

# Global Energy Management System Implementation: Case Study

Global

## IBM Corporation

ISO 50001 Registration: Results and Benefits



### Business case for energy management

IBM is a cognitive solutions and cloud platform company. The company's global capabilities include services, software, systems, fundamental research and financing serving clients in all sectors of economy. IBM's global business activities include data center operations, research and development, product test and assembly, administration, and related real estate.

Energy management has long been an integral component of IBM's global Environmental Management System (EMS). Energy consumption is a key aspect of the program as it represents the main source of IBM's greenhouse gas (GHG) emissions. IBM successfully earned a single worldwide registration of its EMS against the ISO 14001 standard in 1997; and against the ISO 50001 standard in 2012. The ISO 50001 registration, further enhanced our energy management processes and communications. IBM has had a corporate level energy conservation goal, "achieve annual energy conservation savings equal to 3.5% of IBM's total energy consumption", which is IBM's Energy Performance Indicator (EnPI), since 1996 and three consecutive GHG reduction goals since 1998. Our focus on energy management supports IBM's commitment to environmental leadership, reduces energy consumption, operational costs and GHG emissions

while improving operational efficiency. We also commercialize the solutions we develop for and test under our own operations to our clients to improve their operations. IBM's energy management program contributes to realizing the IBM core values of delivering **innovation that matters** and **dedication to every client's success**.

*"The rigor and discipline required to pursue and maintain registration of IBM's global EMS to ISO 50001 have contributed to our successes and driven continual improvement of our energy management program. For example, we have increased focus on utilizing innovative, analytics-based technologies to drive reduction in energy consumption in real time, and anticipate and correct potential problems before they affect energy use."* --

Wayne Balta, VP Corporate Environmental Affairs and Product Safety

### Case Study Snapshot

<b>Industry</b>	Technology and Services
<b>Product/Service</b>	Technology Products, Services, and Solutions
<b>Location</b>	Global
<b>Energy Management System</b>	ISO 50001 Certified
<b>Energy performance improvement period</b>	Annual
<b>Energy performance improvement (%) over improvement period</b>	7.1 % (2015) 7.5% (2013-16, annual average, EnPI)
<b>Total energy cost savings over improvement period</b>	US\$7,600,000 (2015) US\$32,800,000 (2013-16)
<b>Cost to implement EnMS</b>	\$1,200,000, one time
<b>Payback period on EnMS implementation (years)</b>	Less than 1 year
<b>Total Energy Savings over improvement period</b>	460,000 GJ (2015) 2,000,000 GJ (2013-2016)
<b>Total CO<sub>2</sub>-e emission reduction over improvement period</b>	44,000 MT (2015) 187,000 MT (2013-2016)

## Business benefits achieved

IBM's Corporate Energy Management Program (EnMP) and 26 IBM locations have achieved certification against the ISO 50001 standard pursuant to our global strategy. In 2015, our 26 ISO 50001 certified locations represented 32% of IBM's global energy consumption. These sites reduced or avoided 7.1% of their energy consumption compared to the Corporate EnPI target of 3.5%, equaling 127,000 megawatt-hours (MWh), a saving of approximately 7.6 million USD and an avoidance of 44,000 metric tons (MT) of CO<sub>2</sub> emissions. From 2013 to 2016 (Figure 1) our ISO 50001 registered locations reduced their energy consumption by 11%, achieving an average annual EnPI of 7.5%. These conservation efforts reduced or avoided energy consumption by 544,000 MWh, saving 32.8 million USD and avoiding over 187,000 MT CO<sub>2</sub> emissions. Over the same 4 year period, IBM's global operations achieved an EnPI of 5.4%, reduced or avoided an annualized 1,150,000 MWh, saving nearly 100 million USD per year.

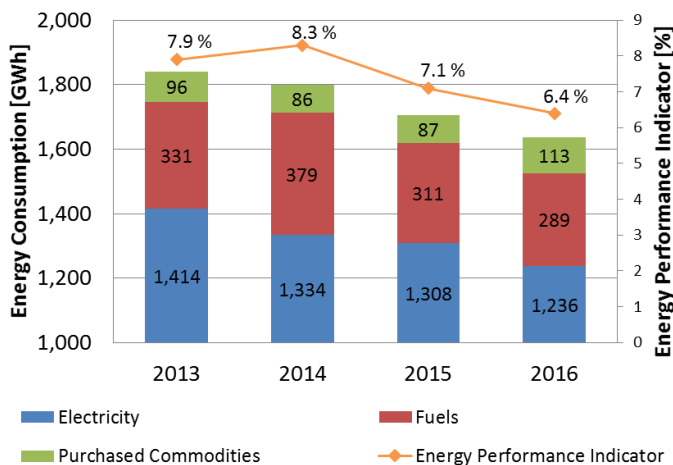


Figure 1: Energy Consumption and EnPI Performance at IBM's 26 ISO 50001 Registered Locations from 2013 to 2016.

The rigor and discipline involved in pursuing and maintaining ISO 50001 registration drove operational process improvements and contributed to our results:

1. Increased participation in the energy management process by the business units responsible for data centers, IT labs, and hardware product assembly operations.

2. Improved consistency in global operating procedures and results through greater collaboration among units and locations.
3. Enhanced global training program.
4. Improved preventative maintenance results through enhanced internal processes and better management of sensors, meters and controls.

IBM routinely communicates these improvements and results generated by its EMS to clients, employees and interested stakeholders to demonstrate its environmental leadership.

## EnMS development and implementation

IBM formalized its Corporate Environmental Policy in 1971 and updated it periodically since. The policy drives IBM's long-standing commitment to environmental leadership in all of our business activities. IBM's global EMS covers the company's business intersections with the environment comprehensively, including energy management, conservation and climate protection. The ISO 50001 processes have provided an opportunity for us to further examine our EnMP, and we have leveraged the standard as an impetus to enhance it.

### Organizational

IBM's formal EnMP dates back to 1974 and has been an integral part of our global EMS. Upon the issuance of the ISO 50001 standard in June 2011, IBM successfully executed a strategy, supported by top management, to register its corporate EnMP to ISO 50001 by demonstrating conformity of our global EMS to the standard. Following that, IBM's energy management team (EMT) registered 26 individual IBM locations to the standard.

Overall responsibility to assess and validate the company's conformance with and continually improve the effectiveness of IBM's global EnMP requirements resides with the Vice President, Corporate Environmental Affairs and Product Safety. The responsibility to execute EnMP requirements resides with the corporate EMT and the operational teams at IBM locations and/or business units.

### Energy review and planning

IBM has long recognized the importance of data (e.g. energy consumption and cost), and the collection of accurate information has been an important aspect of

IBM's EnMP. IBM maintains an enterprise database enabling the accurate and consistent reporting of energy data by its locations and business units, analysis of consumption patterns, and generation of actionable insights. Currently, over 790 locations representing over 96% of IBM's global consumption report data. Energy reduction opportunities are identified, assessed and executed through the following process steps:

- Corporate-wide and location-specific energy consumption data is assessed and assigned and allocated across nine key systems categories.
- The corporate EMT and energy teams at ISO 50001 registered locations determine which systems contribute to more than 10% of total consumption, and thus are significant, at both the corporate and/or location level. Conservation opportunities for systems considered significant must be assessed.
- These top 100 energy using sites representing 85% of consumption must complete global conservation checklists and set and execute a 2 year conservation plan for the 9 key systems every 2 years.
- The conservation plans are reviewed and refined during the annual budgeting process, which includes executive management review, and approved for each fiscal year.

The EMT continually assesses and analyzes the data during the year using online tools. An annual summary report, detailing prior year's consumption, conservation results and trends is issued to executive management in the second quarter of each year.

*“IBM's global EMS and EnMP provide the foundation for IBM's sustained performance, both in generating business benefits and protecting the environment. Conformance to ISO 50001 standard has led to broader engagement with employees and business units enabling cross-functional collaboration to capture major energy conservation projects that we would not have found working separately.”* -Tom Ponesse, Director, Real Estate Asset Management

### Cost benefit analysis

IBM successfully demonstrated conformity of its global EMS against ISO 50001 standard one year after the issuance of the standard. To attain the initial registration IBM prioritized 1.5 person years of internal resources at the corporate level to align our documentation with the standard and to prepare for the external audit. Getting this done was a less daunting task for IBM since we have had a strong, centralized and documented EMS in place for over 3 decades which included key elements of the ISO 14001 and 50001 standards. Each individual registered location required ¼ person years for these two tasks leading up their successful registration. No external resources were needed for the registration process. The majority of the metering and monitoring systems were in place and expansion of the system was part of the ongoing project planning and financing, minimizing unplanned hardware funding needs. We estimate a one time 1.2 million USD to be associated with dedicated, internal resources to achieve the initial registration of the Corporate EnMP and 26 locations. Ongoing expenses of 20,000 USD/year are anticipated to perform surveillance audits involving external auditors.

Given the long history of our EnMP, disaggregating incremental savings and allocating them solely to ISO 50001 registration related activities is difficult. Given the significant and sustained savings we have achieved from sound energy management and conservation, we can assert that the return from our investments toward continually improving our global EMS and EnMP, including pursuing and maintaining ISO 50001 registration, is substantial.

The greatest benefit of maintaining our global EMS's conformity to ISO 50001 is an intangible one. The rigor and discipline driven by the process, the requirement to demonstrate continual improvement, the deeper and broader engagement with employees and business units all contribute toward our ability to uncover and create opportunities to further conserve energy and avoid our operational GHG emissions.

**Approach to determine energy performance improvement**

IBM’s EnPI requires the conservation and avoidance of energy equal to or higher than 3.5% of its total consumption per year, as measured by the following formula:

$$\left[ \left( \frac{\text{Electricity Cost } [\$]}{\text{Total Energy Cost } [\$]} \times \frac{\text{Electricity Savings [MWh]}}{\text{Electricity Consumption [MWh]}} \right) + \left( \frac{\text{Fuels Cost } [\$]}{\text{Total Energy Cost } [\$]} \times \frac{\text{Fuels Savings [MMBtu]}}{\text{Fuels Consumption [MMBtu]}} \right) \right] * 100\%$$

This approach incorporates consumption, use, efficiency and cost into a single, blended metric applied consistently across IBM’s global operations, providing a multi-dimensional measurement of our conservation performance. The related energy savings are claimed for a 12 month period. Project categories cover nine system categories and additional demand categories such as recommissioning and the virtualization and consolidation of IT equipment. IBM has exceeded this goal for each of the last 10 years (Figure 2) as a result of a relentless focus on conservation actions by our EMT. IBM does not permit normalization of performance results for changes in business operations and weather. Our firm expectation is that our global EMT’s focus on what it can physically control will drive continual improvement in operational energy efficiency and achievement of the EnPI each year.

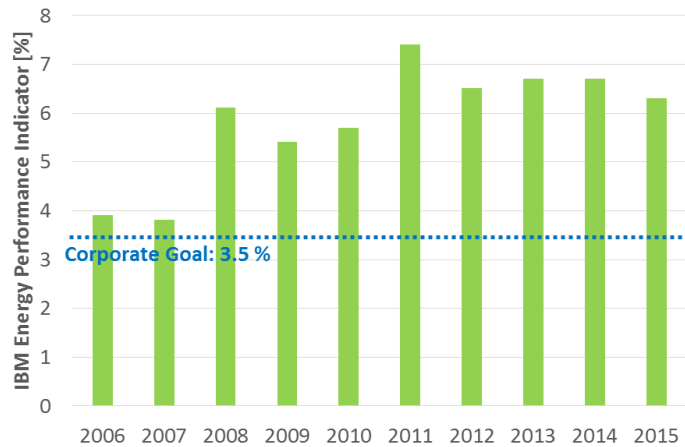


Figure 2: Performance of the IBM Energy Performance Indicator from 2006 to 2015.

**Approach used to validate results**

Data reported to the enterprise database undergoes a rigorous quality control to verify its accuracy. IBM has established global business intelligence tools and executive dashboards, which are updated daily, to track IBM’s energy performance and data integrity at over 790 sites. Analytics-based quality control tools perform a weekly assessment, comparing month to month and year to year data, to identify missing and/or erroneous data and sites not trending toward their annual targets. This process enables quick shifting of resources to required areas as needed. The quality controlled results are mined by the corporate EMT to identify locations that would benefit from point-in-time spot checks of their processes and data. Approximately 20,000 energy bills and 2,800 energy projects are reviewed and verified prior to the final, annual data being rolled up into IBM’s internal and external reports.

**Steps taken to maintain operational control and sustain energy performance improvement**

The energy management processes are run by the global EMT of over 250 performers and energy managers and they are, in turn, responsible for engaging all employees in the management of energy consumption. The global EMT deploys standard, global operating procedures which are adapted to location requirements to ensure the integrity of location-specific operations which affect energy consumption. The energy conservation checklists are deployed at each location in accordance with corporate requirements and energy reduction plans are established as described in the previous section. In addition, IBM has implemented analytics-based monitoring and management systems on over 40% of its building energy consumption, over 60% of its data center energy consumption, and its large central utility plant operations in the U.S. to provide rule based, real-time monitoring, management and optimization of these operations (Figure 3). These real-time systems have consistently reduced energy consumption by 10% to 20% when installed on a building, data center, or central utility plant. New buildings and processes are identified and brought into the system through the energy management process requirements.

The EnPI and supporting management metrics at the top 100 energy using locations are tracked and displayed on the Corporate Energy Management dashboard (see Figure 4) for review by the EMT and responsible management. Process conformance and data integrity are verified by a suite of internal quality management tools as described above. Verified data supports internal and external audit programs required to maintain the ISO 50001 registration.

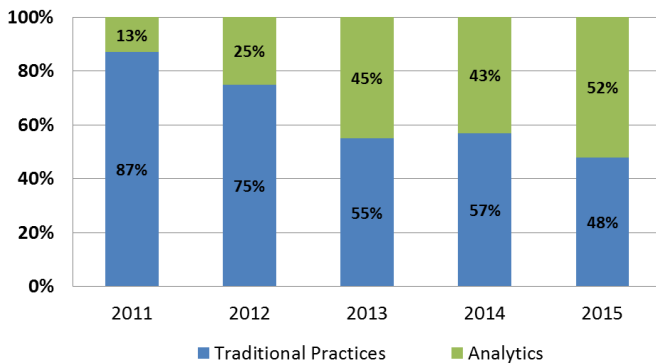


Figure 3: Increased Use of Analytics to Obtain Conservation Results at the Top 10 Energy Consuming Locations.

*“The process of pursuing ISO 50001 registration provided an opportunity for us to evaluate and sharpen our definition of significant energy consumption. It also drove greater collaboration between the Energy Management Team and colleagues in our manufacturing organizations to improve processes, enhance operational control and sustain energy performance at our manufacturing facility.”* — Nathalie Christen, Environment and Energy Program Manager

**Development and use of professional expertise, training, and communications**

The EMT is staffed by full-time engineers or other energy management professionals. They, in turn, deploy responsibility for energy efficiency to the operators, maintenance staff and design teams responsible for each energy consuming system. Each individual employee receives training appropriate to their role from a suite of corporate and local training offerings. In addition, employees receive regular,

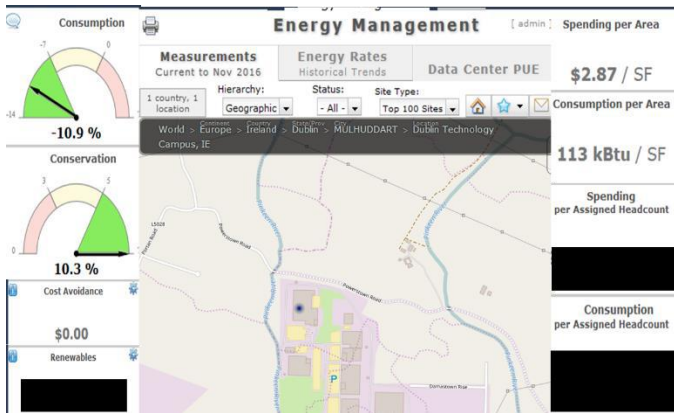
periodic communications on energy management topics. The training and the communications address how each energy management and operational role affects energy consumption, the importance of conforming to the defined processes and procedures to minimize energy consumption and the role of each individual to identify and implement energy conservation and efficiency projects. New employees receive energy efficiency awareness training as part of their orientation.

At a Corporate level, the monthly worldwide steering committee meeting is used to bring together energy managers, procurement staff, design leads, and Corporate Environmental Affairs staff to provide updates on process, policy and project initiatives and to share expertise across the team.

**Tools and resources**

IBM has enabled a suite of tools powered by bills and meter and conservation project data collected in the enterprise-wide database to assess performance against the EnPI and other supporting operational metrics. This data is also used to support required audits connected to maintaining our ISO 50001 registration. The global EMT and management team have access to these tools. Information is updated daily. These tools provide a centralized view, from the corporate to location levels, of the attainment of IBM’s EnPI and supporting measurements. Our business intelligence dashboard (Figure 4) reports on consumption, cost avoidance, renewables and energy benchmarking. Having all of these key metrics available in a single solution allows our users to ask questions and cross pollinate their great ideas on energy savings across our global community and provides management easy access to the energy metrics needed to run the business.

Since data center consumption is a corporate wide significant energy use, we leverage energy metering to calculate and present monthly average Power Usage Effectiveness (PUE), based on 15 minute interval readings, and present them on a datacenter specific dashboard with other key data center energy metrics.



**Figure 4: Energy Management Dashboard**

All of IBM’s outstanding business intelligence capabilities provide the real-time data and analysis. With regard to ISO 50001 standard, these capabilities enable efficient demonstration by locations of the Plan, Do, Check and Act cycle.

## Lessons Learned

A key challenge was keeping the processes and documentation simple and easy to use to enable operations staff to focus their time and efforts on optimizing operational performance and reducing energy consumption. It is also critical to develop solid project justifications, using available incentive programs and new technologies, in order to drive continual improvement even after the higher return projects have been completed. Continuous project monitoring is also important to track performance results.

Our experience, as demonstrated by the EnPI results of 6.4% to 8.3% at the ISO 50001 registered sites from 2013 to 2016, is that the process of continual

improvement is never done. We can always find new energy conservation and efficiency opportunities as we better understand our systems and deploy new technologies. We believe that our energy management system, and the involvement, innovation and mobilization of our employees, together with the application of real time monitoring systems, will make it possible for us to continue to exceed the EnPI target and remain a leader in the field.

## Keys to Success

From our decades-long experience of energy management, we believe in:

- Identifying and concentrating on significant energy users first to capture the best opportunities.
- Developing strong partnerships with the finance team to facilitate funding of projects.
- Engaging non-facility, demand side operations such as data centers to drive energy consumption reductions.
- Investing in training the staff who use the tools and facilitate location energy reduction efforts.
- The use of automated, analytics based systems that enable real-time optimization of energy consuming processes, achieving additional energy reductions of 10% to 20%.

The rigor and discipline required to maintain registration to ISO standards of IBM’s global EMS has deepened our conviction, driven continual improvement, and contributed to our achievements.

Through the Energy Management Working Group (EMWG), government officials worldwide share best practices and leverage their collective knowledge and experience to create high-impact national programs that accelerate the use of energy management systems in industry and commercial buildings. The EMWG was launched in 2010 by the Clean Energy Ministerial (CEM) and International Partnership for Energy Efficiency Cooperation (IPEEC).

For more information, please visit [www.cleanenergyministerial.org/energymanagement](http://www.cleanenergyministerial.org/energymanagement).

