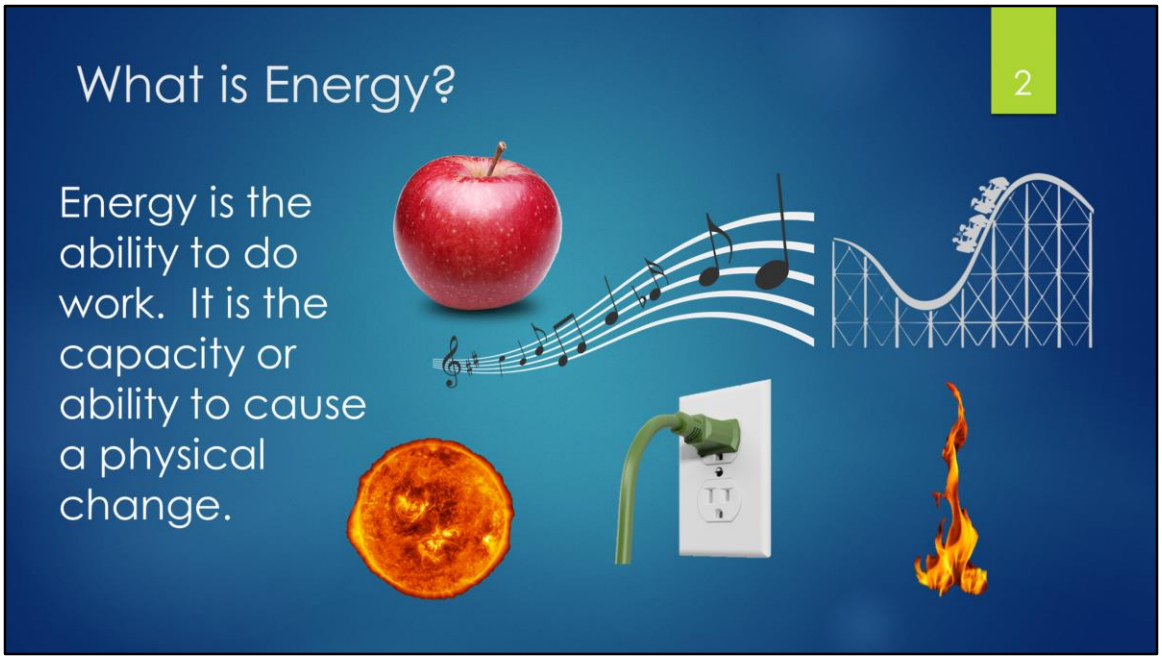
NOTE: The speaker notes are for guidance and are not intended as a script. Additional information is included so the speaker can elaborate as they desire.
NOTE: [CLICK] in the speaker notes means that clicking the mouse will cause material to appear on the screen that goes with the note.

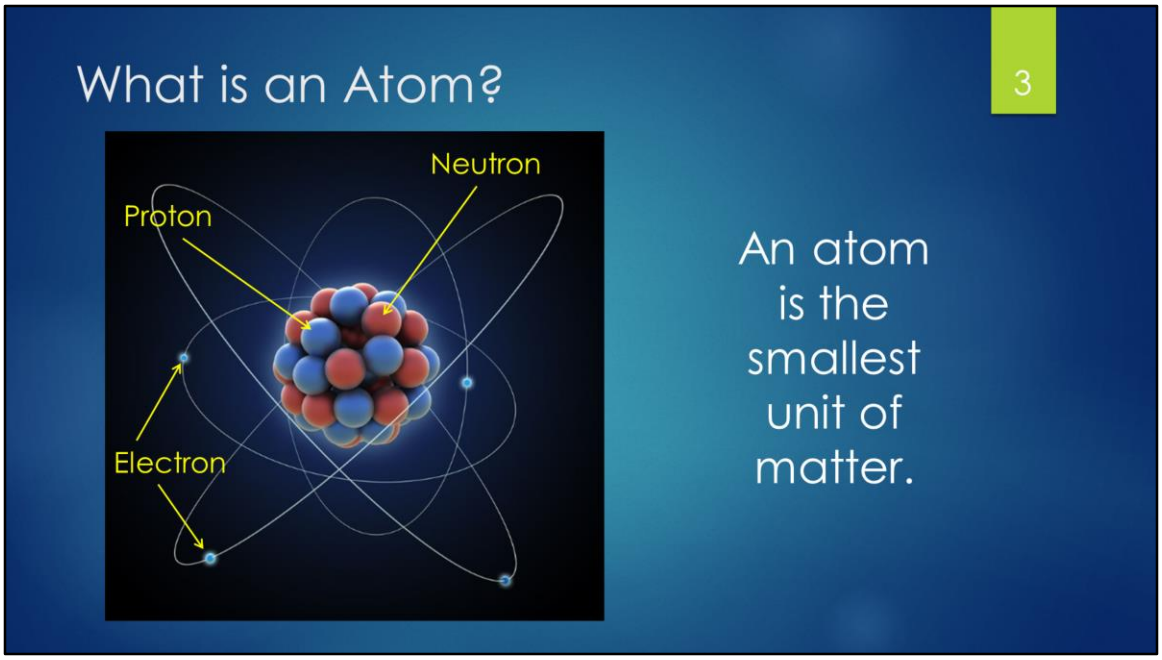
Good afternoon. Thank you so much for having me. My name is ___.
I'm here on behalf of the North American Young Generation in Nuclear. We are an organization of people interested in nuclear technology.
A little bit of your personal background is encouraged. Be warned that kids at this age tend to jump into questions about salary. Be prepared.

Today, we are going to talk about how nuclear energy can help with environmental and societal needs of the future.



Before we get into the real topic, we need to discuss some basics. First, what is energy?
Ask open-ended questions if time permits. The focus is on electrical and thermal energy later in the presentation.

[CLICK] Chemical: When you eat an apple, it converts the *chemical* energy stored in the apple to allow you to run and jump.
[CLICK] Mechanical: Motion (Could discuss potential/kinetic energy of a roller coaster)
[CLICK] Light: Nature's way of transferring energy through space. Energy is moved at an extremely rapid rate. This includes parts of the electromagnetic spectrum that we can't see…such as radio waves, x-rays, microwaves, and UV. Energy from the sun travels 93 million miles to Earth as light and UV waves.
[CLICK] Thermal: explain this with rubbing hands together and the heat from friction that occurs.
[CLICK] Sound: can explain this with clapping your hands
[CLICK] Electrical: The motion of electrons causes motors to spin, lights to turn on, etc.

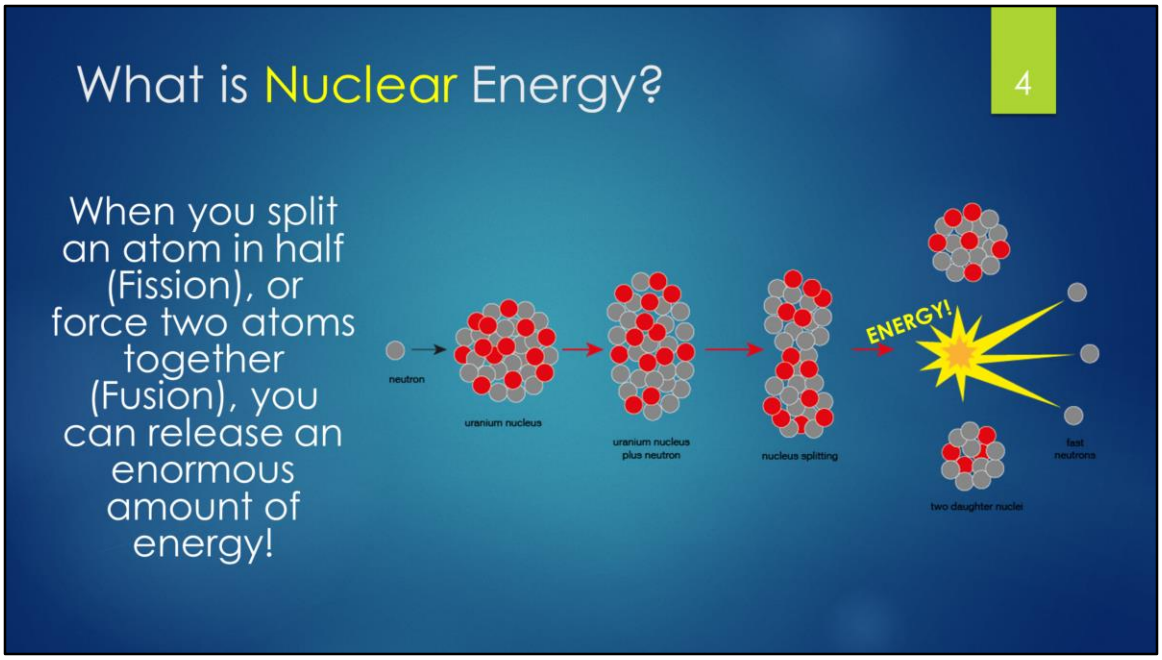


Atoms are the basic building blocks of everything we see around us. The chair you sit in is made up of atoms, the air you breath is made up of atoms, and even YOU are made up of atoms.

Atoms are extremely small! If you had a powerful microscope you would see on the atomic level, that atoms are made up of a nucleus of protons and neutrons, surrounded by electrons.
How many atoms are in a small grain of salt? Approximately 1.2x10^18! That's one billion-billion atoms! Or a million-trillion!
This is the basis for ALL matter!

The secret to an atom is that it contains a tremendous amount of energy!

BONUS DISCUSSION: What are protons, neutrons, and electrons? Elementary particles! Compare electrical attraction to poles on a magnet. Strong forces are needed to keep all of those positive charges together in the nucleus.
What happens if we try to break an atom down? What if we divide a proton or neutron? Quarks! (This level of detail isn't necessary to present, but be ready to answer the question)



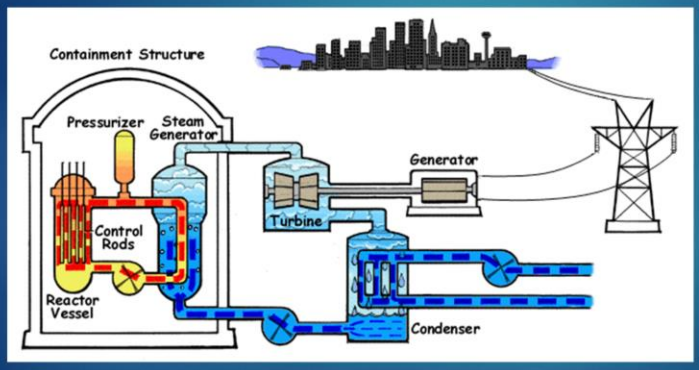
Talk through the diagram explaining how nuclear fission works.

Make mention that we call these events "nuclear reactions" because that is a term that will see again later in the presentation.

Emphasize that there is energy created in this process.

What can we do with Nuclear Energy?

5



If we can capture the energy created from multiple nuclear reactions, we can use it to create electricity!

In a nuclear power plant, we harness the energy created from fission in a nuclear reactor.

Inside a nuclear reactor, there are BILLIONS of nuclear reactions occurring every second! All that energy is harnessed inside the nuclear power plant and is converted to electricity.

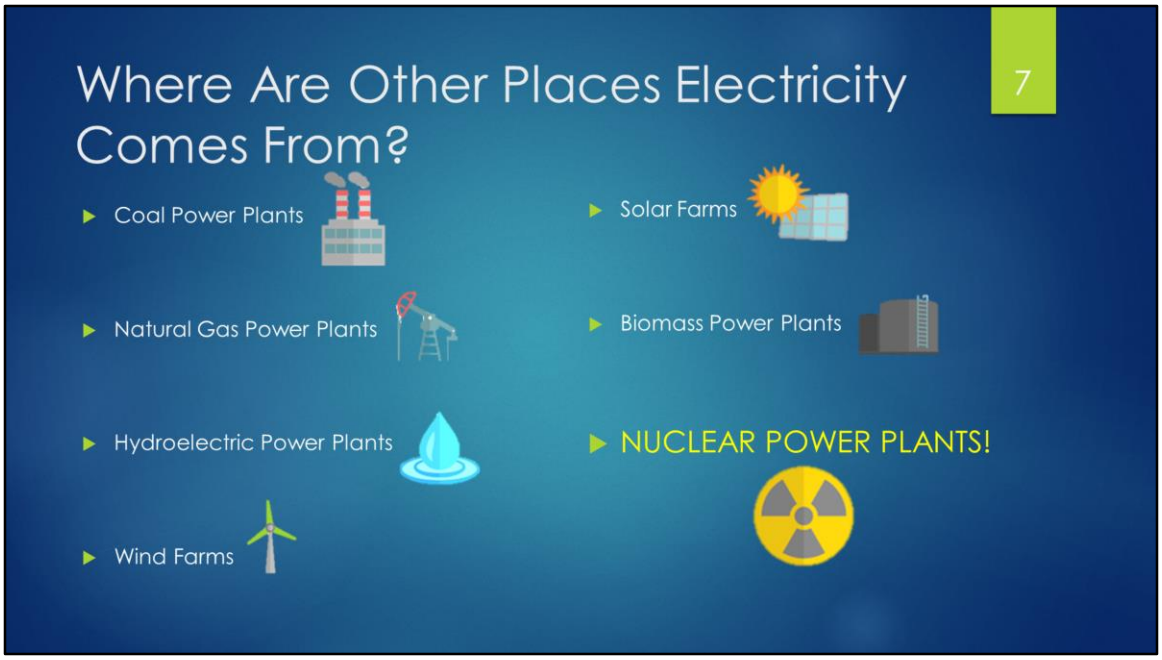
That electricity then travels through the power lines to your school, your house, your parent's work, the grocery store, and everywhere else you go to provide electricity!

So a nuclear power plant essentially just converts Nuclear Energy into Electrical Energy or ELECTRICITY!

Lead in: Almost every man-made instrument or machine uses electricity as the power source. *Let students give examples.*

You might use electricity to…
[CLICK] Learn biology.
[CLICK] Drive a car.
[CLICK] Control the air conditioner.
[CLICK] Watch TV.
[CLICK] Keep your food cold.
[CLICK] Talk to your mom.
[CLICK] Use a computer.
[CLICK] Light your room at night.

QUESTION: Why might you not be able to "plug into" a power source?



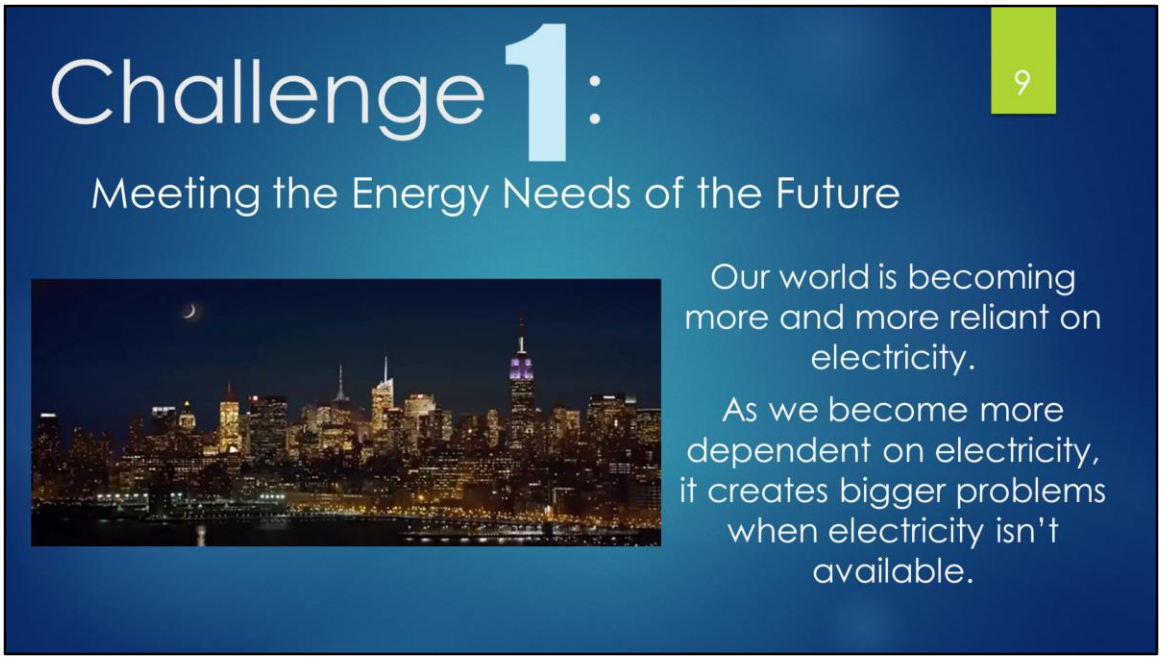
So we already talked about how nuclear power plants produce electricity. Where else might electricity come from? *Let the students give examples*.

Electricity is also made at…
[CLICK] Coal plants by burning coal.
[CLICK] Natural gas plants by burning gas.
[CLICK] Hydroelectric plants by using water to turn large motors.
[CLICK] Wind farms by using wind to turn large motors.
[CLICK] Solar farms by converting sunlight into electricity.
[CLICK] Biomass plants by burning organic matter such as wood or manure.
[CLICK] AND NUCLEAR POWER PLANTS!

8

Let's talk about energy for 2020 and beyond!

What do you think some of the challenges we will face are?



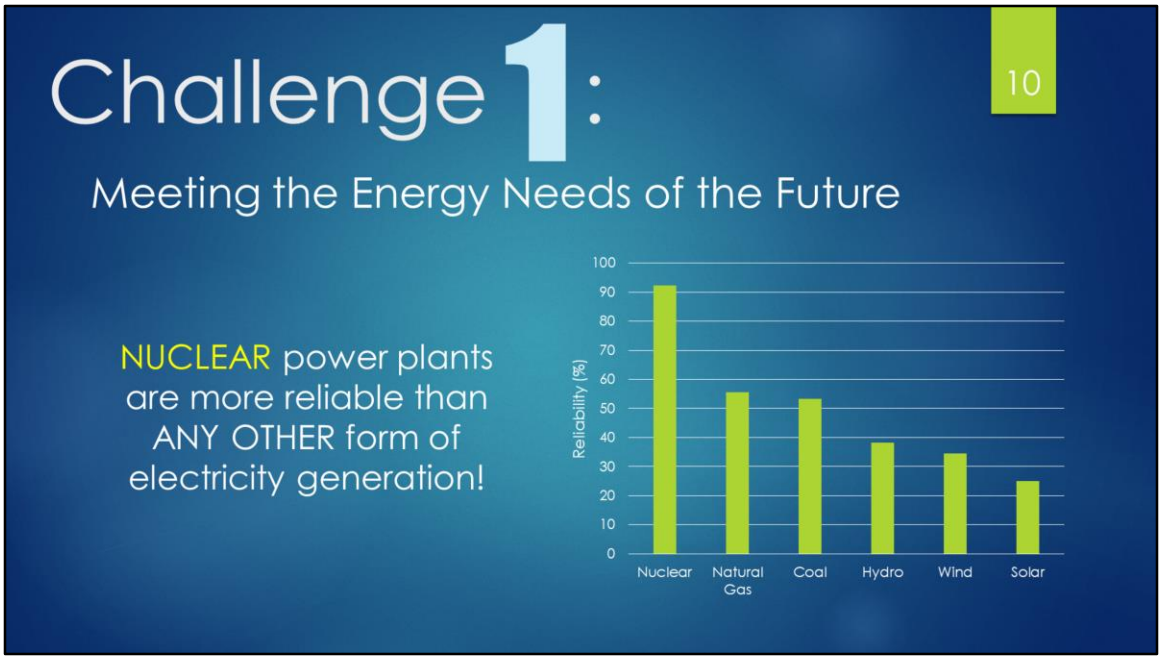
CHALLENGE NUMBER 1

Our society is becoming more and more reliant on electricity. Think of all the things we named just a second ago that use electricity. We use electricity for everything!

Ask the students what the worst things they could think of losing power would be?

Imagine if we didn't have reliable electricity and the hospital lost electricity? Or the airport?

We could lose power to cell phone towers and not be able to call anyone. Banks could lose power and prevent anyone from having access to their money.



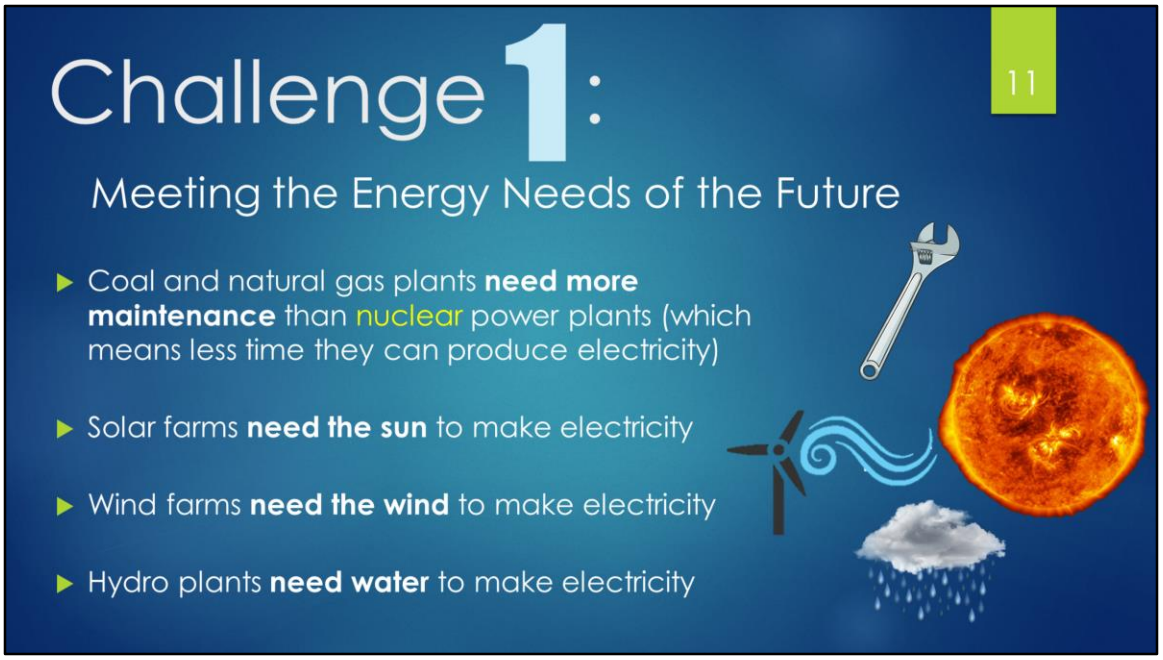
Nuclear Power Plants are the most reliable form of electricity generation we have.

All power plants have a maximum amount of energy that they can produce. Nuclear power plants on average produce 92% of their maximum amount of energy a year. That is significantly more than any other form of electricity generation:

- Natural Gas: ~55%
- Coal: ~53%
- Hydropower: ~38%
- Wind: ~34%
- Solar: ~25%

NOTE: The chart is showing capacity factor, but we'll present it as reliability as this might be easier for the 4th and 5th grade level

Data from energy.org: https://www.energy.gov/ne/articles/what-generation-capacity



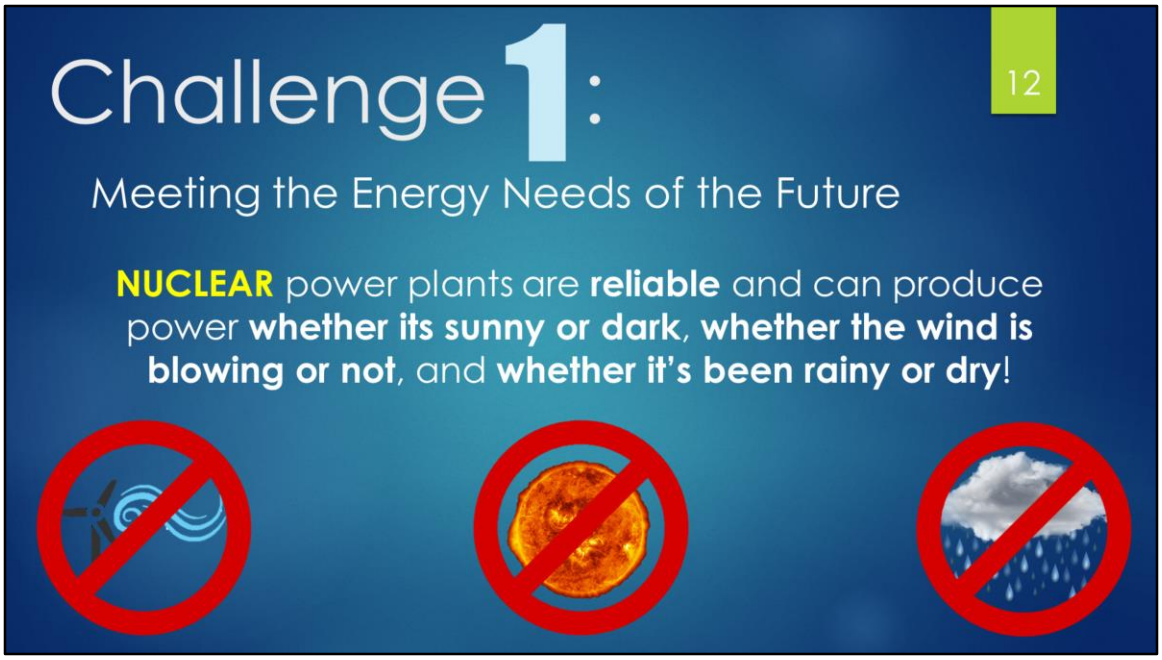
QUESTION to the students: Why do you think other forms of electricity generation aren't as reliable?

[CLICK] Coal and natural gas plants are more prone to needing to stop making power in order to have things that break be fixed.

[CLICK] Solar farms need the sun to make electricity and the sun doesn't shine at night.

[CLICK] Wind farms need the wind to make electricity and the wind doesn't always blow.

[CLICK] Hydro plants need water to move through the plant, so if it hasn't rained in a while and lake and river levels are low, then they can't produce electricity.



Nuclear power plants are so reliable because they don't require the amount of maintenance that coal and natural gas plants do. They don't require the sun to shine, the wind to blow, or rain to fall.

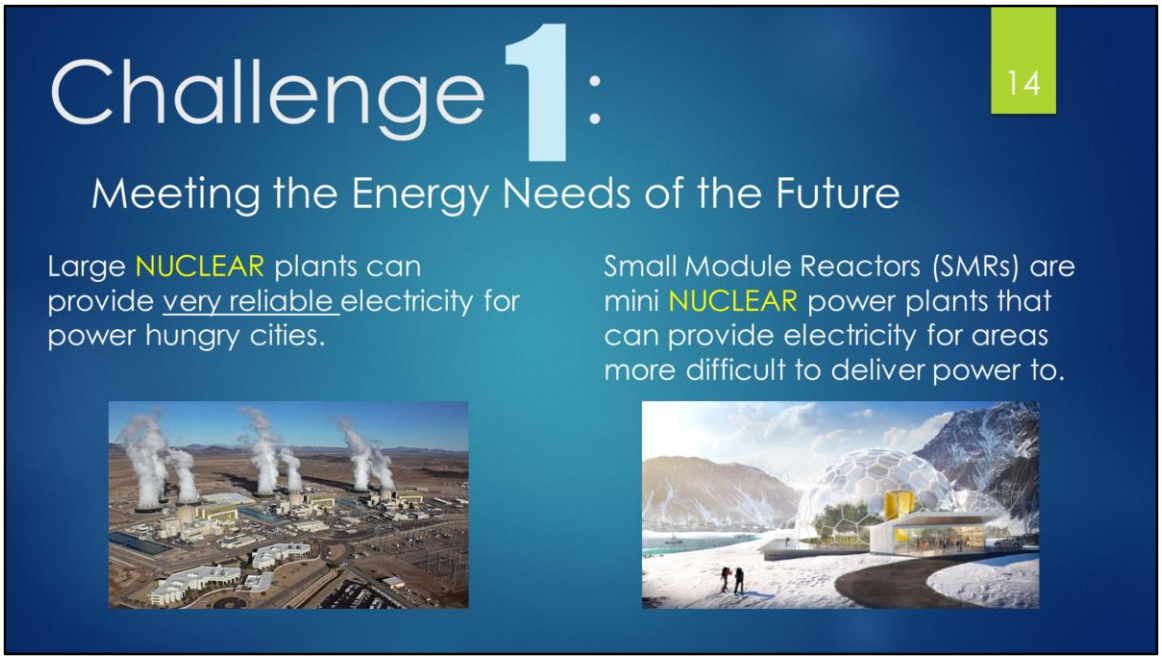
As time goes on, our world is requiring more and more electricity. Population increases result in more people in the world, therefore more electricity needed. As other countries and rural areas become more modernized, they begin using more electricity. As technology advances, we begin using more things that require more electricity.

These things result in…
[CLICK] More houses being built
[CLICK] More steel being made for construction and infrastructure developments
[CLICK] More people driving electric cars
[CLICK] More people using cell phones
[CLICK] Higher demand for air conditioning
[CLICK] More roads being developed

With more people in the world, and more technology being used, we need more electricity. We call this “demand.”

We must be able to produce enough electricity to meet this demand.

Data from EIA: https://www.eia.gov/todayinenergy/detail.php?id=26212



Nuclear power plants have the capability to meet society's power demands, no mater where they are!

Large scale nuclear power plants produce enough electricity to power MILLIONS of homes. The largest nuclear power plant in the United States (Palo Verde) can provide power for about 4 million people.
Make a comparison to your local area of about how many people this is.

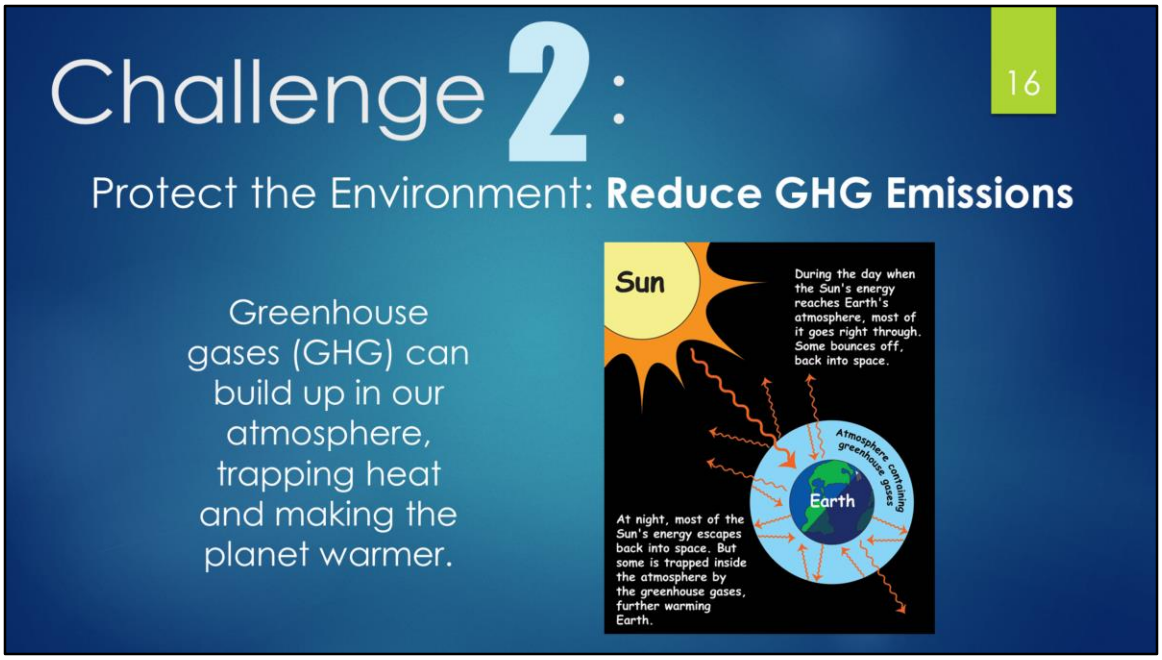
One type of modern nuclear technology are called Small Modular Reactors. SMRs are basically mini nuclear power plants that can be quickly built and installed just about anywhere. They produce a much smaller amount of electricity compared to the large power plants. This is a strength of the SMR because it means they can be used to provide power to remote locations that it has traditionally been difficult to provide power for from the grid. *Make a comparison to a remote location that students in your area might understand.*

SMRs can be used to meet the electricity demand of remote locations and smaller villages that it has traditionally been very hard to provide electricity for.

But SMRs are extremely scalable, meaning if you wanted to produce a lot of power for a city using SMRs, you can still do that too by just installing multiple SMRs at the same site.

By using nuclear power plants, we can meet the electricity demand of the future in a reliable way!

As we make more electricity, we want to do it with as **little impact on the environment** as possible.



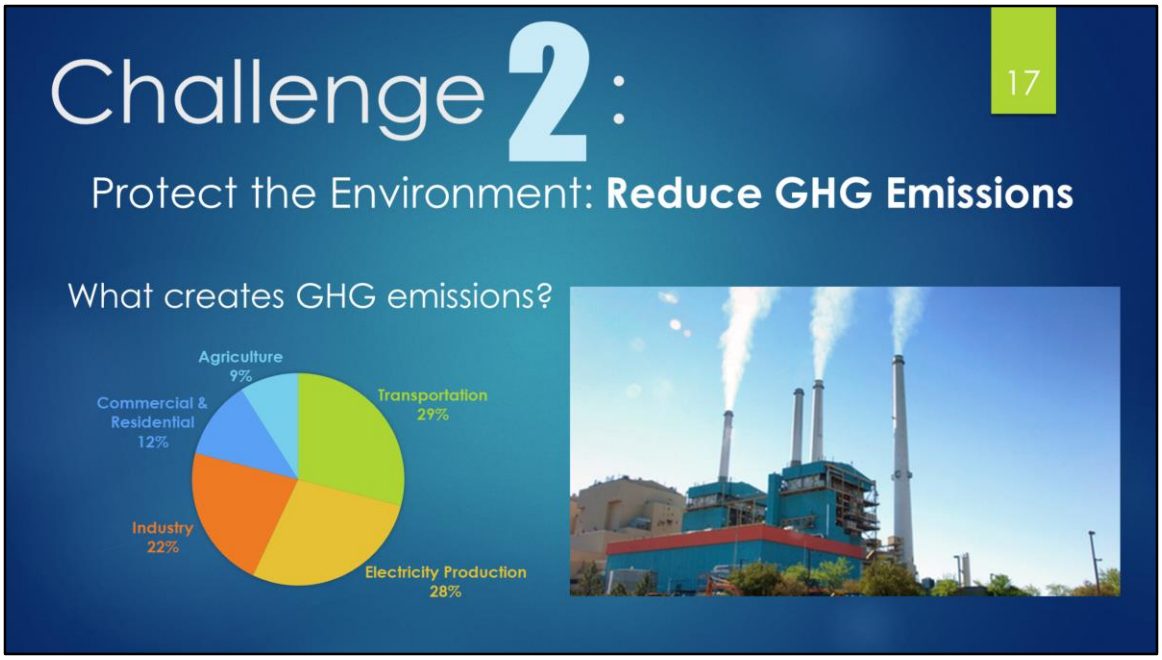
CHALLENGE NUMBER 2

Ask the students if they know what the greenhouse gas effect is and ask them to explain it.

Greenhouse gases can build up in the Earth's atmosphere. When they build up too much, they can result in the Earth getting warmer.

Buzzwords to consider using to help make this relatable to what they might have heard before:

- *Carbon Dioxide or CO2*
- *Global Warming*
- *Greenhouse Effect*
- *Climate Change*
- *Carbon Free*

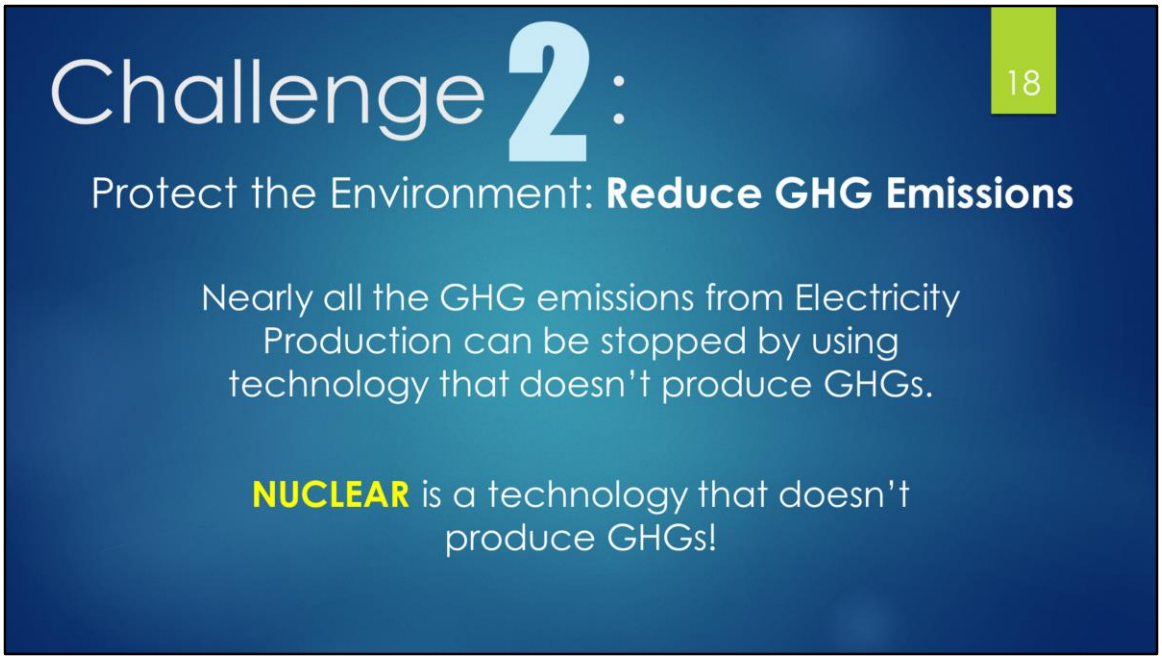


There are all sorts of things that produce greenhouse gases. The most common greenhouse gas is carbon dioxide. Other types of greenhouse gases include methane, nitrous oxide, and water vapor.

The following are the top industries creating greenhouse gases in the United States:

- Transportation – from the exhaust of cars, planes, buses, trains, etc.
- Electricity Production – mostly from the burning of fossil fuels such as coal and natural gas
    - *You might want to dwell on this one for a minute and go into a little more detail about what fossil fuels are and why burning them creates GHGs since we'll focus on the electricity production sector on the next slide*
- Industry – mostly from the burning of fossil fuels the manufacturing of parts and materials
- Commercial and Residential – mostly from the burning of fossil fuels for heating
- Agriculture – from the burning of organic matter and from off-gassing of decomposing matter (manure, etc.)

Data from EPA Inventory of U.S. Greenhouse Gas Emissions and Sinks annual report, 2017 values: https://www.epa.gov/ghgemissions/sources-greenhouse-gas-emissions



Electricity Production is a large contributor (28%) to greenhouse gas emissions. Nearly 100% of the GHG emissions produced from Electricity Production can be stopped by using technology that doesn't produce greenhouse gases such as wind, solar, hydro, and NUCLEAR!

Challenge 2:

Protect the Environment: **Reduce GHG Emissions**

Just like wind, solar, and hydro power production, **NUCLEAR** power plants produce **ZERO greenhouse gases** when generating electricity!

CHALLENGE NUMBER 3

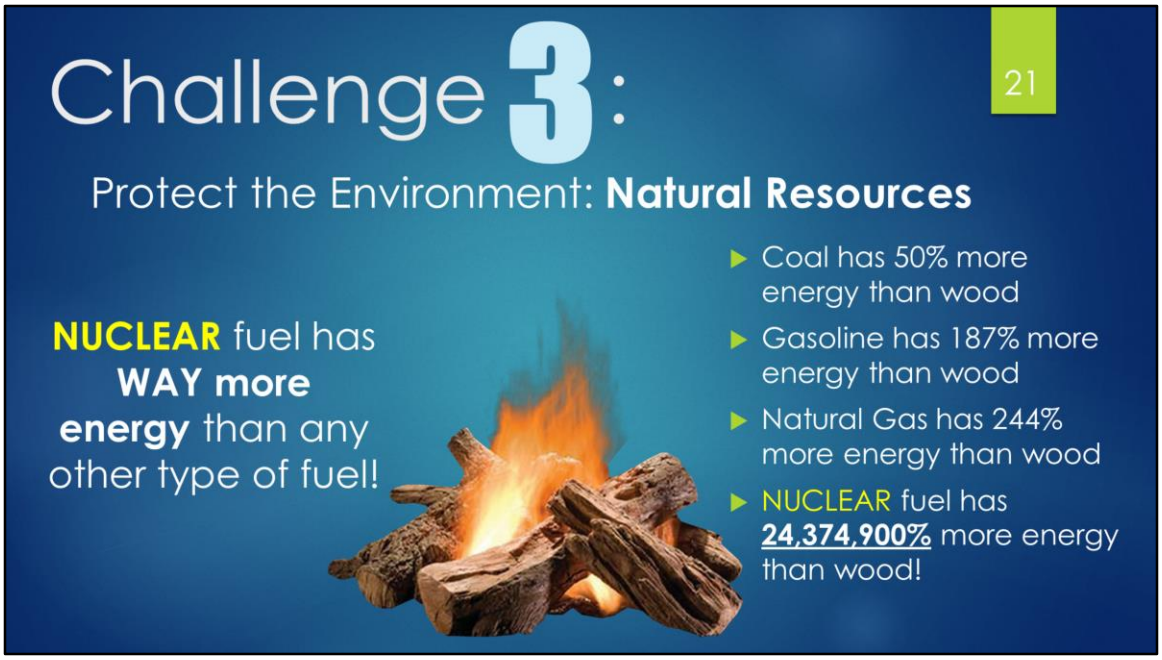
Ask the students why it is good to recycle?

[CLICK] It is good to recycle because it reduces the amount of natural resources that we must consume. For example, by recycling paper, it reduces the amount of trees that must be cut down to make new paper.

It is good to recycle because it saves the environment. By reducing the amount of natural resources we consume, we save the
[CLICK] Plants
[CLICK] Animals

[CLICK] Recycling preserves the environment so that future generations can appreciate it as well.

[CLICK] Recycling is good for the whole world. In general, we want to recycle in order to reduce the amount of natural resources we are consuming.



A way we can reduce the amount of natural resources we're consuming in the energy industry is by using more fuels that contain more energy.

[CLICK] Think about a campfire. Remember when we talked about different forms of energy earlier? A fire is just a form of releasing stored energy. When the wood burns, it gives off that stored energy in the form of heat.

Has everyone been around a campfire before? You know how hot it can get right? It can get pretty hot, and sometimes, burning wood is even used to make electricity. But let's compare the amount of energy that is contained in wood with some other more common fuels used to produce electricity.

- [CLICK] An equivalent weight of coal can produce 50% more energy than wood
- [CLICK] An equivalent weight of gasoline in equal weight to wood can produce 187% more energy than wood
- [CLICK] An equivalent weight of natural gas can produce 244% more energy than wood

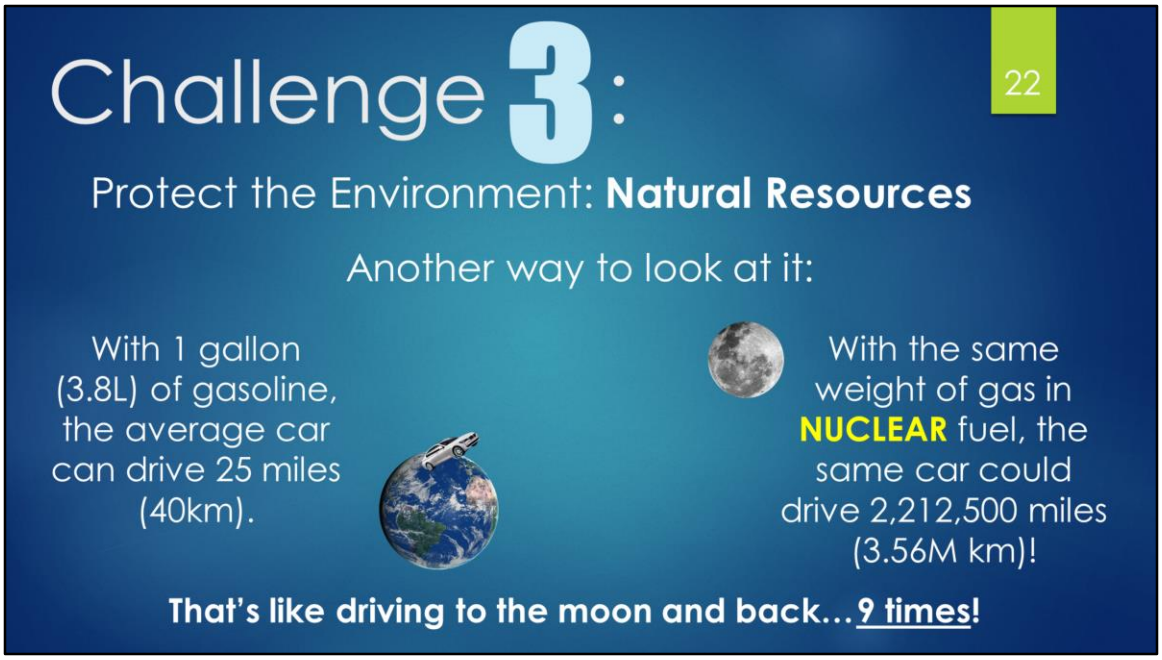
At this point, ask the students to guess how much more energy they think is in nuclear fuel than wood.

- [CLICK] An equivalent weight of nuclear fuel can produce more than 24 million

percent more energy than wood

[CLICK] Nuclear fuel has WAY more energy than any other fuel type.

Data from University of Calgary:
https://energyeducation.ca/encyclopedia/Energy_density



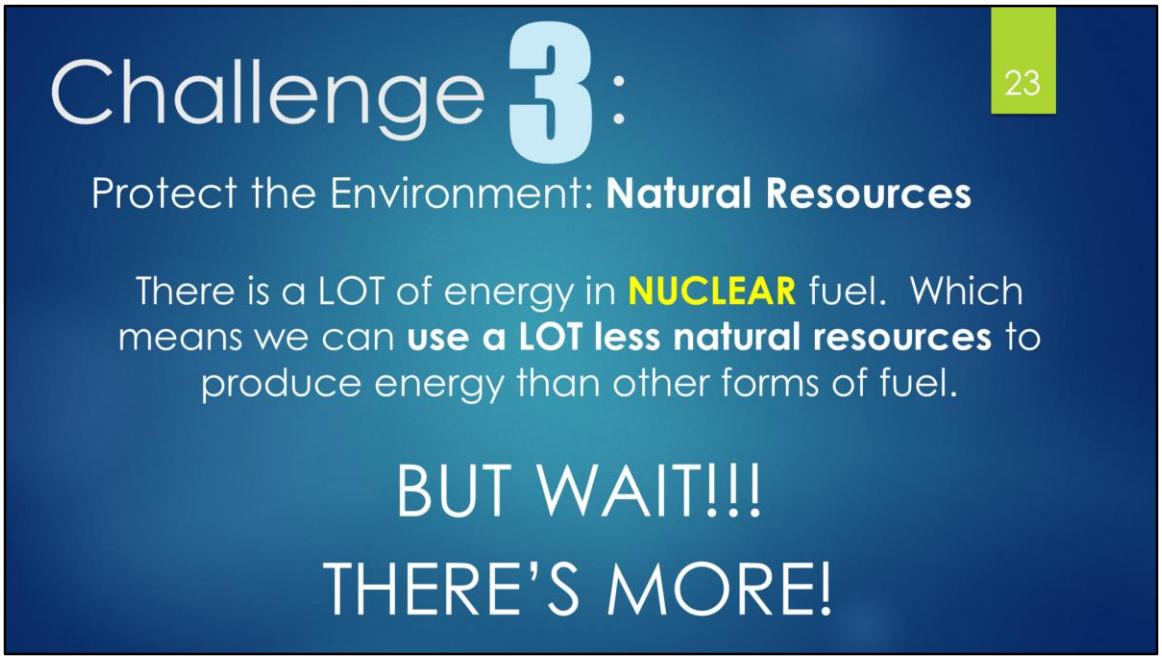
Here's another way to think about the amount of energy in nuclear fuel.

Ask the students if anyone knows how far the average car can drive on 1 gallon of gasoline.
[CLICK] The average car can drive about 25 miles on 1 gallon of gasoline.

Now ask the students if they can guess how far the average car could drive if it could run on the same amount, in weight, of nuclear fuel.
[CLICK] With the same weight of 1 gallon of gas in nuclear fuel, the same card could drive 2.2 million miles!

[CLICK] That's like driving to the moon and back…9 TIMES!

Data from University of Calgary:
https://energyeducation.ca/encyclopedia/Energy_density



There is a LOT of energy in NUCLEAR fuel. Which means we can **use a LOT less natural resources** to produce energy than other forms of fuel.

[CLICK] But wait. There's More!

Challenge 3:

Protect the Environment: **Natural Resources**

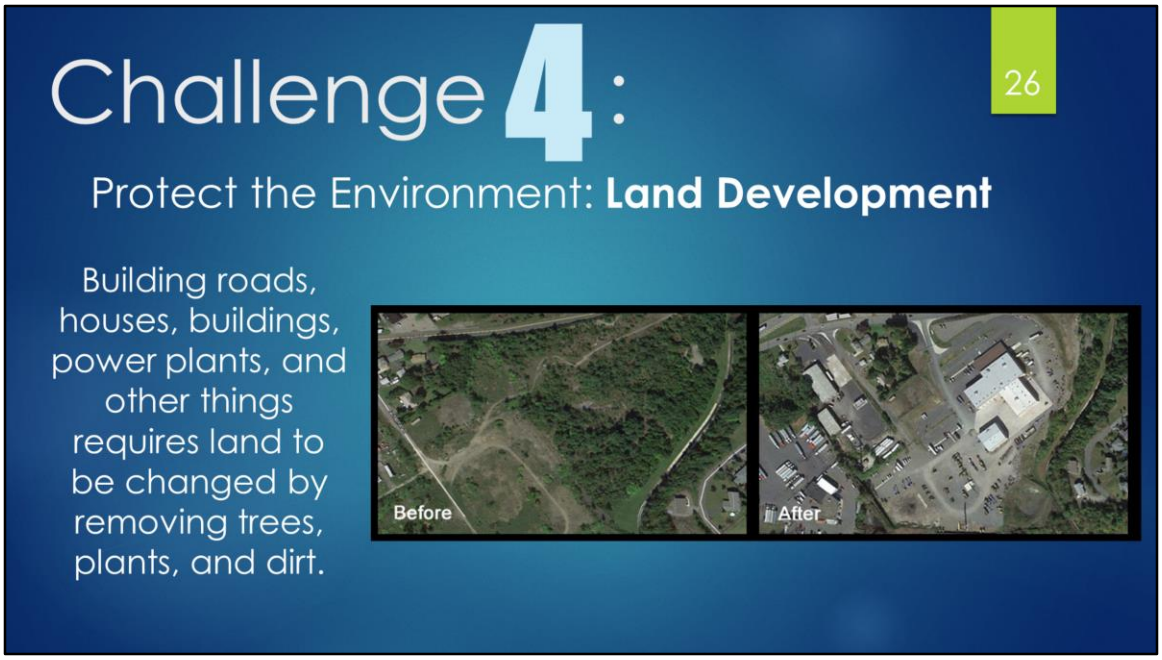
Nuclear fuel can be recycled!

When you burn wood, or coal, or natural gas, there is no energy left once it's burnt.

But when we use nuclear fuel in most nuclear reactors, we don't use up all the energy that it has available. There is about 90% of the energy remaining in the fuel!

With the right technology, we can recycle the used nuclear fuel in order to reuse it again and get even more energy out of it!

This is just like recycling paper or plastics: we are reusing what we've already made in order to avoid having to consume more natural resources.



CHALLENGE NUMBER 4

The last challenge that we'll talk about is with land development.

Any time we build a road, a house, a building, or a power plant, the construction process requires the natural land to be changed in order to build something on it. This involves the removal of trees, plants, and dirt and replacing it with concrete, steel, gravel, etc.

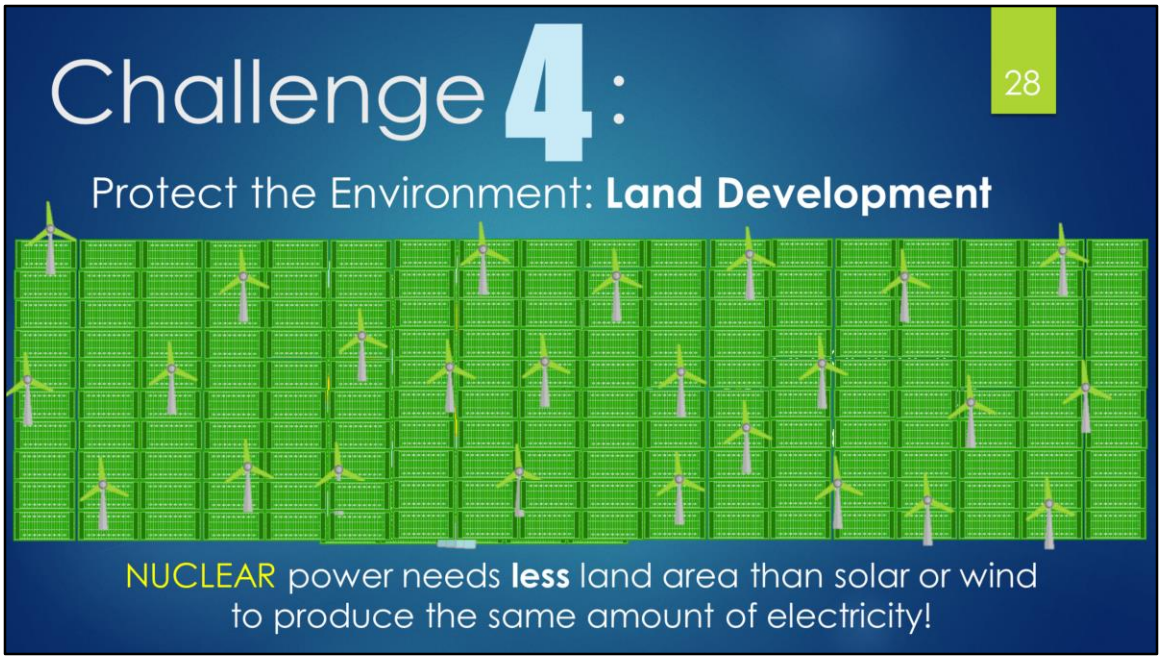
In the photos here, you can see where before we had an area with lots of grass and trees and it was developed into parking lots and buildings.

Ask the students, "Do you think there is any problems that can be created by developing the land from it's natural state?"

[CLICK] Land development can lead to the following problems for the environment:

- [CLICK] Animals must find new homes - this can lead to instability in ecosystems by throwing off the balance between predator and prey
- [CLICK] Plants must be removed
    - The removal of plants leads to less vegetation being available to remove greenhouse gases from the atmosphere
    - The removal of plants means there are less roots in the soil. When you remove the roots from the soil, this can lead to…
- [CLICK] Increased soil erosion
    - Increased erosion can lead to
        - Land slides and sinkholes can form
        - Rainwater not being absorbed into the ground as easily and thus washing away quicker than desired
        - Because ground water is moving faster, this can lead to pollutants and debris getting into our rivers, lakes, and streams more

There are some ways to help prevent these things from happening, but the best way is to not develop our natural landscape as much as possible.



Nuclear power plants have a large advantage over other carbon free electricity sources when it comes to the amount of land area they require.

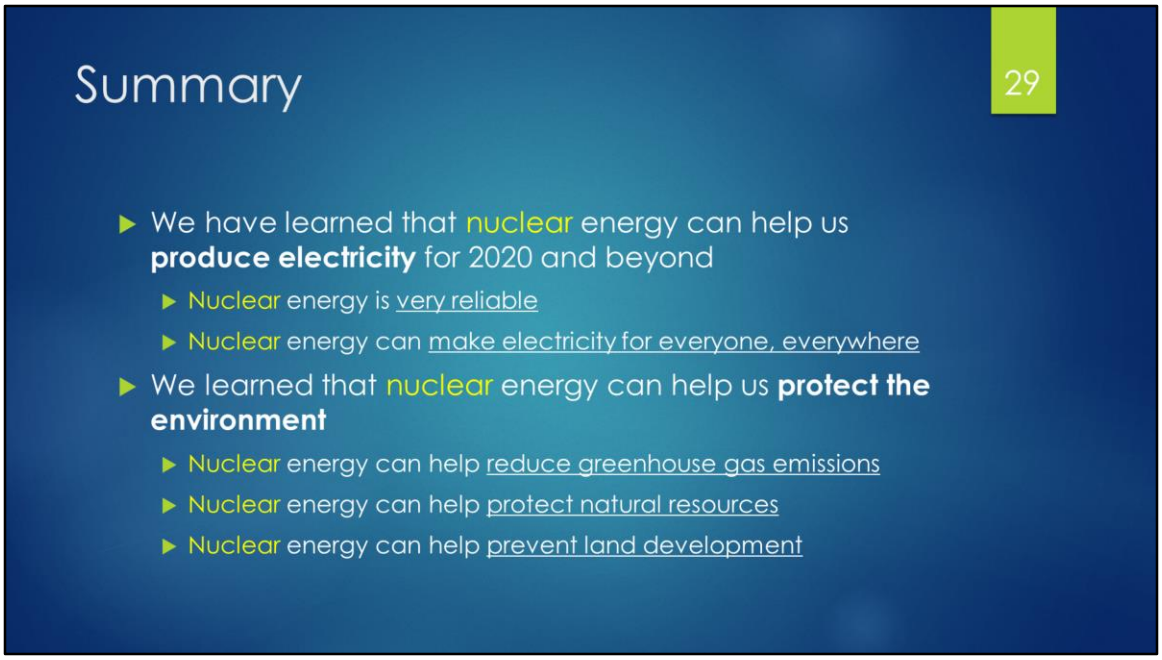
[CLICK] A nuclear power plant about the size of a football field could power approximately 2,000 homes.

[CLICK] It would take solar panels covering approximately 46 football fields to power the same amount of homes.

[CLICK] IT would take wind turbines installed across approximately 200 football fields to power the same amount of homes.

Because nuclear power needs way less land area to provide electricity, that means there would be fewer animal habitats being disrupted, less plants having to be removed, and less erosion and groundwater problems.

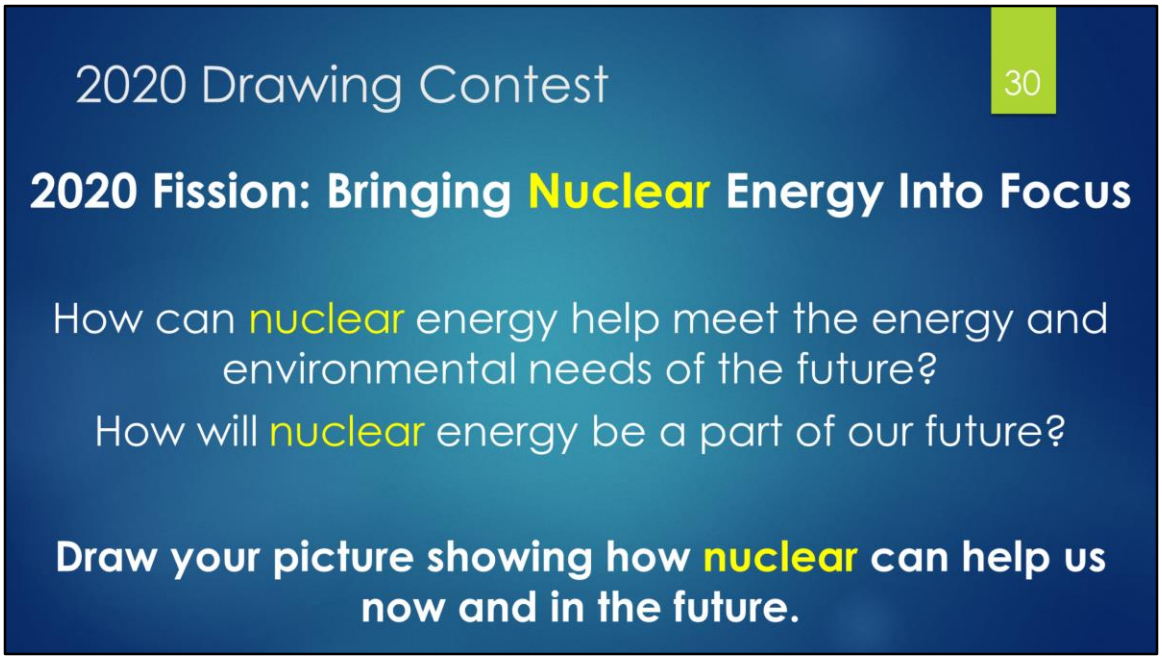
Data from NEI: https://www.nei.org/news/2015/land-needs-for-wind-solar-dwarf-nuclear-plants



So we've focused on nuclear energy today and we've learned nuclear energy can help supply electricity for the future and protect the environment while doing it.

[CLICK] We talked about how nuclear energy can help us produce electricity for the future.
[CLICK] We talked about how reliable nuclear energy is
[CLICK] And we learned that nuclear energy can meet the demand for electricity for everyone, everywhere

[CLICK] We learned about 3 ways nuclear energy can help us protect the environment. Can anyone name some of the environmental challenges we talked about?
Wait for the students to say a them.
[CLICK] Nuclear energy can help reduce greenhouse gas emissions
[CLICK] Nuclear energy can help protect natural resources
[CLICK] Nuclear energy can help prevent land development

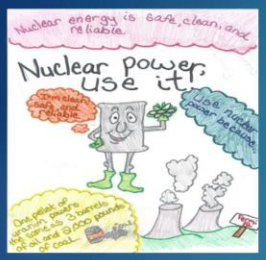


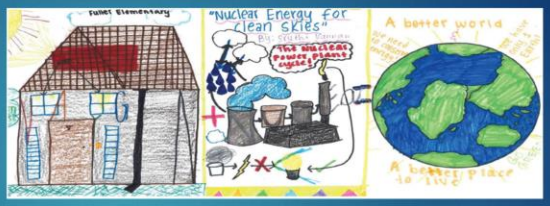
So for the 2020 NAYGN Drawing Contest, the topic is 2020 Fission: Bringing Nuclear Energy Into Focus.

We want to focus on how nuclear energy can help meet the energy and environmental needs of the future. We want to show people that nuclear must be a part of our future in order to meet our energy and environmental needs.

Think about the challenges that we talked about today where nuclear energy can help us going into the future, and draw your pictures showing how nuclear can help us now and in the future with our energy and environmental needs.

QUESTIONS?


Nuclear energy is safe, clean, and reliable.
Nuclear power. use it!
Use nuclear power because
One pellet of uranium creates the same as 3 barrels of oil and 1 ton of coal.


Fuller Elementary
"Nuclear Energy For Clean Skies"
The nuclear Power plants cause!
A better world
A better place to live


LOWER ARE LOWER COSTS • HIGHER ENERGY • NATURAL RESOURCE
HAPPY EARTH • SAVES


Energy
For Clean
Skies