08.02_PH-SUMMER SCHOOL

ELECTRICITY

Composition: PHS 1.0 Passivhaus Schulungsunterlagen 7.1 plus Ernst HEIDUK
Language support: William GALLAGHER, Rob McLEOD, Michael WILLIAMS
Date: 2008-08-01

CONTENT OF THIS PRESENTATION:

08.02.01 Electrical installations – performance of the electrical equipment
08.02.02 Electrical installations – household appliances
08.02.03 Electrical installations – measuring, control, regulation
08.02.04 Energy saving household appliances – available solutions

This presentation is a translation and extension of
“PHS 1.0 Passivhaus Schulungsunterlagen 7.1”.

Source:

Electrical installations

Performance of the electrical equipment

Electrical installations – performance of the electrical equipment

Significance of measuring and control engineering in the PH

The following system components are considered:

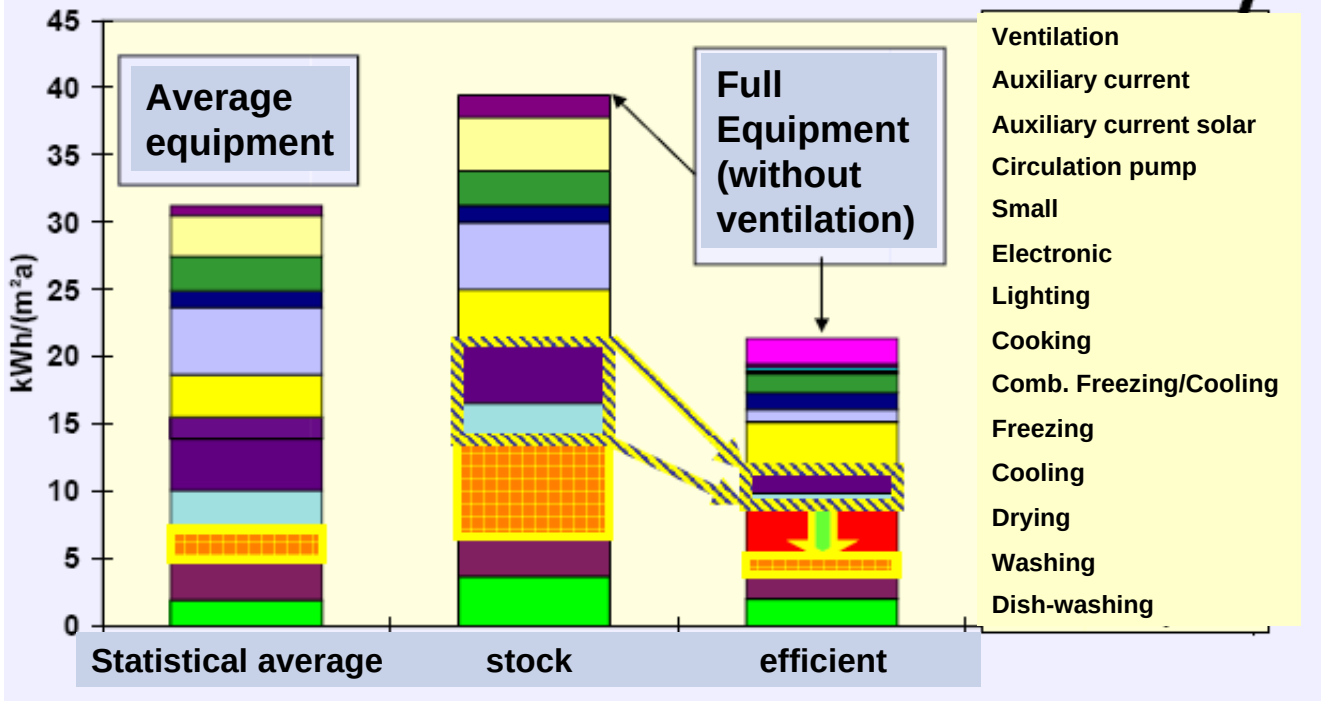
- Vent and control of the ventilation system
- De-icing of the heat transport media
- Auxiliary energy for the heating system
  - Circulation pump
- Auxiliary energy for the boiler (hot-water production)
  - Auxiliary electricity for solar energy system
  - Loading pump for the hot-water boiler
- Other auxiliary electricity

Source: Based upon PHS 1.0 Passivhaus Schulungsunterlagen 7.1.1

Electrical installations – performance of the electrical equipment

Ranking of the domestic electricity demand

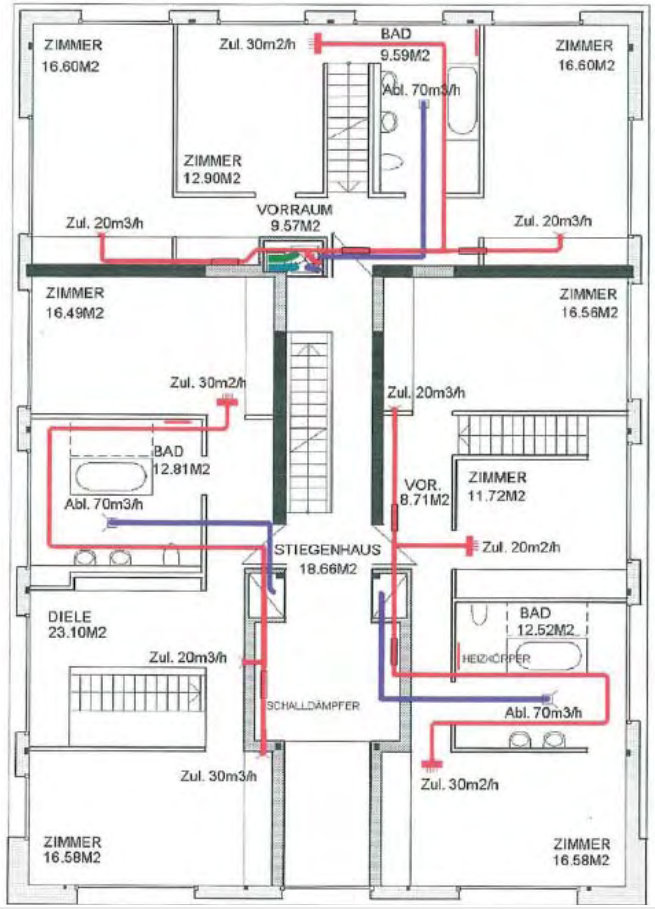
Efficient electricity use in the PH – Comparison to the building stock



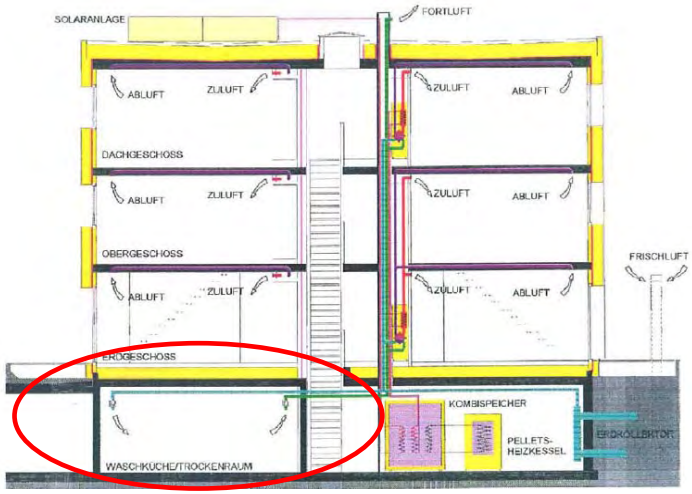
=> Very important is the part of drying the laundry > must be part of planning …

Source: PHS 1.0 Passivhaus Schulungsunterlagen 7.1.2 PHI, Wolfgang Feist

Electrical installations – performance of the electrical equipment



… like in this project.
There is a special room for drying the laundry !!!



Ventilation concept, Project “Wolfurt”

Architect: Gerhard Zweier
Engineering: team GMI

Source: Qualitätssicherung von Passivhäusern in Holzbauweise - teamgmi Ingenieurbüro GmbH, Arch. Ambrozy, H.G

Electrical installations – performance of the electrical equipment

Consumption data for auxiliary drives

Relevant data from the literature are:

- Auxiliary electricity consumption for house technology (ventilation, auxiliary electricity consumption for ventilation, small heating)
  - 18 to 22 kWh/m²a
- Auxiliary electricity consumption for ventilation
  - 2,2 to 5,8 kWh/m²,a
- Auxiliary electricity consumption for hot water
  - 6,5 to 7,0 kWh/m²,a
- Auxiliary electricity consumption for the remaining heat requirement
  - 7,9 kWh/m²,a

Source: PHS 1.0 Passivhaus Schulungsunterlagen 7.1.3

Electrical installations – performance of the electrical equipment

Consumption data for auxiliary drives

Relevant data from the literature are:

- Heating pump
  - 20 to 80 watt
  - 1000 to 2000 operating hours
- Hot-water loading pump
  - 20 to 60 watt
  - 1000 operating hours
- Boiler pump
  - 40 to 80 watt
  - 500 operating hours
- Solar pump
  - 40 to 80 watt
  - 1500 to 2000 operating hours

Source: PHS 1.0 Passivhaus Schulungsunterlagen 7.1.4

Electrical installations – performance of the electrical equipment

Consumption data for auxiliary drives

Relevant data from the literature are:

- Avoidance of unnecessary electrical drives (motors)
  - Specialized planning for utilities technology
  - Supervision of the utilities supply construction
- Lasting efficiency approach
  - Demand-led optimization
  - Function-oriented optimization
  - Product optimization

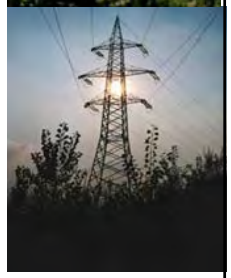
Source: PHS 1.0 Passivhaus Schulungsunterlagen 7.1.5

Electrical installations

Household appliances

Electrical installations – household appliances

Primary energy demand for generating electricity



- "Rule of thumb" (for Germany):
  - For 1 kWh of electricity ~ 3 kWh of Primary energy is used
    [mixture of fossils (gas, fuel, coal), atomic and water-power]

    p_{EL} ~ 3 kWh_{PE}/kWh_{EL}
- Calculation of primary energy factor:
  - Depends on the mix of primary energy, efficiency of power plants / the grid or the efficiency of electricity use.
  - Calculation with programmes such as GEMIS
    (**G**lobal **E**mission **M**odel **I**ntegrated **S**ystems)
- Primary energy factor of PHPP:

    p_{EL} ~ 2,7 kWh_{PE}/kWh_{EL}

(For other countries the factors are weighed differently)

Source: PHS 1.0 Passivhaus Schulungsunterlagen 7.2.1

Electrical installations – household appliances

PH: Primary energy demand value < 120 kWh/m²a

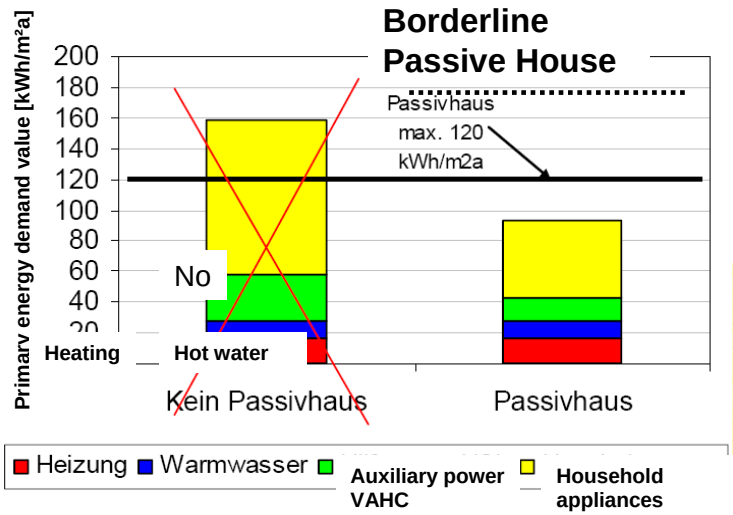
- Requirement of the Passive House - Standard:
  - Primary energy demand value of all consumers (heating, ventilation, warm water production, if necessary cooling, auxiliary current, current for light and equipment):

    PE - demand value **< 120 kWh_{PE}/m^2**
- Recommendations:
  - Electricity consumption < 18 kWh_{EL}/m^2a
  - **Specific Primary Energy Demand** for current applications < 50 kWh_{PE}/m^2a
- Most important power consumers:
  - Home appliances
  - EDV equipment
  - Auxiliary drives of heating, ventilation and warm water production
  - Lighting
  - Elevator, room cooling…

Source: PHS 1.0 Passivhaus Schulungsunterlagen 7.2.2

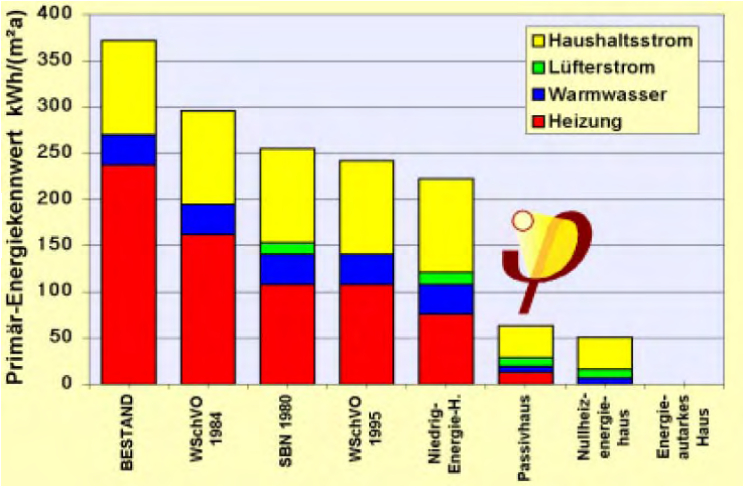
Electrical installations – household appliances

PH: Primary energy demand value < 120 kWh/m²a



Borderline
2000 W - Society

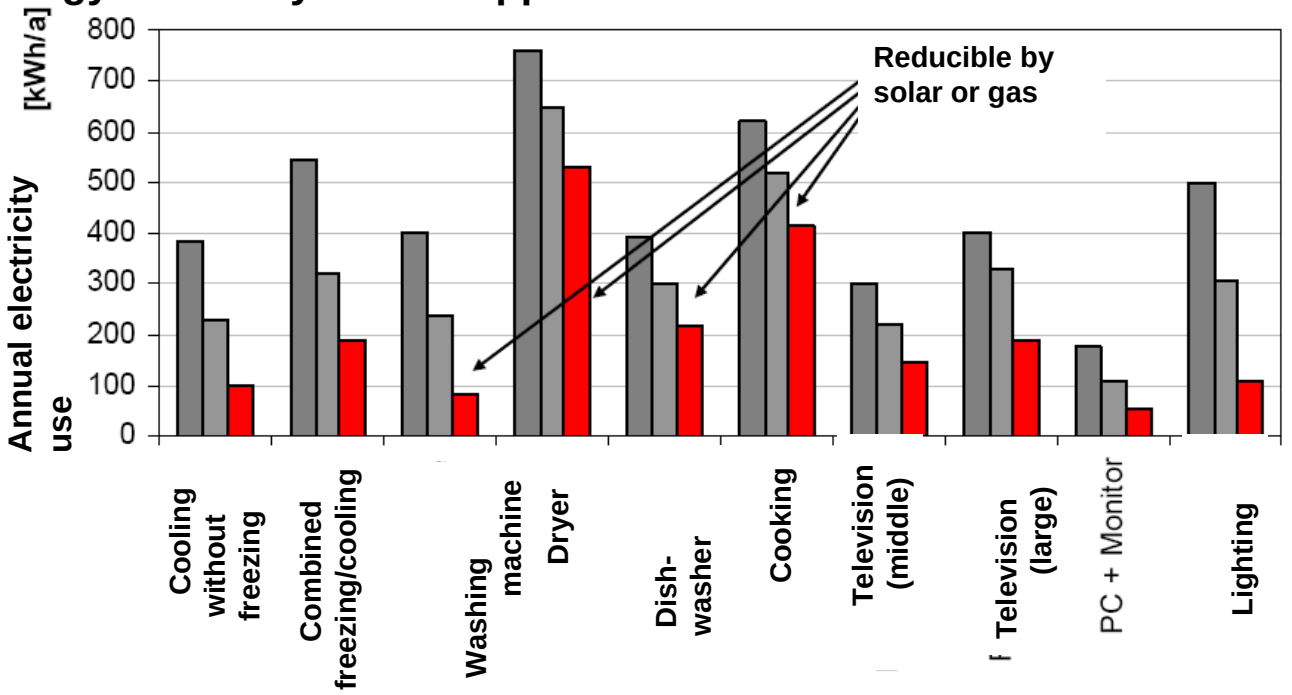
Not only must the heating and the hot water be part of the planning for a Passive House, the electricity for auxiliary power (vents, pumps, …) and for the household appliances is very important too.



Source: PHS 1.0 Passivhaus Schulungsunterlagen 7.2.2

Electrical installations – household appliances

Energy efficiency - home appliances

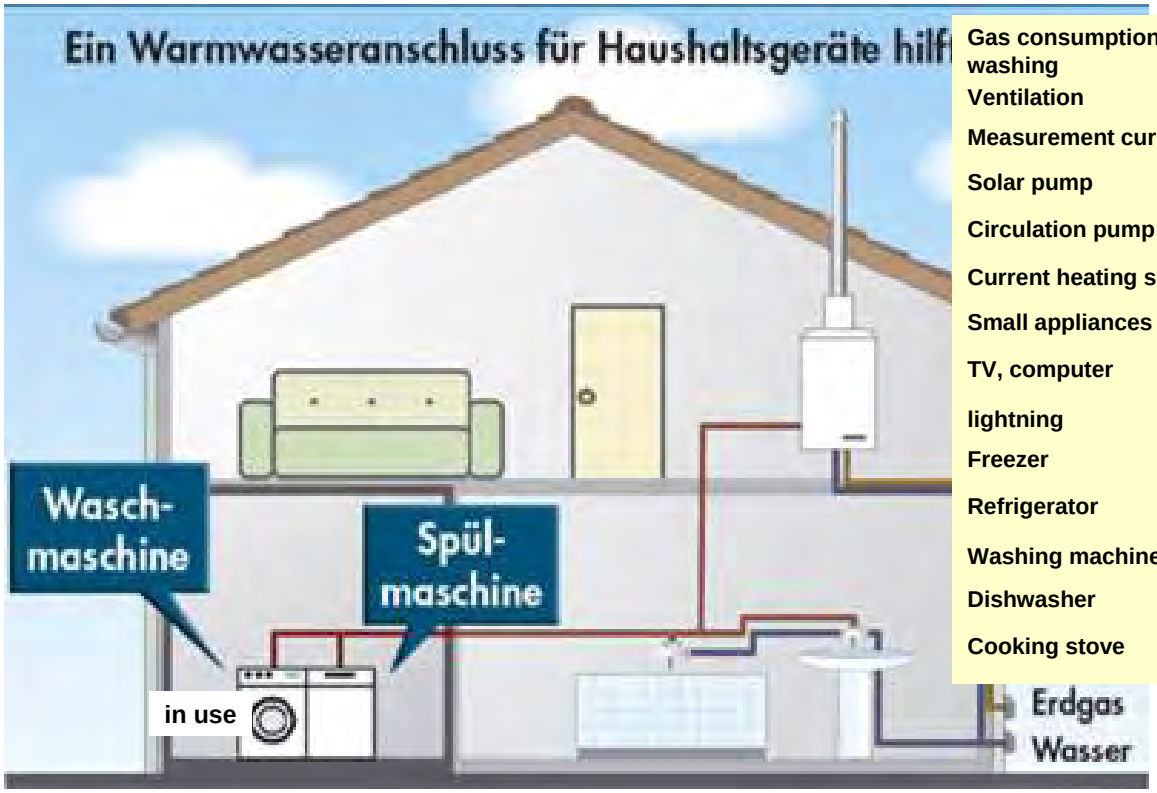


Energy-demand of household appliances currently in use [kWh/a]
New non-optimised energy-demand household appliances [kWh/a]
New optimised energy-demand household appliances [kWh/a]

Source: PHS 1.0 Passivhaus Schulungsunterlagen 7.2.3

Electrical installations – household appliances

Average energy demand of a current Passive House compared to a future Passive House with high efficiency household technology



Gas consumption:
washing
Ventilation
Measurement current
Solar pump
Circulation pump
Current heating system
Small appliances
TV, computer
lightning
Freezer
Refrigerator
Washing machine
Dishwasher
Cooking stove

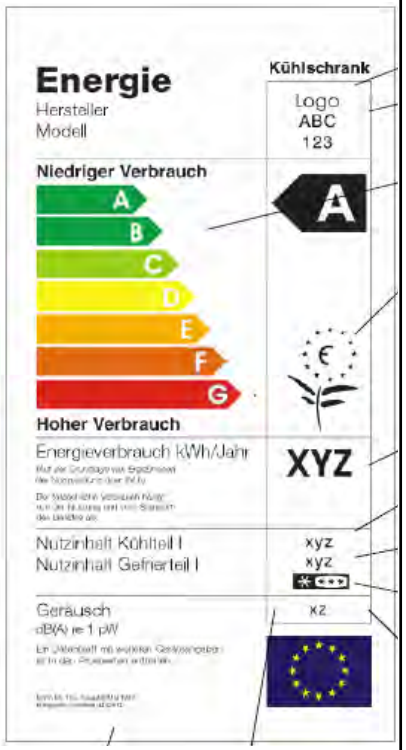
Source:

Electrical installations – household appliances

Identification of power saving equipment

EU- energy label:
Europe-wide uniform label with equipment details:

- Energy efficiency A (very good, low energy consumption to G (bad, high energy consumption).
- Caution: Meanwhile for cooling or freezing equipment the best labelling is A+, A++ or A+++, consuming up to 45 % less current than A equipment!
- Equipment-specific details: water consumption, capacity volume, noise emissions, etc.



Pay attention to high energy efficiency!

To bring a return on existing equipment, for example,

a 10-year-old refrigerator:

Energy : 1 - 3 years (grey energy < electricity savings),

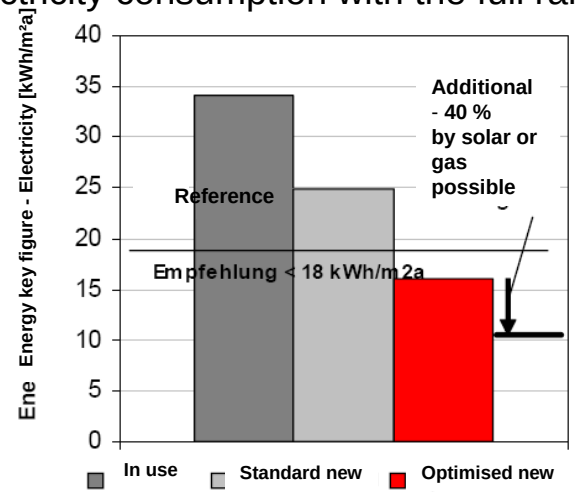
Financial: ~ 10 years >, early trade-in perhaps favourable!

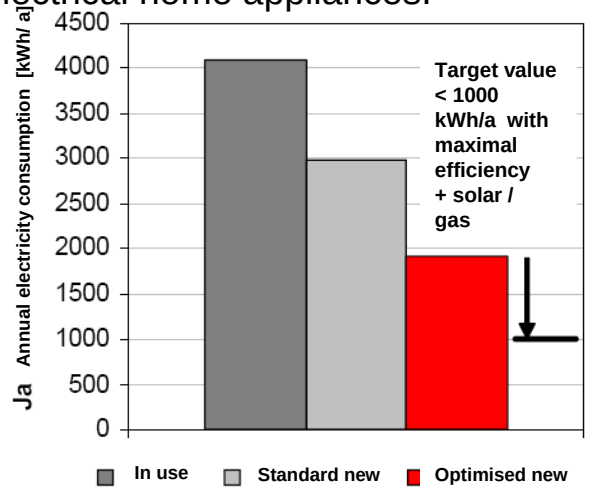
Source: PHS 1.0 Passivhaus Schulungsunterlagen 7.2.4

Electrical installations – household appliances

Complete electricity consumption / current operating costs

Electricity consumption with the full range of electrical home appliances.





Comparison of current “In-use” appliances, “Standard-new" i.e. customary market appliances, and “Energy-efficient” appliances.

Calculation for a 3-person household with 120 m² treated floor area.

Current operating costs at cost of electricity of € 0.15/kWh:

-in use: € 51 /month,

-standard new: € 34 /month, - optimized new: € 24 /month.

Source: PHS 1.0 Passivhaus Schulungsunterlagen 7.2.5

Electrical installations – household appliances

Calculation of demand values for electricity and primary energy - household 1

According to PHPP 2007, for total performance:

$$E_{EL} = s_1 \cdot s_2 \cdot V_{norm} \cdot f_{use} \cdot h \cdot G \cdot f_{EL}$$

- s_1 … indicates if the device is available
- s_2 … indicates whether the device is within the thermal envelope (influencing
- consumption of refrigerators)
- $V_{norm\ ..}$ norm demand of the device (efficiency label)
- f_{use} … utilisation correction factor for the norm demand (usually 1)
- h ... frequency of use per year and per reference quantity G
- g ... reference quantity for **h,** depending on performance: per person, per household, per m^2 of treated floor area or per m^3 of room volume

Internet - online calculations

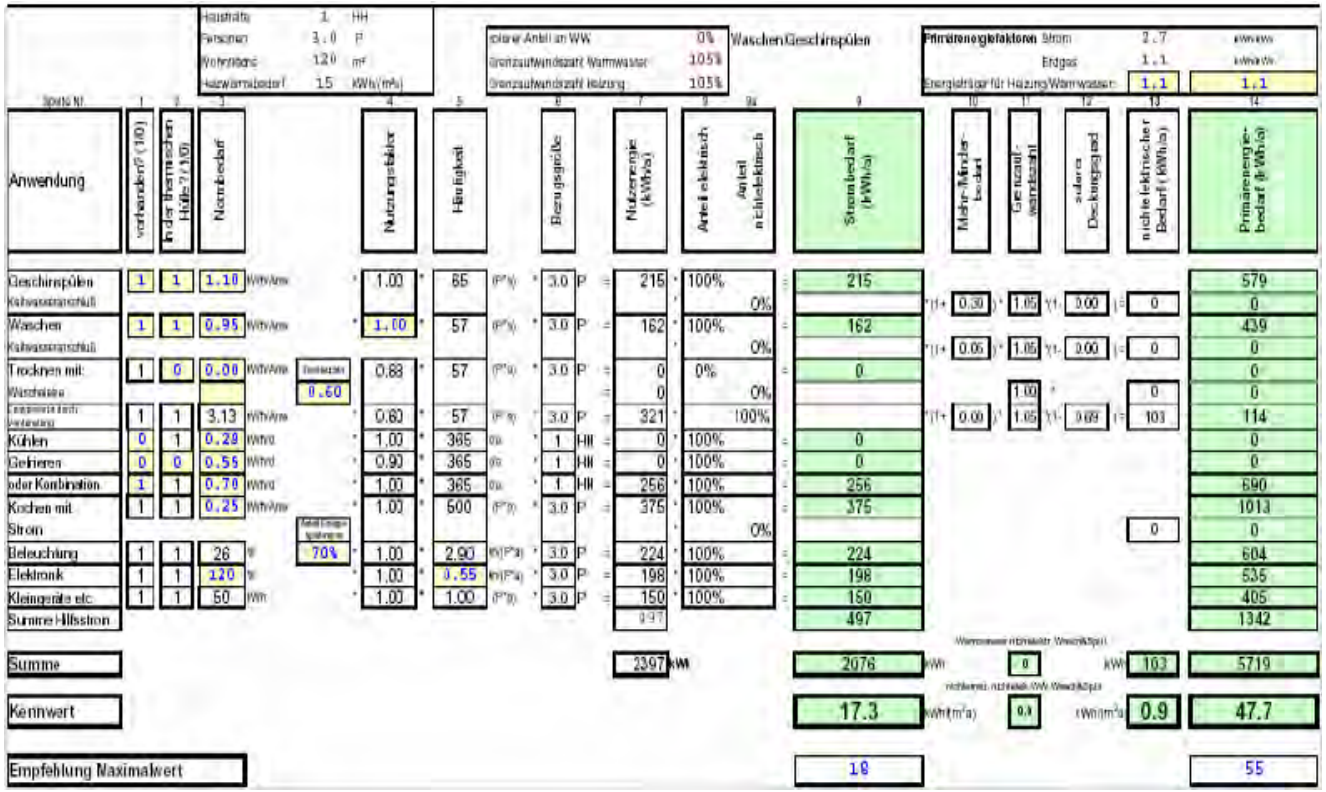
– www.stromeffizienz.de

– www.energyagency.at

Source: PHS 1.0 Passivhaus Schulungsunterlagen 7.2.6

Electrical installations – household appliances

Calculation of demand values for electricity and primary energy - household 2
According to PHPP 2007, for total performance:



Anwendung	vorhanden? (1/0)	in der thermischen Hülle? (1/0)	Nennbedarf		Nutzungsfaktor	Häufigkeit		Bezugsgröße		Nutzenergie (kWh/a)	Anteil elektrisch	Anteil nichtelektrisch	Strombedarf (kWh/a)	Mehr-/Minderbedarf	Gleichzeitigkeitsfaktor	solarer Deckungsgrad	nichtelektrischer Bedarf (kWh/a)	Primärenergiebedarf (kWh/a)
Geschirrspülen	1	1	1.10	kWh/Anw	1.00	85	(P*a)	3.0	P	215	100%	0%	215					579
Waschen	1	1	0.95	kWh/Anw	1.00	57	(P*a)	3.0	P	162	100%	0%	162					439
Trocknen mit:	1	0	0.00	kWh/Anw	0.88	57	(P*a)	3.0	P	0	0%	0%	0					0
Waschleine					0.60					0		0%						0
	1	1	3.13	kWh/Anw	0.80	57	(P*a)	3.0	P	321		100%						114
Kühlen	0	1	0.29	kWh/d	1.00	365	(a)	1	HH	0	100%		0					0
Gefrieren	0	0	0.55	kWh/d	0.90	365	(a)	1	HH	0	100%		0					0
oder Kombination	1	1	0.70	kWh/d	1.00	365	(a)	1	HH	256	100%		256					690
Kochen mit Strom	1	1	0.25	kWh/Anw	1.00	600	(P*a)	3.0	P	375	100%	0%	375				0	1013
Beleuchtung	1	1	26	%	1.00	2.90	kWh/(P*a)	3.0	P	224	100%		224					604
Elektronik	1	1	120	%	1.00	0.55	kWh/(P*a)	3.0	P	198	100%		198					535
Kleingeräte etc.	1	1	50	kWh	1.00	1.00	(P*a)	3.0	P	150	100%		150					405
Summe Hilfsstrom										497			497					1342
Summe										2397 kWh			2076 kWh		0 kWh		103 kWh	5719
Kennwert													17.3 kWh/(m²a)		0.0		0.9 kWh/m²a	47.7
Empfehlung Maximalwert													18					55

Source: PHS 1.0 Passivhaus Schulungsunterlagen 7.2.7

Electrical installations – household appliances

Saving electricity: Tips, internet pages

Tips for saving electricity:

- If buying new appliances, take energy efficiency class A (or for cooling A+, A++ and A+++)
- Check your household with an analyser!
- No washer-driers (if possible).
- Connection of the washing machine and dishwasher to the warm-water (solar) system (if available).
- EDP: energy efficient flat screens or laptop computers, power saving modes when not in use (partial-/self-switching off screen, stand-by)
- all equipment, electronics (TV, Hifi), printer, .: Reduction of stand-by consumption
- suitable hotplates for certain pot sizes
- adjusting washing, pre-wash and temperature only if necessary.

Internet pages to energy efficient appliances + label:

- www.topprodukte.at
- www.eu-label.de
- www.ecotopten.de
- www.oeko.de

Source: PHS 1.0 Passivhaus Schulungsunterlagen 7.2.8

Electrical installations

Measuring, control, regulation

Electrical installations – measuring, control, regulation

Significance of the measuring and control engineering in the PH

- Regulation need from viewpoint of the residents:
  - room temperature
  - hot-water
  - shading
  - air quality

Source: PHS 1.0 Passivhaus Schulungsunterlagen 7.3.1

Electrical installations – measuring, control, regulation

Requirements on the measuring and control engineering

- Room temperature
  - ⇒ change of the room temperature
- Hot-water
  - ⇒ defined time windows for hot-water
- Shading
  - ⇒ weather dependent sensor regulated sun protection
- Air quality
  - ⇒ need for fresh air depending on the presence and number of people

Source: PHS 1.0 Passivhaus Schulungsunterlagen 7.3.2

Electrical installations – measuring, control, regulation

Quality criteria at the measuring and control engineering

- Competent planning of house technology
  - ⇒ House technology works for the user and not the other way round
  - ⇒ The user is an important consideration in the planning phase
- Uniform measuring and control technology
  - ⇒ Coordinated automatic control in modular systems
  - ⇒ Simple and understandable handling
- Regulated house technology components
  - ⇒ Standard use does not require any interventions by the user

Source: PHS 1.0 Passivhaus Schulungsunterlagen 7.3.3

Energy saving household appliances

Available and future solutions

Source:

Energy saving household appliances – available solutions

for the energy-efficient positioning of freezers

Placing the freezers not inside the heated volume /warm envelope of the building. Example: “cold” community freezer room in the basement of an apartment house (and only small freezing sections in the kitchen refrigerator)

Source:

Energy saving household appliances – available solutions

for energy-efficient PC-screens

Old tube screen (left) and an energy-efficient flat screen (TFT).
The savings in electricity amount to more than 70% -
with an improvement in comfort at the same time.

Source: http://www.passivhaustagung.de/Passivhaus_D/energieeffizienz.html

Energy saving household appliances – available solutions

for washing and dish washing with (solar-)heated warm water

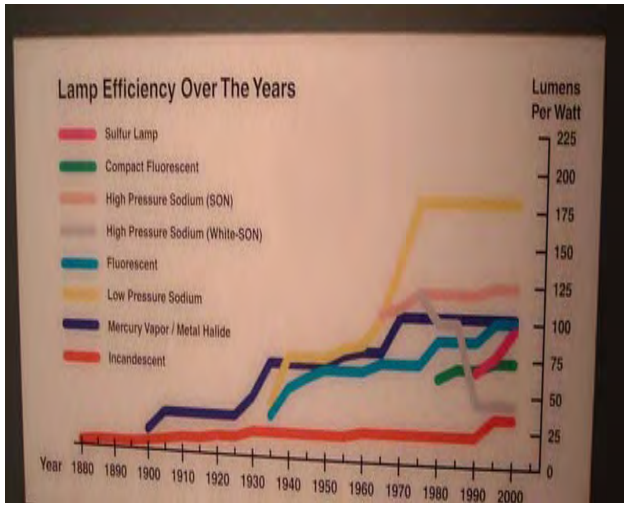
This requires a warm water supply and a washing machine with two incoming water connections ….

Source: Left: www.solarteam-hacker.de/alfaamix.html right Ernst Heiduk

Energy saving household appliances – available solutions

for washing and dish washing with solar-heated warm water

… or a water mixer which sets the temperature of the water before it enters the washing machine



Source: www.solarteam-hacker.de/alfaamix.html www.baulinks.de/webplugin/2005/i/0148-asue.jpg

Energy saving household appliances – available solutions

for standby-electricity losses

EcoButler PC

EcoButler TV

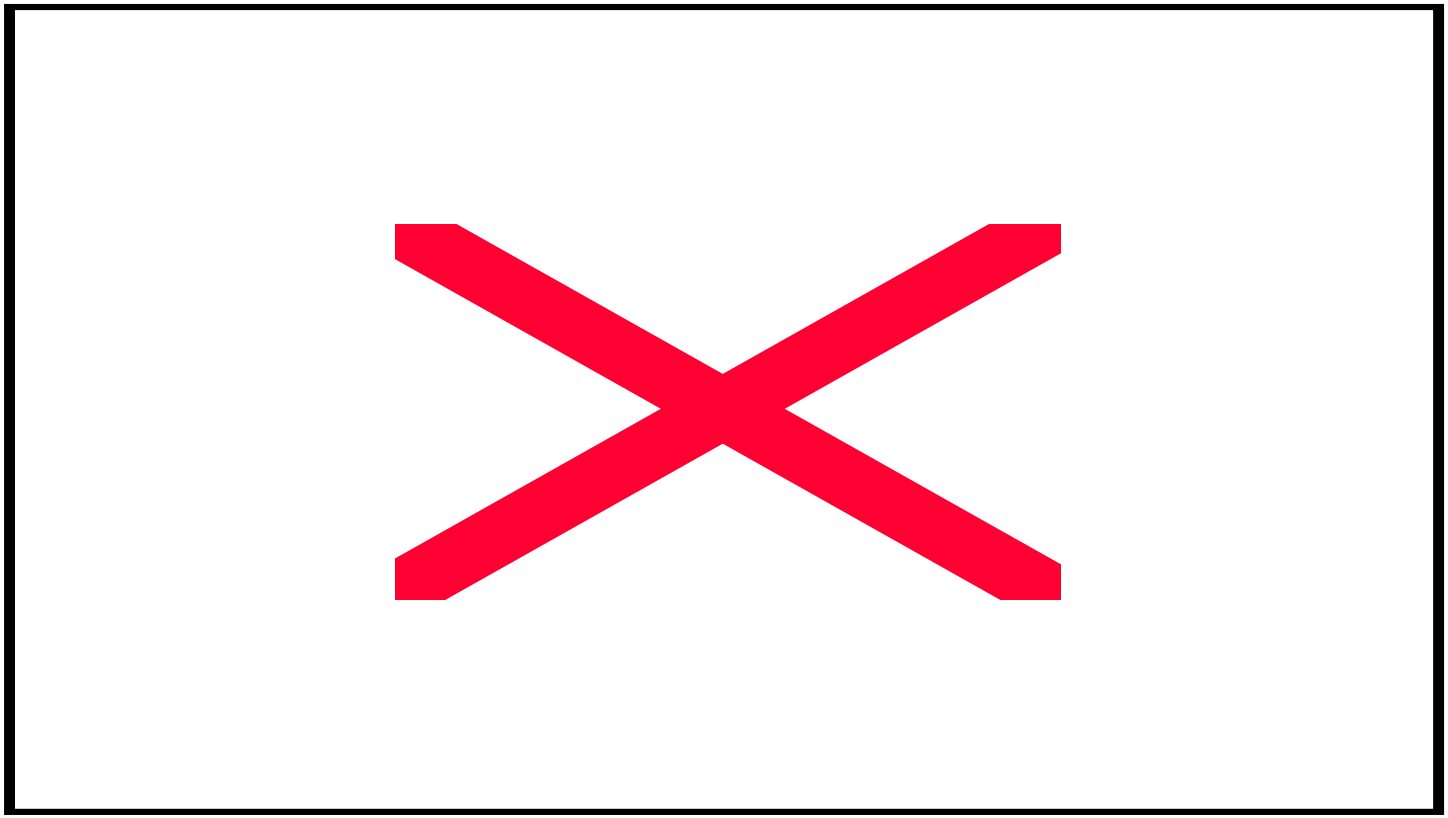
Saves up to 99% of the
Standby-electricity
© ecobutler.de

The EcoButler takes the stand-by-Function of the household appliances and uses less than 0,5 Watt for itself.

Source: www.ecobutler.de/produktbilder/index.php (2008-12-09, 15:45)

Energy saving household appliances – available solutions

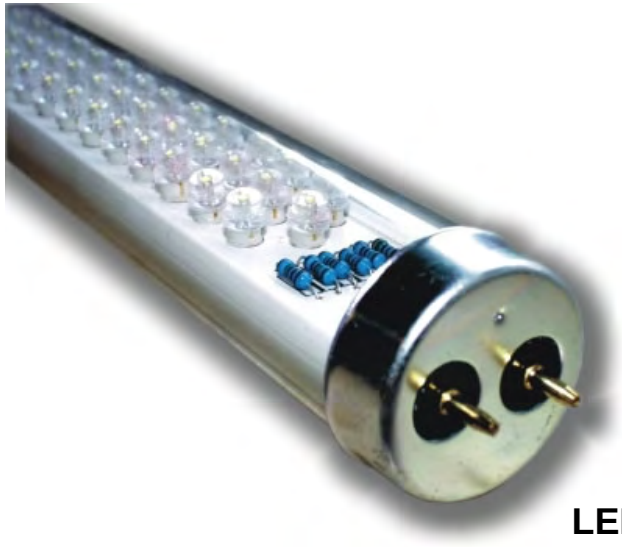
for energy-efficient lighting – historical development



Source: http://upload.wikimedia.org/wikipedia/en/c/cd/LampEfficiency.JPG

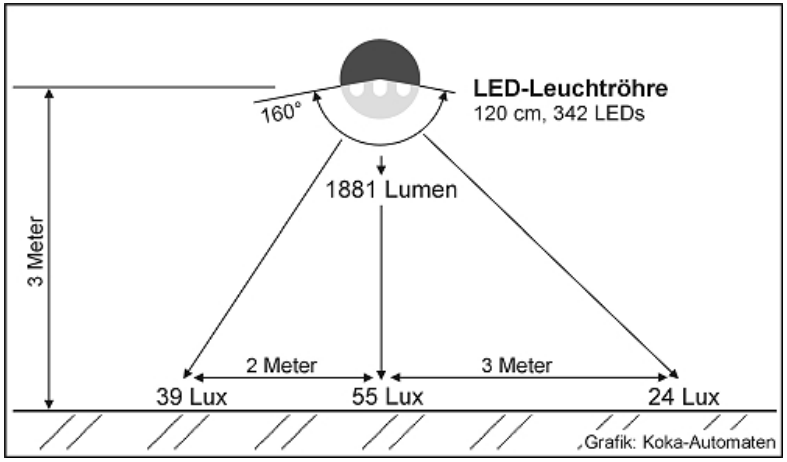
Energy saving household appliances – available solutions

for energy-efficient lighting



LED-Fluorescent Tube

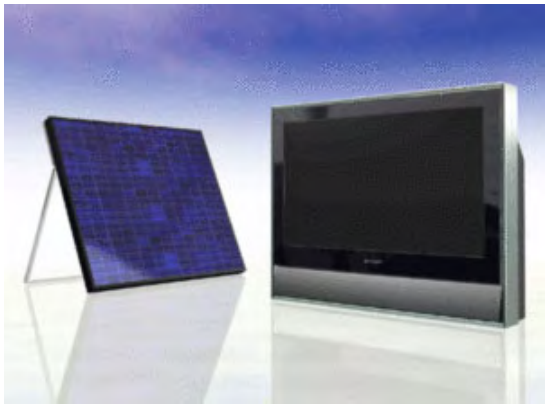
© ecobutler.de



Source: www.ecobutler.de/led-lichttechnik/index.php (2008-12-09, 15:45)

Energy saving household appliances – near future solutions

for energy-efficient TV



Sharps 26-Zoll- LCD-TV
with a PV-solar panel
© sharp-world.com

This LCD-TV has a very small energy need.
Out of this it is possible to provide it with the power of a PV-solar panel of the same size.

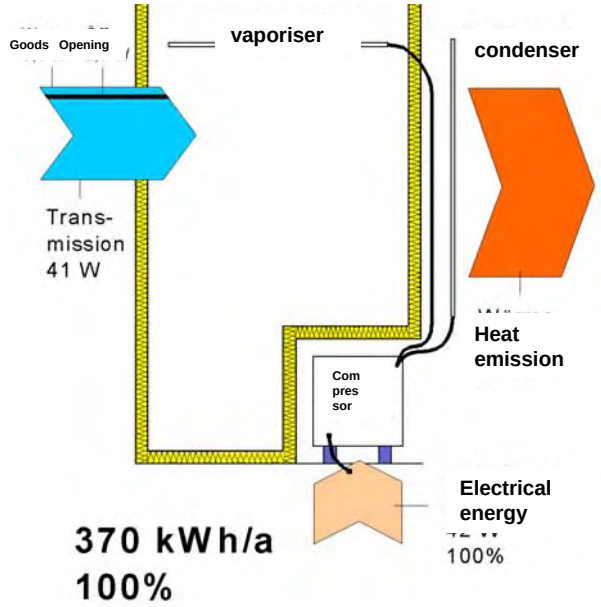
Source: xxx

Energy saving household appliances – near future solutions

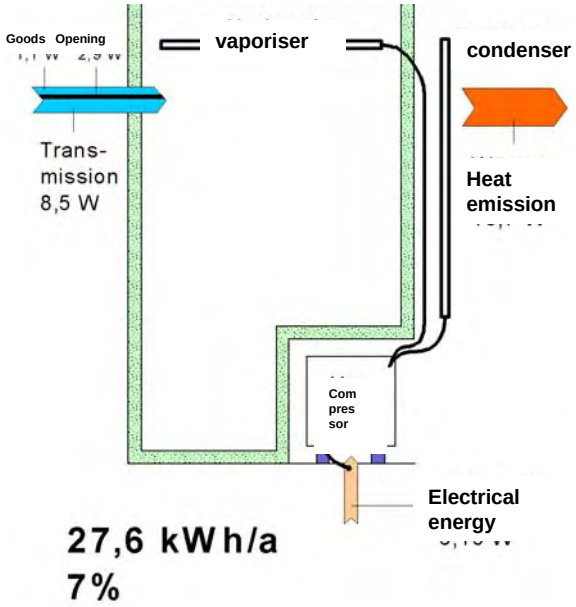
for energy-efficient cooling of food

Next possible generation of refrigerators

Heat insulation: PU = 0,8 W/(m²K)

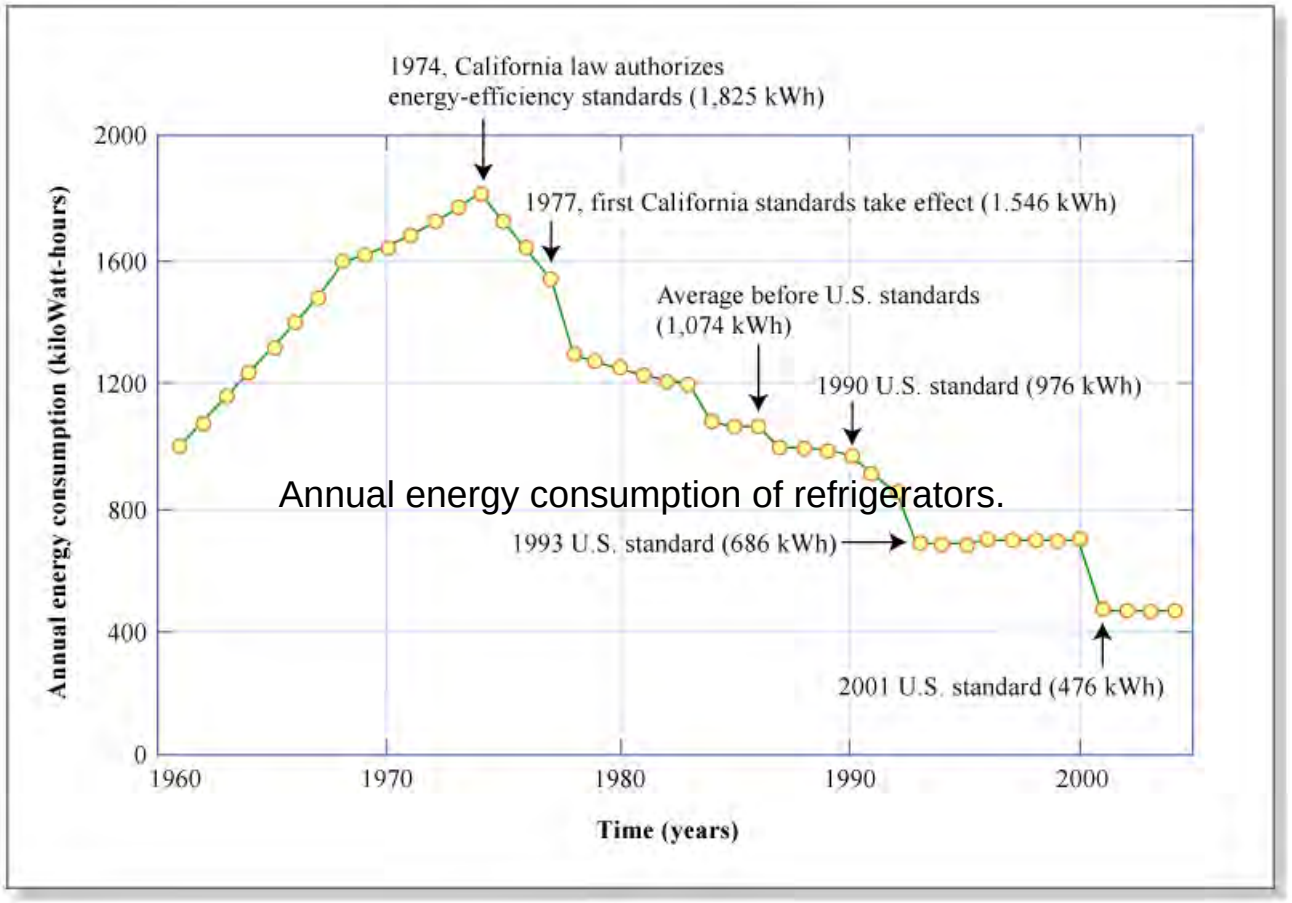


Heat insulation: VIP = 0,16 W/(m²K)



A further improvement through the use of vacuum heat insulation can again reduce the energy consumption significantly.

Source:



Annual energy consumption of refrigerators.

Source: www.flickr.com/photos/mitopencourseware/3249911137/in/set-72157614684839297/