

## Text Notes

### Overview

1. For the complete text of the Energy Policy Act of 2005, see web site [http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=109\\_cong\\_public\\_laws&docid=f:publ058.109.pdf](http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=109_cong_public_laws&docid=f:publ058.109.pdf).
2. Full hybrids include an integrated starter-generator that allows improved efficiency by shutting the engine off when the vehicle is idling and an electric motor that provides tractive power to the vehicle when it is moving. Mild hybrids include only an integrated starter.
3. Energy Information Administration, *Impacts of Modeled Recommendations of the National Commission on Energy Policy*, SR/OIAF/2005-02 (Washington, DC, April 2005), web site [www.eia.doe.gov/oiaf/servicertp/bingaman](http://www.eia.doe.gov/oiaf/servicertp/bingaman), and *Energy Market Impacts of Alternative Greenhouse Gas Intensity Reduction Goals*, SR/OIAF/2006-01 (Washington, DC, March 2006), web site [www.eia.doe.gov/oiaf/service\\_rpts.htm](http://www.eia.doe.gov/oiaf/service_rpts.htm).

### Legislation and Regulations

4. E85 is a fuel containing a blend of 70 to 85 percent ethanol and 30 to 15 percent gasoline by volume.
5. The ethanol tax credit was first established in 1978. It has been extended in 1980, 1983, 1984, 1990, 1998, and 2005.
6. The PTC was subsequently extended in 1999, 2002, 2004, and 2005. Some extensions have included significant modifications, including changes in eligible resources, changes in the value and duration of the credit for certain resources, and changes in the treatment of the credit with respect to the Alternative Minimum Tax.
7. Regional Greenhouse Gas Initiative, "Model Rule & Amended Memorandum of Understanding" (August 2006), web site [www.rggi.org/modelrule.htm](http://www.rggi.org/modelrule.htm).
8. Regional Greenhouse Gas Initiative, "Memorandum of Understanding" (December 2005), web site [www.rggi.org/agreement.htm](http://www.rggi.org/agreement.htm).
9. For the complete text of the Energy Policy Act of 2005, see web site [http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=109\\_cong\\_public\\_laws&docid=f:publ058.109.pdf](http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=109_cong_public_laws&docid=f:publ058.109.pdf).
10. Energy Information Administration, "EPACT2005 Summary," *Annual Energy Outlook 2006*, DOE/EIA-0383(2006) (Washington, DC, February 2006), pp. 15-22, web site [www.eia.doe.gov/oiaf/archive/aeo06](http://www.eia.doe.gov/oiaf/archive/aeo06).
11. See, for example, web site [http://energy.senate.gov/public/\\_files/PostConferenceBillSummary.doc](http://energy.senate.gov/public/_files/PostConferenceBillSummary.doc).
12. U.S. Department of Transportation, National Highway Traffic Safety Administration, "Average Fuel Economy Standards for Light Trucks Model Years 2008-2011," 49 CFR Parts 523, 533 and 537 (Docket No. 2006-24306, RIN 2127-AJ61), web site [www.nhtsa.dot.gov/staticfiles/DOT/NHTSA/Rulemaking/Rules/Associated%20Files/2006FinalRule.pdf](http://www.nhtsa.dot.gov/staticfiles/DOT/NHTSA/Rulemaking/Rules/Associated%20Files/2006FinalRule.pdf).
13. Energy Information Administration, "Proposed Revisions to Light Truck Fuel Economy Standards," *Annual Energy Outlook 2006*, DOE/EIA-0383(2006) (Washington, DC, February 2006), pp. 23-24, web site [www.eia.doe.gov/oiaf/archive/aeo06](http://www.eia.doe.gov/oiaf/archive/aeo06).
14. U.S. Environmental Protection Agency, "Standards of Performance for Stationary Compression Ignition Internal Combustion Engines," 40 CFR Parts 60, 85, 89, 94, 1039, 1065, and 1068 (EPA-HQ-OAR-2005-0029, FRL-8190-7, RIN 2060-AM82), web site [www.epa.gov/fedrgstr/EPA-AIR/2006/July/Day-11/a5968.htm](http://www.epa.gov/fedrgstr/EPA-AIR/2006/July/Day-11/a5968.htm).
15. See Energy Information Administration, "Clean Air Nonroad Diesel Rule," *Annual Energy Outlook 2005*, DOE/EIA-0383(2005) (Washington, DC, February 2005), pp. 14-17, web site [www.eia.doe.gov/oiaf/archive/aeo05](http://www.eia.doe.gov/oiaf/archive/aeo05).
16. Transition regulations apply to engines constructed or ordered after July 11, 2005, and manufactured after April 1, 2006.
17. The regulations specify different time tables and limits for emergency and fire pump engines.
18. Alpha-Gamma Technologies, Inc., "Population and Projection of Stationary Engines" (Memorandum, June 20, 2005), p. 3, web site [www.epa.gov/ttn/atw/nsps/cinsps/nsps\\_population\\_projection4.pdf](http://www.epa.gov/ttn/atw/nsps/cinsps/nsps_population_projection4.pdf).
19. Energy Policy Act of 2005, Section 1501. For complete text, see web site [http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=109\\_cong\\_public\\_laws&docid=f:publ058.109.pdf](http://frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=109_cong_public_laws&docid=f:publ058.109.pdf).
20. Energy Information Administration, "Status and Impact of State MTBE Bans" (March 2003), p. 1, web site <http://tonto.eia.doe.gov/FTPROOT/service/mtbe.pdf>.
21. U.S. Environmental Protection Agency, "State Actions Banning MTBE" (June 2004), web site [www.epa.gov/mtbe/420b04009.pdf](http://www.epa.gov/mtbe/420b04009.pdf).
22. The Federal motor fuels excise tax credit for blending ethanol has been in place since 1978, at 51 cents per gallon. Its expiration date has been extended several times by Congress. Most recently, the American Jobs Creation Act of 2004, Section 301, extended the credit through 2010.
23. U.S. Department of Energy, Energy Efficiency and Renewable Energy, "Federal Fleet Requirements" (May 2006), web site [www1.eere.energy.gov/vehiclesandfuels/epact/federal](http://www1.eere.energy.gov/vehiclesandfuels/epact/federal).
24. The requirement is actually for 2.7 percent oxygen by weight, which corresponds to 7.7 percent ethanol by volume. See Minnesota Department of Agriculture, "Economic Impact of the Ethanol Industry in Minnesota" (May 2003), p. 8, web site [www.mda.state.mn.us/ethanol/economicimpact.pdf](http://www.mda.state.mn.us/ethanol/economicimpact.pdf).
25. State of Hawaii, "New-Fuel.com—Your Source for Information About Hawaii's Transition to Ethanol-Blended Fuel," web site [www.hawaii.gov/dbedt/ert/new-fuel](http://www.hawaii.gov/dbedt/ert/new-fuel).
26. National Biodiesel Board, "Minnesota Diesel Now Contains Two Percent Biodiesel Statewide" (Press

## Notes and Sources

---

- Release, September 29, 2005), web site [www.biodiesel.org/resources/pressreleases/gen/20050929\\_mn\\_mandate\\_implemented.pdf](http://www.biodiesel.org/resources/pressreleases/gen/20050929_mn_mandate_implemented.pdf).
27. National Biodiesel Board, "Washington State Adopts Biodiesel Requirement" (Press Release, March 30, 2006), web site [www.biodiesel.org/resources/pressreleases/gen/20060330\\_WA\\_B2.pdf](http://www.biodiesel.org/resources/pressreleases/gen/20060330_WA_B2.pdf).
  28. Green Car Congress, "Louisiana Legislature Passes 2% Renewable Fuels Standard" (June 9, 2006), web site [www.greencarcongress.com/2006/06/louisiana\\_legis.html](http://www.greencarcongress.com/2006/06/louisiana_legis.html).
  29. State of Louisiana, "Governor Blanco Signs HB 685" (Press Release, June 12, 2006), web site [www.gov.state.la.us/index.cfm?md=newsroom&tmp=detail&articleID=1945](http://www.gov.state.la.us/index.cfm?md=newsroom&tmp=detail&articleID=1945).
  30. Testimony of Robert Carroll, Deputy Assistant Secretary, Tax Analysis, U.S. Department of the Treasury, before the Subcommittee on Highways, Transit, and Pipelines, Committee on Transportation and Infrastructure, U.S. House of Representatives (April 4, 2006).
  31. Testimony of Donald Marron, Acting Director, Congressional Budget Office, before the Subcommittee on Highways, Transit, and Pipelines, Committee on Transportation and Infrastructure, U.S. House of Representatives (April 4, 2006).
  32. The U.S. Department of Defense maintains a detailed compilation of Federal, State, and local fuel taxes, inspection fees, and other environmental taxes and fees that apply to the sale of fuel. This compilation, which was last updated in August 2006, can be found at web site [www.desc.dla.mil/DCM/Files/Tax\\_compilation\\_2006-12.doc](http://www.desc.dla.mil/DCM/Files/Tax_compilation_2006-12.doc).
  33. The ethanol tax credit was first established in 1978 and has been modified or extended in 1980, 1983, 1984, 1990, 1998, and 2005.
  34. D. Nilles, R. Kotrba, J. Williams, and T. Bryan, "A Boost for Biodiesel," *Biodiesel Magazine* (August/September 2005), web site [www.biodieselmagazine.com/article.jsp?article\\_id=376](http://www.biodieselmagazine.com/article.jsp?article_id=376).
  35. Eligible wind, poultry litter, geothermal, and certain hydroelectric and biomass facilities can claim the full 1.9-cent tax credit. Facilities burning eligible waste streams, including municipal waste, landfill gases, agricultural and landscaping residues, and forestry and mill wastes receive one-half the value of the credit given to other facilities, currently 0.95 cents.
  36. Expiration on June 30, 1999, reauthorized on December 17, 1999; expiration on December 31, 2001, reauthorized on March 9, 2002; expiration on December 31, 2003, reauthorized on October 4, 2004. Reauthorized on August 8, 2005, before scheduled expiration at the end of 2005. Current expiration scheduled for December 31, 2007.
  37. Energy Information Administration, "State Renewable Energy Requirements and Goals: Update Through 2005," *Annual Energy Outlook 2006*, DOE/EIA-0383(2006) (Washington, DC, February 2006), pp. 24-27, web site [www.eia.doe.gov/oiaf/archive/aeo06](http://www.eia.doe.gov/oiaf/archive/aeo06).
  38. E-mail communication with Ray Williamson, Arizona Corporation Commission, August 28, 2006.
  39. Arizona Corporation Commission, "In the Matter of the Proposed Rulemaking for the Renewable Energy Standard and Tariff Rules," Docket No. RE-00000C-05-0030, web site [www.cc.state.az.us/utility/electric/RES-03-14-06.pdf](http://www.cc.state.az.us/utility/electric/RES-03-14-06.pdf) (March 14, 2006).
  40. California Public Utilities Commission, "Renewable Energy," web site [www.cpuc.ca.gov/static/energy/electric/renewableenergy](http://www.cpuc.ca.gov/static/energy/electric/renewableenergy).
  41. California Energy Commission, *Renewable Energy Program: Overall Program Guidebook*, CEC-300-2006-008-F (Sacramento, CA, April 2006), web site [www.energy.ca.gov/2006publications/CEC-300-2006-008/CEC-300-2006-008-F.pdf](http://www.energy.ca.gov/2006publications/CEC-300-2006-008/CEC-300-2006-008-F.pdf).
  42. See web sites [www.leginfo.ca.gov/pub/bill/sen/sb\\_0101-0150/sb\\_107\\_bill\\_20060926\\_history.html](http://www.leginfo.ca.gov/pub/bill/sen/sb_0101-0150/sb_107_bill_20060926_history.html) and [www.leginfo.ca.gov/pub/bill/sen/sb\\_0101-0150/sb\\_107\\_bill\\_20060926\\_chaptered.pdf](http://www.leginfo.ca.gov/pub/bill/sen/sb_0101-0150/sb_107_bill_20060926_chaptered.pdf).
  43. State of Connecticut, "An Act Concerning Biomass," Substitute Senate Bill No. 212, Public Act No. 06-74, web site [www.cga.ct.gov/2006/ACT/PA/2006PA-00074-R00SB-00212-PA.htm](http://www.cga.ct.gov/2006/ACT/PA/2006PA-00074-R00SB-00212-PA.htm).
  44. State of Maine, "An Act To Enhance Maine's Energy Independence and Security," Chapter 677, H.P. 1439 - L.D. 2041, web site [www.mainelegislature.org/legis/bills/chapdocs/PUBLIC677.doc](http://www.mainelegislature.org/legis/bills/chapdocs/PUBLIC677.doc).
  45. Commonwealth of Massachusetts, Office of Consumer Affairs and Business Regulation, "Policy Statement on the RPS Eligibility of Retooled Biomass Plants" (October 27, 2005), web site [www.mass.gov/doer/rps/rps-pol-stat-elig-biomass.pdf](http://www.mass.gov/doer/rps/rps-pol-stat-elig-biomass.pdf).
  46. Commonwealth of Massachusetts, Office of Consumer Affairs and Business Regulation, "Annual RPS Compliance Report for 2004" (January 9, 2006), web site [www.mass.gov/doer/rps/rps-2004annual-rpt.pdf](http://www.mass.gov/doer/rps/rps-2004annual-rpt.pdf).
  47. Public Utilities Commission of Nevada, "Revised Adopted Regulation of the Public Utilities Commission of Nevada," LCB File No. R167-05 (February 23, 2006), web site [www.leg.state.nv.us/Register/2005Register/R167-05RA.pdf](http://www.leg.state.nv.us/Register/2005Register/R167-05RA.pdf).
  48. New Jersey Board of Public Utilities, New Jersey Administrative Code Title 14, Chapter 8, Subchapter 2, "Renewable Portfolio Standards (RPS) Rules Adoption" (April 13, 2006), web site [www.state.nj.us/bpu/wwwroot/secretary/RPS\\_148.2.pdf](http://www.state.nj.us/bpu/wwwroot/secretary/RPS_148.2.pdf).
  49. Wisconsin State Legislature, "Engrossed 2005 Senate Bill 459" (February 22, 2006), web site [www.legis.state.wi.us/2005/data/SB-459eng.pdf](http://www.legis.state.wi.us/2005/data/SB-459eng.pdf).
  50. Note that the *AEO2007* reference case is based on the California legislative target (as of September 1, 2006) of 10 percent by 2017. Legislation accelerating the deadline to 2010 was signed into law too late to be included in the *AEO2007* projections.
  51. *Federal Register*, Vol. 70, No. 91 (May 12, 2005), 40 CFR Parts 51, 72, 73, 74, 77, 78, and 96.

52. *Federal Register*, Vol. 70, No. 95 (May 18, 2005), 40 CFR Parts 60, 72, and 75.
53. Energy Information Administration, "Federal Air Emissions Regulations," *Annual Energy Outlook 2006*, DOE/EIA-0383(2006) (Washington, DC, February 2006), pp. 28-29, web site [www.eia.doe.gov/oiaf/archive/aeo06](http://www.eia.doe.gov/oiaf/archive/aeo06).
54. State and Territorial Air Pollution Program Administrators (STAPPA) and the Association of Local Air Pollution Control Officials (ALAPCO), "State Mercury Programs for Utilities" (August/September 2006), web site [www.4cleanair.org/StateTable.doc](http://www.4cleanair.org/StateTable.doc).
55. State of Maine, "States Reach Agreement on Proposed Rules for the Nation's First Cap-and-Trade Program to Address Climate Change" (Press Release, August 15, 2006), web site <http://mobile.maine.gov/news/?sid=22966>.
56. M. Finnegan and M. Lifsher, "State's Greenhouse Gas Bill Signed," *Los Angeles Times* (September 27, 2006).
57. F. Barringer, "Officials Reach California Deal To Cut Emissions," *New York Times* (August 31, 2006).
58. West Coast Governors' Global Warming Initiative, web site [www.ef.org/westcoastclimate](http://www.ef.org/westcoastclimate).

### Issues in Focus

59. The *AEO2007* near-term world oil prices (for 2006 and 2007) are those published in EIA's September 2006 *Short-Term Energy Outlook*, web site [www.eia.doe.gov/pub/forecasting/steo/oldsteos/sep06.pdf](http://www.eia.doe.gov/pub/forecasting/steo/oldsteos/sep06.pdf).
60. The USGS provides three point estimates for undiscovered and inferred resources: the mean, a 5-percent confidence interval, and a 95-percent confidence interval, with no price relationship. *AEO2007* assumes that proven reserves are not subject to much uncertainty.
61. Includes crude oil, condensates, natural gas liquids, and refinery gains.
62. M.S. Crandall, *Energy, Economics, and Politics in the Caspian Region* (Westport, CT: Praeger Security International, 2006), p. 64.
63. International Energy Agency, *Oil Market Report* (October 6, 2006), p. 24, web site <http://omrpublic.iea.org>.
64. BP, *Statistical Review of World Energy 2006*, web site [www.bp.com/productlanding.do?categoryId=6842&contentId=7021390](http://www.bp.com/productlanding.do?categoryId=6842&contentId=7021390) (October 12, 2006).
65. Global Insight, "Brazil Country Brief" (October 18, 2006).
66. International Energy Agency, *Oil Market Report* (October 6, 2006), p. 22, web site <http://omrpublic.iea.org>.
67. American Petroleum Institute, *Joint Association Survey on Drilling Costs* (1996-2004), web site [www.api.org/statistics/accessapi/surveys/survey-description.cfm](http://www.api.org/statistics/accessapi/surveys/survey-description.cfm).
68. This well category—that is, a natural gas development well drilled between 7,500 feet and 9,999 feet—was chosen because: (1) about 75 percent of the wells drilled in the United States are natural gas wells; (2) more than 18 development wells are drilled for every exploration well; (3) exploration wells can have significant and unforeseen cost overruns, whereas the drilling of development wells is a more routine operation; and (4) the depth category of 7,500 to 9,999 feet accounts for the greatest number and proportion of natural gas development wells drilled. Consequently, this category is reasonably representative of the oil industry overall.
69. ODS-Petrodata, Inc., web site <https://www.ods-petrodata.com/RigPoint>.
70. *Oil & Gas Journal*, Nelson-Farrar Cost Indices (published quarterly in January, April, July, and October).
71. Source: Bureau of Labor Statistics, Seasonally Adjusted Producer Price Indices (PPI), Series WPS101. In May 2002, the iron and steel PPI was 112.9; by June 2006 it had risen to 194.0 (preliminary).
72. Baker-Hughes, Inc., "North American Rotary Rig Count," web site [www.bhinet.com/investor/rig/rig\\_na.htm](http://www.bhinet.com/investor/rig/rig_na.htm).
73. U.S. Census Bureau, web site [www.census.gov/industry/ma333f05.xls](http://www.census.gov/industry/ma333f05.xls), product code 3331311 for underground mining machinery.
74. Peabody Energy, Inc., web site [www.peabodyenergy.com/pdfs/05\\_AR\\_FINANCIALS.pdf](http://www.peabodyenergy.com/pdfs/05_AR_FINANCIALS.pdf).
75. Peabody Energy, Inc., web site [www.peabodyenergy.com/pdfs/05\\_AR\\_FINANCIALS.pdf](http://www.peabodyenergy.com/pdfs/05_AR_FINANCIALS.pdf).
76. CONSOL Energy, web site [http://media.corporate-ir.net/media\\_files/irol/66/66439/pdfs/AR05.pdf](http://media.corporate-ir.net/media_files/irol/66/66439/pdfs/AR05.pdf).
77. Massey Energy Company, web site <http://library.corporate-ir.net/library/10/102/102864/items/195646/2005AR.pdf>.
78. The subsidiaries of Joy Global manufacture mining machinery that includes continuous miners, longwall shearers, powered roof supports, armored face conveyors, shuttle cars, flexible conveyor trains, roof bolters, electric mining shovels, rotary blasthole drills, and walking draglines.
79. R. Barrett, "Mining Boom Brightens Joy Global Profits, Developments in China," *Milwaukee Journal Sentinel* (February 25, 2005).
80. BNSF Railway, 2005 Annual Report, web site [www.bnsf.com/investors/annualreports/2005annrpt.pdf](http://www.bnsf.com/investors/annualreports/2005annrpt.pdf).
81. BNSF Railway, 2005 Annual Report, web site [www.bnsf.com/investors/annualreports/2005annrpt.pdf](http://www.bnsf.com/investors/annualreports/2005annrpt.pdf).
82. Toby Kolstad, Rail Theory Forecasts, LLC, personal communication, October 22, 2006.
83. "Acquisitions by Railroads and Others," *Progressive Railroading*, Vol. 48, No. 5 (May 2005), p. 49.
84. Imputed from the number and value of backlogged orders reported in Freight Car America's 2005 Annual Report, web site [www.johnstownamerica.com](http://www.johnstownamerica.com).
85. Freight Car America, 2005 Annual Report, web site [www.johnstownamerica.com](http://www.johnstownamerica.com).
86. P. Foran, "Powergrabs: Traffic Volumes Prompt Railroads To Pursue Locomotive Power—and Lots of It,"

## Notes and Sources

---

- Progressive Railroading*, Vol. 48, No. 5 (May 2005), pp. 50-51.
87. BNSF Railway, 2005 Annual Report, web site [www.bnsf.com/investors/annualreports/2005annrpt.pdf](http://www.bnsf.com/investors/annualreports/2005annrpt.pdf).
88. Surface Transportation Board, U.S. Department of Transportation, "Statistics of Class I Freight Railroads in the United States," web site [www.stb.dot.gov/econdata.nsf](http://www.stb.dot.gov/econdata.nsf).
89. BNSF Railway, 2005 Annual Report, web site [www.bnsf.com/investors/annualreports/2005annrpt.pdf](http://www.bnsf.com/investors/annualreports/2005annrpt.pdf).
90. Reviews of energy demand elasticities include C. Dahl, *A Survey of Energy Demand Elasticities in Support of the Development of the NEMS*, Contract Number DE-AP01-93EI23499 (Washington, DC, October 1993).
91. Federal Energy Regulatory Commission, *Assessment of Demand Response and Advanced Metering*, Staff Report, Docket AD-06-2-000 (Washington, DC, August 2006), web site [www.ferc.gov/legal/staff-reports/demand-response.pdf](http://www.ferc.gov/legal/staff-reports/demand-response.pdf).
92. Energy Information Administration, Commercial Buildings Energy Consumption Survey (2003 data), web site [www.eia.doe.gov/emeu/cbecs](http://www.eia.doe.gov/emeu/cbecs).
93. L.J. Sandahl, T.L. Gilbride, M.R. Ledbetter, H.E. Steward, and C. Calwell, *Compact Fluorescent Lighting in America: Lessons Learned on the Way to Market*, PNNL-15730 (Richland, WA: Pacific Northwest National Laboratory, June 2006), web site [www.eere.energy.gov/buildings/info/documents/pdfs/cfl\\_lessons\\_learned\\_web.pdf](http://www.eere.energy.gov/buildings/info/documents/pdfs/cfl_lessons_learned_web.pdf).
94. Web sites [www.energystar.gov](http://www.energystar.gov) and [www.eere.energy.gov/buildings/building\\_america](http://www.eere.energy.gov/buildings/building_america).
95. K.A. Hanson, "Seasonality of Moves and Duration of Residence," U.S. Census Bureau, Current Population Reports, Household Economic Studies (October 1998), web site [www.census.gov/prod/3/98pubs/p70-66.pdf](http://www.census.gov/prod/3/98pubs/p70-66.pdf).
96. R. Nevin and G. Watson, "Evidence of Rational Market Valuations for Home Energy Efficiency," *Appraisal Journal* (October 1998).
97. Apparently, some very low-cost projects are never undertaken. See S.T. Anderson and R.G. Newell, "Information Programs for Technology Adoption: The Case of Energy-Efficiency Audits," *Resource and Energy Economics*, Vol. 26, No. 1 (March 2004), pp. 27-50. See web site [www.rff.org/~newell/ResEnergyEcon.pdf](http://www.rff.org/~newell/ResEnergyEcon.pdf).
98. R.B. Lung, A. McKane, and M. Olszewski, "Industrial Motor System Optimization Projects in the US: An Impact Study," TAPPI, web site [www.tappi.org/s\\_tappi/sec\\_publications.asp?CID=4583&DID=510344](http://www.tappi.org/s_tappi/sec_publications.asp?CID=4583&DID=510344); and U.S. Department of Energy, Office of Industrial Technologies, "Georgia Pacific's Insulation Upgrade Leads to Reduced Fuel Costs and Increased Process Efficiency," web site [www1.eere.energy.gov/industry/bestpractices/pdfs/insulation.pdf](http://www1.eere.energy.gov/industry/bestpractices/pdfs/insulation.pdf).
99. Based on data from the U.S. Census Bureau's 2004 Annual Survey of Manufactures, published in *Statistics for Industry Groups and Industries: 2004*, M04(AS)-1 (Washington, DC, December 2005), web site [www.census.gov/mcd/asm-as1.html](http://www.census.gov/mcd/asm-as1.html).
100. Based on data from EIA's 2002 Manufacturing Energy Consumption Survey (MECS), Tables 10.2 to 10.13, web site [www.eia.doe.gov/emeu/mecs/mecs2002/data02/shelltables.html](http://www.eia.doe.gov/emeu/mecs/mecs2002/data02/shelltables.html). Petrochemical feedstocks are not reported separately in MECS but are included in this calculation.
101. See W.A. Pizer, W. Harrington, R.J. Kopp, R.D. Morgenstern, and J-S Shih, "Technology Adoption and Aggregate Energy Efficiency," Discussion Paper 02-52 (Washington, DC: Resources for the Future, December 2002), web site [www.rff.org/Documents/RFF-DP-02-52.pdf](http://www.rff.org/Documents/RFF-DP-02-52.pdf).
102. Electricity demand for commercial office equipment is an end-use category separate from miscellaneous consumption.
103. TIAX LLC, *Commercial and Residential Sector Miscellaneous Electricity Consumption: Y2005 and Projections to 2030*, EIA contract report (September 2006).
104. The decline in electricity use per unit is driven by the new California standard that requires less electricity use while in standby mode, which accounts for more than 99 percent of hours of use over the course of a year. See California Energy Commission, *2006 Appliance Efficiency Regulations*, CEC-400-2006-002 (Sacramento, CA, January 2006).
105. Alaska's former governor, Frank Murkowski, supported 20-percent equity ownership for the State, which would also bear 20 percent of the construction costs.
106. The Northern Pipeline Act awarded Foothills Pipe Lines Ltd. the certificate for construction of the Canadian portion of the Alaska Natural Gas Transportation System along the Alaska Highway. After the passage of the Northern Pipeline Act, TransCanada purchased Foothills Pipe Line.
107. BP, ExxonMobil, and ConocoPhillips, "Alaska Producer Pipeline Update" (May 2002), Slide 15, web site [www.arcticgaspipeline.com/Reference/Documents&Presentations/ProducerInformation/5-02AlaskaProducerUpdate.ppt](http://www.arcticgaspipeline.com/Reference/Documents&Presentations/ProducerInformation/5-02AlaskaProducerUpdate.ppt).
108. U.S. Department of Labor, Bureau of Labor Statistics, Seasonally Adjusted Producer Price Indices (PPI), Series WPS101. In May 2002 the PPI for iron and steel was 112.9; in June 2006 it was 194.0.
109. Energy Information Administration, "Coal Distribution Back Issues," web site [www.eia.doe.gov/cneaf/coal/page/coalistrib/coal\\_distributions.html](http://www.eia.doe.gov/cneaf/coal/page/coalistrib/coal_distributions.html).
110. EIA's coal distribution data for 2004 indicate that the mode of transportation for 28 million tons (3 percent) of domestic coal shipments was "unknown."
111. Energy Information Administration, "Coal Transportation: Rates and Trends in the United States, 1979-2001 (with Supplementary Data to 2002)," Table 2.06, web site [www.eia.doe.gov/cneaf/coal/page/trans/ratesntrends.html](http://www.eia.doe.gov/cneaf/coal/page/trans/ratesntrends.html).

112. U.S. Senate, Committee on Energy and Natural Resources, "Coal-Based Generation Reliability," Statement of David Wilks, President of Energy Supply, Xcel Energy, on behalf of the Edison Electric Institute and Consumers United for Rail Equity (May 25, 2006).
113. Average transportation rates are imputed from the difference between average delivered prices, excluding imports, and average minemouth prices.
114. BNSF Railway Company, Quarterly Report (June 30, 2006) web site [www.bnsf.com/investors/secfilings/10Q\\_Railway\\_2Q\\_2006.pdf](http://www.bnsf.com/investors/secfilings/10Q_Railway_2Q_2006.pdf).
115. U.S. Government Accountability Office, *Freight Railroads: Industry Health Has Improved, But Concerns about Competition and Capacity Should Be Addressed*, GAO-07-94 (Washington, DC, October 2006), web site [www.gao.gov/new.items/d0794.pdf](http://www.gao.gov/new.items/d0794.pdf).
116. U.S. Senate, Subcommittee on Surface Transportation and Merchant Marine, "Economics, Service and Capacity in the Freight Railroad Industry," Statement of W. Douglas Buttrey, Chairman, Surface Transportation Board (June 21, 2006).
117. Surface Transportation Board, web site [www.stb.dot.gov](http://www.stb.dot.gov).
118. N. Carey, "Margins, Fuel Charges Boost Union Pacific 4th Qtr," Reuters.com (January 2006).
119. Norfolk Southern, web site [www.nscorp.com/nscorphtml/marketing/pricing/NS8003\\_terms.html](http://www.nscorp.com/nscorphtml/marketing/pricing/NS8003_terms.html).
120. CSX, web site [http://shipesx.com/public/ec.shipcsxpublic/Main?module\\_url=/ec.pricingpublic/About](http://shipesx.com/public/ec.shipcsxpublic/Main?module_url=/ec.pricingpublic/About).
121. Surface Transportation Board Decision, *Rail Fuel Surcharges*, Ex Parte No. 661 (August 3, 2006), web site [www.stb.dot.gov](http://www.stb.dot.gov).
122. Surface Transportation Board, *Rail Fuel Surcharge*, Comments of BNSF Railway (October 2, 2006).
123. "CSX STB Fuel Surcharge Filing" (October 3, 2006) web site [www.csx.com](http://www.csx.com).
124. U.S. Senate, Committee on Energy and Natural Resources, "Coal-Based Generation Reliability," Statement of Howard Gruenspecht, Deputy Administrator, Energy Information Administration (May 25, 2006).
125. R. Smith and D. Machalaba, "As Utilities Seek More Coal, Railroads Struggle To Deliver," *Wall Street Journal* (March 15, 2006), p. A1; and "Coal Stocks Outperform S&P, Metals Securities," *Platts Coal Trader* (November 15, 2005), pp. 2-3.
126. S. Bobb, Group Vice President of Coal Marketing, BNSF Railway, "June 2006 Coal Update," paper presented to staff at the Energy Information Administration (Washington, DC, June 27, 2006).
127. U.S. Senate, Committee on Energy and Natural Resources, "Coal-Based Generation Reliability," Statement of Edward Hamberger, President and Chief Executive Officer, Association of American Railroads (May 15, 2006); and S. Bobb, Group Vice President of Coal Marketing, BNSF Railway, "June 2006 Coal Update," paper presented to staff at the Energy Information Administration (Washington, DC, June 27, 2006).
128. A.J. Cebula, Vice President of Planning & Engineering, CANAC Inc., "Southern Powder River Basin, BNSF/UP Joint Line, Towards Sustainable Operations of 500 mmT," paper presented at the National Coal Transportation Association Annual Fall Meeting & Conference (Denver, CO, September 13, 2006).
129. "CANAC Sees 50 Percent Jump in SPRB Output by 2012," *Argus Coal Transportation*, Vol. 25, No. 17 (September 14, 2006), p. 1.
130. Personal communication to EIA from Doug Conway, General Manager—Coal, DM&E and IC&E Railroads (November 16, 2006).
131. O. Port, "Not Your Father's Ethanol," *Business Week* (February 21, 2005), web site [www.businessweek.com/magazine/content/05\\_08/b3921117.htm](http://www.businessweek.com/magazine/content/05_08/b3921117.htm).
132. National Renewable Energy Laboratory, *Lignocellulosic Biomass to Ethanol Process Design and Economics Utilizing Co-Current Dilute Acid Prehydrolysis and Enzymatic Hydrolysis for Corn Stover*, NREL/TP-510-32438 (Golden, CO, June 2002), web site [www.nrel.gov/docs/fy02osti/32438.pdf](http://www.nrel.gov/docs/fy02osti/32438.pdf).
133. National Biodiesel Board, "Biodiesel—Commonly Asked Questions," web site [www.nbb.org/pdf\\_files/fuelfactsheets/CommonlyAsked.PDF](http://www.nbb.org/pdf_files/fuelfactsheets/CommonlyAsked.PDF).
134. U.S. Department of Energy, Energy Efficiency and Renewable Energy, Alternative Fuels Data Center, "State and Federal Incentives and Laws," web site [www.eere.energy.gov/afdc/progs/view\\_ind\\_mtx.cgi?in/TAX/US/0](http://www.eere.energy.gov/afdc/progs/view_ind_mtx.cgi?in/TAX/US/0).
135. U.S. Department of Agriculture, *The Economic Feasibility of Ethanol Production from Sugar in the United States* (Washington, DC, July 2006), Table 19, web site [www.usda.gov/oce/EthanolSugarFeasibilityReport3.pdf](http://www.usda.gov/oce/EthanolSugarFeasibilityReport3.pdf).
136. U.S. Department of Agriculture, *USDA's 2002 Ethanol Cost-of-Production Survey* (Washington, DC, July 2005), Table 3, web site [www.usda.gov/oce/reports/energy/USDA\\_2002\\_ETHANOL.pdf](http://www.usda.gov/oce/reports/energy/USDA_2002_ETHANOL.pdf).
137. Promar International, *Evaluation and Analysis of Vegetable Oil Market: The Implication of Increased Demand for Industrial Uses on Markets & USB Strategy* (November 2005), pp. 37-41, web site [www.nbb.org/resources/reportsdatabase/reports/gen/20051101\\_gen-368.pdf](http://www.nbb.org/resources/reportsdatabase/reports/gen/20051101_gen-368.pdf).
138. National Renewable Energy Laboratory, *Biomass Oil Analysis: Research Needs and Recommendations*, NREL/TP-510-34796 (June 2004), Table 23, web site [www.nrel.gov/docs/fy04osti/34796.pdf](http://www.nrel.gov/docs/fy04osti/34796.pdf).
139. In 2005, the wholesale price of gasoline was imputed to be \$1.74 per gallon and the wholesale price of diesel \$1.78 per gallon. In 2012, the average U.S. wholesale prices are projected to be \$1.52 and \$ 1.48 per gallon, respectively, as some of the unusual margins of the refinery market are projected to return to the historical pattern.
140. U.S. Department of Agriculture, *USDA's 2002 Ethanol Cost-of-Production Survey* (Washington, DC, July

## Notes and Sources

---

- 2005), Table 3, web site [www.usda.gov/oce/reports/energy/USDA\\_2002\\_ETHANOL.pdf](http://www.usda.gov/oce/reports/energy/USDA_2002_ETHANOL.pdf).
141. S. Howell, "Time To Take the Biodiesel Plunge?" *Ren-der Magazine* (February 2005), pp. 10-14.
142. R. Pruszko, "Rendered Fats and Oils as a Biodiesel Feedstock: The Opportunities and Challenges," *Ren-der Magazine* (February 2006), pp. 10-12.
143. K. Collins, Chief Economist, U.S. Department of Agri-culture, "Statement Before the U.S. Senate Commit-tee on Agriculture, Nutrition, and Forestry" (January 10, 2007), p. 2, web site [www.usda.gov/oce/newsroom/congressional\\_testimony/Collins\\_011007.pdf](http://www.usda.gov/oce/newsroom/congressional_testimony/Collins_011007.pdf).
144. A. Baker and S. Zahniser, "Ethanol Reshapes the Corn Market," *Amber Waves Magazine*, Vol. 4, No. 2 (2006), pp. 30-35, web site [www.ers.usda.gov/AmberWaves/April06/Features/Ethanol.htm](http://www.ers.usda.gov/AmberWaves/April06/Features/Ethanol.htm).
145. Promar International, *Evaluation and Analysis of Vegetable Oil Market: The Implication of Increased Demand for Industrial Uses on Markets & USB Strat-egy* (November 2005), pp. 25-35, web site [www.nbb.org/resources/reportsdatabase/reports/gen/20051101\\_gen-368.pdf](http://www.nbb.org/resources/reportsdatabase/reports/gen/20051101_gen-368.pdf).
146. U.S. Department of Agriculture, *2002 Census of Agri-culture* (Washington, DC, June 2004), Vol. 1, Chapter 1, "U.S. National Level Data," Table 8, "Land: 2002 and 1997," web site [www.nass.usda.gov/census/census02/volume1/us/st99\\_1\\_008\\_008.pdf](http://www.nass.usda.gov/census/census02/volume1/us/st99_1_008_008.pdf).
147. U.S. Department of Agriculture, *Summary Report: 1997 National Resources Inventory* (Washington, DC, December 2000), Figure 1, "How Our Land Is Used, 1997," web site [www.nrcs.usda.gov/Technical/NRI/1997/summary\\_report/figures.html#figure1](http://www.nrcs.usda.gov/Technical/NRI/1997/summary_report/figures.html#figure1).
148. For a description of the Conservation Reserve Pro-gram, see web site [www.nrcs.usda.gov/programs/crp](http://www.nrcs.usda.gov/programs/crp).
149. U.S. Department of Agriculture, Baseline Projection (Washington, DC, February 2006), Tables 8 and 13, "Planted Acres, 2005/06 Marketing Year."
150. Historic crop yields tabulated by U.S. Department of Agriculture, National Agriculture Statistics Service, web site [www.nass.usda.gov/Data\\_and\\_Statistics/Quick\\_Stats/index.asp](http://www.nass.usda.gov/Data_and_Statistics/Quick_Stats/index.asp).
151. Average yield increase calculated from 30-year historic data supplied by U.S. Department of Agriculture, National Agriculture Statistics Service.
152. U.S. Department of Agriculture and U.S. Department of Energy, *Biomass as a Feedstock for a Bioenergy and Bioproducts Industry: The Technical Feasibility of a Billion-Ton Annual Supply*, DOE/GO-102995-2135 (Washington, DC, April 2005), web site [http://feedstockreview.ornl.gov/pdf/billion\\_ton\\_vision.pdf](http://feedstockreview.ornl.gov/pdf/billion_ton_vision.pdf).
153. Renewable Fuels Association, *From Niche to Nation: Ethanol Industry Outlook 2006* (Washington, DC, Feb-ruary 2006), pp. 14-15, web site [www.ethanolrfa.org/objects/pdf/outlook/outlook\\_2006.pdf](http://www.ethanolrfa.org/objects/pdf/outlook/outlook_2006.pdf).
154. Promar International, *Evaluation and Analysis of Vegetable Oil Market: The Implication of Increased Demand for Industrial Uses on Markets & USB Strat-egy* (November 2005), pp. 25-35, web site [www.nbb.org/resources/reportsdatabase/reports/gen/20051101\\_gen-368.pdf](http://www.nbb.org/resources/reportsdatabase/reports/gen/20051101_gen-368.pdf).
155. National Biodiesel Board, "Biodiesel Production," web site [www.nbb.org/pdf\\_files/fuelfactsheets/Production.pdf](http://www.nbb.org/pdf_files/fuelfactsheets/Production.pdf).
156. F. Luxem, "Glycerin as a C-3 Raw Material," pre-sented at the 2006 National Biodiesel Conference.
157. National Corn Grower's Association, "How Much Eth-anol Can Come From Corn?" (May 2006), web site [www.ncga.com/ethanol/pdfs/2006/HowMuchEthanolCanComeFromCorn.v.2.pdf](http://www.ncga.com/ethanol/pdfs/2006/HowMuchEthanolCanComeFromCorn.v.2.pdf).
158. U.S. Department of Agriculture, "Agricultural Base-line Projections 2006-2015," web site [www.ers.usda.gov/Briefing/Baseline/crops.htm](http://www.ers.usda.gov/Briefing/Baseline/crops.htm).
159. National Corn Growers Association, "U.S. Corn Usage by Segment, 2005" (pie chart), web site [www.ncga.com/WorldOfCorn/main/consumption1.asp](http://www.ncga.com/WorldOfCorn/main/consumption1.asp).
160. U.S. Department of Energy, Energy Efficiency and Renewable Energy, Alternative Fuels Data Center, web site [www.eere.energy.gov/afdc/progs/reg\\_matrx.cgi](http://www.eere.energy.gov/afdc/progs/reg_matrx.cgi).
161. K. Collins, Chief Economist, U.S. Department of Agri-culture, "Statement before the U.S. Senate Committee on Environment and Public Works" (September 6, 2006), p. 8, web site [www.usda.gov/oce/newsroom/congressional\\_testimony/Biofuels\\_Testimony\\_9-6-2006.doc](http://www.usda.gov/oce/newsroom/congressional_testimony/Biofuels_Testimony_9-6-2006.doc).

### Market Trends

162. The year 2004 was used as the end point (as opposed to 2005, which is the base year of the *AEO2007* projec-tions) because of the precipitous drop in industrial energy consumption between 2004 and 2005 caused by the impact of hurricanes Katrina and Rita.
163. When the reference case industrial energy intensity projections are decomposed using the Divisia index, structural change accounts for 61 percent of the pro-jected change in energy intensity. A discussion of the index can be found in Boyd et al., "Separating the Changing Effects of U.S. Manufacturing Production from Energy Efficiency Improvements," *Energy Jour-nal*, Vol. 8, No. 2 (1987).
164. The refining portion of the industrial sector is pro-jected to become more energy-intensive over time. Its energy intensity is projected to increase as a result of declining crude oil quality, higher quality products, and the use of alternative inputs and technologies to produce liquid fuels. Coal-to-liquids and biofuel tech-niques are more energy-intensive than standard refin-ing processes.
165. The alternative technology cases change technology characterizations only for sectors represented in the NEMS industrial model. Consequently, in the technol-ogy cases portrayed in Figure 48, refining values are unchanged from those in the reference case projec-tions. The petroleum refining industry displays a range of intensity changes in other alternative *AEO-2007* cases but responds differently from the other

industrial subsectors. For example, because of increased CTL production in the high price case, energy intensity in the petroleum refining industry is higher than in the reference case. In all the other industrial subsectors, energy intensity is lower in the high price case.

166. S.C. Davis and S.W. Diegel, *Transportation Energy Data Book: Edition 25*, ORNL-6974 (Oak Ridge, TN, May 2006), Chapter 3, “All Highway Vehicles and Characteristics,” web site <http://cta.ornl.gov/data/chapter3.shtml>.
167. Unless otherwise noted, the term “capacity” in the discussion of electricity generation indicates utility, nonutility, and combined heat and power capacity. Costs reflect the weighted average of regional costs.
168. Does not include off-grid photovoltaics (PV). Based on annual PV shipments from 1989 through 2004, EIA estimates that as much as 167 megawatts of remote PV applications for electricity generation (off-grid power systems) was in service in 2004, plus an additional 447 megawatts in communications, transportation, and assorted other non-grid-connected, specialized applications. See Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006), Table 10.6 (annual PV shipments, 1989-2004). The approach used to develop the estimate, based on shipment data, provides an upper estimate of the size of the PV stock, including both grid-based and off-grid PV. It overestimates the size of the stock, because shipments include a substantial number of units that are exported, and each year some of the PV units installed earlier are retired from service or abandoned.
169. Avoided cost estimates the incremental cost of fuel and capacity displaced by a unit of the specified resource and more accurately reflects its as-dispatched energy value than comparison to the levelized cost of other individual technologies. It does not reflect system reliability cost, nor does it necessarily indicate the lowest cost alternative for meeting system energy and capacity needs.
170. Although cellulosic ethanol technology currently is not a commercially proven process, researchers and developers are vigorously pursuing cost reduction goals in the technology and production processes that would substantially exceed those considered in the *AEO2007* “lower cost” cases. These even lower production cost goals may be possible, but it is uncertain at present whether, and when, the technology advances necessary to achieve the lowest of the production cost goals will occur. Nevertheless, even the relatively modest reductions in production costs assumed in the *AEO-2007* “lower cost” cases can be seen to result in a significant increase in cellulosic ethanol production.
171. CAIR mandates SO<sub>2</sub> emissions caps in 28 eastern and midwestern States and the District of Columbia. The first compliance period begins in 2010, and a second, more stringent cap takes effect in 2015.

172. The first milestone for reducing NO<sub>x</sub> emissions from electric power generation becomes effective in 2009. A lower limit is mandated for 2015.

173. The Phase I mercury cap is 38 short tons, beginning in 2010. The Phase II cap is 15 short tons, beginning in 2018.

### Comparison with Other Projections

174. Because EVA reports a 2005 price of \$8.84 (2005 dollars per thousand cubic feet), its projection actually shows a greater decline relative to the reported 2005 price than does the *AEO2007* reference case.

175. A delivered natural gas price margin equals the end-use sector natural gas price minus the wellhead natural gas price.

176. It should be noted that the 2005 industrial price reported by the other organizations is about a dollar higher than that reported in *AEO2007*.

### Table Notes and Sources

**Note:** Tables indicated as sources in these notes refer to the tables in Appendixes A, B, C, and D of this report.

**Table 1. Total energy supply and disposition in the *AEO2007* and *AEO2006* reference cases, 2005-2030:**

**AEO2006:** AEO2006 National Energy Modeling System, run AEO2006.D111905A. **AEO2007:** AEO2007 National Energy Modeling System, run AEO2007.D112106A. **Notes:** Quantities are derived from historical volumes and assumed thermal conversion factors. Other production includes liquid hydrogen, methanol, and some inputs to refineries. Net imports of petroleum include crude oil, petroleum products, unfinished oils, alcohols, ethers, and blending components. Other net imports include coal coke and electricity.

**Table 2. Changes in Standard Offer Supply price determinations by supply region and State:** Brubaker and Associates, Inc., “Customer Choice Update: State by State Summary of Restructuring Activities Around the Nation,” in *Retail Competition Struggles As Fuel Costs Rise And Rate Caps Expire* (Spring 2006), web site [www.consultbai.com/publications/newsletter/spring06\\_newsletter.pdf](http://www.consultbai.com/publications/newsletter/spring06_newsletter.pdf). Energy Information Administration Survey Data: 2005 preliminary f-861 database for the Arizona, Connecticut, Delaware, District of Columbia, Illinois, Montana, Nevada, New Hampshire, New York, Ohio, Oregon, Pennsylvania, Rhode Island, and Virginia percent of competitive load. Energy Information Administration, “Status of State Electric Industry Restructuring Activity—as of February 2003,” web site [www.eia.doe.gov/cneaf/electricity/chg\\_str/restructure.pdf](http://www.eia.doe.gov/cneaf/electricity/chg_str/restructure.pdf). Connecticut Department of Public Utility Control, “Decision: Docket No. 06-01-08PH01, DPUC Development and Review of Standard Service and Supplier of Last Report Service—Phase I” (June 21, 2006). District of Columbia Public Service Commission, “Questions And Answers Regarding Pepco’s 2004 Request for Proposals for Standard Offer Service,” web site [www.dcpsc.org/pdf\\_files/hottopics/RisingElectricityPrices\\_FAQ.pdf](http://www.dcpsc.org/pdf_files/hottopics/RisingElectricityPrices_FAQ.pdf). Illinois Commerce Commission, “Electric Switching Statistics” (April

## Notes and Sources

2006), web site [www.icc.illinois.gov/en/switchstats.aspx](http://www.icc.illinois.gov/en/switchstats.aspx). Maine State Legislature, Office of the Revisor of Statutes, "Maine Public Utilities/Standard Offer Law, Title 35-A, Public Utilities, Part 3, Electric Power, Chapter 32, Electric Industry Restructuring, §3212," web site <http://janus.state.me.us/legis/statutes/35-A/title35-Asec3212.html>. Maine Public Utility Commission, Standard Offer Service Rule, Chapter 301, web site [http://Mainegov-Images.Informe.Org/Mpuc/Doing\\_Business/Rules/Part\\_3/Ch-301.pdf](http://Mainegov-Images.Informe.Org/Mpuc/Doing_Business/Rules/Part_3/Ch-301.pdf). Maine Public Utilities Commission, "Maine's Load Served by Competitive Providers as of June 1, 2006," web site [http://mainegov-images.informe.org/mpuc/industries/electricity/electric%20restructuring/Migration\\_Rates\\_Monthly-June06.pdf](http://mainegov-images.informe.org/mpuc/industries/electricity/electric%20restructuring/Migration_Rates_Monthly-June06.pdf). Maryland Public Service Commission, Case No. 8908, "In the Matter of the Commission's Inquiry into the Competitive Selection of Electricity Supplier/Standard Offer Service, The Commission Staff's Report/Observations on the Standard Offer Service Bidding Process and Results" (March 7, 2006). Maryland Public Service Commission, "Electric Choice Enrollment Monthly Report" (July 19, 2006), web site [www.psc.state.md.us/psc/electric/enrollmentrpt.htm](http://www.psc.state.md.us/psc/electric/enrollmentrpt.htm). Massachusetts Department of Technology and Energy, Electric Restructuring in Massachusetts, "Default Service" (2006), web site [www.mass.gov/dte/restruct/competition/defaultservice.htm](http://www.mass.gov/dte/restruct/competition/defaultservice.htm). Massachusetts Division of Energy Resources, "2006 Electric Power Customer Migration Data" (May 2006), web site [www.mass.gov/Eoca/docs/doer/2006migrate.pdf](http://www.mass.gov/Eoca/docs/doer/2006migrate.pdf). Michigan Public Service Commission, "Electric Customer Choice, Program Status: MPSC Reports on the Status of Electric Competition in Michigan, as of July 31, 2006," web site [www.dleg.state.mi.us/mpsc/electric/restruct/status.htm](http://www.dleg.state.mi.us/mpsc/electric/restruct/status.htm). Public Utilities Company of Ohio, "Electric Rate Stabilization Plans: Ensuring Rate Certainty in Ohio," web site [www.puco.ohio.gov/PUCO/Consumer/information.cfm?doc\\_id=1449](http://www.puco.ohio.gov/PUCO/Consumer/information.cfm?doc_id=1449). New Hampshire Public Utilities Commission, Electric Division, web site [www.puc.state.nh.us/Electric/electric.htm](http://www.puc.state.nh.us/Electric/electric.htm). New York Public Service Commission, "Mandatory Hourly Pricing," web site [www.dps.state.ny.us/Mandatory\\_Hourly\\_Pricing.html](http://www.dps.state.ny.us/Mandatory_Hourly_Pricing.html). New York Public Service Commission, "Retail Access Plans," web site [www.dps.state.ny.us/Retail\\_Access\\_Plans.html](http://www.dps.state.ny.us/Retail_Access_Plans.html). New York Public Service Commission, "Staff Report on the State of Competitive Energy Markets: Progress to Date and Future Opportunities" (March 2, 2006), web site [www.dps.state.ny.us/StaffReportCompetition.pdf](http://www.dps.state.ny.us/StaffReportCompetition.pdf). New York Public Service Commission, Case 00-M-0504, "Proceeding on Motion of the Commission Regarding Provider of Last Resort Responsibilities: The Role of Utilities in Competitive Energy Markets and Fostering Development of Retail Competitive Opportunities. Statement of Policy on Further Steps Toward Competition in Retail Energy Markets" (August 25, 2004) web site [http://www3.dps.state.ny.us/pscweb/WebFileRoom.nsf/ArticlesByCategory/F4746B665D1C642685256EFB00622E91/\\$File/201a.00m0504.pdf?OpenElement](http://www3.dps.state.ny.us/pscweb/WebFileRoom.nsf/ArticlesByCategory/F4746B665D1C642685256EFB00622E91/$File/201a.00m0504.pdf?OpenElement). Ohio Public Utilities Commission, "The End of the Market Development Period for Retail Electric Choice," web site [www.puco.ohio.gov/puco/mediaroom/annualpublications.cfm?doc\\_id=1679#Electric](http://www.puco.ohio.gov/puco/mediaroom/annualpublications.cfm?doc_id=1679#Electric). Oregon Public Utility Commission, "Competitive Power Market for Oregon Business Customers," web site [www.puc.state.or.us/PUC/electric\\_restruc/ORDA03-05.pdf](http://www.puc.state.or.us/PUC/electric_restruc/ORDA03-05.pdf). Oregon Public Utility Commission, "Restructuring for Residential Consumers," web site [www.oregon.gov/PUC/electric\\_restruc/consumer/resident.shtml](http://www.oregon.gov/PUC/electric_restruc/consumer/resident.shtml). Oregon Public Utility Commission, "Status Report: Oregon Electric Industry Restructuring," (September, 2006), web site [www.puc.state.or.us/PUC/electric\\_restruc/statrpt/2006/092006\\_status\\_report.pdf](http://www.puc.state.or.us/PUC/electric_restruc/statrpt/2006/092006_status_report.pdf). Pennsylvania Public Utility Commission, "Metropolitan Edison Company & Pennsylvania Electric Company Rate Filing," "Duquesne Light Company Rate Filing," and "Penn Power's POLR Filing," web site [www.puc.state.pa.us/electric/electric\\_index.aspx](http://www.puc.state.pa.us/electric/electric_index.aspx). Pennsylvania Public Utility Commission, "Provider of Last Resort," web site [www.puc.state.pa.us/electric/electric\\_last\\_resort.aspx](http://www.puc.state.pa.us/electric/electric_last_resort.aspx). Pennsylvania Public Utility Commission, "Rulemaking Re Electric Distribution Companies," Docket No. L-00040169, and "Obligation to Serve Retail Customers at the Conclusion of the Transition Period Pursuant to 66 Pa. C.S. §2807(e)(2), Provider of Last Resort Roundtable, Docket No. M-00041792, Proposed Rulemaking Order" (December 14, 2004), web site [www.puc.state.pa.us/PcDocs/514337.doc](http://www.puc.state.pa.us/PcDocs/514337.doc). Texas Public Utility Commission, "Report to the 79th Texas Legislature: Scope of Competition in Electric Markets in Texas" (January 2005), web site [www.puc.state.tx.us/electric/reports/scope/2005/2005scope\\_elec.pdf](http://www.puc.state.tx.us/electric/reports/scope/2005/2005scope_elec.pdf).

**Table 3. OPEC and non-OPEC oil production in three AEO2007 world oil price cases, 2005-2030:** AEO2007 National Energy Modeling System, runs AEO2007.D112106A, HP2007.D112106A, and LP2007.D112106A; and Energy Information Administration, *Short-Term Energy Outlook* (September 2006), web site [www.eia.doe.gov/pub/forecasting/steo/oldsteos/sep06.pdf](http://www.eia.doe.gov/pub/forecasting/steo/oldsteos/sep06.pdf).

**Table 4. Changes in surface coal mining equipment costs, 2002-2005: 2002 and 2003:** Previous editions, web site [www.census.gov/cir/www](http://www.census.gov/cir/www). **2004 and 2005:** U.S. Department of Commerce, Economics and Statistics Administration, U.S. Census Bureau, Current Industrial Reports, *Construction Machinery: 2005*, MA333D(05)-1 (Washington, DC, July 2006).

**Table 5. Miscellaneous electricity uses in the residential sector, 2005, 2015, and 2030:** TIAX LLC, "Commercial and Residential Sector Miscellaneous Electricity Consumption: Y2005 and Projections to 2030" (September 2006); and AEO2007 National Energy Modeling System, run AEO2007.D112106A.

**Table 6. Electricity use and market share for televisions by type, 2005 and 2015:** TIAX LLC, "Commercial and Residential Sector Miscellaneous Electricity Consumption: Y2005 and Projections to 2030" (September 2006).

**Table 7. Miscellaneous electricity uses in the commercial sector, 2005, 2015, and 2030:** TIAX LLC, "Commercial and Residential Sector Miscellaneous Electricity Consumption: Y2005 and Projections to 2030" (September 2006); and AEO2007 National Energy Modeling System, run AEO2007.D112106A.

**Table 8. Revised subgroups for the non-energy-intensive manufacturing industries in AEO2007: energy demand and value of shipments, 2002:** Office of Management and Budget, *North American Industry Classification System—United States* (Springfield, VA, 2002). **Energy:** Energy Information Administration, Manufacturing Energy Consumption Survey 2002. **Value of Shipments:** Global Insight, Inc., *2006 U.S. Energy Outlook* (November 2006).

**Table 9. Effects of DOE's loan guarantee program on the economics of electric power plant generating**



**technologies, 2015:** AEO2007 National Energy Modeling System, runs AEO2007.D112106A and NUCLOAN.D020207A.

**Table 10. Technically recoverable undiscovered oil and natural gas resources in the lower 48 Outer Continental Shelf as of January 1, 2003:** U.S. Department of the Interior, Minerals Management Service, *Report to Congress: Comprehensive Inventory of U.S. OCS Oil and Natural Gas Resources* (February 2006), web site [www.mms.gov/revaldiv/PDFs/FinalInvRptToCongress050106.pdf](http://www.mms.gov/revaldiv/PDFs/FinalInvRptToCongress050106.pdf).

**Table 11. U.S. motor fuels consumption, 2000-2005:** Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006), Table 5.13c, web site [www.eia.doe.gov/emeu/aer](http://www.eia.doe.gov/emeu/aer); Renewable Fuels Association, "Industry Statistics 2006," web site [www.ethanolrfa.org/industry/statistics](http://www.ethanolrfa.org/industry/statistics); National Biodiesel Board, "Estimated U.S. Biodiesel Production," web site [www.biodiesel.org/pdf\\_files/fuelfactsheets/Production\\_Graph\\_Slide.pdf](http://www.biodiesel.org/pdf_files/fuelfactsheets/Production_Graph_Slide.pdf).

**Table 12. Energy content of biofuels:** Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006), Table A.1, web site [www.eia.doe.gov/emeu/aer](http://www.eia.doe.gov/emeu/aer); U.S. Environmental Protection Agency, *A Comprehensive Analysis of Biodiesel Impacts on Exhaust Emissions*, EPA420-P-02-001 (Washington, DC, October 2002), web site [http://65.166.250.34/resources/reportsdatabase/reports/gen/20021001\\_gen-323.pdf](http://65.166.250.34/resources/reportsdatabase/reports/gen/20021001_gen-323.pdf); Argonne National Laboratory, Center for Transportation Research, *REET 1.5 Transportation Fuel Cycle Model: Volume 1, Methodology, Development Use and Results*, ANL/ESD-39 (Argonne, IL, August 1999), Table 3.3, web site [www.transportation.anl.gov/software/REET/pdfs/esd\\_39v1.pdf](http://www.transportation.anl.gov/software/REET/pdfs/esd_39v1.pdf). **Note:** E85 is rarely blended as 85 percent ethanol and 15 percent gasoline. The more typical blend is 77 percent ethanol and 23 percent gasoline, but the term E85 is still used.

**Table 13. U.S. production and values of biofuel co-products:** U.S. Department of Agriculture, "USDA's 2002 Ethanol Cost-of-Production Survey" (Washington, DC, July 2005), web site [www.usda.gov/oce/reports/energy/USDA\\_2002\\_ETHANOL.pdf](http://www.usda.gov/oce/reports/energy/USDA_2002_ETHANOL.pdf); USDA NASS Statistical Database, web site [www.nass.usda.gov/index.asp](http://www.nass.usda.gov/index.asp); Renewable Fuels Association, *2005 Annual Industry Outlook*, web site [www.ethanolrfa.org/industry/outlook](http://www.ethanolrfa.org/industry/outlook).

**Table 14. Vehicle fueling stations in the United States as of July 2006:** National Ethanol Vehicle Coalition E85 Retail Locations Database, web site [www.e85refueling.org](http://www.e85refueling.org); National Biodiesel Board Biodiesel Retail Locations, web site [www.biodiesel.org/buying/biodiesel/retailfuelingsites/showall.asp](http://www.biodiesel.org/buying/biodiesel/retailfuelingsites/showall.asp).

**Table 15. Potential U.S. market for biofuel blends, 2005:** Energy Information Administration, Office of Integrated Analysis and Forecasting.

**Table 16. Costs of producing electricity from new plants, 2015 and 2030:** AEO2007 National Energy Modeling System, run AEO2007.D112106A.

**Table 17. Technically recoverable U.S. natural gas resources as of January 1, 2005:** Energy Information Administration, Office of Integrated Analysis and Forecasting.

## Figure Notes and Sources

**Note:** Tables indicated as sources in these notes refer to the tables in Appendixes A, B, C, and D of this report.

**Figure 1. Energy prices, 1980-2030: History:** Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006). **Projections:** Table A1.

**Figure 2. Delivered energy consumption by sector, 1980-2030: History:** Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006). **Projections:** Table A2.

**Figure 3. Energy consumption by fuel, 1980-2030: History:** Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006). **Projections:** Tables A1 and A17.

**Figure 4. Energy use per capita and per dollar of gross domestic product, 1980-2030: History:** Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006). **Projections: Energy use per capita:** Calculated from data in Table A2. **Energy use per dollar of GDP:** Table A19.

**Figure 5. Electricity generation by fuel, 1980-2030: History:** Energy Information Administration (EIA), Form EIA-860B, "Annual Electric Generator Report—Nonutility"; EIA, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006); and Edison Electric Institute. **Projections:** Table A8.

**Figure 6. Total energy production and consumption, 1980-2030: History:** Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006). **Projections:** Table A1.

**Figure 7. Energy production by fuel, 1980-2030: History:** Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006). **Projections:** Tables A1 and A17.

**Figure 8. U.S. carbon dioxide emissions by sector and fuel, 1990-2030: History:** Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2005*, DOE/EIA-0573(2005) (Washington, DC, November 2006). **Projections:** Table A18.

**Figure 9. Reformed CAFE standards for light trucks, by model year and vehicle footprint:** U.S. Department of Transportation, National Highway Traffic Safety Administration, 49 CFR Part 523, 533 and 537 [Docket No. 2006-24306] RIN 2127-AJ61, "Average Fuel Economy Standards for Light Trucks, Model Years 2008-2011."

**Figure 10. World oil prices in three AEO2007 cases, 1990-2030: History:** Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006). **Projections:** Table C1.

**Figure 11. Changes in construction commodity costs, 1973-2006:** U.S. Department of Labor, Bureau of Labor Statistics, Producer Price Index for WPU112, WPU101, WPU133, and WPU1322.

**Figure 12. Drilling costs for onshore natural gas development wells at depths of 7,500 to 9,999 feet, 1996-2004:** American Petroleum Institute, 2004 Joint Association Survey of Drilling Costs.

## Notes and Sources

**Figure 13. Changes in iron and steel, mining equipment and machinery, and railroad equipment costs, 1973-2006:** U.S. Department of Labor, Bureau of Labor Statistics, Producer Price Indexes for Iron and Steel, Series ID WPU101; Mining Machinery and Equipment Manufacturing, Series ID PCU333131333131; and Railroad Equipment, Series ID WPU144.

**Figure 14. Changes in construction commodity costs and electric utility construction costs, 1973-2006:** *Handy-Whitman Bulletin*, No. 163, "Cost Trends of Electric Utility Construction"; and U.S. Department of Labor, Bureau of Labor Statistics, Producer Price Index, Series ID WPU112.

**Figure 15. Additions to electricity generation capacity in the electric power sector, 1990-2030: History:** Energy Information Administration, Form EIA-860, "Annual Electric Generator Report." **Projections:** AEO2007 National Energy Modeling System, run AEO2007.D112106A.

**Figure 16. Energy intensity of industry subgroups in the metal-based durables group of non-energy-intensive manufacturing industries, 2002:** Computed from Energy Information Administration, Manufacturing Energy Consumption Survey 2002, and Global Insight, Inc., *2006 U.S. Energy Outlook* (November 2006).

**Figure 17. Average annual growth rates of value of shipments for metal-based durables industries in the AEO2006 and AEO2007 reference case projections, 2005-2030: AEO2006:** AEO2006 National Energy Modeling System, run AEO2006.D111905A. **AEO2007:** AEO2007 National Energy Modeling System, run AEO2007.D112106A.

**Figure 18. Average annual increases in energy demand for metal-based durables industries in the AEO2006 and AEO2007 reference case projections, 2005-2030: AEO2006:** AEO2006 National Energy Modeling System, run AEO2006.D111905A. **AEO2007:** AEO2007 National Energy Modeling System, run AEO2007.D112106A.

**Figure 19. Annual delivered energy demand for the non-energy-intensive manufacturing industry groups in the AEO2006 and AEO2007 reference case projections, 2005-2030: AEO2006:** AEO2006 National Energy Modeling System, run AEO2006.D111905A. **AEO2007:** National Energy Modeling System, run AEO2007.D112106A.

**Figure 20. Lower 48 offshore crude oil production in two cases, 1990-2030: History:** Energy Information Administration, Office of Integrated Analysis and Forecasting. **Projections:** AEO2007 National Energy Modeling System, runs AEO2007.D112106A and OCSACC.D112706A.

**Figure 21. Lower 48 offshore natural gas production in two cases, 1990-2030: History:** Energy Information Administration, Office of Integrated Analysis and Forecasting. **Projections:** AEO2007 National Energy Modeling System, runs AEO2007.D112106A and OCSACC.D112706A.

**Figure 22. U.S. ethanol production and production capacity, 1999-2007:** Renewable Fuels Association, "Industry Statistics 2006," web site [www.ethanolrfa.org/industry/statistics](http://www.ethanolrfa.org/industry/statistics). **Note:** In some years, the production capacity is less than the actual amount of consumption, be-

cause the industry as a whole operated above reported nameplate capacity.

**Figure 23. Average U.S. prices for ethanol and gasoline, 2003-2006:** Bloomberg Data Service, Regular Gasoline Average Rack Price (point of first sale) and Ethanol Average Rack Prices (accessed 8/20/06). **Notes:** The large price spike in June 2006 resulted from supply bottlenecks during transition from winter to summer reformulated gasoline blends that incorporated ethanol for the first time as a result of EPACT2005. Corn-based ethanol prices are expected to remain competitive with gasoline over the long term.

**Figure 24. Average annual growth rates of real GDP, labor force, and productivity, 2005-2030:** Table B4.

**Figure 25. Average annual inflation, interest, and unemployment rates, 2005-2030:** Table B4.

**Figure 26. Sectoral composition of industrial output growth rates, 2005-2030:** AEO2007 National Energy Modeling System, runs AEO2007.D112106A, HM2007.D112106A, and LM2007.D112106A.

**Figure 27. Energy expenditures in the U.S. economy, 1990-2030: History:** Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006). **Projections:** AEO2007 National Energy Modeling System, run AEO2007.D112106A.

**Figure 28. Energy expenditures as share of gross domestic product, 1970-2030: History:** U.S. Department of Commerce, Bureau of Economic Analysis; and Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006). **Projections:** AEO2007 National Energy Modeling System, run AEO2007.D112106A.

**Figure 29. World oil prices, 1980-2030: History:** Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006). **Projections:** Table C1.

**Figure 30. U.S. gross petroleum imports by source, 2005-2030:** AEO2007 National Energy Modeling System, run AEO2007.D112106A.

**Figure 31. Unconventional resources as a share of the world liquids market, 1990-2030: History:** Derived from Energy Information Administration, *International Energy Annual 2004*, DOE/EIA-0219(2004) (Washington, DC, July 2006), Table G.4. **Projections:** Table A20. **Note:** Data from Table G.4 are used as a proxy for historical unconventional oil production, because international data are limited. In addition, estimates of historical production from Canadian oil sands and Venezuelan ultra-heavy oil were added to Table G.4. Assumptions about future unconventional oil production are based on current investment reports, published production targets, resource availabilities, and marketplace competition.

**Figure 32. World liquids production shares by region, 2005 and 2030:** AEO2007 National Energy Modeling System, runs AEO2007.D112106A, HP2007.D112106A, and LP2007.D112106A.

**Figure 33. Energy use per capita and per dollar of gross domestic product, 1980-2030: History:** Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006). **Projections: Energy use per capita:** Calculated from data in Table A2. **Energy use per dollar of GDP:** Table A19.

**Figure 34. Primary energy use by fuel, 2005-2030:** **History:** Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006). **Projections:** Tables A1 and A17.

**Figure 35. Delivered energy use by fuel, 1980-2030:** **History:** Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006). **Projections:** Table A2.

**Figure 36. Primary energy consumption by sector, 1980-2030:** **History:** Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006). **Projections:** Table A2.

**Figure 37. Residential delivered energy consumption per capita, 1990-2030:** **History:** Energy Information Administration, "State Energy Consumption, Price, and Expenditure Estimates (SEDS)," (Washington, DC, October 2006), web site [www.eia.doe.gov/emeu/states/seds.html](http://www.eia.doe.gov/emeu/states/seds.html), and *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006). **Projections:** AEO2007 National Energy Modeling System, runs AEO2007.D112106A, BLDFRZN.D112206A, and BLDHIGH.D112206A.

**Figure 38. Residential delivered energy consumption by fuel, 2005, 2015, and 2030:** AEO2007 National Energy Modeling System, run AEO2007.D112106A.

**Figure 39. Efficiency indicators for selected residential appliances, 2005 and 2030:** Energy Information Administration, *Technology Forecast Updates—Residential and Commercial Building Technologies—Advanced Adoption Case* (Navigant Consulting, Inc., September 2004); and AEO2007 National Energy Modeling System, runs AEO2007.D112106A, BLDFRZN.D112206A, and BLDBEST.D112206A.

**Figure 40. Commercial delivered energy consumption per capita, 1980-2030:** **History:** Energy Information Administration, "State Energy Consumption, Price, and Expenditure Estimates (SEDS)" (Washington, DC, October 2006), web site [www.eia.doe.gov/emeu/states/seds.html](http://www.eia.doe.gov/emeu/states/seds.html), and *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006). **Projections:** AEO2007 National Energy Modeling System, runs AEO2007.D112106A, BLDFRZN.D112206A, and BLDHIGH.D112206A.

**Figure 41. Commercial delivered energy consumption by fuel, 2005, 2015, and 2030:** AEO2007 National Energy Modeling System, run AEO2007.D112106A.

**Figure 42. Efficiency indicators for selected commercial energy end uses, 2005 and 2030:** Energy Information Administration, *Technology Forecast Updates—Residential and Commercial Building Technologies—Advanced Adoption Case* (Navigant Consulting, Inc., September 2004); and AEO2007 National Energy Modeling System, runs AEO2007.D112106A, BLDFRZN.D112206A, and BLDBEST.D112206A.

**Figure 43. Buildings sector electricity generation from advanced technologies, 2030:** AEO2007 National Energy Modeling System, runs AEO2007.D112106A, BLDHIGH.D112206A, and BLDBEST.D112206A.

**Figure 44. Industrial delivered energy consumption, 1980-2030:** **History:** Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006). **Projections:** AEO2007 National Energy Modeling System, runs AEO2007.D112106A, HM2007.D112106A, and LM2007.D112106A.

**Figure 45. Average output growth in the manufacturing subsectors, 2005-2030:** AEO2007 National Energy Model System, runs AEO2007.D112106A, HM2007.D112106A, and LM2007.D112106A.

**Figure 46. Average growth of delivered energy consumption in the manufacturing subsectors, 2005-2030:** AEO2007 National Energy Model System, runs AEO2007.D112106A, HM2007.D112106A, and LM2007.D112106A.

**Figure 47. Industrial delivered energy intensity, 1980-2030:** **History:** Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384 (2005) (Washington, DC, July 2006); and Global Insight, Inc., *2006 U.S. Energy Outlook* (November 2006). **Projections:** AEO2007 National Energy Model System, runs AEO2007.D112106A, INDHIGH.D112406A, and INDFRZN.D112406A.

**Figure 48. Average change in energy intensity in the manufacturing subsectors, 2005-2030:** AEO2007 National Energy Model System, runs AEO2007.D112106A, INDHIGH.D112406A, and INDFRZN.D112406A.

**Figure 49. Delivered energy consumption for transportation, 1980-2030:** **History:** Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384 (2005) (Washington, DC, July 2006). **Projections:** AEO2007 National Energy Modeling System, runs AEO2007.D112106A, HM2007.D112106A, LM2007.D112106A, HP2007.D112106A, and LP2007.D112106A.

**Figure 50. Delivered energy consumption in light-duty vehicles, 1980-2030:** **History:** S.C. Davis and S.W. Diegel, *Transportation Energy Data Book: Edition 25*, ORNL-6974 (Oak Ridge, TN, May 2006), Chapter 2, Table 2.6, p. 2-8. **Projections:** AEO2007 National Energy Modeling System, runs AEO2007.D112106A, HM2007.D112106A, LM2007.D112106A, HP2007.D112106A, and LP2007.D112106A.

**Figure 51. Average fuel economy of new light-duty vehicles, 1980-2030:** **History:** U.S. Department of Transportation, National Highway Traffic Safety Administration, *Summary of Fuel Economy Performance* (Washington, DC, March 2005), web site [www.nhtsa.dot.gov/staticfiles/DOT/NHTSA/Vehicle%20Safety/Articles/Associated%20Files/SummaryFuelEconomyPerformance-2005.pdf](http://www.nhtsa.dot.gov/staticfiles/DOT/NHTSA/Vehicle%20Safety/Articles/Associated%20Files/SummaryFuelEconomyPerformance-2005.pdf). **Projections:** AEO2007 National Energy Modeling System, runs AEO2007.D112106A, TRNFRZN.D120806A, TRNHIGH.D120806A, HP2007.D112106A, and LP2007.D112106A.

**Figure 52. Sales of unconventional light-duty vehicles by fuel type, 2005, 2015, and 2030:** AEO2007 National Energy Modeling System, run AEO2007.D112106A.

**Figure 53. Annual electricity sales by sector, 1980-2030:** **History:** Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006). **Projections:** Table A8.

**Figure 54. Electricity generation by fuel, 2005 and 2030:** Table A8.

**Figure 55. Electricity generation capacity additions by fuel type, including combined heat and power, 2006-2030:** Table A9.

## Notes and Sources

---

**Figure 56. Levelized electricity costs for new plants, 2015 and 2030:** AEO2007 National Energy Modeling System, run AEO2007.D112106A.

**Figure 57. Electricity generation capacity additions, including combined heat and power, by region and fuel, 2006-2030:** AEO2007 National Energy Modeling System, run AEO2007.D112106A.

**Figure 58. Electricity generation from nuclear power, 1973-2030: History:** Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384 (2005) (Washington, DC, July 2006). **Projections:** AEO2007 National Energy Modeling System, runs AEO2007.D112106A, HM2007.D112106A, LM2007.D112106A, HP2007.D112106A, and LP2007.D112106A.

**Figure 59. Levelized electricity costs for new plants by fuel type, 2015 and 2030:** AEO2007 National Energy Modeling System, runs AEO2007.D112106A, LONUC07.D112706A, and ADVNUC07.D112906A. **Note:** Includes generation and interconnection costs.

**Figure 60. Nonhydroelectric renewable electricity generation by energy source, 2005-2030:** Table A16.

**Figure 61. Grid-connected electricity generation from renewable energy sources, 1990-2030: History:** Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006). **Projections:** Table A16. **Note:** Data for nonutility producers are not available before 1989.

**Figure 62. Levelized and avoided costs for new renewable plants in the Northwest, 2030:** AEO2007 National Energy Modeling System, runs AEO2007.D112106A, LOREN07.D120806A, and HIREN07.D120806A.

**Figure 63. Renewable electricity generation, 2005-2030:** AEO2007 National Energy Modeling System, runs AEO2007.D112106A and RGRPS07.D121206C.

**Figure 64. Cumulative new generating capacity by technology type, 2006-2030:** Table D6.

**Figure 65. Fuel prices to electricity generators, 1995-2030: History:** Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006). **Projections:** AEO2007 National Energy Modeling System, run AEO2007.D112106A.

**Figure 66. Average U.S. retail electricity prices, 1970-2030: History:** Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006). **Projections:** Table A8.

**Figure 67. Natural gas consumption by sector, 1990-2030: History:** Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384 (2004) (Washington, DC, July 2006). **Projections:** AEO2007 National Energy Modeling System, run AEO2007.D112106A.

**Figure 68. Total natural gas consumption, 1990-2030: History:** Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006). **Projections:** AEO2007 National Energy Modeling System, runs AEO2007.D112106A, HP2007.D112106A, LP2007.D112106A, HM2007.D112106A, and LM2007.D112106A.

**Figure 69. Natural gas consumption in the electric power and other end-use sectors in alternative price cases, 1990-2030: History:** Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006). **Projections:** AEO2007 Na-

tional Energy Modeling System, runs AEO2007.D112106A, HP2007.D112106A, and LP2007.D112106A.

**Figure 70. Natural gas consumption in the electric power and other end-use sectors in alternative growth cases, 1990-2030: History:** Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006). **Projections:** AEO2007 National Energy Modeling System, runs AEO2007.D112106A, HM2007.D112106A, and LM2007.D112106A.

**Figure 71. Lower 48 wellhead and Henry Hub spot market prices for natural gas, 1990-2030: History:** For lower 48 wellhead prices: Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006). For Henry Hub natural gas prices: Energy Information Administration, *Short-Term Energy Outlook* Query System, Monthly Natural Gas Data, Variable NGHHC. **Projections:** AEO2007 National Energy Modeling System, run AEO2007.D112106A.

**Figure 72. Lower 48 wellhead natural gas prices, 1990-2030: History:** Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006). **Projections:** AEO2007 National Energy Modeling System, runs AEO2007.D112106A, HP2007.D112106A, LP2007.D112106A, OGHTEC07.D112706A, and OGLTEC07.D112706A.

**Figure 73. Natural gas prices by end-use sector, 1990-2030: History:** Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006). **Projections:** AEO2007 National Energy Modeling System, run AEO2007.D112106A.

**Figure 74. Average natural gas transmission and distribution margins, 1990-2030: History:** Calculated as the difference between natural gas end-use prices and lower 48 wellhead natural gas prices; Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384 (2005) (Washington, DC, July 2006). **Projections:** AEO2007 National Energy Modeling System, runs AEO2007.D112106A, HP2007.D112106A, and LP2007.D112106A.

**Figure 75. Natural gas production by source, 1990-2030: History:** Energy Information Administration, Office of Integrated Analysis and Forecasting. **Projections:** AEO2007 National Energy Modeling System, run AEO2007.D112106A.

**Figure 76. Total U.S. natural gas production, 1990-2030: History:** Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006). **Projections:** AEO2007 National Energy Modeling System, runs AEO2007.D112106A, HP2007.D112106A, LP2007.D112106A, OGHTEC07.D112706A, and OGLTEC07.D112706A.

**Figure 77. Net U.S. imports of natural gas by source, 1990-2030: History:** Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006). **Projections:** AEO2007 National Energy Modeling System, run AEO2007.D112106A.

**Figure 78. Net U.S. imports of liquefied natural gas, 1990-2030: History:** Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006). **Projections:** AEO2007 National Energy Modeling System, runs AEO2007.D112106A, LP2007.D112106A, HP2007.D112106A, HM2007.D112106A, and LM2007.D112106A.

**Figure 79. Domestic crude oil production by source, 1990-2030: History:** Energy Information Administration, Office of Integrated Analysis and Forecasting. **Projections:** AEO2007 National Energy Modeling System, run AEO2007.D112106A.

**Figure 80. Total U.S. crude oil production, 1990-2030: History:** Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006). **Projections:** AEO2007 National Energy Modeling System, runs AEO2007.D112106A, OGHTEC07.D112706A, and OGLTEC07.D112706A.

**Figure 81. Total U.S. unconventional oil production, 2005-2030:** AEO2007 National Energy Modeling System, runs AEO2007.D112106A and HP2007.D112106A.

**Figure 82. Liquid fuels consumption by sector, 1990-2030: History:** Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006). **Projections:** AEO2007 National Energy Modeling System, run AEO2007.D112106A.

**Figure 83. Net import share of U.S. liquid fuels consumption, 1990-2030: History:** Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006). **Projections:** AEO2007 National Energy Modeling System, runs AEO2007.D112106A, LP2007.D112106A, HP2007.D112106A, HM2007.D112106A, and LM2007.D112106A.

**Figure 84. Average U.S. delivered prices for motor gasoline, 1990-2030: History:** Energy Information Administration, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006). **Projections:** AEO2007 National Energy Modeling System, runs AEO2007.D112106A, LP2007.D112106A, and HP2007.D112106A.

**Figure 85. Cellulose ethanol production, 2005-2030:** AEO2007 National Energy Modeling System, runs HP2007.D112106A, CT\_80PCT\_7L.D120406A, and CT\_80PCT\_7L\_RF.D120406A.

**Figure 86. Coal production by region, 1970-2030: History (short tons): 1970-1990:** Energy Information Administration (EIA), *The U.S. Coal Industry, 1970-1990: Two Decades of Change*, DOE/EIA-0559 (Washington, DC, November 2002). **1991-2000:** EIA, *Coal Industry Annual*, DOE/EIA-0584 (various years). **2001-2005:** EIA, *Annual Coal Report 2005*, DOE/EIA-0584(2005) (Washington, DC, October 2006), and previous issues. **History (conversion to quadrillion Btu): 1970-2005: Estimation Procedure:** EIA, Office of Integrated Analysis and Forecasting. Estimates of average heat content by region and year are based on coal quality data for 2005, collected in various energy surveys (see sources), and national-level estimates of U.S. coal production by year in units of quadrillion Btu, published in EIA's *Annual Energy Review*. **Sources:** EIA, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006), Table 1.2; Form EIA-3, "Quarterly Coal Consumption and Quality Report, Manufacturing Plants"; Form EIA-5, "Quarterly Coal Consumption and Quality Report, Coke Plants"; Form EIA-6A, "Coal Distribution Report"; Form EIA-7A, "Coal Production Report"; Form EIA-423, "Monthly Cost and Quality of Fuels for Electric Plants Report"; Form EIA-906, "Power Plant Report"; Form EIA-920, "Combined Heat and Power Plant Report"; U.S. Department of Commerce, Bureau of the Census, "Monthly Report EM 545"; and Federal Energy

Regulatory Commission, Form 423, "Monthly Report of Cost and Quality of Fuels for Electric Plants." **Projections:** AEO2007 National Energy Modeling System, run AEO2007.D112106A. **Note:** For 2004-2030, the data for "Total Coal Production" include waste coal.

**Figure 87. Distribution of coal to domestic markets by supply and demand regions, including imports, 2005 and 2030: 2005:** Energy Information Administration (EIA), Form EIA-3, "Quarterly Coal Consumption and Quality Report, Manufacturing Plants"; Form EIA-5, "Quarterly Coal Consumption and Quality Report, Coke Plants"; Form EIA-6A, "Coal Distribution Report"; Form EIA-7A, "Coal Production Report"; Form EIA-423, "Monthly Cost and Quality of Fuels for Electric Plants Report"; Form EIA-906, "Power Plant Report"; Form EIA-920, "Combined Heat and Power Plant Report"; U.S. Department of Commerce, Bureau of the Census, "Monthly Report IM 145"; and Federal Energy Regulatory Commission, Form 423, "Monthly Report of Cost and Quality of Fuels for Electric Plants." **Projections:** AEO2007 National Energy Modeling System, run AEO2007.D112106A. **Note:** The region labeled "Demand east of the Mississippi River" includes the New England, Middle Atlantic, South Atlantic, East North Central, and East South Central Census divisions. The region labeled "Demand west of the Mississippi River" includes the West North Central, West South Central, Mountain, and Pacific Census divisions.

**Figure 88. U.S. coal production, 2005, 2015, and 2030:** AEO2007 National Energy Modeling System, runs HCCST07.D112906A; LP2007.D112106A, LM2007.D112106A, AEO2007.D112106A, HM2007.D112106A, HP2007.D112106A, and LCCST07.D112906A. **Note:** Coal production totals include waste coal.

**Figure 89. Average minemouth price of coal by region, 1990-2030: History (dollars per short ton): 1990-2000:** Energy Information Administration (EIA), *Coal Industry Annual*, DOE/EIA-0584 (various years). **2001-2005:** EIA, *Annual Coal Report 2005*, DOE/EIA-0584(2005) (Washington, DC, October 2006), and previous issues. **History (conversion to dollars per million Btu): 1990-2005: Estimation Procedure:** EIA, Office of Integrated Analysis and Forecasting. Estimates of average heat content by region and year are based on coal quality data for 2005, collected in various energy surveys (see sources), and national-level estimates of U.S. coal production by year in units of quadrillion Btu published in EIA's *Annual Energy Review*. **Sources:** EIA, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006), Table 1.2; Form EIA-3, "Quarterly Coal Consumption and Quality Report, Manufacturing Plants"; Form EIA-5, "Quarterly Coal Consumption and Quality Report, Coke Plants"; Form EIA-6A, "Coal Distribution Report"; Form EIA-7A, "Coal Production Report"; Form EIA-423, "Monthly Cost and Quality of Fuels for Electric Plants Report"; Form EIA-906, "Power Plant Report"; Form EIA-920, "Combined Heat and Power Plant Report"; U.S. Department of Commerce, Bureau of the Census, "Monthly Report EM 545"; and Federal Energy Regulatory Commission, Form 423, "Monthly Report of Cost and Quality of Fuels for Electric Plants." **Projections:** AEO2007 National Energy Modeling System, run AEO2007.D112106A. **Note:** Includes reported prices for both open market and captive mines.

## Notes and Sources

---

**Figure 90. Average delivered coal prices, 1980-2030:**

**History:** Energy Information Administration (EIA), *Quarterly Coal Report, October-December 2005*, DOE/EIA-0121 (2005/4Q) (Washington, DC, March 2006), and previous issues; EIA, *Electric Power Monthly*, October 2006, DOE/EIA-0226(2006/10) (Washington, DC, October 2006); and EIA, *Annual Energy Review 2005*, DOE/EIA-0384(2005) (Washington, DC, July 2006). **Projections:** AEO2007 National Energy Modeling System, runs AEO2007.D112106A, LP2007.D112106A, HP2007.D112106A, LM2007.D112106A, HM2007.D112106A, LCCST07.D112906A, and HCCST07.D112906A. **Note:** Historical prices are weighted by consumption but exclude residential/commercial prices and export free-alongside-ship (f.a.s.) prices.

**Figure 91. Coal consumption in the industrial and buildings sectors and at coal-to-liquids plants, 2005, 2015, and 2030:** AEO2007 National Energy Modeling System, run AEO2007.D112106A.

**Figure 92. Carbon dioxide emissions by sector and fuel, 2005 and 2030:** **2005:** Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2005*, DOE/EIA-0573(2005) (Washington, DC, November 2006). **Projections:** Table A18.

**Figure 93. Carbon dioxide emissions, 1990-2030: History:** Energy Information Administration, *Emissions of Greenhouse Gases in the United States 2005*, DOE/EIA-

0573(2005) (Washington, DC, November 2006). **Projections:** Table B2.

**Figure 94. Sulfur dioxide emissions from electricity generation, 1995-2030: History: 1995:** U.S. Environmental Protection Agency, *National Air Pollutant Emissions Trends, 1990-1998*, EPA-454/R-00-002 (Washington, DC, March 2000). **2000:** U.S. Environmental Protection Agency, *Acid Rain Program Preliminary Summary Emissions Report, Fourth Quarter 2004*, web site [www.epa.gov/airmarkets/emissions/prelimarp/index.html](http://www.epa.gov/airmarkets/emissions/prelimarp/index.html). **Projections:** AEO2007 National Energy Modeling System, run AEO2007.D112106A.

**Figure 95. Nitrogen oxide emissions from electricity generation, 1995-2030: History: 1995:** U.S. Environmental Protection Agency, *National Air Pollutant Emissions Trends, 1990-1998*, EPA-454/R-00-002 (Washington, DC, March 2000). **2000:** U.S. Environmental Protection Agency, *Acid Rain Program Preliminary Summary Emissions Report, Fourth Quarter 2004*, web site [www.epa.gov/airmarkets/emissions/prelimarp/index.html](http://www.epa.gov/airmarkets/emissions/prelimarp/index.html). **Projections:** AEO2007 National Energy Modeling System, run AEO2007.D112106A.

**Figure 96. Mercury emissions from electricity generation, 1995-2030: History: 1995, 2000, and 2005:** Energy Information Administration, Office of Integrated Analysis and Forecasting. **Projections:** AEO2007 National Energy Modeling System, run AEO2007.D112106A.