



Strategic Approach

Strategic Approach to foster Energy Efficiency in Residential Buildings for different climates



Status Quo

- Buildings account for almost 30% of global CO2 emissions
- Large savings in energy use (75% or higher) are possible
- Conventional new buildings in OECD countries save 50 % energy compared to stock
- Improving buildings and appliance energy efficiency has up to 80% - 90 % saving potentials



Is a Strategic Approach needed?

- No worldwide consistent standard for primary thermal energy consumption
 - A general definition for low-energy buildings does not exist
 - Numerous definitions of net or nearly Zero Energy Buildings
- No definition that takes into account various levels of ambition
- Target definitions are often not clear



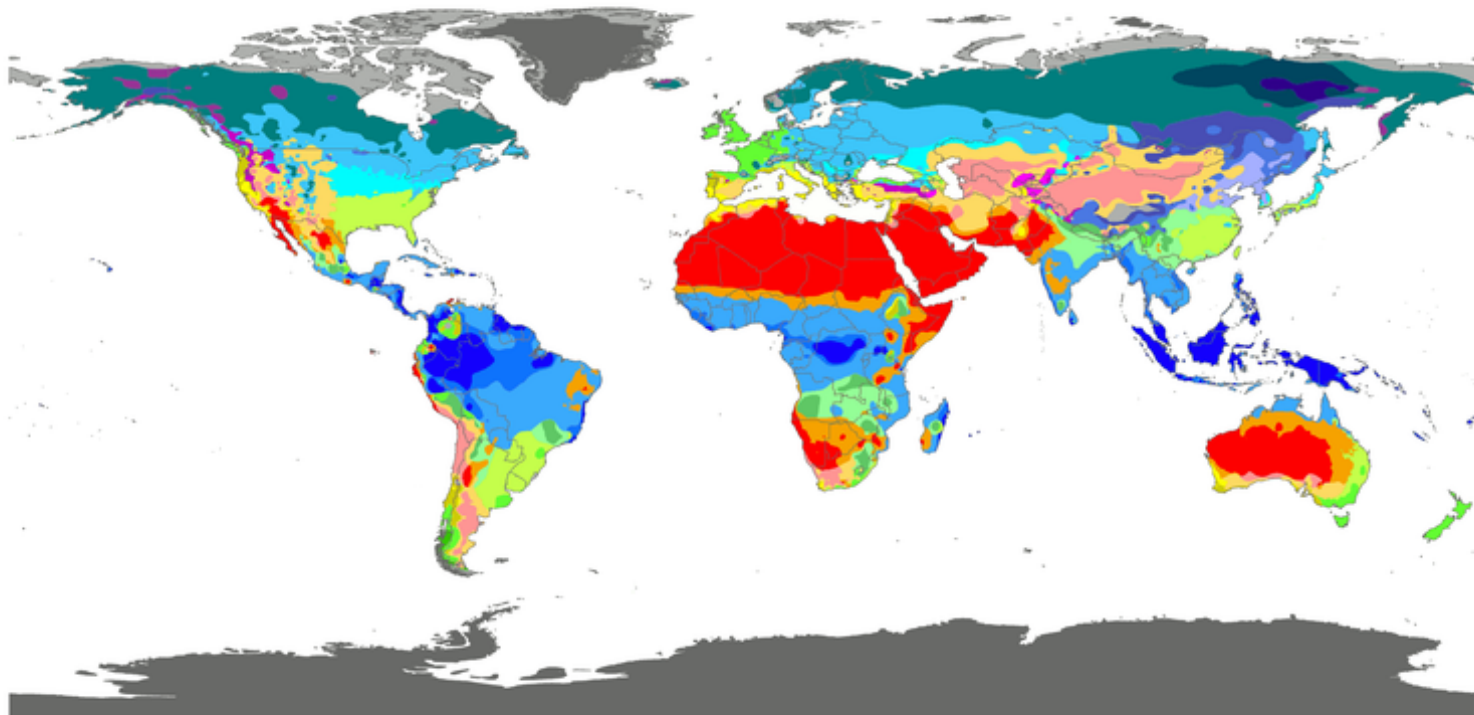
Hypothesis

“Highly energy efficient buildings need a strategic approach of integrated design, combining different design options in an intelligent way to achieve higher energy savings at lower investment costs”



Climate Zones

World map of Köppen-Geiger climate classification



Af	BWh	Csa	Cwa	Cfa	Dsa	Dwa	Dfa	ET
Am	BWk	Csb	Cwb	Cfb	Dsb	Dwb	Dfb	EF
Aw	BSH		Cwc	Cfc	Dsc	Dwc	Dfc	
	BSk				Dsd	Dwd	Dfd	

Contact : Murray C. Peel (mpeel@unimelb.edu.au) for further information

DATA SOURCE : GHCN v2.0 station data
Temperature (N = 4,844) and
Precipitation (N = 12,396)

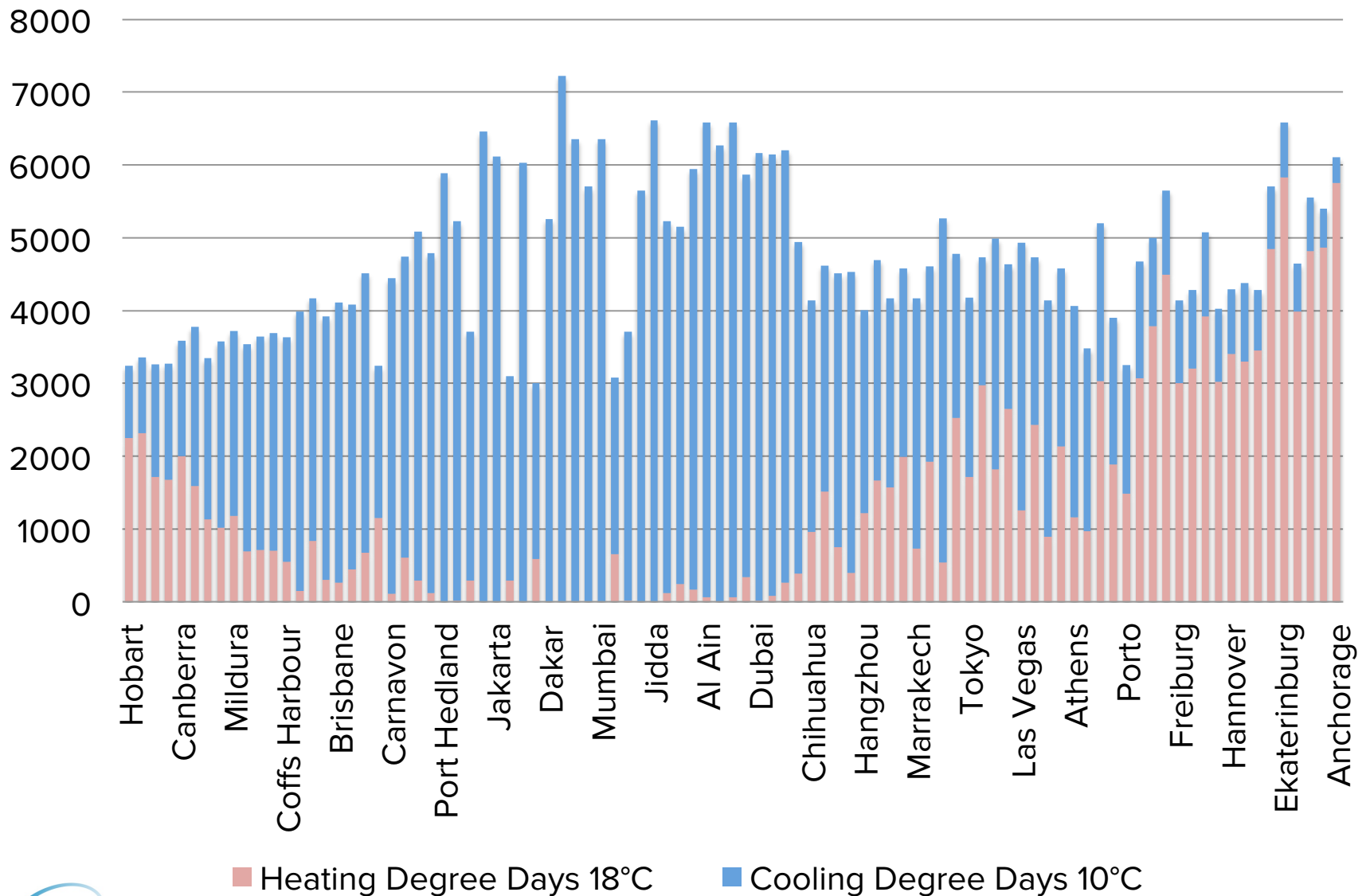
PERIOD OF RECORD : All available

MIN LENGTH : ≥30 for each month.

RESOLUTION : 0.1 degree lat/long



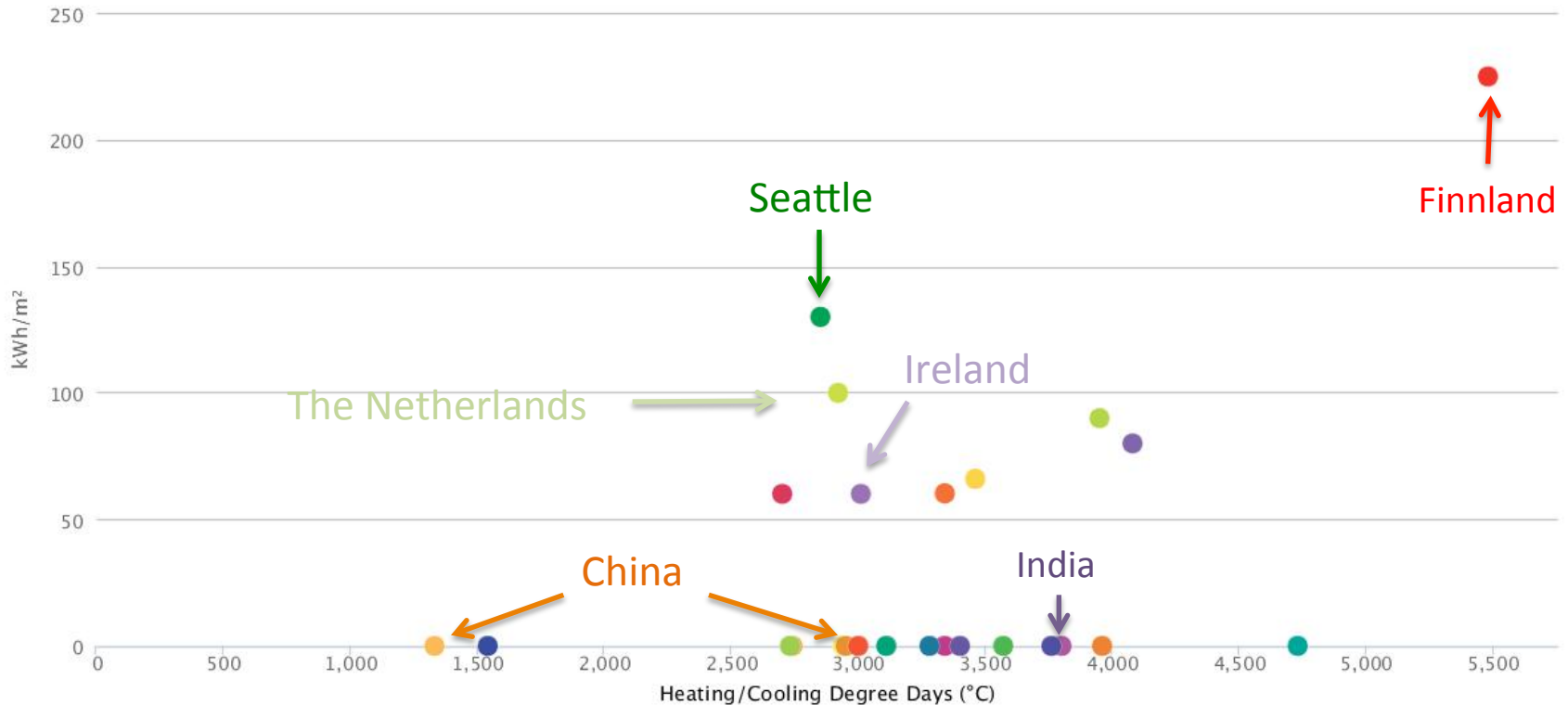
Comparison of Degree Days





Performance relative to climate

Performance Values Relative to Climate

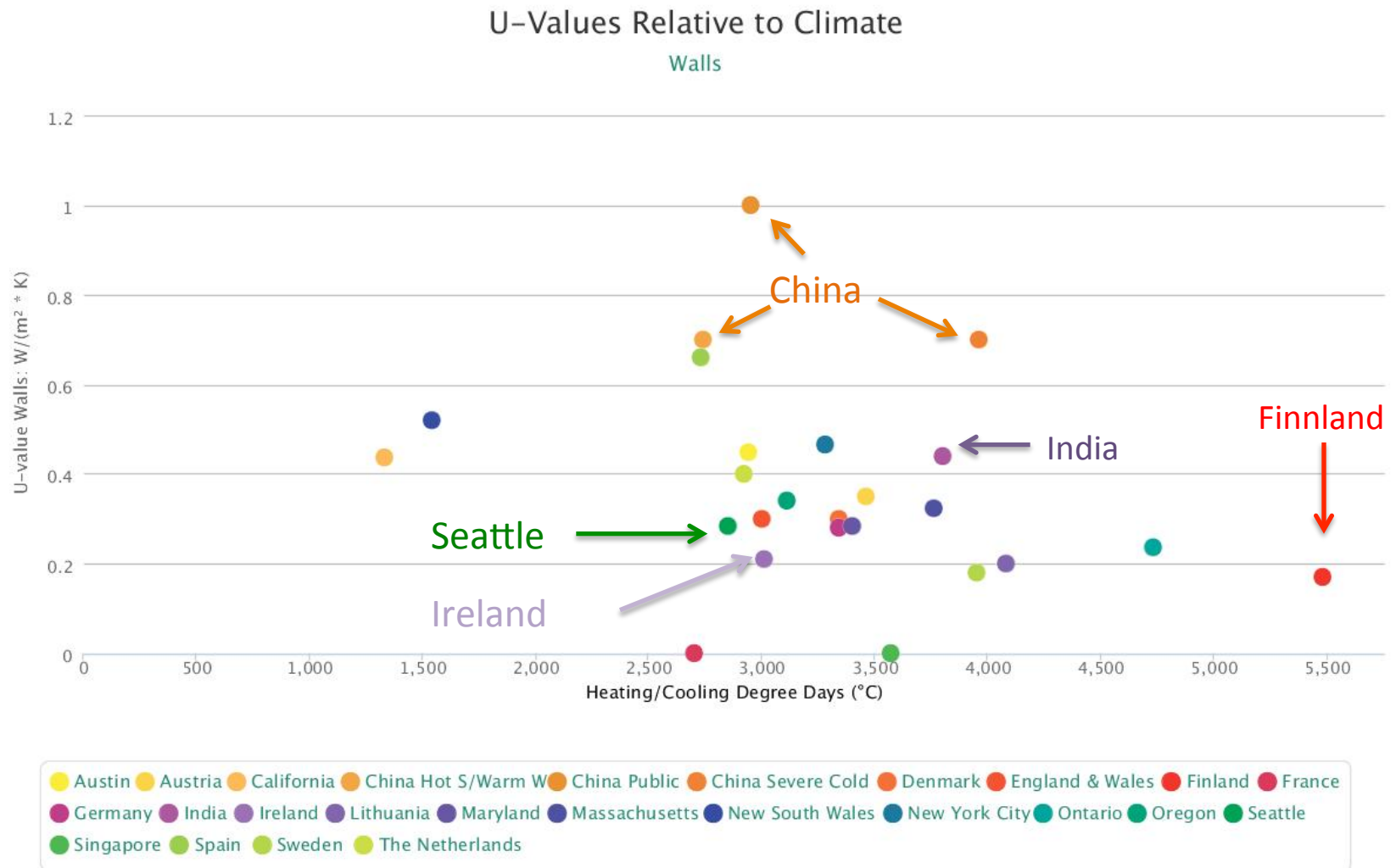


Austin Austria California China Hot S/Warm China Public China Severe Col Denmark England & Wales Finland France Germany India Ireland Lithuania Maryland Massachusetts New South Wales New York City Ontario Oregon Seattle Singapore Spain Sweden The Netherlands

Source: GBPN 2013



U-Values relative to climate

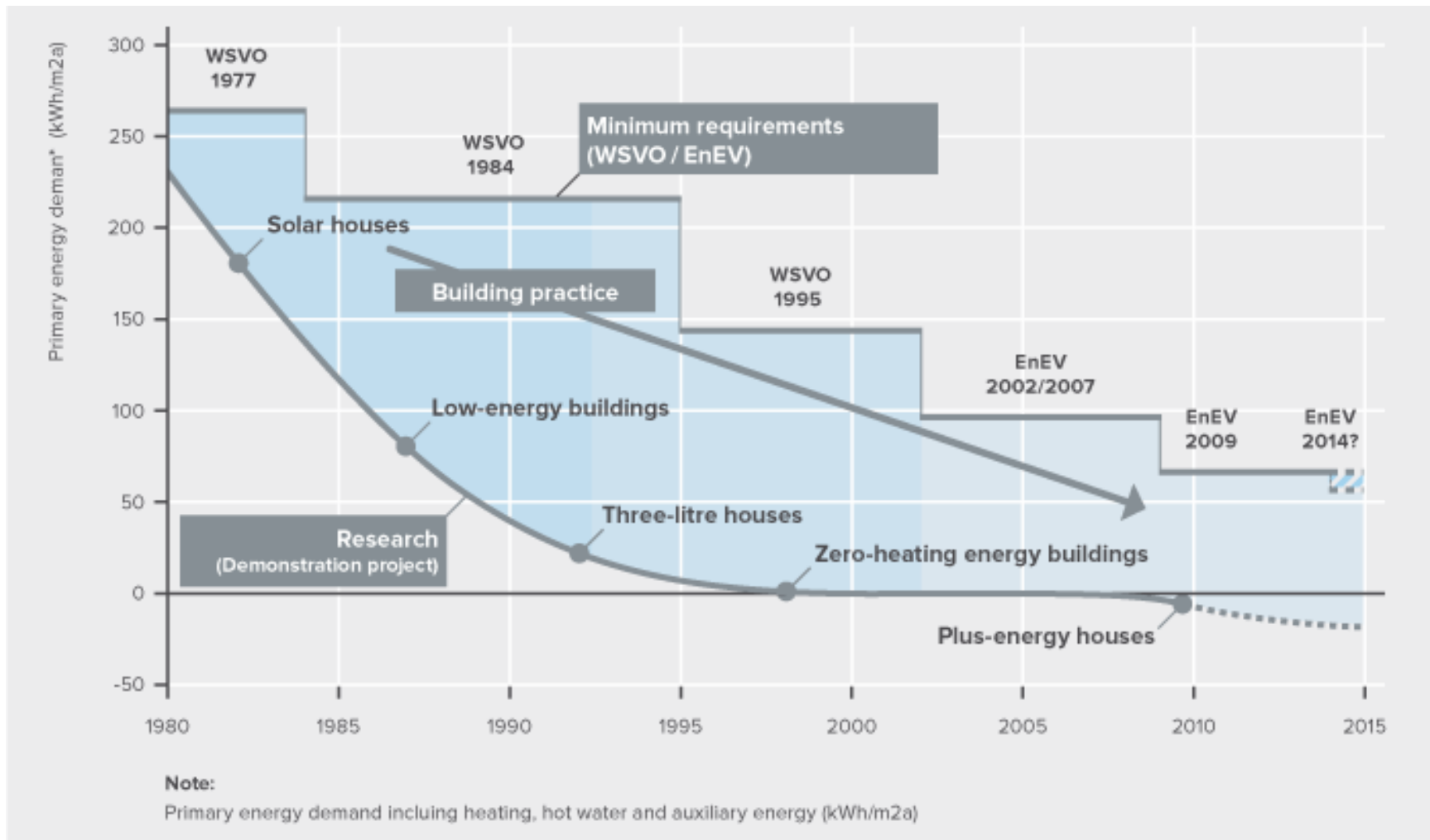


Source: GBPN 2013



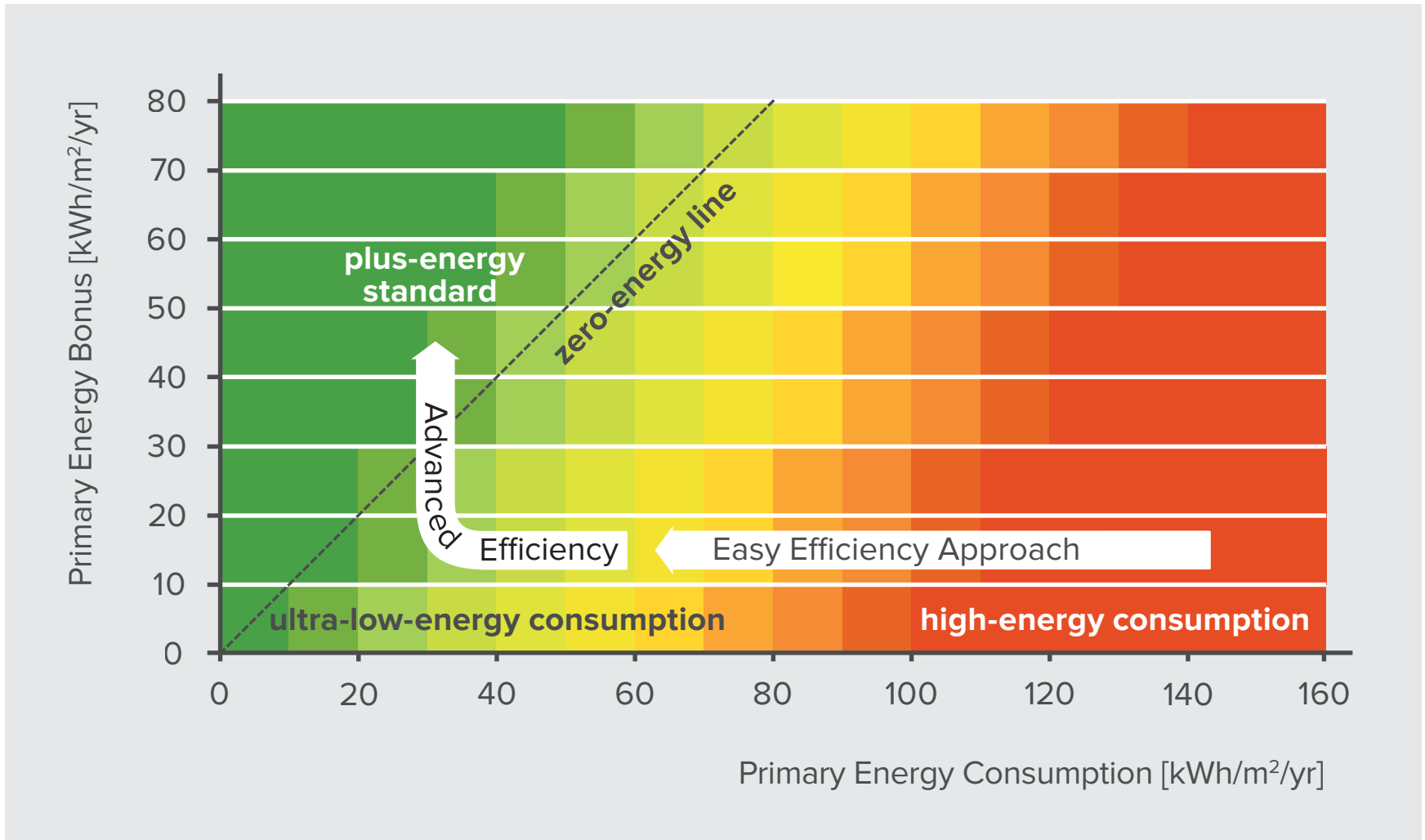
Minimum Energy Performance Standards

Case study: new buildings in Germany





The path to energy efficiency





The scatter plot illustrates the relationship between Degree Days (Kd) on the x-axis and Primary Energy Demand (kWh/m2a) on the y-axis. The x-axis ranges from 0 to 6000 Kd, and the y-axis ranges from 0 to 140 kWh/m2a. A horizontal orange line at 20 kWh/m2a is labeled 'Lucky Climates' with an upward arrow. A red arrow labeled 'High Efforts' points down to the 20 kWh/m2a line at 5000 Kd.

Legend:

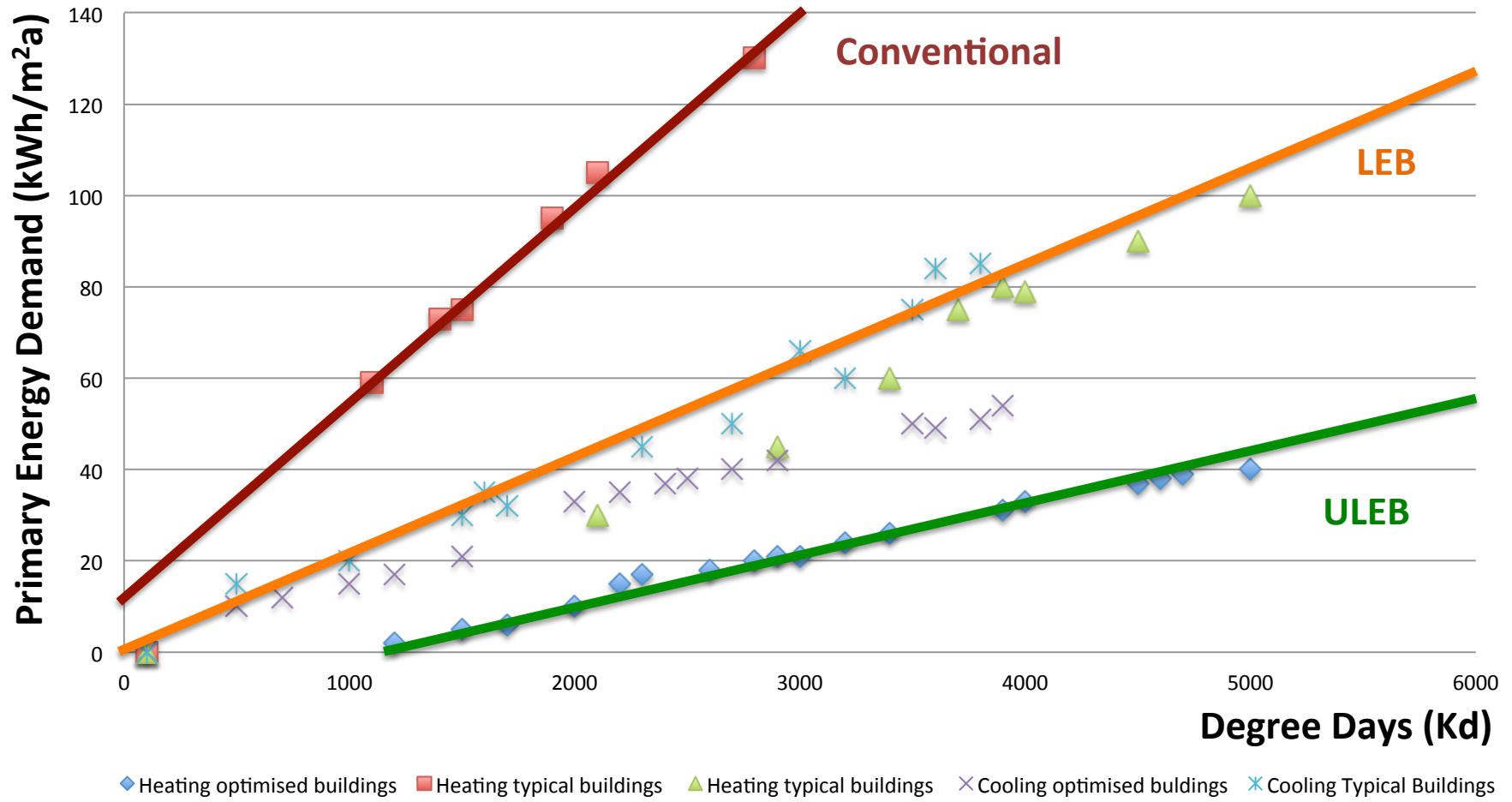
- Heating optimised buildings (Blue diamonds)
- Heating typical buildings (Red squares)
- Heating typical buildings (Green triangles)

Building Type	Degree Days (Kd)	Primary Energy Demand (kWh/m2a)
Heating optimised buildings	1200	2
Heating optimised buildings	1500	5
Heating optimised buildings	1800	8
Heating optimised buildings	2000	12
Heating optimised buildings	2200	15
Heating optimised buildings	2400	18
Heating optimised buildings	2600	20
Heating optimised buildings	2800	22
Heating optimised buildings	3000	24
Heating optimised buildings	3200	26
Heating optimised buildings	3400	28
Heating optimised buildings	3600	30
Heating optimised buildings	3800	32
Heating optimised buildings	4000	34
Heating optimised buildings	4200	36
Heating optimised buildings	4400	38
Heating optimised buildings	4600	40
Heating optimised buildings	4800	42
Heating optimised buildings	5000	44
Heating typical buildings	1000	60
Heating typical buildings	1200	75
Heating typical buildings	1400	78
Heating typical buildings	1800	95
Heating typical buildings	2100	105
Heating typical buildings	2800	130
Heating typical buildings	3500	50
Heating typical buildings	3700	52
Heating typical buildings	3900	54
Heating typical buildings	4100	56
Heating typical buildings	4300	58
Heating typical buildings	4500	60
Heating typical buildings	4700	62
Heating typical buildings	4900	64
Heating typical buildings	5100	66
Heating typical buildings	5300	68
Heating typical buildings	5500	70
Heating typical buildings	5700	72
Heating typical buildings	5900	74
Heating typical buildings	6100	76
Heating typical buildings	6300	78
Heating typical buildings	6500	80
Heating typical buildings	6700	82
Heating typical buildings	6900	84
Heating typical buildings	7100	86
Heating typical buildings	7300	88
Heating typical buildings	7500	90
Heating typical buildings	7700	92
Heating typical buildings	7900	94
Heating typical buildings	8100	96
Heating typical buildings	8300	98
Heating typical buildings	8500	100
Heating typical buildings	8700	102
Heating typical buildings	8900	104
Heating typical buildings	9100	106
Heating typical buildings	9300	108
Heating typical buildings	9500	110
Heating typical buildings	9700	112
Heating typical buildings	9900	114
Heating typical buildings	10100	116
Heating typical buildings	10300	118
Heating typical buildings	10500	120
Heating typical buildings	10700	122
Heating typical buildings	10900	124
Heating typical buildings	11100	126
Heating typical buildings	11300	128
Heating typical buildings	11500	130
Heating typical buildings	11700	132
Heating typical buildings	11900	134
Heating typical buildings	12100	136
Heating typical buildings	12300	138
Heating typical buildings	12500	140
Heating typical buildings	12700	142
Heating typical buildings	12900	144
Heating typical buildings	13100	146
Heating typical buildings	13300	148
Heating typical buildings	13500	150
Heating typical buildings	13700	152
Heating typical buildings	13900	154
Heating typical buildings	14100	156
Heating typical buildings	14300	158
Heating typical buildings	14500	160
Heating typical buildings	14700	162
Heating typical buildings	14900	164
Heating typical buildings	15100	166
Heating typical buildings	15300	168
Heating typical buildings	15500	170
Heating typical buildings	15700	172
Heating typical buildings	15900	174
Heating typical buildings	16100	176
Heating typical buildings	16300	178
Heating typical buildings	16500	180
Heating typical buildings	16700	182
Heating typical buildings	16900	184
Heating typical buildings	17100	186
Heating typical buildings	17300	188
Heating typical buildings	17500	190
Heating typical buildings	17700	192
Heating typical buildings	17900	194
Heating typical buildings	18100	196
Heating typical buildings	18300	198
Heating typical buildings	18500	200
Heating typical buildings	18700	202
Heating typical buildings	18900	204
Heating typical buildings	19100	206



Primary Energy per Degree Day

Comparison of annual Primary Energy consumption per Degree Day





Low Energy Building (LEB)

Compared to conventional new buildings, LEBs have:

- Energy saving potential of 40 to 60 %
- Low or no extra capital costs
- Lower lifetime costs
- Increased thermal comfort
- Enhanced indoor air quality



Ultra low Energy Building (ULEB)

Compared to conventional new buildings, ULEBs have:

- Energy saving potential of 60 to at least 80 % (and in many cases up to 90%)
- High levels of insulation
- Slightly higher or low extra capital costs
- Lower utility costs
- Lower lifetime costs
- Increased thermal comfort
- Enhanced indoor air quality



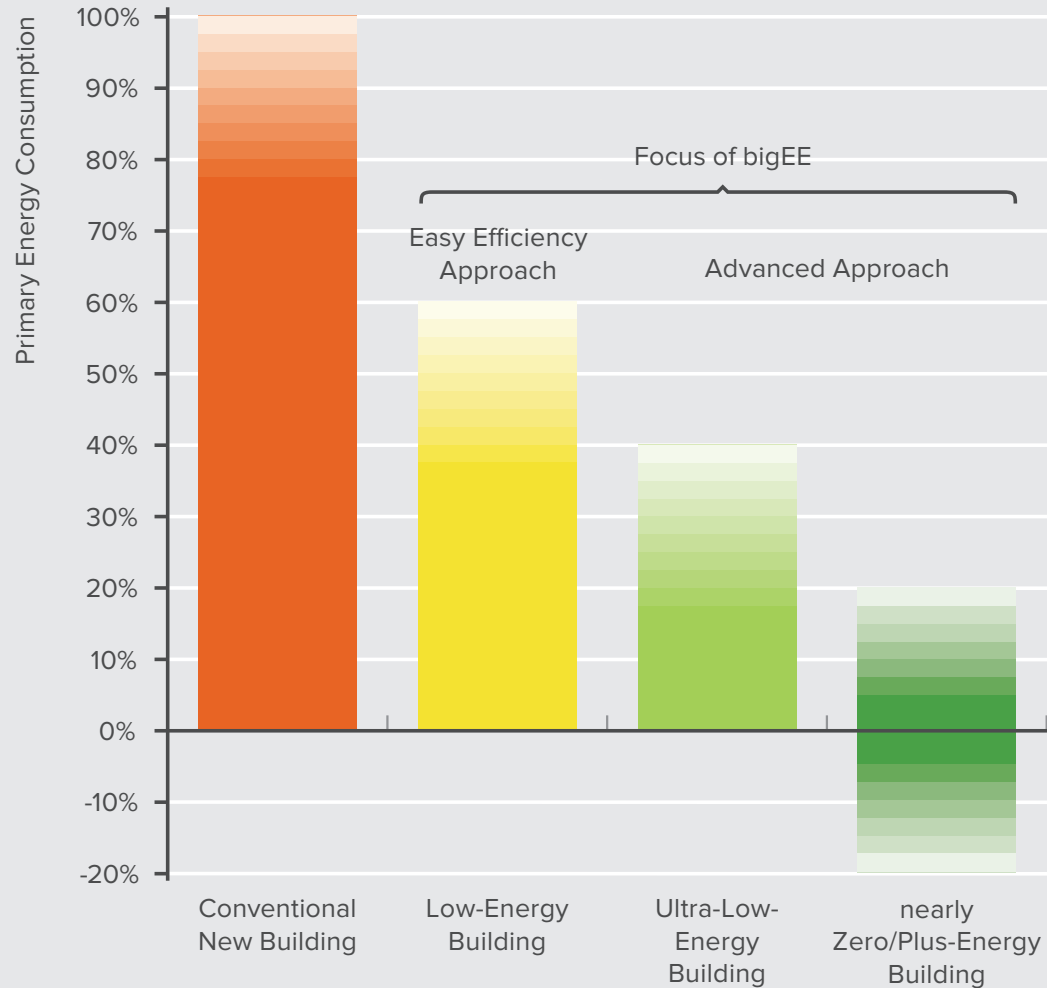
(nearly) Zero Energy and Plus Energy Building

Compared to new buildings, nZEBs and PEBs have:

- Energy saving potential of up to and over 100% respectively
- High levels of insulation
- Slightly higher extra capital costst
- Lower utility costs
- Lower lifetime costs
- Increased thermal comfort
- Better indoor air quality
- Renewable energy to cover energy consumption



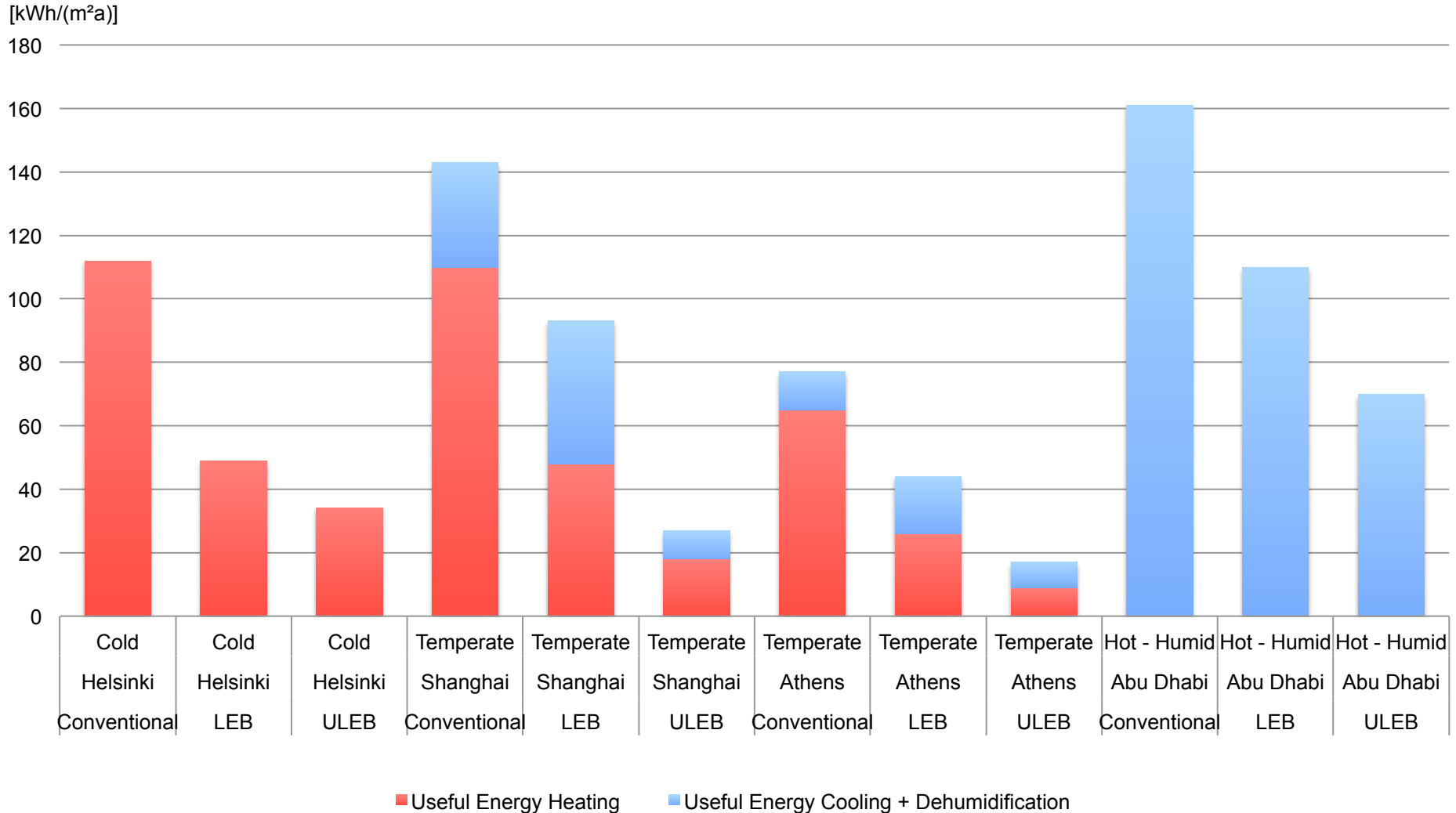
The steps to energy efficiency





Simulation results of buildings

(useful energy; simulations by ECOFYS and Wuppertal Institute)





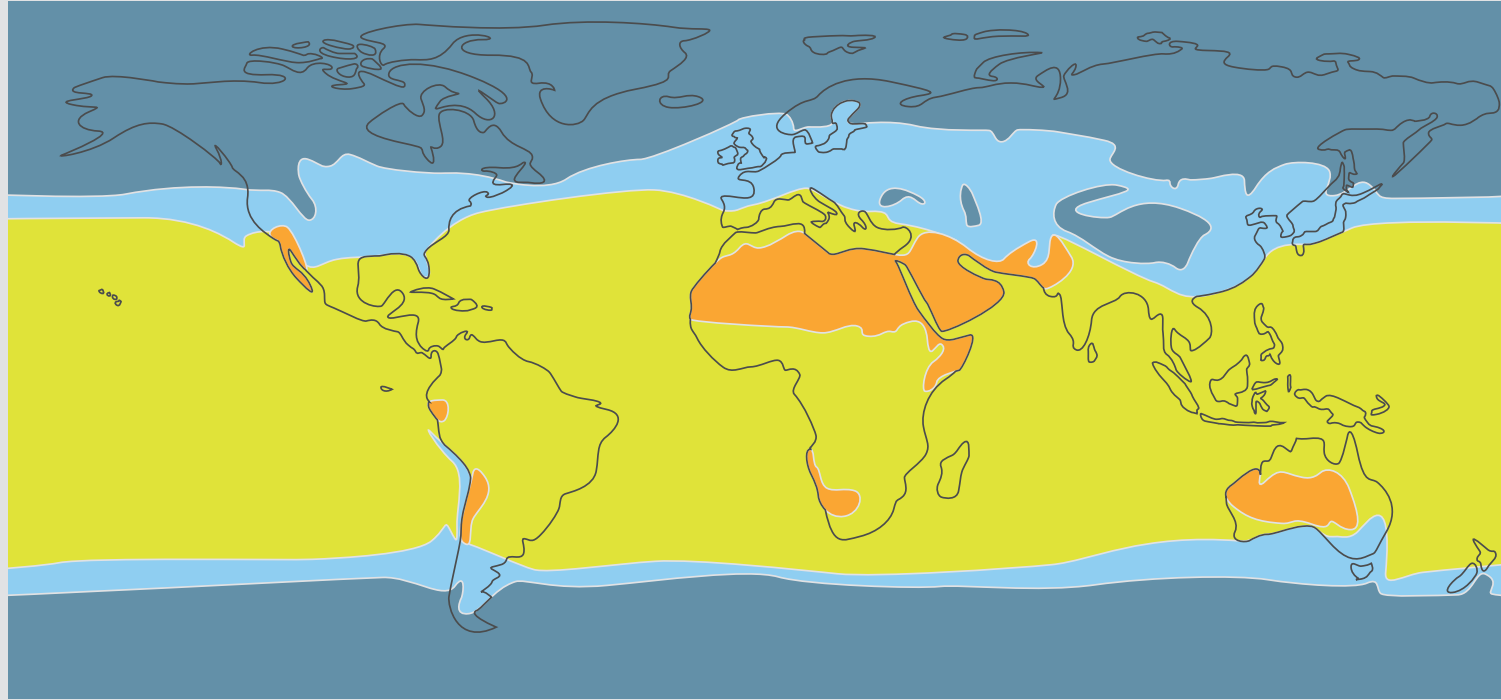
Energy Consumption Levels





	Cold	Temperate	Hot and Humid	Hot and Arid
	e.g. Qinghai	e.g. Beijing/Shanghai	e.g. Shenzhen	
	kWh/m ² _{TFA} yr	kWh/m ² _{TFA} yr	kWh/m ² _{TFA} yr	kWh/m ² _{TFA} yr
LEB	40 – 80	40 – 80	100 – 150	50 – 100
ULEB	20 – 40	20 – 40	50 – 100	25 – 50
nZEB	0 – 20	0 – 20	0 – 50	0 – 25
PEB	++	++	++	++

(TFA: Treated floor area)



bigEE Climate Zones



Climate	LEB	ULEB	nZEB	PEB
 Cold	80-40 kWh/m ² _{TFA} yr	40-20 kWh/m ² _{TFA} yr	20-0 kWh/m ² _{TFA} yr	++
 Temperate	80-40 kWh/m ² _{TFA} yr	40-20 kWh/m ² _{TFA} yr	20-0 kWh/m ² _{TFA} yr	++
 Hot and Humid	150-100 kWh/m ² _{TFA} yr	100-50 kWh/m ² _{TFA} yr	50-0 kWh/m ² _{TFA} yr	++
 Hot and Arid	100-50 kWh/m ² _{TFA} yr	50-25 kWh/m ² _{TFA} yr	25-0 kWh/m ² _{TFA} yr	++



bigEE Climate Zones for China



Climate	Region	LEB	ULEB	nZEB	PEB
 Cold	(e.g. Qinghai)	80-40 kWh/m ² _{TFA} yr	40-20 kWh/m ² _{TFA} yr	20-0 kWh/m ² _{TFA} yr	++
 Temperate	(e.g. Beijing, Shanghai)	80-40 kWh/m ² _{TFA} yr	40-20 kWh/m ² _{TFA} yr	20-0 kWh/m ² _{TFA} yr	++
 Hot and Humid	(e.g. Shenzhen)	150-100 kWh/m ² _{TFA} yr	100-50 kWh/m ² _{TFA} yr	50-0 kWh/m ² _{TFA} yr	++
 Hot and Arid	n.a.	100-50 kWh/m ² _{TFA} yr	50-25 kWh/m ² _{TFA} yr	25-0 kWh/m ² _{TFA} yr	++



The Strategic Approach

First worldwide consistent approach to defining Low-Energy and Ultra-Low-Energy Buildings in different climate zones

- Easy to Define
- Absolute Target Values
- Covering 4 Climate Zones (more to come)
- 4 different types of conditioning
- Numerous Types of Buildings



Your guide to energy efficiency in buildings.

Start now



bigee.net



Wuppertal Institute
for Climate, Environment
and Energy