What is TIDES?

TIDES

TIDES is a research project designed to encourage the development of communities of interest in Stabilization and Reconstruction, Humanitarian Assistance, Disaster Relief, and Building the Capacity of Partner Nations.

Situations include: domestic and foreign, short term (disaster relief) and long term (displaced persons), military involvement, or not.

Each has different needs.

DoD usually is not in the lead for these efforts, but often is called upon to support others, like DHS/FEMA domestically, and the State Department overseas.

TIDES is not trying to solve all problems in these situations, but is focusing primarily on six infrastructures: Shelter, water, power, cooking, cooling/lighting/heating, and Information & Communications Technologies (ICT).

The goal is to build as broad a partnership as possible to deal with the target situations most effectively.

Participation in TIDES does NOT imply endorsement by the US govt.

One goal is to help people live above mere subsistence levels in whatever circumstances they find themselves.

Cultural issues are important--shelters that might raise the standard of living in some foreign refugee camps could be unacceptable for long-term inhabitance by US disaster survivors

The focus is on low-cost, Transportable Infrastructures, not the capital-intensive infrastructures of the developed world, nor the deployable, integrated (and expensive) ones used by the military.

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Shelters

TIDES

The Uni-Fold shelters (#4) took under 10 minutes to deploy. They have integral plastic floors (waterproof in later models). They cost ~$2000-2500, in units of 100. They have been used for things like showers and decontamination stations.

The ShelterBox (#2) from a Rotary Club in Cornwall, England supports up to 10 people with sleeping, cooking, water purification tablets (6 mo), educational materials, etc. Over 50K have been shipped since 2001, supporting over half a million people. A box costs $1000, shipped. They are sent only through Rotary channels.

The YurtDome (#3) packs into a large duffle bag and takes a small team an hour to deploy. It costs around $500 and a range of sizes, up to around 30' across are available.

The hexayurt (#s 1 and 5 on the map) can be assembled in the field with only tape and boxcutters (besides the panels) due to its geometry. The 8-foot high version cost about $200, and took about 2.5 hours to assemble by first-time amateurs. It is lightweight, and well insulated. The 12' hexayurt cost about $350, and also was assembled in a little over 2 hours. It is being used mainly for ICT. Materials in the US building industry supply chain could provide up to 100,000 shelters per day in a catastrophe. Low cost cardboard versions for the developing would cost around $100 each.

Infrastructure

TIDES

CooKit Panel Solar Cooker

Solar Cookers provide smoke- and fuel-free cooking in a variety of climates. Simple cookers can be made by hand in villages and parabolic designs can reach 400°F. Insulated boxes keep food cooking when it is taken out. Drinking water can be purified in solar cookers at only 170°F, and the WAPI indicator shows when the water reaches this temperature.

Wood Gasification Stove

Efficient stoves coupled with solar cookers provide "integrated cooking." Wood gasification stoves burn with almost no emissions and use wood 2x - 3x better than other stove designs. Rocket stoves can be built anywhere out of almost any materials, including scrap tin cans and mud firebricks. Smoke inhalation from cooking fires is a major public health issue all over the world.

AA battery "microsolar" can provide basic services like lighting, charging cell phones, cooling equipment (if it is efficiently designed, see the SleepBreeze system on display,) and power wood gasification stoves. Batteries are charged at a central station and taken home for use. High efficiency CCFL lights can provide bright, even illumination which makes use of the eye's dark adaptation response.

The GATR inflatable satellite dish is very portable and fits in a duffle bag. It also was up and running shortly after the power came on.

The MTN satellite dish was up and running in less than two hours after the generators were turned on.

PACSTAR bridging equipment links various communications equipment together, such as radios to telephones. This supports a telephone in every shelter.

The Humvee optimized for self-contained disaster relief situations is shown at station #14 (on some days).

Local Infrastructure for SSTR

TIDES

Centralized, Industrial Infrastructure
Industrial age infrastructure is marked by a simple template: a factory that produces a service like power or sewage processing and a grid which carries that service to the homes of consumers. You can see this template all over the developed world.

In an SSTR context, this industrial age infrastructure template has four central problems.

1. **Maintaining and protecting the "linear assets" is difficult and expensive.**
   Power lines, gas lines and similar infrastructure are too spread out to guard and damage to one system can affect an entire city.

2. **The infrastructure is often extremely interdependent.**
   If the power fails, it takes down everything too. The water pumps fail, taking down the sewage processing, and before you know it you have a severely impaired civic environment. Cascade failure is the enemy of stable services.

3. **Large amounts of capital** are committed to multi-year projects in order to repair and expand war-torn infrastructure systems. A great deal can change between a project being commissioned and the project's completion. There is no room for adaptation to what is, after all, a highly dynamic environment.

4. **Political exposure from interdependence**
   In the event of state partition or breakdowns of civil authority, control of power stations and similar centralized resources can be a major area of conflict. Partitioning a highly interdependent system creates enormous problems, and may leave no functional system standing at the end.

In short, industrial infrastructure is extremely problematic in unstable environments.

Examples of Local Infrastructure
Autonomous building power systems
At its simplest, this means solar power or wind power systems on the roof of buildings or in the back yard. Coupled with efficient appliances like CFL lights, these systems generate enough power for a high standard of living for relatively low capital costs when compared to constructing a national grid or building power plants.

Composting Toilets
In many climates the complex sewage treatment systems can be abandoned in favor of composting toilets. These toilets safely digest human waste to a few percent of its original volume, and remove all pathogens as they go. Current models are expensive because of a limited market, but a city-sized installation could bring the price down sharply. DIY models, including the extremely simple thermophillic composting toilet, also exist.

Household Water Purification
Homes all over America purify their own well water using a variety of technologies. In an SSTR context, water may still be distributed through pipes, or it may be delivered by truck or carried by hand. There are many household water purification approaches, from high tech reverse osmosis filters through to slow sand filters and solar water pasteurizers.

Consider how much the challenge of restoring basic services to a city would change if 85% of the homes in the city generated their own power, purified their own water, and disposed of their own sewage.

In this situation, municipal services could be scaled back enormously, and that money re-invested in household-level utilities.

Local Infrastructure for Resilient Services
Local infrastructure, also called distributed, decentralized or post-industrial infrastructure, can compete directly in financial terms with industrial infrastructure in peace time as shown by the extremely rapid expansion of decentralized energy resources like wind power. However, the complex and interwoven nature of the national grid and particularly the accounting principles used to finance large energy plants make it hard for these systems to compete when there are alternatives.

However, in the SSTR context, the problems with reconstruction based around industrial infrastructure are well known. With the best will in the world, reconstructing a power grid in a war zone is nearly impossible.

Using local infrastructure is essential in an SSTR context. At least until reconstruction is well under way, most services have to be provided locally. You start where you are.

Improvised local infrastructures are often extremely durable and resilient, but are often inefficient and can be under-engineered. For example, the use of near-disposable diesel generators makes short term financial sense but in many cases a well-chosen wind/solar installation would perform better at lower long-term cost. Because these systems currently require deeper understanding to install at the right size using the right technology to get optimal performance, local energy systems often tend towards the improvised and the low-tech, lowering living standards.

For more information please see *Small is Profitable* by the Rocky Mountain Institute, and *Brittle Power* by Lovins et. al.

Transportable Infrastructure

TIDES

The Starting Point
To understand the refugee condition, imagine you are one of 100,000 people settled in an open area, with a river five miles away and enough firewood for a few weeks, diminishing fast. Food comes in twice a week by truck, and you queue for hours for your share of the incoming shipment. A handful of aid workers try to provide basic medical and other services, but they are so few, and new refugees come in every day, many in worse condition than you are.

You have no idea if you will be here for six months or ten years. Your uncle was a refugee for half of his life. He might be somewhere in this camp too.

Everything you own is gone, and you have no employment or hope of employment. But at least you survived.

What Can Infrastructure Do?
The river is dirty. You're 40 miles downstream of a town, and sanitation is poor. Hauling water is a huge task, and when it arrives, it often makes people sick.

Those are infrastructure problems - water transportation might need a truck, or a water line. Water purification might need a solar pasteurizer, or perhaps a high tech unit that serves the whole camp.

Then there's the firewood situation. The three stone fire you cooked on before the stove came required a firewood gathering expedition three times a week. Now you go once every ten days.

The situation is still terrible, but it's less terrible because you have better tools to survive.

	Developed World Civilian Infrastructure	**Military Infrastructure**	**Transportable Infrastructure**
How is the service supplied? **- power, water etc.**	Systems - power stations - water plants	Objects - gensets - RO units	Objects - hand crank / solar - solar water purifiers
How are services distributed and resupplied?	Pipes and Wires - national grid - water pipes	Trucks and Planes - fuel supply chain - bottled water	Limited Supply Chain - some trucking - favor stand alone systems
Who owns the infrastructure?	Companies and Individuals	Governments	Often Individuals - goes home with them
Cost	Cheap - huge capital investment provides very cheap services	Expensive - reliable, global, secure, resilient	Intermediate - solar $ > grid $ - but there is no grid - make do with less
Readiness	Proven	Proven	In Development

Conceptual Development
In 2002, 84 people from a wide variety of backgrounds, including representatives from UNHCR, UN Development Programme, the World Health Organization, the World Food Programme, Refugees International, US AID, the US Navy and others, met at the Sustainable Settlements Charrette, a design workshop hosted by the Rocky Mountain Institute, an environmental think-and-do tank with a specialization in infrastructure. The goal was to understand and improve how refugee situations are handled.

The conclusions of this Charrette became the input to the Hexayurt Project, a volunteer-run free/open source design projects which applied RMI decentralized infrastructure concepts to the needs of refugees, slum and rural populations in the developing world.

The Strong Angel demonstrations, directed by Dr. Eric Rasmussen, laid the foundation for the approach of a broad, diverse, collaborative group including all relevant and affected parties, working together to find new avenues for cooperation and improved practices.

All of these efforts together focussed attention on infrastructure as an area where there is room for a significant improvement in current practices, by identifying promising candidate technologies which have the right dynamics: small, low cost installations which refugees can take home with them when the crisis is over, blurring the line between disaster relief
and aid.

Hexayurt Infrastructure

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Pipe/Wire	Developed World Civilian Infrastructure	Hexayurt Utilities Package
Electricity	National grid	Solar with rechargeable AA battery storage
Gas	Natural gas system (pipelines, terminals)	Wood Gas Stove Wood and other biomass fuels
Water	Water treatment plants, viaducts	Solar Water Pasturizers
Comms	Wired phone network, cell towers	$100 computers? Cell phones?
Sewage	Sewer system, sewage treatment plants	Composting toilet
Storm-water	Storm drains	Drainage ditches

The Hexayurt Utilities Package
The Hexayurt Project infrastructure package is one example of highly integrated whole systems infrastructure design. It provides a very simple approach to providing the same essential services as developed world infrastructure systems, but for a total cost of $100 - $200 per home. The infrastructure is self-contained and portable, so it can be transported with people when they are resettled at the end of a crisis. These infrastructures are mostly at early stages of development, or adapted commercial products. A full program of testing and additional development will be required before this system is ready to save lives. However, as you can see, the essential systems are very simple and inexpensive.

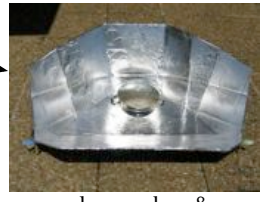
Household Infrastructure Systems


all day solar charger

nimh AA rechargables


cold cathode fluorescent room lighting


wood gas stove


solar cooker & pasteurizer


thermophillic composting toilet system

Property & Ownership
Household systems are typically owned outright by individuals, where as village systems may either be shared or operated as businesses by an owner or a collective. Items like a personal battery charger might be purchased by more affluent families to give the same services that others get from the shared systems. Over a period of time these incremental improvements could lead to a higher standard of living even within a refugee camp.

Village Infrastructure Systems

15 minute fast charger


large solar panel

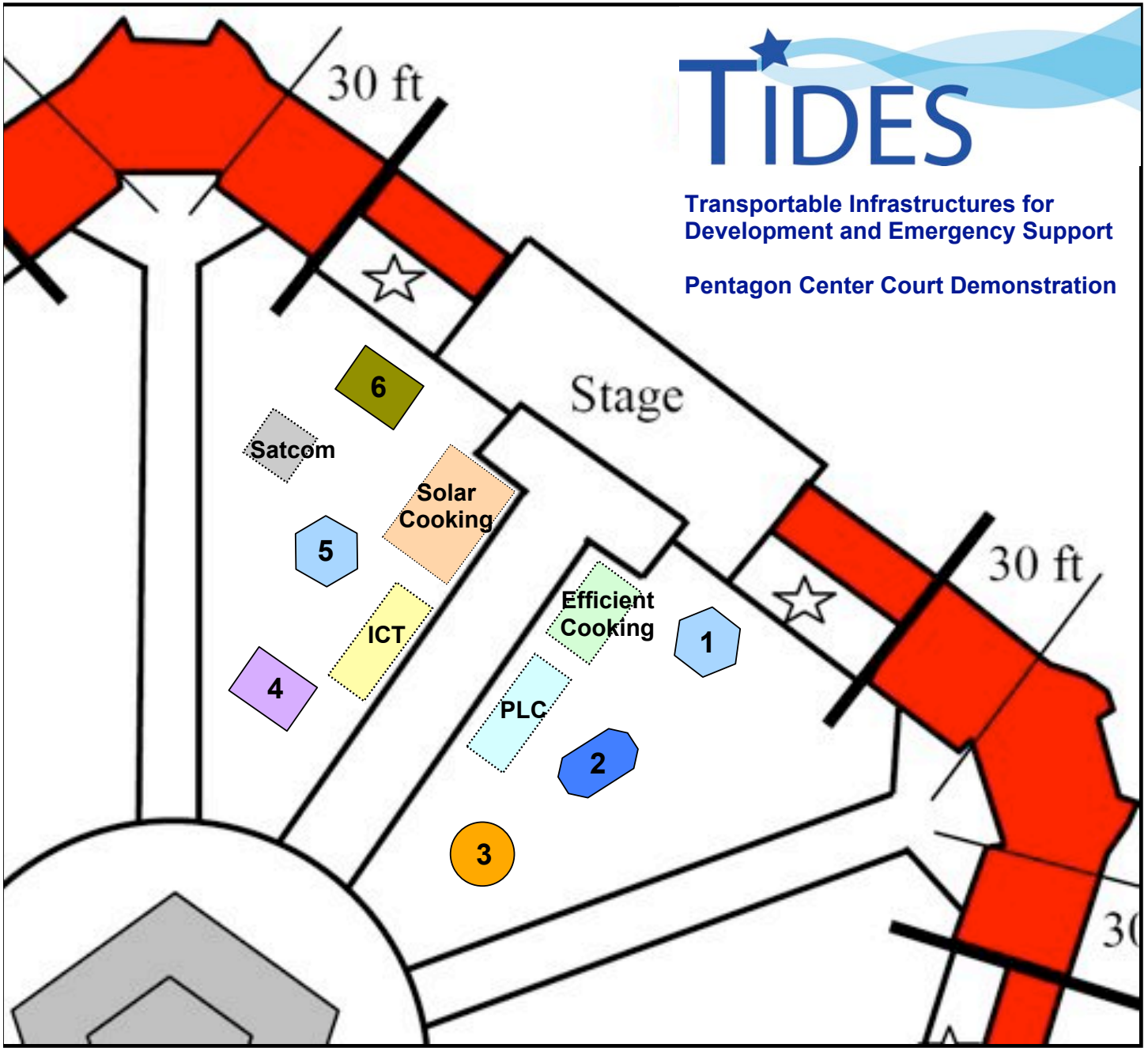
At 15 minutes per set of batteries, a single solar panel can charge around 40 sets of batteries per day. That might be enough to keep the lights on in 40 to 80 homes. Pull-cord chargers might offer even better performance.

Cooking can be done with either the solar cooker or the wood gasification stove. Solar Cookers International calls an approach like this Integrated Cooking and has boards about it here. We favor the wood gas stove because we include electrical supplies and it is more efficient, but without electrical supply, the Rocket Stove is an excellent choice.


inexpensive cell phone


low cost, low power computer

Communications systems and the internet rely on regional infrastructure like the cell phone networks, or relatively expensive municipal infrastructure like a satellite internet connection.



KEY:

1 – Hexayurt 1
2 – Shelter Box
3 – Yurt Dome
4 – Unifold
5 – Hexayurt 2
6 – Military Tent

ICT – Information & Communications Technology

PLC – Power, Lighting & Cooling

Satcom – Satellite Communications Provider