An Investigation of Power Purchase Agreements for the University of Michigan: A Path to Carbon Neutrality

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EXECUTIVE SUMMARY

This report explores the use of power purchase agreements (PPAs) as an option for the University of Michigan to increase its usage of renewable energy. PPAs are becoming increasingly popular for large entities such as corporations and universities to increase their usage of renewable energy in easy and profitable ways. Our report starts by outlining the background of the university’s greenhouse gas emission goals and position as a leader in sustainability.

We then discuss why third-party ownership offers benefits to entities who are not specialists in energy development and for whom it would be difficult to purchase renewable electricity generation assets. We explain what PPAs are, how they work, and various financial models we created regarding different types of PPAs that U-M could engage in. This is followed by examples of other institutions, most notably Ohio State University, who are engaging in and benefitting from PPA arrangements. We also discuss U-M’s current and past electricity usage and expenses in order to find the volatility of past electricity prices and show how much price volatility U-M could avoid using a PPA. We calculate the savings U-M could have had if it had signed a similar PPA to the one OSU signed in 2012. We then discuss projections of future electricity prices to demonstrate that locking in electricity prices now with a PPA could lead to substantial savings over time.
Next, we discuss the results of a student survey we conducted and discuss our finding that a great majority of students at the university support the move to renewables. Finally, we outline what we believe to be U-M’s most viable options and pathways for moving forward with entering into a PPA that could offset up to 100% of U-M’s emissions and create substantial savings in the process.

INTRODUCTION

The University of Michigan prides itself on being the Leaders and Best. As a community of engaged citizens and scholars, everyone at the university holds their actions and ambitions to high standards and set goals that they meet with resolve. One of these goals is to build on the university’s legacy of environmental responsibility. Acknowledging the role of CO₂ in climate change, U-M pledged in 2011 to reduce its greenhouse gas emissions by 25% by the year 2025, using 2006 levels as a baseline.¹

Unfortunately, in the last decade, the university has made little measurable or sustained progress toward that goal. U-M emits almost 700,000 metric tons of carbon dioxide each year, which is well above the goal of 510,000 metric tons as shown in the following graphic.² Only about 2.6% of U-M’s current electricity usage comes from renewable sources.³ This percentage is well below that of its peer institutions, such as Stanford (53% renewable), Northwestern (50% renewable), and even Ohio State University (17% renewable).⁴ While each university is very different in its operations and it is difficult to contrast them in comparable terms, there is a clear trend of advocating for increased usage of renewable energy to cut emissions, enhance marketing, better protect the environment, and potentially create savings.

Tyler Fitch, a student in SEAS, created the following graphics to demonstrate that U-M must take action beyond relying on the additions to the Central Power Plant (CPP), Energy
Management Program (EMP), and Michigan’s Renewable Portfolio Standard (RPS) in order to meet the 2025 goal. His conclusion from his research was that, “If the University of Michigan doesn’t continue to act past what it’s already doing, it will not reach its goal of 25% reductions from 2006 levels by 2025. By the same token, the University is not on track to meet the US’s intended contribution to the Paris Agreement.”

U-M must take further action in order to meet its own stated 2025 goal and to fully support its contribution to the Paris Agreement that President Schlissel signed in 2017. This contribution is reflected by the green line - RCP 2.6 - in the bottom graphic. RCP 2.6 is a Representative Concentration Pathway, which is a measure of the concentration of greenhouse gases used by the Intergovernmental Panel on Climate Change (IPCC). This concentration trajectory is the goal of the Paris Agreement as it is the only scenario that limits subsequent increases in mean average global temperature to below 2°C. Therefore, RCP 2.6 represents humanity’s best chance at limiting the severe effects of anthropogenic climate change.

![Graph showing emissions pathways](image-url)
Fortunately, U-M has a profitable and proven opportunity to be a leader in curtailing greenhouse gas emissions. Renewable energy technologies and financing structures already exist that could transform U-M’s energy portfolio. Clean energy technology has already proven to be cost competitive with fossil fuels in a wide variety of applications. Communities all around the world have realized this and are making significant strides in their use of green power. 40 U.S. cities, including large metropolises like Atlanta and San Diego, have committed to using 100% renewable electricity, and five have already reached this goal. 125 large corporations (shown at the source link) have also made this pledge as part of the RE 100, a global initiative of influential corporations committed to using 100% renewable electricity. Such commitments and achievements demonstrate that it is eminently possible and financially feasible for large institutions to transition to using more renewable electricity.

Seeing this as a critical opportunity for our university to act on its emissions goals and reap the corresponding benefits, our group - originating from the long-standing U-M group Students for Clean Energy - came together to figure out the best way to proceed. Our task force is comprised of students and faculty from many different fields, including finance, economics, environmental studies, and electrical engineering. We are united by a common interest in finding real, feasible solutions to U-M’s energy dilemma. In particular, we are excited about the potential of using power purchase agreements (PPAs) to deploy massive amounts of renewable electricity for the university.

PPAs involve an electricity buyer locking into an extended contract for the purchase of electricity at fixed or escalating rates from the owners of an electricity-generating asset. For the purposes of this report, we will focus only on PPAs for renewable electricity, although they are used in the industry for both renewable and nonrenewable electricity. PPAs can be onsite or offsite. Onsite PPAs involve actual delivery of the purchased electricity and use of it by the buyer. Offsite PPAs involve the buyer guaranteeing that the owner of the renewable power receives a certain price per kilowatt-hour from selling the electricity on the open market in
exchange for the renewable energy certificates created by the project. We analyze both options for U-M.

From the perspective of the University of Michigan as a host institution, the key advantages of PPAs include creating:

- Potential for savings on electricity bills
- Long-term stability against oscillating electricity prices
- Marketing benefits associated from being significantly powered by renewable energy
- An easy way to meet and exceed current emissions goals
- A culture of innovation at the university
- Mitigation of U-M’s contribution to climate change and its consequences
- Environmental benefits including cleaner air and water, mitigation of biodiversity and habitat loss, and social justice

As we will discuss, many large corporations and other universities have already signed power purchase agreements that have greatly increased their usage of renewable energy, including Google, Amazon, P&G, Michigan State University, Ohio State University, Harvard University, Stanford University, and countless others. There are clear monetary and environmental reasons that all of these entities choose pursue renewable PPAs. If U-M follows suit, it will be in good company, and soon it could lead the pack again.

**DIRECT VS. THIRD-PARTY OWNERSHIP**

When adopting renewable energy assets, it is important to consider the benefits and drawbacks of owning and operating the system versus employing a third-party ownership model with a private developer, like a power purchase agreement (PPA).

**Self-Owned and Operated**

The classic example of self-ownership is that of homeowners purchasing and owning solar panels. Large institutions and businesses have gone about transitioning to renewable electricity in this way, but it can involve very high upfront costs or taking on large amounts of debt. If U-M wanted to pursue this route for powering the university, large investments and infrastructure updates would be needed to utilize the energy-generating assets. This would involve either finding a large sum of money to invest, possibly through alumni, or issuing a bond that would weigh on the university’s balance sheet and create future interest expenses.

U-M would also need to acquire enough land area to support the desired amount of electricity produced, which would take extensive negotiations, research, and funding. This could also entail conversion of land that the university already owns into a hospitable area for PVs (such as Radrick Golf Course), but there are significant opportunity costs with this option. There have been multiple proposals for U-M to add solar onto the rooftops of campus buildings but according to Andy Berki and Ken Keeler from the U-M Office of Campus Sustainability, ⅓ of the buildings on campus have scientific instrumentation on them that would preclude solar installations. Furthermore, solar panels on these relatively small roofs would not generate nearly
enough electricity to power the energy-intensive buildings on campus. Finally, Andy Berki has also expressed doubt about the structural integrity and lifetime of some of the roofs of campus buildings, which pose further challenges for placing solar on them. There would also be significant interconnection costs incurred when connecting nearby solar or wind power to the U-M microgrid.

An entity who owns and operates their panels has no electricity costs, assuming that the panels generate enough electricity to cover the building’s usage and there is a net metering structure in place; but, there are still financing repayments, operations costs, maintenance costs, and insurance expenses. Many of the same complications of self-ownership would also be true for wind power, and Ann Arbor is not as suitable for wind energy production compared to other parts of the state and country. Also, entities like the University of Michigan are not able to take advantage of the investment tax credit (ITC) for solar power, the production tax credit (PTC) for wind power, or depreciation tax benefits from depreciating these expensive assets as the university has no tax bill on which to monetize these tax credits.

Purchasing and operating renewable energy assets would also require the hiring or training of experts in order to handle all of the administrative and technical complications that come with the ownership of such assets, creating extra sustained costs for the university. These issues can all be solved with the use of third-party ownership of energy assets, such as power purchase agreements.

**Power Purchase Agreement**

PPAs involve a third party developer that specializes in renewable energy who would own, operate, and maintain a power system at an offsite location, from which U-M could purchase electric output at a negotiated rate for a predetermined period of time. Using this structure instead of self-ownership eliminates many of the downsides discussed in the previous section. To avoid risks with putting solar panels or wind turbines on or near university buildings, the solar or wind farm would be located away from U-M’s main campus, either on nearby farmland in the case of an onsite PPA or land elsewhere in the state or country in the case of an offsite PPA. PPAs ideally involve no upfront costs to the electricity buyer, which removes the need to either find a large funding source or issue a large amount of debt.

Also, as the private developer would actually own the asset, they would be able to effectively monetize all of the associated tax credits to make the project more profitable, potentially leading to a lower rate for electricity. PPAs outsource the development, ownership, and operation of the project along with the downsides of development including traffic, noise, and viewshed impacts. U-M would simply continue paying an electric bill as it does now and receive the renewable energy certificates (RECs) created by the project, allowing emissions to be offset. However, the rates for PPAs can actually be lower than current electricity rates, leading to instant savings. Electric bills under PPAs can also be far cheaper than the financing repayments, O&M costs, insurance expenses, and the hiring/training costs involved in self-ownership, as the third party owners specialize in renewable energy development and can monetize the tax benefits of the project. In the next section, we dive deeper into the specifics of PPAs and analyze different options for U-M to investigate.
Overview
According to the Solar Energy Industries Association:
“"A solar power purchase agreement (PPA) is a financial agreement where a developer arranges for the design, permitting, financing and installation of a solar energy system on a customer’s property at little to no cost. The developer sells the power generated to the host customer at a fixed rate that is typically lower than the local utility’s retail rate. This lower electricity price serves to offset the customer’s purchase of electricity from the grid while the developer receives the income from these sales of electricity as well as any tax credits and other incentives generated from the system. PPAs typically range from 10 to 25 years and the developer remains responsible for the operation and maintenance of the system for the duration of the agreement. At the end of the PPA contract term, a customer may be able to extend the PPA, have the developer remove the system or choose to buy the solar energy system from the developer.""

PPAs are an example of third party ownership of energy assets, meaning that the developer owns the energy asset and sells the generated electricity to the customer for onsite PPAs or on the open market for offsite PPAs. For onsite PPAs, the developer owns the asset while it is located on the customer’s property. For offsite PPAs, the developer owns the land and the energy asset. In either structure, however, the customer must retain the renewable energy certificates (RECs) from the generated electricity in order to offset their greenhouse gas emissions.

One REC is created for each MWh of electricity generated, and they must be “retired” in order to take the credit/offset for the generation of that MWh. Some developers will sell generated RECs on regional marketplaces to offset the costs of the project, so if the buyer wants to reduce their emissions they must be sure to retain the RECs for themselves.

Without the RECs, the host cannot make the claim that they are reducing their greenhouse gas emissions, as this right would be sold away with the sale of the associated RECs. PPAs that add new renewable power to the grid outside of an existing state-mandated renewable portfolio standard (RPS) are considered additional, and this attribute of additionality allows the buyers to claim that their actions are actually offsetting nonrenewable sources of electricity. If the RECs for a PPA originate from an already-existing project or are being used to meet a state’s renewable portfolio standard, then they are not additional as they are not actually offsetting nonrenewable electricity sources. Newly constructed projects not being used to meet a renewable portfolio standard are required in order to fully and truly displace nonrenewable sources.

Some institutions will simply purchase RECs on the regional marketplace in order to claim environmental benefits from renewable energy, but these lack the additionality component. Such RECs originate from previously existing, as opposed to newly constructed, renewable power."
While RECs are the only thing required to claim use of renewable energy, no nonrenewable power is actually displaced from the grid without additionality.

**Types of PPAs**

There are two main types of PPAs: onsite/physical and virtual/financial/synthetic. For onsite PPAs, the electricity generated by the newly constructed renewable energy asset is actually delivered to and used by the customer, who must also receive the RECs from the project in order to make claims about adding new renewable power to the grid. The customer purchases this electricity at a fixed or escalating rate for a predetermined and contractually stipulated amount of time. The buyer directly pays the owner of the renewable energy asset just as they pay their utility company.

For virtual PPAs (VPPAs), the developer constructs a renewable energy plant at any location in the United States, generally but not necessarily in a separate electrical grid system from where the offtaker is located. The structure of a virtual PPA from a buyer’s perspective is shown here:

The buyer still agrees to pay a fixed or escalating rate for the electricity generated by the new asset, but they do not receive the electricity themselves. Rather, the electricity is sold on the open market at market price. The customer continues to receive electricity from their utility and pay their utility bill. The fixed or escalating rate that the customer agrees to pay is compared to the market price for electricity that the developer received by selling the generated electricity on the open market. There are three distinct possibilities at the end of each month when it is time to pay electric bills:

1. If the developer receives the agreed upon rate from the market, then there is no settlement transfer (the amount of money exchanged to fulfill PPA stipulations) between the buyer and the developer.
2. If the developer receives less than the agreed-upon rate, then the buyer pays the difference to the developer as a settlement transfer.
3. If the developer receives more than the agreed-upon rate, then they pay the difference to the buyer as a settlement transfer.

This guarantees that the developer will receive a certain price per MWh allows them to secure the financing to be able to build the project. This structure also operates as a hedge for the energy buyer. If electricity prices increase over time, the buyer will receive the difference in prices between market prices and their PPA price, leading to lower electricity bills than they would have been paying otherwise. They must also retain the RECs from the generated electricity in order to offset their emissions, and with this structure, they would also gain the additionality component from “sponsoring” the addition of new renewable power to the grid.

Virtual PPAs simulate onsite PPAs in some ways, as both act as a hedge against increasing energy prices in the future and have the feature of adding new renewable power to the grid. Both involve the ownership and retiring of RECs from additional renewable energy projects that allow buyers to offset their emissions. This graphic, from the EPA, outlines some of the features of onsite and virtual PPAs:

While VPPAs may seem easier than physical PPAs as there are no interconnection concerns or costs, there are multiple considerations for buyers when choosing between these options. For some institutions, it may not be cost effective to install solar panels or wind turbines on or near their property. For such buyers, VPPAs would likely be their only option. However, for other buyers, they might be more concerned about making a good physical impression to their customers, employees, and other stakeholders. If this is the case, then signing a physical PPA and prominently displaying the panels or turbines would be the proper route. Also, as the comparison graphic states, buyers with distributed load centers may be better off opting for a VPPA due to the complexity involved with installing renewable power on all of their separate centers. An example of this could be a college campus with many buildings; it might be difficult
to install and track solar on each of these buildings which could make a single, aggregate, offsite project much more appealing.

By utilizing a proper PPA advisor and working with trusted and experienced developers, U-M could easily determine whether an onsite PPA, an offsite PPA, or a combination of both would be the best to suit its needs.

PPA Rate Structures
There are two main PPA rate structures: fixed rates and escalating-but-lower-at-first rates. The following images, from the National Renewable Energy Laboratory, show the difference between these structures:⁵

While simpler in structure, the fixed rate may involve a higher upfront price per kWh, which may not yield day one savings. For example, if a customer is currently paying $70/MWh to their local utility, then agree to pay $100/MWh in a PPA, and utility prices increase at 6%/year, it would take over seven years for the utility price to be above $100/MWh, at which point the customer would be saving money. This is a long time to wait for savings and leads to an even longer time for payback. It is possible for PPA prices to be lower than current utility prices in the first year, but the price per MWh for PPAs is heavily dependent on the site, technology, developer, and other specifications of the PPA.

Electricity prices from PPAs can also be structured in an escalating, but lower at first, fashion. In this scenario, the customer generally receives a lower price in the first years in exchange for an increasing price over time. The escalator of PPA prices is determined beforehand and stipulated in the contract, and it often falls in the range of 2-5%.⁶ Energy prices have increased about 6% per year in the past 10 years in Michigan,⁷ and the EIA does not predict there to be any sudden...
drops in energy prices soon, only further increases. This means that an escalating PPA rate that grows at only 2% and starts under the customer’s current electricity bill would likely allow the customer to reap savings from day one throughout the lifetime of the PPA.

These rate structures can apply to both onsite and virtual PPAs. Escalating structures with lower rates at first are generally better for day one savings at the expense of savings later in the lifetime of the project.

**Advantages**

Third party ownership models such as PPAs are advantageous to consumers in that they replicate what conventional utility companies do with lower costs and renewable energy offsets. While the customer must continue to pay the owner of the assets for the renewable energy generated, the customer does not have to pay for insurance, operations, or maintenance as they would if they owned the asset themselves. Furthermore, deals can be structured in a way that there are **no upfront costs** to the customer, meaning that there could be day one savings for the customer if the PPA rate is below the current utility rate.

For non-tax-paying entities such as municipalities and universities, PPAs - and third party ownership in general - are a good way to save on energy expenditures due to private monetization of the solar investment tax credit (ITC). Through 2019, residential and commercial solar developers, including utility companies, receive a 30% tax credit from the purchase of a solar system, which will ratchet down to 26% in 2020, 22% in 2021, and a permanent 10% in and after 2022. This means that, until 2019, installers of solar power are able to reduce their tax payments by 30% of the total purchase price of their solar systems, effectively reducing the price of solar power by 30%. For example, a business that installs a $1,000,000 solar system in 2018 is able to reduce their tax payments in the same year by $300,000, assuming they have at least this amount of taxes to pay. If they do not, they are often able to “sell” the tax credits to entities like banks and still gain similar benefits.

However, entities such as municipalities and universities do not pay taxes, meaning they are not able to monetize these tax credits. Third party ownership allows the actual owners of the assets - the developers or utilities - to either use the tax credit themselves or sell it to another entity with a larger taxable income, which leads to lowered required returns and thus lower electricity rates for the end customer. Furthermore, owners of renewable energy assets may be able to take advantage of tax deductions arising from Modified Accelerated Cost Recovery System (MACRS) depreciation of their systems, whereas non-tax-paying entities are again not able to monetize these tax deductions. The investment tax credit for solar, the production tax credit for wind, and MACRS depreciation tax deductions for private owners make third-party ownership PPA structures more efficient for non-tax-paying entities.

Finally, PPAs offer very clean and simple deal structures. Customers pay predetermined rates to developers and do not have to worry about operating the renewable energy assets. These predetermined rates also hedge against future increases in electricity prices and simplify operating expenditures for electricity. Customers do not have to become experts in renewable energy development and maintenance either; these are completely handled by the third-party
owners. This allows for PPA signers to potentially save money as electricity rates that they would have been paying otherwise from utilities increase. Finally, and most importantly, signers are able to power their operations with renewable electricity, either directly from an onsite PPA or indirectly through receiving additional RECs from a virtual PPA project, allowing them to reap the associated benefits.

Disadvantages
Large energy projects come with inherent disadvantages and risks. One of the largest disadvantages to PPAs is that the customers are strictly locked into buying power from the renewable energy asset at a predetermined rate for a fixed period of time. The massive savings from PPA financial models arise from the increasing difference between locked in PPA rates and escalating electricity rates from conventional utility companies. However, there is a risk that utility prices will remain the same or even decrease, which would cannibalize the projected savings of PPAs. Predicting future movements of energy prices can be very difficult if not impossible, which gives many pause before locking in electricity prices. Later in this report, we discuss the outlook on the energy market and why we, along with many corporate and university PPA signers, believe that locking into fixed electricity prices will be profitable in the long-term. Absorbing this risk of decreasing market electricity prices, however, is what enables renewable power developers to obtain the financing necessary to spearhead these projects.

Further disadvantages of PPAs may include the lack of in-house skill to properly negotiate a PPA, counterparty credit/default risk (owner of renewable energy asset could go bankrupt or not deliver on their electricity production promises, thus breaking the contract leading to legal and administrative issues), and regulatory risk. The lack of in-house skill can be solved by hiring the proper advisers and consultants; we discuss this in our Recommendations section. Counterparty risk is always present in many kinds of deals but is addressed in the initial contract for the PPA. Properly written PPAs involve detailed plans for what would happen in the event of the third party going bankrupt. Regulatory risk can be mitigated by a good relationship with regulators and locking in a deal before regulations or laws are passed that would make the deal unfavorable.

Specific disadvantages for VPPAs include the fact that effectiveness of the VPPA hedge is dependent on correlation between power markets, as the electricity buyer’s utility rates may increase without a corresponding increase in wholesale electricity prices in the region where the renewable energy project is located, leading to large electricity bills and settlement transfers to the owner of the renewable energy asset. VPPAs can be a more difficult story to explain to stakeholders. While the lack of correlation between power markets is a concern, it is not likely that electricity prices will increase or decrease in only one power market in the long run. This means that over time, as all electricity prices change, they will do so mostly in the same direction, allowing the VPPA to at least eventually create its intended savings.

As for stakeholders, various groups may not like or believe the claim that the construction and operation of a new renewable energy asset in a different state offsets emissions in their own state. However, with proper marketing and advertising, stakeholders are generally convinced by environmental claims associated with PPAs. Large corporations like Google and Amazon enter into VPPAs to offset their emissions, and due to their proper marketing and explanations of such
projects, no one questions why the panels or turbines are in cornfields in Texas and not on top of their data centers or facilities. Google in particular has gone to great lengths to create documentation that fully explains their choices regarding PPAs and why it was their best options for using more renewable electricity.¹¹

**U-M Examples**

As part of our research for this report, we constructed four financial models to demonstrate the economic benefits that U-M could receive from signing different types of PPAs. Two of the models show the projected cash flows from an onsite solar PPA, one with a fixed rate and the other with an escalating rate. The other two models show the projects cash flows from an offsite wind VPPA, again one with a fixed rate and the other with an escalating rate. The complete models are located in Exhibit 1 along with a link to download them if you would like to test different assumptions or see how we constructed them.

Here are some assumptions that each model has in common:

- A discount rate of 9.7%. This is the average yearly return of U-M’s endowment over the past 20 years, so we use it to discount future cash flows. This allows the models to account for the time value of money (i.e., money received in the future is worth less than the same amount received today).
- A 2018 U-M electricity cost of 7.33 cents/kWh. Adam Simon, an adviser for this report, informed us that U-M recently signed a PPA (for nonrenewable electricity) with DTE that locks the university into this rate until the end of 2024.
- 472,693,891 nonrenewable kWh purchased by U-M in 2017. We calculated this number based on data in U-M’s FY2017 Environmental Metrics Report. Essentially, we subtracted the reported number of renewable kWh purchased and the renewable energy certificate equivalents from the total amount of kWh purchased from DTE.
- A post-PPA electricity cost escalation of 1.1%. This is the average annual growth rate of the price per kWh that U-M paid from 2005 to 2017. We assumed that U-M’s electricity costs will continue growing at this rate after the current PPA with DTE expires.
- A PPA escalator of 2%. This is based on OSU’s PPA but in reality could be higher or lower depending on the project specifications and negotiations.
- U-M retains and retires all of the renewable energy certificates (RECs) from the electricity generated in order to take credit for the generation and offset emissions.
- Both models only offset the amount of electricity that U-M purchased from DTE in 2017. They both assume that energy efficiency gains evenly offset the growth in energy demand from the university. Even if this is inaccurate, engaging in any PPA would radically shift U-M’s energy profile and help the university meet stated emissions goals.

The onsite solar PPA models share the following assumptions:

- Annual system degradation of .5%. According to the National Renewable Energy Laboratory, solar cells degrade by a median amount of .5% per year.
- Performance standard of 80%. This value, from Michigan Solar Solutions, is the amount of raw energy lost due to line loss, inverter inefficiency, and other technical issues.
4 average peak hours/day of sunlight. While actual solar electricity generation fluctuates throughout the day, the total generation can be expressed as solely the number of peak hours that the panels are generating electricity per day. For the Ann Arbor area, this equates to about 4 hours per day. (Note that 4 hours / 24 hours * the 80% performance standard yields the ~13% average efficiency rating of solar panels.)

The need for roughly 1,300 acres at an upfront cost of about $6 million. U-M would need approximately 400 MW of solar panels to offset 100% of its purchased electricity, which would require about 1,300 acres at an average cost of about $3,975 per acre.

The costs of connecting the 400 MW of solar panels to U-M’s microgrid would be covered by the developer of the project.

The project is done with DTE in order to immediately take advantage of the savings from lower energy bills despite U-M’s currently agreed upon PPA.

The offsite wind VPPA models share the following assumptions:

- Average electricity cost escalation of 2.58%. This is the rate at which electricity becomes more expensive each year and was calculated based on data provided by Statista.
- Midcontinent Independent System Operator (MISO) average electricity cost of 3.619 cents/kWh. This is the average price for which electricity would sell from the offsite project on the open market. We calculated this rate by finding the average of the lowest wholesale energy market prices at MISO’s Indiana Hub over the entire year of 2017. We used the lowest rates provided by the Energy Information Administration to be as conservative as possible with this vital assumption. We then escalated it by 2.58% for 2018, the first year for which we model cash flows.

There are also assumptions in each model about the actual PPA rates that U-M would either have to pay in the case of an onsite PPA or base settlement transfers on in the case of a VPPA. These rates are based on OSU’s PPA and discussions with DTE. **However, these rates may be substantially higher or lower based on the project specifications and negotiations, which could drastically change the profitability of the projections. The models serve as tools to assess different rate structures and assumptions about future electricity price movements rather than to project savings with complete certainty.** Typing in new assumptions to the Excel spreadsheets will show updated NPVs, IRRs, and cash flow graphs which should help assess the profitability of proposed projects.

We created the following graphs based on cash flow data derived from the financial models created using these assumptions. These graphs start in 2018, and they model 25-year PPAs. The blue area in the graphs represents the difference between the price that U-M would be paying without signing the PPA and what it would be paying with the corresponding PPA. The escalating PPAs offer day one savings (the flat rate solar scenario has day one costs but saves money thereafter). All of the models offer increasing savings throughout the life of the PPA due to projected increases in electricity prices, which translates to positive net present values for each scenario at U-M’s discount rate.
The net present values (all future cash flows discounted using the 9.7% annualized 20-year return on the U-M endowment) and internal rates of return for each of these different scenarios, as calculated by our financial models, are as follows:

**Escalating Solar PPA**

NPV: $22,423,066

**Flat Rate Solar PPA**

NPV: $23,514,195
IRR: N/A - Day One Savings  IRR: 45%

Escalating Wind VPPA  Flat Rate Wind VPPA
NPV: $11,529,169  NPV: $4,247,480
IRR: N/A - Day One Savings  IRR: 12%

These models are not a perfect representation of reality yet; they are meant to give the university an idea about the possible savings from different options. U-M would need to engage with a third party developer or PPA consultant/advisory service to get specific rate data in order to get a better sense about what the true NPV is for any particular project. Furthermore, there are extra costs of an onsite PPA versus an offsite PPA that the models do not account for. These could include the training required on the part of U-M workers that would be involved with connecting a nearby solar farm to U-M’s microgrid. They could also include the extra capacity costs from still having to buy electricity from DTE when the panels are not producing electricity, which would likely reduce if not eliminate the NPVs shown above.

An offsite VPPA would involve no physical changes to U-M’s campus nor any sustained labor costs, likely making it the easiest option U-M could engage in to reduce emissions and meet its stated goals. Due to the hidden costs of onsite solar PPAs and the numerous benefits of offsite wind VPPAs, the task force believes that an offsite wind VPPA is the best option for U-M to consider. We discuss how U-M could move forward with evaluating such a project in our Recommendations section.

If these models are roughly accurate, signing a PPA has the potential to save the university millions of dollars in excess of its opportunity cost of capital in addition to offsetting most if not all of its emissions. A U-M PPA definitely merits further investigation and analysis.

OTHER INSTITUTIONS UTILIZING PPAs

As demand for renewable energy grows around the country and institutions are looking for feasible and economical ways to incorporate it into their portfolio, the popularity of renewable PPAs has grown tremendously. Both corporations and universities are engaging in large-scale power purchase agreements, adding significant amounts of new, renewable power to the grid. In the past six years alone, corporations have added over 10 GW of renewable capacity, according to the Rocky Mountain Institute’s Business Renewables Center Deal Tracker. This notable movement toward PPAs from the corporate sector would not be happening without meaningful financial incentives. The benefits of PPAs are being realized and taken advantage of by some of the world’s largest companies. Here are some examples of companies already signed into substantial PPAs since 2012:

Amazon  Anheuser-Busch  Apple
In addition to helping corporations save money and meet their sustainability goals, PPAs have also gained considerable traction on college campuses. As of 2017, over 60 universities in the U.S. have entered into a PPA, including two of U-M’s biggest rivals, Michigan State University and Ohio State University. By signing PPAs, these schools have demonstrated a commitment to financial gain and sustainability, which U-M now also has an opportunity to pursue.

A common driver behind the PPAs signed by universities and corporations is the need to meet self-imposed emissions reduction targets. The bar for sustainability goals is being set higher and higher as the pressure increases on such institutions to be responsible for their large ecological footprints. U-M’s goal of reducing GHG emissions falls short of the goals being set by its Big Ten rivals, as schools are setting ambitious goals and taking aggressive action towards those goals. As of 2018, the EPA’s list of the top 30 colleges and universities using “Green Power” includes five Big Ten schools; U-M is not one. This shows that schools of similar size and stature to U-M are making much more progress on their commitments to sustainability. While it is difficult to compare U-M to corporations and other universities in similar terms due to different goals, histories, buildings, student profiles, energy management, etc. there are good reasons that all of these other institutions are setting aggressive sustainability goals and signing PPAs. These reasons generally include the financial benefits of signing PPAs, better marketing to attract eco-conscious students, having and inspiring a culture of innovation and leadership, and of course helping the environment by reducing greenhouse gas emissions. U-M also has the opportunity to reap such benefits.

The university so far has made very little progress towards its reduction of greenhouse gas emissions. At the end of 2016 there was only a 5.6% decrease in emissions, requiring substantial action to be taken in order to reach and surpass the target of 25% reduction by 2025. Furthermore, after 2025, Michigan does not have any future goals currently set. Meanwhile, at least five other Big 10 schools have goals of becoming carbon neutral by 2050. It is difficult to think about more ambitious goals before a clear path is laid out to reach current targets. Signing a PPA would be a practical step towards greenhouse gas reduction, and there is undoubtedly great potential for U-M to learn from the experience of these other institutions.
opportunity for U-M to improve in this area. Implementation of a PPA has the potential to spur more optimistic goals and ideas for the future of sustainability at the university and help the university start to regain its leadership on the sustainability front.

**CASE STUDY: OHIO STATE UNIVERSITY PPA**

By examining Ohio State University’s PPA, which is of similar size and scope to our proposed project, we gained insight into how to best implement a PPA at the University of Michigan as well as potential benefits for the university and the local economy. A link to view OSU’s PPA contract is located in Exhibit 2.

**Overview of School Energy Profile**
As of fall 2017, Ohio State University has a total of 59,837 students on its Columbus campus, with an annual electricity usage of over 608 million kWh. This amount results to 15.2% more than the University of Michigan's annual electricity consumption.

**Overview of PPA**
In 2008, President Gee of Ohio State University signed the American College and University Presidents Climate Commitment, pledging to make OSU carbon neutral by 2050. In order to fulfill a large part of this promise, OSU entered into a 20-year agreement in 2012 to purchase the electricity generated by 50 MW of the Iberdrola Renewables LLC wind farm. At the time of the deal, solar energy was not widely available in Ohio, so the school decided to utilize a wind energy PPA. The wind energy is harvested off campus at the Blue Creek Wind Farm, operating in northwest Ohio, and transmitted to OSU’s campus by AEP Energy. The choice to use energy generated in Ohio cuts down on energy loss and affords OSU significantly more positive publicity than if it were located out-of-state. By entering into this agreement, the university has ensured that 17% of the annual energy consumption of its Columbus campus is derived from sustainable sources.

**Cost and Savings**
As part of their power purchase agreement, OSU has negotiated a price of 4.65 cents/kWh generated by the 50 MW of the wind farm, with a two percent increase every year, beginning in 2013 and continuing each year thereafter. Therefore, the average price for their wind power over the 20 year deal is about 5.71 cents/kWh. This is significantly lower than what U-M is paying for its electricity right now. As OSU opted for an escalating price PPA, they received day one savings, all without having to pay Iberdrola anything upfront.

For the first two and a half years of their agreement, between November 2012 and June 2015, OSU’s PPA afforded them very favorable rates compared to traditional energy companies in Ohio. According to R. Scott Potter of the Ohio State University Office of Energy and Environment, OSU spent about $4.5 million less on its deal with Iberdrola over this period than industrial customers buying the same amount of electricity from traditional utility companies like AEP Ohio. In this instance, AEP Ohio’s bundled service rate is used as a comparison because AEP is the primary electric utility company in Columbus and has publically available rate
Unfortunately, Mr. Potter stopped tracking OSU’s PPA savings in 2015, because the comparison between the wind PPA rate and the bundled service rate became somewhat faulty. Because OSU opts to buy their electricity on Ohio’s competitive electricity market, their wind PPA is subject to deregulation and unbundling. Thus, each year passes, OSU’s unbundled wind PPA rate has fewer and fewer elements in common with the bundled service rate, and the two datasets diverge. In spite of the lack of hard data since 2015, Mr. Potter estimates that, as of January 2018, they have lost about $10 million over the course of their PPA. This results in an average annual cost of about $1.9 million over the 5.25 years since they signed their PPA. Though this number may seem large, it actually only accounts for about 4.2% of the $45.3 million that OSU spends on electricity every year. Although shifts in the Ohio energy market ultimately ended up hurting OSU’s PPA savings, with proper planning in conjunction with the Michigan Public Service Commission, U-M could possibly mitigate the regulatory risks that would cannibalize the savings from a PPA.

Throughout their PPA, Ohio State has also retained ownership of all of the RECs generated from their section of Blue Creek Wind Farm. They do so in order to take credit for the renewable energy they are adding to the grid as well as demonstrate their commitment to reducing greenhouse gas emissions, but these credits also have monetary value. Over the five years since OSU signed its PPA, the value of RECs has fluctuated from less than $1 per credit to as high as $15 per credit. Because OSU has a relatively large PPA, they have maintained ownership of over 500,000 of these credits, which could be monetized if needed. As such, the RECs that OSU has accrued could be viewed as an additional source of potentially millions of dollars in revenue for the university. If U-M enters into a PPA, we would recommend banking RECs in order to take credit for the renewable energy being added to the grid. However, in a pinch, these RECs could be sold to mitigate or even erase the cost of renewable electricity acquired through the PPA, although this would remove the benefits of reduced emissions and claims of renewable energy usage for the corresponding amount of RECs sold.

Local Economic Benefits
In addition to avoiding harmful greenhouse gas emissions, Ohio State’s partnership with Blue Creek Wind Farm has helped provide a sizeable boost to Ohio’s economy. When the Blue Creek Wind Farm was built in 2011, it was the single largest private investment in Ohio that year. Blue Creek Wind Farm pays approximately $2 million in lease payments to local landowners and $2.7 million in PILOT payments to local taxing bodies each year, making it the largest single taxpayer in its county. The Blue Creek Wind Farm has also created 15-20 permanent jobs in Ohio and, at its peak of construction, created over 500 construction jobs. All told, local spending during construction reached about $25 million. As Ohio State’s PPA amounts to 16.45% of the total energy production of Blue Creek Wind Farm, their direct contribution to Ohio’s green economy has amounted to millions of dollars over several years. If U-M was to sign a similar PPA, a comparable if not larger project would be built in the state of Michigan, increasing the amount of positive publicity, transparency, and community pride associated with the project. Due to its large scope, a U-M PPA would also generate millions of dollars in annual taxes as well as permanent and temporary jobs for Michigan laborers. By building its PPA infrastructure within the state of Michigan, U-M could save on transmission costs and brand its PPA as providing clean, Michigan-grown power.
Educational and Research Benefits
Apart from the fiscal and environmental benefits that come with Ohio State’s PPA, they have also used it to create educational and research opportunities for their university. As part of their PPA, OSU has the ability to explore research opportunities at Blue Creek Wind Farm, including studying turbine degradation, ecological management, and noise abatement. In fact, OSU’s PPA ensures them real-time access to the performance data of the wind turbines at Blue Creek Wind farm, including wind speed, gear temperature, rotation speed, and electrical output. Faculty and students actively use this information to conduct research on and learn about renewable energy.

In addition, OSU is able to bring a group of students to Blue Creek Wind Farm each year to study how the wind turbines work. When the students visit the farm, the operators shut down one of the turbines and allow the students to climb inside it to see how the turbine generates electricity. If U-M were to enter into a solar or wind PPA, it could easily organize a similar arrangement. By giving faculty members real-time access to the performance and weather conditions of the farm or array, U-M could advance research and teaching opportunities on campus. By forming a good relationship with the PPA provider, U-M could also give students invaluable hands-on experience with the function, operation, and business of renewable energy installments.

OPPORTUNITY COSTS AND OFFSETTING VOLATILITY
PPAs offer the potential to offset volatility and hedge against the increasing trend of electricity prices by locking into a fixed price per kilowatt hour over a long period of time spanning anywhere from 10 to 25 years. We gathered data from U-M utility reports regarding electricity purchased from DTE along with the price paid each year. Using this data, we measured past price volatility of electricity purchased from DTE, identified big-picture trends regarding price and usage, and simulated a financial scenario that demonstrates the volatility U-M could have avoided by signing a PPA in the past.

Data-derived Benefits of PPAs
Volatility refers to the price risk that the university faces when negotiating the price per kWh with DTE every few years, which can be estimated using standard deviation. We can measure how the price has been changing according to the university’s utility reports. The standard deviation of price per kWh purchased from DTE shows on average how far the price falls from the mean price; the larger the standard deviation, the more volatile prices have been. We found that electricity prices were somewhat volatile based on available data going back to 2005. We calculated the standard deviation of electricity price per kWh purchased from DTE to be $0.007231 which is 9.39% of the average price since 2005, which was about 7.7 cents/kWh. When looking at aggregate electricity consumption, these small fluctuations and increases in price can dramatically impact the university’s electricity expenses.

Using electricity consumption statistics from fiscal year 2017, we calculated the range over which electricity price per kWh is expected to fluctuate based on its volatility in the previous
decade and a half, from one standard deviation above the mean to one standard deviation below the mean. The range turned out to be $36,650,241 to $44,246,332, yielding a difference of $7,596,091. This figure essentially represents the amount of fluctuation in electricity cost U-M could expect each year given the usage and price in fiscal year 2017. While this may seem insignificant when dealing with the large-scale operations of the university, this is the expected uncertainty for only one year; renewable PPAs often span 25 years, making the total amount of money in question significantly larger.

We recognize that U-M recently signed a nonrenewable PPA with DTE lasting until the end of 2024, which erases the price volatility for purchased electricity for the coming seven years. However, renewable PPAs span for much longer periods of time and stand to decrease volatility to a significant degree over a very long span of time. Erasing electricity price volatility for such a long period could be very beneficial for U-M’s long-term financial planning. In addition to the long-term elimination of volatility, the university would also be reducing carbon emissions significantly and possibly saving money, as discussed previously in this report.

A long-term power purchase agreement can minimize volatility by totally eliminating price variability from the equation. If the university were to lock into a long-term renewable PPA with DTE, for example, it would know the exact rate it would pay per kilowatt hour from the beginning to the end of the agreement, leaving consumption of electricity as the main variable affecting electricity expenses for given years. As seen in the following graph, the behavior of this variable has been more or less consistent with U-M’s growth and by nature is much less volatile than price.
The University of Michigan is constantly expanding with regard to the buildings that it occupies along with the utilization of technology within them. Electricity consumption is far less volatile than electricity price and most drastic changes in consumption will happen under expected circumstances, as the university itself makes decisions to expand or contract property and therefore purchased kWh.

Electricity consumption is much easier to predict on a year-to-year basis than price, and as a long-term PPA would completely terminate the price variability, U-M would be left with a simpler, more predictable variable when determining electricity expenses. This would be immensely beneficial to the university’s financial planning going forward, potentially allowing the university to use its capital more efficiently.

Opportunity Cost of the Status Quo
The data provided by U-M utility reports represents the status quo, where the university renegotiated electricity price per kWh with DTE frequently. In 2006, the university set ambitious goals pertaining to carbon emissions and consequently renewable energy, and having access to electricity-related data since that point allows us to run simulations under a different plans of action that could have been taken in the past.

For example, we can measure what would have happened if U-M locked-in the same PPA as OSU beginning in fiscal year 2012 (when OSU signed this PPA) at a rate of 4.65 cents/kWh increasing at two percent per year. Under the same conditions, U-M would have saved $133,233,868 by the end of 2017. The assumptions and calculations for this scenario are shown here:

<table>
<thead>
<tr>
<th>Year</th>
<th>Total cost from DTE w/ OSU's PPA</th>
<th>Potential savings</th>
<th>PV of savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>$23,190,705.57</td>
<td>$19,898,655.30</td>
<td>$31,612,356.19</td>
</tr>
<tr>
<td>2013</td>
<td>$25,041,338.88</td>
<td>$21,253,610.90</td>
<td>$30,779,334.07</td>
</tr>
<tr>
<td>2014</td>
<td>$23,572,734.87</td>
<td>$20,043,355.08</td>
<td>$26,460,028.22</td>
</tr>
<tr>
<td>2015</td>
<td>$24,094,920.39</td>
<td>$16,221,956.62</td>
<td>$19,521,648.59</td>
</tr>
<tr>
<td>2016</td>
<td>$25,351,486.16</td>
<td>$10,465,904.23</td>
<td>$11,481,096.94</td>
</tr>
<tr>
<td>2017</td>
<td>$26,964,432.94</td>
<td>$13,379,404.11</td>
<td>$13,379,404.11</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td>$133,233,868.13</td>
</tr>
</tbody>
</table>

While it is easy to make retrospective claims about what the university could have done to save money, this analysis is still useful because it demonstrates the monetary power of negotiating a long-term PPA, erasing price volatility, and hedging against increasing electricity prices. The
data provided in the utility reports gives us insight into usage trends, past price volatility, and the opportunity cost of not signing a PPA. However, even more salient to the financial case for signing a PPA is the projection of future energy prices and how the university can capture savings in the future by locking into low rates now.

**PROJECTED ELECTRICITY COSTS FOR U-M**

**Outlook on the Energy Market & Future Electricity Costs**

The financial stability and long-term savings which PPAs have ensured for so many other university, commercial, and industrial electricity consumers relies on the assumption that electricity prices will continue to rise over the 10-25 year period during which they have committed to the agreement. Regardless of the structure of the PPA, they all require increases in market prices beyond the rates stipulated in the agreements in order to create savings. This section explores market outlook reports to build confidence that electricity prices will continue to increase over the next few decades as markets evolve. Moreover, these projections highlight why committing to a PPA could be economically advantageous for the university.

On a national scale, electricity prices are projected to continue to increase over the next few decades, just as they have since the turn of the century.¹ In fact, projection information, which accounts for inflation, provided by the U.S. Energy Information Administration predicts that the price of electricity will increase by about 12.6% over the next 30 years.²

![Energy Prices: Average Price to All Users: Electricity](https://example.com/energy_prices_graph.png)

Specific to Michigan, the commercial electricity rate is the highest in the Midwest at 10.93 cents/kWh, which is 8.33% greater than the national average commercial rate of 10.09 cents/kWh.³ Furthermore, the 2017 outlook report created by the Michigan Agency for Energy (MAE) and the Michigan Public Service Commission (MPSC) with help from the Midcontinent Independent System Operator (MISO) concluded that “long-term scenario analysis for 2035 suggests that higher demand and energy requirements [will] lead to increased capacity additions
and higher overall costs [emphasis added].” Furthermore, the continuous increase in costs is projected throughout all of the different scenarios created in the report and is much higher than the average fixed PPA rate stipulated in other institutional agreements.

Although it is very difficult to have complete certainty regarding what will happen to electricity prices over the next 10-25 years, in all of the energy outlook reports we have evaluated, there are no scenarios in which the price decreases, likely ensuring long-term savings for U-M should it sign a PPA.

**Natural Gas Price Projections**

As coal and nuclear power plants begin to retire, there is a push toward using natural gas to supplement the margin for demand. We propose that this margin of demand has the potential to be supplemented by renewable electricity, which would be a more desirable transition for both the environment and future generations to come. Furthermore as demand for natural gas increases, it is projected that the prices will as well, thus making renewables a competitive option in electricity generation. According to James R. Adams, Director of Utilities at the University of Michigan, “Natural gas costs have slightly increased for FY18 because of increased wholesale market prices and U-M’s forward purchasing plan which currently extends through FY18. Electric costs are forecasted to increase in FY18 due to DTE rate increases which will likely continue an upward trend past FY18.”

This increasing price trend exists on a national level according to data projections created by the U.S. Energy Information Administration. The following graph shows a projected price increase of 61% from 2018 to the year 2050.

This projection reflects the reference case the EIA created, which assumes trends in factors affecting the price of natural gas to continue per usual into the future. However, they also say that “Projected U.S. natural gas prices are highly sensitive to assumptions about domestic resource and technology explored in the side cases.” This highlights the unpredictability surrounding natural gas prices as technology, supply, and policy continues to change alongside the global climate, as shown in the following graphics.
Supplementing additions of natural gas to energy portfolios with renewable electricity and corresponding fixed power purchasing rates will ensure financial stability and hedge against increasing and volatile future prices.

**STUDENT SURVEY**

As an institution that prides itself on serving the needs of the community, student voice should play a significant role in decision-making. The PPA Task Force conducted a student survey to gather the thoughts of students on U-M and renewable energy; a copy of the questions is shown in Exhibit 3. The survey had 203 respondents. 86.7% felt “negative” or “very negative” about the following statistic: “U-M currently uses about 2% renewable energy.” The disappointment felt by the student body regarding the university’s energy usage is strong and warrants attention.

An increasing number of students are learning about and advocating for environmental actions. We found that 98% of U-M students want to see the University of Michigan use more renewable energy (with a 2.5% margin of error). One of the most feasible ways to achieve this is through a renewable PPA. This means that by signing a PPA, U-M could also meet student needs in addition to the myriad of other benefits from using more renewable energy!

In order to show that students are serious in their commitment to U-M using renewable energy, we asked students how much they would be willing to pay in tuition in order to see U-M go 100% renewable. We assessed this desire for renewables by asking, “How much extra tuition would you be willing to pay each year in exchange for U-M being 100% powered by renewable energy?” The question let students enter their own estimations via a short answer rather than select from bins to avoid anchoring bias. Therefore, we had to cleanse the data as many students...
entered a percentage of tuition. In those cases, we used an average tuition of $33,436.50, given that 43% of students pay in-state tuition of $14,826 and 57% of students pay out-of-state tuition of $47,476.

Based on the results, the median student would be comfortable paying $200 per year with the average student willing to pay $587 per year. It is interesting to note the somewhat large gap between the mean and median. We found that the gap was due to a select number of students willing to pay very large percentages of their tuition in order to see this shift. Furthermore, many students who answered $0 thought the university should divert other funds to invest in renewable energy. For example, one student said, “Renewable energy produces profits after a set number of years, and then saves the university money for years to come. I should not have to pay extra tuition.”

To conclude, renewable energy is clearly an issue that students are passionate about, to the extent that a large majority are willing to pay an additional amount to assist the administration in taking action to address their needs. The truth, however, is that a PPA could save U-M money on day one, possibly leading to tuition decreases for students.

With regard to survey design, care was taken to word questions neutrally to gather unbiased data. The survey responses were well-represented from all colleges, with the largest three being 56% LSA, 23% Engineering and 9% Business. Furthermore, there was strong representation from all school years, including 5th year undergraduate and graduate students. A 99% confidence level was used to calculate the 2.5% margin of error figure. When quantifying the willingness-to-pay data, unsure, anomalous or unreasonable responses were discarded, and therefore the sample size for that question is smaller.

**RECOMMENDATIONS AND THE PATH FORWARD**

The time is right for U-M to adopt renewable energy on a large scale. The projected economic benefits of adopting renewable electricity using a PPA are substantial, and students across all colleges want to see it happen. Transitioning away from emitting greenhouse gases would also help U-M meet stated goals and contribute to the grand fight against climate change. Corporations and other universities see the immense value in taking such opportunities, and U-M has the opportunity to outpace them on a massive scale and truly live up to being the Leaders and Best.

All of the research in this report suggests that an offsite wind VPPA would be the most feasible option for U-M to make such a shift in its energy portfolio. An offsite wind VPPA would entail engaging with a private third party, such as DTE or an energy developer, and having them build, own, and operate a wind farm in a very windy area of the country that sells the electricity it generates on the open market. U-M would guarantee that the owner of this wind farm receives a certain price for the generated electricity in exchange for all of the RECs generated by the project. This comes with the possibility to reduce electric bills should the private owner receive more than the agreed upon rate from the marketplace. This option is superior to an onsite solar
PPA as it would involve absolutely no changes to U-M’s campus, buildings, or microgrid, which would be very costly with an onsite solution. An offsite wind project would also allow the turbines to be located in a much windier and more optimal location, leading to a lower PPA rate for the university and thus a higher chance of savings.

**If U-M is interested in pursuing any type of PPA, the path forward would likely involve hiring consultants or PPA advisers to scour the marketplace, make further projections, and find the best possible deal for the university.** There have also been indications that DTE might be interested in helping U-M do this kind of deal, which would reinforce the university’s long history of working with the utility. In fact, Adam Simon and Susan Fancy met with David Harwood, a Director of Renewable Energy at DTE, who claimed that Consumers Energy recently had a customer sign a large offsite wind VPPA deal with them for a rate of only 4.5 cents/kWh, which DTE could possibly replicate for U-M. He also claimed that it is easier to pitch wind, rather than solar, within DTE’s structure.

Furthermore, Mr. Harwood stated that DTE has a large wind project in the works that the company could considerably expand if U-M was interested in pursuing a PPA - which also goes by the names “virtual green pricing” or “green tariffs” when signing a PPA with a utility company - with them. While this was just a preliminary conversation, it is very promising that the possibility of these kinds of PPAs exists and is easily available to large, renowned institutions like the University of Michigan. Adam Simon also said that the MPSC would be extremely interested in helping U-M craft such a PPA with DTE in order to create more jobs in Michigan, demonstrate that the State of Michigan is on the leading edge of utility regulation, and prove to other universities around the country that they can negotiate and work with their local utilities to increase their usage of renewable electricity. U-M, DTE, and the MPSC could make a good trifecta and find an optimal solution for all stakeholders.

Kevin Self, U-M alumnus and SVP at Schneider Electric, sits on the boards of both the Energy Institute and Erb Institute. He is also an advocate for the university to undertake a large renewable electricity initiative. His company, Schneider Electric, recently acquired Renewable Choice Energy (RCE), a company known for its PPA and REC advisory services. RCE has advised institutions like the University of Pennsylvania, the University of Tennessee, the University of South Florida, the University of Vermont, Syracuse University, Microsoft, Intel, and many more on how to green their energy portfolios. In fact, the PPA Task Force has spoken with RCE about this very topic, and they have said they would be happy to help advise U-M on how to move forward should it want to analyze the marketplace for available PPAs. They charge conditional fees, meaning U-M would only have to pay them if a PPA is successfully completed. Kevin Self would also be happy to provide guidance regarding how to proceed.

There has never been a better time to pursue a power purchase agreement and increase the usage of renewable energy due to the tremendous financial, marketing, positioning, cultural, and environmental benefits associated with doing so. PPAs are more proven than ever due to the large number of diverse institutions engaging in them. U-M is endowed with tremendous intellectual capital, so pursuing a well-structured PPA to increase its renewable electricity usage would not be difficult. The only question is if the university will seize this opportunity presented
to it. A large-scale PPA for U-M undoubtedly merits further investigation and analysis, and should the university sign one, there would be significant benefits to all stakeholders involved.

EXHIBITS

Exhibit 1 - U-M PPA Financial Models

This exhibit shows abbreviated screenshots of the financial models the Task Force constructed for four different U-M PPA scenarios. We intentionally removed some years and explanations in order to make the screenshots fit here. The full models can be accessed at this link: https://drive.google.com/drive/folders/1yt_CtwjDyalOOd6k-4rcKpfHEO3JaE6r?usp=sharing
Please feel free to download the models, change the assumptions, and see what happens!

### Escalating rate solar:

<table>
<thead>
<tr>
<th>Assumption</th>
<th>2028 U-M Electricity Cost ($/kWh)</th>
<th>2029 U-M Electricity Cost ($/kWh)</th>
<th>2030 U-M Electricity Cost ($/kWh)</th>
<th>2031 U-M Electricity Cost ($/kWh)</th>
<th>2032 U-M Electricity Cost ($/kWh)</th>
<th>2033 U-M Electricity Cost ($/kWh)</th>
<th>2034 U-M Electricity Cost ($/kWh)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discount Rate</td>
<td>0.7%</td>
<td>0.7%</td>
<td>0.7%</td>
<td>0.7%</td>
<td>0.7%</td>
<td>0.7%</td>
<td>0.7%</td>
</tr>
<tr>
<td>First Year PPA Rate</td>
<td>0.06</td>
<td>0.06</td>
<td>0.06</td>
<td>0.06</td>
<td>0.06</td>
<td>0.06</td>
<td>0.06</td>
</tr>
<tr>
<td>PPA Escalator</td>
<td>2%</td>
<td>2%</td>
<td>2%</td>
<td>2%</td>
<td>2%</td>
<td>2%</td>
<td>2%</td>
</tr>
</tbody>
</table>

*U-M must maintain RECs from PPA to offset emissions
*Assumes interconnection costs covered by developer
*Assumes project is done with DTE and they switch our PPA contract

### PPA Cash Flows

<table>
<thead>
<tr>
<th>PPA Cash Flows</th>
<th>Includes land acquisition cost</th>
<th>Existing PPA expires this year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
<td>2028</td>
<td>2029</td>
</tr>
<tr>
<td>Would Be Electricity Bill</td>
<td>$34,648,462</td>
<td>$34,757,220</td>
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<tr>
<td>Actual Electricity Bill w/ PPA</td>
<td>$28,365,633</td>
<td>$28,734,222</td>
</tr>
<tr>
<td>Net Cash Flow</td>
<td>$1,282,829</td>
<td>$6,022,998</td>
</tr>
</tbody>
</table>

| NPV | $22,239,066 |
| IRR | N/A - Day 1 Savings |
**Flat rate solar:**

<table>
<thead>
<tr>
<th>Assumptions</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discount Rate</td>
<td>9.7%</td>
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<tr>
<td>2018 U-M Electricity Cost ($/kWh)</td>
<td>$0.0733</td>
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<tr>
<td>PPA Rate</td>
<td>$0.07</td>
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<tr>
<td>U-M 2017 Nonrenewable kWh purchased</td>
<td>472,693,891</td>
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<tr>
<td>System Size for 100% offset (kW)</td>
<td>400,704</td>
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<tr>
<td>Acres Required</td>
<td>1,324</td>
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<tr>
<td>Land Acquisition Cost</td>
<td>$5,261,083</td>
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<td>Avg. peak hours/day</td>
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<td>Performance Standard</td>
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<tr>
<td>First Year Generation (kWh)</td>
<td>472,693,891</td>
</tr>
<tr>
<td>Annual System Degradation</td>
<td>0.50%</td>
</tr>
<tr>
<td>Post-PPA Electricity Cost Escalation</td>
<td>1.10%</td>
</tr>
</tbody>
</table>

*U-M must maintain RECs from PPA to offset emissions.
*Assumes interconnection costs covered by developer.
*Assumes project is done with DTE and they switch our PPA contract.

<table>
<thead>
<tr>
<th>PPA Cash Flows</th>
<th>Includes land acquisition cost</th>
<th>Existing PPA expires this year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
<td>2018</td>
<td>2019</td>
</tr>
<tr>
<td>Would Be Electricity Bill</td>
<td>$34,648,462</td>
<td>$34,472,220</td>
</tr>
<tr>
<td>Actual Electricity Bill w/ PPA</td>
<td>$33,088,572</td>
<td>$32,923,129</td>
</tr>
<tr>
<td>Net Cash Flow</td>
<td>($4,571,911)</td>
<td>($1,552,090)</td>
</tr>
</tbody>
</table>

Net Present Value (NPV) | $23,514,195 |
Internal Rate of Return (IRR) | 45% |

**Escalating rate wind:**

<table>
<thead>
<tr>
<th>Assumptions</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Discount Rate</td>
<td>9.7%</td>
</tr>
<tr>
<td>2018 U-M Electricity Cost ($/kWh)</td>
<td>$0.0733</td>
</tr>
<tr>
<td>VPPA Rate ($/kWh)</td>
<td>$0.037</td>
</tr>
<tr>
<td>MISO Avg. Wholesale Electricity Price ($/kWh)</td>
<td>$0.037</td>
</tr>
<tr>
<td>U-M 2017 Nonrenewable kWh purchased</td>
<td>472,693,891</td>
</tr>
<tr>
<td>PPA Escalator</td>
<td>2%</td>
</tr>
<tr>
<td>U-M Post-PPA Electricity Cost Escalation</td>
<td>2.58%</td>
</tr>
</tbody>
</table>

*U-M must maintain RECs from PPA to offset emissions.
*Assuming electricity purchased from DTE will remain constant (e.g., energy efficiency gains offset growth).

<table>
<thead>
<tr>
<th>VPPA Cash Flows</th>
<th>Includes land acquisition cost</th>
<th>Existing PPA expires this year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
<td>2018</td>
<td>2019</td>
</tr>
<tr>
<td>Electricity Bill</td>
<td>$34,648,462</td>
<td>$34,472,220</td>
</tr>
<tr>
<td>VPPA Settlement Transfer</td>
<td>$58,473</td>
<td>$34,472</td>
</tr>
<tr>
<td>Total Electricity Bill</td>
<td>$34,648,462</td>
<td>$34,472,220</td>
</tr>
<tr>
<td>Net Cash Flow</td>
<td>$58,473</td>
<td>$161,422</td>
</tr>
</tbody>
</table>

Net Present Value (NPV) | $11,529,169 |
Internal Rate of Return (IRR) | N/A - Day 1 Savings |
Flat rate wind:

<table>
<thead>
<tr>
<th>Assumptions</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Discount Rate</td>
<td>9.7%</td>
</tr>
<tr>
<td>2018 U-M Electricity Cost ($/kWh)</td>
<td>$0.0733</td>
</tr>
<tr>
<td>VPPA Rate ($/kWh)</td>
<td>$0.045</td>
</tr>
<tr>
<td>ISO Avg. Electricity Cost ($/kWh)</td>
<td>$0.037</td>
</tr>
<tr>
<td>U-M 2017 Nonrenewable kWh purchased</td>
<td>472,093,891</td>
</tr>
<tr>
<td>U-M Post-PPA Electricity Cost Escalation</td>
<td>1.10%</td>
</tr>
<tr>
<td>Avg. Electricity Cost Escalation</td>
<td>2.58%</td>
</tr>
</tbody>
</table>

* U-M must maintain RECs from PPA to offset emissions
* Assuming electricity purchased from DTE will remain constant [e.g., energy efficiency gains offset growth]

VPPA Cash Flows

<table>
<thead>
<tr>
<th>VPPA Cash Flows</th>
<th>This is 2018</th>
<th>Existing PPA expires this year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Year</td>
<td>2018</td>
<td>2019</td>
</tr>
<tr>
<td>Electricity Bill</td>
<td>$34,648,462</td>
<td>$34,648,462</td>
</tr>
<tr>
<td>VPPA Settlement Transfer</td>
<td>$(3,723,078)</td>
<td>$(3,270,336)</td>
</tr>
<tr>
<td>Total Electricity Bill</td>
<td>$38,371,480</td>
<td>$37,918,798</td>
</tr>
<tr>
<td>Net Cash Flow</td>
<td>$(3,723,078)</td>
<td>$(3,270,336)</td>
</tr>
</tbody>
</table>

Net Present Value (NPV)  $4,247,480
Internal Rate of Return (IRR)  12%

Exhibit 2 - Ohio State University PPA

Ohio State University’s PPA agreement with Iberdrola can be accessed at this link: https://drive.google.com/drive/folders/1yt_CtwjDyalOOd6k-4rcKpfHEO3JaE6r?usp=sharing

Exhibit 3 - Student Survey

Below are screenshots of the survey that we sent out to U-M students to assess their thoughts and feelings on the university increasing its usage of renewable energy.
UM Energy Survey

The purpose of this survey is to assess attitudes of UM students toward having the university undertake a large renewable energy project.

After completing this survey, you will be entered into a drawing to win one of five $10 Amazon gift cards (if you want)!

Your email address (gfaber@umich.edu) will be recorded when you submit this form. Not gfaber? Sign out
* Required

1. If you would like to be considered for the Amazon gift card drawing, please enter your uniqname here.

2. Would you like to see the University of Michigan use more renewable energy sources (e.g., wind power, solar power, etc.)? *
   Mark only one oval.
   ○ Yes
   ○ No
   ○ I’m not sure

3. What year are you? *
   Mark only one oval.
   ○ Freshman
   ○ Sophomore
   ○ Junior
   ○ Senior
   ○ Other:
4. Which UM college are you enrolled in? *  
Mark only one oval.

☐ Architecture & Urban Planning  
☐ Art & Design  
☐ Business  
☐ Dentistry  
☐ Education  
☐ Engineering  
☐ Environment and Sustainability  
☐ Information  
☐ Kinesiology  
☐ Law  
☐ Literature, Science, and the Arts  
☐ Medicine  
☐ Music, Theatre & Dance  
☐ Nursing  
☐ Pharmacy  
☐ Public Health  
☐ Public Policy  
☐ Rackham  
☐ Social Work

5. How do you feel about this statistic: "UM currently uses about 2% renewable energy"? *  
Mark only one oval.

1  2  3  4  5

Very negative  ☐ ☐ ☐ ☐ ☐ Very positive

6. How much extra tuition would you be willing to pay each year in exchange for UM being 100% powered by renewable energy? *

Please note that your answer to the question above will not actually be reflected on your tuition bill. Switching to renewable energy may actually lead to decreased tuition if done properly.
Cover Photo

Introduction


Overview of PPAs


Other Institutions Doing PPAs


Case Study: Ohio State University PPA

The Ohio State University statistical summary. (2017). Retrieved from The Ohio State University website: https://www.osu.edu/osutoday/stuinfo.php


Renewable energy purchase agreement for wind energy Sources Between Blue Creek Wind Farm LLC and The Ohio State University [PDF]. (2012, November 1).


Urban Publications.


Historic and Current Electricity Use at U-M

Projected Energy Costs for U-M


from https://www.eia.gov/outlooks/aeo/data/browser/#/?id=3-AEO2017&region=1-0&cases=ref2017~ref_no_cpp&start=2015&end=2050&f=A&linechart=~~~~~~~~~~~ref2017-d120816a.38-3-AEO2017.1-0&map=ref_no_cpp-d120816a.3-3-AEO2017.1-0&ctype=linechart&chartindexed=0&sourcekey=0