

Overview 1 Geospatial data 2 IWU-Tool: Building Performance Simulation in the Urban Scale 3 What is a Building?

1 Research Questions in dataNWG



Sample Survey

- Structural parameters of the non-residential building stock (spatial distribution, building function, building types, total number, total area, building envelope areas etc.)
- Energy-related parameters of building envelopes and technical installations of relevant nonresidential buildings in the stock. Refurbishment progress and annual refurbishment rates of building parts and technical installations
- Underlying conditions of decision making processes in building refurbishment in the nonresidential building stock
- Calibration of reduced order energy performance simulation tools by measured consumption
 data

Geo-spatial Data Analysis:

 Calibration of geoinformatic recognition algorithms of non-residential buildings combined with image processing and machine learning based upon building polygons and 3D building models

Scanarios

- Relevance of energy-related measures in the non-residential building stock in Germany to the achievement of climate protection objectives in 2030 and 2050
- How can geospatial data be used to gather representative information on the energy related performance of the non-residential building stock in German?

2

1 Geospatial Data



Official Building Polygons of Germany (HU-DE)

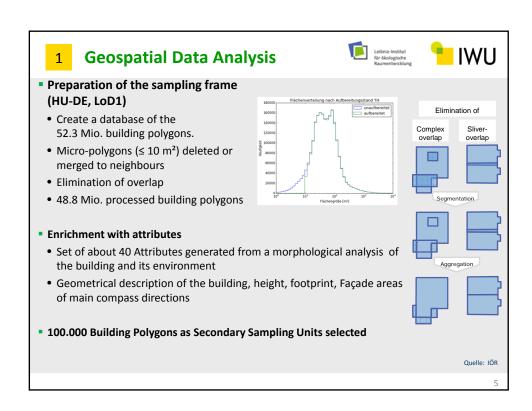
- 55.910.763 Building Polygons from all states
- Reporting date: End of 2014
- Only attribute: Official Municipality Key ("AGS" Amtlicher Gemeindeschlüssel).

Official 3D Building Models

- City-GML (LoD1) from all states
- Building Height
 (as the difference in meters between the highest and lowest point of reference of the building)
- Building Function (state wise different sets of characteristics, > 500 in total)

Official Topographical Cartographic Information System (ATKIS Basis-DLM)

• Combination with road system and land use



1 ALKIS Building Function Attributes



Key	ALKIS Building Function Attribute	Number 492.672	
1	Definitely a non-res. building relevant to the Energy Savings Ordinance (ESO) for which energy is used to condition the indoor climate		
2	Definitely a non-res. building, but not relevant to the ESO (f.i. a building for agricultural production,)	3.176.409	
3	Definitely a non-res. building, but not clearly ESO relevant	12.642.61	
0	Definitely a res. building (or a residence hall)	23.212.97	
-1	Definitely not a building (f.i. technical installation)	2.131.64	
-2	Non-res. building not considered	374.63	
9	Type and/or relevance unclear	9.750.54	
98	Garages	4.129.26	
1+2+3	Non-residential Buildings	16.311.69	
0	Residential Buildings	12.642.61	
-1, -2, 9, 98	Unclear or irrelevant	16.386.08	
	Total	55.910.76	

Key	Abbr.	Building Function	Ordnance Survey Classification*
		Primary Main Category	Class_Desc UK
100	Wohn	Residential	RD, RD02, RD03, RD04, RD06
200	BUGV	Hotel / Accomodation / Restaurants	CH, CH01, CH02, CH03, CL02HA, CC03
300	BVA	Office Buildings/ Public Facilities	CO, CO01, CO02 / CC02, CC08, CC12
400	SKsB	Schools and Child Care	CE02, CE03, CE03, CE04, CE06, CE07
500	FoHo	Research and Higher Education	CE01, CE05
600	KuFr	Culture and Leisure	CL01, CL03, CL04, CL07, CL08, CL09, CL10, CL11SJ, CN03SB CR06, CR07, CR10, CZ
700	Sprt	Sports Facilities	CL06, CL11
800	GuPf	Medical	CM, CN04
900	PWLB	Production / Work-Shop / Storage / Operations	CI01, CI03, CI04, CI05, CI06, CI07, CI08, CN01, CN02, CN03, CN05, CX
1000	Hand	Trade	CR01, CR02, CR04, CR05, CR08, CR09, CR11
1100	Verk	Transport	CT01AY, CT01AI, CT01AP, CT01HS, CT04, CT04AE, CT08, CT10, CT13, CT13FR, CT13NB, CT13NF
1200	Tech	Technical / Utility Building	CU01, CU03, CU04, CU07, CU09RA, CU09SE, CU09CQ, CU10
1300	Sons	Other Non-Residential Building	
1400	kein	No Building	_

	1	Buildings and Zones			¹ IWU				
		Building Function	Ordnance Survey Classification*	Usage zones					
		Primary Category	Class_Desc UK	Typical Usage a Project**	cc. to TEK-				
100	Wohn	Residential	RD, RD02, RD03, RD04, RD06						
				Hotelzimmer	Verkehrsfläche	Nebenfläche n	Lager, Technik	Parkhaus	
200	BUGV	Hotel / Accomodation / Restaurants	CH, CH01, CH02, CH03, CL02HA, CC03	40.00%					
				Einzelbüro	Verkehrsfläche	Gruppenbür o	Lager, Technik	Sitzung	
300	BVA	Office Buildings/ Public Facilities	CO, CO01, CO02 / CC02, CC08, CC12	26,00%		15,00%	14,00%	5,009	
400	SKsB	Schools and Child Care	CE02, CE03, CE03, CE04, CE06, CE07	Klassenzimmer 50,50%			Lager, Technik 6,50%		
500	FoHo	Research and Higher Education	CE01, CE05						
				Ausstellung	Lager, Technik	Verkehrsfläc	Zuschauer	Nebenflächen	
600	KuFr	Culture and Leisure	CL01, CL03, CL04, CL07, CL08, CL09, CL10, CL11SJ, CN03SB, CR06, CR07, CR10, CZ	22,00%					
700	Sprt	Sports Facilities	CL06, CL11						
800	GuPf	Medical	CM, CN04						
900	PWLB	Production / Work-Shop / Storage / Operations	CI01, CI03, CI04, CI05, CI06, CI07, CI08, CN01, CN02, CN03, CN05, CX						
				Standbardal		Gruppenbür	National Pales	eta-alli da-	
1000	Hand	Trade	CR01, CR02, CR04, CR05, CR08, CR09, CR11	84,00%	Lager, Technik 6,00%		Nebenflächen 1,50%		
4400	Mondo		CT01AY, CT01AI, CT01AP, CT01HS, CT04, CT04AE, CT08, CT10, CT13, CT13FR,		.,	.,	,		
1100	Verk	Transport Technical / Utility Building	CT13NB, CT13NF CU01, CU03, CU04, CU07, CU09RA, CU09SE, CU09CQ, CU10						
1300	Sons	Other Non-Residential Building							
1400	kein	No Building							

1 Building Age Bands in dataNWG Typology



 defaults of typical building envelope parameters like U-values

$$U_{\text{D}} = \frac{1}{\frac{1}{U_{\text{O}}} + \frac{d_{\text{D1}}}{\lambda_{1}} + \frac{d_{\text{D2}}}{\lambda_{2}} ... + \frac{d_{\text{D4}}}{\lambda_{i}}} \qquad \qquad \text{in } W/(m^{2} \cdot K)$$

 Defaults of typical technical plant parameters like efficiencies

Screening	Interviews
Historic (<1850)	Until 1859
1850-1949	1860 - 1918
1850-1949	1919 - 1948
1950s	1949 - 1957
4000 4 4070-	1958 - 1968
1960s und 1970s	1969 - 1978
1000-	1979 - 1983
1980s	1984 - 1994
1990s	1995 - 2001
2000s	2002 - 2009
2010s	2010 or later

9

1 Summary



- Official geospatial data provide an appropriate frame to draw representative samples in building stocks
- Pre-processing of the data is necessary, like elimination of overlap.
- ALKIS Building Function Attribute is not meaningful enough to assign usage parameters reliably.
- Attributes concerning the real physical properties, lke Uvalues etc., are not available.
- Surveys are needed to enrich the data with reliable attributes like building function categories, age bands etc.
- In ENOB:dataNWG we use a predefined typology with building categories from German
 Bauwerkszuordnungskatalog (BWZK) and age bands from TABULA

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1WU **IWU-Tool** Approach Goal • Use existing geospatial data • Multiple-zone Model • Estimate building envelope areas from • Collect crucial energy-related data building geometry of buildings in sample surveys Characteristic energy values from survey (nationale stock) or complete • Internal heat gains from standards surveys (city quarter), f.i. U-values Controls from standards • Only missing data are • Heating / Cooling supplemented by default values, f.i. Schedule usage Loop • Feed into E+ - generator • Run (many) simulations - distribution Space heating Ventilation Lighting

Reverse Engineering



1. Step: Create a Building Model (Designbuilder)

- 1 Building, 2 Floors, 4 Zones, Condensing Boiler
- FZK House
- IWU House

2. Step: Analysis in EpXL

- EpXL: Excel-Interface including E+ Schema
 - Comprises all E+ objects and the corresponding variables
- Import of Designbuilder Model
 - all objects to build the model are automatically collected in an EXCEL-file
- Identification of necessary E+ functions
- Definition of function blocks
 - schedules, zoning, materials, windows, technical installations for heating, cooling, ventilation, lighting

13

Building Simulation

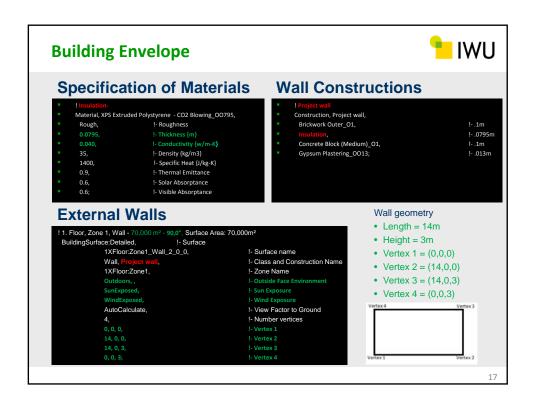


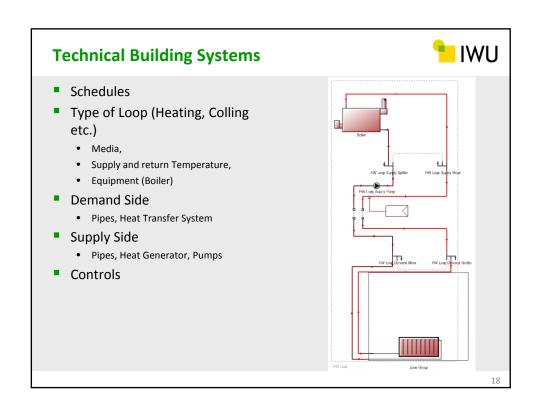
3. Step: Adapt Function Blocks to Survey Data

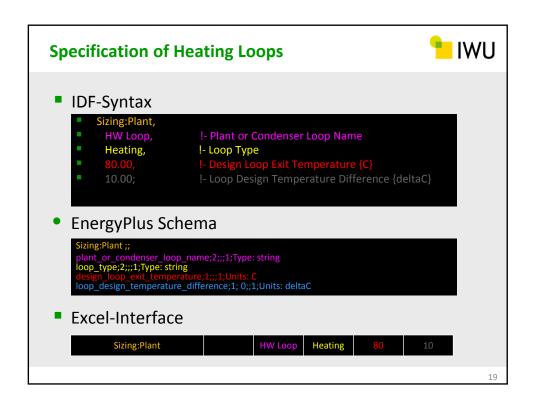
- Import data from survey
 - Derive building geometry from geospatial data and screening of sample buildings
 - Process survey data to fit into E+ function blocks, f.i. translate
 - type and age band of boiler into characteristic efficiency values
 - U-value into thickness and conductivity
- Supplement missing data by E+ defaults

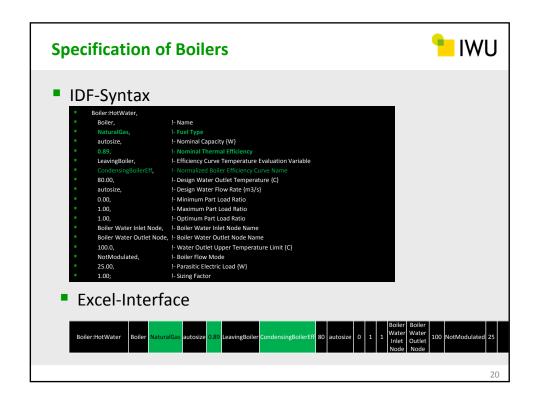
4. Step: IWU-Tool

- Interface between building geometry data, survey tool and EpXL to create function blocks tailored to the survey data
- Create a building model from function blocks
- Create IDF-file from EpXL
- Simulate in E+

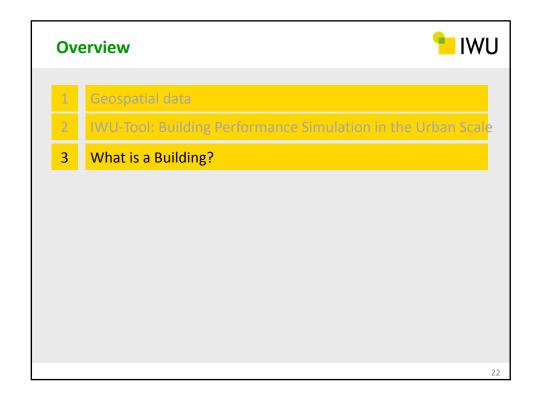








IWU Tool chain Interface between building geometry data derived from geospatial data, ENOB:dataNWG survey tool for 3rd phase on-site inspection and to create tailored function blocks in EpXL Create a building model from function blocks Create IDF-file from EpXL Simulate in E+





2.2 Single Building

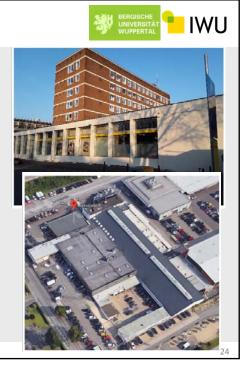
Non-residential Buildings are dedicated to non-residential uses on more than 50% of their useful floor area.

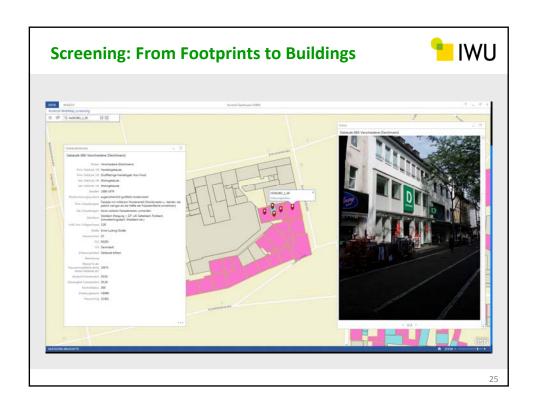
<u>Single</u> Buildings are detached buildings as well as those that consist of building parts having been built based upon an integrated architectural concept at the same time plus retrofitted parts that are to be assigned regarding access and function, because they cannot be used independently.

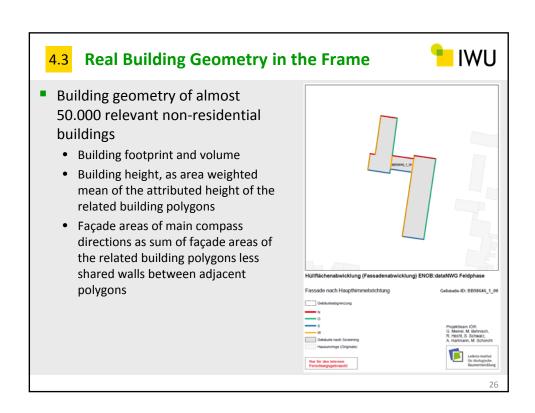
All building parts must be structurally connected on the ground.

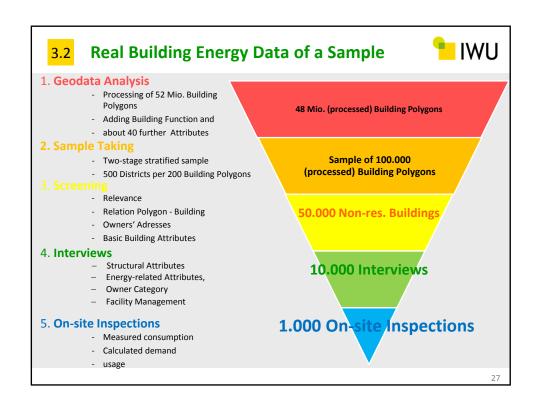
Realisability may be another criterion for determining which parts belong to a single building.

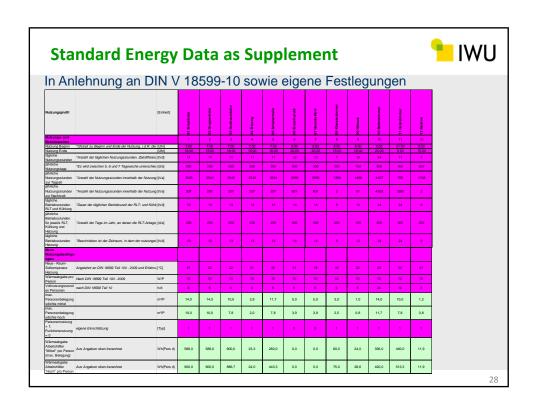
Relevance: Thermally conditioned, i.e. heated and/or cooled, non-residential buildings that fall under the Energy Savings Ordinance.











3 Summary



- Heuristic definition of a single non-residential building
- Building polygons are merged to buildings in a preceding on-site inspection process (screening)
- Enrich building elements with survey data in different levels of detail
- Supplement with default from DIN-standards