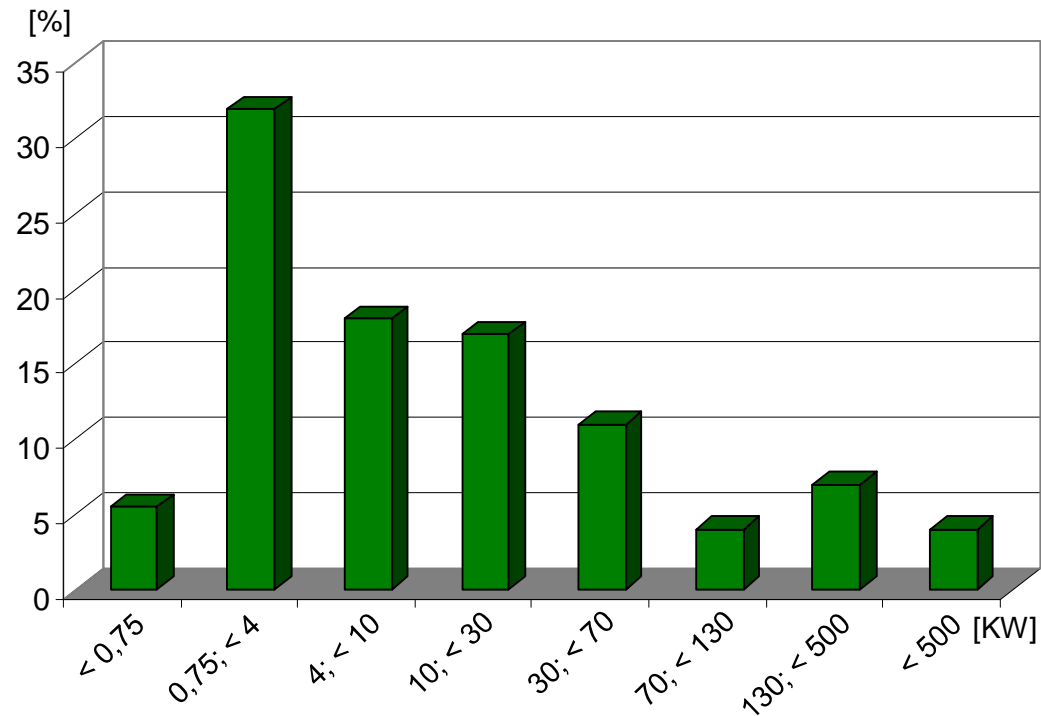


*Efficiency classes of single-speed three-phase,  
cage-induction motors*

*New rules in the EU and Worldwide*

*30 - 40% of the generated electrical energy worldwide is consumed by electric motors*

Savings potential by installed motors in the industry

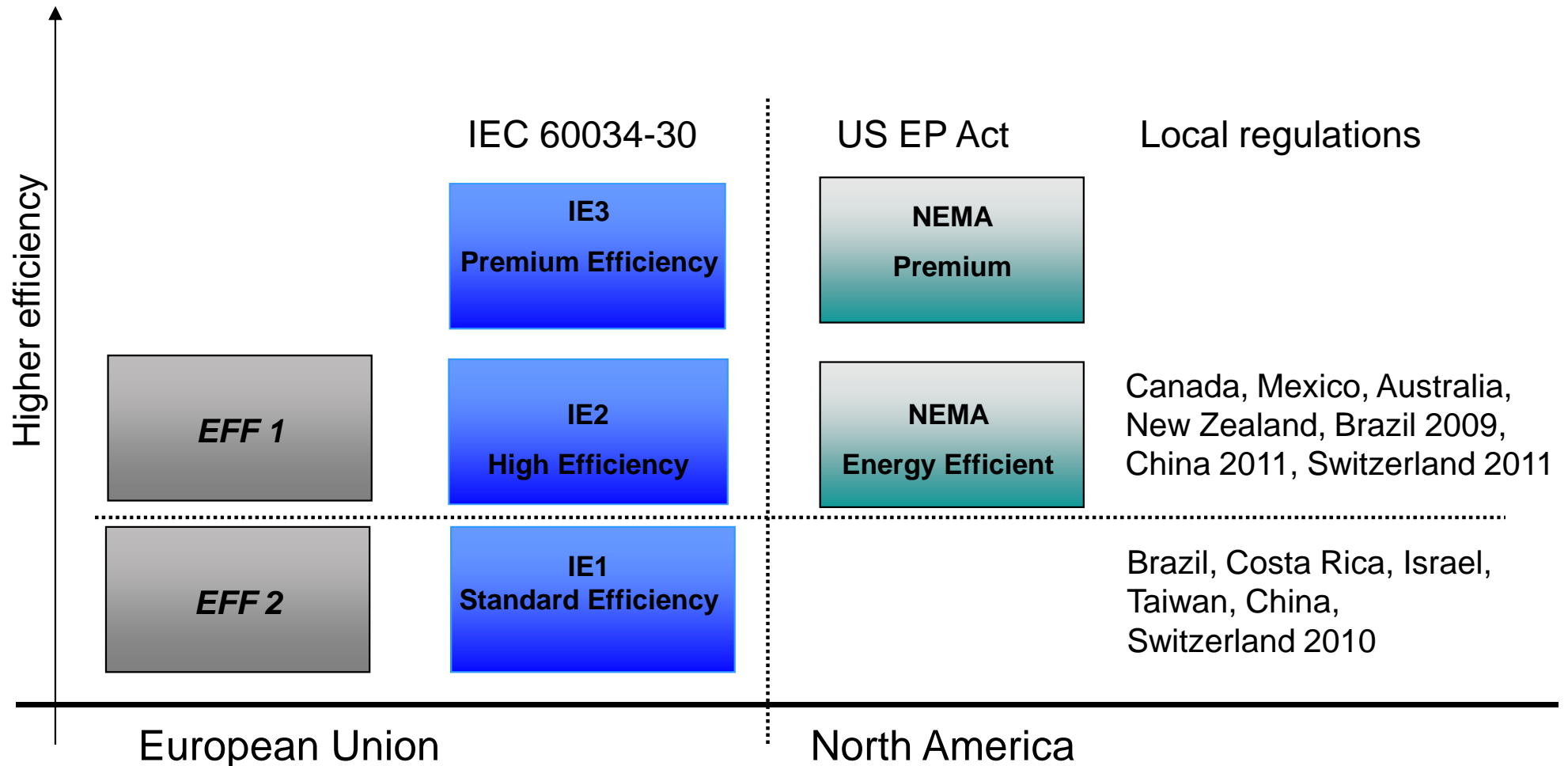


Source: SAVE-Report "Improving the Penetration of Energy Efficient Motors and Drives, 1996

**↔** Improving efficiency of the complete drive system is assumed to save 30 – 60% energy.

*A new harmonized worldwide standard was achieved in 2009*

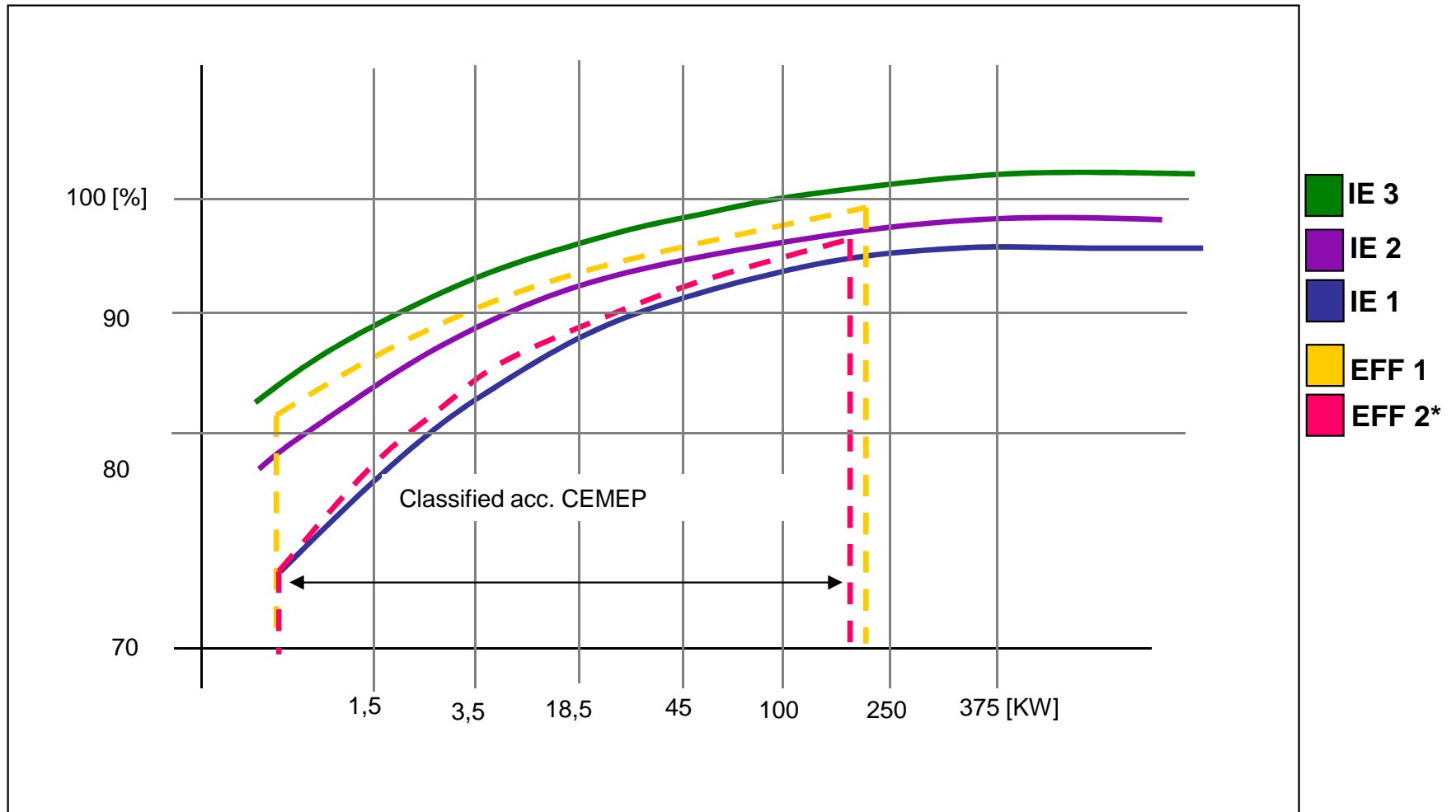
Comparison of old and new standards according to IEC 60034



Source: ZVEI Automation: Motors and controlled drives; ABB-Handout motors&generators, 2009.

*Three new classes replacing the original classification*

Old EFF classes vs. new IE-classification

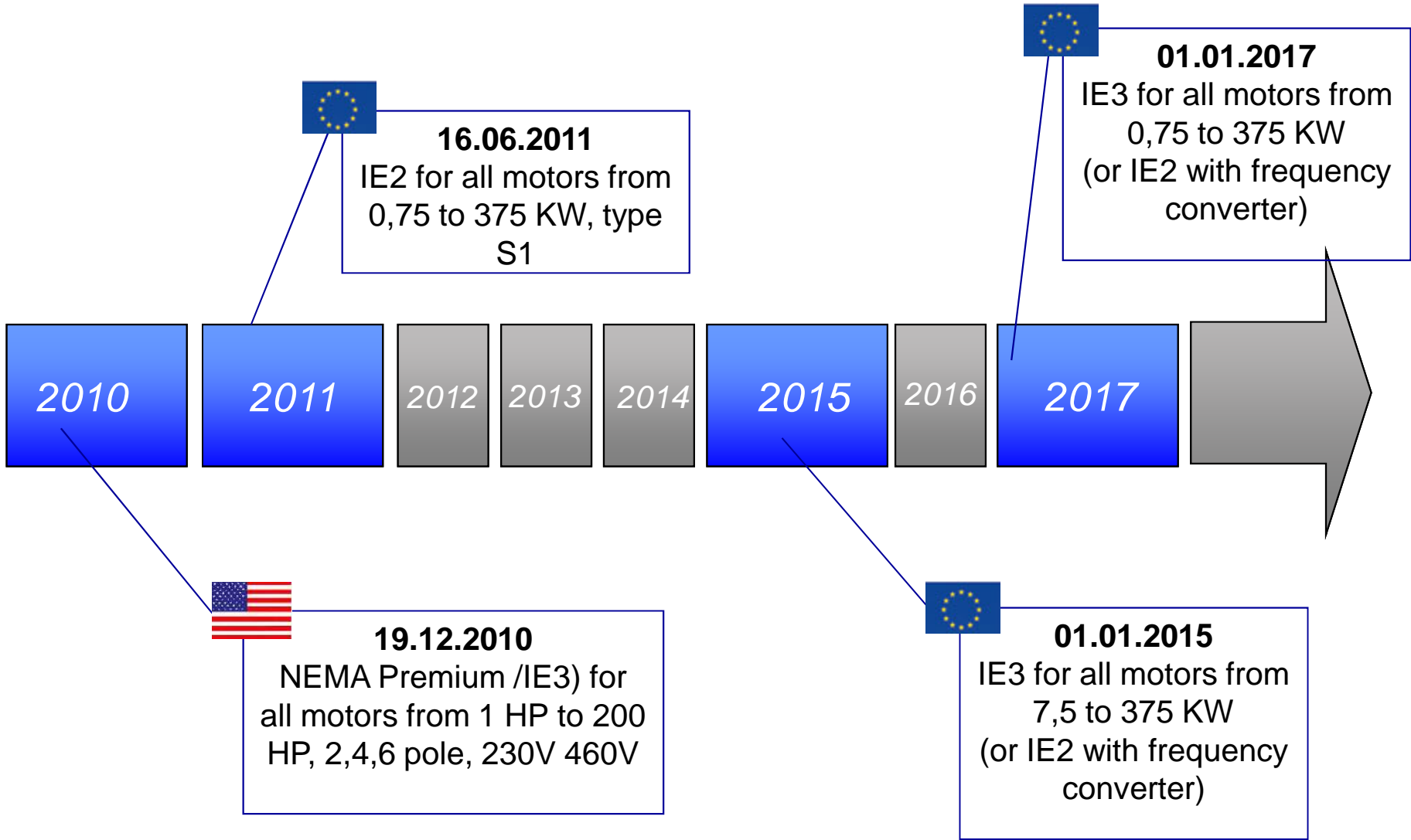


Source: International Electrotechnical Commission (IEC) and motor suppliers data.

\*The efficiency of the new IE classes is slightly lower than those of EFF because  $P_{LL}$  losses have to be individual measured, instead of global deduction of 0,5% within EFF.

*The changes implemented within the last years*

*Timeline for the implementation of the new regulations*



# EU regulation is based on IEC 60034 standard

## Scope of IEC and EU-regulations

| Valid for motors:                                                                                                                                                                                                             | IEC 60034-30: 2008<br>Marking of classes: IE1, IE2, IE3                            | EuP Guideline / regulation<br>640/2009<br>Statutory minimal standard |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------|----------------------------------------------------------------------|
| Single speed, three phase cage induction motors 0,75- 375 KW, 2,4,6-pole, type S1 (continuous duty). Also if completely integrated into a machine.                                                                            | <b>YES</b><br><b>Remark: additional type S3 (intermittent periodic duty ≥ 80%)</b> | <b>YES</b>                                                           |
| Single speed, three phase cage induction motors with auxiliary devices (shaft sealing, back-stop, shaft encoder, ...) 0,75- 375 KW, 2,4,6-pole, continuous duty. Remark: measurement of efficiency without auxiliary devices. | <b>YES</b><br><b>Remark: additional type S3 (intermittent periodic duty ≥ 80%)</b> | <b>YES</b>                                                           |
| Geared motors                                                                                                                                                                                                                 | <b>YES</b>                                                                         | <b>YES</b>                                                           |
| Explosion proof motors                                                                                                                                                                                                        | <b>YES</b>                                                                         | <b>NO</b>                                                            |
| Brake motors: A motor with electro-mechanical brake unit operating directly on the shaft without coupling                                                                                                                     | <b>YES</b>                                                                         | <b>NO</b>                                                            |
| Motors directly attached to a pump, ventilator, gear or compressor where the efficiency can't be measured independently.                                                                                                      | <b>NO</b>                                                                          | <b>NO</b>                                                            |
| Other motors e.g. permanent magnet, pole-changing, servo-motors.                                                                                                                                                              | <b>NO</b>                                                                          | <b>NO</b>                                                            |

## *There is no rule without exception*

---

### Exceptions of EU-regulation 640/2009

The following motors are excluded from the directive:

- Motors designed to operate wholly submerged in a liquid
- Motors completely integrated into a fan where the motors energy performance cannot be tested independently from the fan
- Brake motors

Motors specifically designed to operate:

- Motors without a cooling impeller that can therefore not be tested solitude running (most axial fans of Witt & Sohn)
- At altitudes exceeding 1000 meters above sea level
- Where ambient temperatures exceeds 40°C
- Where ambient air temperatures are less than -15°C (any motor) or less than 0°C (air-cooled motors)
- Maximum operating temperatures above 400°C
- Where the water coolant temperature at the inlet to a product is less then 5°C or exceeds 25 °C
- In potentially explosive atmospheres as defined EuP Guideline 94/9/EC
- Motor manufacturer (Siemens, ABB, VEM) believe, that motors made solely for converter operation are also excluded.

Source: EuP Regulation No. 640/2009

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*How will the motor name plate change?*

Examples for new motor name plates IE-class 1 and 2

The following information must be shown on the motor name plate according to IEC 60034-30; 2008 and European MEPS (Commission Regulation, EC, No 640/2009):

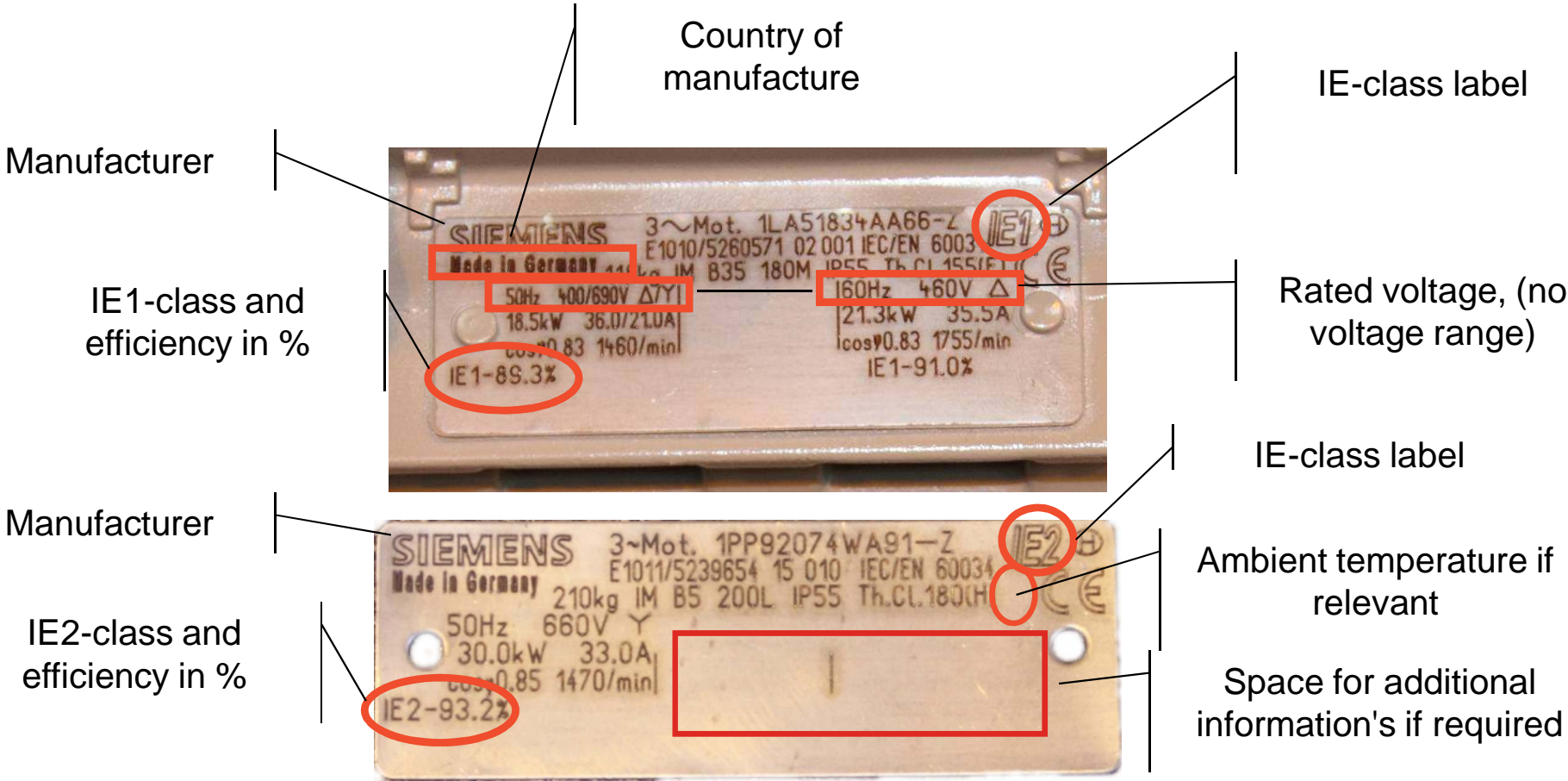


Photo Witt&Sohn AG: Example of motor name plate supplied by Siemens



## The implementation has clear rules

### Examples for daily business







Components are regarded as legally introduced (distributed and / or put into operation), if the equipment has been transferred from one legal entity to another.

|                                                         |                                                                                                                                                                                                                                                                                              |
|---------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Motors                                                  | If purchased <u>and</u> shipped before the 16.06.2011, they <ul style="list-style-type: none"><li>• are allowed to be sold</li><li>• and to be put into operation according to the rules valid <u>before that date</u></li></ul> After that, the new rules apply even if manufactured before |
| Fans (with motors) manufactured in the EU               | If the motors were purchased before the 16.06.2011, then the fans are allowed to be sold <ul style="list-style-type: none"><li>• if the motors are minimum IE1</li><li>• the name of the motor maker is shown</li></ul>                                                                      |
| Fans (with motors) coming from outside the EU( e.g. CH) | If the motors were purchased before the 16.06.2011, they are allowed to be sold <u>only</u> if they fulfil minimum IE2.<br>(The key concept is <u>introduction</u> into the EU)                                                                                                              |
| Replacement motors                                      | Spare motors efficiency class IE1 are not allowed to be supplied after the 16.06.2011 (only according to item 1)                                                                                                                                                                             |
| Motors from consignment stock                           | With shipment to the Witt Group in the EU or a distributor's warehouse in the EU motors have moved to another legal entity.                                                                                                                                                                  |
| Export into a non-EEA country                           | If fans/motors are exported by us or our customers into a non-EEA country the directive 640/2009 <u>is not applicable</u> but local regulations must be regarded                                                                                                                             |

According to the ZVEI (The German electrical manufacturers association, Automation / 2nd edition December 2010.

# New IEC efficiency classes 2011

## An important step on the road to global harmonization

| New efficiency classes according to IEC 60034-30<br>(IE = International Efficiency)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                        | Up to 2009                                                                                                                                                                                                                                                                                                                                                                                                                                                                                              | New in 2010                                                                                                                                                                                                                                                                                                                                                                                                                         | New in 2011                                                                                                                                                                                                                                                                                                                                                                                                            |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p><b>IE3 Premium Efficiency</b><br/>also valid:</p> <ul style="list-style-type: none"> <li>USA: EISA (2007) NEMA Premium (~IE3) as of Dec 2010</li> <li>Canada: Premium (~IE3) as of Jan 2011</li> <li>Mexico: NOM 016 (2009) Premium (~IE3) as of Dec 2010</li> <li>China: GB 18613 (2008); level 1 (~IE3)</li> <li>EU: EuP 2005/32/EC as of Jan 2015 and Jan 2017</li> </ul>                                                                                                                                                                                                                                            |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         | <ul style="list-style-type: none"> <li>USA and Mexico 10/20/12<br/>0.75 ... 150 kW, 2-, 4- and 6-pole</li> </ul>                                                                                                                                                                                                                                 | <ul style="list-style-type: none"> <li>Canada 11/01/01<br/>0.75 ... 150 kW, 2-, 4- and 6-pole</li> </ul>                                                                                                                                                                                                                            |
| <p><b>IE2 High Efficiency</b><br/>also valid:</p> <ul style="list-style-type: none"> <li>USA: EPACKT (1997) NEMA High (~IE2) since Oct 1997</li> <li>Canada: High (~IE2) since 1997</li> <li>Australia/New Zealand: MESP since 2006</li> <li>Brazil: ABNT / NBR 7094 since 2009</li> <li>Korea: REELS (~IE2) since 2008</li> <li>China: GB 18613 (2008); level 2 (~IE2)</li> <li>India: BEE IS 12615 as of 2002 voluntary EFF1, with reservations obligatory as of 2013</li> <li>Japan: JIS 4212</li> <li>EU: EuP 2005/32/EC as of June 2011</li> <li>CEMEP (voluntary European agreement EFF1 until June 2011)</li> </ul> | <ul style="list-style-type: none"> <li>USA/Canada 97/01/10<br/>0.75 ... 150 kW, 2-, 4- and 6-pole</li> <li>Australia 06/01/04</li> <li>New Zealand 06/01/06<br/>0.75 ... 185 kW, 2-, 4- and 6-pole</li> <li>South Korea 08/01/01<br/>45 ... 200 kW, 2-, 4- and 6-pole</li> <li>Brazil 09/08/12<br/>0.75 ... 185 kW, 2-, 4-pole<br/>0.75 ... 150 kW, 6-pole</li> </ul>                                                                                                                                   | <ul style="list-style-type: none"> <li>South Korea 10/01/01<br/>18.5 ... 37 kW, 2-, 4- and 6-pole</li> <li>South Korea 10/01/07<br/>0.75 ... 15 kW, 2-, 4- and 6-pole</li> <li>USA and Mexico 10/20/12<br/>160 ... 375 kW, 2- and 4-pole<br/>160 ... 260 kW, 6-pole</li> <li>USA 10/19/12<br/>0.75 ... 150 kW, 2-, 4- and 6-pole</li> </ul>      | <ul style="list-style-type: none"> <li>Canada 11/01/01<br/>160 ... 375 kW, 2-, 4- and 6-pole</li> <li>Europe 11/16/06<br/>Switzerland 11/01/07<br/>0.75 ... 375 kW, 2-, 4- and 6-pole</li> <li>PR China 11/01/07<br/>0.55 ... 315 kW, 2-, 4- and 6-pole</li> <li>Canada 10/31/12<br/>0.75 ... 150 kW, 2-, 4- and 6-pole</li> </ul>  |
| <p><b>IE1 Standard Efficiency</b><br/>also valid:</p> <ul style="list-style-type: none"> <li>Mexico: NOM 016 (2002) Standard (~IE1) as of March 2003</li> <li>India: BEE IS 12615 as of 2002 voluntary EFF2</li> <li>China: GB 18613 (2008); level 3 (~IE1)</li> <li>EU: EuP 2005/32/EC until June 2011</li> <li>CEMEP (voluntary European agreement EFF2 until June 2011)</li> </ul>                                                                                                                                                                                                                                      | <ul style="list-style-type: none"> <li>Mexico 03/25/03<br/>0.75 ... 375 kW, 2-, 4- and 6-pole</li> <li>PR China 08/01/06<br/>0.55 ... 315 kW, 2-, 4- and 6-pole</li> <li>USA/Canada 97/30/09<br/>0.75 ... 150 kW, 2-, 4- and 6-pole</li> <li>Australia 06/31/03</li> <li>New Zealand 06/31/05<br/>0.75 ... 185 kW, 2-, 4- and 6-pole</li> <li>South Korea 07/31/12<br/>45 ... 200 kW, 2-, 4- and 6-pole</li> <li>Brazil 09/07/12<br/>0.75 ... 185 kW, 2-, 4-pole<br/>0.75 ... 150 kW, 6-pole</li> </ul> | <ul style="list-style-type: none"> <li>Switzerland 10/01/01<br/>0.75 ... 375 kW, 2-, 4- and 6-pole</li> <li>South Korea 09/31/12<br/>18.5 ... 37 kW, 2-, 4- and 6-pole</li> <li>South Korea 10/30/06<br/>0.75 ... 15 kW, 2-, 4- and 6-pole</li> <li>Mexico 10/19/12<br/>0.75 ... 375 kW, 2- and 4-pole<br/>0.75 ... 260 kW, 6-pole</li> </ul>  | <ul style="list-style-type: none"> <li>Europe 11/15/06<br/>Switzerland 11/30/06<br/>0.75 ... 375 kW, 2-, 4- and 6-pole</li> <li>PR China 11/30/06<br/>0.55 ... 315 kW, 2-, 4- and 6-pole</li> </ul>                                                                                                                               |

**GO** = Mandatory








**STOP** = Voluntary

Efficiency increase

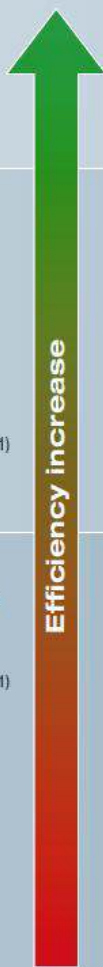
Source: Motor manufacturer SEW, www.sew-eurdrive.de/dr-motor 9\_10



# New IEC efficiency classes 2011

## An important step on the road to global harmonization

| New efficiency classes according to IEC 60034-30<br>(IE = International Efficiency)                                                                                                                                                                                                                                                                                                                                                                                                                                                 | Up to 2009                                                                                                                                                                                                                                                                                                                                                                                                               | New in 2013                                                                                                                                                                                                                                               | New in 2015                                                                                                                                                      | New in 2017                                                                                                                                                       |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>IE3 Premium Efficiency</b><br>also valid:<br>– USA: EISA (2007) NEMA Premium (~IE3) as of Dec 2010<br>– Canada: Premium (~IE3) as of Jan 2011<br>– Mexico: NOM 016 (2009) Premium (~IE3) as of Dec 2010<br>– China: GB 18613 (2008); level 1 (~IE3)<br>– EU: EuP 2005/32/EC as of Jan 2015 and Jan 2017                                                                                                                                                                                                                          |                                                                                                                                                                                                                                                                                                                                                                                                                          | – Australia, with reservations<br>and New Zealand<br>0.75 ... 375 kW,<br>2-, 4- and 6-pole<br>                                                                         | – Europe and Switzerland 15/01/01<br>7.5 ... 375 kW,<br>2-, 4- and 6-pole<br> | – Europe and Switzerland 17/01/01<br>0.75 ... 5.5 kW,<br>2-, 4- and 6-pole<br> |
| <b>IE2 High Efficiency</b><br>also valid:<br>– USA: EPACT (1997) NEMA High (~IE2) since Oct 1997<br>– Canada: High (~IE2) since 1997<br>– Australia/New Zealand: MESP since 2006<br>– Brazil: ABNT / NBR 7094 since 2009<br>– Korea: REELS (~IE2) since 2008<br>– China: GB 18613 (2008); level 2 (~IE2)<br>– India: BEE IS 12615 as of 2002 voluntary EFF1,<br>with reservations obligatory as of 2013<br>– Japan: JIS 4212<br>– EU: EuP 2005/32/EC as of June 2011<br>– CEMEP (voluntary European agreement EFF1 until June 2011) | – USA/Canada 97/01/10<br>0.75 ... 150 kW, 2-, 4- and 6-pole<br>– Australia 06/01/04<br>– New Zealand 06/01/06<br>0.75 ... 185 kW, 2-, 4- and 6-pole<br>– South Korea 08/01/01<br>45 ... 200 kW, 2-, 4- and 6-pole<br>– Brazil 09/08/12<br>0.75 ... 185 kW, 2-, 4-pole<br>0.75 ... 150 kW, 6-pole                                                                                                                         | With reservations<br>– India<br>0.75 ... 15 kW, 2-, 4- and 6-pole<br>With reservations<br>– Australia and New Zealand<br>0.75 ... 185 kW, 2-, 4- and 6-pole<br>        | – Europe and Switzerland 14/31/12<br>7.5 ... 375 kW, 2-, 4- and 6-pole<br>    | – Europe and Switzerland 16/31/12<br>0.75 ... 5.5 kW, 2-, 4- and 6-pole<br>    |
| <b>IE1 Standard Efficiency</b><br>also valid:<br>– Mexico: NOM 016 (2002) Standard (~IE1) as of March 2003<br>– India: BEE IS 12615 as of 2002 voluntary EFF2<br>– China: GB 18613 (2008), level 3 (~IE1)<br>– EU: EuP 2005/32/EC until June 2011<br>– CEMEP (voluntary European agreement EFF2 until June 2011)                                                                                                                                                                                                                    | – Mexico 03/25/03<br>0.75 ... 375 kW, 2-, 4- and 6-pole<br>– PR China 08/01/06<br>0.55 ... 315 kW, 2-, 4- and 6-pole<br>– USA/Canada 97/30/09<br>0.75 ... 150 kW, 2-, 4- and 6-pole<br>– Australia 06/31/03<br>– New Zealand 06/31/05<br>0.75 ... 185 kW, 2-, 4- and 6-pole<br>– South Korea 07/31/12<br>45 ... 200 kW, 2-, 4- and 6-pole<br>– Brazil 09/07/12<br>0.75 ... 185 kW, 2-, 4-pole<br>0.75 ... 150 kW, 6-pole | With reservations<br>– Australia and New Zealand<br>200 ... 375 kW,<br>2-, 4- and 6-pole<br>With reservations<br>– India<br>0.75 ... 15 kW,<br>2-, 4- and 6-pole<br> |                                                                                                                                                                  |                                                                                                                                                                   |

Efficiency increase



 = Mandatory  
 = Voluntary