Research and Action Strategies

For Civic Engagement in the Transition to

Sustainable Energy in Massachusetts Communities

A Guide for Massachusetts Envirothon teams pursuing the 2024 Community Engagement Award (and others interested in exercising their civic muscles!)
version 2.0 March 2024

What energy future should we create?

The transition to a global sustainable energy system is just beginning, but it holds the potential to prevent the worst effects of climate change. The work will take all the scientific and civic power we can muster, but it can pay dividends not only in terms of equitable, ecologically sound development, but also democracy and social justice.

This guide aims to be useful to anyone who wants to participate in this all-hands-on-deck moment.

The focus here is local: Massachusetts communities, where you can see problems and solutions close-up, and you can meet real people who are choosing hope and taking action. The emphasis is civic: on decision-making and action in the public sphere that aims for systemic change.

Civic engagement in the energy transition also requires knowledge in science and engineering. Don't let this turn you aside! Keep asking questions. As a concerned, active citizen you deserve explanations. You will learn as you go along.

What's Your Vision?

Your vision for a sustainable energy future will grow and change as your community research progresses. Keep circling back to refine it!

What could your community look like in 2050 if you made a full transition to renewable, clean energy sources? What would be your sources of power, and how would that power get to you? What would housing look like? Transportation? Work? Recreation? Would schools and education be different? What would be the effect of these changes on natural resources – water, soil, forests, wildlife – and ecosystems generally? What will YOU be doing that contributes to your community and its sustainable energy transition in that year?

Some Big Questions to Start Your Research:

In 2024, how is your community doing in the transition to a sustainable energy system? What's underway? What's being planned? What's going well? What's missing? Is the community thinking ahead? Is action happening fast enough? Are the changes deep enough? Are there side-effects (e.g. on natural resources)? What's needed next (project, project modification, campaign, or other action)?

How are the decisions made to create the changes you want to see? Are there people already working on this? Are there people who have been left out of the conversation? Ideally, who should be involved? Is there a role for a small, energetic group of community members (like your team!)?

Questions to Consider as You Plan to Take Action:

Given your evolving vision, and what you have learned in your research, how can you best participate, or even help to lead the transition? What specific action(s) will you take? What outcomes do you expect? Are you building upon the work of others? Who will you partner with? Who are your allies? What tactics are likely to be most effective? What tactics fit best with who you are and what you are good at?

How to Use This Guide:

This is not a step-by-step guide. It's a starting point. The idea is to provide a springboard rather than a recipe, a general map to explore the landscape rather than a marked trail. ***You will leave this guide behind as you begin to talk with people and discover resources in your community.***

The internet – including social media – can help you get started in your community research and will be an excellent supplemental resource throughout your research. But remember that the internet can also distract, overwhelm, and mislead. **Evaluating Resources and Misinformation** – a library site at the University of Chicago – may be helpful. Your school librarian can be helpful as well.

Begin with research, balancing internet investigations with visits with real people and places. Your best research guides for what's happening locally, and your best allies in action, will be people in your community itself. Your vision for the future will be clearer, and your action choices will be more effective, if you start with this kind of research.

Follow your curiosity. Focus on what counts in the real world. Your team will catch fire. You'll accomplish something that matters.

To make best use of these pages: Start anywhere that your interest is rising. Go into as much depth as feels right to you. Circle back if it's helpful to do so. Then leave this document behind.

Envirothon teams can refer to the **2024 Mass Envirothon Current Issue** page for official guidance and links in preparing your Current Issue presentation. See also the **2024 Research and Action Checklist** for details of what teams need to document in order to qualify for the Envirothon 2024 **Community Engagement Award**.

Questions or comments? Corrections? Suggestions for additional topics/resources? This is intended to be an evolving resource. Contact Will Snyder, Mass Envirothon, at wsnyder@umass.edu or 413.387.2371.

Community Research Strategies (* = resources for a fast start)

a5 Explore some hot topics in the Massachusetts energy transition*
a6 Make the Local Connection - Projects and initiatives*
a7 Make the Local Connection – People engaged in the energy transition*
a8 Consider Massachusetts' options for the future– Proposed Legislation
a9 Reflect on energy education and literacy (yours and others'!)

Considerations for Action Projects
b1 Given what you have learned about how the energy transition is progressing in your community . . .
b2 Consider who YOU are! It takes many kinds of action to make change happen. What part will YOU play?
b3 *"Never doubt that a small group . . ."*

Additional links of interest
c1 A Sample of Critical Perspectives on the Energy Transition
c2 Energy Web Resources: Some Basic Background for the General Public
c3 Some Interesting Angles on Renewable Energy, Efficiency, and Conservation
c4 Massachusetts Legislative Priorities for 2023-24 (from climate/clean energy advocacy groups)
c5 Trees, Forests, and Wood in a Sustainable Energy System
c6 Additional Resources for youth-led community-based research and action

Community Research Strategies

These strategies are suggestions. They are numbered for reference, but you do NOT need to do them in order, or even go into depth in all the areas.

Start anywhere that your interest is rising. Follow links within this document or to the web. Go into as much depth as feels right to you.

1. Consider: Why are renewable energy and the energy transition even an issue? Check out some summary statements from key scientific organizations:

> **Intergovernmental Panel on Climate Change (IPCC):**
> *"We are at a crossroads. The decisions we make now can secure a liveable future. We have the tools and know-how . . . The evidence is clear: the time for action is now. We can halve emissions by 2030."*
> **International Energy Agency 2023:**
> *The path to limiting global temperature rise to 1.5 °C has narrowed, but clean energy growth is keeping it open. . . . Since 2021, record growth in solar power capacity and electric car sales are in line with a pathway towards net zero emissions globally by mid-century . . . . Clean energy innovation has also been delivering more options and lowering technology costs.*
> **Union of Concerned Scientists 2023:**
> *The energy choices that we make today could make or break our ability to fight climate change.*

Of course, not everyone agrees. See this Sample of Critical Perspectives on the Energy Transition.

2. Warm up with some activities to (re)acquaint you with the science of energy, and energy issues, using these exercises or other energy web resources you find. The goal is to generate great questions

for your research, and to begin to map and understand the larger landscape of the world's energy transition as the context of your local research. You might investigate:

- How can you assess your everyday energy use?
- Conservation: What habits or behaviors do you currently practice that use less energy (e.g. shorter showers, putting on a sweater, ride-sharing)? What else might you do? Conservation is the cleanest, cheapest supply of energy! If you are concerned about the impact of energy sources on the environment, the first thing you can do is change your habits to use less.
- "Embodied energy" in your built and natural environment – How much energy did it take to build our homes, manufacture our clothing (hint: see fast fashion and energy), and grow and distribute the food we eat?
- Energy and ecosystem services - How do energy issues connect with natural resource questions? What impact do energy sources have on ecosystems, close to home or far away?
- What are the most inspiring emerging technologies for renewable energy and energy efficiency?

Your School's Energy Transition! For a more in-depth warm-up before launching into community research, perform this quick investigation:

- What energy transition efforts are currently planned or underway in your building or school district?
- What are the goals (e.g. what combination of renewable sources, efficiency technologies, conservation incentives)?
- Who is involved? How could students be involved?
- Are there environmental justice dimensions?
- What other "low hanging fruit" or more ambitious goals are possible – in new efforts or project modifications? What would these cost? What would it take to make them happen?

If you find things happening in your school, this warm-up exercise might be one of the community projects/initiatives you investigate in **Make the Local Connection** below. If you want to take this investigation into action, check out the ideas at Undaunted K12 and the Inflation Reduction Act.

3. Get familiar with key features in the 2024 energy transition landscape

Here are excerpts from summaries of federal and state government law, policy, and research that is setting direction and providing funding for the energy transition:

At the national level:

2021 Infrastructure Investment and Jobs Act (IIJA). This law includes the largest investment in clean energy infrastructure in American history. Its Clean Energy and Power provisions include major funding for: (1) delivering clean power, (2) clean energy demonstrations, (3) energy efficiency and weatherization retrofits for homes, buildings, and communities, and (4) funding for clean energy manufacturing and workforce development.

2022 Inflation Reduction Act (IRA). This law includes some two dozen tax provisions that will save families money on their energy bills and accelerate the deployment of clean energy, clean vehicles, clean buildings, and clean manufacturing. Many of the clean energy tax provisions offer bonus credits to

projects that are located in low-income communities or energy communities, pay prevailing wages and use registered apprentices. The Inflation Reduction Act also provides billions of dollars in grant and loan programs and other investments for clean energy and climate action. As with the tax provisions, Congress and President Biden designed these programs to benefit working families and parts of the United States that are too often overlooked and underserved.

2023 Green New Deal Implementation Guide. The Green New Deal, introduced as a congressional resolution in 2019, lays out a blueprint for how the United States should move toward a more sustainable society, including transitioning to 100% renewable, zero-emission energy sources, and taxing activities that cause climate change. The plan also seeks to address poverty by aiming much of the improvements in frontline and vulnerable communities. **Massachusetts Senator Ed Markey** has been one of its strongest proponents. This Implementation Guide lays out the goal of the Green New Deal and compiles resources from the White House and federal agencies to give cities, states, Tribes, nonprofits, and individuals the tools they need to take full advantage of IIJA and IRA programs and create on-the-ground progress toward a Green New Deal.

2023 ***Accelerating Decarbonization in the United States: Technology, Policy, and Societal Dimensions***
This report from the National Academies of Sciences, Engineering, and Medicine says that the United States is in position to take the lead in the global fight against climate change. Proposing the next steps beyond the accomplishments of the IIJA and IRA, this report aims to provide a comprehensive plan to meet "net zero" carbon emissions goals and ensure a fair and equitable energy transition. Public and private sector engagement and "energy democracy" are themes. See this quick summary from *Grist*: Scientists lay out a sweeping roadmap for transitioning the US off fossil fuels

At the state level, in Massachusetts:

2022 Clean Energy and Climate Plan (CECP) 2025 and 2030
This document presents Massachusetts' comprehensive plans to achieve aggressive emissions reduction in 2025 and 2030, aiming for a 2050 future in which the heat in homes, power in vehicles, and electric grid can all operate with a minimum reliance on fossil fuels.

> **For a summary of the CECP** by Public Radio station WBUR in Boston, see:
> **How Mass. plans to cut emissions and curb climate change in the next decade**

Renewable Energy Snapshot shows the amount of solar, wind and combined heat and power (CHP) installed in Massachusetts.

ISO New England is a good source of information on regional electricity sources and uses. The independent, not-for-profit ISO is responsible for keeping electricity flowing across the six New England states. *Our Vision: To harness the power of competition and advanced technologies to reliably plan and operate the grid as the region transitions to clean energy.*

4. Investigate Massachusetts state agencies involved in the Energy Transition

More than most environmental issues, the energy transition involves a large, diverse mix of stakeholders representing government, business, nonprofit, and combinations of all three. You will need to become familiar with many of these players, but you can't hope to get to know all of them at the outset. The best approach is to pay attention and learn as you go.

For purposes of local energy transition research, you will find that becoming familiar with these statewide government agency and other programs will be particularly helpful:

Massachusetts Department of Energy Resources (DOER)

Green Communities Division: This program provides opportunities for municipalities to obtain grant funding for energy efficiency and renewable energy projects.

Renewable and Alternative Energy Division: This site provides information regarding the different kinds of renewable energy, funding programs and incentives, installation assistance, and more available in Massachusetts.

Massachusetts Department of Agricultural Resources (MDAR) - Energy Programs
Energy Efficiency, Conservation, and Renewables Programs and Services for agriculture-related businesses.

Multi-agency links related to energy within Massachusetts state government:
Renewable Energy
Energy Efficiency

The Massachusetts Clean Energy Center (MassCEC). A state economic development agency dedicated to accelerating the growth of the clean energy sector (including jobs and careers!) across the Commonwealth.
See especially: Clean Energy Careers Training & Education Directory

Mass Save. A collaborative of Massachusetts' electric and natural gas utilities and energy efficiency service providers. We empower residents, businesses, and communities to make energy efficient upgrades by offering a wide range of services, rebates, incentives, trainings, and information. With your help, we are making Massachusetts homes and businesses more energy efficient.

University of Massachusetts Clean Energy Extension
A UMass program that aims to help Massachusetts cities and towns, businesses, institutions, farms, low income and multiunit housing, and others to make the transition to clean energy. Also supports applied research to address technical and policy challenges facing clean energy.

Massachusetts Regional Planning Agencies
Each of these 12 regional agencies serves the local governments and citizens in its region by dealing with issues and needs that cross city, town, county and even state boundaries, including many sustainability and energy issues. For example: see the Metropolitan Area Planning Council's clean energy work.

Green Energy Consumers Alliance
An example of a non-governmental organization performing some valuable functions usually associated with government. Their mission: *to harness our power as energy consumers to speed the transition to a low-carbon future. Our choices as energy consumers are crucial to reducing greenhouse gas emissions and to shaping and enacting public policy that protects people and the environment. Green Energy Consumers' programs allow people to explore cost-effective, green solutions to their energy needs and to advance state policy toward electrification, renewable energy, grid modernization, and climate justice.*

5. Explore some hot topics in the Massachusetts energy transition

This is not an exhaustive list of topics! The internet is your friend here. The links below offer some not-to-be-missed resources. Many of these issues overlap. Many if not most have important **environmental justice dimensions. Suggestions for research:**

- Add <Massachusetts> and/or terms like <environmental justice> as you search any of the topics on this list.
- Another approach: Search up media stories on these topics from a trusted source: For example, try adding <Boston Globe> or <WBUR> to your search terms.

For Example: Some starting topics/search terms/links:

- Energy infrastructure siting
  - Clean Energy Extension: Community Planning for Solar Toolkit
- Solar "farms"
  - Mass Audubon & Harvard Forest: Growing Solar, Protecting Nature
- Transportation – electrification, public and private options
  - U.S. Department of Transportation: Electric mobility basics
- Agriculture and renewable energy
  - Resilient Mass: Farm Energy Best Management Practices Guide
- Education and job training
  - Mass CEC Clean Energy Careers Training & Education Directory
- Specialized and stretch energy building codes
  - WBUR (2022) Massachusetts is drafting a new climate-friendly building code
- Grid modernization
  - Microgrids
  - Distributed energy generation and storage
- Deep Energy Retrofits
  - A Blueprint to Decarbonize Affordable Housing
- Community solar
- Virtual power plants
- Municipal aggregation
  - WBUR: Towns say state is holding up plans for cheaper, greener electricity

6. Make the Local Connection - Projects and initiatives

You will find that there is a lot going on related to energy in your community!

A good place to start your research is at the Green Communities Program website, where you can review the current list of Green Communities and Grant Summaries. Talking with local people who have been involved, and reviewing reports and plans online, will put you on the fast track to understanding much about your municipality's energy priorities, goals, and accomplishments so far.

Then: what can you learn about the energy transition in your community from local government web pages? Check for example: Energy Committee, Sustainability Committee, Conservation Commission, Planning Board, Zoning Board, even the School Board. What local officials and boards are playing a role? Different entities may take the lead in different towns.

Some larger towns have staff – conservation agents, sustainability coordinators, etc. who are a good place to start your community interviews.

What additional partners and organizations are playing key roles related to energy transition issues? Don't forget **higher education institutions** and **consulting businesses**!

Eventually, you will develop your own mental "map" of the programs/projects/campaigns/ entrepreneurial endeavors and other organized energy transition efforts that are underway in your community - and the needs/issues that are being addressed.

Massachusetts' 2022 **Clean Energy and Climate Plan (CECP) 2025 and 2030** sets forth priorities for greenhouse gas emission reductions in several areas that offer opportunities for local action. Which of these (and/or other priorities) are being addressed in your community?

- Ensuring a just transition
- Transforming the transportation system
- Transforming buildings
- Transforming the energy supply
- Protecting natural and working lands

Here are some questions to ask about local energy transition efforts:

- Who are the partners/key players?
- What are the goals/expected results? E.g.
  - New or improved Infrastructure (which energy and/or efficiency technologies?)
  - Education/awareness/persuasion
  - Jobs/skills/careers wide
  - Other
- Where is this happening? (if the project has a specific location, plan a visit!)
- When is this happening (What's the project timeframe)?
- Additional dimensions (secondary outcomes/benefits – planned and unplanned)
  - Conservation/efficiency/renewable sources
  - Justice/equity (EJ)
  - Democracy/participation (EJ)
  - Ecosystem services – effects on land & natural resources
  - What else?
- Are there unexpected positive or negative side-effects (e.g. on natural resources)?
- What have been the unexpected obstacles?
- Where is the money coming from to make this happen?

7. Make the Local Connection – People engaged in the energy transition

A lot of the most important, up to date, relevant information in your research will come from PEOPLE, not books, not the web. Interviews will be a key element of your investigations.

Tips for Interviewing: Here are some things we have learned from listening to Envirothon teams talk about interviewing:

- When you do research in the community on the current issue, there will be lots of people who are happy to share what they know, but it will be up to YOU to ask the questions that will build your own understanding. Don't just sit back and listen! Be prepared with starter questions.

- There's always some awkwardness at the beginning. You may feel embarrassed because you are not familiar with the terminology they are using. And you may not even feel familiar enough with the topic to ask good questions. You've got to push through that. The more questions you ask, the better you will get at asking them, the more familiar the language becomes, and the easier and more fun the research becomes.
- If you can interview these people in their native habitat (in their workplace) you are likely to have a better experience. The questions will come more naturally for you, and the interviewee will be more relaxed in show-and-tell mode.
- We learned during the pandemic that Zoom interviews can be almost as good as being there and are a lot easier to arrange.

Get to know some of the key people involved with energy transition efforts in your community: Their work, yes, but also who they are as people:

- What do they do, day to day? Is their work for the energy transition part of their job?
- What drew them to get involved? How did they arrive at their opinions?
- What knowledge and skills do they need in this work? How did they learn these things?
- How did they make their choices of how to be involved and what actions to take? Do these choices reflect their understanding of the way the world works? Their understanding of who they are and what they can contribute best?
- What do they think should happen next, and how do we get there?

8. Consider Massachusetts' options for the future – Proposed Legislation

What additional tools and strategies are needed for the energy transition? One way to find out is to ask what new laws are being proposed (or opposed) by energy transition advocates.

- Start by asking the people you have met in your community who are involved in energy transition efforts. What changes in the law would be helpful? Is there legislation that they have their eye on?
- Search up <legislative priorities 2024> for clean energy interests and advocacy groups such as Mass Climate Action Network, Mass Sierra Club, Mass Audubon.
- Ask your Mass representative(s) and senator(s) where they stand on these bills. (The more informed and thoughtful your questions are, the more likely you are to get a thoughtful response. And by the way, one important way to take action is to let them know where YOU stand!)

9. Reflect on energy education and literacy (yours and others'!)

Throughout your research, keep a record of the good answers you find to these questions:

- Where are the opportunities, formal and informal, for people in your community to learn about the energy transition so that they can participate in decision-making and take responsible action?
- Where online can people find useful, important information online about the energy transition, energy technologies, etc.? What sites should they avoid, and why?
- What resources do you recommend for inspiration?

Considerations for Action Projects

1. Given what you have learned about how the energy transition is progressing in your community:

- What changes and/or new efforts are needed? Based on what you have learned, what strategies for action are likely to be most successful?
- Who has the power to make these changes or organize these efforts? How are the key decisions made?
- Are there people (individuals or organizations) already taking action in this area?
    - If so, is there a role that your team might play? How might you contribute to this work, given the knowledge and perspective and energy you can offer? Given the time you have available? Do you have strategies for action you would like to suggest?
    - If not, who is working on this issue elsewhere? Does their work offer ideas for effective strategies? Are there allies in your community who could give you good advice?

2. Consider who YOU are! It takes many kinds of action to make change happen. What part will YOU play? What are you good at? What kinds of effective action in the energy transition feel right to you? For an exploration of questions like these, see What kind of Changemaker are you?

3. ***"Never doubt that a small group of thoughtful, committed citizens can change the world; indeed, it's the only thing that ever has."*** (Margaret Mead) Some additional resources: Take inspiration from what other young people have accomplished.

Additional Links of Interest in the Transition to a Sustainable Energy System
November 2023

These links turned up in the process of developing the 2024 Mass Envirothon Community Engagement Award. There's lots of good information here. Way too much, in fact, and at the same time, INCOMPLETE. And the links aren't very well organized. However, browsing some of these sites may help broaden your energy topic horizons, ignite your curiosity, and propel you into your community research and action. Enjoy!

A Sample of Critical Perspectives on the Energy Transition

2024 "Amid explosive demand, America is running out of power" Washington Post. Artificial Intelligence and the boom in clean-tech manufacturing are pushing America's power grid to the brink. Utilities can't keep up. https://www.washingtonpost.com/business/2024/03/07/ai-data-centers-power/

2022 "The Staggering Ecological Impacts of Computation and the Cloud" The MIT press Reader. https://thereader.mitpress.mit.edu/the-staggering-ecological-impacts-of-computation-and-the-cloud/

2011 "The Myth of Renewable Energy" Bulletin of Atomic Scientists. [Note the date on this article. Have they been proven right?]
https://thebulletin.org/2011/11/the-myth-of-renewable-energy/

2022 “The Renewable Energy Transition Is Failing”
We need a realistic plan for energy descent, instead of foolish dreams of eternal consumer abundance by means other than fossil fuels. Currently, politically rooted insistence on continued economic growth is discouraging truth-telling and serious planning for how to live well with less.
https://independentmediainstitute.org/2022/11/21/the-renewable-energy-transition-is-failing/

2023 “Polycrisis”. *The novelty of humanity’s predicament demands novelty in our thinking as well. The polycrisis idea can motivate urgent scientific investigation into the architecture of global crisis interaction. If we’re going to have a clue about how we can address humanity’s intensifying challenges – as an integrated, compounding system of crises, rather than as discrete problems – we need to figure out why and how they’re becoming entangled.*
https://cascadeinstitute.org/earths-polycrisis-is-no-mere-illusion/

Energy Web Resources: Some Basic Background for the General Public

Renewable Energy Explained. U.S. Energy Information Administration
https://www.eia.gov/energyexplained/renewable-sources/
Renewable Energy. Unlimited resources. Little or no pollution. Union of Concerned Scientists
https://www.ucsusa.org/energy/renewable-energy
Learn about Energy and its Impact on the Environment. U.S. Environmental Protection Agency
https://www.epa.gov/energy/learn-about-energy-and-its-impact-environment
Electricity Explained. U.S. Energy Information Administration
https://www.eia.gov/energyexplained/electricity/
Why Clean Energy Matters. U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy. https://www.energy.gov/eere/why-clean-energy-matters
The global economy’s Energy System. International Energy Agency
https://www.iea.org/energy-system
What You Need to Know About Energy. National Academies of Sciences, Engineering, Medicine
http://needtoknow.nas.edu/energy/
GLOSSARY of Energy Terms. U.S. Energy Information Administration
https://www.eia.gov/tools/glossary/index.php?id=renewable
Energy Basics. National Renewable Energy Laboratory
https://www.nrel.gov/research/learning.html

Some Interesting Angles on Renewable Energy, Efficiency, and Conservation

Power Generation

Hydropower
Hydropower and dams in Massachusetts
https://www.massriversalliance.org/hydropower-and-dams

Biomass/biofuels
See also **Trees, Forests, and Wood in a Sustainable Energy System** below
Wood and wood waste
https://www.eia.gov/energyexplained/biomass/wood-and-wood-waste.php

Landfill gas and biogas
https://www.eia.gov/energyexplained/biomass/landfill-gas-and-biogas.php
Is burning wood for heat carbon neutral?
https://www.mprnews.org/story/2019/11/09/climate-curious-is-burning-wood-for-heat-carbon-neutral

Wind
Floating Wind Energy Development in the Gulf of Maine
https://www.nrel.gov/docs/fy23osti/86550.pdf
The kite converts high altitude winds into electricity for remote communities
https://thenextweb.com/news/german-energy-kite-power-startup-launch-ireland
Wind-powered cargo ship sets sail in a move to make shipping greener
https://www.cnn.com/2023/08/22/travel/wind-powered-cargo-ship-cargill-bartech-climate-c2e-spc-intl/index.html
A new generation of airships is taking to the skies
https://www.cnn.com/travel/article/flying-whales-airships-hnk-spc-intl

Geothermal (mostly in the "efficiency" category in Massachusetts, but also offers possibilities as a heat source)
Everywhere in the world, below the surface, geothermal exists. Everywhere. The question is only, how deep is it? And the key to unlocking that clean power comes from a surprising place: the fossil fuel industry.
https://www.climateone.org/audio/geothermal-so-hot-right-now
The country's first gas utility-run networked geothermal heating and cooling system breaks ground in Massachusetts
https://www.wbur.org/news/2023/06/13/networked-geothermal-eversource-heat-pump-gas-utility
Geothermal heating and cooling: Renewable energy's hidden gem
https://yaleclimateconnections.org/2022/08/geothermal-heating-and-cooling-renewable-energys-hidden-gem/

Hydrokinetic power
The earth's tides, waves, ocean currents, and free-flowing rivers contain an untapped, powerful, highly-concentrated and clean energy resource
https://www.fws.gov/node/265253#:~:text=Hydrokinetic%20energy%20is%20the%20energy,concentrated%20and%20clean%20energy%20resource.

Energy harvesting
. . . a process wherein the sources such as mechanical load, vibrations, temperature gradients and light, etc., are scavenged and converted to obtain relatively small levels of power
https://www.sciencedirect.com/topics/engineering/energy-harvesting

Advances in solar photovoltaics
This PV-leaf can harness more power than standard solar panels - And can harvest water in the process
https://thenextweb.com/news/solar-leaf-can-harness-more-power-than-solar-panels
Revolutionary Solar "Leaf" Mimics Nature For Turning Sunshine Into Electricity
https://www.iflscience.com/revolutionary-solar-leaf-mimics-nature-for-turning-sunshine-into-electricity-70319

Combining solar PV with agriculture
https://ag.umass.edu/clean-energy/research-initiatives/solar-pv-agriculture

Controversial non-fossil fuel energy sources:

Large scale solar farms

- https://www.massaudubon.org/our-work/publications-resources/growing-solar-protecting-nature
- https://www.wbur.org/news/2023/10/02/solar-power-farms-clear-cutting-forest
- https://www.perchenergy.com/ (favors all solar installations as "community solar")

Hydro-electric dams

- https://www.massriversalliance.org/hydropower-and-dams

Municipal solid waste

- https://www.wbur.org/news/2022/01/20/trash-incineration-pollution-massachusetts
- https://www.wtienergy.com/about/how-efw-works

Large scale biomass

- https://www.wbur.org/news/2021/04/16/rps-changes-biomass-renewable-energy-subsidies-springfield

Nuclear

- https://commonwealthmagazine.org/energy/regions-aging-nuclear-power-plants-drawing-interest-2/
- https://www.ucsusa.org/energy/nuclear-power

Energy Distribution

The Grid
U.S. Department of Energy, Office of Electricity: Building a 21st century electricity grid
https://www.energy.gov/oe/office-electricity
Smart Grid: "Next generation" devices, software, tools, and techniques
https://www.smartgrid.gov/

Grid modernization in Massachusetts https://www.mass.gov/info-details/grid-modernization#background-
Microgrids https://files.masscec.com/research/Microgrids.pdf

Energy Storage

E.P.A. on electricity storage: The electric power grid operates based on a delicate balance between supply (generation) and demand (consumer use). One way to help balance fluctuations in electricity supply and demand is to store electricity during periods of relatively high production and low demand, then release it back to the electric power grid during periods of lower production or higher demand. Energy can be stored in a variety of ways, including: pumped hydroelectric, compressed air, flywheels, batteries, thermal energy storage.
https://www.epa.gov/energy/electricity-storage

Hydrogen is an energy carrier that in some cases may be a good alternative to electricity and lithium battery storage.
https://www.hydrogen.energy.gov/
https://www.eia.gov/kids/energy-sources/hydrogen/
https://www.carboncapturefacts.org/about
https://www.h2bulletin.com/knowledge/hydrogen-colours-codes/

Gravity energy storage
From Earth Day's magazine, GRIST: How the humble chairlift could revolutionize renewable energy. The United States already uses pumped-storage hydropower. . . . But who needs water when there are all kinds of things we can slide down a mountain or drop off a cliff? Really, you can use almost any material for gravity energy storage, as long as it's heavy, cheap, and you can figure out how to transport it up and down a steep slope.
https://grist.org/article/how-the-humble-chairlift-could-revolutionize-renewable-energy/

From BBC Future: When green energy is plentiful, use it to haul a colossal weight to a predetermined height. When renewables are limited, release the load, powering a generator with the downward gravitational pull. https://www.bbc.com/future/article/20220511-can-gravity-batteries-solve-our-energy-storage-problems

Thermal energy storage
Community scale: https://www.epa.gov/energy/combined-heat-and-power
Building scale: https://www.energy.gov/energysaver/solar-water-heaters
Utility scale: https://www.energy.gov/eere/solar/thermal-storage-system-concentrating-solar-thermal-power-basics#

Storage in Massachusetts:
UMass Clean Energy Extension. Links to Energy Storage Information.
https://ag.umass.edu/clean-energy/energy-storage-information
Massachusetts has made the advancement of energy storage technology a priority in the commonwealth, through the Energy Storage Initiative https://www.mass.gov/energy-storage-initiative and other programs.https://ag.umass.edu/clean-energy/research-new-initiatives/energy-storage

Charging Forward: Energy Storage Toward a Net Zero Commonwealth
This study examines the current deployment and use cases of energy storage in the Commonwealth, as well as how mid- and long-duration energy storage could potentially benefit the grid and ratepayers, including through improving grid reliability.
https://www.masscec.com/program/2023-energy-storage-study

Conservation & Efficiency

What do we mean by "Energy Efficiency" vs. "Energy Conservation"?
Energy efficiency (EE) and energy conservation (EC) are related and often complementary or overlapping ways to avoid or reduce energy consumption. Energy efficiency generally pertains to the technical performance of energy conversion and consuming devices and building materials. Energy conservation generally includes actions to reduce the amount of energy end use.
https://www.eia.gov/energyexplained/use-of-energy/efficiency-and-conservation.php

EmPower Mass Clean Energy 101 Primer – a slide deck with introductory information on some of the most common clean energy technologies. Especially useful for renters or where cost is an obstacle:
https://files-cdn.masscec.com/uploads/attachments/Clean%20Energy%20101%20Primer.pdf

Passive House is a performance-based building certification that focuses on the dramatic reduction of energy use for space heating and cooling. . . . We can deliver a high level of energy savings and carbon

reduction for all building types while providing a healthier and more comfortable space to live and work. https://phmass.org/what-is-passive-house/

Mass. is drafting a new climate-friendly building code. Here's what you need to know (March 2022) https://www.wbur.org/news/2022/03/17/massachusetts-energy-environmental-building-code-proposal-explainer

Transportation

Basics of Electric Mobility
https://www.transportation.gov/rural/ev/toolkit/ev-basics/vehicle-types
Micromobility
https://www.fhwa.dot.gov/livability/fact_sheets/mm_fact_sheet.cfm
What's With All the Electric SUVs?
https://www.autoevolution.com/news/whats-with-all-the-electric-suvs-aren-t-evs-supposed-to-be-super-efficient-138579.html

Massachusetts Legislative Priorities for 2023-24 (from climate/clean energy advocacy groups)

Mass Climate Action Network. MCAN is excited to share our 2023/24 legislative priorities focusing on four critical areas of climate action: 1) equitable building decarbonization; 2) the reduction of embodied carbon in buildings; 3) reforming municipal utilities and advancing energy democracy; and 4) advancing energy and environmental justice. https://www.massclimateaction.org/2023_2024_priorities

Mass Audubon. Policy Priorities. To fight the climate crisis, we must shift to 100% clean energy as quickly as possible. We're working to drive the clean energy transition while safeguarding our irreplaceable ecosystems and wildlife. https://www.massaudubon.org/take-action/advocate/policy-priorities

Massachusetts Sierra Club. 2023-2024 Legislative Priorities. With the new state administrative leadership and the federal government's support, there is no better time to hasten our transition to renewable energy while strengthening our economy and communities. Each of these bills represents a step towards creating a cleaner, healthier, more equitable future for Massachusetts residents. https://www.sierraclub.org/massachusetts/2023-2024-legislative-priorities

Environmental League of Massachusetts. Legislative Priorities.
https://www.environmentalleague.org/legislative-priorities/

MassPIRG. 2023-2024 Legislative Priorities. MASSPIRG is working to safeguard public health, protect consumers in the marketplace, transform our energy and transportation systems, reduce waste, remove toxic threats, curb wasteful spending, revitalize our democracy, and protect our environment. https://pirg.org/massachusetts/resources/masspirgs-2023-2024-legislative-priorities/

Metropolitan Area Planning Council (MAPC). Legislative Priorities: Climate Change and Resilience. We'll need to increase renewable energy production and energy efficiency dramatically – and quickly – while ensuring access and affordability for Environmental Justice (EJ) populations. We must implement microgrids, energy storage, and reduce peak demand. Electric and gas utility markets will need to support greater decentralized generation, better and more expanded transmission, and

much higher levels of renewable energy. We will need resources for deep energy retrofits and higher performance standards for both new construction and renovation of existing buildings. Furthermore, public and personal transportation will need to turn sharply toward an electric future that does not aggravate congestion or sprawl. https://www.mapc.org/get-involved/legislative-priorities/#clean

350 Mass. 350 Mass Legislative Agenda for 2023-2024. Press your legislators to support our campaign priorities. We need to renovate 1 million homes with clean energy by 2030, replace high emitting vehicles with electric ones, increase solar energy, and much more. To get there, we need support in the legislature, which we can only build through grassroots organizing in districts across the state. https://350mass.betterfutureproject.org/legislative_agenda

Trees, Forests, and Wood in a Sustainable Energy System

Trees and forests provide multiple ecosystem services, including many directly related to sustainable energy systems. All Massachusetts communities - from urban to suburban to exurban to rural - receive these benefits to some degree.
Benefits include:

- Water resource conservation
- Wildlife habitat
- Aesthetic and recreational values
- Healthy air quality
- Civic pride

Also some specific energy/climate benefits:

- Carbon sequestration to limit climate change
- Sustainable/energy efficient building materials
- Renewable Fuel for home heating: cordwood and/or wood pellets
- Renewable Fuel for larger scale cogeneration of heat and electric power
- Shade for cooling individual houses and whole neighborhoods

Climate change can make communities vulnerable to power outages and property damage due to trees and branches falling in extreme weather.
Consideration of your community's relationship with trees and forests can provide a practical local case study in the transition to sustainable energy systems.

Here are some resources for considering questions and controversies. They are not all in agreement, and not all of the same quality! As always, evaluate the information and its biases carefully. What additional (trustworthy and thoughtful) resources can you find?

- Trees: Our Mental, Physical, Climate Change Antidote
- Neighborhoods in Mass. could get more shade from trees under new climate bill
- Circularity concepts in wood construction

- The U.S. Energy Information Administration's Biomass explained site includes sections on
    - Wood and wood waste
    - Waste-to-energy (MSW)
    - Landfill gas and biogas
    - Biomass and the environment
- Climate Curious: Is burning wood for heat carbon neutral?

- Solar Panels vs. Trees – How To Choose?
- What Is More Effective Emissions-Wise, Solar Panels Or Trees?
- Scientific American: Plants versus Photovoltaics: Which Are Better to Capture Solar Energy? Determining the relative efficiency of photosynthesis and photovoltaics is not a simple problem
- Do Solar Panels Reduce Attic Temperature?
- Do Solar Panels Contribute to the Heat Island Effect?
- Solar panels can heat the local urban environment, systematic review reveals
- Urban Forests and Climate Change
- Street Trees Could Help Boston Adapt To Climate Change. If They Can Survive, That Is
  Yes, Boston should continue planting trees, but the real canopy payoff will come from preserving bigger, leafier ones.
- Urban Wood Utilization: From Trash to Treasure
  Urban and community wood utilization diverts wood from waste streams and landfills, creating value, driving new markets, generating employment opportunities, and storing carbon in wood destined for landfills.
- How Circular Utilization of Urban Tree Waste Can Help Mitigate Climate Change

Additional Resources for youth-led community-based research and action

The YouthPower Guide is a user-friendly tool that breaks down community planning in a step-by-step fashion. It's written for teens, and explains activities like developing a mission statement, team building, defining community problems, and brainstorming solutions. There's also information about building coalitions, working with municipal departments, and getting publicity. . . . YouthPower members developed their handbook to give young people in other Massachusetts cities the practical advice they need to make a difference in their own backyards. (see Commonwealth Beacon: Holyoke teens take control of their neighborhood)

Youth Participatory Action Research (YPAR) Hub
YPAR is an innovative approach to positive youth and community development based in social justice principles. This hub features expansive curriculum and resources to enrich YPAR projects.

Civics Project Guidebook
Massachusetts Department of Elementary and Secondary Education
The purpose of this *Civics Project Guidebook* is to support meaningful implementation of "student-led civic engagement projects" in Massachusetts secondary schools. It seeks to develop common understanding of the "what" and "how" of high-quality civics projects and includes tools and resources for districts, schools, and educators related to both project planning and implementation. It is not designed as a resource for young people but can be useful for understanding project expectations.