2009 ATEEC Fellows Institute

Instructional Activity

Wind Power Virtual Field Trip

Advanced Technology
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Virtual Field Trip Team

Left to right in photo: Deb Hall, Bill Glover, Stacy Rafter, and Jeff Newmeister

Deb Hall, Valencia Community College, Orlando, FL
Deb, an electrical engineer, teaches Engineering Concepts and Methods, Introduction to Engineering Technology, Mathematics for Electronics, introductory courses on AC and DC circuits, and Engineering Computer Graphics. She is devoted to encouraging girls toward careers in sciences, technology, engineering, and math. Among Deb's professional opportunities was a January 2009 Solar Energy International course, "Solar Electricity for the Developing World," in Costa Rica.

Bill Glover, University of Texas Charter Schools, Austin, TX, 1995-2007 Fellow
As a Science Support Person (Coach), Bill works with science teachers from three of the 16 schools of the University Charter School Program. The three member science support team develops workshops and curriculum guidelines and provides model teaching experiences and teacher support from Kindergarten through High School. Before this current work, Bill retired from many years of teaching high school science and serving as associate principal in Austin. Bill has long been an ATEEC Fellow and has been a Mentor for many of those years.

Stacie Raft, Allegany College of Maryland, Everett, PA (PA campus)
Stacie has been teaching environmental science, physical science, geology, and biology 101. As a former lab tech she conducted histocompatibility testing for potential organ transplant recipients. At a law firm involved in long term-litigation related to cigarettes, Stacie analyzed research and engineering documents and coded the information for the attorneys. Stacie is concerned with energy issues, since she resides in coal-country and finds that wind energy is controversial in her region.

Jeff Newmeister, North Scott High School, Eldridge, IA, 2000-2001 and 2003-2008 Fellow
Jeff teaches Honors Biology, Environmental & General Biology, and General Science. In 2000 and 2001 Jeff was trained at the University of Wisconsin Center on Education and Work to apply the principles of contextual teaching and learning ("CTL"). Jeff was selected as a presenter about CTL for the 2000 Association for Career and Technical Education convention in San Diego. Among Jeff and his students' ongoing CTL work is monitoring surface waters for Iowa's IOWATER data collection program. Among his activities, Jeff volunteers for the X-Stream Mississippi River clean-up and lets off academic steam through coaching football, wrestling, and track.

Welcome to our virtual field trip to a wind farm!

Everything you wanted to know about Wind Energy and MORE…

Select a Virtual Field Trip (VFT) version that suits your technology:

1. View the PowerPoint Presentation with Vimeo links in this document

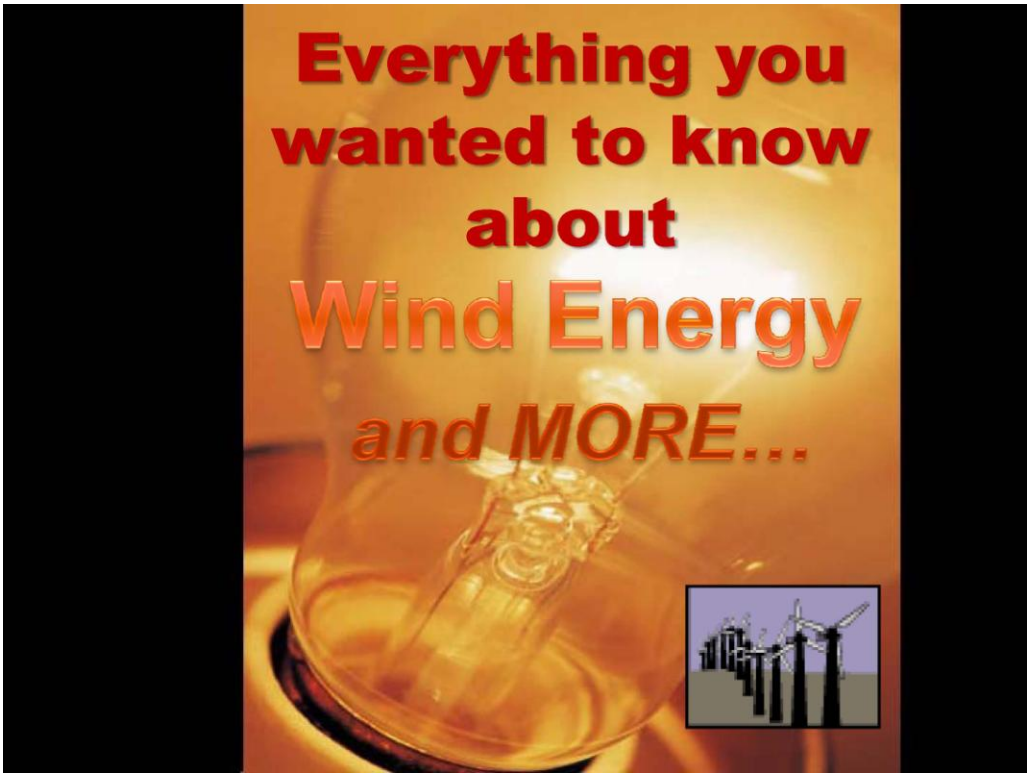
2. Download the PowerPoint Presentation with Vimeo links FREE at www.ateec.org/store/.

    a. Version A: A more modestly sized two-part version, minus only a few decorative images on the full-length version.
        i. Virtual Wind Power Field Trip Part 1 – VWPFT_pt1.ppt (1.4 Mb) and
        ii. Virtual Wind Power Field Trip Part 2 – VWPFT_pt2.ppt (1.6 Mb)

    b. Version B: The original full-length version.
        i. Virtual Wind Power Field Trip – VWPFT.ppt (7.7 Mb)

3. Access the Vimeo videos only

The Virtual Field Trip: PowerPoint and Vimeo



Wind Energy

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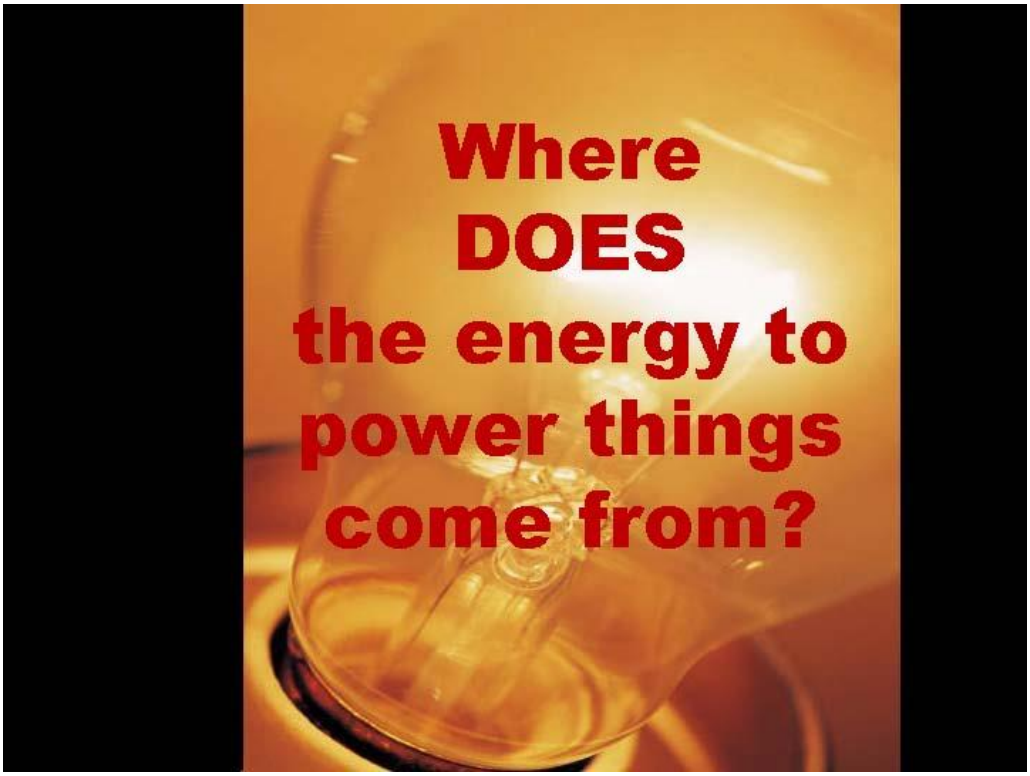
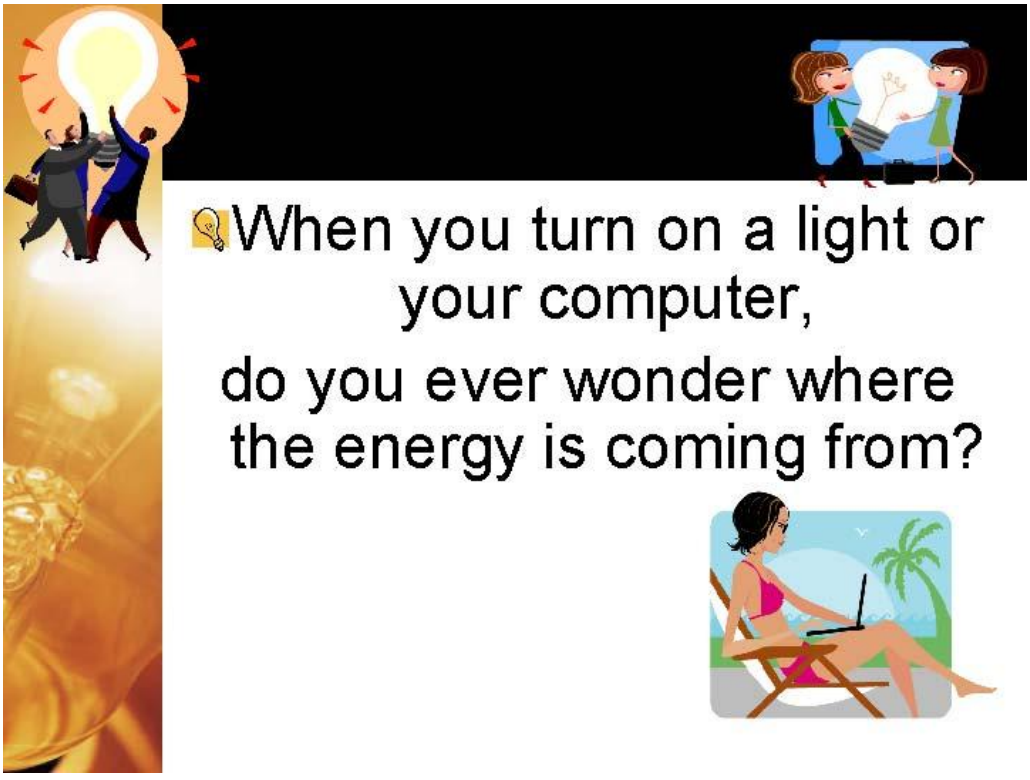
Click on a specific topic to find out more!

- Where does our power come from?
- Energy Grid Systems
- Wind Energy Field Trip
- Transmitting Power
- Wind Energy Instructor Interview
- Wind Turbine Technician Student Interview
- Utility Company Interview
- Wind Turbine Technicians' Interview
- Wind Energy Careers
- Wind Turbine Siting Issues
- Environmental Justice
- Energy Storage
- Impact on Wildlife
- Interesting Websites
- Acknowledgements





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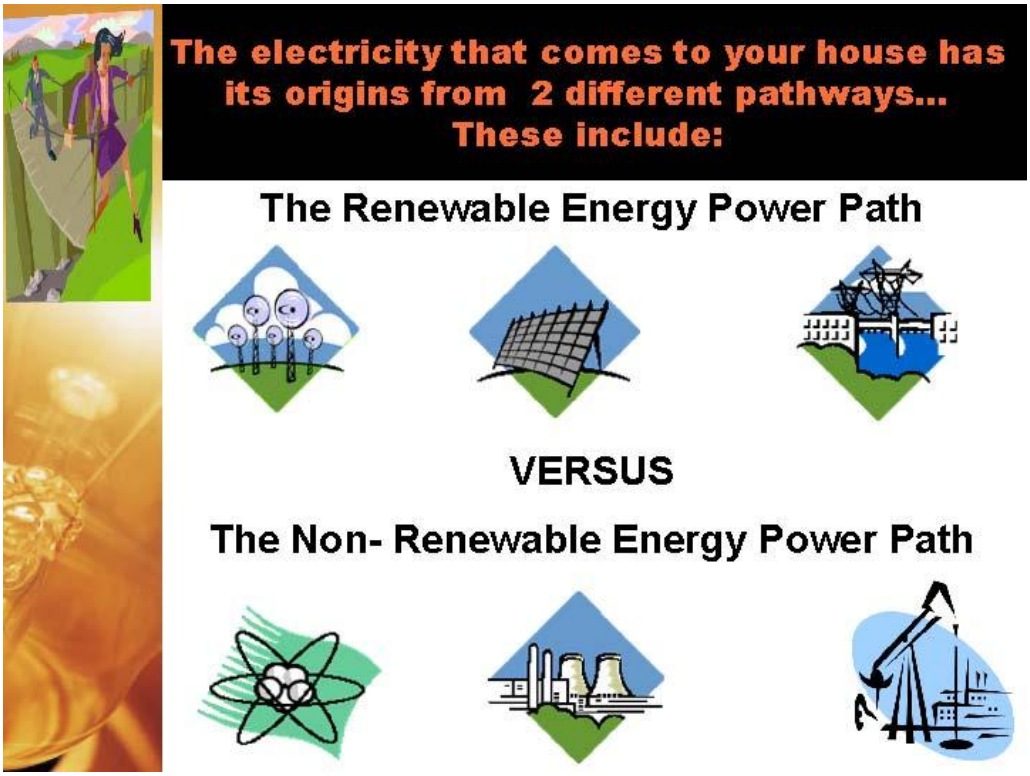

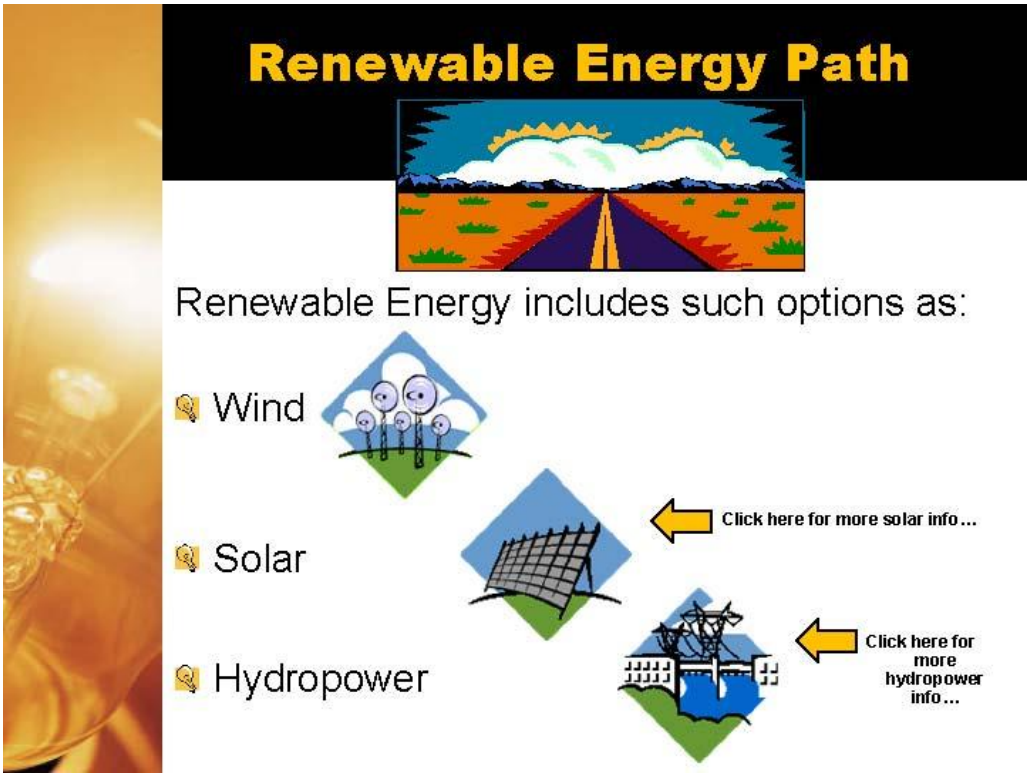

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Non-Renewable Energy Path

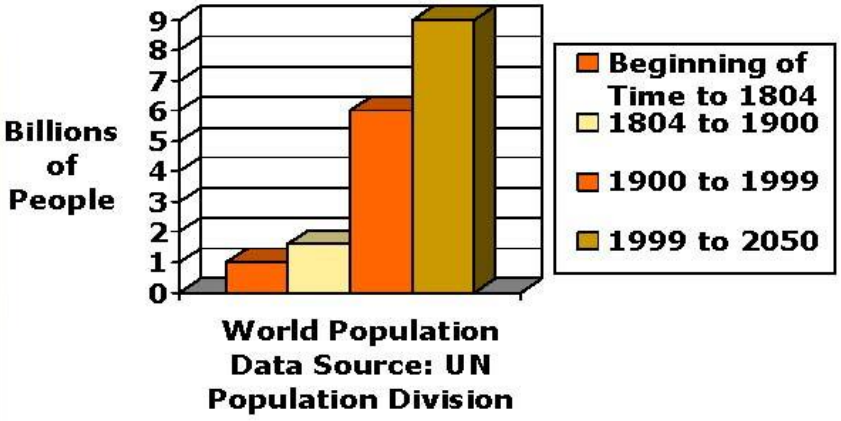
Non-Renewable Energy includes such options as:

- Petroleum
- Natural Gas
- Coal
- Nuclear

Click here for more non-renewable energy info...

Due to LARGE increases in our world's population,

the resulting need for energy resources could deplete the world's energy supply...



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An Engineering Challenge...

If our current levels of energy consumption remain constant ,

Non-renewable reserves *should* supply:

- World petroleum needs for 40 years
- World natural gas needs for 60 years
- World coal needs for 200 years

(Source: US Energy Information Administration)

...or we could choose to walk down the Renewable Energy Path

- 1st step...

to be on the GRID or to NOT be on GRID?

...that truly is our first question to answer!

Do we want to have a ***Stand-Alone "Off the Grid" System***?

OR

a ***Grid-tied System***

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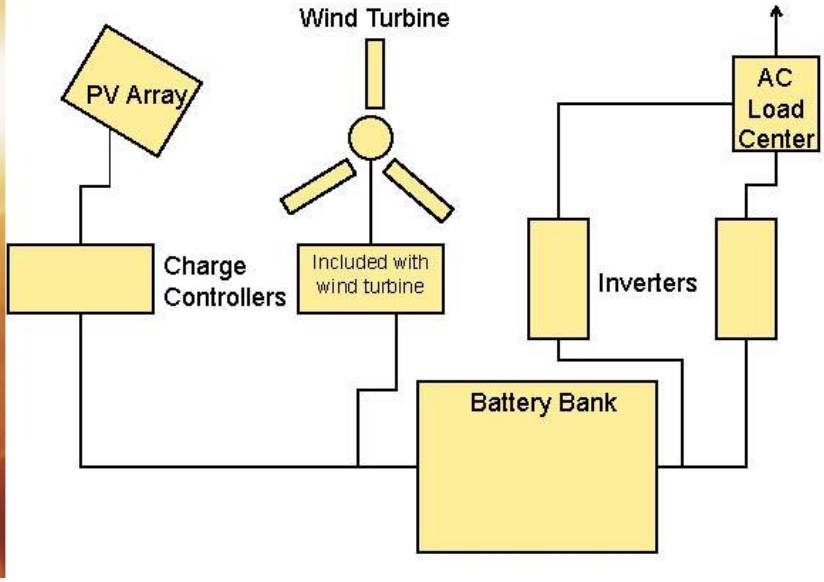
What is a Stand-Alone "Off the Grid" System?

- ***A Stand-Alone System*** means that you are powering your home with one or more energy sources such as:
  - **A Photovoltaic Solar Array**
  - **A Wind Turbine**
  - **Micro-Hydropower**
  - **A Gas-Powered Generator**

that you have had installed and which is sized for your home's power needs...

A Photovoltaic/Wind Hybrid Stand-Alone Example

Note: Certain wire runs are missing for simplification purposes



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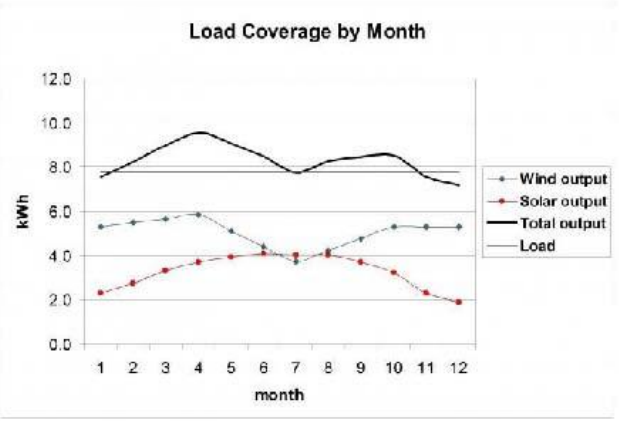
Symbiotic Relationship between Wind and Sun Resources

- This relationship shows how hybrids can provide more reliable power than systems that rely solely on ONE power source…



- Note: Click on graph for more info…

An Engineering Challenge…

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(Source: US Energy Information Administration)

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3 Main Power Grids

- The United States is divided into

3 main power grids:

- The Eastern Interconnected System
- Western Interconnected
- Texas (ERCOT)

What is a SMART power grid?

- ***A SMART power grid*** is an electric grid that delivers energy from generation to consumers via transmission system lines and substations. It utilizes the newest technologies, tools, and techniques to make the grid more efficient.

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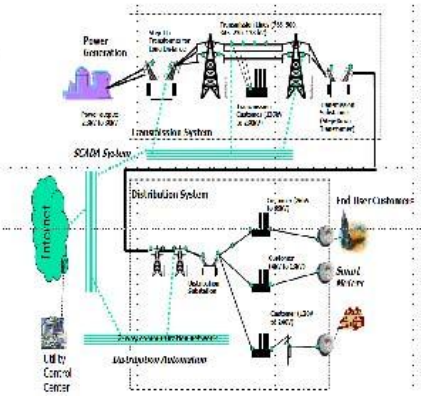
Benefits of a SMART power grid

- Benefits of using small-scale power generation technologies located closer to the load being served are:
  - Lowered costs
  - Improved reliability
  - Expanded energy options…



How about taking a field trip to where utility companies harness the power of the WIND?

- **LET'S GO!!!**
- ***Click on the link below to begin your wind power adventure…***

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Let's take a closer look at wind turbines...

- What is a wind turbine?
- Are there different kinds of turbines?
- How much do they cost?

- Click on the link below for answers to these questions and MORE...

How does a wind turbine work?

- How do they build turbines?
- What are the different parts of a turbine?
- How does it convert wind energy into electricity?

- Click on the link below and you SOON will know...

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Want to see a really cool video about commissioning a wind turbine?

- *Just click on the link below...*

How does this Wind Power get from the Wind Farm to your home?

Transmission lines carry electric energy from one point to another point...

EASY BREEZY, right?

...well, maybe it's not THAT EASY!

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Transmission Lines

- Electricity is not easily stored, therefore the power system must be constantly adjusted to match power consumption…
- There are approximately 150 control area operators that utilize computerized control centers to turn on/off generators as needed.
- Congestion (bottlenecks) occur in transmitting electricity due to increases in power consumption by customers…

Stepping Voltage Up *AND* Stepping Voltage Down…

From ***substations*** located at the wind farm, power is **stepped up** to travel on higher-voltage transmission lines to other ***substations*** where power is then **stepped down** to lower-level voltage lines which eventually lead to your home!

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Why is it necessary to step-up the voltage to travel on higher-voltage transmission lines?

- It all goes back to the formula for power:

P=IV

(POWER = CURRENT x VOLTAGE)

The culprit is CURRENT a.k.a. the intensity of electron flow!

- If current increases, heat is produced and you end up actually LOSING energy due to ***Joule heating***!
- The goal is to keep your current as **LOW** as possible which is ***INVERSELY*** proportional to voltage... **P=IV**
- ***Therefore, we MUST step up that voltage!!!***

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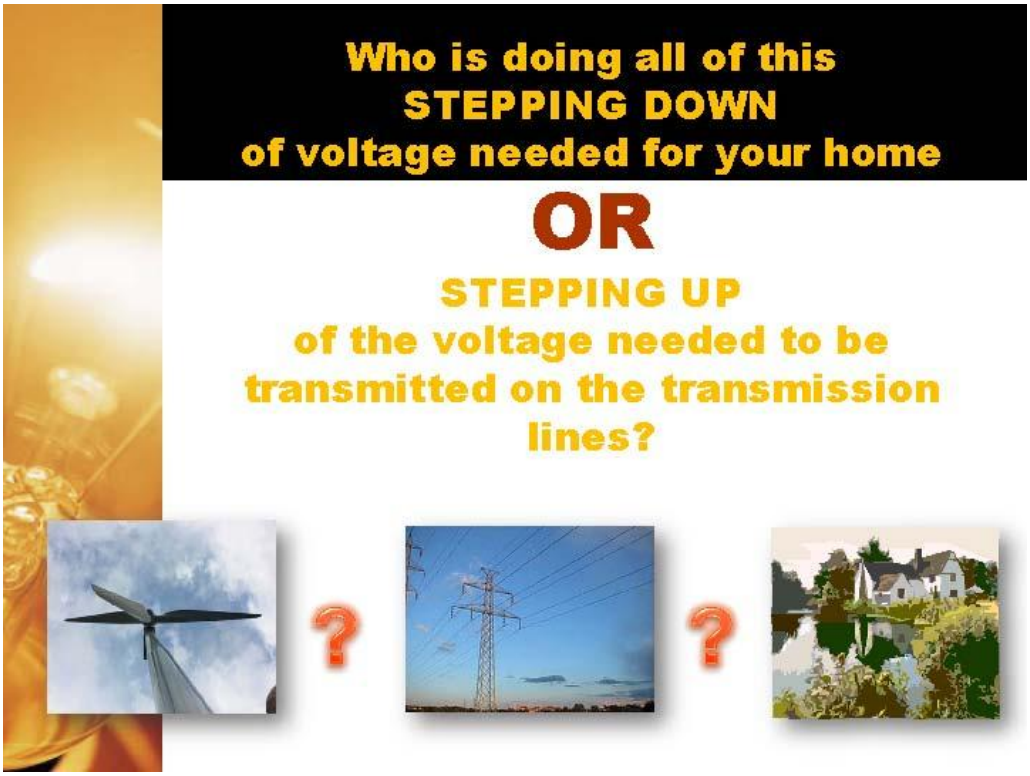

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How does this Wind Power get from the Wind Farm to your home?

- ***Control area operators*** at the utility company continually monitor system voltage levels ensuring that one power system does not cause problems for its neighboring power sources...

Meet some folks who are passionate about Wind Energy...

- Meet Al Zeitz, the Wind Energy Director and Industry Trainer and Craig Evert, a wind energy turbine and technology instructor at Iowa Lakes Community College and learn about their Wind Energy and Turbine Technology program...
- ***Just click on the link below...***

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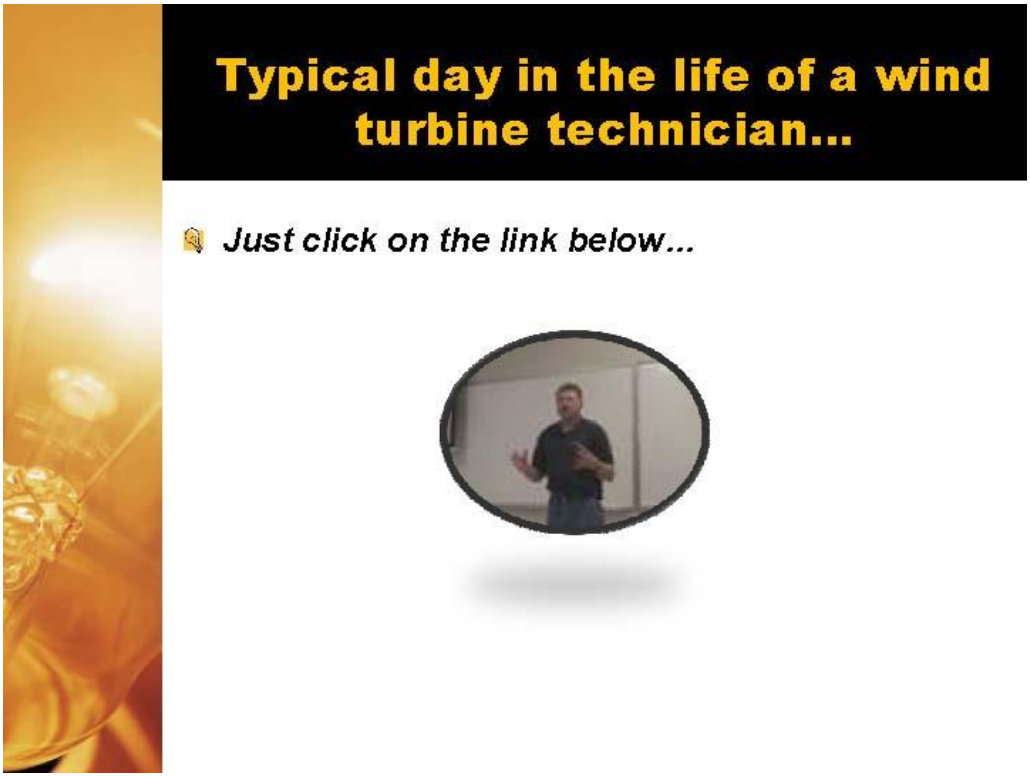

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Meet Joe Brightwell… a wind turbine technician student at Iowa Lakes Community College!

- *Just click on the link below…*

Meet more folks who are passionate about Wind Energy…

- Meet Joseph Bannon, the manager of Environmental Training, Performance, and Support at Iowa's MidAmerican Energy Utility Company…
- Here Joseph provides us with an overview of MidAmerican's wind energy program focusing on MidAmerican's role and funding issues…
- *Just click on the link…*

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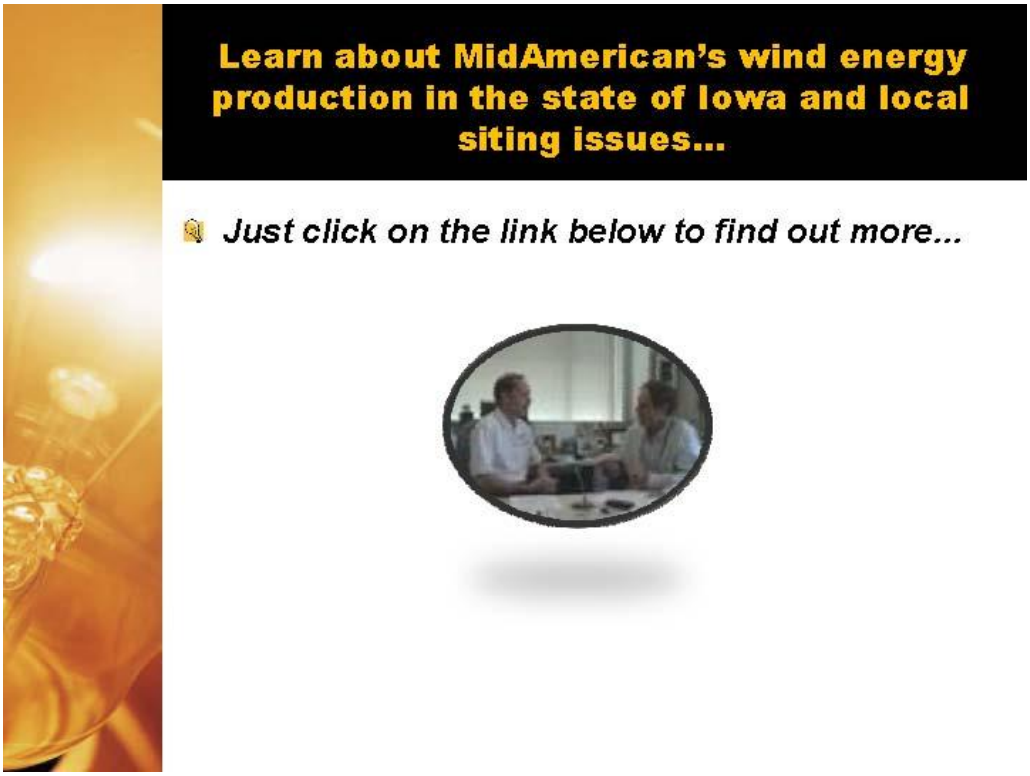

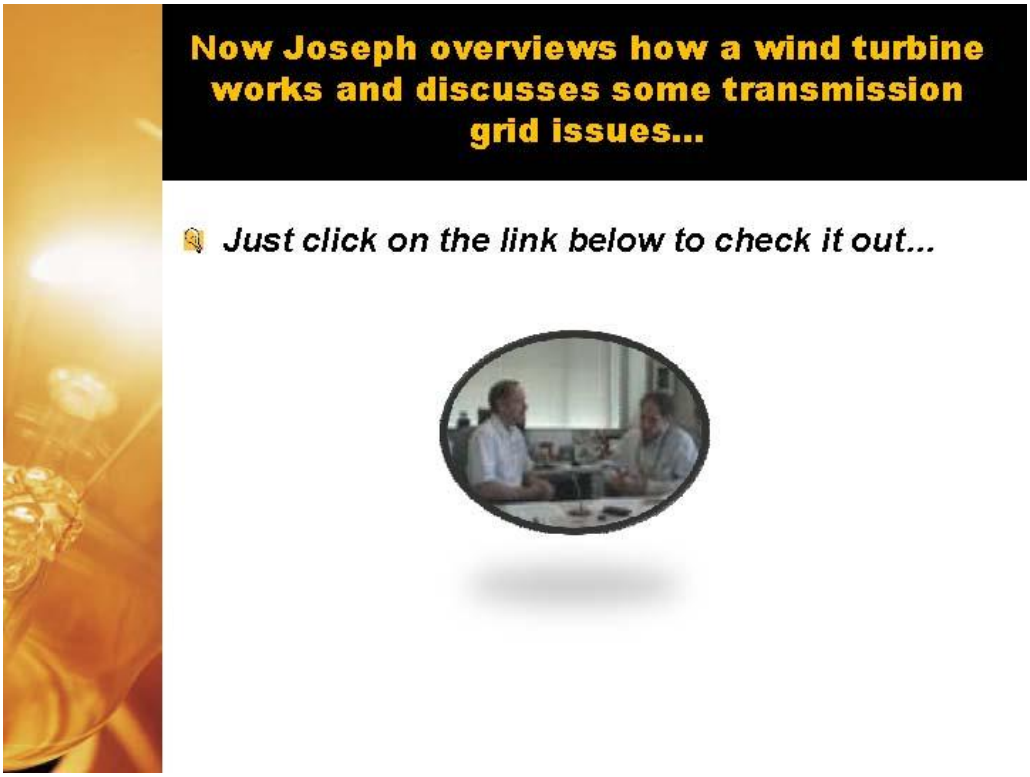

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Learn about MidAmerican's wind energy production in the state of Iowa as well as issues relating to siting a wind farm...

- *Just click on the link below to find out more...*

Meet some more folks who are passionate about Wind Energy...

- Meet Justin and Lance, Vestas wind turbine technicians working on a west Texas wind farm...
- *Just click on the link below...*

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Hey! You seem to *ALSO* be passionate about wind energy...

Want to know MORE about what sort of COOL careers are related to this form of renewable energy?

Just click on the link below...

Want to learn *MORE* about the Scientific and Technical Considerations for Wind Turbine Siting?

Just click on the link below...

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Are there any Environmental Justice Concerns involved with siting wind turbines?

- *Click on the link below to find out!*

Interested in learning MORE about wind energy storage?

- *Just click on the link below…*

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Do wind turbines have any impact upon the local area wildlife?

- *Click on the link below to find out!*

MORE Nifty Websites to Check Out!

- MidAmerican Energy Virtual Plant Tour
- DOE Energy Efficiency and Renewable Energy
- Solar Energy International

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Acknowledgements
The ATEEC 2009
Virtual Wind Farm Field Trip Team
would like to thank the following:
Our FABULOUS ATEEC advisors!!!
National Science Foundation
University of Northern Iowa
MidAmerican Energy Utility Company
Iowa Lakes Community College
Clipper Wind
Vestas
Becks
GO WIND POWER!!!
ALL of the other INCREDIBLE ATEEC teams!

Virtual Field Trip: Vimeo Videos

Video: Clipper Wind Turbine Construction

http://www.vimeo.com/5264577

This video, provided by Clipper Wind, shows a time lapsed look at the assembly of a wind turbine on site.

Video: Commissioning a Wind Turbine

http://www.vimeo.com/5263113

This video was taken on June 16, 2009 at Iowa Lakes Community College. Al Zeitz and Craig Evert are instructors in the Wind Energy and Turbine Technology program. In this video Al discusses the commissioning of a wind turbine.

Video: Decommissioning a Wind Turbine

http://www.vimeo.com/5260463

This video was taken on June 16, 2009 at Iowa Lakes Community College. Al Zeitz and Craig Elvert are instructors in the Wind Energy and Turbine Technology program. In this video, they discuss the decommissioning of a wind turbine.

Video: Defining a Wind Turbine

http://www.vimeo.com/5277913

This video will define a wind turbine.

Video: How a Wind Turbine Works

http://www.vimeo.com/5277955

This video will discuss how a wind turbine works.

Video: Iowa Lakes Community College Wind Energy and Turbine Technology Program

http://www.vimeo.com/5260501

This is a question and answer session with Al Zeitz and Craig Evert, instructors at Iowa Lakes Community College discussing the Wind Energy and Turbine Technology program. The comments were completed on June 16, 2009.

Video: Iowa Lakes Community College Wind Turbine Technician Student Interview

http://www.vimeo.com/5247032

This is an interview with Joe Brightwell, a student at Iowa Lakes Community College discussing the Wind Energy and Turbine Technology program. The interview was completed on June 16, 2009.

Video: MidAmerican Energy Interview – Part 1 Wind Turbines

http://www.vimeo.com/5261902

This interview was completed on June 12, 2009 in Davenport Iowa with Joe Bannon of MidAmerican Energy. This interview provides an overview of MidAmerican's wind energy program focusing on MidAmerican's role, and funding issues.

Video: MidAmerican Energy Interview – Part 2 Wind Turbines

http://www.vimeo.com/5262012

This interview was completed on June 12, 2009 in Davenport Iowa with Joe Bannon of MidAmerican Energy. This interview focuses on MidAmerican's wind energy production in the State of Iowa and local siting issues.

Video: MidAmerican Energy Interview – Part 3 Wind Turbines

http://www.vimeo.com/5262071

This interview was completed on June 12, 2009 in Davenport Iowa with Joe Bannon of MidAmerican Energy. This interview focuses on how a wind turbine works as well as transmission grid issues.

Video: MidAmerican Energy Interview – Part 4 Wind Turbines

http://www.vimeo.com/5262098

This interview was completed on June 12, 2009 in Davenport Iowa with Joe Bannon of MidAmerican Energy. This interview focuses on MidAmerican's wind energy production in the State of Iowa as well as issues relating to siting a wind farm.

Video: Technicians Interview at a Texas Wind Farm

http://www.vimeo.com/5262588

Two wind technicians are interviewed in the field about their work on June 12, 2009.

Video: Typical Day of a Wind Turbine Technician

http://www.vimeo.com/5264058

This video was taken on June 16, 2009 at Iowa Lakes Community College. Al Zeitz and Craig Evert are instructors in the Wind Energy and Turbine Technology program. In this video Al and Chris discusses the typical day of a wind turbine technician.

Video: Wind Turbine Conditioning Monitoring

http://www.vimeo.com/5276578

This video discusses how to monitor the condition of a wind turbine.

Video: Wind Turbine Sounds

http://www.vimeo.com/5247224

This video was taken at Iowa Lakes Community College on June 16, 2009. The video demonstrates the sound level produced by a 1.5 megawatt turbine while running and then as then as the turbine is shut down. Note: some ambient wind sound is heard by the camera microphone.