Natural Resources Canada | Ressources naturelles Canada

CanmetENERGY
Leadership in ecoInnovation
Spring 2009

COMMUNITY ENERGY CASE STUDIES:

Drake Landing Solar Community (DLSC)
Okotoks, AB

District Energy | Community | Biomass | Solar | Wind | CHP | Heat Pump

Integrated Community Energy System Application

- DLSC is a seasonal solar thermal energy storage project.
    - DLSC is heated by a district system designed to store abundant solar energy underground during the summer months and distribute the energy to each home for space heating needs during winter months.
- Homes are certified to Natural Resources Canada's R-2000 Standard and the Built Green™ Alberta Gold Standard.
- Domestic hot water requirements are partially met using self-regulated solar panels.

Context

- The Town of Okotoks is committed to sustainable municipal planning and has set growth targets that ensure that their build-out population would be reached in an environmentally, economically, socially, and fiscally responsible way.

Aerial view of Drake Landing Solar Community, Okotoks, AB

Archetype Characterization

- ***Archetype:***
  New Neighbourhood Development
- ***Size:***
  Building area - 7,250 sq m

  52 single family homes, average house size ranges from 138 - 151 sq m with detached garages
- ***Mix:***
  100% residential

Drivers and Rationale to do the Project

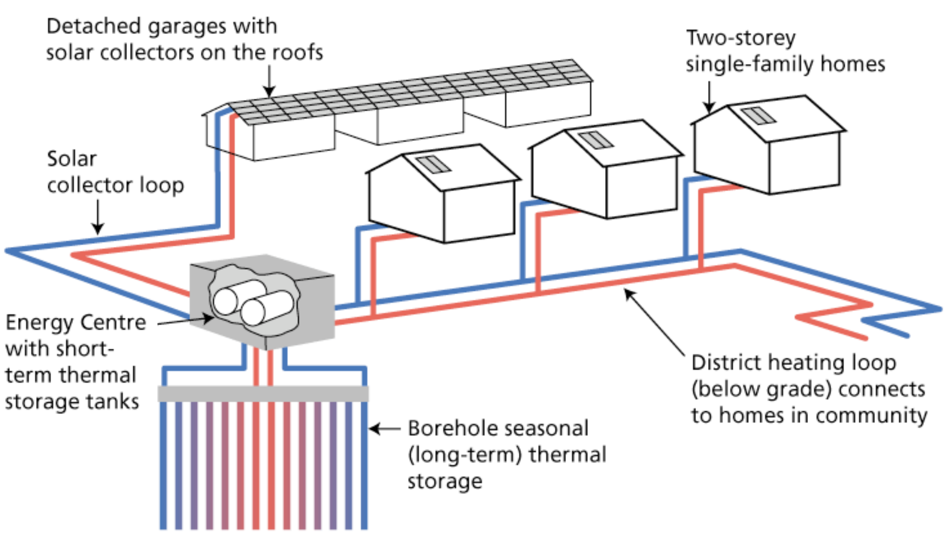
- Okotoks receives solar energy comparable to Italy, Greece and Miami, Florida, making it a prime candidate for using solar energy as a heating source.
- Recent technological advances, combined with falling domestic solar collector prices and increased consumer awareness, created an opportunity to test the viability of a solar community energy system.

Benefits

- 90% of the homes' heating and 60% of hot-water needs will be met by solar power.
- Each home will produce up to 5 tonnes fewer GHG emissions and a reduction of 110.8 GJ of energy per year than a conventional Canadian home.
- Each home will be 30% more efficient than conventionally built houses.

Project Description

- DLSC is located in Okotoks, AB, 15 minutes south of Calgary.
- It is a single-family house subdivision of 52 homes that uses a district heating and borehole seasonal storage system.



Timeline and Status

1998

Town of Okotoks adopted a sustainable approach to future development as part if its Municipal Development Plan.

2003

Feasibility study initiated by partners including Town of Okotoks, ATCO Gas, Natural Resources Canada and United Communities

2004

Feasibility work completed

2005

Design work was completed

Construction commenced

2006

Operation of the Drake Landing Solar Community Utility commenced

2007

Construction and commissioning of the DLSC is completed

- Solar energy began to flow into the borehole thermal energy storage on June 21

- Final construction completed in August

- The community officially opened in September

Future

On going monitoring is underway

Project Description (continued)

There are five main components of the DLSC project:

1. **Solar Thermal Collection**

    - The collection system consists of 800 single-glazed flat plate solar panels organized into four rows mounted on the detached garages behind the homes.
    - The panels are connected via an insulated, underground pipe that carries a glycol solution heated by the panels to the community's Energy Centre.
    - The solar collectors generate 1.5 megawatts of thermal power during a typical summer day.

2. **Energy Centre**

    - The Energy Centre houses the two 120m^3 short term heat storage tanks, the back-up gas boiler, and most of the mechanical equipment such as pumps, heat exchangers, and controls.
    - The solar collector loop, the district heating loop, and the borehole thermal energy storage loop pass through the Energy Centre.

3. **Seasonal Borehole Thermal Energy Storage (BTES) system**

    - The BTES system is an underground structure for storing large quantities of solar heat collected in summer for use later in winter.
    - Solar-heated water is pumped into the centre of the BTES field (an underground system of 144 boreholes) through a series of U-pipes.
    - Heat is transferred to the surrounding soil and rock which reaches a temperature of 80°C by the end of summer.

4. **District heating system**

    - Heated water is circulated from the Energy Centre to each home through an insulated, underground piping network.
    - At each home the heated water passes through an air handler unit located in the basement replacing the need for a conventional furnace.
    - Heat is transferred from water to air and then distributed throughout the house via ductwork.
    - The system has a network capacity of 4.5MW and a demand of 50GJ per house per annum.

5. **Solar Domestic Hot Water**

    - Hot water is generated by a stand-alone solar domestic hot water (SDHW) unit that operates with unique, self-regulated solar panels installed on the roof.
    - A back-up natural gas, power vented hot water unit supplements hot water demands when solar energy is not available.

Considerations for Implementation and Ownership

- The project was conceived by Natural Resources Canada's CanmetENERGY in partnership with governmental organizations and Canadian industries.

Operation - Potential Problems or Challenges

- Large seasonal storage systems require a significant length of time to charge since the storage medium must be heated up to a minimum temperature before any heat can be extracted.
    - The system will reach 90% solar fraction by the fifth year of operation.[1]

Costs and Financing

- Initial start-up capital of $7 million for the Drake Landing system included $2 million from federal government agencies, $2.9 million from the Federation of Canadian Municipalities – Green Municipal Investment Fund and $625,000 from the Alberta Government through its Innovation Program agencies.
- Each house sold for an average of $380,000.
- Homeowners are receiving, on average, a $60 per month solar utility bill for heating.

Relationship to Other Best Practices

- Homes meet Built Green for Alberta Gold Standard; to do so the following materials and practices were used:
    - Upgraded insulation and vapour barrier systems that eliminate drafts and allow for balanced space heating and cooling throughout the home;
    - Lumber certified and produced by sustainable harvested sources;
    - Engineered joists and load bearing components that are stronger, more structurally stable and were produced using sustainable manufacturing practices;
    - A Structural Insulated Panel (SIP) panel system at joist header areas ensures consistent insulation and vapor barrier in this traditionally hard to finish space;
    - Recycled materials in the drywall;
    - Upgraded window systems that add to the superior insulation of the home;
    - An advanced basement air gap wrap to drain water away from the foundation and prevent moisture build-up; and
    - Upgraded roofing material with longer warranties.

---

[1] *Solar fraction is the amount of energy provided by the solar technology divided by the total energy required.*

Lessons Learned

- The $7 million project cost included a significant amount of one-time research and development that would not be necessary if the initiative was to be replicated in another community. It would cost $4 million to repeat this project.
- To realize economies of scale, the optimal size for such a community is a minimum of 200 to 300 homes. The system would be the same but would require more boreholes.
- To implement innovative projects requires political will and a dedicated team of committed individuals championing the project.

Additional Information

- Additional information may be obtained from the Drake Landing web site at www.dlsc.ca