Summary of Presentation by Luncheon Speaker, Bernie Karl

Mr. Bernie Karl, the keynote speaker for the Sustainable Northern Shelter Forum luncheon on October 30th was introduced by Mr. Jack Hébert, President and CEO of the Cold Climate Housing Research Center. Mr. Karl is a man who doesn’t just talk about doing things – he gets them done. Mr. Karl is the owner of K&K Recycling, Kodiak Narrow Cape Lodge and the Chena Hot Springs Resort (CHSR). Chena Hot Spring’s vision is to become a self-sufficient community in terms of energy, food, heating and fuel use to the greatest extent possible. To attain this goal, Chena has developed several renewable energy and sustainable development projects.

Abstract: Mr. Karl discussed how his business, the Chena Hot Springs Resort, has turned the company from a money loser, to a money maker through the implementation of renewable energy projects that save money on fossil fuels. The projects Mr. Karl discussed were an absorption chiller, geothermal wells, greenhouses, Water Ram Pumps, the award winning Chena Geothermal Power Plant, biomass agriculture (farming willows), a biomass combined heat and power (CHP) unit, and hydrogen fuel cells. He concluded his presentation with the example of Reykjavik, Iceland, whose success story gives him the inspiration to achieve his dream to establish a sustainable community in Alaska.

Mr. Karl’s presentation, “From Hot Water to Hydrogen – Renewable Energy and Sustainable Development at Chena Hot Springs Resort,” (CHSR) gave an overview of what CHRS is doing to become a self-sustaining community. The average American uses 107 kW/hrs per day. Americans are energy hogs and that is why the rest of the world hates us. We use 25 – 35% of the world’s energy yet we represent only 5% of the population.

CHSR was spending a fortune on chemicals to treat the water – mineral water that pool customers would prefer NOT treated. He spent $500,000 in legal expenses to get the law changed so they don’t have to use chemicals. He doesn’t understand why people have such issues over policies. His motto is “it’s easier to beg forgiveness than ask permission!” CHSR is located in a semi-remote area where electricity costs 30¢ per kW/hr with an electrical load of 280 – 380 kW per day. It cost $1000 a day at $2.50 per gallon for heating fuel. Heating expenses were about 70% of their energy usage. He began forming partnerships with agencies and organizations such as the university, governmental, private and utilities to assist CHSR with their vision to become sustainable. At first, they said "no" to his ideas, but to Mr. Karl, “no means, maybe and maybe means no!” He told the audience, “Rejection should fuel you. Don’t ever let it defeat you.” Eventually his partners said “yes” to his many plans.

One of these plans was the Aurora Ice Hotel, completed in January 2004 and melted six months later. It was voted as the “dumbest business idea of 2004” by Forbes Magazine. Did that make him give up? No! He rebuilt it in 2005 and it is still standing today, resplendent with its beautiful ice fixtures and ice furniture. How? It takes 180,000 BTU per hour for refrigeration to keep the ice museum frozen. They installed the first three pressure absorption chiller in the world using 65 – 75 gallons per minute of cold water from Monument Creek (~40°F) and 95 gallons per minute of hot water from the geothermal wells (~165°F) to make 15 tons of refrigeration on 10 amps / 1.5 hp of electricity. They move 8,000 cfm of air through the exoskeleton of the building per day. The absorption chiller saved them $700 a day in
refrigeration costs. Convention wisdom says you can’t do this without hot water of ~230°F) but he proved it could work at 165°F and even has it down to 139°F. They are always pushing the envelope to see how far they can go. Absorption chillers work by the following principles: The evaporator allows the refrigerant to evaporate and to be absorbed by the absorbent, a process that extracts heat from the building. The combined fluids then go to the generator, which is heated by the gas or steam, driving the refrigerant back out of the absorbent. The refrigerant then goes to the condenser to be cooled back down to a liquid, while the absorbent is pumped back to the absorber. The cooled refrigerant is released through an expansion valve into the evaporator, and the cycle repeats. Mr. Karl’s system uses ammonia and water with water as the absorber and ammonia as the refrigerant.

When the Karl’s bought the CHSR in 1998, the owners were losing a million dollars a year on the place. Mr. Karl figured the only way to earn money on the place was by finding ways to save money. The previous owners were using oil to heat the pool and buildings on the property, so they drilled the first geothermal well in 1998 and began heating the pool and buildings with geothermal water, yielding ~$283,000 savings per year in heating fuel costs.

They built their first greenhouse in 2004 through a partnership with the University of Alaska Fairbanks (UAF). The first greenhouse cost only $3,500. In 2006 they built a second 6600 sf. greenhouse for $48,000 and now produce crops year round. It only requires 60kW for lighting as all the heat comes from the hot water. They figured out with their annual expenses of $100,000 to run the greenhouses; they can grow tomatoes for $1.50 /lb and lettuce for 75¢ per head. Is it cheaper to grow your own food? No, not when our country imports cheap food from countries with no labor or environmental laws and no import duty. Last year, for the first time in history, America didn’t grow enough food to feed its own people and imported more food than we exported. He isn’t growing food to save money, but does it because it tastes better and it’s the right thing to do.

Another project he did to save money was the Water Ram Pump project to pump water from a nearby creek to a 4200 gallon storage tank to water the gardens via drip irrigation. The Water Ram pump doesn’t require energy and uses the momentum of a relatively large amount of moving water to pump a relatively small amount of water uphill up to 500 feet. The pump has a valve that allows water to flow through the pipe and build up speed. Once it reaches maximum speed, the valve slams shut. The water then builds pressure which forces open a second valve. The water flows through the valve to a delivery pipe. As this happens the pressure falls shutting the valve and then the cycle repeats itself.

They established the Chena Energy Center giving daily tours to locals and tourists about their conservation methods and about alternative energy. They have geothermal, hydro, solar, and wind alternative energy systems all located on their property for students and tourists to learn from.

In 2006 they formed a partnership with the United Technology Corporation to purchase a Carrier Chiller coupled with an Organic Rankine Cycle (ORC) engine to produce power. The Carrier Chiller typically works as a refrigeration unit. The Chena Geothermal Power Plant also dubbed “The Chena Chiller,” uses 165°F water as “fuel” to provide 400 kW of net power. It reduced his cost of electricity from 30¢ / kW to only 5¢. The project cost $2.2 million. Out of that 2.2 million, $246,000 was a grant from the Denali
Commission through the Alaska Energy Authority. They borrowed $650,000 and the rest came from in-kind sources. He used recycled buildings to house it in. The Alyeska Company was going to demolish 24 buildings that were perfectly good buildings but weren’t earthquake proof. He bought all of them $4,000 and hired a structural engineer to make them earthquake proof. Now he rents twelve of these buildings back to Alyeska!

How the Chena Chiller works is the hot water enters the evaporator and boils the refrigerant which is then expanded through the turbine to 1.8 Mach, almost twice the speed of sound, where the turbine impeller spins a generator, producing electricity. They use cooling water from the cold water well and air to cool the condenser and condense the refrigerant. The refrigerant is pumped back into the evaporator and the cycle continues. The Chena Chiller is the first geothermal power plant in Alaska and the only new geothermal plant in 2006 and is the lowest temperature resource used for power generation in the world! They plan to drill another 2,500 foot well next year to reach 240°F water. They extract the water, use it then put it all back with an injection well. The cool water well moves 3,000 gpm of water without a pump. From August 20th to December 31, 2006, the Chena Chiller was 95% available (ran 95% of the time) and produced 87.5% of its projected electrical output. It saved 47,725 gallons of diesel fuel at a savings of $122,000 in electricity and it avoided ~450 tons of CO₂. CHSR hosted the President of Mongolia who came to see the power plant. Mongolia has vast geothermal resources yet relies on oil imported a long distance from Russia for heat and power. Mr. Karl stated that it takes vision and passion, not brains and money to become self-sufficient. The U.S. imports oil from countries that hate us like Saudi Arabia, Iran and Iraq. We shouldn’t be importing any oil, especially in Alaska!

One side benefit from investing in all these sustainability projects was the CHSR has seen an 11% increase in revenue due to so many people coming to CHRS just to see the renewable energy projects and take the free energy tour. Geothermal is a huge resource in the U.S. An August 2007 report stated that if we harvested just 2% of the earth’s geothermal energy it would be enough to take care of all the world’s energy needs in perpetuity. Despite this, the U.S. government completely cut the geothermal budget in 2006 / 07. Mr. Karl estimates there is enough geothermal in Fairbanks to provide ALL of the towns energy needs. The oil and gas companies, especially Conoco Phillips are figuring this out and plan to put a generator up north to use the hot water produced from oil and gas wells. There are millions of oil and gas wells in the U.S. especially in the Gulf Coast Region. Using the processed water from the oil and gas wells just in Alabama, Arkansas, Florida, Louisiana, Mississippi, Oklahoma, and Texas, could produce almost 6,000 MW. That is equivalent to six nuclear power plants with no parasitic load and no emissions. The CHSR received awards for the Chena Chiller project – the 2006 “Project of the Year” from Power Engineering Magazine and the prestigious 2007 R&D 100 Award from R&D Magazine.

Another project Mr. Karl is embarking on is biomass. He sees biomass as the future because it is all around us and is totally renewable. Willows are a fast growing species that can be harvested every three years and have ten times the vitamin C as an orange. There are 39 species in the state of Alaska. They grow well in Alaska in wet soil, dry soil and in the cold and provide excellent habitat for moose and other animals. Yet the state of Alaska does not grow willows as a crop. The U.S. used to grow willows but with our addiction to oil we stopped. Sweden is doing a lot of growing and testing with willows, yet the only test plot in the U.S. he is aware of is at the New York University. They could be used in rural
Alaska along with driftwood and forest harvesting of trees killed by beetles as fuel sources for heating and power generation. Mr. Karl aims to install a 400 kW (300 kW net) Combined Heat and Power (CHP) unit as CHP’s have thermal efficiencies ~80 - 85%.

As the owner of K&K Recycling, Mr. Karl wants to build the biomass plant at K&K to burn 5,000 tons of cardboard, paper and brush salvaged from the Borough Landfill supplemented with his farmed willow. He plans to use a thermal oil boiler (not a water boiler) to produce electricity and heat. You have to provide a use for the heat load (space heating, greenhouse, etc.) He wants to build a one acre greenhouse that could put out 3,300 heads of lettuce a day. He doesn't have a buyer yet but he needs to prove first that he can do this. He figures 40 acres of controlled greenhouse environment can provide enough food to feed Alaska, all 600,000 people! We grow on 2% of what we eat here and import 98%.

He doesn’t care who is right or wrong on the global warming debate. He cares about two things: clean air and clean water. Yet our country keeps building polluting coal and nuclear power plants. Alaska can be totally self-sufficient. If we build the Susitna dam it could provide 16MW of clean power for years to come. Anchorage is running out of natural gas yet their plan is to bring gas from Indonesia! Instead of burning coal you can turn it into a liquid which burns much cleaner. Hydrogen is the future for energy. The largest manufacturer of hydrogen in our country is the oil companies ~ 900,000 tons a year. What do they do with it? The petroleum refineries use it to take sulfur out of fuel. They process the hydrogen out of natural gas which leaves behind carbon dioxide. You can process water to make hydrogen and it’s totally renewable and non-polluting.

He purchased a hydrogen fuel cell that takes 10kW of excess power from the Geothermal Power Plant which goes to an electrolyzer and 50 gallons of distilled water to generate 6 kg of hydrogen per day. It may not be much, but it’s the first step. The equipment cost $250,000 and he projected that it will save him $5,000 to $10,000 per year using the hydrogen to supplement the resorts propane needs. He recycled a building purchased from Alascom to house the hydrogen production facility. Mr. Karl plans to come up with a way to inexpensively ship all the food produced in his greenhouses to off-road Alaska communities using hydrogen powered dirigibles made out of carbon fiber or carbon crystals. Carbon crystal tanks can hold twice the hydrogen as a steel tank. Carbon is 10 times stronger than steel, 10 times lighter than aluminum, and totally recyclable. One dirigible can service a community for months. It stays in the sky, returning to a docking station where the sun heats the hydrogen and releases it from the carbon crystals. Mr. Karl highly recommended we read the book, "The Hydrogen Civilization" by Roy McCallister. They are helping Mr. McCallister to design a carbon crystal tank, the first ones to be built in Alaska. He plans to have a carbon fiber business. They also have two vehicles that run on waste vegetable oil recycled from the resorts restaurant

Mr. Karl is inspired by Reykjavik, Iceland’s success story. In 1932, this community had cut down all their trees, was entirely heated with fossil fuels and was the most polluted city in the world. Today it is one of the cleanest cities in the world – no smoke stacks because they use 20% geothermal with 90MW produced at the Nesjavellir Geothermal Power Plant and 80% hydro. They are building a 780MW dam that should be on line next year. Electricity is so cheap there that many corporations such as the U.S.
Alcoa Corporation, an aluminum manufacturer, and others from all over the world are relocating there to purchase electricity at only 2¢ a kW. Microsoft plans to move its headquarters there.

Iceland is planting 11 million trees per year with imported tree stock from Alaska. Every graduating class in high school must spend time in their senior year planting trees. They have a vision to become the world’s first fully hydrogen–driven economy by 2050. They have a hydrogen fueling station and the community purchased four hydrogen buses at $2 million apiece to provide public transportation. They haven’t had the success they were hoping for yet, but they are working at it. Another renewable resource they have developed is farming freshwater shrimp. They grow to 8 ounces each in four months with fish meal purchased from Alaska for $220 per ton. They ship 2000 kilos a day into Europe. It costs 1 ½ pounds of fish meal at only 11¢ per pound to yield 1 lb. of shrimp that sells for $11 - $15 per pound. Mr. Karl would like to do the same here but the Fish and Game department so far have said “no” (but remember, no means maybe and maybe means yes). So he is working with the University to do it as a school project! He went to Iceland to look at their greenhouse systems for ways to improve his own greenhouses. They grow lettuce, cucumbers, peppers, oranges, even bananas! They turn out 2,500 heads of lettuce daily, package and ship it. It takes only four people to run this greenhouse heated with geothermal heat.

In conclusion, Mr. Karl reminded us why he and the staff at the Chena Hot Springs are doing this - to fulfill their mission to encourage renewable energy and sustainable community development throughout Alaska and to make Alaska a leader in renewable energy development. Sustainability is meeting our own needs without compromising the needs of future generations. Thomas Edison had over 1,000 patents and every one of them went to commercial production because they were improvements of previous patents. Edison said, "If there’s a better way to do it, find it." Edison said it took 90% perspiration and 10% inspiration to develop the filament for the light bulb. Webster said a failure is when you don’t succeed but to Mr. Karl, you only fail if you don’t try.