

# Today I Learned About Energy & Electricity

## Description:

While the terms energy and electricity are often used interchangeably in daily life, understanding the distinction helps students better evaluate energy-related climate solutions. Students explore US energy and electricity data from 2001-2018 to distinguish between the terms and understand their future.

## Skills & Objectives

### SWBAT

- Explain that energy is a general term, and that electricity is a specific form of energy.
- Understand that electricity is generated from multiple sources whose use has changed over time in the US.
- Understand that each sector of the economy uses energy and electricity in different ways.
- Name one solution that changes US energy and/or electricity use in a way that reduces heat-trapping gases.

### Skills

- Reading and interpreting line graphs
- Communication

### Students Should Already Know That

- Energy is the capacity of an object or system to do work.
- Electricity is one form of energy.

### Standards Alignment:

HS-ESS3-4 Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

CCSS.ELA-LITERACY.RI Informational Texts

CCSS.ELA-LITERACY.RST Science and Technical Subjects

CCSS.ELA-LITERACY.SL Speaking & Listening

### Disciplinary Core Ideas:

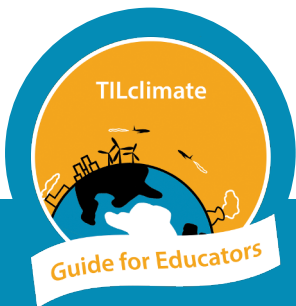
PS3.A Definitions of Energy

ESS3.C Human Impacts on Earth Systems

ESS3.A Natural Resources

ESS3.D Global Climate Change

ETS1.A Defining and Delimiting an Engineering Problem



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## How To Use These Activities:



Pages with the circular “TILclimate Guide for Educators” logo and the dark band across the top are intended for educators. Simpler pages without the dark band across the top are meant for students.

Each of the included activities is designed to be used as a standalone, in sequence, or integrated within other curriculum needs. A detailed table of contents, on the next page, explains what students will do in each activity.

Each of the worksheet sets takes about the same amount of time and could be done as stations or in a jigsaw with students sharing their learning.

## A Note About Printing

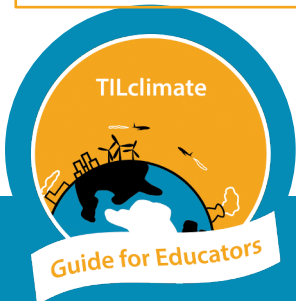
All student pages are designed to be printable in grayscale.

The worksheets do not leave space for students to answer questions. Students may answer these questions in whatever form is the norm for your classroom – a notebook, online form, or something else. This allows you, the teacher, to define what you consider a complete answer.

All data from <https://www.eia.gov/beta/states/data/dashboard/consumption>.

**Podcasts in the Classroom:** Throughout these Guides for Educators, we invite students to think about how they would share their learning with family and friends. One way to do this is to encourage your students to create their own podcasts - they're shareable, creative, and have multiple options for embedded assessment. We would love to hear any podcasts or see any other projects you or your students create! Email us at [tilclimate@mit.edu](mailto:tilclimate@mit.edu), Tweet us @tilclimate, or tag us on Facebook @climateMIT.

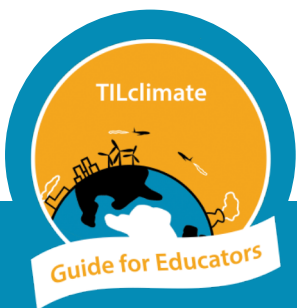
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## Detailed Table of Contents

Page	Title	Description	Time (min)
	Podcast Episode	Students listen to TILclimate: Is it energy or electricity?, either as pre-class work at home or in the classroom. <a href="https://climate.mit.edu/podcasts/e3-it-energy-or-electricity">https://climate.mit.edu/podcasts/e3-it-energy-or-electricity</a>	10-15
1-2	Electricity	Students study graphs of electricity generation and use and answer questions.	10-15
3-4	Energy	Students study graphs of energy consumption by source and sector and answer questions.	10-15
5-6	Renewables	Students study graphs of renewable electricity and energy and answer questions.	10-15
7	Definitions	Definitions of all energy sources and sectors found in the graphs.	n/a



# Today I Learned About Energy & Electricity

## Season 2 Collection

Season 2 of TILclimate from MIT covers a series of interrelated energy subjects. The associated teacher guides are structured for maximum flexibility. Each episode's activities could be done as a whole class or as small-group work while other teams work on other topics and share back in a jigsaw. Some activities also can be enrichment or homework, and many as asynchronous assignments for remote work. Activities of similar length could also be set up as rotating stations, with a group discussion at the end of class.

- Introductory activities are quick (15-25 minutes) and require no internet.
- Dive Deeper activities are longer (30-60 minutes) and require internet access.

The City of the Future overall project is flexible in terms of time, space, and materials. It will be engaging whether students have completed all activities in the collection, or just one. If teams of students have been working on one topic each, the City of the Future process will help them share their learning with the rest of the class.

## Is it Energy or Electricity?

This Educator Guide includes three short graph investigations. Educators may pick and choose among the pieces of the Guide, as suits their class needs.

Parts of this Guide may align with the following topics:

- Physical science: definitions of energy types.
- Life/environmental science: effects of fossil fuels vs other energy sources
- History/social science: impacts of climate change
- ELA/nonfiction: understanding and communicating complex science topics

## MIT Resources

We recommend the following as resources for your own better understanding of climate change or as depth for student investigations. Specific sections are listed below:

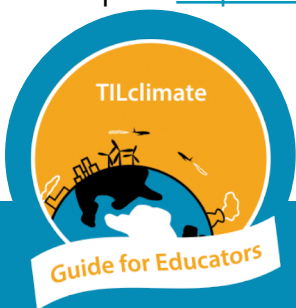
- Climate Science, Risk & Solutions, an interactive introduction to the basics of climate change. <https://climateprimer.mit.edu/>
  - Chapter 02 The greenhouse effect and us
  - Chapter 05 How much of the CO<sub>2</sub> increase is natural?
  - Chapter 10 What can we do?
- MIT Climate Portal Explainers are one-page articles describing a variety of climate topics. <https://climate.mit.edu/explainers>

Greenhouse Gases

Nuclear energy

Biofuel

Renewable Energy



# Today I Learned About Energy & Electricity

## Wrap-Up Discussion Questions

- In daily life, we often use the terms energy and electricity interchangeably. How would you define the differences?
- Based on what you saw in the graphs and what you have heard about, what do you think is the future of energy in the US?
- The switch to a carbon-neutral future includes both energy shift (moving away from fuels and processes that produce heat-trapping gases) and energy efficiency (using less energy overall.) What is one solution you have heard about or seen?
- Based on what you saw in the graphs, which sectors have the most impact on carbon dioxide emissions in the US?

## Climate Solutions

Climate solutions can be thought of as falling into four categories outlined below. Across all categories, solutions at the community, state or federal level are generally more impactful than individual actions. For example, policies that increase the nuclear, solar and wind mix in the electric grid are generally more effective at reducing climate pollution than asking homeowners to install solar panels. For more on talking about climate change in the classroom, see “How to Use This Guide”.

### •Energy Shift

How do decision-makers make the switch from carbon-producing energy to carbon-neutral and carbon-negative energy?

### •Energy Efficiency

What products and technologies exist to increase energy efficiency, especially in heating and cooling buildings?

### •Adaptation

How can cities and towns adapt to the impacts of climate change?

### •Talk About It

Talking about climate change with friends and family can feel overwhelming. What is one thing you have learned that you could share to start a conversation?

What solutions are the most exciting in your classes? We would love to hear from you or your students! Images, video, or audio of student projects or questions are always welcome. Email us at [tilclimate@mit.edu](mailto:tilclimate@mit.edu), Tweet us @tilclimate, or tag us on Facebook @climateMIT.

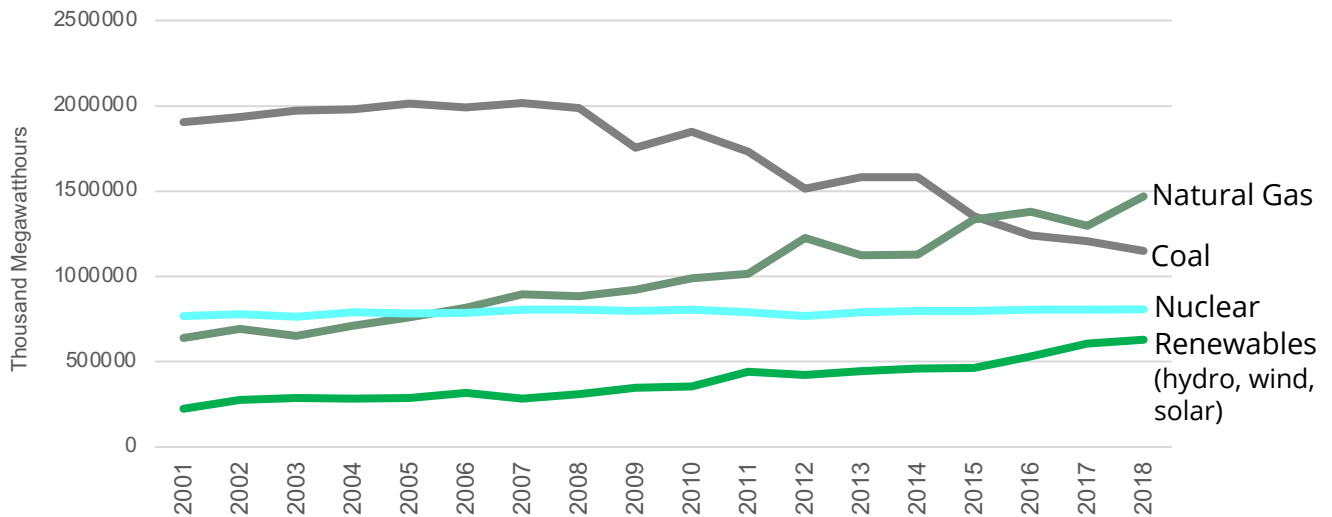


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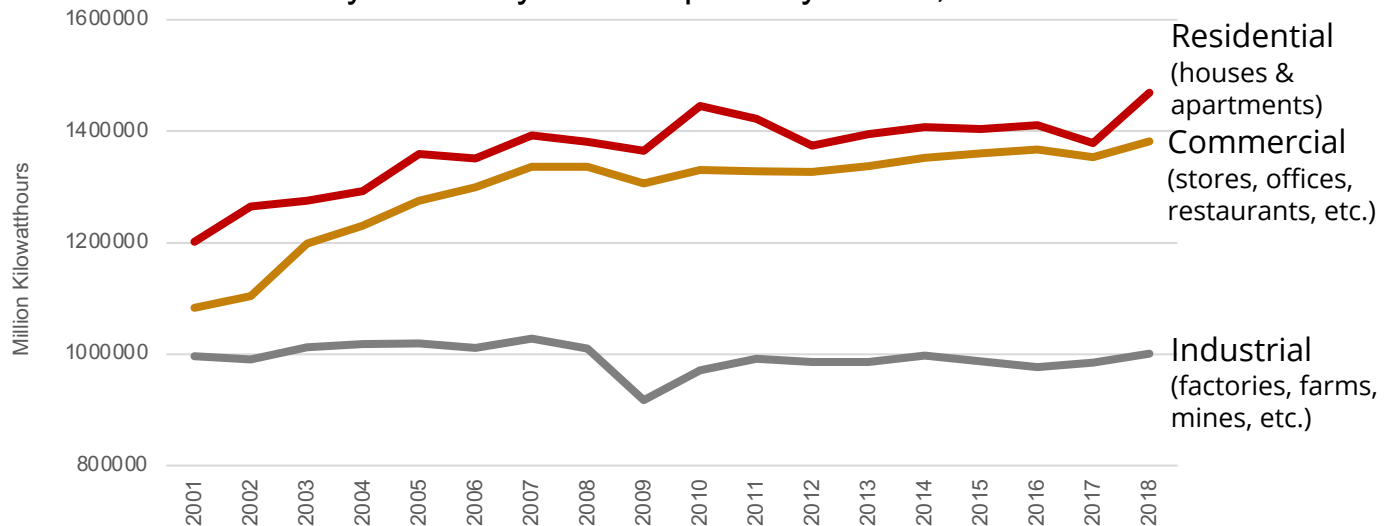
“Energy can be generated in a lot of different ways and be used to do lots of different kinds of things, and making electricity is one of those things.”

*Laur Hesse Fisher, MIT Environmental Solutions Initiative  
TILclimate podcast: Is it energy or electricity?*

## US Utility Electricity Generation by Source, 2001-2018



## US Utility Electricity Consumption By Sector, 2001-2018



These graphs only show electricity in the retail/utility market. Most of our electricity is produced and sold through electric utility companies. Smaller amounts of electricity are also produced and used directly, such as in certain factories.

<https://www.eia.gov/beta/states/data/dashboard/consumption>

# Today I Learned About Energy & Electricity

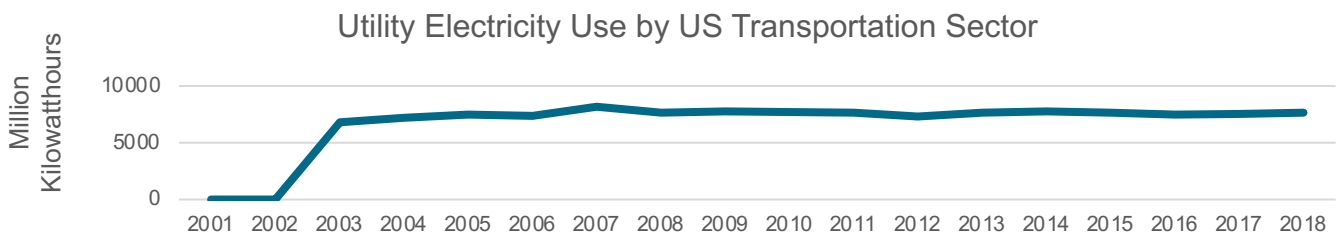
“About 40% of the energy that’s used in the U.S. is used to make electricity, which powers our lights, our computers, our appliances, our air conditioning units. Electricity is typically made in big power plants and then travels over wires to our buildings.”

*Laur Hesse Fisher, MIT Environmental Solutions Initiative*  
*TILclimate podcast: Is it energy or electricity?*

## Explore

1. What do you notice about electricity generation in the US?
2. What do you notice about electricity use by each sector?
3. What questions do you have about how electricity is generated and used in the US?

## Transportation



Between 2001-2018, electricity use for cars and buses was so low that the line was barely visible on the larger graph and had to be moved here at a different scale.

In 2020, multiple major car and truck manufacturers announced that they would be moving to all-electric fleets within the next decade.

4. How would you expect this shift to change electricity use in the US?

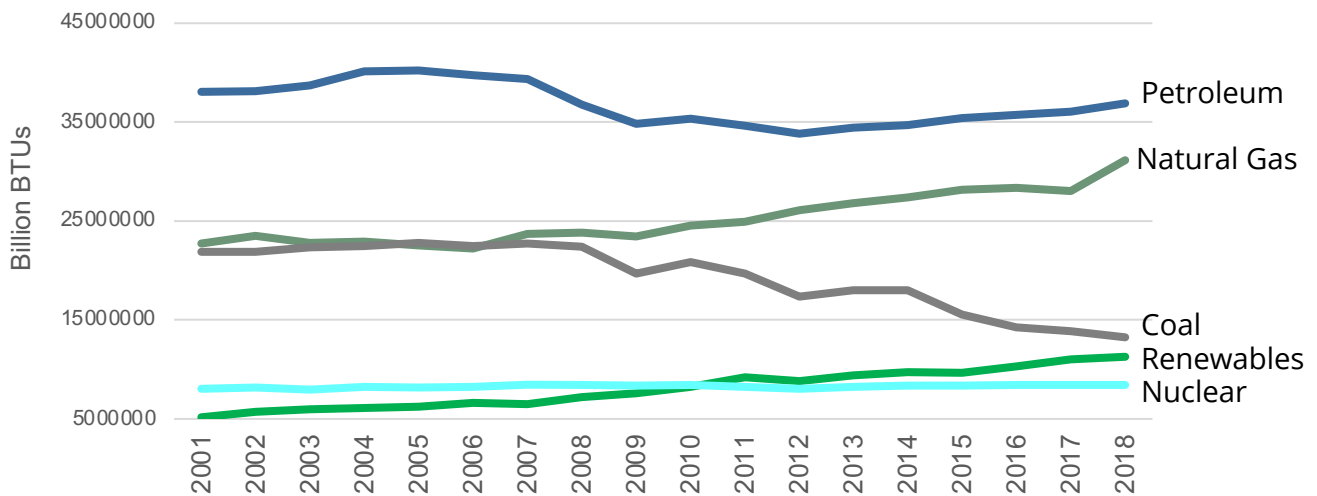
# Today I Learned About Energy & Electricity

“Energy is kind of a catch-all term, whereas electricity is a specific form of energy. Think of a fire and think of the flames of a fire as energy. The flames can warm a pot a water for cooking pasta, or they can keep a room warm. You could also boil water to create steam that turns a turbine and generates electricity.”

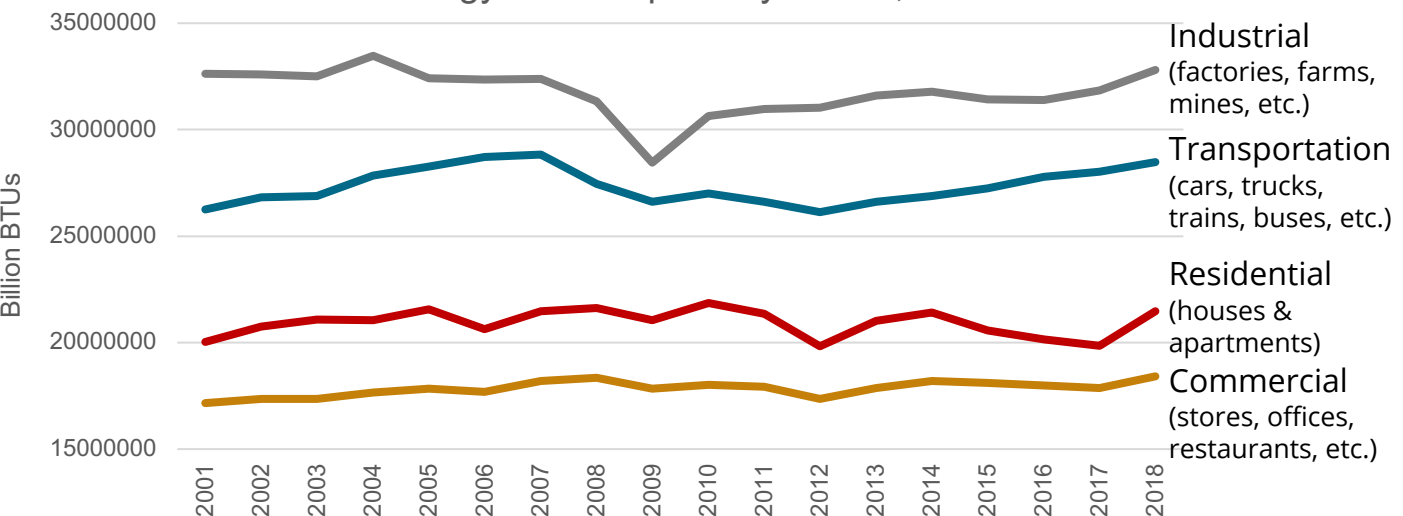
*Laur Hesse Fisher, MIT Environmental Solutions Initiative*  
TILclimate podcast: *Is it energy or electricity?*

Only about 37% of the energy used in the US goes to produce electricity. Most energy is used as fuel for transportation, industry, and heating.

### US Energy Consumption By Source, 2001-2018



### US Energy Consumption by Sector, 2001-2018





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“So what about the other 60% of the energy that’s used in the U.S.? This isn’t used to produce electricity. Some of it is used to produce heat for our homes and buildings, and to heat our water. A lot of energy is consumed by industry and manufacturing plants, who use it to produce heat to help create products like paper, steel, plastics, and chemicals.”

*Laur Hesse Fisher, MIT Environmental Solutions Initiative*

*TILclimate podcast: Is it energy or electricity?*

## Explore

1. What do you notice about energy consumption in the US?
2. What do you notice about energy use by each sector?
3. What questions do you have about how energy is generated and used in the US?

We often use the terms electricity and energy interchangeably (“My phone is running out of energy.”) However, electricity is just one form of energy that we use every day.

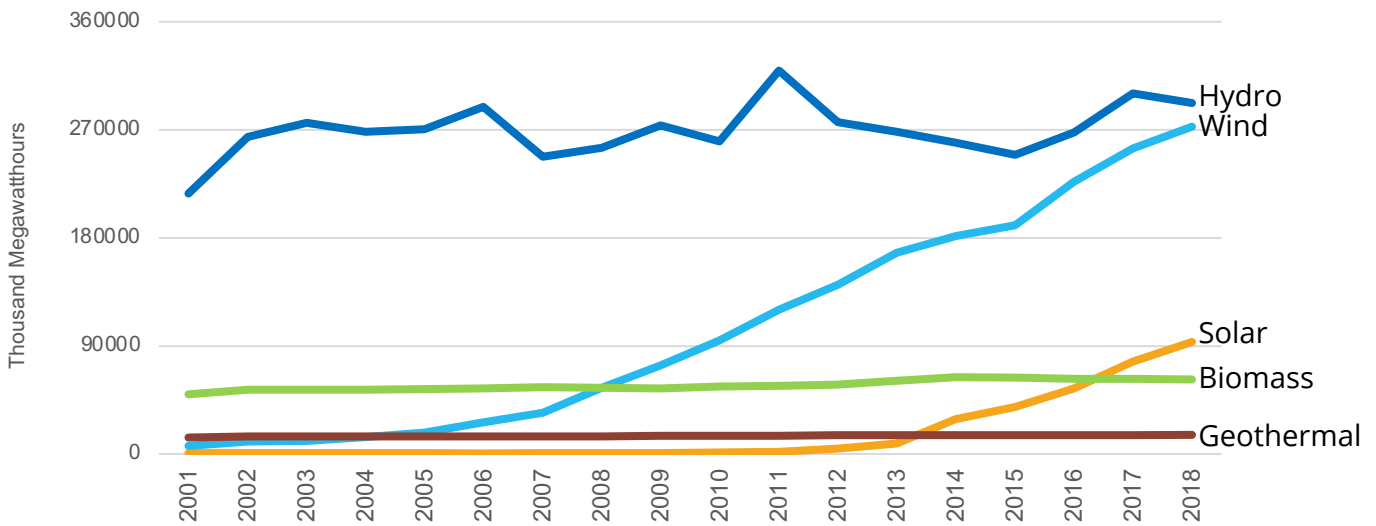
4. In your own life, how do you use energy that is *not* electricity? List three ways. If you know what the source of that energy, list it.

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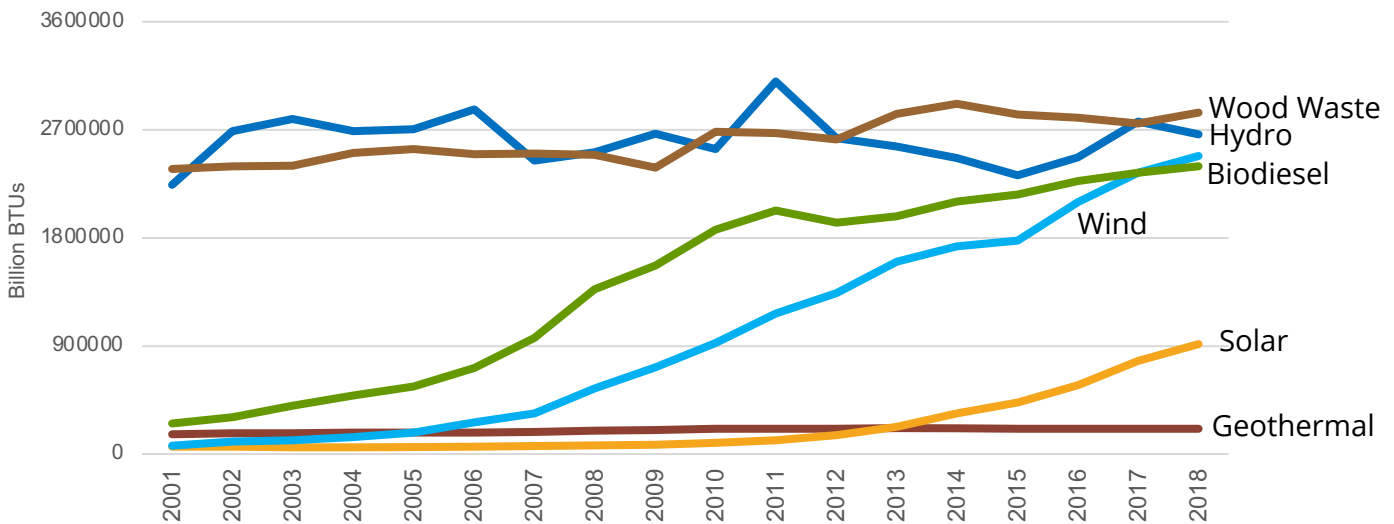
“Renewable energy is energy from sources we cannot run out of. Some types of renewable energy, like wind and solar power, come from sources that are not depleted when used. Others, like biomass, come from sources that can be replenished.”

*Jennifer Morris, MIT Joint Program on the Science and Policy of Global Change  
MIT Explainer: Renewable Energy on [climate.mit.edu](http://climate.mit.edu)*

## US Electricity Generation by Renewables, 2001-2018



## US Energy Production by Renewables, 2001-2018



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“One strategy to reduce CO<sub>2</sub> from energy is to electrify heat and transportation. Instead of burning gas to heat water in our homes, we’d all use electric water heaters. Instead of oil to fuel our cars, we’d all have electric cars that we plug into electrical outlets. And then at the same time, we make it so that our electricity is being created in a way that doesn’t produce CO<sub>2</sub>.”

*Laur Hesse Fisher, MIT Environmental Solutions Initiative  
TILclimate podcast: Is it energy or electricity?*

## What is Next?

When we burn fossil fuels like coal, oil, and natural gas, we release carbon dioxide (CO<sub>2</sub>) into the atmosphere. Carbon dioxide and other gases act like a blanket, trapping heat on Earth. This trapped heat is changing our climate, causing dramatic changes in extreme weather and other effects all over the world.










1. Given what you know about how energy and electricity was generated and used between 2001 and 2018, what would you expect to change by 2030?

The switch to a carbon-neutral future includes both energy shift (moving away from fuels and processes that produce heat-trapping gases) and energy efficiency (using less energy overall.)





2. What is one solution you have heard about or seen?
3. Does that solution support energy shift, energy efficiency, or both?
4. The most effective solutions act at the level of a neighborhood or city. If your solution above is an individual action, how could you grow it to a larger community?

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## Energy Definitions

Energy Source	Where it comes from and how it is used	Renew-able	Low CO <sub>2</sub>
 Natural Gas	Pumped from deposits underground. Refined & burned to create steam for electricity or used directly to create heat.	✗	✗
 Petroleum	Pumped from deposits underground. Refined into oil, diesel, and gasoline and burned for electricity, heat, and transportation.	✗	✗
 Coal	Mined and burned to create steam for electricity or used directly to create heat.	✗	✗
 Nuclear	Uranium is mined and refined. Atoms are split to create heat and steam to generate electricity.	✗	✓
 Biomass	Burning trees, plants, and other organic matter for heat or to generate electricity.	✓	✗
 Wind	Using wind power to turn a turbine and generate electricity.	✓	✓
 Hydro-power	Using flowing water to turn a turbine and generate electricity.	✓	✓
 Solar	Materials mined from underground are used to capture light from the sun and generate electricity	✓	✓
 Geothermal	Using the natural heat and water below Earth's surface to heat & cool buildings or generate electricity.	✓	✓

## Sector Definitions

 Industrial	Manufacturing, agriculture, forestry, mining, oil & gas extraction, and construction. Energy use is mostly heat for manufacturing processes, powering machinery, and heating and cooling buildings.
 Transportation	Cars, trucks, buses, trains, airplanes, and ships that are used to transport people and/or goods. Energy use is mostly fuel for engines.
 Residential	Houses, apartments, condominiums, etc. Energy use is mostly heating, cooling spaces and water, lighting, refrigeration, cooking, etc.
 Commercial	Businesses, restaurants, hotels, stores, government buildings, religious or social organization buildings, institutional living spaces. Energy use is mostly heating, cooling spaces and water, lighting, refrigeration, cooking, etc.

Images from the Noun Project Becris, Koson Rattanaphan, Hamel Khaled, Nawicon, ArmOkay, Jacqueline Fernandes, Tom Fricker, Ivan, Eragon, Ben Davis, Monkik, and Charif Deffa