

Assumptions to the Annual Energy Outlook 2006

Table 17. Industry Categories

Energy-Intensive Manufacturing		Nonenergy-Intensive Manufacturing		Nonmanufacturing Industries	
Food Products	(NAICS 311)	Metal-Based Durables	(NAICS 332-336)	Agricultural Production -Crops	(NAICS 111)
Paper and Allied Products	(NAICS 322)	Balance of Manufacturing	(all remaining manufacturing NAICS)	Other Agriculture Including Livestock	(NAICS 112-115)
Bulk Chemicals				Coal Mining	(NAICS 2121)
Inorganic	(NAICS 32512 to 32518)				
Organic	(NAICS 32511, 32519)				
Resins	(NAICS 3252)				
Agricultural	(NAICS 3253)				
Glass and Glass Products	(NAICS 3272)			Oil and Gas Extraction	(NAICS 211)
Cement	(NAICS 32731)			Metal and Other Nonmetallic Mining	(NAICS 2122-2123)
Iron and Steel	(NAICS 3311-3312)			Construction	(NAICS 233-235)
Aluminum	(NAICS 3313)				

NAICS = North American Industry Classification System.

Source: Office of Management and Budget, North American Industry Classification System (NAICS) - United States (Springfield, VA, National Technical Information Service).

Table 18. Coefficients for Technology Possibility Curve

Industry/Process Unit	Existing Facilities		New Facilities		
	REI 2030 ¹	TPC ²	REI 2002 ³	REI 2030 ⁴	TPC ²
Food Products					
Process Heating	0.900	-0.0038	0.900	0.800	-0.0042
Process Cooling	0.875	-0.0048	0.850	0.750	-0.0045
Other	0.914	-0.0032	0.915	0.810	-0.0043
Paper & Allied Products					
Wood Preparation	0.792	-0.0083	0.882	0.701	-0.0082
Waste Pulping	0.936	-0.0024	0.936	0.936	-0.0000
Mechanical Pulping	0.816	-0.0072	0.931	0.701	-0.0101
Semi-chemical	0.954	-0.0017	0.971	0.937	-0.0013
Kraft, Sulfite, misc. Chemicals	0.870	-0.0049	0.914	0.827	-0.0036
Bleaching	0.798	-0.0080	0.878	0.719	-0.0071
Paper Making	0.869	-0.0050	0.885	0.852	-0.0014
Bulk Chemicals					
Process Heating	0.900	-0.0038	0.900	0.800	-0.0042
Process Cooling	0.875	-0.0048	0.850	0.750	-0.0045
Electro-Chemical	0.980	-0.0007	0.950	0.850	-0.0040
Other	0.914	-0.0032	0.915	0.810	-0.0043
Glass & Glass Products⁵					
Batch Preparation	0.941	-0.0022	0.882	0.882	0.0000
Melting/Refining	0.934	-0.0024	0.900	0.868	-0.0013
Forming	0.984	-0.0006	0.982	0.968	-0.0005
Post-Forming	0.978	-0.0008	0.968	0.955	-0.0005
Cement					
Dry Process	0.905	-0.0036	0.900	0.810	-0.0038
Wet Process ⁶	0.951	-0.0018	NA	NA	NA
Finish Grinding	0.975	-0.0009	0.950	0.950	0.0000
Iron and Steel					
Coke Oven ⁸	0.935	-0.0024	0.902	0.869	-0.0013
BF/BOF	0.994	-0.0002	0.987	0.987	0.0000
EAF	0.955	-0.0028	0.990	0.849	0.0055
Ingot Casting/Primary Rolling ⁶	1.000	0.0000	NA	NA	NA
Continuous Casting ⁷	1.000	0.0000	1.000	1.000	0.0000
Hot Rolling ⁷	0.826	-0.0068	0.800	0.652	-0.0073
Cold Rolling ⁷	0.737	-0.0108	0.924	0.474	-0.0236
Aluminum					
Alumina Refining	0.930	-0.0026	0.900	0.860	-0.0016
Primary Smelting	0.900	-0.0038	0.950	0.800	-0.0061
Secondary	0.875	-0.0048	0.850	0.750	-0.0045
Semi-Fabrication, Sheet	0.900	-0.0038	0.900	0.800	-0.0042
Semi-Fabrication, Other	0.925	-0.0028	0.950	0.850	-0.0040
Metal-Based Durables					
Process Heating	0.900	-0.0038	0.900	0.800	-0.0042
Process Cooling	0.900	-0.0038	0.900	0.800	-0.0042
Other	0.900	-0.0038	0.900	0.800	-0.0042

Table 18. Coefficients for Technology Possibility Curves (Continued)

Industry/Process Unit	Existing Facilities		New Facilities		
	REI 2030 ¹	TPC ²	REI 2002 ³	REI 2030 ⁴	TPC ²
Balance of Manufacturing					
Process Heating	0.900	-0.0038	0.900	0.800	-0.0042
Process Cooling	0.900	-0.0038	0.900	0.800	-0.0042
Other	0.900	-0.0038	0.900	0.800	-0.0042

¹REI 2030 Existing Facilities = Ratio of 2030 energy intensity to average 2002 energy intensity for existing facilities.

²TPC = annual rate of change between 2002 and 2030.

³REI 2002 New Facilities = For new facilities, the ratio of state-of-the-art energy intensity to average 2002 energy intensity for existing facilities.

⁴REI 2030 New Facilities = Ratio of 2030 energy intensity for a new state-of-the-art facility to the average 2002 intensity for existing facilities.

⁵REIs and TPCs apply to virgin and recycled materials.

⁶No new plants are likely to be built with these technologies.

⁷Net shape casting is projected to reduce the energy requirements for hot and cold rolling rather than for the continuous casting step.

NA = Not applicable.

BF = Blast furnace.

BOF = Basic oxygen furnace.

EAF = Electric arc furnace.

Source: Energy Information Administration, *Model Documentation Report, Industrial Sector Demand Module of the National Energy Modeling System*, DOE/EIA-M064(2006) (Washington, DC, 2006).

Table 19. Cost and Performance Parameters for Industrial Motor Choice Model

Industrial Sector Horsepower Range	2002 Stock Efficiency (%)	EPACT Minimum Efficiency (%)	EPACT Minimum Cost (2002\$)	Premium Efficiency (%)	Premium Cost (2002\$)
Food					
1 - 5 hp	81.3	86.7	327	88.9	351
6 - 20 hp	87.1	91.4	901	92.7	947
21 - 50 hp	90.1	92.6	1,448	93.7	1,618
51 - 100 hp	92.7	94.4	3,338	95.1	3,430
101 - 200 hp	93.5	94.6	6,734	95.9	7,670
201 - 500 hp	93.8	93.4	12,147	96.1	13,560
> 500 hp	93.0	94.8	19,148	na	na
Bulk Chemicals					
1 - 5 hp	82.0	86.9	327	89.1	351
6 - 20 hp	87.4	91.6	901	92.9	947
21 - 50 hp	90.4	92.7	1,448	93.8	1,618
51 - 100 hp	92.4	94.4	3,338	95.2	3,430
101 - 200 hp	93.5	94.7	6,734	96.0	7,670
201 - 500 hp	93.3	93.6	12,147	96.1	13,560
> 500 hp	93.2	94.9	19,148	na	na
Metal-Based Durables					
1 - 5 hp	81.9	86.8	327	88.9	351
6 - 20 hp	87.0	91.5	901	92.8	947
21 - 50 hp	90.0	92.6	1,448	93.8	1,618
51 - 100 hp	92.0	94.4	3,338	95.1	3,430
101 - 200 hp	93.5	94.6	6,734	95.9	7,670
201 - 500 hp	93.7	93.5	12,147	96.1	13,560
> 500 hp	93.0	94.8	19,148	na	na
Balance of Manufacturing					
1 - 5 hp	82.9	86.8	327	88.9	351
6 - 20 hp	88.3	91.5	901	92.8	947
21 - 50 hp	90.3	92.6	1,448	93.8	1,618
51 - 100 hp	92.7	94.4	3,338	95.1	3,430
101 - 200 hp	94.3	94.6	6,734	95.9	7,670
201 - 500 hp	94.3	93.5	12,147	96.1	13,560
> 500 hp	92.9	94.8	19,148	na	na

Source: Energy Information Administration, *Model Documentation Report, Industrial Sector Demand Module of the National Energy Modeling System*, DOE/EIA-M064(2006) (Washington, DC, 2006).

Note: The efficiencies listed in this table are operating efficiencies based on average part-loads. Because the average part-load is not the same for all industries, the listed efficiencies for the different motor sizes vary across industries.

**Table 20. 2002 Building Component Energy Consumption
(Trillion Btu)**

Industry	Region	Building Use and Energy Source				Facility Support Total Consumption	Onsite Transportation Total Consumption
		Lighting Electricity Consumption	HVAC Electricity Consumption	HVAC Natural Gas Consumption	HVAC Steam Consumption		
Food Products	1	1.6	1.7	4.0	1.4	0.6	0.9
	2	7.2	7.7	16.9	4.5	3.5	1.2
	3	5.8	6.2	12.1	6.4	2.7	2.1
	4	2.5	2.7	7.5	3.6	1.5	1.8
Paper & Allied Products	1	1.9	2.0	3.6	0.0	0.6	0.9
	2	3.5	3.7	6.4	0.0	0.9	1.2
	3	7.1	7.5	14.0	0.0	2.0	2.6
	4	2.9	3.1	3.4	0.0	0.7	0.7
Bulk Chemicals	1	1.7	2.1	1.4	0.0	0.7	1.1
	2	3.2	3.8	1.9	0.0	1.1	0.5
	3	12.2	14.7	15.8	0.0	6.1	5.9
	4	0.9	1.1	1.1	0.0	0.4	0.1
Glass & Glass Products	1	0.3	0.5	2.2	0.0	0.5	0.5
	2	0.6	0.9	2.1	0.0	0.1	0.1
	3	0.8	1.3	3.3	0.0	0.9	0.9
	4	0.2	0.4	0.9	0.0	0.1	0.1
Cement	1	0.1	0.1	0.1	0.0	0.1	0.7
	2	0.2	0.2	0.4	0.0	0.2	1.5
	3	0.4	0.4	0.6	0.0	0.3	1.5
	4	0.2	0.2	0.3	0.0	0.1	1.4
Iron & Steel	1	0.6	0.7	3.4	0.0	0.6	0.8
	2	2.1	2.6	8.1	0.0	1.6	6.5
	3	2.0	2.5	3.2	0.0	0.9	0.9
	4	0.4	0.4	0.3	0.0	0.1	0.0
Aluminum	1	0.3	0.4	0.7	0.0	0.2	0.1
	2	0.8	1.1	1.6	0.0	0.6	0.1
	3	1.5	2.1	3.7	0.0	1.2	1.2
	4	0.3	0.4	0.5	0.0	0.2	0.0
Metal-Based Durables	1	12.6	18.3	28.4	14.8	4.7	1.2
	2	32.3	46.8	95.0	44.9	12.1	3.5
	3	23.7	34.4	47.3	25.8	8.4	3.3
	4	11.1	16.1	16.7	10.4	3.7	1.1
Balance of Manufacturing	1	8.3	11.2	18.5	12.2	3.0	2.2
	2	21.1	28.3	37.3	27.0	7.8	4.5
	3	36.2	48.4	70.3	48.8	12.1	10.5
	4	10.1	13.5	22.7	14.9	3.4	6.8

HVAC = Heating, Ventilation, Air Conditioning.

Source: Energy Information Administration, *Model Documentation Report: Industrial Demand Module of the National Energy Modeling System*, DOE/EIA-M064(2006), (Washington, DC, 2006).

Table 21. 2002 Boiler Fuel Consumption and Logit Parameter
(trillion Btu)

Industry	Region	Alpha	Natural Gas	Coal	Oil	Renewables
Food Products	1	-1.50	28	2	5	2
	2	-1.50	125	154	4	15
	3	-1.50	86	10	3	33
	4	-1.50	53	13	4	6
Paper & Allied Products	1	-1.50	56	2	30	87
	2	-1.50	64	75	8	103
	3	-1.50	157	128	58	864
	4	-1.50	48	14	7	164
Bulk Chemicals	1	-1.50	41	3	10	0
	2	-1.50	86	31	18	0
	3	-1.50	663	180	319	0
	4	-1.50	48	27	3	0
Glass & Glass Products	1	-1.50	0	0	6	2
	2	-1.50	1	0	0	1
	3	-1.50	1	0	9	1
	4	-1.50	0	0	0	0
Cement	1	-1.50	0	1	0	0
	2	-1.50	0	2	0	0
	3	-1.50	0	3	0	0
	4	-1.50	0	2	0	0
Iron & Steel	1	-1.50	10	1	0	0
	2	-1.50	24	1	0	67
	3	-1.50	9	0	0	22
	4	-1.50	1	0	0	10
Aluminum	1	-1.50	2	0	0	1
	2	-1.50	5	0	0	0
	3	-1.50	10	0	0	8
	4	-1.50	2	0	0	0
Metal-Based Durables	1	-1.50	18	21	5	9
	2	-1.50	63	0	1	13
	3	-1.50	31	0	2	3
	4	-1.50	11	0	1	1
Balance of Manufacturing	1	-1.50	40	1	5	15
	2	-1.50	87	89	4	125
	3	-1.50	153	21	31	158
	4	-1.50	47	6	2	69

Alpha: User-specified.

Source: Energy Information Administration, *Model Documentation Report: Industrial Sector Demand Module of the National Energy Modeling System*, DOE/EIA-064(2006), (Washington, DC, 2006).

Table 22. Cost Characteristics of Industrial CHP Systems

System	Size (kilowatts)	Installed Cost (\$2003 per kilowatt) ¹		O&M Cost (\$2003 per kilowatthour) ¹	
		2003	2030	2003	2030
1 Engine	1000	940	800	0.009	0.008
2 Engine	3000	935	790	0.009	0.008
3 Gas Turbine	1000	1910	NA	0.010	NA
4 Gas Turbine	5000	1024	810	0.006	0.005
5 Gas Turbine	10000	930	760	0.006	0.004
6 Gas Turbine	25000	800	680	0.005	0.004
7 Gas Turbine	40000	702	640	0.004	0.004
8 Combined Cycle	100000	692	655	0.004	0.003

¹Costs are given in 2003 dollars in original source document.

NA = The 1000 kilowatt gas turbine is not expected to be a viable option in the future.

Source: Energy Information Administration, *Model Documentation Report: Industrial Sector Demand Module of the National Energy Modeling System*, DOE/EIA-MO64(2006) (Washington, DC, 2006).

Table 23. Retirement Rates

Industry	Retirement Rate (percent)	Industry	Retirement Rate (percent)
Food Products	1.7	Glass and Glass Products	1.3
Pulp and Paper	2.3	Cement	1.2
Bulk Chemicals	1.7	Aluminum	
Iron & Steel		Metal-Based Durables	
Blast Furnace and Basic Steel Products	1.5	Other Non-Intensive Manufacturing	
Electric Arc Furnace	1.5		
Coke Ovens	2.5		
Other Steel	2.9		

Note: Except for the Blast Furnace and Basic Steel Products Industry, the retirement rate is the same for each process step or end-use within an industry.

Source: Energy Information Administration, *Model Documentation Report: Industrial Sector Demand Module of the National Energy Modeling System*, DOE/EIA-MO64(2006), (Washington, DC, 2006).

Table 24. Coefficients for Technology Possibility Curves, High Technology Case

Industry/Process Unit	Existing Facilities		New Facilities	
	REI 2030 ¹	TPC ²	REI 2030 ³	TPC ²
Food Products				
Process Heating	0.889	-0.004	0.702	-0.009
Process Cooling	0.889	-0.004	0.702	-0.009
Other	0.889	-0.004	0.702	-0.009
Paper & Allied Products				
Wood Preparation	0.747	-0.010	0.532	-0.018
Waste Pulp	0.898	-0.004	0.800	-0.006
Mechanical Pulp	0.771	-0.009	0.580	-0.017
Semi-chemical	0.948	-0.002	0.777	-0.008
Kraft, Sulfite, misc. Chemicals (a)	0.827	-0.007	0.549	-0.018
Bleaching	0.758	-0.010	0.627	-0.012
Paper Making	0.766	-0.009	0.451	-0.024
Bulk Chemicals				
Process Heating	0.897	-0.004	0.710	-0.009
Process Cooling	0.897	-0.004	0.710	-0.009
Electro-Chemical	0.897	-0.004	0.710	-0.009
Other	0.897	-0.004	0.710	-0.009
Glass & Glass Products⁴				
Batch Preparation	0.941	-0.002	0.819	-0.003
Melting/Refining	0.822	-0.007	0.449	-0.025
Forming	0.965	-0.001	0.826	-0.006
Post-Forming	0.971	-0.001	0.865	-0.004

Table 24. Coefficients for Technology Possibility Curves, High Technology Case (Continued)

Industry/Process Unit	Existing Facilities			
	REI 2030 ¹	TPC ²	REI 2030 ⁴	TPC ²
Cement				
Dry Process	0.800	-0.008	0.531	-0.019
Wet Process ⁶	0.894	-0.004	NA	NA
Finish Grinding	0.850	-0.006	0.600	-0.016
Iron & Steel				
Coke Oven ⁵	0.845	-0.006	0.637	-0.012
BF/BOF	0.950	-0.002	0.785	-0.008
EAF	0.845	-0.006	0.655	-0.015
Ingot Casting/Primary Rolling ⁵	1.000	-0.000	NA	NA
Continuous Casting ⁵	1.000	-0.000	1.000	0.000
Hot Rolling ⁶	0.761	-0.010	0.337	-0.030
Cold Rolling ⁶	0.706	-0.012	0.400	-0.029
Aluminum				
Alumina Refining	0.915	-0.003	0.576	-0.016
Primary Smelting	0.800	-0.008	0.522	-0.021
Secondary	0.825	-0.007	0.376	-0.029
Semi-Fabrication, Sheet/plate/foil	0.750	-0.010	0.457	-0.024
Semi-Fabrication, Other	0.825	-0.007	0.467	-0.025
Metal-Based Durables				
Process Heating	0.894	-0.004	0.697	-0.010
Process Cooling	0.894	-0.004	0.697	-0.010
Other	0.894	-0.004	0.697	-0.010
Balance of Manufacturing				
Process Heating	0.892	-0.004	0.701	-0.009
Process Cooling	0.892	-0.004	0.701	-0.009
Other	0.892	-0.004	0.701	-0.009

¹REI 2030 Existing Facilities = Ratio of 2030 energy intensity to average 2002 energy intensity for existing facilities.

²TPC = annual rate of change between 2002 and 2030.

³REI 2030 New Facilities = Ratio of 2030 energy intensity for a new State-of-the-art facility to the average 2002 intensity for existing facilities.

⁴REIs and TPCs apply to virgin and recycled materials.

⁵No new plants are likely to be built with these technologies.

⁶Net shape casting is projected to reduce the energy requirements for hot and cold rolling rather than for the continuous casting step.

NA = Not applicable.

BF = Blast furnace.

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