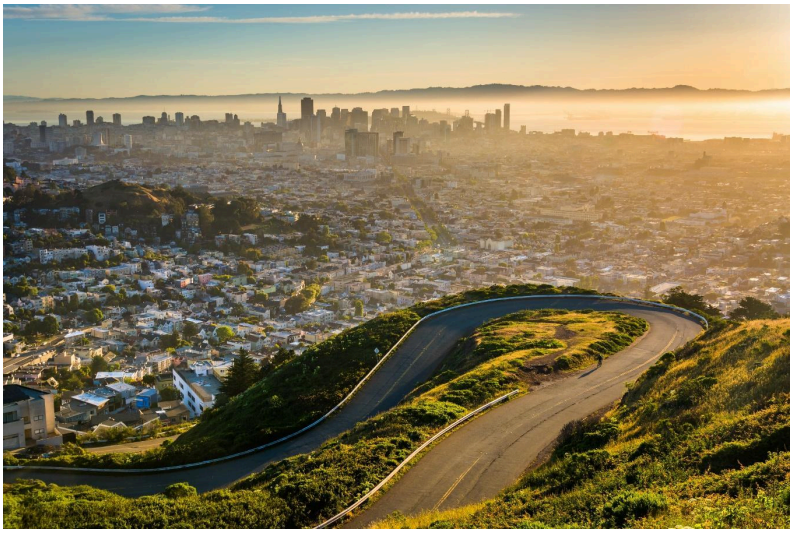
Electricity Choices: Planning for Today and Tomorrow



Learning Goals

Electricity production is a major source of the *increase* in greenhouse gases globally.

Choices made at a system level can help fight the climate crisis.

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You know climate change is a concern and that combustion of fossil fuels contributes greenhouse gases to the atmosphere. The transportation sector releases about 25% of the US's total greenhouse gas emissions. The generation of electricity releases even more: 32%. Reducing the amount of greenhouse gases produced by the transportation *and* electricity sectors would help significantly combat climate change.

Figure 1 The bright lights of San Francisco at night consume electricity. Generally that electricity can release greenhouse gases.

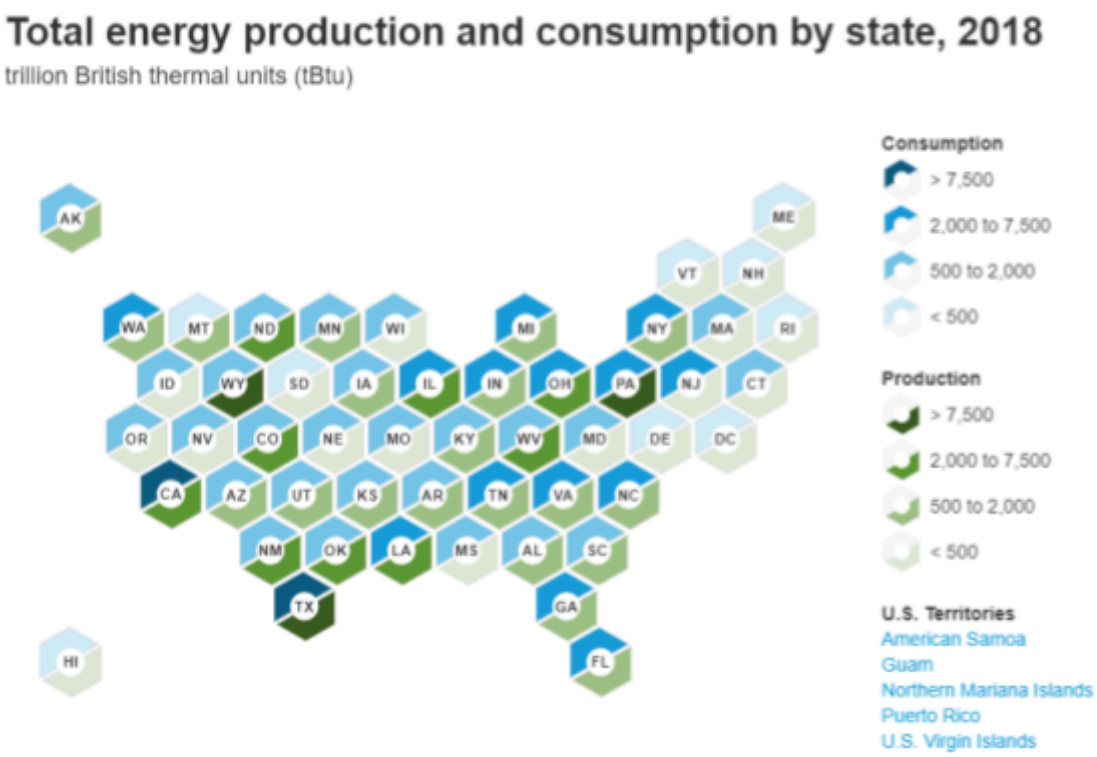
So what can you do? You'll investigate possible changes about electricity production. The small, do-able solutions that people can institute in their homes (turning off lights and power strips when not in use; turning down electric heaters at night; only opening the refrigerator door when you need some food!) are important -- but they won't solve the climate crisis. We need to think about systems change at regional, state and national scales.

Your goal is to make recommendations for large scale changes in the electricity sector in the form of an infographic. You'll learn about infographics in Part A, then create one in Part B.

Part A: The Power of Infographics

It is important to convey information to others. Sometimes that is done through a presentation, but you can't always talk directly to an audience. Instead, you have to convey information visually. What challenges does this present when you can't be present to explain or answer clarifying questions?

Figure 2 Presentations are good, but you can't always speak directly to your audience. That's when using a visual medium like an infographic can be effective.



One way to communicate visually is through something called an infographic. An infographic is designed to clearly convey information and data using graphics and limited text. But not every infographic is successful.

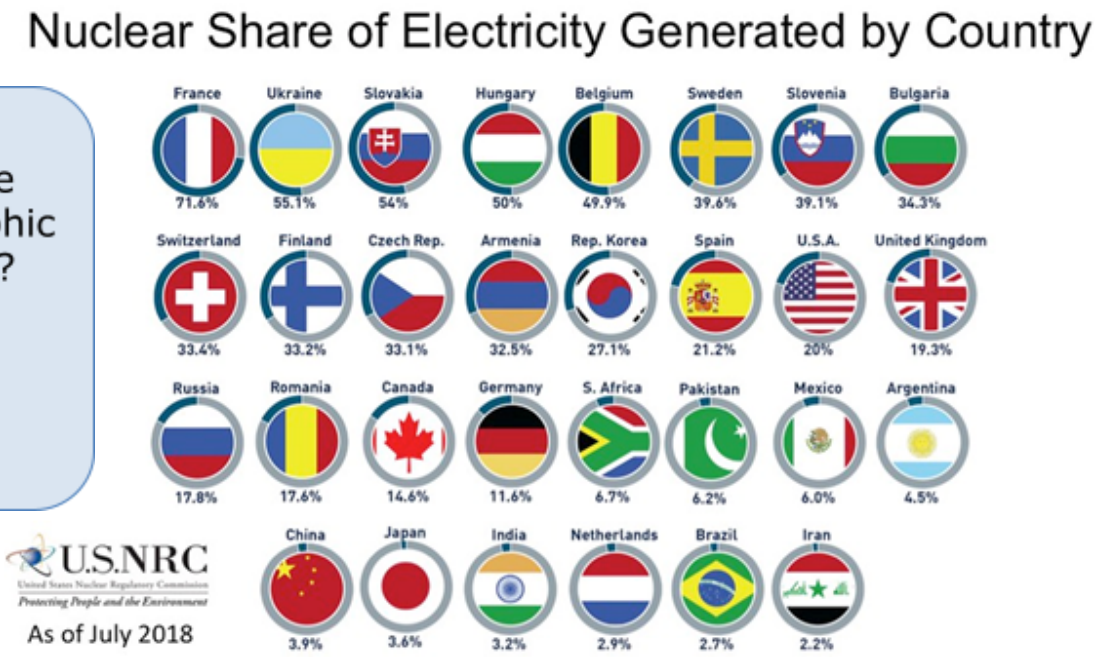
In Part A you will learn about infographics and consider what characteristics make them successful at conveying information. This will help you create your own infographic in Part B.

1. You will consider some examples of infographics on the following pages. You will use the following rubric to evaluate the infographics.

Things to Improve	Criteria	Things that are Amazing
	Text: *minimal amount of text with clear fonts, focus on graphics*	
	Color: *use minimal, complementary colors*	
	Layout: *clear and easy to follow*	
	Graphics: *Use of icons/ graphics to make the point*	

   a. To get started with using the rubric, first look at the following worked example. It shows you how you might evaluate an infographic, fill out the rubric, and suggest changes to improve the infographic.

How would you evaluate the infographic on the right? What is appealing? What is confusing?



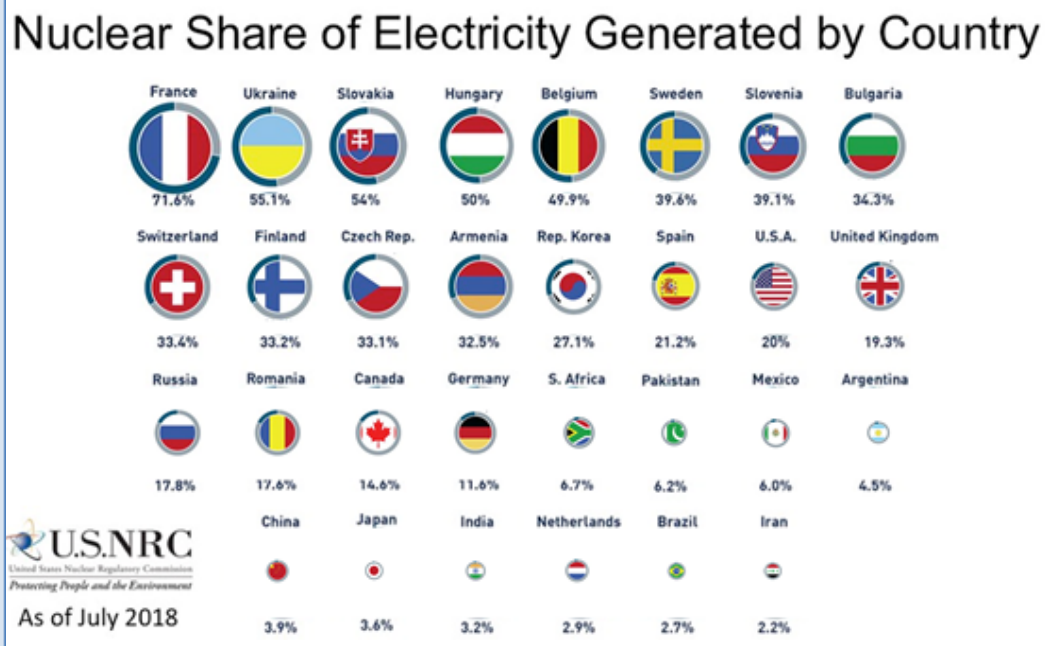
Sample Rubric:

The sample rubric on the right shows how you could evaluate the nuclear infographic.

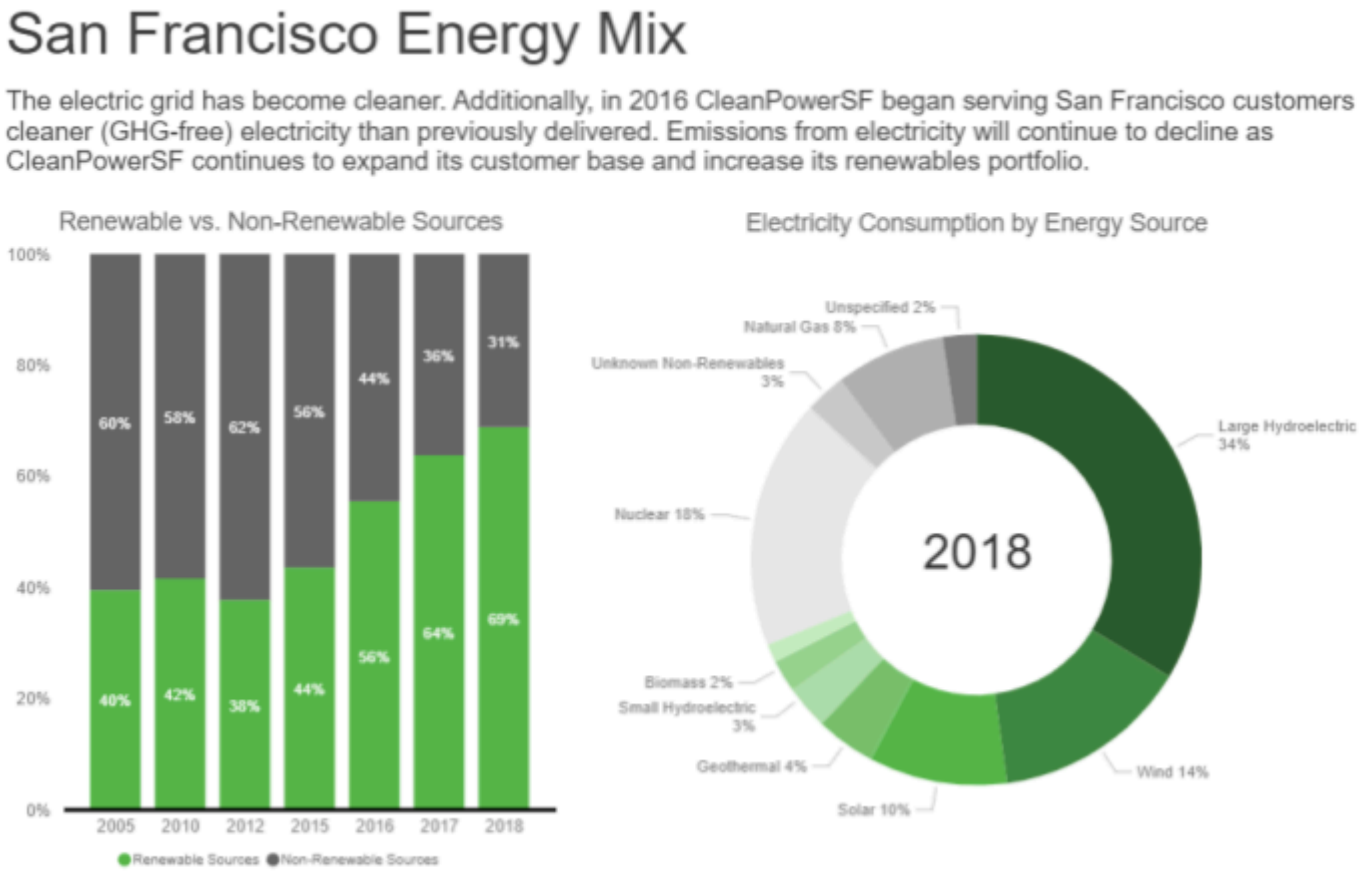
Things to Improve	Criteria	Things that are Amazing
Small text for country names and %s.	**Text:** *minimal amount of text with clear fonts, focus on graphics*	Minimal text is used.
Many different colors in flags.	**Color:** *use minimal, complementary colors*	Font all same color.
Lots going on with all of the different flags and small text. Hard to make sense of information.	**Layout:** *clear and easy to follow*	Like how it's arranged from high to low numbers.
Hard to see numbers quickly to compare countries.	**Graphics:** *Use of icons/graphics to make the point*	Like flags. Like the partial circle of blue around flag to represent the % of the energy portfolio.

Takeaway/ Next Steps: How could the infographic be improved?

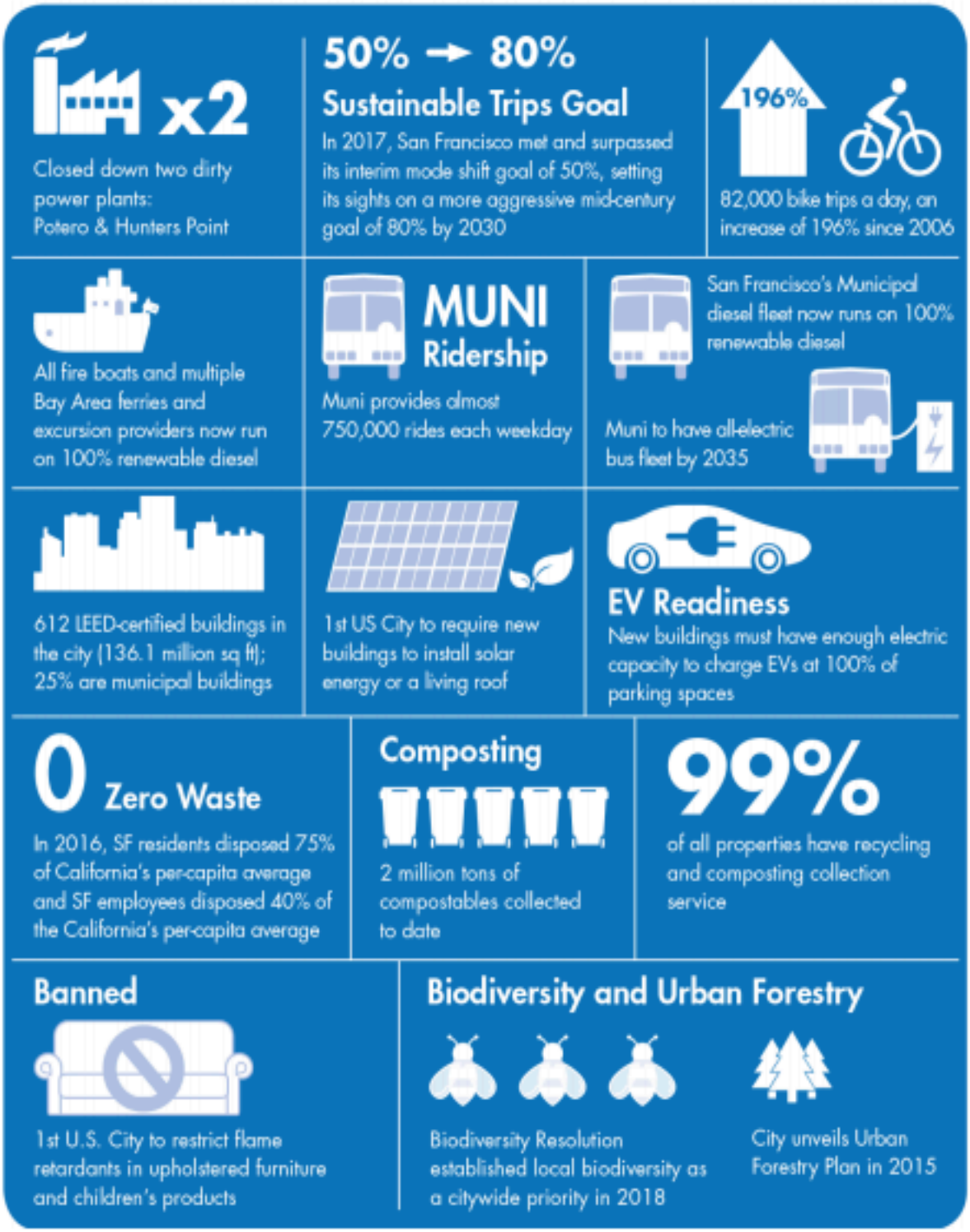
For example: What if a revised infographic used the size of the circle/flag to show the % of the country's electricity portfolio that was sourced from nuclear energy? (see example on right)



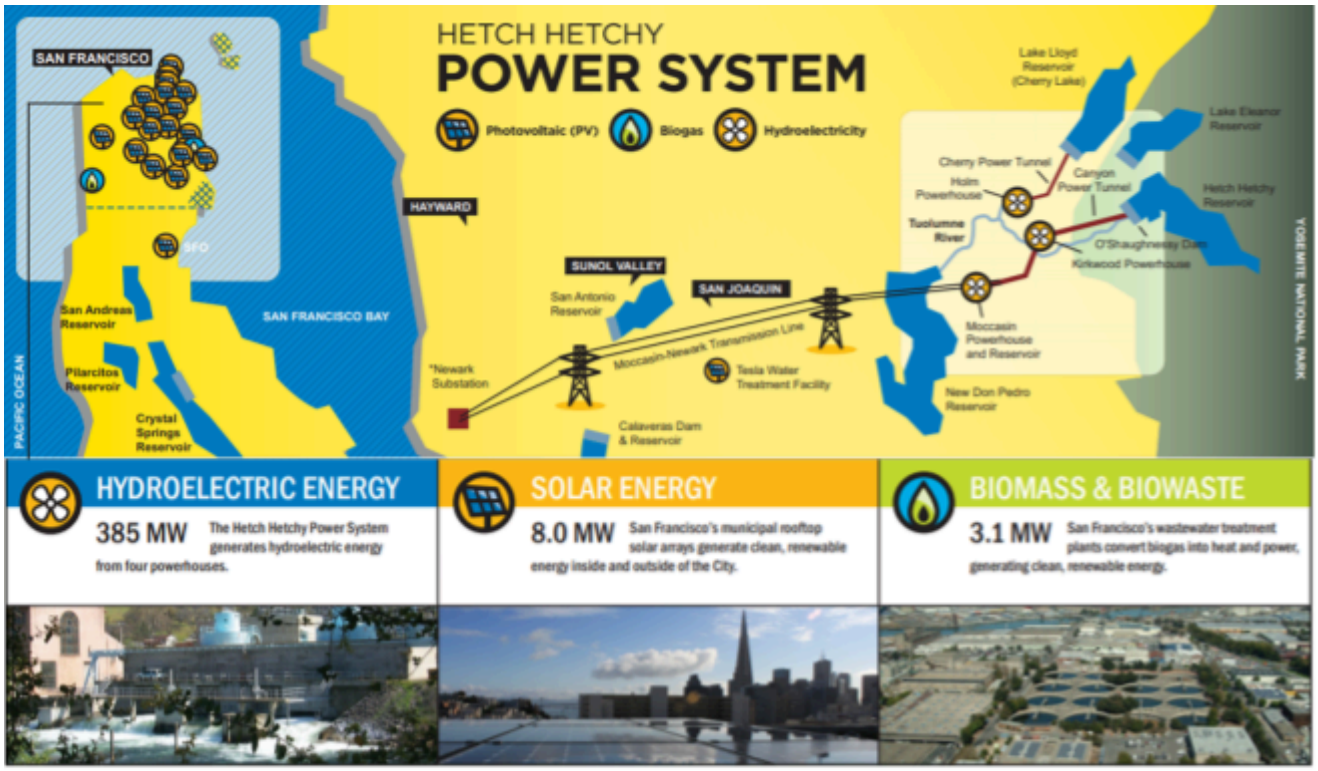
2. Now you have the chance to evaluate 3 infographics on the topics of San Francisco, electricity and climate.
   a. The 3 infographics are:
      I. SF Energy Mix
      II. SF Climate Achievements
      III. SFPUC Hetch Hetchy Power System
   b. Fill in a rubric for each example in your notebook.



I. San Francisco Energy Mix: This shows SF residents how CleanPowerSF has increased the use of renewable energy since 2005 sources and also shows the variety of sources in 2018. (https://sfenvironment.org/sf-climate-dashboard)



II. This infographic was published in July 2019 to celebrate the city of San Francisco's achievements in addressing the climate crisis. The report -- San Francisco's Focus 2030: A Pathway to Net Zero Emissions -- was developed for the Mayor's Office by the San Francisco Department of the Environment.



III. Hetch Hetchy Power System: This shows customers the different ways the San Francisco Public Utilities Commission (SFPUC) has been generating 100% greenhouse gas-free electricity from the Hetch Hetchy Power System for vital City services and facilities.

3. With a partner, choose what you think is the best infographic from this collection.
   a. Who is the intended audience of this infographic?
   b. What are the features that most successfully help to convey information and draw your attention?
   c. Do you feel this infographic is successful in communicating information to its target audience? Why or why not?

Sidebar: Researcher: Renewable energy sector needs more women and people of color as leaders

Transitioning to renewable energy can help reduce global warming, and Jennie Stephens of Northeastern University says it can also drive social change.

For example, she says that locally owned businesses can lead the local clean energy economy and create new jobs in underserved communities.

"We really need to think about … connecting climate and energy with other issues that people wake up every day really worried about," she says, "whether it be jobs, housing, transportation, health and well-being."

To maximize that potential, she says the energy sector must have more women and people of color in positions of influence. Research shows that leadership in the solar industry, for example, is currently dominated by white men.

Figure 3 The governor of Oregon (left) and CEO of Portland General Electric (right) install solar panels next to an interstate near Portland, Oregon in 2008.

"I think that a more inclusive, diverse leadership is essential to be able to effectively make these connections," Stephens says. "Diversity is not just about who people are and their identity, but the ideas and the priorities and the approaches and the lens that they bring to the world."

So she says by elevating diverse voices, organizations can better connect the climate benefits of clean energy with social and economic transformation.

Reporting credit: Sarah Kennedy/ChavoBart Digital Media.

https://yaleclimateconnections.org/2020/08/researcher-renewable-energy-sector-needs-more-women-and-people-of-color-as-leaders/

Credit: Yale Climate Connections (www.yaleclimateconnections.org)

Career Spotlight

Kiara Hermann is a Utility Analyst for SFPUC. She is working to help San Francisco meet its climate goals. She grew up between South Florida, Texas and Puerto Rico, so hurricanes were always a big part of her life. As she got older, she heard more about climate change and the risks it posed to places she held dear: stronger storms, sea level rise, and the displacement of communities she called home. Hurricane Katrina in 2005 set her on a career path tackling climate change.

She graduated from the University of Texas at Austin in 2013 with a degree in Environmental Science. She also helped run the University's radio station and hosted a call-in advice show with close friends! What she has always really enjoyed about studying climate change is that it touches every aspect of our lives and connects us with people across the globe.

In her first job, she worked on the University of California's Energy and Sustainability team supporting the development of Climate Action Plans for each of the UC campuses and the Office of the President's facilities in the US and Mexico. She also collaborated with inspiring student climate leaders to implement greenhouse gas reduction projects like minimizing food waste while tackling food insecurity on campus.

Today, as a Utility Analyst on the SFPUC's CleanPowerSF team, she uses her skills to project our city's future electricity demand as we increase the number of electric vehicles and all-electric buildings in San Francisco and help San Francisco reach its climate goal of a 100% greenhouse gas free electricity supply by 2030. We've got less than 10 years!

San Francisco Water Power Sewer

Services of the San Francisco Public Utilities Commission

Part B: Solutionaries in Action

You are becoming an expert in possible solutions to address the climate crisis. But keeping this information to yourself isn't enough, others need to know! Why? Informed members of society:

- make better individual choices
- pursue education and careers that support solutions
- are more likely to be civically engaged
- vote for candidates and legislation that support the reduction of GHGs (greenhouse gases)

You won't be familiar with all of the solutions in Drawdown. Some of the solutions might be possible here in California, but geography, population density and climate make many solutions inappropriate for our state. But climate change is a global problem, so we have to think of global solutions.

Figure 4 There are a wide variety of electricity solutions. On the left is the living roof of California Academy of Sciences in Golden Gate Park. It provides insulation for the museum below. On the right is a geothermal plant in Iceland. Geothermal power plants produce 25% of that country's energy.

Your goal is to compare and contrast 2 potential solutions and make a recommendation for the future. In order to share your ideas with a wider audience, you'll use the infographic format you learned about in Part A, where the images and text must speak for themselves. You won't be present to teach people the content. Think about some of the best infographics you've seen that taught you something new (think billboards, memes, posters). What made them so effective? Turn on your design thinking caps and get ready to get creative!

1. Learn a bit about SFUSD and its use of energy as it moves to phase out fossil fuel usage in the following reading.

Reading: SFUSD Energy

What is SFUSD's Carbon Footprint? And what responsibility does our school district have to reduce it?

What are the ways that SFUSD uses electricity? SFUSD receives its power and water from the SFPUC's Hetch Hetchy Power System which generates 1.6 billion kilowatt hours of clean, hydroelectric energy each year. As a result, the District's electricity is already 100% greenhouse gas-free (You saw this in the infographics in Part A). But the district still has a carbon footprint. As you can see, it primarily comes from heating buildings and vehicles.

GHG Emissions
FY 2019: 18,500 $mtCO_2e$

Blue = Natural Gas Heating

Yellow = Diesel and gasoline used in vehicles

SFUSD Carbon Reduction Goals

In 2017, the SFUSD School Board, with its Carbon Neutral Schools Resolution, called on the District to achieve the following targets with the goal of **phasing out fossil fuel use by 2040**:

Buildings:

- New buildings will be designed with the goal of using no more energy than they generate on site (ZNE = Zero Net Energy).
- SFUSD will strive to reduce gas usage 30% by 2020, 50% by 2030, and 100% by 2040.

Vehicles:

- All new SFUSD-owned vehicles shall be emissions-free.
- SFUSD will strive to fuel all diesel-powered buses with renewable diesel by 2020.
- All SFUSD-owned vehicles will be electric or powered by low-carbon fuels by 2030.

Figure 5 What does a ZNE building look like? Take a look at SFUSD's first Zero Net Energy building at Claire Lilienthal School on Divisadero St. It will generate all of the energy it uses on site!

Renewable Energy:

- SFUSD will strive to generate 100% of its power needs on site by 2050.

To achieve carbon neutrality in its buildings, SFUSD is focusing its efforts on

switching its heating systems from natural gas to GHG-free electricity through the installation of heat pumps. In addition to eliminating the use of natural gas, it's important that the occupants of the buildings (students and staff) understand how to operate efficient systems. This can lead to significant reductions in energy use!

Want to learn more?

- Check out SFUSD's Carbon Neutral Schools Resolution (https://tinyurl.com/SFUSD-C-Res)
- Stay connected with the SFUSD Office of Sustainability and read the SFUSD Carbon Reduction Plan. (https://www.sfusd.edu/departments/sustainability/energy)
- If your school site doesn't already have a Climate Action Plan, join other Bay Area high school students to develop yours with the Bay Area Youth Climate Summit. (https://www.baycs.org/)

2. You've learned that greenhouse gases are the main driver of climate change. To combat climate change, we need to reduce greenhouse gas (GHG) emissions. A group of scientists have researched different solutions that would decrease (draw down) the quantity of greenhouse gases in the atmosphere. They've published their recommendations on a website and through a book. Their goal is not only to STOP GHG emissions but also to REDUCE (to draw down) current GHG levels in the atmosphere.
   Go to the link https://drawdown.org/sectors/electricity and use the information to answer the questions below.

3. How much could changes in the electricity sector reduce greenhouse gas emissions globally?
4. Which fossil fuels are commonly used to produce electricity?
5. What sectors are the biggest end-users of electricity?
6. What is one change that you would suggest that would support a reduction in electricity usage to help "drawdown" GHG (greenhouse gas) levels in the atmosphere?
7. Pick one of the potential solutions at the bottom of the page, and click on the square solution tile.
   a. Make sure there are numbers at the top for:
      i. gigatons of CO_2 equivalent reduced/sequestered
      ii. net first cost
      iii. lifetime net operational savings

Note: If there are no numbers, pick a different solution.

b. Write down the range for each of the numbers from 7ya. The lower limit is if we limit the average global temperature increase to 2°C. The higher number limits the increase to 1.5°C. What should our temperature goal be?
c. Does your solution impact electricity production, efficiency or transmission systems?
d. Be sure to read all of the content -- including the IMPACT statement in italics.
e. Summarize the solution in your own words. What changes have to happen to transition between the old/current technology and this new solution?
f. What challenges do you see in implementing the solution?

Figure 7 It may not be obvious how some solutions help reduce carbon. For example, low flow fixtures help reduce carbon by reducing the need to use energy to heat and move the water used.

8. Drawdown organizes its electricity sector in two main categories -- building solutions and power sources -- though they often overlap. But which avenue is the best to pursue?
   a. Divide your team of 4 students into 2 pairs. Each pair will compare and contrast 2 solutions in Drawdown's electricity sector. https://drawdown.org/sectors/electricity
   b. You'll spend some time:
      - familiarizing yourself with new solutions
      - considering both their benefits and costs
      - making your recommendations for NEAR term and LONG term solutions.
   c. One pair should pick two solutions from the left column. The other pair should pick two solutions from the right column.

Building Solutions	Power Sources
Building Automation Systems	Biomass Power Concentrated Solar Power

District Heating	Distributed Solar Photovoltaics
Dynamic Glass	Geothermal Power
Green and Cool Roofs	Landfill Methane Capture
High-Efficiency Heat Pumps	Methane Digesters
High-Performance Glass	Micro Wind Turbines
Insulation	Nuclear Power
LED Lighting	Ocean Power
Low-Flow Fixtures	Offshore Wind Turbines
Smart Thermostats	Onshore Wind Turbines
Solar Hot Water	Small Hydropower
	Utility-Scale Solar Photovoltaics
	Waste-to-Energy

Note: Please do not pick 2 solutions that are extremely similar, like offshore vs. onshore wind turbines. Try for variety!

d. Your team's goal is to decide which solution could be implemented in the near future and which is a long term goal. You will answer these questions on your infographic.
   i. Which do you recommend that we do now at a global scale and why?
   ii. Which do you recommend that we need to plan for future implementation at a global scale and why?

9. Do research on the Drawdown website about your solutions.
   a. Go to https://drawdown.org/sectors/electricity
   b. What are the main important points you want to compare/contrast between the solutions?

10. Making the infographic:
    a. Remember from Part A what features you want to include to make a compelling infographic.
    b. You may use paper or technology to make your infographic. You may want to use the infographic template provided or start from scratch. https://tinyurl.com/C13-Infographic
    c. How will you convey the similarities/differences?
    d. How will you use size, color, and other features?
    e. Look at the rubric below to help you know what should be included.

Things to Improve	Criteria: Did you show and write about?	Things that are Amazing
	2 Energy Solutions: • *Description of each Building Solution OR Power Source Solution*	
	Numbers Comparison: • *How much CO_2 is sequestered/ reduced?* • *How much will it cost to implement?* • *How much will it cost/save over time?*	
	Recommendation: • *Which solution should be implemented first and why?*	
	Infographic Design: • *What features of the infographic help convey information?*	

11. It is important to gather feedback when designing an infographic. Gather feedback from another pair.
    a. Use the rubric to evaluate the infographic of another pair.
    b. Use T.A.G. feedback to offer suggestions to the other group.

        i. T = Tell Something you Like
            - I like how you…
            - I think your example…
            - Your graphic helped me understand…
        ii. A = Ask a Question
            - How much…?
            - Did you consider…?
            - How can you represent…?
        iii. G = Give a Suggestion
            - I think you should add…
            - You might want to change/delete…
            - One suggestion is…
    c. Use the completed rubric to help guide your feedback.

12. Look at the feedback you received and discuss with your partner what you want to improve on your infographic.
    a. Once you have revised the infographic, turn it in to your teacher.

13. Some experts suggest that we address climate change by "electrifying everything." If electricity is currently such a big contributor to greenhouse gas emissions, why is this a valid part of the solution? Use what you have learned from your research and creating the infographic.
    Hint: SFUSD is using this strategy to reduce greenhouse gas emissions.

Sidebar: Better efficiency and a cleaner grid would slash carbon pollution from buildings

The U.S. building sector could reduce its energy-related emissions nearly 80% by 2050, a new study finds.

From lighting to heating and cooling, buildings consume almost a third of the energy used in the U.S. That means they produce a lot of carbon pollution.

Chioke Harris is with the National Renewable Energy Laboratory. In a recent study, he and his colleagues found that within 30 years, the U.S. building sector could cut its energy-related carbon dioxide emissions by almost 80% over 2005 levels.

But getting there requires major changes.

"One big one is really driving energy efficiency in all buildings – residential and commercial," Harris says.

For example, high-performance windows and insulation can greatly reduce the need for heating and cooling.

Harris says it's also important to have buildings run as much as possible on clean electricity. That means shifting the grid to renewables, and then using that clean electricity to run systems that were previously powered by natural gas, such as heating and cooling.

"We have to have this sort of combined strategy: moving towards electricity, and moving that electricity towards zero carbon sources," he says. "When those happen together, then we get to the point where we can actually achieve our targets."

And that's critical for avoiding dangerous levels of global warming.

Reporting credit: Sarah Kennedy/ChavoBart Digital Media.

Figure 8 One example of an energy solution is buildings structures that create their own energy through the use of power sources such as solar panels on the roof.

https://yaleclimateconnections.org/2020/10/better-efficiency-cleaner-grid-would-slash-carbon-pollution-from-buildings

Credit: Yale Climate Connections (www.yaleclimateconnections.org)

Credits:

Picture Description	Fig #	Link	Credit Line
road in park		Link	© ESB Professional/Shutterstock.com
SF night lights	1	Link	© Engel Ching/Shutterstock.com
battery presentation	2	Link	top: © SeventyFour/Shutterstock.com
US electricity	2	Link	bottom: By U.S. Energy Information Administration - Total energy production and consumption by state in 2016, Public Domain, https://commons.wikimedia.org/w/index.php?curid=85281026
Nuclear usage		Link	By Nuclear Regulatory Commission from US - Nuclear Share of Electricity Generated by Country, Public Domain, https://commons.wikimedia.org/w/index.php?curid=65648218
SF Acheivements		Link	bottom: SF Department of the Environment
Hetch Hetchy system		Link	top: SFPUC
SF Energy Mix		Link	SF Department of the Environment
Solar panel install	3	Link	By Oregon Department of Transportation - https://www.flickr.com/photos/oregondot/2805584115/, CC BY 2.0, https://commons.wikimedia.org/w/index.php?curid=9771150
Kiara		Link	top: SFPUC
SFPUC logo		Link	bottom: SFPUC
SFUSD energy			top: Courtesy of SFUSD
Cal Academy roof	4	Link	left: By Kaldari - Own work, CC0, https://commons.wikimedia.org/w/index.php?curid=28262612
Geothermal Plant	4	Link	right: By Prosthetic Head - Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=48297823
SFUSD School	5	Link	bottom: Design by Lionakis / Technical Imagery Studios
electric vehicle	6		By RyC - Behind The Lens - IMG_1663, CC BY 2.0, https://commons.wikimedia.org/w/index.php?curid=91763762
C footprint energy		Link	top: © Cienpies Design/Shutterstock.com
EPA low flow	7	Link	bottom: By USEPA Environmental-Protection-Agency - Use low-flow WaterSense showerheads, Public Domain, https://commons.wikimedia.org/w/index.php?curid=51970421
Glass building	8	Link	top: By Jon Rawlinson - This incredible house was featured in WIRED magazine!, CC BY 2.0, https://commons.wikimedia.org/w/index.php?curid=92037660
Wind turbines	8	Link	bottom: By patano, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=58870442
Feedback postits		Link	© Momentum Fotograh/Shutterstock.com
sticky notes		Link	top: © Artur Szczybylo/Shutterstock.com
Solar Panels	9	Link	© Yong006/Shutterstock.com