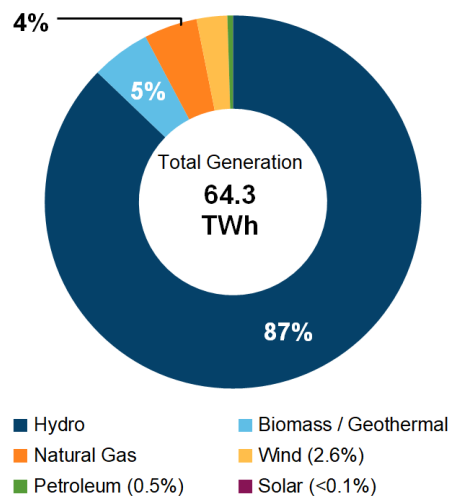


# Goatsville

The name of our city is Goatsville. It is located in British Columbia with a population of 150,009. It is in a coastal area with mountains nearby. The climate of our city is cold and wet. 100 years ago, British Columbia relied on renewable energy, mostly hydroelectric, for 87% percent of electric power. Goatsville still sadly relied on fossil fuels for the remaining 13%. This included coal and natural gas from fracking. Today, we are the first city to use a *combination* of fusion and hydro.

The main impact of using fossil fuels was CO<sub>2</sub> emission, which caused global warming. Natural habitats changed so rapidly that animals could not adapt to the new environment. For example, icebergs melted, which caused floods. Animals died of the liquefied ice. It also caused sea levels to rise, which flooded coastal areas such as Florida. People had to move to different areas, which led to places overflowing. Using fossil fuels increased air pollution which harmed people with respiratory issues and made it harder to breathe. The city also relied on fracking that could contaminate water sources. Finally fossil fuels are finite. If the world hadn't moved away from them, we may have run out of oil 50 years ago and recently coal as well.



## Fig 1. Goatsville Energy Production, 2023

People would want to live in our city because we use clean, renewable and sustainable energy from two sources: nuclear fusion, and hydropower. No traditional fossil fuels are involved, which reduces further air and water pollution.

The main source of energy in our city is nuclear fusion. Fusion occurs when a group of one proton and one neutron, called a nuclei atom collides with another nuclei. The protons have the same magnetic force, hence they will repulse each other. They won't collide unless they are at high speed.

For them to move really fast, the temperature around the area has to be approximately 16,000,000 Celsius. There are two ways to make nuclear fusion happen. One way is to build a large magnet ring and provide a force field. You need to raise the temperature to around 16,000,000 Celsius inside the force field. Another way is that you use a lot of powerful lasers and start shooting them in a massive container, which contains the atoms needed for the fusion.

When the atoms collide, they will form a single heavier atom, called a nucleus. The process releases energy because the total mass of the resulting single nucleus is less than the mass of the two original nuclei. The leftover mass becomes energy.

The next step is converting energy into electricity.

1. The kinetic energy of the fusion products is converted into heat when they strike and penetrate the walls of the reactor. The shielding is designed to stop the particles, spreading out their kinetic energy so that it becomes the motion of many particles. That is, almost all of the energy from the fusions will show up as heat in the reactor shielding.
2. The heat in the shielding is converted into mechanical power through the use of a heat engine. These engines are governed by the limitations imposed by Carnot efficiency. Carnot efficiency describes the maximum thermal efficiency that a heat engine can achieve as permitted. High-quality modern turbines can convert with

approximately 33-48% efficiency depending on temperatures, quality, and working fluid. That is, only 33-48% of the heat energy will be converted into mechanical power.

3. The mechanical power is converted into electric power through various generator technologies.

Nuclear fusion is among the most environmentally friendly sources of energy. No harmful emissions will be generated from the process. Global warming would be significantly alleviated.

Many other benefits exist. This includes that it's an almost inexhaustible energy source without utilizing fossil fuels, making it a clean and reliable energy source.

However, some risks and drawbacks also exist. For example, although nuclear fusion is great, it's only nearly 100% efficient. That is, almost all of the energy from the fusions will show up as heat in the reactor shielding. A small amount of it will go into nuclear reactions caused by the particles hammering the shielding. (You need to use approximately 500 megawatts of energy to use fusion.)

Many engineers, specialists, and physicians from various backgrounds work together in a nuclear fusion plant. These include nuclear engineers, who take a main role in nuclear fusion technology, plasma physicists, who study the relationship between plasma and fusion, environmental specialists, who monitor the impact of the nuclear fusion process on animal and human health, mechanical and aerospace engineers, who work side by side designing the shielding withstanding fusion and finally, electrical engineers, who work on converting fusion energy into electrical energy.

After the initial fusion, the energy generated can be used to power further reactions like creating limitless supply. The material needed for fusion is deuterium, which can be extracted inexpensively from seawater, and tritium produced from naturally abundant lithium. They both are easily attainable materials without disturbing nature. Also, fusion doesn't generate any greenhouse gas.

If you know what a nuclear bomb or nuclear fission is, you might worry, “What would happen if the fusion fails? Would there be any dangerous explosions?” Well, that’s not possible because fusions don’t act like bombs. If it fails, all the atoms will simply stop moving. An explosion isn’t possible.

Our city's second and backup source of power is hydropower. It is fast and efficient, and it is created by using falling or fast moving water to generate electricity. For example, if there is a lake on top of a mountain and there is a river flowing from it, the rushing motion of the water is mechanical energy, as with Goatsville. Then you can station a turbine in the water to generate electricity.

Goatsville is a great place and will be a safe and satisfying place to live.

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# Centropolis

Hi, we are Centropolisians! Our city used to be named Hong Kong. Hong Kong as a city in 2023 was destroyed in The Battle of Hong Kong and now in 2123, we have managed to rebuild the city and have renamed it Centropolis. Centropolis means the center of the world. Before the war, Hong Kong had a population of 1.6 million people but when the war happened the population dropped to 500,000 people. However, our current population has risen to 7.5 million.

Centropolis is a coastal city and a major port in Southern China right next to the beautiful south China sea. Centropolis has a humid subtropical climate with hot, humid summers and mild, drier winters. Centropolis's terrain is hilly and mountainous with steep slopes. It includes 6% arable land and lots of natural harbors.

Imports, exports, fishing, and manufacturing are the main sectors of Centropolis's economy. When we were rebuilding the city, it gave us a chance to fix all the problems that existed in Hong Kong! It wasn't easy but we did it! We are now 100% electric! Let's see how we did it!

We first identified the problems that existed in Hong Kong. Hong Kong used a lot of coal, natural gas, and other fossil fuels to make electricity. Because they used all these non-renewable energy sources, the air got polluted and that harmed the environment and the people living there. It also increased the carbon footprint. Hong Kong's government did not maintain the power plants well which led to a lot of electricity getting wasted in distribution. Because clean energy costs a lot of money they did not invest enough. Infrastructure buildings like hospitals, schools etc. were built poorly which meant a lot more electricity was used for heating and cooling the buildings and for medical equipment to run. Even though Hong Kong was a small city it had a lot of people. Hence there were a lot of vehicles and mostly not electric which caused lot of air pollution.

Next, we looked at our natural resources. One of the things that makes the city special is that we have lots of natural resources to help us make electricity in a clean and green way. The sun shines bright, the wind blows strong, and we're surrounded by the sea acting like gifts from nature.

Let's see what our city engineers came up with, as a solution to get Centropolis 100% electric.

- **Solar energy-** In Centropolis, the engineers have made use of the abundance of sunlight around us by installing photovoltaic panels on all rooftops and other surfaces to convert the harnessed sunlight into electricity. We also store excess energy in battery storage systems to be used during cloudy days or at night hence providing continuous power supply. Solar panels are eco-friendly. Civil engineers have also installed geothermal heat pumps deep underground to capture Earth's natural heat which is used to generate electricity.

This energy is used as a source of power in Centropolis. The scientists have come up with new ways to transmit energy along with the internet and other utilities.
- **Transportation** -Here in Centropolis we made EVERY vehicle electric. Every vehicle has regenerative braking where they convert kinetic energy into electric energy during braking which is then stored in batteries and used to power vehicles. Solar panels are installed on the vehicle surface which captures sunlight and convert into electricity and runs the vehicle.
- **Informed Community**-People in Centropolis are very responsible when it comes to keeping the city green and 100% electric, it's a big change when compared to how we were back in Hong Kong 100 years ago. This is because the city government has taken a lot of initiatives to keep all communities in Centropolis aware of the advantages of 100% green electricity. The generated household waste passes through compactors and incinerators. Engineers have transformed incinerators using advanced technology like scrubbers and filters to capture pollutants and have incorporated energy recovery systems to harness heat generated to further be used to generate electricity.
- **Construction Materials**- Back in 2023 in Hong Kong, almost all buildings were very old and used materials that used way too much electricity for heating and cooling buildings. Here in Centropolis architects have designed the city using construction materials that reduce electricity usage. All buildings are well insulated with reflective roofing materials and energy efficient windows and smart glass that adjusts its tint based on outside conditions optimizing natural light. We also use energy generating materials such as photovoltaic integrated materials with solar cells incorporated within turning the structure itself into a source of renewable energy.
- **Wind Energy**-In Centropolis the engineers have installed windmills and wind turbines in locations with consistent and strong wind patterns. The windmills are spread through the city and further out in

the sea. The kinetic energy from the wind is harnessed by the turbines converting it into electrical energy. We have storage methods such as use of batteries and pumped hydro storage where excess energy is used to pump water to a reservoir and when electricity is needed the stored water is released to generate power.

In conclusion, Centropolis has become a shining example of a 100% electrified city powered by renewable energy. By relying on renewable energy sources, we have reduced our carbon footprint. We have energy independence as we use our natural resources which gives us more energy security. There is an increase in people working in the renewable energy sector hence increasing the economy of Centropolis. Our city engineers have been called to educate on their design and efficient usage of natural resources by a lot of other urban cities hence increasing Centropolis's global standing. We have become a hub for innovation in sustainable technologies attracting businesses, researchers, and others. Centropolis is thriving greatly and is a green paradise and a great place to live. It's not magic; it's just a little bit of science, a dash of creativity, and a lot of heart!

Word count 992



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**Aloha! Welcome to Zincormaba. Zincormaba is a city located on the island of Hawaii “The Big Island,” in the state of Hawaii, in the south west of Waimea. The population of Zincormaba is 321,127 with an area of around 80 square miles. In Zincormaba, some of our natural features are high cliffs, valleys, lakes, oceans, and rivers.**

**In Zincormaba, we have several jobs available for anyone that has the right skill set. We relied heavily on our engineers when designing our city years ago. Our civil engineers made sure our city was laid out well, while our marine engineers made sure that we protected our beautiful surrounding ocean. Electrical engineers were the most important people we had on our island, since we were converting everything into renewable electricity. Of course, we have all the jobs that a thriving and responsible city would need, such as doctors, first responders, teachers, and more. We have a large population of people that work at our renewable power plant. Our education system in Zincormaba is excellent. Our highly trained teachers make sure that students are well prepared for the next stage in learning. Most of our students go on to higher level educational classes, and we also**

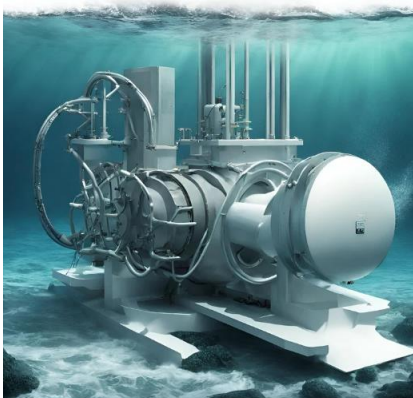
encourage students to learn a trade such as electrician, farmer, or plumber. Many doctors are well trained by professionals so we can ensure our city will be safe and healthy for everyone. All of our first responders are trained to do many jobs in the field. First responders must be trained in many different areas because we are such an isolated island. One of the improvements we made to our fire department is the use of fire extinguisher balls. The balls were invented in early 2000, and unfortunately they were a great idea, but not successful. Now our departments use a variety of sizes for different types of fires. They range in size from handheld, to ones that need to be transported by a helicopter. For travel, most people use electric cars to get around the island, however, we encourage our citizens to use bikes, skateboards, and possibly even electric scooters because it promotes good exercise and is beneficial since our city is very populated. Hyrosopic Transport is one of our proudest creations. It is a traffic solution that keeps the roads clear in case of wrecks, or reckless drivers. It is able to move the wreck, injured passengers, and bystanders safely out of the way of the flow of traffic; as well as provide transportation to medical facilities. Our citizens have a wide range of housing options to choose

from to ensure their needs are met.

**In 2023, the leadership of our city decided that they needed to stop the dependency on fossil fuels to run our electrical grid. Hawaii has to import all coal, oil, and natural gas across the ocean, the cost is very expensive to ship overseas. Citizens pay almost double or even 3 times the amount for petroleum, natural gas, or oil as other citizens of the continental United States. We knew we had to come up with a better solution for electricity. Hawaii is already an expensive state to live in, because all food, goods, and building supplies must be shipped from other countries. Since Hawaii is sunny 90% of the time, then the natural solution would be solar power. We started by putting solar panels, rods, and pyramids on all new buildings. We provided incentives to current residents to put solar panels on their houses or businesses. Because we are surrounded by an ocean, our marine engineers designed hydroelectric**



**tidal power plants that would not take away from the beauty of our beaches or harm our marine life. We took advantage of wind turbines by placing them high on the cliffs. In 2053, we decided to help the citizens of Zincormaba to reduce the cooling costs of their homes. We converted all of our apartments and housing editions to geothermal energy. Although this was at an extremely high cost for our city, and our citizens in the beginning; we knew in the long run it would make our city better. We lost several long term residents due to the high cost, but we gained many that wanted to see us improve the environment. This impact of power is the most important part of our city structure. Before we went to 100% renewable electricity, our city was polluted by the use of fossil fuels, and it came at a high price to our citizens. It was worth it in the long run to make sure the beautiful state of Hawaii was preserved. As of 2123, Zincormaba is no longer dependent on fossil fuels.**



**Zincormaba is located on the most active island of all the Hawaiian islands. There is a constant threat of Kilauea erupting, or even Mauna Kea**

**erupting. Kilauea has been known to burn down multiple parts of Hawaii. We have a big titanium-tungsten wall to make sure you're safe during volcano eruptions. Titanium-tungsten will not melt with normal lava flows. The wall is adjustable, and can raise up to 50 feet. This will provide a barricade so our citizens can relocate if needed. This is one way we keep our citizens safe and their homes protected. We care about your safety and health here to make sure you're okay during these situations.**



**Zincormaba is a wonderful place to visit, but an even better place to live. Since we are 100% self-sustaining with renewable resources, our cost of living is lower than the rest of Hawaii. What you save on electricity, can be used for living resources and housing. Aloha!**

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# Hydropolis

**Welcome to Hydropolis! Our city is located southwest of Stockholm, Sweden, close to the Motala Ström River. Our population is around 537,000 people. Hydropolis was settled in 1947 and named because of our location to water sources. The climate in Hydropolis, Sweden gets very cold in fall and winter, and in spring and in summer it gets a little warmer. The temperature can be as low as 23°F to 71°F.**

**Many of our citizens choose to live in Hydropolis because of technology driven society, and the amount of engineering jobs available to the public. The majority of our housing is apartments, however, each apartment is equipped with individual balconies that can also serve as miniature greenhouses with hydroponics. Each apartment comes with one hydroponic tower, with the availability to rent more for larger families. Due to our city layout and flat land, our citizens are able to bike more often to run errands and get exercise. Our great city provides public transportation like trains,taxis, and buses. We have several types**



**of parks that cater to different groups such as: dogs, golf, children, and sports. We have year round fishing in both cold and warm seasons. Our jobs are plentiful, most of our jobs are work from home, with the occasional trip to the office. We have several engineering jobs that help keep our city running. Our civil engineering department works with our food and farming engineers to help keep our citizens healthy. Project engineers work with construction to make sure that all houses or apartments are able to grow their own food. Our engineers work together to make sure our city runs well.**

**Most of Sweden already uses renewable energy, however there were some concerns about the nuclear power plants. We did not want to be that close to a plant in case of a nuclear meltdown. We decided to make a switch to 100% renewable and clean electricity. We also had problems when the power grid was overloaded. When the power went out we didn't have enough stand alone generators to power houses during outages. For 6 hours or more, our citizens would have suffered in the cold and it impacted our pipes, plants, and**

**communication.**

**Our citizens asked our leaders to come up with a solution for generating power and electricity without using nuclear energy and help out during the winter months of cold. We already use hydropower, solar, and wind, so we added biomass and geothermal. Our main source of energy is hydroelectric and wind, however we boosted their capacity by making them stronger with better turbines. We turned the nuclear power plant into a giant geothermal plant since all of the parts for the plant were already underground. Our biomass production increased because we had more farmland and used corn to make fuel. Of course, it did cost a lot of money for people to change their cars to run on corn fuel or electricity. Although most people kept their jobs when we switched to a geothermal energy, some of our nuclear scientists had to find a new job.**



**Sweden is known for its cold weather, and mild summers. Most of the time people need a**

**jacket. We have rechargeable electrified jackets that will work for hot and cold weather.**



**Additionally, we have drones that are stackable. Each drone can serve as a small generator in case of a power outage or other emergency. The drones are sent from**



**underground to the places where they are needed. Each drone has enough battery power to last 2 hours for an individual house. If more power is needed, another drone is sent out and will stack on top of the other drone. As soon as the emergency is over, the drones return to the charging base.**

**Since most people work from home, we have helper bots that not only keep the city clean, but they can be bought for personal use as well. These bots are solar powered, and have a long battery life. They can do just about everything from washing windows to emptying**

**the trash. We even have tracking robots that work alongside the police officers. They can follow the criminal, and even detect movement and heat signatures through walls. They can be programmed to hold a criminal until a human police officer arrives.**



**These bots are unhackable due to the enhanced technology we have put in place.**

**Our fully electric vehicles have large battery packs inside that will last for about 630 miles per charge. This is a major improvement from the early 2000's electric cars. We also have fast charging stations around the city in parking garages, public parking, and even city parks. Our charging stations can charge a medium sized vehicle in about 10 minutes. However, the price of charging a vehicle costs about \$5 per minute. This is more expensive than charging from your home.**

**Hydropolis is a unique city with high end technology. We do not rely on any fossil fuels to power our city. Although it was difficult convincing our citizens to switch to 100%**

**electric, it was worth it for keeping our city beautiful. We hope that many more people will come and live in Sweden.**

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