

Global Energy Management System Implementation: Case Study

United States of America

Detroit Diesel Corp.

U.S. Dept. of Energy, SEP Platinum Certified



Power to Drive, Passion to Move

Business Benefits Achieved

Detroit Diesel (Detroit) wanted to be the leader in Energy Efficiency in Daimler Trucks outside of Germany. We pioneered new ground in setting up an Energy Management System (EnMS) that would not only improve our energy conservation efforts but reduce our Greenhouse Gas (GHG) emissions.

Our goal was to develop our own EnMS, based on established energy conservation standards and to achieve this by September 2014. The EnMS would allow us to increase energy savings, reduce GHG emissions and improve employee energy conservation awareness. By December 2014, we became ISO 50001 certified, the first Daimler Trucks facility to do so outside of Germany.

In early 2015, we made the decision to submit an application to receive the Superior Energy Performance (SEP) certification from the U.S. Department of Energy (DOE). SEP has 2 pathways, the performance (3 years) or the mature (10 years) pathways; therefore, with Detroit's long history of energy improvements we decided to take the mature pathway. According to SEP standards, because our ISO 50001 certification year was 2014, our baseline was set at 2004.

Detroit Diesel Corporation

Industry	Automotive
Location	Detroit
Energy Management System	ISO 50001
Product/Service	Diesel Powertrain
Energy Performance Improvement (%)	32.5 % (Mature Pathway)
Annual energy cost savings	\$ 3.7 Million
Cost to implement	\$ 30,000 (ISO 50001)
Payback period	2 years

As a result of the SEP "Platinum" certification, Detroit has achieved the following goals over the past 10 years:

- \$ 37,000,000 in cost savings
- 32.5% increase in energy efficiency
- 93% increase in production
- 9% reduction in electricity
- 41% reduction in natural gas
- 35% reduction in diesel fuel
- 84% reduction in Greenhouse Gas
- 81% reduction in air emissions
- 10% reduction in water consumption
- 460,000 sq. ft. of Roof replacement with ASHRAE 24 rated high Energy efficiency insulation (saving 6,145,000 kWh)
- 570 roof-top double layered Energy efficient windows were installed to add more natural light into the poorly lighted production area.
- 50 % light fixtures were replaced with LED lighting. Replaced 2,000 high pressure sodium lighting fixtures with 1600 LED lighting fixtures in the area of 387,000 sq. ft., resulted in an increase of 10 foot candles and (saving 200,600 kWh/year) and improved the visibility for better working conditions.

After achieving ISO 50001, Detroit received the global "Environmental Leadership Award" from Daimler AG and the "Michigan Green Leader Award" from The Free Press.

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Additional efforts were made to improve employee working conditions by replacing existing HVAC system which resulted in improved air quality in offices and plant areas.

“I can highly recommend implementation of an EnMS ISO 50001/SEP. It is painless!!”

—Jeff Allen, Plant Manager

Energy Performance Improvement

In order to verify internal results Detroit used the DOE's Superior Energy Program. The DOE's Energy Performance Indicator (EnPI) Tool showed the following results. (See chart below)

DOE – SEP EnPI Tool	2004	2014
Actual Electricity (MMBTU)	1,203,451	1,192,459
Actual Natural Gas (MMBTU)	555,861	303,052
Actual Diesel (MMBTU)	229,729	299,163
TOTAL (MMBTU)	1,989,041	1,794,674
Adjustment Method	Chaining	Chaining
Modeled Electricity (MMBTU)	939,261	1,180,930
Electricity (MMBTU) Annual Savings	0	-11,529
Modeled Natural Gas (MMBTU)	305,817	323,174
Natural Gas (MMBTU) Annual Savings	0	20,122
Modeled Diesel (MMBTU)	132,534	337,092
Diesel (MMBTU) Annual Savings	0	37,929
Total Modeled Energy Consumption (MMBTU)	1,377,613	1,841,196
EnPI Cumulative	0.693	0.675
Cumulative Improvement (%)	0.00%	32.49%
Annual Improvement (%)	0.00%	1.03%
Annual Savings (MMBTU/year)	0	46,522
Cumulative Savings (MMBTU)	0	4,205,189

While increasing production by 93%, Detroit was able to improve cumulative Energy performance by **32.49%**. The SEP model used 2004 as a baseline year to 2014. The overall achievements are as followed:

- 6,402,963.93 MMBTU
- \$37,311,557.81
- 442,381.02 tons of CO2 avoidance

This equates to an annual reduction of:

- 115,157 MMBtu Electricity
- 222,247 MMBtu Natural Gas
- 134,480 MMBtu Diesel
- 29,100 tons of CO2 emissions avoidance

All results were validated by DEKRA, a DOE approved certification body, in November 2015.

“The lean initiatives have made Daimler AG competitive and our continued focus will position Daimler AG for even further growth. Congratulations to the entire team!”

—Thomas Weber, Chief Technology Officer Daimler AG,



This Is Detroit

A New Name for a New Era

For over 75 years, we have designed and built the heavy-duty engines that fuel commerce and transportation across North America and around the world. Our history is the foundation we build on today. This 3.2 million sq. ft. facility in the heart of Detroit employs 3,400 full time employees.

These days, our business is stronger than ever and headed in even more powerful directions. Our engines drive a wide range of heavy-duty vehicles, and now we're offering our own line of axles and transmissions built with the same precise engineering and rock-solid durability you expect from our engines. Detroit is a full Diesel Powertrain facility.

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Our engineers are pioneering new innovative technologies that preserve our environment and we're offering helpful and convenient services like Detroit Virtual Technician to keep your business running easily and efficiently. Over the next year, we'll be rolling out some amazing additional components in our product line, so keep up: we're running fast and hard.

We believe our new direction deserves a name that recalls our strong past at the heart of American manufacturing, and points the way to our industry-leading future. We're proud to be part of the rebirth currently taking place in one of America's greatest cities. So from now on, you can call us simply:

"Detroit. Hard-working. Confident. Tough. Detroit."

To those who say American manufacturing is dead, we say: look again. The Motor City is revved up and ready to roll. We're forging new paths, setting our sights on new destinations, and hiring new people to join our teams. From the trillions of pounds of cargo stocking store shelves, to the millions of schoolchildren driven to school on time, to emergency vehicles saving millions of lives, we are powered by Detroit. Just look under the hood. And then look inside the chassis. We're putting it all together to work harder for you.

Business Case for Energy Management

Top management committed to save 20% of their overall energy consumption by 2020, as a result of the increased competitiveness in the global market. This goal is based on 2010 energy consumption which results in an annual goal of 2% energy reduction per year. It is Detroit's commitment to our customers and our community to provide the most fuel efficient, clean running engine on the market. In partnership with the US Environmental Protection Agency (EPA), Detroit has invested and developed fuel efficient state of the art diesel engine technologies. Each engine is tested and validated on site, using these new technologies our fuel consumption has dramatically decreased.

In addition, our energy provider DTE has offered incentives to implement energy efficient technologies into the facility. Energy has always been part of the ISO 14001 program. To meet our energy goals, required a more energy focused management program.

"This certification and accomplishment is another tremendous milestone in our journey to be the most energy efficient facility within the Daimler network. In fact, we are the first Daimler facility in North America (including all car, bus and truck facilities) to earn this achievement and I want to thank all parties that were involved. The Detroit team continues to strive for accepting nothing but the best!"

-Juergen Tirann, Head of Energy Management in Daimler Truck Powertrain

Keys to Success

In order to successfully achieve our goals, Detroit management decided to appoint an Energy Advisor and an Energy Manager. To further assist in this endeavor, the EnMS program was integrated into our ISO 14001 system. This allowed us to build upon our successful Environmental Management program tools (e.g. online training, workshops and database) and by September 2014, Detroit had a complete EMS/EnMS up and running.

Key factors which lead to the success of the ISO 50001 program at Detroit were the following:

- Upper management commitment
- Top down communication
- Effective training program
- Integration of ISO 50001 into existing ISO 14001
- Strong experienced plant wide energy team
- Employee involvement
- Share achievements and appreciation
- Teamwork
- Energy awareness culture



Jeff Allen, Plant Manager with Paul Scheihing DOE Rep.

EnMS Development and Implementation

Top management appointed an Energy Advisor and an Energy Manager in March 2014 to form an Energy Management Team. This team was tasked to develop an effective EnMS, based on established energy conservation standards by September 2014, an aggressive 6 month time frame. The EnMS would allow us to increase energy savings by focusing on energy efficiency projects. The success of the EnMS program, took us one step further becoming ISO 50001 certified by December 2014.

The energy expert team, the Detroit Conserves Group (DCG), is a group of mechanical, electrical, energy and environmental engineers. The DCG conducts weekly energy saving meetings and reviews energy usage mapping to determine energy projects. Energy management software was purchased to develop energy maps, flowcharts and track high demand users.

The first DCG energy project, started in April 2014, was to improve energy efficiency by 10% in the Heavy Duty Engine (HDE) Head Machining Line, a significant energy usage process. This project was so successful; it resulted in a 25.3% reduction in energy usage. DCG's second energy project, started in June, was to improve energy efficiency by 10% in the HDE Block Machining Line. We attained 18.4 % reduction in energy usage.

By July 2014, a first of its kind, an internal web-based Energy & Environmental Database was launched and made available to employees. To enhance employee communications, we created the "Green Corner" story boards in the plant providing key energy information to employees. To sustain the effectiveness of our EnMS, new energy and environmental standards for lighting, air handling, heating and cooling were established. Key Performance Indicators (KPIs) were developed based on ISO 50001 standards to compare our success with other industrial leaders and our sister plants in Germany. In September 2014, Detroit Diesel passed the Daimler internal EnMS Audit. In December 2014, we successfully passed the ISO 50001 certification audit. This is the first ISO 50001 certified Daimler Trucks facility in the USA. Also, we are one of the top 20 automotive certified manufacturers in the USA.



Energy team presenting to DOE representative

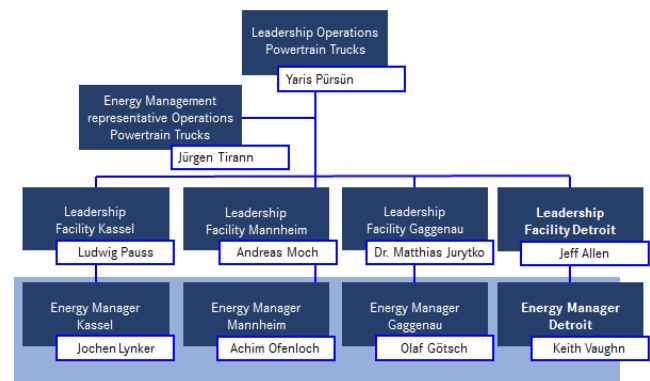
Organization and Roles Responsibilities

Daimler Trucks Organization EnMS

DAIMLER



Operations Powertrain Trucks



Daimler Trucks Roles and Responsibilities

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Roles and Responsibilities of Energy Management Officer Operations Powertrain Trucks

- Head of cross-plant energy team (= Energy Manager of the four sites Kassel, Mannheim, Gaggenau and Detroit)
- Communication interface between the Head of Operations Powertrain Trucks and the Steering Committees of the four sites Kassel, Mannheim, Gaggenau, Detroit
- Responsible for the energy management program of Operations Powertrain Trucks and translation to site-specific goals
- Authorized representative of the Head of Operations Powertrain Trucks for the implementation of defined strategic and operational goals at the sites in compliance with energy policy
- Responsible for know-how dialog between the sites
- Definition and implementation of unified energy efficiency standards at all the sites
- Definition of unified management processes in collaboration with the energy managers of the sites
- Reporting of the results of the sites to the Head of Operations Powertrain Trucks
- Conducting cross-site management reviews

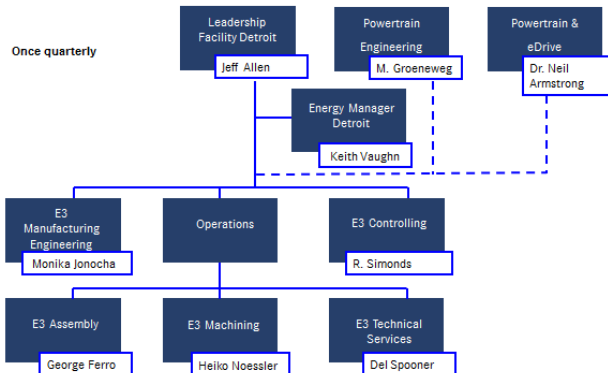
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Detroit Organization EnMS

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Detroit



Cross Functional Roles and Responsibilities

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Roles and Responsibilities of Energy Managers

- Advising the steering committee on all energy-related issues
- Leading the experts committee
- Creation of an energy action plan of approved actions (e.g. expert projects) including time schedule.
- Specialized support of the project leader responsible for the action
- Issuing requirements to the expert team for data collection and monitoring
- Organizing, preparing and conducting internal and external energy management audits
- Creation and evaluation of energy reports for steering committee
- Creation of a commercial and technical decision-making basis for steering committee and presentation of energy saving recommendations for steering committee
- Documentation of the energy management system
- Creation of suitable actions for increasing awareness, capabilities, and motivation for energy savings
- Drawing steering committee's attention to progress and results
- Creation and distribution of regular energy reports for the production departments and site management
- Creation and documentation of an energy forecast (OP process)

"Thank you to all those involved in developing such an award-winning Energy Management program"

-Jeff Allen, Plant Manager

Detroit Roles and Responsibilities

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Roles and Responsibilities of Energy Management Steering Committee

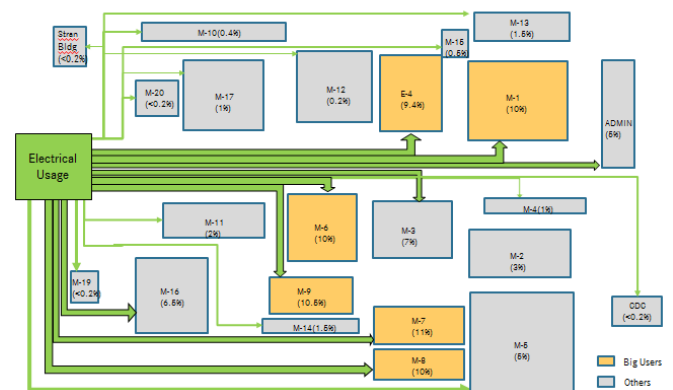
- Specification and approval of energy policy for the site in order to achieve improved energy-related performance in compliance with Group policy (submitted by energy managers)
- Introduction and maintenance of energy policy at the site
- Specification of strategic goals in compliance with energy policy
- Ensuring the availability of required resources for the introduction, realization, maintenance, and improvement of the energy management system (e.g. personnel, special capabilities, technical and financial resources)
- Appointment of the energy manager and providing him with tasks, authorities, and responsibilities
- Approval of validated operational key indicators for evaluating the energy-related performance of the site
- Checking the energy management system by conducting a management review based on required internal system audits and performance audits
- Consenting to the appointment of an interdisciplinary energy team (= expert team)
- Approval of the energy-related operational procedures defined by the expert team
- Approval of energy efficiency actions (expert projects) – approval of actions and specification of responsibilities (project leader)
- Ensuring legal conformity of the site

Energy review and planning

To build a successful and stable EnMS it must have a solid foundation. Analyzation of energy usage was Detroit's first step. To accomplish this, meters had to be installed throughout the facility which allowed us to visualize how energy (Electricity, Natural Gas, Diesel) flows through the plant. The energy map enabled us to identify significant energy users and to prioritize our efforts.

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Energy Map - Electricity

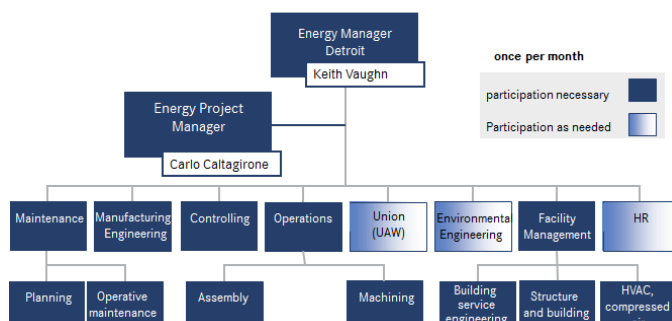


Detroit implemented Kaizen tools (TOS = Truck Operating System) to help us create standardized procedures, visualization and methods. Tools included: Waterfall, Gant, Sankey diagrams, line and bar graphs.

Cross Functional Organization EnMS

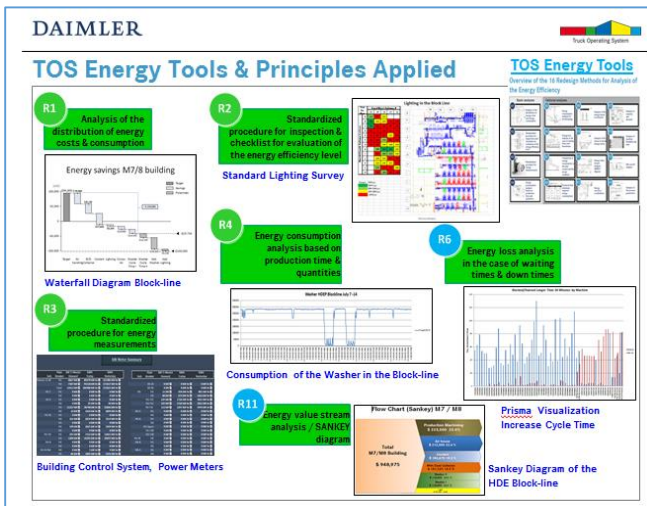
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Deep dive topic: Installation of Energy Management System Interdisciplinary Expert Circle (operative functions) - Detroit

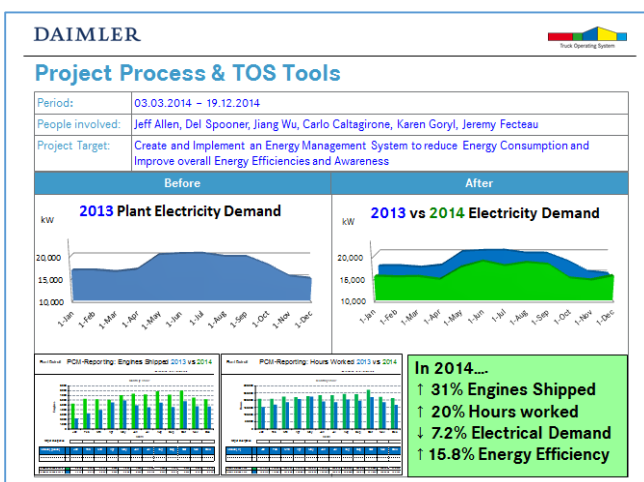
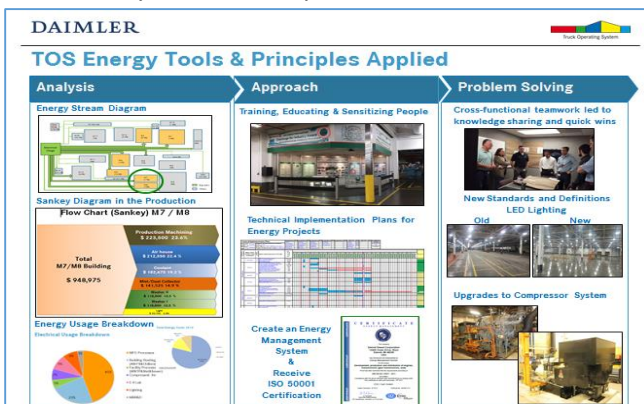


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To approach energy reduction, Significant Energy Users (SEU) was identified on a machine level using a Sankey diagram. The Cross Functional Energy Team brainstormed ideas on how to reduce the energy usage of the SEU. Energy reduction projects with a payback of less than 2 years were implemented.



Project visualization to upper management

Key Performance Indicator (KPI)

KPIs were developed as global standards to track performance to goals. Our KPIs are based on energy used (kWh) per hours worked to standardize measurements for different processes / products.

Development of Expertise and Communications

ISO 50001 Internal Auditor training was provided to plant personnel to increase internal expertise. To lead these auditors a Certified Energy Manager (CEM) was appointed and trained by the Association of Energy Engineers (AEE). Logistical support was provided by an experienced ISO 50001 contractor and corporate Daimler AG.

Employees training and communication consist of: e-learning, new hire orientation, visual aids (using monitors, brochures, good 2 know articles, energy communication talks and Desktop Alerts).

To further enhance our presence monthly plant management meetings are held at the Green Corner, an in plant communication and meeting area, located along the main aisle way in the heart of the plant. These monthly meeting reinforces to all employees top management's commitment to energy sustainability. In July 2014, a first of its kind, internal web-based Energy & Environmental Database was developed and made available to employees online. This database includes Detroit's Energy policy and the complete EnMS.



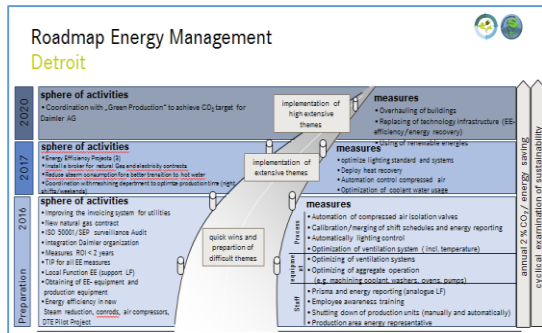
Green Corner

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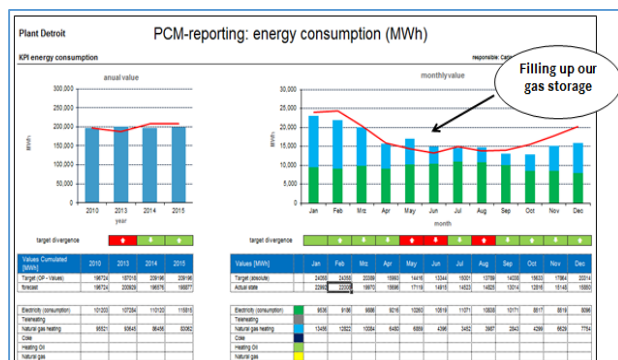
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Tools and Resources

The EnMS Program requires tools to maintain continuous improvement and sustainability. To achieve this we developed a roadmap for energy management.



These are a few of the tools we use to maintain a high level of sustainability in our energy management processes.



Natural Gas Storage Management

We purchase natural gas during the summer (lower Nymex price) to fill up our natural gas storage bank. This bank allows us to use stored natural gas during high peak demands.

"Natural Gas Storage is something each facility should do to lower the natural gas demand on peak times".

-Steve Dunning, Chief Auditor at DEKRA

Detroit's commitment to sustainability started in 1996 introducing the ISO 14001. As part of the ISO 14001, the system addressed conservation of natural resources. Using the Plan, Do, Check, Act, philosophy we introduced a databased that encompassed all environmental and energy aspects. Our lean manufacturing process is based on Kaizen principles which we have named TOS. It allows us to improve and maintain our EnMS in an efficient way. This is supported by our six sigma trained specialists. In cooperation with our local electricity provider (DTE) we were able to implement these successful projects included compressed air leak detection, facility lighting study, financial incentives for implementing energy projects.

Maintain Operational Control

In order to maintain operational control and sustain energy performance improvement we perform the following tasks:

- ISO 50001 audits both internal & external
- Appropriate corrective actions request for findings
- Monthly KPIs review with plant management
- Introduce standard work instructions (SWI)
- Conduct periodic training for all employees
- Quarterly reports to corporate management

To determine improvements in energy performance we verify our results using the following data:

- Energy meters readings, billings, data correlation with KPI, and compare energy usage with production output
- Apply SEP EnPI tool to validate performance and cost reductions

To track our progress towards our energy programs and goals, we use the technical implementation plan to provide management a monthly update on progress to meet our targets. If it is determined that set goals are underperforming, top management provides additional support and direction to ensure targets are met.

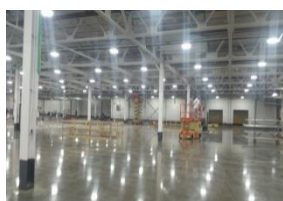
Prior to audit, management reviews are conducted and the audit is scheduled with the 3rd party auditor. This ensures top management support and awareness of our energy processes. Additional training is provided to all personal prior to the EnMS 3rd party audit.

Corporate Energy Guidelines

Corporate guidelines require a return on investment of 2 years. These projects are funded through the annual energy budget with approval from management. Projects with a payback of more than 2 years will require top management approval. Larger projects such as infrastructure improvements (e.g. roof replacements, chiller replacement and HVAC systems) are part of our long term plans and funding is allocated accordingly.

“Making a positive impact on our environment doesn’t just come from creating initiatives, it comes when every employee finds ways to recycle and conserve in his or her own workspace and the ISO 50001 certification reflects that!”

- Del Spooner, Director of Technical Services



Transmissions Before/After energy efficiency upgrades

Lessons Learned

So what are the barriers to success? It’s the same old cliché you hear everywhere, “We have always done it like that.” So how do we change this mindset? We believe it requires good planning, to demonstrate excellent results and gain full support from Top Management. We all agree that it is very challenging to take attention from the production floor. To get funding commitment from top management for energy conservation requires a good Return on Investment (ROI). Another barrier is the low energy price in the U.S. This has increased the ROI to 3-5 years for all energy projects, which makes it very difficult to meet the 2-year corporate target.

Finding a local ISO 50001 / SEP certification registrar was difficult. Therefore, this required Detroit to use DEKRA.

The Energy improvements at our washers and the one of a kind “Green Corner” has been accepted by Daimler Trucks Kassel as a “Best Practice”. After we successfully demonstrated our energy project savings, Top Management became much more supportive. Our Energy and Environmental Database, eLearning, awareness brochure, pocket card, and notification boards were greatly accepted by Daimler Trucks and will be used as templates for their EnMS.

During the 2016 annual Top management review this information was provided to other Daimler Trucks North American facilities to encourage them to adopt the ISO 50001 standard.

“The lean initiatives have made Detroit competitive and our continued focus will position Detroit for even further growth.”

-Jeff Allen, Plant Manager



Detroit’s Energy Management Team

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.

