

# IE5+ series

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## IE5+ catalogue

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### **1 Description of IE5+ series**

#### **1.1 Prehistory**

##### *1.1.1 Conventional design strategy*

In the IEC standard (IEC60034-30-1) it is mentioned that IE5 is not possible for asynchronous motors. This depends on a selected design strategy. We carefully studied published data on IE4 motors of ABB and we reproduced those motors in our models in order to better understand design decisions they were making. Also, there are publications of ABB and WEG discussing the adopted design strategy. Our conclusion is that if you follow the design strategy of ABB and WEG, you indeed would not be able to reach IE5 efficiency class. During development of IE5+ series we have selected a different design strategy.

##### *1.1.2 Starting torque issue*

There is a trend of making IE3 and IE4 asynchronous motors with a high starting torque. In most practical cases this is excessive. Nowadays, only about 10% of applications actually require high starting torque. In the remaining applications a normal starting torque would suffice. However, if you want to achieve both high efficiency and high starting torque, this leads to an extra motor mass and to a reduction of the power factor. This means that the motor cost would increase and the operational costs would also rise. During development of IE5+ we decided to go for a more balanced solution and aim for a normal starting torque while maintaining acceptable motor mass and high power factor.

#### **1.2 Current status on IE5 motors**

IE5 motors are being manufactured as synchronous motors with permanent magnets and distributed by a few companies. For obvious reasons such motors are more expensive compared to asynchronous motors. But the presence of IE5 synchronous motors with permanent magnets on the market confirms the interest for highly efficient motors.

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### 1.3 Features of IE5+ series

#### 1.3.1 Development of IE5+ series

We used our experimentally verified design tools for development of the series. Additionally, we used commercial software for modelling of asynchronous motors for verification of final designs.

#### 1.3.2 Features of motor designs of IE5+ series:

During development of the IE5+ series our goal was to provide correspondence to the existing norms and standards. We were also aiming at conventional manufacturing techniques and use of standard components, such as seals and bearings, available on the market. Furthermore, we were trying to reach the minimal operational costs while maintaining the acceptable motor cost.

The main features of the IE5+ series could be summarized as follows:

- 1) IE5 efficiency class (20-25% lower total losses compared to IE4);
- 2) High power factor;
- 3) Normal starting torque;
- 4) Minimal amount of active materials and minimal motor mass.

Each motor in the series is provided with:

- 1) A full motor specification;
- 2) A stator winding diagram;
- 3) A full supplement of technical drawings (DXF, DWG or PDF) or 3D models (STEP) for the motor components;
- 4) A motor assembly in 3D (STEP) and as a drawing.

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### 2 Motor data for IE5+ motor designs

#### 2.1 2-pole motors

Motor type	Axis height [mm]	Un linear [V]	Output power [kW]	Nominal speed [rpm]	Efficiency at 100% load [%]	Efficiency at 75% load [%]	Efficiency at 50% load [%]	Power factor	In [A]	Is / In	Tn [Nm]	Tl / Tn	Tb / Tn	Mass of active materials [kg]	Motor mass [kg]
ADP56-S2-IE5	56	400 Y	0,09	2709	0,71	0,715	0,684	0,81	0,227	3,93	0,317	2,59	2,69	2,2	7,01
ADP56-L2-IE5	56	400 Y	0,12	2673	0,711	0,722	0,697	0,78	0,314	3,64	0,429	2,62	2,49	2,5	7,48
ADP63-S2-IE5	63	400 Y	0,18	2704	0,755	0,766	0,75	0,85	0,408	4,17	0,636	2,54	2,53	3,58	10,1
ADP63-L2-IE5	63	400 Y	0,25	2730	0,785	0,797	0,786	0,86	0,536	4,51	0,874	2,6	2,63	4,03	10,8
ADP71-S2-IE5	71	400 Y	0,37	2832	0,817	0,817	0,794	0,86	0,757	5,99	1,25	2,88	3,13	5,39	14,6
ADP71-L2-IE5	71	400 Y	0,55	2846	0,845	0,846	0,828	0,86	1,09	6,63	1,85	3,18	3,27	6,59	16,6
ADP80-S2-IE5	80	400 Y	0,75	2897	0,868	0,863	0,838	0,86	1,45	8,21	2,47	3,3	3,72	9,22	23,6
ADP80-L2-IE5	80	400 Y	1,1	2890	0,882	0,882	0,867	0,88	2,05	7,96	3,64	3,1	3,35	10,6	25,8
ADP90-S2-IE5	90	400 Y	1,5	2905	0,888	0,886	0,867	0,89	2,75	8,3	4,93	2,86	3,36	14,2	34
ADP90-L2-IE5	90	400 Y	2,2	2914	0,905	0,904	0,89	0,89	3,92	8,68	7,21	2,75	3,44	17,9	39,3
ADP100-S2-IE5	100	400 Y	3	2926	0,91	0,908	0,893	0,9	5,28	8,05	9,79	2,06	3,18	22,9	54,2
ADP112-S2-IE5	112	400 Y	4	2952	0,923	0,92	0,904	0,88	7,14	7,27	12,9	1,26	3,06	29,6	66,7
ADP132-S2-IE5	132	400 Y	5,5	2951	0,92	0,915	0,896	0,91	9,52	8,49	17,8	1,6	3,08	41,6	99
ADP132-L2-IE5	132	400 Y	7,5	2955	0,931	0,926	0,91	0,91	12,8	8,57	24,2	1,54	3,1	50,3	112

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Motor type	Axis height [mm]	Un linear [V]	Output power [kW]	Nominal speed [rpm]	Efficiency at 100% load	Efficiency at 75% load	Efficiency at 50% load	Power factor	In [A]	Is / In	Tn [Nm]	Tl / Tn	Tb / Tn	Mass of active materials [kg]	Motor mass [kg]
ADP160-S2-IE5	160	400 Y	11	2965	0,933	0,93	0,916	0,91	18,8	8,36	35,4	1,46	3,38	60,4	161
ADP160-M2-IE5	160	400 Y	15	2964	0,94	0,939	0,928	0,92	25,1	8,15	48,3	1,46	3,27	72,7	173
ADP160-L2-IE5	160	400 Y	18,5	2964	0,944	0,944	0,935	0,92	30,7	8,05	59,6	1,47	3,22	82,3	186
ADP180-S2-IE5	180	400 Y	22	2968	0,945	0,942	0,931	0,91	37	8,56	70,8	1,38	3,41	97,3	234
ADP200-S2-IE5	200	400 Y	30	2966	0,949	0,946	0,936	0,92	49,6	8,19	96,6	1,42	3,28	130	314
ADP200-L2-IE5	200	400 Y	37	2965	0,952	0,95	0,943	0,92	60,8	8,21	119	1,46	3,03	142	326
ADP225-S2-IE5	225	400 Y	45	2967	0,952	0,949	0,939	0,92	73,9	7,91	145	1,22	3,21	195	426
ADP250-S2-IE5	250	400 Y	55	2979	0,951	0,947	0,933	0,92	91,1	8,49	176	1,41	3,49	219	555
ADP280-S2-IE5	280	400 Y	75	2982	0,953	0,946	0,931	0,92	123	8,27	240	0,85	4,05	323	805
ADP280-L2-IE5	280	400 Y	90	2982	0,956	0,951	0,938	0,93	146	7,96	288	0,82	3,9	347	830
ADP315-S2-IE5	315	690 Y	110	2982	0,96	0,956	0,944	0,94	102	10,21	352	1,27	3,84	448	1056
ADP315-M2-IE5	315	690 Y	132	2981	0,962	0,959	0,949	0,94	122	14,38	423	2,64	3,78	460	1069
ADP315-L2-IE5	315	690 Y	160	2981	0,964	0,962	0,954	0,95	147	13,97	513	2,6	3,65	498	1108
ADP315-SL2-IE5	315	690 Y	200	2980	0,966	0,965	0,959	0,95	182	13,15	641	2,48	3,42	552	1164
ADP355-S2-IE5	355	690 Y	250	2986	0,971	0,969	0,963	0,95	228	10,54	800	1,23	3,56	733	1659
ADP355-M2-IE5	355	690 Y	315	2986	0,973	0,972	0,967	0,95	286	8,73	1007	0,87	3,48	840	1770
ADP355-L2-IE5	355	690 Y	355	2984	0,973	0,973	0,97	0,95	320	8,24	1136	0,84	3,25	808	1736

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### 2.2 4-pole motors

Motor type	Axis height [mm]	Un linear [V]	Output power [kW]	Nominal speed [rpm]	Efficiency at 100% load [%]	Efficiency at 75% load [%]	Efficiency at 50% load [%]	Power factor	In [A]	Is / In	Tn [Nm]	Tl / Tn	Tb / Tn	Mass of active materials [kg]	Motor mass [kg]
ADP56-S4-IE5	56	400 Y	0,06	1410	0,741	0,726	0,675	0,64	0,181	3,97	0,406	2,7	3,12	2,38	7,05
ADP56-L4-IE5	56	400 Y	0,09	1363	0,75	0,758	0,735	0,74	0,235	3,45	0,631	2,13	2,31	2,59	7,45
ADP63-S4-IE5	63	400 Y	0,12	1375	0,769	0,777	0,756	0,75	0,302	3,42	0,834	1,83	2,31	3,29	9,31
ADP63-L4-IE5	63	400 Y	0,18	1363	0,785	0,802	0,792	0,77	0,431	3,51	1,26	1,89	2,08	4,06	10,5
ADP71-S4-IE5	71	400 Y	0,25	1399	0,817	0,826	0,813	0,76	0,586	4,06	1,71	1,95	2,23	5,72	14,6
ADP71-L4-IE5	71	400 Y	0,37	1406	0,849	0,855	0,842	0,74	0,849	4,16	2,51	1,92	2,31	7,91	18,1
ADP80-S4-IE5	80	400 Y	0,55	1447	0,872	0,869	0,849	0,79	1,15	7,52	3,63	3,38	3,5	9,2	22,9
ADP80-L4-IE5	80	400 Y	0,75	1452	0,885	0,883	0,864	0,8	1,54	7,68	4,93	3,65	3,82	11,6	26,5
ADP90-S4-IE5	90	400 Y	1,1	1451	0,896	0,896	0,882	0,81	2,19	7,7	7,24	3,12	3,32	15,5	34,7
ADP90-L4-IE5	90	400 Y	1,5	1449	0,901	0,904	0,895	0,83	2,89	7,46	9,88	2,96	3,13	18,7	39,2
ADP100-S4-IE5	100	400 Y	2,2	1450	0,912	0,917	0,912	0,84	4,13	6,96	14,5	2,52	2,81	24,4	54,7
ADP100-L4-IE5	100	400 Y	3	1455	0,921	0,924	0,918	0,83	5,64	7,28	19,7	2,55	3,02	32,6	67,1
ADP112-S4-IE5	112	400 Y	4	1467	0,928	0,93	0,923	0,87	7,14	7,92	26	2,3	3,04	38,4	77,6
ADP132-S4-IE5	132	400 Y	5,5	1472	0,935	0,935	0,927	0,87	9,71	7,07	35,7	1,66	2,77	49	107
ADP132-L4-IE5	132	400 Y	7,5	1474	0,94	0,939	0,93	0,86	13,3	7,54	48,6	1,71	2,99	62,2	127

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Motor type	Axis height [mm]	Un linear [V]	Output power [kW]	Nominal speed [rpm]	Efficiency at 100% load [%]	Efficiency at 75% load [%]	Efficiency at 50% load [%]	Power factor	In [A]	Is / In	Tn [Nm]	Tl / Tn	Tb / Tn	Mass of active materials [kg]	Motor mass [kg]
ADP160-S4-IE5	160	400 Y	11	1482	0,944	0,943	0,934	0,87	19,2	8,68	70,9	1,89	3,36	79,6	187
ADP160-L4-IE5	160	400 Y	15	1482	0,947	0,947	0,94	0,88	26	8,93	96,7	2	3,24	94,7	209
ADP180-S4-IE5	180	400 Y	18,5	1485	0,952	0,951	0,943	0,89	31,6	8,32	119	1,66	3,42	117	258
ADP180-L4-IE5	180	400 Y	22	1485	0,953	0,953	0,946	0,89	37,4	8,32	142	1,68	3,16	128	273
ADP200-S4-IE5	200	400 Y	30	1486	0,957	0,958	0,953	0,9	50,4	8,03	193	1,47	3,09	160	347
ADP225-S4-IE5	225	400 Y	37	1489	0,96	0,96	0,955	0,9	61,8	8,55	237	1,53	3,08	209	443
ADP225-L4-IE5	225	400 Y	45	1489	0,963	0,962	0,956	0,89	75,5	8,26	289	1,47	3,01	239	481
ADP250-S4-IE5	250	400 Y	55	1489	0,963	0,961	0,954	0,91	90,5	8,6	353	1,45	3,49	297	642
ADP280-S4-IE5	280	400 Y	75	1489	0,963	0,961	0,953	0,91	123	8,09	481	1,24	3,16	366	857
ADP280-L4-IE5	280	400 Y	90	1489	0,965	0,963	0,956	0,92	147	8,07	577	1,25	3,15	407	898
ADP315-S4-IE5	315	690 Y	110	1488	0,967	0,965	0,958	0,92	103	7,38	706	1,09	2,87	530	1200
ADP315-M4-IE5	315	690 Y	132	1488	0,968	0,966	0,96	0,92	125	7,23	847	1,07	2,83	601	1274
ADP315-L4-IE5	315	690 Y	160	1489	0,97	0,968	0,962	0,92	150	7,49	1026	1,12	2,91	689	1365
ADP315-SL4-IE5	315	690 Y	200	1488	0,97	0,969	0,964	0,92	188	7,12	1283	1,07	2,78	753	1431
ADP355-S4-IE5	355	690 Y	250	1487	0,971	0,97	0,966	0,92	235	6,66	1605	0,98	2,6	911	1885
ADP355-M4-IE5	355	690 Y	315	1488	0,972	0,973	0,969	0,92	296	6,65	2022	0,98	2,6	1017	1996
ADP355-L4-IE5	355	690 Y	355	1488	0,974	0,974	0,971	0,92	330	6,96	2278	1,02	2,69	1061	2042

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### 2.3 6-pole motors

Motor type	Axis height [mm]	Un linear [V]	Output power [kW]	Nominal speed [rpm]	Efficiency at 100% load [%]	Efficiency at 75% load [%]	Efficiency at 50% load [%]	Power factor	In [A]	Is / In	Tn [Nm]	Tl / Tn	Tb / Tn	Mass of active materials [kg]	Motor mass [kg]
ADP71-S6-IE5	71	400 Y	0,18	914	0,768	0,771	0,744	0,66	0,51	3,56	1,88	2,56	2,51	5,05	13,5
ADP71-L6-IE5	71	400 Y	0,25	920	0,792	0,798	0,776	0,67	0,676	3,76	2,6	2,53	2,56	6,34	15,6
ADP80-S6-IE5	80	400 Y	0,37	931	0,819	0,827	0,813	0,72	0,906	3,9	3,79	1,95	2,17	8,05	21,2
ADP80-L6-IE5	80	400 Y	0,55	941	0,843	0,849	0,835	0,71	1,32	4,23	5,58	2,03	2,4	11,2	25,9
ADP90-S6-IE5	90	400 Y	0,75	946	0,86	0,868	0,859	0,74	1,71	4,35	7,57	1,86	2,14	14,1	32,5
ADP90-L6-IE5	90	400 Y	1,1	949	0,872	0,881	0,874	0,74	2,46	4,36	11,1	1,79	2,12	18,9	39,6
ADP100-S6-IE5	100	400 Y	1,5	960	0,885	0,892	0,885	0,74	3,3	4,64	14,9	1,59	2,11	23,5	53,2
ADP112-S6-IE5	112	400 Y	2,2	967	0,898	0,899	0,887	0,78	4,51	6,81	21,7	3,01	3,51	30,3	65
ADP132-S6-IE5	132	400 Y	3	974	0,908	0,909	0,898	0,82	5,79	6,61	29,4	2,09	3,01	37	87,6
ADP132-M6-IE5	132	400 Y	4	974	0,915	0,916	0,906	0,83	7,64	6,57	39,2	2,03	3,02	45,3	100
ADP132-L6-IE5	132	400 Y	5,5	978	0,924	0,924	0,915	0,82	10,5	7,16	53,7	2,31	3,34	61,1	124

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Motor type	Axis height [mm]	Un linear [V]	Output power [kW]	Nominal speed [rpm]	Efficiency at 100% load [%]	Efficiency at 75% load [%]	Efficiency at 50% load [%]	Power factor	In [A]	Is / In	Tn [Nm]	Tl / Tn	Tb / Tn	Mass of active materials [kg]	Motor mass [kg]
ADP160-S6-IE5	160	400 Y	7,5	985	0,933	0,933	0,925	0,83	14	6,9	72,7	1,73	2,8	71,3	174
ADP160-L6-IE5	160	400 Y	11	986	0,937	0,938	0,931	0,82	20,5	6,37	107	1,44	2,72	91	200
ADP180-S6-IE5	180	400 Y	15	988	0,943	0,941	0,932	0,85	27,1	7,74	145	2,06	3,36	126	266
ADP200-S6-IE5	200	400 Y	18,5	989	0,949	0,949	0,941	0,88	32,1	8,42	179	2	3,2	147	334
ADP200-L6-IE5	200	400 Y	22	989	0,95	0,95	0,944	0,88	37,9	8,44	213	2,11	3,03	159	346
ADP225-S6-IE5	225	400 Y	30	990	0,955	0,956	0,951	0,89	51	7,55	289	1,56	2,89	211	447
ADP250-S6-IE5	250	400 Y	37	992	0,956	0,958	0,954	0,9	62,4	7,74	356	1,44	2,91	241	583
ADP280-S6-IE5	280	400 Y	45	992	0,959	0,96	0,955	0,9	75,6	7,17	433	1,17	2,89	335	824
ADP280-L6-IE5	280	400 Y	55	992	0,961	0,962	0,958	0,9	91,8	6,97	529	1,14	2,8	378	868
ADP315-S6-IE5	315	400 Y	75	992	0,965	0,965	0,961	0,9	124	6,72	722	1,05	2,71	477	1113
ADP315-M6-IE5	315	400 Y	90	991	0,965	0,966	0,963	0,91	148	6,31	867	0,99	2,54	515	1152
ADP315-L6-IE5	315	400 Y	110	992	0,967	0,967	0,963	0,9	182	6,4	1059	0,99	2,6	620	1261
ADP315-SL6-IE5	315	400 Y	132	992	0,968	0,968	0,965	0,9	218	6,23	1271	0,96	2,52	683	1326
ADP355-S6-IE5	355	690 Y	160	993	0,97	0,969	0,965	0,92	151	7,31	1539	1,01	2,9	820	1795
ADP355-M6-IE5	355	690 Y	200	992	0,969	0,97	0,967	0,92	188	6,12	1926	0,84	2,43	853	1829
ADP355-L6-IE5	355	690 Y	250	991	0,969	0,971	0,969	0,92	235	5,81	2408	0,81	2,31	966	1946

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## IE5+ catalogue

### 2.4 8-pole motors

Motor type	Axis height [mm]	Un linear [V]	Output power [kW]	Nominal speed [rpm]	Efficiency at 100% load [%]	Efficiency at 75% load [%]	Efficiency at 50% load [%]	Power factor	In [A]	Is / In	Tn [Nm]	Tl / Tn	Tb / Tn	Mass of active materials [kg]	Motor mass [kg]
ADP80-L8-IE5	80	400 Y	0,25	695	0,783	0,783	0,753	0,61	0,755	2,92	3,44	1,86	2,14	7,82	20,6
ADP90-S8-IE5	90	400 Y	0,37	711	0,802	0,792	0,753	0,56	1,19	3,14	4,97	1,87	2,32	9,95	26
ADP90-L8-IE5	90	400 Y	0,55	712	0,826	0,817	0,783	0,55	1,74	3,2	7,37	1,85	2,32	13,4	31,4
ADP100-S8-IE5	100	400 Y	0,75	723	0,853	0,843	0,81	0,54	2,36	3,74	9,9	1,82	2,53	17,9	44,5
ADP100-L8-IE5	100	400 Y	1,1	722	0,866	0,859	0,832	0,56	3,3	3,67	14,5	1,67	2,4	23,4	52,9
ADP112-S8-IE5	112	400 Y	1,5	704	0,857	0,871	0,869	0,74	3,39	3,79	20,4	1,57	1,88	24,8	56,4
ADP132-S8-IE5	132	400 Y	2,2	722	0,893	0,897	0,888	0,74	4,83	4,2	29,1	1,4	2,14	42	7,48
ADP132-L8-IE5	132	400 Y	3	721	0,898	0,903	0,896	0,74	6,56	4,07	39,7	1,32	2,05	49,9	94,3
ADP160-S8-IE5	160	400 Y	4	734	0,911	0,915	0,908	0,75	8,48	4,8	52	1,36	1,94	54,3	157
ADP160-M8-IE5	160	400 Y	5,5	734	0,913	0,919	0,913	0,75	11,6	4,91	71,6	1,38	1,93	62,6	165
ADP160-L8-IE5	160	400 Y	7,5	733	0,92	0,926	0,922	0,76	15,5	4,65	97,7	1,3	1,82	78,5	181
ADP180-S8-IE5	180	400 Y	11	737	0,928	0,93	0,923	0,79	21,8	5,01	143	1,38	2,26	106	246
ADP200-S8-IE5	200	400 Y	15	737	0,932	0,937	0,933	0,81	28,7	5,32	194	1,34	2,08	118	305
ADP225-S8-IE5	225	400 Y	18,5	739	0,938	0,943	0,941	0,83	34,3	5,31	239	1,2	2,03	147	381
ADP225-L8-IE5	225	400 Y	22	739	0,94	0,945	0,943	0,83	40,7	5,28	284	1,2	2,02	164	398
ADP250-S8-IE5	250	400 Y	30	743	0,949	0,951	0,946	0,82	55,6	5,98	386	1,21	2,41	229	571

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## IE5+ catalogue

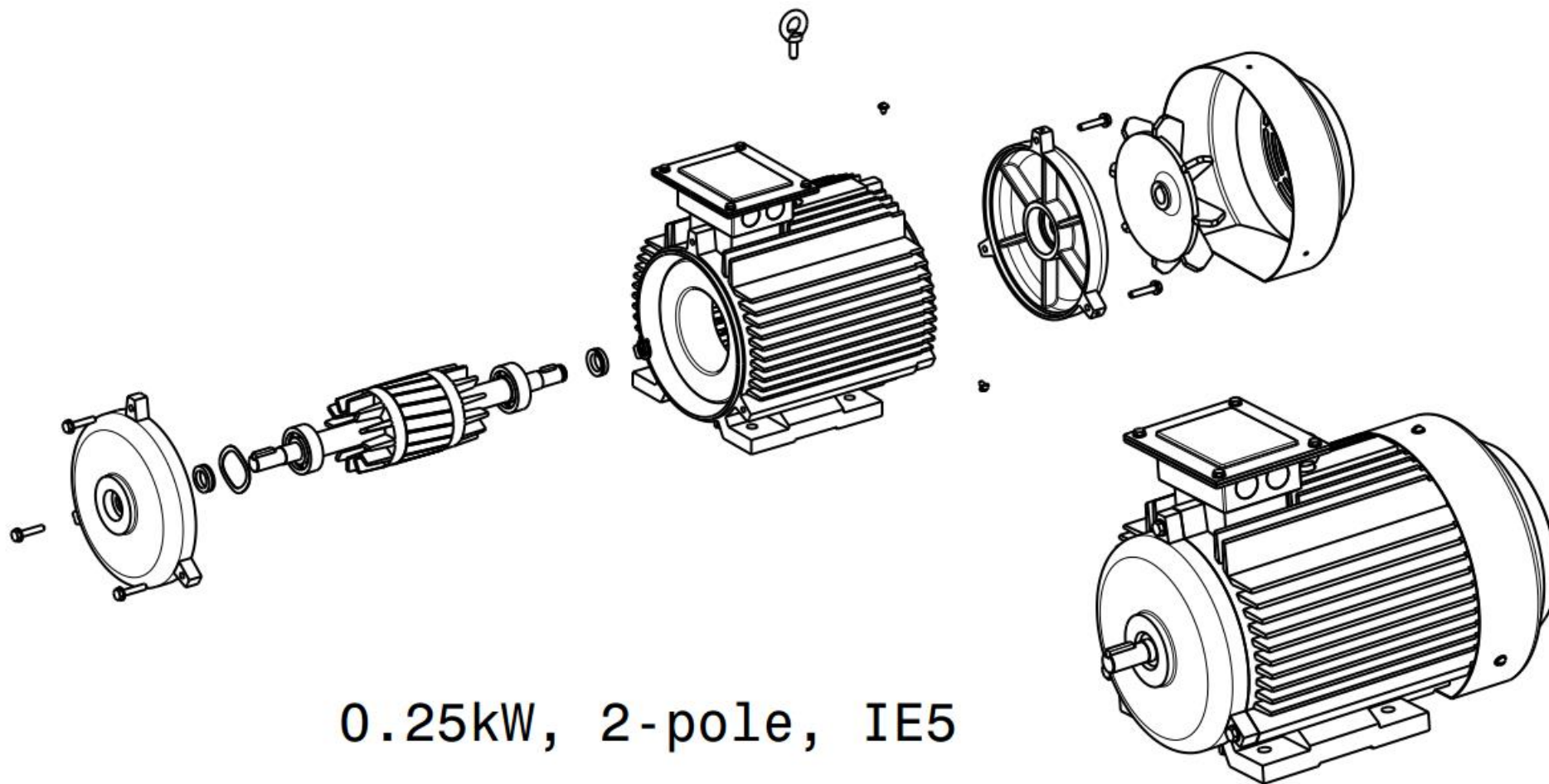
Motor type	Axis height [mm]	Un linear [V]	Output power [kW]	Nominal speed [rpm]	Efficiency at 100% load [%]	Efficiency at 75% load [%]	Efficiency at 50% load [%]	Power factor	In [A]	Is / In	Tn [Nm]	Tl / Tn	Tb / Tn	Mass of active materials [kg]	Motor mass [kg]
ADP280-S8-IE5	280	400 Y	37	744	0,954	0,954	0,949	0,82	68,3	6,38	475	1,25	2,54	329	819
ADP280-L8-IE5	280	400 Y	45	743	0,954	0,956	0,953	0,84	81,1	5,7	579	1,12	2,22	375	865
ADP315-S8-IE5	315	400 Y	55	743	0,96	0,961	0,957	0,85	97,1	5,85	707	1,11	2,27	522	1160
ADP315-M8-IE5	315	400 Y	75	743	0,962	0,963	0,958	0,84	133	5,74	964	1,06	2,24	603	1244
ADP315-L8-IE5	315	400 Y	90	743	0,962	0,964	0,961	0,85	158	5,52	1157	1,03	2,14	665	1308
ADP315-SL8-IE5	315	400 Y	110	741	0,96	0,963	0,963	0,86	193	4,79	1417	0,9	1,84	689	1333
ADP355-S8-IE5	355	690 Y	132	743	0,963	0,965	0,964	0,88	130	6,07	1695	0,97	2,25	755	1728
ADP355-M8-IE5	355	690 Y	160	743	0,964	0,966	0,965	0,88	157	5,93	2055	0,95	2,19	865	1842
ADP355-L8-IE5	355	690 Y	200	744	0,965	0,967	0,966	0,88	196	5,97	2568	0,96	2,21	1037	2019

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IE5+ catalogue

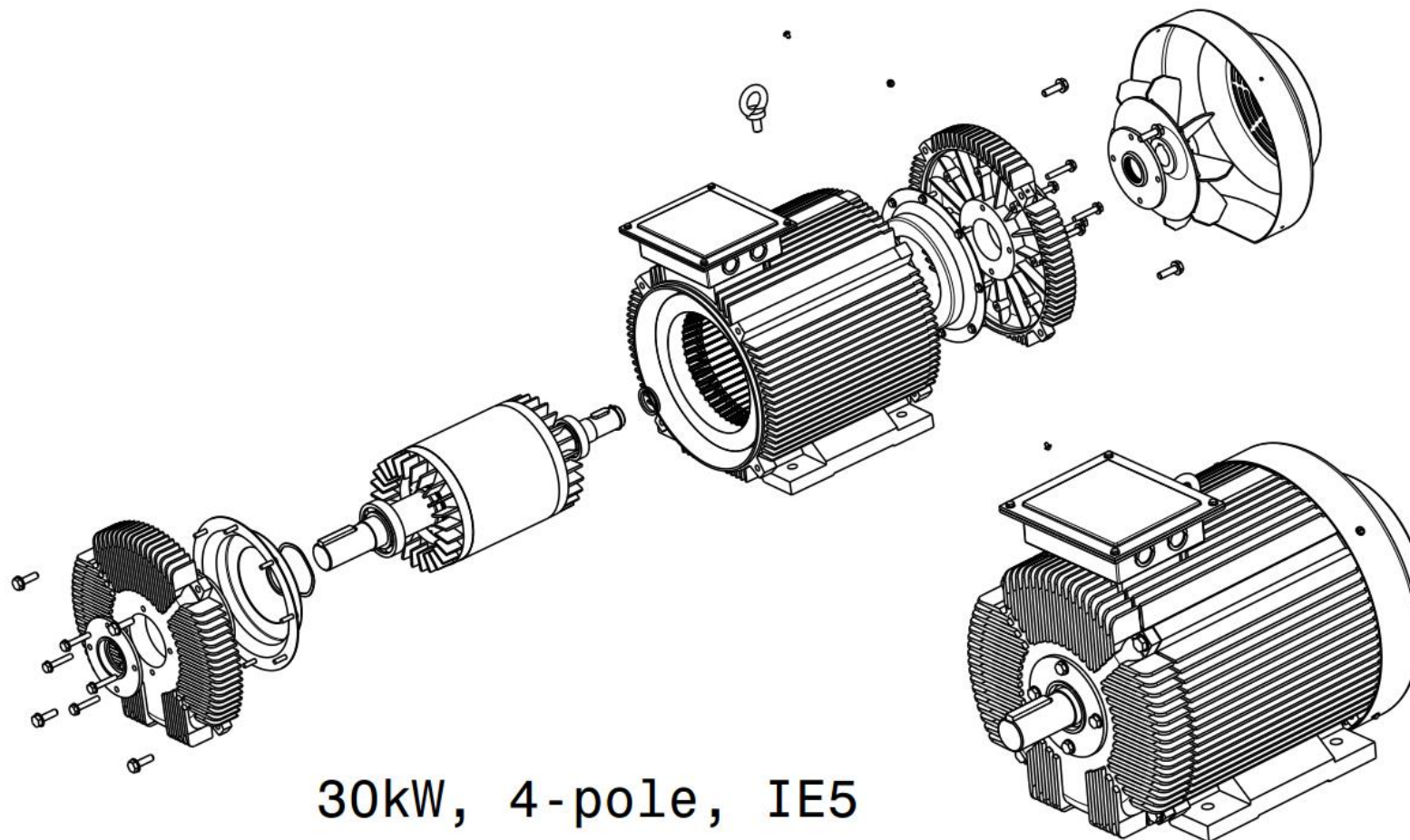


0.25kW, 2-pole, IE5

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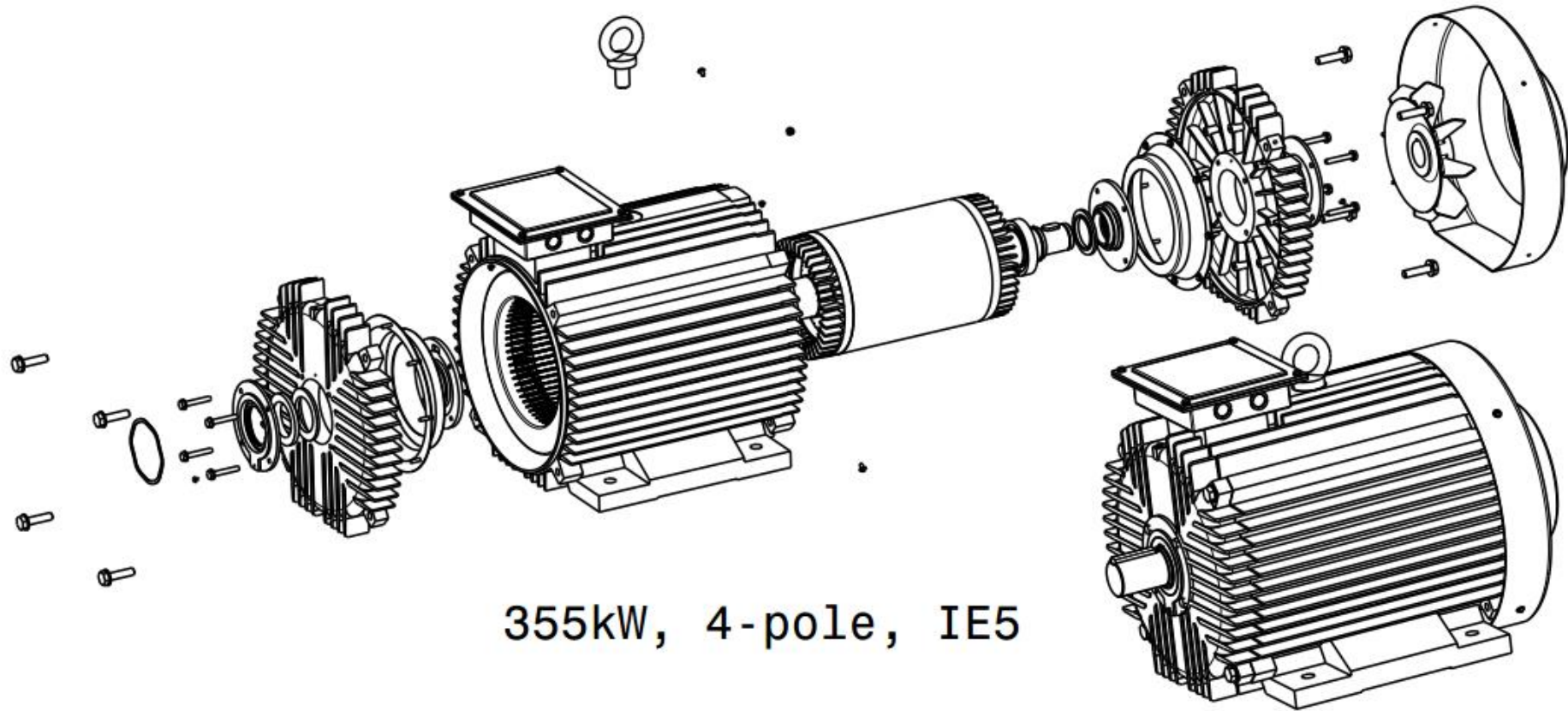
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IE5+ catalogue



355kW, 4-pole, IE5

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## IE5+ catalogue

### 3 Economic effect of replacing conventional IE3 motors with IE5+ motors

#### 3.1 Benefit of replacing IE3 motor with IE5+ motor (55 kW, 1500 rpm) for Italy

1. Price of 1 kWh of active power in Italy in Euro:  $Ca_{Italy} = 0.24$  Euro/kWh.
2. Power factor of the motor IE5+:  $\cos(\varphi) = 0.91$ .
3. Price of 1 kVAh of reactive power in Italy in Euro for IE5+, for  $\cos(\varphi) = 0.91$ :  $Cr5_{Italy} = 0$  Euro/ kVAh.

if  $\cos(\varphi) > 0.9$ , then  $Cr5_{Italy} = 0$  Euro/kVAh,  
if  $0.8 \leq \cos(\varphi) \leq 0.9$ , then  $Cr5_{Italy} = 0.032$  Euro/kVAh,  
if  $\cos(\varphi) < 0.8$ , then  $Cr5_{Italy} = 0.042$  Euro/kVAh.

4. Duration of motor operation in hours per year (8 hours per day, 288 days per year):  $t_{work} = 2304$  hours.
5. Motor efficiency of IE5+:  $\eta_{ie5+} = 0.965$ .
6. Standard motor efficiency of IE3:  $\eta_{ie3} = 0.946$
7. Active power consumption by IE5+ and IE3 motors:

$$Pa_{ie5+} = \frac{P_{2n}}{\eta_{ie5+}} t_{work} = \frac{55}{0.965} \cdot 2304 = 131352 \text{ kWh},$$

$$Pa_{ie3} = \frac{P_{2n}}{\eta_{ie3}} t_{work} = \frac{55}{0.946} \cdot 2304 = 133953 \text{ kWh}.$$

8. Payment for consumed active power by IE5+ and IE3 motors:

$$pay_{ie5+} = Pa_{ie5+} \cdot Ca_{Italy} = 31525 \text{ Euro},$$

$$pay_{ie3} = Pa_{ie3} \cdot Ca_{Italy} = 32149 \text{ Euro}.$$

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## IE5+ catalogue

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9. Benefit per year due to increased efficiency

$$E_{act} = pay_{ie3} - pay_{ie5+} = 624 \text{ Euro.}$$

10. Power factor of an average IE3 motor:  $\text{Cos}(\varphi)_{ie3} = 0.84$ .

11. Price of 1kVAh of reactive power in Italy in Euro for the IE3 motor ( $\text{Cos}(\varphi)_{ie3} = 0.84$ ):

$$Cr3_{Italy} = 0.032 \text{ Euro/ kVAh.}$$

12. Reactive power consumption by IE5+ and IE3 motors:

$$Q_{ie5+} = Pa_{ie5+} \cdot \frac{\sqrt{1-\text{Cos}^2(\varphi)}}{\text{Cos}(\varphi)} = 59555 \text{ kVAh,}$$

$$Q_{ie3} = Pa_{ie3} \cdot \frac{\sqrt{1-\text{Cos}^2(\varphi)_{ie3}}}{\text{Cos}(\varphi)_{ie3}} = 86525 \text{ kVAh.}$$

13. Payment for consumed reactive power by IE5+ and IE3 motors:

$$payr_{ie5+} = Q_{ie5+} \cdot Cr5_{Italy} = 0 \text{ Euro,}$$

$$payr_{ie3} = Q_{ie3} \cdot Cr3_{Italy} = 2769 \text{ Euro.}$$

14. Benefit per year due to increased power factor:

$$E_{react} = payr_{ie3} - payr_{ie5+} = 2769 \text{ Euro.}$$

15. Benefits per year due to increased efficiency and increased power factor:

$$E_{act} = 624 \text{ Euro,} \quad E_{react} = 2769 \text{ Euro.}$$

16. Total benefit per year due to replacement of an average IE3 motor with an IE5+ motor:

$$E_{one\_year} = E_{act} + E_{react} = 3393 \text{ Euro.}$$

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## IE5+ catalogue

### 3.2 2-pole motors

Motor type	Axis height [mm]	Output power [kW]	Nominal speed [rpm]	Benefit act. IE3 [EURO]	Benefit react. IE3 [EURO]	Benefit total IE3 [EURO]
ADP56-S2-IE5	56	0,09	2709	16	8	24
ADP56-L2-IE5	56	0,12	2673	16	3	19
ADP63-S2-IE5	63	0,18	2704	19	12	32
ADP63-L2-IE5	63	0,25	2730	22	13	35
ADP71-S2-IE5	71	0,37	2832	27	7	34
ADP71-L2-IE5	71	0,55	2846	31	10	40
ADP80-S2-IE5	80	0,75	2897	36	41	77
ADP80-L2-IE5	80	1,1	2890	45	21	67
ADP90-S2-IE5	90	1,5	2905	51	23	75
ADP90-L2-IE5	90	2,2	2914	72	37	110
ADP100-S2-IE5	100	3	2926	83	130	213
ADP112-S2-IE5	112	4	2952	115	-5	110
ADP132-S2-IE5	132	5,5	2951	105	317	423
ADP132-L2-IE5	132	7,5	2955	147	331	478
ADP160-S2-IE5	160	11	2965	152	431	583
ADP160-M2-IE5	160	15	2964	206	682	888
ADP160-L2-IE5	160	18,5	2964	240	797	1036
ADP180-S2-IE5	180	22	2968	247	1130	1377

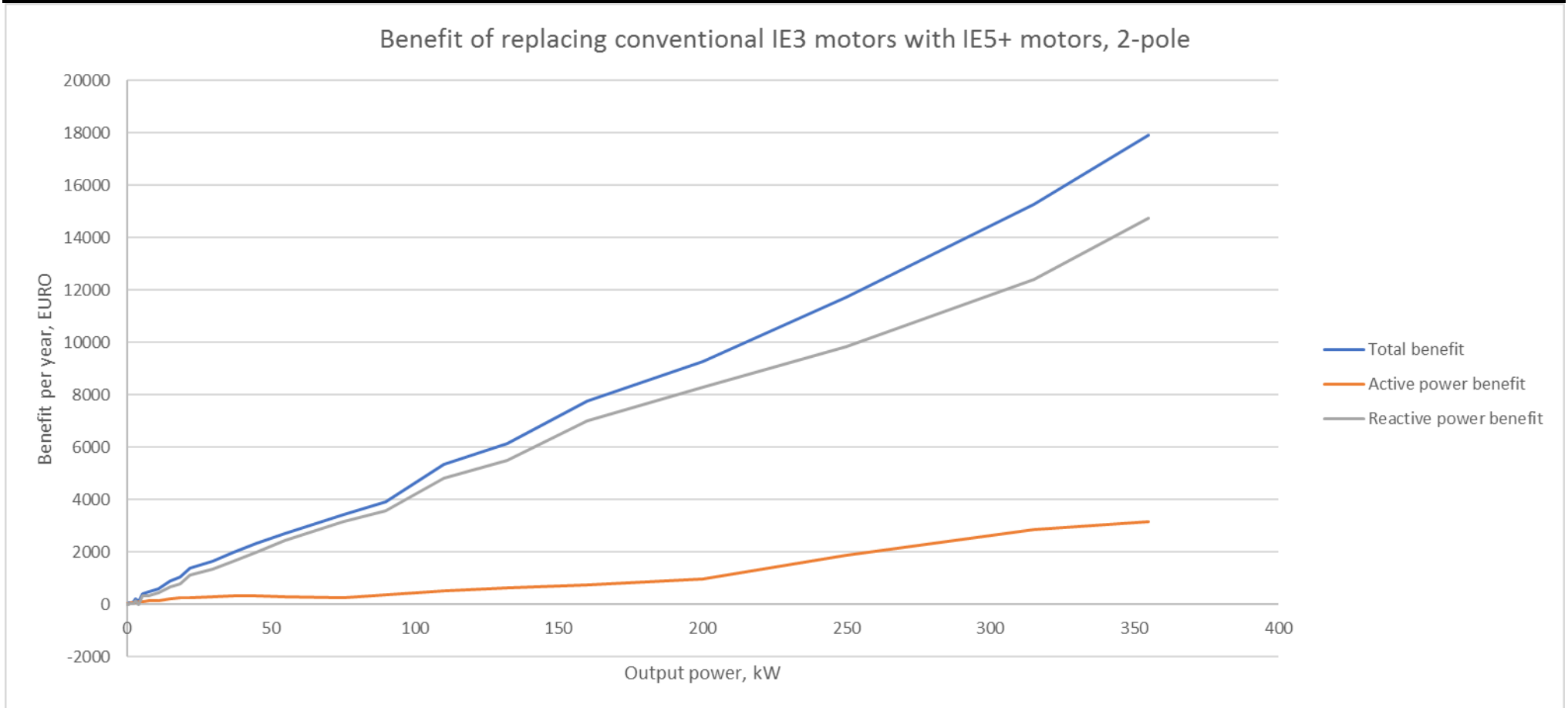
Motor type	Axis height [mm]	Output power [kW]	Nominal speed [rpm]	Benefit act. IE3 [EURO]	Benefit react. IE3 [EURO]	Benefit total IE3 [EURO]
ADP200-S2-IE5	200	30	2966	295	1344	1638
ADP200-L2-IE5	200	37	2965	333	1650	1983
ADP225-S2-IE5	225	45	2967	345	2000	2345
ADP250-S2-IE5	250	55	2979	284	2437	2721
ADP160-S2-IE5	160	11	2965	152	431	583
ADP160-M2-IE5	160	15	2964	206	682	888
ADP160-L2-IE5	160	18,5	2964	240	797	1036
ADP180-S2-IE5	180	22	2968	247	1130	1377
ADP200-S2-IE5	200	30	2966	295	1344	1638
ADP280-S2-IE5	280	75	2982	273	3152	3425
ADP280-L2-IE5	280	90	2982	357	3578	3935
ADP315-S2-IE5	315	110	2982	531	4828	5359
ADP315-M2-IE5	315	132	2981	640	5506	6146
ADP315-L2-IE5	315	160	2981	757	6993	7750
ADP315-SL2-IE5	315	200	2980	958	8308	9265
ADP355-S2-IE5	355	250	2986	1870	9857	11727
ADP355-M2-IE5	355	315	2986	2873	12420	15293
ADP355-L2-IE5	355	355	2984	3167	14746	17913

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## IE5+ catalogue

### 3.3 4-pole motors

Motor type	Axis height [mm]	Output power [kW]	Nominal speed [rpm]	Benefit act. IE3 [EURO]	Benefit react. IE3 [EURO]	Benefit total IE3 [EURO]
ADP56-S4-IE5	56	0,06	1410	12	2	14
ADP56-L4-IE5	56	0,09	1363	14	5	20
ADP63-S4-IE5	63	0,12	1375	16	4	20
ADP63-L4-IE5	63	0,18	1363	16	8	24
ADP71-S4-IE5	71	0,25	1399	19	12	31
ADP71-L4-IE5	71	0,37	1406	24	13	37
ADP80-S4-IE5	80	0,55	1447	28	9	37
ADP80-L4-IE5	80	0,75	1452	34	17	51
ADP90-S4-IE5	90	1,1	1451	44	43	87
ADP90-L4-IE5	90	1,5	1449	52	77	129
ADP100-S4-IE5	100	2,2	1450	70	83	153
ADP100-L4-IE5	100	3	1455	91	30	120
ADP112-S4-IE5	112	4	1467	114	62	176
ADP132-S4-IE5	132	5,5	1472	142	220	362
ADP132-L4-IE5	132	7,5	1474	177	118	295
ADP160-S4-IE5	160	11	1482	210	142	352

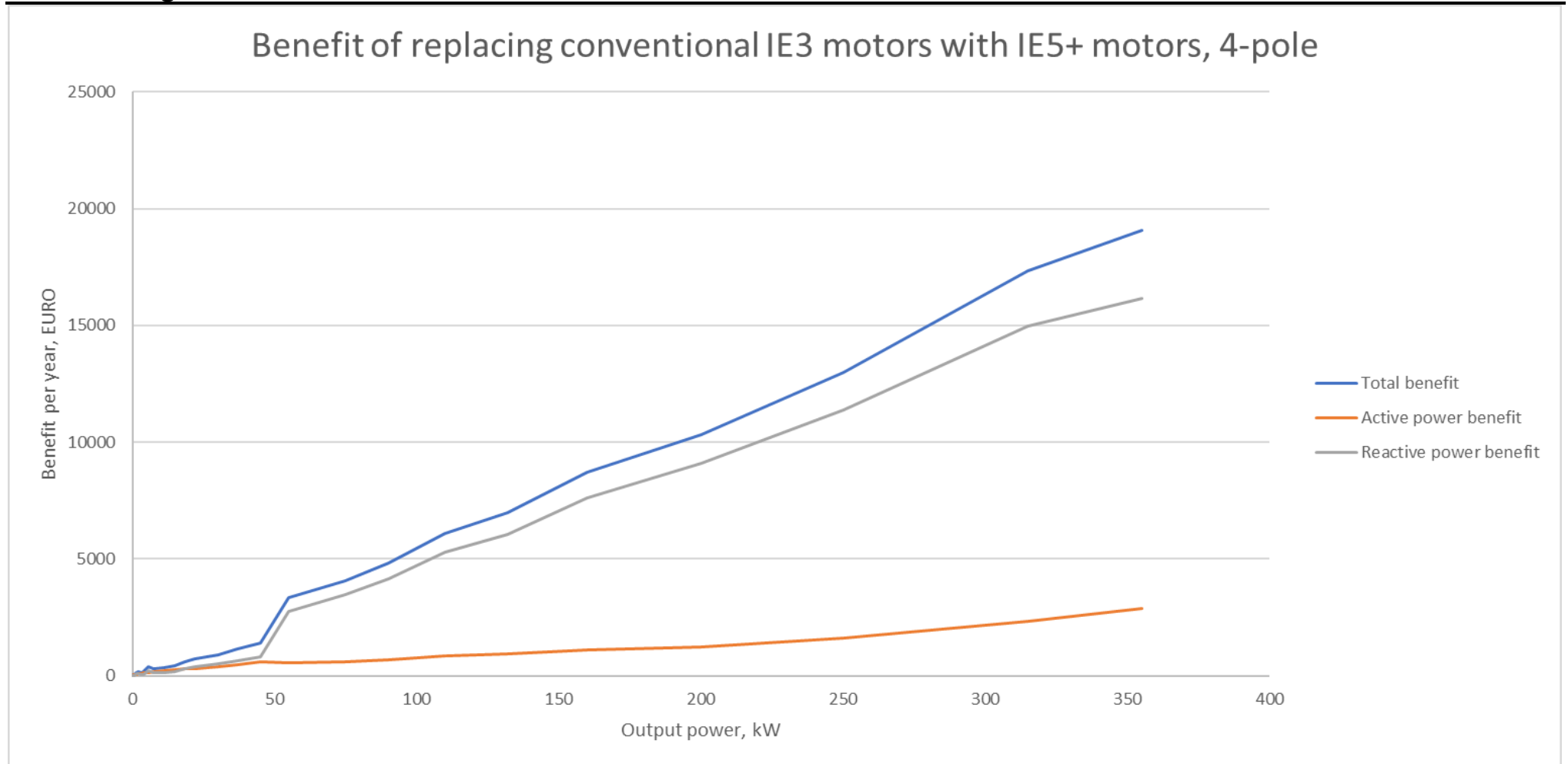
Motor type	Axis height [mm]	Output power [kW]	Nominal speed [rpm]	Benefit act. IE3 [EURO]	Benefit react. IE3 [EURO]	Benefit total IE3 [EURO]
ADP160-L4-IE5	160	15	1482	249	178	427
ADP180-S4-IE5	180	18,5	1485	298	284	581
ADP180-L4-IE5	180	22	1485	318	398	716
ADP200-S4-IE5	200	30	1486	396	509	905
ADP225-S4-IE5	225	37	1489	478	647	1125
ADP225-L4-IE5	225	45	1489	574	821	1395
ADP250-S4-IE5	250	55	1489	566	2769	3334
ADP280-S4-IE5	280	75	1489	589	3454	4043
ADP280-L4-IE5	280	90	1489	696	4136	4831
ADP315-S4-IE5	315	110	1488	842	5269	6110
ADP315-M4-IE5	315	132	1488	941	6040	6981
ADP315-L4-IE5	315	160	1489	1099	7631	8730
ADP315-SL4-IE5	315	200	1488	1217	9114	10331
ADP355-S4-IE5	355	250	1487	1608	11393	13000
ADP355-M4-IE5	355	315	1488	2339	14993	17332
ADP355-L4-IE5	355	355	1488	2898	16178	19076

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## IE5+ catalogue

### 3.4 6-pole motors

Motor type	Axis height [mm]	Output power [kW]	Nominal speed [rpm]	Benefit act. IE3 [EURO]	Benefit react. IE3 [EURO]	Benefit total IE3 [EURO]
ADP71-S6-IE5	71	0,18	914	26	8	34
ADP71-L6-IE5	71	0,25	920	27	4	31
ADP80-S6-IE5	80	0,37	931	29	6	35
ADP80-L6-IE5	80	0,55	941	33	12	45
ADP90-S6-IE5	90	0,75	946	43	19	62
ADP90-L6-IE5	90	1,1	949	54	31	84
ADP100-S6-IE5	100	1,5	960	68	36	105
ADP112-S6-IE5	112	2,2	967	88	78	166
ADP132-S6-IE5	132	3	974	111	168	279
ADP132-M6-IE5	132	4	974	131	248	379
ADP132-L6-IE5	132	5,5	978	164	324	488
ADP160-S6-IE5	160	7,5	985	208	229	437
ADP160-L6-IE5	160	11	986	247	323	570
ADP180-S6-IE5	180	15	988	300	177	477

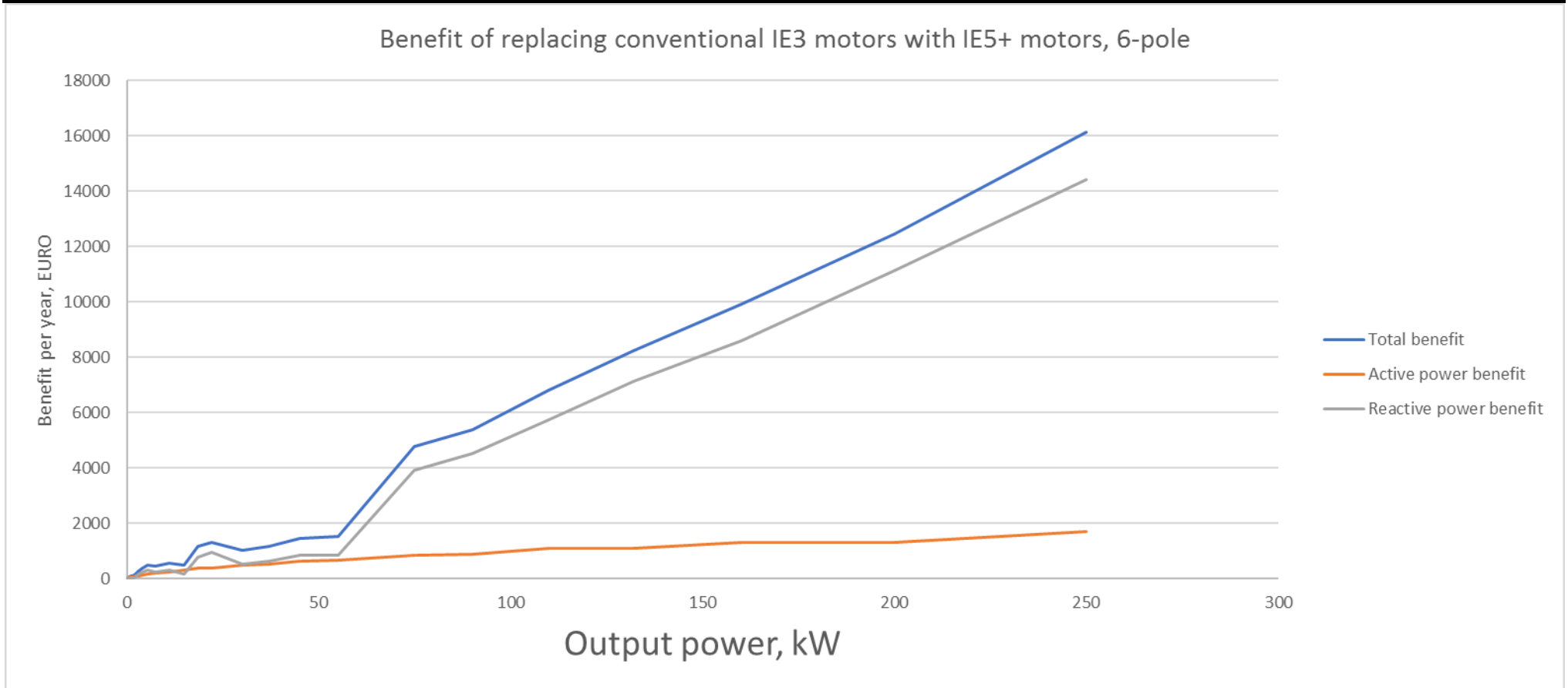
Motor type	Axis height [mm]	Output power [kW]	Nominal speed [rpm]	Benefit act. IE3 [EURO]	Benefit react. IE3 [EURO]	Benefit total IE3 [EURO]
ADP200-S6-IE5	200	18,5	989	373	782	1156
ADP200-L6-IE5	200	22	989	383	945	1328
ADP225-S6-IE5	225	30	990	494	530	1024
ADP250-S6-IE5	250	37	992	534	618	1151
ADP280-S6-IE5	280	45	992	621	846	1467
ADP280-L6-IE5	280	55	992	671	850	1521
ADP315-S6-IE5	315	75	992	859	3928	4787
ADP315-M6-IE5	315	90	991	869	4516	5386
ADP315-L6-IE5	315	110	992	1083	5731	6814
ADP315-SL6-IE5	315	132	992	1107	7121	8228
ADP355-S6-IE5	355	160	993	1306	8613	9919
ADP355-M6-IE5	355	200	992	1310	11144	12454
ADP355-L6-IE5	355	250	991	1689	14430	16119

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### 3.5 8-pole motors

Motor type	Axis height [mm]	Output power [kW]	Nominal speed [rpm]	Benefit act. IE3 [EURO]	Benefit react. IE3 [EURO]	Benefit total IE3 [EURO]
ADP80-L8-IE5	80	0,25	695	39	10	49
ADP90-S8-IE5	90	0,37	711	40	7	47
ADP90-L8-IE5	90	0,55	712	48	-9	39
ADP100-S8-IE5	100	0,75	723	67	-11	56
ADP100-L8-IE5	100	1,1	722	80	-11	70
ADP112-S8-IE5	112	1,5	704	73	61	134
ADP132-S8-IE5	132	2,2	722	123	46	169
ADP132-L8-IE5	132	3	721	140	47	187
ADP160-S8-IE5	160	4	734	181	101	282
ADP160-M8-IE5	160	5,5	734	197	82	279
ADP160-L8-IE5	160	7,5	733	240	123	363
ADP180-S8-IE5	180	11	737	312	159	470
ADP200-S8-IE5	200	15	737	361	524	884

Motor type	Axis height [mm]	Output power [kW]	Nominal speed [rpm]	Benefit act. IE3 [EURO]	Benefit react. IE3 [EURO]	Benefit total IE3 [EURO]
ADP225-S8-IE5	225	18,5	739	448	156	603
ADP225-L8-IE5	225	22	739	483	669	1152
ADP250-S8-IE5	250	30	743	689	6	696
ADP280-S8-IE5	280	37	744	843	1133	1976
ADP280-L8-IE5	280	45	743	919	1533	2452
ADP315-S8-IE5	315	55	743	1186	1870	3056
ADP315-M8-IE5	315	75	743	1451	825	2276
ADP315-L8-IE5	315	90	743	1557	1114	2672
ADP315-SL8-IE5	315	110	741	1539	1445	2983
ADP355-S8-IE5	355	132	743	1862	5159	7021
ADP355-M8-IE5	355	160	743	2024	2595	4619
ADP355-L8-IE5	355	200	744	2320	3624	5944

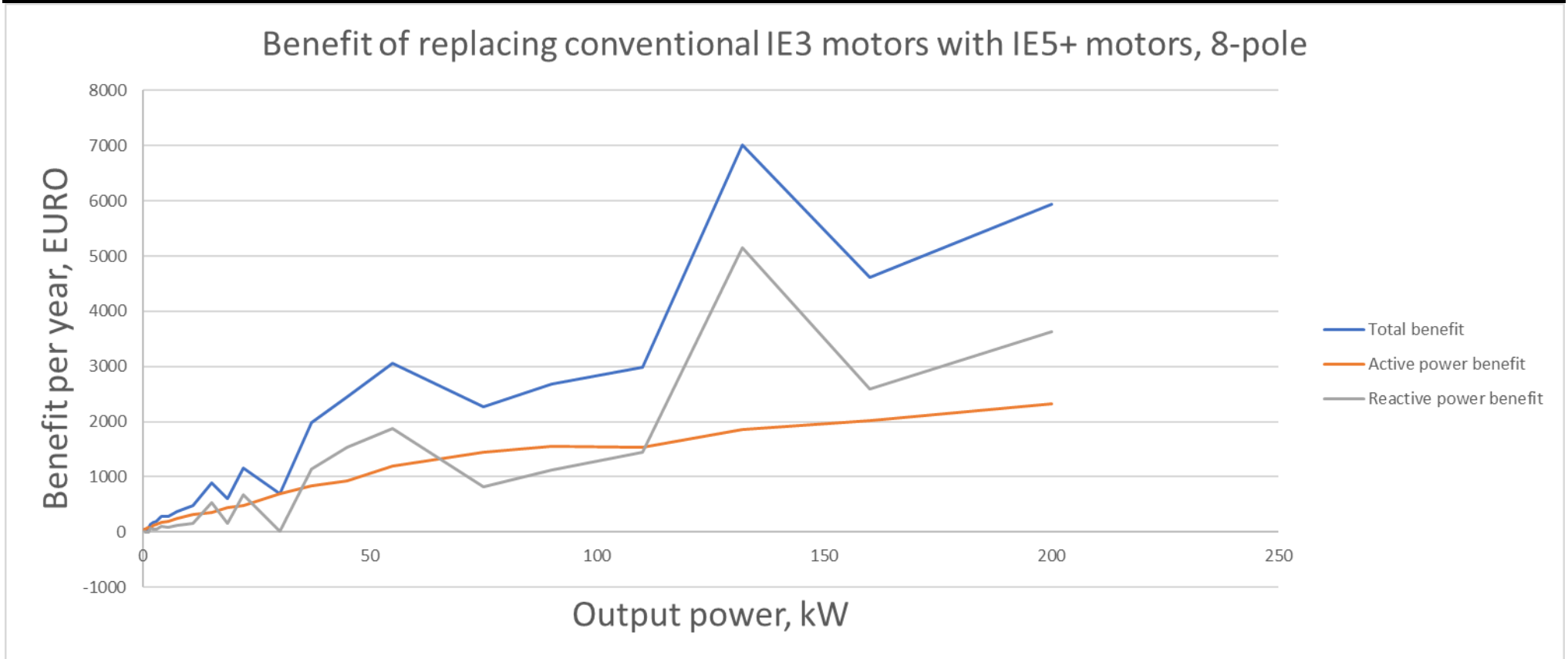
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