

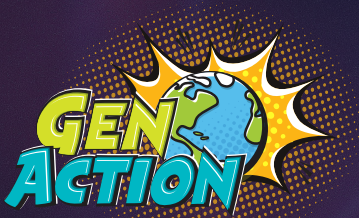


SCIENCE
SPOTLIGHT

ATOMS AND WIND
KEEPING US POWERED

This project was undertaken with the financial support of the Government of Canada.

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Atoms and Wind Keeping Us Powered

Origin Story:

GREEN OPTIONS TO THE RESCUE

Modeling the Future

Large amounts of carbon dioxide, or CO_2 , have been put into the atmosphere through our burning of fossil fuels, like oil and coal, leading to climate change. Scientists are now looking for solutions to help address this issue, while still continuing to raise the standards of living for millions of people.

Different communities need different amounts of energy, and how much they need changes over time. Energy can come from many sources, including burning fossil fuels, solar power, wind power, and nuclear power. Scientists can create **models** to compare how much energy we need to how much energy is available from different sources.

What Are Scientific Models?

Models are how scientists understand the world around us and can help them make predictions about the future. Scientists observe the world around them to gather data, then analyze the data to create a model. This model is a representation of events, ideas, or processes and can help scientists and researchers understand and find patterns within complex systems.

When creating these scientific models, researchers consider economic, environmental, and social impact factors. These models can be used by decision-makers to understand how much energy is needed, and where it can be found. This will help them figure out the best policies to replace the current energy generation that creates CO_2 with green alternatives.

Creative and Impactful Solutions

One of these studies was conducted by a group of researchers from the University of Regina, led by Dr. Guohe Huang in Saskatchewan. This province currently generates heat and electricity mainly by burning fossil fuels in the form of coal and gas, but like the rest of the world and Canada, it is working on transitioning to green energy sources that will help its citizens enjoy a better future.

This group of researchers proposes replacing Saskatchewan's current coal plants with two combined sources of energy generation, wind and nuclear. Wind energy would be produced in the form of wind turbines, and nuclear energy produced by using Small Modular Nuclear Reactors (SMRs). The combination of these energy sources will provide energy autonomy to the province in the future without releasing more CO_2 into the environment.





Did you say nuclear ?!



Atoms and the Power Within

Every atom in the universe is held together by enormous amounts of energy. We can harvest this energy by splitting the core, or nucleus, of these tiny particles in a process called fission. This process is done in a nuclear power plant.

One key aspect of nuclear energy generation is known as a chain reaction. In the case of nuclear energy generation, it is a process that starts with a particle hitting and splitting an atom. The result of this collision is energy and the release of multiple smaller particles that will repeat the process of splitting atoms and releasing more energy and more particles until the source of energy is consumed.

LOCATION, LOCATION, LOCATION

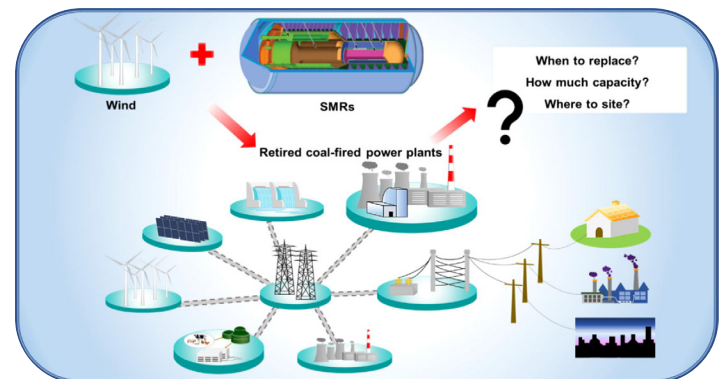
One big challenge when replacing energy generation sources is connecting the new source of power to the places where electricity is needed. Electrical power gets to our homes and businesses through the power lines that are along streets - this system is called the electrical grid.

In the case of Saskatchewan, the creative solution is to build the new power plants, friendly to wind and nuclear energy, in the same place where the old generation power stations are located. This solves the problem of connecting the new source to the current grid, lowering costs, and speeding up the process, and also ensures the closure of the previous carbon-emitting power plant.

SMALL MODULAR NUCLEAR REACTORS (SMRS)

SMRs, like all nuclear power plants, provide stability to the power grid because electricity can be produced all year round, regardless of the weather or time of day. Compared to traditional nuclear reactors, SMRs are recommended by researchers because they:

- Have lower cost as they can be mass-produced in factories, instead of on location.
- Are generally simpler and safer as they incorporate extra protection measures in their design.
- Require less fuel.



The image is taken from the Paper "Development of an optimization-aided small modular reactor siting model - A case study of Saskatchewan, Canada" by Liu, Yanyan, Guohe Huang, Jiawei Chen, Xiaoyue Zhang, Xiaogui Zheng, and Mengyu Zhai. 2021. "Development of an optimization-aided small modular reactor siting model - A case study of Saskatchewan, Canada." Applied Energy 305, no. 2022, 1-15. <https://doi.org/10.1016/j.apenergy.2021.117867>

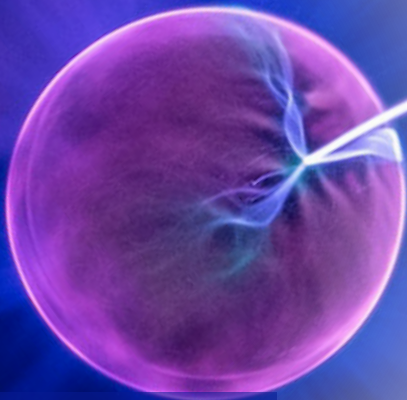
The Wind Moving Us Forward

Due to Saskatchewan's geographical location and topography, wind is an attractive and important source of energy to incorporate in the replacement of non-green alternatives.

Wind power is the generation of electricity by capturing kinetic energy, the energy that objects have because of their motion, present in the wind. To capture and use this energy, turbines connected to generators transform the rotation of the blades into electricity.

Wind power is a viable alternative to supplement energy production within the province because:

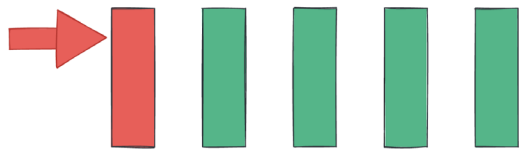
- The region, due to its geographical location, is rich in wind resources. The winds in the area are strong and abundant.
- The technology is environmentally friendly, renewable, and safe.
- There is support from the province and the community.



Try This at Home: CHAIN REACTION

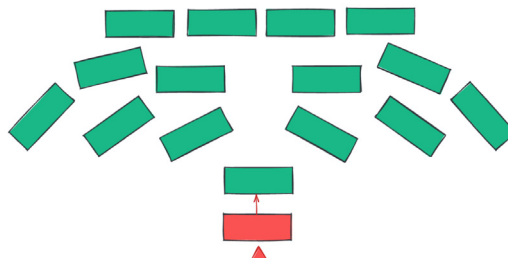
Experiment with two different types of chain reactions by using dominoes. With this experiment you will experience a chain reaction that grows linearly, meaning that it grows by the same amount for as long as it runs, and the other grows exponentially, meaning that it will speed up at a rate proportional to the number of elements in the reaction.

Design One - Linear Growth



1. Create a line of dominoes following the image above. Use as many dominoes as you like.
2. Tip the first domino and time how long it takes for all the pieces to fall.
3. Note down the time.

Design Two - Exponential Growth



1. Replicate the design above, using the same number of dominoes as you did in Design one.
2. Tip the domino at the bottom of the structure and time the reaction.
3. Note down the time.

Compare the two different times. The second design illustrates the process happening on a chain nuclear reaction as each element in the design will trigger two new reactions (hit two dominoes).

Time for **GENACTION!**



CLIMATE ACTION

When dealing with large-scale projects such as closing coal power plants to lower CO₂ emissions, the best tool we have as citizens is participating in the democratic system and directly contacting and asking our elected representatives for effective policies that will help us see a better future.

You may be too young to vote, but you are a powerful climate ally. By learning about climate change and particularly about the technologies discussed in this spotlight, nuclear and wind energy, you can create change in your community, starting with those close to you. Knowledge shared is the power to make the world a better place.



Climate Change Past, Present, and Future

Earth is the only planet in the solar system known to support life. What makes our home so special? Earth has an atmosphere, a layer of gases between our planet and space. Some of these gases, like carbon dioxide, are called **greenhouse gases**. They are crucial parts of our atmosphere; they trap in the heat of the sun, similar to how heat is trapped in a greenhouse, or in a car on a hot day. This process, called the **greenhouse effect**, keeps Earth's temperature warm enough for living things to thrive.

The sun's rays hit our round, tilted planet unevenly. This uneven heating of Earth's surface leads to differences in temperature, which drives weather patterns. We call the patterns in temperature and weather over long periods of time **climate**. Different parts of the world have vastly different climates; it depends on how much heat they receive, as well as what landscape features are nearby. Water, mountains, ocean currents, and forests all impact our climate. In turn, living things around the world have adapted to the climate they live in.

Something, though, is changing. Over the past two hundred years, humans have been burning fossil fuels, such as coal and oil, to make energy to power our daily lives. Fossil fuels are made from decomposed plant matter and microscopic life millions of years old. This matter is full of carbon, and, burning it releases, or emits, billions of tonnes of **carbon dioxide** gas into the atmosphere every year. When too much carbon dioxide is emitted, the delicate balance of greenhouse gases maintaining

Earth's climate is upset. More and more heat is trapped, causing the planet to warm. Weather patterns change, water

levels rise, storms get worse.

Climate has changed many times throughout Earth's history, from ice ages to periods much hotter than today. So why is this time any different? Scientists agree on two things. One, temperatures are rising faster than they ever have in documented climate history. Two, this climate change is driven by human activities, due primarily to greenhouse gas emissions.

Climate change is already impacting people's ways of life all over the world. Powerful storms, droughts, forest fires, and floods are threatening people's access to food, water, and safe homes.

The most important step we can take to prevent serious climate change is to reduce greenhouse gas emissions. Incredibly brave and caring people around the world are finding new ways to reduce emissions and make our communities climate resilient every single day. And you can join them! These Science Spotlights are here to help us learn more about climate change and how you can take action.

Our Commitment to the Decolonization of Science

Institutions of GenAction initiative respect and affirm the inherent and Treaty Rights of all Indigenous Peoples across what we now know as Canada. We give thanks to the Indigenous Peoples who care for this land since time immemorial and pay respect to their traditions and ways of knowing. We acknowledge their many contributions to innovations in Science, Technology, Engineering, and Mathematics, past and present, and are committed to deepening engagement and collaborating with Indigenous Peoples as partners in order to advance truth and reconciliation and the decolonization of science.

