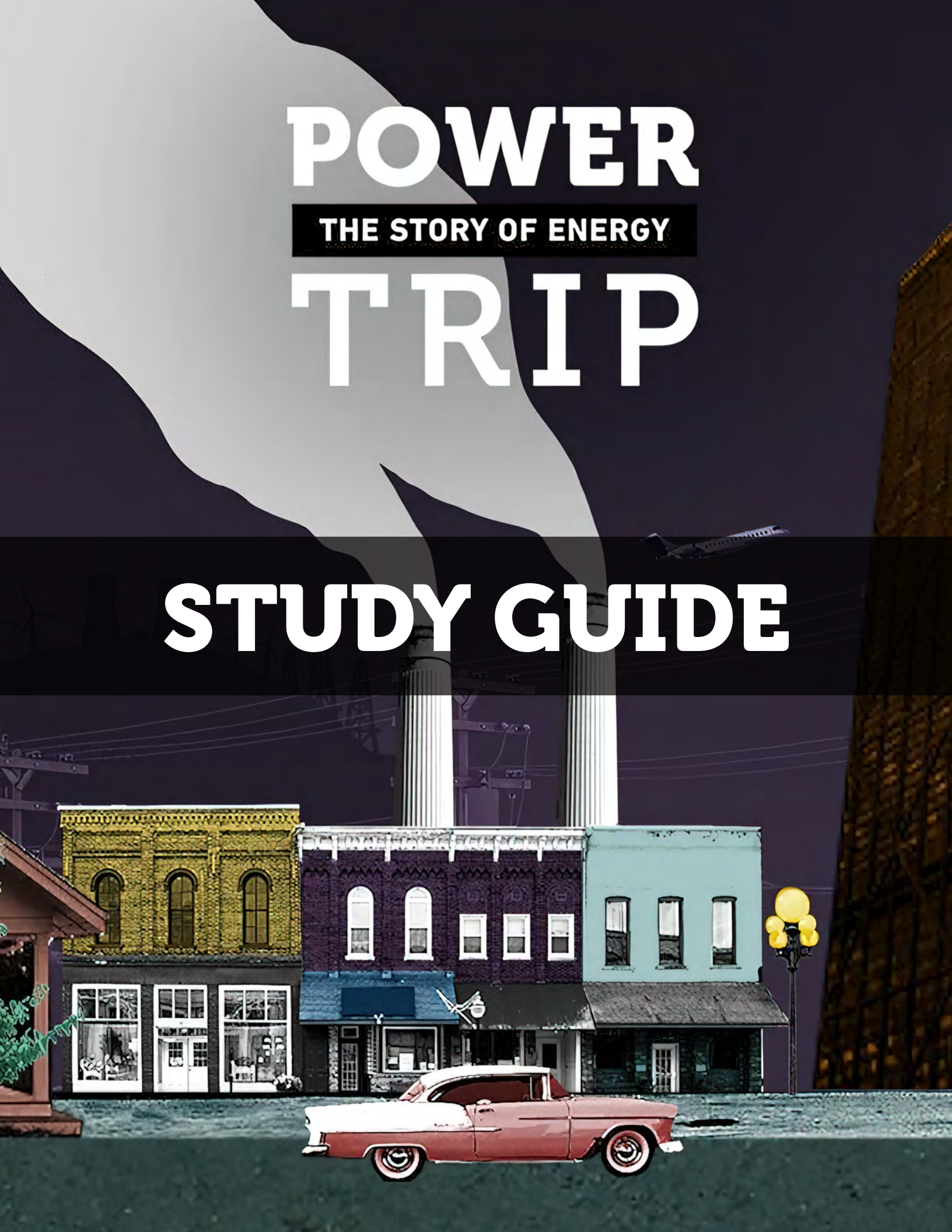
POWER TRIP

THE STORY OF ENERGY

STUDY GUIDE



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Author's Note

Energy is like a form of magic that is all around us but invisible, hidden in plain sight. Yet it moves mountains, brings light to dark, warmth to cold, and done the right way makes our lives comfortable, prosperous and safe. But energy done the wrong way can make us sick, poor, and insecure. That means it's important we operate our energy system the right way. And that means we need to understand energy.

A key point is that we all have a stake in a better energy system. And that for energy, unlike many other aspects of modern life, each of us is a decision-maker. We decide how to use it, whether to leave the lights on, and whether we care about its environmental impacts. Getting smart on energy helps all of us.

I wrote *Power Trip* to convey the magical powers of energy while explaining some of the nuances and risks. Energy is worth mastering because it affects every part of our daily lives. I hope this study guide helps you on your journey towards energy literacy!

Michael E. Webber
Josey Centennial Professor in Energy Resources
The University of Texas at Austin

From the Series Director

Power Trip takes viewers on a journey, around the world and through history, to look at how energy transforms lives. As a filmmaker, what could be better than a journey like that? In this series, we wore clean suits to take our cameras into a vast urban farm in Japan, plodded onto the beaches of Normandy, and rode in a horse-drawn carriage through the streets of London. We explored skyscrapers in Chicago, the history-changing River Shannon Dam in Ireland, and a cutting edge desalination plant in Israel.

Learning about energy is as easy as looking at all the devices, machines, and consumer goods at your fingertips, but it's more fun to see where the energy comes from and what it's capable of. Wind farms, factories, remote villages, and massive cities were among the dozens of locations on three continents for *Power Trip*, and telling the stories of innovators and experts in all those places has been a career highlight for me.

Years of collaboration with Dr. Webber bringing his research to life through documentary film has taught me the importance of energy in the pursuit of freedom and prosperity. My personal goal is that sharing what I learn out on the road filming will have an impact on future generations of energy trailblazers and increase viewer awareness about the importance of conservation.

— Mat Hames, Director
Power Trip: The Story of Energy

About the Series

The story of how societies rise and fall can be told by tracing the story of energy. Energy is the secret underlying force that drives the systems of our modern world, but is often invisible to us, hidden right in front of our eyes. *Power Trip: The Story of Energy* explores humanity's most important resource by revealing the energy embedded in our water, food, wealth, cities, transportation and war.

Each of these one hour episodes begins with energy's end use, but then moves backwards and sideways to uncover the energy that was crucial to developing a vast, ubiquitous system. Filmed in stunning locations around the world, the series features notable experts like Author and Professor Michael Webber; Ernest Moniz, former Secretary of Energy of the United States; and Author Vijaya Nagarajan.

The series will leave viewers with historical context, a global perspective, and an optimistic view of the future for energy. As our modern world faces growing demand for and worsening environmental impacts from energy, we are at a crossroads and the stakes are high. But history shows us that energy's great value is that it allows societies to reinvent themselves.

Power Trip explores how energy has transformed societies of the past and offers wisdom for today's looming energy crisis. As in the past, each new energy innovation comes with trade-offs. Energy advances always come with costs, some of which won't be seen until centuries later. Energy initiatives need to be tailored to individual societies. We must look for long-term solutions. Our current energy crisis is real, but it is solvable. We have the power.

What is Energy?

Knowledge regarding the world's natural energy resources is not commonly understood. The average person is unaware of the energy embedded in their surroundings. Often, the water we use comes from a faucet or is bought from a store, our clothes are made with materials derived from places around the world, and we can travel internationally in a matter of hours. Over time, the disconnect we experience with the natural environment has become severe; the overconsumption of energy resources has also become the standard. But what is energy? And why is the responsible use of our natural resources so important?

Energy is the propeller of the processes we need to function in our daily lives. We need the energy to survive on the most foundational levels. Still, we can and have also used energy to improve the systems we use for food production, transportation, medicine, infrastructure, and much more. Solar energy, for example, powers our food system through photosynthesis, cellular function, and the water cycle, and our modern energy system through solar panels that create electricity.

Modern technology changed the world, but commonly used energy sources, such as water, coal, and fossil fuels, are not unlimited. The overconsumption of these resources can have serious consequences. Investing time in learning more about our energy resources and being more mindful of the energy needed to produce the products you purchase can make a huge difference.

Episode 1
Water

About the Episode

The story of energy begins with water. Today water and energy are interconnected — for better or worse. Running out of water in one place can cause an energy shortage in another, but the reverse is also true. Saving water saves energy and vice versa. How can we make energy "less thirsty" and water less energy-intensive? "Water" traces a centuries-long journey across the Middle East, Europe, Asia, and the United States to show the history of energy and water.

Intended Audience

This episode is intended for high school students and young adults who want to learn more about energy, water, their influence on our society, and the amazing careers that bring them together.

Episode Objective

Over the years, our relationship with our water resources has become distant. We no longer have to pump water by hand or live next to rivers and streams to access clean water. The turn of a lever is all that's needed. So why is the relationship between water and energy so important? As much as we would like clean, fresh water to be an unlimited resource, it is not. The irresponsible use of our water resources to provide the food, electricity, sanitation, and products that we overindulge in today has created obstacles with drastic consequences.

Educating our students on the overwhelming significance of water in advancing our civilization and its continued influence on the modern-day energy sector is paramount for real change to be achieved in the future. *Power Trip: The Story of Energy* "Water" aims to educate its viewers on the relationship between water and energy and their influence on our daily lives and vice versa. Hoping, consequently, to inspire its viewers to be more mindful of their water consumption. Creativity, technological innovation, and ingenuity are all needed to solve the world's modern-day water dilemmas. By shining a light on water-related industries and organizations, "Water" aims to lead students on the path to discovering new career paths and opportunities in the energy sector that could put them in a position to make a difference in the future.

How is water connected to energy?

The average person uses 400 liters of water per day. This may come as a surprise to some people; after all, how is it possible for our daily water consumption to be so high? It's important to understand that our daily water consumption goes far beyond the water we use to drink, cook, and clean. Many people don't realize the vast need for water in our energy systems. We rely on energy to access water and we rely on water to access energy. This is known as the Energy-Water Nexus. Water is utilized to produce food, manufacture clothes, cool power plants, create electricity, extract raw materials, and much more. This means that every time you buy new clothes, turn on the lights or drive your car, you are in some way consuming water. Unfortunately, due to the disconnect we experience with our energy resources, most of us don't think about the consequences that can come from this.

Excessive water use risks leaving water contaminated, increases the risk of drought, and can negatively impact the environment. We additionally run the risk of being unable to support juxtaposing energy systems, leaving us vulnerable to the possibility of lacking sufficient energy in the future. At the end of the day, the closely intertwined relationship between water and energy means that you can't have one without the other. Entire civilizations, historically, have fallen due to lack of water, and the modern-day political environment continues to be drastically influenced by the energy-water nexus. As a society, we have become very comfortable indulging in excess of the resources we have available to us. The disconnect has grown. However, awareness of the effect our actions have on our resources could help us get through the obstacles we face today.

Dear Educators!

As leaders and teachers, educators uphold one of the most important jobs when it comes to clean energy and sustainability. By creating an environment in which students are exposed to energy education in a way that they can connect to their personal lives, educators are able to carve the path to a better future. You are encouraged to use the study guide as a reference when learning about the history, development, and importance of water conservation and sustainability practices. Encourage your students to ask questions and to use their creativity when completing the activities included in this study guide. Below are pre-viewing questions for educators to analyze their student's preconceived notions and ideas surrounding water and energy and set the stage for the journey presented in "Water." After viewing the documentary episode, post-viewing questions are included to assess the students' understanding of water and energy.

Pre-viewing Questions

- What do you know about the correlation between water and energy?
- What do you know about the history of water in our society?
- What do you think about when analyzing the relationship between water and energy?
- What jobs do you associate with water?
- How many gallons of water do you think you use per day?
- Do you feel stress or concern regarding water resources and the accessibility of water in the future?
- What real-life examples can you think about regarding situations that resulted in dangerous circumstances created due to poor water management systems?
- Are you currently interested in pursuing a water or energy-related career?
- If so, what career path?

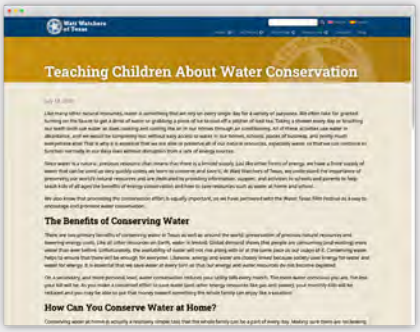
Post-viewing questions:

The post-viewing questions are meant to be answered quickly after watching the documentary episode. They aim to determine the immediate effect the documentary had on the student by demonstrating their change in attitude and knowledge on the topic compared to the answers in the Pre-viewing questions section.

- What new information did you learn about water?
- Did you see any new jobs or careers in the water and energy sector that you previously did not know existed?
- What job shown in the documentary did you find the most interesting? Why?
- Do you feel that your stress (If any) regarding future water accessibility increased or decreased after watching the documentary?
- What message do you believe the documentary series is trying to convey to its viewers?
- What additional information would you like to learn about water and energy?

Additional Resources

The content covered throughout *Power Trip: The Story of Energy* can serve as a great supplement to your sustainability and green energy curriculums. Before showing episode "Water" to your students, consider reviewing the following resources to familiarize yourself with the topic of water and energy. A quick revision of the following texts and activities can serve as an introduction to the topics discussed and provide some inspiration for ways you could incorporate the information highlighted throughout the episode into your classroom activities.



[Teaching Children About Water Conservation]

[Watt Watchers Water Activities]

[World Water Day]

[PBS Learning Media]

[Resourcefulness]

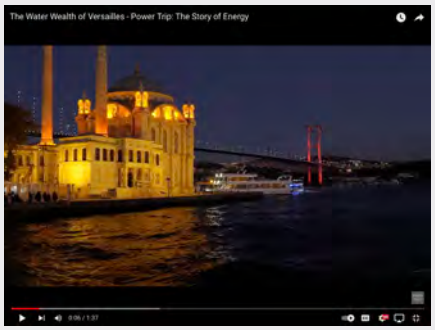
[Hidden Heroes]

Videos

The following video clips highlight the Energy Water Nexus as is discussed in "Water" and are meant to encourage their viewers to begin thinking about water as a limited and essential resource in our modern energy sector. Feel free to use these resources to give your students a look into water-related energy history, modern day technology and career opportunities!

[From Toilet to Tap in Singapore]

[How did we pump water without electricity?]



[The Water Wealth of Versailles]

[Hauling water is hard!]

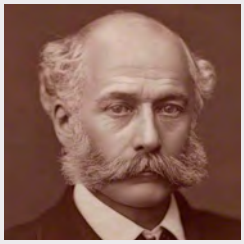
[Aquaponics]

Activities Overview

The activities at the end of the study guide are meant to supplement the material covered throughout Power Trip's "Water" episode. Individual and group activities will encourage your students to think critically about the world's water and energy-related obstacles! Feel free to pick the best exercises for your classroom dynamic and teaching style. Keep in mind that water-related problems are abundant and vary drastically around the world. With the ease we experience accessing water thanks to modern-day technology, it can be easy not to see all the hard work that makes our daily water and energy consumption a reality. Educators are advised to use the activities in this study guide to shine a light on the water and energy-related problems seen in the students' communities. This could mean investigating the water purification system used to provide safe drinking water, fracking activities, or natural water resources to create energy in your community. Encourage your students to be creative when brainstorming solutions to real-world scenarios. Our goal is to have them see that the world needs people with innovative ideas who care about the planet and are eager to have the power to change the future of water and energy.

The matching activity aims to help students connect-the-dots when it comes to their actions, activities, and lifestyles and the effect they have on the world's energy resources and vice versa. To complete the activity, they must use the information learned from the documentary episode to match the action, policy, or historical event with its outcome.

Vocabulary



Joseph Bazalgette Developed a system of intersecting sewers to manage London's wastewater.

Clean Water Act A federal law passed in 1948 that regulates and protects the water quality in the United States.

Energy-Water Nexus The relationship between water and energy production.

The Great Stink A severe stench caused by hot weather and untreated human waste that occurred in the summer of 1858 in central London.

Hydraulic Fracturing (Fracking) The fracturing of bedrock formations through drilling and the use of a pressurized liquid to extract fossil fuels.

Hydroelectric Power Power generated from flowing or falling water.

Dr. John Snow English physician who discovered the connection between Cholera as a disease and water transmission of disease.

Tennessee Valley Authority An American federal electric utility corporation.

Water Reclamation The purposeful or non-purposeful reuse of a water supply.

Define and Explain Activity

Have your students write their own definitions of the vocabulary words based on the context of the documentary.

Then have students explain the significance of the vocabulary word and its influence on history and their modern day way of life.

Discussion Questions

- How did the use of rivers in the United States evolve and increase in importance?
- How did the use of hydropower through the building of dams affect the lives of women?
- Why is the river Thames a particularly important body of water for England?
- Why was it safer to drink beer or gin at a tavern than it was to drink water?
- Why was the Mississippi river a game-changer for the new pioneers?

Solve a water-related problem in your city!

Have your students research a water-related problem in their hometown or community. These problems can range from depleting natural water resources to water contamination or drought. Have your students then outline the primary factors contributing to the consequences they find. In researching possible solutions to these problems, have them investigate how other communities have used innovation and technology to tackle similar situations. Finally, have the students write a letter to their community leaders, laying out the problems and solutions they have found, urging them to take action!

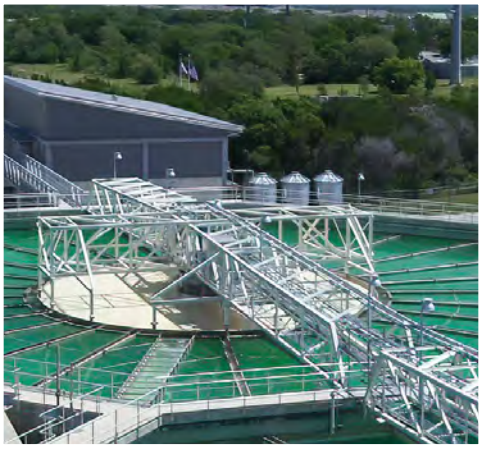
Gallery Walk

Separate your students into groups using the following categories:

- How water and energy technology advancements affect women's lives
- Water reclamation facilities
- Water desalination facilities

The students will then have to draw an advertisement depicting either (1) a consequence or advancement achieved thanks to new technology or (2) an advertisement convincing their city they need a new water facility. Display the advertisements around the classroom and have the students do a gallery walk to view and later discuss each other's work and ideas.

How water and energy technology advancements affect women's lives



Water reclamation facilities

Water desalination facilities

Multiple Choice Questions

1. Gathering _____ water has been our number one priority for thousands of years.
   A. clean
   B. salt
   C. cold

2. We need _____ to make use of _____.
   A. energy, water
   B. food, water
   C. water, land

3. In our home, we use more water for _____ than we do for _____.
   A. food, cleaning
   B. showers and faucets, electric devices
   C. electric powered items that are plugged in, showers and faucets

4. When the Romans would conquer new land, they would build waterworks to _____.
   A. transport food
   B. project their power
   C. make goods

5. We use about _____ liters of water per person per day.
   A. 400
   B. 30
   C. 250

6. The myth of the unicorn says that the unicorn's horn was magical because it could _____.
   A. destroy cities
   B. rid a stream of poison
   C. create fertile land

7. Drought has historically shown to lead to many civilizations, like three Chinese dynasties and potentially the Mayans _____.
   A. collapse
   B. prosparity
   C. creation

8. Water was used for mechanical power for _____.
   A. fueling showers, manufacturing clothes
   B. watering fields, crushing grain
   C. grinding wheat, sharpening iron, and crushing grain

9. _____ are the economic and political powerhouses of the world.
   A. Farms
   B. Cities
   C. Schools

10. It wasn't until the _____ that we needed to have an imported water supply.
    A. industrial revolution
    B. first world war
    C. baby boom

11. People thought disease was spread through smells in the air because _____.
    A. the king announced that it was
    B. it was scientifically proven at the time
    C. the severity of the pollution resulted in making the air smell foul

12. What was a symbol that the water problem had been solved in metropolitan London?
    A. Blue water in the rivers
    B. Safety signs throughout the city
    C. Clean public water fountains

13. Historically the primary role of rivers in the United States was for what?
    A. Swimming
    B. Commerce
    C. Transportation

14. The energy harvested from water was used to _____.
    A. manufacture goods and food, and then transport those products to customers
    B. maintain the agriculture industry
    C. create beverages and food products

Cause-and-Effect Matching Game

Connect the actions on the left to the outcomes on the right.

People, like all other living organisms, need water to live and thrive in their environment.

The development of cities, such as those found in the Roman Empire, cannot always be constructed right next to bodies of water large enough to sustain their population.

Drought or faulty infrastructure leads to a lack of water.

Limited knowledge on bacteria and germs coupled with faulty waste management systems leads to the people drinking contaminated water that often makes them sick.

Water contaminated with human waste leads to deadly cholera outbreaks in cities around the world. English physician John Snow then tracks down the cholera outbreaks to the Broad Street pump. Allowing him to make the connecting between cholera as a disease and waterborne transmission of disease.

In 1858 hot weather heated up the untreated human waste and industrial runoff piled up along the River Thames creating a horrible smell known as The Great Stink.

Two days of labor are required to grind a bushel of wheat into flour.

Hydroelectric facilities allow for energy in the form of electricity to be transferred through wires as opposed to gears and wheels, allowing factories and other industrial buildings to experience more flexibility in terms of where they can be built and how they can operate.

The powerful waters of Niagara Falls allow for the production of large quantities of cheap hydroelectric power.

There is a massive build out of dams and other electricity infrastructure in the United States. Bringing electricity to many rural areas.

Untreated sewage is released into the environment for years with little to no regulation.

The clean water act is established to help protect the nation's water resources.

Nations reach their peak when it comes to its water resources, meaning that the renewable and nonrenewable water resources found in the environment are beginning to run out.

The fermentation process to create beer kills harmful bacteria making beer safer to drink than water and making European colonists wary of the drinking water in the Americas.

Communities form near bodies of water.

The need for water treatment before consumption is discovered.

The energy of flowing water through water mills is used to grind dozens of bushels of wheat into flour and corn into meal daily.

London's government worked with civil engineer Joseph Bazalgette to design a series of sewers and pumping stations to lift and remove the waste from the city.

Women are liberated from a lot of manual labor in their homes, allowing them to have time to join the workforce and accumulate wealth.

Alternative water resources in the form of water recycling, stormwater capture and water desalination need to be implemented to satisfy increasing water demand.

Electricity intensive manufacturing facilities and industries were established in Niagara Falls.

The possibility of opening up an electric grid comes into play.

The water quality in the United States improves substantially leading to the approval of other environmental acts such as the endangered species act and the clean air act.

The great lakes and rivers of the United States become so contaminated that their smell makes them unbearable to walk next to, they become unsafe for swimming, some begin to dry out and can even catch on fire due to the harmful pollutants, chemicals and materials in the water.

Water importation systems such as the Roman aqueducts are constructed to import water from neighboring lakes and rivers.

The civilization collapses.

Water Bingo

Water the grass during cool times of the day	Don't let the water run continuously while washing dishes by hand	Turn off the lights when you leave a room	Have a water filter in your home	Avoid taking baths; opt for a shower
Thaw frozen food in the regrigerator overnight	Regularly check your home's faucets for leaks	Turn the water off when you brush your teeth	Have a water-saving shower head installed	Scrape plates instead of rinsing when loading the dishwasher
Wash clothes using cold water	Use a food compost bin	**FREE**	Use the dishwasher instead of hand-washing dishes	Make sure your sprinkler isn't watering the gutter or concrete
Wash full loads when possible in the washing machine	Don't leave the water running while shaving	Take short showers	Avoid single-use plastic water bottles	Don't buy produce you won't eat
Sweep the driveway instead of hosing it off	Own a water-smart irrigation system	Use a refillable water bottle	Use extra measures to conserve water during a drought	Live in a city with a water recycling system

Solutions

Multiple Choice

1-A; 2-A; 3-C; 4-B; 5-A; 6-B; 7-A; 8-C; 9-B; 10-A; 11-C; 12-C; 13-B-; 14-A

Matching Game

People, like all other living organisms, need water to live and thrive in their environment. **Communities form near bodies of water.**

The development of cities, such as those found in the Roman Empire, cannot always be constructed right next to bodies of water large enough to sustain their population. **Water importation systems such as the Roman aqueducts are constructed to import water from neighboring lakes and rivers.**

Drought or faulty infrastructure leads to a lack of water. **The civilization collapses.**

Limited knowledge on bacteria and germs coupled with faulty waste management systems leads to the people drinking contaminated water that often makes them sick. **The fermentation process to create beer kills harmful bacteria making beer safer to drink than water and making European colonists wary of the drinking water in the Americas.**

Water contaminated with human waste leads to deadly cholera outbreaks in cities around the world. English physician John Snow then tracks down the cholera outbreaks to the Broad Street pump. Allowing him to make the connecting between cholera as a disease and waterborne transmission of disease. **The need for water treatment before consumption is discovered.**

In 1858 hot weather heated up the untreated human waste and industrial runoff piled up along the River Thames creating a horrible smell known as The Great Stink. **London's government worked with civil engineer Joseph Bazalgette to design a series of sewers and pumping stations to lift and remove the waste from the city.**

Two days of labor are required to grind a bushel of wheat into flour. **The energy of flowing water through water mills is used to grind dozens of bushels of wheat into flour and corn into meal daily.**

Hydroelectric facilities allow for energy in the form of electricity to be transferred through wires as opposed to gears and wheels, allowing factories and other industrial buildings to experience more flexibility in terms of where they can be built and how they can operate. **The possibility of opening up an electric grid comes into play.**

The powerful waters of Niagara Falls allow for the production of large quantities of cheap hydroelectric power. **Electricity intensive manufacturing facilities and industries were established in Niagara Falls.**

There is a massive build out of dams and other electricity infrastructure in the United States. Bringing electricity to many rural areas. **Women are liberated from a lot of manual labor in their homes, allowing them to have time to join the workforce and accumulate wealth.**

Untreated sewage is released into the environment for years with little to no regulation. **The great lakes and rivers of the United States become so contaminated that their smell makes them unbearable to walk next to, they become unsafe for swimming, some begin to dry out and can even catch on fire due to the harmful pollutants, chemicals and materials in the water.**

The clean water act is established to help protect the nation's water resources. **The water quality in the United States improves substantially leading to the approval of other environmental acts such as the endangered species act and the clean air act.**

Nations reach their peak when it comes to its water resources, meaning that the renewable and nonrenewable water resources found in the environment are beginning to run out. **Alternative water resources in the form of water recycling, stormwater capture and water desalination need to be implemented to satisfy increasing water demand.**

Episode 2
Food

About the Episode

The miracles of energy enable a stable supply in our global food system. But when food goes from farm to table to landfill, that embedded energy is wasted. How do we harness energy to feed our growing population without the downsides of industrialization? "Food" traces a centuries-long journey across Europe, Asia, and the United States to show us the energy it takes to bring us our food.

Intended Audience

This study guide is intended for high school students and young adults who want to learn more about energy, the world's food systems, and the careers that bring them together to make our eating habits possible in our modern world.

Episode Objective

We waste forty percent of the food we produce worldwide. Such an enormous amount of food has enough embedded energy to power entire countries for years, so why is modern food waste so prominent? The cultural shift we see today in which we find ourselves with easy access to the produce and meat products we love creates a disconnect with the energy it takes to get these products on our tables. Power Trip's "Food" aims to highlight the history and development of our modern-day food system to demonstrate the drastic consequences of waste on the environment. Understanding the connection between food and energy is paramount when learning about sustainability. In establishing these connections, "Food" hopes to inspire its viewers to be more thoughtful about their food sources and mindful of the quantities they buy to avoid waste. Creativity, technological innovation, and ingenuity are all needed to solve the world's modern-day food dilemmas. By shining a light on food-related industries and organizations, "Food" aims to lead students to discover new career paths and opportunities in the energy sector that could put them in a position to make a difference in the future.

How is food connected to energy?

Our relationship with food has changed dramatically over the history of mankind. From hunter gatherer communities to farmers to modern-day consumers, the way we acquire our food influences our routines in more ways most people can imagine. Modern energy has successfully managed to facilitate the production and distribution of produce and meat products on a larger scale than ever before. Modern day society seems to no longer be subject to regional or seasonal limitations. Consequently, we have with food, much like with energy, developed a culture of overconsumption. But how exactly is food correlated with energy? And why is building a sustainable food system so important?

Energy is all around us. Foundationally, the relationship between our food system and energy resources can be seen through the solar energy and water that allows plants to go through photosynthesis, providing produce for ourselves and the livestock we eat. However, energy is embedded in our food system in less obvious ways. The process of producing flour in our modern day world, for example, requires solar energy to grow the grain, water to irrigate the land, and machinery to plow the land and mill the grain, even package the flour once the process has been completed. The trackers, grain mills, and any other machinery involved will likely require fossil fuels and electricity to function. Water will likely additionally be needed to acquire these fossil fuels, and potentially even create the electricity.

Overconsumption of food items can be seen in the enormous amount of food that the world wastes.

The complex processes needed to produce the foods we love are excessively energy intensive so being aware of our food consumption is paramount for sustainability to be achieved.

Dear Educators!

As leaders and teachers, educators uphold one of the most important jobs when it comes to clean energy and sustainability. By creating an environment in which students are exposed to energy education in a way that they can connect to their personal lives, educators are able to carve the path to a better future. You are encouraged to use the study guide as a reference when learning about the history, development, and importance of responsible food production and sustainability practices. Encourage your students to ask questions and to use their creativity when completing the activities included in this study guide. Below are pre-viewing questions for educators to analyze their student's preconceived notions and ideas surrounding food and energy and set the stage for the journey presented in Power Trip: The Story of Energy "Food." Post-viewing questions are also included to assess the students' understanding of food and energy.

Pre-viewing Questions

- How aware are you about the source of the food you consume on a daily basis?
- What comes to mind when you think about the relationship between food and energy?
- What do you know about the history of food in the world?
- What personal experiences can you think about regarding food waste?
- Can you think about a moment that you were unable to find a specific type of food that you wanted?
- What types of jobs do you think about when you think of the food industry?
- Do you have any experience working in any part of the food industry?
- Would you be interested in pursuing a job in the food industry?
- If so, what type of career?

Post-viewing questions:

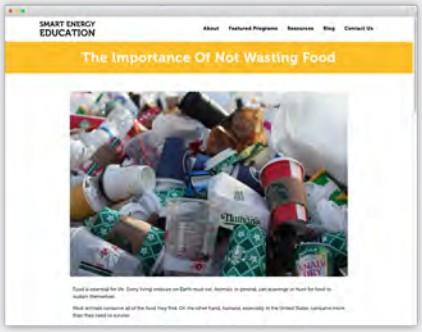
The post-viewing questions are meant to be answered quickly after watching the documentary episode. They aim to determine the immediate effect the documentary had on the student by demonstrating their change in attitude and knowledge on the topic compared to the answers in the Pre-viewing questions section.

- What new information did you learn about food and the food industry?
- What new information did you learn about the history of food production?
- What job in the documentary did you find the most interesting? Why?
- Do you feel that your stress (If any) regarding food accessibility in the future increased or decreased after watching the documentary?
- What message do you believe the documentary series is trying to convey to its viewers?
- What additional information would you like to learn about food and energy?

Additional Resources

The content covered throughout *Power Trip: The Story of Energy* can serve as a great supplement to your sustainability and green energy curriculums. Before showing episode "Food" to your students, consider reviewing the following resources to familiarize yourself with the topic of food and energy. A quick revision of the following texts and activities can serve as an introduction to the topics discussed and provide some inspiration for ways you could incorporate the information highlighted throughout the episode into your classroom activities.

Building a Better Local Food System



The Importance of Not Wasting Food

Watt Watchers Activities: Food

PBS Learning Media

Resourcefulness

Hidden Heroes

Videos

The following video clips highlight the relationship between the history of our food systems and their relationship with modern day energy as is discussed in "Food." These clips are meant to encourage their viewers to begin thinking about the energy needed to produce the food we eat each day and to understand that our energy resources are limited and should be used responsibly. Use these resources to give your students a look into the technology and careers that make our modern day food systems possible and encourage them to learn more about how they could make more sustainable and eco friendly food choices.

The Cold Chain and Food Waste

Aquaponics

Vertical Farming in Japan

The 5,000 Mile Salad

Activities Overview

The activities at the end of the study guide are meant to supplement the material covered throughout Power Trip's "Food" episode. Individual and group activities will encourage your students to think critically about the world's food and energy-related obstacles! Feel free to pick the best exercises for your classroom dynamic and teaching style. Keep in mind that food-related problems vary around the world. With the ease we experience accessing water thanks to modern-day technology, it can be easy not to see all the hard work that makes our daily food accessibility a reality. Educators are advised to use the activities in this study guide to shine a light on the food and energy-related problems seen in the students' communities. This could mean investigating local farms and food production facilities, local food waste statistics, or local produce practices in the area. Encourage your students to be creative when brainstorming solutions to these real world scenarios. Our goal is to have them see that the world needs people with innovative ideas who care about the planet and are eager to have the power to change the future of water and energy.

The matching activity aims to help students connect-the-dots when it comes to their actions, activities, and lifestyles and the effect they have on the world's energy resources and vice versa. To complete the activity, they must use the information learned from the documentary episode to match the action, policy, or historical event with its outcome.

Vocabulary

Aquaponics A system in which fish or other aquatic animals feed hydroponically (water grown) grown plants instead of using fertilizers and pesticides.

A worker harvests hydroponically-grown lettuce.

Bovine Bubbles Greenhouse-like structures utilized at UC Davis to conduct research on air pollution created by cows by monitoring gas emissions produced during belching.

Holstein dairy cows inside a "bio-bubble" at UC Davis

Cold Chain A temperature controlled supply chain that maintains the integrity of perishable products during their production, distribution and consumer storage, until their consumption.

Crop Rotation The process of planting varying crops on one plot of land to maintain and improve the integrity of the soil, increasing its fertility.

Green Revolution A dramatic increase in crop yields in the late 1960's thanks to high-yield crop techniques and fertilizers.

Haber-Bosch Process A chemical process created in the early 1900s by Fritz Haber, a German chemist. The process creates ammonia through nitrogen and hydrogen and was industrialized by Carl Bosch to fertilize land used for crops, in effect, revolutionizing the agriculture industry.

Kitchen Debate A famous debate between U.S. Vice President Richard Nixon and Soviet leader Nikita Khrushchev at the opening ceremony of the American National Exhibition in Moscow in a model kitchen regarding capitalism and communism.

Richard Nixon and Nikita Khrushchev engaged in the Kitchen Debate.

Vertical Farming A system in which crops are grown on stacked, vertical rows.

Crops grow in stacked rows on this vertical farm.

Define and Explain Activity

Have your students write their own definitions of the vocabulary words based on the context of the documentary.

Then have students explain the significance of the vocabulary word and its influence on history and their modern day way of life.

Discussion Questions

- Describe the significance of technological ingenuity on our modern-day energy systems through what you have learned about crop rotation and the Haber-Bosch Process.
- What was the significance of crop rotation in the green revolution?
- Why did major food companies locate their mills in Minneapolis?
- Describe the relationship between meat and energy. What does meat offer that other food sources do not?
- Explain the function of Bovine Bubbles and their potential impact on future livestock practices.
- What does California's new methane law require? How will this law influence farming in the future?
- Why is livestock such a vital component in our energy system? What would be a negative consequence of getting rid of livestock?
- What was the significance of the Kitchen Debate between Richard Nixon and Nikita Khrushchev? Why was the location of the debate important?
- Describe the impact meal kits can have on energy.
- How does Yesh Lee manage to grow herbs and vegetables in his home without using soil and using water as the only base?
- How does the Apeel product make produce last longer?
- Why is eating locally grown lamb in Britain more energy-intensive than eating imported lamb?
- Describe the potential applications of indoor vertical farming in our modern day world.
- What moral consequences arise as a result of refrigeration in India?

Solve a food-related problem in your city!

Have your students research a food-related problem in their hometown or community. These problems can range from food waste to a lack of fresh meat and produce as is seen in food deserts. Have your students then outline the primary factors contributing to the issues they find. In the process of researching possible solutions to these problems, have them investigate how other communities have used innovation and technology to tackle similar situations. Finally have the students write a letter to their community leaders, laying out the problems and solutions they have found, urging them to take action!

Gallery Walk

Separate your students into groups using the following categories:

- The Haber-Bosch Process
- Bovine Bubbles
- Meal Kits
- Aquaponics
- Apeel Product
- Indoor Vertical Farming

The students will then have to draw an advertisement for the technological process or invention labeled on their paper. Display the advertisements around the classroom and have the students do a gallery walk to view and later discuss each other's work and ideas.

The Haber-Bosch Process

Bovine Bubbles

Meal Kits

Aquaponics

Apeel Product

Indoor Vertical Farming

Multiple Choice Questions

1. We have more energy embedded in the food we throw away than Sweden uses for _____ over the course of _____.
   A. the food system, over the course of a year
   B. all purposes, over the course of a year
   C. all purposes, over the course of five years

2. Our modern-day food system is now dependent on _____.
   A. petroleum, natural gas, and electricity
   B. natural gas, water, and wind
   C. animals and coal

3. Reliable _____ was the key to food abundance and food abundance enabled...
   A. water, hunting practices
   B. animal sources, strong populations
   C. water, stable societies

4. Food is grown primarily through _____ energy
   A. wind
   B. solar
   C. hydro

5. The food system was revolutionized by _____ for tractors _____ for fertilizers and insecticides, and _____ for refrigeration.
   A. oil, wind, solar
   B. diesel, oil and gas, electricity
   C. electricity, water, solar

6. One consequence of modern energy in our food system was a _____ in the 20th century that transformed agriculture and caused farm productivity to _____.
   A. green revolution, grow exponentially
   B. produce revolution, grow exponentially
   C. green revolution, decline exponentially

7. _____ is the industrial process that allows for the manufacture of ammonia from hydrogen and nitrogen, only made possible by a series of chemical reactions powered by fossil fuels
   A. The nitrogen process
   B. The Green Revolution
   C. The Haber-Bosch process

8. What made Minneapolis the milling capital of the world was that they figured out a way on an enormous industrial scale to produce _____which then dramatically _____the price.
   A. brown flower, reduced
   B. pure white flower, increased
   C. pure white flower, reduced

9. _____ in one place along the Mississippi river gave the water power that was necessary to operate really big mills, making Minneapolis at one point one of the _____ milling centers.
   A. Falling water, smallest
   B. Falling water, biggest
   C. Rising water, biggest

10. All foods require _____.
    A. energy, land, water
    B. soil and water
    C. energy, wind and water

11. The meat system is much more _____ than the _____.
    A. labor intensive, water system
    B. land intensive, grain system
    C. energy intensive, grain system

12. Methane is a _____ and greenhouse gasses go into the atmosphere and they _____ which exacerbates the effects we are already seeing from _____.
    A. greenhouse gas, release heat, excessive rain
    B. chemical, cool the air, climate change
    C. greenhouse gas, trap heat, climate change

13. Three ways to preserve foods are to _____.
    A. dry, smoke, salt
    B. eat, dry, water
    C. grow, dry, salt

14. There is a lot more energy in the _____ of a water bottle than the _____.
    A. design, creation
    B. filtration and purification of the water, packaging
    C. packaging, filtration and purification of the water

15. Generally speaking, when you look at the footprint of food, the vast majority of the energy used and greenhouse gas emissions wind up being in the _____ of the food itself.
    A. consumption
    B. production
    C. irrigation

Cause-and-Effect Matching Game

Connect the actions on the left to the outcomes on the right.

Diesel is used for tractors, oil is used to make fertilizers and insecticides, and electricity is used for refrigeration.	Less energy resources like water and fossil fuels are used to package, store and transport the food the community consumes.
The Haber-Bosh process allows for farmers to increase the nitrogen in their soil, fertilizing it on a larger scale.	People are released from the shackles of manual labor previously required to produce food, the unpredictability of nature is reduced and people are less likely to have to battle hunger.
White flour, preferred by nutritionists at the time, required continuous sifting and great amounts of energy to produce in the late 1800's.	Farmers no longer have to rely on manure and can grow crops faster and often healthier than in the past.
Millers in Minneapolis figure out how to create huge amounts of white flour through industrial mechanical machines.	People will salt, smoke, dry or refrigerate food.
California implements Methane Law, which requires a 40% reduction of methane achieved by the year 2030.	New technology like that of Apeel Sciences, is developed to help perishable food last longer and reduce waste over time.
Food spoils, making it difficult to store for an extended amount of time.	Only rich people had access to white flour.
Modern energy allows for easy access to food, separating people from the agricultural process that produces our food and releasing us from some of the pressures in regard to where our next meal will come from.	The price of white four is dramatically reduced, becoming accessible for everyone in the world.
Perishable foods like fruits and vegetables often go bad in the fridge before being consumed, creating high amounts of unnecessary waste.	Farmers have to seek out scientists to gather research to show the current level of methane emissions produced by their livestock today. A question never asked in history. leading to new investigations and possibly new discoveries.
Before refrigeration in India, extra meals would be given to beggars at the end of every meal. The introduction of refrigerators into peoples homes eliminates the need or desire to give the beggars the leftovers.	Society views food differently, now worrying more about trying different food and learning how to prepare food in different ways as opposed to ensuring there is enough food to survive.
Instead of relying on imported food products from around the world, the community maximizes the potential of their environment to live off the land in their region.	The sensitivity that people feel regarding food lessens. People begin to feel more detached to their food resources and are more likely to save those resources for themselves.

Food Bingo

Eat the leftovers from a restaurant	Grow your own produce in a backyard garden	Prep meals to avoid buying excess food	Raise your own chickens	Save the seeds when you carve a pumpkin
Use a reusable shopping bag at the grocery	Buy fruits when the are locally in season	Smoke foods to make them last longer	Use citrus peels to add flavor to water	Eat edible skins on fruits and vegetables
Buy locally farmed meat	Use a meal kit service	FREE	Buy locally grown produce	Use a compost bin
Shop at a local farmer's market	Eat the crusts on your sandwiches	Make homemade vegetable broth	Grow your own produce in an indoor garden	Eat all of the produce you buy
Make homemade chicken broth	Freeze leftovers and eat later	Buy freshly butchered meat	Don't leave the refrigerator door open	Make jam from extra berries to avoid waste

Solutions

Multiple Choice

1-B; 2-A; 3-C; 4-B; 5-B; 6-A; 7-C; 8-C; 9-B; 10-A; 11-C; 12-C; 13-A-; 14-C; 15-B

Matching Game

Diesel is used for tractors, oil is used to make fertilizers and insecticides, and electricity is used for refrigeration. **People are released from the shackles of manual labor previously required to produce food, the unpredictability of nature is reduced and people are less likely to have to battle hunger.**

The Haber-Bosh process allows for farmers to increase the nitrogen in their soil, fertilizing it on a larger scale. **Farmers no longer have to rely on manure and can grow crops faster and often healthier than in the past.**

White flour, preferred by nutritionists at the time, required continuous sifting and great amounts of energy to produce in the late 1800s. **Only rich people had access to white flour.**

Millers in Minneapolis figure out how to create huge amounts of white flour through industrial mechanical machines. **The price of white four is dramatically reduced, becoming accessible for everyone in the world.**

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Food spoils, making it difficult to store for an extended amount of time. **People will salt, smoke, dry or refrigerate food.**

Modern energy allows for easy access to food, separating people from the agricultural process that produces our food and releasing us from some of the pressures in regard to where our next meal will come from. **Society views food differently, now worrying more about trying different food and learning how to prepare food in different ways as opposed to ensuring there is enough food to survive.**

Perishable foods like fruits and vegetables often go bad in the fridge before being consumed, creating high amounts of unnecessary waste. **New technology like that of Apeel Sciences, is developed to help perishable food last longer and reduce waste over time.**

Before refrigeration in India, extra meals would be given to beggars at the end of every meal. The introduction of refrigerators into peoples homes eliminates the need or desire to give the beggars the leftovers. **The sensitivity that people feel regarding food lessens. People begin to feel more detached to their food resources and are more likely to save those resources for themselves.**

Instead of relying on imported food products from around the world, the community maximizes the potential of their environment to live off the land in their region. **Less energy resources like water and fossil fuels are used to package, store and transport the food the community consumes.**

Episode 3
Transportation

About the Episode

Innovations in energy have revolutionized transportation over time from literal horsepower for horse drawn carriages to modern combustion engines, electric vehicles, and rockets. Transportation changes societies and our sense of place changes along with it. Machines help us travel over land and across the sky, but they require an enormous amount of energy. "Transportation" traces a centuries-long journey across the world to show us the energy that brings us modern transportation.

Intended Audience

This study guide is intended for high school students and young adults who want to learn more about energy, the world's transportation systems, and the careers that bring them together to make transportation possible in our modern world.

Episode Objective

Power Trip: The Story of Energy "Transportation" hopes to inspire its viewers to be more mindful of the world's transportation systems. Transportation across large areas, over the years, has become an essential part of our lives. We thrive off being able to work and live in different parts of a city and vacation in different parts of the world. Consequently we have become increasingly reliant on not having to work very close to home. We have developed a love for discovering new places, and interacting with people from different cultures. While there are many benefits to large-scale transportation systems, they are excessively energy consumptive and are not exempt from the harmful effects caused to the environment and our energy resources. "Transportation" takes its viewers through time and around the world to learn about the critical history of transportation and energy. Additionally, "Transportation" highlights the technological advancements essential to making our modern-day transportation systems a reality and aims to lead students on the path to discovering new career opportunities in the energy sector that could put them in a position to make a difference in the future.

How is transportation connected to energy?

Through the evolution of transportation worldwide, we have successfully managed to innovate our way past the good old days of utilizing manpower and animal power to get to close by regions. Now using modern energy to cross entire oceans in a matter of hours, the ability to move around such large distances changed society forever. The evolution of transportation has allowed us to develop complex industries, giving rise to car culture, travel lifestyles, and the need for new inventions and ideas.

The connection between transportation, energy, and the environment is more evident to the average person than most other things. If you own a car, you need gas or electricity for the vehicle to get you where you need to go. This means you need fossil fuels to burn as gas. Being aware of the energy resources that are most prominent in your region can help you make more eco-friendly choices. For example, you might think that driving an EV will always be a cleaner alternative to a gas car. But if the electricity used to power the EV is derived from fossil fuels, it can have a more negative impact than a standard gasoline-powered car.

With the rise of new technology, keeping up with our growing energy demand without dwindling our natural resources requires strategic planning. It is a responsibility we only recently started to take seriously. Much-needed improvements need to be made to reach sustainability. Thankfully, we have a lot to look forward to. Fantastic new jobs and career opportunities have been developed due to this new awareness and have become an essential part of travel and transportation. Everything from pilots and drivers to engineers, builders, and landscape architects are increasingly in high demand. Change starts with our personal choices, so carpool and use public transportation when you can, and be thoughtful about the world's energy resources when purchasing new products.

Dear Educators!

As leaders and teachers, educators uphold one of the most important jobs when it comes to clean energy and sustainability. By creating an environment in which students are exposed to energy education in a way that they can connect to their personal lives, educators are able to carve the path to a better future. You are encouraged to use the study guide as a reference when learning about the history, development, and importance of sustainable transportation practices. Included in the guide are pre-viewing questions that you can use to gain a greater understanding of your students' preconceived notions and ideas surrounding transportation and energy and set the stage for the journey presented in *Power Trip: The Story of Energy* "Transportation." Final, post-viewing questions are additionally included to determine what the students have learned and if their attitudes towards energy have changed.

Pre-viewing Questions

- How aware are you about the energy required for you to get to school and to work everyday?
- What comes to mind when you think about the relationship between transportation and energy?
- What do you know about the history of transportation in the world?
- What has been your personal experience regarding public transportation?
- If you could change one thing about transportation in the US what would it be?
- What types of jobs do you think about when you think of the transportation sector?
- What type of transportation do you primarily use on a day to day basis?
- Do you, or does anyone you know drive an electric vehicle?
- What do you think about when considering the relationship between sustainability and electric vehicles?
- Would you be interested in pursuing a job in the transportation sector? If so, what type of career?

Post-viewing Questions

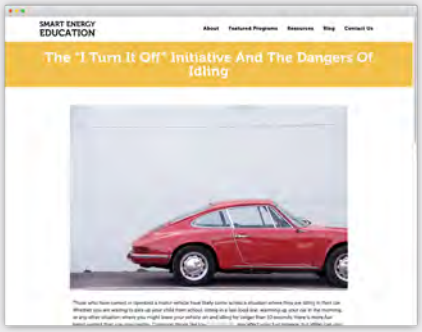
The post-viewing questions are meant to be answered quickly after watching the documentary episode. They aim to determine the immediate effect the documentary had on the student by demonstrating their change in attitude and knowledge on the topic compared to the answers in the Pre-viewing questions section.

- What new information did you learn about the transportation sector?
- What new information did you learn about the history of transportation?
- What job in the documentary did you find the most interesting? Why?
- Do you feel that your stress (if any) regarding contamination caused by the transportation sector increased or decreased after watching the documentary?
- What message do you believe the documentary series is trying to convey to its viewers?
- What additional information would you like to learn about transportation and energy?

Additional Resources

The content covered throughout *Power Trip: The Story of Energy* can serve as a great supplement to your sustainability and green energy curriculums. Before showing episode "Transportation" to your students, consider reviewing the following resources to familiarize yourself with the topic of transportation and energy. A quick revision of the following texts and activities can serve as an introduction to the topics discussed and provide some inspiration for ways you could incorporate the information highlighted throughout the episode into your classroom activities.

Personal Fuel Consumption and the Environment



The "I Turn It Off" Initiative and the Dangers of Idling

Watt Watchers Activities: Transportation

PBS Learning Media

Resourcefulness

Hidden Heroes

Videos

The following video clips highlight the relationship between the history of our transportation systems and their relationship with modern day energy as is discussed in "Transportation". These clips are meant to encourage their viewers to begin thinking about the energy needed to facilitate the transportation we enjoy each day and to understand that our energy resources used to make this our reality are limited and should be used responsibly. Use these resources to give your students a look into the technology and careers that make our modern day transportation systems possible and encourage them to learn more about how they could make more sustainable and eco friendly transportation choices.

Can the Hyperloop Solve Traffic?

Frank Whittle and the Jet Age

Powering the New York City Subway

Activities Overview

These activities are meant to supplement the material covered throughout *Power Trip's* "Transportation" episode. Individual and group activities will encourage your students to think critically about the world's food and energy-related obstacles! Feel free to pick the best exercises for your classroom dynamic and teaching style. Keep in mind that transportation-related problems vary around the world. With the ease we experience moving around thanks to modern-day technology, it can be easy not to see all the hard work that makes access to transportation a reality. Educators are advised to use the activities in this study guide to shine a light on the transportation and energy-related problems seen in the students' communities. This could mean investigating local public transportation systems, third-party transportation services statistics, or local transportation preferences in the area and the pros and cons of each. Encourage the students to be creative and consider their own experiences when brainstorming solutions to these real-world scenarios. At the end of the day, we want them to see that the world needs people with innovative ideas to have the power to change the future of transportation and energy.

The matching activity aims to help students connect-the-dots when it comes to their actions, activities, and lifestyles and the effect they have on the world's energy resources and vice versa. To complete the activity, they must use the information learned from the documentary episode to match the action, policy, or historical event with its outcome.

Vocabulary

Autonomous Vehicle A vehicle that can drive on its own or autonomously.

An autonomous vehicle being tested in Austin, Texas.

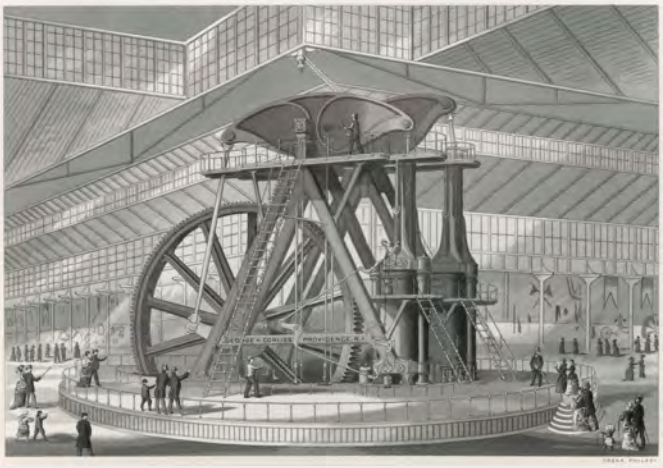
Friar Roger Bacon A medieval English philosopher and Franciscan friar who placed considerable emphasis on the study of nature through empiricism.

Alfred Beach An American inventor credited with designing New York City's earliest subway system.

EV (Electric Vehicle) A vehicle that uses electricity as its primary fuel source.

The Tesla Model 3 is a popular EV, or elelectric vehicle.

Steam Engine An engine that uses steam to produce mechanical energy.



The Corliss Centennial Engine was a specially built steam engine that powered virtually all of the exhibits at the Centennial Exposition in Philadelphia in 1876.

The Industrial Revolution The period in Great Britain between 1760–1840 that marked an economic shift from agricultural and rural practices to industrial, manufacturing and factory dominant practices.

Internal Combustion Engine An engine that creates mechanical power through burning fuel.

Gasoline and diesel cars use an internal combustion engine like this one.

Route 66 Established November 11, 1926, Route 66 was one of the first highways built in the United States.

Mural touting the historic U.S. Route 66 as it winds through Tulsa, Oklahoma.

Stanley Steamer An early steam-powered automobile.

A 1908 Stanley Steamer runabout on display at the Gilmore Car Museum.

James Watt An 18th-century Scottish inventor credited with improving the steam engine, allowing it to become a pivotal part of the industrial revolution.

Frank Whittle An English engineer and inventor credited with inventing the turbojet engine.

Define and Explain Activity

Have your students write their own definitions of the vocabulary words based on the context of the documentary.

Then have students explain the significance of the vocabulary word and its influence on history and their modern day way of life.

Discussion Questions

- How did rivers and canals influence the currency used in the United States?
- Why were steam powered trains transformative during the industrial revolution?
- What are the challenges and consequences of horse drawn public transportation discussed in the episode?
- Explain the basic mechanics of a nomadic tunnel as they are discussed in the documentary.
- Explain the challenges and consequences of an elevated railroad system as they are discussed in the documentary.
- How did subways transform cities?
- Explain the significance of the internal combustion engine.
- Why was the Ford Model T revolutionary?
- How did the accessibility of cars influence the infrastructure in the United States?
- What consequences caused by large scale car use do we have to manage?
- What are the potential benefits of autonomous vehicles?
- Explain what would happen if only wind, solar and nuclear energy were used to create electricity.

Solve a transportation-related problem in your city!

Have your students research a transportation-related problem in their hometown or community. These problems can range from a lack of public transportation and excessive traffic to pollution. Have your students then outline the primary factors contributing to the issues they find. In the process of researching possible solutions to these problems, have them investigate how other communities have used innovation and technology to tackle similar situations. Finally have the students write a letter to their community leaders, laying out the problems and solutions they have found, urging them to take action! This activity works best when completed in small groups of 3–4 students.

Gallery Walk

Separate your students into groups using the following categories:

- Internal Combustion Engine
- Electric Vehicles
- Autonomous Vehicles
- Hyperloop

The students will then have to draw an advertisement depicting either (1) a consequence of the new technology or (2) an advertisement in favor of the invention. Display the advertisements around the classroom and have the students conduct a gallery walk to view and later discuss each other's ideas.

Internal Combustion Engine

Hyperloop

Autonomous Vehicle

Electric Vehicle

Multiple Choice Questions

1. Long ago, if we wanted to travel anywhere, our options were limited to _____ power, _____ power, or _____ power.
   A. muscle, animal, wind
   B. machine, muscle, animal
   C. animal, horse, wind

2. Friar Roger Bacon predicted _____.
   A. the steam engine
   B. horse power
   C. modern transportation

3. One of the challenges of sailing is the wind is constantly _____.
   A. sill
   B. changing
   C. silent

4. Much of the economic growth of the United States in the early 1800s is tied to the development of _____.
   A. canals
   B. trains
   C. cars

5. Access to _____ is one of the defining factors of a civilization
   A. water
   B. wind
   C. animals

6. Thanks to _____, _____, _____ and _____, our world is more interconnected than ever before.
   A. animals, cars, boats, water
   B. trains, automobiles, canals, planes
   C. trains, canals, wind, boats

7. The steam engine rose hand in hand with the _____ because of its breakthrough ability to turn _____ into _____.
   A. Industrial Revolution, heat, motion
   B. Industrial Revolution, motion, heat
   C. Kings of England, heat, motion

8. In America, cities would seemingly pop out of nowhere because the _____arrived.
   A. boat
   B. car
   C. train

9. With the rise of cities came the _____.
   A. concentration of livestock
   B. concentration of people
   C. increase of water resources

10. With horse power comes horse _____, leading to a _____ problem
    A. manure, pollution
    B. value, inflation
    C. manure, fertilization

11. Early in the subway's history, the trains were powered by burning _____or _____ right on the train
    A. fossil fuels, electricity
    B. coal, diesel
    C. diesel, wind

12. New York city was built first with the _____ and then with the birth and growth of the _____.
    A. train system, Erie Canal
    B. Erie Canal, subway street
    C. Erie Canal, subway system

13. The internal combustion engine _____ land based travel, but jet fuels and rocket fuels took us to the _____.
    A. democratized, past
    B. increased, future
    C. democratized, future

14. We went from riding horses in the late _____ to reaching space in the _____.
    A. 1900s, 1970s
    B. 1850s, 1890s
    C. 1890s, 1950s

15. Today depending on where you live in the United States, you can actually create more _____by operating an EV vs. a traditional combustion engine.
    A. CO_2
    B. hydrogen
    C. nitrogen

Cause-and-Effect Matching Game

Connect the actions on the left to the outcomes on the right.

People, like all other living organisms, need water to live and thrive in their environment.

The development of cities, such as those found in the Roman Empire, cannot always be constructed right next to bodies of water large enough to sustain their population.

Drought or faulty infrastructure leads to a lack of water.

Limited knowledge on bacteria and germs coupled with faulty waste management systems leads to the people drinking contaminated water that often makes them sick.

Water contaminated with human waste leads to deadly cholera outbreaks in cities around the world. English physician John Snow then tracks down the cholera outbreaks to the Broad Street pump. Allowing him to make the connecting between cholera as a disease and waterborne transmission of disease.

In 1858 hot weather heated up the untreated human waste and industrial runoff piled up along the River Thames creating a horrible smell known as The Great Stink.

Two days of labor are required to grind a bushel of wheat into flour

Hydroelectric facilities allow for energy in the form of electricity to be transferred through wires as opposed to gears and wheels, allowing factories and other industrial buildings to experience more flexibility in terms of where they can be built and how they can operate.

The powerful waters of Niagara Falls allow for the production of large quantities of cheap hydroelectric power.

There is a massive build out of dams and other electricity infrastructure in the United States. Bringing electricity to many rural areas.

Untreated sewage is released into the environment for years with little to no regulation.

The clean water act is established to help protect the nation's water resources.

Nations reach their peak when it comes to its water resources, meaning that the renewable and nonrenewable water resources found in the environment are beginning to run out.

The great lakes and rivers of the United States become so contaminated that their smell makes them unbearable to walk next to, they become unsafe for swimming, some begin to dry out and can even catch on fire due to the harmful pollutants, chemicals and materials in the water.

The need for water treatment before consumption is discovered.

Alternative water resources in the form of water recycling, stormwater capture and water desalination need to be implemented to satisfy increasing water demand.

Communities form near bodies of water.

London's government worked with civil engineer Joseph Bazalgette to design a series of sewers and pumping stations to lift and remove the waste from the city.

The energy of flowing water through water mills is used to grind dozens of bushels of wheat into flour and corn into meal daily.

Electricity intensive manufacturing facilities and industries were established in Niagara Falls.

Water importation systems such as the Roman aqueducts are constructed to import water from neighboring lakes and rivers.

The water quality in the United States improves substantially leading to the approval of other environmental acts such as the endangered species act and the clean air act.

The fermentation process to create beer kills harmful bacteria making beer safer to drink than water and making European colonists wary of the drinking water in the Americas.

The possibility of opening up an electric grid comes into play.

The civilization collapses.

Women are liberated from a lot of manual labor in their homes, allowing them to have time to join the workforce and accumulate wealth.

Transportation Bingo

Ride the bus to school	Use the motor oil recommended by your car manufacturer	Walk to avoid using gas when possible	Own an electric vehicle	Keep your car tires properly inflated
Keep up with your car maintenance	Have ridden in an electric vehicle	Walk to school or work	Carpool to social events	Combine several errands in one car trip
Own a high-efficiency gas vehicle	Opt for a small car instead of a large truck	**FREE**	Ride your bike to avoid using gas	Regularly replace your car's air filters
Avoid rapid acceleration and braking while driving	Avoid frequent flying	Carpool to school or work	Keep your car uncluttered to avoid extra weight	Ride the subway to get to school
Have a metro card	Use a ride sharing service like Uber or Lyft	Ride the train	Ride a motorcycle	Avoid leaving the car running while parked

Solutions

Multiple Choice

1-A; 2-C; 3-B; 4-A; 5-A; 6-B; 7-A; 8-C; 9-B; 10-A; 11-B; 12-C; 13-C-; 14-C; 15-A

Matching Game

People learn to harness wind energy to sail at higher speeds and longer distances. **Sea travel is facilitated, allowing for exploration of distant lands and easier trade of foreign goods.**

The power to turn heat into motion through steam is discovered. **The industrial revolution began with the power of efficient machines that could be used to produce steel, develop ships, train, and automobile engines, and manufacture products like textiles.**

The development of the efficient steam engine by James Watt allowed steam-powered trains and boats to travel across the American continent. **Railroads allow for cities to grow and prosper economically due to increased access to travel, opportunities to settle in different regions, and transportation and shipment of consumer and agricultural goods.**

Increased efficient and cheaper transportation creates hubs of trade, commerce, and technology known as cities. **The world's populations begin to shift from rural regions to urban regions looking for opportunity and wealth.**

The elevated railway car and underground subway system are developed in New York City. **Excessive pollution caused by horse manure, feces and carcasses are allowed to clear and create a safer and cleaner city.**

The internal combustion engine, a smaller yet powerful engine with a larger range (can travel longer distances) than an electric vehicle is invented. **The Model-T Ford is mass produced and marks the historic moment in which the personal automobile became an accessible product for the average consumer bringing about the rise of car culture and freedom to travel.**

Energy allowed for the invention of cars, reducing the time and effort needed to cross large areas. **The infrastructure of the regions being traveled upon needs investment, so it can be updated and developed to account for new technology.**

In 1956 the United States government raised the gas tax substantially to pay for road infrastructure. **The interstate highway system is created allowing people to travel across the country with increased ease and safety, creating the possibility for roadtrips.**

Frank Whittle invents the jet engine. This engine uses a compressor turbine system to squeeze, heat, and expand air through a nozzle. Consequently, allowing planes to get the thrust needed to get moving quickly and avoid engine failure when flying at higher altitudes where the air is thinner (compressed air in the engine solves the thinning air obstacle) and at higher speeds (higher altitude means less resistance). **International travel is facilitated, leading to an increasingly globalized economy and society.**

Cars are so readily available that many people consider them a necessity and a symbol of freedom. **Cars nearly outnumber people in some cities, decrease air quality, create noise pollution, increase traffic and damage the environment.**

City states like Singapore or other small regions have limited land, fewer options when it comes to housing and transportation as the population grows and more limited resources for the community **Create a limit on the number of people who can have a personal car and improve the effectiveness and comfortability of the public transport system.**

Episode 4
Wealth

About the Episode

Before modern energy, wealth was tied to land ownership. Today, wealth is tied to energy and who controls it. Energy changes the way wealth is concentrated, creating a cascade of social and economic effects. "Wealth" traces a centuries-long journey across the world to show us the energy that gives us wealth.

Intended Audience

This episode is intended for students and viewers who are interested in learning more about the historic correlation and continued influence between wealth and energy.

Episode Objective

Wealth and energy are more connected than most people imagine. The relationship we have with energy affects every aspect of our society; it has the power to improve our quality of life and open the door to new opportunities. The history of wealth and energy can be seen in the value of our precious energy resources. The drastic impacts of energy on a region's economy, political power, and social fabric are demonstrated most clearly with the start of the Industrial Revolution in Great Britain. With the ability to manufacture goods more efficiently at a much lower cost thanks to modern energy, people outside of the aristocracy were able to accumulate wealth, allowing them to acquire power, and influence, carving the path to a new future. *Power Trip: The Story of Energy* aims to demonstrate the impact of modern energy on the world while also highlighting modern society's effects on our environment and energy resources. "Wealth" hopes that by highlighting the relationship between wealth and energy, its viewers will understand their potential to impact the world through their actions and inspire them to look at the world's energy resources in a new light.

How is wealth connected to energy?

Wealth can be described as the possessions, goods, and liberties that provide a person with their quality of life. The more wealth a person has, the higher quality of life they can enjoy. Modern energy has catapulted our wealth to new levels. Life today is much different than it used to be. Not too long ago, for example, the medical sector produced a much different environment than the one we see today. We no longer have to endure the horrors of 19th-century surgery and medicine. With access to electric lighting, operating machines, medications, antiseptics, and new technology, modern energy has provided us the opportunity to improve our lives by improving our health.

A healthy population is better able to work and contribute to the community, elevating the wealth of the community as a whole. This can be seen in how we produce food, manufacture goods, facilitate transportation, and much more. By opening the door to new possibilities, a community with access to modern energy is more likely to have access to education, healthcare, and overall liberties that can improve their quality of life. This pattern can be a game-changer for many communities. However, the path to access these opportunities does not come without obstacles. Our natural resources, which provide us with the energy to produce electricity, rubber, metals, medicines, and everything else that we enjoy today, are not unlimited. The overconsumption of our energy resources can lead to severe environmental damage.

Modern energy and wealth have allowed us to live with a level of comfortability that propels a certain amount of disconnect with our energy resources. We do not have to put in nearly the same effort to get what we need to survive. Thanks to this phenomenon, communities with great access to modern energy are likely to be over consumers. As a society, our goal should be to create a world in which there is a balanced distribution of wealth and a culture that encourages awareness of our natural resources and the energy they provide.

Dear Educators!

As leaders and teachers, educators uphold one of the most important jobs when it comes to clean energy and sustainability. By creating an environment in which students are exposed to energy education in a way that they can connect to their personal lives, educators are able to carve the path to a better future. You are encouraged to use the study guide as a reference when learning about the history, influence, and correlation between wealth, energy, and sustainability practices. Encourage your students to ask questions and to use their creativity when completing the activities included in this study guide. Below are pre-viewing questions for educators to analyze their student's preconceived notions and ideas surrounding the correlation between wealth and energy and set the stage for the journey presented in *Power Trip: The Story of Energy* "Wealth." After viewing the documentary episode, post-viewing questions are included to assess the students' understanding of the relationship between wealth and energy.

Pre-viewing Questions

- What do you think about when you think of wealth?
- What connection do you see between wealth and energy?
- How do you think energy impacts your wealth?
- What types of jobs do you associate with the energy industry?
- How do you think energy could help improve people's wealth?
- What do you know about when considering the history of wealth?
- What jobs do you associate with wealth in modern day society? How do you think these jobs influence or are influenced by energy?
- How do you think your current job or a member of your family's job is influenced by energy?

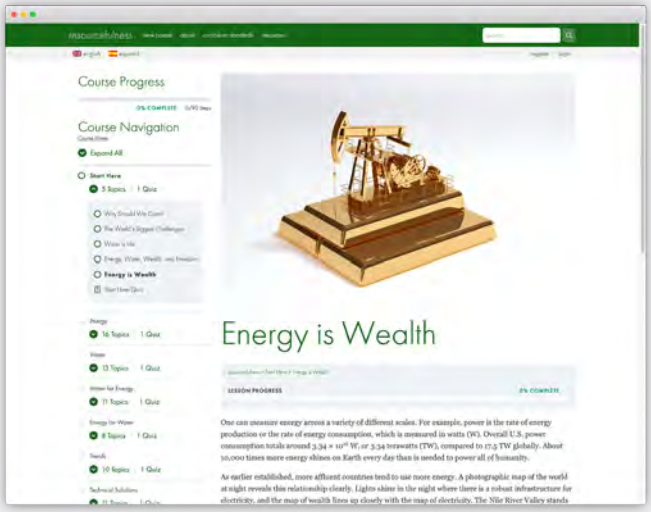
Post-viewing Questions

The post-viewing questions are meant to be answered quickly after watching the documentary episode. They aim to determine the immediate effect the documentary had on the student by demonstrating their change in attitude and knowledge on the topic compared to the answers in the Pre-viewing questions section.

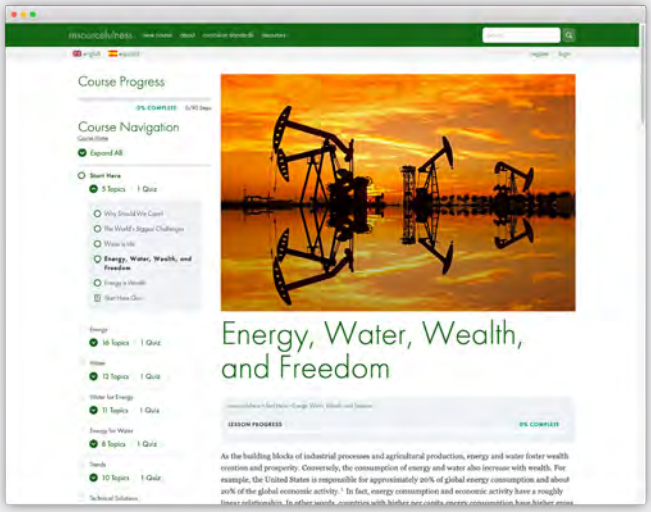
- What surprised you most about Power Trip's "Wealth?"
- Did you learn anything new about the correlation between wealth and energy?
- Has your perspective on energy changed after watching "Wealth?" If so, how?
- What new information did you learn about the history of wealth and its connection to energy?
- What message do you believe "Wealth" wants to convey to its viewers?
- Has your attitude regarding wealth changed after watching the episode? If so, how?

Additional Resources

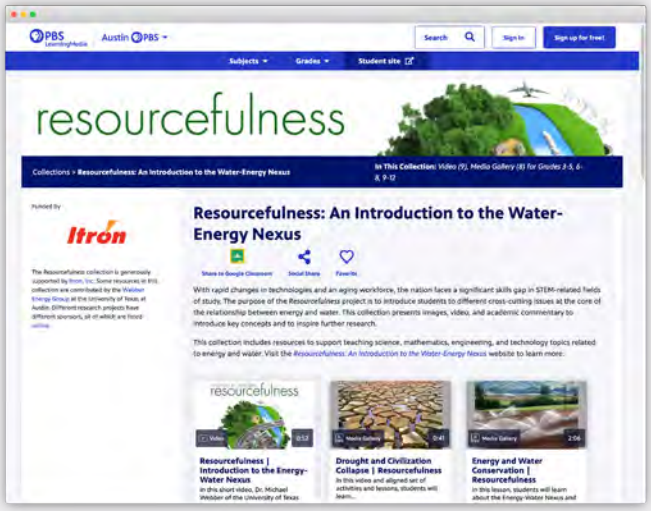
The content covered throughout *Power Trip: The Story of Energy* can serve as a great supplement to your sustainability and green energy curriculums. Before showing episode "Wealth" to your students, consider reviewing the following resources to familiarize yourself with the topic of transportation and energy. A quick revision of the following texts and activities can serve as an introduction to the topics discussed and provide some inspiration for ways you could incorporate the information highlighted throughout the episode into your classroom activities.



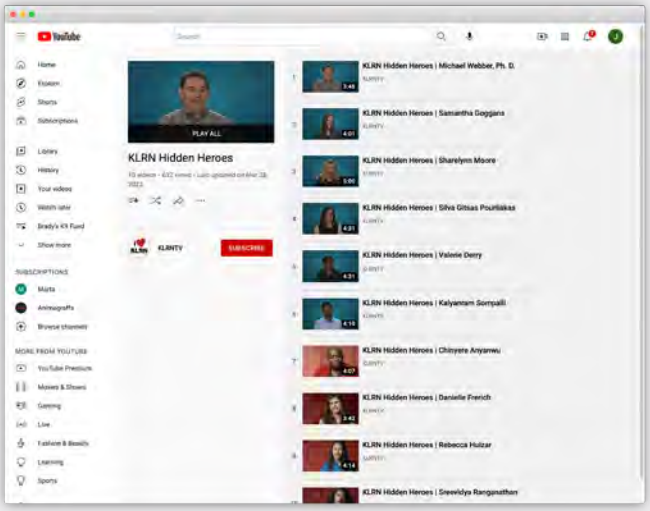
Resourcefulness: Energy is Wealth



Resourcefulness: Water, Wealth and Freedom



PBS Learning Media



Hidden Heroes

Activities Overview

The activities at the end of the study guide are meant to supplement the material covered throughout Power Trip's "Wealth" episode. Individual and group activities will encourage your students to think critically about the world's wealth and energy-related obstacles! Feel free to pick the best exercises for your classroom dynamic and teaching style. Keep in mind that the connection between wealth and energy can be seen in varying ways worldwide. Educators are advised to use the activities in this study guide to shed light on the wealth and energy-related correlation seen in the students' communities. Encourage your students to be creative when investigating the connection between wealth and energy in their community. Energy is wealth, and access to modern energy can be life-changing. The world needs people with innovative ideas who care about the environment and are eager to make a difference. Our goal is to have students see the juxtaposition of opportunity for economic and social growth in modern energy and the risk of overconsumption of energy associated with wealthy regions.

The matching activity aims to help students connect-the-dots when it comes to their actions, activities, and lifestyles and the effect they have on the world's energy resources and vice versa. To complete the activity, they must use the information learned from the documentary episode to match the action, policy, or historical event with its outcome.

Vocabulary

The Anglo Persian Oil Company Oil company based in the Middle East owned primarily by Great Britain after buying the majority of the company's shares in 1914.

Francis and John Glessner Wealthy couple with influence who manufactured agricultural equipment in Chicago in the late 19th century.

The Great Horse Manure Crisis of 1894 Crisis in the UK in which large cities were overflowing with manure due to the overuse of horses as the primary form of transportation.

Haymarket Riot Workers riot in Chicago demanding 8 hour work days and better working conditions.

Innovation Africa Non profit organization dedicated to bringing Israeli solar, water and agricultural technologies to rural African communities.

Thomas McLaughlin Proposed the idea of harnessing the energy from the river Shannon in Ireland to provide Ireland with electricity

The River Shannon Hydroelectric Scheme The largest river hydroelectric project in Ireland, established in the early 1920s.

Ardnacrusha Hydroelectric Station, Ireland

Spindletop An oil field in Beaumont, Texas, which sparked the start of the booming oil industry in Texas.

Lucas Gusher, Spindeltop, Texas

James Watt An 18th-century Scottish inventor credited with improving the steam engine, allowing it to become a pivotal part of the industrial revolution.

Define and Explain Activity

Have your students write their own definitions of the vocabulary words based on the context of the documentary.

Then have students explain the significance of the vocabulary word and its influence on history and their modern day way of life.

Discussion Questions

- How did the lack of modern energy in 19th century Great Britain influence the lives of the common people? How has modern energy changed the daily tasks and chores of common peoples lives?
- Why does the land in 19th century Great Britain dictate the ceiling on overall growth?
- How does Great Britain's access to coal influence its economic development?
- How did the industrial revolution influence the social fabric of Great Britain?
- How did modern energy revolutionize the medical sector?
- What was the social and cultural influence of the River Shannon Hydroelectric Scheme in Ireland?
- What energy factors contributed to the rise of Chicago and the wealth of its people?
- How is the Glossner's library indicative of a social and cultural shift in the United States? How was this shift related to energy?
- How did industrialism affect the laws and regulations surrounding workers? What demographics were particularly protected with these laws?
- Dr. Webber describes the difference between the democratized access of energy and the concentrated ownership of energy. What examples can you find of each in the documentary? How does this influence the social fabric of the community?
- How did Texas oil influence politics in the United States?
- What factors influence the decision to nationalize oil in Iran? What global effects followed this decision?
- How is Innovation Africa working to improve quality of life in African communities? What factors make Innovation Africa a unique program?
- The duel conundrum of reducing the impact of energy consumption in developed communities and providing access to energy in less developed and poor communities requires a delicate balance. How do you see this dilemma in your own country or community?

Understand the wealth of your community!

Energy and wealth go hand in hand. Understanding the origins of your community's wealth will help you recognize the importance of maintaining your energy resources. Research the primary sources of wealth in your community along with the resources that allow industries to harness their energy. Make a connection between the importance of sustainability and the longevity of the industry your city or community relies on. Use your findings to write a letter to your community leaders, urging them to take action in favor of sustainability and renewable energy.

Gallery Walk

Separate your students into groups using the following categories:

- Modern Energy and Wealth for Women
- The Industrial Revolution and Politics
- Modern Energy and Medicine
- Modern Energy and Modern Working Conditions
- Spindletop and Texas Oil Economy
- Innovation Africa, Israeli Energy and Economic Growth

Create a flyer or advertisement highlighting one of the topics above. Demonstrate the significance of the connection between the two subjects. Display the advertisements around the classroom and have the students do a gallery walk to view and later discuss each other's work and ideas.

Modern Energy and Wealth for Women

The Industrial Revolution and Politics

Modern Energy and Medicine

Modern Energy and Modern Working Conditions

Spindletop and Texas Oil Economy

Innovation Africa, Israeli Energy and Economic Growth

Multiple Choice Questions

1. Before the industrial revolution, the wealth of Great Britain was tied up in the _____?
   A. aristocracy
   B. military
   C. common people

2. When thinking about the way the industrial revolution unfolded, it was always a _____ process.
   A. local
   B. global
   C. European

3. You can't understand wealth without also understanding _____ during the 19th century.
   A. colonialism
   B. industrialism
   C. aristocracy

4. To be rich in 19th century England, what three things do you need?
   A. To be related to the king, loyal to the crown, own the latest fashion.
   B. To be friends with the king, own a castle, work in agriculture
   C. To be best friends with the king, have a title like Lord or Sir and have large amounts of land.

5. To what type of organizations do James Watt and Boulton primarily sell steam engines to?
   A. manufacturers
   B. restaurants
   C. train stations

6. Pre 18th century England was all about _____; after is the _____.
   A. middle class and inventors, large landed gentry farms
   B. large agricultural fields, steam engines
   C. large landed gentry farms, middle class and inventors

7. The Industrial Revolution means that lots of goods and services are produced at much _____ prices.
   A. lower
   B. higher
   C. greater

8. Minimalism is to Victorians, a lack of _____.
   A. individualism
   B. patriotism
   C. independence

9. Queen Victoria was very conscious that it was the _____ that she had to please.
   A. upper class
   B. middle class
   C. lower class

10. Why did pre modern energy operating theater require saw dust areound the table?
   A. to decorate the area
   B. to sanitize the area
   C. to soak up all the blood

11. In 1761, a hot bath in Paris cost about _____ pounds, but the daily wage for a craftsman was _____pounds, therefore a craftsman would have to work _____days just to get enough money to bathe.
    A. 3, ½, 6
    B. ½, 3, 5
    C. 2, 7 , 1

12. What power station in Ireland was created through harnessing the energy from the river Shannon?
    A. Ardnacrusha Power Plant
    B. Shannon Power Plant
    C. Ireland National Power Plant

13. The residents of wealthy neighborhoods in Chicago at the turn of the century worked primarily in what industry?
    A. banking
    B. manufacturing
    C. transportation

14. More than _____ of the ingredients in fragrances are from petroleum.
    A. 95%
    B. 25%
    C. 70%

15. Spindletop, in its first _____ months generated more oils that had ever been found in the history of the United States.
    A. 4
    B. 5
    C. 7

16. In most places, the _____ not the _____ owns the minerals below ground .
    A. company, landowner
    B. landowner, government
    C. government, landowner

17. What year did the British become the primary shareholders of the Anglo Persian oil company?
    A. 1946
    B. 2001
    C. 1914

18. Oil from where fuels the British forces at the start of the First World War?
    A. Africa
    B. The Middle East
    C. Latin America

Cause-and-Effect Matching Game

Connect the actions on the left to the outcomes on the right.

Coal replaces organic materials such as wood as the primary source of energy in Great Britain, increasing the nation's access to energy substantially. Factories, coal mines and train tracks are built to process and transport coal and other products.	Before modern energy, medical patients were extremely likely to pick up an infection at the hospital and die when seeking treatment.
The amount of energy required to make products in Europe before the industrial revolution makes it illogical to buy new things for fun, fashion, or variety. However, the industrial revolution reduces the energy intensity of product production, making new items much more accessible to the public.	Ireland sees an increase in literacy levels in women and children.
A lack of electricity and technology in medicine creates dangerous conditions in the medieval medical sector.	Great Britain sees a cultural shift in consumer mentality, allowing fashion trends, clutter and the collection of material goods to develop as a form of patriotism.
Hydroelectric power from the river Shannon is used to distribute electricity to the people of Ireland.	Laws and regulations to protect laborers in the workplace are implemented to protect people and children from exploitation, unfair wages and excessive work hours.
Modern energy creates an environment where the economy can thrive through the production of steel, iron, commercial products and other materials made in factories as well as agricultural products. But to make the most profit from these activities, intense labor is used around the clock and minimum wages are paid to blue collar workers.	The power in Great Britain begins to shift from the monarchy to the middle class as the middle class gains access to opportunities for economic growth.
Chicago is situated on the great lakes with access to two rivers, giving them easy access to trade, and hydro energy which facilitated their ability to manufacture goods and produce high demand metals like iron and steel.	Chicago becomes one of the fastest growing and economically prosperous cities in the world.
In the United States, the minerals found underground are owned by those who own the land.	Persia's ruler decides to nationalize oil in Iran.
The British government became a majority shareholder in the Anglo Persian Oil company six weeks before the start of the first world war.	Oil booms, such as Spindletop, allow everyone from the property owners to the oil companies involved in the process to become rich. Additionally, this allows Texas to leverage political power.
An overwhelming amount of Middle Eastern oil is leaving the country and many feel it is not being re-invested into the economy of Middle Eastern nations.	Oil from the Middle East is fueling the British military in their war efforts.

Solutions

Multiple Choice

1-A; 2-B; 3-A; 4-C; 5-A; 6-C; 7-A; 8-B; 9-B; 10-C; 11-A; 12-A; 13-B; 14-A; 15-B; 16-C; 17-C; 18-B

Matching Game

Coal replaces organic materials such as wood as the primary source of energy in Great Britain, increasing the nation's access to energy substantially. Factories, coal mines and train tracks are built to process and transport coal and other products. **The power in Great Britain begins to shift from the monarchy to the middle class as the middle class gains access to opportunities for economic growth.**

The amount of energy required to make products in Europe before the industrial revolution makes it illogical to buy new things for fun, fashion, or variety. However, the industrial revolution reduces the energy intensity of product production, making new items much more accessible to the public. **Great Britain sees a cultural shift in consumer mentality, allowing fashion trends, clutter and the collection of material goods to develop as a form of patriotism.**

A lack of electricity and technology in medicine creates dangerous conditions in the medieval medical sector. **Before modern energy, medical patients were extremely likely to pick up an infection at the hospital and die when seeking treatment.**

Hydroelectric power from the river Shannon is used to distribute electricity to the people of Ireland. **Ireland sees an increase in literacy levels in women and children.**

Modern energy creates an environment where the economy can thrive through the production of steel, iron, commercial products and other materials made in factories as well as agricultural products. But to make the most profit from these activities, intense labor is used around the clock and minimum wages are paid to blue collar workers. **Laws and regulations to protect laborers in the workplace are implemented to protect people and children from exploitation, unfair wages and excessive work hours.**

Chicago is situated on the great lakes with access to two rivers, giving them easy access to trade, and hydro energy which facilitated their ability to manufacture goods and produce high demand metals like iron and steel. **Chicago becomes one of the fastest growing and economically prosperous cities in the world.**

In the United States, the minerals found underground are owned by those who own the land. **Oil booms, such as Spindletop, allow everyone from the property owners to the oil companies involved in the process to become rich. Additionally, this allows Texas to leverage political power.**

The British government became a majority shareholder in the Anglo Persian Oil company six weeks before the start of the first world war. **Oil from the Middle East is fueling the British military in their war efforts.**

An overwhelming amount of Middle Eastern oil is leaving the country and many feel it is not being re-invested into the economy of Middle Eastern nations. **Persia's ruler decides to nationalize oil in Iran.**

Episode 5
Cities

About the Episode

Energy is all around us, hidden in every aspect of our lives. The future of cities and the future of energy are closely connected. Cities shape our relationship with the natural and built environment and consume 40% of U.S. energy. "Cities" traces a centuries-long journey across the Middle East, Europe, Asia, and North America to show us the energy that gave us modern cities.

Intended Audience

This study guide is intended for high school students and young adults who want to learn more about energy, cities, and the careers that bring them together in our modern world.

Episode Objective

The number of people worldwide who reside in urban areas has grown exponentially. With no signs of slowing down, the growth of the world's cities foreshadows a greater need for innovative ideas and sustainable practices. When the average person considers the difference between rural and urban areas, the immediate comparison comes down to the nightlife, schools, rent, and the overall quality of life each can offer. However, the maintenance and growth of each depend on the other. The intricacies of the relationship between the two often go unnoticed.

Without rural areas, urban areas would be unable to feed and produce the energy needed to sustain such large compact populations. At the same time, the ability to spend time focusing on creative and innovative new projects allows urban areas to come up with the latest technology. Technology and innovation will enable us to develop techniques to use our energy resources more efficiently, helping rural areas make the most of their resources. Cities are like living organisms. They consume energy and produce waste. However, if that waste is not disposed of properly or is produced in extreme quantities, there is a risk that rural areas will be contaminated and harmed. Consequently, they impede their ability to deliver the resources needed for themselves and urban communities.

As you can see, there is a delicate balance between the city and the countryside. It is a delicate relationship that needs to be nurtured and protected. The world needs innovative thinkers who care about the environment's future on the front line. *Power Trip: The Story of Energy*, "Cities," hopes to highlight these obstacles further and shine a light on the fantastic careers that make our modern way of life a reality. In demonstrating the relationship between modern energy and our daily lives, "Cities" aims to inspire its viewers to be more mindful of their energy resources and consumption and encourage them to take a stand and make a difference.

What is the connection between cities and energy?

Cities such as those found in Ancient Mesopotamia first developed around 6,000 years ago. Thanks to the stable production of food achieved through agricultural practices juxtaposed with the ability to access, transport, and distribute water, the residents of these areas were freed from the manual labor that would have otherwise consumed their time entirely. The production of goods was facilitated, and trade and exchange could thrive unlike ever before. As a side effect, cultural customs developed and expanded at a larger scale, and the community's leaders acquired more power, becoming kings and queens.

Parallel to this phenomenon is the Industrial Revolution, an era that began in Great Britain and propelled the nation to wealth and prosperity. Much like the populations of Ancient Mesopotamia, access to energy resources such as coal allowed Great Britain to free themselves from the manual labor needed to produce the goods that fed their economy. They developed factories to produce steel, iron, textiles, and other goods in mass quantities. Consequently, people began to migrate to the city, where job opportunities were more readily available, and large modern-day cities were born.

From a modern-day perspective, the city and the countryside offer distinct freedoms. In one, you have access to services nearly 24/7. You can order food to your door at three in the morning and hop on a ten-minute bus ride to your job, eliminating the physical labor required in an agricultural environment. The other allows you free range to roam without the worries of breathing in contaminated air. You have room to grow and harvest your food, releasing you from the shackles of grocery store prices and giving you more control over food quality. In the simplest form, each allows for a distinct lifestyle that will seem more appetizing depending on personal preferences. However, as different as they might seem, one cannot exist without the other.

For a city like Chicago to have enough energy to function effectively they rely on natural resources found in the state of Illinois. This includes land used to harvest wind power, hydroelectric power, fossil fuels and renewable energy. Not to mention the food required to feed the growing population. At the same time, the ability for tech industries to develop in cities creates a relationship in which urban areas can develop ways to use our natural resources more efficiently. It's a symbiotic relationship that runs the risk of being disrupted by one primary factor, waste.

Cities are like living organisms, they consume energy and produce waste. This waste, if produced in too large quantities or if not disposed of properly can cause serious problems for the environment. For example, the excessive use of air conditioning on hot summer days requires great amounts of energy. This energy is often produced using fossil fuels which release greenhouse gasses into the atmosphere. Consequently, the hot summer days get hotter and even more energy is needed to cool our homes. It's important to remember that our energy resources are not unlimited, being mindful of our energy use is extremely important. Being efficient and producing less waste is essential for sustainability to be achieved.

Dear Educators!

As leaders and teachers, educators uphold one of the most important jobs when it comes to clean energy and sustainability. By creating an environment in which students are exposed to energy education in a way that they can connect to their personal lives, educators are able to carve the path to a better future. You are encouraged to use the study guide as a reference when learning about the history, influence, and correlation between cities, energy, and sustainability practices. Encourage your students to ask questions and to use their creativity when completing the activities included in this study guide. Below are pre-viewing questions for educators to analyze their student's preconceived notions and ideas surrounding the correlation between cities and energy and set the stage for the journey presented in *Power Trip: The Story of Energy* "Cities." After viewing the documentary episode, post-viewing questions are included to assess the students' understanding of the relationship between wealth and energy.

Pre-viewing Questions

- What do you think about when you think of cities?
- How many people do you think live in your city?
- How much food, water, gas and electricity do you think is necessary to sustain the population of your city?
- What connection do you see between cities and energy?
- What jobs do you think about when you think of cities?
- What jobs do you think about when you think of the countryside?
- What connections do you see between rural and urban areas?
- Would you prefer to live in an urban or rural area? Why?
- What are the benefits and downfalls of living in urban and rural areas?
- Do you feel that your city uses its energy resources efficiently? Why or why not?

Post-viewing Questions

The post-viewing questions are meant to be answered quickly after watching the documentary episode. They aim to determine the immediate effect the documentary had on the student by demonstrating their change in attitude and knowledge on the topic compared to the answers in the Pre-viewing questions section.

- What new information did you learn about cities?
- What did you learn about the connection between urban and rural areas?
- Did you learn of any new careers you had not previously seen before?
- Did your attitude regarding rural or urban life change after watching "Cities?"
- Did your stress if any regarding the world's energy resources decrease or increase after watching "Cities?"
- Do you feel that your city uses its energy resources efficiently? Why or why not?

Additional Resources

The content covered throughout *Power Trip: The Story of Energy* can serve as a great supplement to your sustainability and green energy curriculums. Before showing episode "Cities" to your students, consider reviewing the following resources to familiarize yourself with the topic of cities and energy. A quick revision of the following texts and activities can serve as an introduction to the topics discussed and provide some inspiration for ways you could incorporate the information highlighted throughout the episode into your classroom activities.

Resourcefulness: Defining Energy and Power

Resourcefulness: The World's Biggest Challenges

What Are The Benefits Of Energy?

Ideas For Building A More Sustainable Community

Sustainable Energy Conservation

Hidden Heroes

Videos

The following video clips highlight the relationship between cities and energy as is discussed in "Cities" and are meant to encourage their viewers to begin thinking about our natural resources as limited and essential in our modern energy sector. Feel free to use these resources to give your students a look into the history of cities, modern day energy, technology and the careers that make it all possible!

How Oil Changed Texas

Skyscrapers and the Chicago Architecture Center

Urban Metabolism

Singapore and Urban Design

Moonlight Towers in Austin

Skyscrapers and the Golden Age of Elevators

What is a Smart City?

The Lamplighters of London

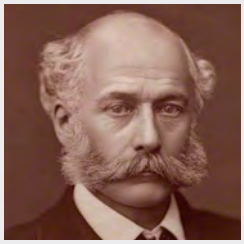
Activities Overview

The activities at the end of the study guide are meant to supplement the material covered throughout Power Trip's "Cities" episode. Individual and group activities will encourage your students to think critically about the world's cities and their energy-related obstacles! Feel free to pick the best exercises for your classroom dynamic and teaching style. Keep in mind that the connection between cities and energy can be seen in varying ways worldwide. Educators are advised to use the activities in this study guide to shed light on the correlation between cities and energy seen in the students' communities. Encourage your students to be creative when investigating the connection. Cities rely on an extreme amount of energy resources, and access to modern energy can be life-changing. The world needs people with innovative ideas who care about the environment and are eager to make a difference. Our goal is to have students see the juxtaposition of opportunity for economic and social growth in modern energy and the risk of overconsumption of energy associated with urban areas.

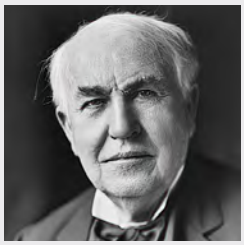
The matching activity aims to help students connect-the-dots when it comes to their actions, activities, and lifestyles and the effect they have on the world's energy resources and vice versa. To complete the activity, they must use the information learned from the documentary episode to match the action, policy, or historical event with its outcome.

Vocabulary

Joseph Bazalgette Developed a system of intersecting sewers to manage London's wastewater.



Thomas Edison American inventor credited with inventing the incandescent light bulb in the late 1870s.



The Housing Development Board in Singapore Singapore's public housing authority.

Moonlight Tower Arclights (a giant spark running through two sticks of carbon that create an extraordinarily bright light) placed at the top of a high tower and used as street lighting. They were particularly popular in the 1880s and 1890s.

A moonlight tower in Austin, Texas.

Renewable Energy Energy that is not depleted from its source when used and can be replenished such as wind or solar energy.

Solar energy is an example of renewable energy.

Smart City A city who uses modern energy and technology to optimize operations and systems to improve its function.

The Urban Metabolism Resources coming in and waste going out of a city in a series of inputs and outputs.

Define and Explain Activity

Have your students write their own definitions of the vocabulary words based on the context of the documentary.

Then have students explain the significance of the vocabulary word and its influence on history and their modern day way of life.

Discussion Questions

- How did the Chicago fire in 1871 influence the economic development of the city?
- How do natural disasters affect the way we view the infraestructura and energy resources of our cities? Use your own city as an example if possible.
- How did the Chicago school of architecture influence the development of Chicago economically? How did it shape their outlook on energy and energy resources?
- Why were elevators viewed with novelty and pride in late 1800's Chicago? What does this demonstrate in regards to the connection between energy and urban culture?
- How did public lighting change the level of safety and security in modern day cities? How does modern energy and technology continue to improve our safety today?
- How does effective public lighting influence a city's economy?
- What does the push for indoor air conditioning on behalf of movie theaters demonstrate regarding the connection between modern energy and a city's economic and industrial structure?
- What makes the town of Punggol in Singapore so significant when it comes to energy and sustainability? What can the rest of the world learn from this?

Create your own city!

There are many advantages to living in the modern world with modern energy. However not everything's perfect. Creating and developing a city can be a difficult task, full of obstacles to overcome and problems to solve. For this activity, have your students create their own city from scratch. They can do this on the medium they choose, through a poster or virtual presentation or 3D model (for example using Lego bricks). In their city they must represent the symbiotic relationship between the urban and the rural area by demonstrating a clear transfer of resources from one to the other. The disposal and treatment of the waste must also be represented to demonstrate the social views the city upholds regarding waste and sustainability. Finally, the student will have to write out the history, culture and economy of the city and present it alongside the visual representation.

Final Presentation Outline

Fictional city name

Short history on how your city was founded

The city of Mangomango was founded in the late 1800s thanks to an abundance of waterfalls that allowed the community to produce great amounts of hydroelectric power, which they use to power their homes and businesses and also sell to nations around the world as well as a booming agricultural industry fueled by the tropical environment that helps them produce large amounts of mangos.

A description of your city's primary energy resources and geography

The city of Mangomango is a small island nation. It relies primarily on the hydroelectric power created by its waterfalls. However, they also produce energy from wind power, solar power, natural gas, and imported fossil fuels.

A description and history of your city's economy.

Before the city of Mangomango had developed a way to produce hydroelectric power, the community was relatively poor. They were able to sell mangos locally and to neighboring cities; however, they relied heavily on imported fossil fuels and their small natural gas reserves, which were very expensive. However, once the amazing Mangomango engineers and architects came together to build hydroelectric plants on some large Mangomango waterfalls, the city was able to import fewer amounts of fossil fuels, helping them save money by powering the city with their own resources. Additionally, they were able to slow down the use of their natural gas reserves, elongating the time they will be available for use. Finally, the additional energy from the hydroelectric plants allowed them to build mango production and shipping sites to maximize their mango businesses, further fuel and expand their economy and create new products. Mangomango now not only produces and sells hydroelectric power and mangos, but they are also a hub for tourism and new technology.

A clear description of the relationship between your city and the countryside that fuels it.

In 2022, the city of MangoMango has grown substantially and now houses approximately 3.5 million people. Its residents primarily work in technology development, landscaping, architecture, tourism, restaurant, and agricultural industries. To keep up with the growing population, Mangomango uses the technology developed in the city to improve its agricultural system to more efficiently grow mangos and other fruits without damaging the land or exhausting their water resources and developing water treatment plants for potable water. In return, Mangomango's agricultural sector uses the food produced to feed its population and collects the water needed for its residents and visitors.

How does your city deal with waste?

To avoid excessive waste, the city of Mangomango uses recyclable materials for all its products and provides drop-off stations around the city as well as pick-up vehicles where residents can dispose of their trash to be recycled and reused for new products. Additionally, Mangomango implements strict laws against the improper disposal of harmful chemicals and materials that could hurt the environment or the city's residents.

Discover and research a sustainable building

With changing cultural and political views regarding sustainability and eco-friendly practices, new and exciting projects are beginning to come to life around the world. As helpful as it would be to be able to stop building and take a step back, our growing populations make that a nearly impossible task. In order to combat this issue, countries around the world are investing in new technology to create revolutionary sustainable buildings.

For this activity, have your students discover and research different eco-friendly buildings around the world. Have them create a presentation explaining their history, what makes them special and how they made sustainability history.

At the very end have them brainstorm what they would do to make their own home or school building more sustainable.

The presentation must answer the following questions:

- When was the building built?
- Who was the architect?
- What energy efficient, sustainability or green energy features does the building include?
- How does the building reduce the environmental damage caused by traditional buildings?
- How do you think this building will pave the way for sustainable architecture? Do you know of any examples of how it has already done this? For example, can you find any examples of how the building's unique sustainability feature have been adopted by other buildings?

Sustainable building examples:

- The Marco Polo Tower in Hamburg, Germany
- Suzlon One Earth, India
- One Central Park, Australia
- The Crystal, London, UK

Build a timeline of your city

Living in your day to day life, it can often be difficult to see how your community got to the place where it is today. You may live in an urban, rural or suburban area, either way your community has an important history which can help you determine its relationship with neighboring communities, or even communities thousands of miles away.

For this activity, have your students research the history of their hometown. They must create a visual timeline demonstrating the following:

- City Name
- Date Founded
- Population Growth Per Decade
- Primary Economy Per Decade
- Primary Job Opportunities Per Decade
- Primary Demographic Per Decade
- Waste Management Obstacles Per Decade
- Primary Connections With Outside Regions Per Decade
- Estimated Future Population Growth
- Estimated Future Industry and Economic Growth

Multiple Choice Questions

1. Modern day Mesopotamia, which consists of Iraq, parts of Iran, Syria, southern Turkey, is often referred to as the _____.
   A. origin of humanity
   B. cradle of civilization
   C. birth of civilization

2. How many rail carts of coal were needed to run the Sears merchandise and catalog center in Chicago each day?
   A. 17
   B. 23
   C. 9

3. The rise of _____ gave rise to _____which gave rise to _____.
   A. coal/steel/skyscrapers
   B. steel/coal/skyscrapers
   C. skyscrapers/steel/coal

4. By the 1850's the population in London had gone up to about _____?
   A. 1.2 billion
   B. 1.5 billion
   C. 1 billion

5. In the ancient world _____, _____,and _____ were the only options to see after sunset.
   A. moonlight, candles, lamps
   B. flashlights, fire, sunlight
   C. torches, fire, candles

6. What was the main method of street lighting in Austin in the 1920s?
   A. moonlight towers
   B. gas lamps
   C. standard electric street lamps

7. How many outdoor light poles are there worldwide?
   A. 350 million
   B. 206 thousand
   C. 36 million

8. It is a lot more difficult to _____a building and to _____ it.
   A. heat/cool
   B. maintain/cool
   C. cool/heat

9. Cities, because they have a concentration of people, also have a concentration of _____.
   A. water
   B. food
   C. waste

10. The houses in Punggol are oriented in a north-south orientation to reduce_____.
   A. sunlight and heat
   B. sunlight and humidity
   C. wind and cool temperatures

11. Who developed a system of intercepting sewers to manage London's wastewater?
   A. Joseph Bazalgette
   B. James Watt
   C. Benjamin Franklin

12. Who invented the incandescent lightbulb in the late 1870's and commercialized it by the early 1880's?
   A. James Watt
   B. Benjamin Franklin
   C. Thomas Edison

13. Large tower structures with arclights commonly used for street lighting are known as _____?
   A. sun towers
   B. moonlight towers
   C. electric lamp

14. _____ was developed as an eco-town in Singapore.
   A. Yishun
   B. Punggol
   C. Serangoon

Cause-and-Effect Matching Game

Connect the actions on the left to the outcomes on the right.

Humanity achieves stability in terms of food production, allowing people to stay in one place instead of moving around as hunter-gatherers and producing enough food for a community without needing everyone involved in the agricultural processes.

Chicago has ample access to resources such as coal, allowing them to more easily produce large amounts of steel.

London, around the 1850s, imported their water to the city through private companies who took their supplies from different sources like the river Thames. The use of water in the cities increased, creating waste that could not be filtered out or treated.

A lack of street lighting before modern energy in England allows crimes like those of Jack the Ripper to take place without identifying the criminal.

Fossil fuels and the invention of the electric light bulb make indoor lighting more accessible to the average person.

Singapore creates buildings designed to allow the minimum sunling and maximum breeze to flow through the building's flats.

Modern energy makes street lighting accessible, increasing safety at night and allowing nightlife to flourish.

An overwhelming stink pushes London's parliament to contract Joseph Bazalgatte, an engineer, to develop a system of sewers, cleansing the river Thames and getting rid of London's sewage problem.

People have the time and support needed to participate in non-agricultural activities like politics, cultural activities and trade.

New Singapore flat owners in the town of Punggol can avoid turning on the AC on hot summer days.

Chicago is able to use its resources to create innovative, new architecture like what is used to build skyscrapers.

Factory workers are able to work night shifts and people are able to continue with activities like reading and writing once the sun goes down. This creates economic and educational opportunities and makes people's homes more comfortable.

Solutions

Multiple Choice

1-B; 2-A; 3-A; 4-B; 5-C; 6-A; 7-A; 8-C; 9-C; 10-A; 11-A; 12-C; 13-B-; 14-B

Matching Game

Humanity achieves stability in terms of food production, allowing people to stay in one place instead of moving around as hunter-gatherers and producing enough food for a community without needing everyone involved in the agricultural processes. **People have the time and support needed to participate in non-agricultural activities like politics, cultural activities and trade.**

Chicago has ample access to resources such as coal, allowing them to more easily produce large amounts of steel. **Chicago is able to use its resources to create innovative, new architecture like what is used to build skyscrapers.**

London, around the 1850s, imported their water to the city through private companies who took their supplies from different sources like the river Thames. The use of water in the cities increased, creating waste that could not be filtered out or treated. **An overwhelming stink pushes London's parliament to contract Joseph Bazalgatte, an engineer, to develop a system of sewers, cleansing the river Thames and getting rid of London's sewage problem.**

A lack of street lighting before modern energy in England allows crimes like those of Jack the Ripper to take place without identifying the criminal. **Modern energy makes street lighting accessible, increasing safety at night and allowing nightlife to flourish.**

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Singapore creates buildings designed to allow the minimum sunling and maximum breeze to flow through the building's flats. **New Singapore flat owners in the town of Punggol can avoid turning on the AC on hot summer days.**

Episode 6
War

About the Episode

Energy can be both the cause and the instrument of modern war. Advances in energy have historically arisen during the urgency of wartime. Energy done the right way can lead to peace, energy done the wrong way leads to instability and conflict. "War" traces a centuries-long journey across the world to show us how energy changed the way we fight wars.

Intended Audience

This study guide is intended for high school students and young adults who want to learn more about how energy affects the way we wage war.

Episode Objective

A nation's security is essential for its development. Stability is tough to achieve when a nation's leaders cannot guarantee their citizens will have access to the resources they need. Thanks to modern energy, our societies have changed dramatically. We now have more access to amazing goods, services, and opportunities at our fingertips than we could have only dreamed of not so long ago. However, these resources are not always easy to come by. Throughout the years, nations have fought hard for the world's natural resources, and our natural resources have influenced and maximized their ability to fight. This relationship between war and energy is an ongoing battle for innovation and self-sustainability. Wasting the resources we have only puts us at a disadvantage and exposes our vulnerabilities. Militaries understand this very well, as seen in their strategic energy use and energy conservation methods. However, the general public also needs to make an equal effort to achieve sustainability.

At the end of the day, energy sustainability is wealth, prosperity, health, and security. *Power Trip: The Story of Energy* "War" aims to educate its viewers on the connections between war, sustainability, and energy to make them more aware of their energy resources and encourage them to be more mindful of their use. Additionally, this episode highlights the tremendous technological innovation and the careers that make our modern way of life a reality—hopefully inspiring its young viewers to consider pursuing a career in the energy sector. Energy is everywhere and is essential to maintain our modern way of life. We need creative and innovative minds on the front line who care about their nation's resources and are willing to do what they can to make a difference.

How is war connected to energy?

War has been a pivotal part of humanity since the very beginning. We fight wars over water, land, spices, resources, and energy. However, despite energy being something we battle to control, its influence and contribution to war are much more important than one might initially think. Before modern energy, wars were fought on a much smaller scale. Men on horseback or foot would battle face to face with swords and other short-range weapons. In the most large-scale situations, cannons, which require an exceptional amount of energy, would be used. In the end, wars were much less destructive than today and caused death on a much smaller scale.

Before the First World War, when battles were fought at a much closer range, the soldiers were much more exposed than they are today. Modern energy allowed the world to create machines and weapons that could attack with more range, as seen in the First World War through tanks, machine guns, and aerial strikes and in more recent warfare through unmanned drones, lasers, and satellite spying. Consequently, helping keep their soldiers a little farther from direct contact with the enemy soldiers. This phenomenon created a cycle in which new technology must be continually developed, machinery must be replaced when destroyed, and improvements must be continually made to keep the upper hand. All of this requires enormous amounts of energy. The production of metals to make weapons, planes, and vehicles requires electricity, water, and fossil fuels. This leads to the realization that in attacking a nation's

energy resources, you are essentially attacking their source of power. Following this realization, we now find ourselves in a situation where energy and war go hand in hand.

Energy creates wealth, prosperity, security, and health. It is essential to our modern-day life, making it something that we can not only use to protect ourselves but also as an incentive to go to battle in the first place, especially when it comes to unrenewable resources such as oil and natural gas. The days of hand-to-hand combat are long gone. Heavy reliance on foreign nations for natural resources has led to conflict time and time again. A nation's security relies on its ability to rely heavily on its energy resources.

While this may be difficult to do in many countries, the diversification of energy resources, that's to say, the use of a combination of solar, water, fossil fuels, etc., instead of the complete reliance on one form of energy can make a huge difference when it comes to security. Additionally, this creates a much more sustainable system in which the environment is less affected, and the nation can operate at a much more efficient level.

In the end, energy is tied to everything. It provides us with our modern-day life and economy, facilitates the health and education of our populations, and has proven to be something worth fighting for. It is something we must use wisely and protect.

Dear Educators!

As leaders and teachers, educators uphold one of the most important jobs when it comes to clean energy and sustainability. By creating an environment in which students are exposed to energy education in a way that they can connect to their personal lives, educators are able to carve the path to a better future. You are encouraged to use the study guide as a reference when learning about the history, influence, and correlation between war and energy. Encourage your students to ask questions and to use their creativity when completing the activities included in this study guide. Below are pre-viewing questions for educators to analyze their student's preconceived notions and ideas surrounding the correlation between wealth and energy and set the stage for the journey presented in *Power Trip: The Story of Energy* "War." After viewing the documentary episode, post-viewing questions are included to assess the students' understanding of the relationship between war and energy.

Pre-viewing Questions

- What do you think about when you think of energy?
- What do you think about when you think of war?
- What connection do you see between war and energy?
- How do you think energy has historically influenced the way that wars are fought?
- How do you think modern energy has influenced political regimes around the world?
- How do you think sustainable energy ties into war efforts?
- Does the consumption of the world's energy resources cause you stress? If so, why?
- Have you ever considered pursuing a career in energy? If so, what career and why?

Post-viewing Questions

The post-viewing questions are meant to be answered quickly after watching the documentary episode. They aim to determine the immediate effect the documentary had on the student by demonstrating their change in attitude and knowledge on the topic compared to the answers in the Pre-viewing questions section.

- How has your perception of energy changed if at all?
- How has your perception of war changed if at all?
- What is your understanding of war and energy?
- What new information did you learn about the historical influence of energy and war?
- Do you feel you are more aware of the political incentives behind acquiring natural resources?
- Did your stress regarding the consumption of the world's energy resources change after watching "War?" If so, why?
- Did you discover any new careers you had previously been unaware of?
- Would you now consider pursuing a career in the energy sector?

Additional Resources

The content covered throughout *Power Trip: The Story of Energy* can serve as a great supplement to your sustainability and green energy curriculums. Before showing episode "War" to your students, consider reviewing the following resources to familiarize yourself with the topic of war and energy. A quick revision of the following texts and activities can serve as an introduction to the topics discussed and provide some inspiration for ways you could incorporate the information highlighted throughout the episode into your classroom activities.

Energy and War Discussion

What Are The Benefits Of Energy

Drought and Civilization Collapse: Resourcefulness

Hidden Heroes

Videos

The following video clips highlight the importance of energy in society and the relationship between war and energy as is discussed in "War." They are meant to encourage their viewers to begin thinking about our natural resources as limited and essential for our modern energy sector and modern day of life. Feel free to use these resources to give your students a look into war-related energy history, modern day technology!

Frank Whittle and The Jet Age

How Oil Changed Texas

Power Trip: The Story of Nuclear Energy

The Water Wealth of Versailles

What is a Smart City?

Activities Overview

The activities at the end of the study guide are meant to supplement the material covered throughout *Power Trip's* "War" episode. Individual and group activities will encourage your students to think critically about the world's war and energy-related obstacles! Feel free to pick the best exercises for your classroom dynamic and teaching style. Keep in mind that the connection between war and energy can be seen in varying ways worldwide and in history. Encourage your students to be creative when investigating the connection between war and energy. Energy is wealth and stability and access to modern energy can be life-changing. The world needs people with innovative ideas who care about the environment and are eager to make a difference. Our goal is to have students see the juxtaposition of opportunity for economic and social growth in modern energy and the implications that access or a lack of access to energy can have in communities and international relationships.

The matching activity aims to help students connect-the-dots when it comes to their actions, activities, and lifestyles and the effect they have on the world's energy resources and vice versa. To complete the activity, they must use the information learned from the documentary episode to match the action, policy, or historical event with its outcome.

Vocabulary

Atlantic Wall Fortification and defense system built along the west coast of Europe by Nazi Germany during World War II to impede and delay the invasion of the allied forces into Europe.

One of the casemates of the Longues-sur-Mer battery in Normandy.

Big Inch and Little Big Inch Pipelines (The Inch Pipelines) Petroleum pipelines built during the Second World War to transport oil from Texas to the east coast due to Axis attacks on Allied shipping.

Workers assembling sections of the Big Inch Pipeline.

Carter Doctrine President Carter's 1980's state of the union speech in which he pledged that the United States would take any means necessary to defend the Persian Gulf, including military force.

Fischer–Tropsch Fuel Liquid hydrocarbon fuel created in Germany during World War Two for German troops after the Allies cut off their oil supplies.

G7 Partnership organization between the UK, United States, Canada, Japan, Germany, France and Italy, plus the EU: the world's seven largest advanced economies.

Manhattan Project US nuclear weapons development program in World War II.

The Trinity test of the Manhattan Project was the first detonation of a nuclear weapon..

Normandy Landing (D-Day) The coastal invasion of Western Europe by the Allied forces in World War II. To this day it is the largest seaborne invasion in history.

Gen. Dwight D. Eisenhower, speaking with American Army paratroopers prior to D-Day.

J. Robert Oppenheimer
American theoretical physicist credited with developing the atomic bomb. He is often called "father of the atomic bomb."

Red Ball Express Convoy of trucks used to get food and supplies to soldiers after the Normandy Landing in World War Two.

Tennessee Valley Authority An American federal electric utility corporation.

Yom Kippur War War between Israel and a coalition of Arab states led by Egypt and Syria from October 6 to October 25, 1973.

Destroyed Israeli M48 Patton tanks on the banks of the Suez Canal.

1970's Oil Embargos Oil shortages and increased oil prices in the 1970's due to the Organization of Arab Petroleum Exporting Countries (OAPEC) oil embargo following the Yom Kippur War.

Define and Explain Activity

Have your students write their own definitions of the vocabulary words based on the context of the documentary.

Then have students explain the significance of the vocabulary word and its influence on history and their modern day way of life.

Discussion Questions

- Prior to industrial societies and modern energy, wars were fought on foot with short range weapons and at a much larger scale. How might this influence society's view on war? How has this view shifted with the introduction of modern energy in modern war?
- How does the origin of the Industrial Revolution influence the outcome of World War I?
- Thanks to Spindletop, an exceptionally large oil field in Texas, the United States had access to more oil than the majority of the world. How does this influence the World War I?
- How does Normandy landing demonstrate the ties between energy, industry and security?
- What was the significance of aluminum in World War II? How did this influence energy production in the United States?
- Explain the significance of the attack on oil in Kuwait. How did this event influence the future of energy around the world?
- How does the oil demand crisis in 2008 demonstrate the international relationship between economic development, growth and energy resources.
- How did hydraulic fracturing affect the international reliance of the United States with foreign countries? Why is there hesitation to utilize this method in developing countries?
- How does world geography influence the world's ability to create safe energy resource networks between countries? Provide an example.
- What would be the immediate and long term effects of having the electricity cut off in the United States for a week?
- What are the benefits and downfalls of being a part of a globalized economy that relies on each other's energy resources.
- How could a country's allies' reliance on natural resources from certain regions elicit national security issues?
- How does nuclear energy pose a unique obstacle in terms of international energy and security?
- How does the diversification of energy resources improve the security and economic stability of a nation? Provide an example.
- Describe the juxtaposition of the United States military and public views on energy consumption and sustainability.
- How does the US military's energy conservation efforts demonstrate the potential efficiency capabilities in the United States?
- How do you think the United States could recreate the patriotic incentive to not waste and be mindful of the available resources as they did during WWII?

War Research Project

Have your students research a large war in history. Have them determine the connection between the war and energy. To do this, they must determine the war's participants, the geography and access to energy resources, and the advantages and disadvantages each has depending on said access to energy resources. They must determine whether or not energy contributed to the war's outcome and, if so, how. Have them present their findings to the class.

Gallery Walk

Separate your class into groups using the following categories.

- World War II Recycle and Reuse
- The Big Inch and Little Big Inch Fund
- The Red Ball Express Fund
- The Manhattan Project Energy Fund
- The Cold War Energy Fund
- Diversify Your Energy Resources

Have your students create an advertisement or flyer for their category. Their goal is to convince their classmates to donate to their cause. Each advertisement or flyer must include the type of energy resources needed for their category. For example, metals like aluminum for World War II Recycle and Reuse. Additionally, the advertisement or flyer must include a quick explanation of why the resources they need are essential to the cause. Display the final presentations around the classroom and have the students do a gallery walk to review each other's work. After the gallery walk, the student can discuss each other's presentations and analyze if they would or would not give to each other's cause and why.

After the gallery walk, the student can discuss each other's presentations and analyze if they would or would not give to each other's cause and why.

World War II Recycle and Reuse

The Big Inch and Little Big Inch Fund

The Red Ball Express Fund

The Manhattan Project Energy Fund

The Cold War Energy Fund

Diversify Your Energy Resources

Multiple Choice Questions

1. What was the first war fought with modern energy?
   A. World War I
   B. World War II
   C. The Cold War

2. During World War I, England relied on oil from _____?
   A. Africa
   B. Latin America
   C. The United States and its allies

3. World War II started in _____?
   A. 1920
   B. 1939
   C. 1950

4. After difficulties transporting oil, the United States had to resort to building an extensive pipeline network from Texas to the Northeast because it was safer to transport oil by _____ than by _____.
   A. land, ship
   B. ship, land
   C. land, air

5. As oil demand goes _____ and oil availability stays level or goes _____, there are potentials for more conflict over oil.
   A. down, up
   B. up, down
   C. up, up

6. What was at the heart of Japan's military strategy during WWII?
   A. access to coal
   B. access to oil
   C. access to navy ships

7. In an attempt to keep fighting in the war after having their oil supplies cut off by the Allies, the Axis powers relied on what new form of fuel?
   A. Fischer–Tropsch fuel
   B. diesel fuel
   C. gasoline

8. One of the most important metals in World War II was _____?
   A. Copper
   B. Steel
   C. Aluminum

9. Producing aluminum in the Tennessee River Valley was highly driven by cheap _____power.
   A. electric
   B. hydroelectric
   C. coal

10. By the 1970's the United States and Europe relied heavily on _____ oil.
    A. South American
    B. Asian
    C. Middle Eastern

11. Cheap oil in the Cold War led to _____ _____ with much wider reach.
    A. nuclear missiles
    B. atomic bomb
    C. machine guns

12. By 1970 the United States imported _____ of their oil and gas.
    A. 1/5
    B. 1/4
    C. 1/3

13. Arab oil producing nations angry over support for Israel during the Yom Kippur war, reduced their oil output by about _____ barrels per day and fixed prices _____% above their normal level.
    A. 500, 5 million
    B. 5 million, 500
    C. 500, 500

14. _____ has always been a target in a time of war.
    A. civilians
    B. infrastructure
    C. coastal areas

15. There are three major electric grids in the United States. _____of the military bases in the United States have a single power feed to the base.
    A. 90%
    B. 30%
    C. 50%

16. The US military reduced their consumption of petroleum products by _____ between 2007 and 2015.
    A. 5%
    B. 10%
    C. 20%

Cause-and-Effect Matching Game

Connect the actions on the left to the outcomes on the right.

Weapons used before modern energy are less destructive and have a shorter range.	The Allied forces are able to build and power tanks, trucks, ships and artillery needed for the allied forces, giving them a military advantage.
The United States, Texas in particular, had abundant oil during the first world war.	If one energy source becomes compromised, the nation can hold itself together through its other resources.
The Allied powers had access to about 95% of the world's energy reserves leaving only 5% to the Axis powers.	The reliance on foreign countries for energy creates a distinct vulnerability that makes the nation importing oil susceptible to attacks.
A nation, for example, the US during the 70's, imports the majority of its oil from foreign countries.	People are unable to communicate digitally, financial transactions become extremely limited. basic utilities like water, sewage systems and transportation systems are unable to function properly.
A nation's power grid fails for a couple days.	Wars are fought on foot, face to face and cause smaller-scale destruction.
A nation diversifies its energy resources to include a combination of renewable and nonrenewable resources to avoid relying too heavily on one resource.	The Axis powers create expansion propaganda that in reality is meant to help them gain access to energy in different regions.

Solutions

Multiple Choice

1-A; 2-C; 3-B; 4-A; 5-B; 6-B; 7-A; 8-C; 9-B; 10-C; 11-A; 12-C; 13-B-; 14-B; 15-A; 16-C

Matching Game

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