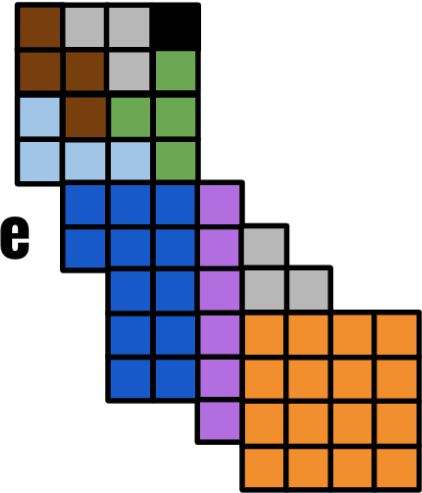


Power Play

The California Energy Game



POWER PLAY: FACILITATION GUIDE



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ESSENTIAL QUESTION:

How can consumers help California be a leader in using more renewable energy and reduce greenhouse gas emissions by changing their own behavior?

WHY WE CARE:

California has ambitious goals to use 100% carbon-free electricity by 2045. It has the opportunity to show the rest of the country and the world that it is possible to fuel a large economy in a cleaner way by using energy more efficiently and transitioning to renewables. Individuals have a role to play. We can change our behavior by using electricity more mindfully at different times of day in order to avoid using fossil fuels. Power Play's goal is to connect people to their electricity and specifically:

- Electricity comes from different sources during the day
- Renewables are intermittent (are not available at all hours)
- Energy supply (electricity that is generated) and demand (what we use) need to always match

IMPACT STORY:

Energy, and electricity, is at the core of human activities, everything we do requires it, as our bodies need food, every system requires a "fuel". It fuels our cooking, food and material production, machinery, vehicles, and our homes and places of work, yet we rarely know where that energy comes from. "Power Play" is a game where participants can visually see what energy demand looks like in California and how it gets fulfilled. Participants will understand that there are several sources for electricity and learn that there are times of day when it is "cleaner." Electricity production is a major contributor of greenhouse gas emissions. To combat this, renewable energy sources need to be deployed. The new renewable sources behave differently than traditional fossil fuels, and need to fit into the electricity grid in a new and unique way.

POWER PLAY!

Objective:

Provide a fun experience for 21-year-old+, “science curious” participants at the California Academy of Science’s NightLife events to learn about the electricity grid in California, where their energy comes from, how it is used throughout the day, and inspire them to be smart and efficient consumers. Players can connect game concepts to their own electricity use and contribute to the overall goal of making California the first state using 100% carbon-free electricity by 2045.

GUIDING QUESTIONS

- Do you know the different sources of electricity in California?
- Which sources have a greater carbon footprint or are more polluting than others?
- Do you think that the time in the day that you use electricity makes a difference in your carbon footprint?
- When is the greenest and cleanest time to use electricity during the day?
- What do you think we can do to reduce your electricity use?
- What time of day do people use the most electricity?
- Why do you think we have so many natural gas pieces?
- Are some pieces harder to use than others? Do you think some resources are harder to use than others?

MATERIALS

- 1 double-sided metallic board with legs to stand up, and wheels to be moved. Both sides have the energy demand curve as a grid where participants can place the tiles.
- 1 set of magnetic energy tiles that represents the California grid mix, through their colors and shapes (Appendix 1)
- 1 set of context cards (Appendix 2)
- 1 Timer
- 2 Key Sheets with the different tiles and points
- 2 Instructions/Facilitation guides for each team

HOW TO PLAY - for facilitators and Cal Academy staff

You are a grid operator in California. Your team’s job is to fill in the space on the board with pieces to deliver electricity to the people in California through the day.

Two people, or two teams, stand in front of their puzzle board with their set tiles and their set of context cards. They have two rounds of 5 minutes each round to finish the challenge.

1) **First round:** Timer starts and teams have 5 minutes to fill up the area under the demand curve. Each tile has the number of points people get when they play it (this information is also on the key). Renewable energies give more points. Solar energy tiles can be played only during sunlight hours (shaded in orange on the board). Teams will try to cover as much area as possible since every square they do not cover will cost 3 points (“undergeneration”). Overgeneration is possible (going over the demand curve) but is also penalized with 1 point per square overgenerated.

Compare both demand curves to see how the teams played their tiles.

COUNTING POINTS

The easiest way to count points: you have enough pieces to get 200 - teams will have to subtract the pieces that they *did not play*, and subtract their over- and undergeneration, as well.

2) **Second round:** Teams draw 5 cards from their context card deck. After reading and analyzing them, they will choose 3. Those cards present different scenarios, teams may receive new tiles, get batteries, be rewarded for using different types of energy, etc. (See Appendix 2.)

Repeat from the first round!

FINAL COUNTING POINTS

Knowing the original number of points in the *original set of tiles* = 200, teams need to add the potential new points from new pieces they chose via their context cards, and any differences in points due to the context cards they chose (ie. renewables worth double). Add the total points and compare!

The team with the most points wins!

As a facilitator, you can ask the players for feedback about the game. Ask what they enjoyed and what could be done better! Ask them what they learned and if they had fun.

If players want more information about how to contribute from home, they can sign up for “**OhmConnect**” via Cal Academy’s referral link. OhmConnect rewards people for using less electricity during hours when fossil fuel plants are generating electricity.



Before you Start

Make sure that you have the right starting pieces to match the current electricity mix in California. The number of each piece is shown in the **key**. Then, shuffle the grid improvement card deck to be used in round 2. You're ready to play!

Facilitation Guide

You are a grid operator in California. Your team's job is to fill in the space on the board with pieces to deliver electricity to the people in California through the day.

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Compare both demand curves to see how you and your competitors played the tiles.

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This is *Power Play*, the puzzle game that makes the electricity grid fun, helps players understand where their electricity comes from, and empowers them to support a greener grid.

BACKGROUND RESOURCES

- Ohmconnect.com
- [Clean Power Exchange: California Community Choice](#)
- [KQED: Why 100 Percent Clean Energy in California is Gonna be Tricky](#) (great chart of CA energy sources)

FAQs

Question	Answer
What is the electrical grid?	The “grid” is the system that generates and distributes electricity. The grid consists of different energy sources that generate electricity and the transmission network that delivers it to users of electricity.
What is the demand curve?	The demand curve is a graph of overall electricity use throughout the day. In our game, the demand curve we use represents California’s electricity use which is controlled by an organization called CAISO (California Independent System Operator)
How does the time when I charge my devices affect the use of greener energy?	The electricity grid is interesting because until just a couple of years ago, there weren’t many ways to cheaply store electricity. So the generation and use of electricity needs to exactly line up at every moment of the day. That means the electricity you use is almost always powered by the resources that are being used at that moment to generate electricity.
What sources of energy would be considered clean?	Generally speaking, we can consider sources that are renewable to be clean. Once sources

	<p>like wind and solar are installed, they keep generating electricity without any pollution or greenhouse gas emissions.</p> <p>Some sources like hydro also don't have emissions but may have big ecological impacts based on where and how they are implemented.</p>
<p>What sources of energy are not very clean?</p>	<p>Sources that are called fossil fuels are usually not clean, although not all fossil fuels are the same. When fossil fuels are burned to generate electricity they emit pollution and greenhouse gases that contribute to climate change.</p> <p>In California, our largest source of electricity is natural gas, a fossil fuel that pollutes less than other sources like coal, but still creates pollution.</p>
<p>What is the deal with nuclear energy?</p>	<p>Nuclear energy is a complicated subject! It is not renewable because it still uses a fuel, usually uranium. This fuel is really energy dense, so it creates lots of electricity with very little fuel. If done right, nuclear can be really cheap and safe. However, an accident with nuclear energy creates hazards that last for thousands of years. The most tricky part of nuclear power is what to do with the used fuel. It is dangerous to humans and stays that way for thousands of years. There is no real long term solution for what to do with that used fuel, and that creates some serious problems for nuclear energy, especially as other clean sources become really cheap.</p>
<p>Why is coal considered "bad"?</p>	<p>Coal has always been a really cheap and plentiful source of energy that can be used. The problem with coal is that it creates a lot of pollution. Lots of greenhouse gases that contribute to climate change and air pollution that is dangerous to human health. In recent years, other sources have actually become even cheaper than coal, and so the share of electricity that comes from coal has been declining.</p>

Is geothermal energy clean?	Yes! As with all energy sources, it is important to be careful about where the resource comes from and make sure that it doesn't endanger wildlife habitat or human health. Geothermal energy uses the heat from within the earth to generate electricity. Geothermal energy only exists in some places, but where it does it can be a really cheap and clean form of electricity.
What is a carbon tax?	When carbon dioxide is emitted into the atmosphere, it contributes to climate change, that has big impacts on the environment, human health, and the economy. The idea behind a carbon tax is to put a price on those emissions of carbon dioxide to offset the cost of those emissions on our society, and to encourage less emissions of carbon in the first place. Without a price on carbon, everyone would behave like their emissions have no impact, and our environment and people within society would be stuck dealing with the consequences of those emissions. In California we have a slightly different system than a carbon tax, we have a carbon market. Rather than paying a tax, emitters of carbon need to buy permits so they have the right to emit them. These permits can be sold and traded, and in the end we still achieve a way to encourage less emissions.









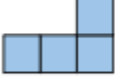

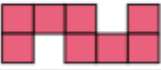




VOCABULARY

Word	Definition
Demand curve	Power Play uses the concept of an "energy demand curve" as the base for the puzzle. The energy demand curve represents the actual or forecasted amount of energy (often in kilowatt-hours) that consumers use at every hour of the day. Often, demand curves are represented as a single day.
Electricity grid	The electricity grid is the interconnected network of power plants, transmission lines, and substations that connect energy producers with customers/consumers.
Sustainable	"avoidance of the depletion of natural

	resources in order to maintain an ecological balance” (Google)
Efficient	“achieving maximum productivity with minimum wasted effort or expense” (Google)
Green energy	Green energy, or clean energy, refers to energy sources that do not emit carbon dioxide. Often, green energy is synonymous with “renewables.”
Renewables	Renewable energy is energy that is collected from renewable resources, which are naturally replenished on a human timescale, such as sunlight, wind, rain, tides, waves, and geothermal heat.
Fossil fuel energy	Fossil fuels energies include coal, natural gas, oil, that is formed from the remains of past living organisms. Burning these fuels creates carbon dioxide which is a greenhouse gas and major contributor to climate change. They also produce other pollutants that affect human health.

APPENDIX 1: Key for pieces and points

Type and number of tiles and the points you get when you play them

Key		
Energy source	Points	Pieces
 Solar 	+20	2
 Hydro 	+6	7
 Wind 	+6	6
 Geothermal	+6	3
 Nuclear	+6	3
 Biomass 	+4	2
 Offshore Wind 	+12	2 in Round 2
 Natural gas	+2	20
 Coal	-2	1
Over-generation: pieces above the line	-1	-
Under-generation: squares left empty	-3	-
 = renewable energy sources		

APPENDIX 2: Context cards



California has a **carbon tax**.

Each fossil fuel piece is **1 point less**.



Each renewable piece is worth **2 extra points**.



Demand response programs help reduce energy use.

There is **no penalty for 3 squares** of under-generation**.

**You can leave three squares empty without losing points.



Large-scale battery storage technology has improved.

There is **no penalty for 8 squares** of over-generation*.

*You can go over the line in 8 squares without losing points.

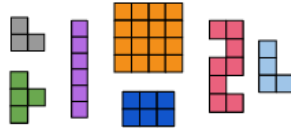


California has built an offshore wind farm. Grab **2 pieces!**



California has ambitious clean energy goals.

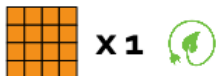
Each renewable piece, plus nuclear and geothermal, are worth **2 extra points each!**



Nuclear power plants are decommissioned. **10-point bonus** for each nuclear piece **not used**.



It's a very sunny day. Grab **1 extra solar piece!**



It's a very windy day. Grab **4 extra wind pieces!**

