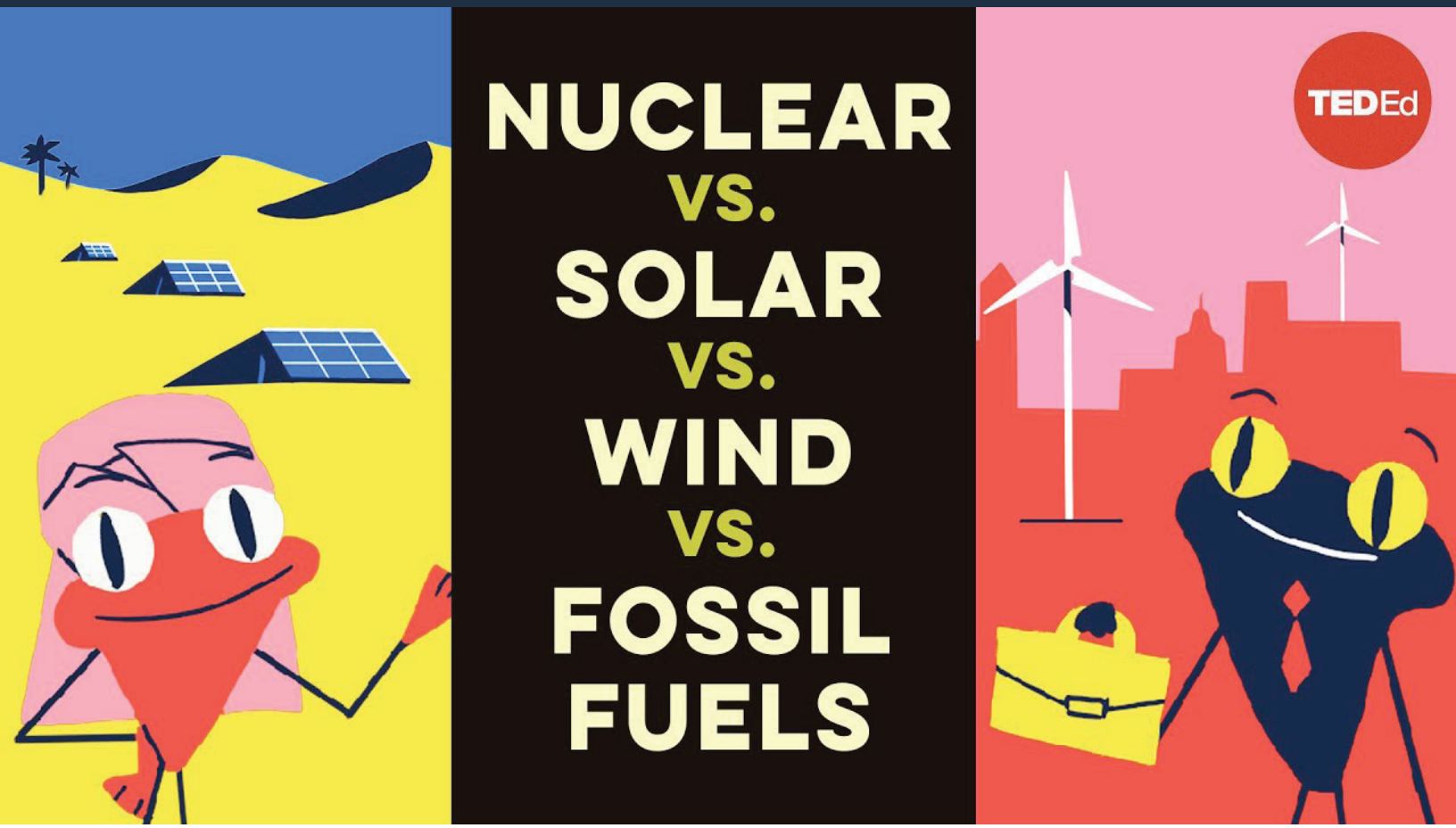

How much land does it take to power the world?

Making electricity takes space. Different power sources, like fossil fuels, nuclear, and renewables, require different amounts of space to create the electricity we need to power our lives. In this video, we examine the amount of physical space different power sources need to generate electricity on a global scale, and how we can use space as a resource to achieve sustainable energy Solutions for our world.

0:07

Animation of land use for electricity.

No matter how we make electricity, it takes up space. Electricity from coal requires mines, and plants to burn it and convert the heat into electricity. Nuclear power takes uranium mines, facilities to refine the uranium, a reactor, and a place to store the spent fuel safely. Renewable energy needs wind turbines or solar panels. How much space depends on the power source. Say you wanted to power a 10-watt light bulb with fossil fuels like coal. Fossil fuels can produce up to 2,000 watts per square meter, so it would only take a credit card-sized chunk of land to power the light bulb. With nuclear power, you might only need an area about the size of the palms of your hands.

1:02

Animation of energy demand and land use.

With solar power, you'd need at least 0.3 square meters of land—twice the size of a cafeteria tray. Wind power would take roughly 7 square meters—about half the size of a parking space—to power the bulb. When you consider the space needed to power cities, countries, and the whole world, it adds up fast. Today, the world uses 3 trillion watts of electricity. To power the entire world with only fossil fuels, you'd need at least about 1,200 square kilometers of space—roughly the area of Grand Bahama island. With nuclear energy, you'd need almost four times as much space at a minimum —roughly 4,000 square kilometers, a little less than the area of Delaware. With solar, you'd need at least 95,000 square kilometers, approximately the area of South Korea. With wind power, you'd need two million—about the area of Mexico. For each power source, there's variability in how much power it can generate per square meter, but these numbers give us a general sense of the space needed.

2:02

Animation of energy sources for different environments.

Of course, building energy infrastructure in a desert, a rainforest, a town, or even in the ocean are completely different prospects. And energy sources monopolize the space they occupy to very different extents. Take wind power. Wind turbines need to be spread out—sometimes half a kilometer apart— so that the turbulence from one turbine doesn't reduce the efficiency of the others. So, much of the land needed to generate wind power is still available for other uses. But the baseline amount of space still matters, because cities and other densely populated areas have high electricity demands, and space near them is often limited. Our current power infrastructure works best when electricity is generated where and when it's needed, rather than being stored or sent across long distances. Still, space demands are only part of the equation. As of 2020, 2/3 of our electricity comes from fossil fuels.

3:04

Animation of emissions from energy.

Every year, electricity generation is responsible for about 27% of the more than 50 billion tons of greenhouse gases we add to the atmosphere, accelerating climate change and all its harms. So although fossil fuels require the least space of our existing technologies, we can't continue to rely on them.

Animation of cost of energy sources.

Cost is another consideration. Nuclear plants don't emit greenhouse gases and don't require much space, but they're way more expensive to build than solar panels or wind turbines, and have waste to deal with. Renewables have almost no marginal costs—unlike with plants powered by fossil fuels, you don't need to keep purchasing fuel to generate electricity. But you do need lots of wind and sunlight, which are more available in some places than others. But you do need lots of wind and sunlight, which are more available in some places than others.

3:57 No single approach will be the best option to power the entire world while eliminating harmful greenhouse gas emissions. For some places, nuclear power might be the best option for replacing fossil fuels. Others, like the U.S., have the natural resources to get most or all of their electricity from renewables. And across the board, we should be working to make our power sources better, safer in the case of nuclear, and easier to store and transport in the case of renewables.