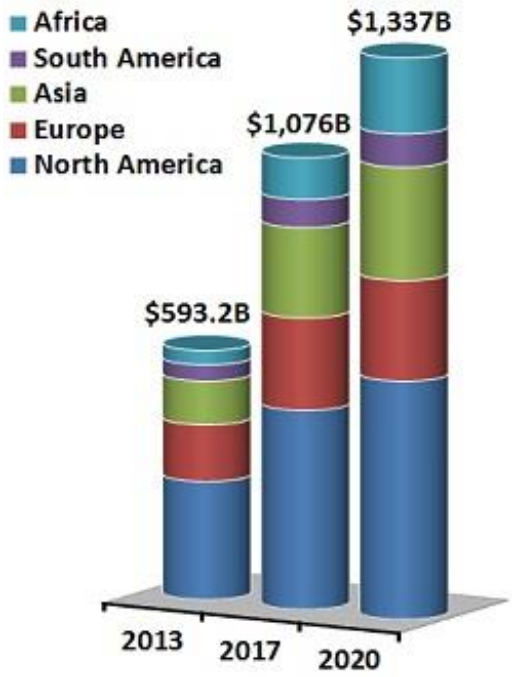
Geospatial technologies fuel the *data economy*

- In **2020**, the **location-based service** market will be a **US$1.3 trillion** industry(1)
- In **2020**, use of **geo-location data**, including GPS, will generate **US$500 billion** in consumer value(2)
- Geographer **jobs will grow** by 35% per annum, while those of cartographers and photogrammetrists will grow by 22% **between 2010 and 2020**(3)

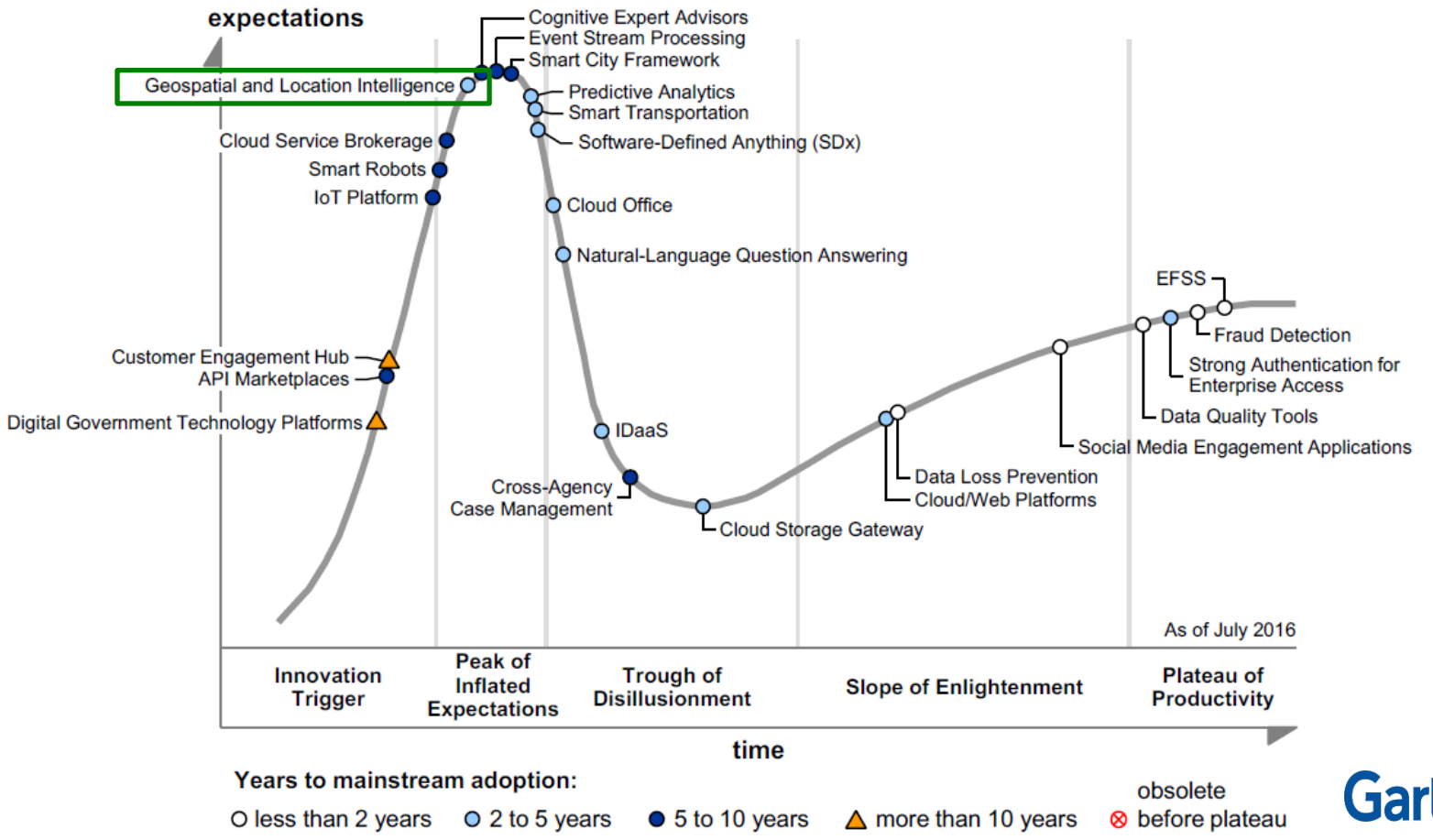


Location-based services market forecast – 2013-2020

1. *"Location Based Services – Market and Technology Outlook – 2013-2020," Market Info Group LLC, http://www.marketinfogroup.com/location-based-services-market-technology/*
2. *"Implications of the ICT Skills Gap for the Mobile Industry," MacLeod Consulting, http://www.gsma.com/events/wp-content/uploads/2013/08/ICT-Skills-Gap-Research.pdf*
3. *$3.7 Billion Reasons Why GIS Technology is The Future," American Sentinel University, http://www.americansentinel.edu/about-american-sentinel-university/newsroom/3-7-billion-reasons-why-gis-technology-is-the-future*

The role of Geospatial and Location Intelligence for Digital Governments is paramount and expected to find mind mainstream adoption in next 2-5 years

Figure 1. Hype Cycle for Digital Government, 2016



Source: Gartner (July 2016)

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Geospatial and Location Intelligence supports many existing and emerging e-Government services

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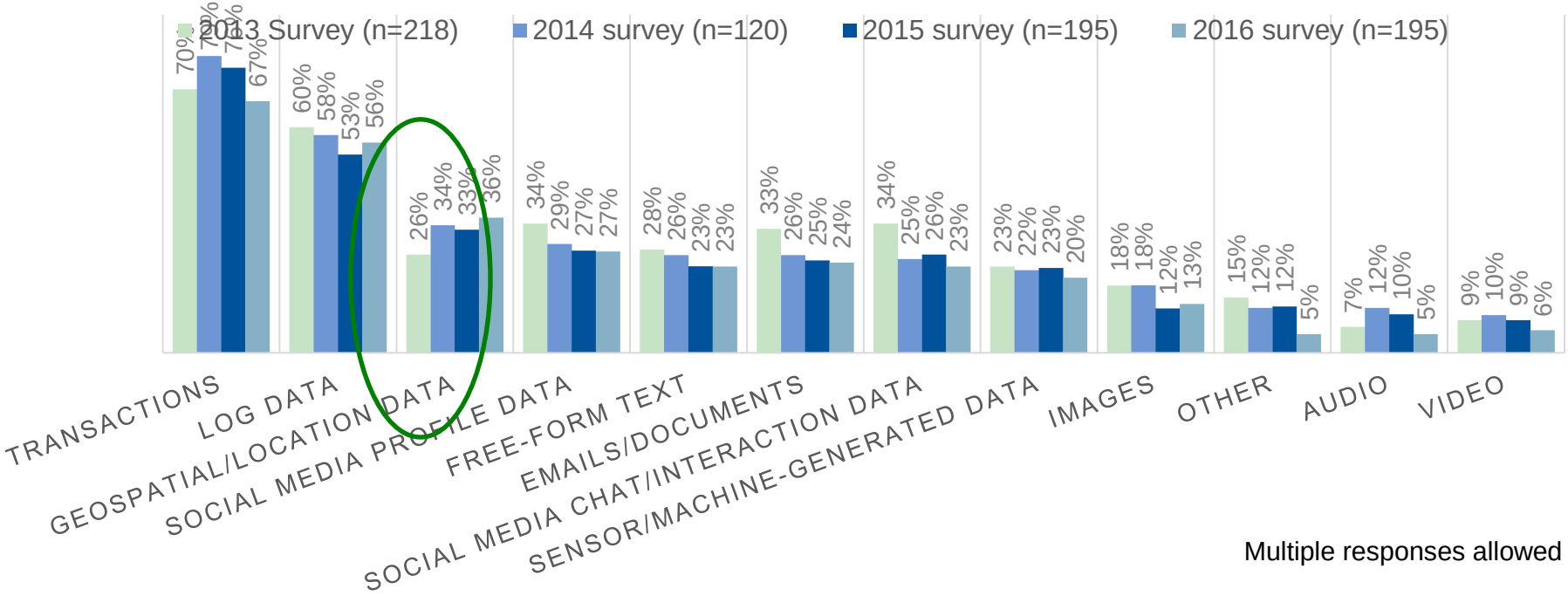
Geospatial Data is 36% of Big Data analysed and has been on the rise since 2013

Q04_1. Which types of big data does your organization currently analyze?

Base: Invested in big data technology (Q1)



Multiple responses allowed

Base: Investing/planning to invest (Q01) (n=146)

Q. Which types of big data does your organization currently analyze and which do you plan to add to your analytics in the future?

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Location intelligence analytics are mostly in demand in government, energy and utilities

Figure 2. Data Source and Analytics Methods Demand by Industry Vertical Domain

Industry → / Data Source/Method ↓	Banking, Finance & Insurance	Government	Manufac-turing	Services	Education	MISC	Healthcare	Energy & Utilities	Retail	Transport-ation	Media
Business Intelligence	10	10	9	9	8	8	6	6	6	5	1
Machine Learning	10	8	8	9	7	6	6	5	5	4	4
Streaming Analytics	6	5	5	5	4	4	4	4	3	3	3
Fraud and Behavioral Analytics	7	5	5	5	4	4	4	4	4	1	3
Biometrics (Facial, etc.)	8	5	4	5	4	5	4	2	3	3	3
Predictive Analytics	5	5	5	5	4	4	4	3	3	3	1
Location Intelligence	4	6	4	4	4	4	3	5	3	3	2
Text Analytics	5	4	4	4	4	4	4	3	3	3	3
Data Discovery	5	5	5	4	4	4	3	3	3	3	2
Social Analytics	4	4	3	4	4	3	3	2	3	1	2
Simulation	4	3	4	4	3	3	2	3	2	2	2
Self-Service Data Preparation	4	3	4	3	3	3	3	3	2	2	2
Image and Video Analytics	3	3	3	3	3	3	1	3	3	3	3
Optimization	4	3	3	3	3	3	3	3	2	2	1
Cloud Analytics	3	3	4	3	3	3	2	3	2	2	2
BI Reporting and Dashboard	3	3	3	3	2	3	2	2	2	2	2
Traditional Analytics (Descriptive, Diagnostic, OLAP)	3	3	3	3	3	2	2	2	2	2	2
Mobile Analytics	3	3	3	3	3	2	2	2	2	2	1
IoT Analytics	3	2	3	2	3	2	2	2	1	2	1
Audio Analytics	1	2	2	1	2	1	1	1	2	1	1

Search Range	Value Assigned
0-1	1
1-50	2
50-100	3
100-300	4
300-600	5
600-1000	6
1,000-1,500	7
1,500-2,500	8
2,500-3,500	9
3,500 and up	10

Legend	
1	Very Cold
2	
3	
4	
5	
6	
7	
8	
9	
10	Very Hot

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BI = business intelligence; IoT = Internet of Things; OLAP = online analytical processing

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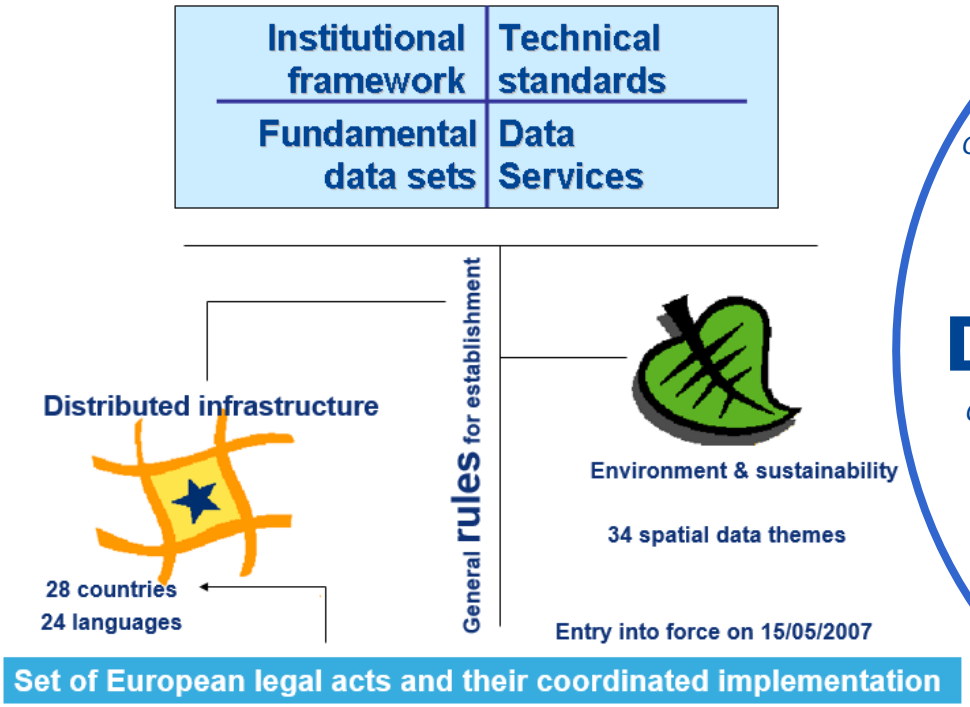
INSPIRE, Europe's *lingua franca* for anything geospatial

Directive 2007/2/EC of the European Parliament and of the Council of 14 March 2007 establishing an Infrastructure for Spatial Information in the European Community (INSPIRE)



Directive 2013/37/EU of 26 June 2013 amending Directive 2003/98/EC on the **re-use of public sector information** *(PSI) Directive 2003/98/EC*

Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee, and the Committee of the Regions: **A Digital Agenda for Europe** *- COM(2010) 245 final/2*

Digital Single Market

Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee, and the Committee of the Regions: **EU eGovernment Action Plan 2016-2020** COM(2016) 179 final

Towards ***interoperability for European public services*** *COM(2010) 744*

EU implementation of the **G8 Open Data Charter**

EU Open Data Strategy

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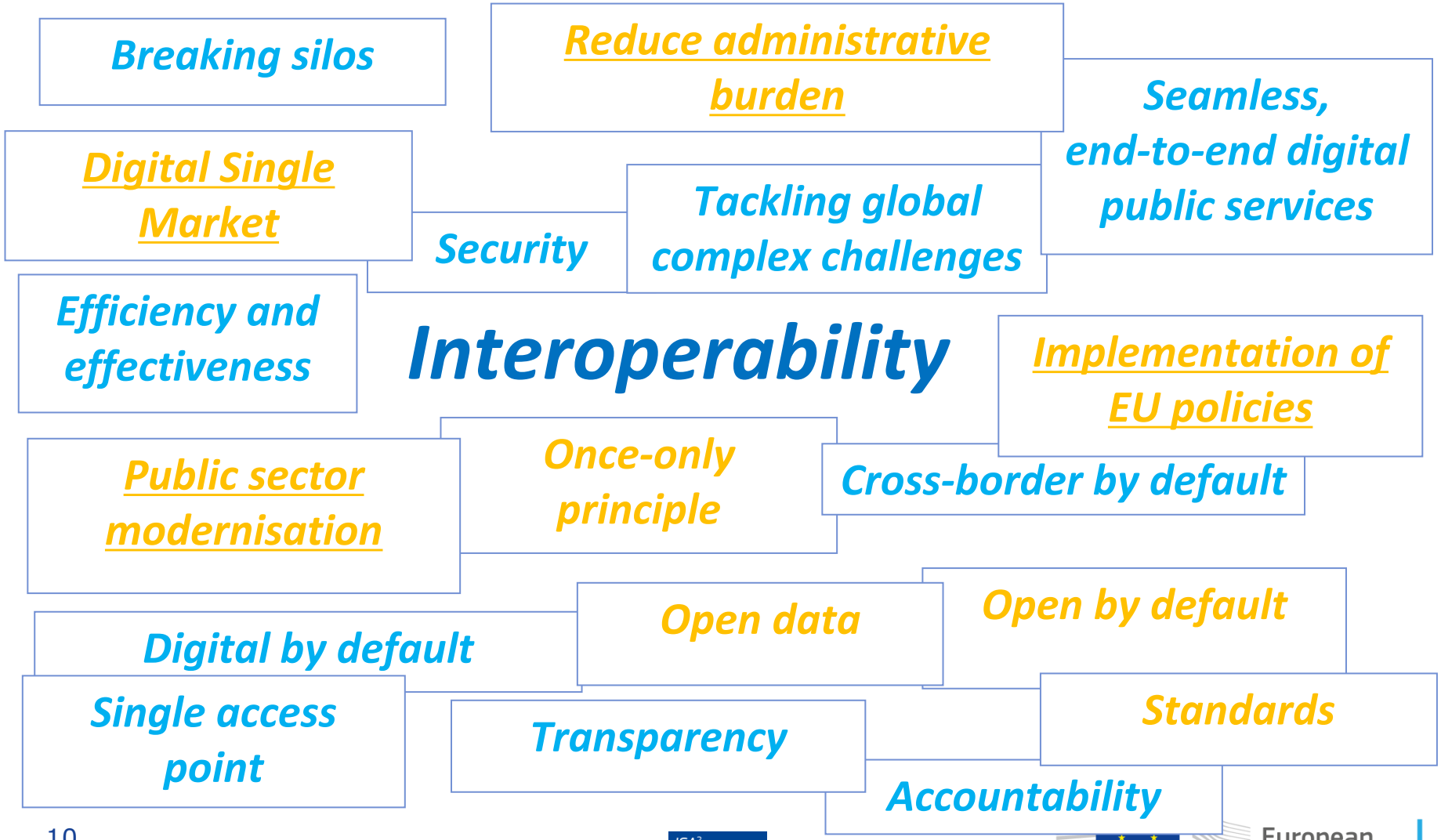
ISA² Programme: Interoperability Solutions for Government, Businesses and Citizens



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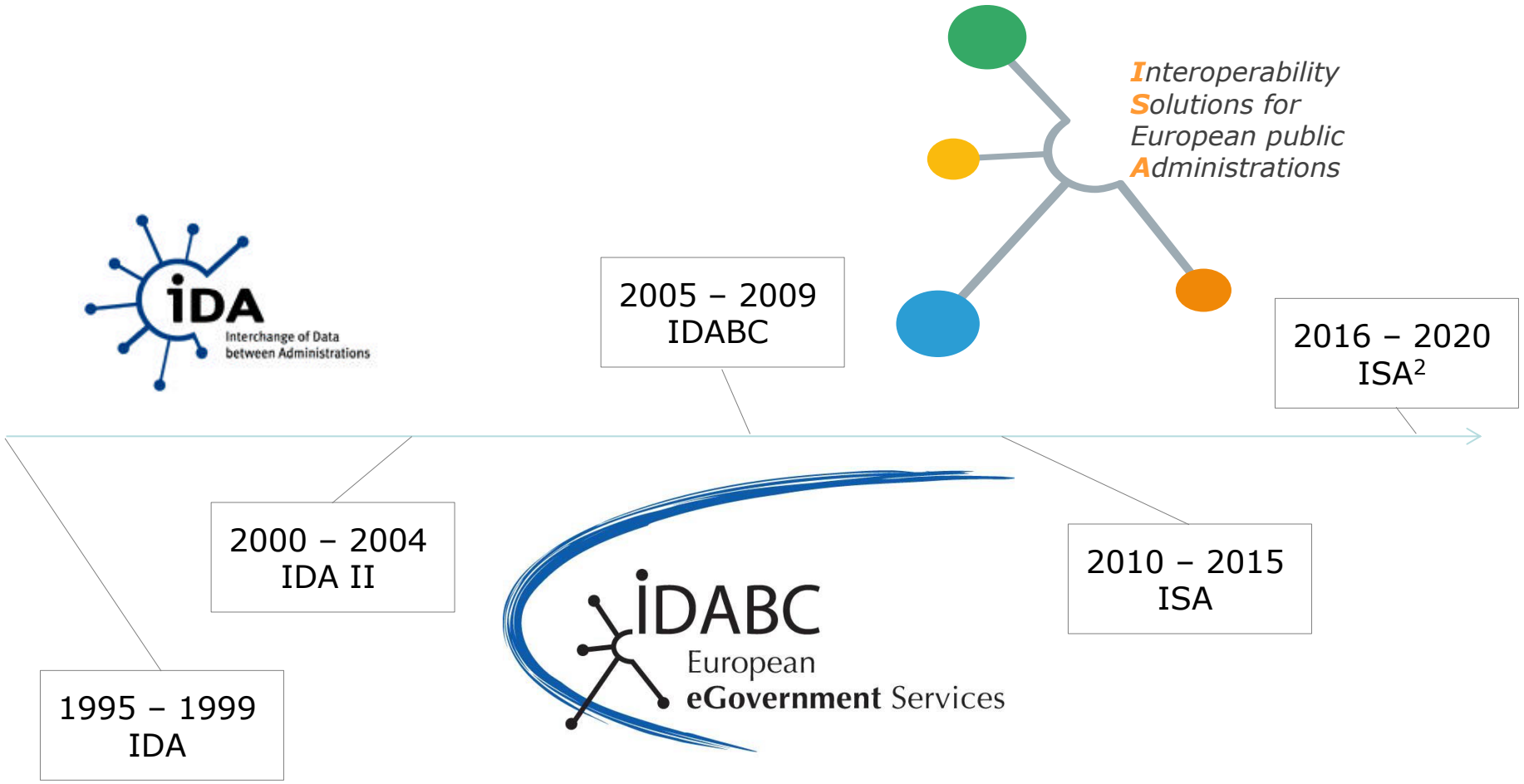
Evolution of interoperability programmes in the EU



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ISA²: The Scope

Programme on interoperability solutions and common frameworks for European public administrations, businesses and citizens as a means for modernising the public sector

Proposals from Member States and Commission services

~131M Euros 2016-2020

Execution by the European Commission

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ELISE contribution to ISA² using INSPIRE

To build solutions for e-Government based on INSPIRE, EULF and ARE3NA and act as 'geo' knowledge-base for ISA²

INSPIRE · Infrastructure for Spatial Information in Europe

eulf European Union Location Framework

ARe³NA

INSPIRE · Infrastructure for Spatial Information in Europe

Efficient and effective electronic G2G/C/B cross-border/sector interactions, through studies, frameworks, applications & services

Support to Digital Single Market, Better Regulation and Public Sector Modernisation

ISA²

Link geo-data and statistics, helps build the location-related data economy, improves links between public sector, businesses and citizens in key policy areas

Implementation of 'common services' such as geo-names and addresses to support multiple use cases in portals and applications

Value development path

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ELISE contribution to EU Policies - selected cases

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ISA Programme: Geospatial ISA Actions

EU Location Framework (EULF)

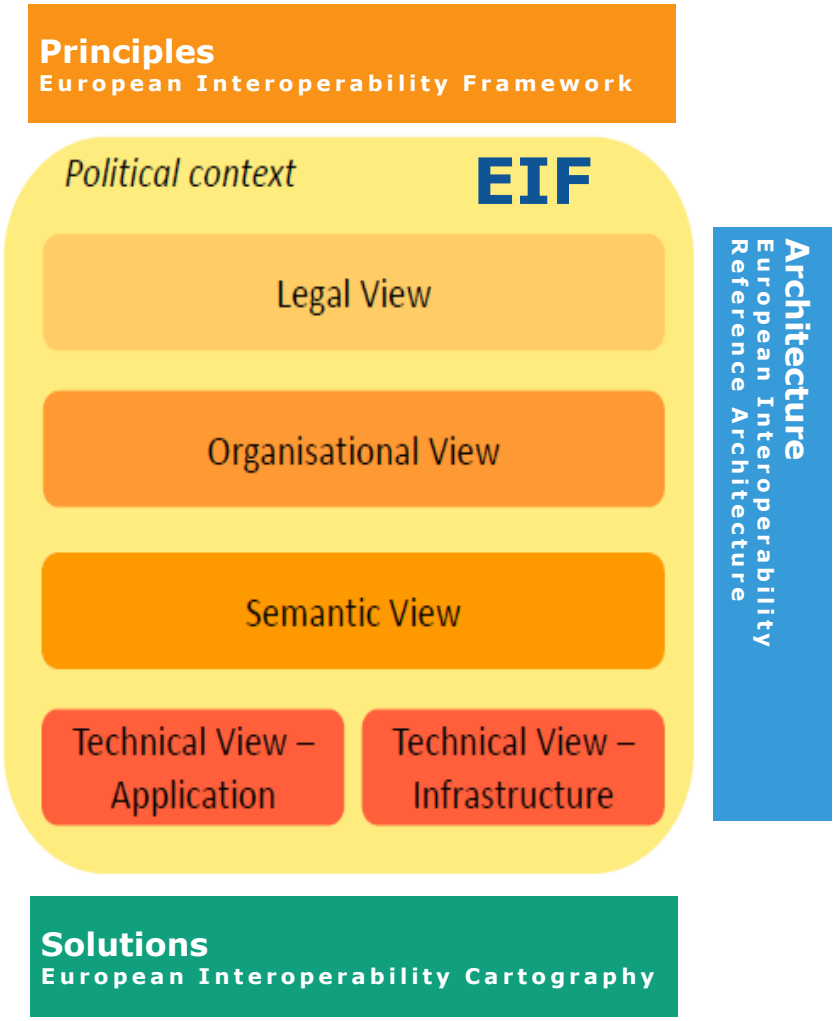
Location enabling e-government
Using the SDI to serve government, citizens and businesses: cross-sector and cross-border Strategic Framework (guidance, best practices, capacity building, problem solving, benefits…)

INSPIRE

Creating a Spatial Data Infrastructure (SDI) for Europe
Legislative and technical framework
Data and service publication
Environmental policy

A Reusable INSPIRE Reference Platform (ARE3NA)

Creating and sharing reusable geospatial interoperability solutions for INSPIRE and beyond; a stakeholder 'arena' and common reference frame for solution providers, implementers and users



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Business as *un*usual: EULF
the European Union Location Framework

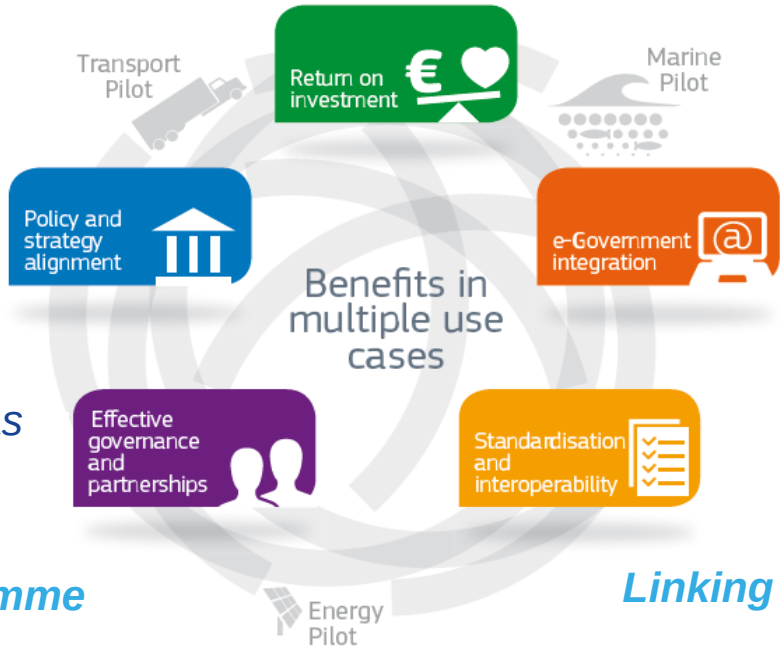
Helps build a stronger data economy in support of the **Digital Single Market**

Promotes INSPIRE as a multi-purpose infrastructure for a range of **policy areas**, including e-government, transport, marine, and energy

Identifies and promotes opportunities for the **private sector**

Strategic framework based on EU survey

Practical problems solved through pilot studies



Recommendations and guidance in 5 focus areas

Working together with MS to address priorities

Part of the ISA Programme

Linking INSPIRE and e-Government

Delivering savings, growth and better services through "location-enabled government"

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INSPIRE… and beyond: EULF Pilots

EULF: provides the strategic framework, turning its recommendations into action and learning from the results

INSPIRE Directive

Environmental Sector

JRC

G2B

G2G

G2C

DG MOVE

DG ENV
DG MARE

DG ENER

Transport Sector

ITS Directive

Marine Sector

MSFD Directive Marine Knowledge 2020

Energy Sector

COM SEAPs, EPBD and EED Directives

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Pilots for Business opportunities

Commercial map providers like **HERE** and **TomTom** need **road** network **data** that are

- consistent
- accurate
- up-to-date

In the **Transportation Pilot**, INSPIRE standards are used to get **geospatial data from public administrations**

Significant **reduced error rates in maps of from 25% to 7%**, and Road Authorities (SE, NO) upgraded **from Quarterly to Daily updates** to map providers

Commercial map providers able to move **from disparate** national processes **to more standardised processes** in different EU countries

Transportation Pilot

Up-to-date flow of road safety data between Road Authorities and private map providers

https://www.youtube.com/watch?v=jnny5ATwTYE

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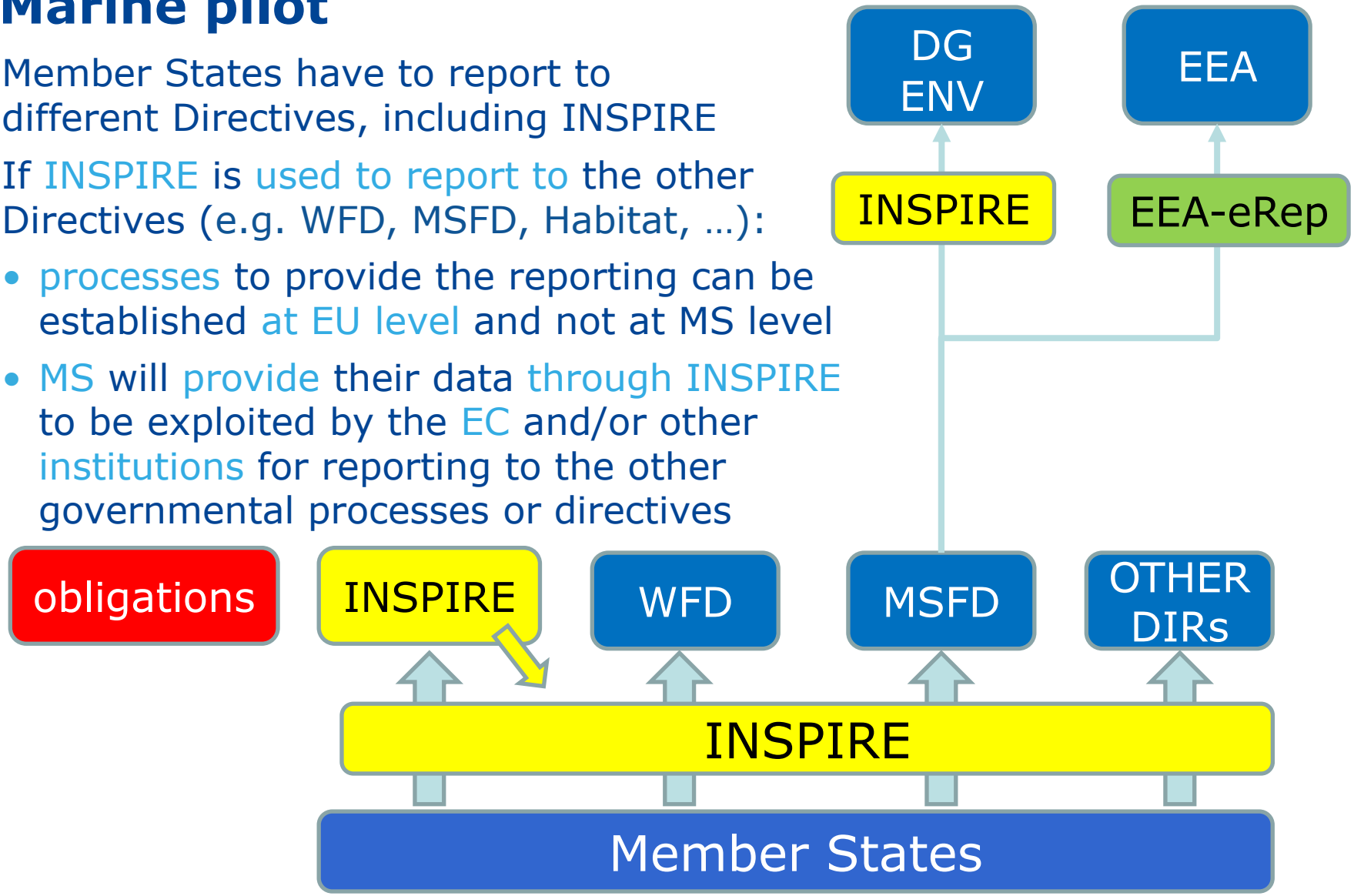
Marine pilot

Member States have to report to different Directives, including INSPIRE

If INSPIRE is used to report to the other Directives (e.g. WFD, MSFD, Habitat, …):

- processes to provide the reporting can be established at EU level and not at MS level
- MS will provide their data through INSPIRE to be exploited by the EC and/or other institutions for reporting to the other governmental processes or directives



https://www.youtube.com/watch?v=ROJqljr8aDU&feature=youtu.be

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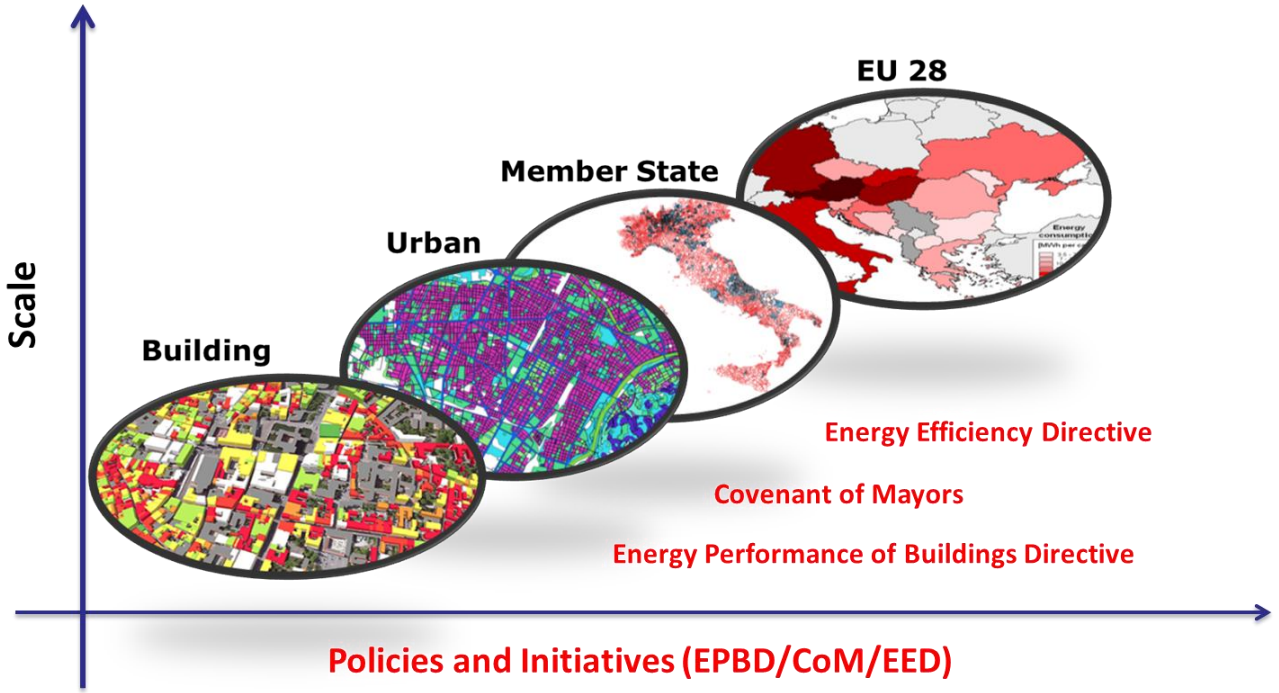
Energy Pilot

Aim: use location data to support stakeholders engaged in energy efficiency policies' lifecycle



To leverage location-based data at building level as enabling factor to scale-up the methodologies to assess energy consumption and performance from local to urban to district to regional to MS level as required by the European Directives in the field of energy efficiency

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Focus on Buildings

According to studies conducted by BPIE (Buildings Performance Institute Europe):

- Buildings are responsible for the 40% of final energy consumption
- Over 75% of building stock is older than 25 years
- Averaged final energy consumption data: 185 kWh/m^2 for residential buildings and 280 kWh/m^2 for non-residential buildings
- Deep renovation of buildings could cut 36% of their energy consumption by 2030

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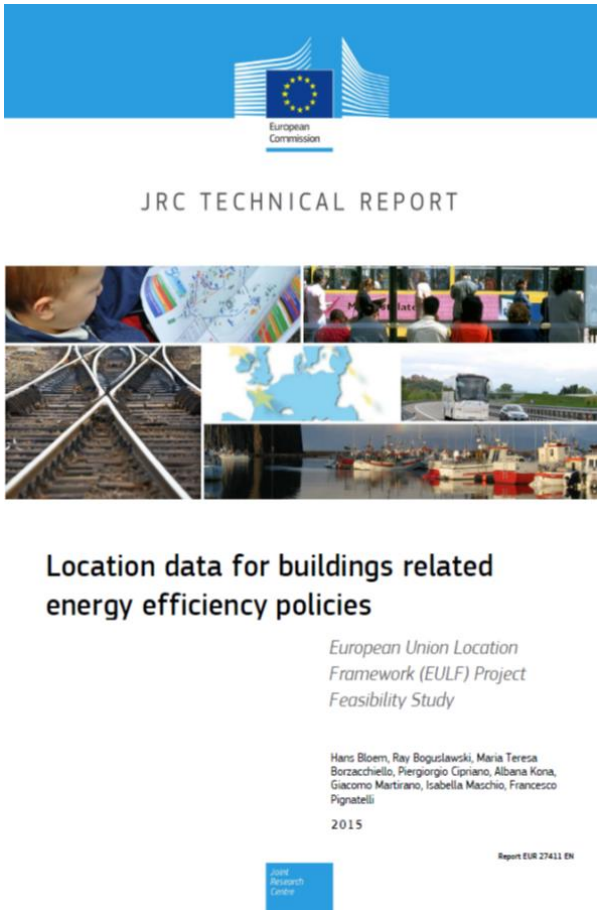
Location data for buildings related energy efficiency policies
Feasibility study 2015

- Identified an approach to compare different methodologies to support EPBD, EED and CoM policy instruments, based on the re-use of INSPIRE components
- Made an initial analysis of the data flows relevant to EPBD, EED and CoM, has identified the relevant INSPIRE data themes best fitting for purpose and has made an initial mapping exercise
- Outlined scope and content of a full pilot project, started in 2016



http://publications.jrc.ec.europa.eu/repository/handle/JRC96946

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Energy Pilot: Objectives

Showing the benefits of an integrated approach for reporting, monitoring and planning, to handle multiple aspects of energy (energy performance of buildings, energy consumption and production at local level – renewable/non renewable, etc.) by:

- Adoption of common structured data models (extending few INSPIRE core data models) and of common data access mechanisms (INSPIRE Network Services)
- Re-use of (parts of) datasets for different reporting, monitoring or planning purposes
- Use of both centralised and distributed IT infrastructures which make accessible data needed to fulfil reporting, monitoring and planning requirements

Energy Pilot: Roadmap

JRC concluded a Feasibility Study "Location Data for Buildings related Energy Efficiency Policies" in 2015

- Identified an approach to compare different methodologies to support EPBD, EED and CoM policy instruments, based on the re-use of INSPIRE components
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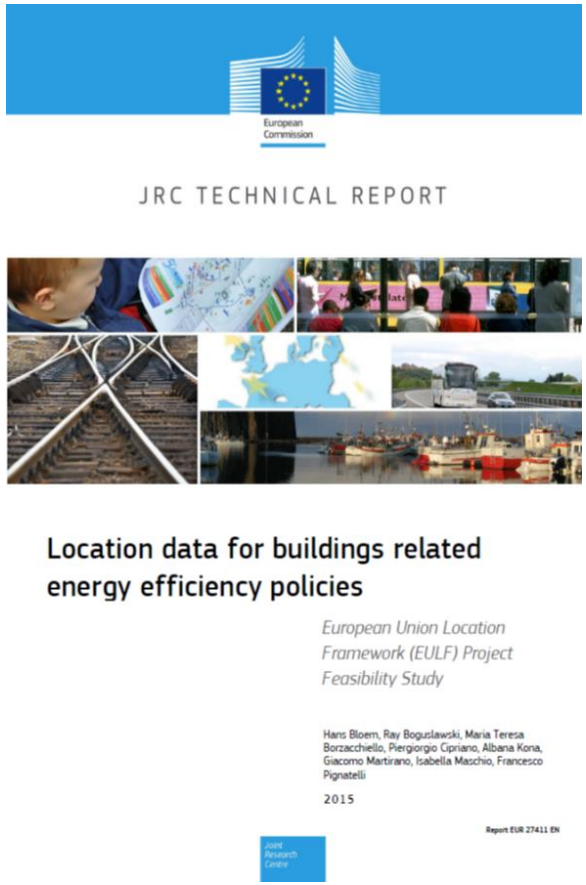

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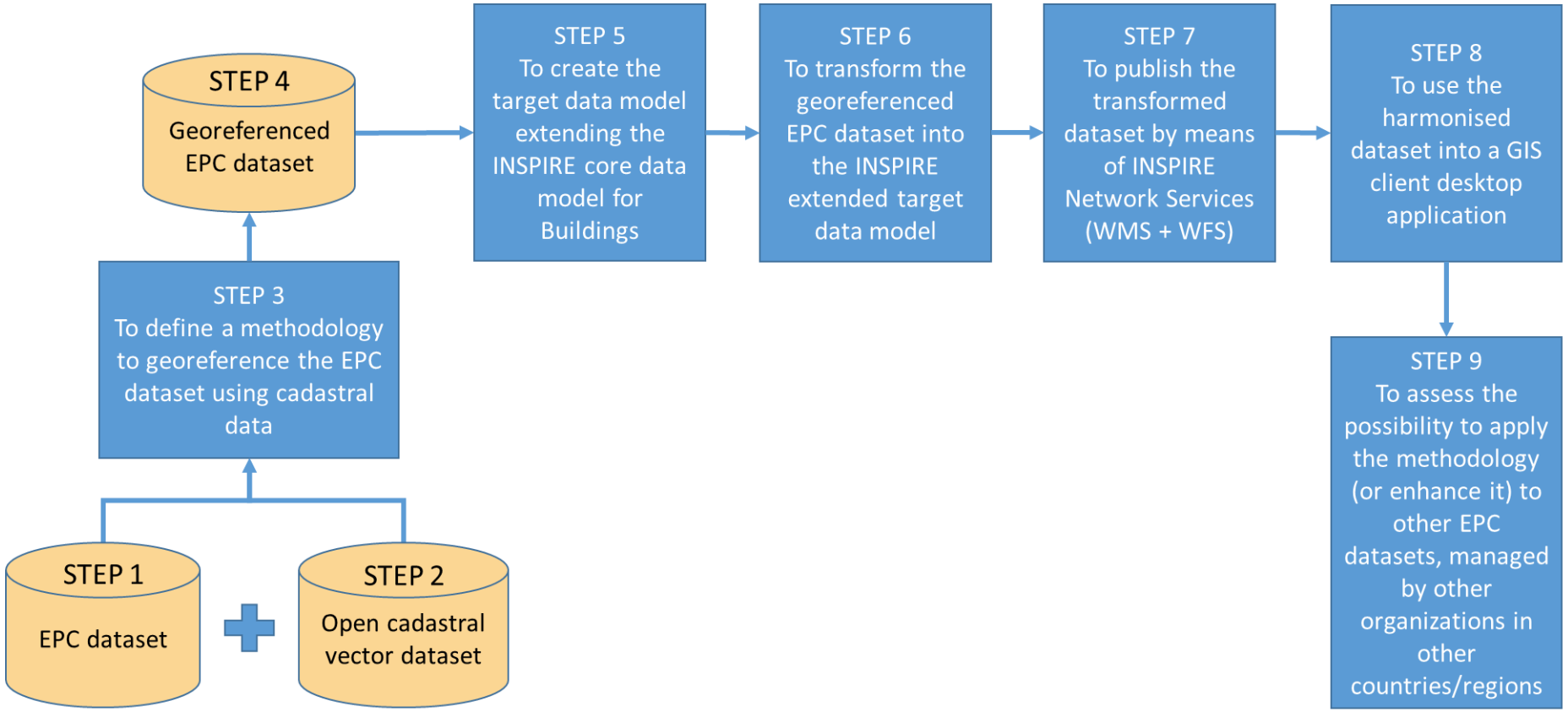
Energy Pilot: possible Use Cases

The pilot will be tested by means of a set of Use Cases (under finalization), involving different actors (public authorities at regional and local level, businesses working in the energy sector, citizens)

1) INSPIRE harmonization of existing Energy Performance Certificate datasets
2) Comparing different buildings' Energy Performance Labelling
3) Assessing energy flows at different geographical scales with dynamic measured data
4) Supporting buildings' energy efficiency driven refurbishment planning at local level
5) Supporting integrated energy planning and monitoring at urban/local level (SEAP BEI/MEI)
6) Supporting the design and implementation of a regional energy strategy

Overview of Use Case 1



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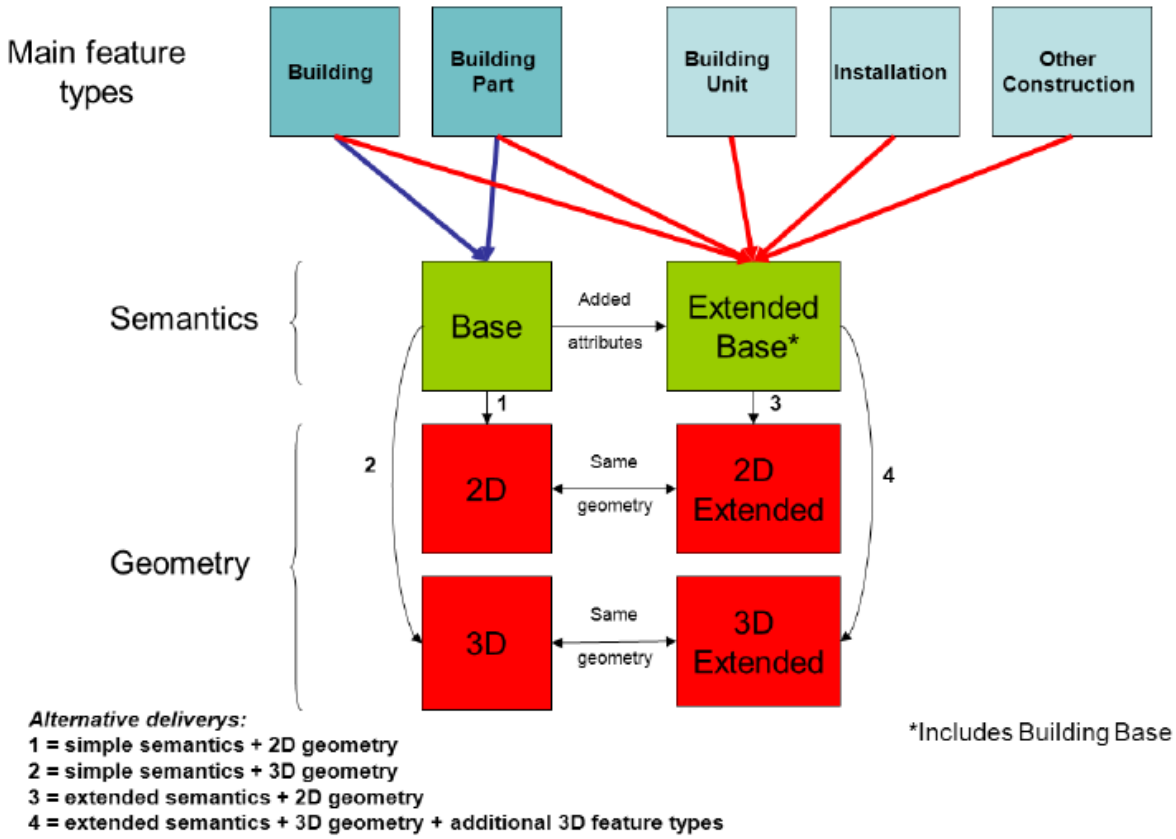
INSPIRE core schemas extension

- Content and structure of INSPIRE application schemas for theme Buildings



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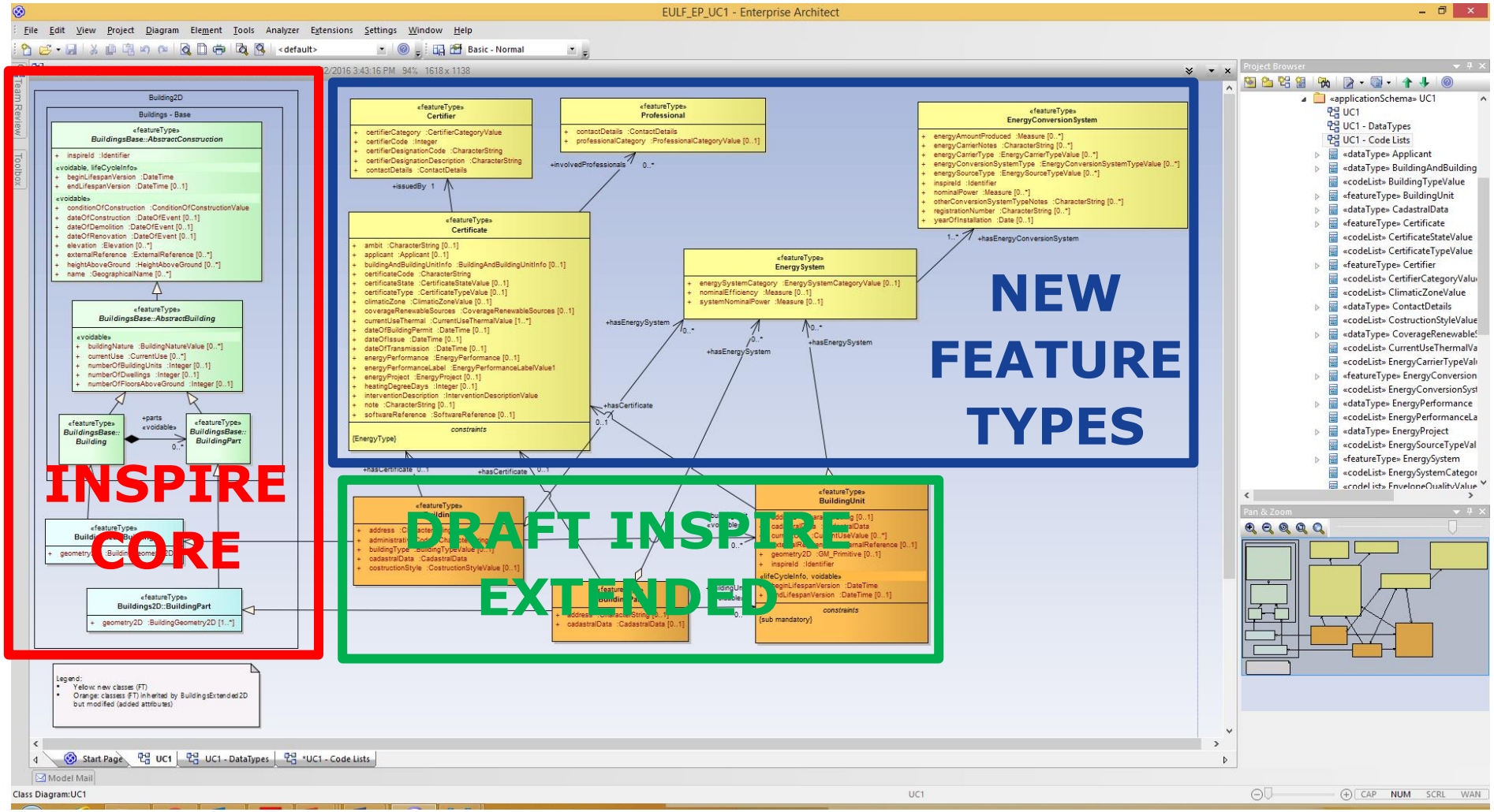
INSPIRE core schemas extension



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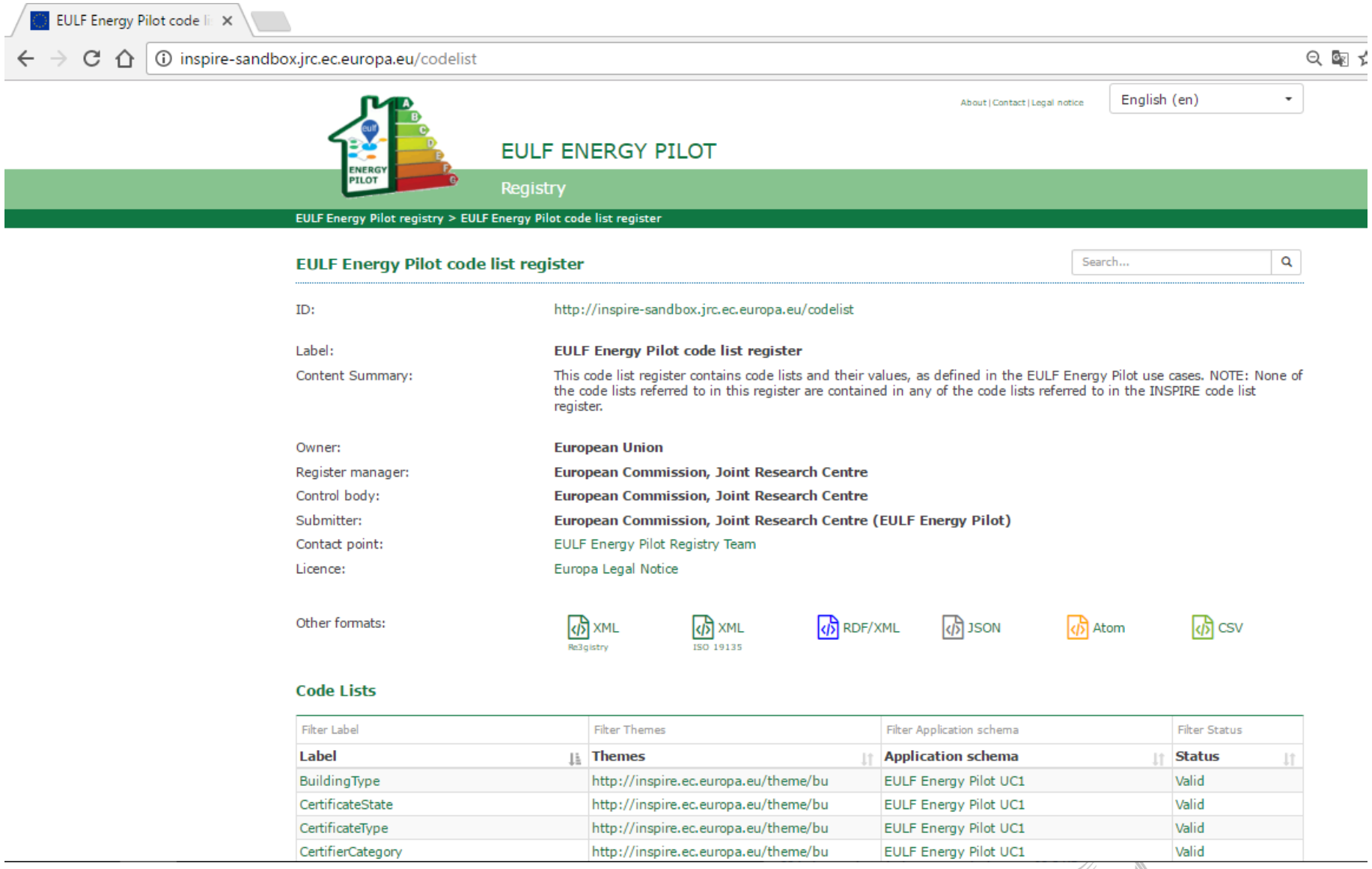
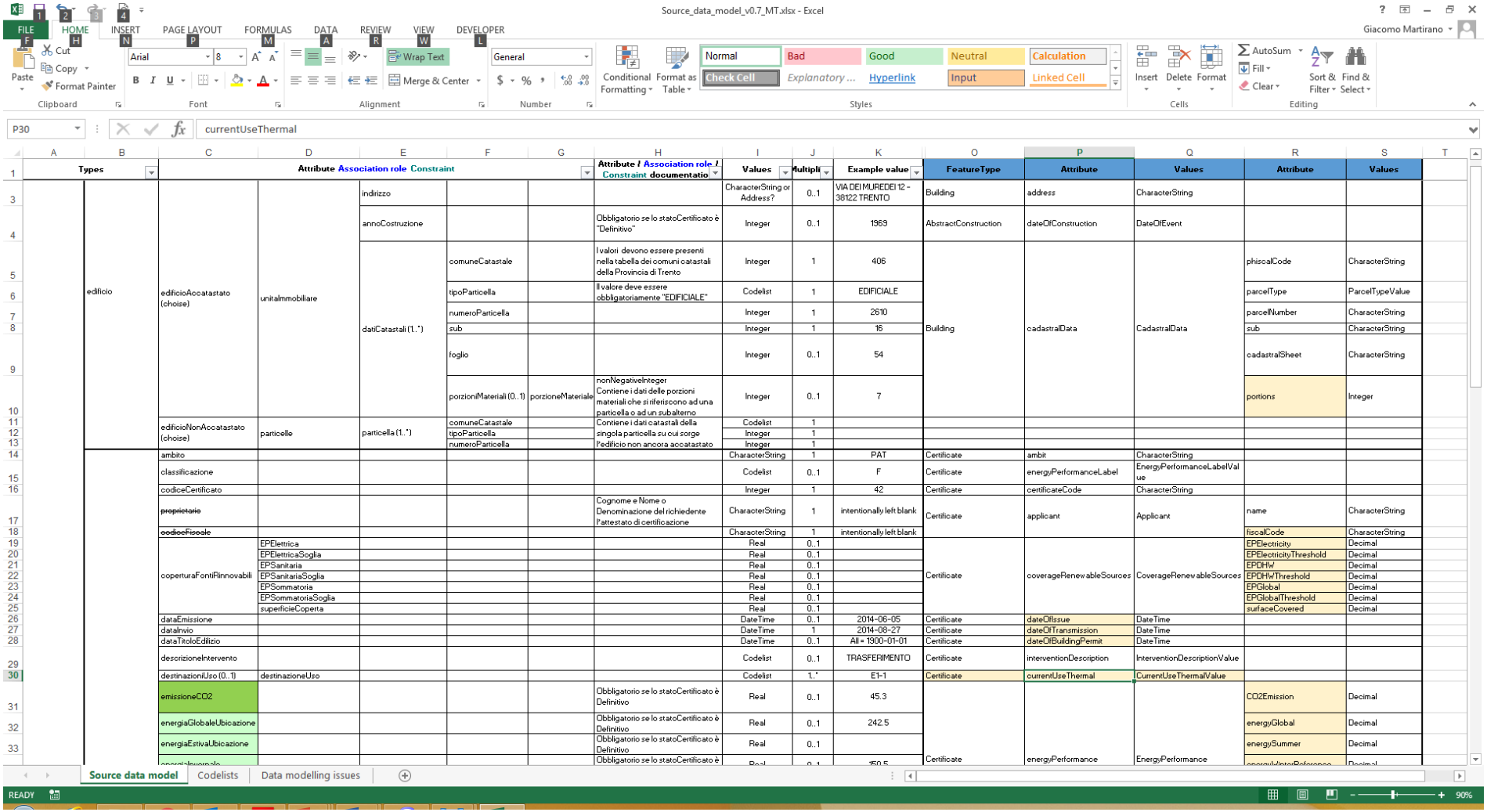
Re3gistry implementation



Data transformation



Types		Attribute Association role Constraint					Attribute / Association role / Constraint documentation	Values	Multipli	Example value	FeatureType	Attribute	Values	Attribute	Values
				indirizzo				CharacterString or Address?	0..1	VIA DEI MUREDEI 12 - 38122 TRENTO	Building	address	CharacterString		
				annoCostruzione			Obbligatorio se lo statoCertificato è "Definitivo"	Integer	0..1	1969	AbstractConstruction	dateOfConstruction	DateOfEvent		
	edificio	edificioAccatastato (choise)	unitaImmobiliare	datiCatastali (1..*)	comuneCatastale		I valori devono essere presenti nella tabella dei comuni catastali della Provincia di Trento	Integer	1	406	Building	cadastralData	CadastralData	fiscalCode	CharacterString
					tipoParticella		Il valore deve essere obbligatoriamente "EDIFICIALE"	Codelist	1	EDIFICIALE				parcelType	ParcelTypeValue
					numeroParticella			Integer	1	2610				parcelNumber	CharacterString
					sub			Integer	1	16				sub	CharacterString
					foglio			Integer	0..1	54				cadastralSheet	CharacterString
					porzioniMateriali (0..1)	porzioneMateriale	nonNegativeInteger Contiene i dati delle porzioni materiali che si riferiscono ad una particella o ad un subalterno	Integer	0..1	7				portions	Integer
		edificioNonAccatastato (choise)	particelle	particella (1..*)	comuneCatastale		Contiene i dati catastali della singola particella su cui sorge l'edificio non ancora accatastato	Codelist	1						
					tipoParticella			Integer	1						
					numeroParticella			Integer	1						
		ambito						CharacterString	1	PAT	Certificate	ambit	CharacterString		
		classificazione						Codelist	0..1	F	Certificate	energyPerformanceLabel	EnergyPerformanceLabelValue		
		codiceCertificato						Integer	1	42	Certificate	certificateCode	CharacterString		
		~~proprietario~~					Cognome e Nome o Denominazione del richiedente l'attestato di certificazione	CharacterString	1	intentionally left blank	Certificate	applicant	Applicant	name	CharacterString
		~~codiceFiscale~~						CharacterString	1	intentionally left blank				fiscalCode	CharacterString
			EPElettrica					Real	0..1					EPElectricity	Decimal
			EPElettricaSoglia					Real	0..1					EPElectricityThreshold	Decimal
			EPSanitaria					Real	0..1					EPDHW	Decimal
		coperturaFontiRinnovabili	EPSanitariaSoglia					Real	0..1		Certificate	coverageRenewableSources	CoverageRenewableSources	EPDHWThreshold	Decimal
			EPSommatoria					Real	0..1					EPGlobal	Decimal
			EPSommatoriaSoglia					Real	0..1					EPGlobalThreshold	Decimal
			superficieCoperta					Real	0..1					surfaceCovered	Decimal
		dataEmissione						DateTime	0..1	2014-06-05	Certificate	dateOfIssue	DateTime		
		dataInvio						DateTime	1	2014-08-27	Certificate	dateOfTransmission	DateTime		
		dataTitoloEdilizio						DateTime	0..1	All = 1900-01-01	Certificate	dateOfBuildingPermit	DateTime		
		descrizioneIntervento						Codelist	0..1	TRASFERIMENTO	Certificate	interventionDescription	InterventionDescriptionValue		
		destinazioniUso (0..1)	destinazioneUso					Codelist	1..*	E1-1	Certificate	currentUseThermal	CurrentUseThermalValue		
		emissioneCO2					Obbligatorio se lo statoCertificato è Definitivo	Real	0..1	45.3				CO2Emission	Decimal
		energiaGlobaleUbicazione					Obbligatorio se lo statoCertificato è Definitivo	Real	0..1	242.5				energyGlobal	Decimal
		energiaEstivaUbicazione					Obbligatorio se lo statoCertificato è Definitivo	Real	0..1					energySummer	Decimal
		energiaInvernale					Obbligatorio se lo statoCertificato è	Real	0..1	150.5	Certificate	energyPerformance	EnergyPerformance	energyWinterReference	Decimal

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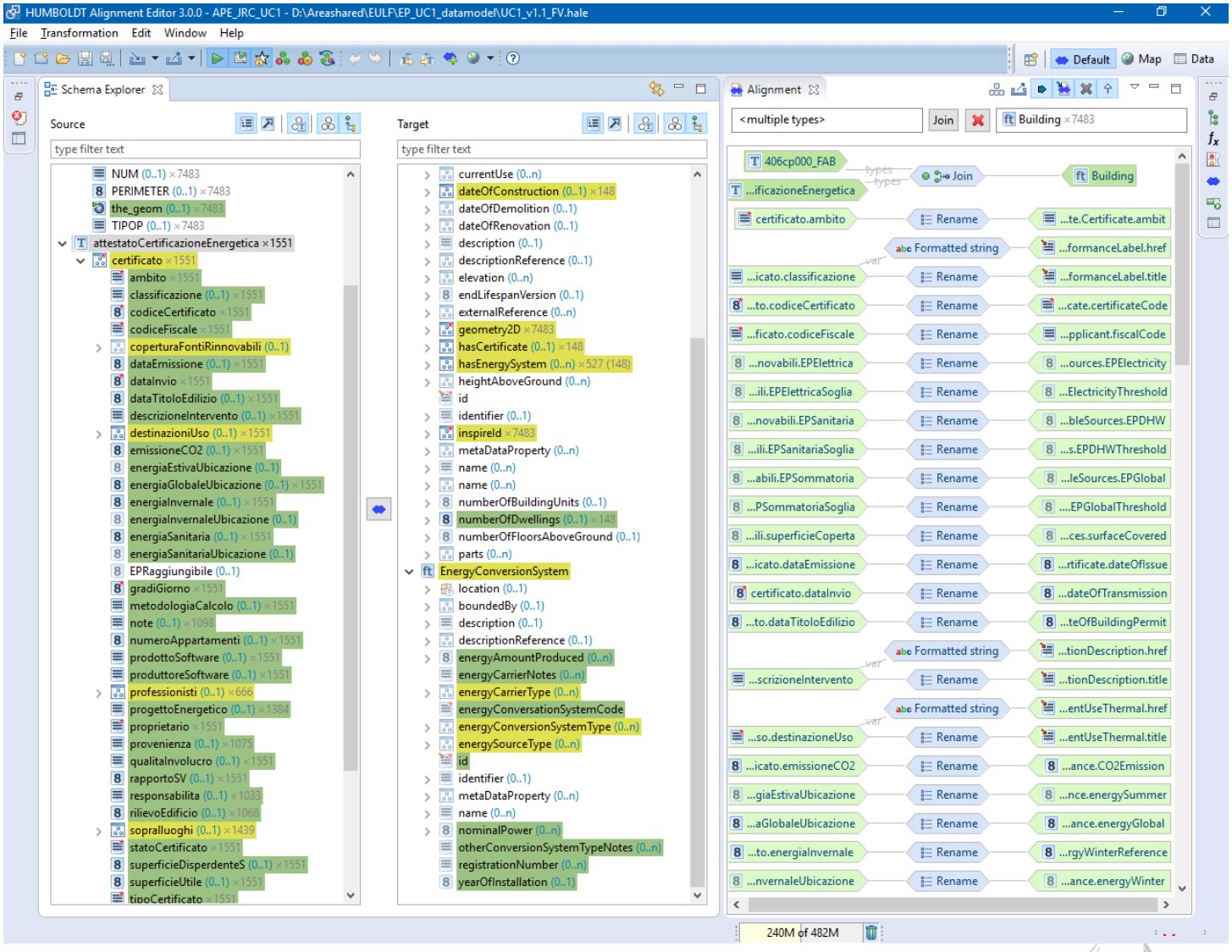
Data transformation



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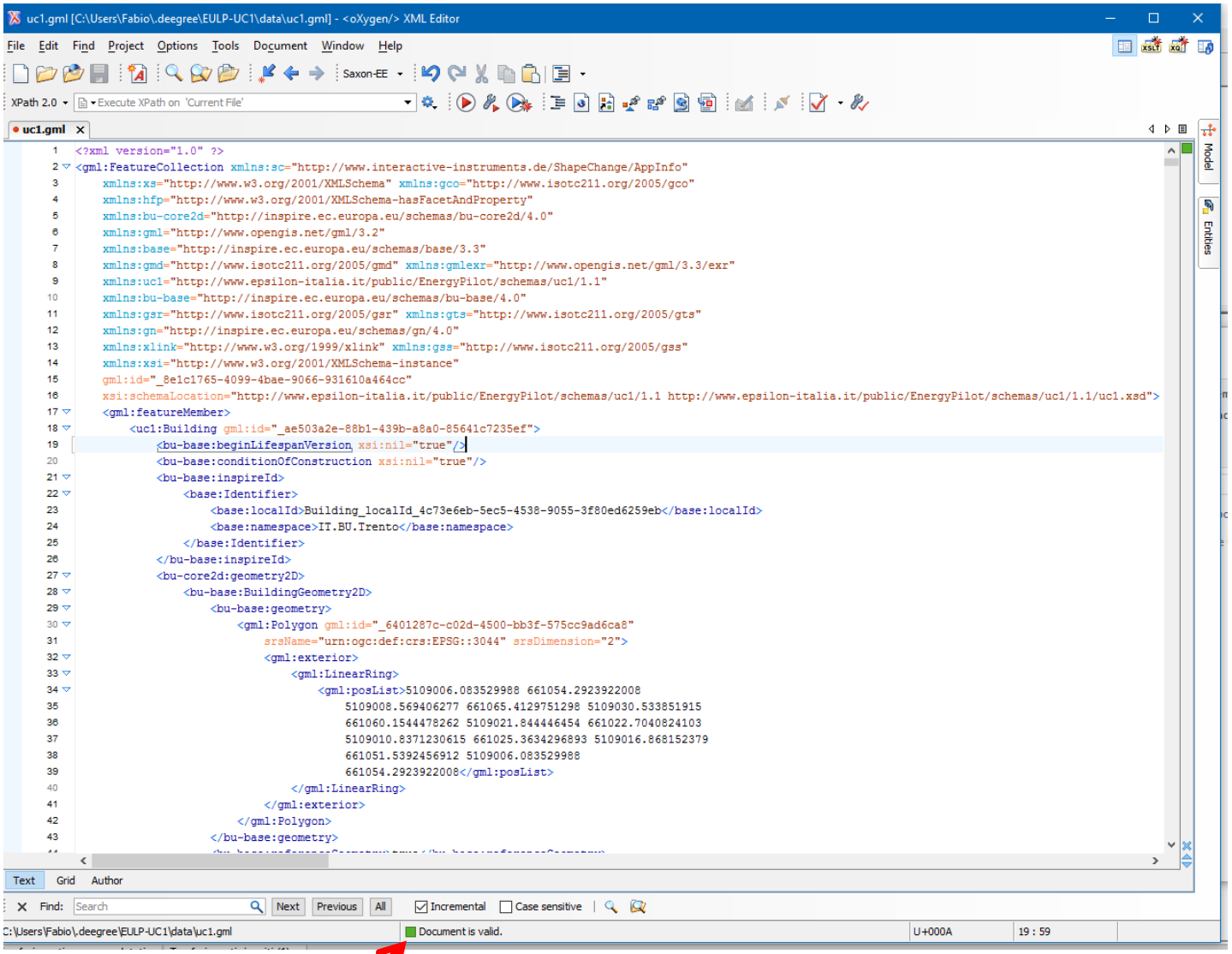
Data validation



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Data publication

deegree

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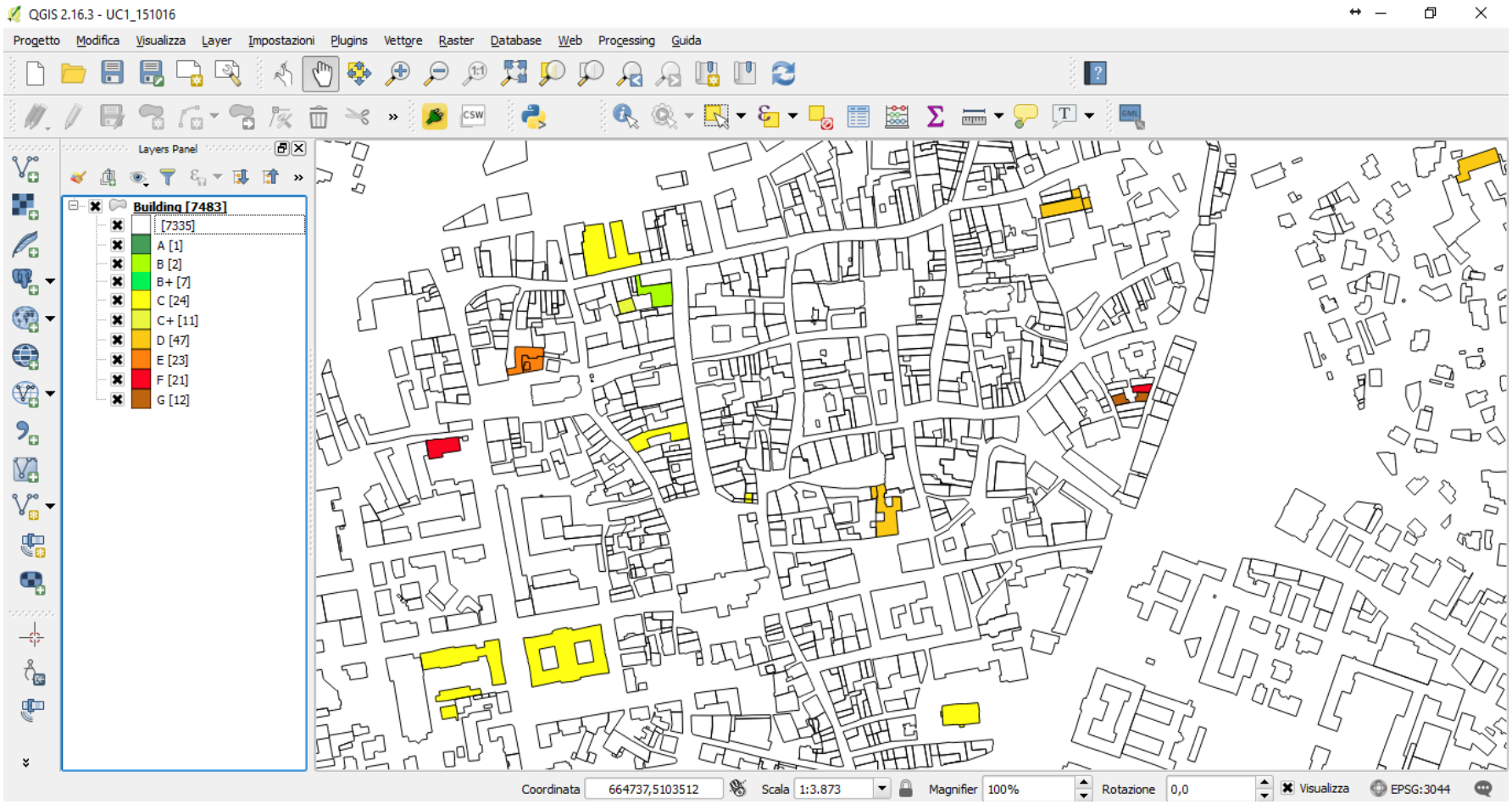
Data use



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Smart Cities and the Digital Single Market

Smart cities have much to gain from the EU's plan for the digital single market.

Smart cities are built on devices, data and interoperability; they rely on the security and resilience of their digital infrastructures and cannot function without the trust and confidence of their citizens.

DSM initiatives on the digital transformation of government, standardisation, the Internet of Things, cloud, cyber security, ePrivacy, and the free flow of data, all coming in 2016, will have a direct impact on smart cities.

Recommendations:

- Need to deploy infrastructures with modular architectures,
- Increase the interoperability of Internet of Things,
- Foster data openness policies,
- Configure an adaptable privacy and security framework integrating legal issues with the deployed technology,
- Define common problems in representative cities and focus on citizens'/users' needs,
- Pilots on Smart Cities should provide evidence that business aspect guarantees sustainability of the investment beyond the end of the project, through clear business plans and public-private collaboration mechanisms,
- To tackle multiple domains or verticals, exploiting data from existing systems and platforms in the city, and test the legal boundaries and the feasibility of technical solutions.