

M-Solid Green House



Mongolia's winter climate is one of the planet's most extreme; the average winter temperature in Ulan Bator is -15.2C, making it coldest capital city in the world. In Mongolia, a significant percentage of the population relies on coal and wood for heating and cooking. The air pollution in Ulan Bator is some of the worst in the world, according to the World Health Organization. Ulan Bator is characterized by *ger* villages on the outskirts; these contain traditional *gers* (or yurts); heating and cooking depends on coal. Although M-Solid Green House is a demonstration house, a married couple lives in the residence so that the building reflects actual use. M-Solid, a manufacturer of insulated walls and roof boards, installed a hybrid solar and wind power system to reduce this reliance on coal and wood, and by extension, the country's level of CO₂ emissions. Located in a modest mixed-use commercial and residential area in the eastern outskirts of Ulan Bator, the M-Solid Green House is a demonstration building designed to provide an affordable solution to reduce air pollution and potentially to provide power for the many rural Mongolians who are not connected

to the electrical grid. The project achieves energy efficiency through three unique features: high-performance thermal insulation material, high-efficiency infrared heating panels, and a hybrid power system of wind and solar energy.

GREEN FEATURES AND SUSTAINABLE TECHNOLOGIES

HIGH-PERFORMANCE THERMAL INSULATION MATERIAL

Due to Mongolia's extreme winters, heat-loss is a primary and costly concern, which is why the walls and roof of the M-Solid Green House are insulated with magnesium oxide. The main ingredients of M-Solid's insulation products are MgO and MgCl₂, which are naturally abundant in Mongolia. The company hopes that its product will help reduce the exploitation of trees which are scarce in the country. Furthermore, M-Solid states that magnesium oxide boards outperform conventional materials such as drywall, OSB, plywood, and gypsum board as heat insulators; moreover they are fire-, mold-, water-, and shrink resistant. Their thermal flow rate is much lower than that of houses using traditional building

PROJECT DETAILS

LOCATION

Ulan Bator, Mongolia

NAME

Green House

ARCHITECTURAL DESIGN

M-SOLID LLC

CONSTRUCTION AND INSTALLATION

M-SOLID LLC

PV SYSTEM DESIGN

DuPont Apollo Ltd.

SIZE

12.05 meters (Length)

4.7 meters (Width)

2.7 meters (High)

TYPE

Residence

COMPLETION

Q2 2012

MEASURABLE RESULTS

PV OUTPUT ENERGY

6,216 kWh/year

WIND POWER OUTPUT ENERGY

750 kWh/year

RENEWABLE ENERGY PERCENTAGE

100%

REDUCTION IN CO₂ EMISSIONS

16.75 tons/year/house

materials. Magnesium oxide is non-toxic, environmentally safe, and recyclable; and is both light weight and durable.

HIGH-EFFICIENCY INFRARED HEATING PANELS

The structure's heating is provided by high-efficiency heating panels powered by a wind/solar hybrid power system. Affixed to the walls and ceiling, the infrared radiating panels transmit heat in an unconventional way, projecting it inwards from the exterior surfaces of the house – the walls and roof – as opposed to a conventional stand-alone furnace which projects heat outwards from a single source within a house. Compared with traditional heating, the infrared panel system can save up to 60% on heating costs. Maximum output can be reached within 30-40 minutes.

HYBRID SOLAR/WIND POWER SYSTEM

Using high-performance PV modules that feature building-integrating glass-to-glass design, the hybrid power system satisfies energy as well as aesthetic requirements. The PV modules are also able to generate power in weak light environments and use a low-voltage design for stand-alone application. Making use of the plentiful winds blowing through Ulan Bator, the M-Solid Green House has incorporated a wind-power component to its energy system. The solar and wind components share a combiner box, battery, and inverter; battery storage allows the house to be completely independent of the grid. In order to verify results, the house also has a monitoring system. M-Solid states that the hybrid power system offers more stable output power and nullifies power generation cost.

Power is stored on site in a 48V battery system with a total storage capacity of 48V 800Ah, an amount that equates to two days' worth of electricity. The power system is a stand-alone system, meaning that it is off-grid and unconnected to any external power source.

Together, this chain of innovative technologies is able to provide a domestic heating system that is both efficient and completely self-sustaining.