Reference Guide

**Sample Only**

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Revision 3

Solar

**1. How the Calculation Works**

**Demand Analysis, Energy Opportunity Cost:**

The opportunity cost module computes the dollar amount saved (+) or lost (-) from the purchase of a solar electricity system. Specifically, it is the difference between the *Total Solar Cost* and the *Total Grid Cost*.

***OpportunityCost* (B32:M32)=*TotalSolarCost* (B30:M30)–*TotalGridCost* (B31:M31)**

Where *Total Solar Cost* and *Total Grid Cost* are calculated as follows:

***TotalSolarCost*=*AnnualSystemPayment* (B25:M25)+*GridElectricityCost* (B29:M29)**

***TotalGridCost*=*EnergyConsumption* (B27:M27)\**GridPriceBuy* (B23:M23)**

The Grid Electricity Price in the Opportunity Cost computation is calculated using:

***IF (EnergyConsumption-*SystemOutput(B26:M26)*>=0, (EnergyConsumption-SystemOutput)\*GridPriceBuy,(EnergyConsumption-SystemOutput)\*GasPriceSell*(B24:M24)*)***

This conditional computation takes the difference between the average household energy consumption and the solar systems capacity **(B26:M26)** and if the difference is positive (or zero) it calculates the amount of money generated when the surplus is sold to the grid, which is subtracted from annual system payment. If the difference is negative, the household energy demand is greater than the energy the solar system can produce and the difference must be purchased from the grid at the grid electricity price. The Annual System Payment portion of the Opportunity Cost computation is generated with the following formula:

 **= *-PMT(InterestRate* (B4)*,SystemLif*e(B6)*,SystemPrice* (9))**

This financial formula calculates the yearly cost of a solar system purchase over its’ useful live when it is financed at the specified interest rate.

**Demand Analysis, Solar System Demand:**

The solar system demand module calculates the expected sales volume of solar systems as a function of the opportunity cost generated by the opportunity cost module. The total solar system demand (market) is computed using the series of nested conditions in the formula below:

***=IF(AND(OpportunityCost>UpperRange1,OpportunityCost<LowerRange1),NumberOfHouseholds\*PerDemand1,IF(AND(OpportunityCost>UpperRange2,OpportunityCost<LowerRange2),NumberOfHouseholds\*PerDemand2,IF(AND(OpportunityCost>UpperRange3,OpportunityCost<LowerRange3),NumberOfHouseholds\*PerDemand3,IF(AND(OpportunityCost>UpperRange4,OpportunityCost<LowerRange4),NumberOfHouseholds\*PerDemand4,IF(AND(OpportunityCost>UpperRange5,OpportunityCost<LowerRange5),NumberOfHouseholds\*PerDemand5)))))***

This formula references the Opportunity Cost to Demand Parameters **(D6:I10)** to generate what percentage of the total market size **(B10)** will purchase a solar system at a given opportunity cost. Specifically, it identifies what upper **(E6:E10)** and lower **(G6:G10)** ranges the periods opportunity cost falls in and multiples the total market size by the respective percent demand **(I6:I10)**. Total Sales Volume, the product of the Demand Analysis worksheet, is calculated by multiplying the demand for solar systems by the percentage of market share expected for the company. The formula used to calculate the sales volume is:

***SalesVolume*(B38:M38*)=SolarSystemDemand*(B36:M36)*\*Market Share*(B37:M37)**

**Payroll Analysis, Number of Staff Module:**

With the exception of the president and attorney, which are predefined values, the number of each type of staff is calculated based on a specified “driver”. For the Marketing, Purchasing, Sales, Installation (Technicians) staff the “driver is sales volume; for Human Resources staff, the “driver” is number of all the other staff. Each staff type relates to their respective driver differently these difference are as follows.

The estimated Marketing staff required to support the company for the sales volume projected in the Demand Analysis section of the model is defined by the formula:

***IF(DemandAnalysis!SalesVolume<15000,1,IF(DemandAnalysis!SalesVolume <50000,2,IF(DemandAnalysis!SalesVolume<100000,3,IF(DemandAnalysis!SalesVolume<200000,4,5))))***

The formulas states that if the sales volume is less than 15,000 units, 1 marketer is required; if it is between 15,000 and 50,000, 2 Marketers are required; if it is between 50,000 and 100,000 units, 3 marketers are required; if it is between 100,000 and 200,000 units, 4 marketers are required. If the sales volume is over 200,000 units five Marketers are required. For Purchasing staff, the calculation is similar to the Marketing staff calculation. The formula below states that if the sales volume is less than 20,000 units only one Purchaser is needed, but if the sales volume exceeds that value two purchasers are needed.

 ***IF(DemandAnalysis!SalesVolume<20000,1,2)***

The formula can be modified in the exact same way as the Marketing staff formula by both changing the threshold value(s) and or adding new thresholds with nested formula(s). When changing this value, one should consider the impact on the cost per order used to calculate the EOQ in the Inventory Analysis section. The sales staff required for the company is also relative to the sales volume, but also the number of work days and the number of sales calls for each staff member. The formula:

***INT((DemandAnalysis!SalesVolume/WorkDays*(B10)*)/CallsPerDay*(B8)*)+1***

defines this relationship. It divides the total sales volume for each period by the number of work days per year (period) to obtain the call volume. Subsequently, the call volume is divided by the number of calls that can be done in a day per Sales Rep. The integer function is then used to truncate the number of people (roundup could also be used depending on management policy) and one rep is added as a workload buffer/minimum amount.The Administrative Assistant (AA’s) personnel category is calculated based on the total number of the other personnel at the company. As indicated by the formula below, if the sum of the other personnel for that period is less than 100, one AA will be required for that period. If the sum is greater than 100 but less than 500, two AA’s will be hired; between 500 and 1000, three AA’s will be required. For a staff greater than 1000, 4 AA’s are necessary.

***=IF(President*(B20:M20)*+Marketers*(B20:M20)*+Technicians*(B24:M24)*+PurchasingDept*(B22:M22)*+SalesRep*(B23:M23)*+Lawyer*(B25:M25)*<100,1,IF(President+Marketers+Technicians+PurchasingDept+SalesRep+Lawyer<500,2,IF(President+Marketers+Technicians+PurchasingDept+SalesRep+Lawyer<1000,3,4)))***

From the number of personnel calculated for each category, the “Number of Staff Required Module” summarizes the total number of staff required as well as the total cost for period one through twelve. The total personnel cost for each period is the result of the total number of personnel multiplied by their respective salaries. This is accomplished in a single step with the following array multiplication formula:

 ***=MMULT(TRANSPOSE(PersonnelCost*(B2:B8)*),NumberOfStaff*(B20:M26)*)***

**Payroll Analysis, Hiring Stream Module:**

The Staff Hire Module of the payroll analysis is used to calculate the total number of each personnel category hired that year. As such, a positive number indicates new hires and a negative number indicates layoffs. The first year is taken directly from the first year of the staff required module, because there are no previous values to refer to. For years two through twelve, the number of hires is the difference between that year and the previous year of the staff required Module. An example of the later is specified below

 ***=NumStaffYr(X)–NumStaffYr(X-1), where X is a year***

EXAMPLE: ***=NumStaffYr2*(C20:C26) *–NumStaffYr1* (B20:B26)**

**Operations Analysis, Operations Equipment Module:**

The primary objective of the Operations Equipment Module is to calculate the cost of new equipment purchases per period and the depreciation expense per period. The cost of new equipment purchases is the sum of the equipment categories for that year.

 ***=SUM(B23:B25)***

This includes the cost of equipment for the personnel, office and technicians. For the personnel, the equipment cost is calculated by multiplying the cost of office equipment per person by the total number of office personnel for that period generated by the payroll analysis.

***=IF(OfficeEquipmentPersonnelCost*(B3)*\*(PayRollAnalysis!PresidentHires+PayRollAnalysis!MarketersHires+PayRollAnalysis!PurchasingDeptHires+PayRollAnalysis!SalesRepHires+PayRollAnalysis!AdminHRHires)<0,0,OfficeEquipmentPersonnelCost\*(PayRollAnalysis!PresidentHires+PayRollAnalysis!MarketersHires+PayRollAnalysis!PurchasingDeptHires+PayRollAnalysis!SalesRepHires+PayRollAnalysis!AdminHRHires))***

As the formula above states, if a negative value is generated from the sum of personnel for a given period, that value will default to zero to avoid negative equipment costs. This model does not include a module for income (such as that generated by selling used office equipment) other than product sales. The cost of equipment for the office each period is tied directly proportional to the number of AA’s that are hired.

***=IF(OfficeEquipmentforOffice*(B4)*\*PayRollAnalysis!AdminHRHires<0,0,OfficeEquipmentforOffice\*PayRollAnalysis!AdminHRHires)***

Once again, if AA’s are laid off, the negative value that would be generated by multiplying the “negative hires” by the cost of the equipment for each AA defaults to zero. Finally, the equipment for each technician team is calculated

***=IF(TechnicianTools*(B17)*\*PayRollAnalysis!TechniciansHires/TechniciansperInstallation*(B15)*<0,0,TechnicianTools\*PayRollAnalysis!TechniciansHires/TechniciansperInstallation)***

This formula works identically to the previous formula for AA’s with one exception. Since there are multiple technicians per installation, the number of technicians hired each period must be divided by the number of technicians per installation prior to calculating the cost of the equipment. These three equipment costs are then summed (New Equipment Cost ***=SUM(B23:B25)***), which is used to generate the cumulative equipment purchase cost **(B27:M27)** with an ***Up+Lt-(XY), where (XY) is the reference to the cell with the previous periods deprication***. The cumulative equipment cost is important in generating the depreciation expense of the equipment purchased, a value that is generated by convolving the new equipment costs for all twelve periods with the depreciation rate base.

***=convolve(NewEquipmentCost*(B26:M26)*,DepreciationBase*(B28:M28)*)***

**Operations Analysis, Other Operations Expenses Module:**

The total cost of operating expenses that can’t be depreciated include office supplies which are based on the cost of office supplies per person,

***=OfficeSupplyCost*(B5)*\*(PayRollAnalysis!President+PayRollAnalysis!Marketers+PayRollAnalysis!PurchasingDept+PayRollAnalysis!SalesRep+PayRollAnalysis!AdminHR)***

the percentage of revenues that funds sales and marketing campaigns,

***=(DemandAnalysis!SalesVolume\*DemandAnalysis!SystemPrice)\*MarketingSalesCostRatio*(B13)**

the cost of fuel ***=DemandAnalysis!SalesVolume\*FuelPricePerInstall*(11),** which is the number of installations per year times the fuel cost per install, the facilities rent **(B7)**, and finally the cost of insurance for the equipment ***=TotalEquipmentValue\*InsuranceRate*(B12).** Subsequent to calculating each of these cost series, they are summed **(B39:M39)** for each period (example: **=SUM(B33:B38)**)

**Inventory Cost Analysis, Inventory Cost Module:**

Calculating the cost of goods sold involves calculating the total number of orders and the average inventory for each period. To guide these values, the economic order quantity was calculated using the following formula:

***=ROUNDUP(SQRT((2\*YearlyDemand*(B9:M9)*\*DemandAnalysis!SystemPrice\*CarryCost*(B3)*)/(DemandAnalysis!SystemPrice\*CarryCost*(B3)*)),0)***

The average inventory **(B12:M12)** is the EOQ divided by two and the number of orders per year **(B13:M13)** the yearly product demand divided by the EOQ. The cost of good sold **(B14:M14)** is:

***=DemandAnalysis!SystemCost\*YearlyDemand+NumberOfOrders\*OrderCost+AverageInventory\*CarryCost***

**IncomeAnalysis, Income Statement Module:**

The income analysis worksheetis a series of simple arithmetic operations used to calculate the two output streams. The first output stream, revenues **(B4:M4),** is a straightforward calculation that takes the sales volume generate from the demand and analysis and multiplies it by the selling price of the unit (***=DemandAnalysis! SalesVolume\* DemandAnalysisSystemPrice).*** From revenues, the total cost streams (intermediate value streams) generated from the payroll, operations and inventory analysis sheets are subtracted from the total revenues to obtain the earnings before interest and taxes (EBIT). A fixed 30% tax rate is subsequently applied to the EBIT to generate net income, the second output stream.

**2. How to locate the inputs, outputs and intermediate results**

There are a total of five worksheets in the Acme Solar model. The first four worksheets, Demand Analysis, Payroll Analysis and Operations Analysis have a discreet set of user inputs located in the top section of the first four worksheets. The lower section of these first four pages contains the calculations performed and the respective intermediate values that are generated to calculate the models output. The fifth worksheet, Income Analysis, contains all of the models outputs.

**3. Guide to visual cues**

As mentioned in the previous section, all of the parameters are located in the upper section of the first four worksheets. This section can be easily identified by its light grey background color. Within each of these “parameter blocks”, the variable quantities that are set by each user are highlighted in a soft yellow color. Non-maintenance users should only use these yellow cells. The intermediate values that carry to other worksheets are designated by a green background, making them easy to distinguish. Finally, the outputs streams on the Income Analysis page are highlighted in orange.

**4. How to make changes**

There are a couple of ways to change this model, which include adding inputs (streams or parameters) and changing the way calculations are performed. Adding input streams and parameters is relatively straight forward once a strategic location is identified. For ease of use it is strongly recommended that inputs be added to follow the flow of the data so that it is easier to follow for a variety of users. Once the new input data is entered, the cells or arrays should be defined locally and always referred to by their defined name going forward. The naming convention used in this model uses capital letters for the first letter in each word of the name and numbers (example: ElectricityPriceBuy1). Abbreviations that aren’t common or obvious should be avoided, as should those that make one name appear similar to another. Once entered into the appropriate place and named, new data must be tied into the relevant calculations. For simple calculations that perform arithmetic on cells or arrays, adding new data is a simply matter, illustrated best by an example. To add a “gas surcharge” as a separate input stream to the opportunity cost module of the demand analysis worksheet, one simply has to create the input stream in the parameter block (below the grid electricity price is the best fit) and then define the array (example: GasSurcharge). Now the new grid in the lower section needs to reflect the price of the fuel surcharge, this is done by adding the fuel surcharge to the formula in the row named “GridPriceBuy/Electricity” **(C23)**

There are also more complex calculations in the model that require more complex solutions when either trying to add new categories of information to calculate or changing some of the intrinsic parameters of the formula. Once again, an example best illustrates how to approach this modification. In the The formula used to calculate the number of marketing staff required makes marketing staff dependent on sales volume and sets threshold as to how many marketers are needed to support a range of sales volumes.

***=IF(DemandAnalysis!SalesVolume<15000,1,IF(DemandAnalysis!SalesVolume<50000,2,IF(DemandAnalysis!SalesVolume<100000,3,IF(DemandAnalysis!SalesVolume<200000,4,5))))***

Should the thresholds for the Marketing personnel be determined to be inaccurate, they can be easily modified to suit the users’ needs. For example if it is determined that the first Marketer can only handle a work load that supports a sales volume of 10,000 instead of 15,000, the model administrator can change the formula from <15000 to <10000 and so on. Furthermore, if it is discovered that additional thresholds are needed, they can be added by replacing the final value (the “then” value) 5 with an additional series of nested statements (of the form: *IF(DemandAnalysis!SalesVolume<x,y,z),* where z is either a default value or another nested formula of the same type). These nested conditional formulas are heavily relied upon in this model. Another set of formula that needs to be considered when adding inputs are the convolve and mmult formulas used. When adding arrays to matrices, it is important that the matrices be redefined to include the new data. An obvious direction to expand this model is to develop a more comprehensive evaluation of the opportunity cost calculation and market segmentation. There are also a variety of potential intangibles that could provide a weight to one side. Market segmentation would also help tighten the correlation between the values projected by the model and the actual values.