

**Table 1. Top R&D Opportunities for Energy Savings in Commodity/Process Manufacturing**

Initiatives that provide the largest energy and dollar savings.

Type of Opportunity	Leading Industry Recipients	Total Energy Savings		Total Cost Savings	
		(Trillion Btu)	Percent of Total	(\$mil.)	Percent of Total***
<b>Waste heat and energy recovery:</b>		<b>1,831</b>	<b>35</b>	<b>\$6,408</b>	<b>34</b>
• From gases and liquids (including hot gas cleanup and dehydration of liquid waste streams).	chemicals, petroleum, forest products	851	16	2,271	12
• From drying processes.	chemicals, forest products, food processing	377	7	1,240	7
• From gases in metals and non-metallic minerals manufacture-excluding calcining (including hot gas cleanup).	iron and steel, cement	235	5	1,133	6
• From by-product gases.	petroleum, iron and steel	132	3	750	4
• From using energy export and co-location (i.e., fuels from pulp mills, forest bio-refineries, co-location of energy sources/sinks).	forest products	105	2	580	3
• From calcining (not flue gases).	cement, forest products	74	1	159	1
• From metal quenching/cooling processes.	iron and steel, cement	57	1	275	1
<b>Improvements to boilers, fired systems, process heaters and cooling opportunities</b>		<b>907</b>	<b>17</b>	<b>\$3,077</b>	<b>16</b>
Advanced industrial boilers	chemicals, forest products, petroleum, steel, food processing	400	8	1,090	6
Improved heating/heat transfer systems (i.e., heat exchangers, new materials, improved heat transport).	petroleum, chemicals	260	5	860	5
Improved heating/heat transfer for metals, melting, heating, annealing (i.e., cascade heating, batch to continuous process, improved heat channeling, modular systems).	iron and steel, metal casting, aluminum	190	4	915	5
Advanced process cooling and refrigeration	food processing, chemicals, petroleum and forest products	57**	1	212	1
<b>Energy system integration and best practices opportunities</b>		<b>1,438</b>	<b>28</b>	<b>\$5,655</b>	<b>30</b>
Steam best practices (i.e., improved generation, distribution and recovery), not including advanced boilers.*	all manufacturing	310	6	850	5
Pump system optimization*	all manufacturing	302**	6	1,370	7
Energy system integration*	chemicals, petroleum, forest products, iron and steel, food, aluminum	260	5	860	5
Energy efficient motors and rewind practices*	all manufacturing	258**	5	1,175	6
Compressed air system optimization*	all manufacturing	163**	3	740	4
Optimized materials processing*	all manufacturing	145**	3	660	3
<b>Energy source flexibility and combined heat and power</b>		<b>828</b>	<b>16</b>	<b>\$3,100</b>	<b>16</b>
Combined heat and power onsite in manufacturers' central plants, producing both thermal and electricity needs.*	forest products, chemicals, food processing, metals, machinery	634	12	2,000	11
Energy source flexibility (i.e., heat-activated power generation, waste steam for mechanical drives, indirect vs. direct heat vs. steam).*	chemicals, petroleum, forest products, iron and steel	194	4	1,100	6
<b>Energy source flexibility and combined heat and power</b>	chemicals, petroleum, forest products, iron and steel, food, cement, aluminum	<b>191</b>	<b>4</b>	<b>\$630</b>	<b>3</b>
<b>TOTALS</b>		<b>5,195</b>		<b>\$18,870</b>	

Source: Department of Energy Industrial Technologies Program, Energy Use, Loss, and Opportunities Analysis, U.S. Manufacturing &amp; Mining, December 2004.

NOTE: All are R&amp;D opportunities EXCEPT items denoted by an asterisk (\*), which are near-term best practices, are applicable to current assets.

\*\* Energy savings figures include the corresponding recapture of losses inherent in electricity generation, transmission and distribution.

\*\*\*Totals may not equal 100 percent due to rounding.