Local Government & Public Sites Renewable Energy Blue Print

CONNECT Our Future
Vibrant Communities – Robust Region


Iredell
Rowan
Lincoln
Cabarrus
Cleveland
Gaston
Stanly
Mecklenburg
York
Union
Anson
Union
Chester
Lancaster

Local Government & Public Sites Renewable Energy Blue Print

As local governments and organizations continue to plan for the future with sustainable growth in mind, adoption of renewable energy initiatives are imperative and represent an incredible opportunity to ensure the high standard of living all people want.

To that point, in order to ensure that government organizations and policy makers are executing sound long term decisions and controlling costs, it is necessary to research the financial and technological feasibility of clean energy before making investments in them. This guide explains the financial considerations that are key to understanding prior to adopting renewable energy policy.

"CONNECT Our Future" is a process in which communities, counties, businesses, educators, non-profits and other organizations work together to grow jobs and the economy, improve quality of life and control the cost of government. This project will create a regional growth framework developed through extensive community engagement and built on what communities identify as existing conditions, future plans and needs, and potential strategies.

The work that provided the basis for this publication was supported by funding under an award with the U.S. Department of Housing and Urban Development. The substance and findings of the work are dedicated to the public. The author and publisher are solely responsible for the accuracy of the statements and interpretations contained in this publication. Such interpretations do not necessarily reflect the views of the Government.

This document was prepared by Centralina Council of Governments and Catawba Regional Council of Governments in partnership with Calor Energy Consulting, LLC

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CHANGING ENERGY

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Executive Summary

This guidebook is designed to allow decision-makers at public institutions – governments and non-profits – to make informed decisions in regard to the economics and basic technology of renewable energy. It includes chapters of a general nature, including descriptions of basic economics, tax incentives, and common deal structures in this industry, and provides six case studies which represent a variety of types of sites and technologies.

The case studies are not existing installations but are sites where a certain type of renewables technology has been proposed in the past. The exercise it to build a financial scenario where such a technology could be feasible, in order to illustrate how it would likely work – a brief blueprint for other similar sites – and at the same time help the technology champion at the specific site in their efforts at implementation.

The aim of this book is to de-mystify the specifics for how renewable energy projects are implemented at public sites, primarily the financial aspects of them.

The sites were selected by a large panel – the Energy Working Group (EWG) – of stakeholders from the Charlotte region in the government, utility and non-profit industries. The additional chapters were included to answer questions generated by a series of six presentations to the CONNECT Our Future project at the Centralina Council of Governments.

The biggest challenge in assembling this guidebook was in condensing information. This topic is extensive and filled with data and multiple methods for technology, finance and deal structure. After much consultation with the EWG, the editing/writing team and CONNECT staff, it has been written as concisely as possible. It is brief in length in order to be unburdensome, yet informative, to busy public officials and staff. It is considered an introduction to these concepts, and is purposely general. The proposed scenarios – deal structures, pro formas, etc. – are one way that such a project could be structured, similar to best practices nationally. But there are many ways to get to implementation, and so these are considered instructive but certainly not exhaustive.

For technical considerations, a general description of technologies is provided, but pricing – capital and operating costs – is a rough approximation rather than bankable number. The pricing for renewable energy is notoriously variable, and reliant on final design that is not the scope of this project. The numbers provided here, therefore, are also instructional rather than specific, although they are tied to the latest market information at the time of publication.

Most importantly, the book is designed to answer basic questions about how such projects work, and to provide the tools for the reader to find out more. A list of professionals, who are willing to answer additional questions and provide more data, is included with contact information. This is not an endorsement of these professionals, but simply a team with which the authors have worked successfully in the past. The contact info for the writing/editing team is also listed in this appendix, and they are happy to talk and provide more information.

Acknowledgements

This book is funded by the Sustainable Communities program at the federal Department of Housing and Urban Development, part of a national effort to help communities plan for more livable, sustainable, healthy communities. The purpose of the book is to give public officials and their staff the information they need to make relevant planning decisions regarding the implementation of renewable energy. There are interesting options now in the field of renewable energy, and they are often the best use of public budgets from an economic, return-on-investment, and environmental perspective. But it is hard to know where to start without some background information.

The book is divided into a short executive summary and introduction, chapters with general conversation about issues relevant to all such projects, and more specific descriptions of the renewable energy technologies chose for the book, and then specific site case studies. A conclusion and appendix with a wealth of relevant information follows.

This book was primarily written by Rich Deming, the Energy Lead at the Centralina Council of Governments; additional writing and editing was completed by Justin Sharp, financial modeling, and some additional writing, was done by Walter Putnam. The project was strongly supported by the Energy Working Group – a panel of 15 public and private sector energy leaders convened at the CCOG under HUD program. Special acknowledgement is given to CCOG energy liaison Jason Wager, and CONNECT program manager Sushil Nepal. Lisa Lee Morgan, the EWG chairperson, is President of Calor Energy, under whose auspices this report was developed.

This guide is focused on explaining the financials rather than the technical aspects of each project, other than a basic description of the technologies, a link to further descriptions, and – wherever possible – previous feasibility studies which go into more detail regarding technology.

To make sure technology choices were a good fit for a particular site, the project master plan was reviewed at inception by Ollie Frazier, PE and former Director of Renewable Energy/Carbon Strategy for Duke Energy. Mr. Frazier generally vetted the technology to assure that basic assumptions were correct.

From a financial perspective, the guide was reviewed by Randy Lucas, principal at Lucas Tax + Energy, to insure that the business and financial models and other finance related information is accurate and acceptable for standard use.

Introduction

Often the public officials and/or staff managing public facilities have an interest in finding a better way to utilize and even generate energy. Regardless of widely varying opinions about climate change or the environment, the technology behind renewable energy generation has reached a tipping point of sorts, becoming economically feasible or even superior to traditional forms of energy from a fiscal perspective.

Additionally, public officials have a responsibility for public safety and stability in emergency or fuel shortage situations, and a diverse energy mix contribute to this need. For these reasons, and a generally growing consensus about quality of life and stewardship issues, there has been a marked increase in the desire for information about various renewable energy technologies, especially how they work financially.

An Obvious Divide

While there have been excellent strides in the last five years of implementing renewable energy technology in the public sector, it has lagged dramatically behind the private sector. This is due to a variety of factors: public sites have no tax liability and so cannot utilize tax credits, the general inertia of managing a government is typically a large enough burden without trying to figure out new technologies and outside-of-the-box financials, and the basic difference in sharing information for planning purposes in the public sector and the private development sector.

Often, the role and responsibilities of a manager in the public sector do not make a good fit for private energy project developers. Whereas the former require all information to be public and all procurement to be open and competitive, the latter often need to operate with a certain amount of secrecy – their business models and processes are proprietary information, and to varying degrees they guard this information as a closely held secret. This is a fundamental conflict: the public official or manager cannot make effective decisions without full and open information, while the private sector stakeholders most able to implement profitable renewable energy projects are often resistant to providing such information in an environment of public, competitive procurement.

Serving a Purpose

The goal of this study is to shed light on the process, to inform the managers of public sites how the economics and deal structures of a wide variety of renewable energy technology can work on a wide variety of public sites including:

- solar photovoltaic
- energy from biosolids
- wind
- anaerobic digestion
- geothermal

Locations include schools, public housing, Native American reservations and waste-water treatment plants. Hopefully, after a perusal of this guide an official will have a better understanding of how a technology he or she is interested could be installed. This will enable them to take the next step of vetting a project – of speaking in a well-informed manner to energy installation companies and project developers, of types of deal structures (such as third-party tax equity finance with a roof lease, for example), of how to proceed with a request for proposals or qualifications.

Although this is labeled a collection of feasibility studies because that is the generally-accepted terminology for vetting a specific project, this guide is envisioned more as a series of scenario-building exercises with narratives describing how such a project can proceed and what the budget and finances would look like for such a project. In some cases, the economics of a project are very difficult – like putting PV solar on a school with no tax liability. Those cases are included with commentary about why they are challenging, and a discussion of how those challenges might be overcome. In other cases, like creating a product with market value – and even energy – from waste-water sludge, will provide obvious examples of places where cutting-edge energy technology is obviously superior to the old way of doing things and cash-flow positive very quickly.

There will be information about technology, but technology changes quickly and it is not the purpose of this study to try to keep up with it – it would be obsolete very quickly. Likewise, there will be budget numbers, but these are also meant to be used more to illustrate the economics of a project than to be taken as static costs. Prices for this type of technology are in flux from month to month. The primary goal of this guide is to illustrate roughly how budgets and cash flow look at present, to provide examples of deal structures – the charts and diagrams showing how private and public ownership of a renewable energy facility work, for example – and to inform generally about getting this type of project started through the public procurement process.

Sites

The sites for this study were not chosen haphazardly. An excellent group of regional stakeholders were formed into an Energy Working Group (EWG). Work sessions were undertaken to develop extensive criteria for selection of sites, public organizations and technologies. Over 25 were initially selected by the study team, then those were vetted and the list was sharpened to 10. The EWG then chose a final 6, which are included here. They were selected very specifically to give a wide variety of location types by organization, by site type, and by technology desired. No site was selected unless some person at that site – an official or a committed staffer – was an active "champion" of the project.

Scope

This document is intended to serve as a general guide for public decision-makers in the region around Charlotte and beyond. The examples and information in the book are designed to be general in nature, scalable to other sites, and easily replicated. If, by fleshing out these examples, one of these local "champions" were able to inform his or her stakeholders about how a project could proceed, and were able to start down a path of implementation, that is an excellent coincidence.

About the Author

The primary author of this study has served, as an outside contractor, as the Energy Lead at the CCOG since 2008. In that capacity, he has advised many of the municipalities and counties in the large 14 county CCOG region on issues of energy efficiency and renewable energy. At the same time, the team at Calor Energy Consulting has served dozens of private developers and technology providers in the private sector. The disconnect between the two groups, as described above, became very obvious early on. This guide will serve to close that gap, and to show that renewable energy technology can now be implemented in a way that makes sense from the perspective of cutting government costs, increasing the quality of life of the employees and citizens of a region, and promoting economic development and the growth of regional employment in a new industry.

General Incentives and Utility Considerations

The debate around incentives

Any description of a renewable energy project must acknowledge the use of Federal and state tax incentives as part of the financial structure. This fact often causes some amount of debate, principally centered around the argument that if incentives must be used to make a project feasible, then it must be that the technology is too immature or otherwise inappropriate for implementation.

Any project should be strongly vetted to determine if it really makes sense. The aim for this guide was to illustrate methods of getting projects done; for one of the sites selected for the final six, biosolids to energy in Mooresville, an economically sensible scenario could not be built, but served to highlight how, at times, it simply does not make sense to implement new technology.

Direct Economics & Tax Incentives

A blanket rejection of the need for incentives as prima facie proof that a project is not a good one ignores the reason renewables have such incentives in the first place:

- Incentives are not simple hand-outs: they are created with for rational purposes and provide economic benefits for far more than just the project developers. Tax credits taken by renewable energy projects developed between 2007 and 2012 generated $1.87 in state or local revenue for every $1.00 of incentive. Since 2007, the state's clean energy policies have been a net revenue generator for the state of $113 million. The same applies at the federal level – in the global economy – and at the local level.

- Incentives help to level the external costs of traditional forms of energy. While direct incentives may appear to favor renewable energy, traditional energy comes with intangible costs that renewables do not – for coal it may be environmental degradation or health costs, for hydro-power it may be large-scale evaporation and resulting pressure on water supplies. Incentives for renewables correct for those off-balance sheet, or "sunk" costs that are not reflected in a utility bill.

- Incentives are designed to build a part of the energy business in its infancy, much as public funding was used to build traditional energy infrastructure. Our existing utility system did not spring fully formed as it is today – over a century of public investment has assisted in the process; current incentives are a new chapter in an old playbook.

Tax Credits and Incentives for Renewable Energy Installations – Technology Neutral

As noted throughout this report, there are substantial incentives for private entities with a tax liability. At present, there is a 30% Federal Investment Tax Credit and a 35% North Carolina renewable energy tax credit that is applicable to direct investment in renewable energy generating infrastructure.

Additionally, accelerated depreciation is available to this asset class which further enhances the returns taxable entities can realize. The aforementioned variables dramatically affect the financial modeling of renewable energy installations. These are included on the private side of each of the financial models and are calculated as follows:

Federal Investment Tax Credit

This tax credit applies to corporate federal income tax or personally accrued passive income tax. This is a dollar for dollar credit that deducts directly from taxes owed. Therefore, it is money that stays in a corporation's coffers. The credit is allotted for 30% of the system's cost and can be monetized in its entirety in the first year of system operation.

Calculation: (System Cost * 30%)

Yr. 1 Example: ($1,000,000 * 30%) = **$300,000 / 1st Year Only**

NC Renewable Energy Tax Credit

This tax credit applies to North Carolina corporate income tax or personally accrued passive income tax. The credit is allotted for 35% of the projects cost and is monetized in equal installments over five years.

Calculation: (System Cost * 35%) / 5 Years

Yr. 1 Example: ($1,000,000 * 35%) / 5 = **$70,000 / Year for 5 Years**

This book is meant to give a general guide to the economics of renewable energy and as such is not specific to North Carolina. However, as many of the sites selected for case studies are in North Carolina, it is appropriate to mention this. Many states have different incentives, and some have none at all. This radically changes the economics and viability of renewable energy projects from state to state.

Renewable Energy Certificates

One method that is used to compensate for external costs (see above) is the system of Renewable Energy Certificates (RECs). RECs are created every time one megawatt hour of electricity is generated from a renewable energy source. They represent the environmental attributes of power generated from renewable energy, and are carefully tracked on a government registry (In North Carolina, for example, on NC-RETS) to create a secure, transparent market. Unlike tax credits, RECs can be generated and sold by any public entity, regardless of tax liabilities.

Often, the value of RECs is not constant and cannot be utilized to support long term project feasibility, but they are useful to provide additional revenue and the market for them, after a period of severe contraction, has become more diverse, including a voluntary market in which institutions and governments purchase them to achieve their own carbon footprint goals.

Environmental Benefits as an Incentive

It is not considered to be part of the scope of this book to consider the intangible benefit of the environmental benefits of utilizing renewable energy. That debate tends to be vigorous and sometimes nuanced; this book is focused on tangible factors, particularly finance.

However, public institutions are supposed to represent their constituents, whether voters or the community supporting or surrounding a non-profit or university. As part of this representation, such institutions often find themselves under pressure to pursue more aggressive environmental policies from their stakeholders. This may take the form of symbolic displays of renewables, projects which do not provide investment grade financial returns, or other projects.

Because by definition a public entity does not focus narrowly on fiscal issues – though fiscal discipline is essential – the benefits of representing constituent environmental concerns or goals are a tangible factor even if the direct environmental benefits are not.

Energy Security as an Incentive

One responsibility of governments in particular is to provide secure response to disasters and other emergencies which cause interruptions in fuel and power supplies. Supporting distributed generation of energy creates redundancies which allow particular sites to function in such an emergency.

An excellent example of renewable energy providing energy security would include a program in Florida which used public money to install 10 kW solar/battery systems to schools throughout the state which act as shelters in hurricanes and other disasters. While it may not be the case that those systems provide a strong financial return, it is undeniable that they increase energy security and disaster response efforts.

Technologies

Solar Energy

Solar energy is radiant light and heat that comes from the sun and is harnessed using a range of ever-evolving technologies such as solar heating, solar photovoltaics (PV), solar thermal electricity, and others. For the purposes of this feasibility study, we have looked at the primary source of solar in North Carolina, solar PV.

Solar technologies are broadly characterized as either passive solar or active solar depending on the way they capture, convert and distribute solar energy. Active solar techniques include the use of photovoltaic panels and solar thermal collectors to harness the energy. Passive solar techniques include orienting a building to the sun, selecting materials with favorable thermal mass or light dispersing properties, and designing spaces that naturally circulate air. Active solar technologies increase the supply of energy and are considered supply side technologies, while passive solar technologies reduce the need for alternate resources and are generally considered demand side technologies

There are many benefits of embracing solar energy: it increases energy security through reliance on an inexhaustible and mostly import-independent resource, enhances sustainability, and reduces pollution from other traditional electricity sources.

In the United States, concerns of reliance on finite fossil fuels and the environmental impacts of traditional energy sources have prompted leaders, on both the federal and state level, to adopt favorable tax incentives to promote renewable energies such as solar. This has created a strong demand for the technology, and in the past 3 years the price of installation has declined considerably.

Financial Considerations

Costs

Project costs vary widely from project to project depending on procurement and the level of sophistication and time associated with permitting, contractual agreements (PPA), construction and financial structure. The PPA and financial structure used in all of the models shown are industry standard and work towards efficient deployment of capital.

Capital

As discussed, the capital required to build a solar system like the one contemplated here can come from several sources: private entities seeking tax advantages, private debt (for developers) normal public budgeting, and bonding (especially QECBs).

Operation & Maintenance

An industry accepted O&M rate applied to solar installations at present is $.015 cents per watt including a 2.5% annually compounding escalator. This amount will cover the requirements for scheduled and extra-ordinary O&M costs. This amount is listed in the following modeling as adequate to cover the cover costs regardless of the variable ownership scenarios conveyed. In the case of a public entity owner, this amount would be adequate to pay an outside contractor or train and hire a public staff member to maintain the system.

Capital

As discussed, the capital required to build a solar system like the one contemplated here can come from several sources: private entities seeking tax advantages, private debt (for developers) normal public budgeting, and bonding (especially QECBs).

Facility Charge

In addition to the one-time interconnection fee, which is necessary to build out the infrastructure, there will be an annual facilities charge from Duke Energy. This fee is assessed to any merchant power producer in order for the utility to recapture soft costs associated with monitoring another power producer on their grid. A conservative annual estimate was made to reflect this fee.

Insurance

In addition to the one-time interconnection fee, which is necessary to build out the infrastructure, there will be an annual facilities charge from Duke Energy. This fee is assessed to any merchant power producer in order for the utility to recapture soft costs associated with monitoring another power producer on their grid. A conservative annual estimate was made to reflect this fee.

Asset Management

Accounting services must be retained for the purpose of distributing cash flows and internal reporting. There are also ancillary (but necessary) cost associated with keeping a limited liability company in good standing with the state.

Geothermal

Geothermal energy is the temperature difference (or delta) between the air and the ground. Geothermal power is considered to be sustainable because the temperature extraction is small compared with the ground content. Resources of geothermal energy range from the shallow ground to hot water and rock found a few miles beneath the Earth's surface, and down even deeper to the extremely high temperatures of molten rock called magma. In modern direct-use systems, a well is drilled into a geothermal reservoir to provide a steady stream of hot water. The water is brought up through the well, and a mechanical system - piping, a heat exchanger, and controls - delivers the heat directly for its intended use. A disposal system then either injects the cooled water underground or disposes of it on the surface.

Almost everywhere, the shallow ground or upper 10 feet of the Earth's surface maintains a nearly constant temperature between 50° and 60°F. Geothermal heat pumps can tap into this resource to heat and cool buildings. A geothermal heat pump system consists of a heat pump, an air delivery system (ductwork), and a heat exchanger-a system of pipes buried in the shallow ground near the building. In the winter, the heat pump removes heat from the heat exchanger and pumps it into the indoor air delivery system. In the summer, the process is reversed, and the heat pump moves heat from the indoor air into the heat exchanger. The heat removed from the indoor air during the summer can also be used to provide a free source of hot water.

In the U.S., more than 120 large scale operations, with hundreds of individual systems at some sites, are using geothermal energy for district and space heating. In both types, the geothermal production well and distribution piping replace the fossil-fuel-burning heat source of the traditional heating system. Geothermal district heating systems can save consumers 30% to 50% of the cost of natural gas heating.

Energy from Biosolids

Energy from Biosolids provides a clever way to produce baseload power in a co-generation atmosphere. A few technology providers have invented a way to utilize sewage sludge by an energy self-sufficient method. Co-generated power and heat are used on site to provide electricity and the drying component of the solids leftover from the wastewater treatment process. Other municipal waste, such as yard and park waste, screenings and compost residues, can be co-processed with dried sludge.

Sludge mass is reduced by drying and incineration to about 10 %. The remaining ash is deposited on a separate site, thus permitting later recovery of its phosphorus content.

Micro Wind

Wind is created by the unequal heating of the Earth's surface by the sun. Wind turbines convert the kinetic energy in wind into clean electricity. When the wind spins the wind turbine's blades, a rotor captures the kinetic energy of the wind and converts it into rotary motion to drive the generator. Most turbines have automatic overspeed-governing systems to keep the rotor from spinning out of control in very high winds. Small-scale wind, also known as micro-wind, has the ability to offset electrical loads in a distributed fashion. These turbines are very low cost, easy to install and have minimal operations and maintenance costs.

A small wind system can be connected to the electric grid through a power provider or it can stand alone (off-grid). This makes small wind electric systems a good choice for rural areas that are not already connected to the electric grid.

Anaerobic Digestion (AD)

Anaerobic digestion is a collection of processes by which microorganisms break down biodegradable material in the absence of oxygen. The process is used for industrial or domestic purposes to manage waste and/or to produce methane rich biogas for alternative energy.

The digestion process begins with bacterial hydrolysis of the input materials. Insoluble organic polymers, such as carbohydrates, are broken down to soluble derivatives that become available for other bacteria. Acidogenic bacteria then convert the sugars and amino acids into carbon dioxide, hydrogen, ammonia, and organic acids. These bacteria convert these resulting organic acids into acetic acid, along with additional ammonia, hydrogen, and carbon dioxide. Finally, methanogens convert these products to methane and carbon dioxide. The methanogenic archaea populations play an indispensable role in anaerobic wastewater treatments.

AD is used as part of the process to treat biodegradable food waste, industrial processing facilities and sewage sludge. As part of an integrated waste management system, AD reduces the emission of landfill gas into the atmosphere. Anaerobic digesters can also be fed with purpose-grown energy crops, such as maize. AD is widely used as a source of renewable energy, due to the constant flow of waste available. The process produces a biogas, consisting of methane, and carbon dioxide. This biogas can be used directly as fuel, in combined heat and power gas engines or upgraded to natural gas-quality biomethane. The nutrient-rich digestate also produced can be used as fertilizer. With the re-use of waste as a resource and new technological approaches that have lowered capital costs, anaerobic digestion has in recent years received increased attention among governments in a number of countries.

Further Information

As noted, these descriptions are intended to give a general idea of the technologies included in this book. If one of the technologies is off interest to a reader, he or she is encouraged to contact the professionals listed in the appendix of the book or the book authors for more information.

Disclaimer: Financial modeling and related information provided herein are based on estimates and industry standard simulations. Calor Energy and the participating companies take no liability for the correctness of the information provided. Calor Energy is not a CPA or law firm and does provide tax or legal advice.

Third Creek Elementary School: Solar PV

General Background

Third Creek Elementary School is located in Statesville, North Carolina, in Iredell County. The site has been considered for a solar PV system in the past, and in 2012 a group of students enrolled in the Certificate for Renewable Energy Management (CREM) at NC State University completed a feasibility study that included technical and financial information about the project. This excellent feasibility study is included in the appendix to this study (at least in the electronic version). While the study did outline several financial methods of implementing the system, each of the viable approaches depended upon special programs – such as Progress Energy's Sunsense – which paid high rates for solar-generated electricity and are no longer in existence.

Currently, there is a far more difficult financial environment which must be navigated for any successful implementation.

This project represents an excellent comparison to the environment for renewables in a state with robust incentives for them, like North Carolina, and a state with minimal incentives, such as the Catawba Indian Nation solar project described later in this guidebook.

Challenges & Opportunities

This project faces several very tough challenges from a financial perspective:

- The system is relatively small, at 200 kW, which creates economies of scale issues.
- The utility regulatory framework is difficult because the solar can't be utilized on-site.
- The rate paid for power is very small (avoided cost)
- The school cannot take any tax credits.

However, there are opportunities for making the finances work. Specifically, using a third-party public/private model, it is possible to garner sufficient returns due to the availability of the North Carolina tax credit – but only if an investor or a group of investors can be gathered by the solar developer. The opportunity lies in the intangible goodwill that a school system typically has.

- Schools, like universities and non-profits, often have dedicated boosters or supporters
- These supporters, if they have tax liabilities, make excellent investors in a third party investment model.

Proposed Scenario

The best solution to the Third Creek Elementary site is to locate a group of investors with North Carolina tax appetite willing to invest in the system as a private third party entity. The returns will not be spectacular – almost 5% for a 10 year investment – but they are solid, better than very conservative investments for a relatively safe vehicle. A group with an affinity for the organization – parents or other boosters – would be more likely to make such an investment for intangible reasons. This model has been used in the past for universities and churches: supporters of the organization who like to see it implement forward-thinking programs can support it and still get a good return on investment.

Deal Structure

This deal structure is not unlike the other solar project, at the Catawba Indian Reservation – both involve a private, special interest entity that will carry the investment for the system costs and pass through the tax benefits to the investors. The difference is that moderate returns can be realized without needing a special grant. Instead, the North Carolina renewables tax credit of 35% of the investment is sufficient, for the right investor. The following graphic illustrates how a deal like this is set up.

Pro Forma

The following pro forma illustrates the cash-flows from the Third Creek project. Three lines of the pro forma are important to the school decision-maker: first is the lease payment, which is the amount that the school would get under this scenario. Due to the project economics, this is not going to be a large number, but because the private entity will be picking up all associated costs, at least the system will be cash-flow positive to the school from the beginning. The second is the S-RECs line. In this pro forma this line is blank, because the value of S-RECs is highly variable. Still, there is value in them, and more markets are opening up. But it is important for a renewable energy champion to note that S-RECs have some value, are being generated, and the school is eligible to utilize them in a revenue positive way. The details of this would be worked out in final negotiations with the investors and solar developer.

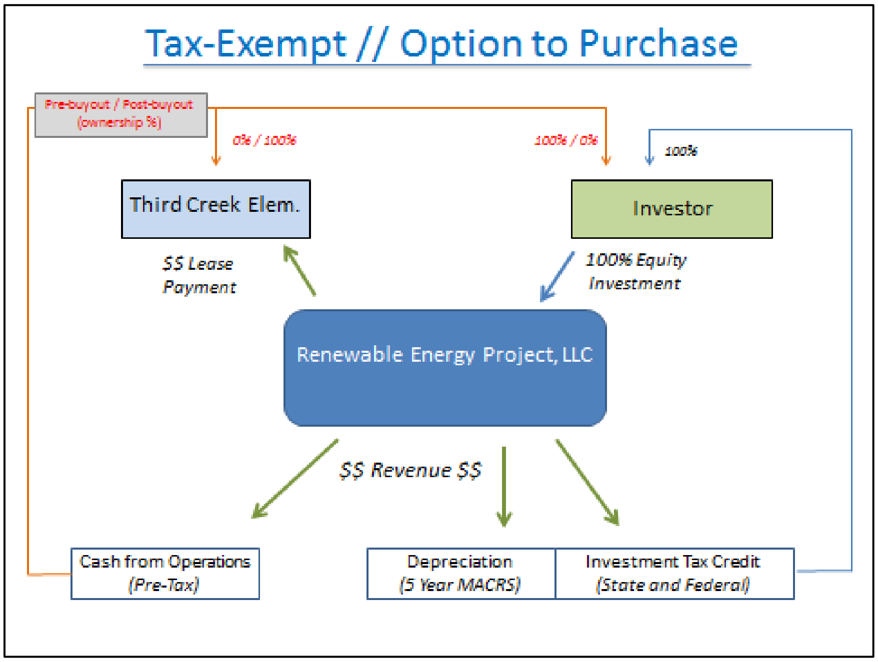
Perhaps the most important part of the pro forma, from the perspective of the school system, is the green line toward the bottom of the sheet labeled "Buyout" option. This line illustrates the cost to purchase the solar PV system from the private investment group. The PV system would typically be purchased after the tax credits are depleted in year 7. In this model, such a buy-out is illustrated for year 10, with ROI computed for that purchase.

This buy-out pricing is a valuation that is well-tested in similar projects within the IRS, and the value represents that the private group has already depreciated the equipment and extracted the tax credit value, so it is an excellent deal for the school. However, the school can structure the project so that it never has to purchase the system – it can continue to make a small lease payment and capture the REC value, and execute the buy-out option only if and when it wishes to.

Conclusions

It is difficult to make a project like the Third Creek Elementary project work financially – the system is not large, and the price paid for the power generated by it is low. Still, because there is a tax credit of 35% in North Carolina, a public/private partnership is possible that allows sufficient returns to attract an investor. The investment group will have to be interested in mid-range, very stable and safe returns and the school would likely need to participate, in conjunction with the solar developer, in assembling this group from parents or school boosters.

Such a project would provide several intangible benefits, like the educational aspect of having a system on the school, and even the ability to use the power as back-up in case of an emergency.
As noted, this model will work well with the school, but is even more applicable to institutions where there is a larger group of long term members, and boosters such as a non-profit club, a church, etc.

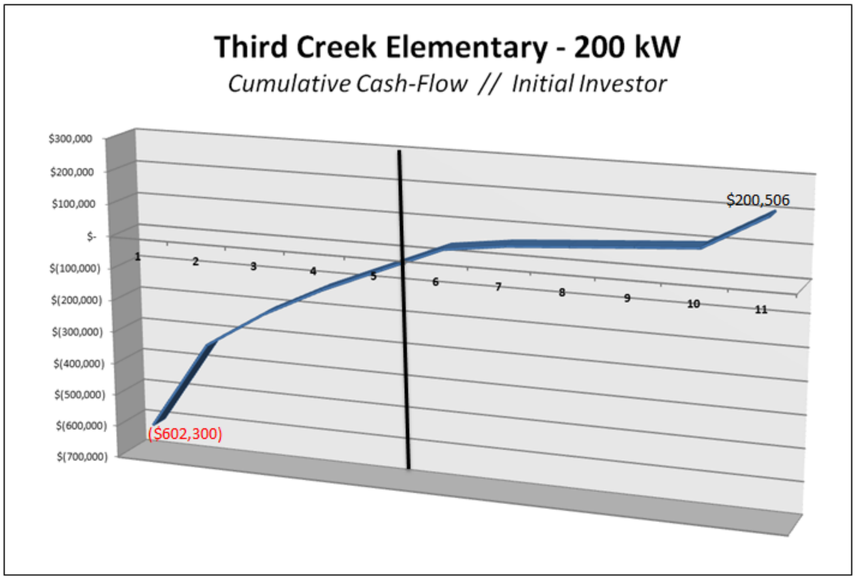


200 kW Public/Private Partnership

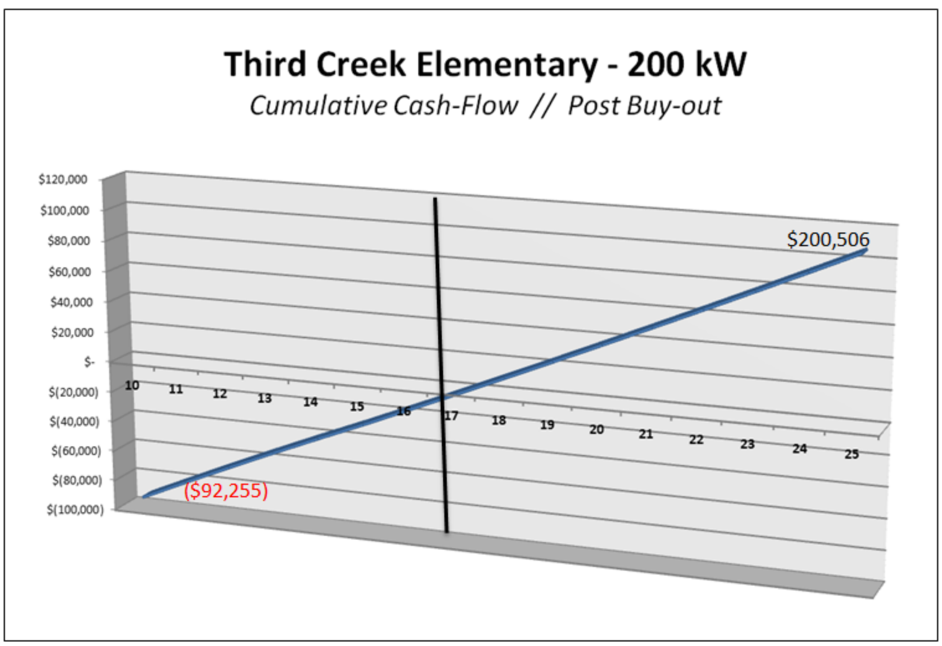
3rd Party owned with Option to Purchase

System Details				
DC System Size *(kW)*	263,000	Cost per Watt	$	2.29
AC System Size *(kW)*	202,510	Total System Cost	$	602,300
Annual Output *(kWh)*	346,581	Interconnection Cost	$	10,000
Annual System Degradation	0.5%	Annual Facility Charge	$	1,000
		O&M Cost per Watt	$	0.015
PPA Assumptions		**Net-Meter Assumptions**		
Avoided Cost Rate (kWh)	0.0650	2013 Value of Power Offset (kWh)	$	0.0500
Term (years)	15	Term (years)		10
REC Price	$ -	Annual Electricity Price Inflation		2.00%
Property				
Roof Size *(sq. ft)*		Term *(years)*		25
Lease Rate	$ -	Lease Rate Escalator *(every 5 years)*		-
Annual Lease Payment	$ 1,000.00	Property Tax *(county owned)*	$	-
Tax Considerations				
NC Renewable Energy Tax Credit	35%	Federal Tax Rate		35%
Federal Investment Tax Credit	30%	Federal Depreciation *(5-yr MACRS)*		Yes

Financial Metrics			
Capital Expense *(Project Cost)*	Payback Period *(Years)*	Internal Rate of Return *(10 Years)*	Internal Rate of Return *(15 Years)*
$ 602,300.00	5	8.96%	N/A



Financial Metrics			
Capital Expense *(Project Cost)*	Payback Period *(Years)*	Internal Rate of Return *(10 Years)*	Internal Rate of Return *(15 Years)*
$ 92,255.00	8	6.82%	11.45%



Catawba Indian Nation: Utility Scale Solar PV

General Background

The Catawba Indian Nation (CIN) consists of 700 acres located in South Carolina, close to the North Carolina border in York County, near Rock Hill, SC. This scenic site sits adjacent to the Catawba River and includes a 300 acre site known as the Green Earth parcel. The tribe would like to have this site used for environmentally-oriented businesses or projects to fit the context of the land and the tribe's beliefs.

In 2010 the CIN commissioned a solar feasibility study for the site, with funding from the Interior Ministry's Power and Mines division. This study proposed a 1 MW facility, and is attached at the end of this report. The study was excellent from a technical perspective and did provide a large amount of pricing data, but did not provide a clear pathway for implementation to the CIH leadership and so no movement was made after the study was completed.

For information about the general technology, please consult page 8, solar photovoltaic.

Challenges & Opportunities

Four primary challenges face the CIN in implementing solar at their site:

- As a non-taxable entity, none of the tax incentives available for a solar project are useful to the CIN.
- They are located in South Carolina, which has very small state tax incentives for solar power, limiting even what private investment is available.
- They are located in a utility service are with very low "avoided cost", which determines how much they will be paid for the power generated by a utility scale solar project.
- A project to provide the power the CIN needs on site is not feasible because the cost of power storage (batteries) is prohibitively high; a grid connection is essential, and this locks the CIN into existing utility rate plans that are not favorable to the economics of solar.

With multiple utilities and agencies, an exhaustive search of financial resources to create feasibility was undertaken by the study group. The following opportunities were unearthed:

- The servicing utility has a net-metering program up to 100 kW which would provide a feasible financial return.
- There is an aggressive program within the Tribal Energy division of the Department of Energy, which will provide up to 50% of the cost of a solar PV system on CIN land; it is "community-based", which means an installation appropriate to the CIN population. The public sites team met with the administrators of this division in Washington, DC and determined that there is an excellent chance to receive this funding.
- This funding will allow the CIN to put together a hybrid version of the public/private project described in terms and definitions.

Proposed Scenario

The best method for moving forward with a solar PC installation at the CIN is to apply for the Tribal Energy Grant to support 50% of the cost of a 500 kW system and 100% of the cost of an adjacent 100 kW net-metered system. This is not the size recommended in the previously completed feasibility study. But it does fit the parameters of financial feasibility.

It should be noted: because of the low renewable energy incentives in South Carolina, this project is not feasible without the Tribal Energy grant program and is dependent on an award.

Deal Structure

The first part of the project, a 100KW net metered project, would be fully owned by the tribe.

The proposed structure for the second larger system is to set up a private entity that is taxable, to allow private investors to fund 50% of the system.

The other 50% of the system will be funded by a DOE Tribal Energy grant, which will allow the CIN to receive greater benefits from the system – over the standard lease payment – and to receive a lower "buy-out" price when the tax credits have been expended.

The chart on the following page describes such a structure scenario.

Pro Forma

Included here are two pro formas – one describing a 100 kW net-metered system purchased with grant funding, and the other a private entity lease and buy-back arrangement. The former is rather straight forward (please see the chapter on renewable finance and pro forma basics page 6), and shows a modest return for a small system.

The second pro forma describes the arrangement under which a private entity would purchase the system, monetize the tax credits, and retain revenue from some combination of electrical power and renewable energy certificates. The tribe, by way of its grant-funded contribution, would be a partner in the LLC and would split the proceeds with the private (individuals or businesses) entity, taking cash rather than tax credits.

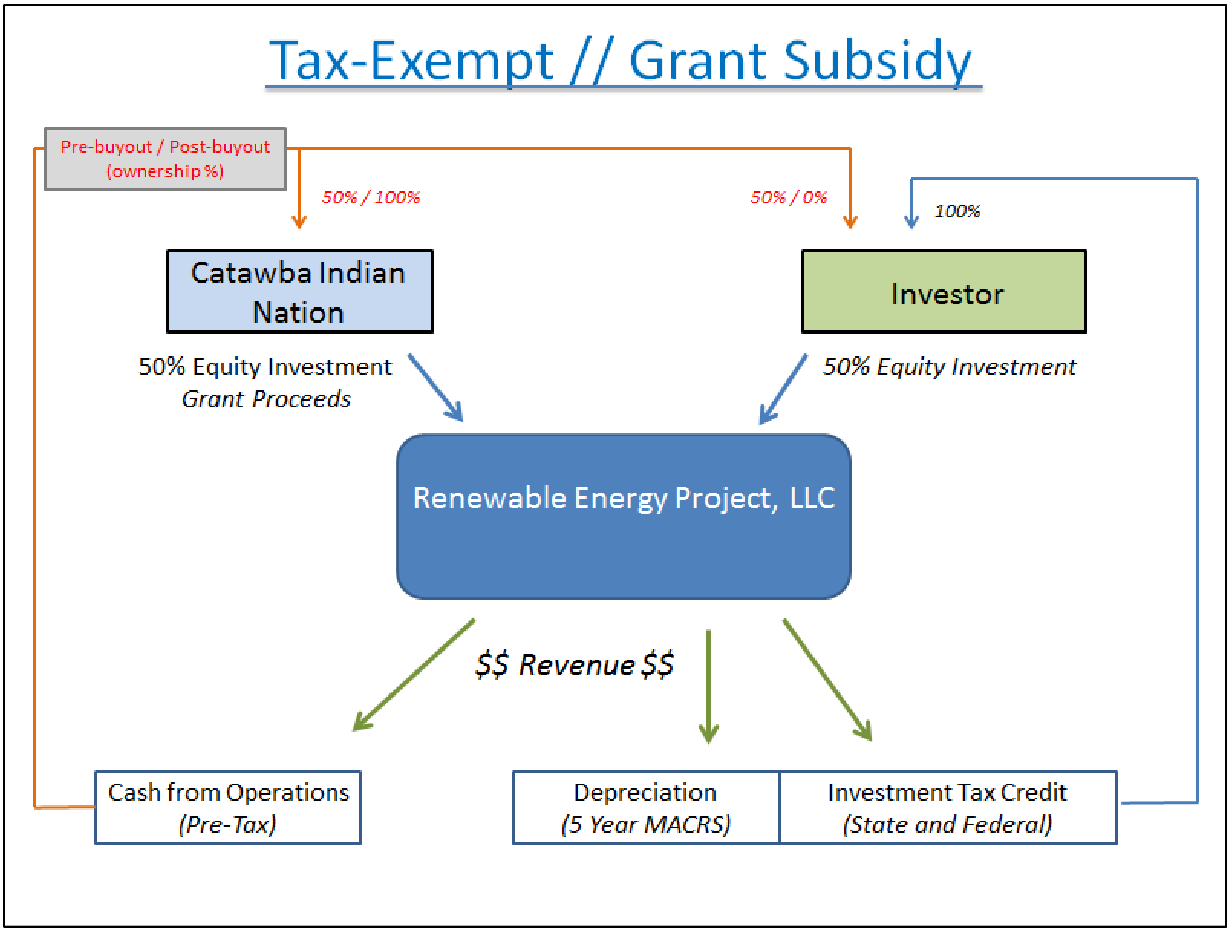
The CIN would be able to purchase the system from the developer after the tax credits are exhausted – and thus the system has been substantially depreciated.

Conclusions

The technical aspects of how to install solar at CIN have already been well established, but the economics of it are more complex. By utilizing DOE Tribal Energy funding and an outside investor, it is possible for the CIN to have solar installed on the Green Earth parcel and to achieve a decent cash flow without direct expenditure. The granting agency has indicated a high willingness to fund the project, thus making feasibility likely.

This case is an excellent example of finding alternative funding for renewable energy projects. In this case, the program is tribal. However, there are other scenarios for funding which are beyond the norm, especially when the site is unique as at the Green Earth. For example, there have been projects in which the RECs are bought by a University to fulfill climate change goals, thus making a project with sub-standard economics work. The most useful conclusion from the CIN site is that, if funding is the primary obstacle to a renewable installation at a public site, it is worthwhile for a champion of the project to do as much research as possible for all potential funding sources.

Ownership Structure
500 KW Public/Private Partnership



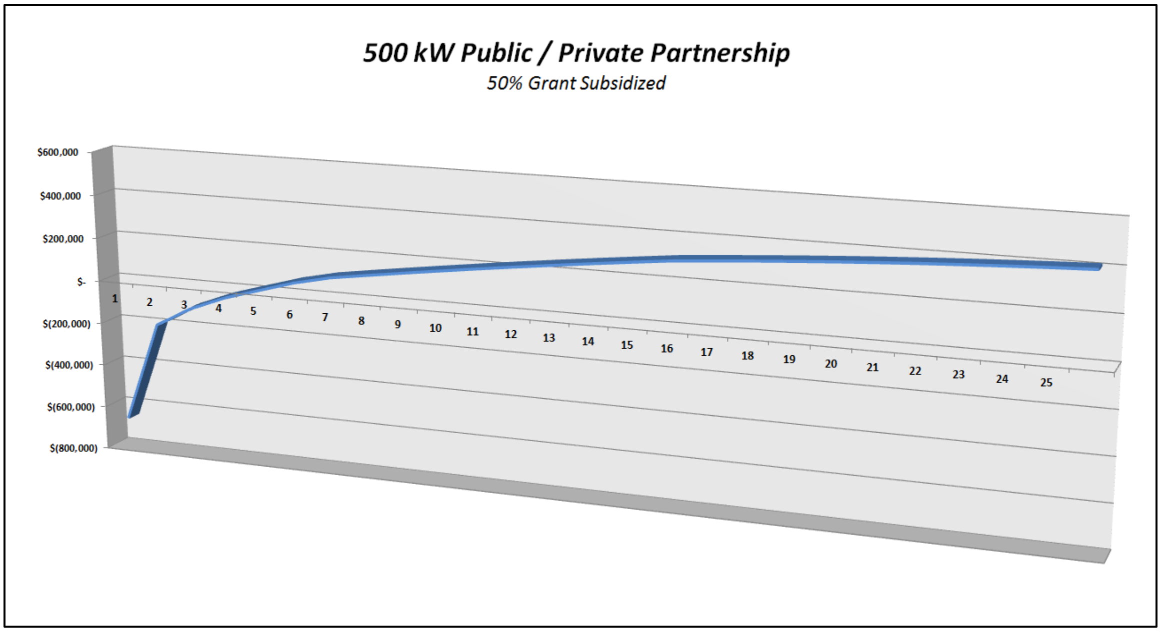
500 kW Public/Private Partnership
50% Grant Subsidized

System Details				
DC System Size *(kW)*	644,000	Cost per Watt	$	2.05
AC System Size *(kW)*	495,880	Total System Cost	$	1,318,600
Annual Output *(kWh)*	848,663	Interconnection Cost	$	25,000
Annual System Degradation	0.5%	Annual Facility Charge	$	1,000
		O&M Cost per Watt	$	0.015

PPA Assumptions			Post-PPA Assumptions		
Avoided Cost Rate (kWh)	$	0.060	90% of previous contract amount	$	0.0540
Term (years)		1 to 15	Term (years)		16 to 25
Degredation per Year		0.5%	Annual Electricity Price Inflation		0.00%
REC Price	$	-			

Property					
Acerage		3	Term *(years)*		25
Lease Rate	$	350.00	Lease Rate Escalator *(every 5 years)*		10.0%
Annual Lease Payment	$	1,050.00	Property Tax *(county owned)*	$	-

Tax Considerations				
SC Tax Credit		$35,000 | Max of $3,500/Year	Federal Tax Rate	35%
Federal Investment Tax Credit		30%	Federal Depreciation *(5-yr MACRS)*	Yes
Grant Proceeds	$	659,300		



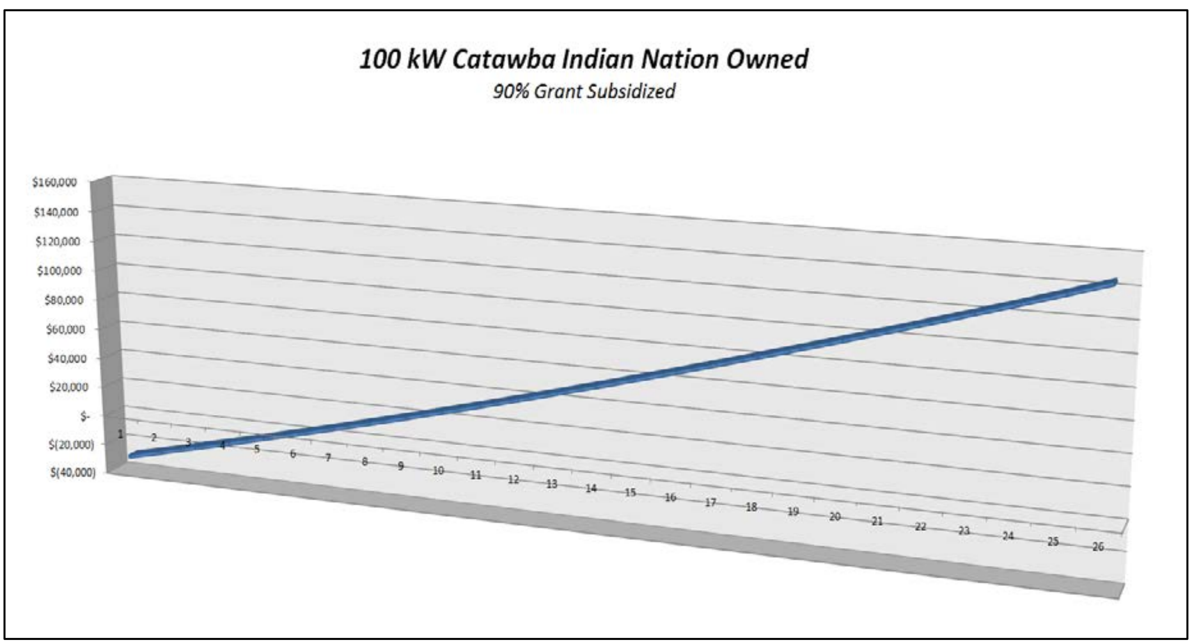
100 kW Net-Metered System
90% Grant Subsidized

System Details			
DC System Size *(kW)*	129,000	Cost per Watt	$ 2.27
AC System Size *(kW)*	99,330	Total System Cost	$ 293,400
Annual Output *(kWh)*	169,996	Interconnection Cost	$ 2,500
Annual System Degradation	0.5%	Annual Facility Charge	$ 250
		O&M Cost per Watt	$ 0.025

Price of Power Assumptions	
Avoided Cost Rate (kWh)	$ 0.069
Term (years)	15
Degredation per Year	0.5%
Annual Electicity Rate Inflation	2%

Property			
Acreage	1	Term *(years)*	25
Lease Rate	$ -	Lease Rate Escalator *(every 5 years)*	0.0%
Annual Lease Payment	$ -	Property Tax	$ -

Tax Considerations			
SC Tax Credit	0%	Federal Tax Rate	0%
Federal Investment Tax Credit	0%	Federal Depreciation *(5-yr MACRS)*	No
Grant Proceeds	$ 264,060		



Johnson C. Smith University: Micro Wind Turbine

General Background

Johnson C. Smith is a non-profit University located in Charlotte, NC. It has a strong focus on and commitment to sustainability, from the installation of energy efficient lighting and HV/AC systems to the ongoing implementation on campus of a model "Eco-village". The eco-village is being built with advice and assistance of other humanitarian non-profits with the aim of creating a model that can be built in the 3rd world, starting in Haiti.

Thus the site, which currently has a hydroponic fishing operation, among other sustainability projects, holds both the promise of education for the students of the University and visitors, and of providing a laboratory for the use of renewable energy systems in off-grid population centers globally.

The Eco-village is adjacent to a hill overlooking Uptown Charlotte, with access to more wind than typical for the area. The decision-makers at JCSU asked for a study of the scenario of installing a small-scale wind turbine at that location. The wind turbine, called a micro-turbine, would generate power for the Eco-village and serve an excellent symbol for the off-grid nature of the project.

A turbine called the Aviax, sold by ARVA Energy in Rock Hill, South Carolina, was selected. The ARVA turbine has the advantage of being horizontal in nature (see spec sheet in appendix) and of generating power even under very low wind conditions.

Challenges & Opportunities

The challenges of this project from a fiscal perspective are difficult:

- The region of Charlotte, NC is not considered a high wind region.
- The price of power is so low at the facility that the payback would be in excess of 10 years under normal conditions.

It is clear that if the project were to be judged only from the standpoint of ROI, it would not be feasible. However, in this case the intangibles are significant, representing several opportunities:

- The site, on a hill near an interstate, does represent a micro-climate that is windy.
- The project is a model of a 3rd world application, where power is generated by diesel and very expensive.
- The project has direct educational value that is very tangible – students will get class credit for working on the eco-village – and thus weighs more heavily than financial considerations.

Proposed Scenario

The proposed scenario is for JCSU to install the ARVA Aviax wind turbine on the hillside at the eco-village, using one of two methods described below. The wind turbine fits three important scenarios: it can be deployed in a remote location easily, it is an attractive symbol of the eco-village, and it provides an excellent way for students to learn the basics of wind industry at a low cost.

Deal Structure

The capital costs for this project are $30,000; this is much too low for structuring any sort of public/private investment scenario – the transaction costs of such a strategy would exceed the costs of the entire project.

Instead, and because the benefits of the system are intangible rather than financial, two relatively simple methods are proposed:

1. That JCSU simply purchase the micro-turbine and have it installed.

2. That a benefactor of JCSU with a North Carolina tax liability purchase the system, have it installed on the site of the Eco-village, take the Federal and North Carolina state tax credits (65% of the cost of the system, or a credit of nearly $20,000), and then donate the system to JCSU.

Obviously, if a donor like this can be found by JCSU, #2 is the best method of moving forward. There are some structural and timeline issues related to this option: the title to the system could not be transferred for 5 years while the state tax credit is exhausted, for example. Such a scenario would have to be vetted carefully by a tax professional to match the donors' financial situation to the project, but would fit into existing regulatory law.

Conclusions

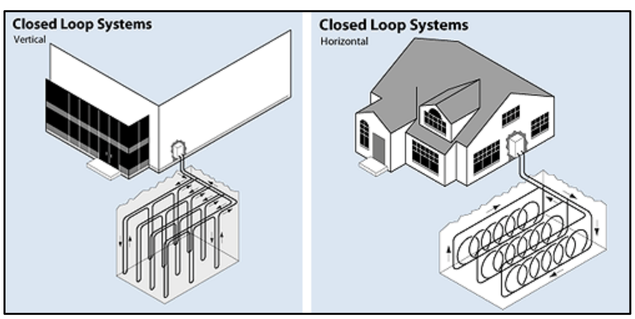
The JCSU wind project represents the sort of renewables installation that is not-uncommon for public sites. The intangibles of education, pilot projecting, and even symbolism outweigh the standard expense justification. As noted under the deal structure section, interesting twists involving benefactors and donations are possible with a public non-profit site, and it is hoped that as the JCSU eco-village progresses a donor can be found.

Charlotte Mecklenburg Housing Partnership: Geothermal

General Background

The Charlotte-Mecklenburg Housing Partnership designed a new housing complex, called the Catawba Senior Housing Complex, to be built northwest of Charlotte in Mecklenburg County. The complex is made up of one large L-shaped building on a large lot, and is currently designed for standard electrical heating and cooling.

The construction management at the facility expressed strong interest in seeing the economic variables associated with installing a geothermal heating and cooling system as part of that organization's commitment to energy efficiency and sustainability.



Challenges & Opportunities

There are several challenges associated with this project:

- Geothermal technology is not widely used in the region, so support from vendors is sporadic. For this study, a vendor in Pennsylvania was used.
- Geothermal is outside of the norm, so design and permitting issues can take longer.
- Getting thorough information about geothermal is problematic.

Opportunities

- At construction the economics of a system are far superior to replacing an existing system.
- Geothermal is fully integrated into the facility and capital costs are amortized along with the building.
- The economics of geothermal are far superior to traditional heating and cooling.

When the economics of geothermal are investigated, it is difficult to understand why more construction does not use it. However, there is a bit of a chicken-and-egg syndrome occurring with the technology: because more people do not use it, it is not familiar to designers or vendors; but because it is not familiar, more people do not use it.

The problem particularly exists in the design stage. It is far simpler to estimate costs and scheduling for a traditional electric or gas heating and cooling system because it is so routine. Everyone – designers, building officials, builders and contractors – all understand the process very well and thus it is easy. If a site owner wishes to vet a technology such as geothermal, it is difficult to find the vendors who can provide adequate information for the design and procurement process, and to implement it.

As the construction community has become more energy conscious, however, this has changed, and in the last few years there have been many high profile projects, especially at public sites. The Char-Meck Partnership project is an excellent site for this technology.

Proposed Scenario

The proposed scenario for this site is very simple – that a ground-loop geothermal site be implemented into the design and financing of the building. Because a geothermal system is so tightly integrated into the rest of the building structure, models for any sort of public/private project are very rare; moreover, there is less need for it because, with the increased efficiency and with the cost of the system amortized over the life of the facility financing, the project is cash-flow positive from year one even without tax or other incentives.

Deal Structure

As noted, no particular deal structure is required for this type of renewable energy. It is simply built into the facility and owned in the normal manner.

Conclusions

The economics of geothermal are excellent, but the technology is not widespread. This is driven by inertia, and will remain a factor until more building owners or construction and design professionals specifically request that the technology be seriously considered for their projects.

This project especially illustrates how efficient it is for the technology to be implemented at the time of initial construction – the logistics and economics of the system would likely be prohibitive in a retrofit situation.

This project also illustrates how well the economics of renewable energy fit when the cost of them are amortized into facility construction – the "payback" becomes a matter of months rather than years, and decades of cash-flow positive operation become possible.

Comparison of Options - Assumptions

Outdoor Split System - Electric Heat and Hot Water			Geothermal - Heating and Cooling, District Hot Water		
HVAC Installed Cost / Sq. Ft	$	6.384	HVAC Installed Cost / Sq. Ft	$	7.400
Additional Up-front Cost	$	-	Additional Up-front Cost	$	584,800.00
Maintenance Cost / Year	$	5,000.00	Maintenance Cost / Year	$	3,000
Equipment Service Life		15 years	Equipment Service Life		23 Years

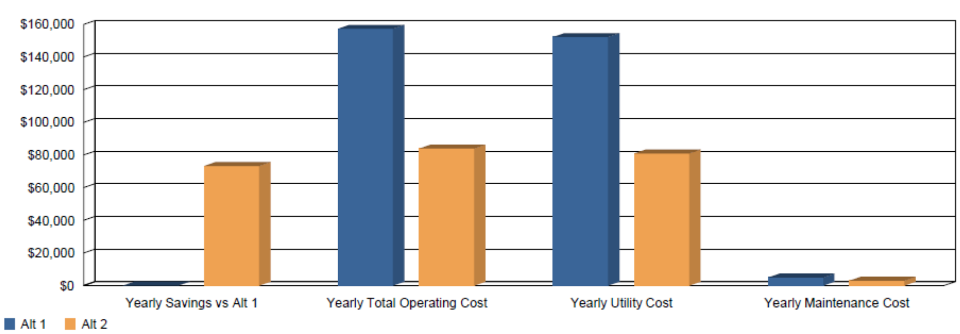
Project Information

Location	Charlotte, NC	Study Life:	20 years
Project Name	Catawba Senior Housing	Cost of Capital:	8 %
User	Mike Lemmon	Alternative 1:	Catawba Split System w Elect DWH
Company	WaterFurance International	Alternative 2:	Catawba Ground Source CLG - HTG- DHW
Comments			

Economic Comparison of Alternatives

	Yearly Savings ($)	First Cost Difference ($)	Cumulative Cash Flow Difference ($)	Simple Payback (yrs.)	Net Present Value ($)	Life Cycle Payback (yrs.)	Internal Rate of Return (%)	Life Cycle Cost
Alt 2 vs Alt 1	73,354	668,189	869,581	9.1	187,335	14.3	14.0	187,334.70

Annual Operating Costs



	Yearly Savings vs Alt 1	Yearly Total Operating Cost ($)	Yearly Utility Cost ($)	Yearly Maintenance Cost ($)	Plant kWh/ton-hr
Alt 1	0	157,326	152,326	5,000	0.473
Alt 2	73,354	83,973	80,973	3,000	0.617

City of Gastonia: Anaerobic Digestion

General Background

The Crowder's Creek Bioenergy Center in Gaston County, North Carolina is an aggressively planned combination of waste-to-energy technologies which will use a variety of waste feedstocks to create pipeline quality natural gas and electricity.

The economics of creating energy from waste are complex – for reference see the following chapter describing the energy from waste project that did not work economically.

As following sections describe, however, the right combination of variables is in place at the BioEnergy Center for a successful anaerobic digestion project.

An extensive feasibility study of this site was completed concurrently to this book by Lisa Lee Morgan of Calor Energy (also, coincidentally, the Chair of the Energy Working Group which supervised this work). That study provided much of the information used in this chapter, though because it is proprietary; it has been put into the more general format appropriate to a guidebook.

Challenges & Opportunities

Several challenges serve as barriers to waste-to-energy projects in general:

- The price paid for both gas and electricity is very low in the Southeast Region, which creates smaller margins, and thus attracts investment with more difficulty.
- Energy from waste projects can carry more difficult permitting requirements.
- EfW require feedstock logistics like hauling waste to and from the site, etc.
- EfW projects most often fail due to lack of long-term feedstock agreements (i.e. where is the feedstock coming from?)
- Because the technology is more complex, financing the plants, on the private side of the partnership, can be more complicated and difficult.

At the BioEnergy Center, there are several opportunities:

- The feedstocks available include not only the waste water treatment center biosolids, but also feedstocks generated nearby including high BTU oils and greases.
- The project is supported financially by a nearby sustainable community – the Villages at Cramerton – which helps with financing. The Villages will be an off-taker for the gas produced at the site, as well as the Renewable Energy Certificates.
- There is a natural gas line nearby which facilitates the transmission of gas from the BioCenter to the Villages.

Proposed Scenario

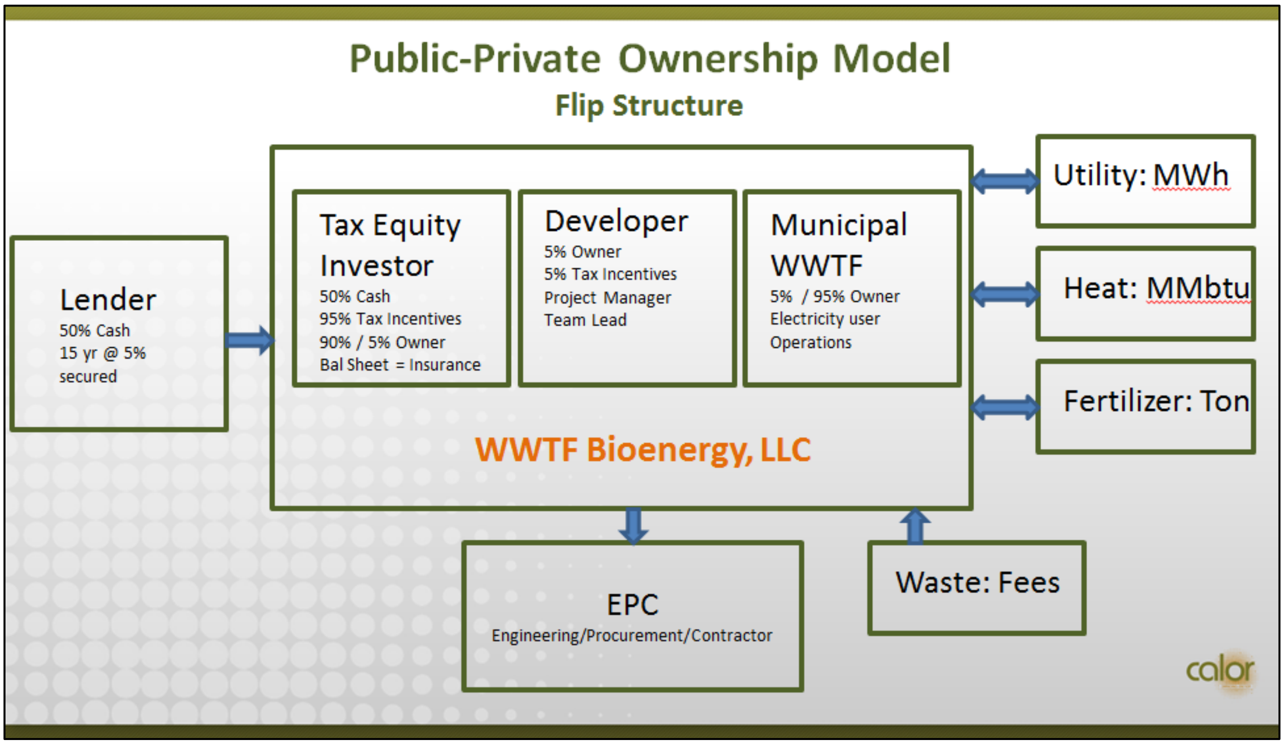
The best way for a complex project such as this to be structured is to have a private group establish a single-purpose LLC to own the project. The private group should own 90% of the LLC until the tax credits are expended, while the City owns 5%.

No lease payment will be paid, because at the end of a 7 year period, the ownership of the facility will revert to 95% ownership by the City. This will leave it in the hands of the City for an effective life of decades, without the City having paid anything for it.

This deal structure is illustrated in a chart on the following page.

Conclusions

At present, the City pays a tipping fee to get rid of its biosolids. Under this scenario, the private partnership it used to leverage additional nearby feedstocks into one stream which can then be used to create revenue. The City does not give up anything tangible – only space at the facility that is currently not utilized anyway – and in a short period will end up owning a cutting edge energy technology facility with long-term feedstock and off-take agreements.



City of Gastonia
Waste Water Treatment Facility
Anaerobic Digestion

REVENUE				
Disposal Fees for FOG	52,125	Tons/yr	$ 50.00	$ 2,606,250
Disposal Fees for Biosolids	41,700	Tons/yr	$ 28.00	$ 1,167,600
Disposal Fees for 20% Biosolid cake	4,170	Tons/yr	$ 28.00	$ 116,760
Disposal Fees for Villages@Cramert	435	Tons/yr	$ 35.00	$ 15,225
Gas to Nat Gas pipeline	170,491	MMBtu/yr	$ 3.50	$ 596,719
REC/RIN Environmental credits	avoided	Ton	$ 7.00	$ 58,938
Digestate liquid to fertilizer manuf	19,781,775	gal	$ 0.03	$ 593,453
Annual Projected Revenue				**$ 5,154,946**

EXPENSE				
15-year loan @ 5%	15	12	15,884.21	$ 190,610.52
AD- PSA + Compressor O+M				$ 210,240
AD-Digestate storage tanks O+M				$ 5,000
AD-Cost to remove sulfur				$ 51,868
General maintenance	12	mon	$ 25,000	$ 300,000
Development service fee	12	mon	$ 8,000	$ 96,000
Operations -6 salaries @ 50K+benefits	6	people	$ 75,000	$ 450,000
Waste collection, transport	12	mon	$ 150,000	$ 1,800,000
Insurance	LS			$ 500,000
Taxes	0.006	rate	#############	76,760
Annual Projected Expense				**$ 3,680,478**

PRE-TAX, OPERATIONAL RETURN	
EQUITY INVESTMENT	$ 6,396,625
ANNUAL INCOME	$ 5,154,946
ANNUAL EXPENSE	$ 3,680,478
PROFIT	$ 1,474,468
PROFIT PERCENTAGE	29%
ANNUAL ROI	23%

Town of Mooresville Waste-Water Treatment Facility: Energy from Biosolids

General background

The Mooresville Waste-Water Treatment Facility (WWTF) for many years used a standard method of disposing of its biosolids – it sent them to a landfill at great cost. In 2012 this method was replaced when they purchased equipment from the Huber Company that allowed them to dry their biosolids into pellets which are then sold to the agricultural industry as a natural fertilizer.

Analysis was requested to determine if this process could be refined one additional step, and the pellets be utilized to feed an energy from waste (EfW) plant capable of creating electricity. This site was selected by the Energy Working Group for study and a wide range of possibilities were researched. This chapter of the guidebook represents a departure from the others for this simple reason: no scenario or deal structure was found which would allow this type of implementation to be feasible.

Thus, instead of an illustration of what works, this chapter will include a discussion of how waste-to-energy economics work and how to quickly assess whether this type of technology should be considered for a site. The next chapter will build a scenario under which waste-to-energy does work economically.

Challenges & Opportunities

An understanding of the project challenges requires a brief primer on the economics of waste-to-energy projects. EfW is an excellent technology when it transforms streams of waste materials, which are destined to go to a landfill, into energy feedstock. This is because it costs money to landfill material – known a tipping fee. In a situation where the price of power is very low – the avoided cost – the tipping fee must provide a large enough revenue stream to pay for most of the system.

Tipping fees vary widely – in the Northeastern U.S. a tipping fee for municipal solid waste may be in excess of $100 – that revenue makes the economics for such a project attractive.
In the case of the Mooresville WWTF, by installing the HUBER belt dryer and finding a buyer of the resulting materials, the plant no longer has a waste stream to divert – it has a revenue-producing product. Thus, no economic model exists under which an EfW plant at the site would be economically feasible.

Conclusions

An EfW project requires some balance of a feedstock that carries a price *and* revenue from the energy produced. If one side of that equation is very low (say less than $20 per ton tipping fee or under $.10 per KW for electricity), then the other must be relatively high. If the waste is actually producing revenue which must be replaced – e.g. it is currently being sold – then it is likely impossible to make any type of EfW project work. This study concludes, thus, that the Mooresville WWTF should be left as it is and the management of it congratulated for creating an excellent feasibility strategy creating fertilizer.

Conclusions

Renewable energy technologies come in many shapes and sizes – solar, geothermal, wind, waste-to-energy – and they become more economically feasible every year as equipment prices decrease and energy prices increase. However, most technologies are immature and often require support in the form of tax credits. Often, in order to make projects economically feasible for public sites, complex structures are necessary. Other times, for a variety of tangible in intangible reasons, such structures are not required.

Investigating with finance professionals, engineers and technology vendors how to build successful scenarios for implementing renewable energy have generated a number of findings, listed in chapter x, and recommendations, which are listed here:

1. The economics of renewable technologies are always changing and it is worth a revisit every year or two.

2. The opportunities for renewable energy implementation will be directly dependent on the regularoty and incentive framework in the state the site is located in. What works in one state does not in another.

3. Use rules-of-thumb to quickly decide if something is worth it. If not, is it worth it for intangible reasons? If not, discard for now. One of the "knocks" on renewable energy is that people spend a lot of time on it without fruition. Consult experts quickly to determine if a project should be shelved until the economics change.

4. Assess all options during the design and construction phase, when the economics are optimal. It is far, far better to build renewable energy into new designs and finance it over long periods rather than separately.

5. Carefully study 3rd Party Public/Private Partnerships unless the scale is small or the technology property does not "stand alone". While such projects are more complex, the economic feasibility of a project is likely far greater utilizing such a structure.

Taking into account all of the financial structures that were considered in this report, a third party owned system is by far the most advantageous to tax-exempt public entities for the following reasons:

- A third party can take advantage of tax incentives and therefore realize an sizable return

- Financial structure will provide the hosting entity with an option to purchase the system outright from the third party investor

- The purchase option is ultimately flexible and allows the hosting entity to decide when and/or if purchasing the system makes fiscal sense

6. Public procurement offers two methods of moving forward:

- A very general RFP will allow for creative solutions from the private sector.

- A government can pay for some engineering/design work and issue an RFP for a very specific system in order to directly compare apples-to-apples.

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Vibrant Communities – Robust Region

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