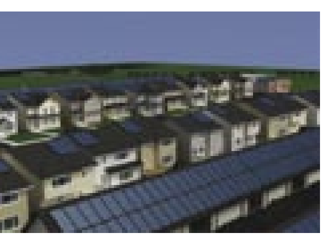
Soaking up the Sun

CANADIAN HEATING PROJECT TAKES SHAPE

By Todd O'Brien

BY COLLECTING SOLAR ENERGY IN THE SUMMER, NOVEL NEW HOUSING PROJECT IN ALBERTA HEATS HOMES IN THE WINTER.



Images courtesy of: DNA Digital Inc.

^ Construction work has begun on a novel solar-powered community in Alberta, Canada. Computer-generated images provide a glimpse of what the project will look like.

THE AVERAGE CANADIAN home produces approximately 6 to 7 tons of greenhouse gas (GHG) emissions per year. Thanks to the Okotoks Solar District Heating Project; however, 52 houses located in the Drake Landing Solar Community in Okotoks, Alberta, will be an exception to this rule. The first subdivision of its kind in North America, these homes will slash those GHG numbers by more than 70 percent — down to only 1 to 2 tons per year as a result of the deployment of pioneering energy technology.

Work on the project began in March, and the home construction is expected to be completed in two years. ATCO Gas, a natural gas utility, is helping to fund the project. The energy systems that will be built to serve the development are expected to cost $3.2 million.

The project combines three technologies: solar collectors, seasonal storage of thermal energy, and a district heating system to distribute energy. The seasonal storage system collects excess solar energy during the summer and stores it as heated rock/soil in the borehole thermal energy storage under a community park. When fully charged, the heating system will provide 90 percent of the space heating requirements for each home through solar energy. The cost of the project is heavily supported by grants from federal, provincial and private funding agencies. As a result, the project is built as a demonstration and will not be replicated in a significant way in the immediate future. How does it work?

SYSTEM COMPONENTS

The major components of the district heating system include a solar collector system, an energy building, a borehole thermal energy storage system, and a district loop. The following sections summarize how each component contributes to the overall operation of the system.

SOLAR COLLECTOR SYSTEM. A total of 800 4-foot by 8-foot solar collectors and associated piping will be installed on the south side of the homes' garage roofs. Two collectors will also be installed on the roofs to supply about 60 percent of domestic hot water requirements. The garages will be connected by breezeways to give a continuous roof where the solar collectors will be installed. The collectors will heat glycol that will be pumped through piping to a heat exchanger that transfers the heat to water. The water will be pumped to short-term thermal storage tanks located in an energy building.

ENERGY BUILDING. The 2,500-square-foot energy building will house the short-term storage tanks as well as most of the mechanical equipment (pumps, heat exchangers, natural gas boiler, controls, etc.). A display window in front of the energy building will show how the system works, and provide actual real-time data on system performance. The same performance data will be available on the Internet, allowing researchers, homeowners, and the merely curious to observe the system.

BTES SYSTEM. The borehole thermal energy storage system will consist of 144 boreholes drilled to a depth of 35 meters (115 feet). Plastic "U-tubes" will be inserted into the boreholes. The boreholes are then filled with a high thermal conductivity grouting material. There will be a distance of 2.25 meters between the boreholes. At the surface, the U-tubes are joined together in groups of six (called a series) that radiate from the center to the outer edge, and then connect back to the energy building. There will be a header piping network complete with necessary valving on the top of the BTES field. An insulating barrier will be installed over the piping and 2 meters (6 feet) of cover installed on top. Installed under a municipal park, the BTES field will be totally out of sight. The insulating barrier and the 2 meters of backfill will ensure that despite temperatures in the 80°C range in the BTES system, there will be no adverse effect on the public park that will be developed over it. When the short term storage tanks are filled, the excess heated water is injected into the borehole thermal energy storage system (BTES). This water will heat the rock/soil in the BTES field. In the winter, water will be circulated through the BTES field, picking up the heat and delivering it through the district heating system to the homes. When fully charged the temperature in the BTES field will be around 80°C (176°F).

District Loop. Insulated PEX piping originating in the energy building will be installed on property in easements in the front of the homes to distribute the hot water for space heating. The hot water will flow into the home, pass through an air handler and then back out to the district loop. The cool water is then pumped back to the energy building to be re-heated.

UTILITY INVOLVEMENT

Before the project could come together, the Okotoks Solar District Heating group needed a utility company's involvement to own and operate the district heating system over the long term to make the project viable. It approached ATCO Gas in late 2003. ATCO Gas was eager to learn more about the revolutionary technology. Interested in pursuing and evaluating alternate forms of energy that are not only environmentally friendly, but also help the company reach its vision of being the preferred energy supplier for Albertans long after the supply of fossil fuels has expired, ATCO Gas jumped on the opportunity.

The key strategic objectives included in ATCO Gas' business case are:

- **The opportunity must be supported by a proper business case that shows there is an expectation that a return on the investment will be achieved.**
- **The project must enhance ATCO Gas' understanding of the underlying technology, both from an engineering and a financial perspective.**
- **The project must provide associated non-monetary benefits, such as public acknowledgement of the benefits of the project and/or environmental considerations.**
- **ATCO Gas is committed to keeping customers "warm" at a reasonable cost with no environmental impacts. The project must enhance ATCO Gas' reputation with customers and at various levels of government.**

ATCO Gas will manage the project during the initial construction period. After construction is completed, ATCO Gas will operate the system and be a 25 percent owner during a four-year commissioning period. This period will be used by experts to analyze and evaluate the system and monitor its performance. Upon successful completion of the commissioning period, ATCO Gas will assume ownership of the solar district heating system.

Considering the current natural gas prices in Alberta, the economic benefit of replication is uncertain. The long-term benefits will depend on how often and how quickly the system or its parts are replicated in Canada and other countries. Nevertheless, as energy prices rise and replication occurs, the economics of this type of system will inevitably become more attractive as design and construction costs decrease.

Todd O'Brien is a supervising engineer for ATCO Gas in Calgary, Alberta.

Key Players

FUNDING PARTICIPANTS

- Natural Resources Canada
- Federation of Canadian Municipalities
- Alberta Innovation and Science
- Climate Change Central
- ATCO Gas

PROJECT PARTICIPANTS

- The Town of Okotoks (municipal authority)
- United Communities (land developer)
- Sterling Homes (home and garage builder)
- ATCO Gas (utility operator)
- Enermodal Engineering Ltd. (solar and heating system designer)
- Sunbow Consulting Ltd. (subdivision designer)
- Hurst Construction Management Inc. (energy building and system construction)
- EnerWorks Inc. (solar collector supplier)
- Nu-Air (air handler and HRV supplier)