The Middle Schoolers Guide to Renewable Energy

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INTRODUCTION

Every year EARTHDAY.ORG sets the theme for Earth Day, which is marked every year on April 22. Next year we have chosen a theme called—Our Power, Our Planet, championing renewable energy.

Renewable energy is energy that will never run out, like **solar**, **wind**, **geothermal**, **hydroelectric** and **tidal**. This booklet is a guide to each energy source and how they can help us generate electricity.

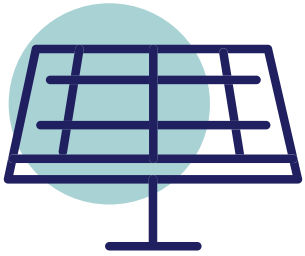
If you are an educator and want to join the EARTHDAY.ORG network, consider supporting our mission to put climate education into every single classroom around the world and please utilize more of our free resources on climate education and why it matters here.

If you are a teacher in the K – 12 grades please consider utilizing our free guide, The School Guide to Teaching Climate Education, because you can never start teaching students about climate change early enough!

01

BRIGHT IDEAS WITH SOLAR ENERGY

WHAT IS SOLAR ENERGY?



When you stand in sunlight and it heats your skin, that is solar energy. Have you ever thought about how we can use sunlight to power our schools? That's what solar energy is all about! Solar energy uses sunlight to create electricity or warm air and water. Here's how:

- **Solar Panels:**[1] These are special flat panels designed to catch sunlight and turn it into electricity. They're usually found on rooftops or in big fields. When sunlight hits the solar cells in the panels, it creates an electrical current that powers things like lights and computers in schools!
- **Solar Heating:**[2] This method uses sunlight to heat water or air. Special devices called solar collectors absorb sunlight and warm it up. This means schools can have hot water for showers or keep classrooms warm without using as much electricity or gas.

So, even though solar panels and solar heating both use sunlight, they do different things. Solar panels make electricity, while solar heating creates hot water and warm air!

Solar energy is great for schools because it helps save money and keeps the air clean. Why? Well because solar doesn't create harmful gases like carbon dioxide or methane, which come from burning fossil fuels like coal and oil.

These gases can trap heat in the atmosphere around our planet, causing climate change, which makes our planet warmer and can lead to extreme weather. They can also cause air pollution, making it harder for us to breathe and affecting our health.

SCHOOLS GOING SOLAR

Many schools are now using solar energy. For example, in California, lots of schools have installed solar panels. This helps them save a lot of money on electricity bills and teaches students about being kind to the Earth.

California is a leader in using solar power. Nearly 2,500 schools[3] there have solar panels! Schools like the San Diego Unified School District[4] are saving millions of dollars and showing kids how solar energy works.

It's not just schools in California that are using solar, but all across the U.S. In Aurora, Illinois West Aurora High School[5] makes the same amount of energy as almost 3,000 pounds of methane and helps reduce CO_2 pollution just like planting 806 trees. In Massachusetts, Murray Elementary School[6] has installed solar panels that provide enough energy to power the entire school. In 2010, in Colorado, Denver Public Schools[7] launched a massive solar project, aiming to have solar panels in all their schools. It has been very successful, covering about 10% of their energy needs and saving the district 7% of their energy costs.

These schools are just a few examples of how solar energy is lighting up the educational landscape across the United States.

By using solar energy, we can help fight climate change and protect our Earth for future generations. So, when we power our schools with sunlight, we're not just saving money; we're also making the world a better place!

AWESOME SOLAR SCHOOLS AROUND THE WORLD

Here are some schools from different places that use solar energy or teach their students about it:

- **The Green School (Bali, Indonesia):**[8] This school is one of the most sustainable there is, and solar power is a big part of that. Students at this school got to help install their solar panels and learned how they work in the process!
- **Richard Montgomery High School (Maryland, USA):**[9] This school has solar panels on its roof that power the school. This has covered almost half of their energy needs while saving the school money – a win-win.
- **Danish School of Education (Denmark):**[10] This school has solar panels covering the entire building- like diamond Minecraft armor! Not only does the school look like a cool art piece, but this gives students the chance to learn lessons about solar energy and helps students understand how it can help the Earth.
- In Australia, **St. Andrew's Cathedral School**[11] in Sydney has a solar system that generates over 100,000 kWh of clean energy annually.
- Meanwhile, in India, **The K. C. Mahindra Education Trust**[12] supports solar-powered schools in rural areas, helping to provide electricity to over 10,000 students who previously had limited access to resources.

By harnessing the power of the sun, these schools are not only saving money but also inspiring the next generation to care for the planet!

LEARNING ABOUT SOLAR ENERGY

Schools that use solar energy are also able to really teach students[13] all about it. Kids get to do fun projects, like building small solar-powered cars or learning how solar panels work. By having solar around them, students can gain a deeper understanding of how it works and build "Green Muscle Memory".[14] Let's build those muscles to save the Earth!

SOLAR IS TAKING OFF GLOBALLY

Almost 5%[15] of all energy from around the world comes from solar power. Places like the United States and Germany are using a lot of solar power to help the planet. But it is China[16] that is leading in solar energy. As time goes on, we are going to get more energy from solar; it is the fastest growing energy source.[17]

Of course, solar energy isn't perfect. Making solar panels can use materials that need to be handled carefully, and sometimes the sun doesn't shine, which can make it a bit tricky. But solar can power a lot without polluting the environment[18] like fossil fuels do.

WRAPPING UP ON SOLAR ENERGY

Solar energy is a fantastic way to use sunlight to make electricity. Schools all over the world are using this cool technology to save money and teach kids about being eco-friendly.

By learning about solar energy and using it in our schools, we can help create a brighter and cleaner future for everyone!

02

WIND POWER: BLOWING IN THE BREEZE

WHAT IS WIND ENERGY?

Have you ever felt the wind blowing through your hair? Well believe it or not that wind can be turned into electricity!

Big machines called wind turbines help capture the wind's power. Most wind farms, where many turbines are found, are on land, but some are built in the ocean too! There are two main types of wind turbines:

- **Horizontal-axis turbines:** These are the tall ones that look like giant fans.
- **Vertical-axis turbines:** These look like spinning egg beaters!

HOW DO WIND FARMS WORK?

The electricity a wind farm can make depends on two things:[1] how fast the wind blows and how many turbines are on the farm. The more wind and the more turbines mean the more electricity! It's like having more friends to help you blow up a lot of balloons—more wind equals more power!

A LEADER IN WIND ENERGY

Germany[2] is a superstar when it comes to wind energy! By the end of 2023, they had over **28,677 wind turbines**[3] on land, producing enough electricity to power 50 million homes. That's like lighting up a whole city! Germany also has **29 wind farms**[4] offshore, in the ocean, making them one of the top countries for wind energy.

LEARNING ABOUT WIND ENERGY

In Germany, schools and universities are teaching students all about wind energy. Students can choose special degrees focused on wind power, especially at places like the University of Bayreuth.[5] Other schools like the University of Oldenburg and Leibniz Universität Hannover also offer degrees related to wind energy.[6] You can become a specialist in wind energy!

COOL SCHOOL PROJECTS FOR A GREEN FUTURE!

To help save energy, schools in Germany are getting creative! One project called Clever fürs Klima[7] helps schools reduce their energy use by at least 10% each year. Another project, Halbe-Halbe,[8] rewards schools that save energy with money back! In one school year, 14 schools saved 40,000 euros, which they could use for fun new projects!

WIND ENERGY IN U.S. SCHOOLS TOO!

In the United States, wind energy in schools is picking up some speed too. Over 30 states, more than 100 schools[9] are already using wind energy systems.

Globally, there are also many schools that utilize wind power. In New Zealand, **Raglan Area School**[10] is powered by wind, inspiring students and community members alike to think about innovative ways to create a cleaner, greener future!

By using wind energy, these schools not only help the environment but also save the school money while teaching students about important topics like clean energy, engineering, and science!

THE FUTURE LOOKS BREEZY!

The world is getting really good at using wind energy, and that's super exciting! When we harness the power of the wind, we help our planet in many ways. First, wind energy doesn't create any smoke or pollution, which means we get to breathe cleaner air. This is important because it helps keep us healthy!

Plus, using wind energy helps fight climate change, a big problem that makes our weather change in strange ways. By reducing the bad greenhouse gases that can harm our planet, which are created by old fashioned fossil fuels, we're making sure it stays beautiful for you and future kids. And guess what? Building more wind farms also creates jobs for people, giving them new opportunities! So, by investing in wind energy, we're not just helping ourselves today; we're taking care of the Earth for tomorrow!

So, next time you feel the wind, remember—it's not just for flying kites; it's also powering our homes and your schools!

EARTH'S SECRET ENERGY: GEOTHERMAL!

WHAT IS GEOTHERMAL ENERGY?

Geothermal energy is a type of renewable energy that comes from the heat inside the Earth. The word "geothermal" means "Earth's heat," with "geo" meaning earth and "thermal" meaning heat.

The Earth gets really hot—about 1,000 °C[1] near the crust and even hotter as you go deeper! This natural heat can be used to generate electricity and power our homes and schools.

WHY IS GEOTHERMAL ENERGY GOOD FOR THE PLANET?

Geothermal energy is great for our planet for several reasons:

- **Cleaner Air:**[2] It produces very little pollution or greenhouse gases (GHG). This helps keep our air clean and it is important for fighting climate change, which is when the Earth gets warmer and causes problems for our environment.
- **Always Available:**[3] Geothermal energy is renewable, meaning we can keep using it without it ever running out, unlike the fossil fuels of oil, gas and coal. The Earth's heat will always be there!
- **Reliable Energy:**[4] Geothermal energy provides a steady supply of power,

even when the sun isn't shining or the wind isn't blowing. This helps keep our lights on!

- **Local Jobs:**[5] Using geothermal energy helps create jobs in local communities, so people can work and support their families.

By using geothermal energy, we can meet our energy needs while also taking care of our planet for the future!

THE RING OF FIRE

A special place to find geothermal energy is called the **Ring of Fire**.[6] This is a big area that circles the Pacific Ocean and is known for having many volcanoes and earthquakes. It's like a giant ring made of several pieces of the Earth's surface that fit together, called tectonic plates.

When these tectonic plates meet, they can create cracks in the Earth, letting us access the heat inside. The Pacific Ring of Fire is a part of this area and is famous for its volcanoes, which provide a lot of underground heat.

Countries like the Philippines and Indonesia are great at using this geothermal energy because they have many volcanoes that help produce it.

GEOTHERMAL ENERGY IN SOUTHEAST ASIA

Southeast Asia has a lot of geothermal energy—about 25%[7] of the world's total! Most of this energy comes from the Philippines and Indonesia.

One way this works is through geothermal heat pump systems. In winter, these systems pull warmth from the ground to heat buildings, and in summer, they do the opposite.

This energy helps these countries have a strong supply of electricity and build better roads, schools, and other important things. For example, the Philippines gets about 12%[8] of its energy from geothermal sources and plans to double that by 2040!

HOW GEOTHERMAL ENERGY POWERS SCHOOLS IN THE US TOO!

Geothermal energy is also making a difference in schools around the world! Here are some exciting examples:

- **Carleton College**[9] in Northern Minnesota uses geothermal heat pump systems. They expect to reduce their energy use from fossil fuels by 40% as a result, which means lower bills and more money for student activities!
- **Davis School District**[10] in Utah has implemented geothermal systems in several of their schools. These systems help save about $1 million a year in energy costs! That money can be spent on new books and sports equipment.
- **Texas A&M University**[11] has also gone green with geothermal technology. Their systems help reduce energy use and provide hands-on learning opportunities for students studying renewable energy.

Globally, a small percentage of schools are using geothermal energy right now, but this number is growing![12] Many countries are starting to realize the benefits, and with more awareness, we can see even more schools switching to this clean energy source.

LEARNING ABOUT GREEN ENERGY

Schools can use geothermal systems to save money but also to teach students about renewable energy technologies. This approach has worked well with solar energy. In fact, as of recent reports, about 7% of schools in the U.S.[13] use solar energy to power their facilities. This percentage is growing rapidly as more schools recognize the benefits of renewable energy.

Globally, the adoption of solar energy in schools varies by region, but recent estimates suggest that thousands upon thousands[14] use solar power. This includes significant numbers in countries like India, where many rural schools benefit from solar installations

By using renewable energy in schools, students gain valuable knowledge about energy conservation and sustainability. Schools that integrate solar energy not only save on energy bills but also create hands-on learning opportunities, helping students understand how clean energy works and why it's important for the environment.

THE FUTURE IS GREEN!

Imagine a future where students learn how to harness the Earth's heat, design solar panels, or build wind turbines. These lessons can empower young minds to innovate and tackle the challenges of climate change and consider a job in the green economy.

With hands-on experiences in renewable technologies, students will not only be prepared for exciting careers but also become stewards of the environment.

Investing in education today means a brighter, cleaner tomorrow for all. Together, we can lead the way toward a more sustainable world!

04: WATER WORLD: HYDRO-POWER

MAKING WAVES WITH HYDROPOWER

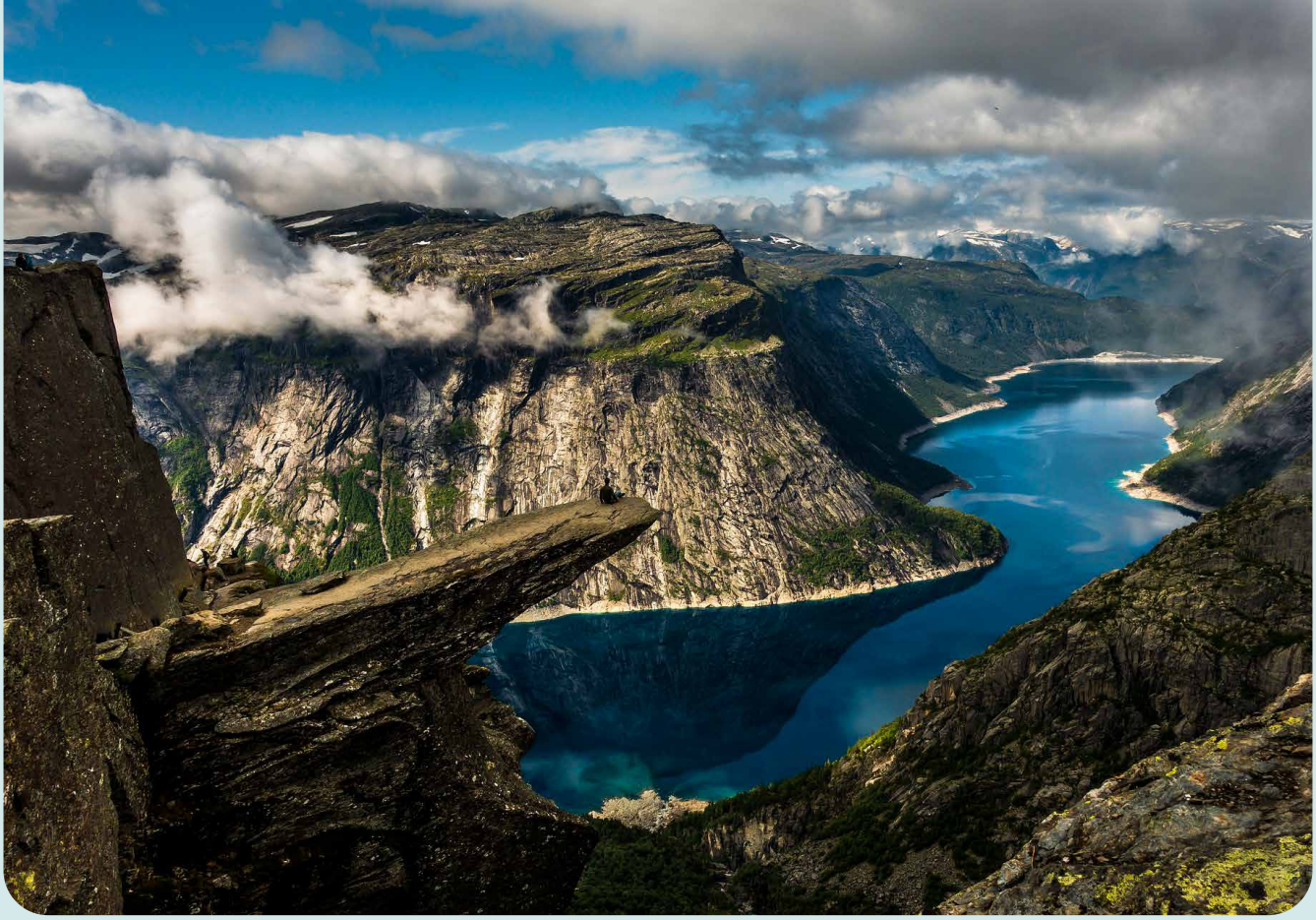
Have you ever thought about how we can use water to create electricity? That's what hydro-power is all about!

Hydropower is like a big energy generator! It works by using the movement of water, like rivers or waterfalls, to create electricity. There are two main types of hydropower:

- **Flexible Hydropower:**[1] These systems can quickly change how much electricity they make. They store water in big lakes called reservoirs and release it when people need more power, like on hot days when everyone turns on their air conditioning.
- **Intermittent Hydropower:**[2] This type depends on the natural flow of water. It can be a little unpredictable, just like the weather! Sometimes it makes a lot of power, and sometimes it doesn't, but it still helps create energy.

So, hydropower can use water to help power our homes and schools!

Did you know that hydro power makes more electricity than all the other renewable sources,[3] like solar and geothermal, combined? It's expected to stay the biggest source of clean energy for many years!



NORWAY'S WATER WONDER

Norway is a country that really loves hydro power! In fact, nearly 92%[4] of its energy comes from water. Because of all this water energy, it's super important for people in Norway to learn about how hydropower works.

In Norway, schools help kids learn about hydropower and how to create green jobs. When students move up in school, they get to learn even more about working in renewable energy.

For example, at the Norwegian University of Science and Technology (NTNU),[5] students can study hydropower and learn how to help the environment with their careers!

Norwegian schools also teach special skills in technical colleges.[6] They have programs for things like building, electricity, and even cooking! All of this helps kids get ready for jobs that are good for the Earth.

BUILDINGS THAT HELP THE PLANET

Schools in Norway are getting super cool upgrades! They are building places that don't create carbon emissions, which means they don't release harmful gases that can hurt our planet.

For example, Heimdal High School in Trondheim[7] is one of the greenest schools in the world! It will make more energy than it needs and can even share extra energy with a nearby swimming pool. That way, the school can save money and help the planet at the same time!

NOT JUST NORWAY!

Here are a few schools around the world that incorporate hydropower or teach students about it:

- **The Green School[8] (Bali, Indonesia):** This school is run completely on renewables; they get their hot water and energy to cook from hydropower. Students get to learn all about how hydropower works, experimenting with water wheels and discovering how they can help the planet by using clean energy.
- **Burlington High School[9] (Vermont, USA):** Burlington is one of the first US cities to be run completely on renewables, and this includes their schools. Located near the Winooski River, schools engage in projects that promote understanding of hydropower and its environmental benefits.
- **Forth Valley College[10] (Scotland):** While not a K-12 school, this college incorporates hydropower education into its curriculum and has practical projects related to renewable energy.

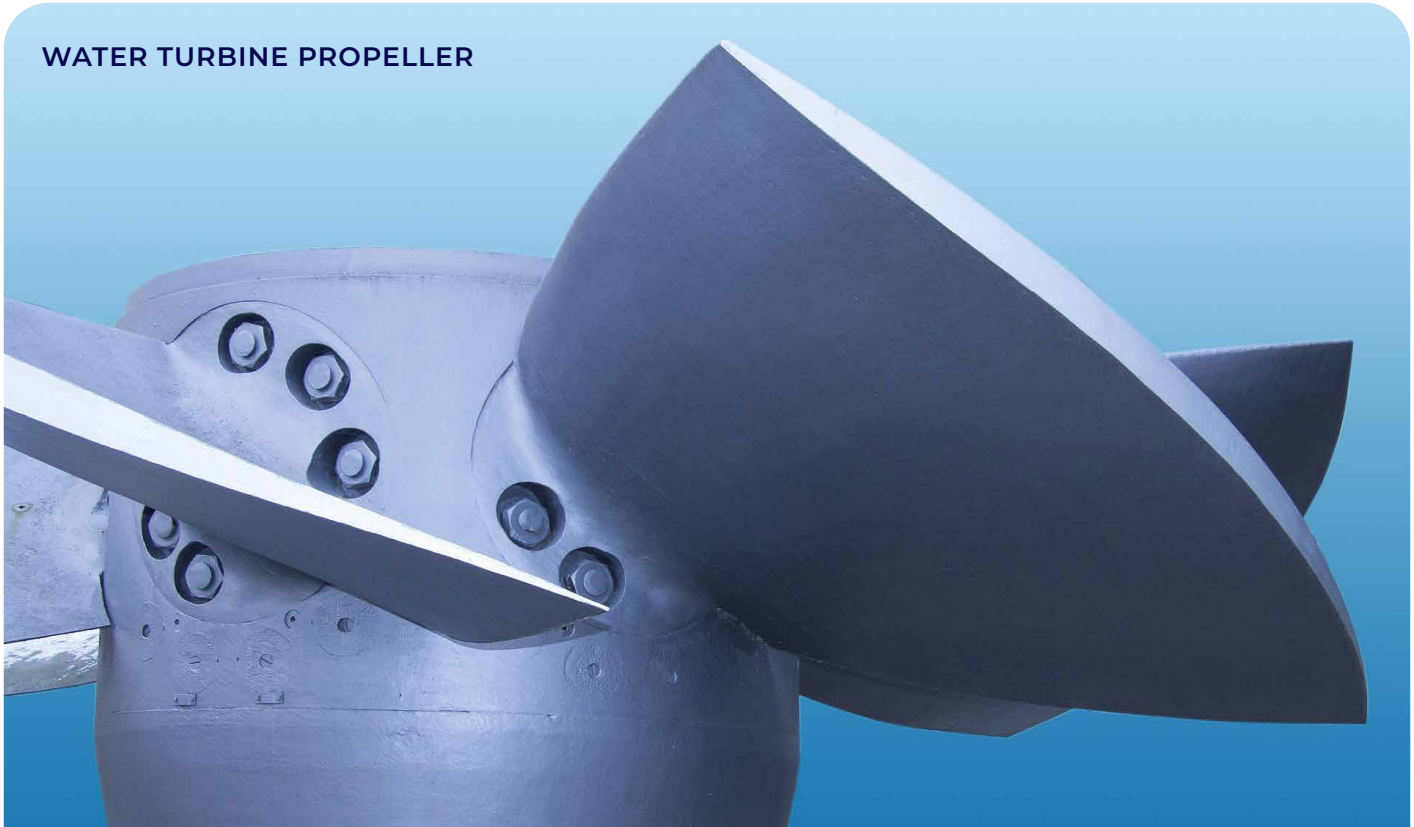
These schools not only use hydropower but also teach students about its importance in promoting clean energy and protecting the environment. Let me know if you need more information!

WRAPPING UP ON HYDROPOWER

Hydropower is a one way to create clean energy using the movement of water from rivers and waterfalls. Countries like Norway show how we can use hydropower to produce almost all their electricity without polluting the air.

However, it's important to remember that hydropower isn't perfect. Building big dams can change the environment and affect fish and wildlife. It can also take away water from local areas, which might impact people who need it for farming or drinking.

Even though there are challenges, hydropower remains a valuable source of energy. By learning about it and finding smart ways to use it responsibly, we can help create a cleaner, healthier planet for everyone!



05

HOW WAVES MAKE ELECTRICITY: WAVE POWER

WHAT IS TIDAL ENERGY?

Tidal energy is like magic from the ocean! It's a special type of energy that comes from the movement of water in the seas. There are four cool ways to capture this energy:

- **Tidal Barrage:**[1] A big dam in the ocean with gates. It holds water when the tide comes in and lets it out when the tide goes out, spinning turbines to make electricity.
- **Tidal Stream:**[2] Underwater turbines that work like fans. They spin with the ocean currents created by tides, generating electricity.
- **Wave:**[3] Machines that move up and down with ocean waves. This movement turns gears to create electricity, like bouncing on a trampoline!
- **Ocean thermal:**[4] Uses warm water on the surface and cold water below. The temperature difference makes a gas spin a turbine to generate electricity.

Each of these uses water in its own unique way to create electricity!

WHY DO WE NEED TIDAL ENERGY?

Did you know that about three billion people live near coastlines?[5] That's almost half of all the people in the world! Using tidal energy is super smart because

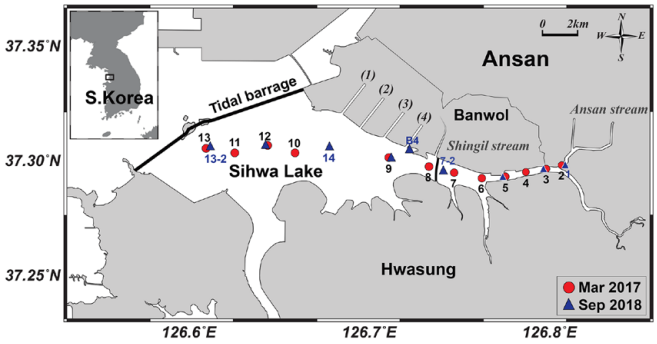
it can help provide power to all those people while being friendly to our planet. Tidal energy comes from the movement of ocean tides, which means it's always available as long as the tides are flowing.

This is great because tidal energy helps us make clean electricity without causing pollution. Unlike fossil fuels, like coal and oil, tidal energy doesn't release harmful gases into the air. These gases can trap heat in our atmosphere and make the Earth warmer, which is called climate change. Climate change can cause problems like stronger storms, rising sea levels, and changes in weather patterns.

By using tidal energy, we reduce the pollution that contributes to climate change. Plus, tidal energy systems can protect coastlines from erosion and help keep ocean habitats safe. So, by choosing tidal energy, we can power our homes and schools while taking care of our planet and ensuring a healthier future for everyone!

Plus, the ocean is always moving, which means tidal energy is reliable and strong!

MEET THE BIGGEST TIDAL POWER PLANT!



In South Korea, there's a giant tidal power plant called the Sihwa Lake[6] tidal power station. It can produce 254 megawatts of electricity! Wow, that's a lot! To give you an idea, 1 megawatt can power about 800 to 1,000 homes. So, when you add it all up, 254 megawatts can power around 200,000 to 254,000 homes. That's like a small city! This shows just how powerful tidal energy can be in providing electricity for so many people.

This plant uses special turbines and gates to harness the energy of the water. It's like having a big water wheel that turns and creates power!

SIHWA LAKE TIDAL POWER STATION

FUN PROJECTS ON THE HORIZON!

South Korea is also working on exciting new projects, like a wave energy converter[7] that can help power remote islands. This means even places far from the mainland can get energy from the ocean waves!

FLOATING TURBINES CAN HARNESS TIDAL POWER

SCHOOLING FOR SUSTAINABILITY!

Since 2022, schools in South Korea[8] have started teaching kids about climate change and how to take care of the Earth. They're making sure that students learn important skills for a greener future!

Did you know that 70%[9] of high school graduates in South Korea go to college? At places like Sejong University,[10] students can study things like Water Resources and Environmental Engineering, which help them learn how to protect our planet!

Across the globe, many other schools are exploring the benefits of tidal energy to power their campuses. For example, **Portsmouth High School**[11] in the United Kingdom has worked with local tidal energy projects, allowing students to learn about renewable energy firsthand.

In Canada, **The Pearson College**[12] has partnered with researchers to study the effects of tidal energy on the environment, allowing students to learn about tidal energy and preparing them for jobs in the field.

In the United States, **University of Washington**[13] has engaged in projects that study the potential of tidal energy, and **The University of Maine**[14] incorporates tidal energy into its curriculum, offering hands-on experiences with tidal turbines and marine renewable energy technologies.

GREEN SCHOOLS = HAPPY JOBS!

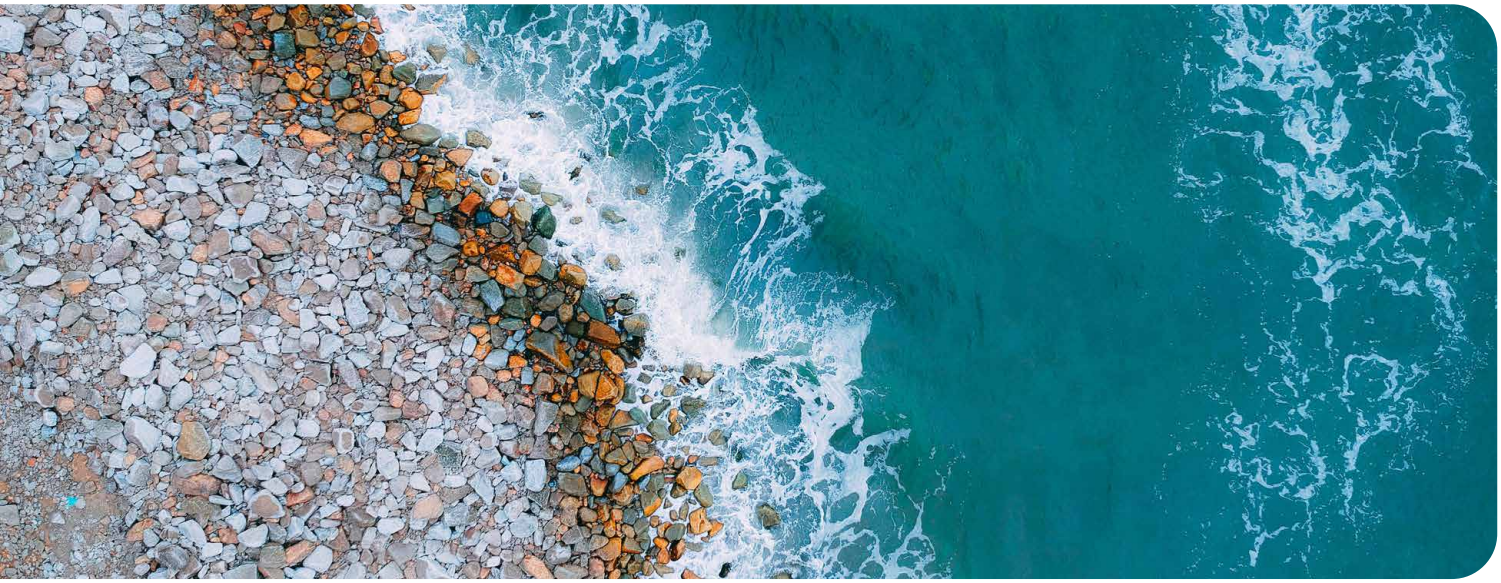
As part of a big plan called the Korean New Deal, South Korea is investing a lot of money to create green and smart schools! This will create even more job opportunities in the field of clean energy capture and generation.

By 2025, it's expected that **nearly 400,000 new jobs**[15] will be created. That's a lot of new people to help the planet.

THE FUTURE IS BRIGHT WITH TIDAL ENERGY!

As the world works toward a greener future, we support climate education and training in schools. This way, they can teach people how to design and maintain cool renewable energy systems, from tidal to wind, to solar, geothermal and hydroelectric. Tidal energy is just one part of the adventure, and it's exciting to think about what the future holds for our oceans and the people living by them!

So, next time you see the waves at the beach, remember that they're not just for playing; they're also a powerful source of energy that can help our world!



IF YOU ARE A STUDENT AND WANT TO LEARN MORE ABOUT RENEWABLE ENERGY CONSIDER READING THESE BOOKS:

Solar Story[16] by Allan Drummond, best for ages four to eight. This book is based on the origin story of a solar installation in Toucan, Mali. This follows the changes solar energy has on a community.

The Boy Who Harnessed Wind, Young Reader's Edition[17] by William Kamkwamba, Bryan Mealer, best for ages eight to 12. The book takes place in a place where resources are limited. Following the main character, readers experience courage, hope, and resiliency.

Planet Power: Explore the World's Renewable Energy[18] by Stacy P. Clark, best for ages eight to 12. What is renewable energy? Clark discusses wind, solar, hydro, geothermal—in a way that is both accessible and exciting.

Charged: A History of Batteries and Lessons for a Clean Energy Future[19] by James Morton Turner, best for ages 12 to 16.

This is a bit more in depth! James Turner discusses the extraction of raw materials like lithium and cobalt, the environmental costs of battery production, and the broad scaling of supply chains. He emphasizes the need for sustainable practices in battery innovation. Furthermore, he covers the need for sustainable technologies to meet the world's demand for electricity.

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BRIGHT IDEAS WITH SOLAR ENERGY

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WIND POWER: BLOWING IN THE BREEZE

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