

# VFD retrofit program for fixed speed electric motors (TopVFD)

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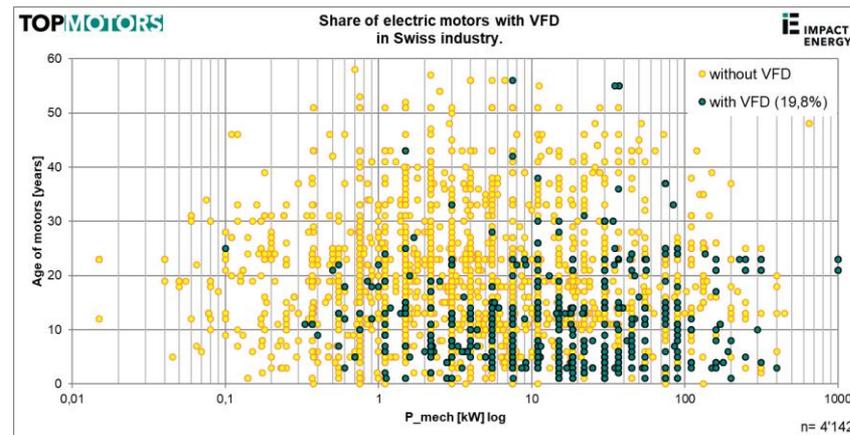
# Overview

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# Background

- 4'142 motor systems have been analysed
- only 19.8% already have a VFD
- 50-60% of the motors could be operated reasonably with a VFD



# Scope of TopVFD

The subsidy program targets electric motor systems in industry, large public or commercial buildings and infrastructure facilities.

- Eligible for funding are motors which are
  - larger than 7.5 kW output power
  - younger than 6 years
  - payback > 4 years.

For motors older than 6 years, the upgrading to an IE4 motor (applied together with a VFD) is also eligible for financial support.

# Funding

- The program has a duration of 3 years and is supported by the ProKilowatt program of the Swiss Federal Department of Energy with a total of USD 1 million.
- It subsidizes measures with up to 30% of the costs of:
  - components (VFD, motor)
  - material (control cabinets, cables, etc.)
  - labor costs (implementation, measurements, etc.)

# Calculation of energy savings

The savings can either be based on the result of :

- the especially developed software tool
- or on on-site measurements.



# Avoid installation of VFDs

- Where no load variation exists
- for oversized motors
- for older motors, not capable to handle voltage peaks and variation
- only as a starting device

# Software tool for VFDs

**The software tool calculates the potential energy savings with several values:**

## **Input data of the motor system:**

- nominal output power of the motor (kW)
- efficiency (existing motor: IE code)
  - IE1 (eff2)
  - IE2 (eff1)
  - IE3
- operating hours per year (h/a)
- application
  - pump, open system, < 20 kW
  - pump, open system, > 20 kW
  - pump, closed loop, < 20 kW
  - pump, closed loop, > 20 kW
  - ventilation fan
  - conveyor
  - other motor driven systems

## **Default values of the tool:**

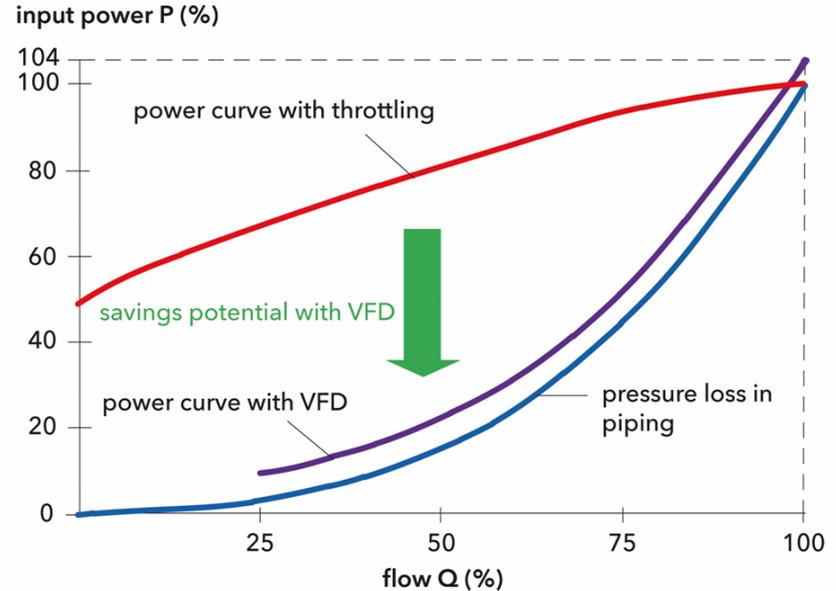
- average load factor (current state)
- efficiency at nominal and reduced speed
  - motors (fixed speed)
  - motors (VFD driven)
  - VFD (IE2)
- stand-by losses VFD
- specific market price (CHF/kW)
  - VFD
  - motors
- average load factor (target state)

# Calculation of energy savings

- Depending on the application, different physical effects occur that affect the electric input power
- in closed systems, the input power is reduced by the 3<sup>rd</sup> power of the speed/flow reduction of the pump/fan
- example: - 20% speed/flow

$$(80\%)^3 = 0.8^3 = 0.8 * 0.8 * 0.8 = 0.512$$

new input: 51.2% (+ losses)



# Measurements

- Contain electric input and mechanical output measurements to determine the current state, the eventual target state and the resulting energy savings.
- Measurements, necessary for the retrofit of a VFD and IE4 motors, are part of the project costs (up to 30% subsidized).
- A special budget is available for additional measurements, to get a better understanding of the energetic condition of large and complex systems (100% subsidized).



# Goal

- The goal is, to save 32.8 GWh electricity over the creditable lifetime of the VFDs and motors
- achieved with the improvement of some 108 motor systems

measure	quantity	total financial support [USD]	creditable lifetime	Cumulative electricity savings [GWh]
retrofit VFD control	13	65 000	15	2.3
VFD + IE4 Motor < 20 kW	55	330 000	15	11.7
VFD + IE4 Motor ≥ 20 kW	40	280 000	25	18.8
<b>Total</b>	<b>108</b>	<b>675 000</b>		<b>32.8</b>

# Expert network

To promote the TopVFD program, a network of around 15 service companies and manufacturers has been established and trained in Switzerland.

Their tasks: (depending on their service portfolio) :

- inform customers, support them to apply to TopVFD
- on-site measurements
- consulting and technical support
- delivering components and installation, on-site check
- confirm the successful implementation

# timeline of TopVFD

- 01 March 2019: start
- 01 September 2019: program buildup completed  
[www.TopFU.ch](http://www.TopFU.ch) online  
calculation tool finished  
documents published  
(flyer, general terms and conditions)
- 10 September 2019 expert-network training workshop ----- today
- 31 December 2021 end of implementing phase - evaluation
- 31 March 2022 end of TopVFD - final reporting

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