Sustainable Cities Go Passive
A small step for the owner - A giant leap for the world
Ing. Günter Lang / LANG consulting
Summary of North America presentation tour from 11th to 27th March 2015
### Annual end energy requirement for buildings in kWh/m²a

**Head demand max. 15 kWh/m²a = 4.75 kBTU/ft²yr**

<table>
<thead>
<tr>
<th></th>
<th>USA</th>
<th>Austria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passive house</td>
<td>0.06%</td>
<td>25%</td>
</tr>
<tr>
<td>Building America</td>
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<td>Programm DOE</td>
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<td>IECC 2009</td>
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<td>International</td>
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<tr>
<td>Energy Conservation Code</td>
<td></td>
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<td>Old buildings</td>
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<table>
<thead>
<tr>
<th>End energy requirement in kBTU/ft² yr</th>
<th>15.85</th>
<th>31.70</th>
<th>47.55</th>
<th>63.40</th>
<th>79.25</th>
<th>95.10</th>
</tr>
</thead>
</table>
Passive House - A small step for the owner
A giant leap for the world

Summary of G. Lang North America presentation tour in March 2015

Primary energy demand in kBTU/ft² yr

- Curtain wall high rise commercial: 222 kBTU/ft² yr
- Masonary high rise commercial: 217 kBTU/ft² yr
- Low rise commercial: 290 kBTU/ft² yr
- Window wall high rise residential: 136 kBTU/ft² yr
- Masonary high rise residential: 113 kBTU/ft² yr
- Low rise residential: 136 kBTU/ft² yr
- Row house: 144 kBTU/ft² yr
- Single family house: 153 kBTU/ft² yr
- Technical University, Vienna: 17,75 kBTU/ft² yr
- Bavarian Parliament, Munich: 34 kBTU/ft² yr
- RHW.2 skyscraper Vienna: 37 kBTU/ft² yr
- Center of justice Korneuburg: 32,6 kBTU/ft² yr
- Communalcenter St. Gerold: 33,4 kBTU/ft² yr
- Raxstr. Vienna: 35,8 kBTU/ft² yr
- Kaisermühlenstr. Vienna: 33,3 kBTU/ft² yr
- Aspernstr. Vienna: 38 kBTU/ft² yr
- Olympic Village Innsbruck: 34,2 kBTU/ft² yr
- Lodenareal Innsbruck: 37,1 kBTU/ft² yr

81% reduction of primary energy demand

Authority of typical consumption in New York 2010 [90 by 50 / URBAN GREEN COUNCIL/2013]
Authority of examples of Passive Houses in Europe [G. Lang / Passivhaus Austria]
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Summary of G. Lang North America presentation tour in March 2015

Saved Energy costs | reliable performance through quality

Energy demand for heating kWh/(m²a) *

Building stock Belgiersiedlung
Belgiersiedlung Kassel, 98 flats

LEH 41 h. Niedernhausen
Passive House Settlements
Wiesbaden Hannover Stuttgart
Hannover Kronsberg Feuerbach

average measured 158 kWh/(m²a)
average measured 13 kWh/(m²a)
average measured 14 kWh/(m²a)

Performance Gap?

Calculation results

*) useful living space
2nd Largest Passive House worldwide
Lodenareal / Innsbruck
Developer: Neue Heimat Tirol
Architect: teamk2 / din a4
Building physics: Herz & Lang GmbH

361 flats/ 299,300 ft²
Primary energy 37.1kBTU/ft²yr

Pellets consumptions 321 cubic yards
It’s the same as the consumption of 6 single family houses
Inhabitant satisfaction result 95%
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
Primary energy demand: 33.28 kBTU/ft²yr

Floor space 264,600ft²
Year of construction: 2014
Building costs: 141 $/ft²
Example: Residential and commercial building L

Rüdiger Lainer + Partner Architects
Win4Win Bauträger

Floor space: 137,800 ft²
128 flats,
Doctor's practice,
Kindergarten, Supermarket

Year of construction 2013
Wall/Roof/Cellar R 63
Primary energy: 35.8 kBTU/ft²yr
Building costs: 146 $/ft²

Summary of G. Lang North America presentation tour in March 2015
Neighbourhood Passive House Sonnwendviertel, 1100 Vienna
4 residential buildings with 285 flats

Example:
"so.vie.so" – Social Housing - Vienna
Architect:  s&s architekten - C. Schindler & R. Szedenik
Developer: BWS-Gruppe
Treated floor area: 82,340 ft²
Heat demand: 4.44 kBTU/ft²
Heat load: 3.17 BTU/hr.ft²
Primary energy: 34.2kBTU/ft²

Exterior wall R-value: R 44
Roof U-value: R 52
Year of construction: 2013

Photo: Alexander Schindler
Neighbourhood Passive House Mautner Markofgründe, 1110 Vienna
4 residential buildings with 275 flats

Example: "JOIN IN" intercultural housing
Architect: Architekten Tillner & Willinger
Treated floor area: 86,540ft²
Heat demand: 4.44kBTU/ft²
Heat load: 3.17 BTU/hr.ft²

Exterior wall R-value: R57
Floor slab R-value: R71
Roof R-value: R52
Windows $U_w$-value 0.014BTU/hr.ft².°F
Airtightness: 0.18 Ach
Year of construction: 2014
Neighbourhood Passive House Seestadt Aspern, Vienna 1220

Actually finished in Passive House
4 dormitory buildings with 340 flats
1 office building with 78,850 ft²
Technology Center Aspern,

2 residential buildings

Example: Greenhouse Student Dormitory Sonnenstraße
Student housing for 300 students
Architect aap.architekten ZT-GmbH
Developer WBV-GPA

Head demand
4.75 kBTU/ft²yr

Primary energy
37kBTU/ft²yr

Building costs:
146 $/ft²
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Summary of G. Lang North America presentation tour in March 2015

Building costs $/ft²

- Holm Frankfurt: 223 $/ft²
- Court building Korneuburg: 270 $/ft²
- Office building Ulm: 139 $/ft²
- RHW.2 skyscraper Vienna: 202 $/ft²
- Passivhausscheibe...: 129 $/ft²
- GreenFlexStudios: 141 $/ft²
- Greenhouse: 146 $/ft²
- Molkereistraße: 118 $/ft²
- Raxstr. Vienna: 146 $/ft²
- Kaisermühlenstr. Vienna: 141 $/ft²
- Aspernstr. Vienna: 146 $/ft²
- Olympic Village Innsbruck: 150 $/ft²
- Lodenareal Innsbruck: 162 $/ft²

Residential buildings in middle 141 $/ft²
Sustainability evaluation of Viennese housing estates in Passive House standard – A post occupancy reflection of selected criteria

Construction costs per treated floor area and compactness

Energy demand for space heating and life cycle costs per treated floor area

Roman Smutny, Christoph Neururer & Martin Treberspurg, BOKU (2012)
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Summary of G. Lang North America presentation tour in March 2015

Economy of Passive Houses (Central Europe)

2015 lifecycle 50 a no subsidies
2.0% real interest rate
energy price 8 Cent/kWh

Net Present Value [€/m²]

4.75 kBTU/ft²yr

Passive Houses

Annual Heating Energy Requirement kWh/(m²a)
Mission Building Christophorus Haus
4651, Stadl-Paura / Upper Austria

Energy demand: 4.44kBTU/ft²yr
Heat load: 4.44BTU/hr.ft²
Airtightness $n_{50}$: 0.40 Ach

Heat & cooling costs:
€ 490.-/yr
$ 3.03/ft²yr!!

Floor area: 20,250 ft²
Wooden construction

Arch. DI. Böhm + Mag. Frohnwieser
BBM-Beschaffungsbetrieb der MIVA

Summary of G. Lang North America presentation tour in March 2015
Center of justice Korneuburg - Court
DIN A4 Architektur ZT GmbH, Innsbruck
Owner: Bundesimmobiliengesellschaft (BIG)
Building physics: Herz & Lang GmbH

Floor space: 181,200 ft²
Working places: 180 employees
Heat demand: 3.7kBTU/ft²yr
Heat load: 5.07 BTU/ft²
Primary energy demand: 32.6 kBTU/ft²yr
Airtightness: 0.20 Ach
Completion: 2012

Markus Bstieler © markus bstieler

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Summary of G. Lang North America presentation tour in March 2015
Raiffeisen-Holding NÖ-Wien building first Passive-Skyscraper worldwide
Architects DI Dieter Hayde and DI Ernst Maurer Vasko & Partner IBO

258,300ft² office space for 900 employees
Building costs 202 $/ft²
Additional costs of 6% of construction costs for energy efficiency + renewable energy supply amortizes in 14 years
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A giant leap for the world

Summary of G. Lang North America presentation tour in March 2015

Raiffeisen-Holding NÖ-Wien office at Danube Canal

World’s first Passive-skyscraper

Architects DI Dieter Hayde and DI Ernst Maurer

Skyscraper benchmarks energy consumption in kWh/m² GFA a

<table>
<thead>
<tr>
<th>Skyscraper Type</th>
<th>Energy Consumption kWh/m² a</th>
<th>Energy Consumption kBtu/ft² yr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional US skyscraper</td>
<td>312</td>
<td>100</td>
</tr>
<tr>
<td>RHW.2 skyscraper</td>
<td>117</td>
<td>37</td>
</tr>
</tbody>
</table>

thereof 18.4 kBtu/ft² yr from bio gas

User
Building equipment
Cooling
Heating
Operating costs of skyscrapers are very expensive.

Operating and energy costs can be reduced by 70 to 80%!

The first Passive House skyscrapers in Europe:

- Raiffeisen-Tower 1020 Wien/Austria 258,300ft²
- Donau Marina 1020 Wien/Austria 485,000ft²
- Police headquarter Charleroi/Belgium 250,000ft²
- Bureaux pour la CEE Brussels/Belgium 2,293,000ft²

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Summary of G. Lang North America presentation tour in March 2015
Vienna 3., EUROGATE – Aspanggründe
Multi family houses district with 1,900 flats
around 1,679,000 ft²
Masterplan Project: Albert Wimmer ZT-GmbH
Visualisierung: beyer.co.at

World’s first Passive House city district
World’s largest Passive House city district **Heidelberg-Bahnstadt**
116 ha for 5,000 new job places + 1,700 flats
Passive House as Standard for urban development

www.heidelberg-bahnstadt.de

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Summary of G. Lang North America presentation tour in March 2015
Heidelberg Bahnstadt

- Housing: 9 Hektar
- Business: 16.5 Hektar
- Campus: 4.5 Hektar
- Public buildings:
  - 2 Kindergartens
  - 1 School
  - 1 People center

Laboratorium and office

© Copyright City of Heidelberg

Kindergarten Schwetzinger Terrasse
Fire brigade station in Heidelberg
Architect: Prof. Peter Kulka, Dipl. Architekt BDA

Floor area: 37,000 ft²
Year of construction: 2007
Heat demand: 4.75 kBTU/ft² yr
Airtightness: n₅₀ = 0.49 Ach
Curtain-wall-facade Uₜ-Wert: 0.14 BTU/hr.ft²°F
Photovoltaic on facade + roof: 60kWp

Fotocredits: GGH Heidelberg
Antwerp (Belgium)

The city of Antwerp is consciously choosing to lead as an example and is already building all projects owned by the city according to Passive House standard.

With its climate plan (2011), the city of Antwerp has committed to use energy and resources sparingly and sustainably. The region aims to achieve CO₂ neutrality by 2050.

Nieuw Zuid, a new, mixed residential quarter in the south of the city, is a prime example of the type of development being promoted. All of the buildings in this area are being designed to Passive House level.

2,000 dwellings, offices and other amenities
City of Frankfurt  Resolution of 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.

All communal buildings must be Passive
All residential buildings from FAAG must be Passive
Province Hessen/Germany:
Provincial buildings since 2008 in general
in Passive House standard
Offices, administration buildings, schools, hospitals,…

School with gym and youth center in Frankfurt Riedberg
Owner: HA Hessen Agentur GmbH
Architect: Ackermann+Raff
Resolution of the Bavarian government May 24th 2011
All new government buildings have to be built in
Passive House standard

Bavarian Parliament
Bayerischer Landtag in München
Maximilianum
Architect:
Léon Wohlhage Wernik Architekten

Construction: Massive
Year of construction: 2012
Heat demand 34 kBtU/ft²yr
Energy & sustainable buildings in Brussels

2004
Ambitious energy policy:
- stimulation of demand
- control of good conception
- experiences on life-size scale

2007
Energy is the driver but also approach of sustainability
1st Call for projects “Exemplary Buildings”
From building to neighbourhood

2009
Government declaration
Announcing passive standard for 2015

2010
Commitment of public authorities: obligation Passif 2010
Alliance Employment – Environment – Sustainable Construction

2011
From exemplarity to common use
Decree of 5 May 2011

2013
Negociation and agreement with the sector

2014
Belgian assessment method for sustainable buildings: voluntary approach

2015
1st January – every new building passive, heavy refurbishment low energy
From 0 to 265,000m² Passive House buildings / Brusselles

Starting in 2007 with a first single family house, three years later 2,850,000 ft² floor area in Passive House standard was built
Thibaut HERMANS, Brussels Environment

• subsidy of 13 $/ft² for new build passive houses
• subsidy of 20 $/ft² for retrofit to passive houses
• support
• promotion

…“easily” reached the required specific space heat demand for Passive Houses
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Summary of G. Lang North America presentation tour in March 2015
Are you normal? campaign www.areyounormal.be

“Populist” Actions communicate these advances widely to the public

In your passivehouse, the most extraordinary is YOU
Passive House - A small step for the owner
A giant leap for the world

Campaign: www.areyounormal.be

“Populist” Actions communicate these advances widely to the public

I live in a passivehouse but I'm normal…

In your passivehouse, the most extraordinary is YOU
Passive house front-runner regions

Today Europe has

31 Passive House front-runner regions with 40 Million inhabitants

Which city or state will be the first USA Passive House front runner region?
New Plus Energi Headquarters for Syd Energi

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

Treated floor area: 117,900 ft²
Year of construction: 2013

Annual heat demand: 2.53 BTU/ft² yr
Primary energy requirement: 68.8 BTU/ft² yr
Curtain wall R-value: R 30
Roof R-value: R 87

Heat pump using both heat recovery from the server room as a geothermal system
Passivhaus Scheibe Salzkammergut
First certified Passive House Austria's
Architecture: Hermann Kaufmann + LANG consulting
More than 2,500 visitors since 1999
Treated floor area: 1,510 ft²
Head energy demand \(4,33 \text{kBTU/ft}^2\text{a} = 2.9 \text{gal bioalcohol} + 5,460 \text{kBTU green electricity}\)
365 days stay in climatic spa

Permanently fresh air, but no traffic noise, insects, dust, smog or pollen. The heat keeps inside.

Just a health and comfortable room conditions
Temporarily Passivhaus-dormitory for 40 students in Vienna
Constructor: Obermayr Holzbau
Consultant: LANG consulting

Treated floor area 10,760 ft²
Heat demand 4.1 kBTU/ft²yr
Primary energy demand 31.7 kBTU/ft²yr
One GreenFlexStudio-Box 55 ft * 18 ft

Building costs: 141 $/ft²
Passive House trends in Europe from 2010 to 2021

Summary of G. Lang North America presentation tour in March 2015
3,200 projects worldwide in www.passivehouse-database.org

Passive House Database

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Summary of G. Lang North America presentation tour in March 2015
BABY IT’S COLD INSIDE – LET’S CHANGE TO PASSIVE

Passive House makes resilient

What a blackout?

38.9 kBTU/ft² yr

25.4 kBTU/ft² yr

4.47 kBTU/ft² yr

72,440 yard³ Gas

55,400 m³ Gas

61 yard³ Wood pellets
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Retrofitting of the secondary school
Fitting in 4 days
Factor 10 reduction of heat energy
Factor 7 reduction of artificial light using
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 107,640 ft²

Heat demand: before 39.6 kBTU/ft²yr
after 5.5 kBTU/ft²yr
Retrofitting Public Passive Houses
EXPOST Bolzano Administration building of the Autonom Province Bolzano/Italy
110 workplaces

Heating demand after renovation: 3.8 kBTU/ft²yr
Treated floor area: 31,000 ft²
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Summary of G. Lang North America presentation tour in March 2015

First retrofit to Passive House Plus
Office building Technical University Vienna
Architect: Arch. DI Gerhard Kratochwil
Building physic: Schöberl & Pöll GmbH
Owner: BIG Bundesimmobilien gesmbH

Treated floor area: 80,000 ft²
Heat demand: 4.4 kBTU/ft²yr
Heat load: 2.85 BTU/ft²
Primary energy: 17.75 kBTU/ft²yr
Constructions costs and more costs

First retrofit to Passive House Plus
Office building Technical University Vienna
Architect: Arch. DI Gerhard Kratochwil

19.4 Million Euro
without tax, for 145,300 ft² Net floor area, = 140 $/ft²
including Photovoltaic and IT-infrastructure like Servers

<table>
<thead>
<tr>
<th>Gebäudebereich</th>
<th>Costs (exkl. USt)</th>
<th>Add. Costs (exkl. USt)</th>
<th>Additional Costs in per cent</th>
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</thead>
<tbody>
<tr>
<td>Passive House facade excl. Sun production</td>
<td>2,854,368</td>
<td>471,353 ¹</td>
<td>2.4%</td>
</tr>
<tr>
<td>Central ventilation</td>
<td>53,973</td>
<td>-35,963</td>
<td>-0.2%</td>
</tr>
<tr>
<td>Concrete activation</td>
<td>142,797</td>
<td>-61,879</td>
<td>-0.3%</td>
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<tr>
<td>Cooling maschine</td>
<td>79,153</td>
<td>42,827</td>
<td>0.2%</td>
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<tr>
<td>Office ventilation</td>
<td>711,142</td>
<td>310,329</td>
<td>1.6%</td>
</tr>
<tr>
<td>LED-lighting</td>
<td>518,634</td>
<td>306,609</td>
<td>1.6%</td>
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<tr>
<td>Movement detector</td>
<td>41,800</td>
<td>21,450</td>
<td>0.1%</td>
</tr>
</tbody>
</table>

¹ Mehrkosten auf Basis von [Kl10], Code 337.41.81 und einer Fassadenfläche von 4.766 m²
Fronius International headquarter office, Wels
PAUAT ARCHITEKTEN

Retrofit brick facade Industry building
Wall indoor 4.7in, Roof 2ft insulation
Passive House windows

Heat demand old 65 kBTU/ft²yr
Heat demand new 7.3 kBTU/ft²yr
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Used refurbishment standards:
- EnerPHit & Passive House refurbishment
- Low temperature heating/cooling with tunnel water
- High temperature heating/cooling with industrial waste heat
- Renewable energy plants
- Electric mobility stations

[SINFONIA_IBK_BUILDINGS](https://www.google.com/maps/d/viewer?mid=z-vC5WtCljks.kAjrARF7RS-E)
Costs for gas-fired power plant Klagenfurt € 300 Mio.
CO₂ certificate costs for 20 years (calc. € 30.-/t CO₂ + 10%/a) € 1,500 Mio.
Energy costs (gas) for 20 years (calc. € 0.025/kWh + 10%/a) € 5,200 Mio.

New Power Plant:
- 400 GWh/a thermal energy production
- 2,250 GWh/a electric energy production
- +1,000,000 t increase of CO₂-emission

In whole Austria there shall be built 9 such new power plants

Energy efficiency offensive has the highest potential but costs just 20% as new power plants

Thermal renovated with 85% savings

Study result for Austrian prime minister in 2008 by Passivhaus Austria / Günter Lang
Energy efficiency offensive costs just 20%

€ 100.-/m² = $ 13.-/ft² for thermal renovated with 85% savings

650,000 flats
5,000 public buildings
4,500 office buildings

650,000 electric equipment change A++
130,000 photovoltaic unit with 5 kWp
360,000 thermal solar collectors

Energy efficiency offensive has the highest potential
but costs just 20% as new power plants

Thermal renovated with 85% savings

Study result for Austrian prime minister in 2008 by Passivhaus Austria / Günter Lang
NYC-Mayor’s programme: One City Build at Last 90 by 50

Sure in minimum same potential NYC as Austria
By 2024 build up 200,000 new units in Passive House and retrofit 800,000 units to EnerPHit-standard in NYC

Energy efficiency offensive has the highest potential but costs just 20% as new power plants
Thermal renovated with 85% savings
Study result for Austrian prime minister in 2008 by Passivhaus Austria / Günter Lang
Are retrofits in USA by cheap energy price possible?

Two examples from New York

While energy price is really cheap, no one is thinking about energy savings.

Results are much higher energy bills than in Europe by same time worst comfort!

Retrofit to EnerPHit and Passive House Standard as well very economic in USA!!!
Master plan for North American energy revolution

€ 690 billion $ subsidy by 2030
€ 13.- $/ft² subsidy for retrofits with 85% EE

Result:
• 85% energy savings +
• remainder 100% coverable by RES
• 5.0 billion m² / 54 billion ft² living area
• 1,000 TWh in energy savings per year
• 3,412,000,000 kBTU in energy savings per year
• 530 million ton CO₂ reduction per year
• 2.2 million additional green jobs per year
• Let’s rise up the comfort and healthiness in buildings

Win – Win – Win strategy against economic crises!
Master plan for North American energy revolution

690 billion $ subsidy by 2030
13.- $/ft² subsidy for retrofits with 85% EE

Economic facts for the next 20 years:
- 690 billion $ subsidy
- 950 billion $ 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!
Study „Monetary benefits of ambitious building energy policies“
It’s worth it for economies, not to do things by halves on energy efficiency

Source: ABUD and GBPN
“Life-cycle costs” for different Building standards
Cost transparency - calculated 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!
Passive House Quality has one worldwide standard

Take care for certified Passive Houses
with in summary 1,092,056 m² = 10.604 WE

Use Certified Passive House Components
Over 571 from 26 countries

5,900 Certified Passive House Designers from 50 countries
1,073 Certified Passive House Tradesperson from 20 countries

Calculate and design right in all climate zones!

**designPH** is set to revolutionise the way we use PHPP

designPH is a plugin for Trimble Sketchup which allows you to design Passive House projects in 3D and import the model into PHPP

---

**Passive House - A small step for the owner**
**A giant leap for the world**

Summary of G. Lang North America presentation tour in March 2015
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 buildings 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
Passive House - A small step for the owner
A giant leap for the world

Summary of G. Lang North America presentation tour in March 2015

@ClaudeTurmes thanks @WolfgangFeist for his effort on #PassiveHouse-Standard and energy efficiency #eufores

@MarosSefcovic: "We have the technology like #Passivhaus to create energy efficient buildings" #energyunion #eufores

220 EU parliamentary and EU commission met at 16th March in Vienna about energy efficiency
Worldwide greening of Austrian Embassies in Passive House
Bundesministerium für europäische und internationale Angelegenheiten

Passive House - A small step for the owner
A giant leap for the world

Summary of G. Lang North America presentation tour in March 2015
YES, we do!!!

More than 60,000 Passive House buildings all over the world

Passive House is our success all over the world
Because energy efficiency is our largest energy resource
Good envelope – low heating load

High quality – good result!

Thank you for your attention!

www.passivehouse.com
www.naphnetwork.org
www.nypassivehouse.org
www.phnw.org
www.better-bee.com
www.langconsulting.at
www.passivhaus-austria.org
www.passivehouse-international.org