LIGHTING UP LIVES

EARTH matters
Studies For Our Global Future

introduction

For many, it's hard to imagine a life without electrical power and modern cooking appliances, as they are so central to our lives. Yet today, 10 percent of people around the world lack access to electricity and one-third of the world's people continue to cook traditionally with **biomass** such as charcoal, cardboard, and dung. This lack of adequate energy services for basic needs like cooking, warmth and lighting, and essential energy services for schools, health centers and income generation, is called **energy poverty.**

Traditional forms of energy can be detrimental to health, economic development, and the environment. Goal 7 of the **United Nations Sustainable Development Goals (SDGs)** calls for action to accelerate the transition to universal access to affordable, reliable, and modern energy. With population growth on the rise and **climate change** at the top of policy priorities, this goal will come with tremendous challenges. However, finding ways to deliver affordable, modern energy in **less developed countries** will enable more people to live healthier lives, build stronger communities, and find a path out of poverty.

Vocabulary: biomass, climate change, energy poverty, less developed countries, OECD (Organisation for Economic Co-operation and Development), United Nations Sustainable Development Goals (SDGs)

materials

Part 1

- None

Part 2

- Student Reading (provided)
- Assignment Sheet (provided)
- Role Identity Cards (provided)

Part 1: The Energy Divide

procedure

1. Ask the class to brainstorm a list of things in our lives that depend on energy.

concept

Energy poverty is a significant barrier to economic and social development, traps people in poverty, and has implications on the environment as well as the health of people across the globe.

objectives

Students will be able to:

- Define energy poverty.
- Explain why disparities in energy access exist around the world.
- Report on how energy access impacts different community sectors and specifically women.
- Create a sustainable solution to combat energy poverty within the context of one community sector.
- Effectively present their findings and solutions to classmates.

subjects

AP Human Geography, Geography, Economics, English Language Arts

skills

Analyzing data, reading comprehension, researching, synthesizing research, creating an action plan, public speaking

method

By taking on the role of a community member, students analyze how energy poverty impacts people living in Monrovia, Liberia and create an action plan for a sustainable solution.

Answers may include: *cooked food, boiled water, warmth, reliable and efficient lighting, mechanical power, transportation, telecommunication services.*

2. Write the word "Energy Poverty" on the board and ask students to hypothesize what the term means.

3. Display the charts below:

Population without electricity by region/country

Region/Country	Number of people without electricity (millions)	Percent of the population lacking electrification (%)
Developing Countries	838	13%
Africa	579	44%
North Africa	<1	<1%
Sub-Saharan Africa	578	52%
Developing Asia	155	4%
China	<1	<1%
India	6	<1%
Latin America and Caribbean	16	3%
Middle East	19	8%
OECD Countries	0	0%
United States	0	0%
World	838	10%

Source: International Energy Agency. (2020). *World Energy Outlook 2020*. [2019 data].

Population relying on traditional use of biomass

Region/Country	Number of people relying on traditional biomass (millions)	Percent of population lacking access to clean cooking fuels and technology (%)
Developing Countries	2,374	44%
Africa	853	71%
North Africa	4	2%
Sub-Saharan Africa	848	83%
Developing Asia	1,460	43%
China	242	28%
India	681	51%
Latin America	53	11%
Brazil	6	4%
Middle East	9	4%
World	2,374	35%

Source: International Energy Agency. (2019). *World Energy Outlook 2019*. [2018 data].

4. In reference to these charts, discuss with the class how access to modern energy is not distributed equally across the world. Point out the transition economies and OECD countries. **OECD (Organisation for Economic Co-operation and Development)** is an organization of member countries dedicated to economic development. This includes both North America and Europe, which both have 100 percent electrification rate and zero percent use of traditional cooking fuels.

   Part 2 of the lesson focuses specifically on electricity issues in Liberia, a country of 5 million people in West Africa. To transition from a global focus, you might share the following regional information before moving on to the country level.

   - 1 in 4 health centers in sub-Saharan Africa function with no electricity at all.[1]
   - Only 35 percent of primary schools in sub-Saharan Africa had access to electricity in 2017.[2]

Part 2: Monrovia's Energy Challenge

procedure

1. Divide the class into five groups. Distribute the Student Reading and the Assignment Sheet to each student.

2. Distribute one Role Identity Card to each group. Explain that each group represents a part of Monrovia's community and will ultimately need to present on the implications of energy poverty to their role, and how they might improve energy access.

3. Allow students time to conduct research, by either providing one or two class periods or assigning it as homework. Each student should individually conduct research on how their role is impacted when energy services, like electricity and modern cooking appliances, are limited or non-existent. Students should use the questions on their Role Identity Cards to guide their research.

   Each student should also research and design a sustainable energy plan to help improve access to energy services in coordination with their role. (Access defined as: available and affordable energy.) Examples could be related to micro-hydro power, solar powered solutions, low smoke LPG stoves, small scale wind power, etc.

4. Back in their groups, have students discuss their findings and create a presentation that a) explains some of the challenges, in relation to their role, that exist due to energy poverty, and b) suggests one sustainable solution to improve access to energy services. Advise them to use the presentation outline on their Assignment Sheet and encourage them to use charts and posters to summarize their findings.

5. Student groups share their presentations with the class.

discussion questions

1. How does energy poverty contribute to a continuing cycle of economic poverty?

   People living in poverty are most likely to be without access to power. When people are without power, they may struggle to complete schoolwork or paid work, which affects their future or current earnings. People also must dedicate more of their time to domestic chores like collecting biomass for fuel and cooking without electrical appliances.

2. What are some of the health risks associated with using traditional fuels for cooking and having inadequate electricity? Are there any subsets of the population that are disproportionately impacted by this?

   Women and girls bear the primary responsibility for fetching firewood, cooking and other domestic work, making them disproportionately affected by energy poverty across less developed countries. Inhalation of the smoke and fumes produced from burning traditional fuels results in over 4 million deaths per year, mainly among women and children. That's more deaths than from malaria and HIV/AIDS combined. Expected diseases are acute respiratory infections, lung cancer, asthma, and other diseases.

   Additionally, the lack of potable water, sanitary living conditions, and the other benefits from access to commercial energy have contributed to higher incidence of disease and mortality, especially among infants.

3. How can improved energy services contribute to improved lives for women and children in particular?

   Energy is vital to women's daily lives in less developed countries, especially serving food, lighting for teaching their children at night, energy for a small business, etc. Improved energy services could allow them to be more financially independent and also advance the health and living standards of their families.

4. Why do you think modern energy is spread so disproportionately across the globe?

   Answers will vary. Students may mention global disparities in infrastructure for producing and storing electricity or the high cost of extending power grids to rural populations. Even within a country's population, the poorest members of society are most likely to lack electricity access.

5. Some say the push to reduce fossil fuels because of climate change, while also trying to get all people access to modern energy services, can be contradicting. Why?

   The world's less developed countries are suffering from energy poverty, but they are also the most vulnerable to the policies aimed at reducing fossil fuel use, which generally result in an increased cost of energy use. There is a need to find the right balance between energy development and climate change mitigation for many of these countries.

   There is also the argument that pushing less developed countries to use less fossil fuel is hypocritical coming from the world's wealthiest nations, as places like western Europe and the U.S. were able to industrialize with almost no restrictions on their fuel use. These same countries still burn more fossil fuels than the world's least developed countries, where fossil fuel use is a tiny fraction of the expenditures in countries like the United States, Saudi Arabia, and Japan.

6. How can renewable energy play a role in eliminating energy poverty?

   Countries are shifting from fossil fuels to renewable forms of energy with massive new investments in well-known types of renewables, like hydropower, geothermal, solar, and wind. For example, in countries like Bangladesh and Mongolia, small-scale solar power is dramatically changing the lives of people in poverty, lighting up their homes with low-cost solar systems.

7. How do you think population growth will impact modern energy access in the future?

   The International Energy Agency (IEA) estimates that 660 million people will still be without access to electricity in 2030, in part owing to rapid population growth, mostly in sub-Saharan Africa and south Asia. The number of people without access to clean cooking stoves and fuels is similarly projected to drop only slightly, from 2.6 billion to 2.4 billion.

assessment

Assess the quality of students' research and presentations.

follow-up activities

1. Have students work together in the same groups to research what is already being done to fight energy poverty (e.g. SDG#7, Sustainable Energy for All, etc.).

2. Have students graph the charts from Part 1, either on graph paper or electronically in Excel or Google Sheets, to visualize the difference in access to energy between various regions of the world.

3. As homework, have students watch the documentary, Switch On (2020; Run time: 1:19), exploring energy projects across the developing world. Alternatively, select one or more episodes of Switch On: The Series (2021; Run times 15-30 minutes). Episode topics include modern cooking fuels, urban grid expansion, hydropower, and more. Dr. Scott Tinker is a geologist/energy expert who travels the world to understand the issues driving energy development in Africa, Asia, and Latin America. Lead a class discussion on what students learned.

[1,2] IEA, IRENA, UNSD, World Bank, WHO. (2021). Tracking SDG 7: The Energy Progress Report. Retrieved from https://trackingsdg7.esmap.org/data/files/download-documents/2021_tracking_sdg7_chapter_1_access_to_electricity.pdf

Monrovia's Energy Challenge

Liberia is a small country on the west coast of Africa, known for its soft sand beaches, multicultural population, and rich biodiversity. The 2021 population of Liberia was 5.2 million people and 1.5 million people live in the capital city, Monrovia.

Monrovia was once a place with sufficient access to electricity, pipe borne water, and improved infrastructure like roads and schools. However, the city was devastated by 14 years of civil conflict that only ended in 2003. Half a million people were displaced from their homes during this time and many moved to the country's capital where they built and lived in slums and informal settlements.[1]

The hydropower plant that generated electricity for Monrovia was destroyed during the war. Nearly two decades after the civil war ended, Monrovia's hospitals, schools, businesses, and households continue to suffer from complete darkness or minimal light. Currently, Liberia has one of the lowest electricity access rates in the world at 12 percent and Monrovia is only slightly higher at 20 percent electrification.[2]

The cost for the people of Monrovia to utilize electricity from the Liberia Electricity Corporation is a whopping 35 cents per kWh, one of the highest in the world.[3] To put this in perspective, the average U.S. household pays a rate of 14 cents per kWh, less than half of Liberia's rate.[4] Additionally, because 2 million people, 44 percent of the population in Liberia, live on less than two dollars a day, the high electricity cost limits most of the population's ability to access it.[5] As a result, the vast majority of the country's population is reliant upon various informal and unreliable systems of energy such as firewood, charcoal, candles, kerosene, battery-powered flashlights, palm oil, and small gasoline and diesel generators. Many of these traditional energy sources are toxic and create pollutants that have serious health consequences.

Liberia's population is expected to grow 80 percent by 2050. The unprecedented energy challenges to meet the needs of a growing population, along with concerns around fossil fuels and climate change worldwide, will continue to be at the forefront of development policy in Liberia.

By 2030, the government of Liberia aims to serve 1 million customers, connecting 70 percent of the population in Monrovia and providing access to 35 percent of the rest of the country.[6]

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[1] Hughes, A.K. (2013 February). Focus on Land in Africa Brief, Liberia, Lesson 2: Using Land Policy to Improve Life for the Urban Poor. World Resources Institute. Retrieved from https://gatesopenresearch.org/documents/3-527

[2,3,6] USAID. (2020, April). Liberia: Power Africa Factsheet. Retrieved from https://www.usaid.gov/powerafrica/liberia

[4] EIA. Electric Power Monthly, Table 5.6.A. Average Price of Electricity to Ultimate Customers by End-Use Sector, June 2021. Retrieved September 22, 2021 from https://www.eia.gov/electricity/monthly/epm_table_grapher.php?t=epmt_5_6_a

[5] World Bank. (2016). *Poverty headcount ratio at $1.90 a day (2011 PPP) (% of population).* [Data set]. Retrieved from https://data.worldbank.org/indicator/SI.POV.DDAY?locations=LR

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Research Instructions

Using the information and questions on your Role Identity Card, research and create a presentation with your group. Be sure to use multiple sources. A list of resources has been provided to help you get started.

The research will involve two parts:

a. First, research how energy poverty impacts the role when energy services, like electricity and modern cooking appliances, are limited or non-existent. Use the questions on your Role Identity Card to guide your research.

b. Second, research and design a sustainable energy program to help improve access (access defined as: available and affordable) to energy services in coordination with your role. Examples could be related to micro-hydro power, solar powered solutions, low smoke LPG stoves, small scale wind power, etc. Be creative!

Suggested Resources

International Energy Agency – https://www.iea.org/
ONE – https://www.one.org/us/issues/affordable-and-clean-energy/
Sustainable Energy for All – https://www.seforall.org/
Practical Action – https://practicalaction.org/energy-that-transforms
UN SDG, Goal 7 – https://sdgs.un.org/goals/goal7
Power for All – https://powerforall.org/

Presentation Plan Organizer

I. Introduction to your role in Monrovia, Liberia	II. How does energy poverty impact your role?	III. Sustainable solution	IV. Wrap-up and conclusion

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Family of Five

Your family is made up of a mother, father, two daughters (6 and 12 years old) and a son (10 years old).

Your family lives in West Point, the largest slum in Monrovia and uses traditional fuels like wood, charcoal, and dung to heat their home and cook meals. The children are responsible for helping their mother collect materials for cooking in the morning and in the evening. Your family also lacks reliable electricity in the home and often uses a kerosene lamp for light.

Questions:

1. Are there any health effects of using traditional biomass fuels for cooking? Who does this affect in the family the most?
2. Are there environmental impacts of using traditional fuels for cooking, warmth, and light?
3. How does having inadequate electricity in the home affect the children who go to school?
4. How do kerosene lamps impact the health and cost of the household?

Local School

You are the directors of an elementary school in Monrovia and you have limited electricity available in your classrooms and throughout the school.

Questions:

1. How does limited electricity affect classroom resources?
2. How does limited electricity impact study time?
3. Does the lack of reliable electricity impact the amount of time kids are in school?
4. How does lack of electricity play a role in retaining adequate teachers?

Community Clinic

You are doctors at a local clinic. You have little to no electricity at the clinic and you often rely on informal lighting, like kerosene lamps or open fires, for emergency light.

Questions:

1. Does lack of electricity play a role in surgical procedures or examinations at the clinic?
2. How would this impact a pregnant women or a person with an emergency operation?
3. How are vaccines or medicines impacted by lack of electricity?
4. How does limited electricity impact the clinic's medical equipment?
5. How does the use of kerosene lamps or open fires affect peoples' health at the clinic?

Small Business

You run a small food market with a store in Monrovia that has little electricity and you have to rely on a diesel generator at times to keep your business functions running.

Questions:

1. How does the lack of electricity play a role in your store's ability to generate income?
2. Are your products affected by lack of reliable electricity?
3. How do the costs of a diesel generator impact the business in Monrovia?
4. Does a lack of electricity impact the security of the store or your workers?

College Student

You go to the University of Liberia in Monrovia. Your college has electricity but it goes off and on throughout the day. At home, your electricity is even less reliable, and sometimes you have no electricity for days at a time.

Questions:

1. How does the lack of electricity affect studying at school and at home?
2. How is communication with your professors and friends affected by limited electricity?
3. How are the classroom resources affected by inefficient electricity?
4. What difficulties do you have when your electricity at home is much worse than your electricity at school?