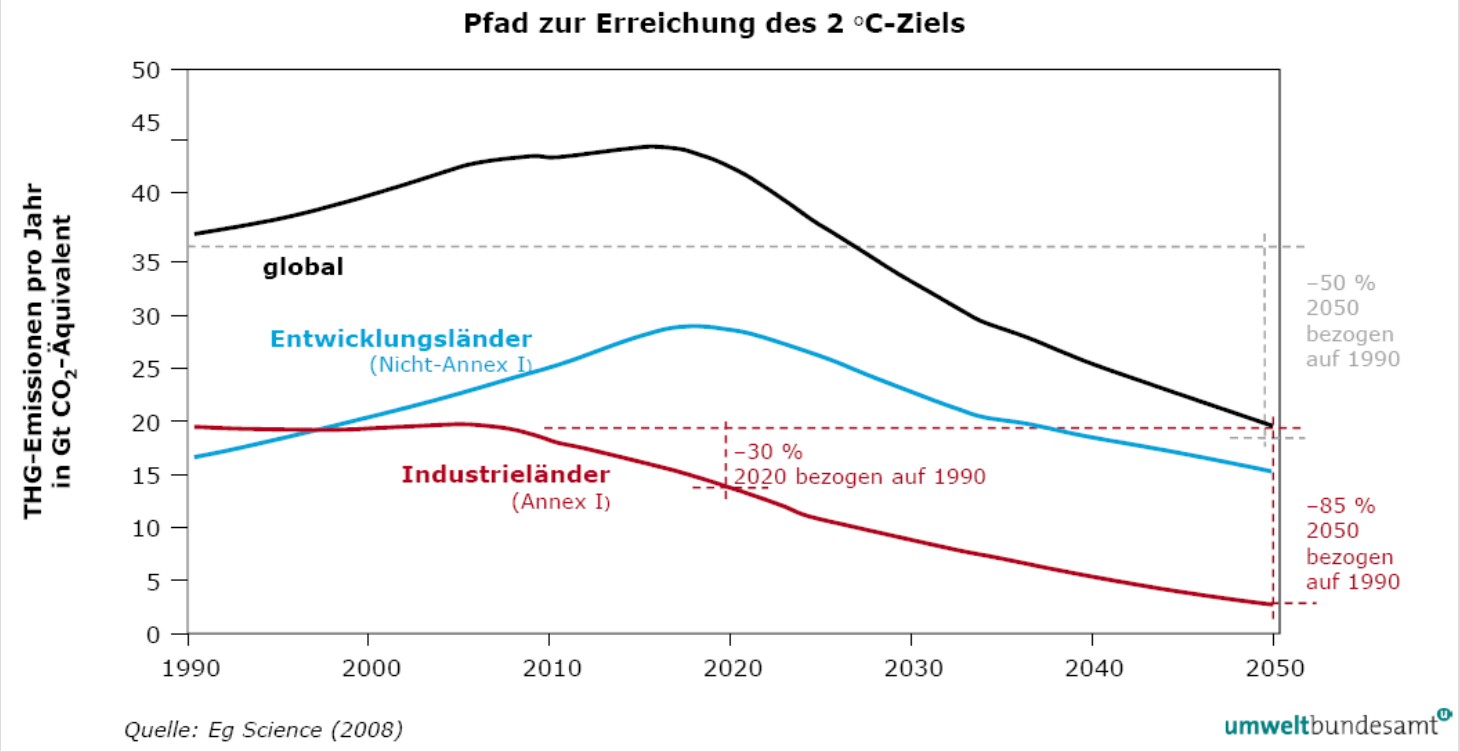
The Future is Massive:
Big Buildings from Vienna to Beijing and beyond

Ing. Günter Lang / LANG consulting

New York, 2014-06-17

Sustainable Passive Houses for old and new buildings

LANG consulting
Passivhäuser – Innovative Baukonzepte für Alt- und Neubau
www.langconsulting.at



Information of European Commission from 2011-03-08

Road map for lean CO_2 economy until 2050

Reduction of CO_2-emissions at 80 – 95% until 2050

Building sector: **Reduction of CO_2-emissions at 53% until 2030**
Reduction of CO_2-emissions at 91% until 2050

Resolution of European Commission from 2009-12-18
Official journal of EU published on 2010-06-18

“Utilize all energy efficiency potentials of buildings”

All new buildings must be “Nearly Zero Energy Buildings” at least by 2020

That implies:

- **new build must comply Passive House Standard at least**
- **minimal residual energy demand must be covered with renewable energy**

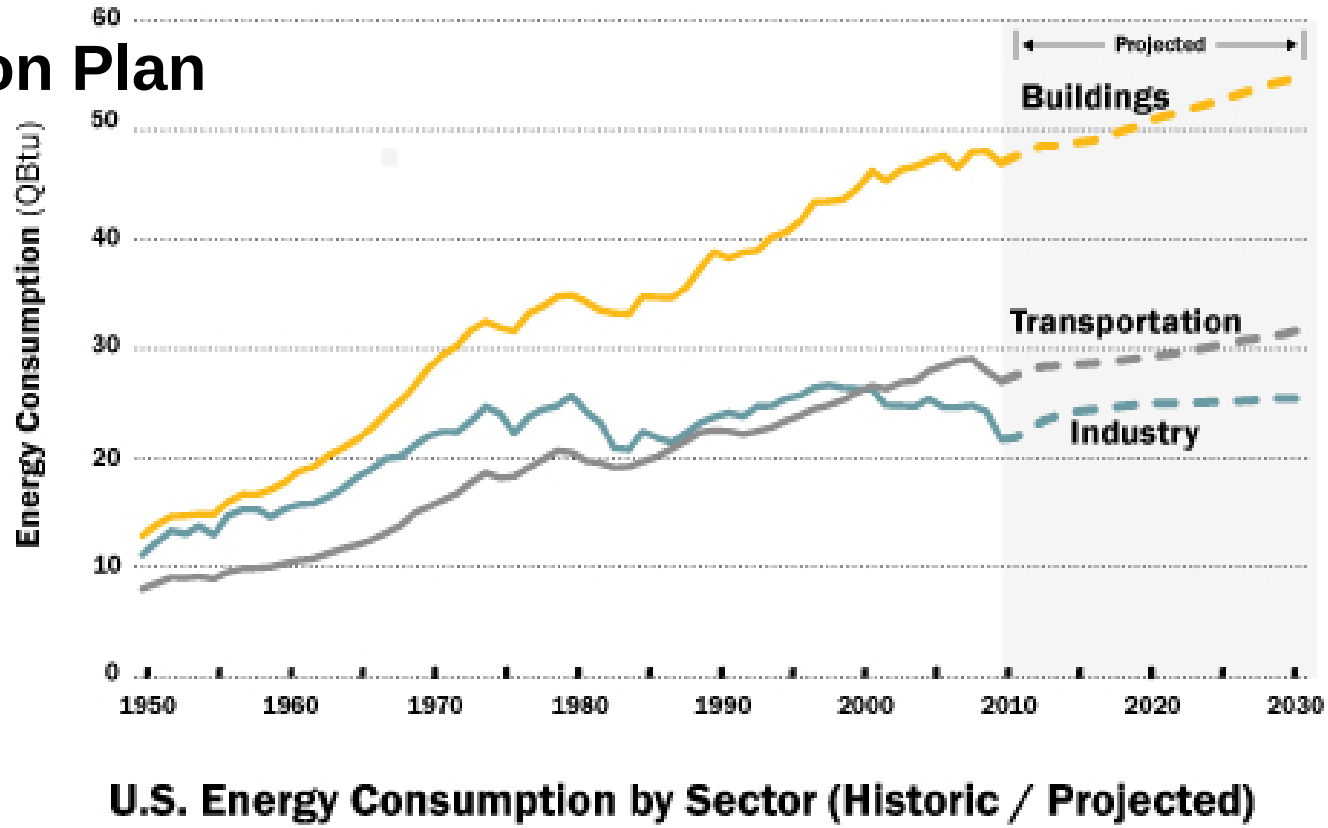
At retrofits max. efficiency potential shall be used

Buildings in US consume more energy than any other sector
In New York bildings need 75 % of all energy consumption!

The building sector is the largest contributor to US CO_2 Emissions

US Climate Action Plan
- 80% by 2050

http://architecture2030.org/

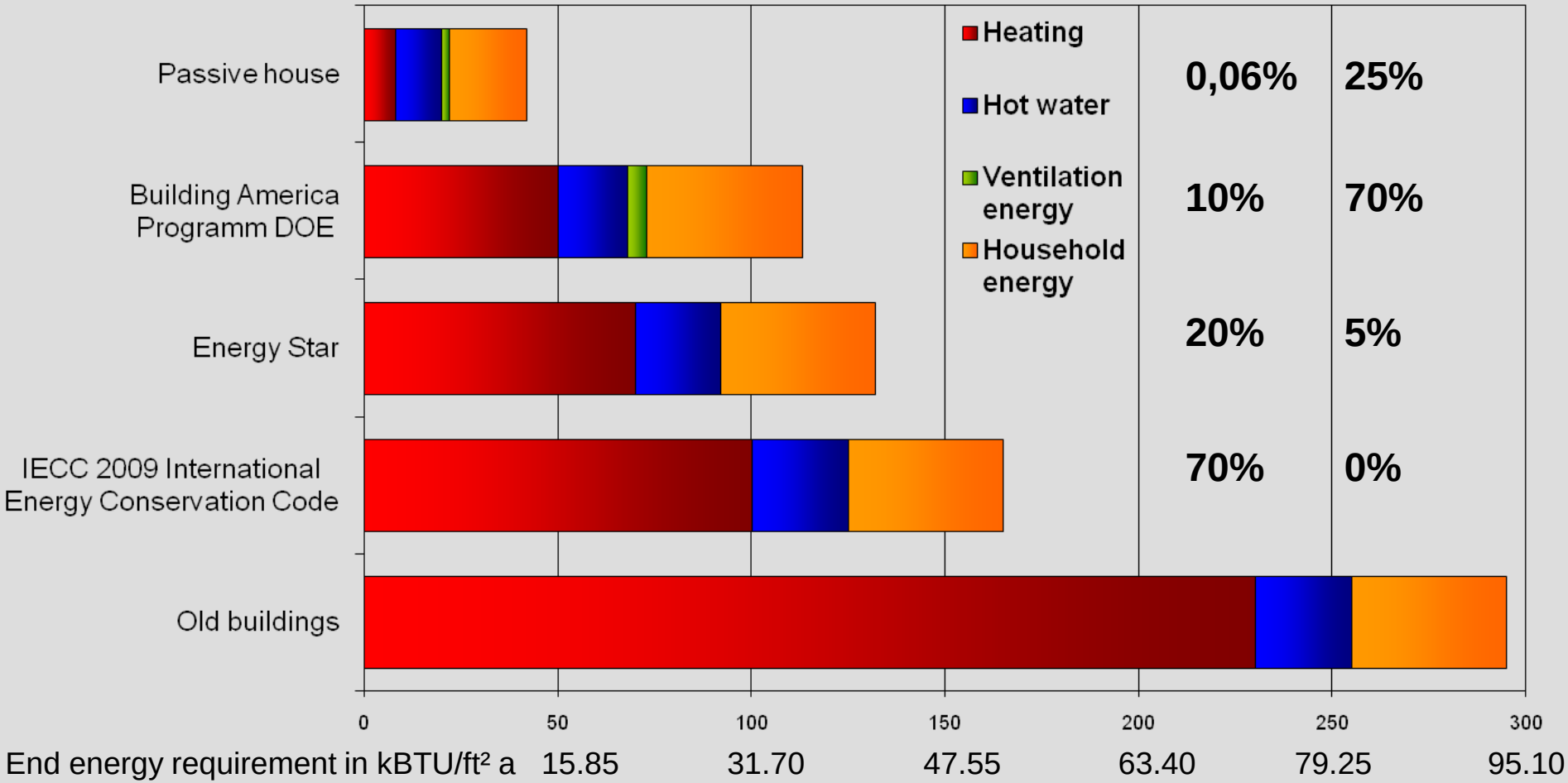


U.S. Energy Consumption by Sector (Historic / Projected)

Source: ©2010 2030, Inc. / Architecture 2030. All Rights Reserved.
Data Source: U.S. Energy Information Administration.

Annual end energy requirement for buildings in kWh/m²a

Head demand max.15 kWh/m²a =4.75 kBTU/ft²a



MFH Mühlweg, Wien 21

Dietrich / Untertrifaller Architekten
B.A.I. Bauträger Austria Immobilien

Heat demand: 13.1kWh/m²a = 4.15kBTU/ft²a
Heat load: 11.40 W/m² = 3.61BTU/ft²
Pressure test n_{50} : 0.20 1/h

Floor area: 9,050.00 m²
97,400.00 ft²
Apartments: 70
Construction: Wood

Once Passive House standard – Always Passive House!

„Experience the fantastic air quality in our student house,
and you will require it every time !“
Günther Jedliczka, ÖAD

Treated floor area 7,171 m²
77,200 ft²
133 student flats

Heat demand 12.20 kWh/m²a
= 3.87 kBTU/ft²a

Heat load 8.70 W/m²
2.8 Btu/h/ft²

Building costs 1,202 €/m²
151 €/ft²

Passive House students home, Wien, Arch. Baumschlager & Eberle

WHA IMPULS Pernerstorfergasse
Architect: Albert Wimmer ZT GmbH
Developer: GPA

8,314.9 m^2 = 89,500 ft^2 with 108 flats

Heat demand: 12 kWh/m^2a = 3.8 $kBTU/ft^2a$
Head load: 9 W/m^2 = 2.85 $Btu/h/ft^2$

2nd Largest Passive House worldwide

Lodenareal / Innsbruck

Developer Neue Heimat Tirol

Architect: teamk2 / din a4

354 flats/ 26,000 m² = 279,860 ft²

Pellets consumptions 246m³/a = 8,690 ft³

like 6 single family home consumption

Inhabitant satisfaction result 95%

Largest Passive House worldwide
Multi-family-dwelling

Olympic Village 2012 in Innsbruck / Tyrol
Architect: Reitter - Eck & Reiter Architekten ZT GmbH & Architekturwerkstatt din a4

Apartments:		444 flats
Treated floor area:		**32,229 m² = 346,920 ft²**
Heat demand:	Part 1	14.8 kWh/m²a = 4.69kBTU/ft²a
	Part 2	18.2 kWh/m²a = 5.77kBTU/ft²a
Total primary energy demand:		108 kWh/m²a = 34.24 kBTU/ft²a
Heat load:	Part 1	13.3 W/m² = 4.22BTU/ft²
	Part 2	10.0 W/m² = 3.17BTU/ft²
Building costs:		**1,489 €/m² = 187 $/ft²**

Apartment complex 1220 Vienna, Kaisermühlenstrasse

Third largest Passive House appartment complex in Austria

264 flats, 4 offices, 4 stores

Developer: BWS

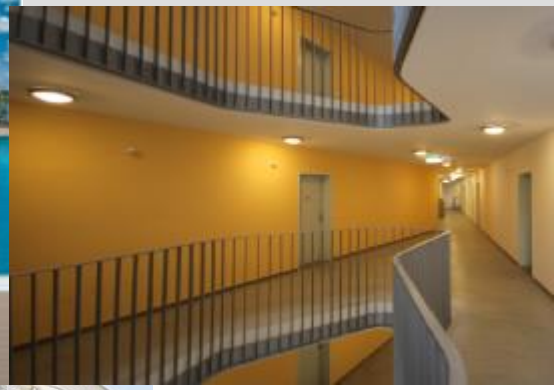
Arch.: Treberspurg & Partner Architekten Ziviltechniker GmbH

Floor space:
24,585 m² = 264,600ft²
Year of construction:
2014
Building costs:
1,403 €/m² = 176 $/ft²

Residential and commercial building
Raxstrasse, 1100 Vienna (element L)
Rüdiger Lainer + Partner Architekten
Win4Win Bauträger

128 flats floor space:	10,730m² =	115,500ft²
Doctor's practice:	750 m² =	8,070ft²
Kindergarten :	1,285 m² =	13,800ft²
Year of construction:	2013	

Building costs: 1,450 €/m² = 182 $/ft²



Apartment complexe 1220 Vienna, Aspernsstrasse

Architects: s&s architekten – C. Schindler & R. Szedenik

Developer: Pro Wohnbau AG

Floor space: **19,366 m² = 208,500 ft²**

Building costs: 1,451 €/m² = 183 $/ft²

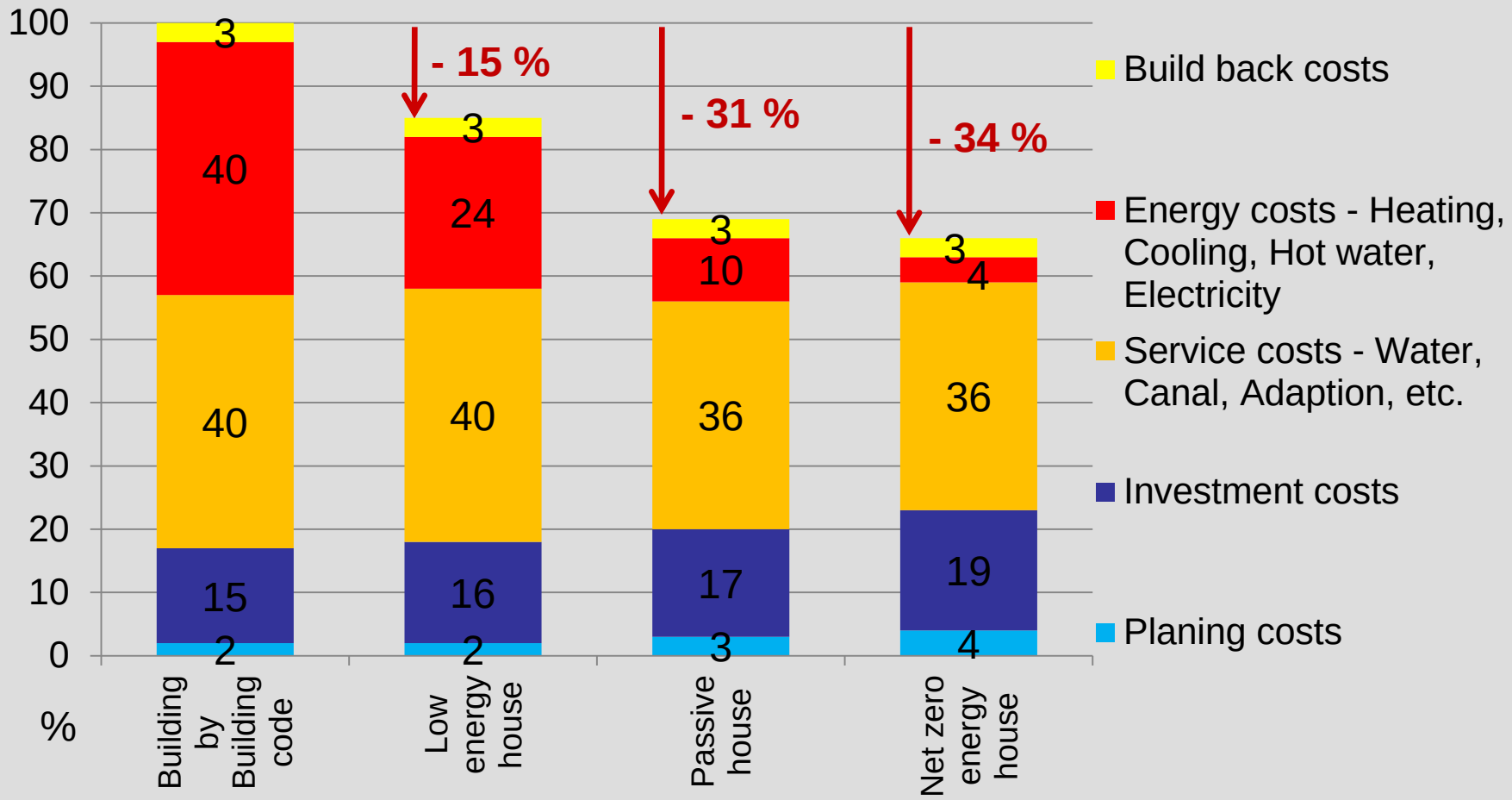
Heat demand: 15 kWh/m²a = 4.75 kBTU/ft²a

Flats: 220

Year of construction: 2012

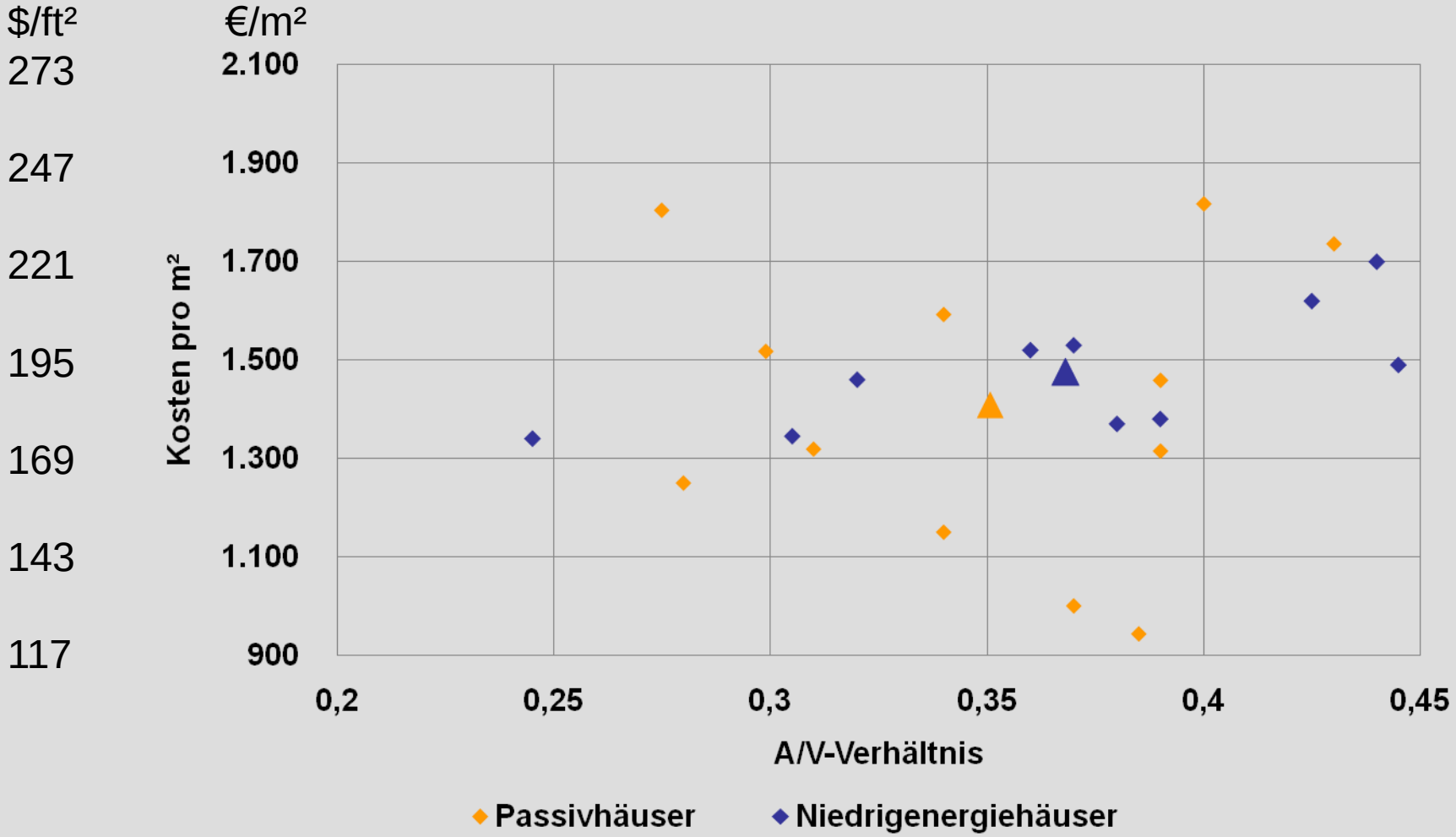
“Life-cycle costs” for different Building standards

Cost transparence - calculaded with the same energy costs over 40 years!



In Passive houses the saved „life-cycle costs“ are the double as the construction costs of a building according to minimum standard!

Analysis of construction costs in compare to low energy houses



Analysis of large-scaled dwellings in Austria of construction costs in €/m² regarding ÖNORM 1801-1

Quelle: Passivhaus Datenbank Analyse großvolumiger Wohnbau - LANG consulting / 2010 und
Univ. Prof. Arch. DI Dr. Martin Treberspurg, DI Roman Smutny BOKU Wien – AG Ressourcenorientiertes Bauen

Xolar fabric building in 4653 Eberstalzell

Design Hörndler Bauplanung

Heat demand 9 kWh /m²a = 2.85 kBTU/ft²a

Floor space: 16,926m² = 182,200ft²

Construction: mixed

Year of construction: 2008

Heat load: 18 W/m² = 5.7 BTU/ft²

n_{50} : 0.08/h

Exhibition hall and burrow, Wels / OÖ

AT4 Architekten, Wels
Messe Wels

Heat demand: 16 kWh/m²a = 5.1 kBTU/ft²a
Cooling demand: 27 kWh/m²a = 8.1 kBTU/ft²a

Effective area: 17,500 m² = 188,000 ft²
Construction: Wood

Office building **Energy Base in Vienna**
Architect: pos architekten ZT keg

Treated floor area:	7,516 m²	= 80,900 ft²
Annual heat demand:	10.83 kWh/m²a	= 3.4 kBTU/ft²a
Heat load:	13.2 W/m²	= 4.2 BTU/ft²

Diversity in wood, glass, metal und stone

Passive House standard – a real straight thing

„Standort Niederösterreich“ in St. Pölten

Public administrative building

Four quarters at 7,900 m² = 85,000 ft²

Communal center St. Gerold

Treated floor area	**571 m²**	**= 6,150 ft²**
Heat demand	**12.8 kWh/m²a**	**= 4.0 kBTU/ft²a**
Heat load	**15 W/m²**	**= 4.7 Btu/h/ft²**
Primary energy	**118 kWh/m²a**	**= 37.4 kBTU/ft²a**

Zertifiziertes Passivhaus
Passivhaus Institut

cukrowicz nachbaur Architekten ZT GmbH / Bregenz

Photo credits Hanspeter Schiess

Center of justice Korneuburg Court

Architekturwerkstatt Din a4, Innsbruck
Owner: Bundesimmobiliengesellschaft (BIG)

Floor space: **16,850 m² = 181,200 ft²**
Working places: 180 employees
Head demand: 11.7kWh/m²a = 3.7kBTU/ft²a
Head load 16.0 W/m² = 5.07 BTU/ft²
Primary energy demand: 103.0 kWh/m²a = 32.6 kBTU/ft²a

Airtightness: 0.20 1/h
Completion: 2012

Center of justice Korneuburg
Prison

Dieter Mathoi Architekten, Innsbruck
Owner: Bundesimmobiliengesellschaft (BIG)
Passive house design: Herz&Lang/Airoptima
Prison for 255 prisoners
Floor space: **16,700 m² = 179,800ft²**
Heat demand: 9.3kWh/m²a = 2.95kBTU/ft²a
Primary energy demand 366 kWh/m²a = 116 kBTU/ft²a (incl. electronic for prison, workshops, kitchen)
Airtightness: 0.43 1/h

New Plus Energi Headquarters for Syd Energi

Esbjerg / Denmark

Architecture GPP Arkitekter A/S
Building physics Esbensen A/S

Treated Floor Area 10,952 m^2 = 117,900 ft^2
Year of construction 2013

Annual heating demand 8 kWh /m^2a = 2.53 BTU/ft^2a
Primary energy requirement 217.0 kWh /m^2a = 68.8 BTU/ft^2a

Heat pump using both heat recovery from the server room as a geothermal system

Zertifiziertes Passivhaus
Passivhaus Institut

Life cycle tower

LCT 1
in Dornbirn/Austria

Hermann Kaufmann Architekten
Rhomberg Bau GmbH

Heat demand: 13kWh/m²a = 4.15kBTU/ft²a

Floor area: 2,355 m² = 25,400 ft²
Construction: Wood Frame
Slab: Hybrid wood / concrete

<u>Contact in USA</u>:
Nabih Tahan, AIA

PASSIVHAUS Austria
www.passivhaus-austria.org

Sustainable Passive Houses for old and new buildings

LANG consulting
Passivhäuser – Innovative Baukonzepte für Alt- und Neubau
www.langconsulting.at

OPEC-Office

Constructed in 1972/1973
Domicile of OPEC since 1977

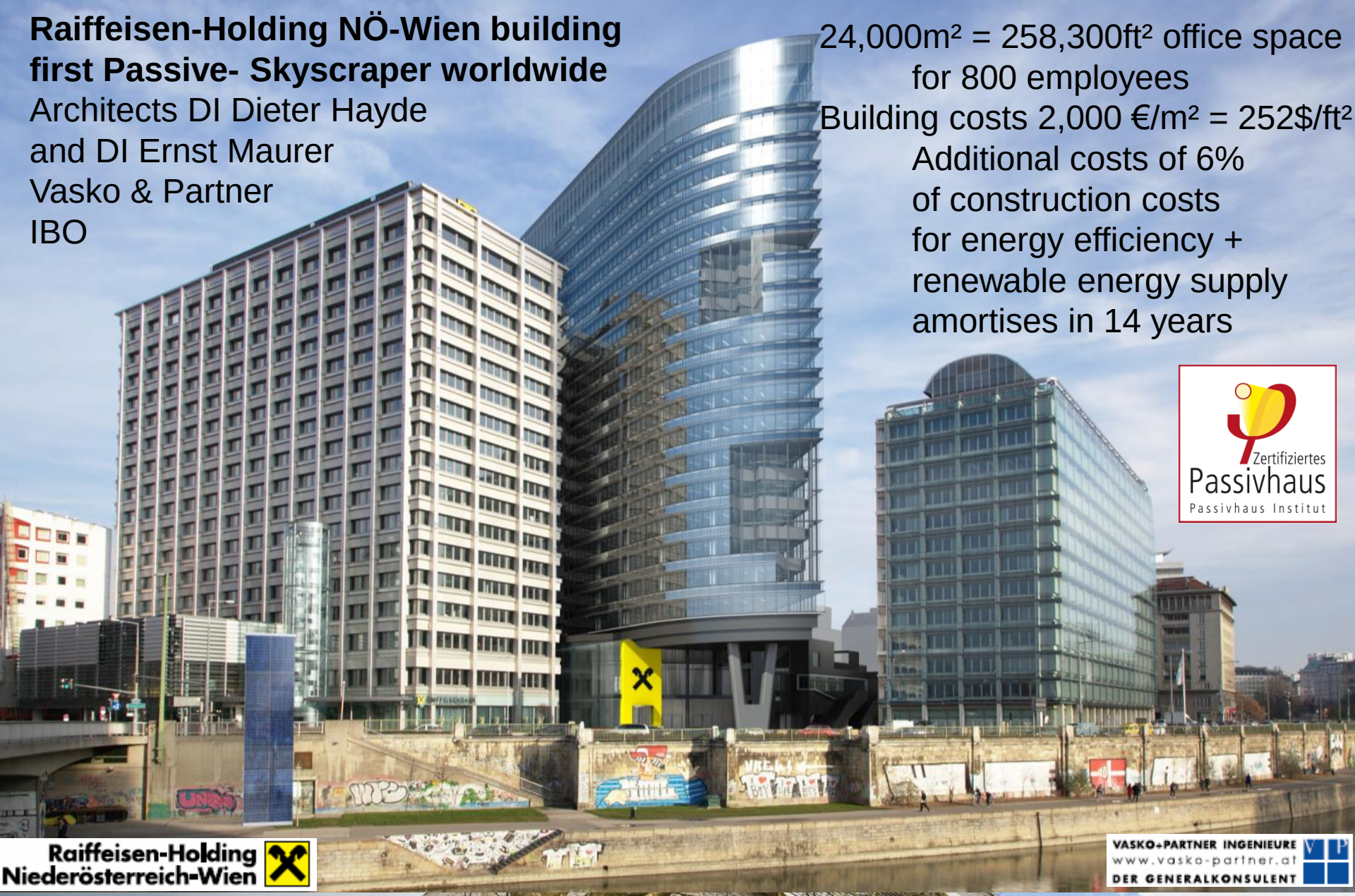
Property bought by
Raiffeisen Holding NÖ – Wien in 2007

Organization of the Petroleum Exporting Countries

Raiffeisen-Holding NÖ-Wien building
first Passive- Skyscraper worldwide

Architects DI Dieter Hayde
and DI Ernst Maurer
Vasko & Partner
IBO

24,000m² = 258,300ft² office space
for 800 employees
Building costs 2,000 €/m² = 252$/ft²
Additional costs of 6%
of construction costs
for energy efficiency +
renewable energy supply
amortises in 14 years



Zertifiziertes Passivhaus
Passivhaus Institut

Raiffeisen-Holding Niederösterreich-Wien

VASKO+PARTNER INGENIEURE
www.vasko-partner.at
DER GENERALKONSULENT

PASSIVHAUS Austria
www.passivhaus-austria.org

Sustainable Passive Houses for old and new buildings

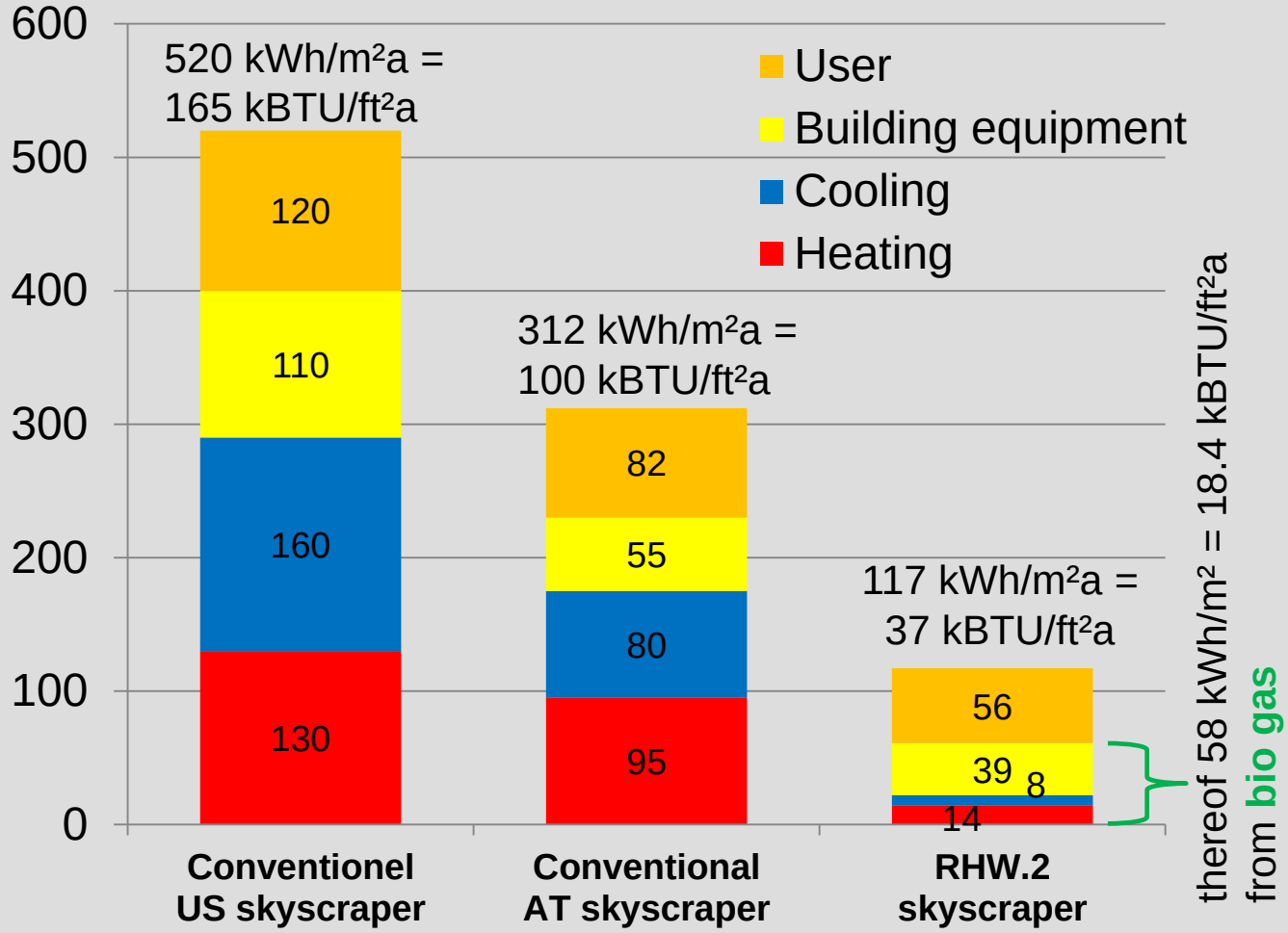
LANG consulting
Passivhäuser – Innovative Baukonzepte für Alt- und Neubau
www.langconsulting.at

Raiffeisen-Holding NÖ-Wien office at Danube channel

World's first Passive-skyscraper

Architects DI Dieter Hayde and DI Ernst Maurer

Skyscraper benchmarks energy consumption in kWh/m²$_{GFA}$a



- 300 conventional skyscrapers in China under construction
  400 further conventional skyscrapers are planned
- Operating costs of skyscrapers are very expensive

Operating and energy costs can be **reduced by 70%** !

The first Passive House skyscrapers in Europe

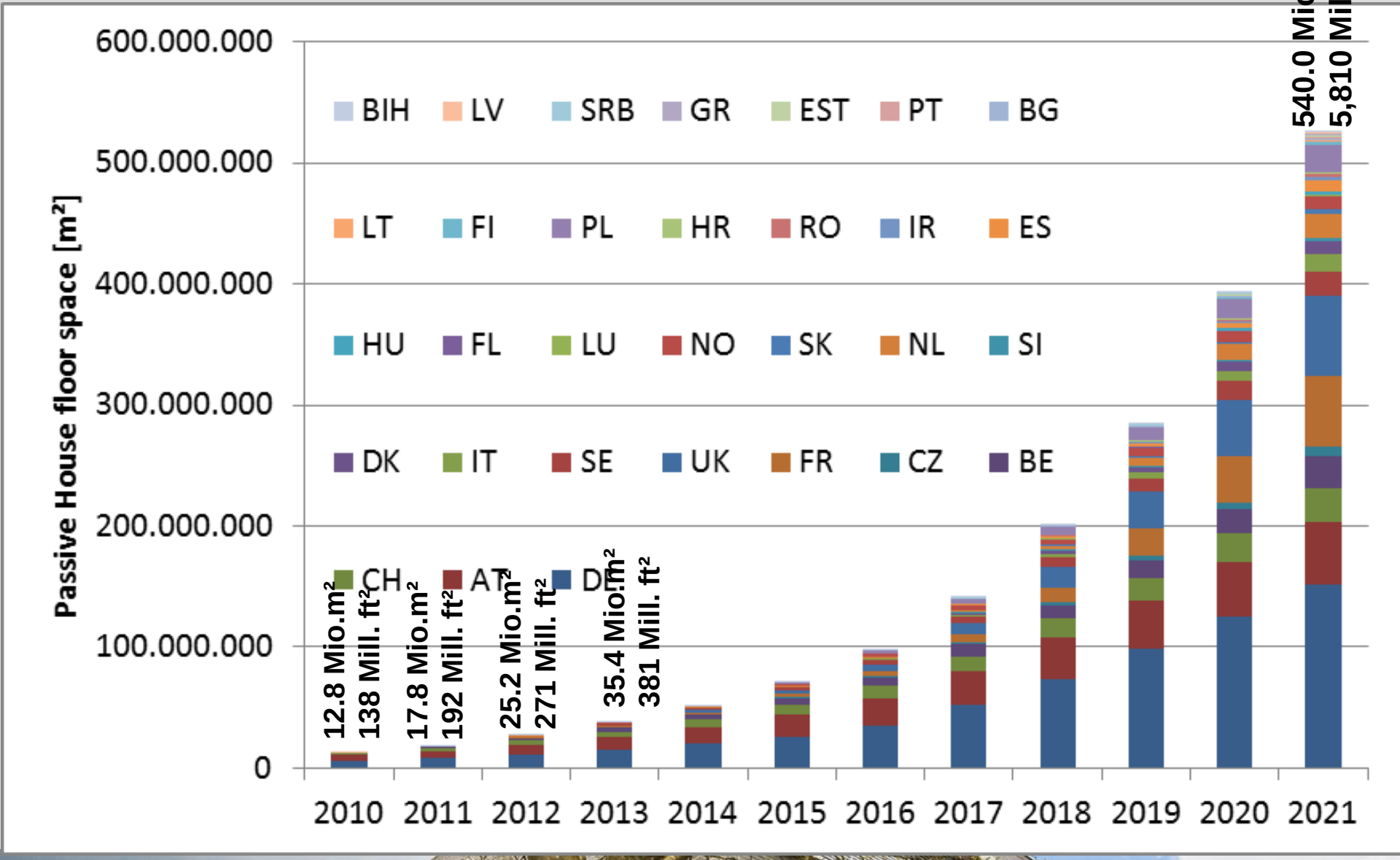
Raiffeisen-Tower
1020 Wien/Austria

Donau Marina
1020 Wien/Austria

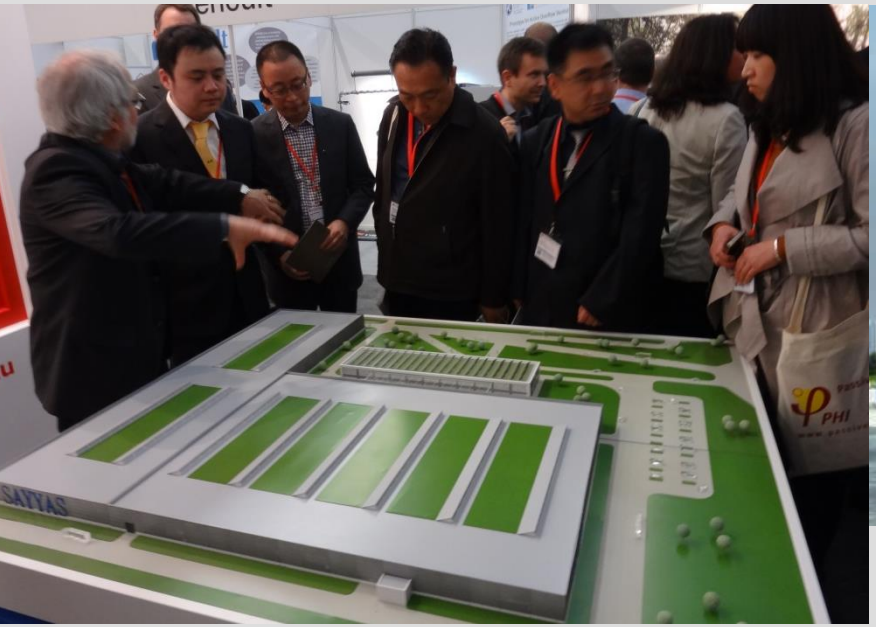
Police headquarter
Charleroi/Belgium

Bureaux pour la CEE
Brussels/Belgium

Passive House trends in Europe from 2010 to 2021



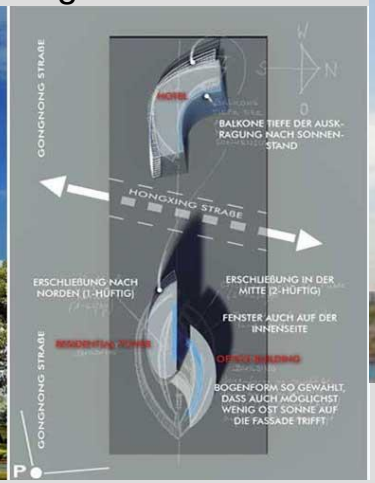
In China first Passive House projects are developed



哈尔滨零排放建筑门窗公司Sayyas 2013 设计/ Rongen Architekten GmbH

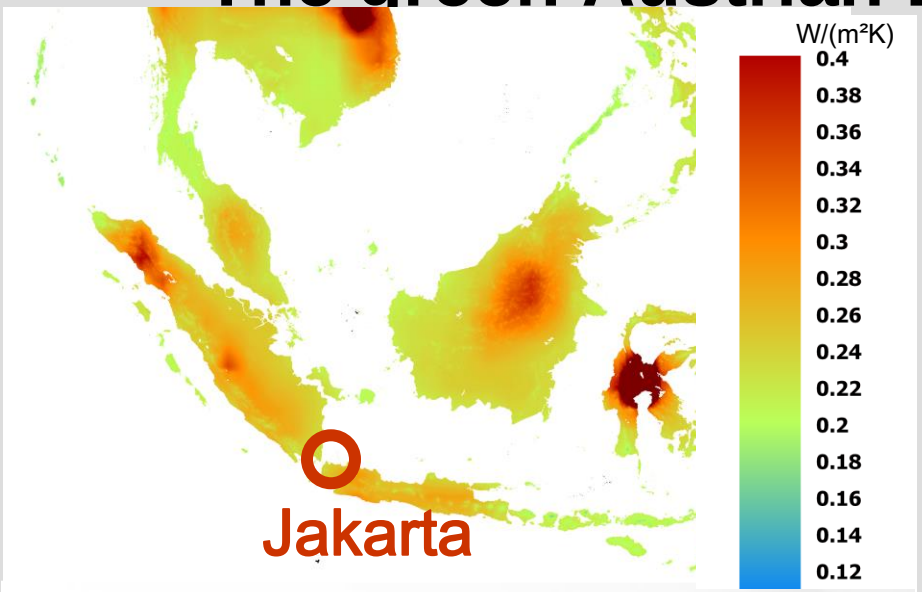
中国常州零排放建筑2012设计/ Rongen Architekten GmbH

南通大厦2011设计 / Rongen Architekten GmbH



4 栋18层住宅楼中国青岛hoch 2012设计 / Rongen Architekten GmbH

The green Austrian Embassy in Indonesia



Pos architekten, Fritz Oettl

So in terms of healthy and fine indoor comfort and environmentally friendly design the New Austrian Embassy may be a big leap forward for office buildings in hot and humid climates.

Reduction demand: *shading*, low-E

Comfortable cooling and *fresh air provision*

Minimization of *transmission load*

Airtight building shell

Energy efficient climatic guidelines

Careful planning and simulation

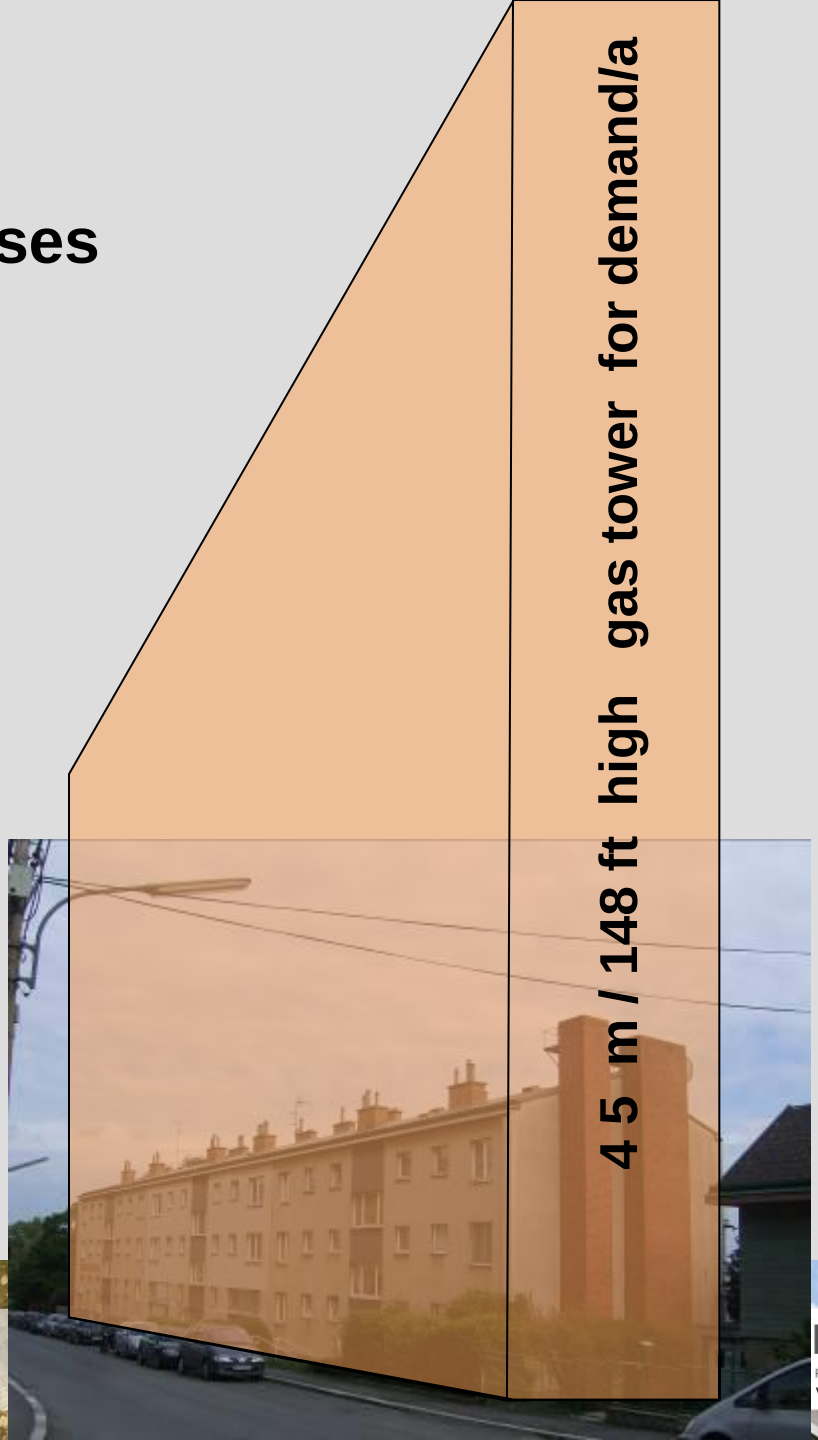
Energy *efficient ventilation* and *dehumidification* device

Waste energy in old houses

Middle energy demand
150 kWh/m²a = 47.5 kBTU/ft²a

- 95%

7,5 kWh/m²a = 2.4 kBTU/ft²a



ENERGIESPAREN MIT EINEM PASSIVHAUS

95%

„Was kümmert mich der Ölpreis!"

IG Passivhaus Österreich

First Multi-family house retrofit to Passive house standard
MFH Makartstraße, Linz

Head demand before: **179.0 kWh/m²a** = 56.74 kBTU/ft²a
Head demand after: **14.7 kWh/m²a** = 4.66 kBTU/ft²a
Nutzfläche vor: **2,860 m²** = 30,780ft²
Nutzfläche nach: **3,106 m²** = 34,014 ft²

Construction 1957
Retrofit 2005

Developer:
GIWOG

Architect:
Arch & More Architekten

WHA Dieselweg Graz with 204 flats, over 10,000 m² = 107,640 ft² floor space

Dieselweg 3-19
142 kWh/m²a -> 13,6 kWh/m²a

Dieselweg 4, 6, 8
184 kWh/m²a -> 9,6 kWh/m²a

Dieselweg 12, 14
225 kWh/m²a -> 9,6 kWh/m²a

45.01 kBTU/ft²a -> 4.31 kBTU/ft²a

58.33 kBTU/ft²a -> 3.04 kBTU/ft²a

71.33 kBTU/ft²a -> 3.04 kBTU/ft²a

Developer: GIWOG

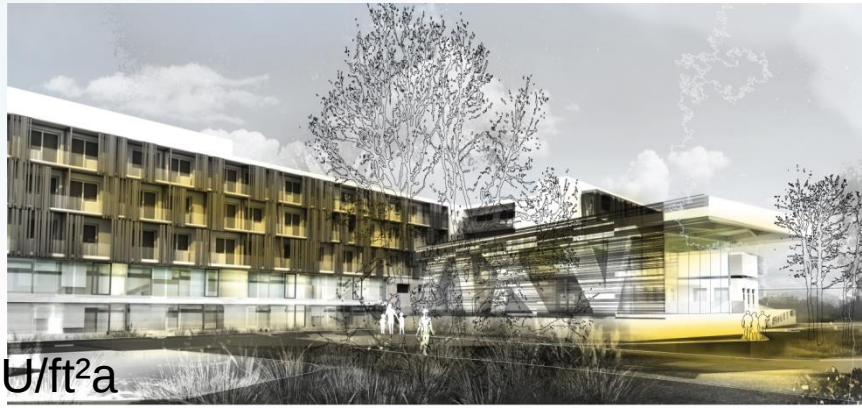
Healthcare center Bad Schallerbach
Owner: National health insurance agency for railroads and mining

Architect: Architects Collective

Retrofit and expansion of a therapy center with accommodation facility for 120 beds

Gross floor area 10,000 m² = 107,640 ft²

Heat demand: before 125.0kWh/m²a = 39.6 kBTU/ft²a
after 17.5kWh/m²a = 5.5 kBTU/ft²a

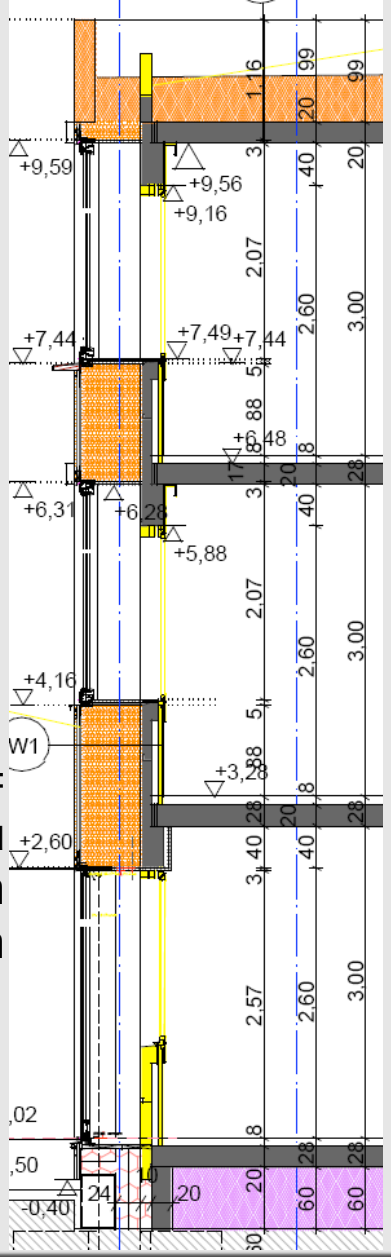


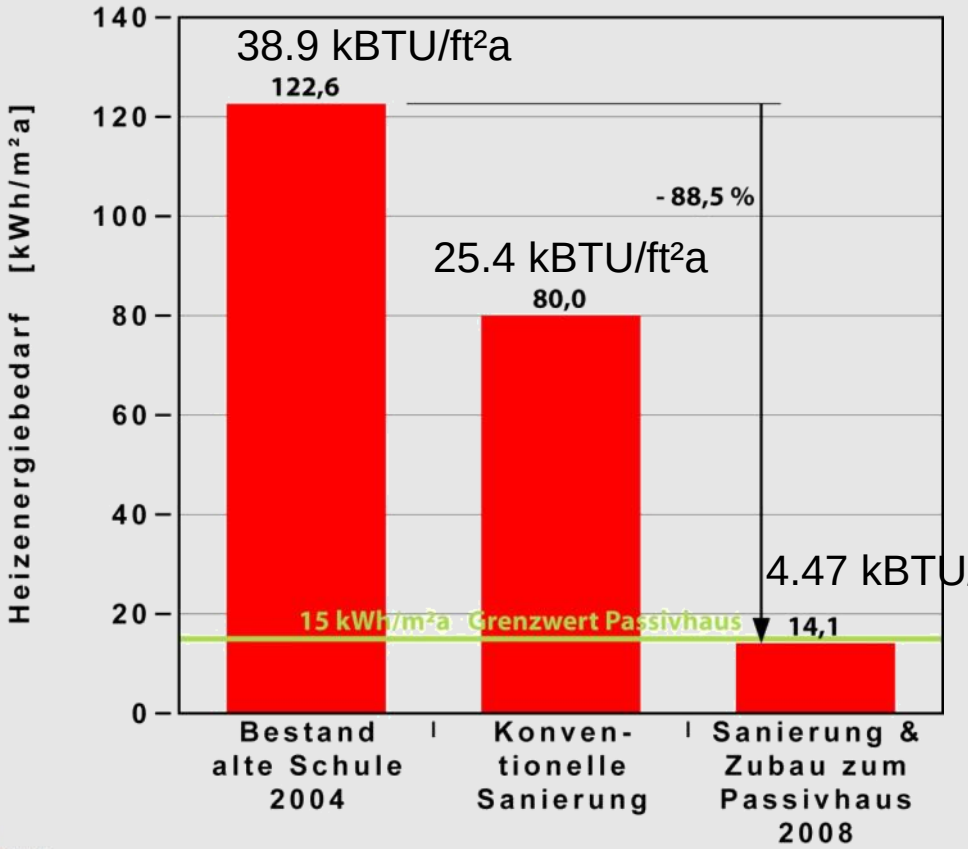
First Austrian school retrofitting to Passive House

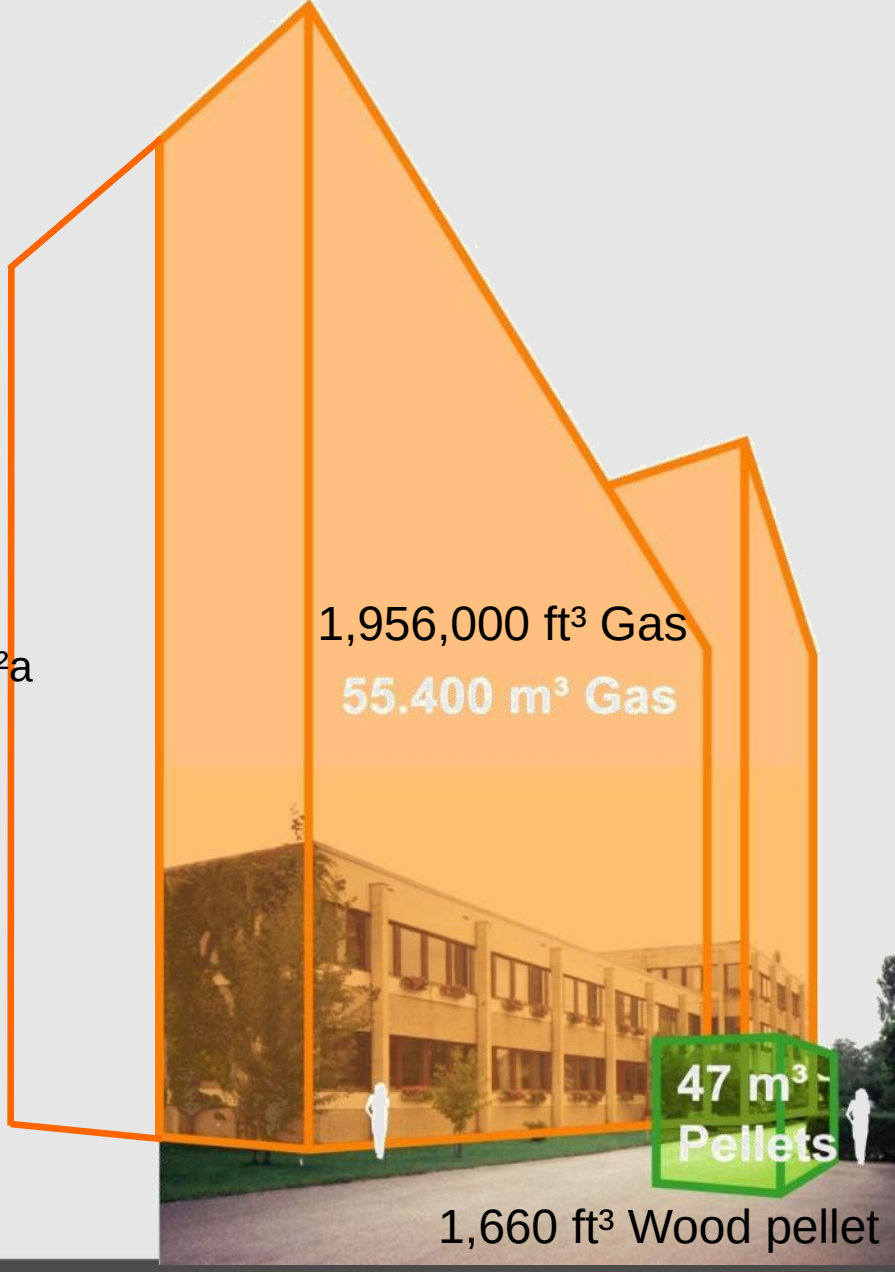
HSII + Polytech school
Schwanenstadt/Upper Austria
PAUAT architekten
Obermayr Holzkonstruktionen
LANG consulting

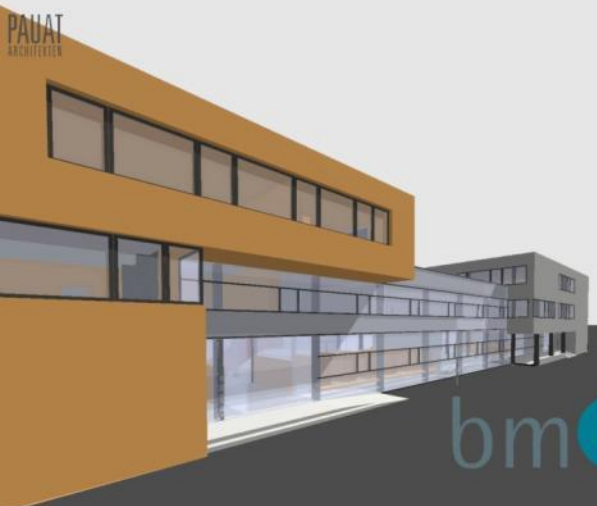
Super envelope for old school
New facade fixed to the old pillars

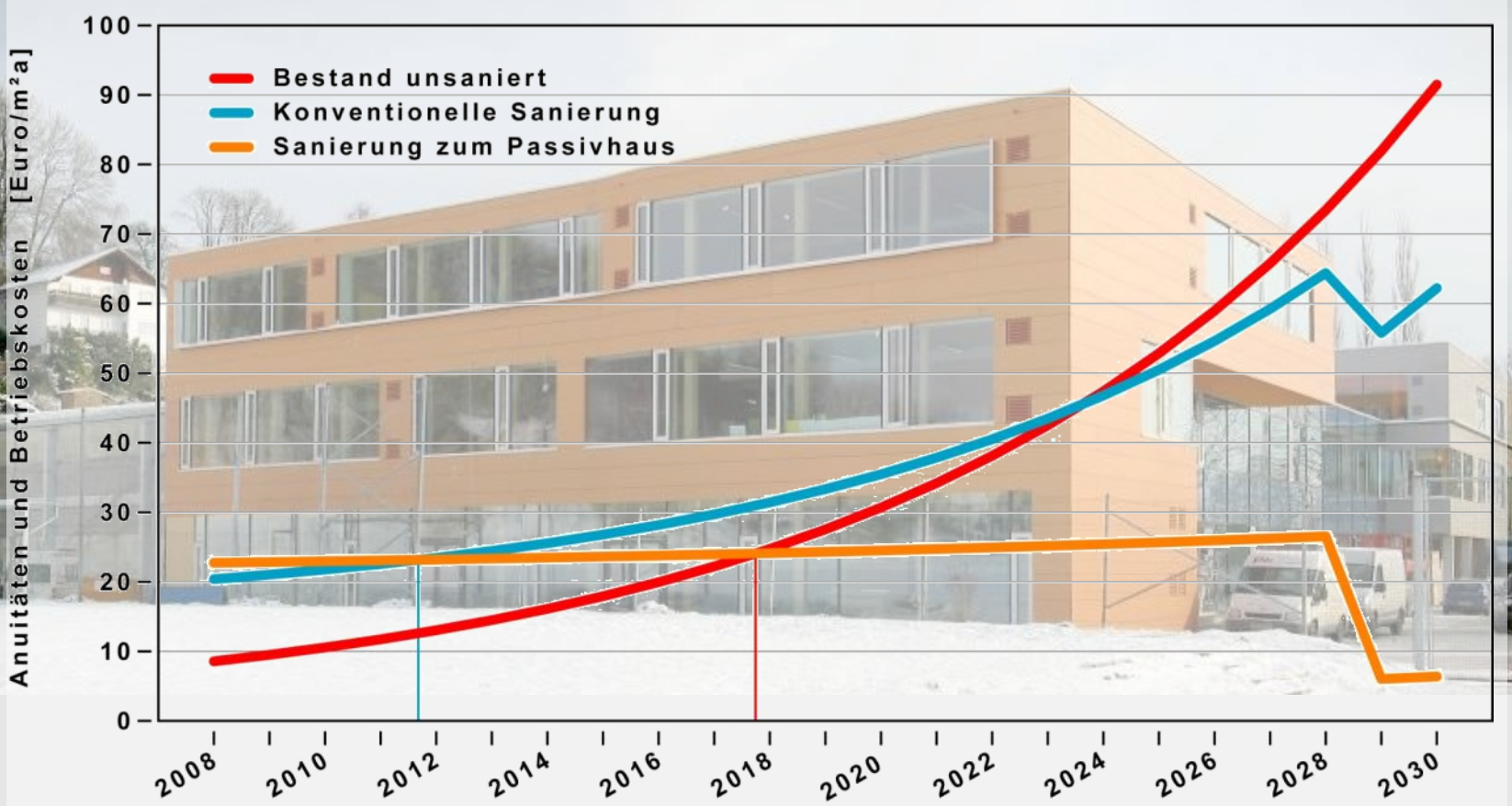
U-value = 0.08 W/m²K =
R-value = 71h ft² F/Btu
58 cm = 1.9 ft insulation
between wood construction




Heizenergiebedarf [kWh/m²a]
140
120
100
80
60
40
20
0
38.9 kBTU/ft²a
122,6
- 88,5 %
25.4 kBTU/ft²a
80,0
4.47 kBTU/ft²a
15 kWh/m²a Grenzwert Passivhaus
14,1
Bestand alte Schule 2004
Konven-tionelle Sanierung
Sanierung & Zubau zum Passivhaus 2008


1,956,000 ft³ Gas
55.400 m³ Gas
47 m³ Pellets
1,660 ft³ Wood pellet


PAUAT



Graph: Amortization of renovation on Passive House standard within 5 or rather 11 years

Additional costs Passive House standard	ca. 8%
Day- and artificial-light management	ca. 2%
Ecologic sustainable actions	ca. 3%

Allgemeine Sonderschule Linz 06
Retrofit to Passive House

Designer: Enzenhofer & Dornstädter ZT GesmbH Floor space: 2,098 m^2 = 22,580 ft^2

Heat demand = 13.10 kWh/m^2a = 4.15 $kBTU/ft^2a$ Wall U-value: 0.10 W/m^2K = R-value 57h ft^2 F/Btu

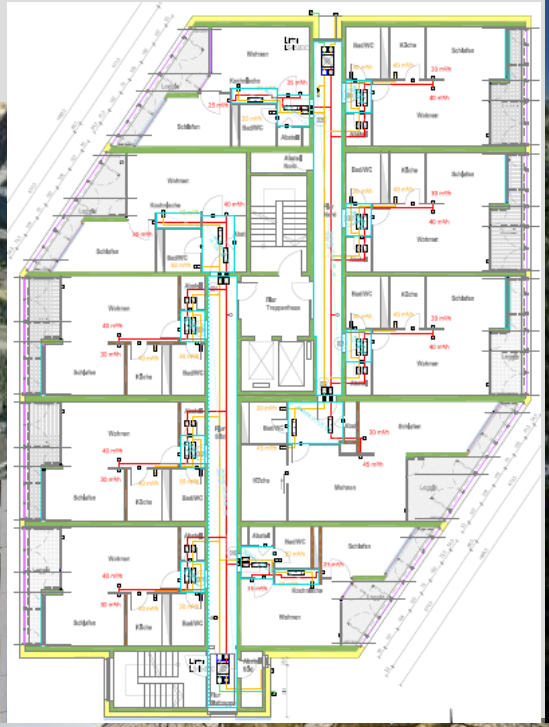
PASSIVHAUS Austria
www.passivhaus-austria.org

Sustainable Passive Houses for old and new buildings

LANG consulting
Passivhäuser – Innovative Baukonzepte für Alt- und Neubau
www.langconsulting.at

Hamburg, Reeperbahn / Germany
Architect Georg W. Reinberg/Vienna
20-story multi family skyscraper

Heat demand: before 170kWh/m²a = 53.9 kBTU/ft²a
after 14kWh/m²a = 4.4 kBTU/ft²a
Retrofit to passive house standard,
Ventilation system with heat recovery,
passive solar recovery, photovoltaic,
solar collectors



Retrofitting Public Passive Houses

EXPOST Bolzano Administration building of the Autonom Province Bolzano/Italy

110 workplaces

Zertifiziertes Passivhaus
Passivhaus Institut

Arch. Michael Tribus

Heating demand after renovation:
12.00 kWh/m²a = 3.8 kBTU/ft²a

Treated floor area:
2,800 m² = 31,000 ft²

PASSIVHAUS Austria
www.passivhaus-austria.org

Sustainable Passive Houses for old and new buildings

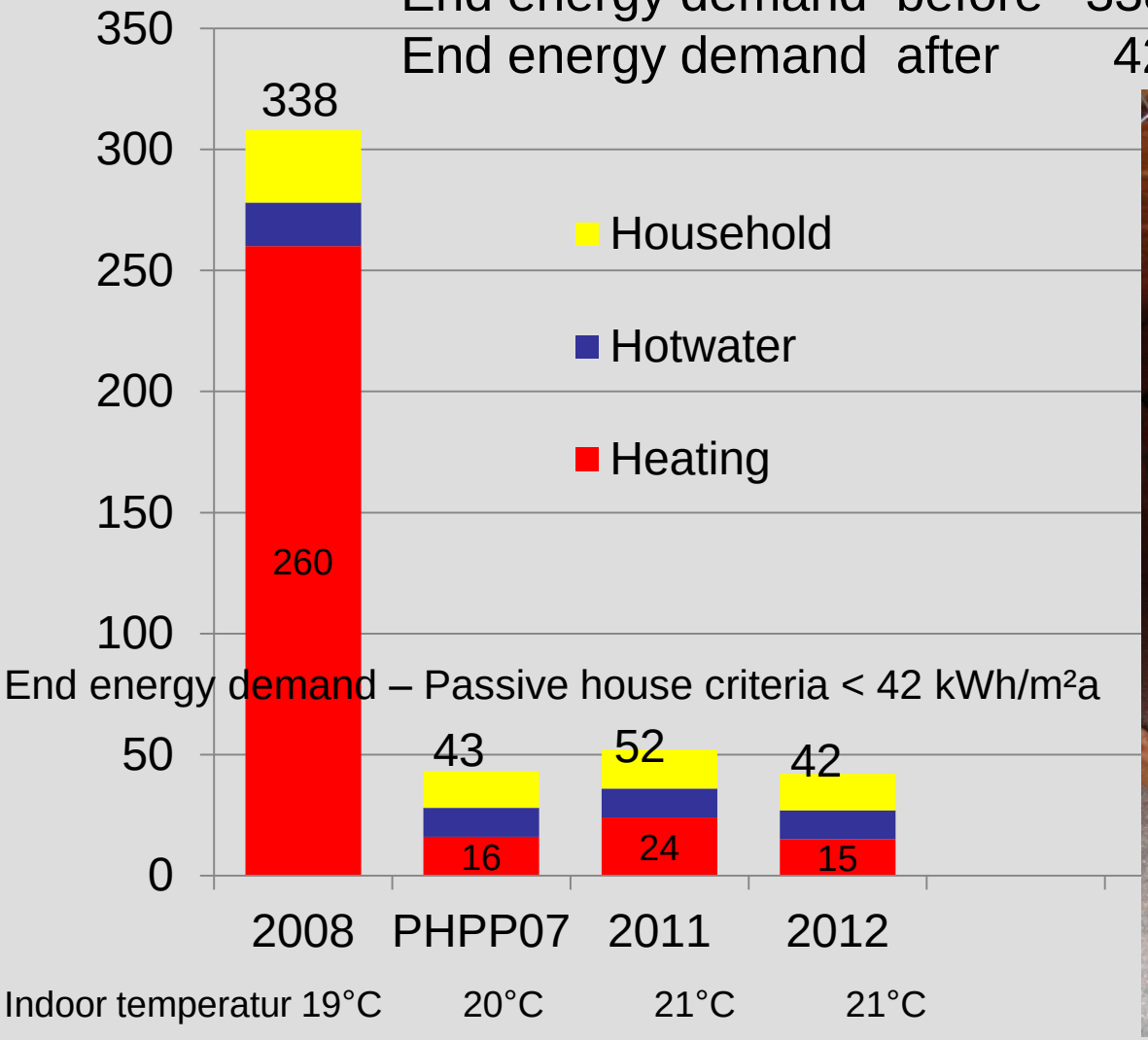
LANG consulting
Passivhäuser – Innovative Baukonzepte für Alt- und Neubau
www.langconsulting.at

First retrofit to Passive house / Single-family-home Tad Everhart in Portland

First evaluation results from the University of Portland

End energy demand before 338 kWh/m²a = 107 kBTU/ft²a

End energy demand after 42 kWh/m²a = 13 kBTU/ft²a



Fronius International headquarter office, Wels

PAUAT ARCHITEKTEN

Retrofit brick fassade Industry building

Wall indoor 12 cm = 4.7in, Roof 60 cm = 2ft insulation

Passive House windows

Heat demand $_{old}$ 204 kWh/m²a = 65 kBTU/ft²a

Heat demand $_{new}$ 24 kWh/m²a = 7.3 kBTU/ft²a

Master plan for North American energy revolution

€ 500 billion = 690 billion $ subsidy by 2030

€ 100.- /m² **= 13.- $/ft²** subsidy for retrofits with 85% EE

Result:

- 85% energy savings +
- remainder 100% coverable by RES
- 5.0 billion m² living area
- 1,000 TWh in energy savings per year
- 530 million ton CO_2 reduction per year
- 2.2 million additional green jobs per year

Win – Win – Win strategy against economic crises !

Concept LANG consulting

Master plan for North American energy revolution

€ 500 billion = 690 billion $ subsidy by 2030

€ 100.- /m² **= 13.- $/ft²** subsidy for retrofits with 85% EE

Economic facts for the next 20 years:

- 690 billion $ subsidy
- 950 billion $ VAT + taxes

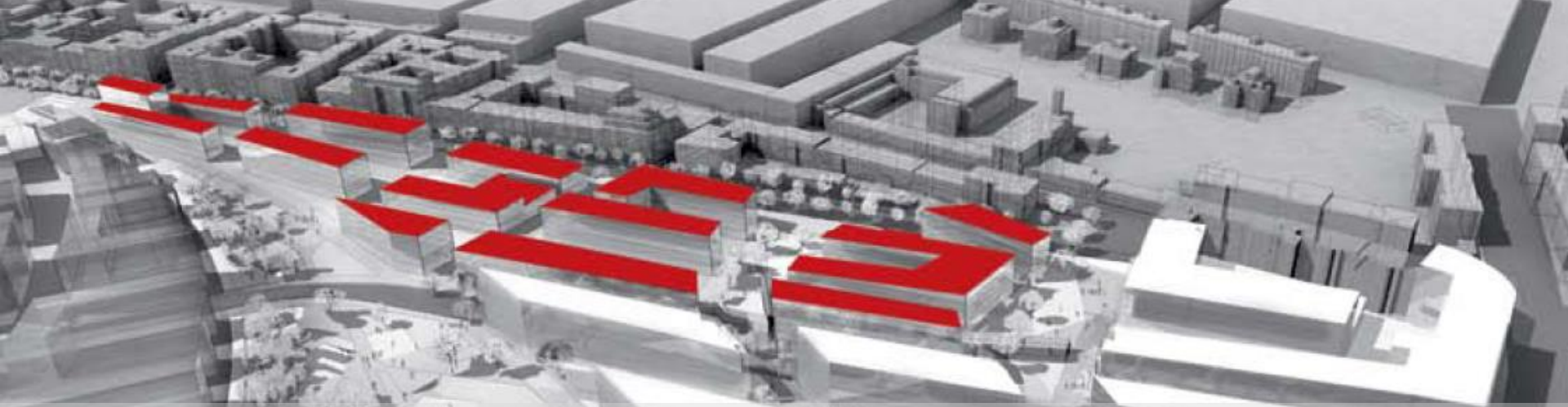
  260 billion $ benefit for national budgets

- 4,900 billion $ investment
- 6,200 billion $ energy saving costs

  1,300 billion $ benefit for the EU population

Win – Win – Win strategy against economic crises !

Concept LANG consulting



Wien 3., EUROGATE – Aspanggründe

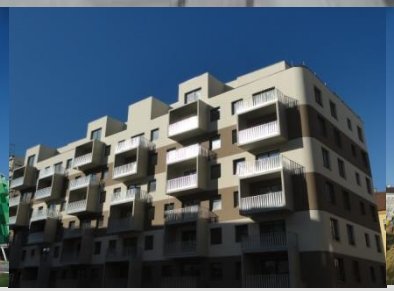
Multi family houses areal with **1,900 flats**

around 156,000 m² = 1,679,000 ft²

Stadtentwicklung Projekt: Albert Wimmer ZT-GmbH

Visualisierung: beyer.co.at

Part of big city in Passive House standard



PASSIVHAUS Austria
www.passivhaus-austria.org

Sustainable Passive Houses for old and new buildings

LANG consulting
Passivhäuser – Innovative Baukonzepte für Alt- und Neubau
www.langconsulting.at

World's largest Passive House city area

Zero-Emission-City areal **Heidelberg-Bahnstadt**
116 ha for 5,000 new job places + 1,700 flats
Passive House as Standard for urban development

www.heidelberg-bahnstadt.de

- Wohnen: 9 Hektar
- Gewerbe: 16,5 Hektar
- Campus: 4,5 Hektar
- öffentliche Einrichtungen:
  2 Kindertagesstätten, 1 Grundschule,
  1 Bürgerzentrum

HEIDELBERG BAHNSTADT
FREIRAUM FÜR IDEEN

PASSIVHAUS Austria
www.passivhaus-austria.org

Sustainable Passive Houses for old and new buildings

LANG consulting
Passivhäuser – Innovative Baukonzepte für Alt- und Neubau
www.langconsulting.at

Passive house front-runner regions

Frankfurt Beschluss vom 06.09.2007:

Der Magistrat wird aufgefordert sicherzustellen, dass alle neuen Gebäude der Stadtverwaltung, städtische Einrichtungen und Eigenbetriebe sowie alle Gebäude, die im Rahmen von PPP-Modellen künftig für die Stadt Frankfurt errichtet werden, dem Passivhaus-Standard genügen und entsprechend konzeptioniert werden. Sollte dieser Standard nicht erreicht werden können, ist dies zu begründen. In allen Fällen gilt als Mindeststandard eine dreißig Prozent bessere Energieeffizienz, als die EnEV verlangt.

Europe has 30 Passive House front-runner regions with 39 Million inhabitants

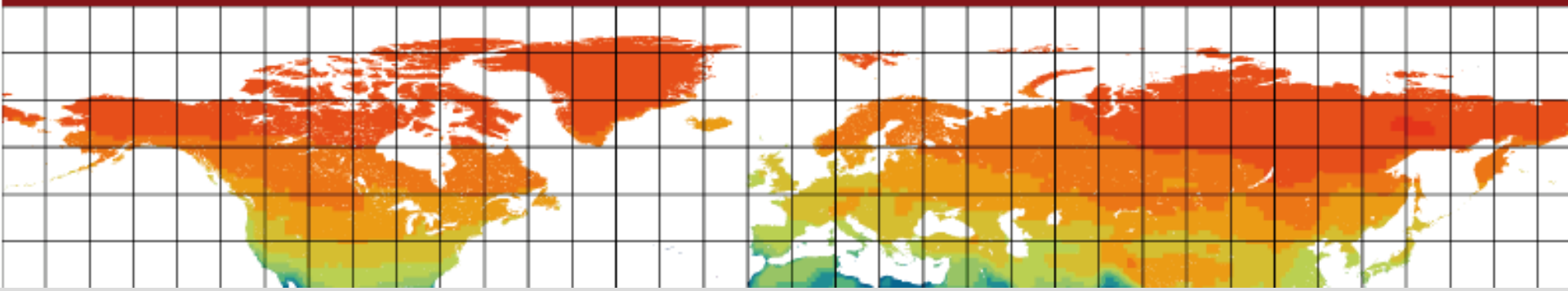
Which city or state will be the

first US Passive House front runner region?

Passive House Globally: Climate

Heating

Insulation level for winter



The only „unlimited“ energy source is energy efficiency !

- Energy efficiency never stops and future supply is 100 % sure
- Energy efficiency does not get more expensive (like fossil fuels)
- Energy efficiency is good for the environment and health
- Energy efficiency makes you independent

We need to use enormous amount of Energy Efficiency !

Passive House standard also in Antarctic

No limits!

Resarch base Princess Elisabeth Station on Antarktis

The future challenges are big
The targets are very high

Big Passive Houses
for Big Apple!

With visions and the Passive House
we can master the future!

www.passiv.de
www.langconsulting.at
www.passivhaus-austria.org
www.passivehouse-international.org