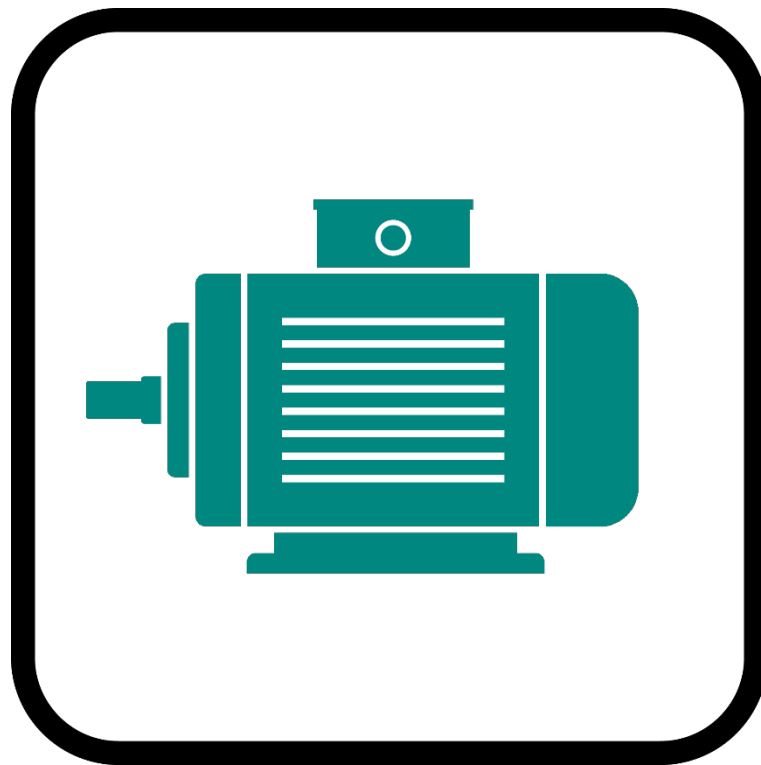




Report from July 2018 (second revised edition)

Topmotors Market Report Switzerland 2017



TOPMOTORS

TM-MR17-EN-2



Date: July 2018

Town: Bern

Publisher:

Swiss Federal Office of Energy SFOE
CH-3003 Bern
www.bfe.admin.ch

Agent:

Impact Energy
Gessnerallee 38a, 8001 Zurich
www.impact-energy.ch

IHS Markit
3301 Northland Dr #400, Austin, TX 78731, USA
<https://ihsmarket.com>

Author:

Conrad U. Brunner, Impact Energy, cub@impact-energy.ch
Rita Werle, Impact Energy, rita.werle@impact-energy.ch

SFOE head of domain: Richard Phillips,
Richard.Phillips@bfe.admin.ch

SFOE programme manager: Richard Phillips,
Richard.Phillips@bfe.admin.ch

SFOE contract number: SI/402584-06

The author of this report bears the entire responsibility for the content and for the conclusions drawn therefrom.

The second edition of the Topmotors Market Report 2017 includes findings from the report 2018 that have improved the estimate of the share of 8-pole motors.

Swiss Federal Office of Energy SFOE

Mühlestrasse 4, CH-3063 Ittigen; postal address: CH-3003 Bern
Phone +41 58 462 56 11 · Fax +41 58 463 25 00 · contact@bfe.admin.ch · www.bfe.admin.ch



Contents

Contents	3
List of abbreviations	3
1 Summary	4
1.1 Goal.....	4
1.2 Relevance of electric motor market for electricity consumption in Switzerland	4
1.3 Key findings.....	4
2 Background.....	4
3 Goal.....	5
4 Scope	6
5 Methodology.....	6
6 Results	7
6.1 Motor sales and compliance	7
6.2 Availability of efficient motors.....	11
6.3 Motor prices	13
6.4 VFD prices	14
7 Next steps	14
8 References.....	15

List of abbreviations

EnEV	Swiss energy efficiency ordonnance
EnG	Swiss energy act
IE1, IE2, IE3, IE4	IE-code for motor efficiency according to IEC 60034-30-1
MEPS	Minimum Energy Performance Standards
OEM	Original Equipment Manufacturer
SFOE	Swiss Federal Office of Energy
VFD	Variable Frequency Drive



1 Summary

1.1 Goal

This Topmotors Market Report informs on the status of the market of electric motors in Switzerland in the year 2016. This first-time research serves to inform the Swiss Federal Office of Energy (SFOE) and all interested stakeholders on the compliance of electric motors, the number and efficiency of motors sold, their availability and specific price - the latter also for Variable Frequency Drives (VFDs).

1.2 Relevance of electric motor market for electricity consumption in Switzerland

Over 170'000 new electric motors were sold in Switzerland in 2016. These motors have an aggregated installed electric power of 1'000 MW and are estimated to demand around 3'000 GWh/a of electricity consumption, i.e. 5% of the total Swiss electricity consumption. The new motors sold help to rejuvenate the existing motor stock of approximately 2 million motors and to increase the efficiency by replacing older, inefficient motors.

1.3 Key findings

The key findings of the survey of the 2016 low voltage motor market can be summarized as follows:

- a. From the total 173'040 electric motors sold in Switzerland in 2016, 21'224 were within the scope of the legal requirements¹ (i.e. between 7.5 - 375 kW mechanical output power with 2-, 4- and 6-poles). From these, 76.6% (IE3 and IE4) fulfilled the legal requirements, 0.8% (IE1) did not and for 22.7% (IE2) it cannot be accurately determined to what percentage they fulfilled the MEPS, while it is assumed that they did to a large extent.
- b. Motors of higher efficiency classes IE3 and IE4 are now readily available on the market and can be delivered in a large variety of sizes and poles by a number of suppliers within 4 to 6 weeks.
- c. The price of IE3 premium motors is 17% more than the lower efficient IE2 class. The price of the next generation IE4 motors is 21% more than of IE3.

2 Background

The program Topmotors, managed by Impact Energy, implements governmental and voluntary policies on efficient motor systems, pumps, fans, compressors, transport and process machines, since 2007 with the support of SFOE.

Motor systems represent a large portion of Swiss electricity consumption (49%). About half of this is for industrial applications (including large commercial and public buildings, etc.), representing 27% of Swiss electricity consumption (see Figure 1).

¹ The share of 8-pole motors was revised for the second edition of the Market Report 2017 with better data from the 2018 Report. This leads to a slightly altered number of motors in the scope.



With system optimization, 20 - 30% of energy savings are possible. [1] [3] [5]

The Swiss national Energy Strategy 2050, approved by a public referendum in May 2017, wants to specifically introduce energy efficiency measures in industry in order to harvest the large savings potential.

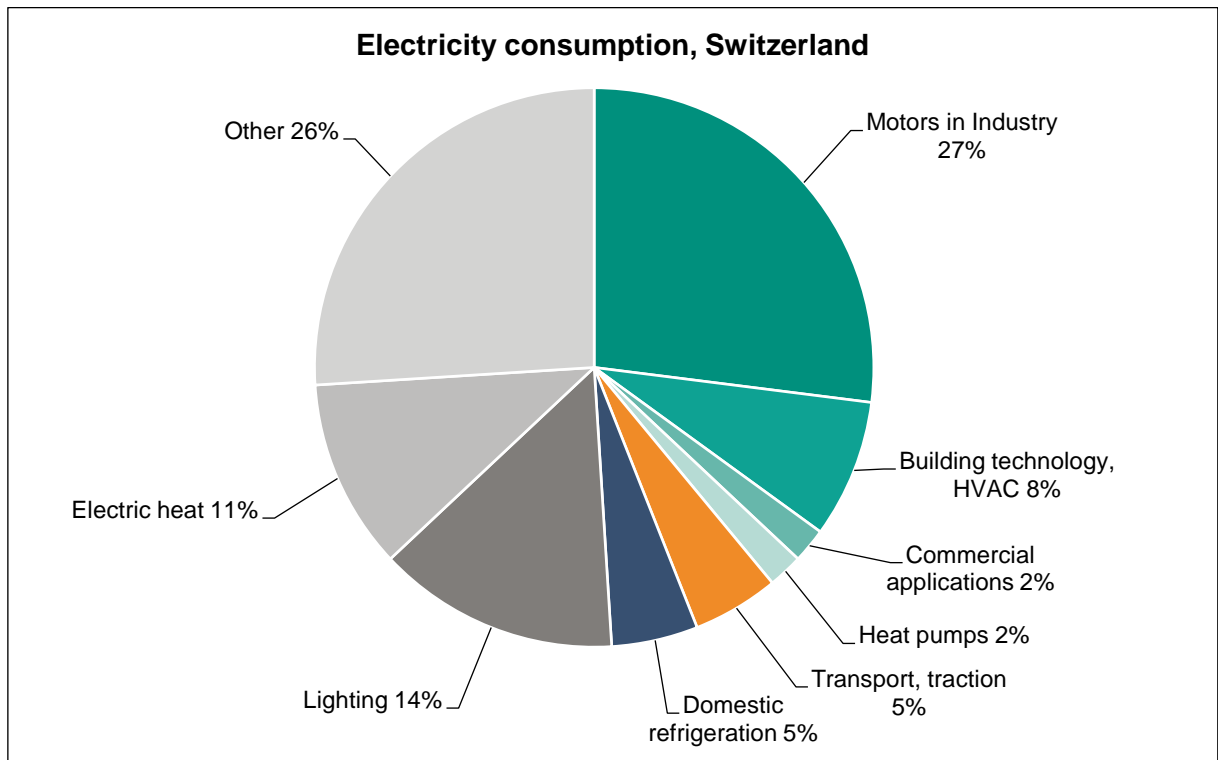


Figure 1: Share of electric motor systems in Swiss electricity consumption (S.A.F.E./J. Nipkow 2013)

3 Goal

The SFOE as the federal implementing organization of legal measures in the field of energy is interested to monitor the market development of all energy using products closely. It is especially focused on products with MEPS like motors, circulators, water pumps and fans in order to check compliance and plan future development of requirements. It is important to monitor the market transformation towards energy efficient equipment and especially the effect of Minimum Energy Performance Standards (MEPS) to verify the success and effectiveness of policy instruments and to adequately sharpen their scope.

The analysis for this first Topmotors Market Report was launched in 2017 to research the sale, compliance, availability and specific price of electric motors and the specific price of VFDs. The goal was to cover at least 50% of the market with available data. The analysis is directed at the preceding year's data (2016). The Topmotors Market Report will be published annually to inform SFOE and all interested stakeholders on the status of the market.



4 Scope

In Switzerland, MEPS are in effect for motors, circulators and water pumps (EnG/EnEV). These MEPS are fully synchronized with the European Ecodesign regulations (see Table 1).

Product	European Union: Ecodesign directive, no.	Swiss Energy Act (EnG), Ordinance for Energy Efficiency (EnEV), annex no.
Motor	640/2009	2.7
Circulator	641/2009	2.8
Water pump	547/2012	2.9
Fan	327/2011	2.6

Table 1: MEPS in the European Union and Switzerland

The following criteria apply for the electric motors falling under the scope of MEPS in Switzerland, as laid out in the Swiss energy efficiency ordinance 2.7:

- From 1 August 2016: 7.5 kW - 375 kW mechanical output power
- From 1 January 2017: 0.75 kW to 375 kW mechanical output power
- 2-, 4-, 6- poles
- Minimum IE3 efficiency class or IE2 sold in combination with a Variable Frequency Drive (IE-codes as defined in IEC 60034-30-1).

The MEPS effective in 2016 affect only motors above 7.5 kW.

5 Methodology

In order to secure an impartial, scientific and anonymous market research, SFOE has mandated Impact Energy to conduct a market survey. Impact Energy has mandated IHS Markit, the leading market research agency, with global know-how, expertise and experience concerning industrial products. IHS Markit's task was especially the interaction with the industrial companies who manufacture, import or sell the products to large end consumers, Original Equipment Manufacturers (OEM) and wholesalers.

All survey companies have been informed with a letter by SFOE on the intent of the research, clearly stating that the data gathered will be kept confidential and used in an anonymous manner. For the availability of motors, the surveyed companies gave their consent to publish their names.

The survey was sent out with a questionnaire in spring 2017 in Switzerland. A total of 59 companies involved in motors, pumps, fans and VFDs were contacted. Useful answers for the research could be derived from 16 motor and 13 VFD companies. The direct results of the survey cover 60% of the market volume. All data were collected bilaterally by IHS Markit and kept anonymously. The subsequent data evaluation work by Impact Energy was based on anonymous files. The participating companies were given an outline of the results of the research. First results were shown at the Motor Summit 2017 Switzerland on 21 November 2017 in Zurich.



The reliability of the data gathered is satisfactory, as it covers more than the planned 50% of the market. At the same time, it has to be critically evaluated, as the results of the research are based on self-declared data by manufacturers, complemented by estimates of IHS Markit based on larger samples in Europe. The goal for the coming years is to increase the quality and reliability of the raw data.

6 Results

6.1 Motor sales and compliance

For the interpretation of the results, the following assumptions were made and need to be taken into account:

1. The motor sales were derived from direct survey results of motor sales in Switzerland combined with market estimates from IHS Markit based on previously available European data. The direct results of the survey cover at least 60% of the Swiss market volume.
2. 8-pole motors are assumed to represent 5% of the sum of 2-, 6-, 8-pole motors sold².
3. It is assumed, that about 50% of the IE2 motors were sold and used together with a VFD.

A total of 173'040 electric motors were sold in Switzerland in 2016 (see Table 2). These motors cover the full range of IEC 60034-30-1 from 0.12 to 1000 kW, IE-code IE1 to IE4 and 2-, 4-, 6-, 8-poles. The data can be classified into 28 distinguished output power classes. The largest group is the 0.12 - 0.75 kW size, representing 60% of the total number of motors sold in 2016 (see Figure 2).

² The earlier estimate was based on a 25% share of 8-pole motors. Now, based on the more recent and more detailed research in the Market report 2018, it was changed to 5%.

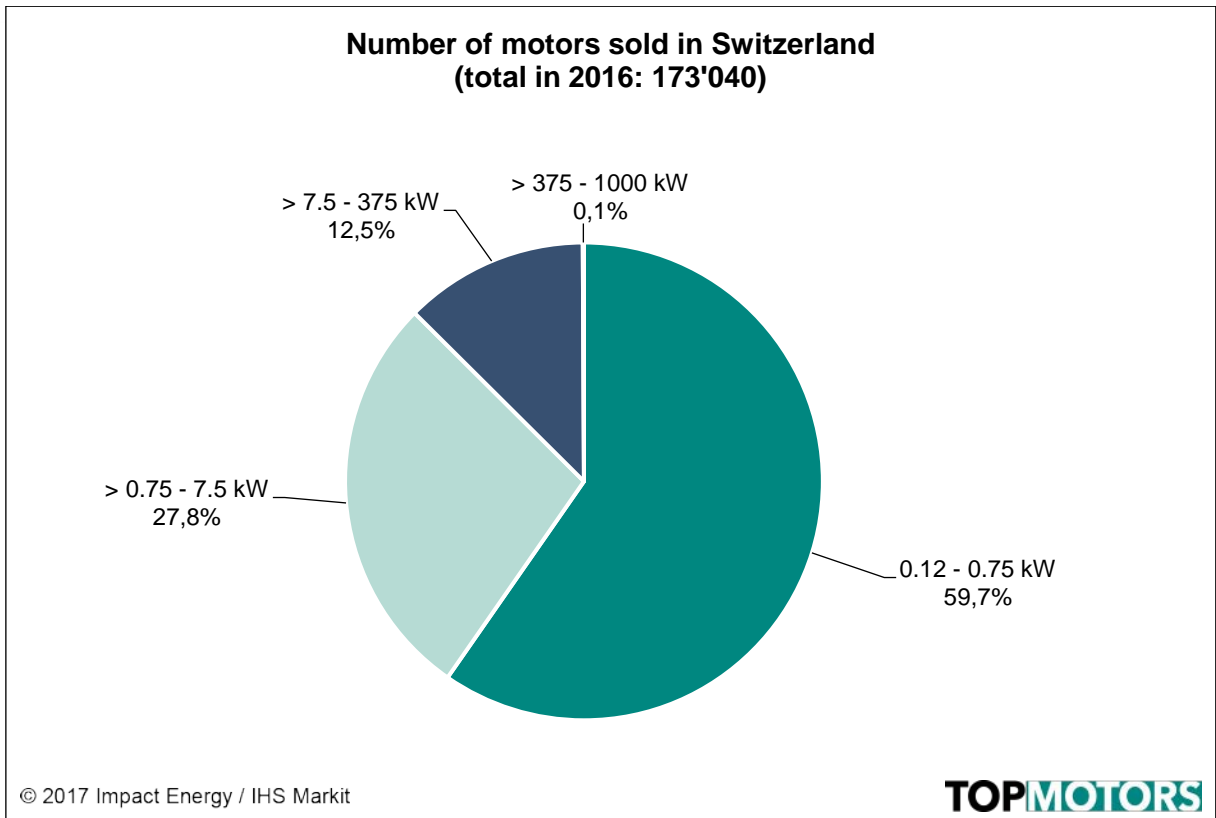


Figure 2: Number of motors sold in Switzerland per range of mechanical output power (2016)

The electric energy consumption of these motors was estimated by using an average configuration of 4'500 running hours per year, an annual average load factor 0.7 and the respective efficiency of each class. With these assumptions the total installed electric power is 1'033 MW and the annual electricity demand is 2'252 GWh/a.

Motors sold in Switzerland 2016	Quantity		El. power MWe	Electricity consumption	
	Number	Share		GWh/a	Share
0.12 – 0.75 kW	103'256	59.7 %	54	171	5.3 %
> 0.75 – 7.5 kW	48'071	27.8 %	140	440	13.5 %
> 7.5 – 375 kW	21'575	12.5 %	750	2'362	72.6 %
> 375 – 1'000 kW	138	0.1 %	89	279	8.6 %
Total	173'040	100 %	1'033	3'252	100 %

Table 2: Motor sales in Switzerland per output power range (2016)

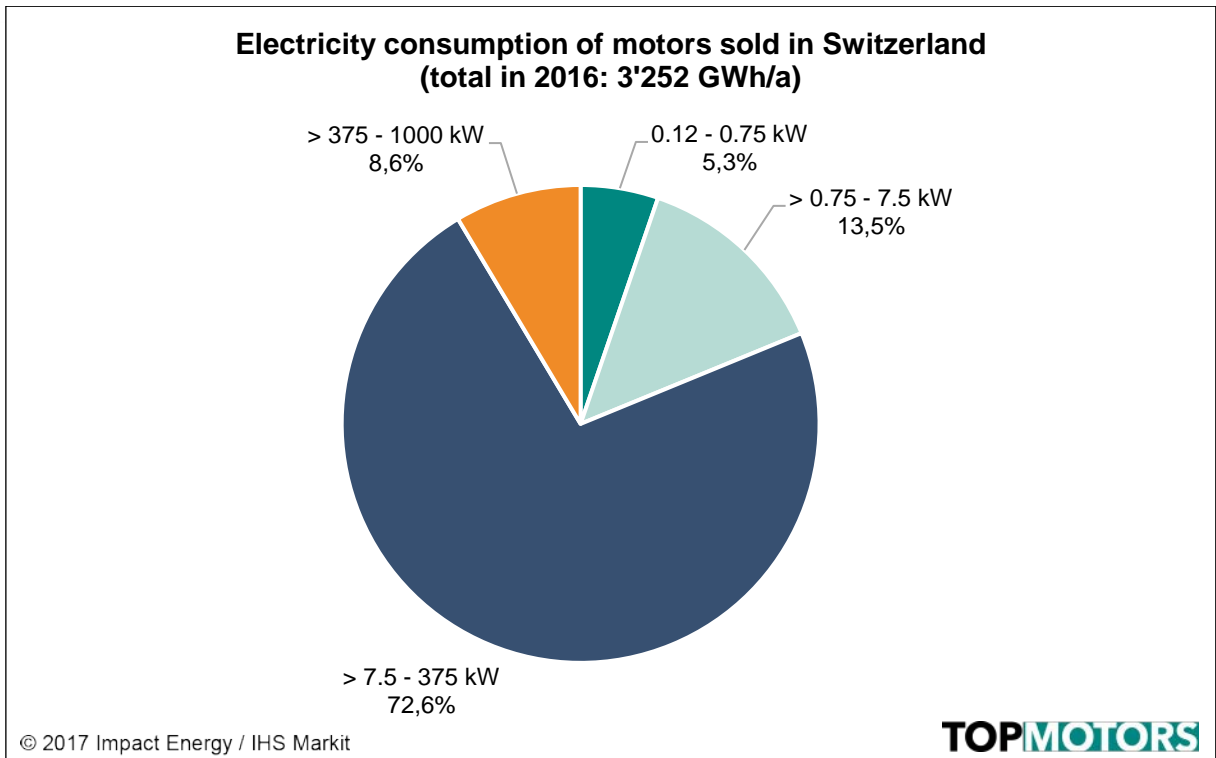


Figure 3: Electricity consumption of motors sold in Switzerland per range of mechanical output power (2016)

Figure 2 in comparison with Figure 3 shows that motors in the output power range between 7.5 and 375 kW are responsible for 72.6% of the electric energy consumption, while they represent only 12.5% of the number of all motors sold in 2016.

Motors sold in Switzerland 2016	Total	IE1	IE2	IE3	IE4
Total	173'040	6'883	102'931	59'153	4'073
Share	100.0%	4.0%	59.5%	34.2%	2.4%

Table 3: Motor sales in Switzerland by efficiency class (2016)

The total number of motors within the scope of the 2016 MEPS is 21'224 (12.3%). The remainder have been excluded mainly because of size (below 7.5 kW), and because of having 8 poles, thus falling outside the scope of the MEPS effective in 2016.

Motors in scope, sold in Switzerland 2016	Total	IE1	IE2	IE3	IE4
Total	21'224	161	4'819	15'679	565
Share	100%	0.8%	22.7%	73.9%	2.7%

Table 4: Motors in scope of the Swiss MEPS in 2016

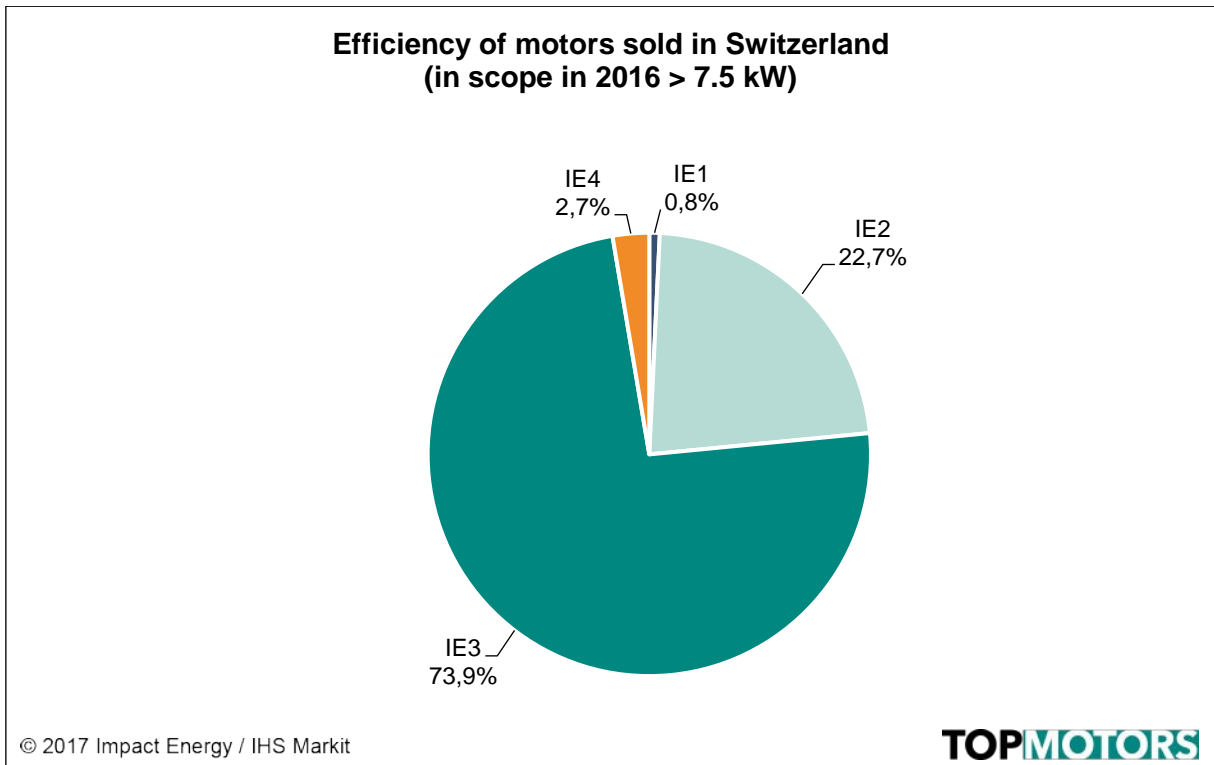


Figure 4: Efficiency of motors under the Swiss MEPS effective in the year 2016

The results concerning motors sold in 2016 (see Table 4 and Figure 4) show the following:

- 0.8% of motors (IE1) did not comply to the MEPS.
- 76.6% of motors (IE3 and IE4) complied to the MEPS.
- for 22.7% of motors (IE2) it cannot be accurately determined to what percentage they fulfilled the MEPS, while it is assumed that they did to a large extent, taking into account the following assumptions and considerations:
 - Some of the motors sold in 2016 did not have to comply with the MEPS as they were not S1 (capable of continuous operation as required in Ecodesign directive no 640/2009) standard motors, thus outside the scope of the MEPS.
 - As the MEPS took effect from 1 August 2016, there is a time lag in the compliance of motors sold during 2016. The current analysis covers the time period 1 January to 31 December 2016. It is assumed that the analysis includes motors sold before 1 August 2016, not reaching the IE2 or IE3 level, which at that time were allowed to be sold.
 - It is assumed, that about 50% of the IE2 motors were sold together with a VFD.

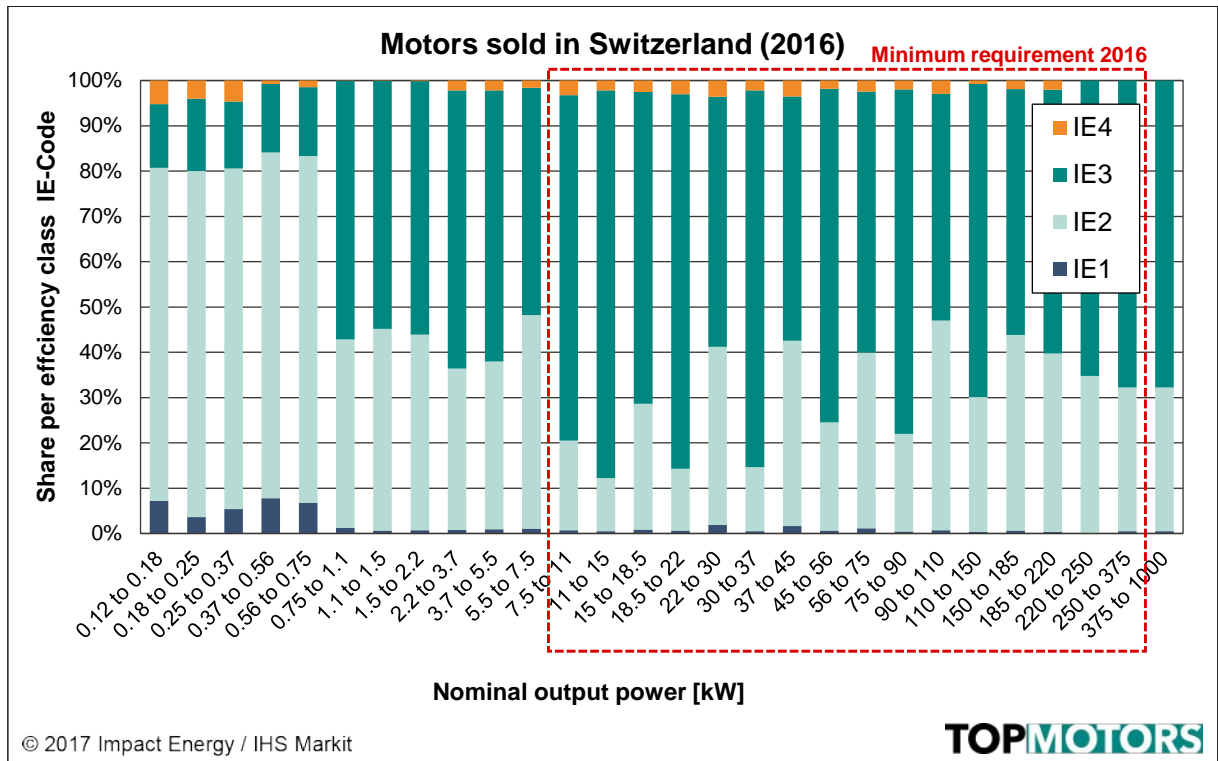


Figure 5: Share by efficiency class of motors sold in Switzerland per output power range (2016)

6.2 Availability of efficient motors

The survey also included questions regarding the availability of efficient motors in different output power sizes from 0.12 to 1000 kW and 2 to 8 poles (see Table 5). A delivery time of 4 to 6 weeks was considered to be tolerable.

The table with the results shows that in the full range of IE3 motors now a fair number of suppliers is on the market. Surprisingly, it also shows that already a considerable number of market players include IE4 in their product range.



Nominal output power (kW)	IE3 according to IEC 60034-30-1				IE4 according to IEC 60034-30-1			
	2-Pole	4-Pole	6-Pole	8-Pole	2-Pole	4-Pole	6-Pole	8-Pole
0.12 to < 0.18	L, W	L, W	L, W	L, W	L	L	L	L
0.18 to < 0.25	L, N, W	L, W	S, A, L, N, W	L, W	L	L	L	L
0.25 to < 0.37	L, N, W	S, A, L, N, W	S, A, L, N, W	L, W	L	L	L	L
0.37 to < 0.56	S, A, L, N, W	S, A, L, N, W	S, A, L, N, W	L, W	L	L	L	L
0.56 to < 0.75	S, A, L, N, W, ATB	S, A, L, N	S, A, L, N	L	L	L	L	L
0.75 to < 1.1	S, A, L, N, W, ATB	N, L, S, A, W	N, L, S, A, W	L, W	N, L	N, L	N, L	L
1.1 to < 1.5	S, A, L, N, W, ATB	S, A, L, N, W, ATB	S, A, L, N, W, ATB	L, W	N, L, S, A	N, L, S, A	N, L, S, A	L
1.5 to < 2.2	S, A, L, N, W, ATB	S, A, L, N, W, ATB	S, A, L, N, W, ATB	L, W	N, L, S, A	N, L, S, A	N, L, S, A	L
2.2 to < 3.7	S, A, L, N, W, ATB	S, A, L, N, W, ATB	S, A, L, N, W, ATB	L, S, A, W	N, L, S, A	N, L, S, A	N, L, W	L
3.7 to < 5.5	S, A, L, N, W, ATB	S, A, L, N, W, ATB	S, A, L, N, W, ATB	L, S, A, W	N, L, S, A	N, L, S, A	N, L, W	L
5.5 to < 7.5	S, A, L, N, W, ATB	S, A, L, N, W, ATB	S, A, L, N, W, ATB	L, S, A, W	N, L, S, A, W	N, L, S, A, W	N, L, W	L
7.5 to < 11	S, A, L, N, W, ATB	S, A, L, N, W, ATB	S, A, L, N, W, ATB	L, S, A, W	N, L, S, A, W	N, L, S, A, W	N, L, W	L
11 to < 15	S, A, L, N, W, ATB	S, A, L, N, W, ATB	S, A, L, N, W, ATB	L, S, A, W	N, L, S, A, W	N, L, S, A, W	N, L, W	L
15 to < 18.5	S, A, L, N, W, ATB	S, A, L, N, W, ATB	S, A, L, N, W, ATB	L, S, A, W	N, L, S, A, W	N, L, S, A, W	N, L, W	L
18.5 to < 22	S, A, L, N, W, ATB	S, A, L, N, W, ATB	S, A, L, N, W, ATB	L, S, A, W	N, L, S, A, W	N, L, S, A, W	N, L, W	L
22 to < 30	S, A, L, N, W, ATB	S, A, L, N, W, ATB	S, A, L, N, W, ATB	L, S, A, W	N, L, S, A, W	N, L, S, A, W	N, L, W	L
30 to < 37	S, A, L, N, W, ATB	S, A, L, N, W, ATB	S, A, L, N, W, ATB	S, A, W	N, L, S, A, W	N, L, S, A, W	N, W	
37 to < 45	S, A, L, N, W, ATB	S, A, L, N, W, ATB	S, A, L, N, W, ATB	S, A, W	N, S, A, W	N, S, A, W	W	
45 to < 56	S, A, L, N, W, ATB	S, A, L, N, W, ATB	S, A, L, N, W, ATB	S, A, W	N, S, A, W	N, S, A, W	W	
56 to < 75	N, S, A	N, S, A	S, A	S, A	N, S, A	N, S, A		
75 to < 90	S, A, L, N, W, ATB	N, S, A, W, ATB	S, A, W, ATB	S, A, W	N, S, A, W	N, S, A, W	W	
90 to < 110	S, A, L, N, W, ATB	N, S, A, W, ATB	S, A, W, ATB	S, A, W	N, S, A, W, ATB	N, S, A, W, ATB	W	
110 to < 150	S, A, L, N, W, ATB	N, S, A, W, ATB	S, A, W, ATB	S, A, W	N, S, A, W, ATB	N, S, A, W, ATB	W	
150 to < 185	S, A, L, N, W, ATB	N, S, A, W, ATB	S, A, W, ATB	A, W	N, S, A, W, ATB	N, S, A, W, ATB	W	
185 to < 220	S, A, L, N, W, ATB	N, S, A, W, ATB	S, A, W, ATB	W	N, S, A, W, ATB	N, S, A, W, ATB	W	
220 to < 250	S, A, L, N, W, ATB	N, S, A, W, ATB	W, ATB	W	N, W	N, W, ATB	W	
250 to < 375	S, A, L, N, W, ATB	N, S, A, W, ATB	W, ATB	W	N, W	N, W, ATB	W	
375 to 1000	S, A, L, N, W, ATB	N, S, A, W, ATB	W, ATB	W	N, W	N, W, ATB	W	

© 2017 Impact Energy / IHS Markit

The abbreviations in the cells above indicate the names of the companies that are capable to deliver this specific type of motors within 4 to 6 weeks.

A = ABB, ATB = ATB Motors (Wolong), L = Lafert, N = Nidec (Leroy Somer), S = Siemens, W = WEG

Table 5: Availability of IE3 and IE4 motors with 2-, 4-, 6- and 8-poles in Switzerland in 2016



6.3 Motor prices

The survey also requested data concerning the price of motors in the Swiss market in 2017. Up to date price data provides a point of reference, facilitates and qualifies the work of project engineers optimizing the energy consumption of motor systems.

A very important element of the sales price for motors is the relative spread between IE2, IE3 and IE4. Table 6 shows the relative price premiums: IE3 over IE2 is only 16.9% more expensive, IE4 over IE3 is 20.5% more expensive. The upgrading from IE2 to IE4 is 41.1% more expensive.

Additional market price		
IE3 <> IE2	IE4 <> IE3	IE4 <> IE2
16.9%	20.5%	41.1%

Table 6: Motors Switzerland: average price premium between IE-codes (2017)

The specific price of motors expressed in CHF/kW (see Figure 6) shows a sharp increase for small motors below 2.2 kW. The results show that a mid-size motor (10 to 30 kW) seems very cheap, while larger motors (50 to 200 kW) become more expensive. This "camel shape" is not yet fully explained and potentially has to do with the high market volume in the mid-size range, while larger sizes are rarely ordered and more often custom made.

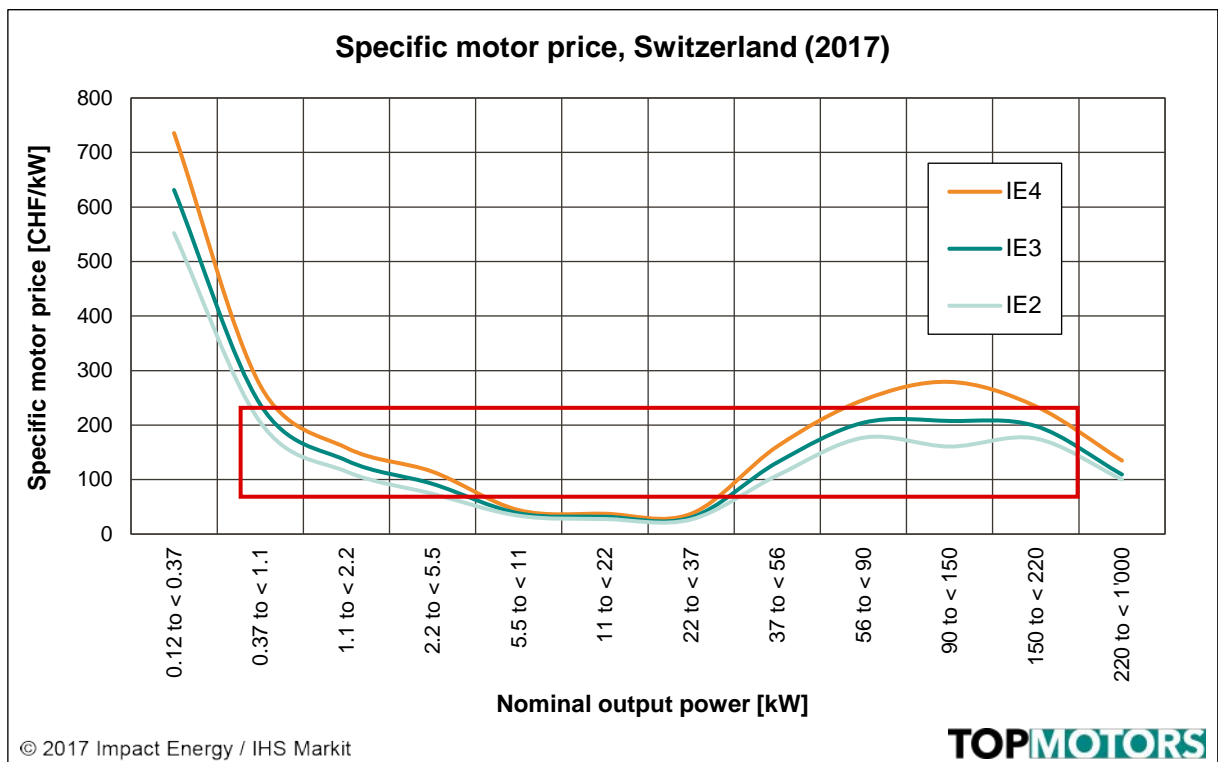


Figure 6: Motors Switzerland: specific price per kW (2017). For the practical application of the price data found in the survey, the red box in the figure shows the most probable price range of the specific motor cost.

6.4 VFD prices

The survey requested data also concerning the price of VFDs in the Swiss market in 2017.

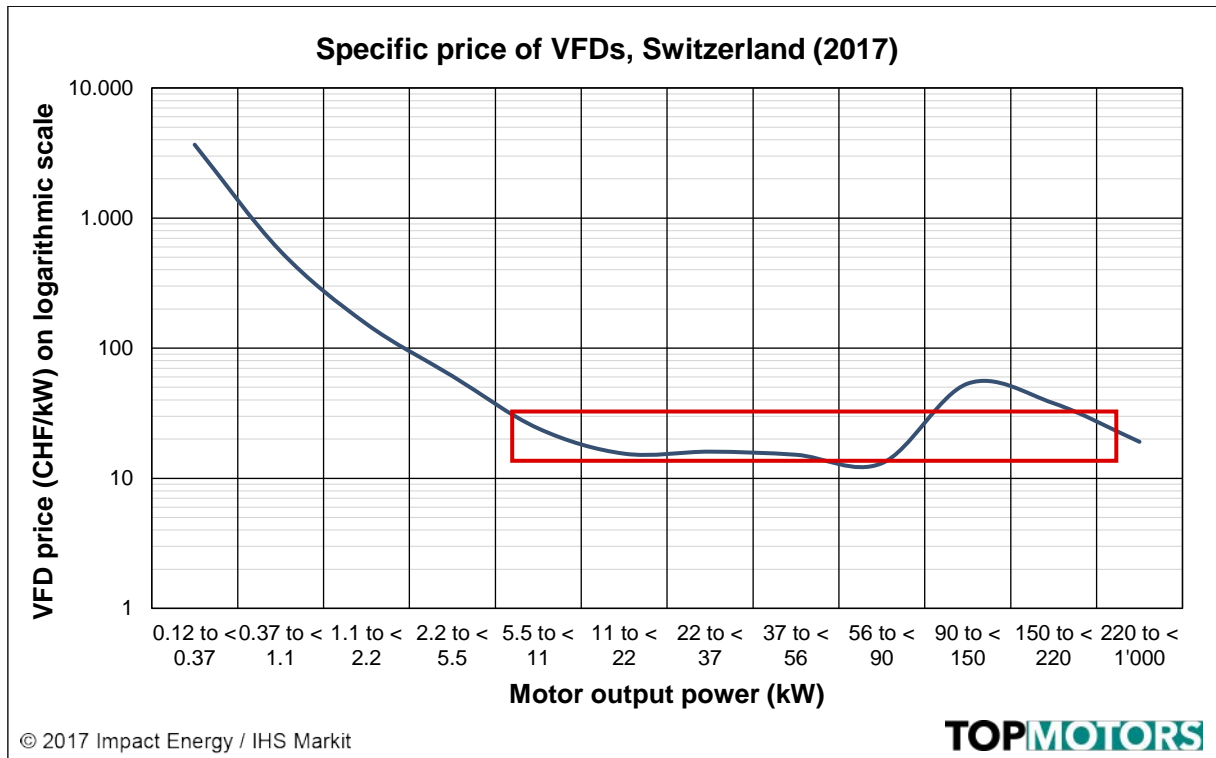


Figure 7: VFDs Switzerland: specific price per kW (2017).
For the practical application of the price data found in the survey, the red box in the figure shows the most probable price range of the specific VFD cost.

The specific price of VFDs expressed in CHF/kW (see Figure 7) shows a sharp increase for smaller VFDs below 10 kW. The results also show that a mid-size VFD (10 to 50 kW) seems cheap, with larger VFDs (50 to 200 kW) becoming more expensive. This "camel shape" is not yet fully explained and potentially has to do with the high market volume in the mid-size range, while larger sizes are rarely ordered and more often custom made.

7 Next steps

This research including the survey will be repeated annually. Based on the results of this first research, some adjustments will be made for the second survey. It is expected to have an increased number of participating companies and get more detailed raw data which will improve the data quality and reliability. It is envisaged that from 2018 (Topmotors Market Report 2018) the survey will include also an analysis for water pumps, fans, and circulators.

The results of the Topmotors Market Report will be used both nationally and internationally to inform interested stakeholders on the ongoing market transformation towards energy efficient industrial products.



8 References

- [1] Paul Waide, Conrad U. Brunner et al.: Energy-Efficiency Policy Opportunities for Electric Motor-Driven Systems, International Energy Agency (IEA), Paris France, 2011.
- [2] Konstantin Kulterer, Rita Werle, Petra Lackner, et al., Policy Guidelines for Electric Motor Systems – Part 2: Toolkit for Policy Makers, October 2014
- [3] 4E Energy efficiency roadmap for electric motors and motor systems, November 2015
- [4] Maarten van Werkhoven, Rita Werle, Conrad U. Brunner: 4E EMSA Policy Guidelines for Motor Driven Units – Part 1: Analysis of standards and regulations for pumps, fans and compressors, October 2016
- [5] Rolf Tieben, Rita Werle, Conrad U. Brunner: EASY- Lessons learned from four years of the Swiss EASY audit and incentive program. In: proceedings of the International Conference on Energy Efficiency in Motor Driven Systems, Helsinki, Finland, 15 – 17 September 2015.
- [6] International Energy Agency: World Energy Outlook 2016; OECD/IEA, Paris 2016.