Powering Planet Earth in the 21st Century

In today's society with a "greener and leaner" focus on one's lifestyle, most would agree that increasing energy efficiency is a good thing; in fact, the general consensus seems to be that reducing global energy usage is more than a personal choice, it has become a worldwide priority. While each region of the world is driven by differing needs and requirements, ultimately everyone benefits from increased energy efficiency.

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The benefits of energy efficiency are far reaching - lower energy bills, improved air quality; reduced greenhouse gases, energy security, more efficient use of dwindling natural resources and deferred infrastructure costs. Numerous studies document the prevalence of economically attractive opportunities for energy savings. The failure to implement these opportunities indicates persistent market and other barriers to efficiency. Government policies are designed to target these barriers and enable the benefits of energy efficiency to be realized [1].

Government activities to accelerate energy efficiency

As the number of electronic devices continues to grow exponentially and as infrastructure and advances in technology bring electricity and electronic products to more and more corners of the globe, ensuring maximum efficiency truly becomes a global imperative. Benefits range from individually focused in that using less electricity saves money on utility bills – to entire governments reaping benefits; including reducing demand on the grid and a reduction in greenhouse gases. In fact, according to the US Department of Energy, Building Technologies Office – Appliance and Equipment Standards states: The cumulative energy savings of standards phased in through 2012 will be about 70 quadrillion British thermal units (quads) of energy through 2020, and will amount to 120 quads through 2030. (The US consumes a total of about 100 quads of energy per year.) The cumulative utility bill savings to consumers of these standards are estimated to be over $900 billion by 2020, growing to over $1.6 trillion through 2030 [2].

To ensure that citizens of the world meet or exceed these projections, governments worldwide are pursuing policies and standards to warrant that the next generation of products both maximize efficiency and reduce energy use as much as possible. Such standards and policies also make it easier for device manufacturers and product designers to meet new requirements. As always, innovation is critical and necessary to achieve ever-more-stringent efficiency targets.

As an example: As of 16 June 2011, only motors that meet or exceed the IE2 level are permitted to be sold and installed within the European Union. From January 2015 onward, all motors will need to meet IE3 specs (IE2 motors can be used if they are controlled by variable-speed drives). The European Union MEPS (Minimum Energy Performance Standard) scheme, which mandates compliance with the IEC 60034-30 energy-efficiency classes, covers most two-, four- and six-pole motors rated from 0.75 to 375kW for power supplies at 50 and 60Hz. It is predicted that some 30 million existing industrial motors in Europe alone will gradually need to be replaced under the MEPS scheme; resulting in energy savings in the order of 5.5 billion kilowatt-hours of electricity each year and a corresponding reduction in carbon dioxide emissions of 3.4 million tonnes [3].

EU at the forefront

One area of emerging technology that is covered by the European Union MEPS policy and that stands to have a significant impact on overall energy usage is the brushless DC (BLDC) motors. A 3-phase BLDC motor is synchronous, it has permanent magnets residing on the rotor and coil windings. These produce electrical magnets on the stator of the motor. Electrical terminals are directly connected to the stator windings; hence there are no brushes or mechanical contacts to the rotor such as in brushed motors. This in turn reduces the energy required to run the motor, all while maintaining the same or greater power output as alternating current (AC) or brushed DC motors.

The use of brushless motors in household appliances alone would lead to enormous savings based on economies-of-scale, which is further increased by its adoption in industrial systems, white goods and even automotive applications. These applications are all related in that they all use relatively high amounts of electricity and offer numerous opportunities for significant energy savings through the adoption of brushless motors (see Table 1).

Brushless DC motors can replace AC motors or mechanical pumps and movements. Key benefits of using brushless motors include: higher efficiency, less heat generated, higher reliability and longer life (because there is no direct

Segments	Policies & Mandates	End Products
White Goods	Europe: Drive Towards Clean Energy & Power Efficiency	Washers Dryers Refrigerators
Industrial	Europe: 3-Phase "Inverter Drive" Power Efficiency Mandate	Pumps Fans Air conditioners Mixers HVAC
Home Appliance	Clean Energy & Power Efficiency Government Subsidies	Pumps Fans Air conditioners Blenders Hand power tools Kitchen appliances

Table 1. Products benefiting from brushless motor technology

Parameter	AC Motors	Brushless Motors
Size and Weight	100 Percent	55 Percent
Efficiency	40 Percent - 50 Percent	70 Percent -75 Percent
Speed Control	Difficult	Easy & Linear
Accuracy and Speed	3 Percent - 5 Percent	0.5 Percent
Torque Control	Poor	Excellent
Reliability	Parts Wear	No Wear
Safety	Brush Dust is a Hazard in Dangerous Environments	No Brush Dust

Table 2. Advantages of brushless DC motors

contact from the commutator and electrical terminals such as is found in the brushed motors), safer operation in a dangerous environment (no brush dust generated as in brushed motors), and reduction in overall system weight. Finally, since brushless motors are commutated electronically, it is much easier to control the torque and RPM of the motor and at much higher speeds. Ultimately, the benefits of longer operational lifetime and minimized maintenance translate into lower cost (see Table 2).

Today's engineers use both digital and analog technologies to overcome challenges like motor speed control, rotation direction, drift and motor fatigue. Implementing MCUs provides the ability to dynamically control motor actions so that they respond to environmental stresses and conditions. Brushless motor control does add additional complexity compared to brushed DC or AC motors and the collaboration between digital and analog components becomes very important. For this reason, it is important to work with suppliers who understand the complexities and can work with customers to optimize brushless motor design for each and every target application.

It is a scientifically recognized fact that earth's fossil fuel energy resources are finite and therefore limited. While great progress is being made to identify, harness and make alternative energy sources available and affordable, the very design of tomorrow's electricity-using products will go far towards minimizing their impact on the planet. Just imagine the reduction in energy usage if all of the motors in use today, in every appliance, heating and air conditioning system, and automotive components were replaced with ones that are 25 to 30 percent more efficient. It just goes to show that even a seemingly "small" technology can have a major impact on powering planet earth in the 21st century.

Literature

[1] Energy Efficiency Policy in the United States: Overview of Trends at Different Levels of Government. Elizabeth Doris, Jaquelin Cochran, and Martin Vorum.

[2] US Department of Energy, Building Technologies Office – Appliance and Equipment Standards; http://www1.eere.energy.gov/buildings/appliance_standards/m/history_and_impact.html

[3] Looking ahead to the next generation of energy efficient motors, Alistair Rae, EngineerLive.com.