

Sol Noctis (Gates Intermediate School)
Essay

The Innovative Green Living Unit (IGLU)

Throughout human existence, we have worked with forcefulness and industry, yet we have not improved the world in which we live. Ants have been laboring for much longer, and none of their efforts have damaged their environment. Keeping this in mind, we have created the Innovative Green Living Unit (IGLU), the first internationally marketed, user-adaptive, net-positive home.

The IGLU was developed for use as an Accessory Dwelling Unit (or ADU) and as such, can be easily adapted to a variety of locations throughout lower-density urban environments. The home was designed for a target demographic of citizens earning 50 – 80% of the city’s median income. The suggested users includes young couples, elderly couples with a reduced income, those suffering economically (i.e., those unemployed for an extended period of time), or in the most extreme circumstances, anyone who has lost their home due to a natural disaster.

IGLUs relate well to the needs of citizens. They are easy to construct (taking only one to two weeks), relatively inexpensive, and can accommodate a variety of lifestyles and personal preferences and tastes. IGLUs provide citizens with a peace of mind in the comfort of knowing they have an affordable option in case of emergency.

The IGLU has variations in size, style, and lifespan. The unit is made in single family, multi-family, or communal models, providing housing for individuals, couples, families, or unrelated groups. The single family unit has a square footage of 800 – 1,000 square feet while the multi-family units can range up to 1,800 square feet.

While the building materials are consistent, the IGLUs are easily adaptable to a variety of styles to suit the local environment and taste. The building envelope is constructed from SmartWrap, an innovative technology that has the ability to change the appearance of the home’s facade. The versatility of SmartWrap allows the homeowners to choose from a wide variety of styles incorporating Greenland’s architectural heritage and culture. These include brightly-colored traditional Greenlandic homes found on the western coast, native hunting lodges of the Northern Inuits, and for the true traditionalists, SmartWrap can even create the illusion of a seal-skin tent! In this sense, SmartWrap can truly adapt well to its surrounding community, blending in stylistically and culturally.

With its structurally sound construction, the unit has been designed to have a useful life in excess of 100 years. The materials have been selected so that they may be “upcycled” into the supply chain to make other houses, thereby giving the IGLU an infinite lifespan.

Not only does the IGLU last, but its chosen materials have completely eliminated the concept of construction waste. One of our major design principles is simply the concept of “Waste = Food,” where our materials are chosen for their ability to become “nutrients” for the production of more materials, while maintaining the original integrity of the product. For instance, this concept of upcycling can be found in everything from the raw technical materials embedded in the SmartWrap technology to the furnishings inside the home.

In terms of aesthetics, the house is constructed with clean, straight lines, and simple shapes, making it pleasing to the eye. To supplement the SmartWrap envelope, users can also opt for NanaWalls, glass walls with a higher R-value that allow for breathtaking views of the landscape without losing heat. Finally, each IGLU has a “green roof” whose natural vegetation has all the aesthetic benefits of a rooftop garden.

To develop the IGLU, we researched and improved upon 21st century technologies to harness solar income including passive, active, power generation, and storage systems. Passively, we harness the technique of natural lighting by using high visible light transmittance windows, sun shelves to reflect light farther into the building, and shading structures over the windows to reduce the solar heat gain coefficient as necessary. For our active systems, we have efficient LED lighting, radiant heating and cooling similar to the systems at NASA’s Sustainability Base in California. IGLUs use solar energy in the form of photovoltaic panels on the roof. Finally, to store this power we use High Capacity Solar Batteries (HCSBs), which retain 85% of the sun’s energy for up to six months.

Aside from current technologies, the most important innovation in the structure of the building is the new SmartWrap 3.0, which has been updated with an auto-tinting function, miniature video camera/microphone and a flexible silicon chip to enable computer use. This material is built with a high visible light transmittance, but incorporates phase-change materials to allow a varying solar heat gain coefficient (from .1 to .8), so we can optimize natural light and heat. The LEDs that allow the illusions of different facades are powered by the solar cells embedded in the film. Additionally, designated SmartWalls in the house are made of SmartWrap, and serve as the systems integration component for communication throughout the house. These walls also display energy-usage statistics and trends, allowing homeowners to be better informed about their energy consumption.

Users need not worry too much about their energy consumption, however, as the IGLU is designed to excel in the categories of economy, efficiency, and sustainability. For instance, EcoRock, a recently developed gypsum drywall replacement is extraordinarily inexpensive and efficient. EcoRock is mold and termite resistant, fully upcyclable, and energy-efficient, using 90% less than conventional sheetrock. In keeping with our net-positive goal, nothing is wasted and we create surplus energy. Using these strategies we have received a LEED 9.3 rating of Diamond (over 250).

Furthermore, the IGLU is affordable as well as sustainable. The units are constructed in large part from materials found in local industries so shipping costs are minimized. They are as inexpensive to operate as they are to purchase. With a sustainable energy system, homeowners only have minimal water bills, which are often offset by town purchase of their surplus energy.

In its design, the IGLU did face some tradeoffs between economics and efficiency, however. In particular, we had originally planned to use Building Integrated Photovoltaic panels (BIPVs) but found that they were inefficient and too expensive to make the home truly affordable for the target demographic. Thus they became a victim of value engineering.

Fortunately, with closed loop cycles of productivity and through materials that enhance rather than detract from our environment, we were able to avoid any tradeoffs with sustainability. For instance, at the end of its useful life, the IGLU's materials can be completely reclaimed for reuse, without any loss in integrity. Homes in extreme environments, for example, require Vacuum Insulated Panels (VIPs) in addition to the SmartWrap skin. This added insulation is sustainable in the sense that it can be upcycled, as the high strength aluminum is separated from the spray foam it contains, and both are rematerialized into further production.

In addition, the building itself is sustainable in its durability. SmartWrap is able to withstand up to Category 3 hurricane winds. Furthermore, during its lifespan, the building requires very little maintenance, from the long-lasting LED lights to the exterior finish – every material has been chosen to eliminate constant maintenance.

As important as durability issues, however, are environmental considerations. The IGLU has a positive environmental footprint because it enhances its surroundings. Creating a surplus of solar energy, the house is not only self-sustaining, but it is actually net-positive and adds energy back to the municipal system. The green roofs allow the IGLUs to function as a natural habitat for a variety of local flora and fauna, creating oxygen, and integrating the home within its natural surroundings while celebrating biodiversity rather than trampling on it. Therefore, our homes benefit the environment greatly.

Overall, the IGLU was envisioned and designed to improve quality of life, not just for its surroundings, but for its occupants too. With the use of natural lighting and sophisticated air filtration, heating, and cooling systems, the indoor environment is exceptionally healthy. The house is chemically safe, because we have eliminated out-gassing products, toxins, and carcinogens. All furniture and carpeting, apart from being inexpensive and chemical-free, is easy to assemble and repair, and can be upcycled. Nylon 6, for instance, is one of the many technical nutrients found in the home that can be continuously reclaimed and reused. Used in our carpets and furnishings, nylon 6 can be de-polymerized back into caprolactum, which is then rematerialized into more nylon 6 – a closed loop of safe and infinite sustainability.

The IGLU also benefits the community and environment. As ADUs, our IGLUs provide tax incentives while housing the otherwise homeless and the construction of the building provides local jobs. The building strengthens the community's infrastructure as well, adding green power and water.

As one may imagine, many design professionals were involved in the planning and construction of the IGLU. Architects developed the layout and as the design progressed, other engineering disciplines were brought in. For example, engineers – including structural, electrical, mechanical, and chemical – collaborated in the design of the SmartWrap. Structural engineers ensured that the building could withstand the forces that it would be subjected to, including wind and seismic. The role of the electrical engineer was critical in the design of the photovoltaics and the distribution and control of the generated power. Environmental and process engineers were necessary to incorporate the photovoltaic panels seamlessly into the green roofs. In essence, the design of the IGLU required the expertise of many engineers and design professionals.

Our intent for the IGLU is a living space design that would integrate the home with its environment and demonstrate the three basic principles of the coming Green Industrial Revolution¹. With its success, we hope that it will be the cornerstone of a global effort to live in harmony with our natural surroundings.

Word Count: 1,626

¹ Waste = Food, Use Existing Solar Income, and Celebrate Biodiversity

References

- "Making NextGen SmartWrap." *KieranTimberlake ISO*. Web. 04 Jan. 2010.
<<http://blog.kierantimberlake.com/making-nextgen-smartwrap%E2%84%A2-115>>.
- McDonough, William, and Michael Braungart. *Cradle to Cradle*. New York: North Point, 2002.
- NanaWall Systems, Inc. Home*. Web. 2 Jan. 2010.
<http://www.nanawall.com/Default.aspx?_kk=nanawalls&_kt=1029d98e-626a-425b-a6fe-e81a2a0d891e>.
- Rodriguez/Maek It Right, Cesar. "Conversation with the Product Coordinator for the Make it Right, an organization helping to rebuild New Orleans Lower 9th Ward in the wake of Hurricane Katrina." Telephone interview. 3 Dec. 2009.
- "Serious Materials | EcoRock Green Drywall." *Serious Materials - Energy Efficient Building Materials*. Web. 28 Dec. 2010.
<<http://www.seriousmaterials.com/html/ecorock.html>>.
- Shuler/NASA Ames Research Center, Ray. "Conversation with NASA's Design Engineer/Project Manager for the NASA Sustainability Base now under construction in Moffett Field, California." Telephone interview. 30 Dec. 2009.
- U.S. Department of Energy's Solar Decathlon Home Page*. Web. 2 Jan. 2010.
<<http://www.solardecathlon.org/>>.
- "Vacuum Insulation Panels - General Information." *Glacier Bay, Inc.* Web. 3 Jan. 2010.
<<http://www.glacierbay.com/vacpanelinfo.asp>>.
- Yudelson, Jerry. *Green Building A to Z: Understanding the Language of Green Building*. New Society, 2007.