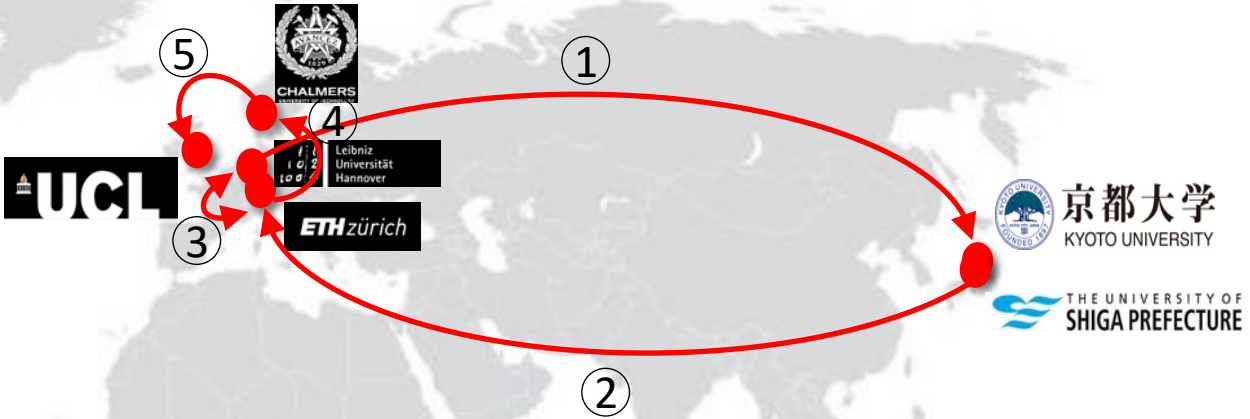
Building Stock Modelling

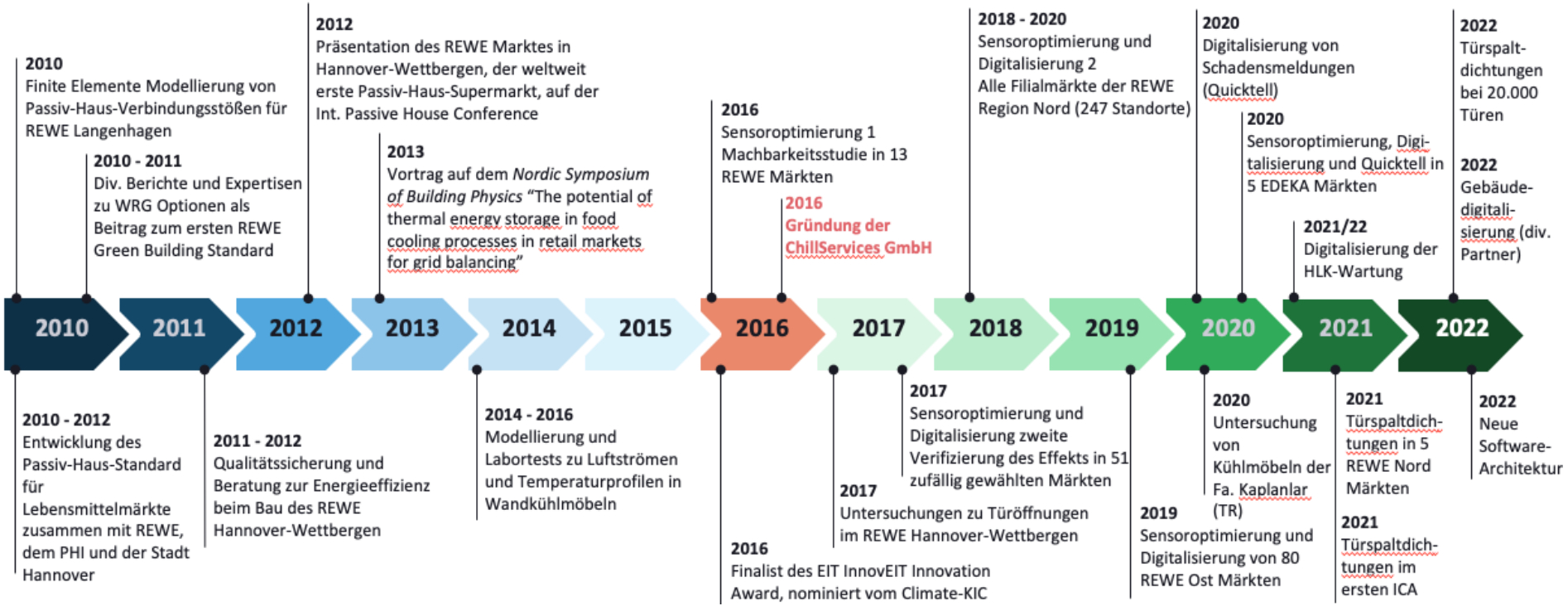
York Ostermeyer, PhD

Professor for Energy and Building Data

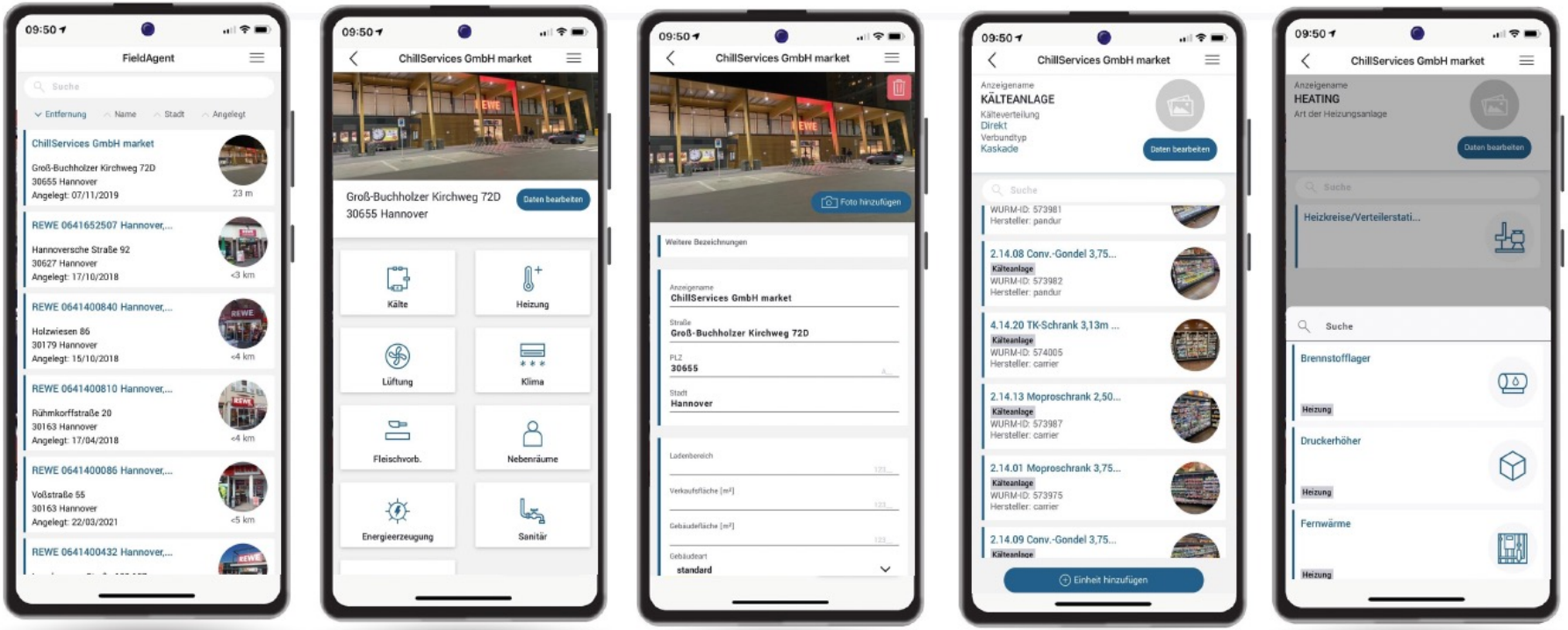
Werdegang


5
CHALMERS
1
4
Leibniz Universität Hannover
UCL
3
ETH zürich
京都大学
KYOTO UNIVERSITY
THE UNIVERSITY OF SHIGA PREFECTURE
2

Impact


2010
Finite Elemente Modellierung von Passiv-Haus-Verbindungsstößen für REWE Langenhagen
2010 - 2011
Div. Berichte und Expertisen zu WRG Optionen als Beitrag zum ersten REWE Green Building Standard
2012
Präsentation des REWE Marktes in Hannover-Wettbergen, der weltweit erste Passiv-Haus-Supermarkt, auf der Int. Passive House Conference
2013
Vortrag auf dem *Nordic Symposium of Building Physics* "The potential of thermal energy storage in food cooling processes in retail markets for grid balancing"
2016
Sensoroptimierung 1 Machbarkeitsstudie in 13 REWE Märkten
2016
Gründung der ChillServices GmbH
2018 - 2020
Sensoroptimierung und Digitalisierung 2
Alle Filialmärkte der REWE Region Nord (247 Standorte)
2020
Digitalisierung von Schadensmeldungen (Quicktell)
2020
Sensoroptimierung, Digitalisierung und Quicktell in 5 EDEKA Märkten
2021/22
Digitalisierung der HLK-Wartung
2022
Türspaltdichtungen bei 20.000 Türen
2022
Gebäudedigitalisierung (div. Partner)
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022
2010 - 2012
Entwicklung des Passiv-Haus-Standard für Lebensmittelmärkte zusammen mit REWE, dem PHI und der Stadt Hannover
2011 - 2012
Qualitätssicherung und Beratung zur Energieeffizienz beim Bau des REWE Hannover-Wettbergen
2014 - 2016
Modellierung und Labortests zu Luftströmen und Temperaturprofilen in Wandkühlmöbeln
2016
Finalist des EIT InnovEIT Innovation Award, nominiert vom Climate-KIC
2017
Untersuchungen zu Türöffnungen im REWE Hannover-Wettbergen
2017
Sensoroptimierung und Digitalisierung zweite Verifizierung des Effekts in 51 zufällig gewählten Märkten
2019
Sensoroptimierung und Digitalisierung von 80 REWE Ost Märkten
2020
Untersuchung von Kühlmöbeln der Fa. Kaplanlar (TR)
2021
Türspaltdichtungen in 5 REWE Nord Märkten
2021
Türspaltdichtungen im ersten ICA
2022
Neue Software-Architektur

Fakten



www.chilservices.com

Zurück zu Wohngebäuden

Die grosse Frage

1. Was wissen wir, was wissen wir nicht?

2. Was können wir, was können wir nicht?

3. Was machen wir nun? Wie geht es weiter?


PAF!
BANG!
BLOING!
BLOING!

Wissenschaftlicher Konsens

25% aller Schweizer Ärzte verschreiben mindestens einmal im Jahr homöopatische Mittel, 23% dieser Ärzte sind von der Wirksamkeit überzeugt

https://smw.ch/index.php/smw/article/view/2373

92% des Deutschen Krankenhaus Personals ist dreifach oder vierfach, weitere 4% einfach oder doppelt geimpft

https://www.br.de/nachrichten/deutschland-welt/faktenfuchs-corona-impfskepsis-bei-aerzten-selten-aber-folgenschwer,Sv3Ed2L

Über 99,9 % der Klimawissenschaftler stimmen der These zu, dass der menschengemachte Klimawandel existiert

Lynas, Mark; Houlton, Benjamin Z.; Perry, Simon: *Greater than 99% consensus on human caused climate change in the peer-reviewed scientific literature*. In: *Environmental Research Letters*. Band 16, Nr. 11, 19. Oktober 2021, S. 114005, doi:10.1088/1748-9326/ac2966(iop.org).

1. Was wissen wir, was wissen wir nicht?

2. Was können wir, was können wir nicht?

3. Was machen wir nun? Wie geht es weiter?

Baualtersklasse		EFH	RH	MFH	GMH	HH
		Basis-Typen				
A	... 1859					
B	1860 ... 1918					
C	1919 ... 1948					
D	1949 ... 1957					
E	1958 ... 1968					
F	1969 ... 1978					
G	1979 ... 1983					
H	1984 ... 1994					
I	1995 ... 2001					
J	2002 ... 2009					
K	2010 ... 2015					
L	2016 ...					

Sonderfälle						
	F/F	1969 ... 1978	Fertig-haus			
Neue Bundesländer industrieller Wohnungsbau	NBL_D	1946 ... 1960				
	NBL_E	1961 ... 1969				
	NBL_F	1970 ... 1980				
	NBL_G	1981 ... 1985				
	NBL_H	1986 ... 1990				

IWU

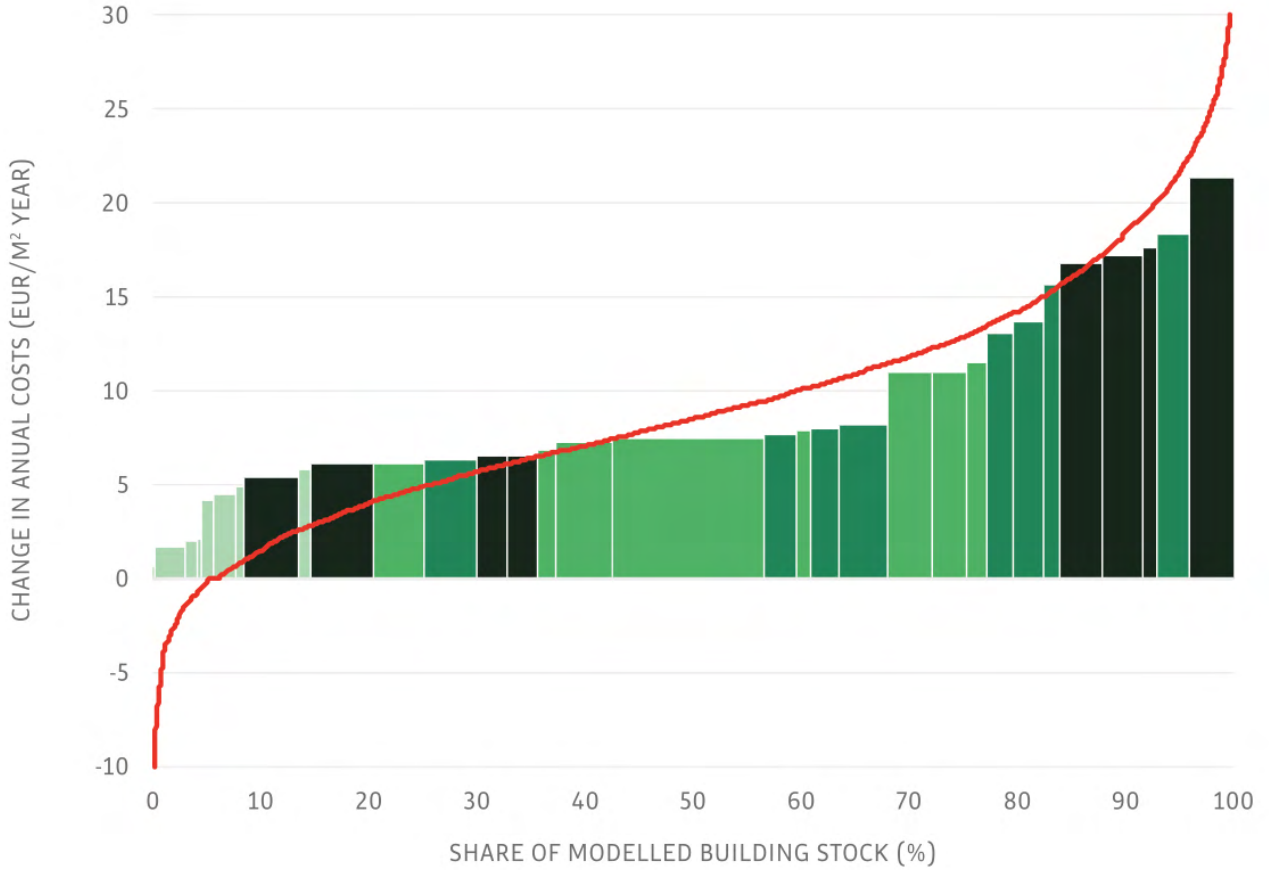
Deutsche Wohngebäudetypologie
Beispielhafte Maßnahmen
zur Verbesserung der Energieeffizienz von typischen Wohngebäuden
– zweite erweiterte Auflage –
Tobias Loga, Britta Stein, Nikolaus Diefenbach, Rolf Born

9.3
EUR/m² year
Average change in annual costs

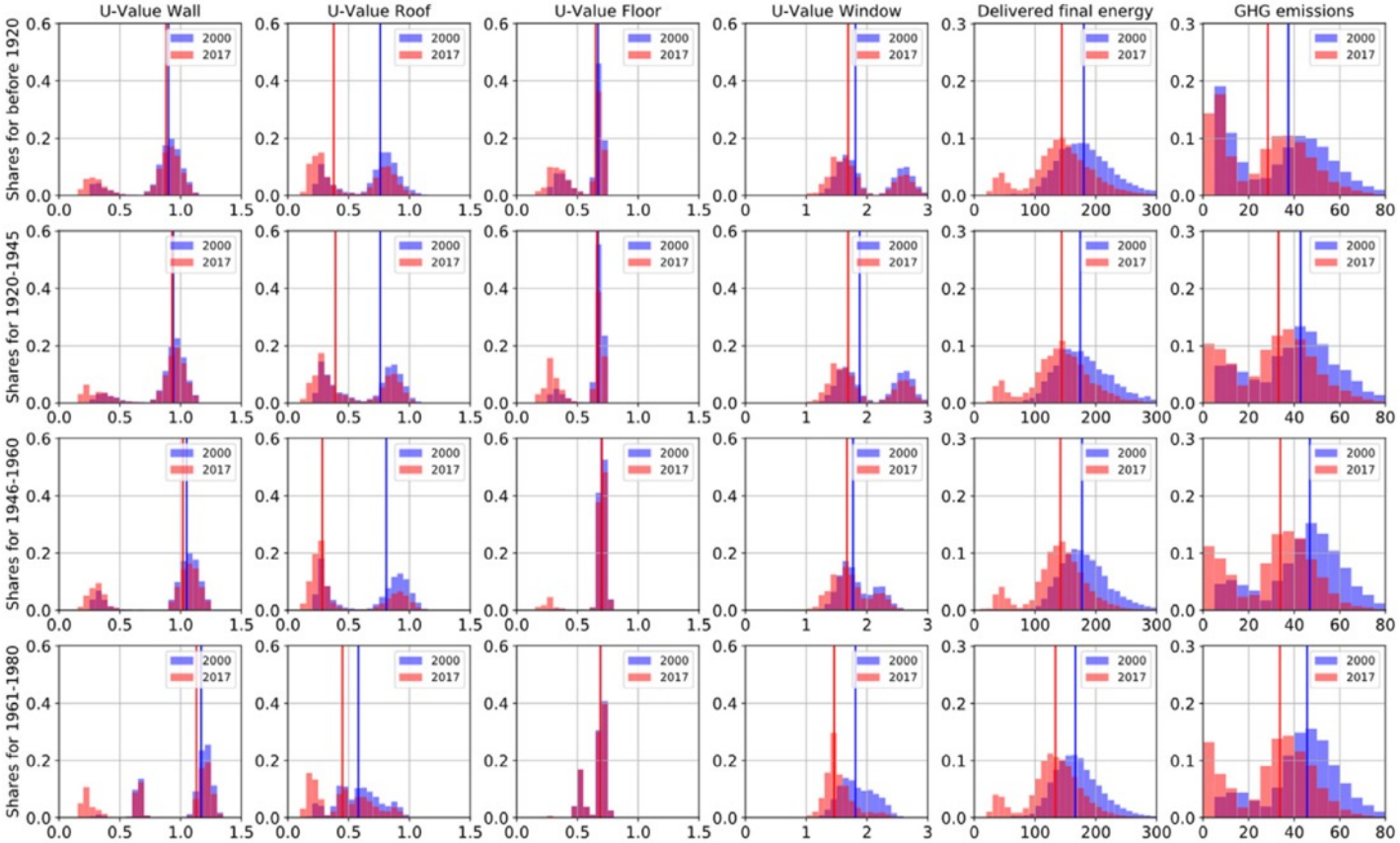
32
Typologies

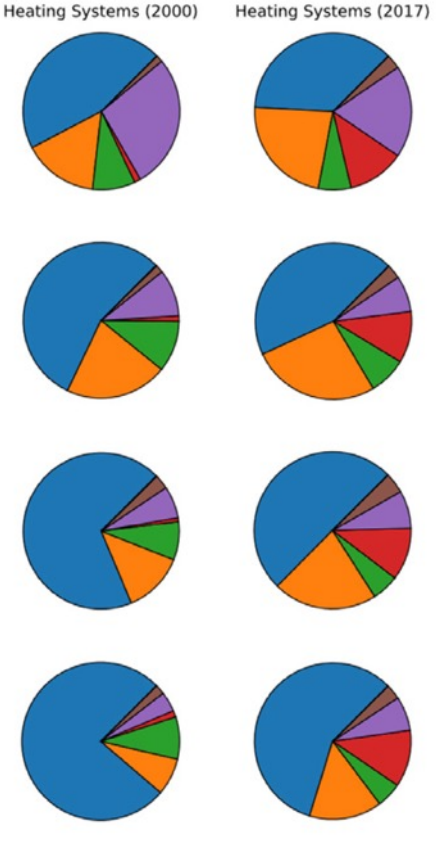
10.000
Representative buildings

527M. m2
Total heated floor area

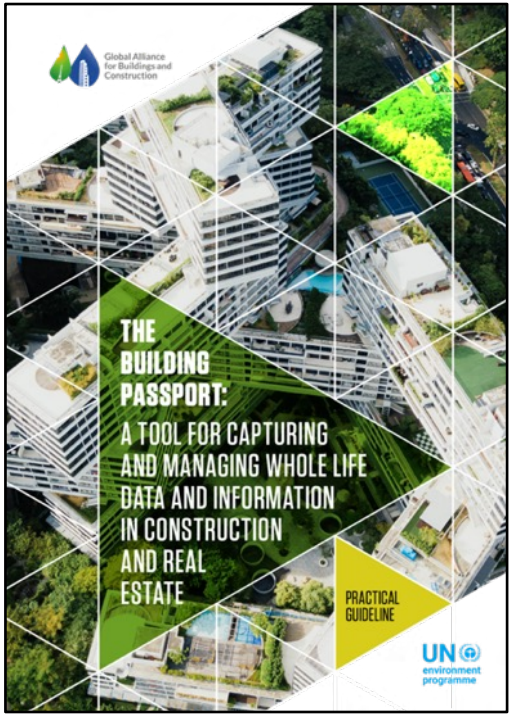


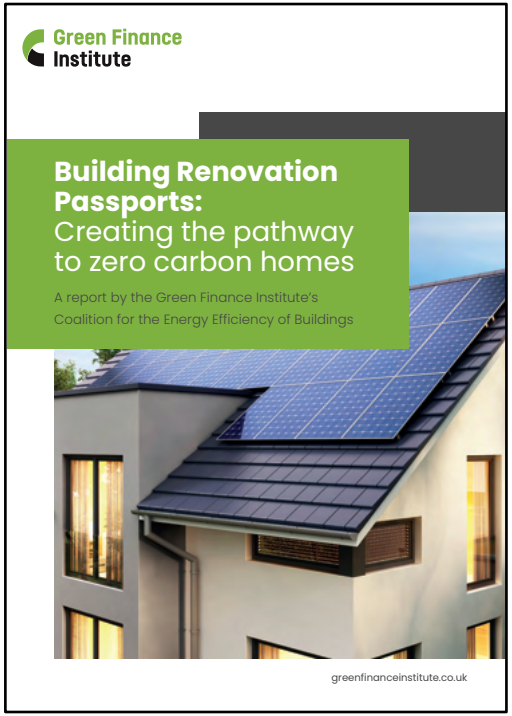
Ostermeyer, Y.; Camarasa, C.; Naegeli, C.: Saraf, S.; "Building Market Brief Switzerland", ISBN 978-90-827279-0-6



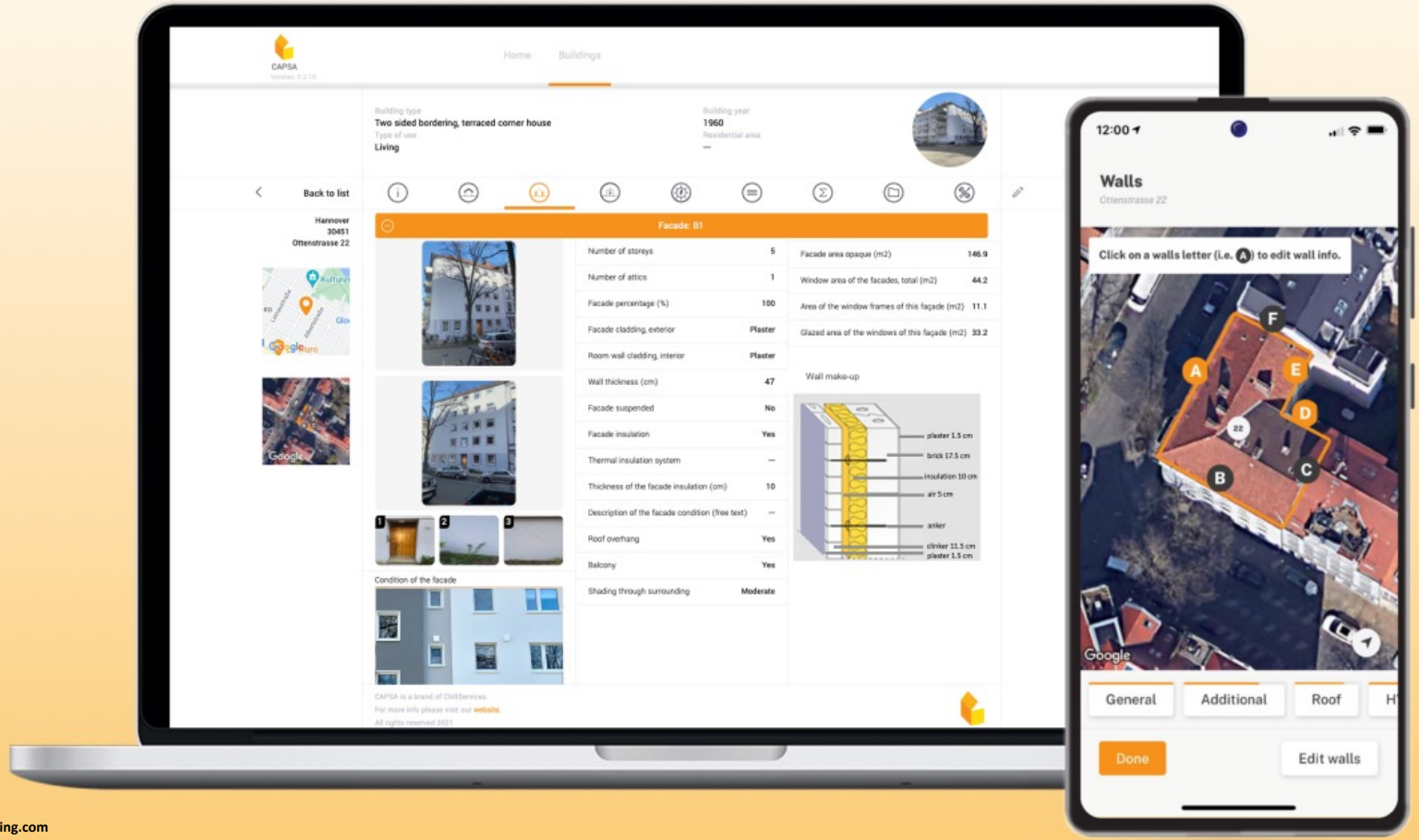


Nägeli, C., Jakob, M., Catenazzi, G., Ostermeyer, Y. (2020). Towards agent-based building stock modeling: Bottom-up modeling of long-term stock dynamics
affecting the energy and climate impact of building stocks. Energy and Buildings, 211. http://dx.doi.org/10.1016/j.enbuild.2020.109763


Global Alliance for Buildings and Construction
THE BUILDING PASSPORT:
A TOOL FOR CAPTURING AND MANAGING WHOLE LIFE DATA AND INFORMATION IN CONSTRUCTION AND REAL ESTATE
PRACTICAL GUIDELINE
UN environment programme


Green Finance Institute
Building Renovation Passports:
Creating the pathway to zero carbon homes
A report by the Green Finance Institute's Coalition for the Energy Efficiency of Buildings
greenfinanceinstitute.co.uk


European Commission
Study on the Development of a European Union Framework for Digital Building Logbooks
FINAL REPORT
R2M SOLUTION
vito
BPIE
December 2020



www.capsa-building.com

Building Components

Passive Components	Reference Unit
1. Outer walls against air	m^2 surface area
2. Outer walls against earth	m^2 surface area
3. Basement floor	m^2 surface area
4. Floors against unheated	m^2 surface area
5. Ceiling against unheated	m^2 surface area
6. Flat roof	m^2 surface area
7. Tilted roof	m^2 surface area
8. Windows in Wall	m^2 surface area
9. Windows in Tilted Roof	m^2 surface area
10. Windows in Flat Roof	m^2 surface area

Active Components	Reference unit
11. Heating System	$kW_{Thermal}$
12. Heat Distribution	$kW_{Thermal}$ or m^2
13. Ventilation	m^3/h
14. Cooling System	$kW_{Cooling}$
15. Lighting	m^2 floor area
16. Shading	m^2 window
17. Solarthermal	m^2 collector
18. Storage Tank	m^3 tank volume
19. PV	kW_{peak}
20. Control Systems	
21. Battery Systems	$kWh_{Capacity}$

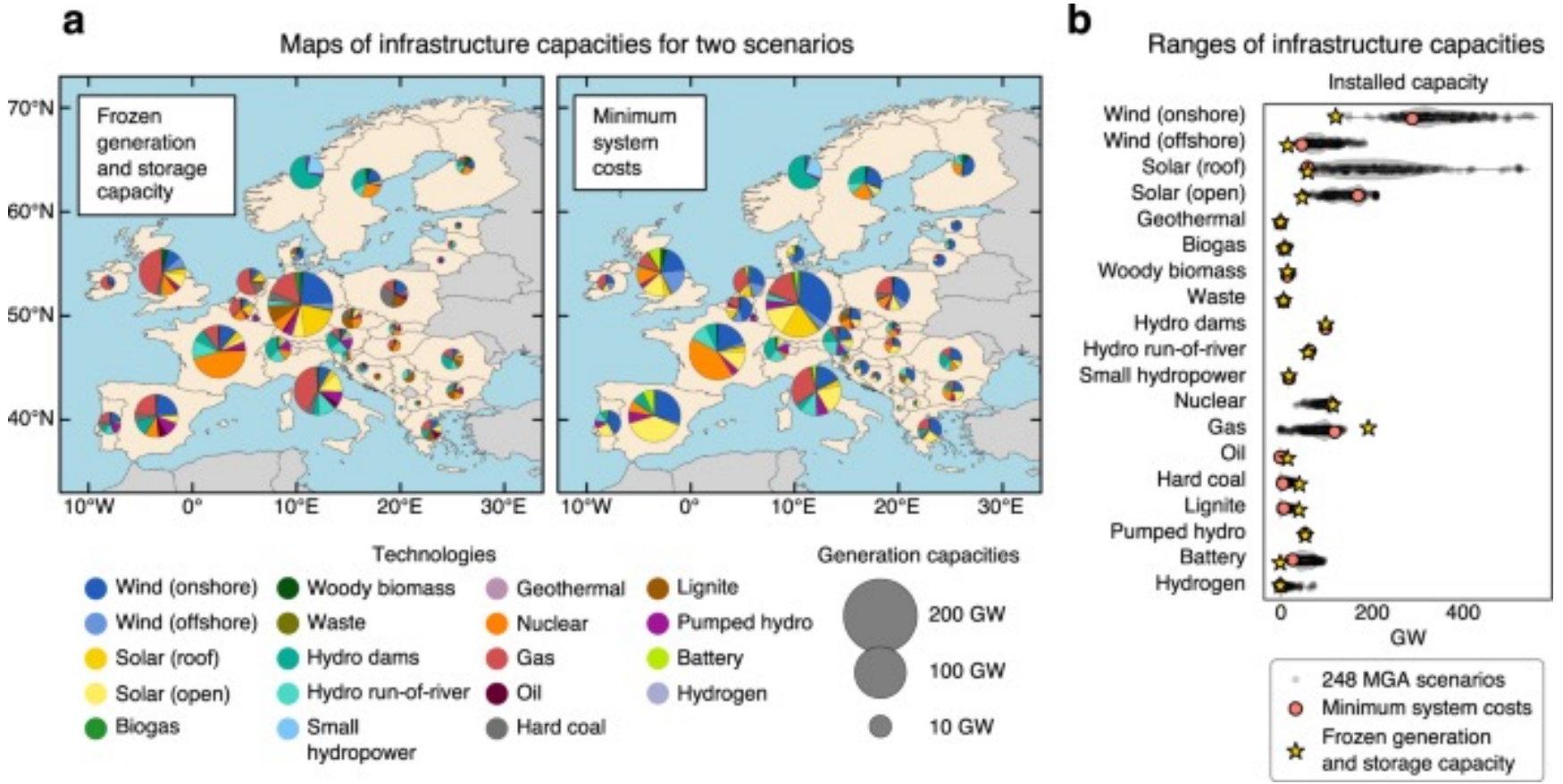
Refurbishment Solutions

ID	Solution	Insulation
1.1.	External insulation	
1.1.1.	Brickwall	50 mm
1.1.1.	Brickwall	80 mm
1.1.1.	Brickwall	100 mm
1.1.1.	Brickwall	120 mm
1.1.1.	Brickwall	150 mm
1.1.1.	Brickwall	170 mm
1.1.2.	Sandwich	50 mm
1.1.2.	Sandwich	80 mm
1.1.2.	Sandwich	120 mm
1.1.2.	Sandwich	150 mm
1.1.2.	Sandwich	200 mm
1.1.3.	Wooden Facade	45mm
1.1.3.	Wooden Facade	70 mm
1.1.3.	Wooden Facade	120 mm
1.1.3.	Wooden Facade	170 mm
1.1.3.	Wooden Facade	220 mm
1.2.	Internal insulation	
1.2.1.	Wooden Substructure	45 mm
1.2.1.	Wooden Substructure	70 mm
1.2.1.	Wooden Substructure	120 mm
1.2.2.	Steel Substructure	45 mm
1.2.2.	Steel Substructure	70 mm
1.2.2.	Steel Substructure	120 mm

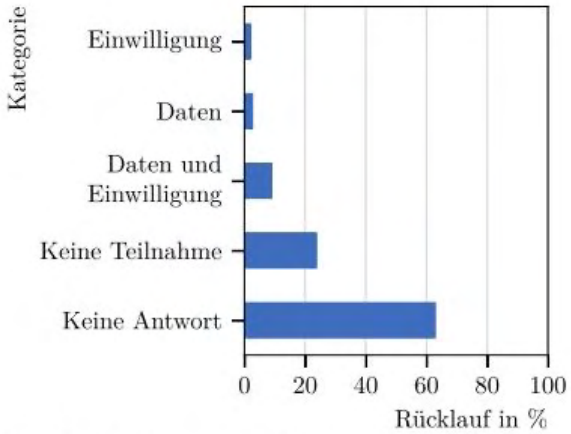
Material and Labour Breakdown

ID	Materials	Reference Unit	Material Cost [SEK]	Labour [h]	Labour Costs [SEK]
1.	Scaffolding	1.15m^2	33	0.18	35.1
2.	Façade plaster	1m^2	0	0.4	78
3.	Cardboard, demolished	1m^2	0	0.02	3.9
4.	Lock panel	1m^2	105.4	0.78	152.1
5.	Lath	3m	8.45	0.03	5.85
6.	Gypsum board, windshield	1m^2	40.95	0.14	27.3
7.	Mineral wool board	1m^2	41.6	0.09	17.55
8.	45x70 Bars	3.5m	8.9	0.08	15.6
9.	Plank wall, retained	1m^2	0	0	0
10.	Plastic foil incl. Tape	1m^2	7.55	0.09	17.55
11.	Gypsum board	1m^2	40.7	0.16	31.2

Nägeli, C., Camarasa, C., Jakob, M., Catenazzi, G., Ostermeyer, Y. (2018). Synthetic building stocks as a way to assess the energy demand and greenhouse gas emissions of national building stocks. Energy and Buildings, 173: 443-460. http://dx.doi.org/10.1016/j.enbuild.2018.05.055



Sasse, JP., Trutnevyte, E. A low-carbon electricity sector in Europe risks sustaining regional inequalities in benefits and vulnerabilities. *Nat Commun* **14**, 2205 (2023). https://doi.org/10.1038/s41467-023-37946-3



(a) Rücklaufquote der 304 befragten Mitglieder des AGFW. Informationen zu den Kategorien sind in **Tab. 3-2** zusammengestellt.

1. Was wissen wir, was wissen wir nicht?

2. Was können wir, was können wir nicht?

3. Was machen wir nun? Wie geht es weiter?

Wir können Infrastrukturanalysen

WP möglich

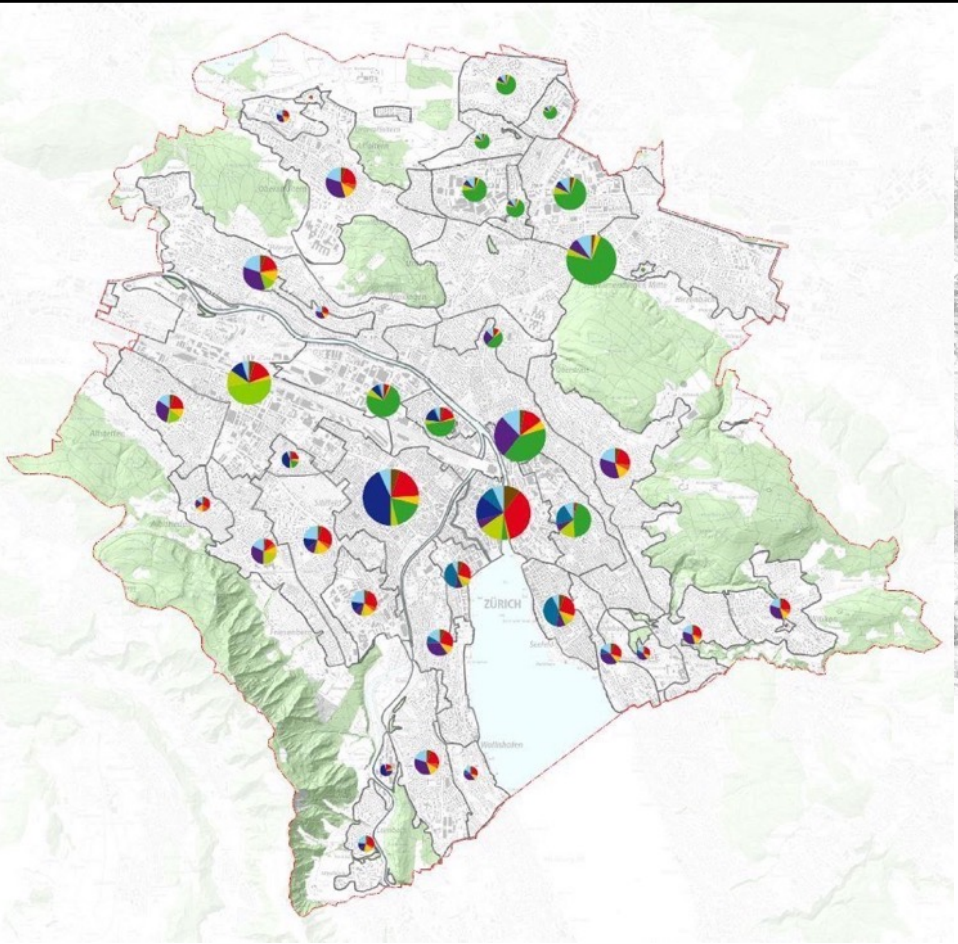
Energieverbrauch
- tief
- mitteltief
- mittelhoch
- hoch
- zu hoch

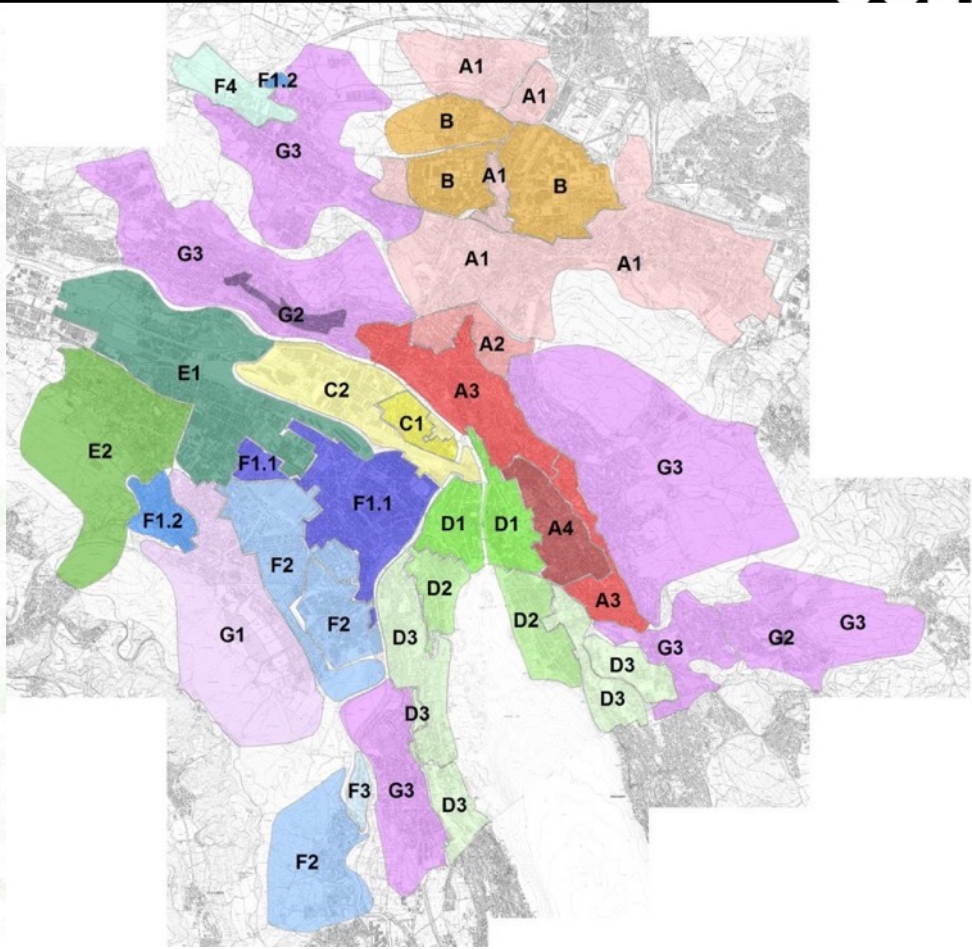
Abstand WP
- tief
- mitteltief
- mittelhoch
- hoch

Harmonisierte Bauzonen
- Wohnzonen
- Mischzone

Martin Jakob, TEP Energy

Wir können gute Infrastrukturplanung





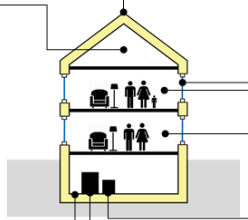
Wir können Daten ergänzen

Building	
Building type	Multi-Dwelling Building
Climate zone	Switzerland
Construction year	1926
Scaling factor	
Representative floor area	
Number of floors	2
Number of basement floors	1
Roof type	Pitched
Number of dwellings	2
Residential floor area	211 m²
Heated floor area	253 m²
Footprint area	126 m²
Height floor	2.9 m
Perimeter	19.0 m
Volume	761 m³
Ventilation rate infiltration	
Electricity auxiliary	
Heat capacity	

Opaque Components	
Component Type	Roof
Year	1979
Surface Area	152 m²
U-Value	
Insulation thickness	
Orientation	
Angle	

Transparent Components	
Component type	Window
Year	1987
Surface area	
U-value	
g-value	
Shading factor	
Frame ratio	
Orientation	
Angle	

Dwellings	
Dwelling area	105 m²
Number of rooms	
Number of occupants	
Occupancy time	
Indoor temperature	
Consumption hot water	
Electricity lighting	
Electricity appliances	



Ventilation	
Ventilation type	Natural
Year	
Central	
Ventilation rate	
Efficiency heat recovery	
Specific fan power	
Maintenance costs	0 CHF/a

Heating System	
System type	
Year	
Central	
Power	
Efficiency	
Energy carrier	
Maintenance costs	680 CHF/a

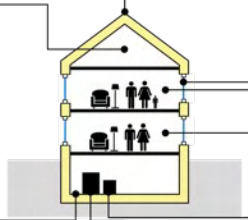
Hot Water System	
System type	
Year	
Central	
Volume	
Efficiency	
Energy carrier	
Maintenance costs	386 CHF/a

Building	
Building type	Multi-Dwelling Building
Climate zone	Switzerland
Construction year	1926
Scaling factor	109
Representative floor area	27721 m²
Number of floors	2
Number of basement floors	1
Roof type	Pitched
Number of dwellings	2
Residential floor area	211 m²
Heated floor area	253 m²
Footprint area	126 m²
Height floor	2.9 m
Perimeter	19.0 m
Volume	761 m³
Ventilation rate infiltration	86 m³/h
Electricity auxiliary	1066 kWh/a
Heat capacity	234 kJ/K m²

Opaque Components	
Component Type	Roof
Year	1979
Surface Area	152 m²
U-Value	0.53 W/m² K
Insulation thickness	75 mm
Orientation	139°/319°
Angle	20°

Transparent Components	
Component type	Window
Year	1987
Surface area	20.7 m²
U-value	1.7 W/m² K
g-value	0.69
Shading factor	0.71
Frame ratio	0.12
Orientation	144°
Angle	90°

Dwellings	
Dwelling area	105 m²
Number of rooms	5
Number of occupants	2
Occupancy time	15 h/pers. Day
Indoor temperature	20.9 °C
Consumption hot water	32 m³/pers. Day
Electricity lighting	407 kWh/a
Electricity appliances	2231 kWh/a



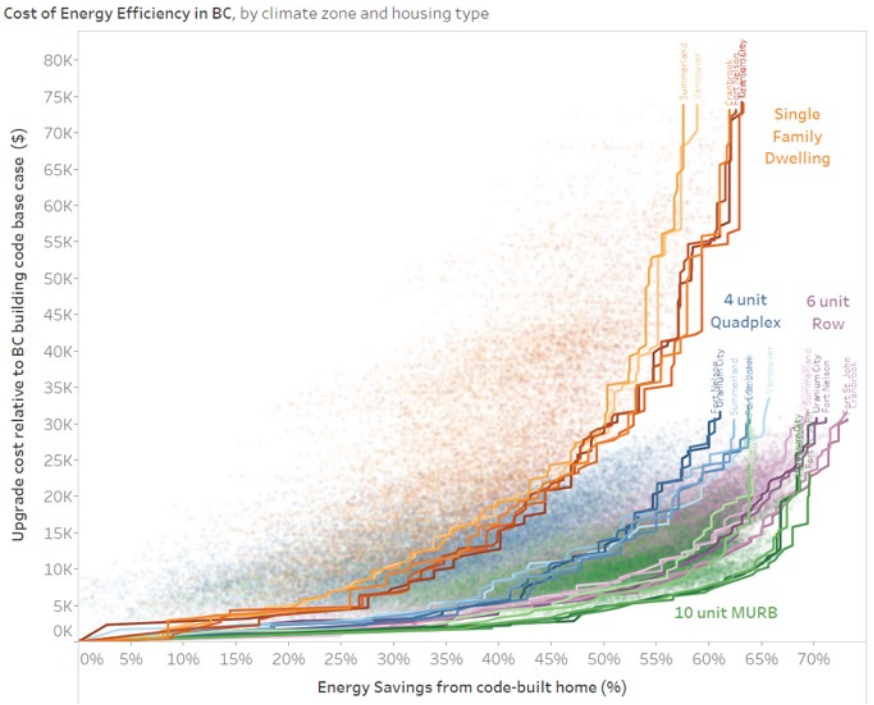
Ventilation	
Ventilation type	Natural
Year	-
Central	False
Ventilation rate	296 m³/h
Efficiency heat recovery	0%
Specific fan power	0 W/m³ h
Maintenance costs	0 CHF/a

Heating System	
System type	Oil Boiler
Year	1991
Central	True
Power	20 kW
Efficiency	80 %
Energy carrier	Oil
Maintenance costs	680 CHF/a

Hot Water System	
System type	Electric water heater
Year	1991
Central	False
Volume	200 l / day
Efficiency	66 %
Energy carrier	Electricity
Maintenance costs	386 CHF/a

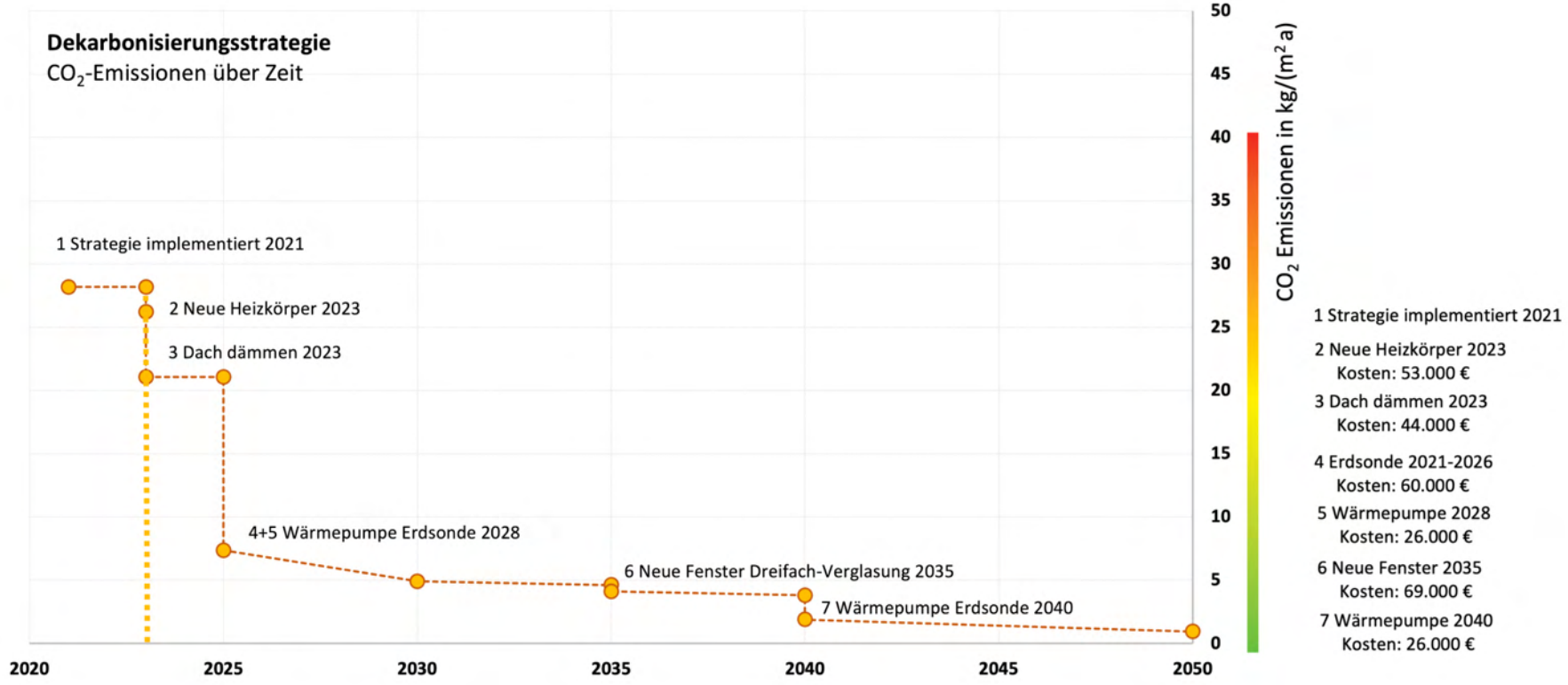
Nägeli, C., Camarasa, C., Jakob, M., Catenazzi, G., Ostermeyer, Y. (2018). Synthetic building stocks as a way to assess the energy demand and greenhouse gas emissions of national building stocks. Energy and Buildings, 173: 443-460. http://dx.doi.org/10.1016/j.enbuild.2018.05.055

Wir können (fast alles) optimieren

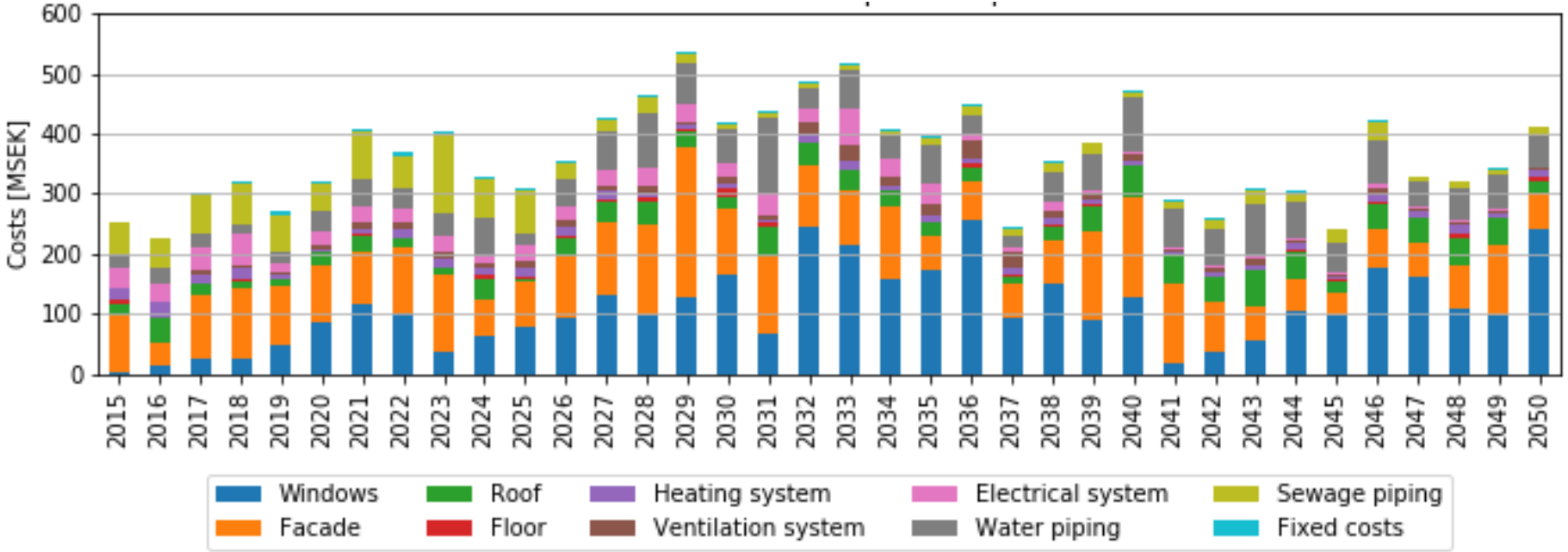


ICEM, TaNDM, HTAP & BTAP for Annex 70 partners, Jessica Webster, MCIP RPP
Energy Planning Analyst CanmetENERGY Ottawa, NRCan

Wir können Absenkpfade oder Roadmaps



Summieren können wir auch



Nägeli, C., Camarasa, C., Jakob, M., Catenazzi, G., Ostermeyer, Y. (2018). Synthetic building stocks as a way to assess the energy demand and greenhouse gas emissions of national building stocks. Energy and Buildings, 173: 443-460. http://dx.doi.org/10.1016/j.enbuild.2018.05.055

1. Was wissen wir, was wissen wir nicht?

2. Was können wir, was können wir nicht?

3. Was machen wir nun? Wie geht es weiter?

Da kommt auf Dauer keiner dran vorbei

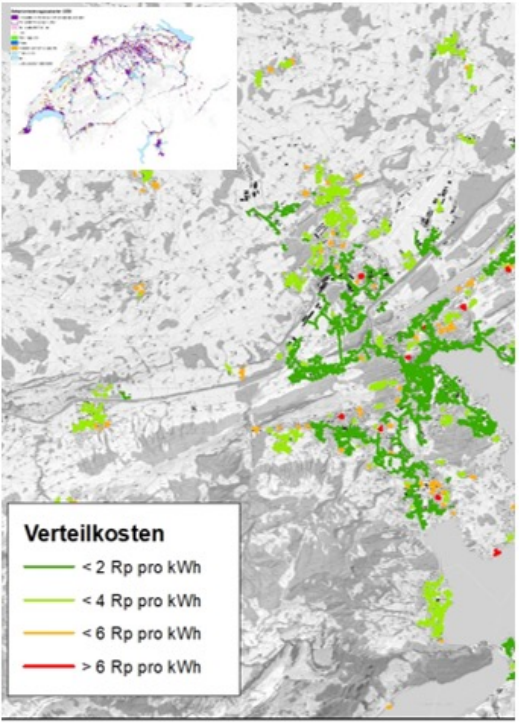
Heute

Morgen

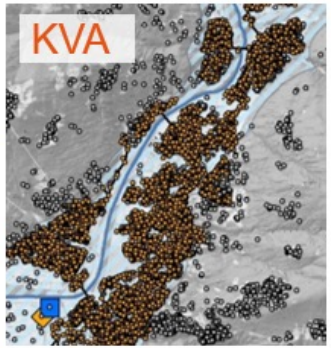
Sie werden Daten sammeln

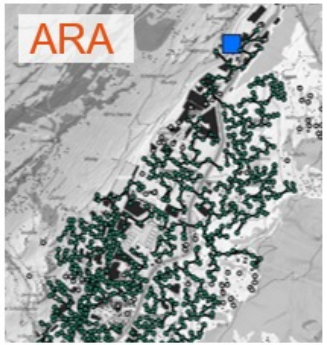
Infrastrukturanalysen und Kommunale Energiepläne

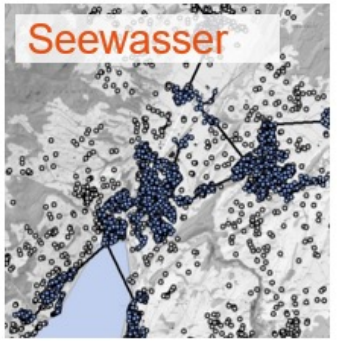
Nachfrage-Cluster

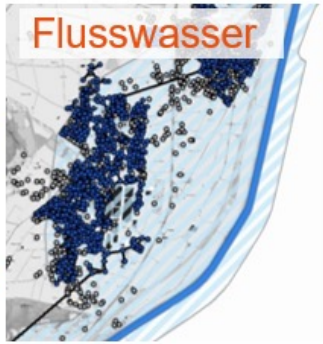


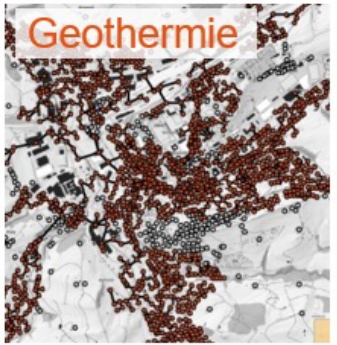
Potenzial- und Angebots-Cluster



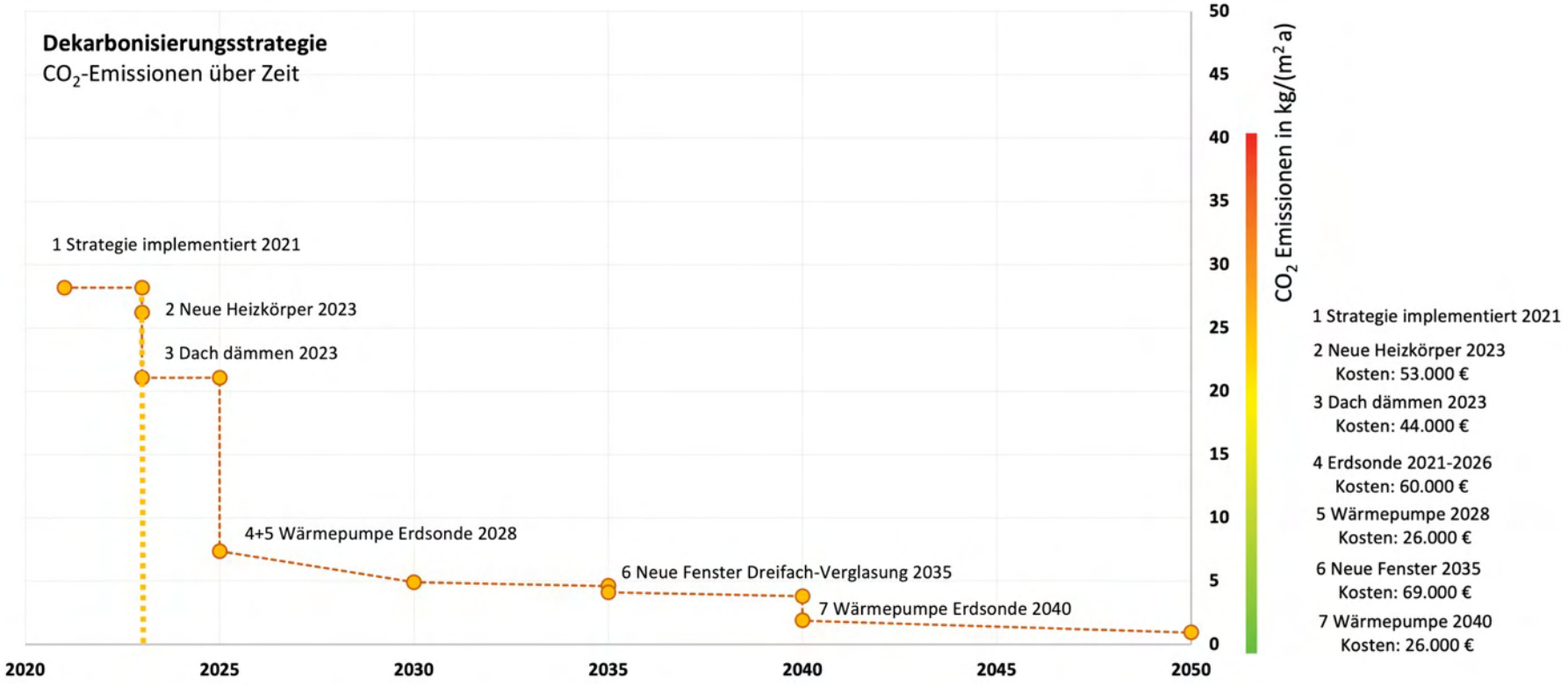








Wird für jedes Gebäude vorliegen müssen

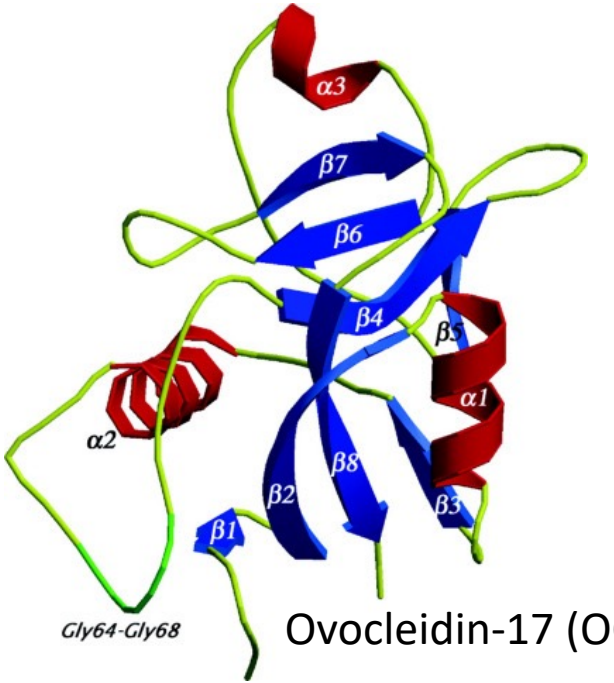


Die grosse Frage

Die grosse Frage

Die grosse Frage

Die grosse Frage



Ovocleidin-17 (OC-17)

Structural Control of Crystal Nuclei by an Eggshell Protein
Colin L. Freeman, John H. Harding, David Quigley, P. Mark Rodger Prof.
First published: 07 July 2010
https://doi.org/10.1002/anie.201000679