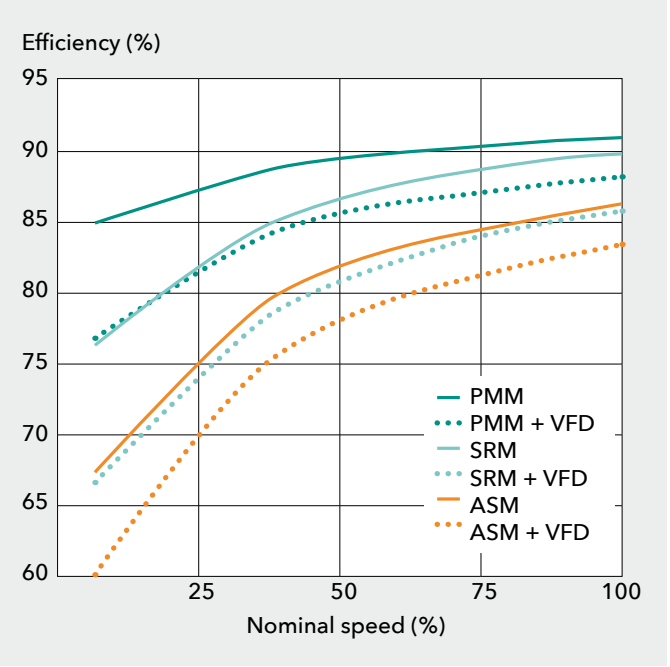
New motor-driven technologies

As a three-phase squirrel-cage rotor, the **asynchronous motor (ASM)** has been the 'workhorse' of industry since 1889. It is robust, reliable and wears well. The asynchronous motor changed very little as a standard motor over 100 years until 1992 when US legislation stipulated minimum efficiency standards for motors (now IE2). Soon after this, the US industry association NEMA launched the Premium Motor (now IE3). Without further ado, the old induction motor was to be improved by better geometry, more copper and more precise manufacturing. With the adoption of the IE2 and now IE3 standard in the EU's Ecodesign legislation, the market for efficient motors began to expand rapidly, in Switzerland and elsewhere, in 2011. ASMs can even be geared towards IE4 with the use of an expensive copper rotor.

From 1970, following its use as a servomotor and further improvements, the **permanent magnet motor (PMM)** was launched on the market. This works with magnets made of rare-earth elements and has a number of advantages over the asynchronous motor. The PMM is a synchronous motor, as there is no difference in speed (slip) between the stator and the rotor. The permanent magnets ensure the necessary lossless magnetisation of the rotor, which increases the efficiency of the motor compared to the asynchronous motor. For a time, magnet prices were very high. In recent years, prices for rare-earth elements have stabilised again as new mines for these raw materials have opened up and replacement products have been found. The PMM needs a **variable frequency drive (VFD)** to start and to control the operating speed. However, it is also available as an expensive hybrid PMM, which can be operated directly from the grid without a VFD. PMM's reach IE3 and IE4 efficiency levels.

Synchronous reluctance motors (SRM) are another variant of three-phase motors. Special rotor sections direct the magnetic lines inside the rotor, thus generating reluctance momentum with high energy efficiency. In practice, therefore, efficiency levels ranging from IE2 to IE4 are currently achieved. The SRM usually requires a VFD to start and to control the operating speed. However, it is also available in the more expensive hybrid version, which can be operated directly from the grid without a VFD.

It is important for the user when the use of high-efficiency motors is appropriate and rotational speed control is necessary. That determines which motor technology is best suited to a particular scenario. The saving step from IE3 to IE4 is smaller than the step from IE1 to IE2 was a few years ago, and is worthwhile only if there are more than 2000 operating hours annually.



Comparison of efficiency of 4-pole 2.2 kW motors with torque of 7 Nm (from: Jorge Estima/EEMODS'17)

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