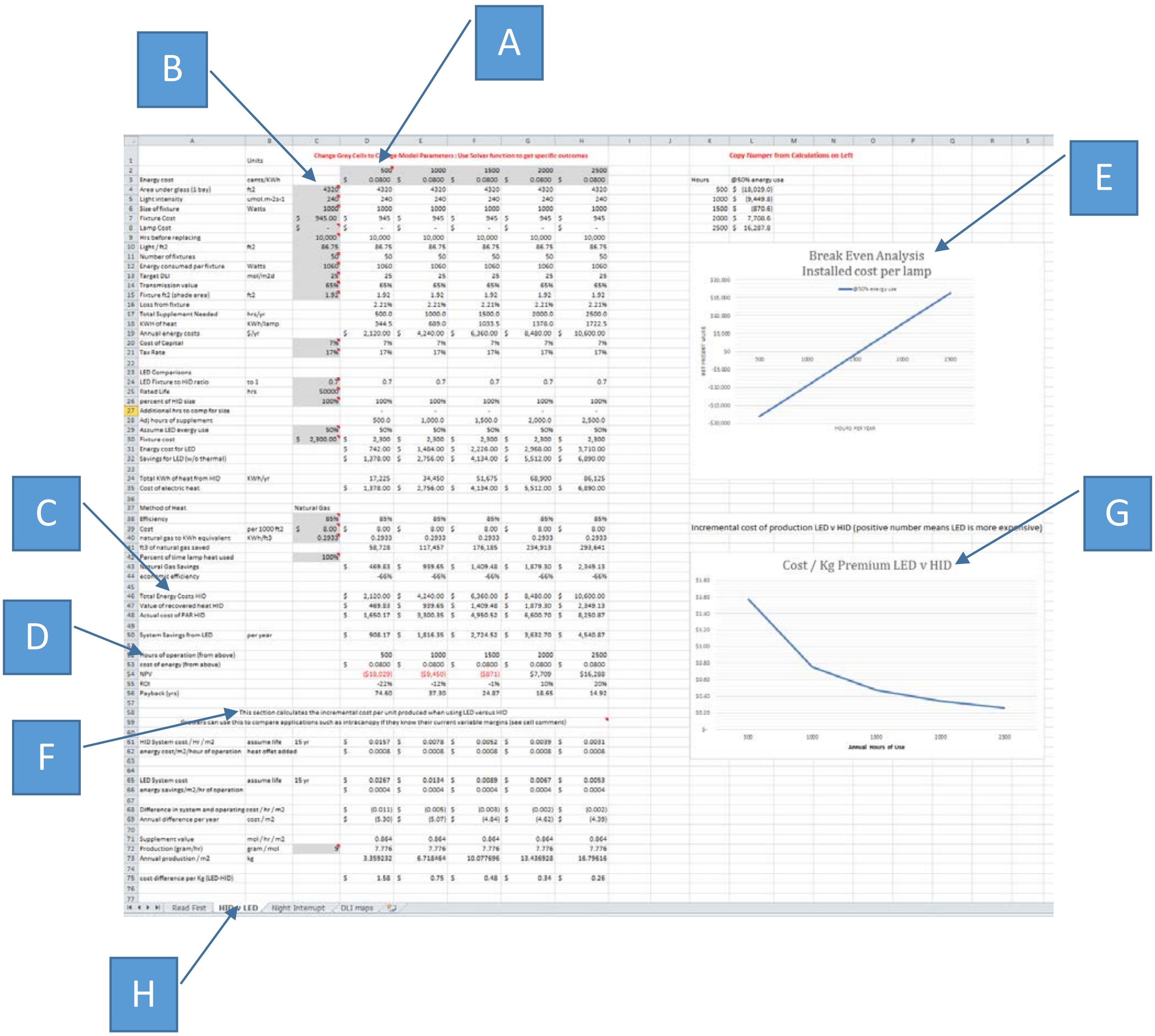
Overview of LED cost comparison worksheet



Explanation of sections and methodologies

A) This is the input area for electricity prices and number of hours the lighting is used. For any individual user, electricity prices typically do not vary by amount consumed, but the model allows for different pricing (most common in co-generation). Because the number of hours used per year can vary by cultivar choice or section of the greenhouse based on different plant DLI requirements, the columns help calculate return over a number of usage scenarios.

B) The grey column are input for your specific usage scenarios. This includes several relevant operating parameters like number of fixtures needed per square foot, installed cost per lamp, and size of fixture because luminaires shade natural light. Note that it is the difference in overhead light source which is the most meaningful since supplemental lighting will need to be adjusted accordingly.

   a. Cost of capital (your company's interest rate) is included because large capital investments typically involve financing through additional debt.

   b. Tax rate is included because with capitalized expenditures are allowed to be depreciated which lowers the amount of tax paid. Because of this, it effectively reduces the actual cost of the investment

C) This section is the total cost of standard HID lighting adjusted for the reduced heat load which needs to be replaced with supplemental heat such as natural gas.

   a. The default value assumes more lighting is used when the days are shorter and this is in the cooler months. Thus, if the lighting is not warming the plants, more heat will be necessary from a secondary source. If this is not your situation, you can change the usage the Lamp heat used anywhere from 100% to 0%. If you do not vent heat while you are using your lights roughly 75% of the time, set this number to that value.

b. Cost and furnace efficiency is in the cells above the cost figures for heat. Efficiency defaults to 85% as this is the US average efficiency with current installed technology. If a different heating type is used, there are adjustments that can be made for cost/unit volume and BTU equivalent per unit volume of the replacement.

D) Three different summary calculations are provided:

a. Net Present Value (NPV). NPV can be thought of as how much value the investment is adding to the value of the firm. This is the preferred method in finance for prioritizing investment as other measures may be more attractive such as payback period, but have less of an enterprise value impact on the firm. In this case, most lighting systems will last 15 years which mean the company saves money during the life of the product. This should not be ignored as these savings can have a material impact on the firm. The savings (or costs) are discounted at the company's loan rate of interest. Thus NPV shows the value of the project to the firm after interest on the loan is paid and takes into account the time value of money ($100 paid in ten years is not as valuable as $100 now).

i. It is also common to discount at a 'hurdle rate'. A hurdle rate is the return a company requires to undertake a project. These rates are above the loan interest rate and, from an economic standpoint, are supposed to take into account the minimum growth required by management or shareholders.

ii. When NPV equals 0, this is the project "break even". In this context, this means that the benefits from the project when discounted over time are equivalent to the costs of the project.

iii. There is an embedded assumption which is important to note. This model assumes that each system will last 15 years with lamp replacement on HID. This is different than a fixed number of hours useful life warranted by LED providers. This is done for two reasons. First, the actual life of the LED *system* is unknown. There is a lot of history around failure rate of LEDs, but as more parts are introduced into the system, you have a compounded effect on probability of failure. That being said, 2500 hours per year of use for 15 years exceeds most manufactures warrantees. Second, as you decrease the use of LED's per year, you should increase the number of useful years if life is determined by usage hours alone. However, less use per year generates less savings per year which discounted for time value of money has less (though not zero) impact than savings in earlier years.

b. Return on Investment (ROI) – Return on investment is calculated by discounting the future savings in the same manner as NPV. Thus the ROI is calculated as (total benefit/total costs). The reason NPV is preferred over ROI is that NPV takes into account the total enterprise value of the project where ROI can be attractive for small investments which still take managements time. In other words, if you only have resources to do one project and your choices are

   i. Project A: make $75k from a $50K investment (ROI 50%)
   ii. Project B: make $50K from a $30k investment (ROI 67%)

Project A adds $25k to the firm and is preferred over Project B as this only adds $20k to the firm. This example illustrates a fundamental axiom of NPV versus ROI. NPV is most easily used when deciding between project "A" and "B" if only one can be chosen. If you can do two Project B in the same time you can do Project A, 2xProject B is preferred ($NPV_B+NPV_B > NPV_A$)

c. Payback period – payback period is provided for reference and is calculated simply by looking at the savings versus incremental costs of LED versus HID. This does not take into account depreciation which is added savings. While payback period is a simple and convenient measure, the main drawback is it ignores any savings which accrues to the firm after the payback period. Large capital investments which provide enduring value to the firm should not be measured against payback period. For example, an investment in a new greenhouse may have an 8 year payback but provides savings for 20 years. Investment in a new packaging line may have an 8 year payback but provide savings for 10 years. If using payback period as the measure, you would be indifferent between the two projects. However, intuitively we can see that the additional life and associated savings of the greenhouse investment adds value

E) Graph of NPV values at different usage and constant electrical costs - The upward slope of the output is simply explained by the more you use your asset which generates savings the more cumulative savings you will have.

F) This shows the difference in cost per unit output of LEDs versus HID. The model is currently using a calculation of grams/mol. For something like tomatoes this is about 9 grams/mol of product. If the number is positive, it is cheaper to use HID than LED. However this calculation is important because there are practical limits with the use of HID. Plants can be 'burnt' with too much radiant heat or in close proximity to LEDs. LED's are a way to introduce more umol/m2/sec without significant heat load introduced overhead or intracanopy. In theory, growers should add more light (or other input) as long as the contribution margin is positive (revenue – variable costs). An easy way to think about this is to think about the decision of using supplemental lighting. If you used natural light, your profit per unit would be high but your yield would be low. By adding more expensive lighting, you can increase your yield, but your profits are reduced the more supplemental lighting you add.

G) This is a graph of the calculation above. The interpretation is similar to the concept of economies of scale. The more the asset is used for production, the lower the cost per unit. The investment is amortized over a greater number of units. If our output is linear, meaning that every unit of light adds the same amount of value to our crop, we can compare the increase in cost to our current variable margin. If the increase in costs is lower than our variable margin, adding LEDs for that amount of use per year is of net benefit to the company.

H) There two tabs of primary interest are two scenarios of usage. The first is HID versus LED which would represent most indoor operations from bedding plants to vegetable production. The second is an analysis of intermittent light such as night interrupt using incandescent versus lower wattage LEDs. This worksheet is significantly more straightforward as there are less operating parameters to consider, the cost are not capitalized needing treatment for depreciation and the costs for incandescent replacement is negligible.