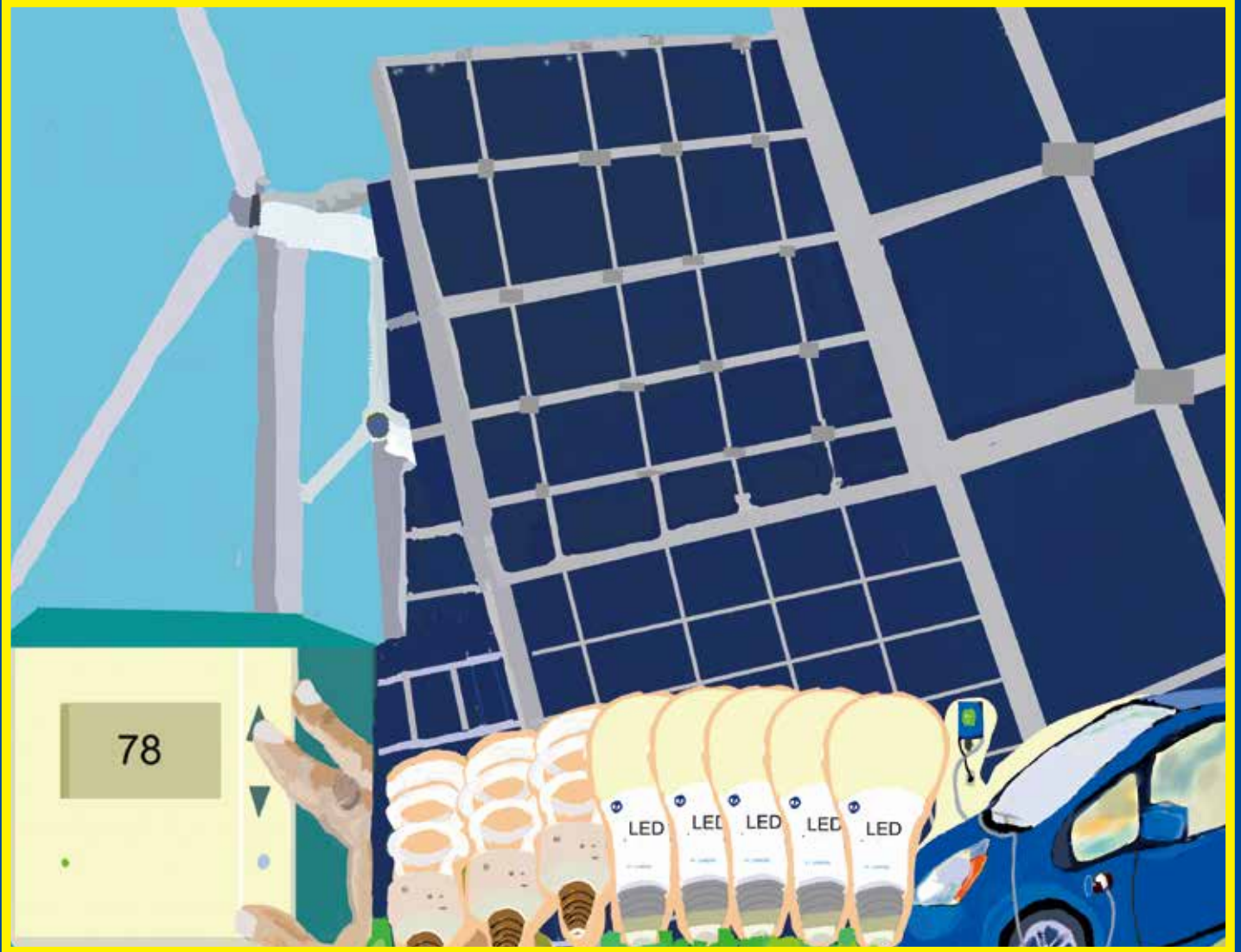


LOS ANGELES CLEAN ENERGY FUTURE



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**Judith Love Cohen
and
Robyn C. Friend**

Edited by Lee Rathbone



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Published by Cascade Pass, Inc.
4223 Glencoe Avenue, Suite C-105
Marina del Rey CA 90292-8801
Phone: (310) 305-0210
Printed in Hong Kong by South China Printing Co.

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First Edition 2015

Los Angeles Clean Energy Future was written by Robyn C. Friend and Judith Love Cohen, and edited by Lee Rathbone. Book designed and illustrated by David Katz.

This book is one of a series that emphasizes the environment and the value of preserving it by depicting what real people are doing to meet the challenges.
This is the seventh book in the series.

Library of Congress Cataloging-in-Publication Data

Cohen, Judith Love, 1933- author.

Los Angeles clean energy future / Judith Love Cohen and Robyn C. Friend ; edited by Lee Rathbone. -- First edition.

pages cm

Audience: Ages 9-13.

Audience: Grades 4 to 6.

ISBN 978-1-935999-09-6 (alk. paper)

1. Electric power production--Environmental aspects--California--Los Angeles--Juvenile literature. 2. Electric power-plants--Environmental aspects--California--Los Angeles--Juvenile literature. 3. Clean energy--Juvenile literature. 4. Energy policy--California--Los Angeles--Juvenile literature. I. Friend, Robyn C., 1955- author. II. Rathbone, Lee, editor. III. Title.

TK1005.C6183 2015
333.793'209794'94--dc23

2015035166

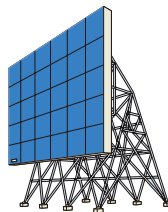
Introduction

You walk into your room after dinner to do your homework. You don't even think about what you are doing as your hand reaches the light switch and turns it on. And you never even notice that the switch responds and turns on the light.

It's so simple and so expected! But to get that electrical power to your house took a lot of planning, work, and equipment.

In this book, we talk about how Los Angeles creates and delivers the electricity we need now and how, in the future the energy will be produced in more "green" (environmentally friendly) ways with fewer disruptions in electrical service.

This is the seventh book in the Cascade Pass environmental series. Los Angeles Clean Energy Future provides an example of how electricity can be produced and delivered with less *pollution*, using *renewable resources* such as wind and *solar*.

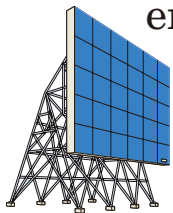


How does the electricity get to your house?

It makes a long journey, but first it has to be *generated*. What does that mean? Electricity has to be created by machines called *generators*. These machines take some kind of fuel and use it to spin a *turbine* and the turbine spins the generator, which actually converts the energy stored in the fuel into electricity we can use in our homes and businesses. The fuel can be coal or natural gas, all of which will be burned up and will create exhaust that includes some form of air pollution. In the newer, “greener” world, the machines can use sunlight or wind or heat from other sources to turn the generators and create the electricity. The generators can also be turned by water flowing downhill and spinning them. This is called *hydroelectric* power.

If you live in Los Angeles, this hydroelectric power is one of the earliest forms of electricity that came to houses about a hundred years ago. When the Los Angeles Aqueduct was built to bring water to Los Angeles, the Bureau of Los Angeles Aqueduct Power was created to build hydroelectric power plants along the Los Angeles Aqueduct.

The hydroelectric power plants were first used to provide power to build the aqueduct, but eventually with Hoover Dam, enough electricity was produced to power much of Los Angeles.



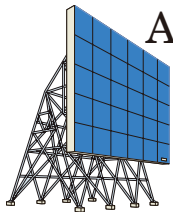


Hydroelectric Power

Today, there are many *power plants* and *generating stations* creating electricity for Los Angeles. Some still burn coal or natural gas, some are geothermal or nuclear powered, some are powered by wind, some are hydroelectric and the sun powers some.

They are located in many different areas even beyond California. There are wind farms in Washington and Oregon that are nearly 900 miles from Los Angeles and even one as far away as Wyoming. There is a coal generating station and a wind farm in Utah, and a nuclear generating station in Arizona. There are two large solar plants in Nevada along with a geothermal plant, a natural gas plant, and hydroelectric power from Hoover Dam. Between Los Angeles and the Owens Valley along the eastern side of the Sierra Nevada Mountains, there are hydroelectric plants, a wind farm, and several large solar plants. Nearly 200 miles away to the south, there are geothermal plants near the Salton Sea. Inside Los Angeles there are four natural gas generating stations, some small hydroelectric plants, and many rooftop solar power plants in Los Angeles itself.

How does all this get to people's houses? There are more than 15,000 *transmission towers* carrying 3,500 miles of power lines from the power plants to the 21 *receiving stations* in Los Angeles.



Electrical Processes



Generation



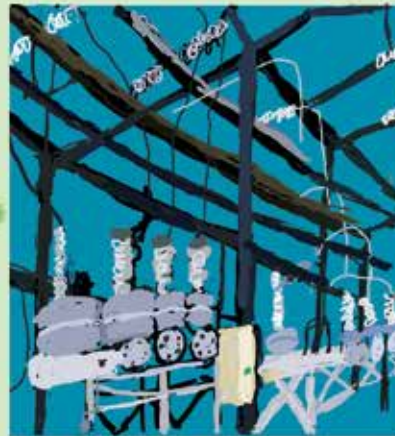
Transmission



Receiving



User



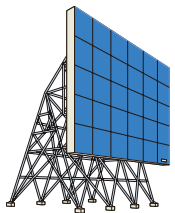
Distribution

The power that comes out of the generator is at a very high *voltage*. What is voltage? Think of a garden hose: if the hose is big and the water flow is small, we call it low water pressure. If the amount of water is big and the hose is small, or you put your thumb over the end of the hose, this increases the pressure (high water pressure).

The voltage of electricity is kind of like the water pressure in a hose. Just as water pressure moves water, voltage is the force that moves electricity. The transmission lines carry the high-voltage power to the receiving stations. These receiving stations lower the voltage so that the electricity is more usable and send the electricity to 150 distributing stations. They in turn further lower the voltage to a safe and usable level and run wires on wooden or metal power poles or underground to the businesses and factories as well as to the homes of customers.

So, power flows from the generating stations to the receiving stations and then to the distributing stations and out to the businesses and homes.

70% of this electricity goes to factories and businesses and the rest goes to people's homes.

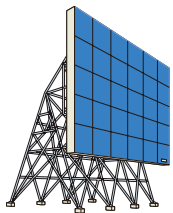


Electricity to Your House



What do we mean by “clean energy”? The atmosphere that surrounds the Earth contains the air that we breathe, including gases like oxygen and nitrogen. It also contains *greenhouse* gases such as carbon dioxide that can trap heat above the Earth. Without these gases, the Earth would be a frozen world. However, with too much of these gases, the Earth might become too warm. When we burn *fossil fuels* like coal or gasoline, *carbon dioxide* is released into the atmosphere, along with *pollutants*.

Engineers and scientists have designed special equipment that greatly reduce the harmful emissions from power plants, but there are still too many harmful emissions. When we use the sunlight or the wind to create electricity, there are no emissions like carbon dioxide or other pollutants added to the atmosphere, so we say that producing energy by hydro or solar or wind power is “clean.”



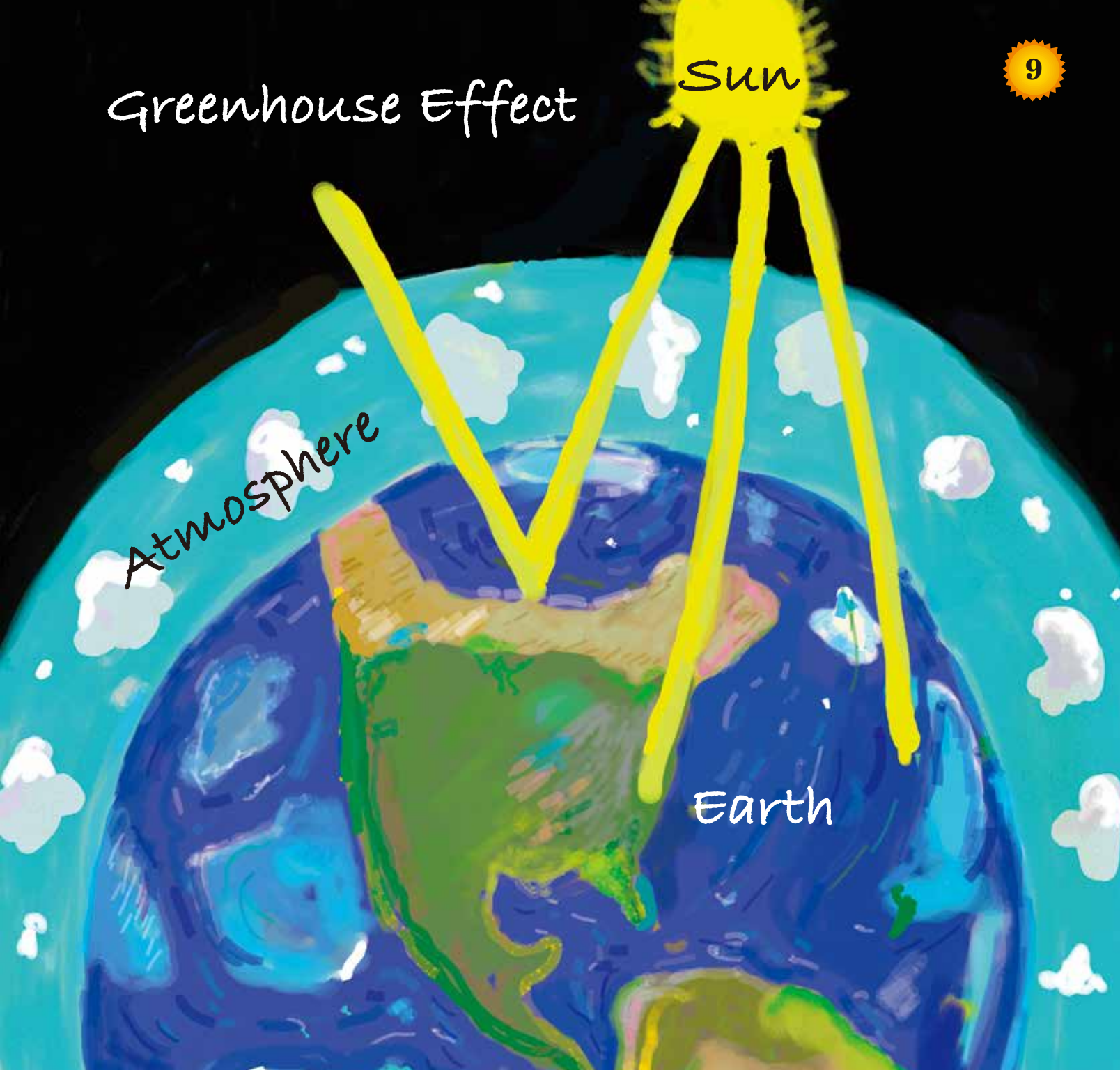
Greenhouse Effect

Sun

9

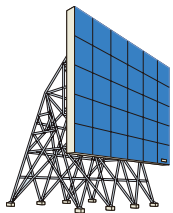
Atmosphere

Earth

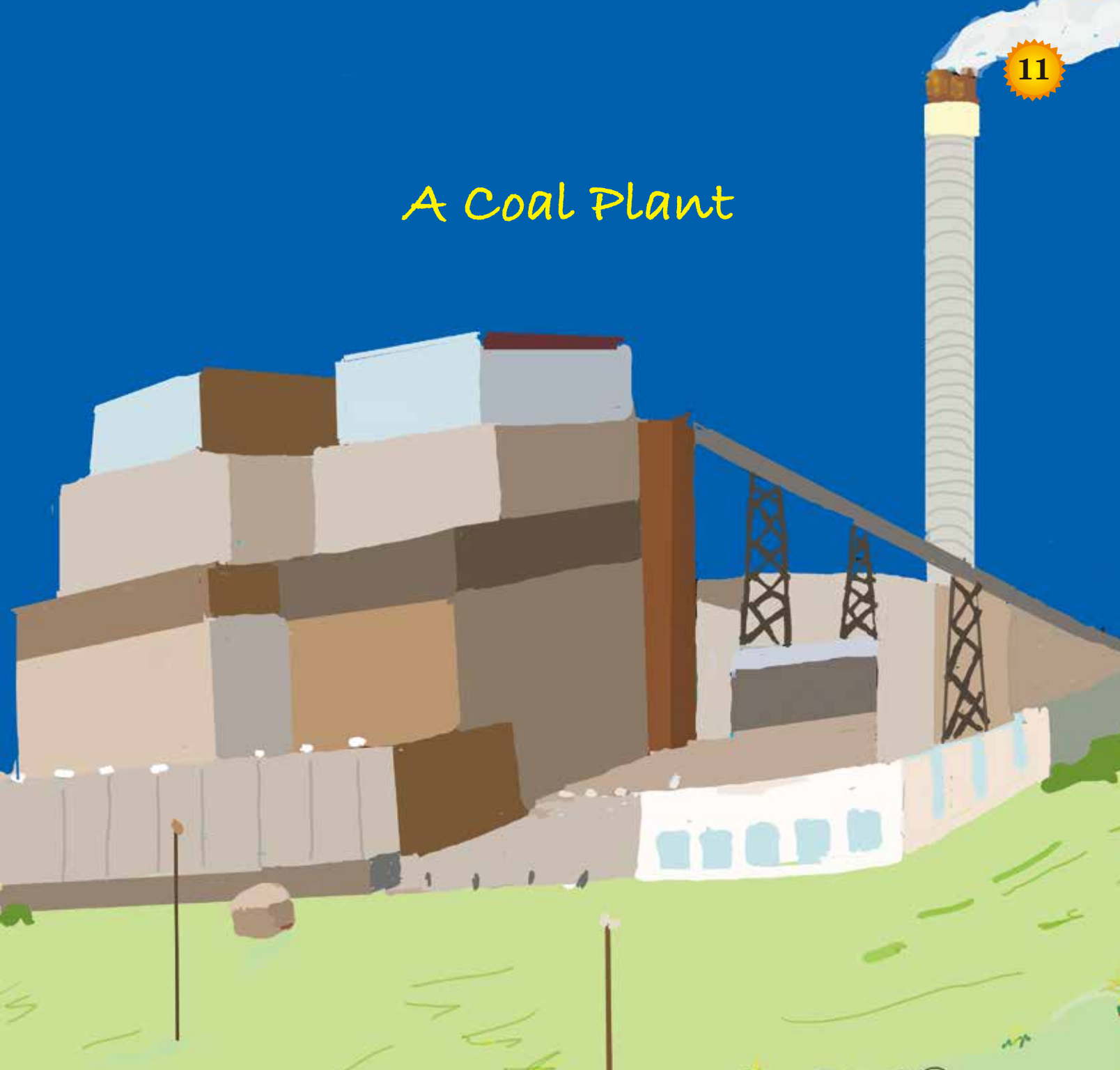


Over a billion tons of greenhouse gases are added to the earth's atmosphere every year by fossil fuel-powered electrical power plants supplying people with electricity. A large portion of our nation's electricity is produced by burning coal and natural gas, or at *nuclear plants*. The Los Angeles Department of Water and Power (LADWP) has the goal of reducing the amount of these greenhouse gases, particles, and pollutants produced during the process of producing power, by building more power plants that use renewable sources like hydro, geothermal, solar, and wind.

Also, by increasing *energy efficiency*, we preserve and improve our environment. Energy efficiency is the use of appliances such as lighting and air conditioning that use less electricity.



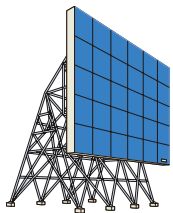
A Coal Plant



How can we stop using energy based on fossil fuels and start using greener and cleaner electricity? The LADWP has set goals to accomplish this, along with laws or mandates from the state of California. The main goals are to reduce electricity usage and increase the use of renewable energy to produce this electricity. The LADWP has plans to meet the state's current and future requirements. For example, a *Weatherization Assistance Program* provides money to help customers *insulate* their homes to reduce heating and air-conditioning energy usage. Programs to encourage use of more efficient light bulbs and refrigerators have also been in use for several years. Using less power helps the environment.

LADWP is meeting California's renewable energy requirements. For example, in the Tehachapi Mountains in Kern County in the central part of California, LADWP built the Pine Tree Wind Power Plant, the country's largest wind farm owned and operated by a public utility. Of course, some kind of backup power plants have to be available if the wind isn't blowing at a particular time.

The amount of renewable energy produced by solar, wind and geothermal facilities all is now more than 20% of the total energy delivered to Los Angeles.

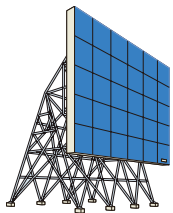




Pine Tree
Wind Farm

LADWP, to meet the state of California's requirements for renewable energy, also built their first major solar plant. In 2012 LADWP completed the Adelanto Solar Power Project in Adelanto, near Victorville in the Mojave Desert. This solar power plant produces enough electricity to power more than three thousand homes and reduces an amount of pollution equal to what two thousand cars would add.

Here also, backup power plants have to be available if the sun isn't shining, for example, when clouds block out the sun.



Adelanto Solar Project

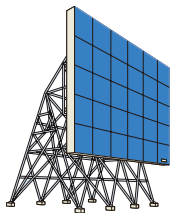


The Future

The LADWP has many plans to create a cleaner and greener power supply in the future. The current goal is to achieve 33% renewable energy by the year 2020 and 50% by the year 2030.

One of these plans is to stop using energy from coal-fired power plants. For a number of years, LADWP was getting the largest portion of its electric power from two coal-fired power plants. LADWP is now in the process of ending use of power from coal-fueled plants.

There are several ways to replace coal power including renewable power, more energy efficiency and more efficient and clean-burning natural gas to produce power.



Clean Green Energy

Wind
Power

Solar
Power

78

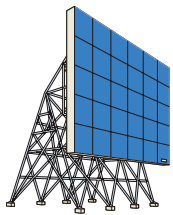
Energy
Efficiency



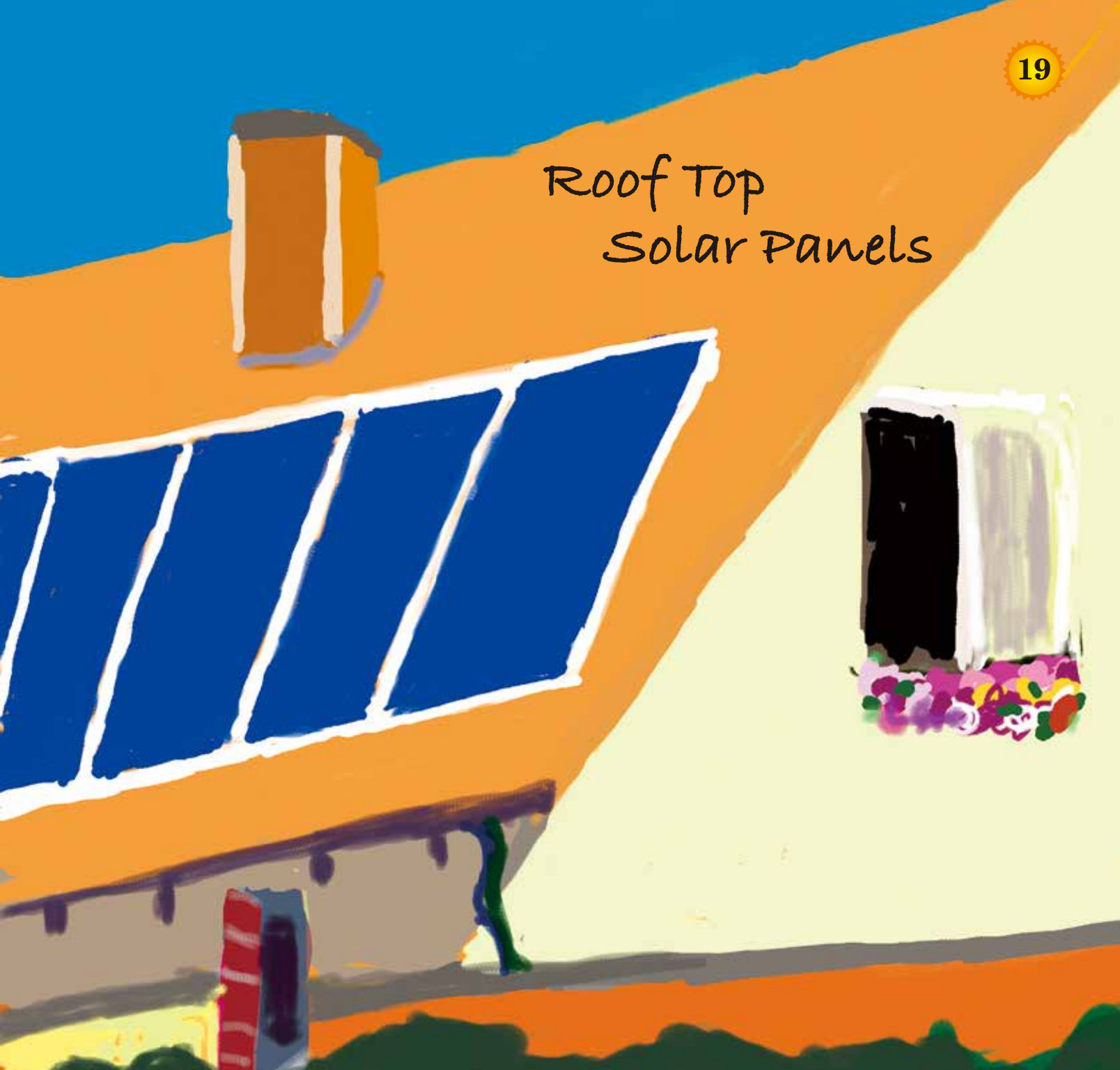
Another way to replace coal power is through renewable, clean energy, like solar power. California's sunny climate and large areas of desert are ideal for solar power plants. The LADWP is planning to build more solar power plants.

These solar power plants are expected to provide enough green energy to power 180,000 homes in Los Angeles.

Also California's climate makes it possible for individual homeowners and businesses in Los Angeles to construct rooftop solar panels, and get electricity from solar power. It is so important to build local solar projects in Los Angeles that LADWP helps its customers pay for the solar panels to be installed.

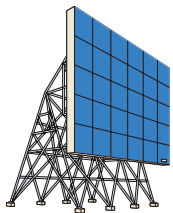


Roof Top
Solar Panels



One issue for power production is the power losses during the delivery process. When power is produced at a facility far away, like a wind farm or solar farm, it has to travel down power lines from the power plant to your house. All along that trip from the power plant to you, some of the electricity is lost in the form of heat. This is called *resistance*. A small portion of the electricity generated at the power plant can be lost on the way to its destination!

The power resources we use today such as power plants and transmission lines were developed and built over the last 100 years and it is important that we replace these items more frequently. The LADWP plans to replace more than 70% of these power resources by 2030. The generating stations that are replaced will be more fuel efficient than the old ones and the new power lines will lose less electricity caused by heat.



Replacing Pole

Transformers

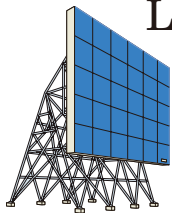


In Los Angeles, 80% of the pollution comes from transportation. Electric cars don't cause any pollution while operating since they don't use fossil fuels directly, but they can't go a long distance without recharging their batteries. The pollution caused to generate the power to recharge it depends on where the car is located. In Los Angeles, the pollution caused to generate the electricity is only 25% of the pollution that would be caused by driving a gasoline-powered car.

You would probably need to have a charger at home. Chargers can be expensive, so the LADWP helps customers pay for the chargers at home, at businesses, and in public places.

If you install a charger at your home, you can get credit from LADWP when you purchase and install it. If you also install a time of use meter you can receive an additional credit on your electricity bill!

Businesses can also get similar credits. A company can also install chargers in public places and get similar credits or incentives. These additional chargers can reassure electric vehicle drivers that they can drive farther and not worry about running out of power. This increased use of electric cars also will reduce the pollution from cars, trucks, buses, and trains in Los Angeles.





EV Charging
Station

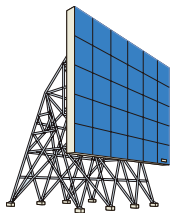
What You Can Do To Help

The LADWP is working hard to reduce the use of fossil fuels like oil and coal, to improve energy efficiency in the power grid, and to increase power production using renewable energy sources like solar, hydro, geothermal and wind farms. But there are lots of things that you can do to help, too!

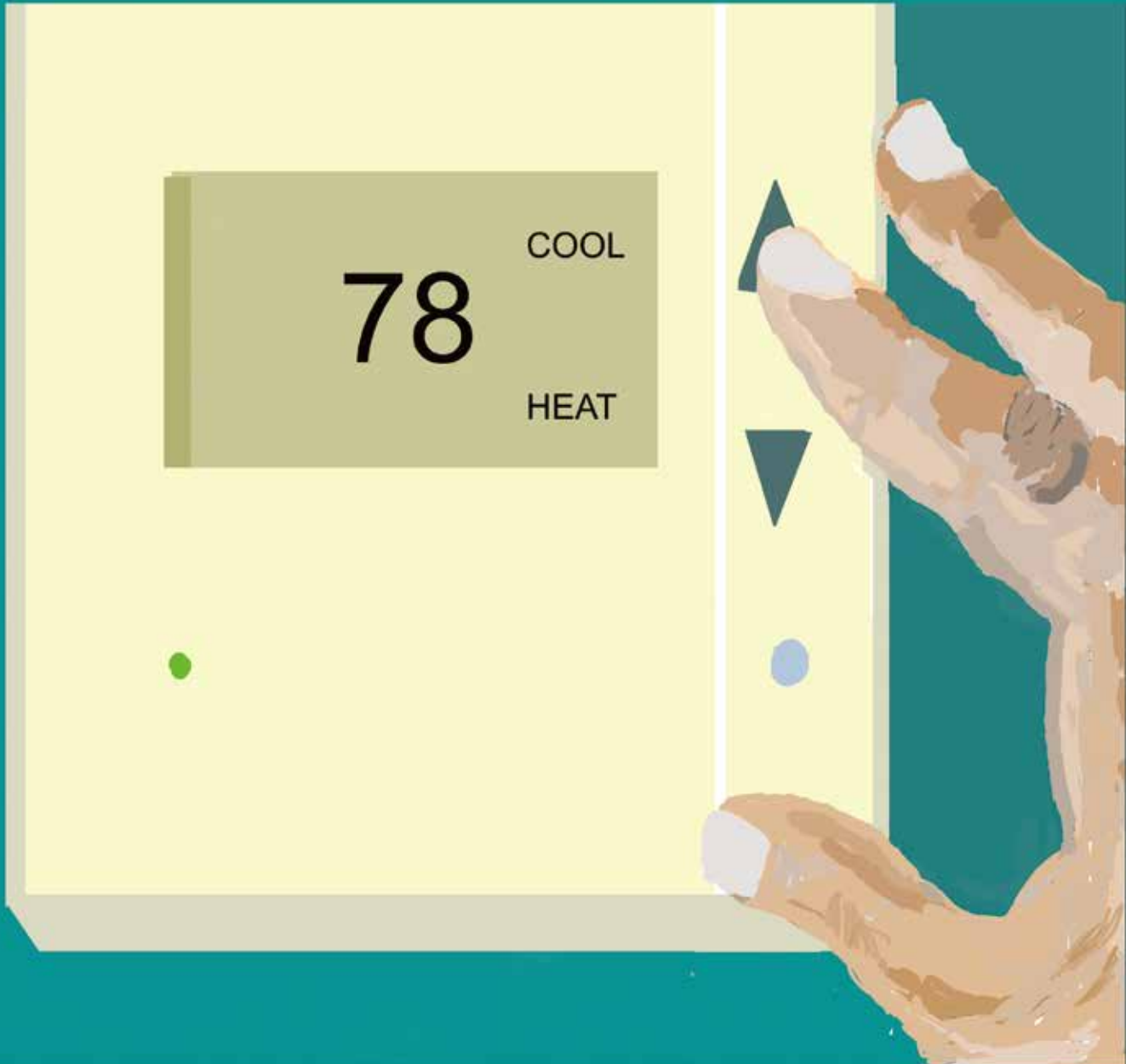
A lot of the energy used by people at home is to keep the home cool in the hot weather.

So first, in summer, you can set the air conditioner to a higher temperature.

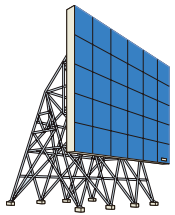
You can learn to use less electricity!



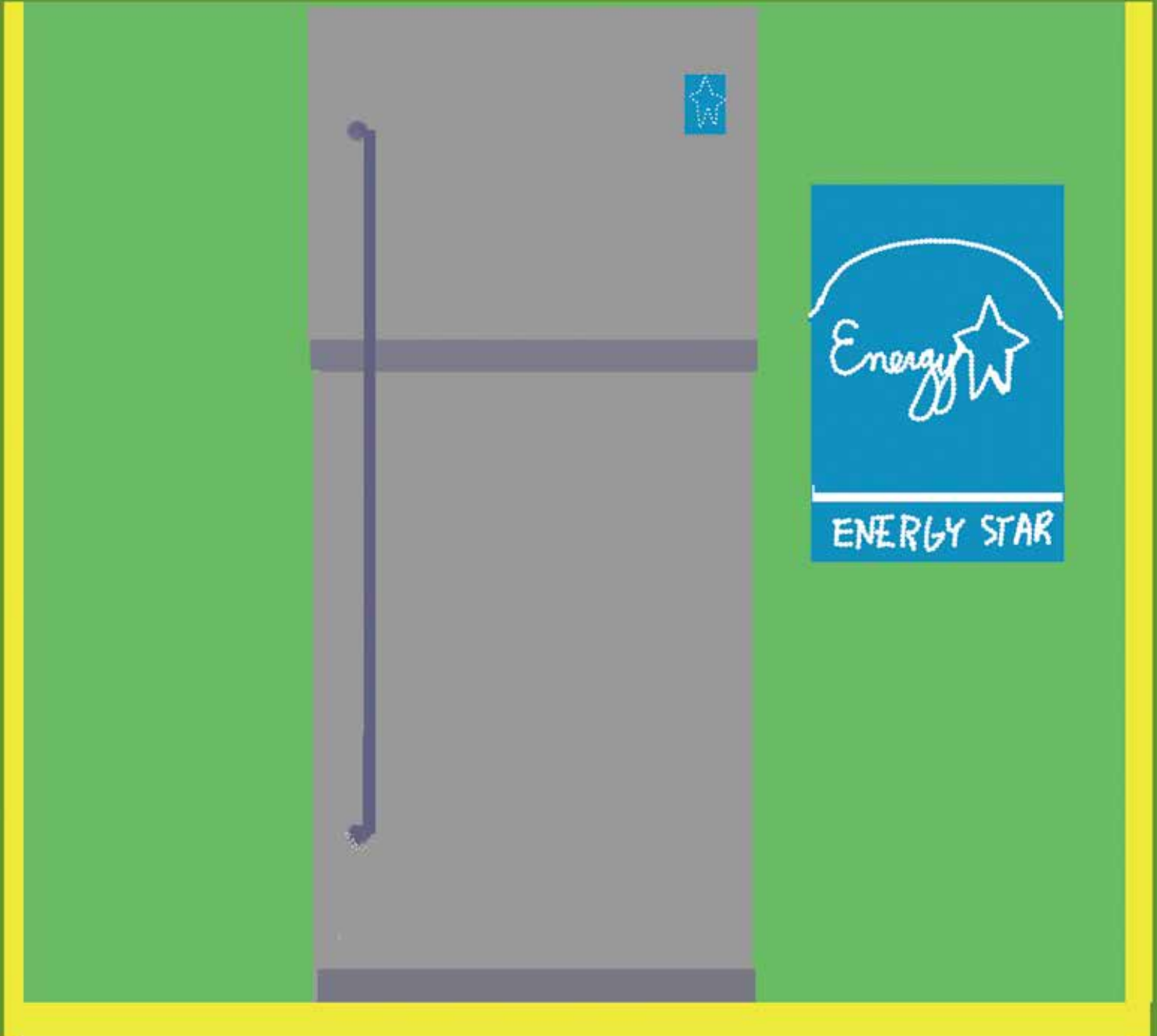
Turn Up the Thermostat



Second, when your appliances need to be replaced, be sure to replace them with energy-efficient appliances that have an Energy Star on them. These are small things to save energy, but if everyone did them, they would add up to a lot!



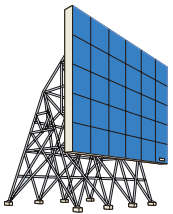
More Efficient Refrigerator



Third, you can do a lot of easy, simple things, like turning off the lights when you leave a room, and turning off the television and computer when you are done with them.

Some light bulbs use less electricity than others. You can get the older, more energy-hungry light bulbs replaced by the newer, more efficient ones. These lights also last a lot longer than the older kinds.

Providing electrical power to a large city like Los Angeles and making sure it is reliable and available when it is needed is a big responsibility. There are over 1.4 million homes, businesses, schools, and hospitals that need electrical power. Los Angeles will be making a big effort over the next 15 years so that more of its power comes from renewable energy. So the next time you turn on that light switch, remember that the power is coming from many different sources like geothermal, hydro, solar, and wind and from many different areas. Some of the power comes from many miles away. Please do your part to conserve the energy and help our environment in the ways we have suggested or other ways that you have figured out.





Replace



Light



Bulbs

Glossary

Carbon Dioxide: Carbon dioxide sometimes called by its chemical formula, CO_2 , is a colorless, odorless gas that all animals including people create when we exhale. Burning and other chemical reactions also give it off.

Energy Efficiency: Using a lesser amount of energy to perform tasks or operate machines.

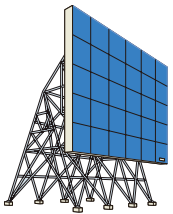
Fission: Fission is the process where a radioactive material such as radium or uranium decays giving off heat energy. This is how nuclear power is generated.

Fossil Fuel: “Fossil fuel” means things that were created by nature from decayed plants and animals (that’s the “fossil” part) that we can burn for heat and energy (that’s the “fuel” part).

Generator: A generator is like an electric motor that works in reverse. To spin the generator, a turbine is attached. When it spins it produces electricity. Most often, we convert the energy by burning fuel such as coal, which boils water to create steam that flows through turbines to drive through a generator to create electrical energy.

Generating Station: This is where the creation of thermal energy takes place. Electrical energy is produced at these plants when coal or natural gas is burned or when fission occurs creating heat and water vapor. This water vapor in turn moves a turbine, creating electricity.

Greenhouse Gas: These are the gases that produce the greenhouse effect. Water vapor is the most important greenhouse gas, followed by carbon dioxide. If we put a lot more carbon dioxide into the atmosphere by burning fossil fuels, it might raise the temperature of the Earth.



Greenhouse Effect: This is a term used to describe the effect when water vapor, carbon dioxide and other “greenhouse gases” prevent the heat of the sun from escaping from the Earth’s atmosphere, and help thereby to keep the Earth warm. It was thought to resemble the way a garden greenhouse warms the inside, thereby the name.

Hydroelectric Power: Hydroelectric power takes energy from the movement of water flowing through turbines which drives a generator to create electrical energy.

Insulate: To insulate is to use materials surrounding an area to prevent heat or energy from escaping a designated area.

Pollutants: These are substances introduced into the environment that can harm your health when breathing them and harm the environment by causing haze which reduces visibility.

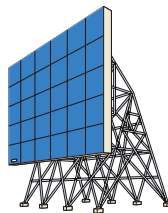
Pollution: The introduction of harmful substances or products into the environment.

Power Generator: A machine that converts one form of energy into another form. Most often, we convert the energy in fuel such as coal or natural gas into electrical energy.

Power Lines: Power lines are wires used to transport electrical power over long distances.

Power Plant: This is the place where the creation of energy takes place using renewable sources such as wind, solar, geothermal or hydroelectric. Electrical energy is produced at these plants when this energy in turn moves a turbine creating electricity.

Receiving Station: A facility where energy is received and transformed to a lower voltage before distribution.



Renewable Resources: These are resources that are replaced naturally in time and will be abundant despite being used, such as sun or wind.

Resistance: An electrical quality of a material that reduces the electricity that can flow through it.

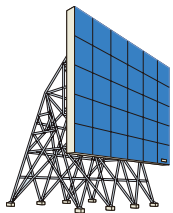
Solar: Relates to or denotes energy derived from the sun's rays.

Transmission Tower: A tall steel tower that supports power lines.

Turbine: A turbine is a machine that uses the movement of air, wind, steam or water to turn a fan-like assembly. That turning motion can be used directly to operate a machine or the pump water or it can drive an electric generator to generate electricity.

Voltage: This is the quantitative measure of the electrical potential energy. The greater the voltage means the greater flow of electrical current.

Weatherization: Improvements to the home that can save energy such as insulation and sealing cracks.



LOS ANGELES CLEAN ENERGY FUTURE

LESSON PLAN 1

PURPOSE: Electricity is made today largely by burning coal. Carbon dioxide is produced when you burn fossil fuels like coal or oil. Using wind or solar panels to drive the generators and produce the energy does not produce carbon dioxide.

This game helps to show the reduction of greenhouse gases as we change to the use of renewable energy generators versus coal burning generators.

MATERIALS: Twenty balloons or rubber balls.

PROCEDURES: Two teams of five children line up facing each other.

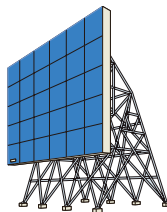
Both team have signs that say “Coal burning generators.”

Each generator will throw two balloons, which represent carbon dioxide, into the air.

Repeat with one side changing their sign to “wind power generators.” The wind power generators do not have any black balloons.

Repeat with the other side now having a new sign that reads “solar power generators.” There are no black balloons.

CONCLUSIONS: What are we doing if we replace our coal powered generators with solar or wind powered generators instead?



LESSON PLAN 2

PURPOSE: To understand what the electricity at our homes is used for and how to use less.

MATERIALS: Paper and pencils.

PROCEDURES: Have the children take paper and pencils home and write down all the things in their home that are plugged in. Some things, such as computers and TV sets that are plugged in continue to use electricity even when they are off.

How many are lights that are on?

More than half the energy comes from heating and cooling the indoors and warming water.

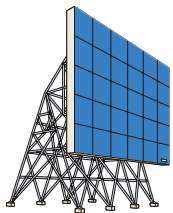
Have the children find the thermostat at their home and see what temperatures it is set at to heat or to air condition.

Have the children share their lists and figure out ways to save on the electricity use at home.

Have the children invite the custodian or plant manager to the classroom to discuss ways to save electricity at school.

CONCLUSIONS: Most of us can find a few ways to save on the electrical energy we use at home and at school.

RESOURCES: Pictures of energy saving light bulbs and regular light bulbs.



ABOUT THE CONTRIBUTORS:

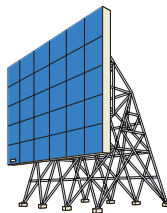
Robyn C. Friend, author, is a singer, dancer, choreographer, and writer. She earned a Ph.D. in Iranian Linguistics at University of California, Los Angeles, and promptly launched a twenty-year career building spacecraft. She has written for both scholarly and popular publications on a wide variety of subjects, including folkloric dance, world music, linguistics, travel, and the exploration of Mars by balloon.

Judith Love Cohen, author, is a Registered Professional Electrical Engineer with bachelor's and master's degrees in engineering from the University of Southern California and University of California, Los Angeles. She has written plays, screenplays, and newspaper articles in addition to her series of children's books that began with *You Can Be a Woman Engineer*.

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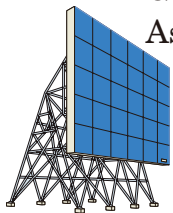
John R. Dennis, contributor, is the Director of Power Planning & Development Division. He received a BS degree in Mechanical Engineering from California State University, Northridge and has been with LADWP for 33 years in the planning, design, construction, and operation of power system facilities. He is married with 4 children and 3 grandchildren.

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ACKNOWLEDGEMENTS

Graphic materials created by **Kana Tatekawa**, graphic designer of Tatekawa and Associates.



TOGETHER WE ARE BUILDING OUR FUTURE!



The Los Angeles Department of Water and Power and our employees have partnered with schools, teachers, students and parents for more than four decades on numerous award-winning and nationally-recognized programs and activities to enhance learning and help young people prepare for future careers.

We continue to assist schools and our communities now and will do so in the future.

We are excited to have been involved in the development of this book to help young people better understand energy, renewable sources and the importance of conservation.

For further information about programs and activities we offer for young people in the City of Los Angeles, go to www.ladwp.com/education



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Los Angeles Clean Energy Future by Judith Love Cohen and Robyn C. Friend tells the story of how Los Angeles creates and transmits the electrical power we need now and how, in the future, the energy will be generated in more “green” ways and reliability will be improved.

This book is one of a series that emphasizes the environment and the value of preserving it by depicting people and organizations who are working to improve the health of our planet. *Los Angeles Clean Energy Future* provides an example of how energy generation and distribution can be made to use less carbon, using renewable resources, while improving usage.



Robyn C. Friend



Judith Love Cohen

