Spotlight: Wind Turbine Technicians

Teacher Manual: Lesson 16

Essential Question

How are wind turbine technicians essential to the offshore wind industry and our energy goals in Massachusetts?

Learning objectives. Students will be able to

1. Understand wind turbine technician roles and contributions to clean energy
2. Recognize the link between climate goals and the need for wind turbine technicians
3. Explore the skills, training, and pathways for wind turbine technician careers
4. Connect personal interests to possible roles in wind turbine technology.

Lesson Summary

This lesson introduces students to the role of wind turbine technicians within the clean energy industry. It focuses on wind energy's growing importance for climate goals and job creation. Through discussions, activities, and a hands-on problem-solving scenario, students will explore the daily tasks, required skills, and long-term career potential in wind energy. The lesson also highlights Massachusetts's renewable energy initiatives, including large-scale offshore wind projects.

This is one of seven lessons to highlight specific climate-critical in-demand careers.
Other career-specific lessons include:

11. Electricians
12. Engineers
13. Lineworkers
14. Managers and Analysts
15. Construction, Installation, and Maintenance Workers
16. Wind Turbine Technicians
17. Sales and Customer Service Workers

Technology referenced in this lesson:

- Wind

Careers referenced in this lesson:

- Wind turbine technicians: Install, maintain, and repair wind turbines
- Engineers: Design and test turbine components
- Electricians: Connect wind energy systems to the grid
- Assemblers: Manufacture and assemble wind turbine parts

Agenda	Timing	PPT Slide	
Opening Activity	5 minutes	2	**Pre-lesson**
Present agenda and learning objectives	5 minutes	3–5	
Direct Instruction Video Technology introduced Careers introduced	20 minutes	6–12	
Primary Learning Activity Partner or small group work Reinforce what was learned	20 minutes	13–14	
Closing Review learning objectives Closing activity Reflection	5 minutes	15–17	
Extension			
Handouts			
TOTAL TIME	**55 mins**		

Preparation:

- Read Student Presentation Deck (PPT).
- Watch the video(s) included in the Student Presentation Deck (most are available on the MassCEC YouTube channel).
- Print worksheets before class.
- Verify that the computer hosting the presentation deck is connected to the internet for video and hyperlink viewing.
- Check any links in the slide deck to ensure they work as intended, then review the content below.

Where to learn more about the lesson's content

If additional preparation time is available, these resources will provide additional background on the topics covered in this lesson:

1. Massachusetts Clean Energy Workforce Needs Assessment—the report describes the most in-demand jobs for reaching Massachusetts's 2025 and 2030 climate goals.
2. Global Wind Energy Council
3. Massachusetts Maritime Academy
4. National Offshore Wind Institute at Bristol Community College
5. Wind Works—FAQs
6. Vineyard Wind Offshore Wind Project—first offshore wind project in Massachusetts
7. Southcoast Wind—next offshore wind project in Massachusetts starting in 2025

Overview and Opening Activity (10 mins)

Materials and resources:

- Slide deck
- Worksheets (optional)

Opening activity: Get students thinking and talking right away.
Activity objective: Introduce students to the personal protective equipment (PPE) used by wind turbine technicians and similar roles in clean energy sectors.

Background: Many clean energy workers work in environments with high heights, strong winds, and heavy machinery, where PPE is essential.

Instructions:

- Ask students to get into pairs (or small groups if necessary).
- Present the images on screen.
- With their partner, students should discuss what they believe each item shown is and what risks it protects against in a real job setting.
- Encourage them to start with wind turbine technicians, but students may consider any clean energy project discussed so far in class.
- After two or three minutes, go through the objects one at a time and invite students to share their ideas with the class:
    - Helmet (protection from head injuries, falling objects, accidental impacts).
    - Harness (fall prevention, used during climbs and repairs at height).

    - Goggles (eye protection from dust, debris, and strong winds).
    - Work gloves (hand protection from sharp objects, electrical components, and exposure to the elements).
    - Steel-toed boots (foot protection from heavy equipment, objects, and tools).
    - Ear protection (noise reduction, protecting hearing from loud machinery sounds and exposure to the elements).
- PPE and safety protocols govern tasks such as how workers climb and manage tools and even how often they check the weather; these are critical to jobs like those of wind turbine techs.
- Wind turbine techs face unique hazards, especially from heights and weather conditions. They're exposed to strong winds and sometimes extreme temperatures.
- Working safely allows techs to keep the turbines running correctly, contributing to climate goals—remember, the goal is to have a cleaner and healthier Massachusetts!

Present the agenda. Students should be familiar with the format:

- After the opening activity, they will learn new information. The main activity helps them apply the new information and practice in the climate-critical occupation. The closing activity helps them synthesize what they learned and transfer knowledge.

Present the big question and lesson objectives:

- How are wind turbine technicians essential to the offshore wind industry and our energy goals in Massachusetts?
- Understand wind turbine technician roles and contributions to clean energy.
- Recognize the link between climate goals and the need for wind turbine technicians.
- Explore the skills, training, and pathways for wind turbine technician careers.
- Connect personal interests to possible roles in wind turbine technology.

Key points to emphasize:

- This lesson will explore one of the fastest-growing career opportunities in clean energy.
- Wind energy plays a crucial role in meeting climate goals and creating jobs.
- Students will reflect on how this career could align with their skills and values.

Direct Instruction (20 mins)

Provide information to help the students achieve the learning objectives and prepare them to actively engage with the activity.

- Use inquiry-based learning strategies to engage learners where possible.
- Highlight careers related to the technologies.
- Help the learners to relate the learning to themselves and their communities.

Show the video (3–5 minutes), and follow it with a brief check-in to hear what students took away. *The Mass Clean Energy Center did not produce this video. The MassCEC video is coming soon.*

Video Debrief (for Non-MassCEC Video)

1. What stood out to you or surprised you about the daily work of a wind technician?
2. Wind technicians describe their role as mainly proactive and preventative. Why are those operations critical?
3. The wind farm in the video is on land. How might working on an offshore wind farm compare to this example?

Wind Turbine Technicians—What Do They Do?

- Wind turbine technicians perform several tasks essential to the wind energy industry, including maintenance, installation, and troubleshooting.
- Technicians ensure turbines operate safely and efficiently, which is critical as we expand wind energy.

Wind Energy Goals

Connect the job role to the state climate goals students learned about in lessons 2 (Climate Solutions) and 7 (Offshore Wind).

- Massachusetts has ambitious climate goals, and wind is essential to that plan.
- Wind turbine technicians are, therefore, essential to Massachusetts achieving those climate goals.
- Demand for these jobs will continue to increase in Massachusetts and the United States.
- Massachusetts aims to produce more than 20 percent of US wind-generated power by 2027.

Anticipated Student Questions

How much energy can one turbine produce in a year?

A: About 6 million kWh, enough to power hundreds of homes.

Why are wind turbines so tall?

A: The taller they are, the more wind they can capture to generate more energy.

How do wind turbines work? [recall lesson 7]

A: Wind turbines capture energy and convert it to electricity that can power homes and

businesses in their community.

Why is Massachusetts focused on wind energy?

A: The state's coastal location is ideal for offshore wind farms, which contribute to local clean energy goals.

Skills and knowledge:

- Review the skills and knowledge unique to a job that requires mechanical aptitude and a willingness to work at heights and in harsh conditions.
- Many employers are willing to hire fit, dedicated employees and provide on-the-job training or pay for their training.

Required qualifications (from sample job posting):

- Need to be physically fit and have good stamina, as this is a physically demanding job that involves climbing and heavy lifting.
- Able to climb 300-foot (80-meter) steel towers daily.
- Able to lift 30 kg worth of equipment.
- Willing to work overtime and on short notice.
- Technically minded and have an aptitude for mechanical systems and processes.
- Consistently meet standards and have strong attention to detail to maintain safety compliance.
- Rigging experience is a must.

Key points to emphasize:

- Wind turbine technicians ensure that turbines are functional, safe, and efficient.
- Their work includes climbing high towers, handling electrical systems, and performing regular maintenance.
- Physical fitness, technical skills, and safety awareness are essential.

Training Pathways

Available training in MA includes:

- Basic safety training: First aid, manual handling, fire awareness, working at heights, sea survival
- Advanced rescue training: Hub rescue, nacelle, tower, and basement rescue; single rescuer: hub, spinner, and inside the blade
- Basic technical training: Mechanical, electrical, bolt tightening, hydraulics, installation

Primary Learning Activity (20 mins)

Materials:

- Worksheets

Turbine Troubleshoot Challenge

Activity Objective: Students will analyze common scenarios wind turbine technicians face. They will identify the problem and outline the safety considerations, skills, and knowledge necessary to diagnose and fix it.

Instructions

- Divide students into four groups and assign each group one of four troubleshooting scenarios from their worksheets:
    - **Scenario 1: Power Drop**—the turbine's power output has suddenly dropped. Possible causes include electrical system issues, a fault in the gearbox, or poor wind conditions.
    - **Scenario 2: Blade Imbalance**—A sensor shows that one of the turbine blades is out of balance, which could be due to blade wear, debris accumulation, or a mechanical issue.
    - **Scenario 3: Control System Error**—the turbine's control system has triggered an error code. Possible causes are a software glitch, a wiring issue, or a sensor malfunction.
    - **Scenario 4: Weather-Related Shutdown**—the turbine shut down due to extreme weather conditions. The team must inspect it to ensure it's safe to resume operations.
- Working as a team of wind technicians, each group must review details of their scenarios, including the common causes of the issues their turbines are currently experiencing. Then, they must decide how they would diagnose the problem:
    - What safety considerations are there for this issue? What precautions should be taken? Why?
    - What skills, knowledge, expertise, and tools would be necessary? Why?
    - Besides wind turbine technicians, are there other roles they might need to bring in to support them?
- After 10–12 minutes, each group will present its scenario to the class along with its plan for troubleshooting the problem. The presentations should last approximately one minute each.

Presentations and debrief:

- What was most challenging about identifying the cause of the problem?

- How does the speed of problem-solving contribute to energy reliability?
- What role does safety play in a wind turbine technician's day-to-day work?
- Encourage students to consider the complexity of real-life troubleshooting and how it requires a combination of technical skills and problem-solving.
- Reinforce that wind turbine techs play a vital role in ensuring turbines operate at full capacity, directly supporting clean energy goals.
- Safety protocols protect techs and ensure work is done efficiently.
- Help students connect the dots between reliable turbine operations and Massachusetts's targets for clean energy production.

Key points to emphasize:

- Technicians must prioritize safety, especially in adverse conditions.
- Effective teamwork and communication are vital for resolving unexpected issues.
- Technicians often face real-time challenges that require quick problem-solving.

Summarize key takeaways:

1. Wind turbine technicians are essential to expanding wind energy in Massachusetts.
2. They need a combination of technical skills and physical endurance.
3. Demand for technicians is growing due to the state's clean energy goals.

Differentiations and Adaptations—Learning Activity

For students who benefit from interactive visualizations: Use a 3D model or digital simulation.
Adaptation: Provide a physical 3D model of a wind turbine or use an interactive digital simulation in which students can "inspect" different parts of the turbine. This could include labels for components and possible failure points corresponding to their scenario. Groups could use the model to explain their troubleshooting plan during their presentation visually.
Goal: Help students better understand the mechanics of the turbine and visualize their diagnostic process, enhancing comprehension and engagement.

For students who struggle with open-ended tasks: Provide diagnostic flowcharts.
Adaptation: Provide a step-by-step diagnostic flowchart to guide students through troubleshooting. For example, "If the issue is with the blades, check for damage or imbalance"

or “If the issue is with the generator, inspect wiring connections first.” Students can use the flowchart to organize their approach and ensure they do not miss any steps.
Goal: Reduce decision-making stress for students who may find open-ended tasks overwhelming while maintaining the problem-solving aspect of the activity.

For students who perform better in specific roles: Assign specialized roles.
Adaptation: Assign each student in a group a specific role, such as “safety officer,” “diagnostic specialist,” or “tools and equipment manager.” Provide role-specific prompts to guide their contributions (e.g., the safety officer identifies safety hazards and precautions, while the diagnostic specialist focuses on identifying the issue based on symptoms).
Goal: Engage students by allowing them to focus on a specific aspect of the challenge, catering to their strengths while encouraging collaboration.

Closing Activity (5 mins)

Materials:

- Presentation/Slide deck, slides
- Reflection journal or worksheets

Activity objective: Encourage students to reflect on key takeaways and identify areas of curiosity for further exploration.

Invite students to respond to these two questions in journal/worksheets; invite a few students to share responses aloud:

1. What is one aspect of this role that matches your skills or interests?
2. How does this role contribute to Massachusetts’s status as a climate leader?

Check individual understanding of learning objectives.

Extensions—if learners are loving this topic and want more …

1. **Build a model wind turbine**
    - **Activity**: Students design and build small wind turbine models to explore turbine mechanics and blade design.
    - **Focus**: Hands-on engineering and problem-solving.
2. **Wind energy careers research project**

- **Activity**: Research different careers in wind energy (e.g., technicians, engineers), and present findings with infographics or videos.
- **Focus**: Career exploration and understanding pathways in renewable energy.

3. **Field trip or virtual tour of a wind farm**
    - **Activity**: Visit a local wind farm or take a virtual tour to see turbines up close, and hear from professionals in the field.
    - **Focus**: Real-world application and insights into the renewable energy industry.

Handouts—Group Activity (below)

Turbine Troubleshoot Challenge

Instructions

Your group has been assigned a specific wind turbine issue. Work together to analyze the provided details. For each scenario, you are provided a description of what is currently known about the issue and three common causes. It is up to you to decide whether any of these causes apply in this specific case.

Based on the scenario, identify the possible issue(s), list the key safety considerations your team needs to remember, identify the skills and expertise required to address the problem, create a detailed plan to resolve it, and present it to the class.

Project Details

Scenario 1: Power Drop

The wind turbine has experienced a sudden drop in power output and is not generating electricity as expected. It is still operational, but its efficiency has decreased significantly. Recent wind speeds have been steady and within the optimal range for generating electricity. During a routine maintenance check, workers noticed unusual vibrations from the gearbox, but there were no interruptions in the power grid.

Common causes:

- Electrical system issues: A fault in the electrical wiring or components could interrupt power transmission.
- Gearbox fault: A mechanical issue in the gearbox may be reducing the turbine's ability to convert wind energy into electrical energy.
- Wind conditions: Wind speed or direction changes may affect performance, though the turbine is designed to handle moderate variations.

Scenario 2: Blade Imbalance

A vibration sensor has triggered an alert about a possible turbine blade imbalance, which could cause damage if not addressed quickly. Residents nearby have reported unusual noises during high winds, and recent weather has included rain and sleet. From the ground, one blade appears slightly discolored.

Common causes:

- Blade wear: Physical wear or damage to one blade might have created the imbalance.
- Debris accumulation: Dirt, ice, or other debris may have built up unevenly on the blades.
- Mechanical issue: The connection between the blade and the hub might be loose or faulty.

Scenario 3: Control System Error

The turbine has shut down, and the control panel displays an error code indicating a communication failure. Operators have not been able to determine the exact issue using remote diagnostics. Data from the sensors stopped updating shortly before the shutdown. A recent software update was skipped, and upon inspection, some wiring connections in the control panel are loose.

Common causes:

- Software glitch: The turbine's control software may need an update or a reset.
- Wiring issue: A loose or damaged connection might interrupt the information flow between the sensors and the control system.
- Sensor malfunction: A faulty sensor may send incorrect data, causing the turbine to shut down.

Scenario 4: Weather-Related Shutdown

The turbine shut down automatically during a recent thunderstorm with high winds and lightning. Lightning was reported to have struck nearby power lines. The turbine's safety system logs show a sudden spike in power just before the shutdown, but no external damage is visible from the ground. Although the turbine is designed to handle extreme weather, it requires an inspection before it can resume operations.

Common causes:

- Lightning damage: Electrical components may have been damaged by lightning strikes.
- Mechanical stress: High winds might have caused stress or minor damage to the blades or tower.
- Safety system trigger: The turbine's safety system may have initiated the shutdown to protect it from damage.

Discussion Prompts

Use the prompts below to guide your discussion and plan your solution as a team.

What do you believe caused the issue?

What steps should your team take to ensure safety while inspecting and fixing the issue? Consider height, weather, and any hazards specific to your scenario.

Which roles and skills are required to fix this issue?

Write a plan to address the problem. Include steps your team will take to diagnose and fix the issue, the tools or equipment needed, and the impact this might have on energy output or performance.