EECE 326 Fundamentals of Energy Systems & Lab

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Lab 10. Renewable Energy Micro-Power System Design

EECS
Howard University

Lab 10 Design for an Actual System

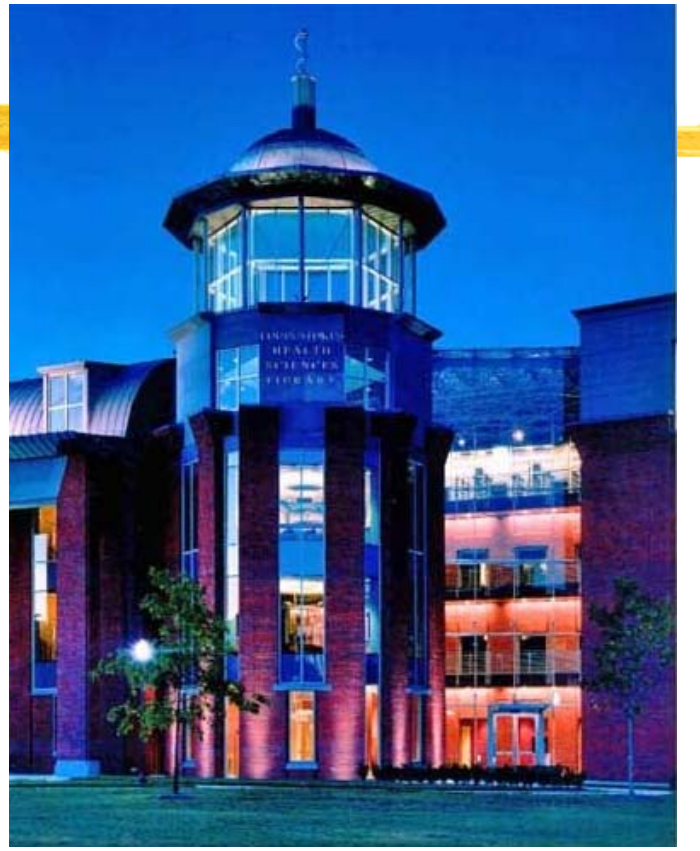
- Work on your own project (Choose 1 of the 3 examples shown in pages 4 – 7)
- Lab Objectives (1):
  - Site Identification → Mission or Goal
  - **Load study** → Should match with the site and the goal → Must be able to justify and **realistic**
  - Find the Solar Radiation, and give Sensitivity values
  - Find the Wind Speed, and give sensitivity values
  - A 100% Renewable Energy System – no grid, nor diesel generator

Lab 10 Design for an Actual System

- Lab Objectives (2):
  - **Find the realistic prices for the components/devices selected in the HOMER**
  - **Physical Size must be considered against the project site area**
  - Calculate and Check the Optimization results for Cost of Energy (COE)
  - Check the Sensitivity Results

Project 1 – Green Campus

- Green Campus Feasibility Study for Howard University
- a building (Engineering Building Night Lighting) or Blackburn etc)
- an area (such as Quadrangle's night lighting)
- Or



Project 2 - Solar/Wind Pump

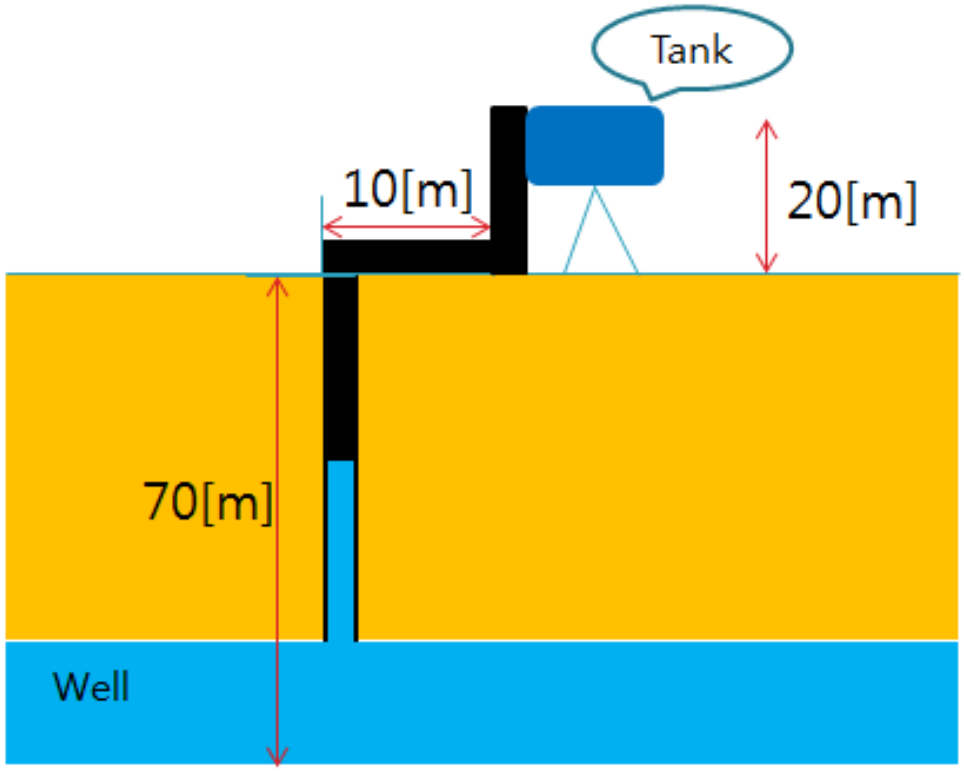
- Site Information
  - Location : Bayannuur, Bulgan, Mongolia (Lat : 47.83. Long : 104.44)
  - Population: 1000
  - Elevation : 850[m]
  - Wind Speed : 10~12[m/s]
  - Temperature : -42~30[℃]
- Needs
  - Supplying power to a submerged pump from Solar and Wind energy sources and providing drinking water to the village folks.

Project 2 (continued) - Water Flow

- Water Need per day: 1000 Gal
- Insolation: Full Sun Hours = 4.04
- Q(GPM)=4.2

Static and Dynamic Head:
Elbow = 3[ea] ⇒ 6[ft]
Check Valve ⇒ 5[ft]
Gat Valve ⇒ 1[ft]

Total Head= 340[ft]



Project 3 – Night Lighting the 14th Bridge

- 100% Renewable Sourced Night Flood Lighting System for the 14th Street Bridge

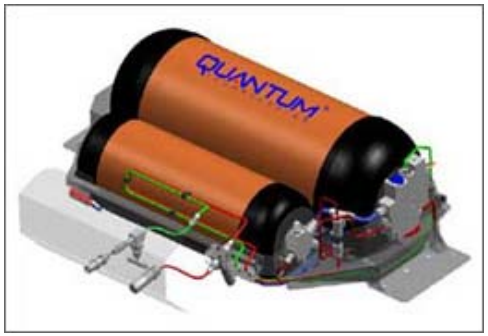
Suggested Component Data – Wind and PV

- Wind Turbine
  - Furhlander 30
    - Size: 30 kW
    - Lifetime: 20 years
    - Quantity: 10: [0, 5, 10]
    - Capital Cost: $???? [for 1 unit]
    - Replacement Cost: 10% of the Capital Cost
    - O&M Cost/Year: 5% of the Capital cost

- PV Module
  - Size: 200kW: [0,100,200,300] kW
  - Derating Factor: 90%
  - Lifetime: 20 years
  - Capital Cost: $?????/kW
  - Replacement Cost: 10% of Capital Cost
  - O&M: 1% of Capital Cost

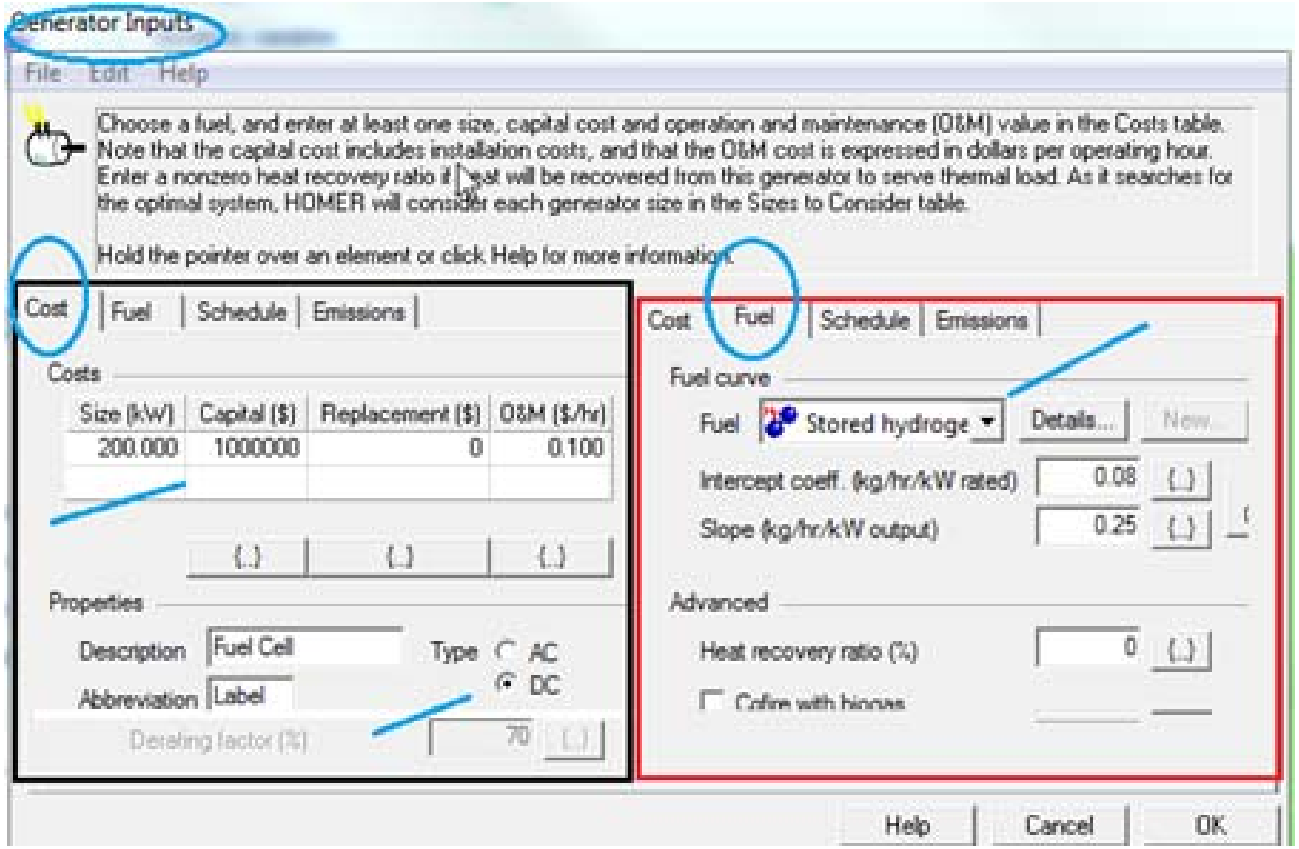
Suggested Component Data – Hydrogen

- Electrolyzer
  - Size: 100kW: [0, 50, 100] kW
  - Lifetime: 20 years
  - Capital Cost: $???? /kW
  - Replacement cost: 50% of Capital Cost
  - O&M Cost/Year: 5% of Capital cost
- Fuel Cell
  - Size: 200kW: [0, 100, 200, 300] kW
  - Lifetime: 30000 operating hours
  - Capital Cost: $????/kW (or $???/kW)
  - Replacement Cost: $0
  - O&M cost: $0.1/hour
- Hydrogen Tank
  - Size: 2000 kg: [0, 1000, 2000, 3000]kg
  - Lifetime: 25 years
  - Capital Cost: $???? /kg
  - Replacement Cost: 10% of Capital Cost
  - O&M Cost/year: 0.5% of the Capital Cost



Fuel Cell Modeling

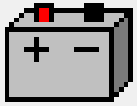
- Fuel Cell In HOMER modeling:
  - Pick a generator
  - Type: DC
  - Fuel: Stored Hydrogen



Suggested Component Data – Converter & Battery

- Converter
  - Size: 200kW: [0, 100, 200, 300]kW
  - Lifetime: 20 years
  - Efficiency: 90%
  - Capital Cost: $??? /kW
  - Replacement Cost: 30% of Capital Cost
  - O&M Cost/Year: 10% of Capital Cost

- Battery
  - Size: 20kW/200kWh: [10, 20, 50, 100]kW
  - Lifetime: 10 years
  - Efficiency: 90%
  - Capital Cost: $??? /kW
  - Replacement Cost: 100% of Capital Cost
  - O&M Cost/Year: 1 % of Capital Cost



Example 3 – Lighting 14th Bridge by Renewable Energy

- 100% Renewable Sourced Night Flood Lighting System for the 14th Street Bridge

Report and Homer Code Submission

- **0. Everyone should have one's own application**
- **1. Report File (MS Word File)**
  - Explanation of
    - Mission, System Site, Location,
    - **Load profile (based on realistic data)**
    - **Realistic Price of Components**
    - Economics → Cost of Energy
    - Optimum result → Comment and Opinion
    - Appendix: Homer produced report
      - Input Report
      - Output Result
  - Put all into 1 MS Word file
  - File name: Lab10_Lastname.docx
- 2. Homer Code File
  - Filename: Lab10_lastname.hmr
- **3. Report File and Homer Code Submission (Via email):**
  - **M 1:00pm April 30, 2018**
- **4. Lab Report Hardcopy (without Homer Code) Submission**
  - **M 4:00pm April 30, 2018**