KAESER COMPRESSORS

Heat recovery for hot air and hot water applications

Heat recovery

Why recover heat?

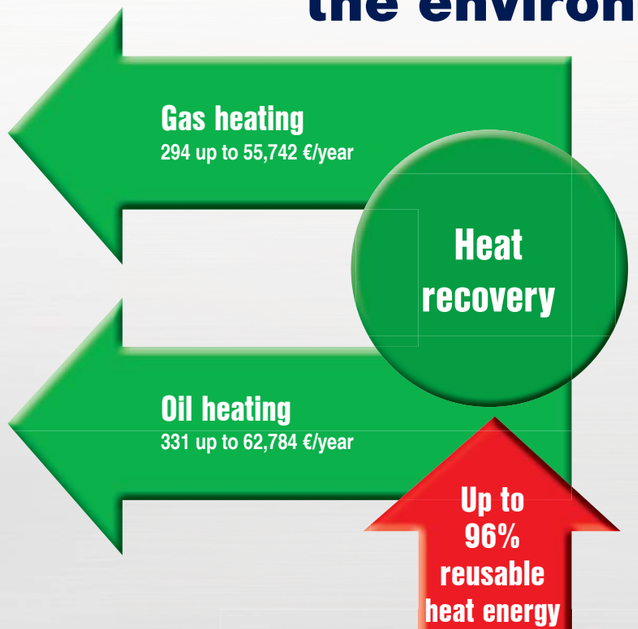
The question should in fact be: Why not? Amazingly, 100 percent of the (electrical) energy input to a compressor is converted into heat. Up to 96 % of this energy can be recovered and reused for space heating or hot water production purposes. This not only reduces primary energy consumption, but also 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.

Saves money and benefits the environment



For plate heat exchanger systems	Compressor size		
	"Small"	"Medium"	"Large"
Compressor model	SM 15	BSD 83	FSD 471
Rated power	9 kW	45 kW	250 kW
Annual savings potential with fuel oil	€ 982	€ 6,326	€ 33,916
	3,826 kg CO_2	24,644 kg CO_2	132,126 kg CO_2

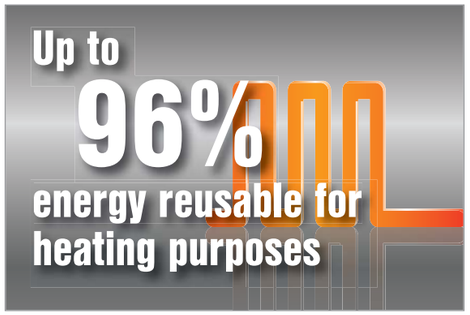
► See pages 10 and 11 for details regarding calculation of savings potential.

KAESER COMPRESSORS

Heat recovery

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 percent 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

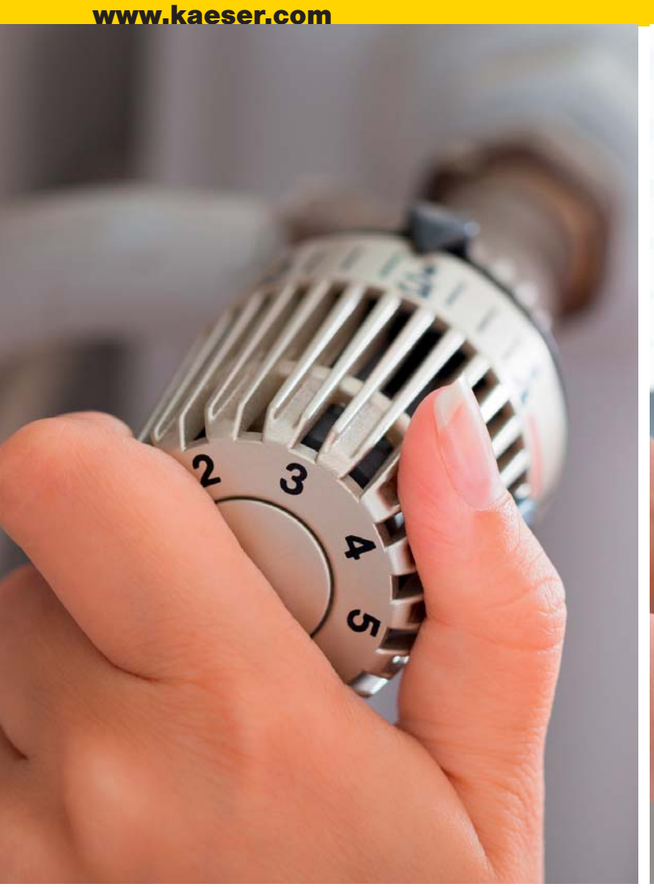
Amazingly, 100 percent of the electrical drive energy input to a compressor is converted into heat. From that, up to 96 percent is available for heat recovery purposes. Use this potential to your advantage!

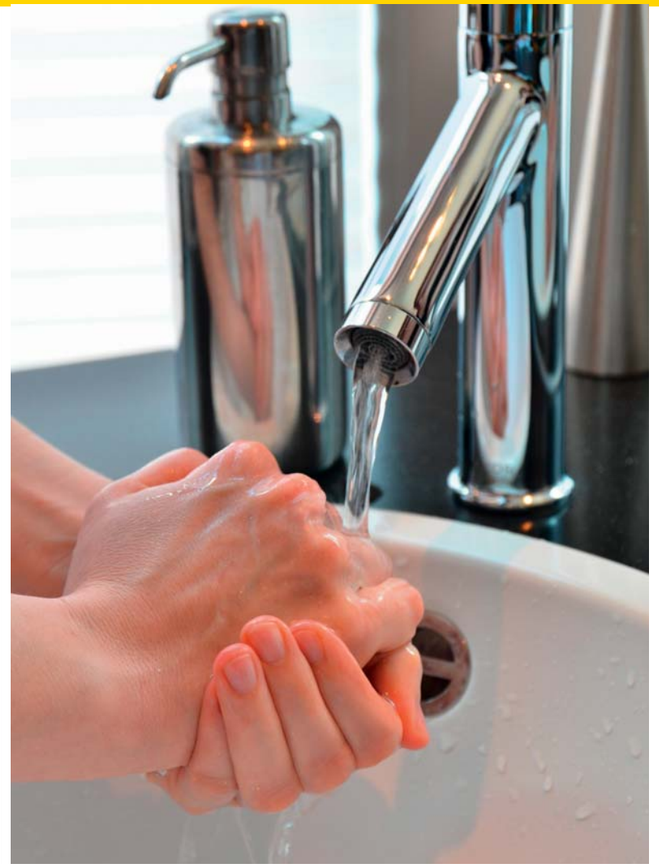
Heating with hot air

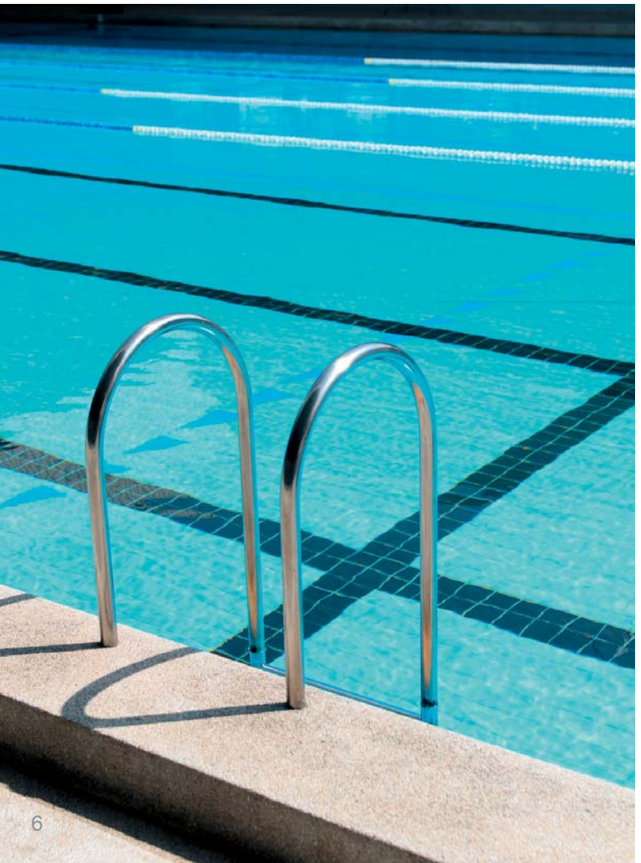
Warmed compressor cooling air can be ducted away to provide highly effective space heating. With this method, up to 96 percent of the compressor's input energy can therefore be recovered as heat.

Heat neighbouring rooms

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







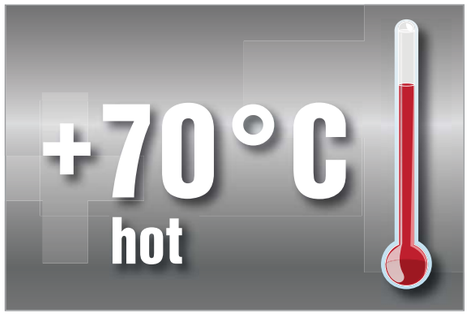
Heat recovery

Minimise primary 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. Neighbouring rooms and warehouse space, for example, can be heated with the warmed cooling air.

Fields of 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.

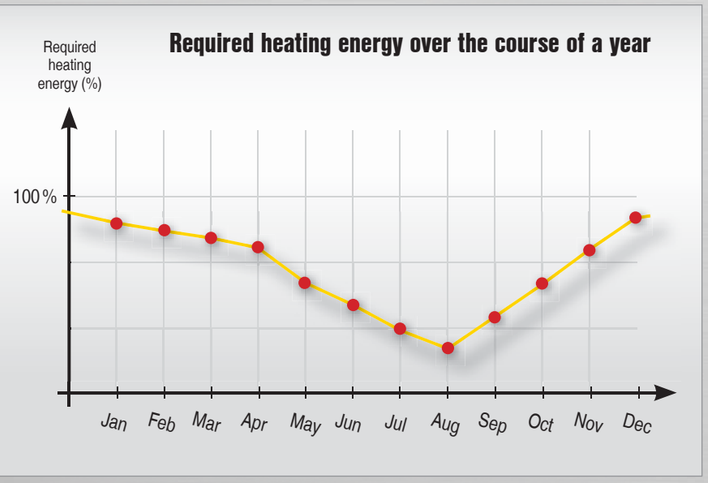
Fields of application
- Feed into central heating systems
- Laundries
- Electroplating
- General process heating
- Cleaning water in the food industry
- Swimming pool heating
- Hot water for shower and washroom facilities

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 regarding which design is right for your particular application.

Image: PTG plate heat exchanger

Image: Tube-type heat exchanger



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.

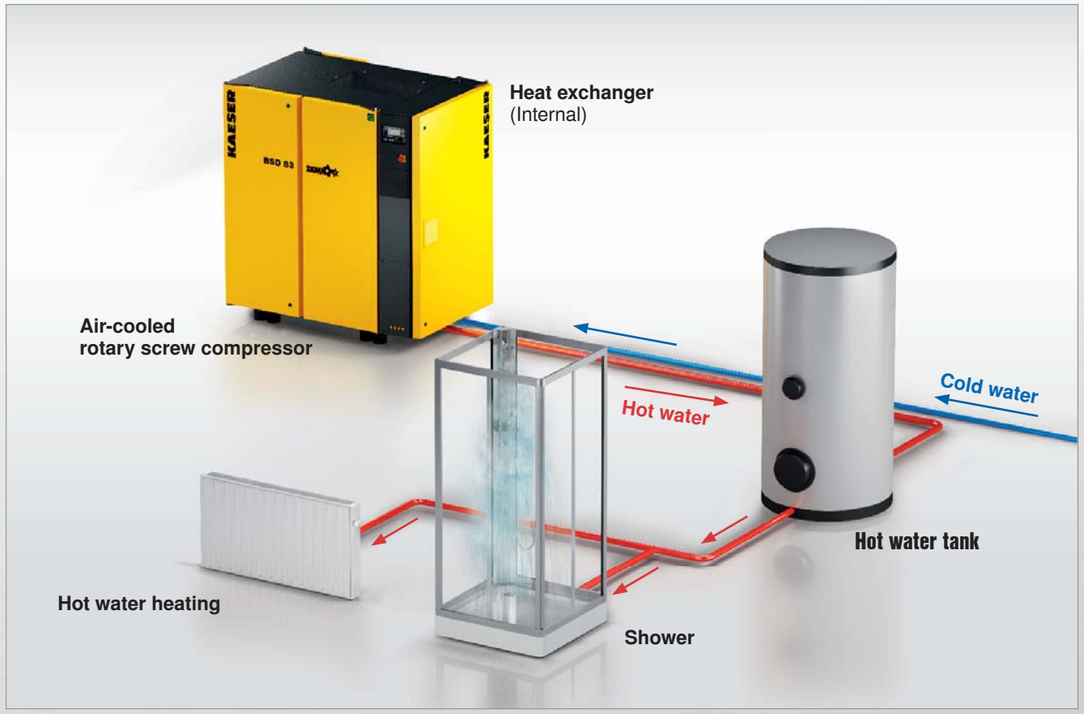


Image: Heat recovery process

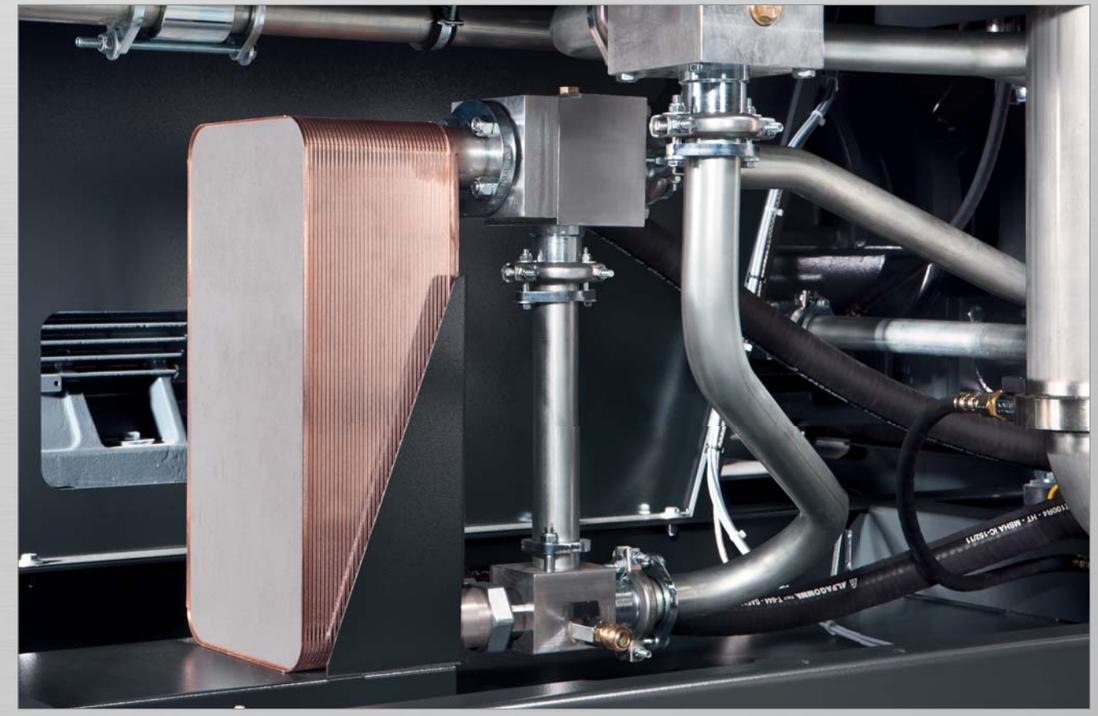


Image: Internal layout of a compressor – system comprising plate heat exchanger, thermostatic valve and complete pipework

Technical specifications

Savings through hot air heat recovery

For rotary screw compressor Model	At max. operating pressure bar	Rated motor power kW	Maximum available heating capacity kW	Maximum available heating capacity MJ/h	Usable volume of heating air m³/h	Amount cooling air is heated K (approx.)	Potential fuel oil saving: Fuel oil l	Potential fuel oil saving: CO_2 kg	Potential fuel oil saving: Heating cost saving €/Year	Potential natural gas saving: Natural gas m³	Potential natural gas saving: CO_2 kg	Potential natural gas saving: Heating cost saving €/Year
SX 3	8	2.2	2.8	10	1000	8	473	1290	**331**	392	784	**294**
SX 4		3	3.5	13	1000	11	592	1614	**414**	490	980	**368**
SX 6		4	4.5	16	1000	14	761	2075	**533**	630	1260	**473**
SX 8		5.5	6.1	22	1300	14	1031	2812	**722**	854	1708	**641**
SM 9	8	5.5	6.8	25	2100	10	1149	3133	**804**	952	1904	**714**
SM 12		7.5	9.0	32		13	1521	4148	**1,065**	1261	2522	**946**
SM 15		9	11.8	43		17	1994	5438	**1,396**	1653	3306	**1,240**
SK 22	8	11	13.2	48	2500	16	2231	6084	**1,562**	1849	3698	**1,387**
SK 25		15	16.5	59	3000	17	2789	7606	**1,952**	2311	4622	**1,733**
ASK 28	8	15	18.4	66	4000	14	3110	8481	**2,177**	2577	5154	**1,933**
ASK 34		18.5	22.8	78	4000	17	3854	10510	**2,698**	3193	6386	**2,395**
ASK 40		22	26.8	96	5000	16	4530	12353	**3,171**	3754	7508	**2,816**
ASD 35	8.5	18.5	20.2	73	3800	16	4552	12413	**3,186**	3772	7544	**2,829**
ASD 40		22	23.8	86	3800	19	5363	14625	**3,754**	4444	8888	**3,333**
ASD 50		25	28.3	102	4500	19	6378	17393	**4,465**	5285	10570	**3,964**
ASD 60		30	34.9	126	5400	19	7865	21448	**5,506**	6517	13034	**4,888**
BSD 65	8.5	30	35.2	127	6500	16	7932	21631	**5,552**	6573	13146	**4,930**
BSD 75		37	43.4	156	8000	16	9780	26670	**6,846**	8105	16210	**6,079**
BSD 83		45	52.0	187	8000	20	11718	31955	**8,203**	9711	19422	**7,283**
CSD 85	8.5	45	50	180	9400	16	11268	30728	**7,888**	9337	18674	**7,003**
CSD 105		55	63	227	9400	20	14197	38715	**9,938**	11765	23530	**8,824**
CSD 125		75	76	274	10700	21	17127	46705	**11,989**	14192	28384	**10,644**
CSDX 140	8.5	75	85	306	11000	23	19155	52236	**13,409**	15873	31746	**11,905**
CSDX 165		90	102	367	13000	24	22986	62683	**16,090**	19048	38096	**14,286**
DSD 142	9	75	84	302	9000	28	18930	51622	**13,251**	15686	31372	**11,765**
DSD 172	8.5	90	98	353	14000	21	22085	60226	**15,460**	18301	36602	**13,726**
DSD 202	8.5	110	124	446	14000	27	27944	76203	**19,561**	23156	46312	**17,367**
DSD 238	8.5	132	150	540	21000	21	33803	92181	**23,662**	28011	56022	**21,008**
DSDX 245	8.5	132	143	515	21000	20	32226	87880	**22,558**	26704	53408	**20,028**
DSDX 305		160	176	634		25	39662	108158	**27,763**	32866	65732	**24,650**
ESD 352	8.5	200	221	796	34000	20	49803	135813	**34,862**	41270	82540	**30,953**
ESD 442		250	254	914		22	57240	156093	**40,068**	47432	94864	**35,574**
FSD 471	8	250	278	1001	40000	21	62649	170844	**43,854**	51914	103828	**38,936**
FSD 571		315	341	1228		26	76846	209559	**53,792**	63679	127358	**47,759**
HSD 662	8.5	360	21	74	10000	6	4642	12659	**3,249**	3847	7694	**2,885**
HSD 722		400	23	82		7	5116	13951	**3,581**	4239	8478	**3,179**
HSD 782		450	25	88		7	5521	15056	**3,865**	4575	9150	**3,431**
HSD 842		500	26	94		8	5904	16100	**4,133**	4893	9786	**3,670**

Savings potential for 1500 hrs

Savings potential for 2000 hrs

Calculation example for ASD 35

For fuel oil

Maximum available heat 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:	0.70 €/l	1 kW = 1 MJ/h x 3.6

Cost saving: $\frac{20.2 \text{ kW} \times 2000 \text{ h}}{0.9 \times 9.861 \text{ kWh/l}}$ x 0.70 €/l **= € 3,186 per year**

For natural gas

Maximum available heat 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 €/m³	1 kW = 1 MJ/h x 3.6

Cost saving: $\frac{20.2 \text{ kW} \times 2000 \text{ h}}{1.05 \times 10.2 \text{ kWh/m}^3}$ x 0.75 €/m³ **= € 2,829 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

For rotary screw compressor Model	At max. operating pressure bar	Rated motor power kW	Maximum available heat capacity kW	Maximum available heat capacity MJ/h	Heated water volume Heated to 70 °C (ΔT 25 K) m³/h	Heated water volume Heated to 70 °C (ΔT 55 K) m³/h	Installation of the PTG system Int./ext.	Potential fuel oil saving: Fuel oil l	Potential fuel oil saving: CO_2 saving kg	Potential fuel oil saving: Heating cost saving €/Year	Potential natural gas saving: Natural gas m³	Potential natural gas saving: CO_2 saving kg	Potential natural gas saving: Heating cost saving €/Year
SM 9	8	5.5	4.6	17	0.16	0.07	External	777	2119	**544**	644	1288	**483**
SM 12		7.5	6.2	22	0.21	0.10		1048	2858	**734**	868	1736	**651**
SM 15		9	8.3	30	0.29	0.13		1403	3826	**982**	1162	2324	**872**
SK 22	8	11	9.4	34	0.32	0.15	External	1589	4333	**1,112**	1317	2634	**988**
SK 25		15	12.0	43	0.41	0.19		2028	5530	**1,420**	1681	3362	**1,261**
ASK 28	8	15	13.6	49	0.47	0.21	Internal	2299	6269	**1,609**	1905	3810	**1,429**
ASK 34		18.5	16.9	61	0.58	0.26		2856	7788	**1,999**	2367	4734	**1,775**
ASK 40		22	19.8	71	0.68	0.31		3347	9127	**2,343**	2773	5546	**2,080**

Savings potential for 1500 hrs

Savings with PTG heat exchanger systems

For rotary screw compressor Model	At max. operating pressure bar	Rated motor power kW	Maximum available heat capacity kW	Maximum available heat capacity MJ/h	Heated water volume Heated to 70 °C (ΔT 25 K) m³/h	Heated water volume Heated to 70 °C (ΔT 55 K) m³/h	Installation of the PTG system Int./ext.	Potential fuel oil saving: Fuel oil l	Potential fuel oil saving: CO_2 kg	Potential fuel oil saving: Heating cost saving €/Year	Potential natural gas saving: Natural gas m³	Potential natural gas saving: CO_2 kg	Potential natural gas saving: Heating cost saving €/Year
ASD 35	8.5	18.5	15.2	55	0.52	0.24	Internal	3425	9340	**2,398**	2838	5676	**2,129**
ASD 40		22	18.1	65	0.62	0.28		4079	11123	**2,855**	3380	6760	**2,535**
ASD 50		25	21.6	78	0.74	0.34		4868	13275	**3,408**	4034	8068	**3,026**
ASD 60		30	26.6	96	0.92	0.42		5994	16346	**4,196**	4967	9934	**3,725**
BSD 65	8.5	30	27.1	98	0.93	0.42	Internal	6107	16654	**4,275**	5061	10122	**3,796**
BSD 75		37	33.5	121	1.15	0.52		7549	20586	**5,284**	6256	12512	**4,692**
BSD 83		45	40.1	144	1.38	0.63		9037	24644	**6,326**	7488	14976	**5,616**
CSD 85	8.5	45	38.6	139	1.33	0.60	Internal	8699	23722	**6,089**	7208	14416	**5,406**
CSD 105		55	48.4	174	1.67	0.76		10907	29743	**7,635**	9038	18076	**6,779**
CSD 125		75	59.0	212	2.03	0.92		13296	36258	**9,307**	11018	22036	**8,264**
CSDX 140	8.5	75	66	238	2.30	1.03	Internal	14873	40559	**10,411**	12325	24650	**9,244**
CSDX 165		90	79	284	2.70	1.24		17803	48549	**12,462**	14753	29506	**11,065**
DSD 142	9	75	66	238	2.30	1.03	Internal	14873	40559	**10,411**	12325	24650	**9,244**
DSD 172	8.5	90	76	274	2.60	1.19		17127	46705	**11,989**	14192	28384	**10,644**
DSD 202	8.5	110	97	349	3.30	1.52		21859	59609	**15,301**	18114	36228	**13,586**
DSD 238	8.5	132	118	425	4.10	1.85		26592	72516	**18,614**	22035	44070	**16,526**
DSDX 245	8.5	132	105	378	3.60	1.64	Internal	23662	64526	**16,563**	19608	39216	**14,706**
DSDX 305		160	130	468	4.50	2.04		29296	79890	**20,507**	24276	48552	**18,207**
ESD 352	8.5	200	172	619	5.90	2.69	Internal	38761	105701	**27,133**	32120	64240	**24,090**
ESD 442		250	198	713	6.80	3.10		44620	121679	**31,234**	36975	73950	**27,731**
FSD 471	8	250	215	774	7.40	3.37	External	48451	132126	**33,916**	40149	80298	**30,112**
FSD 571		315	266	958	9.20	4.17		59944	163467	**41,961**	49673	99346	**37,255**
HSD 662	8.5	360	291	1048	10.0	4.56	Internal	65578	178831	**45,905**	54342	108684	**40,757**
HSD 722		400	323	1163	11.1	5.06		72790	198498	**50,953**	60317	120634	**45,238**
HSD 782		450	348	1253	12.0	5.45		78423	213860	**54,896**	64986	129972	**48,740**
HSD 842		500	374	1346	12.9	5.86		84283	229840	**58,998**	69841	139682	**52,381**

Savings potential for 2000 hrs

Calculation example for ASD 35

For fuel oil

Maximum available heat capacity:	15.2 kW	
Fuel value per litre of fuel oil:	9.861 kWh/l	
Fuel oil heating efficiency:	0.9	
Price per litre of fuel oil:	0.70 €/l	1 kW = 1 MJ/h x 3.6

Cost saving: $\frac{15.2 \text{ kW} \times 2000 \text{ h}}{0.9 \times 9.861 \text{ kWh/l}}$ x 0.70 €/l **= € 2,398 per year**

For natural gas

Maximum available heat capacity:	15.2 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 €/m³	1 kW = 1 MJ/h x 3.6

Cost saving: $\frac{15.2 \text{ kW} \times 2000 \text{ h}}{1.05 \times 10.2 \text{ kWh/m}^3}$ x 0.75 €/m³ **= € 2,129 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.

KAESER – The world is our home

As one of the world's largest compressed air systems providers and compressor manufacturers, KAESER KOMPRESSOREN is represented throughout the world by a comprehensive network of branches, subsidiary companies and authorised partners in over 100 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 all products operate at the peak of their performance at all times and provide maximum availability.

LGA InterCert
Certified QM/EM System
ISO 9001:2008 / ISO 14001:2004

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