

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

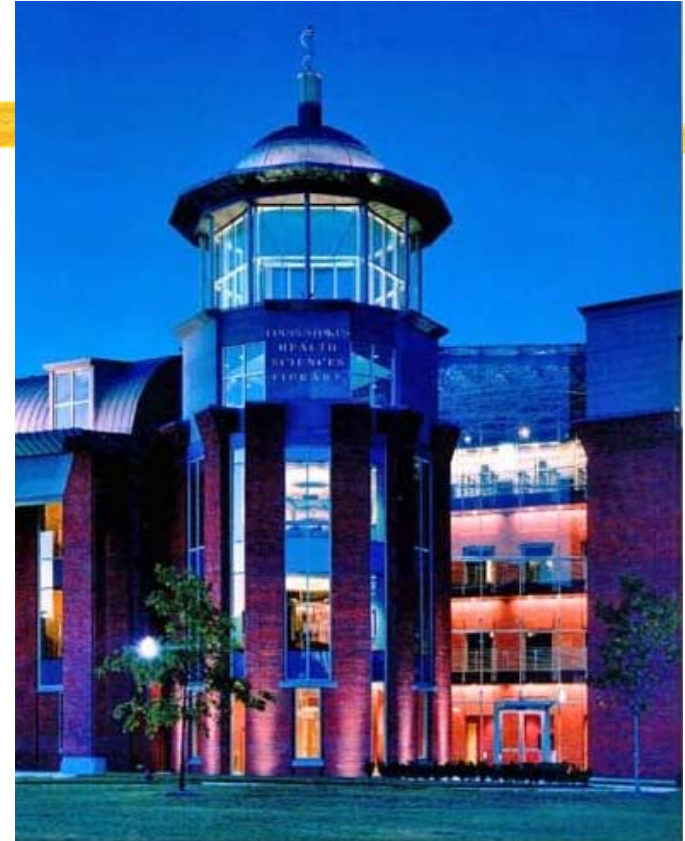
Lab 10 Design for an Actual System

⌘ 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[°C]

⌘ 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
- ⌘ $Q(\text{GPM})=4.2$

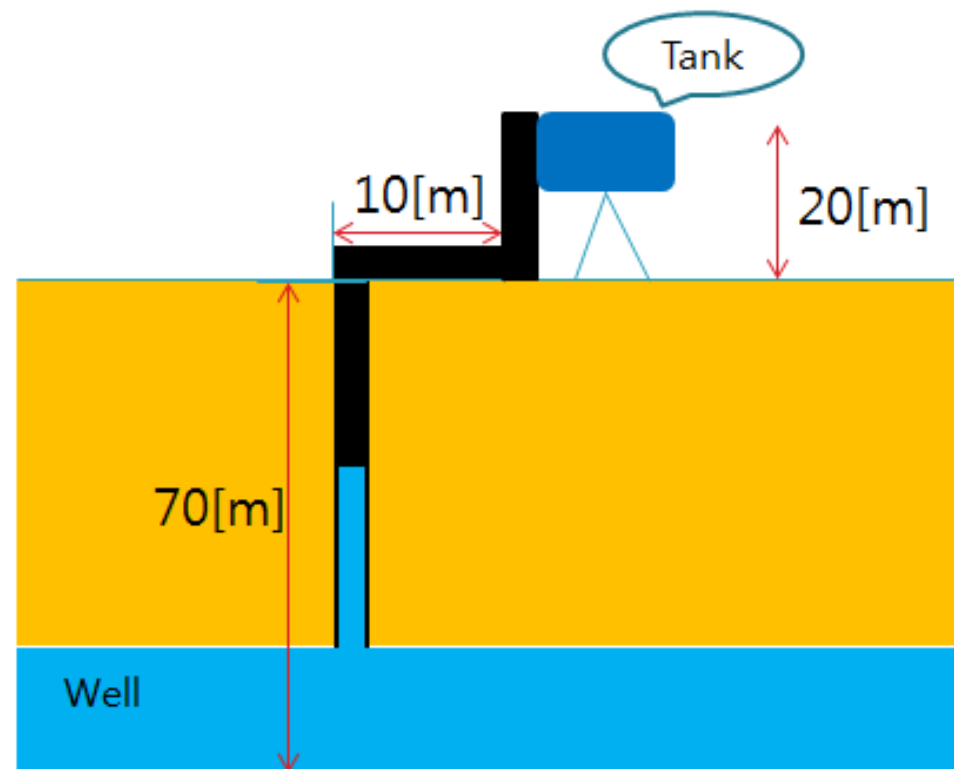
Static and Dynamic Head:

Elbow = 3[ea] \Rightarrow 6[ft]

Check Valve \Rightarrow 5[ft]

Gate Valve \Rightarrow 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



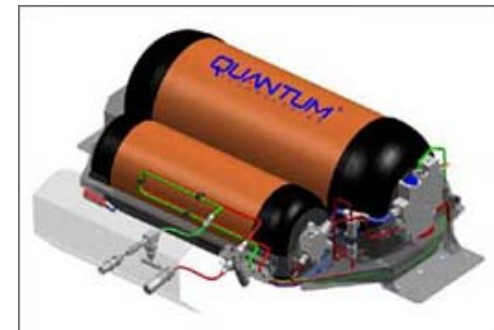
⌘ Fuel Cell

- ☒ 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

Generator Inputs

File Edit Help

Choose a fuel, and enter at least one size, capital cost and operation and maintenance (O&M) value in the Costs table. Note that the capital cost includes installation costs, and that the O&M cost is expressed in dollars per operating hour. Enter a nonzero heat recovery ratio if heat will be recovered from this generator to serve thermal load. As it searches for the optimal system, HOMER will consider each generator size in the Sizes to Consider table.

Hold the pointer over an element or click Help for more information.

Cost Fuel Schedule Emissions

Costs

Size (kW)	Capital (\$)	Replacement (\$)	O&M (\$/hr)
200.000	1000000	0	0.100
(.)	(.)	(.)	(.)

Properties

Description Fuel Cell Type AC DC

Abbreviation Label

Derating factor (%) 70

Fuel curve

Fuel Stored hydrogen Details... New...

Intercept coeff. (kg/hr/kW rated) 0.08 (.)

Slope (kg/hr/kW output) 0.25 (.)

Advanced

Heat recovery ratio (%) 0 (.)

Configure with biomass

Help Cancel OK

Suggested Component Data – Converter & Battery

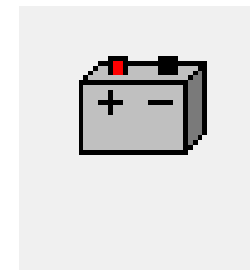
⌘ Converter

- ⊞ 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