Today I Learned About The Electric Grid

Description:

The electric grid is an invisible and yet deeply necessary part of modern life. Through a game, students understand the challenges of keeping the grid balanced. Students explore two map-based datasets to explain why and how the grid stays balanced. A deeper dive into their own local electric grid makes the learning relevant.

Skills & Objectives

SWBAT

- Explain why the electric grid needs to be balanced over space and time.
- Evaluate choices made in a region in terms of how electricity is generated and transmitted.

Skills

- Map reading
- Data interpretation
- Communication

Students Should Already Know That

- Electricity flows through wires in a grid across the US.
- Many different power sources are used to create electricity.
- The US is divided into Time Zones.

Standards Alignment:
HS-PS2-6 Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.
HS-ESS3-4 Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
CCSS.ELA-LITERACY Informational Texts, Science and Technical Subjects

- Connect investigation of the local electric grid to news articles about changes to the local electric makeup.

CCSS.ELA-LITERACY.RH History/Social Studies

- The growth of the electric grid is a driving force for 20th century societal, technological, and demographic change.

Disciplinary Core Ideas:
PS3.B: Conservation of Energy and Energy Transfer
ETS1.A: Defining and Delimiting Engineering Problems

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How To Use These Activities:

Pages with the circular "TILclimate Guide for Educators" logo 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.

The game, History of Electric Grid reading, Time Zones worksheet, and Version B of the Data Exploration worksheet each take about the same amount of time. These four activities could be done as stations or a jigsaw.

Version A of the Data Exploration and both parts of the Dive Deeper activity require internet use and could be done as homework or asynchronous remote work.

A Note About Printing

Most of these pages can be printed in grayscale for student use, including the graph on page 5. However, the maps on pages 9 and 10 are in full color. In order to save on color printing, larger versions of these images have been included, which could be printed as a shared resource (1 copy for 4-5 students) or projected in the classroom.

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. Student-created podcasts are 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, Tweet us @tilclimate, or tag us on Facebook @climateMIT.

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Detailed Table of Contents

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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.

The Electric Grid

This Educator Guide includes a game, short reading, introductory worksheets, and a deeper dive into two data-visualization websites. 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: electricity, electron movement, load-balancing, engineering
- Life/environmental science: impacts of energy use on natural systems, climate change
- History/social science: impacts of the growth of electric grids through the early 1900s, impacts of energy use and climate change on human systems
- ELA/literature: connections to 1920s and 1930s literature, rural communities, damming rivers for hydroelectricity
- ELA/nonfiction: news articles about changes to the local electric grid to include more renewable resources

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/
  - 05: How much of the CO_2 increase is natural?
  - 10: What can we do?
- MIT Climate Portal Explainers are one-page articles describing a variety of climate topics. https://climate.mit.edu/explainers
  - Cities and Climate Change
  - Energy Storage
  - Renewable Energy

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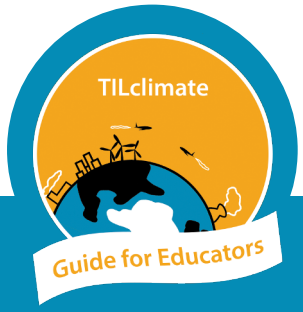
Wrap-Up Discussion Questions

- Electric grids can be both resilient and fragile. What contributes to the resilience and fragility of an electric grid?
- As you learned about our own local electric grid, what surprised you?
- If you were going to design the electric grid from scratch, what would you do differently?
- As we shift from fossil fuel energy that is adding to the heat-trapping blanket to renewable electricity sources like solar and wind, our electric grid needs to adapt to a changing balancing act. What are some ways that we can change the way we produce and use electricity?
- Professor Michaels talks about the combination of steps that can get us to a "climate solution": making the electric grid mostly carbon-free, making buildings more energy-efficient, and electrifying buildings and transportation. Why is it so important to also increase the energy efficiency of buildings, rather than only electrifying them?

Climate Solutions

Climate solutions can be thought of as falling into four co-equal categories. Across all categories, a focus on community-level solutions leads to more effective action. Community-level solutions change decision-making so that the default option for individuals is the one that has the best result for the climate. For example, policies that increase the solar and wind mix in the electric grid, instead of 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 we adapt buildings to keep people safe from heat and cold?
- **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, Tweet us @tilclimate, or tag us on Facebook @climateMIT.

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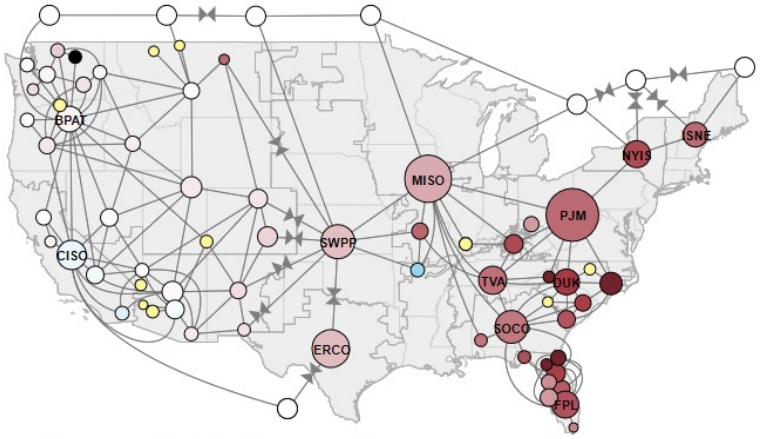
3-4am PST



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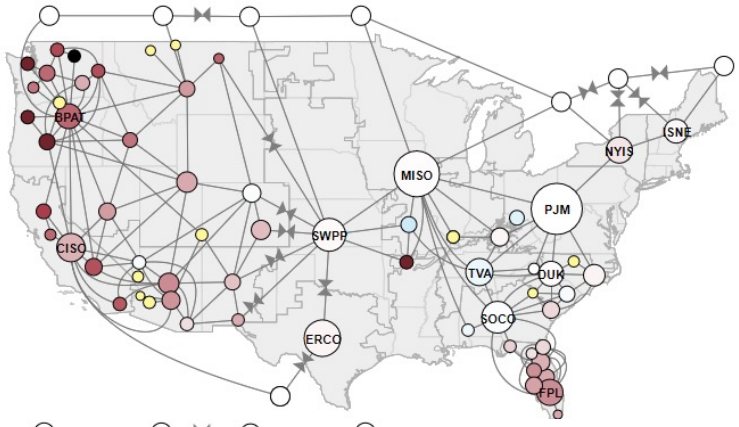

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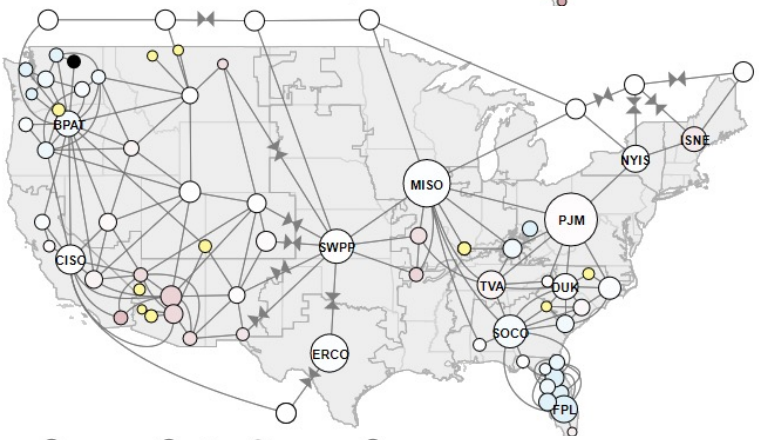

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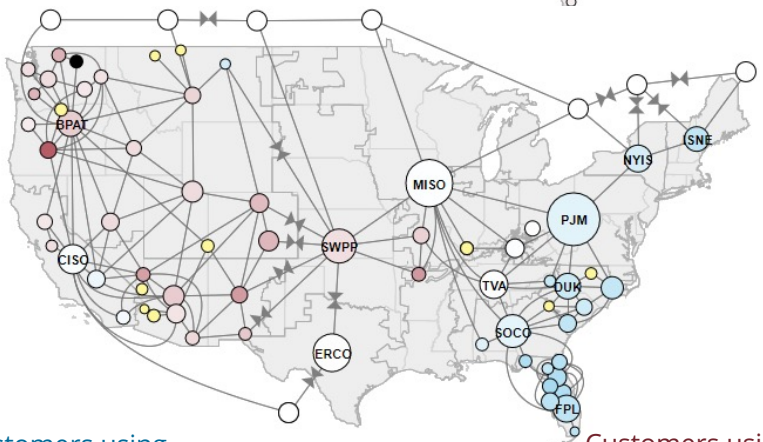

Customers using less electricity

Customers using more electricity

Data from March 15, 2016 https://www.eia.gov/beta/electricity/gridmonitor/dashboard/electric_overview/US48/US48

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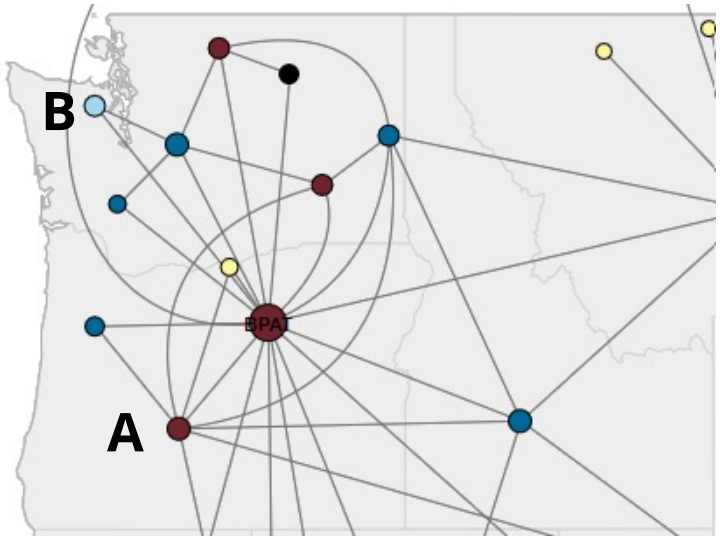

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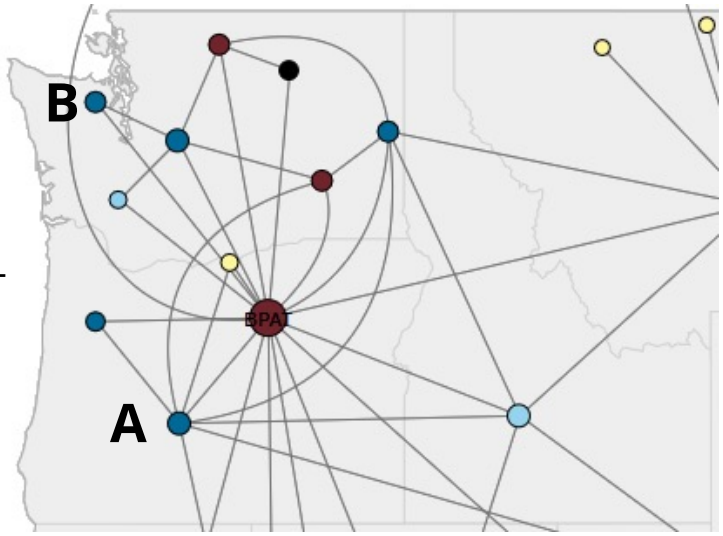

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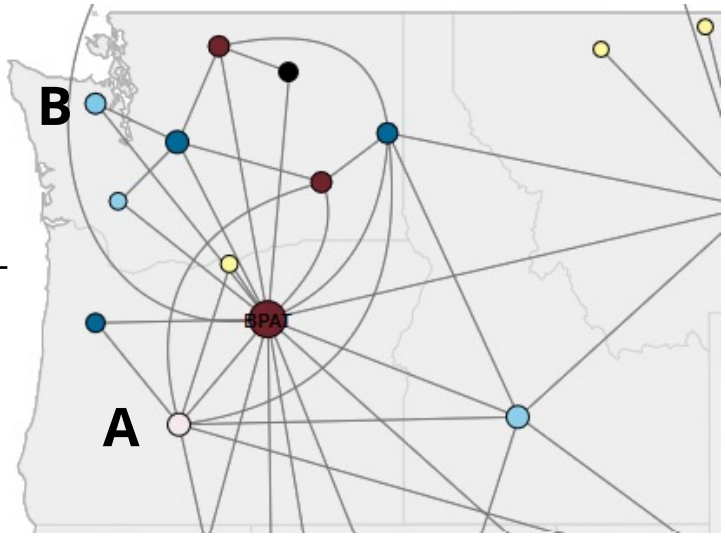

Net inflow — Net outflow

https://www.eia.gov/beta/electricity/gridmonitor/dashboard/electric_overview/US48/US48