Heating with Air Conditioners: Swiss Case Studies

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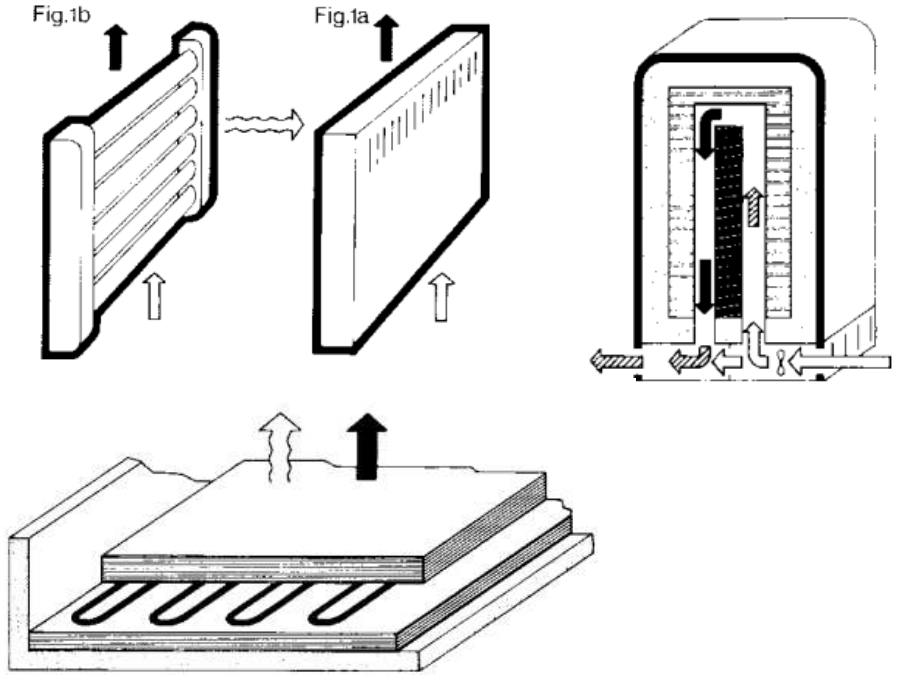
Electric heating systems

Electric resistance heating



Pictures: RAVEL, Elektroheizungen, 1992, Bundesamt für Konjunkturfragen

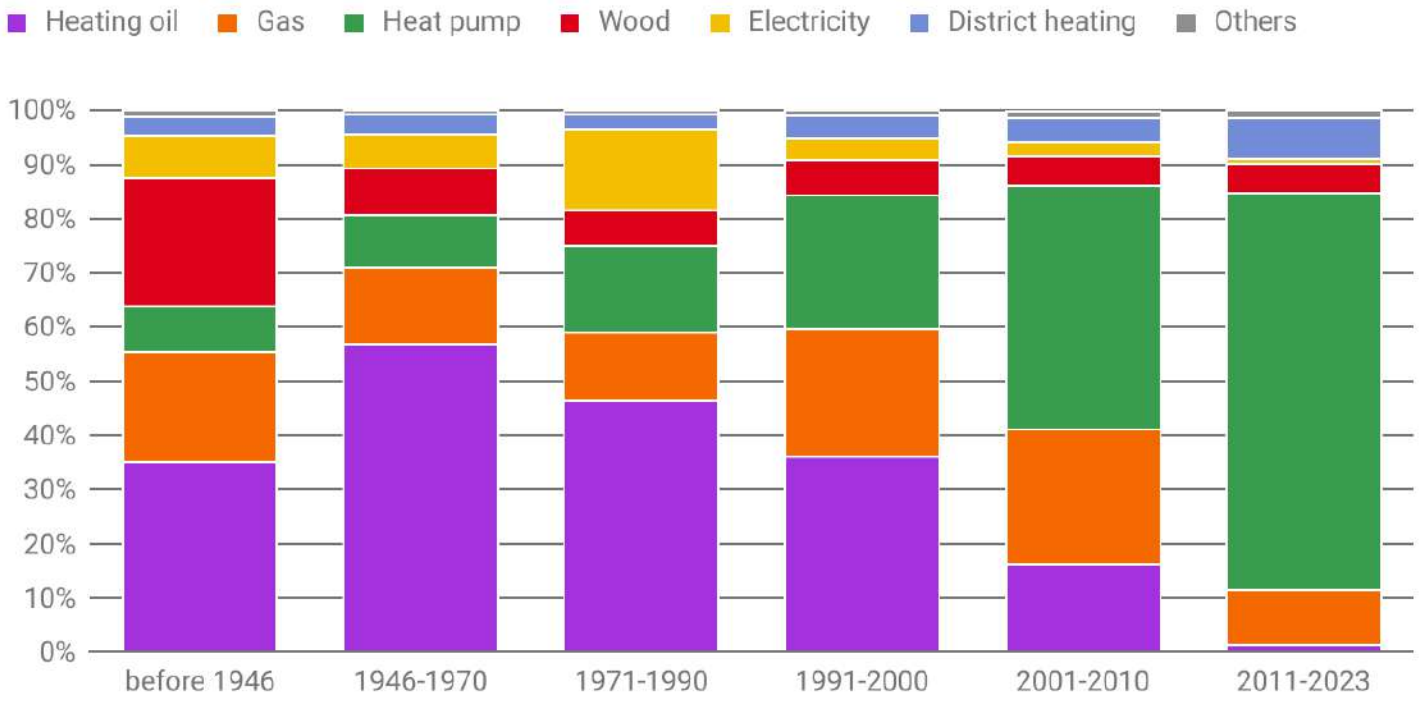
Air conditioner (air-to-air heat pump)

Source: Bosch

Heating culture in Switzerland: Electric popular in the 70s / 80s

Residential buildings by main heating energy source and period of construction

2023



Data as on: 31.12.2023
Source: FSO - BDS

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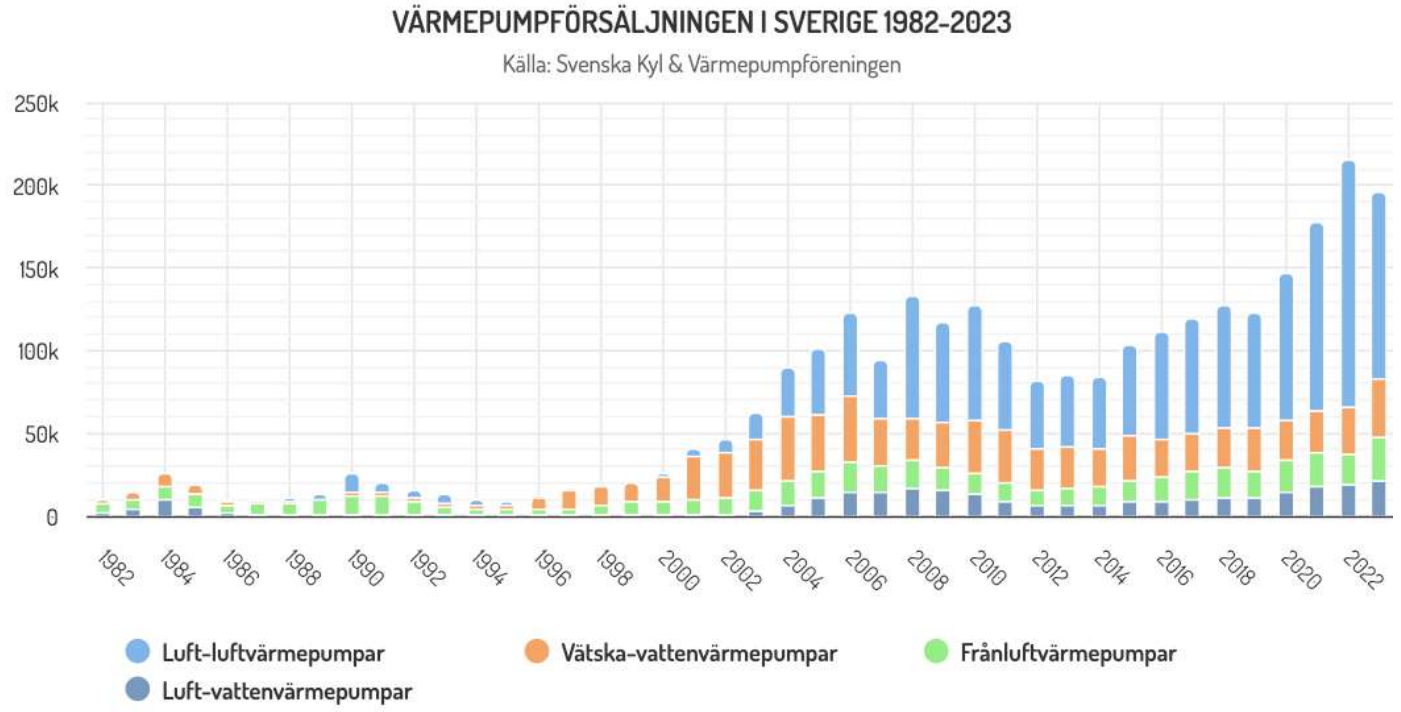
Market shares vary between countries

Market share of air-to-air heat pumps in Sweden is over 50%.

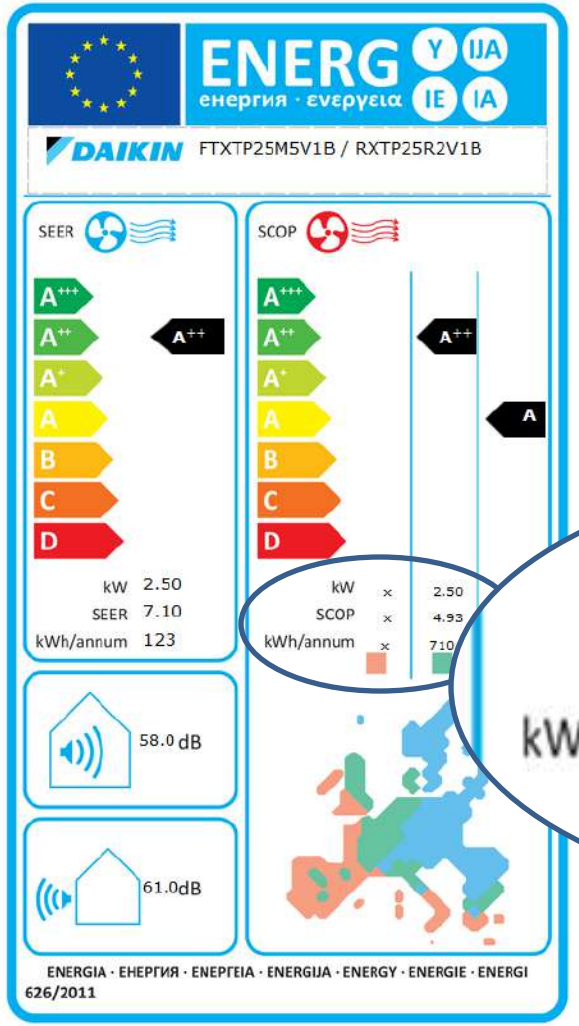
In other countries like Austria, Switzerland, Czech Republic, Germany or UK very few air-to-air heat pumps are sold.



Source:
https://skvp.se/nyheter-o-statistik/statistik/varmepumpforsaljningen

Split air conditioners are air-to-air heat pumps with high efficiency

Example: SCOP value of 4 means, that the air conditioner uses only 1/4 (25%) of the energy for heating compared to an electric resistance heater.

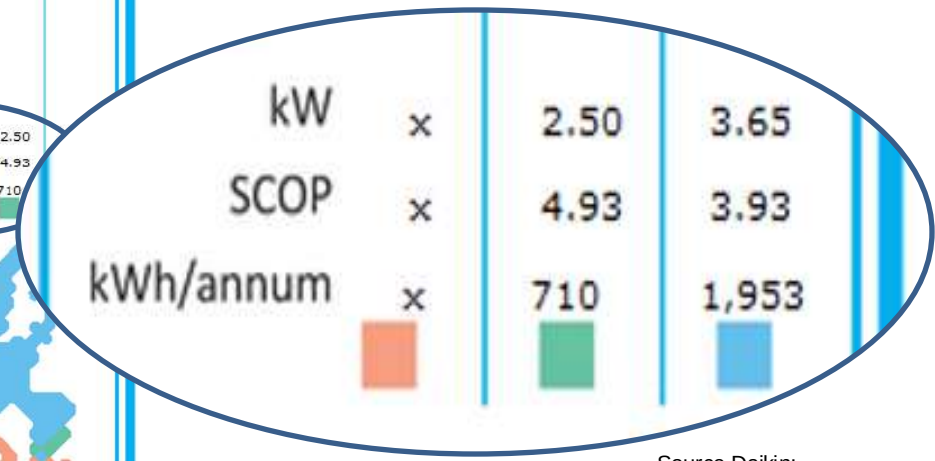


Warmer climate

Average climate

Colder climate

SCOP = Seasonal Coefficient of Performance



Source Daikin: https://energylabel.daikin.eu/de/de_DE/lot10/jcr:content/root/services.json/lot10/energylabel/pdf?product=FTXTP25M5V1B%20/%20RXTP25R2V1B&locale=de_DE

High energy efficiency

Rule of thumb: Air conditioners need 3 to 5 times less energy for heating than electric resistance heaters. They save 60 - 80% energy.

Consumer organisation Stiftung Warentest (June 2024) tested 7 models and measured SCOP values between 3.5 and 4.41 → https://www.test.de/Klimageraete-im-Test-4722766-0/

Warmer
13 591 models

Class	Entries	%
A+++	8 824	64,9
A++	3 786	27,9
A+	656	4,8
A	321	2,4
B	2	0,0
C	1	0,0
D	1	0,0

Average
22 248 models

Class	Entries	%
A+++	684	3,1
A++	2 626	11,8
A+	15 596	70,1
A	3 337	15,0
B	4	0,0
C	0	0,0
D	1	0,0

Colder
7 538 models

Class	Entries	%
A+++	11	0,1
A++	11	0,1
A+	155	2,1
A	597	7,9
B	789	10,5
C	5 935	78,7
D	40	0,5

Source: EPREL, reversible products, total 22'695, 26.09.2024

Energy efficiency classes for air conditioners, except double ducts and single ducts

Energy Efficiency Class	SEER	SCOP
A+++	SEER ≥ 8,50	SCOP ≥ 5,10
A++	6,10 ≤ SEER < 8,50	4,60 ≤ SCOP < 5,10
A+	5,60 ≤ SEER < 6,10	4,00 ≤ SCOP < 4,60
A	5,10 ≤ SEER < 5,60	3,40 ≤ SCOP < 4,00
B	4,60 ≤ SEER < 5,10	3,10 ≤ SCOP < 3,40
C	4,10 ≤ SEER < 4,60	2,80 ≤ SCOP < 3,10
D	3,60 ≤ SEER < 4,10	2,50 ≤ SCOP < 2,80
E	3,10 ≤ SEER < 3,60	2,20 ≤ SCOP < 2,50
F	2,60 ≤ SEER < 3,10	1,90 ≤ SCOP < 2,20
G	SEER < 2,60	SCOP < 1,90

Efficient also at -20° C outside temperatures

There are air conditioners on the market that achieve a SCOP of 1.5 even at an outside temperature of -20° C.

Recommendation for planning: The air conditioning unit must be dimensioned so that it still gives off enough heat when the outside temperature is well below zero.

Declared coefficient of performance* / Colder season, at indoor temperature 20 °C and outdoor temperature Tj			
Tj = -7°C	COPd	3.40	-
Tj = 2°C	COPd	5.11	-
Tj = 7°C	COPd	6.06	-
Tj = 12°C	COPd	7.56	-
Tj = Bivalent temperature	COPd	1.95	-
Tj = operating limit	COPd	1.56	-
Tj = -15°C	COPd	1.95	-

operating limit			
heating / Average	Tol	-10	°C
heating / Warmer	Tol		°C
heating / Colder	Tol	-22	°C

Source: energylabel.daikin.eu/ie/en_IE/lot10/jcr:content/root/services.json/lot10/datasheet/html?product=FTXTP25M5V1B / RXTP25R2V1B&locale=en_US

Report with market analysis and case studies

Authors

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Commissioned by

energieschweiz	Energieschweiz, a programme by the Swiss Federal Office of Energy, Switzerland
EKZ	EKZ Power Utilities of the Canton of Zurich, Switzerland

Download study (German): https://pubdb.bfe.admin.ch/de/publication/download/11728

Purpose of case studies

Methods

- Documentation of existing installations in various types of buildings, uses (living, working, temporary, vacation homes) and climate zones
- Interviews with users and installers
- If possible, check of electricity bills

Examined points

- Suitability in different buildings / uses
- Suitability for mild (e.g. Ticino) and cold ambient temperatures (e.g. in the mountains)
- Comfort (temperatures, humidity)
- Noise (inside and outside)
- Design solutions for outdoor and indoor units
- Obstacles to obtaining a building permit

Overview 12 case studies

		
Bike repair shop, St. Gallen, 5.1 kW	Single familiy home, Ticino, 22.0 kW	Tiny house, Berne, 4.2 kW
		
Mobile home, Fribourg, 5.2 kW	Mobile home, Fribourg, 4.0 kW	Art atelier, St. Gallen, 6.2 kW

Overview 12 case studies

		
Commercial building, Melano, 13 kW	Single familiy home, Cerentino, 8 kW	Residential building, Ticino, 15 kW
		
Holiday home, Castaneda, 5 kW	Alpine restaurant, Flims, 4 kW	Single familiy home, Grisons, 4 kW

Noise

Inside noise

- The issue of noise was never addressed proactively by interviewees
- Inverter products do not have a pure on-off operation and thus keep the temperature at a constant level with little noise
- Practically all modern products have inverters and silent / night modes
- Noise is primarily noticeable in the initial warm-up phase

Outside noise

- No known complaints from neighbors or residents themselves
- There was no case in which the noise level of the outdoor unit prevented approval/building permits
- Noise protection hoods allow more flexibility in the installation location, e.g. in compact inner cities, in order to meet sound insulation requirements. Expensive, but can reduce noise by up to 10 dB(A)

Construction solutions for outdoor units

- Identical issue as with external parts of conventional heat pumps (i.e. air-water heat pumps)
- Look similar to air-water heat pumps but are usually smaller

Construction solutions for indoor units

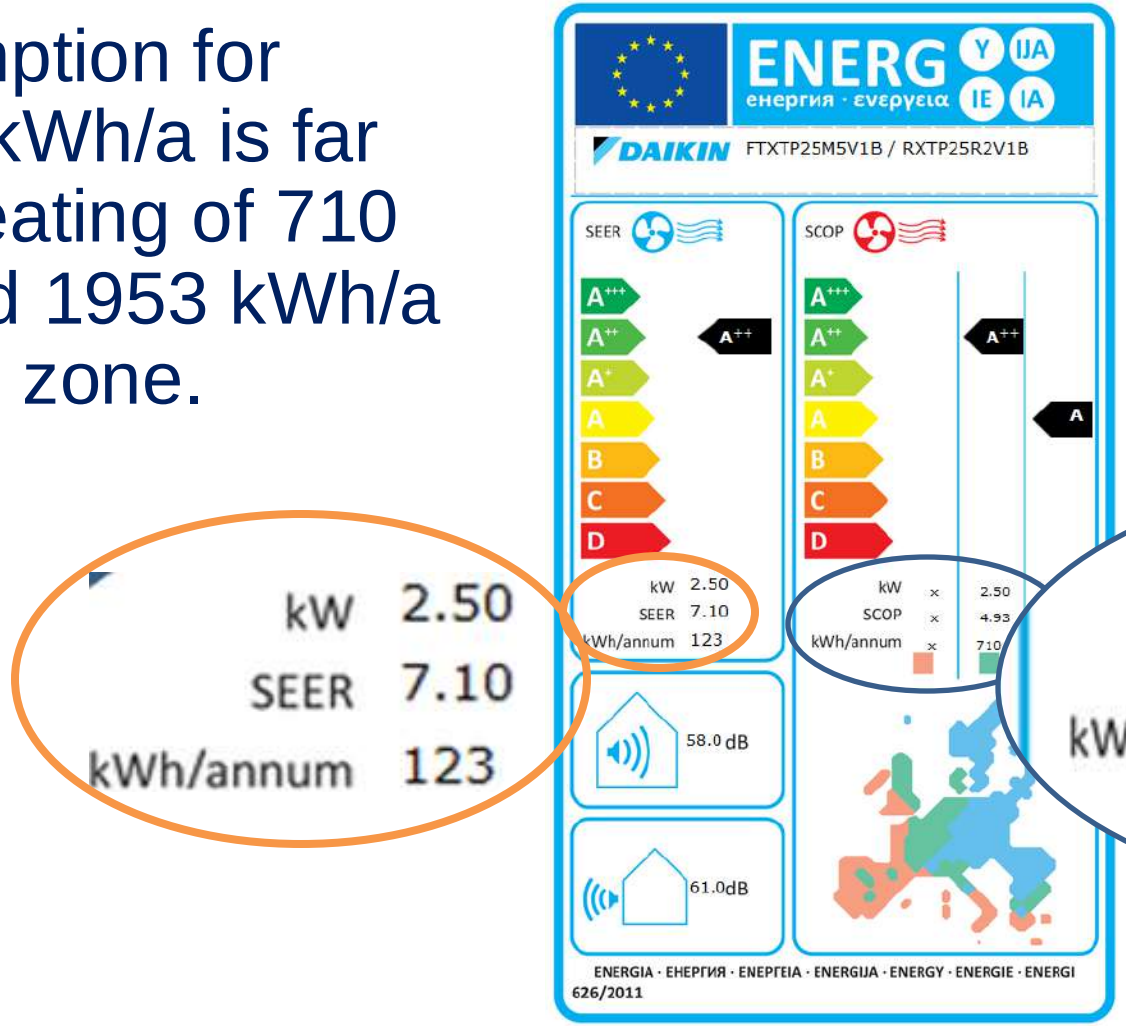
- There are aesthetically good solutions for internal units
- Features: shape + position, colour, discreet routing of lines (power + refrigerant)

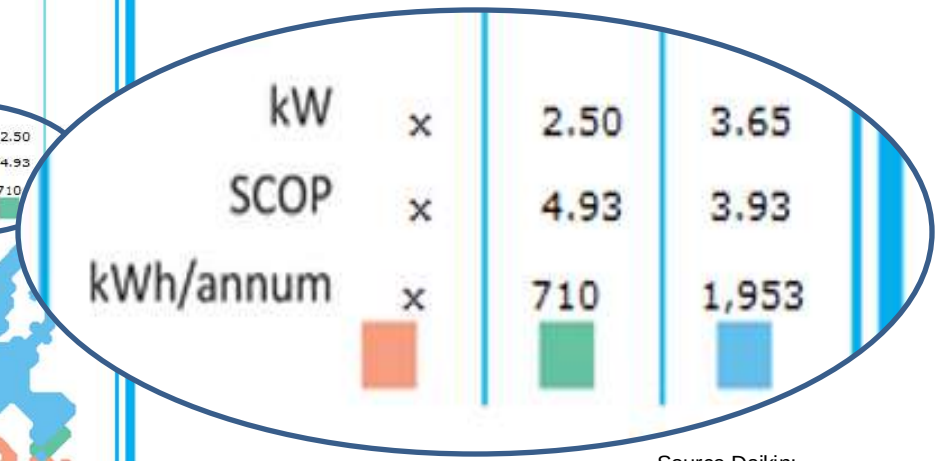
Other experiences from the case studies:

- Obtaining **building permits** followed the usual course as with other heat pumps. There was no “harassment” by authorities, for example, that the cooling requirement would have to be proven, although the installation was intended for heating only, and not for cooling.
- There were no cases in which users stated that the **desired temperatures** were not reached and that they were cold, despite having been installed in areas where very low temperatures are common in winter. The appliances were apparently correctly selected and dimensioned in all cases.
- Another advantage lies in the **fast responsiveness** of the air conditioning units. This is particularly important in cases of irregular use or for buildings with low thermal capacity. On top of this, air conditioning units can react very quickly to solar gains through large windows.
- Overall, the residents and users of the cases analysed, expressed a **high level of satisfaction** with their heating solution and would recommend the heating concept with air conditioning units to others.

What about additional energy use for cooling?

Annual consumption for cooling of 123 kWh/a is far less then for heating of 710 for average and 1953 kWh/a for cold climate zone.





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AC for heating extend range of electric cars

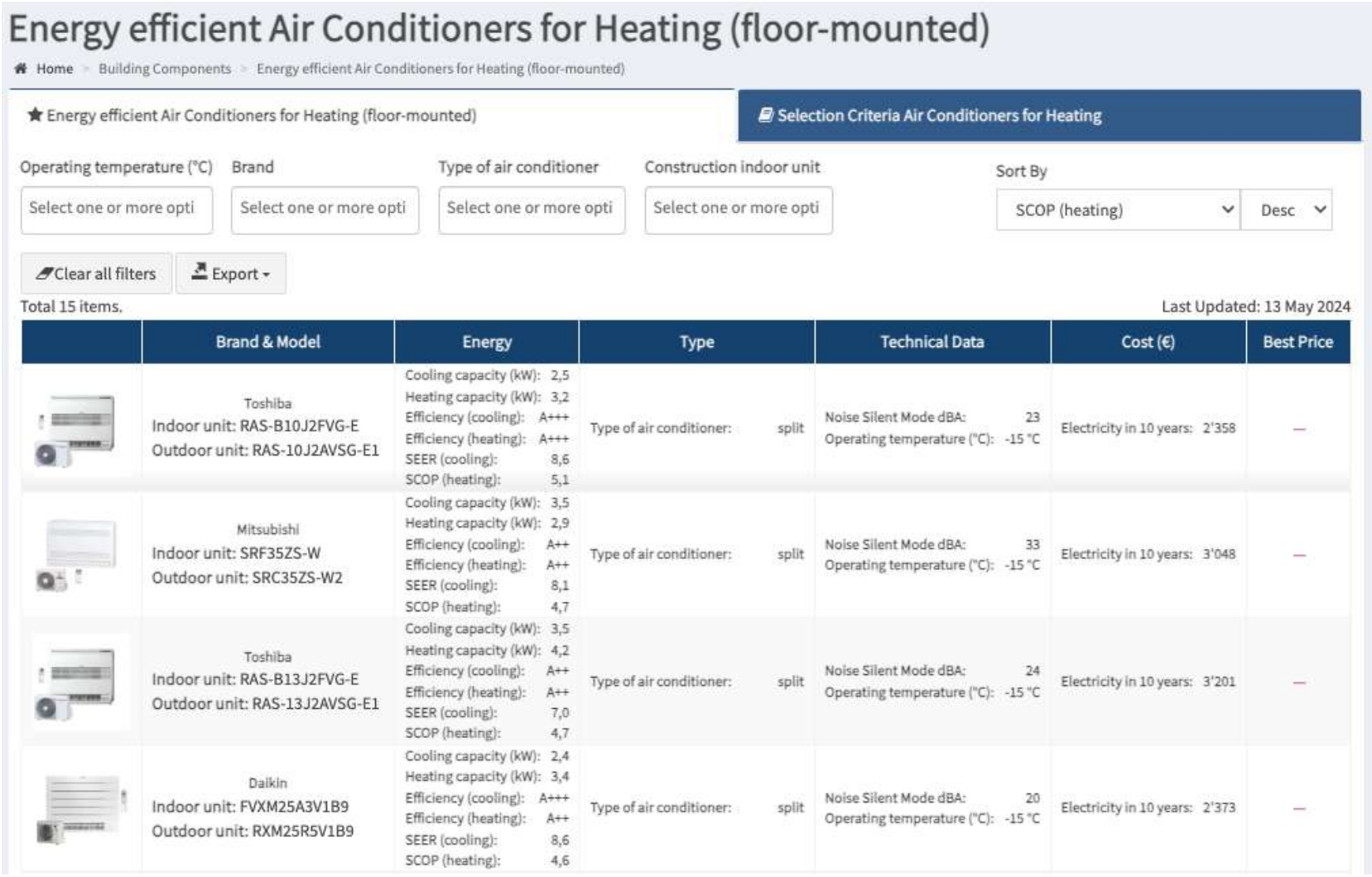
Air-to-air heat pumps are also used in modern electric cars because they increase the range by up to 20% compared to electric cars with electric resistance heating. Tesla was therefore one of the first manufacturers to start installing heat pumps in its Model Y in 2021 and is now doing so across its entire model range.

https://www.youtube.com/watch?v=DyGgrkeds5U

Conclusion & Recommendation

- Air-to-air heat pumps (air conditioners) are a very efficient heating method and require around 4 times less electricity than electric resistance heaters
- Air-to-air heat pumps are still rarely used in many countries like AT, CH, CZ, DE or UK: big untapped savings potential
- We propose information campaigns and subsidy programs to accelerate the dissemination

Product list on topten.eu



Energy efficient Air Conditioners for Heating (floor-mounted)

Home > Building Components > Energy efficient Air Conditioners for Heating (floor-mounted)

★ Energy efficient Air Conditioners for Heating (floor-mounted) | Selection Criteria Air Conditioners for Heating

Operating temperature (°C) | Brand | Type of air conditioner | Construction indoor unit | Sort By: SCOP (heating) Desc

Clear all filters | Export

Total 15 items. Last Updated: 13 May 2024

	Brand & Model	Energy	Type	Technical Data	Cost (€)	Best Price
	Toshiba Indoor unit: RAS-B10J2FVG-E Outdoor unit: RAS-10J2AVSG-E1	Cooling capacity (kW): 2,5 Heating capacity (kW): 3,2 Efficiency (cooling): A+++ Efficiency (heating): A+++ SEER (cooling): 8,6 SCOP (heating): 5,1	Type of air conditioner: split	Noise Silent Mode dBA: 23 Operating temperature (°C): -15 °C	Electricity in 10 years: 2'358	—
	Mitsubishi Indoor unit: SRF35ZS-W Outdoor unit: SRC35ZS-W2	Cooling capacity (kW): 3,5 Heating capacity (kW): 2,9 Efficiency (cooling): A++ Efficiency (heating): A++ SEER (cooling): 8,1 SCOP (heating): 4,7	Type of air conditioner: split	Noise Silent Mode dBA: 33 Operating temperature (°C): -15 °C	Electricity in 10 years: 3'048	—
	Toshiba Indoor unit: RAS-B13J2FVG-E Outdoor unit: RAS-13J2AVSG-E1	Cooling capacity (kW): 3,5 Heating capacity (kW): 4,2 Efficiency (cooling): A++ Efficiency (heating): A++ SEER (cooling): 7,0 SCOP (heating): 4,7	Type of air conditioner: split	Noise Silent Mode dBA: 24 Operating temperature (°C): -15 °C	Electricity in 10 years: 3'201	—
	Daikin Indoor unit: FVXM25A3V1B9 Outdoor unit: RXM25R5V1B9	Cooling capacity (kW): 2,4 Heating capacity (kW): 3,4 Efficiency (cooling): A+++ Efficiency (heating): A++ SEER (cooling): 8,6 SCOP (heating): 4,6	Type of air conditioner: split	Noise Silent Mode dBA: 20 Operating temperature (°C): -15 °C	Electricity in 10 years: 2'373	—

Selection criteria topten.eu

Indoor unit	Air conditioner type	Efficiency class cooling / heating function
Floor standing	Single-split	**A++ / A++**
	Multi-split	**A+ / A+**
Wall mounted	Single-split ≤ 4kW	**A+++ / A+++**
	Single-split > 4kW	**A++ / A++**
	Multi-split	**A++ / A++**

Source:
https://www.topten.eu/private/products/aircon_heating
https://www.topten.eu/private/products/air_conditioners

Air-to-air heat pumps in German building subsidy program

- Federal funding for efficient buildings (KfW, 2024a)
- Installation of efficient heating systems (KfW, 2024b)
- Catalogue of eligible heating technology contains heat pumps:
  Air-to-air heat pumps are explicitly included
- Maximum funding contribution per single-family home: 21'000 Euro

Einzelmassnahme	Grundförderung	Effizienzbonus	Klimageschwindigkeitsbonus	Einkommensbonus	Max. Total
Wärmepumpen	30%	5%	20%	30%	70%

EKZ (Zürich): Subsidy programme planned

- EKZ supply area: 9’846 electric heaters (2020) with electricity consumption of around 140 GWh/year
- Subject of funding: Air-to-air heat pump (i.e. air conditioning unit with at least one external and internal part)
- Efficiency criterion for operation in heating mode: A++
- Installation in the EKZ supply area
- Funding contribution per device: CHF 2’000 (2’400 US$)
- Goal: Simple funding with little administration (lump sum contributions)

Thank you!