FREEDIN SYSTEMS CENTER

Advances in Machines and Drives for Industrial Energy Efficiency

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Advances in Machines and Drives for Industrial Energy Efficiency

- Introduction: ABB, Energy Efficiency
- Highlighting the opportunity
 - Electric Motors
 - Variable Speed Drives
 - Full Industrial Systems

Let's write the future. Together.

ABB



ABB is a technology leader in **electrification** and **automation**, enabling a more sustainable and resource-efficient future.

The company's solutions connect engineering know-how and software to optimize how things are **manufactured**, **moved**, **powered** and **operated**.

ABB purpose

We enable a more sustainable and resource-efficient future with our technology leadership in electrification and automation.













Main sustainability ambitions 2030 targets



We enable a low-carbon society

- Carbon neutrality in own operations
- Support our customers in reducing annual CO₂ emissions by >100 Mt¹
- Work with most impactful suppliers to reduce their emissions by 50%

We preserve **resources**

- 80% of ABB products
 & solutions covered by circularity approach
- Zero waste to landfill²
- Supplier Sustainability
 Framework

We promote social progress

- Zero harm to our people and contractors
- Comprehensive D&I framework³; 25%
 women among ABB leaders
- Top-tier employee engagement score in our industry
- Impactful support for communitybuilding initiatives

INTEGRITY AND TRANSPARENCY ACROSS OUR VALUE CHAIN

Savings in the year 2030 from solutions provided to customers 2021-30
 Wherever local conditions allow

3. Diversity & Inclusion framework

Our business areas

Electrification

Motion

Process Automation

Robotics & Discrete Automation



Well aligned to supportive mega-trends

Exposure to strong longterm market trends

Flexibility

Reshoring, diversification, regionalization at forefront due to new technologies and policy environment

Shift to electrification

Electricity demand grows 2x faster than other energy sources

Sustainability

ESG in focus with

strong drivers from regulations, financials

and shareholder

Urbanization

Globally increasing energy consumption

drives development

of smart cities

value

Labor shortage

Aging population drives demand for automation. 25% of China's population +60 years in 2030

electricity consumption 1/3rd of world's

Increased

electricity consumed by electric motors

Digitalization & e-commerce

Focus on solutions, data analytics (incl. AI), connected factory data

Maximum productivity, quality, flexibility and simplicity

Automation & robotization

Slide 5

ABB and R&D Drivers and Demands

Motion

- Growing population, urbanization and digitalization
- Requires industrial processes, energy efficiency and electric mobility



Electrifications

- Electricity demand grows 2x faster than other energy sources
- Digitalization accelerates demand for intelligent solutions



Robotics & Discrete Manufacturing

- Individualized consumers, labor shortage, digitalization and uncertainty
- Automation solutions, increased productivity, highest flexibility, improved quality and maximum simplicity



Process Automation

- Increasing demand for end-toend integrated, connected solutions and advanced services
- Increasing demand for applications to drive autonomous operations



ABB has been pushing the boundaries of technology for +130 years



ABB

ABB



R&D facts & figures



4.7% of revenues spent on R&D and digital



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7000+ Scientists and Technologists which >60% focused on digitalization

- 11 countries with major R&D Centers
- >100 University collaborations
- >25,000 active patents to secure IP
- Start-up engagement direct or via our own ATV & Synerleap >15 strategic Partnership



Corporate Research Fueling tomorrow's innovation



Mission

- Develop/monitor technologies to de-risk future
- Pool of experts in common technologies
- Provide expert advice and support
- Actively link with academia
- Provide high quality talent to the organization

Technology Areas

of common interest within the ABB group



Sensing

We create solutions to transform real-world parameters into valuable information using competencies ranging from sensing technology and signal processing to information extraction and sensor system design.



Switching

We explore technologies for current interruption, from arc physics and gaseous insulation, to new interruption and breaker actuation principles, and up to the integration and coordination of protection and control devices at system level.



Software & Connectivity

We design next-gen software and communication systems, which involves areas of research such as software engineering and technologies, connectivity and communication architecture, system architecture and integration, cybersecurity, artificial intelligence & analytics technologies, and user experience.

Technology Areas of common interest within the ABB group



Multiphysics

We drive sustainabilityoriented innovations in products and solutions. Multiphysics is the study of multiple interacting physical properties, and we improve productivity by merging physical properties with digital transformation.



Mechatronics

We develop intelligent products by integrating mechanical, electrical/electronics, software, control and sensing components into one system.



Power Electronics

We develop technologies for solid state power electronics (PE). PE enables conversion, control and protection of electrical power in applications like industrial drives, robotics, EV chargers, marine, mining, ultrafast breakers and direct current (DC) distribution.



Control & Optimization

We research advanced modelling, control and optimization as well its engineering in automation systems. **Global #1 in motion industries – leading from a strong foundation**





01. Pioneering technology leader



02. Domain expertise



03. Global scale and coverage

ABB Motion

We keep the world turning while saving energy every day!

Key figures Global #1

#1 in motors

#1 in drives

\$80 bn 2018 market size \$6.9 bn

2021 revenues

17.1%

2021 Op. EBITA

>20 k Employees

worldwide

Europe

Business mix (by revenue)





We keep the world turning

Our motors and drives are an integral part in everyone's lives

Did you know...



...opening a water tap, the water pressure is built by pumps powered by motors and drives.

... being in an airconditioned building:

motors and drives are powering the

compressors and fans to keep the air

cool and flowing.

*



...your daily commute to work in case you go for public transportation: it will be motors and drives moving you reliably and safely to your destination.

...buying processed food in the supermarket, motors and drives run the machines and the conveyor belts.

...refueling your car: the oil and refinery process was powered by electrical motors and drives to get crude oil to gasoline suitable for your car.



This is only a small fraction of examples where our motors and drives keep the world turning efficiently, reliably and safely.



The critical role of motors

- 45% of the world's electricity is used to power electric motors in building and industrial applications
- Investing to upgrade the equipment used in these systems will yield significant rewards in terms of efficiency and sustainability



Motion offering

Drives

- Ability[™] offering
- Low voltage drives
- Medium voltage drives



Electrical Motors

- Ability[™] offering
- IEC Motors
- NEMA Motors
- Large Motors & Generators







ABB Ability[™]



Insight. It's the power to see and understand how something works in a new way, to unravel complexity and take action. It comes from visibility, intelligence and experience. It's what makes transformation possible.

ABB Ability solutions combine ABB's deep domain expertise with connectivity and software innovation to empower realtime, data-driven decisions for safer, smarter operations that maximize resource efficiency and contribute to a low-carbon future.

Our large portfolio of digital solutions helps organizations automate, optimize and future-proof their business to achieve new heights of performance and drive sustainable progress.

Innovation, the way forward from ABB

One motor can make a big difference

Our Large Motor technologies provide the powerful solutions the world needs

99.05% efficiency

With such high-efficiency ratings, they are capable of producing massive energy savings



Product Group NEMA Motors : Baldor-Reliance®

Celebrating >100 years of motor experience



https://www.referenceforbusiness.com/history2/24/Baldor-Electric-Company.html

Making the case for energy efficiency

The global population is expected to rise to **9.7 billion** by 2050

Urbanization, and the rise of living standards will increase the **demand for energy**

Critical processes can't stop, but need to be energy efficient to reduce CO₂ emissions The global economy is expected **to double** over the same period

The demand for the drive systems powered by **electric motors will grow**

With **high-efficiency motors** and variable speed drives we can do just that

Energy efficiency makes the difference

It has been estimated that, if all of the more than 300 million industrial electric motor-driven systems currently in operation were replaced with optimized, high-efficiency equipment, global electricity consumption could be reduced by up to 10 percent

Energy efficiency in electrical motors

Typically ~75% to 98%, increasing with larger power ratings

Efficiency "
$$\eta$$
" = $\frac{Power Out}{Power In}$ = $\frac{Power Out}{Power Out + Losses}$

Standard strategies to increase motor efficiency

For a given type of electric motor or generator

ABB IE5 synchronous reluctance motors

Elimination of rotor losses

IE5 SynRM Motors

- Output: 5.5-315 kW
- Frame sizes: IEC 132–315

■ I²R Rotor ■ Other ■ I²R Stator

The new first choice for energy efficiency ABB IE5 synchronous reluctance motors

ABB IE5 SynRM motors deliver a new level of efficiency: Ultra-premium

Significantly **more efficient** than IE3 motors

Higher efficiency IE5

Energy losses of 40% less

Lowest energy consumption

Reduce emissions

EC Titanium motor design Variable speed motor with IE5 ultra-premium efficiency

Designed for easy setup and operation

Cover designed for maximum cooling and quiet operation

easy access motor and drive technical data

Longer component life & reliability for the product

No maintenance or re-greasing required Resistance to water and dust ingress

Why adding a drive matters

It is estimated that **23%** of the world's industrial motors are equipped with a drive That figure is expected to only increase to **26%** over the next five years

While not every motor can use a drive, experts suggest that roughly **50%** of industrial motors would benefit from being paired with one

When added to the existing motor of a pump, fan or compressor, a variable speed drive can typically reduce power consumption by **25%**

Variable Speed Drive (VSD)

Typically ~90-98% efficient

Drive Itself

To minimize switching and conduction losses

- WBG devices, topologies
- Control and switching strategies

Enabled by the Drive

- Optimize system control of speed and torque
- Eliminate need for gearbox or pullies (in some cases)
- Reduced speed at partial loads
 - Avoid mechanical throttling, valves, dampers, vanes...
- Regenerative breaking

Save money

Save energy

Reduce emissions

Overall System Efficiency VSD + Motor + Load

- Total system efficiency, over typical load cycles
- Opportunity to minimize input power for desired output result
- Material usage and component lifetime
- Total lifecycle, from raw materials to disposal or recycling

Looking ahead

No one solution fits all

Continual improvement:

- Materials: WBG, electrical steel, magnets, conductors...
- Alternative topologies

System Optimization:

- Loads not restricted by 50/60Hz induction motor speeds
- Scale with multiple motors and/or drives depending on application

Much higher than 10% electricity savings possible with load and total systems optimization

The way forward

All stakeholders have a critical role to play

- ABB, along with other global technology companies, need to always provide the most energy efficient solutions and to continue to innovate for more
- We also need to **explain the value** of these technologies and accelerate their adoption
- Public decision-makers and government regulators will need to incentivize the rapid adoption of the latest technology
- Businesses, countries and cities need to make the investment
- Investors need to **reallocate capital** towards companies better prepared to address the climate risk

It's clear that deploying more high-efficiency motors and drives, and embracing digitalization represents a tremendous opportunity as the world seeks to achieve greater energy efficiency and cut CO₂ emissions

Discover how you can make a difference

www.energyefficiencymovement.com

