IPRO 345

Fuel Cell/Geothermal Sustainable Energy at the USX Site
Team

- Sponsors: HNTB
- Schools: UIC
- Students: CHE 496, CHE 296, IPRO 345
Team

• Subteams:
  • Environmental
  • Economics
  • Design
  • Ethics
  • Deliverables
Problem

- There is a need for Clean and Sustainable energy
- There is a need to promote Fuel Cell and Geothermal Heat Pump technology
Solution

- Software tool
  - User-friendly
  - Easy-Access
    - Design
    - Cost
    - Benefits
- Algorithm
- Database
Conceptual Design

- Natural Gas: 4.4 cubic meters per minute
- Electricity: 800 MW/h
- Community Use
- Exhaust Heat: 340 °C, 6260 kg/h
- Long-term heat storage tank: 7 cubic meters heat storage
Technology-Fuel Cell

- Electrochemical device
- Converts chemical energy to electricity
- Type: Molten Carbonate
- Fuel: Natural gas
Technology – Geothermal Heat Pump

- Taps stored energy of Earth
- Stores and uses waste heat from Fuel Cell
- Provides heating, cooling and hot water
Design Assumptions

- Household demand (2.5 persons/home)
  - Electricity: 1.5 MWh/month
  - Heat: .3MWh/month (assumes heat pump)
- “Off the shelf” units when possible
- Take advantage of government subsidies and grants
Economics

- Initial Total System Costs: $5,420,000
- Developer cost instead of individual
- Annual Savings: $400,000
- Simple Payback Period: 13.5 years
- Other incentives available
Environmental

- Low emissions
- Low or negligible emission of SOx and NOx
- Carbon trading potential
- Methane can be used as a power source

Comparison of Emissions
(Traditional generation values from a Midwest Survey)
Software Design

- If specific data is unknown, the user imports the area of surfaces.
- If specific data is known, the program takes the following values:
  - Location of project
  - Types of Buildings
  - Number of Buildings
- Compare with eQuest
Algorithm Layout

- eQuest
- Site Loads
  - Design Equations
  - Economic Analysis
    - Equipment Size
      - Payback Period
Obstacles

- Software Design
- Scope of Project
- Remaining Objective
- Communication
Summary

• Fuel cell/Geothermal technology
• Environmentally friendly
• Potentially economically feasible
• Software design
Recommendations

- Enhance the database for wider implementation
- Increase thoroughness of economic analysis
- Minimize assumptions of design equations
- Develop optimization protocols
- Test the results against a real world case study
- Determine degree of marketability