Results comparative calculation of energy systems

Project name: AKH Wien-Nord

Project number: 0987654

Project part: Anbau Psychyatrie

All results are rounded to nearest whole number. The values used for energy-prices represent estimated cost forecasts last updated 2024. A cost spread of around 20% is possible.

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Inhalt

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Input values/Energy requirement

Known input values	
Building type	Single family home
Heat-load	5.000 W
Household / business electricity demand (HHED/BSB)	4.000 kWh/a
Operating hours	1.800 h
People	4

Determined energy requirement	
Heat-load	5 kW
Cooling-load	20 kW
Annual energy req. hot water	4.015 kWh/a
Annual energy req. room heating	9.000 kWh/a
Annual energy req. electricity (HHED)	4.000 kWh/a

Solar thermal system	
Flat plate collector area (FPC)	20 m^2
FPC costs per m^2	375.75 €/m^2
Collector angle	30 °
Collector orientation (south-east/west-north)	0 °
Horizontal solar radiation	1084 kWh/m^2

Base costs				
	Labor price	Base price	Performance price	rcalc.headline_energy_cost_adaption_short
Electricity costs	0,18 €/kWh	50,52 €/a		2,4 %
Pellets heating	335,74 €/t			2,1 %
Gas heating	0,08 €/kWh	49,71 €/a		3,6 %
District heating	0,10 €/kWh	170,97 €/a	39,24 €/kW a	1,3 %
Annual energy price changes				
Imputed interest rate				2 %
Maintenance costs				1 %
Inflation				2 %

Photovoltaic system (PV)					
Name	Area	Cost Inst.	Cost	Angel	Align.
-	10 m^2	800 €/kwp	67 €/m^2	30°	0°
Common values					
Horizontal solar radiation			1084 kWh/m^2		

CO_2 Tax per year within calculation period																			
Year 1:	30 €/t	Year 2:	35 €/t	Year 3:	40 €/t	Year 4:	45 €/t	Year 5:	50 €/t	Year 6:	55 €/t	Year 7:	60 €/t	Year 8:	65 €/t	Year 9:	70 €/t	Year 10:	75 €/t
Year 11:	80 €/t	Year 12:	85 €/t	Year 13:	90 €/t	Year 14:	95 €/t	Year 15:	100 €/t	Year 16:	105 €/t	Year 17:	110 €/t	Year 18:	115 €/t	Year 19:	120 €/t	Year 20:	125 €/t

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System comparison

System comparison					
	Gas	**District**	**Air-water ***	**Geothermal**	**Pellets**
Subsidy sum	-111 €	-	-	-	-
Investment costs	43.601 €	31.807 €	21.989 €	44.437 €	23.586 €
Energy demand per year (RH + HW)	9.474 kWh	13.015 kWh	3.557 kWh	2.603 kWh	13.846 kWh
Energy demand per year excl. HHED	11.326 kWh	13.015 kWh	3.557 kWh	4.452 kWh	13.846 kWh
Electricity requirement per year incl. HHED (grid feed-in)	4.696 kWh	4.180 kWh	6.209 kWh	7.104 kWh	4.180 kWh
Energy costs in the 1st year	765 €	1.606 €	-	-	930 €
Electricity costs in the 1st year (grid feed-in)	883 €	792 €	1.151 €	1.310 €	792 €
CO_2 tax cost in the 1st year	102 €	125 €	42 €	48 €	37 €
Total CO_2 tax cost after 20 years	5.279 €	6.458 €	2.184 €	2.500 €	1.923 €
Total energy cost after 20 years	44.192 €	56.426 €	29.117 €	33.133 €	42.837 €
Total cost after 20 years	**108.520 €**	**97.321 €**	**62.670 €**	**89.548 €**	**94.328 €**
CO_2 equivalent per year	**3.406 kg**	**4.166 kg**	**1.409 kg**	**1.613 kg**	**1.241 kg**
CO_2 equivalent after 20 years	**73 t**	**84 t**	**32 t**	**37 t**	**26 t**

* No noise reduction measures are taken into account

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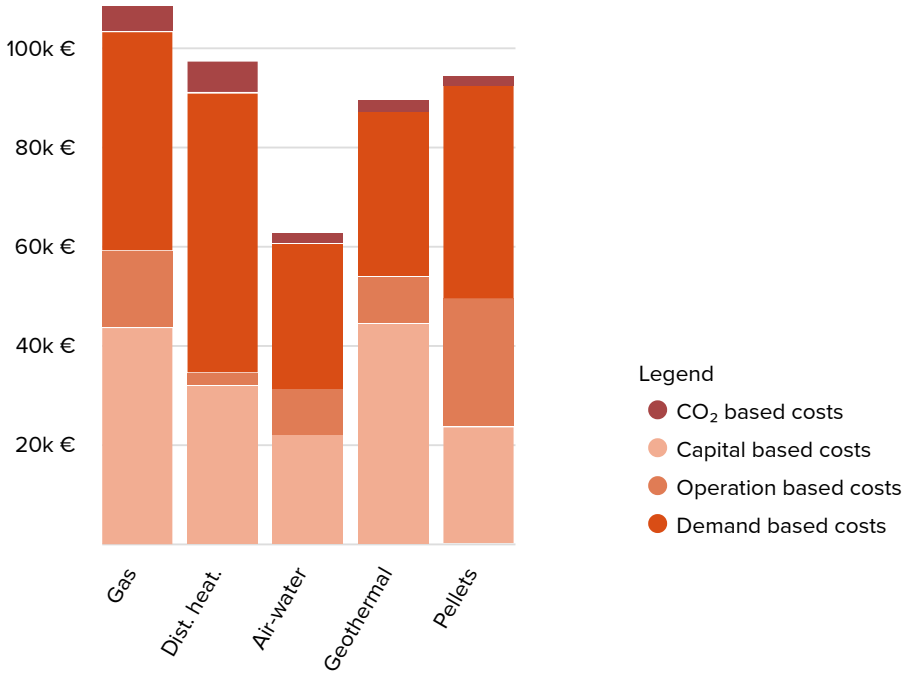
Total cost comparison



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Amortisation/CO_2-Reduction

Base system		Total cost after 20 years	CO_2 equivalent after 20 years	
Gas with PV		108.520 €	73 t	

Compare system	Amortization time	Net Value (profit) after 20 years (€)	CO_2 reduction (absolute)	CO_2 reduction (percent)
Gas	0 Year(s)	519 €	-3 t	-4 %
District	0 Year(s)	10.858 €	-11 t	-15 %
Air-water	0 Year(s)	41.106 €	38 t	52 %
Air-water with PV	0 Year(s)	41.023 €	41 t	56 %
Geothermal	0 Year(s)	14.840 €	33 t	45 %
Geothermal with PV	1 Year(s)	14.757 €	37 t	50 %
Pellets	0 Year(s)	15.267 €	48 t	65 %

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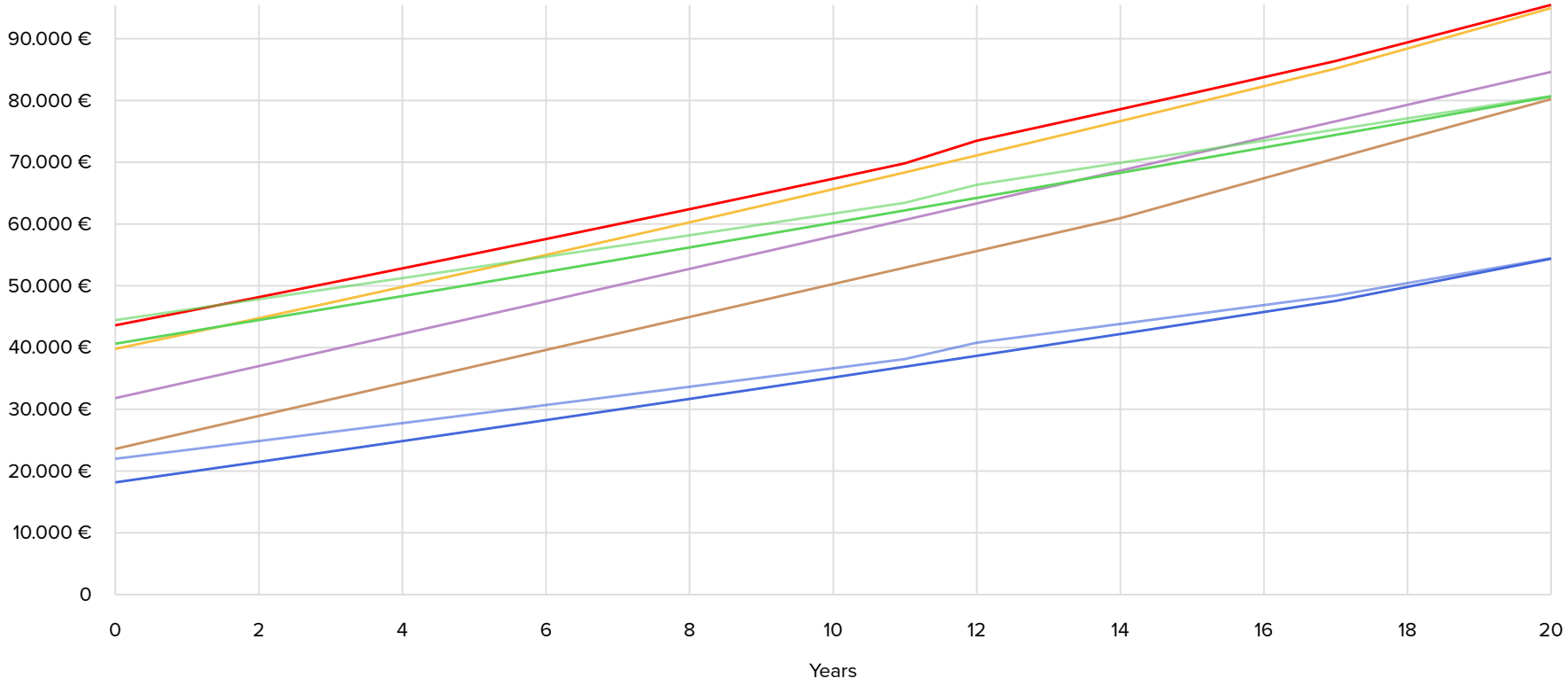

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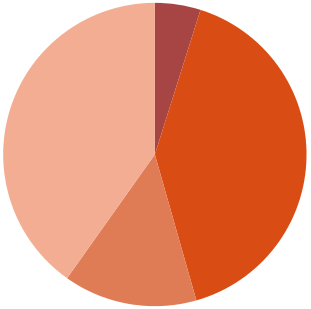
System data: Gas heating

Investment costs		CO_2 amount
Gas burner	9.576 €	115 kg
Ventilation	8.000 €	-
Installation	1.200 €	-
Connection	2.375 €	-
Buffer storage tank	1.316 €	316 kg
Drinking water storage tank	3.615 €	588 kg
Split air conditioner	6.292 €	514 kg
Modules (PV)	669 €	2.811 kg
Installation (PV)	1.707 €	-
Inverter (PV)	1.446 €	included at Modules (PV)
Solar thermal	7.515 €	983 kg
Subsidy sum	-111 €	-
Total	**43.601 €**	**5.328 kg**

Additional information	
Power heater	44 W
Auxiliary energy per year (heater)	79 kWh/a
Gas usage per year	947 m^3/a
per hour	1 m^3/h

Cost allocation diagram



Cost allocation		
CO_2 based costs	5.279 €	5 %
Operation based costs	15.449 €	14 %
Capital based costs	43.601 €	40 %
Demand based costs	44.192 €	41 %
Total	**108.520 €**	

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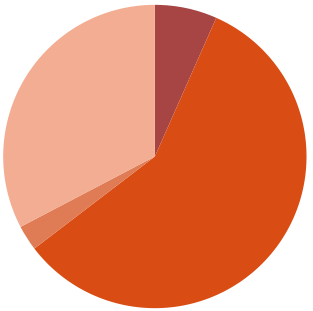
System data: District heating connection

Investment costs		CO_2 amount
Transfer station	3.983 €	19 kg
Installation	1.200 €	-
Connection	22.000 €	-
Buffer storage tank	1.316 €	316 kg
Drinking water storage tank	3.307 €	504 kg
Subsidy sum	-	-
Total	**31.807 €**	**839 kg**

Cost allocation diagram



Cost allocation		
Operation based costs	2.631 €	2 %
CO_2 based costs	6.458 €	7 %
Capital based costs	31.807 €	33 %
Demand based costs	56.426 €	58 %
Total	**97.321 €**	

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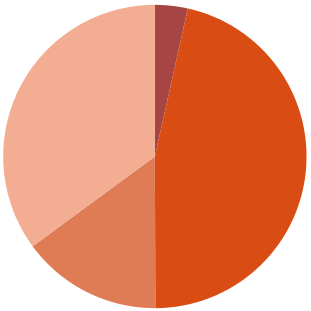
System data: Air-water heat pump

Investment costs *		CO_2 amount
Air-water heat pump	12.343 €	162 kg
Installation	1.200 €	-
Buffer storage tank	1.316 €	316 kg
Drinking water storage tank	3.307 €	504 kg
Modules (PV)	669 €	2.811 kg
Installation (PV)	1.707 €	-
Inverter (PV)	1.446 €	included at Modules (PV)
Subsidy sum	-	-
Total	**21.989 €**	**3.793 kg**

* No noise reduction measures are taken into account

Additional information	
Annual performence factor heat-pump hot-water	3,8
Annual performence factor heat-pump room-heating	3,6

Cost allocation diagram



Cost allocation		
CO_2 based costs	2.184 €	3 %
Operation based costs	9.379 €	15 %
Capital based costs	21.989 €	35 %
Demand based costs	29.117 €	47 %
Total	**62.670 €**	

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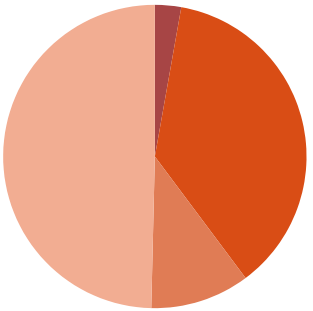
System data: Geothermal heat pump

Investment costs		CO_2 amount
Geothermal heat pump	13.791 €	471 kg
Geothermal probe	16.000 €	441 kg
Installation	1.200 €	-
Buffer storage tank	1.316 €	316 kg
Drinking water storage tank	3.307 €	504 kg
Cost cooling extension	5.000 €	-
Modules (PV)	669 €	2.811 kg
Installation (PV)	1.707 €	-
Inverter (PV)	1.446 €	included at Modules (PV)
Subsidy sum	-	-
Total	**44.437 €**	**4.543 kg**

Additional information	
Annual performance factor heat pump	5
Spezific extraction performance ground	30 W/m
Drilling cost per m^2	100 €/m
Full drilling depth	160 m

Cost allocation diagram



Cost allocation		
CO_2 based costs	2.500 €	3 %
Operation based costs	9.478 €	10 %
Demand based costs	33.133 €	37 %
Capital based costs	44.437 €	50 %
Total	**89.548 €**	

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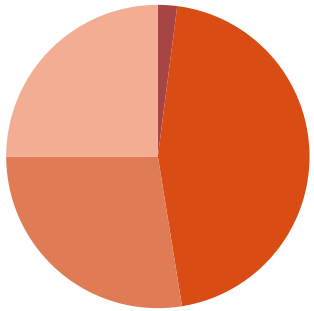
System data: PelGesamtkostenvergleichlets heating

Investment costs		CO_2 amount
Boiler	11.783 €	241 kg
Storage system	3.979 €	-
Ventilation	2.000 €	-
Installation	1.200 €	-
Buffer storage tank	1.316 €	316 kg
Drinking water storage tank	3.307 €	504 kg
Subsidy sum	-	-
Total	**23.586 €**	**1.061 kg**

Cost allocation diagram



Additional information	
Auxiliary energy per year	180 kWh/a
Auxiliary power	100 W
Pellets usage per year	2.769 kg/a
Pellets usage per hour	2 kg/h

Cost allocation		
CO_2 based costs	1.923 €	2 %
Capital based costs	23.586 €	25 %
Operation based costs	25.982 €	28 %
Demand based costs	42.837 €	45 %
Total	**94.328 €**	

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Result cooling system

Cooling input values					
Common declarations		**Indoor cooling-load**		**Outside cooling-load**	
Operating hours cooling-system	500 h	Heat emission people		Heat-load from external component transfer	
Height above sea-level	-	Heat-load through physical exertion	Normal	Building envelope	300 m^2
Density of air	1,200 kg/m^3	People	4	Heat transfer coefficient	1.3
Rated indoor temperature	25 °C	Heat emission illumination		Heat-load from outside air	
Season for calculation	July	Lighting type	Lightbulbs	Air exchange rate	0.5
Rated outside temperature	30 °C	Lighted area (ground plan)	100 m^2	Gross volume	100 m^3
Building orientation	South	Heat dissipation facilities		Ventilated net room volume	90 m^3
		Number of PC stations	10 x	Heat-load through radiation from transparent external components	
		Number of kitchens	1 x	Sunlit transparent area	50 m^2
		Number of residential units	1 x	Total transparent area	100 m^3
		Number of print stations	2 x	Glazing	Sheet glass double glazing
				Sunprotection	External joalousie opening angle 45°
				Second sunprotection	Inside-curtains-bright
				Construction and sun protection	Inner sun protection - lightweight construction

Results cooling extension					
	Gas	**District**	**Air-water**	**Geothermal***	**Pellets**
Cooling-load	20,38 kW	-	-	20,38 kW	-
Indoor cooling-load	15.850 W	-	-	15.850 W	-
Outside cooling-load	4.529 W	-	-	4.529 W	-

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Results cooling extension					
	Gas	**District**	**Air-water**	**Geothermal***	**Pellets**
Investment cost	6.292 €	-	-	5.000 €	-

* Delivery system must be tuned for active cooling. Maximum cooling limited via surface delivery system. Note the dew point temperature.

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Result solar gains

Seperate photovoltaik systems		
Name of the system	**System performance**	**Generated electricity per year**
	2 kWp	2.247 kWh

Result Photovoltaic					
	Gas	**District**	**Air-water**	**Geothermal**	**Pellets**
Annual electricity demand	5.932 kWh	-	7.557 kWh	8.452 kWh	-
System performance	2 kWp	-	2 kWp	2 kWp	-
Generated electricity per year	2.247 kWh	-	2.247 kWh	2.247 kWh	-
Own consumption of electricity per year	1.236 kWh	-	1.348 kWh	1.348 kWh	-
Electricity fed in per year	1.011 kWh	-	899 kWh	899 kWh	-
Degree of self sufficiency	21 %	-	18 %	16 %	-
Self consumption rate	55 %	-	60 %	60 %	-
Cost modules	669 €	-	669 €	669 €	-
Cost installation	1.707 €	-	1.707 €	1.707 €	-
Cost inverter	1.446 €	-	1.446 €	1.446 €	-
Investment Cost	**3.822 €**	**-**	**3.822 €**	**3.822 €**	**-**
Cost after 20 years	**5.708 €**	**-**	**5.708 €**	**5.708 €**	**-**

Solar thermal					
	Gas	**District**	**Air-water**	**Geothermal**	**Pellets**
Energy	9.106 kWh	-	-	-	-
Subsidy solar thermal system	111 €	-	-	-	-

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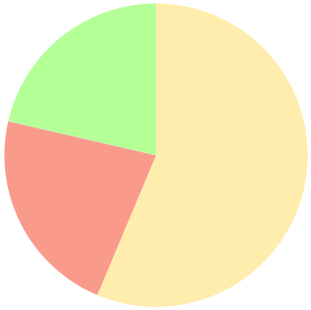
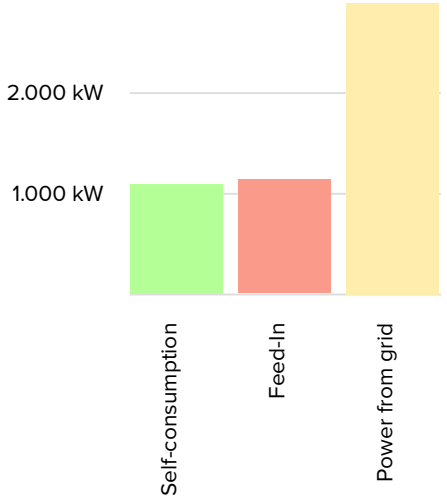
Annual energy req. with PV

PV Comparision Inputs	
Annual electricity demand	4.000 kWh
Factor PV/Annual energy req.	0,53
Self consumption	49 %
Feed-In	51 %
Degree of self sufficiency (with battery storage)	28 %

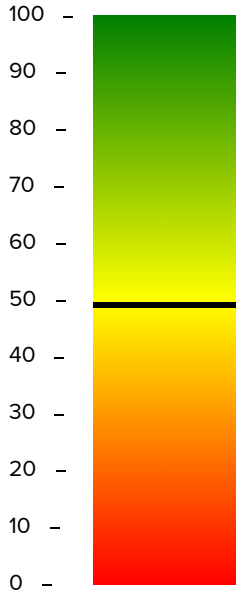
Consumption Allocation



Energy balance



Self consumption rate [%]



Parts		
Usage Direct	1.101 kWh	21 %
Feed-In to power grid	1.146 kWh	22 %
Power from grid	2.899 kWh	56 %

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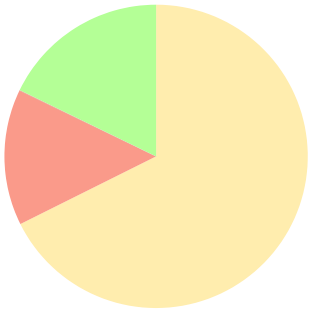
Gas with PV

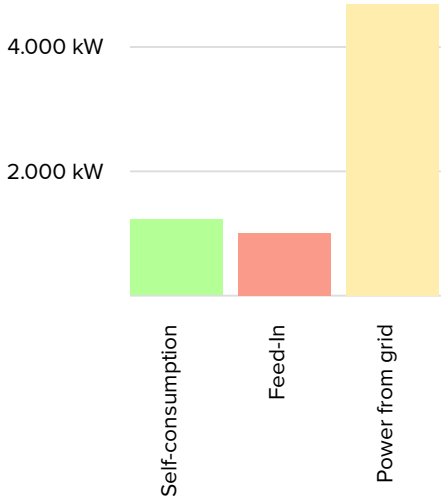
PV Comparision Inputs	
Annual electricity demand	5.932 kWh
Factor PV/Annual energy req.	0,36
Self consumption	55 %
Feed-In	45 %
Degree of self sufficiency (with battery storage)	21 %

Consumption Allocation

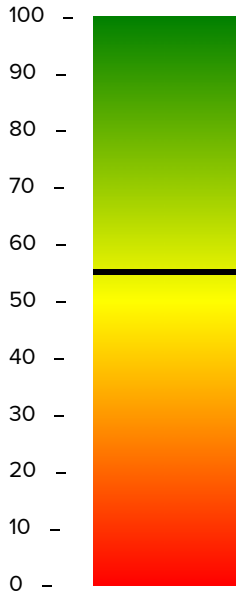


Parts		
Feed-In to power grid	1.011 kWh	15 %
Usage Direct	1.236 kWh	18 %
Power from grid	4.696 kWh	68 %

Energy balance



Self consumption rate [%]



All results are rounded to nearest whole number. The values used for energy-prices represent estimated cost forecasts last updated 2024. A cost spread of around 20% is possible.

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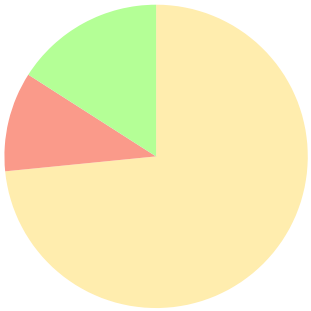
Reckoning Of Sustainable Energysystems

Air-water with PV

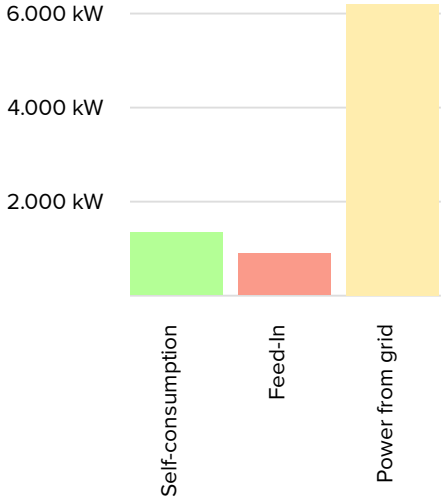
PV Comparision Inputs	
Annual electricity demand	7.557 kWh
Factor PV/Annual energy req.	0,28
Self consumption	60 %
Feed-In	40 %
Degree of self sufficiency (with battery storage)	18 %

Consumption Allocation

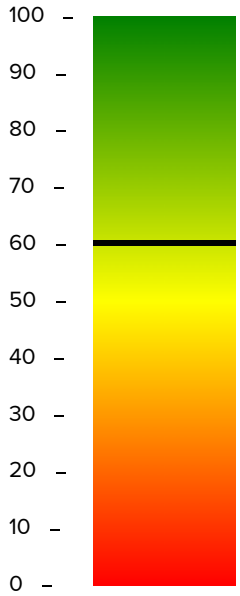


Parts		
Feed-In to power grid	899 kWh	11 %
Usage Direct	1.348 kWh	16 %
Power from grid	6.209 kWh	73 %

Energy balance



Self consumption rate [%]



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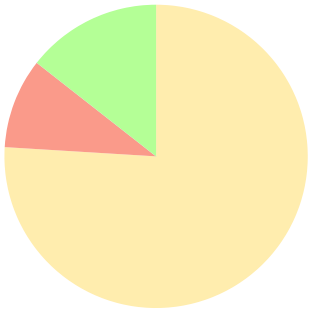
Geothermal with PV

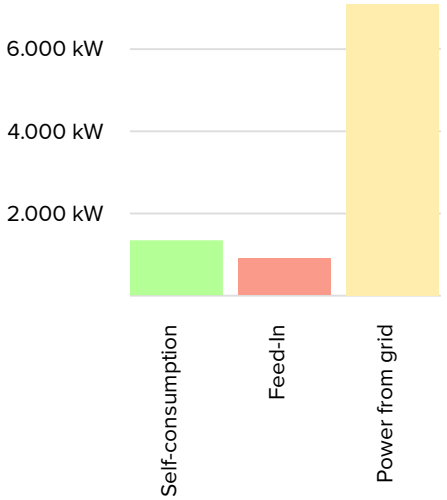
PV Comparision Inputs	
Annual electricity demand	8.452 kWh
Factor PV/Annual energy req.	0,25
Self consumption	60 %
Feed-In	40 %
Degree of self sufficiency (with battery storage)	16 %

Consumption Allocation

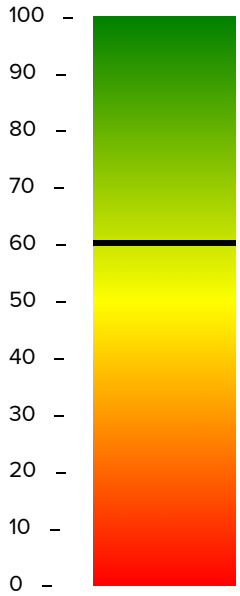


Parts		
Feed-In to power grid	899 kWh	10 %
Usage Direct	1.348 kWh	14 %
Power from grid	7.104 kWh	76 %

Energy balance



Self consumption rate [%]



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