



The Energy Storage Problem

Climate change is caused by **excess greenhouse gases** being released into the atmosphere. These gases can come from many different sources, such as cars, farms and factories. However, the single largest source of these greenhouse gases is energy production. Humans mostly burn fossil fuels like coal, gas and oil to produce energy. When burned, they release greenhouse gases that warm up the Earth.

ClimateScience's second book, [Sven's Search for Clean Energy](#), explains this concept in a way that is easy for children to understand without worrying them too much about the future. We end on a bright note, where Sven, Earthly, and their friend Johannes talk about what we can do to make energy without producing greenhouse gases!

This activity involves a group discussion about energy storage. This is one of the biggest issues that renewable energy faces and will require a lot of brain power to fix.

Instructions and preparation

The book is available on our website, for free. You can either project the book to the class or print out one or multiple copies. Read the book to the class or have the students take turns reading it aloud. Once finished, ask your students the following question: Now that we know we can power our cities with solar and wind power, **what do we do when the sun isn't shining or when the wind isn't blowing?**

Give them some time to think about this. Someone may mention the word **storage**. If not, you may mention that we've all seen **batteries**, and that they're able to store energy in a small cylinder so that we can use it whenever we need it. From there, we suggest talking through the possible solutions outlined below.

Possible solution 1: Well, what if we made massive batteries that were able to store all the energy that cities needed so that when the sun wasn't shining or the wind wasn't blowing we could still have energy?

Talking points: The students may think that this is a good idea, but it would be **extremely** expensive. Current batteries are not very efficient and are very heavy. Various metals and other components are needed to make these batteries, and the amount of energy they store is not on the scale needed for a global solution.





Batteries to store the amount of energy the world uses per day would cost \$70,000,000,000,000



World GDP in 2018 was \$85,000,000,000,000

In fact, if we wanted to store all the energy the world uses in one day into batteries, it would cost around 70 trillion dollars. That's a seven followed by thirteen zeroes! To put that into perspective, the value of all the goods and services produced in 2018 was 85 trillion dollars – that's everything that was made plus everything that was done for money throughout that whole year across the entire world! So, this is an impossible number to get to.

What we need to Improve in Batteries



Lighter



Smaller



Increase number of cycles



Cheaper



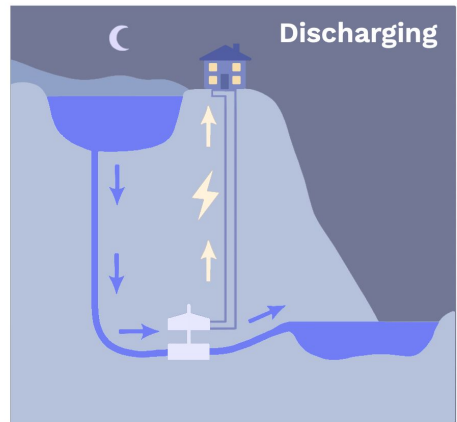
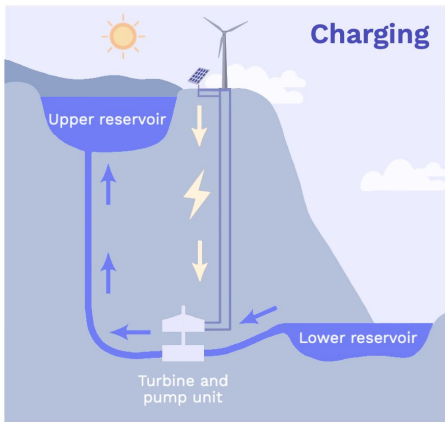
Sustainable materials



Possible solution 2: There are other options like pumped hydro storage, which uses renewable energy to pump water up a mountain into a reservoir. Then when the sun goes down or the wind stops we can release the water to spin a turbine and make electricity on demand. These reservoirs act like giant batteries!

However, it can only be done in specific locations and still wouldn't be enough to power everything. Also, flooding land to make reservoirs can cause other environmental problems.

Pumped Hydroelectric Storage

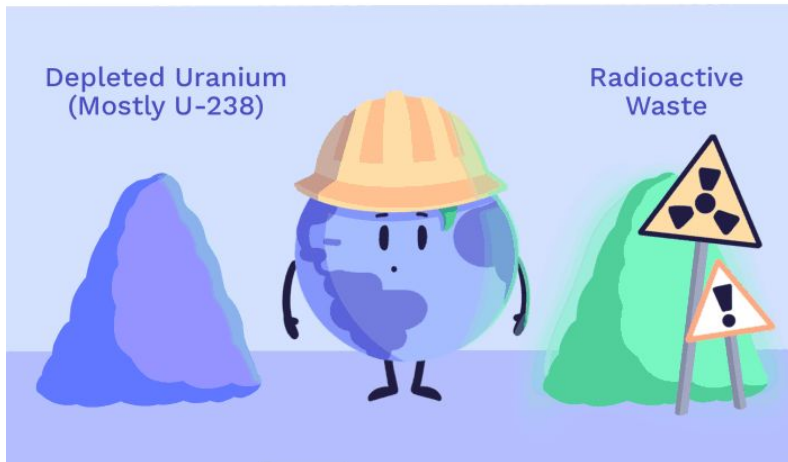


Possible solution 3: Instead of storage, we could have another energy source which is reliable (unlike solar or wind). This could be used when renewables are not producing much energy. Nuclear energy produces fewer carbon emissions and, despite some bad publicity, is actually 350 times safer than coal!

This is calculated by the number of deaths caused for every terawatt hour (unit of energy) produced. However, nuclear power produces highly toxic waste that needs to be properly stored for thousands of years!



Most Important Types Of Waste From Nuclear Power



The conclusion here is that we still haven't got it all figured out. To be able to shift to zero carbon society, we will need to put our brains together to find more ways of storing energy in large quantities!

We welcome feedback and would be delighted to hear your thoughts on this activity. Feel free to send an email to schools@climatescience.org and we'll be sure to get back to you soon :)