

Lessons from a
Teenager:
Renewable Energy
and Climate Anxiety

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The History of Windmills

The earliest recorded windmill was between 850 and 870 AD in Persia. Windmills first appeared in England in the late 12th century and spread rapidly, by the 14th century several thousand had been built in England. Windmills could be used to grind grain, pump water, saw milling of timber and processing paints and dyes. They were very popular as unlike watermills, that have to be by a stream, windmills could be placed anywhere.

How Windmills Work

There are many different types of windmills, there were 3 main styles of windmills in Europe. These were post mills, brick and stone tower mills and smock mills. Post mills were structures that were manually rotated into the wind on centred timber pots. The second mill commonly used was a brick and stone tower mill, these had rotating tops that then turned sails into the wind. The third type of mill was smock mills, these had polygonal wooden framed sides that sloped outwards at the bottom (wind energy revolution by Christopher C Gillis sr). Windmills work by having the wind turn the sails, that then the rotor moves as the sails of the windmill move helping it to grind grain or what that windmill was used for.

How are windmills used today?

Thanks to the industrial revolution and the introduction of more efficient steam engines in the 18th century there was a steady decline in windmills. This is because steam engines could produce flour that was cheaper. Traditional Windmills are no longer used today although we do use the modern version, the wind turbine to create renewable energy. They use hydroelectric power (wind power) to create electricity by having 2 or 3 blades around a rotor. The rotor then spins a generator to create electricity.

The need for renewable energy like windmills

The high oil prices during the early 1970s prompted the development of renewable energy (wind turbines). However, by the 1980s the high prices that helped start the development of renewables were gone. Though the need for renewables was not gone as there was growing evidence that the burning of fossil fuels was contributing to the greenhouse gas emissions. Wind energy (turbines) was the cheapest option of renewable energy at the time and is still one of the cheapest options along with solar.

How could teenagers become interested?

To get people interested in windmills you could create a mini windmill, or you could tell people stories about windmills- what they made, how big was it, any facts about the windmill. You could tell them about the people that worked in the mill and their stories to make it more interesting for them. You could show them the process of making the product and get people to try it themselves like making flour using the old method.

The History of Watermills

There are 5 phases of milling- human muscle, human and animal power, waterpower, steam power and the nuclear age. Water powered mills were the first to use inanimate source of power in milling. Watermills are far more effective than grinding by hand. As using the oldest type of hand quern (a quern is two circular stones rubbed together) which is a saddle quern it would take 2 hours to make half a pound of flour. Watermills could provide even more power and save labour. The first water wheel in a mill was vertical, it wasn't until 240 BC that the horizontal water wheel was used. This has been the water wheel used until the early 20th century.

How watermills work

Watermills force water to move through the blades/ turbines of the windmill. This then rotates an axle that turns all the other machinery. They are a renewable energy source as they use hydroelectric power(water) to turn the turbine/wheel. They are renewable as the water can be used over and over again and not run out. Watermills can make lumber, flour, paper and textiles. They can also make electricity. They are normally near rivers as this is the water that is moved through the watermill, but this does not have to be the case.

How are watermills used today?

In present day, some watermills are used to generate electricity. As you can connect a turbine and a generator and create renewable energy out of these old watermills. Though many watermills have been demolished. Around the 1890s writers started to write about the decline in watermills, at the beginning of the 20th century preservation work started, in 1904 the mill at troswick had its horizontal wheel restored by Gilbert Goudie (waterpower and watermills by Jonathan brown). At the end of the century more than 100 mills has been preserved. Mainly the preserved mills are corn mills however some mining and industry mills still remain.

How could teenagers become interested?

To get people interested in this topic you could tell them about the history behind each mill. You could include old photos and stories about the building to get people interested about them. You could say what type of mill they are if the mill is haunted or has any stories from records of the people that worked there. You could show them the processes and add that the women using saddle querns had the same amount of muscle as Olympic rowers.

Watermill Case Studies

Abbey Mill, Abingdon

The abbey mill, Abingdon was a watermill that made corn and has been there since at least 1890. It is based by the river Thames and there has been a mill at that location ever since the Saxon age and was rebuilt during the Norman age.

Heron Corn Mill, Beetham

The heron corn mill, Betham dated to the first half of the 18th century although there has always been a mill on that site since the 13th century. The site is looked after by the Beetham trust. The watermill has installed hydro-turbines to generate electricity, bringing it into the 21st century.

Widows Running Watermills

Some women ran their own mills like a Mrs Dickinson who ran their watermill after her husband's death in 1936. She was one of the only female millers at the time the newspaper article about her came out. The mill she ran was called the Thunder bridge and was a water mill like the mill at the abbey in Abingdon and so many others in the country. There are many processes you need to learn when running a mill – how to the stone, how to control the flow of corn. Mill workers have to run up and down the stairs in between the floors to check everything is working properly. Watermills can produce one ton of ground flour a day. Mrs Dickinson was described as very jolly and loved her work, she worked with her dog, Don.

However, there were other women running their own mills at the time like Winifred Bailey who lived in a watermill with her husband. She was the daughter of a miller and was engaged to a man named Stephen Letton before falling in love with a man called Thomas Bailey. Despite this the Baileys and Letton remained friends. Mr Bailey and Letton has to go on a business trip where he was framed by Letton for murder. Letton then sent Bailey £1800 that he owed Bailey that had blood stains on then this tied Bailey to the crime scene and although he pleaded guilty, he was sentenced to life in prison but died after 10 years. Leaving his wife to run the watermill alone. Letton confessed on his death bed to framing Bailey.

What it was like Working in a Watermill

The days at a watermill were very long during the Victorian times, often 12-17 hours. The mill Workers worked in dangerous conditions, as Robert Stone describes in his diaries that a piece of steel flew into his eye. During the Victorian times, steam powered mills were becoming more popular, and the use of watermills was declining as the steam mills were more effective. In Roberts diaries he says that sometimes the water level was too low at the mill to make flour and he had to carry it to the next mill to be turned into flour.

How to Make a Mini Watermill or Windmill

- Lolly pop sticks
- Glue
- Two cardboard boxes- one bigger than the other
- Pieces of wood- thin, long, round
- Cardboard
- https://youtu.be/jy_pGGNs9OK - YouTube video on how to make a water wheel.
- <https://youtu.be/y5ylpY44RL8> - YouTube video on how to make a windmill.

The History of Renewable Energy

During the eighteenth century, the energy source typically used was biomass like wood or charcoal. In the industrial revolution there was a rise in the use of coal due to the fact it was used to power factories. As steam engines needed lots of coal to power them and coal was a more available source of energy than wood, that was used at the time. (Hannah Ritchie (2021) - "How have the world's energy sources changed over the last two centuries?" Published online at OurWorldInData.org. Retrieved from: '<https://ourworldindata.org/global-energy-200-years>' [Online Resource])

In recent years, there has been a switch to renewable energy sources like solar, wind and water. As people are becoming more conscious about the effects that fossil fuels like coal and biomass like wood are having on the planet. renewable energy is energy that won't run out and can be reused.

Though hydroelectric power has always been used in watermills by having the water turn a water wheel to drive a mechanical process.

How do they work?

Hydroelectric(water): hydroelectric power can be used in hydroelectric dams. This is when water is stored high above ground, the dam then traps the water allowing the water to fall and spins a turbine. This then turns a generator and creates electricity.

Solar(sun): solar power is used in solar panels, these store sunlight using solar panels (panels made of solar cells). Sunlight hits the layers of silicon in solar cells that are in the panels. This creates a flow of electricity by building up the electric charge.

Wind: wind power is used in wind turbines, it is used by the wind which turn the blades of a wind turbine that then spin a generator, creating electricity. Wind power has also been used in the sails of boats and in windmills to grind grain.

How could teenagers become interested?

To get these ideas across to people you could make 3D models of these ideas and show it to them, for example, you can show the way the renewable energy creates energy to help people understand the process like the build-up of electricity in solar panels through arrows on the model. For hydroelectric power you could make a wheel connected to a mini turbine and generator and then have a light bulb at the end to show how it creates electricity. For wind power you could make a mini wind turbine and attach it to a generator and light bulb like the model for waterpower and show how it makes electricity. You could also show them an online version to show how these renewables create electricity.

Combating Climate Anxiety, Using *Not the End of the World* by Hannah Ritchie

Not the end of the world, so why do we think it is?

Parents tell their children about the horrors of climate change, to tell them their going to die because of it. Heatwaves, wildfires, floods, starvation, all things that add up to the anxiety and dread people feel. Many teenagers and young adults feel the world is doomed as we are never offered solutions to these problems. Doomsday thinking is damaging as the messages are often not true and make scientists seem less trustworthy to the public. As Hannah Ritchie says in her book we will have a future, collectively as a species and we can decide how many people get a future through our actions, but we will survive.

Hans Rosling

Hans Rosling is a Swedish physician, statistician, and public speaker. He explained the data told us about the metrics of human wellbeing. If you take a step back and look at the data, it's not as bad as you think. But instead, we look at the news that tells us the newest natural disaster we see them in the news so often we get used to them and think they are normal. They aren't that's why they're on the news. The only way to look at these problems is to take a step back and look at the data. That's what Hans Rosling did.

The world has never been sustainable.

The UN defined sustainability as meeting the needs of the present without compromising the ability of future generations to meet their own needs. This means making sure we can live a good life and so can the future generations. Although the Oxford Dictionary describes it as the property of being environmentally stable; the degree to which a process or enterprise is able to be maintained or continued while avoiding the long term depletion of natural resources. The world has never been sustainable as we have never been able to fulfil both parts of the definition.

There is no better time to be alive than today.

Number 1: child mortality has decreased significantly, and this is a recent development, for a lot of human history there was a 50% chance of living to adulthood. In the 19th century 43% of children died before their fifth birthday, now it's only 4%.

Number 2: mothers dying has decreased and giving birth is much safer for women. As nowadays the odds of dying in childbirth are 1 in 10,000.

Number 3: life expectancy has increased significantly, by the turn of the century it was 50 years old and by the middle it was 70 years old.

Now it's time for the second half of the equation

Air pollution, it kills an estimated 9 million people a year. But it is not a new thing, for as long as we have had fire we have had air pollution. We know that it is possible as in many rich countries the air is the cleanest it's ever been. Climate change, global temperatures are rising, ice sheets are melting, and we are at risk for flood. The main reason is carbon emissions. We have made progress over the last couple years in reducing carbon emissions and we've done it quickly. Deforestation, in the last 10,000 years we have cut down 1/3 rd of the worlds forest. though it may feel like deforestation is at its peak, it isn't we have made progress in fixing the problem over the last few decades.

Depopulation: breathing clean air

Air pollution is not a new thing as long as we have been burning things like coal and wood there has been pollution. We know this because of pollutants we have found in remains of people, like the preserved teeth of hunter-gatherers from Qesem cave 40,000 years ago. We have cleaned the air before, for example, acid rain was a global issue that all countries were worried about, so they brought in tight regulations and added a reactant to the smokestack of coal plants. This reduced sulphur dioxide and acid rain pollution (as acid rain is caused by sulphur dioxide and nitrogen oxides) by 95%. we have also fixed the ozone layer, when the ozone layer was depleting 43 countries signed the Montreal protocol in 1987, agreeing to phase out substances that destroy the ozone layer. Today many of us are breathing the cleanest air in centuries. For example, in the UK there was the great smog in December 1952 that killed 10,000 people but now London air pollution is a fraction of what it used to be.

Turning Down the Thermostat

In 2015 scientists said temperatures could rise by 6 degrees Celsius by 2100. A rise of 6 degrees would be devastating the ice would melt causing floods, crops would fail, and island nations would be submerged. Without policies and climate pledges that is what the world would look like. However, we seem to be reaching a rise by 2.5-2.8 degrees Celsius by 2100. This is still terrible, but it would not be as bad as if it were to rise by 6 degrees.

Many people think that the number of natural disasters is increasing as we see so many of them on the news. But this is actually not true, if you look at the data over the last half a century it has fallen roughly 10 times than what it was. Many people are unaware of this fact and in a study 48% of people said it had gone up not down. As climate change has been talked about more often there have been more misconceptions surrounding it like the one about natural disasters.

How Not to Eat the Planet

If all the planet's food was shared equally, we could all have 5000 calories a day. The world has made a dramatic reduction in hunger. For example, Haber-Bosch made a product that bonded nitrogen and hydrogen to get it into a form plants could use (ammonia) this is now called fertiliser. It was introduced in the middle of the century and was really popular in the US and became an essential to the agriculture industry. This means we can grow more food than we can ever need.

Today in wealthier countries, we feed food to animals and use it in other products but in poorer countries they use more than 90% of the food for humans. For example, ¾ of the world's soy is fed to pigs and chickens and cows. Most calories are wasted when we feed livestock for meat.

Seeing the Wood for the Trees

By the 15th and 16th century many rich countries were running out of forests as they were burning wood for energy. Three quarters of British and French forests have been cut down. This is when most countries switched to coal which produces twice as much energy. In the UK one thousand years ago 15% of the country was forest but by the 19th century it was only 5% but is now growing. When countries get rich enough, forest stage their comeback. Like in France in the 1800s wood per person plummeted from 1.8m³ in 1815 to 0.2m³ in 1900. We have lost one third of its forest since the ice age, this is mainly due to agriculture as it has been the driving force for deforestation.

Today deforestation has fallen from its peak in the 1980s and has regrown about 50 million hectares of forest. Overall deforestation rates are still worryingly high with having the highest rates of deforestation in over 15 years. Rich countries are gaining forest, low income countries are losing theirs. Forest cover follows a u shaped curve that also tracks those countries development. This curve has 4 stages- the pre-transition phase, a country has lots of forest and is not losing much over time. The second stage is the early transition phase, countries start to lose forest rapidly. The third stage is the late transition phase, this is where deforestation slows down and countries are still losing forest but at a slower rate. In stage 4 the post transition stage, countries start to gain forest, either it regrows naturally, or the trees get replanted.

Biodiversity Loss: Protecting the World's Wildlife

The Washington post said that two generations of humans have killed off more than half the world's wildlife population. Headlines like this get attention all the time when the world wildlife fund publishes a big report of the state of wildlife in the world. And the numbers get misinterpreted. These are measured in the living planet index (LPI) and it measures the change in species abundance (a large quantity of something). almost half the populations are increasing – 47% of mammal species have increased.

We haven't lost more than half of all species in a decade as then we are very close to mass extinction of lots of animal and that is not true. Although, wildlife populations are struggling and

have been when humans first arrived in Australia a giant kangaroo species went extinct and in south Africa where a land sloth went extinct after humans moved there. People have been driving wild mammals into decline for a long time. In 1900 wild mammals only made up 17% of total mammal biomass.

Overfishing: Pillaging the Oceans

In 2006 a man named Boris Worm said there would be a global collapse of fish species by 2048. When Worm was writing his paper in 2006, we didn't have much data on the abundance of fish and so when he said there would be a collapse in fish species, he was talking about the number of fish we catch. We would say the fish species had collapsed if the number of fish we caught fell below 100,000. This didn't mean there would be no fish left just a significant decrease which is still not good.

What does fish sustainability mean? There are two main thought processes to sustainable fishing- views fish as animals and if they are endangered like animals, we should let them increase back to the populations that they were. The other thought process is that fish are a resource as many people have jobs from fishing. scientists can calculate a good number of fish to have an enough but not deplete their population. This would make them biologically sustainable.

Ocean Plastics: Drowning in Waste

There have been claims that by 2050 there will be more plastic in the ocean than fish, but we don't actually know how many fish are in the ocean. There are between 2-5 billion tonnes of marine life in the ocean. People have dumped plastic into the oceans for a long time and a consequence of it effect id the great pacific garbage patch. It is 1.6 million square kilometres. Some plastic end up eaten by sea creatures and the waste ends up in the stomachs of whales and turtles. Plastic was invented by a man called Leo Baekeland and became very popular as by the millennium the world was producing 200 million tonnes a year.

This leads up to today, where plastics used in almost everything and the average British person produces the weight on an average man in plastic every year (its 77 kilograms). Packaging is the most common use for plastics, as 44% of the world's plastic goes to packaging. If we want to stop plastic pollution, we should stop using so much single use plastic that cannot be recycled. Unfortunately, most plastic ends up in landfill and recycled plastic is only used for something else once or twice. The biggest problem with plastic is how to dispose of it as it can stay for millions of years. The focus currently is on cleaning u rivers, so plastic doesn't harm animals and get into the ocean.

Conclusion

There are three things to remember, being an effective environmentalist may make you feel like a really bad one. Like eating apples from France, as local food is no better than food that has been shipped in. Number 2 - systematic change needs to happen, we will not make change though individual behaviour, we need political and economic change if anything is going to change. Number 3- work with people who want to help solve the problem, there is no point working with people who are not interested in solving the problem.

We can be the first generation to be sustainable. We have made progress towards it for years like in Beijing, which used to be known to have some of the worst air quality is now not even in the top 200 polluted cities. They did this by enforcing tough regulations on industrial plants, shut down coal stations, took old cars off the road and switched from coal to gas. This all helped the air quality, and we could do this everywhere and get better air quality in the world, it is possible.

Ideas for Further Exploration

To get people interested in this you could tell them more stories and statistics as they are comforting and interesting as it's our future. Tell people what they can do to help stop climate change like getting a bus. You could explain a bit more about climate anxiety and why they shouldn't be stressed about it cause compared to other times in history it's not that bad.