

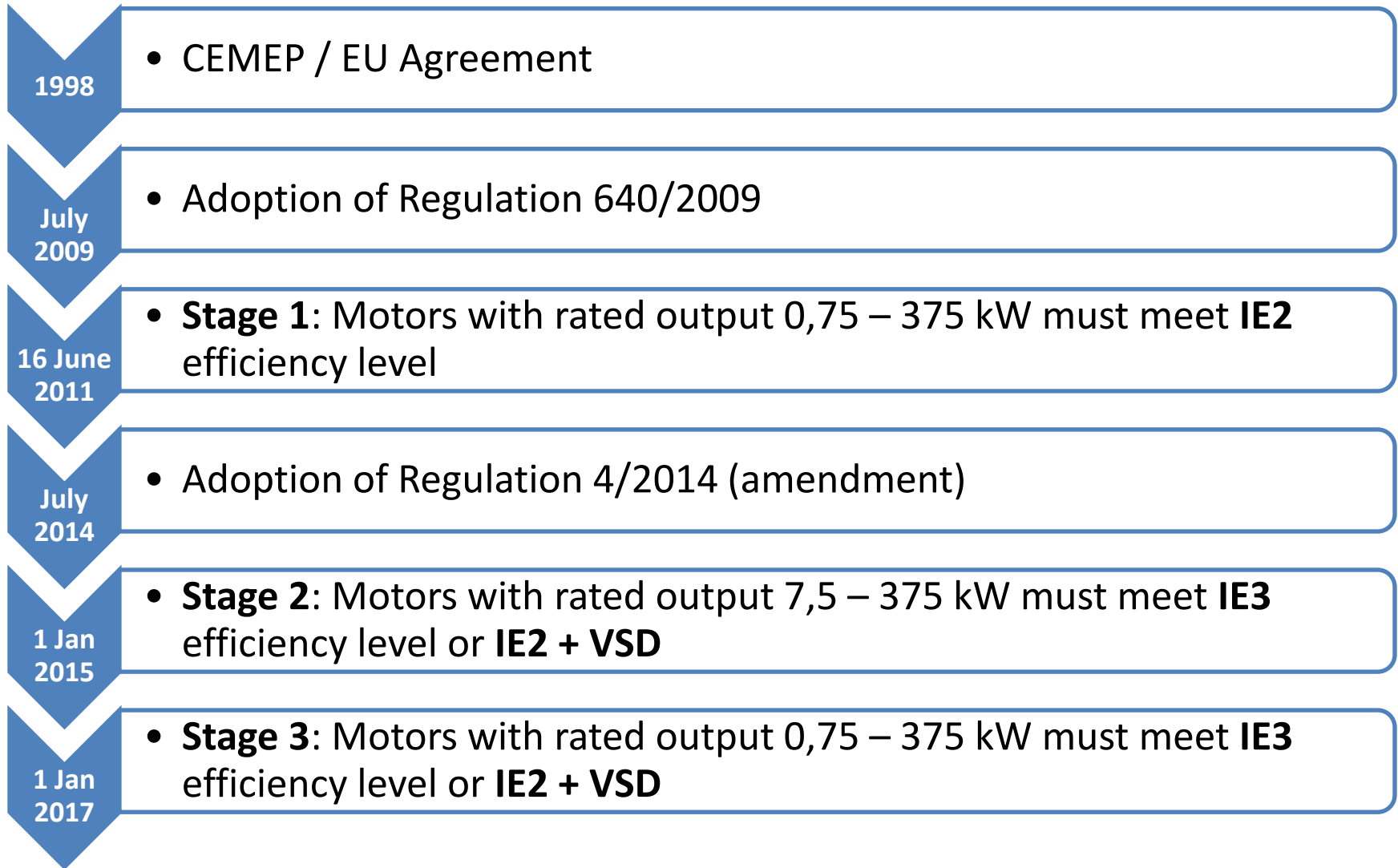
# European Ecodesign Lot 30: new ideas for advanced MEPS

Anibal De Almeida

ISR – University of Coimbra

Zurich, October 8, 2014

# Timeline of EU motor policies



# The Lot 30 Study

The study addressed:

- Motors outside the scope of Regulation 640/2009
  - Extended Power range
    - ≥0.12 up to 0.75 kW
    - >375 up to 1000 kW
  - Other motor technologies
- Motor controllers:
  - VSDs
  - Soft-starters

# Exclusions

- Motors with mechanical commutators (such as DC-motors);
- Increased safety motors;
- Motors in cordless or battery operated equipment (off-grid applications);
- Motors in hand-held equipment whose weight is supported by hand during operation.
- Motors completely integrated into a machine (for example pump, fan and compressor) that cannot be practically tested separately from the machine even with provision of a temporary end-shield and drive-end bearing.

# Identified Policy Options

## PO1a

1 Jan 2018

- Single Phase Motors ( $\geq 0.12$  kW - MEPS at **IE2**)

## PO1b

1 Jan 2018

- Small ( $\geq 0.12$  to  $< 0.75$  kW) Three Phase Motors - MEPS at **IE2**

## PO1c

1 Jan 2018

- Large motors ( $> 375$  kW to  $1,000$  kW) LV and MV - MEPS at **IE3**

## PO2

1 Jan 2022

- Remove IE2+VSD option – all motors  $\geq 0,75$  kW at **IE3**

## PO3

1 Jan 2018

- Include explosion proof and brake motors

## PO4

1 Jan 2018

- Mandatory Information Requirements for motors and VSDs

## PO5

1 Jan 2018

- VSDs to meet **IE1** (Class 1) performance as MEPS

## PO6a

1 Jan 2022

- Medium ( $\geq 0.75$  kW to  $375$  kW) motors – MEPS at **IE4**

## PO6b

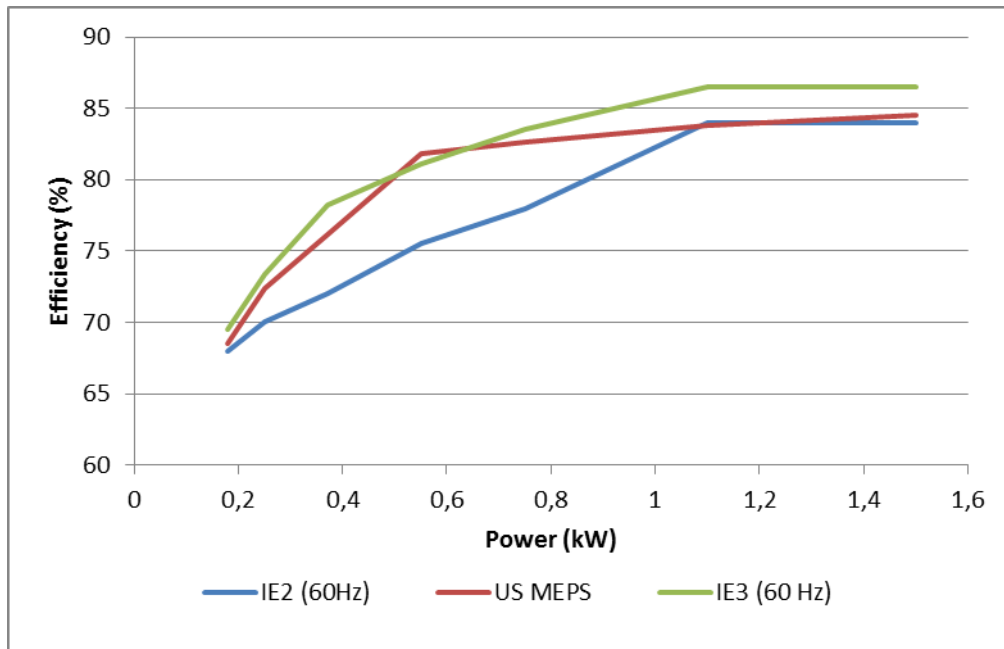
1 Jan 2022

- Large ( $> 375$  kW –  $1,000$  kW) motors – MEPS at **IE4**

# Policy Option 1a

1 Jan 2018

*All single phase motors with a rated output of greater than or equal to **120W** shall not be less efficient than the **IE2** efficiency level*



4,6  
TWh

**US MEPS (Jan-2015) for small 1-phase motors VS. IEC 60034-30-1 efficiency levels**

# Policy Option 1b

1 Jan 2018

*Three-phase motors with a rated output of  $\geq 120\text{W}$  to  $< 750\text{W}$  shall not be less efficient than the **IE2** efficiency level*

9,9  
TWh

- Of all the possible measures evaluated, this leads to the highest energy savings. The preparatory study has identified IE2 level as cost effective and widely available efficiency level for these motors.
- MEPS (Jan-2015) approved in the US at close to IE3

# Policy Option 1c

1 Jan 2018

*Three-phase, LV and MV motors with a rated output of >375kW to 1000kW shall not be less efficient than the IE3 efficiency level*

4,2  
TWh

- Even if a relatively small numbers of motors between 375 kW and 1 000 kW are placed on the market each year, they operate a large number hours making them an important energy consumer. Removing the least efficient motors from the market would have important impacts.
- China has already put in place minimum requirements for medium and high voltage large motors.
- The efficiency classification standard IEC 60034-30-1 needs to be extended to MV motors.



# Policy Option 2

1 Jan 2022

*Remove the "IE2+VSD" alternative to the mandatory purchase of an IE3 motor*

## Options for an 11kW motor (example)

IE3 Motor	690 €
OR	
IE2 Motor	600 €
+ VSD	1 200 €
+ VSD Installation	200 €
<b>Total</b>	<b>2 000 €</b>

2,7  
TWh

- on the basis of economics alone, the existing concession will not be sufficient to induce users to specify a VSD
- A delayed implementation date of 2022 is suggested in order to give 7 years for the existing policy to be used for the promotion of VSDs.

# Policy Option 3

1 Jan 2018

*Include **Explosion proof** and **brake motors** in the scope of regulation.*

0,9  
TWh

There is no technical or commercial reason why the exemption would need to be maintained. USA also removed these exemptions.

# Policy Option 4

1 Jan 2018

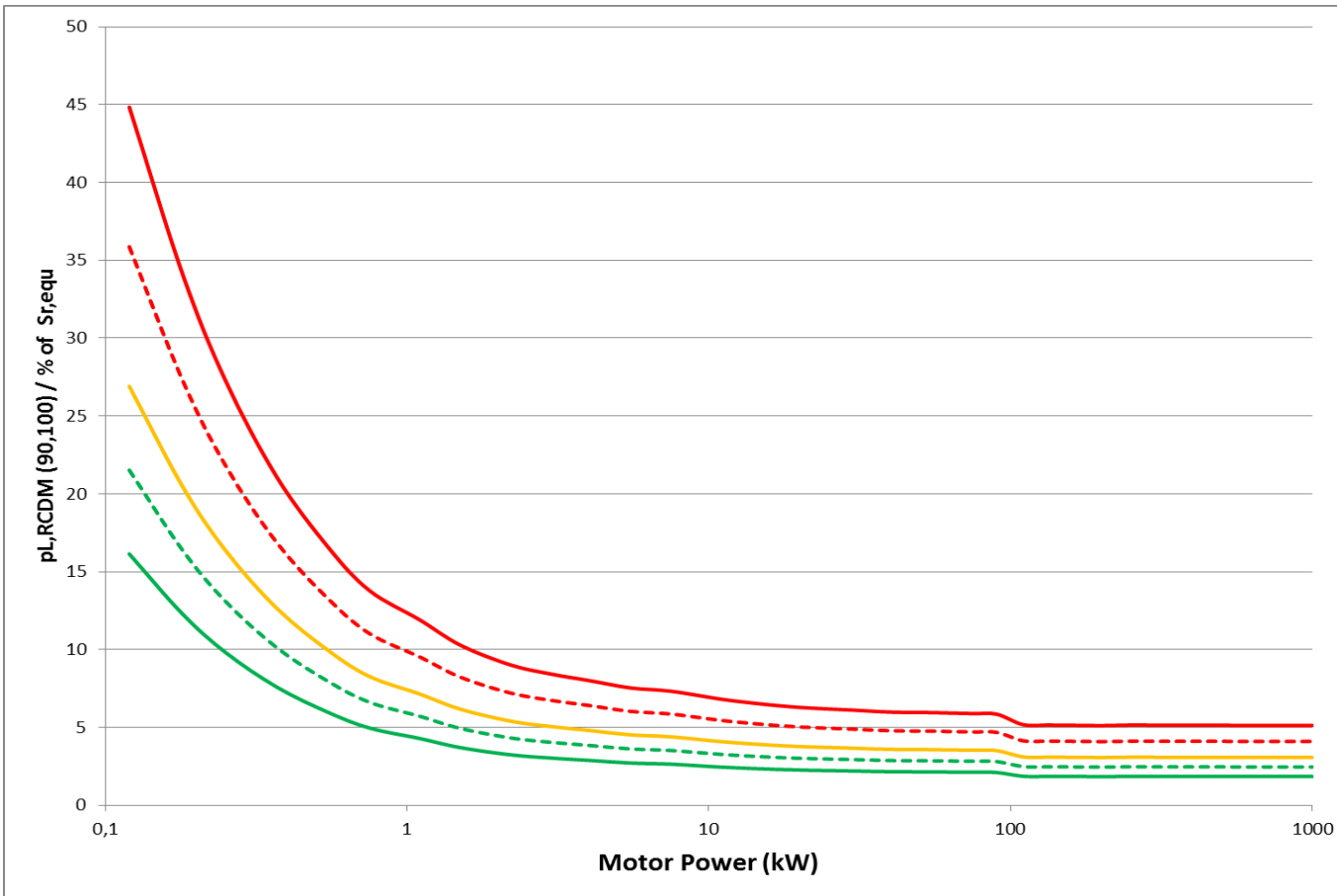
*The existing Product Information requirements within 640/2009 should be extended to include all products in the new scope*

- Information requirements under the existing Regulation 640/2009 can reasonably be extended to all types of motors and VSDs within the proposed extended scope of this Regulation.
- Include other relevant information, such as VSD stand-by power

# Policy Option 5

1 Jan 2018

## Mandatory MEPS for VSDs at IE1 (EN50598-2 Draft)



Remove from the market VSDs with performance below IE1, mostly being imported into the EU.

**There are products well above this level**

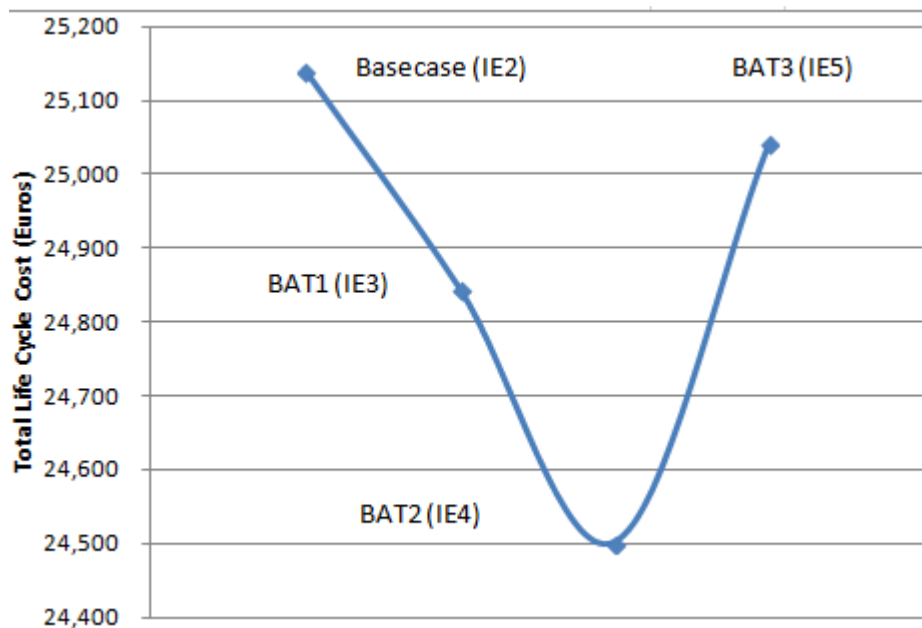
--- IE1 Reference Value  
--- IE2 Reference Value (estimated)

# Policy Option 6

1 Jan 2018

Raising of MEPS from IE3 to **IE4** (7.9 Twhpa)

9,4  
TWh



11 kW induction motor  
15 years lifetime  
3000 hours/year

IE4 induction motors are already available over a wide power range, although so far with limited manufacturer availability and very low sales.

# EC Proposed Measures and Timeline

1 Jan  
2018

- Small single phase motors (120 W – 750 W) - IE2
- Small three phase motors (120 W – 750 W) - IE2
- Large low voltage motors (375 kW – 1 000kW) - IE3
- Explosion proof and brake motors in the scope of the Regulation
- VSDs - IE1

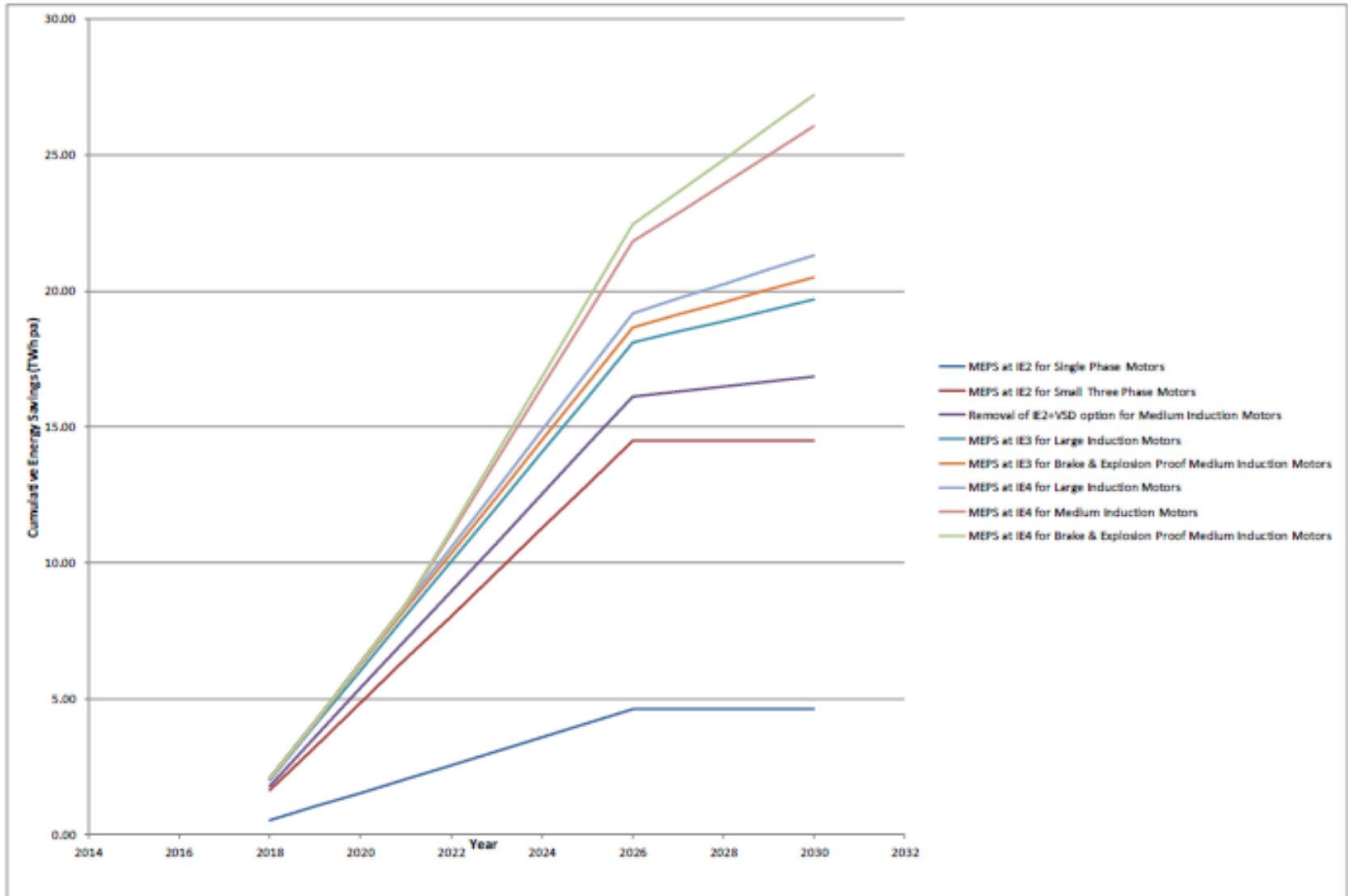
1 Jan  
2020

- Large medium voltage motors (375 kW – 1 000kW) - IE3
- Removal of option to use an IE2 motor where a VSD is used

To be  
considered

- Medium motors (750 W – 375 kW) - IE4

# Energy Savings



# Energy Savings

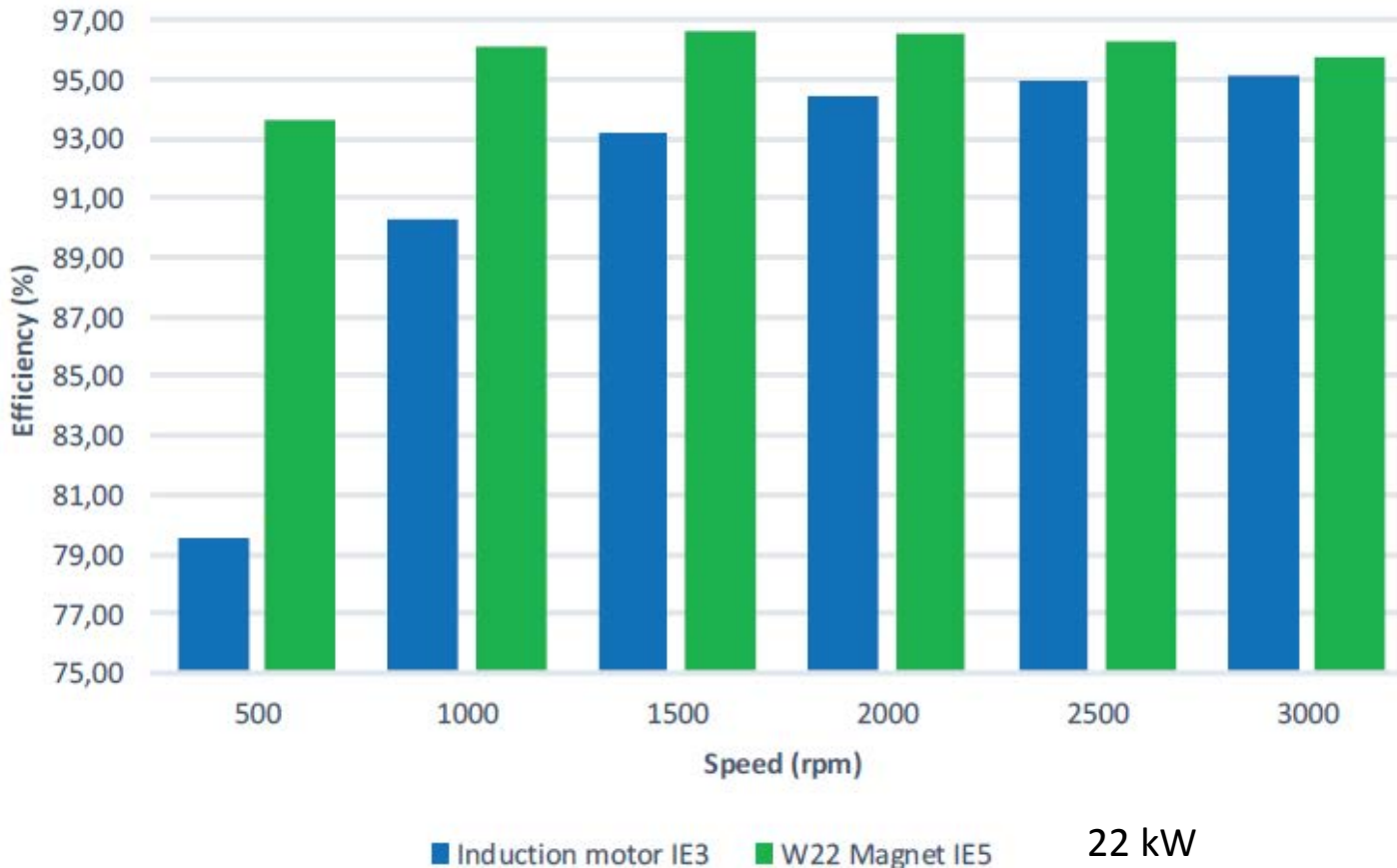
Policy Option	Total Energy Saving [TWhpa]	Energy Saving [TWhpa in 2030]
Policy Option 1a. Single Phase Motors to have a MEPS of IE2 (with the addition of a second capacitor to create a CSCR motor suggested as being most cost effective)	4.6 TWhpa	4.6 TWhpa
Policy Option 1b. Small (<0.75 kW) Three Phase Motors to have a MEPS of IE2	9.9 TWhpa	9.9 TWhpa
Policy Option 1c. Large motors (375 – 1,000kW) LV and MV - Extension of existing regulation to introduce Mandatory MEPS at IE3. Of this, 3.1TWhpa is from LV motors, and 1.1TWhpa from MV motors.	4.2 TWhpa	2.9 TWhpa
Policy Option 2. Removal of Option to use an IE2 motor where a VSD is used – all motors 0.75kW – 375kW to be IE3.	2.7 TWhpa	2.7 TWhpa
Policy Option 3. Expanding the types of motor included in existing regulation– Explosion proof and brake motors (Medium sized motors only)	0.95 TWhpa	0.86 TWhpa
Policy Option 4. Mandatory Information Requirements	Not Applicable	Not Applicable
Policy Option 5. Mandatory Measures for VSDs , to meet IE1 performance as MEPS	Unknown	Unknown
Policy Option 6a. Raising of MEPS for medium induction motors (0.75kW to 375kW) from IE3 to IE4	7.9 TWhpa	5.6 TWhpa
Policy Option 6b. Raising of MEPS for large induction motors (0.375 to 1000kW) from IE3 to IE4	1.4 TWhpa	
<b>Total Energy Savings</b>	<b>31.2 TWhpa</b>	<b>26 TWhpa</b>



# Motor Efficiency Keeps Moving Up – IE5

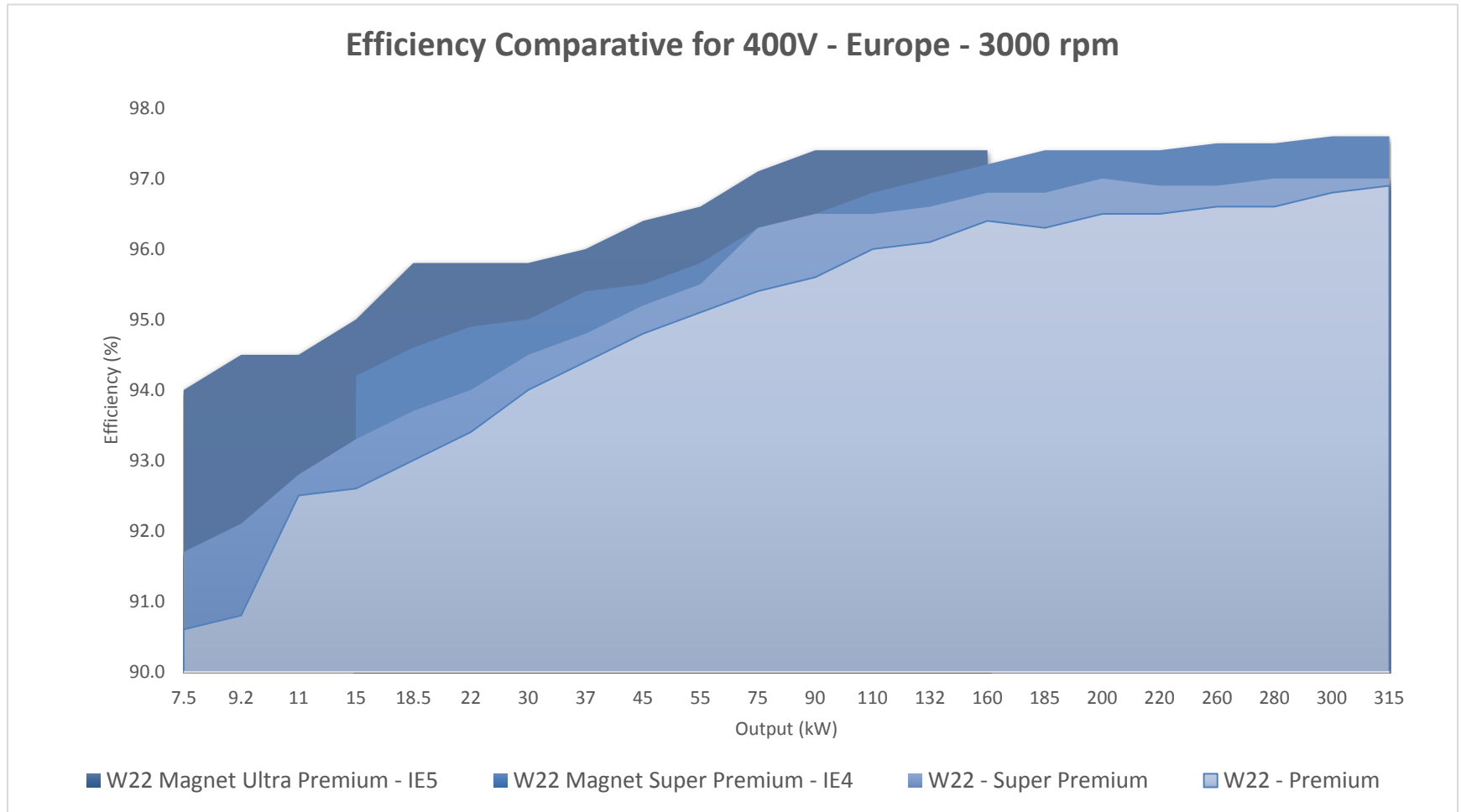
- Synchronous motor operation
- Low cost ferrite magnets
- Amorphous metals
- Improved and innovative design
- So far all designs need a electronic controller

# IE5 – WEG Ultra Premium Motors

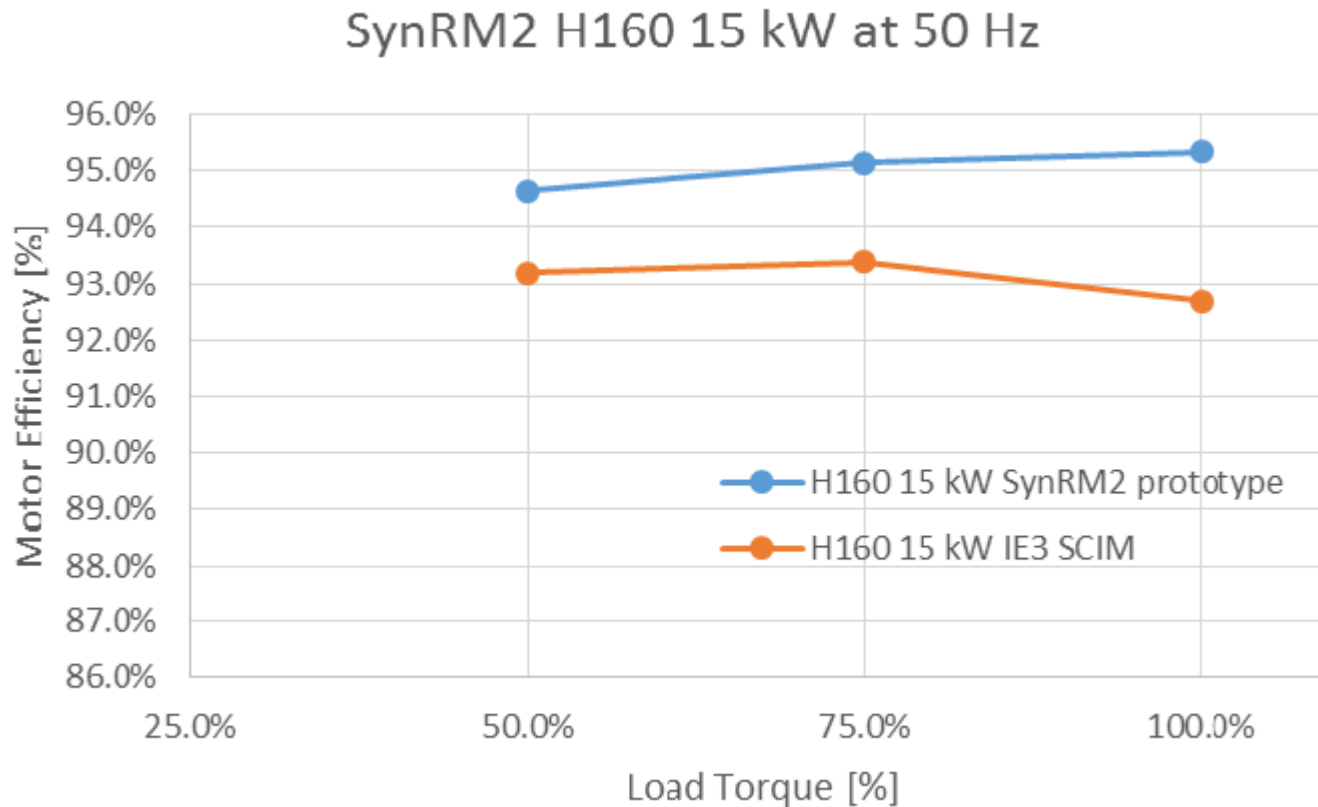


- 30% price premium over IE3+VSD
- Interchangeable - Same frame size as IE3

# IE5 – WEG Ultra Premium Motors

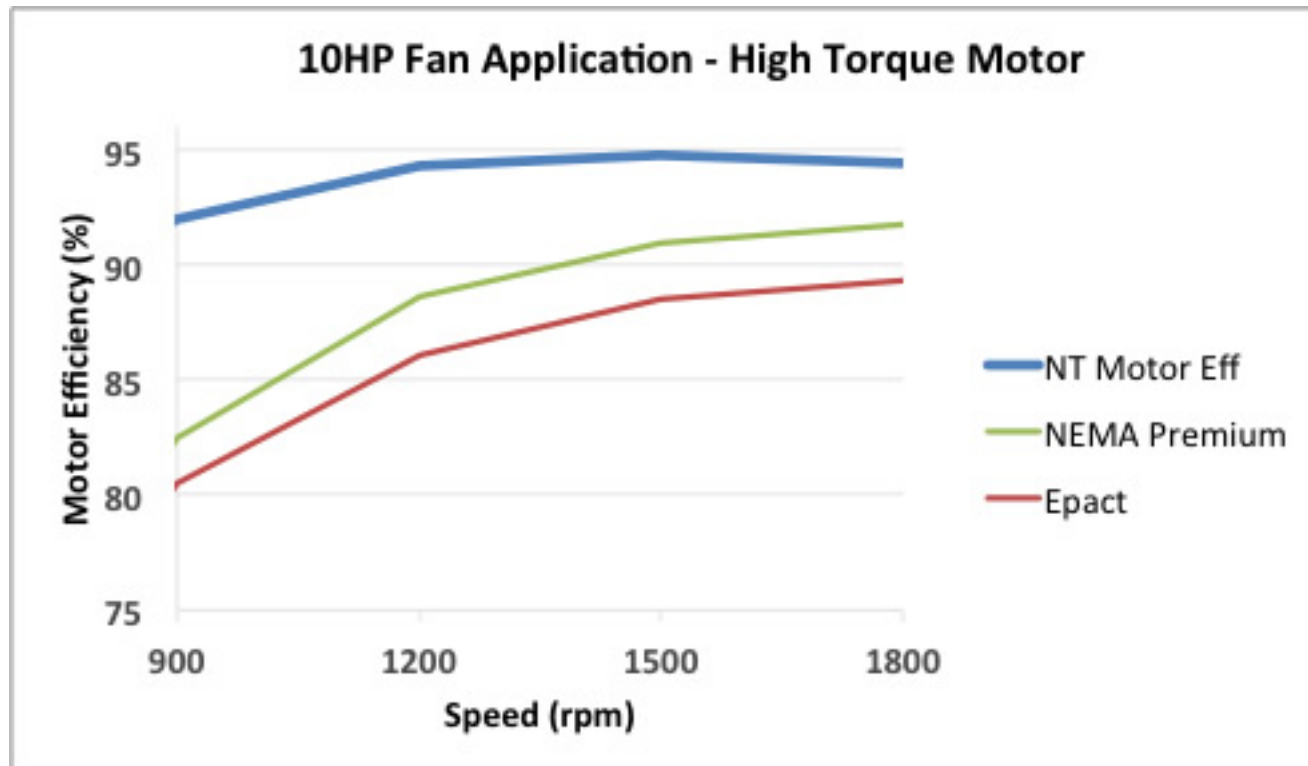


# IE5 – ABB Ultra Premium Motors



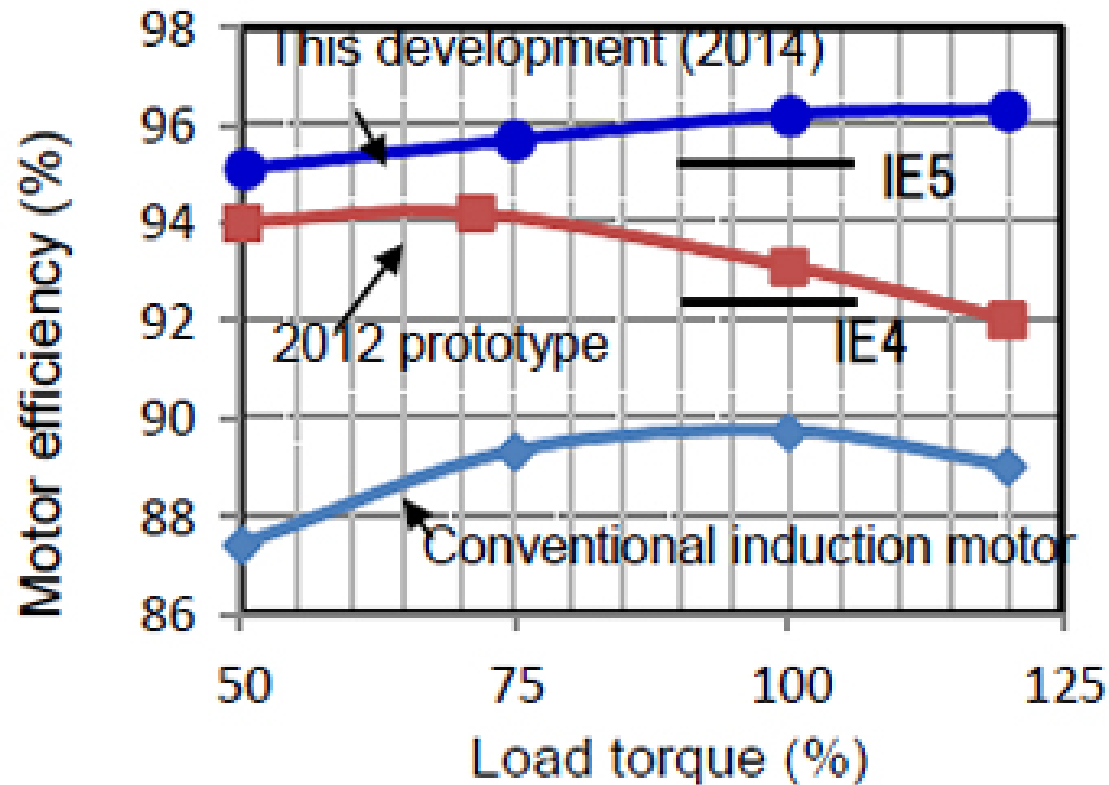
Efficiency values for SynRM2 motor refer to VSD supply, direct measurement including harmonic losses

# IE5 – NovaTorque Ultra Premium Motors



# IE5 – Hitachi Ultra Premium Motors

## Comparison of Motor efficiency (11 kW)



**Amorphous metal and ferrites – 96% efficiency**

# Conclusions

- Since 2000 (70% motor sales were IE0), major changes happened in the EU motor market.
- A variety of measures were identified than can save about around 31 TWh, (26 TWh) by 2030.
- IE4 motors appear to be cost-effective , although their availability is limited. MV motors regulation requires extension of IEC 60034-30-1
- The regulation proposed for VSDs was based on the draft EN 50598-2. This proposal needs to be analysed based on the products already on the market by major manufacturers.
- New IE5 motors became available recently, showing the innovation capacity of the industry