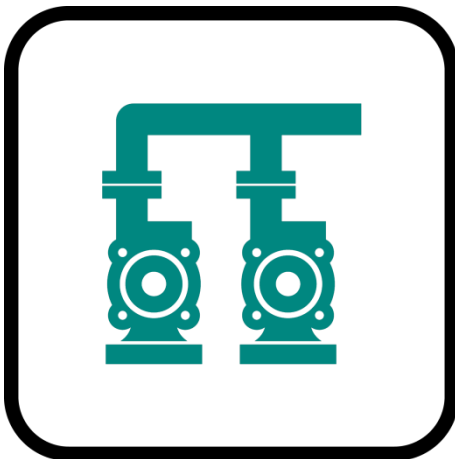
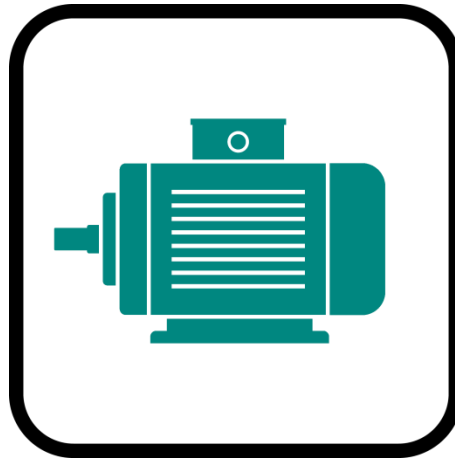




Report from May 2019 (second revised edition)

# Topmotors Market Report Switzerland 2018



**TOPMOTORS**



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## List of abbreviations

SFOE	Swiss Federal Office of Energy
EEI	Energy efficiency index for circulators
EnG	Swiss energy act
EnEV	Swiss energy efficiency ordinance about the energy efficiency requirements of series-produced installations, vehicles and equipment (since 2018)
EnV	Swiss energy ordinance (until 2017)
VFD	Variable Frequency Drive
IE1/IE2/IE3/IE4	IE-code for motor efficiency according to IEC 60034-30-1
MEI	Minimum efficiency index for water pumps



# 1 Summary

## 1.1 Goal

This Topmotors Market Report provides information on the status of the electric motor market in Switzerland for the year 2017. This study, conducted for the second time, serves to inform the Swiss Federal Office of Energy (SFOE) and all interested stakeholders about the number of electric motors sold and their compliance with minimum energy performance standards (MEPS). The study also covered the availability of motors according to efficiency class and the sale prices of motors and variable frequency drives (VFDs). In addition, market data on circulators, water pumps and fans were collected for the first time.

## 1.2 Share of the electric motor market within Swiss electricity consumption

Over 177 786 new electric motors were sold in Switzerland in 2017. These motors have an aggregated installed electric power of some 1 000 MW and demand around 3 432 GWh/a of electricity consumption, corresponding to 5% of total Swiss electricity consumption. The new motors sold help to rejuvenate the existing motor stock of approximately 2 million motors and boost efficiency by replacing older, inefficient motors.

## 1.3 Key findings

The key findings of the survey of the 2017 market for low voltage electric motors, pumps and fans can be summarized as follows, in comparison to the previous year [1]:

### MOTORS

- From the total 177 786 electric motors sold in Switzerland in 2017, 70 143 (2016: 21 207), or 39.5% (2016: 12.3%) were in MEPS scope (i.e. between 0.75 – 375 kW nominal output power with 2-, 4- and 6- poles).
- Of this total, 64.0% (76.6% in the previous year) were MEPS-compliant (IE3 and IE4) while 0.6% (previous year: 0.8%) were not (IE1). For the remaining 35.4% (previous year: 22.7%) (IE2) it cannot be accurately determined to what extent they complied with the MEPS, while it is assumed that they did so to a large extent.
- Motors of higher efficiency classes IE3 and IE4 are now readily available on the market and can be delivered in a large variety of nominal output power and poles by a number of suppliers within 4 to 6 weeks.
- The price of IE3 premium motors is 14% higher (previous year: 17%) than the less efficient IE2 class. The price of the next generation IE4 motors is 17% higher (previous year: 21%) than IE3 motors.<sup>1</sup> Thus, the additional cost of the more efficient motors has diminished.

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<sup>1</sup> Absolute prices cannot be compared directly with the findings of the Topmotors Market Report 2017 because the 2018 prices are based on a different size classification.



## CIRCULATORS

In 2017, 398 870 circulators (integrated and non-integrated) were sold in Switzerland, of which 98.4% had an energy efficiency index (EEI) of  $\leq 0.23$  and thus complied with the MEPS set out in Annex 2.8 of the Swiss Energy Efficiency Ordinance (EnEV). This reflects a real technological and energy success story, which began in 1993 with new pump technologies and better dimensioning.

Non-integrated pumps are sold separately (not as part of a machine or system) and also have their own sales price. Integrated pumps are part of a machine or system that has its own sales price. The end user buys the system.

Switzerland's share of the European circulator market is 2.2% of the number of units.

## WATER PUMPS

In 2017, 51 577 water pumps were sold in Switzerland. The vast majority complied with the MEPS according to EnEV Annex 2.9 with a minimum efficiency index (MEI) of  $\geq 0.4$ . Some pumps even met the higher MEI value of 0.7.

91% of the pumps were smaller than 10 kW, often under 2 kW. Switzerland's share of the European water pump market is 1.9% of the total of the number of units.

A notable high share (39.8%) of the water pumps sold in Switzerland (in Europe as high as 45%) are submersible multistage pumps. In this field, no ISO standards currently exist for submersible pumps, nor are there any IEC standards for electric motors in submersed applications. Accordingly, the emphasis must be placed on standardization with a view to boosting efficiency.

## FANS

In 2017, 115 647 fans were sold in Switzerland, of which 83.4% were below 10 kW. Some 30% of the fans were used in homes, 50% in the service sector and 20% in industry.

Switzerland accounts for 1.0% of the number of all fans sold in the European Union.

Axial fans have the largest market share in Switzerland with 56% (54% in the EU). The more efficient, backward-curved fans have a market share of some 19% in Switzerland (18% in the EU).



## 2 Background

The Topmotors programme, managed by Impact Energy, has been promoting efficient motor systems, pumps, fans, compressors, transport and process machines since 2007 with the support of the SFOE.

Motor systems represent a large share of Swiss electricity consumption (49%). More than half of this is for industrial applications and building technology in the service sector (including infrastructure facilities, commercial applications, etc.), accounting for some 37% of Swiss electricity consumption (see Figure 1).

With system optimization, 20-30% of energy savings are possible [1] [4] [7], as can be seen from many best practices (see [www.topmotors.ch/en/best-practices](http://www.topmotors.ch/en/best-practices)).

The Swiss National Energy Strategy 2050, approved via public referendum in May 2017, is specifically designed to introduce energy efficiency measures in industry so as to reap the large energy savings potential.

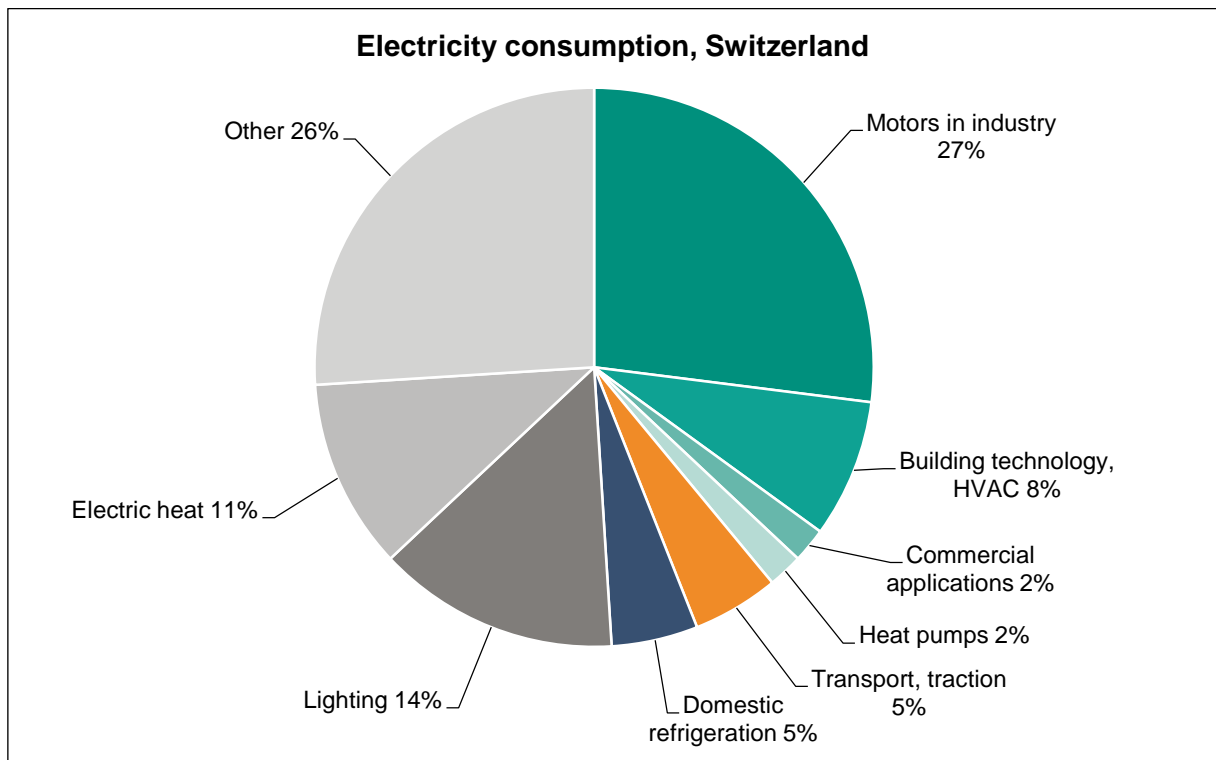


Figure 1: Share of electric motor systems in Swiss electricity consumption (S.A.F.E. / J. Nipkow 2013)

## 3 Goal

The SFOE, as the federal organization responsible for implementing legal measures in the energy field, closely monitors market developments for all energy-using products. It is especially focused on products subject to MEPS such as motors, circulators, water pumps and fans in order to check compliance and plan future requirements. Here, 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 adequately sharpen their scope.



The analyses for the Topmotors Market Report were first launched in 2017 to research the sale, efficiency (MEPS compliance), availability and specific price [CHF/kW] of electric motors and the specific price of VFDs. The goal was to cover at least 50% of the market with available data. The Topmotors Market Report will be published annually to inform the SFOE and all interested stakeholders on the status of the market. The analysis is directed at the previous year's data. The Topmotors Report 2018 is the second such report and covers sales data for 2017. In addition to motors and VFDs, it also contains market data on the sale of circulators, water pumps and fans in Switzerland and elsewhere in Europe.

## 4 Scope

In Switzerland, MEPS are in effect for motors, circulators and water pumps (Swiss energy act EnG/ Swiss energy efficiency ordinance EnEV) and are fully synchronized with the European Ecodesign Directive (see Table 1).

Product	European Union: Ecodesign directive, regulation no.	Switzerland: Efficiency ordinance (EnEV), Annex no.
<b>Motors</b>	640/2009	2.7
<b>Circulators</b>	641/2009	2.8
<b>Water pumps</b>	547/2012	2.9
<b>Fans</b>	327/2011	2.6

**Table 1: MEPS in the European Union and Switzerland**

From 1 January 2017, the following criteria apply to electric motors falling under the scope of MEPS in Switzerland, as laid out in Annex 2.7 of the Swiss Energy Efficiency Ordinance:

- Scope:
  - Motors with nominal output power of minimum 0.75 kW up to maximum 375 kW;
  - 2-, 4-, 6- poles.
- Minimum requirement (energy efficiency class as defined in IEC 60034-30-1):
  - Efficiency class IE3;
  - Or IE2 sold in combination with a VFD.

As before, the energy efficiency of electric motors is measured according to IEC 60034-30 and has applied since 2014 as per IEC 60034-30-1 from 0.12 kW to 1000 kW for 2-, 4-, 6- and 8-pole motors under 1 000 V:

IE-code	Designation
<b>IE1</b>	Standard Efficiency
<b>IE2</b>	High Efficiency
<b>IE3</b>	Premium Efficiency
<b>IE4</b>	Super Premium Efficiency

**Table 2: Efficiency classes (IE-code)**



## 5 Methodology

The survey of motors and VFDs for the Topmotors Market Report 2018 followed the same methods as the one already conducted in 2017 by IHS Markit (see Topmotors Market Report 2017). Leading companies in Switzerland were surveyed that deliver motors, circulators, water pumps, compressors and VFDs, which account for some 60% of the motor market. A total of 18 companies participated in the survey (including all large international manufacturers), three of which are manufacturing in Switzerland.

In order to ensure impartial, scientific and anonymous market research, the SFOE mandated Impact Energy to conduct a market survey. In turn, Impact Energy commissioned IHS Markit, the leading market research agency with global know-how, expertise and experience concerning industrial products. As a neutral body, it was tasked with gathering and anonymizing the market data. IHS Markit's primary task was interacting with the industrial companies which manufacture, import or sell the products to large end users, original equipment manufacturers (OEMs) and wholesalers. In this connection, it is difficult to ascertain how many of these products were purchased as standalones or integrated into machines and exported abroad from Switzerland.

Companies surveyed were informed about the purpose of the research by a letter of SFOE, clearly stating that the data gathered would be kept confidential and used in an anonymous manner.

The survey was sent out with a questionnaire in spring 2018. A total of 59 companies involved in motors, pumps, fans and VFDs in Switzerland were contacted. Useful answers for the research could be derived from 18 companies. The direct findings of the survey cover around 60% of the market volume. All data were collected by IHS Markit and anonymized. The subsequent data evaluation work by Impact Energy was based on anonymous files. The first results were presented at the Motor Summit 2018 Switzerland on 14 November 2018 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 must be evaluated critically, as the research findings are based on self-declared data by manufacturers complemented by IHS Markit estimates for the entire Swiss market based on larger samples in Europe.

The findings for motors and VFDs, which were surveyed for the second time in 2018, show consistent data. For pumps and fans, which were surveyed for the first time in 2018, data consistency can only be verified in coming years. The goal for the coming years is to increase the quality and reliability of the raw data and their evaluation, which can also be achieved by having more companies participate in the survey.

A few survey elements were refined and improved in 2018:

- The group of large motors with mechanical output power of 220 kW to 1000 kW was subdivided into two: 220 kW to 375 kW and 375 kW to 1 000 kW;
- 2-, 4-, 6- and 8-pole motors were surveyed separately for all pole numbers;
- Motor prices were surveyed in smaller size classes (28 instead of 12).

The motors' electric energy consumption was estimated using the same method and with the same assumptions as in the Topmotors Market Report 2017:

- Average configuration of 4 500 running hours per year;
- Annual average load factor of 0.7;
- The respective efficiency of each class.

As the available data on the size of pumps and fans is scarce, it is not possible to calculate energy consumption.





In the revised edition (June 2020), sales data for integrated circulators is included, in addition to non-integrated circulators. Also, the data for fans could be further refined. Through the update, the overall quality and reliability of the data presented could be improved.



## 6 MOTORS and VFDs

### 6.1 Motor sales

The scope of motors required to comply with the Swiss MEPS in 2017 changed in comparison to 2016:

<b>Scope</b>	from 1 August 2016	from 1 January 2017
<b>Applicable ordinance</b>	EnV, Annex 2.10	EnEV, Annex 2.7
<b>Nominal output power</b>	7.5 - 375 kW	0.75 - 375 kW

**Table 3: Scope of the 2017 and 2018 surveys (the survey refers to the previous year)**

The total number of electric motors sold in Switzerland increased by 2.7% from 2016 to 2017 to 177 786 motors, see Table 4.

The type of motor technology used was not surveyed. It can be assumed that the bulk of the motors sold were over 0.75 kW three-phase asynchronous motors (ASMs). With regard to IE4 motors, some permanent magnet and synchronous reluctance motors were also sold. As for smaller motors between 0.12 kW and 0.75 kW, single-phase ASMs and shaded-pole motors were also sold.

The absolute and relative share of the more efficient IE2/IE3/IE4 motors sold rose slightly when compared with 2016, while the IE1 share fell significantly. The IE1 share is now at only 5 668 motors (3.2%, see Table 4).

<b>Motors: sold in Switzerland 2017</b>	2016		2017		Change (absolute)	Change (%)
IE1	6 883	4%	5 668	3.2%	-1 215	-17.7%
IE2	102 931	59.5%	106 472	59.9%	3 541	3.4%
IE3	59 153	34.2%	61 364	34.5%	2 211	3.7%
IE4	4 073	2.4%	4 282	2.4%	208	5.1%
Total	173 040	100%	<b>177 786</b>	100%	4 745	<b>2.7%</b>

**Table 4: Change in efficiency classes of motors sold**

For the first time, data were collected on motors number of poles and rotational speed (see Figure 2 and Figure 3 as well as Table 5). The previous assumptions were confirmed insofar as 4-pole motors accounted for just over half of all sales, with 50.8%. One surprising finding was the high share of faster 2-pole motors with 41.1%, especially in the 0.12 kW to 11 kW segment, as compared to a mere 8.1% for the slower 6- and 8-pole motors.

<b>Number of poles</b>	<b>Synchronous speed (r/min)</b>	<b>Market share (units)</b>
2	3 000	41.1 %
4	1 500	50.8 %
6	1 000	5.7 %
8	750	2.4 %

**Table 5: Number of poles and synchronous speed**

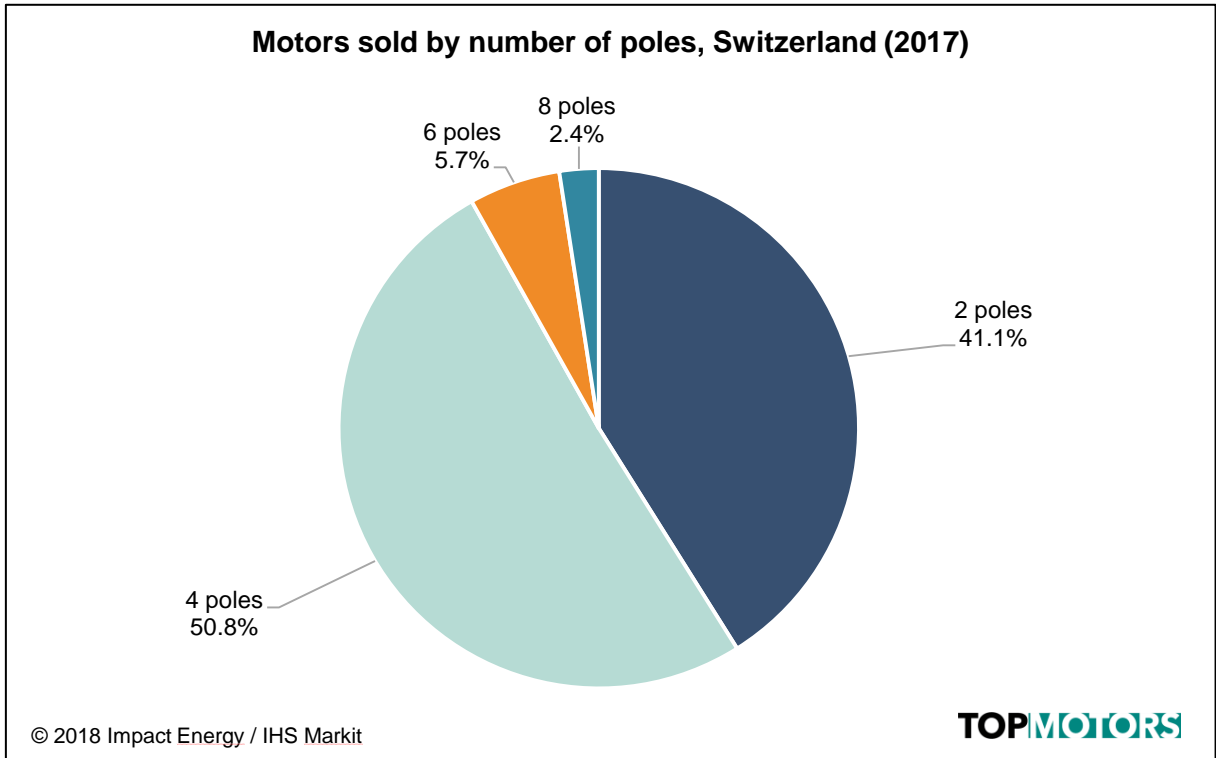


Figure 2: Motors sold by number of poles

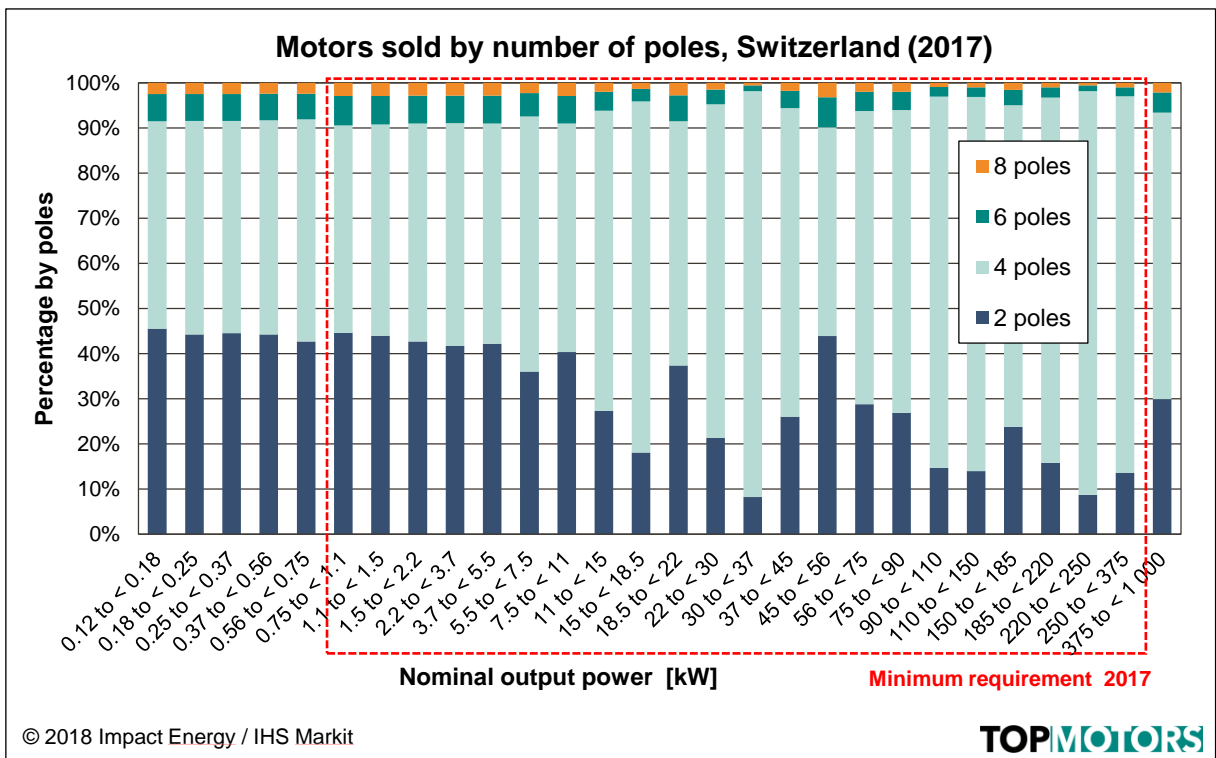


Figure 3: Motors sold by nominal output power and number of poles

In 2017, the motors in the size category with the most units sold (0.75 kW - 375 kW) totalled 71 931 units (40.5% of all motors sold). They accounted for 829 MW of output (82.9 %) and 2 827 GWh/a of electric energy (82.4 %) (see Table 6 and Figure 4 for 2017, and Figure 5 for 2016).



Motors sold in Switzerland 2017	Quantity		Motor output (mech.)		Electricity consumption	
	Nominal output power (kW)	Number	Share	MW <sub>mech</sub>	Share	GWh/a
0.12 - 0.75 kW	105 641	59.4%	40	4%	175	5.1%
> 0.75 - 375 kW	<b>71 931</b>	<b>40.5%</b>	<b>829</b>	<b>82.9%</b>	<b>2 827</b>	<b>82.4%</b>
> 375 – 1 000 kW	214	0.1%	131	13.1%	430	12.5%
Total	177 786	100%	1 000	100%	3 432	100%

**Table 6: Quantities for 2017, motor output and electricity consumption by size class (all numbers of poles)**

## 6.2 Motor efficiency

Using the standard assumptions (4 500 running hours per year, an annual average load factor of 0.7, and the respective efficiency of each class), the total installed electric power of all motors sold in 2017 is 1 000 MW<sub>mech</sub> and the annual electricity demand is 3 432 GWh/a (see Table 6).

Nominal output power (kW)		Number of poles				
from	to	2	4	6	8	
0.12	0.75	all motors of the study (177 786)				
0.75	7.5	<b>In scope in 2017 (total 70 143) *</b>				All motors between 0.75 and 375 kW (71 931)
7.5	375					
375	1 000					

**Table 7: Motors in scope of the Swiss MEPS**  
 \*The motors in scope in 2016 totalled only 21 207 units. This is due to the fact that motors below 7.5 kW were not included in the scope of MEPS in 2016.

In 2017, the motors in scope of Swiss MEPS (0.75 kW - 375 kW and 2-, 4-, 6-poles) totalled 70 143 units (2016: 21 207), or 39.5% (2016: 12.3%) of all motors sold (see Table 8).

The motors in scope (size and number of poles) account for 81% of electricity consumption of all motors sold. With regard to the number of compliant motors, in addition to all IE3 and IE4 motors, IE2 motors are estimated at 50%, as the exact number of IE2 motors sold in combination with a VFD is not known.

Out of the motors in scope, it is assumed that 57 292 or 81.7% met the 2017 MEPS.

In 2016, the scope of MEPS did not include motors below 7.5 kW (for which the share of IE2 motors sold is higher than for larger motors), therefore the corresponding figure for 2016 was higher at 87.9%.

With regard to the motors sold in 2017 (see Figures 8 and 10), the detailed findings are as follows:

- 0.6% of the motors (IE1) did not comply with the MEPS (if they are actually within the scope).
- 64.0% of the motors (IE3 and IE4) complied with the MEPS.
- For 35.4% of the motors (IE2), it cannot be accurately determined to what percentage they met the MEPS, while it is assumed that they did so to a large extent, taking into account the following assumptions and considerations:
  - Many of the motors sold in 2017 did not have to comply with the MEPS as they were not capable of continuous operation as required in Ecodesign Directive No. 640/2009 or have other specialities (explosion-proof, brake motors, etc.), thus are outside the scope of the MEPS.
  - It is assumed that 50% of the IE2 motors were sold together with a VFD.



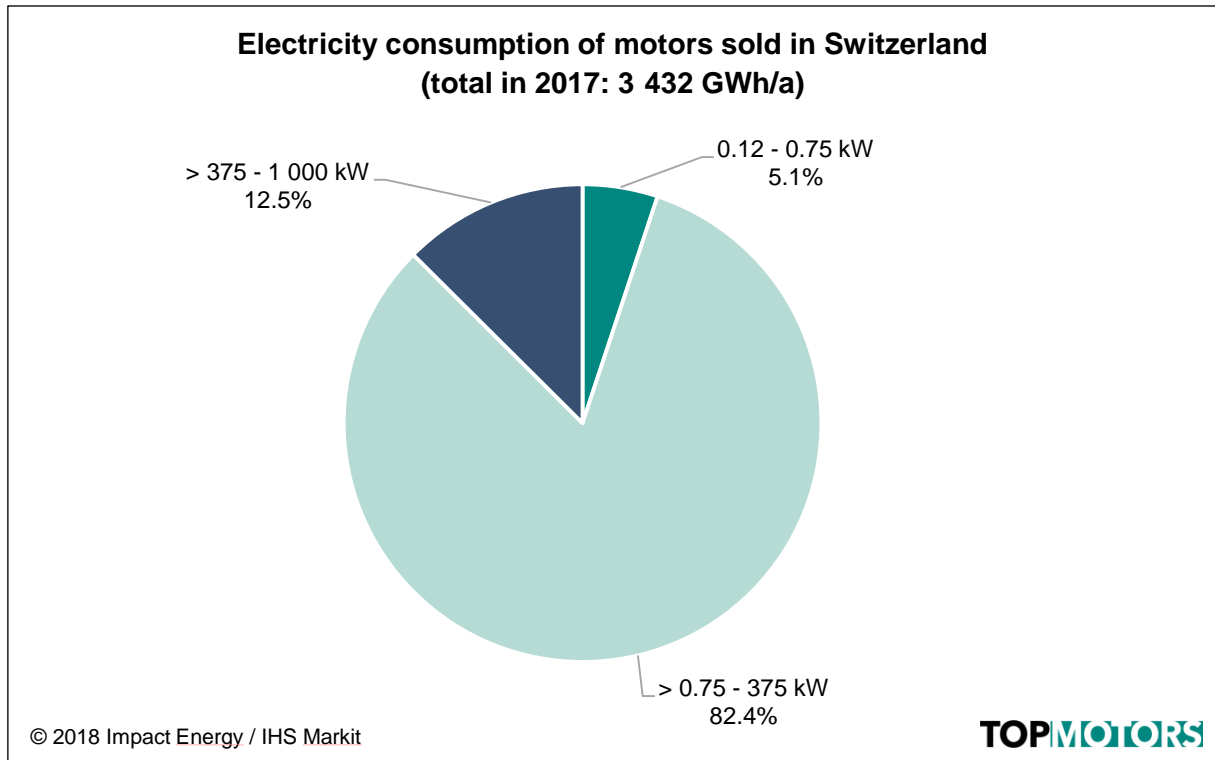
Motors sold in Switzerland 2017	Total	IE1	IE2	IE3	IE4
All motors sold	<b>177 786</b>	5 668	106 472	61 364	4 282
	100%	3.2%	59.9%	34.5%	2.4%
Motors in 2017 scope: > 0.75 kW, < 375 kW, w/o 8-pole motors	<b>70 143</b>	441	24 820	43 829	1 053
	100%	0.6%	35.4%	62.5%	1.5%

Motors compliant with 2017 MEPS	<b>57 292</b>	0	12 410	43 829	1 053
	100%	0%	21.7%	76.5%	1.8%

Share compliant within scope, Total **81.7%** (Assumption for IE2: 50%)

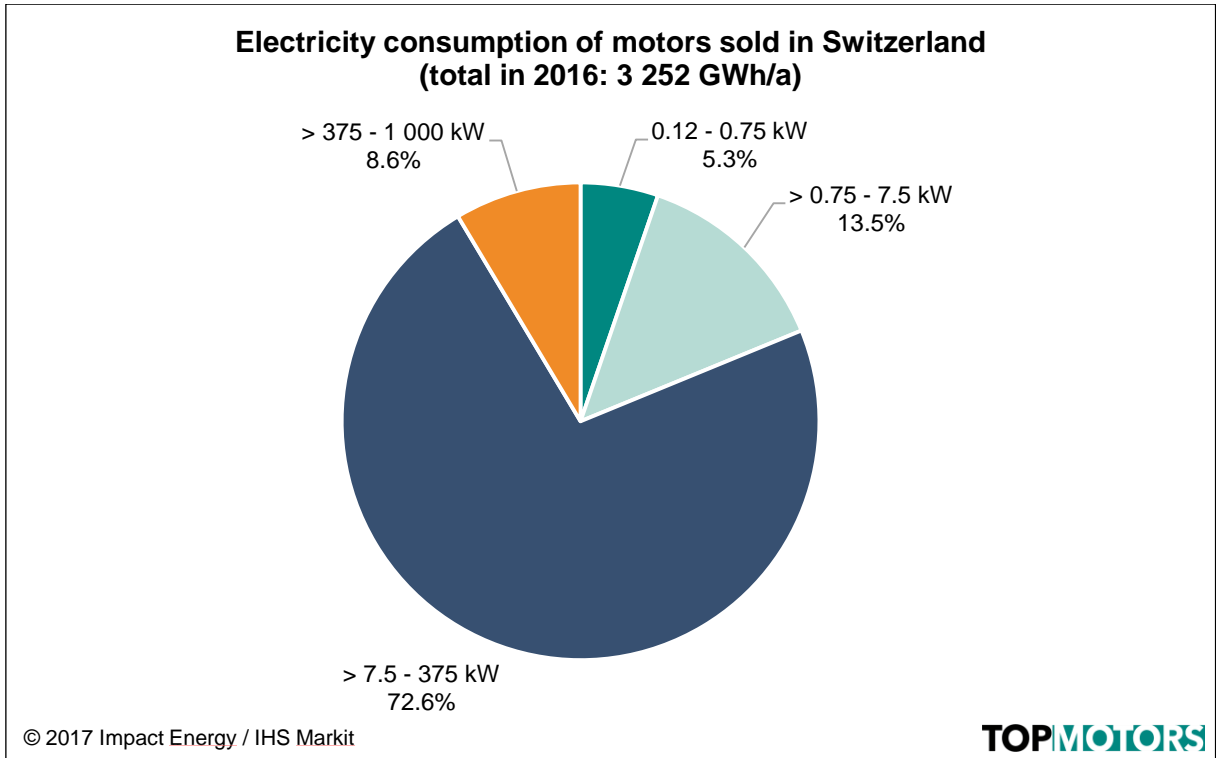
**Table 8: Motors sold in Switzerland in 2017 within scope by efficiency class (assumption: 50% of IE2 are equipped with VFDs and thus meet the requirements)**

The share of all motors sold by efficiency class in 2017 (and in comparison to 2016) is shown below. Figure 4 shows sales figures for 2017, whereby 82.4% of electricity consumption in 2017 was between 0.75 kW and 375 kW.



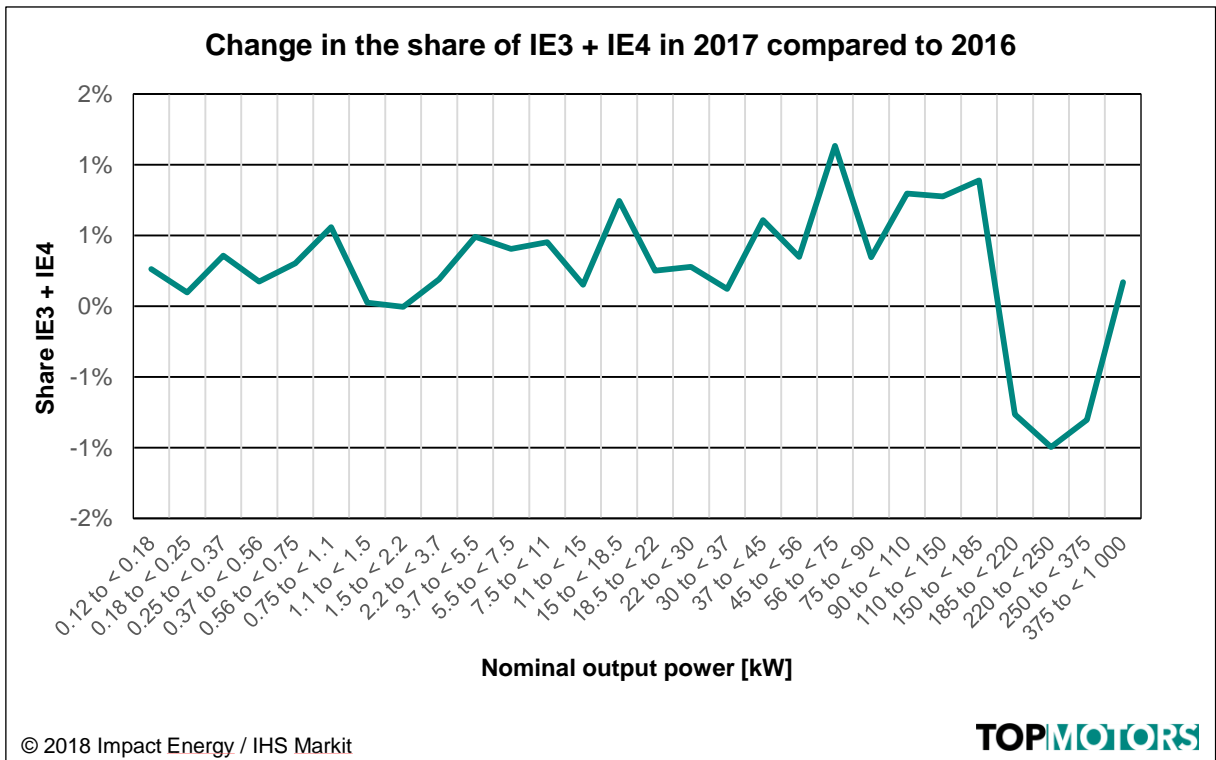
**Figure 4: Motors sold in Switzerland in 2017: electricity consumption by class size**

Figure 5 shows the sales figures for 2016, where motors between 7.5 kW and 375 kW accounted for only 72.6% of electricity consumption in 2016.



**Figure 5: Motors sold in Switzerland in 2016: electricity consumption by size category**

An efficiency class comparison between 2017 and 2016 by individual motor size reveals a slightly positive trend in the 0.12 kW to 56 kW segment and a clearly positive change between 56 kW and 185 kW (see Figure 6). The overall breakdown for all efficiency categories is shown in Figure 7 for 2017 and Figure 8 for 2016.



**Figure 6: Change in the share of high-efficiency motors in 2017 compared to 2016**



A comparison of the data for 2017 and 2016 shows the change in MEPS scope in Figure 7 and Figure 8 and Figure 9 and Figure 10.

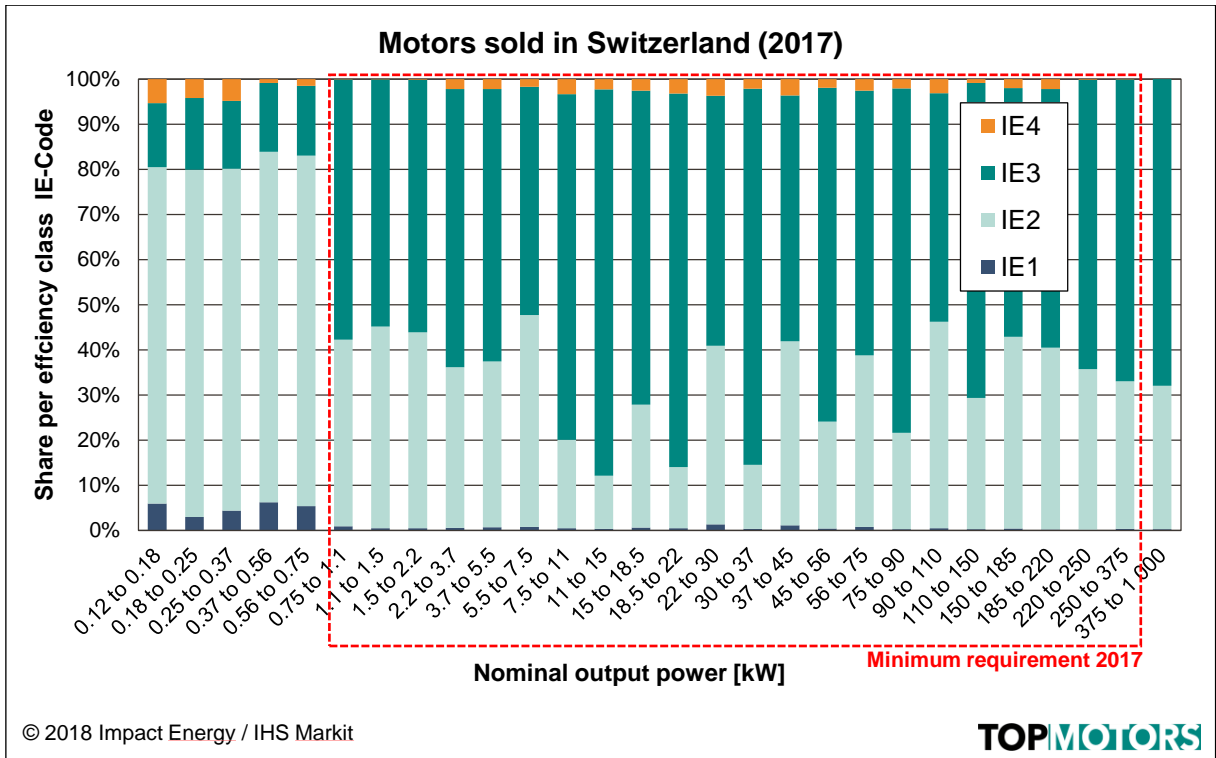


Figure 7: Efficiency class by size (2017): 39.5% of all motors sold were in scope

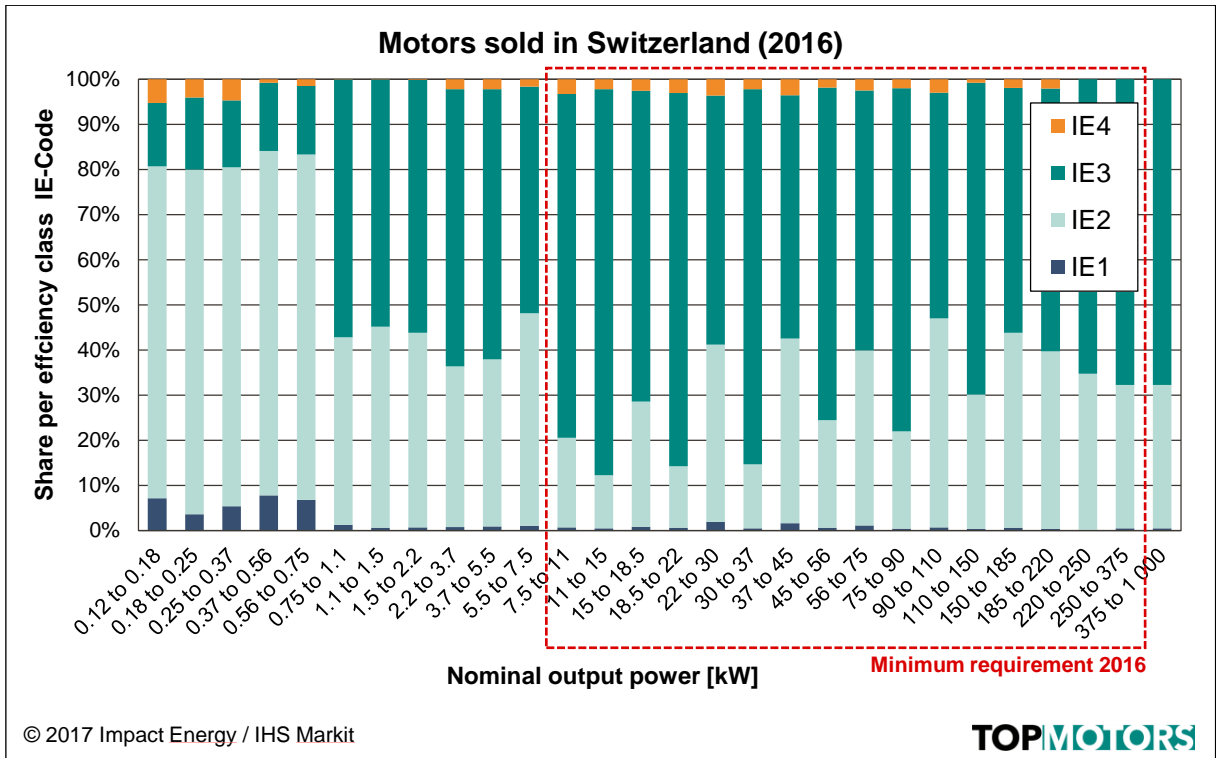
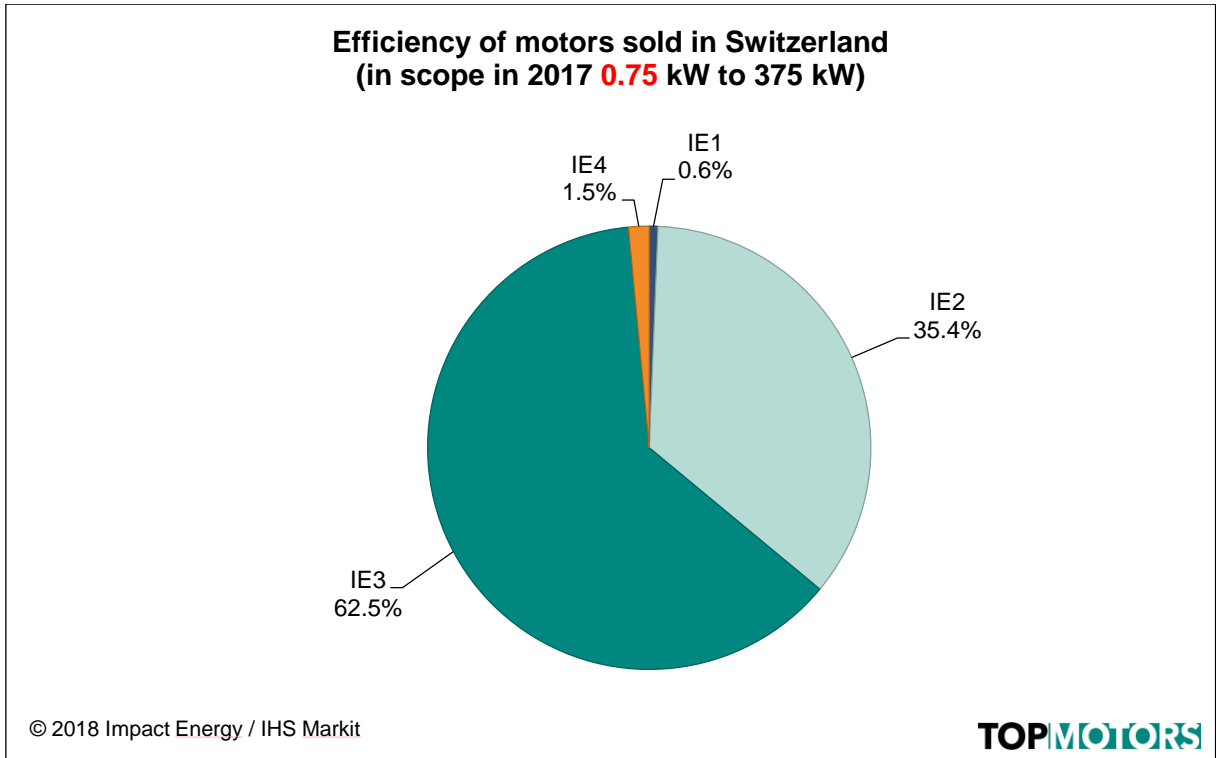
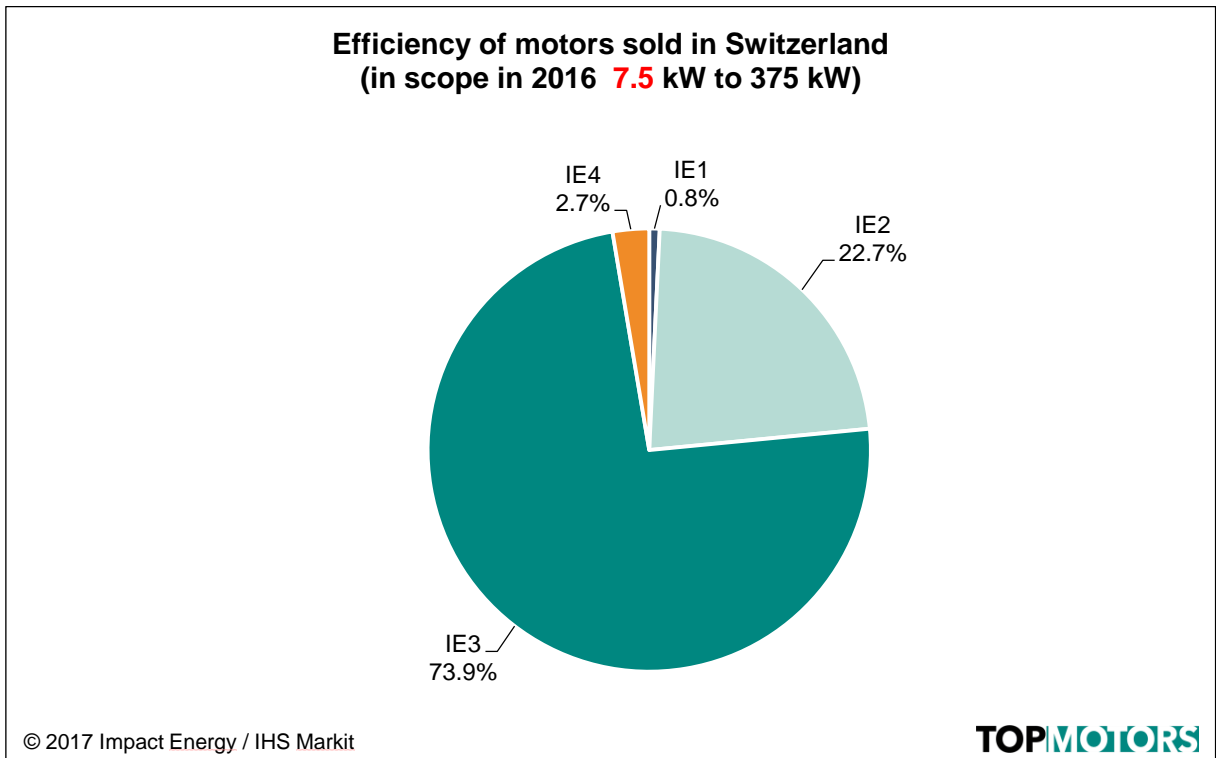


Figure 8: Efficiency class by size (2016): only 12.3% of all motors sold were in scope



**Figure 9:** Motors by efficiency class (2017): 0.75 - 375 kW, 2-, 4-, 6-poles



**Figure 10:** Motors by efficiency class (2016): 7.5 - 375 kW, 2-, 4-, 6-poles





### 6.3 Motor availability

A comparison of motor availability by efficiency class, number of poles and size between 2016 and 2017 shows a slight rise in supply for IE3 and a significant increase in the number of suppliers of IE4 motors (see Table 9 and Table 10).

Nominal output power [kW]	2017							
	IE3 according to IEC60034-30-1				IE4 according to IEC60034-30-1			
	Number of poles				Number of poles			
	2	4	6	8	2	4	6	8
0.12 to < 0.18	2	2	2	2	2	2	2	2
0.18 to < 0.25	3	2	5	2	2	2	2	2
0.25 to < 0.37	3	5	5	2	2	2	2	2
0.37 to < 0.56	5	5	5	2	2	2	2	2
0.56 to < 0.75	6	4	4	2	2	2	2	2
0.75 to < 1.1	6	5	5	2	3	3	3	2
1.1 to < 1.5	6	6	6	2	5	5	5	2
1.5 to < 2.2	6	6	6	2	5	5	5	2
2.2 to < 3.7	6	6	6	4	5	5	3	2
3.7 to < 5.5	6	6	6	4	5	5	3	2
5.5 to < 7.5	6	6	6	4	5	5	3	2
7.5 to < 11	6	6	6	4	5	5	3	2
11 to < 15	6	6	6	4	5	5	3	2
15 to < 18.5	6	6	6	4	5	5	3	2
18.5 to < 22	6	6	6	4	5	5	3	2
22 to < 30	6	6	6	4	5	5	3	2
30 to < 37	6	6	6	3	5	5	2	1
37 to < 45	6	6	6	3	4	4	1	1
45 to < 56	6	6	6	3	4	4	1	1
56 to < 75	4	4	3	3	3	3	1	1
75 to < 90	6	5	4	3	4	4	1	1
90 to < 110	6	5	4	3	5	5	1	1
110 to < 150	6	5	4	3	5	5	1	1
150 to < 185	6	5	4	2	5	5	1	1
185 to < 220	6	5	4	1	5	5	1	1
220 to < 250	6	5	2	1	2	3	1	1
250 to < 375	6	5	2	1	2	3	1	1
375 to < 1 000	6	5	2	1	2	3	1	1

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**Table 9: Motor availability by efficiency class, number of poles and size (2017)**  
The numbers in the cells indicate the number of manufacturers surveyed who are able to deliver such motors within 4 to 6 weeks.



2016								
Nominal output power [kW]	IE3 according to IEC60034-30-1				IE4 according to IEC60034-30-1			
	Number of poles				Number of poles			
	2	4	6	8	2	4	6	8
0.12 to < 0.18	2	2	2	2	1	1	1	1
0.18 to < 0.25	3	2	5	2	1	1	1	1
0.25 to < 0.37	5	5	5	2	1	1	1	1
0.37 to < 0.56	6	5	5	2	1	1	1	1
0.56 to < 0.75	6	4	4	1	1	1	1	1
0.75 to < 1.1	6	5	5	2	2	2	2	1
1.1 to < 1.5	6	6	6	2	4	4	4	1
1.5 to < 2.2	6	6	6	2	4	4	4	1
2.2 to < 3.7	6	6	6	4	4	4	3	1
3.7 to < 5.5	6	6	6	4	4	4	3	1
5.5 to < 7.5	6	6	6	4	5	5	3	1
7.5 to < 11	6	6	6	4	5	5	3	1
11 to < 15	6	6	6	4	5	5	3	1
15 to < 18.5	6	6	6	4	5	5	3	1
18.5 to < 22	6	6	6	4	5	5	3	1
22 to < 30	6	6	6	4	5	5	3	1
30 to < 37	6	6	6	3	5	5	2	0
37 to < 45	6	6	6	3	4	4	1	0
45 to < 56	6	6	6	3	4	4	1	0
56 to < 75	3	3	2	2	3	3	0	0
75 to < 90	6	5	4	3	4	4	1	0
90 to < 110	6	5	4	3	5	5	1	0
110 to < 150	6	5	4	3	5	5	1	0
150 to < 185	6	5	4	2	5	5	1	0
185 to < 220	6	5	4	1	5	5	1	0
220 to < 250	6	5	2	1	2	2	1	0
250 to < 375	6	5	2	1	2	2	1	0
375 to < 1 000	6	5	2	1	2	2	1	0

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**Table 10: Motor availability by efficiency class, number of poles and size (2016)**  
 The numbers in the cells indicate the number of manufacturers surveyed who are able to deliver such motors within 4 to 6 weeks.



### 6.4 Motor prices

The average specific prices for motors in all three efficiency categories rose by some 3% in 2017 as against 2016. The methodology for surveying motor prices was refined in 2017, so the results are not directly comparable with the results for 2016.

Specific price 2017 (CHF/kW)		
IE2	IE3	IE4
180	204	237

Table 11: Average specific motor prices CHF/kW by efficiency class for 2017 (average value for 28 size classes)

The price differentials between the best and worst motors diminished (see Table 12). Owing to the differentiated survey, the figures are not directly comparable with the results for the previous year.

Additional market price		
IE3 < > IE2	IE4 < > IE3	IE4 > > IE2
13.6%	16.8%	32.8%

Table 12: Price differentials (average value of specific prices for all sizes)

The «camel shape» of specific prices by size category did not change significantly compared with the previous year and is not yet fully explained. The red box with typical motor prices became a bit smaller because the prices surveyed clearly did not show as wide a spread (see Figure 11).

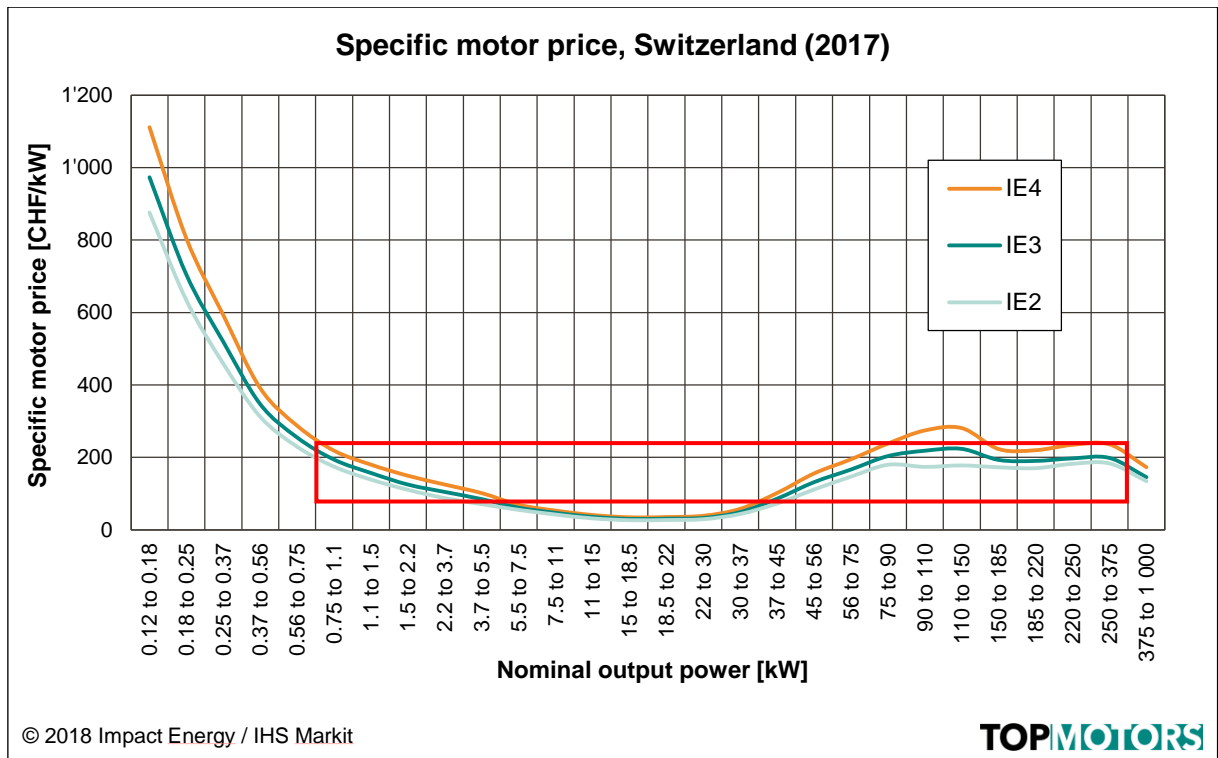


Figure 11: Specific motor prices for 2017 (the red box indicates the typical range for motor prices)



The price premium for more efficient motors (IE3 and IE4) as compared with standard motors (IE2) was surveyed by motor size. The three curves compared are shown in Figure 12:

- IE3 as compared with IE2
- IE4 as compared with IE3
- IE4 as compared with IE2

The cost differential varies significantly depending on nominal output power (see Figure 12):

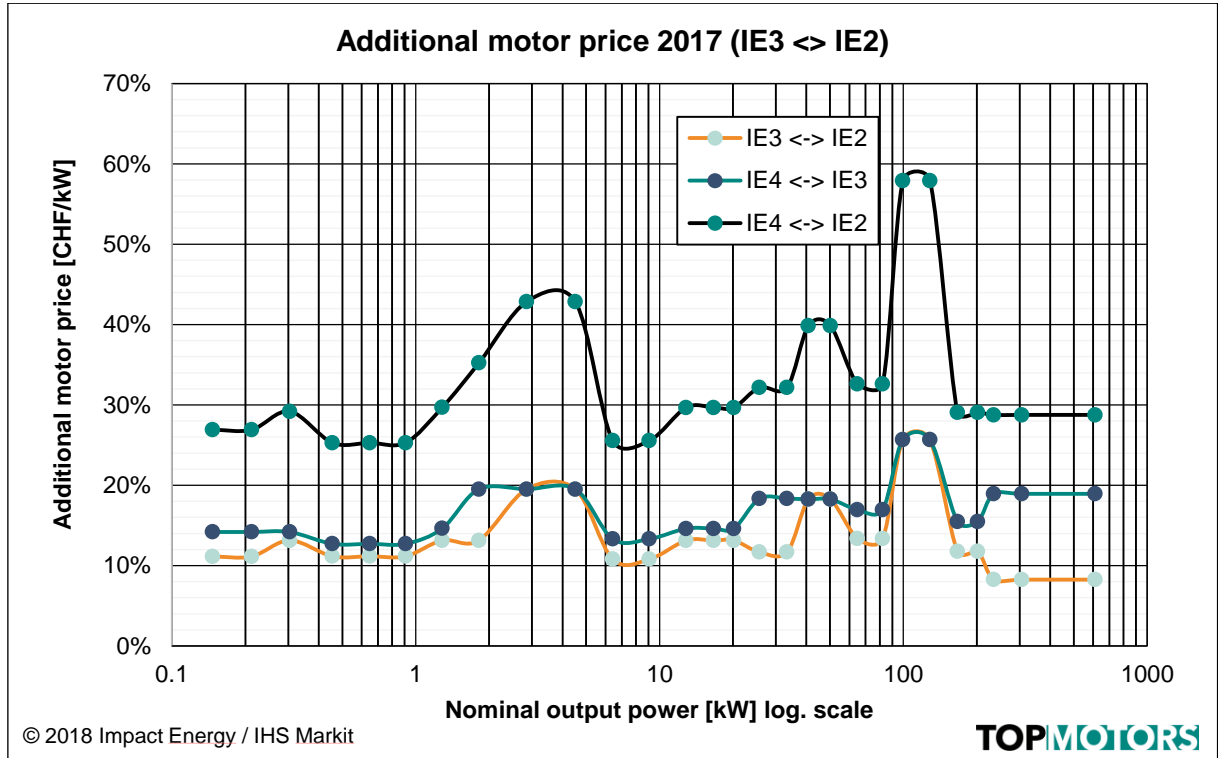


Figure 12: Additional motor price by size category

The highest price premiums are for 1.5 - 5 kW and for 90 - 150 kW.

### 6.5 Motor age

In 2017, 177 786 motors were sold in Switzerland. On the basis of various previous surveys, the stock of electric motors in Switzerland is estimated at some two million. The stock divided by the number of motors sold in 2017 gives the figure of about 11.2 years, which is not the same thing as the average useful life of the motors in service. This would only be the case if all motors sold were replacement products. In reality:

- old products keep running longer than assumed (or are no longer used but not yet disposed of),
- new products are purchased as replacements (or stored as a backup),
- other new motors are purchased and used for further applications.

In fact, according to previous surveys by Topmotors, there are 4 142 motors whose actual average age of motors in use is significantly higher at 17.3 years.<sup>2</sup>

<sup>2</sup> Rolf Tieben, Rita Werle, Conrad U. Brunner Impact Energy Inc.: EASY- Lessons learned from four years of the Swiss EASY audit and incentive program, in EEMODS, conference proceedings, Helsinki, 2015



It would be useful to conduct an energy-monitoring study to see how the new motors have changed the overall electricity consumption for motors. This would require a motor inventory model and a so-called “ageing study” (growth, replacement, disposal).

### 6.6 VFD prices

The average specific prices of VFDs rose by 5% in 2017 compared to 2016, as the specific prices rose in the medium size categories (see Table 13 and Figure 13).

Price of Variable Frequency Drives (CHF/kW) average	
2016	356.6
2017	374.3
<b>Additional price 2017/2016</b>	<b>+5.0%</b>

Table 13: Average value of specific VFD prices in 2016 and 2017, average value for 12 size classes

The «camel shape» of specific VFD prices disappeared in 2017: at present, there is a plausible decrease between small and large VFDs (see Figure 13). Between 2016 and 2017, prices increased for VFDs between 2 kW and 90 kW.

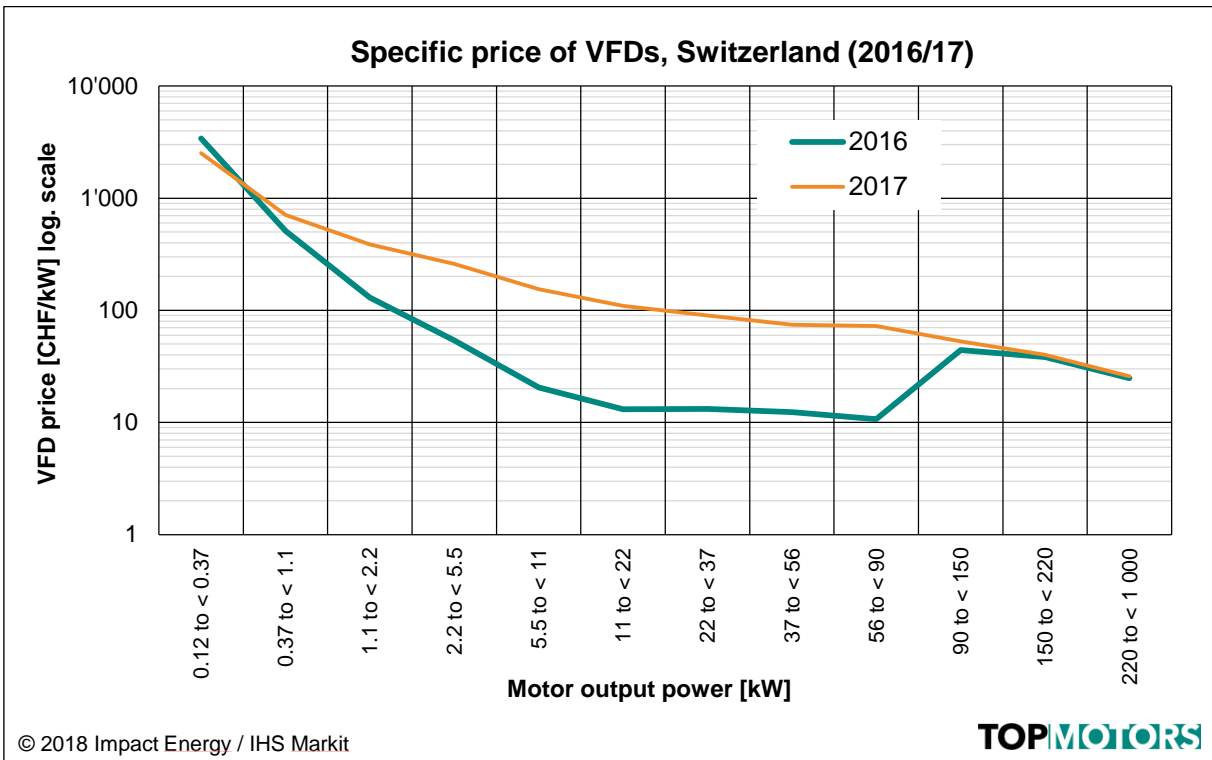


Figure 13: Specific price of VFDs 2016 and 2017



# 7 PUMPS and FANS

## 7.1 Pumps

### Circulators

The following are the findings of the first market survey on circulators in Switzerland and the European Union (EU):

Glandless circulators are used to circulate water in a closed circuit, primarily in heating systems but also in cooling systems and other types of systems (they are not used for drinking water or waste water). In accordance with the EU's 2009 Ecodesign Regulation No. 641, a glandless circulator is a circulator where the shaft of the motor is directly coupled to the impeller and the motor is immersed in the pumped medium.

The Ecodesign Regulation for glandless circulators with hydraulic power of between 1 and 2 500 W has been in force in Europe since 2013. The Regulation was tightened in 2015. The implementation of this Regulation in Europe, and subsequently in Switzerland, prompted a major development in the market, which had a significant impact on energy considerations. The original technology was launched in Switzerland in 1993<sup>3</sup>. The minimum requirements can only be met by using an integrated, high-efficiency pump, consisting of a variable frequency drive (VFD), permanent magnet motor (PM motor) and an efficient impeller.

In 2017, 398 870 circulators (integrated and non-integrated) were sold in Switzerland. Of these, 98.4% had an energy efficiency index (EEI) of  $\leq 0.23$ , i.e. they satisfied the minimum requirements of Annex 2.8 of the Swiss Energy Efficiency Ordinance (EnEV) for circulators with less than 2 500 W<sub>hydr</sub>. The share of circulator sales in Switzerland is equivalent to 2.2% of the units sold in the European circulator market.

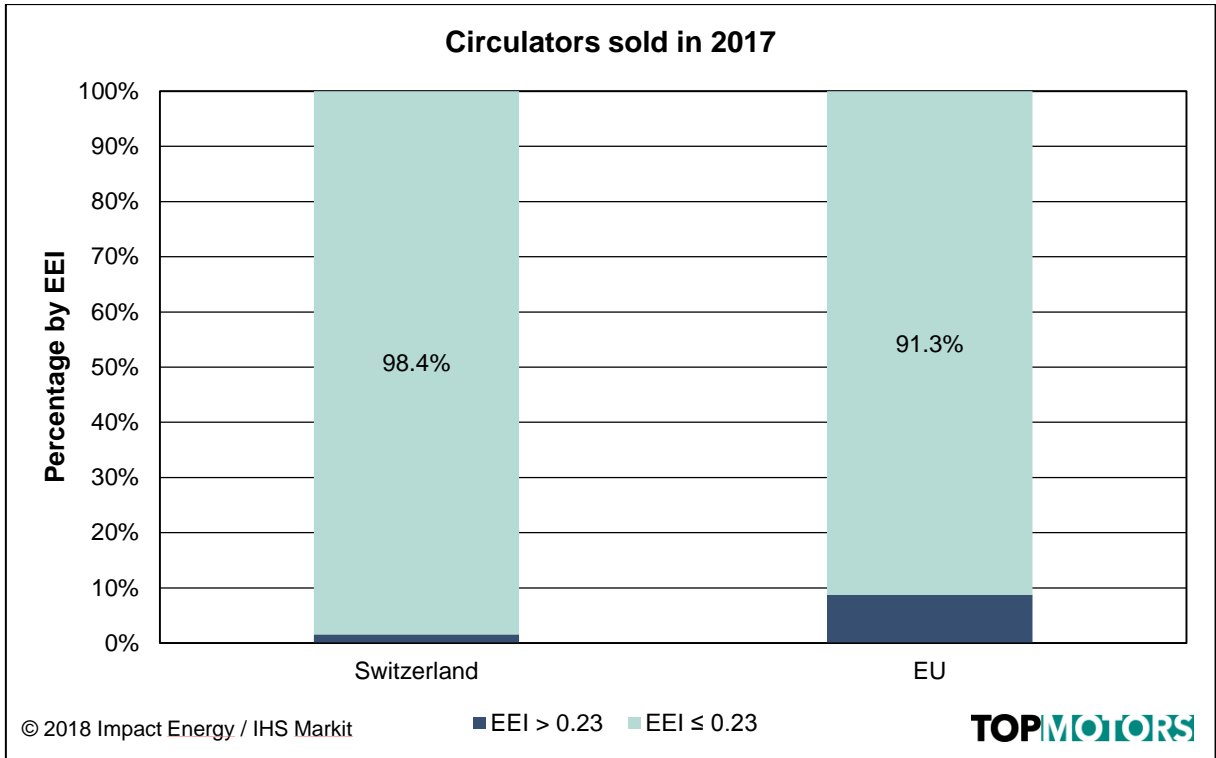
In 2017, 17 908 367 circulators (integrated and non-integrated) were sold in the European Union. Of these, 91.3% had an EEI of  $\leq 0.23$ , i.e. they satisfied the minimum requirements of EU Ecodesign Regulation 641/2009.

Circulator	CH - compliance: 98.4%		EU - compliance: 91.3%	
	Switzerland		European Union	
	Number	Share	Number	Share
EEI > 0.23	6 236	1.6%	1 566 384	8.7%
EEI $\leq$ 0.23	392 634	98.4%	16 341 983	91.3%
<b>Total</b>	<b>398 870</b>	<b>100%</b>	<b>17 908 367</b>	<b>100%</b>
CH as share of EU	2.2%			

**Table 14: Pump sales in Switzerland and the EU in 2017: circulators (integrated and non-integrated)**

The market trend in new, high-efficiency circulators can be described as exemplary. The development of the technology was followed by a rapid transformation of the market, supported by voluntary labelling programmes. The circulator market was revolutionised by a new, efficient technology within 20 years.

<sup>3</sup> Jürg Nipkow, Klein-Umwälzpumpe mit hohem Wirkungsgrad, Swiss Federal Office of Energy, 1994



**Figure 14:** Share of sales of circulators according to EEI ( $\leq 0.23$  is the minimum requirement for Switzerland/European Union)

### Water pumps

The following are the findings of the first market survey on water pumps in Switzerland and the EU:

Glanded water pumps are used in many different ways to transport liquids. Clean water is paramount (i.e. not waste water or drinking water) and axial, multistage and submersible pumps are used. The five types of water pumps with a capacity of less than 150 kW, as specified by EU Ecodesign Regulation No. 547/2012 and also referred to in Annex 2.9 of the EnEV, are not yet very common among pump manufacturers and retailers (although this Regulation was adopted in 2012 and has been in force since 2013). According to IHS Markit, therefore, the relevant findings must be treated with some caution.

A distinction is made between the following five water pump types in the Directive:

- ESOB: end suction own bearing
- ESCC: end suction close coupled
- ESCCi: end suction close coupled inline
- MS-V: vertical multistage
- MSS: submersible multistage

In 2017, 51 577 water pumps were sold in Switzerland. The vast majority of them met the minimum requirement of a minimum efficiency index (MEI) of  $\geq 0.4$  as set out in Annex 2.9 of the EnEV. Some pumps were even available with the higher MEI value of 0.7. Most of the pumps (91%) were smaller than 10 kW, and frequently were smaller than 2 kW. The share of water pump sales in Switzerland is equivalent to 1.9% of the units sold in the European water pump market.



A high share of 39.8% of water pumps sold in Switzerland worth mentioning are submersible multistage pumps (MSS); in the EU it is even 45%. These permanently installed or mobile pumps are used for a wide range of purposes, such as supplying water, irrigation (e.g. in agriculture), construction, swimming pools and aquariums. They are also used by fire services and disaster management personnel. This is clearly an important market segment. However, no ISO standards currently exist for submersible pumps, nor are there any IEC standards for electric motors in submersed applications.

In 2017, 2 736 388 water pumps were sold in the EU. Of these, 85.4% were smaller than 10 kW. There are no precise figures for the share of pumps that meet the minimum requirement of a MEI of  $\geq 0.4$  as specified by EU Ecodesign Regulation No. 547/2012.

Water pumps	Switzerland		European Union	
	Number	Share	Number	Share
< 10 kW	46 934	91%	2 335 671	85.4%
> 10 kW	4 643	9%	400 717	14.6%
<b>Total</b>	<b>51 577</b>	<b>100%</b>	<b>2 736 388</b>	<b>100%</b>
CH share EU	1.9%			

Table 15: Pump sales in Switzerland and the EU in 2017: water pumps (Source IHS Markit, 2018)

Water pumps by type	Switzerland					
	< 10 kW		> 10 kW		Total	
	Number	Share	Number	Share	Number	Share
ESCC	6 386	13.6%	639	13.8%	7 024	13.6%
ESCCi	6 030	12.8%	628	13.5%	6 658	12.9%
MS-V	10 731	22.9%	1 063	22.9%	11 794	22.9%
MSS	18 714	39.9%	1 790	38.6%	20 504	39.8%
ESOB	5 073	10.8%	523	11.3%	5 596	10.8%
<b>Total</b>	<b>46 934</b>	<b>100%</b>	<b>4 643</b>	<b>100%</b>	<b>51 577</b>	<b>100%</b>
CH share EU	2%		1.2%		1.9%	

Table 16: Pump sales in Switzerland in 2017: water pump units by type (Source IHS Markit, 2018)

Water pump by type	European Union					
	< 10 kW		Above 10 kW		Total	
	Units	Share	Units	Share	Units	Share
ESCC	293 543	12.6%	50 713	12.7%	344 255	12.6%
ESCCi	269 515	11.5%	47 656	11.9%	317 171	11.6%
MS-V	479 302	20.5%	84 860	21.2%	564 162	20.6%
MSS	1 056 576	45.2%	173 893	43.4%	1 230 469	45%
ESOB	236 736	10.1%	43 595	10.9%	280 331	10.2%
<b>Total</b>	<b>2 335 671</b>	<b>100%</b>	<b>400 717</b>	<b>100%</b>	<b>2 736 388</b>	<b>100%</b>

Table 17: Pump sales in the EU in 2017: water pump units by type (Source IHS Markit, 2018)



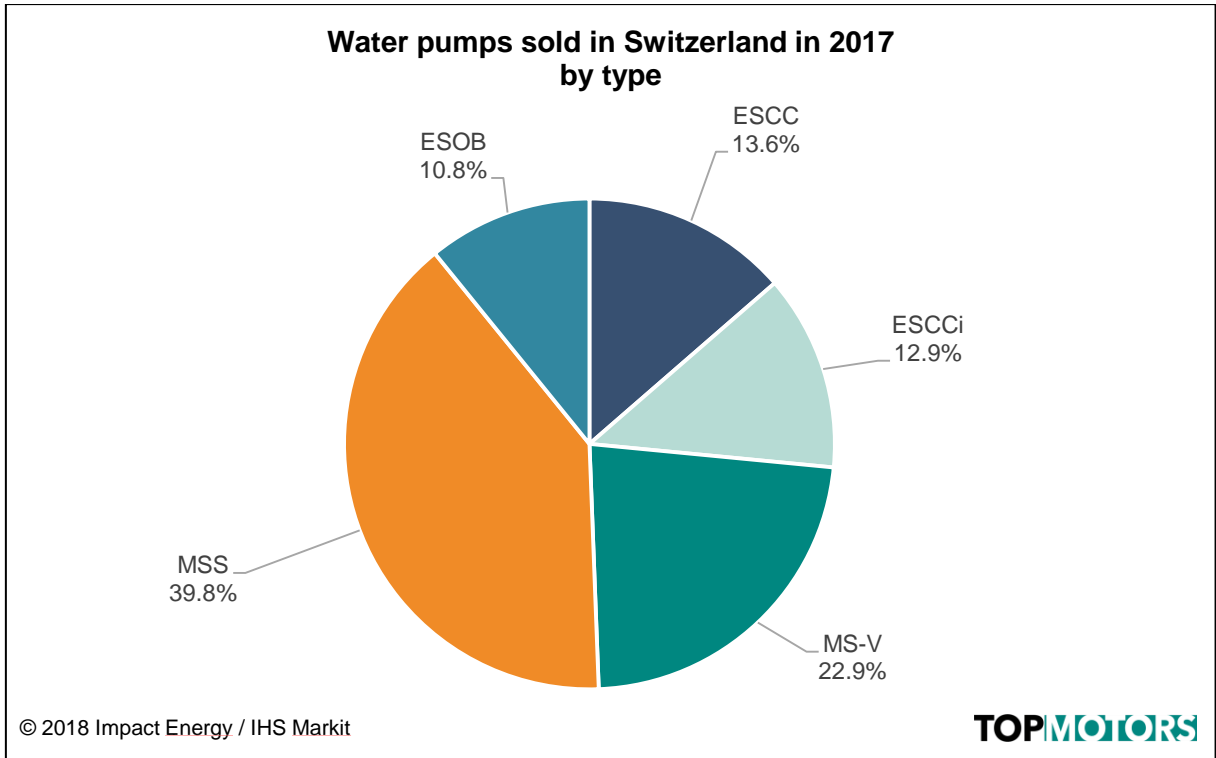


Figure 15: Water pumps sold in Switzerland in 2017 by type

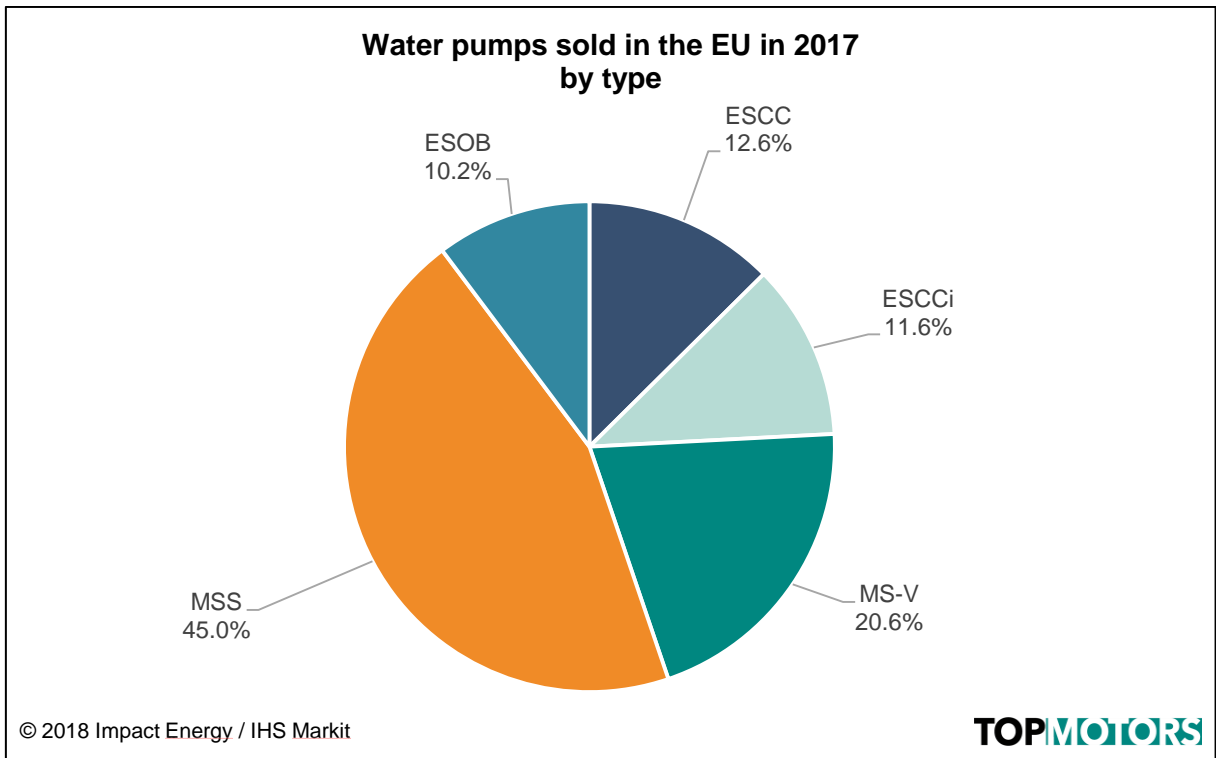


Figure 16: Water pumps sold in the EU in 2017 by type



## 7.2 Fans

The following are the findings of the first market survey on fans in Switzerland and the EU:

A distinction is made between the following six fan types in EU Ecodesign Regulation No. 327/2011:

- axial fans
- centrifugal forward-curved fans and centrifugal radial bladed fans
- centrifugal backward-curved fans without housing
- centrifugal backward-curved fans with housing
- mixed flow fans
- cross flow fans

In 2017, 115 647 fans were sold in Switzerland. Of these, 83.4% were smaller than 10 kW. Approximately 30% of the fans were used in homes, 50% were used in the service sector and 20% was used in industry.

The fans sold in Switzerland account for 1.0% of all fans sold in the EU.

In 2017, 11 616 614 fans were sold in the EU. Of these, 82.5% were smaller than 10 kW. Approximately 32% of the fans were used in households, 49% were used in the service sector and 19% was used in industry. The share of fans that meet the minimum requirements set out by EU Ecodesign Regulation No. 327/2011 is not known.

Fan	Switzerland		European Union	
	Number	Share	Number	Share
< 10 kW	96 415	83.4%	9 587 536	82.5%
> 10 kW	19 232	16.6%	2 029 078	17.5%
<b>Total</b>	<b>115 647</b>	<b>100%</b>	<b>11 616 614</b>	<b>100%</b>
CH share EU	1.0%			

**Table 18: Total fan sales in Switzerland and the EU in 2017**

The distribution of fan types that were sold in Switzerland and the EU in 2017 is displayed in Table 19 and Table 20 and in Figure 18 and Figure 19.

Axial fans have the largest market share in Switzerland with 56% (54% in the EU). The more efficient, backward-curved fans have a market share of some 19% in Switzerland (18% in the EU).

Figure 17 shows the fan efficiency of the four different basic fan types.

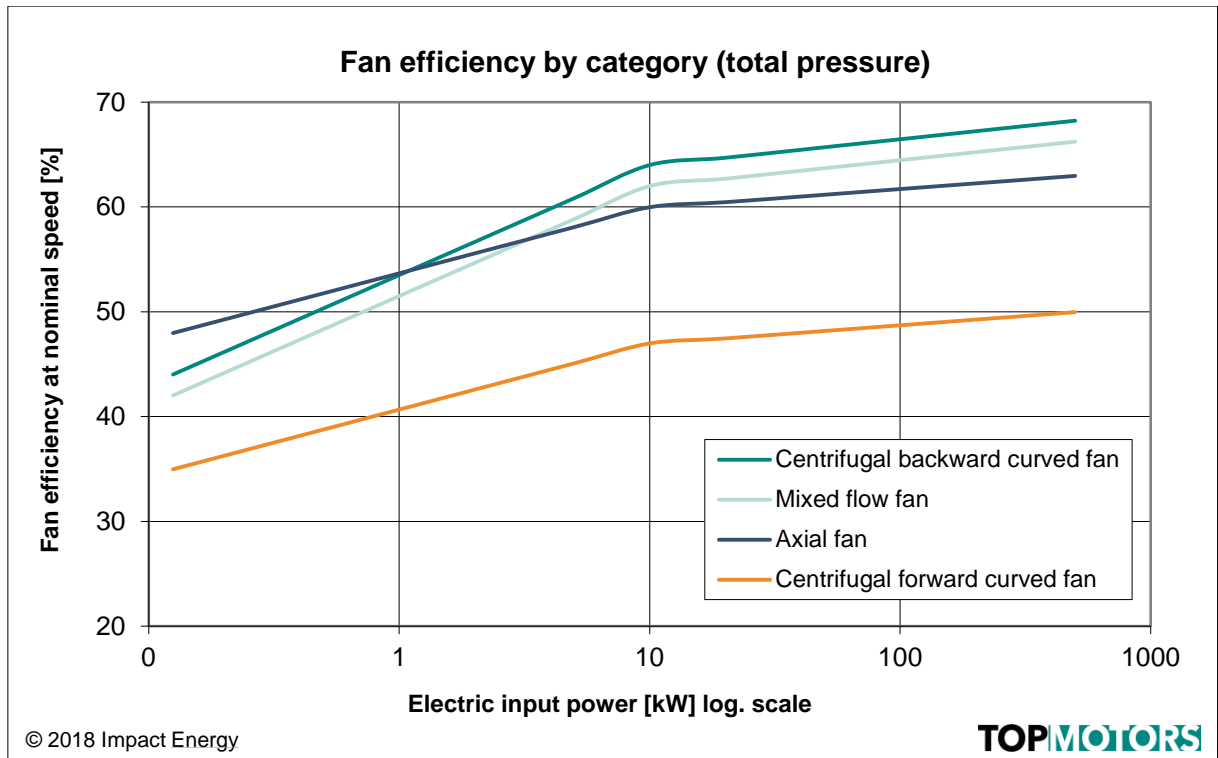


Figure 17: Fan efficiency by type and size at maximum speed in accordance with EU Ecodesign Directive No. 327/2011

Fan by type	Switzerland					
	< 10 kW		> 10 kW		Total	
	Number	Share	Number	Share	Number	Share
Axial fan	56 309	58.4%	7 956	41.4%	64 265	55.5%
Centrifugal forward-curved fan Centrifugal radial bladed fan	19 892	20.6%	5 301	27.6%	25 193	21.8%
Backward-curved fan (without housing)	4 595	4.8%	5 325	27.7%	9 920	8.6%
Backward-curved fan (with housing)	11 204	11.6%	545	2.8%	11 749	10.2%
Cross flow fan	1 023	1.1%	106	0.6%	1 128	1.0%
Mixed flow fan	3 392	3.5%	0	0.0%	3 392	2.9%
<b>Total</b>	<b>96 415</b>	<b>100%</b>	<b>19 232</b>	<b>100%</b>	<b>115 647</b>	<b>100%</b>
CH share EU	1.0%		0.9%		1.0%	

Table 19: Fan sales in Switzerland in 2017: quantities by fan type

Fan by type	European Union					
	< 10 kW		> 10 kW		Total	
	Number	Share	Number	Share	Number	Share
Axial fan	5 434 421	56.7%	784 875	38.7%	6 219 296	53.5%
Centrifugal forward-curved fan Centrifugal radial bladed fan	2 222 274	23.2%	603 609	29.7%	2 825 883	24.3%
Backward-curved fan (without housing)	501 788	5.2%	577 790	28.5%	1 079 579	9.3%
Backward-curved fan (with housing)	991 292	10.3%	50 857	2.5%	1 042 149	9.0%
Cross flow fan	116 240	1.2%	11 947	0.6%	128 187	1.1%
Mixed flow fan	321 521	3.4%	0	0.0%	321 521	2.8%
<b>Total</b>	<b>9 587 536</b>	<b>100%</b>	<b>2 029 078</b>	<b>100%</b>	<b>11 616 614</b>	<b>100%</b>

Table 20: Fan sales in the EU in 2017: quantities by fan type

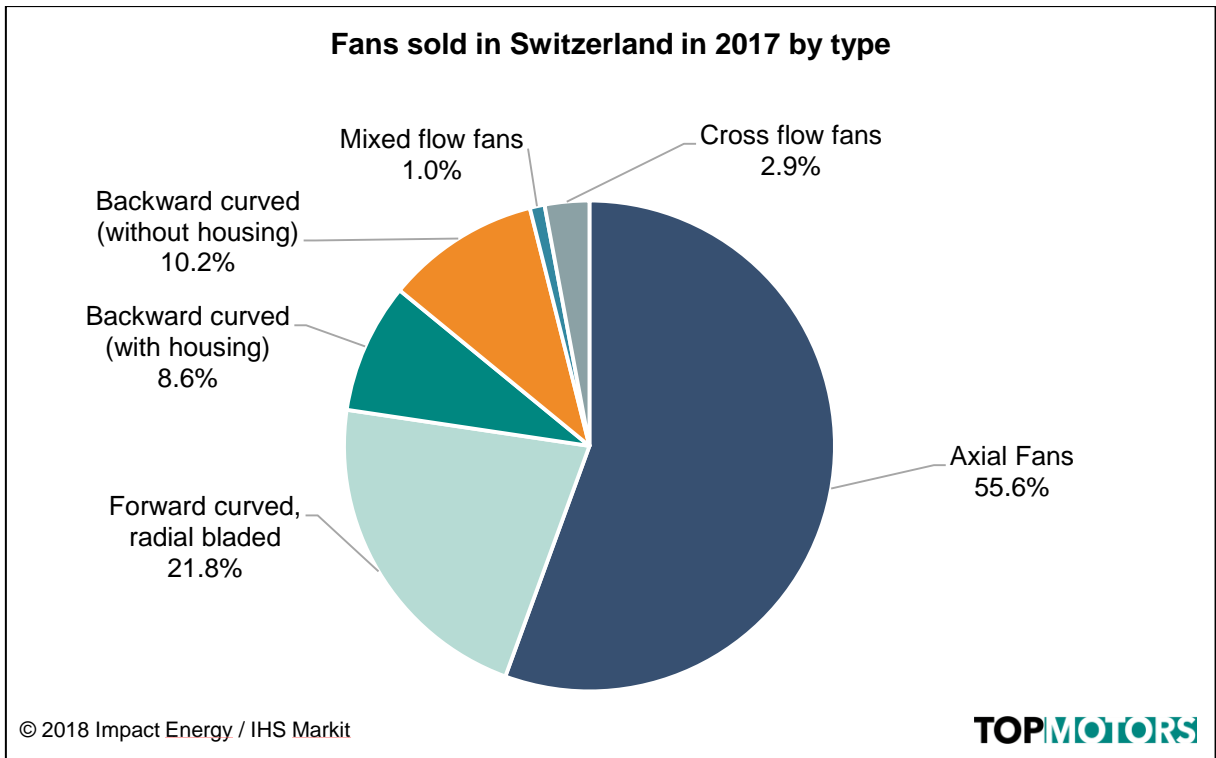


Figure 18: Fans sold in Switzerland in 2017 by type

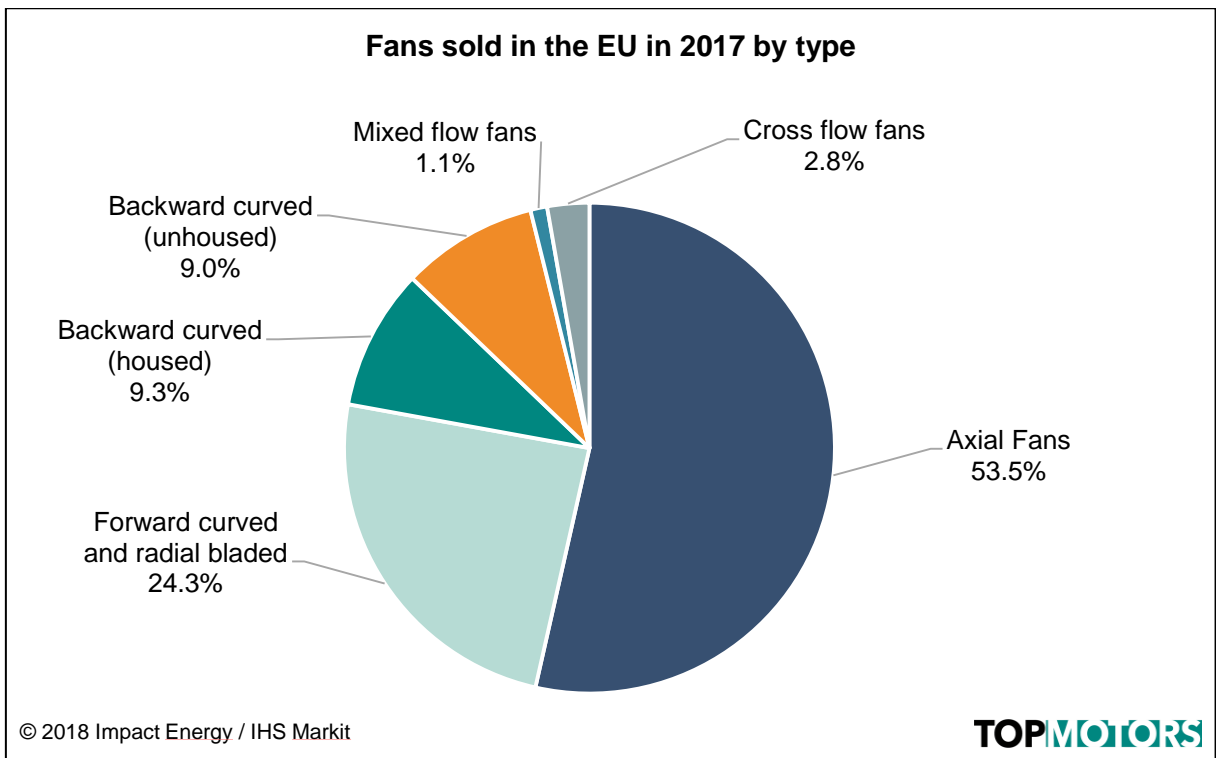


Figure 19: Fans sold in the EU in 2017 by type



## 8 Observations and recommendations

This study is the second of its kind to be conducted in Switzerland. The motor section in the Topmotors Market Report 2017 was enhanced and refined. The section on pumps and fans is new, as is the comparison with EU data.

The findings for the development of elements subject to minimum requirements in Switzerland are promising and must be monitored annually.

In terms of motors, the entry into force of revised Regulation 640 (currently under revision) of the Ecodesign Directive means that a new chapter will be opened in 2021 because the efficiency of smaller (from 0.12 kW) and larger (up to 1 000 kW) motors as well as VFD losses will be subject to revised MEPS.

In terms of pumps and fans, this data, which has been collected for the first time, and the development of market shares, should be pursued in the coming years. In the case of fans in particular, approaches can be discerned that may affect the objective of increased efficiency by promoting the use of backward-curved fans.

## 9 Contact

To improve the collection of data, all manufactures and representatives of the products in the Swiss market analysed here are invited to make their data available to the market research group IHS Markit (if they have not already done so). Citing «Topmotors Market Report 2018», please contact: Preston Reine (Preston.Reine@ihsmarkit.com).



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