ISO 50001 Energy Management System
Case Study

Global

3M

Energy as a 3M competitive advantage

3M Science. Applied to Life.

Case Study Snapshot	
Industry	Manufacturing
Product/Service	Multiple
Location	30 sites in 7 countries
Energy management system	Energy Management System (ISO 50001) and Superior Energy Performance (ISO 50021)
Energy performance improvement period	3 years (2016-2018)
Energy Performance Improvement (%) over improvement period	4.5%
Total energy cost savings over improvement period	13,500,000 USD
Cost to implement EnMS	2,000,000 USD
Total Energy Savings over improvement period	1,960,700 GJ
Total CO_2-e emission reduction over improvement period	330,000 tCO2

Organization Profile & Business Case

Since 3M's founding in 1902, the company has expanded from a small-scale mining venture to a global manufacturing powerhouse with over 90,000 employees operating in 71 countries. 3M provides 55,000 unique products found in every household, business, and industry across 200+ countries.

3M is both a global leader in environmental stewardship, driving energy and climate sustainability efforts through a holistic approach, ensuring every life is improved. From establishing the Corporate Energy Management Department in 1973, in addition to over 40 years of setting sustainability targets, energy has always played a big part in our sustainable actions. The Energy Policy developed in 1991 incorporates energy conservation into our business practices. As a result of this effort, we continue to lower operational costs, reduce our carbon footprint, increase the reliability of our energy supply, and strengthen our brand image. Starting in 2019, our sustainability goals extend to integrating a *Sustainability Value Commitment* into all our new products so that our customers are confident that they are also reducing their carbon footprint.

ISO 50001/SEP for 3M – Our journey with ISO 50001 began as a pilot venture with the joint support of the Department of Energy (US) and Natural Resources Canada in 2011. 3M presented themselves, selecting one plant from each country: 3M Cordova in Illinois, US and 3M Brockville in Ontario, Canada. Growing from 2 sites in the pilot, we now have 30 sites globally that are ISO 50001 certified; 14 of which have taken the additional step to achieve SEP certification (see Figure 1).

Country and SEP Levels	SEP Certification Body	SEP Accreditation Body
United States (3 Gold, 3 Silver)	DEKRA Certification	ANSI National Accreditation
Canada (2 Platinum, 1 Gold, 3 Silver)	Canadian Welding Bureau	ANSI National Accreditation
South Korea (1 KSEP certification)	Korean Energy Agency	DQS GmbH

Figure 1: SEP certification by country and levels, and the certification and accreditation bodies.

In 2014, 3M developed the new company sustainability goals in accordance with the United Nations Development Goals. There are 15 goals categorized under Raw Materials, Water, Climate & Energy, Health & Safety, and Education & Development. Every year, we publish an annual sustainability report that celebrates our progress and successes towards each of the goals.

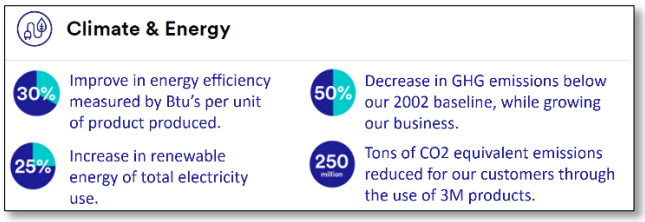

Figure 2: Corporate Sustainability Goals for Climate and Energy

Our corporate energy target is derived from the Climate & Energy sustainability goals (Figure 2); to improve energy performance by 3% annually from our 2015 baseline and applies to each global facility.

"Implementing ISO 50001 and Superior Energy Performance has provided measurable results and raised the visibility of the energy program at 3M."

— Steve Schultz, Corporate Energy Manager, 3M

Business Benefits

With the 30 certified sites combined, we have improved our energy performance by 4.5% during the improvement period of 2016 to 2018.

Cost Estimate – Through learned experiences and adopted metering technologies, the implementation process for the EnMS has been quicker and more cost effective. For our first certification, it took 18 months for implementation whereas now, it takes us 6 months. At any point, we were not acquiring any additional resources.

Implementing costs are estimated to be $63,000 USD per site on average. Generally, $30,000 USD would be spent towards the certification itself and the remaining will be towards internal staff, and metering and monitoring. Recertification occurs every 3 years from initial certification and only requires an external audit. The enterprise-wide certification yielded in up to 77% reduced spending for 3rd party auditing and certification.

Other Benefits – The EnMS system also provides benefits that extend beyond monetary gain. As stated within 3M's Energy Policy, all employees are encouraged to take part in continuous energy improvement activities. ISO 50001 and SEP provides a structured platform to make this possible. Additionally, our customers value and commend our commitment to sustainability, improving customer satisfaction and brand image.

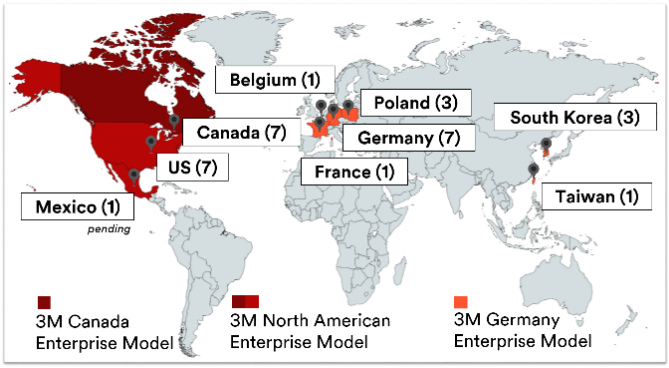

Figure 3: Enterprise Models for ISO 50001 (total 30 sites certified).

Enterprise Advantage – Our focus is to develop a global enterprise model for 3M in the future. Currently, there are three ISO 50001/SEP enterprise models: 3M Canada, 3M (US) and 3M Germany (Figure 3). We are in the works of establishing a North-American enterprise-model that includes the US, Canada and Mexico. 11 additional sites are to be certified next, including 3M Center headquarters and 6 other US sites, 3M Canada headquarters, 2 sites in Singapore, and one plant in Mexico. With the US sites, we will be utilizing the DOE

tool, 50001 Ready as well as utility company incentives to prepare for the ISO 50001 certification audits.

The benefits of our enterprise-model are clear to us:

- Commitment from Senior-Executive Management
- Centralized system for common documents
- Conduct external audits for sampled sites only
- Knowledge shared effectively amongst sites (reduced cost, time and resources)
- Common energy efficiency guidelines for design and procurement

Plan

In early 2000, an energy management system modelled by Georgia Institute of Technology was deployed across 3M sites around the globe. The model included a dedicated corporate energy team coordinating with local energy champions at each facility. Together, they provided awareness training, reward programs, and resources for energy-saving projects, instilling an energy-conscious culture at 3M. At the end of the year, facilities who have met the corporate goals would be recognized with a 3M Global Energy Award. The existing structures became the backbone for ISO 50001 and instituted a rigid energy management system recognized internationally.

Establishing local cross-functional energy teams and third-party resources propelled the implementation process. Metering and monitoring of energy consumption was identified to be a lacking resource, thus, meters for energy sources for each equipment were added along with a human-machine interface software program to view the live data. Metering data identifies significant energy users, inefficient processes, and plant loads. This can be used to operational control, optimization projects and equipment upgrades. For example, in one of our plants creating weekend shutdown checklists realized a reduction in energy use to 5.7% of the peak load, translating to $264,000 USD of energy cost savings for the first year. These impressive numbers in energy savings within each plant fortified Top Management support for energy management.

Once there are identified projects and opportunities for improvement in our energy hopper, we evaluate for feasibility. A project selection scorecard that assesses costs, energy impact, safety and risks, is used to justify projects. Projects must score 25 of the available 42 points. Resources for implementation upon selection are allocated by local facilities. Local utilities and other incentive programs reduces the simple payback period for the facility. Should the energy-related project meet the cost-benefit requirements of the Corporate Sustainability Fund, 3M is able to provide additional support and resources.

From the beginnings of energy management, three things have stayed true to help us achieve our targets:

1. Metering and targeting allows energy to be visible, provides real-time energy information for operating personnel, and pinpoints the areas to focus on.
2. Upgrading to energy-efficient technologies for equipment and processes gives an inherent advantage in saving energy.
3. People are the catalysts to making progress in energy. Our employees who are aware of the energy use around them are motivated to act.

"International standards like ISO 50001 provide a consistent best practice for designing, implementing, measuring, and optimizing your energy management process.."

—Andrew Hejnar, Energy Manger, 3M Canada

Do, Check, Act

Building channels for sharing information and maintain consistent communication ensures that we achieve our corporate sustainability goals. 3M has maintained equal or similar processes and systems for energy management between all our sites.

The Energy Teams – Forming a concrete structure to involve, top management, facility management, and all employees allowed us to coordinate implementation. Figure 4 outlines the key teams involved.

3M reviews its Strategic Energy Management Plan annually to prioritize programs and meet global goals. The plan uses input from stakeholders, including executive management, manufacturing directors, plant managers, and employees. Goals of the plan include to continually improve results, leverage engineering expertise and advances, drive facility-level efficiency improvements, and maintain top management support.

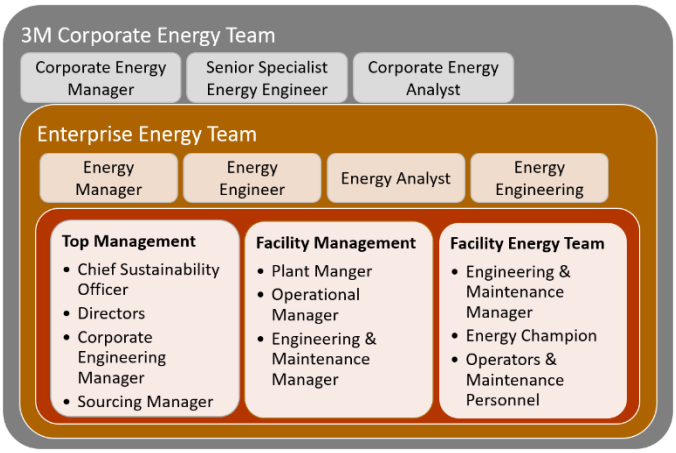

Figure 4: Hierarchical Representation of Energy Management Teams

Energy Performance Derivation and Validation – 3M measures energy performance utilizing three key factors: measured energy use normalized for weather, production and/or occupancy, energy savings from energy projects implemented, and the effectiveness of the EnMS. These factors are included on the energy dashboard for each facility and are part of each facility's management review.

Our baseline year for energy modelling is 2015 with a timeframe of 1 year. The current reporting period is from 2016 to 2018. The modelling software tools provide a top-down verification, while a bottom-up approach is to tabulate savings through completion of action plans and projects. SEP Measurement and Verification Protocol and IPMVP international standard is used to ensure performance has been improved. The effectiveness of the EnMS is measured using an energy program effectiveness survey completed annually by each facility energy team and is substantiated through the supporting ISO certifications. We institutionalize continual improvement in energy management by scheduling "checkpoints" for milestones reached. The EnMS is evaluated during top management reviews, internal audits, quarterly corporate reporting, and monthly team meetings.

Projects and Actions – Most of our energy savings were achieved by performing studies and executing relevant projects. Some examples include:

- Lighting retrofit upgrades to metal halide and high-pressure sodium lights
- Compressor and HVAC equipment optimization plan: upgraded existing infrastructure to energy-efficient technologies
- Installing co-generation systems such as Combined Heat & Power units (Canada, US, Poland)
- Improving the building envelope
- Improve utilization of energy in manufacturing processes
- DC to AC motor conversions and drive upgrades
- Establishing sources for renewable energy (one of the largest solar power systems in Singapore)

Operational Control – Documentation systems such as Corrective Action/Preventative Action (CAPA), the EnMS manual, SharePoint (common online platform), and Standard Operating Procedures (SOP) and associated checklists that guide our energy program with continuous improvement in mind. We strive to induce engineering and administrative controls in addition to energy projects. Examples include ensuring preventative maintenance is compliant for significant energy users (equipment) and establishing 12hr, 24hr and 48hr shutdown checklists for trained personnel.

Communication – Our sites utilize a plethora of avenues to motivate employees, increase awareness and promote engagement. At each facility, there is an employee suggestion system, on-site energy boards, informational cards held within badges, layered process audits, poster campaigns, energy improvement tags, energy treasure hunts, comic-style quarterly energy newsletters, annual Earth Day celebrations, energy fairs,

and lunch-n-learn activities. We provide energy and ISO 50001/SEP awareness training for new employees and site visitors, and refresher training is available for existing employees every two years. Furthermore, the Corporate Energy Team provides online webinars, quarterly newsletters, and energy dashboards to show progress towards our corporate energy goals.

Procurement – Consideration for energy has been integrated in our procurement and sourcing activities. The revised sourcing standard stipulates that 3M is committed to increasing energy and resource efficiency in manufacturing and supply chain. For example, new equipment is required to have metering installed when energy use is expected to exceed thresholds outlined in Figure 5. It is also communicated to our suppliers – available for review on the 3M Supplier Direct website.

Utility	Threshold Criteria
Chilled Water	> 50 TONS
Compressed Air	> 75 SCFM
Natural Gas / LP	400 MBtu / hr
Electrical	35 kW
Steam	900 lbs / hr

Figure 5: Threshold requirements for energy metering

Tools & Resources – It was of benefit to leverage existing corporate tools and resources; including legacy of corporate leadership in sustainability, Management of Change (MOC) processes, ISO 9001 and ISO 14001 systems, and our corporate energy data and project databases. A global enterprise-wide SharePoint system was developed to house the EnMS tools & resources, providing easy access and document control. Each site utilizes the components of the system as needed to integrate with existing procedures and practices, while meeting the requirements of the standard. The following tools and databases have been key in the development of our EnMS: Energy Review and Planning Tool (ERPT), RETScreen Expert platform, Energy Performance Indicator (EnPI) tool, Site Energy Data System (SEDS, Figure 6), and Energy Cost Reduction Projects (ECRP).

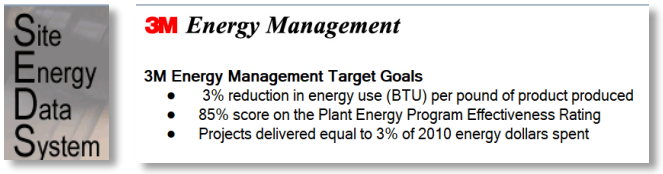

Figure 6: Site Energy Data System (SEDS) is unique to 3M and stores energy data for each 3M location globally.

Transparency

Our Energy Policy is proudly presented at the entrance of our buildings, alongside Quality, Health and Safety, and Environmental policies. It is further communicated during energy team meetings and training packages. As well, our annual sustainability reports are publicly available online.

Our public presence is represented though the numerous awards and organization we have participated in over the year. The following have catalyzed our efforts:

- *Dow Jones Sustainability Index* – 3M selected for inclusion for 19 consecutive years
- *Energy Star* – 10-time *Partner of the Year Sustained Excellence* award from 2004-2014; *Industrial Challenge* participant
- *Carbon Disclosure Project* – ranking A- in climate change for 2016
- *DOE's Better Buildings, Better Plants* – *Challenge Partner* (met partner goals in 2015, established new goals)
- *Pilot program for The Commission for Environmental Cooperation (CEC)* – in collaboration with Natural Resources Canada, Canada Brockville PSD, US Cottage Grove & Mexico SLP sites participated as part of Clean Energy Ministerial
- *Clean Energy Ministerial (CEM)* – Insight Awards
  - 3M Global Energy Management (2017)
  - National Award for 3M Canada (2016)
  - National Award for Korea (2016)
- *German Sustainability Award* Foundation – Award for *Resource Efficiency* (2013), Sustainable Future Strategy (2011)
- *Shanghai Water Affairs Bureau* – Water Saving Enterprises (2017)

- *International Energy Agency (IEA), Asia-Pacific Economic Cooperation (APEC) Energy Workshops, Singapore Manufacturing Federation (SMF) and Singapore National Environment Agency* – guest presentation from 3M to showcase energy management success stories with our key accounts
- *Association of Energy Engineers (AEE)* – founding member of AEE (1977); presented at multiple conferences, reaching large audiences annually

"The enterprise-wide approach has enabled us to learn from the other participating locations and to leverage best practices. Implementation does take management commitment of resources, but the payback in the end is well worth the effort."

— Robin Higgs, 3M Manufacturing Director, Film and Material Resources Division

Lessons Learned

Overcoming obstacles during implementation furthered the penetration of energy management into our business practices. Prior to the implementation of the Energy Management System (EnMS), the local energy management teams faced many challenges. Once the ISO 50001 and SEP standards were set, energy initiatives were prioritized in a systematic way, while keeping business practices in mind. Some of our obstacles and the resolutions include:

- **Limited by available capital –** Energy planning provided clear foresight on initiatives and helped include projects within facility annual budget; top management involvement secured corporate resources through a dedicated Energy and Sustainability Fund
- **Limited priority for energy management –** Top management involvement ensured energy is considered during major business decisions
- **Substantial gains were difficult to maintain** – Metering & targeting technologies and practices put in place to track key performance indicators
- **Lack of granularity for metering and information systems –** 3M global standard revised to require metering for projects above utility consumption thresholds
- **Approach to energy management varied by facility -** Enterprise-model allowed for unified approach through standardizing the energy planning tool and developing document templates

The evolution from a single-facility EnMS to an enterprise-level ISO 50001 system has provided 3M a valuable learning experience. In summary, our key success factors (Figure 7) have helped us not only achieve our energy goals but to gain an exceptional level of expertise to lead the industry to a sustainable future.

Figure 7: Key success factors of ISO 50001 and SEP at 3M.

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.

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