Industrial LV Motors & Drives: A Global Market Update

January 2014

• Introduction to IHS
• Overview & Segmentation of the Market
• LV Motors & Drives Market Comparison
• LV Motor Market Data & Trends

Mark Meza, Principal Analyst
Mark.Meza@IHS.com
+1 512 582 2008
About IHS

IHS Brings Content & Expertise to Clients Across a Range of Industries

Industries Served

- Aerospace & Defense
- Agriculture
- Automotive
- Chemicals
- Construction
- Consumer & Retail
- Clean Energy
- Energy Oil & Gas
- Electronics & Telecom
- Financial
- Government
- Healthcare
- Metals & Mining
- Military & Security
- Power & Utilities
- Shipping & Transportation
The World Market for Low Voltage Motors

LV Motors are characterized as motors running at 690V & below

IE1: Standard Efficiency – Below EPAct
IE2: High Efficiency – EPAct, GB3
IE3: Premium Efficiency – NEMA Premium™, GB2
IE4: Super Premium Efficiency – GB1

Other, non-classified
- Definite & Special Purpose
- Submersible, fire pump, oven motors
- Motors that use refrigerant as a coolant
- ↑10-poles, ↑375kW/500HP

DC Motors
- Brushed & Brushless

Fast Facts:
- Industrial purpose LV motors consume 28% of the world’s electricity
- Even a 1% efficiency gain in a LV motor can save 10s of $1,000s in electricity costs over the lifetime of the motor.
- Depending on duty cycle & operating conditions, a LV motor can operate for 10, 15, 20 years or more.
Low Voltage Motors – 2013 Market Data

LV motors ≈ 49.6 million units shipped, Average Selling Price ≈ $322
MV motors ≈ 57,840 units shipped, Average Selling Price ≈ $102,600
Low Voltage Drives – 2013 Market Data

LV drives ≈ 20.4 million units shipped, Average Selling Price ≈ $620
MV drives ≈ 11,700 units shipped, Average Selling Price ≈ $239,300
Motors v. Drives – Ratio Comparison

2 LV motors are sold for every 3 LV drives sold

- A significant portion of LV drives are sold into retro-fit applications for installed-base LV motors
- The worldwide installed base of integral HP LV motors is thought to be between 750 million – 1 billion units

5 MV motors are sold for every 1 MV drive sold

- A MV motor+drive system is a significant cost expenditure ($100,000+, usually more)
- The market for retro-fitting a MV drive onto an installed-base MV motor has significant potential.
- The worldwide installed base of integral HP LV motors is thought to be between 1.8 – 2.2 million units
Low Voltage Motors – Revenue Growth

Revenue growth in the LV market is based on two key factors:

1) Organic revenue growth
   - The market’s natural demand for motors
   - Based heavily on economic circumstances
   - Significantly influences unit growth

2) Inorganic revenue growth
   - Revenue growth catalyzed by energy efficiency regulations
   - Higher efficiency & thusly more expensive motors are to be sold
   - Independent of economic circumstances
   - Regulations do not significantly influence unit growth

2-3%
   - Typical CAGR for Average Selling Price in any given time period
   - Based on price increases in raw materials (copper, iron, steel, etc.)

5-6%
   - Estimated CAGR for Average Selling Price from 1997 – 2017
   - Includes raw materials price increases
   - AND... 10+ regulated transitions to high efficiency/more expensive motors

© 2012, IHS Inc. No portion of this presentation may be reproduced, reused, or otherwise distributed in any form without prior written consent.
Low Voltage Motors – Legislative Timeline

Key Concerns During Regional Efficiency Transitions:

• Is there adequate enforcement of regulations?
• What to do about exploitation of regulatory loopholes?
Low Voltage Motors – Market Data

WORLD - 2013 - Region by Revenue ($M) and Share (%)

<table>
<thead>
<tr>
<th>Region</th>
<th>Revenue ($M)</th>
<th>Share (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Americas</td>
<td>$5,205.4</td>
<td>32.5%</td>
</tr>
<tr>
<td>EMEA</td>
<td>$5,153.9</td>
<td>32.2%</td>
</tr>
<tr>
<td>China</td>
<td>$2,994.6</td>
<td>18.7%</td>
</tr>
<tr>
<td>Rest of Asia</td>
<td>$2,638.7</td>
<td>16.5%</td>
</tr>
</tbody>
</table>

2013 Market Size ($M) $15,992.6

High Efficiency Motor Markets

- Mexico, IE2/2004
- Australia, IE2/2006
- South Korea, IE2/2008, 2010
- Brazil, IE2/2009
- US, IE3/2010
- European Union, IE2/2011
- Turkey, IE2/2012
- China, IE2/2012

IE3 in the EU in 2015 for >7.5kW (>10HP)
- **Min effect** on inorganic revenue growth
- Power range is <10% of Eurozone units

IE3 in the EU in 2017 for <7.5kW (<10HP)
- **Max effect** on inorganic revenue growth
- Power range is >90% of Eurozone units
- 15-20% growth is expected from 2017-2020

© 2012, IHS Inc. No portion of this presentation may be reproduced, reused, or otherwise distributed in any form without prior written consent.
Low Voltage Motors – 2013 Market Data

- 90%+ of units sold in each region are between 1-10HP (0.75kW – 7.45kW)
- A thriving IEC market exists in NEMA-centric North America
- Because of the huge unit volumes they account for, The Discrete Sector (OEMs) have a major influence on the rate of transition to higher efficiency motors
Low Voltage Motors – Market Data

WORLD - 2013 - Efficiency Class Transition by Share (%): 2013 to 2017

- Will OEMs choose IE3 or IE2+VFD in 2017?
- OEMs account for >70% of the Eurozone market in terms of units
Low Voltage Motors – Technology Trend

The IE4 Super Premium Market is Poised for Strong Growth

- China will be the top supplier of neodymium & dysprosium for the foreseeable future.
- Neodymium prices stabilized in mid-2012, but still remain high due to export caps.
- This market reality has been the catalyst for other/new IE4 motor technologies to emerge as viable alternatives to NdFeB-based PM motors.

Motor types that achieve IE4:

No Magnets
- Synchronous Reluctance, SynRM™
- Switched Reluctance

Magnets
- NdFeB & SmCO-based PM
- ECPM (DC Brushless, ferrite magnets)
- AM+FM (FeSiB) axial flux motor technologies
- Copper rotors
- New ferrite magnet-based motor technologies?
Low Voltage Motors – REM Price Trends

REM Production
China, 2012
80,000 metric tons

US, 2018 or later
500 metric tons
Hitachi Metals Ltd. – AM+FM IE4 Technology

- Joint effort b/w Hitachi & Hitachi Industrial Equipment Systems
- 11kW (15HP) synchronous IE4, 93% efficiency
- Designed for large cooling fans & industrial fluid pumps

Advantages:
- 10x ↑ magnetization v. Si steel
- 10% ↓ iron loss v. Si steel
- >IE4 efficiency at ↑ torque v. Si steel
- AM+FM realizes lowest core losses

Disadvantages:
- ↑ production cost v. Si steel
- Specific motor structure needed for AM stator
- AM easily magnetized, but ↓ saturation v. Si steel
- FM has 12% magnetic attraction force of REMs
- ↓ starting torque (not good for electric vehicles)
Low Voltage Motors – IE4 Market Data

Target Markets: End-users w/ continuous duty cycle (S1) applications

**TREND:**
End-equipment mftrs such as KSB (pumps) using IE4 synchronous reluctance motors:

and OEMs such as Bauer Gear Motor (gearboxes) are producing high efficiency products equipped w/ IE4 induction motors.

**Other New IE4 products?**
Lafert Group has produced an IE4 PM motor with an integrated VFD

Target Market Shares:
- Compressors 43.9%
- Elevators & Lifts 29.6%
- Fans 13.8%
- Other 3.0%
- Pumps 2.4%
- Extruders 2.6%
- Crusher 1.8%
- Conveyors 2.9%
- Crushers 1.8%
- Extruders 2.6%

© 2012, IHS Inc. No portion of this presentation may be reproduced, reused, or otherwise distributed in any form without prior written consent.
The World Low Voltage Motor Market in 2012

Top Industry Sectors by Revenues
• Commercial HVAC, 31%
• Food, Beverage & Tobacco, 13.5%
• Mining, 7.5%
• Utilities, 5.0%
• Other Sectors, 43%

Top Application Sectors by Revenues
• Compressors, 27%
• Pumps & Fans, 52%
• Other Applications, 21%

Industry Sector Performance in 2013
• After years of strong growth, global mining sector began to slow in early 2013

Outperforming sectors:
• Oil & LNG; “fracking” for shale gas in NAm & SAm
• Chemicals & Petroleum, Commercial HVAC
• Shipbuilding (carriers and specialized for LNG)

Underperforming sectors:
• Rubber & Plastics
• Cement, Pulp & Paper
• Printing, Woodworking
Low Voltage Motors – Market Data
Estimated Market Shares by Revenues for 2013
*rounded to the nearest 0.5%

**WORLD**

14.0% - ABB (inc. Baldor)
9.5% - Siemens
7.0% - WEG (inc. Electric Machinery)
3.0% - TECO E&M/TECO-Westinghouse
2.5% - Regal Beloit
2.5% - Leroy Somer
1.5% - Shandong Huali
1.5% - Hyundai Heavy Industries/Ideal
1.5% - Hyosung Corporation
1.5% - NIDEC (US Emerson)

≤ 1.0% World Market Share

- LEZ Ruselprom
- Toshiba International Corp.
- ATB Group
- VEM Group
- Luan JiangHuai
- Anhui Wannan

- GE Industrial
- Tech Full Simo
- Cantoni Motor
- Fuji Electric
- Hengshui (OX)
- Crompton Greaves
- Tatung Corporation

© 2012, IHS Inc. No portion of this presentation may be reproduced, reused, or otherwise distributed in any form without prior written consent.
Low Voltage Drives – Market Data
Estimated Market Shares by Revenues for 2013
*rounded to the nearest 0.5%

<table>
<thead>
<tr>
<th>WORLD</th>
<th>Top Industry Sectors</th>
<th>WORLD</th>
<th>Top Industry Sectors</th>
</tr>
</thead>
<tbody>
<tr>
<td>15.5% - ABB</td>
<td>16% - Food, Beverage &amp; Tobacco</td>
<td>3.5% - Textiles</td>
<td></td>
</tr>
<tr>
<td>13.5% - Siemens</td>
<td>10.5% - Water &amp; Wastewater</td>
<td>3% - Elev. &amp; Escalators</td>
<td></td>
</tr>
<tr>
<td>7.5% - Rockwell Automation</td>
<td>10.5% - Comm. HVAC</td>
<td>3% - Infrastructure</td>
<td></td>
</tr>
<tr>
<td>7.5% - Danfoss</td>
<td>6% - Power Generation</td>
<td>2.5% - Automotive</td>
<td></td>
</tr>
<tr>
<td>7.0% - Mitsubishi Electric</td>
<td>5.5% - Metals Processing</td>
<td>2% - Shipbuilding &amp; Marine</td>
<td></td>
</tr>
<tr>
<td>6.5% - Schneider Electric/STI</td>
<td>4% - Conveyors</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Low Voltage Motors – Trends & Events

Recent Market Activity
• ABB acquiring Baldor: Assumes #1 share position in the world for LV motors, overtaking Siemens
• Chinese Wolong acquired Austria’s ATB Group; Carlyle Group acquired Italy’s Marelli Motori
• Regal Beloit acquired Italian hazardous motor manufacturer CEMP
• Low growth in W. Europe in 2013 & expected in 2014 due to recovery from Eurozone debt crisis
• IEC motor market growing rapidly in a NEMA-centric market (North America)
• Hazardous are LV motor segment experiencing higher YoY growth than in past years
• End-equipment manufacturers & OEMs producing IE4 motor-equipped products

Regulatory Activity
• Canada transitioned to IE3/Premium Efficiency on January 1st, 2012; Turkey to IE2 on June 18th, 2012
• Japan’s ‘Top Runner’ program will prompt the country’s industry to transition to IE3 starting in 2015
• In 2015 & 2017, the EU will allow IE2 motor + VFD in order to satisfy IE3 requirement; in contrast, IE3/Premium mandate in the US in December 2010 did not allow this alternative
• Systems efficiency regulations are coming, first in pumps & fans, then in the compressors applications
• Efficiency transitions occurring slowly: lack of enforcement & exploitation of regulatory loopholes
• Regulatory bodies in N. America & Europe are discussing expanding the current scope of motor efficiency regulations to include more motor types, more usage models & higher power ratings
• After 2017 (EU), there are no more scheduled motor efficiency transitions set to occur in any region

© 2012, IHS Inc. No portion of this presentation may be reproduced, reused, or otherwise distributed in any form without prior written consent.
Low Voltage Motors – Trends & Events

China News
• After years of double-digit growth, China’s LV motor market contracted by an estimated 7.0% in 2012
• China officially began the transition to IE2/GB3 in Sept. 2012
• Low-cost Chinese IE1 motors sold into Europe with false IE2 specs causing trouble in the marketplace
• Chinese vendors seeking access to European OEM distribution channels is intensifying
• Neo-magnet price crisis caused by China reducing REM exports is similar to SmCO magnet crisis in mid-1980s. Back then, SmCO crisis hastened introduction of NdFeB magnets to the market
• Domestic production of REMs & capping of exports, processing capabilities & government incentives for the use of PM motors will make China the largest IE4 motor market by the end of the decade

The State of the DC Motor Market
• The DC motor market continues to shrink rapidly, but remains a viable legacy replacement market
• Most steel rolling mills in China & Japan have converted their DC installed base to AC induction.
• Currently, the US has the largest DC motor installed base in the world, with Baldor (ABB) and GE being the major players
• Most major motor manufacturers have eliminated their respective integral HP DC motor product lines
• To address the DC-to-AC transition in the mill motor sectors, some companies developing ‘drop-in’ AC induction replacement motors designed to DC specifications