
03

Environment

52 – 54

Energy efficiency, renewable energy and climate

55 – 57

Resource efficiency

ENERGY EFFICIENCY, RENEWABLE ENERGY AND CLIMATE

Working to reduce climate impacts

Just as we target energy and resource efficiency and mitigation of climate change for our customers, through ABB’s product and solution portfolio, we have also been working for many years to manage and reduce the impacts of our own operations.

As part of our Group-wide sustainability objective to progressively increase the efficiency of our own operations, we have set ourselves the target to reduce the energy intensity of our business by 20 percent by 2020 from a 2013 baseline. This includes both direct fuel consumption and the use of electricity and district heating for manufacturing processes and to operate buildings. We also aim to cut greenhouse gas (GHG) emissions by reducing direct fuel consumption, converting to lower carbon sources of energy and improved handling of sulfur hexafluoride gas (SF₆).

To implement the objective, all sites were required to establish an energy savings program and to undertake actions to reduce GHG emissions. By the end of 2016, country energy savings plans were in place for 40 countries, covering 99 percent of ABB energy use, and more than 280 energy savings projects were under way at ABB sites.



9%
reduction in energy consumption since 2013

These focused activities have brought results, with absolute reductions in both energy consumption and GHG emissions realized between 2013 and 2016. However, due to lower revenues and capacity utilization, ABB’s energy intensity, measured as MWh per million US dollar sales, was 13 percent higher in 2016 than the 2013 baseline.

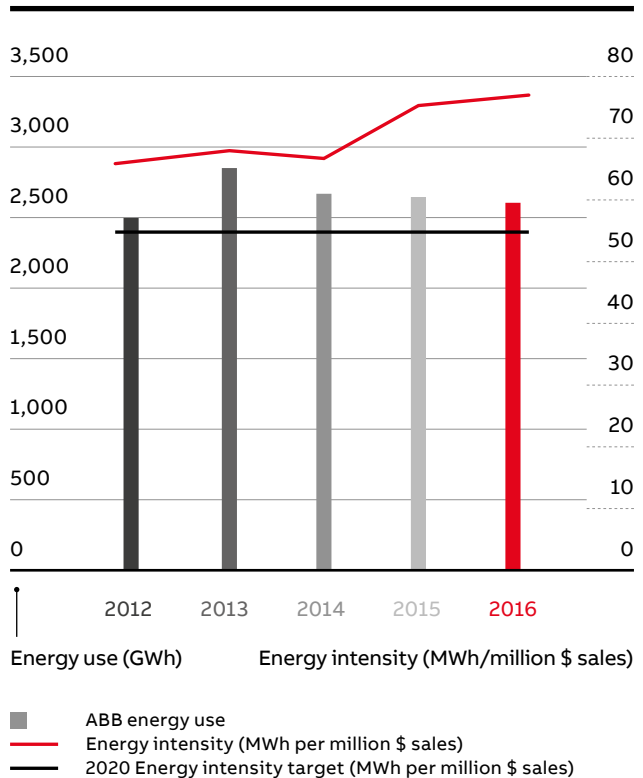
Energy efficiency in our operations

A wide variety of energy savings projects were implemented across the company to achieve the reductions observed in 2016. Most commonly, and cost effectively, facilities implemented energy-efficient lighting solutions. Other activities included optimizing heating, ventilation and cooling processes, investments in more efficient equipment, investigating and optimizing compressed air systems, behavioral change programs, and implementing or updating heat recuperation from machines and processes, often using our own technology.

ABB in Switzerland continued its program of lighting system upgrades, with projects completed at facilities

in Altstetten, Baden and Untersiggenthal during 2016. Energy-efficient LED lights were installed along with ABB’s KNX control systems with daylight sensors and dimming/motion detectors, resulting in better quality illumination of workspaces and significant energy and cost reductions. The company expects an annual energy saving of 1,600 MWh from these three facilities alone. In total, more than 120 lighting replacement projects were undertaken across ABB in 2016, with expected annual energy savings of more than 8,500 MWh.

Total energy use and energy intensity



A number of sites reviewed their compressed air systems, including Rogersville in the US, where actions to address the findings of an air leak survey are expected to save up to two percent – over 450 MWh – of the site’s annual energy consumption. The Kecskemet facility in Hungary installed new, more energy-efficient compressors and now

also uses the waste heat generated by the equipment to produce hot water, saving 120 MWh.

Other, novel approaches to heating and cooling are also providing promising results. At the Nowa Wies Leborska site in Poland, analysis of heating needs resulted in the replacement of natural gas heating with floor heating film, bringing savings of more than nine percent of the site's total energy consumption. The Oiartzun site in Spain installed a system to extract and redirect waste heat from one part of the factory to the employees' locker rooms, enabling deactivation of the original heaters. While in Bulgaria, installation of efficient groundwater pumps and heat exchangers connected to the plant's cooling system has provided highly energy efficient additional cooling capacity needed to cover the plant's requirements and to create a better working environment.

Many facilities have also chosen to implement formal energy management systems (EnMS), with 48 of the 99 sites with an EnMS now externally certified to ISO 50001 or EN 16247. ABB in Spain has implemented a unified EnMS for six main manufacturing and service sites, representing more than 95 percent of ABB's total energy consumption in the country, and achieved certification in early 2015. Each site works towards annual targets based on its unique circumstances and, through these efforts, ABB in Spain reached its 2020 goal to achieve a 20 percent reduction in country-wide energy intensity by the end of 2016.

Driving efficiency in our real estate portfolio

ABB's corporate real estate management also plays a key role in our energy efficiency performance. The ABB Green Building Policy guides the acquisition, development, refurbishment and management activities related to our worldwide portfolio of about 8.4 million square meters of building space. The policy covers both owned and rented space and sets out detailed criteria, including site selection, building design, and choice of materials to optimize resources. Implementation of the policy is helping ABB to achieve our goals for improved environmental performance, financial savings and greater employee satisfaction.

To supplement site by site improvement projects, in 2013 ABB real estate management kicked off a significant project to introduce systematic real estate energy efficiency programs across Europe. Energy monitoring, technical assessments and evaluation of efficiency measures were completed at more than 70 sites across 13 European countries by the end of 2016. Sites in two further countries were expected to complete their projects by early 2017.

More than 600 energy efficiency measures were identified in the course of the projects, along with three key, recurrent themes: lighting, distribution grids and compressed air. To help structure and expedite relevant energy efficiency improvement activities, we created guidelines for our real estate network and compiled useful information around these common issues.

Beyond Europe, the energy efficiency project was expanded to Canada, the US and China in 2016, with activities in India and Brazil scheduled to start in 2017.



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Reducing carbon intensity of energy

As part of our goal to cut both direct and indirect GHG emissions, ABB seeks to reduce the carbon intensity of our energy sources. Several ABB countries – Belgium, France, Italy and the Netherlands – now purchase all of their electricity from renewable sources. Thomas & Betts plants in these countries will also join these programs as their current contracts reach expiration. In Sweden, almost 20 percent of electricity purchased was “green” energy, while globally, 130 GWh, or almost 8 percent of ABB's 2016 electricity was purchased as certified “green” electricity.



11% reduction
in GHG emissions
(Scope 1 + 2) since 2013

Increasing numbers of ABB facilities are also installing on-site photovoltaic (PV) power plants to reduce environmental impact and demonstrate ABB's solar capabilities. PV plants are now installed at 33 sites in 22 countries across Asia-Pacific, Europe and Latin America. While contributing only a small proportion of our global electricity needs, these plants are often a key part of local energy strategies to replace diesel generation with low carbon reliable power.

Extending this concept, ABB installed an integrated solar PV-diesel-battery microgrid at our Longmeadow facility in Johannesburg, South Africa in 2016. The microgrid integrates multiple energy sources and battery-based stabilization technology within a smart control system, supplying reliable power 24/7 while also optimizing the site's use of solar energy sources. In late 2016, ABB also announced that we will install a fully integrated microgrid at our Vadodara facility in Gujarat, India to help boost renewable energy generation while reducing dependency on fossil fuel.



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Cutting greenhouse gas emissions

ABB's total GHG emissions (Scope 1 + 2) decreased by 7 percent in 2016 to 1.38 million tons, with an overall 11 percent reduction since 2013. Around 70 percent of the saving in 2016 was due to an overall reduction in the carbon intensity of electricity supply. That is, CO₂ emissions from electricity consumption were 10 percent lower in 2016 than 2015, even though electricity consumption remained essentially unchanged year on year.



The remainder of the savings were due to decreased gas consumption and a reduction in SF₆ emissions from production processes and gas handling on site. During 2016, a number of facilities redesigned certain production processes to reduce and, where possible, eliminate SF₆ use. For example, one of our US facilities eliminated the use of SF₆ in its die casting process, reducing emissions by more than 4,500 t CO_{2e}. Other facilities took measures to improve handling, leak detection and storage procedures for the gas. See the “Approach to reporting” section of this report for details of our GHG calculation methodology.

Transport, logistics and packaging

Implementation of ABB’s global fleet management tool and processes progressed during 2016. Fleet procurement and management processes were harmonized across Europe and will be rolled out in the Americas and Asia in 2017. Baseline, global fleet data were assembled and uploaded to our fleet management tool during the year, with actual fuel and mileage data entry to follow during 2017. The tool will enable tracking of fleet efficiencies and sharing of good practices across our businesses.

Mobility initiatives were also undertaken in a number of locations during 2016. ABB in Canada implemented a pilot GPS service vehicle monitoring program at six of its sites, allowing identification of the closest service vehicle to reduce distance traveled, plus other efficiencies, expected to reduce fuel consumption by 15 percent. In time, this program will be extended to all ABB vehicles in North America. Driver training programs were implemented by a number of businesses to improve both safety and fuel efficiency, while ABB Benelux received a Lean & Green Personal Mobility Award for their actions to reduce CO₂ emissions from transport. Initiatives included greening the company car fleet, driver training and providing a pool of electric vehicles for use by employees.

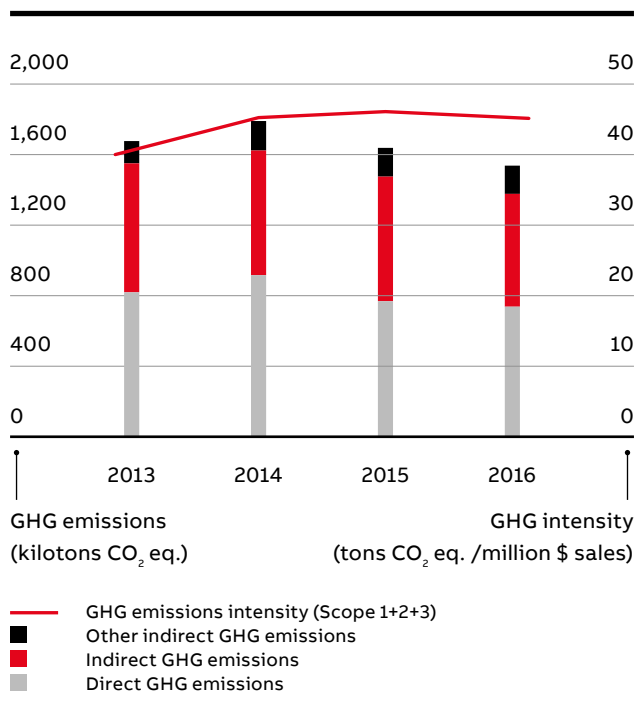
ABB is also significantly expanding its program to optimize logistics operations, with the introduction of ten Transportation Management Centers (TMCs) to serve all ABB businesses globally.

A successful TMC pilot in China consolidated the transport, trade and logistics processes of 36 factories into one TMC location in Shanghai. The new set up, covering all ABB businesses in China, led to significant improvements in all key performance indicators, achieving over 98 percent on-time delivery (OTD) and 99.9 percent damage-free shipments, along with significant reductions in cost and transport-related CO₂ emissions.

As a further step, we have invested in a cutting-edge transportation management system (TMS), which suggests route- and load-optimized shipment plans. It will be deployed across all TMCs as they are rolled out. With this tool, ABB’s supply chain management is digitalizing the planning and execution of the physical movement of goods, enabling real-time monitoring and reductions in cost, lead time and inventories.

In 2016, the TMC in Bangalore, India was the second global center to go live, covering domestic freight for 39 local plants. During 2017, the remaining eight Transport Management Centers will be rolled out, enabling more efficient management of millions of shipments worldwide. TMCs will play an active part in making ABB a stronger, more agile and productive company, helping us to increase customer satisfaction while reducing both costs and environmental impacts.

Total greenhouse gas (GHG) emissions and GHG intensity



RESOURCE EFFICIENCY

Reducing both costs and environmental impacts

ABB is committed to optimize the use of resources, minimize waste and ensure that the materials and components we use and the products we produce comply with our own and our stakeholders’ standards.

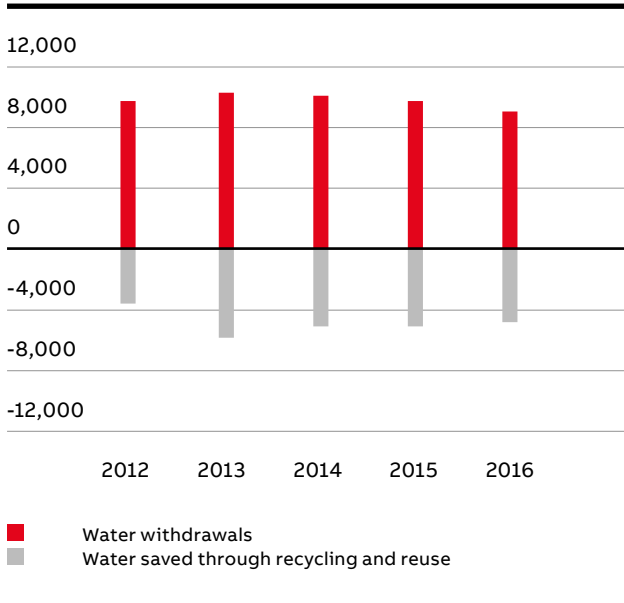
Water in our global operations

Although the majority of our manufacturing processes do not consume significant amounts of water, ABB is nonetheless committed to reducing our impact on water resources.

Across ABB Group, water withdrawals were reduced by six percent (570 kilotons or 570,000 m³) during 2016. This was achieved with a variety of water efficiency projects that included improved monitoring of water flows, up-graded processes for increased recycling or reuse of water, repair and refurbishment of water systems and water conservation training and awareness-raising programs.

The use of closed-loop systems for process water and the reuse of water in other ways, such as in gardening, saved approximately 4,800 kilotons (4.8 million m³) of water in 2016. Without this recycling and reuse, ABB’s water withdrawals would have been 52 percent higher. In addition, the use of closed-loop systems for cooling water eliminated more than 5,800 kilotons in water withdrawals.

Water withdrawals and water reused / recycled (kilotons)



Almost 50 percent of ABB’s total water withdrawals were used for cooling processes, 20 percent for manufacturing processes and the remainder for domestic purposes such as sanitation, cooking or garden maintenance.

Reducing impact where it’s most needed

In order to focus savings where water stress is felt most acutely, ABB is committed to reduce absolute water withdrawals by 25 percent between 2013 and 2020 at facilities in watersheds with extremely high, high, and medium to high baseline water stress.

We have mapped our facilities using the World Business Council for Sustainable Development’s [Global Water Tool](#) and have classified them according to the level of “baseline water stress” of the watershed where they are located. Higher stress values indicate more competition among users within the watershed.

15%
decrease in water withdrawals in water stressed areas in 2016

Of the 581 ABB locations mapped in 2016, 81 are located in watersheds with extremely high water stress, 116 in areas with high stress and 90 in areas with medium to high stress. Even though approximately 50 percent of our facilities and offices and our employees are located in these high water stress areas, these facilities accounted for only 30 percent of ABB’s global water withdrawal in 2016.

We have selected 64 of these sites, located in 23 countries, as the initial focus of our 2020 water reduction commitment. In 2016, these 64 facilities accounted for 72 percent of ABB’s water withdrawal in extremely high, high and medium to high stress watersheds.

To support these locations in their water reduction efforts, we updated and simplified our ABB Water Tool for mapping and analysis of water flows and retrained our

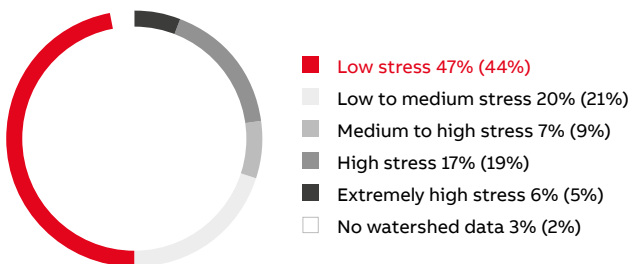
environmental network in its use. Case studies of good practices provided inspiration for further activities.

Many of the selected facilities have initiated activities to reduce their water withdrawals and improve their water efficiency. Some have made significant investments in new processes to reduce water consumption, while others have redesigned systems to transport, treat, recycle and reuse water.

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These investments and process changes have brought results. By the end of 2016, the 64 selected sites had already recorded an overall 25 percent reduction in water withdrawals compared with their 2013 baseline. For all ABB sites in these stressed watersheds, total water withdrawals in 2016 were 18 percent lower than the 2013 baseline – well on the way to achieving our 2020 reduction target.

Water withdrawal per water stress area in 2016 (2015)



Waste and recycling

ABB products contain mostly steel, copper, aluminum, oil and plastics. Consequently, the main waste streams at ABB facilities are metal, oil and plastic, as well as wood and cardboard from packaging materials and paper from office activities.



16%
reduction in waste generated since 2013

We aim to optimize material use, reduce the amount of waste generated and increase the share of waste that is reused or recycled. We are committed to reduce the amount of waste sent to final disposal – both hazardous and non-hazardous – by 20 percent by 2020. This is measured as the proportion of total waste that is sent for final disposal and compared with a 2013 baseline.

In 2016 we saw good progress to that objective, with 16 percent less waste generated than in 2013, while the proportion of waste sent to final disposal was down to 18 percent compared to 20 percent in 2013. In-house recycling and reuse, mainly of packaging materials and thermoplastics, reduced the amount of waste by 3,500 tons.

This improvement in performance was supported in 2016 by a Group-wide systematic analysis of existing waste practices that resulted in the roll out of an ABB guideline on good practice in material flows and resource efficiency. The guideline, specific to ABB’s business operations, was designed to reinforce action to reduce use of raw materials in processes and to increase recycling and reuse of waste.

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Around 80 recycling or waste reduction projects were under way in 2016, half of which focused on improved recycling practices. A number of these programs included a detailed waste analysis to ensure improvement activities were well-targeted. In Canada, employees at seven locations even undertook ‘dumpster dives’ to conduct mini waste audits and examine how much recyclable material was being disposed. Site level improvement targets and programs were then developed to address issues identified at each of the sites.

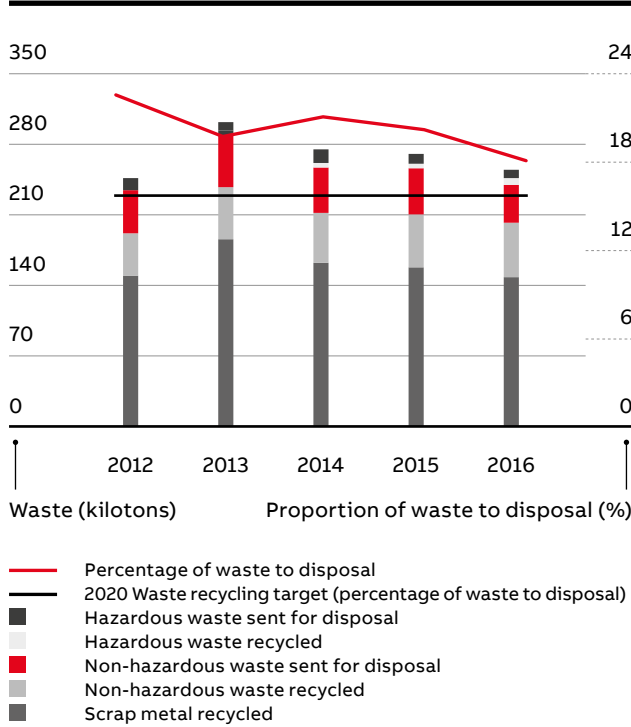
Many other sites focused on replacement of disposable products such as plastic and Styrofoam containers and paper towels with more sustainable alternatives and on better separation of food waste for composting.

Several facilities, for example in Mexico and South Africa, have gone further and engaged permanent employees from their recycling vendor companies to ensure appropriate sorting and waste management on site. Others have invested in equipment such as cardboard balers and shredders or a magnetic labeling system. These investments have been worthwhile, resulting in significant savings from less waste to landfill, reduced hazardous waste treatment and disposal from better waste classification, and improved rebates from better quality recycled materials.

As part of their continuous improvement programs, our operations also review production processes to identify cost savings from process efficiencies and input optimization. Inevitably, these improvements result in decreased environmental impacts as well, often due to reduction of waste.

For example, a project at our manufacturing plant at Santa Palomba, Italy made significant cost savings by reusing plastic material left over from the molding process, reducing waste to zero, without compromising the quality of products. Prior to the project, about 15 per-

Waste and recycling



cent of plastic material was wasted across the plant, ranging from two to 57 percent depending on product line. A multi-disciplinary team developed a pilot program focused on one product line and saved 17 percent of the previously-wasted material with no impact on product quality. This achievement earned the team a bronze CEO Excellence Award in 2016 and the program is now being expanded to further product lines at the plant.

Another process optimization project at an ABB plant in Sweden aimed to reduce scrap in filament winding by minimizing variation along the entire process chain. The project realized cost savings of 30 times the project investment and also reduced waste by 130 tonnes, 60 percent greater than originally forecast.

Reducing hazardous substances

ABB continues to phase out hazardous substances in products and processes, where technically and economically feasible. We have compiled lists of prohibited and restricted substances to guide this process and update them regularly, in line with international regulations. These lists help our facilities to comply with regulatory requirements, ensure a high level of protection for human health and the environment, and manage risks encountered by chemicals present in various products.

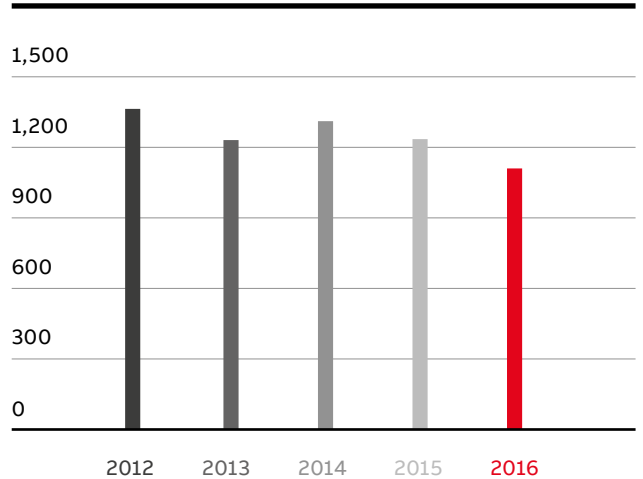
Regulatory compliance is also part of ABB's Global Terms and Conditions for suppliers and our Supplier Code of Conduct. We have developed a [Guide for Suppliers to the ABB List of Prohibited and Restricted Substances](#) to support suppliers' understanding of their obligations.

As well as ensuring compliance with the list of prohibited and restricted substances, ABB facilities are required to work to phase out hazardous substances in their in-processes and products. In 2016, more than 40 projects were under way to reduce hazardous substances and volatile organic compounds (VOC) emissions.

As facilities continue to phase-out the use of solvent-based paints and other products, we saw a 10 percent reduction in VOC emissions during 2016. Much of this success has come via collaborative efforts with suppliers, raising awareness about our needs and the opportunities for substitution.

Due to the variety of manufacturing processes and products across ABB, reducing hazardous substances is generally implemented site by site, depending on site and product characteristics and supply chain. However, ABB in Sweden is taking a systematic, country-wide approach, in a phased, multi-year process. All substances have been identified and ranked on priority for substitution, according to advice from government chemicals agencies. Progress is tracked at quarterly country management meetings to ensure that hazardous substances are phased out according to the agreed schedule.

Emissions of total volatile organic compounds (tons)



Promoting material compliance

ABB's network of environmental specialists works alongside our product development and supply chain function to promote material compliance. During 2016, we developed further training on the application of REACH and RoHS to ABB products and processes and delivered that training to our environment and R&D staff as well as other functions, including supply chain and sales.