The coal fired electrical generation plant at Laughlin, NV produces 1,580 MW at 55% efficiency using a coal with a heating value of 13,000 BTU/lb. The plant wants to evaluate the conversion of its air fired combustors to oxygen fired combustors for oxyfiring with carbon sequestration. This produces a high purity CO₂ stack gas at 15 psia and 250 F after the heat is extracted for generating electricity. Assuming that the coal is 100% carbon, the flow of CO₂ is 7.917 kmol/s. With oxyfiring, the plant wants to compress the CO₂ to super critical conditions assuming 90% adiabatic efficiency. The critical point is 7.38 MPa at 31.1 °C. Once compressed to 7.5 MPa and 50°C, it will be sold for $25/tonne to a CO₂ pipeline company in the area. Perform a complete profitability analysis on the installation of a CO₂ compression system for this purpose. Compare just the compression cost to not making the changes in the plant and continuing to sending the CO₂ in the combustion gasses to the stack but assume a CO₂ tax of $50/tonne will be imposed in 2012. Also please determine the power generation penalty due to the power requirement needed to run the compressors (i.e. less electricity generated). Use a discounted price for electricity of $0.035/KW-hr for your calculations.

Figure 1 Phase Diagram for CO₂.
FOSSIL-FUEL COSTS

**NRC STUDY:** Billions of dollars in health-related damages are not included in the price of energy.

Coal-fired power plant emissions cause $63 billion in damages in the U.S. each year, with just 10 plants responsible for 43%, or $27 billion, of those damages.

**FOSSIL-FUEL-BASED** energy production, mostly from coal and oil, causes $120 billion worth of health and other non-climate-related damages in the U.S. each year that are not figured into the price of energy, says a National Research Council report released last week.

The dollar amount is primarily based on health impacts and premature deaths of nearly 20,000 people annually that result from air pollution generated by coal-fired electric power plants and motor vehicles. Specifically, the report looked at damages caused by emissions of sulfur dioxide, particulates, and nitrogen oxides.

Using life-cycle analyses, the study finds that nearly all of the $120 billion in damages is due to electricity generation ($63 billion) and transportation fuel production and use ($56 billion), says Jared L. Cohon, committee chairman and president of Carnegie Mellon University. The remaining $1 billion is due to heating. But the total is conservative, he continues, because it does not reflect the impact of climate change, harm to ecosystems, or the effect of toxic air pollutants, such as mercury or lead.

Most of the $63 billion in damages attributed to electricity comes from coal-fired power plants, which produce half the nation's electricity. Nearly half of these damages come from emissions by the 10 dirtiest coal plants—the U.S. has some 406 such plants. The report also finds that although natural gas generates 20% of U.S. electricity, it contributes only about $1 billion in health and non-climate-related damages.

For transportation, the report finds that damages total some $56 billion from vehicles and motor fuels over their full life cycles, from extraction to refining use in a vehicle. Most of the damage costs come from extraction and production, and only one-third are due to motor vehicle operation.

The 19-member report panel of economists found that damages from corn-grain-based biofuels are similar to or slightly worse than those from gasoline because the energy needed to produce and convert corn to fuel. But for ethanol from cellulosic feedstock, the damages decrease.

The panel could not tightly tie down climate-change impacts, and the report finds a wide range of damage costs due to carbon dioxide emissions—between $1.20 and $100 per ton. Considering the size of U.S. CO₂ emissions, this works out to $7 billion to $700 billion in annual damages from greenhouse gas emissions. —JEFF JOHNSON