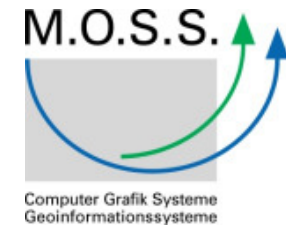


# 3rd Joint SIG 3D and OGC Workshop - CityGML EnergyADE for building energy calculation



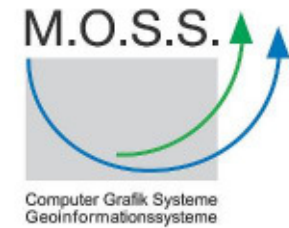
## Working group metadata



Part I

# Three Approaches

## Questions to keep in mind



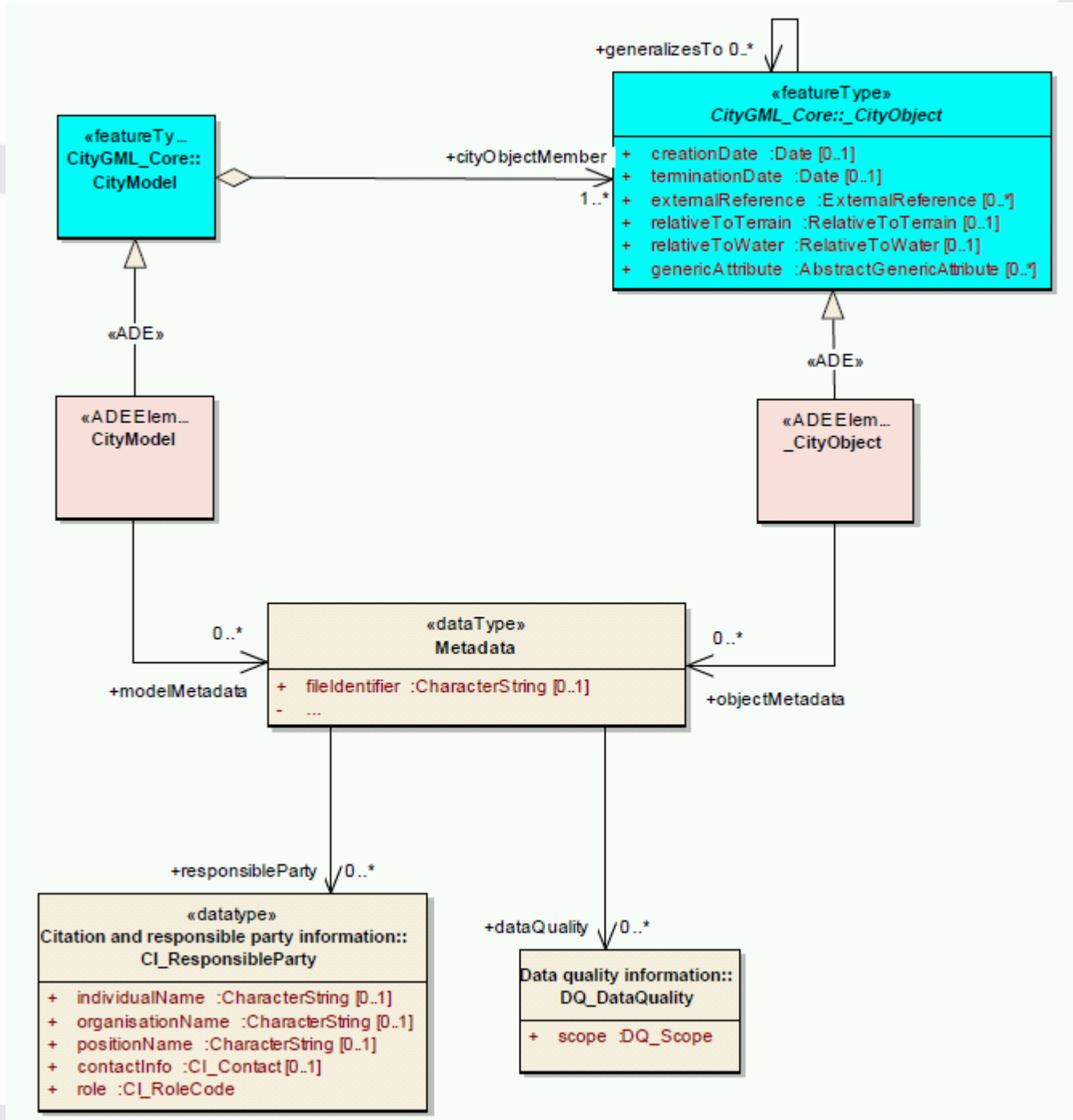
Should metadata in CityGML be close to ISO 19115 or is there a need for own structures?

Should we include metadata into the CityGML dataset or should metadata be excluded?

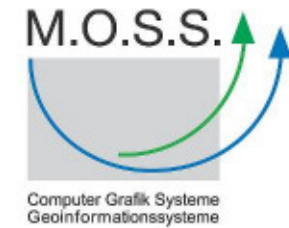
In case of included metadata – should we use the ADE mechanism or the GML mechanism?

Should metadata be linked to every Feature or in a grouped structure?

# Metadata as ADE



## ResponsibleParty & DataQuality



The ADE consists mainly of two elements from ISO 19115

### **CI\_ResponsibleParty**

a complex element for providing contact details also used in ISO 19115:

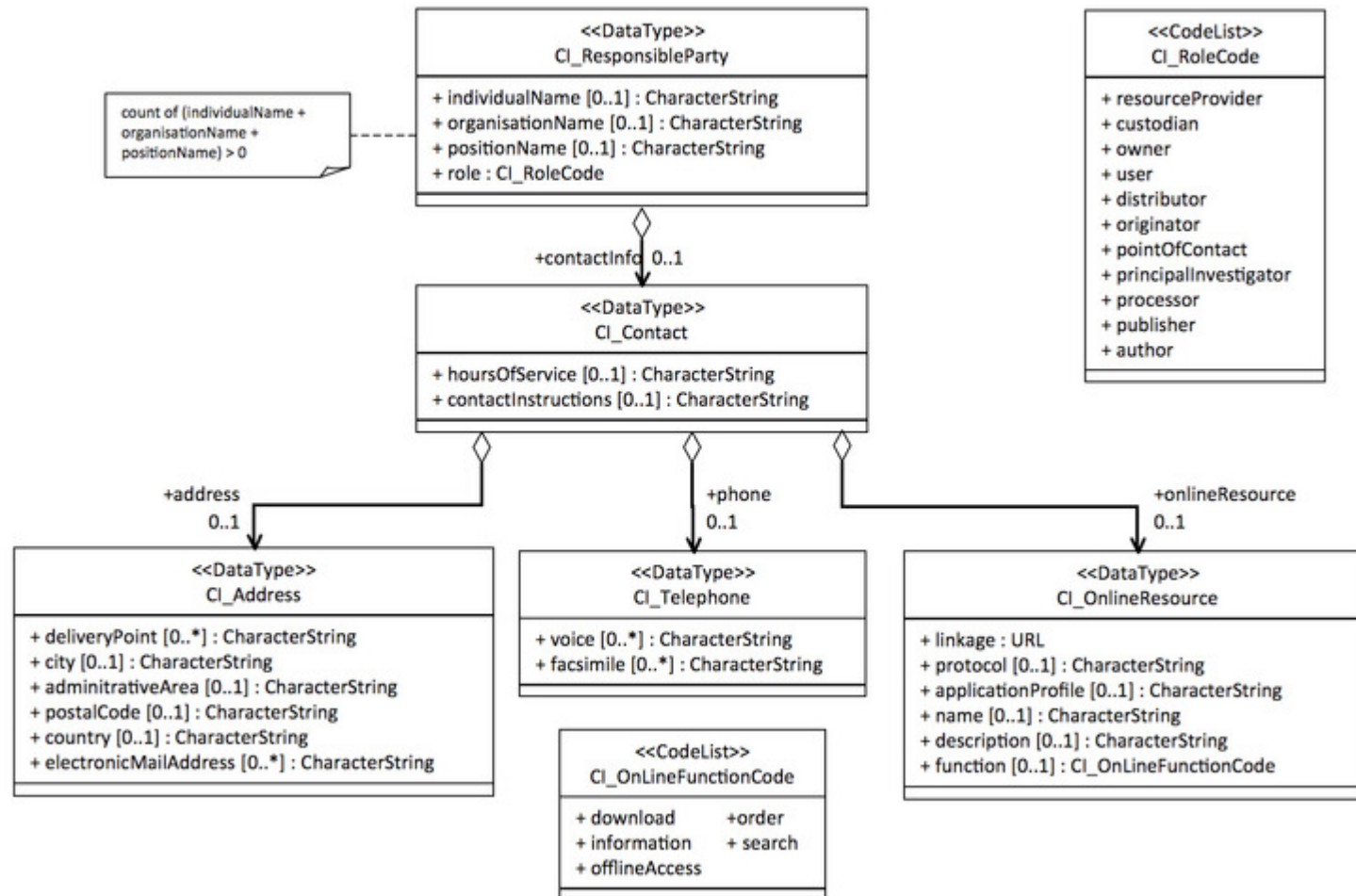
[https://geo-ide.noaa.gov/wiki/index.php?title=CI\\_ResponsibleParty](https://geo-ide.noaa.gov/wiki/index.php?title=CI_ResponsibleParty)

### **DQ\_DataQuality**

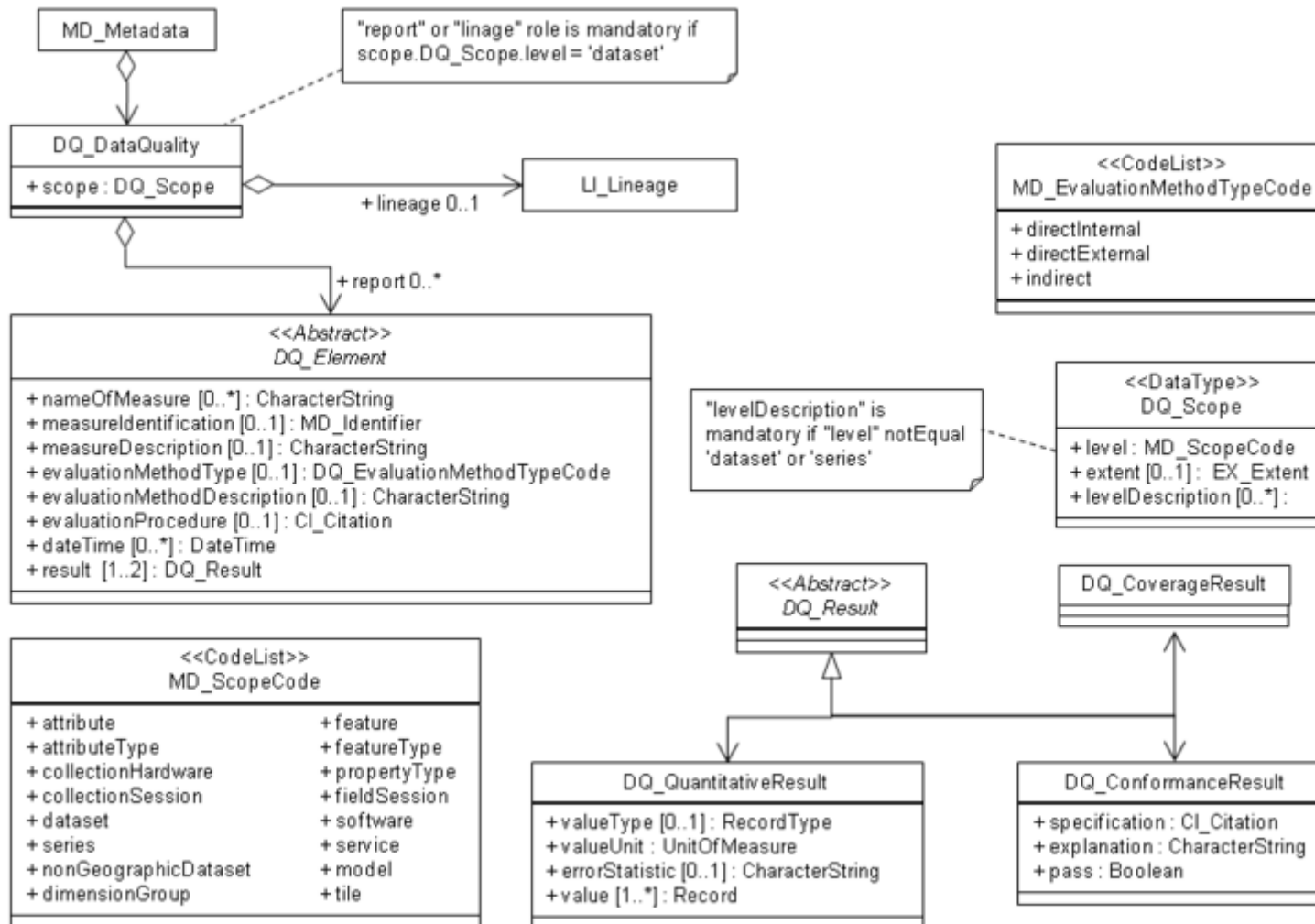
element also from ISO 19115 provides information about generation process of the data and quality which can be expected.

[https://geo-ide.noaa.gov/wiki/index.php?title=ISO\\_Data\\_Quality](https://geo-ide.noaa.gov/wiki/index.php?title=ISO_Data_Quality)

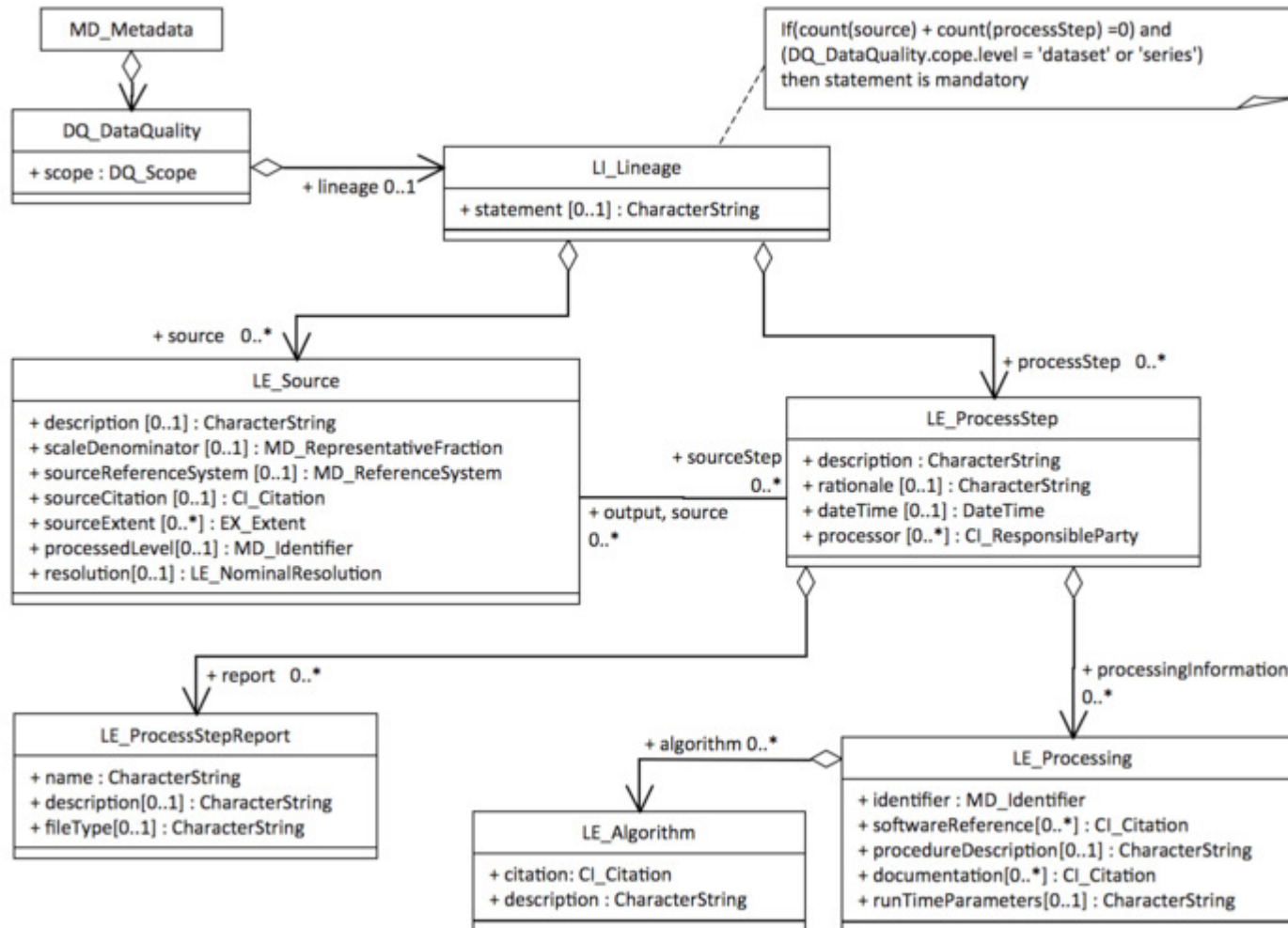
# ResponsibleParty



# DataQuality



# Lineage



## Example dataset



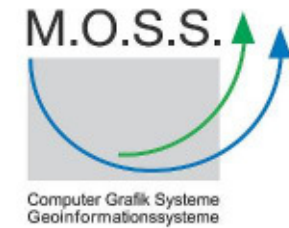
```
<energy:Metadata>
  <gmd:fileIdentifier>
    <gco:CharacterString>2462eaeb-9ee2-4bf7-8e68-185add5a14ea</gco:CharacterString>
  </gmd:fileIdentifier>
  <gmd:language>
    <gmd:LanguageCode codeList="http://www.loc.gov/standards/iso639-2/" codeListValue="eng"/>
  </gmd:language>
  <gmd:characterSet>
    <gmd:MD_CharacterSetCode codeListValue="utf8" codeList="http://standards.iso.org/ittf/Public
  </gmd:characterSet>
  <gco:DateTime>2015-04-21T17:12:33</gco:DateTime>
  <gmd:CI_ResponsibleParty>
    <gmd:individualName>
      <gco:CharacterString>Horst Severs</gco:CharacterString>
    </gmd:individualName>
    <gmd:organisationName>
      <gco:CharacterString>Prime Energy Solutions Group</gco:CharacterString>
    </gmd:organisationName>
    <gmd:positionName gco:nilReason="missing">
      <gco:CharacterString/>
    </gmd:positionName>
    <gmd:contactInfo>
      <gmd:CI_Contact>
        <gmd:phone>
          <gmd:CI_Telephone>
            <gmd:voice gco:nilReason="missing">
              <gco:CharacterString/>
            </gmd:voice>
            <gmd:facsimile gco:nilReason="missing">
              <gco:CharacterString/>
            </gmd:facsimile>
          </gmd:CI_Telephone>
        </gmd:phone>
        <gmd:address>
          <gmd:CI_Address>
            <gmd:deliveryPoint gco:nilReason="missing">
              <gco:CharacterString/>
            </gmd:deliveryPoint>
            <gmd:city>
              <gco:CharacterString>Dresden</gco:CharacterString>
            </gmd:city>
          </gmd:CI_Address>
        </gmd:address>
      </gmd:CI_Contact>
    </gmd:contactInfo>
  </gmd:CI_ResponsibleParty>
</energy:Metadata>
```

## Example dataset



```
<gmd:DQ_DataQuality>
  <gmd:scope>
    <gmd:DQ_Scope>
      <gmd:level>
        <gmd:MD_ScopeCode codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources/codelist/ML_gmxCodeList"
        </gmd:level>
      </gmd:DQ_Scope>
    </gmd:scope>
    <gmd:report>
      <gmd:DQ_QuantitativeAttributeAccuracy>
        <gmd:nameOfMeasure>
          <gco:CharacterString>Control measurements for fine tuning PRISM+</gco:CharacterString>
        </gmd:nameOfMeasure>
        <gmd:measureDescription>
          <gco:CharacterString>Trainee job with Trotec TP-9</gco:CharacterString>
        </gmd:measureDescription>
        <gmd:evaluationMethodType>
          <gmd:DQ_EvaluationMethodTypeCode codeList="http://standards.iso.org/ittf/PubliclyAvailableStandards/ISO_19139_Schemas/resources/codelist"
          </gmd:evaluationMethodType>
        </gmd:DQ_QuantitativeAttributeAccuracy>
      </gmd:report>
      <gmd:lineage>
        <gmd:LI_Lineage>
          <gmd:statement>
            <gco:CharacterString>Prime Energy Solutions Group</gco:CharacterString>
          </gmd:statement>
          <gmd:processStep>
            <gmd:LI_ProcessStep>
              <gmd:description>
                <gco:CharacterString>Preprocessing input data for Prime Energy Solutions Groups modelling software PRISM+</gco:CharacterString>
              </gmd:description>
              <gmd:rationale>
                <gco:CharacterString>Estimating EnergyCoverage_1</gco:CharacterString>
              </gmd:rationale>
              <gmd:dateTime>
                <gco:DateTime>2015-04-21</gco:DateTime>
              </gmd:dateTime>
            </gmd:LI_ProcessStep>
          </gmd:processStep>
          <gmd:processStep>
            <gmd:LI_ProcessStep>
              <gmd:description>
                <gco:CharacterString>Generating CityGML ADE Energy features with PRISM+2CityGML converter</gco:CharacterString>
              </gmd:description>
              <gmd:rationale>
            </gmd:rationale>
          </gmd:LI_ProcessStep>
        </gmd:lineage>
      </gmd:lineage>
    </gmd:report>
  </gmd:DQ_DataQuality>
```

## Pros/cons



### **Pros:**

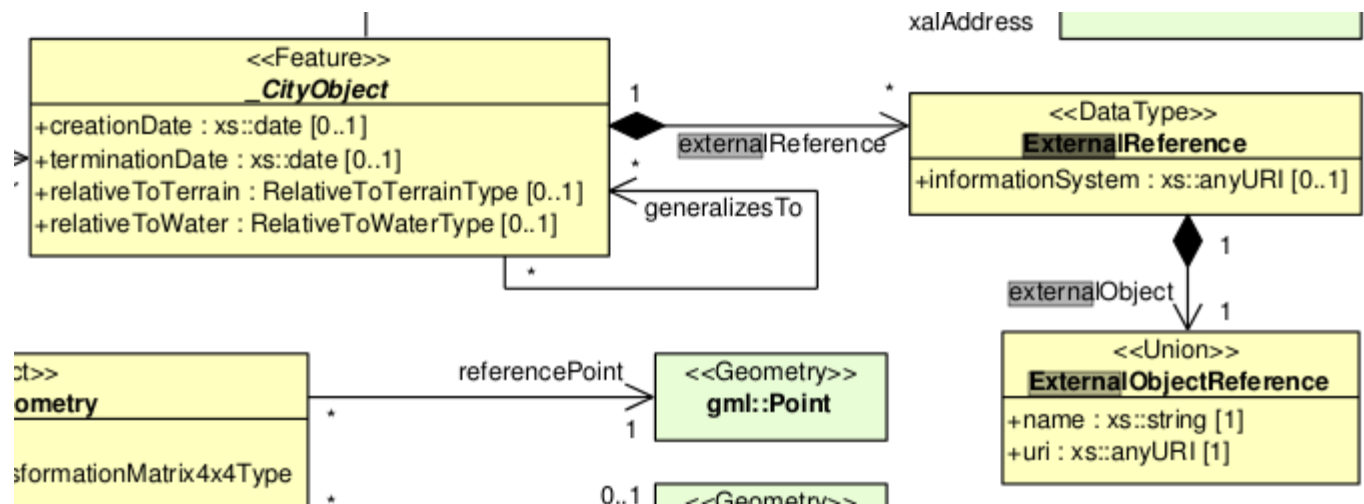
- Defining an ADE is a "Classic"
- Subset of ISO 19115 – so external Metadataset can be easily created and maintained
- ISO 19115 provides already tried and tested structures
- Information stored in CityGML so it is available without external dataset or catalogue

### **Cons:**

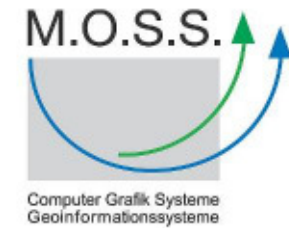
- Complex structures from ISO 19115 add complexity to CityGML datasets
- Not all CityGML software supports ADEs

## Approach II: external references

- External references link to ISO 19115 datasets
- ISO 19115 datasets points to the whole CityModel



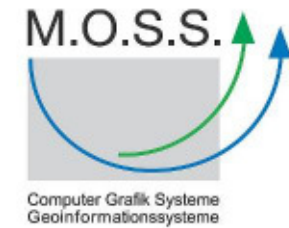
## Approach II: Citymodel improvements



### Basic metadata description on CityModel level:

- Filing a change request for CityGML 3.0 to allow external reference to CityModel
- While working on CityModel → Extending the attributes of the CityModel
- Add an element to describe features and attributes within the CityModel (feature/attribute name, author, creation date, validity date, generation process (codeliste), generation settings, description)
- Add the possibility to link from Features to this attribute

## Pros/cons



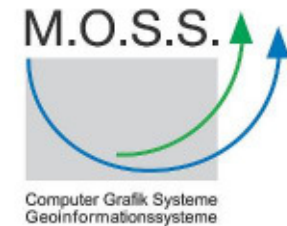
### **Pros:**

- No „clutter“ in CityGML datasets
- Complete ISO 19115 dataset
- Already works with existing means
- In case of extended attributes on CityGML → very slim method to describe features (doesn't scale up with number of features)

### **Cons:**

- Additional metadata files might get lost when transferred
- There might be no metadata catalogue available
- As it is a CityModel doesn't come with external reference – so they can't refer to but only can be referred to from metadata
- Two data sources have to be maintained

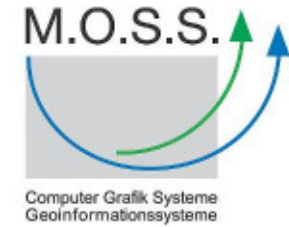
## Approach III: metaDataProperty



- CityGML is based on GML
- GML comes with a tag metaDataProperty:
- `<element ref="gml:metaDataProperty" minOccurs="0" maxOccurs="unbounded"/>`
- So the means to store metadata in CityGML doesn't have to be an ADE but could also make use of already existing tools
- This means we could define metadata schemata derived from `gml:AbstractMetadataPropertyType`

```
▼<complexType name="AbstractMetadataPropertyType" abstract="true">
  ▼<annotation>
    ▼<documentation>
      To associate metadata described by any XML Schema with a GML object, a property element shall be defined whose content model is derived by extension from gml:AbstractMetadataPropertyType. The value of such a property shall be metadata. The content model of such a property type, i.e. the metadata application schema shall be specified by the GML Application Schema. By default, this abstract property type does not imply any ownership of the metadata. The owns attribute of gml:OwnershipAttributeGroup may be used on a metadata property element instance to assert ownership of the metadata. If metadata following the conceptual model of ISO 19115 is to be encoded in a GML document, the corresponding Implementation Specification specified in ISO/TS 19139 shall be used to encode the metadata information.
    </documentation>
  </annotation>
  <sequence/>
  <attributeGroup ref="gml:OwnershipAttributeGroup"/>
</complexType>
```

## Pros/cons



### **Pros:**

- Makes elegant use of existing capabilities of gml → No redundant features are created

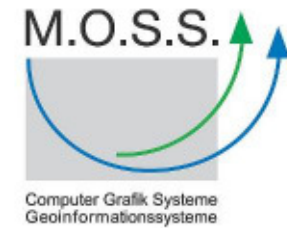
### **Cons:**

- Existing software probably doesn't support this

Part III

# Discussion

## Questions



Should metadata in CityGML be close to ISO 19115 or is there a need for own structures?

Should we include metadata into the CityGML dataset or should metadata be excluded?

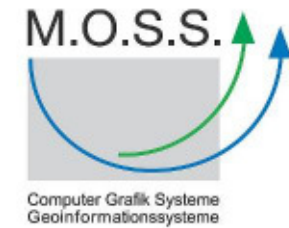
In case of included metadata – should we use the ADE mechanism or the GML mechanism?

Should metadata be linked to every Feature or in a grouped structure?

Excursion

# ADE support in 3DCityDB

## Introduction



- novaFACTORY – a software from M.O.S.S. for managing all kinds of spatial data - can also manage CityGML in 3DCityDB's
- Datasets can be imported and exported by services
- Imports and exports can be encapsulated by pre- and post-processes which are run automatically
- Within SimStadt project we developed a mechanism for storing CityGML with ADE elements in 3DCityDB

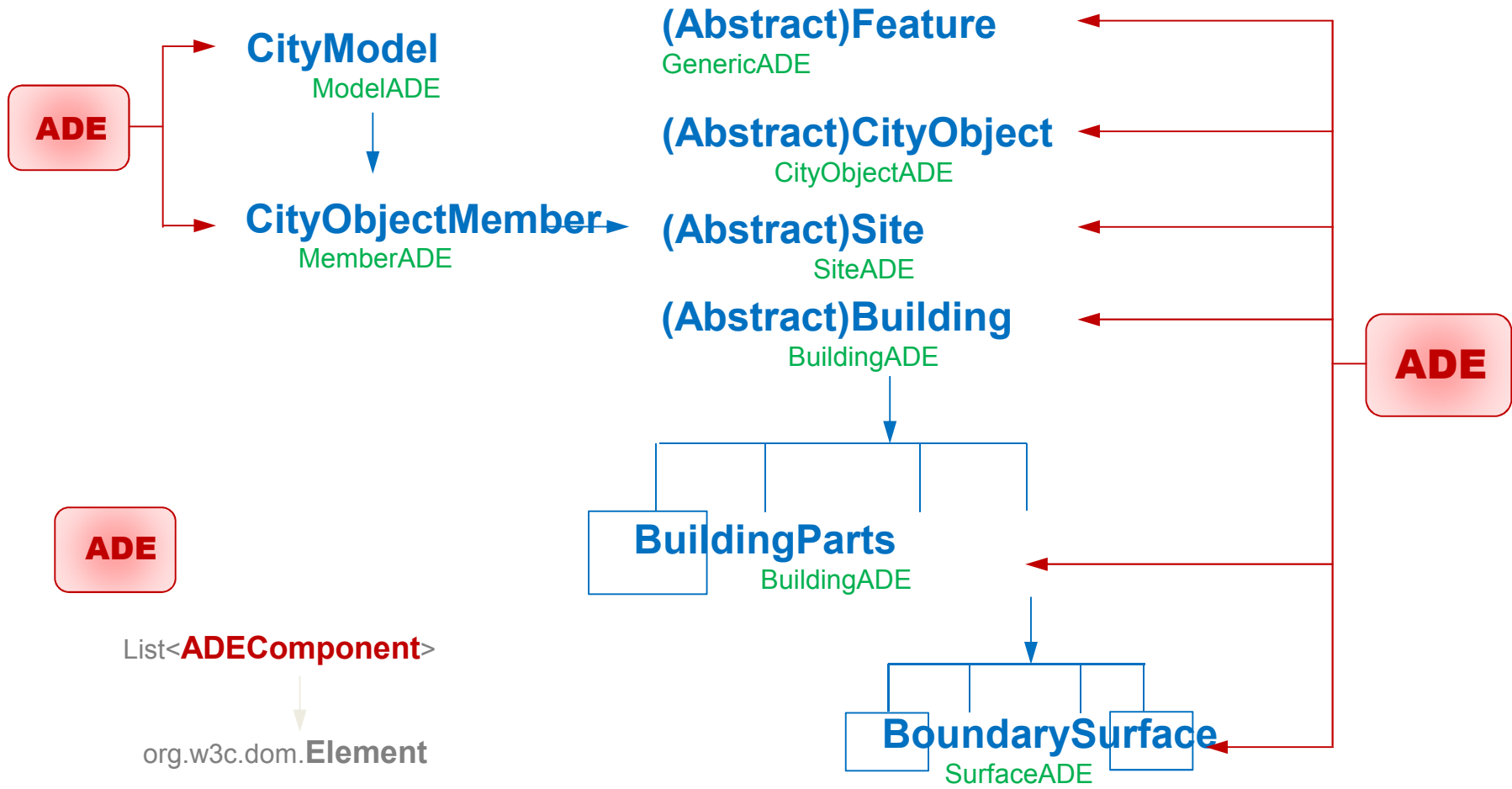
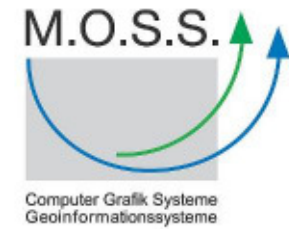
# ADE



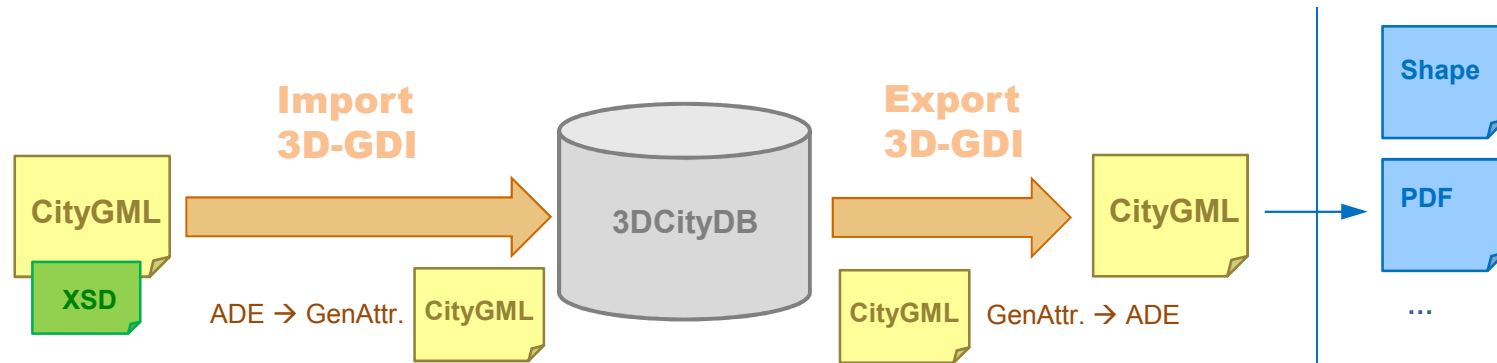
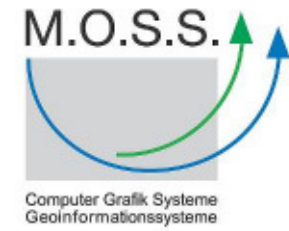
```
<core:creationDate>2013-07-30</core:creationDate>
<bldg:lod2MultiSurface>
  <gml:MultiSurface gml:id="UUID_03edbc36-ca5a-40b1-8a7c-837470">
    <gml:surfaceMember>
      <gml:Polygon gml:id="DEBW_LOD2_1006525_e6724bbd-8299-4695">
        <gml:exterior>
          <gml:LinearRing gml:id="DEBW_LOD2_1006525_e6724bbd-82">
            <gml:posList srsDimension="3">3513787.18 5417970.88
          </gml:LinearRing>
        </gml:exterior>
      </gml:Polygon>
    </gml:surfaceMember>
  </gml:MultiSurface>
</bldg:lod2MultiSurface>
<energy:exteriorSurfaceArea>4.67</energy:exteriorSurfaceArea>
<energy:sharedSurfaceArea>7.9</energy:sharedSurfaceArea>
<energy:coldSurfaceAreaAboveGround>1.1</energy:coldSurfaceAreaA
<energy:coldSurfaceAreaBelowGround>2.2</energy:coldSurfaceAreaB
<energy:azimuth>45</energy:azimuth>
<energy:inclination>90</energy:inclination>
<energy:shortWaveIrradiance>1 2 3 4 5 6</energy:shortWaveIrradi
<energy:shellProperties>
  <energy:constructionTypeId>Construction_Type_2</energy:constr
  <energy:uValue>4.32</energy:uValue>
  <energy>windowRatio>6.1</energy>windowRatio>
  <energy>windowFrameRatio>0.9</energy>windowFrameRatio>
  <energy>windowTypeId>Window_Type_5</energy>windowTypeId>
  <energy>windowOpenableRatio>1.4</energy>windowOpenableRatio>
  <energy>shadingTypeId>Shading_Type_2</energy>shadingTypeId>
  <energy>shortWaveReflectance>4.5</energy>shortWaveReflectance>
</energy:shellProperties>
</bldg:WallSurface>
```

**Application Domain Extension  
Extends the CityGML-Schema  
XSD Definition  
Basis: org.w3c.dom.Element  
Examples for ADEs  
energy, noise, bridge, ...  
3D-CityDB Import/Export-Tool  
doesn't support ADEs**

# ADE in CityGML



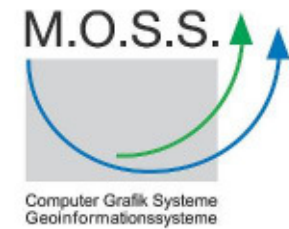
# Integration in novaFACTORY



- export
- import
- logs
- xsd
- stylesheet
- template

Ausgabe-Bezugssystem (SRS)	ETRS_1989_UTM_32N	
CityGML Ausgabeformat	<input type="radio"/> Basis <input checked="" type="radio"/> Normal <input type="radio"/> AdV	
CityGML Detailstufen (LoD)	0 1 2 3 4 <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>	<input checked="" type="radio"/> alle gewählten LoD-Stufen <input type="radio"/> nur kleinste LoD-Stufe <input type="radio"/> nur höchste LoD-Stufe

# Transformed CityGML



```
<gen:stringAttribute name="ade(obj):energy:dwellingNumber">
  <gen:value>123.0</gen:value>
</gen:stringAttribute>
<gen:stringAttribute name="ade(obj):energy:__namespaceURI__">
  <gen:value>http://simstadt.eu/ade/energy</gen:value>
</gen:stringAttribute>
<gen:stringAttribute name="ade(obj):energy:__XSD__">
  <gen:value>energy.xsd</gen:value>
</gen:stringAttribute>
<gen:stringAttribute name="ade(obj):energy:physicsProperties:yearOfRefurbishment">
  <gen:value>1981</gen:value>
</gen:stringAttribute>
<gen:stringAttribute name="ade(obj):energy:physicsProperties:variant">
  <gen:value>Variante_A</gen:value>
</gen:stringAttribute>
<gen:stringAttribute name="ade(obj):energy:physicsProperties:atticHeating">
  <gen:value>heated</gen:value>
</gen:stringAttribute>
<gen:stringAttribute name="ade(obj):energy:physicsProperties:basementHeating">
  <gen:value>notHeated</gen:value>
</gen:stringAttribute>
<gen:stringAttribute name="ade(obj):energy:physicsProperties:surfaceAreaToVolumeRatio">
  <gen:value>1.45</gen:value>
</gen:stringAttribute>
<gen:stringAttribute name="ade(obj):energy:physicsProperties:heatedArea">
  <gen:value>90.7</gen:value>
</gen:stringAttribute>
<gen:stringAttribute name="ade(obj):energy:physicsProperties:heatedVolume">
  <gen:value>410.1</gen:value>
```

**ADE elements transformed into generic attributes**

# novaFACTORY attribute filter



**Attributfilter für Ebene**

Filter für **SADET\_geb**

Suche    Erweiterte Suche

Attribute    Attributwerte

genStr.ade(obj):energy:energyU    555

≥1 Wert

SQL-Filterausdruck

```
((genStr.Firsthoehe] < 30.0)
AND
([genStr.ade(obj):energy:energyUse:dhwDemand]= '555')
```

Hinweis: kein Auftragsgebiet ausgewählt.

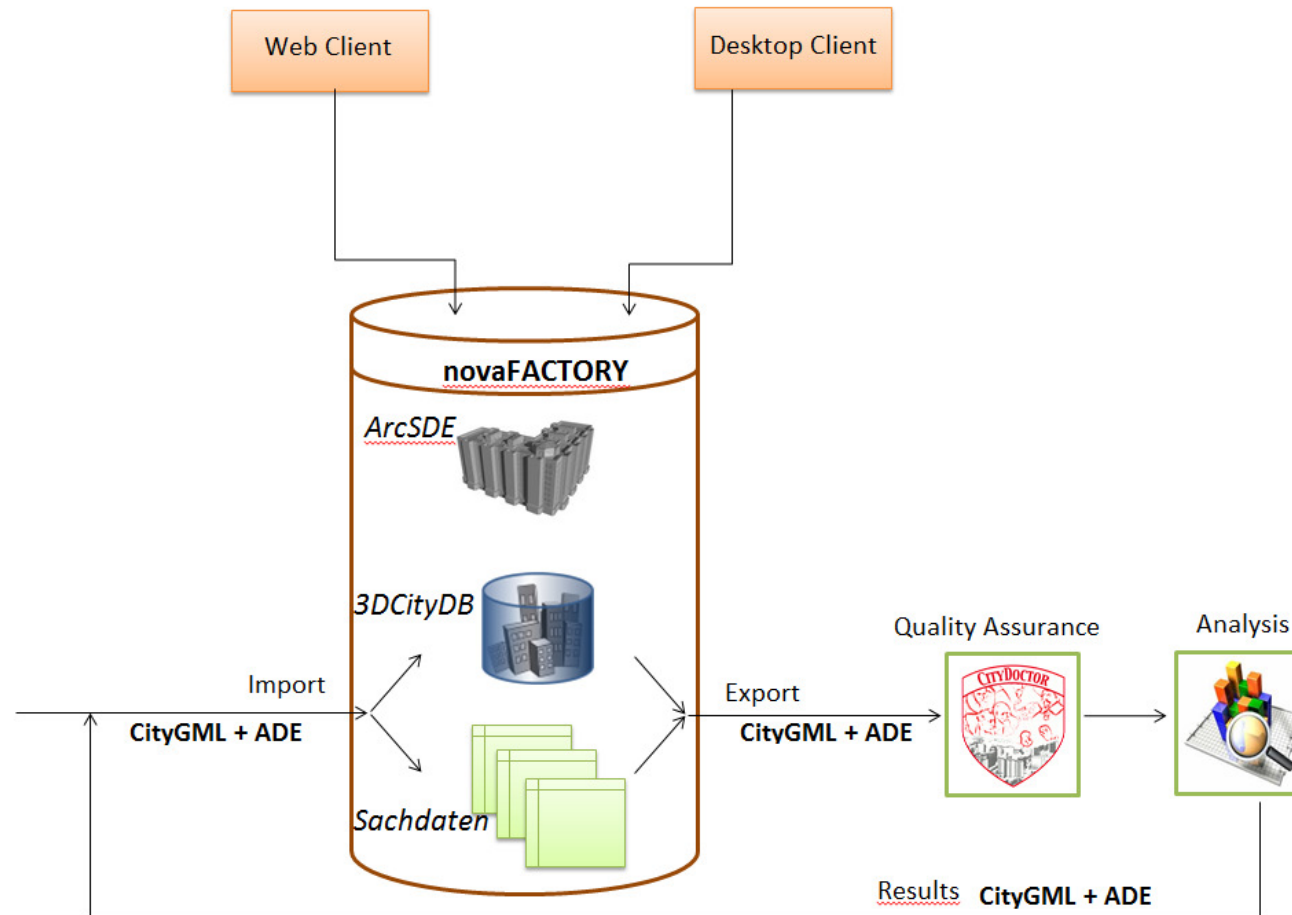
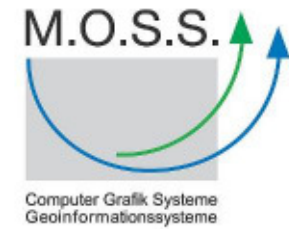
Attribute lesen    Filter testen

**Attributkatalog**

Baumansicht    Listenansicht

- Generische Attribute (gen\*)
- ADE (Objekt)
  - energy
    - physicsProperties
    - energyUse
      - dhwDemand**
      - primaryEnergyDemand
      - spaceHeatingDemand
      - maxHeatLoad
      - emissionCO2
      - spaceCoolingDemand
  - spacialProperties
  - usageZoneList
    - \_\_namespaceURI\_\_
    - \_\_XSD\_\_
    - dwellingNumber
- ADE (Flaeche)
- Adressdaten (addr.\*)
- Gebaeude-Attribute (bld.\*)
- CityObject-Attribute (co.\*)
- Objektklasse (oc.\*)

# Data management



## Export result



```
<core:creationDate>2013-07-30</core:creationDate>
<bdg:lod2MultiSurface>
  <gml:MultiSurface gml:id="UUID_03edbc36-ca5a-40b1-8a7c-8374703e0b9b">
    <gml:surfaceMember>
      <gml:Polygon gml:id="DEBW_LOD2_1006525_e6724bbd-8299-4695-bd98-1e778fb402ae_poly">
        <gml:exterior>
          <gml:LinearRing gml:id="DEBW_LOD2_1006525_e6724bbd-8299-4695-bd98-1e778fb402ae_poly_0">
            <gml:posList srsDimension="3">3513787.18 5417970.88 289.0355 3513787.18 5417970.88 293.
          </gml:LinearRing>
        </gml:exterior>
      </gml:Polygon>
    </gml:surfaceMember>
  </gml:MultiSurface>
</bdg:lod2MultiSurface>
<energy:exteriorSurfaceArea>4.67</energy:exteriorSurfaceArea>
<energy:sharedSurfaceArea>7.9</energy:sharedSurfaceArea>
<energy:coldSurfaceAreaAboveGround>1.1</energy:coldSurfaceAreaAboveGround>
<energy:coldSurfaceAreaBelowGround>2.2</energy:coldSurfaceAreaBelowGround>
<energy:azimuth>45</energy:azimuth>
<energy:inclination>90</energy:inclination>
<energy:shortWaveIrradiance>1 2 3 4 5 6</energy:shortWaveIrradiance>
<energy:shellProperties>
  <energy:constructionTypeId>Construction_Type_2</energy:constructionTypeId>
  <energy:uValue>4.32</energy:uValue>
  <energy>windowRatio>6.1</energy>windowRatio>
  <energy>windowFrameRatio>0.9</energy>windowFrameRatio>
  <energy>windowTypeId>Window_Type_5</energy>windowTypeId>
  <energy>windowOpenableRatio>1.4</energy>windowOpenableRatio>
  <energy>shadingTypeId>Shading_Type_2</energy>shadingTypeId>
  <energy>shortWaveReflectance>4.5</energy>shortWaveReflectance>
</energy:shellProperties>
</bdg:WallSurface>
```