



# FEMA

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Enhancing Preparedness  
Strengthening Homeland Security

**Lessons Learned  
Information Sharing**  
LLIS.gov

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## LLIS.gov Resource Compilation For Hurricane Sandy

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*The LLIS.gov team has compiled various resources to help support the efforts and initiatives in preparedness, response, and recovery during Hurricane Sandy. These resources are topic-specific and have been analyzed and used for deployment purposes to help provide support during the hurricane.*

### Specific Housing Solutions

*Jump to within document:*

[Graywater Systems](#)

[Push Button House](#)

[Ikea Concept](#)

[Heston Modulares](#)

[Portable House](#)

[Tripod](#)

[Modular Expandable Living Unit \(ME:LU\)](#)

[Second Life Iraqi Housing](#)

[Additional Shelter/Housing Solutions](#)

[Additional Information](#)

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**Note:** Based on the research conducted, the IKEA Concept (p. 5) appears to be one of the most promising options. These housing solutions are affordable and the building/designing company appears to have in place the infrastructure needed to deliver these products.

**Potential Next Step:** Several other solutions could be investigated:

1. Cold Weather Conditions: Temporary housing for remote sites in Alaska (mining, logging, construction camps, engineering trailers, field labs, dormitories, etc.)
2. Extreme Cold Weather Conditions: Patagonia, North Face, REI, etc. sheltering solutions
3. Housing for Migrant Populations: Monsanto, DuPont, Perdue Farms, etc. housing solution for migrant farm worker

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### GREYWATER SYSTEMS

➤ **Open Source: Types of Package Systems**

<http://www.greywater-systems.com/packaged.htm>

Packaged greywater systems are difficult to find in the USA. In fact, through my research I have found very few are manufactured in the USA. Most are made by overseas companies in drought prone areas or countries that are known for environmental advocacy/awareness.

**Greywater for Toilet Flushing:** Some systems available in the US contain a tank to filter and collect the grey water for reuse in flushing toilets. One such unit fits under the bathroom sink. Other systems are located in the basement or lower area of the home and pump greywater back to toilets for flushing.

➤ **Open Source: Solar Power To The Rescue: Life, Water After Disasters**

<http://www.smartplanet.com/blog/intelligent-energy/solar-power-to-the-rescue-life-water-after-disasters/15399>

San Francisco start-up [Green Horizon](#) has begun shipping a portable, self-sufficient emergency response system called the CSU (Central Service Unit). The CSU operates without any supporting infrastructure, providing communications, water, and power.

While the genesis of the CSU was disaster relief, the company believes there are also markets for NGOs, mining material exploration, fuel exploration, and military uses.

The CSU is built to ISO specifications for shipping on aircraft, railcars, and trucks, said Green Horizon CFO Bob Booth. It is designed to be set up within minutes, and will endure up to 150 mph winds once it's leveled. Features include:

- A self-leveling equalization system that works within minutes
- Multiple power sources (5 KW solar, and a 12 KW back-up diesel generator)
- 74,000 watts of power on the inverter and solar system along
- A hydrogen fuel cell technology provides a further 5kW of charge power for the batteries
- Communications system has Wi-Fi, phone, and cable services.
- Power, communications and additional Green Horizon products can be monitored from remote locations
- CSU provides water, power, communications, security monitoring, and grey and brackish water systems
- 19,000 gallon a day water filtration system and a 2,000-gallon per day grey water system

Each CSU costs approximately US\$200,000-\$220,000. Green Horizon also builds modular housing; each CSU can support about 20 housing units. The homes are designed to be as eco-friendly as possible, and are mostly locally sourced, Booth said. "When a disaster hits, people can only go without water for certain periods of time. We are trying to provide an environment for people to survive and start recovering. [CSU] will bridge the gap between the time it hit and emergency relief services arrive for support," Booth said.

This company produces: (See <http://www.greenhorizonmfg.com/products/rapid-response> for specifications)

**CSU**



**QUICKCOVER**



**QUICKHAB**



**SFH40B**



- **Open Source: Freewater UK**  
<http://www.freewateruk.co.uk/>

"Greywater recycling" is typically defined as being water from the bath, shower, wash hand basin. The ideal situation for 'Greywater' is in living accommodation where sufficient amounts are generated daily for reuse in toilets, washing machine and outside tap.

**Membrane Filter Technology. How does it work ?**

All system functions are managed by Siemens Logic microprocessor control. The greywater is collected from bath, shower and hand wash basin by gravity into the first greywater tank, and is first processed biologically. Bacteria with the addition of oxygen decompose the organic substances in the grey water at timed intervals. The pre-cleaned water is then processed further through the submerged membrane filter. The membrane filter unit physically cleans the partially clean water through the (MicroClear®System) membrane filter, which has extremely fine membrane pores, and blocks 99.9999% of all bacteria from passing through it, guaranteeing that no germs can remain in the cleaned water.

- **Open Source: Hydration Technology Innovations**  
<http://www.ottawacitizen.com/homes/Adding+grey+water+recovery+system/6037675/story.html>

The unit, from Montreal's Brac Systems ([bracsystems.com](http://bracsystems.com)) and costing about \$2,000 installed, collects and sanitizes water from the home's three showers and two bathtubs for storage in a 150-litre tank in the basement.

Smaller scale grey-water recovery systems are also available. Walmar Mechanical Sales in Nepean ([www.walmar.net](http://www.walmar.net)) sells the AQUUS system, which sanitizes water from the bathroom sink before pumping it into the toilet tank to supplement city-supplied water. It costs \$320 plus installation.

- **Conference: Nov 15, 2012 - Nov 16, 2012 - California Greywater Conference**  
<http://greywateraction.org/workshop/2012/11/15/california-greywater-conference>

This conference is sponsored by the Tuolumne County, California, Environmental Health Department. The website lists workshops and speakers.

- **Company: NAHB Research Center (Maryland). Greywater Reuse**  
<http://www.toolbase.org/Technology-Inventory/Sitework/greywater-reuse>

Systems generally consist of a three-way diverter valve, a treatment assembly such as a sand filter, a holding tank, a bilge pump, and an irrigation or leaching system. The holding tank cools the water and temporarily holds it back from the drain hose. Systems can either be custom designed and built, or purchased as a package. Techniques include recessed or raised planter soilboxes, water injection without erosion, gravity or pressure leach chamber, and irrigated greenhouses. Some system components can retrofit existing irrigation systems.

- **Company: Sierra Watershed Progressive**  
<http://www.sierrawatershedprogressive.com/#/>

"There are many methods we employ to accomplish our larger aims of water conservation by re-appropriation and re-use. We've developed methods that are easily adaptable to small-scale residential projects, large-scale commercial projects, and everything in between."

## PUSH BUTTON HOUSE

- **Open Source: Container Homes That Open In 90 Seconds. Push Button Houses by Adam Kalkin.**

<http://ifitshipitshere.blogspot.com/2012/03/container-homes-that-open-in-90-seconds.html>

Architect Adam Kalkin's Push Button homes are fascinating. A shipping container that unfolds with the push of a button in 90 seconds to reveal a living space complete with a bedroom, a bathroom, kitchenette, and living area. Kalkin's concept uses hydraulic power to lift and lower the sides of the shipping container, expanding the usable living space.



- **Company: Architecture and Hygiene**  
<http://www.a/rchitectureandhygiene.com/main.html>

This website includes information regarding: Quik house, Rammed earth quik house, 12 container house, \$99,000 house (below), Bunny lane, Kalkin house, Old lady house, Push button house, and Push button house 2.

## IKEA CONCEPT

- **Open Source: The Huffington Post. IKEA Houses: IKEA Portland And Ideabox Debut Prefab Homes At Portland Home And Garden Show [UPDATE] (3/2/2012)**  
[http://www.huffingtonpost.com/2012/03/01/ikeahouse\\_n\\_1314356.html?s747761&title=IKEA\\_ho use](http://www.huffingtonpost.com/2012/03/01/ikeahouse_n_1314356.html?s747761&title=IKEA_ho use)

Prefab housemaker [Ideabox](http://www.ideabox.us/) previewed its first U.S. home, "Aktiv," at the Portland Home & Garden Show last week, Sustainable Business Oregon reports. The home was designed in collaboration with IKEA Portland.

But buyers of the one bedroom Aktiv, which costs \$86,500, won't have to figure out where to put 1,000 tiny screws. The house can be delivered to your empty lot by a semi-truck in one or two big pieces. It arrives already constructed and partially furnished, with an IKEA bedroom, kitchen, and bathroom installed.

- **Company: IdeaBox**  
<http://www.ideabox.us/>

This website includes information on several types of housing solutions, including:

Type	Typically Priced at:
Confluence	\$ 103,500
Cottage	\$ 85,500
Aktiv	\$ 86,500
Noorthwest Model	\$ 75,500
Minibox	\$ 42,500
Drift	\$ 155,000

### Northeast Modern



- **Company: BOKLOK**  
<http://www.boklok.com/theconcept/Start/>

Pioneered by IKEA and Skanska, BoKlok homes have been created through a fruitful collaboration between skilled architects who know how to create comfortable homes and IKEA interior designers who understand how people want to live. They have been designed around factory processes which enables them to be far more efficiently constructed in quality-controlled conditions than would be possible through site-based construction.

All BoKlok schemes are sold through special sales events in the closest IKEA store. The BoKlok Concept is owned jointly by Skanska and IKEA. This is realized through the 50-50 joint venture BoKlok AB, who develops the concept and hold all property rights. BoKlok AB is a concept company with its head office in Malmö, Sweden. BoKlok is active on six markets: Sweden, Denmark, Norway, Finland, Great Britain and Germany.

## HESTON MODULARS

**Company: The Heston Group USA. Disaster Relief Services**  
[http://www.heston-usa.com/dis\\_relief.htm](http://www.heston-usa.com/dis_relief.htm)

Heston is an industry leader in providing much needed housing aid to disaster- torn areas of the country and around the globe. The flexibility of the Heston Homes housing option serves as an immediate availability to companies and governments to quickly provide assistance to families and individuals who become displaced due to unforeseen natural or unnatural events.

The units can be dispatched and assembled anywhere in the continental United States within a week of order placement as a 2,3, and 4 bedroom home, medical facilities, office space, gymnasiums, eating-station/dining hall, and many other options.

The units arrive flatpacked with all materials included and are assembled on-site until the need for its use is served, at which time the units are repackaged and removed from site and placed in storage to be reused at a later time.

Being that a typical Heston Home construction can withstand hurricane force winds of up to 145 miles per hour and are environmentally sound, many chose to convert their Heston Home to a permanent dwelling. By laying a traditional slab or girder foundation and incorporating other low-cost modifications, Heston Homes are able to conform to most widely accepted housing codes for permanent structures.



## PORTABLE HOUSE

➤ **Company:** MEDCottage

<http://www.medcottage.com/index.php>

“MEDCottage — a prefabricated 12-by-24-foot bedroom-bathroom-kitchenette unit that can be set up as a free-standing structure in your backyard. It’s more than a miniature house — it’s decked out with high-tech monitoring and safety features that rival those of many nursing homes.”

The MEDCottage is a modular building, which provides round-the-clock monitoring in a freestanding unit dependent on a caregiver's house. The MEDCottage efficiently combines sleeping, bathing, cooking, and living area in a 12 foot by 24-foot area. A senior or disabled family member can gain some privacy and independence in a setting where state-of-the-art technology is available to monitor the occupant when needed.

MEDCottage runs its water, electric, and waste disposal systems off the caregiver's home systems. Caregivers can choose to either buy a MEDCottage outright or lease one for a shorter period, providing complete flexibility. Equipped for long-term care of the aged or disabled, each structure is like a portable nursing home room that also includes its own kitchenette and laundry machines.

- 288 square feet unit (12 ft x 24 ft)
- Electricity and water connected directly to homeowner's utilities
- A kitchen with a small refrigerator, microwave, and medication dispenser.
- Bedroom and additional accommodation for a caregiver's visit.
- The bathroom is handicapped accessible.



- **Company: Global Portable Buildings, Inc.**  
<http://tinyhouseblog.com/pre-fab/global-portable-buildings/>  
<http://www.globalportablebuildings.com/Ultimate.html>

Global Portable Buildings, Inc. of Santa Rosa, California, makes a standard storage container into a livable structure for under \$20,000 dollars.

Standard features include kitchen, bathroom (with shower, toilet, sink), AC electrical system, telephone/internet connection, 2" rigid insulated finished walls and ceiling, windows, entrance door, finished linoleum/vinyl floor and utility room.

Global Portable Buildings stocks over 300 multi-purpose portable buildings ready to ship. Although aimed at the construction industry, you the buyer will need to verify with your area what permits etc. are required. These are very affordable with the 8 x 20 starting at \$16,500 and the 8 x 40 starting at \$23,500. Connecting units are available for larger spaces.



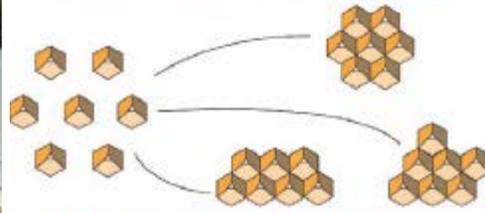
- **Company: The Habihut**  
<http://www.thehabihut.com/>

HabiHuts can be packed in a single box, approximately 96"x 48"x 24". They are easy to stack and economical to ship. Seventy-two units can fit in a standard cargo container. Each unit weighs less than 400 lbs (182 kg) and can be constructed with minimal labor in fewer than 2 hours. Units can also be easily moved, for added flexibility and future redeployment. Minimal tools are required.

The life expectancy of a HabiHut is 10-15 years and each unit comes with a 5-year warranty. All parts are interchangeable, so future repair is convenient. An added bonus is that due to the hexagonal form, multiple units can be joined together to form a larger structure -- much like a beehive -- permitting maximum expandability without the sacrifice of valuable land space. Windows are tamperproof and doors lock for privacy and protection. (No power or water)



**FAST, FLEXIBLE AND EXPANDABLE**



**MODULAR, HONEYCOMB SHAPE CREATES DIFFERENT SPACES FOR SCHOOL, MEDICAL OR COMMUNITY CENTER**

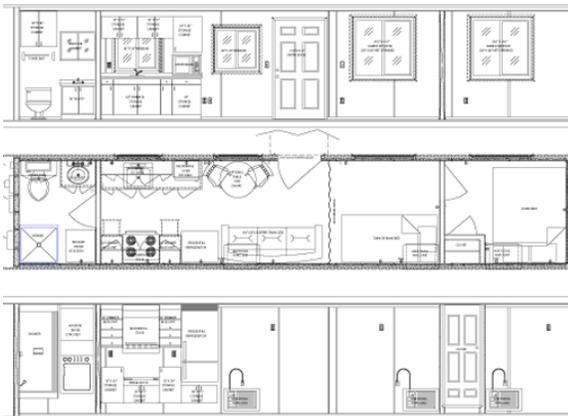
➤ **Company: Energistx**

<http://www.energistx.com/spaces/8x40trailersystem.html>

These self-contained portable homes are crafted within solid steel 40 ft recycled ISO shipping containers. They are outfitted with windows, plumbing, electrical, comfort amenities and interior finishing, bath and kitchen included.

The Portable Buildings require no foundation or construction, and can withstand winds up to 120 MPH without anchoring. In addition, they can be mounted on a mobile trailer chassis system or permanent axle for easy transport from site to site.

In disaster relief circumstances, up to 50 units can be manufactured per day and delivered within 3 days for economical solutions to housing shortages and disaster relief of any kind. Homes can be trucked or ocean freighted for plug-n-play homes anywhere. Units can be stacked and linked to camp infrastructure.



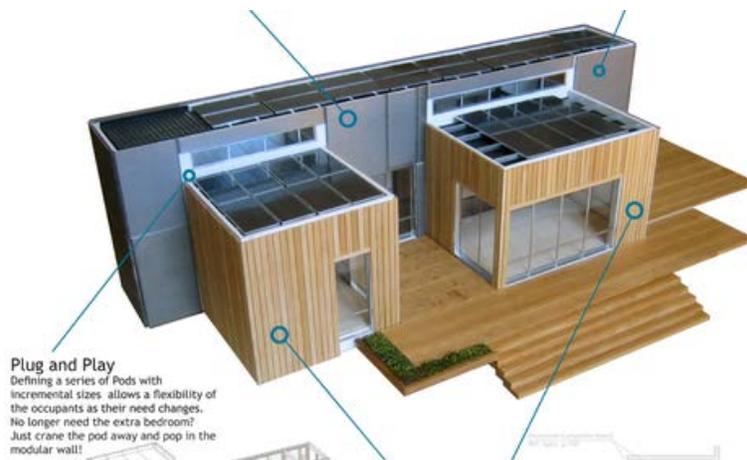
## TRIPOD

- **Academic Institution: Carnegie Mellon Solar Decathlon Team. Tripod.**  
<http://www.andrew.cmu.edu/org/SD2007/house/design/plugnplay.html>

Submitted by the Carnegie Mellon University Solar Decathlon team, this project won both in the Building Category (Student) as well as the Outstanding Achievement Award: Best Greenhouse Gas Reduction Design. TriPod is a prototype house demonstrating the "Plug and Play" concept and is designed to provide an innovative alternative to the current housing industry.

TriPOD is "an 800 ft<sup>2</sup> home for two. As the name indicates, this model has three Pods: Kitchen, Bedroom and Live/Work space. Meanwhile, the Core houses all the home's utilities, including a Bathroom and a laundry closet. Our design also seeks to blend indoor and outdoor spaces, showcasing a Greenscape to the north and a Courtyard to the south."

"The idea of a Plug n' Play house boils down to the use of modularity on a variety of scales. In order to make this feasible, we worked to design the house and all of its components on an 18-inch grid. This allowed us the maximum in flexibility with respect to configuration of spaces, interchangeability of fixtures and customizability of materials and finishes."



## MODULAR EXPANDABLE: LIVING UNIT (ME:LU)

- **Company:** AB Design Studio. **Modular Expandable: Living Unit (ME:LU)**  
<http://www.jetsongreen.com/2008/10/green-building-2.html>

Submitted by Clay Aurell of AB Design Studio, this design was named **Honorable Mention in the Building Category (Professional-Unbuilt)**. Honorable mention for excellent use of a container. ME:LU stands for Modular Expandable: Living Unit and is based on a concept of providing a housing module that can work for a single person, a family, or even a temporary work force while still exemplifying a lifecycle form of design.



## SECOND LIFE IRAQI HOUSING

- **Academic Institution:** University of Utah. **Second-Life Iraqi Housing: Temporary to Permanent**  
<http://www.jetsongreen.com/2008/10/green-building-2.html>

Submitted by Eric Hansen of the University of Utah, this design was named **Honorable Mention in the Building Category (Student)**. Honorable Mention for a realistic solution to a real-life problem. The design consists of flat-packed, folding panels, which are brought to the site by Marines, along with the supplies they already bring. The structure can be quickly erected by the workforce of 36 marines during the night.



## ADDITIONAL SHELTER/HOUSING SOLUTIONS

- **Company: IADDIC Shelters**  
<http://iaddicshelters.net/>

IADDIC Shelters housing solutions create affordable homes, alternative homes, micro homes, emergency relief housing, disaster relief shelters, and tents.

### **Disaster Relief Shelters**

The IADDIC Disaster Relief Shelter comes in one of two models. The rigid iShelter disaster relief shelter deploys rapidly and is built on site utilizing local resources and produces the most secure, longest lasting and well insulated shelter available. The iTents are pre-manufactured and are 100% finished disaster relief shelters. They are highly insulated and are intended to last well into the reconstruction phase of disaster recovery.



### **Housing Solutions**

The iSeries housing solutions are built to last and are packed with features like R15 walls, R30 roofs, and hurricane and earthquake resistance. They will not rot or rust, they are insect resistant, and fire rated. These versatile low cost houses are well suited for projects large or small. These houses can be built in a few hours.

- **Company: Factory Expo**  
<http://www.factoryexpomobilehomes.com/>

The mobile homes are built at the Fleetwood factory in Rocky Mount, Virginia. All the homes meet HUD specifications. The houses are delivered to Virginia, Pennsylvania, Maryland, Delaware, Kentucky, New Jersey, Washington D.C., and West Virginia.

The singlewide home below is \$16,900; two beds, two baths is \$24,150.



## **ADDITIONAL INFORMATION**

### ➤ **Drinking Water: NASA Forward Osmosis Bag (FOB)**

[http://www.nasa.gov/mission\\_pages/station/research/experiments/FOB.html](http://www.nasa.gov/mission_pages/station/research/experiments/FOB.html)

Forward osmosis is a low-resource water treatment technology that offers the advantage of high rejection of a wide range of contaminants than traditional membrane processes.

### **Earth Applications**

Hydration Technology Innovations (HTI), the manufacturer of the Forward Osmosis membrane used in NASA's greywater recycling system, has used the same technology to create a lifesaving water filter. This filter is called the HydroPack, and will provide a clean, safe drink from any contaminated water source by simply dropping the product in water and leaving it to hydrate for ten hours. The Forward Osmosis membrane blocks all contaminants and provides an electrolyte enhanced drink that is beneficial to anyone in a water emergency situation.

This product has been successfully used in disaster relief efforts for the 2010 earthquakes in both Haiti and Chile and tested in the waters from the aftermath of Katrina. One helicopter filled with HydroPacks is equivalent to sending 14 helicopters of bottled water. The logistical benefits combined with the new Kenya research project data illustrates that HydroPacks are the best solution for providing emergency hydration during the initial phase of disaster relief situations.

## **DISCLAIMER**

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