Technische Universität Berlin

Institute of Energy Engineering

Chair of Building Energy Systems

Hermann-Rietschel-Institut

Barbara Münch

Hermann-Rietschel-Institut

1885 Hermann Rietschels Appointment as Professor for Heating and Ventilation

1965 New Building

2013 Renovation of Building

app. 1.200 Publications

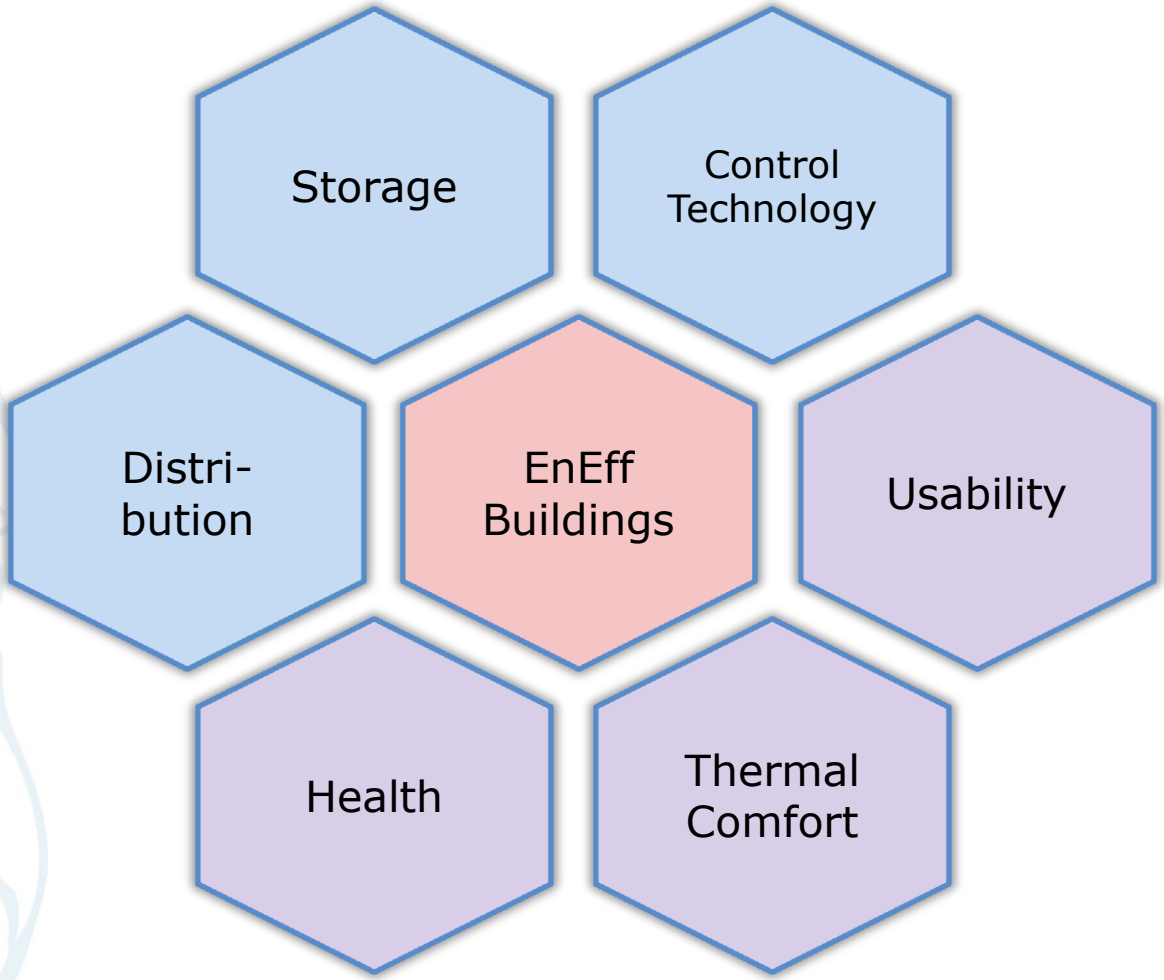
Prof. Dr.-Ing. Martin Kriegel

1994 – 2001	Studies of Building Technologies (Diploma) at TU Berlin
2001 – 2005	Doctoral Thesis at HRI, TU Berlin
2005 – 2011	Project Manager and Deputy CEO of an engineering office
06/2011	Professor of Building Energy Systems, Head of HRI, TU Berlin
04/2013	Head of Institute of Energy Engineering, TU Berlin

Hermann-Rietschel-Institut

1 Professor, 1 Administration, 3 Technical,
25 Research Associates, 22 Student Assistants

Research Focus



Research Areas in 2016

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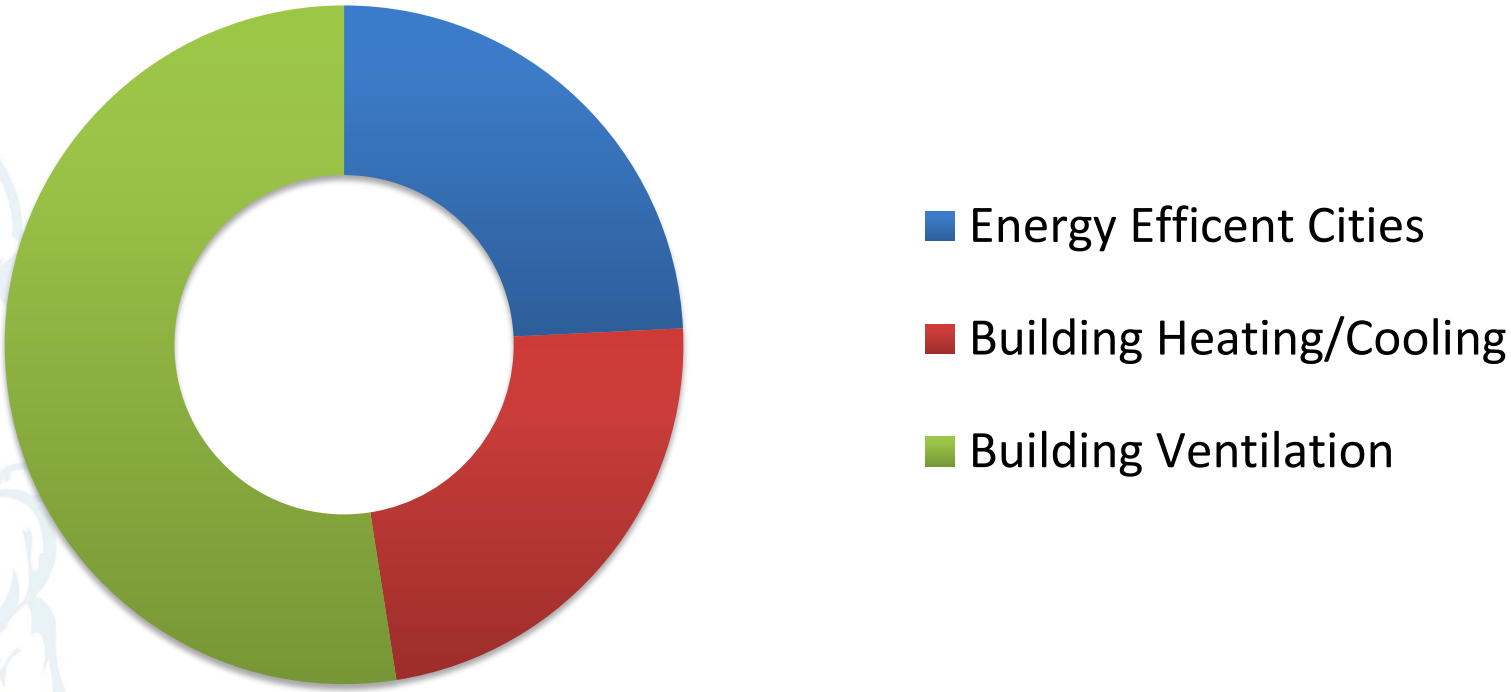
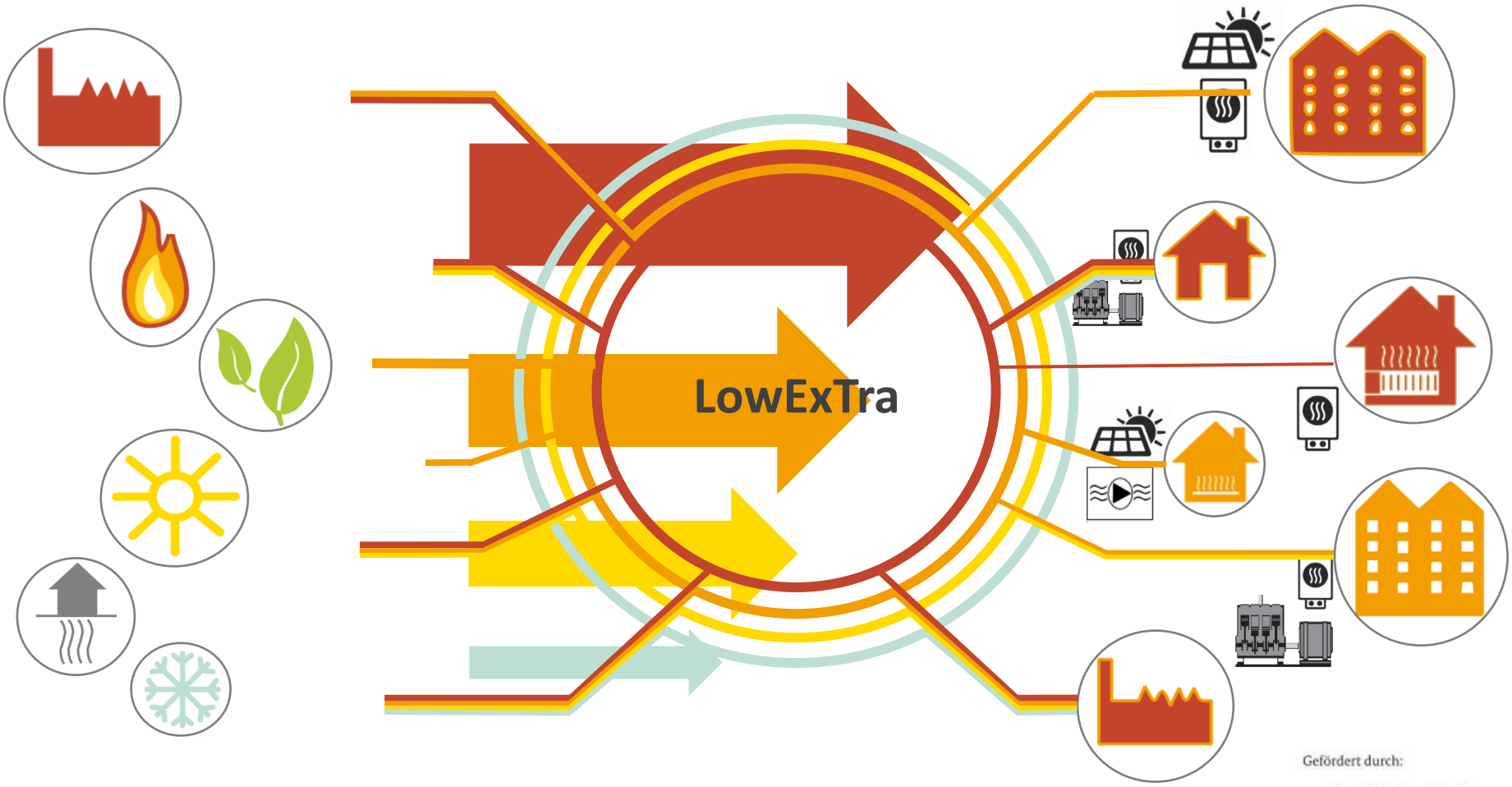
Topics



Unique Selling Points: Research Cleanroom and Research Data Center Labs

Third-Party Fundings: app. 1.8 Million € per Year

LowExTra Research Project



Gefördert durch:
Bundesministerium für Wirtschaft und Energie
aufgrund eines Beschlusses des Deutschen Bundestages

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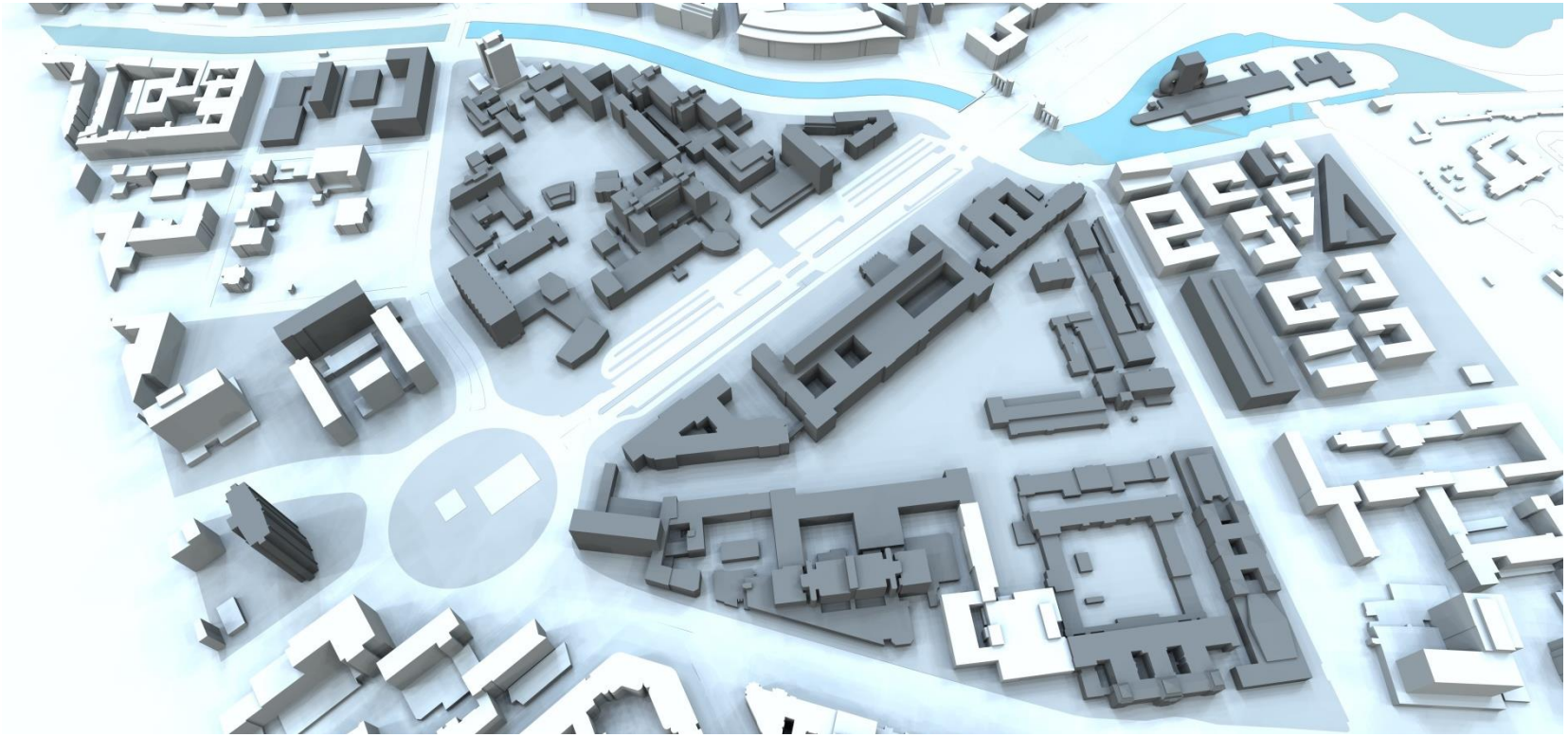
aufgrund eines Beschlusses des Deutschen Bundestages
BMWI - FKZ 03ET1354

Eneff: HCBC - **H**ochschul**C**ampus **B**erlin-**C**harlottenburg

Demonstration of an innovative management strategy of thermal energy for an existing urban quarter



Visualisierung von gte auf Basis von 3D-Stadtmodell Berlin

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University Campus Berlin-Charlottenburg

- more than 40 buildings and building ensembles (1883 – 2011)
- more than 40,000 people
- 500,000 sqm building space

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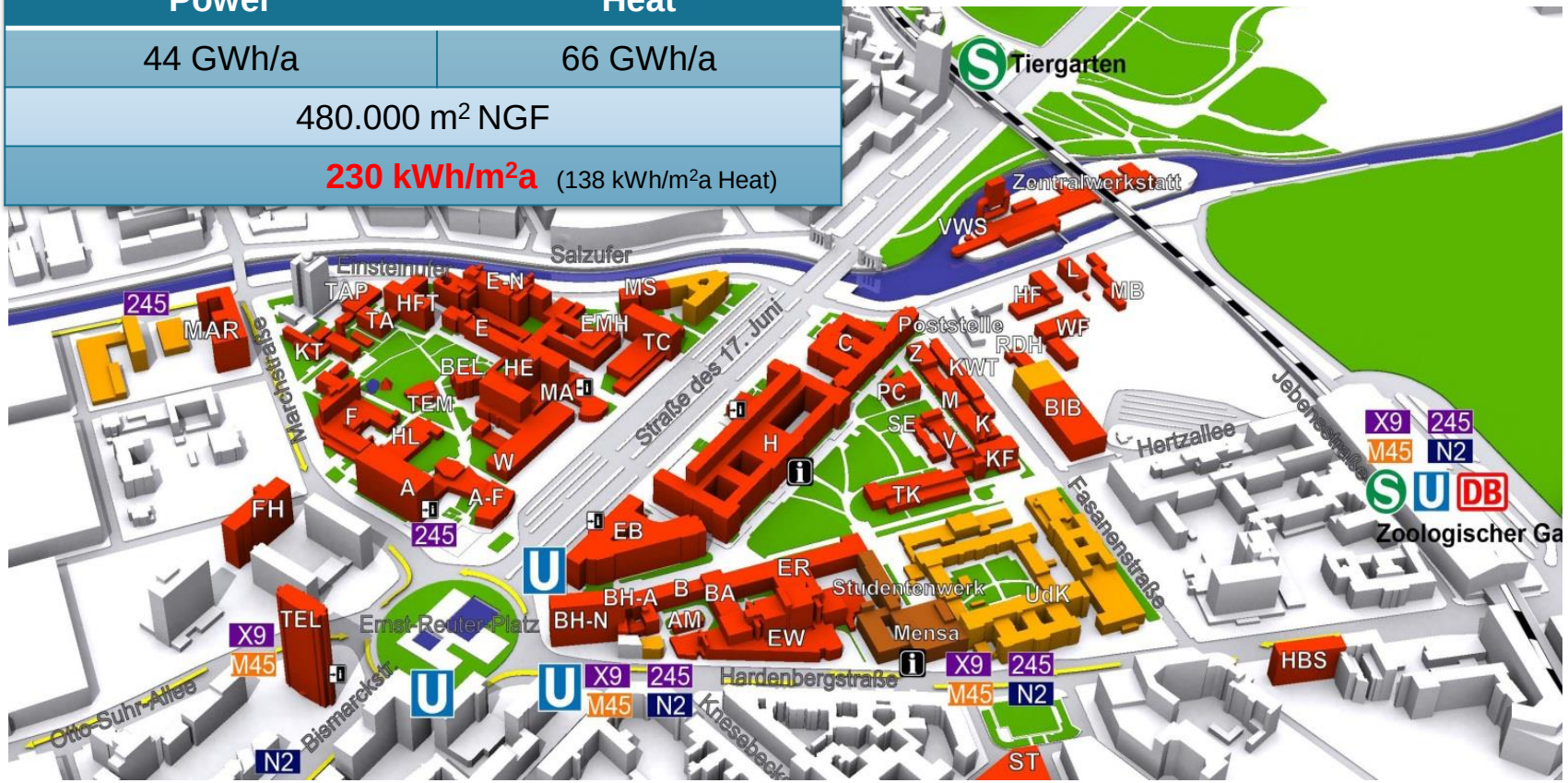
UdK Berlin

University Campus Berlin-Charlottenburg

Technische Universität Berlin

Energy Demand (Ø Endenergie 2011- 2015)

Power	Heat
44 GWh/a	66 GWh/a
480.000 m² NGF	
230 kWh/m²a (138 kWh/m²a Heat)	



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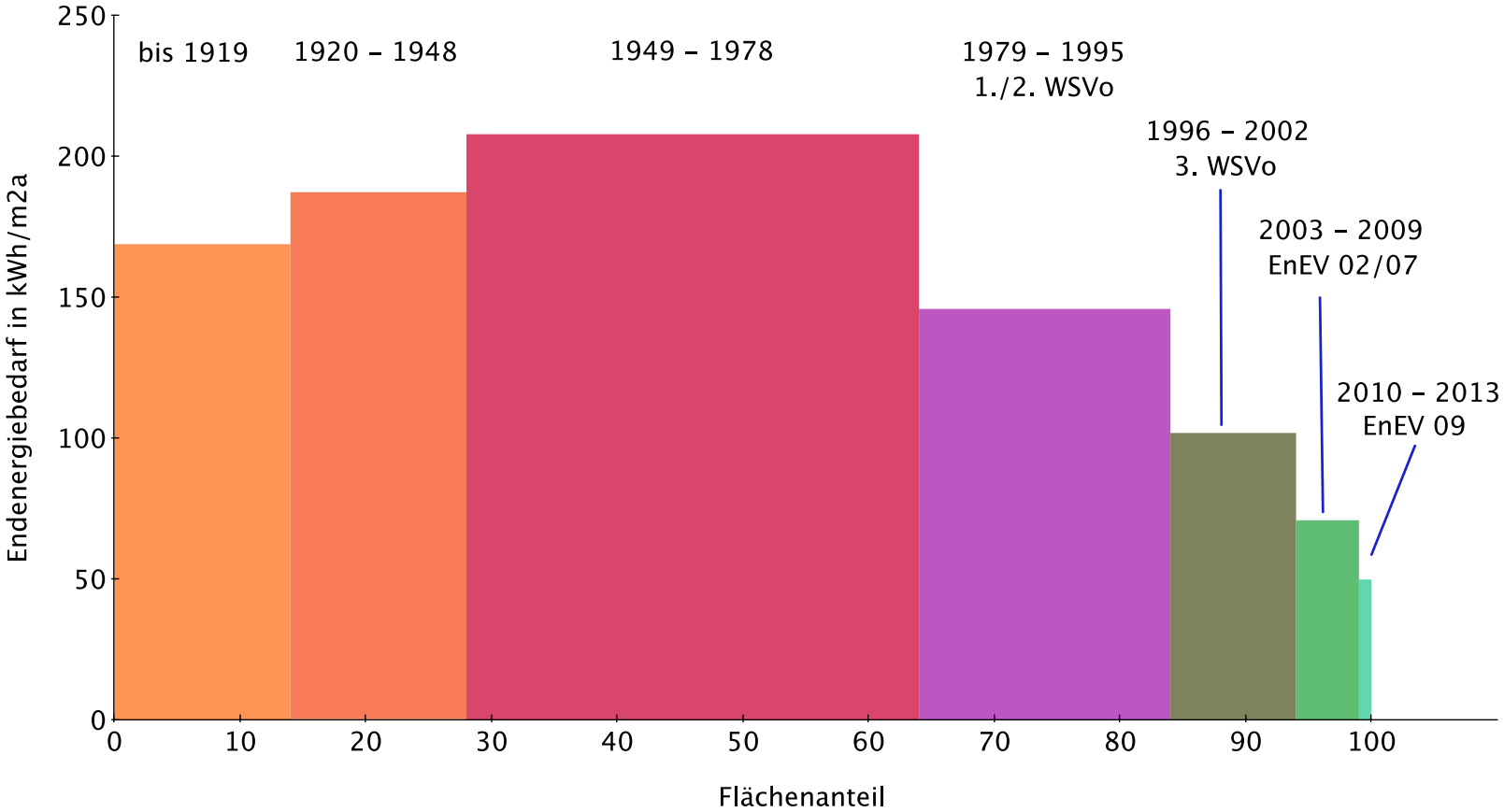
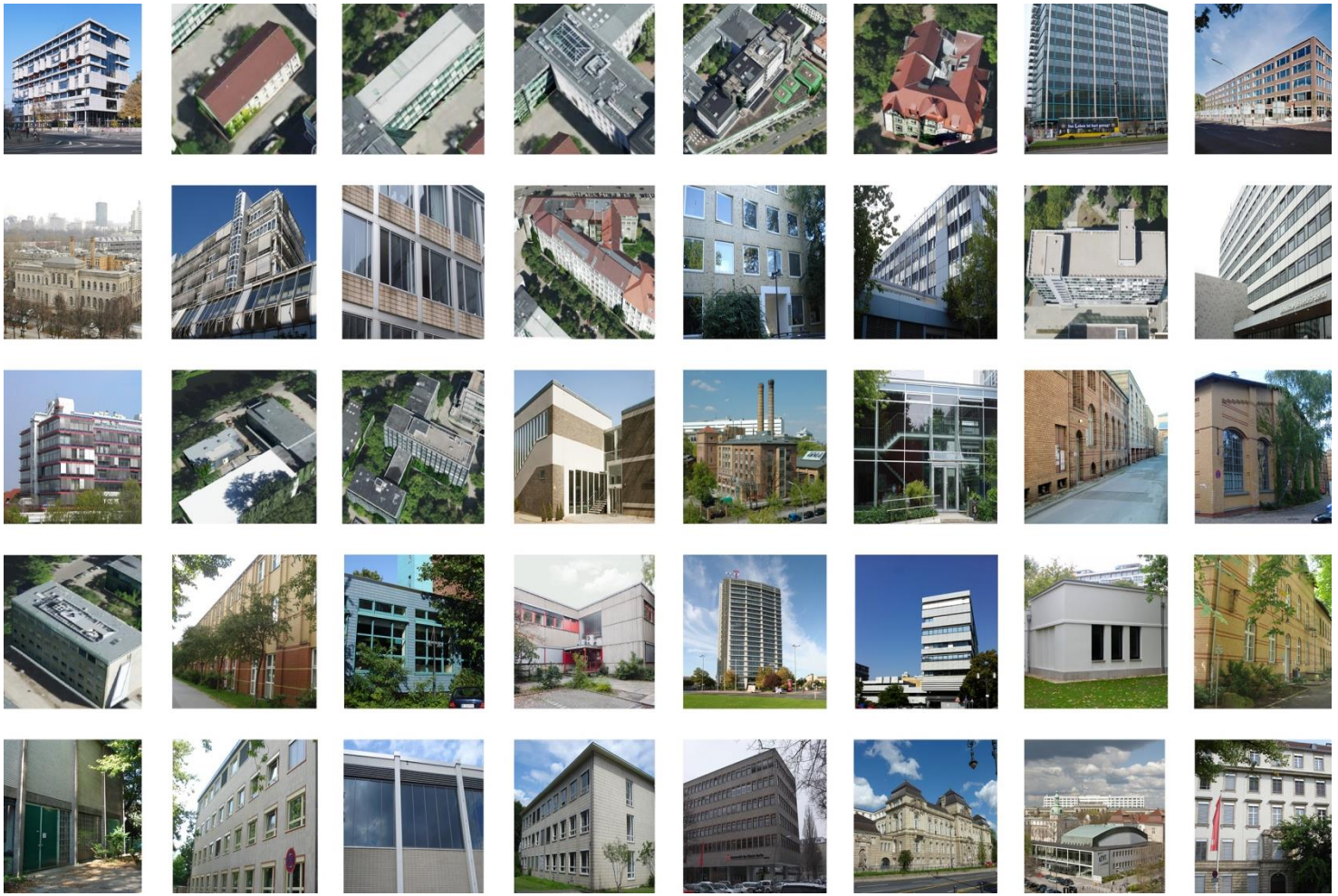
Results of Energy Policy in Germany



Quelle: Sanierungsbedarf im Gebäudebestand, BMWi, Dez. 2014

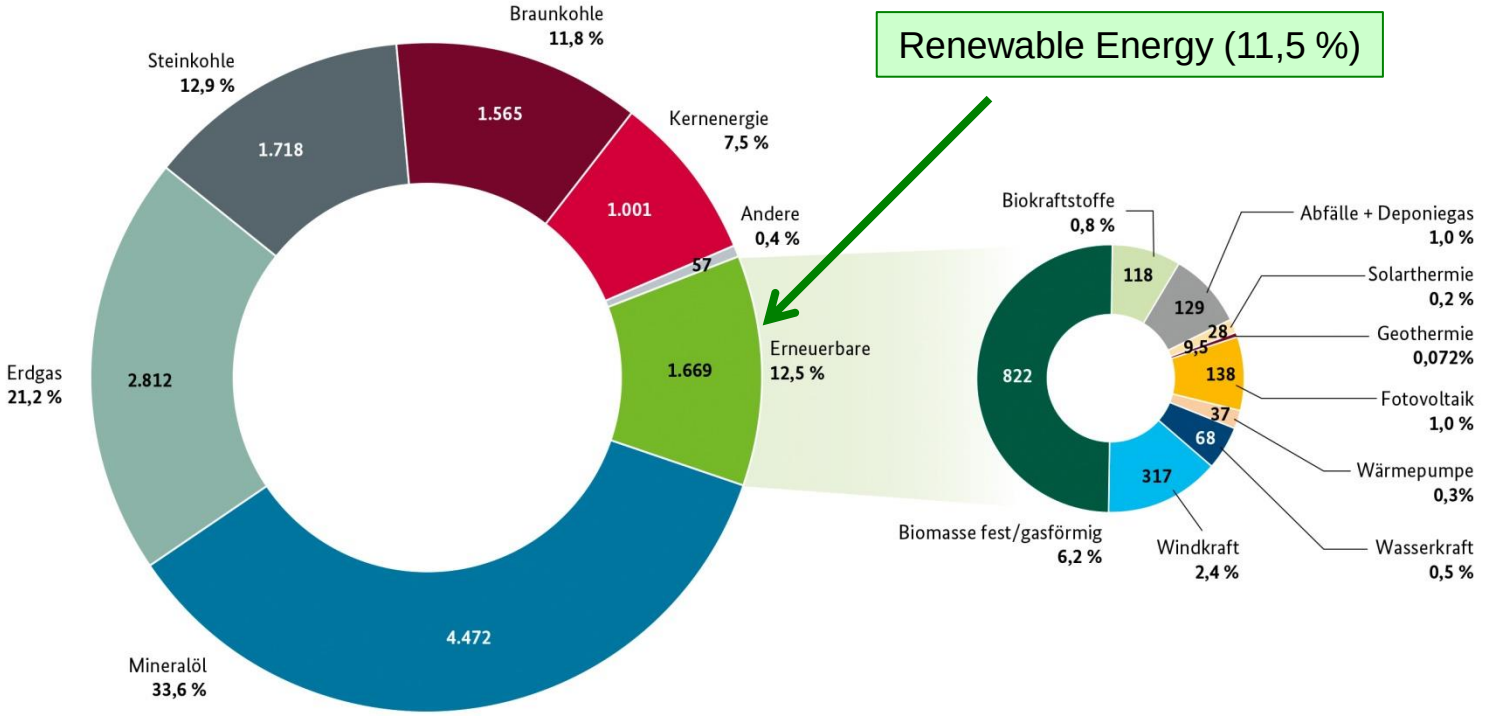
University Campus Berlin-Charlottenburg

40 buildings (1883 – 2011)



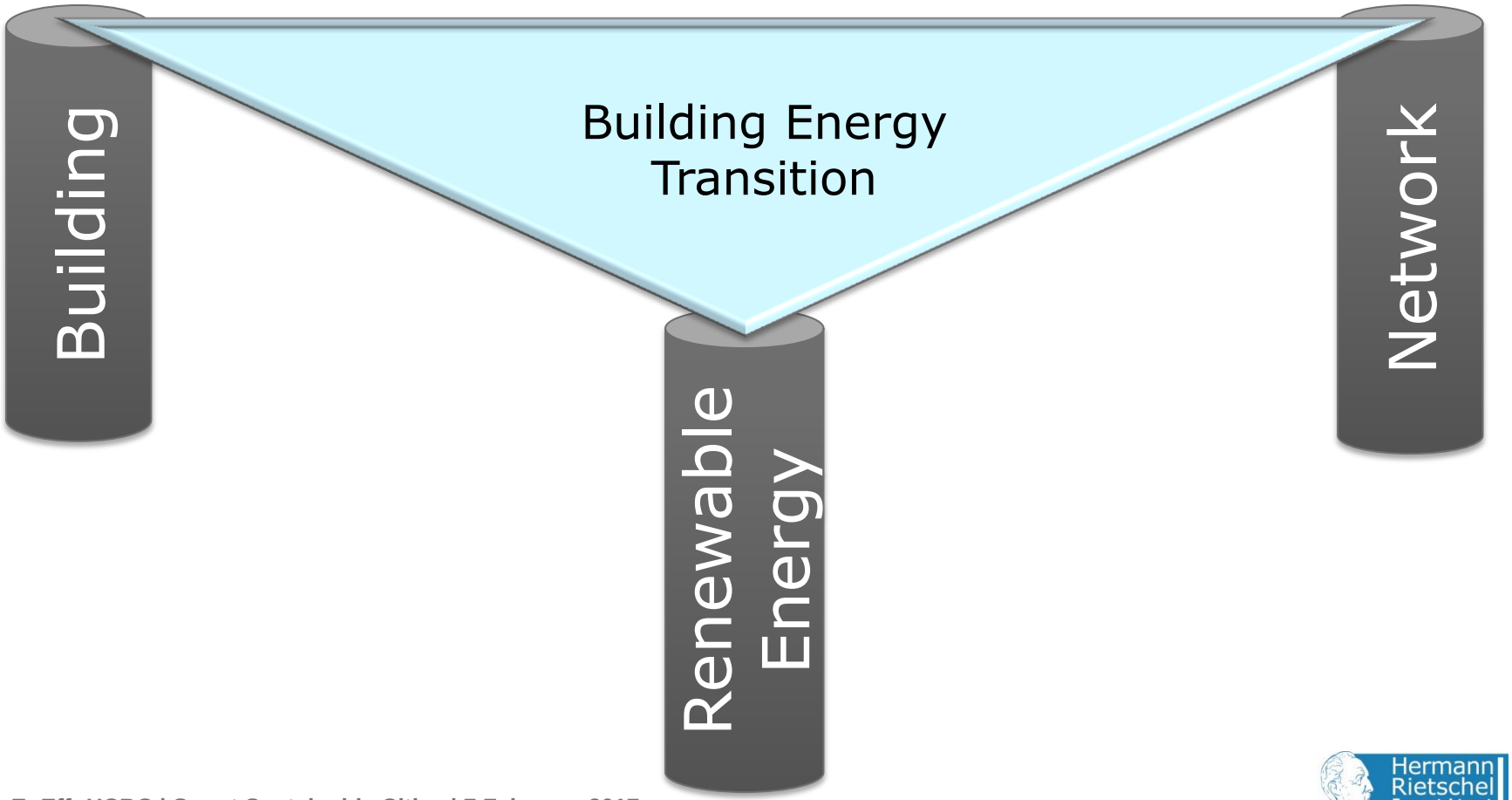
Results of Energy Policy in Germany

Consumption of primery energy in Germany 2015



Quelle: Arbeitsgemeinschaft Energiebilanzen (AGEB), Arbeitsgruppe Erneuerbare Energien-Statistik (AGEE-Stat)

How can we reach the target ?



Goals of the project

Primary Intentions:

- Reduction of demand of useful energy
- Increase of use of environmental energies / waste heat
- Smart distribution and storage of thermal energy

Project Objectives:

- Implement and demonstrate the Energy Concept 2050 of the German Federal Government at the level of our campus quarter by 2025

- Shift the thermal energy balance from building to the city quarter

- Use the campus as test and innovation laboratory to create a model for energy efficient redevelopment of existing urban quarters

University Campus - Characteristics

- Central location on central axis
- Compact unit
- Homogeneous ownership
- Control of energy consumption of building stock
- High Expertise on site
- Data on energy consumption of each building
- Considerable renovation backlog of several hundred million Euros regarding buildings and technical equipment
- Large potential for new buildings and campus extention at the eastern part of exisiting campus site

-> Eneff: HCBC as show case and pilot project of German „Energiewende“

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Sensitivity Analysis

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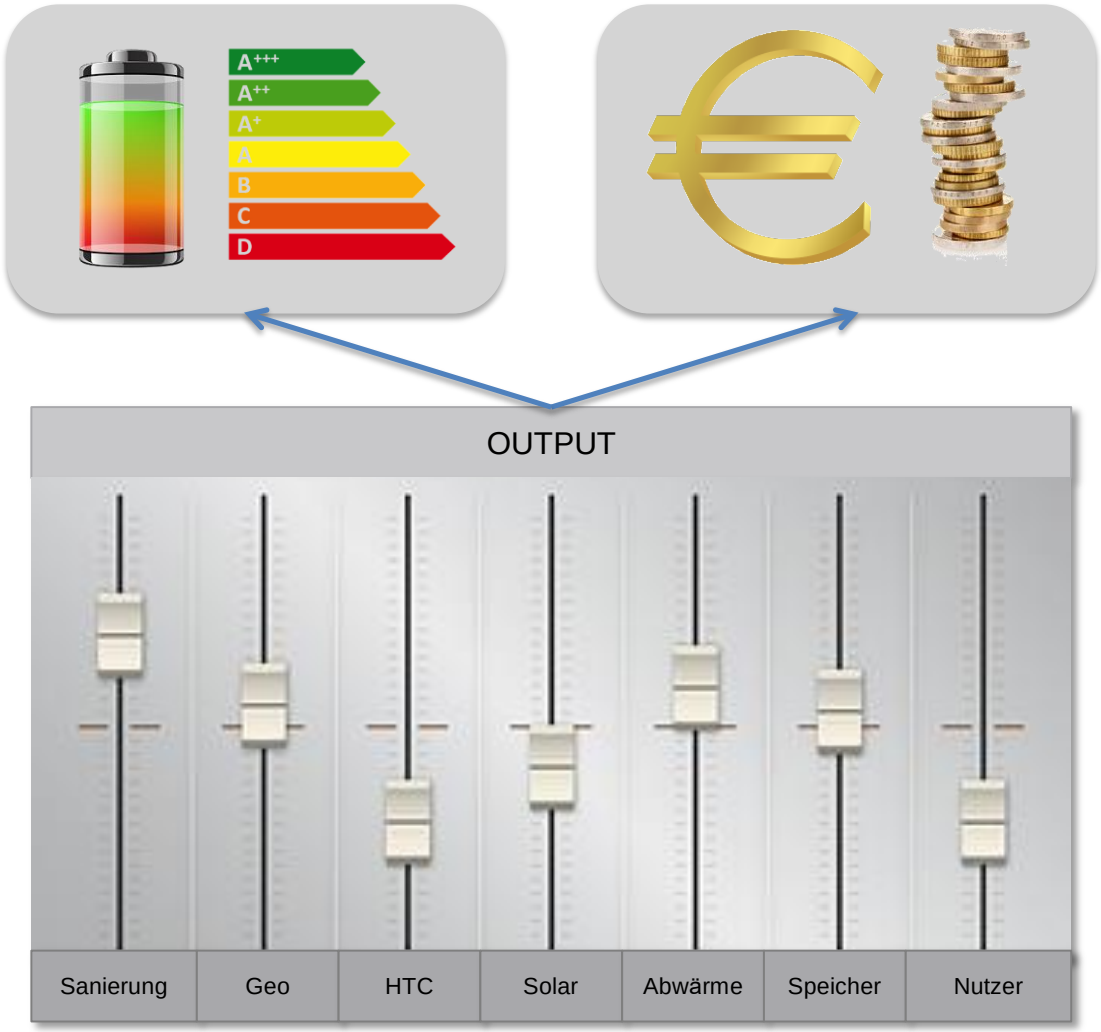

- To find a technically and economically optimal mix of

- energy savings through building renovation
- local production of renewable energy
- Set up of an energy grid that allows the smart distribution and storage of thermal energy within the campus

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Potential Analysis

Biomass for HTC
(Hydrothermal Carbonisation)

Solar thermal energy

Geothermal energy

Waste heat utilization

Building renovation

Necklace of R&D Diamonds

Hydrothermal Carbonisation HTC

from biomass (leaves, green cut, sludge, muck, animal poo) → CO_2 free coal

Prof: Dr. Markus Antonietti; Max Planck Institute for Colloid and Interfaces MPIKG Potsdam-Golm, Patent Holder

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Necklace of R&D Diamonds

Absorption-Chiller-System

Solar Cooling or Cooling by using Low Temperature Waste Heat

Prof. Dr. Ing. Felix Ziegler

Head of Department Machine- and Energy-Plant Technology of TU Berlin, Faculty III, Process Engineering Sciences, Patent Holder Chair for Energy Conversion Technology

Gefördert durch:

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aufgrund eines Beschlusses des Deutschen Bundestages

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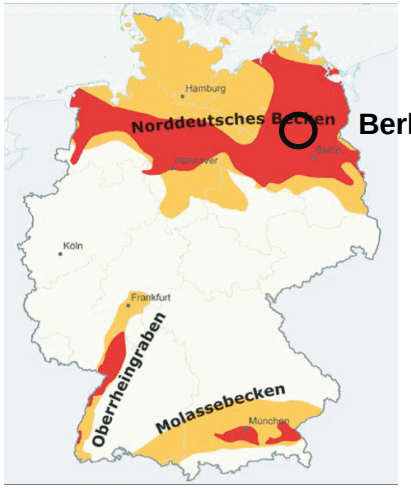
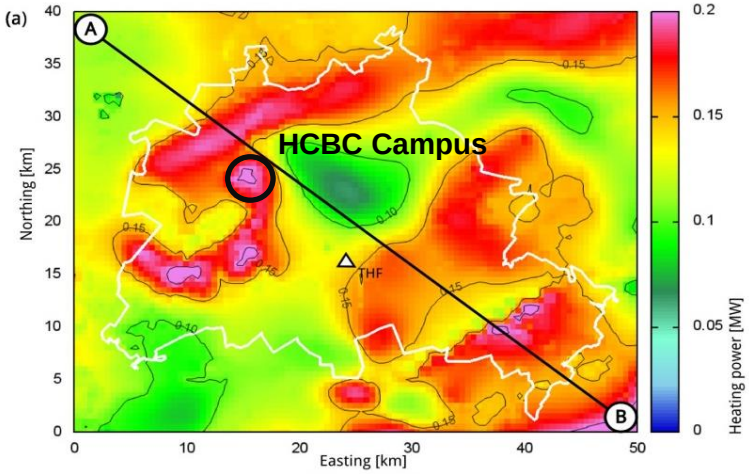
Necklace of R&D Diamonds

Deep Geothermal

Heat Potential in Berlin Region for Heating and Cooling (Absorption-Chiller)





Prof. Dr. Ernst Huenges, Dr. Ing. Habil. Oliver Kastner, GFZ Potsdam, Reservoir Technologies, Coop Partner HCBC
Dipl. Ing. Thomas Edelmann, Head of Research Herrenknecht AG, Coop Partner HCBC

Necklace of R&D Diamonds

Roof Top Potential of Berlin for Solar Energy Harvesting; e.g. roof tops Berlin-Mitte HCBC roofs as „Solar Power Plant“

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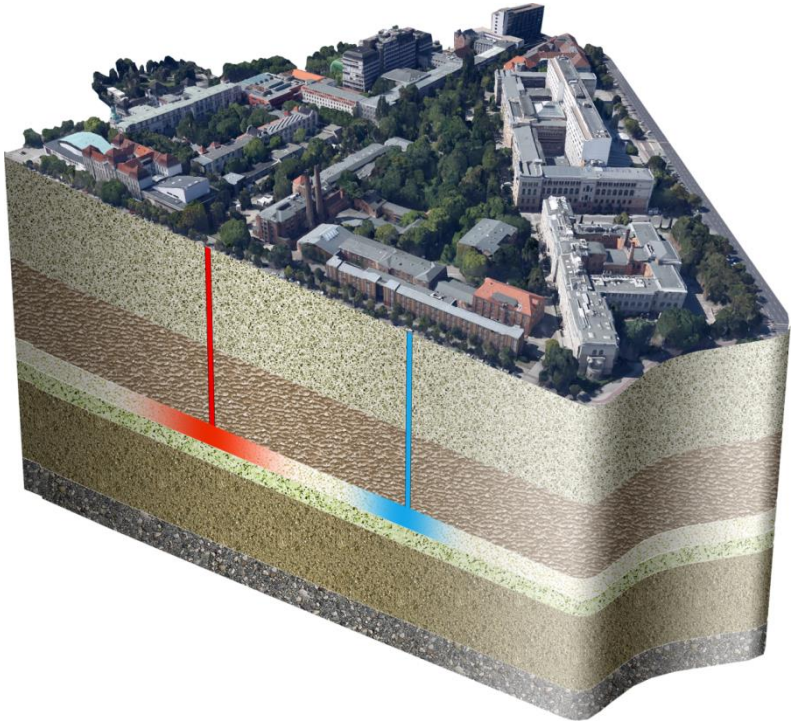
Necklace of R&D Diamonds

ATES - Aquifer Thermal Energy Storage

Efficiency and reliability of energy systems in urban districts with seasonal energy storage



1 Helmholtz Centre Potsdam GFZ German Research Centre for Geosciences,
2 Institute of Architecture and Urban Planning, University of Arts Berlin, Berlin,
3 TU Berlin, Institut für Energietechnik, KT 2, FG Maschinen- und Energieanlagentechnik

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Necklace of R&D Diamonds

EnEff: COP100

Free adiabatic cooling without chillers and thermal energy supplier

Prof. Dr.-Ing. Martin Kriegel

Hermann-Rietschel-Institut,
TU Berlin

Hermann Rietschel Institut
Gebäude-Energie-Systeme

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Data Collection: Building Envelope

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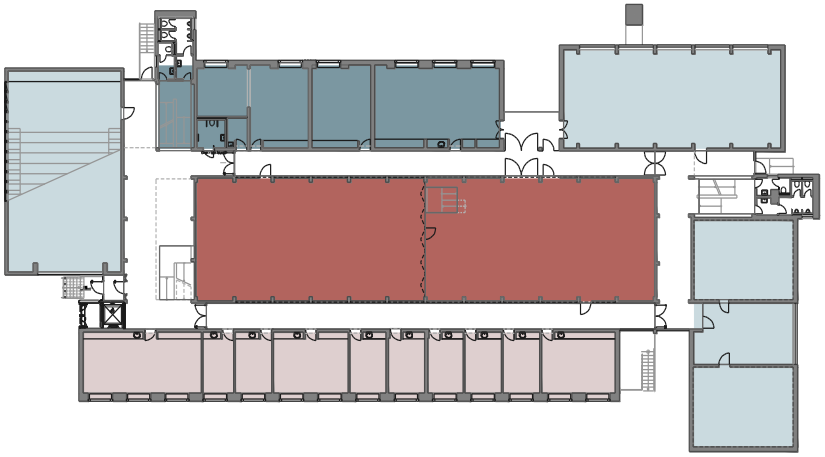
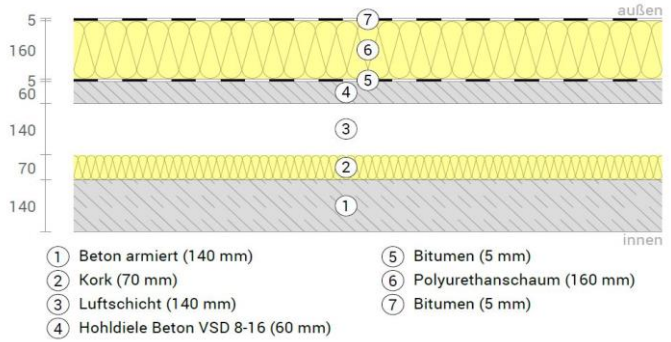
Geometry

Calculation of all vertical and horizontal surfaces in 3D



Building Physics

Layers of all surfaces to calculate U-values



#		Material	λ [W/mK]	R [m²K/W]	Temperatur [°C] min	Temperatur [°C] max	Gewicht [kg/m²]
		Wärmeübergangswiderstand*		0,130	18,8	20,0	
1	14 cm	Beton armiert (2%)	2,500	0,056	18,5	18,8	336,0
2	7 cm	Kork	0,050	1,400	11,8	18,5	11,2
3	14 cm	Luftschicht (ruhend)	0,778	0,180	11,0	11,8	0,2
4	6 cm	Hohldiele Beton VSD 8-16	1,230	0,049	10,7	11,0	97,5
5	0,5 cm	Bitumen	0,170	0,029	10,6	10,7	5,3
6	16 cm	Polyurethanschaum (PU)	0,050	3,200	-4,7	10,6	11,2
7	0,5 cm	Bitumen (Membran/Bahn)	0,230	0,022	-4,8	-4,7	5,5
		Wärmeübergangswiderstand*		0,040	-5,0	-4,8	
	58 cm	Gesamtes Bauteil		5,106			466,8

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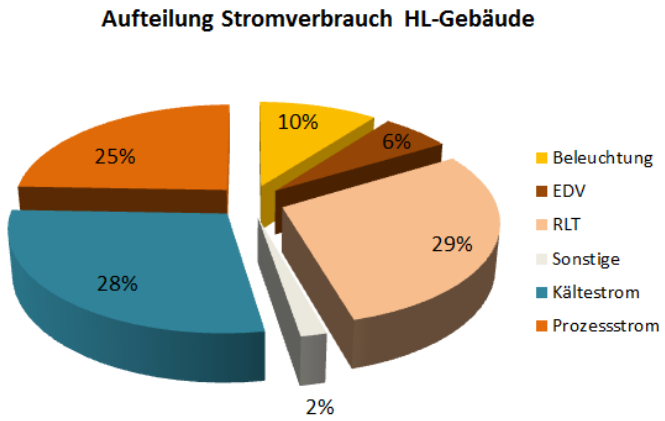
Gebäude-Energie-Systeme

Example: HL Gebäude

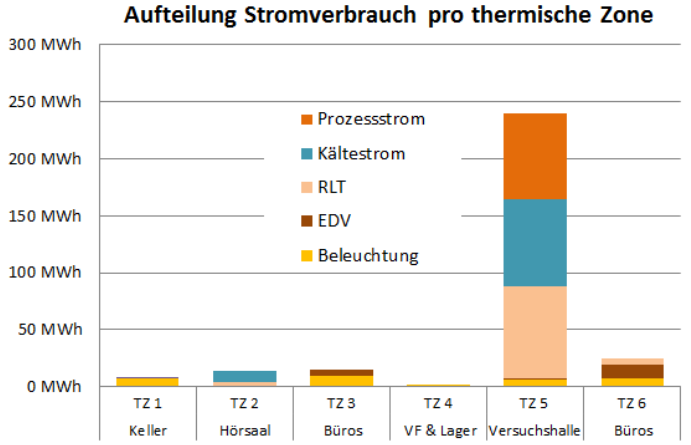
Merkmale:

- In 2014 saniert
- Stromverbrauch 2015: 365 504 kWh
- 6 thermische Zonen mit verschiedenen Hauptnutzungs-kategorien (Büros, Hörsaal, Versuchshalle etc.)

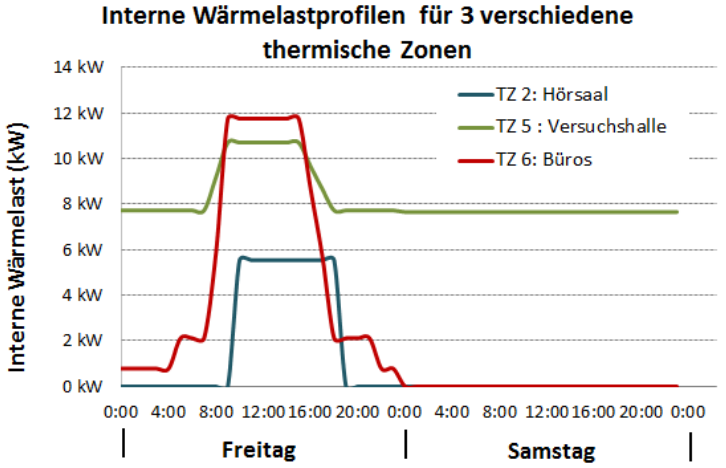
1. Calculation of the various power consumption



2. Power consumption for each building zone

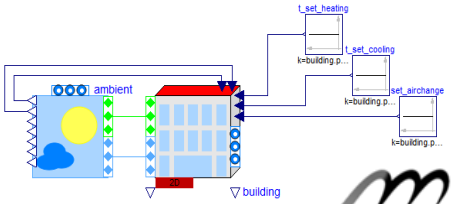


3. Creation of load profiles



From the building data to the simulation model

HL-Gebäude



MODELICA

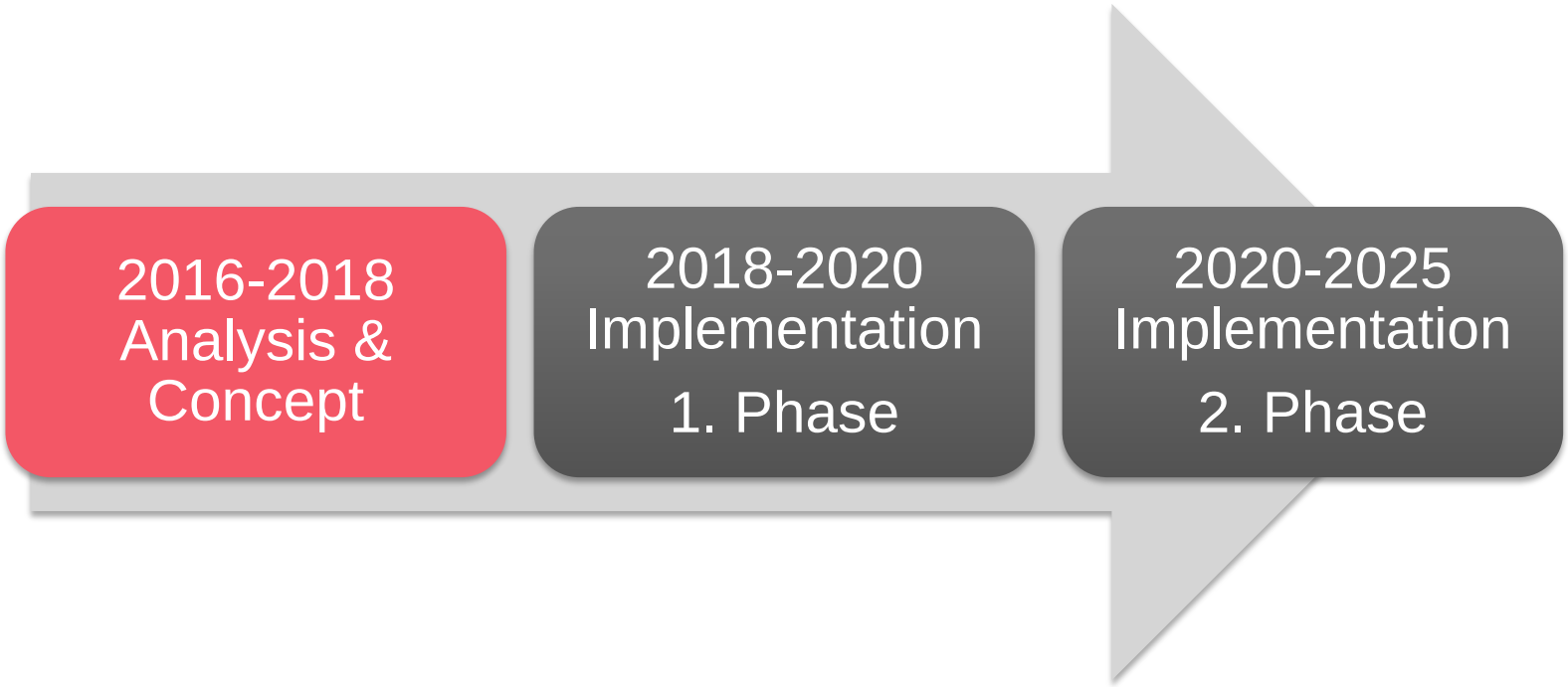
Modelica-Code HL-Gebäude

Daten erheben → in Datenbank einpflegen → Daten auslesen → Mapping auf Code-Template → Template in Modelica- Code übersetzen

python

mako

Overall time schedule



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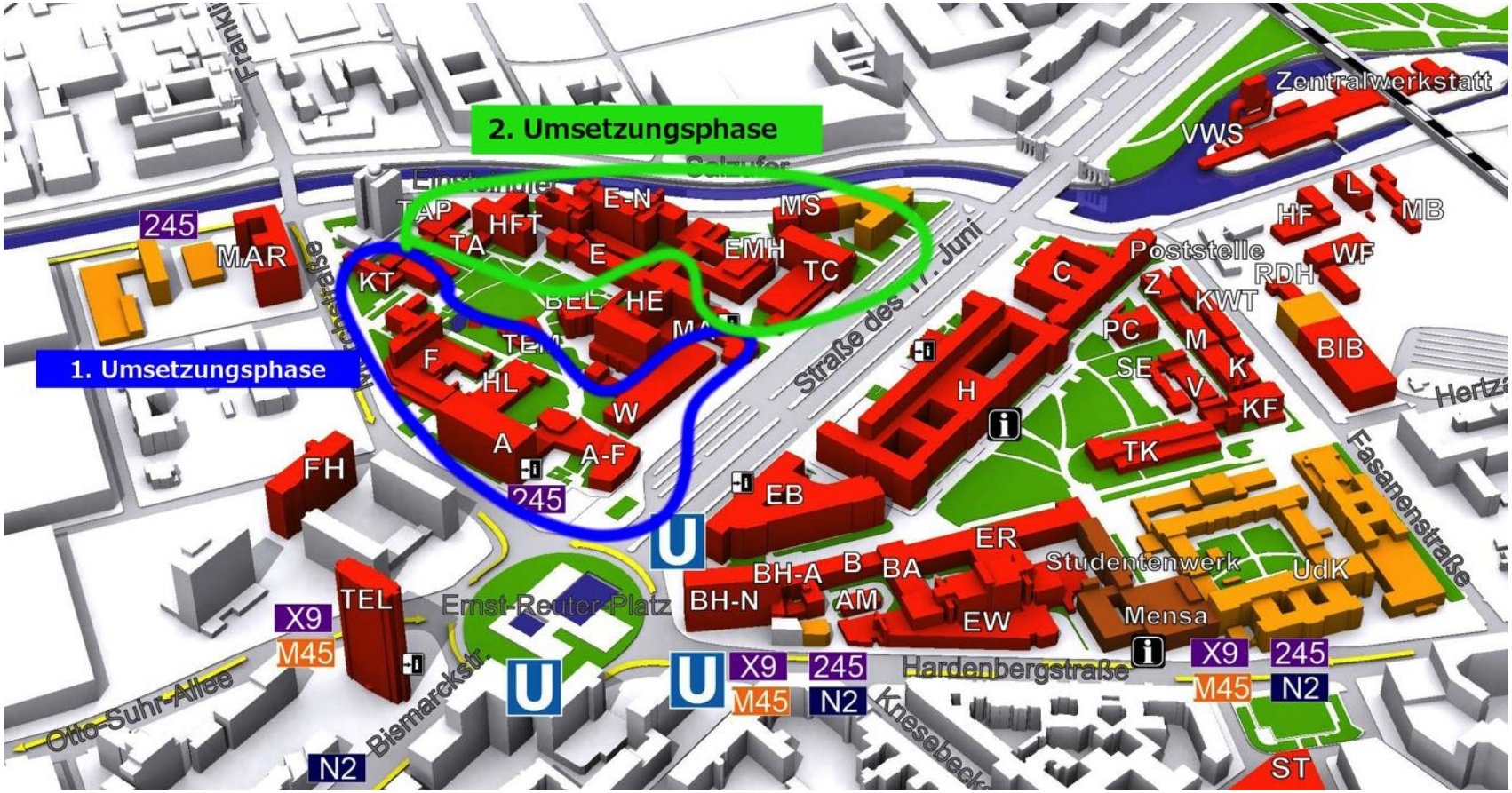
Implementation strategy



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Thank you for your attention

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