NORTHERN ARIZONA UNIVERSITY

Memorandum

Design4Practice (D4P) Program

To: Professor David Trevas

From: Richard Hamilton

Date: October 11, 2020

Re: Individual Analysis 2

Introduction

For the Vertical Farming's team project, many electronics must be used to circulate water, allow plant growth indoors, distribute nutrients, and monitor the water level. All of these components require electricity to run for various amounts of time during the day and night. In this memo, power consumption for these devices will be reevaluated, estimated, and an overall cost for running the system will be obtained.

Differences from the last Analysis

Compared to the last individual analysis, in this power consumption estimation, the most recent supplies and electronics being used will be evaluated. This includes using a smaller fish tank, different lights, and the correct model of pump. The equations being used in this analysis are the same as the last one being mainly addition and multiplication. The team is using a 16 Watt pump, 120 gallon tank, and 2 lights consuming 300 Watts each for this analysis. This combined with assuming 3 Watts per gallon of water for heating, 10 Watts for the filtration system, and an extra 5 Watts for sensors lead to a consumption of 991 Watts or just under 1 kW at any given time. Other than these changed variables, the assumptions for time running and frequency are the same as the original analysis.

Equations and Calculations

For this analysis, I used MATLAB to calculate the total wattage and cost with an assumed 14 cents per kWh. The code for this can be found in the appendix below. A summary of the results can be seen in figure 1 below. Overall, the total wattage is below 1800 Watts, the maximum for a household outlet.

```
Total =

    0.9910

Total_Cost =

    2.0530
```

```
Weekly =

   14.3707

Monthly =

   57.4829

Yearly =

  749.3304

Growth_Cycle =

  205.2960
```

Figure 1: Cost totals for running the system in USD

Results

Overall, the cost of running the system has gone down compared to the last analysis. This is surprising as the team is using higher powered led panels as well as having a filter system for the tank. The selected pump has allowed the team to reduce the estimated number of watts used on pumping water thus lowering the cost. Compared to the values found in the original analysis, the assumed values for the calculations were quite close. Per growth cycle there was only a $5 cost difference between the 2 analyses. With these current estimated values, the team is below the $60 a month operating cost budget set by the client. Moving forward, once the project is assembled, the team will monitor the wattage used over a minimum of one 24 hour period. With this testing data, it may be found that the cost of operation is lower than expected.

Appendix

```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%

% Script Individual Analysis 2

% 10/11/2020

% Richard Hamilton

% eqn:

%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%%%%%%%

%% Clear and close command prompt

clear; clc;

%close all;


%% Variables

Cost = 0.14;     %Cents per KW/Hr

Capacity = 125 - 5; %Gallons


Pump = 16;    %Watts

Lights = 600;

Filter = 10;

Arduino = 5;

Heater = Capacity * 3;  % 3 Watts per gallon


%% Calculations


Total = Pump + Lights + Filter + Arduino + Heater;
```

```
Total = Total * 10^(-3) %KW


%Running times and power consumption

Pump = Pump * 24;   %kWh

Lights = Lights * 16;

Filter = Filter * 24;

Arduino = Arduino * 24;

Heater = Heater * 12;   %Maximum 12 hours a day the heater will be on, most likely less.


Total_Cost = (Pump + Lights + Filter + Arduino + Heater)*10^(-3) * 0.14 %Operating Cost per day


Weekly=Total_Cost * 7

Monthly=Weekly * 4

Yearly=Total_Cost * 365

Growth_Cycle=Total_Cost * 100   %Assuming 100day growth cycle
```