



Heat recovery

For hot air and hot water applications

Why recover heat?

The question should in fact be: Why not? Amazingly, 100 percent of the (electrical) energy input to a compressor is converted into heat. Up to 96 % of that energy can be reused for heating purposes. This not only reduces primary energy consumption, but also significantly improves the total energy balance.

Heat in the compressor

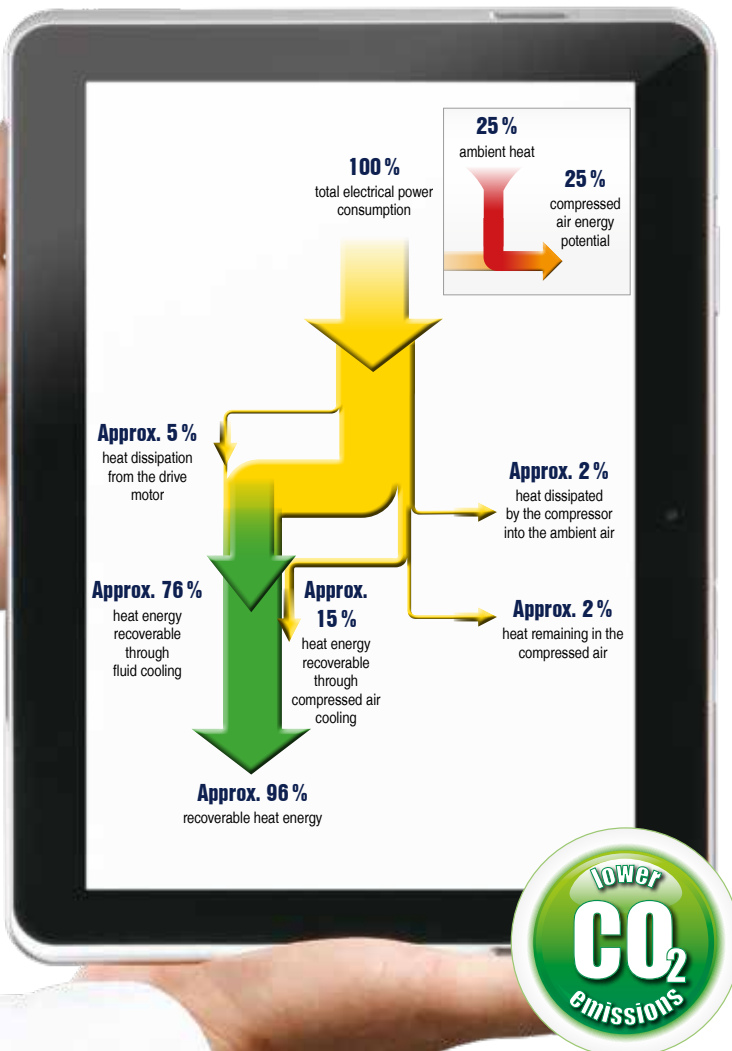
Amazingly, almost 100 percent of the electrical drive energy input to a rotary screw compressor is converted into heat.

The adjacent **heat flow diagram** (left) shows how this energy is distributed throughout the compressor system and how it can be recovered:

Approximately 96 percent of the energy can be recovered for reuse, two percent remains in the compressed air and two percent radiates away from the compressor package into the ambient surroundings. So where does the usable energy in compressed air come from?

The answer is actually quite simple and perhaps surprising: during the compression process and conversion of the electrical drive energy into heat, the compressor charges the air it draws in with energy potential. This corresponds to approximately 25 percent of the compressor's electrical power consumption. This energy is only usable however once the compressed air expands at its point of use and in so doing absorbs heat energy from the ambient surroundings. Of course the amount of this energy that is available for use depends on the pressure and leakage losses within the compressed air system.

► See pages 10 and 11 for details regarding calculation of savings potential.



Saves money and benefits the environment

Savings

Gas heating
€ 284 to € 52,381/year

Oil heating
€ 274 to € 50,570/year

**Heat
recovery**

**Up to
96 %
reusable
heat energy**

Electrical power



For plate-type heat exchanger systems	Compressor size		
	"Small"	"Medium"	"Large"
Compressor model	SM 15	BSD 83	FSD 475
Motor rated capacity	9 kW	45 kW	250 kW
Potential savings per year: heating oil	842 €	5,422 €	27,313 €
	3,826 kg CO ₂	24,644 kg CO ₂	124,138 kg CO ₂

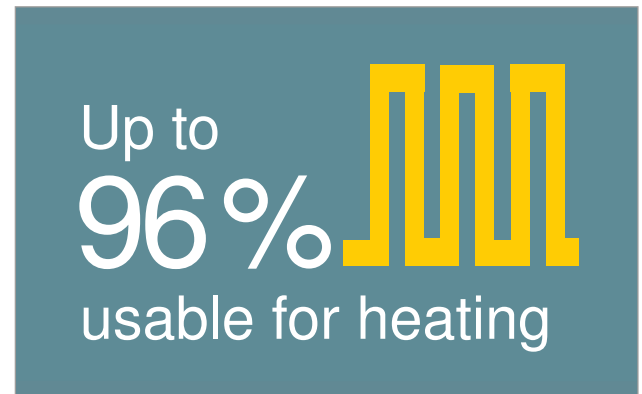


Minimise primary energy consumption for heating

The enclosed, compact design of modern rotary screw compressors makes them especially suitable for heat recovery.

Direct use of the recyclable heat via a ducting system enables up to 96 % of the compressor's total energy requirement to be recovered and used for heating purposes.

This is the case irrespective of whether fluid-injection cooled compressors or dry-running screw compressors are used.



Heat recovery a win

Amazingly, 100 percent of the electrical energy input to a compressor is converted into heat. From that, up to 96 percent is available for heat recovery purposes. Use this potential to your advantage!



Heating with hot air

Warmed compressor cooling air can be ducted away to provide highly effective space heating. With this method, up to 96 percent of the compressor's input energy can therefore be recovered as heat – either for space heating or for use as process heat.



Heat adjacent rooms

When using recyclable heat for space heating, ducting simply feeds the warmed cooling air to where it is needed, e.g. adjacent facilities, such as warehouses or workshops.

Minimise energy consumption for warming of process, heating and service water

Using recyclable heat from the compressor, heat exchanger systems can provide on-demand heating and service water warmed to temperatures up to 70 °C, or even 90 °C, depending on requirement.

Conventional warming of heating and service water using recyclable heat is performed by PTG plate heat exchanger systems.

Special fail-safe heat exchangers are recommended for applications that have no other interconnecting water circuits and where it is essential that the water being warmed remains uncontaminated, as is the case with cleaning-water in the food industry for example.



Process, heating and service water

Hot water – up to 70 °C – can be produced from reusable compressor heat via PWT heat exchanger systems. Please contact KAESER regarding higher temperature requirements.



Feed heat energy to a heating system

Up to 76 percent of the original input energy for the compressor system can be recovered for use in hot water heating systems and service water installations. This significantly reduces primary energy demand required for heating purposes.



PTG plate heat exchanger

High quality plate-type heat exchangers are the first choice when it comes to using recyclable heat from rotary screw compressors for warming process and service water, or for process heat production.



Equipment

Hot air heat recovery

All KAESER-rotary screw compressors can be fitted with exhaust ducting. The ducting is installed on-site. Adjacent rooms and warehouse space, for example, can be heated with the warmed cooling air. Application: Drying processes, heating of halls and buildings, air curtain systems, pre-heating of burner air.



PTG plate heat exchanger system

Rotary screw compressors from the SM series (from 5.5 kW) upwards can be equipped with PTG systems. Depending on the size of the compressor system, the PTG heat exchanger is either integrated within the unit or is installed externally. Fields of application: Feed into central heating systems, laundries, electroplating, general process heating, cleaning water in the food industry, swimming pool heating, hot water for shower and washroom facilities

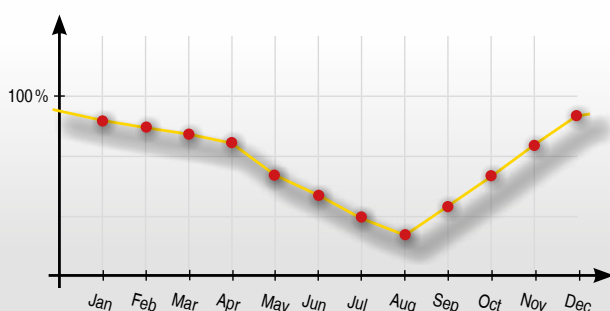


Tube-type heat exchanger

Depending on the available water quality, either integrated plate or tube-type heat exchangers can be used in water-cooled systems. Our compressed air specialists can advise you about which design is right for your particular application.

Required heating energy over the course of a year

Required heating energy (%)



Heat is not only needed in winter

It goes without saying that heating is necessary during the winter months, but it is also required for significant periods at other times of the year, such as in spring and autumn. This means that heating energy is actually required for approximately 2000 hours per year.

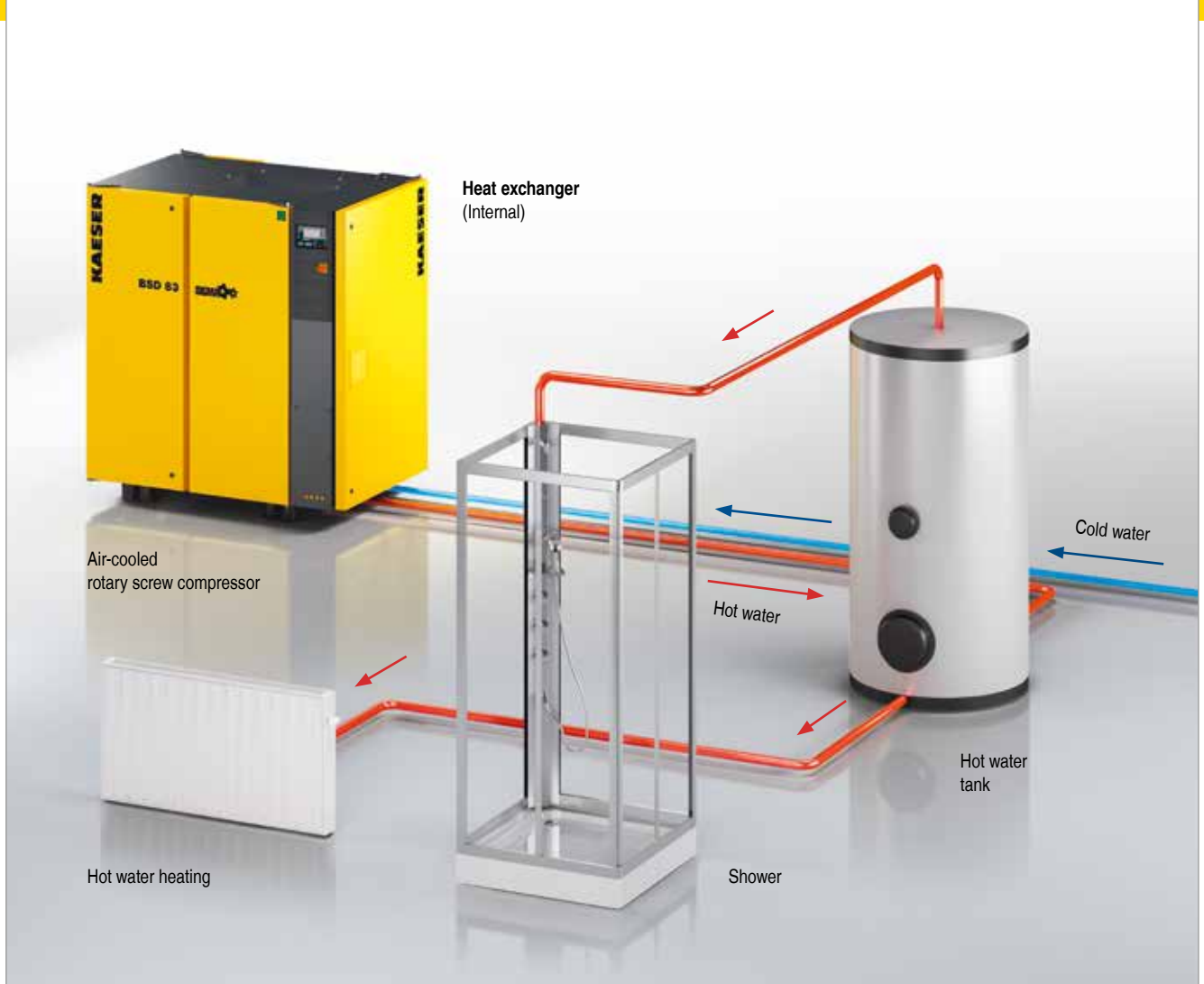


Image: Heat recovery process. Applications for potable water possible only in conjunction with safety heat exchanger (SWT)



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

Technical specifications

Savings through hot air heat recovery

Type	At max. gauge pressure	Motor rated capacity	Maximum available heating capacity		Amount of reusable hot air	Amount cooling air is heated	Potential fuel oil savings			Potential natural gas savings		
			kW	MJ/h			Fuel oil	CO ₂	Heating cost savings	Natural gas	CO ₂	Heating cost savings
	bar	kW			m³/h	K (approx.)	l	kg	€/Year	m³	kg	€/Year
SX 3	8	2.2	2.7	10	1000	8	456	1244	274	378	756	284
SX 4		3	3.4	12	1000	10	575	1568	345	476	952	357
SX 6		4	4.4	16	1000	13	744	2029	446	616	1232	462
SX 8		5.5	6.0	22	1300	14	1014	2765	608	840	1680	630
SM 9	8	5.5	6.8	25	2100	10	1149	3133	689	952	1904	714
SM 12		7.5	9.0	32		13	1521	4148	913	1261	2522	946
SM 15		9	11.8	43		17	1994	5438	1,196	1653	3306	1,240
SK 22	8	11	13.2	48	2500	16	2231	6084	1,339	1849	3698	1,387
SK 25		15	16.5	59	3000	17	2789	7606	1,673	2311	4622	1,733
ASK 28	8	15	18.4	66	4000	14	3110	8481	1,866	2577	5154	1,933
ASK 34		18.5	22.8	82	4000	17	3854	10510	2,312	3193	6386	2,395
ASK 40		22	26.8	96	5000	16	4530	12353	2,718	3754	7508	2,816
ASD 35	8.5	18.5	20.2	73	3800	16	4552	12413	2,731	3772	7544	2,829
ASD 40		22	23.8	86	3800	19	5363	14625	3,218	4444	8888	3,333
ASD 50		25	28.3	102	4500	19	6378	17393	3,827	5285	10570	3,964
ASD 60		30	34.9	126	5400	19	7865	21448	4,719	6517	13034	4,888
BSD 65	8.5	30	35.2	127	6500	16	7932	21631	4,759	6573	13146	4,930
BSD 75		37	43.4	156	8000	16	9780	26670	5,868	8105	16210	6,079
BSD 83		45	52.0	187	8000	20	11718	31955	7,031	9711	19422	7,283
CSD 85	8.5	45	50	179	9400	16	11223	30605	6,734	9300	18600	6,975
CSD 105		55	62	223	9400	20	13972	38102	8,383	11578	23156	8,684
CSD 125		75	75	270	10700	21	16902	46092	10,141	14006	28012	10,505
CSDX 140	8.5	75	84	302	11000	23	18930	51622	11,358	15686	31372	11,765
CSDX 165		90	101	364	13000	23	22761	62069	13,657	18861	37722	14,146
DSD 145	9	75	82	295	11000	22	18479	50392	11,087	15313	30626	11,485
DSD 175	8.5	90	96	346	13000	22	21634	58996	12,980	17927	35854	13,445
DSD 205	8.5	110	120	432	17000	21	27043	73746	16,266	22409	44818	16,807
DSD 240	8.5	132	145	522	20000	22	32676	89107	19,606	27077	54154	20,308
DSDX 245	8.5	132	143	515	21000	20	32226	87880	19,336	26704	53408	20,028
DSDX 305		160	176	634		25	39662	108158	23,797	32866	65732	24,650
ESD 375	8.5	200	221	796	30000	22	49803	135813	29,882	41270	82540	30,953
ESD 445		250	254	914	34000	22	57240	156093	34,344	47432	94864	35,574
FSD 475	8.5	250	274	986	40000	21	61747	168384	37,048	51167	102234	38,375
FSD 575		315	333	1199		25	75043	204642	45,026	62185	124370	46,639
HSD 662	8.5	360	21	74	10000	6	4642	12659	2,785	3847	7694	2,885
HSD 722		400	23	82		7	5116	13951	3,070	4239	8478	3,179
HSD 782		450	25	88		7	5521	15056	3,313	4575	9150	3,431
HSD 842		500	26	94		8	5904	16100	3,542	4893	9786	3,670

Calculation example for ASD 35

For fuel oil	
maximum available heating capacity:	20.2 kW
Fuel value per litre of fuel oil:	9.861 kWh/l
Fuel oil heating efficiency:	0.9
Price per litre of fuel oil:	€ 0.60/l (1 kW = 1 MJ/h x 3.6)
Cost savings:	$\frac{20.2 \text{ kW} \times 2000 \text{ h}}{0.9 \times 9.861 \text{ kWh/l}} \times € 0.60/l = € 2,731 \text{ per year}$

For natural gas	
maximum available heating capacity:	20.2 kW
Fuel value per m³ natural gas:	10.2 kWh/m³
Natural gas heating efficiency:	1.05
Price per m³ of natural gas:	€ 0.75/l (1 kW = 1 MJ/h x 3.6)
Cost savings:	$\frac{20.2 \text{ kW} \times 2000 \text{ h}}{1.05 \times 10.2 \text{ kWh/m}^3} \times € 0.75/l = € 2,829 \text{ per year}$

Note: The highlighted potential energy savings are based on 8 / 8.5 / 9 bar compressors at operational temperature and at max. working pressure. Values may differ for other pressures.

Savings with PTG plate heat exchanger system

Type	At max. gauge pressure	Motor rated capacity	Maximum available heating capacity		Heated water volume Heated to 70 °C		Installation of the PTG system	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
SM 9	8	5.5	4.6	17	0.16	0.07	External	777	2119	Savings potential for 1500 hrs 466	644	1288	Savings potential for 1500 hrs 483
SM 12		7.5	6.2	22	0.21	0.10		1048	2858		868	1736	
SM 15		9	8.3	30	0.29	0.13		1403	3826		1162	2324	
SK 22	8	11	9.4	34	0.32	0.15	External	1589	4333	953	1317	2634	988
SK 25		15	12.0	43	0.41	0.19		2028	5530		1681	3362	
ASK 28	8	15	13.6	49	0.47	0.21	Internal	2299	6269	Savings potential for 1500 hrs 1,379	1905	3810	Savings potential for 1500 hrs 1,429
ASK 34		18.5	16.9	61	0.58	0.26		2856	7788		2367	4734	
ASK 40		22	19.8	71	0.68	0.31		3347	9127		2773	5546	
ASD 35	8.5	18.5	15.2	55	0.52	0.24	Internal	3425	9340	Savings potential for 2000 hrs 2,055	2838	5676	Savings potential for 2000 hrs 2,129
ASD 40		22	18.1	65	0.62	0.28		4079	11123		3380	6760	
ASD 50		25	21.6	78	0.74	0.34		4868	13275		4034	8068	
ASD 60		30	26.6	96	0.92	0.42		5994	16346		4967	9934	
BSD 65	8.5	30	27.1	98	0.93	0.42	Internal	6107	16654	3,664	5061	10122	3,796
BSD 75		37	33.5	121	1.15	0.52		7549	20586		6256	12512	
BSD 83		45	40.1	144	1.38	0.63		9037	24644		7488	14976	
CSD 85	8.5	45	38.6	139	1.33	0.60	Internal	8699	23722	Savings potential for 2000 hrs 5,219	7208	14416	Savings potential for 2000 hrs 5,406
CSD 105		55	48.4	174	1.67	0.76		10907	29743		9038	18076	
CSD 125		75	59.0	212	2.03	0.92		13296	36258		11018	22036	
CSDX 140	8.5	75	66	238	2.30	1.03	Internal	14873	40559	8,924	12325	24650	9,244
CSDX 165		90	80	288	2.80	1.25		18028	49162		14939	29878	
DSD 145	9	75	61	220	2.10	0.96	Internal	13747	37488	Savings potential for 2000 hrs 8,248	11391	22782	Savings potential for 2000 hrs 8,543
DSD 175	8.5	90	71	256	2.40	1.11		16000	43632		13259	26518	
DSD 205	8.5	110	88	317	3.00	1.38		19831	54079		16433	32866	
DSD 240	8.5	132	107	385	3.70	1.68		24113	65756		19981	39962	
DSDX 245	8.5	132	105	378	3.60	1.64	Internal	23662	64526	Savings potential for 2000 hrs 14,197	19608	39216	Savings potential for 2000 hrs 14,706
DSDX 305		160	130	468	4.50	2.04		29296	79890		24276	48552	
ESD 375	8.5	200	162	583	5.6	2.54	Internal	36507	99555	21,904	30252	60504	22,689
ESD 445		250	187	673	6.4	2.93		42141	114919		34921	69842	
FSD 475	8.5	250	202	727	7.0	3.16	Internal	45522	124138	27,313	37722	75444	28,292
FSD 575		315	246	886	8.5	3.85		55437	151177		45938	91876	
HSD 662	8.5	360	291	1048	10.0	4.56	Internal	65578	178831	Savings potential for 2000 hrs 39,347	54342	108684	Savings potential for 2000 hrs 40,757
HSD 722		400	323	1163	11.1	5.06		72790	198498		60317	120634	
HSD 782		450	348	1253	12.0	5.45		78423	213860		64986	129972	
HSD 842		500	374	1346	12.9	5.86		84283	229840		69841	139682	

Calculation example for ASD 35

For fuel oil		For natural gas	
maximum available heating capacity:	15.2 kW	maximum available heating capacity:	15.2 kW
Fuel value per litre of fuel oil:	9.861 kWh/l	Fuel value per m³ natural gas:	10.2 kWh/m³
Fuel oil heating efficiency:	0.9	Natural gas heating efficiency:	1.05
Price per litre of fuel oil:	€ 0.60/l (1 kW = 1 MJ/h x 3.6)	Price per m³ of natural gas:	€ 0.75/l (1 kW = 1 MJ/h x 3.6)
Cost savings:	$\frac{15.2 \text{ kW} \times 2000 \text{ h}}{0.9 \times 9.861 \text{ kWh/l}} \times € 0.60/l = € 2,055 \text{ per year}$		$\frac{15.2 \text{ kW} \times 2000 \text{ h}}{1.05 \times 10.2 \text{ kWh/m}^3} \times € 0.75/l = € 2,129 \text{ per year}$

Note: The highlighted potential energy savings are based on 8 / 8.5 / 9 bar compressors at operational temperature and at max. working pressure. Values may differ for other pressures.

The world is our home

As one of the world's largest compressed air system providers and compressor manufacturers, KAESER KOMPRESSOREN is represented throughout the world by a comprehensive network of branches, subsidiary companies and authorised partners in over 140 countries.

With innovative products and services, KAESER KOMPRESSOREN's experienced consultants and engineers help customers to enhance their competitive edge by working in close partnership to develop progressive system concepts that continuously push the boundaries of performance and compressed air efficiency.

Moreover, the decades of knowledge and expertise from this industry-leading system provider are made available to each and every customer via the KAESER group's global computer network.

These advantages, coupled with KAESER's worldwide service organisation, ensure that every product operates at the peak of its performance at all times and provides maximum availability.



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