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## A Spreadsheet Algorithm for Determining the Economic Feasibility of Micro-CHP Systems in the Arkansas Manufacturing Sector

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A Spreadsheet Algorithm for Determining the Economic Feasibility of Micro-CHP Systems in  
the Arkansas Manufacturing Sector

A thesis submitted in partial fulfillment  
of the requirements for the degree of  
Master of Science in Mechanical Engineering

by

Ford Lewallen  
University of Arkansas  
Bachelor of Science in Mechanical Engineering, 2014

August 2017  
University of Arkansas

This thesis is approved for recommendation to the Graduate Council.

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## **Abstract**

Combined heat and power (CHP) systems are not new to the market. However, advances in technology, specifically MicroTurbines, have presented new opportunities for installations of micro-CHP units - defined as 50 kWe to 300 kWe, specifically at small- to medium-sized industrial facilities. One pressing concern is whether or not an industrial plant has a high enough process thermal load requirement to fully utilize the energy output.

This thesis will discuss simulations that were run on several actual electric and thermal load combinations, which correspond to types of manufacturing facilities commonly found in Arkansas. Analysis of the plant usage profiles will identify economically feasible scenarios from CHP production based on electric and thermal loads, electric demand and energy costs, the cost of natural gas, and CHP unit size and efficiencies. The spreadsheet algorithm will be written in a form to allow a user to select utility rate structures from major utility companies in Arkansas, or customize their own rate schedule, and enter their monthly energy usages and demands. The user can then compare and contrast costs and savings of different CHP units, and then make informed decisions on whether a company would benefit from installing a CHP system.

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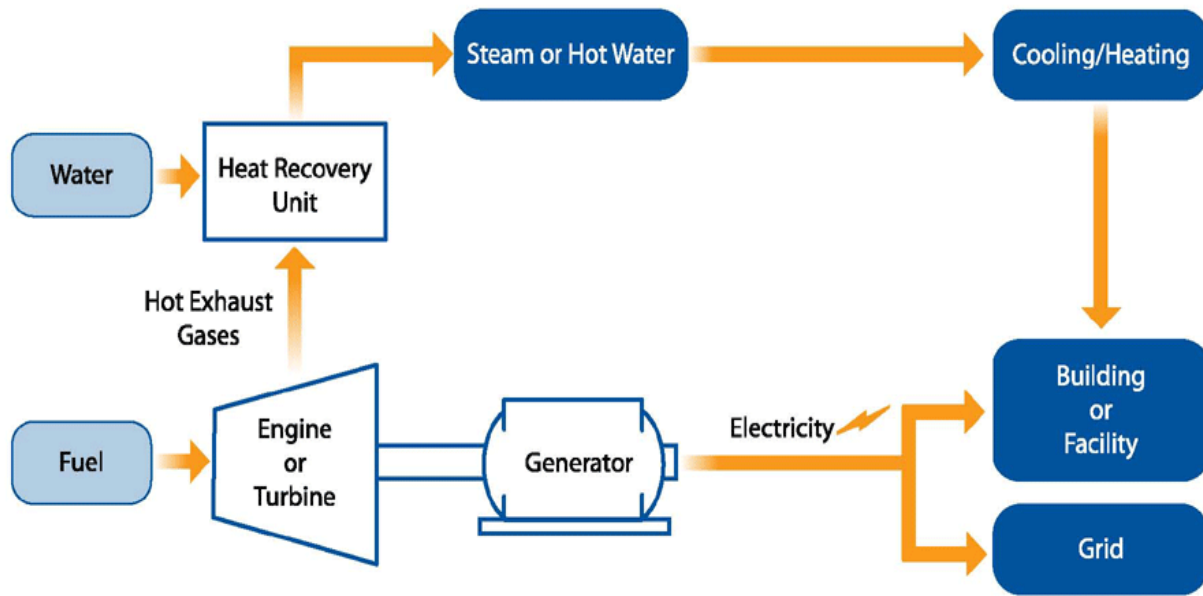
## **Chapter 1: Background**

### **1.1 Introduction**

Combined Heat and Power (CHP) generation is defined as the sequential production of thermal and electrical energy from a single fuel source. CHP, also known as cogeneration, is not a technology but an approach, rather, which has been around for over a century in which separate technologies are integrated to achieve a high efficiency of energy production.

CHP systems are comprised of four main components. The prime mover produces mechanical energy by combustion of a fuel. This could be a reciprocating engine or a steam or gas turbine, among other several other options. An electricity generator converts the mechanical energy created by the prime mover into electricity. A heat recovery system uses a heat exchanger to recover heat (thermal energy) from exhaust gas or from a cooling jacket. Finally, each CHP system must have a control system to control individual components, such as exhaust gas flow temperature or pressure, to ensure synchronicity of the whole system.

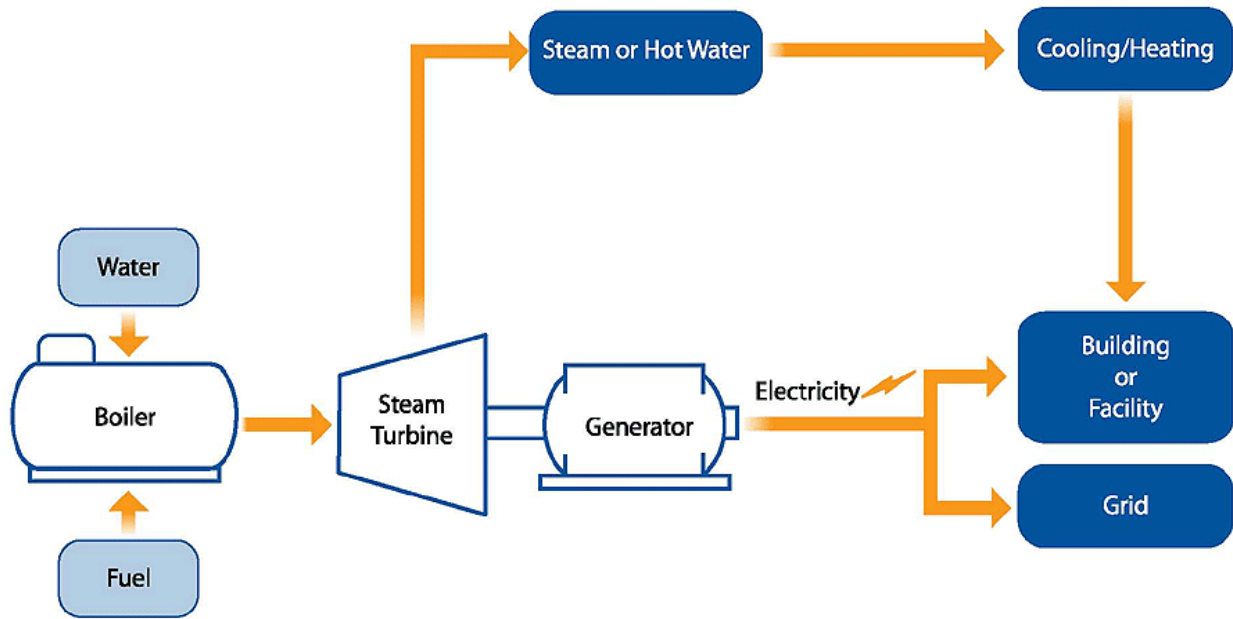
Two types of general cycles are defined. The topping cycle (shown in Figure 1.1) uses a fuel as the prime mover to generate electricity or mechanical power as first means of work done. The system then recovers the waste or exhaust heat to provide process heat, hot water or steam, or provide space heat. Topping CHP systems are designed to meet a baseload thermal demand.



**Figure 1.1:** CHP Topping Cycle

The second approach is the bottoming cycle (shown in Figure 1.2). In the bottoming cycle, also known as waste heat to power, the thermal demand of a furnace or other high temperature industrial process is met by the fuel first. Then the rejected/waste/exhaust heat is recovered for power production, typically in a boiler or steam turbine. Bottoming cycles are rarely economical due to the low efficiency of electricity generation with the low temperature heat [Rohrer, 1996].





**Figure 1.2:** CHP Bottoming Cycle

In large systems it is possible to construct a combined cycle. In the combined cycle the first prime mover is a combustion turbine used to generate electricity. The waste heat is recovered and used to produce steam, which then powers a steam turbine. If the temperature of the steam is high enough after passing through the steam turbine it may be used to support process requirements.

## 1.2 History

Perhaps the first application of combined heat and power was in the 1882 at Thomas Edison's Pearl Street Station. The world's first central power plant produced grid electricity while also distributing the waste heat thermal load in the form of steam to nearby industrial sites for manufacturing processes as well as to local buildings for space heat. By the early 20<sup>th</sup> century, most industrial plants generated their own electricity on-site. And it's estimated that 58% of the total power produced in these plants utilized cogeneration (Aung, 2002).

As a result of the stock market crash in 1929 congress passed the Public Utility Holding Company Act (PUHCA) in 1935 to essentially prevent utility holding companies from holding shares of any other company. It did so by requiring any firm that sold electricity to another party, even in the smallest amount and unrelated to the firm's primary line of business, to be subjected to profit regulation by the state ( Fox-Penner,. 1990). Utility holding companies had been relying on the consistent utility company income to sponsor riskier business ventures around the world. When the stock market crashed the banks asked for their loans from the holding companies and a total of 53 of these holding companies had to file for bankruptcy.

The development of large utility plants by the 1950's provided cheaper energy costs than on-site production. Industrial plants had use for recovering the extra heat for steam and other processes. Power plants had no such use and could not effectively transport the heat to the industrial sites. Additionally, low fuel costs in this time drove industrial plants to ignore the energy conservation opportunity provided by cogeneration. Installing less costly and less efficient boilers were judged to be the most cost efficient option and were chosen in lieu of more energy efficient but more expensive boilers. Between 1950 and 1974 on-site cogeneration contributions fell from 15% to 4% of total electricity generated in the United States.

An increased regulation of electricity generation and the availability of low-cost liquid and gaseous fuels discouraged cogeneration. The most common CHP configuration was a bottoming cycle, using a boiler to generate steam and then recovering excess steam to power an electric generator. And due to the complexity and high capital expenses of this configuration, CHP systems were largely confined to 50 MWe and higher.

The oil crisis of 1974 pushed utility companies to invest in coal and nuclear power plants. The costs of the investments trickled down to the consumer in the form of high electricity rates.

In response, Jimmy Carter and Congress passed the Public Utility Regulated Policy Act (PURPA) was to promote alternative fuel options, establish a market for distributed generation, and to encourage high-energy efficiency standards. The act required the nearest utility to purchase all power added to the grid by a Qualifying Facility (QF) of cogeneration at a rate equal to the utility's full avoided cost. This rate was previously mandated by the state. To be a QF of cogeneration, non-utility power generation must have met the following efficiency standards:

$$42.5\% \leq \frac{(Power\ Output + 1/2\ Useful\ Thermal\ Output)}{Energy\ input}$$

**Equation 1.1**

To be an Independent Power Producer (IPP) QF a non-utility power generating plant must produce its electricity via at least one of several renewable fuel sources, such as wind, solar, or hydro-electric energy.

The combination of mandating the possibility of connection and sale of electricity to the grid, plus reasonable rates for backup electricity provided a guaranteed market for on-site industrial power generators. America saw a 300% increase in non-utility generators from 1978 to 1992 (Kolanowski, 2000). CHP technology surged in this time period until the Energy Policy Act of 2005 (EPAct 2005) put a damper on the CHP development. Under the EPAct 2005 utility companies are no longer obliged to purchase power.

While this may discourage on-site CHP and distributed generation to some extent, the U.S. government has enacted several policies over the last couple of decades to promote technological advances in energy efficiency. Likewise, individual states have recognized their responsibility to promote energy efficiency by developing incentives, interconnection requirements, and simplifying environmental permitting procedures (Sweetser, 2015).

## 1.3 CHP Today

**1.3.1 Efficiency.** The desire to install CHP systems to provide on-site electric and thermal loads is driven by the overall efficiency of the system. Electricity generator efficiencies usually lie within the range of 30 to 35%. And the remaining thermal energy is wasted. Applying a heat recovery system to the exhaust gas raises the efficiency of the overall cogeneration system often times to between 80% and 90%. If the CHP generation site has a need for the recovered thermal load, and uses it, then it decreases the average energy rate. CHP boasts another advantage over traditional electricity generation because it minimizes distribution loss when the electricity is produced locally. Energy is lost by transforming the voltage up to the required level for transporting over distances, and then down again to the proper levels for end use. There are also the losses from the resistance over the wire, which is a function of distance. And, of course, it locally produces heat for space or process heating. And natural gas prices are regionally dependent due to the cost of transportation over long distances.

**1.3.2 Pollutant Emissions.** Using Natural Gas as the prime mover in energy production has lower CO<sub>2</sub> emissions per unit of electricity in comparison to conventional thermal power plants (Mansour, 2007). Another environmental advantage of combining heat and power production is that often times at utility plants heat is pumped into lakes. Raising the water temperature has a negative effect on the aquatic habitat (Harris, 2014). Renewable energy sources, such as fuel cells, have no CO<sub>2</sub> emissions.

**1.3.3 DOE Installations.** Europe and Asia have long been leading the way in taking advantage of the benefits and energy savings of on-site power generation and the applications of waste heat (Harris, 2014). North America has not been forced to invest in the infrastructure due to acceptable utility rates, whereas other parts of the world have been driven into higher

efficiency operations. However, this landscape in North America is changing. Electricity produced by CHP is expected to be 24% by 2030, twice the current capacity (DiCampi, 2013).

CHP schemes ranging from 15 kWe to 100 MWe have been applied for over one hundred years. Economic viability of combined heat and power schemes relies on highly utilizing the heat production. Most literature indicates both heat and power need to be fully utilized for 4,500 hours/year.

Currently, the majority of installed CHP systems in the range of 50 kWe to 300 kWe are supporting hospitals, educational buildings, hotels or multi-family housing, waste and waste water treatment. According to the Department of Energy (DOE) CHP Project Profiles Database (PPD) only one CHP installation in the manufacturing market sector was in this range. The manufacturing sector included the following installations: 280 kWe (Coffee and tea mfg.); 390 kWe (plastics); 750 kWe (plastics); and up to 200 MWe (anomaly) and 20 MWe. Pulp and paper market sector installed a 283 kWe biomass steam turbine.

## **1.4 Types of CHP**

Steam turbines are a form of a topping cycle. This type of cogeneration is capital intensive, suitable only for large-scale process heat requirement. Steam turbines configurations are most suitable for industrial facilities where solid fuel feeds the boiler.

Natural gas (NG) combustion turbines ensure less capital costs compared to steam turbine due to lack of a boiler. NG is more environmentally friendly than the oil that steam turbines use. Some systems generate steam from exhaust gas, which can be used to generate extra work or electricity in Heat Recovery Steam Generator (HRSG) (Aung, 2002). Some generators are able to function on multiple fuel sources. They are designed to run on the most economic fuel at the time.

Fuel cells use hydrogen and water to generate electrical current with water and heat as byproducts. They offer no pollution, low maintenance, few moving parts, and high efficiency and a flexible heat to power ratio. The combination of reduced costs of fuel cell systems due to technological advances and progress of safety code infrastructure suggest fuel cell systems are the most feasible choice for residential, single-family CHP production. However, the technology is still being developed and initial costs could remain a drawback.

The Organic Rankine Cycle (ORC) is based on the process using an organic working fluid as opposed to water. Biomass is the world's 4<sup>th</sup> largest energy source and a crucial fuel source for many developing countries. The ORC biomass-fired CHP units are now commercially available in the range of 400 kWe to 1.5 MWe. (Dong, 2009).

Reciprocating engines, typically stirling engines or internal combustion engines, offer a high efficiency for small scale applications such as 15 kWe or less. However there are many moving parts which typically require more maintenance. Stirling engines need maintenance every 5,000 to 8,000 hours (Onovwiona, 2004).

MicroTurbines have few moving parts, less pollution, comparable efficiency, low capital costs, low maintenance, and fuel flexibility. The absence of reciprocating and friction components means few balancing problems and the use of lubricating oil is low.

## **1.5 Commercial and Residential Sectors**

Commercial sector buildings include healthcare buildings, institutional buildings, hotels, and more. The commercial sector includes CHP is a good match in the commercial sector because most commercial buildings are high volume (space heat), a high water heating load, and have a significant electric load; and a relatively constant one at that. CHP technology in commercial applications really began to emerge in the mid 2000's. It was already relatively

common in industrial applications, however not at the micro-CHP scale yet (Zogg, 2005). Health care buildings dominate the commercial market with about 2/3 of the installations and over 90% of the capacity of those installations (Zogg, 2005). Most systems are in the range of 150-500 kWe. What makes CHP such a viable option in the commercial sector when compared to industry is that the buildings typically have a lower ratio of thermal to electric load.

Using extra waste heat to drive absorption chillers, known as trigeneration or Combined Cooling, Heat and Power (CCHP), is also a common application in the commercial sector in order to raise efficiency and help to meet the space cooling load.

Multi-family CHP (10-30kWe) and single-family (<10 kWe) CHP configurations consist of reciprocating internal combustion (IC) engines, MicroTurbines, fuel cells and external combustion Stirling engines. As of 2006 IC engines were the only cost effective option, but they operate at undesirably high emission levels. MicroTurbines have lower efficiencies at lower energy output sizes (Onovwiona, 2004). More are being developed below the 25-80 kWe range. Fuel cells, IC engines, and Stirling engines are suitable for single-family homes and MicroTurbines are suitable for multi-family residencies, commercial, and institutional applications.

Japan surely leads the exploration into single-family home sized CHP units, if not for all residential applications. While Europe is not far behind, North America simply does not have the market demand for the single-family home systems yet. In addition to the relatively warm climates and low fuel prices, single-family homes don't typically have coinciding thermal and electric demands. But multi-family residential homes thermal and electric loads don't fluctuate as much.

## 1.6 Industry

**1.6.1 Applications.** According to the U.S. Energy Information Administration (EIA), industrial energy consumption is the third largest end-use sector at 23% of the entire planet's energy use. While the major end-use on the planet is transportation, second is energy lost in the generation and transmission of electricity.

Some of the most suitable industries for CHP installations include food processing, chemical processing, pulp and paper mills, and petroleum refining. The key to achieving a reasonable payback period is designing to the thermal load. Usually CHP units are selected to match the thermal base load of the facility. The electricity generation, which can be three to four times less than the usable thermal energy generated, serves as a reliable and consistent reduction of monthly electric utility bills. One major obstacle in earning back the investment of a CHP system is the fact that the thermal baseloads fluctuate seasonally. So while a manufacturing plant may have what seems to be an annual thermal load that can be addressed with a CHP unit, the system is not efficient enough if it is designed closer to peak thermal loads.

Food and chemical processing industries also have cooling loads. These plants can fully utilize their CHP system's energy production by including an absorption chiller in a trigeneration configuration.

**1.6.2 MicroTurbines.** MicroTurbines run on what is known as a Brayton cycle. Air is compressed and then preheated by exhaust air in a recuperator to increase efficiency, thus increasing the expansion power from the combustion in the turbine. Fuel is burned at the same pressure as the air. A permanent magnet generator rotor is turned by spinning turbine, which converts mechanical energy into electrical energy.



In the early 2000's many were looking to MicroTurbines as the future of the micro-CHP market. In comparison to reciprocating engines, gas turbines have fewer moving parts and less vibration, which translates into less maintenance costs. They have multi-fuel capabilities and a low noise output. At this time MicroTurbines on the market ranged from about 25 to 80 kWe, and for this size application, reciprocating engines were more efficient in terms of electrical energy production.

Now it is common for vendors to offer packages of multiple MicroTurbines integrated to form one CHP system. For example, AEGIS offers CHP systems up to 300 kWe by combining four of their 75 kWe MicroTurbines. Capstone offers the option as well, having combined five 60 kWe MicroTurbines to create a 300 kWe CHP system for Astor Chocolate. This helps the facility adhere to the state's net metering rules by shutting down two of the MicroTurbines at night time to avoid over-production of electricity.

In 2005 advanced IC engines were considered more efficient in electricity production than MicroTurbines (42% vs 26-31%). However, new research predicts that a 500 kWe two-shaft intercooled and recuperated gas turbine is capable of efficiencies up to 45%. Aurelia Turbines and LUT were expected to test first prototype by the end of 2015. This shows that MicroTurbines are still being developed and that there is relatively little information on efficiency as well as maintenance.

Company	Fuel	kWe	Btu/hr	Elec Eff	Therm Eff	Tot Eff	Modular	Hot Water	Steam	Exhaust	Fuel Input		
AEGEN	NG	75	523,000	N/A	N/A	82%	YES	X		X	930	scfh	
Capstone	bio, NG, Diesel, NG & Diesel	30	251,974	26%	64%	90%	YES			X	.31 kg/s	EXHAUST	
Capstone	bio, NG, Diesel, NG & Diesel	65	466,522	29%	61%	90%	YES			X	.49 kg/s	EXHAUST	
Capstone	bio, NG, Diesel, NG & Diesel	200	1,178,740	33%	57%	90%	YES			X	1.3 kg/s	EXHAUST	
Ener-G	NG	79	421,980	34%	54%	88%		X		X	840	scfh	
Ener-G	NG	158	815,040	36%	54%	90%		X		X	1620	scfh	
Ener-G	NG	263	1,404,420	35%	55%	91%		X		X	2760	scfh	
KRAFT Energy LLC	NG	55	300,318	34%	54%	88%		X		X	557	scfh	
KRAFT Energy LLC	NG	80	426,518	34%	54%	88%		X		X	794	scfh	
KRAFT Energy LLC	NG	150	784,793	36%	55%	90%		X		X	1434	scfh	
KRAFT Energy LLC	NG	250	1,340,972	35%	55%	90%		X		X	2430	scfh	
KRAFT Energy LLC	NG	100	494,761	35%	51%	86%		X		X	976	scfh	
KRAFT Energy LLC	NG	190	948,575	35%	51%	86%		X		X	1859	scfh	
KRAFT Energy LLC	NG	270	1,259,080	36%	50%	86%		X		X	2537	scfh	
2G Energy	NG	100	487,936	35%	50%	85%	YES			Heat storage		N/A	N/A
2G Energy	NG	190	825,738	36%	55%	91%	YES			Heat storage		N/A	N/A
2G Energy	NG	270	958,812	35%	50%	85%	YES			Heat storage		N/A	N/A
2G Energy	NG	100	1,412,627	36%	55%	91%	YES			Heat storage		N/A	N/A
2G Energy	NG	160	1,289,790	36%	49%	85%	YES			Heat storage		N/A	N/A
2G Energy	NG	200	897,393	38%	46%	84%	YES			Heat storage		N/A	N/A
2G Energy	NG	265	1,020,230	39%	46%	85%	YES			Heat storage		N/A	N/A

**Table 1.1:** Specifications of various available packaged CHP system

## **1.7 Arkansas' Interconnection Laws**

In July 2002, the Arkansas Public Service Commission (PSC) adopted net-metering rules allowing the interconnection of net-metered facilities to the existing electric utility grid. Eligible facilities include those that produce electric energy via solar, wind, hydroelectric, geothermal, or biomass resources including, but not limited to, fuel cells and MicroTurbines that generate electricity if the fuel source is entirely derived from renewable resources.

While the state created PSC to encourage CHP and clean energy, it did not include any updates that would apply to a CHP system where the prime mover is an ICE or MicroTurbine using natural gas or oil. The rules and regulations that apply to these types of CHP systems are described in the PURPA from 1968. Technological advances make it easy for CHP plant to qualify as a QF.

Each month the net-metering customer shall be billed the difference between the electricity supplied by an electric utility-this is measured in kilowatt-hours (kWh<sub>e</sub>)-and the electricity generated by the net metering customer that is fed back into the grid. If the net metering customer has a net excess generation, in comparison to the electricity supplied by the electric utility, then the customer is credited with any accumulated kWh for the next monthly billing cycle. These credits shall roll over indefinitely into the succeeding annual and monthly billing cycles. It is required that the flow of electricity is metered in both directions.

The net-metering customer's monthly peak demand is also offset by the power supplied by the CHP system. However, if a CHP system supplies more power than the customer's monthly peak demand the customer will not receive any compensation.

If the net-metering customer has had net excess generation in their account for more than 24 months, the customer may choose to have the utility purchase the kWh at the electric utility's

estimated average avoided cost rate for wholesale energy. But, the sum to be paid to the net-metering customer must be at least one hundred dollars (\$100).

According to the Arkansas Public Commission's Net Metering Rules a net-metering facility may redistribute their net excess kWh to one or more of the net-metering customer's meters (additional meters). The meters must be in an account owned by the same customer. The customer shall provide the utility with a ranking of the meters to which the net excess generation shall be applied with at least 30 days' notice.

In the case of industrial sized net metering facilities, equipment upgrades and their respective expenses usually incur, as required by the standard interconnection agreement.

If the net metering customer ceases to be a customer of the utility, ceases to operate the net-metered facility, or transfers the facility to another person, the utility will purchase any net excess generation accumulated according to the utility's annual average avoided cost rate for wholesale energy.

### **1.8 Justification for Study**

As stated in section 1.3, CHP installations are on the rise around the world and have begun to infiltrate their way into the North American markets. In the U.S., to this point, they are more common in Northern states and other areas with longer winters and higher utility rates. They are also generally larger applications. However, Arkansas is home to enough food processing plants, paper mills, and other types of manufacturing plants where micro-CHP systems often offer short payback periods. In addition, natural gas is inexpensive and the micro-CHP system types that consume natural gas continue to advance technologically-specifically MicroTurbines. Manufacturers are always trying to cut operating costs and government programs often looks favorably upon cutting emissions. Now is an appropriate time to explore the

Arkansas manufacturing sector's CHP savings opportunities. A user friendly Excel VBA spreadsheet algorithm tool would be useful in providing manufacturers with a way to accurately determine the economic feasibility of a micro-CHP system.

## Chapter 2: Methodology

If implementing micro-CHP systems in the state of Arkansas are proven economical, then there would be a need for an Arkansas-market inspired preliminary evaluation tool. This could save manufacturing leaders time before making a decision to hire a consultant.

An Excel VBA algorithm spreadsheet tool was created for manufacturing facilities to enter their utility information and run simulations with certain sizes and certain types of micro-CHP systems. The simulation uses electric energy savings, electric peak-demand reductions, and natural gas consumption increases to regenerate utility bills. In addition to utility cost savings, it also provides the Internal Rate of Return (IRR), SPP, and the ROI, which is the reciprocal of the SPP in percentage form.

$P$  : Initial Investment

$n$  : Life

$i$  : Interest Rate

$C_t$  : Cash Flow at the end of period  $t$

$$NPW = -P + \sum_{t=1}^n \frac{C_t}{(1+i)^t}$$

**Figure 2.1:** Internal Rate of Return (listed as Interest Rate above) formula with variables, where NPW is the Net Present Worth

$$SPP = \frac{(Implementation\ Cost)}{(Net\ Annual\ Savings)}$$

**Equation 2.1**

$$ROI = \frac{1}{(SPP)} \times 100$$

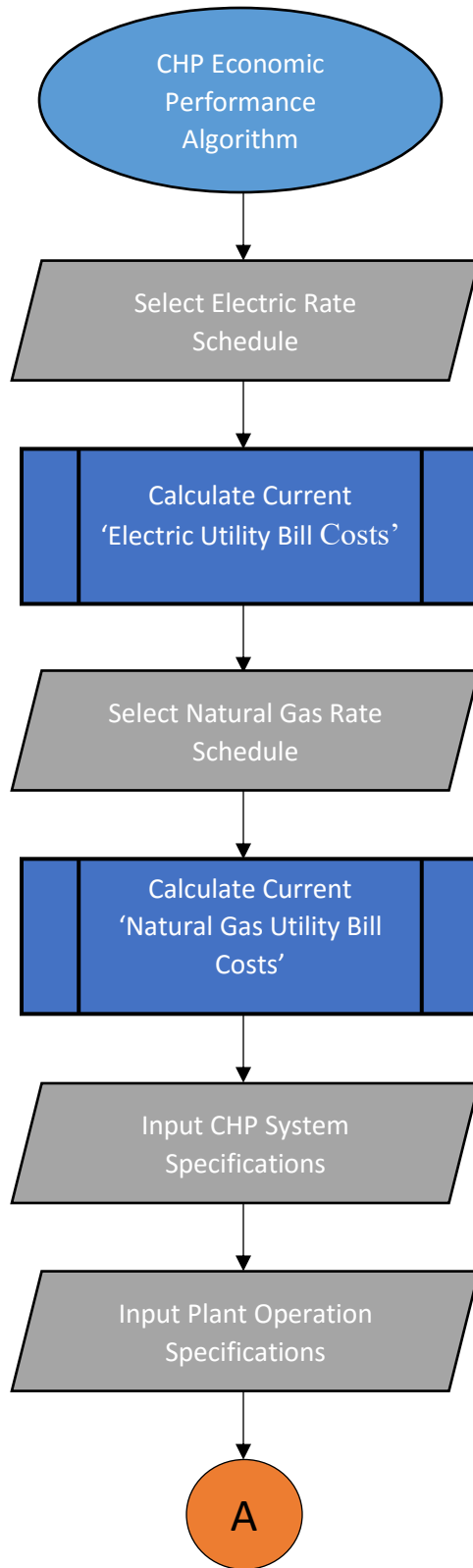
**Equation 2.2**

To cater to manufacturers in the state, the tool includes models of appropriately sized rate schedules from local major electric and natural gas utility providers. In total, there are 10 electric utility rate schedules from Southwestern Electric Power Company (SWEPCO), Oklahoma Gas and Electric (OG&E), and Entergy built into the tool. In addition, there are nine natural gas

utility rate schedules from Black Hills Energy, Arkansas Oklahoma Gas Corporation (AOGC), and CenterPoint built into the tool. As the rates for each company are update, the user can access each company's sheet in the spreadsheet file and change the values for any charge.

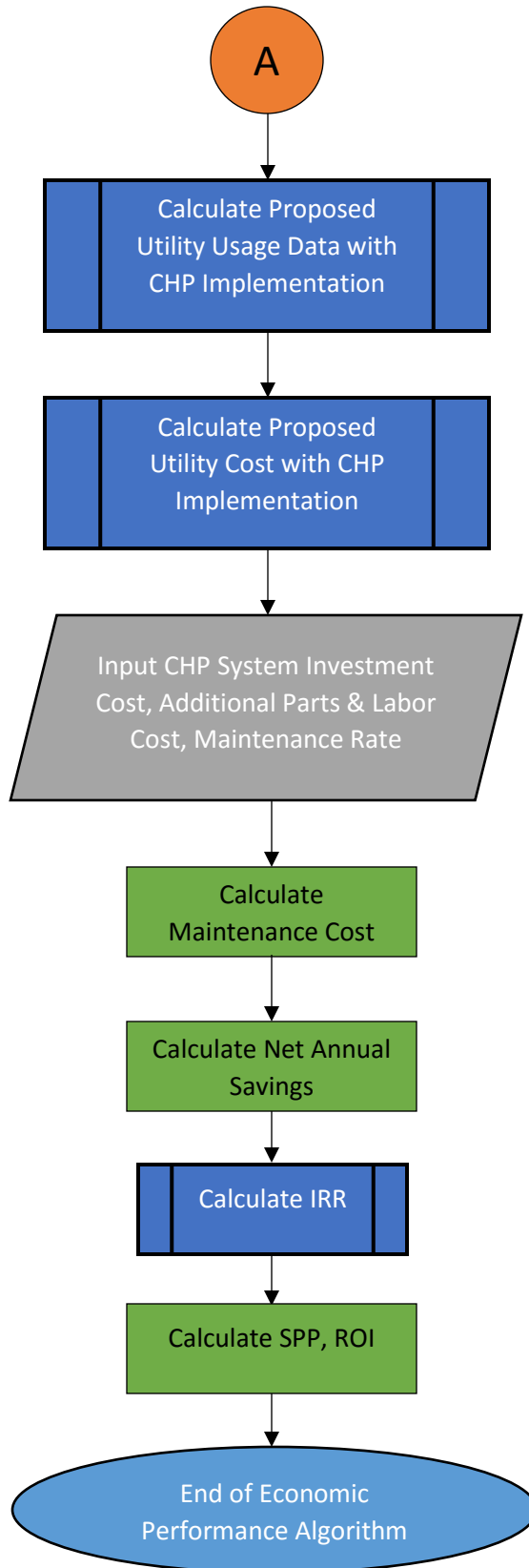
For each utility type there is also the option for the user to customize their own rate schedule. This is useful for manufacturing facilities located in smaller rural areas where electric co-ops and city-managed utilities are common.

Below is a generalized flowchart that begins with the plant's usage profiles and the CHP's operating specifications, uses the CHP information to create new usage profiles and calculates the associated savings, producing the IRR, SPP, and ROI. More detailed algorithm flowcharts can be found in Appendix B.



**Figure 2.2:** Algorithm flowcharts for calculating economic performance of CHP systems using algorithm spreadsheet tool (cont. on next page)





**Figure 3.2:** (Cont.) Algorithm flowcharts for calculating economic performance of CHP systems using algorithm spreadsheet tool

## **2.1 CHP Analysis Algorithm Tool Instructions**

The following sections will provide instructions for how to enter a year's up to 12 months of a manufacturing facility's electric and natural gas utility information, CHP system specifications, and implementation cost information to calculate economic performance measures, such as net annual savings, IRR, SPP, and ROI. These instructions show a scenario for a sweet potato products plant on utility rate schedules specific to Springdale, Arkansas.

1. Select electric and natural gas utility rate schedules on the first sheet, titled "Ground Zero."

a. Click the “Begin with Main Userform” button

This is the starting point, page 1, of this CHP savings tool. The button below will activate the Main UserForm. Throughout the Main UserForm you will select electric and natural gas utility rate schedules, enter usage information, estimate plant usage profiles, and enter CHP unit specifications to calculate potential savings when implementing a CHP system. Please read the TextBox below to before getting started.

Begin with Main Userform

Calculate Electric Costs

10 CCF = 1 MCF = 1.023 MMBtu

To begin, select your electric rate schedule and enter additional information at the bottom of the same tab (if applicable). Continue to the "Select Natural Gas Rate Schedule" Tab in the Main UserForm and complete the same process for natural gas. Leave the UserForm, enter usage information in the blue cells to the right, click the "Calculate Electric Costs" and the "Calculate NG Costs" buttons, and then the "Return To UserForm" button.

Return To Main Userform

Calculate NG Costs

Ground Zero | DIY El. Rates | DIY NG Rates | CHP Info | Cost Savings | Load Profiles | Entergy | OG&E | SWEPCO | AOGC-Ark | Black Hills | CenterPoint

Figure 2.3: Step 1a of section 2.1

- b. Select electric utility rate schedule; input taxes and fees; select service options; click “Next Page”

The screenshot shows a software window titled "Main UserForm" with three tabs: "Customizable Natural Gas Rate Schedule", "CHP System Information", and "Costs and Savings". The "Customizable Electric Rate Schedule" sub-tab is active. The main section is titled "Select Electric Utility Provider And Rate Schedule" and contains three columns of radio button options for utility providers: Entergy, OG&E, and SWEPCO. Under Entergy, options include Large General Service (LGS), Large General Service - Time-Of-Use (GST), Large Power Service (LPS), and Large Power Service - Time-Of-Use (PST). Under OG&E, options include Lighting & Power (PL-1), Lighting & Power Time-of-Use Demand (PL-TOU-D), and Lighting & Power Time-of-Use Energy (PL-TOU-E). Under SWEPCO, options include Lighting & Power (selected), Large Lighting & Power, and Lighting & Power - Time-of-Use. There is also an "Other" section with a radio button for "Customizable Electric Rate Schedule".

Below this section is a "Taxes, Fees, and Service Options" section with input fields and dropdown menus:

City Tax Rate (%)	<input type="text" value="2"/>	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>
County Tax Rate (%)	<input type="text" value="1"/>	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>
State Tax Rate (%)	<input type="text" value="3.25"/>	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>
Municipal Tax (%)	<input type="text" value="4"/>	Service Type	<input type="text" value="PRIMARY"/>
<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	Time-of-Use?	<input type="text" value="YES"/>

A "Next Page" button is located at the bottom right of the form, circled in red.

**Figure 2.4:** Step 1b of section 2.1

- c. Select natural gas utility rate schedule; input taxes and fees; select service options; click “Next Page;” exit the userform

The screenshot displays a software window titled "Main UserForm" with a close button in the top right corner. The window is divided into three main sections: "Customizable Natural Gas Rate Schedule", "CHP System Information", and "Costs and Savings". The "Customizable Natural Gas Rate Schedule" section is active and contains a sub-section titled "Select Natural Gas Utility Provider And Rate Schedule". This sub-section is organized into three columns: "AOGC", "Black Hills", and "CenterPoint". Under "AOGC", there are radio buttons for "Medium Business Sales" and "Large Business Sales". Under "Black Hills", there are radio buttons for "Business 3 Sales" (which is selected), "Business 4 Sales", and "Business 5 Sales". Under "CenterPoint", there are radio buttons for "Small Commercial Firm Sales Service (SCS-1)", "Large Commercial Firm Service (LCS-1)", and "Small Commercial Firm Sales Service - Off-Peak (SCS-2)". Below these columns is an "Other" section with a radio button for "Customizable Natural Gas Rate Schedule".

The second section is titled "Taxes, Fees, and Service Options". It contains four rows of input fields: "City Tax Rate" with a text box containing "2" and a dropdown menu showing "N/A"; "County Tax Rate" with a text box containing "1" and a dropdown menu showing "N/A"; "State Tax Rate" with a text box containing "3.25" and a dropdown menu showing "N/A"; and "Franchise Tax" with a text box containing "4".

At the bottom of the form, there are two buttons: "Previous Page" and "Next Page". The "Next Page" button is circled in red.

**Figure 2.5:** Step 1c of section 2.1

- d. Enter utility information into the blue highlighted cells; click “Calculate Electric Cost;” click “Calculate NG Cost”

B	C	D	E
<b>Lighting &amp; Power</b>			
Year	Month	Total	Total
		kWh	kW-mo
2016	April	635,400	2,599.2
2016	May	618,840	2,598.8
2016	June	597,480	2,584.0
2016	July	621,400	2,592.4
2016	August	664,400	2,582.4
2016	September	711,160	2,411.6
2016	October	782,520	2,411.2
2016	November	687,400	2,412.8
2016	December	613,640	2,412.0
2017	January	568,360	2,414.4
2017	February	528,720	2,414.8
2017	March	497,480	2,423
<b>Totals:</b>		<b>7,526,800</b>	<b>29,856</b>

Calculate Electric Costs

**Figure 2.6:** Step 1d part one of section 2.1

<b>Lighting &amp; Power</b>								
Year	Month	Total	Total	kWh Cost	kW Cost	Subtotal	Taxes & MFA	Total
		kWh	kW-mo	\$	\$	\$	\$	\$
2016	April	635,400	2,599.2	\$27,495.03	\$13,905.72	\$46,596.54	\$4,892.64	\$51,489.18
2016	May	618,840	2,598.8	\$33,678.51	\$17,671.84	\$57,794.82	\$6,068.46	\$63,863.28
2016	June	597,480	2,584.0	\$32,516.06	\$17,571.20	\$56,373.21	\$5,919.19	\$62,292.39
2016	July	621,400	2,592.4	\$33,817.83	\$17,628.32	\$57,902.64	\$6,079.78	\$63,982.42
2016	August	664,400	2,582.4	\$36,157.98	\$17,560.32	\$60,459.94	\$6,348.29	\$66,808.24
2016	September	711,160	2,411.6	\$38,702.75	\$16,398.88	\$62,016.88	\$6,511.77	\$68,528.66
2016	October	782,520	2,411.2	\$33,861.21	\$12,899.92	\$52,629.65	\$5,526.11	\$58,155.76
2016	November	687,400	2,412.8	\$29,745.17	\$12,908.48	\$48,006.69	\$5,040.70	\$53,047.39
2016	December	613,640	2,412.0	\$26,553.43	\$12,904.20	\$44,409.56	\$4,663.00	\$49,072.57
2017	January	568,360	2,414.4	\$24,594.07	\$12,917.04	\$42,218.76	\$4,432.97	\$46,651.73
2017	February	528,720	2,414.8	\$22,878.77	\$12,919.18	\$40,290.59	\$4,230.51	\$44,521.11
2017	March	497,480	2,423	\$21,526.95	\$12,961.98	\$38,817.30	\$4,075.82	\$42,893.11
	<b>Totals:</b>	<b>7,526,800</b>	<b>29,856</b>	<b>\$361,527.76</b>	<b>\$178,247.08</b>	<b>\$607,516.58</b>	<b>\$63,789.24</b>	<b>\$671,305.83</b>

**Figure 2.7:** Step 1d part two of section 2.1

<b>Business 3 Sales</b>				
<b>Year</b>	<b>Month</b>	<b>Total</b>	<b>Total</b>	<b>Monthly</b>
		<b>Consumption</b>	<b>Consumption</b>	<b>Demand</b>
		<b>CCF</b>	<b>MMBtu</b>	<b>MMBtu</b>
2016	April	21,788.9	2,229.0	N/A
2016	May	24,828.9	2,540.0	N/A
2016	June	5,914.0	605.0	N/A
2016	July	10,156.4	1,039.0	N/A
2016	August	20,185.7	2,065.0	N/A
2016	September	24,134.9	2,469.0	N/A
2016	October	28,797.7	2,946.0	N/A
2016	November	34,496.6	3,529.0	N/A
2016	December	33,333.3	3,410.0	N/A
2017	January	8,416.4	861.0	N/A
2017	February	17,018.6	1,741.0	N/A
2017	March	25,474.1	2,606.0	N/A
	<b>Totals:</b>	<b>254,545.5</b>	<b>26,040.0</b>	<b>0.0</b>

Calculate NG Costs

**Figure 2.8:** Step 1d part three of section 2.1



<b>Business 3 Sales</b>												
Year	Month	Total Consumption	Total Consumption	Monthly Demand	Customer Charge	Delivery Charge	Cost of Gas	Sum of Riders Costs	Demand Cost	Subtotal Cost	Total Taxes & Fran. Tax	Total
		CCF	MMBtu	MMBtu	\$	\$	\$	\$	\$	\$	\$	\$
2016	April	21,788.9	2,229.0	N/A	\$283.46	\$3,758.58	\$8,665.43	\$440.13	N/A	\$13,192.63	\$1,385.23	\$14,577.86
2016	May	24,828.9	2,540.0	N/A	\$283.46	\$4,282.99	\$9,874.47	\$501.54	N/A	\$14,987.49	\$1,573.69	\$16,561.18
2016	June	5,914.0	605.0	N/A	\$283.46	\$1,020.16	\$2,351.99	\$119.46	N/A	\$3,820.10	\$401.11	\$4,221.21
2016	July	10,156.4	1,039.0	N/A	\$283.46	\$1,751.98	\$4,039.20	\$205.16	N/A	\$6,324.83	\$664.11	\$6,988.94
2016	August	20,185.7	2,065.0	N/A	\$283.46	\$3,482.04	\$8,027.86	\$407.75	N/A	\$12,246.14	\$1,285.85	\$13,531.99
2016	September	24,134.9	2,469.0	N/A	\$283.46	\$4,163.27	\$9,598.45	\$487.52	N/A	\$14,577.73	\$1,530.66	\$16,108.40
2016	October	28,797.7	2,946.0	N/A	\$283.46	\$4,967.60	\$11,452.83	\$581.71	N/A	\$17,330.62	\$1,819.72	\$19,150.34
2016	November	34,496.6	3,529.0	N/A	\$283.46	\$5,950.66	\$13,719.29	\$696.83	N/A	\$20,695.27	\$2,173.00	\$22,868.27
2016	December	33,333.3	3,410.0	N/A	\$283.46	\$5,750.00	\$13,256.67	\$673.33	N/A	\$20,008.49	\$2,100.89	\$22,109.38
2017	January	8,416.4	861.0	N/A	\$283.46	\$1,451.83	\$3,347.21	\$170.01	N/A	\$5,297.55	\$556.24	\$5,853.79
2017	February	17,018.6	1,741.0	N/A	\$283.46	\$2,935.70	\$6,768.29	\$343.78	N/A	\$10,376.26	\$1,089.51	\$11,465.76
2017	March	25,474.1	2,606.0	N/A	\$283.46	\$4,394.28	\$10,131.05	\$514.58	N/A	\$15,368.40	\$1,613.68	\$16,982.08
	<b>Totals:</b>	<b>254,545.5</b>	<b>26,040.0</b>	<b>0.0</b>	<b>\$3,401.52</b>	<b>\$43,909.09</b>	<b>\$101,232.73</b>	<b>\$5,141.82</b>		<b>\$154,225.52</b>	<b>\$16,193.68</b>	<b>\$170,419.20</b>

Figure 2.9: Step 1d part three part four of section 2.1

e. Click "Return to Main Userform" button to continue to enter CHP specifications

This is the starting point, page 1, of this CHP savings tool. The button below will activate the Main UserForm. Throughout the Main UserForm you will select electric and natural gas utility rate schedules, enter usage information, estimate plant usage profiles, and enter CHP unit specifications to calculate potential savings when implementing a CHP system. Please read the TextBox below to before getting started.

Begin with Main Userform

Calculate Electric Costs

10 CCF = 1 MCF = 1.023 MMBtu

To begin, select your electric rate schedule and enter additional information at the bottom of the same tab (if applicable). Continue to the "Select Natural Gas Rate Schedule" Tab in the Main UserForm and complete the same process for natural gas. Leave the UserForm, enter usage information in the blue cells to the right, click the "Calculate Electric Costs" and the "Calculate NG Costs" buttons, and then the "Return To UserForm" button.

Return To Main Userform

Calculate NG Costs

Lighting & Power									
Year	Month	Total kWh	Total kW-mo	kWh Cost \$	kW Cost \$	Subtotal \$	Taxes & MFA \$	Total \$	
2016	April	635,400	2,599.2	\$27,495.03	\$13,905.72	\$46,596.54	\$4,892.64	\$51,489.18	
2016	May	618,840	2,598.8	\$33,678.51	\$17,671.84	\$57,794.82	\$6,068.46	\$63,863.28	
2016	June	597,480	2,584.0	\$32,516.06	\$17,571.20	\$56,373.21	\$5,919.19	\$62,292.39	
2016	July	621,400	2,592.4	\$33,817.83	\$17,628.32	\$57,902.64	\$6,079.78	\$63,982.42	
2016	August	664,400	2,582.4	\$36,157.98	\$17,560.32	\$60,459.94	\$6,348.29	\$66,808.24	
2016	September	711,160	2,411.6	\$38,702.75	\$16,398.88	\$62,016.88	\$6,511.77	\$68,528.66	
2016	October	782,520	2,411.2	\$33,861.21	\$12,899.92	\$52,629.65	\$5,526.11	\$58,155.76	
2016	November	687,400	2,412.8	\$29,745.17	\$12,908.48	\$48,006.69	\$5,040.70	\$53,047.39	
2016	December	613,640	2,412.0	\$26,553.43	\$12,904.20	\$44,409.56	\$4,663.00	\$49,072.57	
2017	January	568,360	2,414.4	\$24,594.07	\$12,917.04	\$42,218.76	\$4,432.97	\$46,651.73	
2017	February	528,720	2,414.8	\$22,878.77	\$12,919.18	\$40,290.59	\$4,230.51	\$44,521.11	
2017	March	497,480	2,423	\$21,526.95	\$12,961.98	\$38,817.30	\$4,075.82	\$42,893.11	
	<b>Totals:</b>	<b>7,526,800</b>	<b>29,856</b>	<b>\$361,527.76</b>	<b>\$178,247.08</b>	<b>\$607,516.58</b>	<b>\$63,789.24</b>	<b>\$671,305.83</b>	

Business 3 Sales												
Year	Month	Total Consumption CCF	Total Consumption MMBtu	Monthly Demand MMBtu	Customer Charge \$	Delivery Charge \$	Cost of Gas \$	Sum of Riders Costs \$	Demand \$	Subtotal Cost \$	Total Taxes & Fran. Tax \$	Total \$
2016	April	21,788.9	2,229.0	N/A	\$283.46	\$3,758.58	\$8,665.43	\$440.13	N/A	\$13,192.63	\$1,385.23	\$14,577.86
2016	May	24,828.9	2,540.0	N/A	\$283.46	\$4,282.99	\$9,874.47	\$501.54	N/A	\$14,987.49	\$1,573.69	\$16,561.18
2016	June	5,914.0	605.0	N/A	\$283.46	\$1,020.16	\$2,351.99	\$119.46	N/A	\$3,820.10	\$401.11	\$4,221.21
2016	July	10,156.4	1,039.0	N/A	\$283.46	\$1,751.98	\$4,039.20	\$205.16	N/A	\$6,324.83	\$664.11	\$6,988.94
2016	August	20,185.7	2,065.0	N/A	\$283.46	\$3,482.04	\$8,027.86	\$407.75	N/A	\$12,246.14	\$1,285.85	\$13,531.99
2016	September	24,134.9	2,469.0	N/A	\$283.46	\$4,163.27	\$9,598.45	\$487.52	N/A	\$14,577.73	\$1,530.66	\$16,108.40
2016	October	28,797.7	2,946.0	N/A	\$283.46	\$4,967.60	\$11,452.83	\$581.71	N/A	\$17,330.62	\$1,819.72	\$19,150.34
2016	November	34,496.6	3,529.0	N/A	\$283.46	\$5,950.66	\$13,719.29	\$696.83	N/A	\$20,695.27	\$2,173.00	\$22,868.27
2016	December	33,333.3	3,410.0	N/A	\$283.46	\$5,750.00	\$13,256.67	\$673.33	N/A	\$20,008.49	\$2,100.89	\$22,109.38
2017	January	8,416.4	861.0	N/A	\$283.46	\$1,451.83	\$3,347.21	\$170.01	N/A	\$5,297.55	\$556.24	\$5,853.79
2017	February	17,018.6	1,741.0	N/A	\$283.46	\$2,935.70	\$6,768.29	\$343.78	N/A	\$10,376.26	\$1,089.51	\$11,465.76
2017	March	25,474.1	2,606.0	N/A	\$283.46	\$4,394.28	\$10,131.05	\$514.58	N/A	\$15,368.40	\$1,613.68	\$16,982.08
	<b>Totals:</b>	<b>254,545.5</b>	<b>26,040.0</b>	<b>0.0</b>	<b>\$3,401.52</b>	<b>\$43,909.09</b>	<b>\$101,232.73</b>	<b>\$5,141.82</b>		<b>\$154,225.52</b>	<b>\$16,193.68</b>	<b>\$170,419.20</b>

Ground Zero | DIY El. Rates | DIY NG Rates | CHP Info | Cost Savings | Load Profiles | Entergy | OG&E | SWEPCO | AOGC-Ark | Black Hills | CenterPoint

Figure 2.10: Step 1e of section 2.1

- If you arrive at the “CHP Info” sheet via the Main Userform, the CHP System Information tab of the userform will be visible. Otherwise, click the “Return to Main Userform” button and the CHP System Information tab of the userform will be visible.

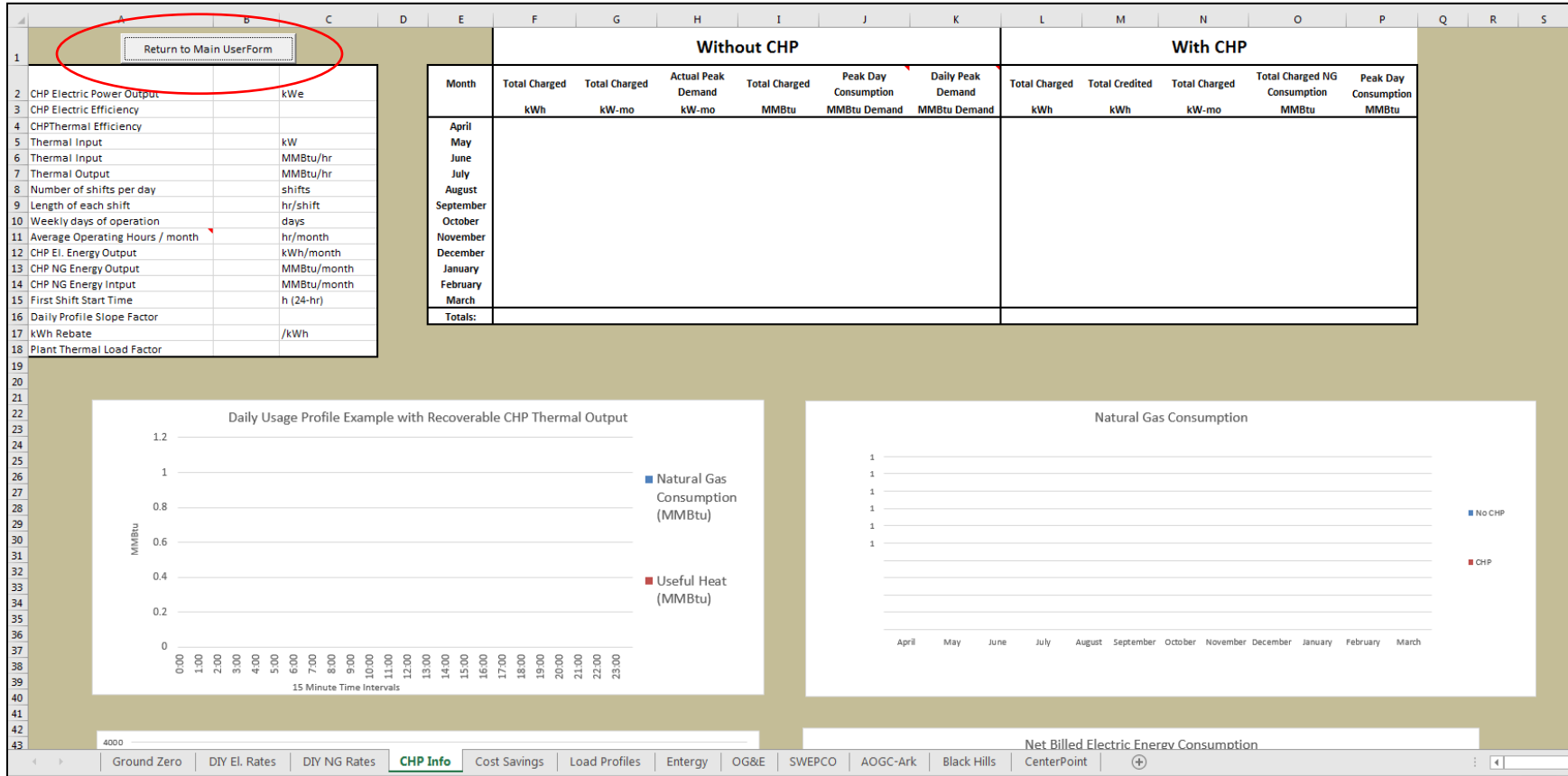


Figure 2.11: Step 2 of section 2.1

a. Enter the CHP system information and click “Apply CHP Info”

The screenshot shows a software window titled "Main UserForm" with a close button in the top right corner. The window is divided into several tabs: "Select Electric Rate Schedule", "Customizable Electric Rate Schedule", "Select Natural Gas Rate Schedule", "Customizable Natural Gas Rate Schedule", "CHP System Information", and "Costs and Savings". The "CHP System Information" tab is active.

At the top right of the form, there are "Suggested Ranges" for "IC Engine" and "MicroTurbine".

Parameter	Value	Unit	Suggested Ranges
CHP Electric Power Output	300	kWe	30 kWe - 300 kWe
CHP Electric Efficiency	34.5	%	30% - 39%
CHP Thermal Efficiency	50.5	%	46% - 55%
CHP Thermal Input	869.6	kW	The thermal input and output can be calculated using the electric power output and the efficiencies (see button below), or these values can be manually entered.
CHP Thermal Input	2.967	MMBtu / hr	
CHP Thermal Output	1.4983	MMBtu / hr	
Number of Shifts	3	/ day	Calculate Thermal Input & Output
Length of Shift	8	hr / shift	
Weekly Operating Days	7	day / wk	
What time does the first shift begin?	0	h (24-hr clock)	
Estimated Daily Plant Thermal Load Factor	0.5		Load Factor is the ratio of energy usage over a period of time (MMBtu) to the amount of energy that would have been consumed if used at peak demand during the entire period, or billing cycle (MMBtu demand times monthly operating hours).
Thermal Load Factor is used to estimate daily plant thermal load profile.			
Daily Usage Profile Slope (Enter between 0 and 1)	0.5		
kWh Credits Value	\$0.00	\$/kWh	

At the bottom of the form, there are two buttons: "Previous Page" and "Apply CHP Info". The "Apply CHP Info" button is circled in red.

Figure 2.12: Step 2a of section 2.1

- b. The following two tables are produced from the CHP system information. They include CHP system information calculations and summaries of utility usage before and after CHP implementation, which are located on the CHP Info sheet.

CHP Electric Power Output	300	kWe
CHP Electric Efficiency	34.5%	
CHP Thermal Efficiency	50.5%	
Thermal Input	869.6	kW
Thermal Input	2.967	MMBtu/hr
Thermal Output	1.4983	MMBtu/hr
Number of shifts per day	3.0	shifts
Length of each shift	8.0	hr/shift
Weekly days of operation	7.0	days
Average Operating Hours / month	730.0	hr/month
CHP El. Energy Output	219,000	kWh/month
CHP NG Energy Output	1,094	MMBtu/month
CHP NG Energy Input	2,166	MMBtu/month
First Shift Start Time	0	h (24-hr)
Daily Profile Slope Factor	0.50	
kWh Rebate	\$0.03	/kWh
Plant Thermal Load Factor	0.50	

**Figure 2.13:** Step 2b part one of section 2.1

	Without CHP						With CHP				
Month	Total Charged kWh	Total Charged kW-mo	Actual Peak Demand kW-mo	Total Charged MMBtu	Peak Day Consumption MMBtu Demand	Daily Peak Demand MMBtu Demand	Total Charged kWh	Total Credited kWh	Total Charged kW-mo	Total Charged NG Consumption MMBtu	Peak Day Consumption MMBtu
April	635,400	2,599	2,599	2,229	N/A	6	416,400	0	2,299	3,301	
May	618,840	2,599	2,599	2,540	N/A	7	399,840	0	2,299	3,612	
June	597,480	2,584	2,584	605	N/A	2	378,480	0	2,284	2,171	
July	621,400	2,592	2,592	1,039	N/A	3	402,400	0	2,292	2,283	
August	664,400	2,582	2,582	2,065	N/A	6	445,400	0	2,282	3,140	
September	711,160	2,412	2,412	2,469	N/A	7	492,160	0	2,112	3,541	
October	782,520	2,411	2,411	2,946	N/A	8	563,520	0	2,111	4,018	
November	687,400	2,413	2,413	3,529	N/A	10	468,400	0	2,113	4,601	
December	613,640	2,412	2,412	3,410	N/A	9	394,640	0	2,112	4,482	
January	568,360	2,414	2,414	861	N/A	2	349,360	0	2,114	2,204	
February	528,720	2,415	2,415	1,741	N/A	5	309,720	0	2,115	2,833	
March	497,480	2,423	2,423	2,606	N/A	7	278,480	0	2,123	3,678	
<b>Totals:</b>	<b>7,526,800</b>	<b>29,856</b>	<b>29,856</b>	<b>26,040</b>	<b>N/A</b>	<b>71.3</b>	<b>4,898,800</b>	<b>0</b>	<b>26,256</b>	<b>39,864</b>	

Figure 2.14: Step 2b part two of section 2.1

- c. The monthly utility costs before and after CHP implementation, and the monthly savings or losses are calculated when clicking the “Apply CHP Info” button. This table is displayed on the Costs and Savings sheet.

	Without CHP			With CHP			
Month	Electric Utility Cost	Natural Gas Utility Cost	Total Cost	Electric Utility Cost	Natural Gas Utility Cost	Total Cost	Utility Cost Savings
	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)
April	\$51,489.18	\$14,577.86	\$66,067.04	\$37,707.28	\$22,395.39	\$60,102.67	\$5,964.36
May	\$63,863.28	\$16,561.18	\$80,424.46	\$46,503.51	\$24,470.37	\$70,973.87	\$9,450.59
June	\$62,292.39	\$4,221.21	\$66,513.60	\$44,932.62	\$14,850.52	\$59,783.15	\$6,730.46
July	\$63,982.42	\$6,988.94	\$70,971.36	\$46,622.65	\$15,598.84	\$62,221.49	\$8,749.87
August	\$66,808.24	\$13,531.99	\$80,340.23	\$49,448.47	\$21,318.02	\$70,766.48	\$9,573.75
September	\$68,528.66	\$16,108.40	\$84,637.06	\$51,168.89	\$23,996.52	\$75,165.40	\$9,471.65
October	\$58,155.76	\$19,150.34	\$77,306.10	\$44,373.86	\$27,180.00	\$71,553.86	\$5,752.24
November	\$53,047.39	\$22,868.27	\$75,915.66	\$39,265.49	\$31,070.93	\$70,336.42	\$5,579.25
December	\$49,072.57	\$22,109.38	\$71,181.95	\$35,290.67	\$30,276.72	\$65,567.39	\$5,614.56
January	\$46,651.73	\$5,853.79	\$52,505.52	\$32,869.83	\$15,070.59	\$47,940.42	\$4,565.10
February	\$44,521.11	\$11,465.76	\$55,986.87	\$30,739.21	\$19,268.51	\$50,007.72	\$5,979.16
March	\$42,893.11	\$16,982.08	\$59,875.19	\$29,111.22	\$24,910.85	\$54,022.07	\$5,853.12
<b>Totals:</b>	<b>\$671,305.84</b>	<b>\$170,419.20</b>	<b>\$841,725.04</b>	<b>\$488,033.70</b>	<b>\$270,407.25</b>	<b>\$758,440.95</b>	<b>\$83,284.09</b>

Figure 2.15: Step 2c of section 2.1

- After clicking the “Apply CHP Info” button on the CHP System Information tab in the Main Userform, the Costs and Savings tab will be activated and the user will be brought to the Cost Savings sheet.

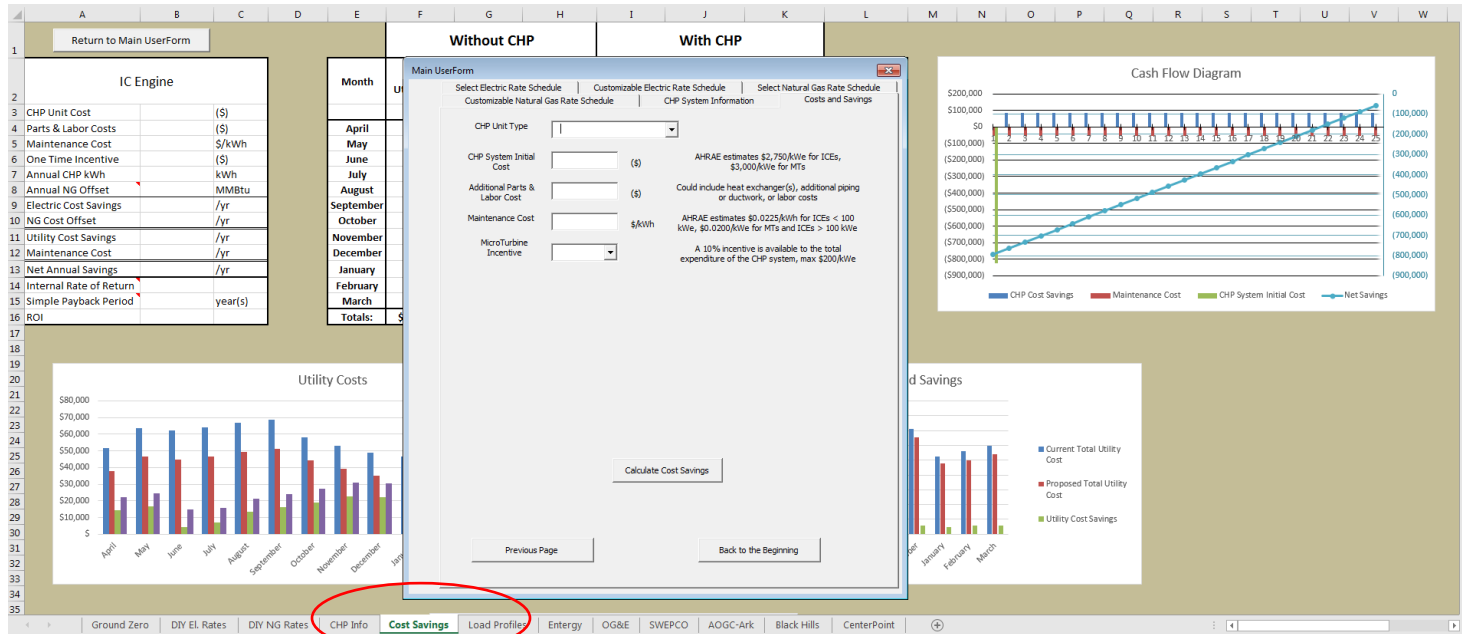


Figure 2.16: Step 3 image one of section 2.1

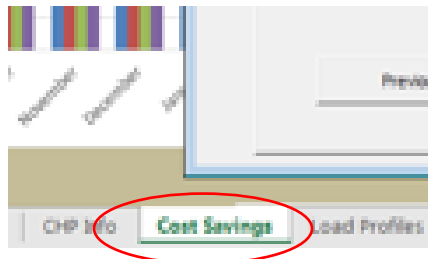


Figure 2.17: Step 3 image two of section 2.1



- a. Input the CHP unit prime mover type, the unit's additional cost, parts and labor costs, and select whether or not a federal MicroTurbine incentive is to be applied. Click "Calculate Cost Savings"

The screenshot shows a software window titled "Main UserForm" with a close button in the top right corner. The window contains several tabs: "Select Electric Rate Schedule", "Customizable Electric Rate Schedule", "Select Natural Gas Rate Schedule", "Customizable Natural Gas Rate Schedule", "CHP System Information", and "Costs and Savings". The "CHP System Information" tab is active. It contains the following fields and text:

- CHP Unit Type:** A dropdown menu set to "Internal Combustion Engine".
- CHP System Initial Cost:** A text box containing "825,000" followed by a "\$" symbol. To the right, text reads: "AHRAE estimates \$2,750/kWe for ICES, \$3,000/kWe for MTs".
- Additional Parts & Labor Cost:** A text box containing "0" followed by a "\$" symbol. To the right, text reads: "Could include heat exchanger(s), additional piping or ductwork, or labor costs".
- Maintenance Cost:** A text box containing "\$0.0200" followed by "\$/kWh". To the right, text reads: "AHRAE estimates \$0.0225/kWh for ICES < 100 kWe, \$0.0200/kWe for MTs and ICES > 100 kWe".
- MicroTurbine Incentive:** A dropdown menu set to "No". To the right, text reads: "A 10% incentive is available to the total expenditure of the CHP system, max \$200/kWe".

At the bottom center of the form, a button labeled "Calculate Cost Savings" is circled in red. At the bottom left, there is a "Previous Page" button, and at the bottom right, there is a "Back to the Beginning" button.

**Figure 2.18:** Step 3a of section 2.1

- b. The table created by clicking the “Calculate Cost Savings” button presents the IRR, SPP, and ROI (in this case, the IRR cell displays, “Error,” because the CHP implementation will not pay for itself within 25 years.

IC Engine		
CHP Unit Cost	\$825,000	(\$)
Parts & Labor Costs	\$0	(\$)
Maintenance Cost	\$0.0200	\$/kWh
One Time Incentive	\$0	(\$)
Annual CHP kWh	2,628,000	kWh
Annual NG Offset	25,991	MMBtu
Electric Cost Savings	\$183,272	/yr
NG Cost Offset	\$99,988	/yr
Utility Cost Savings	\$83,284	/yr
Maintenance Cost	\$52,560	/yr
Net Annual Savings	\$30,724	/yr
Internal Rate of Return	Error	
Simple Payback Period	26.8519	year(s)
ROI	3.72%	

**Figure 2.19:** Step 3b of section 2.1

## **2.2 Customizable Rate Schedule Instructions**

Instructions are given on how to create your own rate schedule. This set of instructions will create an electric rate schedule, which is nearly identical to the process for creating a natural gas rate schedule.

1. The customizable electric and natural gas rate schedule userforms can be activated by going to the “DIY El. Rates” sheet and the “DIY NG Rates” sheet, respectively. They can also be activated when selecting rate schedule in the Main Userform. After selecting this type of rate schedule, skip the Taxes, Fees, and Service Options and click “Next Page.”

Main UserForm

Customizable Natural Gas Rate Schedule | CHP System Information | Costs and Savings

Select Electric Rate Schedule | Customizable Electric Rate Schedule | Select Natural Gas Rate Schedule

Select Electric Utility Provider And Rate Schedule

Entergy	OG&E	SWEPCO
<input type="radio"/> Large General Service (LGS)	<input type="radio"/> Lighting & Power (PL-1)	<input type="radio"/> Lighting & Power
<input type="radio"/> Large General Service - Time-Of-Use (GST)	<input type="radio"/> Lighting & Power Time-of-Use Demand (PL-TOU-D)	<input type="radio"/> Large Lighting & Power
<input type="radio"/> Large Power Service (LPS)	<input type="radio"/> Lighting & Power Time-of-Use Energy (PL-TOU-E)	<input type="radio"/> Lighting & Power - Time-of-Use
<input type="radio"/> Large Power Service - Time-Of-Use (PST)		

Other

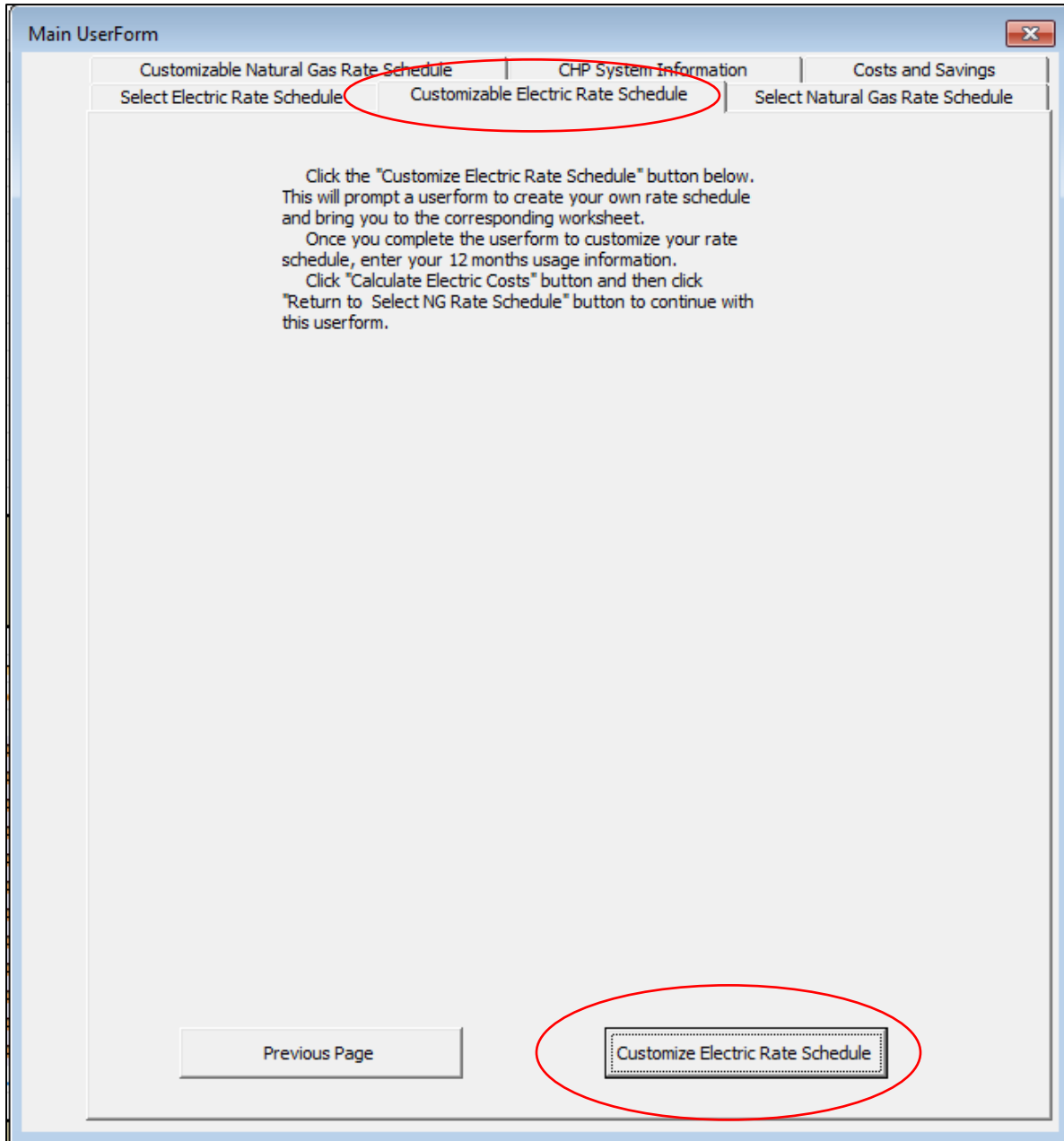
Customizable Electric Rate Schedule

Taxes, Fees, and Service Options

City Tax Rate (%)	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>
County Tax Rate (%)	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>
State Tax Rate (%)	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>
	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>
	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>
	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>	<input type="text" value="N/A"/>

Figure 2.20: Step 1 of section 2.2

- The user is brought to the next page, which provides instructions, and then must click “Customize Electric Rate Schedule.” This tab can be reached via the previous step of the instructions, or simply by changing the tab at the top of the Main Userform.



**Figure 2.21:** Step 2 part one of section 2.2

The screenshot shows a spreadsheet interface with a dialog box titled "Customizable Electric Utility Rate Schedule Userform". The dialog box contains the following configuration options:

- Does your rate schedule include seasons for energy rates?**
  - Yes
  - No
- If there are no seasons, is there a peak?**
  - Yes
  - No
- Summer Peak?**
  - N/A
  - Peak
  - No Peak
- Winter Peak?**
  - N/A
  - Peak
  - No Peak
- Is there a block expander?**
  - Yes
  - No
- How many blocks?**
  - 2
  - 3
- Are the block sizes fixed or based on demand?**
  - Fixed (kWh)
  - Demand Based (kWh/kW-mo)
- How many kWh riders would you like to add?**
  - 0
  - 1
  - 2
- Does your rate schedule include seasons for demand rates?**
  - Yes
  - No
- If there are no seasons, is there a peak?**
  - Yes
  - No
- Summer Peak?**
  - N/A
  - Peak
  - No Peak
- Winter Peak?**
  - N/A
  - Peak
  - No Peak
- Is there a minimum billed demand?**
  - Yes
  - No
- Is there a ratchet clause?**
  - Yes
  - No
- How many months back does the ratchet clause cover?**
  - N/A
  - 1
  - 2
- How many kW-mo riders would you like to add?**
  - 0
  - 1
  - 2
- Include franchise fee?**
  - Yes
  - No
- Include taxes?**
  - Yes
  - No
- Select the first month of bills**
  - February
  - March
  - April
- Select the first month of Summer billing**
  - April
  - May
  - June
- How many Summer months are there?**
  - N/A
  - 1
  - 2

Below the dialog box, there are two buttons: "Calculate Electric Costs" and "Return to Select NG Rate Schedule". The spreadsheet's tab bar at the bottom shows "Ground Zero", "DIY El. Rates", "DIY NG Rates", "CHP Info", "Cost Savings", "Load Profiles", "Entergy", "OG&E", "SWEPCO", "AOGC-Ark", "Black Hills", and "CenterPoint".

Figure 2.22: Step 2 part two of section 2.2

3. The Customizable Electric Rate Schedule gives you the following options:
  - a. Energy
    1. Seasonal rates
    2. Peak time rates (variable by season if applicable)
    3. Block expander rates (This cannot be combined with peak rates, but can be seasonal)
      - a. Block sizes based on monthly peak demand
      - b. Fixed block sizes
    4. Up to 8 miscellaneous riders
  - b. Demand
    1. Seasonal rates
    2. Peak time rates (variable by season if applicable)
    3. Minimum billed peak demand
    4. Ratchet clause
      - a. Ratchet percentage value
      - b. Number of previous months the ratchet clause includes
    5. Up to 8 miscellaneous riders
  - c. Miscellaneous
    1. Taxes
    2. Franchise Fee/Municipal Adjustment
    3. First month of utility bills
    4. First month of summer
    5. Number of summer months

4. The Customizable Natural Gas Rate Schedule gives you the following options:
  - a. Energy
    1. Seasonal rates
    2. Peak time rates (variable by season if applicable)
    3. Block expander rates (This cannot be combined with peak rates, but can be seasonal)
      - a. Block sizes based on monthly peak demand
      - b. Fixed block sizes
    4. Up to 8 miscellaneous riders
  - b. Demand
    1. Seasonal rates
    2. Minimum billed peak demand
    3. Ratchet clause
      - a. Ratchet percentage value
      - b. Number of previous months the ratchet clause includes
    4. Up to 8 miscellaneous riders
  - c. Miscellaneous
    1. Taxes
    2. Franchise Fee/Municipal Adjustment
    3. First month of utility bills
    4. First month of summer
    5. Number of summer months



5. Once finished selecting all options, click “Create Utility Table and Input Cells.”

The screenshot shows a software dialog box titled "Customizable Electric Utility Rate Schedule Userform". It contains several sections of configuration options:

- Energy Rates:** "Does your rate schedule include seasons for energy rates?" (Yes/No), "If there are no seasons, is there a peak?" (N/A/Yes), "Summer Peak?" (N/A/Peak/No Peak), "Winter Peak?" (N/A/Peak/No Peak), "Is there a block expander?" (Yes/No), "How many blocks?" (2/3), "Are the block sizes fixed or based on demand?" (Fixed (kWh)/Demand Based (kWh/kW-mo)), "How many kWh riders would you like to add?" (1/2/3).
- Demand Rates:** "Does your rate schedule include seasons for demand rates?" (Yes/No), "If there are no seasons, is there a peak?" (N/A/Yes), "Summer Peak?" (N/A/Peak/No Peak), "Winter Peak?" (N/A/Peak/No Peak), "Is there a minimum billed demand?" (Yes/No), "Is there a ratchet clause?" (Yes/No), "How many months back does the ratchet clause cover?" (N/A/1/2).
- Other Options:** "How many kW-mo riders would you like to add?" (0/1/2), "Include franchise fee?" (Yes/No), "Include taxes?" (Yes/No), "Select the first month of bills" (February/March/April), "Select the first month of Summer billing" (April/May/June), "How many Summer months are there?" (2/3/4).

A button labeled "Create Utility Table and Input Cells" is located at the bottom center of the dialog box and is circled in red.

Figure 2.23: Step 5 of section 2.2

6. Input cells for rates, taxes, minimum-billed demand amounts, etc. are created as applicable. A table is created below these cells to input monthly usages.

	B	C	D	E	F	G	H	I	J	K
4				Fuel Charge (\$)						
5										
6				Summer On-peak Cost per kWh (\$)	Summer Off-peak Cost per kWh (\$)	Winter Cost per kWh (\$)				
7										
8				Rider 1 (\$/kWh)	Rider 2 (\$/kWh)	Rider 3 (\$/kWh)				
9										
10				Summer On-peak Cost per kW-mo (\$)	Summer Off-peak Cost per kW-mo (\$)	Winter Cost per kW-mo (\$)				
11										
12				Ratchet Percentage (%)	Minimum Billed Demand (kW-mo)					
13				N/A						
14				Rider 1 (\$/kW-mo)	Rider 2 (\$/kW-mo)					
15										
16				Franchise Fee Percentage(%)	Total Tax Percentage(%)					
17										
18				Customer Charge (\$)						
19										
20										
21										
22										
23										
24										
25										
26				Summer On-peak	Summer Off-peak	Winter	Summer On-peak Actual Demand	Summer Off-peak Actual Demand	Winter Actual Demand	
27				kWh	kWh	kWh	kW-mo	kW-mo	kW-mo	
28			April							
29			May							
30			June							
31			July							
32			August							
33			September							
34			October							
35			November							
36			December							
37			January							
38			February							
39			March							
40										
41				Calculate Electric Costs	Return to Select NG Rate Schedule					
42										
43										
44										

Figure 2.24: Step 6 of section 2.2

7. After entering all information, click “Calculate Electric Costs”

	B	C	D	E	F	G	H	I	J	K
4				Fuel Charge (\$)						
5				\$0.30						
6				Summer On-peak Cost per kWh (\$)	Summer Off-peak Cost per kWh (\$)	Winter Cost per kWh (\$)				
7				\$0.10	\$0.025	\$0.065				
8				Rider 1 (\$/kWh)	Rider 2 (\$/kWh)	Rider 3 (\$/kWh)				
9				\$0.01	\$0.02	\$0.03				
10				Summer On-peak Cost per kW-mo (\$)	Summer Off-peak Cost per kW-mo (\$)	Winter Cost per kW-mo (\$)				
11				\$10.00	\$2.50	\$6.50				
12				Ratchet Percentage (%)	Minimum Billed Demand (kW-mo)					
13				N/A	1,800					
14				Rider 1 (\$/kW-mo)	Rider 2 (\$/kW-mo)					
15				\$0.55	\$0.33					
16				Franchise Fee Percentage(%)	Total Tax Percentage(%)					
17				4.000%	6.250%					
18				Customer Charge (\$)						
19				\$420.00						
20										
21										
22										
23										
24										
25										
26				Summer On-peak kWh	Summer Off-peak kWh	Winter kWh	Summer On-peak Actual Demand kW-mo	Summer Off-peak Actual Demand kW-mo	Winter Actual Demand kW-mo	
27										
28			April			635,400			2,599.2	
29			May	495,072	123,768		2,079.0	519.8		
30			June	477,984	119,496		2,067.2	516.8		
31			July	497,120	124,280		2,073.9	518.5		
32			August	531,520	132,880		2,065.9	516.5		
33			September			711,160			2,411.6	
34			October			782,520			2,411.2	
35			November			687,400			2,412.8	
36			December			613,640			2,412.0	
37			January			568,360			2,414.4	
38			February			528,720			2,414.8	
39			March			497,480			2,422.8	
40										
41										
42				Calculate Electric Costs	Return to Select NG Rate Schedule					
43										
44										

Figure 2.25: Step 7 of section 2.2

8. Clicking “Calculate Electric Costs” creates a table of summarized costs below the button. Next, click “Return to Select NG Rate Schedule” to apply the usage and cost information to the simulation going forward.

	B	C	D	E	F	G	H	I	J	K	L
25											
26				Summer On-peak	Summer Off-peak	Winter	Summer On-peak	Summer Off-peak	Winter Actual		
27				kWh	kWh	kWh	Actual Demand	Actual Demand	Demand		
28			April			635,400					
29			May	495,072	123,768		2,079.0	519.8			
30			June	477,984	119,496		2,067.2	516.8			
31			July	497,120	124,280		2,073.9	518.5			
32			August	531,520	132,880		2,065.9	516.5			
33			September			711,160			2,411.6		
34			October			782,520			2,411.2		
35			November			687,400			2,412.8		
36			December			613,640			2,412.0		
37			January			568,360			2,414.4		
38			February			528,720			2,414.8		
39			March			497,480			2,422.8		
40											
41				Calculate Electric Costs		Return to Select NG Rate Schedule					
42											
43											
44				Fuel Cost	Energy Cost	Riders Cost	Demand Cost	Demand Riders Cost	Subtotal	Taxes & Fees	Total
45				(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)
46			April	\$190,620.00	\$41,301.00	\$38,124.00	\$16,894.80	\$2,287.30	\$289,647.10	\$30,412.95	\$320,060.05
47			May	\$185,652.00	\$52,601.40	\$37,130.40	\$22,089.80	\$2,286.94	\$300,180.54	\$31,518.96	\$331,699.50
48			June	\$179,244.00	\$50,785.80	\$35,848.80	\$21,964.00	\$2,273.92	\$290,536.52	\$30,506.33	\$321,042.85
49			July	\$186,420.00	\$52,819.00	\$37,284.00	\$22,035.40	\$2,281.31	\$301,259.71	\$31,632.27	\$332,891.98
50			August	\$199,320.00	\$56,474.00	\$39,864.00	\$21,950.40	\$2,272.51	\$320,300.91	\$33,631.60	\$353,932.51
51			September	\$213,348.00	\$46,225.40	\$42,669.60	\$15,675.40	\$2,122.21	\$320,460.61	\$33,648.36	\$354,108.97
52			October	\$234,756.00	\$50,863.80	\$46,951.20	\$15,672.80	\$2,121.86	\$350,785.66	\$36,832.49	\$387,618.15
53			November	\$206,220.00	\$44,681.00	\$41,244.00	\$15,683.20	\$2,123.26	\$310,371.46	\$32,589.00	\$342,960.46
54			December	\$184,092.00	\$39,886.60	\$36,818.40	\$15,678.00	\$2,122.56	\$279,017.56	\$29,296.84	\$308,314.40
55			January	\$170,508.00	\$36,943.40	\$34,101.60	\$15,693.60	\$2,124.67	\$259,791.27	\$27,278.08	\$287,069.35
56			February	\$158,616.00	\$34,366.80	\$31,723.20	\$15,696.20	\$2,125.02	\$242,947.22	\$25,509.46	\$268,456.68
57			March	\$149,244.00	\$32,336.20	\$29,848.80	\$15,748.20	\$2,132.06	\$229,729.26	\$24,121.57	\$253,850.83
58											
59											
60											
61											
62											

Figure 2.26: Step 8 image one of section 2.2

Customizable Electric Rate Schedule												
	Summer On-peak	Summer Off-peak	Winter	Summer On-peak Actual Demand	Summer Off-peak Actual Demand	Winter Actual Demand	kWh Cost	kW-mo Cost	Subtotal	Taxes & Fees	Total	
	kWh	kWh	kWh	kW-mo	kW-mo	kW-mo	(\$)	(\$)	(\$)	(\$)	(\$)	
April			635,400			2,599	\$270,045.00	\$19,182.10	\$289,647.10	\$30,412.95	\$320,060.05	
May	495,072	123,768		2,079	520		\$275,383.80	\$24,376.74	\$300,180.54	\$31,518.96	\$331,699.50	
June	477,984	119,496		2,067	517		\$265,878.60	\$24,237.92	\$290,536.52	\$30,506.33	\$321,042.85	
July	497,120	124,280		2,074	518		\$276,523.00	\$24,316.71	\$301,259.71	\$31,632.27	\$332,891.98	
August	531,520	132,880		2,066	516		\$295,658.00	\$24,222.91	\$320,300.91	\$33,631.60	\$353,932.51	
September			711,160			2,412	\$302,243.00	\$17,797.61	\$320,460.61	\$33,648.36	\$354,108.97	
October			782,520			2,411	\$332,571.00	\$17,794.66	\$350,785.66	\$36,832.49	\$387,618.15	
November			687,400			2,413	\$292,145.00	\$17,806.46	\$310,371.46	\$32,589.00	\$342,960.46	
December			613,640			2,412	\$260,797.00	\$17,800.56	\$279,017.56	\$29,296.84	\$308,314.40	
January			568,360			2,414	\$241,553.00	\$17,818.27	\$259,791.27	\$27,278.08	\$287,069.35	
February			528,720			2,415	\$224,706.00	\$17,821.22	\$242,947.22	\$25,509.46	\$268,456.68	
March			497,480			2,423	\$211,429.00	\$17,880.26	\$229,729.26	\$24,121.57	\$253,850.83	
	2,001,696	500,424	5,024,680	8,286	2,072	19,499	\$3,248,932.40	\$241,055.42	\$3,495,027.82	\$366,977.91	\$3,862,005.73	

Figure 2.27: Step 8 image two of section 2.2

## 2.3 Additional Instructions

1. Once the user completes all calculations, the user can restart entirely, or jump back in at almost any point. Wherever the new starting point is, the user must complete every step after that. The information in the previous steps will remain pertinent (see part c).
2. If restarting from “Ground Zero” the user can select a new electric or natural gas utility rate schedule without needing to redo the other utility rate schedule and cost calculation. The user will need to re-enter the utility usage information of utility that is being reselected.
  - a. Selecting a new non-customizable rate schedule (electric or natural gas) will erase any corresponding usage and cost information.
  - b. If selecting a customizable rate schedule, no values will be erased until the “Return to Select NG Rate Schedule” button (on DIY El. Rates sheet) or the “Return to Main Userform” button (on DIY NG Rates sheet) are clicked.
3. The user can recalculate costs for different usage information simply by replacing the original usage input information and clicking the relevant cost calculation button.
4. If a customizable rate schedule is selected for either utility type, the original utility usage information must be re-entered and the costs must be recalculated before applying different CHP system information (SPP, IRR, ROI etc. can be recalculated without re-completing the customizable rate schedule utility costs).
5. When using the customizable rate schedules, the user must take note of the following:
  - a. If there are seasonal rates, the second answer in the left and center columns must be “N/A”

- b. "N/A" cannot be selected to the summer and winter peak questions, if there are seasonal rate variations within the rate schedules.
- c. There cannot be any peak variances for energy if there is a block expander.
- d. If there are seasons applied, the number of summer months does not need to be adjusted/selected. The first summer month also does not need to be adjusted/selected.

## Chapter 3: Verification

### 3.1 Cooper Union CHP System

In order to verify that the algorithm tool created is a sufficient means to estimate economic performance for a proposed CHP system, external validation was performed. The algorithm tool was used to accurately reproduce multiple CHP analysis simulations, which were performed by Jonathan O. Rodriguez and documented in his thesis, “Technical and Economic Assessment of a Cogeneration System in an Urban Academic Building,” (Rodriguez, 2014). This building is located at 41 Cooper Square, at Cooper Union in New York City and had the CHP system commissioned in December 2011. The four simulations of utility cost estimates that were repeated with the algorithm tool are: no CHP system operation (Simulation 1), the current 250 kWe CHP system operation (Simulation 2), retrofitted CHP system operation (Simulation 3), and an original Request for Proposal (RFP) 390 kWe CHP system operation-this proposal was revised due to higher than anticipated pricing (Simulation 4).

In order to quantify the economic performance of each scenario, Rodriguez(2014) uses the average electric and natural gas rates listed below in Table 3.1 and applies them to monthly and weekly usage profiles, which are established and/or explained in the following sections.

**Table 3.1:** Average Utility Rates

Utility Rates		
<b>Electrical</b>	\$	0.176 /kWh
<b>Natural Gas</b>	\$	1.029 /therm

**3.1.1 No CHP System Operation.** Because the CHP system was first commissioned in 2011, and the study was performed in 2013-2014, there is no available utility information on the building without the CHP system operating. Before the first simulation, Rodriguez(2014) calculates the electric and heating demand profiles for solely the building based on data obtained



from the Cogeneration Management System (CMS) and utility bills from January 2013 to December 2013, which reflect the CHP system savings. Table 2.2 tabulates the electrical and natural gas consumption from the utility bills since January 2013. (Figures in this table are directly from Table G-2 of (Rodriguez, 2014).

**Table 3.2:** Electrical and Natural Gas Consumption at 41 Cooper Square

Month	Utility Bills after Cogen System	
	Electrical Consumption (kWh)	Natural Gas Consumption (therms)
Jan-13	288,400	35,934
Feb-13	290,400	35,819
Mar-13	279,600	50,862
Apr-13	316,200	15,275
May-13	330,600	23,484
Jun-13	340,600	24,334
Jul-13	349,800	20,387
Aug-13	306,200	17,428
Sep-13	320,000	15,483
Oct-13	295,800	24,403
Nov-13	292,200	32,705
Dec-13	284,200	23,423

Electrical production, fuel use, and heat use by the CHP system are shown in Table 3.2 (Figures in this table are directly from Table G-3 of (Rodriguez, 2014). The fuel used by the CHP system is equivalent to the natural gas consumed by the CHP system in order to produce electricity (electrical production). The heat use refers to the amount heat recovered for heating in the CHP system’s hot water heat exchanger (HWHX). February 2013 is grey to show that information was not available for this month and is replaced by information from February 2012.

**Table 3.3:** Electricity Produced, Fuel Used, and Heat Used by CHP System at 41 Cooper Square

Month	Cogeneration Management System Data		
	Electrical Production (kWh)	Fuel Used (therms)	Heat Used (therms)
Jan-13	96,052	11,212	3,039
Feb-13	131,769	15,308	5,909
Mar-13	157,816	18,776	2,911
Apr-13	70,938	8,362	1,180
May-13	122,920	14,610	0
Jun-13	164,622	19,096	0
Jul-13	142,811	16,695	0
Aug-13	149,501	16,441	1,544
Sep-13	128,767	15,730	4,881
Oct-13	157,642	18,500	4,334
Nov-13	132,539	15,376	3,597
Dec-13	112,842	13,228	4,460

The thesis back-calculates the building's actual demand profile, CHP system generation omitted. The electrical demand of the building is said to be the sum of the utility bill electrical energy consumption and the electrical production by the CHP system. In calculating the heat demand of the building, the fuel used by the boiler with the CHP running is calculated as the difference between the utility bill natural gas consumption and the fuel consumed by the CHP system. The heat use of the building is said to be the sum of the fuel used by the boiler, and the heat use by the cogeneration system (heat recovered by the CHP system HWHX). These calculations produce the following table of values, according to Rodriguez(2014).

**Table 3.4:** Electrical and Natural Gas Consumption at 41 Cooper Square

Month	Electrical Demand (kWh)	Heat Demand (therms)
Jan-13	329,675	25,288
Feb-13	283,847	24,494
Mar-13	320,934	31,789
Apr-13	357,565	7,401
May-13	371,995	7,987
Jun-13	382,026	4,714
Jul-13	391,256	3,323
Aug-13	347,687	2,433
Sep-13	361,518	4,658
Oct-13	337,348	9,646
Nov-13	333,779	19,193
Dec-13	325,809	13,636

While the heat demand values are consistent, the electrical demand values are not, according to the definition of the values as described in the thesis. They result in significantly lower monthly total utility costs than provided by Table 6-3 of the thesis (Rodriguez, 2014). The following adjustments were made to more accurately represent 41 Cooper Square’s demand profile without the CHP system: recalculate monthly electrical demand numbers, add peak demand charge.

**3.1.2 Electrical Demand Recalculations.** As stated in the thesis, “the electrical demand is the sum of the electricity produced by the cogeneration system [Table 3.3 Column 2] and the electrical consumption from the utility bill, [Table 3.2 Column 2],” (Rodriguez, 2014). The calculation for January 2013 monthly electrical demand should go as follows:

$$\begin{aligned}
 & \text{(January Electrical Demand)} = \\
 & \text{(CHP Electricity Production)} + \text{(Billed Electrical Consumption)}
 \end{aligned}
 \tag{Equation 2.1}$$

$$\begin{aligned}
 \text{(January Electrical Demand)} &= (288,400 \text{ kWh}_e) + (96,052 \text{ kWh}_e)
 \end{aligned}
 \tag{Equation 2.2}$$

$$\text{January Electrical Demand} = 384,452 \text{ kWh}_e$$

Equation 2.3

The new electrical demand values are shown in Appendix A.

**3.1.3 Peak Demand Charge.** After making the above correction to each month, the newly calculated total monthly utility costs are still significantly less than the utility costs provided by Table 6-3 of the thesis. The only component of the electric utility cost given is the average price per kWh<sub>e</sub> of consumption. However, the report also states that, “electric bills are more complicated because two quantities are measured; the energy consumption, billed on a per kWh<sub>e</sub> rate and the peak power demand during the month, billed on a per kW<sub>e</sub> rate.” Peak demand charges are common in utility rates that apply to non-residential customers. Rodriguez(2014) continues to explain that, “The peak power is billed because both utilities need to have some reserve or standby power available based on the peak power as the electrical demand fluctuates throughout the day,” but does not offer any insight to the nature of this charge in 41 Cooper Square’s electric rate schedule. Considering the importance of this component of the electric bill and the fact that the average \$/kWh<sub>e</sub> and average \$/therm<sub>t</sub>, when applied to the electrical and heat demands, respectively, don’t add up to the total monthly costs given by Rodriguez(2014), an average \$/kW<sub>e</sub> is developed to account for the difference in total monthly costs by the following method:

$$\begin{aligned} & \text{(Calculated Annual Utility Cost)} \\ & = (\text{Annual Electrical Demand} * \text{Average cost per kWh}_e) \\ & + (\text{Annual Heat Demand} * \text{Average cost per therm}_t) \end{aligned}$$

Equation 3.4

$$\begin{aligned} & \text{(Calculated Annual Utility Cost)} \\ & = (5,262,219 \text{ kWh}_e * \$0.176/\text{kWh}_e) + (154,438 \text{ therm}_t * \$1.029/\text{therm}_t) \end{aligned}$$

Equation 3.5

$$\text{Calculated Annual Utility Cost} = \$1,085,067$$

Equation 3.6

$$\begin{aligned} & \text{(Average Electric Peak Demand Rate)} \\ & = \frac{(\text{Given Annual Utility Cost}) - (\text{Calculated Annual Utility Cost})}{(\text{Estimated Annual Charged Peak Demand})} \end{aligned}$$

Equation 3.7

$$\text{(Average Electric Peak Demand Rate)} = \frac{(\$1,176,000) - (\$1,085,067)}{(10,405 \text{ kW} - mo_e)}$$

Equation 3.8

$$\text{Average Electric Peak Demand Rate} = \$8.739/\text{kW} - mo_e$$

Equation 3.9

The estimated annual charged peak demand is estimated by viewing the typical weekly electrical demand figures for each month of the year. These figures are found in Appendix G of Rodriguez’s thesis and can be found in Appendix A along with the estimations used for the validation (Rodriguez, 2014).

To estimate the amount of heat that can be usefully recovered for processes, Rodriguez(2014) also develops heat demand profiles for a typical week for each month throughout the year. These figures, which can be found in Appendix A, are used to estimate monthly peak heat demands. Then, a weighted average annual thermal load factor is calculated as a ratio of monthly heat demand to what monthly heat demand would be if it were equal to the peak heat demand for the entire month. Each monthly thermal load factor is weighted by the percentage of that month’s heat demand compared to the annual heat demand. A calculation for January’s thermal load factor and its weight on the annual thermal load factors are shown below and the rest of the numbers can be found in Appendix A.

$$\begin{aligned}
 & \text{(January Thermal Load Factor)} \\
 & = \frac{\text{(January Heat Demand)}}{\text{(January Estimated Peak Heat Demand)} * \text{(January Hours of Operation)}}
 \end{aligned}
 \tag{Equation 3.10}$$

$$\text{(January Thermal Load Factor)} = \frac{(25,289 \text{ therm}_t)}{(51 \text{ therms/hr}) * (31 \text{ days} * 24 \text{ hr/day})}
 \tag{Equation 3.11}$$

$$\text{January Thermal Load Factor} = 0.666
 \tag{Equation 3.12}$$

$$\begin{aligned}
 & \text{(January Weighted Thermal Load Factor)} \\
 & = \text{(January Thermal Load Factor)} * \frac{\text{(January Heat Demand)}}{\text{(Annual Heat Demand)}}
 \end{aligned}$$

**Equation 3.13**

$$\begin{aligned}
 & \text{(January Weighted Thermal Load Factor)} \\
 & = \text{(January Thermal Load Factor)} * \frac{\text{(January Heat Demand)}}{\text{(Annual Heat Demand)}}
 \end{aligned}$$

**Equation 3.14**

$$\text{(January Weighted Thermal Load Factor)} = (0.666) * \frac{(25,289 \text{ therm}_t)}{(154,438 \text{ therm}_t)}$$

**Equation 3.15**

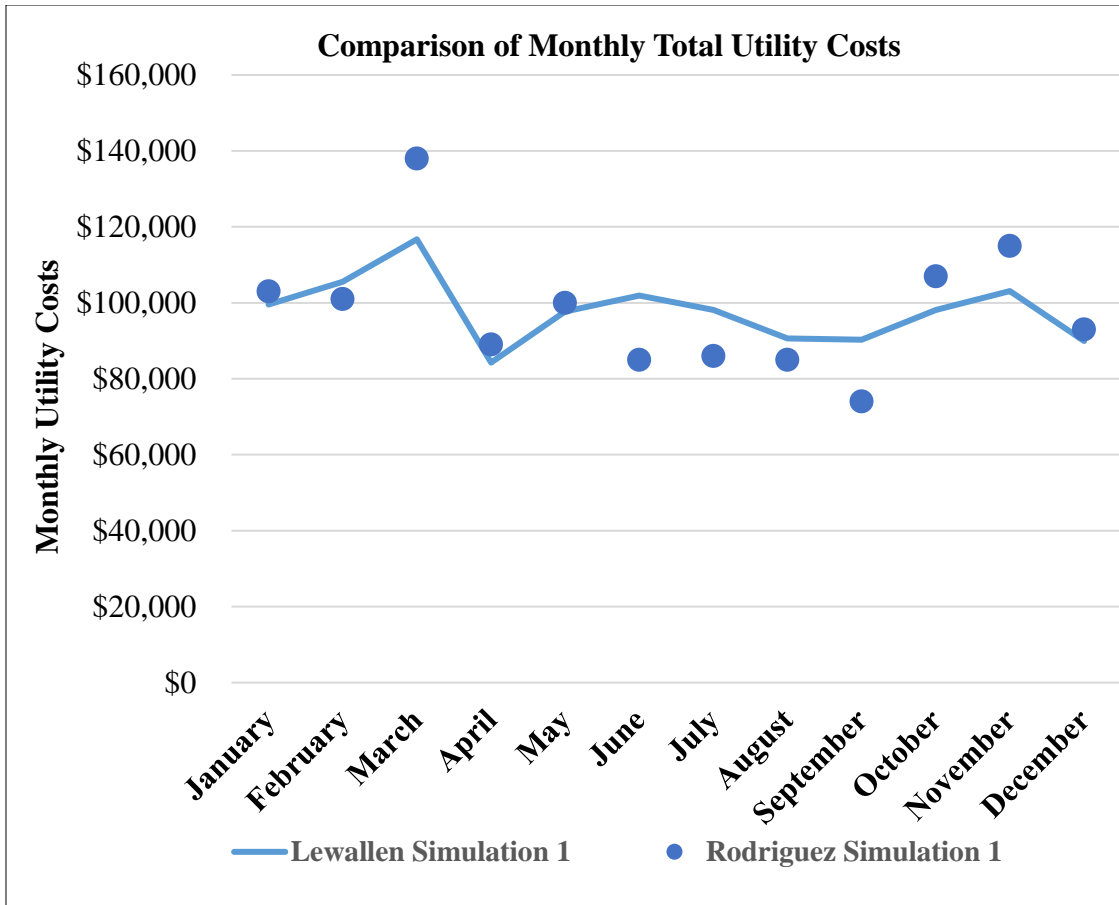
<b><i>January Weighted Thermal Load Factor = 0.109</i></b>
------------------------------------------------------------

**Equation 3.16**

While Rodriguez’s thesis utilizes a typical weekly usage profile for each month, my algorithm tool establishes a different daily usage profile for each month (Rodriguez, 2014). The user of my algorithm tool can enter an average thermal load factor, which is then applied to each month to calculate heat demand in 15-minute intervals for a typical day in each month. This difference in monthly usage profile approximations should result in a smaller deviation in monthly utility costs using my algorithm tool (for simulations in this validation) than the actual monthly utility costs. However, over the course of a year, the utility costs should even out.

**3.1.4 Simulation 1.** The first simulation calculates monthly utility costs as if there were no CHP system. Remember, the only utility information available is after the CHP system was commissioned.

Figure 3.1 compares the utility cost calculations from my algorithm tool (Simulation 1) to those of Rodriguez’s(2014) method (No Cogen).



**Figure 3.1:** Comparison of total monthly utility cost simulations of 41 Cooper Square without the CHP system

The simulation with my model and my algorithm tool resulted in an annual utility cost of \$1,175,996, compared to Rodriguez’s(2014) \$1,176,000 per year utility cost.

### 3.2 CHP System Operation

**3.2.1 CHP System Deficiencies.** As described by Rodriguez(2014), there are a number of deficiencies prohibiting the CHP system from achieving maximum savings.

#### 1. Partial Loading During Overnight Hours

Between 12 a.m. and 8 a.m. the CHP unit must be throttled down to 175 kW<sub>e</sub> (70% of full load) due to a, “design oversight of the electrical system oversight,” (Rodriguez, 2014).

## 2. Part Load During Fall and Spring

For 3 months in both Fall and Spring the CHP unit is throttled down to 220 kW<sub>e</sub> to keep it from being starved of fuel and shutting off. In these seasons the boilers cycle on and off. When the boilers start-up they require extra fuel, which can deny the CHP unit sufficient fuel to operate at full load.

## 3. Gas Meter Not Commissioned

The NYC Department of buildings has not allowed the CHP unit's gas consumption to be sub-metered and qualify for a 20% discount.

## 4. Undersized Hot Water Heat Exchanger

The current hot water heat exchanger used in the CHP system can only recover 9.2 therm<sub>i</sub>/hr-much less than the 15.68 therm<sub>i</sub>/hr that is recovered from the CHP unit's engine jacket.

Although the building's heat demand is low during the summer, heat can be recovered to supply the absorption chiller with hot water. Running the absorption chiller instead of the centrifugal chiller saves 35.0 kW<sub>e</sub> during the daytime and 27.0 kW<sub>e</sub> during the nighttime (see deficiency #1 above).

The last adjustment made for Simulation 2 was to the daily hours of CHP operation. The generating electricity with an average CHP output of 215 kW<sub>e</sub> for 24 hours a day, 7 days a week, 365 days a year does not add up to an annual electricity generation of 1,568,219 kWh<sub>e</sub> given by Rodriguez(2014). Therefore, the daily hours of CHP operation was limited to 19.98 hours per day to match.

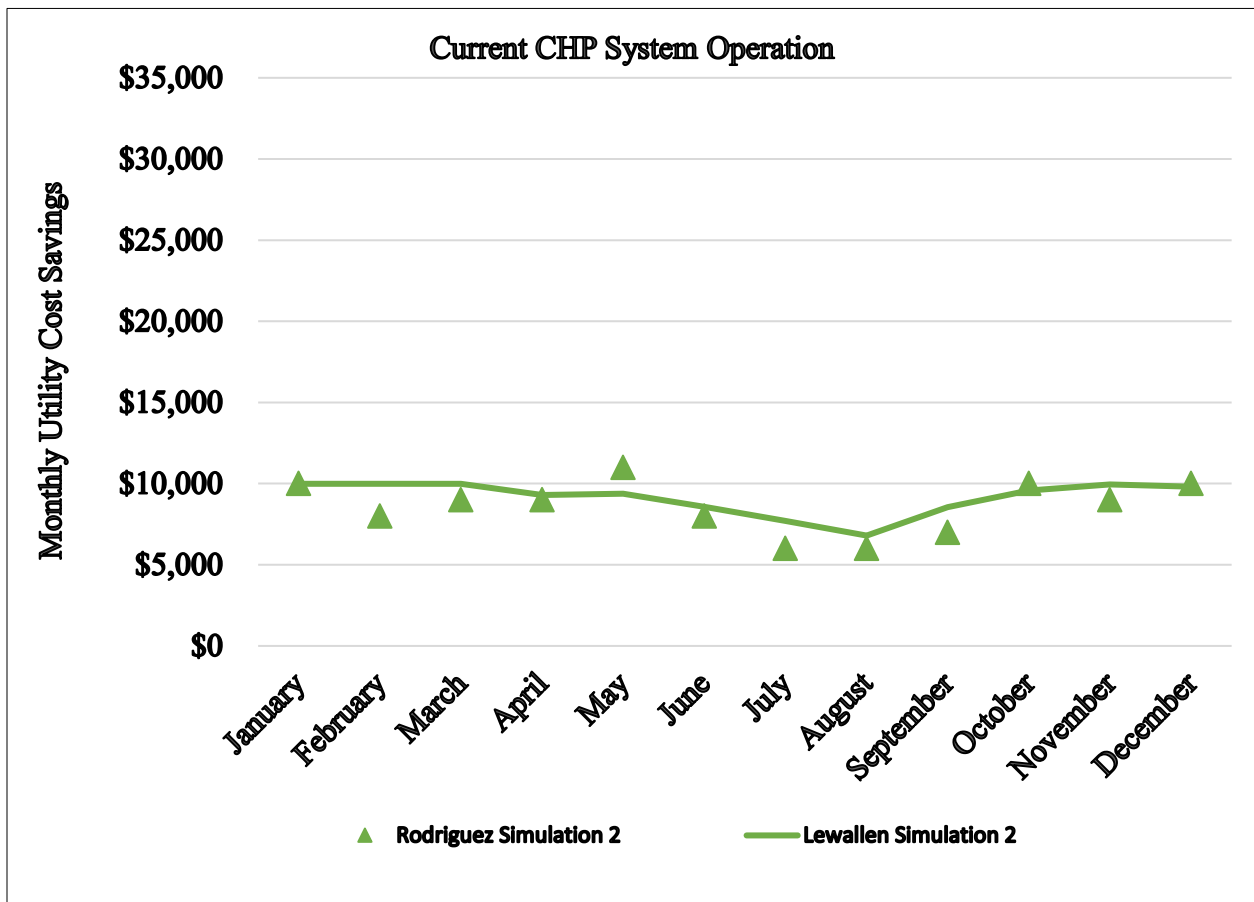
**3.2.2 Simulation 2.** Table 3.5 shows the CHP System Information and Cost & Savings input values used in my algorithm tool for my simulation.



**Table 3.5: CHP System Scenario Inputs for 41 Cooper Square**

Simulation 2 Inputs		
Energy cost	\$0.176	per kWh
Peak Demand cost	\$8.739	per kW-mo
Natural Gas cost	\$10.290	per MMBtu
CHP Power	223.083	kWe
CHP Input	734.775	kWt
CHP Input	2.507	MMBtu/hr
CHP Output	0.920	MMBtu/hr
Maintenance cost	\$0.0446	per kWh
Length of Shift	19.98	hr/day
Thermal L.F.	0.5791	

Figure 3.2 shows monthly utility cost savings of my simulation compared to Rodriguez’s(2014) simulation.



**Figure 3.2:** Comparison of monthly utility cost savings simulations of 41 Cooper Square the CHP system

The simulation with my model and my algorithm tool resulted in annual savings of \$109,589, compared to \$101,000 from Rodriguez's(2014) simulation. Considering a capital investment of \$1,200,000, and a \$70,000 yearly maintenance contract, the SPP is 10.95 years which yields a 9.13% ROI according to my simulation, and a SPP of 11.88 years with an 8.42% ROI according to Rodriguez's(2014) simulation.

### **3.3 Retrofitted CHP System Operation**

**3.3.1 CHP System Retrofits.** In Simulation 3, the current deficiencies of the CHP system (listed in the previous section) are theoretically corrected for in the following ways:

#### **1. Partial Loading During Overnight Hours**

Between 12 a.m. and 8 a.m. the CHP unit must be is not throttled down to 175 kW<sub>e</sub> and is run at 250 kW<sub>e</sub> by combining utility meters.

#### **2. Part Load During Fall and Spring**

A natural gas pressure issue is resolved. The boilers can now cycle on and off without choking the CHP unit of fuel. The CHP system is run at 250 kW<sub>e</sub> during the Fall and Spring.

#### **3. Gas Meter Not Commissioned**

The CHP system's natural gas meter is commissioned. The new average price of natural gas is \$0.932/therm<sub>t</sub>.

#### **4. Undersized Hot Water Heat Exchanger**

A new HWHX replaces the undersized HWHX. 1.568 therm<sub>t</sub>/hr can now be recovered from the engine jacket.

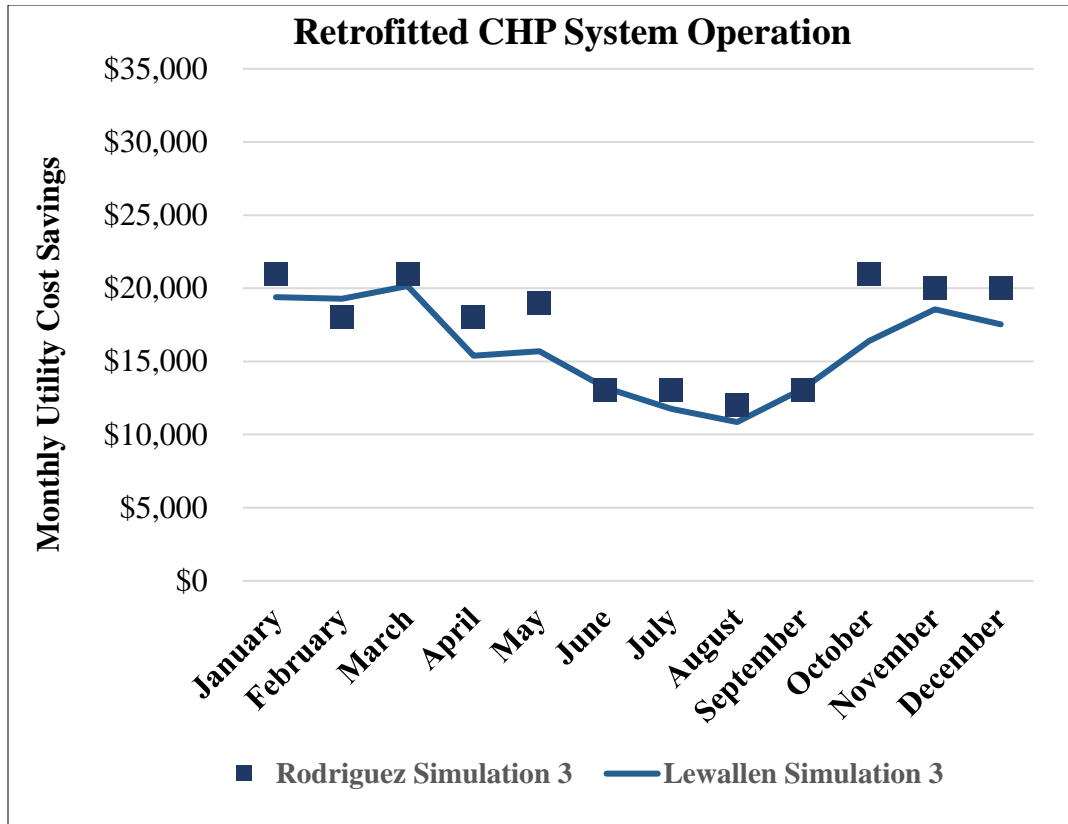
The daily hours of CHP operation input remains the same, as does the average thermal load factor. By resolving the first issue listed above, supplying hot water to the absorption chiller in the summer now saves 35.0 kW<sub>e</sub> during the day and the night.

**3.3.2 Simulation 3.** Table 2.6 shows the CHP System Information and Cost & Savings input values used in my algorithm tool for my simulation.

**Table 3.6:** Retrofit CHP System Scenario Inputs for 41 Cooper Square

<b>Simulation 3 Inputs</b>	
Energy cost	\$0.176 per kWh
Peak Demand cost	\$8.739 per kW-mo
Natural Gas cost	\$9.320 per MMBtu
CHP Power	258.75 kW <sub>e</sub>
CHP Input	815 kW <sub>t</sub>
CHP Input	2.780 MMBtu/hr
CHP Output	1.568 MMBtu/hr
Maintenance cost	\$0.0385 per kWh
Length of Shift	19.98 hr/day
Thermal L.F.	0.5791

Figure 3.3 shows monthly utility cost savings of my simulation compared to Rodriguez's(2014) simulation.



**Figure 3.3:** Comparison of monthly utility cost savings simulations of 41 Cooper Square the CHP system

The simulation with my model and my algorithm tool resulted in annual savings of \$191,391, compared to \$206,000 from Rodriguez’s(2014) simulation. Considering the same capital investment of \$1,200,000, and the same \$70,000 annual maintenance contract, the simple payback period is 6.27 years (SPP) which yields a 15.95% return on investment (ROI) according to my simulation, and a SPP of 5.83 years with an 17.17% ROI according to Rodriguez’s(2014) simulation.

### 3.4 RFP CHP System Operation

**3.4.1 RFP CHP System.** Simulation 4 assumes the current CHP system deficiencies are resolved just like they are in Simulation 3. The purpose of this scenario is to explore the potential economic performance of a 390 kW<sub>e</sub> CHP system made up of two 195 kW<sub>e</sub> CHP units. The

original RFP package includes a 120 ton absorption chiller, instead of the 80 ton absorption chiller chosen, which provides an extra 13.75 kW<sub>e</sub> of savings when avoiding the use of the centrifugal chiller in the summer.

New capital investment costs and maintenance contract costs are based on the ratio of the new CHP system electric power output to the old CHP system electric power output.

$$(RFP \text{ Capital Investment}) = (Initial \text{ Capital Investment}) * \left(\frac{390 \text{ kW}_e}{250 \text{ kW}_e}\right)$$

**Equation 3.17**

$$(RFP \text{ Capital Investment}) = (\$1,200,000) * \left(\frac{390 \text{ kW}_e}{250 \text{ kW}_e}\right)$$

**Equation 3.18**

<b><i>RFP Capital Investment = \$1,880,000</i></b>
----------------------------------------------------

**Equation 3.19**

$$(RFP \text{ Annual Maintenance Cost}) = (Initial \text{ Annual Maintenance Cost}) * \left(\frac{390 \text{ kW}_e}{250 \text{ kW}_e}\right)$$

**Equation 3.20**

$$(RFP \text{ Capital Investment}) = (\$70,000) * \left(\frac{390 \text{ kW}_e}{250 \text{ kW}_e}\right)$$

**Equation 3.21**

<b><i>RFP Capital Investment = \$109,2000</i></b>
---------------------------------------------------

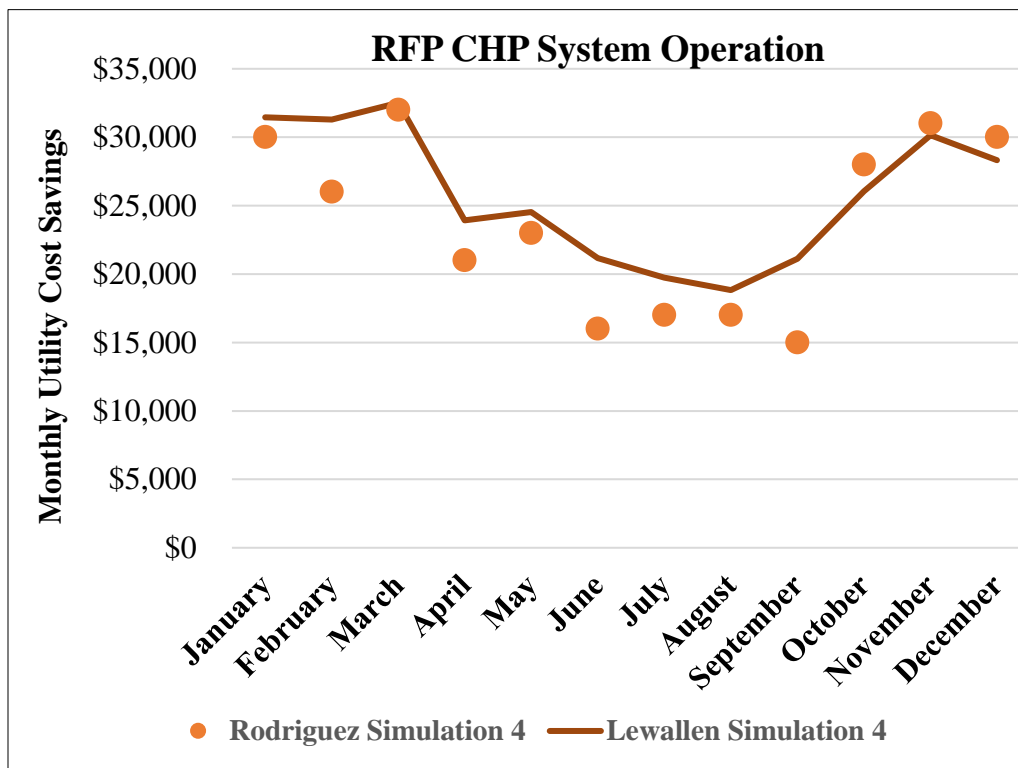
**Equation 3.22**

**3.4.2 Simulation 4.** Table 3.7 shows the CHP System Information and Cost & Savings input values used in my algorithm tool for my simulation.

**Table 3.7: RFP CHP System Scenario Inputs for 41 Cooper Square**

Simulation 4 Inputs	
Energy cost	\$0.176 per kWh
Demand cost	\$8.739 per kW-mo
Natural Gas cost	\$10.290 per MMBtu
CHP Power	403.75 kW <sub>e</sub>
CHP Input	1,270 kW <sub>t</sub>
CHP Input	4.334 MMBtu/hr
CHP Output	2.445 MMBtu/hr
Maintenance cost	\$0.0398 per kWh
Length of Shift	19.98 hr/day
Thermal L.F.	0.5791

Figure 3.4 shows monthly utility cost savings of my simulation compared to Rodriguez's(2014) simulation.



**Figure 3.4:** Comparison of monthly utility cost savings simulations of 41 Cooper Square the CHP system

The simulation with my model and my algorithm tool resulted in annual savings of \$269,924, compared to \$286,000 from Rodriguez's(2014) simulation. The capital investment of and maintenance contract cost were scaled up by a ratio of 390 kW<sub>e</sub> to 250 kW<sub>e</sub>. The resulting capital

investment is \$1,880,000, and the annual maintenance contract is \$109,200. The SPP is 6.96 years, which yields a 14.36% ROI according to my simulation. In comparison, Rodriguez(2014) calculates a SPP of 6.57 years with a 15.21% ROI.

### **3.5 Verification Conclusion and Errors**

After reviewing all of the simulations the annual utility costs, utility cost savings, and economic performance measurements (NAS, SPP, and ROI) are in good agreement with Rodriguez's(2014), but there are some discrepancies. Monthly net cost savings are typically higher toward the summer months, when Rodriguez(2014) calculates lower monthly savings, and lower toward the winter months, when Rodriguez(2014) calculates higher monthly savings. These values are closer to the averages than Rodriguez's(2014) values are. This is a result of Rodriguez(2014) using a typical weekly profile for each month, and then extrapolating data for that entire month, compared to my simulation that uses a typical daily profile and then extrapolating that data for each corresponding month. The result is less seasonal variability in my monthly utility savings and utility cost savings calculations.

## **Chapter 4: Potential Savings Analysis & Discussion**

The most important factors for whether or not a facility can implement a CHP system with a positive economic performance are: electric utility costs, natural gas utility costs, and the size of the CHP system compared to the size and nature of the plant's usage profile.

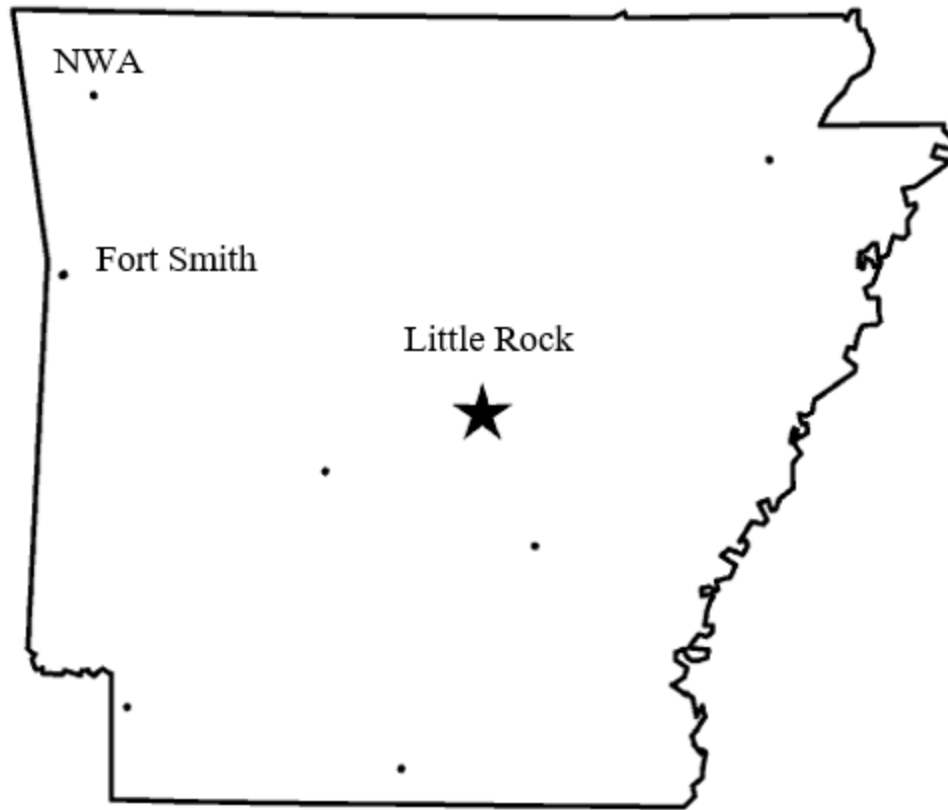
### **4.1 Utility Rates Analysis and Discussion**

Manufacturing plants with high electric utility rates are more likely to be viable candidates for CHP technology. Electricity is the more expensive of the two energy utilities. The utility company uses natural gas or other fuels to produce electricity. The efficiency of large power plants is generally below 40%. So naturally, electricity rates are higher than those of natural gas.

Second, but maybe not as critical as the following factor, is the price of natural gas. The CHP system can only be economical with the recovery of the exhaust heat from the electricity production. However, generating the electricity still requires an overall monthly increase in natural gas consumption. The cheaper the natural gas utility rates are, the less the natural gas utility bills will increase.

SWEPCO and Black Hills are available to the Northwest Arkansas region, OG&E and AOGC are available in Fort Smith, and Entergy and CenterPoint are available in Little Rock. These three locations are shown in Figure 4.1.





**Figure 4.1:** Map of Arkansas highlighting the three locations of the utility companies represented in the spreadsheet algorithm tool

The following tables show a fictional plant's usage profile with 12 months of utility data, and compares the resulting annual utility costs on each of the rates that are built into the CHP algorithm tool. The first table shows electric usage information for rate schedules that charge the customer based on total monthly consumption and monthly peak demand. The next table shows the annual electric utility costs.

The monthly peak demand ( $\text{kW}_e\text{-mo}$ ) chosen for the fictional plant is simply based on typical small- to medium- sized manufacturing plants' monthly peak demands. The peak demand is higher in the summer, due to air conditioning, and lower in the winter. The electric consumption ( $\text{kWh}_e$ ) is calculated based on a plant load factor of 0.5 and annual plant operating hours from 16 hours per day and five days per week. The load factor is defined as the

energy consumption for a period of time divided by the product of the peak consumption and the hours of operation.

**Table 4.1:** Fictional Plant Electric Usage Profile

	<b>Total kWh</b>	<b>Total kW-mo</b>
<b>Apr-16</b>	180,762	1,040
<b>May-16</b>	184,238	1,060
<b>Jun-16</b>	187,714	1,080
<b>Jul-16</b>	191,190	1,100
<b>Aug-16</b>	194,667	1,120
<b>Sep-16</b>	198,143	1,140
<b>Oct-16</b>	194,667	1,120
<b>Nov-16</b>	191,190	1,100
<b>Dec-16</b>	187,714	1,080
<b>Jan-17</b>	184,238	1,060
<b>Feb-17</b>	180,762	1,040
<b>Mar-17</b>	177,286	1,020
<b>Totals:</b>	<b>2,252,571</b>	<b>12,960</b>

**Table 4.2:** Electric rates for fictional plant profile

<b>Company</b>	<b>Rate Schedule</b>	<b>Total Cost</b>
<b>Entergy</b>	LGS	\$312,005
	LPS	\$312,474
<b>OG&amp;E</b>	PL-1	\$184,562
	PL-2	\$211,652
	PL-3	\$213,247
	PL-4	\$213,089
	PL-5	\$220,544
<b>SWEPSCO</b>	LP-primary	\$230,631
	LP-secondary	\$246,114
	LLP-primary	\$1,023,089
	LLP-secondary	\$1,138,414

The following two tables show 12-month natural gas usage consumption of the fictional plant and the annual costs associated with each rate schedule. The natural gas consumption is based on typical small- to medium- sized manufacturing plants' monthly consumption. The consumption is higher in the winter, due to space heating, and lower in the summer. The peak

day demand for each month is calculated as twice that of the average day consumption for 5 days per week of plant operation.

**Table 4.3:** Fictional Plant Natural Gas Usage Profile

	Natural Gas			
	CCF	MCF	MMBtu	MMBtu Demand
<b>Apr-16</b>	37,000	3,700	3,785	261
<b>May-16</b>	34,000	3,400	3,478	240
<b>Jun-16</b>	31,000	3,100	3,171	219
<b>Jul-16</b>	28,000	2,800	2,864	198
<b>Aug-16</b>	31,000	3,100	3,171	219
<b>Sep-16</b>	34,000	3,400	3,478	240
<b>Oct-16</b>	37,000	3,700	3,785	261
<b>Nov-16</b>	40,000	4,000	4,092	283
<b>Dec-16</b>	43,000	4,300	4,399	304
<b>Jan-17</b>	46,000	4,600	4,706	325
<b>Feb-17</b>	43,000	4,300	4,399	304
<b>Mar-17</b>	40,000	4,000	4,092	283
<b>Totals:</b>	<b>444,000</b>	<b>44,400</b>	<b>45,421</b>	<b>3,136</b>

**Table 4.4:** Natural gas rates for fictional plant profile

Company	Rate Schedule	Total Cost
<b>AOGC-Ark</b>	Med Business	\$342,514.94
	Large Business	\$306,612.18
<b>Black Hills</b>	Business 3	\$489,137.40
	Business 4	\$467,254.42
	Business 5	\$466,136.63
<b>CenterPoint</b>	SCS-1	\$401,103.86
	SCS-2	\$403,823.82
	LCS-1	\$389,710.59

Table 4.2 shows that OG&E provides the lowest rates for electricity. The total costs vary based on the means of distribution and voltage size. Entergy has the next lowest rates. The two rate schedules are designed based on size, but yield very similar total costs in this case, and the utility consumer can choose its rate schedule. For SWEPCO, the LLP rate schedules are much more expensive. However, this fictional plant would not be on these rate schedules because the

peak demand is too low, and the total costs are so high because of a minimum billed demand that would apply.

Table 4.4 shows that AOGC has lower rates than Black Hills. Each company's rate schedules shown in Table 4.4 differ based on the annual consumption of the natural gas consumer. The fictional plant would actually be on AOGC's Large Business rate schedule or on Black Hills' Business 4 rate schedule. The annual usage is just over the cutoff point for CenterPoint's smaller usage rate schedules (SCS-1 and SCS2). This makes the total costs all very close. Since the annual usage is high enough, though, the fictional plant would be allowed on the LCS-1 rate schedule with lower rates.

According to the tables above, Entergy in Little Rock charges the most for electricity and Black Hills, which is located in NWA, charges more for natural gas. AOGC typically provides natural gas in areas that overlap OG&E electricity service areas (Fort Smith, Arkansas). Fort Smith has higher lower electric rates and natural gas rates. Areas with a better opportunity for CHP are expected to have higher electric rates and lower natural gas rates. While Little Rock has the highest electric rates, it has the second highest natural gas rates (Entergy and CenterPoint, respectively). NWA has the second highest electric rates and the highest natural gas rates, but the electric rates are expected to have more of an impact on the economic viability of CHP implementation. CHP implementations are expected to be more economically feasible in these two regions.

## **4.2 Impact on CHP Sizing**

Electric utility companies in Arkansas are required to purchase electricity from CHP plants as long as the plants are QFs, as defined by PURPA. First, any electricity produced by a CHP system offsets the CHP plant's monthly electricity usage. If more electricity is produced

than is consumed, the electric utility company must compensate the CHP plant for the extra electricity provided to the grid.

However, the nature of taking economical advantage of the CHP system's thermal output is different. No company is required to purchase waste heat from the CHP plant. And not only that, but in this study it is assumed that the CHP plant does not even have the option to sell waste heat to any neighboring facilities. Any heat exhausted by the CHP unit must be recovered and used for either space heat or process heat.

Considering these two factors, it can be expected that maximum savings occur when the CHP system is sized to meet the CHP plant's thermal base demand. Any exhaust heat recovered by heat exchangers can be used for space heat or process heat. All of this heat is reused to assist in meeting the plant's thermal demand. If the CHP system's thermal output were larger than the plant's baseload, more heat would be wasted than necessary. The CHP system would not be operating at its maximum rate thermal efficiency. Meanwhile, any electricity produced by the CHP system will be accounted for on the monthly electric bill. This is true even if at any given time the CHP plant is producing more electricity than it is consuming.

As a general rule, once a manufacturing facility is determined to be a viable candidate for implementing a CHP system, the system size should be fine-tuned so that the thermal output matches the CHP plant's thermal baseload.

## **Chapter 5: Arkansas Case Studies' Results and Discussion**

This chapter evaluates three actual Arkansas manufacturing plants and their opportunity for CHP systems. First, a sweet potato products plant (known as Sweet Potato Plant) is evaluated at its actual location. Following this scenario, Sweet Potato Plant, a frozen yogurt products plant (known as Frozen Yogurt Plant), and a poultry products plant (known as Poultry Plant) are evaluated using NWA's, Fort Smith's, and Little Rock's combinations of utility rate companies. Each evaluation calculates the economic performance of implementing a range of both MicroTurbines and ICE. After all of the evaluations are discussed, the criteria for a good CHP opportunity are explained.

### **5.1 Sweet Potato Plant**

Due to the sanitation requirements of the food industry, Sweet Potato Plant has a high thermal demand compared to its electric demand. The small municipality in which the plant is located has its own electric and natural gas utility company for the city. The local natural gas company has gas transported in from another company. The rates used for the simulation and the plant's electric and natural gas utility usage profiles are shown below.

**Table 5.1:** Sweet Potato plant’s current electric utility rates & input information for CHP algorithm tool simulation

<b>Electric Utility Rates</b>		
Cust Charge	\$ 200.00	per mo
NL Charge	\$ 132.99	per mo
<b>1st 100 hr</b>	<b>\$ 0.0276</b>	<b>/kWh</b>
<b>Next 260 hr</b>	<b>\$ 0.0233</b>	<b>/kWh</b>
<b>Remaining</b>	<b>\$ 0.0215</b>	<b>/kWh</b>
<b>Fuel Adj</b>	<b>\$0.04227</b>	<b>/kWh</b>
<b>Demand</b>	<b>\$ 3.50</b>	<b>/kW-mo</b>
Franchise	5%	
Discount	-5%	
<b>State Tax</b>	<b>6.50%</b>	
<b>County Tax</b>	<b>1.00%</b>	
<b>City Tax</b>	<b>2.00%</b>	
Small Account Averages	\$ 333.71	per mo
<b>Total Charges</b>	<b>\$ 666.70</b>	<b>per mo</b>

**Table 5.2:** Sweet Potato Plant’s current natural gas utility rates & input information for CHP algorithm tool simulation

<b>Natural Gas Utility Rates</b>		
<b>Transportation Cost</b>		
<b>Transportation</b>	<b>\$ 4.148</b>	<b>/MMBtu</b>
Trans City Tax	2%	
Trans County Tax	1%	
Trans State Tax	7%	
Effective Trans Taxes	6.19%	
<b>Fuel Cost</b>		
Customer Charge	\$ 240.98	per mo
TA Charge	\$ 97.68	per mo
<b>Delivery Charge</b>	<b>\$ 1.46212</b>	<b>/MMBtu</b>
<b>Avg EECR</b>	<b>\$ 0.15739</b>	<b>/MMBtu</b>
<b>Act 310</b>	<b>\$ 0.03591</b>	<b>/MMBtu</b>
<b>Main Rep. Rider</b>	<b>\$ 0.00037</b>	<b>/MMBtu</b>
Franchise Fee	4.0%	
Effective Franch Fee	1.05%	
Small Account Average	\$1,235.38	
<b>Total Effective Tax</b>	<b>7.24%</b>	
<b>Total Monthly Charge</b>	<b>\$1,574.04</b>	<b>per mo</b>

**Table 5.3:** Sweet Potato Plant’s electric and natural gas utility information

Month	Electricity		Natural Gas
	kWh	kW-mo	MMBtu
<b>May-14</b>	635,400	2,599	2,229
<b>Jun-14</b>	618,840	2,599	2,540
<b>Jul-14</b>	597,480	2,584	605
<b>Aug-14</b>	621,400	2,592	1,039
<b>Sep-14</b>	664,400	2,582	2,065
<b>Oct-14</b>	711,160	2,412	2,469
<b>Nov-14</b>	782,520	2,411	2,946
<b>Dec-14</b>	687,400	2,413	3,529
<b>Jan-15</b>	613,640	2,412	3,410
<b>Feb-15</b>	568,360	2,414	861
<b>Mar-15</b>	528,720	2,415	1,741
<b>Apr-15</b>	497,480	2,423	2,606
<b>Totals:</b>	<b>7,526,800</b>	<b>29,856</b>	<b>26,040</b>

The bolded values are the values used in the customizable rate schedule cost calculations and may be combinations of other rates or charges that are shown in the tables. The Small Account Average in the Table 5.2 is the monthly average of a smaller utility meter that will not be affected by the CHP system. It is included in the calculations for thoroughness.

The sizes of the CHP system used are 50 kW<sub>e</sub>, 100 kW<sub>e</sub>, 150 kW<sub>e</sub>, 200 kW<sub>e</sub>, 250 kW<sub>e</sub>, and 300 kW<sub>e</sub>. Both MicroTurbines and ICE are considered. The efficiencies used are the averages of the ranges of efficiencies suggested in the tool. These values are 34.5%, 50.5%, 29.5%, and 60.5%. The first two values are ICE electric and thermal efficiencies, respectively, and the last two values are MicroTurbine electric and thermal efficiencies, respectively. The efficiencies are used to calculate the thermal input [kW<sub>t</sub> & MMBtu/hr] and thermal output [MMBtu/hr]. The plant operates all 8,760 hours of the year and can be modeled as one 24-hour shift, two 12-hour shifts, three eight-hour shifts, or anything that adds up to 24 hours per day. It operates all seven days of the week. The first shift’s starting time does not affect any calculations, only the graphs that show 15-minute interval thermal plant demand and CHP



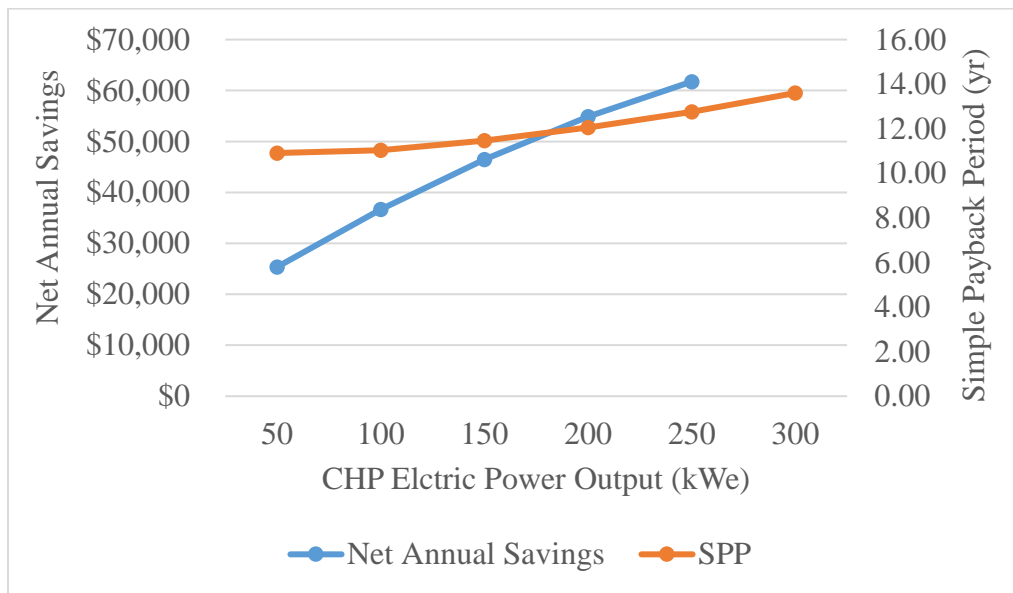
thermal output. The average thermal load factor (LF) is estimated to be 0.5 and the average thermal slope factor (SF) to be 0.5 as well. The LF calculates an average daily thermal peak demand and the SF determines the nature of the plant's build up to that daily peak demand. The last input value on the CHP System Information tab is \$0.03/kWh<sub>e</sub> for any credited kWh<sub>e</sub> (though no extra monthly electricity was credited to the CHP plant).

Finally, the investment costs used are \$2,750/kW<sub>e</sub> for ICE and \$3,000/kW<sub>e</sub> for MicroTurbines. These numbers also account for the additional parts and labor costs. Maintenance estimates are \$0.02/kWh<sub>e</sub> for MicroTurbines and ICE greater than 100 kW<sub>e</sub> and \$0.0225/kWh<sub>e</sub> for ICE of 100 kW<sub>e</sub> or less. A federal MicroTurbine incentive is applied to all MicroTurbines. This incentive is a one-time grant of 10% of any costs associated with implementing the CHP system up to \$200/kW<sub>e</sub>.

Results from the simulation are shown below, divided by MicroTurbine and ICE CHP systems. The best case scenario for Sweet Potato Plant is to implement a 50 kW<sub>e</sub> ICE or a 200 kW<sub>e</sub> MicroTurbine. However, the SPP is at best just below 11 years. ICE typically only have a lifetime of about 15 years so this would not be economical. Likewise, MicroTurbines typically last about 20 – 25 years. Still, such a long payback period is undesirable and the 250 kW<sub>e</sub> MicroTurbine would not be considered economical either.

**Table 5.3:** Sweet Potato Plant MicroTurbine NAS, electric power, and SPP

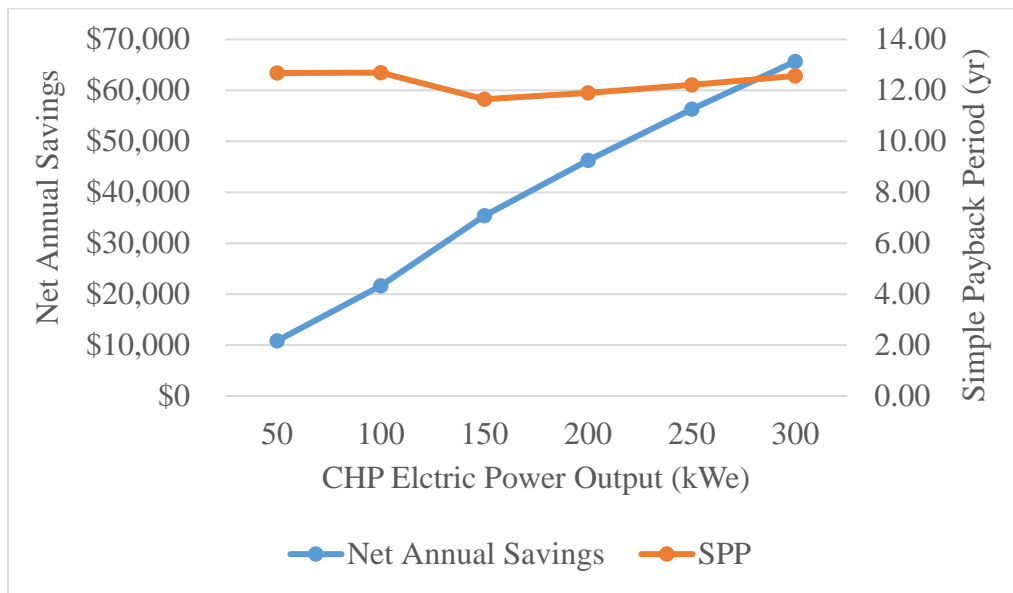
MicroTurbine		
Net Annual Savings	Power <sub>e</sub>	Simple Payback Period
\$12,830	50	10.91
\$25,371	100	11.04
\$36,645	150	11.46
\$46,440	200	12.06
\$54,877	250	12.76
\$61,744	300	13.60



**Figure 5.1:** Plot of NAS vs. SPP for range of MicroTurbine electric power at Sweet Potato Plant

**Table 5.4:** Sweet Potato Plant IC Engine NAS, electric power, and SPP

Internal Combustion Engine		
Net Annual Savings	Power <sub>e</sub>	Simple Payback Period
\$10,844	50	12.68
\$21,659	100	12.70
\$35,401	150	11.65
\$46,232	200	11.90
\$56,278	250	12.22
\$65,669	300	12.56



**Figure 5.2:** Plot of NAS vs. SPP for range of IC engine electric power at Sweet Potato Plant

As the plots show, the SPP seems to hit a limit as the electric output of the CHP system increases, and in the case of the MicroTurbine, eventually becomes less economic. In the case of the ICE, the estimated maintenance rate is reduced to \$0.02/kWh<sub>e</sub> from \$0.0225/kWh<sub>e</sub>, which is reflected with a slight dip in the plot. Due to the highly seasonal nature of Sweet Potato Plant’s thermal demand, as the CHP system increases in size, less of its thermal output is able to be recovered for useful plant promises. Even though electric utility cost savings increase, so does

the cost to run the CHP system. The increasing price and decreasing overall thermal efficiency create a limit for CHP systems most feasible payback scenario.

This limit is based on a plant's baseload thermal demand and the peak thermal demand to some extent. In reality, as CHP systems get much bigger, outside of the range of micro-CHP systems considered here (50 kW<sub>e</sub> to 300 kW<sub>e</sub>) the \$/kW<sub>e</sub> investment rate and the \$/kWh<sub>e</sub> maintenance rates decrease. These two rates are essentially constant in the micro-CHP range.

## **5.2 Statewide Scenario Analysis**

**5.2.1 Sweet Potato Plant Scenario.** Sweet Potato Plant is evaluated at the three locations across the state under the same circumstances as the evaluation at its actual location. The only differences are the utility rates determining its annual utility costs and annual utility cost savings.

**5.2.2 Frozen Yogurt Plant Scenario.** Frozen Yogurt Plant has a smaller but non-seasonal thermal demand and operates 2,900 hours per year, 5 days a week, with a 0.9 LF. A 0.9 SF is also used. The rest of the inputs are the same as the first simulation. The usage profile is shown below in Table 3.5.

**Table 2.5:** Frozen Yogurt Plant electric and natural gas usage profile

Month	Electricity		Natural Gas
	kWh	kW-mo	MMBtu
Sep-12	226,560	882.0	987
Oct-12	161,120	849.0	907
Nov-12	147,840	812.0	946
Dec-12	141,760	813.0	747
Jan-13	153,520	824.0	999
Feb-13	167,440	861.0	1,003
Mar-13	182,240	846.0	1,090
Apr-13	227,520	1,062.0	1,141
May-13	249,160	1,043.0	1,112
Jun-13	269,560	1,092.0	1,155
Jul-13	262,200	1,139.0	1,023
Aug-13	238,040	1,096.0	897
<b>Totals:</b>	<b>2,426,960</b>	<b>11,319</b>	<b>12,007</b>

**5.2.3 Poultry Plant Scenario.** Poultry Plant has a slightly higher thermal demand than the sweet potato plant with some seasonality, but not as much. It operates for 4,960 hours per year, 6 days per week with a LF and SF of 0.6.

**Table 5.6:** Poultry Plant electric and natural gas usage profile

Month	Electricity		Natural Gas
	kWh	kW-mo	MMBtu
May-11	1,090,750	2,348.3	1,735
Jun-11	1,172,750	2,456.8	1,756
Jul-11	1,337,750	2,463.2	1,707
Aug-11	1,206,750	2,561.7	1,742
Sep-11	1,245,000	2,537.2	2,134
Oct-11	1,219,250	2,315.8	2,196
Nov-11	1,086,000	2,361.3	2,354
Dec-11	1,110,250	2,295.1	2,831
Jan-12	1,151,000	2,379.3	4,245
Feb-12	936,750	2,157.2	2,520
Mar-12	933,250	2,156.2	2,545
Apr-12	1,079,000	2,232.2	2,083
<b>Totals:</b>	<b>13,568,500</b>	<b>28,264</b>	<b>27,848</b>

### 5.3 Discussion

The table below shows all of the most lucrative sizes of CHP systems for both MicroTurbines and ICE for all three plants (sweet potato, frozen yogurt, and poultry products) considering all three combinations of utility rates based on locations. The least economical place to implement a CHP system would be in Fort Smith due to the already low electric utility costs. The MicroTurbine is almost always more economical or approximately even with the ICE, though only due to the incentive. The SPP from the utility rates corresponding to Little Rock are lowest for Frozen Yogurt Plant, but the SPP is lower in NWA for the other two plants.

Frozen Yogurt Plant and Poultry Plant are more economical with larger CHP systems, and Sweet Potato Plant has varying results. This shows for each individual energy usage profile there is an optimum size of micro-CHP system that is not only based on the monthly average thermal demand, but also the monthly peak thermal demand, the monthly baseload thermal demand, and seasonal variance in thermal demand.

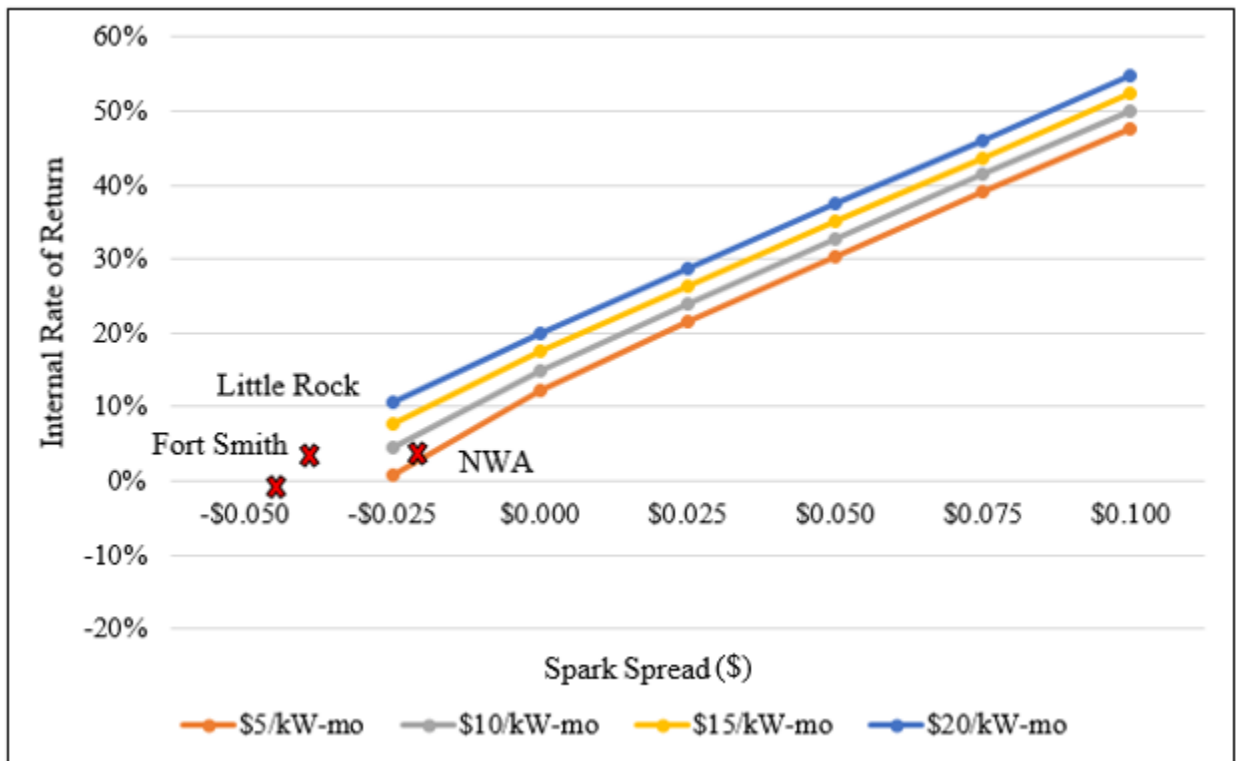
**Table 5.7:** Comparison of NAS, SPP, and electric power for most lucrative MicroTurbine and ICE sizes in multiple locations for Sweet Potato Plant, Frozen Yogurt Plant, and Poultry Plant

Facility Products	Locations	Utility Company	CHP Type	kW <sub>e</sub>	Net Annual Savings	Simple Payback Period
Sweet Potato Products	Original Location	Custom	MicroTurbine	50	\$12,830	10.91
		Custom	ICE	150	\$35,401	11.65
	NWA	SWEPCO Black Hills	MicroTurbine	150	\$26,519	26.95
			ICE	250	\$25,985	26.46
	Fort Smith	OG&E AOGC	MicroTurbine	150	(\$12,575)	-33.40
			ICE	250	(\$20,950)	-32.82
Little Rock	Entergy CenterPoint	MicroTurbine	150	(\$1,601)	-262.34	
		ICE	250	(\$1,825)	-376.66	
Frozen Yogurt	NWA	SWEPCO Black Hills	MicroTurbine	250	\$13,305	52.61
			ICE	250	\$11,828	58.12
	Fort Smith	OG&E AOGC	MicroTurbine	300	\$16,109	52.14
			ICE	300	\$14,043	58.75
	Little Rock	Entergy CenterPoint	MicroTurbine	300	\$35,279	23.81
			ICE	300	\$32,740	25.20
Poultry	NWA	SWEPCO Black Hills	MicroTurbine	300	\$31,711	26.49
			ICE	300	\$28,528	28.92
	Fort Smith	OG&E AOGC	MicroTurbine	300	\$3,456	243.06
			ICE	300	\$14,043	58.75
	Little Rock	Entergy CenterPoint	MicroTurbine	300	\$26,638	31.53
			ICE	300	\$22,403	36.82

Considering all optimally sized micro-CHP systems, implementation is not economically feasible in any of the three major regions considered. The utility rates in these non-rural areas of Arkansas are still low enough compared to the price of micro-CHP implementation for manufacturing companies to not need to implement micro-CHP technology. However, as rates and technology change, or if a manufacturing plant is located in a less populous area where electric rates are more expensive, a plant could use the algorithm spreadsheet tool to make an accurate first assessment.

The following plot compares what combination of rates would be favorable for CHP implementation for a plant that operates 8,760 hours a year with a one to one ratio of baseload thermal demand to electric energy consumption. The vertical axis shows the spark spread, which is the difference between the rate at which electricity is purchased from the grid, and the rate at

which electricity can be created using purchased natural gas (\$7.00/MMBtu), taking into account the electric efficiency of the CHP system. To represent these spark spread values the natural gas rates were held constant – natural gas rates are not expected to rise for the foreseeable future. An average MicroTurbine electric efficiency value was selected (29.5%) and the electric kWh rate was changed to produce the spark spread values in the plot below. The spark spread is plotted against the IRR on the y-axis for four different demand charge values from \$5/kW-mo to \$20/kW-mo.



**Figure 5.3:** Plot of IRR vs. spark spread for four different demand charge values

The spark spreads for the three manufacturing locations are marked by the red Xs based demand charges. As the plot shows, the relationship between the spark spread and the internal rate of return are almost linear. The three manufacturing locations examined in this study all offer negative spark spread values that yield extremely low IRR values. In order to achieve the



maximum 7-year simple payback as mentioned to be desirable earlier in the report, the price per unit of electricity would need to be above \$0.08/kWh<sub>e</sub> for a \$10/kW<sub>e</sub>-mo electric demand rate.

## Chapter 6: Conclusions

An algorithm tool was developed using Excel's Visual Basic for Applications (VBA) program for manufacturing plants to explore the possibilities of implementing CHP systems. The CHP algorithm tool was proven to be accurate when it was used to recalculate CHP savings from 3 different scenarios and simulations as performed by Rodriguez(2014) in, "A Technical and Economic Assessment of a Cogeneration System in an Urban Academic Building."

The tool was then used to calculate the Net Annual Savings (NAS), Internal Rate of Return (IRR), Simple Payback Period (SPP), and Return on Investment (ROI) for 6 different sizes of micro-CHP systems (ranging from 50 kW<sub>e</sub> to 300 kW<sub>e</sub>) for both MicroTurbines and ICE in 3 different locations throughout the state of Arkansas, all with different applicable utility rates.

As predicted, the most important factor for achieving economic feasibility was the utility rates, and not the size or type of CHP system. Little Rock, AR and the Northwest Arkansas (NWA) metropolitan area both had higher utility rates than in Fort Smith, AR. Higher utility rate costs resulted in higher utility rate cost savings. For example, saving one kWh<sub>e</sub>, or one kW<sub>e</sub>, or one MMBtu<sub>t</sub> to a manufacturing plant in Little Rock or NWA is more valuable than it is to a manufacturing plant in Fort Smith. Therefore, these two locations would be more interested in implementing a CHP system.

However, while all three locations could reduce the cost of their utility bills (by reducing electric utility costs and increasing natural gas utility costs to run the CHP system) the cost to maintain the CHP system created lower NAS, and sometimes even negative NAS.

Only a couple of the 120 scenarios that were simulated achieved a SPP between ten and 15 years. Generally, a manufacturing plant of this size would not want to invest in a project with a SPP of much greater than 7 or 8 years. In conclusion, manufacturing plants in the state of

Arkansas are not likely to consider purchasing and implementing CHP systems due to poor economic feasibility. This could change in the future if technology develops enough to reduce the prices of CHP systems or the spark spread in Arkansas increases to at least above \$0.00 or an average price per kWh of \$0.08.

The spreadsheet algorithm tool did show that it can sufficiently analyze a scenario for micro-CHP implementation. And though micro-CHP implementation is unfavorable now, the tool is flexible for future use. The custom rate schedules feature allows for the user to examine scenarios in any location of the state on many imaginable structures of rate schedules. In addition, users can update the rates for the major companies included in the tool.

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## **Appendix A: Validation**

**Table A.1:** Electric and natural gas usage profiles used in the verification simulations

	<b>Electrical Demand</b> <b>kWh<sub>e</sub></b>	<b>Electrical Peak Demand</b> <b>kW<sub>e</sub>-mo</b>	<b>Heat Demand</b> <b>MMBtu<sub>t</sub></b>
<b>January</b>	384,452	675	2,529
<b>February</b>	422,169	705	2,437
<b>March</b>	437,416	805	3,179
<b>April</b>	387,138	975	740
<b>May</b>	453,520	1,110	799
<b>June</b>	505,222	930	471
<b>July</b>	492,611	915	332
<b>August</b>	455,701	910	243
<b>September</b>	448,767	745	466
<b>October</b>	453,442	965	965
<b>November</b>	424,739	980	1,919
<b>December</b>	397,042	690	1,364
<b>Totals:</b>	<b>5,262,219</b>	<b>10,405</b>	<b>15,444</b>

**Table A.2:** CHP System Scenario Inputs for 41 Cooper Square

<b>Simulation 2 Inputs</b>	
Energy cost	\$0.176 per kWh <sub>e</sub>
Peak Demand cost	\$8.739 per kW <sub>e</sub> -mo
Natural Gas cost	\$10.290 per MMBtu <sub>t</sub>
CHP Power	223.083 kW <sub>e</sub>
CHP Input	734.775 kW <sub>t</sub>
CHP Input	2.507 MMBtu <sub>t</sub> /hr
CHP Output	0.920 MMBtu <sub>t</sub> /hr
Maintenance cost	\$0.0446 per kWh <sub>e</sub>
Length of Shift	19.98 hr/day
Thermal L.F.	0.5791



**Table A.3:** Retrofit CHP System Scenario Inputs for 41 Cooper Square

<b>Simulation 3 Inputs</b>	
Energy cost	\$0.176 per kWh <sub>e</sub>
Peak Demand cost	\$8.739 per kW <sub>e</sub> -mo
Natural Gas cost	\$9.320 per MMBtu <sub>t</sub>
CHP Power	258.75 kW <sub>e</sub>
CHP Input	815 kW <sub>t</sub>
CHP Input	2.780 MMBtu <sub>t</sub> /hr
CHP Output	1.568 MMBtu <sub>t</sub> /hr
Maintenance cost	\$0.0385 per kWh <sub>e</sub>
Length of Shift	19.98 hr/day
Thermal L.F.	0.5791

**Table A.4:** RFP CHP System Scenario Inputs for 41 Cooper Square

<b>Simulation 4 Inputs</b>	
Energy cost	\$0.176 per kWh <sub>e</sub>
Demand cost	\$8.739 per kW <sub>e</sub> -mo
Natural Gas cost	\$10.290 per MMBtu <sub>t</sub>
CHP Power	403.75 kW <sub>e</sub>
CHP Input	1,270 kW <sub>t</sub>
CHP Input	4.334 MMBtu <sub>t</sub> /hr
CHP Output	2.445 MMBtu <sub>t</sub> /hr
Maintenance cost	\$0.0398 per kWh <sub>e</sub>
Length of Shift	19.98 hr/day
Thermal L.F.	0.5791

**Table A.5:** Economic performance of Simulation 2

<b>Current CHP System</b>	
CHP Unit Cost	\$1,200,000 (\$)
Parts & Labor Costs	\$0 (\$)
Maintenance Cost	\$0.0446 \$/kWh <sub>e</sub>
Annual CHP kWh	1,568,251 kWh <sub>e</sub>
Annual NG Offset	17,624 MMBtu <sub>t</sub>
Electric Cost Savings	\$309,725 /yr
NG Cost Offset	\$130,136 /yr
Utility Cost Savings	\$179,589 /yr
Maintenance Cost	\$70,000 /yr
Net Annual Savings	\$109,589 /yr
Simple Payback Period	10.95 year(s)
ROI	9.13%
<b>Actual Values from Rodriguez's Thesis</b>	
Report Ann Sav.	\$101,000
Rep. SPP	11.88 year(s)
Rep ROI	8.42%

**Table A.6:** Economic performance of Simulation 3

<b>Retrofitted CHP System</b>	
CHP Unit Cost	\$1,200,000 (\$)
Parts & Labor Costs	\$0 (\$)
Maintenance Cost	\$0.0385 \$/kWh <sub>e</sub>
Annual CHP kWh	1,818,987 kWh <sub>e</sub>
Annual NG Offset	19,543 MMBtu <sub>t</sub>
Electric Cost Savings	\$359,244 /yr
NG Cost Offset	\$97,853 /yr
Utility Cost Savings	\$261,391 /yr
Maintenance Cost	\$70,000 /yr
Net Annual Savings	\$191,391 /yr
Simple Payback Period	6.27 year(s)
ROI	15.95%
<b>Actual Values from Rodriguez's Thesis</b>	
Report Ann Sav.	\$206,000
Rep. SPP	5.83 year(s)
Rep ROI	17.17%

**Table A.7:** Economic performance of Simulation 4

<b>RFP CHP System</b>	
CHP Unit Cost	\$1,880,000
Parts & Labor Costs	\$0
Maintenance Cost	\$0.0398 \$/kWh <sub>e</sub>
Annual CHP kWh	2,838,322 kWh <sub>e</sub>
Annual NG Offset	30,468 MMBtu <sub>t</sub>
Electric Cost Savings	\$560,560 /yr
NG Cost Offset	\$181,435 /yr
Utility Cost Savings	\$379,124 /yr
Maintenance Cost	\$109,200 /yr
Net Annual Savings	\$269,924 /yr
Simple Payback Period	6.96 year(s)
ROI	14.36%
<b>Actual Values from Rodriguez's Thesis</b>	
Report Ann Sav.	\$286,000
Rep. SPP	6.57 year(s)
Rep ROI	15.21%

**Table A.8:** Simulation results from algorithm tool showing Simulation 1 and Simulation 2

Month	Without CHP			Current CHP			Utility Cost Savings (\$)
	Electric Utility Cost	Natural Gas Utility Cost	Total Cost	Electric Utility Cost	Natural Gas Utility Cost	Total Cost	
	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	
January	\$73,562.38	\$26,022.18	\$99,584.56	\$47,751.99	\$36,014.43	\$83,766.42	\$15,818.14
February	\$80,462.74	\$25,075.60	\$105,538.34	\$54,652.35	\$35,070.41	\$89,722.76	\$15,815.58
March	\$84,020.11	\$32,710.26	\$116,730.37	\$58,209.72	\$42,700.78	\$100,910.50	\$15,819.87
April	\$76,656.81	\$7,616.35	\$84,273.16	\$50,846.42	\$18,297.35	\$69,143.77	\$15,129.39
May	\$89,519.81	\$8,218.21	\$97,738.02	\$63,709.42	\$18,809.48	\$82,518.90	\$15,219.12
June	\$97,046.34	\$4,850.91	\$101,897.25	\$71,235.95	\$16,261.08	\$87,497.03	\$14,400.22
July	\$94,695.72	\$3,419.16	\$98,114.88	\$68,885.33	\$15,695.61	\$84,580.94	\$13,533.94
August	\$88,155.87	\$2,502.84	\$90,658.71	\$62,345.48	\$15,682.56	\$78,028.04	\$12,630.67
September	\$85,493.55	\$4,793.80	\$90,287.35	\$59,683.16	\$16,228.36	\$75,911.52	\$14,375.83
October	\$88,238.93	\$9,926.45	\$98,165.38	\$62,428.54	\$20,327.37	\$82,755.91	\$15,409.47
November	\$83,318.28	\$19,749.70	\$103,067.98	\$57,507.89	\$29,776.57	\$87,284.46	\$15,783.52
December	\$75,909.30	\$14,030.93	\$89,940.23	\$50,098.91	\$24,187.90	\$74,286.81	\$15,653.42
<b>Totals:</b>	<b>\$1,017,079.84</b>	<b>\$158,916.39</b>	<b>\$1,175,996.23</b>	<b>\$707,355.16</b>	<b>\$289,051.90</b>	<b>\$996,407.06</b>	<b>\$179,589.17</b>

*Note: Utility Cost Savings do not reflect maintenance costs*

**Table A.8:** Simulation results from algorithm tool showing Simulation 1 and Simulation 3

Month	Without CHP			Retrofitted CHP			Utility Cost Savings (\$)
	Electric Utility Cost	Natural Gas Utility Cost	Total Cost	Electric Utility Cost	Natural Gas Utility Cost	Total Cost	
	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	
January	\$73,562.38	\$26,022.18	\$99,584.56	\$43,625.36	\$30,729.07	\$74,354.43	\$25,230.13
February	\$80,462.74	\$25,075.60	\$105,538.34	\$50,525.73	\$29,898.85	\$80,424.58	\$25,113.76
March	\$84,020.11	\$32,710.26	\$116,730.37	\$54,083.10	\$36,660.57	\$90,743.67	\$25,986.70
April	\$76,656.81	\$7,616.35	\$84,273.16	\$46,719.80	\$16,327.64	\$63,047.44	\$21,225.72
May	\$89,519.81	\$8,218.21	\$97,738.02	\$59,582.80	\$16,620.80	\$76,203.60	\$21,534.42
June	\$97,046.34	\$4,850.91	\$101,897.25	\$67,109.33	\$15,754.79	\$82,864.12	\$19,033.13
July	\$94,695.72	\$3,419.16	\$98,114.88	\$64,758.71	\$15,752.18	\$80,510.89	\$17,603.99
August	\$88,155.87	\$2,502.84	\$90,658.71	\$58,218.85	\$15,750.49	\$73,969.34	\$16,689.37
September	\$85,493.55	\$4,793.80	\$90,287.35	\$55,556.53	\$15,754.69	\$71,311.22	\$18,976.13
October	\$88,238.93	\$9,926.45	\$98,165.38	\$58,301.91	\$17,624.40	\$75,926.31	\$22,239.07
November	\$83,318.28	\$19,749.70	\$103,067.98	\$53,381.27	\$25,296.40	\$78,677.67	\$24,390.31
December	\$75,909.30	\$14,030.93	\$89,940.23	\$45,972.29	\$20,599.64	\$66,571.93	\$23,368.30
<b>Totals:</b>	<b>\$1,017,079.84</b>	<b>\$158,916.39</b>	<b>\$1,175,996.23</b>	<b>\$657,835.68</b>	<b>\$256,769.53</b>	<b>\$914,605.21</b>	<b>\$261,391.02</b>

*Note: Utility Cost Savings do not reflect maintenance costs*

**Table A.9:** Simulation results from algorithm tool showing Simulation 1 and Simulation 4

Month	Without CHP			RFP CHP			Utility Cost Savings (\$)
	Electric Utility Cost	Natural Gas Utility Cost	Total Cost	Electric Utility Cost	Natural Gas Utility Cost	Total Cost	
	(\$)	(\$)	(\$)	(\$)	(\$)	(\$)	
January	\$73,562.38	\$26,022.18	\$99,584.56	\$26,849.07	\$35,444.69	\$62,293.76	\$37,290.80
February	\$80,462.74	\$25,075.60	\$105,538.34	\$33,749.43	\$34,670.45	\$68,419.88	\$37,118.46
March	\$84,020.11	\$32,710.26	\$116,730.37	\$37,306.80	\$41,072.75	\$78,379.55	\$38,350.82
April	\$76,656.81	\$7,616.35	\$84,273.16	\$29,943.50	\$24,561.71	\$54,505.21	\$29,767.95
May	\$89,519.81	\$8,218.21	\$97,738.02	\$42,806.50	\$24,562.82	\$67,369.32	\$30,368.70
June	\$97,046.34	\$4,850.91	\$101,897.25	\$50,333.03	\$24,556.65	\$74,889.68	\$27,007.57
July	\$94,695.72	\$3,419.16	\$98,114.88	\$47,982.41	\$24,554.02	\$72,536.43	\$25,578.45
August	\$88,155.87	\$2,502.84	\$90,658.71	\$41,442.56	\$24,552.35	\$65,994.91	\$24,663.80
September	\$85,493.55	\$4,793.80	\$90,287.35	\$38,780.24	\$24,556.54	\$63,336.78	\$26,950.57
October	\$88,238.93	\$9,926.45	\$98,165.38	\$41,525.62	\$24,750.84	\$66,276.46	\$31,888.92
November	\$83,318.28	\$19,749.70	\$103,067.98	\$36,604.98	\$30,483.45	\$67,088.43	\$35,979.55
December	\$75,909.30	\$14,030.93	\$89,940.23	\$29,195.99	\$26,585.37	\$55,781.36	\$34,158.87
<b>Totals:</b>	<b>\$1,017,079.84</b>	<b>\$158,916.39</b>	<b>\$1,175,996.23</b>	<b>\$456,520.13</b>	<b>\$340,351.65</b>	<b>\$796,871.78</b>	<b>\$379,124.45</b>

*Note: Utility Cost Savings do not reflect maintenance costs*

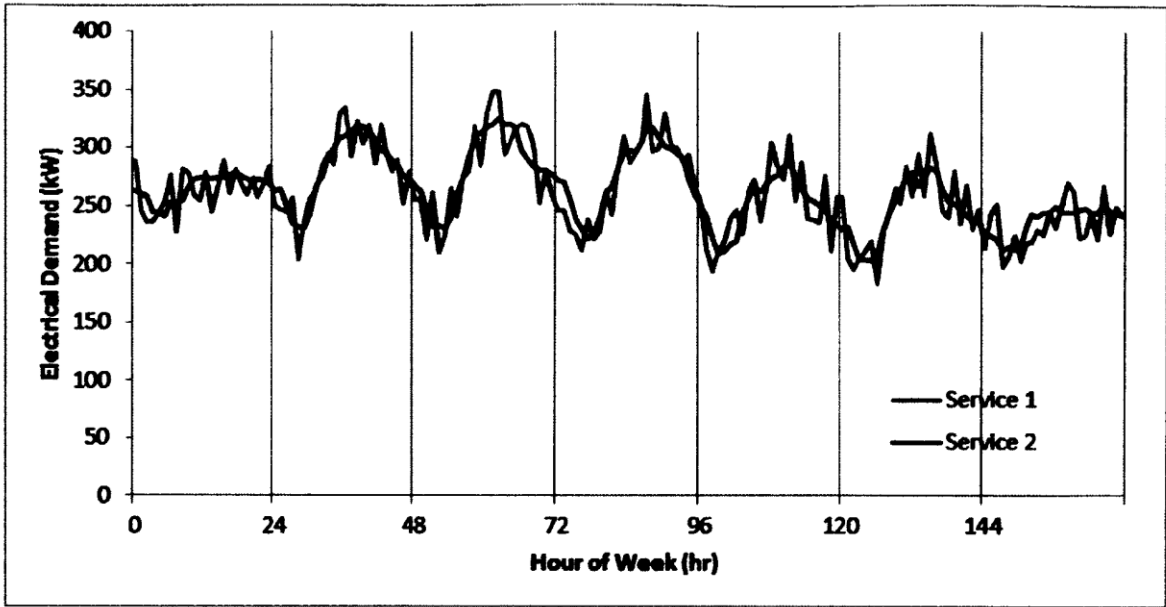


Figure A.1: Weekly Electrical Demand for January

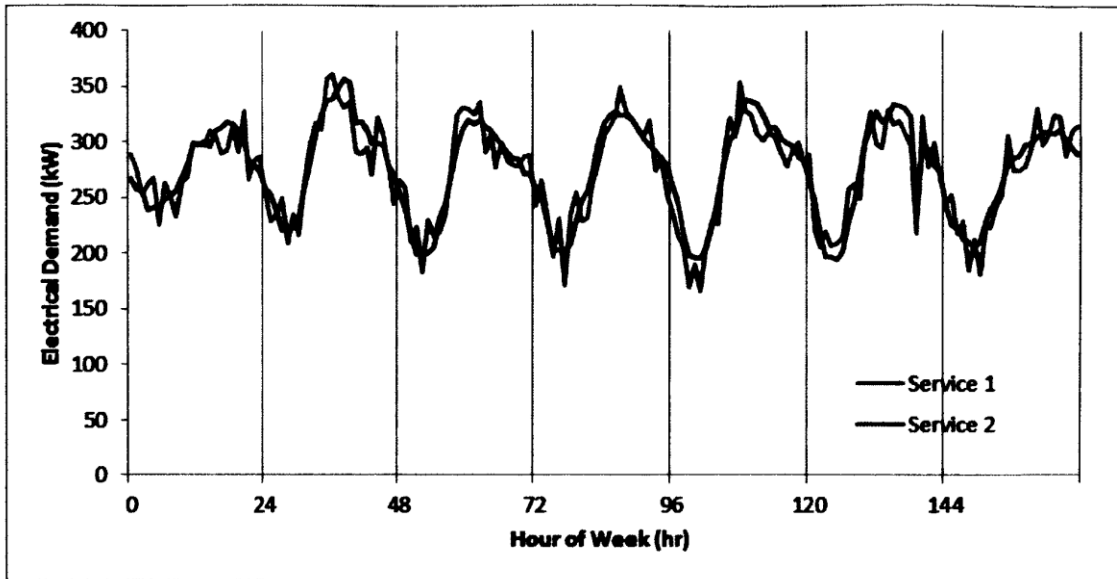


Figure A.2: Weekly Electrical Demand for February

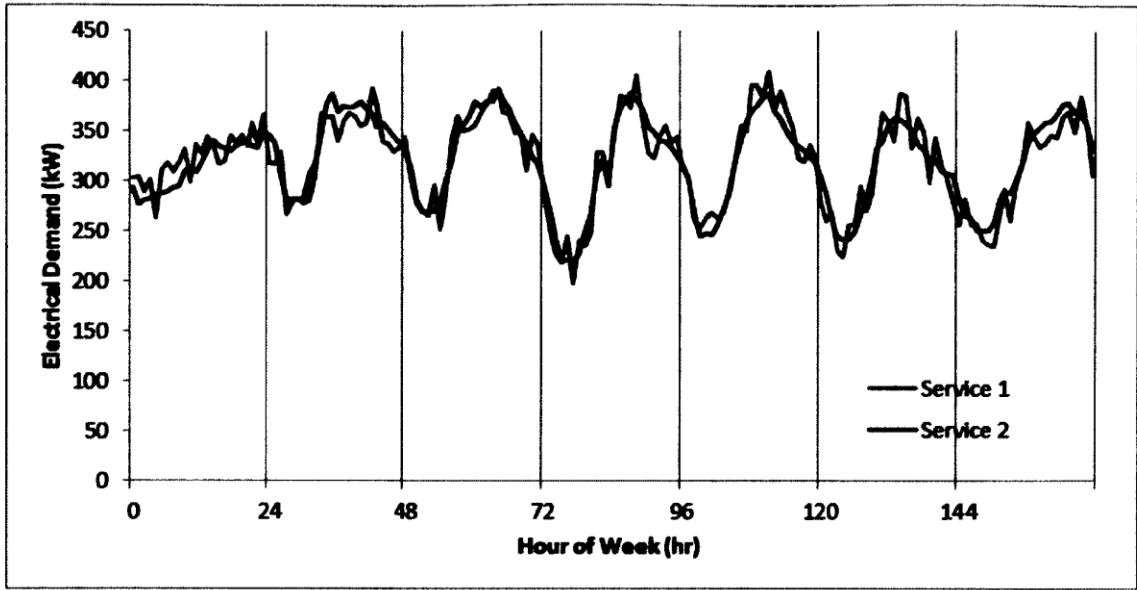


Figure A.3: Weekly Electrical Demand for March

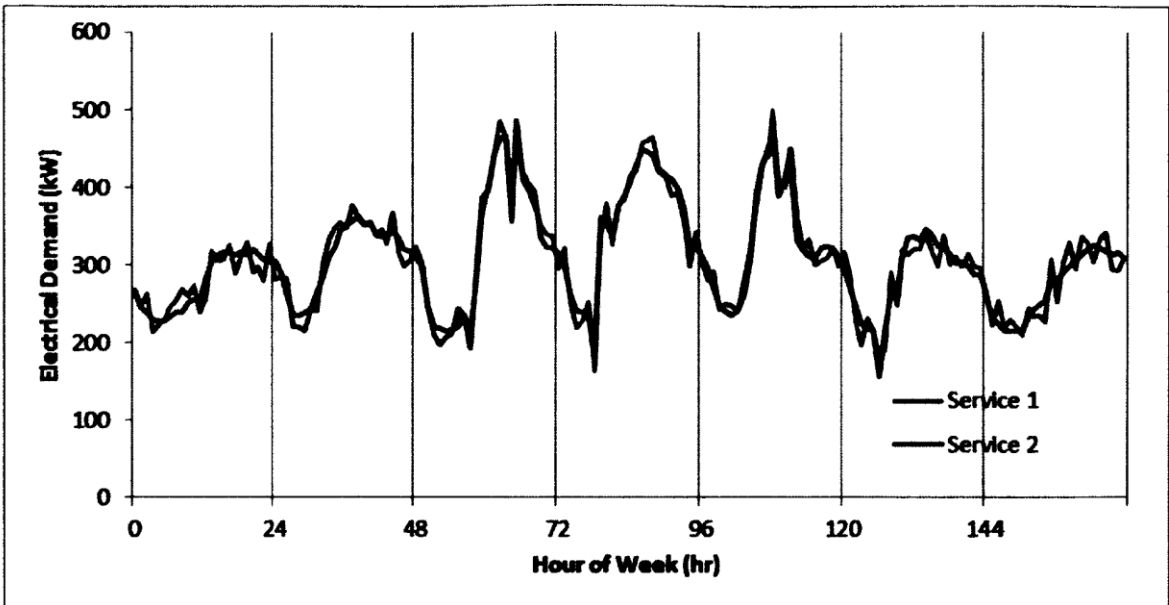


Figure A.4: Weekly Electrical Demand for April



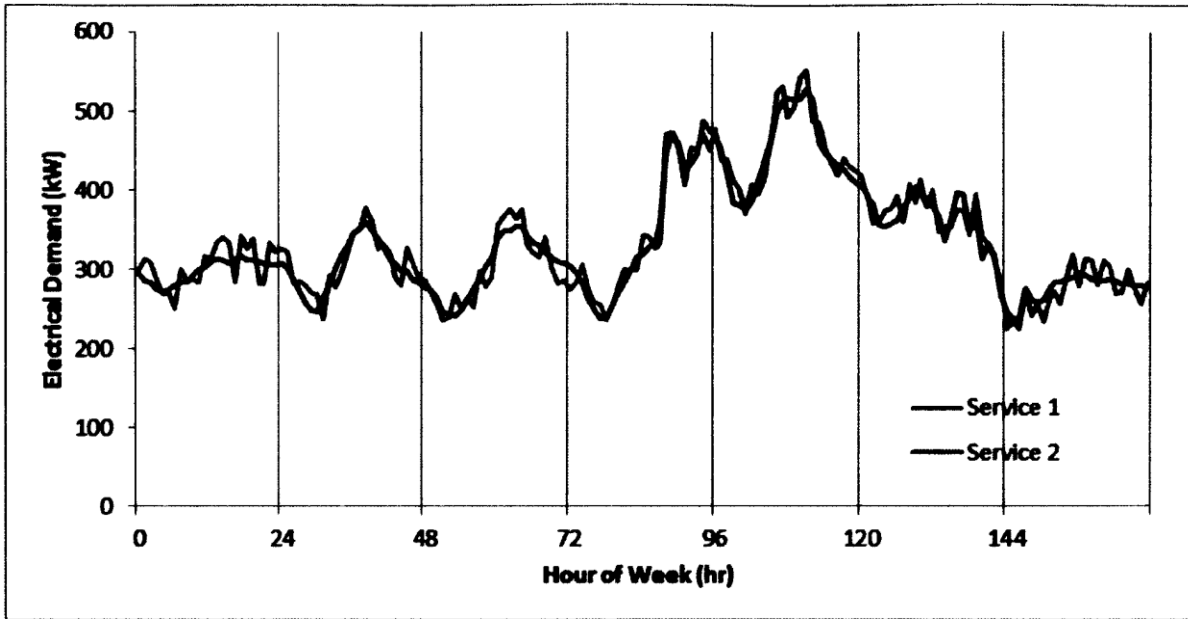


Figure A.5: Weekly Electrical Demand for May



Figure A.6: Weekly Electrical Demand for June

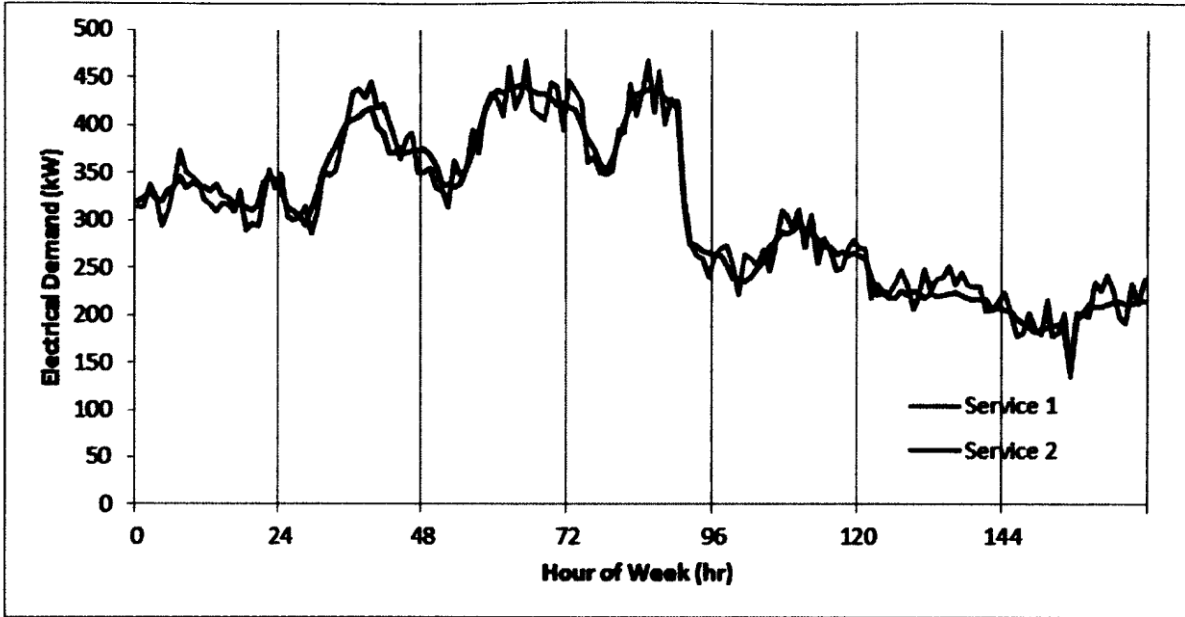


Figure A.7: Weekly Electrical Demand for July

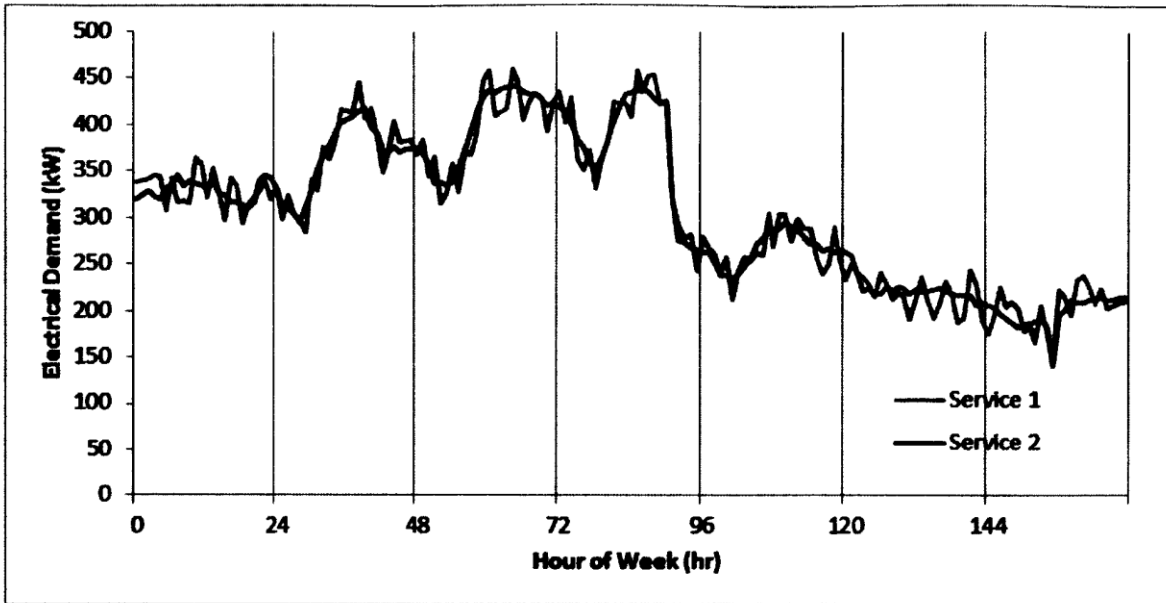


Figure A.8: Weekly Electrical Demand for August

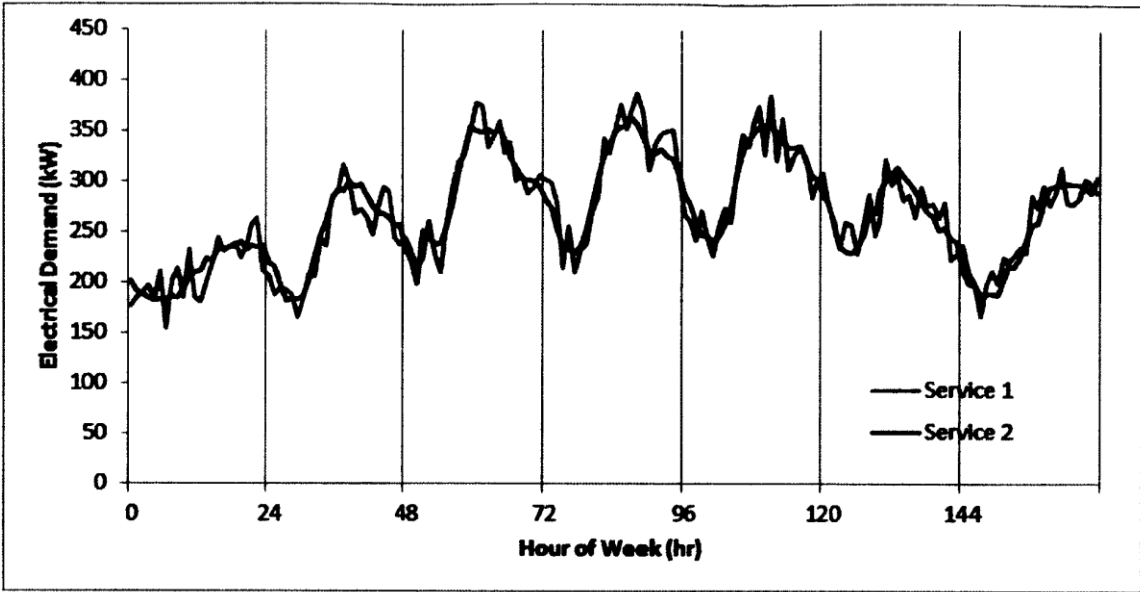


Figure A.9: Weekly Electrical Demand for September

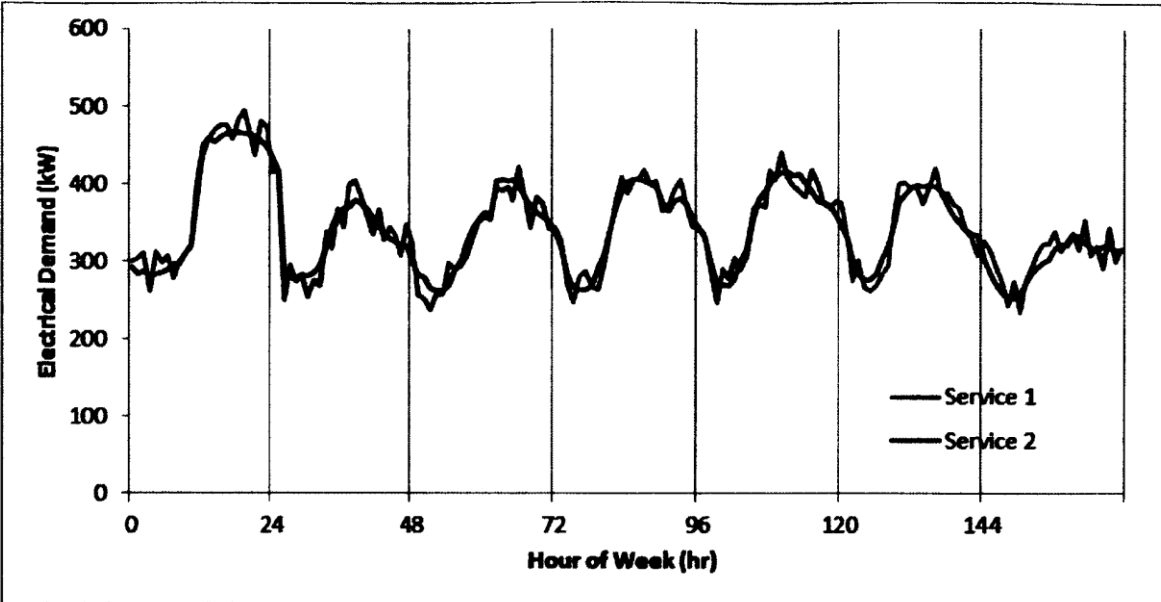


Figure A.10: Weekly Electrical Demand for October

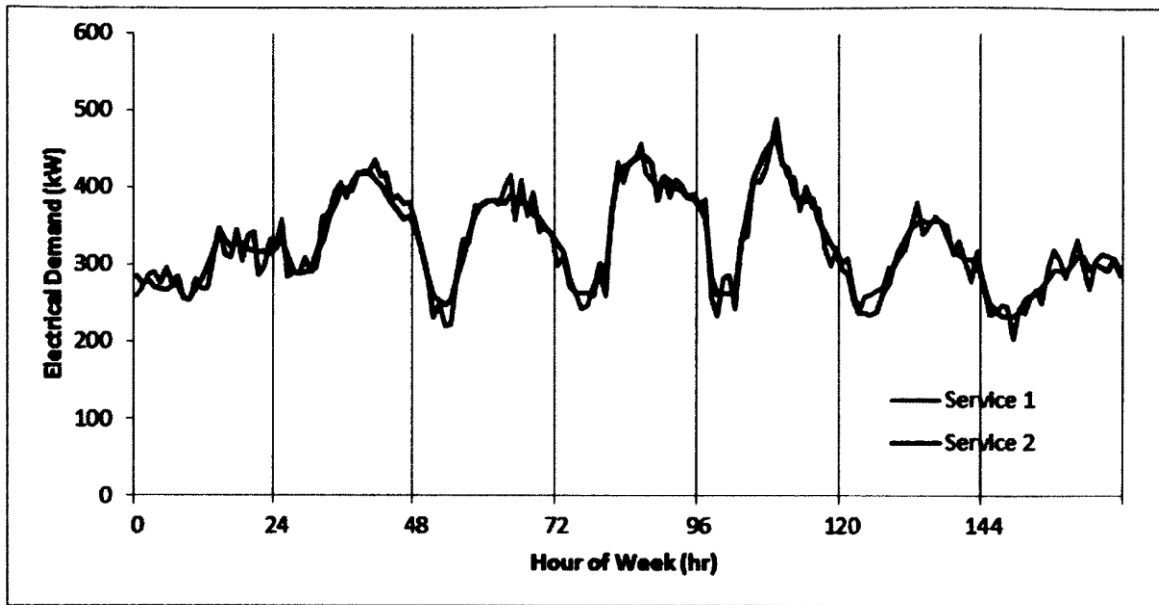


Figure A.11: Weekly Electrical Demand for November

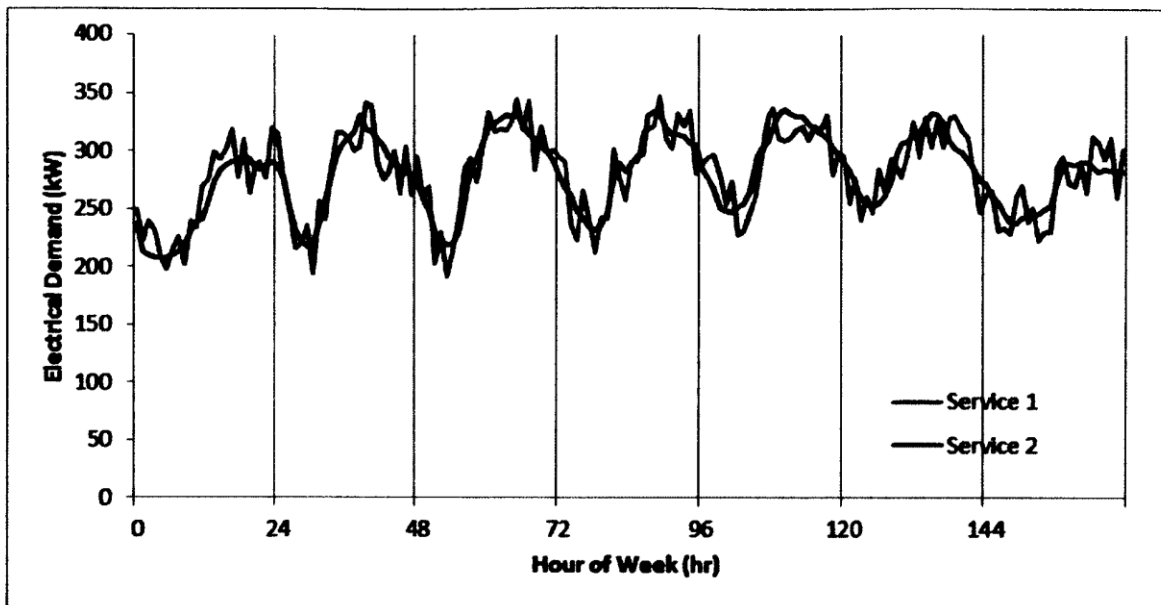


Figure A.12: Weekly Electrical Demand for December

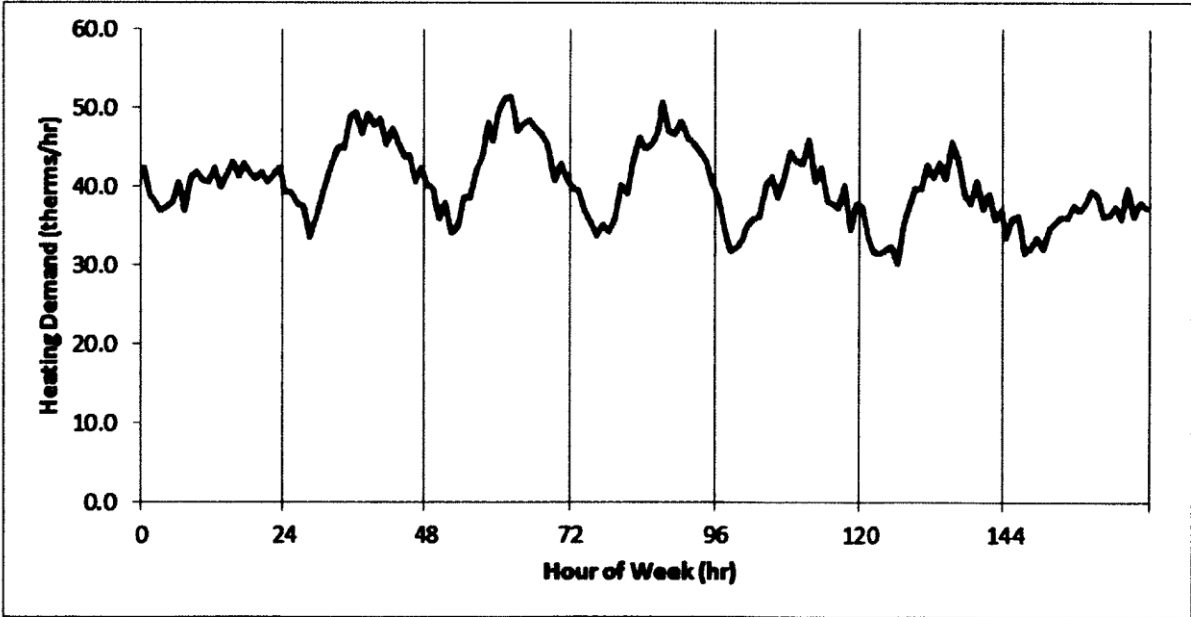


Figure A.13: Weekly Heat Demand for January

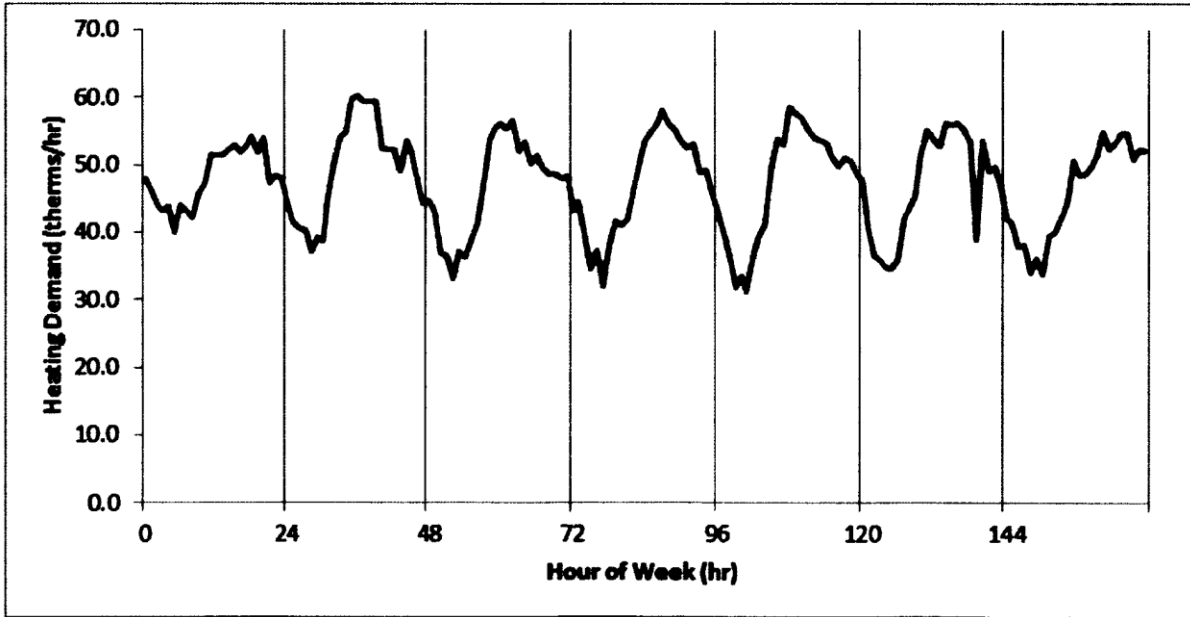


Figure A.14: Weekly Heat Demand for February

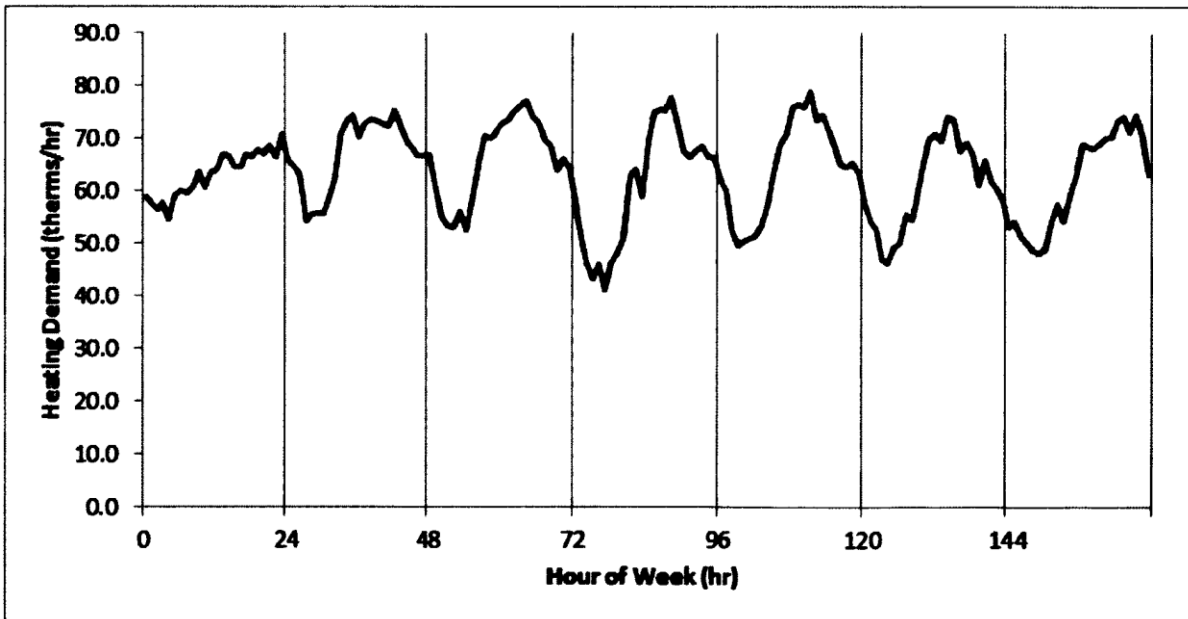


Figure A.15: Weekly Heat Demand for March

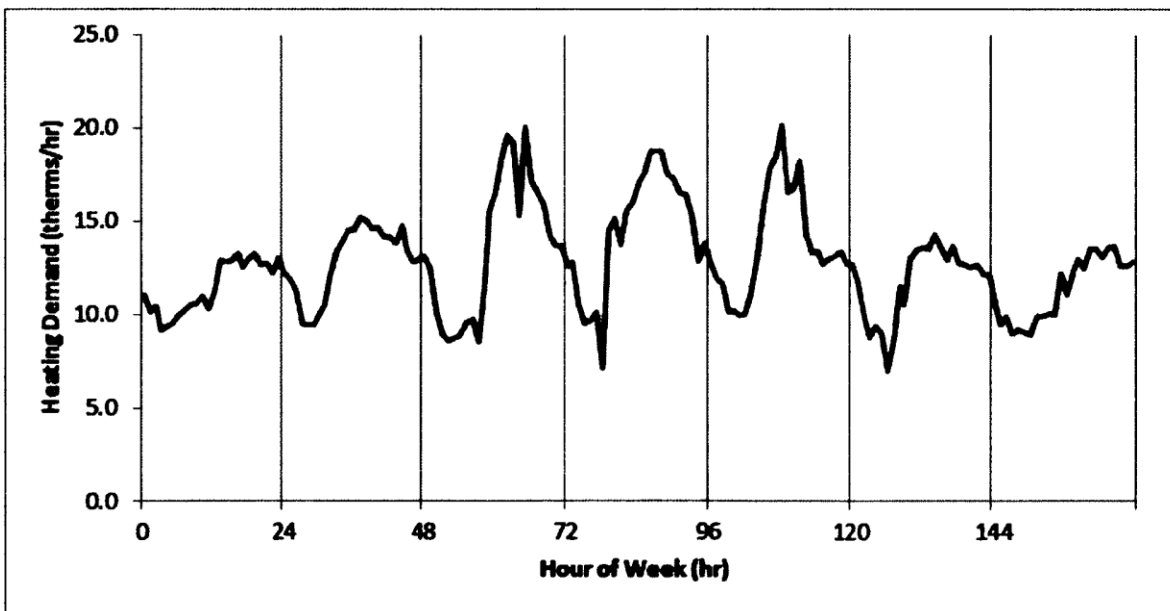


Figure A.16: Weekly Heat Demand for April

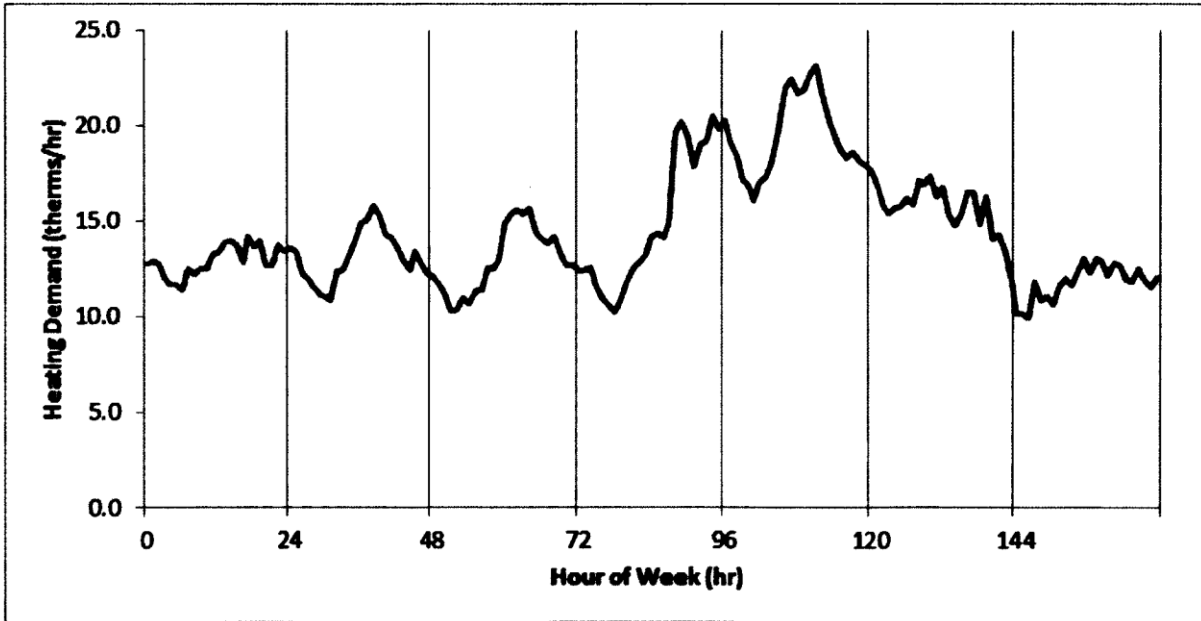


Figure A.17: Weekly Heat Demand for May

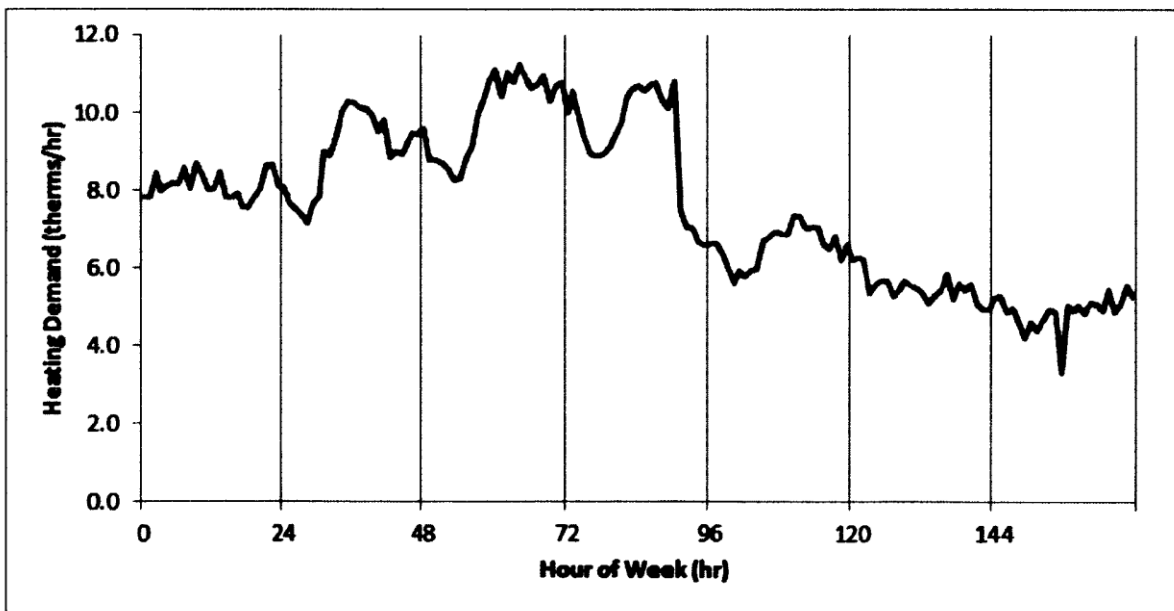


Figure A.18: Weekly Heat Demand for June

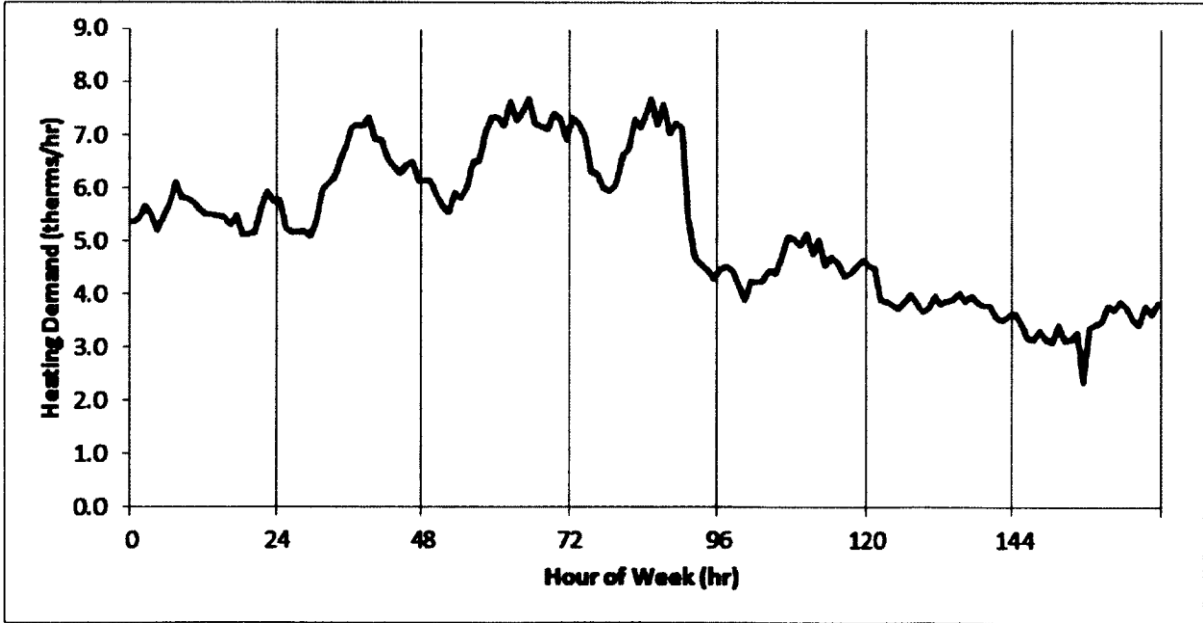


Figure A.19: Weekly Heat Demand for July

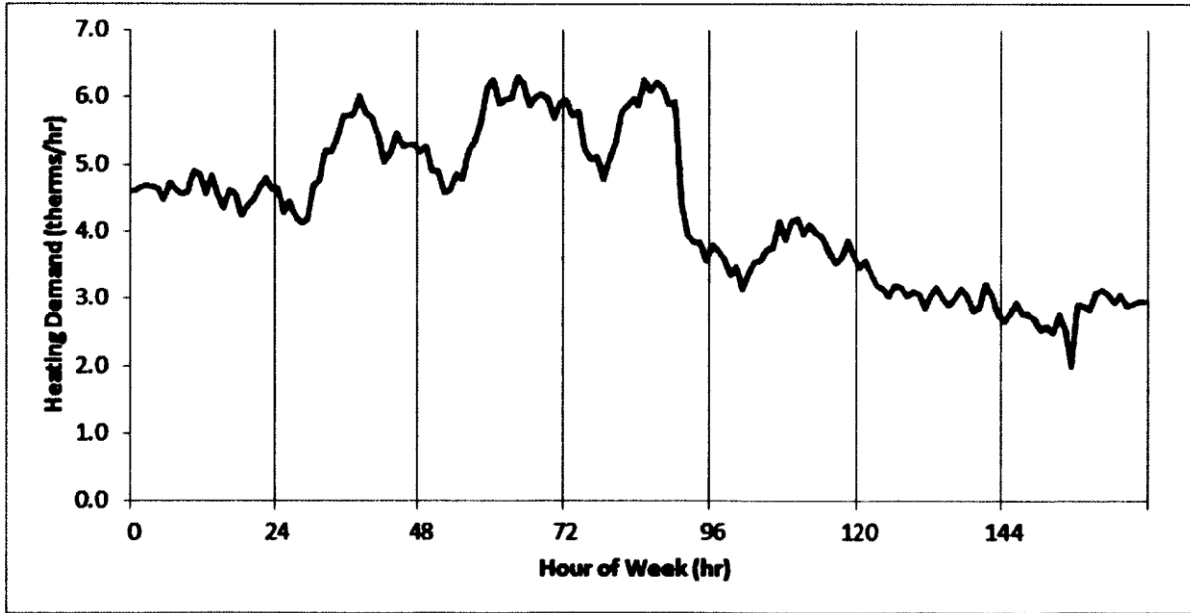


Figure A.20: Weekly Heat Demand for August



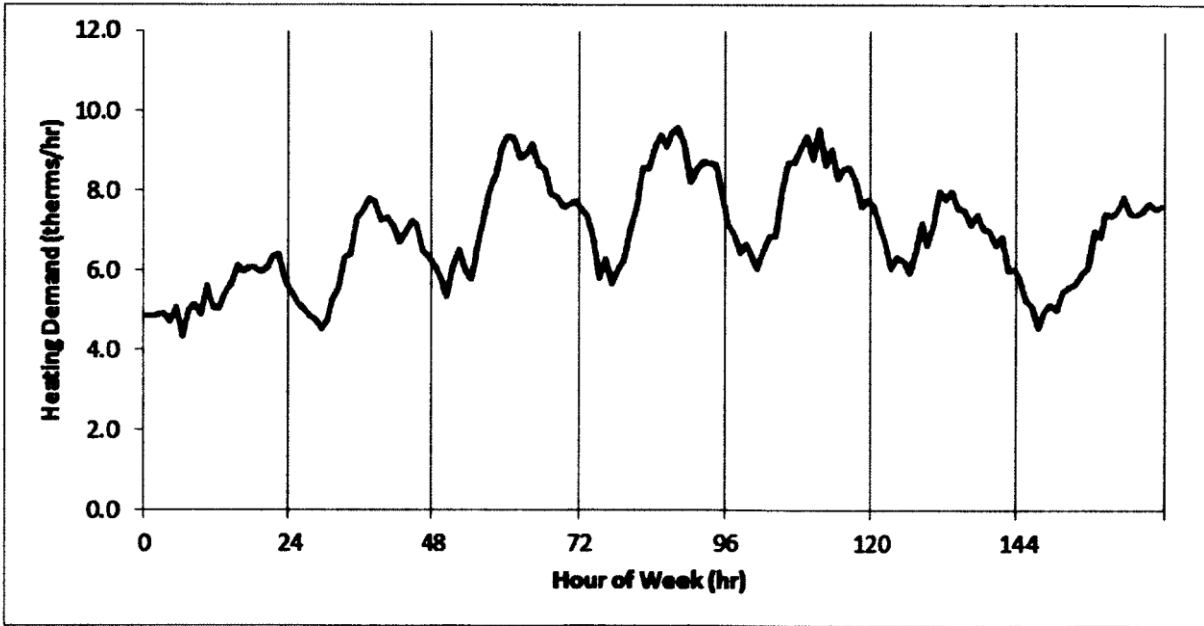


Figure A.21: Weekly Heat Demand for September

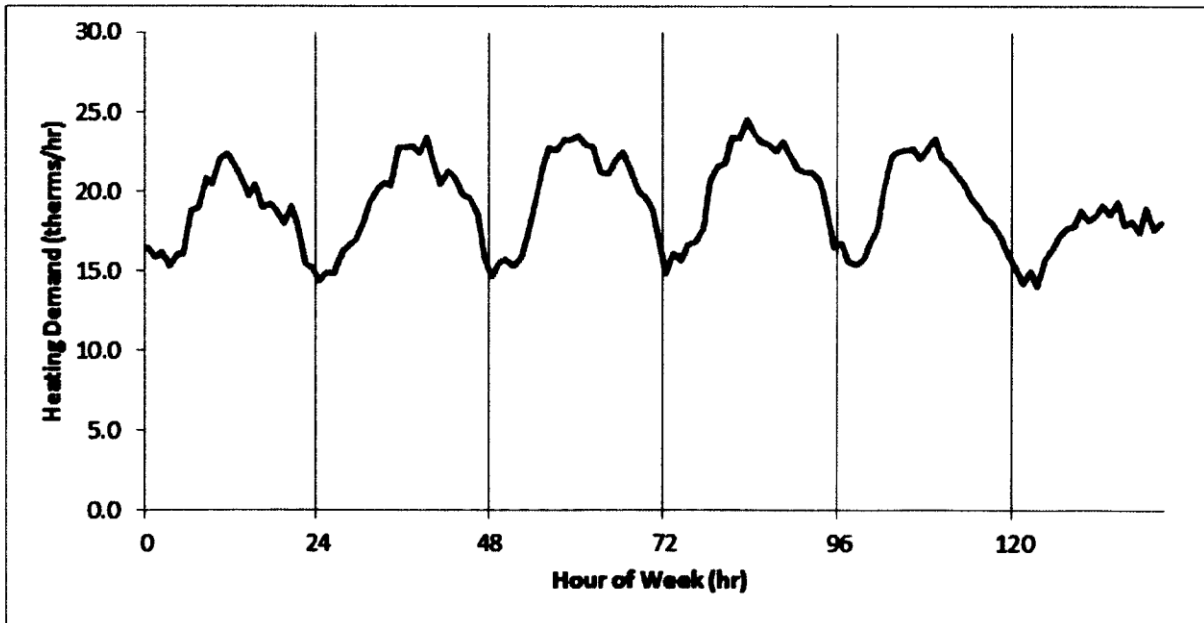


Figure A.22: Weekly Heat Demand for October

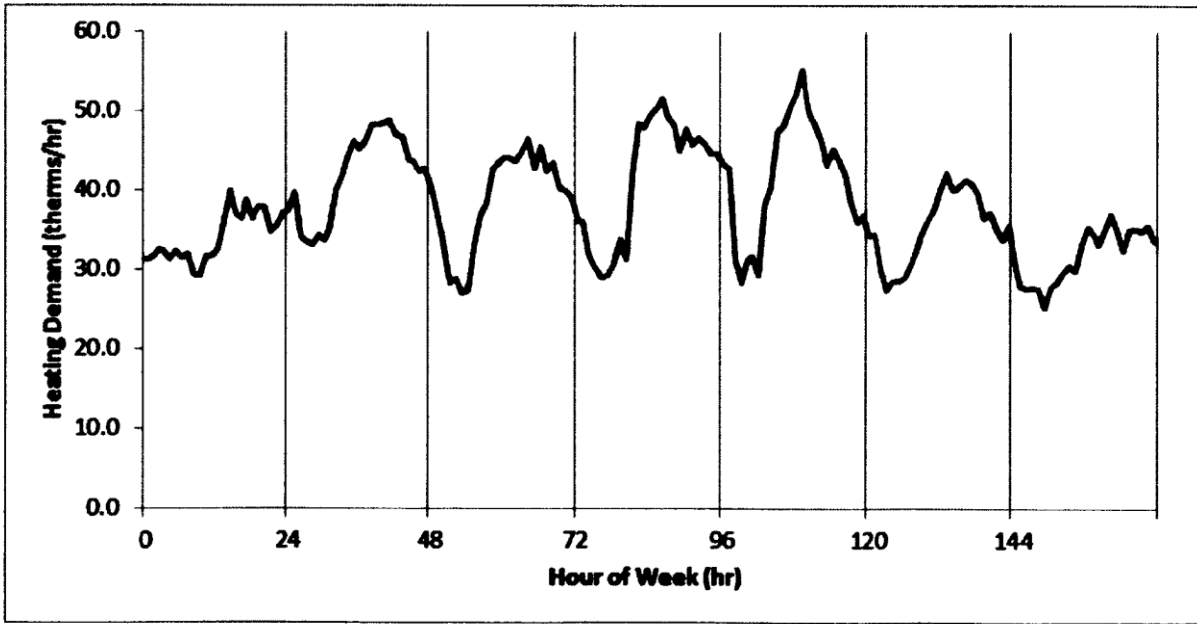


Figure A.23: Weekly Heat Demand for November

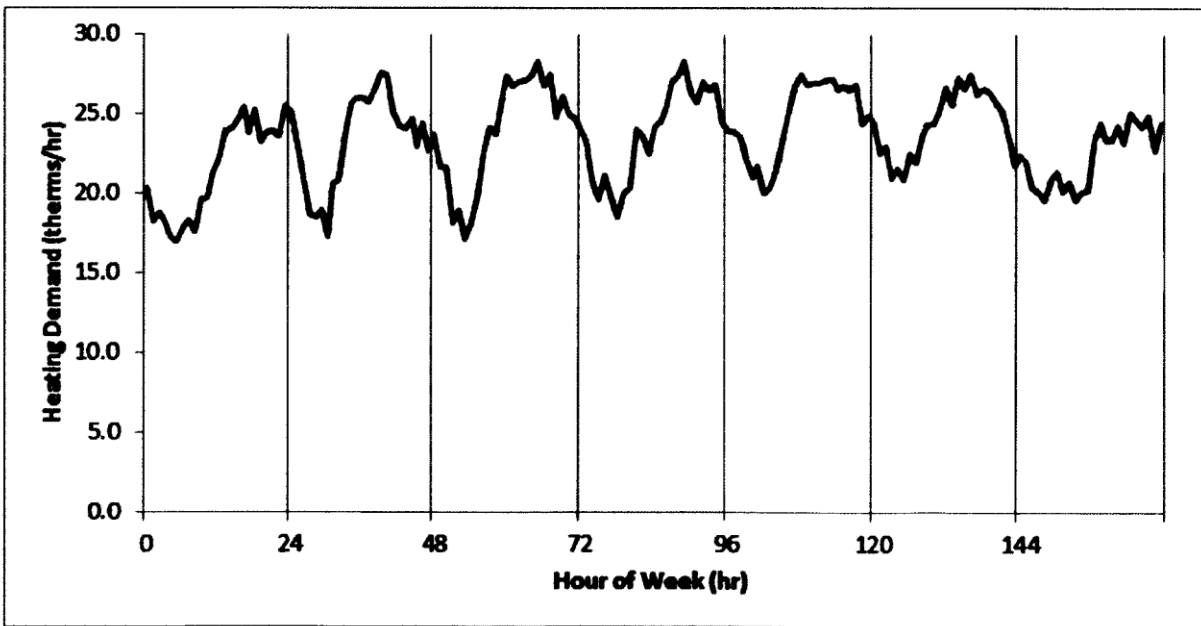
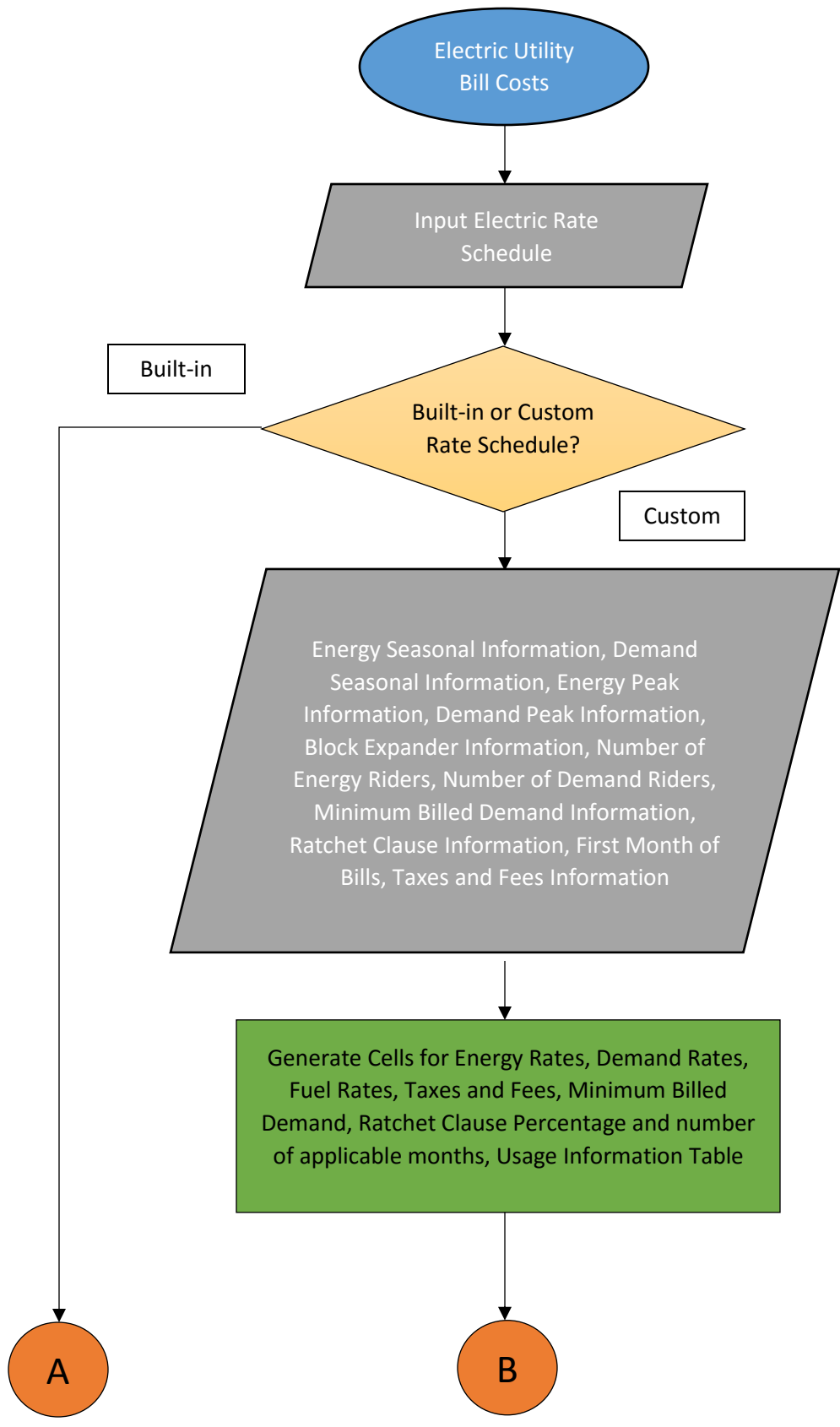
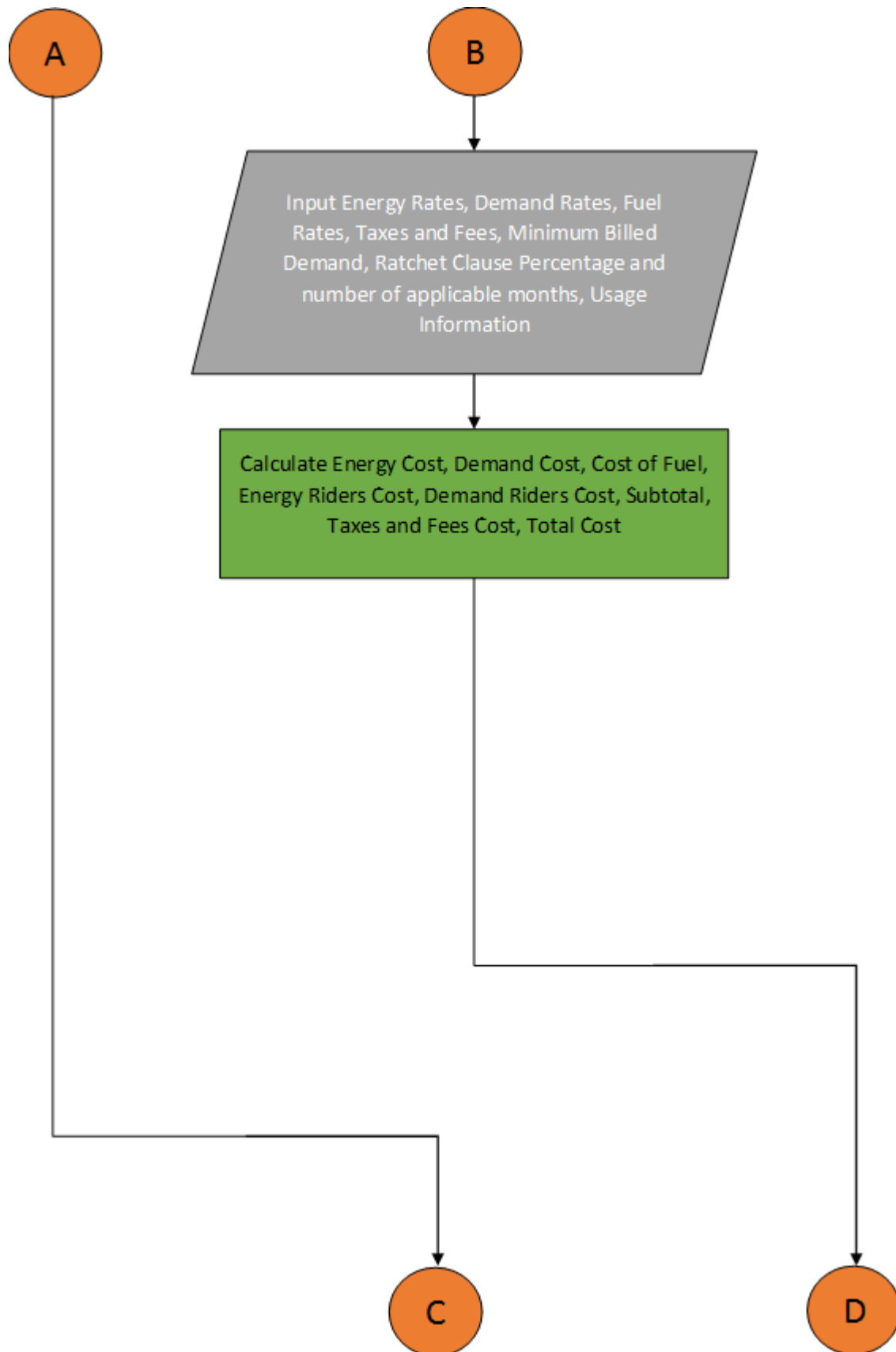
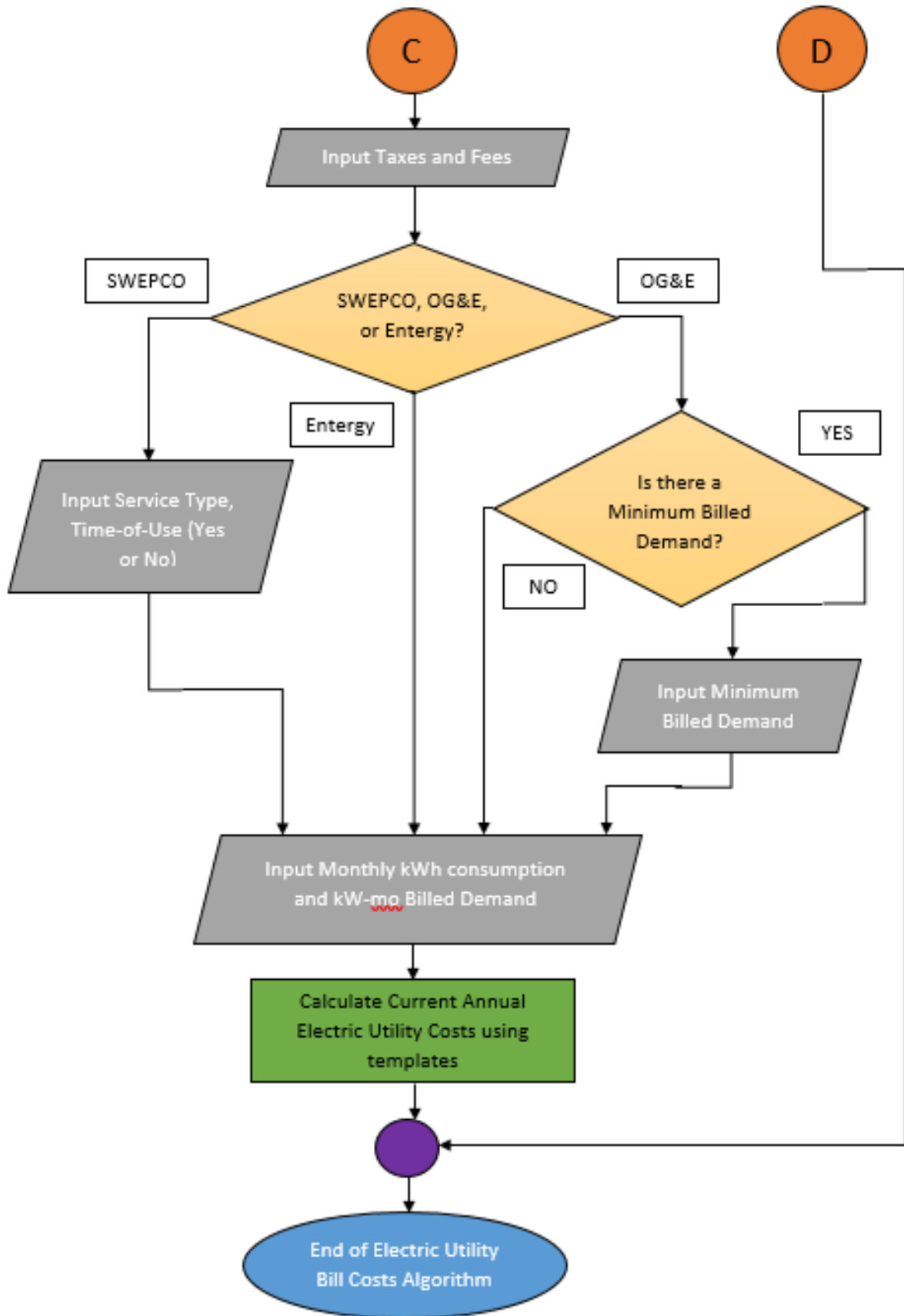


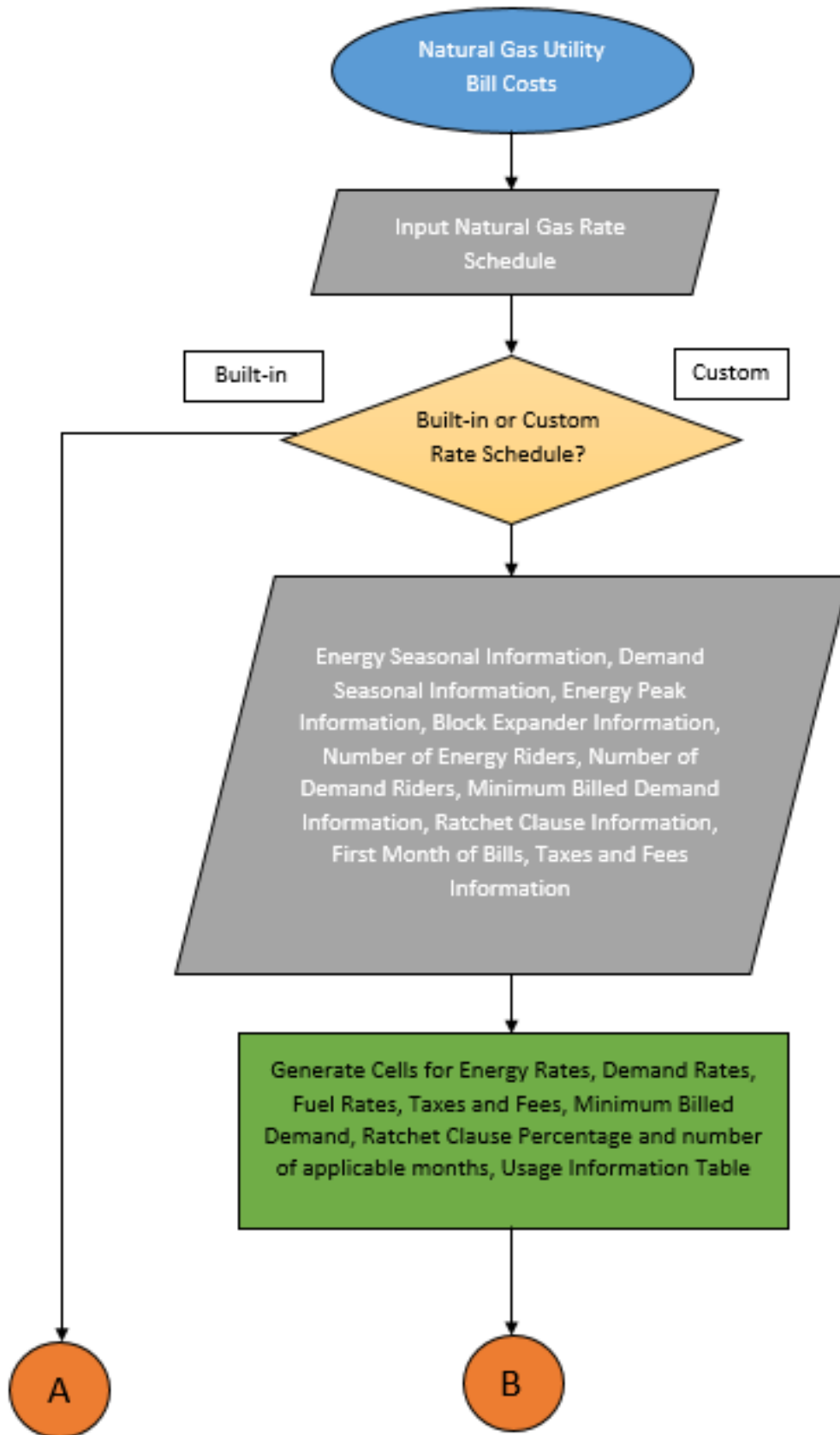
Figure A.24: Weekly Heat Demand for December

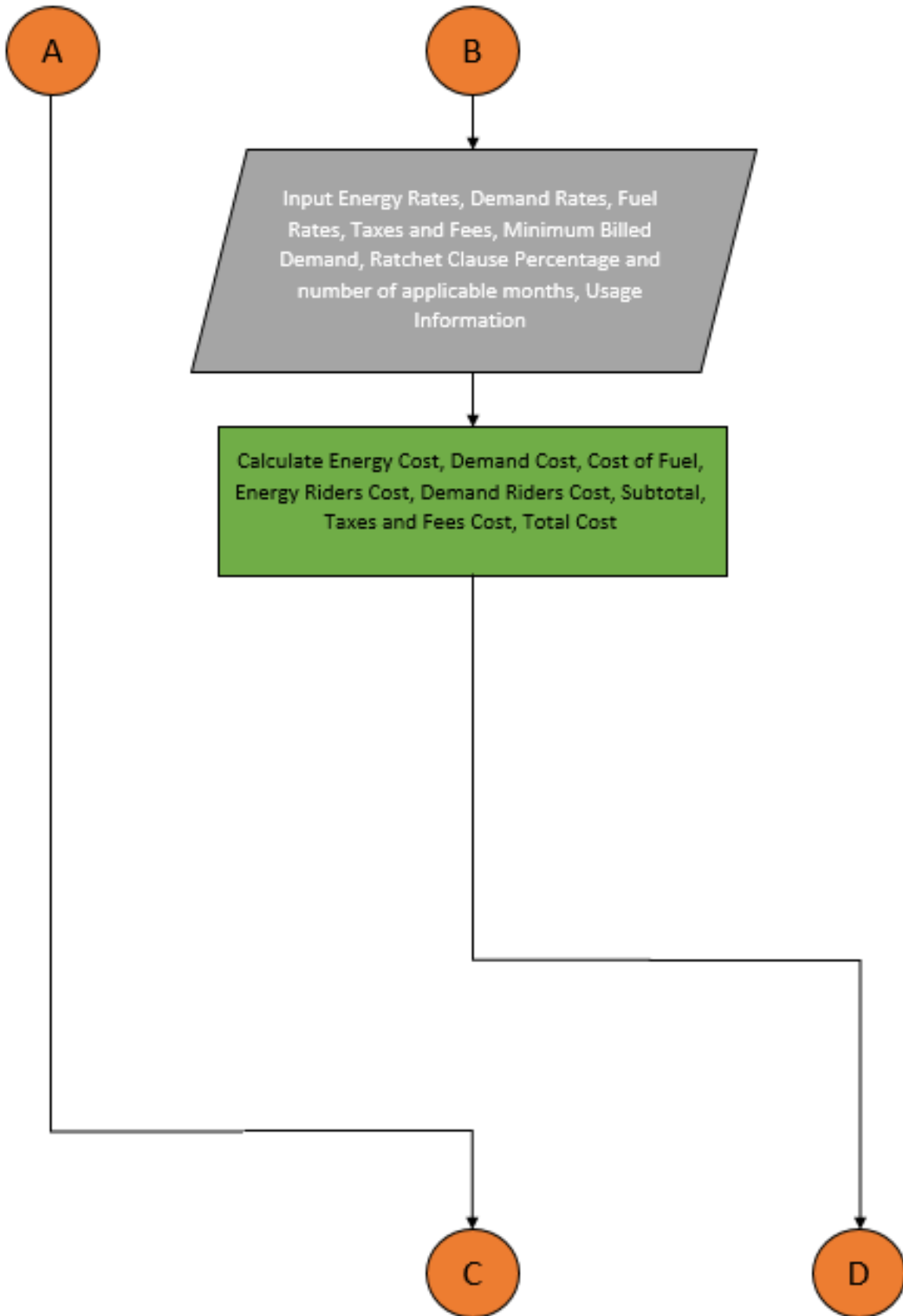
**Appendix B:**  
**Detailed Algorithm Flowcharts**



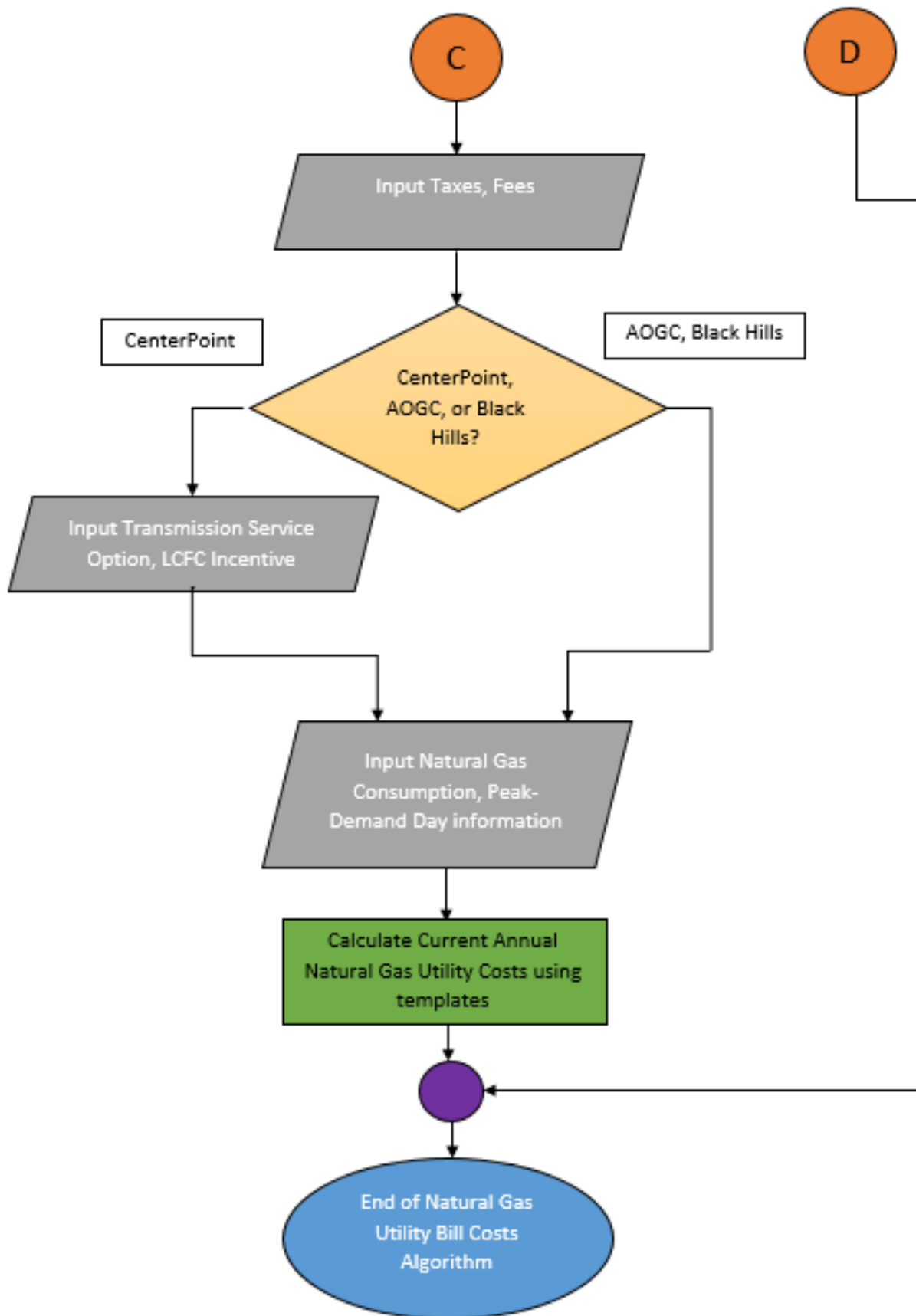


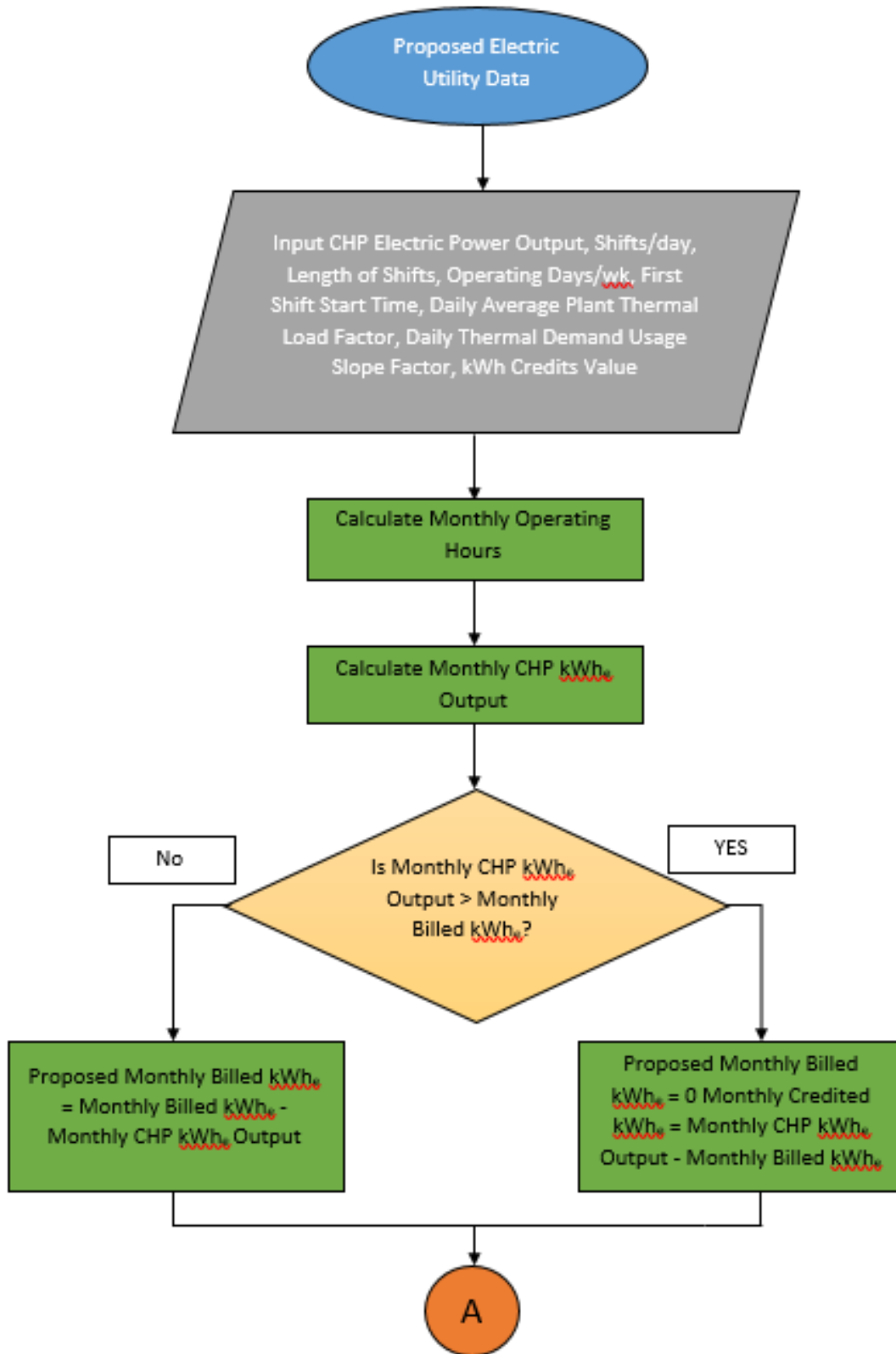


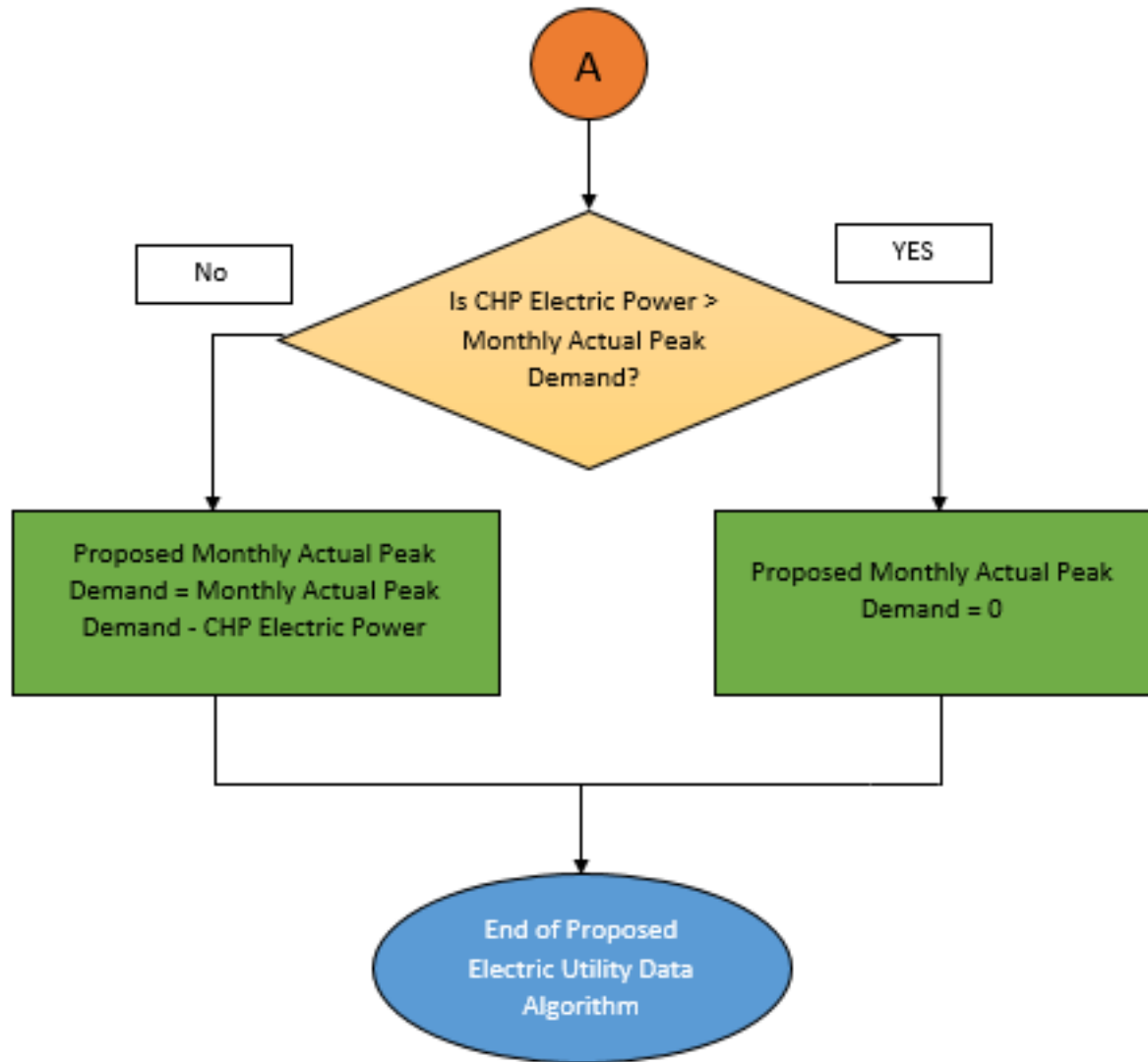


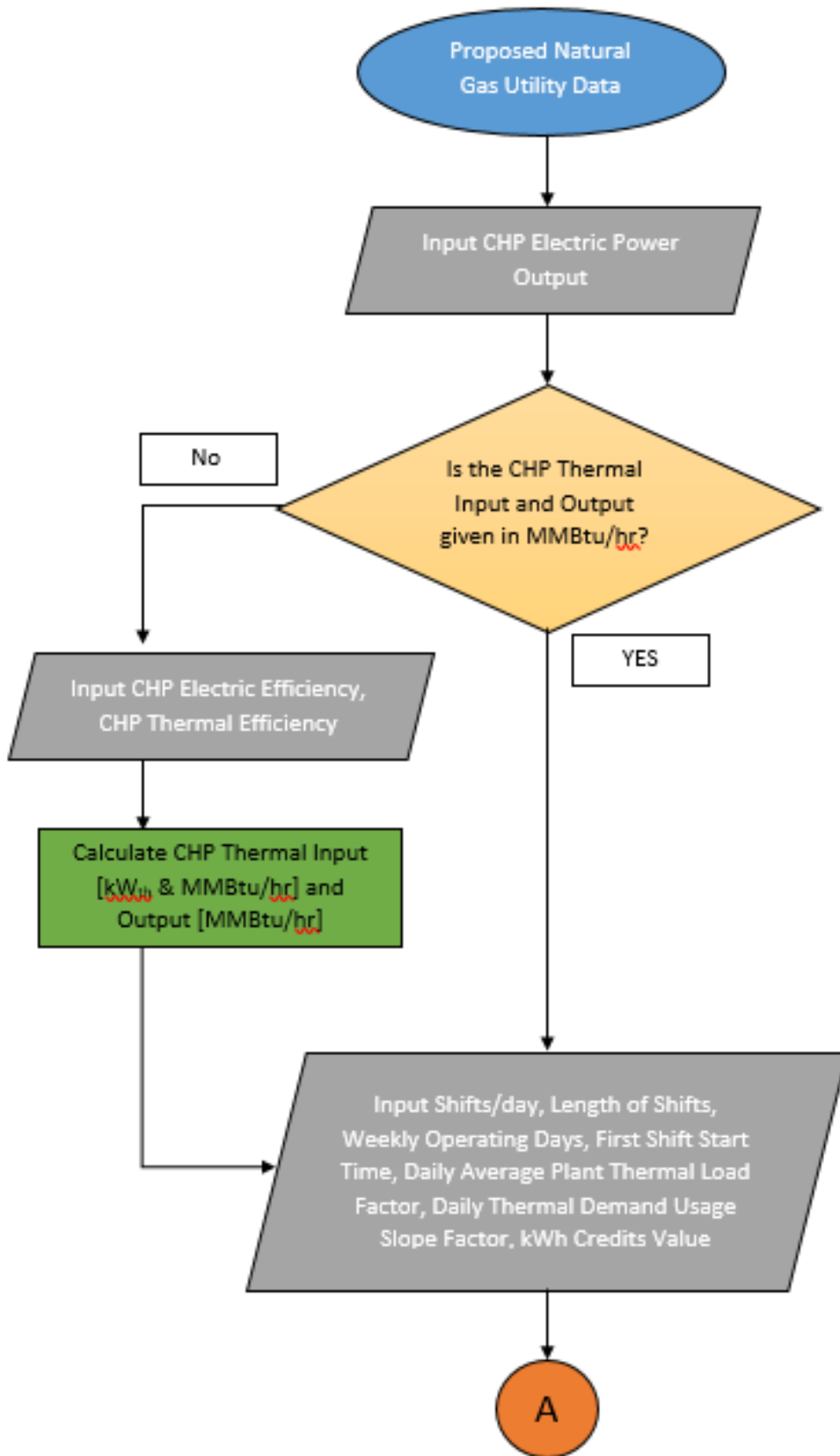


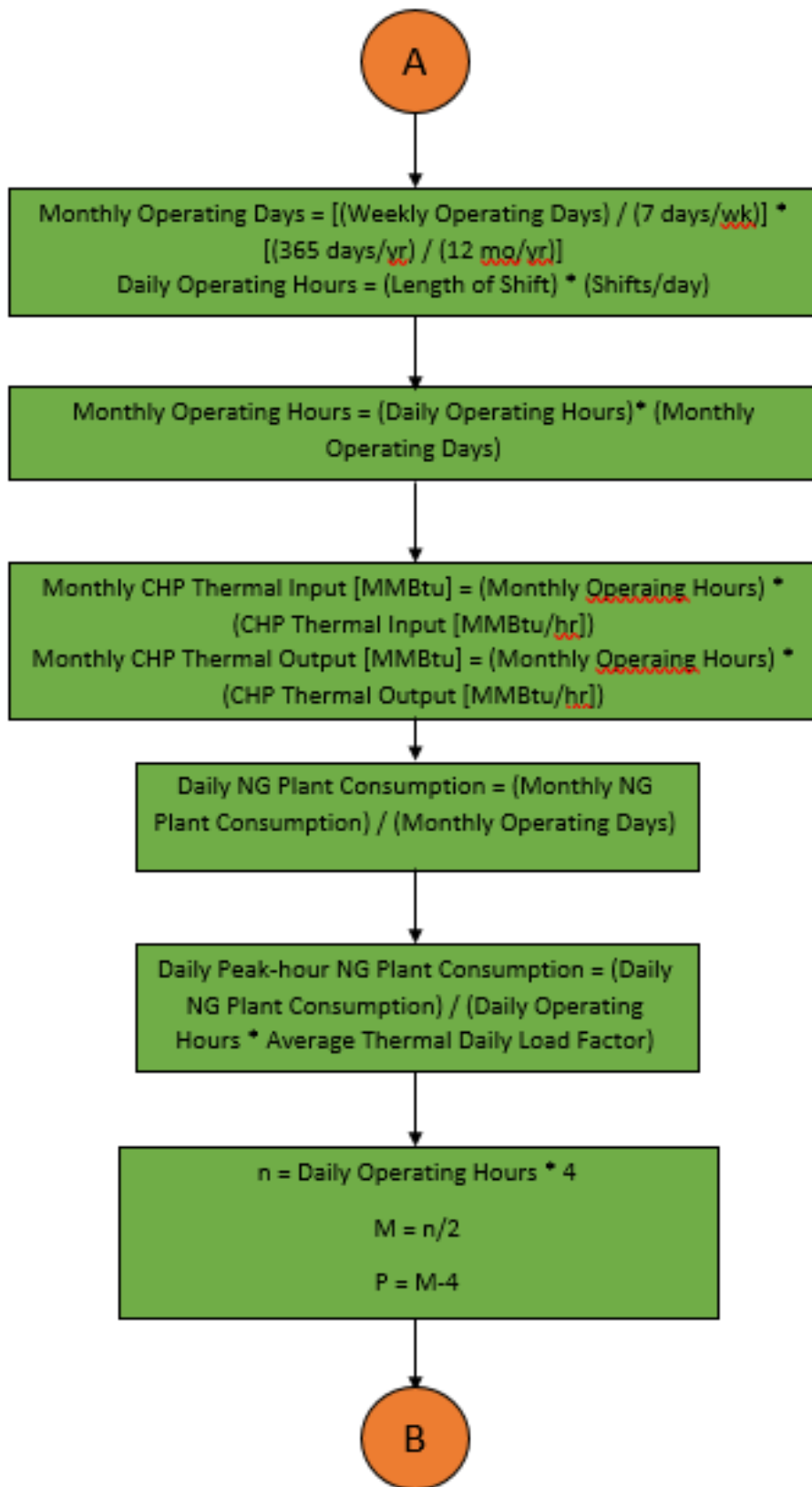


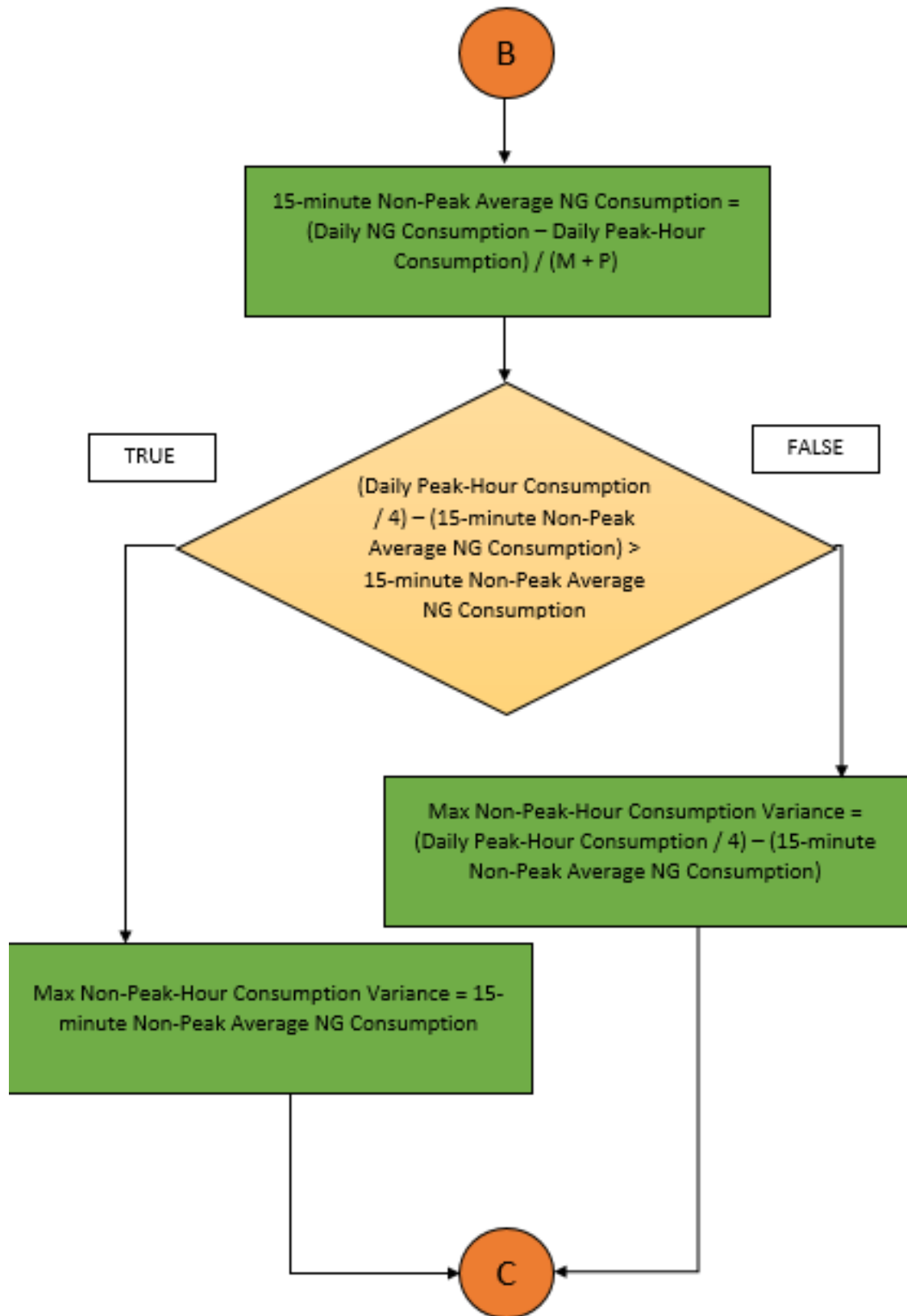


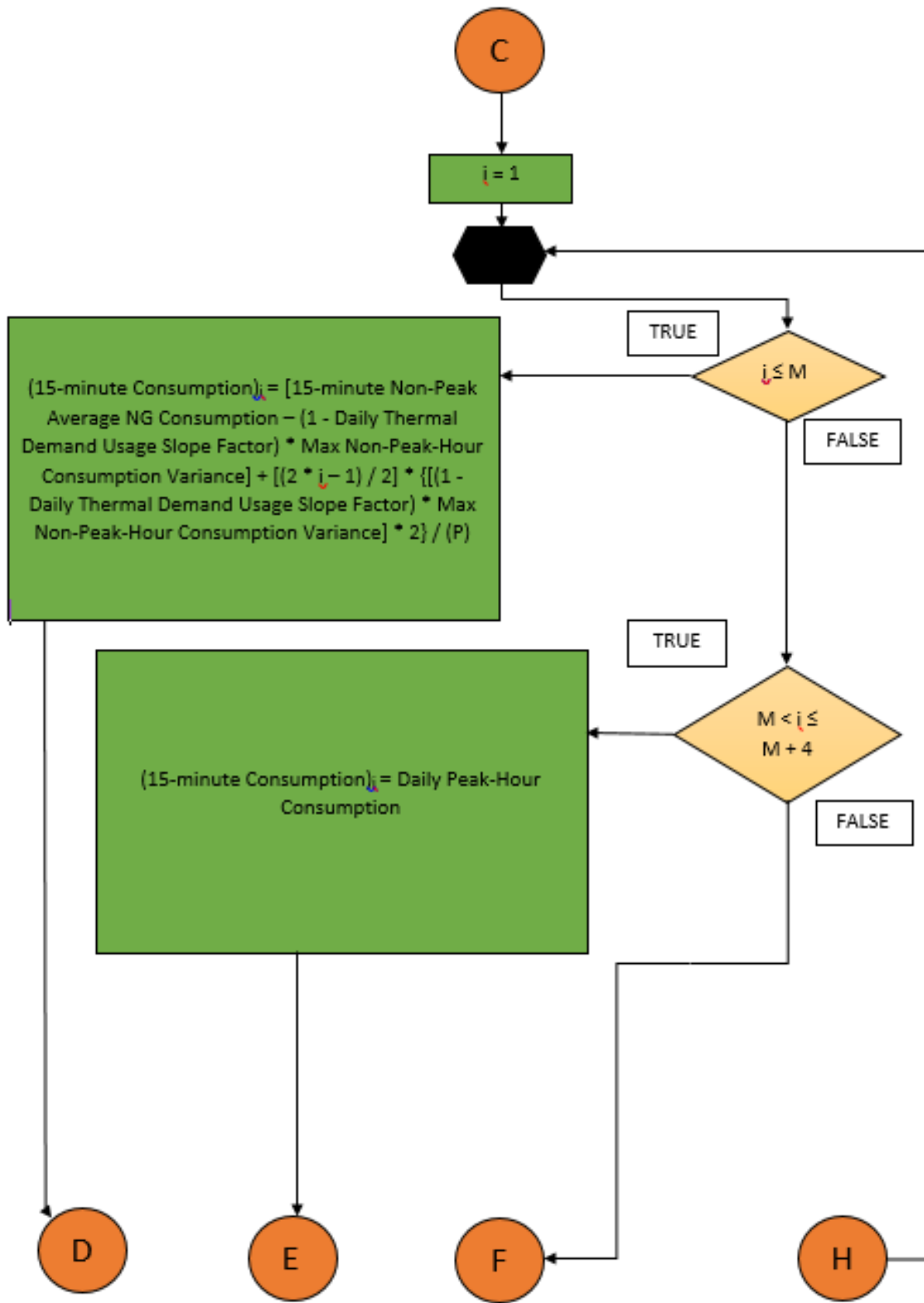


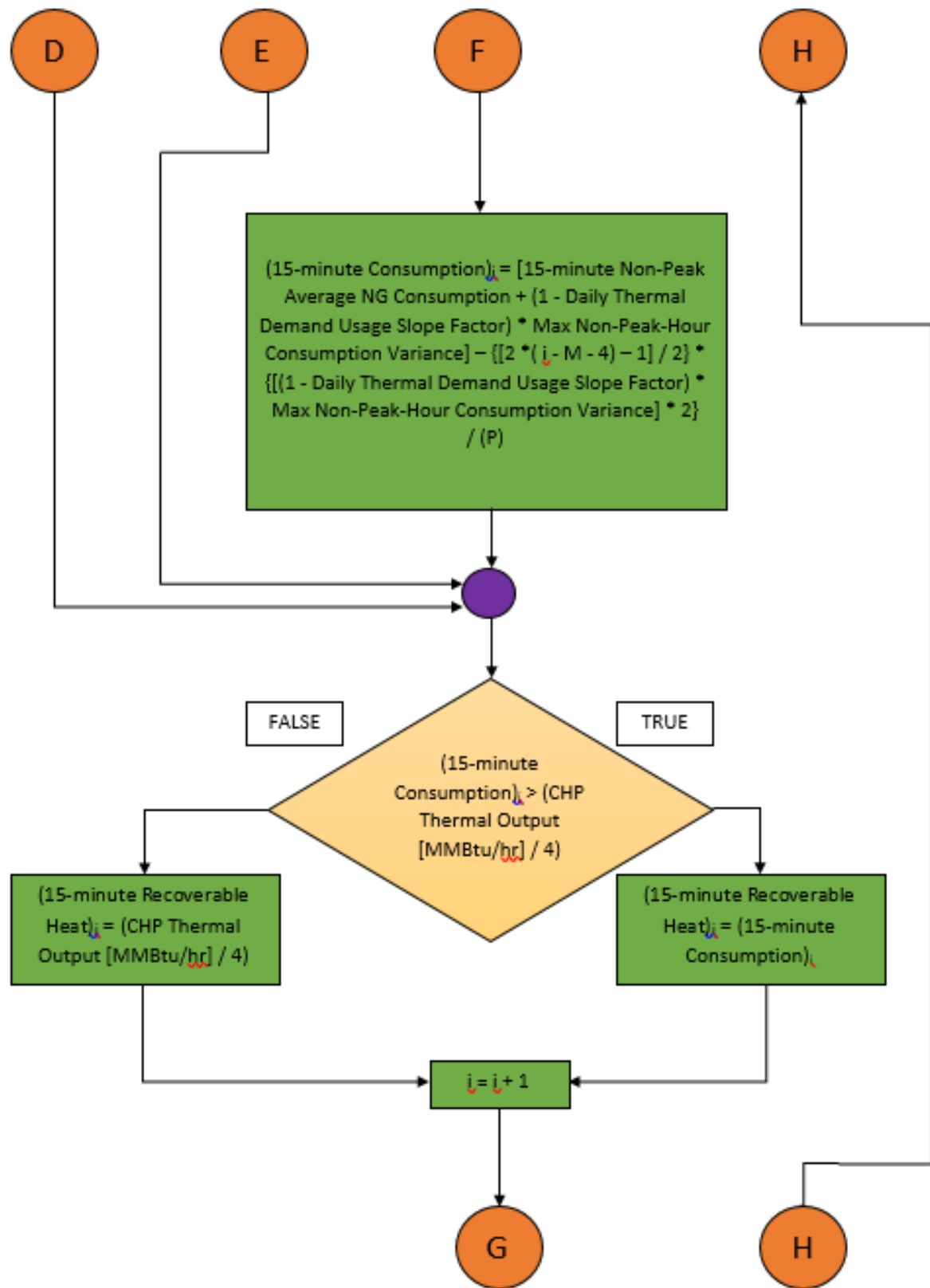




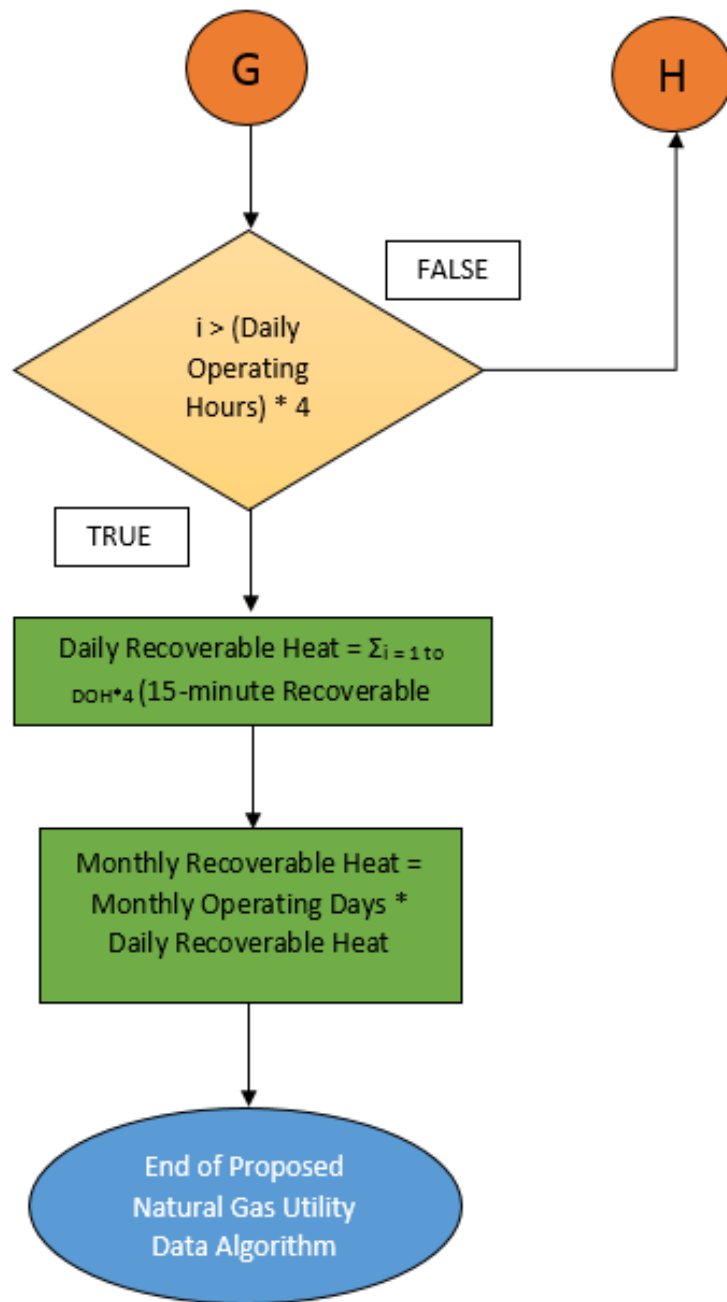


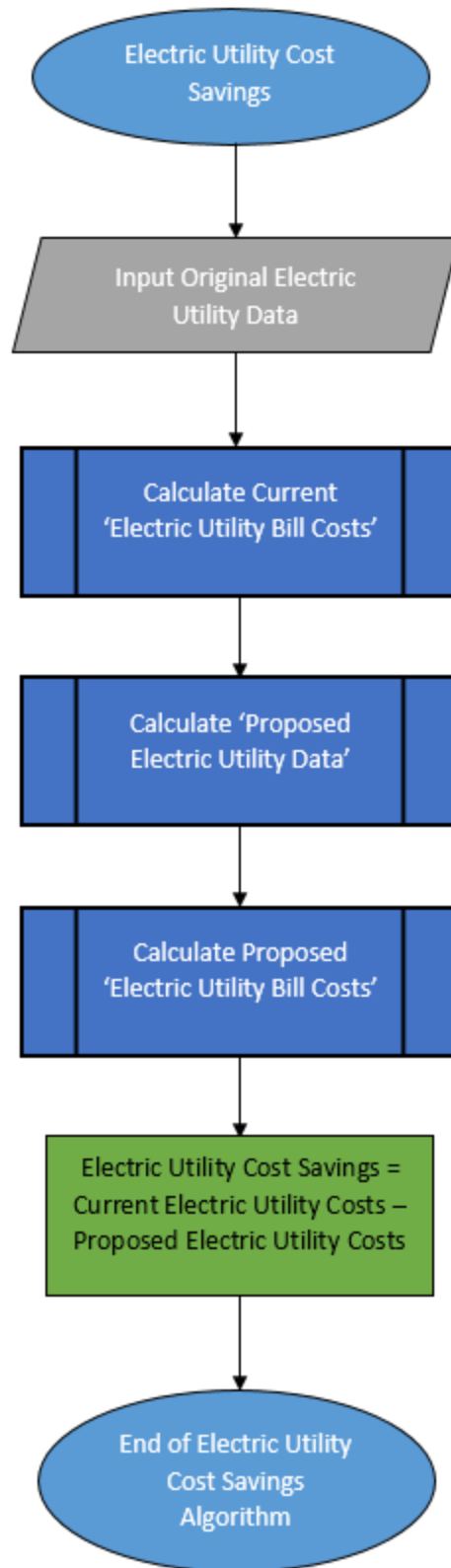


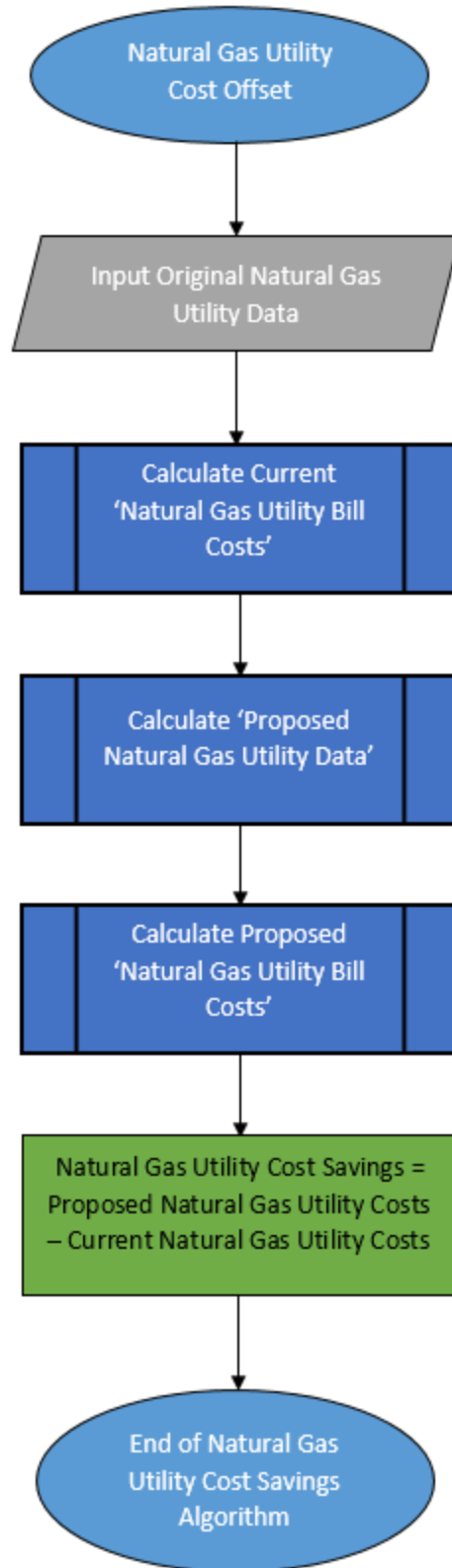


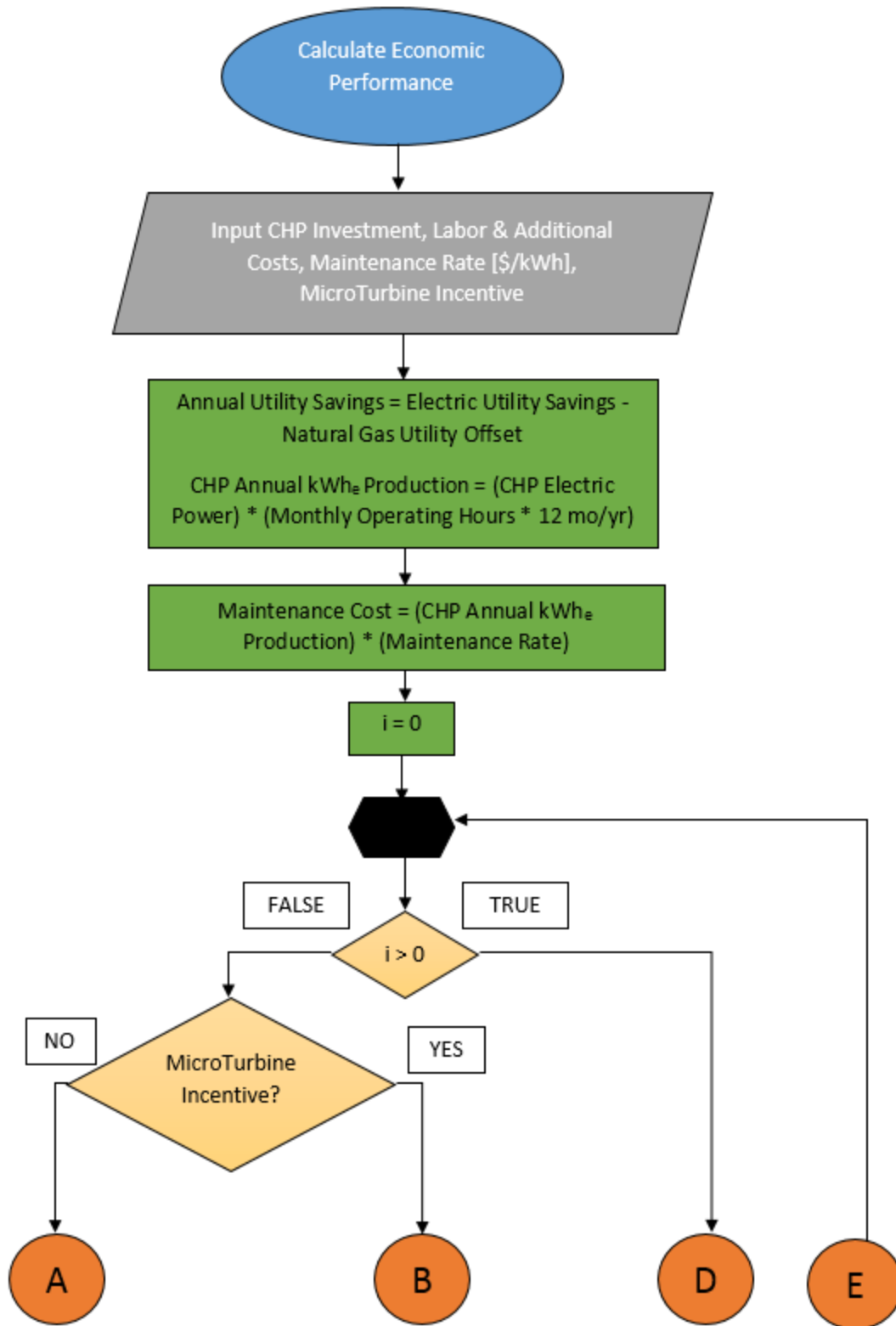


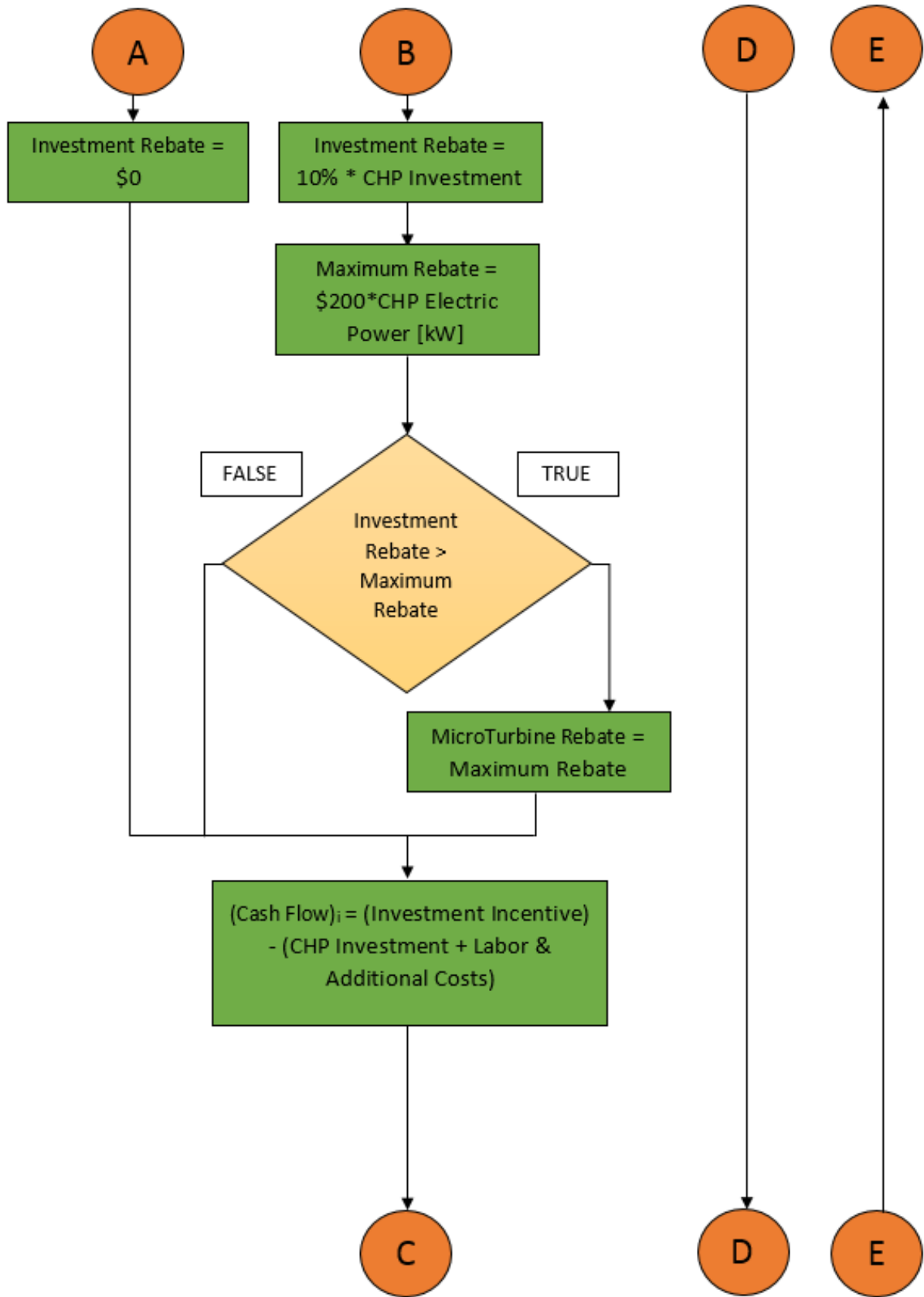


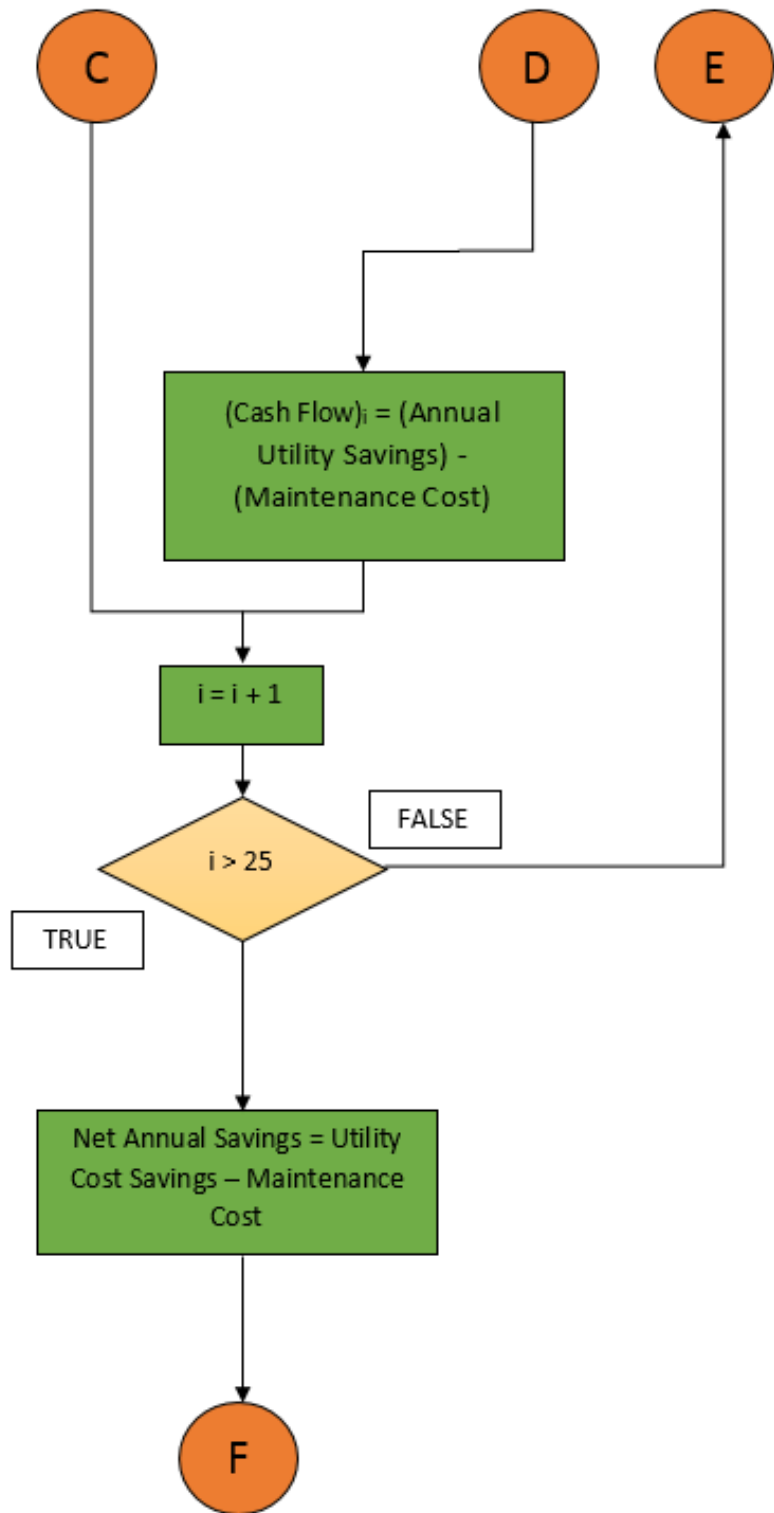


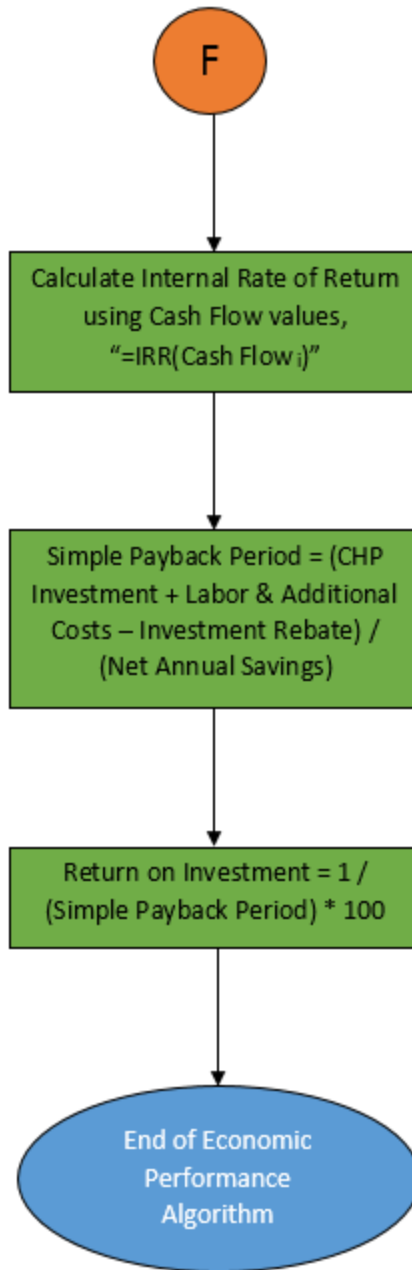












**Appendix C:**  
**VBA Algorithm Code**



## Select Electric Rate Schedule

Public Sub ElSelectNextButton\_Click()

CurrentPage = 0

If OptButtonCustomizeEl.Value = True Then

NextPage = CurrentPage + 1

Worksheets("Ground Zero").Range("Z1").Value = NextPage

MultiPage1.Value = NextPage

Else:

If (CityTaxTB = Empty Or CityTaxTB = "N/A") Then

CityTaxTB = 0

End If

If (CountyTaxTB = Empty Or CountyTaxTB = "N/A") Then

CountyTaxTB = 0

End If

If (StateTaxTB = Empty Or StateTaxTB = "N/A") Then

StateTaxTB = 0

End If

If (MFATB = Empty Or MFATaxTB = "N/A") Then

MFATB = 0

End If

If (IBRATB = Empty Or IBRATB = "N/A") Then

IBRATB = 0

End If

With Sheet1

'Assign Tax values etc. from userform to Entergy Rate Schedule Sheet'

.Range("M4").Value = CityTaxTB / 100

.Range("M5").Value = CountyTaxTB / 100

.Range("M6").Value = StateTaxTB / 100

.Range("M9").Value = MFATB / 100

If IBRATB <> "N/A" Then

.Range("M7").Value = IBRATB / 100

End If

End With

With Sheet3

'Assign Tax values etc. from userform to OG&E Rate Schedule Sheet'

.Range("N11").Value = CityTaxTB / 100

.Range("N12").Value = CountyTaxTB / 100

.Range("N13").Value = StateTaxTB / 100

.Range("N16").Value = MFATB / 100

.Range("E3").Value = ServiceLevelCB

.Range("I20").Value = MinBillTB

If (MinBillTB <> 0 And MinBillTB <> "N/A") Then

.Range("E4").Value = "YES"

Else: .Range("E4").Value = "NO"

End If

End With

With Sheet2

'Assign Tax values etc. from userform to SWEPCO Rate Schedule Sheet'

.Range("I7").Value = CityTaxTB / 100

.Range("I8").Value = CountyTaxTB / 100

.Range("I9").Value = StateTaxTB / 100

.Range("I12").Value = MFATB / 100

.Range("C5").Value = ServiceTypeCB

.Range("E5").Value = TOUCB

End With

'FORMATTING TIMEEEE'

'If statement counts the number of usage columns'

'Usage columns will have commas & no decimal place'

'Cost columns will be currency format with 2 decimal places'

```
If (OptButtonLGS.Value = True Or OptButtonLPS.Value = True Or _  
    OptButtonPL1.Value = True Or OptButtonLP.Value = True Or _  
    OptButtonLLP.Value = True) Then  
    UsageCol = 2
```

End If

```
If (OptButtonGST.Value = True Or OptButtonPST.Value = True Or _  
    OptButtonPLTOUD.Value = True Or OptButtonPLTOUE.Value = True Or _  
    OptButtonLPT.Value = True) Then  
    UsageCol = 4
```

End If

With Worksheets("Ground Zero")

For j = 0 To 12

For i = 0 To UsageCol - 1

.Cells(4 + j, 4 + i).NumberFormat = "#,###"

If j <> 12 Then

.Cells(4 + j, 4 + i).Interior.Color = 15986394

End If

Next i

For i = UsageCol To UsageCol + 4

.Cells(4 + j, 4 + i).NumberFormat = "\$#,###.00"

Next i

Next j

End With

'Go To Next Page'

NextPage = CurrentPage + 2

Worksheets("Ground Zero").Range("Z1").Value = NextPage

MultiPage1.Value = NextPage

End If

End Sub

## Calculate Electric Utility Cost

Private Sub ElCost\_Click()

Dim UsageCol As Integer

Dim Sum As Single

If Worksheets("Ground Zero").Range("B1").Value = "Large General Service (LGS)" Then

    Worksheets("Ground Zero").Range("F2:L16").Value =

Worksheets("Entergy").Range("F36:L50").Value

    UsageCol = 2

ElseIf Worksheets("Ground Zero").Range("B1").Value = "Large General Service - Time-Of-Use (GST)" Then

    Worksheets("Ground Zero").Range("H2:L16").Value =

Worksheets("Entergy").Range("H54:L68").Value

    UsageCol = 4

ElseIf Worksheets("Ground Zero").Range("B1").Value = "Large Power Service (LPS)" Then

    Worksheets("Ground Zero").Range("F2:L16").Value =

Worksheets("Entergy").Range("F72:L86").Value

    UsageCol = 2

ElseIf Worksheets("Ground Zero").Range("B1").Value = "Large Power Service - Time-Of-Use (PST)" Then

    Worksheets("Ground Zero").Range("H2:L16").Value =

Worksheets("Entergy").Range("H90:L104").Value

    UsageCol = 4

ElseIf Worksheets("Ground Zero").Range("B1").Value = "Lighting & Power (PL-1)" Then

Worksheets("Ground Zero").Range("F2:L16").Value =

Worksheets("OG&E").Range("F31:L45").Value

UsageCol = 2

ElseIf Worksheets("Ground Zero").Range("B1").Value = "Lighting & Power Time-of-Use  
Demand (PL-TOU-D)" Then

Worksheets("Ground Zero").Range("H2:L16").Value =

Worksheets("OG&E").Range("H51:L65").Value

UsageCol = 4

ElseIf Worksheets("Ground Zero").Range("B1").Value = "Lighting & Power Time-of-Use  
Energy (PL-TOU-E)" Then

Worksheets("Ground Zero").Range("H2:L16").Value =

Worksheets("OG&E").Range("H71:L85").Value

UsageCol = 4

ElseIf Worksheets("Ground Zero").Range("B1").Value = "Lighting & Power" Then

Worksheets("Ground Zero").Range("F2:L16").Value =

Worksheets("SWEPCO").Range("F35:L49").Value

UsageCol = 2

ElseIf Worksheets("Ground Zero").Range("B1").Value = "Large Lighting & Power" Then

Worksheets("Ground Zero").Range("F2:L16").Value =

Worksheets("SWEPCO").Range("F54:L68").Value

UsageCol = 2

```
ElseIf Worksheets("Ground Zero").Range("B1").Value = "Lighting & Power - Time-of-Use"
```

```
Then
```

```
    Worksheets("Ground Zero").Range("H2:L16").Value =
```

```
Worksheets("SWEPCO").Range("H73:L87").Value
```

```
    UsageCol = 4
```

```
ElseIf Worksheets("Ground Zero").Range("B1").Value = "Customizable Electric" Then
```

```
    Worksheets("DIY El. Rates").Activate
```

```
    'UCount on DIY El. Rates page cell A172 is one less than the actual count'
```

```
    'I subtracted one to make it more usable for i = 0 to UCount, but it is less clear'
```

```
    UsageCol = Worksheets("DIY El. Rates").Range("A172").Value + 1
```

```
End If
```

```
For i = 0 To UsageCol - 1
```

```
    Sum = 0
```

```
    For j = 0 To 11
```

```
        Sum = Sum + Cells(4 + j, 4 + i).Value
```

```
        If Cells(3, 4 + i).Value = "kWh" Then
```

```
            Cells(3 + j, 4 + i).NumberFormat = "#,###"
```

```
        ElseIf Cells(3, 4 + i).Value = "kW-mo" Then
```

```
            Cells(3 + j, 4 + i).NumberFormat = "#,###.0"
```

```
        End If
```

```
    Next j
```

```
Cells(4 + 12, 4 + i).Value = Sum
```



```
Cells(4 + 12, 4 + i).NumberFormat = "#,###"
```

```
Next i
```

```
'FORMATTING TIMEEEE'
```

```
With Worksheets("Ground Zero")
```

```
For i = UsageCol To UsageCol + 4 - 1
```

```
For j = 0 To 11
```

```
.Cells(4 + j, 4 + i).Interior.Color = 15523812
```

```
Next j
```

```
Next i
```

```
End With
```

```
Range("B2:P17").HorizontalAlignment = xlCenter
```

```
Range("B2:P17").VerticalAlignment = xlCenter
```

```
Range("B1:C16").Font.FontStyle = "Bold"
```

```
Range("D2:P3").Font.FontStyle = "Bold"
```

```
Range("D16:L16").Font.FontStyle = "Bold"
```

```
Range("B1").Font.Underline = xlUnderlineStyleSingle
```

```
Worksheets("Ground Zero").Columns("C:Y").AutoFit
```

```
Range("B2:P17").Rows.AutoFit
```

End Sub

## **Create Customizable Electric Rate Schedule Table and Inputs Cells**

Public Sub CreateTable\_Click()

Worksheets("DIY El. Rates").Activate

Dim C As Integer

Dim R As Integer

Dim TC As Integer

Dim TR As Integer

Dim TTC As Integer

Dim TTR As Integer

Dim ExR As Integer

Dim UCount As Integer

Dim CCount As Integer

Dim Subcount As Integer

Dim Subcount1 As Integer

Dim Subcount2 As Integer

Dim Subcount3 As Integer

Dim Subcount4 As Integer

Dim Subcount5 As Integer

Dim Subcount6 As Integer

Dim Subcount7 As Integer

Dim Subcount8 As Integer

Dim Energy As Single

```

C = 5          ' Reference Cell Column
Cells(116, 1).Value = C
Worksheets("Ground Zero").Range("Z43").Value = C
R = 4          ' Reference Cell Row
Cells(118, 1).Value = R
Worksheets("Ground Zero").Range("Z45").Value = R
TC = 0         ' Column offset for the Usage Information Table.'
Cells(120, 1).Value = TC
Worksheets("Ground Zero").Range("Z47").Value = TC
TR = 23        ' Row offset for the Usage Information Table.'
Cells(122, 1).Value = TR
Worksheets("Ground Zero").Range("Z49").Value = TR
TTC = TC + 0   ' Column offset for the Costs Table
Cells(124, 1).Value = TTC
Worksheets("Ground Zero").Range("Z51").Value = TTC
TTR = TR + 18  ' Row offset for the Costs Table
Cells(126, 1).Value = TTR
Worksheets("Ground Zero").Range("Z53").Value = TTR
RS = 0         ' (Row Space) This is the spacing between rows for the table where the
               ' customers enter their their information regarding their rate schedule
               ' charges.'
ExR = 0        ' (Extra Row) This is the number of extra rows for the table where
               ' the customers enter their information regarding their rate schedule charges.'

```

UCount = 0           ' Ongoing tally for number of rows for the Usage Information Table.  
                      ' This ensures columns are created one cell over from the previous column.'

CCount = 1           ' Ongoing tally for number of rows for the Costs Table.

Subcount = 1

'BEGINNING OF PAGE FORMATTING' (CLEAR TRACES OF PAST USE)'

With Range("B1:Z100")

    .ClearContents

    .ClearFormats

End With

Range("A68").Value = Months

Range("A94").Value = SummerStart           ' First Summer Month

Range("A103").Value = SummerLength       ' Number of Summer Months

'Create Months Columns, Bold Summer Months (for double-checking),

MoNo = MonthNo(Months)

SumMo = MonthNo(SummerStart)

For j = 0 To 11

    M = MoNo + j

        If M > 12 Then

            M = M - 12

        End If

Cells(R + TR + 1 + j, C + TC - 1).Value = MonthName(M)

Cells(R + TTR + 1 + j, C + TTC - 1).Value = MonthName(M)

If (M >= SumMo And M < SumMo + SummerLength) Then

Cells(R + TR + 1 + j, C + TC - 1).Font.Bold = True

Cells(R + TTR + 1 + j, C + TTC - 1).Font.Bold = True

Else: Cells(R + TR + 1 + j, C + TC - 1).Font.Bold = False

Cells(R + TTR + 1 + j, C + TTC - 1).Font.Bold = False

End If

Next j

Range("A5").Value = EnergySeasons.Value ' Seasons YES or NO

Range("A165").Value = SimplePeak ' If there are no seasons, is there a peak? YES  
or NO'

Range("A33").Value = Block ' Block Expander YES or NO

Range("A38").Value = NumBlock ' Number of Blocks in Expander

Range("A145").Value = BlockBase ' Block Size: Fixed kWh amount or specific  
kWh per kW-mo of demand

Range("A10").Value = SumPeak.Value ' Summer peak YES or NO for Energy

Range("A15").Value = WintPeak.Value ' Winter peak YES or NO for Energy

' Months represents the first month of the 12 month billing year'

' SummerStart represents the first month of the summer months'

' SummerLength represents the number of summer months'

' M is the number of the month'

' S is the number of the summer month (first summer month is 1)'

Cells(R + ExR, C).Value = "Fuel Charge (\$)"

Cells(R + ExR + 1, C).NumberFormat = "\$0.00#####"

ExR = ExR + 2

'ENERGY CHARGES; ON-PEAK/OFF-PEAK, SUMMER/WINTER, AND BLOCKS'

If EnergySeasons.Value = "No" Then                    ' There is either a simple \$/kWh charge or the  
first row is the block expander charges'

    If Block = "No" Then                    ' NO Seasons NO Block: The 1st line is just \$/kWh  
since there is NO block expander (or seasons)'

        If SimplePeak = "No" Then

            Cells(R + ExR, C).Value = "Cost per kWh (\$)"

            Cells(R + ExR + 1, C).NumberFormat = "\$0.00#####"

            Cells(R + TR - 1, C + TC).Value = "Total"

            Cells(R + TR, C + TC).Value = "kWh"

        For j = 1 To 12

```

Cells(R + TR + j, C + TC).Interior.Color = 15986394

Cells(R + TR + j, C + TC).NumberFormat = "#,###"

Next j

UCount = UCount + 1

Cells(132, 1).Value = 1

ElseIf SimplePeak = "Yes" Then

Cells(R + ExR, C).Value = "On-peak Cost per kWh ($)"

Cells(R + ExR + 1, C).NumberFormat = "$0.00#####"

Cells(R + TR - 1, C + TC).Value = "On-peak"

Cells(R + TR, C + TC).Value = "kWh"

UCount = UCount + 1

Cells(R + ExR, C + 1).Value = "Off-peak Cost per kWh ($)"

Cells(R + ExR + 1, C + 1).NumberFormat = "$0.00#####"

Cells(R + TR - 1, C + TC + 1).Value = "Off-peak"

Cells(R + TR, C + TC + 1).Value = "kWh"

For j = 1 To 12

    For i = 0 To 1

        Cells(R + TR + j, C + TC + i).Interior.Color = 15986394

        Cells(R + TR + j, C + TC + i).NumberFormat = "#,###"

    Next i

Next j

UCount = UCount + 1

Cells(132, 1).Value = 2

```



```

End If

ExR = ExR + 2          ' The first row is complete, so new input info. labels will
be two rows down'

Cells(133, 1).Value = 0

Cells(134, 1).Value = 0

ElseIf Block = "Yes" Then          ' NO Seasons YES Block: The 1st line will be Block
Expander, 2nd line is Block Sizes'

    For i = 1 To NumBlock - 1          ' For Loop to create correct
amount of blocks'

        Cells(R + ExR, C + i - 1).Value = "Block #" & i & " Cost per kWh ($)"

        Cells(R + ExR + 1, C + i - 1).NumberFormat = "$0.00#####"

    Next i

    Cells(R + ExR, C + NumBlock - 1).Value = "Remaining kWh Cost per kWh ($)"          ' Last
cell is "Remaining" Block'

    Cells(R + ExR + 1, C + NumBlock - 1).NumberFormat = "$0.00#####"

    Cells(R + TR - 1, C + TC).Value = "Total"

    Cells(R + TR, C + TC).Value = "kWh"

    For j = 1 To 12

        Cells(R + TR + j, C + TC).Interior.Color = 15986394

        Cells(R + TR + j, C + TC).NumberFormat = "#,###"

    Next j

```

```

UCount = UCount + 1                                ' UCount used for Usage table
column count'

ExR = ExR + 2

Cells(132, 1).Value = 0

Cells(133, 1).Value = NumBlock

Cells(134, 1).Value = NumBlock - 1

If SimplePeak.Value = "Yes" Then

    MsgBox "Peaks are not allowed with" & vbNewLine & "Block Expanders. Thank You."

End If

' 1st row complete. New input info will be 2 rows down.'

If BlockBase.Value = "Fixed (kWh)" Then                ' Next (2nd) line is
Block Sizes'

    For i = 1 To NumBlock.Value - 1                    ' For Loop to create
correct amount of block size cells'

        Cells(R + ExR, C + i - 1).Value = "Block " & i & " Size (kWh)"

        Cells(R + ExR + 1, C + i - 1).NumberFormat = "#,###"

    Next i

ElseIf BlockBase.Value = "Demand Based (kWh/kW-mo)" Then                '

If/ElseIf statement decides whether blocks sizes are based on strictly kWh or kWh/kW-mo'

    For i = 1 To NumBlock.Value - 1

        Cells(R + ExR, C + i - 1).Value = "Block " & i & " Size (kWh/kW-mo)"

```

```

Cells(R + ExR + 1, C + i - 1).NumberFormat = "#,###"

Next i

End If

Cells(R + ExR, C + NumBlock - 1).Value = "Remaining kWh"

Cells(R + ExR + 1, C + NumBlock - 1).Value = "(Different Each Month)"

ExR = ExR + 2

End If

' Both options for NO Seasons has been completed'

ElseIf EnergySeasons.Value = "Yes" Then

If Block = "Yes" Then

    UCount = 0

    If (SumPeak.Value = "Peak" Or WintPeak.Value = "Peak") Then

        MsgBox "Peaks are not allowed with" & vbNewLine & "Block Expanders. Thank You."

    End If

    Cells(R + ExR, C - 1).Value = "Summer: "

    For i = 1 To NumBlock - 1                                ' For Loop to create correct
amount of blocks'

        Cells(R + ExR, C + i - 1).Value = "Block #" & i & " Cost per kWh ($)"

        Cells(R + ExR + 1, C + i - 1).NumberFormat = "$0.00#####"

    Next i

    Cells(R + ExR, C + NumBlock - 1).Value = "Remaining kWh Cost per kWh ($)"

Last cell is "Remaining" Block'

```

```

Cells(R + ExR + 1, C + NumBlock - 1).NumberFormat = "$0.00#####"
ExR = ExR + 2

Cells(R + ExR, C - 1).Value = "Winter: "

For i = 1 To NumBlock - 1                                ' For Loop to create correct
amount of blocks'

    Cells(R + ExR, C + i - 1).Value = "Block #" & i & " Cost per kWh ($)"
    Cells(R + ExR + 1, C + i - 1).NumberFormat = "$0.00#####"
    Next i

Cells(R + ExR, C + NumBlock - 1).Value = "Remaining kWh Cost per kWh ($)"
Cells(R + ExR + 1, C + NumBlock - 1).NumberFormat = "$0.00#####"
Cells(R + TR, C + TC).Value = "Total kWh"

For j = 1 To 12
    Cells(R + TR + j, C + TC).Interior.Color = 15986394
    Cells(R + TR + j, C + TC).NumberFormat = "#,###"
    Next j

ExR = ExR + 2

If BlockBase.Value = "Fixed (kWh)" Then                    ' Next (2nd) line is
Block Sizes'

    For i = 1 To NumBlock.Value - 1                        ' For Loop to create
correct amount of block size cells'

        Cells(R + ExR, C + i - 1).Value = "Block " & i & " Size (kWh)"

```

```

Cells(R + ExR + 1, C + i - 1).NumberFormat = "#,###"

Next i

ElseIf BlockBase.Value = "Demand Based (kWh/kW-mo)" Then '
If/ElseIf statement decides whether blocks sizes are based on strictly kWh or kWh/kW-mo'

For i = 1 To NumBlock.Value - 1

Cells(R + ExR, C + i - 1).Value = "Block " & i & " Size (kWh/kW-mo)"

Cells(R + ExR + 1, C + i - 1).NumberFormat = "#,###"

Next i

End If

Cells(R + ExR, C + NumBlock - 1).Value = "Remaining kWh"

Cells(R + ExR + 1, C + NumBlock - 1).Value = "(Different Each Month)"

ExR = ExR + 2

UCount = UCount + 1 ' UCount used for Usage

table column count'

Cells(132, 1).Value = 0

Cells(133, 1).Value = NumBlock

Cells(134, 1).Value = NumBlock - 1

ElseIf Block = "No" Then

If SumPeak.Value = "No Peak" Then

Cells(R + ExR, C).Value = "Summer Cost per kWh ($)"

Cells(R + ExR + 1, C).NumberFormat = "$0.00#####"
```

Cells(R + TR - 1, C + TC) = "Summer"

Cells(R + TR, C + TC) = "kWh"

For j = 1 To 12

'Summer/Winter Determination'

M = MoNo + j - 1

If M > 12 Then

M = M - 12

End If

If (M >= SumMo And M < SumMo + SummerLength) Then

Cells(R + TR + j, C + TC).Interior.Color = 15986394

Cells(R + TR + j, C + TC).NumberFormat = "#,###"

End If

Next j

UCount = UCount + 1

If WintPeak.Value = "No Peak" Then

Cells(R + ExR, C + UCount).Value = "Winter Cost per kWh (\$)"

Cells(R + ExR + 1, C + UCount).NumberFormat = "\$0.00#####"

Cells(R + TR - 1, C + UCount - 1 + TC).Value = "Total"

Cells(R + TR, C + UCount - 1 + TC).Value = "kWh"

For j = 1 To 12

Cells(R + TR + j, C + TC).Interior.Color = 15986394

Cells(R + TR + j, C + TC).NumberFormat = "#,###"

```

Next j

Subcount = Subcount + 0

ElseIf WintPeak.Value = "Peak" Then

Cells(R + ExR, C + UCount).Value = "Winter On-peak Cost per kWh ($)"

Cells(R + ExR + 1, C + UCount).NumberFormat = "$0.00#####"

Cells(R + TR - 1, C + UCount + TC).Value = "Winter On-peak"

Cells(R + TR, C + UCount + TC).Value = "kWh"

For j = 1 To 12

'Summer/Winter Determination'

M = MoNo + j - 1

If M > 12 Then

M = M - 12

End If

If (M < SumMo Or M >= SumMo + SummerLength) Then

Cells(R + TR + j, C + TC + UCount).Interior.Color = 15986394

Cells(R + TR + j, C + TC + UCount).NumberFormat = "#,###"

End If

Next j

Subcount = Subcount + 1

UCount = UCount + 1

Cells(R + ExR, C + UCount).Value = "Winter Off-peak Cost per kWh ($)"

Cells(R + ExR + 1, C + UCount).NumberFormat = "$0.00#####"

```

Cells(R + TR - 1, C + UCount + TC).Value = "Winter Off-peak"

Cells(R + TR, C + UCount + TC).Value = "kWh"

For j = 1 To 12

'Summer/Winter Determination'

M = MoNo + j - 1

If M > 12 Then

M = M - 12

End If

If (M < SumMo Or M >= SumMo + SummerLength) Then

Cells(R + TR + j, C + TC + UCount).Interior.Color = 15986394

Cells(R + TR + j, C + TC + UCount).NumberFormat = "#,###"

End If

Next j

Subcount = Subcount + 1

UCount = UCount + 1

End If

End If

If SumPeak.Value = "Peak" Then

Cells(R + ExR, C).Value = "Summer On-peak Cost per kWh (\$)"

Cells(R + ExR + 1, C).NumberFormat = "\$0.00#####"

Cells(R + TR - 1, C + TC).Value = "Summer On-peak"



Cells(R + TR, C + TC).Value = "kWh"

For j = 1 To 12

'Summer/Winter Determination'

M = MoNo + j - 1

If M > 12 Then

M = M - 12

End If

If (M >= SumMo And M < SumMo + SummerLength) Then

Cells(R + TR + j, C + TC + UCount).Interior.Color = 15986394

Cells(R + TR + j, C + TC + UCount).NumberFormat = "#,###"

End If

Next j

UCount = UCount + 1

Cells(R + ExR, C + UCount).Value = "Summer Off-peak Cost per kWh (\$)"

Cells(R + ExR + 1, C + UCount).NumberFormat = "\$0.00#####"

Cells(R + TR - 1, C + UCount + TC).Value = "Summer Off-peak"

Cells(R + TR, C + UCount + TC).Value = "kWh"

For j = 1 To 12

'Summer/Winter Determination'

M = MoNo + j - 1

If M > 12 Then

M = M - 12

End If

```

If (M >= SumMo And M < SumMo + SummerLength) Then
    Cells(R + TR + j, C + TC + UCount).Interior.Color = 15986394
    Cells(R + TR + j, C + TC + UCount).NumberFormat = "#,###"
End If
Next j
Subcount = Subcount + 1
UCount = UCount + 1

If WintPeak.Value = "No Peak" Then
    Cells(R + ExR, C + UCount).Value = "Winter Cost per kWh ($)"
    Cells(R + ExR + 1, C + UCount).NumberFormat = "$0.00#####"
    Cells(R + TR - 1, C + UCount + TC).Value = "Winter"
    Cells(R + TR, C + UCount + TC).Value = "kWh"
For j = 1 To 12
    'Summer/Winter Determination'
    M = MoNo + j - 1
    If M > 12 Then
        M = M - 12
    End If
If (M < SumMo Or M >= SumMo + SummerLength) Then
    Cells(R + TR + j, C + TC + UCount).Interior.Color = 15986394
    Cells(R + TR + j, C + TC + UCount).NumberFormat = "#,###"
End If

```

```

Next j

Subcount = Subcount + 1

UCount = UCount + 1

ElseIf WintPeak.Value = "Peak" Then

Cells(R + ExR, C + UCount).Value = "Winter On-peak Cost per kWh ($)"

Cells(R + ExR + 1, C + UCount).NumberFormat = "$0.00#####"

Cells(R + TR - 1, C + UCount + TC).Value = "Winter On-peak"

Cells(R + TR, C + UCount + TC).Value = "kWh"

For j = 1 To 12

'Summer/Winter Determination'

M = MoNo + j - 1

If M > 12 Then

M = M - 12

End If

If (M < SumMo Or M >= SumMo + SummerLength) Then

Cells(R + TR + j, C + TC + UCount).Interior.Color = 15986394

Cells(R + TR + j, C + TC + UCount).NumberFormat = "#,###"

End If

Next j

Subcount = Subcount + 1

UCount = UCount + 1

Cells(R + ExR, C + UCount).Value = "Winter Off-peak Cost per kWh ($)"

```

Cells(R + ExR + 1, C + UCount).NumberFormat = "\$0.00#####"

Cells(R + TR - 1, C + UCount + TC).Value = "Winter Off-peak"

Cells(R + TR, C + UCount + TC).Value = "kWh"

For j = 1 To 12

    'Summer/Winter Determination'

    M = MoNo + j - 1

        If M > 12 Then

            M = M - 12

        End If

    If (M < SumMo Or M >= SumMo + SummerLength) Then

        Cells(R + TR + j, C + TC + UCount).Interior.Color = 15986394

        Cells(R + TR + j, C + TC + UCount).NumberFormat = "#,###"

    End If

Next j

Subcount = Subcount + 1

UCount = UCount + 1

End If

End If

ExR = ExR + 2

Cells(132, 1).Value = Subcount

Cells(133, 1).Value = 0

Cells(134, 1).Value = 0

End If

End If

'KWH RIDERS'

Subcount = 0

Range("A80").Value = RiderskWh

If RiderskWh <> 0 Then

    If RiderskWh < 5 Then

        For i = 1 To RiderskWh

            Cells(R + ExR, C + i - 1).Value = "Rider " & i & " (\$/kWh)"

            Cells(R + ExR + 1, C + i - 1).NumberFormat = "\$0.00#####" & ""

            Subcount = Subcount + 1

        Next i

    Cells(135, 1).Value = Subcount

    Cells(136, 1).Value = 0

    ExR = ExR + 2

ElseIf RiderskWh > 4 Then

    For i = 1 To 4

        Cells(R + ExR, C + i - 1).Value = "Rider " & i & " (\$/kWh)"

Cells(R + ExR + 1, C + i - 1).NumberFormat = "\$0.00#####"

Subcount = Subcount + 1

Next i

Cells(135, 1).Value = Subcount

ExR = ExR + 2

Subcount = 0

For i = 5 To RiderskWh

Cells(R + ExR, C + Subcount).Value = "Rider " & i & " (\$/kWh)"

Cells(R + ExR + 1, C + Subcount).NumberFormat = "\$0.00#####"

Subcount = Subcount + 1

Next i

Cells(136, 1).Value = Subcount

ExR = ExR + 2

End If

ElseIf RiderskWh = 0 Then

Cells(135, 1).Value = 0

Cells(136, 1).Value = 0

End If

'DEMAND CHARGES; ON-PEAK/OFF-PEAK, SUMMER/WINTER'

Range("A19").Value = DemandSeasons

Range("A170").Value = SimplePeakDem

Range("A24").Value = SumPeakDem

Range("A29").Value = WintPeakDem

Subcount = 0

If DemandSeasons.Value = "No" Then

    If SimplePeakDem = "No" Then

        Cells(R + ExR, C + Subcount).Value = "Cost per kW-mo (\$)"

        Cells(R + TR - 1, C + UCount + TC).Value = "Total Actual Demand"

        Cells(R + TR, C + UCount + TC).Value = "kW-mo"

    For j = 1 To 12

        Cells(R + TR + j, C + TC + UCount).Interior.Color = 15986394

        Cells(R + TR + j, C + TC + UCount).NumberFormat = "#,##0.0"

    Next j

    UCount = UCount + 1

    Subcount = Subcount + 1

ElseIf SimplePeakDem = "Yes" Then

    Cells(R + ExR, C + Subcount).Value = "On-Peak Cost per kW-mo (\$)"

    Cells(R + TR - 1, C + UCount + TC).Value = "On-Peak Actual Demand"

    Cells(R + TR, C + UCount + TC).Value = "kW-mo"

    For j = 1 To 12

        Cells(R + TR + j, C + TC + UCount).Interior.Color = 15986394

        Cells(R + TR + j, C + TC + UCount).NumberFormat = "#,##0.0"

    Next j

UCount = UCount + 1

Subcount = Subcount + 1

Cells(R + ExR, C + Subcount).Value = "Off-Peak Cost per kW-mo (\$)"

Cells(R + TR - 1, C + UCount + TC).Value = "Off-Peak Actual Demand"

Cells(R + TR, C + UCount + TC).Value = "kW-mo"

For j = 1 To 12

Cells(R + TR + j, C + TC + UCount).Interior.Color = 15986394

Cells(R + TR + j, C + TC + UCount).NumberFormat = "#,##0.0"

Next j

UCount = UCount + 1

Subcount = Subcount + 1

End If

ElseIf DemandSeasons.Value = "Yes" Then

If SumPeakDem.Value = "No Peak" Then

Cells(R + ExR, C + Subcount).Value = "Summer Cost per kW-mo (\$)"

Cells(R + TR - 1, C + UCount + TC) = "Summer Actual Demand"

Cells(R + TR, C + UCount + TC) = "kW-mo"

For j = 1 To 12

'Summer/Winter Determination'

M = MoNo + j - 1

If M > 12 Then

M = M - 12



```

    End If

    If (M >= SumMo And M < SumMo + SummerLength) Then

        Cells(R + TR + j, C + TC + UCount).Interior.Color = 15986394

        Cells(R + TR + j, C + TC + UCount).NumberFormat = "#,##0.0"

    End If

    Next j

    UCount = UCount + 1

    Subcount = Subcount + 1

    If WintPeakDem.Value = "No Peak" Then

        Cells(R + ExR, C + Subcount).Value = "Winter Cost per kW-mo ($)"

        Cells(R + TR - 1, C + UCount - 1 + TC).Value = "Total Actual Demand"

        Cells(R + TR, C + UCount - 1 + TC).Value = "kW-mo"

        For j = 1 To 12

            'Summer/Winter Determination'

            Cells(R + TR + j, C + TC + UCount - 1).Interior.Color = 15986394

            Cells(R + TR + j, C + TC + UCount - 1).NumberFormat = "#,##0.0"

        Next j

        UCount = UCount + 1

        Subcount = Subcount + 1

    ElseIf WintPeakDem.Value = "Peak" Then

```

Cells(R + ExR, C + Subcount).Value = "Winter On-peak Cost per kW-mo (\$)"

Cells(R + TR - 1, C + UCount + TC).Value = "Winter On-peak Actual Demand"

Cells(R + TR, C + UCount + TC).Value = "kW-mo"

For j = 1 To 12

'Summer/Winter Determination'

M = MoNo + j - 1

If M > 12 Then

M = M - 12

End If

If (M < SumMo Or M >= SumMo + SummerLength) Then

Cells(R + TR + j, C + TC + UCount).Interior.Color = 15986394

Cells(R + TR + j, C + TC + UCount).NumberFormat = "#,##0.0"

End If

Next j

UCount = UCount + 1

Subcount = Subcount + 1

Cells(R + ExR, C + Subcount).Value = "Winter Off-peak Cost per kW-mo (\$)"

Cells(R + TR - 1, C + UCount + TC).Value = "Winter Off-peak Actual Demand"

Cells(R + TR, C + UCount + TC).Value = "kW-mo"

For j = 1 To 12

'Summer/Winter Determination'

M = MoNo + j - 1

```

    If M > 12 Then
        M = M - 12
    End If

    If (M < SumMo Or M >= SumMo + SummerLength) Then
        Cells(R + TR + j, C + TC + UCount).Interior.Color = 15986394
        Cells(R + TR + j, C + TC + UCount).NumberFormat = "#,##0.0"
    End If

    Next j

    UCount = UCount + 1
    Subcount = Subcount + 1

End If

End If

If SumPeakDem.Value = "Peak" Then
    Cells(R + ExR, C + Subcount).Value = "Summer On-peak Cost per kW-mo ($)"
    Cells(R + TR - 1, C + UCount + TC).Value = "Summer On-peak Actual Demand"
    Cells(R + TR, C + UCount + TC).Value = "kW-mo"
    For j = 1 To 12
        'Summer/Winter Determination'
        M = MoNo + j - 1
        If M > 12 Then
            M = M - 12

```

```

End If

If (M >= SumMo And M < SumMo + SummerLength) Then

    Cells(R + TR + j, C + TC + UCount).Interior.Color = 15986394

    Cells(R + TR + j, C + TC + UCount).NumberFormat = "#,##0.0"

End If

Next j

UCount = UCount + 1

Subcount = Subcount + 1

Cells(R + ExR, C + Subcount).Value = "Summer Off-peak Cost per kW-mo ($)"

Cells(R + TR - 1, C + UCount + TC).Value = "Summer Off-peak Actual Demand"

Cells(R + TR, C + UCount + TC).Value = "kW-mo"

For j = 1 To 12

    'Summer/Winter Determination'

    M = MoNo + j - 1

    If M > 12 Then

        M = M - 12

    End If

    If (M >= SumMo And M < SumMo + SummerLength) Then

        Cells(R + TR + j, C + TC + UCount).Interior.Color = 15986394

        Cells(R + TR + j, C + TC + UCount).NumberFormat = "#,##0.0"

    End If

Next j

```

UCount = UCount + 1

Subcount = Subcount + 1

If WintPeakDem.Value = "No Peak" Then

Cells(R + ExR, C + Subcount).Value = "Winter Cost per kW-mo (\$)"

Cells(R + TR - 1, C + UCount + TC).Value = "Winter Actual Demand"

Cells(R + TR, C + UCount + TC).Value = "kW-mo"

For j = 1 To 12

'Summer/Winter Determination'

M = MoNo + j - 1

If M > 12 Then

M = M - 12

End If

If (M < SumMo Or M >= SumMo + SummerLength) Then

Cells(R + TR + j, C + TC + UCount).Interior.Color = 15986394

Cells(R + TR + j, C + TC + UCount).NumberFormat = "#,##0.0"

End If

Next j

UCount = UCount + 1

Subcount = Subcount + 1

ElseIf WintPeakDem.Value = "Peak" Then

Cells(R + ExR, C + Subcount).Value = "Winter On-peak Cost per kW-mo (\$)"

Cells(R + TR - 1, C + UCount + TC).Value = "Winter On-peak Actual Demand"

Cells(R + TR, C + UCount + TC).Value = "kW-mo"

For j = 1 To 12

'Summer/Winter Determination'

M = MoNo + j - 1

If M > 12 Then

M = M - 12

End If

If (M < SumMo Or M >= SumMo + SummerLength) Then

Cells(R + TR + j, C + TC + UCount).Interior.Color = 15986394

Cells(R + TR + j, C + TC + UCount).NumberFormat = "#,##0.0"

End If

Next j

UCount = UCount + 1

Subcount = Subcount + 1

Cells(R + ExR, C + Subcount).Value = "Winter Off-peak Cost per kW-mo (\$)"

Cells(R + TR - 1, C + UCount + TC).Value = "Winter Off-peak Actual Demand"

Cells(R + TR, C + UCount + TC).Value = "kW-mo"

For j = 1 To 12

'Summer/Winter Determination'

M = MoNo + j - 1

If M > 12 Then

M = M - 12

End If

If (M < SumMo Or M >= SumMo + SummerLength) Then

Cells(R + TR + j, C + TC + UCount).Interior.Color = 15986394

Cells(R + TR + j, C + TC + UCount).NumberFormat = "#,##0.0"

End If

Next j

UCount = UCount + 1

Subcount = Subcount + 1

End If

End If

End If

'Demand Charge Formatting'

iC = 0

Do While Cells(R + ExR, C + iC).Value <> Empty

iC = iC + 1

Loop

For i = 0 To iC - 1

Cells(R + ExR + 1, C + i).NumberFormat = "\$#.00#####"

Next i

ExR = ExR + 2

Cells(137, 1).Value = Subcount

'Assign Userform entries to fixed cells (demand section)'

Range("A42").Value = Ratchet

Range("A160").Value = RatchMos

Range("A46").Value = MinDem

Range("A50").Value = Franchise

Range("A54").Value = Taxes

'RATCHET CLAUSE AND MINIMUM BILLED DEMAND'

'RATCHET CLAUSE'

Subcount = 0

Cells(R + ExR, C + Subcount).Value = "Ratchet Percentage (%)"

Cells(R + ExR + 1, C + Subcount).NumberFormat = "0.00%"

If Ratchet = "No" Then

Cells(R + ExR + 1, C + Subcount).Value = "N/A"

End If

Subcount = Subcount + 1

'MINIMUM BILLED DEMAND'

Cells(R + ExR, C + Subcount).Value = "Minimum Billed Demand (kW-mo)"

Cells(R + ExR + 1, C + Subcount).NumberFormat = "#,###"



If MinDem = "No" Then

Cells(R + ExR + 1, C + Subcount).Value = "N/A"

End If

Subcount = Subcount + 1

ExR = ExR + 2

'DEMAND RIDERS'

'DEMAND RIDERS UP TO 4'

Subcount = 0

Range("A114").Value = RiderskWmo

If RiderskWmo <> 0 Then

If RiderskWmo < 5 Then

For i = 1 To RiderskWmo

Cells(R + ExR, C + Subcount).Value = "Rider " & i & " (\$/kW-mo)"

Cells(R + ExR + 1, C + i - 1).NumberFormat = "\$0.00#####"

Subcount = Subcount + 1

Next i

Cells(138, 1).Value = Subcount

Cells(139, 1).Value = 0

ExR = ExR + 2

'DEMAND RIDERS UP TO 8'

ElseIf RiderskWmo > 4 Then

For i = 1 To 4

Cells(R + ExR, C + Subcount).Value = "Rider " & i & " (\$/kW-mo)"

Cells(R + ExR + 1, C + i - 1).NumberFormat = "\$0.00#####"

Subcount = Subcount + 1

Next i

Cells(138, 1).Value = Subcount

ExR = ExR + 2

Subcount = 0

For i = 5 To RiderskWmo

Cells(R + ExR, C + Subcount).Value = "Rider " & i & " (\$/kW-mo)"

Cells(R + ExR + 1, C + Subcount).NumberFormat = "\$0.00#####"

Subcount = Subcount + 1

Next i

Cells(139, 1).Value = Subcount

ExR = ExR + 2

End If

Else:

Cells(138, 1).Value = 0

Cells(139, 1).Value = 0

End If

## 'TAXES AND FRANCHISE FEE'

### 'FRANCHISE FEE'

Subcount = 0

Cells(R + ExR, C + Subcount).Value = "Franchise Fee Percentage(%)"

Cells(R + ExR + 1, C + Subcount).NumberFormat = "0.000% "

If Franchise = "No" Then

Cells(R + ExR + 1, C + Subcount).Value = "N/A"

End If

Subcount = Subcount + 1

### 'TAXES'

Cells(R + ExR, C + Subcount).Value = "Total Tax Percentage(%)"

Cells(R + ExR + 1, C + Subcount).NumberFormat = "0.000% "

If Taxes = "No" Then

Cells(R + ExR + 1, C + Subcount).Value = "N/A"

End If

Subcount = Subcount + 1

ExR = ExR + 2

Cells(140, 1).Value = Subcount

### 'CUSTOMER CHARGE'

Cells(R + ExR, C).Value = "Customer Charge (\$)"

Cells(R + ExR + 1, C).NumberFormat = "#,##0.00"

'OFFICIAL Usage Count

UCC = 0

Do While Cells(R + TR, C + TC + UCC).Value <> Empty

    UCC = UCC + 1

Loop

UCount = UCC

Worksheets("Ground Zero").Range("Z39").Value = UCount - 1

Worksheets("DIY El. Rates").Range("A172").Value = UCount - 1

'END OF PAGE FORMATTING (PREPARE FOR FUTURE USE)'

'END OF PAGE FORMATTING (PREPARE FOR FUTURE USE)'

'CCC = Costs Columns Count'

'UCC = Usage Columns Count'

UCC = 0

Do While Cells(R + TR, C + TC + UCC).Value <> Empty

    UCC = UCC + 1

Loop

For i = 0 To UCC - 1

    Cells(R + TR - 1, C + TC + i).Font.FontStyle = "Bold"

    Cells(R + TR, C + TC + i).Font.FontStyle = "Bold"

Next i

CCC = 0

Do While Cells(R + TTR, C + TTC + CCC).Value <> Empty

CCC = CCC + 1

Loop

If CCC > 0 Then

For j = 0 To 13

For i = 0 To CCC

Cells(R + TTR + j - 1, C + TTC + i).ClearContents

Next i

Next j

End If

For j = 0 To 10

For i = 0 To 3

If Cells(R + j \* 2, C + i).Value <> Empty Then

Cells(R + j \* 2, C + i).Font.FontStyle = "Bold"

Cells(R + j \* 2, C + i).Font.Underline = xlUnderlineStyleSingle

Cells(R + j \* 2 + 1, C + i).Borders.LineStyle = xlContinuous

End If

Next i

Next j

With Worksheets("DIY El. Rates").Range("B1:Y100")

```
.HorizontalAlignment = xlCenter
.VerticalAlignment = xlCenter
.Columns("B:Y").AutoFit
.Rows("1:100").AutoFit
For i = C + 0 - 1 To C + 10 - 1
With .Columns(i)
If .ColumnWidth > 20 Then
.ColumnWidth = 20
.WrapText = True
ElseIf .ColumnWidth < 15 Then
.ColumnWidth = 15
End If
End With
Next i
.Columns("B:Y").AutoFit
End With
End
End Sub
```

## Calculate Customizable Rate Schedule Electric Utility Cost

Sub Calculate\_Costs\_Click()

Dim C As Integer

Dim R As Integer

Dim TC As Integer

Dim TR As Integer

Dim TTC As Integer

Dim TTR As Integer

Dim ExR As Integer

Dim UCount As Integer

Dim CCount As Integer

Dim Subcount As Integer

Dim SCSznEn As Integer

Dim SCNumBlock As Integer

Dim SCBlockSize As Integer

Dim SCkWhRider14 As Integer

Dim SCkWhRider58 As Integer

Dim SCSznDem As Integer

Dim SCkWRider14 As Integer

Dim SCkWRider58 As Integer

Dim SCMisc As Integer

Dim SummerLength As Integer

C = Cells(116, 1).Value

R = Cells(118, 1).Value

TC = Cells(120, 1).Value

TR = Cells(122, 1).Value

TTC = Cells(124, 1).Value

TTR = Cells(126, 1).Value

'BEGINNING OF PAGE FORMATTING' (CLEAR TRACES OF PAST USE)'

'CCC = Costs Columns Count"

CCC = 0

Do While Cells(R + TTR, C + TTC + CCC).Value <> Empty

CCC = CCC + 1

Loop

For j = 0 To 12

For i = 0 To CCC

Cells(R + TTR + j, C + TTC + i).ClearContents

Cells(R + TTR + j, C + TTC + i).ClearFormats

Next i

Next j

'SC Stands for Subcount, running talleys from the userform algorithm, max 4'

SCSznEn = Cells(132, 1).Value

' Number of Energy peaks and/or

season combinations



SCNumBlock = Cells(133, 1).Value ' Number of blocks in block  
 expander; !IF SEASONS YES AND BLOCKS YES THEN SUMMER/WINTER BLOCK#  
 SHARE SAME SUBCOUNT!  
 SCBlockSize = Cells(134, 1).Value + 1 ' Number of blocks, Used for the  
 size of each block  
 SCkWhRider14 = Cells(135, 1).Value ' Number of kWh riders between  
 from 1 - 4  
 SCkWhRider58 = Cells(136, 1).Value ' Number of kWh rider from 5 -  
 8  
 SCSznDem = Cells(137, 1).Value ' Number of Demand peaks and/or  
 season combinations  
 SCkWRider14 = Cells(138, 1).Value ' Number of kW riders between  
 from 1 - 4  
 SCkWRider58 = Cells(139, 1).Value ' Number of kW rider from 5 - 8  
 SCMisc = Cells(140, 1).Value ' Number of Miscellaneous columns

ExR = 0

Subcount = 1

'Cost Table column count -1; Counts columns that have been finished in the Costs Table so  
 CCount can be added to the Cells() column reference for the current calculations column'

CCount = 0

'Usage Table column count -1; Counts columns that have been finished in the Usage Table so  
UCount can be added to the Cells() column reference for the current calculations refernce  
column'

UCount = 0

EnergySeasons = Range("A5").Value

SumPeak = Range("A10").Value

WintPeak = Range("A15").Value

Block = Range("A33").Value

BlockBase = Range("A145").Value

Months = Range("A68").Value ' First month of Utility data

SummerStart = Range("A94").Value

SummerLength = Range("A103").Value

MoNo = MonthNo(Range("A68").Value) ' Number for of Months'

SumMo = MonthNo(Range("A94").Value) ' Number for SummerStart'

If SCSznEn = 0 Then

SCFuel = 1

Else: SCFuel = SCSznEn

End If

Cells(R + TTR - 1, C + CCount).Value = "Fuel Cost"

Cells(R + TTR, C + CCount).Value = "\$"

FuelCharge = Cells(R + ExR + 1, C).Value

For j = 1 To 12

    TotalkWh = 0

    For i = 1 To SCFuel

        TotalkWh = TotalkWh + Cells(R + TR + j, C + i - 1).Value

    Next i

    FuelCost = TotalkWh \* FuelCharge

    Cells(R + TTR + j, C + CCount).Value = FuelCost

Next j

CCount = CCount + 1

ExR = ExR + 2

Cells(R + TTR - 1, C + TTC + CCount).Value = "Energy Cost"

Cells(R + TTR, C + TTC + CCount).Value = "\$"

If EnergySeasons = "No" Then                   ' There is either a simple \$/kWh charge or the first row  
is the block expander charges'

    If Block = "No" Then                   ' NO Seasons NO Block: The 1st line is just \$/kWh  
since there is NO block expander (or seasons)'

        For j = 1 To 12

            Energy = 0

            For i = 1 To SCSznEn

                Energy = Energy + Cells(R + ExR + 1, C + i - 1).Value \* Cells(R + TR + j, C + TC + i  
- 1).Value

            Next i

```

Cells(R + TTR + j, C + TTC + CCount).Value = Energy
Next j
UCount = UCount + SCSznEn
ExR = ExR + 2           ' The first row is complete, so new input info. labels will
be two rows down'

ElseIf Block = "Yes" Then           ' NO Seasons YES Block: The 1st line will be Block
Expander, 2nd line is Block Sizes'

If BlockBase = "Fixed (kWh)" Then

For j = 1 To 12

Energy = 0

TotalkWh = Cells(R + TR + j, C + TC + UCount).Value

Remaining = TotalkWh

For i = 1 To SCNumBlock           ' For Loop to create correct
amount of blocks'

If Remaining > 0 Then

If i <> SCNumBlock Then

BlockCharge = Cells(R + ExR + 1, C + i - 1).Value

BlockSize = Cells(R + ExR + 1 + 2, C + i - 1).Value

If Remaining < BlockSize Then

BlockSize = Remaining

End If

Energy = Energy + BlockCharge * BlockSize

```

Remaining = Remaining - BlockSize

ElseIf i = SCNumBlock Then

BlockCharge = Cells(R + ExR + 1, C + i - 1).Value

Energy = Energy + BlockCharge \* Remaining

End If

End If

Next i

Cells(R + TTR + j, C + TTC + CCount).Value = Energy

Next j

ExR = ExR + 4

ElseIf BlockBase = "Demand Based (kWh/kW-mo)" Then

For j = 1 To 12

Energy = 0

TotalkWh = Cells(R + TR + j, C + TC + UCount).Value

Remaining = TotalkWh

MonthDemand = Cells(R + TR + j, C + TC + 1 + DC + UCount).Value

For i = 1 To SCNumBlock

' For Loop to create correct

amount of blocks'

If Remaining > 0 Then

If i <> SCNumBlock Then

BlockCharge = Cells(R + ExR + 1, C + i - 1).Value

BlockSize = Cells(R + ExR + 1 + 2, C + i - 1).Value \* MonthDemand

If Remaining < BlockSize Then

BlockSize = Remaining

End If

Energy = Energy + BlockCharge \* BlockSize

Remaining = Remaining - BlockSize

ElseIf i = SCNumBlock Then

BlockCharge = Cells(R + ExR + 1, C + i - 1).Value

Energy = Energy + BlockCharge \* Remaining

End If

End If

Next i

Cells(R + TTR + j, C + TTC + CCount).Value = Energy

Next j

UCount = UCount + 0

' UCount remains at 0, kWh

Riders calculation comes next, which is still based on Total kWh'

ExR = ExR + 4

' Current focus is on Block#

Charges, which deals with the Block Sizes in the cells below, to continue, must jump down 4 cells (skipping Block Sizes).'

End If ' END Block Base IF'

End If ' END of Block YES/NO'

CCount = CCount + 1

' Both options for NO Seasons has been completed'

```

ElseIf EnergySeasons = "Yes" Then

    If Block = "Yes" Then

        If BlockBase = "Fixed (kWh)" Then

            For j = 1 To 12

                ' The following line determines if the current month's single digit value is outside the
                range of single digit values of 'Summer Months' '

                If (MonthNo(Cells(R + TR + j, C + TC - 1).Value) < MonthNo(Range("A94").Value)
                Or MonthNo(Cells(R + TR + j, C + TC - 1).Value) >= (MonthNo(Range("A94").Value) +
                SummerLength)) Then

                    SznR = 2    ' The season additional rows is defined; Winter block charges are
                    [SznR=] 2 rows down from the summer block charges'

                    Else: SznR = 0

                    End If

                    Energy = 0

                    TotalkWh = Cells(R + TR + j, C + TC + UCount).Value

                    Remaining = TotalkWh

                    For i = 1 To SCNumBlock                ' For Loop to create correct
                    amount of blocks'

                        If Remaining > 0 Then

                            If i <> SCNumBlock Then

                                BlockCharge = Cells(R + ExR + 1 + SznR, C + i - 1).Value

                                BlockSize = Cells(R + ExR + 1 + 4, C + i - 1).Value

                                If Remaining < BlockSize Then

```

```

        BlockSize = Remaining

    End If

    Energy = Energy + BlockCharge * BlockSize

    Remaining = Remaining - BlockSize

    ElseIf i = SCNumBlock Then

        BlockCharge = Cells(R + ExR + 1 + SznR, C + i - 1).Value

        Energy = Energy + BlockCharge * Remaining

    End If

End If

Next i

Cells(R + TTR + j, C + TTC + CCount).Value = Energy

Next j

CCount = CCount + 1

ExR = ExR + 6

ElseIf BlockBase = "Demand Based (kWh/kW-mo)" Then

    For j = 1 To 12

        ' The following line determines if the current month's single digit value is outside the
range of single digit values of 'Summer Months' '

        If (MonthNo(Cells(R + TR + j, C + TC - 1).Value) < MonthNo(Range("A94").Value)
Or MonthNo(Cells(R + TR + j, C + TC - 1).Value) >= (MonthNo(Range("A94").Value) +
SummerLength)) Then

```



```

        SznR = 2      ' The season additional rows is defined; Winter block charges are
[SznR=] 2 rows down from the summer block charges'

    Else: SznR = 0

    End If

    Energy = 0

    TotalkWh = Cells(R + TR + j, C + TC + UCount).Value

    Remaining = TotalkWh

    MonthDemand = Cells(R + TR + j, C + TC + 1 + DC + UCount).Value

    For i = 1 To SCNumBlock                                ' For Loop to create correct
amount of blocks'

        If Remaining > 0 Then

            If i <> SCNumBlock Then

                BlockCharge = Cells(R + ExR + 1 + SznR, C + i - 1).Value

                BlockSize = Cells(R + ExR + 1 + 4, C + i - 1).Value * MonthDemand

                If Remaining < BlockSize Then

                    BlockSize = Remaining

                End If

                Energy = Energy + BlockCharge * BlockSize

                Remaining = Remaining - BlockSize

            ElseIf i = SCNumBlock Then

                BlockCharge = Cells(R + ExR + 1 + SznR, C + i - 1).Value

                Energy = Energy + BlockCharge * Remaining

```

End If

End If

Next i

Cells(R + TTR + j, C + TTC + CCount).Value = Energy

Next j

UCount = UCount + 0

' UCount remains at 0, kWh

Riders calculation comes next, which is still based on Total kWh'

CCount = CCount + 1

ExR = ExR + 6

' Current focus is on Block#

Charges, which deals with the Block Sizes in the cells below, to continue, must jump down 4 cells (skipping Block Sizes).'

End If ' END Block Base IF'

ElseIf Block = "No" Then

If (WintPeak = "No Peak" And SumPeak = "No Peak") Then

SummEnCharge = Cells(R + ExR + 1, C).Value

WintEnCharge = Cells(R + ExR + 1, C + 1).Value

For j = 1 To 12

Energy = 0

'Summer/Winter Determination'

M = MoNo + j - 1

If M > 12 Then

M = M - 12

```

    End If

    If (M >= SumMo And M < SumMo + SummerLength) Then

        EnergyCharge = SummEnCharge

    Else: EnergyCharge = WintEnCharge

    End If

    Energy = Cells(R + TR + j, C + TC).Value * EnergyCharge

    Cells(R + TTR + j, C + TTC + CCount).Value = Energy

    Next j

    UCount = UCount + 0 'still have to do riders'

Else:

    For j = 1 To 12

        Energy = 0

        For i = 1 To SCSznEn

            Energy = Energy + Cells(R + ExR + 1, C + i - 1).Value * Cells(R + TR + j, C + TC
+ i - 1).Value

            Next i

            Cells(R + TTR + j, C + TCC + CCount).Value = Energy

            Next j

        End If

    If SumPeak = "No Peak" Then

        If WintPeak = "Peak" Then

            UCount = UCount + 2

        End If

```

End If

If SumPeak = "Peak" Then

    If WintPeak = "No Peak" Then

        UCount = UCount + 2

    ElseIf WintPeak = "Peak" Then

        UCount = UCount + 3

    End If

End If

ExR = ExR + 2

CCount = CCount + 1

End If

End If

If SCkWhRider14 > 0 Then

    Cells(R + TTR - 1, C + TTC + CCount).Value = "Riders Cost"

    Cells(R + TTR, C + TTC + CCount).Value = "\$"

    For j = 1 To 12

        TotalkWh = 0

        If SCSznEn > 1 Then

            For i = 1 To SCSznEn

                TotalkWh = TotalkWh + Cells(R + TR + j, C + TC + i - 1).Value

```

        Next i
    Else: TotalkWh = Cells(R + TR + j, C + TC).Value
End If

If SCkWhRider14 > 0 Then

    RiderSum = 0

    For i = 1 To SCkWhRider14

        RiderSum = RiderSum + TotalkWh * Cells(R + ExR + 1, C + i - 1).Value

    Next i

    If SCkWhRider58 > 0 Then

        For i = 1 To SCkWhRider58

            RiderSum = RiderSum + TotalkWh * Cells(R + ExR + 1 + 2, C + i - 1).Value

        Next i

    End If

    Cells(R + TTR + j, C + TTC + CCount).Value = RiderSum

End If

Next j

End If

```

```

If SCkWhRider14 > 0 Then

    CCount = CCount + 1

    ExR = ExR + 2

    If SCkWhRider58 > 0 Then

```

ExR = ExR + 2

End If

End If

If ((EnergySeasons = "Yes" And WintPeak = "No Peak" And SumPeak = "No Peak") Or  
SCSznEn > 2 Or Block = "Yes") Then

UCount = UCount + 1

End If

'DEMAND CALCULATIONS'

DemandSeasons = Range("A19").Value

SumPeakDem = Range("A24").Value

WintPeakDem = Range("A29").Value

RatchMos = Range("A160").Value

SimplePeakDem = Range("A170").Value

Cells(R + TTR - 1, C + CCount).Value = "Demand Cost"

Cells(R + TTR, C + CCount).Value = "\$"

MinDem = Cells(R + ExR + 1 + 2, C + 1).Value

If (MinDem = "N/A" Or MinDem = 0) Then

Cells(R + ExR + 1 + 2, C + 1).Value = 0

MinDem = Empty

End If

If (Cells(R + ExR + 1 + 2, C).Value = "N/A" Or Cells(R + ExR + 1 + 2, C).Value = 0) Then

Cells(R + ExR + 1 + 2, C).Value = 0

RatchMos = Empty

End If

Subcount = 0

If DemandSeasons = "No" Then

If SimplePeakDem = "No" Then

For j = 1 To 12

Billed = 0

DemCost = 0

Billed = Cells(R + TR + j, C + TC + UCount).Value

If Billed < MinDem Then

Billed = MinDem

End If

For i = 1 To RatchMos

RM = i

If j - RM <= 0 Then

RM = RM - 12

```

End If

RatchDem = Cells(R + TR + j - RM, C + TC + UCount).Value * Cells(R + ExR + 1 +
2, C).Value

If Billed < RatchDem Then

    Billed = RatchDem

End If

Next i

DemCost = Cells(R + ExR + 1, C).Value * Billed

Cells(R + TTR + j, C + TTC + CCount).Value = DemCost

Next j

UCount = UCount + 1

ElseIf SimplePeakDem = "Yes" Then

For j = 1 To 12

    Billed = 0

    DemCost = 0

    Billed = Cells(R + TR + j, C + TC + UCount).Value

    If Billed < MinDem Then

        Billed = MinDem

    End If

For i = 1 To RatchMos

    RM = i

    If j - RM <= 0 Then

```



RM = RM - 12

End If

RatchDem = Cells(R + TR + j - RM, C + TC + UCount).Value \* Cells(R + ExR + 1 +  
2, C).Value

If Billed < RatchDem Then

Billed = RatchDem

End If

Next i

OnCost = Cells(R + ExR + 1, C).Value \* Billed

OffCost = Cells(R + ExR + 1, C + 1).Value \* Cells(R + TR + j, C + TC + UCount +  
1).Value

DemCost = OnCost + OffCost

Cells(R + TTR + j, C + TTC + CCount).Value = DemCost

Next j

UCount = UCount + 2

End If

ElseIf DemandSeasons = "Yes" Then

'TWO SEASONS...'

If SumPeakDem = "No Peak" Then

'TWO SEASONS, NO SUMMER PEAK...'

If WintPeakDem = "No Peak" Then

'TWO SEASONS, NO PEAKS'

For j = 1 To 12

Billed = 0

DemCost = 0

Billed = Cells(R + TR + j, C + TC + UCount).Value

If Billed < MinDem Then

Billed = MinDem

End If

For i = 1 To RatchMos

RM = i

If j - RM <= 0 Then

RM = RM - 12

End If

RatchDem = Cells(R + TR + j - RM, C + TC + UCount).Value \* Cells(R + ExR + 1 +

2, C).Value

If Billed < RatchDem Then

Billed = RatchDem

End If

Next i

'Summer/Winter Determination'

M = MoNo + j - 1

If M > 12 Then

M = M - 12

End If

If (M >= SumMo And M < SumMo + SummerLength) Then

DemCharge = Cells(R + ExR + 1, C).Value

Else: DemCharge = Cells(R + ExR + 1, C + 1).Value

End If

DemCost = DemCharge \* Billed

Cells(R + TTR + j, C + TTC + CCount).Value = DemCost

Next j

UCount = UCount + 0

ElseIf WintPeakDem = "Peak" Then

'TWO SEASONS, ONLY WINTER PEAK'

'Summer Demand Cost (No Peak)'

For j = 1 To 12

'Summer/Winter Determination'

M = MoNo + j - 1

If M > 12 Then

M = M - 12

End If

If (M >= SumMo And M < SumMo + SummerLength) Then

SummBilled = 0

SummDemCost = 0

SummBilled = Cells(R + TR + j, C + TC + UCount).Value

'Minimum Billed Demand'

```

If SummBilled < MinDem Then
    SummBilled = MinDem
End If

'Ratchet Clause'
For i = 1 To RatchMos
    RM = i
    If j - RM <= 0 Then
        RM = RM - 12
    End If
    'Ratchet Clause recognizes Summer/Winter'
    If (M >= SumMo And M < SumMo + SummerLength) Then
        RatchDem = Cells(R + TR + j - RM, C + TC + UCount).Value * Cells(R + ExR + 1
+ 2, C).Value
    Else: RatchDem = Cells(R + TR + j - RM, C + TC + UCount + 1).Value * Cells(R +
ExR + 1 + 2, C).Value
    End If
    If SummBilled < RatchDem Then
        SummBilled = RatchDem
    End If
Next i

'Summer Cost is Billed Demand * Summer Charge'
SummDemCharge = Cells(R + ExR + 1, C).Value
SummDemCost = SummDemCharge * SummBilled

```

'If Winter month, Summer Costs equal 0'

Else: SummDemCost = 0

End If

'Winter Demand Cost (w/Peak)'

'Winter/Summer Determination

If (M < SumMo Or M >= SumMo + SummerLength) Then

WintBilled = 0

WintDemCost = 0

WintBilled = Cells(R + TR + j, C + TC + UCount + 1).Value

'Minimum Billed Demand applied'

If WintBilled < MinDem Then

WintBilled = MinDem

End If

'Ratchet Clause applied'

For i = 1 To RatchMos

RM = i

If j - RM <= 0 Then

RM = RM - 12

End If

'Ratchet Clause recognizes Summer/Winter'

If (M >= SumMo And M < SumMo + SummerLength) Then

RatchDem = Cells(R + TR + j - RM, C + TC + UCount).Value \* Cells(R + ExR + 1 + 2, C).Value

Else: RatchDem = Cells(R + TR + j - RM, C + TC + UCount + 1).Value \* Cells(R + ExR + 1 + 2, C).Value

End If

If WintBilled < RatchDem Then

WintBilled = RatchDem

End If

Next i

'(Possibly Change)On-peak Cost checks minimum demand and ratchet clause,

'Off-peak does not'

WintOnCost = Cells(R + ExR + 1, C + 1).Value \* WintBilled

WintOffCost = Cells(R + ExR + 1, C + 2).Value \* Cells(R + TR + j, C + TC + UCount + 2).Value

'If Summer month, Winter Costs equal 0'

'Ratchet Clause recognizes Summer/Winter'

Else:

WintOnCost = 0

WintOffCost = 0

End If

WintDemCost = WintOnCost + WintOffCost

'Combine Summer and Winter Costs'

DemCost = SummDemCost + WintDemCost

Cells(R + TTR + j, C + TTC + CCount).Value = DemCost

Next j

UCount = UCount + 3

End If

End If

If SumPeakDem = "Peak" Then

'TWO SEASONS, SUMMER PEAK...'

If WintPeakDem = "No Peak" Then

'TWO SEASONS, ONLY SUMMER PEAK'

'Summer Demand Cost (w/Peak)'

For j = 1 To 12

'Summer/Winter Determination'

M = MoNo + j - 1

If M > 12 Then

M = M - 12

End If

If (M >= SumMo And M < SumMo + SummerLength) Then

SummBilled = 0

```

SummDemCost = 0

SummBilled = Cells(R + TR + j, C + TC + UCount).Value

'Minimum Billed Demand applied'

If SummBilled < MinDem Then

    SummBilled = MinDem

End If

'Ratchet Clause applied'

For i = 1 To RatchMos

    RM = i

    If j - RM <= 0 Then

        RM = RM - 12

    End If

    'Ratchet Clause recognizes Summer/Winter'

    If (M >= SumMo And M < SumMo + SummerLength) Then

        RatchDem = Cells(R + TR + j - RM, C + TC + UCount).Value * Cells(R + ExR +
1 + 2, C).Value

        Else: RatchDem = Cells(R + TR + j - RM, C + TC + UCount + 2).Value * Cells(R +
ExR + 1 + 2, C).Value

    End If

    If SummBilled < RatchDem Then

        SummBilled = RatchDem

    End If

Next i

```



'(Possibly Change)On-peak Cost checks minimum demand and ratchet clause,

'Off-peak does not'

SummOnCost = Cells(R + ExR + 1, C).Value \* SummBilled

SummOffCost = Cells(R + ExR + 1, C + 1).Value \* Cells(R + TR + j, C + TC +

UCount + 1).Value

'If Winter month, Summer Costs equal 0'

ElseIf (M < SumMo Or M >= SumMo + SummerLength) Then

SummOnCost = 0

SummOffCost = 0

End If

SummDemCost = SummOnCost + SummOffCost

'Winter Demand Cost (No Peak)'

If (M < SumMo Or M >= SumMo + SummerLength) Then

WintBilled = 0

WintDemCost = 0

WintBilled = Cells(R + TR + j, C + TC + UCount + 2).Value

'Minimum Billed Demand'

If WintBilled < MinDem Then

WintBilled = MinDem

End If

'Ratchet Clause'

For i = 1 To RatchMos

```

RM = i
If j - RM <= 0 Then
    RM = RM - 12
End If

'Ratchet Clause recognizes Summer/Winter'

If (M >= SumMo And M < SumMo + SummerLength) Then

RatchDem = Cells(R + TR + j - RM, C + TC + UCount).Value * Cells(R + ExR + 1
+ 2, C).Value

Else: RatchDem = Cells(R + TR + j - RM, C + TC + UCount + 2).Value * Cells(R +
ExR + 1 + 2, C).Value

End If

If WintBilled < RatchDem Then

    WintBilled = RatchDem

End If

Next i

'Winter Cost is Billed Demand * Winter Charge'

WintDemCharge = Cells(R + ExR + 1, C + 2).Value

WintDemCost = WintDemCharge * WintBilled

'If Summer month, Winter Costs equal 0'

Else: WintDemCost = 0

End If

'Combine Summer and Winter Costs'

```

DemCost = SummDemCost + WintDemCost

Cells(R + TTR + j, C + TTC + CCount).Value = DemCost

Next j

UCount = UCount + 3

ElseIf WintPeakDem = "Peak" Then

'TWO SEASONS, PEAKS IN BOTH SEASONS'

For j = 1 To 12

'Summer Demand Cost (w/Peak)'

'Summer/Winter Determination'

M = MoNo + j - 1

If M > 12 Then

M = M - 12

End If

If (M >= SumMo And M < SumMo + SummerLength) Then

SummBilled = 0

SummDemCost = 0

SummBilled = Cells(R + TR + j, C + TC + UCount).Value

'Minimum Billed Demand applied'

If SummBilled < MinDem Then

SummBilled = MinDem

```

End If

'Ratchet Clause applied'

For i = 1 To RatchMos

    RM = i

    If j - RM <= 0 Then

        RM = RM - 12

    End If

    'Ratchet Clause recognizes Summer/Winter'

    If (M >= SumMo And M < SumMo + SummerLength) Then

        RatchDem = Cells(R + TR + j - RM, C + TC + UCount).Value * Cells(R + ExR +
1 + 2, C).Value

        Else: RatchDem = Cells(R + TR + j - RM, C + TC + UCount + 2).Value * Cells(R +
ExR + 1 + 2, C).Value

    End If

    If SummBilled < RatchDem Then

        SummBilled = RatchDem

    End If

Next i

'(Possibly Change)On-peak Cost checks minimum demand and ratchet clause,
'Off-peak does not'

SummOnCost = Cells(R + ExR + 1, C).Value * SummBilled

SummOffCost = Cells(R + ExR + 1, C + 1).Value * Cells(R + TR + j, C + TC +
UCount + 1).Value

```

```

'If Winter month, Summer Costs equal 0'
ElseIf (M < SumMo Or M >= SumMo + SummerLength) Then
    SummOnCost = 0
    SummOffCost = 0
End If
SummDemCost = SummOnCost + SummOffCost

```

```

'Winter Demand Cost (w/Peak)'
If (M < SumMo Or M >= SumMo + SummerLength) Then
    WintBilled = 0
    WintDemCost = 0
    WintBilled = Cells(R + TR + j, C + TC + UCount + 2).Value
'Minimum Billed Demand applied'
If WintBilled < MinDem Then
    WintBilled = MinDem
End If
'Ratchet Clause applied'
For i = 1 To RatchMos
    RM = i
    If j - RM <= 0 Then
        RM = RM - 12
    End If

```

'Ratchet Clause recognizes Summer/Winter'

If (M >= SumMo And M < SumMo + SummerLength) Then

RatchDem = Cells(R + TR + j - RM, C + TC + UCount).Value \* Cells(R + ExR + 1 + 2, C).Value

Else: RatchDem = Cells(R + TR + j - RM, C + TC + UCount + 2).Value \* Cells(R + ExR + 1 + 2, C).Value

End If

If WintBilled < RatchDem Then

WintBilled = RatchDem

End If

Next i

'(Possibly Change)On-peak Cost checks minimum demand and ratchet clause,

'Off-peak does not'

WintOnCost = Cells(R + ExR + 1, C + 2).Value \* WintBilled

WintOffCost = Cells(R + ExR + 1, C + 3).Value \* Cells(R + TR + j, C + TC + UCount + 3).Value

'If Summer month, Winter Costs equal 0'

ElseIf (M >= SumMo And M < SumMo + SummerLength) Then

WintOnCost = 0

WintOffCost = 0

End If

WintDemCost = WintOnCost + WintOffCost

'Combine Summer and Winter Costs'

DemCost = SummDemCost + WintDemCost

Cells(R + TTR + j, C + TTC + CCount).Value = DemCost

Next j

UCount = UCount + 4

End If

End If

End If

CCount = CCount + 1

'Skip Costs per kW-mo (\$) and skip Ratchet/Minimum Billed Demand Rows'

ExR = ExR + 4

'Arrives at either kW-mo Riders Row (if SCkWRider14 > 0)

' or Franchise Fee (if SCkWRider14 < 0)'

Do While Cells(R + TR, C + TC + kWhC).Value = "kWh"

kWhC = kWhC + 1

Loop

Do While Cells(R + TR, C + TC + kWhC + kWmoC).Value = "kW-mo"

kWmoC = kWmoC + 1

Loop

SCSznDem = kWmoC

If SCkWRider14 > 0 Then

Cells(R + TTR - 1, C + TTC + CCount).Value = "Demand Riders Cost"

Cells(R + TTR, C + TTC + CCount).Value = "\$"

TotalkW = 0

For j = 1 To 12

TotalkW = 0

For i = 0 To SCSznDem - 1

TotalkW = TotalkW + Cells(R + TR + j, C + TC + UCount - SCSznDem + i).Value

Next i

If SCkWRider14 > 0 Then

RiderSum = 0

For i = 1 To SCkWRider14

RiderSum = RiderSum + TotalkW \* Cells(R + ExR + 1, C + i - 1).Value

Next i

If SCkWRider58 > 0 Then

For i = 1 To SCkWRider58

RiderSum = RiderSum + TotalkW \* Cells(R + ExR + 1 + 2, C + i - 1).Value

Next i

End If



```

        Cells(R + TTR + j, C + TTC + CCount).Value = RiderSum
    End If
Next j
End If

If SCkWRider14 > 0 Then
    CCount = CCount + 1
    ExR = ExR + 2
    If SCkWRider58 > 0 Then
        ExR = ExR + 2
    End If
End If

End If

' Subtotal is the sum of everything from the first column (i=0) to the previous column (i =
CCount - 1) (CCount is the current column).'
```

' Each months Subtotal (for j = 1 to 12) is entered into the cell in the current column (CCount).'

```

Cells(R + TTR - 1, C + TTC + CCount).Value = "Subtotal"
Cells(R + TTR, C + TTC + CCount).Value = "$"
CustomerCharge = Cells(R + ExR + 2 + 1, C).Value
For j = 1 To 12
    Subtotal = 0
    For i = 0 To CCount - 1
```

Subtotal = Subtotal + Cells(R + TTR + j, C + TTC + i).Value

Next i

Subtotal = Subtotal + CustomerCharge

Cells(R + TTR + j, C + TTC + CCount).Value = Subtotal

Next j

CCount = CCount + 1

' Franchise Fee = (Municipal Tax Rate) \* (Subtotal)'

' FranchiseRate = Municipal Tax Rate'

' Franchise = Franchise Fee'

' SubFranch = Franchise + Subtotal

' Taxes = (Total Tax Rate) \* (Subtotal + Franchise Fee)'

' TotalTaxRate = Total Tax Rate'

' Taxes = Total Taxes'

' Taxes and Franchise Fee will be combined in one column (CCount) and as one combined value'

' TaxesFees = Franchise Fee + Total Taxes'

Cells(R + TTR - 1, C + TTC + CCount).Value = "Taxes & Fees"

Cells(R + TTR, C + TTC + CCount).Value = "\$"

FranchiseRate = Cells(R + ExR + 1, C).Value

If FranchiseRate = "N/A" Then

    FranchiseRate = Empty

End If

TotalTaxRate = Cells(R + ExR + 1, C + 1).Value

If TotalTaxRate = "N/A" Then

    TotalTaxRate = Empty

End If

For j = 1 To 12

    Subtotal = Cells(R + TTR + j, C + TTC + CCount - 1).Value

    Franchise = FranchiseRate \* Subtotal

    SubFranch = Franchise + Subtotal

    Taxes = SubFranch \* TotalTaxRate

    TaxesFees = Franchise + Taxes

    Cells(R + TTR + j, C + TTC + CCount).Value = TaxesFees

    Next j

CCount = CCount + 1

Cells(R + TTR - 1, C + TTC + CCount).Value = "Total"

Cells(R + TTR, C + TTC + CCount).Value = "\$"

For j = 1 To 12

    Total = Cells(R + TTR + j, C + TTC + CCount - 2) + Cells(R + TTR + j, C + TTC + CCount - 1)

    Cells(R + TTR + j, C + TTC + CCount).Value = Total

    Next j

Worksheets("Ground Zero").Range("Z41").Value = CCount

Worksheets("DIY El. Rates").Range("A174").Value = CCount

'END OF PAGE FORMATTING (PREPARE FOR FUTURE USE)'

CCC = 0

Do While Cells(R + TTR, C + TTC + CCC).Value <> Empty

CCC = CCC + 1

Loop

UCC = 0

Do While Cells(R + TR, C + TC + UCC).Value <> Empty

UCC = UCC + 1

Loop

For i = 0 To CCC - 1

Cells(R + TTR - 1, C + TTC + i).Font.FontStyle = "Bold"

Cells(R + TTR, C + TTC + i).Font.FontStyle = "Bold"

For j = 1 To 12

Cells(R + TTR + j, C + TTC + i).NumberFormat = "\$#,##0.00"

Next j

Next i

With Worksheets("DIY El. Rates")

.Range("B1:Y100").HorizontalAlignment = xlCenter

.Range("B1:Y100").VerticalAlignment = xlCenter

For i = CCC - UCC To CCC - 1

Columns(C + TTC + i).AutoFit

If .Columns(C + TTC + i).ColumnWidth < 15 Then

.Columns(C + TTC + i).ColumnWidth = 15

End If

Next i

End With

End Sub

## Select Natural Gas Rate Schedule

Private Sub NGSelectNextButton\_Click()

CurrentPage = 2

If OptButtonCustomizeNG.Value = True Then

NextPage = CurrentPage + 1

Worksheets("Ground Zero").Range("Z1").Value = NextPage

MultiPage1.Value = NextPage

Else:

If (NGCityTaxTB = Empty Or NGCityTaxTB = "N/A") Then

NGCityTaxTB = 0

End If

If (NGCountyTaxTB = Empty Or NGCountyTaxTB = "N/A") Then

NGCountyTaxTB = 0

End If

If (NGStateTaxTB = Empty Or NGStateTaxTB = "N/A") Then

NGStateTaxTB = 0

End If

If (NGMFATB = Empty Or NGMFATB = "N/A") Then

NGMFATB = 0

End If

With Sheet5

'Assign Tax values etc. from userform to AOGC Rate Schedule Sheet'

.Range("J5").Value = NGCityTaxTB / 100

.Range("J6").Value = NGCountyTaxTB / 100

.Range("J7").Value = NGStateTaxTB / 100

.Range("J9").Value = NGMFATB / 100

End With

With Sheet9

'Assign Tax values etc. from userform to Black Hills Rate Schedule Sheet'

.Range("J12").Value = NGCityTaxTB / 100

.Range("J13").Value = NGCountyTaxTB / 100

.Range("J14").Value = NGStateTaxTB / 100

.Range("J15").Value = NGMFATB / 100

End With

With Sheet10

'Assign Tax values etc. from userform to CenterPoint Rate Schedule Sheet'

.Range("L9").Value = NGCityTaxTB / 100

.Range("L10").Value = NGCountyTaxTB / 100

.Range("L11").Value = NGStateTaxTB / 100

.Range("L12").Value = NGMFATB / 100

.Range("C4").Value = NGTSOCB

.Range("C20").Value = NGLCFCCB

End With

NextPage = CurrentPage + 2

Worksheets("Ground Zero").Range("Z1").Value = NextPage

MultiPage1.Value = NextPage

End If

'FORMATTING TIMEEEE'

'If statement counts the number of usage columns'

'Usage columns will have commas & no decimal place'

'Cost columns will be currency format with 2 decimal places'

With Worksheets("Ground Zero")

If (OptButtonMediumSales.Value = True Or OptButtonBusiness3.Value = True Or \_

OptButtonBusiness4.Value = True Or OptButtonSCS1.Value = True Or \_

OptButtonSCS2.Value = True) Then

For j = 0 To 11

.Cells(25 + j, 4).Interior.Color = 15986394

.Cells(25 + j, 6).Value = "N/A"

Next j



End If

If (OptButtonLargeSales.Value = True Or OptButtonBusiness5.Value = True \_

Or OptButtonLCS1.Value = True) Then

For j = 0 To 11

.Cells(25 + j, 4).Interior.Color = 15986394

.Cells(25 + j, 6).Interior.Color = 15986394

Next j

End If

If OptButtonCustomizeNG.Value = False Then

UsageCol = 3

For j = 0 To 12

For i = 0 To UsageCol - 1

Cells(25 + j, 4 + i).NumberFormat = "#,##0.0"

If j = 12 Then

Cells(25 + j, 4 + i).Font.FontStyle = "Bold"

End If

Next i

For i = UsageCol To UsageCol + 5

Cells(4 + j, 4 + i).NumberFormat = "\$#,###.00"

```
    If j = 12 Then
        Cells(25 + j, 4 + i).Font.FontStyle = "Bold"
    End If
    Next i
Next j
End If
```

```
.Range("D22:P24").Font.FontStyle = "Bold"
```

```
.Range("B22:C37").Font.FontStyle = "Bold"
```

```
End With
```

```
End Sub
```

## Calculate Natural Gas Utility Cost

Private Sub NGCost\_Click()

With Worksheets("Ground Zero")

With .Range("G22:P37")

.ClearContents

.ClearFormats

End With

If .Cells(24, 4).Value = "MCF" Then

For j = 0 To 11

.Cells(25 + j, 4 + 1).Value = .Cells(25 + j, 4 + 0).Value \* 1.023

Next j

ElseIf .Cells(24, 4).Value = "CCF" Then

For j = 0 To 11

.Cells(25 + j, 4 + 1).Value = .Cells(25 + j, 4 + 0).Value \* 0.1023

Next j

End If

If (.Range("B21").Value = "Medium Business Sales" Or \_

.Range("B21").Value = "Large Business Sales") Then

```

.Range("G22:N36").Value = Worksheets("AOGC-Ark").Range("F14:M29").Value
CostCol = 8

ElseIf (.Range("B21").Value = "Business 3 Sales" Or _
.Range("B21").Value = "Business 4 Sales" Or _
.Range("B21").Value = "Business 5 Sales") Then
.Range("G22:N36").Value = Worksheets("Black Hills").Range("F22:M37").Value
CostCol = 8

ElseIf (.Range("B21").Value = "Small Commercial Firm Sales Service (SCS-1)" Or _
.Range("B21").Value = "Large Commercial Firm Service (LCS-1)" Or _
.Range("B21").Value = "Small Commercial Firm Sales Service - Off-Peak (SCS-2)") Then
.Range("G22:N36").Value = Worksheets("CenterPoint").Range("F32:M47").Value
CostCol = 7

End If

UsageCol = 3

For i = 0 To UsageCol - 1

Sum = 0

For j = 0 To 11

If .Cells(25 + j, 4 + i).Value <> "N/A" Then

Sum = Sum + .Cells(25 + j, 4 + i).Value

End If

Next j

```

```
.Cells(25 + 12, 4 + i).Value = Sum
.Cells(25 + 12, 4 + i).Font.FontStyle = "Bold"
.Cells(25 + 12, 4 + i).Interior.Pattern = xlNone
.Cells(25 + 12, 4 + i).NumberFormat = "#,##0.0"
Next i
```

```
For i = UsageCol To UsageCol + CostCol - 1
```

```
Sum = 0
```

```
For j = 0 To 12
```

```
With .Cells(25 + j, 4 + i)
```

```
    If .Value <> "N/A" Then
```

```
        .NumberFormat = "$#,##0.00"
```

```
        If j <> 12 Then
```

```
            Sum = Sum + .Value
```

```
            If i <> UsageCol + CostCol - 1 Then
```

```
                .Interior.Color = 15523812
```

```
            Else: .Interior.ColorIndex = 0
```

```
            End If
```

```
        ElseIf j = 12 Then
```

```
            If Sum <> 0 Then
```

```
                .Value = Sum
```

```
                .Interior.ColorIndex = 0
```

```
                .Font.FontStyle = "Bold"
```

```
        End If
    End If
End If
End With
Next j
Next i
.Range("B22:P37").HorizontalAlignment = xlCenter
.Range("B22:P37").VerticalAlignment = xlCenter
.Range("B21:C37").Font.FontStyle = "Bold"
.Range("D22:P24").Font.FontStyle = "Bold"
.Columns("C:Y").AutoFit
.Range("B22:P37").Rows.AutoFit
End With

End Sub
```

## Create Customizable Natural Gas Rate Schedule Table and Inputs Cells

Private Sub CreateNGTable\_Click()

Worksheets("DIY NG Rates").Activate

Dim C As Integer

Dim R As Integer

Dim TC As Integer

Dim TR As Integer

Dim TTC As Integer

Dim TTR As Integer

Dim ExR As Integer

Dim UCount As Integer

Dim CCount As Integer

Dim Subcount As Integer

Dim Subcount1 As Integer

Dim Subcount2 As Integer

Dim Subcount3 As Integer

Dim Subcount4 As Integer

Dim Subcount5 As Integer

Dim Subcount6 As Integer

Dim Subcount7 As Integer

Dim Subcount8 As Integer

Dim Consumption As Single

C = 5                ' Reference Cell Column

Cells(116, 1).Value = C

R = 6                ' Reference Cell Row

Cells(118, 1).Value = R

TC = 0                ' Column offset for the Usage Information Table.'

Cells(120, 1).Value = TC

TR = 21                ' Row offset for the Usage Information Table.'

Cells(122, 1).Value = TR

TTC = TC + 0                ' Column offset for the Costs Table

Cells(124, 1).Value = TTC

TTR = TR + 18                ' Row offset for the Costs Table

Cells(126, 1).Value = TTR

RS = 0                ' (Row Space) This is the spacing between rows for the table where the  
' customers enter their their information regarding their rate schedule  
' charges.'

ExR = 0                ' (Extra Row) This is the number of extra rows for the table where  
' the customers enter their information regarding their rate schedule charges.'

UCount = 0                ' Ongoing tally for number of rows for the Usage Information Table.  
' This ensures columns are created one cell over from the previous column.'

CCount = 1                ' Ongoing tally for number of rows for the Costs Table.

Subcount = 1



'BEGINNING OF PAGE FORMATTING' (CLEAR TRACES OF PAST USE)'

With Range("B1:Z100")

.ClearContents

.ClearFormats

End With

'MONTHS BASED ON FIRST MONTH'

' Assigning the Months value to Cell A68 displays the selection from the above list's

' drop down box.

' MoNo is the single digit representation of the month selected in the Months drop down box.

' MonthNo is a function I wrote to assign a single digit representation to the name of

' a month.

' The For Loop generates the 11 months subsequent to the Months Value. Given the single

' digit representation for the Months Value, the next 11 numbers are calculated, starting

' back at 1 after 12.

'

' Example: If the selected month is October, its single digit representation is 10.

'     When  $j = 4$ ,  $M = 14$ , but since  $M$  is  $> 12$ , 12 is subtracted from  $M$ .

'     So the new  $M$  value is 2 which corresponds to February.

'     February is 4 months after October.

' NGMonths represents the first month of the 12 month billing year'

' NGSummerStart represents the first month of the summer months'

' NGSummerLength represents the number of summer months'

' M is the number of the month'

' S is the number of the summer month (first summer month is 1)'

Range("A68").Value = NGMonths

Range("A94").Value = NGSummerStart                    ' First Summer Month

If NGSummerLength = "N/A" Then

    NGSummerLength = Empty

End If

Range("A103").Value = NGSummerLength                    ' Number of Summer Months

'Create Months Columns, Bold Summer Months (for double-checking),

MoNo = MonthNo(NGMonths)

SumMo = MonthNo(NGSummerStart)

For j = 0 To 11

    M = MoNo + j

        If M > 12 Then

            M = M - 12

        End If

    Cells(R + TR + 1 + j, C + TC - 1).Value = MonthName(M)

    Cells(R + TTR + 1 + j, C + TTC - 1).Value = MonthName(M)

    If (M >= SumMo And M < SumMo + NGSummerLength) Then

        Cells(R + TR + 1 + j, C + TC - 1).Font.Bold = True

        Cells(R + TTR + 1 + j, C + TTC - 1).Font.Bold = True

Else: Cells(R + TR + 1 + j, C + TC - 1).Font.Bold = False

Cells(R + TTR + 1 + j, C + TTC - 1).Font.Bold = False

End If

Next j

'STORE MORE VALUES'

Range("A5").Value = NGConsumptionSeasons ' Seasons YES or NO

Range("A165").Value = NGSimplePeakCons ' If there are no seasons, is there a  
peak? YES or NO'

Range("A33").Value = NGBlock ' Block Expander YES or NO

Range("A38").Value = NGNumBlock ' Number of Blocks in Expander

Range("A145").Value = NGBlockBase ' Block Size: Fixed MMBtu amount or  
specific MMBtu per MMBtu Demand of demand

Range("A10").Value = NGSumPeakCons ' Summer peak YES or NO for Energy

Range("A15").Value = NGWintPeakCons ' Winter peak YES or NO for Energy

Cells(R - 2, C).Value = "Transportation Charge (\$/MMBtu)"

Cells(R - 2 + 1, C).NumberFormat = "\$0.00#####"

'ENERGY CHARGES; ON-PEAK/OFF-PEAK, SUMMER/WINTER, AND BLOCKS'

If NGConsumptionSeasons.Value = "No" Then ' There is either a simple \$/MMBtu  
charge or the first row is the block expander charges'

If NGBlock = "No" Then                                     ' NO Seasons NO Block: The 1st line is just  
\$/MMBtu since there is NO block expander (or seasons)'

If NGSimplePeakCons = "No" Then

Cells(R, C).Value = "Cost per MMBtu (\$)"

Cells(R + TR - 1, C + TC).Value = "Total"

Cells(R + TR, C + TC).Value = "MMBtu"

For j = 1 To 12

Cells(R + TR + j, C + TC).Interior.Color = 15986394

Cells(R + TR + j, C + TC).NumberFormat = "#,###"

Next j

UCount = UCount + 1

Cells(132, 1).Value = 1

ElseIf NGSimplePeakCons = "Yes" Then

Cells(R, C).Value = "On-peak Cost per MMBtu (\$)"

Cells(R + TR - 1, C + TC).Value = "On-peak"

Cells(R + TR, C + TC).Value = "MMBtu"

UCount = UCount + 1

Cells(R, C + 1).Value = "Off-peak Cost per MMBtu (\$)"

Cells(R + TR - 1, C + TC + 1).Value = "Off-peak"

Cells(R + TR, C + TC + 1).Value = "MMBtu"

For j = 1 To 12

For i = 0 To 1

Cells(R + TR + j, C + TC + i).Interior.Color = 15986394

```

Cells(R + TR + j, C + TC + i).NumberFormat = "#,###"

Next i

Next j

UCount = UCount + 1

Cells(132, 1).Value = 2

End If

ExR = ExR + 2          ' The first row is complete, so new input info. labels will
be two rows down'

Cells(133, 1).Value = 0

Cells(134, 1).Value = 0

ElseIf NGBlock = "Yes" Then          ' NO Seasons YES Block: The 1st line will be
Block Expander, 2nd line is Block Sizes'

For i = 1 To NGNumBlock - 1          ' For Loop to create
correct amount of blocks'

Cells(R + ExR, C + i - 1).Value = "Block #" & i & " Cost per MMBtu ($)"

Next i

Cells(R + ExR, C + NGNumBlock - 1).Value = "Remaining MMBtu Cost per MMBtu ($)"

' Last cell is "Remaining" Block'

Cells(R + TR, C + TC).Value = "Total MMBtu"

For j = 1 To 12

Cells(R + TR + j, C + TC).Interior.Color = 15986394

Cells(R + TR + j, C + TC).NumberFormat = "#,###"

```

```

Next j
UCount = UCount + 1           ' UCount used for Usage table
column count'
ExR = ExR + 2
Cells(132, 1).Value = 0
Cells(133, 1).Value = NGNumBlock
Cells(134, 1).Value = NGNumBlock - 1

If NGSimplePeakCons.Value = "Yes" Then
    MsgBox "Peaks are not allowed with" & vbNewLine & "Block Expanders. Thank You."
End If

' 1st row complete. New input info will be 2 rows down.'

If NGBlockBase.Value = "Fixed (MMBtu)" Then           ' Next (2nd)
line is Block Sizes'
    For i = 1 To NGNumBlock.Value - 1                 ' For Loop to create
correct amount of block size cells'
        Cells(R + ExR, C + i - 1).Value = "Block " & i & " Size (MMBtu)"
    Next i
ElseIf NGBlockBase.Value = "Demand Based (MMBtu/MMBtu Demand)" Then
' If/ElseIf statement decides whether blocks sizes are based on strictly MMBtu or
MMBtu/MMBtu Demand'
    For i = 1 To NGNumBlock.Value - 1

```

```

Cells(R + ExR, C + i - 1).Value = "Block " & i & " Size (MMBtu/MMBtu Demand)"

Next i

End If

Cells(R + ExR, C + NGNumBlock - 1).Value = "Remaining MMBtu"

Cells(R + ExR + 1, C + NGNumBlock - 1).Value = "(Different Each Month)"

ExR = ExR + 2

End If

' Both options for NO Seasons has been completed'

ElseIf NGConsumptionSeasons.Value = "Yes" Then

If NGBlock = "Yes" Then

    UCount = 0

    If (NGSumPeakCons.Value = "Peak" Or NGWintPeakCons.Value = "Peak") Then

        MsgBox "Peaks are not allowed with" & vbNewLine & "Block Expanders. Thank You."

    End If

    Cells(R + ExR, C - 1).Value = "Summer: "

    For i = 1 To NGNumBlock - 1                                ' For Loop to create
correct amount of blocks'

        Cells(R + ExR, C + i - 1).Value = "Block #" & i & " Cost per MMBtu ($)"

    Next i

    Cells(R + ExR, C + NGNumBlock - 1).Value = "Remaining MMBtu Cost per MMBtu ($)"

' Last cell is "Remaining" Block'

ExR = ExR + 2

```

```

Cells(R + ExR, C - 1).Value = "Winter: "

For i = 1 To NGNumBlock - 1                                ' For Loop to create
correct amount of blocks'

    Cells(R + ExR, C + i - 1).Value = "Block #" & i & " Cost per MMBtu ($)"

Next i

Cells(R + ExR, C + NGNumBlock - 1).Value = "Remaining MMBtu Cost per MMBtu ($)"

Cells(R + TR, C + TC).Value = "Total MMBtu"

For j = 1 To 12

    Cells(R + TR + j, C + TC).Interior.Color = 15986394

    Cells(R + TR + j, C + TC).NumberFormat = "#,###"

Next j

ExR = ExR + 2

If NGBlockBase.Value = "Fixed (MMBtu)" Then                ' Next (2nd)
line is Block Sizes'

    For i = 1 To NGNumBlock.Value - 1                        ' For Loop to create
correct amount of block size cells'

        Cells(R + ExR, C + i - 1).Value = "Block " & i & " Size (MMBtu)"

    Next i

ElseIf NGBlockBase.Value = "Demand Based (MMBtu/MMBtu Demand)" Then

' If/ElseIf statement decides whether blocks sizes are based on strictly MMBtu or
MMBtu/MMBtu Demand'

    For i = 1 To NGNumBlock.Value - 1

```



Cells(R + ExR, C + i - 1).Value = "Block " & i & " Size (MMBtu/MMBtu Demand)"

Next i

End If

Cells(R + ExR, C + NGNumBlock - 1).Value = "Remaining MMBtu"

Cells(R + ExR + 1, C + NGNumBlock - 1).Value = "(Different Each Month)"

ExR = ExR + 2

UCount = UCount + 1

' UCount used for Usage

table column count'

Cells(132, 1).Value = 0

Cells(133, 1).Value = NGNumBlock

Cells(134, 1).Value = NGNumBlock - 1

ElseIf NGBlock = "No" Then

If NGSumPeakCons.Value = "No Peak" Then

Cells(R, C).Value = "Summer Cost per MMBtu (\$)"

Cells(R + TR - 1, C + TC) = "Summer"

Cells(R + TR, C + TC) = "MMBtu"

For j = 1 To 12

'Summer/Winter Determination'

M = MoNo + j - 1

If M > 12 Then

M = M - 12

```

End If

If (M >= SumMo And M < SumMo + NGSummerLength) Then

    Cells(R + TR + j, C + TC).Interior.Color = 15986394

    Cells(R + TR + j, C + TC).NumberFormat = "#,###"

End If

Next j

UCount = UCount + 1

If NGWintPeakCons.Value = "No Peak" Then

    Cells(R, C + UCount).Value = "Winter Cost per MMBtu ($)"

    Cells(R + TR - 1, C + UCount - 1 + TC).Value = "Total"

    Cells(R + TR, C + UCount - 1 + TC).Value = "MMBtu"

    For j = 1 To 12

        Cells(R + TR + j, C + TC).Interior.Color = 15986394

        Cells(R + TR + j, C + TC).NumberFormat = "#,###"

    Next j

    Subcount = Subcount + 0

ElseIf NGWintPeakCons.Value = "Peak" Then

    Cells(R, C + UCount).Value = "Winter On-peak Cost per MMBtu ($)"

    Cells(R + TR - 1, C + UCount + TC).Value = "Winter On-peak"

    Cells(R + TR, C + UCount + TC).Value = "MMBtu"

    For j = 1 To 12

```

'Summer/Winter Determination'

$M = MoNo + j - 1$

If  $M > 12$  Then

$M = M - 12$

End If

If ( $M < SumMo$  Or  $M \geq SumMo + NGSummerLength$ ) Then

$Cells(R + TR + j, C + TC + UCount).Interior.Color = 15986394$

$Cells(R + TR + j, C + TC + UCount).NumberFormat = "\#,###"$

End If

Next j

$Subcount = Subcount + 1$

$UCount = UCount + 1$

$Cells(R, C + UCount).Value = "Winter Off-peak Cost per MMBtu (\$)"$

$Cells(R + TR - 1, C + UCount + TC).Value = "Winter Off-peak"$

$Cells(R + TR, C + UCount + TC).Value = "MMBtu"$

For j = 1 To 12

'Summer/Winter Determination'

$M = MoNo + j - 1$

If  $M > 12$  Then

$M = M - 12$

End If

If ( $M < SumMo$  Or  $M \geq SumMo + NGSummerLength$ ) Then

$Cells(R + TR + j, C + TC + UCount).Interior.Color = 15986394$

```

        Cells(R + TR + j, C + TC + UCount).NumberFormat = "#,###"
    End If
Next j
Subcount = Subcount + 1
UCount = UCount + 1

End If

End If

If NGSumPeakCons.Value = "Peak" Then
    Cells(R, C).Value = "Summer On-peak Cost per MMBtu ($)"
    Cells(R + TR - 1, C + TC).Value = "Summer On-peak"
    Cells(R + TR, C + TC).Value = "MMBtu"
    For j = 1 To 12
        'Summer/Winter Determination'
        M = MoNo + j - 1
        If M > 12 Then
            M = M - 12
        End If
        If (M >= SumMo And M < SumMo + NGSummerLength) Then
            Cells(R + TR + j, C + TC + UCount).Interior.Color = 15986394
            Cells(R + TR + j, C + TC + UCount).NumberFormat = "#,###"
        End If
    
```

```

    Next j

    UCount = UCount + 1

    Cells(R, C + UCount).Value = "Summer Off-peak Cost per MMBtu ($)"

    Cells(R + TR - 1, C + UCount + TC).Value = "Summer Off-peak"

    Cells(R + TR, C + UCount + TC).Value = "MMBtu"

    For j = 1 To 12

        'Summer/Winter Determination'

        M = MoNo + j - 1

        If M > 12 Then

            M = M - 12

        End If

        If (M >= SumMo And M < SumMo + NGSummerLength) Then

            Cells(R + TR + j, C + TC + UCount).Interior.Color = 15986394

            Cells(R + TR + j, C + TC + UCount).NumberFormat = "#,###"

        End If

    Next j

    Subcount = Subcount + 1

    UCount = UCount + 1

    If NGWintPeakCons.Value = "No Peak" Then

        Cells(R, C + UCount).Value = "Winter Cost per MMBtu ($)"

        Cells(R + TR - 1, C + UCount + TC).Value = "Winter"

        Cells(R + TR, C + UCount + TC).Value = "MMBtu"

```

For j = 1 To 12

'Summer/Winter Determination'

M = MoNo + j - 1

If M > 12 Then

M = M - 12

End If

If (M < SumMo Or M >= SumMo + NGSummerLength) Then

Cells(R + TR + j, C + TC + UCount).Interior.Color = 15986394

Cells(R + TR + j, C + TC + UCount).NumberFormat = "#,###"

End If

Next j

Subcount = Subcount + 1

UCount = UCount + 1

ElseIf NGWintPeakCons.Value = "Peak" Then

Cells(R, C + UCount).Value = "Winter On-peak Cost per MMBtu (\$)"

Cells(R + TR - 1, C + UCount + TC).Value = "Winter On-peak"

Cells(R + TR, C + UCount + TC).Value = "MMBtu"

For j = 1 To 12

'Summer/Winter Determination'

M = MoNo + j - 1

If M > 12 Then

M = M - 12

```

End If

If (M < SumMo Or M >= SumMo + NGSummerLength) Then

    Cells(R + TR + j, C + TC + UCount).Interior.Color = 15986394

    Cells(R + TR + j, C + TC + UCount).NumberFormat = "#,###"

End If

Next j

Subcount = Subcount + 1

UCount = UCount + 1

Cells(R, C + UCount).Value = "Winter Off-peak Cost per MMBtu ($)"

Cells(R + TR - 1, C + UCount + TC).Value = "Winter Off-peak"

Cells(R + TR, C + UCount + TC).Value = "MMBtu"

For j = 1 To 12

    'Summer/Winter Determination'

    M = MoNo + j - 1

    If M > 12 Then

        M = M - 12

    End If

    If (M < SumMo Or M >= SumMo + NGSummerLength) Then

        Cells(R + TR + j, C + TC + UCount).Interior.Color = 15986394

        Cells(R + TR + j, C + TC + UCount).NumberFormat = "#,###"

    End If

Next j

Subcount = Subcount + 1

```

UCount = UCount + 1

End If

End If

ExR = ExR + 2

Cells(132, 1).Value = Subcount

Cells(133, 1).Value = 0

Cells(134, 1).Value = 0

End If

End If

iC = 0

Do While Cells(R + ExR - 2, C + iC).Value <> Empty

iC = iC + 1

Loop

For i = 0 To iC - 1

Cells(R + ExR - 1, C + i).NumberFormat = "\$0.00#####"

Next i

'Consumption RIDERS'

Subcount = 0

Range("A80").Value = NGRidersCons



If NGRidersCons <> 0 Then

    If NGRidersCons < 5 Then

        For i = 1 To NGRidersCons

            Cells(R + ExR, C + Subcount).Value = "Rider " & i & " (\$/MMBtu)"

            Cells(R + ExR + 1, C + i - 1).NumberFormat = "\$0.00#####"

            Subcount = Subcount + 1

        Next i

    Cells(135, 1).Value = Subcount

    Cells(136, 1).Value = 0

    ExR = ExR + 2

    ElseIf NGRidersCons > 4 Then

        For i = 1 To 4

            Cells(R + ExR, C + Subcount).Value = "Rider " & i & " (\$/MMBtu)"

            Cells(R + ExR + 1, C + i - 1).NumberFormat = "\$0.00#####"

            Subcount = Subcount + 1

        Next i

    Cells(135, 1).Value = Subcount

    ExR = ExR + 2

    Subcount = 0

    For i = 5 To NGRidersCons

        Cells(R + ExR, C + Subcount).Value = "Rider " & i & " (\$/MMBtu)"

Cells(R + ExR + 1, C + Subcount).NumberFormat = "\$0.00#####"

Subcount = Subcount + 1

Next i

Cells(136, 1).Value = Subcount

ExR = ExR + 2

End If

ElseIf NGRidersCons = 0 Then

Cells(135, 1).Value = 0

Cells(136, 1).Value = 0

End If

'DEMAND CHARGES; ON-PEAK/OFF-PEAK, SUMMER/WINTER'

Range("A19").Value = NGDemandSeasons

Subcount = 0

If NGDemandSeasons.Value = "No" Then

Cells(R + ExR, C + Subcount).Value = "Cost per MMBtu Demand (\$)"

Cells(R + TR - 1, C + UCount + TC).Value = "Total"

Cells(R + TR, C + UCount + TC).Value = "MMBtu Demand"

For j = 1 To 12

Cells(R + TR + j, C + TC + UCount).Interior.Color = 15986394

Cells(R + TR + j, C + TC + UCount).NumberFormat = "#,###.0"

Next j

UCount = UCount + 1

Subcount = Subcount + 1

ElseIf NGDemandSeasons.Value = "Yes" Then

Cells(R + ExR, C + Subcount).Value = "Summer Cost per MMBtu (\$)"

Cells(R + TR - 1, C + UCount + TC) = "Summer"

Cells(R + TR, C + UCount + TC) = "MMBtu Demand"

For j = 1 To 12

'Summer/Winter Determination'

M = MoNo + j - 1

If M > 12 Then

M = M - 12

End If

If (M >= SumMo And M < SumMo + NGSummerLength) Then

Cells(R + TR + j, C + TC + UCount).Interior.Color = 15986394

Cells(R + TR + j, C + TC + UCount).NumberFormat = "#,###.0"

End If

Next j

UCount = UCount + 1

Subcount = Subcount + 1

Cells(R + ExR, C + Subcount).Value = "Winter Cost per MMBtu (\$)"

Cells(R + TR - 1, C + UCount + TC - 1).Value = "Total"

Cells(R + TR, C + UCount + TC - 1).Value = "MMBtu Demand"

For j = 1 To 12

'Summer/Winter Determination'

M = MoNo + j - 1

If M > 12 Then

M = M - 12

End If

If (M < SumMo Or M >= SumMo + NGSummerLength) Then

Cells(R + TR + j, C + TC + UCount - 1).Interior.Color = 15986394

Cells(R + TR + j, C + TC + UCount - 1).NumberFormat = "#,###.0"

End If

Next j

Subcount = Subcount + 1

End If

ExR = ExR + 2

Do While Cells(R + ExR - 2, C + iC).Value <> Empty

iC = iC + 1

Loop

For i = 0 To iC - 1

Cells(R + ExR - 1, C + i).NumberFormat = "\$0.00#####"

Next i

Cells(137, 1).Value = Subcount

'Assign Userform entries to fixed cells (demand section)'

Range("A42").Value = NGRatchet

Range("A160").Value = NGRatchMos

Range("A46").Value = NGMinDem

Range("A50").Value = NGFranchise

Range("A54").Value = NGTaxes

'RATCHET CLAUSE AND MINIMUM BILLED DEMAND'

'RATCHET CLAUSE'

Subcount = 0

Cells(R + ExR, C + Subcount).Value = "Ratchet Percentage (%)"

Cells(R + ExR + 1, C + Subcount).NumberFormat = "0.00% "

If NGRatchet = "No" Then

Cells(R + ExR + 1, C + Subcount).Value = "N/A"

End If

Subcount = Subcount + 1

'MINIMUM BILLED DEMAND'

Cells(R + ExR, C + Subcount).Value = "Minimum Billed Demand (MMBtu Demand)"

Cells(R + ExR + 1, C + Subcount).NumberFormat = "#,###"

If NGMinDem = "No" Then

Cells(R + ExR + 1, C + Subcount).Value = "N/A"

End If

Subcount = Subcount + 1

ExR = ExR + 2

'DEMAND RIDERS'

'DEMAND RIDERS UP TO 4'

Subcount = 0

Range("A114").Value = NGRidersDem

If NGRidersDem <> 0 Then

If NGRidersDem < 5 Then

For i = 1 To NGRidersDem

Cells(R + ExR, C + Subcount).Value = "Rider " & i & " (\$/MMBtu Demand)"

Cells(R + ExR + 1, C + i - 1).NumberFormat = "\$0.00#####"

Subcount = Subcount + 1

Next i

Cells(138, 1).Value = Subcount

Cells(139, 1).Value = 0

ExR = ExR + 2

'DEMAND RIDERS UP TO 8'

ElseIf NGRidersDem > 4 Then

For i = 1 To 4

Cells(R + ExR, C + Subcount).Value = "Rider " & i & " (\$/MMBtu Demand)"

Cells(R + ExR + 1, C + i - 1).NumberFormat = "\$0.00#####"

Subcount = Subcount + 1

Next i

Cells(138, 1).Value = Subcount

ExR = ExR + 2

Subcount = 0

For i = 5 To NGRidersDem

Cells(R + ExR, C + Subcount).Value = "Rider " & i & " (\$/MMBtu Demand)"

Cells(R + ExR + 1, C + i - 4 - 1).NumberFormat = "\$0.00#####"

Subcount = Subcount + 1

Next i

Cells(139, 1).Value = Subcount

ExR = ExR + 2

End If

ElseIf NGRidersDem = 0 Then

Cells(138, 1).Value = 0

Cells(139, 1).Value = 0

End If

#### 'TAXES AND FRANCHISE FEE'

'FRANCHISE FEE'

Subcount = 0

Cells(R + ExR, C + Subcount).Value = "Franchise Fee Percentage(%)"

Cells(R + ExR + 1, C + Subcount).NumberFormat = "0.000% "

If NGFranchise = "No" Then

Cells(R + ExR + 1, C + Subcount).Value = "N/A"

End If

Subcount = Subcount + 1

'TAXES'

Cells(R + ExR, C + Subcount).Value = "Total Tax Percentage(%)"

Cells(R + ExR + 1, C + Subcount).NumberFormat = "0.000% "

If NGTaxes = "No" Then

Cells(R + ExR + 1, C + Subcount).Value = "N/A"

End If

Subcount = Subcount + 1

ExR = ExR + 2

Cells(140, 1).Value = Subcount



```
Cells(R + ExR, C).Value = "Customer Charge ($)"
```

```
Cells(R + ExR, C).NumberFormat = "$#,##0.00"
```

' All cells are formatted to center alignment and the column widths are autofitted.

' The final Count number is displayed for as a double checking method for code writing

' purposes.

```
Range("B1:Z100").HorizontalAlignment = xlCenter
```

```
Range("B1,Z100").Columns.AutoFit
```

```
'END OF PAGE FORMATTING (PREPARE FOR FUTURE USE)'
```

```
'END OF PAGE FORMATTING (PREPARE FOR FUTURE USE)'
```

```
'CCC = Costs Columns Count"
```

```
'UCC = Usage Columns Count"
```

```
UCC = 0
```

```
Do While Cells(R + TR, C + TC + UCC).Value <> Empty
```

UCC = UCC + 1

Loop

For i = 0 To UCC - 1

Cells(R + TR - 1, C + TC + i).Font.FontStyle = "Bold"

Cells(R + TR, C + TC + i).Font.FontStyle = "Bold"

Next i

CCC = 0

Do While Cells(R + TTR, C + TTC + CCC).Value <> Empty

CCC = CCC + 1

Loop

If CCC > 0 Then

For j = 0 To 12

For i = 0 To CCC

Cells(R + TTR + j, C + TTC + i).ClearContents

Next i

Next j

End If

For j = 0 To 10

For i = 0 To 3

If Cells(R + j \* 2 - 2, C + i).Value <> Empty Then

Cells(R + j \* 2 - 2, C + i).Font.FontStyle = "Bold"

```

        'Cells(R + j * 2 - 2, C + i).Font.Underline = xlUnderlineStyleSingle
        Cells(R + j * 2 + 1 - 2, C + i).Borders.LineStyle = xlContinuous
    End If
Next i
Next j

With Range("B1:Y100")
    .HorizontalAlignment = xlCenter
    .VerticalAlignment = xlCenter
    .Columns("B:Y").AutoFit
    .Rows("1:100").AutoFit

For i = C + 0 - 1 To C + 10 - 1
    With .Columns(i)
        If .ColumnWidth > 15 Then
            .ColumnWidth = 15
            .WrapText = True
        ElseIf .ColumnWidth < 10 Then
            .ColumnWidth = 10
        End If
    End With
End With
Next i

```

```
Columns("B:Y").AutoFit
```

```
End With
```

```
End
```

```
End Sub
```

## Calculate Customizable Rate Schedule Natural Gas Utility Cost

Sub NGCalculateButton\_Click()

Dim C As Integer

Dim R As Integer

Dim TC As Integer

Dim TR As Integer

Dim TTC As Integer

Dim TTR As Integer

Dim ExR As Integer

Dim UCount As Integer

Dim CCount As Integer

Dim Subcount As Integer

Dim SCSznCons As Integer

Dim SCNumBlockNG As Integer

Dim SCBlockSizeNG As Integer

Dim SCConsRider14 As Integer

Dim SCConsRider58 As Integer

Dim SCSznDemNG As Integer

Dim SCDemRider14 As Integer

Dim SCDemRider58 As Integer

Dim SCMiscNG As Integer

Dim NGSummerLength As Integer

C = Cells(116, 1).Value

R = Cells(118, 1).Value

TC = Cells(120, 1).Value

TR = Cells(122, 1).Value

TTC = Cells(124, 1).Value

TTR = Cells(126, 1).Value

'CCC = Costs Columns Count"

CCC = 0

Do While Cells(R + TTR, C + TTC + CCC).Value <> Empty

    CCC = CCC + 1

Loop

For j = 0 To 13

    For i = 0 To CCC

        Cells(R + TTR + j - 1, C + TTC + i).ClearContents

    Next i

Next j

'SC Stands for Subcount, running talleys from the userform algorithm, max 4'

SCSznCons = Cells(132, 1).Value

' Number of Energy peaks and/or

season combinations

SCNumBlockNG = Cells(133, 1).Value ' Number of blocks in block  
 expander; !IF SEASONS YES AND BLOCKS YES THEN SUMMER/WINTER BLOCK#  
 SHARE SAME SUBCOUNT!  
 SCBlockSizeNG = Cells(134, 1).Value + 1 ' Number of blocks, Used for  
 the size of each block  
 SCConsRider14 = Cells(135, 1).Value ' Number of kWh riders  
 between from 1 - 4  
 SCConsRider58 = Cells(136, 1).Value ' Number of kWh rider from 5 -  
 8  
 SCSznDemNG = Cells(137, 1).Value ' Number of Demand peaks  
 and/or season combinations  
 SCDemRider14 = Cells(138, 1).Value ' Number of kW riders between  
 from 1 - 4  
 SCDemRider58 = Cells(139, 1).Value ' Number of kW rider from 5 - 8  
 SCMiscNG = Cells(140, 1).Value ' Number of Miscellaneous  
 columns  
  
 ExR = 0  
 Subcount = 1  
 'Cost Table column count -1; Counts columns that have been finished in the Costs Table so  
 CCount can be added to the Cells() column reference for the current calculations column'  
 CCount = 0

'Usage Table column count -1; Counts columns that have been finished in the Usage Table so  
UCount can be added to the Cells() column reference for the current calculations refernce  
column'

UCount = 0

NGConsumptionSeasons = Range("A5").Value

NGSumPeakCons = Range("A10").Value

NGWintPeakCons = Range("A15").Value

NGBlock = Range("A33").Value

NGBlockBase = Range("A145").Value

NGSummerStart = Range("A94").Value

NGSummerLength = Range("A103").Value

MoNo = MonthNo(Range("A68").Value) ' Number for of Months'

SumMo = MonthNo(Range("A94").Value) ' Number for SummerStart'

Cells(R + TTR - 1, C + TTC + CCount).Value = "Transportation Cost"

Cells(R + TTR, C + TTC + CCount).Value = "\$"

TransportCharge = Cells(R - 1, C).Value

For j = 1 To 12

Consumption = 0

For i = 1 To SCSznCons

Consumption = Consumption + Cells(R + TR + 1, C + i - 1).Value



```

Next i
TransportCost = Consumption * TransportCharge
Cells(R + TTR + j, C + TTC + CCount).Value = TransportCost
Next j
CCount = CCount + 1

Cells(R + TTR - 1, C + TTC + CCount).Value = "Energy Cost"
Cells(R + TTR, C + TTC + CCount).Value = "$"
If NGConsumptionSeasons = "No" Then          ' There is either a simple $/kWh charge or
the first row is the block expander charges'

    If NGBlock = "No" Then                    ' NO Seasons NO Block: The 1st line is just $/kWh
since there is NO block expander (or seasons)'

        For j = 1 To 12
            Energy = 0
            For i = 1 To SCSznCons
                Energy = Energy + Cells(R + ExR + 1, C + i - 1).Value * Cells(R + TR + j, C + TC + i
- 1).Value
            Next i
            Cells(R + TTR + j, C + TTC + CCount).Value = Energy
        Next j
        UCount = UCount + SCSznCons
        ExR = ExR + 2                          ' The first row is complete, so new input info. labels will
be two rows down'

```

```

ElseIf NGBlock = "Yes" Then          ' NO Seasons YES Block: The 1st line will be
Block Expander, 2nd line is Block Sizes'

If NGBlockBase = "Fixed (kWh)" Then

  For j = 1 To 12

    Energy = 0

    TotalkWh = Cells(R + TR + j, C + TC + UCount).Value

    Remaining = TotalkWh

    For i = 1 To SCNumBlockNG          ' For Loop to create
correct amount of blocks'

      If Remaining > 0 Then

        If i <> SCNumBlockNG Then

          BlockCharge = Cells(R + ExR + 1, C + i - 1).Value

          BlockSize = Cells(R + ExR + 1 + 2, C + i - 1).Value

          If Remaining < BlockSize Then

            BlockSize = Remaining

          End If

          Energy = Energy + BlockCharge * BlockSize

          Remaining = Remaining - BlockSize

        ElseIf i = SCNumBlockNG Then

          BlockCharge = Cells(R + ExR + 1, C + i - 1).Value

          Energy = Energy + BlockCharge * Remaining

        End If

```

```

    End If

    Next i

    Cells(R + TTR + j, C + TTC + CCount).Value = Energy

    Next j

    ExR = ExR + 4

    ElseIf NGBlockBase = "Demand Based (kWh/kW-mo)" Then

        For j = 1 To 12

            Energy = 0

            TotalkWh = Cells(R + TR + j, C + TC + UCount).Value

            Remaining = TotalkWh

            MonthDemand = Cells(R + TR + j, C + TC + 1 + DC + UCount).Value

            For i = 1 To SCNumBlockNG                                ' For Loop to create
correct amount of blocks'

                If Remaining > 0 Then

                    If i <> SCNumBlockNG Then

                        BlockCharge = Cells(R + ExR + 1, C + i - 1).Value

                        BlockSize = Cells(R + ExR + 1 + 2, C + i - 1).Value * MonthDemand

                        If Remaining < BlockSize Then

                            BlockSize = Remaining

                        End If

                        Energy = Energy + BlockCharge * BlockSize

                        Remaining = Remaining - BlockSize

```

ElseIf i = SCNumBlockNG Then

BlockCharge = Cells(R + ExR + 1, C + i - 1).Value

Energy = Energy + BlockCharge \* Remaining

End If

End If

Next i

Cells(R + TTR + j, C + TTC + CCount).Value = Energy

Next j

UCount = UCount + 0

' UCount remains at 0, kWh

Riders calculation comes next, which is still based on Total kWh'

ExR = ExR + 4

' Current focus is on Block#

Charges, which deals with the Block Sizes in the cells below, to continue, must jump down 4 cells (skipping Block Sizes).'

End If ' END Block Base IF'

End If ' END of Block YES/NO'

CCount = CCount + 1

' Both options for NO Seasons has been completed'

ElseIf NGConsumptionSeasons = "Yes" Then

If NGBlock = "Yes" Then

If NGBlockBase = "Fixed (kWh)" Then

For j = 1 To 12

' The following line determines if the current month's single digit value is outside the range of single digit values of 'Summer Months' '

```

    If (MonthNo(Cells(R + TR + j, C + TC - 1).Value) < MonthNo(Range("A94").Value)
Or MonthNo(Cells(R + TR + j, C + TC - 1).Value) >= (MonthNo(Range("A94").Value) +
NGSummerLength)) Then

        SznR = 2      ' The season additional rows is defined; Winter block charges are
[SznR=] 2 rows down from the summer block charges'

    Else: SznR = 0

    End If

    Energy = 0

    TotalkWh = Cells(R + TR + j, C + TC + UCount).Value

    Remaining = TotalkWh

    For i = 1 To SCNumBlockNG                                ' For Loop to create
correct amount of blocks'

        If Remaining > 0 Then

            If i <> SCNumBlockNG Then

                BlockCharge = Cells(R + ExR + 1 + SznR, C + i - 1).Value

                BlockSize = Cells(R + ExR + 1 + 4, C + i - 1).Value

                If Remaining < BlockSize Then

                    BlockSize = Remaining

                End If

                Energy = Energy + BlockCharge * BlockSize

                Remaining = Remaining - BlockSize

            ElseIf i = SCNumBlockNG Then

```

```

        BlockCharge = Cells(R + ExR + 1 + SznR, C + i - 1).Value
        Energy = Energy + BlockCharge * Remaining
    End If
End If
Next i
Cells(R + TTR + j, C + TTC + CCount).Value = Energy
Next j
CCount = CCount + 1
ExR = ExR + 6
ElseIf NGBlockBase = "Demand Based (kWh/kW-mo)" Then
    For j = 1 To 12
        ' The following line determines if the current month's single digit value is outside the
range of single digit values of 'Summer Months' '
        If (MonthNo(Cells(R + TR + j, C + TC - 1).Value) < MonthNo(Range("A94").Value)
Or MonthNo(Cells(R + TR + j, C + TC - 1).Value) >= (MonthNo(Range("A94").Value) +
NGSummerLength)) Then
            SznR = 2    ' The season additional rows is defined; Winter block charges are
[SznR=] 2 rows down from the summer block charges'
        Else: SznR = 0
        End If
        Energy = 0
        TotalkWh = Cells(R + TR + j, C + TC + UCount).Value
        Remaining = TotalkWh
    
```

MonthDemand = Cells(R + TR + j, C + TC + 1 + DC + UCount).Value

For i = 1 To SCNumBlockNG ' For Loop to create  
correct amount of blocks'

If Remaining > 0 Then

If i <> SCNumBlockNG Then

BlockCharge = Cells(R + ExR + 1 + SznR, C + i - 1).Value

BlockSize = Cells(R + ExR + 1 + 4, C + i - 1).Value \* MonthDemand

If Remaining < BlockSize Then

BlockSize = Remaining

End If

Energy = Energy + BlockCharge \* BlockSize

Remaining = Remaining - BlockSize

ElseIf i = SCNumBlockNG Then

BlockCharge = Cells(R + ExR + 1 + SznR, C + i - 1).Value

Energy = Energy + BlockCharge \* Remaining

End If

End If

Next i

Cells(R + TTR + j, C + TTC + CCount).Value = Energy

Next j

UCount = UCount + 0 ' UCount remains at 0, kWh

Riders calculation comes next, which is still based on Total kWh'

CCount = CCount + 1

ExR = ExR + 6

' Current focus is on Block#

Charges, which deals with the Block Sizes in the cells below, to continue, must jump down 4 cells (skipping Block Sizes).'

End If ' END Block Base IF'

ElseIf NGBlock = "No" Then

If (NGWintPeakCons = "No Peak" And NGSumPeakCons = "No Peak") Then

SummEnCharge = Cells(R + 1, C).Value

WintEnCharge = Cells(R + 1, C + 1).Value

For j = 1 To 12

Energy = 0

'Summer/Winter Determination'

M = MoNo + j - 1

If M > 12 Then

M = M - 12

End If

If (M >= SumMo And M < SumMo + NGSummerLength) Then

EnergyCharge = SummEnCharge

Else: EnergyCharge = WintEnCharge

End If

Energy = Cells(R + TR + j, C + TC).Value \* EnergyCharge

Cells(R + TTR + j, C + TTC + CCount).Value = Energy



```

    Next j

    UCount = UCount + 0 'still have to do riders'

Else:

    For j = 1 To 12

        Energy = 0

        For i = 1 To SCSznCons

            Energy = Energy + Cells(R + ExR + 1, C + i - 1).Value * Cells(R + TR + j, C + TC
+ i - 1).Value

            Next i

            Cells(R + TTR + j, C + TCC + CCount).Value = Energy

        Next j

    End If

    If NGSumPeakCons = "No Peak" Then

        If NGWintPeakCons = "Peak" Then

            UCount = UCount + 2

        End If

    End If

    If NGSumPeakCons = "Peak" Then

        If NGWintPeakCons = "No Peak" Then

            UCount = UCount + 2

        ElseIf NGWintPeakCons = "Peak" Then

            UCount = UCount + 3

```

End If

End If

ExR = ExR + 2

CCount = CCount + 1

End If

End If

If SCConsRider14 > 0 Then

Cells(R + TTR - 1, C + TTC + CCount).Value = "Riders Cost"

Cells(R + TTR, C + TTC + CCount).Value = "\$"

For j = 1 To 12

TotalkWh = 0

If SCSznCons > 1 Then

For i = 1 To SCSznCons

TotalkWh = TotalkWh + Cells(R + TR + j, C + TC + i - 1).Value

Next i

Else: TotalkWh = Cells(R + TR + j, C + TC).Value

End If

If SCConsRider14 > 0 Then

RiderSum = 0

For i = 1 To SCConsRider14

RiderSum = RiderSum + TotalkWh \* Cells(R + ExR + 1, C + i - 1).Value

```

    Next i
  If SCConsRider58 > 0 Then
    For i = 1 To SCConsRider58
      RiderSum = RiderSum + TotalkWh * Cells(R + ExR + 1 + 2, C + i - 1).Value
    Next i
  End If
  Cells(R + TTR + j, C + TTC + CCount).Value = RiderSum
End If
Next j
End If

```

```

If SCConsRider14 > 0 Then
  CCount = CCount + 1
  ExR = ExR + 2
  If SCConsRider58 > 0 Then
    ExR = ExR + 2
  End If
End If

```

```

If ((NGConsumptionSeasons = "Yes" And NGWintPeakCons = "No Peak" And
NGSumPeakCons = "No Peak") Or SCSznCons > 2 Or NGBlock = "Yes") Then
  UCount = UCount + 1

```

End If

'DEMAND CALCULATIONS'

NGDemandSeasons = Range("A19").Value

NGRatchMos = Range("A160").Value

Cells(R + TTR - 1, C + CCount).Value = "Demand Cost"

Cells(R + TTR, C + CCount).Value = "\$"

NGMinDem = Cells(R + ExR + 1 + 2, C + 1).Value

If (NGMinDem = "N/A" Or NGMinDem = 0) Then

Cells(R + ExR + 1 + 2, C + 1).Value = 0

NGMinDem = 0

End If

If (Cells(R + ExR + 1 + 2, C).Value = "N/A" Or Cells(R + ExR + 1 + 2, C).Value = 0) Then

Cells(R + ExR + 1 + 2, C).Value = 0

NGRatchMos = 0

End If

Subcount = 0

If NGDemandSeasons = "No" Then

```

For j = 1 To 12
    Billed = 0
    DemCost = 0
    Billed = Cells(R + TR + j, C + TC + UCount).Value
    If Billed < NGMinDem Then
        Billed = NGMinDem
    End If
    For i = 1 To NGRatchMos
        RM = i
        If j - RM <= 0 Then
            RM = RM - 12
        End If
        RatchDem = Cells(R + TR + j - RM, C + TC + UCount).Value * Cells(R + ExR + 1 +
2, C).Value
        If Billed < RatchDem Then
            Billed = RatchDem
        End If
    Next i
    DemCost = Cells(R + ExR + 1, C).Value * Billed
    Cells(R + TTR + j, C + TTC + CCount).Value = DemCost
Next j
UCount = UCount + 1
ElseIf NGDemandSeasons = "Yes" Then

```

For j = 1 To 12

Billed = 0

DemCost = 0

Billed = Cells(R + TR + j, C + TC + UCount).Value

If Billed < NGMinDem Then

Billed = NGMinDem

End If

For i = 1 To NGRatchMos

RM = i

If j - RM <= 0 Then

RM = RM - 12

End If

RatchDem = Cells(R + TR + j - RM, C + TC + UCount).Value \* Cells(R + ExR + 1 +

2, C).Value

If Billed < RatchDem Then

Billed = RatchDem

End If

Next i

'Summer/Winter Determination'

M = MoNo + j - 1

If M > 12 Then

M = M - 12

```

End If

If (M >= SumMo And M < SumMo + NGSummerLength) Then

    DemCharge = Cells(R + ExR + 1, C).Value

Else: DemCharge = Cells(R + ExR + 1, C + 1).Value

End If

DemCost = DemCharge * Billed

Cells(R + TTR + j, C + TTC + CCount).Value = DemCost

Next j

UCount = UCount + 0

End If

CCount = CCount + 1

ExR = ExR + 4

Do While Cells(R + TR, C + TC + SCSznEn + UDC).Value <> Empty

    'UDC = Usage Demand Column Count'

    UDC = UDC + 1

Loop

SCSznDemNG = UDC

If SCDemRider14 > 0 Then

    Cells(R + TTR - 1, C + TTC + CCount).Value = "Demand Riders Cost"

    Cells(R + TTR, C + TTC + CCount).Value = "$"

```

```

TotalDem = 0
For j = 1 To 12
    TotalDem = 0
    For i = 1 To SCSznDemNG
        TotalDem = TotalDem + Cells(R + TR + j, C + TC + UCount - SCSznDemNG +
i).Value
    Next i
    If SCDemRider14 > 0 Then
        RiderSum = 0
        For i = 1 To SCDemRider14
            RiderSum = RiderSum + TotalDem * Cells(R + ExR + 1, C + i - 1).Value
        Next i
        If SCDemRider58 > 0 Then
            For i = 1 To SCDemRider58
                RiderSum = RiderSum + TotalDem * Cells(R + ExR + 1 + 2, C + i - 1).Value
            Next i
        End If
        Cells(R + TTR + j, C + TTC + CCount).Value = RiderSum
    End If
Next j
End If

If SCDemRider14 > 0 Then

```



CCount = CCount + 1

ExR = ExR + 2

If SCDemRider58 > 0 Then

    ExR = ExR + 2

End If

End If

' NGSubtotal is the sum of everything from the first column (i=0) to the previous column (i = CCount - 1) (CCount is the current column).'

' Each months NGSubtotal (for j = 1 to 12) is entered into the cell in the current column (CCount).'

Cells(R + TTR - 1, C + TTC + CCount).Value = "Subtotal"

Cells(R + TTR, C + TTC + CCount).Value = "\$"

For j = 1 To 12

    NGSubtotal = 0

    For i = 0 To CCount - 1

        NGSubtotal = NGSubtotal + Cells(R + TTR + j, C + TTC + i).Value

    Next i

    NGCustomerCharge = Cells(R + ExR + 2 + 1, C).Value

    NGSubtotal = NGSubtotal + NGCustomerCharge

    Cells(R + TTR + j, C + TTC + CCount).Value = NGSubtotal

Next j

CCount = CCount + 1

' Franchise Fee = (Municipal Tax Rate) \* (Subtotal)'

' NGFranchiseRate = Municipal Tax Rate'

' NGFranchise = Franchise Fee'

' NGSubFranch = NGFranchise + NGSubtotal

' Taxes = (Total Tax Rate) \* (Subtotal + Franchise Fee)'

' NGTotalTaxRate = Total Tax Rate'

' NGTaxes = Total Taxes'

' Taxes and Franchise Fee will be combined in one column (CCount) and as one combined value'

' NGTaxesFees = Franchise Fee + Total Taxes'

Cells(R + TTR - 1, C + TTC + CCount).Value = "Taxes & Fees"

Cells(R + TTR, C + TTC + CCount).Value = "\$"

NGFranchiseRate = Cells(R + ExR + 1, C).Value

If NGFranchiseRate = "N/A" Then

    NGFranchiseRate = Empty

End If

NGTotalTaxRate = Cells(R + ExR + 1, C + 1).Value

If NGTotalTaxRate = "N/A" Then

    NGTotalTaxRate = Empty

End If

For j = 1 To 12

NGSubtotal = Cells(R + TTR + j, C + TTC + CCount - 1).Value

NGFranchise = NGFranchiseRate \* NGSubtotal

NGSubFranch = NGFranchise + NGSubtotal

NGTaxes = NGSubFranch \* NGTotalTaxRate

NGTaxesFees = NGFranchise + NGTaxes

Cells(R + TTR + j, C + TTC + CCount).Value = NGTaxesFees

Next j

CCount = CCount + 1

Cells(R + TTR - 1, C + TTC + CCount).Value = "Total"

Cells(R + TTR, C + TTC + CCount).Value = "\$"

For j = 1 To 12

NGTotal = Cells(R + TTR + j, C + TTC + CCount - 2) + Cells(R + TTR + j, C + TTC + CCount - 1)

Cells(R + TTR + j, C + TTC + CCount).Value = NGTotal

Next j

'END OF PAGE FORMATTING (PREPARE FOR FUTURE USE)'

CCC = 0

Do While Cells(R + TTR, C + TTC + CCC).Value <> Empty

CCC = CCC + 1

Loop

UCC = 0

```

Do While Cells(R + TR, C + TC + UCC).Value <> Empty
    UCC = UCC + 1
Loop
For i = 0 To CCC - 1
    Cells(R + TTR - 1, C + TTC + i).Font.FontStyle = "Bold"
    Cells(R + TTR, C + TTC + i).Font.FontStyle = "Bold"
    For j = 1 To 12
        Cells(R + TTR + j, C + TTC + i).NumberFormat = "$#,##0.00"
    Next j
Next i

With Worksheets("DIY NG Rates")
    .Range("B1:Y100").HorizontalAlignment = xlCenter
    .Range("B1:Y100").VerticalAlignment = xlCenter
    For i = CCC - UCC To CCC - 1
        Columns(C + TTC + i).AutoFit
        If .Columns(C + TTC + i).ColumnWidth < 15 Then
            .Columns(C + TTC + i).ColumnWidth = 15
        End If
    Next i
End With

End Sub

```

## Calculate CHP Thermal Inputs and Output

Private Sub CHPFillInfo\_Click()

If CHPEIEffTB.Value >= 1 Then

    CHPThermInkWTB.Value = CHPEIPowerTB.Value / (CHPEIEffTB.Value / 100)

    CHPThermInMMTB.Value = CHPEIPowerTB.Value / (CHPEIEffTB / 100) \* 0.003412

    CHPThermOutMMTB.Value = CHPEIPowerTB.Value / (CHPEIEffTB / 100) \_  
        \* 0.003412 \* (CHPThermEffTB.Value / 100)

End If

End Sub

## Calculate Proposed Utility Usages and Costs

Private Sub CHPEnterButton\_Click()

Dim CurrentPage As Integer

Dim ShiftNum As Single

Dim DailyHours As Single

Dim ShiftDays As Single

Dim Percentage As Single

Dim CHPEIPower As Single

Dim CHPEIEff As Single

Dim CHPThermEff As Single

Worksheets("CHP Info").Activate

CurrentPage = 4

ShiftNum = Val(ShiftNumTB)

ShiftLength = Val(ShiftLengthTB)

DailyHours = ShiftNum \* ShiftLength

ShiftDays = Val(ShiftDaysTB)

Percentage = Val(PercentageTB)

CHPEIPower = Val(CHPEIPowerTB)

CHPEIEff = Val(CHPEIEffTB) / 100

CHPThermEff = Val(CHPThermEffTB) / 100

CHPThermInkW = Val(CHPThermInkWTB)

CHPThermInMMBtu = Val(CHPThermInMMTB)  
CHPThermOutMMBtu = Val(CHPThermOutMMTB)  
MonthlyOH = (365 / 12) \* DailyHours \* Val(ShiftDaysTB) / 7  
EILF = Val(EILFTB)  
ThLF = Val(ThLFTB)  
CHPkWh = CHPEIPower \* MonthlyOH  
MonthlyMMBtuIn = MonthlyOH \* CHPThermInMMBtu  
MonthlyMMBtuOut = MonthlyOH \* CHPThermOutMMBtu  
CreditsRate = CreditsRateTB.Value  
ShiftStart = Val(ShiftStartTB)

'Transfer Values from Main UserForm to CHP Info Page'

With Worksheets("CHP Info")

.Range("B2") = CHPEIPower  
.Range("B2").NumberFormat = "#,###"  
.Range("B3").Value = CHPEIEff  
.Range("B3").NumberFormat = "0.0% "  
.Range("B4").Value = CHPThermEff

.Range("B4").NumberFormat = "0.0% "  
.Range("B5").Value = CHPThermInkW  
.Range("B5").NumberFormat = "#,###.0"  
.Range("B6").Value = CHPThermInMMBtu  
.Range("B6").NumberFormat = "#,##0.000"  
.Range("B7").Value = CHPThermOutMMBtu  
.Range("B7").NumberFormat = "#,##0.0000"  
.Range("B8").Value = ShiftNum  
.Range("B8").NumberFormat = "#.0"  
.Range("B9").Value = ShiftLength  
.Range("B9").NumberFormat = "#.0"  
.Range("B10").Value = ShiftDays  
.Range("B10").NumberFormat = "#.0"  
.Range("B11").Value = MonthlyOH  
.Range("B11").NumberFormat = "#,##0.0"  
.Range("B12").Value = CHPkWh  
.Range("B12").NumberFormat = "#,##0"  
.Range("B13").Value = MonthlyMMBtuOut  
.Range("B13").NumberFormat = "#,##0"  
.Range("B14").Value = MonthlyMMBtuIn  
.Range("B14").NumberFormat = "#,##0"  
.Range("B15").Value = ShiftStartTB



```
.Range("B16").Value = Percentage
.Range("B16").NumberFormat = "0.00"
.Range("B17").Value = CreditsRate
.Range("B17").NumberFormat = "$0.00#####"
.Range("B18").Value = ThLF
.Range("B18").NumberFormat = "0.00"
```

End With

'Create columns (based on Ground Zero tables) for total charged kWh, kW-mo,  
'MMBtu consumption and MMBtu Demand.'

With Worksheets("Ground Zero")

```
kWhC = 0
```

```
Do While .Cells(3, 4 + kWhC).Value = "kWh"
```

```
    kWhC = kWhC + 1
```

Loop

```
kWmoC = 0
```

```
Do While .Cells(3, 4 + kWhC + kWmoC).Value = "kW-mo"
```

```
    kWmoC = kWmoC + 1
```

Loop

```
Do While .Cells(3, 4 + kWhC + kWmoC + CCC).Value <> Empty
```

```
    CCC = CCC + 1
```

Loop

```

MonthlykWhSum = 0
For j = 0 To 11
'Total Charged kWh'
    MonthlykWh = 0
    For i = 0 To kWhC - 1
        MonthlykWh = MonthlykWh + .Cells(4 + j, 4 + i).Value
    Next i
    MonthlykWhSum = MonthlykWhSum + MonthlykWh
Worksheets("CHP Info").Cells(4 + j, 6).Value = MonthlykWh
Worksheets("CHP Info").Cells(4 + j, 6).NumberFormat = "#,###"
Next j
Worksheets("CHP Info").Cells(4 + 12, 6).Value = MonthlykWhSum
Worksheets("CHP Info").Cells(4 + 12, 6).NumberFormat = "#,###"
'Total Charged kW-mo'
kWmoPeakSum = 0
MonthlykWmoSum = 0
For j = 0 To 11
    MonthlykWmo = 0
    CHPkWmo = 0
    kWmoPeak = 0
    For i = kWhC To kWhC + kWmoC - 1
        MonthlykWmo = MonthlykWmo + .Cells(4 + j, 4 + i).Value
        If .Cells(4 + j, 4 + i).Value > kWmoPeak Then

```

```

kWmoPeak = .Cells(4 + j, 4 + i).Value

End If

Next i

MonthlykWmoSum = MonthlykWmoSum + MonthlykWmo
kWmoPeakSum = kWmoPeakSum + kWmoPeak

Worksheets("CHP Info").Cells(4 + j, 7).Value = MonthlykWmo
Worksheets("CHP Info").Cells(4 + j, 7).NumberFormat = "#,###"
Worksheets("CHP Info").Cells(4 + j, 8).Value = kWmoPeak
Worksheets("CHP Info").Cells(4 + j, 8).NumberFormat = "#,###"

Next j

Worksheets("CHP Info").Cells(4 + 12, 7).Value = MonthlykWmoSum
Worksheets("CHP Info").Cells(4 + 12, 7).NumberFormat = "#,###"
Worksheets("CHP Info").Cells(4 + 12, 8).Value = kWmoPeakSum
Worksheets("CHP Info").Cells(4 + 12, 8).NumberFormat = "#,###"

```

'Total Charged MMBtu Consumption'

If .Range("B21").Value <> "Customizable Natural Gas Rate Schedule" Then

```
MonthlyMMBtu = 0
```

```
MonthlyMMBtuSum = 0
```

```
For j = 0 To 11
```

```
MonthlyMMBtu = .Cells(25 + j, 5).Value
```

```
Worksheets("CHP Info").Cells(4 + j, 9).Value = MonthlyMMBtu
```

```
MonthlyMMBtuSum = MonthlyMMBtuSum + MonthlyMMBtu
```

```

Next j
Worksheets("CHP Info").Cells(4 + 12, 9).Value = MonthlyMMBtuSum
'Total Charged MMBtu Demand'
'If the Rate Schedule includes Demand then it will transfer the MMBtu
' Demand Values or convert MCF Demand Values to MMBtu Demand Values
' and then transfer it.'
MonthlyDem = 0
MonthlyDemSum = 0
MonthlyPeak = 0
MonthlyPeakSum = 0
For j = 0 To 11
    MonthlyMMBtu = Worksheets("CHP Info").Cells(4 + j, 9).Value
    If .Range("B21").Value = "Large Business Sales" Then
        MonthlyDem = .Cells(25 + j, 6).Value * 1.023
    Else: MonthlyDem = .Cells(25 + j, 6).Value
    End If
    MonthlyPeak = MonthlyMMBtu / (ThLF * MonthlyOH)
    Worksheets("CHP Info").Cells(4 + j, 10).Value = MonthlyDem
    If MonthlyDem = "N/A" Then
        MonthlyDem = 0
    End If
    Worksheets("CHP Info").Cells(4 + j, 11).Value = MonthlyPeak
    MonthlyDemSum = MonthlyDemSum + MonthlyDem

```

```

MonthlyPeakSum = MonthlyPeakSum + MonthlyPeak
Next j
Worksheets("CHP Info").Cells(4 + 12, 10).Value = MonthlyDemSum
Worksheets("CHP Info").Cells(4 + 12, 10).NumberFormat = "#,##0.0"
Worksheets("CHP Info").Cells(4 + 12, 11).Value = MonthlyPeakSum
Worksheets("CHP Info").Cells(4 + 12, 11).NumberFormat = "#,##0.0"
If Worksheets("CHP Info").Cells(4 + 11, 10).Value = "N/A" Then
    Worksheets("CHP Info").Cells(4 + 12, 10).Value = "N/A"
End If

```

Else:

```

MMCC = 0
Do While .Cells(24, 4 + MMCC).Value = "MMBtu"
    MMCC = MMCC + 1
Loop
MMDC = 0
Do While .Cells(24, 4 + MMCC + MMDC).Value = "MMBtu Demand"
    MMDC = MMDC + 1
Loop
Sum = 0
For j = 0 To 11
    MonthlyMMBtu = 0
    For i = 0 To MMCC - 1

```

```

MonthlyMMBtu = MonthlyMMBtu + .Cells(25 + j, 4 + i).Value
Next i
Worksheets("CHP Info").Cells(4 + j, 9).Value = MonthlyMMBtu
Worksheets("CHP Info").Cells(4 + j, 9).NumberFormat = "#,###"
Sum = Sum + MonthlyMMBtu
Next j
Worksheets("CHP Info").Cells(4 + 12, 9).Value = Sum
Worksheets("CHP Info").Cells(4 + 12, 9).Font.FontStyle = "Bold"
Worksheets("CHP Info").Cells(4 + 12, 9).NumberFormat = "#,###"

' Total MMBtu Charged and keep track of Max Peak Demand'
Sum = 0
MaxPeakSum = 0
For j = 0 To 11
    MaxPeak = 0
    MonthlyMMDem = 0
    MonthlyMMBtu = Worksheets("CHP Info").Cells(4 + j, 9).Value
    For i = MMCC To MMDC + MMCC - 1
        MonthlyMMDem = MonthlyMMDem + .Cells(25 + j, 4 + i).Value
    Next i
    MaxPeak = MonthlyMMBtu / (MonthlyOH * ThLF)
    Worksheets("CHP Info").Cells(4 + j, 10).Value = MonthlyMMDem
    Worksheets("CHP Info").Cells(4 + j, 10).NumberFormat = "#,###"

```

```
Worksheets("CHP Info").Cells(4 + j, 11).Value = MaxPeak
```

```
Worksheets("CHP Info").Cells(4 + j, 11).NumberFormat = "#,###"
```

```
Sum = Sum + MonthlyMMDem
```

```
MaxPeakSum = MaxPeakSum + MaxPeak
```

```
Next j
```

```
Worksheets("CHP Info").Cells(4 + 12, 10).Value = Sum
```

```
Worksheets("CHP Info").Cells(4 + 12, 10).Font.FontStyle = "Bold"
```

```
Worksheets("CHP Info").Cells(4 + 12, 10).NumberFormat = "#,###"
```

```
Worksheets("CHP Info").Cells(4 + 12, 11).Value = MaxPeakSum
```

```
Worksheets("CHP Info").Cells(4 + 12, 11).Font.FontStyle = "Bold"
```

```
Worksheets("CHP Info").Cells(4 + 12, 11).NumberFormat = "#,###"
```

```
End If
```

```
End With
```

```
'Export Months to Load Profiles page'
```

```
With Worksheets("Load Profiles")
```

```
For j = 0 To 11
```

```
.Cells(2, 4 + j * 2).Value = _
```

```
Worksheets("CHP Info").Cells(4 + j, 9).Value  
.Cells(3, 4 + j * 2).Value = _  
Worksheets("CHP Info").Cells(4 + j, 11).Value  
Next j
```

```
.Range("A1").Value = ShiftStartTB  
n = ShiftNum * ShiftLength * 4  
M = n / 2  
P = M - 4  
.Range("Q6").Value = n  
.Range("Q7").Value = M  
.Range("Q8").Value = p  
StartSegment = Val(ShiftStartTB) * 4
```

```
.Range("C6:AA101").ClearContents  
For i = 1 To n  
If .Cells(5 + StartSegment + i, 1) = Empty Then  
    .Cells(5 + i - Offset, 3).Value = i  
Else:  
    .Cells(5 + StartSegment + i, 3).Value = i  
    Offset = i  
End If
```



Next i

DaysPerMonth = ShiftDays / 7 \* (365 / 12)

For j = 0 To 11

MonthlyCons = .Cells(2, 4 + j \* 2).Value

DailyCons = MonthlyCons / DaysPerMonth

MonthlyPeak = .Cells(3, 4 + j \* 2).Value

NonPeakAve = (DailyCons - MonthlyPeak) / (M + P)

For nn = 1 To 24 \* 4

i = .Cells(5 + nn, 3).Value

If MonthlyPeak / 4 - NonPeakAve > NonPeakAve Then

MaxMin = NonPeakAve

Else: MaxMin = (MonthlyPeak / 4 - NonPeakAve)

End If

If (i <> Empty And i <= M) Then

.Cells(5 + nn, 4 + j \* 2).Value = (NonPeakAve - (1 - Percentage) \* MaxMin) + \_

((2 \* i - 1) / 2) \* (((1 - Percentage) \* MaxMin) \* 2) / (M)

'(DailyCons / N - MonthlyPeak / 4) / (N - 4) \* i

ElseIf (i > M And i <= M + 4) Then

```

.Cells(5 + nn, 4 + j * 2).Value = MonthlyPeak / 4

ElseIf (i > M + 4 And i <= n) Then

.Cells(5 + nn, 4 + j * 2).Value = (NonPeakAve + (1 - Percentage) * MaxMin) - _
((2 * (i - M - 4) - 1) / 2) * (((1 - Percentage) * MaxMin) * 2) / (P)

End If

Recoverable = 0

CHPTh15Out = CHPThermOutMMBtu / 4

If .Cells(5 + nn, 4 + j * 2).Value > CHPTh15Out Then

    Recoverable = CHPTh15Out

Else: Recoverable = .Cells(5 + nn, 4 + j * 2).Value

End If

.Cells(5 + nn, 4 + j * 2 + 1).Value = Recoverable

Next nn

Next j

```

'Daily Example Profile is all set. Now to Sum up the days into monthly usage

' (just for double checking) and monthly recoverable heat'

```
MonthlyCons = 0
```

```
For j = 0 To 11
```

```
    MonthlyCons = .Cells(104, 4 + j * 2).Value * DaysPerMonth
```

```
    .Cells(105, 4 + j * 2).Value = MonthlyCons
```

```
    MonthlyRec = .Cells(104, 4 + j * 2 + 1).Value * DaysPerMonth
```

```
    .Cells(105, 4 + j * 2 + 1).Value = MonthlyRec
```

Next j

End With

With Worksheets("CHP Info")

'NEW KWH CALCULATIONS'

NewkWhSum = 0

kWhCreditSum = 0

For j = 0 To 11

NewkWh = 0

kWhCredit = 0

NewkWh = .Cells(4 + j, 6).Value - CHPkWh

If NewkWh <= 0 Then

kWhCredit = -NewkWh

NewkWh = 0

End If

.Cells(4 + j, 12).Value = NewkWh

.Cells(4 + j, 12).NumberFormat = "#,##0"

.Cells(4 + j, 13).Value = kWhCredit

.Cells(4 + j, 13).NumberFormat = "#,##0"

kWhCreditSum = kWhCreditSum + kWhCredit

NewkWhSum = NewkWhSum + NewkWh

Next j

.Cells(4 + 12, 12).Value = NewkWhSum

.Cells(4 + 12, 12).NumberFormat = "#,##0"

.Cells(4 + 12, 13).Value = kWhCreditSum

.Cells(4 + j, 13).NumberFormat = "#,##0"

'NEW NG CONSUMPTION (MMBtu) CALCULATIONS'

NewMMBtuSum = 0

For j = 0 To 11

NewMMBtu = 0

MonthlyRec = Worksheets("Load Profiles").Cells(105, 5 + 2 \* j).Value

New MMBtu is (Current Consumption) + (NG to run CHP) - (Useful CHP Heat in  
MMBtu)

NewMMBtu = .Cells(4 + j, 9).Value + MonthlyMMBtuIn - MonthlyRec

.Cells(4 + j, 15).Value = NewMMBtu

.Cells(4 + j, 15).NumberFormat = "#,##0"

NewMMBtuSum = NewMMBtuSum + NewMMBtu

Next j

.Cells(4 + 12, 15).Value = NewMMBtuSum

.Cells(4 + 12, 15).NumberFormat = "#,##0"

End With

Dim C As Integer

Dim R As Integer

Dim TC As Integer

Dim TR As Integer

Dim TTC As Integer

Dim TTR As Integer

'RECALCULATION OF COSTS'

'Send New kWh usage from CHP Info worksheet to corresponding rate schedule page'

'ENTERGY'

'Large General Service (LGS)

If Worksheets("Ground Zero").Range("B1").Value = "Large General Service (LGS)" Then

For j = 0 To 11

Worksheets("Entergy").Cells(114 + j, 4).Value = \_

Worksheets("CHP Info").Cells(4 + j, 12).Value

Worksheets("Cost Savings").Cells(4 + j, 6).Value = \_

Worksheets("Ground Zero").Cells(4 + j, 10).Value

kWmo = Worksheets("CHP Info").Cells(4 + j, 7).Value

NewkWmo = kWmo - CHPEIPower

If NewkWmo < 0 Then

```

    NewkWmo = 0

End If

Worksheets("Entergy").Cells(114 + j, 5).Value = NewkWmo

Worksheets("CHP Info").Cells(4 + j, 14).Value = NewkWmo

CostSum = CostSum + Worksheets("Ground Zero").Cells(4 + j, 10).Value

Next j

Worksheets("CHP Info").Cells(4 + 12, 14).Value = NewkWmoSum

Worksheets("Cost Savings").Cells(4 + 12, 6).Value = CostSum

For j = 0 To 11

    Worksheets("Cost Savings").Cells(4 + j, 9).Value = _
    Worksheets("Entergy").Cells(114 + j, 10).Value - _
    CreditsRate * Worksheets("CHP Info").Cells(4 + j, 13).Value

    NewCostSum = NewCostSum + Worksheets("Cost Savings").Cells(4 + j, 9).Value

Next j

Worksheets("Cost Savings").Cells(4 + 12, 9).Value = NewCostSum

```

'Large General Service - Time-Of-Use (GST)

```

ElseIf Worksheets("Ground Zero").Range("B1").Value = "Large General Service - Time-Of-Use
(GST)" Then

```

```

    NewkWmoSum = 0

```

```

    For j = 0 To 11

```

```

OnkWh = Worksheets("Ground Zero").Cells(4 + j, 4).Value
OffkWh = Worksheets("Ground Zero").Cells(4 + j, 5).Value
OnkWmo = Worksheets("Ground Zero").Cells(4 + j, 6).Value
ExcesskWmo = Worksheets("Ground Zero").Cells(4 + j, 7).Value
MonthlykWh = OnkWh + OffkWh
OnkWhFract = OnkWh / MonthlykWh
OffkWhFract = OffkWh / MonthlykWh
MonthlykWmo = OnkWmo + ExcesskWmo
NewOnkWh = OnkWhFract * Worksheets("CHP Info").Cells(4 + j, 12).Value
NewOffkWh = OffkWhFract * Worksheets("CHP Info").Cells(4 + j, 12).Value
Worksheets("Entergy").Cells(132 + j, 4).Value = NewOnkWh
Worksheets("Entergy").Cells(132 + j, 5).Value = NewOffkWh
If CHPEIPower <= OnkWmo Then
    NewOnkWmo = OnkWmo - CHPEIPower
    NewExcesskWmo = ExcesskWmo
ElseIf CHPEIPower > OnkWmo Then
    NewOnkWmo = 0
    NewExcesskWmo = OnkWmo + ExcesskWmo - CHPEIPower
    If NewExcesskWmo < 0 Then
        NewExcesskWmo = 0
    End If
End If
NewMonthlykWmo = NewOnkWmo + NewExcesskWmo

```

NewkWmoSum = NewkWmoSum + NewMonthlykWmo

Worksheets("Entergy").Cells(132 + j, 6).Value = NewOnkWmo

Worksheets("Entergy").Cells(132 + j, 7).Value = NewExcesskWmo

Worksheets("CHP Info").Cells(4 + j, 14).Value = NewMonthlykWmo

'Putting Before/After Costs on Cost Savings worksheet table'

Worksheets("Cost Savings").Cells(4 + j, 6).Value = \_

Worksheets("Ground Zero").Cells(4 + j, 12).Value

CostSum = CostSum + Worksheets("Cost Savings").Cells(4 + j, 6).Value

Next j

Worksheets("CHP Info").Cells(4 + 12, 14).Value = NewkWmoSum

Worksheets("Cost Savings").Cells(4 + j, 6).Value = CostSum

For j = 0 To 11

Worksheets("Cost Savings").Cells(4 + j, 9).Value = \_

Worksheets("Entergy").Cells(132 + j, 12).Value - \_

CreditsRate \* Worksheets("CHP Info").Cells(4 + j, 13).Value

NewCostSum = NewCostSum + Worksheets("Cost Savings").Cells(4 + j, 9).Value

Next j

Worksheets("Cost Savings").Cells(4 + j, 9).Value = NewCostSum

'Large Power Service (LPS)

ElseIf Worksheets("Ground Zero").Range("B1").Value = "Large Power Service (LPS)" Then



For j = 0 To 11

Worksheets("Entergy").Cells(150 + j, 4).Value = \_

Worksheets("CHP Info").Cells(4 + j, 12).Value

Worksheets("Cost Savings").Cells(4 + j, 6).Value = \_

Worksheets("Ground Zero").Cells(4 + j, 10).Value

CostSum = CostSum + Worksheets("Cost Savings").Cells(4 + j, 6).Value

kWmo = Worksheets("CHP Info").Cells(4 + j, 7).Value

NewkWmo = kWmo - CHPEIPower

If NewkWmo < 0 Then

    NewkWmo = 0

End If

NewkWmoSum = NewkWmoSum + NewkWmo

Worksheets("Entergy").Cells(150 + j, 5).Value = NewkWmo

Worksheets("CHP Info").Cells(4 + j, 14).Value = NewkWmo

Next j

Worksheets("CHP Info").Cells(4 + 12, 14).Value = NewkWmoSum

Worksheets("Cost Savings").Cells(4 + 12, 6).Value = CostSum

For j = 0 To 11

Worksheets("Cost Savings").Cells(4 + j, 9).Value = \_

Worksheets("Entergy").Cells(150 + j, 10).Value - \_

CreditsRate \* Worksheets("CHP Info").Cells(4 + j, 13).Value

NewCostSum = NewCostSum + Worksheets("Cost Savings").Cells(4 + j, 9).Value

Next j

Worksheets("Cost Savings").Cells(4 + 12, 9).Value = NewCostSum

'Large Power Service - Time-Of-Use (PST)

ElseIf Worksheets("Ground Zero").Range("B1").Value = "Large Power Service - Time-Of-Use

(PST)" Then

NewkWmoSum = 0

For j = 0 To 11

OnkWh = Worksheets("Ground Zero").Cells(4 + j, 4).Value

OffkWh = Worksheets("Ground Zero").Cells(4 + j, 5).Value

OnkWmo = Worksheets("Ground Zero").Cells(4 + j, 6).Value

ExcesskWmo = Worksheets("Ground Zero").Cells(4 + j, 7).Value

MonthlykWh = OnkWh + OffkWh

OnkWhFract = OnkWh / MonthlykWh

OffkWhFract = OffkWh / MonthlykWh

MonthlykWmo = OnkWmo + ExcesskWmo

NewOnkWh = OnkWhFract \* Worksheets("CHP Info").Cells(4 + j, 12).Value

NewOffkWh = OffkWhFract \* Worksheets("CHP Info").Cells(4 + j, 12).Value

Worksheets("Entergy").Cells(168 + j, 4).Value = NewOnkWh

Worksheets("Entergy").Cells(168 + j, 5).Value = NewOffkWh

```

If CHPEIPower <= OnkWmo Then
    NewOnkWmo = OnkWmo - CHPEIPower
    NewExcesskWmo = ExcesskWmo
ElseIf CHPEIPower > OnkWmo Then
    NewOnkWmo = 0
    NewExcesskWmo = OnkWmo + ExcesskWmo - CHPEIPower
    If NewExcesskWmo < 0 Then
        NewExcesskWmo = 0
    End If
End If

NewMonthlykWmo = NewOnkWmo + NewExcesskWmo
NewkWmoSum = NewkWmoSum + NewMonthlykWmo
Worksheets("Entergy").Cells(168 + j, 6).Value = NewOnkWmo
Worksheets("Entergy").Cells(168 + j, 7).Value = NewExcesskWmo
Worksheets("CHP Info").Cells(4 + j, 14).Value = NewMonthlykWmo

Next j

Worksheets("CHP Info").Cells(4 + 12, 14).Value = NewkWmoSum

'Putting Before/After Costs on Cost Savings worksheet table'

For j = 0 To 11
    Worksheets("Cost Savings").Cells(4 + j, 6).Value = _
    Worksheets("Ground Zero").Cells(4 + j, 12).Value

```

CostSum = CostSum + Worksheets("Cost Savings").Cells(4 + j, 6).Value

Worksheets("Cost Savings").Cells(4 + j, 9).Value = \_

Worksheets("Entergy").Cells(168 + j, 12).Value - \_

CreditsRate \* Worksheets("CHP Info").Cells(4 + j, 13).Value

NewCostSum = NewCostSum + Worksheets("Cost Savings").Cells(4 + j, 9).Value

Next j

Worksheets("Cost Savings").Cells(4 + 12, 6).Value = CostSum

Worksheets("Cost Savings").Cells(4 + 12, 9).Value = NewCostSum

'OG&E'

'Lighting & Power (PL-1)

ElseIf Worksheets("Ground Zero").Range("B1").Value = "Lighting & Power (PL-1)" Then

For j = 0 To 11

Worksheets("OG&E").Cells(94 + j, 4).Value = \_

Worksheets("CHP Info").Cells(4 + j, 12).Value

Worksheets("Cost Savings").Cells(4 + j, 6).Value = \_

Worksheets("Ground Zero").Cells(4 + j, 10).Value

CostSum = CostSum + Worksheets("Cost Savings").Cells(4 + j, 6).Value

kWmo = Worksheets("CHP Info").Cells(4 + j, 7).Value

NewkWmo = kWmo - CHPEIPower

If NewkWmo < 0 Then

NewkWmo = 0

End If

NewkWmoSum = NewkWmoSum + NewkWmo

Worksheets("OG&E").Cells(94 + j, 5).Value = NewkWmo

Worksheets("CHP Info").Cells(4 + j, 14).Value = NewkWmo

Next j

Worksheets("CHP Info").Cells(4 + 12, 14).Value = NewkWmoSum

Worksheets("Cost Savings").Cells(4 + 12, 6).Value = CostSum

For j = 0 To 11

Worksheets("Cost Savings").Cells(4 + j, 9).Value = \_

Worksheets("OG&E").Cells(94 + j, 10).Value - \_

CreditsRate \* Worksheets("CHP Info").Cells(4 + j, 13).Value

NewCostSum = NewCostSum + Worksheets("Cost Savings").Cells(4 + j, 9).Value

Next j

Worksheets("Cost Savings").Cells(4 + 12, 9).Value = NewCostSum

'Lighting & Power Time-Of-Use Demand (PL-TOU-D)

ElseIf Worksheets("Ground Zero").Range("B1").Value = "Lighting & Power Time-of-Use  
Demand (PL-TOU-D)" Then

NewkWmoSum = 0

For j = 0 To 11

MonthlyWh = Worksheets("Ground Zero").Cells(4 + j, 4).Value

```

OnkWWh = Worksheets("Ground Zero").Cells(4 + j, 5).Value
MaxkWmo = Worksheets("Ground Zero").Cells(4 + j, 6).Value
OnkWmo = Worksheets("Ground Zero").Cells(4 + j, 7).Value
OnkWWhFract = OnkWWh / MonthlykWWh
NewMonthlykWWh = 1 * Worksheets("CHP Info").Cells(4 + j, 12).Value
NewOnkWWh = OnkWWhFract * Worksheets("CHP Info").Cells(4 + j, 12).Value
Worksheets("OG&E").Cells(114 + j, 4).Value = NewMonthlykWWh
Worksheets("OG&E").Cells(114 + j, 5).Value = NewOnkWWh
If CHPEIPower <= OnkWmo Then
    NewOnkWmo = OnkWmo - CHPEIPower
    NewMaxkWmo = MaxkWmo - CHPEIPower
ElseIf CHPEIPower > OnkWmo Then
    NewOnkWmo = 0
    NewMaxkWmo = MaxkWmo - CHPEIPower
    If NewMaxkWmo < 0 Then
        NewMaxkWmo = 0
    End If
End If
NewMonthlykWmo = NewOnkWmo + NewMaxkWmo
NewkWmoSum = NewkWmoSum + NewMonthlykWmo
Worksheets("OG&E").Cells(114 + j, 6).Value = NewOnkWmo
Worksheets("OG&E").Cells(114 + j, 7).Value = NewMaxkWmo
Worksheets("CHP Info").Cells(4 + j, 14).Value = NewMonthlykWmo

```

Next j

Worksheets("CHP Info").Cells(4 + 12, 14).Value = NewkWmoSum

'Putting Before/After Costs on Cost Savings worksheet table'

For j = 0 To 11

Worksheets("Cost Savings").Cells(4 + j, 6).Value = \_

Worksheets("Ground Zero").Cells(4 + j, 12).Value

CostSum = CostSum + Worksheets("Cost Savings").Cells(4 + j, 6).Value

Worksheets("Cost Savings").Cells(4 + j, 9).Value = \_

Worksheets("OG&E").Cells(114 + j, 12).Value - \_

CreditsRate \* Worksheets("CHP Info").Cells(4 + j, 13).Value

NewCostSum = NewCostSum + Worksheets("Cost Savings").Cells(4 + j, 9).Value

Next j

Worksheets("Cost Savings").Cells(4 + 12, 6).Value = CostSum

Worksheets("Cost Savings").Cells(4 + 12, 9).Value = NewCostSum

'Lighting & Power Time-Of-Use Energy (PL-TOU-E)

ElseIf Worksheets("Ground Zero").Range("B1").Value = "Lighting & Power Time-of-Use

Energy (PL-TOU-E)" Then

NewkWmoSum = 0

For j = 0 To 11

MonthlykWh = Worksheets("Ground Zero").Cells(4 + j, 4).Value

OnkWh = Worksheets("Ground Zero").Cells(4 + j, 5).Value

SuperkWh = Worksheets("Ground Zero").Cells(4 + j, 6).Value

MaxkWmo = Worksheets("Ground Zero").Cells(4 + j, 7).Value

OnkWhFract = OnkWh / MonthlykWh

SuperkWhFract = SuperkWh / MonthlykWh

NewMonthlykWh = 1 \* Worksheets("CHP Info").Cells(4 + j, 12).Value

NewOnkWh = OnkWhFract \* Worksheets("CHP Info").Cells(4 + j, 12).Value

NewSuperkWh = SuperkWhFract \* Worksheets("CHP Info").Cells(4 + j, 12).Value

Worksheets("OG&E").Cells(134 + j, 4).Value = NewMonthlykWh

Worksheets("OG&E").Cells(134 + j, 5).Value = NewOnkWh

Worksheets("OG&E").Cells(134 + j, 6).Value = NewSuperkWh

If CHPEIPower <= MaxkWmo Then

    NewMaxkWmo = MaxkWmo - CHPEIPower

ElseIf CHPEIPower > OnkWmo Then

    NewMaxkWmo = 0

End If

NewkWmoSum = NewkWmoSum + NewMaxkWmo

Worksheets("OG&E").Cells(134 + j, 7).Value = NewMaxkWmo

Worksheets("CHP Info").Cells(4 + j, 14).Value = NewMaxkWmo



Next j

Worksheets("CHP Info").Cells(4 + 12, 14).Value = NewkWmoSum

'Putting Before/After Costs on Cost Savings worksheet table'

For j = 0 To 11

Worksheets("Cost Savings").Cells(4 + j, 6).Value = \_

Worksheets("Ground Zero").Cells(4 + j, 12).Value

CostSum = CostSum + Worksheets("Cost Savings").Cells(4 + j, 6).Value

Worksheets("Cost Savings").Cells(4 + j, 9).Value = \_

Worksheets("OG&E").Cells(134 + j, 12).Value - \_

CreditsRate \* Worksheets("CHP Info").Cells(4 + j, 13).Value

NewCostSum = NewCostSum + Worksheets("Cost Savings").Cells(4 + j, 9).Value

Next j

Worksheets("Cost Savings").Cells(4 + 12, 6).Value = CostSum

Worksheets("Cost Savings").Cells(4 + 12, 9).Value = NewCostSum

'SWEPCO'

'Lighting & Power

ElseIf Worksheets("Ground Zero").Range("B1").Value = "Lighting & Power" Then

For j = 0 To 11

Worksheets("SWEPCO").Cells(93 + j, 4).Value = \_

Worksheets("CHP Info").Cells(4 + j, 12).Value

Worksheets("Cost Savings").Cells(4 + j, 6).Value = \_

```

Worksheets("Ground Zero").Cells(4 + j, 10).Value

CostSum = CostSum + Worksheets("Cost Savings").Cells(4 + j, 6).Value

kWmo = Worksheets("CHP Info").Cells(4 + j, 7).Value

NewkWmo = kWmo - CHPEIPower

If NewkWmo < 0 Then
    NewkWmo = 0
End If

NewkWmoSum = NewkWmoSum + NewkWmo

Worksheets("SWEPCO").Cells(93 + j, 5).Value = NewkWmo

Worksheets("CHP Info").Cells(4 + j, 14).Value = NewkWmo

Next j

Worksheets("CHP Info").Cells(4 + 12, 14).Value = NewkWmoSum

Worksheets("Cost Savings").Cells(4 + 12, 6).Value = CostSum

For j = 0 To 11
    Worksheets("Cost Savings").Cells(4 + j, 9).Value = _
    Worksheets("SWEPCO").Cells(93 + j, 10).Value - _
    CreditsRate * Worksheets("CHP Info").Cells(4 + j, 13).Value
    NewCostSum = NewCostSum + Worksheets("Cost Savings").Cells(4 + j, 9).Value
Next j

Worksheets("Cost Savings").Cells(4 + 12, 9).Value = NewCostSum

```

'Large Lighting & Power

ElseIf Worksheets("Ground Zero").Range("B1").Value = "Large Lighting & Power" Then

For j = 0 To 11

Worksheets("SWEPCO").Cells(112 + j, 4).Value = \_

Worksheets("CHP Info").Cells(4 + j, 12).Value

Worksheets("Cost Savings").Cells(4 + j, 6).Value = \_

Worksheets("Ground Zero").Cells(4 + j, 10).Value

CostSum = CostSum + Worksheets("Cost Savings").Cells(4 + j, 6).Value

kWmo = Worksheets("CHP Info").Cells(4 + j, 7).Value

NewkWmo = kWmo - CHPEIPower

If NewkWmo < 0 Then

NewkWmo = 0

End If

NewkWmoSum = NewkWmoSum + NewkWmo

Worksheets("SWEPCO").Cells(112 + j, 5).Value = NewkWmo

Worksheets("CHP Info").Cells(4 + j, 14).Value = NewkWmo

Next j

Worksheets("CHP Info").Cells(4 + 12, 14).Value = NewkWmoSum

Worksheets("Cost Savings").Cells(4 + 12, 6).Value = CostSum

For j = 0 To 11

```

Worksheets("Cost Savings").Cells(4 + j, 9).Value = _
Worksheets("SWEPCO").Cells(112 + j, 10).Value - _
CreditsRate * Worksheets("CHP Info").Cells(4 + j, 13).Value
NewCostSum = NewCostSum + Worksheets("Cost Savings").Cells(4 + j, 9).Value
Next j
Worksheets("Cost Savings").Cells(4 + 12, 9).Value = NewCostSum

```

Lighting & Power Time Of Use

```

ElseIf Worksheets("Ground Zero").Range("B1").Value = "Lighting & Power - Time-of-Use"

```

Then

```

NewkWmoSum = 0

```

```

For j = 0 To 11

```

```

    OnkWh = Worksheets("Ground Zero").Cells(4 + j, 4).Value

```

```

    OffkWh = Worksheets("Ground Zero").Cells(4 + j, 5).Value

```

```

    OnkWmo = Worksheets("Ground Zero").Cells(4 + j, 6).Value

```

```

    OffkWmo = Worksheets("Ground Zero").Cells(4 + j, 7).Value

```

```

    MonthlykWh = OnkWh + OffkWh

```

```

    OnkWhFract = OnkWh / MonthlykWh

```

```

    OffkWhFract = OffkWh / MonthlykWh

```

```

    NewOnkWh = OnkWhFract * Worksheets("CHP Info").Cells(4 + j, 12).Value

```

```

    NewOffkWh = OffkWhFract * Worksheets("CHP Info").Cells(4 + j, 12).Value

```

```

    Worksheets("SWEPCO").Cells(131 + j, 4).Value = NewOnkWh

```

```

Worksheets("SWEPCO").Cells(131 + j, 5).Value = NewOffkWh
NewOnkWmo = OnkWmo - CHPEIPower
NewOffkWmo = OffkWmo - CHPEIPower
If OnkWmo < 0 Then
    NewOnkWmo = 0
End If
If NewOffkWmo < 0 Then
    NewOffkWmo = 0
End If
NewMonthlykWmo = NewOnkWmo + NewOffkWmo
NewkWmoSum = NewkWmoSum + NewMonthlykWmo
Worksheets("SWEPCO").Cells(131 + j, 6).Value = NewOnkWmo
Worksheets("SWEPCO").Cells(131 + j, 7).Value = NewOffkWmo
Worksheets("CHP Info").Cells(4 + j, 14).Value = NewMonthlykWmo

Next j

Worksheets("CHP Info").Cells(4 + 12, 14).Value = NewkWmoSum

'Putting Before/After Costs on Cost Savings worksheet table'
For j = 0 To 11
    Worksheets("Cost Savings").Cells(4 + j, 6).Value = _
    Worksheets("Ground Zero").Cells(4 + j, 12).Value
    CostSum = CostSum + Worksheets("Cost Savings").Cells(4 + j, 6).Value

```

```

Worksheets("Cost Savings").Cells(4 + j, 9).Value = _
Worksheets("SWEPCO").Cells(131 + j, 12).Value - _
CreditsRate * Worksheets("CHP Info").Cells(4 + j, 13).Value
NewCostSum = NewCostSum + Worksheets("Cost Savings").Cells(4 + j, 9).Value
Next j
Worksheets("Cost Savings").Cells(4 + 12, 6).Value = CostSum
Worksheets("Cost Savings").Cells(4 + 12, 9).Value = NewCostSum

```

'CUSTOM'

ElseIf Worksheets("Ground Zero").Range("B1").Value = "Customizable Electric Rate Schedule"

Then

With Worksheets("DIY El. Rates")

C = .Cells(116, 1).Value

R = .Cells(118, 1).Value

TC = .Cells(120, 1).Value

TR = .Cells(122, 1).Value

TTC = .Cells(124, 1).Value

TTR = .Cells(126, 1).Value

'New CCC Calculated For the Costs Table on the DIY El. Rates sheet instead of

' counting the Ground Zero Costs columns'

CCC = 0

Do While .Cells(R + TTR, C + TTC + CCC).Value <> Empty

CCC = CCC + 1

Loop

End With

'Count Total Usage Columns (UCC), Then kWh Columns (kWhC), Then kW-mo Columns (kWC)

UCC = kWhC + kWmoC

With Worksheets("Ground Zero")

'kWh column fraction calculations and New kWh after CHP values entered into original usage table.'

For j = 0 To 11

MonthlykWh = 0

For i = 0 To kWhC - 1

MonthlykWh = MonthlykWh + .Cells(4 + j, 4 + i).Value

If i = 1 - 1 Then

kWh1 = .Cells(4 + j, 4 + i).Value

ElseIf i = 2 - 1 Then

kWh2 = .Cells(4 + j, 4 + i).Value

ElseIf i = 3 - 1 Then

kWh3 = .Cells(4 + j, 4 + i).Value

```

ElseIf i = 4 - 1 Then

    kWh4 = .Cells(4 + j, 4 + i).Value

End If

Next i

kWhFract1 = kWh1 / MonthlykWh
kWhFract2 = kWh2 / MonthlykWh
kWhFract3 = kWh3 / MonthlykWh
kWhFract4 = kWh4 / MonthlykWh

NewkWh1 = kWhFract1 * Worksheets("CHP Info").Cells(4 + j, 12).Value
NewkWh2 = kWhFract2 * Worksheets("CHP Info").Cells(4 + j, 12).Value
NewkWh3 = kWhFract3 * Worksheets("CHP Info").Cells(4 + j, 12).Value
NewkWh4 = kWhFract4 * Worksheets("CHP Info").Cells(4 + j, 12).Value

For i = 0 To kWhC - 1

    If i = 1 - 1 Then

        If Worksheets("DIY El. Rates").Cells(R + TR + j + 1, C + i).Value <> Empty Then

            Worksheets("DIY El. Rates").Cells(R + TR + j + 1, C + i).Value = NewkWh1

        End If

    ElseIf i = 2 - 1 Then

        If Worksheets("DIY El. Rates").Cells(R + TR + j + 1, C + i).Value <> Empty Then

            Worksheets("DIY El. Rates").Cells(R + TR + j + 1, C + i).Value = NewkWh2

        End If

    ElseIf i = 3 - 1 Then

        If Worksheets("DIY El. Rates").Cells(R + TR + j + 1, C + i).Value <> Empty Then

```



```

Worksheets("DIY El. Rates").Cells(R + TR + j + 1, C + i).Value = NewkWh3
End If
ElseIf i = 4 - 1 Then
    If Worksheets("DIY El. Rates").Cells(R + TR + j + 1, C + i).Value <> Empty Then
        Worksheets("DIY El. Rates").Cells(R + TR + j + 1, C + i).Value = NewkWh4
    End If
End If
Next i
Next j
End With

'kW-mo column calculations and New kW-mo after-CHP values entered into
' original usage table.'
With Worksheets("Ground Zero")
    For j = 0 To 11
        NewMonthlykWmo = 0
        For i = kWhC To kWhC + kWmoC - 1
            If .Cells(4 + j, 4 + i).Value <> Empty Then
                NewSpkWmo = 0
                NewSpkWmo = .Cells(4 + j, 4 + i).Value - CHPEIPower
                If NewSpkWmo < 0 Then
                    NewSpkWmo = 0
                End If
            ElseIf .Cells(4 + j, 4 + i).Value = Empty Then

```

```

        NewSpkWmo = Empty
    End If

    Worksheets("DIY El. Rates") _

        .Cells(R + TR + j + 1, C + TC + i).Value = NewSpkWmo

    NewMonthlykWmo = NewMonthlykWmo + NewSpkWmo

    Next i

    Worksheets("CHP Info").Cells(4 + j, 14).Value = NewMonthlykWmo

    NewMonthlyWmoSum = NewMonthlyWmoSum + NewMonthlykWmo

    Next j

    Worksheets("CHP Info").Cells(4 + 12, 14).Value = NewMonthlyWmoSum

End With

'Caclulate Costs based on new kWh and kW-mo information, which was re-entered into the
'  DIY El. Rates worksheet'

Worksheets("DIY El. Rates").Calculate_Costs_Click

'Transfer Original Costs

MonthlyCost = 0

CostSum = 0

For j = 0 To 11

    MonthlyCost = Worksheets("Ground Zero").Cells(4 + j, 4 + UCC + 5 - 1).Value

    Worksheets("Cost Savings").Cells(4 + j, 6).Value = MonthlyCost

    CostSum = CostSum + MonthlyCost

Next j

```

Worksheets("Cost Savings").Cells(4 + 12, 6).Value = CostSum

'Transfer New Costs'

NewMonthlyCost = 0

NewCostSum = 0

For j = 0 To 11

NewMonthlyCost = Worksheets("DIY El. Rates").Cells(R + TTR + j + 1, C + TTC + CCC  
- 1).Value

Worksheets("Cost Savings").Cells(4 + j, 9).Value = NewMonthlyCost - \_

CreditsRate \* Worksheets("CHP Info").Cells(4 + j, 13).Value

NewCostSum = NewCostSum + NewMonthlyCost

Next j

Worksheets("Cost Savings").Cells(4 + 12, 9).Value = NewCostSum

End If

'AOGC-Ark'

If Worksheets("Ground Zero").Range("B21").Value = "Medium Business Sales" Then

For j = 0 To 11

Worksheets("AOGC-Ark").Cells(36 + j, 3).Value = \_

Worksheets("CHP Info").Cells(4 + j, 15).Value \* 1.023

Worksheets("AOGC-Ark").Cells(36 + j, 4).Value = \_

Worksheets("AOGC-Ark").Cells(36 + j, 3).Value / 1.023

Worksheets("AOGC-Ark").Cells(36 + j, 5).Value = "N/A"

Next j

For j = 0 To 11

Worksheets("Cost Savings").Cells(4 + j, 7).Value = \_

Worksheets("AOGC-Ark").Cells(17 + j, 13).Value

Worksheets("Cost Savings").Cells(4 + j, 10).Value = \_

Worksheets("AOGC-Ark").Cells(36 + j, 13).Value

Next j

ElseIf Worksheets("Ground Zero").Range("B21").Value = "Large Business Sales" Then

For j = 0 To 11

Worksheets("AOGC-Ark").Cells(36 + j, 3).Value = \_

Worksheets("CHP Info").Cells(4 + j, 15).Value \* 1.023

Worksheets("AOGC-Ark").Cells(36 + j, 4).Value = \_

Worksheets("AOGC-Ark").Cells(36 + j, 3).Value / 1.023

Worksheets("AOGC-Ark").Cells(36 + j, 5).Value = \_

DailyHours \* (CHPThermInMMBtu - CHPThermOutMMBtu) \* 1.023 + \_

Worksheets("AOGC-Ark").Cells(17 + j, 5).Value

Next j

For j = 0 To 11

Worksheets("Cost Savings").Cells(4 + j, 7).Value = \_

Worksheets("AOGC-Ark").Cells(17 + j, 13).Value

Worksheets("Cost Savings").Cells(4 + j, 10).Value = \_

Worksheets("AOGC-Ark").Cells(36 + j, 13).Value

Next j

'Black Hills'

ElseIf Worksheets("Ground Zero").Range("B21").Value = "Business 3 Sales" Then

For j = 0 To 11

'New Monthly MMBtu Consumption converted to CCF and entered in Black Hills table'

Worksheets("Black Hills").Cells(44 + j, 3).Value = \_

Worksheets("CHP Info").Cells(4 + j, 15).Value \* 10.23

'CCF in Black Hills table converted to MMBtu'

Worksheets("Black Hills").Cells(44 + j, 4).Value = \_

Worksheets("Black Hills").Cells(44 + j, 3).Value / 10.23

'No Peak-Day Consumptin (Demand Charge) in this rate schedule'

Worksheets("Black Hills").Cells(44 + j, 5).Value = "N/A"

Next j

For j = 0 To 11

'Original Costs entered on Cost Savings Page'

Worksheets("Cost Savings").Cells(4 + j, 7).Value = \_

Worksheets("Black Hills").Cells(25 + j, 13).Value

'New Costs entered on Cost Savings Page'

Worksheets("Cost Savings").Cells(4 + j, 10).Value = \_

Worksheets("Black Hills").Cells(44 + j, 13).Value

Next j

ElseIf Worksheets("Ground Zero").Range("B21").Value = "Business 4 Sales" Then

For j = 0 To 11

'New Monthly MMBtu Consumption converted to CCF and entered in Black Hills table'

Worksheets("Black Hills").Cells(44 + j, 3).Value = \_

Worksheets("CHP Info").Cells(4 + j, 15).Value \* 10.23

'CCF in Black Hills table converted to MMBtu'

Worksheets("Black Hills").Cells(44 + j, 4).Value = \_

Worksheets("Black Hills").Cells(44 + j, 3).Value / 10.23

'No Peak-Day Consumptin (Demand Charge) in this rate schedule'

Worksheets("Black Hills").Cells(44 + j, 5).Value = "N/A"

Next j

For j = 0 To 11

'Original Costs entered on Cost Savings Page'

Worksheets("Cost Savings").Cells(4 + j, 7).Value = \_

Worksheets("Black Hills").Cells(25 + j, 13).Value

'New Costs entered on Cost Savings Page'

Worksheets("Cost Savings").Cells(4 + j, 10).Value = \_

Worksheets("Black Hills").Cells(44 + j, 13).Value

Next j

ElseIf Worksheets("Ground Zero").Range("B21").Value = "Business 5 Sales" Then

For j = 0 To 11

'New Monthly MMBtu Consumption converted to CCF and entered in Black Hills table'

Worksheets("Black Hills").Cells(44 + j, 3).Value = \_

Worksheets("CHP Info").Cells(4 + j, 15).Value \* 10.23

'CCF in Black Hills table converted to MMBtu'

Worksheets("Black Hills").Cells(44 + j, 4).Value = \_

Worksheets("Black Hills").Cells(44 + j, 3).Value / 10.23

'New Peak Day Consumption entered in Black Hills Table

Worksheets("Black Hills").Cells(44 + j, 5).Value = \_

DailyHours \* (CHPThermInMMBtu - CHPThermOutMMBtu) + \_

Worksheets("Black Hills").Cells(25 + j, 5).Value

Next j

For j = 0 To 11

'Original Costs entered on Cost Savings Page'

Worksheets("Cost Savings").Cells(4 + j, 7).Value = \_

Worksheets("Black Hills").Cells(25 + j, 13).Value

'New Costs entered on Cost Savings Page'

Worksheets("Cost Savings").Cells(4 + j, 10).Value = \_

Worksheets("Black Hills").Cells(44 + j, 13).Value

Next j

'CenterPoint'

ElseIf Worksheets("Ground Zero").Range("B21").Value = "Small Commercial Firm Sales  
Service (SCS-1)" Then

For j = 0 To 11

'New Monthly MMBtu Consumption converted to CCF and entered in Black Hills table'

Worksheets("CenterPoint").Cells(55 + j, 3).Value = \_

Worksheets("CHP Info").Cells(4 + j, 15).Value \* 10.23

'CCF in Black Hills table converted to MMBtu'



Worksheets("CenterPoint").Cells(55 + j, 4).Value = \_

Worksheets("CenterPoint").Cells(55 + j, 3).Value / 10.23

'New Peak Day Consumption entered in Black Hills Table

Worksheets("CenterPoint").Cells(55 + j, 5).Value = "N/A"

Next j

For j = 0 To 11

'Original Costs entered on Cost Savings Page'

Worksheets("Cost Savings").Cells(4 + j, 7).Value = \_

Worksheets("CenterPoint").Cells(35 + j, 12).Value

'New Costs entered on Cost Savings Page'

Worksheets("Cost Savings").Cells(4 + j, 10).Value = \_

Worksheets("CenterPoint").Cells(55 + j, 12).Value

Next j

ElseIf Worksheets("Ground Zero").Range("B21").Value = "Large Commercial Firm Service  
(LCS-1)" Then

For j = 0 To 11

'New Monthly MMBtu Consumption converted to CCF and entered in CenterPoint table'

Worksheets("CenterPoint").Cells(55 + j, 3).Value = \_

Worksheets("CHP Info").Cells(4 + j, 15).Value \* 10.23

'CCF in CenterPoint table converted to MMBtu'

Worksheets("CenterPoint").Cells(55 + j, 4).Value = \_

Worksheets("CenterPoint").Cells(55 + j, 3).Value / 10.23

'New Peak Day Consumption entered in CenterPoint Table

Worksheets("CenterPoint").Cells(55 + j, 5).Value = \_

DailyHours \* (CHPThermInMMBtu - CHPThermOutMMBtu) + \_

Worksheets("CenterPoint").Cells(35 + j, 5).Value

Next j

For j = 0 To 11

'Original Costs entered on Cost Savings Page'

Worksheets("Cost Savings").Cells(4 + j, 7).Value = \_

Worksheets("CenterPoint").Cells(35 + j, 12).Value

'New Costs entered on Cost Savings Page'

Worksheets("Cost Savings").Cells(4 + j, 10).Value = \_

Worksheets("CenterPoint").Cells(55 + j, 12).Value

Next j

ElseIf Worksheets("Ground Zero").Range("B21").Value = "Small Commercial Firm Sales

Service - Off-Peak (SCS-2)" Then

For j = 0 To 11

'New Monthly MMBtu Consumption converted to CCF and entered in Black Hills table'

Worksheets("CenterPoint").Cells(55 + j, 3).Value = \_

Worksheets("CHP Info").Cells(4 + j, 15).Value \* 10.23

'CCF in Black Hills table converted to MMBtu'

Worksheets("CenterPoint").Cells(55 + j, 4).Value = \_

Worksheets("CenterPoint").Cells(55 + j, 3).Value / 10.23

'New Peak Day Consumption entered in Black Hills Table

Worksheets("CenterPoint").Cells(55 + j, 5).Value = "N/A"

Next j

For j = 0 To 11

'Original Costs entered on Cost Savings Page'

Worksheets("Cost Savings").Cells(4 + j, 7).Value = \_

Worksheets("CenterPoint").Cells(35 + j, 12).Value

'New Costs entered on Cost Savings Page'

Worksheets("Cost Savings").Cells(4 + j, 10).Value = \_

Worksheets("CenterPoint").Cells(55 + j, 12).Value

Next j

'CUSTOM'

ElseIf Worksheets("Ground Zero").Range("B21").Value = "Customizable Natural Gas Rate  
Schedule" Then

With Worksheets("DIY NG Rates")

C = .Cells(116, 1).Value

R = .Cells(118, 1).Value

TC = .Cells(120, 1).Value

TR = .Cells(122, 1).Value

TTC = .Cells(124, 1).Value

TTR = .Cells(126, 1).Value

'New CCC Calculated For the Costs Table on the DIY El. Rates sheet instead of  
' counting the Ground Zero Costs columns'

CCC = 0

Do While .Cells(R + TTR, C + TTC + CCC).Value <> Empty

CCC = CCC + 1

Loop

End With

'Count Total Usage Columns (UCC), Then kWh Columns (kWhC), Then kW-mo Columns  
(kWC)

UCC = MMCC + MMDC

With Worksheets("Ground Zero")

' kWh column fraction calculations and New kWh after CHP values entered into original

' usage table.'

For j = 0 To 11

MonthlyMMBtu = 0

For i = 0 To MMCC - 1

MonthlyMMBtu = MonthlyMMBtu + .Cells(25 + j, 4 + i).Value

If i = 1 - 1 Then

MMBtu1 = .Cells(25 + j, 4 + i).Value

ElseIf i = 2 - 1 Then

MMBtu2 = .Cells(25 + j, 4 + i).Value

ElseIf i = 3 - 1 Then

MMBtu3 = .Cells(25 + j, 4 + i).Value

ElseIf i = 4 - 1 Then

MMBtu4 = .Cells(25 + j, 4 + i).Value

End If

Next i

MMBtuFract1 = MMBtu1 / MonthlyMMBtu

MMBtuFract2 = MMBtu2 / MonthlyMMBtu

MMBtuFract3 = MMBtu3 / MonthlyMMBtu

MMBtuFract4 = MMBtu4 / MonthlyMMBtu

NewMMBtu1 = MMBtuFract1 \* Worksheets("CHP Info").Cells(4 + j, 15).Value

NewMMBtu2 = MMBtuFract2 \* Worksheets("CHP Info").Cells(4 + j, 15).Value

NewMMBtu3 = MMBtuFract3 \* Worksheets("CHP Info").Cells(4 + j, 15).Value

NewMMBtu4 = MMBtuFract4 \* Worksheets("CHP Info").Cells(4 + j, 15).Value

For i = 0 To MMCC - 1

    If i = 1 - 1 Then

        Worksheets("DIY NG Rates").Cells(R + TR + j + 1, C + i).Value = NewMMBtu1

    ElseIf i = 2 - 1 Then

        Worksheets("DIY NG Rates").Cells(R + TR + j + 1, C + i).Value = NewMMBtu2

    ElseIf i = 3 - 1 Then

        Worksheets("DIY NG Rates").Cells(R + TR + j + 1, C + i).Value = NewMMBtu3

    ElseIf i = 4 - 1 Then

        Worksheets("DIY NG Rates").Cells(R + TR + j + 1, C + i).Value = NewMMBtu4

    End If

Next i

Next j

End With

'MMBtu Demand column calculations and New MMBtu Demand after-CHP values entered  
into

' original usage table.'

With Worksheets("Ground Zero")

    For j = 0 To 11

        NewPeakDayMMBtu = 0

        For i = MMCC To MMCC + MMDC - 1

            PeakDayMMBtu = .Cells(25 + j, 4 + i).Value

DailyCHPMMBtuIn = DailyHours \* CHPThermInMMBtu

If PeakDayMMBtu <> Empty Then

    NewPeakDayMMBtu = DailyCHPMMBtuIn + PeakDayMMBtu

Else: NewPeakDayMMBtu = PeakDayMMBtu

End If

Worksheets("DIY NG Rates") \_

    .Cells(R + TR + j + 1, C + TC + i).Value = NewPeakDayMMBtu

Next i

Worksheets("CHP Info").Cells(4 + j, 16).Value = NewPeakDayMMBtu

NewPeakDayMMBtuSum = NewPeakDayMMBtuSum + NewPeakDayMMBtu

Next j

Worksheets("CHP Info").Cells(4 + 12, 16).Value = NewPeakDayMMBtuSum

If Worksheets("CHP Info").Cells(4 + 11, 16).Value = Empty Then

    Worksheets("CHP Info").Cells(4 + 12, 16).Value = Empty

End If

End With

'Caclulate Costs based on new kWh and kW-mo information, which was re-entered into the  
' DIY El. Rates worksheet'

Worksheets("DIY NG Rates").NGCalculateButton\_Click

'Transfer Original Costs

MonthlyCost = 0

CostSum = 0

For j = 0 To 11

MonthlyCost = Worksheets("Ground Zero").Cells(25 + j, 4 + CCC - 1).Value

Worksheets("Cost Savings").Cells(4 + j, 7).Value = MonthlyCost

CostSum = CostSum + MonthlyCost

Next j

Worksheets("Cost Savings").Cells(4 + 12, 7).Value = CostSum

'Transfer New Costs'

NewMonthlyCost = 0

NewCostSum = 0

For j = 0 To 11

NewMonthlyCost = Worksheets("DIY NG Rates").Cells(R + TTR + j + 1, C + TTC + CCC  
- 1).Value

Worksheets("Cost Savings").Cells(4 + j, 10).Value = NewMonthlyCost

NewCostSum = NewCostSum + NewMonthlyCost

Next j

Worksheets("Cost Savings").Cells(4 + 12, 10).Value = NewCostSum

End If

Worksheets("Cost Savings").Cells(4 + 12, 7).Formula = "=Sum(G4:G15)"

Worksheets("Cost Savings").Cells(4 + 12, 10).Formula = "=Sum(J4:J15)"

Worksheets("Cost Savings").Cells(4 + 12, 6).Formula = "=Sum(F4:F15)"



```
Worksheets("Cost Savings").Cells(4 + 12, 9).Formula = "=Sum(I4:I15)"
```

```
NextPage = CurrentPage + 1
```

```
Worksheets("Ground Zero").Range("Z1").Value = NextPage
```

```
MultiPage1.Value = NextPage
```

```
End Sub
```

## Calculate Economic Performance

Private Sub RedoCostsButton\_Click()

Worksheets("Cost Savings").Activate

ShiftNum = Val(ShiftNumTB)

ShiftLength = Val(ShiftLengthTB)

DailyHours = ShiftNum \* ShiftLength

MonthlyOH = (365 / 12) \* DailyHours \* Val(ShiftDaysTB) / 7

AnnualOH = MonthlyOH \* 12

CHPEIPower = Val(CHPEIPowerTB)

CHP kWh = CHPEIPower \* MonthlyOH

AnnualCHP kWh = CHP kWh \* 12

CostofCHP = CostofCHPTB.Value

AdditionalCosts = AdditionalCostsTB.Value

MaintenanceCost = MaintenanceCostTB.Value

If ICEMTCB.Value = "MicroTurbine" Then

    Worksheets("Cost Savings").Range("A2").MergeArea.Value = "MicroTurbine"

End If

If ICEMTCB.Value = "Internal Combustion Engine" Then

    Worksheets("Cost Savings").Range("A2").MergeArea.Value = "IC Engine"

End If

Worksheets("Cost Savings").Range("B3").Value = CostofCHP

CostofCHPTB = Format(CostofCHPTB, "\$#,##0")

Worksheets("Cost Savings").Range("B3").NumberFormat = "\$#,##0"

Worksheets("Cost Savings").Range("B4").Value = AdditionalCosts

AdditionalCostsTB = Format(AdditionalCostsTB, "\$#,##0")

Worksheets("Cost Savings").Range("B4").NumberFormat = "\$#,##0"

Worksheets("Cost Savings").Range("B5").Value = MaintenanceCost

MaintenanceCostTB = Format(MaintenanceCostTB, "\$0.0000#")

Worksheets("Cost Savings").Range("B5").NumberFormat = "\$0.0000#"

IncentiveMax = 200 \* CHPEIPower

If (IncentiveCB.Value = "No" Or IncentiveCB.Value = Empty) Then

    IncentiveTotal = 0

ElseIf IncentiveCB.Value = "Yes" Then

    IncentiveTotal = (CostofCHPTB + AdditionalCosts) \* 0.1

    If IncentiveTotal > IncentiveMax Then

        IncentiveTotal = IncentiveMax

    End If

End If

'n = number of years to plot costs/savings'

Dim IRRnum As Single

Static Values(26) As Double

With Worksheets("Cost Savings")

n = 25

AnnualSavings = .Cells(16, 12).Value

AnnualMaintCost = MaintenanceCost \* AnnualCHPkWh

AnnualNGOffset = Worksheets("CHP Info").Range("B14").Value \* 12

ElCostSavings = .Range("F16").Value - .Range("I16").Value

NGCostOffset = .Range("J16").Value - .Range("G16").Value

.Cells(2 + 1, 30).Value = -CostofCHP - AdditionalCosts + IncentiveTotal

.Range("B6").Value = IncentiveTotal

.Range("B6").NumberFormat = "\$#,##0"

.Range("B7").Value = AnnualCHPkWh

.Range("B8").Value = AnnualNGOffset

.Range("B9").Formula = "=(F16 - I16)"

'.Range("B9").Value = ElCostSavings

.Range("B10").Formula = "=(J16-G16)"

'.Range("B10").Value = NGCostOffset

```

.Range("B11").Formula = "=(B9-B10)"
'.Range("B11").Value = AnnualSavings
.Range("B12").Value = AnnualMaintCost
.Range("B13").Formula = "=(B11-B12)"
'.Range("B13").Value = AnnualSavings - AnnualMaintCost

```

Values(0) = -CostofCHP - AdditionalCosts + IncentiveTotal

For i = 1 To n

```

.Cells(2 + i, 27).Value = i
.Cells(2 + i, 28).Value = AnnualSavings
.Cells(2 + i, 29).Value = -AnnualMaintCost
Values(i) = AnnualSavings - AnnualMaintCost
.Cells(29 + i, 28).Value = Values(i)
Next i

```

If ((-CostofCHP - AdditionalCosts) \* (AnnualSavings - AnnualMaintCost) > 0 \_

Or Values(1) \* n + Values(0) < 0) Then

```

.Range("B14").Value = "Error"

```

Else: IRRnum = IRR(Values())

```

.Range("B14").Value = IRRnum

```

End If

```

.Range("B15").Formula = "=(B3+B4-B6)/(B13)"

```

```
.Range("B16").Formula = "=1/(B15)"
```

```
End With
```

```
End Sub
```