

Energie-GR Kap Verde

EnergieEffiziente Gebäudetechnologien und
Erneuerbare Energien (PV)
Passive House an ideal basis for energy efficient building design
Renewable Energy (PV)

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2021-11-16



Passive House Building design in a nutshell.....

Contents and Summary

what is essential for Energy Efficient Passive House buildings!

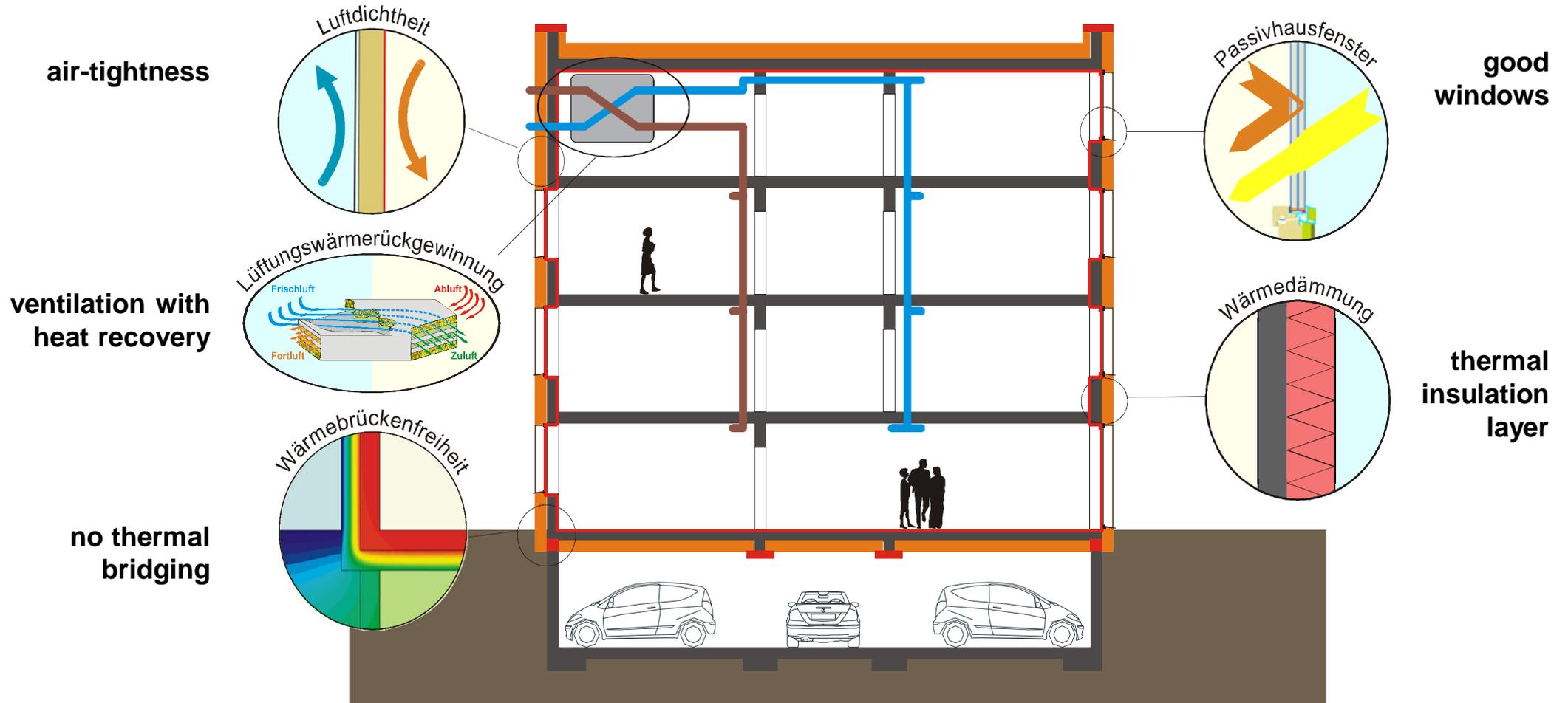
- thermal insulation layer (thick enough!) is absolutely needed
- thermal bridge optimized design, air-tightness and good windows
- fresh-air-ventilation system with heat recovery
- low power heating (AC) system including hot water preparation

everything is economically reasonable for new built and retrofit (EnerPHit)

Renewable Energy (PV) is welcome: PER assessment

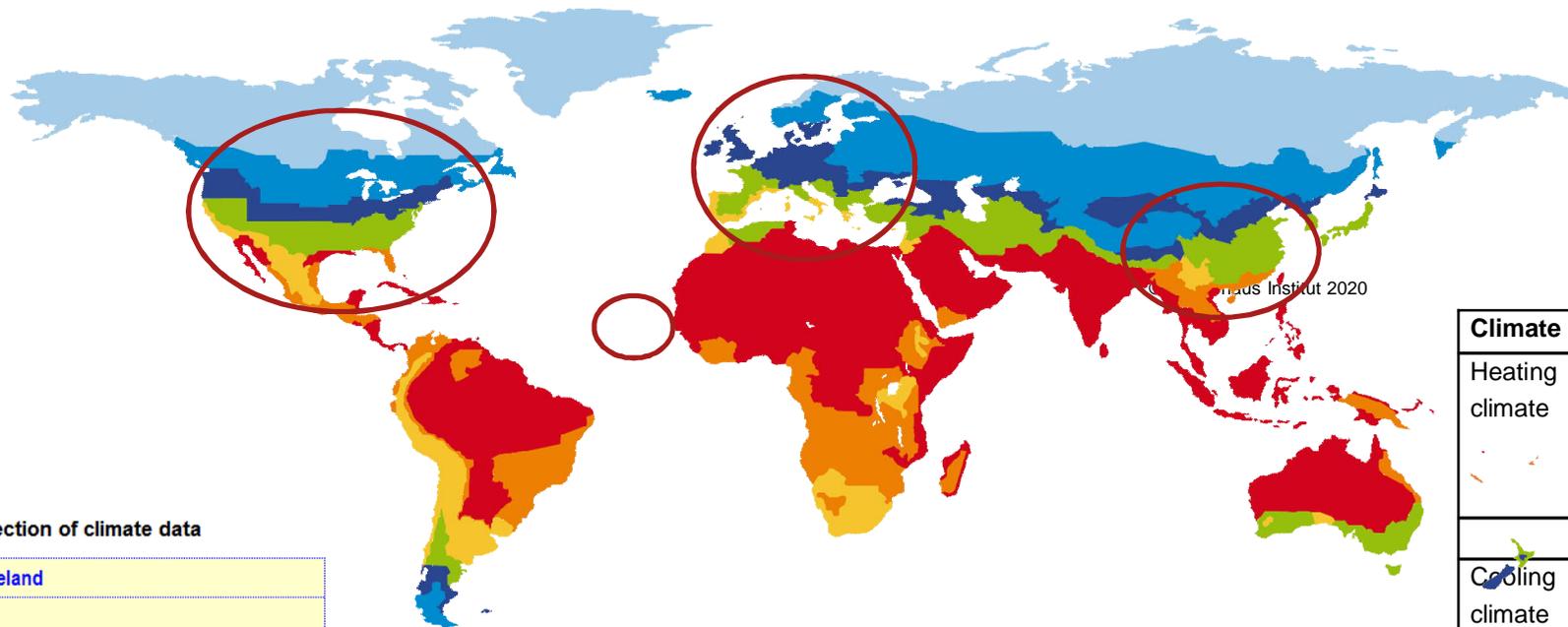
- Quality control has to be done during realization:
- ... training of tradesperson is crucial!
- **Routine helps for Quality!.... repeat again, what you have learned once!**

The five main features of PH buildings!



Check with PHPP for all international climate zones

- Cooling load and dehumidification (latent cooling) is crucial in Climate Zone 4...7
- detailed check with PHPP should be done for each individual building



Climate	No	Region
Heating climate	1	Arctic
	2	Cold
	3	Cool-temperate
Cooling climate	4	Warm-temperate
	5	Warm
	6	Hot
	7	Very hot

Selection of climate data

Country:

Region:

1-Alphabetic sorting

Climate data set:

Climate zone:

Same components usable for retrofit of buildings



Certified
Retrofit

Passive House Institute

| classic | plus | premium |



EnerPHit Standard for renovation

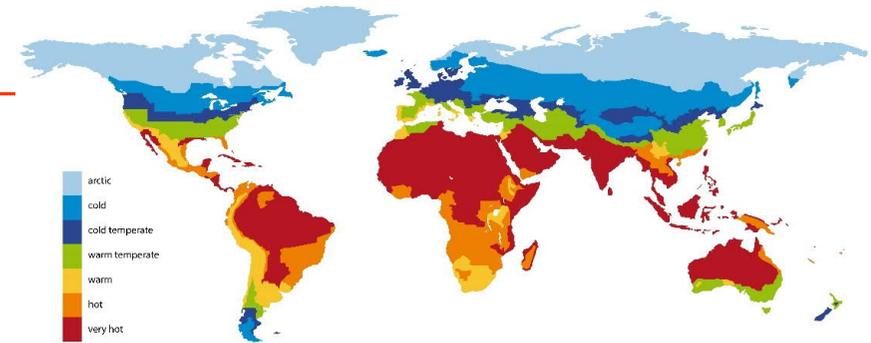
- Guideline and incentive for an optimal efficiency standard for retrofits
- Certification as quality assurance for building owners

Energy Retrofit with Passive House Components

© PHI

the building component method for retrofit:

Climate zone according to PHPP	Opaque envelope ¹ against...				Windows (including exterior doors)			Ventilation			
	...ground	...ambient air			Overall ⁴			Solar load ⁶			
	Insulation	Exterior insulation	Interior insulation ²	Exterior paint ³	Max. heat transfer coefficient (U _{D/W, installed})			Solar heat gain coefficient (g-value)			
	Max. heat transfer coefficient (U-value)			Cool colours	Max. heat transfer coefficient (U _{D/W, installed})			Max. specific solar load during cooling period			
	[W/(m²K)]			-	[W/(m²K)]			%			
Arctic	Determined in PHPP from project specific heating and cooling degree days against ground.	0.09	0.25	-	0.45	0.50	0.60	U _g - g*0.7 ≤ 0	100	80%	-
Cold		0.12	0.30	-	0.65	0.70	0.80	U _g - g*1.0 ≤ 0		80%	-
Cool-temperate		0.15	0.35	-	0.85	1.00	1.10	U _g - g*1.6 ≤ 0		75%	-
Warm-temperate		0.30	0.50	-	1.05	1.10	1.20	U _g - g*2.8 ≤ -1		75%	-
Warm		0.50	0.75	-	1.25	1.30	1.40	-		-	-
Hot		0.50	0.75	Yes	1.25	1.30	1.40	-		-	60 % (humid climate)
Very hot		0.25	0.45	Yes	1.05	1.10	1.20	-		-	60 % (humid climate)

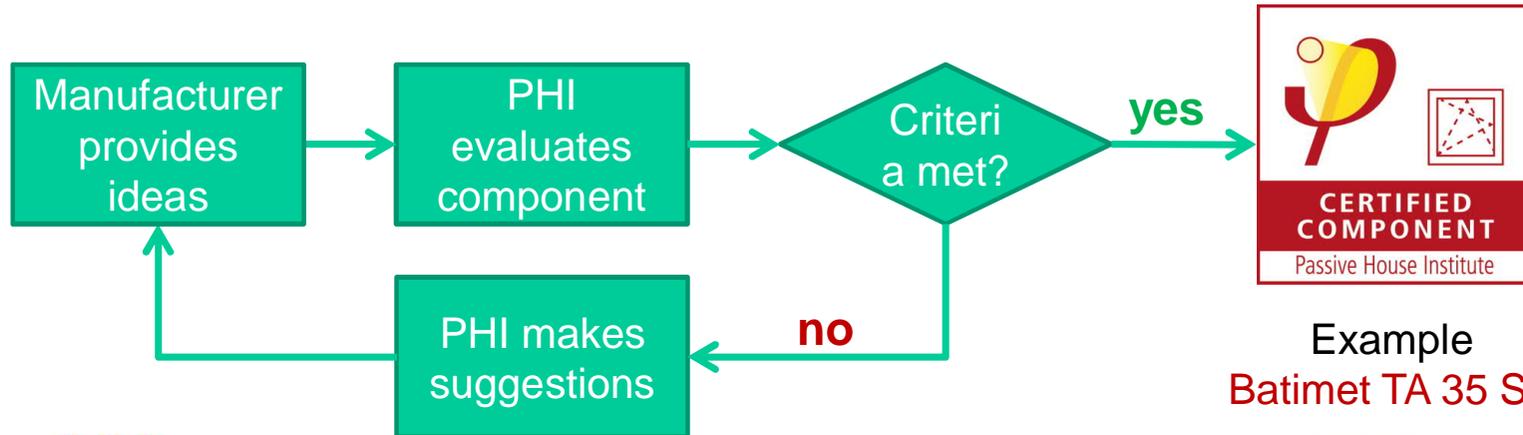


or alternatively, energy demand method:

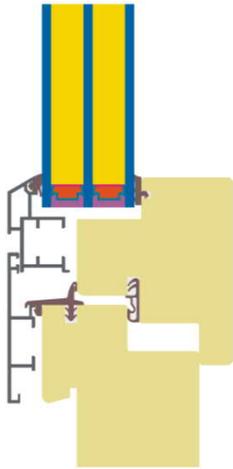
Climate zone according to PHPP	Heating	Cooling
	Max. heating demand	Max. cooling + dehumidification demand
	[kWh/(m²a)]	[kWh/(m²a)]
Arctic	35	equal to Passive House requirement
Cold	30	
Cool-temperate	25	
Warm-temperate	20	
Warm	15	
Hot	-	
Very hot	-	

© PHI

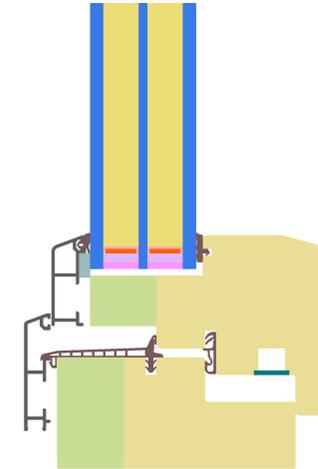
Certification process – developing high performance components



Example
Batimet TA 35 SE

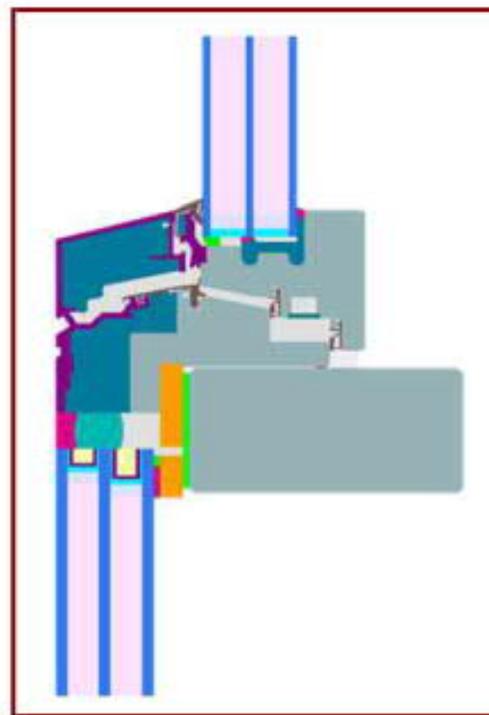


- evaluation may be done in one week...
- But some more cycles might be necessary. In some cases this process might take more than a year



Curtain wall construction Sayyas, Harbin

- operable wing to be included to curtain wall construction

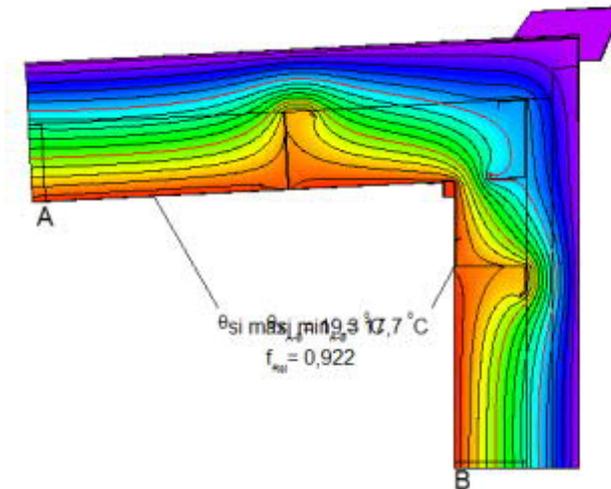
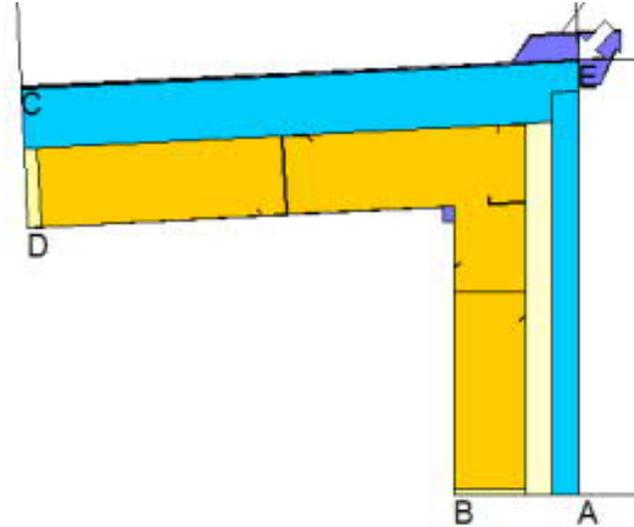
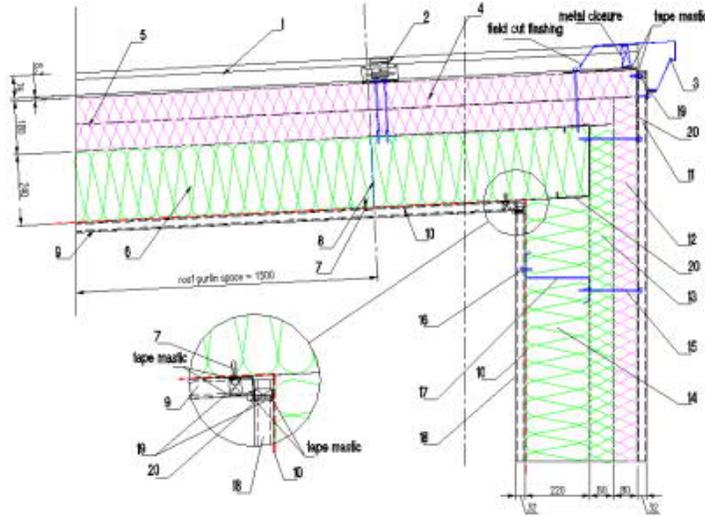


Thermal data for the window frame

	U_f-value [W/(m²K)]	Width [mm]	Ψ_g [W/(mK)]	f_{Rsi=0.25} [-]
Spacer	SWISSP. Ultimate PU*			
Mullion (m)	0.66	75	0.040	0.72
Transom (t)	0.66	75	0.040	
Opening element	0.75		0.030	0.68
Thermal glass carrier bridge χ _{GT} [W/K]:				0.000
1: Includes ΔU = 0 W/(m²K), determined by 3d-thermal flux sim. (PHI)				
2: Determined by 3d-thermal flux sim. (PHI)				

Category: **Curtain wall**
 Manufacturer: **Harbin Sayyas Windows Stock Co. Ltd**
150088 Harbin, China
 Product name: **Pcw70**

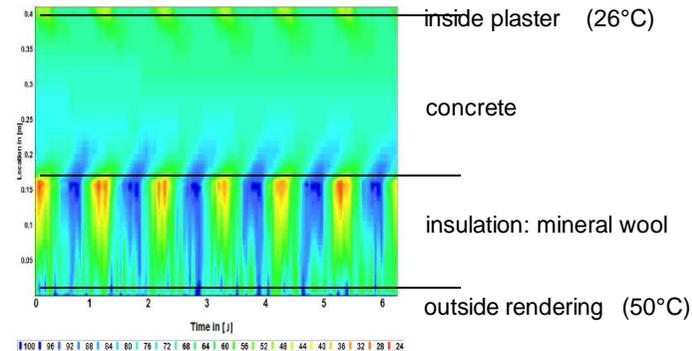
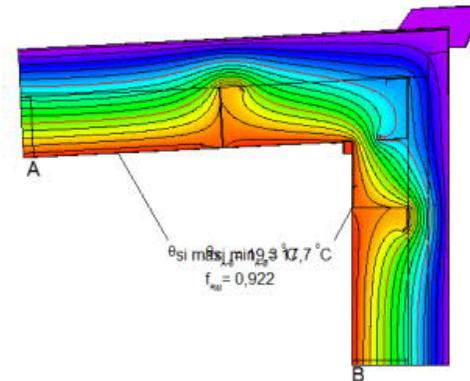
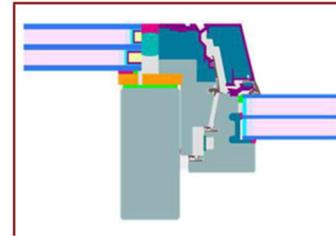




- **check for inside – outside**
- steel construction needs special attention on screws and other penetrations of insulation layer
- overall average U-value including screws must be evaluated carefully
- prefabrication is good to guarantee for quality

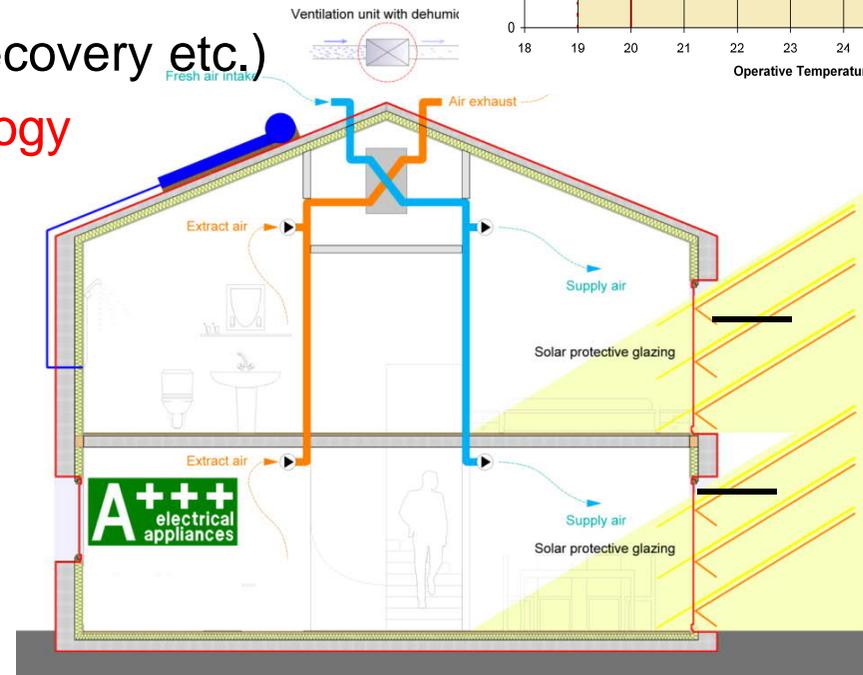
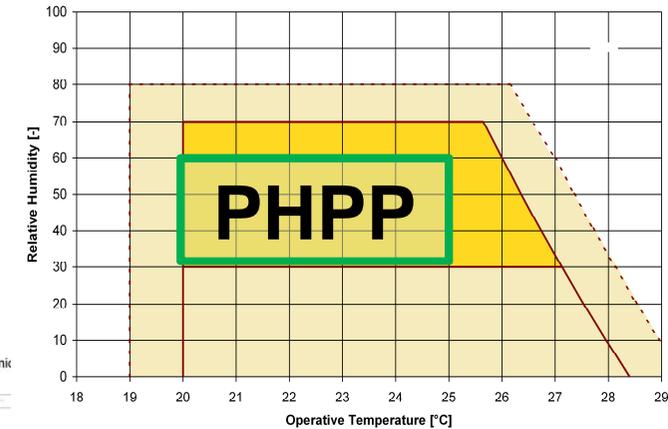
Component evaluation & certification

- windows
- prefabricated elements
- thermal bridge effects
- air tightness
- hygro-thermal behavior of envelope elements



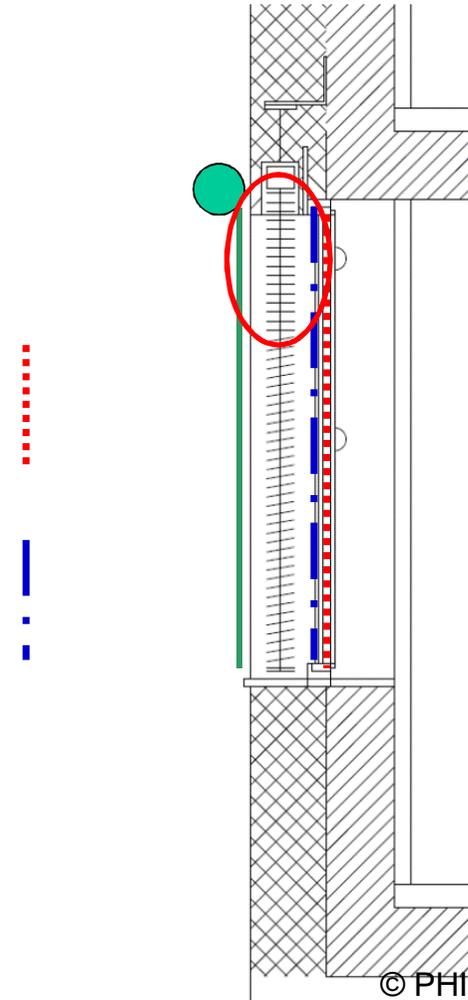
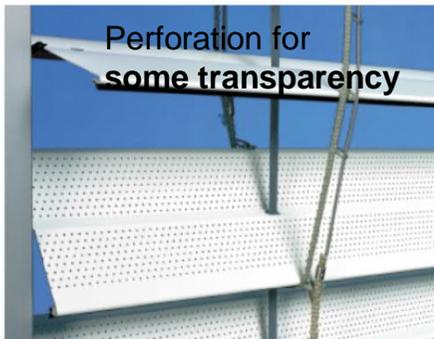
Crucial aspects in hot and humid climates

- Reduce exterior loads (heat & humidity) — shading!
- Reduce interior loads (heat & humidity)
- allow for slightly higher temperatures: 26°C and 60% r.H. is quite good (if outside temp > 35°C)
- higher temperatures are acceptable with low humidity
- Use passive means if possible (e.g. natural ventilation, humidity recovery etc.)
- **Implement efficient cooling technology with independently working**
- sensible cooling....
- and dehumidification
- **always care for controlled & balanced ventilation**
- **trust in ... low power cooling**

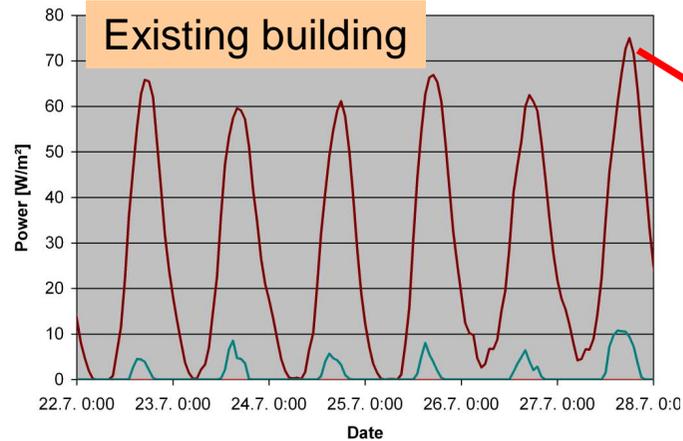


Shading: Solutions and Products

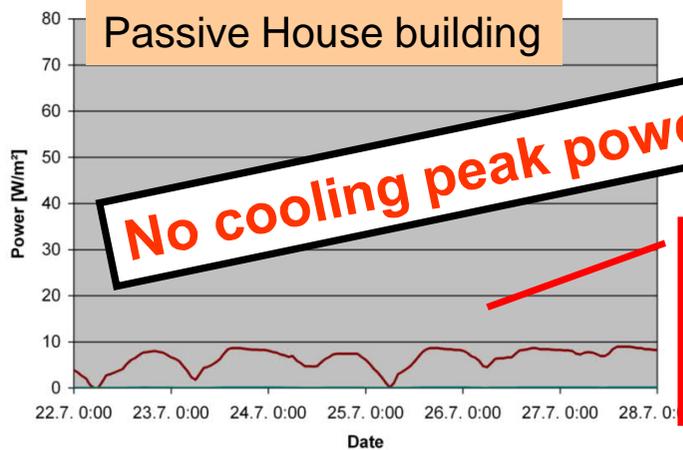
- **Lamella:**
Perforation helpful for transparency
separated top/down lamella
- **Curtains (semi-transparent):**
Issues: **wind** may destroy curtains, noise
- **Lamella** in between glass panes:
glazing edge should be thermally separated
- **Electrochromic** glazing:
question: $g_{\text{open}} / g_{\text{closed}}$ ($g_{\text{open}} \leq 0.3$ is too low)



low power cooling helps for power supply, too!



Significant peak demands!



No cooling peak power problem!

Continuous demand on a much lower level

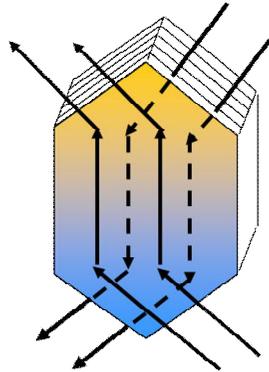


source: *Passive Houses in South West Europe*; J.Schneider; PHI; 2009

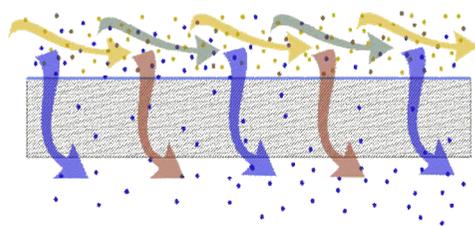
In hot and humid climates....

... we as well need balanced mechanical ventilation!

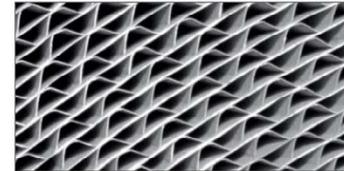
- Moisture recovery > 60% (as much as possible)
 - Counter flow heat exchanger with water-permeable membrane for moisture recovery
 - Rotary wheel with sorption surface



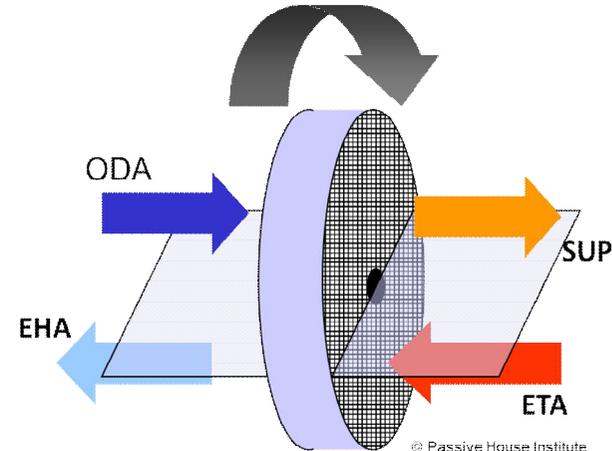
© Passive House Institute



source: Paul Wärmerückgewinnung



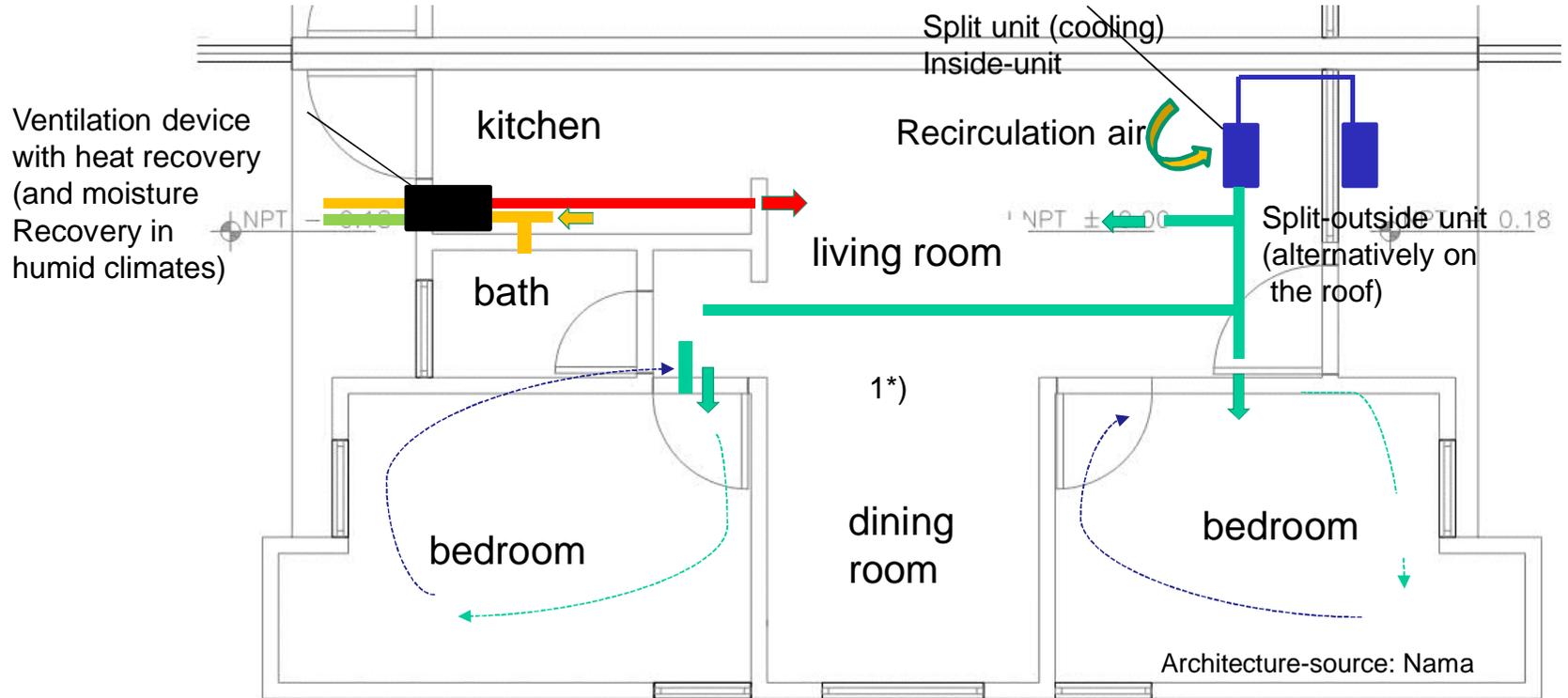
Source: Lautner Energietechnik GmbH



© Passive House Institute

... we need mechanical ventilation ... !

... with HR and Moisture Recovery to support cooling

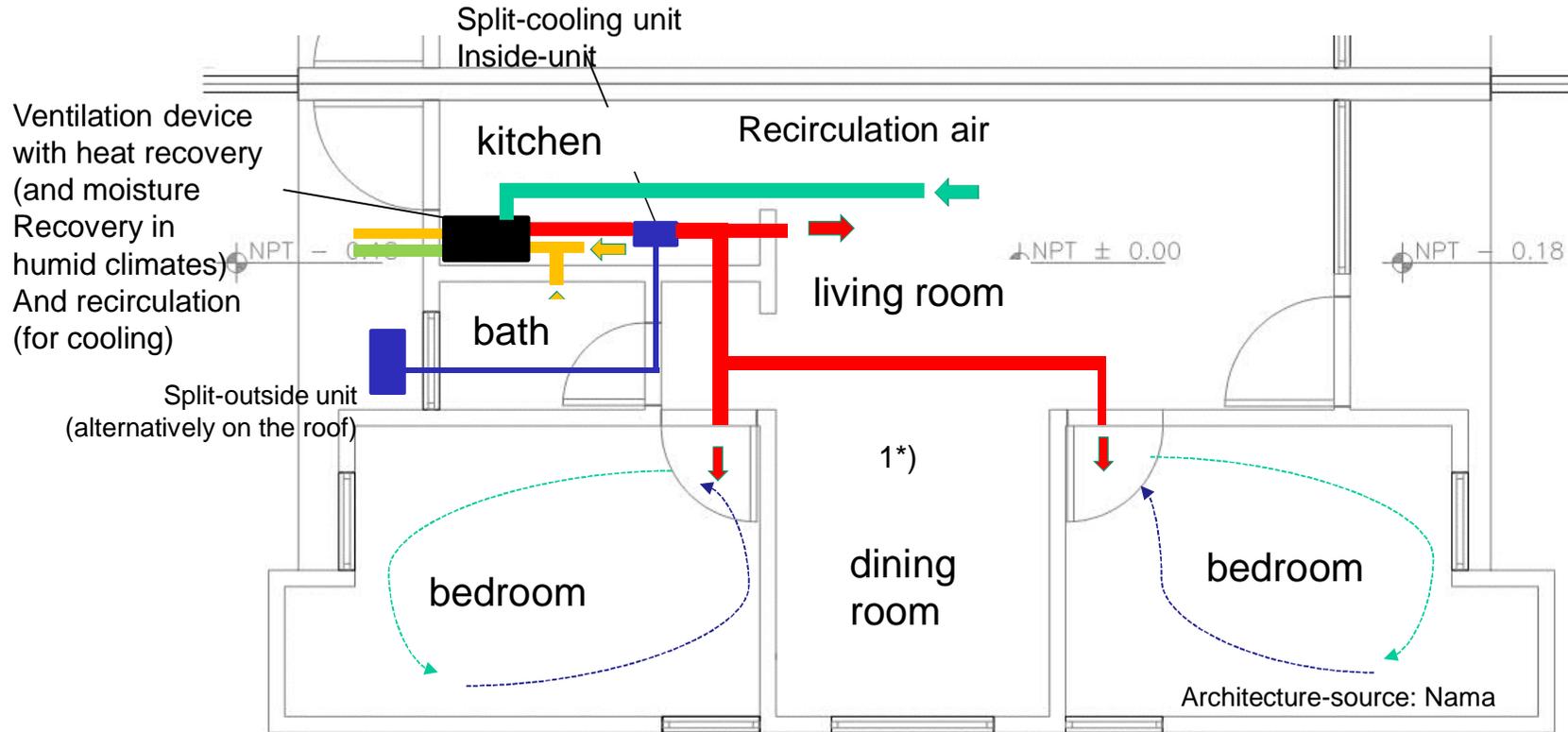


1*) Additional: dehumidification in the living area (hot and humid climates only)

Building services – concept 1 (based on readily existing components)

... we need mechanical ventilation ... (!)

... with HR and Moisture Recovery to support cooling



1*) Additional: dehumidification in the living area (hot and humid climates only)

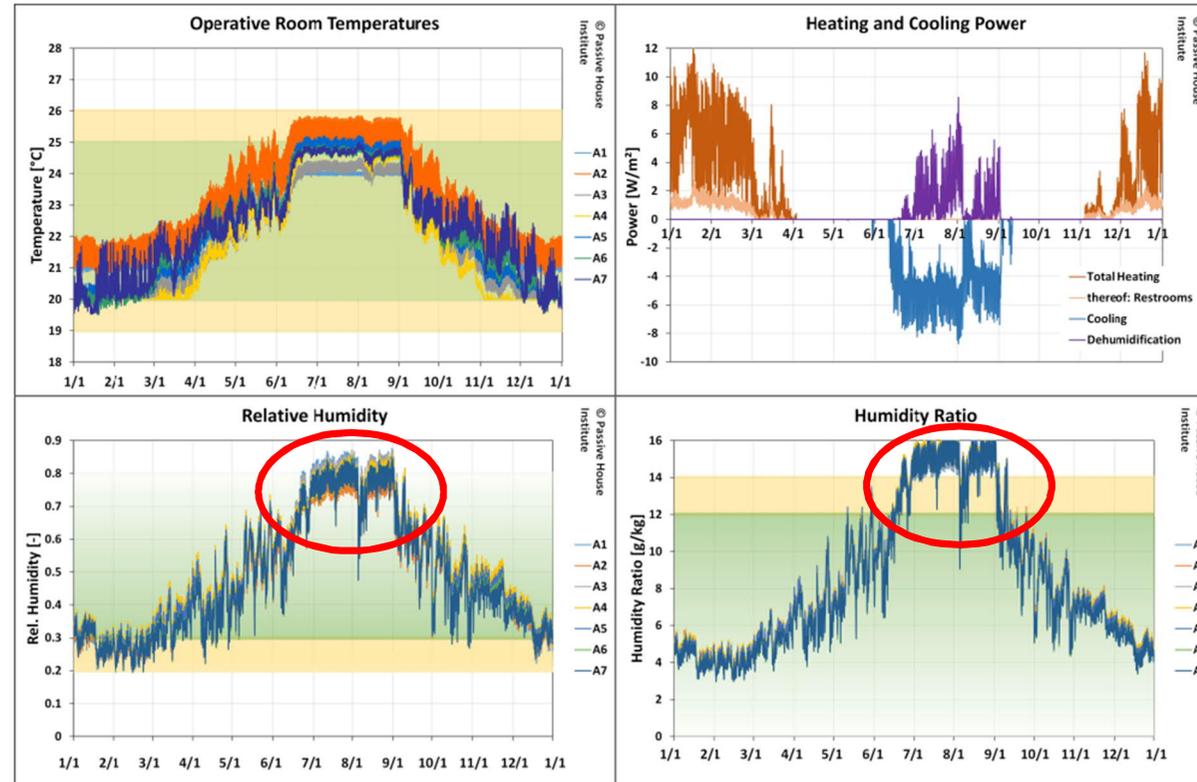
Building services – concept 2b cooling unit with recirculation air

remember! – typical split units....

.... must be modified to meet appropriate sensible/latent ratio

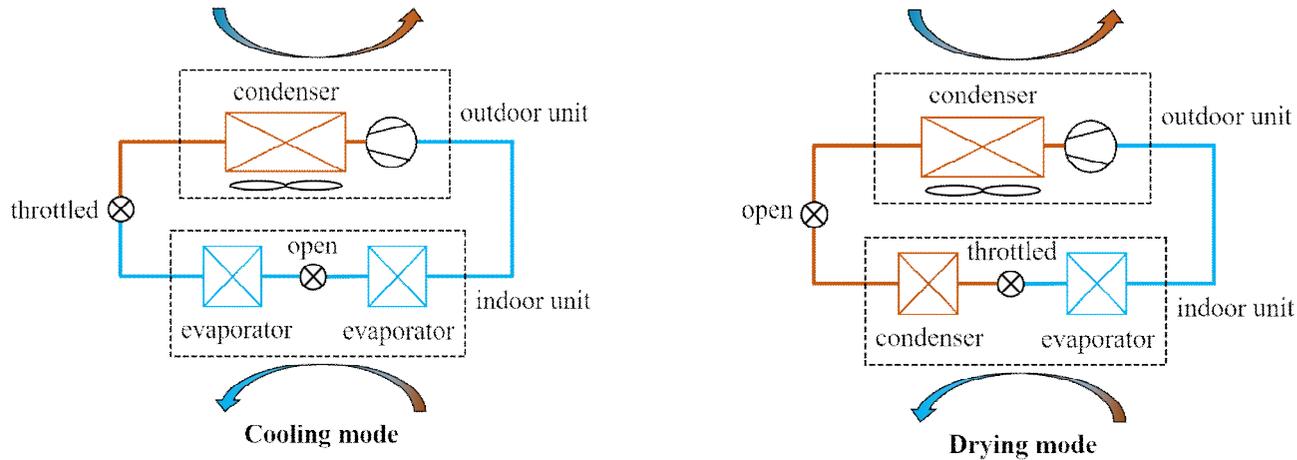
- typical split unit in a PH-apartment (Beijing) will provide good summer indoor temperatures, **but leave too high indoor humidity**

China Climate-Zone Study page 28



AC-Systems based on minisplit need re-design

minisplit + internal condenser



ventilation with heat&humidity recovery can support AC

both has to be combined

sensible cooling load is well reduced in PH

SHR SensibleHeatRatio (sensible / total) becomes lower ≤ 0.5

humidity control becomes crucial

Such products are not yet very widespread on the market

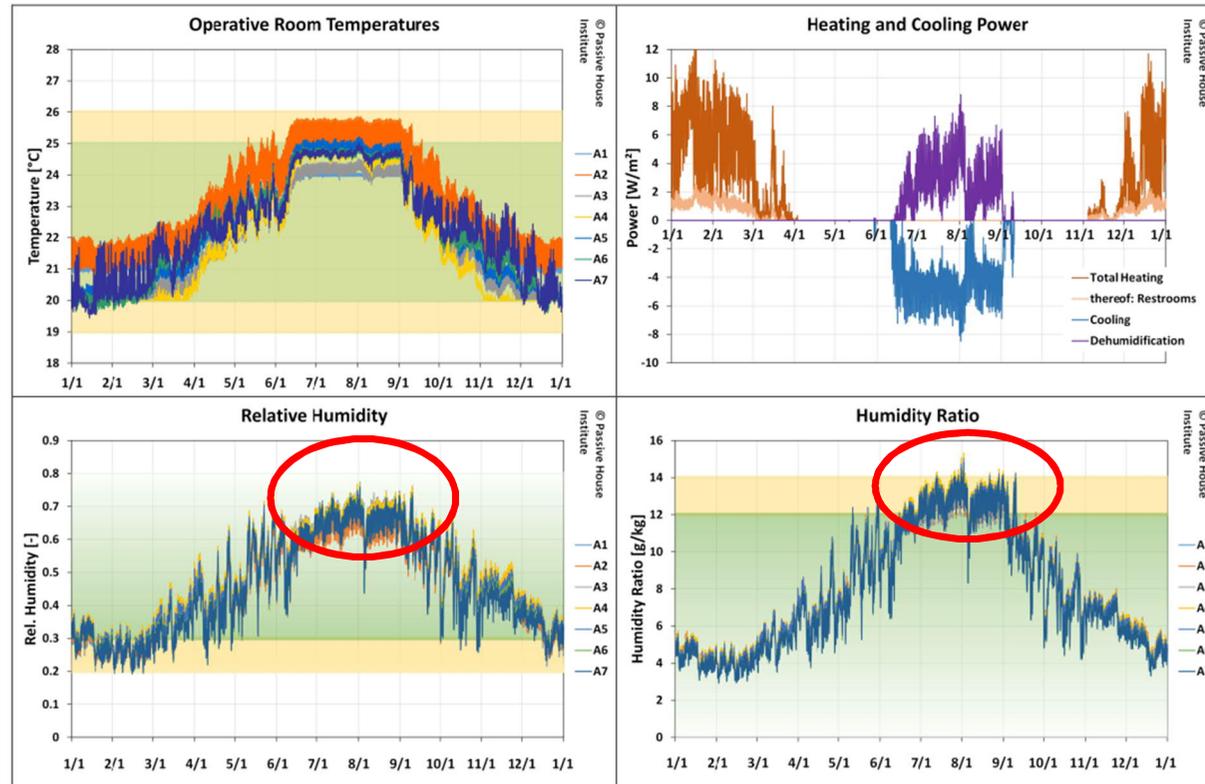


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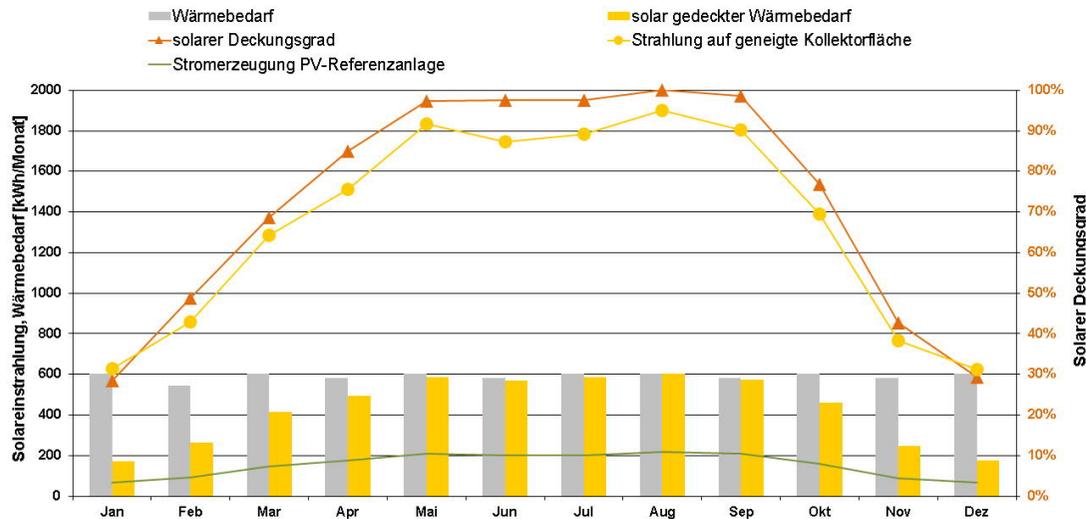
- this is done by adding an **option to re-heat air after cooling** when needed: when sensible cooling might be overdone

China Climate-Zone Study page 44

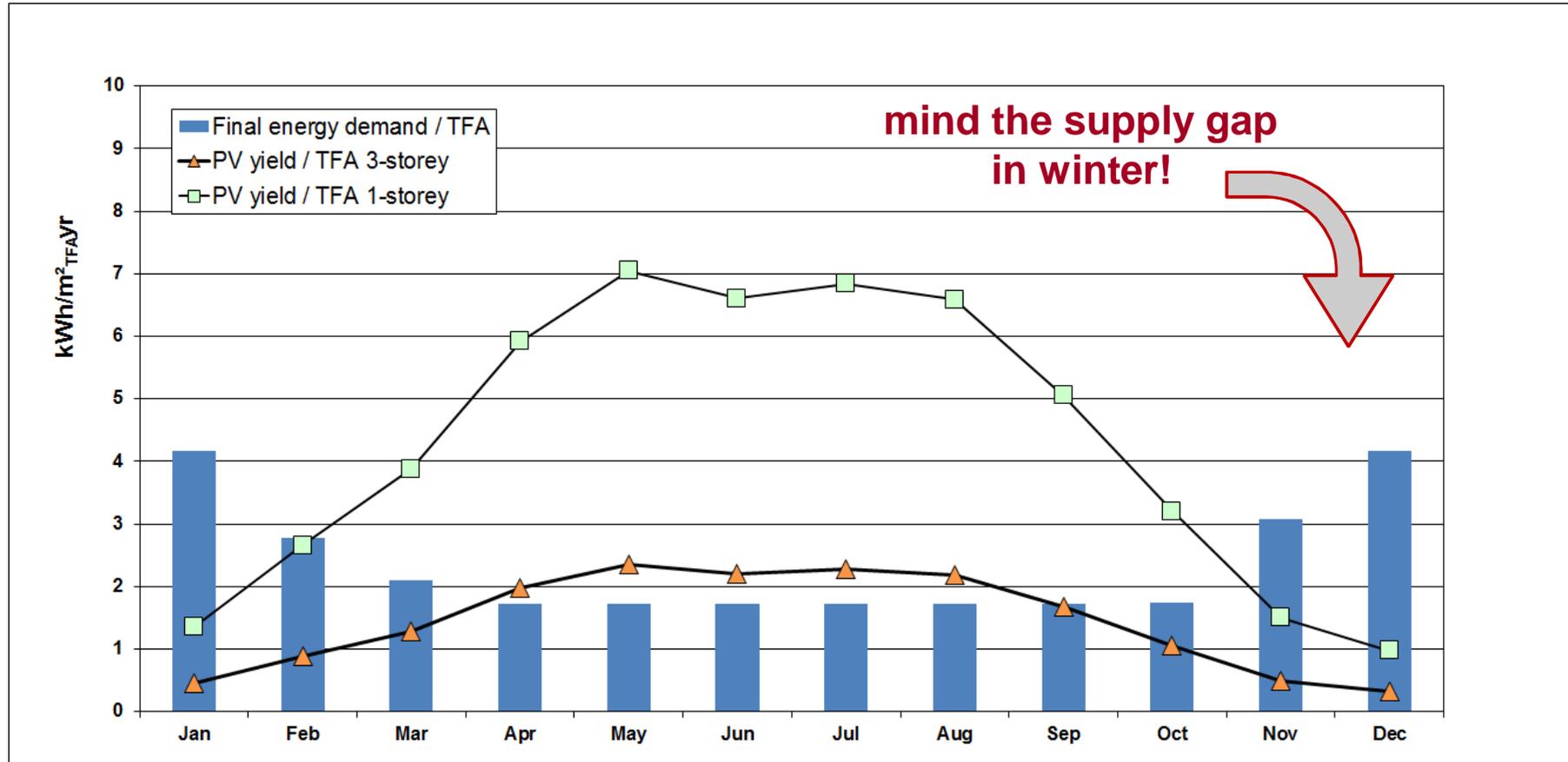


Solar Thermal & PV input is welcome in Passive Houses

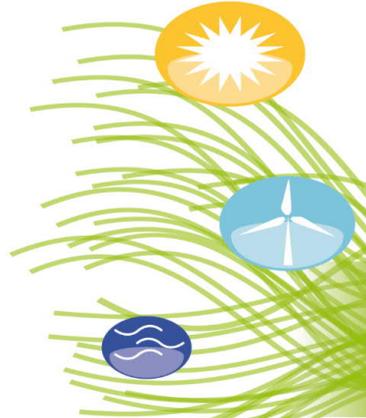
- cold winter – well insulated vacuum tube collectors needed
- monthly energy balance in PHPP shows relevant parameters
- example: Urumqi – Xingfubao Passive House building



be careful: simple net-zero does not make sense!



Approx. energy demand of a bungalow & three-storey PH with HP as heating supply compared to PV generation on 80% of the respective roof area (Germany).

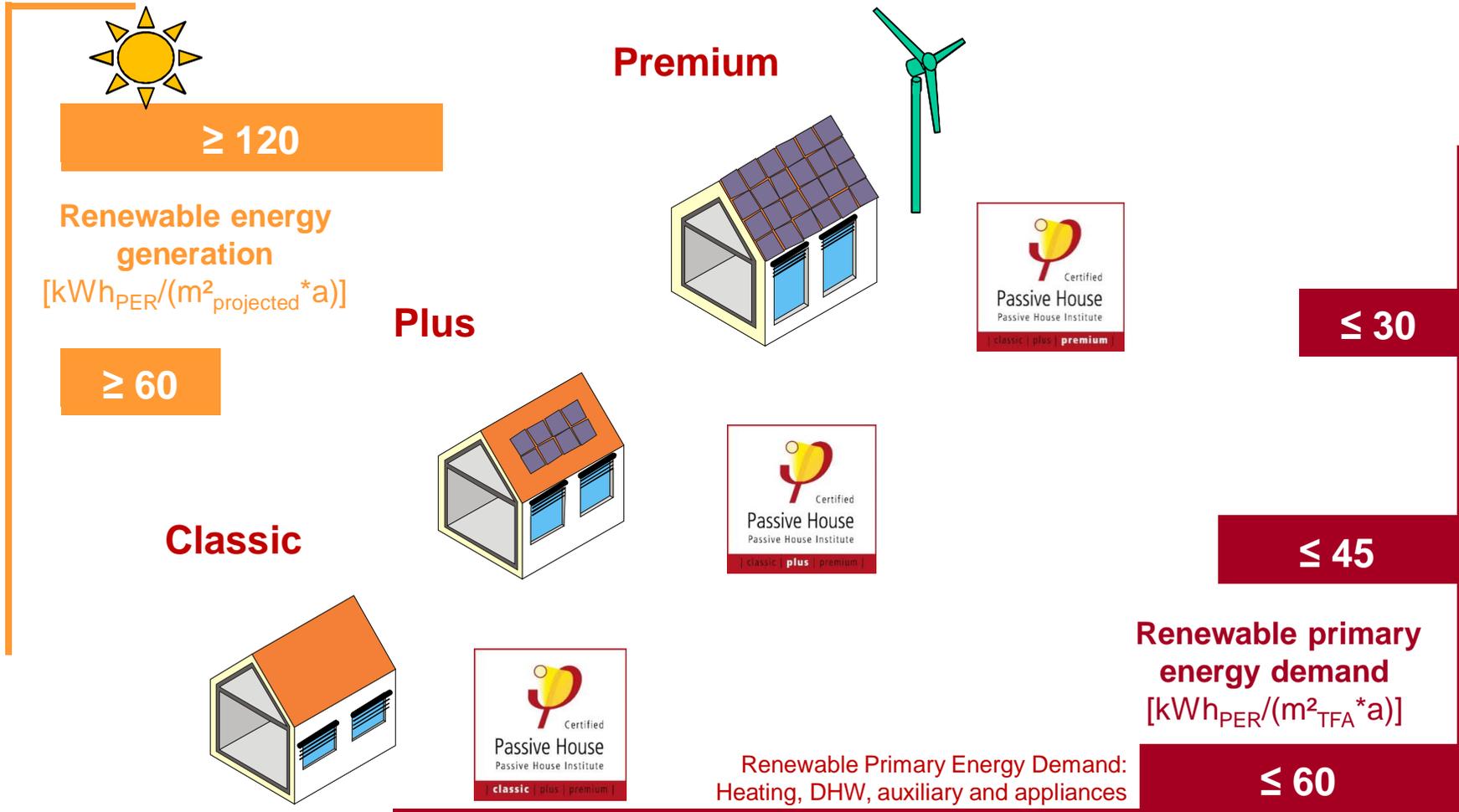


Typical PER weighting factors

- Electricity
Hot water PER ~1.3
- Heating PER ~1.7 in heating climates
- Cooling &
Dehumidification } PER ~ 1 in heating climates
PER ~ 1.5 in cooling climates



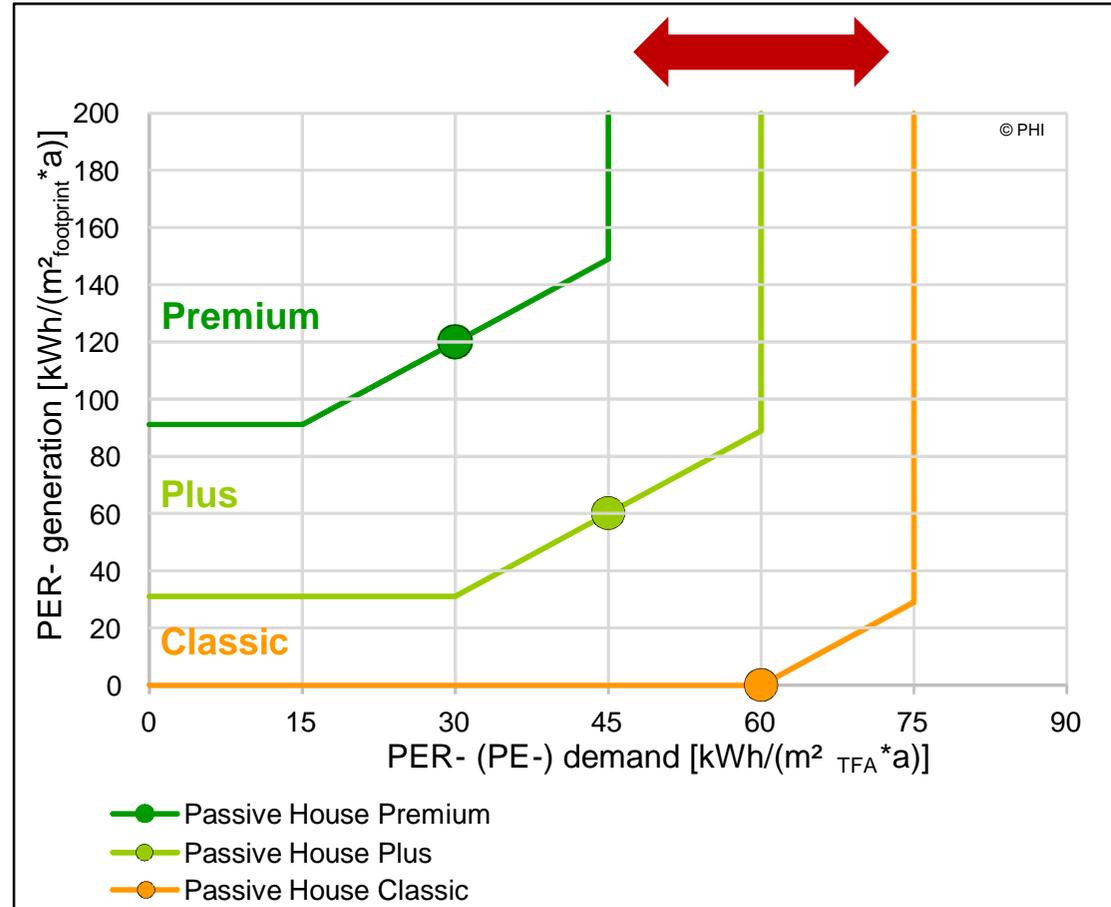
The new Passive House classes including PER assessment



The new PH classes including PER assessment

+/- 15 kWh/m² per yr of PER demand

**Offset of efficiency level
+/- equivalent PER supply**



Quality Assurance is crucial

- Q&A is a consultation process during planning&realisation
- certification (label) is the result of a successful Q&A process
- certification is more than just a business model

Certification of buildings:
Based on PHPP Verification required e.g.
of component specifications,
thermal bridges and



Certification of suitable components

- Window and door frames
- Glazing
- Ventilation units
- Compact heat pump units
- Prefabricated houses
- Connection details
- ...



Criteria available at www.passivehouse.com

Why component development is **important**

- **Research** is the one precondition for development.
- **Regionally produced and locally available** Passive House components are the second key to successful development!
- PHI helps manufacturers to develop high quality components
- PHI supports component development by certification
- Certification makes data available for PHPP
- ... Independent verification of specifications

Marketing — is a side effect...

- Listing in the Passive House component database
- Sales promotion and visibility
via Certified Passive House Component seal



Passive House Building design in a nutshell.....

Contents and Summary

what is essential for Energy Efficient Passive House buildings!

- thermal insulation layer (thick enough!) is absolutely needed
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Renewable Energy (PV) is welcome: PER assessment

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- ... training of tradesperson is crucial!
- **Routine helps for Quality!.... repeat again, what you have learned once!**

Renovation of Historical building in Songyang, China

- Passive building envelope: airtight, very good thermally insulated...
 - ... is a precondition for low power cooling & dehumidification



Historical building with
HP-combi-system



Ao'ni courtyard project in Songyang

Thank you!

Further information

- www.passivehouse.com
- www.passipedia.org
- www.passivehouse-international.org
- www.europhit.eu

International Passive House Conference