

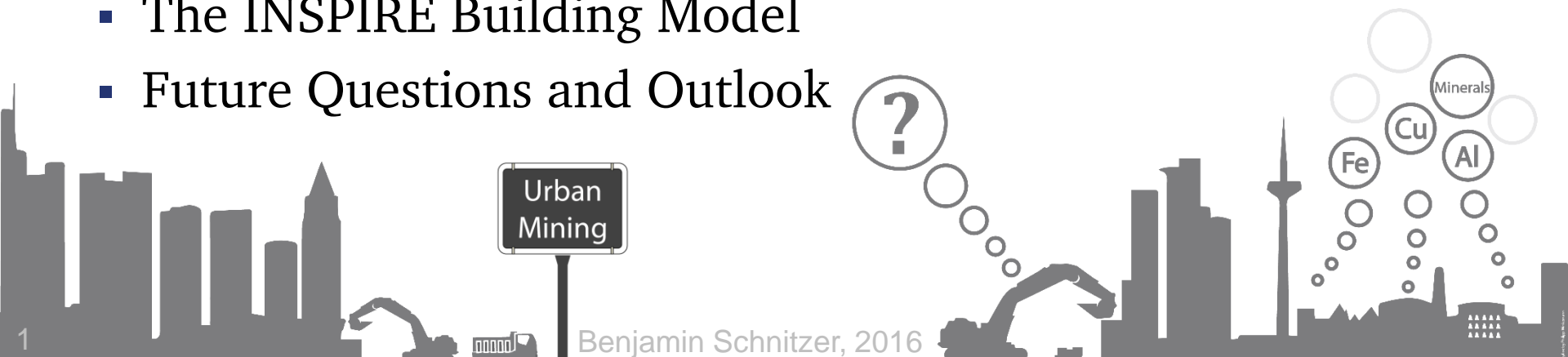
‘Urban Mining Cadastre’ – INSPIRE building model as harmonized foundation for Europe?

MINEA Workshop, 11.08 – 12.08.2016 Odense

“Characterizing the built environment stocks”

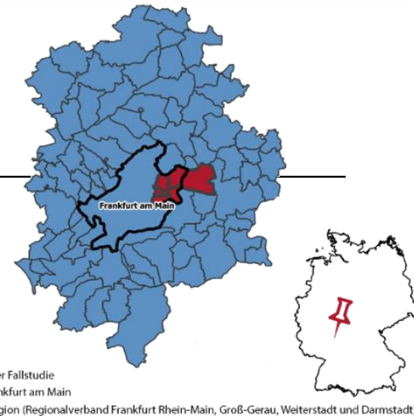
Agenda

- Background
- Research Question & current Problems
- INSPIRE EU - a European Spatial Data Infrastructure (SDI)
- The INSPIRE Building Model
- Future Questions and Outlook



Background - How did the Question appear?

- Research project at TU Darmstadt (2013-2016)
 - „PRRIG“ (next Presentation by A. Köhn)
 - Material-Stocks of the non-residential Buildings in the Frankfurt Rhine/Main Region
 - Definition of Spatial Data Models for Buildings
 - How to compare results?
 - Transferability to other Regions
 - How to exchange and combine “in-stock” analytics of single buildings with other projects
- Data standardization \neq Data availability



Quelle: Jan Wöltjen,
Institut für Baubetrieb



landmanagement

Benjamin Schnitzer, 2016

Question – ‘Spatial Perspective’

„Application“

Material Flow Analytics
(Scenarios, Implications)

**Inventory
Calculation**

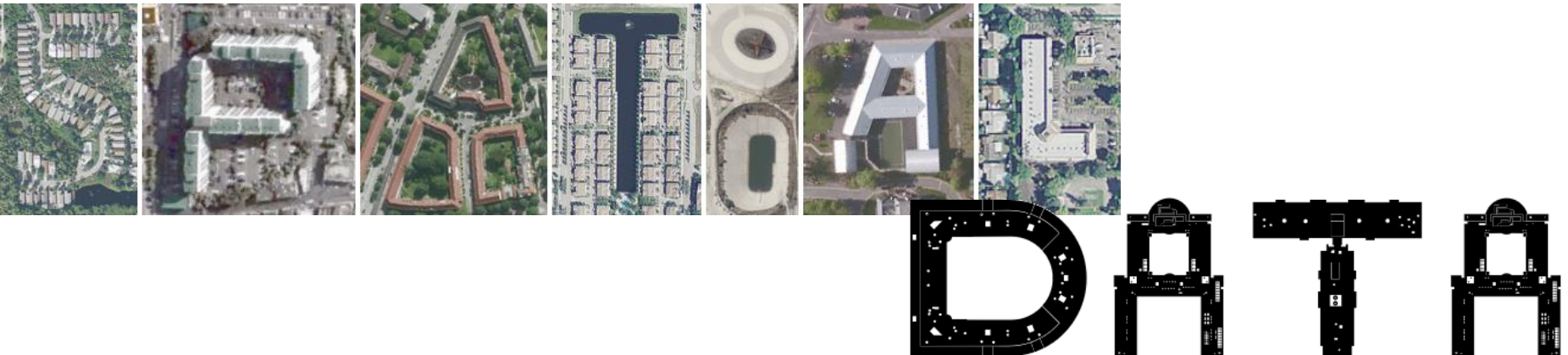
Material intensities of specific building types
(scenarios - e.g. renovations)

Layer of
„assumption“

Assumptions (Statistics) to fill data gaps:
Age-class distributions, basement-heights, roof types, preservation
order, regional features, etc.

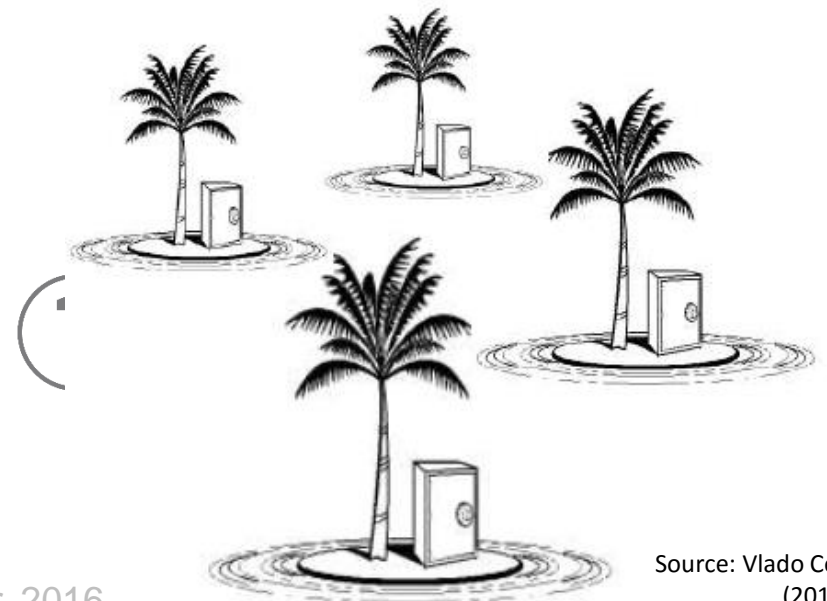
Data Layer

„GIS“ Spatial Data Models
(2D, 3D, 4D)



What is INSPIRE?

- **Infrastructure for Spatial Information in the EU – INSPIRE**
- **The challenge**
 - Harmonize Europe's patchwork of several countries with different traditions, cultures and socio-economic models
 - Interoperable Spatial Data (Models)
- INSPIRE provides a comprehensive framework for interoperability of spatial data



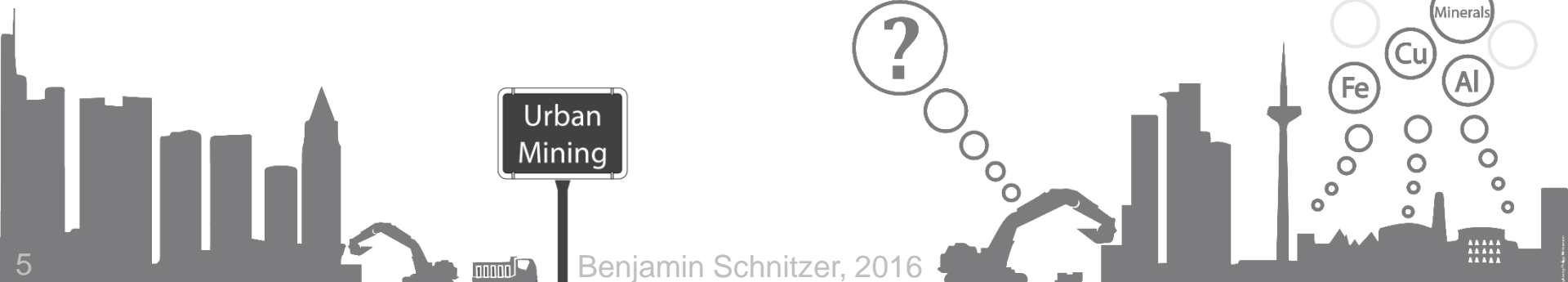
Urban Mining

What is INSPIRE?



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)

- In progress since 2007
- Implemented by the member states
 - Legally binding Implementing Rules
 - Data has to be provided by 'Geo Web Services'
- Fully operable in 2020+ (Step by Step approach)
- Focus
 - environmental applications
 - Data exchange
 - EU reporting
- Interoperability: Data Specifications for 34 spatial data themes
- Data harmonisation have just started
- Evaluation by EU Commission 2016



What is INSPIRE? The Topics (Annex I-III)



















ANNEX 1

 Addresses	 Geographical names
 Administrative units	 Hydrography
 Cadastral parcels	 Protected sites
 Coordinate reference systems	 Transport networks
 Geographical grid systems	

ANNEX 2

 Elevation
 Geology
 Land cover
 Orthoimagery

ANNEX 3 By 2020

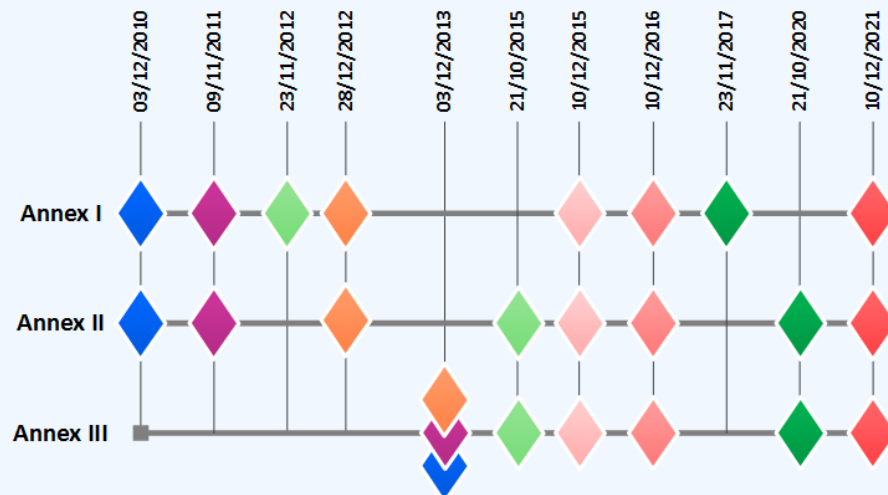
 Agricultural and aquaculture facilities	 Habitats and biotopes	 Population distribution and demography
 Area management / restriction / regulation zones & reporting units	 Human health and safety	 Production and industrial facilities
 Atmospheric conditions	 Land use	 Sea regions
 Bio-geographical regions	 Meteorological geographical features	 Soil
 Buildings	 Mineral Resources	 Species distribution
 Energy Resources	 Natural risk zones	 Statistical units
 Environmental monitoring Facilities	 Oceanographic geographical features	 Utility and governmental services

Source:
<http://inspire.ec.europa.eu/>

INSPIRE Roadmap

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)

INSPIRE Implementation Roadmap



Discovery metadata shall be available for spatial data sets and services



Spatial data sets shall be available for **discovery and view** from the INSPIRE geo-portal (data does not yet need to be conformant to IR-ISDSS)



Spatial data sets shall be available for **download and transformation** (whenever applicable¹) from the INSPIRE geo-portal (data does not yet need to be conformant to IR-ISDSS²)



Newly collected and extensively restructured spatial data sets shall be conformant to IR-ISDSS (incl. **metadata for interoperability**) and available through network services



All spatial data sets shall be conformant to IR-ISDSS (incl. **metadata for interoperability**) and available through network services



All invocable spatial data services shall be conformant to **Annex V of IR-ISDSS** (incl. **metadata**)



Invocable spatial data services related to newly collected and extensively restructured spatial data sets shall be conformant to **Annexes VI and (where practicable) VII of IR-ISDSS** (incl. **metadata**)



All invocable spatial data services shall be conformant to **Annexes VI and (where practicable) VII of IR-ISDSS** (incl. **metadata**)

IR-ISDSS = Implementing Rules on interoperability of spatial data sets and services (Commission Regulation (EU) No. 1089/2010), including its amendments Regulations (EU) No. 102/2011, 1253/2013 and 1312/2014

¹ Transformation Services only need to be provided if data sets are not made conformant with the IR-ISDSS by some other means (see Art. 7(3) of the INSPIRE Directive)

² With the exception of newly collected and extensively restructured Annex I data sets, which already have to be compliant with the IR-ISDSS by 23/11/2012

Source:
<http://inspire.ec.europa.eu/>



The INSPIRE Building Model

- Developed by a Team of 15 Experts since 2010 (TWG BU)
- Identification of requirements
- Analysis of use-cases for building information
 - 70 use-cases: Environment, Safety, Navigation, Map generation, Statistics, Energy, ...
- Analysis of existing standards in the context of buildings
 - national (e.g. the German AAA-Model)
 - international:
 - **CityGML (3D City Models)**
 - IFC (Building Information Models, BIM)
- Analysis of data availability in EU member states

Source: G. Gröger (2014)

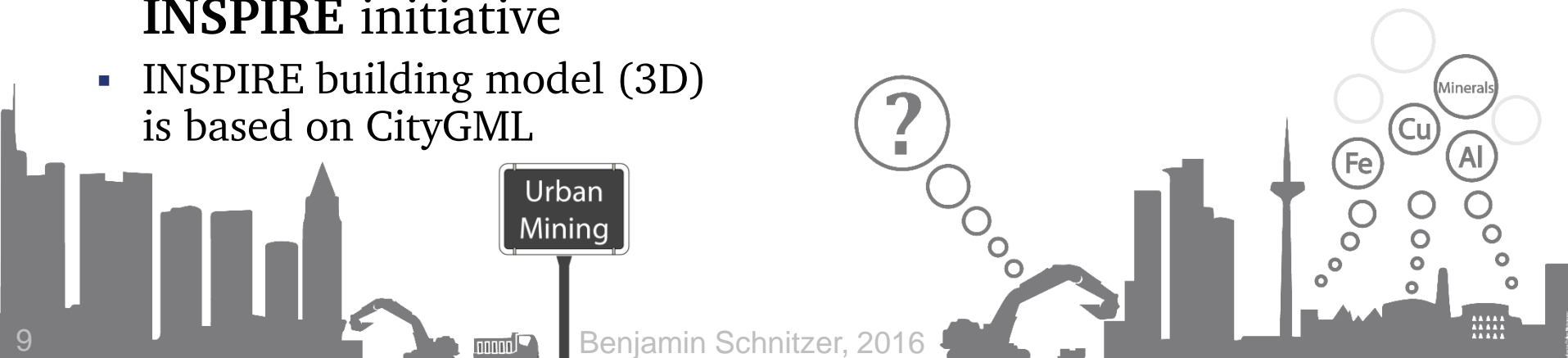


The INSPIRE Building Model

- Use-cases in the definition Process
 - Energy Performance of Buildings
 - Solar Potential calculation
 - spatial planning
 - Security
 - Infrastructure
- CityGML is **reference model** in the European **INSPIRE** initiative
- INSPIRE building model (3D) is based on CityGML



Source: G. Gröger (2013)

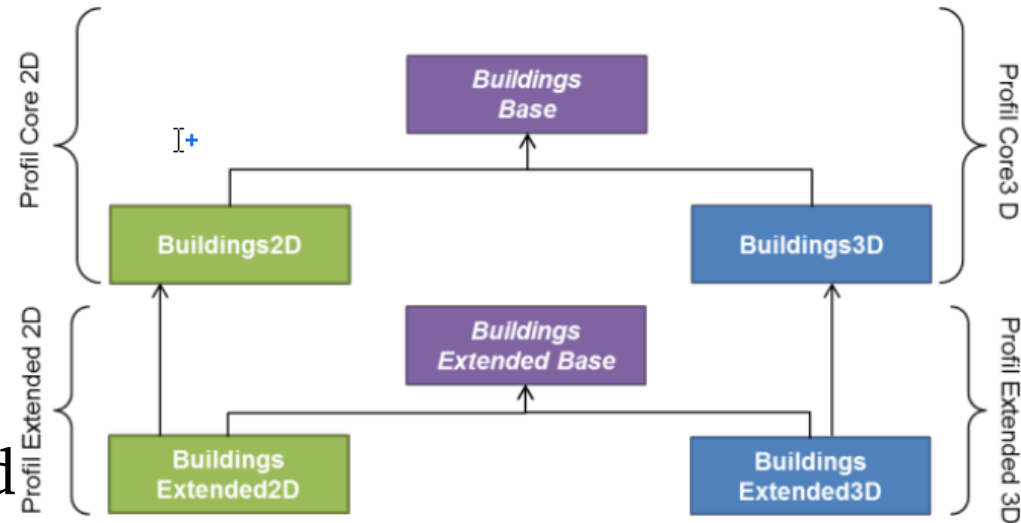


The INSPIRE Building Model

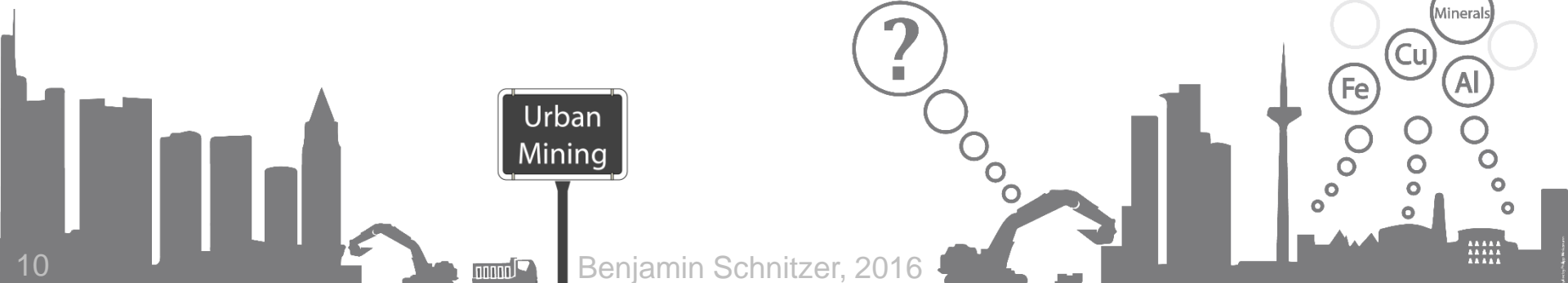
- INSPIRE Building Model:

- flexible model
(4 profiles, 2D and 3D)
- Influenced by **CityGML**, extends CityGML
- Core 2D and Core 3D are legally binded

- The profile “Core 2D” and “Core 3D” data is only containing basic semantic information.



Source: Roschlaub & INSPIRE Thematic Working Group Buildings (2013)



The INSPIRE Building Model

- INSPIRE Building Model:

Profile	Normative	Geometry	Semantics
Core2D	Yes	2D/2.5D, polygon/point	features: Buildings, BuildingParts basic semantics: yearOfConstruction, name, usage, #storeys, ...
Core3D	Yes	3D, CityGML LoD1-3	same as Core2D
Extended2D	No	2D/2.5D, polygon/point	Core2D, plus features Constructions, Installations; rich semantics: materials of façade/roof, heating system, energy performance, ...
Extended3D	No	3D, CityGML LoD1-4	Extended2D, plus CityGML-features (Walls, Doors, Windows, Installations, Textures...), Materials for WallRoofSurfaces

Codelists - semantics

«codeList» 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» CurrentUseValue
tags
extensibility = 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

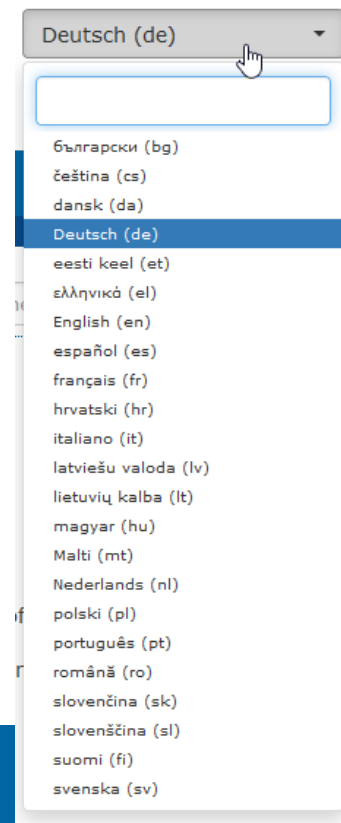
«codeList» ConditionOfConstructionValue
tags
extensibility = none obligation = implementingRule vocabulary = http://inspire.ec.europa.eu/codeList/ConditionOfConstructionValue

declined, demolished,
functional, projected,
ruin, under
construction.

Urban
Mining

INSPIRE Codelist ‘current use’

- Codelists are multilingual (Registry)
- The code list for attribute **currentUse** may also be extended [...] but only by providing more detailed values, under the hierarchical structure [...].
- Extensibility: Different types possible
 - any, none or
 - narrower = only on sublevels
- Extended Codelists can be stored in “Registries”



INSPIRE
Registry

INSPIRE Codelist 'current use' – Registry

Themes:

Bygninger

<http://inspire.ec.europa.eu/codelist/CurrentUseValue>

Applikationsskema:

Bygninger – Basis

Udvidelsesmuligheder:

Kan udvides med underliggende værdier

Andre formater:



Kodelisteværdi

Filter Etiket	Filter Forælder	Filter Governance level	Filter Status
Etiket	Forælder	Governance level	Status
anneks		eu-legal	Gyldig
beboelse		eu-legal	Gyldig
handel	handel og service	eu-legal	Gyldig
handel og service		eu-legal	Gyldig
individuel beboelse	beboelse	eu-legal	Gyldig
industriel		eu-legal	Gyldig
kollektiv beboelse	beboelse	eu-legal	Gyldig
kollektivbolig	beboelse	eu-legal	Gyldig
kontor	handel og service	eu-legal	Gyldig
landbrug		eu-legal	Gyldig
mere end to boliger	kollektiv beboelse	eu-legal	Gyldig
offentlige tjenester	handel og service	eu-legal	Gyldig
to boliger	kollektiv beboelse	eu-legal	Gyldig

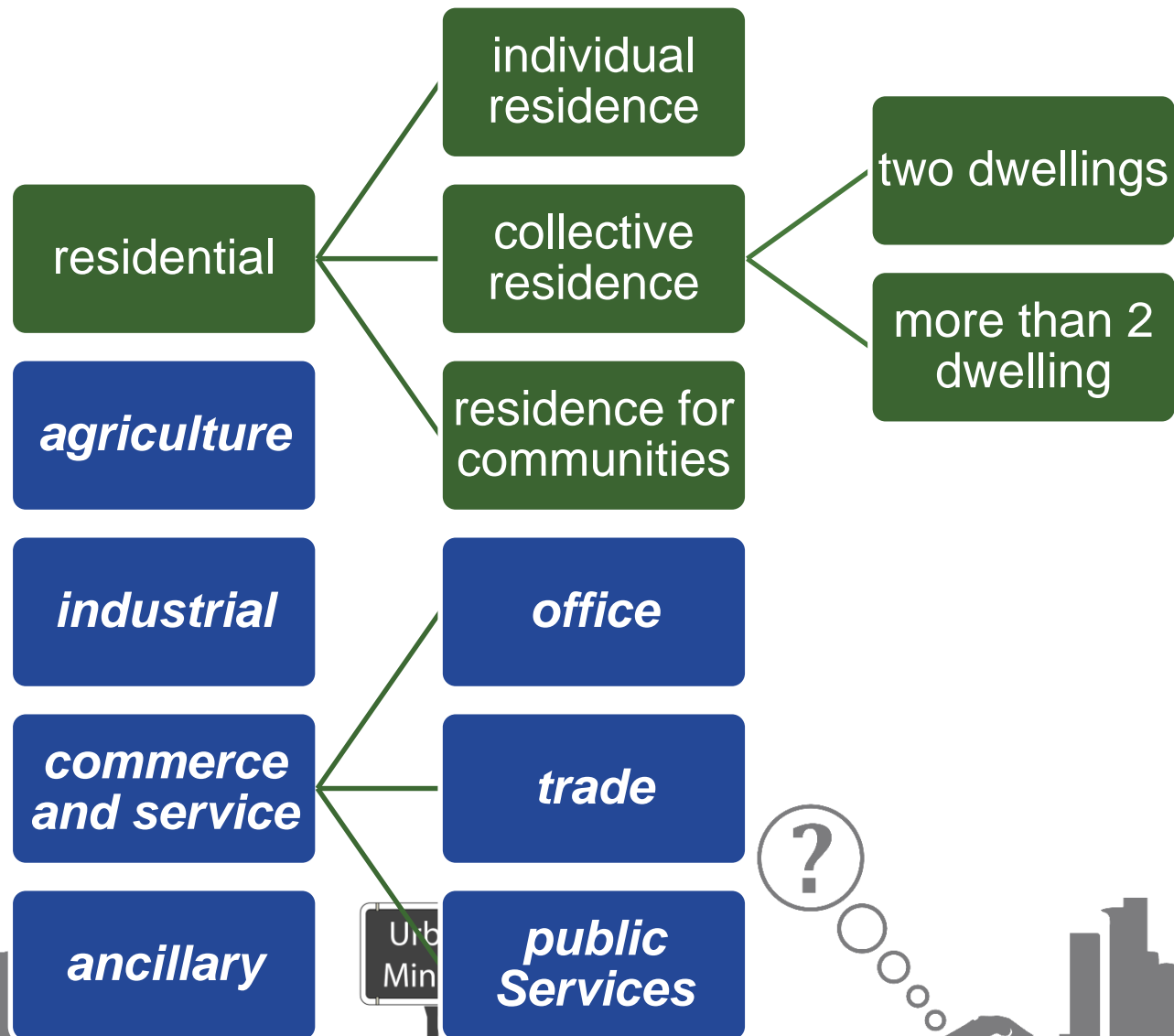
Poster per side 50 Viser 1 til 13 af 13 poster

Første Forrige 1 Næste Sidste

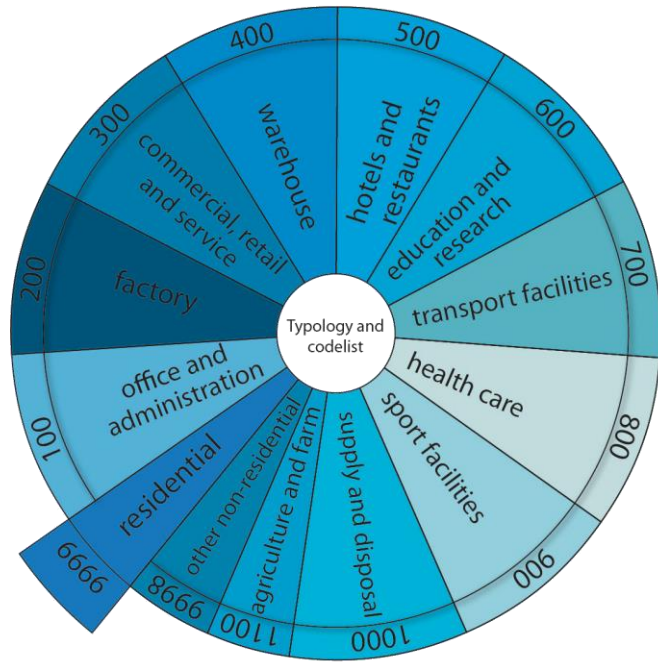
Mining



Building codelist 'current use'

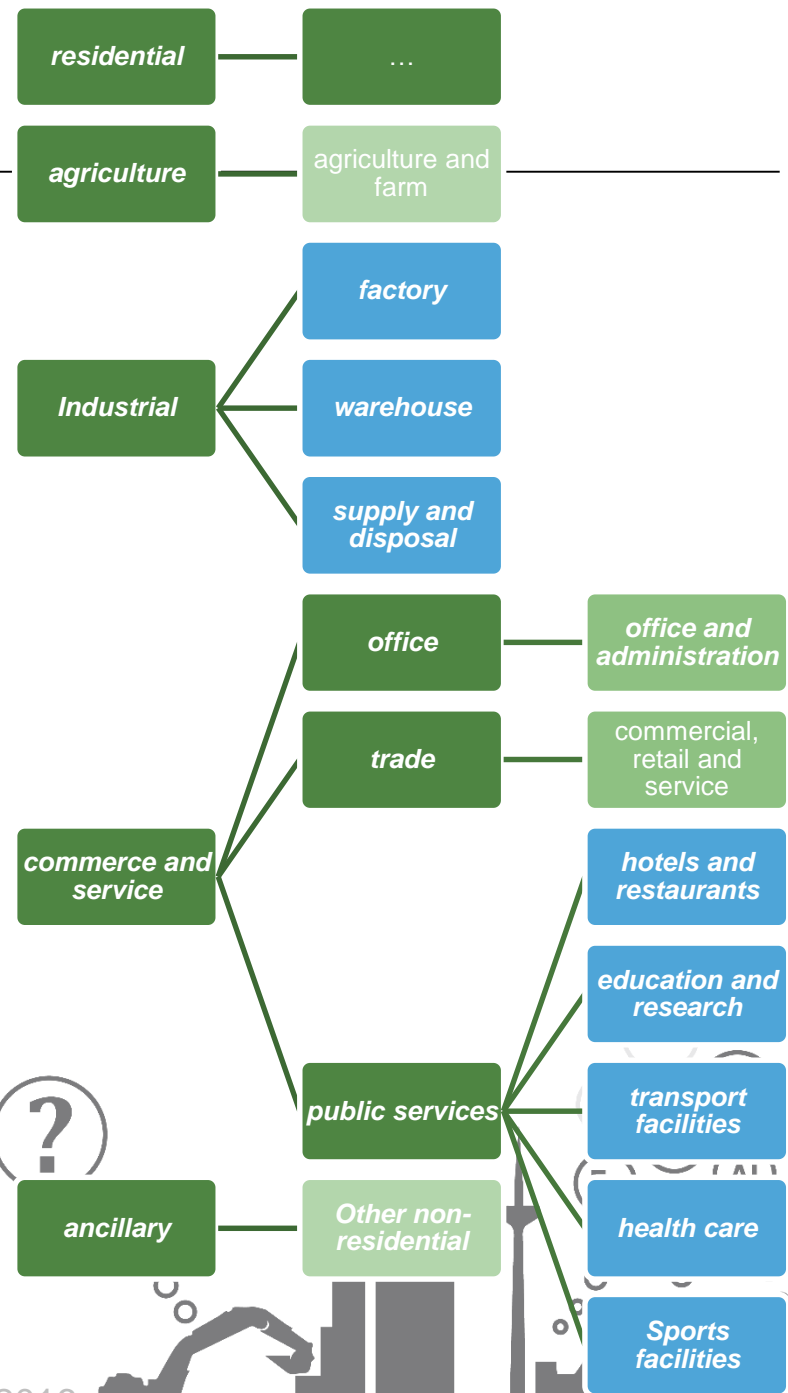


Example: Extensible <narrow> Codelist (Example PRRIG)

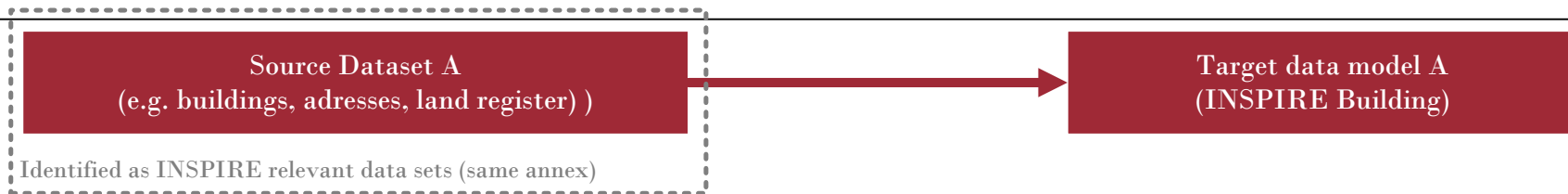


1:1 fit extension

Urban Mining



Mapping of codelist 'current use'



Eurostat classification

Residential buildings

One-dwelling buildings
Two- and more dwelling buildings
- two dwellings
- more than two dwellings
Residences for communities

Non-residential buildings

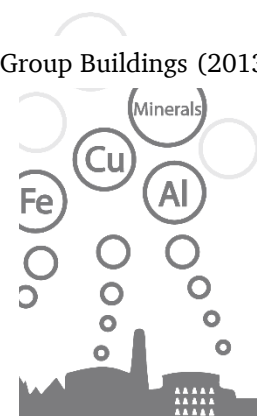
Industrial buildings and warehouses
Office buildings
Hotels and similar buildings
Wholesale and retail trade buildings
Traffic and communication buildings
Public entertainment, education, hospital or institutional care buildings
Other non-residential buildings
- religious buildings
- historic monuments
- farm buildings
- other

INSPIRE classification

residential
individualResidence
collectiveResidence
twoDwellings
moreThanTwoDwellings
residenceForCommunities
agriculture
industrial
commerceAndServices
office
trade
publicServices
ancillary

Source: INSPIRE Thematic Working Group Buildings (2013)

Figure 73: Matching example from EUROSTAT classification to INSPIRE classification of current use



Mapping of codelist 'current use'

Example 1: from Dutch Dwelling Register to INSPIRE

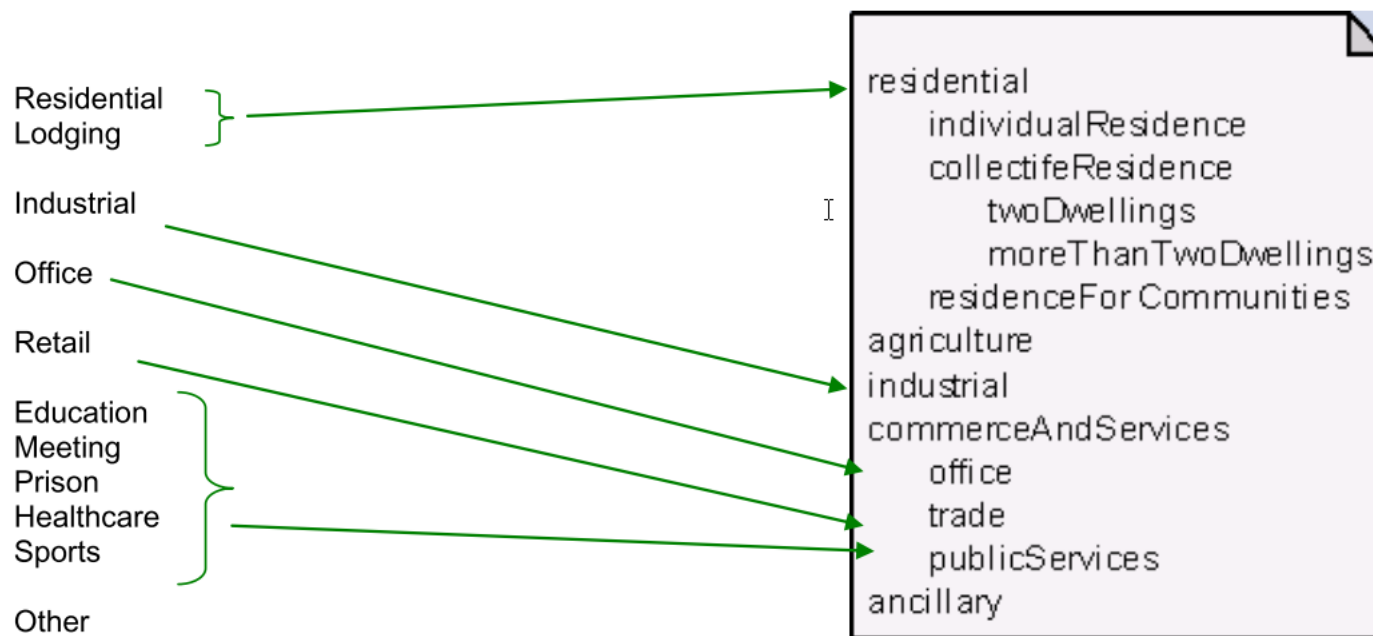
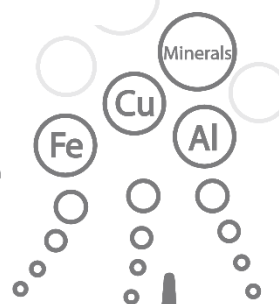


Figure 72: Matching example from national classification to INSPIRE classification of current use

Source: INSPIRE Thematic Working Group Buildings (2013)

Urban Mining

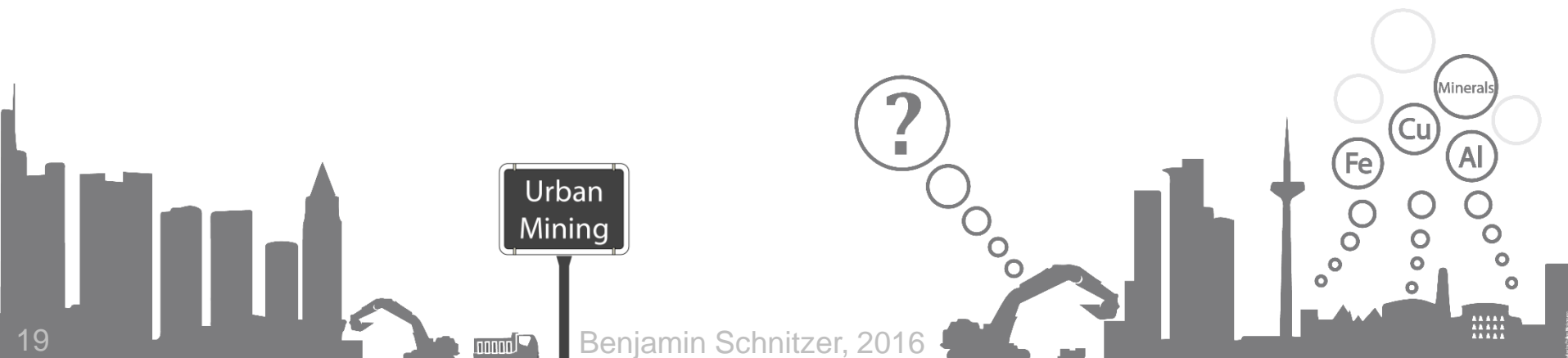
Benjamin Schnitzer, 2016



Mapping of codelist 'current use' for Urban Mining

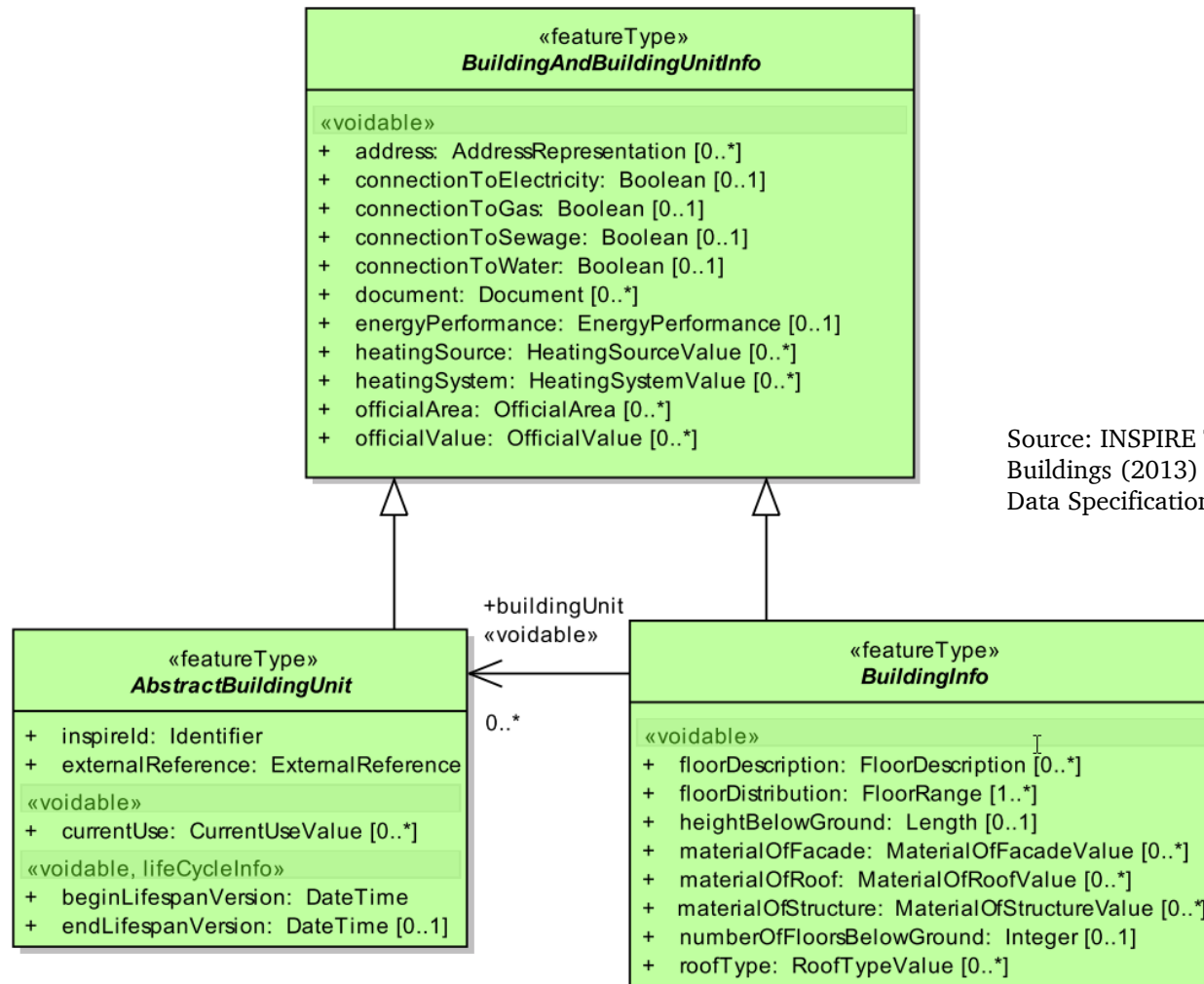
- Draft and not complete

INSPIRE	Kleemann et. al. 2016	Ortlepp et. al. 2015 (only non-residential)	Lichtensteiger & Baccini 2008	Wiedenhofer et. al. 2015 for EU	Daxbeck et. al. 2015 Graz (UMKAT)
residential individual residence collective residence residence for communities	residential		One-family buildings multi-family buildings	single family houses multi family houses <i>high-rise buildings</i>	Residential (age-classes)
aggricuture		Agricultural buildings			Non-residential
industrial	industry	Factory and workshop buildings	production buildings		
commerce and service office trade public services	commercial	Office and administrative buildings Trade and storage buildings <i>Hotels and restaurants; Institutional buildings</i>	service buildings		
ancillary					
	no information excluded	Other non-domestic buildings			

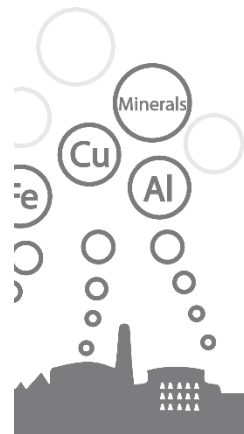


Outlook INSPIRE BU

- How detailed is the model in theory?
- application schema Extended2D and Extended3D



Source: INSPIRE Thematic Working Group
Buildings (2013)
Data Specification on Buildings



Outlook INSPIRE BU

■ Why Buildings parts and LODs?


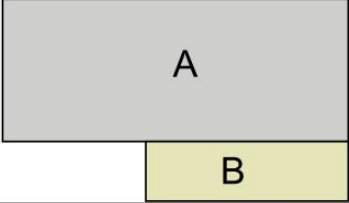
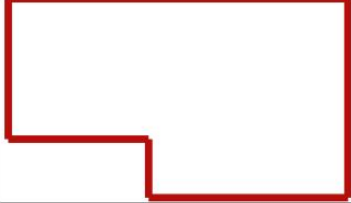

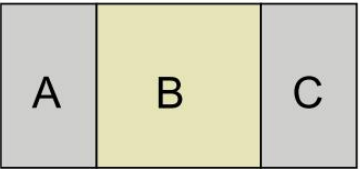

		
Real world building	The Building may be split into 2 BuildingParts A and B because of different height above ground (e.g. 8 m for A, 6m for B)	The building may be represented just as single generalised Building (e.g. with height above ground = 8 m)

Figure 64: Split into building parts (example 1)

EXAMPLE 2:

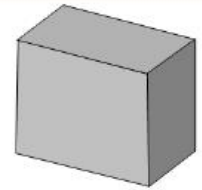
I

		
Real world building	This Building may be split into 3 BuildingParts A, B and C because of different number of floor above ground (e.g. 20 floors for A and B, 5 floors for B)	The building may be represented just as single generalised Building (e.g. with number of floors above ground = 20)

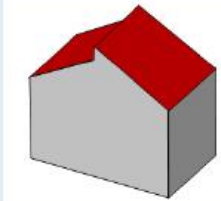
Urban Mining

Source: INSPIRE Thematic Working Group Buildings (2013) Data Specification on Buildings

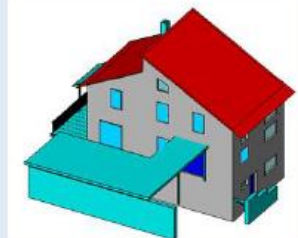
LoD1



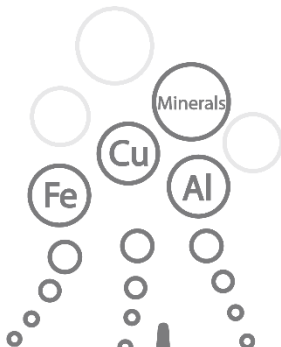
LoD2



LoD3



Source: Gröger et. al. & KIT



The INSPIRE Building Model

- Example 'Building height'

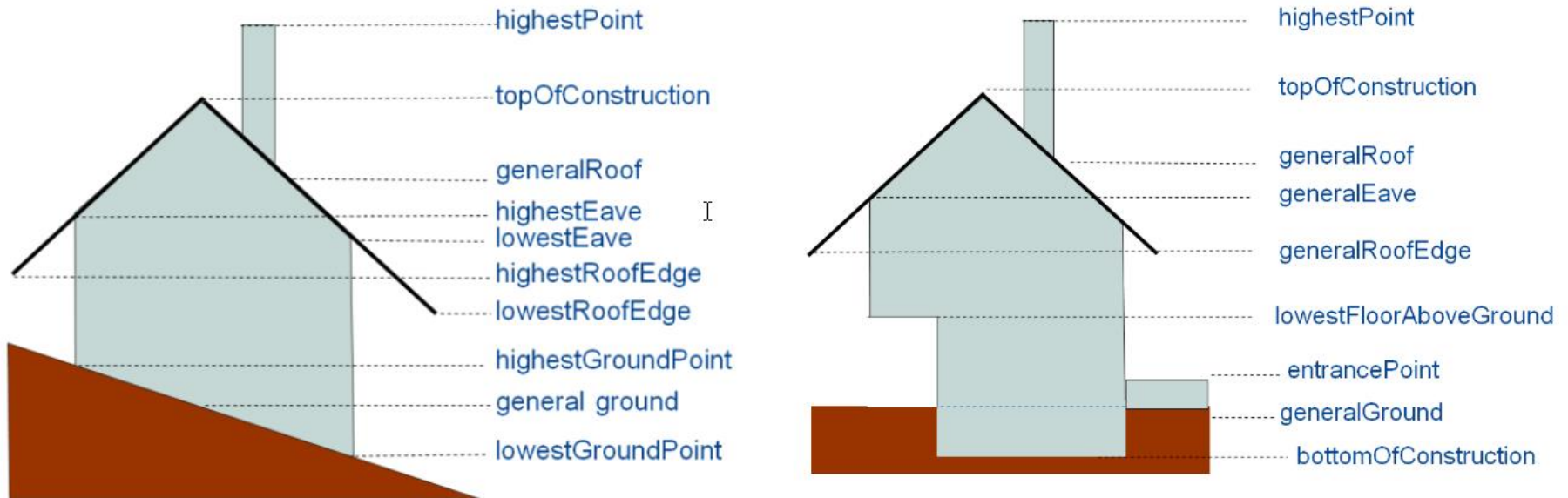
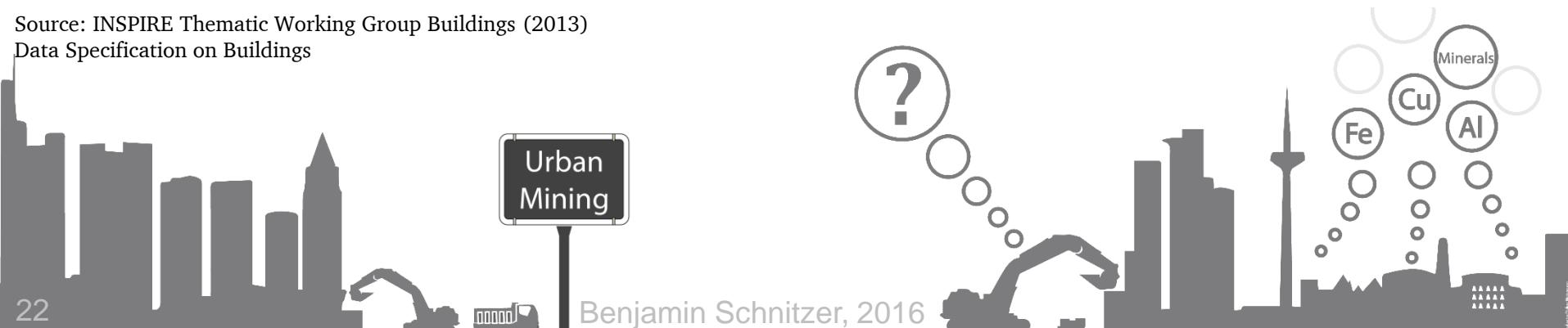


Figure 15: Examples of elevation references for different kinds of building

Source: INSPIRE Thematic Working Group Buildings (2013)
Data Specification on Buildings



Outlook INSPIRE BU - Extended Profile

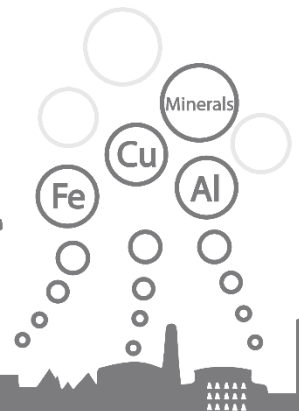
■ How detailed is the model in theory?

5.6.1.1.6. *Attribute MaterialOfStructure*

This attribute may take the following values:

			
adobeBlockWalls	concreteBlockMasonry	earth	firedBrickMasonry
			
informalConstructions	massiveStoneMasonry	mobileHomes	mudWalls
			

Source: INSPIRE Thematic Working Group Buildings (2013)
Data Specification on Buildings















Outlook INSPIRE BU – Extended Profile

■ How detailed is the model in theory?

5.6.1.1.3. Installations

Installations inherit of the attributes of AbstractConstruction (from <BuildingsBase>) and are mainly described by their nature, that may take the following values.

					
airConditioningI	externalLift	railing	ramp	solarPanel	stairway
					
balcony	stairway	stairway	tower	windTurbine	windTurbine






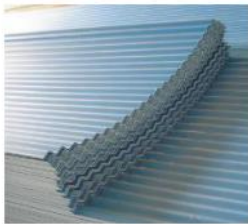






Source: INSPIRE Thematic Working Group Buildings (2013)
Data Specification on Buildings

Outlook INSPIRE BU

■ How detailed is the model in theory? (voidable)

5.6.1.1.8. *MaterialOfRoof*

This attribute may take the following values:

			
asbestos	ceramicTiles	clayTile	composition
			
concreteTile	corrugatedSheet	glass	hotMoppedAsphalt
			
metal	reinforcedConcrete	slate	slate

Source: INSPIRE Thematic Working Group Buildings (2013) Data Specification on Buildings

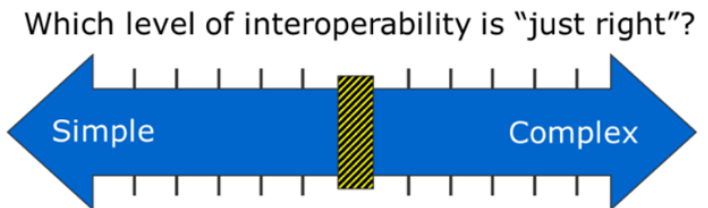


Some conclusions on the INSPIRE state of play

- Report 2016:
 - Data politics still a big problem (open licenses)
 - The „Balance“ of data models
 - more use-cases needed?
- INSPIRE will not solve the problem of missing semantics in current data sets
- State of Play in Germany
 - Building data expected to be available by 2020
 - Transformation processes are heavily under development

(Roschlaub et. al. (2016), Aringer et. al. (2016) and other)

“The Balance Challenge”



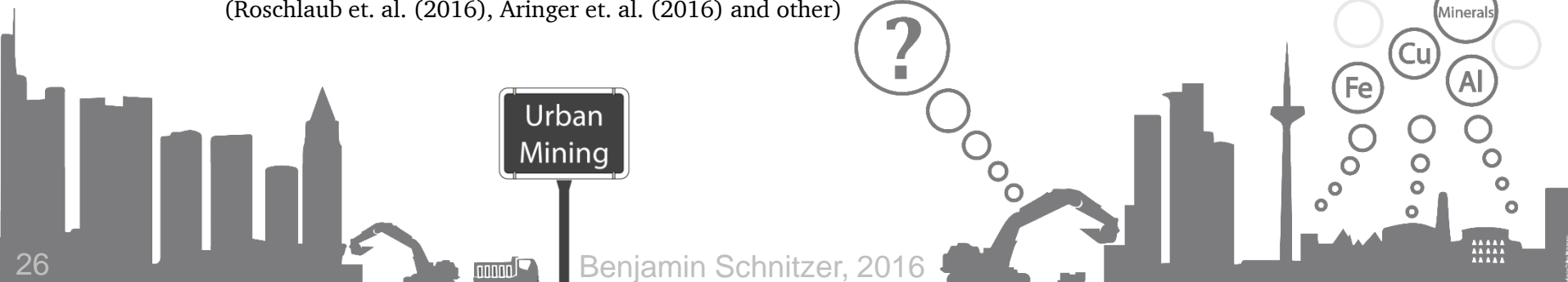
Too simple:

- Identified requirements can not be supported
- Insufficient harmonisation
- Few benefits

Too complex:

- Difficult to implement
- Substantial benefits available only to few users
- High costs

DG ENV; JRC; EEA (2016)



Questions & Outlook

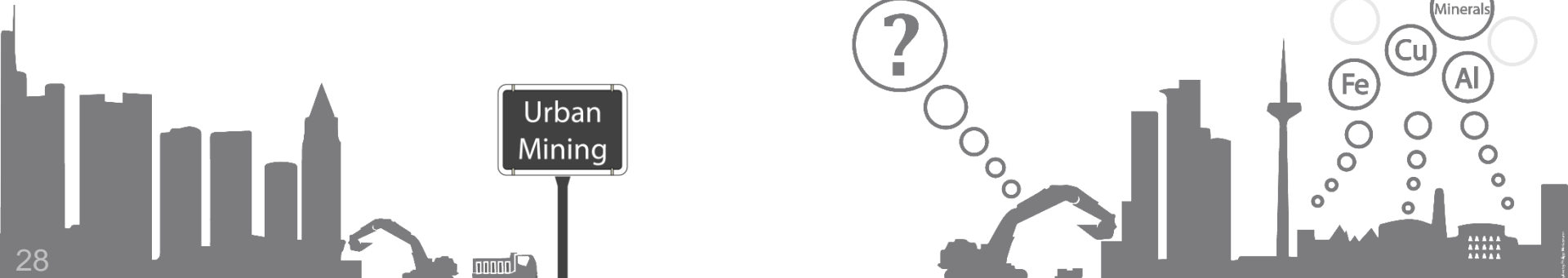
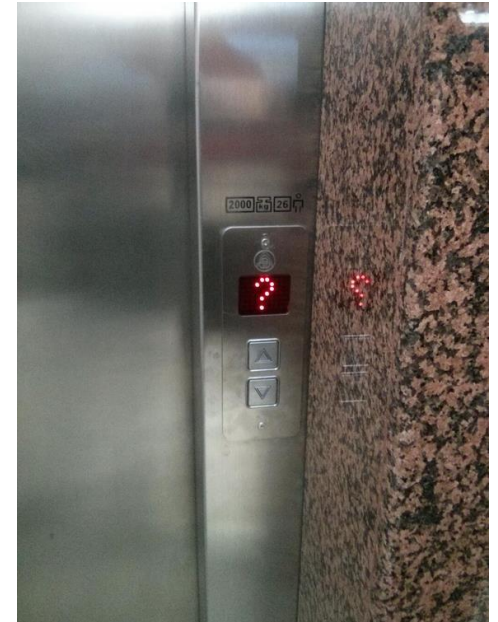
- Where is a need for standards?
 - Buildingtypes (multilingual Buildingtypology)
 - *Age-classes*
 - Materials
 - (regional?) material masses (kg/m^3 ; kg/m^2 floor space)
 - Regional differences in Europe (How can this be included in the structure?)
- Can the INSPIRE Building Model be a suitable basement for future Urban Mining considerations?
 - Joint proposal for a codelist extension ,current use‘
- Can the ‘Urban Mining’ Community deliver necessary use-cases (here is the Community?)



THANK.YOU. QUESTIONS?

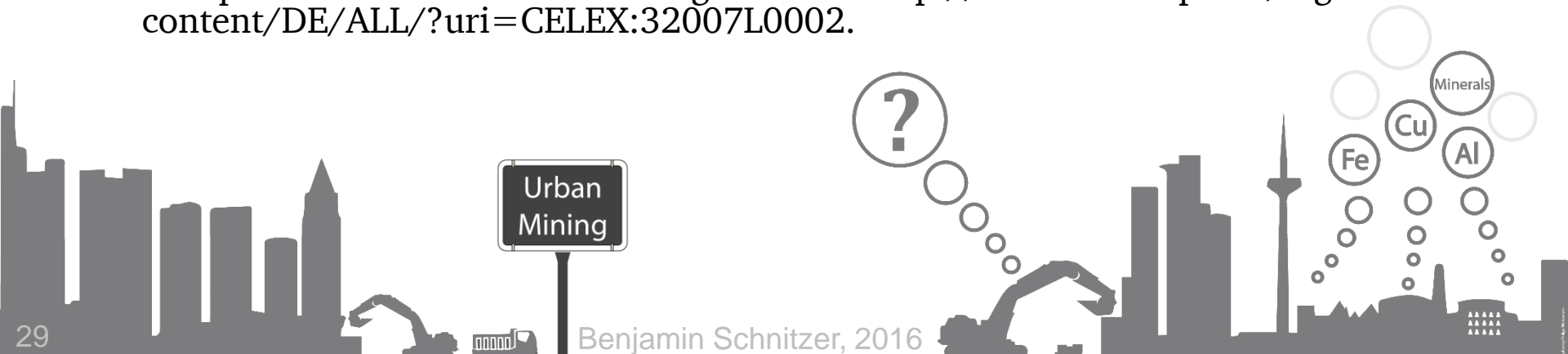
CONTACT

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schnitzer@geod.tu-darmstadt.de



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'SHARING IS EVERYTHING'



Source: Clare Hadley, INSPIRE Conference, 2010

Urban
Mining

Benjamin Schnitzer, 2016

Minerals

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