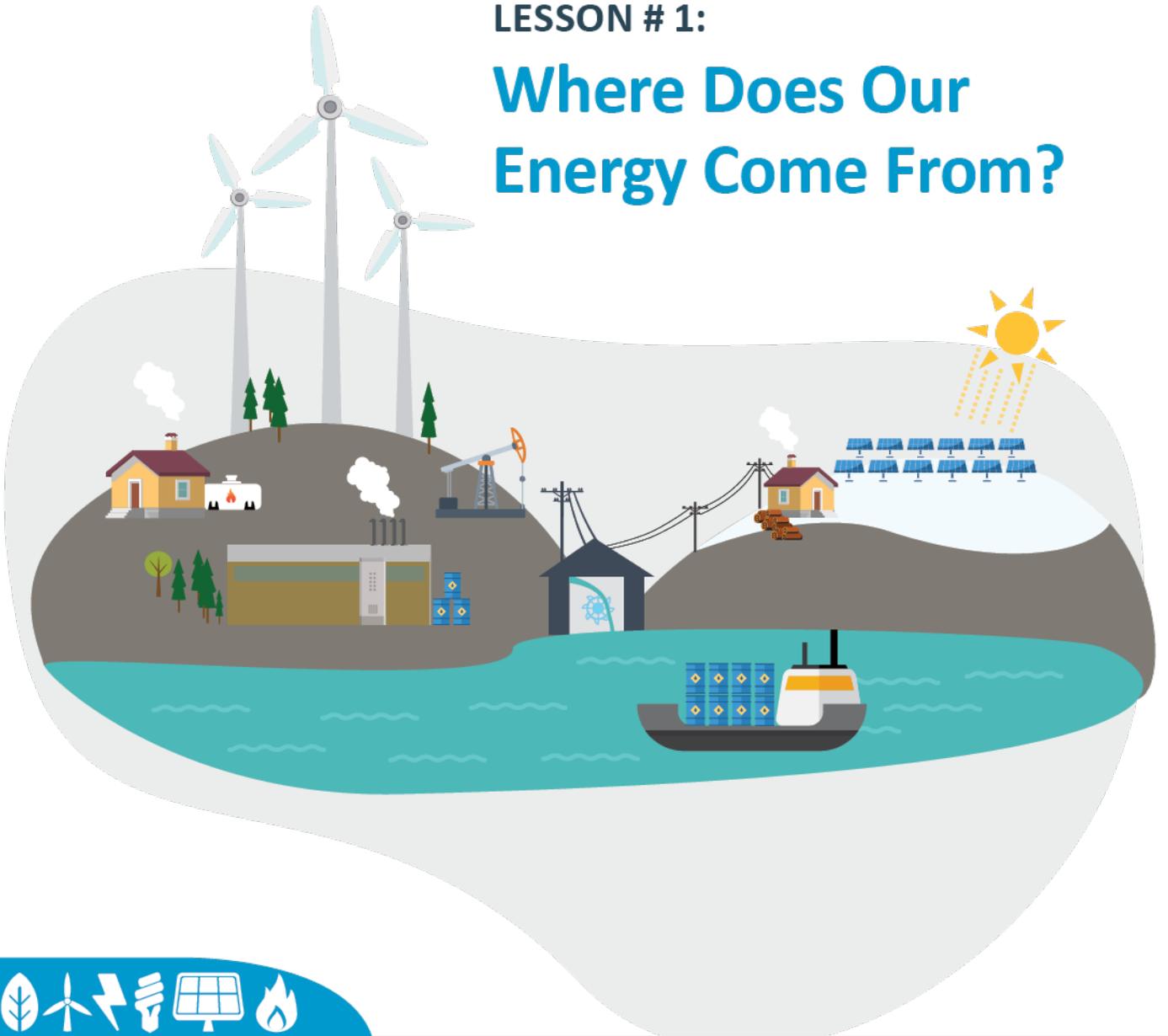




LESSON # 1:

# Where Does Our Energy Come From?



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## INTRODUCTION

The majority of scientists around the world agree that the emissions from fossil fuels have contributed to global climate change. Governments around the world are working at various levels to develop policies for industry and citizens to lessen their reliance on fossil fuels and expand the use of green energy. The GNWT has produced—through public consultations and focus groups—the 2030 Energy Strategy, which articulates a long-term strategic vision and short-term initiatives to reduce GHG emissions. However, getting the message out on what can be done as individuals, business and industry has been a major hurdle. In many cases people only take notice of electricity and where it comes from, when the lights go out.

This is a normal reaction, as most people do not think about where their electricity comes from when they flip on a light switch or use their microwave oven. Yet with the rapid on-set of climate change taking place in the north, people are beginning to realize their behaviour and actions individually and as a society contribute to GHG emissions and climate change. Behavioural change and awareness are the first steps in creating a green energy economy. If people know that they can get their electricity from renewable resources without harming the environment, in a safe, economic manner they are more likely to take part in such actions. This activity is an opportunity for students to add their collective voices for green, secure, sustainable and self-reliant sources of energy.

The activity goal, “WHERE DOES YOUR ENERGY COME FROM?” can be framed as a media campaign designed to inform local citizens where their energy comes from, and how they can use local resources to efficiently produce sustainable and reliable green energy while reducing their carbon footprint.

The focus should be on creating an info-graphic that captures and presents data on the current mode(s) of electrical generation and how alternative forms of energy can be produced locally to supplant the reliance on fossil fuels for heat and electrical energy generation. Students will collect, interpret and present data and other forms of information (e.g. oral, written and numerical) in a variety of ways, to objectively and ethically support their research findings.

Ideally you want to encourage student creativity, so your role is to act more as a guide / facilitator to help them along the way. As part of the introduction explore with students info-graphic from a variety of sources and topics to stimulate student creativity. The end produce will depend on the focus of the scoring rubric, but students should have a clear understanding of where their heat and electrical energy comes from and have identified mitigation steps to empower local residence in reducing their greenhouse gas emissions and dependence on fossil fuels, while saving money.

This activity uses a Science, Technology, Engineering and Mathematics (STEM) multidisciplinary approach the curricular outcomes and can be mapped back to Experiential Science 10-20-30 outcomes as detailed in the curriculum map. As this is a multi-disciplinary activity, outcomes in Language Arts, Social Studies, Northern Studies and CTS multimedia can also be incorporated into the project to increase the real-world connections for students. This creates a learning environment where they must use a variety of skills, knowledge and competencies to create and design new and novel approaches to presenting materials.

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## LESSON PLAN #1: WHERE DOES YOUR ENERGY COME FROM?

### GOAL

Students will develop an energy info-graphic that depicts current sources and modes of electrical energy generation in their community and highlight the potential sources for sustainable alternate forms of green-energy that could be used to reduce the reliance on fossil fuels to have a secure, economical, reliable and self-sustaining source of energy in their community.

### KEYWORD SEARCH

Alternative forms of green energy, generating electricity, Carbon-neutral communities, Community Energy Plans, sustainable energy, GNWT Energy Action Plan, NWT Arctic Energy Alliance, Info-graphic design methods

### TIME

Plan 1 hour of discussion, research and group planning. Students will need additional time in class for info-graphic design and presentation (2-3 hours). Budget 1 hour for class presentations.

### CURRICULUM CONNECTIONS

#### **Experiential Science 10, Unit 4 Resource Management and Population Dynamics**

General Learning Outcome:

- Students will gain an understanding of the basic processes to ensure sustainable resources.

Specific learning Outcome:

- Students will gain an understanding of the foundations of a sustainable future, economics and ethics by: Investigating the uses of renewable resources in the sub-Arctic and Arctic to reduce the ecological footprint with regard to: Renewable sources of energy, and cost effectiveness
- Researching and developing a media promotion campaign that would encourage people to gain an appreciation of the “Beauty of the Land” and the need to preserve it for future generations.

#### **Experiential Science 20, Unit 4, Petrology and the Ocean Environment**

General Learning Outcome:

- Students will gain a general understanding of the petroleum industry including the processes involved in manufacturing petroleum products, the environmental impact of this industry and the careers available related to the petroleum resource industry.

Specific Learning Outcome:

- Students will gain an understanding of the environmental issues surrounding the petroleum resource industry by: Evaluating alternative renewable forms of energy (e.g. wind, geothermal, solar, biomass, heat pumps) by considering: i. Availability ii. Cost and efficiency iii. Environmental impact iv. Other relevant “cultural” considerations

#### **Associated Curricular Connections:**

- Language Arts: public speaking, presentation skills, communication skills literature research, technical writing, interpreting information from a variety of genre.
- Social Studies & Northern Studies: Citizenship, self-efficacy, networking and teamwork.

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## PROGRESSION AND METHODS

### PART A – RESEARCH AND DESIGN

1. Introduce the concept of info-graphics as a media-source of information that is easily understood by the general public. Conduct a quick online search for info-graphic examples that capture the Big Idea of the message, messaging strategies and presentation genera. Direct Students to the Infographic handout that details 3 infographics on infographics as well as an overview on what a good infographic should look like (See “Infographics Handout” attached)
2. Set the stage by forming student groups to research, design, create and produce an info-graphic that clearly explains where their electricity comes from and ways in which alternative energies can be used to supplant the reliance and use of fossil fuels for energy. Direct students to handout with the explanation of the project as well as the criteria on which they will be assessed. (See Lesson #1 Student Handout attached)
3. Provide the students with the backgrounders and how to access information, such as the NWT Energy Action Plan, NWT Energy Report, and the Arctic Energy Alliance website. This will get them started on research and planning. They can use this and the internet keyword search as a jump point to find other information on info-graphics, NWT energy data and green energy. (See Lesson #1 Student Reading Alternative Energy Backgrounders attached)
4. Students should review their research materials and develop a rough outline of what they want to focus on and how they will go about presenting the information on their info-graphic. This will take about one class period, but will require additional research and development time for the students as they go from the planning phase to the production phase.

### PART B – DEVELOPMENT AND PRESENTATION

1. Build into your plan, class time for student self-reflection on the project and individual group discussions for you and your students to check their project against the scoring rubric and general conditions of the presentation.
2. During the development phase is a perfect opportunity to model constructive criticism and provide feedback and guidance to better the final product. Providing feedback on the level of science, technology, engineering and mathematics detail will help students develop their written science presentation skills, bring focus to the intended audience and use plain language to explain complex ideas.
3. Student presentations can be static displays and or multimedia presentations but they will need to produce a hard copy for display purposes.
4. When the projects are completed each group will have to present their info-graphic and point out its key ideas and strategies for getting the message out to the general public. This can be done as an in class activity but students should be encouraged to present their findings and projects to community leaders, the general public and other students, as this can build self-confidence, self-esteem and actively engage students in a meaningful social context.

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## INQUIRY QUESTIONS

- Where does electrical energy come from in my community?
- How can green-energy be used to offset fossil fuel electrical generation?
- How can the NWT tap into the southern electrical grid?
- How can the NWT become self-reliant energy producers?

## SHARING THE MESSAGE

Students can share their data and sources of data with classmates and post their presentation on social media to share with friends and family, to practice, key messaging and debate skills. Also this would be a good opportunity for students to get involved with local politicians and other decision makers by presenting their findings on how their community could move toward a carbon neutral, sustainable, energy self-reliant community.

## ENRICHMENT ACTIVITIES/FAST FINISHERS

As this activity produces a group info-graphic and presentation, students can record or make a “YouTube” type video clip on what they did. This would further integrate language arts and CTS multi-media outcomes while providing another avenue for students to express their ideas.

## STUDENT HANDOUTS

- Infographics Handout
- Lesson #1 Student Handout
- Lesson #1 Student Reading (Alternative Energy Backgrounders)
  - Hydroelectricity
  - Solar Electricity
  - Solar Heating
  - Wind Power
  - Biomass
  - Geothermal Power
  - Residential Heat Recovery
  - Conservation and Efficient Energy Technologies.
  - Renewable Energy in the North
  - NWT Energy Inventory
- <http://aea.nt.ca/>

## EVALUATION

The Rubric for this Assignment evaluates the content, visual appeal and presentation of the Infographic. Feel free to add in other sections. The curriculum map provides point of articulation for addressing the front end matter as well as specific learning outcomes. The integration of Art, Language Arts, CTS and Social Science outcomes could also be included in the rubric design. (See Lesson #1 Student Handout page 2 attached)

## ALTERNATIVE ENERGY BACKGROUNDERS: STRATEGIES FOR GREEN ENERGY

### A. HYDROELECTRICITY:

Hydroelectric power has been used in the NWT since the early 1940's to provide and support cheap energy for home and industrial uses. The NWT has some the best underdeveloped hydroelectric power in all of Canada.

In the NWT there are considerable challenges to making hydroelectric power reach its potential. Because of the small economic scale of small community closed grids (no external sources of power) and remote locations, considerations such as construction costs, lack of capital investment, environmental, socio-economic impacts as well as the public desire for cheap energy can limit possible options for alternative forms of energy production. Also, there are long standing community concerns about developing local hydro potential, which when coupled with the logistics of acquiring power from sources further away from a community, can lead to complex discussion. However, for the most part the general public is not fully aware of the new technologies and developmental processes that can make hydro projects environmentally sound and produce clean cheap energy without GHG's.

The GNWT is committed to building a sustainable and reliable hydropower (macro and micro projects) legacy and is looking at many options to produce clean, sustainable energy. Current process for hydro development focuses on high pressure dams, which can cost a lot and impact the local environments and river system. However, there are increasingly more options for low-pressure hydro projects that have minimal environmental impact and do not require dams or large changes in elevation to work. This means that micro-hydro projects could be developed that could be closer to a community and only require a small amount of the water to be diverted without the need for the construction of a costly head pond or changes to the river bottom.

Below is a map indicating current and potential hydro projects to generate clean, reliable electrical energy. (NOTE: Graphic designer place in high-resolution image from source GNWT Energy Division)

Use the map as a starting point to investigate the potential use of hydropower for your community. Locate the current and potential hydro projects near your community and think about how you could access this energy as part of your community energy plan. Keep in mind that not all water resources are the same. Some rivers, because of their geography, are better suited for hydropower development but may be far from a town. This results in additional construction costs as access into the site can be limited and expensive transmission lines would have to be put in place. However, keep in mind that the energy is "free" and clean once the hydro project is in place, which adds to the cost benefit of hydro power.



Use this information and the internet keyword search to find more information on the NWT hydro potential for your community.

**Keyword Search:** NWT hydro potential, future sites NWT hydro, alternative hydro projects, small scale hydro projects, creating off-grid hydro, innovations in small scale hydro.

Use the section below for your research notes and citations.

**Research Notes & Citations:**

## B. SOLAR ELECTRICITY

Solar panel technology, or photovoltaic cells, is becoming more available and efficient at converting the sun's rays into electrical energy. In many cases solar technology, in the north, can outperform its rated capacity due to snow reflection, a cooler operating climate and prolonged summer sun. In the early days of alternative energy many northerners started using solar technology as a source of renewable energy for off-grid camps and homes. Since then solar power has expanded from single dwellings to solar farms which supply electricity to a community. This provides people with the quality of life they want without increasing their greenhouse gas emissions and having to rely on fossil fuels for electrical generation.

However, the seasonal availability of the sun can shorten photovoltaic daily output in the winter, when the demand for electricity is the highest. Yet solar energy is still a viable source of energy, which can offset the demand for electricity during the sunny months of spring and summer. This allows many standalone small community generators to install hybrid systems where solar power offsets diesel consumption when the sun shines. Further, if solar power tied into other sources of alternative energy, the system can use the alternative energy first, thereby reducing need of the diesel generator and use of fossil fuels. Also, in hydro communities every time alternative forms of energy are produced and used first it can allow the head pond to fill with water during the summer. This allows the stored potential energy of the water to be used during the high demand periods, especially in the winter. With an integrated electrical system, whether it be an open or closed grid, allows the operators to use renewable sources of energy first and supplement with diesel power as a last resort thereby reducing overall greenhouse gas emissions. Ideally this saves thousand and even millions of dollars annually on the purchase of diesel fuel, while increasing northerners' own self-reliance on secure energy that is not influenced by rapid fluctuations in global energy supplies.

Below is a map indicating the current solar power generating capacity. (Source NT Energy pg 8, A vision for the NWT Power System Plan.)

Find your community on the map. Does your community use solar power to generate electricity? What is its capacity? How does this system reduce greenhouse gases? How would you use solar technology in your community energy plan?

**Figure 3 – Existing Solar Generation in the NWT**



Use your internet keyword search to find more information on the solar energy / photovoltaic cells as a potential source of energy for your community.

**Keyword Search:** NWT Solar power, photovoltaic power, off-grid photovoltaic cells, solar hybrid power generation, solar energy systems, NWT Power System Plan

Use the section below for your research notes and citations.

**Research Notes & Citations:**

## C. SOLAR HEATING

In the North the spring and summer sun is long and intense, which is an opportunity to take advantage of passive solar energy to heat airspace and water. With the use of simple collection panels and tubes, filled with water, the sun's energy can be captured by the water and used to heat homes and preheat hot water. These systems produce no greenhouse gases and can save a great deal of money by acting as a supplemental heat source thereby reducing the use of fossil fuels for space and hot water heating. The sun's energy is free for the taking and can off-set your energy bills by hundreds of dollars annually.

Any time hot water needs to be heated, whether it be for domestic hot water or summer community swimming pools, solar powered hot water collection panels can significantly offset the use of fossil fuels by as much as 50%. Over an entire summer this is a huge savings on the purchase of fossil fuel while reducing greenhouse gas emissions significantly.

Solar heating has such huge cost-free benefits that governments, corporations and private citizens are designing buildings and houses to take advantage of this free source of heat. With the development of new technologies, materials and designs people are seeing huge reductions in their energy costs of fossil fuels. This has two major benefits: 1. Less fossil fuels are used therefore lower GHG emissions and 2. You are accessing free renewable energy that has no GHG emissions.

Use the internet keyword search to find more information on the potential applications of solar heat for use in your community.

**Keyword Search:** NWT solar power, passive and active solar heating, energy efficient home design solar heating, solar farm technology, solar energy house designs.

Use the section below for your research notes and citations.

### **Research Notes & Citations:**

## D. WIND POWER

Northern Canada has significant wind power resources and in many remote arctic areas wind generated electrical power can be a reliable source of energy. Unlike solar, which works best in the spring and summer months, wind is a constant source of energy that is available all year long. Wind turbines have become more common in many countries as they can tie the electricity generated from these wind turbines into the main electrical grid. However in northern Canada, most small communities have a closed electrical grid that is not connected to other sources of electricity. This can leave a community vulnerable to discontinuous electricity and the need to supplement with diesel fuel generators.

New technologies and control systems allow for hybrid wind/diesel generators to operate based on the wind turbines ability to generate electricity and the additional demand supplemented with the diesel generator. In other words when the wind is turning the wind turbine and producing lots of electricity, the control systems powers back the diesel generator thereby using less fossil fuel. As the wind dies down or the demand increases the diesel generator can power back up to take more of the load and the community has a seamless source of reliable energy. In areas that have significant wind potential large-scale wind turbines could produce more than half of the electrical needs of a community. Although this technology is very reliable and proven, it does have its challenges in that wind turbines are very large, cold temperatures can affect their operation, they require specially trained personnel for maintenance and operation, as well as large cranes to hoist the towers. This can raise the cost of installation, however the offset in diesel fuel savings and reduction in greenhouse gas emissions can be significant. Keep in mind that once the wind turbine is in place, the wind is a free and sustainable source of energy.

Use the internet keyword search to find more information on the potential use of wind power for your community.

**Keyword Search:** Wind power NWT, wind energy, wind farms, renewable wind energy, hybrid wind energy, best practices wind power, advances in wind turbine

Use the section below for your research notes and citations.

**Research Notes & Citations:**

## E. BIOMASS

For centuries people in northern Canada and around the world have used biomass (wood) to heat their homes and cook their food, as firewood has been a reliable carbon neutral source of energy. Today's biomass technologies have taken us from inefficient old fashion wood stoves to high tech pellet boilers that can heat large spaces such as schools and public buildings. Buildings that were once heated by fossil fuels can now be heated with renewable wood pellets. In the north this is an emergent technology but one that is quickly gaining favour as a reliable and inexpensive heating source. Since the north, within the tree line, has large forested areas and quantities of firewood, biomass can be used to heat homes and hot water. However, at the moment, wood pellets are manufactured outside of the NWT and we have to rely on transporting pellets by transport truck from southern Canada. As this creates a supply chain it could leave people vulnerable to interruptions in wood pellet supplies.

As with any new or renewed approach, there are emergent entrepreneurs in the NWT that are actively engaging in producing wood pellets. This would make northern communities more independent and have access to a secure supply of wood pellets with a much shorter supply chain. This would employ local people and provide a carbon neutral source of heat that could reduce the reliance on fossil fuel for heat and electrical energy.

Use the internet keyword search to find more information on the use of biomass as a potential source of heat for your community.

**Keyword Search:** Biomass alternative energy, Biomass NWT, NWT Biomass energy strategy, Arctic Energy Alliance biomass, best practices biomass energy

Use the section below for your research notes and citations.

### **Research Notes & Citations:**

## F. GEOTHERMAL POWER

Geothermal energy is energy, in the form of heat, that is taken from the earth. There are few places on earth where there is sufficient geothermal power to produce conventional electricity using high-pressure steam. These high-grade geothermal resources, such as those found in Iceland, can provide an almost endless supply of clean electricity, space heating and hot water to large sectors of their population. However, these high-grade geothermal areas are limited to a few “hot spots” around the world. Yet, low-grade geothermal resources, (lower temperature) like those found in southwestern NWT, are more widely distributed globally and can be used to offset local heating costs. By using low-grade geothermal energy to heat buildings and homes can have many benefits to a community’s energy plan. For example, if geothermal heat is used to heat spaces and hot water the need to generate electricity or use fossil fuels for heating is decreased. Accessing this source of heat can have unseen benefits for communities that access hydro power as they can store unused water in the head pond and use it during periods of high demand. The combination of renewable energy resources enables us to access carbon neutral energy which further reduces our dependence on fossil fuels and reduces greenhouse gas emissions. Remember that for every litre of diesel fuel that we do not burn, there are 2.6 kg less CO<sub>2</sub> going into the atmosphere and contributing to greenhouse gases.

Use the internet keyword search to find more information on the geothermal heat potential for your community.

**Keyword Search:** NWT geothermal map, NWT geothermal inventory, geothermal energy, alternative geothermal projects, uses of geothermal energy, geothermal technology

Use the section below for your research notes and citations.

### Research Notes & Citations:

## G. RESIDENTIAL HEAT RECOVERY

Communities that rely heavily or solely on diesel fuel to generate electricity are often referred to as “thermal communities”. They are called this because the diesel generators and diesel fuel used to produce electricity is quite inefficient as only one-third of the potential energy of the fuel is converted into electricity. The other two-thirds of the energy (heat) goes into the generators cooling system and exhaust as heat and greenhouse gases. However, engineers have developed new technologies to capture some of this waste heat to heat water to redistribute the heat to nearby buildings, thereby offsetting the need for fuel oil. This increases the overall efficiency of the diesel generator as the waste heat is now used to heat buildings. Although this is a good use of waste heat energy the diesel generating process consumes large quantities of diesel fuel and produces large quantities of greenhouse gases which increases the rate of climate change.

Heat recovery just increases the efficiency of energy exchange but it still results in the combustion of fossil fuels and the production of greenhouse gases.

Use your internet keyword search to find more information on the potential for residential heat recovery in your community.

**Keyword Search:** Heat recovery systems, electrical energy heat recover, thermal communities NWT heat recovery

Use the section below for your research notes and citations.

### **Research Notes & Citations:**

## H. CONSERVATION AND EFFICIENT ENERGY TECHNOLOGIES

As the population increases so does the demand of energy, but in many cases the infrastructure to produce energy can be limited. This is why conservation, innovation and the use of new energy efficient technologies have to be part of any community based energy plan. Whether you are on or off the grid or in an open or closed electrical grid using energy wisely is key to energy security, sustainability and self-reliance.

Conservation can mean many things from retrofitting homes and the work place to using alternate sources of green energy to installing energy efficient appliances, lighting and heating technology. All of these steps contribute to reducing our ecological footprint and help us move to a carbon neutral society with limited greenhouse gas emissions. These actions not only helps the environment but they also makes things cost less to operate while providing a high quality of life and comfort.

Governments at all levels, including the GNWT, have implemented energy conservation policies and efficiency programs to help make homes, buildings and business more efficient and lessen their reliance on fossil fuels by fostering alternative energy use. This includes setting building standards that exceed National Building Codes, redesigning northern house and retrofitting older ones to be more efficient to take advantage of free source of energy such as solar and geothermal. The GNWT has also put in place incentive programs and rebates for people who buy energy efficient appliances or use green technologies for heating or lighting their homes and businesses. All of these incentives, large or small add up to reduce our greenhouse emissions as a society.

Further the GWNT supports the Arctic Energy Alliance and not-for profit agency that helps ordinary people and business convert and or utilize green conservation technologies. Organizations such as the Arctic Energy Alliance provide many services and programs, such as energy audits, financial and technical support and guidance in developing energy action plans.

Use the internet keyword search to find more information on conversation and use of new efficient technologies for your community energy plan.

**Keyword Search:** Energy conservation technologies, changing energy consumption behaviour, building a green energy future, carbon neutral housing, alternative energy housing.

Use the section below for your research notes and citations.

### **Research Notes & Citations:**

## BACKGROUND: RENEWABLE ENERGY FOR THE NORTH

Providing energy to meet the needs of northern homes, businesses and industries is no easy task. In a modern society everyone wants energy that is reliable, sustainable and inexpensive but in the NWT this can be difficult to attain due to a small population and a large number of remote communities that cannot access a large multi-source electrical grid. This means that most communities have to rely on expensive, carbon intense thermal power to generate electricity.

Fossil fuels still provide a large percentage of heat and power for the NWT. The reliance on fossil fuels put northerners at an economic disadvantage due to oil's high cost, fluctuations in the global energy markets and supplies chain disruption, which increase our energy vulnerability. Plus the use of fossil fuels also contributes to greenhouse gasses, which compounds the effects of global climate change.

Governments around the world acknowledge they have a role to play in mitigating GHG emissions to lessen the impact of climate change. Currently, the GNWT has developed a cyclical approach of frameworks, action plans and policies that are revisited and revised to combat climate change and reduce our reliance on fossil fuels. These action plans are a proactive step in creating policies and programs to enable people to reduce their GHG emissions and lessen the community's reliance of diesel power for electrical generation and fuel oil for heating. The long term goal is to create a multi-dimensional electrical infrastructure that employs a variety of cost-effective sources of green energy. This creates an electrical system that is more reliable, sustainable and reduces GHG emissions.

For example actions with in the NWT Energy Priorities Framework includes:

1. Educating and empowering people to manage their own energy consumption through energy conservation awareness and efficiencies of new technologies and behavioural practices.
2. Researching and investing in alternative sources of energy and applications of new technologies.
3. Public Works and Services (PWS) along with the NWT housing Corporation are improving the energy efficiency and performance of buildings and public housing.

All of these actions are attainable and can be done now. By focusing on proven technologies, that can reduce reliance on fossil fuels for power generation and heating, gives people a solution for the 'now' and provides opportunities to carefully plan for future large scale projects. This would include longer term plans like the NWT Biomass Energy Strategy and the NWT hydro Strategy. Both seek to supplant fossil fuels, one by using local renewable wood products and the other using NWT water resources to generate heat and electricity that is near carbon neutral, renewable, sustainable and reliable. Strategies and programs to off-set GHG emissions and access green energy technology are on-going and expanding every year. For the most current listing of GNWT initiatives and strategies to combat climate change and alternative energy projects use the keyword search GNWT, ENR, PWS, AEA NTPC, climate change, alternative energy. This will give you online access to the most current projects, policies and data that you can use for your projects.

Also, the GNWT funds a number of programs delivered by the Arctic Energy Alliance to assist local people with reducing the high cost of energy and shifting peoples' perceptions and access to renewable resources. Three such programs are:

- Energy Efficiency Incentive Program (EEIP),
- Energy Conservation Program and the
- Alternative Energy Technologies Program (AETP).

These programs are administered through the Arctic Energy Alliance, a not for profit organization supported by the GNWT. AEA's role is to provide supports through financial incentives, program and educational supports, to individual residents, businesses and the community programs on energy efficiencies and alternative energy programs. AEA is continually expanding their list of incentives and program supports which are outlined on their website, [www.aea.nt.ca](http://www.aea.nt.ca). Visit their site for helpful information on green energy.

The intent of these energy programs, policies and strategies is to make northerners aware that they have an active role to play in mitigating greenhouse gases and using our local energy wisely. Since we live in such a remote cold environment the NWT tends to have one of the highest per capital carbon footprint of peoples in Canada. Making conscious efforts to reduce our use of fossil fuels, no matter how small, will be a positive step forward. Remember that for ever litre of diesel fuel we burn 2.6 kilograms of CO<sub>2</sub> is produced. If all 45,000 people in the NWT reduced their consumption by just one litre that would be 117,000 kgs less CO<sub>2</sub> entering the atmosphere. Expanding these habits and ways of knowing how to use our energy wisely we can greatly reduce our GHG emissions as a territory.

So you might ask, "why should I care about green energy alternatives"? The answer quite simple is the Arctic and in particular Canada's Arctic, is experiencing some of the most rapid and intense climate change on the planet. Although global temperatures have increased by 1-2oC, the NWT Arctic along the Mackenzie River corridor is experiencing a positive 5-7oC degree changes in temperature with some estimates set even higher. This will have an impact on all aspects of northern living, from where we get food to travelling on the land to turning on the lights or dealing with bizarre weather. Any way you look at it there will be a need for secure and reliable power and we must prepare for a future less reliant on oil for fuel.

These unprecedented shifts in warming throughout the NWT are changing permafrost ranges (depth and area) as well reducing annual surface ice thicknesses on lake, oceans and rivers. This is having a significant impact on infrastructure and is making traditional ice road resupplies to remote communities more challenging and predictably less reliable. With many small remote communities relying on ice road delivery of diesel fuel for electrical generation the need to secure local reliable sources of energy increases with each passing year.

The uncertainty and negative impact of fossil fuels on the environment is causing society to pause and think about where our energy comes from. Anytime there is a shift in thinking it takes time for people to engage in the new train of thought, including the need to invest in clean energy. As all forms of alternative green energy cost money it is important to strategically invest funding into projects that provide a good return on investment while providing a reliable, sustainable source of energy. Focusing on readily available renewables such as hydro and wood provide an opportunity for our society to make some changes that will have an immediate noticeable positive impact. The key to success is about using the resources that are close at hand so not all community energy plans will look alike or appear equal. This is why we must look at each community for the local potential sources of energy that exist whether it be hydro, biomass, wind, solar, geothermal and even tidal and wave energy. Community based energy

plans will have to investigate the potential sources of local energy as well as create a strategic plan for their long-term energy needs.

Community based, targeted energy plans and energy awareness can provide a community with the tools and voice to become self-reliant green energy producers while reducing their carbon footprint.

In the NWT most homes are still heated with petroleum-based fuel oil, especially in the remote communities. However, there are a significant number of homes, in the tree line, that do use firewood as a supplemental heat source, which is a good first step in displacing the use of fossil fuels. This self-reliant practice has kept people comfortable throughout the generations. So what is old is new again as wood provides a carbon neutral source of heat. This coupled with more hydro, solar, wind and geothermal expansion could lead to less dependence on fossil fuels while providing clean renewable energy.

Although these alternate energy programs cost money the cost of doing nothing would set everyone up for failure with even high costs for energy and leave us vulnerable to global uncertainties in the energy market. By individuals and communities working together to do create climate change mitigation and alternate energy plans, over time, we will construct a reliable, secure and sustainable alternative energy system for the NWT. This will require people to think outside the box and use this as an opportunity to try out new technologies for green energy. Through trial and error learning we will learn new strategies and create opportunities for green energy that protects the environment and land for future generations.

To find the most recent literature on the effects of climate change and renewable energy in the arctic use the keyword search NASA climate change, Arctic Canada climate change, NWT Climate Change Strategy, Alternative source of energy combat climate change. These sites will provide useful project information for you when working on your energy projects.

## NWT ENERGY INVENTORY

The GWNT and energy providers have studied the range of various renewable resources in the NWT to develop a renewable energy inventory. This inventory provides people with real-world data on hydro, wind, solar, biomass, geothermal and other potential sources of energy for electricity and heating in our arctic and sub-arctic environment.

The cost of energy in the NWT is significantly higher than in southern Canada because of economy of scales and having an electrical grid that is open so distributors can optimally manage the highs and low in energy demand. This results in competitive economies, which can force the cost of energy down. For example, in areas where nuclear and hydro produce the majority of the electricity electrical rates can be ten to fifteen cents a kilowatt-hour. Unfortunately for many remote NWT communities that rely on diesel power for electricity there is no cheap electrical grid to tap into and the cost of electrical production can exceed two dollars a kilowatt hour. Find out the cost of electricity in your community, how does it compare to other NWT communities and countries around the world?

These remote communities are considered to be on a closed grid, as they have no access to other sources of electricity through transmission lines. Closed electrical grids that are stand-alone diesel generators must be designed to handle the peak demands of the community therefore they are over designed and use significantly more fossil fuel to create electricity as they are running at full capacity all the time. However, with the use of renewable energy and new hybrid diesel engines we can reduce the use of diesel. Supplementing the closed grid with renewable forms of energy, coupled with conservation methods, teaching people to be aware of energy consumption and using their electrical energy wisely can help reduce greenhouse gas emissions and reduce our overall reliance of fossil fuels. To find out more on the NWT Energy Inventory use the keyword search NWT Energy Inventory, NWT hydro potential, NWT solar potential, NWT geothermal potential, NWT wind potential.

Engaging individuals and communities through new policy changes, and those on the way, will encourage entrepreneurs and corporations to become energy producers. Through net metering programs people can become energy producers, where renewable forms of energy that they produce are merged within the existing grid help to build a broader network of energy sources. Policies and programs work hand in hand to help bring down the cost of setting up alternative forms of renewable energy infrastructure as interested individuals and groups can pool their resources to install and maintain their system.

This means that as more people become aware of their personal energy consumption and energy use behaviour throughout the day, they can strategically plan when to use the energy when it is most effective. By changing ones daily habits and activities, with energy usage, it will allow us to use energy strategically to have a reliable and sustainable green energy. This will lessen our dependence on fossil fuels and make northerners more independent energy users. To find out more about energy smart behavioural changes use the keyword search energy behaviour changes, smart energy, carbon neutral houses, zero carbon housing, energy conservation behaviour.

# WHERE DOES OUR ENERGY COME FROM?

## INFOGRAPHIC ASSIGNMENT

1. In your groups of 3 you will research, design, create and produce an info-graphic that clearly explains **Where our electricity comes from and ways in which alternative energies can be used to supplant the reliance and use of fossil fuels for energy**. Refer to the Infographic Backgrounder for some inspiration.
2. Research your topic thoroughly. Use the backgrounders NWT Energy Action Plan, NWT Energy Report, and the Arctic Energy Alliance website. DO AN INTERNET SCAVENGER HUNT for the following keywords: Alternative forms of green energy, generating electricity, Carbon-neutral communities, Community Energy Plans, sustainable energy, GNWT Energy Action Plan, NWT Arctic Energy Alliance, Info-graphic design methods
3. Develop a rough outline of what they want to focus on and how they will go about presenting your information on their infographic. Please submit your rough draft with your final product, as well as a list of sources.
4. Your Group will present your infographic and point out its key ideas and strategies for getting the message out to the public.

Group Members

	100%-85%	85%-70%	70%-65%	65%-50%
<b>Content</b>	<p>The infographic clearly answers the question 'where does our electricity come from'</p> <p>The infographic clearly and thoroughly provides information on where alternative energies could be used</p>	<p>The infographic answers the question 'where does our electricity come from'</p> <p>The infographic provides information on where alternative energies could be used</p>	<p>The infographic partially answers the question 'where does our electricity come from'</p> <p>The infographic provides some information on where alternative energies could be used</p>	<p>The infographic fails to answer the question 'where does our electricity come from'</p> <p>The infographic provides little information on where alternative energies could be used</p>
<b>Visual Appeal</b>	<p>The Infographic is eye catching and clever</p> <p>Outstanding use of design, colour and space; Original and creative</p>	<p>Overall the infographic is pleasing and harmonious</p> <p>Good use of colour, design and space; we see creativity and originality</p>	<p>Infographic lacks organization and thought</p> <p>Little use of colour, design and space and lacks creativity</p>	<p>Little attempt to use colour, design, and space appropriately</p> <p>Design is Dull Project is sloppy in appearance</p>
<b>Presentation</b>	<p>Demonstrates full knowledge by answering all class questions with explanations and elaborations.</p> <p>Provides clear purpose and subject; pertinent examples, facts, and/or statistics; supports conclusions/ideas with evidence</p> <p>Demonstrates strong enthusiasm for the subject.</p> <p>Significantly increases audience understanding and knowledge of the topic, convinces the audience of the importance of the subject.</p>	<p>Demonstrates knowledge by answering class questions without elaborations,</p> <p>Uses pertinent examples facts and statistics</p> <p>Shows some enthusiasm for the subject</p> <p>Raises audience understanding and awareness of most points</p>	<p>Demonstrates little understanding and is only able to answer rudimentary questions</p> <p>Uses some pertinent examples facts and statistics</p> <p>Shows little enthusiasm for the subject</p> <p>Raises audience understanding of some points</p>	<p>Does not have a grasp of information and cannot answer questions about the subject</p> <p>Provides weak examples, facts and statistics which do not adequately support the subjects</p> <p>Includes thin data or evidence</p> <p>Shows no interest for the subject</p> <p>Fails to increase audience knowledge of topic</p>

Group Members \_\_\_\_\_

<b>Comments</b>	