

ME 1065: Group Design Project Fall 2008

For Part 3 of the Design Project:

The report for Part 3 is a comprehensive report (please see the guidelines on the wiki page), and should include specifications and calculations from Parts 1 and 2. In addition, you must analyze your system from an (1) economic, (2) environmental, and (3) regulatory perspective.

Economic Analysis

Assuming that your building operates for 15 years, and that you can get financing for your initial costs at a rate of 6% (with monthly payments), *what is the monthly cost of creating and operating your building?* Monthly costs should include fuel (natural gas, electricity, etc.), water consumption and sewage disposal, maintenance, and payments on an amount borrowed to finance your initial costs. Annual maintenance costs can be assumed to be 8% of your initial costs.

For continuously-incurred costs, justifications must be given for the quantity and rate of those costs. For initial costs, you can neglect the cost of the land, electrical wiring, installation, and the brick-and-mortar-type building materials. You must include, however, the costs of your piping and ducting networks, and any insulation specific to those networks (ie, not wall insulation). You must also include all capital equipment, such as heat pumps, PV panels, water heaters, wind turbines, boilers, etc.

Cost information for many of these components is available from the *Mechanical Cost Data* handbooks on hold in the library. Additional information can also be found on the web. If you are unable to find specific information relevant to your configuration, however, the following rough estimates of initial costs may prove useful.

Gas Compressor: \$50/kW of required power input

Gas Turbine: \$45/kW of gross power output

Gas Combustor: \$2 per lbm/hr of air flow

Gas Reheat Combustor: \$2 per lbm/hr of air flow

Waste Heat Steam Generator: \$5 per lbm/hr of steam flow through the generator

Steam Turbine: \$40/kW of gross power output

Steam Condenser: \$6 per lbm/hr of steam flow

Pumps: \$75.00/kW of pump input power

Steam Generator: \$6.00 per lbm/hr of steam flow rate

Heat Exchangers: \$5.00 per lbm/hr of hot fluid flow

Process Heater: \$4.50 per lbm/hr of steam flow rate

Environmental Analysis

There are many ways to evaluate the environmental impact of a building (or any system). The most accurate way is to include the impact of constructing and demolishing the system (a “cradle-to-cradle,” or LCA approach), as well as the operational impact. An LCA analysis is beyond the scope of this class, so we will instead look at the environmental impact of operating your building. There are also many metrics that can be used to assess this, but we will choose the annual emissions of carbon dioxide.

For all fuel (natural gas, electricity, etc.) consumption, *calculate the tons of CO₂ emitted annually*. You must find the emissions equivalent for your fuel type (this is usually given in tons of CO₂ per energy consumed), and then combine that with the consumption levels to find the overall amount of emissions. This is the only quantitative output for this part of the project, but you should also consider other potential environmental impact factors in your “Recommendations” and “Conclusions” sections.

Regulatory/Code Standards

This analysis may be quantitative or qualitative, but you should *answer the following questions*:

- Is your system “up to code?” In other words, does it meet national/international standards for air flow, clearances, etc.?
- What is the risk assessment of your system?

The written report and powerpoint file for the oral report for Part 3 is due on December 3, and is worth 15% of your grade.