Minnesota Technical Assistance Program

Compressed Air Efficiency Opportunities at Caterpillar Paving Products

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Company Overview: Cat® Paving Products

- **Operations headquartered in Brooklyn Park, MN**
  - -372,000 sq. ft. (8.5+ acre) facility
  - -Over 736 employees

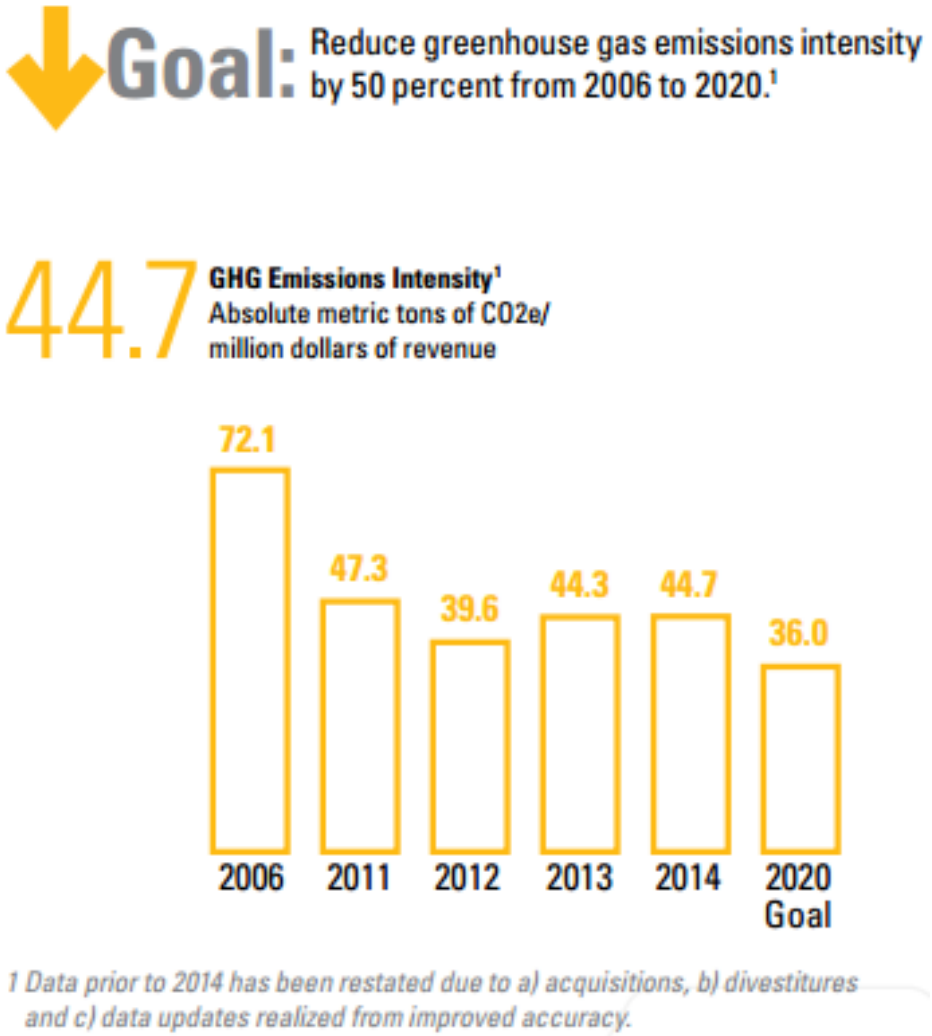
- **Designs and manufactures road construction machinery**
  - -Asphalt pavers, screeds, compactors and road reclaimers

- **Compressed air used extensively throughout fabrication and assembly processes**
  - -11% of total electricity consumption

Incentives to Change

- **Corporate Sustainability Goals**
  -Intensity based
  -Maintain or reduce energy consumption as production rates increase

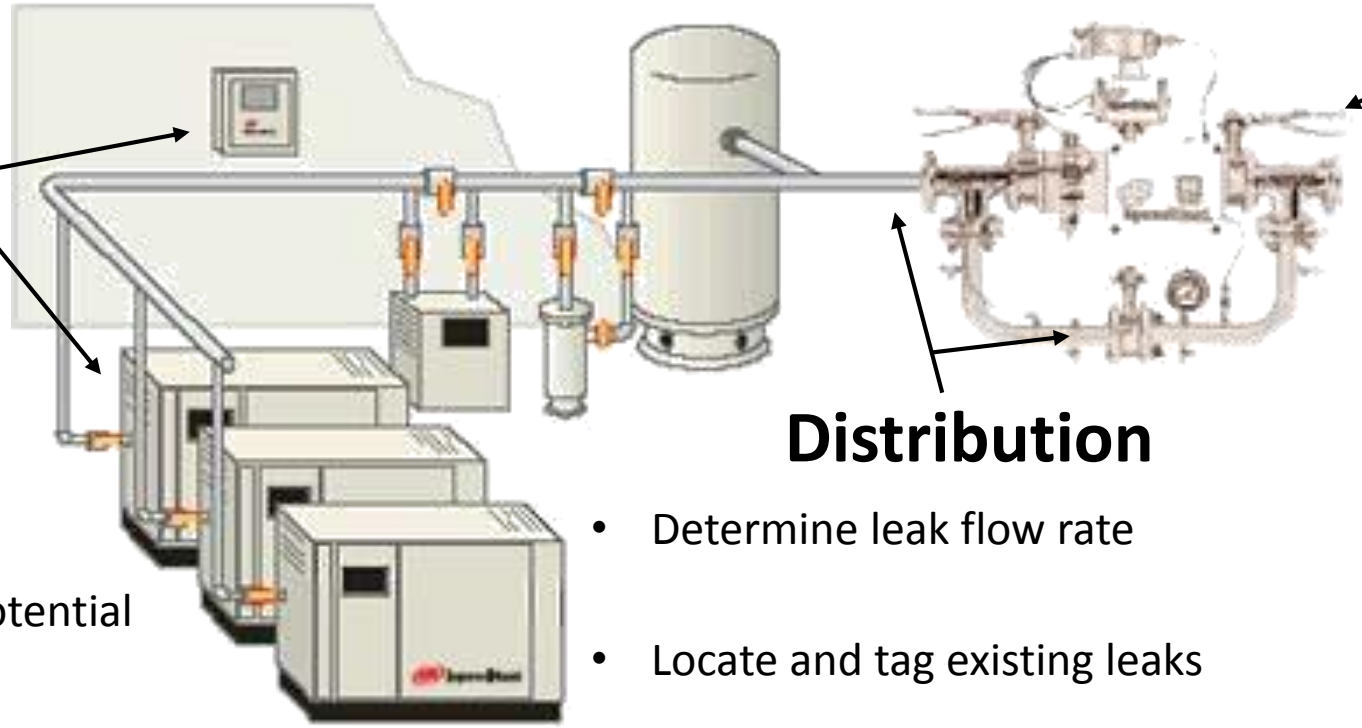
- **Process Efficiency Program**
  -Rebate opportunities
  -Access to technical assistance
  -Data logging



Project Approach

Supply

- Determine baseline energy consumption
- Profile air flow demands
- Model energy saving potential for system upgrades



Distribution

- Determine leak flow rate
- Locate and tag existing leaks

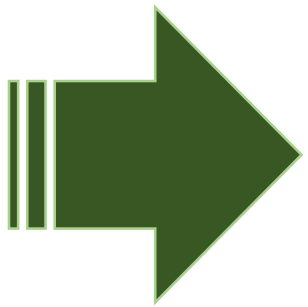
Demand

- Determine minimum pressure requirements and down-regulate pressures
- Measure and catalog air flow to major end uses and determine costs
- Consider higher efficiency alternatives to air-driven systems

Opportunities Overview

Step 1: Demand-Side Reductions

- **Repair existing compressed air leaks**
- Regulate pressures; reduce artificial demand
- Use alternatives to compressed air when possible



Step 2: Supply-Side Improvements

- **Generate air more efficiently using a Variable Speed Drive (VSD) Compressor**
- **Upgrade central control system to optimize compressor outputs**

Leak Reduction Opportunity

- Initial leak flow rate (approx.): **91 CFM**
  Annual energy waste: **155,700 kWh/yr**
  Annual cost: **$14,560**

Cost and Savings Summary for Leak Repair					
Number of Leaks Tagged	**Labor Cost**	**Energy Saved (kWh/yr)**	**Cost Savings ($/yr)**	**Indirect Emissions Prevented (MT CO_2-eq)**	**Simple Payback**
110	$5,500	116,752	$10,921	55.2	6 months

Artificial Demand Reductions

- **Adjusted regulators throughout fabrication processes**
  - -Estimated 14 CFM reduction to average production demand
- **Identified flow reduction potential for air pallets on Pavers Line**
  - -61 CFM reduction to peak flow demand
- **Identified flow reduction potential for RM air pallet**
  - -55 CFM reduction to peak flow demand

Eliminating Pneumatic Inefficiencies

- **Replace pneumatic drum pumps and mixers with electric**

  Annual Energy Savings: 76,667 kWh
  Annual Cost Savings: $7,171
  Simple Payback: 1.3 years

- **Engineer alternatives for RM and Paver air pallets**

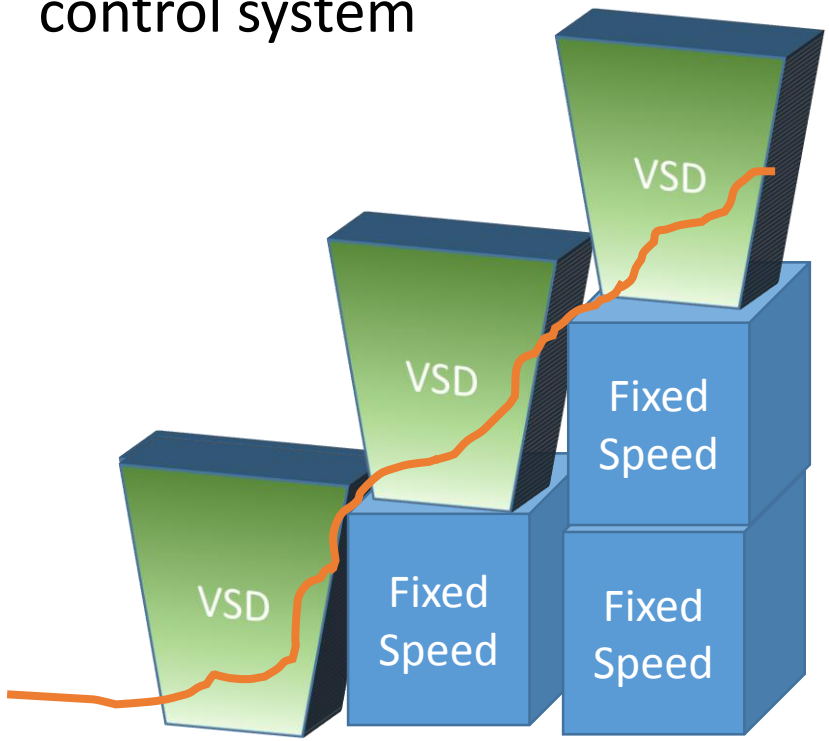
  -Eliminate need for 3rd compressor

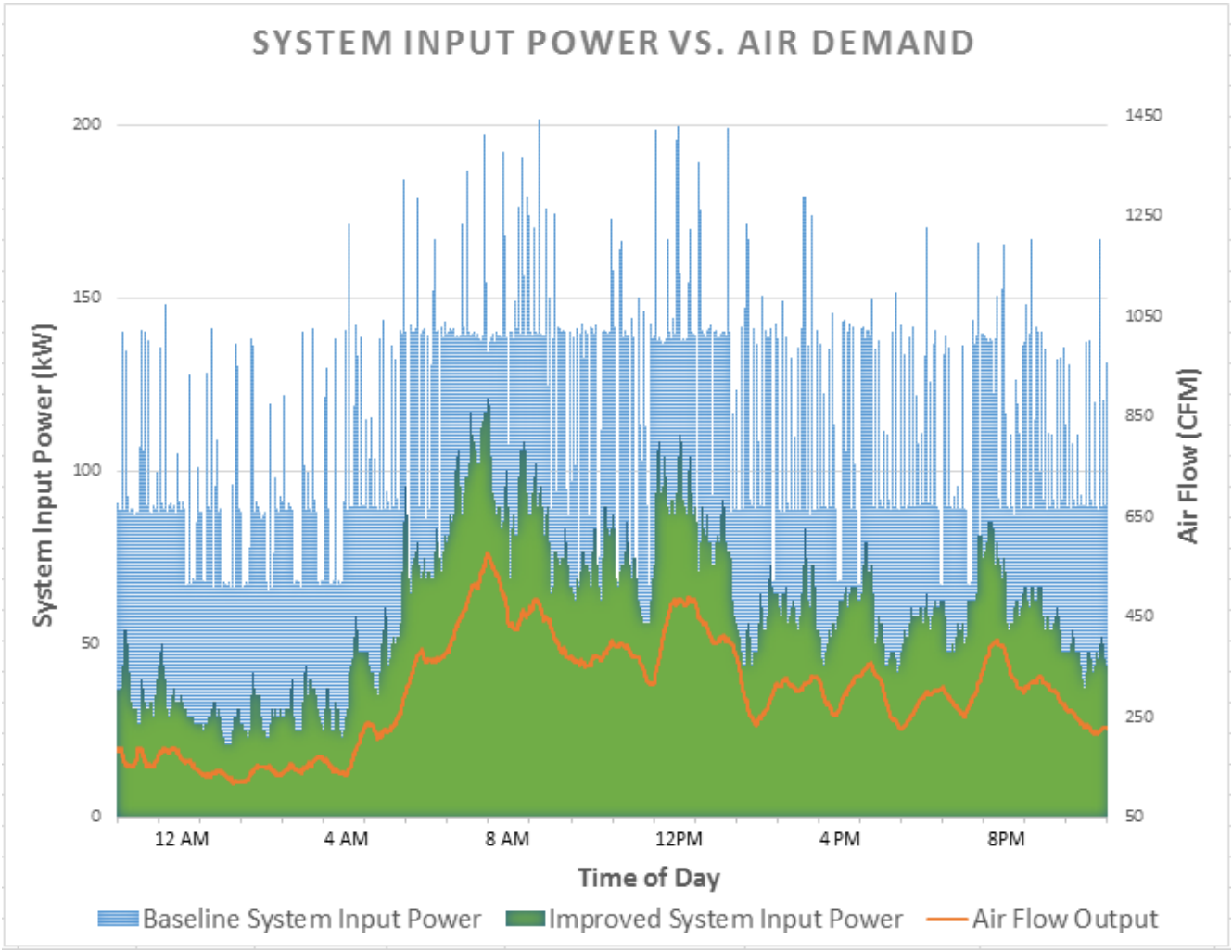
  Annual Energy Savings: 21,257 kW
  Peak Billable Demand Reduction: 38 kW
  Annual Cost Savings: $6,052

RM air Pallet

Improving Supply-Side Efficiency

- Replace one of three compressors with VSD model and upgrade control system





Energy, Costs & Savings Breakdown

Total Cost of Upgrade:	$51,639
Xcel Rebate:	-$18,000
	$33,639
Simple Payback:	**1.9 years**

92 MT CO_2-eq Emissions Prevented

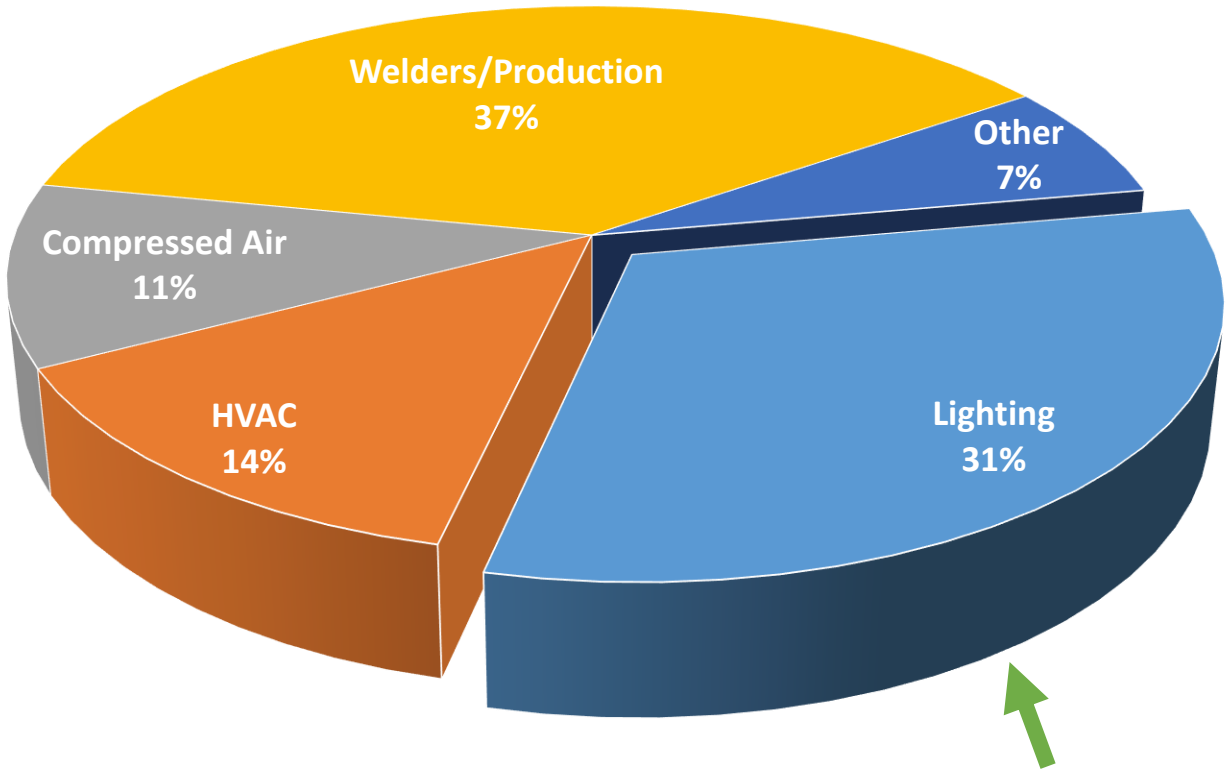
Energy and Cost Comparison			
	Primary System (Baseline)	**With VSD & Control Upgrades**	**Savings**
Average Total Power (kW):	74.0	51.9	**22.1 kW**
Peak Total Power, Billable (kW):	168	123	**45 kW**
Annual Energy (kWh/yr):	648,300	454,900	**193,400 kWh**
Annual Cost ($/yr):	$60,640	$42,550	**$18,090**

Recommendation Summary

Recommendation	Energy Saved per Year	Annual Cost Savings	Emissions Prevented (MT CO_2-eq)	Payback period	Status
Repair all tagged leaks	116,752 kWh	$10,920	55	0.5 years	Implementation In Progress
Control upgrades and integration of VSD into Primary Compressor System	193,400 kWh	$18,090	92	1.9 years	Implementation In Progress
Regulator adjustments (fabrication)	15,126 kWh	$1,415	7.2	Immediate	Implemented
Pneumatic Pump/Mixers to electric	76,667 kWh	$7,171	36	1.3 years	Recommended
Engineer alternatives to large air pallets	21,257 kWh	$6,052 (peak based)	10	Unknown	Analysis Incomplete

Additional Opportunities

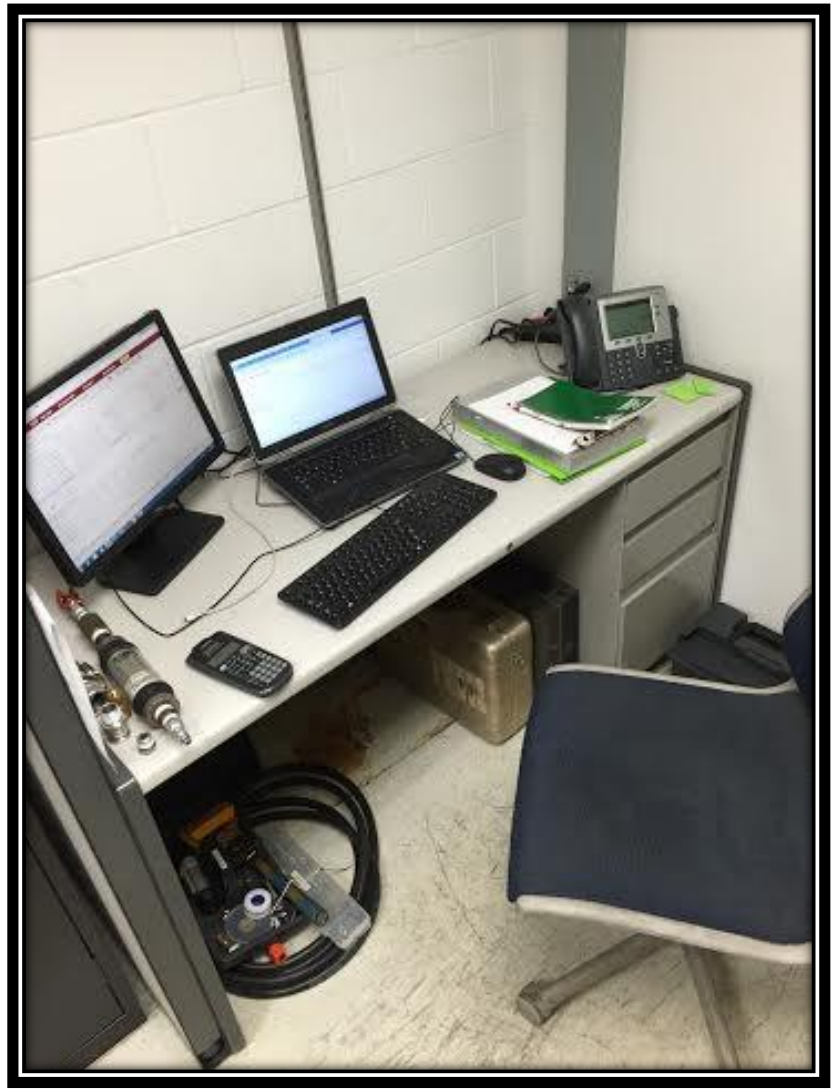
- **Pollution prevention and waste reduction in painting operations**
  - Find alternative solvent for flushing paint lines
  - Improve transfer efficiency
  - Recycle water with closed-loop pressure washing booths



- Retrofit LED
- High-bay occupancy sensors

Personal Benefits

- Better understanding of industrial compressed air systems
- Real-world experience implementing projects within a large corporation
- Improved analytical skills
- Networking



Thank You

Questions?