Electric Thermal Storage:
Space Heating with Renewable Energy

Workshop Report

May 13-14, 2014 – Whitehorse, Yukon

Cold Climate Innovation Director Stephen Mooney presents Beverley Gray's book *The Boreal Herbal* to ETS workshop speakers

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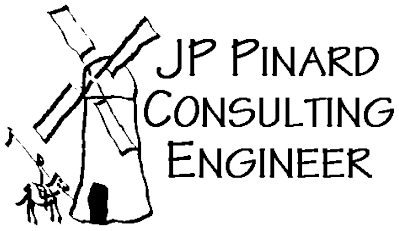

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Yukon Conservation Society

YESAB
Yukon Environmental and
Socio-economic Assessment Board

Yukon Education / Éducation

Yukon Energy, Mines and Resources

Yukon Environment

STEFFES Heating Systems

JP PINARD CONSULTING ENGINEER

MILLIGAN Sheet Metal Ltd.

YUKON BREWING
WHITEHORSE • YUKON

Alpine ORGANIC Bakery
YUKON

LIST OF ACRONYMS AND DEFINITIONS

ACRONYMS

CCI	Cold Climate Innovation (Yukon Research Centre, Yukon College)
EMR	Energy Mines and Resources (Yukon Government)
ETS	Electric Thermal Storage (storage of electricity in the form of heat)
GHG	Greenhouse Gas
REAP	Renewable Energy Alaska Project
NRCAN	Natural Resources Canada, Government of Canada
SCADA	Supervisory Control and Data Acquisition (an electricity management system)
TOR	Terms of Reference
YC	Yukon College
YCS	Yukon Conservation Society
YEC	Yukon Energy Corporation (public utility)
YECL	Yukon Electrical Company Limited (private utility now known as ATCO Electric Yukon)
YESAB	Yukon Environmental and Socioeconomic Assessment Board
YDC	Yukon Development Corporation
YUB	Yukon Utilities Board

DEFINITIONS

Design Heat Load Heating power required to keep a home at room temperature during the coldest winter temperature.

Load Factor The average load divided by the peak load in a specified time period (typically a year). A higher load factor means the system is used more efficiently.

1. EXECUTIVE SUMMARY

The Yukon Conservation Society (YCS) hosted a workshop **Electric Thermal Storage: Space Heating With Renewable Energy** on May 13 and 14, 2014 in Whitehorse.

The facilitated workshop brought speakers from across North America to share their experience with using Electric Thermal Storage (ETS) and smart grids to integrate renewable energy and displace fossil fuels. Participants included energy experts from both Yukon utilities (Yukon Energy Corporation and Yukon Electrical Company Limited), Yukon government, non-governmental organizations and the broader community.

The goals of the ETS workshop were to:

- Increase awareness about ETS-Wind systems by providing key information
- Understand economic and infrastructure needs
- Learn and apply information from case studies
- Identify obstacles and potential solutions

Piers McDonald, Yukon Energy Corporation Board Chair, welcomed speakers and participants and gave opening remarks. Over the course of two days, JP Pinard, Greg Gaudet, Al Takle, Steven Wong, Luigi Zanasi, Dennis Meiners, Sally Wright and Gerry Quarton shared their experience with ETS and smart grid technologies in presentations, followed by questions. Mark Nelson and Lou Villeneuve of Cambio Consulting were the main facilitators.

Tim Green, Glenn Piwowar and Rod Savoie, members of the Association of Professional Engineers of Yukon, assisted in facilitating break away sessions during the second afternoon. Participants flowed through four theme tables exploring ETS in the context of infrastructure, economics, partnerships, and consumers. After a break, people were grouped in sectors (utilities representatives, government policy people, consumers) and incorporated information from the previous theme discussions. Each of these three groups identified three next steps or goals to work toward for increasing renewable energy use in the territory.

Interestingly, the groups all came to similar conclusions about the required next steps. These conclusions are discussed in detail in Part 5 of this report, but in general they were: mandate the Yukon Utilities Board to include the environment and sustainability in its decisions, establish an energy partnership or commission to promote renewable energy and conservation, revisit the Yukon's Energy Strategy, Climate Change Action Plan and other energy policies, conduct an ETS pilot project, and use an integrated approach between various stakeholders to implement solutions.

2. BACKGROUND & CONTEXT

The Yukon Territory faces unique energy challenges and opportunities associated with our existing energy sources, our isolated electrical grid and cold climate. While our hydro facilities provide secure and, to an extent, storable energy, it is less available in the winter. As a result, daily load fluctuations on the grid often require our public utility to burn fossil fuels to meet the daytime peaks when demand for electricity exceeds the supply of renewable energy – especially in cold weather.

ETS is a proven technology that reduces peak electrical demand, fossil fuel use and greenhouse gas emissions in other jurisdictions by heating homes and businesses with renewable energy. ETS ensures that electric heat doesn't add to daytime peaks by drawing electricity overnight, when overall electrical demand is lowest, and storing it in the form of heat.

ETS can reduce our diesel consumption during the winter, optimize the grid and allow for the development of intermittent renewable energy sources such as wind and solar. ETS can shift space and water heating demand away from the daytime diesel peaks and into the nighttime surplus hydro valleys – or shift demand to times when intermittent renewable energy is available – maximizing renewable energy use and reducing fossil fuel requirements on the Yukon's grid.

The risk of adding new renewable energy generation capacity like hydro and wind to the Yukon electrical grid system is increased by the uncertainty of mining and other industrial loads staying in business long enough to financially justify these projects. That risk can be reduced by accessing an energy market that will provide guaranteed long-term sales for Yukon Energy Corporation and independent renewable energy developers. Looking at the Yukon's Big Energy Picture (Figure 1), space heating is a stable market that could double electricity sales for our utilities, and allow them to manage this designed heating load to match renewable energy resources. Space heating is the second most greenhouse gas intensive sector in the Yukon as most of the Yukon's electrical customers currently use oil and propane to heat their homes and businesses.

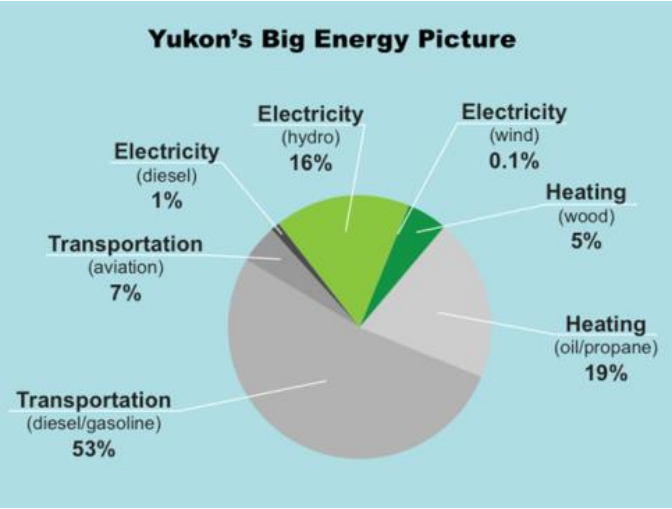

Figure 1: Energy Pie Chart used by JP Pinard for TEDxWhitehorse, 2013. Sources of data are from Yukon Energy, Energy Solution Centre, Forest Pearson, and others.

ETS could be a 'win-win' solution for the Yukon. ETS systems can be charged when renewable energy is available and then deliver heat as needed. ETS systems not only contribute to the economy through guaranteed long term sales and

provide energy storage capacity in homes and commercial buildings, they also shift the daily load on the grid to non-peak times, maximizing renewable energy integration (wind and hydro) and reducing fossil fuel requirements on the Yukon's grid and in homes and businesses.

Discussions with Yukon Energy Corporation, Yukon Government, Yukon Environmental and Socio-economic Assessment Board and others have shown there is keen interest in understanding the role ETS can play in the Yukon. To address the need for more information and further discussions, YCS fundraised for and coordinated the ETS workshop. The purpose of this workshop was to inform Yukoners about ETS and smart grid technology, present the experience of other jurisdictions in Canada and the USA including Alaska, and chart a path for bringing this technology to the Yukon.

YCS is committed to helping bring forward solutions to our unique energy challenges that will realize some of our vast renewable energy potential and reduce our dependence on fossil fuels.

3. PANEL PRESENTATIONS

PDF versions of these presentations can be found on the Yukon Conservation Society website under "Issues: Energy and Climate Change": http://www.yukonconservation.org/

Panel 1: Electric Thermal Storage Basics

J.P. Pinard, PhD., P.Eng., Whitehorse YT – *ETS To Build Renewable Energy and Reduce Fossil Fuels*

JP Pinard, a Whitehorse researcher of renewable energy solutions, presented his understanding of the Yukon's energy grid and the opportunity for introducing Electric Thermal Storage (ETS), smart grid, and wind energy.

The presentation started with a look at the Yukon's big energy picture where hydro meets only 16% of Yukon's total energy demand. There is an opportunity to replace fossil fuels to meet space heating demand, which represents 20% of the Yukon's energy needs. Ground transportation represents 50% of the Yukon's energy needs and a portion of this could be met with electric vehicles.

The Yukon's grid is isolated and depends mainly on hydro with some diesel for electricity. The SCADA (Supervisory Control and Data Acquisition) system presently only manages the hydro and diesel generators and simply responds to, but does not manage, the grid load. A smart(er) grid would entail an expanded SCADA system that manages the load demand to match the available renewable energy.

There are also four diesel micro-grids in the Yukon that could benefit from a smart grid, ETS and renewables.

Space heating from fossil fuels presents a bigger energy draw than the total hydro generation on the grid. Space heating from electricity is about 12% of hydro, which is an opportunity for converting electric furnaces or baseboards to ETS. This change-out would maintain electric heat, but would remove that load from peaks and add it to surplus valleys, levelling out the demand over a 24 hour period and utilizing intermittent renewable energy like wind when it is available.

Wind energy resources follow the seasonal heating demand. Hydro tends to produce less power in winter as it is locked up in ice and snow, and water levels are lower. Hydro can provide backup energy storage and firm energy output that complements intermittent wind.

An ETS unit consists of hot bricks in an insulated box and is a demand-side and distributed form of storage that enhances total grid storage capacity. ETS is a cheap way to store energy in homes and businesses, at about one tenth the cost of normal chemical batteries.

Demand-side storage needs a smart grid or expanded SCADA to allow Yukon Energy to manage the renewable energy generation and the customer side energy storage. A smart grid combines renewable energy with distributed storage through a communication and control system (SCADA). A smart grid reduces day time peaks, reduces diesel use, can reduce brownout, increases power quality and increases renewable energy uptake.

Al Takle, Steffes Corporation – *ETS Technology and Equipment*

Steffes manufactures ETS units for industrial, commercial and residential buildings. The units come as simple room units, central forced air, and central hydronic systems. Simply put, the ETS technology stores electricity in the form of heat. Water can also be used as a heat storage form but the boiling point of water limits the temperature range, whereas bricks can handle temperatures up to over 600°C.

The ETS technology was invented after the Second World War in Europe and Great Britain and came to North America in the early 1970s. There are at least 100,000 ETS systems in North America today.

The ETS units are fully automatic with air handling and heat exchanging controlled by microprocessors. The heating of the internal bricks can be programmed to occur during nighttime off-peak period or when there is available renewable energy. Units come with a display that can indicate time, on or off peak period, charging period and inside/outside temperature.

The ETS units have variable speed blowers which makes them quiet, accurate and comfortable. While the core temperature can become very hot, the skin temperature is safe to touch and the discharge temperature is controllable to the user's comfort. Optional equipment for the ETS units includes remote room temperature sensors, outdoor temperature sensors, and power line transceivers.

The ETS room units (2100 series) are popular, safe, easy to install, and flexible. They range from 1.32 to 10.8 kW in power draw and delivery. The room units can be used in retrofits, to replace or supplement baseboard heaters, to replace or supplement wood stoves, and can be used in cold spot heating. No ducts are required with the room units. Throughout the United States, room units have been used in homes, large daycare facilities, in an art gallery, historical buildings, schools, churches, apartments, inns and hotels, and retirement homes.

Forced air central furnaces (3100 and 4100 series) range in sizes from 14 kW to 46 kW recharge rates. The air blows through the bricks, through a modulation unit, and is then distributed to the building. These units can also be coupled with an air conditioning unit or with a heat pump. The heat pump options are low cost investments compared to stand alone heat pump systems.

The hydronic central furnaces (5100 series) range in size from 19.2 to 45.6 kW. The hydronic system circulates air through the bricks to a heat exchanger that transfers hot air to water. The hot water can be distributed through baseboards, in-floor heating, or to a ducted heating and cooling system. Output water temperature can be controlled to suit user needs. Hydronic units can be stacked together in parallel to suit building size or to add redundancy (back up capacity with existing oil or gas boilers).

The Steffes company has been working on a new grid system model called Grid-interactive Electric Thermal Storage (GETS). This system dynamically couples consumer usage to real-time grid needs. With this model, water heating is included since domestic hot water also stores energy and can be controlled much in the same way as ETS space heating units. The ETS provides a "double green" benefit as it can save money by avoiding using more expensive fossil fuels as well as increasing renewable energy uptake.

Greg Gaudet, Director of Municipal Services, Summerside, Prince Edward Island (PEI) – *MyPowerNet: "Our" Creation of Electrical Infrastructure Networks (Smart Grid) to Integrate Energy Thermal Storage*

The City of Summerside, PEI uses ETS with smart grid to increase wind energy uptake from their City utility-owned wind farm. Most homes in Summerside are heated by imported fossil fuels, and most electricity is generated from fossil fuels. Presently 10% of Summerside's home heating is from wind electricity and it is growing. The City uses SCADA and Ethernet to manage heating loads from both ETS and domestic hot water.

The City plans to expand the fibre optic communication to run SCADA for growth into electric vehicles, and home Photo Voltaic net metering. The City has several partners including Steffes, Rheem Marathon water heaters, Tantalus, Fibre Connections plus local businesses.

Research and Development is being dedicated towards real time control strategies to integrate wind and smart grid with heating systems. Summerside found financial advantages to smart grid management by just charging ETS units during off-peak times when surplus wind energy would otherwise be sold at a loss to neighbouring jurisdictions.

The smart grid manages wind energy use on a daily basis to charge up heat storage in homes and businesses. They use web-based portals to inform consumers of their energy use and cost savings. The municipally-owned utility has increased electric sales from wind, reduced imported heating oil, increased local profits, and provided savings to customers. The ETS is a prime driver in increasing economic and environmental sustainability for the City of Summerside.

Panel 2: Cost/Benefits and Economics

Steven Wong, CanmetENERGY, NRCAN – *Benefits and Costs of Adding Wind and ETS to the Yukon Electrical Grid*

CanmetENERGY is Canada's largest energy science and technology group and a leader in clean energy research and development. One of its goals is to increase integration of renewable and distributed energy into Canada's electric grid.

Yukon's electric grid is a medium-sized isolated system with a large complement of hydro resources (much of which is flexible) and supplementary diesel for filling in peaks and acting as a backup. Given these characteristics, CanmetENERGY has found that there is a good opportunity for ETS to help meet current and future energy needs with renewable energy in addition to increasing utility load factors. Load factor is calculated as the average annual electricity load divided by annual peak electrical load. A higher load factor, or a lower peak means that the electrical load is more constant and requires less extra power capacity to meet peaks, and is therefore less expensive from an infrastructure invest perspective.

The Yukon hydro system has several unique parts to it:

- Whitehorse River Rapids, a run-of-the-river system with little storage. From July to October its potential output is 40 MW with unused energy spilled; from November to January this potential diminishes to around 21 MW and down further to 15 MW in May.
- Mayo, composed of two run-of-the-river facilities with storage capabilities, with a maximum output of 12.5 MW (lower in winter) and a design output average of 8.9 MW.
- Aishihik Lake, a facility with multi-season storage capabilities. Most akin to a battery, it can vary its output as needed, from 0 MW during summer to 37 MW for winter peaking. Typically it stores energy by holding back water through spring and summer and has a design output average of 13.1 MW. Like Mayo, actual output depends on natural water resources, which vary from year to year.

Aided by the hydro resources, there is also good potential to capture wind energy for use in the Yukon's electric grid. The hydro resources can be used to balance the variability of wind, ensuring a constant supply of energy. Excess wind energy that cannot be immediately captured by load can displace hydro potential for use to another period, essentially storing the energy. However, in extreme cases wind energy can also be lost if there is no available capacity to store.

ETS units can also be used to supplement this storage capacity, capturing the potential that would otherwise have been lost and reducing renewable energy spillage and subsequently diesel use. Although ETS can be controlled independently with clocks, the best results in the CanmetENERGY modelling exercise were found to be achieved through real-time smart control of each unit.

This study used numerical modelling tools to explore scenarios on the potential for ETS and wind to complement the hydro system and reduce diesel use on the Yukon grid. Essentially, the resulting model aimed to minimize costs, dispatching generation in the following (diminishing) order of importance:

1. Wind,
2. Whitehorse Rapids Hydro,
3. Mayo and Aishihik hydro, and
4. Diesel.

This was subject to meeting the grid demand and capitalizing on the Yukon electric grid's ability to displace hydro for use at another time, and shifting loads through ETS units.

In the study, the model also looked at how ETS could be used to increase load factor, either increasing the average load relative to peak load or decreasing peak load relative to the average load, by reducing load peaks and filling load troughs (daily). Benefits of this include higher asset utilization and reduced need for capital investments.

One exercise conducted in this study looked at how peak diesel use could be reduced from 13.8 MW to 6 MW – trying to find 7.8 MW capacity through optimization of existing assets and the economic addition of wind and ETS. It was found that this could be accomplished by adding just 1331 ETS units and 0.6 MW of wind, and would also result in a beneficial increase in load factor of 5 percentage points and a diesel generation reduction of 2000 MWh (70%).

Additional exercises adding load growths plus new electrically heated homes found that, without wind and ETS resources, large increases in diesel generation and small decreases in spilled hydro would result. However, with added wind resources coupled with existing hydro, it was found that increases in diesel consumption could be kept minimal. The addition of ETS could further decrease this diesel use (and allow the capture of otherwise spilled hydro and wind potential).

Luigi Zanasi, Economist – *Feasibility Study on Yukon ETS*

This presentation provides a preliminary analysis of the cost and benefits of applying ETS technology for peak shifting on the present Yukon hydro-diesel grid scenario. It mainly looks at the potential savings in diesel fuel and in required capacity by shifting the existing electric heating loads from daytime to nighttime. The focus was on residential space heating looking at what level of incentives, both upfront and through energy rebates, would be needed to make ETS attractive for consumers.

Modelling carried out by JP Pinard showed a potential for shaving 7.6 MW of peak load by shifting electric heat to nighttime using smart grid control. This is based on a design heat load of 9 MW or about 1,440 homes converted from electric baseboard to ETS.

Diesel fuel savings would be about 2,470 MWh/yr (31% saving on the average consumption of diesel for the years 2010-2012). At $0.32/kWh this is a saving of $790,000 per year.

Their study estimated that 0.9 to 1.3 MW of new additional capacity will be required each year to meet the demand for electric heat in new housing. They assumed a cost of $1.5M per MW to add new diesel capacity, which translates to an estimated cost of $9,600 per new dwelling on electric heating. To avoid adding diesel, new homes could be offered up to $9,600 to use ETS instead of electric baseboard heating.

ETS installation was estimated to cost between $8,730 and $12,730 per home for new and existing homes respectively. Costs per apartment were estimated to be $6,324 and $7,324 for new and existing apartments respectively.

Grants based on diesel capacity savings for new homes could cover the cost of purchase and installation of ETS. For existing homes, the grants could cover up to 90% of the ETS cost. If diesel fuel savings are taken into account as well as the capacity savings then the utility could afford to pay for conversion of electric baseboard to ETS in existing homes. Other subsidy options include offering a kWh energy rebate over a set number of years or a combination of grant and rebate.

Panel 3: ETS Case Studies

Greg Gaudet – *City of Summerside's Heat For Less Now and other programs*

The MyPowerNet program in the City of Summerside, PEI, is designed around using smart technology to strengthen businesses and the community. The City has a vision that incorporates innovation and future needs by embracing entrepreneurial thinking, technology and innovation.

The City of Summerside owns an electric utility that purchases, sells, produces, transmits and distributes electricity to 7,000 customers. The utility has an annual sale of 127 GWh with $18,500,000 revenue, with 16 employees. The City's utility imports 68 GWh of energy, generates 1 GWh from diesel and 58 GWh from 21 MW wind farms. At a 46% penetration rate, Summerside has the highest wind integration for a utility in North America.

The vision of MyPowerNet is to pass on wind energy benefits to residents, create additional revenue for the utility, and create economic development opportunities. To implement the vision of MyPowerNet, the following elements were required: a business plan with limited risk and no subsidies; a new easy-to-understand electric rate that needed no lifestyle change and created customer trust; and partnerships with local contractors, suppliers, and manufacturers.

The MyPowerNet required new plans for sales, marketing, training, and servicing. The program required going beyond the meter and into the homes and personal space of customers. The utility needed to implement new software and new information network capacity. The MyPowerNet program was implemented in phases to ETS customers, switching them from timer off-peak control to smart communication and anytime management of ETS and domestic hot water.

Future plans for the MyPowerNet program are to integrate plug-in hybrid electric vehicles, behind-the-meter renewables like a PV system on a customer's home, and other smart end-use and distributed generation and storage devices. Important features of the program for the consumer include: financial savings, a stable price instead of volatile fossil fuel prices, and no change in living habits.

Summerside offers a consumer program called Heat For Less Now where customers can purchase, lease or rent appliances, and pay 8 ¢ /kWh for hot water and space heating compared to 13 ¢ for regular customers without ETS and hot water storage control. The intention is for customers to realize a 5-year payback (ROI > 20%) and a savings of 36% on heating against oil prices. In reality, paybacks have been much more successful and have ranged from 1.3 to 6.8 years for businesses and residences.

The MyPowerNet was designed to stop leakage inefficiencies and the export of taxes and investment dollars out of the community. The program is designed to keep dollars in the local economy. The program has brought in 201 ETS units into 142 premises, creating an additional 4.7 GWh and $224,000 in new sales for utility. The program resulted in 99% customer satisfaction, and a 42% reduction in GHG emissions for participating customers. About $218,000 annually is staying in community.

Once the smart communications network is in place it provides a gateway to economic opportunities through future development in energy management and renewable energy innovations. The City is creating a Living City Laboratory for research and development in the energy sector. The MyPowerNet program provides three pillars of sustainability: environmental stewardship, economic prosperity, and social responsibility (see Figure 3).

Sally Wright and **Gerry Quarton** – *ETS Units in Two Whitehorse Homes*

Both homes have a central furnace-style ETS installed at a cost of $16,000 to $17,000. Both included upgrades to 200 amp service at significant cost. The consumption of electricity increased by about 11,450 kWh/yr and 14,700 kWh/yr for each residence. There have been no cost savings in energy use from the switch over. The benefits to the residents have been the following:

- No more oil delivery, only one bill.
- No risk of carbon monoxide poisoning.
- No more oil tank and risk of spilling.
- Fuel oil cost has increased almost 3 times from 45 ¢ to $1.23 per litre from 2001 to 2013; the cost of electricity had been steady at about 13 ¢/kWh until 2013; it is now about 16 ¢/kWh in 2014.
- Less maintenance needed.
- Environmental and social stewardship by using less fossil fuel and more renewable hydro.

The benefits to Yukon's utilities are:

- More electricity sales – especially from hydro and less from diesel-electric plant.
- No added capacity to meet new load because units only recharge at night to avoid peak hours.

Dennis Meiners, Intelligent Energy Systems – *ETS and Wind/Diesel in Alaskan villages*

In rural Alaska, the high cost of energy from fossil fuels is a burden on the economic well-being of the communities. Over one quarter of rural budgets are spent on fossil fuels and the cost continues to rise. In many rural communities, about one quarter of families are below the poverty line. Over 180 communities that depend on diesel for electricity and heating are looking to local renewable energy as a solution.

The Chaninik Wind Group Villages, which includes Kongiganak, Kwigillingok, Kipnuk, and Tuntutuliak are in the southwest part of Alaska. Their heating needs make up about 60% of their total energy use: electricity is about one third and the rest is for transportation. However, the wind resources in this part of the state are very good and are plentiful during the winter.

ETS is a low cost form of energy storage that is being used with their village wind-diesel smart grids. The three communities of Kongiganak, Kwigillingok, and Tuntutuliak each have five wind turbines at

95 kW and 20 to 30 ETS units. All three villages use smart metering and controls to manage the ETS units to match the wind resource. The ETS and the smart controls help to maximize the absorption of available wind and to stabilize the grid, which improves the quality of the electricity such as more constant frequency and voltage and fewer power outages.

The cost of heating fuel is about $7 per gallon, whereas the cost of ETS heating with wind is about $3 per gallon equivalent. While the customer realizes the benefit of lower heating bills, the utility benefits from additional sales of electricity directly from wind to heating.

The next step in smart grid development in the Chaninik Wind Group Villages is the introduction of vehicle batteries for increased energy storage. The short-term goal is to turn off the diesel plant for one third of the year and achieve 40% fuel savings with wind.

The challenge for the utility is to provide stable, reliable, economical and efficient power with renewable energy. Optimization is key and there is a need for managing the assets and distribution of energy supply. Assisting with this is a user-friendly software database with mapping and data analysis capability that provides tools to manage the utility's electrical system.

Al Takle, Steffes Corp. – *ETS Program Examples*

Al Takle defines ETS as storage of electricity in the form of heat. ETS is used primarily to recharge by using electrical energy to heat high-density bricks during off-peak hours (nighttime) when demand is low and when electricity is more economical. The technology's purpose is to reduce peak demand, eliminate generation and transmission constraints, and to best utilise renewables.

ETS also improves frequency regulation and promotes arbitrage: the use of lower priced energy source like hydro (10 ¢/kWh) over another more expensive source like diesel (30 ¢/kWh). Off-Peak programs include controlling water heaters, ETS, dual source heating, and time of use pricing. Incentives can include equipment rebates and/or financing, monthly compensation, or rate reduction on billing.

Historically, control of the ETS and other storage has been done by radio frequency (RF), power line carrier (PLC), FM transmission, paging system, time clocks, and a switch from the utility meter.

Because wind and solar are intermittent sources of energy, the best way to use these two sources is through a smart grid with energy storage to manage the renewables with energy demand in real time. Smart grid is integral to ETS and allows the most efficient use of grid infrastructure. Large quantities of renewables will require real time controls. ETS with smart grid can provide fast responses to grid fluctuations.

Steffes proposes a dynamic dispatch system with grid-interactive ETS that includes managing domestic hot water tanks. Under this scenario the energy levels and charge rates of the ETS and hot water tanks can be managed and reported with precision.

ETS is very economical compared to using electrochemical battery storage, and it has environmental benefits from a materials perspective and from its ability to use renewable energy.

4. ROUNDTABLE BREAKOUT DISCUSSIONS

Following the panel presentations, participants divided into four breakout groups composed of a mix of people from the general public (consumers), utilities companies, and government/research institutions.[1] These groups rotated through four different tables with breakout facilitators, each with a different theme:

1. **Infrastructure and Facilities**
2. **Economics**
3. **Consumer Needs**
4. **Partnerships & Policy**

The participants spent twenty minutes at each table, and addressed three questions for each theme area:

- What are the **strengths** in this area in the Yukon?
- What **barriers** exist in this area?
- What **opportunities** exist?

The detailed table notes from these discussions can be found in Appendix 2. Some of the major themes emerging from them are addressed in Section 6 below.

Figure 2: Picture of a summary of main desired outcomes from three workshop working groups: Consumers, government, and utilities representatives.

[1] Although a number of contractors and people from the building industry attended the panel discussions, there were no members from this sector involved in the breakout sessions.

5. THREE KEY STEPS - COLLEAGUE/SECTOR GROUPS

Following the mixed-group roundtable discussions, participants were asked to form groups with their colleagues or people attending from the same sector: Public/Consumers, Government/Policy, and Utilities. Each group was asked to review the major obstacles and opportunities for their sector, and produce **three key steps that would enable greater use of renewable energy and new heating technologies such as ETS**. Detailed notes from each colleague/sector group's discussion can be found in Appendix 3. At the end of the discussion, the groups produced the following ideas:

Consumers (group 1)

1. Mandate YUB to conduct regulatory review to better incorporate environmental considerations
2. Provide incentives and education to move consumers from fossil fuels to renewable energy (through pilot projects / practical education)
3. Revisit the Energy Strategy for Yukon and Yukon Government's Climate Change Action Plan

Consumers (group 2)

1. Skagway line to increase capacity and reduce diesel (and enable more ETS)
    - Extractive industry builds renewable energy legacy and own energy sources
2. Pilot projects for wind and ETS (e.g. Burwash, Haeckel Hill)
3. Public commission on Yukon's Energy future

Government and Policy-Makers

1. YUB should be mandated to consider energy and sustainability
2. Set up energy partnership (with governments, consumers, and utility) for renewables, efficiency, and conservation
3. Yukon government to review, update, promote Energy Strategy (and emerging technologies)

Utilities

1. Allowance given to operate out of "the box"
2. Conduct/build a pilot project
3. Integrated approach, multi-stakeholders coordination

6. EMERGING THEMES

This section explores themes that emerged throughout the workshop discussions, which are drawn from the discussion notes in Appendix 2 and 3. These themes include common patterns of ideas in the discussions, along with key strategic concepts that captured participants' attention. These observations are intended to draw some conclusions from the workshop, while understanding that each of these themes will require detailed analysis and discussion in the future.

Social, Environmental and Economic Sustainability

Greg Gaudet's presentation of the Summerside PEI approach to ETS included a diagram that defined sustainability as the area where social, environmental, and economic needs overlap. The take-away message was that widespread change towards renewable energy requires an economic model that allows people to meet their social, environmental and economic needs and aspirations.

Figure 3: Adapted from City of Summerside's "My*Power*Net" presentation, May 2014

Mr. Gaudet emphasized a key difference between Summerside and Whitehorse - the former was producing excess wind energy that it was selling to other provinces, while still importing and burning expensive and polluting fossil fuels. ETS worked for them as a mechanism to capture and use this excess renewable energy, and reduce fossil fuel imports and consumption. The Yukon is currently at the "early adopter" phase with ETS technology, and has made marginal progress on wind energy to date despite strong wind resources that meet the seasonal energy needs. For a significant shift towards renewable energy to occur in the Yukon, better cooperation is necessary between the parties involved to develop viable models that work for our situation.

Mandates and Partnerships

For the vision of a sustainable renewable energy future to become a reality, several key pieces of our energy system must move in unison: new energy sources must be developed and distribution infrastructure and equipment must be upgraded. This must happen within a viable economic model that satisfies the Yukon Utilities Board (YUB). Currently, the key players in generating and distributing energy in Yukon (YEC and YECL) have no mandate to explore new renewable energy models. YUB's main focus is ensuring stability for electricity ratepayers, and significant innovations that are beneficial to the environment are challenging to develop if they could result in increased costs to ratepayers.

There is currently no high-level official entity for collaborative work on Yukon's energy future.[2] This is a critical element if all the partners involved in developing policy, in generating, distributing, regulating, and using energy can coordinate to work together towards a sustainable energy future. Such a partnership could help integrate choices around new energy projects, upgrades to distribution infrastructure, and consumer incentives. A strong mandate to explore and promote new renewable energy models would be critical to such an entity. Success stories about partnerships that work (such as the City of Summerside, PEI and the Rural Energy Alaska Partnership - REAP) can provide inspiration, guidance, and learning opportunities. Participants also noted that First Nations governments are well-established in Yukon, and eager to find ways to combine economic development with environmental stewardship.[3]

Pilot Projects

Participants recognized the challenge of fostering change in a complex, highly integrated system such as our energy regime. Many people suggested small pilot projects as an approach to testing new ideas, working out issues, and building awareness about new options. Such projects could be great starting points for the inter-agency partnership entity discussed above. Participants also emphasized the key role of Yukon College, Yukon Research Centre and Cold Climate Innovation. These groups are in a strong position to help develop and support innovative energy pilot projects. As well, rural Yukon communities that currently burn diesel for electricity may be eager partners in such pilot projects.

Consumer Awareness

Workshop participants noted both strengths and weaknesses regarding consumer awareness. Yukoners are generally quite environmentally aware and want to do what's best for the environment; First Nations have particularly strong motivations in this regard. There is a sense that most Yukoners would support innovative approaches to renewable energy, even if they include some growing pains. However, there is also a sense that many people do not clearly understand the issues and options. Many consumers are unaware of the relationships between EMR, YUB, YEC and YECL and the issues

[2] There is currently an informal working group called Yukon Energy Partners that allows for sharing of information, but there is no formal mandate to innovate or develop pilot projects.

[3] Kluane First Nation in Burwash Landing is currently undertaking a wind energy generation project.

regarding mandate and economics. Many do not understand the sources of their electricity, the impacts associated with energy use, and the limits of the current system. And many are unaware of the overall energy picture in the Yukon and the strong rise in fossil fuel prices relative to electric energy. Often consumers are simply confused and unsure of the best decisions to make given a lack of clear, integrated planning for the future. So in conjunction with the need for more partnerships and expanded mandates, there is a need for more consumer awareness about energy issues and options.

Energy Related Plans

As the population of the Yukon is increasing so is the demand for energy production. There is a need to review and update the Yukon government's Energy Strategy for Yukon (2009) as well as the Yukon government's Climate Change Action Plan (2009) to reflect continuing shifts in the energy landscape (e.g. continually rising fossil fuel prices and new technologies). All plans need to be integrated together as a means to inform and engage the public, and be understood as part of a global shift towards renewable energy solutions.

Community Size and Layout

The Yukon population is relatively small, and as a result, innovative system-wide changes may be easier to effect than in more populated places. Communication and education are also easier, as word of new ideas can spread quickly. However, the Yukon population is also very spread out, and Whitehorse is a very dispersed city. This can mean increased costs for distribution and new equipment (e.g. transmission lines, fiber optic lines for smart grid systems).

Economics and Incentives

At present, there is no economic incentive for consumers to convert to ETS systems. Initial capital costs are high, and depending on the efficiency of buildings, there is currently little difference in monthly costs between oil, propane and electric heat. As part of a viable economic system, incentives are needed to increase awareness and investment in ETS. Incentives could come in the form of rebates, reimbursements, and subsidies. According to Luigi Zanasi's feasibility study (discussed in section 3), around 1400 Yukon homes could convert to ETS space heating from electric baseboards without overtaxing hydroelectricity resources, thereby avoiding adding to the load on the system during peak times in the winter months. However, beyond about 1400 new ETS users, an integrated strategy is required to coordinate supply and demand so that renewable energy sources are used, not fossil fuels.

Clarity needed around ETS potential

Both utilities raised doubt that there was currently any renewable energy being spilled or wasted in the winter that could be better utilised through ETS technology. Some workshop participants thought that ETS would result in the utilities burning more diesel, not less. This uncertainty permeated the

workshop. When clarity was sought, the responses highlighted the complexities of Yukon's hydro-diesel electrical system. Utility representatives explained that there was a risk that using ETS to shave the peaks and fill the valleys in the coldest months of the year could result in prematurely spending hydro capacity needed in the spring when hydro resources are lacking. This, it was explained, would only result in a shift of fossil fuel-based electricity generation to later in the season.

We need to better understand whether ETS is a solution for our system now, or whether we have already reached a saturation point in overall electrical demand and renewable energy capacity. ETS proponents suggest the research and modelling show that switching electric baseboards to ETS units would shift peak demand resulting in grid optimization and significantly reduced peaks currently being met with fossil fuels.

New installations of ETS units (as opposed to existing baseboard change-outs) would increase loads on the system. However, as these systems would be controlled by the utility to match renewable energy and low peak times, this would not necessarily add significantly to peaks.

Regardless of the uncertainty or disagreement about the ability of ETS to help reduce diesel peaking in the current energy situation, the group agreed that ETS has the potential to meet a critical energy need, displace fossil fuels, and maximize the grid's ability to integrate more intermittent renewable energy sources.

7. APPENDICES

APPENDIX 1: Roundtable Mixed-Group Discussion Notes

These are the verbatim notes from the mixed-group breakout tables as recorded by the breakout table facilitators. They did their best to capture the words and ideas of the participants as precisely as possible. The notes are organized according to the four theme areas addressed (Infrastructure, Economics, Partners and Policies, Consumers), and the strengths, barriers, and opportunities within each of those areas.

1. Infrastructure

Strengths

- 3 dams (7.6 MW)
- 2 wind studies
    - Few years to develop
- Skagway power link
    - Unlock energy at Fraser
- Internet in homes to do metering
    - Lots of work already done
- Power poles/transformers are not expensive to upgrade
- Consensus on fossil fuels being of the past
- REAP-Alaska example
    - Can help the government to do a better job (continuity)
    - Social context to engage issues
    - Helps understand information
    - Independent, multi-agency support
- Energy Solutions Centre (government body)
    - Works on energy policy
    - Cannot advocate –follows YG energy strategy
    - Leads case studies
- Outside government organizations can lobby
- Cold Climate Research Center
- New Sales give YECL ability to upgrade
- Availability of wind possibilities
- 2 utilities, not many own infrastructures
- Seed funding through Yukon Research Center
- Yukon Energy Partners
- Small enough we can communicate

- Isolated grid

Barriers

- Mines need power
- No lines to Skagway
- Huge city – hard to lay fiber
    - Expensive (Summerside PEI: $25M)
- Smart metering network
- YECL distribution capacity
- Effectiveness of planning before board hearing
- Last meter upgrade application by YECL turned down
- Utilities board main focus is protecting rate payer
    - Need more forward thinking
- How to cushion both supply and demand
    - Need seasonal solutions (ETS solves small window)
- Opposition to almost any infrastructure project
- Not everyone has good info
    - People want to pick on each other
    - How do we engage about the info
- Utilities need to keep the train running
- Current lines, transformers, substations cannot accommodate more energy load
    - Need upgrade
    - Currently feed 4-8 homes/transformer
- Buy-in from existing oil-based industry (businesses)
- How to bring multiple stakeholders together?
    - One-against-the-other
    - Governments and lobbyists get co-opted
    - REAP-style solution

Opportunities

- Mines/Casino provide own renewable power
    - Leave a legacy project
    - Possibly buy additional power (if connected to grid)
- New technology makes smart grid more viable
- Look at long-term solutions not band-aids when addressing options (board hearings)
- Royal Commission on Energy
    - Independent

    - High level visioning
    - Election issue
- Create collaborative social infrastructure of equal footing to engage issues
- Retraining of existing contractors to renewable like ETS
    - Business will move with transitions
    - Courses at the college / human infrastructure
- Multi-agency organization like REAP
    - Holistic approach
    - Independent
    - Information collection and sharing
    - Need buy-in = trust
- Next workshop
- Organize ETS investors to help utilities find wind
    - Need to come with $ to balance risk
- Trials, pilots, “early wins” in communities (Burwash)
- Additional case studies on new approaches like ETS
    - Change needs research
- Industrial Research Chair (IRC) on renewable energy for Yukon
    - Innovation research projects
- Upgrade distribution
    - Collaboration with Northwestel and Utilities
- Avoid new fossil fuel infrastructure
- Slower discharge modifications on ETS to allow more electric heat on current system
- This workshop!

2. Economics

<u>Strengths</u>

- Availability of wind in the winter
- Small community (x2)
    - Can work together
    - We can talk to each other directly
- Engaged community
- Public education can change behavior
- Independent grid
    - Can work on own ideas
- Full residential survey of how energy is being used in Yukon Territory

- Good power infrastructure
- Existing grid infrastructure
- We have legacy hydro, wind, potential
- Wind and hydro are quite cheap to run in the long term
- At times we have excess of renewable power (x2)
- Crown corporation for energy
- ETS could displace new generation
- There is a lot of "low hanging fruit" re: demand side management

Barriers

- Independent grid
    - No cheap "out"
- No economic incentive to buy ETS
- Cost (Capital investment) of building in North
- Shipping costs
- Regulatory barriers e.g. YUB
- More electric heat equals more energy infrastructure
- Baseboard heat installation is cheapest
- No government will power or believe in climate change
- Not including cost of climate change in economic analysis
- Not enough variety of output energy and demand
- We only have a limited amount of hydro so leveling peaks and troughs doesn't necessarily get us off diesel
- New mines require a lot of energy
- YUB bases decisions on economics only
- Adding more ETS means more people on electric heat, will tax power demands on local distribution system
- Not enough renewable energy to adopt ETS
- Limited amount of annual hydro energy available
- Everyone uses power at the same time
- No incentive to change time of use
- Time of use metering without technology doesn't get much uptake
- Businesses that want oil and gas industry and businesses in YT can put crown corporation in competition with private businesses
- People who depend on fossil fuels for employment (e.g. oil delivery) won't support renewable
- Conflict of interest
- Public utility is under government department responsible for economic development
- High capital cost to start renewable energy generation (e.g. wind, hydro)

- Lack of leadership in innovation
- Storage is a problem with wind and run of river hydro
- Very limited capacity to replace diesel with electric heat
- Long term impact of fossil fuels isn't recognized
- YESAB doesn't take GHG emission outside Yukon into account

Opportunities

- More studies/ more info needed / need to understand (x2)
    - How much energy is available
    - Costs of additional capacity
    - Energy uses
    - Cost of ETS units
    - Business cases
- Need to understand and help present business case, using standard economic tests for investments and incentives etc.
- Study to get a better handle of how hydraulic capacity can be managed with ETS
- Need rebates on purchase of ETS
- Clarity re: obligation to serve industries and customers
- Use ETS to level peaks and troughs of energy use to provide time to develop renewables
- Price differentiate for time of use
    - Can be through internet
- Smart meters needed to underpin incentives for consumers
- Smart metering
- Need financial incentives and technology making access easy
- Public education can change habits
- Divert some federal transfer payments:
    - To up front subsidies for buying ETS
    - Or to subsidize the utility to invest in smart grid/meters and renewables
- Voters change or influence government/politicians
- Install more wind or renewables to make ETS more effective
- Add more capacity (generation and distribution)
- Wind is a relatively quick source of new generation
- Implement in larger commercial and industrial customers for more cost-effective results
- Matching new generation to energy needs to best integrate renewable energy sources that have challenges
- Major industry like mining supply their own power
- Policy of renewable energy legacy by new industrial developments
- Revisit basis of YUB decision-making

- YESAB to consider GHG content for out-of-territory inputs
- Reduce economic leakage of outside energy sources
- Formation of storage utility (co-op)
- Increased heat storage
- Further "low-hanging fruits" to be had in DSM
- Certified home energy assessments are cheap ($200) and can tell building owners best approach to increase efficiency

3. Partners and Policies

Strengths

- Some Yukoners and utilities are interested in:
    - Reducing costs
    - Reducing Carbon footprint
- Governments like "partnerships"
- Some First Nations are settled and integrated in partnerships
- Existing partnerships with First Nation with an energy component
- Some First Nations are innovative
- YEC and YECL work in partnerships
- Skagway as neighbor is a potential partner
- Presence of a progressive college (YC)
- Presence of the Yukon Research Center
- CCIC is located at the YC as of the Yukon Research Center
- Local connection and common goals to improve renewable energy
- Existence of the Yukon Energy Partners group
- Fewer levels of approval due to the small size of the Yukon Territory
- Existence of a Climate Change Action Plan and a Yukon Energy Strategy

Barriers

- Narrow focus of the electricity regulatory regime impedes looking at the entire picture/energy in general
- YUB process doesn't look at the environmental impact of a utility choices
- There is a lack of integration between YESAB and YUB
    - YESAB only looks at projects
    - YUB only looks at rate payer
- No holistic approach
- YUB, Producer, Distributor, Politicians and Consumers do not have shared common goals

- Lack of clarity around the roles of YEC, YECL, YUB, YCS
- Lack of input from consumers into energy planning
- The Yukon Energy Strategy plan is unclear, outdated, and unknown by the general public
- Lack of public awareness
- Some resistance from a portion of society
- ETS is not included in the Yukon Energy Strategy plan
- Costs and payback of ETS
- Lack of knowledge of ETS
- Not a win-win-win situation between producer-distributor-customer (no win for customer)
- Need to make a good business case
- Need to build additional infrastructure
- Possible lack of will on parts of the government, YUB, YEC and YECL
- Risk of spending in research then not being accepted by YUB
- Lack of partnerships between YEC, YECL and YUB

Opportunities

- Clarify the difference between YEC and YECL
    - Change the name of one of the organization YEC and or YECL
    - Refer to the organizations with their full names
- Review/upgrade the Yukon Energy Strategy
- Develop an energy plan with partners
- Integrate all partners and different plans in making a new Yukon Energy Strategy and include academic studies
- Potential partnerships with Skagway and Alaska
- ETS could level the energy consumed
    - Organize the relationship between YEC and consumers
- Explore and create values of win-win partnership between distributor, producer, and consumers
- Producer and distributor and consumer working towards improving the system
- Public ownership of one organization that would include distributor and producer
- Create an inclusive energy policy (electricity-oil-propane-L.N.G...)
- YUB consider electric heat as utility
- Explore and create partnerships with other regions e.g. Scandinavia, Summerside P.E.I., and Alaska
- Set up partnerships with other jurisdictions that are innovative e.g. PEI, AK
- Reach out (not reinventing the wheel)
- Give the college equipment to improve renewable energy and ETS, so the knowledge is there when the technology is out
    - Students and teachers can become ambassadors

- Create a community energy plan
- Get mainstream involved
- Innovate/improve marketing to engage mainstream
    - Internet, social media, TV
- Create a "Royal Commission" to engage the population
- Increase participation in the Yukon Energy Partners group
- Update the Climate Change Action Plan
- Update the Yukon Energy Strategy
- Increase collaboration between YEC, YG, YC, YECL and universities
- Get approval of research projects before they occur
- Add a research chair in energy
- Invest some YEC research money in Yukon college
- Explore partnerships
- Partner together to acquire and invest funding for research and get college to conduct research
- Research alternative energy options

4. Consumers

Strengths

- Everyone understands language of money
- Consumers ultimately have power to drive market "This is what I want, I am paying, give it to me."
- Generating structures that are usable to consumers, not hidden away
- Yukoners are knowledgeable, educated, and energy literate
- People care and are interested in: environment, costs, self-sufficiency, and are excited to try new things
- Consumer base is small
    - Easier to get consensus
    - Easier to communicate with/reach
- Consumers have internet access, most are on the grid, good range of services
- Consumers control because they are in a regulated environment
- Scalable adoption
    - Momentum can build quickly
- ETS heat is pleasant
    - Attractive: not noisy, clean, don't have to haul wood
- Other benefits: dry cloths, start beer making
- Long heat retention even if power goes off
    - Battery can be added to turn pump and fan (fix) universal power supply (UPS).

- No chimney needed
- Training for installation relatively simple
- Yukoners want to do what's right
    - Closer to nature
    - If shown benefits, willing to invest
    - Willingness to do right thing and pay a little more for it

Barriers

- Lack of knowledge about ETS and larger issue (shaving peaks, filling troughs)
- People don't want to be educated/other priorities/fatigue
- ETS is expensive
- Capital costs
- No program: plan, system of incentives
- No preferred rates/payback
    - No incentives
- Consumers don't want rates to change
- Average person at end of month trying to cover bills doesn't care
- Energy literacy (e.g. kW vs kWh)
- Smaller rate base
- Average consumer does not understand regulatory process
- Public involvement not taken seriously/erosion of public confidence
- Lack of skills for installation and servicing
- Government: high electrical rates, low fuel costs/liter, propane is cheap
- Lack of YUB power
- YUB process slow
- Process is established but not being followed - consumer does not understand decision making process
- Upfront cost
    - Freight (heavy)
    - Need economies of scale
- Dependency on utility that is not dependable
    - Wood stove for back up
- Need for qualified and available technicians
- Current lack of renewable energy
- Utilities need to start to build business case and plan for heating load instead of mining load
- Educated so we want to see a payback
- Need education/needs to reach wide population
- Hard to be heard

    - No effective mechanism for consumer engagement, especially at policy level
- Dilution of public input into public charrettes
    - Erosion of trust
    - Input not being received as presented
- Retrofitting for ETS brings additional costs

Opportunities

- Flatten demand
    - Benefit from government
    - Low oil costs, high electricity costs
- Yukon housing (?)
    - Low cost loan for people to invest in ETS
- Energy audits
- Help maximize benefits of technology
- Utilities need to facilitate defining ETS program
    - Goes in front of YUB
- Consumers drive increased electricity sales
    - Need control over that
- Use what we have more wisely and increase generation
- Political leadership
- Renewable energy cooperative
    - Seeks own customers
- Strong, vibrant, growing company will be invested in by consumers
- Educate on issues
- Approved program
    - Information, education
    - Incentives
- Rate structure changes to incentivize conservation
    - Long-term
- Rate structure
    - Encouraging conservation
    - Rates different at different times
- Give us a deal
- Financing program
- Subsidies
- Bulk discounts
- Incentives
    - Financial

    - Name in paper
- Need business case
- Thank you letter from YEC
    - Customers need something
- Get rid of fossil fuels

APPENDIX 2: Colleague/Sector Group Notes

Below are the flipchart notes recorded by breakout table facilitators during the colleague/sector group discussions. Discussions in these groups were focused around opportunities and barriers to integrating ETS into Yukon. These notes provided a basis for developing the three key steps in each sector area that are presented in Section 5.

Utilities

- Misunderstanding of choices, motives
- Misunderstanding backup versus primary
    - Need backup under regulations
- Mandate of utility
    - Can play role in reducing fossil fuels use
    - Limited to electricity
    - Need high level mandate to be productive on heating/transport
    - (Utility Board limits us)
- Let the Yukon energy "out of the electricity box"
    - Look at the big picture
    - Broader mandate from board, government
- Nearly at capacity now
    - Can't add new load
- Complexity of hydro-system
    - "Are we out of hydro?"
    - Small population base, large territory
- Innovation/Change/Smart Grid requires trust in utility
    - Number/consumer complaint
    - Lack of cohesive plan, or not well communicated
    - Small/scale pilot demo of innovative approach (e.g. ETS-Wind in Burwash)
- Regulatory context, process
- Consumers do what is economical
    - Switching to electric
    - Demand drives utilities
- More or less 30 MW buffer right now (counting diesel)
- Need enough backup to deal will loss of biggest source (Aishihik)
- Complete integration, multi-stakeholder approach
    - YDC, YUB, YEC, YG

Government - Policy

- Decision making based on accounting only rather then true/full cost
- Fragmented decision making
- Lack of analytical capacity
- Lack of leadership/integrated action
- Middle of the road/broad appeal solutions
- Work constructively towards solutions
- Reducing of our energy load is part of the solution
- YUB consider life cycle, Cost/impact
    - Energy not just electricity

Consumers

- Environmentally aware
- People will respond if there are economic incentives
- People don't fully understand how our power system work
    - Technically
    - Rates
- No good process in place to allow people access to decision making
    - Lack of trust in process
    - Expectation aren't being met
    - Will of people not being reflected in final decisions
- System dynamics are confusing
- No place in regulations that reflects to environment
    - YUB doesn't address environment in costs
    - Not part of their mandate
- Perception that YESAB will pick up environment aspects but rate applications are only YUB
- Possible solution: Change legislation (TOR) to include environment in YUB
- How long have YUB rules and regulations in place?
    - Established 1987, fine tuned 2012
- Change YUB mandate to allow them to consider environmental costs
- Mandate YUB to conduct regulatory review to better incorporate the environment
- Population increasing, demand increasing, demand on YEC also increasing
    - Need smart long-term growth
    - Will need to build more stuff
- Revisit energy strategy

- Renew Climate Change Action Plan
- Common goals are root of trust
    - Need to trust utilities and regain trust
- Money is an issue
- Future for children
    - Clean air and clean water
- Economic Development branch of YG needs to be focused on sustainable development not resource extraction
- Bring together resources to develop portfolio for options
    - Education clearing house
- Incentivize getting off fossil fuels
    - Info needed on greenhouse gases not released
- Pull plug on fossil fuel incentives and inject into renewable resources
- Incentives for solar renewables
- Someone needs to fund a pilot project
    - Residential demo
    - Business demo
    - Whistle Bend 10-20 units
- Pilot project where single utility is involved wind/ETS
    - Use ETS with existing turbines
    - Could be done quite cheaply
- More renewable energy needed/wind
- Demand Side Management/Advanced Demand Response
- Smart grid
- No energy agreements with mining companies
    - Mines get their own renewable legacy
- Transmission line to Skagway
- Financial incentives
    - Rebate/grant
    - Financing
    - Rate incentives
- Arms length public commission into future of energy in Yukon as election issue
- Have concrete goals re: energy future as election issue
- All the energy parties work together, YEC, YECL, ... Collaborative process
- Rural electric cooperatives
    - Distribution
- “Super Coops” for generation
- From ETS standpoint, having generation and distribution by same entity works better