Slide 1.

What is LooLoo? LooLoo is a revolutionary mobile toilet for maximum UX! It's got 1 kW solar power. Cell phone charging ports. Commercial-Off-The-Shelf materials. No special skills, materials or tools to construct. Ultraviolet germicidal irradiation (UVGI). LED lighting. Hand sanitizer. Powered ventilation. Financial incentives to use wisely. Unprecedented!

The goal of this project is to build a four-season, innovative structure that collects human waste. But wait! It does so much more! It is envisioned as a temporary not a permanent structure. It is maintained by local community people. And it provides financial incentives for caretakers on a rotating basis using electronic transfer funds (ETF). What's not to like?

See the slide show, download the proposal and other documents at: http://www.thehomeshelter.org

I contacted California Governor Gavin Newsom, the American Red Cross, universities, designforthehomeless, US Interagency Council on Homeless, even the National Park Foundation for interest, ideas, critical assessment, funding or a grant application. No responses. No feedback. Nothing. So, I thought I'd try crowdsourcing. I not sure where this will go but I thought I'd throw it out there. Research, design, build, and test one yourself. Good luck!

Slide 2.

LooLoo objectives are simple and straightforward. It's extremely low cost (less than $1000 for all materials), low maintenance and simple construction for easy assembly and disassembly by two people is a huge advantage over expensive public toilets. It uses splines, pressure fittings and a limited number of fasteners rather than welded steel seams, plastic or rivets. It uses readily available cleansers and disinfectants to reduce pathogens. It's designed for four season use. The target weight is less than 500 lbs. with each panel weighing less than 60 lbs. It reduces maintenance and increases cleanliness by strongly encouraging males to sit rather than stand. Its electronic feature allows users to charge their cell phones which are a lifeline for people living rough. And the external surface treatments make it attractive and part of the environment.

Slide 3.

The entire structure could be constructed using eight (8) sheets of 0.5-inch-thick pressure treated 4 feet x 8 feet ACX plywood sheets. Each sheet weighs about 60 lbs. so the entire structure might weigh about 500 lbs. Its sheer weight discourages tipping or removal. Each sheet costs about $40 at Home Depot. Since it is constructed with splines as shown above and limited fasteners, it is easy to assemble and disassemble with portable power tools. The pallet base enables forklift transportation. Splines provide more contact surface between panels. It includes a 'power cap' as designed for the HOME Shelter, its predecessor. The nearly inaccessible power cap contains the electronic components. Watch a video of its features and construction at http://www.thehomeshelter.org

Slide 4.

LooLoo is innovative in several ways compared to other outdoor toilets. To start with its structure encourages users to sit rather than stand. Sitting reduces overspill and splashing. LooLoo's power cap combination of solar panel, battery, and inverter enable charging your phone. Electronics are enclosed in a solid wood structure to discourage vandalism. LooLoo's financial incentive arrangement with a local

charity or credit union reinforce community involvement. The caretaker is responsible for encouraging best use and not abuse by users. Users take responsibility for cleaning and maintaining LooLoo, not the municipal government.

Slide 5.

The role of the caretaker is an important distinction from all other public toilets. LooLoo involves the local user community. The caretaker is given financial, maintenance and social responsibility to maintain LooLoo for a year. It's to their advantage to maintain the facility and encourage users in the local community. Most encampments are cooperative with local community enforcement. Read about it in the documents section. And the financial benefits and responsibilities are rotated around the community so everyone who wants an opportunity can have one. In a sense, members of the local community are on a payroll setup through a local bank or credit union or charity. This is unprecedented in humanitarian community projects.

Slide 6.

One approach is for a university or college to adopt LooLoo as a Capstone or Senior Design project. This project requires innovative civil and environmental engineering plus additional substantial inputs and cooperation from the college of business and college of arts and sciences. I believe this project will improve with input from the College of Arts and Science, namely, Art and Art History and Environmental Sciences and College of Business, Marketing or Management. The departments of civil and environmental engineering need to investigate and estimate structural loads, ventilation, effects of composting, electronic power supply, durability and effects of temperature (freezing poop). The college of arts and science will investigate artistic effects, application of trompe l'eoil, and digital design. The college of business will develop a business plan for municipalities, electronic fund transfers via cell phone, marketing and management of LooLoo at the city level.

Slide 7.

Here's a more detailed look at the operational elements of LooLoo. You have the limited life structure, private contractor or municipal septic pumping, volunteer or city employed social workers to assist the caretaker, the caretaker and consumables like paper, cleanser, sanitizer. It's important to remember that LooLoo is a system not just a structure. It actively involves members of the local community. That's why most other attempts have failed; waste management involves the local community, financial incentives, ensuring usability for an optimal experience, and allowing the user additional incentives like charging a cell phone while using LooLoo. LooLoo is a total system concept.

Slide 8.

There are several options for the physical or structural layout. LooLoo could have a center, corner, or offset seat. The entrance can be on either on the front or side of the structure depending on your viewpoint. There is a distinction between 'door' and entrance. A door implies a hinged panel that swings left or right. Suppose we think of the opening as an entrance. Think of a way to allow someone to enter and exit a structure. If you don't think of a door, then how you exit and enter is wide open. Pun intended…. Considerations include sizing for 95th percentile male, including accessories like a backpack or heavy clothing, large bag, etc. The offset seat allows for placing extra items next to the user without dropping them on the floor. All other restrooms use a center seat. A center seat restricts

horizontal storage space. Perhaps an offset seat is better? Since the concept uses a split 55-gallon plastic drum as storage, how do you minimize moving the drum around if the seat is fixed and still use both halves?

Slide 9.

A trapezoidal design like this one encourages the user (mark zuckerberg, as shown) to sit rather than stand to avoid bumping the head. If the height of the ceiling is reduced to 72 inches, this vertical dimension further restricts standing and encourages sitting. There's another advantage to a lower ceiling. Lowering the ceiling from 8 to 6 feet saves 1 4 x 8 sheet of plywood. The ripped 2-foot long pieces from 3 sides can be used for the seat and riser.

A pallet base could provide more stability and transportability. Most are 48 inches x 40 inches. A 48-inch x 48-inch will work here since the notional design uses 4-foot x 8-foot plywood. Two-inch diameter holes drilled in the sides and rear allow visibility inside from outside and vice versa. No other restroom considers visibility for users and a caretaker to ensure safety.

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I not sure where this will go but I thought I'd throw it out there. Research, design, build, and test one yourself. Good luck!

Slide 10.

LooLoo has an off-center seat as shown. There are two features of this design that encourages users to sit rather than stand: one – a lowered 6-foot ceiling and two – a pedestal with a charging station. A lowered ceiling risks bumping your head if you stand up. Lowering the ceiling from 8 to 6 feet saves 1 4 x 8 sheet of plywood since the ripped 2-foot long pieces are used for the seat and riser. The pedestal stand is wired for charging a cell phone. The charger allows the user to sit and charge a cell phone while reading messages or sending a message. The seat is sloped to discourage prolonged sitting. The half drum container is accessed from the rear via a pop-out panel. A pallet base could provide more stability and transportability. A 48-inch x 48-inch pallet will work here since the notional design uses 4-foot wide x 8-foot high plywood . Two-inch diameter holes drilled in the sides and rear allow visibility inside from outside and vice versa. No other restroom considers visibility for users and a caretaker to ensure safety.

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Slide 11.

The external outside appearance is extremely important. It's part of the UX. Suppose you used trompe l'oeil to disguise the appearance? Of course, you still know it's a toilet but if it looks like part of the environment rather than a big blue box isn't that more pleasing and interesting? The outside of LooLoo might look like a wall or a shrub or a brick wall. Color and design might be applied on the site by a local artist or at a pre-fab shop using vinyl coating like you see on the side of a bus. High school students even grammar school students could paint one. The possibilities are endless. Although trompe l'oeil is a 3D effect, the outside design might be any kind of painting.

Slide 12.

A trompe l'oeil effect would make LooLoo appear more interesting and appealing. If the effect is mass produced on vinyl, then it could be applied before assembly. Or a mural could be painted or applied on site that would match the surrounding landscape like a building or not.

Slide 13.

Many attempts were made in the past 10 years to design and build a public toilet. About 20 cities have public toilets. The most successful is the 2012 Portland public toilet called 'Portland Loo.' It costs about $100,000 per unit to construct and install. Some estimates are as high as $250,000 per toilet. In New York City, public toilet installation and maintenance can top $1,000.000. The Portland Loo is popular in Oregon, but its design is not suitable for harsh environments with winter and snow and sleet. A driving rain with blow right through it. And the cost is rather high considering it must include hooking up to city sewers and water. While it is designed for public use including moms with kids and students with backpacks and bicycles, it does place a maintenance burden on the community for years. Public toilets like the Portland Loo are designed for last 10 – 20 years. They're constructed of welded ¼ stainless steel panels with special powder coatings. LooLoo is designed to be a consumable item, something that might last one season or a year at most.

Slide 14.

Notice that the common Porta Potty prevents users and caretaker to see out or inside. This lack of visibility can be threatening for personnel safety. While it is easy to clean the plastic surfaces, the Porta Potty is extremely sterile and encourages users to place items on the floor which is dubious. By encouraging sitting through good design, LooLoo eliminates the extra urinal you see attached to the side wall plus any interfaces to the waste tank.

Slide 15.

This table compares LooLoo with Porta Potty and Portland Loo against 14 criteria from research on toilet design. Porta Potty scores six (6) NO features. Portland Loo scores three (3) NO features. LooLoo scores only one (1) NO feature. While Portland Loo and Porta Potty might be graffiti resistant, LooLoo encourages external surface treatments which might be construed as graffiti. LooLoo is not ADA compliant but the argument is that LooLoo is not a true public toilet. It is designed for a specific user community on a temporary basis. No other toilet has a charging station or the extensive use of solar power. And it can be designed to be a four-season structure at a reasonable cost.

Slide 16.

The basic structure is held together with splines, tracks and screws. The sliding door is captive between a bottom and top track. There are no hinges or hardware that can break. Cutouts in the sliding panel act as door handles. You do not need a doorknob or handle. The door measures about 24 inches wide; the minimum for door width. The door is captive to the structure. Door is set in a standard 4-foot x 8-foot ACX sheet of plywood. This 2-foot wide door allows a 95th percentile person to enter and exit sideways. Watch a video at: http://www.thehomeshelter.org.

Slide 17.

This pictograph shows the basic assembly sequence. You start from the bottom and work up to the top. Some preassembly is done in a workshop. Preassembled units are delivered to the installation site. For instance, the electronics can be preassembled in the power cap including wiring and then sealed. Tracks, side panels and the door can be precut in a workshop. The seat openings are cut and fit-checked for the vent pipe. The charging station is preassembled, also. Total assembly in the field might take about 4 hours.

Slide 18.

Power is stored in one or two 12 Volt, Absorbed Glass Mat (AGM) batteries which can be placed in any position and has no risk for spilling. That's an important feature of AGM batteries for both users, local community, and the environment. The final components selected for the electrical system include a solar panel with built-in voltage regulator, a separate charge controller, and a separate power inverter.

Slide 19.

The power cap contains the electronic components in a sealed compartment. The cap is most likely pre-assembled and installed on site. It might weigh about 95 lbs. so two people can lift it into place. It might be painted or sealed in some way to keep out mice and moisture.

Slide 20.

There are components that require electricity – (1) electrical outlets, (2) interior lighting and (3) USB charging sockets. Having 1 string of LED 5 mm light strings 'ON' for 4 hours a day consumes almost as much power as using a tablet for 4 hours per day. Cell phones require very little relative to the other items. Plus, you can have a UVGI lamp to kill germs and bacteria. A small ventilation fan in the vent stack will remove odor from the waste tank or drum. These power requirements are estimates. A more extensive power load analysis is required.

Slide 21.

Here is a simple schematic of LooLoo electronics. One solar panel could provide 50 – 100 Watts. A single flat panel minimizes cost and complexity compared to small panels used by hikers and backpackers. Peripheral electronics like the LED lighting, fan, and cell phone chargers plug into sockets built into the inverter.

Slide 22.

We assume only 4 hours per day of sun exposure to charge the battery. More analysis is needed to specify the requirements for the electronic components based on certain cell phone charging assumptions.

Slide 23.

Here is a good candidate for the solar panel component. It is a mono crystalline Grape Solar 100-watt panel readily available from HOME Depot, Costco and Amazon. It is small enough to fit on top of the power cap. It would be bolted, and glued in place to discourage vandalism. Monocrystalline panels are 20% efficient, at best.

Slide 24.

There are a few types of lead acid deep cycle batteries: flooded, sealed gelled, or sealed AGM. For most situations a sealed AGM (Absorbed Glass Mat) is the safest and best option. AGM batteries require little maintenance. There is no need for ventilation, and they will not spill. Flooded batteries have the advantage of being significantly less expensive, but they require adequate ventilation, maintenance, and also have the potential liability of tipping or spilling. AGM batteries are typically lighter and less expensive per amp-hour compared to gel.

Chargers designed for long term charging of flooded cell (*or AGM*) batteries will frequently have a remote temperature sensor (battery charging voltage is temperature sensitive) and 2-3+ charging stages--with the last stage a "float" voltage setting (backs charging voltage back to around 12.7-13.6 volts to prevent boiling a battery dry) and/or an automatic or manual equalize setting (which can be turned off/adjusted for AGM/sealed batteries).

Flooded Lead acid are constant current charged at the C/10 rate until they reach 2.45 Vpc. Gel are constant current charged at the C/20 until they reach 2.35 Vpc. AGM are constant current charged at as high as C/5 until they reach 2.35 Vpc

Morningstar SunSaver 15 Amp MPPT has jumper and switches for 4 battery types, including AGM. Major name brand, trusted. You don't worry about it like the $30 version from eBay. if it's too pricey at $250, you can hunt through the rest of the Morningstar line, or others, and view the manuals, before you buy. If your solar panel Vpmax is under 20v or so, you don't NEED a MPPT, but the old school PWM will work well too. If your PV Vpmax is over 20V, you will see increased performance with MPPT.

Operating Temperature: -10 ~ 55 °C

Storage Temperature: -25 ~ 55 °C

Humidity Requirements: ≤ 90% , no condensation

Slide 25.

AGM batteries are not the best choice for all applications - they are rather expensive compared to flooded batteries. However, their safety and design features make them the battery of choice for many applications, such as:

Where you cannot have fumes or hydrogen, such as in poorly ventilated areas, or where fumes may cause corrosion to electronics, such as repeater and cell phone sites.
Where resistance to shock and vibration is important.
Where spilled acid from leaking, tipped, or broken batteries cannot be tolerated.
When installed in a location where maintenance would be difficult or expensive, such as remote communications sites.
Where the batteries may be subject to freezing (-40 degrees F or lower).
Anyplace where you need a reliable totally sealed battery for safety or environmental reasons - wheelchairs, medical standby power, inside RV's, computer room UPS systems, or in enclosed spaces in boats.

Slide 26.

Charge Controllers

The primary function of a solar PV charge controller is to prevent the solar battery from being overcharged by the photovoltaic array and constantly monitors battery voltage. Solar PV charge controllers are a necessary component in every solar power energy system. When the batteries are fully charged, the controller will stop or decrease the amount of current flowing from the photovoltaic array into the battery. When the batteries are being discharged to a low level, many controllers will shut off the current flowing from the battery to the DC load(s). Solar PV charge controllers come in a variety sizes from a just a few amps to as many as 80 amps. A wide range of quality PV charge controllers from such qualities manufacturers as Steca, Morningstar, Xantrex and many others.

For example, you may have appliances in your house powered by solar energy. As you use the various appliances, the battery gets drained and depleted. If you leave for an extended period of time—say for a vacation—the batteries will continue to charge. Ideally speaking, you do not want your battery to get topped off and have the solar panels continue to charge after it is at capacity. The solar charge controller will prevent this. When the batteries are fully charged, the controller will stop or decrease the amount of current flowing from the photovoltaic array into the battery. When the batteries are being discharged to a low level, many controllers will shut off the current flowing from the battery to the DC load(s). All solar charge controllers are for off grid solar energy systems.

Terms such as “charge controller” and “solar charge controller” are interchangeable. Ones used for solar cells or solar panels can also be used for other purposes including wind power charge controller. Solarblvd sells three types of solar charge controllers: 1. PWM solar charge controller: this type of solar cell charge controller can only go from the same voltage to the same voltage, for instance from 24v to 24v, for 100% efficiency. If you use a PWM solar charge controller to go from a 24v panel to a 12v panel, you will lose about 50% of efficiency from your solar panel. PWM solar charge controllers tend to be lower in price for this reason and are for use in smaller footprint situations such as on boats or RVs. 2. MPPT solar charge controller: recently becoming quite popular as homes continue to integrate solar panels in a drive to move off the grid. MPPT (Maximum Power Point Tracking) allows you to have a 24v panel and want to charge a 12v battery bank. The MPPT solar charge controller would regulate the battery and drop it to 12v without losing any efficiency in the panel. MPPT charge controllers will give you the most out of your solar energy system; 100w out of a 100w solar panel. MPPT charge controllers are big and bulky, thus more suited for a home or cabin environment. 3. Lighting control is a timer like a sprinkler system. It works as a solar charge controller and also controls your lights on/off schedule.

These controllers actually detect the optimum operating voltage and amperage of the solar panel array and match that with the battery bank. The result is additional 15-30% more power out of your solar array versus a PWM solar controller. Although the MPPT solar charge controller is more expensive than its PWM counterpart, it is generally worth the investment for any solar electric system over 200 watts.

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REQUIREMENTS - 10 Amp Charge Controller:
Helps prevent the overcharging and discharging of 12-volt batteries
Keeps 12-volt batteries in a fully charged state to maintain voltage
For use with 12-volt solar panels and batteries only
Handles up to 150 watts of solar power
Handles up to 10 amps of array current
Small and compact for added convenience

Maintenance free protection of your solar panels and batteries
LCD digital display continuously shows battery voltage
LED indicator shows when charging and when system is over voltage

Technical Information for 12V Systems:

Rated solar input: 10A/20A
Rated Load: 10A/20A
25% Overload: 1 minute
Load disconnect: 11.1V

SPECIFICATIONS:

Load reconnect: 12.6V
Equalization voltage (30 minutes): 14.6v
Boost voltage (30 minutes): 14.4v
Float voltage: 13.6v
Temp Comp. (mV/C°):-30mV
Temperature: -35°C to +55°C
For wire sizes to 6mm^2

Slide 28.

With a two-year manufacturer's warranty, this item provides 600 continuous watts and 1200 surge watts of energy. Two easily accessed AC outlets allow for charging two items simultaneously. The fact that it's a true sine wave inverter means that there's less harmonic distortion in the DC to AC conversion, so it can be used to power sensitive electronic devices. It also features Dual GFCI AC receptacles and USB power connection facility, both of which are invaluable.

Product Features:

600/1000/2000 watts maximum, 1200/2000/3000-watt surge capability
Built-in digital display for DC volts and output power
Built-in USB port
Dual GFCI AC receptacles for safe operation
Heavy duty terminals for trouble-free battery connection
Available ON/OFF remote switch (with ignition lockout)
Two year warranty

Protection Features:

Low voltage shutdown (10.5 Vdc)
Low voltage alarm (11.0 Vdc)
Over voltage protection (15.5 Vdc)
Overload shutdown
Over temperature shutdown
GFCI protection

Slide 29.

The suggested power components are single Grape Solar panel, two (2) Universal Batteries (12 v AGM), Morningstar charge controller and Xantrex PRO Watt power inverter. These cost estimates are retail. The pendant cell phone charger cables are replaceable.

Slide 30.

Here are the estimated non-recurring and recurring costs. Non-recurring cost is approximately $1,000. However, you have recurring costs for consumables, the caretaker salary, and waste pumping. Basically, you can build and maintain ten LooLoos for every Portland Loo. The cost of one LooLoo is comparable to a Porta Potty. However, a porta potty does not offer interior lighting or cell phone charging or active ventilation.

Slide 31.

There are many issues to research and analyze prior to building a LooLoo. A 3D model would help. A more thorough electronic load analysis is needed. Ensuring that the structure can be assembled, and waterproofed is critical.