12.01_PH-SUMMER SCHOOL

PH - RETROFIT

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This presentation is an excerpt of the European Intelligent Energy Programme "**PassivHaus retrofit kit**" of "Energieinstitut Vorarlberg"

The only change is the substitution of the term Passive House with PassivHaus.

Homepage:
http://www.energieinstitut.at/Retrofit/?to=1&forward=BTYPES&id=97dfd52b4cb4984b15b19df801b6ff2e&dmy=28bfc6f5f5fc7ad8d452309541d74c35

PassivHaus Retrofit – Introduction

PassivHaus retrofit - Introduction

What does PassivHaus retrofit (PHR) mean?

In the past few years, PassivHaus principles and components have been successfully introduced in the retrofitting of existing buildings.

Depending on the building type, energy savings vary from 80 to 95%. The specific heating demand is typically reduced from values between 150 and 280 kWh/m²a to less than 30 kWh/m²a.

In some cases, the PassivHaus standard of 15 kWh/m²a is reached. As pilot projects in different countries demonstrate, these PassivHaus retrofit (phr) are economically feasible for a range of building types.

Source: PassivHaus retrofit kit, Energieinstitut Vorarlberg

PassivHaus retrofit - Introduction

What does the PassivHaus-retrofit-tool aim at?

The PassivHaus-retrofit-tool is an easy to use method, that helps housing companies decide which of their buildings qualify for a PassivHaus retrofit and how this can be done most economically.

The tool provides general information about phr principles and advantages, about measures, costs and economic feasibility.

Its main instrument is a typology, presenting energy concepts for different building types from various construction periods.

Source: PassivHaus retrofit kit, Energieinstitut Vorarlberg

PassivHaus retrofit - Introduction

How does the PassivHaus retrofit tool work?

At the start, an overview is given of the main building typologies in the country selected.

The typology selected is hypothetically renovated according to

1) the national building code and

2) by PassivHaus retrofitting.

The resulting energy demand (calculated using the PassivHaus Projecting Package program) and the energy savings are compared to the investment required. In the section ‘incomplete phr’, a single particular measure is not applied (e.g. heat recovery) to show the effect this measure has on the energy consumption. In addition, each measure can be studied in detail by clicking on it in the list of phr-measures.

Source: PassivHaus retrofit kit, Energieinstitut Vorarlberg

About the Europe-version of the tool

The Europe-version of the web-tool is based on the Austrian version as in Austria most experience in PHR is available.

The general principles, advantages are valid in great parts of Europe, building-types, climate and costs given are specific for Austria.

Source: PassivHaus retrofit kit, Energieinstitut Vorarlberg

PassivHaus Retrofit – Principles

PassivHaus retrofit - Principles

Minimised transmission losses

Heat, that is kept inside the house need not be replaced by using energy – this is the most important PassivHaus principle.

For this reason the building envelope has a very high standard of insulation – typical thicknesses for wall and roof are around 20 to 40 cm.

Typical windows will be triple-glazed. Specific building details will reduce thermal bridges to practically zero.

Source: PassivHaus retrofit kit, Energieinstitut Vorarlberg

PassivHaus retrofit - Principles

Minimised ventilation losses

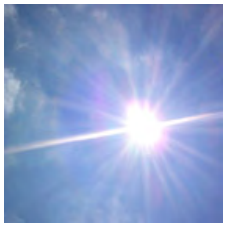
In well insulated houses, ventilation losses have a great share in the total heat losses.

Heat recovery in the ventilation system will reduce losses by about 80% while increasing both thermal comfort and air quality. The fresh, filtered air is preheated to 17,5°C or more.

A precondition for heat recovery is a high level of air tightness of the building envelope, minimizing losses from warm air leaking through cracks and crevices.

Source: PassivHaus retrofit kit, Energieinstitut Vorarlberg

Passive and active solar



The lower the heat losses, the higher the contribution of internal heat gains (from people, lights, electrical equipment etc.) and solar radiation to the heating demand.

Examples show that also houses with an unfavourable orientation (few or small windows towards the south) can reach PassivHaus-Standard.

In addition to passive solar gains, active systems like thermal collectors or PV-systems can be used.

Source: PassivHaus retrofit kit, Energieinstitut Vorarlberg

PassivHaus retrofit - Principles

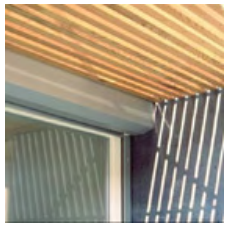
Efficient energy supply

A PassivHaus has a very low heating demand but still needs a heating system for the coldest winter days and a system providing domestic hot water.

This remaining energy demand is supplied by very efficient systems like special heat pumps, high efficiency gas boilers or wood pellet burners.

Source: PassivHaus retrofit kit, Energieinstitut Vorarlberg

PassivHaus retrofit - Principles



Overheating control

Since a very high thermal comfort is one of the main goals in the development of a PassivHaus, overheating control is an important issue.

Mainly passive measures like overhangs, shading devices, (e.g. awnings) are used.

Measurements in pilot projects have shown that with these measures, a PassivHaus actually suffers less from overheating than regular houses because the thermal insulation keeps the summer heat out.

Source: PassivHaus retrofit kit, Energieinstitut Vorarlberg

PassivHaus Retrofit – Advantages

PassivHaus retrofit - Advantages

Low energy costs - good funding

With energy prices rising, a reduction of energy costs by a factor of 10 is a good investment.

In many countries good funding makes PassivHaus retrofit even more feasible.

Source: PassivHaus retrofit kit, Energieinstitut Vorarlberg

PassivHaus retrofit - Advantages

Thermal comfort

PassivHaus retrofit initially is about energy savings – but the perfect thermal comfort is what counts most for tenants.

Inhabitants describe both winter and summer thermal comfort as much better, than in normal houses.

Source: PassivHaus retrofit kit, Energieinstitut Vorarlberg

PassivHaus retrofit - Advantages

Low energy costs - good funding

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In many countries good funding makes PassivHaus retrofit even more feasible.

Source: PassivHaus retrofit kit, Energieinstitut Vorarlberg

PassivHaus retrofit - Advantages

Air quality and health

The constant air renewal provides for very good indoor air quality, removing odours and harmful pollutants.

Thermal insulation and good air tightness avoid condensation and thus growth of moulds and fungus.

Source: PassivHaus retrofit kit, Energieinstitut Vorarlberg

PassivHaus retrofit - Advantages

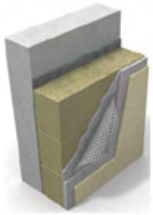
Improved lettability

First projects show, that for housing companies one of the major advantages of PassivHaus retrofit is the improved lettability.

The good experiences of inhabitants are the best argument for PassivHaus retrofitted houses.

Source: PassivHaus retrofit kit, Energieinstitut Vorarlberg

PassivHaus retrofit - Advantages



Protection of construction

Because of the thermal insulation, the construction is protected from internal condensation and lasts longer.

Minimisation of cold bridges and an improved air tightness also reduces structural damages.

Source: PassivHaus retrofit kit, Energieinstitut Vorarlberg

PassivHaus retrofit - Advantages

Climate protection – conservation of resources

PassivHaus retrofit reduces emissions of greenhouse gases and all other polluting gases to less than 10% of the original state.

Natural resources like oil and gas are conserved as a PassivHaus saves up to 90% of heating energy.

Source: PassivHaus retrofit kit, Energieinstitut Vorarlberg

PassivHaus retrofit - Advantages

Urbanistic revaluation

As examples demonstrate, whole settlements can be revaluated, when PHR is combined with urbanistic measures.

Source: PassivHaus retrofit kit, Energieinstitut Vorarlberg

PassivHaus Retrofit – Building types

PassivHaus retrofit – Building types

	big apartment house	row house	small apartment house
1960 - 1969	1960´s typical big apartment house, compact, with balconies 		1960´s typical small apartment house, compact, with balconies 
1970 - 1979	1970´s typical big apartment house, compact, with balconies, flat roof 	1970´s typical row house, compact no balconies 	1970´s typical small apartment house, compact, with balconies 

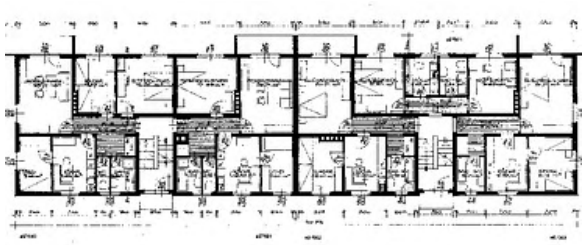
Source: PassivHaus retrofit kit, Energieinstitut Vorarlberg

PassivHaus retrofit – Building types

Big apartment house 1960 - Actual state

Typical appearance

Typical floor plan



General information

Region	Europe
Characteristics, brief description	1960´s typical big apartment house, compact, with balconies
Period of construction	1960 - 1969
Number of floors	4 - 6
Number of dwellings	12 -30
Enclosed Volume	3.000 - 8.000 m³
Treated floor area	1.000 - 2.500 m²
Ratio surface/volume	0.35 - 0.45

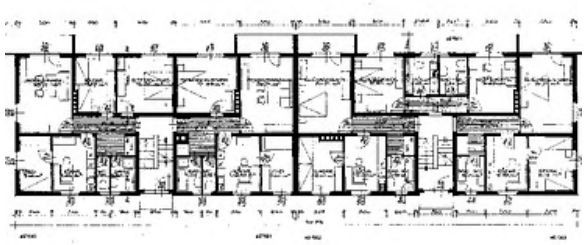
Source: PassivHaus retrofit kit, Energieinstitut Vorarlberg

PassivHaus retrofit – Building types

Big apartment house 1960 - Actual state

Typical appearance

Typical floor plan



Building elements

External wall	1.03 W/(m²K)
Roof	0.77 W/(m²K)
Basement ceiling	1.17 W/(m²K)
Window	2.7 W/(m²K)
Air-tightness	n50 = 3,0 h-1
Ventilation	0,5 h-1 (window)
Active solar	no
Household appliances	no efficient appliances
Overheating protection	roller blinds

Heating system

Type of heat generator	gas boiler, year of construction 1983
Heating system efficiency	72% annual efficiency

Energy need

Energy need (heating)	150 - 220 kWh/m²a
Energy need (cooling)	0 kWh/m²a

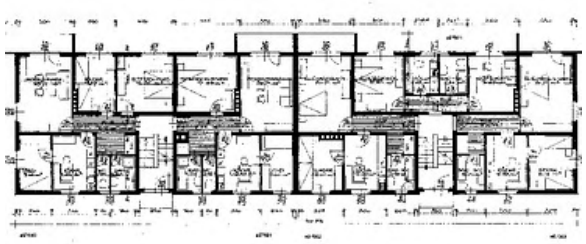
Source: PassivHaus retrofit kit, Energieinstitut Vorarlberg

PassivHaus retrofit – Building types

Big apartment house 1960 – PHR-Measures

Typical appearance

Typical floor plan



Building elements	Value	Description
External wall	0.15 W/m²K	Insulation by 200 mm of insulation (λ = 0.035 W/mK)
Roof	0.12 W/m²K	Insulation by 250 mm of insulation (λ = 0.035 W/mK)
Basement ceiling	0.21 W/m²K	Insulation by 140 mm of mineral fibre (λ = 0.035 W/mK)
Window	0.82 W/m²K	Triple glazed insulated, wooden frames + thermal spacer
Thermal bridges	0.15 W/m²K	Thermal bridges reduced to 0.03 W/m²K
Air-tightness	0.6 h-1	Outer side of external walls used as air tightness layer
Ventilation	0,44 h-1	One ventilation system with heat recovery per apartment
Active solar	Solar fraction 50% of domestic hot water	Solar collectors on tilted roof
Space heating and dhw	99% annual efficiency	High efficiency gas fired burner

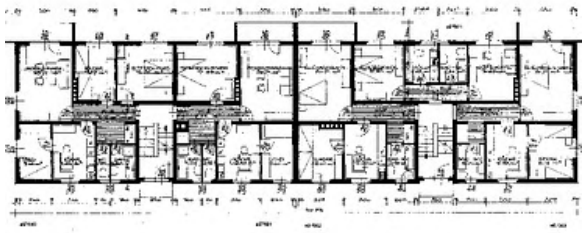
Source: PassivHaus retrofit kit, Energieinstitut Vorarlberg

PassivHaus retrofit – Building types

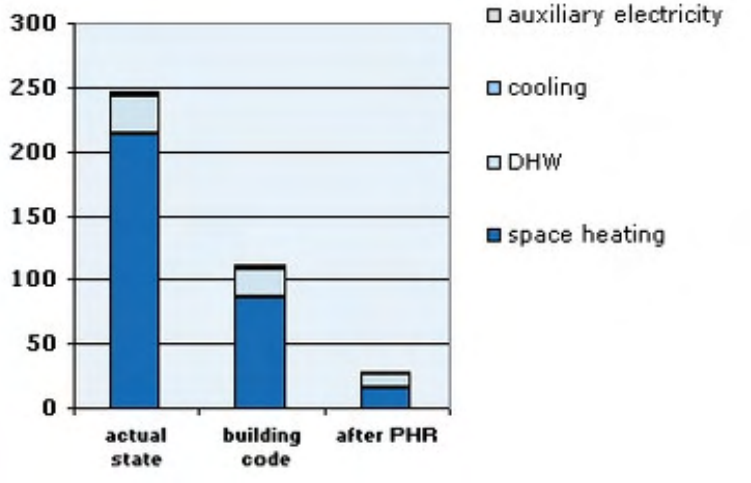
Big apartment house 1969 - Summary

Typical appearance

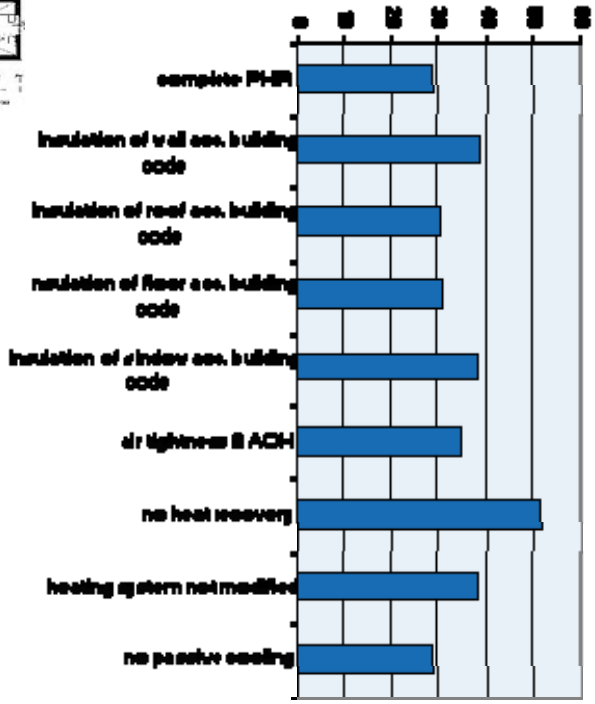
Typical floor plan



Final energy demand



Delivered energy for incomplete PHR in kWh/m²/a



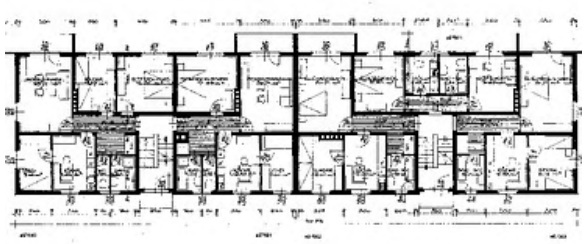
Source: PassivHaus retrofit kit, Energieinstitut Vorarlberg

PassivHaus retrofit – Building types

Big apartment house 1960-1969 - Summary

Typical appearance

Typical floor plan



Summary

For typical big apartment houses of the 60´s, the energy need for heating can be reduced from about 150 to 15 kWh/m²a.

The delivered energy demand for heating, cooling, dhw and auxiliary electricity can be reduced from almost 250 to less than 30 kWh/m²a.

As typical buildings of the period are quite compact, savings can be achieved in an economically feasible way.

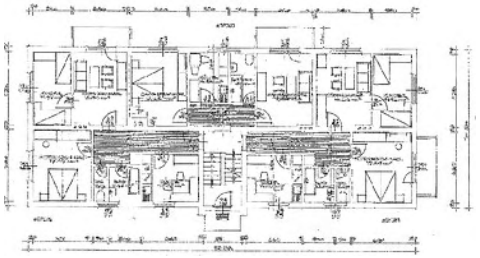
Source: PassivHaus retrofit kit, Energieinstitut Vorarlberg

PassivHaus retrofit – Building types

Small apartment house 1960 – Actual state

Typical appearance

Typical floor plan



General information

Region	Europe
Characteristics, brief description	1960´s typical small apartment house, compact, with balconies
Period of construction	1960 - 1969
Number of floors	3 - 4
Number of dwellings	6 - 12
Enclosed Volume	1.500 - 3.000 m³
Treated floor area	500 - 1.000 m²
Ratio surface/volume	0.45 - 0.55

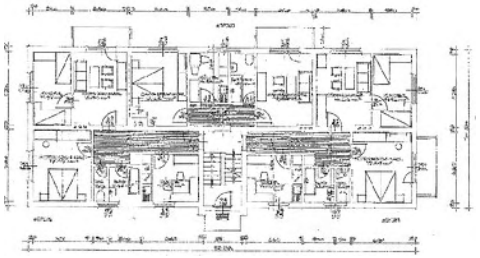
Source: PassivHaus retrofit kit, Energieinstitut Vorarlberg

PassivHaus retrofit – Building types

Small apartment house 1960 – Actual state

Typical appearance

Typical floor plan



Building elements

External wall	1.61 W/(m²K)
Attic floor	0.79 W/(m²K)
Basement ceiling	1.54 W/(m²K)
Window	2.66 W/(m²K)
Air-tightness	n50 = 3,0 h-1
Ventilation	0,5 h-1 (window)
Active solar	no
Household appliances	no efficient appliances
Overheating protection	roller blinds

Heating system

Type of heat generator	gas boiler, year of construction 1980
Heating system efficiency	67% annual efficiency

Energy need

Energy need (heating)	200 - 270 kWh/m²a
Energy need (cooling)	0 kWh/m²a

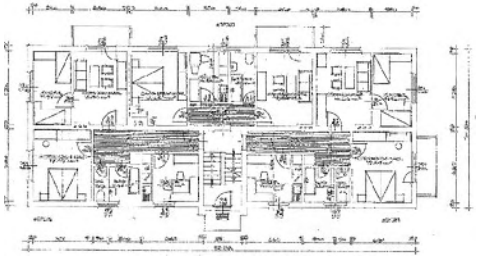
Source: PassivHaus retrofit kit, Energieinstitut Vorarlberg

PassivHaus retrofit – Building types

Small apartment house 1960 – PHR-Measures

Typical appearance

Typical floor plan



Building elements	Value	Description
External wall	0.16 W/m²K	Insulation by 200 mm of insulation (λ = 0.035 W/mK)
Attic floor	0.12 W/m²K	Insulation by 250 mm of insulation (λ = 0.035 W/mK)
Ventilation	0,44 h-1	Ventilation system with heat recovery decentralized (one per room)
Active solar	Solar fraction 50% of domestic hot water	Solar collectors on flat roof
Space heating and dhw	85% annual efficiency	Biomass fired heating system

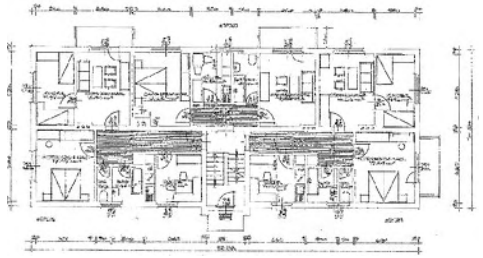
Source: PassivHaus retrofit kit, Energieinstitut Vorarlberg

PassivHaus retrofit – Building types

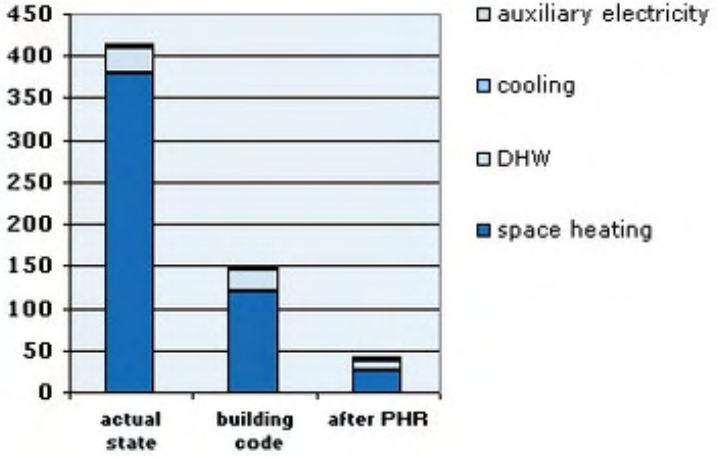
Small apartment house 1960 - 1969 – Summary

Typical appearance

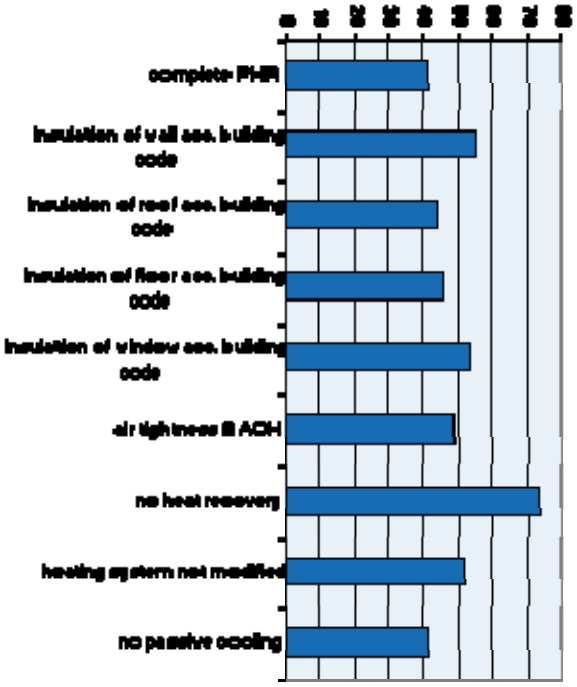
Typical floor plan



Final energy demand



Delivered energy for incomplete PHR in kWh/m²/a



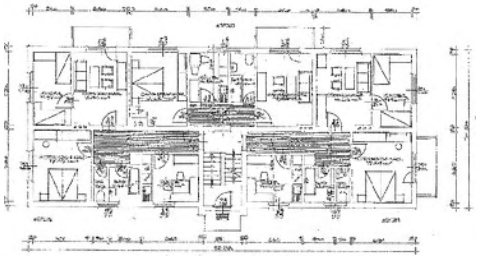
Source: PassivHaus retrofit kit, Energieinstitut Vorarlberg

PassivHaus retrofit – Building types

Small apartment house 1960 - 1969 – Summary

Typical appearance

Typical floor plan



Summary

The energy need for heating can be reduced from 255 to 23 kWh/m²a.

The delivered energy demand for heating, cooling, DHW and auxiliary electricity can be reduced from 414 to 41 kWh/m²a.

Annual energy costs for a 80 m² apartment will be 201 instead of almost 1.800 EUR/a. When renovated according to building code, the energy cost would be 643 EUR/a.

Source: PassivHaus retrofit kit, Energieinstitut Vorarlberg