Welcome

Conservation Applied Research & Development (CARD) Webinar

February 22, 2018
Overlooked Opportunity: Compressed Air Demand Reduction through Air Tool Replacement
Compressed Air Demand Reduction through Air Tool Replacement

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Webinar Basics

- Attendees in listen-only mode
- Type your questions into Question Box
- Questions addressed at end
- Webinar recorded & archived online
- Two Handouts
  - Webinar slide deck
  - Document with links to Air Tool Calculator
• Purpose to help Minnesota utilities achieve 1.5% energy savings goal by:
  • *Identifying new technologies or strategies to maximize energy savings*;
  • *Improving effectiveness of energy conservation programs*;
  • *Documenting CO₂ reductions from energy conservation programs*.

  *Minnesota Statutes §216B.241, Subd. 1e*

• Utility may reach its energy savings goal
  • Directly through its Conservation Improvement Program (CIP)
  • Indirectly through energy codes, appliance standards, behavior, and other market transformation programs
CARD RFP Spending by Sector thru mid-FY2017

- Multifamily 5+ unit (4), 6.6%
- Agricultural (6), 3.1%
- Multi-sector (21), 25.3%
- Commercial (36), 37.6%
- Residential 1 - 4 unit (15), 18.7%
- Industrial (10), 8.6%

- 8 Funding Cycles
- Nearly 380 proposals
- 92 projects funded
- Over $21 million in research
Compressed Air Demand Reduction through Air Tool Replacement

A.J. Van den Berghe, C.E.M.
MnTAP Staff Engineer
MnTAP Overview – Who We Are

• Located at University of Minnesota
• Grant-funded
• 34 year history serving our state
• Staffed by scientists and engineers
MnTAP Overview – What We Do

Help businesses:

• Reduce waste
• Conserve water
• Conserve energy
• Reduce air emissions
• Increase efficiencies
• Save money
MnTAP Overview – How We Work

• On-site assistance
  • Site assessment visits
  • Intern Program
  • Company team facilitation

• Minnesota Materials Exchange

• Targeted Research

• Communications and outreach
  • Website, fact sheets, and case studies

• Confidential, free, and non-regulatory
Why Reduce Compressed Air Usage?

- Widespread use in industry – opportunity scales
- Inefficient utility
  - Only about 10% of energy in can be used for work
  - Prone to leakage
  - Often considered “free”
Why Replace Pneumatic Tools?

Why not?

- Electric savings
- Cost savings
- Alternatives readily exist: wired or battery-powered
- Frees compressor capacity for other, more appropriate uses
Primary Research Goals

1. Define Minnesota opportunity potential
2. Develop resources to help MN businesses
   1. Guide for facilities
   2. Energy/Cost savings calculator
3. Disseminate results
   1. Today’s Webinar
   2. CARD Final Report – soon
   3. Ongoing MnTAP assistance
Identifying Key Industries

Determine which subsectors/industries:

• Use compressed air?
  • US DOE data – Industrial Assessment Centers

• Have a presence in Minnesota?
  • U of M Libraries business reference databases

• Use pneumatic tools?
  • MnTAP informational interviews
Interviewing Industry

Outcomes:
• 285 unique facilities contacted
  • 63 successful interviews
    • From 40 unique industries
      • From 7 unique subsectors

What we asked –
(basis for statewide estimation):
• Number of employees
• Type of tools used
• Quantity of tools used
• Runtime of tools
## Tool Type Matters

<table>
<thead>
<tr>
<th>Tool Type</th>
<th>Average Airflow Requirement (CFM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>7” Sander/Grinder</td>
<td>53</td>
</tr>
<tr>
<td>Reciprocating Saw</td>
<td>49</td>
</tr>
<tr>
<td>¾” Impact Wrench</td>
<td>36</td>
</tr>
<tr>
<td>4-½” Sander/Grinder</td>
<td>30</td>
</tr>
<tr>
<td>¼” Die Grinder</td>
<td>25</td>
</tr>
<tr>
<td>Screwdriver</td>
<td>20</td>
</tr>
<tr>
<td>18 Gauge Shears</td>
<td>16</td>
</tr>
<tr>
<td>Nailer</td>
<td>3</td>
</tr>
</tbody>
</table>
# Research Findings – Key Industries

<table>
<thead>
<tr>
<th>NAICS</th>
<th>Manufacturing Description</th>
<th>Facility Count</th>
<th>Annual Pneumatic Tool Energy Use (kWh)</th>
<th>Average Annual Pneumatic Energy Use per Facility (kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>331-</td>
<td>Primary Metal</td>
<td>325</td>
<td>67,200,000</td>
<td>206,800</td>
</tr>
<tr>
<td>336-</td>
<td>Transportation Equipment</td>
<td>750</td>
<td>38,100,000</td>
<td>50,800</td>
</tr>
<tr>
<td>333-</td>
<td>Machinery</td>
<td>2,392</td>
<td>17,900,000</td>
<td>7,500</td>
</tr>
<tr>
<td>332-</td>
<td>Fabricated Metal Products</td>
<td>2,421</td>
<td>12,500,000</td>
<td>5,200</td>
</tr>
<tr>
<td>321-</td>
<td>Wood Products</td>
<td>1,534</td>
<td>6,700,000</td>
<td>4,400</td>
</tr>
<tr>
<td>337-</td>
<td>Furniture &amp; Related Products</td>
<td>1,018</td>
<td>3,200,000</td>
<td>3,100</td>
</tr>
<tr>
<td>339-</td>
<td>Miscellaneous Manufacturing</td>
<td>3,753</td>
<td>3,200,000</td>
<td>900</td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td></td>
<td><strong>12,193</strong></td>
<td><strong>148,800,000</strong></td>
<td><strong>Mean Average: 12,200</strong></td>
</tr>
</tbody>
</table>
Research Findings – Potential

Annual Pneumatic Tool Energy: 148,800,000 kWh
Annual Equivalent Electric Tool Energy: - 11,000,000 kWh
Annual Electric Savings Potential: 137,800,000 kWh
( $0.07/kWh )
Annual Electric Cost Savings Potential: $9,673,560
Facilities’ Guide Available Now

Direct Link to Facilities’ Guide
(http://z.umn.edu/ToolGuide)

Provides additional information on tool differences:
• Functionality
• Ergonomics
• Cost
• Additional References
Pneumatic to Electric Tool Calculator Demo

Jon Vanyo C.E.M.
Minnesota Technical Assistance Program
Overview

Calculator Overview

Calculation Overview

Basic Calculator Demo: Example 1

Advanced Calculator Demo: Example 2
Calculator
The Calculator

MnPAC Pneumatic to Electric Tool Cost Calculator

The purpose of this calculator is to compare the cost of using pneumatic tools with the cost of using electric tools. This calculator has been designed to estimate the cost savings that can be achieved by using electric tool over pneumatic tool.

Simple Results

Below are the estimated savings for switching from compressed air driven tools to electric tools:

<table>
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<tr>
<th>Annual Energy Savings</th>
<th>Annual Cost Savings</th>
<th>Simple Payback Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>$70,273</td>
<td>$4,483</td>
<td>3 months</td>
</tr>
</tbody>
</table>

Detailed Results

Comparison of Tool System:

<table>
<thead>
<tr>
<th></th>
<th>Compressed Tools</th>
<th>Electric Tools</th>
<th>Annual Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Energy Savings</td>
<td>$70,273</td>
<td>$4,483</td>
<td></td>
</tr>
<tr>
<td>Annual Cost Savings</td>
<td>$3,909</td>
<td>$1,500</td>
<td></td>
</tr>
<tr>
<td>Total Annual Savings</td>
<td>$3,570</td>
<td>$3,283</td>
<td></td>
</tr>
</tbody>
</table>

Projected Savings Over Time

Interpretation of Results:

If you choose to use this tool, you will see a significant cost savings. This tool has been designed to help you make an informed decision about the best tool for your needs.
Calculations
Our ultimate goal is to get the energy and cost to run pneumatic hand tools and similar electric hand tools.

We then use costs to calculate savings and simple payback period.

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<td>70,273 kWh</td>
<td>$4,883</td>
<td>3 months</td>
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</table>
Pneumatic Tool Energy Consumption

Energy (kWh) = Power(kW) * Time(h) / (1-System Leak Rate)

Power(kW) = Airflow(CFM) * Compressor Specific Power (kW/CFM)

Airflow(CFM) from tool specifications catalogues.
Compressor Specific Power = 20 kW/100CFM (efficient sys.)
Compressor Specific Power = 30 kW/100CFM (inefficient sys.)
System Leak Rate = .2 (default)
Electric Tool Energy Consumption

Energy (kWh) = Power(kW) * Time(h)

Power (kW) = Voltage (V) * Current (amp) / 1000 (W/kW)

Voltage and Current from tool specifications catalogues.
Calculating Tool Energy Cost

Cost ($) = Energy (kWh) * Cost per unit Energy ($/kWh)

Cost per unit Energy = $.0702 (MN industry average blended)
Calculations – Simple Payback Period (1)

At this point we have tool energy and energy cost. We need simple payback period (SPP)

\[
SPP = \frac{\text{initial purchase cost}}{\text{annual savings}}
\]

initial purchase cost = electric tool cost from catalogues
Calculations – Simple Payback Period (2)

annual savings ($) =
annual pneumatic tool cost(A) – annual electric tool cost(B)

(A) = annual pneumatic physical tool cost +
annual pneumatic maintenance cost +
annual pneumatic energy cost

annual physical tool cost = initial tool cost / pneumatic tool lifetime
annual maintenance cost = 0 (default)
annual energy cost was calculated on the previous slides
pneumatic tool lifetime default = 3 years
Calculations – Simple Payback Period (3)

annual savings ($) =
annual pneumatic tool cost(A) – annual electric tool cost(B)

(B) = annual electric physical tool cost +
      annual electric maintenance cost +
      annual electric energy cost

annual physical tool cost = initial tool cost / electric tool lifetime
annual maintenance cost = 0 (default)
annual energy cost was calculated on the previous slides
electric tool lifetime default = 2 years
Calculations – Simple Payback Period (4)

SPP = initial purchase cost / annual savings

We have now calculated energy (kWh), cost ($), and Simple Payback Period associated with switching from pneumatic to electric tools.

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Basic Calculator Demo
Basic Calculator Demo (1)

Finding the calculator:

- Go to: MnTAP web page (www.mntap.umn.edu)
- In the “Focus Areas,” click on “Energy Efficiency”
- Click on “Compressed Air”
- Scroll down to resources and click on the link to the calculator

Direct Calculator Link
(http://z.umn.edu/ToolCalc)
Basic Calculator Demo (2)

We have three, 5” pneumatic sanders that we use for three hours each day, 250 days per year.

We want to know the energy and cost savings for replacing these with corded electric sanders.
Basic Calculator Demo (3)

Example 1:

- Three 5” pneumatic sanders
- Three hours per day
- 250 days per year
- Switching from pneumatic to corded electric sanders
Basic Calculator Demo (4)

Example 1 Results:

- $1,700 - $2,700 per year savings
- 24,500 – 38,500 kWh per year savings
- 3 – 4 month payback period
Advanced Calculator Demo
Advanced Calculator Demo (1)

Example 2:

We have five 1/2” pneumatic impact wrenches that we use for six hours each day, 250 days per year.

We want to make some changes to the default calculations:
Advanced Calculator Demo (2)

Example 2 Tool Info:

- Five 1/2” impact wrenches
- Six hours per day
- 250 days per year
- Switching from pneumatic to cordless electric impact wrenches

Cramo Group, Cramo Impact wrench
Mats Jarmer, Flickr Creative Commons
Example 2 System Info:

Pneumatic lifetime 4 years
Electric lifetime 3 years

Unknown Tool Costs
Unknown Tool CFM or Amperage

$100 per tool per year maintenance for pneumatic
$150 per tool per year maintenance for electric
Advanced Calculator Demo (4)

Example 2 System Info:

15% Leak Rate
$.07 per kWh blended rate

Cramo Group, Cramo Impact wrench
Mats Jarmer, Flickr Creative Commons
Advanced Calculator Demo (5)

Example 2 Compressor Info:

125 HP Compressor
125 PSI
One-Stage Rotary Screw
Variable Speed Drive
70% Average Load

Cramo Group, Cramo Impact wrench
Mats Jarmer, Flickr Creative Commons
Advanced Calculator Demo (6)

Example 2 Results:

$1,400 per year savings
30,500 kWh savings
2 year payback period

Cramo Group, Cramo Impact wrench
Mats Jarmer, Flickr Creative Commons
Special Thanks to Brandon Noel
Questions?

Overlooked Opportunity: Compressed Air Demand Reduction through Air Tool Replacement

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Send us your questions using GoToWebinar question box
Conservation Applied Research and Development

Funds projects to identify new technologies or strategies to maximize energy savings, improve the effectiveness of energy conservation programs, or document the carbon dioxide reductions from energy conservation projects.

Background

The Next Generation Energy Act of 2007 (the Act) established energy conservation as a primary resource for meeting Minnesota’s energy needs while reducing greenhouse gases and other harmful emissions. The Act also established a savings goal of 1.5 percent of annual retail electricity and natural gas sales for all utilities in the state. The utilities may reach this annual goal directly through its utility Conservation Improvement Program (CIP) and, indirectly, through energy codes, appliance standards, behavioral and other market transformation programs.

To help utilities reach their energy savings goal, the Act authorizes the commissioner to assess utilities $3.600.000 annually for grants for applied research and development projects:

- $2.600.000 for the Conservation Applied Research and Development (CARD) program through which Commerce awards grants in a competitive Request for Proposal (RFP) process.
- $500.000 for the Center for Sustainable Building Research to coordinate activities related to Sustainable Building 2030 (SB2030).
- $500.000 for the Clean Energy Resources Teams (CERTs) for community energy technical assistance and outreach.

Webinar Recording & Final Report available in few weeks
Thanks for Participating!

**Upcoming CARD Webinars:**
- **Mar 14:** Increasing Energy Code Compliance through Support & Assistance
- **Mar 27:** Increasing Residential Boiler Efficiency with QI & Retro-Cx

**Commerce Division of Energy Resources e-mail list sign-up**

If you have questions or feedback on the CARD program contact:
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651-539-1872