Envirovibes Final Design Report

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Abstract

The central goal our group is to effectively and efficiently convey the functions of wind and solar energy to students at Henley Middle School in Crozet, Virginia. Through two interactive presentations on wind energy December 14th and 15th, and a successive series of discussions on solar energy this coming Spring, we hope to increase these students' knowledge on both wind turbines and solar panels, both of which are being installed in the school. Through communication with our primary contact Remy Luerssen, we have formulated our presentation to include both a brief discussion on wind energy and how wind turbines produce energy. An interactive portion where students can see a wind turbine in motion and create take-home models of the turbines will engage the students to apply this new knowledge. Costs for our presentations are relatively low, limited only to craft supplies that we need for the students to create their own models of wind turbines. Thus far, we have held a successful conference with two sixth grade science teachers, Remy, and Lindsay Snoddy, the environmental manager at the Albemarle Resource Center. We established dates and times for these presentations to occur, and received a wealth of information on wind and solar energy, which we intend to incorporate in our lesson plan. We have been presented the unique opportunity of not only communicating with students in the environmental club but also two science classes. Though our progress is limited to planning and the school conference, we anticipate that our meeting on December 8th the following presentations should be very effective and fulfill our desired to goal, to spread awareness of sustainable energy practices occurring right by the school's sports fields.

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The Problem

The lack of awareness about alternative energy opportunities and the lasting benefits in the implementation of sustainable programs is an existing predicament in local communities and infrastructures. There have been many improvements made in the last decade in regards to sustainability education in the local Charlottesville area and surrounding counties. However, in many circumstances, opportunities to practice environmental consciousness are available, but the community is unaware of how these sustainable programs or machines will aid their environment. Most practices and behaviors are learned from a young age, and upon reaching adulthood, it becomes much more difficult to inspire a person to change their habits. Therefore, part of the problem lies within the education of America's youth. By not introducing and encouraging sustainable behaviors in schools, society is crippling future generations in their ability to address the growing environmental concerns for the future. It is important to put further emphasis on teaching sustainability and alternative sources of energy in primary schools, in order to equip the future generations with the necessary tools to carry out change.

Goals and Objectives

Our primary goal is to increase the knowledge and interest of Henley Middle School students in the wind turbine installation at their school. We chose to work with Henley Middle School because they just received a grant for a wind turbine. For this reason, the teachers and administrators at the school were in need of college students to help facilitate interest about the project. Remy Luerssen, our community partner, connected our team to Henley Middle. Remy Luerssen is the coordinator for the "Wind For Schools" program, which focuses on educating students about the wind turbines that get installed in their school. We contacted Miss Luerssen with the hope that she could point us in the direction of a school that would be willing to take on our "Green Club" project. However, instead of simply giving our team the contact information to another school, Remy worked with our group to combine our efforts with her own. Our team opted to participate in a series of presentations at Henley after several altercations to our original design plan. Whereas our first intentions were to facilitate the creation of an environmental club, we were informed that one already existed and we had the opportunity to not only address the students involved in the club but two additional sixth grade science classes going through a sustainable energy unit. Upon several conversations with our primary advisor, Remy Leurssen, we held a formal meeting with her, the two science teachers at Henley, and Lindsay Snoddy, who is facilitating manager for the project. In this meeting we established our goals and objectives as a group, and determined that an interactive series of environmental lessons on both solar and wind energy, including the opportunity to physically present a turbine and solar panel, would be most

effective in have a resonating educational impact on the students. We have begun preliminary planning for our presentations, and a meeting on December 8th will be the final design discussion with Miss Luerssen before our formal discussions with the student's the following week.

Through interactive and engaging meetings and presentations, we hope to reveal the unique challenge that faces our youth in the forthcoming years of taking initial steps wherever possible to be more sustainable. We hope through facilitating wind and solar energy workshops, interest will spread throughout the school and back to students' homes. We feel that several meetings throughout the school year will spark an appreciation of the wind turbine and further sustainable energy measures in the school.

Stakeholders and their roles

The key stakeholder in our project is Henley Middle School. The school's main role is to provide a medium/location through which it can facilitate the interaction between the energy-efficient technology and the entire community. Within the school, the students of Henley MS have an important role, as they will be the first individuals to have access to the lessons about sustainable practices, specifically focused on energy efficiency and alternative energy sources. They also will be the key participants in the variety of experiences the installation of the wind turbine will provide, such as recording and analyzing the data that the turbine generates. The students' final role will be to act as ambassadors, along with the project leaders, to engage with the community, gain support, and spread awareness.

The Crozet community, the region surrounding the school, also has a key role in the project. One of the intentions of the grant/installation of the turbine is to create a learning center or gathering place (named the Renewable Energy Resource Center). The Crozet community has the role to utilize and support the Renewable Energy Resource Center, in order to fulfill its intended purpose.

In addition, UVA students hold an important function in the project. Our group's role is to act as mentors to the students of Henley Middle School, and help the teachers to introduce excitement and intrigue into the wind turbine installation. Not only will we help broaden and expand their education regarding alternative energy sources, but also we will help them continue to generate school and community-wide support. In future years, other UVA students in courses such as Global Sustainability can use the Renewable Energy Resource Center to develop

classes and activities for not only Henley Middle School, but also many K-12 students in the Charlottesville/Albemarle region.

The turbine installation company, Southern Energy Management, has the role to actually set up/construct the technology in the pre-determined location on the Henley Middle School property. Additionally, the installer will also help in the educational lessons to fully engage and explain to the students specifically how the wind turbine will function.

Project Description

Our project changed significantly throughout the course of the semester. Team Envirovibes came across many obstacles and barriers that helped to shape our project. After having little luck finding someone in the community who was interested in working with our group, we decided to turn to alternative possible connections. One team member's father is involved with the National Energy Education Development Project (NEED) and as a result, was able to put us in contact with Remy Luerssen, our team's community partner. Remy immediately seemed interested in working with our group. One member of our team established the initial email contact with Remy and organized a phone call. During the phone call Remy explained her connection with Crozet Middle School and told us about their grant for a wind turbine and the program "Wind For Schools". Remy expressed interest in working with a group of UVA students to help educate students of Crozet Middle School about their new wind turbine. Thus, our community partner was established. At the end of the first phone call, a conference call was arranged for later that week to introduce Remy with the rest of our team and further discuss plans for the project.

After first talking with Remy on the phone, she emailed the group a copy of the official grant proposal for the installation project. Each member acquainted him/herself with the plans and outlines, and prepared any questions we had about the process. After familiarizing ourselves with the proposal, we held an informal

conference call with Remy to go over each other's respective roles. We provided Remy with a more in-depth idea of what we hoped for the overall experience to be, and she expressed her own expectations for our collaboration. During the conference call, we also decided upon the need to have a preliminary meeting at the school, and afterwards determined an available date for all parties to meet.

On December 1st, our team drove to Crozet to have our first meeting with Remy Luerssen, Lindsay Snoddy, and sixth grade teachers of Henley Middle School. At the beginning of the meeting, we met with the librarian, Susan Guerrant, who also served as the coordinator for the environmental club for the school. Mrs. Guerrant told our group all about the grant they received for a wind turbine. She described where the wind turbine would go and went into detail about her concerns. She wanted to be sure the students of Henley Middle School fully understood the purpose and importance of the wind turbine their school was receiving. Our team explained our objectives for our own project. When we initially went to the meeting, we thought we would be working with the school to start a "Green Club." However, after talking to Mrs. Guerrant we learned that there was already an Environmental Club established. After meeting two sixth grade teachers, we discovered that they had very little SOL restrictions and they were very flexible. We decided to take a different approach and facilitate an in class work shop. Both teachers were willing to take a day off from their syllabi and allow our team to come into their classes and work with the students to encourage interest and increase awareness about alternative energy, specifically focused on the school's new wind turbine.

During this meeting we finalized days and time with the teachers and Remy. Since the school has a block schedule, we made sure that we were coming on one orange day and one blue day so we can reach all of the sixth grade science students. After comparing schedules and suggesting days, we decided to meet on the 14th and 15th of December. The teachers were able to give us detailed schedules that had the start time and end time of each class so we will be able to plan when we are getting to the school. While this was the ideal time for the school and our group, Remy Luerssen will not be able to make it on the 14th, so we also decided to have a preliminary meeting with her.

In this meeting, which will be held on December 8th, our group will meet with Remy, the science teachers at Henley Middle School, and Susan Guerrant, the librarian to finalize our plans for our presentation. Since Remy cannot attend the presentation on the 14th, she is planning to show us how to assemble and operate the wind turbine, which will be essential in our display. We will be going over what information needs to be presented to establish a base knowledge for these students and how to create their take-home wind turbine models. This meeting is planning to last for two hours and we hope to leave with a concrete design of how we will address the students the forthcoming week.

We also made a plan for our workshops on December 14th and 15th. We decided that we will split our group into two teams, and each team will go into a

different science class because both teachers have classes at the same time. Each team will give a presentation to their respective classes about wind energy, focusing mainly on their specific project and the wind for schools program. After the presentation, we will have the students do a 45-minute project (See Appendix) in which they explore the differences between different shaped turbine blades. Remy was able to give us a detailed description of how to conduct the project with the students, and gave us worksheets to have the students fill out while doing the project. After we complete the project we will take them to the library where there will be a sample wind turbine set up. This will give the students a visual aid, which will allow them to understand more clearly how wind turbines create energy.

Remy also explained the Wind for Schools program that she works for and gave us more information about the project. This made it much more clear to us the goals and objectives of the program and this project in particular. The Wind for Schools program likes to bring in engineering students to work with them on the placement of the wind turbine and the design of the turbine itself. Our group, however, will be working on the education side of things, which is a new initiative for the Wind for School program.

We created a survey based on the resources that Remy gave us and information we were able to find on the Internet to test the students' knowledge about wind energy prior to our workshop. We also added questions to assess the

interest of the students in alternative energy. We will give the students a post-assessment after the workshops on the 14th and 15th. Comparing the results of both the knowledge-based questions and the interest-based question will be one of the ways that we measure the success of our project. (See appendix)

Approach

Different Approaches we considered:

1. Educate in classes about sustainability
2. Educate by holding an assembly
3. Create a website to inform people about sustainability
4. Create a public service announcement
5. Create pamphlets to be handed out at community events
6. Provide information to teaches to put into their curriculum
7. Reach out to local businesses
8. Facilitate an in class workshop to spread awareness
9. Get people to sign a pledge to be more sustainable

Criteria important to our project:

1. Cost Effective
2. Time
3. Fewer Resources Required
4. Safety
5. No Additional Skills Required
6. Able to show progress
7. Non-Interference with SOL's
8. Distance
9. Demographic that we are reaching

The matrix below serves to help our group compare various approaches in order to chose the most effective one:

Criteria	Workshop	Website	Assembly
Cost Effective	Yes	Yes	No
Time	No	Yes	Yes
Fewer Resources Required	No	Yes	No
No Additional Skills Required	Yes	No	No
Personal Interaction	Yes	No	No
Able to show Progress	Yes	No	No
Non-interference with SOL's	Yes	Yes	No
Distance	No	Yes	No
Demographic	Yes	No	Yes

Key People and Resources

Remy Luerssen is the Director of Education and Outreach at the Virginia Center for Wind Energy. She connected us with Henley Middle School. She informed us that they were in need of college students to help them explain to their students the value of a wind turbine and why one is being installed at Henley Middle School. She also provided us with lots of valuable information about Wind for Schools, the organization that is helping schools like Henley Middle School get wind energy. In addition, she showed us many projects that we could do with the kids at each step of the installation process. We will be implementing one of her suggested projects on December 14th and 15th with the students. Remy will also be bringing a wind turbine model kit and a sample wind turbine for the Henley Middle School Environmental Club to observe on December 8th and for the 6th grade students to observe on December 14th and 15th.

Lindsay Snoddy, is the Environmental Manager at Albemarle Resource Center and the Project Manager. She is facilitating this specific project. She is working directly with Henley Middle School and was very involved in the process of getting the grant and installation set up.

Susan Guerrant is the Librarian and Environmental Coordinator at Henley Middle School, and does public outreach for the Renewable Energy Resource Center. She heads the environmental club at Henley Middle School, and therefore is very invested in the project. She will be helping us when we meet with the club on December 8th and will also be a resource for us when we do projects with the students on December 14th and 15th.

Patrick McLaughlin is the Principal at Henley Middle School, and will oversee project progress. He has been very cooperative in the process of getting the turbine installed and quite enthused about our group coming to talk to the students about the wind turbine.

Southern Energy Management is the company that will be installing wind turbine at Henley Middle School. One of their representatives will be coming to the school to talk to the students about the wind turbine and explain the more technical aspects of it. He will be aiding us in our education of these students.

Dana Stokes and Leslie Kenner are the 6th grade teachers at Henley Middle School. We will be going into their classes to teach the students about wind turbines and wind energy. Alternative energy is one of the topics on the 6th grade science curriculum, so it does not disrupt their lesson plan. They will be helping us with the projects that we do with the kids and providing us with an environment to teach the students.

Chosen Design: Educational Workshop

We have chosen to design and lead a workshop for sixth grade science students at Henley Middle School. This choice was based on the belief that the personal interaction and connection associated with our message would be most effective with a core group of students. Most of the resources necessary for the workshop are easily attainable, and we will be in direct control of interaction with students and the information we wish to relay. The workshop is the best option because it meets all but three criteria and is the most feasible option for our group. In addition to the two-day workshop, our group will work with the Outdoors and Environmental Club, the pre-established "green" club at Henley, to continue to raise awareness about the wind turbine and generate interest within the school community.

While a website has the potential to reach a larger audience, it does not guarantee that the information will be absorbed and resonate to the degree that we desire. It also would have to be heavily advertised for it to reach the demographic that we would like to teach. It would also require with help from a professional, or the gaining of new skills by one of our group members to complete the website. Also, as we have said, we believe that personal interaction is an important part of the learning process and a website cannot provide that.

The concept of an assembly could be effective, but takes a mass coordination with teachers and administration and is only a single day affair. This option meets the least amount of our criteria. There would be no way to show progress because

we would have no way to determine the students previous knowledge, and we do not have the skills at this time to put on such a large event.

Overall, the combination of setting up a workshop and assisting the environmental club is the best option because of the reasons stated above. Henley Middle School recently received a grant to install a wind turbine, therefore we will be teaching the students about wind energy and other topics regarding wind turbines.

Our workshop will be during school hours, specifically during the class periods of the sixth grade science classes. This is the most fitting situation given that the sixth grade science curriculum is currently focused on alternative energy, so our subject matter will directly relate and reinforce the teachers' goals for their students.

Another benefit of this option is that we have a strong contact, and the school is looking for a group of college students to help with this, so we know that there will be help and support from the school administration and compliance from teachers. Because our interaction with the club will specifically target those students who are most interested in environmental issues, and our interaction with the classrooms will target students who are already learning about alternative energy, our hope is that both groups of students will be able to act as ambassadors throughout the school, passing on the knowledge we convey to them to their peers and parents. One possibility would be for the club to host some sort of event to present the information to more people in the community. We think that this is the best approach to address our specific problem.

Budget and Funding

The costs for this project will be minimal because the school will be providing us with most of the resources that we need. The main costs in our budget will be paying for gas to get to and from Henley Middle School which is roughly 20 minutes away from Charlottesville in Crozet, VA, and paying for any supplies for hands-on projects that we would like to do with the students. We plan to cover basic costs like gas and small craft supplies and most other supplies like the display turbine and solar panel are available through Remy's contacts at JMU. If they are unable to we may try to obtain funding from the company that is installing the wind turbine, the National Energy Education Development Project (through which we could potentially obtain wind energy kits), the Albemarle County Public School system, or potentially provide funds ourselves if the cost of supplies is low.

The following chart displays the estimated cost for the actual installation of the Solar/Wind/Geothermal Energy Devices:

Item Description	**Requested Grant Funds**	**Federal Leveraged Funds**	**Non-Federal Leveraged Funds**	**In-kind Cost Share**	**Total Project Funding**
Personnel Costs				$10,000.00	$10,000.00
Fringe Benefits					$0.00
Travel				$1,000.00	$1,000.00
Project Equipment	$205,700.00				$205,700.00
Supplies					$0.00
Contractual					$0.00
Construction	$15,000.00		$75,000.00		$90,000.00
Other					$0.00
Total Direct	$220,700.00	$0.00	$75,000.00	$11,000.00	$306,700.00
Indirect Charges Program Income	$0.00				$0.00
Total Direct &Indirect	**$220,700.00**	**$0.00**	**$75,000.00**	**$11,000.00**	**$306,700.00**

This chart is taken from Albemarle Public School's Application to the Virginia Local Government and School Renewable Energy Utilization Program for Henley Middle School.

Conclusion

Despite initial hardships that our team faced, we have overcome a variety of issues and worked to develop a successful project. Upon meeting with the teachers Dana Stokes and Leslie Kenner, and Susan Guerrant, the librarian and Environmental Coordinator, we worked out the most effective plan through which the students would gain the most benefit. We will conduct educational workshops for the sixth grade science students over the duration of two days at Henley Middle School. This method will help us reach over 250 students in a fun, interactive and informative setting.

One significant accomplishment that contributes to our project's success is that we have a specific outline and plan drawn out for the two days we will spend at Henley Middle School. After our primary introduction and brief informational presentation about alternative energy and wind turbines, we will lead an interactive, hands-on activity that will both engage and inform the students. The culminating component of the workshops will be to take the students to see the real turbine (sample) in action and further explain its qualities, encouraging the students to take the opportunity to ask questions.

In addition, one of our main accomplishments is the establishment of our coordination with Remy Luerssen. With her help and support, we have gained access to a number of teaching and learning tools to supplement our presentation to the students. We will be able to utilize miniature wind turbine models to first

introduce and exemplify the fundamental properties and functions of a turbine. Additionally, the small-scale models will then be central components of the interactive activity we conduct. We also will be using a transportable SkyStream turbine that has been designed for use in instructional settings to demonstrate to the students how the school's personal turbine will eventually function.

By establishing contact with a number of the faculty within the school, in addition to our community partner Remy Luerssen, we have ensured that our intentions are reasonable and non-obstructive to the daily routine and objectives of the students. Through our collaboration we have been able to gain valuable advice from those who work closely with the students already, and who understand what will be most feasible.

While we have full confidence in our project, some barriers still remain. The success of our goal, to enhance the awareness of students, is contingent upon their reception of the information and response to the workshop. Given the inconsistent nature of adolescents during middle school age, the students of Henley may react in an unpredictable manner. In order to prepare for this, our group intends to lead an age-appropriate seminar that holds their attention and captivates their interest. One of the most important goals of the project is for the students to recognize the significance that the wind turbine has in each of their lives, and why it is important to support initiatives to install alternative energy sources at other schools. Without the students' engagement in the project, it will not be able to ultimately succeed.

Our ultimate basis for success was the flexibility that our group exercised. Due to our open nature, we were able to continue to adapt the project to include newer and more effective plans of action. Despite the frustration experienced due to the impermanence and instability of the project, the process was necessary and beneficial as it pushed our group to continually improve. At each step new factors were introduced that forced our group to adjust previous plans or expectation. As a result, our group has worked to develop the project that best addresses the objectives we looked to accomplish.

Documentation and Assessment

We plan to document our project using surveys, graphs, and pictures. We will have a survey (See Appendix), which will serve both as a pre-assessment and post-assessment for the students in the club. The survey will be composed of a series of questions, in multiple-choice format, to test the students' knowledge about wind energy and other alternative energies that are used at the school. In addition the survey includes a questionnaire related to the students' individual interests and opinions. For each question, we will find the percent of students that answered the question correctly. We can use a bar graph to display the percentages of both the pre and post assessment for each question side by side so a comparison can be made. We will also be using photos to document our time at Henley and showcase what we accomplish in each visit. This will allow us to display in more detail what we are doing with the school/students.

We have defined success for our project as an increase in the knowledge and recognition of alternative energy sources by the students and community. To measure the extent to which we achieved success we will use the information from the pre and post assessments. To make sure that one question does not throw off our average score we will look at the improvement both in overall score, and in the percentage right on each question.

In addition, because we will not be able to conduct the post-assessment before the end of the semester, we will also somewhat measure our success through the apparent interest generated by the students during our meetings/workshops with them. For example, if the majority of the students appear to remain attentive, and show interest in the discussion topics, this would indicate a higher likelihood of absorbing and retaining the information that we hope to convey.

Future Work

On December 14th and 15th we will be conducting our first workshop with the sixth grade students at Henley Middle School. The first workshop will be about wind energy, focusing mainly on their wind turbine will affect the school. We will be going in to the two science classes and giving a short presentation about wind energy, and explaining the Wind For Schools process, to show the students how this is a national process that they are a part of. After our brief presentation, we will do a project with the students so that they learn about wind turbines in a very interactive way. We have decided to do a Blade Design Analysis and Test project with the students (see appendix). We will show them four blade designs for a turbine, and have each person rank the blades in order of which they think will produce the most energy when attached to the wind turbine model. Then each team of students will test one blade type and record their results. After all types have been tested, each team will present their findings to the rest of the class. We will then have the students discuss why they think this blade design worked best, and why they predicted certain rankings.

After the lesson we will take the students down to the library while a sample teaching wind turbine will be set up. This sample will allow the students to look into all the different parts to see how the turbine works. Our hope is that after doing the interactive project, the students will be very interested in examining the actual wind turbine.

During the spring semester, we plan to have more workshops, with a similar

structure to this one, about other alternative energies. Because they are getting solar panels we would like to conduct a workshop explaining solar energy to them, using solar ovens or another interactive project. We also hope to continue meeting with the environmental club to help them expand their knowledge on this subject that they have expressed interest in.

If in the future we wished to disseminate the results of the project, we could take advantage of several possible routes. One option would be to maintain a record of all the activities/events associated with project, including examples of lesson plans, pictures, or flyers. Then compile all of the information into an accessible handbook or guide that could be distributed as a model to other schools or communities. Another method could be to contact local media outlets, such as newspapers or websites, to describe our project, its goals, and the results. Finally we could create a summarized version of our final presentation to distribute to all of our community partners to provide a succinct overview of the project's progress.

Timeline for design implementation

November 29 – meeting with Lindsay Snoddy, supervising teacher, and prospective turbine installer at Henley Middle School in Crozet.

December 8 – Remy will bring the sample turbine and model kits to Henley Middle School, and along with the environmental club we will help her to set them up in the library.

- 1:00 Meet with Remy Luerssen to talk about the wind turbine and make sure that we know everything that we need to know about it and will be able to teach it to the kids the next week

- 2:00-2:45 -- Meet with environmental club to set up wind turbine

December 14 – First day of teaching students about wind energy

- Blue day at Henley Middle School

- 9:05-10:34 -- Two classes to teach, wind turbine project and then showing them the sample wind turbine

- 12:04-2:00 -- Two classes to teach, wind turbine project and then showing them the sample wind turbine

- 2:30-4:00 -- One class to teach, wind turbine project and then showing them the sample wind turbine

December 15 – second and final day of teaching students about wind energy

- Orange day at Henley Middle School

- 9:06-10:25 --Two classes to teach, wind turbine project and then showing them the sample wind turbine

- 10:29-11:49 -- One class to teach, wind turbine project and then showing them the sample wind turbine

- 1:17-2:37 -- Two classes to teach, wind turbine project and then showing them the sample wind turbine

Lessons Learned and Obstacles

At the start of the semester our group, Team Envirovibes, decided to undertake on the task of creating a Green Club in a local Charlottesville middle school. However, our initial design shifted as we had to formulate our "club" design into a series of workshops for Henley Middle School, which has a pre-existing environmental club. Initially, our plan was to teach a series of interactive lessons on general topics of sustainability but our efforts are now more focused on wind and solar energy. The issues that we faced were most always intrapersonal problems. Our obstacles included losing our first contact, finding an adequate and willing school, and working around Henley Middle School's schedule, rather than our own. If we could have altered our primary efforts in planning, we would have networked better with area schools, and proposed more broad concepts for educational assistance in the schools. We envisioned this simplistic route of designing a green club without considering the notion that one might already exist, and should have weighed more options of other areas where environmental education could be utilized.

Our first contact was Kristel Riddervold, the Environmental Administrator for the City of Charlottesville's Department of Public Works. She responded to an email we sent out about our group's potential project. After several contacts and phone calls she offered to help find our team a school. After a lack of response, we chose to seek an alternative contact who would hopefully respond to our proposition. Though we

lost valuable time where we could have been working with a school, we attempted to construct an outlined plan faster to facilitate a faster response time from our sponsors. In retrospect our group would have been more successful if we had established a backup contact in advance and worked to find another school much sooner. Though the loss of our first contact was a significant setback, our group mentality shifted towards finding another community partner as efficiently as possible, utilizing both e-mails and phone calls to reach another potential partner.

The next obstacle we faced was finding a school that was willing to implement our Green Club idea, or something similar like an environmental conference. We had lost a great deal of time in just finding a school , leaving only a short period in the semester to finalize our plans. Our group sent emails out to 3 middle schools in the local Charlottesville area and surrounding Albemarle County. These emails were sent out to the school principals; however there was no response from any . Had we sent more e-mails to administrators and teachers in the Albemarle network we could have potentially avoided this major lapse in time. Also, getting in contact with Lindsay Snoddy early in the semester would have been beneficial to our group, because she is in contact with many schools in Charlottesville and Albemarle County. We were able to resolve this obstacle by agreeing to alter our Green Club concept to simply organizing and facilitating an energy workshop. By remaining flexible, our group was able to ensure that we had a successful project.

The problem our group still faces is to work around the time schedule of our

current mentor and the administrators at Henley Middle School. This project has many deadlines and every other week there is some kind of progress assessment that is due. This gives our group strict regulations on what we need to have accomplished. Our mentor, Remy Luerssen, is working to establish a meeting time with Henley Middle School. However, Henley Middle School just recently received a grant to build the wind turbine, so the administrators at Henley Middle School are more focused on working out the details of the actual installation. This leaves our initiative to create a club low on the agenda of the school's list of priorities.

At the beginning of the semester, our group's goals were finding a school willing to let us install a Green Club that would effectively and efficiently instill the concept of environmental consciousness into students' minds. Where we initially thought we would be discussing recycling habits and water conservation, we now are concentrating on wind and solar energy. One the most influential lessons our group has learned is to adapt to the circumstances necessary. While we had a plan in mind, the opportune timing of Henley Middle School's wind turbine and solar energy panel installations led us to recreate a project design that could teach students the exciting sustainable energy efforts occurring at their own school. Not that teaching about other subjects would have been ineffective, but the ability for us to be able to physically display the turbines and panels, as well as describe their use, should be both a learning and attraction factor for these students.

Creating change is something we hope to gauge on the visible interest level in

the students and their responses in our final survey. Knowledge is not a tangible matter that can be quantified, but if we are able to increase these students' awareness about both the turbine and solar panel usage, then we have hopefully created a change in their perspective. The intention of environmental education, especially at such a young age, is to invoke any type of lifestyle change that is more complementary to the environment. The students' conscious recognition of the purpose of wind and solar energy will hopefully encourage them to seek ways they can live more sustainable lives in their own homes. Since we have not completed our presentations at Henley yet, our hope is that we can address all the necessary functions of turbine and solar panel use in a manner that is understandable to these students. Our primary concern would be layering our discussions with information that is too complex for the children to understand; therefore our presentations will be centered on language and explanations that are comprehendible.

If we could start this project all over, our group would have been more open-minded to adapt to a school's needs rather than our own. Upon hearing confirmation, we would have formulated a more concrete plan to present to the school instructors and our community advisor rather than having an ambiguous initial design that had to be worked through. We would have better prompted interactive activities for the students ourselves rather than relying on supplies from the school and external sources. Though there are definite changes we would have made, our design ended up working sufficiently in the end.

Appendix 1: This is a flier explaining specifically how Virginia is getting involved in the wind energy process through their schools. This gives us more information about the specific program that we are a part of.

VIRGINIA WIND FOR SCHOOLS PROGRAM

PROGRAM OVERVIEW

Wind for Schools is a Department of Energy funded program through Wind Powering America that began in 2005. There are currently 11 states that are part of the program with Virginia joining in 2010. The goal of the program is to raise awareness in rural America about the benefits of wind energy, while simultaneously developing a wind energy knowledge base in future leaders of our communities, states, and nation. The basic structure of a Wind for Schools program includes the creation of a Wind Application Center at a university where wind energy education will be infused into the undergraduate and graduate curriculum. Additionally, a state facilitator is appointed to reach out to K12 schools (host schools) to encourage the implementation of a small wind turbine at the school to increase awareness and education about wind energy.

WIND APPLICATION CENTER (WAC)

As the WAC, James Madison University (JMU) will work to develop more courses to be offered at the University that incorporate wind energy. In addition, the WAC Leader will make available wind related projects for seniors for completion of their capstone requirement. Undergraduate projects typically involve working with teachers, school administrators, students and installers on small wind project development.

STATE FACILITATOR

The Facilitator is responsible for seeking K12 schools around the state that are interested in developing a small wind project on their campus. The Facilitator will also work with JMU students to oversee the project development at the school. Additionally, the Facilitator will work directly with the teachers and the school administration to aid in the planning and funding for the project and will also help in finding a qualified installer for the project. Once the turbine is installed, the Facilitator will provide training for any teachers that are interested in using the real time data from the turbine in their classroom for teaching SOLs related to wind energy.

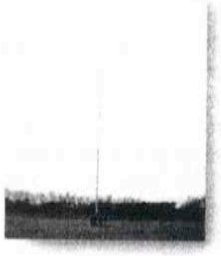
CHOOSING HOST SCHOOLS

The goal of the Wind for Schools program is to put up turbines at four to five host schools each year. In order to select those schools an application process is in place. In March a proposal will be required from any school that would like to pursue a wind project on their campus. This proposal is very simple and requests information on campus location, intended use of wind turbine in classroom, school support, community awareness, and more.

From there JMU student in a course about Wind for Schools will review and rank proposals. The top four to five schools will be notified during the summer about the acceptance of their project proposal. JMU will offer training for interested teachers over the summer on how to engage their students in the project development process as the project is progressing at the school in the next year. JMU seniors will also be working through the project development process for some of the schools as part of a senior capstone project requirement and may be available to engage students at the K12 schools and provide technical assistance. The hope is that turbines will be installed on campuses in late spring.

Partner Schools

Because of the diverse wind resource in Virginia and our goal to put up four to five wind turbines a year at schools, we realize that not every school that wants a turbine will get one. So we offer a Partner School program in which we offer 20m meteorological towers outfitted with an anemometer and a wind vane to schools that have little to no wind resource but would like to be part of the Wind for Schools program or would like to get a turbine at their school but don't have the funds ready or are not able to get into the program that year due to high demand.



As a partner school, schools will be adding data to the Virginia wind data repository as well as be partnered with a nearby school with a turbine. Sister schools are encouraged to communicate monthly with project updates and share stories of wind activities they have done and data they have gathered as well as take field trips to visit each other each year.

Affiliate Schools

There are many schools in Virginia that have put up wind turbines without the help of the Wind for Schools program. The Wind for Schools affiliate program has been implemented to allow these schools to be part of the Wind for Schools network and benefit from those services that come with being part of the network. Schools that join the affiliate program will receive access to technical assistance, program web sites, and information. Schools will also be eligible for teacher training to assure that the turbines and the data collected by the system are being used in the classrooms for educational purposes.

Museum Partners

As informal science education institutions, museums have the opportunity to educate students from many schools in their area as well as the public. Museums are encouraged to install a Skystream 3.7 wind turbine at their location and use the real time data to educate visitors about wind energy. In addition, museums are a perfect place for holding regional teacher training workshops on wind energy curricula as well as providing a location for gatherings of all the Wind for Schools schools in the area.

Contact Information

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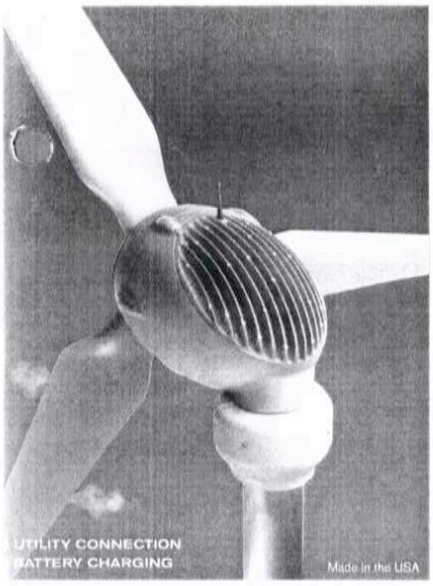
Harrisonburg, VA 22807
540-568-8768
luerssrm@jmu.edu

Appendix 2: This is a flier explaining the specific model of wind turbine that will be installed in the school. It gives specifications, which will be helpful when explaining it to students, and gives helpful charts and graphs to show the power that will be produced by this turbine.



SKYSTREAM 3.7

2.4 KW DISTRIBUTED WIND ENERGY SYSTEM

Take Control of Your Energy Needs

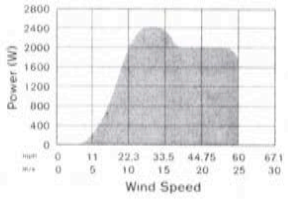
Designed for homes and small businesses, the Skystream 3.7 converts wind into clean electricity you can use. It's the first compact, user-friendly, all-inclusive wind generator (with controls and inverter built in) designed to provide quiet, clean electricity in very low winds.

With a rated capacity of 2.4 kW, Skystream can help offset a household or small business's total energy needs.[1] And because it operates at a low RPM, Skystream is as quiet as the trees blowing in the wind.

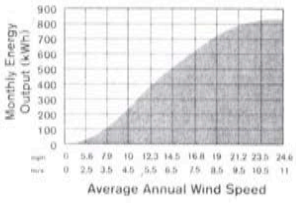
Technical Specifications

[illegible]ed Capacity	2.4 kW
Rotor Diameter	12 ft (3.72 m)
Weight	170 lb (77 kg)
Swept Area	115.7 ft² (10.87 m²)
Type	Downwind rotor with stall regulation control
Direction of Rotation	Clockwise looking upwind
Blades	(3) Fiberglass reinforced composite
Rated Speed	50 - 330 rpm
Maximum Tip Speed	216.5 ft/s (66 m/s)
Alternator	Slotless permanent magnet brushless
Yaw Control	Passive
Grid Feeding	120/240 VAC Split 1 Ph, 60 Hz 120/208 VAC 3 Ph compatible, 60 Hz (Check with dealer for other configurations)
Battery Charging	Battery Charge Controller kit available for battery charging systems
Braking System	Electronic stall regulation with redundant relay switch control
Cut-in Wind Speed	8 mph (3.5 m/s)
[illegible]Rated Wind Speed	29 mph (13 m/s)
[illegible]r Monitoring	Wireless 2-way interface
Survival Wind Speed	140 mph (63 m/s)
Warranty	5 year limited warranty

POWER



MONTHLY ENERGY



FIVE YEAR WARRANTY

Southwest Windpower
1801 W. Route 66 928.779.9463
Flagstaff, AZ 86001 USA www.skystreamenergy.com

Makers of Skystream 3.7 / AIR / Whisper

[1] Actual savings is based on wind speed at the site and monthly energy consumption.
[2] Data measured and compiled by USDA-ARS Research Lab, Bushland, TX.

Printed on recycled paper with vegetable inks using 100% new wind energy.

Appendix 3: This is a flier describing how different states have incorporated wind energy into their schools. This is helpful to see how other places are approaching this same problem and their successes. Also, it is a good resource to show the students that they are part of a national effort in wind energy.

Spirit Lake, Iowa. Spirit Lake Community Schools District/PIX11342

Wind energy projects can power schools with clean energy, provide revenue for districts, and provide educational opportunities for students. The nation's school districts, always striving to provide the best educational experience possible with limited resources, are installing an increasing number of wind projects. Each project is tailored to benefit local needs and priorities, and the innovative methods of financing these projects are as varied as the communities that implement them.

Iowa

Iowa leads the way in developing school wind projects, in number of projects and project size. As of this writing, eight schools have wind turbines installed, ranging in size from 50 kilowatts (kW) to 750 kW.

The Spirit Lake Community School District pioneered the effort by installing a 250-kW turbine in 1993. The district received a U.S. Department of Energy (DOE) grant of $119K and funded the remainder of the project with a low-interest loan from the Iowa Department of Natural Resources (DNR).

As of February 2001, the district saved $124.9K on electric bills and installed a second, larger machine (750 kW) that year. When both turbines are paid off in 2007, the revenue generated (estimated to be $120K/year) will be used to enhance school programs. District members are also proud of the turbines' contribution to the educational curriculum and the environment.

Iowa school districts have capitalized on state and federal tax incentives. These include the Renewable Energy Production Incentive (REPI) and the Iowa Energy Center's Alternative Energy Revolving Loan Program. The schools learned from each other's experiences, and the Iowa DNR facilitated the process. Early projects relied on grants for seed money, and later projects relied on low-interest loans. For more information, see www.state.ia.us/dnr/energy/MAIN/renewable/index.html.

Minnesota

In 1995, Lac Qui Parle Valley Schools became the first Minnesota school district to erect a turbine. The district combined a $60K state grant with a $200K state interest-free loan to purchase a 225-kW NEG Micon turbine, which provides energy to school buildings. Power generated when school is not in session is sold to Ottertail Power. The system has an anticipated 10-year payback.

Pipestone School District installed a 750-kW NEG Micon, which was funded through the Xcel Energy Renewable Energy Fund. Proceeds are returned to the school fund. Macalester College in St. Paul has a 10-kW turbine on their campus. And Carleton College plans to dedicate a 1.65-MW turbine in September 2004. The turbine will offset about 40% of the college's electricity use (although Carleton plans to sell the electricity to Xcel Energy, rather than use it on campus). The college took advantage of two incentive programs: 1) Minnesota's 1.5 cent/kWh REPI and 2) the Federal REPI.

For more information, see www.windustry.com/community/default.htm.

Illinois

Members of the Bureau Valley School District in Manlius, Illinois, spent a year performing a financial and technical analysis and preparing a proposal for a new 660-kW turbine project with an estimated cost of $965K. Their analysis shows that the turbine could provide about $90K per year in energy savings for the district for the next 20 years – money that can be spent on education rather than energy. They received a $331K grant from the Illinois Clean Energy Fund and a $150K grant from the Illinois Department of Commerce and Economic Development. The turbine is planned to be online and generating power by the end of 2004.

Pennsylvania

The Shade School in Somerset, Pennsylvania, received a grant from the Community Foundation for the Alleghenies to develop a renewable energy demonstration site to be used in environmental education. Waste Management Inc., which has a landfill in the community, and the local power company provided matching funds for the project. The system, which includes a Whisper H80 wind turbine, photovoltaic panels, and storage, is housed in a freestanding building near the sports fields. The building provides space for activities such as the school's environmental camp, and the power is used for scoreboards, lighting, etc. The school receives a utility bill credit for power generated and used locally.

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Wind & Hydropower Technologies Program

Vermont

The Danville School supplemented a $33K grant from the state Public Service Board with $5K of local in-kind services to install its 90-foot-tall, 10-kW, grid-connected system. The turbine is operational but not yet fully instrumented. The school plans to use the system for educational purposes and to generate energy cost savings.

For more information about wind power on state-owned lands in Vermont, please visit www.state.vt.us/psd/Menu/EE_and_Renewable/ee20.htm.

Massachusetts

Building on the Massachusetts Department of Education's School Building Assistance Program, the Massachusetts Technology Collaborative (MTC) launched its Green Schools Initiative in 2001. The intent was to facilitate the construction of high-performance green schools that included significant energy efficiency measures and renewable technologies, such as wind and solar. MTC awarded feasibility study grants to 38 schools and awarded design and construction grants to other schools.

The design and construction projects are in varying stages of completion. Wind turbines as large as 10 kW are planned for areas with good wind resources. In areas with a less desirable wind resource, small units for demonstration and educational purposes are planned. The feasibility studies and descriptions of designs are posted at www.mtpc.org/RenewableEnergy/green_schools.htm. A 100-kW PV array and a 10-kW wind turbine were already installed at Beverly High School in Beverly, Massachusetts, but the school plans to use its grant to pursue adding additional renewable energy features as part of a major renovation project.

Michigan

Zeeland West High School in Holland, Michigan, is home to a 10-kW Bergey XL-10, which was financed primarily through donations. The Zeeland Board of Public Works donated $20K. Craig Brumels, a local contractor and enthusiast, donated the tower and his time to assemble the tower and turbine. GMB Architects-Engineers donated time for design and engineering, and the school district contributed $25K.

The system is fully monitored so that students and the public can see how it performs. Maintenance entails annual inspection and lubrication. The school will use all the electricity generated and expects to save $1,200 per year in utility bills.

Beverly, Massachusetts. Kimberly Cullinane/PIX13457

Browning, Montana. Martin Wilde, Blackfeet Community College/PIX04697

Zeeland, Michigan. Steve Hamstra/PIX13489

For more information about school wind projects in Michigan, please visit the Energy Office of Michigan Web site at www.michigan.gov/cis/0,1607,7-154-25676--,00.html.

Native American Community Colleges

The Blackfeet Tribe partially matched a DOE planning grant with Tribal funds to develop a small utility-scale turbine for the Blackfeet Community College in Browning, Montana. Partners in the effort included DOE, the Blackfeet Tribal Business Council, Blackfeet Community College, Glacier Electric Cooperative, Zond Systems Inc., and Montana State University.

A 100-kW Vestas V-17 turbine provides power to offset the college's electric costs through an arrangement with Glacier Electric Cooperative. In the initial test year, the power was purchased at 2.7 cents/kWh, and the college received a $4.9K credit toward its annual electric bill. Local workers were hired for construction and operations and maintenance, and students participated in environmental analysis.

Installation of a Vestas V-47 660-kW turbine is planned for the Turtle Mountain Community College in North Dakota and another for the Fort Peck Community College in Montana.

For more information on the DOE Tribal Energy Program, see www.eere.energy.gov/tribalenergy.

State Trust Lands

Landowners who lease their lands for utility-scale wind electricity generation are typically compensated at the rate of $2K to $5K per year per megawatt-scale turbine. Texas led the way in leasing school state trust lands (sometimes called "endowment lands") to wind farm developers. In Texas, the funds generated from the leases go to the permanent school fund. This model is becoming common in western states. In 2003, the Washington State Department of Natural Resources signed a lease with Sagebrush Power Associates allowing it to locate about a quarter of the new 121-turbine Kittitas Valley Wind Power Project on state trust lands. Expected revenues, which will be used for school construction, are $5.6M in the first 25 years.

For more information, visit www.glo.state.tx.us/sustain/#wind.

For more information contact: EERE Information Center • 1-877-EERE-INF (1-877-337-3463) • www.eere.energy.gov

A Strong Energy Portfolio for a Strong America

Energy efficiency and clean, renewable energy will mean a stronger economy, a cleaner environment, and greater energy independence for America. Working with a wide array of state, community, industry, and university partners, the U.S. Department of Energy's Office of Energy Efficiency and Renewable Energy invests in a diverse portfolio of energy technologies.

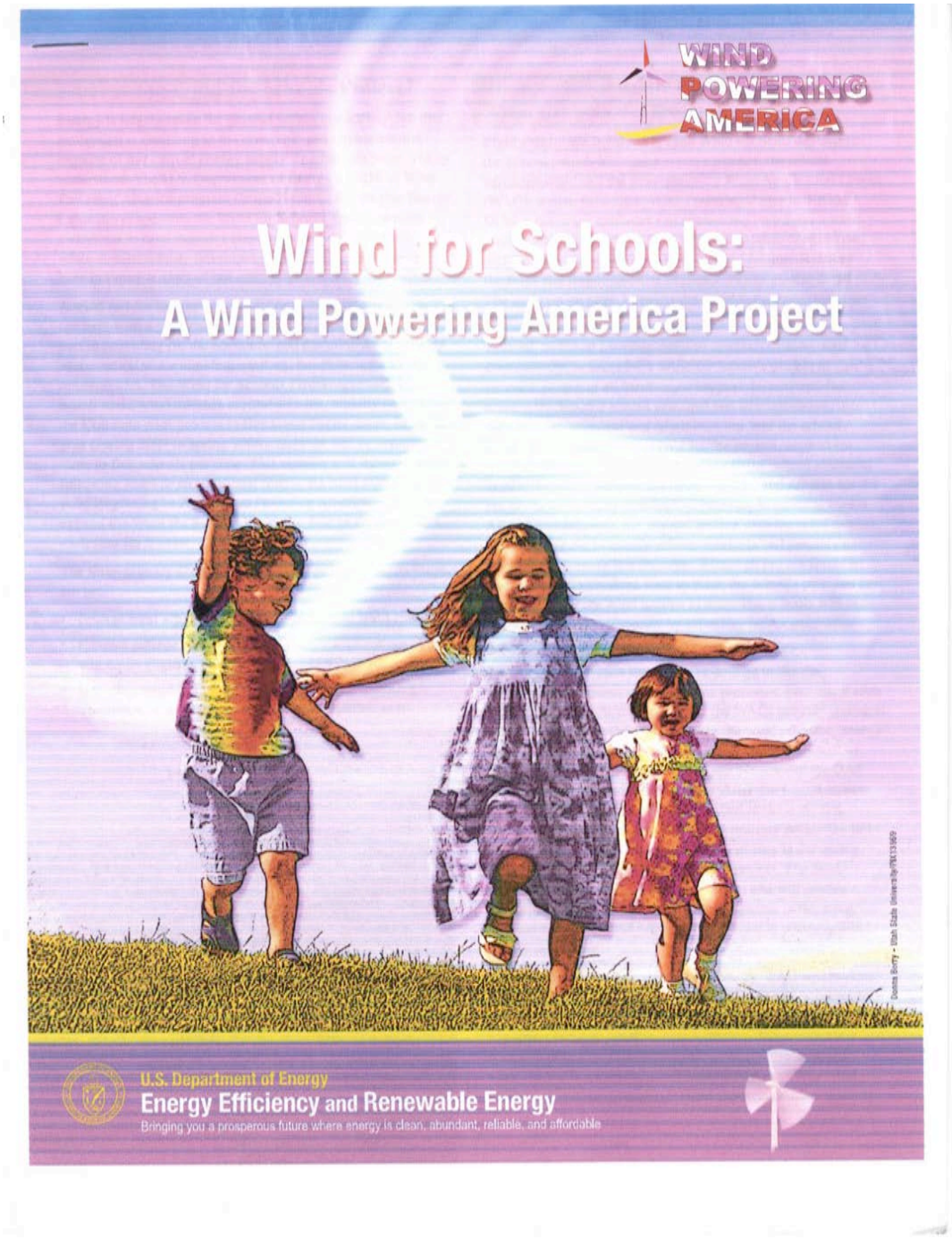
Produced for the U.S. Department of Energy by the National Renewable Energy Laboratory, a DOE national laboratory

DOE/GO-102004-1973 • August 2004

Printed with a renewable-source ink on paper containing at least 50% wastepaper, including 20% postconsumer waste.

WIND POWERING AMERICA

Appendix 4: This is a guide explaining the goals and objectives of the Wind for Schools Program, which engages schools, college students, and communities in the process of furthering wind energy. This is the program through which Henley Middle School is receiving their wind turbine and provides us with helpful information about how to go about teaching the students about the project.



What is the Wind for Schools Project?

Energy is largely taken for granted within our society, but that perception is changing as the economic and environmental impacts of our current energy supply structure are more widely understood. The U.S. Department of Energy's (DOE's) Wind Powering America program (at the National Renewable Energy Laboratory) sponsors the Wind for Schools Project to raise awareness in rural America about the benefits of wind energy while simultaneously developing a wind energy knowledge base in future leaders of our communities, states, and nation.

A wind turbine located at a school provides students and teachers with a physical example of how communities can take part in providing for the economic and environmental security of the nation while allowing exciting, hands-on educational opportunities. The Wind for Schools Project approach is to install small wind turbines at rural schools, initially replicating the Colorado pilot process in five Great Plains states. In the first year (spring 2007 to spring 2008), turbines will be installed at three to five schools per state. This number will increase in the following years to an additional four to six rural schools per year. Beginning in 2008, Wind Powering America expects to expand the Wind for Schools Project to four to six new states each year for 5 years.

The three primary project goals of the Wind for Schools Project are to:

- Engage rural school teachers and students in wind energy
- Educate college students in wind energy applications, which will equip engineers for the growing U.S. wind industry
- Introduce wind energy to rural communities, initiating a discussion of wind energy's benefits and challenges.

Andy Swapp/PIX14985

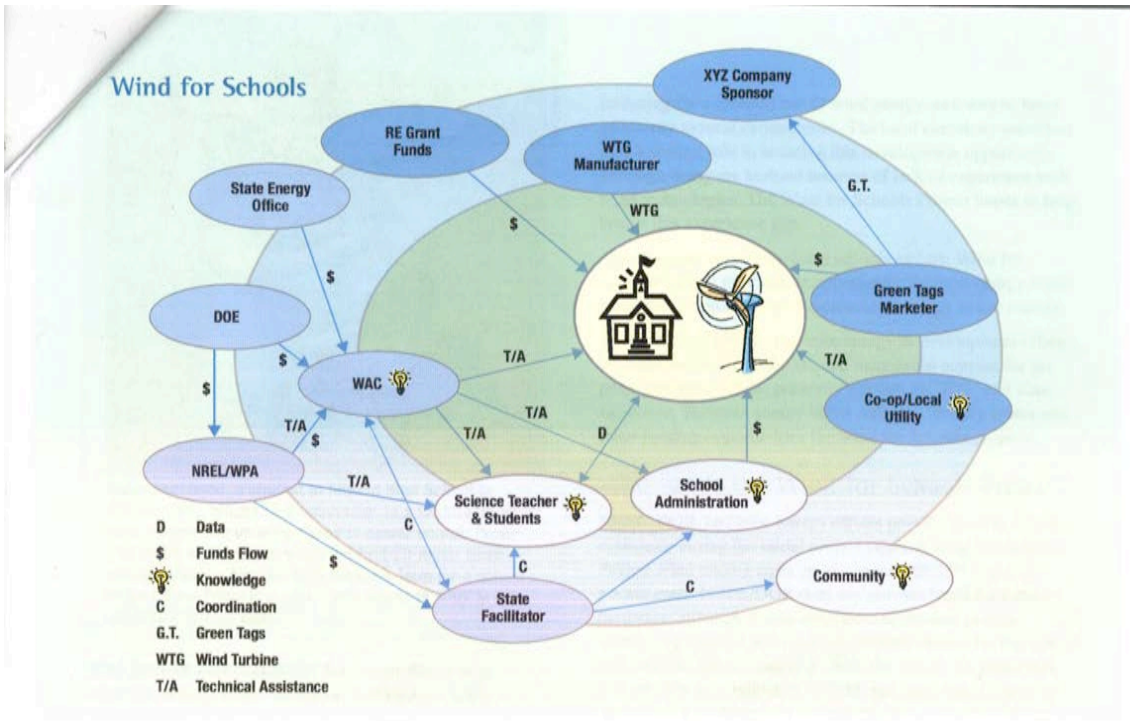
Who participates in the Wind for Schools Projects?

Eight entities are involved in each Wind for Schools Project: the school (which includes a science teacher, the school administration, and the community); a Wind Application Center (WAC); a state facilitator; Wind Powering America/NREL/DOE; a green tag marketer and sponsoring company; a wind turbine manufacturer; the local utility or electric cooperative; and the state energy office. The following section describes the roles and responsibilities of each entity in greater detail. The diagram on page 3 depicts the Wind for Schools program structure.

School, science teacher, school administration, and community: In order for a Wind for Schools project to succeed, people at all levels must support the concept: the science teacher, the school principal and administration, the district superintendent and administration, and the school board. The school provides land for the project, support for the interconnection of the wind turbine to the school electrical system, facilities support, financial support, and support for the project in community meetings or other organizational events. After the installation, the science teacher uses the wind turbine as a teaching aid in energy-related curricula and possibly as a source for science fair concepts. Although project financial structures will vary from state to state, the schools own and are responsible for the wind turbine system. The schools will save a minimal amount of money by offsetting power generation.

Wind Application Center (WAC): A WAC will be implemented at a state university or college under the leadership of an interested university professor. Fashioned after the Industrial Applications Centers, the WACs provide technical assistance to rural schools (analyzing the wind resource, energy usage, siting, permitting, land use, and financials, as well as overseeing the installation of the power system and the DAS and analyzing the performance data). After the first year, new K-12 candidate schools will be identified in the early fall. The WAC will conduct analysis and permitting during the fall academic semester and will install the turbines in the spring, possibly as a junior or senior academic project. The WAC will implement a wind energy curriculum and will graduate engineers and systems analysts knowledgeable in the wind application process and hopefully interested in pursuing wind energy as a career.

After the 3-year implementation period, the WAC will assume the responsibilities of the state facilitator and will become the primary repository of wind energy applications knowledge and expertise. Schools, small business owners, residential users, state policymakers, regulators, and other stakeholders will view the WAC as the source of information regarding wind energy applications. Although Wind Powering America/NREL



will provide technical and financial support to develop the WAC, it is anticipated that after 3 years the WAC will develop additional funding sources.

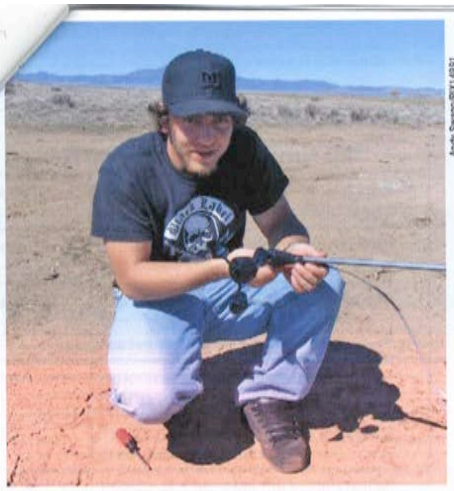
Facilitator: This individual or organization assists Wind Powering America in developing the Wind for Schools Project in each state. The facilitator's primary responsibility is to identify candidate K-12 schools and science teachers and support the project's development by working with the local communities and school administrations. The state facilitator is also responsible for working with Wind Powering America and the WAC to line up funding and implement each project. The facilitator's role is designed to last about 3 years, at which point the WAC assumes the facilitator responsibilities. Wind Powering America will provide initial funding for the state facilitators.

The success of the Wind Application Centers is one of the long-term goals of the Wind for Schools Project. The 20% Wind Energy by 2030 Scenario estimates that 3 million new positions will be created if the wind industry expands to provide 20% of the nation's electrical energy; therefore, there is an urgent need for colleges and universities to train future wind energy practitioners.

Wind Powering America/NREL/DOE: In each state, Wind Powering America will provide technical and financial assistance to the WAC and state facilitator over the first few years of the project, including:

- Conducting the annual wind energy applications training program
- Assisting in the analysis of Wind for School Projects
- Providing analysis models and other tools to support project development
- Providing turbine installation and commissioning procedures training
- Assisting in curricula development for the K-12 schools and the WAC
- Hosting students, professors, and teachers with summer projects at NREL.

Green tag marketer and sponsoring companies: The energy from the wind turbines will offset a modest amount of energy usage at the school. The green attributes for the energy produced by the Wind for Schools Project turbines will be sold to defray the wind turbine costs. Through a green tag marketer (e.g., Community Energy), a sponsoring company will pre-purchase the green tag production from the turbine over the first 10 years of operation.



Andy Swapp/PIX14951

Tyson Sherwood, a student at Milford High School in Milford, Utah, affixes an anemometer to a Skystream tower for a comparison on wind speed to power output. Tyson was in the eighth grade when the first 20-meter tower was installed on teacher Andy Swapp's farm for a school project. Now Tyson is a senior who hopes to work in the renewable energy field.

Wind turbine manufacturer: Southwest Windpower (www.windenergy.com) has joined the Wind for Schools Project as the initial supplier of all Wind for Schools systems. The standard system will incorporate a SkyStream 3.7™ wind turbine on a 70-ft guyed tower. This 1.8-kW wind turbine will produce about 3,600-4,000 kWh/year, depending on annual average wind speeds. Several tower options will also be available (including a monopole tower, or self-supporting tower without guy wires), although these tower options will incur an additional cost to the school. Other wind turbines or configurations will not be considered part of the Wind for Schools Project initial offering, although after a few years of operation this program may include other turbine options.

Local utility or electric cooperative: To ensure the success of a Wind for Schools project, the local electricity provider should be involved. The utility or cooperative should provide technical expertise (both in terms of installation and education) and assist in the installation of the wind turbine and associated hardware. The school and state facilitator (or the WAC after the initial years) will be expected to secure the support and assistance from the local provider.

Community education is one of the goals of the Wind for Schools Project, and the local electricity provider is a critical project partner. In most rural areas, the local utility or energy cooperative is one of the key community members, an entity that supplies the services that have expanded development and the quality of life. The Wind Powering America program supports an environmentally sustainable energy economy, including the expanded use of wind energy, as a way to bring prosperity to rural communities. The local electricity providers play a special role in assisting this development opportunity, although many are hesitant because of lack of experience with wind technologies. The Wind for Schools Project hopes to help bridge this experience gap.

Also, partnering with the local schools and the Wind for Schools Project provides an opportunity for local energy organizations to highlight the importance of energy in our society.

State energy office: The state energy or development office provides technical, financial, and managerial support for the project as appropriate, generally through the WAC and state facilitator. The state energy office will also identify grants and other funding opportunities for Wind for Schools projects.

Who funds the Wind for Schools Project?

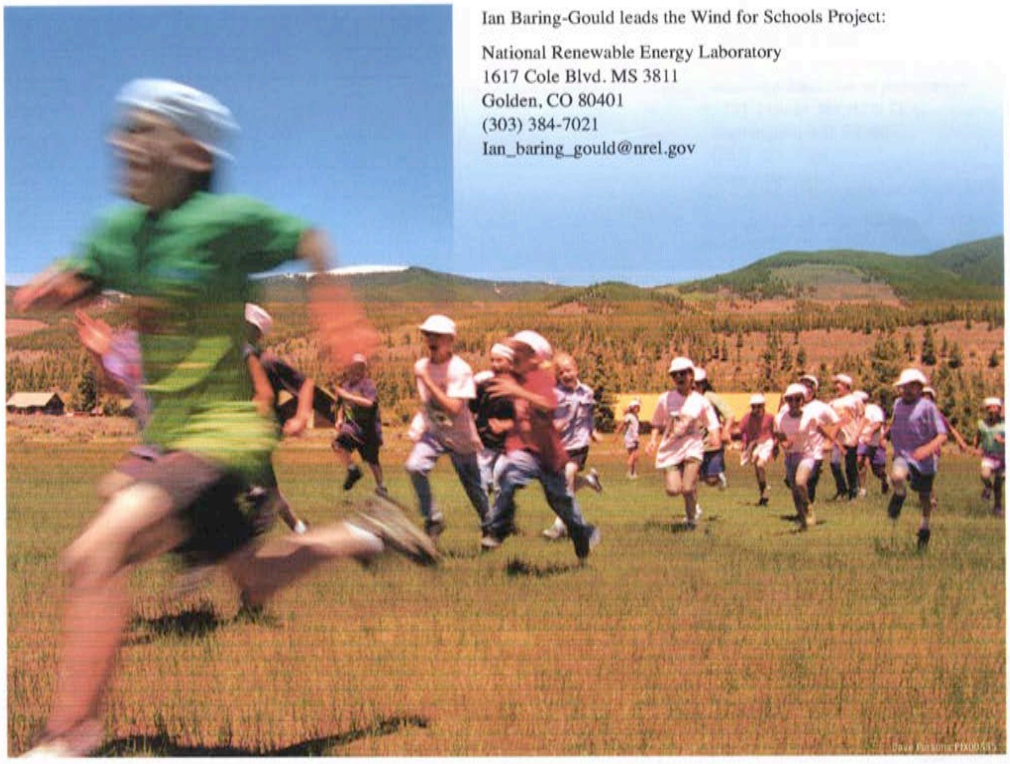
NREL, DOE, and state energy offices provide general support, especially during the initial project years. A Wind for Schools Project wind turbine costs approximately $6,000 in out-of-pocket costs. NREL/DOE does not provide funds for turbine hardware, although it may contribute to the cost of data monitoring systems and other educational materials. The school will provide approximately $1,500, the sale of the green tags will provide approximately $2,000, and state-based grants or equipment buy-down will provide the remaining $2,500. Many project participants donate their time, and the local utility or co-op hopefully will provide in-kind support for the turbine installation. Other funding options, such as low- or no-interest loans, a revolving loan fund, or other financial assistance, may be available from state organizations or local benefactors.

What is the basic system configuration for a Wind for Schools project?

The Wind for Schools Project basic system configuration incorporates a single SkyStream™ wind turbine, a 70-ft guyed tower, disconnect boxes at the base of the turbine and at the school, and an interconnection to the school's electrical system. The Wind for Schools system includes all of the disconnects and tower hardware associated with the project. For simplicity, the WACs will only install this basic power system configuration, although other tower options are available for special circumstances. If schools are interested in larger or different turbines, the state team may assist in the technical (but not financial) portions of the project.

A separate document, Wind for Schools Project Power System Brief, describes the specifications of the Wind for Schools Project system in greater detail. A PDF is available at www.windpoweringamerica.gov/pdfs/wpa/schools_wind_brief.pdf.

Basic Timetable for Wind for Schools Projects	
Summer	Identify nine to ten candidate host schools; narrow selection to four to six for analysis
Summer	Convene training week at National Wind Technology Center
Early fall	Implement initial Web-based analytical training of WACs and host schools as needed
Fall	Perform analysis of candidate schools (WACs)
Fall	Secure financing for projects (including green tags transaction)
Winter	Permits and planning the installation of projects at host schools
Spring	Install systems at host schools
Spring/Fall	Institute host school K-12 curriculum



Depending on the requirements of a specific project, a foundation and guy wire anchors must be installed prior to turbine installation. Turbine foundations must be installed 1 month prior to the turbine installation. In some cases, fencing around the base of the wind turbine should be installed.

Early discussion with the local power cooperative or utility is essential because the wind turbine is a power generation device. The local power cooperative or utility should be an integral part of the Wind for Schools Project and should assist in the turbine installation and associated electrical interconnections. However, special electrical permits are not required because the turbine is not expected to produce enough energy to supply a large portion of the school's power needs, even at low-load periods during the summer or at night.

How do I learn more?

The Wind Powering America Web site offers a section devoted exclusively to wind energy and schools, including updates on the Wind for Schools Project: www.windpoweringamerica.gov/schools.asp.

Ian Baring-Gould leads the Wind for Schools Project:

National Renewable Energy Laboratory
1617 Cole Blvd. MS 3811
Golden, CO 80401
(303) 384-7021
Ian_baring_gould@nrel.gov

www.windpoweringamerica.gov

WIND POWERING AMERICA

Summary

The U.S. Department of Energy's (DOE's) Wind Powering America program (based at the National Renewable Energy Laboratory) sponsors the Wind for Schools Project to raise awareness in rural America about the benefits of wind energy while simultaneously educating college seniors regarding wind energy applications.

The three primary project goals of the Wind for Schools Project are to:

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- Equip college students in wind energy applications
- Introduce wind energy to rural communities, initiating a discussion of wind energy's benefits and challenges.

Resources

U.S. Department of Energy
Wind Energy Program
Forrestal Building
1000 Independence Ave., S.W.
Washington, D.C. 20585
(202) 586-5348
www.eere.energy.gov/windandhydro
www.windpoweringamerica.gov/schools.asp

National Renewable Energy Laboratory
National Wind Technology Center
1617 Cole Blvd.
Golden, CO 80401
(303) 384-6979
www.nrel.gov/wind

American Wind Energy Association
1101 14th St. NW, 12th Floor
Washington, D.C. 20005
(202) 383-2500
www.awea.org

December 2007 • DOE/GO-102007-2461

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For more information contact:
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Appendix 5: Site Map of Henley Middle School

Appendix 6:

Ranking sheet

Turbine Design #	***1st***	***2nd***	***3rd***	***4th***
#1				
#2				
#3				
#4				

Ranking sheet

Turbine Design #	***1st***	***2nd***	***3rd***	***4th***
#1				
#2				
#3				
#4				

Appendix 7:

Blade Design Analysis and Testing Lesson Plan

45 MIN CLASS PERIOD

1. Intro to wind energy
2. Show 4 designs – rank them silently (see ranking sheets), use 2 models/fans
3. Assign a design to each team – analyze design, make hypotheses about why it will perform like they think, test their designs – 3 tests and then average, discuss what they could do to make it better (see worksheet)
4. Teams report back results – discuss why or why not perform as expected

EXTENSION: If have more time allow students to redesign their blades to make them better

Appendix 8:

Wind Turbine Blade Design Analysis and Testing Worksheet

Names of group members:

Date:

ANALYSIS

Design #:

Shape of blades (draw a picture):

Number of Blades:

Length of Blades (inches):

Width of Blades (at widest point; inches):

Pitch of Blades (°):

Distance to the hub (inches):

Blade material:

Hypothesis (How many volts will it generate? Why?):

TESTING

Test	*Volts Generated*
1	
2	
3	
Average	

Did the design perform as you hypothesized? Why or why not?

What could you do to make this design better?

Appendix 9:

Survey:

1. Where did most of the energy we use originally come from?
    a. the sun
    b. the wind
    c. the soil
    d. the oceans
2. Electrical Energy can be produced from;
    a. Mechanical Energy
    b. Chemical Energy
    c. Radiant Energy
    d. All of the above
3. Which uses the most energy in American homes each year?
    a. lighting
    b. water heating
    c. heating and cooling rooms
    d. refrigeration
4. Which produces more carbon emissions, wind power or natural gas?
    a. wind power
    b. natural gas
5. Which of these is a problem when using wind as a power source?
    a. It causes climate change
    b. The wind doesn't blow all the time
    c. They have to be close to major cities
6. According to the World Wind Energy Association, what percent of the world's electricity comes from wind?
    a. 1-2%
    b. 10%
    c. 15%
    d. 50%
7. How does a wind turbine make electricity?
    a. The spinning blades turn a shaft that connects to a generator

   b. They raise water that then flows downhill and runs a turbine that connects to a generator
   c. Tiny elves inside the blades run on treadmills

8. Do you find the topic of alternative energy interesting?
   a. Yes
   b. No
9. Do you know what sustainability means?
   a. Yes
   b. No
10. Are you interested in learning more about alternative energies?
   a. Yes
   b. No