

# Sapporo Net-Zero Energy Home Hokkaido, Japan

## Description

The first Super E<sup>®</sup> net-zero energy house was built by the oldest Super E<sup>®</sup> partnership. Tsuchiya Two-by and K. Ito and Associates constructed the very first Super E<sup>®</sup> house in Japan, and have added innovative features to a standard Super E<sup>®</sup> home to allow it to produce as much renewable energy as it consumes on an annual basis.



## Setting

The home is located on the outskirts of Sapporo, the largest city on the north island of Hokkaido, Japan. It has a temperate climate, with cold and snowy winters and hot summers. Unlike most of the rest of Japan, summers are not humid. Sapporo is considered one of the snowiest cities in the world.

## Super E<sup>®</sup> Japanese Member

Tsuchiya Two-By is one of the leading energy-efficient builders in Hokkaido, and the first company to build a home under the Super E<sup>®</sup> house program. The Tsuchiya/K. Ito partnership is the oldest Super E<sup>®</sup> partnership, and together, the two companies have designed and built over 20 Super E<sup>®</sup> homes, mostly in Hokkaido.

## Super E<sup>®</sup> Canadian Member

Engineers and designers of advanced buildings, K. Ito and Associates is based in Vancouver. The company has mainly focused on the energy-efficient housing market in Japan for the last 20 years, and was a founding member of the Super E<sup>®</sup> House Program. K. Ito and Associates has constructed nearly 80 Super E<sup>®</sup> houses with a number of Japanese Member-Partners.

# Member Commentary

Although this house was constructed as a demonstration home, open to the public, it is for sale. It has been monitored for energy performance by Hokkai Gakuen University in Sapporo, and has performed very well.



**The Sapporo net-zero energy house nearing completion. The large solar panels in the foreground generate about 7,600 kWh of electricity per year. The raised solar panel on the right is for heating domestic water.**

Both companies say construction of this home was an education. Kimi Ito, of K. Ito and Associates, says the innovative vacuum insulated panels proved very difficult to work with.

“We had to order approximately a third more panels than we put in the building, because the way we were working with them, we tended to damage them,” he said. He is confident that, if

he uses the panels again, there would be a major savings in material and labour costs because of the lessons learned from building this house.

The home is so innovative that it has drawn considerable media attention in Japan. Over 80 members of the news media attended an information session on the house held in Tokyo, with many others visiting the house at its official opening in June 2008.

# House Performance

Even though the house employs standard Super E® features such as air tightness and whole-house mechanical ventilation with heat recovery, the added features and design considerations allow the home to generate as much energy as it consumes on an annual basis.

The home has upgraded insulation and uses vacuum insulated panels to make a very air tight, highly insulated envelope. Canadian-made triple glazed windows were added, and special care was taken in the design of the house. To take maximum advantage of solar heat gains, roof overhangs were designed to allow maximum sunlight in the winter, while shading windows in the summer. The heating advantage was amplified by the addition of thermal mass in the building.

The house is heated and cooled by a geothermal heat pump system – another upgrade from standard Super E®. Domestic water is heated by a solar water heater, and a drainwater heat recovery system has been added, which captures the heat from waste water and re-uses it to heat incoming fresh water.

A total of 51 photovoltaic panels produce about 7,600 kWh/yr, which is more than enough to handle the needs of the household. During the day, excess electricity is sold to the grid. At night, when electricity is required, it is purchased from the grid. As long as the energy sold to the grid and the energy purchased are equal at the end of the year, the house is considered “net-zero,” and its energy consumption is 0 kWh/m<sup>2</sup>/yr.

## Unique Features

**Water Based Foam Insulation:** The house uses the leading soft foam insulation and air barrier system, and 100% water –blown foam insulation to minimize air-leakage for increased energy-efficiency. It does not sag, shrink or settle.

**Vacuum Insulation Panel (VIP):** VIP insulation is added to offer very high insulation levels almost 40 times more than the insulation value of conventional glass wool insulation.

**High Performance Fiberglass Windows:** Windows are triple glazed with the air space between the glazings filled with argon, an inert gas which further cuts heat transmission. In addition, low-e coatings reduce solar radiation, keeping heat inside in the winter, and cutting solar heat gain during the summer. The fiberglass frames provide excellent thermal performance and durability with little maintenance.



### Drain Water Heat Recovery System (DWHR):

The innovative DWHR system captures heat from water going down the drain to preheat cold water coming in from municipal service lines. This is a simple technology that has proven its capacity to reduce hot water heating demand.

**Geothermal heat pump:** Heat from the ground is used to heat the house in the winter, and heat is pumped into the ground to cool the house in the summer.

### Energy Recovery Ventilator (ERV):

An ERV provides fresh air constantly to every room in the Super E<sup>®</sup> net-zero house, and expels stale air to the outside. The ERV captures not only heat from the outgoing air to condition the incoming air, but also controls inside relative humidity. The ERV in the Super E<sup>®</sup> net-zero energy home uses a high-efficiency motor to further save energy.

### Solar Thermal Water Heater:

The energy of the sun is put to best use in the Super E<sup>®</sup> net-zero energy home. Heat from the sun is collected by the house and used to heat domestic water, eliminating the need for a domestic water heater – the second most costly energy demand in the average house.

**Photovoltaic Panels:** The roof is covered with photovoltaic panels, which convert the sun's energy into electricity to power the house. The photovoltaic panels (PVs) produce as much electricity as a homeowner uses over a year.

**How the House is Heated:** The Super E<sup>®</sup> net-zero energy home uses a radiant heating system to ensure the home stays warm in the winter. The water-based system gathers heat from the geothermal heat pump and circulates through wall-

mounted radiators. In addition, south-facing windows allow heat from the sun to warm the house during the winter. Its airtight construction and whole-house ventilation system ensure there are no drafts or cold spots in the house, just even heat throughout.

**How the House is Cooled:** In the summer, overhangs shade incoming sun, and opening windows located around the house will allow prevailing winds in the summer to provide cooling by cross ventilation. If additional cooling is required, the geothermal system sends cool liquid through the coils. A fan blows air over the cool coils and distributes cool air through the house.

### Reduced Environmental Impact:

The Super E<sup>®</sup> net-zero energy home helps the environment by reducing carbon impact. Since it produces all the energy it requires from renewable sources, it releases no carbon from the burning of fossil fuels. In addition, the

Super E<sup>®</sup> net-zero home reduces environmental impact through careful, water-conserving landscape design, rainwater capture and low-flow plumbing fixtures.

**House Orientation:** Windows are located and oriented to capture sunlight in the winter. Overhangs are positioned above the southward facing windows to shade them from the summer sun.

**Thermal mass:** Warmth from the sun is stored in materials located in the home such as the concrete floor slab, the wood flooring, the interior wall and ceiling finishes and the wood frame structure.



# Services Provided by Super E<sup>®</sup>

Since the K. Ito/Tsuchiya partnership is one of the most experienced Super E<sup>®</sup> builders, very little in the way of hands-on training was provided by the Super E<sup>®</sup> infrastructure. Most assistance was in the form of public and media relations.

Super E<sup>®</sup> helped organize the information sessions for the media in Tokyo and Sapporo, and assisted with the official house opening. A bilingual (Japanese and English) brochure highlighting the features of the house was created by the Super E<sup>®</sup> Office and funded by CMHC International. The brochure profiled the major Canadian suppliers to the house, including Icynene Inc (spray insulation), Duxton Windows and Doors, Thermo Dynamics Ltd. (solar thermal systems) and Renewability (drain water heat recovery).