**Science 9 – Environmental Chemistry Project Plan**

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**Issue:**

*Should nuclear power or biogas power plants be used as a new alternative to generating clean electricity in Alberta?*

**Source of Info for research (Bibliography):**

NUCLEAR: (Section was compiled on Feb. 9, 2011)

* <http://library.thinkquest.org/06aug/01335/nuclear.htm>
* <http://www.kids.esdb.bg/uranium.html>
* <http://tiki.oneworld.net/energy/energy7.html>
* <http://en.wikipedia.org/wiki/Economics_of_new_nuclear_power_plants>
* <http://ca.answers.yahoo.com/question/index;_ylt=Ap4Op2f2SkQP8Ig2heHe9bzpFQx.;_ylv=3?qid=20080708102010AASoQbI>
* <http://ca.answers.yahoo.com/question/index;_ylt=AoG3GETqWv1Ft8Bc.vpi4_zpFQx.;_ylv=3?qid=20091019194850AAxbnCB>
* <http://www.dulabab.com/energy-transportation/nuclear-power/>

BIOGAS: (Section was compiled on Feb. 11, 2011)

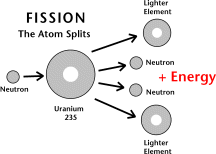
* <http://www.energy.alberta.ca/bioenergy/1109.asp>
* <http://www.energy.alberta.ca/BioEnergy/pdfs/FactSheetBioenergy.pdf>
* <http://ca.answers.yahoo.com/question/index;_ylt=Ap4Op2f2SkQP8Ig2heHe9bzpFQx.;_ylv=3?qid=20080708102010AASoQbI>
* <http://uk.answers.yahoo.com/question/index?qid=20100912094907AAXPfX2>
* <http://wiki.answers.com/Q/What_are_the_advantages_and_disadvantages_of_biogas>
* <http://wiki.answers.com/Q/What_are_the_disadvantages_of_biogas_plants>
* <http://greenanswers.com/q/58846/energy-fuels/alternative/biomass/what-are-advantages-and-disadvantages-b>

**Guiding questions: (these will help in background info and POV generating)**

1. How do the (plants) generate electricity?
2. Are the plants effective and safe to operate?
3. Are they reliable sources for electric energy?
4. What are economic effects caused by the use of these plants?
5. What are consequences of using these alternatives?
6. What external factors may affect the process of generating electricity (for these plants)?
7. What are some “political” / government standpoints on the issue?

**Proposed alternatives:**

**Nuclear power plant:**

Nuclear power is a very “bright” hope for clean energy in the future; since the 50’s nuclear energy plants have been popping up around the world. Electricity can be achieved through two nuclear processes – fusion and fission. Fusion is when atoms fuse together and release energy, just like how the Sun releases energy. Fusion cannot be performed conventionally on Earth yet as extremely high temperatures and control is required, so the process cannot be used for now. ***\**** Fission however is a practical process for generating electricity – neutrons are shot at uranium atom fuel pellets to split it, unleashing large amount of energy and a chain reaction that continually generates enough steam to drive a turbine and generate electricity.

**Advantages of this method: (P)**

* Nuclear energy, for now, is a renewable and reliable way of generating electricity.
* Much more effective than traditional coal fire plant – 250 g uranium produces 20000 times more electricity than 250 g coal. Lots of electric power – one plant = a whole city!
* Surprisingly clean to atmosphere –virtually no harmful greenhouse gases (COx, NOx, SO2) is produced.
* Little waste is produced! Waste is stored in very much fire, water and earthquake-proof capsules.
* On the long term, it is pretty cheap to run, and can run long.
* Miscellaneous economic advantages (ex: cheap to run)

**Disadvantages of this method: (M)**

* Pollution in form of radioactive waste. Dangerous to organisms. (Process is getting cleaner too.)
* Accidents can happen – for ex: radiation leakage, plant meltdown, human error (like Chernobyl)
* Expensive to build. There will be downtime for maintenance.
* Not entirely renewable, if uranium resources run out, the plant will be useless.
* Uranium transport and radioactive waste storage an issue of its own.

Interesting:

***Clean to environment, but potentially dangerous way to generate electricity.***

Point of view analysis: (POS = Positive) (NEG = Negative)

*Scientific (POS):* Nuclear power plant is by far the most “environmentally friendly” power generating plant available. Data and studies show that while coal fired plants generate 950 – 1000 g of CO2 per kWh of electricity; nuclear power plants generate only 5 g of CO2 /kWh! That is huge difference! Nuclear power plants are clean and effective.

*Technological (POS):*  Use of nuclear fission technology in generating electricity is clean, reliable and very efficient. Instead of an inefficient system (like burning coal,) this system is more efficient –a lot less Uranium is needed to produce larger amounts of electricity. It can sustain the energy needs of the people while (with no harmful greenhouse gas emissions) not impacting the environment. The technology is developed and safe to use on a mass scale. The technology is also not restricted by weather conditions (like sun and wind,) so it is easily deployable.

*Environmental (POS):*  Nuclear fission is a great alternative to current day electrical generation technologies; it has very little impact to the environment in terms of air and water quality. If properly managed and controlled, this may be the wonder power generator that doesn’t toll the environment!

*Environmental (NEG):*  The radioactive waste nuclear power plants produce from fission is very toxic to the environment if released. Although chances may be slim, it is still a direct threat to the environment, one that may be dead more serious than global warming we are experiencing right now – direct radiation. Radiation is harmful to organisms and the environment and is a serious health risk (can cause diseases like cancer), so using nuclear fission to generate electricity may not be so “clean” after all.

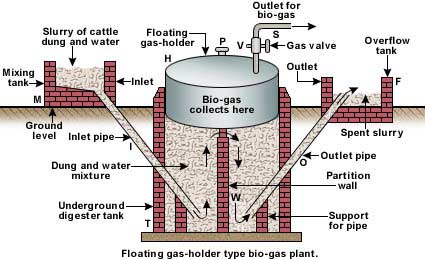
*Economic (POS):* The plant, on the long term, is cheap to run (as the fuel Uranium is pretty cheap; it is needed in lower quantities and is easy to transport, leading to lower fees.)The plant will also provide great job opportunities for the workforce. Simply speaking, the plant may prove to be an economical alternative over a period of time!

*Economic (NEG):* A nuclear power plant is expensive to build and requires huge effort and financial support to complete. During the running process, many operating costs, including waste disposal costs, must be accounted. If management and electricity costs rise over time like currently, the plant may become uneconomical to run.

*Political (POS):* The government and the plant-runner will need to impose strict monitoring to prevent any accidents from happening like in Chernobyl. As long as the power plant meets and follows the government (safety and operation) standards, it should be fine to go.

*Political (NEG):* As we all know (from the Iran nuclear program issue) nuclear power is a pretty big and controversial issue in politics and it may not be appealing to the public either. We should seriously consider this alternative.

**Biogas power plant:**



Biogas power plants are also a stellar choice for clean energy in the future. A very “natural” alternative, biogas is essentially “renewable energy gas,” containing 70% methane. It is created from the fermentation of organic waste, feed stock and dead plants. The “biofuel” is then fed into biodigestors, which heats the fuel and allows anaerobic bacteria to multiply and feed on the fuel – biodegradation. The by-product is biogas, which is piped and used as steam to drive turbines and generate electricity.

**Advantages of this method: (P)**

* A renewable and natural process – use of organic waste and organic (anaerobic) biodegradation.
* Biogas cheap to produce
* Non-polluting, relatively clean to the environment
* Easy to apply in use – can be used on small to large operations.
* Very effective – organic waste is disposed of in transformation to gas. Good source of energy - One cm3 of biogas is equivalent to an L (or 1000 cm3) of gasoline.
* Miscellaneous economic advantages (cheap to run.)

**Disadvantages of this method: (M)**

* Limited electric energy production.
* Rate of gas production is unstable (can take a long time to biodegrade the fuel into gas.)

Interesting:

***Clean to environment, but energy produced is rather limited and more “small scale.”***

Point of view analysis: (POS = Positive) (NEG = Negative)

*Scientific (POS):*  Biogas electric generation is a relatively simple, clean, cheap and very natural way of generating electricity. Studies show that biogas generation outputs only 25-93g of CO2 per kWh of electricity generated. Compared to coal (950 – 1000g) this is a huge advantage and (if adopted) can significantly reduce greenhouse gases emissions.

*Technological (POS):*  Biogas is a very natural, simple and cheap technology that, applied in the masses, can really provide the world with a good amount of energy! It is very simple and is not restricted by any factors - , which makes it readily applicable.

*Technological (NEG):*  Biogas is a good alternative, but it is unreliable. The natural process of biodegrading the fuel into gas is inconsistent (time and speed of the process varies) and therefore the energy amount generated is inconsistent too, so it is not very practical to use biogas to generate electricity. Unless this can be controlled, biogas may be adopted.

*Environmental (POS):* Biogas is a creative solution to the current “energy vs. environment crisis.” It is much cleaner than current fossil fuel electric generation systems and can really do some good to this environment. The process is natural and simple and does the job – that’s creative! Biogas generation is a great alternative for generating electricity.

*Economic (POS):* Biogas is a really cheap way to produce energy; since the energy production is cheap and relatively simple, it can be readily used by the masses, encouraging job and economic growth in the natural resources, agricultural and power sectors. That is very good to the economy!

*Political (POS):* Current government policies support green and environmentally friendly ways to generate electricity. Biogas electric generation is very much green and environmentally friendly. As long as the plant operates under government standards and monitoring, this is good to go.

**Final Alternative**

*After a long process of deciding and analyzing,* ***NUCLEAR POWER*** *has been chosen as the alternative to generating clean energy in Alberta. Why?*

1. Nuclear power is clean and does not contribute to global warming / enhanced greenhouse effect.
2. Nuclear power is reliable and effective and (as far as we see) a renewable source for power, balancing the needs of the people and the environment. *This is mainly the reason biogas was not chosen as the power it generates is inconsistent and unreliable for the energy needs of all the people.*
3. Nuclear power, on a long run, is economically beneficial.
4. Nuclear power is pretty safe.

**Brief POV on the issue:**

***Scientific:* Nuclear power generates only 3 – 6 g of CO2 per kWh, while biogas generates 25 – 93 g. Nuclear power is cleaner, so we should go with nuclear.**

***Technological:* Nuclear power generation is more effective, constant and reliable than biogas. Going with nuclear power generation!**

***Environmental:* Nuclear power is cleaner when it comes to greenhouse emissions than biogas. Going with nuclear power generation!**

*Economic:* Biogas plants are relatively cheaper to run and maintain (fuel cost low) than nuclear power. Going with biogas power generation!

*Political:* Nuclear power plants are a pretty controversial issue in politics and not-so appealing to public. Biogas power plants, however, aren’t. We should go with biogas power plants because they are green and appeal to the public – great for the government in a way!

**PMI:**

|  |  |  |
| --- | --- | --- |
|  | Nuclear Generation  + - | Biogas Generation  + - |
| Environmental / Scientific | |  |  | | --- | --- | | Surprisingly clean to atmosphere –virtually no harmful greenhouse gases (COx, NOx, SO2) is produced – only 3 – 6 g per kWh  Little waste is produced! Waste is stored in very much fire, water and earthquake-proof capsules. | Pollution in form of radioactive waste. Dangerous to organisms. (Process is getting cleaner too.) | | |  |  | | --- | --- | | Non-polluting, relatively clean to the environment – 25 to 93 g of CO2 per kWh of electricity. |  | |
| Technological | |  |  | | --- | --- | | Little waste is produced! Waste is stored in very much fire, water and earthquake-proof capsules.  Nuclear energy, for now, is a renewable and reliable way of generating electricity.  Much more effective than traditional coal fire plant – 250 g uranium produces 20000 times more electricity than 250 g coal. Lots of electric power – one plant = a whole city! | Accidents can happen – for ex: radiation leakage, plant meltdown, human error (like Chernobyl)  Uranium transport and radioactive waste storage an issue of its own. | | |  |  | | --- | --- | | A renewable and natural process – use of organic waste and organic (anaerobic) biodegradation.  Biogas cheap to produce  Easy to apply in use – can be used on small to large operations.  Very effective – organic waste is disposed of in transformation to gas. Good source of energy - One cm3 of biogas is equivalent to an L (or 1000 cm3) of gasoline. | Limited electric energy production.  Rate of gas production is unstable (can take a long time to biodegrade the fuel into gas.) | |
| Economical | |  |  | | --- | --- | | Miscellaneous economic advantages (ex: cheap to run)  On the long term, it is pretty cheap to run, and can run long. | Expensive to build. There will be downtime for maintenance.  Not entirely renewable, if uranium resources run out, the plant will be useless. | | |  |  | | --- | --- | | Miscellaneous economic advantages (cheap to run.) |  | |

*There are consequences however, some very grave. Here are some brief statements:*

**Scientific:** Nuclear fission is effective, but very dangerous. It is clean, but poses serious risks – leaks, meltdowns and accidents.

**Technological:** Nuclear fission is a controversial technology that generates problem of its own, like uranium transport, radioactive waste / and storage and plant meltdown / failure. These issues are very hard to solve, and are obstacles to the success of nuclear power generation.

**Environmental:** Nuclear fission generates radioactive waste, which is deadly to the environment. If anything like Chernobyl happens, if radioactive waste leaks from storage, if any accident happens during Uranium transport, deadly radiation will be released – and that poses more harm to the environment then global warming.

**Economic:** Nuclear power plants are a huge investment and are expensive to build. Huge funds are required to kick-start nuclear power generation.

**Political:** Nuclear power is a controversial issue in the political world. Government may require heavy convincing for the plan to work as nuclear power tends to be not so welcomed in politics (mainly due to the bad effects associated to nuclear energy.) Monitoring and standards must be strict and followed.