KERR Compressor Engineers
Compressors • Vacuum Pumps • Blowers

KAESER COMPRESSORS ®

Heat Recovery Systems

For hot air and hot water applications

www.kerrcompressors.co.uk

Why choose heat recovery?

In fact, the question should be: Why not? Amazingly, virtually 100% of the electrical energy supplied to a rotary screw compressor is converted into heat energy.

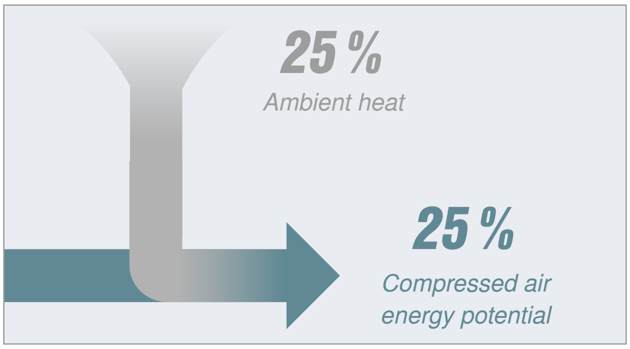
Up to 96% of this energy can be recovered and reused for heating purposes. This not only reduces primary energy consumption, but also significantly improves a company's overall energy balance.

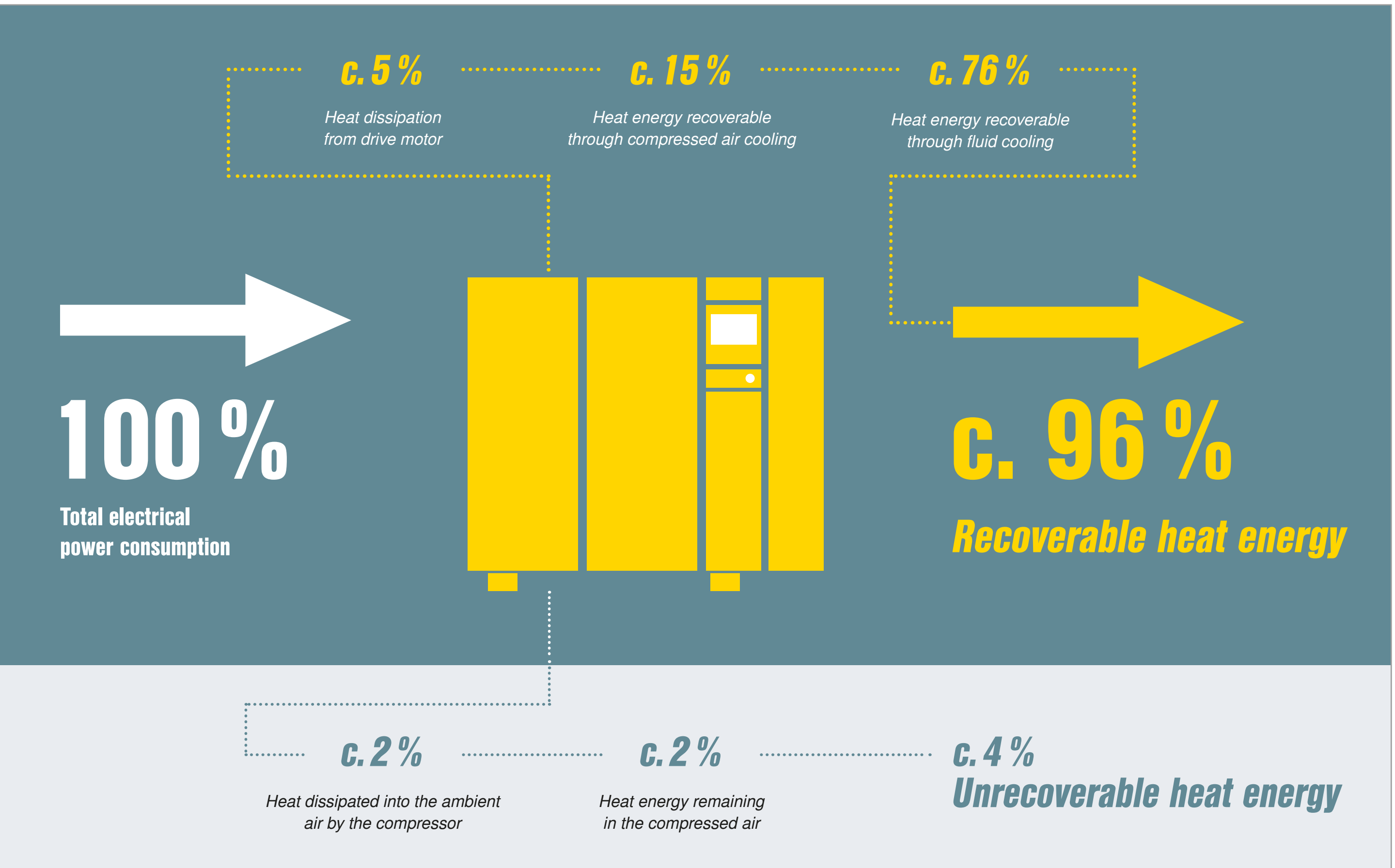
Compressor heat

Rotary screw compressors, boosters and blowers convert almost 100% of the electrical drive energy supplied to them into heat. The heat flow diagram (below) shows how this energy is distributed within the compressor system and how much of it is reusable.

Approximately 96% of the energy input can be recovered for reuse, whilst 2% remains in the compressed air and another 2% is dissipated into the ambient surroundings. But where does the usable energy in compressed air come from?

The answer is actually quite simple and perhaps surprising: during the compression process, the compressor converts electrical drive energy into heat energy. At the same time, it charges the intake air with energy potential. This corresponds to approximately 25% of the compressor's electrical power consumption. However, this energy only becomes usable when the compressed air expands again at its point of consumption and, in doing so, absorbs heat energy from the ambient surroundings. Of course, the amount of energy available for reuse depends on the pressure and leakage losses within the compressed air system.





Save money whilst conserving the environment

Savings

Gas heating
€ 302 to € 83,810/year

Oil heating
€ 304 to € 84,283/year

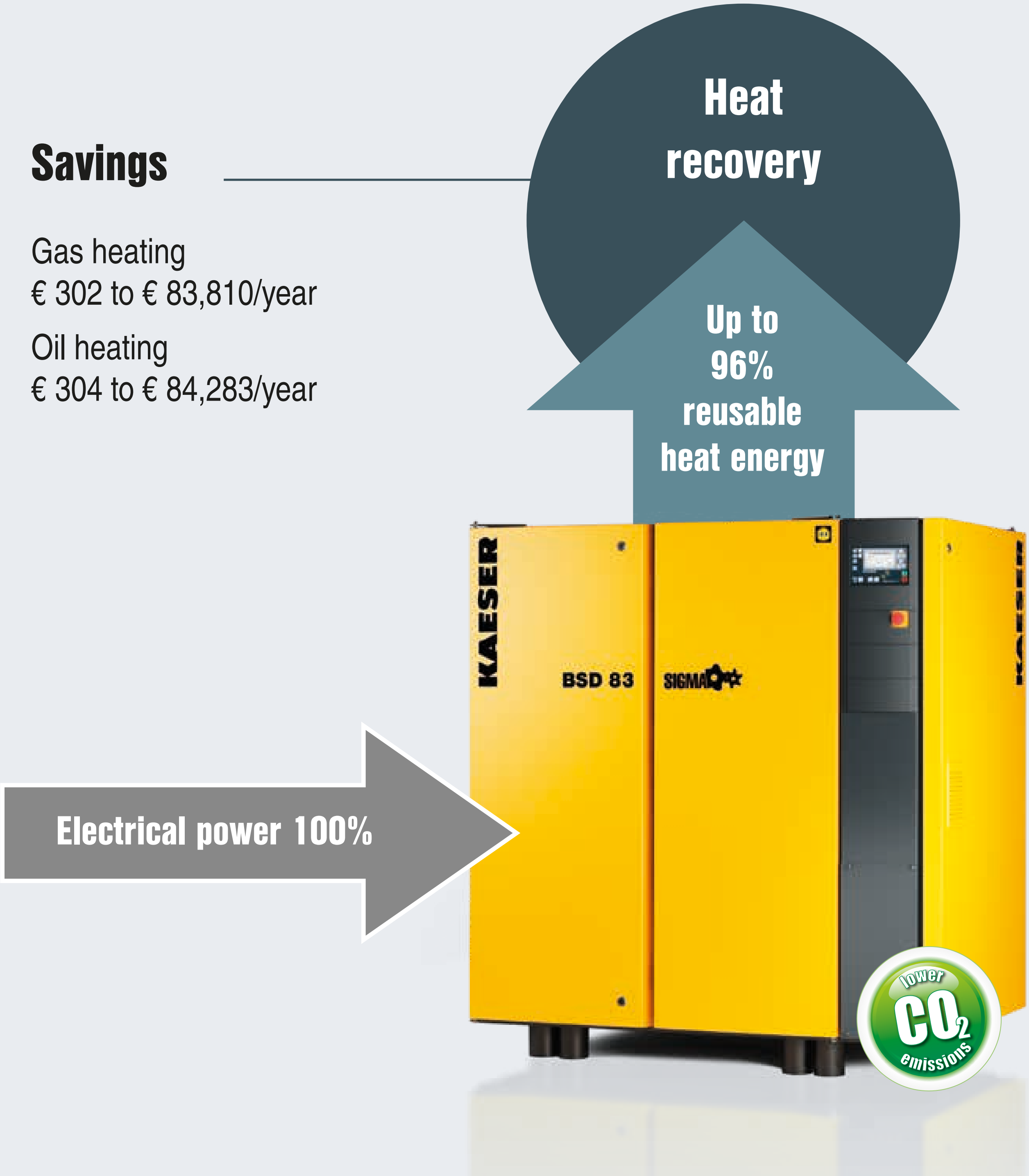


Plate-type heat exchanger systems	Compressor size		
	"Small"	"Medium"	"Large"
Compressor model	SM 16	BSD 83	FSD 475
Drive motor rated power	9 kW	45 kW	250 kW
Potential savings per year: Heating oil	€ 857	€ 9,037	€ 45,522
	4671 kg CO_2	49,285 kg CO_2	248,274 kg CO_2

Image: DN 45 C booster with hot air heat recovery

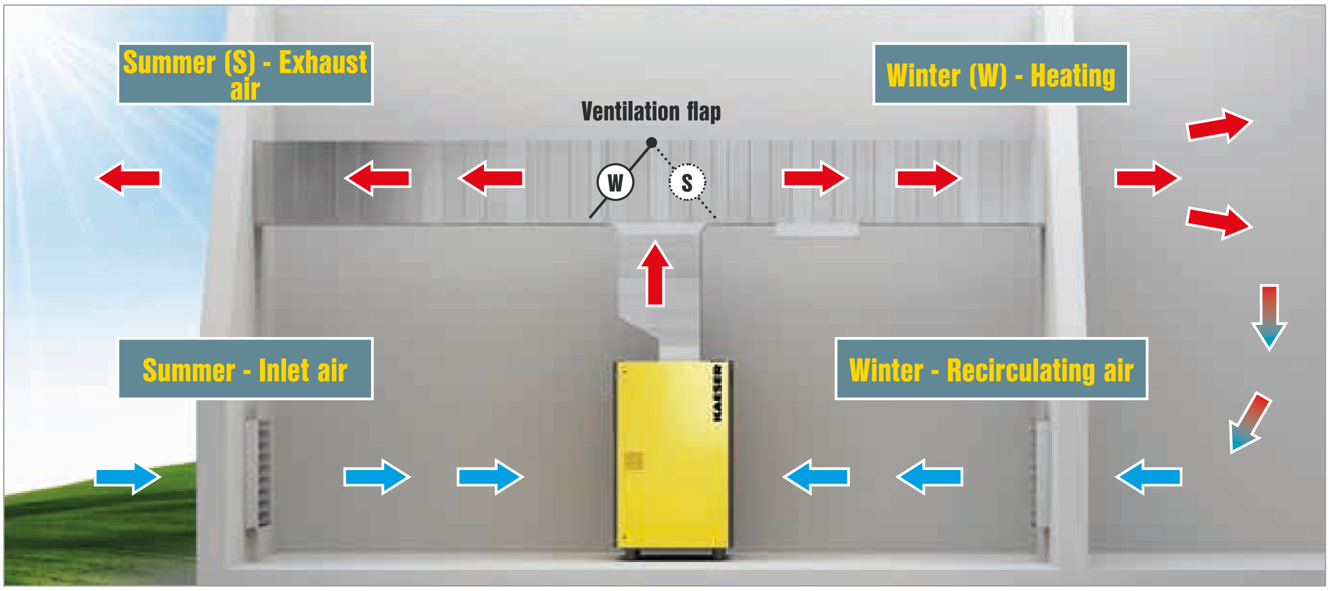
Minimise primary energy consumption for heating

As self-contained complete systems, modern rotary screw compressors, boosters and blowers are especially well suited for heat recovery systems.

In particular, direct usage of the recoverable heat via an exhaust air ducting system enables up to 96% of the total energy input to be recovered and reused.

This is the case regardless of whether a fluid-injecting or a dry-running rotary screw compressor, a booster or a blower is involved.

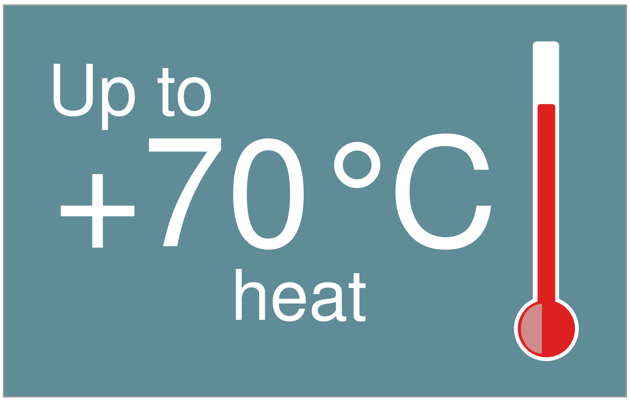
Up to
96 %
usable for heating



Heating with hot air

By using heated cooling air from the compressor, neighbouring spaces can be heated simply and effectively via exhaust air ducting. In this way, up to 96% of the electrical power supplied to a compressor can be reused – either for the purposes of space heating or for use as process heat. When using recovered compressor exhaust heat for space heating purposes, exhaust air ducting simply feeds the heated cooling air to wherever it is needed, thereby allowing such spaces as storage areas or workshops to be heated free of charge. A ventilation flap allows the heated cooling air to be conveyed outside during summer operation (S) or to the areas that require heating during winter operation (W).

Minimise primary energy consumption for process, service and hot water heating



By reusing the exhaust heat from the compressor, heat exchanger systems can provide heating and service water on demand at temperatures up to +70 °C, or even +90 °C if required.

For standard applications using heat recovery systems for the production of hot water and service water, PTG plate-type heat exchangers are used.

Special, fail-safe heat exchangers are used in the case of operations without an interconnected water circuit, or for applications with the highest demands of purity for the heated water, such as with cleaning water in the food industry.

Hot water with temperatures up to +70 °C can easily be produced using a heat exchanger system, with even higher temperatures available upon request.

Use heat energy for your heating systems

Up to 76% of the electrical power originally supplied to a compressor can be recovered for use in hot water heating systems and service water installations. This significantly reduces the amount of primary energy required for heating purposes.

PTG plate-type heat exchanger

High-quality, stainless steel plate-type heat exchangers are the first choice when it comes to using heat recovered from rotary screw compressors for heating process and service water, or for generating process heat.


2
3
4
5


Equipment for rotary screw compressors

Hot air heat recovery

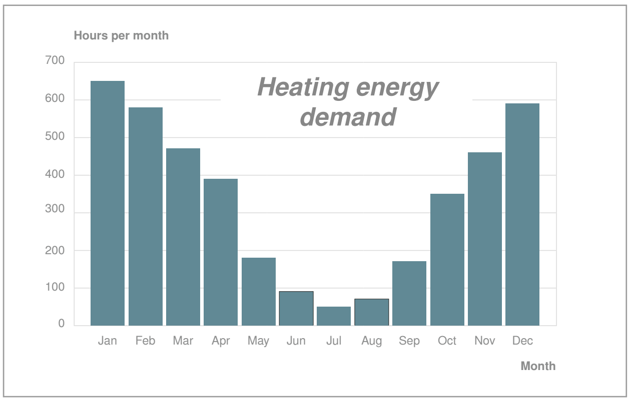
All KAESER rotary screw compressors can be connected to user-end exhaust air ducting, allowing the heated cooling air to be used for the purposes of space heating. Possible applications include drying processes, heating of halls and buildings, air curtain systems and the preheating of burner air.

PTG plate-type heat exchanger system

Rotary screw compressors from the SM series (from 5.5 kW) and upwards can be equipped with PTG systems. Depending on the size of the system, the PTG heat exchanger can either be integrated into the compressor or installed externally. Possible areas of application: Supplying heat for central heating systems, laundry facilities, electroplating, general process heat.
With special, fail-safe heat exchangers: Cleaning water in the food industry, swimming pool heating, hot water for shower and washroom facilities.

Shell and tube heat exchanger

For cases where the cooling water quality is inadequate (e.g. hard, contaminated cooling water or seawater with high salt content), special shell and tube heat exchangers are optionally available. Our compressed air specialists can advise you regarding the right design for your particular application.



Heating – not just needed in winter

It goes without saying that heating is necessary during the winter months. However, it is also required to a greater or lesser extent throughout the year, e.g. for supplying hot water. This means that the energy demand for heating is actually approximately 4000 hours per year.

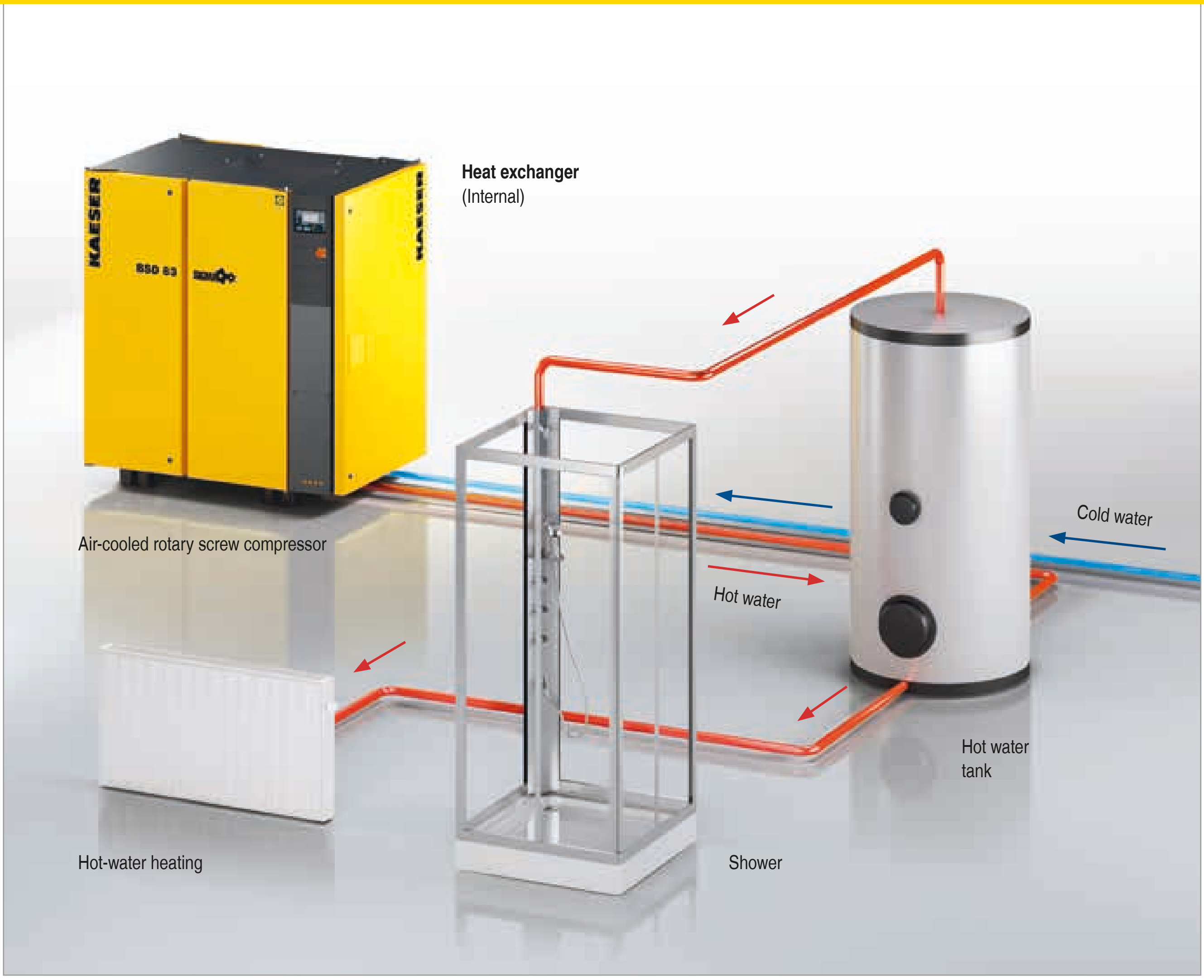


Image: Heat recovery process. Potable water applications only possible in conjunction with special, safety heat exchanger

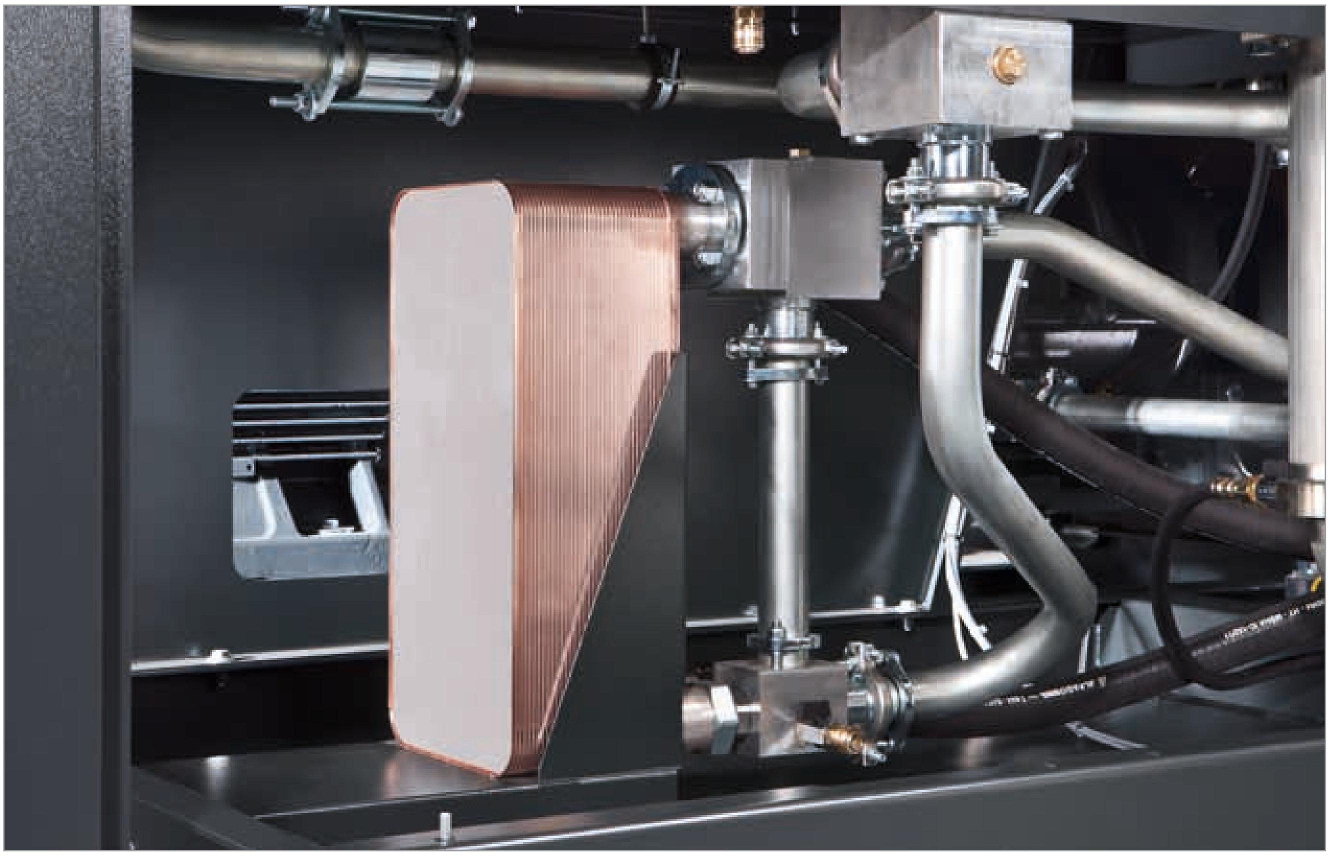


Image: Internal layout of a compressor – system comprising plate-type heat exchanger, thermostatic valve and complete piping

Technical specifications for...

Hot air

Type	At max. gauge pressure	Rated motor power	Maximum available heating capacity		Usable hot air volume	Cooling air heated by	Potential fuel oil savings			Potential natural gas savings		
							Fuel oil	CO_2	Heating cost savings	Natural gas	CO_2	Heating cost savings
	bar	kW	kW	MJ/h [*]	m³/h	K (approx.)	l	kg	€/year	m³	kg	€/year
Savings potential for 2000 hrs/yr												
SX 3	8	2.2	2.7	10	1000	8	608	1658	304	504	1008	302
SX 4		3	3.4	12	1000	10	766	2089	383	635	1270	381
SX 6		4	4.4	16	1000	13	992	2705	496	822	1644	493
SX 8		5.5	6.0	22	1300	14	1352	3687	676	1120	2240	672
SM 10	8	5.5	6.8	25	2100	10	1532	4178	766	1270	2540	762
SM 13		7.5	9.1	33		13	2051	5593	1,026	1699	3398	1,019
SM 16		9	11.1	40		16	2501	6820	1,251	2073	4146	1,244
SK 22	8	11	13.2	48	2500	16	2975	8113	1,488	2465	4930	1,479
SK 25		15	16.5	59	3000	17	3718	10,139	1,859	3081	6162	1,849
ASK 28	8	15	18.4	66	4000	14	4147	11,309	2,074	3436	6872	2,062
ASK 34		18.5	22.8	82	4000	17	5138	14,011	2,569	4258	8516	2,555
ASK 40		22	26.8	96	5000	16	6040	16,471	3,020	5005	10,010	3,003
Savings potential for 4000 hrs/yr												
ASD 35	8.5	18.5	19.9	72	3800	16	8969	24,458	4,485	7432	14,864	4,459
ASD 40		22	23.5	85	3800	19	10,592	28,884	5,296	8777	17,554	5,266
ASD 50		25	28.0	101	4500	19	12,620	34,415	6,310	10,458	20,916	6,275
ASD 60		30	34.6	125	5400	19	15,595	42,528	7,798	12,923	25,846	7,754
BSD 65	8.5	30	35.2	127	6500	16	15,865	43,264	7,933	13,147	26,294	7,888
BSD 75		37	43.4	156	8000	16	19,561	53,343	9,781	16,209	32,418	9,725
BSD 83		45	52.0	187	8000	20	23,437	63,913	11,719	19,421	38,842	11,653
CSD 85	8.5	45	50	179	9400	16	22,445	61,208	11,223	18,599	37,198	11,159
CSD 105		55	62	223	9400	20	27,944	76,203	13,972	23,156	46,312	13,894
CSD 125		75	75	270	10,700	21	33,803	92,181	16,902	28,011	56,022	16,807
CSDX 140	8.5	75	84	302	11,000	23	37,860	103,244	18,930	31,373	62,746	18,824
CSDX 165		90	101	364	13,000	23	45,522	124,138	22,761	37,722	75,444	22,633
DSD 145	9	75	82	295	11,000	22	36,958	100,784	18,479	30,626	61,252	18,376
DSD 175	8.5	90	96	346	13,000	22	43,268	117,992	21,634	35,854	71,708	21,512
DSD 205	8.5	110	120	432	17,000	21	54,085	147,490	27,043	44,818	89,636	26,891
DSD 240	8.5	132	145	522	20,000	22	65,353	178,218	32,677	54,155	108,310	32,493
DSDX 245	8.5	132	143	515	21,000	20	64,451	175,758	32,226	53,408	106,816	32,045
DSDX 305		160	174	626		25	78,423	213,860	39,212	64,986	129,972	38,992
ESD 375	8.5	200	221	796	30,000	22	99,607	271,628	49,804	82,540	165,080	49,524
ESD 445		250	254	914	34,000	22	114,480	312,187	57,240	94,865	189,730	56,919
FSD 475	8.5	250	274	986	40,000	21	123,494	336,768	61,747	102,334	204,668	61,400
FSD 575		315	333	1199		25	150,086	409,285	75,043	124,370	248,740	74,622
HSD 662	8.5	360	21	76	10,000	6	9465	25,811	4,733	7843	15,686	4,706
HSD 722		400	24	86		7	10,817	29,498	5,409	8964	17,928	5,378
HSD 782		450	25	90		7	11,268	30,728	5,634	9337	18,674	5,602
HSD 842		500	28	101		8	12,620	34,415	6,310	10,458	20,916	6,275

[*] 1 MJ/h = 1 kW x 3.6

Savings calculation example for ASD 50

For fuel oil

Maximum available heating capacity:	28.0 kW
Calorific value per litre of fuel oil:	9861 kWh/l
Fuel oil heating efficiency:	90 %
Price per litre of fuel oil:	€ 0.50/l

Cost savings: $\frac{28.0 \text{ kW} \times 4000 \text{ hrs/yr}}{0.90 \times 9861 \text{ kWh/l}} \times € 0.50/\text{l}$ **= € 6,310 per year**

For natural gas

Maximum available heating capacity:	28.0 kW
Calorific value per m³ natural gas:	10.2 kWh/m³
Natural gas heating efficiency:	105 %
Price per m³ of natural gas:	€ 0.60 /m³

Cost savings: $\frac{28.0 \text{ kW} \times 4000 \text{ hrs/yr}}{1.05 \times 10.2 \text{ kWh/m}^3} \times 0.60\ €/\text{m}^3$ **= € 6,275 per year**

Note: The potential energy savings indicated are based on compressors at operating temperature and max. gauge pressure (8.0 / 8.5 / 9.0 bar). At other pressures, values may vary.

...rotary screw compressors

Hot water

Type	At max. gauge pressure	Rated motor power	Maximum available heating capacity		Hot water volume (heating to 70 °C)		PTG system location	Potential fuel oil savings			Potential natural gas savings		
								Fuel oil	CO_2	Heating cost savings	Natural gas	CO_2	Heating cost savings
	bar	kW	kW	MJ/h *)	(ΔT 25 K) m³/h	(ΔT 55 K) m³/h	Int./ext.	l	kg	€/year	m³	kg	€/year
										Savings potential for 2000 hrs/yr			Savings potential for 2000 hrs/yr
SM 10 **SM 13** **SM 16**	8	5.5 7.5 9	4.5 6.2 7.6	16 22 27	0.16 0.21 0.29	0.07 0.10 0.13	External	1014 1397 1713	2765 3810 4671	507 699 857	840 1158 1419	1680 2316 2838	504 695 851
SK 22 **SK 25**	8	11 15	9.4 12.0	34 43	0.32 0.41	0.15 0.19	External	2118 2704	5776 7374	1,059 1,352	1755 2241	3510 4482	1,053 1,345
ASK 28 **ASK 34** **ASK 40**	8	15 18.5 22	13.6 16.9 19.8	49 61 71	0.47 0.58 0.68	0.21 0.26 0.31	Internal	3065 3808 4462	8358 10,384 12,168	1,533 1,904 2,231	2540 3156 3697	5080 6312 7394	1,524 1,894 2,218
										Savings potential for 4000 hrs/yr			Savings potential for 4000 hrs/yr
ASD 35 **ASD 40** **ASD 50** **ASD 60**	8.5	18.5 22 25 30	15.2 18.1 21.6 26.6	55 65 78 96	0.52 0.62 0.74 0.92	0.24 0.28 0.34 0.42	Internal	6851 8158 9735 11,989	18,683 22,247 26,547 32,694	3,426 4,079 4,868 5,995	5677 6760 8067 9935	11,354 13,520 16,134 19,870	3,406 4,056 4,840 5,961
BSD 65 **BSD 75** **BSD 83**	8.5	30 37 45	27.1 33.5 40.1	98 121 144	0.93 1.15 1.38	0.42 0.52 0.63	Internal	12,214 15,099 18,073	33,308 41,175 49,285	6,107 7,550 9,037	10,121 12,512 14,977	20,242 25,024 29,954	6,073 7,507 8,986
CSD 85 **CSD 105** **CSD 125**	8.5	45 55 75	38.6 48.4 58.6	139 174 211	1.33 1.67 2.02	0.60 0.76 0.92	Internal	17,397 21,814 26,412	47,442 59,487 72,026	8,699 10,907 13,206	14,416 18,077 21,886	28,832 36,154 43,772	8,650 10,846 13,132
CSDX 140 **CSDX 165**	8.5	75 90	66 80	238 288	2.30 2.80	1.03 1.25	Internal	29,747 36,057	81,120 98,327	14,874 18,029	24,650 29,879	49,300 59,758	14,790 17,927
DSD 145 **DSD 175** **DSD 205** **DSD 240**	9 8.5 8.5 8.5	75 90 110 132	61 71 88 107	220 256 317 385	2.10 2.40 3.00 3.70	0.96 1.11 1.38 1.68	Internal	27,493 32,000 39,662 48,226	74,973 87,264 108,158 131,512	13,747 16,000 19,831 24,113	22,782 26,517 32,866 39,963	45,564 53,034 65,732 79,926	13,669 15,910 19,720 23,978
DSDX 245 **DSDX 305**	8.5	132 160	105 129	378 464	3.60 4.40	1.64 2.04	Internal	47,324 58,142	129,053 158,553	23,662 29,071	39,216 48,179	78,432 96,358	23,530 28,907
ESD 375 **ESD 445**	8.5	200 250	162 187	583 673	5.60 6.40	2.54 2.93	Internal	73,015 84,283	199,112 229,840	36,508 42,142	60,504 69,841	121,008 139,682	36,302 41,905
FSD 475 **FSD 575**	8.5	250 315	202 246	727 886	7.00 8.50	3.16 3.85	Internal	91,043 110,874	248,274 302,353	45,522 55,437	75,444 91,877	150,888 183,754	45,266 55,126
HSD 662 **HSD 722** **HSD 782** **HSD 842**	8.5	360 400 450 500	291 323 348 374	1048 1163 1253 1346	10.00 11.10 12.00 12.90	4.56 5.06 5.45 5.86	Internal	131,156 145,579 156,847 168,565	357,662 396,994 427,722 459,677	65,578 72,790 78,424 84,283	108,683 120,635 129,972 139,683	217,366 241,270 259,944 279,366	65,210 72,381 77,983 83,810

*) 1 MJ/h = 1 kW x 3.6

Savings calculation example for ASD 50

For fuel oil

Maximum available heating capacity:	21.6 kW
Calorific value per litre of fuel oil:	9861 kWh/l
Fuel oil heating efficiency:	90 %
Price per litre of fuel oil:	€ 0.50/l

Cost savings: $\dfrac{21.6 \text{ kW} \times 4000 \text{ hrs/yr}}{0.9 \times 9861 \text{ kWh/l}} \times € 0.50/\text{l}$ **= € 4,868 per year**

For natural gas

Maximum available heating capacity:	21.6 kW
Calorific value per m³ natural gas:	10.2 kWh/m³
Natural gas heating efficiency:	105 %
Price per m³ of natural gas:	€ 0.60 /m³

Cost savings: $\dfrac{21.6 \text{ kW} \times 4000 \text{ hrs/yr}}{1.05 \times 10.2 \text{ kWh/m}^3} \times 0.60\ €/\text{m}^3$ **= € 4,840 per year**

Note: The potential energy savings indicated are based on compressors at operating temperature and max. gauge pressure (8.0 / 8.5 / 9.0 bar). At other pressures, values may vary.

Heat recovery systems for...

Hot air

The Air-Cooled Aftercooler (ACA) is an air/air heat exchanger. Process air is cooled in a cross-flow process, whereby ambient air is heated via a thermal energy exchange. In terms of a medium supply, only an electrical connection for the fan is needed. At an ambient temperature of +20 °C, for example, the process air flowing into the cooler can be cooled down from +150 °C to +30 °C. The ACA offers particular advantages when it comes to the pneumatic conveying of temperature-sensitive bulk materials. Furthermore, should a production hall need to be heated during the winter, the ACA can do that as well. The exhaust air flow from the cooler contains up to 75% of the electrical power in the form of blower heat. To maximise the energy gain and ensure optimum cooling efficiency, the maximum pressure loss is no more than 35 mbar. An integrated thermostat monitors operation of the unit by detecting the process air discharge temperature and activates a floating contact by means of an adjustable trigger point.

Application examples

- Cooling of process air from blowers, e.g. for bulk materials conveying
- Space heating for production halls

Hot water

The water-cooled WRN aftercooler is a shell and tube heat exchanger. With this system, the process air passes through multiple cooling pipes, around which water flows. The water serves as both a cooling and a heat transfer medium. This type of heat exchanger is individually customised for each project, so as to ensure that the drop in process air temperature and the increase in water temperature match the operator’s requirements precisely. In order to minimise pressure loss resulting from the additional power consumption of the blower and to achieve maximum heat transfer, a variety of cooling pipe geometries are used. Furthermore, several different materials can be used for the cooling pipes, depending on the quality of the water supply. The cooler shrouding is enamel coated. The maximum achievable water temperature for the return flow is approx. 5 K below the process air inlet temperature inside the heat exchanger.

Application examples

- Integration into heating circuits to raise return air temperature
- Integration into heat pump circuits
- Floor heating
- Sludge drying

...blowers

Image: DC 236 C with ACA compressed air aftercooler

Image: FBS 660 S SFC with shell and tube heat exchanger

Technical specifications:
Heat recovery systems...

Hot air

Model	Max. process air flow rate Nm³/min	Max. pressure loss mbar	Max. fan flow rate *) m³/h	Fan power supply (400V) A	Fan power *) W	Total mass kg	Dimensions W x D x H mm	Connection nominal width DN
ACA 53	5	15	1700	0.24	110	58	980 x 650 x 610	50
ACA 88	7	25	1700	0.24	110	58	980 x 650 x 610	65
ACA 130	12	25	3100	0.43	210	97	980 x 650 x 610	80
ACA 165	14	30	3100	0.43	210	97	980 x 650 x 610	100
ACA 235	22	30	6200	0.43 (2x)	210	193	1900 x 850 x 1200	100
ACA 350	30	35	6200	0.43 (2x)	210	199	1900 x 850 x 1280	150

*) at max. compression

Savings calculation example for ACA 350 (production hall heating)

Blower (37 kW)	
Flow rate:	30 m³/min
Pressure differential:	600 mbar
Inlet temperature:	0 °C
Discharge temperature:	+52 °C

ACA 350	
Heat output:	25 kW
Air heating capacity:	2200 m³/h from 0 to +35 °C
Process air pressure loss:	35 mbar = 2.2 kW

Cost savings approx. € 5,600 per year*

* Calculation as per rotary screw compressors

...for blowers

Hot water

Model	Nominal width	V max (air)	V max (H_2O)	Connection dimensions		Dimensions		Weight
		Nm³/min	m³/h	Air	Water	∅ Shrouding	Length *)	kg
WRN 50 smooth	125	15	1	DN 125, PN 16	1 ¼	168	1410	71
WRN 90 smooth	200	30	1.5	DN 200, PN 16	1 ¼	245	1430	145
WRN 130 smooth	250	42	2	DN 250, PN 10	1 ½	273	1441	225
WRN 170 smooth	300	57	2.5	DN 300, PN 10	2	324	1441	280
WRN 250 smooth	350	75	3	DN 350, PN 10	DN 65, PN 16	375	1641	400
WRN 350 smooth	450	108	3.5	DN 450, PN 10	DN 80, PN 16	450	1649	590
WRN 450 smooth	500	145	4.5	DN 500, PN 10	DN 100, PN 16	519	1655	690

*) With welded counterflange (included in scope of delivery)

Savings calculation example for WRN 170 (supplementary heating)

Blower (37 kW)	
Flow rate:	30 m³/min
Pressure differential:	600 mbar
Inlet temperature:	0 °C
Discharge temperature:	+52 °C

WRN 170	
Heat output:	14 kW
Water heating capacity:	600 l/h water from +25 °C to +45 °C
Process air pressure loss:	20 mbar = 2 kW (approx. 1.2 kW more at blower)

Cost savings approx. € 3,150 per year*

* Calculation as per rotary screw compressors

The world is our home

As one of the world's largest manufacturers of compressors, blowers and compressed air systems, KAESER KOMPRESSOREN is represented throughout the world by a comprehensive network of branches, subsidiaries and authorised distribution partners in over 140 countries.

By offering innovative, efficient and reliable products and services, KAESER KOMPRESSOREN's experienced consultants and engineers work in close partnership with customers to enhance their competitive edge and to develop progressive system concepts that continuously push the boundaries of performance and technology. Moreover, decades of knowledge and expertise from this industry-leading systems provider are made available to each and every customer via the KAESER group's advanced global IT network.

These advantages, coupled with KAESER's worldwide service organisation, ensure that every product operates at peak performance at all times, whilst providing maximum availability.

KERR Compressor Engineers
Compressors • Vacuum Pumps • Blowers

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