15. Joseph Torrillo (Prof. Jamie Winebrake) Public Policy

The Public Policy Program in the Department of STS/Public Policy is pleased to have selected Joseph Torrillo as its 2007-08 Kearse Award winner. Joe is receiving this award for his paper entitled "Validating Barriers for Implementing Renewable Energy Technology in National Parks along the East Coast", which was written for his Senior Project. In this study, Joe explores the barriers that have prevented the implementation of renewable energy technologies at U.S. National Parks, with particular attention paid to those parks on the U.S. East Coast. Using survey data and statistical analysis, Joe draws correlations among park attributes and the likelihood of renewable energy adoption. Through this study, Joe identified systemic issues within the National Parks Service that inadvertently imposed significant barriers to renewable energy implementation. These results are currently being used to assist managers at the National Park Service Headquarters and the U.S. Department of Energy design programs and policies that will be more effective at introducing renewable energy within our National Park system.

Validating Barriers for Implementing Renewable Energy Technology in National Parks along the East Coast

A project submitted to the Public Policy Program at Rochester Institute of Technology in fulfillment of 0521-405

By

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1. Abstract

To this day the United States has been a nation dependent on non-renewable sources of energy. The dependency of Americans on natural gas, coal, and foreign sources of oil has left the United States citizens and their environment vulnerable. The dependency Americans have on foreign oil to supply more than half[1] of their oil consumption, in association with the costs of recovering and importing it, has left Americans victim to ever increasing prices of energy. In addition, fossil fuels subject Americans to greater health and safety risks because greenhouse gases (GHGs) and other toxins are released into the atmosphere when they are used. With awareness being raised to preserve the natural environment, the 2005 Energy Policy Act (EPACT)[2] has demanded national parks across the United States to increase their use of renewable energy sources. This alone is not enough to cause significant changes in our national parks because a clause in EPACT stipulates that national parks can claim exemption from implementing renewable energy technologies (RETs) if there are natural barriers inhibiting them from doing it. Exploration, definition and validation of these barriers are ways to shape policy to overcome them. Recent research [Green, 2006][3] has been conducted in the Pacific West Region (PWR) of the United States that defines and validates barriers that inhibit National Park Service (NPS) areas from implementing RETs. This project is designed to identify and compare the attributes of a sample set of national parks located along the East Coast of the U.S. with the attributes of national parks in the PWR. The goal is to find out if the attributes linked to barriers in the PWR are similar to the attributes of national parks that lack RET implementation along the East Coast. If the attributes are similar, then it may be possible to validate that the same

barriers exist in NPS areas along the East Coast. This information could prove useful if the Federal Government wanted to develop a national policy that could assist national parks in overcoming the natural barriers that inhibit RET implementation.

2. Introduction

We are a nation dependent on foreign oil and on other non-renewable energy sources, such as natural gas and coal. [Although the United States is the third largest producer of crude oil, nearly 55% of the oil that the U.S. depends on is imported; mostly from the Middle East.[4] If the U.S. were to suddenly have all of its' oil supply cut off, (i.e. the oil embargo of 1973 and 1974[5]) the U.S. would only have about 690 million barrels of oil saved in underground salt caverns along the Gulf of Mexico (approximately a 60-day supply) in the Strategic Petroleum Reserve (SPR).][6] Therefore, the U.S. economy is at risk. When foreign countries can set the price of the oil that Americans depend on for its' energy needs, Americans can suffer from ever increasing oil prices. In addition, when foreign countries can choose to cut off oil supply to the U.S. at any time, the U.S. economy could suffer a threatening recession or depression because there is currently no long-term renewable energy-supply capable of meeting the growing demands of its citizens.

The United States is heavily dependent on another non-renewable energy source; coal. With about 52% of energy in the United States coming from the combustion process of coal[7], an increase in CO2 levels in the atmosphere is becoming a huge concern as it is linked to global warming. Global warming poses devastating threats to the world as temperatures rise, weather patterns change, ice caps melt, coastlines and surrounding communities experience flash floods (i.e. Hurricane Katrina), natural habitats are

destroyed (increasing extinction probabilities for endangered species) and humans face greater health and security risks. CO2 and other toxins emitted during the combustion process of coal pose serious risks to human health because of the increase in GHGs and other pollutants in the air we breathe. GHGs, such as CO2, trap and subject humans to more intense and harmful UV rays which can cause severe burns and skin cancer or even death when natural disasters, such as flash flooding, occur.

The U.S. must make an effort to decrease our foreign dependency on oil. This will decrease consumer prices and other threats to the U.S. economy. The U.S. must also reduce their dependency on other non-renewable energy sources so that the affects of global warming and other associated health risks will also be reduced. Implementation of RETs across the nation can provide a solution to this problem. The U.S. needs to determine a method for implementing RETs that will work.

The Federal Government is trying to regulate non-renewable energy consumption by implementing policies that require federal government agencies and buildings to increase their use of RETs. The NPS is a federally funded organization and therefore must adhere to federal regulations regarding dependency on RETs. Due to the great magnitude of visitors that National Parks receive each year, they have become a prime target for marketing RETs because they can set an example for everyone to see. Unfortunately, the process of implementing RETs and increasing renewable energy usage has been slow. Barriers exist that inhibit the implementation process, thus prolonging the continued dependency on non-renewable energy. The objective of this study is to determine if any of the barriers for implementing RETs in National Parks in the PWR can be validated for National Parks along the East Coast by comparing the attributes of parks

with and without RETs in both regions. This information will be useful to the federal government when they are trying to develop a national energy policy with regards to RET implementation as they will have a better understanding of what barriers exist and how that will affect their targeted renewable energy dependency goals. They may even be able to incorporate steps for overcoming individual barriers into the actual policies which could theoretically reduce the number of entities that claim exemption instead.

3. Background

Section 203 of EPACT [2005][8] requires Federal buildings and agencies to use renewable energy. EPACT further defines this requirement by demanding all Federal agencies to be 3.0% dependent on renewable energy by 2007, and 7.5% dependent on renewable energy by 2013. Unfortunately the same section of the EPACT allows for Federal government agencies to merely meet these requirements "*to the extent economically feasible and technically practical*"[9]. This means that if there are natural barriers that inhibit the implementation of RETs then an exemption claim can be made removing the responsibility of a federal building or agency from having to meet the 2005 EPACT requirements. This study believes that this is the case with certain areas of the NPS. This project is designed to determine what barriers may be validated along the East Coast region so that there may be a better understanding of what is causing NPS areas to claim exemption from EPACT requirements.

The wording of EPACT leaves a lot of room for national parks to avoid implementing RETs. There is no specific definition of what constitutes valid barriers for implementing RETs. Theoretically, NPS areas could find many different reasons why it wouldn't be economically feasible or technically practical for an area to meet the

requirements of EPACT. This does not necessarily mean that the NPS is not in favor of RETs. It simply means that it may be very difficult or even impossible for them to implement the required RETs under their specific set of circumstances and therefore it may be easier and smarter for them to find a reason to fall under the "exemptions" of EPACT. A detailed policy that could identify these barriers on a case by case basis, and could incorporate them into the policy along with steps to overcome them, could potentially allow a greater number of national parks to meet the full requirements of EPACT. This would be a progressive step towards preserving our national environment by keeping it clean and safe. It would also help secure our economic growth by reducing our dependency on foreign oil. "*The immediate effects [of RET implementation] include rapidly declining costs, impressive technology advances, and growing economic power and broad-based political support, which in turn are leading to further policy reforms and even faster growth." (Steffen, 2006).*[10] Thus, preserving our natural resources and producing cleaner, cheaper energy would also allow us to be more competitive in the global market.

The prior research [Green, 2006] conducted in the PWR found that the NPS operates as an agency and therefore the agency, as a whole, is responsible for meeting the requirements of EPACT. This means that some areas of the NPS do not have to use RETs as long as other areas make up for it. Thus, the NPS' overall dependency on renewable energy may meet the EPACT requirement, but any policies with goals that were hoping or intending to get each NPS area to implement RETs would prove unsuccessful. Hopefully the research will give decision makers a way to rewrite the policy to require each individual NPS park to implement RETs. With a larger number of

park services exhibiting RETs, hopefully a greater proportion of the public will learn about RETs and choose to use them as well.

Executive orders similar to EPACT have been issued regarding renewable energy dependency, but the policies can be rewritten to incorporate and provide procedure for overcoming specific barriers in individual locations. A few of these regulations are seen in *Executive Order 13123* and the Department of the Interior's *Buildings/Facilities Energy Management & Water Conservation Plan*. Section 204 of EPACT established a program with the objective of installing PV systems on Federal Buildings by 2010. "The Green Energy Parks Program (GEPP) in 1999 was created through an agreement between the DOI and DOE to further goals of public education, use of sustainable energy sources and environmental protection. It was proposed to save energy costs and taxpayer dollars, reduce air pollution, reduce dependence on foreign oil, create jobs, encourage technological innovation, transform the marketplace, and enhance park visitor experience" (Memorandum, para.11) (Green pg 22).

4. Methodology

In order to keep my work consistent with that of prior research [Green, 2006], some background information regarding the prior research is applicable. RETs refer to technologies that harness energy from the sun and the earth to generate electricity; they include solar (photovoltaic systems), wind (wind turbines), geothermal, and micro-hydropower technologies.[11] "*Renewable energy sources are clean and essentially inexhaustible. Photovoltaic systems use photovoltaic solar cells to convert the energy from sunlight directly into electricity. Wind turbines capture the wind's energy with propeller-type blades to produce electricity. Geothermal energy technologies harness*

the earth's heat for various uses; they include geothermal heat pumps, direct applications, and electricity production technologies. Micro-hydro systems are hydropower systems up to 100 kW in size where flowing water, from streams or other water sources, is captured to create electricity"[Green, 2006]. Fuel Cells are an alternative to conventional energy. "*Fuel Cells use hydrogen – or a hydrogen-rich fuel such as methane- and oxygen to create electricity where the only byproducts are heat and water. Although fuel cells are not necessarily renewable, fuel cells can be considered an RET when the hydrogen used is produced from renewable energy.*" [Green, 2006]

Previous research [Green, 2006] has taken an in depth look at barriers for implementing RETs in NPS areas in the PWR of the United States. I will expand the research onto the East Coast of the United States by attempting to validate barriers in the East Coast region. I will look at which NPS areas do not have RETs and compare their characteristics with those found in similar areas in the PWR areas. If the attributes are similar, then we can claim that the barriers validated in the PWR are also valid in the East Coast region. If the characteristics are determined to be different, we can hypothesize why that is and determine if the research is inconclusive or if the barrier cannot be validated in the East Coast region. I should also be able to hypothesize which national parks would be considered good candidates for implementing RETs based on the absence of any common barriers. This study could also create a foundation for future research as procedures for overcoming any of the discovered barriers could later be defined.

"The PWR accounts for over 50 areas (national parks, monuments and historic sites), encompasses 12 million acres of land and hosts 20% of National Park visitors. The region has considerable amounts of solar, geothermal and wind resources." [Green, 2006]

The East Coast, by its geographic location, differs from the PWR. Differences in geographic location could mean differences in weather patterns, types of energy used, resources available, associated costs, etc, and can therefore create differences in results found in the study. I am going to define the East Coast as all of the original 13 colonies (New Hampshire, Massachusetts, Rhode Island, Connecticut, NY, NJ, Delaware, Maryland, Pennsylvania, Virginia, North Carolina, South Carolina and Georgia), all other states actually touching water on the East Coast (Maine and Florida) and any other entity encompassed by these 15 states (Vermont, Washington D.C.). Under this definition, the East Coast accounts for 160 areas.

In the 2007 Greenbook[12] (a government published table filled with statistical information on nearly all NPS areas), the Department of Interior (DOI) summarized and published data for 122 of the 160 previously defined, East Coast areas while 38 of them were not reported on. Based on this data, the DOI reports that the East Coast accounts for a little over 30% of NPS full time employees (FTEs), about 35% of the overall NPS budget, around 40% of NPS area visitors and around 5% of the gross NPS area acreage (4 million). These percentages do not reflect the areas included in the East Coast that the DOI did not report in the 2007 Greenbook. Therefore, the actual percentages should be higher than what is reported above.

Some of the different barriers validated in the PWR include the size of the NPS area, the number of visitors that area gets, their budget, how many people work there, whether or not it's a historic site, and whether or not they collect fees. These statistics, as well as some other information, can all be found in the 2007 Greenbook. These statistics are shown in the following tables:

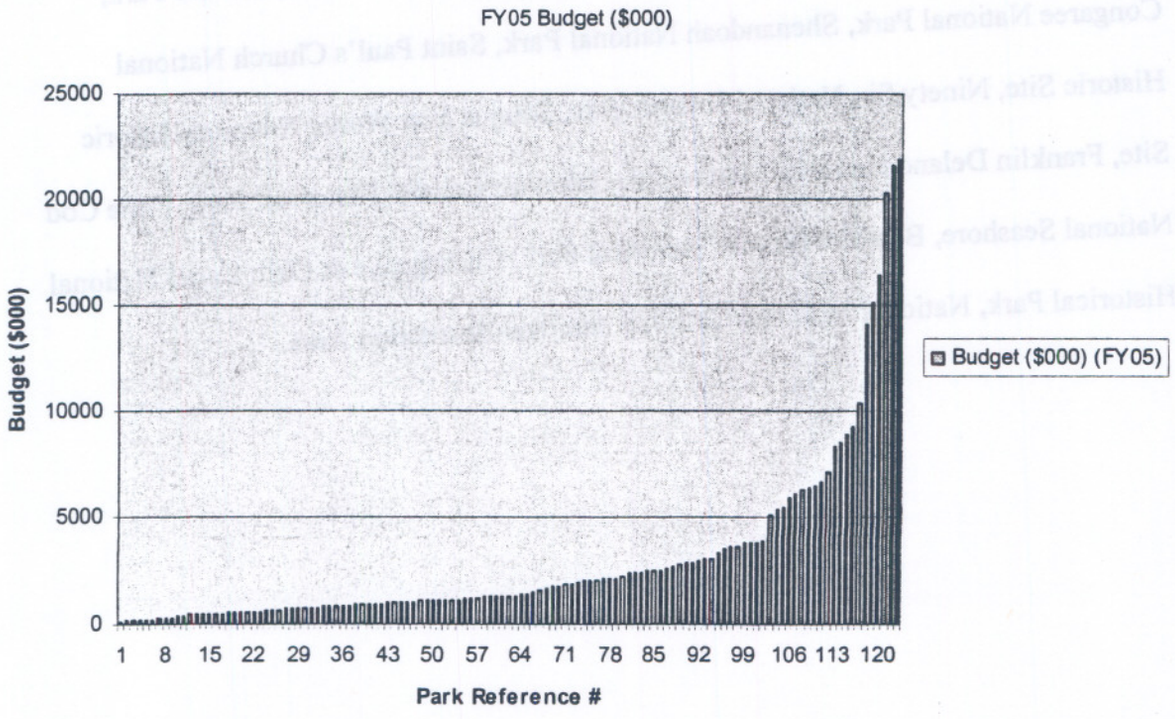
Table 4.1 East Coast Summary Statistics

Summarized Data for All NPS East Coast Areas (NH, MA, RI, CT, NY, NJ, DE, MD, PA, VA, NC, SC, GA, ME, FL, VT, D.C.)				
Category	**FTE (FY05)**	**Budget ($000) (FY05)**	**Visitors (FY05)**	**Gross Acreage (FY05)**
East Coast Total	4917	$358,128	107984352	4037173
NPS Total	16153	$1,028,690	273417178	84552321
East Coast Percent of NPS	30.4%	34.8%	39.5%	4.8%

(Excluded Areas)

Due to the incredible number of areas in the East Coast region, the number of areas analyzed in this project will be reduced using a random sample. To get the random sample, the data for the 122 NPS areas will be placed in a bar chart based on FY05 budget data. This way we can get an overall look at what the budget range for the East Coast NPS areas is. The graph is below:

Figure 4.1 Overall Budgets for East Coast NPS Areas



Based on the graph, I decided to break down the parks into categories. It appears the budgets range anywhere from $100,000 to $21,000,000. A good proportion of parks have budgets under $5,000,000. There seems to be a jump right around that mark up to $10,000,000. Then there are a few park budgets that range well over $10,000,000. For this reason I am going to split up 122 parks into 3 groups. The group "small" includes 101 NPS areas. The group "medium" accounts for 14 NPS areas. The group "large" accounts for 7 NPS areas. Since there were only 7 NPS areas in the large group, I decided to use 5 of them that I was able to gather information for. I also took 5 from the medium range, and 5 from the small range for a total of 15 NPS areas. The 5 NPS areas I got from the small and medium ranges were done by random sampling using the random generation function in Excel. Excel assigned each NPS area in these categories a number and I chose the smallest 5 numbers in each category to achieve 15 NPS areas total.

The NPS areas that were randomly selected for the sample set were Cape Hatteras National Seashore Everglades National Park, Independence National Historic Park, Congaree National Park, Shenandoah National Park, Saint Paul's Church National Historic Site, Ninety Six National Historic Site, Saugus Iron Works National Historic Site, Franklin Delano Roosevelt Memorial, Colonial National Historical Park, Cape Cod National Seashore, Boston National Historical Park, Chesapeake & Ohio Canal National Historical Park, National Mall and Gateway National Recreation Area.

Figure 4.2 Budget Statistics for East Coast NPS Area Sample Set

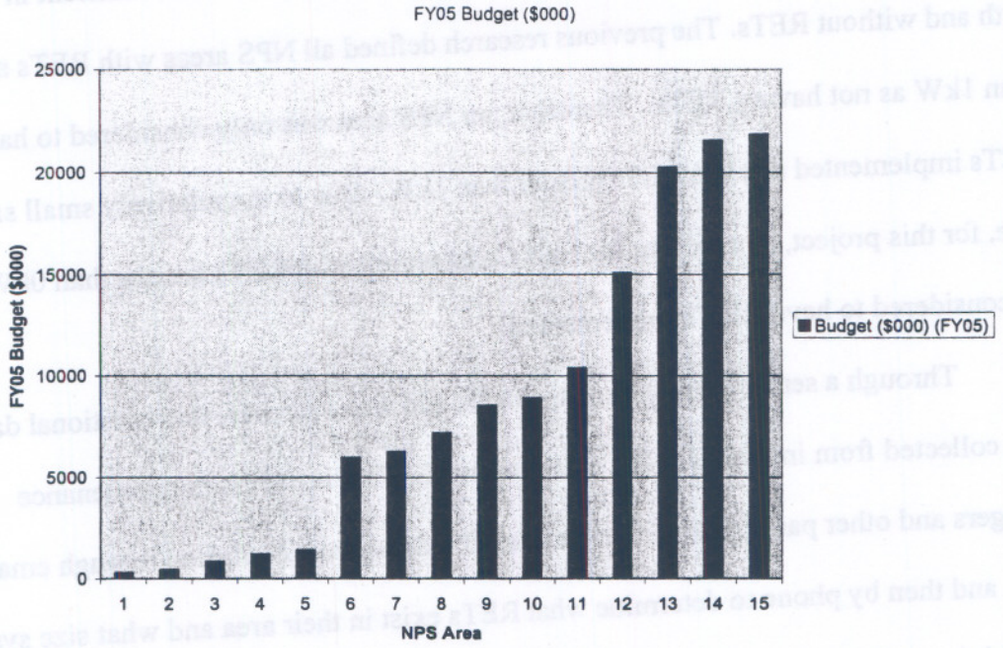
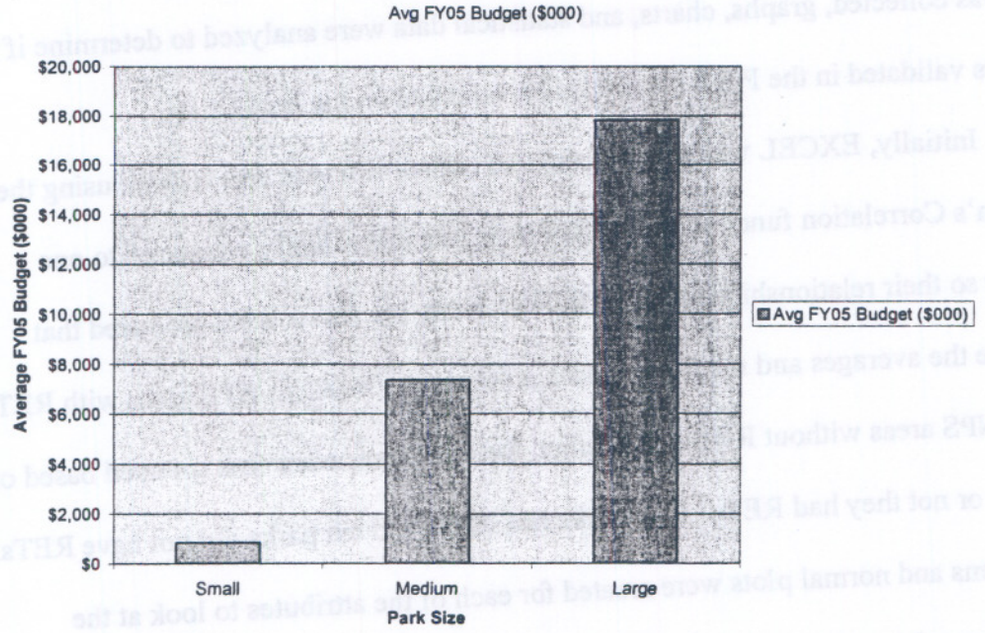


Figure 4.3 East Coast Budget Classifications



[Green] also differentiated between national parks with RETs and national parks without RETs. That way it is easier to see which characteristics are consistent in parks with and without RETs. The previous research defined all NPS areas with RETs smaller than 1kW as not having RETs. Therefore, an NPS area was only considered to have RETs implemented if it has RETs greater than 1kW. Due to the relatively small sample size, for this project, any park in the East Coast region with RETs greater than 0kW will be considered to have RET's implemented.

Through a series of phone calls, emails, and web searches, this additional data was collected from individual NPS area personnel. That is, facilities maintenance mangers and other park personnel in chosen NPS areas were contacted through email first, and then by phone to determine what RETs exist in their area and what size system (kW) it is. Additional questions were asked through email or over the phone to gather any information that the 2007 Greenbook or the NPS website[13] did not provide. Once the data was collected, graphs, charts, and statistical data were analyzed to determine if the barriers validated in the PWR could also be validated on the East Coast.

Initially, EXCEL was used to compare each attribute to one another using the Pearson's Correlation function. Each attributes was individually compared to one another so their relationships could be shown. Next, bar charts were produced that compare the averages and medians of each attribute according to NPS areas with RETs versus NPS areas without RETs. Therefore, the NPS areas were first grouped based on whether or not they had RETs. Five parks had RETs and ten parks did not have RETs. Histograms and normal plots were created for each of the attributes to look at the distribution of the data set and to test for normality. Then the averages and medians of

each attribute for both groups were calculated and displayed in graphical notation. In addition, a two-sample t-test comparing the means of each attribute (assuming equal variances) was performed to mathematically denote the relationship between NPS areas with RETs versus NPS areas without RETs. Lastly, bar charts were created that, A) Compared the percentage of NPS areas with RETs that were historic versus non-historic and B) Compared the percentage of NPS areas with RETs that collect fees versus NPS areas with RETs that do not collect fees. The tables, graphs and t-test results are provided below:

5. Results

The first table shows the Pearson's Correlation (R) of each attribute with another. In the second table the r^2 values were calculated to further define how much variability in the data can be explained by the model that compares them.

Table 5.1 Pearson Correlation

Pearson Correlation R						
Attribute	**Acreage**	**Visitation**	**Budget**	**FTE's**	**Historic**	**Collect Fees**
Acreage	1.00					
Visitation	-0.16	1.00				
Budget	0.24	0.71	1.00			
FTE's	0.32	0.61	0.95	1.00		
Historic	-0.30	-0.35	-0.25	-0.39	1.00	
Collect Fees	0.29	-0.28	-0.12	0.02	0.07	1.00

Pearson Correlation R^2						
Attribute	**Acreage**	**Visitation**	**Budget**	**FTE's**	**Historic**	**Collect Fees**
Acreage	1.00					
Visitation	0.02	1.00				
Budget	0.06	0.51	1.00			
FTE's	0.10	0.37	0.89	1.00		
Historic	0.09	0.12	0.06	0.15	1.00	
Collect Fees	0.08	0.08	0.01	0.00	0.01	1.00

Based on the data, it appears that there is a good relationship between "Budget" and "Visitation", and between "Budget" and "FTE's". It is a positive relationship which means that as one attribute increases, the other attribute does too. A negative relationship, such as the relationship between "Historic" status and "FTE's" would indicate the opposite circumstance. A higher number represents a stronger relationship as compared to a lower number. Naturally, "1.00" represents a perfect relationship. A significant amount of variability (89%) can be explained in the comparison between "FTE's" and "Budget". Likewise, 37% of the variability in the data can be explained when comparing "FTE's" and "Visitation". In the rest of the relationships relatively little variability is explained in the data.

Figure 5.1 Histogram of Data: Acreage, Visitors, Budget, FTE

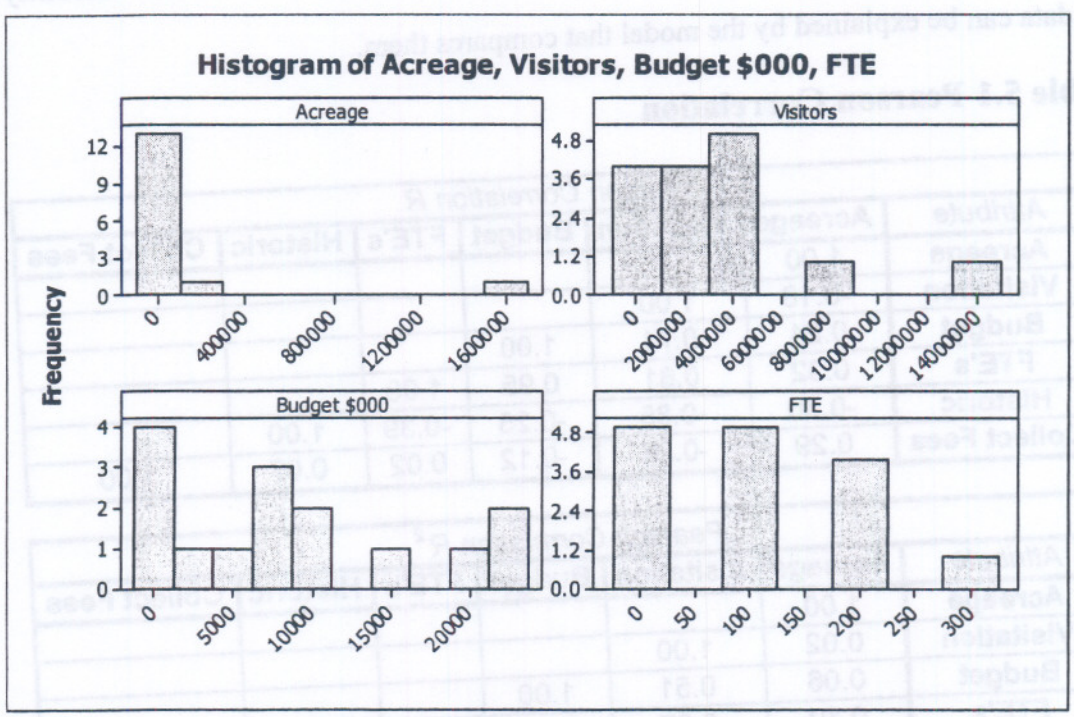
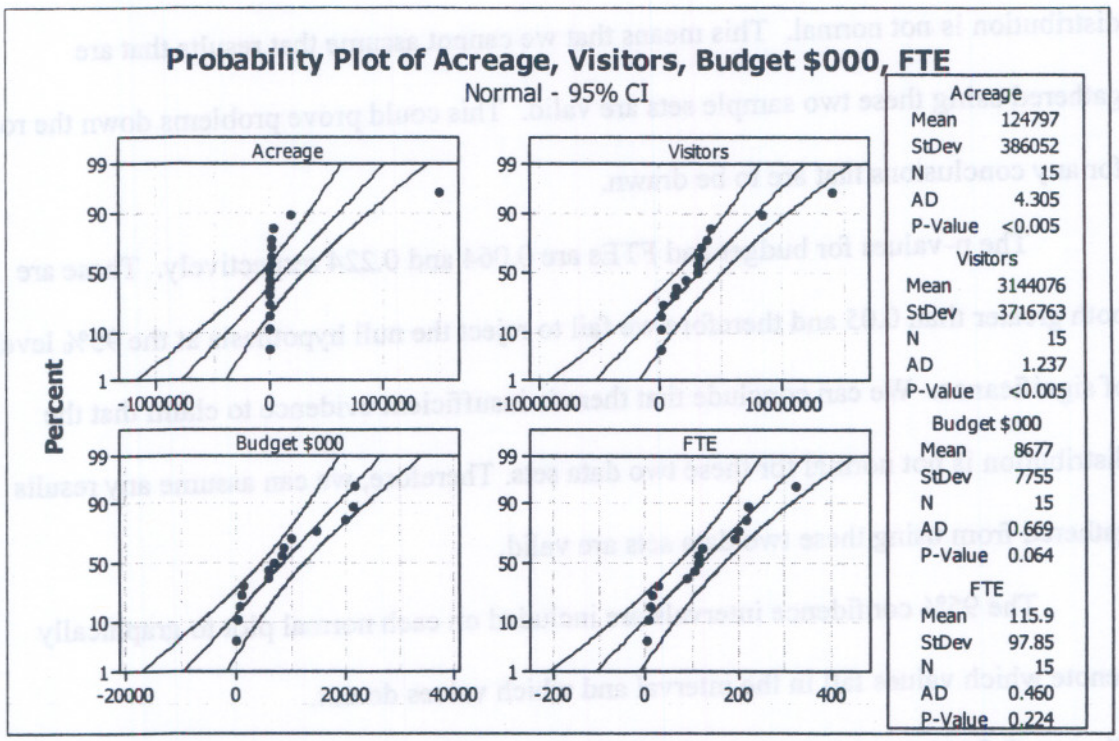


Figure 5.2 Normal Plot of Data: Acreage, Visitors, Budget, FTE



The histograms of the data sets graphically denote that acreage and visitors have less of an even distribution as budget and FTEs as they are not as symmetrical in shape. Budget and FTEs histograms prove to have a relatively more symmetrical distribution across the entire range of values.

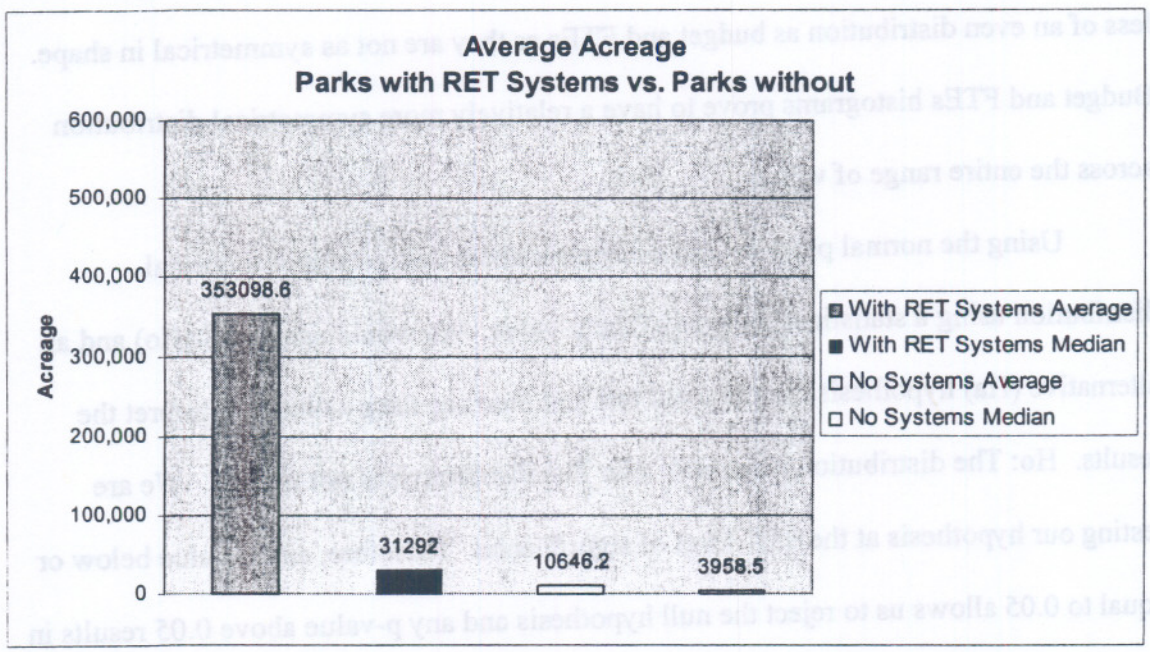
Using the normal plots we can determine which data sets have a normal distribution using a statistical analysis of the p-value. We would use a null (Ho) and an alternative (Ha) hypothesis to define our test and then use the p-value to interpret the results. Ho: The distribution is normal. Ha: The distribution is not normal. We are testing our hypothesis at the 95% level of significance. Therefore, any p-value below or equal to 0.05 allows us to reject the null hypothesis and any p-value above 0.05 results in a failure to reject the null hypothesis. The p-values for acreage and visitors are both less than 0.005. Therefore, in both cases, we reject the null hypothesis at the 95% level of

significance and conclude that there is sufficient evidence to support the claim that the distribution is not normal. This means that we cannot assume that results that are gathered using these two sample sets are valid. This could prove problems down the road for any conclusions that are to be drawn.

The p-values for budget and FTEs are 0.064 and 0.224 respectively. These are both greater than 0.05 and therefore we fail to reject the null hypothesis at the 95% level of significance. We can conclude that there is insufficient evidence to claim that the distribution is not normal for these two data sets. Therefore, we can assume any results gathered from using these two data sets are valid.

The 95% confidence intervals are included on each normal plot to graphically denote which values fall in the interval and which values do not.

Figure 5.3 Average Acreage RET vs. No RET



Based on the chart that compares average/median acreage of NPS areas with RETs versus NPS areas without RETs, we can see, graphically, that parks with RETs

generally have a significantly greater amount of land. However, Everglades National Park skews this average tremendously as it is significantly larger in acreage than all of the other parks. In this case, comparing the medians of the data sets would prove useful. We can see that the median acreage for parks with RETs is significantly larger than the median for parks without RETs. Parks with RETs center on a median value of approximately 31,000 acres while parks without RETs center on a median value of approximately 4,000 acres.

Table 5.2 T-Test Acreage

t-Test: Two-Sample Assuming Equal Variances

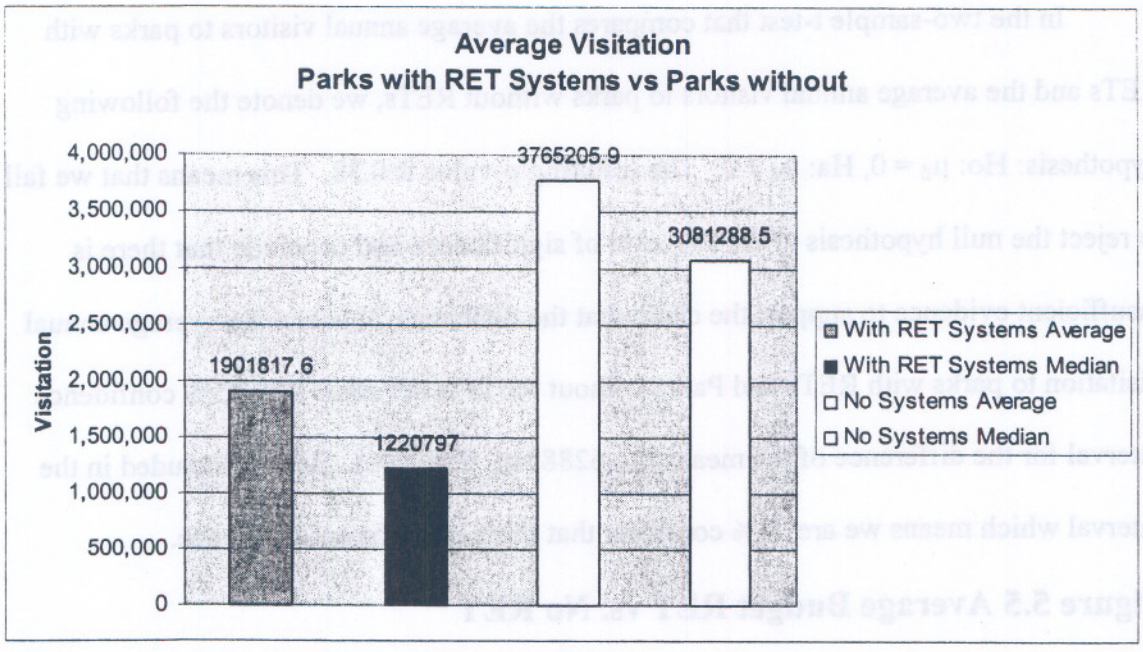
	Gross Acreage (FY05)	*Gross Acreage (FY05)*
Mean	353098.6	10646.2
Variance	4.23401E+11	220416761.1
Observations	5	10
Pooled Variance	1.3043E+11	
Hypothesized Mean Difference	0	
df	13	
t Stat	1.731214916	
P(T<=t) one-tail	0.053530285	
t Critical one-tail	1.770931704	
P(T<=t) two-tail	0.107060569	
t Critical two-tail	2.16036824	

The two-sample t-test produces a p-value that will either support or discredit any similarities in the sample sets regarding the means. The test that is performed is a test to support whether or not a given hypothesis is true or if we lack sufficient evidence to support our hypothesis. In this case, the null and alternative hypotheses we will use are that Ho: $\mu_d = 0$, and Ha: $\mu_d \neq 0$. This means that null hypothesis suggests that there is no difference between the means of the two sample sets (parks with RETs and parks without RETs) or, in other words, that they are equal. The alternative hypothesis, Ha, suggests that the difference between the means does not equal zero. In other words, the means are significantly different. The p-value that the t-test provides will tell us whether or not we

can accept or reject the null hypothesis at whichever level of significance we choose, and whether or not we have sufficient evidence to support the alternative hypothesis. For this analysis, we are using a 95% ($p <= 0.05$) level of significance.

In this case, in a two-sample t-test of the average acreages of parks with RETs (first "gross acreage" column) and parks without RETs (second "gross acreage" column), the result is a p-value of 0.107. With a 5% level of significance, any resulting p-value less than or equal to 0.05 supports the alternative hypothesis and we reject the null hypothesis, and any p-value higher than 0.05 suggests we have insufficient evidence to support the claim made by the alternative hypothesis and we fail to reject the null hypothesis. In this case, we lack sufficient evidence to support the claim that the difference between the average acreages of parks with RETs, and parks without RETs, is zero. This can be due largely to the small sample size. However, the 95% confidence interval for the difference of the means is (-84891, 769796) [Minitab] and zero is included in the interval. This means that we are 95% confident that there is no difference or that the difference is zero.

Figure 5.4 Average Visitation RET vs. No RET



The chart above compares average/median, annual, visitation between parks with RETs versus parks without RETs. The average, annual, visitation for parks with RETs was 1,901,818 for this sample set. The average, annual, visitation for parks without RETs was 3,765,206. This means that there are a greater number of visitors, on average, attending parks without RETs than parks with RETs.

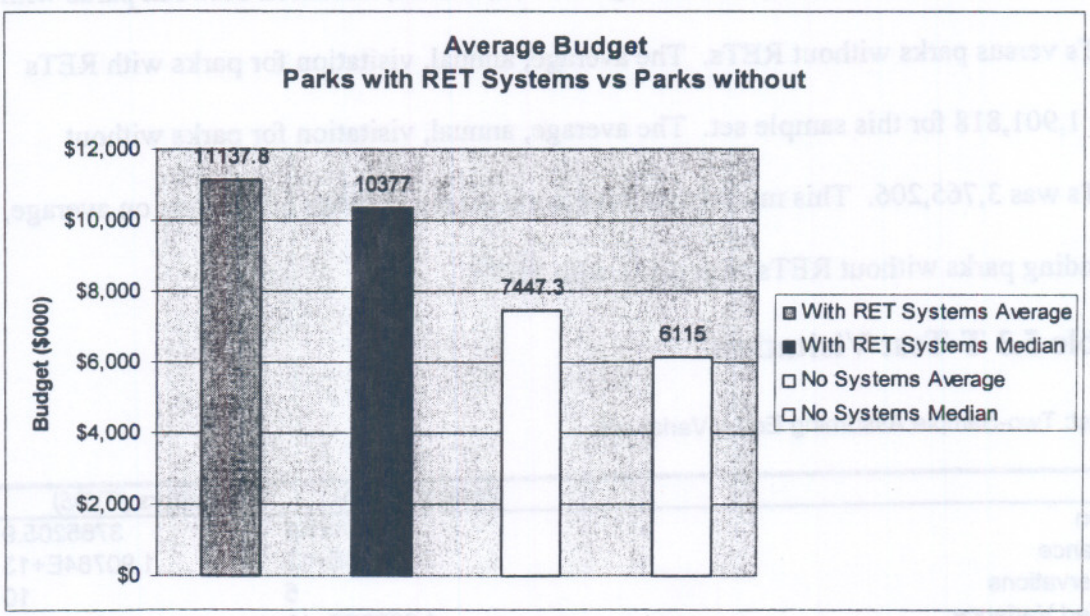
Table 5.3 T-Test Visitation

t-Test: Two-Sample Assuming Equal Variances

	Visitors (FY05)	*Visitors (FY05)*
Mean	1901817.6	3765205.9
Variance	2.53013E+12	1.90784E+13
Observations	5	10
Pooled Variance	1.39867E+13	
Hypothesized Mean Difference	0	
df	13	
t Stat	-0.909673991	
P(T<=t) one-tail	0.189775715	
t Critical one-tail	1.770931704	
P(T<=t) two-tail	0.37955143	
t Critical two-tail	2.16036824	

In the two-sample t-test that compares the average annual visitors to parks with RETs and the average annual visitors to parks without RETs, we denote the following hypothesis: Ho: $\mu_d = 0$, Ha: $\mu_d \neq 0$. The resulting p-value is 0.38. This means that we fail to reject the null hypothesis at the 5% level of significance and conclude that there is insufficient evidence to support the claim that the difference between the average annual visitation to parks with RETs and Parks without RETs is not zero. The 95% confidence interval for the difference of the means is (-6288716, 2561940). Zero is included in the interval which means we are 95% confident that there could be no difference.

Figure 5.5 Average Budget RET vs. No RET



The above chart describes the average/median budgets of parks with RET systems and parks without RET systems. According to the results, the average budget for parks with RET systems is approximately $11.1 million and the average budget for parks

without RET systems is approximately $7.4 million. This would support the theory that parks that have RET systems generally have a larger overall budget.

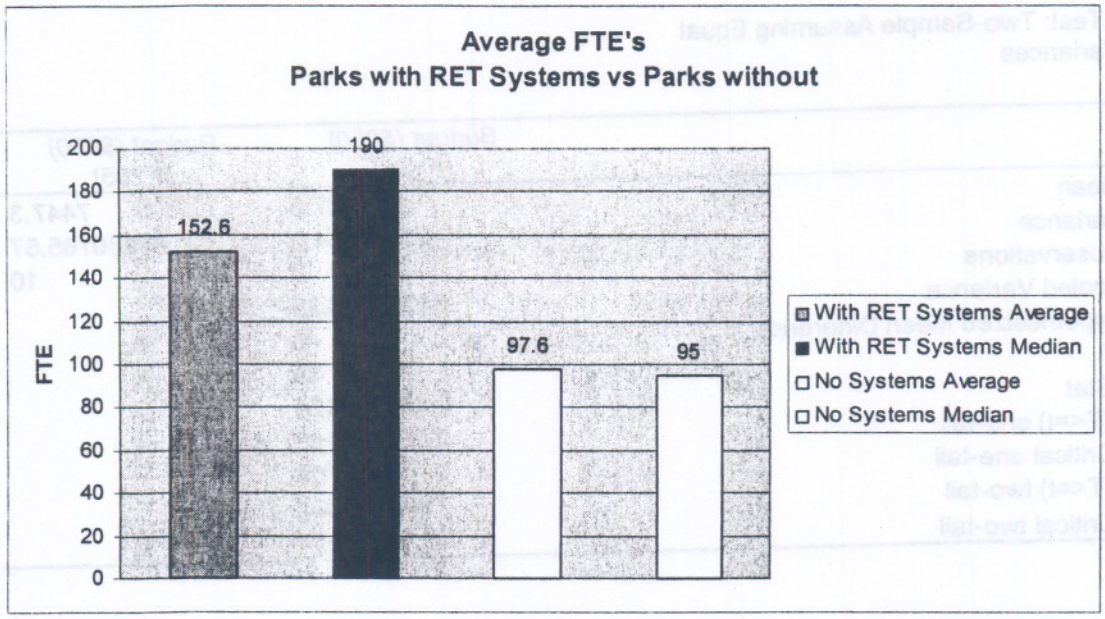
Table 5.4 T-Test Budget

t-Test: Two-Sample Assuming Equal Variances

	Budget ($000) (FY05)	*Budget ($000) (FY05)*
Mean	11137.8	7447.3
Variance	61387554.2	61230765.57
Observations	5	10
Pooled Variance	61279008.22	
Hypothesized Mean Difference	0	
df	13	
t Stat	0.860733524	
P(T<=t) one-tail	0.202490193	
t Critical one-tail	1.770931704	
P(T<=t) two-tail	0.404980387	
t Critical two-tail	2.16036824	

The t-test that compares the average budgets for parks with RET systems and parks without RET systems produces a p-value of 0.41 and a 95% confidence interval of (-5572, 12953). This means that we fail to reject the null hypothesis and conclude that there is insufficient evidence to support the claim that the difference between the average budgets for parks with RET systems and parks without RET systems is not zero.

Figure 5.6 Average FTE's RET vs. No RET



This chart compares the average number of full time employees at parks with RET systems and parks without RET systems. The average number of full time employees at parks with RET systems is approximately 153 and the average number of full time employees at parks without RET systems is approximately 98. The median for parks with RET systems is significantly higher than the average which means that the data could be skewed do to an extreme outlier. In this case, it is apparent that Congaree National Park has only 14 FTE's and brings the average number of full time employees for parks with RET systems down significantly.

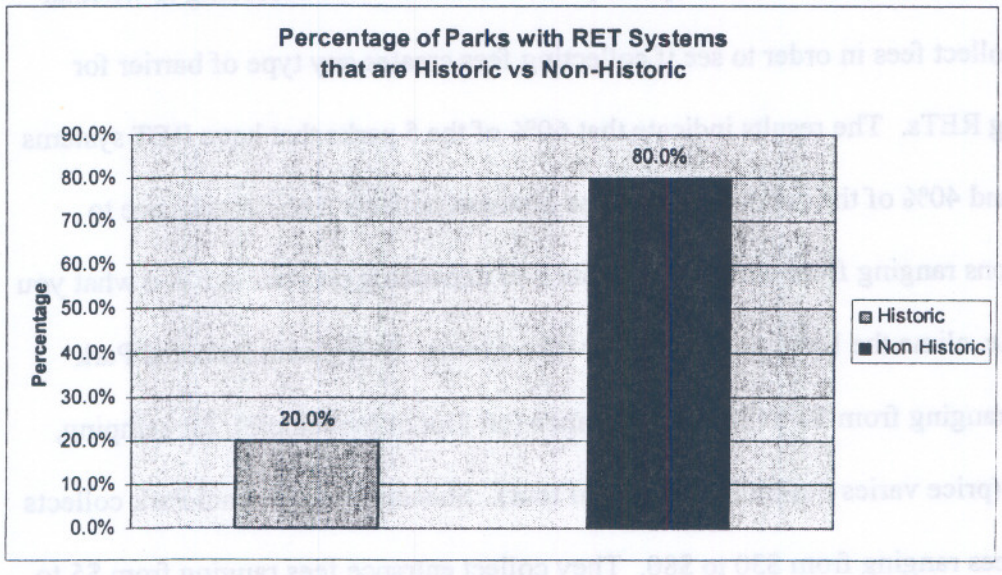
Table 5.5 T-Test FTE

t-Test: Two-Sample Assuming Equal Variances

	FTE (FY05)	*FTE (FY05)*
Mean	152.6	97.6
Variance	7608.3	10392.71111
Observations	5	10
Pooled Variance	9535.969231	
Hypothesized Mean Difference	0	
df	13	
t Stat	1.02829954	
P(T<=t) one-tail	0.16128124	
t Critical one-tail	1.770931704	
P(T<=t) two-tail	0.322562481	
t Critical two-tail	2.16036824	

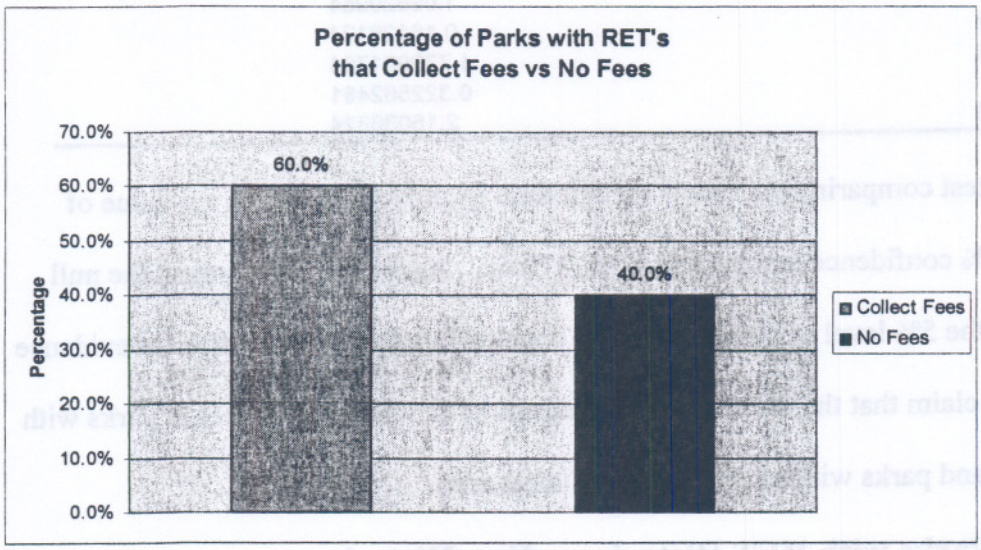
The t-test comparing the means for full time employees produces a p-value of 0.32 and a 95% confidence interval of (-60.6, 170.6). Again, we fail to reject the null hypothesis at the 5% level of significance and conclude that there is insufficient evidence to support the claim that the difference of the means of full time employees at parks with RET systems and parks without RET systems is not zero.

Figure 5.7 Parks with RET Historic vs. Non-Historic



The graph above accounts only for parks with RET systems and compares whether or not they are historic. This graph is generated to compare whether or not a park that is labeled historic creates any barrier for implementing renewable energy technology. The results conclude that, out of 5 parks, 20% were historic, where as 80% were non-historic.

Figure 5.8 Parks with RET Collect Fees vs. No Fees



The second graph (above) compares parks that have RETs according to whether or not they collect fees in order to see if collecting fees creates any type of barrier for implementing RETs. The results indicate that 60% of the 5 parks that have RET systems collect fees and 40% of the parks do not. Cape Hatteras collects fees for entrance to various sections ranging from about $3 to about $30 depending on your age and what you want to do (i.e. clime the lighthouse, camp, or take a tour). Everglades National Park collects fees ranging from $5 to $200 for entrance (on foot or by vehicle), for camping, and for tours (price varies depending on size of tour). Shenandoah National Park collects annual pass fees ranging from $30 to $80. They collect entrance fees ranging from $5 to

$25 (depends on whether or not you enter by foot, motorcycle, car/van etc.) and they collect tour fees ranging from $25 to $200 (depending on the number of people).

6. Comparisons: EAST COAST and PWR

[Green] created the same type of Pearson's Correlation chart. The results also proved that "budget" vs. "visitation" as well as "budget" vs. "full time employees" had the two highest correlation coefficients. Similarly, her results indicated negative correlations between "historic" status and all other attributes. The only difference was that the PWR found a positive correlation between "Collect Fees" vs. "Visitation" and "Collect Fees" vs. "Budget" where as my results proved a negative relationship. However, the correlation itself was extremely weak and considerably insignificant.

Of greater note, when comparing parks with RET systems and parks without RET systems, most of the PWR t-tests proved statistical insignificance. Similarly, my t-tests proved the same. A resulting t-stat of 1.96 would prove statistical significance at the 95% level, however, most of my t-tests failed to produce a resulting t-stat that great in magnitude. A two sample t-test of the means of average acreage produced an approximate t-stat of 1.73; [visitation, -0.909]; [budget, 0.86]; [FTE's, 1.028]. In addition, I lacked sufficient evidence to support the claim that the mean difference of any attribute (comparing parks with RET systems to parks without RET systems) was anything other than zero. Thus, I could not statistically prove that there was a significant difference in the averages.

Data from the PWR did show that the sample of parks in the PWR that had instances of RET systems had overall higher average budgets, acreage, and full time employees. Similarly, my graphs proved the same result in all three categories. Parks

with greater overall acreage, more employees, and a larger budget tend to have greater instances of RETs.

Another similarity can be seen in the results of the PWR graphs that compared parks with RET systems according to fee collection and historic status. In the PWR a greater percentage of parks that had instances of RET systems had both collected fees and were of non-historic status. This was the same result for the sample of parks that were analyzed in the East Coast Region.

The only surprising result was seen in the graph of average visitation between parks with RET systems and parks without RET systems. Parks without RET systems had a greater overall average annual visitation statistic than did parks with RET systems. An analysis of this result will be done in the conclusion.

7. Conclusion

The following results were found for the PWR: [*Green p.88-89]*

"The results validate the findings of Section 4.4, that funding, staff, visual and Historic resource issues are of central barriers to using RETs in the parks:

• Parks that do not collect fees—and therefore are denied a discretionary budget and parks with lower budgets are less likely to have RETs, supporting the perception that funding and initial cost are significant barriers.

• Parks with RETs have far more FTEs, supporting the perception that staff availability and staff expertise are barriers of importance, as parks with more FTEs not only have more staff available, but staff is more highly specialized.

• Parks with RETs on average have hundreds of thousands more acres than do parks without systems, supporting the perception that visual quality concerns and

that any valid results could be drawn from them. Therefore, it makes it extremely difficult to prove statistically that these barriers are validated for the East Coast region even though they were in the PWR.

Based on this conclusion, I would hypothesize that the extremely small sample size ultimately inhibited the ability of this study to statistically prove that these attributes were valid barriers in the NPS East Coast region. With more parks in the sample size, the distributions would hopefully become more normal and valid results could be concluded. With more time and a greater sample size it would be reasonable to hypothesize that some of these barriers would prove to have greater statistical significance with regards to their effect on RET implementation.

Using the attributes that we found to be more "consistent" with NPS areas in the East Coast that have RETs we could hypothesize that Gateway National Recreation Area is a great candidate for RETs. The only thing Gateway does not do is collect fees. All of the other attributes would hypothetically make it a prime location for RETs. In addition, the National Mall, which is made up of NPS areas in various locations, is a good candidate but is small (in terms of acreage) and is not capable of hosting large RET systems that take up a lot of room. The Chesapeake & Ohio Canal National Historic Park is a good candidate but is of historic status and therefore runs into barriers that deal with preservation and aesthetics. Shenandoah National Park has a small RET system. However, based on the characteristics of their park, they should be capable of implementing a much larger system. They have all of the characteristics a potential candidate for RET implementation should have.

The rest of the parks don't have the right combination of attributes to be deemed good candidates. They would most likely fall under the exemption clause in the 2005 EPACT since it is not practically, or technically, feasible for them to implement RETs based on their current situations. It is important to realize that even the smallest RET systems have a positive impact on the environment and small contributions by many different NPS areas can make a significant contribution towards the goals of the 2005 EPACT. Each individual NPS area must experience a positive change in order to get RET systems implemented in more locations. Otherwise, the minority of NPS areas with the larger systems will continue to make up for the majority of NPS areas that lack RET systems. Eventually, they will reach their maximum capacities to do this as the standards for RET dependency continue to rise. The overall result could be a failure in the ability of the NPS to keep up with the policy which means more exemptions, extended deadlines, and unsuccessful policies. The United States government needs to consider this when instituting the policies that set standards for RET dependency. If policies do not consider each parks' actual attributes as possible barriers to implementing RET systems, then a feasible design that supports RET implementation may not be found.

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Table 8.1 Excel Spreadsheet

Area	RET Size (Kw)	RET	Analytical Size (Kw)	FTE (FY05)	Budget ($000) (FY05)	Visitors (FY05)	Gross Acreage (FY05)	0=Non Historic 1=Historic	0=No Fee 1=Yes Fee
Cape Hatteras National Seashore	2.5	Yes	2.5	121	7170	2997784	31292	0	1
Everglades National Park	2.6	Yes	2.6	217	15086	1220797	1508537	0	1
Independence National Historical Park	360	Yes	360	221	21856	4051711	44	1	0
Congaree National Park	0.06	Yes	0	14	1200	97694	26546	0	0
Shenandoah National Park	0.08	Yes	0	190	10377	1141102	199074	0	1
	73.048		73.02	152.6	11137.8	1901817.6	353098.6	0.2	0.6
	2.5		2.5	190	10377	1220797	31292	0	1

Area	RET Size (Kw)	RET	Analytical Size (Kw)	FTE (FY05)	Budget ($000) (FY05)	Visitors (FY05)	Gross Acreage (FY05)	0=Non Historic 1=Historic	0=No Fee 1=Yes Fee
Manhattan Sites: Saint Paul's Church National Historic Site	0	No	0	0	293	13971	6	1	1
Ninety Six National Historic Site	0	No	0	5	430	31840	1022	1	0
Saugus Iron Works National Historic Site	0	No	0	10	856	15703	9	1	0
Franklin Delano Roosevelt Memorial	0	No	0	24	1407	3055625	8	0	0
Colonial National Historical Park	0	No	0	85	5969	3339020	8677	1	1
Cape Cod National Seashore	0	No	0	112	6261	3706094	43609	0	1
Boston National Historical Park	0	No	0	105	8527	2020983	43	1	1
Chesapeake & Ohio Canal National Historical Park	0	No	0	111	8890	3106952	19586	1	1
National Mall	0	No	0	200	20267	13963661	6895	0	0
Gateway National Recreation Area	0	No	0	324	21573	8398210	26607	0	0
			Average	97.6	7447.3	3765205.9	10646.2	0.6	0.5
			Median	95	6115	3081288.5	3958.5	1	0.5

Attribute	Acreage	Visitation	Budget ($000)	FTE's
With RET Systems Average	353098.6	1901817.6	11137.8	152.6
With RET Systems Median	31292	1220797	10377	190
No Systems Average	10646.2	3765205.9	7447.3	97.6
No Systems Median	3958.5	3081288.5	6115	95

Attribute	0=Non Historic 1=Historic	0=No Fee 1=Yes Fee	
Cape Hatteras	0	1	
Everglades	0	1	
Independence	1	0	
Congaree	0	0	
Shenandoah	0	1	
Historic	20.0%	60.0%	Collect Fees
Non Historic	80.0%	40.0%	No Fees

Table 8.2 MINITAB T-Test Output:

Two-Sample T-Test and CI: Acreage (RET), Acreage (No RET)

```
Two-sample T for Acreage (RET) vs Acreage (No RET)

           N      Mean     StDev   SE Mean
Acreage    5    353099    650693    290999
Acreage   10     10646     14846      4695

Difference = mu Acreage (RET) - mu Acreage (No RET)
Estimate for difference:  342452
95% CI for difference: (-84891, 769796)
T-Test of difference = 0 (vs not =): T-Value = 1.73  P-Value = 0.107  DF = 13
Both use Pooled StDev =  361151
```

Two-Sample T-Test and CI: Visitors (RET), Visitors (No RET)

```
Two-sample T for Visitors (RET) vs Visitors (No RET)

           N      Mean     StDev   SE Mean
Visitors   5   1901818   1590638    711355
Visitors  10   3765206   4367888   1381247

Difference = mu Visitors (RET) - mu Visitors (No RET)
Estimate for difference:  -1863388
95% CI for difference: (-6288716, 2561940)
T-Test of difference = 0 (vs not =): T-Value = -0.91  P-Value = 0.380  DF = 13
Both use Pooled StDev =  3739874
```

Two-Sample T-Test and CI: Budget $000 (RET), Budget $000 (No RET)

```
Two-sample T for Budget $000 (RET) vs Budget $000 (No RET)

             N      Mean     StDev   SE Mean
Budget $     5     11138      7835      3504
Budget $    10      7447      7825      2474

Difference = mu Budget $000 (RET) - mu Budget $000 No RET
Estimate for difference:  3690
95% CI for difference: (-5572, 12953)
T-Test of difference = 0 (vs not =): T-Value = 0.86  P-Value = 0.405  DF = 13
Both use Pooled StDev =  7828
```

Two-Sample T-Test and CI: FTE (RET), FTE (No RET)

```
Two-sample T for FTE (RET) vs FTE (No RET)

             N      Mean     StDev   SE Mean
FTE (RET     5     152.6      87.2        39
FTE (No     10        98       102        32

Difference = mu FTE (RET) - mu FTE (No RET)
Estimate for difference:  55.0
95% CI for difference: (-60.6, 170.6)
T-Test of difference = 0 (vs not =): T-Value = 1.03  P-Value = 0.323  DF = 13
Both use Pooled StDev = 97.7
```

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McKenzie Prize for Writing in the First-Year

The next prize -- in both first and second places -- is being given for only the second time today and has been made possible by the generosity of RIT Provost and Chief Academic Officer, Dr. Stan McKenzie. Himself an RIT professor for over 40 years, Dr. McKenzie took on a new RIT mission in 1994 when he was named Provost and Vice President for Academic Affairs. Now that he is stepping down from the Provost's position, he is looking forward to re-joining his colleagues in the Department of English and teaching his favorite Shakespeare courses. Perhaps next year, one of his students ill be standing here receiving the Kearse Award in literature! I'd like to invite Dr. McKenzie to say a few words about the award, and ask that Andy Perry and Sueann Wells, the two faculty members whose students are the recipients of the McKenzie Prizes for Writing in the First-Year, join him to make the awards.