DTE

EDUCATOR COMPANION GUIDE

Renewable Energy Virtual Field Trip

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Overview

DTE's renewable energy virtual field trip travels to Polaris Wind Park, Lapeer Solar Park and O'Shea Solar Park to teach students about clean energy resources and the increasingly important role they play in helping us combat climate change. During the field trip, students will learn how we are using the wind and the sun to generate power, how this energy travels from where it is created to our homes and business as well as the different types of job opportunities that exist in the Energy industry. They will also learn about different ways to reduce their energy use and lower their carbon footprint.

The purpose of this guide is to provide educators with ideas for additional learning activities they can use to enhance the educational value of the field trip.

Key Learning Objectives:

Students will be able to:

- Explain how we generate energy from the wind and sun
- Explain how this energy travels along the power grid
- Imagine new ways to generate more energy from the wind and sun
- Understand the importance of addressing climate change
- Identify ways they can use energy more efficiently and reduce their carbon footprint
- Explore how individuals, businesses, nonprofit organizations and government can work together to create a more sustainable future
- Learn about different careers in the clean energy sector

Classroom and Small Group Discussion Topics:

A. **To successfully combat climate change, lawmakers, companies and community members all need to work together. Let's think about the different ways these groups can collaborate to create a cleaner future.**

- How do you measure your carbon footprint and what steps can you take to reduce yours?
- How could different groups work together to make our cities and communities more sustainable? For example, how could energy and automotive companies encourage more people to drive electric vehicles? What other partnerships could be formed to encourage clean energy development or technological innovation?

B. **Let's imagine the future of energy. What can you picture? What advances to existing technologies need to be made for this vision to become a reality? How can power be generated from wind and solar energy even more efficiently?**

- Imagining the cities of the future, how could wind turbines be designed differently to be used in urban environments?
- How could we use solar panels to generate more energy from the sun? Can you think of other places solar panels could be installed or located?

Research Projects:

A. As engineers looked to the windmill for inspiration when developing a wind turbine, what made them consider a 3-blade design? Why is this design more effective? What are the main components of a wind turbine? Why are wind turbine blades shaped the way they are? How are the blades angled and positioned in relation to the wind? What type of energy is used and generated by a wind turbine?

B. The price of solar energy has decreased dramatically in recent years due to advancements in solar technology. What other innovations can you think of to increase generation from solar energy?

C. What are greenhouse gases? How are they contributing to climate change? What are some effects of climate change on the environment, agriculture and food supply, weather, economies, or where we live? What other potential impacts can you identify? What are some strategies to combat climate change?

D. Despite the overwhelming consensus among the scientific community, there are those that still deny that climate change is real. Create a 60-second commercial to convince the audience of the existence of climate change, the negative impacts to the earth and steps that they can take to be part of the solution.

Suggested rubric:

- References multiple sources
- Effective use of maps, charts or diagrams (clearly labeled, neat) to illustrate points
- Provides evidence to illustrate their point and make the case
- Addresses multiple questions in the topic overview
- Tone – serves to educate, not talk down to
- Is compelling and engages the reader/ audience
- Uses descriptive words, powerful language and compelling imagery to educate and influence
- Presents a clear call to action as appropriate

Job skills and related careers in energy

1 What skills/talents do you have?

2 List three jobs mentioned on the virtual field trip.

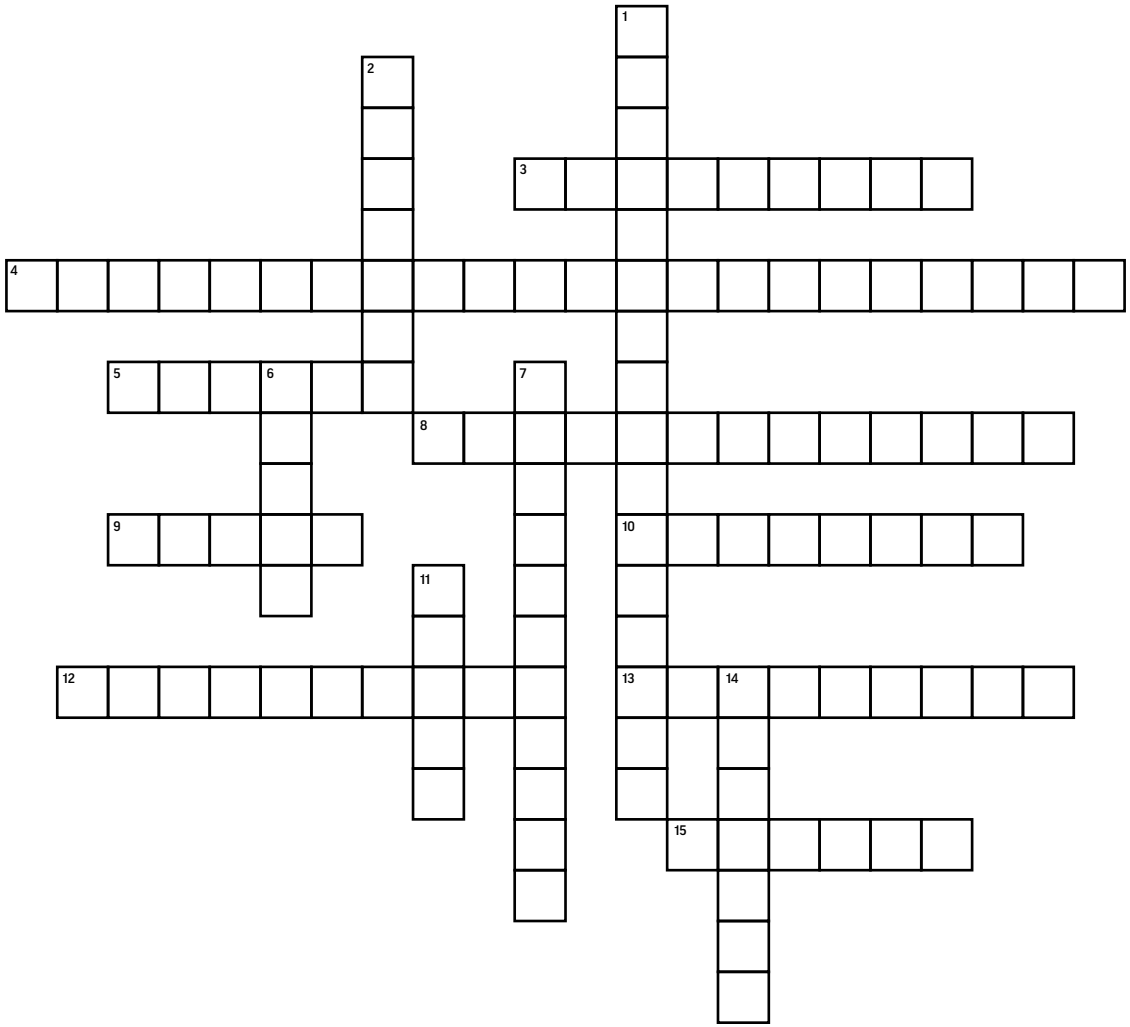
3 For each job, list 2 required skills – check if they match any of your skills/interests.

Job	Required Skills	Skill Matches

4 For each job, list what interests you about that career.

Job	Interests me because...

Crossword puzzle



Down:

1. Type of energy converted to electrical energy by a wind turbine
2. Atomic element found in solar panels
6. Energy generated from the sun
7. Uses blades to generate energy
11. Angle of the blades on a wind turbine
14. Operations center of the wind turbine

Across:

3. Vehicle the size of the nacelle
4. Goal of DTE by 2050
5. Patented the first light bulb
8. Impact of greenhouse gases
9. Series of solar panels
10. Negatively charged particle inside an atom
12. Measures the speed of the wind
13. Doesn't get used up
15. _____ reuse and recycle

Definitions

While watching the video (or after) write a definition for each of the following terms related to wind and solar energy.

i. Electrical energy	
ii. "Net zero" carbon emissions	
iii. Rotor	
iv. Nacelle	
v. Silicon	
vi. Electron	
vii. Power grid	
viii. Anemometer	
ix. Array	
x. Renewable	

Answer Keys:

CROSSWORD PUZZLE

Down:

1.	Mechanical Energy
2.	Silicon
6.	Solar
7.	Wind Turbine
11.	Pitch
14.	Nacelle

Across:

3.	School Bus
4.	Net Zero Carbon Emissions
5.	Edison
8.	Climate Change
9.	Array
10.	Electron
12.	Anemometer
13.	Renewable
15.	Reduce

DEFINITIONS

i.	**Electrical energy**	Energy created by the flow of electrons.
ii.	**"Net zero" carbon emissions**	The status of off-setting carbon emissions by reducing or eliminating carbon emissions elsewhere.
iii.	**Rotor**	The blades and hub that are attached to the generator at the top of the wind turbine.
iv.	**Nacelle**	The operations center of the wind turbine. The nacelle houses the gear box, low- and high-speed shafts, a generator, the controller, and the brake, and sits atop the wind turbine.
v.	**Silicon**	The element found in the material used to create solar panels.
vi.	**Electron**	Negatively charged particle inside an atom that orbits the nucleus.
vii.	**Power grid**	A network of transformer stations, transmission towers and substations that transport electricity from a generating station and into our homes and businesses.
viii.	**Anemometer**	An instrument for measuring the speed of wind.
ix.	**Array**	A series of solar panels connected together to generate electricity.
x.	**Renewable**	A source of energy that is not depleted by use, such as water, wind, or solar power.

Additional Resources and Hands-On Demonstrations/Activities:

Bringing Science to Life

Materials that allow for demonstrations and hands-on learning can help students better understand the concepts being illustrated – especially visual learners. Here are a few items that can be used in a classroom along with a description of how to use them to support concepts being discussed.

1. Floating magnets can help illustrate the concept of positive and negative charges.
2. Energy sticks are a fun way to demonstrate how electrons flow in a closed circuit. Let one of your hands off of the energy stick, and the circuit is broken.
3. Wind turbine models are a great way for students to experiment with pitch and yaw – how the blades of a wind turbine need to be angled to capture the wind's energy and what direction the rotor and blades need to be facing.
4. Solar mechanics kits and pre-built solar cars allow students to see how solar panels perform at different angles.
5. Carbon footprint calculators can help students measure their impact on the environment.

Disclaimer:
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Glossary of Terms

Carbon footprint: The total output of greenhouse gas emissions caused by an organization, event, product or person.

Net zero carbon emissions: Balancing carbon emissions with carbon removal or simply eliminating carbon emissions altogether.

Renewable energy sources: Energy sources that do not get depleted or used up when they are used. Renewable energy is also clean energy meaning it does not produce byproducts that are harmful to the environment.

Pitch: The angle of the blades attached to the rotor.

Yaw: The direction of the rotor in relation to the wind. The rotor needs to be facing into the wind for the blades to rotate effectively.

Climate change: The average temperature of the earth is rising. We refer to this phenomenon as global warming. Global warming is resulting in changes to weather patterns including increasing or decreasing rainfall amounts, extreme weather incidents, variations in the timing of the arrivals of the seasons, and more. Collectively, global warming and its effects are known as climate change.

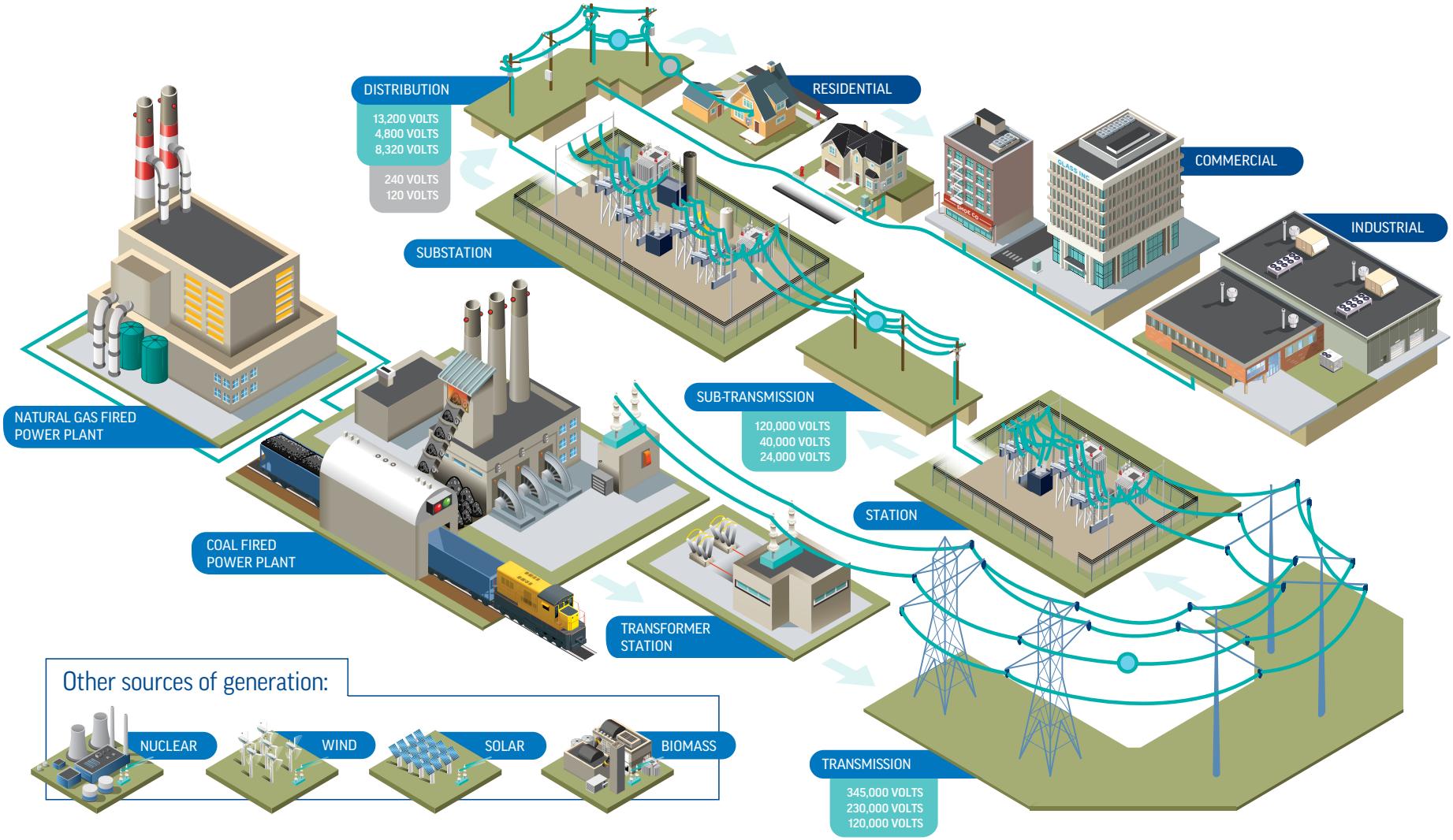
Quiz Game: Questions

Category 1	Category 2	Category 3	Category 4	Category 5	Category 6
Solar Energy	**Electricity**	**Wind Energy**	**Renewable Energy**	**From point A to point B**	**Wildcard**
Solar panels are made of this element.	Electricity is the flow of this particle.	Home to cows and crops, these are ideal locations for wind turbines.	Often called this type of energy since it doesn't pollute the environment	The journey of electricity starts at this kind of station.	Coal-fired power plants emit this pollutant into the air.
This is the location of one of the largest solar parks east of the Mississippi river.	Electrons are found inside these.	Wind turbines in Michigan are taller than this national monument.	In addition to wind and solar, this type of renewable energy is produced along Lake Michigan's shoreline.	The network of power lines, transformer stations, towers and substations is collectively called this.	This man patented the first light bulb.
This is the average lifespan of a solar panel.	When the sun's rays strike a solar panel, they knock electrons out of these, sometimes called shells.	The size of a school bus, this is the operations center of the wind turbine.	Changing weather patterns and rising sea levels are two effects of this.	A substation converts power to a lower and _____ level of power?	O'Shea Solar Park is home to 20,000 of these insects.
Solar panels capture the greatest amount of energy during this season.	DC is short form for this kind of current, generated when electrons flow within a solar panel.	This sits on top of the wind turbine to measure the speed of the wind.	By adding more renewable energy, DTE plans to achieve this by 2050.	Energy can travel hundreds of this distance unit before arriving in your home.	This term refers to how much carbon your actions are responsible for emitting.
Multiple solar panels linked together are called this.	So that it can travel efficiently over long distances, direct current is converted to this.	Polaris Wind Park generates enough energy to power this many homes.	The two most common renewable energy sources used in Michigan.	A generating station generates this kind of energy.	The R word that begins the expression, _____, reuse and recycle.

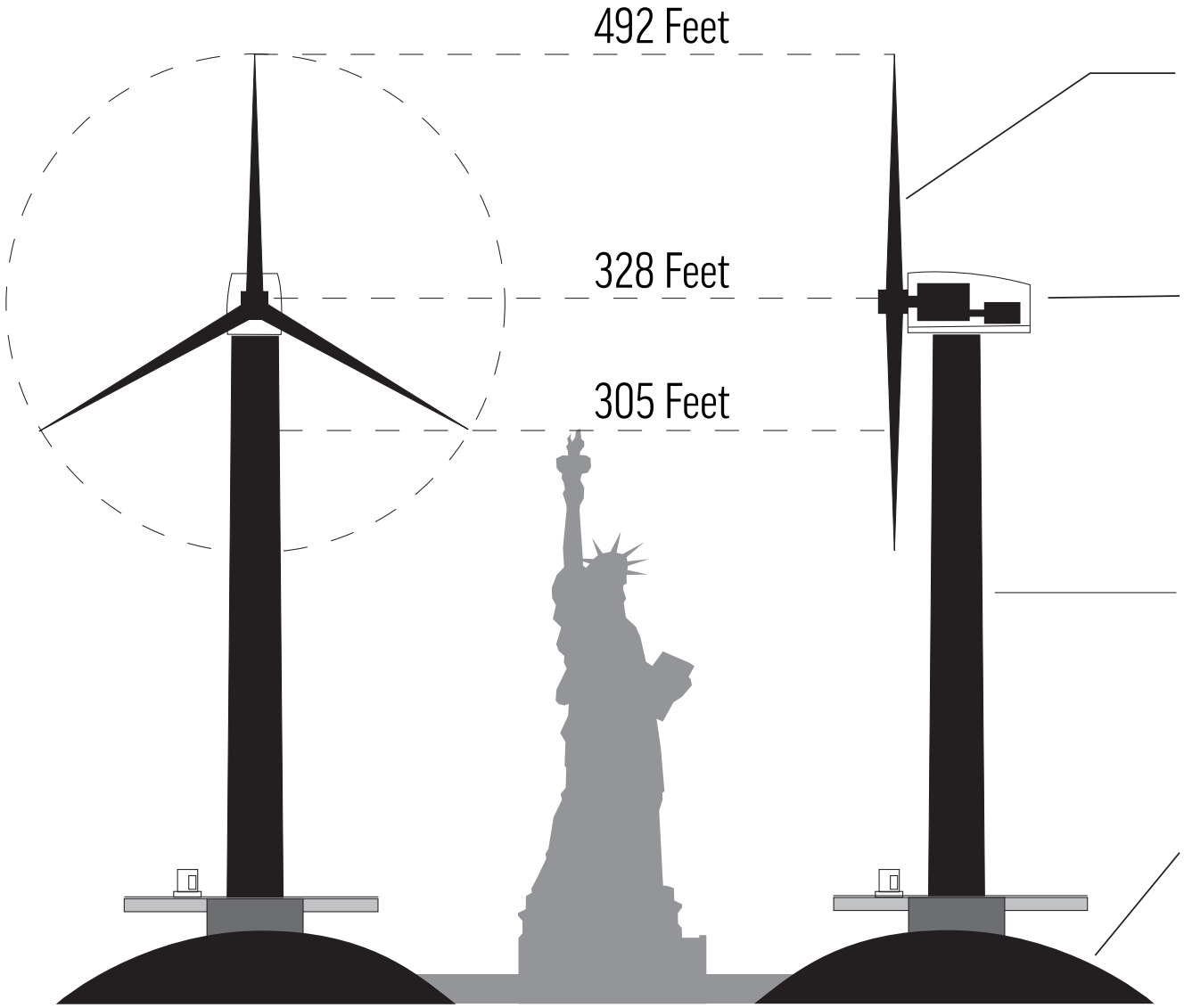
Quiz Game: Answer key

Category 1	Category 2	Category 3	Category 4	Category 5	Category 6
Solar Energy	**Electricity**	**Wind Energy**	**Renewable Energy**	**From point A to point B**	**Wildcard**
What is silicon (or silicon dioxide)?	What is an electron?	What are farms?	What is clean energy?	What is a generating station?	What is carbon (or carbon dioxide)?
What is Lapeer?	What are atoms?	What is the Statue of Liberty?	What is hydropower?	What is the power grid?	Who is Thomas Edison?
What is 25 – 35 years?	What are orbits?	What is the nacelle?	What is climate change?	What is safer?	What are honey bees?
What is summer?	What is direct current?	What is an anemometer?	What is net zero carbon emissions?	What is miles?	What is your carbon footprint?
What is an array?	What is alternating current (or AC)?	What is more than 64,000?	What are wind and solar?	What is electrical energy?	What is reduce?

Electrical Distribution System



Size and weight of wind turbine components



Rotor
Blades: Length 160ft/
Weight 7 tons
Hub: Weight 7 tons

Nacelle
Generator
Gearbox: Length 30ft /
Width 12ft /
Height 8ft /
Weight 63 tons

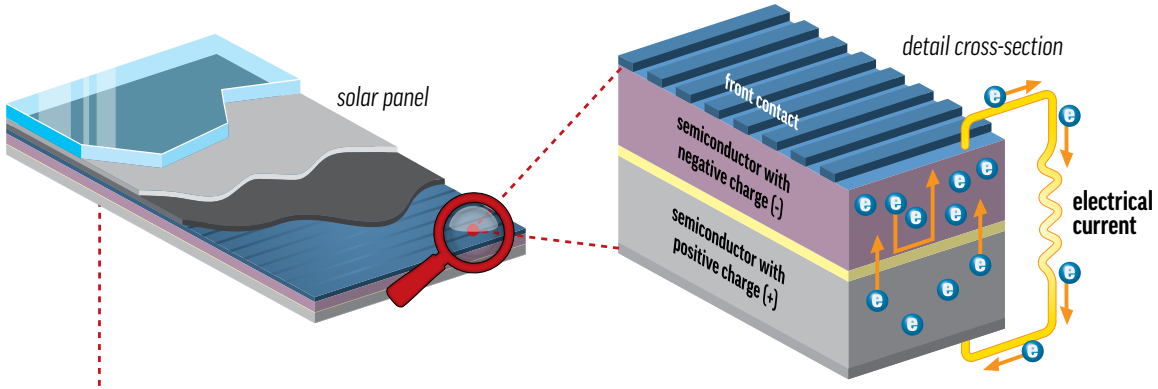
Tower Sections
Top, Mid(s) Base
Lengths from
50 ft to 70 ft /
Weight 260 tons

Foundation
384 yards of concrete, or
40 truckloads
35 tons of reinforced steel

Typical wind turbine dimensions

How solar energy works: From sun to socket

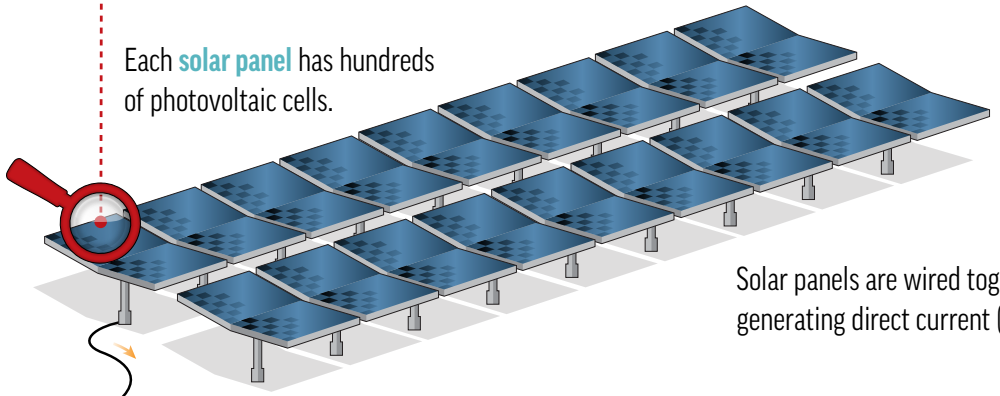
Each **photovoltaic cell** includes two layers of semiconductor material with opposite charges. In between is a layer that allows electrons to flow in only one direction.



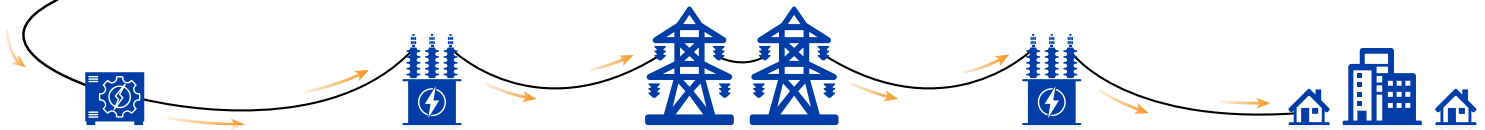
The sun's energy frees up electrons in the top and bottom layers. They start crowding into the top (negative) layer.

The only way electrons can get back to the bottom (positive) layer is to move through a **circuit**, creating an **electrical current**.

Each **solar panel** has hundreds of photovoltaic cells.



Solar panels are wired together to create a **solar array**, generating direct current (DC).



An **INVERTER** turns direct current (DC) into alternating current (AC), which can be transmitted long distances.

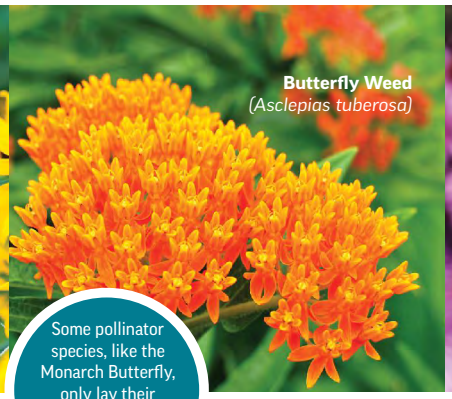
A **STEP-UP TRANSFORMER** increases the voltage for transmission across the grid.

Electricity is transmitted across **HIGH-VOLTAGE POWER LINES**.

A **STEP-DOWN TRANSFORMER** reduces voltage so it can be used in homes and business.

Energy is **DELIVERED** to power our communities.

Pollinators



Native Pollinator Habitat

Providing Nectar Resources for Survival

The plants you see in this illustration are species native to Michigan and they all serve as a source of food for different pollinators, including native bees, butterflies, and hummingbirds. These pollinators rely on the nectar, or the energy-packed sugary liquid that flowers produce. The plant's pollen rubs off onto the gentle feet, wings, and bodies of pollinators as they drink. The pollen is moved from flower to flower, helping the plants to reproduce by making fruits and seeds. They even pollinate food we eat like tomatoes and apples.

Some pollinator species, like the Monarch Butterfly, only lay their caterpillar eggs on native Milkweed plants.

IMPORTANT PLANTS

- Butterfly Weed *(Asclepias tuberosa)*
- Purple Coneflower *(Echinacea purpurea)*
- Brown Eyed Susan *(Rudbeckia hirta)*
- Showy Goldenrod *(Solidago ohioensis)*

IMPORTANT POLLINATORS

- Honey bee *(Apis mellifera)*
- Bumble bee *(Bombus spp.)*
- Monarch Butterfly *(Danaus plexippus)*
- Painted Lady *(Vanessa cardui)*
- Ruby-Throated Hummingbird *(Archilochus colubris)*

Ruby-Throated Hummingbird
(Archilochus colubris)

Honey bee
(Apis mellifera)

Monarch Butterfly
(Danaus plexippus)

Purple Coneflower
(Echinacea purpurea)

HERE ARE SOME BENEFITS OF POLLINATOR PLANTINGS:

1. Increase water absorption, resulting in less runoff to storm/sewer drains
2. Provide critical habitat for pollinator species
3. Lessen noise and air pollution from mowers

Bumble bee
(Bombus spp.)

Showy Goldenrod
(Solidago ohioensis)

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