GEOTHERMAL ENERGY DEVELOPMENT-A COMPETITIVE ADVANTAGE

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WHAT IS INNOVATION IN THE BUSINESS WORLD

- The process of translating an idea or invention into a good or service that creates value or for which customers will pay.
- To be called an innovation, an idea must be replicable at an economical cost and must satisfy a specific need.
- Innovation involves deliberate application of information, imagination and initiative in deriving greater or different values from resources, and includes all processes by which new ideas are generated and converted into useful products.
- In business, innovation often results when ideas are applied by the company in order to further satisfy the needs and expectations of the customers.

Read more: http://www.businessdictionary.com/definition/innovation.html

WHAT IS INNOVATION IN THE SOCIAL CONTEXT

- In a social context, innovation helps create new methods for alliance creation, joint venturing, flexible work hours, and creation of buyers' purchasing power.
- Innovations are divided into two broad categories:
  1)Evolutionary innovations (continuous or dynamic evolutionary innovation) that are brought about by many incremental advances in technology or processes and
- 2)Revolutionary innovations (also called discontinuous innovations) which are often disruptive and new.

Read more: http://www.businessdictionary.com/definition/innovation.html

WHY INNOVATION IS INVOLVED IN ECONOMIC DEVELOPMENT

- Innovation is synonymous with risk-taking and organizations that create revolutionary products or technologies take on the greatest risk because they create new markets.
- Imitators take less risk because they will start with an innovator's product and take a more effective approach. Examples are IBM with its PC against Apple Computer, Compaq with its cheaper PC's against IBM, and Dell with its still-cheaper clones against Compaq.

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WHAT IS GEOTHERMAL ENERGY

- The adjective *geothermal* originates from the Greek roots *γη (ge)*, meaning earth, and *θερμος (thermos)*, meaning hot.
- Geothermal energy is the heat from the Earth. It's clean and sustainable. Resources of geothermal energy range from the shallow ground to hot water and hot rock found a few miles beneath the Earth's surface, and down even deeper to the extremely high temperatures of molten rock called magma.
- Almost everywhere, the shallow ground or upper 10 feet of the Earth's surface maintains a nearly constant temperature between 50° and 60°F (10° and 16°C). Geothermal heat pumps can tap into this resource to heat and cool buildings.

HISTORY OF GEOTHERMAL

- In North America 10,000 years ago indigenous peoples were drawn to hot springs for both spiritual and practical reasons.
- Similarly in the 4th century BC Greeks and Romans built shrines around hot springs and also used them for more practical applications like space heating.
- In 1904, Italian scientist Piero Ginori Conti successfully used geothermal energy to generate electricity.
- Currently there are many examples of both high temperature (power generation) and low temperatures (heating and cooling) geothermal application across the world.

TYPES OF GEOTHERMAL SYSTEMS

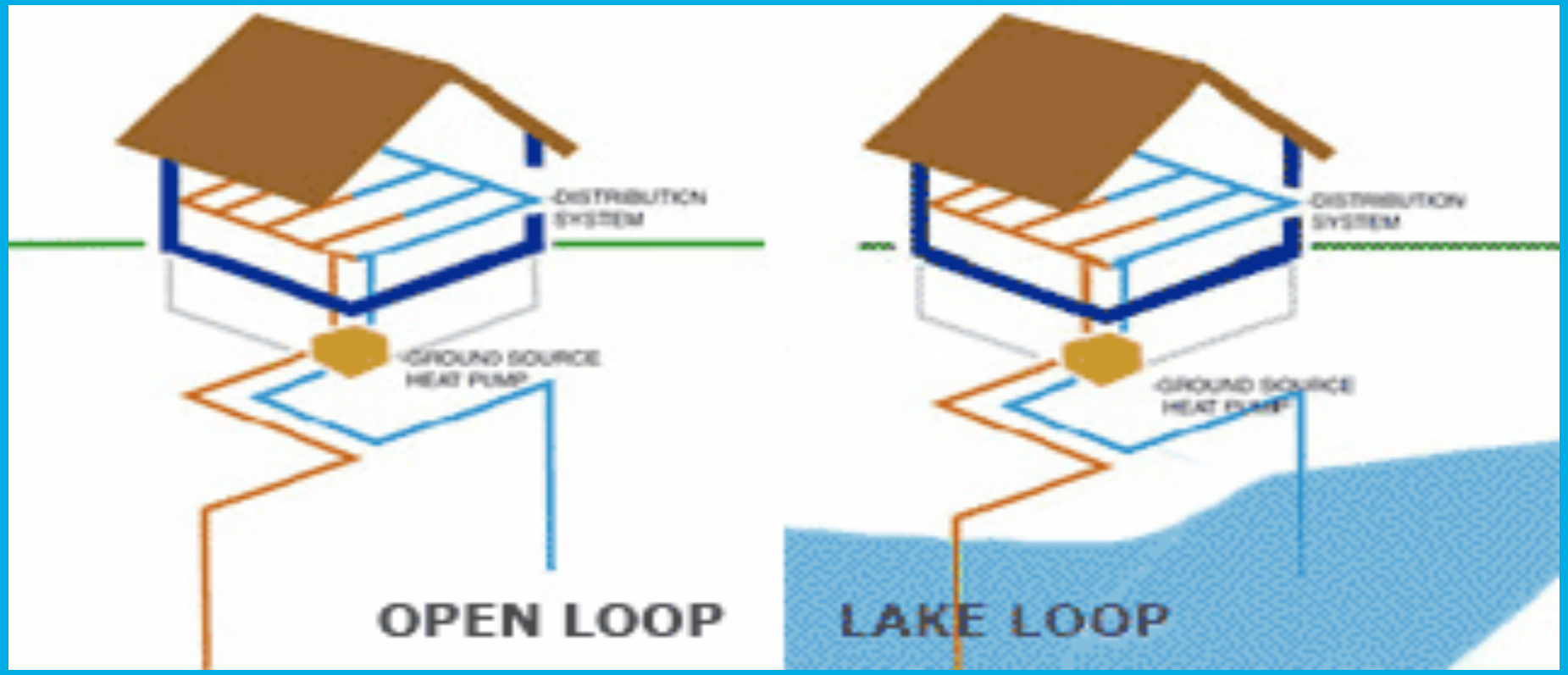
OPEN LOOP

- An open loop system pumps water from a body of water (well, pond or lake) and returns it to surface water or an injection well.

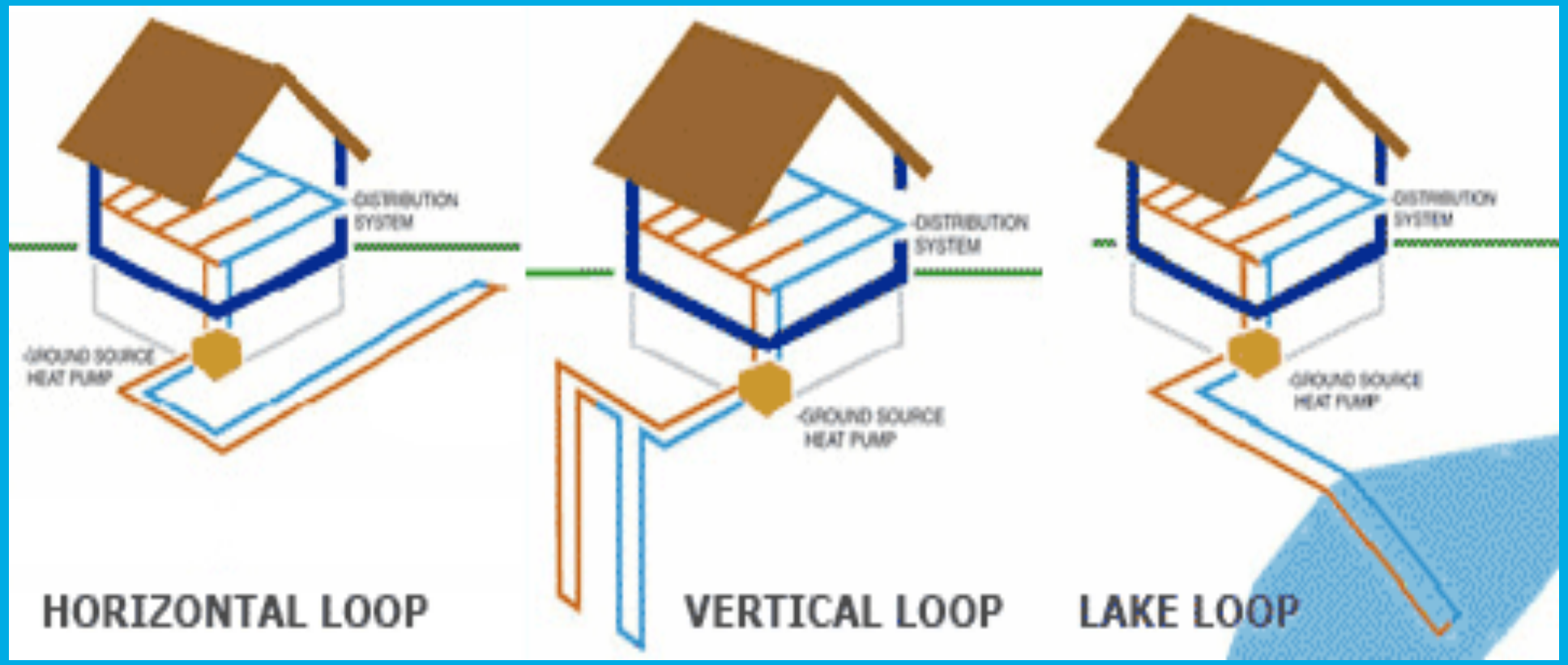
CLOSED LOOP

- A closed loop system utilizes a grid of pipes to pump heat transfer fluid through either a horizontal or vertical circuit of underground piping between the ground and the building.

OPEN LOOP SYSTEMS



CLOSED LOOP SYSTEMS



SUSSEX ECONOMIC SITUATION

Situation Analysis

- Potash Corp decommissions its 35 year old original mine and suspends operation at new mine laying off 430 miners earning good wages
- Decommissioned mine has been removing water for past 20 years
- Surrounding land is largely agriculture with CN Rail line, 3 phase power, 4 lane highway, skilled work force and strong supply chain
- Water reservoir in mine workings is expected to reach 3 million cubic meters of heated brine
- Question= What do we do with this unique opportunity

COMMUNITY APPROACH TO DEVELOPMENT

- Sussex Region established an Economic Response Plan based on community consultation, dedicated research of identified opportunities, priority setting based on reality and employment potential
- Geothermal from decommissioned mine was identified as a priority
- Working Group of key local participants (current/former mine officials, geologist, local & provincial government officials)
- Government support allowed the undertaking of Technical Feasibility Study of the Geothermal Capacity of the Penobsquis Mine Site

WHY CONSIDER GEOTHERMAL

- The increased efficiency and lower consumption of electricity than conventional systems make geothermal systems a more cost-effective option in the long run.
- When properly installed, the piping in the earth has a very long shelf life and the maintenance expenses have proven to be less expensive than solar, wind and traditional power sources.
- A geothermal system reduces the dependence on fossil fuels and subsequently the building's overall carbon footprint.
- Ontario Geothermal Association web site

TECHNICAL FEASIBILITY STUDY OF THE GEOTHERMAL CAPACITY

- Undertaken by Wood Environment &Infrastructure Solutions, a division of Wood Canada Limited (formerly Amec Foster Wheeler)
- This Technical Feasibility study assembled background data (ground temperatures, water levels, mining data, energy consumption etc.) from local Penobsquis industry partners, PotashCorp and Avon Valley Floral, to enable the modelling of 20 example geothermal applications.
- The modeled outputs for a given example were: capital costs, energy consumption, energy savings, maintenance costs and CO_2 emissions and a calculated discounted payback period.

TECHNICAL FEASIBILITY STUDY STATED

The over 3 million m^3 of heated brine which will occupy the Penobsquis mine offers a unique investment opportunity. Documented studies and practical examples have proven that the geothermal potential of abandoned and flooded mines can offer an economic advantage. The assembled information and modelling of the 20 example geothermal applications suggest that:

- Open loop systems offer a better discounted payback period and lower capital costs compared to closed loop systems.
- The geothermal potential of the Penobsquis mine is economically attractive, provided the key assumptions made during the study (Section 13.0) can be confirmed.

TECHNICAL FEASIBILITY STUDY STATED

- A district open loop geothermal system heating a 20 Acre greenhouse (with supplemental boiler) and cooling 10 refrigeration warehouses for a 12-month period carried an estimated capital cost of $11.3 Million dollars and a discounted payback period of approximately 7 years.
- Installation of a district system allow for a cost sharing arrangement which can provide beneficial economics to both a utility provider and prospective businesses.
- In a cost sharing arrangement, an investment from a utility provider to construct a district open loop geothermal system is estimated to be approximately $6.68 Million dollars (includes design and approval fees of 15% and 3% of the $5.7 Million capital cost, respectively).

TECHNICAL FEASIBILITY STUDY STATED

- In the cost sharing arrangement, an investment from the prospective businesses (excluding fees for connection to district system, design and approvals) is estimated to be $3.9 Million for the 20 Acre Greenhouse and $173,000 for each of the individual refrigeration warehouses.
- Installation of a district system in the Penobsquis area could allow Avon Valley Floral to operate for a 12-month period and transition 38 to 48 seasonal jobs to full time employment.

THE COMPETITIVE ADVANTAGE HIGHLIGHTS

- The heating and cooling costs as well as the demand costs are significantly lower on a geothermal system than a conventional fossil fuel system. (Could be 50% reduction)

- Environmentally friendly: geothermal systems burn no fossil fuels and therefore produces fewer greenhouse gas emissions

BENEFIT OF REDUCING CARBON EMISSIONS

- In 2016, the Federal Government and most Provinces and Territories, including New Brunswick, committed to objectives and actions in the Pan-Canadian Framework on Clean Growth and Climate Change
- In this plan, each jurisdiction has established targets for 2030 and 2050 to reduce Greenhouse Gas (GHG) emissions, increase the percentage of clean energy sources, and establish a carbon pricing mechanism by 2018.
- New Brunswick's "Transitioning to a Low-Carbon Economy" identified specific actions, including supporting the transition from traditional fossil fuels **to clean energy such as geothermal** and the establishment of a carbon price
- In any case the cost of carbon is expected to increase in the future and the use of geothermal energy will reduce the amount of energy used, carbon emitted and total energy costs.
- It is also possible that Provinces may fund incentive programs for installation or conversion to geothermal energy from fossil fuels further reducing energy costs.

WHY GEOTHERMAL

- Significant resources.
- Generally small environmental footprint.
- One system can provide both heating and cooling.
- Some provinces offer incentives
- Can decrease greenhouse gas emissions if it replaces the fossil fuels used for heating and cooling.
- Geothermal can operate continuously at up to 98% capacity—their is a constant source of energy and requires very little down time for operations and maintenance.

TECHNICAL FEASIBILITY STUDY RESULTS

- The most favorable example was a district open loop geothermal system heating a 20 Acre greenhouse (with supplemental boiler) and cooling 10 refrigeration warehouses for a 12-month period.
- The capital investment for this geothermal system example, not including the costs for engineering design, environmental permitting and approvals, was estimated to be $11.3 Million dollars and carried a discounted payback period of approximately 7 years.
- A cost sharing model, whereby a utility provider could install and operate the district system and offer a fee based connection to prospective business, creates an economic advantage for both the utility provider and prospective businesses