

# Conveyor Belt to Energy Savings

adidas Group's efficiency strategy for Material Handling Equipment

“Reducing first costs during design won't optimize efficiency and cost over the long term. The adidas Group is now modeling and comparing lifecycle cost of material handling equipment (MHE) and holding vendors to high standards for energy management.”

*Eric Shrago, EDF Climate Corps 2014 fellow at adidas Group*

## A Lifecycle Cost approach to Material Handling Equipment yields nice rewards for distribution centers.

### Summary

The adidas Group enlisted EDF Climate Corps fellow Eric Shrago to investigate energy efficiency opportunities in their distribution facilities. From his observations, the adidas Group created a set of guidelines for new distribution center construction. While every distribution center is different, Eric's findings have relevance across the warehousing and logistics industry; even small improvements can have significant carbon and cost reductions at scale. The adidas Group is applying these practices across their 15 million square feet of owned and leased distribution space globally, and sharing key practices with their contract logistics providers around the world.

**The adidas Group** is a global leader in the sporting goods industry, offering a broad portfolio of footwear, apparel and hardware for sport and lifestyle around the core brands adidas, Reebok, TaylorMade, Rockport and Reebok-CCM Hockey. Headquartered in Herzogenaurach/Germany, the Group employs more than 50,000 people across the globe and generated sales of € 14.5 billion in 2013.

**Environmental Defense Fund (EDF)**, a leading international nonprofit organization, creates transformational solutions to the most serious environmental problems. EDF links science, economics, law and innovative private-sector partnerships.

**Climate Corps** is EDF's innovative summer fellowship program that places specially trained graduate students within organizations as dedicated environmental problem solvers. Having worked with over 300 organizations since 2008, Climate Corps has launched a series of case studies called Scalable Solutions highlighting best practices in energy management.





### The Story

adidas Group's greenENERGY Fund wanted to dig deeper to investigate energy-efficiency opportunities in their approximately 15 million square feet of owned or leased distribution space. Previously, the greenENERGY Fund had made investments in lighting, building automation, controls and ventilation, and it was time to tackle what can be the largest and most complex energy user in a distribution center: the Material Handling Equipment (MHE). They partnered with Environmental Defense Fund's Climate Corps program to address two questions:

- 1) What, if any, opportunities exist to improve the efficiency of the existing MHE?
- 2) What should the guidelines be for new distribution center (DC) construction?

EDF Climate Corps fellow Eric Shrago, from Columbia University, led the investigation using the adidas Group's Spartanburg, South Carolina DC as a case study.

### Eric's Target Areas

#### Motor Efficiency

Eric determined that the most effective place to start was by looking at the efficiency of the motors that drive the belts. He found that there would be energy savings from upgrading the motors, but at Spartanburg's electricity rate of \$0.08/kWh, the

value of the energy savings over the life of the new motor did not justify a proactive retrofit. That said, when a motor failed, replacing it with a "premium efficiency" motor would pay back in approximately 2 years.

#### Belts & Rollers

Eric then looked into the different types of belts. Spartanburg mostly has "roller belts," a more efficient belt type than "slide belts," which have increased resistance. However, the most efficient conveyor is the "Motor Driven Roller" (MDR). These systems have no belt, but have a motor embedded inside the lead roller. Each roller only runs when triggered by a sensor, and the motor is not damaged by frequent on/off cycling. Most MDR installations shut down after seven seconds of inactivity. While there is a cost premium for MDR up-front, there is considerable electricity and maintenance savings over the life of the equipment. Additionally, MDR costs have fallen over the last decade. Based on Eric's analysis, adidas Group will specify more MDR in

#### About Spartanburg

adidas Group's Spartanburg DC is 2 million square feet and sorts and ships 200,000 items of apparel, shoes and sports equipment daily. There are more than three miles of conveyor belts powered by 1,600 motors in addition to two Sorters. The site is considered "semi-automated" and spends almost half of their electricity bill to operate MHE Equipment.

future DCs. In many applications, the additional upfront costs are offset by energy savings.

### **Runtime**

Next, Eric investigated whether it might be possible to minimize the runtime of the various belts. He found that, in general, the MHE was running more than necessary and that several belts run nonstop. For example, belts for Trash and Corrugate Supply run continuously. By setting these belts to run half of the time (e.g., running a complete revolution of 15 minutes to clear all of the trash on the belt, and then turning the belt off for 15 minutes), Eric estimated that the facility could see energy savings of up to one third. There would also be additional maintenance savings from reduced motor runtime and extended equipment life.

### **Sensors**

Photometric and weight sensors automatically shut off sections of MHE after periods of inactivity. In Spartanburg, Eric found that most of the motors were already linked to photo eyes. He was able to identify a few locations that needed additional sensors in order to maximize off time, but this was not a significant source of savings.

### **Controls**

Perhaps the key finding, and the one that resonated with DC managers at other sites, is that many energy-saving opportunities are buried under the utter complexity of the Warehouse Control System (WCS) that controls the MHE. For example, one day Eric was watching the WCS software countdown from 15 minutes to zero, at which point, a section of conveyor was supposed to shut off due to inactivity. Oddly, when it reached 0:00, the clock reset, and the belts immediately resumed running for another 15 minutes. This cycle continued, over and over. It turned out that a secondary software condition was preventing a handful of conveyor sections from turning off when inactive. Changing the WCS software rules would allow these individual areas to shut down. Reprogramming would deliver several tens of thousands in energy savings each year.

The Spartanburg DC Operations team members are world-class logistics pros, but due to staff turnover, the team that installed the WCS is no longer part of the operation. The Ops team agreed that the facility would benefit from regular training & optimization sessions with the WCS vendor to document, revise and refine the shutdown sequences. Of all Eric's recommendations, this likely has the quickest payback.

## **Other Best Practices**

Eric identified a number of design practices and operating improvements in Spartanburg that would likely be transferrable across many other distribution centers.

### **Interchangeable Workstations**

Design workstations to be functionally interchangeable in the Value Added Services, Seeding and Packing areas. Rather than have areas that are associated with a specific task, all work stations should be fungible, allowing the MHE servicing those areas to run, only when they are in use. In Spartanburg, for example, Eric estimated a savings of \$7,000 per lane, per year for every 10 percent reduction in runtime, assuming a current usage of 6,000 hours per year.

### **Weight Sensors**

Typically, Sorters are designed so that the belts at the base run constantly. When a wave of product cascades through the sorter, the belts are on and ready to take the cartons away. However in reality, often there are only a few chutes in use and only a few cartons filling with product. After installation, adding weight sensors to the belts could trim a belt's energy use by anywhere from 30-50 percent.

### **Programming Logic**

Shutdowns in one area should logically drive shutdowns downstream. For example, at night, the Print-and-Apply area is used in Spartanburg for accumulation and to build up a critical mass of boxes for shipping. When this occurs, nothing flows out of Print-and-Apply, but the downstream lanes in shipping continue to run. Turning off the downstream lanes could save considerable energy and money.

### **Employee-activated Controls**

"Green cords," are manual pull cords that start a belt for a fixed time, allowing an employee to control a section of conveyor. This could work well on Return belts in Value Added Services, Seeding and Packing areas. The benefit is that a motor only runs when an employee activates it; otherwise it is off.

### **Employee-led night audits**

Most of Eric's findings were discovered at night, when the facility was operating at a reduced pace. Other DCs could benefit from sending staff in after hours with a critical eye towards what could be turned off.

### Guidance for New Distribution Centers

Retrofitting MHE systems is complex and facility downtime is expensive, so there is a clear business case for designing and installing efficient equipment and controls during construction. Here is a summary of adidas Group's new approach:

**Optimize the lifecycle cost of owning and operating these significant assets.** Energy usage must be a focus at all stages of distribution center building and operation. This is best achieved by designing systems and selecting equipment that:

1. Is the right size for the job
2. Is energy efficient
3. Runs only when needed

**Compare MHE designs based on the cost per item moved through the warehouse.** Ensure that energy expense is optimized with respect to the other costs. This is defined by:

$$\text{Cost per item Shipped} = \frac{(\text{Maintenance} + \text{Labor} + \text{electricity} + \text{amortized fixed costs of MHE} + \text{etc.})}{\text{projected volume}}$$

**Request that designers & manufacturers provide detailed estimates of energy use when responding to our RFPs.** This will enable a lifecycle cost approach to evaluating designs.

#### *Build according to the following equipment guidance*

**Setup and design** – Value Added Services, Seeding, Packing, QA and e-Commerce functions are interchangeable workstations. All side functions are independently powered and wired and can be shut down without forcing other areas to shut down. There is a WCS in place that logs usage timings of each motor and functional area that allows for trend analysis.

**Belts** – No slide belts are to be used unless absolutely required by the operation. All side lanes in areas where people are working alongside the conveyors, including return lanes, are to be Motor Driven Roller. For all main conveyors, vendors are requested to provide the cost difference between using MDR and alternatives.

**Motors** – The motors are not more powerful than what was prescribed by the MHE consultant. Premium efficiency motors are specified in all instances except specific zones where the upcharge does not warrant their installation (i.e., very low runtime areas).

**Soft Starters** – There are soft starters on all motors. These will allow motors to minimize the energy that they use when they are turned on.

**Sensors** – All belts have sensors on them. These are linked to the WCS and the conditions for shutdown are provided.



#### *Appoint an energy manager.*

Once the distribution center is built, energy management becomes an ongoing responsibility, with someone dedicated to it professionally.

Key responsibilities include:

- Monitor KPIs like Energy Cost per item Shipped.
- Convene a regular forum where maintenance and engineering staff discuss their latest efficiency achievements, challenges and projects.
- Refine and adjust WCS shut down settings based on trends and operational needs.
- Perform a monthly check on all MHE and compare the hours that each motor has logged as running versus estimates based on volumes.

### A Scalable Solution

Warehouses and distribution centers are a key element of the supply chains of retail stores, restaurants, online shopping and consumer brands. Virtually every vendor that that sells to the public has products that come through a distribution center or warehouse. While every distribution center is different, Eric's findings are relevant to many different types of facilities. Historically, operating MHE has been considered 'just a cost of doing business.' adidas Group's experience shows that proactive energy management and a lifecycle cost to design can cut cost and carbon for retailers and logistics providers around the world.