Middlebury Electric

A comprehensive report of fiscal considerations and economic feasibility

Executive Summary

Anders Holm is proposing a 1 Megawatt run-of-river hydroelectric generating station on the western side of Otter Creek Falls. Small hydroelectric sites have significant generation potential in the state of Vermont. Producing clean, local, stable, emission-free electricity, these sites may provide a buffer to the uncertainty surrounding Vermont Yankee and Hydro Quebec. Unfortunately, burdensome regulation and unfavorable economic returns have dampened the prospects of many of these renewable projects. This paper will analyze the diverse range of economic, regulatory, and non-market considerations of the proposed Middlebury Electric turbine on Middlebury Falls, with the end goal of better informing the decision making process of Anders Holm and Middlebury College.

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May 10, 2007
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Middlebury Electric

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1.1 Hydroelectricity in Vermont (as presented by Anders Holm[1])

Hydroelectric power generation proved vital to the initial economic growth of Vermont. Like many other towns in the state, Middlebury used waterpower to fuel industrial activity and development. Currently, 1,000 dams or their remnants remain in Vermont, with only 106 in operation. The Middlebury site is a prime example of the future potential of similar sites in the state.

Middlebury Falls produced power from 1774 to 1966. The Middlebury Electric Company, which Anders Holm intends to resurrect, generated electricity from the Falls starting in the 1890s, and was eventually purchased by Central Vermont Public Service (CVPS). The site was finally dismantled in response to the emergence of "brown" energy and low electricity prices via other sources.

In 1982 CVPS proposed a new plan for the Middlebury Falls that was strongly opposed by the public for aesthetic reasons. In particular, the proposed 1.7 MW turbine would have altered the flow of the main Falls to enhance energy capture. This fact, combined with poor fiscal incentives, prevented execution of the 1982 plan.

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[1] "Sustainable Hydropower in Vermont Back to The Future?" Anders Holm MD, PowerPoint

The current plan for Middlebury Falls differs substantially from that of 1982. First and foremost, the new plan will maintain the aesthetics of the current Falls, making use of the existing flume. The design will be "pure run-of-river" with no alteration of the existing flow. Furthermore, the civil improvements needed to install the generator will decrease erosion directly downstream of the Falls, and improve the structural integrity of the flume and associated buildings. The site has a potential generation capability of 2.5 – 3 MW, but the project will not fully exploit this potential to maintain aesthetics. As a result, the turbine is expected to produce 1 – 2 MW of power, translating into an estimated 6 million KWH annually. Equivalent energy production would require 6,000 tons of coal and dramatically higher emissions of CO_2. (Note that in Vermont, electricity generation is largely hydroelectric and nuclear, so the proposed small-scale hydroelectric plan will not necessarily displace an equivalent amount of production from coal).

The potential benefits to Middlebury of a revived Middlebury Electric are substantial. Local generation on the Falls would not only create a source of clean energy, but would also reduce transmission costs and efficiency losses. In addition, local power may provide local rate stabilization in the face of an uncertain energy future. This is particularly relevant in light of Vermont's energy dependence upon Hydro Quebec and Vermont Yankee, which will be further addressed below.

Anders Holm proposes installing a compact axial turbine to generate electricity. Such a turbine represents the state-of-the-art: maximizing power output, while minimizing impact to stream flow and the downstream environment. Importantly, the proposed project can be considered sustainable hydropower. Whereas large hydroelectric generation sites can disrupt local ecosystems, the environmental impact of the proposed site is expected to be small. Specifically, potential impacts include: fish passage, aeration, and water temperature increase as a result of energy capture. Environmental studies of Middlebury Falls have indicated that the small portion of the overall flow used, venting nature of the turbine, and consistent monitoring, combined with the substantial anticipated challenges associated with climate change suggest that the environmental benefits of the project outweigh the costs.

1.2 Analysis Focus

It is our hope that the following analysis will better inform the investment decision processes of Anders Holm and Middlebury College, ultimately resulting in a clean, renewable, dependable source of energy.

The remainder of this paper will now proceed to analyze four specific topics:

1. **Electricity:** What factors influence the electricity market? What factors are unique to Vermont?

2. **Demand for Clean Energy:** How are other colleges and universities responding to the increased student demand for clean energy? How can this inform Middlebury College's demand for clean energy?

3. **Regulation:** What are the regulatory hurdles Middlebury Electric will face?

4. **Finance:** What will the financial structure of the deal look like? How should expected return be quantified? What is the expected payback period? How will the project be financed?

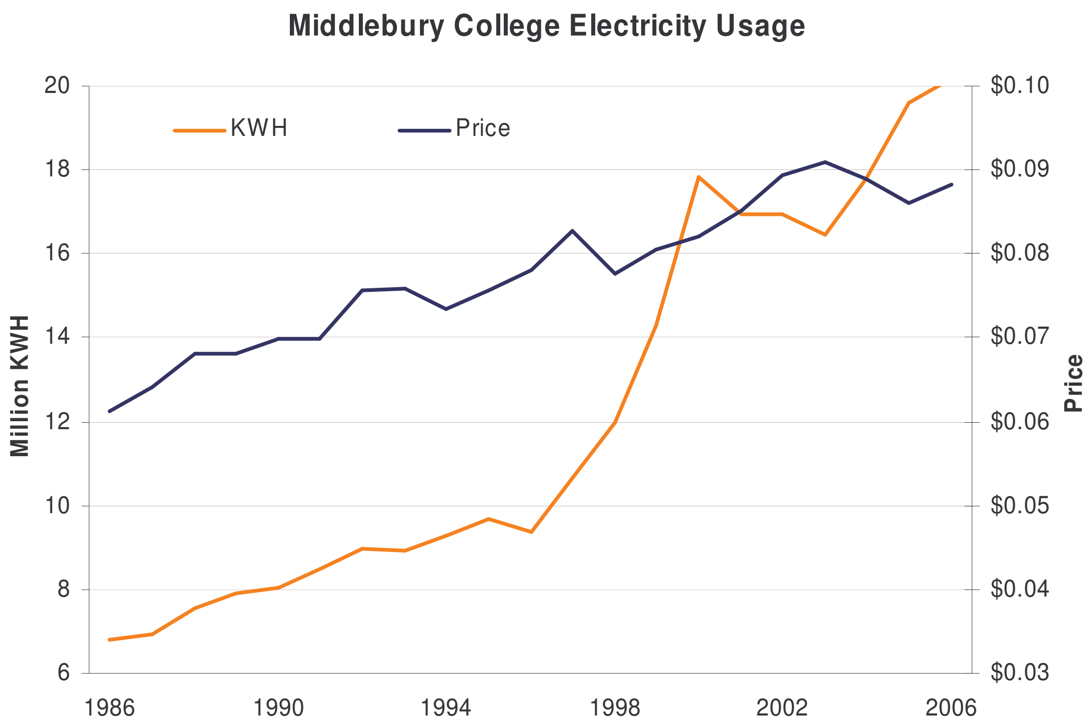
The Market for Electricity

Electricity, at a fundamental level, fuels global economic growth. At the macroeconomic scale, electricity is a commodity that can be traded on an open market. As such, the price of electricity is exposed to shocks that occur on both the supply and demand side of the equation. Evidence suggests that, in the long run, volatility is smoothed out and energy prices reflect basic economic fundamentals. In some situations, electricity can be viewed as a service: value can be added to make it distinguishable, e.g. Cow Power. In such a situation local factors including regulation, geography, infrastructure, distribution policies and consumer preferences allow local electricity prices to deviate from regional market prices.

We will proceed to examine electricity as both a commodity and a service. Our study will begin with the assumption that over the long run electricity prices reflect the basic supply and demand fundamentals of the global market for electricity-generating inputs. Then we will focus on specific factors within Vermont that may lead to prices above the national average. The latter focus is particularly relevant to Middlebury Electric if it were to pursue a sales strategy similar to Cow Power.

Future energy prices will be examined on an intermediate time scale – until the year 2030. Attention will be given to the current global trends in energy demand and supply that are likely to have the largest impact on prices in the foreseeable future. Finally, we will place these global trends in a context framed by factors unique to Vermont. The reader is cautioned that the following review will lead to two different conclusions. When taking a global perspective, prices should be relatively stable throughout the given time period. When looking through a local lens at circumstances unique to Vermont, credence is given to the argument that Middlebury College will be exposed to a dramatic price increase of electricity in the next 5- 7 years. The authors of this paper are unable to predict with certainty which scenario will actually unfold. The following is an objective analysis of both scenarios. Figure 1 provides historical data of Middlebury College's electricity use and purchase price.

Figure 1[2]

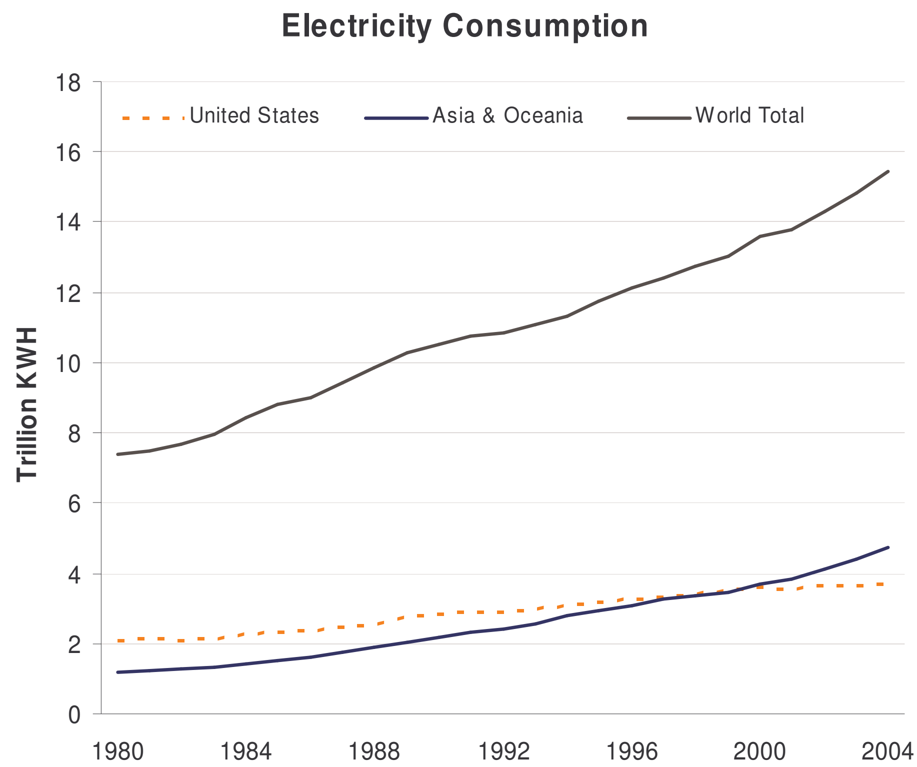


2.1 Electricity as a Commodity: Global Fundamentals

Energy consumption on a global scale has risen dramatically since 1980. A primary driver, as demonstrated in Figure 2, has been robust economic growth in Asia. The current global trends of increasing population and consumer consumption are likely to increase electricity demand through 2030.

[2] Mike Moser, Middlebury College

Figure 2 [3]



The EIA estimates that global electricity consumption will double from its current level by 2030. 71% of increased electricity use will come from the unquenchable appetite of developing nations with demand expected to grow at an annualized rate of 3.9%. The remaining 29% of consumption will come from developed nations with their demand increasing 1.5% annually.[4] Clearly, electricity consumption correlates strongly with economic growth, and as living standards increase, so too does the demand for electricity.

Figure 3 demonstrates the expected impact of rising global living standards. By 2015 demand for electricity in non-OECD nations is projected to surpass the demand for electricity in OECD nations. As a result, prices for coal, uranium, and other important electricity-generating inputs can expect to see a shift out of the demand curve. Without a corresponding shift out in supply, prices of inputs, and thus electricity, will increase.

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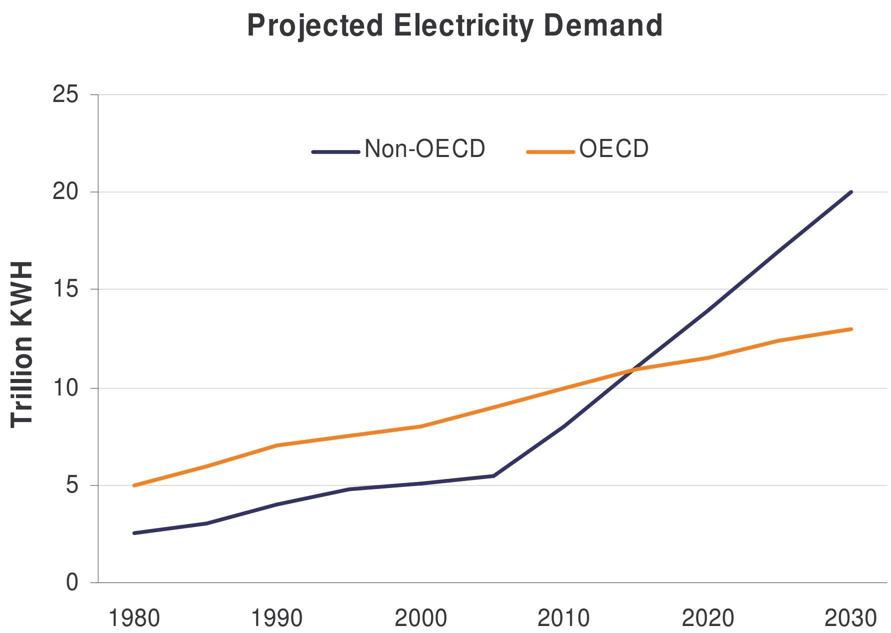
[3] IEA 2004 Energy Outlook Report
[4] EIA. International Energy Outlook 2006. http://www.eia.doe.gov/oiaf/ieo/pdf/0484(2006).pdf (63)

Figure 3 [5]



2.2 Electricity as a Commodity: United States

The Energy Information Administration (EIA) forecasts energy prices and reports to the United States Government. Within each forecast the EIA models several scenarios, affording policy makers the opportunity to prepare for best and worst case situations. When assuming robust economic growth, the EIA anticipates electrical demand rising by 54% from 2003 levels by 2030. When assuming low economic growth and a slowing demand for electricity, the EIA anticipates that the United States will experience an increase in demand of 28% by 2030.[6] Some of this demand should be offset by gains in efficiency throughout the market. Likewise, higher energy prices should encourage investment in energy efficient technologies.

Regardless of which assumptions are used, high or low demand growth, all regions in the United States will be forced to implement new generating capacity beyond that currently installed. Figure 4 exhibits the current distribution of electricity generation by source in the

[5] http://www.eia.doe.gov/oiaf/ieo/pdf/electricity.pdf
[6] EIA. Annual Energy Outlook 2007 w/ Projections. http://www.eia.doe.gov/oiaf/aeo/pdf/0383(2007).pdf (82)

United States. Hydroelectric generation accounts for a small proportion of total generation. Looking into the future, hydroelectric production as a fraction of renewable production is expected to fall throughout the United States. This anticipated decline is attributable to environmental concerns surrounding turbine construction and a limited number of new sites that have yet to be developed.

Figure 4 – United States Electricity Generation by Source [7]

Source	Contribution (%)
Coal	50
Gas	19
Nuclear	19
Hydroelectric	7
Petroleum	3
Renewable	2

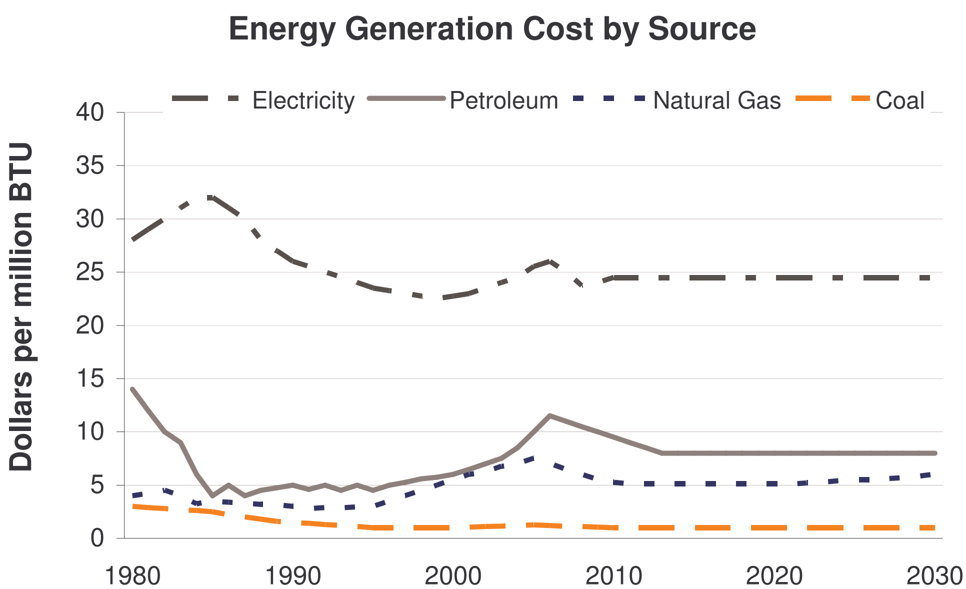
In anticipation of growing demand it is clear that global generating capacity will need to be increased. Studies indicate that to meet growing demand global capacity must rise from a current level of 3710 gigawatts to 6349 gigawatts by 2030.[8] The sources used in each nation to generate this increased capacity will vary depending upon the country's natural endowment of resources. These sources have changed dramatically over the past 40 years. For instance, the demand for oil as a source of electricity production has been slowing steadily since 1970, and recently renewables have gained momentum.[9]

To determine expected future generation cost we must examine input costs. Figure 5 compares energy generation cost by source. Electrical production is driven by three primary factors: capital, fuel, and maintenance. Different electricity price estimates can be derived by making various assumptions about the costs of these input factors. The EIA, in their best guess model, believes that electricity prices in the United States peaked in 2006 at 8.3 cents per kilowatt

[7] EIA. www.eia.doe.gov
[8] EIA. International Energy Outlook 2006 (65)
[9] EIA. International Energy Outlook 2006 (66)

hour. Prices are expected to fall to 7.7 cents per kilowatt hour in 2015.[10] These price reductions will not be evenly distributed throughout the United States, as reductions will occur faster in states with competitive energy markets than in states with regulated energy markets (Vermont). In competitive energy markets, rates are set at the marginal cost production rather than at average cost in non-competitive markets.[11] Distribution costs are expected to decline 8% during the next 25 years while transmission costs are expected to rise 29%.[12] By 2030, electricity prices are expected to be between 7.8 and 8.4 cents per kilowatt hour.[13] It is important to note that given existing infrastructure, an uncompetitive market place, and transmission difficulty within the state, it is unlikely Vermont will benefit from stable national electricity prices.

Figure 5 [14]



[10] EIA. Annual Energy Outlook 2007 w/ Projections (88)
[11] EIA. Annual Energy Outlook 2007 w/ Projections (88)
[12] EIA. Annual Energy Outlook 2007 w/ Projections (88)
[13] EIA. Annual Energy Outlook 2007 w/ Projections (88)
[14] http://www.eia.doe.gov/oiaf/aeo/pdf/0383(2007).pdf (4)

2.3 Electricity as a Service: Unique Factors in Vermont

The global energy market will have a tremendous impact on Vermont's electricity prices. However, "Vermont's energy picture looks very different from the regional one. The bulk of energy in the New England power grid – 80 percent – is sourced from fossil fuels and nuclear power plants, raising concerns over greenhouse gas emissions and of nuclear waste storage… [15] Vermont's energy is derived from the following sources: 37% hydroelectric (27% hydro Quebec), 36% nuclear (VT Yankee), 17% regional system, 9% renewables, and 1% oil and gas.[16]

Vermont's unique geography also makes estimating future energy prices a unique challenge. As a small state, efficient energy distribution is difficult. Likewise, its population density is only 68.5 people per square mile.[17] Inadequate infrastructure in the state makes distribution from other markets costly and inefficient.

The economic climate in Vermont is relatively strong with the state having the lowest unemployment rate in the nation.[18] It is projected, however, that future economic growth will begin to slow. Similar to the global pattern, electrical consumption is closely tied to economic growth. Electricity sales in Vermont have increased at an annual rate of 1.3% since 1992.[19] In the next decade sales are estimated to grow at a modest annual rate of 1.0%.[20] This growth rate estimate may be high when one considers that from 2000 to 2003 demand increased at only 0.3% annually.[21] Higher estimates suggest that in 2015 Vermont will use 16% more power than it did in 2005.[22]

A great deal of concern surrounds Vermont's energy alternatives after the VT Yankee power plant contract expires in 2012. "Built in 1972 with a 40-year lifespan, Vermont Yankee is

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[15] Chandler, Carrie. Inconvenient Choices
http://www.vermontwoman.com/articles/0407/energyfeature.shtml
[16] Chandler, Carrie. Inconvenient Choices
[17] Vermont Electric Energy Efficiency Potential Study 2007. http://publicservice.vermont.gov/energy-efficiency/vteefinalreportjan07v3andappendices.pdf (23)
[18] Vermont Electric Energy Efficiency Potential Study 2007 (24)
[19] Vermont Electric Energy Efficiency Potential Study 2007 (25)
[20] Vermont Electric Energy Efficiency Potential Study 2007 (27)
[21] Vermont Electric Energy Efficiency Potential Study 2007 (29)
[22] Chandler, Carrie. Inconvenient Choices

one of the nation's oldest operating nuclear power plants. The original contract expires in 2012, but Entergy, the Louisiana-based owner of the plant, is applying for a 20-year license extension, following its successful uprate request in 2005 to run the plant at 120 percent of its designed capacity."[23] There is local opposition to relicensing the facility. But, since few nuclear facilities are in development and meeting electricity demand is a growing government concern, relicensing may occur.

Unfortunately, Vermont has been slow to produce alternative energy plans. But a study conducted by New York State examining its dependency on the Indian Point Power Plant paints is illustrative. The study estimates that if the power plant were to go down costs would be "over $1 billion a year in electricity costs, and would lead to electricity shortages, price spikes of as much as 40 percent, and rolling blackouts."[24] Such an example lends credence to the argument that energy independence is an attractive alternative for Middlebury College.

Certainly, uncertainty surrounds the 2012 contract. It should be noted, however, that electrical utilities in Vermont are accustomed to finding alternative sources of energy. Every 12 to 18 months the Yankee Nuclear power plant is shut down for one month to perform standard operating maintenance. During this time power providers are forced to look elsewhere for their energy. Providers lock in rates using forward contracts. While this works in the short term, there is evidence that prices will rise in the future and that these increases will be passed along to consumers. In 2005, CVPS was forced to purchase power at a rate that was not covered by retail charges.[25] Such practices are not sustainable in the long run, and would inevitably lead to retail price increases.

Obtaining exact estimates for energy prices in Vermont has proven difficult at best. Scott Anderson of CVPS commented that the power provider doesn't make public its future rate

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[23] Chandler, Carrie. Inconvenient Choices
[24] http://www.safesecurevital.org/vital/index.html#needs
[25] CVPS 2006 Annual Report. http://library.corporate-ir.net/library/11/116/116923/items/237778/CVPS06AR.pdf (89)

forecasting models. Anderson expressed complete confidence that power service will in no way be disrupted while making it clear that it has been the practice of CVPS to keep power increases below the rate of inflation. These measured price increases are in fact consistent with past CVPS behaviors.

The following excerpt from CVPS 2006 annual report conveys the uncertainties Vermont will face in 2012:

> “Our primary power supply contracts are with VYNPC and Hydro-Quebec. Combined these contracts make up nearly 80 percent of our committed resources. The contract for power purchases from VYNPC ends in 2012, and deliveries under the contract with Hydro-Quebec end in 2016 with the level of deliveries decreasing starting in 2012. There is a risk that future sources available to replace these contracts may not be as reliable and the price of such replacement power could be significantly higher than what we have in place today. Planning for future power supplies with other Vermont utilities and our regulators is a key initiative for us.”[26]

It remains too early to speculate how exactly this additional supply will be secured. Currently Act 208 as evoked by the Vermont legislature directs the Department of Public Service (DPS) and the legislature's Joint Energy Committee to:

> “Conduct a comprehensive statewide public engagement process on energy planning, focused on electric energy supply choices facing the state beginning in 2012.”

The DPS intends to use information gathered from this process to update the “20-Year Electric Plan” and provide direction to Vermont utilities, as well as to the Public Service Board (PSB), of power supply decisions. However, this study is only now beginning to gain traction. Actionable recommendations appear distant.

No forecast can be certain. Using the best information available it appears likely that Vermont consumers will experience an electricity rate hike within the next 10 years. This is not a result of macro fundamentals but rather of the circumstances that are unique to Vermont.

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[26] CVPS 2006 Annual Report. http://library.corporateir.net/library/11/116/116923/items/237778/CVPS06AR.pdf (18)

Valuing Renewable Energy at Middlebury College

The proposed hydroelectric project is valuable to Middlebury College on a number of levels including energy security, price stability, and environmental stewardship. We will attempt to value the last of these benefits in two specific ways. First we will examine the result of an online survey we conducted of Middlebury College students. Second we will estimate Middlebury College students' and administrators' willingness to pay (WTP) for renewable energy, using other institutions' WTP as a guide.

3.1 Contingent Valuation: A Survey Approach

In April 2007 we conducted a survey of the Middlebury College student body to assess their stated preferred WTP for environmental initiatives. We also hoped to gauge the importance of environmental initiatives in comparison to others at Middlebury College. Here we will focus on the most important results (the complete survey can be found in Appendix A3).

The 583 respondents were well distributed by class year. To achieve the most accurate representation of Middlebury students, we framed the survey as a general information query designed to help better inform decision making at Middlebury. It should be noted, however, that since the survey was not randomized, there may be responder bias in the results. That is, those students most interested in the environmental questions asked may have responded in greater than representative numbers than those less interested. Furthermore, we must always be wary of hypothetical bias associated with contingent valuation approaches.

Compared to other NESCAC schools, surveyed students viewed academic and environmental reputation to be Middlebury's greatest strengths. Given the option, students would prefer to see investments in clean energy (30%) to more prominent speakers (27%) and another large concert (12%). Of carbon neutrality, financial aid, more teachers, and room draw reform, carbon neutrality ranked second behind improved financial aid.

Based on these survey results, it is clear that environmental issues are important to Middlebury students. The average respondent would be willing to contribute $95 to a senior class gift of hydroelectric power (Figure 6). Regarding tuition, students indicated that they would be willing to accept (WTA) a $753 increase to make Middlebury carbon neutral in the next 10 years (Figure 7).

Figure 6

Senior Gift Option	Reported Contribution ($)
Prominent speaker fund	52
Fund faculty position	142
Hydroelectric power	95
Increase in student activity fund	35

Figure 7

Initiative	WTA Tuition Increase ($)
Carbon neutrality	753
Improved social life	740
More faculty	909

Students were generally concerned about Vermont's future energy independence, with 62% indicating the issue as "very" or "somewhat" important. In addition, students perceive hydroelectricity to "good for the environment," with only 10% indicating reservations about its environmental impacts, as compared to 37% indicating environmental concerns over nuclear power.

We conclude from the survey results a strong willingness to pay for clean energy. More importantly, students indicate that environmental issues surrounding energy production rank high on their agenda. We turn now to an alternative method of valuing students' willingness to pay for renewable energy in light of these survey results.

3.2 Estimating Students' WTP for Renewable Electricity

First, let us examine the value students place on the use of renewable energy. One shortcoming of the survey approach is section 3.1 is hypothetical bias. Simply stated, hypothetical bias means that responses may not reflect actual WTP since respondents are not required to pay their stated WTP. With the following analysis we eliminate hypothetical bias by examining revealed preferences from various academic institutions. At least twenty-one colleges and universities have approved student activity fees to pay for renewable energy sources.[27] Typically, fees range from $2 to $30 per student per year, and have been authorized by student governing bodies and / or the colleges' board of trustees.

The fees at these colleges are collected on a per-year, per-semester, per-quarter, or per-credit basis. For per-quarter fees, we assumed that students remain on campus for three quarters, often taking the summer quarter off. For per-credit fees, colleges designated a maximum fee per quarter. We took the maximum fee to be the price paid by students. Most colleges spent their revenue solely on the premium price associated with certified renewable electricity. However, some schools split the revenue between renewable electricity and funding for on-campus efficiency and conservation projects. In the case of these 'hybrid' approaches, fees were slightly higher. The average 'hybrid' fee was $17. The average fee for all schools with data available was $15. At least 4 colleges generate over $100,000 in revenue annually. If Middlebury instituted a fee equal to the average of $15, its 2,350 students would generate $35,000 annually. Currently, Connecticut College and Tufts are the only NESCAC members with fees, charging $25 and $20 respectively. By charging the average of these two rates, Middlebury could generate $53,000 annually.[28] These revenues would have a significant positive impact on the financial feasibility of the proposed project and thus should be strongly considered by Middlebury's administrators and

[27] See A4
[28] See A4

students. In fact, as the table below suggests, the present value of $50,000 collected annually is substantial, worth nearly $500,000 at a 9% discount rate.

Figure 8 – Present value of $50,000 annually collected over 20 years

Discount Rate	Present Value
5.00%	654,000
6.00%	608,000
7.00%	567,000
8.00%	530,000
9.00%	498,000
10.00%	468,000

3.3 Estimating Administrators' WTP

With an understanding of students' willingness to pay for renewable electricity, we turn now to college administrations' willingness to pay. While many administrators believe in renewable energy, a non-trivial motivating factor is improving the school's environmental image. A green reputation will not only keep students happy, but will also attract top perspective students and may increase donations to the College. To estimate willingness to pay for such benefits, we will examine two scenarios: first, hiring a sustainability coordinator; second, purchasing renewable energy at a premium rate.

First note that it is difficult to measure the value of green initiatives that lack discrete cash flows. Compact fluorescent lights (CFLs), for example, can be valued by weighing their upfront investment cost against their quantifiable payback period to calculate a rate of return. In many cases, colleges should choose to install CFLs regardless of their views toward the environment based purely on the economics. Valuing investments that do not generate a financial return, however, is less straightforward.

Many colleges have hired campus Sustainability and Environmental Coordinators. These coordinators may end up saving the College money through efficiency initiatives, but there is no guarantee. The coordinators may suggest projects with high social and environmental rates of return but no financial rates of return. At Middlebury, initiatives such as Yellow Bikes, public transportation, and high-profile environmentally minded speakers all have intrinsic value but do not provide the College with a financial return. Thus the salary of a Sustainability Coordinator might be a reasonable indicator of the College's willingness to pay for a 'green' reputation. A recent survey of 36 American Sustainability Coordinators found their average salary to be $51,164.[29] Since Middlebury College already employs a Sustainability Coordinator, this result is less relevant than the other measures. However, it still serves as a general measure of the importance of environmental initiatives at Middlebury and other colleges.

Perhaps the best way to estimate willingness to pay for green energy is to examine colleges that have purchased Renewable Energy Credits (RECs). RECs are sold through electricity providers at a premium to market rates. The premium is earmarked towards subsidies for renewable energy projects with high upfront costs. The purchase of RECs is instructive here because they provide no financial return to the college that buys them – colleges purchase RECs to obtain a 'green' reputation. Here we will examine NESCAC colleges that have purchased RECs via operating budgets, and not explicit student fees. We will consider the total purchase price of RECs per student, when available:

- Bowdoin College purchases RECs for 70% of its electricity at a cost of $130,000. The remaining 30% of electricity is sourced from renewable sources, as mandated by the state of Maine.[30]

- Bates purchases 100% of its electricity from biomass and small hydroelectric generators. They have locked into a 5-year contract, paying a premium of $76,000 annually.[31]

- Amherst College purchases wind RECs for 175 MWH of their electricity.[32] (We estimate the cost of these RECs to be about $3,500).

[29] http://www.aashe.org/resources/sust_professionals.php
[30] Katherine Kirklin, Bowdoin campus coordinator for the Climate Campaign
[31] www.bates.edu/x80314.xml
[32] www.amherst.edu/~pubaff/news/news_releases/05/2006_02millionmonitor.html

- Wesleyan University purchases 2,100 MWH of renewable energy for an additional $40,000 annually.[33]

Given the competitiveness of NESCAC colleges, it is likely that in the near future more schools will subscribe to 100% renewable energy. Indeed, Middlebury College plans to be carbon neutral by 2016.[34] If Middlebury College was willing to pay the same amount per student as Bates or Bowdoin for green energy, then its total WTP would be between $106,000 and $179,000, respectively, which we approximate at $142,000.[35]

We have used three independent tools for measuring the implicit value of 'green' reputations and renewable energy sources, the results of which are summarized in Table 4. Note that renewable energy student fees are collected annually, and thus have substantial value when discounted to the present, as illustrated in Figure 9.

Figure 9 – Renewable Energy Student Fees (see A4 for additional details)

		NPV of 20 years of fee	
		5% discount	10% discount
NESCAC (average per student)	$22.50		
Potential Revenue at Middlebury	**$52,875**	**692,000**	**495,000**
NESCAC (average per student – 100% renewable)	$60.58		
Potential WTP revenue at Middlebury	**$142,000**	**1,860,000**	**1,330,000**
WTP for Sustainability Coordinator	**$51,164**	**670,000**	**479,000**

3.4 Intangible Valuation Conclusion

In conclusion, we find the intangible value of green energy to be substantial, particularly when future fees are discounted to the present. As a result, we recommend that Middlebury College strongly considers fees in the investment decision not only to inform them of students' willingness to pay for clean energy, but also as a source of financing.

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[33] www.eere.energy.gov/greenpower/resources/tables/customers
[34] Ronald D. Liebowitz, email to Middlebury College student and faculty, May 6, 2007
[35] See A4

Regulatory Challenges

The Federal Energy Regulatory Commission (FERC) is responsible for the authorization and regulation of the nation's non-federal hydro-power resources under the Federal Power Act. In this oversight role, FERC issues 30-50 year licenses to operators of qualified hydroelectric facilities. In deciding whether to grant a license, FERC must give equal consideration to both developmental and environmental aspects of the project. Traditionally, this is a long, complex, and expensive process involving the assessment of flora, fauna, aesthetic, cultural, and recreational resources at the site. This is a collaborative process in which FERC considers reports by federal and state entities, Indian tribes, and the public. In terms of the proposed Middlebury facility, Gomez and Sullivan Engineers, P.C. estimated the licensing cost to be $250,000 to $500,000 over a period of up to five years or more.[36] At almost one sixth of the cost of the entire project, this is a significant and uncertain financial constraint. In our financial model we have allowed for $500,000 of regulatory related expenses over three years. Though this intensive regulatory process is important for many projects, it can present an overly large financial burden on small/low impact hydroelectric projects.

There has been a recent surge of interest in small/low impact hydroelectric projects. To better accommodate and expedite these projects, FERC allows license exemptions for qualified projects of 5MW or less. Though these exemptions are still subject to regulatory proceedings, obtaining an exemption can be a shorter and less expensive process than traditional licensing as projects are not subject to the Federal Power Act's (FPA) comprehensive development standard. The application deadlines for the exemption have shorter time intervals than those associated with the license. An additional advantage is that exemptions generally only require an Environmental Assessment rather than a full Environmental Impact Statement.

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[36] "Middlebury Hydro Pre-Feasibility Study," Gomez and Sullivan Engineers, P.C., September 2006, p12

In 2000, The State of Alaska further streamlined its process for small hydro projects by adding the amendment Section 32 [16 U.S.C 823c] to the Federal Power Act. This amendment allows Alaska full state jurisdiction over small hydro projects and thus negates the need for an exemption or license from FERC. This program has a projected cost to the State of Alaska of $280,000 per year,[37] but greatly reduces the regulatory costs for developers of small hydro projects. Vermont's representatives could propose an amendment to Alaska's amendment that would include the "State of Vermont" in Alaska's exemption. Since the Middlebury project will only produce a small amount of power (and revenue by extension), the large decrease in regulatory fees that would result from the amendment would greatly increase the project's financial viability. In light of overwhelming interest in using Vermont's many small hydro resources to meet the state's renewable portfolio standards, there has been discussion of making the Middlebury Electric Company a 'pilot project' for Vermont oversight.

Until this amendment is proposed and passed, however, the Middlebury Electric Company will be best served to apply for the 5MW Exemption from FERC licensing. The original cost estimate proposed by Gomez and Sullivan Engineers was based on applying for a traditional license. As stated previously, the high estimate of fees associated with the license would be on the order of $500,000. The FERC website mentions a number of factors that can reduce time and costs during regulation: that the project is at an existing dam, that there is little change to water flow and use, and that it is unlikely to affect threatened or endangered species or need fish passage.[38] As of the preliminary assessment (Gomez and Sullivan), the Middlebury Electric project has all of these characteristics. In addition, Anders Holm has stated that State and Town officials have been initially receptive to the project. The support from the State and Town

[37] Kleweno, Kevin, "Establishing a state regulatory program for qualifying water-power development projects," Regulatory Commission of Alaska, Available online: http://www.state.ak.us/rca/Hydroelectric/pres1.pdf, April 21, 2007

[38] "Guide to Developing Small/Low Impact Hydropower Projects," Federal Energy Regulatory Commission, Available online: http://www.ferc.gov/industries/hydropower/gen-info/licensing/small-low-impact/small-hydro.pdf, May 1, 2007

is crucial to the FERC process. An example of a successfully expedited project on the FERC website obtained an exemption 10 months after filing the application[39] – this stands in stark contrast to the possible 60 months required to obtain a license. Note that, given the uncertainty of the regulatory proceedings, we have modeled the proposed project with $500,000 of regulatory related expenses. If in fact the Middlebury Electric Project is granted regulatory exemptions, then the costs of approval will likely be reduced, and the financial viability of the project increased. The following section will address the intricacies of how the Middlebury Electric project could potentially qualify for the exemption.

4.1 The 5MW Exemption

By definition, a 5MW Exemption is an exemption from the licensing provisions of Part 1 of the Federal Power Act. Specifically, this means that the applicant will not be subject to the comprehensive development standard (FPA section 10 (a)(1)) and other aspects of Part 1. 18 CFR 4.30 (b)(29) defines a "small hydroelectric power project" as one in which the total installed capacity will be no greater than 5MW. Included in this definition are two caveats that (i) the project utilize an existing non-federal dam or (ii) the project utilize a natural water feature such as a waterfall and not retain any water behind the structure for storage. The Middlebury Electric project is proposed to be a 1 MW generating station. A likely scenario is that this project will fit part (ii) of the definition of a small hydroelectric power project. The Middlebury project will rely on the waterfall and the natural gradient of the site to provide the kinetic energy to spin the turbine. As the project currently stands, there will be no flashboards installed in the river to store water upstream of the Falls. Note that flashboard installation would likely violate part (ii) and would disqualify this project from exemption.

There is clearly no dam at the Middlebury Falls, but it is important to properly categorize the historic sluiceway (sometimes called a flume, this is the diversion structure under Anders

[39] Ibid

Holm's building through which the water will flow to the generator) that will be utilized. 18 CFR 4.30 (b)(4)(iii) defines "dam" for the purposes of the 5MW exemption as a structure that impounds or diverts all or a substantial amount of the river's flow. Though the sluice is a diversion structure, it does not and will not divert a large proportion of the Otter Creek's water. Thus it is safe to say that under the definitions, the Middlebury Electric project will not utilize an 'existing dam' nor does it plan to construct one.

18 CFR 4.30 (b) (23) defines what it means to be a "qualified exemption applicant." This definition states that a qualified exemption applicant is one that meets the requirements set fourth in18 CFR 4.31. This definition specifically refers to section 18 CFR 4.31(b)(2), but this seems to be a typographic mistake. Section (b)(2) refers to exemptions for a "small conduit hydroelectric facility." Section (c)(2) refers to exemptions for a "small hydroelectric power project." Regardless of the possibility of a typographic error, the definitions of a qualified applicant are the same in parts (b)(2) and (c)(2). 18CFR 4.31(c)(2)(ii) states that the applicant must have all of the real property interests or option to obtain them for all non-federal lands associated with the project. "Real property interests" is defined in 18 CFR 4.30(b)(26) as "ownership in fee, rights-of-way, easements, or leaseholds." The definition of "project" is also important to examine here as, according to 18 CFR 4.30(b)(22), this includes "any associated dam, intake, water conveyance facility, power plant, [and] primary transmission line." This is an area that Anders Holm must focus on to become a qualified exemption applicant. Though he owns the building above the sluice and the sluice itself ("intake"), the Town of Middlebury owns the shore along Otter Creek where the proposed conveyance structure, power house, and primary transmission line would be constructed. Either a sale of the necessary land or another kind of "real property interest" will have to be negotiated among Anders Holm, the Town of Middlebury, and any other property holders within the project boundary in order to qualify for the 5MW Exemption.

Finance

In this section we will examine the financial considerations of the Middlebury Electric project. First, we propose three unique company ownership structures; second, we introduce our financial model and examine the financial returns that can be expected; finally, we discuss financing options.

5.1 Project Structure

We have analyzed three distinct ownership structures of the proposed hydroelectric project on Middlebury Falls. The first is full ownership control under Anders Holm; the second, a joint venture (JV) with Holm and Middlebury College; and the third, full ownership under Middlebury College. Each has its own benefits and costs, as discussed below.

5.1.1 Anders Holm Full Control

Our first discussions with Anders Holm centered on his full ownership of the project, selling the generated power directly to the grid via a to-be-designed program analogous to Cow Power. As such, we analyzed Cow Power's business model to see how, if at all, it would be applicable to Anders' plans. In Vermont, Cow Power is run through CVPS, which offers a $0.04/KWH wholesale premium to conventional generation, with the premium passed on to consumers through the retail price. The program is novel to the extent it captures methane gas from cow by-product and then uses the gas to produce electricity. The benefits are two fold: first, methane, a powerful greenhouse gas, is no longer released into the atmosphere; and second, electricity is produced on a secure, regional level. While Cow Power is proving successful, it operates at a small scale, with less than 10 million KWH generated annually.[40] By way of comparison, Middlebury Falls is expected to produce 6 million KWH annually. As a result, we had reservations surrounding consumer demand for additional expensive clean power from Middlebury Electric. After all, a $0.04/KWH premium will be felt by most electricity consumers.

[40] http://www.cvps.com/cowpower/Our%20Farms.html (accessed 5/6/07)

Furthermore, since Anders would be selling through CVPS he would receive the wholesale, and not retail, price as income.

Full ownership by Anders requires other considerations as well. Effectively, Anders would be operating in the utility sector, an industry in which he has little experience. Turbine installation would represent only the beginning of the project. Maintenance and other business management issues would be required on an annual basis. We advise that Anders should not underestimate the time and potential difficultly such a project would create. In addition, as the sole owner, Anders would bear substantial financial risk. Such risks include: generator failure, rogue accident, declining electricity prices, and inadequate water flow. The realization of any or a number of these risks could spell financial difficulty, particularly if the deal were financed with debt. In light of these considerations, a joint venture with Middlebury College appears especially attractive.

5.1.2 Middlebury College / Anders Holm Joint Venture

We believe there to be substantial potential within the JV framework. Such a venture would be beneficial to both Anders Holm and Middlebury College. First, Anders would reduce his exposure to financial risk and have the ability to lock in a long-term contract. This would reduce his time cost of managing the business: if all the electricity went to Middlebury College via a fixed contract there would be little to worry about from a revenue generation perspective. Note, however, that Anders would still be exposed to potential risks from generator failure, accident, or inadequate water flow. Second, Anders would avoid the electricity transmission costs CVPS would charge by selling electricity directly to Middlebury College. Third, Middlebury College would secure a long-term energy source that could provide up to one-third of current electricity demand. Fourth, Middlebury College would reduce the risk of a carbon spike in 2012 if electricity supply were to shift from sources such as Hydro Quebec and Vermont Yankee to coal in the wake of un-renewed contracts. This should be of particular concern to the

College in light of its recent pledge to become carbon neutral by 2016, the same year as Vermont's contract with Quebec Hydro expires.

A JV does raise new questions that will require the outside consultation of a financial advisor. In particular, the tax consequences of a separate entity created by a for-profit and a non-profit entity are complex, as the for-profit entity can shield income taxes with depreciation, while the non-profit cannot. In addition, Middlebury College would need to determine an appropriate balance between initial investment and future electricity rates.

A final consideration for both Anders and Middlebury is the dependence that such an arrangement would create. De facto Middlebury would have substantial power if it were the sole consumer of Anders' electricity, highlighting the importance of a well-structured contract.

5.1.3 Middlebury College Full Control

Full ownership by Middlebury College does not eliminate the risks described above: generator failure, rogue accident, declining electricity prices, and inadequate water flow. However, the College is in a substantially better financial position to deal with adverse outcomes based on its large operational budget, endowment, and access to capital markets.

In many ways full ownership makes sense for both the College and Anders. Addressing Anders first, it would allow him to receive certain profit by selling his property while simultaneously having the hydroelectric facility installed per his original plans. This shifts the financial risk from Anders to the College, and affords Anders substantial wealth enhancing opportunity via the property sale.

From the College's perspective, Middlebury Falls represents a valuable asset that the College is in a unique position to utilize. The College's property is nearly adjacent to the Falls, easing regulatory dilemmas, the generation capabilities of the Falls match Middlebury's electricity demand, and the College has the financial and human infrastructure to properly maintain a turbine on the Falls.

Despite the proposed benefits, there are other considerations. Anders expressed little interest in such a plan, in spite of the substantial financial benefits it may afford. In addition, town residents are increasingly hesitant of the encroachment of the College into the town's center.

5.1.4 Recommended Structure

At this time we cannot propose a structure. Rather, we strongly encourage the interested and relevant parties, namely Anders Holm, Middlebury College, and the Town of Middlebury, to have a serious discussion about the possibilities outlined above. Without the much needed discussion, it is difficult to legitimately weigh the relevant benefits and costs. Both Middlebury College and Anders Holm should be more proactive in their discussions and more forthright in their respective expectations.

5.2 Financial Model

The financial model allows the user to quantify the expected return of a given investment in the proposed hydroelectric generation site. There is substantial flexibility within the model, so we will proceed first with the features in the model, and then with an illustrative example of our best estimates of the financial trajectory of this project. We recommend the reader further explore the excel file, as there are an unlimited number of scenarios which, for obvious reasons, we cannot explore in this text.

5.2.1 Features of Model

There are three components to the financial model: "Basic Financial Model," "Property Value to Middlebury College," and "Nominal Payback Analysis." The basic financial model serves as a foundation from which the other two components run, and should be the core focus of analysis. Its outputs are the net present value (NPV) of the entered parameters, the internal rate of return (IRR) of invested funds, and the nominal payback period in years, starting from the first year of revenue.

The following refers directly to the excel model. Working from the top of the basic financial model assumptions down, we will proceed to explain the various model parameters. Note that all blue numbers in yellow cells may be changed, with all dollar values in thousands unless otherwise indicated. Be advised that Excel must be set per the model's instructions.

Description of "Basic Financial Model" Parameters and Output:

1. Financial assumptions
   - Model year start – enter the first year of the model
   - Discount rate – enter the preferred discount rate, we recommend a market rate of 9%, or opportunity cost of capital
   - Tax rate – should be set to the marginal tax rate, if applicable, of the residual claimant
   - Tax on? – entering "1" in the associated cell turns the tax calculation feature of the model on. Tax should be turned off for non-taxable entities by entering "0"
   - Depreciation – enter the number of years the invested asset will be depreciated. We have modeled this via straight-line convention for simplicity
   - Depreciation on? – entering "1" turns on the depreciation calculation. Since non-profit entities do not pay income taxes and thus cannot shield taxable income, depreciation should be turned off by entering "0"
2. Revenue
   - First year of revenue – enter the first full year of revenue (note that for simplicity, and with minimal loss of generality, the model calculates on an annual basis)
   - MWH – this is the annual generation capacity of the plant, which we take to be 6,000 MWH
   - Electricity price – enter price in $/KWH for the first year of the contract, or first year of operation
      i. Growth rate – indicates the annual growth rate of electricity prices. If the reader is modeling a "lock in" contract, then growth rate should be set to 0%
   - Contract length – indicates the length of contract. Note that the model allows for 20 years of calculation, starting from "model year start." Modeling for a longer period becomes speculative for two reasons: first, discounting reduces the present value of future cash flows significantly; second, twenty years is far away, and the energy landscape will likely change substantially between now and then
3. Construction and maintenance costs
   - Civil – enter the full civil construction cost (including turbine) year and amount, with the amount in thousands
   - Advisory – enter the advisory fees, year and amount. Three years of fees are allowed
   - Annual maintenance cost – running the turbine requires annual maintenance costs
      i. Growth rate – enter the expected annual growth rate in maintenance costs
4. Grants
   - Grants tax exempt? – if grants are tax exempt, enter "1", else enter "0"
   - Grant size and year – enter the year the grant will be received and the associated size, in thousands

5. Output
   - Net Present Value – returns the NPV per the entered parameters
   - IRR – returns the IRR per the entered parameters
   - Nominal Payback – returns the nominal payback per the entered parameters, in years, starting from the first year of revenue

Description of "Property Value to Middlebury College" Parameters and Output:

1. First, it is important to note that the parameters for the "Basic Financial Model" form the foundation of the property value calculation
2. Second, this subset of the model aims to value Anders' property to Middlebury College, given the entered parameters
3. Financial
   - Discount rate – enter the discount rate for the property value calculation
4. CVPS Rate
   - Price ($/ KWH) at first year revenue – enter the expected CVPS electricity price during the first year of revenue, as specified in the basic financial model assumptions
   - Growth rate – enter the expected annual growth rate in the CVPS price
5. Output
   - NPV Middlebury Falls generation cost – returns the NPV of all costs that Middlebury College is expected face if it were to fully own and operate the generation site
   - NPV CVPS electricity cost – returns the NPV of expected cost of purchasing electricity from CVPS were the hydroelectric generation site not installed
   - Property value – Returns the difference between the above two outputs. Thus, it should be noted that taxes, intrinsic value, and other parameters that may materially affect property value are not included. Rather, this output is intended to serve as an approximation of the economic value of the generation capabilities of the Falls vis a vis purchasing electricity from CVPS

Description of "Nominal Payback Analysis" Parameters and Output:

1. The goal of this calculation is to answer the question "what would CVPS rates need to be to achieve a specific nominal payback period if Middlebury College fully invested in the project?"
2. Nominal payback analysis utilized the parameters of the basic model as a foundation
3. Required Payback – enter the number of years within which require nominal payback to occur
4. CVPS rate – enter in the expected annual growth rate in CVPS prices
5. Output
   - Required CVPS rate in YYYY – returns the required rate of CVPS to achieve the specified nominal payback
   - Percent annual growth – simply the same number as entered above in "CVPS rate"

5.2.2 Illustrative Example

The following illustrative example represents our best estimation of the financial costs and benefits of the proposed project. Specifically, we modeled a contracting ownership structure with Middlebury College purchasing electricity from Middlebury Electric through a 15 year contract locked in at a fixed rate of $0.12/KWH. Parameters are specified in accordance with the model. Note that there are significant uncertainties surrounding the project and this example should not necessarily be considered indicative the future.

"Basic Financial Model" Parameters and Output:

1. Financial assumptions
   - Model year start – 2007
   - Discount rate – 9%
   - Tax rate – 35%
   - Tax on? – 1
   - Depreciation – 15
   - Depreciation on? – 1
2. Revenue
   - First year of revenue – 2010 (we assume three years to receive approval from FERC, etc.)
   - MWH – 6,000
   - Electricity price – $0.12 (best estimate at a reasonable price for Middlebury to lock into)
     i. Growth rate – 0%
   - Contract length – 15
3. Construction and maintenance costs
   - Civil – year: 2009, cost: 3,000
   - Advisory – $167.33 each year from 2007 to 2009 (reflecting the long and costly permitting process)
   - Annual maintenance cost – 70
     ii. Growth rate – 3%
4. Grants
   - Grants tax exempt? – 1
   - Grant size and year – no grants (we are interested in determining the true financial viability) of this project
5. Output
   - Net Present Value – $300,000
   - IRR – 10.6%
   - Nominal Payback – 7 years

Discussion: If the project were to proceed as specified above then the economics look strong. The net present value at a 9% discount rate is $300,000, suggesting that the project will create economic value. The IRR of 10.6% is attractive, and reflects the rate at which funds invested in the project will compound. Nominal payback is relatively quick, at 7 years after the first year of revenue. The project specified above is financially viable. When also considering the social benefits not explicitly valued in the model, the investment case for the project is compelling.

"Property Value to Middlebury College" Parameters and Output:

1. Financial
   a. Discount rate – 5% (Middlebury indicated that applied a 5% discount rate, its approximate cost of capital, to the biomass project and would likely do the same here)
2. CVPS Rate
   b. Price ($/ KWH) at first year revenue – $0.10 / KWH in 2010 (reflects growth of current rate, $0.088, with inflation)
   c. Growth rate – 3% (CVPS's target rate of growth, and historical average)
3. Output
   d. NPV Middlebury Falls generation cost – 3,993
   e. NPV CVPS electricity cost – 6,819
   f. Property value – $2.8 million

Discussion: With the entered parameters, Anders' property is estimated to be worth $2.8 million to Middlebury College. This is a simplistic calculation of property value, capturing only the differences in discounted costs between generation from the Falls, and expected discounted costs of purchasing from CVPS. Note that the calculation is highly sensitive to discount rate, reflecting the different cash flow patterns of the two alternatives: the cost of the proposed project are largely realized in upfront and short-term costs, while the cost of CVPS electricity is distributed across time. Setting the discount rate to 9%, for example, results in a property value to Middlebury College of only $1.3 million.

"Nominal Payback Analysis" Parameters and Output:

1. Required Payback – 10 years
2. CVPS rate – 3%
3. Output
   a. Required CVPS rate in 2010 – $0.057 / KWH
   b. Percent annual growth – 3%

Discussion: This analysis reveals that the CVPS rate need only be $0.057/ KWH during the first year of electricity generation and grow at 3% annually to achieve a nominal payback of 10 years.

Note that the “payback” is not actually cash flow, but rather the absence of cash flow to CVPS, since full ownership by Middlebury College would not require paying another entity for the generated electricity, thus effectively resulting in a positive cash flow (although there is no flow of cash from outside the College to the College for electricity).

5.3 Financing

There are many financing options for the proposed project, as implied by the various equity structures. Grants would reduce the realized upfront cost of the project, increasing its attractiveness. However, after conducting independent research and consulting Rob Ide, we have found little success in securing grants. In particular, potential contributors are hesitant to commit to the size of grant funds available. We believe that Middlebury College and its associated political weight may be able to assist in securing grant money, and strongly support further pursing this avenue of (essentially free) financing as the project progresses. The Vermont Clean Energy Development Fund looks promising.

Debt financing is also an option, although one that Middlebury College has indicated an aversion to pursuing. Thus, our attention turned to the possibility of augmenting Anders’ equity contribution with debt. We have identified a number of loans available from the state of Vermont through George Robson of the Vermont Department of Economic Development, as well as through an Addison County representative. There is up to $100,000 available from Addison County, and up to $1.3 million from the state. The borrower would be required to pass the usual litmus tests of any financing, such as stable and sufficient cash flow and collateral. While it is not inconceivable, it is highly unlikely that this project could be financed heavily with debt: the primary assets are a turbine and sunk civil construction costs, neither of which serves as particularly compelling collateral. Furthermore, it is difficult to guarantee cash flow from the project. We thus recommend that the interested parties further pursue grants and equity contributions.

Financial Model

Illustrative Example

Hydroelectric Investment Model

Preliminary Financial Analysis

May 10 2007

In thousands unless otherwise noted

About this model:

The core of this spreadsheet is the "Basic Financial Model" section. Property valuation and nominal payback analysis are most relevant where Middlebury College assumes full control of the proposed project

Assumptions

Basic Financial Model

Financial

Model start year	2007	
Discount rate	9.0%	
Tax rate	35.0%	
Tax on?	1	1=yes
Depreciation duration (years)	15	years
Depreciation on?	1	1=yes

Revenue

First year of revenue	2010	
MWH	6,000	
Electricity price / KWH ($)	$ 0.120	first year contract
Growth rate	0.0%	
Contract length	15	years

Construction and maintenance costs

Civil	year	2009	3,000	cost
Advisory	year	2007	167	cost
	year	2008	167	cost
	year	2009	167	cost
Annual maintenance cost		70		
Growth rate		3.0%		

Grants

Grants tax exempt?		1	1=yes	
Grant size and year	year	2007	-	size
	year			size
	year			size

Property Value to Middlebury College

Notes: Assumes full property ownership by college
Utilizes assumptions of "Basic Financial Model" unless specified

Financial

Discount rate	5.0%	

CVPS Rate

Price ($/ KWH) at first year revenue	0.100	in year 2010
Growth rate	3.0%	

Nominal Payback Analysis

Answers question: what would CVPS rates need to be to achieve a specific nominal payback if Middlebury College fully invested in project?

Notes:
+ begins calculating nominal payback with first year of generation
+ uses investment in "Basic Financial Model"

Required Payback - Press "F9" key 6 times after changing

Years until nominal investment payback	10

CVPS Rate

Annual growth rate	3.0%

Output

Net Present Value	**300**
IRR	**10.6%**
Nominal Payback	**7 Years**
NPV Middlebury Falls generation cost	**3,993**
NPV CVPS electricity cost	**6,819**
Property value	**$ 2.826 million**
Required CVPS rate in 2010	**$ 0.057 / KWH**
Percent annual growth:	**3.0%**

Financial Model

Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Income Statement																				
Electricity Revenue	-	-	-	720	720	720	720	720	720	720	720	720	720	720	720	720	720	720	-	-
Construction	-	-	3,000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Regulatory, advisory, legal fees, etc.	167	167	167	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Grants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Maintenance	-	-	-	70	72	74	76	79	81	84	86	89	91	94	97	100	103	106	-	-
Depreciation	-	-	-	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	-	-
Pre tax income	(167)	(167)	(3,167)	450	448	446	444	441	439	436	434	431	429	426	423	420	417	414	-	-
Taxable income	-	-	-	450	448	446	444	441	439	436	434	431	429	426	423	420	417	414	-	-
Income taxes	-	-	-	158	157	156	155	154	154	153	152	151	150	149	148	147	146	145	-	-
Net Income	(167)	(167)	(3,167)	293	291	290	288	287	285	284	282	280	279	277	275	273	271	269	-	-
Discounted Cash Flow Analysis																				
Net income	(167)	(167)	(3,167)	293	291	290	288	287	285	284	282	280	279	277	275	273	271	269	-	-
Depreciation	-	-	-	200	200	200	200	200	200	200	200	200	200	200	200	200	200	200	-	-
Free cash flow	(167)	(167)	(3,167)	493	491	490	488	487	485	484	482	480	479	477	475	473	471	469	-	-
Discounted FCF	(167)	(153)	(2,665)	380	348	318	291	266	244	223	204	186	170	156	142	130	119	108	-	-
Net Present value	**300**																			
IRR	**10.6%**																			

Property Value

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026
Middlebury falls - cost of generation																				
Investment	167	167	3,167	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Maintenance	-	-	-	70	72	74	76	79	81	84	86	89	91	94	97	100	103	106	-	-
Total cost	167	167	3,167	70	72	74	76	79	81	84	86	89	91	94	97	100	103	106	-	-
Discounted Cash Flow Analysis																				
Discounted Middlebury Falls cost	167	159	2,872	60	59	58	57	56	55	54	53	52	51	50	49	48	47	46	-	-
NPV cost	3,993																			
CVPS Cost																				
Electricity cost	-	-	-	600	618	637	656	675	696	716	738	760	783	806	831	855	881	908	-	-
Discounted Cash Flow Analysis																				
Discounted CVPS cost	-	-	-	518	508	499	489	480	471	462	453	444	436	428	419	411	404	396	-	-
NPV cost	6,819																			
NPV Surplus of Hydro Project	**2,826**																			

Appendix

A1 Important Meetings [Many other meetings, but these were most pivotal to project]

4/12/07 – Patrick Norton and Tom Corbin
- Established strong interest of Middlebury College in consuming all electricity from Falls
- Interested in possibly entering into a JV with Anders Holm
- Middlebury College concerned about deal structure, property rights, and politics
- Learned of new "Energy Procurement Group" at Middlebury College

4/17/07 – Anders Holm
- Anders highly receptive to Middlebury College's interest
- Requested that we build a financial model

4/18/07 – Mike Moser
- Discussed profile of Middlebury's electricity consumption
- Discussed implications of hydroelectric project on Middlebury's profile
- Moser addressed the strategic importance of stable energy prices, such as via lock-in contract

4/23/07 – Patrick Norton
- Proposed idea of Middlebury assuming full ownership of project
- Norton requested model to determine necessary CVPS rates for payback

4/26/06 – Anders Holm
- Proposed idea of Middlebury assuming full ownership of project

5/1/07 – Anders Holm
- Final meeting to shape focus of paper

A2 Contacts

Contact	Title	Discussion Focus
Edward Abrams	FERC Small Hydropower Specialist	Discussed 5MW exemption
George Robson	Vermont Department of Economic Development	Available loans in state of Vermont
Julie Rosenbach	Bates College Environmental Coordinator	Discussed Bates' purchase of RECs
Katherine Kirklin	Bowdoin Campus Coordinator for the Climate Campaign	Discussed Bowdoin's purchase of renewable energy
Mike Moser	Middlebury College, Assistant Dir of Facilities Services, Central Heating/Utilities	Middlebury's electricity usage and impacts of project on that usage
Mohamad Fayyad	FERC Engineering Team, Lead Division of Hydropower Administration and Compliance	Discussed possible tax credits and 5MW exemption
Patrick Norton	Middlebury College, Associate VP for Finance and Controller	Financial considerations of project vis a vis college
Rob Ide	Energy Efficient Director for Vermont Department of Public Service	Discussed possible state grants and loans
Sarah Creighton	Tufts University Sustainability Coordinator	Discussed Tufts' purchase of RECs and salaries for sustainability coordinators
Tom Corbin	Middlebury College, Assistant Treasurer and DBS	Middlebury's interest in hydroelectric project

A3 Survey Results

The SurveyMonkey.com survey results of 583 respondents are summarized below. Totals may not add due to rounding:

1. Please indicate your class year:

Year	Percent
First year	26
Sophomore	21
Junior	25
Senior	25
Other	2

2. Rank in order of importance which factors had the greatest impact on your decision to attend Middlebury College:

Rank	1	2	3	4
Academic reputation	75%	7%	2%	17%
Athletic reputation	11%	35%	26%	27%
Commons system	13%	13%	28%	46%
Environmental reputation	9%	36%	36%	18%

3. Middlebury' greatest strength in comparison to other NESCAC schools is:

Strength	Ranking as first (%)
Academic reputation	51
Athletic reputation	11
Commons system	3
Environmental reputation	35

4. Given the option you would most prefer to see:

Option	Ranking as first (%)
Large concert	12
Improved senior housing	31
Investment in clean energy	30
More speakers	27

5. Please rank in importance the following initiatives:

Rank	1	2	3	4
Carbon neutrality	22%	28%	27%	23%
Increased financial aid	45%	23%	15%	16%
More teachers	16%	28%	33%	23%
Room draw reform	18%	22%	22%	38%

6. Given the following hypothetical senior gifts, how much would you be prepared to contribute if you were a senior graduating this spring?

Option	Average response ($)
Prominent speaker fund	52
Fund faculty position	142
Hydroelectric power	95
Increase in student activity fund	35

7. You would accept an increase of $ ____ in tuition to see Middlebury become carbon neutral in the next 10 years
   a. **Average response: $753**

8. You would accept an increase of $ ____ in tuition to see Middlebury improve social life on campus over the next 10 years
   a. **Average response: $740**

9. You would accept an increase of $ ____ in tuition to see Middlebury hire more faculty in the next 10 years
   a. **Average response: $909**

10. Global Warming is:

Description	Response (%)
A serious threat	79
Somewhat a threat	19
Not a threat	3

11. Should Middlebury require investments in alternative energy sources have the same economic returns as traditional responses?

Description	Response (%)
Yes	34
No	32
Don't know	34

12. Are you concerned about the future of Vermont's energy independence:

Description	Response (%)
Very	18
Somewhat	44
A little	18
No	21

13. Do you perceive nuclear energy to be:

Description	Response (%)
Good for the environment	19
Bad for the environment	37
Neither good nor bad	40
Unrelated to the environment	4

14. Do you perceive hydroelectric generation to be:

Description	Response (%)
Good for the environment	62
Bad for the environment	10
Neither good nor bad	27
Unrelated to the environment	0

15. What is the approximate current market rate of a 1 ton carbon offset in the United States?

Price / Ton	Response (%)
$5	23
$35	41
$65	28
$95	8

16. Does the United States currently endorse Kyoto?

Description	Response (%)
No	93
Yes	7

A4 Valuation Appendices

Renewable Energy Student Activity Fees[41]

School	Student Fee
Central Oregon Community College	6.00
Connecticut College	25.00
Cornell	10.00
Evergreen State College^	60.00
Harvard	10.00
Mesa State College	2.00
Middle Tenn. State University^	16.00
Tufts*	20.00
U of California, Santa Cruz	9.00
U of Colorado at Boulder	2.00
U of Colorado at Denver (and Auraria)^	2.00
U of Denver	18.00
U of Illinois at Urbana-Champaign^	4.00
U of Oregon^	1.20
U of the South at Sewanee	45.00
U of Utah	2.00
U of Wisconsin-Green Bay	3.38
U Tenn. at Chattanooga*	10.00
UC Santa Cruz	9.00
Warren Wilson College	22.00
Western Washington U	31.50

Average		Potential Revenue
All	14.67	34,476
Hybrid Spending	16.64	39,104
NESCAC	22.50	52,875

* = Not yet active
^ = Hybrid Spending

NESCAC Renewable Energy Purchases

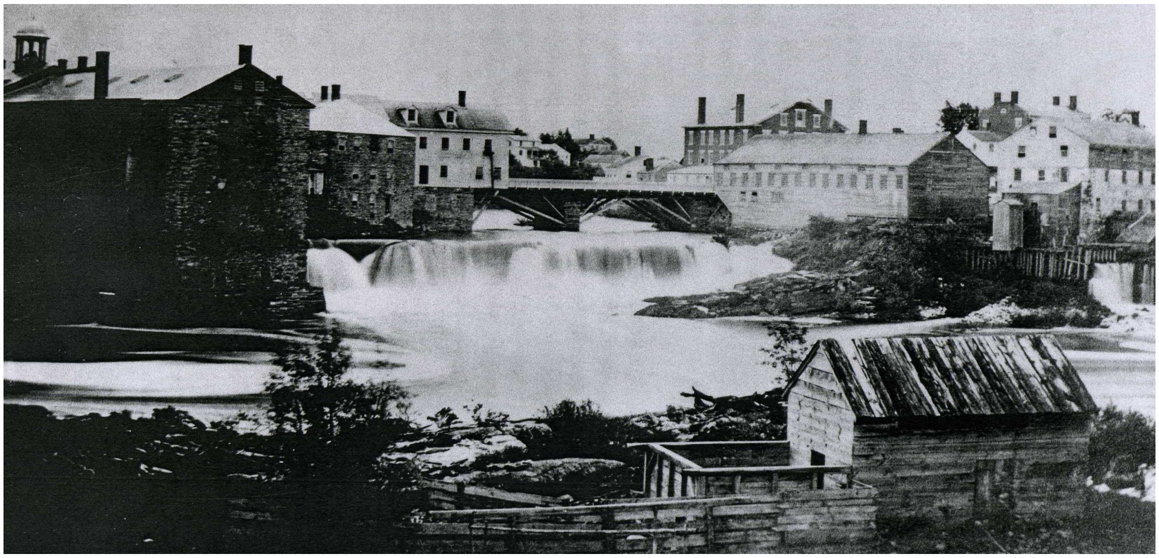
	100% Renewable	Annual cost of RECs	Students	Cost / Student	Midd Potential Revenue
Bates	Yes	76,000	1,684	45.13	106,057
Bowdoin	Yes	130,000	1,710	76.02	178,655
Amherst	No	3,500	1,648	2.12	4,991
Wesleyan	No	40,000	2,700	14.81	34,815

[41] http://www.aashe.org/resources/mandatory_energy_fees.php, http://www.news.cornell.edu/stories/March07/SA.elections.dea.html, http://media.www.dailyhelmsman.com/, http://jmugreenteam.com, http://media.www.utcecho.com

A5 Pamphlet (for May 9, 2007 community gathering)

Middlebury Electric

A Compelling Solution to Growing Energy Demand



Historic Middlebury Falls

Summary of Middlebury Electric Project:

Doctor Anders Holm is proposing a 1 Megawatt run-of-river hydroelectric generating station on the western side of the Otter Creek Falls. With the revival of historic Middlebury Electric, Anders plans to use existing infrastructure to produce clean, local, emissions-free electricity. The benefits of this project are compelling, likely creating significant social *and* economic return.

Who will buy the electricity?

While the final details have not yet been determined, there are two distinct possibilities. The first is selling electricity through CVPS in a program similar to Cow Power. The second is directly distributing to Middlebury College.

Project Goal:

Our goal from the perspective of EC265 was to analyze the diverse range of economic, regulatory, and non-market considerations for the proposed Middlebury Electric turbine on Middlebury Falls.

(over for details)

Electricity Prices:

- Vermont's energy is derived from the following sources:
  - 37% hydro (27% hydro Quebec),
  - 36% nuclear (VT Yankee),
  - 17% regional systems,
  - 9% renewables,
  - 1% oil and gas
- In 2012 Vermont Yankee license **expires**
- In 2016 Quebec Hydro contract with Vermont **expires**
- In 2005, due to supply shortages, CVPS was forced to purchase power at a rate that was **not covered** by retail charges, i.e. at a loss
- Estimates suggest that in 2015 Vermont will use 16% **more power** than it did in 2005 – how will this new demand be met?

Regulation:

- Regulation and licensing introduce significant barriers to small hydroelectric projects. Gomez and Sullivan Engineers, P.C. estimate licensing costs of $250,000- $500,000, nearly one-sixth of the total cost of the project
- Reduce regulatory red tape: add the "State of Vermont" to Alaska's amendment. Due to strong demand and widespread interest, there has much talk of making the Middlebury Electric Company a **'pilot project'** for Vermont oversight

What Middlebury Students Think (Social Return):

- We surveyed nearly 600 students and found:
  - **79%** of Middlebury students consider global warming a serious threat
  - **62%** indicated Vermont's energy independence to be "very" or "somewhat" important
  - Students ranked carbon neutrality high in importance: just behind improving financial aid, but ahead of hiring more teachers or reforming room draw
  - **90%** of students considered hydroelectricity to be either "good for the environment" or "neither good nor bad" for the environment
- Middlebury peer institutions are acting to make change: four NESCAC colleges currently pay premiums for clean electricity

Economic Return:

- Middlebury Electric has the potential to create substantial economic value. Our best estimates predict an internal rate of return of invested funds of **10%,** and a **nominal payback period of 7 years**.

Disclaimer

The authors consider the analysis contained herein an initial step in the decision making process of Middlebury Electric and Middlebury College. The authors do not accept responsibility for action taken in response to the analysis presented above.