Comparative analysis of different methodologies and datasets for Energy Performance Labelling of buildings

City of Essen (Germany)

City of Zwolle (The Netherlands)

INSPIRED Energy workshop – INSPIRE Conference 2017, Kehl (DE), 5 September 2017
Agenda

- Introduction and goal
- Methodologies
- Datasets
- Challenges and results
- Discussion
Introduction

• The work presented is being executed in the frame of one of the use cases of the Energy Pilot, which is a pilot project of the ELISE Action (European Location Interoperability Solutions for e-Government) of the ISA2 Programme (Interoperability solutions for public administrations, businesses and citizens) of DG Informatics of EC, running from 2016 to 2020.

• Partners involved:
  - Dutch Kadaster (NL)
  - Stuttgart Technology University of Applied Sciences – HFT (DE)
  - Saxion University of Applied Sciences (NL)
  - DG JRC of European Commission
Goal

- To make a comparative analysis of different methodologies for Energy Performance Labelling of buildings, applied to sample datasets of buildings of DE and NL.

- To make the analysis results re-usable in other geographical areas (Member States) by parties aiming to assess the energy performance labels of their building stock and interested to preliminary assess costs & benefits of applying the same (or similar) methodologies based on the availability of similar datasets, with respect to those used in the comparative analysis.
Methodology of The Netherlands Energy Performance Label

A **provisional** energy label was issued to every owner of a dwelling (01-01-2015)
- based on a simplified model and data from Key Registers
- Mainly used in a communication campaign

A **definitive** EPBD compliant label is mandatory when selling a house, enforced with a fine
- Based on an advanced model and dwelling specific data
- A webtool is used for application, data input, and expert validation of the energy label
- No on site inspection of the dwelling is needed
Average energy index Dutch dwellings per year of construction

Source: Voorbeeldwoningen 20011. Onderzoeksverantwoording, AgentschapNL, Sittard, Ministerie van Binnenlandse zaken en koninkrijksrelaties.
Provisional energy label: simplified model and data from public Key Registers

## Model

<table>
<thead>
<tr>
<th>Dwelling type</th>
<th>Year of construction (period)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seperate</td>
<td>G</td>
</tr>
<tr>
<td>Semi-detached</td>
<td>G</td>
</tr>
<tr>
<td>Detached corner</td>
<td>G</td>
</tr>
<tr>
<td>Detached</td>
<td>F</td>
</tr>
<tr>
<td>Flat / appartment</td>
<td>G</td>
</tr>
</tbody>
</table>

Source: 60 Referenties ten behoeve van voorlopige energielabel v2.0 oktober 2014, RVO 2014

## Data

<table>
<thead>
<tr>
<th>Data</th>
<th>Energy label Provisional</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dwelling type</td>
<td>X</td>
</tr>
<tr>
<td>Year of construction</td>
<td>X</td>
</tr>
</tbody>
</table>

INSPIREd Energy workshop – INSPIRE Conference 2017, Kehl (DE), 5 September 2017
Definitive (EPBD compliant) energy label: advanced model, data from public Key Registers and additional dwelling specific data

Model based on:
• NEN 7120
• NEN 8088-1
• NEN 1068:2012
• additional prescriptions (10-02-2014)

<table>
<thead>
<tr>
<th>Data</th>
<th>Provisional Energy Label</th>
<th>EPBD compliant Energy Label</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building usage</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Dwelling type</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Year of construction</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Dwelling subtype</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Floor surface</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Type of window pane</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Type and age of heating units</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Presence of solar panel or boiler</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Air ventilation system</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Facade and roof insulation</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>
Energy index, Energy Label and Energy Usage

- **Former** Energy Label (before 01-01-2015)
  Index, Label and Usage are related in the Methodology

<table>
<thead>
<tr>
<th>Energie-index (GJ per m² per jaar)</th>
<th>A+</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
</tr>
</thead>
<tbody>
<tr>
<td>minder dan 0,7</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0,7 - 1,05</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,05 - 1,3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,3 - 1,6</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1,6 - 2,0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2,0 - 2,4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2,4 - 2,9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>meer dan 2,9</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Bron: Ministerie van Financiën*

- **Current** Energy Label (after 01-01-2015)
  Index, Label and Usage are **not** related

*Bron: Ministerie van Financiën*
Utilisation and significance of the EPL in The Netherlands

- 40% of all dwellings have an EPBD compliant label
- 85% of sold houses are labeled
- Convenant: Housing corporation dwellings have mean label B by 2020
- Several banks give mortgage discounts for ‘good’ labels
- In 2023 only C or better labeled office buildings are permitted
EPBD compliant certificate in Germany

- Certificate (EnEV) will be issued based on heat demand or on heat consumption
- Certificate is mandatory for
  - new buildings (based on demand)
  - buildings to be sold
  - non-residential buildings
- Residential buildings 1977 or older based on demand (since 2008) (with exceptions)
- Non-residential based on demand or consumption
Research approach

• Simulate building heating demand based on 3D city model using monthly energy balance (DIN 18599)

• Pre-Calculate demand oriented energy performance label (no certificate!)
How to calculate energy consumption?

(DIN V 18599):

- Qh heating demand
- Qw hot water heating demand
- Qs solar gains
- Qi internal gains
- HT transmission heat loss
- HV ventilation losses
3D City Model

- City GML format
- Simstadt is suitable for all LoD-Stages (1-4)
- Includes attributes concerning the building year and function of the buildings
Visualization heating demand in Essen
National system of key registers in The Netherlands

Administrative Data

- Building usage: X
- Dwelling type: X
- Year of construction: X
- Floor surface: X

Provisional Energy Label

- Finalised
- In progress
Kadaster sources

- BRK
- BRT
- BAG
- WOZ
- GBA

Key Register Cadastre
Key Register Topography
Key Register Addresses & Buildings
Real Estate Valuation
Municipal Personal Records Database
  - Jan de Vries
  - 01/06/1970

And much more...

Energy labels of buildings
Spatial plans
Public restrictions
Cable and Pipeline information Centre
Public Services on the MAP

INSPIReEd Energy workshop – INSPIRE Conference 2017, Kehl (DE), 5 September 2017
Available 3D data The Netherlands

- Countrywide: 3D TOP10NL (2015), Level of Detail 1 (LOD1)
- Pilot area Zwolle: 3D BGT (2017), LOD1, Interoperable with Key Registers
- Many local initiatives on municipal and district scale, LOD1 – LOD4
Available data in Germany

- LoD 1 and LoD 2 models available from most states
- Some open data (NRW 10 Million Buildings)
- Usually Missing: Year of construction (third party data source)
- Refurbishment (not available at all)

http://nrw.virtualcitymap.de/
3D City Models

Europe

Germany

State (ADV)

Municipality

Exchange

INSPIRE BU 3DI

CityGML ADV profile

CityGML SIG3D Modelling Guide

INSPIRe Energy workshop – INSPIRE Conference 2017, Kehl (DE), 5 September 2017
## Comparing methodologies and data

<table>
<thead>
<tr>
<th>Methodology</th>
<th>Essen (DE)</th>
<th>Zwolle (NL)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>current</td>
<td>current</td>
</tr>
<tr>
<td>Express (or energy character)</td>
<td>kW/m2/yr</td>
<td>kW/m2/yr</td>
</tr>
<tr>
<td>Available administrative data</td>
<td>Third party</td>
<td>Third party</td>
</tr>
<tr>
<td>Available geometrical data</td>
<td>LOD2</td>
<td>LOD2</td>
</tr>
</tbody>
</table>
Buildings Classification NL

Usage of building classification
- Housing (dwelling)
- Gathering
- Cell (prison)
- Health
- Industry
- Office
- Lodging (hotel)
- Education
- Sport
- Shop
- Other

Dwelling type classification
- Separate house
- Semi detached house
- Detached house
- Detached corner house
- Flat / apartment
# Deutsche Gebäudetypologie

## Systematik und Datensätze

<table>
<thead>
<tr>
<th>Baujahrsklasse</th>
<th>EFH</th>
<th>RH</th>
<th>MFH</th>
<th>GMH</th>
<th>HH</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>vor 1918</td>
<td>Fachwerk</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>vor 1918</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C</td>
<td>1919-1946</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>D</td>
<td>1949-1957</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E</td>
<td>1958-1968</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>1959-1978</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>G</td>
<td>1979-1983</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>H</td>
<td>1984-1994</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>1995-2001</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>J</td>
<td>nach 2002</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Mapping CityGML to INSPIRE BU 3D

- Identified for Test areas in Essen
- Successfully converted LoD 1 CityGML model to INSPIRE BU 3D using HALE Studio software
- LoD 2 needs to be further investigated
- Apply to large model
- Exent SimStadt to work with INSPIRE data
Planned activities

• Complete the formal process of signing a multilateral non-monetary collaboration agreement between JRC and the partners involved (by the end of 2017)
• Comparative analysis of the Energy Performance Labelling of buildings currently in use in NL and DE
• Application of the two methodologies to sample datasets of NL and DE
• INSPIRE harmonisation of the datasets produced as output of the application of the methodologies
• Cost-benefit analysis
• Dissemination activities, including the publication of a scientific paper (by the end of 2018)
Conclusions

• Detailed planning of the use case activities completed
• Test areas in DE and NL identified
• Input data in test areas collected
• Preliminary tests on data transformation from CityGML LOD1 to INSPIRE BU 3D completed
• Main challenges identified
• Future activities planned
Thank you for your attention!

Martinus Vranken: martinus.vranken@kadaster.nl
Volker Coors: volker.coors@hft-stuttgart.de
Christian Struck: c.struck@saxion.nl
Giacomo Martirano: giacomo.martirano@ext.ec.europa.eu