

GEOHERMAL GREENHOUSES IN KYUSHU, JAPAN

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INTRODUCTION

The New Energy Foundation (NEF) invited two members of the Geo-Heat Center staff to Tokyo to present two workshops on the direct uses of geothermal energy in the United States. Prior to the meetings, a field trip was arranged by NEF to visit geothermal power plants and direct use sites on Kyushu. Seven areas were toured on February 27 and 28th, including the Sensui Rose Garden greenhouse, a demonstration greenhouse at the Hatchobaru power station and the Kokonoe Bio Center.

SENSUI ROSE GARDEN

Near Otake, the Rose Garden consist of 20 double glass greenhouses at 792 m² (8,525 ft²) each. The greenhouses are terraced on a hill side in rows of five double houses as shown in Figure 1. A 100°C (121°F) geothermal well located 500 m (1,640ft) above the greenhouses can deliver 98°C (208°F) fluid at 7 tons/hr (31 gpm).



Figure 1. A row of five double greenhouses.

Perimeter mounted finned pipe, as shown in Figure 2, is used for the heating system in which 36 tons/hr (158 gpm) of fluid is circulated. Approximately 2.5 tons/hr (11 gpm) of geothermal make-up fluid is delivered to the heating system. Heat for the greenhouses is controlled by roof vents and thermal blankets which employ automatically at night. Conventional heat would cost about \$260,000 to \$280,000 per year. Geothermal fluids after heating the greenhouses supply a Japanese-style bathhouse (Figure 3), then disposed of to a nearby river.

The Rose Garden produces 1.8 million rose stocks per year selling at about \$1.00/stock. They are trucked to Tokyo where they are sold at about \$3.00/stock. The greenhouses were built in 1990 at a cost of about \$8 million including the well, etc.



Figure 2. Roses and finned-pipe heating system.



Figure 3. Japanese-style bath using the effluent from the greenhouses.

HATCHOBARU GREENHOUSE

Near the cooling tower for the Hatchobaru power plant, a demonstration greenhouse has been built. The greenhouse was constructed of glass and is approximately 10 m (33 ft) by 20 m (66 ft) in size. The heating system utilizes 106°C (223°F) water from the condenser supplied to a forced-air heat exchanger. The heat exchanger is a cylindrical tank (1 m in diameter and 2 m high) with coiled 1 cm (0.4 in.) plastic tubing, and a fan is mounted on the top. The forced-air distribution system uses plastic polyethylene tubes (0.3 m or 1 ft diameter) placed under benches. Orchids are grown in the greenhouse.



Figure 4. Hatchobaru demonstration greenhouse.

KOKONOE BIO CENTER

The Bio Center is operated by the city of Kokonoe to raise bacteria-free plant starts sold to local farmers. Plants grown include gypsophila, eustoma, strawberry, and lavender flowers. Tips (from 0.1 to 0.2 mm) which are bacteria free are cut from new plants and transplanted to a sterile house where

uniform heat is maintained. Geothermal heat keeps the air dry, therefore, limiting bacteria growth. Geothermal fluid at 60°C (140°F) is delivered from the Otake plant about 5 km (3 mi) and is also used for space heating and hot water in 150 homes in Kokonoe.

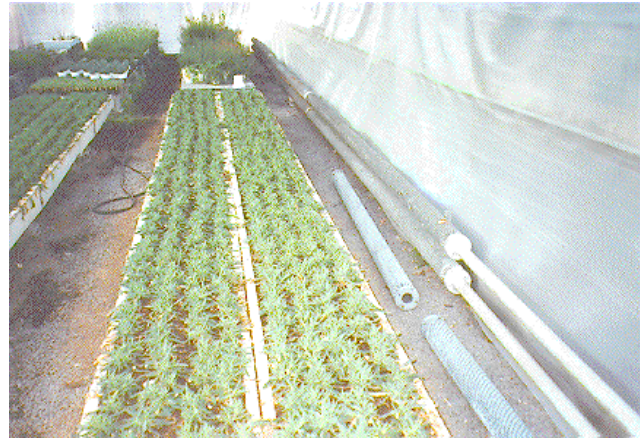


Figure 5. Bio Center greenhouse.