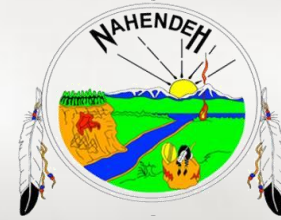


# Ft. Liard Geothermal Energy Project

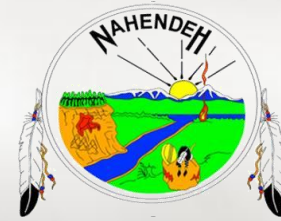
Borealis Geopower Inc.  
Tim Thompson, P.Eng MBA  
Craig Dunn, P.Geol

# ADK/Borealis Geothermal Project

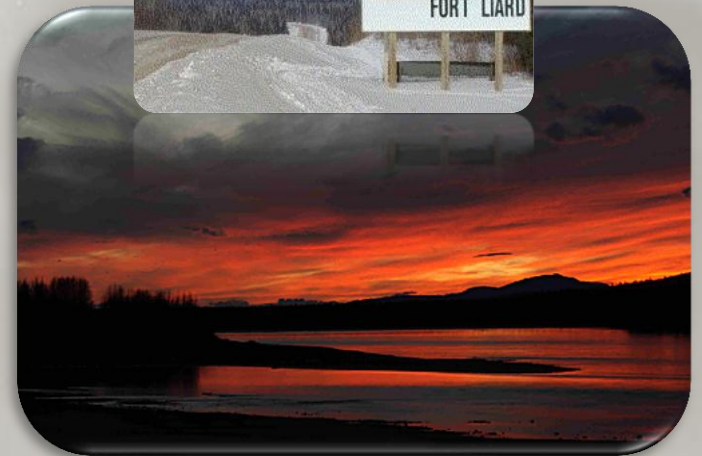


- ADK/Borealis Geothermal Project is a combined geothermal heat & power project (<1MWe) to supply the Hamlet of Fort Liard
- Borealis Geopower Inc. (Borealis), a geothermal energy company, partnered with the Acho Dene Koe First Nation (ADK), the resident First Nations band in Fort Liard, NWT to file and be awarded Federal Government "Clean Energy Funding"
- Project will offer cost effective electricity generation and direct heat opportunities to a native community that is currently producing its' power from diesel generation: Electricity price: 4-8x conventional urban pricing
- Geothermal (or earth heat) energy is a clean, renewable source of both power and heat
- A geothermal resource requires; necessary heat resources, a permeable rock environment to transfer heat and a medium (usually water) to bring the heat resource to surface. The geothermal reservoir operates like an underground heat exchanger; injected water is circulated through the reservoir and is exposed to the surfaces of hot rock allowing it to remove heat.
- The Ft. Liard Project design involves two geothermal wells (one production, one injection well), binary turbine technology and interconnection with the existing power grid
- There are agreements with local community, federal and territorial government and an open regulatory context to permit geothermal to develop and operate

# Project Partners

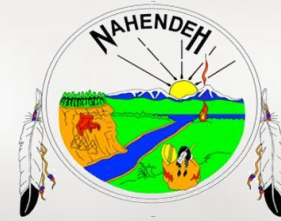


- This project involves a number of key partners
- Acho Dene Koe First Nations: Local first nations community in the Hamlet in Ft. Liard
- Borealis Geopower: private geothermal energy company, acting as technical team for project development
- Natural Resource Canada/Federal Government with Clean Energy Funding
- Northwest Territories Power Corporation (NTPC): current power utility in the community of Ft. Liard
- Northwest Territories Energy and Natural Resources (NWT ENR)
- Supporting Organizations: Indian and Native Affairs Canada (INAC), the Canadian Geothermal Energy Association (CanGEA)
- In total, the project was to be financed through a combination of federal and territorial government incentives and community participation.



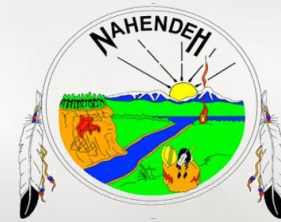
*"Acho Dene of the Liard Valley take our place in the world, ready for the 21st century, secure in our ability to do business and remain strong in our traditions and culture"*

# Ft. Liard, NWT Acho Dene Koe

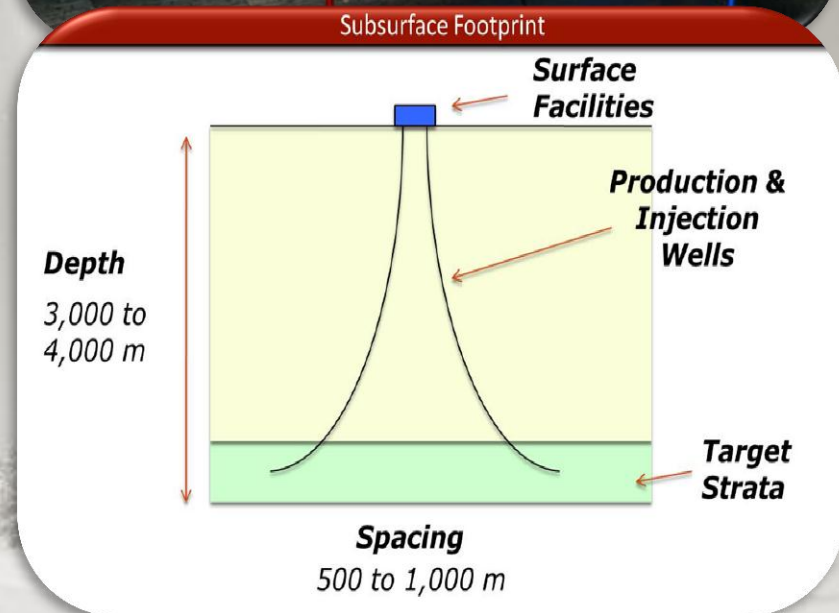
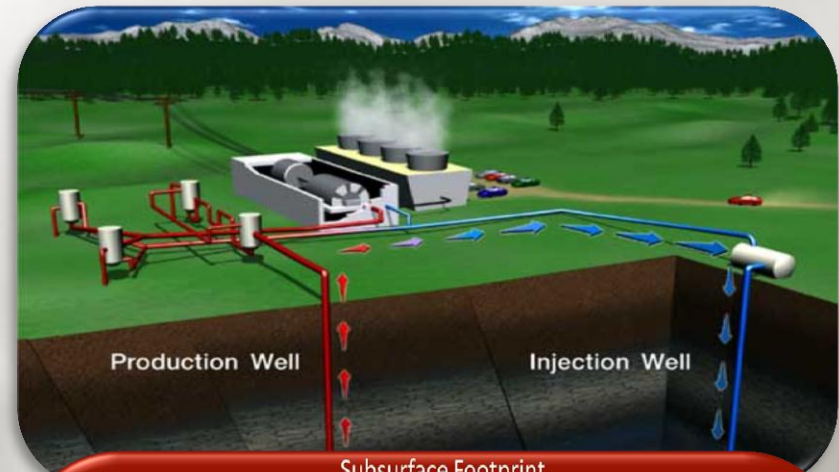


- Community Population: 530-600, ~160 homes
- History of exploration: Oil & Gas Development
- Above average temperature Gradient: 35-47<sup>0</sup>C/km & proven heat resource @ depth (184<sup>0</sup>C @ 4,579m)
- Price Point in 2008: ~61.20 (res) & 53.78 (biz) ¢/kWh
- Infrastructure in place (Road, water access)
- Community support and local availability to land

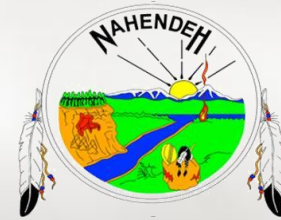
# Subsurface & Well Design



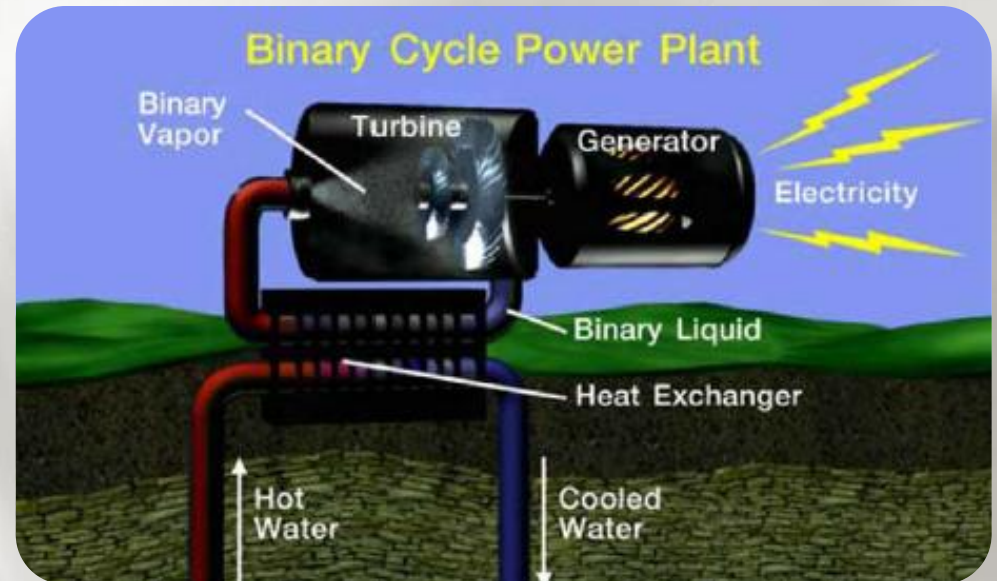
- Heat is the resource, water (used for the transfer of heat) is recycled in the system
- Continuous heat supply = renewable energy resource
- 2\* directional wells
  - 1 injection to ~1,500m
  - 1 production to ~4,200m
- Drilled using standard oil and gas drilling rigs & modified techniques for geothermal production
- Close proximity to current electrical and community infrastructure
- Subsurface heat modelling: @ 7.5km<sup>3</sup> volume & 165°C reservoir temperature =  $6.34 \times 10^{17}$  joules of heat in the reservoir



# Binary Cycle Power Plant

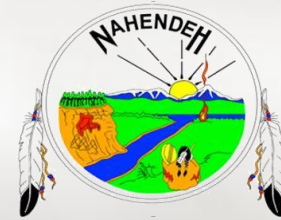


- Closed Loop heat exchange: Organic Rankin Cycle
- Hot geothermal fluid is used to heat secondary fluid with lower boiling point
- Secondary fluid is vaporized into steam and used to power turbine to generate electricity
- Electricity production is based on  $\Delta t$ ; More Heat = More Power
- At water temperature of  $160^{\circ}\text{C}$ : 25L/sec is necessary to generate  $\sim 880$  kWe of power.

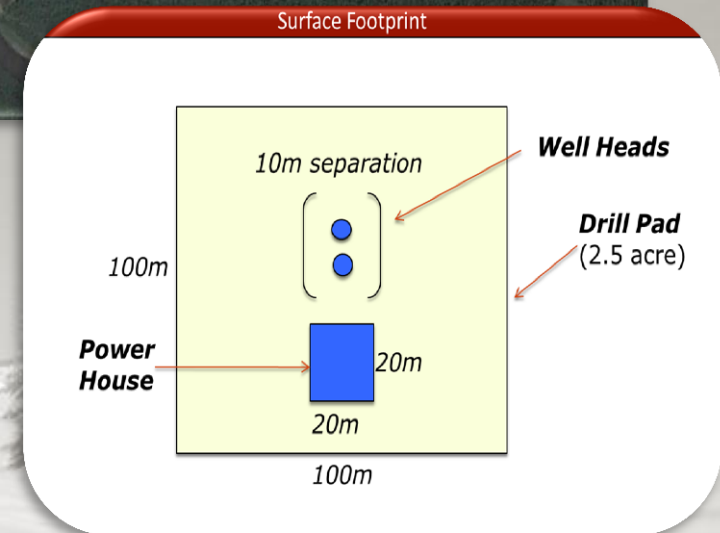


- Binary turbine technology can operate  $76^{\circ}\text{C}$  to  $\sim 180^{\circ}\text{C}$
- Estimated project resource for Ft. Liard Project:  $165^{\circ}\text{C}$  to  $185^{\circ}\text{C}$

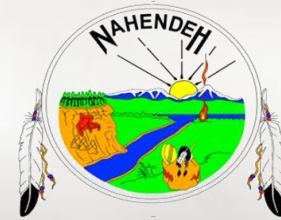
# Power & Surface Facilities



- Single pad for wells, binary facility & piping
- Small environmental surface footprint: <1 hectare
- Close proximity to existing transmission infrastructure
- Goal: 700-1,000kWe net power production
  - Binary Turbine power plants
  - Firm/baseload power
  - Above peak of 520kWe
  - Deliver >2,900 MWh electricity
- Air or water cooled binary turbine system: well suited to northern environment
- At the power production of ~880 kWe, the subsurface heat reservoir would be sustainable for 310 years



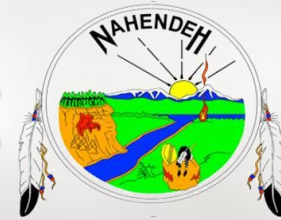
# Heat Opportunity



- Initially designed as heat & power project
- Reservoir:  $6.34 \times 10^{17}$  joules of heat
- <9% of heat resource converted to electricity = 9,800 kW of thermal energy at little to no incremental cost
- Significant heat project opportunities to community of Ft. Liard
  - District heating of community facilities
  - Residential heating
  - Greenhouses
  - Industrial applications
  - Tourism/Spa destination
- Heating opportunities can be built into initial project design
  - Well location advantageous for heat transfer to community
  - Heat transfer infrastructure integrated with binary turbine power facility



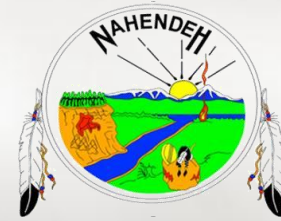
# Regulatory Environment



- Open regulatory context to permit geothermal to develop
- Subsurface
  - Geothermal rights to local community?
  - No rights to oil/gas or mining)
- Land (Community or Federal Land access)
- Power (NTPC, Public Utilities Board)

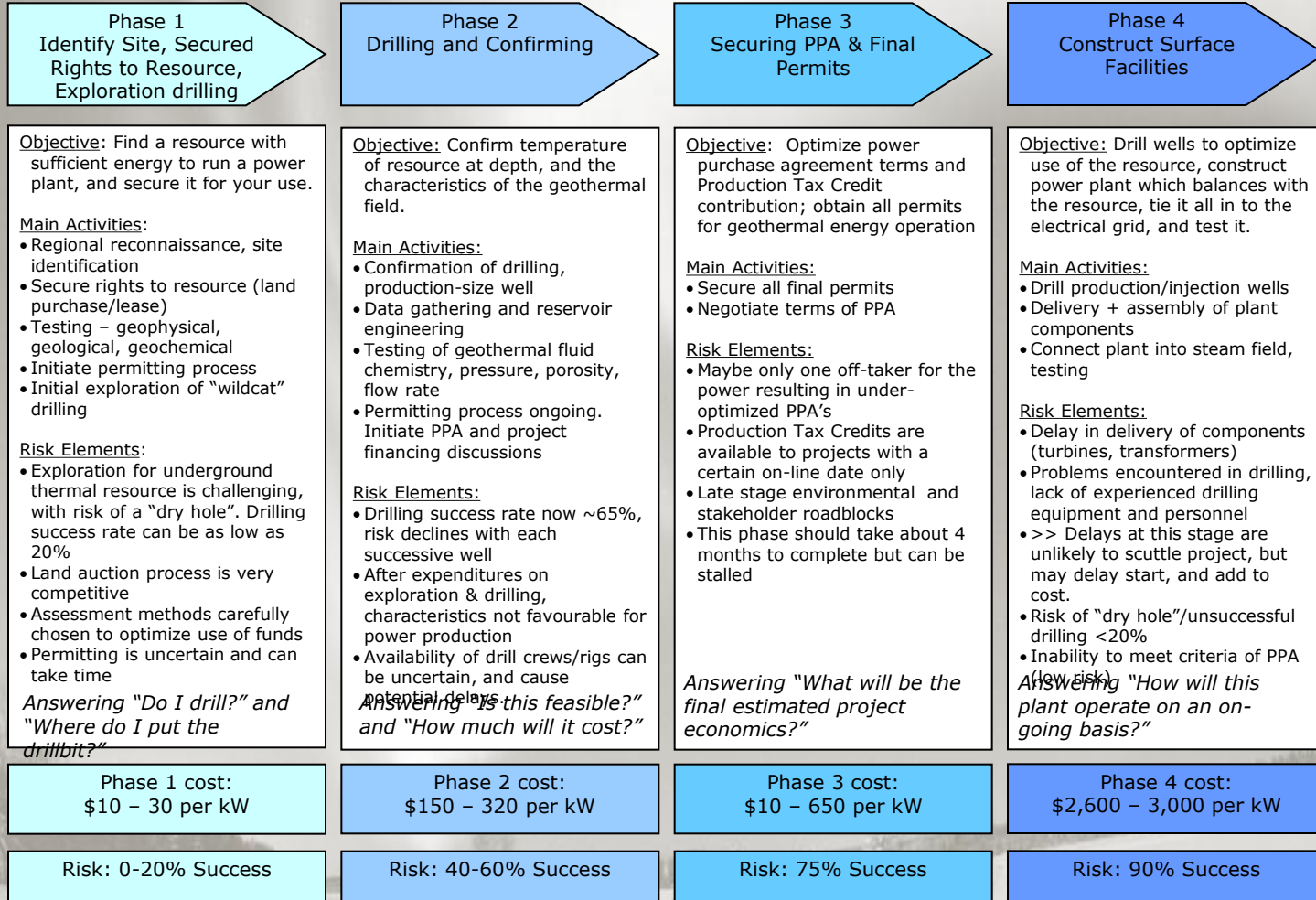
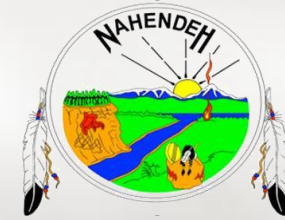


# Development Plan

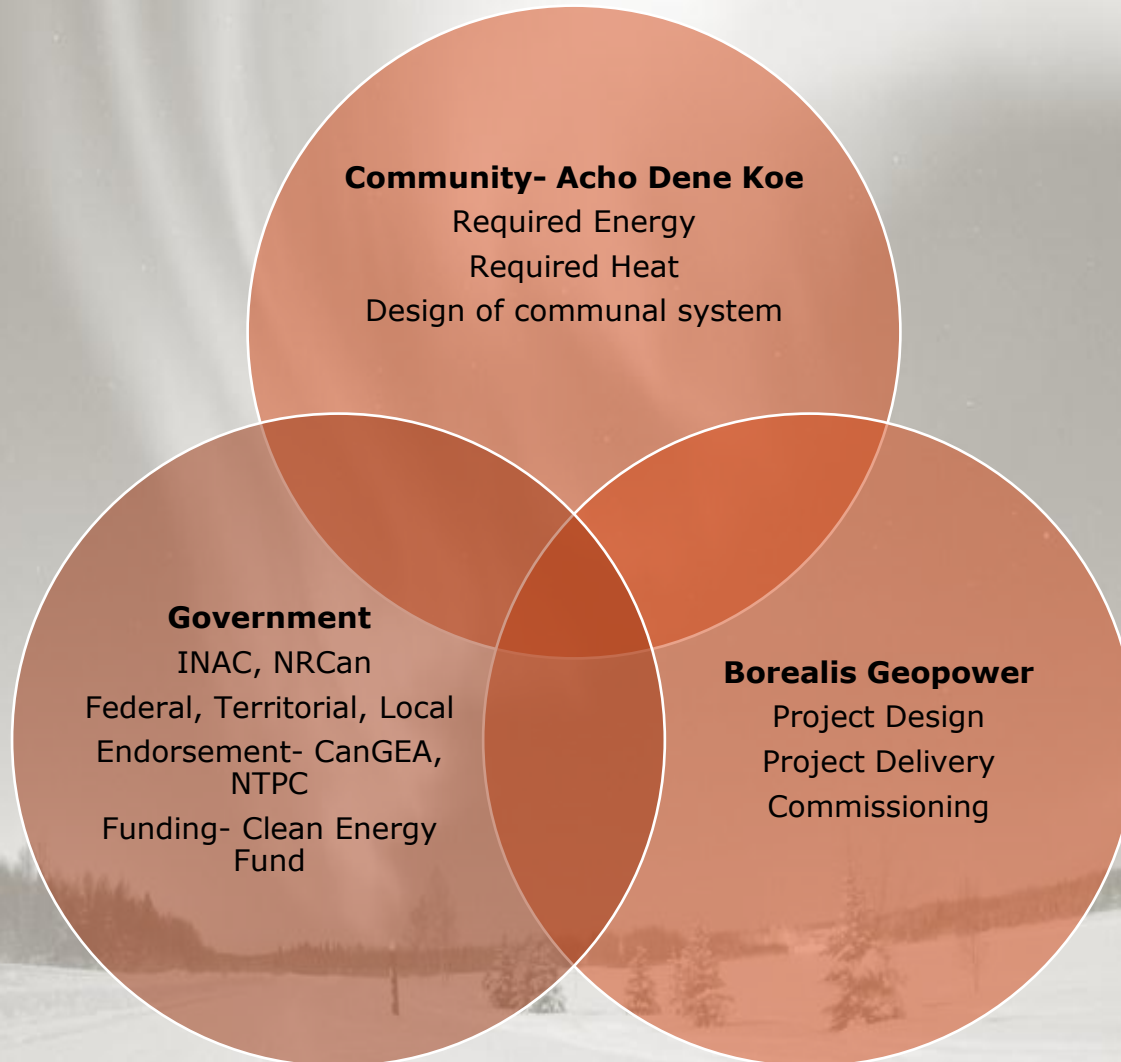
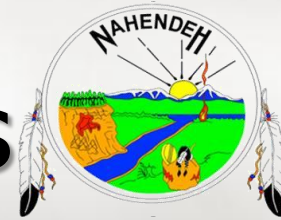


- Phase I – Subsurface and Surface Assessment
  - Develop a detailed (as possible) view of the best design for surface and subsurface resources
  - Work with the Government(s) and Ft. Liard to determine the best plan for moving forward with development
  - Legal documentation and finalization of financials
  - Timeline < 1 year, Cost \$1 MM
- Phase II – Explore, Delineate, Produce & Commission Geothermal Plant
  - Project Initialization and Construction: Drilling, pipeline, power plant construction
  - Finalize development and bring into service all relevant facilities: Power online
  - Timeline < 2 years, Cost \$12-15MM

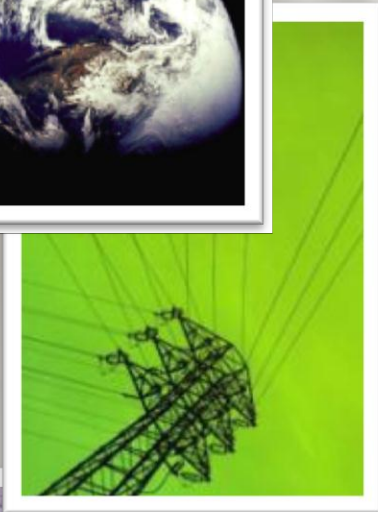
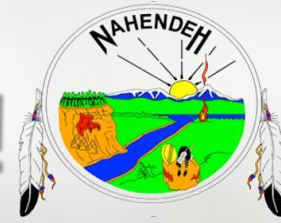
# Development Path



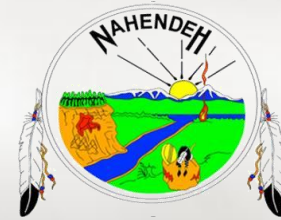
# Necessary Partnerships



# Why Geothermal Energy!



- Renewable, reliable source of electricity and heat
- Long term revenues with no fuel costs and near zero emissions
- Small environmental footprint compared to other power sources
- Geothermal power plants are base load (24/7/365 days a year) can continuously deliver power
- Preferred choice of renewable energy for many utilities



# Thank you for your interest

## Borealis GeoPower Inc

*“Down to Earth”*

[www.borealisgeopower.com](http://www.borealisgeopower.com)  
[craig@borealisgeopower.com](mailto:craig@borealisgeopower.com)

*1% of all Profits donated to the Environment*