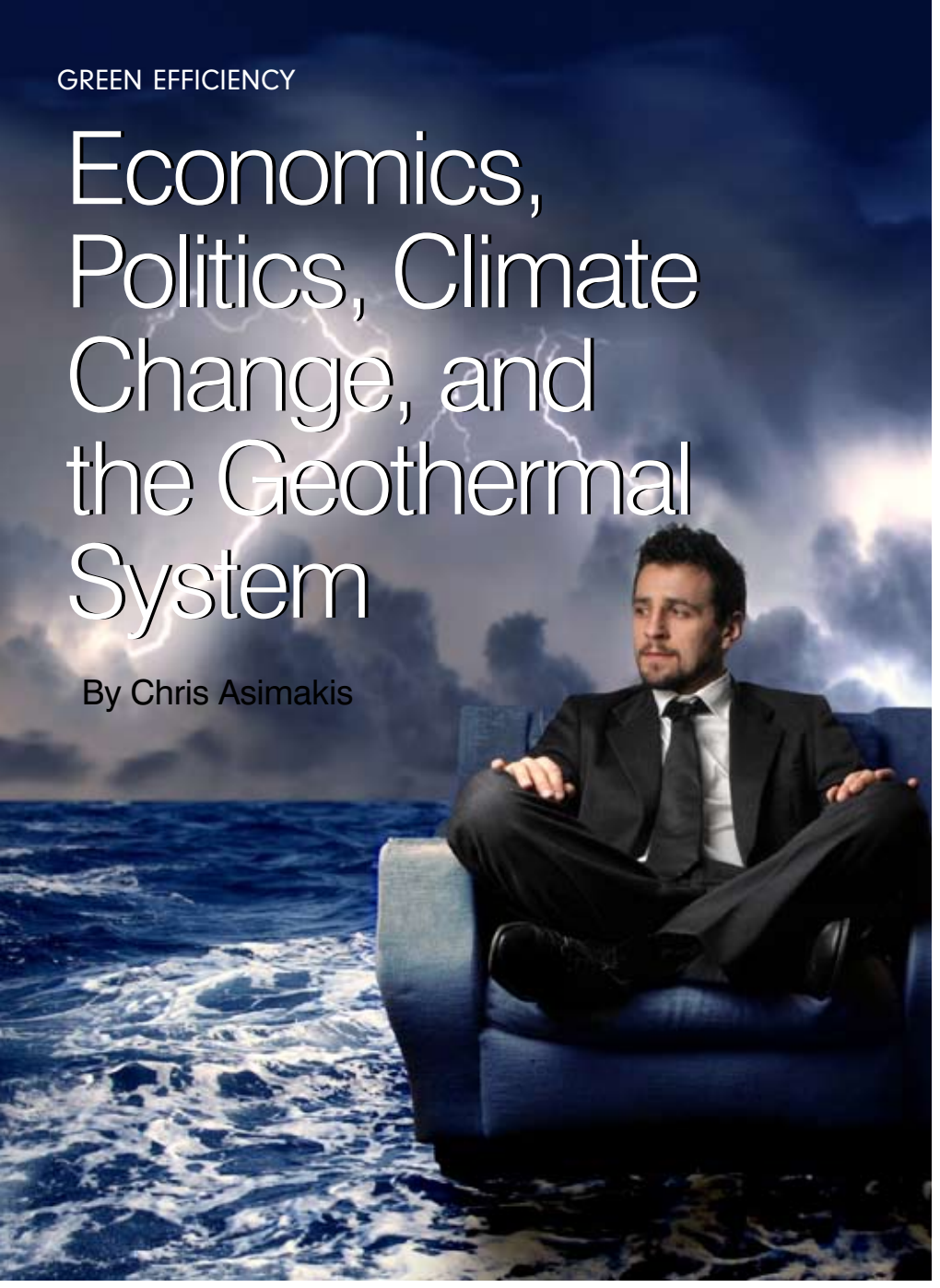
Economics, Politics, Climate Change, and the Geothermal System

By Chris Asimakis



In 2002, when I first started in the renewable energy business, the commercial marketplace was not overly receptive to our product offerings. Today it's a different story. I would suggest that there are three good reasons for consumers to move towards energy efficiency and renewable energy practices as good, long-term strategy.

1. SUPPLY AND DEMAND

Basic supply and demand economics would suggest that if you have a limitless supply of an input product the outputs over the long term would be relatively inexpensive. The alternative, increasing dependency on a limited resource, is an unnecessary risk that can only lead to higher and more volatile pricing.

2. CLIMATE CHANGE

I believe that climate change is a serious risk and if it does materialize, even to a lesser scale than what is predicted, it could have catastrophic effects on the economy and the world in general. In order to mitigate this risk we must look to implement cost effective energy efficiency and renewable energy.

3. CONSUMER DEMAND

An ever-increasing number of consumers are demanding environmental consideration from the companies they purchase products and services from. The vast majority of new building developments are seeking some level of LEED certification and older buildings are being retrofitted using the LEED credit system.

In today's news, there is great debate about the costs of renewable energy. It is unfair, however, to lump all renewable energy sources into one broad category with one simple cost scenario. From my perspective and at a minimum, renewable energy falls into two big categories with multiple sub-categories.

The first major category is a fuel source that, although renewable, is purchased in a similar manner to energy delivered today. As a result, although it is renewable, inherently it contains similar economic risks of the non-renewable energy market. It can be monopolized and price can be speculated against and traded. Energy from waste, biomass or ethanol falls into this category as well as potentially grid delivered wind or solar. A friend of mine runs a large district energy plant in St. Paul Minnesota and he converted one of his larger boilers to run on wood waste. When the boiler was commissioned he entered into a 5-year contract with companies to deliver wood waste to his plant. After the first five year term was over the local companies that delivered the wood waste to the plant got wise to the value of their "product" and more than doubled the price. Ethanol is another good example where the value of the fuel source, mainly corn, has tripled in price recently.

The second category of renewable energy is where Mother Nature provides the fuel source and therefore, there is no ongoing cost for the supply, no price to purchase it, and therefore no ability to speculate against the price over time. In my opinion, it is

GEOTHERMAL CASE STUDIES BY MCW GROUP OF COMPANIES

By Stephen Lau and Sam Louie

Since 1964, the MCW Group of Companies have been successfully delivering Professional Consulting Engineering Services, Energy Management Services, and Engineering Development Services.
MCW provides sustainable building designs with the goal of permanently reducing their clients' environmental footprint. MCW's work has reduced the amount of carbon emitted into the atmosphere by over 332,000 tonnes. That's equal to 55,000 domestic cars taken off the road for one year or enough water to meet the needs of every Canadian for two days.
MCW has extensive geothermal experience, having designed over 50 geothermal projects across Canada since 1984.
Geothermal provides efficient heating and cooling through heat exchange between the building and the ground. The system's efficiency creates energy savings as it eliminates natural gas consumption for heating and significantly reduces electrical energy and demand. These two case studies, one in Aurora, Ontario and the other in Richmond, British Columbia, are examples of what MCW has successfully completed. Visit www.mcw.com to learn more.

CASE STUDY 1

Client: York Catholic District School Board (YCDSB) Education Centre (Aurora, Ontario)

System installed: 1992

Project description: YCDSB's Education Centre is a 100,000 square foot building with a 300 ton cooling load. Today, the system is functioning very well with a fluid cooler and a small boiler interface.

How it works: The system is a water-to-air heat pump system with ground loop sized for heating load only and connected to a closed loop fluid cooler for supplemental heat rejection. This hybrid geothermal system heats and cools the building based on 130 feet per ton of vertical field installed beneath the parking lot. The geothermal field consists of 39,000 feet over multiple vertical bore holes. The heat is transferred between the geothermal field and the building's individual water-to air heat pumps by two circulation pumps. The water-to-air heat pumps located throughout the building extract heat from, or reject heat to, the heat pump hydronic loop. The overall mechanical design of the ground loop is extremely efficient, as a small fluid cooler has been added to the system for topping up the peak load required for cooling. In general, the vertical bore hole requirement for cooling in Ontario is between 170 – 180 feet per ton. Because of this reduced piping design, the building's environmental footprint was significantly reduced due to the efficiency of the heating/cooling system. YCDSB has been very satisfied with the performance of the system to date.

this type of renewable energy that holds the most promise. Locally supplied solar, wind and geothermal energy make up this category of renewable energy.

With the risk of complicating this further, simply saying renewable energy is the solution is not enough. The specifics of the solution need to fit the specifics of the situation. For solar power, year round sunny and dry locations would seem to make the most sense. Arizona, for example, has a percentage of annual sunlight greater than most other jurisdictions. In addition, Arizona buildings have to deal with hot sunny days and cool comfortable nights throughout the entire year, which results in a good match between the building's needs and the resource availability.

In Southern Ontario, however, we have to deal with hot, humid peak summer days and nights with temperature highs that rival the southern US and arctic winter lows that make heating a critical safety issue and not just a comfort concern. While these extreme conditions may only involve a few weeks in the summer and winter, they dominate much of the design considerations for the building. Geothermal heat pump systems provide the right renewable resource system to meet these needs.

WHAT IS A GEOTHERMAL HEAT PUMP SYSTEM AND WHY IS IT A RENEWABLE RESOURCE?

The earth serves as a large thermal solar energy heat collector and low temperature energy storage facility. Basically, the property around and under your building, landscaping, parking, etc., is a solar collector where the ground temperature just a few feet below the surface remains at a fairly constant temperature (around 10 to 12 degrees Celsius in most areas). At this constant temperature, common refrigeration equipment (heat pumps) are able to efficiently extract and make use of this solar "renewable" energy for heating.

In addition, an important side benefit of the systems is that this constant ground temperature also results in a more efficient cooling system since it is easier to reject the building's heat to the 12 degrees C ground than to 32 degrees C air as would be the case with traditional cooling systems.

To get this renewable energy and take advantage of the system's efficiency, a water alcohol mixture is circulated through pipes that are installed in the ground allowing for heat transfer to take place.

WHY DOES GEOTHERMAL MAKES SENSE?

Most green or renewable energy technologies are characterized by higher capital and installation costs, however, these costs are offset by lower operating and maintenance costs.

Geothermal systems follow this model. As an example, our company is currently

CASE STUDY 2

Client: British Columbia Institute of Technology (BCIT) Aerospace Technology Campus (Richmond, British Columbia)

System installed: 2007

Energy savings: Minimum of $33,332 annually and 29.2% reduction in energy costs

Project description: MCW designed a hybrid system that is currently operating for the BCIT Aerospace Technology Campus which is 50% geothermal field and 50% cooling tower. For this project, MCW was awarded both the ASHRAE BC Chapter Award and the ASHRAE Ralph Robson Region XI Technology Award in 2008 and in 2009, the Consulting Engineers of British Columbia Award of Engineering Excellence for Buildings.

How it works: The building is heated and cooled with a hybrid geothermal system using a 150 Ton vertical field installed beneath the hanger apron. The hanger itself is naturally ventilated and heated with an in-slab radiant system. Hanger ventilation air serves dual purpose as it is also drawn through adjacent shop spaces before being exhausted. Energy is transferred between the geothermal field and the building's central heat pump loop via four water source heat pumps. These extract heat from, or reject to, the central heat pump hydronic loop that feed the water-to-air heat pumps located throughout the campus. This configuration allows simultaneous heating and cooling throughout the year. Heat rejected by the electrical rooms and air compressor is recovered and used to heat other areas of the building, enhancing the building's energy efficiency. The overall mechanical design of the building is 35% more energy efficient than the Model National Energy Code of Canada for Buildings standard, as certified by the NRCAN CBIP program. The environmental footprint of the building has been greatly reduced due to the efficiency of the heating/cooling system. The annual energy costs for the building are estimated to be $84,296 as compared to $117,628 for the reference building, an energy savings of $33,332 per year. The 29.2% reduction in energy costs was modeled in a conservative manner, and it is fairly certain that the building will exceed these amounts.

working on a project to complete a hybrid geothermal, solar thermal with some supplementary boiler and chiller capability. The site characteristics and stats are as follows:

Segment: Multi-user industrial/office/retail
Location: Ontario
Square Footage: 148,372
Incremental Capital: $560,000
Simple Payback: Under 6 years

This site was well suited as there was available space for the installation of a ground loop and the existing heating and air conditioning system required replacement. In addition, one of the major tenants was pushing property management to green the building as part of the leasing arrangements.

With well-designed geothermal systems, the internal building distribution systems for heating and air conditioning remain the same - but there is one notable addition and one notable deletion to the process.

The addition comes in the form of the ground loop and the deletion is the relative reduction in the reliance on grid energy. This addition and deletion to the heating and air conditioning process introduces a new business model that sees the substitution of the input fossil fuel based grid energy for cost, with the input of earth energy at no cost.

The introduction of the ground loop is an augmentation to the heating and cooling process and therefore results in an increase in capital cost over a more traditional system. However, the increase in cost of the ground loop is offset by greater efficiencies and from the utilization of the sun's thermal "renewable" energy stored in the ground.

The use of the earth's energy, in a well-designed system, dramatically improves the efficiency of the heating and air conditioning process. The combination of the sun's energy stored in the ground with electricity from the grid, affords an average efficiency of a properly designed geothermal application of 400% or a coefficient of performance of 4 or great (COP is defined as the ratio of useful work or output to the work or energy input).

In other words, for every 1kWh purchased from the electricity grid, the earth provides 3kWh free or charge providing a total of 4kWh of useful energy to the building. As a result, the high efficiency characteristics of a geothermal system have that added output of reducing carbon emissions of approximately 65 percent when compared to a traditional gas boiler, electric chiller system.

There is a tremendous amount of research and development activity occurring worldwide in the area of green energy. This activity is targeted at creating products that utilize no or fewer carbon-based fuels. And while this activity is good and necessary, many of the green technologies struggle for economic viability. As a result, governments are trying to create programs that fund research and development. We should also consider initiatives that reduce energy consumption and carbon emissions and are economically viable today.

These basic characteristics of a geothermal technology make it a system ideal for consideration in the backdrop of a world that is quickly consuming its energy resources and becoming ever more sensitive to the effect human activity is having on our health, financial well-being - and on the planet.

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