ENERGY MANAGEMENT PRACTICES BY SME

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MY BACKGROUND

• Professor, West Virginia University (WVU), USA
• Director, Industrial Assessment Center at WVU
• President, Pro-Plus Engineering, PLLC
• Qualifications
  • PhD in Industrial Engineering (Virginia Tech)
  • MS in Operations Research (SMU)
  • B.E. (Honors) in Production Engineering (University of Madras, India)
  • Registered Professional Engineer in WV
  • Certified Energy Manager (Assoc of Energy Engineers)
  • US DOE Qualified Specialist in Steam, Process Heating, Compressed Air, and Fans
  • Conducted over 250 energy assessments for SME and large manufacturing facilities
Industrial Assessment Centers (IAC) Program, Advanced Manufacturing Office (AMO), US Department of Energy (DOE)
SME Focused IAC Energy Assessment Program

- Qualifying Manufacturing Plants
  - Within Standard Industrial Classification (SIC) 20-39 or North American Industry Classification System (NAICS) 31-33
  - Within 150 miles of a host campus
  - Gross annual sales below $100 million
  - Fewer than 500 employees at the plant site
  - Annual energy bills more than $100,000 and less than $2 million
  - No professional in-house staff to perform the assessment
IAC Database Summary

• Since 1981, 50 assessment centers have entered approximately:
  • 15,200 Assessments
  • 115,000 Recommendations
  • Excellent resource for SME to identify and analyze energy efficiency recommendations

http://iac.rutgers.edu/database/
Industrial Assessment Centers Database

SEARCH: Assessments
15,192 Assessments Found

- Year: <= 2011
- SIC Code
- NAICS Code
- Energy Cost: <= Any Number
- Select State: Any State
- Products
- Filter by Center: Any Center

<table>
<thead>
<tr>
<th>ID</th>
<th>Year</th>
<th>Products</th>
</tr>
</thead>
<tbody>
<tr>
<td>UD0844</td>
<td>2011</td>
<td>Hydraulic hose, fittings, couplings</td>
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<tr>
<td>TT0083</td>
<td>2011</td>
<td>Practice bomb shells</td>
</tr>
<tr>
<td>OK0818</td>
<td>2011</td>
<td>Heavy duty pick up truck for recreational towing</td>
</tr>
<tr>
<td>MA0683</td>
<td>2011</td>
<td>Extruded and coated film</td>
</tr>
<tr>
<td>UF0451</td>
<td>2011</td>
<td>Ammunition and pyrotechnics</td>
</tr>
<tr>
<td>CT0887</td>
<td>2011</td>
<td>Switchgear</td>
</tr>
<tr>
<td>MA0682</td>
<td>2011</td>
<td>Braided PTFE Hoses</td>
</tr>
<tr>
<td>TT0079</td>
<td>2011</td>
<td>Automotive Seating</td>
</tr>
<tr>
<td>LL0390</td>
<td>2011</td>
<td>Vegetable Oils</td>
</tr>
<tr>
<td>UF0450</td>
<td>2011</td>
<td>Printed Circuit Boards</td>
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<tr>
<td>MA0681</td>
<td>2011</td>
<td>Extruded plastic</td>
</tr>
<tr>
<td>IG0191</td>
<td>2011</td>
<td>Chocolate</td>
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<tr>
<td>LI0359</td>
<td>2011</td>
<td>Bread</td>
</tr>
<tr>
<td>UA0968</td>
<td>2011</td>
<td>Plastic Medical Supplies</td>
</tr>
<tr>
<td>RD0800</td>
<td>2011</td>
<td>Low carbon steel balls</td>
</tr>
</tbody>
</table>
US MANUFACTURING SECTOR
SME in US Manufacturing Sector
NAICS 311 - 339

- Aluminum
- Brewing
- Cement
- Chemical
- Corn Refining
- Food Processing
- Forest Products
- Glass
- Metal Casting
- Automotive and Vehicle Manufacturing
- Petrochemical
- Petroleum Refining
- Pharmaceuticals
- Pulp & Paper
- Steel & Iron
- Textiles

Source: Energy Intensive Industries, US DOE
Small – Medium Sized Manufacturing Establishments – US

<table>
<thead>
<tr>
<th>2007 NAICS code</th>
<th>Meaning of Employment size of establishments code</th>
<th>Number of establishments</th>
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<tbody>
<tr>
<td>31-33</td>
<td>All establishments</td>
<td>332,536</td>
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<tr>
<td>31-33</td>
<td>Establishments with 0 to 4 employees</td>
<td>133,805</td>
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<tr>
<td>31-33</td>
<td>Establishments with 5 to 9 employees</td>
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<tr>
<td>31-33</td>
<td>Establishments with 10 to 19 employees</td>
<td>46,814</td>
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<tr>
<td>31-33</td>
<td>Establishments with 20 to 49 employees</td>
<td>48,768</td>
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<tr>
<td>31-33</td>
<td>Establishments with 50 to 99 employees</td>
<td>25,019</td>
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<tr>
<td>31-33</td>
<td>Establishments with 100 to 249 employees</td>
<td>19,334</td>
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<tr>
<td>31-33</td>
<td>Establishments with 250 to 499 employees</td>
<td>6,154</td>
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<tr>
<td>31-33</td>
<td>Establishments with 500 to 999 employees</td>
<td>2,410</td>
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<tr>
<td>31-33</td>
<td>Establishments with 1,000 to 2,499 employees</td>
<td>822</td>
</tr>
<tr>
<td>31-33</td>
<td>Establishments with 2,500 employees or more</td>
<td>192</td>
</tr>
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</table>

Total 99,275

Source: 2007 Economic Census, Census.gov
## US Establishments with Employees 20 - 499

<table>
<thead>
<tr>
<th>NAICS</th>
<th>NAICS Description</th>
<th>All Establishments</th>
<th>SME Establishments (employees 20 - 499)</th>
<th>%</th>
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</thead>
<tbody>
<tr>
<td>311</td>
<td>Food manufacturing</td>
<td>24731</td>
<td>7941</td>
<td>32%</td>
</tr>
<tr>
<td>312</td>
<td>Beverage and tobacco product manufacturing</td>
<td>4222</td>
<td>1084</td>
<td>26%</td>
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<tr>
<td>313</td>
<td>Textile mills</td>
<td>2679</td>
<td>929</td>
<td>35%</td>
</tr>
<tr>
<td>314</td>
<td>Textile product mills</td>
<td>6557</td>
<td>986</td>
<td>15%</td>
</tr>
<tr>
<td>315</td>
<td>Apparel manufacturing</td>
<td>7688</td>
<td>1299</td>
<td>17%</td>
</tr>
<tr>
<td>316</td>
<td>Leather and allied product manufacturing</td>
<td>1246</td>
<td>240</td>
<td>19%</td>
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<tr>
<td>321</td>
<td>Wood product manufacturing</td>
<td>15142</td>
<td>4428</td>
<td>29%</td>
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<tr>
<td>322</td>
<td>Paper manufacturing</td>
<td>4706</td>
<td>2880</td>
<td>61%</td>
</tr>
<tr>
<td>323</td>
<td>Printing and related support activities</td>
<td>30526</td>
<td>5391</td>
<td>18%</td>
</tr>
<tr>
<td>324</td>
<td>Petroleum and coal products manufacturing</td>
<td>2281</td>
<td>546</td>
<td>24%</td>
</tr>
<tr>
<td>325</td>
<td>Chemical manufacturing</td>
<td>13138</td>
<td>5285</td>
<td>40%</td>
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<tr>
<td>326</td>
<td>Plastics and rubber products manufacturing</td>
<td>13351</td>
<td>6340</td>
<td>47%</td>
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<tr>
<td>327</td>
<td>Nonmetallic mineral product manufacturing</td>
<td>16319</td>
<td>4397</td>
<td>27%</td>
</tr>
<tr>
<td>331</td>
<td>Primary metal manufacturing</td>
<td>4753</td>
<td>2353</td>
<td>50%</td>
</tr>
<tr>
<td>332</td>
<td>Fabricated metal product manufacturing</td>
<td>57762</td>
<td>15864</td>
<td>27%</td>
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<tr>
<td>333</td>
<td>Machinery manufacturing</td>
<td>24926</td>
<td>8380</td>
<td>34%</td>
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<tr>
<td>334</td>
<td>Computer and electronic product manufacturing</td>
<td>13544</td>
<td>5004</td>
<td>37%</td>
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<tr>
<td>335</td>
<td>Electrical equipment, appliance, and component manufacturing</td>
<td>5960</td>
<td>2458</td>
<td>41%</td>
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<tr>
<td>336</td>
<td>Transportation equipment manufacturing</td>
<td>12091</td>
<td>4683</td>
<td>39%</td>
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<tr>
<td>337</td>
<td>Furniture and related product manufacturing</td>
<td>18572</td>
<td>3344</td>
<td>18%</td>
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<tr>
<td>339</td>
<td>Miscellaneous manufacturing</td>
<td>28740</td>
<td>4805</td>
<td>17%</td>
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<tr>
<td></td>
<td></td>
<td>308,934</td>
<td>88,637</td>
<td>29%</td>
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</tbody>
</table>

Source: 2009 Business Patterns, Census.gov
Small and Medium Enterprises in USA

- More than 80% of manufacturing businesses have less than 250 employees
- SME (Manufacturing) with 500 or less employees consume 50% of industrial energy
- Manufacturing businesses with 250 or lesser employees constitute 25% of industrial energy use

Source: ACEEE, 2001
# Energy Intensity in US Manufacturing Sector

<table>
<thead>
<tr>
<th>NAICS</th>
<th>Description</th>
<th>Establishments</th>
<th>1 to 19 emp</th>
<th>20 to 99 emp.</th>
<th>Value of shipments ($1,000)</th>
<th>Energy Use Btu</th>
<th>Industrial Energy Intensity</th>
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<tbody>
<tr>
<td>311</td>
<td>Food Manufacturing</td>
<td>19,162</td>
<td>11,394</td>
<td>5,368</td>
<td>587,040,074</td>
<td>1,186</td>
<td>2,020.31</td>
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<tr>
<td>312</td>
<td>Beverage and Tobacco Product Manufacturing</td>
<td>3,491</td>
<td>2,494</td>
<td>739</td>
<td>127,625,182</td>
<td>107</td>
<td>838.39</td>
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<tr>
<td>313</td>
<td>Textile Mills</td>
<td>2,798</td>
<td>1,670</td>
<td>664</td>
<td>35,816,220</td>
<td>178</td>
<td>4,969.82</td>
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<tr>
<td>314</td>
<td>Textile Product Mills</td>
<td>6,471</td>
<td>5,274</td>
<td>944</td>
<td>28,684,971</td>
<td>72</td>
<td>2,510.03</td>
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<tr>
<td>315</td>
<td>Apparel Manufacturing</td>
<td>7,968</td>
<td>6,484</td>
<td>1,294</td>
<td>24,299,632</td>
<td>14</td>
<td>576.14</td>
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<tr>
<td>316</td>
<td>Leather and Allied Product Manufacturing</td>
<td>1,260</td>
<td>977</td>
<td>216</td>
<td>5,698,278</td>
<td>3</td>
<td>526.47</td>
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<tr>
<td>321</td>
<td>Wood Product Manufacturing</td>
<td>16,668</td>
<td>10,925</td>
<td>3,742</td>
<td>102,001,662</td>
<td>451</td>
<td>4,421.50</td>
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<tr>
<td>322</td>
<td>Paper Manufacturing</td>
<td>4,984</td>
<td>1,806</td>
<td>1,861</td>
<td>176,018,245</td>
<td>2,354</td>
<td>13,373.61</td>
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<tr>
<td>323</td>
<td>Printing and Related Support Activities</td>
<td>32,199</td>
<td>26,090</td>
<td>5,109</td>
<td>103,216,535</td>
<td>85</td>
<td>823.51</td>
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<tr>
<td>324</td>
<td>Petroleum and Coal Products Manufacturing</td>
<td>2,294</td>
<td>1,656</td>
<td>417</td>
<td>606,004,340</td>
<td>6,894</td>
<td>11,328.65</td>
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<tr>
<td>325</td>
<td>Chemical Manufacturing</td>
<td>13,079</td>
<td>7,614</td>
<td>3,939</td>
<td>722,493,722</td>
<td>5,149</td>
<td>7,126.71</td>
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<tr>
<td>326</td>
<td>Plastics and Rubber Products Manufacturing</td>
<td>12,534</td>
<td>6,118</td>
<td>4,872</td>
<td>211,531,165</td>
<td>337</td>
<td>1,593.15</td>
</tr>
<tr>
<td>327</td>
<td>Nonmetallic Mineral Product Manufacturing</td>
<td>16,649</td>
<td>11,127</td>
<td>4,608</td>
<td>127,239,663</td>
<td>1,114</td>
<td>8,755.13</td>
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<tr>
<td>331</td>
<td>Primary Metal Manufacturing</td>
<td>4,328</td>
<td>1,878</td>
<td>1,572</td>
<td>257,851,365</td>
<td>1,736</td>
<td>6,732.56</td>
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<tr>
<td>332</td>
<td>Fabricated Metal Product Manufacturing</td>
<td>60,284</td>
<td>42,539</td>
<td>14,540</td>
<td>345,104,298</td>
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<td>1,147.48</td>
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<tr>
<td>333</td>
<td>Machinery Manufacturing</td>
<td>22,752</td>
<td>14,295</td>
<td>6,905</td>
<td>347,930,344</td>
<td>204</td>
<td>586.32</td>
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<tr>
<td>334</td>
<td>Computer and Electronic Product Manufacturing</td>
<td>13,806</td>
<td>8,475</td>
<td>3,710</td>
<td>395,409,844</td>
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<td>335</td>
<td>Electrical Equipment, Appliance, and Component Manufacturing</td>
<td>4,952</td>
<td>2,712</td>
<td>1,690</td>
<td>129,270,659</td>
<td>103</td>
<td>796.78</td>
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<tr>
<td>336</td>
<td>Transportation Equipment Manufacturing</td>
<td>12,691</td>
<td>6,863</td>
<td>2,944</td>
<td>734,244,498</td>
<td>477</td>
<td>649.65</td>
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<tr>
<td>337</td>
<td>Furniture and Related Product Manufacturing</td>
<td>21,734</td>
<td>17,385</td>
<td>3,339</td>
<td>84,989,575</td>
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<td>717.74</td>
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<td>339</td>
<td>Miscellaneous Manufacturing</td>
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<td>4,429</td>
<td>145,839,426</td>
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<td><strong>Grand Total</strong></td>
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<td><strong>214,186</strong></td>
<td><strong>73,372</strong></td>
<td><strong>5,298,309,698</strong></td>
<td><strong>21,099</strong></td>
<td><strong>3,982</strong></td>
</tr>
</tbody>
</table>

Intensity expressed in Btu/USD (sales)

Sources:
1. Census.gov, County Business Patterns
2. Manufacturing Energy Consumption Survey (MECS), 2006
## Energy Intensities in US – SME (IAC Database) Btu/Sales Dollar (Nominal)

<table>
<thead>
<tr>
<th>NAICS</th>
<th>Description</th>
<th>Nominal Sales Dollars</th>
<th>Production Units Reported</th>
<th>Total Energy Purchased (Btu)</th>
<th>Total Energy Cost (Nominal Sales $)</th>
<th>BTU/Nominal Sales $</th>
<th>BTU/Unit of Production</th>
</tr>
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<tbody>
<tr>
<td>311</td>
<td>Food Manufacturing</td>
<td>37,625,260,296</td>
<td>34,874,188,787</td>
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<td>560,515,618.39</td>
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<tr>
<td>312</td>
<td>Beverage and Tobacco Product Manufacturing</td>
<td>11,610,259,999</td>
<td>8,357,509,944</td>
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<td>93,467,920.28</td>
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<tr>
<td>313</td>
<td>Textile Mills</td>
<td>2,725,333,471</td>
<td>1,899,856,596</td>
<td>8,145,708.98</td>
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<td>2,988.89</td>
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<td>Textile Product Mills</td>
<td>2,040,105,475</td>
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<td>315</td>
<td>Apparel Manufacturing</td>
<td>520,800,000</td>
<td>421,164,000</td>
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<td>1,771.87</td>
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<td>Leather and Allied Product Manufacturing</td>
<td>57,500,000</td>
<td>1,055,700</td>
<td>90,322.96</td>
<td>1,230,410.73</td>
<td>1,570.83</td>
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<tr>
<td>321</td>
<td>Wood Product Manufacturing</td>
<td>11,922,336,860</td>
<td>3,816,391,274</td>
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<td>939,561.80</td>
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<td>Paper Manufacturing</td>
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<td>323</td>
<td>Printing and Related Support Activities</td>
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<td>64,114,266.12</td>
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<td>324</td>
<td>Petroleum and Coal Products Manufacturing</td>
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<td>270,195,563.73</td>
<td>3,008.73</td>
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<tr>
<td>325</td>
<td>Chemical Manufacturing</td>
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<td>38,404,007,749</td>
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<td>633,573,369.37</td>
<td>4,716.95</td>
<td>3,733.61</td>
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<tr>
<td>326</td>
<td>Plastics and Rubber Products Manufacturing</td>
<td>13,827,694,635</td>
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<td>Nonmetallic Mineral Product Manufacturing</td>
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<td>267,082,051.31</td>
<td>7,443.32</td>
<td>6,673.23</td>
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<tr>
<td>331</td>
<td>Primary Metal Manufacturing</td>
<td>23,161,375,291</td>
<td>8,475,306,791</td>
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<tr>
<td>332</td>
<td>Fabricated Metal Product Manufacturing</td>
<td>19,300,855,534</td>
<td>38,252,283,051</td>
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<td>320,500,659.53</td>
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<td>723.09</td>
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<tr>
<td>333</td>
<td>Machinery Manufacturing</td>
<td>29,419,489,923</td>
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<td>334</td>
<td>Computer and Electronic Product Manufacturing</td>
<td>37,986,850,000</td>
<td>4,539,337,610</td>
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<td>123,722,558.44</td>
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<tr>
<td><strong>Grand Total</strong></td>
<td><strong>309,425,351,476</strong></td>
<td><strong>441,346,710,892</strong></td>
<td><strong>10,971,715,436.12</strong></td>
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<td><strong>2,018.31</strong></td>
<td><strong>1,491.33</strong></td>
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</table>

* Excluded from intensity calculation
Manufacturers’ Electricity Distribution in US

- Machine drive 52%
- Process heating 11%
- Facility HVAC 9%
- Electro-chemical processes 8%
- Process cooling and refrigeration 7%
- Facility lighting 6%
- Other 7%

Source: U.S. DOE 2010
Manufacturers’ Fuel Use Distribution in US

- Process heating: 44%
- Boiler fuel: 22%
- CHP and/or cogeneration processes: 20%
- Facility HVAC: 6%
- Machine drive: 3%
- Other: 5%

Source: US DOE, 2010
## Fuel Use and Distribution in US Manufacturing Industry

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<tr>
<th>NAICS</th>
<th>Sector</th>
<th>Fuel (TBtu)</th>
<th>Boiler</th>
<th>Process Heating</th>
<th>Cooling</th>
<th>Drives</th>
<th>Building HVAC</th>
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<tr>
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<td>9%</td>
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<td>0%</td>
<td>5%</td>
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<tr>
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</table>

Source: Energy Information Administration. 2002 Manufacturing Energy Consumption Survey
# Electricity Use and Distribution in US Manufacturing Industry

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<thead>
<tr>
<th>NAICS</th>
<th>Sector</th>
<th>Electricity (10^9 kWh)</th>
<th>Process Heat</th>
<th>Cooling</th>
<th>Drives</th>
<th>Electro-chemical Process</th>
<th>Building HVAC</th>
<th>Lighting</th>
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<td>1%</td>
<td>3%</td>
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<tr>
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<td>Plastic &amp; Rubber</td>
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<td>15%</td>
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<td>10%</td>
<td>8%</td>
<td>2%</td>
<td>1%</td>
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<td>5%</td>
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<td>1%</td>
<td>4%</td>
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<td>2%</td>
<td>4%</td>
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<td>2%</td>
<td>7%</td>
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<td>18%</td>
<td>13%</td>
<td>2%</td>
<td>5%</td>
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<tr>
<td>334</td>
<td>Computer &amp; Electronics</td>
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<td>23%</td>
<td>3%</td>
<td>28%</td>
<td>13%</td>
<td>7%</td>
<td>5%</td>
</tr>
<tr>
<td>335</td>
<td>Appliances</td>
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<td>11%</td>
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Source: Energy Information Administration. 2002 Manufacturing Energy Consumption Survey
Energy Use and Emissions are Related

Source: Energy Information Administration, Short Term Annual Energy Outlook, 2011
Energy Efficiency Opportunity in US

The manufacturing sector offers *significant* opportunities for *cost-effective* savings through increased energy efficiency.

<table>
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<tr>
<th></th>
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<tbody>
<tr>
<td>Manufacturing and Other Industrial</td>
<td>5,030 TBtu/yr $47 billion/yr</td>
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<td>$442 billion</td>
<td>330,000 establishments</td>
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<td>Commercial, Private**</td>
<td>1,840 TBtu/yr $11 billion/yr</td>
<td>$73 billion</td>
<td>$104 billion</td>
<td>57 billion sq ft</td>
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<td>Commercial, State &amp; Local**</td>
<td>860 TBtu/yr $5 billion/yr</td>
<td>$26 billion</td>
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<td>18.2 billion sq ft</td>
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<td>CHP</td>
<td>1,470 TBtu/yr $7.8 billion/yr</td>
<td>$56 billion</td>
<td>$77 billion</td>
<td>50 GW of additional power</td>
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Notes: Savings achieved are net present value (NPV) positive for the 10-year period of 2010-2020. * Not incremental; does not include maintenance costs ** Includes existing buildings and excludes new construction

1 TBtu = 36,000 tce
ENERGY EFFICIENCY AND MANAGEMENT APPROACH IN SME
Energy Management Approach in SME

• STEP 1: Make Commitment
• STEP 2: Assess Performance
• STEP 3: Set Goals
• STEP 4: Create Action Plan
• STEP 5: Implement Action Plan
• STEP 6: Evaluate Progress
• STEP 7: Recognize Achievements

Source: EPA, Energy Star Program
Major Energy Systems in SME

- Motors
- Process heating
- Steam
- Pumps
- HVAC
- Lighting
- Compressed air
Energy Management Personnel in SME Focus Factors

- Training in energy efficiency and management principles
- Dedicated energy management efforts
- Value added per employee for large enterprises is almost twice that for smaller enterprises
- Understanding of energy system operations
- Recognizing the importance of sub metering of utilities
- Ability to quantify energy efficiency measures
- Ability to integrate energy efficiency into the energy management plan
- Preventive maintenance procedures and understanding of overall equipment effectiveness
ENERGY MANAGEMENT PRACTICES
FOCUS ON ENERGY EFFICIENCY
## Energy Efficiency Measures (EEM) With Near Term Return on Investment

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Times Imp</th>
<th>Total Occur.</th>
<th>% Imp</th>
<th>kWh Saved (MMBtu/yr)</th>
<th>NG Saved (MMBtu/yr)</th>
<th>kW Reduced</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>ELIMINATE LEAKS IN INERT GAS AND COMPRESSED AIR LINES/VALVES</td>
<td>4,137</td>
<td>5,142</td>
<td>80%</td>
<td>74,019.85</td>
<td>-</td>
<td>142.49</td>
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<td>2</td>
<td>REDUCE THE PRESSURE OF COMPRESSED AIR TO THE MINIMUM REQUIRED</td>
<td>1,401</td>
<td>2,905</td>
<td>48%</td>
<td>47,256.07</td>
<td>-</td>
<td>133.24</td>
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<tr>
<td>3</td>
<td>UTILIZE HIGHER EFFICIENCY LAMPS AND/OR BALLASTS</td>
<td>1,520</td>
<td>2,443</td>
<td>62%</td>
<td>24,317.93</td>
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<td>UTILIZE ENERGY-EFFICIENT BELTS AND OTHER IMPROVED MECHANISMS</td>
<td>1,309</td>
<td>2,191</td>
<td>60%</td>
<td>25,535.96</td>
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<tr>
<td>5</td>
<td>INSTALL COMPRESSOR AIR INTAKES IN COOLEST LOCATIONS</td>
<td>1,042</td>
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<td>66.12</td>
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<td>ANALYZE FLUE GAS FOR PROPER AIR/FUEL RATIO</td>
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<td>REDUCE ILLUMINATION TO MINIMUM NECESSARY LEVELS</td>
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<td>TURN OFF EQUIPMENT WHEN NOT IN USE</td>
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<td>140,109.80</td>
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<td>862.71</td>
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1 MMBtu = 1.06 GJ

Source: IAC Database, 2011
## Energy Efficiency Measures (EEM) With Medium Term Return on Investment

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<th>Description</th>
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<th>kWh Saved (MMBtu/yr)</th>
<th>NG Saved (MMBtu/yr)</th>
<th>kW Reduced</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>INSTALL OCCUPANCY SENSORS</td>
<td>535</td>
<td>1621</td>
<td>33%</td>
<td>25,383.57</td>
<td>-</td>
<td>55.67</td>
</tr>
<tr>
<td>2</td>
<td>USE MORE EFFICIENT LIGHT SOURCE</td>
<td>752</td>
<td>1402</td>
<td>54%</td>
<td>43,760.79</td>
<td>-</td>
<td>48.78</td>
</tr>
<tr>
<td>3</td>
<td>OPTIMIZE PLANT POWER FACTOR</td>
<td>283</td>
<td>719</td>
<td>39%</td>
<td>1,586.59</td>
<td>-</td>
<td>686.11</td>
</tr>
<tr>
<td>4</td>
<td>INSTALL TIMERS AND/OR THERMOSTATS</td>
<td>356</td>
<td>700</td>
<td>51%</td>
<td>8,633.49</td>
<td>320.46</td>
<td>128.46</td>
</tr>
<tr>
<td>5</td>
<td>USE MULTIPLE SPEED MOTORS OR AFD FOR VARIABLE PUMP, BLOWER AND COMPRESSOR LOADS</td>
<td>199</td>
<td>678</td>
<td>29%</td>
<td>240,297.30</td>
<td>-</td>
<td>128.46</td>
</tr>
<tr>
<td>6</td>
<td>ANALYZE FLUE GAS FOR PROPER AIR/FUEL RATIO</td>
<td>403</td>
<td>634</td>
<td>64%</td>
<td>225.20</td>
<td>590.53</td>
<td>-</td>
</tr>
<tr>
<td>7</td>
<td>RECOVER HEAT FROM AIR COMPRESSOR</td>
<td>181</td>
<td>606</td>
<td>30%</td>
<td>2,129.29</td>
<td>379.38</td>
<td>-</td>
</tr>
<tr>
<td>8</td>
<td>INSULATE STEAM / HOT WATER LINES</td>
<td>322</td>
<td>551</td>
<td>58%</td>
<td>4,693.27</td>
<td>499.29</td>
<td>-</td>
</tr>
<tr>
<td>9</td>
<td>USE WASTE HEAT FROM HOT FLUE GASES TO PREHEAT COMBUSTION AIR</td>
<td>89</td>
<td>464</td>
<td>19%</td>
<td>4,490.02</td>
<td>3,813.92</td>
<td>-</td>
</tr>
<tr>
<td>10</td>
<td>USE POWER FACTOR CONTROLLERS</td>
<td>38</td>
<td>142</td>
<td>27%</td>
<td>15,678.92</td>
<td>-</td>
<td>131.29</td>
</tr>
</tbody>
</table>

1 MMBtu = 1.06 GJ

Source: IAC Database, 2011
## Energy Efficiency Measures (EEM) With Far Term Return on Investment

<table>
<thead>
<tr>
<th>No.</th>
<th>Description</th>
<th>Times Imp</th>
<th>Total Occur.</th>
<th>% Imp</th>
<th>kWh Saved</th>
<th>NG Saved (MMBtu/yr)</th>
<th>kW Reduced</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>USE MOST EFFICIENT TYPE OF ELECTRIC MOTORS</td>
<td>1223</td>
<td>2058</td>
<td>59%</td>
<td>56,479.39</td>
<td>117.17</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>USE OR REPLACE WITH ENERGY EFFICIENT SUBSTITUTES</td>
<td>89</td>
<td>216</td>
<td>41%</td>
<td>85,758.71</td>
<td>206.23</td>
<td>1,568.74</td>
</tr>
<tr>
<td>3</td>
<td>IMPROVE AIR CIRCULATION WITH DESTRATIFICATION FANS / OTHER METHODS</td>
<td>53</td>
<td>205</td>
<td>26%</td>
<td>10,095.38</td>
<td>-</td>
<td>634.10</td>
</tr>
<tr>
<td>4</td>
<td>REPLACE EXISTING HVAC UNIT WITH HIGH EFFICIENCY MODEL</td>
<td>69</td>
<td>183</td>
<td>38%</td>
<td>146,932.87</td>
<td>296.80</td>
<td>87.85</td>
</tr>
<tr>
<td>5</td>
<td>INSTALL SKYLIGHTS</td>
<td>26</td>
<td>174</td>
<td>15%</td>
<td>67,545.13</td>
<td>86.72</td>
<td>-</td>
</tr>
<tr>
<td>6</td>
<td>RECOVER WASTE HEAT FROM EQUIPMENT</td>
<td>37</td>
<td>169</td>
<td>22%</td>
<td>969,341.64</td>
<td>3.23</td>
<td>583.98</td>
</tr>
<tr>
<td>7</td>
<td>USE PROPER THICKNESS OF INSULATION ON BUILDING ENVELOPE</td>
<td>68</td>
<td>168</td>
<td>40%</td>
<td>2,125.52</td>
<td>3.87</td>
<td>1,110.27</td>
</tr>
<tr>
<td>8</td>
<td>USE FLUE GAS HEAT TO PREHEAT BOILER FEEDWATER</td>
<td>29</td>
<td>155</td>
<td>19%</td>
<td>-</td>
<td>-</td>
<td>1,055.06</td>
</tr>
<tr>
<td>9</td>
<td>USE RADIANT HEATER FOR SPOT HEATING</td>
<td>38</td>
<td>152</td>
<td>25%</td>
<td>1,662.57</td>
<td>4.70</td>
<td>1,278.53</td>
</tr>
<tr>
<td>10</td>
<td>USE A FOSSIL FUEL ENGINE TO COGENERATE ELECTRICITY OR MOTIVE POWER; AND UTILIZE HEAT</td>
<td>10</td>
<td>132</td>
<td>8%</td>
<td>5,598,223.44</td>
<td>7,853.71</td>
<td>-49,630.90</td>
</tr>
</tbody>
</table>

1 MMBtu = 1.06 GJ

Source: IAC Database, 2011
## SME Energy Savings

<table>
<thead>
<tr>
<th>Description</th>
<th>Times Recommended</th>
<th>Average Savings</th>
<th>Average Payback (Years)</th>
<th>Implementation %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Combustion Systems</td>
<td>6,434</td>
<td>$25,783</td>
<td>1.3</td>
<td>48.03%</td>
</tr>
<tr>
<td>Thermal Systems</td>
<td>14,810</td>
<td>$20,473</td>
<td>3.5</td>
<td>42.73%</td>
</tr>
<tr>
<td>Electrical Power</td>
<td>4,759</td>
<td>$42,936</td>
<td>1.5</td>
<td>37.15%</td>
</tr>
<tr>
<td>Motor Systems</td>
<td>32,369</td>
<td>$7,021</td>
<td>1.8</td>
<td>57.63%</td>
</tr>
<tr>
<td>Industrial Design</td>
<td>420</td>
<td>$41,694</td>
<td>1.6</td>
<td>35.84%</td>
</tr>
<tr>
<td>Operations</td>
<td>5,108</td>
<td>$6,921</td>
<td>0.6</td>
<td>55.24%</td>
</tr>
<tr>
<td>Building and Grounds</td>
<td>32,590</td>
<td>$6,105</td>
<td>2</td>
<td>49.54%</td>
</tr>
<tr>
<td>Ancillary Costs</td>
<td>2,282</td>
<td>$20,595</td>
<td>1.4</td>
<td>51.49%</td>
</tr>
<tr>
<td>Alternative Energy Usage</td>
<td>199</td>
<td>$103,640</td>
<td>14.3</td>
<td>6.16%</td>
</tr>
</tbody>
</table>

Source: IAC Database, 2011
TECHNOLOGIES THAT SUPPORT ENERGY EFFICIENCY AND MANAGEMENT
Technologies

Modular equipment that enables more flexible operations while achieving enormous energy savings

Isothermal Melting (ITM) Process

- Continuous flow system with immersion heaters that convert electricity to melting energy with 98% efficiency
  - 50% less energy consumption than traditional furnace
  - Zero in-plant emissions
  - April 2006 ribbon-cutting ceremony highlighted scale-up demonstration at a General Motors facility

SuperBoiler

- Gas-fired package boiler incorporating innovative concepts in combustion, heat transfer, heat recovery, and control components
  - Capable of achieving energy efficiencies >94%
  - Field evaluation of firetube boiler initiated in 2006

Source: US DOE
Technologies

- **Dimple-Tube Heat Exchangers**
  - GTI has identified an approach—Vortex Heat Transfer Enhancement (VHTE)—that increases heat transfer without any significant increase in pressure drop.

- **Distributed Wireless Multisensors**
  - Sensors are often used to monitor the efficiency of motors used in Industrial applications to reduce plant power consumption.
  - Distributed wireless technology offers continuous monitoring to both smaller and less critical motors through low-cost, distributed, multi-measure, wireless sensors.

Source: US DOE
Technologies

- **Thermal Imaging Control of High Temperature Furnace**
  - The near-infrared thermal imaging system fine-tunes the main furnace controller for improved combustion performance.

- **Solid State Sensors for Monitoring Hydrogen**
  - Hydrogen-specific sensing systems that can detect hydrogen against virtually any background gases. These hydrogen-sensing devices can detect hydrogen in 1 to 10 seconds, thus allowing the devices to be used in control systems.

*Source: US DOE*
Technologies

- High Efficiency, Low NOx Burners

- Waste Fluid Heat Recovery System
  - A common industrial application is to cool effluent to meet environmental or waste treatment regulations.

Source: US DOE
STRUCTURED ENERGY MANAGEMENT PROTOCOL
Energy Management – ISO 50001

ISO 50001 energy management standard will establish a framework for industrial and commercial facilities and organizations to manage energy.

Potential impacts:
- Could influence up to 60% of the world’s energy use across many economic sectors

Uptake of ISO 50001 will be driven by companies seeking an internationally recognized response to:
- Corporate sustainability programs
- Energy cost reduction initiatives
- Demand created along the manufacturing supply chain
- Future national cap and trade programs; carbon or energy taxes; increasing market value of “green manufacturing” / reduced carbon footprint
- International climate agreements

Status of ISO 50001
- Developed by ISO Project Committee 242; United States and Brazil lead effort with United Kingdom and China
- 56 countries participating, 13 of which are observing
- Published June 15, 2011
- ISO PC 242 transitioned to TC 242, developing standards and guidance related to implementation of ISO 50001

Source: WEEC, 2011
ISO 50001: Model

Source: WEEC, 2011
Energy Performance

It’s all about improving energy performance!

Source: WEEC, 2011
P-D-C-A to ISO 50001

- **PLAN**
  - Policy
  - Management responsibility
  - Energy planning

- **DO**
  - Training
  - Documents
  - Communication
  - Design
  - Operational control
  - Procurement

- **CHECK**
  - Measuring and monitoring
  - Internal auditing
  - Nonconformance, corrective, preventive
  - Records

- **ACT**
  - Management review

Source: Georgia Tech, ISO 50001 Training
Superior Energy Performance

Save Energy Now LEADER Program
Provides resources to companies (usually multiple facilities) that pledge to reduce their energy intensity 25% in 10 years. Guidance and tools can also help plants and companies gain ISO and SEP certification.

ISO 50001 is a foundational tool that any organization can use to manage energy.

Superior Energy Performance
Single facility ISO 50001 conformance with validated energy performance improvement

ISO 50001
Components in place:
• Baseline
• Policy
• Plan
• Team/Leader

ISO 50001
• Plan
• Do
• Check
• Act

Source: Georgia Tech, ISO 50001 Training
Proposed M&V Rigor of SEP

- ISO 50001 Conformance
- SEP Self-Declaration (Partner)
- SEP Remote Review (Registered Partner) Bottom-up spot check
- SEP Onsite Review (Certified Partner) Bottom-up spot check

Utility Validation Requirements
Carbon Trading Validation Requirements

Source: Georgia Tech, ISO 50001 Training
INCENTIVES AND REBATES FOR ENERGY EFFICIENCY AND MANAGEMENT
Federal Resource Database for Energy Efficiency

http://www.eere.energy.gov/industry/states/state_activities/incentive_search.aspx
Federal Resources: Example

- **Energy Efficiency Improvements Loan**
  Loans are available for the purchase of renewable energy generating systems by small rural businesses or agricultural producers.
  **Program Sponsor:** U.S. Department of Agriculture

- **Business and Industry Guaranteed Loans**
  Loans of up to $10 million are available to rural industrial manufacturers to improve the economic and environmental climate in their communities.
  **Program Sponsor:** U.S. Department of Agriculture

- **Renewable Energy Production Incentive (REPI)**
  REPI provides financial incentives of $0.015/kWh of electricity generated from renewable sources. This incentive is issued for the first decade of operation.
  **Program Sponsor:** U.S. Department of Energy

- **ENERGY STAR® for Industry**
  The ENERGY STAR® program is a joint initiative of the U.S. Department of Energy and Environmental Protection Agency which seeks to increase implementation of energy efficient equipment and techniques.
  **Program Sponsor:** U.S. Environmental Protection Agency

Source: US DOE
Federal Resources: Example

- **Combined Heat and Power (CHP)**
  A 10% investment tax credit for CHP property, applicable to only the first 15MW of CHP property.
  **Program Sponsor:** Internal Revenue Service

- **Fuel Cells and Microturbines Tax Incentive**
  Tax credits of up to $3,000 per kWh are available for the purchase of fuel cells, while tax credits of up to $200 per kWh are available for microturbines.
  **Program Sponsor:** Internal Revenue Service

- **Production Tax Credit (PTC)**
  Through the 2009 American Recovery and Reinvestment Act, Congress acted to provide a three-year extension of the PTC through December 31, 2012. Additionally, wind project developers can choose to receive a 30% investment tax credit (ITC) in place of the PTC for facilities placed in service in 2009 and 2010, and also for facilities placed in service before 2013 if construction begins before the end of 2010. The ITC then qualifies to be converted to a grant from the Department of Treasury. The Treasury Department must pay the grant within 60 days of an application being submitted.
  **Program Sponsor:** U.S. Department of the Treasury

Source: US DOE
State Incentives Database

http://www.dsireusa.org/
State and Utility Resources: Example

### Ohio Job Stimulus Plan (Advanced Energy Program)

**Last DSIRE Review:** 12/06/2010

#### Program Overview:

| **State:** | Ohio |
| **Incentive Type:** | Industry Recruitment/Support |
| **Eligible Efficiency Technologies:** | See the website for details |
| **Amount:** | $50,000 to $2 million |
| **Start Date:** | 06/12/2008 |
| **Web Site:** | [http://www.ohioairquality.org/advanced_energy_program](http://www.ohioairquality.org/advanced_energy_program) |
| **Authority 1:** | ORC § 3706.25 et seq |
| **Date Enacted:** | 06/12/2008 |
| **Date Effective:** | 06/12/2008 |

#### Summary:

Source: dsireusa.org
State and Utility Resources: Example

### Ohio Incentives/Policies for Renewables & Efficiency

#### Duke Energy (Electric) - Commercial/Industrial Energy Efficiency Rebate Program

**Program Overview:**
- **State:** Ohio
- **Incentive Type:** Utility Rebate Program

**Applicable Sectors:** Commercial, Industrial, Schools, Institutional

**Amount:** Custom incentives: 50%
- Fluorescent Fixtures: $6-$29
- High Bay Fixtures: $55-$100
- CFL and Metal Halide Fixtures: $50-$75
- Light Tube: $100
- LED Exit Signs: $12/sign
- LED Case Lighting: $50/door ($100/sensor)
- LED Traffic Signals: $12.50-$25
- Occupancy Sensors: $40-$60/sensor
- Air Conditioners: $20-$40/ton
- Heat Pumps: $20-$40/ton
- Room/Sleeve A/C Units: $25-$50/unit
- Heat Pump Water Heaters: $2,000-$9,000/unit
- Programmable Thermostats: $50/unit
- Window Fans: $1/linear foot
- Chillers: $5-$30/ton + additional incentives depending on full load kW/ton and EER
- Chiller Tune Ups: 50%
- Thermal Storage Units: $1900/kW shifted
- Pumps: $122-$400/pump
- VFDs: $45/HP (for process pumping), $100/HP (applied to HVAC equipment)
- Barrel Wraps: $10/unit
- Pellet Dryer Duct Insulation: $1.13-$14/foot
- Engineered Compressed Air Nozzles: $20/unit
- Vending Equipment Controllers: $50
- Head Pressure Controls: $60/unit
- Anti-Sweat Heater Controls: $40/door
- Display Light Covers: $50/ft.
- Commercial Refrigerator: $50-$125
- Ice Machines: $150-$500
- Cooking Equipment: $150-$1000/unit

Source: dsireusa.org
GOVERNMENT ASSISTANCE FOR ENERGY EFFICIENCY AND MANAGEMENT
Energy Efficiency and Management Assistance for SME

U.S. Manufacturing Plants: By Size

Number of U.S. Plants

- Small Plants: 84,298
- Mid-Size Plants: 112,398
- Large Plants: 4,014
- All Plants: 200,710

Annual Energy Consumption

- <26 BBtu
- 26-500 BBtu
- >500 BBtu

Percent of Total Manufacturing Energy

- Large: 58%
- Mid-Size: 37%
- Small: 5%

Source: US DOE
Advanced Manufacturing Office (AMO) Delivers Solutions

Delivering technology solutions to make American industry the global leader in high-impact, clean, efficient, energy technologies and practices.

Collaborative R&D
- Energy-intensive Process Technologies
- Crosscutting Technologies

Technology Delivery
- Assessments
- Training & Tools
- Technology Demonstrations

Source: US DOE
US DOE AMO Mobilized Capabilities and Services

- Suite of respected software tools for assessing plant systems
- Established training programs
- Cadre of Qualified Specialists in various assessment tools/systems
- Network of university-based Industrial Assessment Centers (IACs)
- In-depth experience in conducting plant energy assessments
- Strong partnerships and high credibility with influential companies in the manufacturing sector
US DOE Lab Initiatives

A comprehensive research system employing 30,000+ scientists and engineers

Source: ORNL, 2010
International Activities

International Industrial Energy Efficiency Training and Deployment Project in China, Lawrence Berkeley National Laboratory (LBNL) with the Institute for Sustainable Communities and Oakridge National Laboratory (ORNL)

http://www.iscchina.org/what_we_do/Industrial_Energy_Efficiency

Process heating and steam system energy assessment workshops in China and India from ORNL and LBNL

Development of the Industrial Assessment Center model for China and India by ORNL

Best Practices software tools for improving energy systems in Chinese
Technology R&D: Focus on Energy Efficiency

**Industrial Reaction & Separation**
- Develop technologies for efficient reaction and separation processes

**High-Temperature Processing**
- Develop energy-efficient, high-temperature process technologies for producing metals and non-metallic minerals

**Energy Conversion Systems**
- Develop high-efficiency steam generation and combustion technologies and improved energy recovery technologies

**Fabrication & Infrastructure**
- Develop energy-efficient technologies for making near net-shape finished products from basic materials

Source: US DOE
Energy Assessments Available to SME

- Energy assessments help SME save energy and train the next generation of energy engineers
- Focus on all energy systems
- Energy management
- Advanced energy analysis and diagnostics instrumentation

Source: US DOE
### Identified Energy Savings Through Energy Assessments

**U.S. Energy Savings Results**

The table below shows the overall potential annual savings identified in *Save Energy Now* energy audits.*

<table>
<thead>
<tr>
<th></th>
<th>Large Enterprises</th>
<th>Small or Medium Enterprises</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Average Savings Amount Identified Per Audit</strong></td>
<td>(annual source energy consumption &gt; 0.5 trillion Btu** or 18,000 tce)</td>
<td>(annual source energy consumption &lt; 0.5 trillion Btu or 18,000 tce)</td>
</tr>
<tr>
<td><strong>Cost Savings</strong></td>
<td>$1.4 million USD</td>
<td>$165,000 USD</td>
</tr>
<tr>
<td><strong>Energy (source)</strong></td>
<td>190 billion Btu (6.5%) (6,840 tce)</td>
<td>23 billion Btu (8%) (830 tce)</td>
</tr>
<tr>
<td><strong>Natural Gas</strong></td>
<td>128 billion Btu (4,600 tce)</td>
<td>8.7 billion Btu (313 tce)</td>
</tr>
<tr>
<td><strong>Carbon Dioxide (CO₂)</strong></td>
<td>12,000 metric tons</td>
<td>1,400 metric tons</td>
</tr>
</tbody>
</table>

*Annual savings numbers based on small, medium, and large plant assessments as of September 2010.

**BTU (British Thermal Unit). 1 billion Btu = 36 tce.
Energy Savings Assessments Success

Estimated Payback Periods for Recommended Actions

- **< 9 months**
  - Improve insulation
  - Implement steam trap program
  - Clean heat transfer surfaces

- **9 mo. – 2 years**
  - Heat feed water with boiler blowdown
  - Lower excess oxygen
  - Flue gas heat recovery

- **> 4 years**
  - Install CHP system

- **2 – 4 years**
  - Modify steam turbine operation
  - Use oxygen for combustion
  - Change process steam use

Source: US DOE
IAC Energy Efficiency Recommendations

Source: IAC Database, 2011
Average Estimated Payback on Investment on IAC Recommendations

Source: IAC Database, 2011
Implementation Rates on IAC Recommendations

Source: IAC Database, 2011
Tools Available through DOE – AMO Website

- **Steam System Assessment Tool** Assesses potential benefits of specific steam system improvements.
- **Process Heating Assessment and Survey Tool** Models energy use and ways to improve performance.
- **Steam System Scoping Tool** Profiles and grades large steam system operations and management to find opportunities.
- **International Motor Master** Assists in energy-efficient motor selection and management.
- **Pumping System Assessment Tool** Helps assess the efficiency of pumping system operations.
- **Air Master+** Provides comprehensive information on assessing compressed air systems.
- **3EPlus Insulation Assessment Tool** Calculates most economical insulation thickness under various operating conditions.
- **Fan System Assessment Tool** Assesses efficiency of fan system operations and quantifies benefits of system optimization.
- **Plant Energy Profiler** Helps plants assess plant-wide operation to identify savings and efficiency opportunities.

Source: US DOE
Plant Energy Profiler Tool: ePEP

**INPUTS**
- Plant description
- Utility supply data – electricity, fuel & steam
- Energy consuming system information
- Scorecard responses

**OUTPUTS**
- Overall picture of plant energy use
- Summary of energy cost distributions
- Preliminary assessment & comparison
- Areas or energy efficiency improvement

Source: US DOE
Industrial Energy Savings Recognition From DOE

• Energy efficiency awards were presented to manufacturing facilities in two categories:
  • Energy Champion Plant—More than 250,000 MMBtu total energy savings or more than 15% total energy savings.
  • Energy Saver—More than 75,000 MMBtu total energy savings or more than 7.5% total energy savings.

Source: US DOE
CASE STUDIES FROM ENERGY ASSESSMENTS FOR SME
Case Study – Miba Bearings US, LLC

- Metal fabrication plant in McConnelsville, OH
- Area 136,635 sq. ft.
- Use 100,000 MMBtu of energy annually
- $1.1 Million in annual energy costs
Case Study – Industry (Contd.)

- Energy efficiency recommendations in
  - Boilers
  - Process
  - Compressed air
  - Lighting
  - HVAC
- 9,174 MMBtu/year Implemented energy Savings
- $142,502/year Cost savings
- Investment capital of $124,553
- Payback on investment of less than a year
Power Factor Correction Installation – Cost Savings

• Connected a capacitor bank that was already present in the plant to reduce the excess KVA demand charges.

• Calculation of excess kVA

\[
\text{Excess kVA} = \frac{\text{Billed KW}}{\text{PFavg}} - 1.15 \times \text{Billed KW}
\]

• Excess kVA savings of 5,066 kVA

• Cost savings of $20,264/year

• Installation Cost was low – since company had already one purchased

• 3 Months payback on investment

\[
\begin{align*}
\text{Control Cost} &= $3,000 \\
\text{Engineering Cost} &= $1,000 \\
\text{Labor Cost} &= 10 \text{ labor hrs} \times $49/\text{hr} = $490 \\
\text{Total} &= $4,490
\end{align*}
\]
Adjust Air to Fuel Ratio on Boiler Combustion

• Boiler combustion tuned to have ideal oxygen level in stack gas
• Implemented energy saving, 1,487 MMBtu/year
• Implemented cost saving, $15,167 per year
• Payback on investment, 2 months
Superfros Packaging Energy Assessment

• Plastics packaging plant located in Cumberland, MD
• Annual energy cost, $762,000/year
• Recommended energy savings 2.5 million kWh/year, $179,959/year
• Implemented cost savings, $98,542/year
• Average payback on investment, less than 2 years
• Major implemented recommendation: Insulate mold barrels
Superfos Packaging Energy Assessment

- Insulate mold barrels recommendation
- Implemented energy savings 1.6 million kWh/year
- Implemented cost savings $76,401/year
- Implementation cost, $2,253
- Payback on investment, 2 months

Source: machinerylubrication.com
ENERGY MANAGEMENT CHALLENGES FOR SME
SME Energy Management Challenges

• SME pay more energy cost per production unit as compared to large enterprises
• Lack of in-house technical skills to identify, investigate, and implement energy efficiency opportunities
• Lack of capital
SME Energy Management Challenges

- SME have very high stakes in committing investments
- High energy costs and slim profit margins
- Energy paradox exists
- Often do not use life cycle cost analysis: use payback analysis
- Risk significantly higher compared to larger counterparts: great barrier
- Due to economy of scale, paybacks on investment can be higher on similar energy efficiency opportunities
SME Energy Management Challenges

- No dedicated staff for energy management
- Low investment capital for sub-metering
- Rewards for energy efficiency lower compared to other production related issues
- Lack of energy efficiency awareness
- Uncertainty about future cash flows and changes in product, process, and system parameters
- Primary motivation to continue production and increase value to shareholders, sometimes prevents effective analysis of energy efficient alternatives
Future Directions for EMAK

- Foster synergistic partnerships and support for SME efforts in energy management
- Enable effective energy management training possibilities for SME personnel
- Support output based emissions regulations that promote energy efficiency
- Widespread dissemination of successful energy management case studies
- Support the availability of incentives and rebates for energy efficiency
Thank you! Questions?