Superior Energy Performance®
U.S. DEPARTMENT OF ENERGY

Case Study
February 2017

Detroit Diesel Saves $37 Million over 10 Years

Daimler's Detroit Diesel Corporation facility in Detroit, Michigan earned Platinum certification to the U.S. Department of Energy's (DOE's) Superior Energy Performance® (SEP™) program. The facility used a rigorous energy management system (EnMS) to meet the requirements of the ISO 50001 standard and saved $37 million over 10 years. Using SEP's robust Measurement and Verification (M&V) protocol to verify its energy performance improvement, the facility improved its energy performance by nearly 33% over 10 years, even as production increased by 93% over the same time span.[1]

Business Benefits Achieved

During the 12 month period following ISO 50001 certification, Detroit Diesel saved $815,000 in annual energy costs, yielding a two-month payback—based solely on operational savings. SEP cost-benefit analyses focused exclusively on savings from changes in operating procedures because those savings can be directly linked to the EnMS implementation investment (mostly staff time and training). While an EnMS will help to identify capital investments that can further improve energy performance, those capital projects have unique scopes and paybacks.

Independent, third-party verification provided corporate management greater confidence in the financial numbers, leading to additional capital funding for future energy projects at the facility and relaxation of the payback period requirements.

Facility Profile

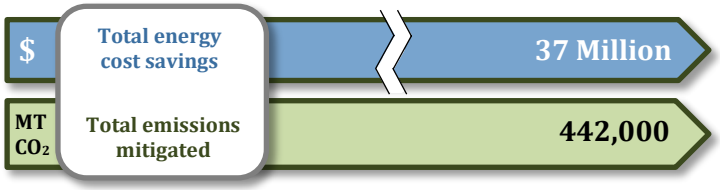
Detroit Diesel's Detroit facility is 3.2 million square feet and employs 3,000 staff to manufacture and assemble diesel engines, axles, transmissions, and

Detroit Diesel was the first U.S.-based Daimler subsidiary to implement ISO 50001 and achieve SEP certification.

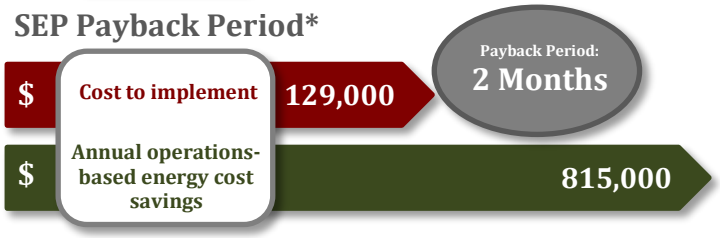
"Investments in energy projects are typically expected to have a payback of 1–2 years. Using SEP to validate what we've saved over the past 10 years [$37 million] gave us credibility. Our management is now much more receptive to investing in 3–5 year payback projects across the facility."

—Del Spooner
Detroit Diesel Technical Services Director

Energy and Emissions Savings (over 10 yrs)



SEP Payback Period*



* SEP marginal payback is based on operational energy cost savings attributable to ISO 50001 and SEP.

[1] "Daimler's Detroit Diesel Plant Earns Superior Energy Performance, Saves $37 million", accessed August 2016.

components for its affiliate, Daimler Trucks North America LLC. The campus includes research and development (R&D) labs, machining, assembly, and engine test equipment.

Business Case for Energy Management

Averaging $3.7 million in annual energy cost savings over 10 years helped the Detroit Diesel facility validate the business case for implementing an EnMS. Over that period, the facility also reduced its CO_2 emissions by over 440,000 tons.[2] Annual, operational no cost/low cost savings attributable to ISO 50001 and SEP totaled $815,000. Detroit Diesel's results demonstrate that even mature facilities with a history of leadership in environmental management and energy-related projects can reap considerable benefits from an energy management system.

Mature Energy Plants: Detroit Diesel achieved business benefits, despite its long track record of energy-efficient operations.

Meeting Corporate Sustainability Goals

SEP certification helps Detroit Diesel meet and surpass its broader corporate goals for energy efficiency and carbon emissions. In 2015, production-related CO_2 emissions were reduced by 20% per vehicle in all divisions, compared to 2007. Building on this success, Detroit Diesel set a goal to reduce energy consumption 2% per year–compared to the reference year 2010–for a total of 20% by 2020.[3] The facility's EnMS will help ensure that energy and carbon savings persist forward to meet the 2020 targets.

Public Recognition and Regulatory Benefits

Detroit Diesel's senior management is pleased to participate in recognition and awards programs such as SEP that provide financial and other benefits. After achieving ISO 50001 and SEP certification, Detroit Diesel received the global "Environmental Leadership Award" from Daimler and the "Michigan Green Leader Award" from the *Detroit Free Press*. Detroit Diesel became the first Daimler subsidiary in the United States to implement ISO 50001 and achieve SEP certification.

In addition, the State of Michigan recognized Detroit Diesel Corporation as a Michigan Clean Corporate Citizen (C3). The C3 program publicly acknowledges regulated establishments that reliably demonstrate environmental stewardship without requiring rigorous oversight. Organizations with C3 status receive certain regulatory benefits, including greater permitting flexibility and expedited processing.

"Since we were able to quantify [energy savings and energy saving opportunities], it got the attention from not only me, but my boss and all of the top management in Germany…this has opened doors for us."

—Jeff Allen
Detroit Diesel Plant Manager

EnMS Development and Implementation

The defined scope of Detroit Diesel's EnMS covers the entire campus, including R&D labs; machining; assembly equipment for engines, axles, and truck transmissions; and engine test devices, such as AC dynamometers.

Top management appointed an Energy Advisor and an Energy Manager in March 2014 to form an Energy Management Team. Daimler sent a corporate energy management specialist from Germany to assist the Detroit facility with implementation.

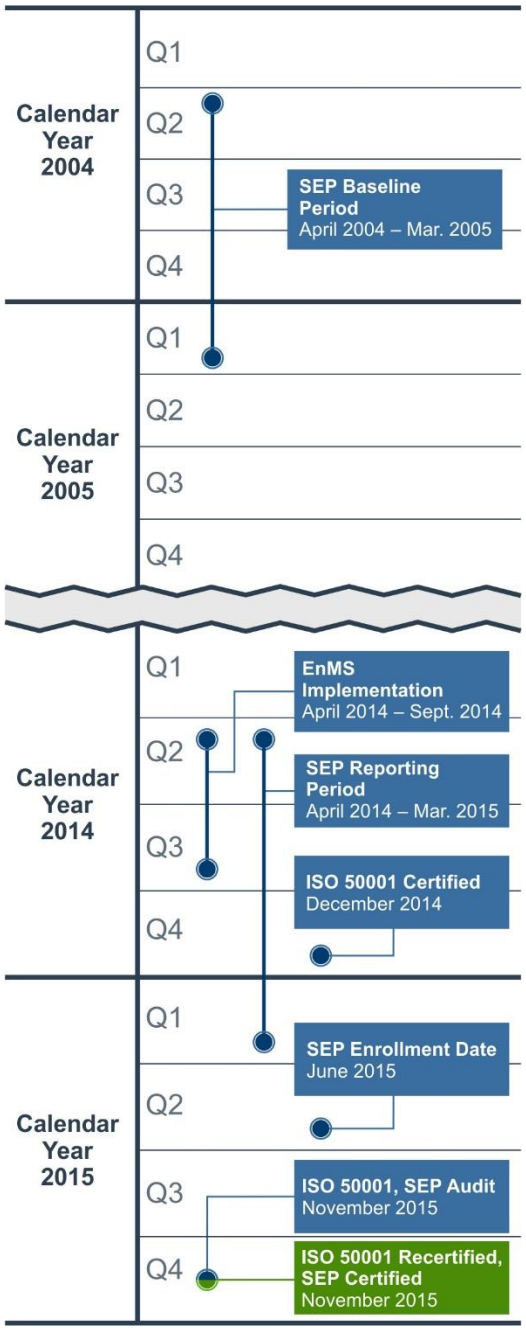
[2] "Daimler's Detroit Diesel Plant Earns Superior Energy Performance, Saves $37 million", accessed August 2016.

[3] Clean Energy Ministerial Case Study: Detroit Diesel (2016), accessed August 2016.

EnMS Rollout

Following ISO 50001 guidance, the Energy Management Team developed clear roles and responsibilities, performed a gap analysis, identified significant energy uses (SEUs), and integrated each element into the EnMS. German colleagues with ISO 50001 expertise also helped with defining and implementing the EnMS.

Detroit Facility SEP Certification Timeline



The facility's lean manufacturing process, Truck Operating System (TOS), is based on Kaizen principles and embodies a philosophy of continuous improvement of work practices. Supported by the plant's Six Sigma trained specialists, TOS enables Detroit Diesel to efficiently maintain and improve its EnMS.

Detroit Diesel staff started the EnMS implementation in April 2014 and became ISO 50001 certified in December of that year. The facility then earned ISO 50001 recertification to meet the requirements for SEP certification, achieving both in November of 2015 (see timeline at left).

Leveraging Experience with ISO 14001

Daimler staff were experienced with ISO management system standards, as the company's production facilities worldwide are certified to the ISO 14001 Environmental Management System (EMS) standard and 22 locations in Germany are certified to ISO 50001.

> **Previous ISO Experience:** The Detroit facility was already certified to ISO 14001 and ISO 9001. Implementation of ISO 50001 was similar to ISO 14001 and assimilated seamlessly.

The facility's ISO 14001-certified EMS was extremely useful. Staff leveraged the existing ISO 14001 framework, including existing databases, management systems, and internal audit procedures to streamline the EnMS implementation process. Expertise and experience with ISO 14001 enabled a smooth integration of ISO 50001 into existing management systems and organizational processes, seamlessly "blending" together the two management systems. Plant staff combined the ISO 50001 EnMS measures and the ISO 14001 EMS measures into a

single database for efficiently tracking all aspects of environmental and energy performance.

Metering Infrastructure

Detroit Diesel significantly expanded its infrastructure for monitoring energy use by individual processes or pieces of equipment. The plant more than doubled the number of meters in use. It now has 120 WiFi meters, and meters are routinely placed on all new machines. Prior to participating in SEP, the staff would simply monitor the utility meters. Now, extensive sub-metering provides facility managers and staff with in-depth information on energy use by individual systems and processes throughout the facility.

Energy Profile

To measure and track improvements achieved across the facility, Detroit Diesel used DOE's Energy Performance Indicator (EnPI) tool to model plant-wide energy consumption. Plant staff used the tool to track energy performance and attribute energy consumption to specific energy-consuming processes in the plant. Facility personnel then developed historical energy performance indicators for the Detroit facility, as required for SEP certification.

Plant staff identified the boiler room and an engineering laboratory as the top energy consumers. Using the EnPI tool, they identified significant potential for improved energy performance.

Achieving ISO 50001 and SEP Certification

Internal and Third-Party Audits

Detroit Diesel sought both domestic and international support to prepare for third-party verification. A consultant from PHI, an environmental consulting company, and colleagues from Germany conducted internal audits and provided guidance and support. This combined support helped to ensure adherence to ISO 50001 and SEP.

Internal audits for ISO 14001 and ISO 50001 were conducted jointly. This approach enabled plant staff to also conduct a gap analysis of the SEUs and conform to other ISO 50001 and SEP requirements. Detroit Diesel hired the SEP Verification Body, DEKRA, to conduct the third-party verification to determine if SEP certification requirements were met.

"Not only is our Superior Energy Performance important to the environment, but any opportunity for us to conserve directly affects the bottom line. The money we saved, $37 million, can be reinvested in the plant to create more jobs for the people here in Detroit."

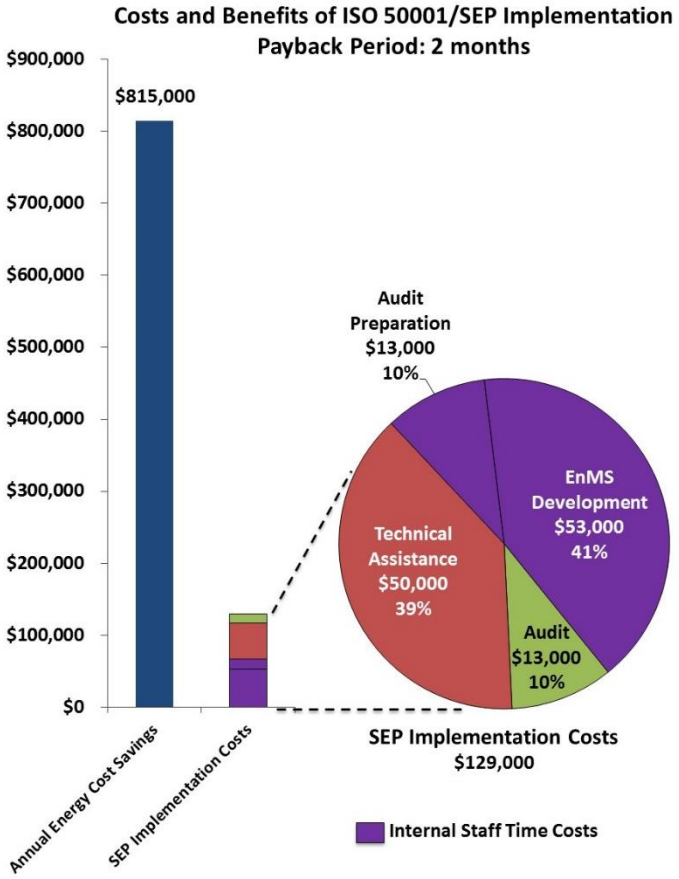
—Jeff Allen
Detroit Diesel Plant Manager

Evaluating the Costs and Benefits of Implementing SEP

Following the SEP certification, a detailed analysis quantified the costs and benefits associated with implementing SEP/ISO 50001 at the Detroit Diesel plant. The results show that the $129,000 investment in implementing the EnMS and related technical assistance is yielding savings of $815,000 per year, and provided full payback in just two months.

As shown in the pie chart (see figure on the next page), this analysis considers four categories of program implementation costs:

- Internal, supplemental staff time spent on developing and implementing the EnMS
- Internal staff time spent preparing for the SEP/ISO 50001 audits
- Technical assistance for EnMS implementation
- The third-party audit



To evaluate the impacts of energy efficiency measures, energy consumption levels during the baseline period (April 2004-March 2005) and the SEP reporting period (April 2014-March 2015) were normalized to account for variations in production and weather conditions during the model year (see timeline for SEP certification on page 3). Energy and cost savings were then calculated using utility data.

Detroit Diesel's experience with ISO standards helped limit the cost for internal staff time to develop and implement the ISO 50001 EnMS and prepare for the SEP/ISO 50001 audits. Internal staff time costs totaled $67,000 after rounding.

Barriers

Internal Staff Effort

Despite familiarity with management systems such as ISO 14001, considerable internal staff time was required to stand up the EnMS and properly establish all the necessary documentation and operational procedures. The validated savings helped justify the investment, but executing tasks to implement the EnMS proved more resource-intensive than anticipated. Detroit Diesel staff noted that the process would have been smoother if additional personnel had been assigned to assist with the ISO 50001 and SEP implementation and certification processes.

Competing for Internal Resources with Non-Energy Projects

Daimler and Detroit Diesel's management understands the value of energy efficiency improvements, yet the company has limited internal resources to devote to such projects. This means that the EnMS implementation, ISO 50001 and SEP certification, and energy efficiency projects must compete with funding for other important business priorities, e.g., quality, environmental performance, et al. Transforming the culture and convincing plant management to invest in energy efficiency became less of a barrier as the program became more robust and was able to demonstrate verified savings.

As a required component of the implementation of ISO 50001 and SEP, a management representative was established as the dedicated energy manager. This facility energy manager effectively elevated energy management as a priority issue for senior leadership.

Lessons Learned

An EnMS Raises Awareness of Energy Use

The EnMS helps plant personnel understand the impact of their actions on energy performance. Detroit Diesel's staff now provide monthly reports to senior management on plant energy performance, further engaging executives and providing visibility into the energy performance achievements of the facility. In addition, Detroit Diesel added an environmental and energy component to its new hire orientation, conducts energy awareness training, and communicates environmental and energy-related issues internally.

Robust Metering Improves Decision-Making

Installation of additional meters enables more accurate accounting of the results of energy conservation measures, which better informs decision-making. The facility's metering infrastructure also provides more precise tracking of energy consumption by SEUs and other equipment in the facility.

EnPI Tool Communicates Benefits to Stakeholders

The DOE's EnPI tool provides a top-down approach to measuring energy performance. When combined with bottom-up process- or equipment-specific "sanity" checks, it helps verify overall energy savings reported to management. Detroit Diesel's experience specifically highlights the importance of relating energy saving actions to cost reductions that directly affect the bottom line of the business.

Build Confidence for Future Investments: SEP provides independent validation of energy savings and helps build confidence for management to proceed with future investments in energy efficiency measures.

Plant staff cited the quantification of results as a unique benefit of the SEP program. Furthermore, the processes implemented as part of the EnMS have drawn more attention to the SEUs and reports regularly generated summarizing boiler efficiency and diesel fuel consumption. Though the plant produced these reports before ISO 50001 and SEP certification were achieved, they were not closely reviewed and acted upon. Now these reports prompt inquiries from plant staff and are more actively monitored, leading to increased awareness and improved operational effectiveness at the plant.

SEP Participation Strengthens Collaboration

Detroit Diesel's collaboration with German colleagues and borrowing energy management specialists from Daimler's European operations facilitated information exchange and strengthened relations among the business units. Daimler management was so impressed with the Detroit facility's success that the company now aims to replicate ISO 50001 and SEP activities and successes at German plants and other Daimler Trucks North America facilities.