

Ing. Naděžda Pavelková, Ph.D

Nová legislativa motory a měniče EU MEPS

Automatizace výroby a pohony

Nadezda Pavelkova

Technical Support Manager

ABB s.r.o.

Drives Sales

Stetkova 1638/18

140 00, Praha 4, Czech Republic, CZ

Phone: +420 234 322 342

Telefax: +420 234 322 310

Mobile: +420 731 552 253

email: nadezda.pavelkova@cz.abb.com

Web: www.abb.cz, facebook.com/ABBCzech



Nabídka ABB s.r.o.

Divize a portfolio produktů a služeb



Výrobky pro energetiku

Transformátory, zařízení pro rozvodny VN a VVN, vypínače, rozváděče, svodiče přepětí, rozváděče VN, přístrojové transformátory proudu a napětí VN, senzory



Systémy pro energetiku

Rozvodny, FACTS, HVDC, HVDC Light, elektrárny & automatizace sítí, rozváděče ochran a řídicích systémů pro rozvodny VVN a VN, kabelové systémy VVN



Automatizace výroby a pohony

Pohony, motory, frekvenční měniče, výkonová elektronika, opravy elektromotorů, roboty, kompletní robotizovaná řešení, poradenství a servis, výroba standardizovaných svařovacích buněk, oprava použitých průmyslových robotů



Výrobky nízkého napětí

Přístroje a rozváděče nízkého napětí, domovní elektroinstalační materiál, vypínače a odpojovače, inteligentní systémy elektroinstalace



Procesní automatizace

Řídicí systémy a komplexní dodávky automatizačních řešení, analytika a instrumentace, inženýring a servis pohonů, Operační centrum Česká republika

Snížení ztrát v energetickém řetězci

Moderní technologie pomáhají ve všech stupních

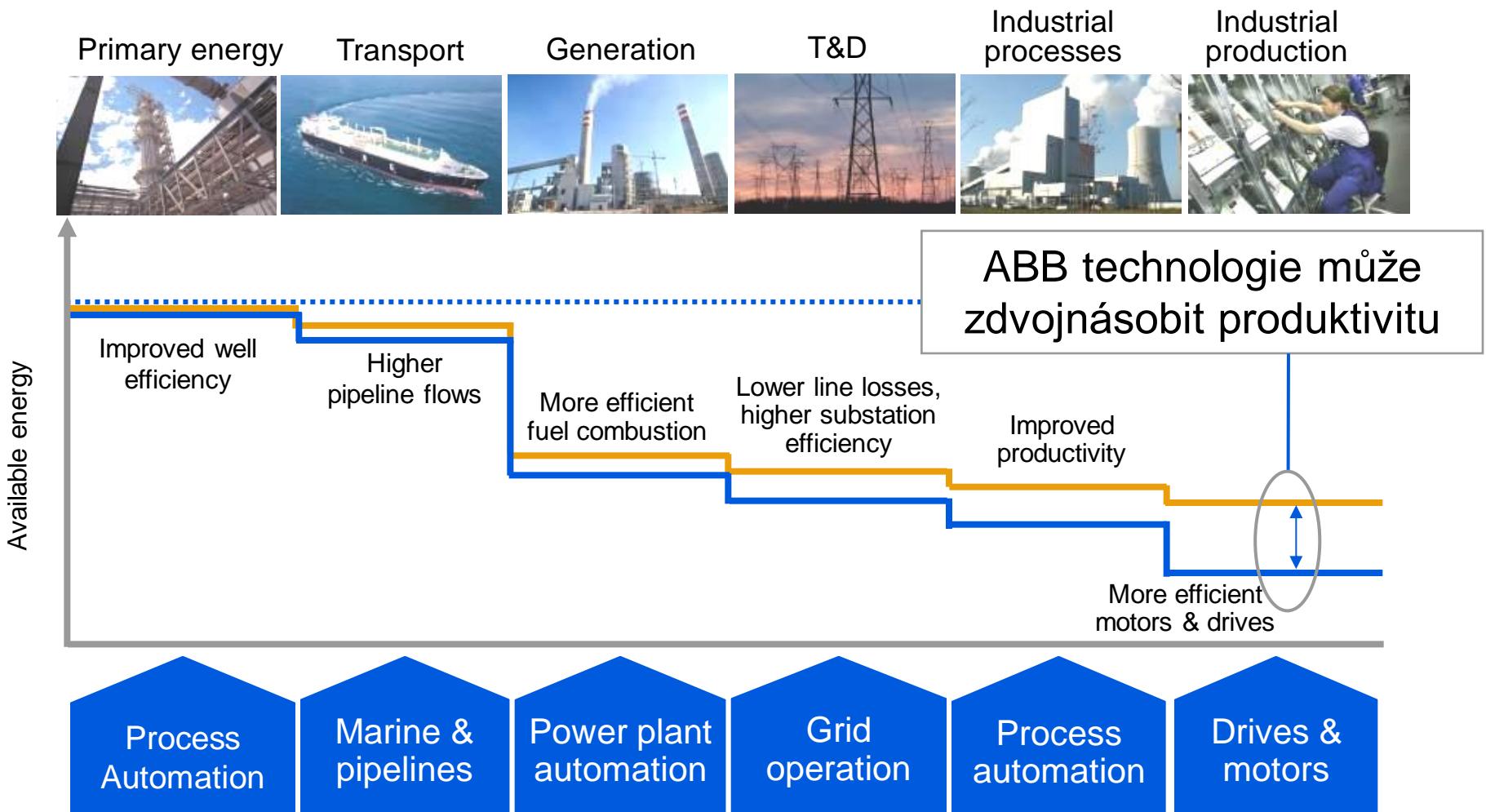


ABB Motory a generátory

Kompletní nabídka



IEC motory

- NN a VN motory a generátory
- Synchronní motory
- Motory do Ex
- Motory pro námořní průmysl
- DC motory
- Trakční motory
- Motory s permanentními magnety
- Vysokootáčkové motory
- Synchronní reluktanční motory
- Motory pro válečkové tratě, kouřové ventilátory a sušárny



NEMA motory

- NN AC motory
- Motory s brzdou
- HVAC motory
- Pump motory
- DC Motory
- DC motory s permanentními magnety



Generátory

- Indukční a synchronní motory a synchronní generátory pro větrné turbíny
- Synchronní generátory pro dieslové a větrné turbíny
- Synchronní generátory pro plynové a parní turbíny
- Synchronní generátory pro námořní aplikace
- Synchronní generátory pro průmysl
- Trakční generátory



Prvky pro mechanický přenos energie

- Ložiska
- Převodovky
- Spojky
- Prvky pro dopravníky

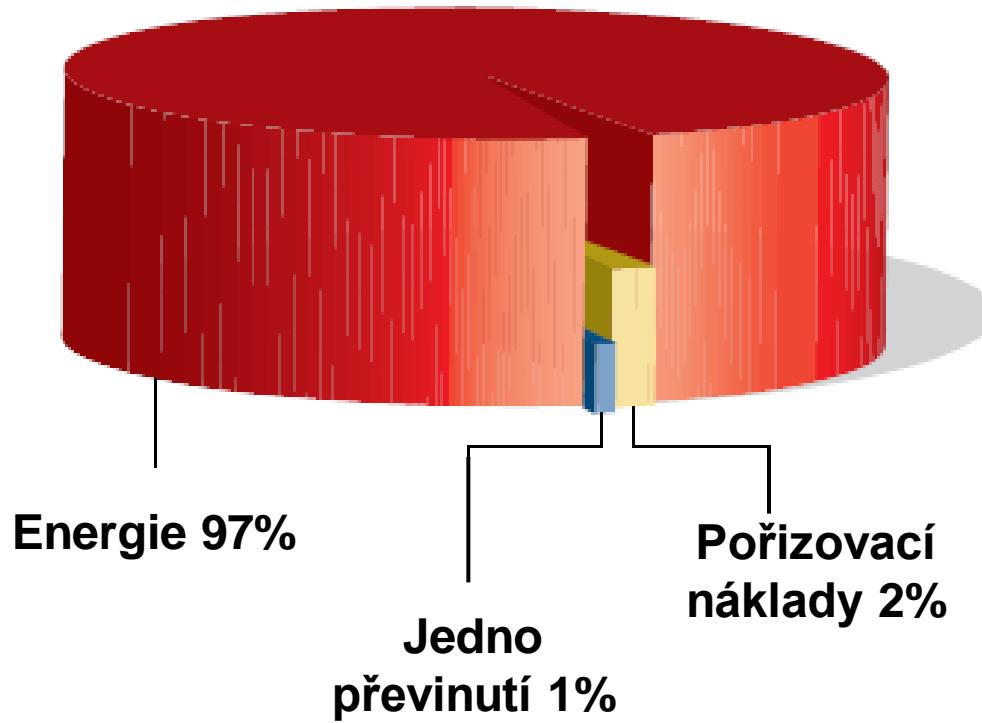


Servis

- Poradenství, konzultace, diagnostika
- Mach Sense, Leap
- Instalace, uvádění do provozu
- Opravy
- Náhradní díly

Spotřeba el. energie - elektrický motor

Vyšší účinnost – menší ztráty – nižší spotřeba

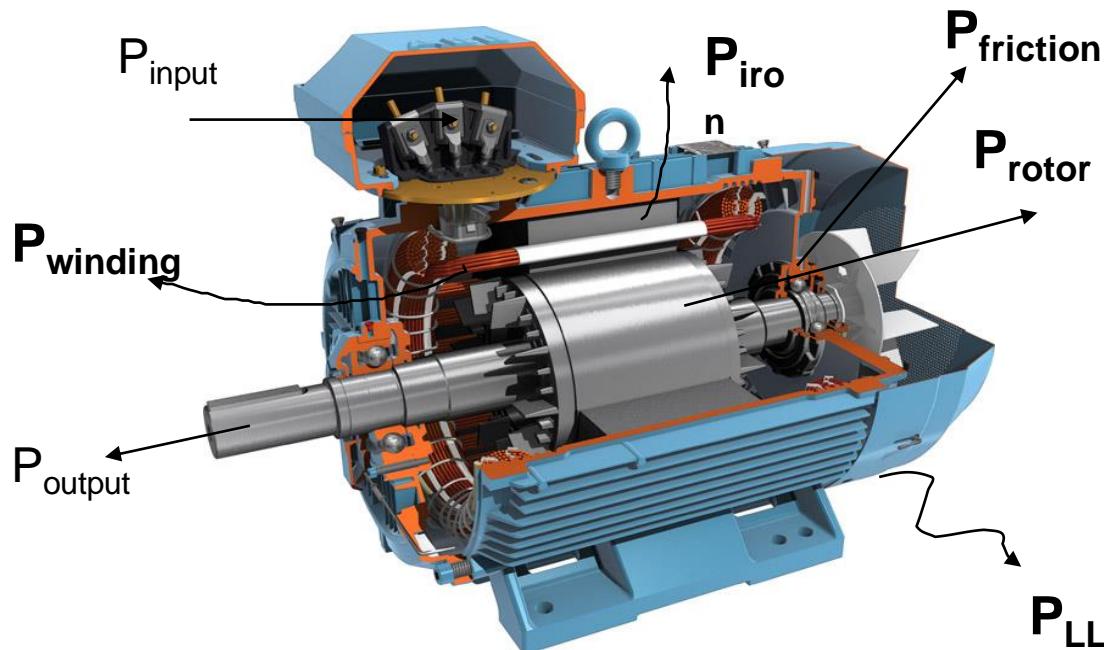


Normy pro stanovení účinnosti LV motorů IEC/EN 60034-2-1: 2007 (revize 2014)



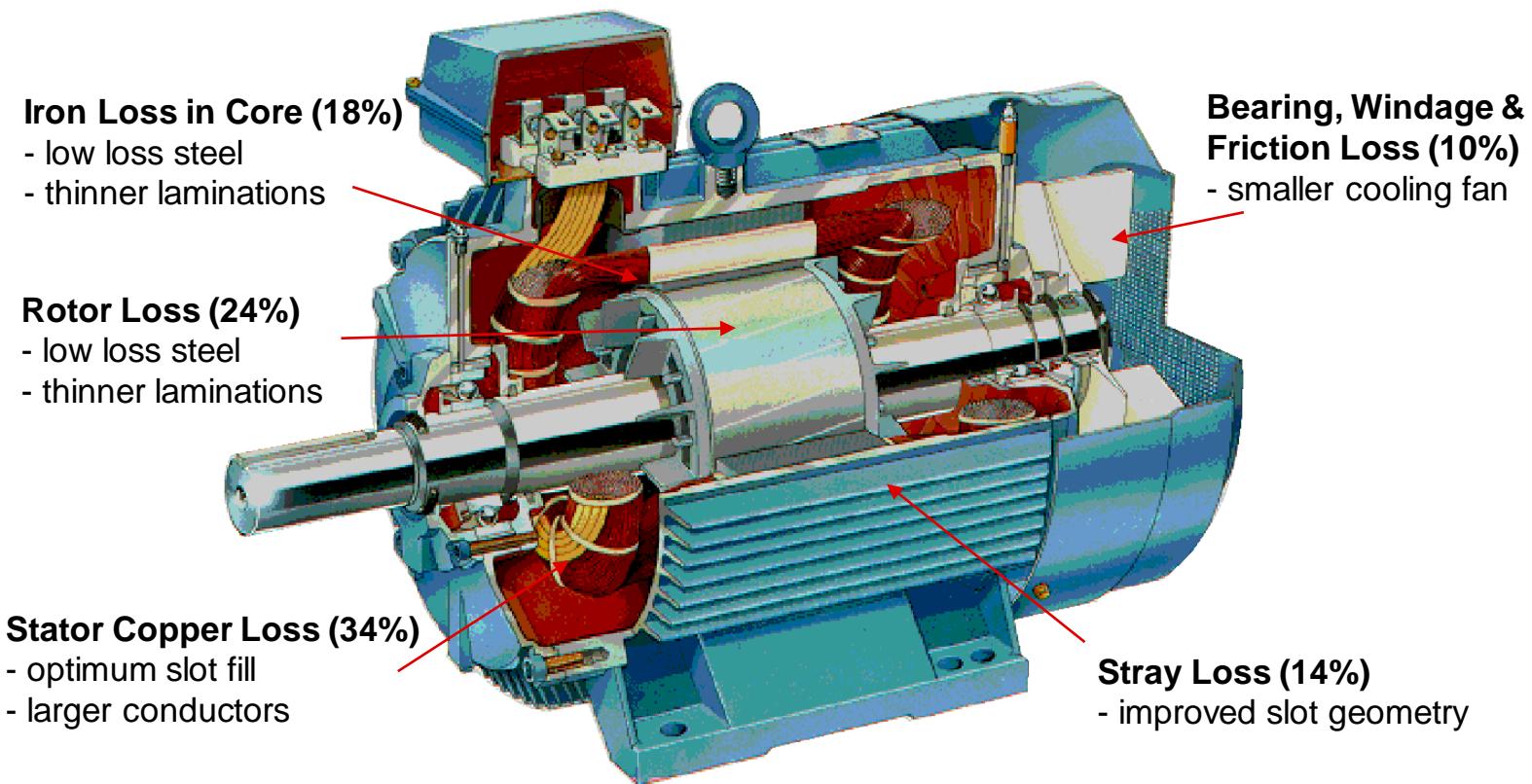
Ztráty v motoru

- Friction (P_{friction}) v ložikách
- Iron (P_{iron}) v železe
- Winding (P_{winding}) ve vinutí
- Rotor (P_{rotor}) v rotoru
- Additional load losses (P_{LL}) přídavné
 - Additional load losses are due to: leakage flux, mechanical imperfections in the air gap and irregularities in the air gap flux density

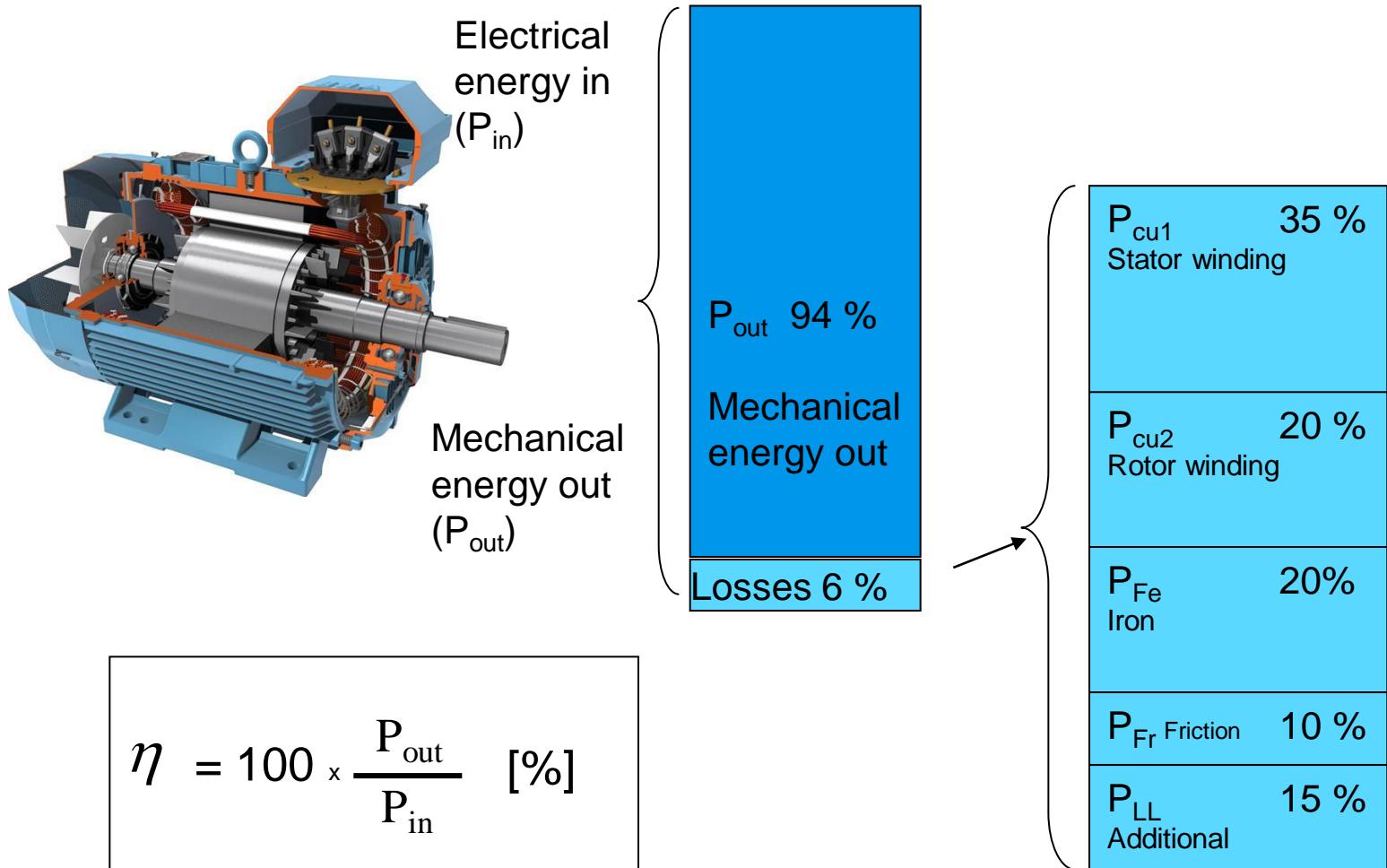


Rozložení ztrát

- Less energy lost from the motor as heat



Ztráty a účinnost elektrického motoru



EU MEPS pro nn motory



EU MEPS 640/2009, napětí do 1000 V, 2-6 pólové Minimum Energy-efficiency Performance Standard

Note! IE
classes
required by
the regulation
correspond to
IE class
defined in
IEC/EN
60034-30
standard

| | |
|---------------------------------------|---|
| Fáze 1: Od 16. června, 2011 | Motory musí mít min IE2 (ne IE1) |
| Fáze 2: Od 1. ledna, 2015 | Motory o výkonu 7.5 – 375 kW musí mít buď IE3 nebo IE2 pokud jsou napájené z měniče frekvence |
| Fáze 3: Od 1. ledna, 2017 | Motory o výkonu 0.75 – 375 kW musí mít buď IE3 nebo IE2 pokud jsou napájené z měniče frekvence |

IEC/EN 60034-30 versus EU MEPS

Společné:

- Jednorychlostní, 3 fáz
- 2, 4 a 6-pol
- Výkony 0.75 to 375 kW, S1
- Determination of total losses with P_{LL} determined from residual losses

Vyjmuty z IEC/EN 60034-30:

- Motory přímo vyrobené pro provoz s měniči frekvence dle IEC 60034-25
- Motory kompletně zabudované ve strojním zařízení které nelze vyjmout a samostatně měřit

Vyjmuty z (EC) No 640/2009 of 22 July 2009

(in addition to IEC/EN 60034-30) :

- Motory do Ex designed for use in potentially explosive atmospheres as defined in ATEX Directive 94/9/EC
- Brzdové motory
- Motory pro teplotu okolí (-15°C..+40°C)
- Motory navržené nad 1000m n.v.
- Motory navržené na teplotu nad 400°C

Hlavní změny



- Main changes to Article 1:

2. This Regulation shall not apply to:
 - (a) motors specified to operate wholly immersed in a liquid;
 - (b) motors completely integrated into a product (for example gear, pump, fan or compressor) of which the energy performance cannot be tested independently from the product;
 - (c) motors specified to operate exclusively:
 - (i) at altitudes exceeding 4 000 metres above sea-level;
 - (ii) where ambient air temperatures exceed 60 °C;
 - (iii) in maximum operating temperature above 400 °C;
 - (iv) where ambient air temperatures are less than -30 °C for any motor or less than 0 °C for a motor with water cooling;
 - (v) where the water coolant temperature at the inlet to a product is less than 0 °C or exceeding 32 °C; or
 - (vi) in potentially explosive atmospheres as defined in Directive 94/9/EC(*);
 - (d) brake motors,

except as regards the information requirements of Annex 1, points 2 (3) to (6) and (12).

Novela EC640/2009 EU4/2014

Hlavní změny



2. This Regulation shall not apply to:

(a) motors **specified to operate** wholly immersed in a liquid

(c)

Motors
specifically
designed to
operate

change

motors
specified
to operate
exclusively

(i) at altitudes exceeding
4000 m ASL;

1000 m change 4000 m

(ii) where ambient air
temperatures exceed 60 °C;

40 °C change 60 °C

(iv) where ambient air
temperatures are less than
-30 °C for any motor or less
than 0 °C for a motor with
water cooling;

-15 °C change -30 °C

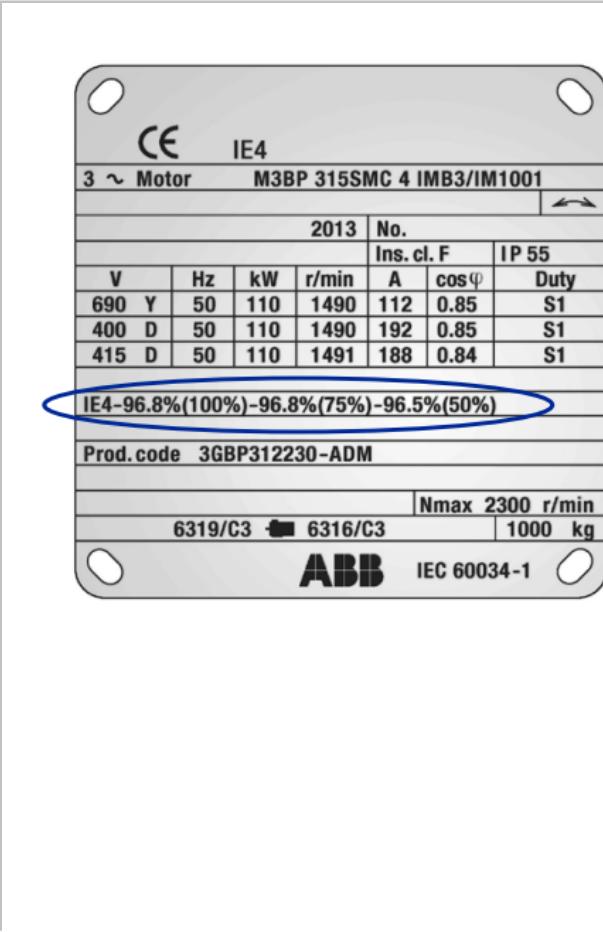
Air change Water

(v) where the water coolant
temperature at the inlet to a
product is less than 0 °C or
exceeding 32 °C;

5 °C change 0 °C

25 °C change 32 °C

EU 4/2014 a ABB



Regulation will slightly relax requirements for markings

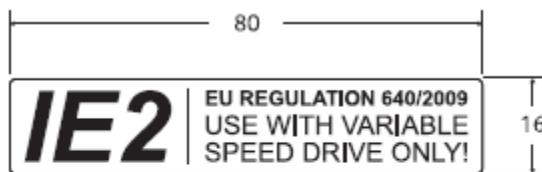
- It will allow marking of nominal efficiency at only 100% rated load for small motors due to the limited size of their rating plates
- ABB continues to stamp partial load efficiencies
- As a global player, ABB will follow the requirements of IEC/EN 60034-30 and IEC/EN 60034-30-1. Even though it is not required under EU MEPS, ABB also provides IE markings as standard for motors for explosive atmospheres.

EU MEPS

Značení pro IE2 motors



Dimensions: 80x16mm
Print Color: White 100%
Label: Transparent



Dimensions: 80x16mm
Print Color: Black 100%
Label: Transparent

- Povinné značení
- OMS/CQP AO's and Offers to be provided with a standard message :

IE2 motors included in the scope of EC 640/2009 can be used within EC market area with a variable speed drive only!
- This text will be adopted on a local level by SU's
- Our policy is to provide IE2 motors falling into the scope of the EC 640 Regulation with stickers as default

Normy pro stanovení účinnostních tříd IEC/EN 60034-30: 2008 a IEC/EN 60034-30-1: 2014



Normy pro stanovení účinnostních tříd IEC/EN 60034-30: 2008

- IEC/EN 60034-30 October 2008
 - Definuje účinnostní třídy pro motory
 - Účinnost stanovena dle IEC/EN 60034-2-1 IE2, IE3 and **IE4**
 - Používá se pro implementaci **MEPS (= Minimum Energy-efficiency Performance Standard)**
 - Novelizace IEC/EN 60034-30-1: 2014

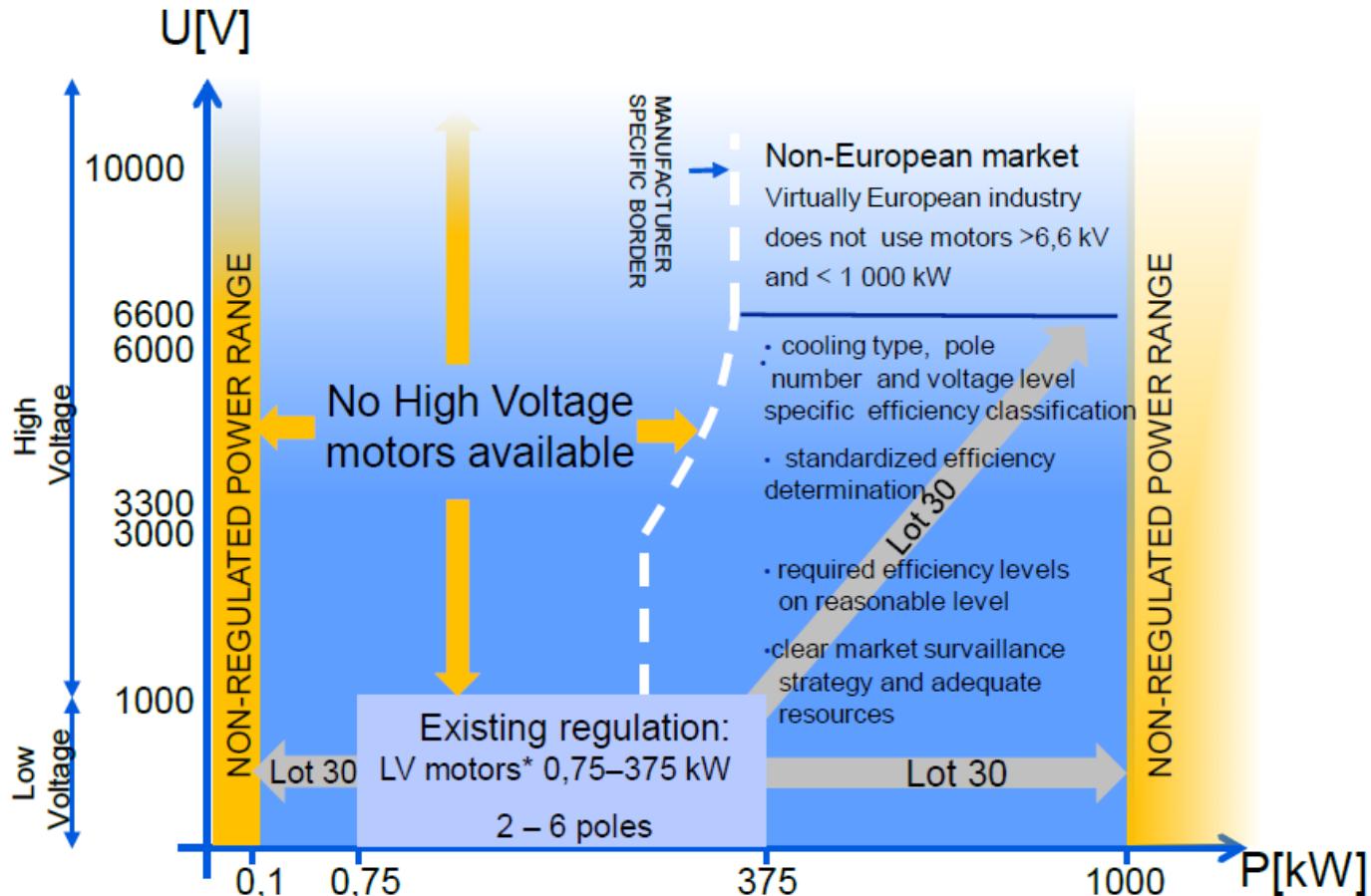
Účinnostní třídy dle IEC/EN 60034-30-1:2014

| | | |
|----------------------------|-----|--------------------------|
| Super premium efficiency * | IE4 | Super premium efficiency |
| Premium efficiency | IE3 | Premium |
| High efficiency | IE2 | Comparable to EFF1 |
| Standard efficiency | IE1 | Comparable to EFF2 |

Motory zahrnuté do IEC/EN 60034-30-1: 2014

- IEC/EN 60034-30-1 všechny motory (for example standard, motors for explosive atmospheres, marine and brake motors):
 - Single-speed, three-phase, 50 and 60 Hz
 - 2, 4, 6 i **8** poles
 - 0.12 to 1000 kW
 - U_N nad 50 V up to 1 kV
 - S1
 - 20°C to +60°C
 - Do 4000 m m.n.v.
- Změna EU MEPS bude následovat

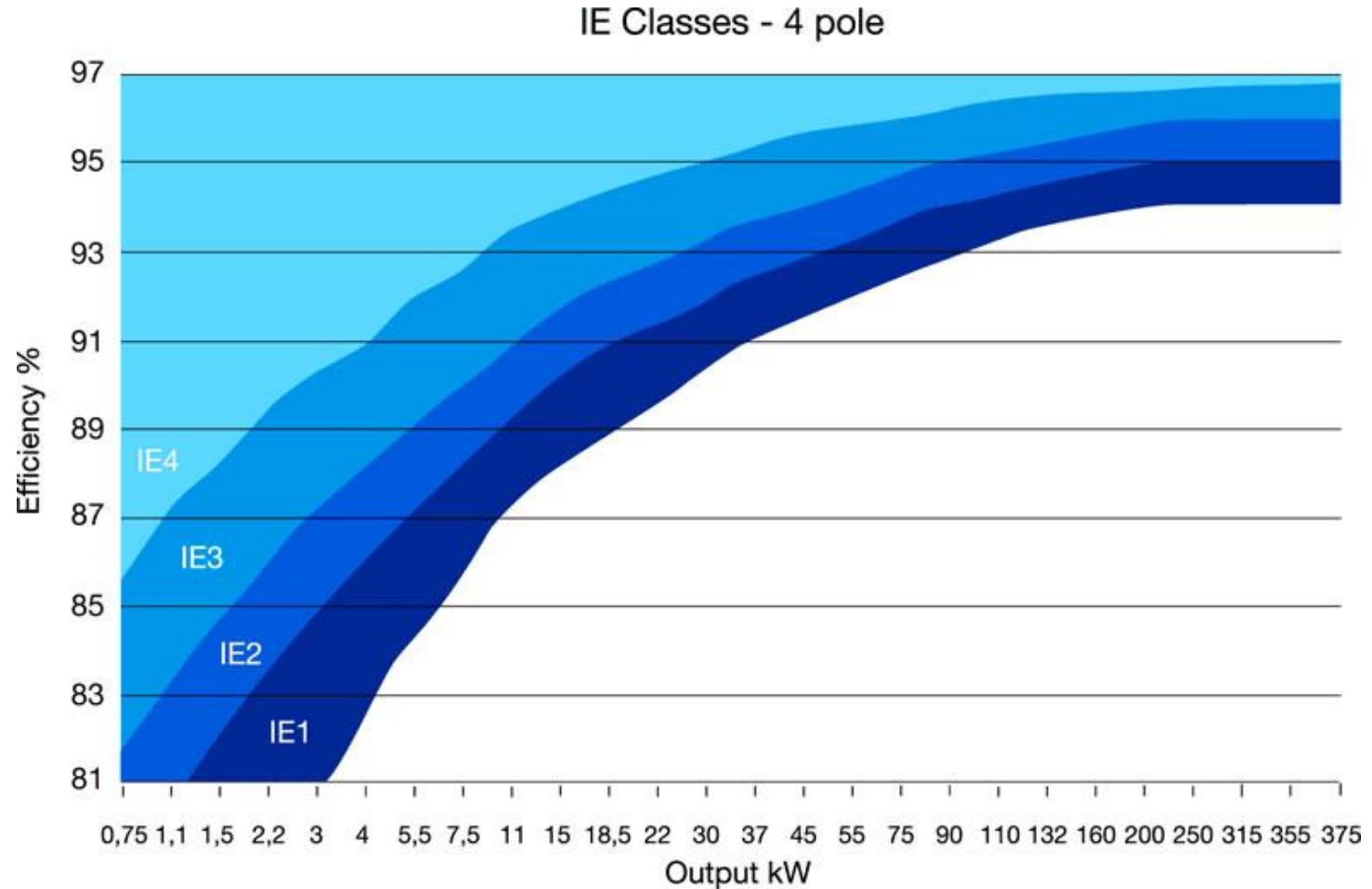
Připravuje se LOT 30

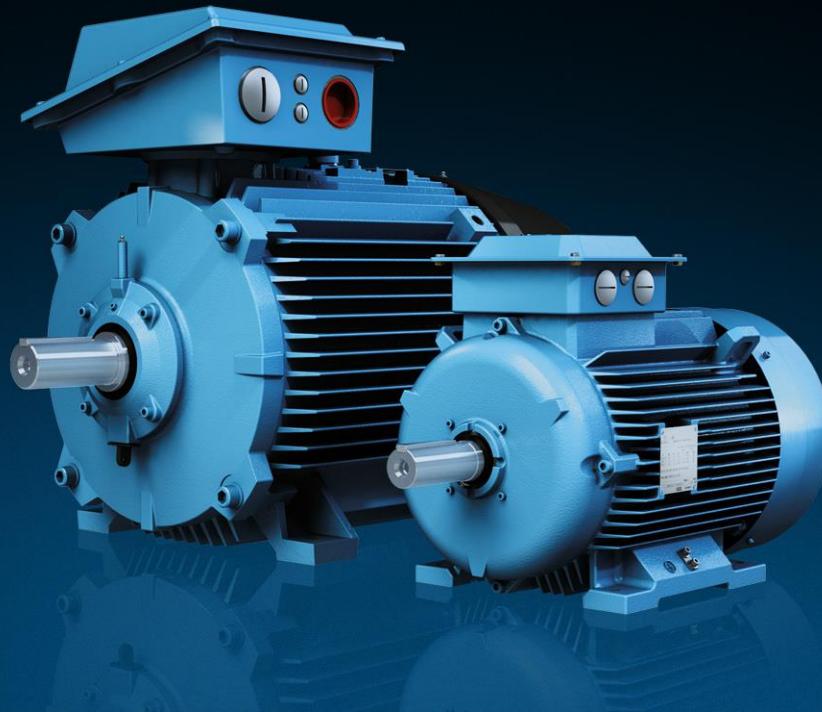


- * with some exemptions
- ** VSD excluded

IE IEC/EN 60034-30-1

IE 50 Hz 4-pole motors





General performance cast iron M2BAX motors

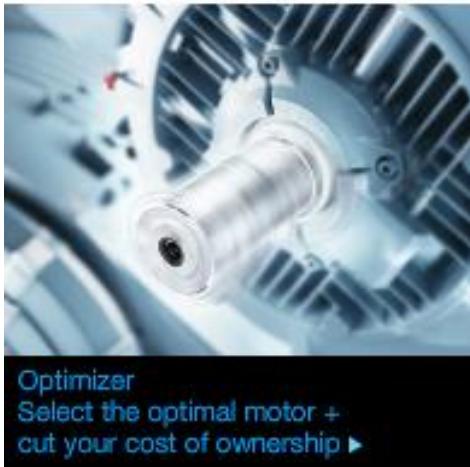
Novinka pro splnění požadavků

Power and productivity
for a better world™



General performance cast iron M2BAX motors

Motor range



- Extensive range
 - Motor type M2BAX
 - Frame size 71 -355
 - Power 7.5 – 355 kW
 - 2, 4 and 6 pole
 - IE2 and IE3
- Mounting; Foot, flange, foot/flange
- Ambient temperature: 40°C, at 1000 m.a.s.l
- IP55
- [Optimizer](#) – easy-to-use tool for MEPS compliance and documents

Optimizer – výpočty a dokumentace

<http://www145.abb.com/selection>

The screenshot shows the ABB Optimizer web application interface. At the top, there is a header bar with browser navigation icons, a URL field containing <http://www145.abb.com/selection>, and a tab labeled "ABB - LV Motors - O...". On the right side of the header are icons for home, star, and settings.

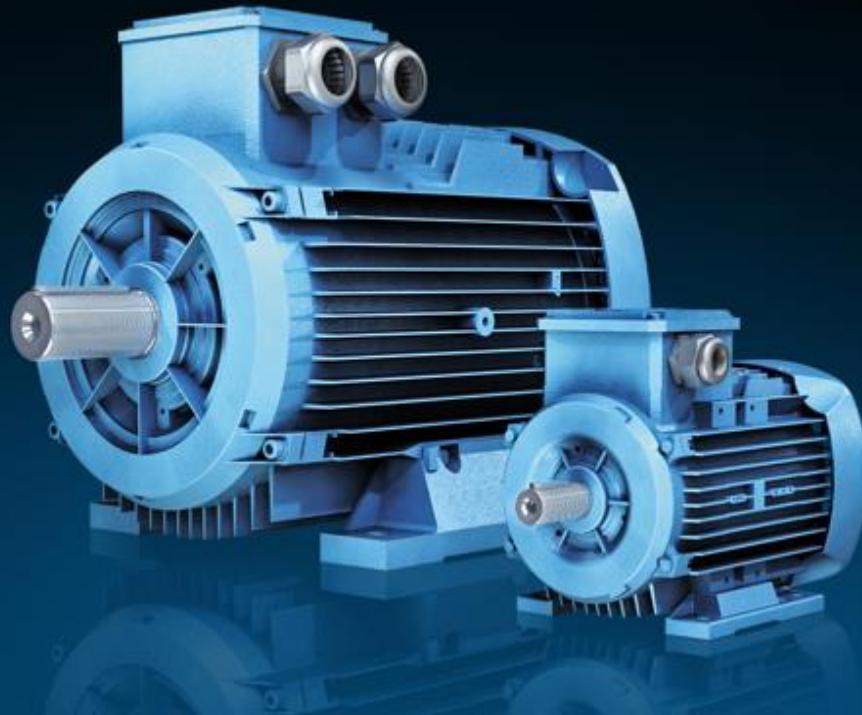
The main content area has a title "Optimizer" and a subtitle "Select, compare running costs and find documentation for low voltage motors". To the right of the subtitle is the ABB logo with the tagline "Power and productivity for a better world™". Below the title are links for "Clear saved data", "Language", and "Contact us".

A large blue header bar contains the heading "Find motors". Below it are several filter sections:

- MEPS** [Required] (dropdown: Select MEPS) > Efficiency class (dropdown: All types) > Frame mat. (dropdown: All frames) > Motor range (dropdown: All motor ranges)
- Voltage** (dropdown: All voltages) > Frequency (dropdown: All frequencies) > Speed (dropdown: All poles) > Output (dropdown: All outputs (kW))
- RESET FILTERS** button

To the right of these filters is a sidebar with a search bar for "Find by product code or motor type" (e.g. M3BP280SMA / 3GBP282210) and a note: "Input the product code to quickly find the motor you are looking for."

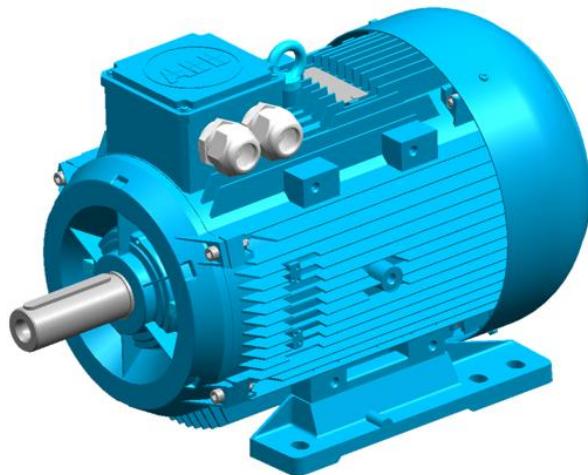
At the bottom of the page is a table with columns: Output, Volt./Hz, Eff. class, Type, Speed, Motor range, Data, and Frame mat. There is also a "My motors" section with a delete and info icon.



General performance IE1 Aluminum M1AA motors Novinka s IE1

General performance IE1 aluminum M1AA motors

What is the new product?

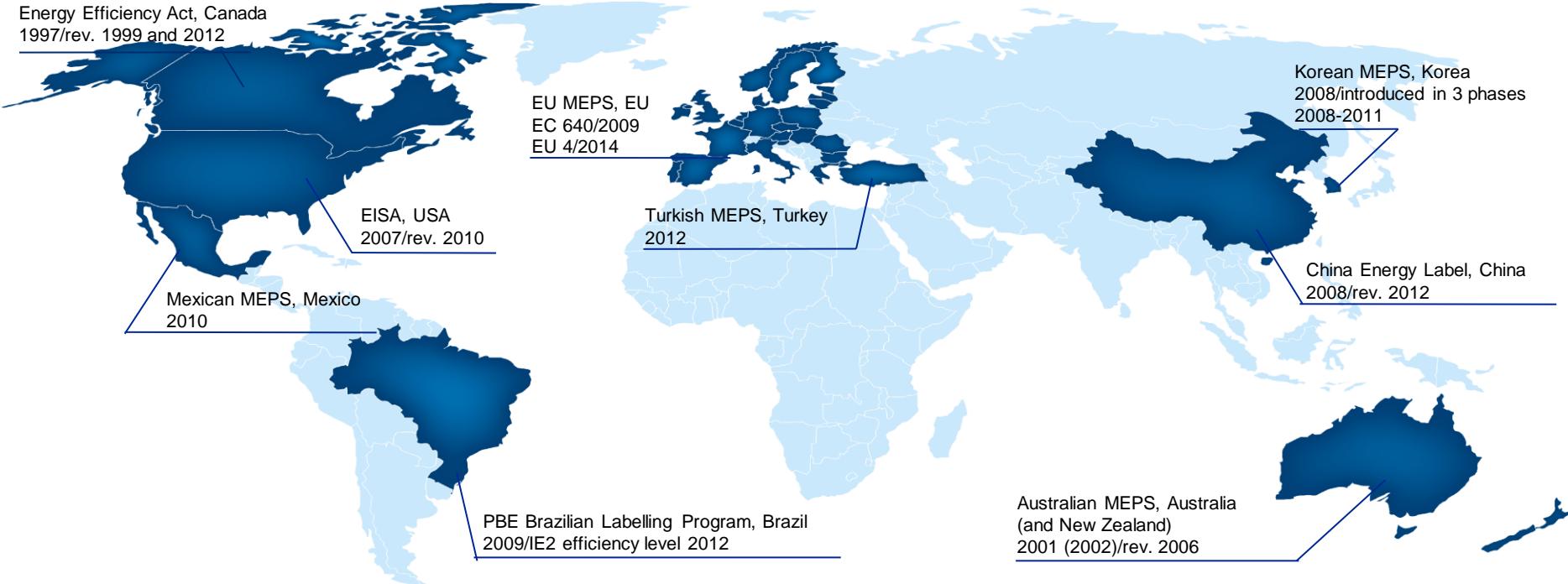


The range covers the right scope is highly versatile and enables you to tailor it to fit your customer's needs.

- M1AA 63-250
- Power output, Cenelec and High Output 0,12 – 55 kW
- Standard Efficiency IE1
- Insulation class F / Temp rise B
- IP55, S1
- 50 and 60 Hz rating
- Half key balanced, vibration level grade A

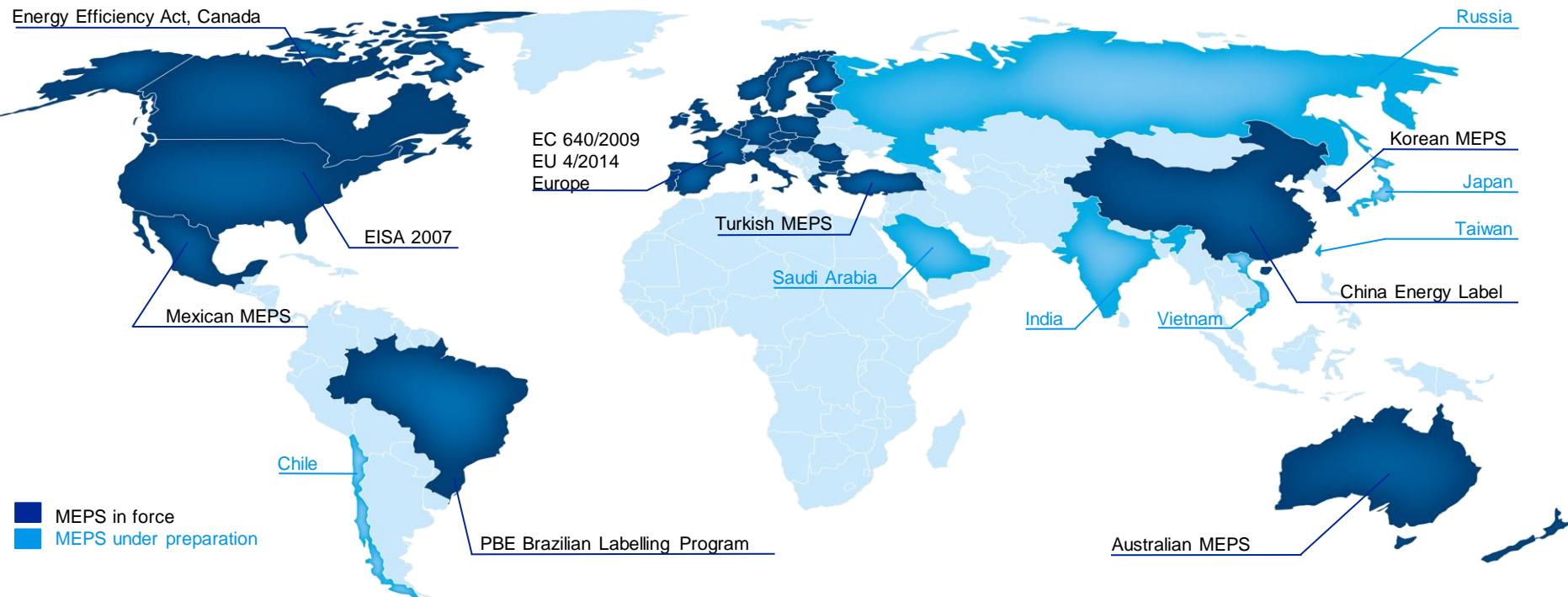
Global MEPS regulations for low voltage motors

Nyní



Global MEPS regulations for low voltage motors

Připravované



Úspory elektrické energie

EN 50598-2

ABB měniče frekvence a PLC Produkty

Low voltage AC and DC drives

- Micro drives 0.18 to 4 kW
- Machinery drives 0.18 to 560 kW
- General purpose drives 0.75 to 355 kW
- Motion control products 0.75 to 160 kW
- Industrial drives
 - Low voltage AC 0.55 to 5600 kW
 - Low voltage DC 7.5 kW to 4.8 MW
- Industrial specific drives 0.37 to 400 kW
 - Drives for HVAC
 - Drives for water



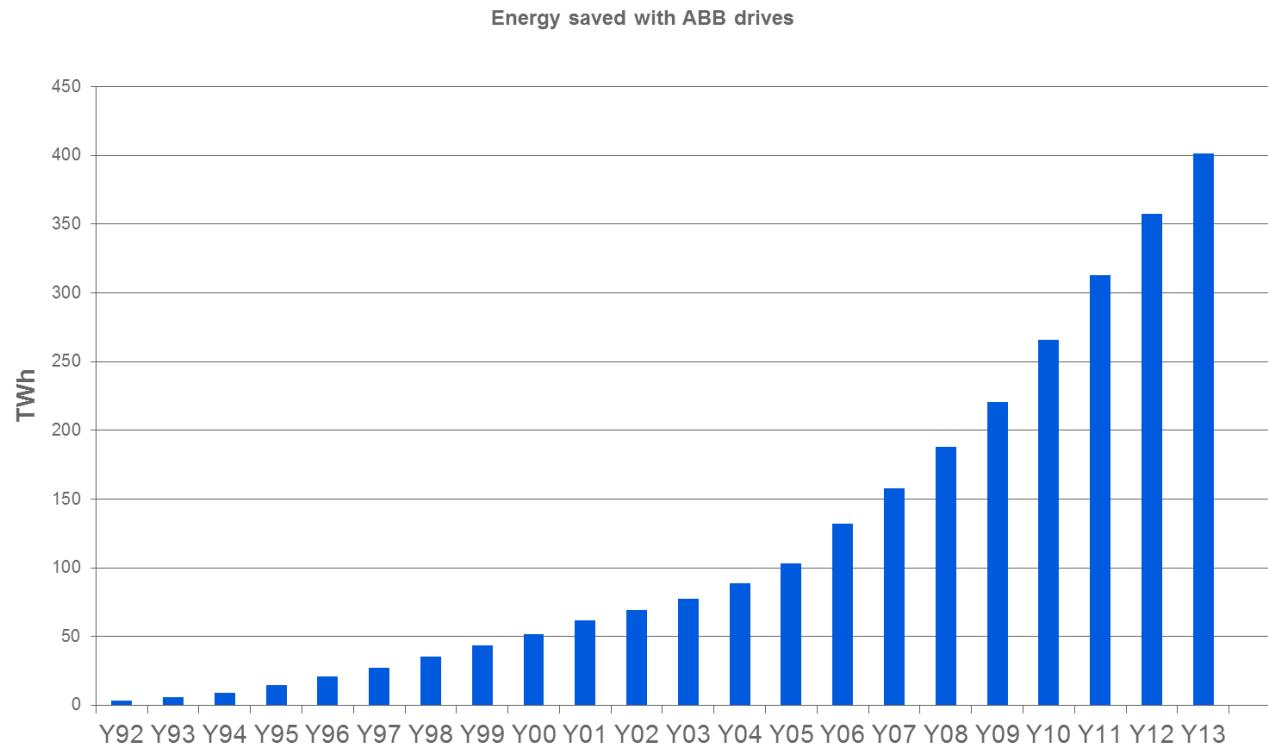
Medium voltage AC drives

- General purpose drives 0.25 to 7 MW
- Special purpose drives 2 to 100 MW

PLC and Automation products

- AC500-eCo, AC500
- AC500-S, AC500-XC
- S500 Remote I/O
- CP600 HMI

Energy saved with ABB drives



- The installed base of ABB drives saved about 400 TWh in 2013, equivalent to the consumption per year of more than 100 million households in the EU-27.
- If that 400 TWh would have been generated by fossil fuel powered electricity plants, ABB drives reduced CO2 emissions in 2013 by about 340 million tonne, corresponding with the yearly emission of almost 85 million cars

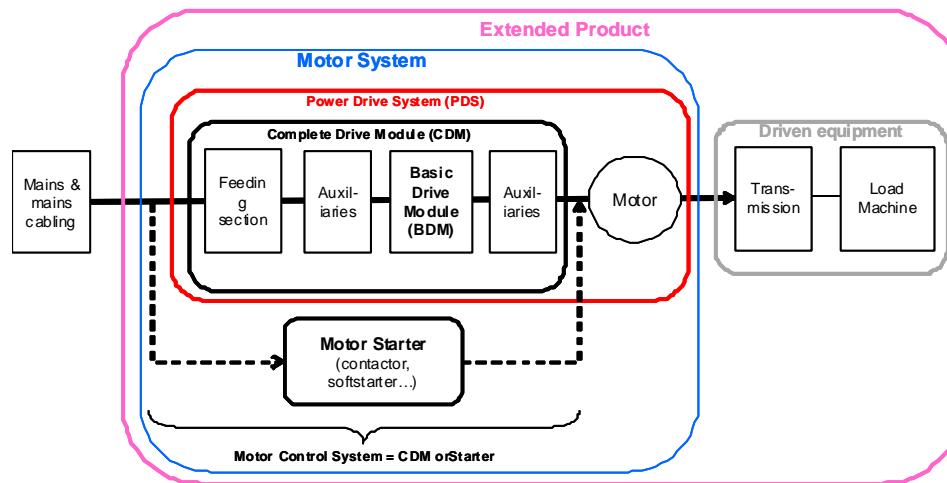
Normy pro účinnost Pro regulované pohony (VSD) a systémy

- EN 50598-2 bude Q3 2014
 - MEPS budou následovat
 - Pro EU 2015 nebo později
 - Globálně až po IEC 61800-9; nejdříve 2017

Normy účinnosti pro PDS a CDM

CDM = VSD a PDS = Motor + VSD

- Ecodesign pro PDS = Power drive systems, stykače, softstartéry, výkonovou elektroniku a její řízení



- Trafo je součástí PDS pokud je trafo nezbytné pro CDM (Complete Drive Modul) a motor.

Standardization work at EU level

Scope (CDM)

- Standard specifies the **Energy Efficiency requirements** for power driven systems (PDS), motor starters, power electronics (e.g. **Complete Drive Modules**, CDM) used in motor driven applications.
 - Power limit up to 1000 kW
 - Voltage from 100 to 1000 V, only LV in 1st edition
 - Applicable for motor driven loads
 - Classification is for a system driving one motor

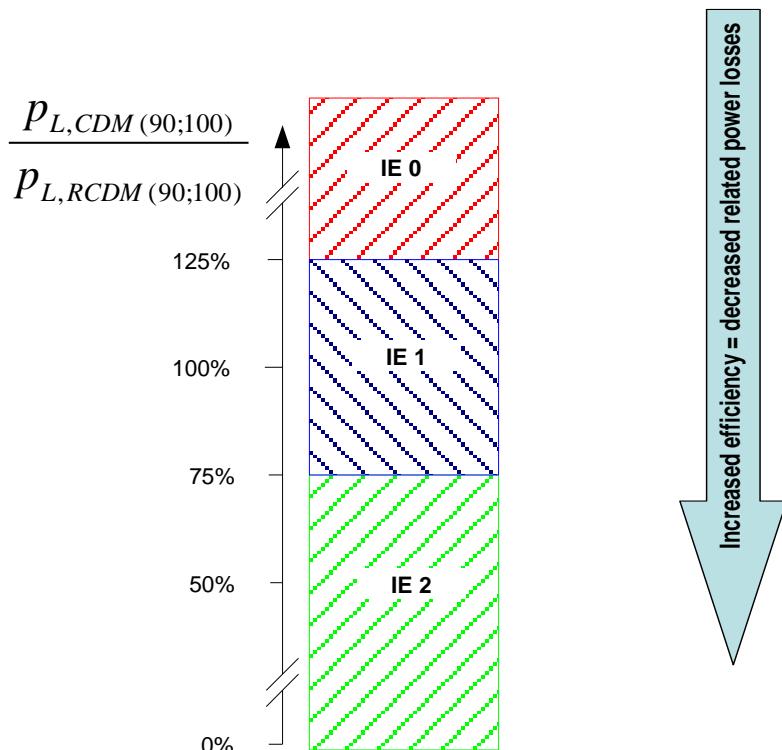
Standardization work at EU level

Scope (PDS)

- Standard specifies the **Energy Efficiency requirements** for **power driven systems (PDS)**, motor starters, power electronics (e.g. Complete Drive Modules, CDM) used in motor driven applications.
 - Power limit up to 1000 kW
 - Voltage from 100 to 1000 V, only LV in 1st edition
 - Applicable for motor driven loads
 - Classification is for a system driving one motor
 - All type of motors are included

Energy efficiency classes VSDs and systems (Motor + VSD)

- Ztráty VSD (CDM) a systémů (PDS) jsou dané normou
- Klasifikace - porovnání ztrát reálné a referenční CDM



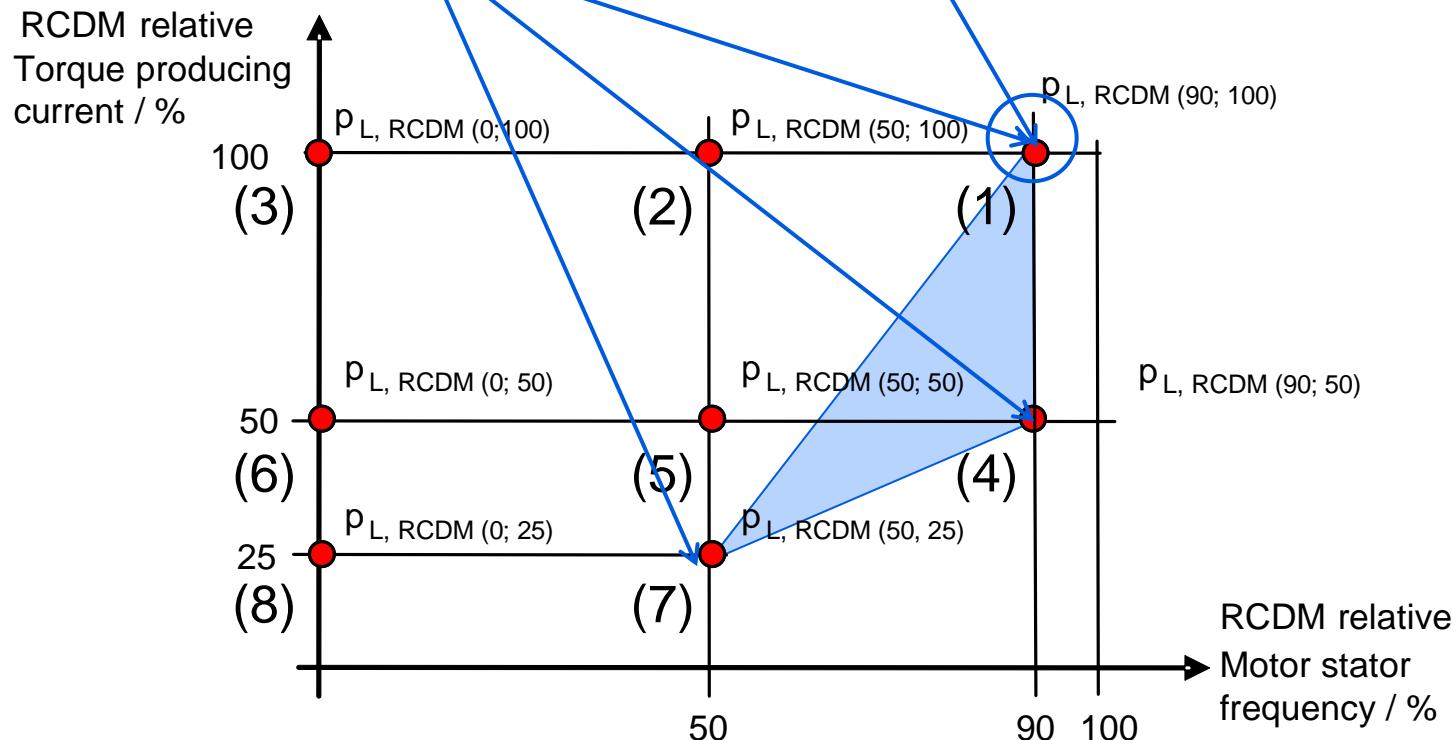
| Line fed motors Efficiency | Converter fed motors Efficiency | Converters (CDM) losses related to rated power | Power Drive systems (PDS) losses related to rated power |
|---|--|--|--|
| IE0 – not used | IE0 – u.c. | IE0 – more than 25% higher than reference value | IES0 – more than 20% higher than reference value |
| IE1 – can be mostly technically achieved | IE1 – u.c. | IE1 – reference value ±25% | IES1 – reference value ±20% |
| IE2 – can be achieved by enhancement | IE2 – u.c. | IE2 – more than 25% lower than reference value | IES2 – more than 20% lower than reference value |
| IE3 – needs significant amount of techniques | IE3 – u.c. | IE3 – u.c. | IES3 – u.c. |
| IE4 – will require new techniques | IE4 – u.c. | IE4 – u.c. | IES4 – u.c. |
| IE5 – experimental new technologies | IE5 – u.c. | IE5 – u.c. | IES5 – u.c. |
| IE6 – not used | IE6 – u.c. | IE6 – u.c. | IES6 – u.c. |
| IE7 – not used | IE7 – u.c. | IE7 – u.c. | IES7 – u.c. |
| IE8 – not used | IE8 – u.c. | IE8 – u.c. | IES8 – u.c. |
| IE9 – not used | IE9 – u.c. | IE9 – u.c. | IES9 – u.c. |

u.c. = under consideration

Provozní body pro CDM

NOTE! IE classification is based on one operation point

Points for pump applications



- The number of part load operation points can be reduced, if the final application only requires a limited number of load points according to the extended product approach. If the manufacturer of the CDM/PDS only provide limited part load operation point to support specific applications, this shall be stated in the manual

ABB VSD



ACS580-01

- 400 V, 50 Hz, IP21 and IP55, R0-R9, 0,75 – 250 kW, all 8 operating points -> Preliminary done

IE2

ACS880-01

- 400 V, 50 Hz, IP20/IP21 and IP55, R1-R9, 0,75 – 250 kW, all 8 operating points -> Preliminary done
- 500 V, 50 Hz, IP20/IP21 and IP55, R1-R9, 0,75 – 250 kW, all 8 operating points -> Preliminary done
- 690 V, 50 Hz, IP20/IP21 and IP55, R5-R9, 5,5 – 250 kW, all 8 operating points -> Preliminary done

IE2

ACS880-04

- 400 V, 50 Hz, IP20, R10-R11, 250 – 500 kW, all 8 operating points -> Ongoing

ABB motory



- Preparations ongoing for gate 0.
- Starting point:
 - collecting DOL loss data in various operating points (traditionally data collected only in nominal operating point)
 - adding VSD supply related additional losses according to standard
 - Process performance motors IE3, IE2

ABB nástroje připravované

Calculation tool for CDM losses at arbitrary operating point

User input **Output**

- Give apparent power of the CDM
S_{app} [kVA] kVA
- Enter required operating point for the CDM
OP identifier Frequency [%], Current [%]
2
- Select calculation method 1 = maximum losses, 2 = inter- or extrapolation
2
- Give CDM losses at standardized operating points, according to IEC 61800-9-2 draft
OP identifier Frequency [%], Current [%], losses [%]

| OP identifier | Frequency [%] | Current [%] | losses [%] |
|---------------|---------------|-------------|------------|
| 1 | 90 | 100 | 5.91 |
| 2 | 50 | 100 | 4.58 |
| 3 | 0 | 100 | 3.89 |
| 4 | 90 | 50 | 3.45 |
| 5 | 50 | 50 | 3.09 |
| 6 | 0 | 50 | 2.88 |
| 7 | 50 | 25 | 2.64 |
| 8 | 0 | 25 | 2.56 |

Interpolation for the CDM losses, the following operating points are used
OP identifier Frequency [%], Current [%], losses [%], Interpolation point

| OP identifier | Frequency [%] | Current [%] | losses [%] | Interpolation point |
|---------------|---------------|-------------|------------|---------------------|
| 8 | 0 | 25 | 2.56 | A |
| 7 | 50 | 25 | 2.64 | B |
| 6 | 0 | 50 | 2.88 | C |
| 5 | 50 | 50 | 3.09 | D |

Losses [%]

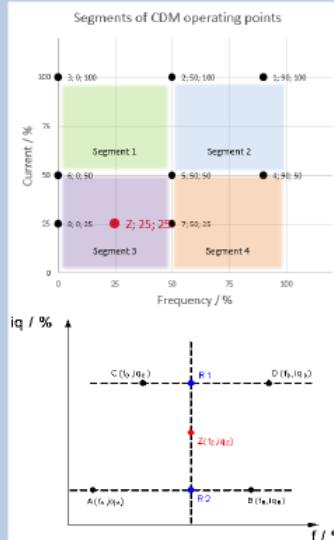
$$P_{L,R}(f_2) = P_{L,C} + \frac{P_{L,D} - P_{L,C}}{f_D - f_C} \cdot (f_2 - f_C)$$

$$P_{L,R1}(f_2) = P_{L,A} + \frac{P_{L,B} - P_{L,A}}{f_B - f_A} \cdot (f_2 - f_A)$$

$$P_{L,R2}(i_2) = P_{L,R1} - \frac{P_{L,R1} - P_{L,R2}}{i_{R2} - i_{R1}} \cdot (i_2 - i_{R1})$$

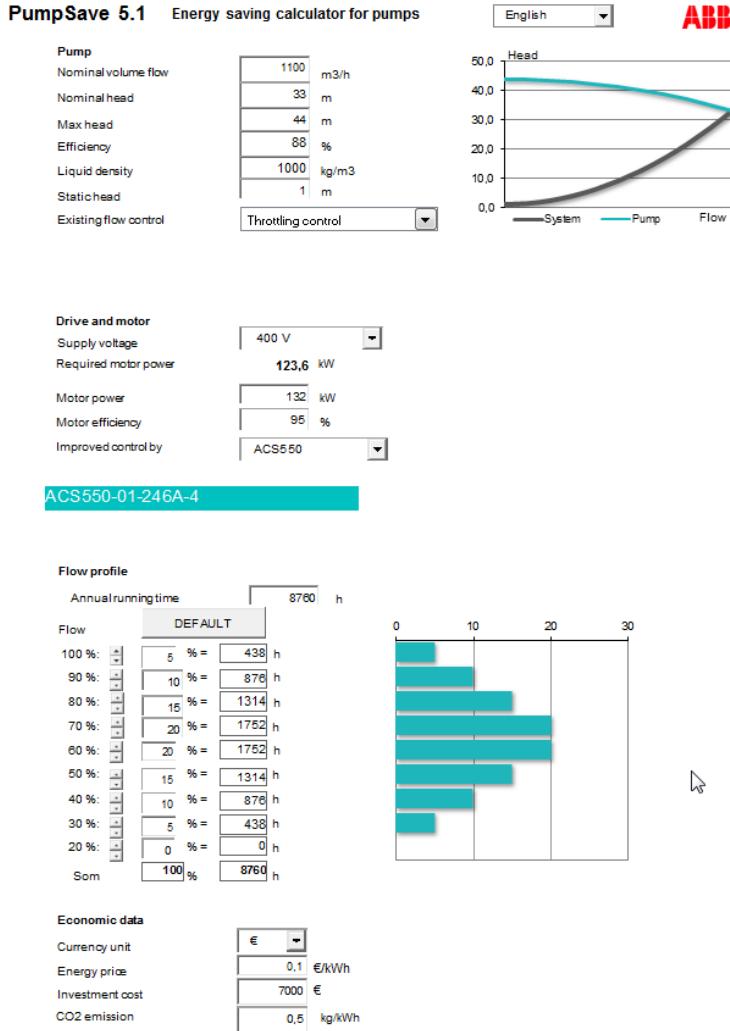
Check results of loss calculation of the CDM

| Power [kVA] | Frequency [%] | Current [%] | losses [%] | losses [W] |
|-------------|---------------|-------------|------------|------------|
| 9.95 | 25 | 25 | 2.60 | 259.7 |



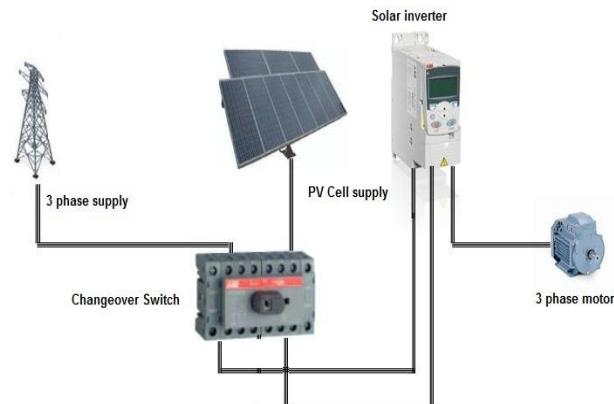
- Before can be started, requires enough data from Drives losses and Motor losses
- Web tool, excel or DriveSize?

ABB nástroje pro výpočet úspor



- Pumpsave a Fansave
 - Verze 5.2
- Volně k dispozici na ABB stránkách

ACS 355 + N827 Solarní pohon čerpadel



Power and productivity
for a better world™

