



The Power of Climate Solutions

Teacher Manual: Lesson 2

Essential Question

How is Massachusetts working to be more efficient, transition to renewable energy, optimize energy transmission, protect natural lands, and prepare for climate challenges?

Learning objectives. Students will be able to

1. Identify strategies to improve energy efficiency
2. Identify examples of climate technology that advances the use of renewable energy sources
3. Explore how different combinations of climate solutions can position us for a healthier future.

Lesson Summary

Students are introduced to Massachusetts's plan for a future in which there is minimal reliance on fossil fuels for heating homes, powering vehicles, and operating the electric grid.

Technology referenced in this lesson:

- Solar
- Wind
- Hydropower
- Electric vehicles
- Energy efficiency and efficient building design
- Conservation and land restoration

Careers referenced in this lesson:

- None

Agenda	Timing	PPT Slide	Pre- lesson
Opening Activity	5 minutes	2	
Present agenda and learning objectives	5 minutes	3–5	
Direct Instruction Video Technology introduced Careers introduced	20 minutes	6–16	
Primary Learning Activity Partner or small group work Reinforce what was learned	20 minutes	17–19	
Closing Review learning objectives Closing activity Reflection	5 minutes	20–22	
Extension			
Handouts			
TOTAL TIME	55 mins		

preparation:

- Read Student Presentation Deck (PPT).
- Watch the video(s) included in Student Presentation Deck (Most are available on the [MassCEC YouTube channel](#)).
- Print the worksheets and handouts prior to the 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 make sure they work as intended, and 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.

- [MA Clean Energy and Climate Plan for 2025 and 2030](#)
- [MA Decarbonization](#) Roadmap. A report commissioned by the Massachusetts Executive Office of Energy and Environmental Affairs to identify cost-effective and equitable strategies to ensure Massachusetts achieves net-zero greenhouse gas emissions by 2050.

Overview and Opening Activity (10 mins)

Materials and resources:

- Slide deck
- Student worksheets

Opening activity. Get students thinking and talking right away.

Activity objective: To encourage students to think about how their actions can contribute to decarbonization and lower energy usage. This activity will set up students' connections to broader climate solutions.

Instructions:

- Ask all students to take one minute to write down three energy-consuming actions they take every day. Encourage students to think broadly. Examples could include turning on the lights in their homes, using heat/air conditioning, or transportation to and from school.
- Ask students to write one or two ideas for each action that would help lower their energy usage.
- Invite a handful of students to share some of their ideas aloud. Then, discuss as a group, highlighting that these daily actions, though small, have a significant environmental impact.
- Variation—Students can also do this exercise as a pair share rather than as a group discussion.

Present the agenda. Students should be gaining familiarity with the format:

- After the opening activity, they will learn new information. The main activity is intended to put them in the role of a lineworker. The closing activity helps them synthesize what they learned and helps with knowledge transfer.

Present the big question and lesson objectives:

- How is Massachusetts working to make our energy use more efficient, support renewable energy, and protect natural lands?
 - Ask the students to reflect on the question.
 - By the end of the lesson, they will have the tools to begin answering it and to relate this question and its answer to their own lives.
- Identify strategies to improve energy efficiency.
- Identify examples of climate technology that advance the use of renewable energy sources.
- Explore how different combinations of climate solutions can position us for a healthier future.

- Strategies and technologies do not need to be large scale to be effective or worthwhile; daily individual habits can also be impactful and can add up to considerable change.

Direct Instruction (20 mins)

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

- 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.

MA Vision for 2050

Discussion guidance:

- Massachusetts’s climate plan drives toward achieving net-zero emissions by 2050.
- “Net zero” means balancing the emissions we put into the atmosphere with those removed.
- It’s likely impossible to emit absolutely zero carbon by 2050, so we need to combine efforts to lower carbon—reducing emissions—with efforts to capture or sequester existing carbon from the atmosphere.
- We’re mostly going to focus on this first piece—reducing emissions. We can replace fossil fuels with clean energy sources, electric transportation, and improved efficiency.

Decarbonization

Discussion guidance:

- Another term for this process is decarbonization. This means lowering the amount of carbon dioxide released into the atmosphere or actively removing carbon dioxide from the atmosphere.
- Remember, carbon dioxide traps heat in Earth’s atmosphere and is a primary factor in climate change.
- We must reduce the amount of carbon dioxide in Earth’s atmosphere to prevent it from getting too hot or climate change from getting worse.
- [Source: [MA 2050 Decarbonization Roadmap](#)]

Projected Greenhouse Gas Emissions

This figure from the state Clean Energy and Climate Plan for 2025 and 2030 shows the historical greenhouse gas (GHG) emissions in Massachusetts by four major sectors of the economy: electricity, buildings, transportation, and non-energy and industrial sectors. The diamonds represent goals for GHG reduction in the years 2020, 2025, and 2030.

Show the video (3–5 minutes) and follow it with a brief check-in to hear what students took away.

MassCEC-produced video will be available in 2025.

Decarbonize the Electrical Grid

Discussion guidance:

- Achieving Massachusetts’s climate goals will require multiple strategies to decarbonize the electricity sector while responding to the growing demands for resources such as heating and transportation.
- Investments in solar energy and offshore wind, combined with imports of Canadian hydropower, all contribute to a decarbonized electricity grid.

Four strategies:

1. Improve energy efficiency.
2. Install renewable energy power.
3. Reduce pollution from transportation.
4. Conserve and restore natural land.

Improve energy efficiency:

- Energy efficiency is utilizing energy to maximize output while minimizing waste and unnecessary consumption. It involves optimizing energy systems, processes, and technologies to achieve the desired performance or service level with the least energy input. There are many ways to do this with homes and other buildings.
- One of Massachusetts’s primary strategies to reduce building emissions is to improve energy efficiency and convert home and business climate control systems to electric heat pumps.
- Heating and cooling are most efficient when the building has a good “envelope.”
- Weatherization, such as insulation and sealing air leaks, keeps the building warm or cool. If the building is appropriately sealed, the system doesn’t need to run continuously, saving energy.
- Anything that runs on power, such as light bulbs, washing machines, televisions, computers, or anything else, can be on a spectrum of energy efficiency. Tools such as LED lightbulbs, high-efficiency appliances, or energy-efficient power strips can help ensure that anything plugged in doesn’t waste or drain unnecessary power. This lowers the building’s carbon footprint and can lower utility bills.
- Similarly, smart technologies such as smart thermostats can help make buildings more energy efficient by adjusting energy output based on specific needs. So, if no one is

home, there's no need for the lights to be on or the air conditioning to be all the way up, even if it was left running.

Install renewable energy:

- Renewable energy sources are becoming more common and more accessible every day.
- In Massachusetts, solar, wind, and hydropower are increasingly important replacements for fossil fuels.
- By 2050, Massachusetts aims to have 97 percent of its energy come from renewable sources.
- How are we doing on that goal?
 - In 2022, renewable energy provided almost twice as much power as it did in 2015. [Source: [EIA](#)]
 - In 2022, nearly 20 percent came from solar power, 4 percent of total generation from hydropower, and 1 percent from wind power

Reduce Pollution from Transportation

Discussion guidance:

- Transportation is another significant contributor to carbon emissions. Massachusetts plans to reduce pollution from transportation by 2050 in two ways.
- Ask the students to call out ideas for what they might be:
 - Reducing growth in total vehicle miles traveled by improving public transportation options and transit-oriented development
 - Transitioning most vehicles on the road to electric vehicles
- Students might also suggest things such as riding bikes, walking, scooters, and rideshares.

Conserve and Restore Natural Land

Discussion guidance:

Ask the students: We have been talking about energy production and use. Why do you think conserving and restoring natural land is part of the climate plan? [Hint: Think about what was learned in Lesson 1 about greenhouse gases.]

- Natural and working lands, such as forests, farmland, or wetlands, absorb and store carbon.
- Trees, soil, and other natural components absorb carbon from the atmosphere and store it. Because they are separating it from the atmosphere, this is one method of sequestering or capturing carbon.
- Conserving and restoring natural lands allows us to use nature's power to help balance carbon emissions that are harder to reduce directly.

- There are three main ways we do this:
 - Conservation: Protect undeveloped land; this helps prevent carbon loss that land has absorbed.
 - Restoration: Replant trees and other plants, repopulate and restore wetlands, and enhance soil health; all of these help increase the amount of carbon that land can sequester.
 - Urban greening: Plant trees and create green spaces in cities or other densely populated areas to improve air quality. Trees can act as natural air filters, removing carbon and other pollutants from the air.
- As part of the Climate Energy Plan, Massachusetts aims to conserve 40 percent of its lands and waters by 2050.

Community Impact

Ask the students what their reaction is to looking at these two images.

- The image on the right is New York City in 2023 with smoke from the Canadian wildfires.
 - Cleaner air and reduced pollution create healthier communities, particularly in densely populated urban areas.
 - The differences are not only on the surface, however.
 - The community pictured on the left is more climate resilient. Its buildings are designed to be more efficient and to withstand certain climate events. Its grid and power sources are more efficient. Its public transportation is not only cleaner, its routes are also efficient, and it's likely been updated far more recently than the community on the left.
 - This doesn't happen overnight. This doesn't happen in only a decade. This might be a work in progress for 50 years. But every step of progress is significant.
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Primary Learning Activity (20 mins)

Materials:

- Worksheets

Activity Objective: Invite the students to apply what they have learned about Massachusetts's strategies to decarbonize the state's grid to their community by determining their top two ways to improve energy efficiency and/or renewable energy.

Students will work in small groups to create a plan to make their town greener using the strategies discussed in class today. Ensure students have their worksheets, which will help guide them through the activity.

Instructions:

- Divide the students into small groups of three or four.
- Each group will
 - List and describe ways people in town use energy, such as cars, home heating, or electricity. Encourage the students to think about which energy use is most prominent in their town or in the areas/spaces they inhabit.
 - Think of areas that could be improved, and choose two improvements that their group believes would make the biggest difference for the community, for example, adding public transportation or installing solar panels on rooftops of all public buildings.
- The students may use ideas from any two of the strategies discussed today; they should try to use only one solution from each strategy category. For example, they shouldn't suggest public transportation and electric personal vehicles as their two solutions.
- Each group will share the energy issues they identified and their chosen solutions.
 - During presentations, prompt students to include why they chose the solutions they did and how they believe each solution will benefit the community (if they do not share this on their own).

Debrief discussion:

- How do your plans connect to the Massachusetts Clean Energy Plan?
- Which ideas work well with what Massachusetts is already doing?
- How could our community's choices affect Massachusetts's goals for 2050?

Summarize key takeaways:

1. Energy efficiency, renewables, and clean transportation are critical to a clean future.
2. We can contribute to the transition, both now and in our careers.
3. Massachusetts is leading by example, and we can support that in our community.
4. Each student makes choices that matter every day.
5. Clean energy careers will be essential in this journey to a clean energy future.

Differentiations and Adaptations: Learning Activity**For students with focus or cognitive needs: Provide pre-selected examples.**

Adaptation: Offer a list or visual chart of common ways energy is used in a community (e.g., transportation, heating, lighting, and appliances) and potential improvement strategies (e.g., upgrading to energy-efficient appliances or promoting public transportation).

Goal: To simplify the brainstorming process by reducing the cognitive load and allowing students to focus on analyzing and selecting the most impactful strategies.

For students who benefit from movement or hands-on activities: Interactive mapping

adaptation: Use a large map of the local community and provide labeled icons (e.g., cars, houses, and factories) to represent energy use. Have students place these on the map, and then suggest improvements by attaching corresponding icons (e.g., solar panels or public transit).

Goal: To engage kinesthetic learners and provide a tangible way to explore and connect energy use to real-world solutions.

Closing Activity (5 mins)**Materials:**

- Presentation/slide deck, slides
- Large index cards
- Reflection journal/worksheets

Activity objective: To encourage students to visualize the practical and everyday impact of the clean energy plan for daily life.

- Invite students to write a short postcard to themselves from their future selves on large index cards.
- Ask students to hand in their index cards (or worksheets) before exiting class.

Check individual understanding of learning objectives.

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

Energy Audit of Their Home

Prompt: Conduct a simple energy audit at home by identifying how energy is used (e.g., lighting, heating, or appliances). Write a list of at least three ways your household could improve energy efficiency (e.g., switching to LED bulbs, unplugging devices, or adjusting the thermostat). Share your findings in a short paragraph, model, or presentation.

Goal: To encourage students to apply what they've learned to their personal lives and explore real-world, energy-saving opportunities.

Explore Careers in Energy Efficiency

Prompt: Research a career focused on improving energy efficiency, such as an energy auditor or renewable energy engineer. Create a short summary of what this person does, why their work is important, and how it connects to the strategies discussed in class.

Goal: To help students see how their interest in energy solutions can translate into impactful career opportunities.

Handouts: Group Activity (below)

Design Our Community's Clean Energy Future

Instructions

Work with your group to assess your community's current energy use and discuss ways to improve it using the strategies explored in class today, detailed below. Use the notes below to guide your plan. Choose one or two specific strategies, and describe how they can be applied in your community on the following page.

Massachusetts Climate Strategies

Strategy #1: Improve Energy Efficiency

Use less energy to perform the same tasks by upgrading systems and reducing waste.

Examples:

- Retrofitting buildings with better insulation and energy-efficient windows
- Switching to LED lighting in homes, schools, and streetlights
- Installing energy-efficient appliances such as refrigerators, washers, and dryers

Benefits:

- Saves money on energy bills
- Reduces energy demand and greenhouse gas emissions

Strategy #2: Renewable Energy Sources

Generate electricity using sustainable sources such as the sun, wind, or water.

Examples:

- Installing solar panels on homes, schools, or municipal buildings
- Building wind turbines to power parts of the town
- Encouraging community solar projects where multiple households share renewable energy

Benefits:

- Reduces reliance on fossil fuels
- Provides clean, sustainable energy for the future

Strategy #3: Clean Transportation

Reduce emissions by improving and encouraging cleaner alternatives to traditional vehicles

Examples:

- Adding electric vehicle charging stations around town
- Promoting public transportation such as buses or trains, especially electrified options
- Creating bike lanes and improving walkability in neighborhoods

Benefits:

- Reduces air pollution and greenhouse gas emissions
- Encourages healthier, more sustainable ways to travel

Discussion Prompts

Use the prompts below to discuss your community's current energy usage, and identify one or two strategies for improving energy efficiency. Then, prepare to present your improvement plan to the class.

What types of energy are commonly used?

Are there visible signs of energy inefficiency or pollution (e.g., older buildings or traffic congestion)?

Which two strategies do you think would make the biggest impact in your community?

Why did you choose these strategies?

Plan your solution. How would you apply these strategies? What changes would you make? Who in the community would benefit the most from these changes?