

## KEY FINDINGS

# Hidden Costs of Energy

## Unpriced Consequences of Energy Production and Use

Energy production and use have many well-known benefits to society, but they also have adverse effects on human health, property, and the environment that are not reflected in market prices. This report from the National Research Council, requested by Congress, examines those “hidden costs” of energy, with the following key findings.

1. Hidden costs of damages in 2005 amounted to more than \$120 billion dollars, including those associated with pollution’s effect on human health, crops, timber yields, and other areas.
  - Because there were many areas where it was not possible to quantify damages, the true external costs are likely to be far higher than this figure.
2. The committee considered the issue of climate change, which is expected to negatively affect agriculture, ecosystem services, and human health. The committee could not assign climate-related damages a specific dollar value, but estimated a range of possible damages based on previous scientific research.
  - Including estimates of future damages from climate change could potentially more than double the \$120 billion figure.
3. Coal-fired electricity plants generated the most damages.
  - Without counting the costs of climate change, damages from coal plants amounted to \$62 billion in 2005. Non-climate damages from natural gas plants amounted to \$740 million that year.
4. The differences in damages among different coal-fired plants was huge:
  - The “worst” (most damaging) 20 percent of coal plants produced 63 percent of the total non-climate damages from coal plants. On the other hand, the less-damaging 50 percent of coal plants produced only 12 percent of that \$62 billion.
  - Differences in damages among plants reflect, in part, variations in the amount of electricity they produce. However, variations from coal-fired plants were also influenced by the sulfur content of the coal, type of emission controls, and age of the plant.
  - Natural gas fired plants also showed a skewed distribution, with 10% of the plants causing 65 percent of the aggregate damages.

### How Damages Were Assessed

Energy technologies were evaluated over their full life cycles: fuel extraction, production, distribution, use, and waste disposal. Damages associated with air pollution from electricity generation and transportation were assessed by (1) using emissions data on particulate matter (PM), sulfur dioxide (SO<sub>2</sub>), and oxides of nitrogen (NO<sub>x</sub>) from various sources; (2) translating emissions into ambient air concentrations; and (3) estimating health and other impacts associated with changes in air quality. Estimated dollar values were then assigned to those impacts.

5. Average damages associated with coal-fired plants per kilowatt-hour were 20 times higher than the average damages associated with natural gas fired plants per kilowatt-hour.
6. Highway vehicles—considering energy production and use over the lifecycles of vehicles and fuels—caused \$56 billion in health and other non-climate damages, with \$36 billion from light-duty vehicles and \$20 billion from heavy-duty vehicles.
  - Surprisingly, most of the vehicle-fuel combinations produced relatively similar damages, although the relative contribution of damages from the vehicles' and fuels' lifecycles varied.
7. Although most people only consider the emissions from vehicle tailpipes when thinking about transportation-related damages, the emissions from driving a vehicle accounted for only one-quarter to one-third of the total damages related to vehicles, according to the committee's modeling. The majority of damages—two-thirds to three-quarters—result from the manufacturing of the vehicle and production of the fuel for it.
  - It is essential to take the damages of vehicle manufacturing and fuel production into account when considering transportation-related damages.
  - Some “green” transportation technologies, such as corn ethanol and plug-in electric vehicles, were actually estimated to produce as many or more non-climate damages than traditional fuels and vehicles when the full vehicle lifecycle was taken into account.
  - Plug-in electric vehicles were estimated to produce some of the highest damages, largely because they rely on fossil-fuel based electricity. The damages from electric vehicles would be expected to decrease if the production of energy becomes less damaging in the future.
  - Corn ethanol was estimated to produce some of the highest non-climate damages in 2005 because the production and conversion of corn into fuel is energy-intensive.
8. Regulations that are currently in place and will be carried out in the future, including light-duty fuel economy standards, are expected to reduce non-climate damages by 2030.
  - However, further reducing energy's non-climate damages in a significant way will require new technological breakthroughs, especially in transportation.

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\* Resigned from the committee on August 2, 2009, to accept an appointment as the administrator of the U.S. Energy Information Administration.

The National Academies appointed the above committee of experts to address the specific task requested by the United States Congress. The members volunteered their time for this activity; their report is peer-reviewed and the final product approved by both the committee members and the National Academies. This report derivative was prepared by the National Research Council based on the committee's report.



For more information, contact the Board on Environmental Studies and Toxicology at (202) 334-3060 or <http://dels.nas.edu/best>. *Hidden Costs of Energy: Unpriced Consequences of Energy Production and Use* is available from the National Academies Press; call (800) 624-6242 or (202) 334-3313, or visit the NAP website at [www.nap.edu](http://www.nap.edu).

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