Make the Difference

A Call to Action for the Current Challenges Facing Hurricane Affected Areas in the Caribbean

Initiated by:

FIELD READY

In conjunction with:

BUILDING MOMENTUM

Background

The hurricanes that have recently ravaged the Caribbean have been the most powerful and destructive hurricane recorded in the Atlantic. This regional catastrophe is the largest disaster to strike the area since the 2010 earthquake in Haiti. The destruction began in the Caribbean with the Hurricane Irma and continued with the equally destructive Hurricane Maria. Communities across the region were left without basic services including food and water, electricity and mobility.

Field Ready is currently carrying out an action assessment in the USVI – a country which received very significant damage – to identify and address unique needs not normally addressed by traditional relief and recovery efforts. Thus far, a range of challenges persist which need urgent action if they are to be resolved.

In the pages that follow, eight problems and their possible remedies are outlined with the intention to draw attention and mobilize the necessary resources to address them as soon as possible.

A Call to Action!

There are two ways to get involved, funding support and technical support.

1) **Funding Support**

Financial donations are requested to support our ongoing efforts. Donations of less than $10,000 can be made simply by clicking the hurricane donation banner found at www.fieldready.org. For larger amounts or institutional grants, please contact eric@fieldready.org. As this is an ongoing problem meeting immediate needs, donations of all amounts are greatly appreciated.

2) **Technical Support**

Submit a short email to brad@buildingmomentum.us explaining the approach/concept and materials needed by Monday, October 16th. If the concept meets the unique requirements, an email response will be sent within 24 hours requesting that a prototype is to be built and shipped to Alexandria, VA prior to 30 October. Once the prototype arrives, the Building Momentum team will conduct relevant tests to ensure it works as intended. If successful, the prototype will be flown to USVI and installed by local engineers. Installation and operation will be captured via photos/video and posted to various maker outlets detailing process success.

Thank you. Together we can make the difference!

Challenge #1: Potable Water

Problem: Most residents have easy access to seawater but it is unfit for consumption and other uses. This water requires desalination to be useful. A low/zero cost approach to desalinating sea water for individuals is essential.

Action: Develop a desalination technology or concept using found and/or upcycled materials. If power is required, the system may use upcycled solar panels. The water does not need to be potable, just desalinated. The preferred minimum desalination rate is 2L/hour.

Additional Information:

- Upcycled solar panels, on average, have open circuit voltages from 30VDC-45VDC and short circuit current from 3-8A in direct sunlight, depending on the amount of damage to the individual panels
- Assume charge controllers and inverters are extremely hard to find and should not be factored into the final solution
- The Field Ready team on St. Thomas has two 3D printers capable of producing parts if needed in the design, they just need a .stl file
- There is a workshop on St. Thomas that has laser cutters, wood working equipment, and other fabrication tools that can be leveraged in the final solution
- Mechanical solutions must try to maximize water output while minimizing effort as some of the residents are older and/or are in poor health
- Solutions that will, in the end, allow for the population to source materials, assemble, and install are preferred.

Challenge #2: Sustainable Means of Cooking

Problem: In the USVI, cooking is done using electrical or gas stoves but electricity is out in most areas and gas is hard to access. Instead, seawater can be used for cooking if it can be converted into useable fuel. Residents have access to seawater and non-potable water that can be electrolyzed to make hydrogen for cooking using upcycled solar panels.

Action: Develop a safe and effective cook stove by electrolyzing water using upcycled solar panels. The cook stove does not need to dynamically make hydrogen while cooking (i.e. it can store compressed hydrogen made earlier). The cook stove needs the correct air/hydrogen mix to create a consistent flame while ensuring the system will not explode/catch on fire if operated incorrectly. Solutions that use found/upcycled materials are preferred.

Additional Information:

- Upcycled solar panels, on average, have open circuit voltages from 30VDC-45VDC and short circuit current from 3-8A in direct sunlight, depending on the amount of damage to the individual panels

- Assume charge controllers and inverters are extremely hard to find and should not be factored into the final solution
- The Field Ready team on St. Thomas has two 3D printers capable of producing parts if needed in the design, they just need a .stl file
- Metal casting of needed parts is possible
- There is a workshop on St. Thomas that has laser cutters, wood working equipment, and other fabrication tools that can be leveraged in the final solution
- Solutions that will, in the end, allow for the population to source materials and assemble the stoves are preferred.

Challenge #3: Water storage

Problem: Many residents on USVI use cisterns to collect rainwater and re-use as drinking water or non-potable water. These cisterns often lie below the home or apartment and use electric pumps to bring the water up to the faucet. When there is a loss of power the residents cannot access the water.

Action: Develop a cistern pump that is largely or entirely made from found/upcycled materials in the USVI that can pump water up at least two stories (10m+) and is either mechanically powered or uses upcycled solar panels. Pump must be made as cheaply as possible to enable wide distribution and access.

Additional Information:

- Upcycled solar panels, on average, have open circuit voltages from 30VDC-45VDC and short circuit current from 3-8A in direct sunlight, depending on the amount of damage to the individual panels
- Assume charge controllers and inverters are extremely hard to find and should not be factored into the final solution
- The Field Ready team on St. Thomas has two 3D printers capable of producing pump parts if needed in the design, they just need a .stl file
- There is a workshop on St. Thomas that has laser cutters, wood working equipment, and other fabrication tools that can be leveraged in the final solution
- Mechanical solutions must try to maximize water output while minimizing effort as some of the residents needed this pump are older and/or are in poor health
- Solutions that will, in the end, allow for the population to source materials, assemble, and install these pumps are preferred.

Challenge #4: Sustainable Food & Medicine Storage

Problem: Power outages quickly result in wasted food and medicines. Most USVI residents have refrigerators but need a way to keep a portion of the refrigerator or freezer cool for essential foods and medicines.

Action: Develop a refrigeration system that uses existing freezer space to keep milk, medicines, and a few perishables cold using found/upcycled materials like solar panels. Solutions should not require disabling the existing refrigerator but may consist of refrigerator door modifications if they are reversible upon power restoration. There may be a need to source and import special components of the solution but the more upcycled/found materials used the better.

Additional Information:

- Upcycled solar panels, on average, have open circuit voltages from 30VDC-45VDC and short circuit current from 3-8A in direct sunlight, depending on the amount of damage to the individual panels
- Assume charge controllers and inverters are extremely hard to find and should not be factored into the final solution unless absolutely critical to success
- The Field Ready team on St. Thomas has two 3D printers capable of producing parts if needed in the design, they just need a .stl file
- Metal casting of needed parts is possible
- There is a workshop on St. Thomas that has laser cutters, wood working equipment, and other fabrication tools that can be leveraged in the final solution
- Solutions that will, in the end, allow for the population to source materials, assemble, and install are preferred.

Challenge #5: Replacement Parts

Problem: Disaster recovery solutions sometimes require replacement or bespoke metal parts. A small, portable casting system that can safely melt found metals like galvanized and tin metal sheets used in roofing (all over the Caribbean), downed cabling and scrap metals from poles, nails/screws pulled from destroyed homes, and any other sources of metal using found wood from fallen trees and, if needed, power from upcycled solar panels (for blowers, venting, etc.)

Action: This solution will likely consist of two parts, the 'sandbox' where the molten metal is poured/cast is made and the kiln that can safely melt a host of metals using recovered wood from fallen trees. Galvanized sheet steel is the most common metal readily available but there are many sources around the communities to include aluminum cans. The kiln must be able to melt metals other than aluminum and the casting 'sandbox' must be able to accommodate hotter metals. It is preferred if the kiln can be reproduced *in situ*.

Additional Information:

- The portable metal casting system will be operated, at least initially, by trained Field Ready staff and does not need to be scaled such that the population will have one. But plans for safe and large-scale casting systems have potential.
- Using fallen tree wood commonly found in USVI for the kiln is imperative

- Upcycled solar panels, on average, have open circuit voltages from 30VDC-45VDC and short circuit current from 3-8A in direct sunlight, depending on the amount of damage to the individual panels
- Assume charge controllers and inverters are extremely hard to find and should not be factored into the final solution unless it is critical to a successful design
- The Field Ready team on St. Thomas has two 3D printers capable of producing parts, to include the plastic molds, if needed in the design, they just need a .stl file
- There is a workshop on St. Thomas that has laser cutters, wood working equipment, and other fabrication tools that can be leveraged in the final solution
- A solution that is easily transported (i.e. not heavy or messy) via plane/jeep is preferred
- There is some access to materials as there are hardware stores with limited supplies

Challenge #6: Telecommunications

Problem: Disasters often result in overloaded or destroyed communications infrastructure. Cell phone towers are damaged or overloaded, internet connectivity is sparse or non-existent, and traditional phone lines are often damaged or compromised. Providing the community with low cost 'call boxes' that connect neighborhoods with the local fire/police departments even when the communications infrastructure is damaged is much needed. Ideally, this call-box network would push information through the radios like a self-healing or ad hoc network such that there is no need for hierarchical coordination.

Action: Using radios other than cell phones might be part of the solution, like Xbee or other similar radios, that can form their own network independent of existing infrastructure. The information passed to fire/police departments would ideally be voice messaging or real time voice communications but, at a minimum, text-like messaging. The system may operate off of upcycled solar panels and, if absolutely necessary, car batteries and inverters. The system must be extremely easy—from a human factors and operation perspective—to use but can be assembled and coded, if necessary, by Field Ready and Building Momentum engineers. The hardware for each call box, not including the wood/solar panels/batteries, must be as low cost as possible and minimize power usage when not in use. If keyboards and/or other I/Os are required ensure they are part of the total solution package.

Additional Information:

- Using Arduino and/or Raspberry Pi is preferred as these are well known platforms for support and implementation
- Transmitters must be able to push data at least 5km in free space
- Any code needs to be available to the Building Momentum and Field Ready team to edit, if needed, for different scenarios
- The 'call box' itself can be made in situ by the Field Ready team from a provided design using reclaimed wood and plywood, the communications hardware should leverage low-cost components as much as possible

- Upcycled solar panels, on average, have open circuit voltages from 30VDC-45VDC and short circuit current from 3-8A in direct sunlight, depending on the amount of damage to the individual panels
- Assume charge controllers and inverters are extremely hard to find and should not be factored into the final solution unless it is critical to a successful design
- The Field Ready team on St. Thomas has two 3D printers capable of producing parts if needed in the design, they just need a .stl file
- There is a workshop on St. Thomas that has laser cutters, wood working equipment, and other fabrication tools that can be leveraged in the final solution
- A solution that is easily transported via plane/jeep is preferred
- There is some access to materials as there are hardware stores with limited supplies

Challenge #7: Maintaining Cleanliness for the Elderly

Problem: Following the storms, many residents are forced to wash clothes in sinks and need methods for rapidly drying the clothes (rain storms, high humidity, windy conditions, and lack of space hinder line-drying). Additionally, many residents have rain-soaked rugs, furniture, books, and other belongings that are difficult to dry on lines or in existing dryers when—and if—they can get to a laundromat.

Action: Develop methods for rapidly drying clothes and other belongings using little or no power and found/upcycled materials.

Additional Information:

- If required, upcycled solar panels, on average, have open circuit voltages from 30VDC-45VDC and open circuit amperage from 3-8A, depending on the amount of damage to the individual panels
- Assume charge controllers and inverters are extremely hard to find and should not be factored into the final solution
- The Field Ready team on St. Thomas has two 3D printers capable of producing parts if needed in the design, they just need a .stl file
- There is a workshop on St. Thomas that has laser cutters, wood working equipment, and other fabrication tools that can be leveraged in the final solution

Challenge #8: Traffic Control

Problem: During persistent/long term power outages, street lights no longer function resulting in traffic jams. Emergency responders, residents, and humanitarian efforts are hindered due to that traffic. Low powered traffic aids that are easily emplaced in (or near) existing lights, serve the same purpose of the existing lighting signals, and programmable for various turn/straight scenarios would greatly improve the reaction time of officials and aid workers. Staffing each lighted intersection with trusted personnel is not practical as most first responders are active in other tasks. Any proposed solution will be particularly helpful reducing this problem in future disasters.

Action: Using a low powered processor, control a set of visual cues (light emitting and/or reflective) that take the place of and serve the same purpose of the non-powered lights. The replacement signal must be easily programmed by a removable programmer. The proposed system must be easily transportable and adaptable to standard lighting (3-light and 1-light). The system can be emplaced on the existing lighting, or just near/above/below without interfering with height clearances from existing lighting. The optimal power solution for the system is to implant-and-forget, meaning it will run indefinitely on the power sources. Solar power can be cumbersome for this scenario (and may be stolen), and large panels are not acceptable. If stored energy is the only solution it must run for 6 months before servicing/replacing the power source.

Additional Information:

- Using Arduino and/or Raspberry Pi is preferred as these are well known platforms for support and implementation
- Any code needs to be available to the Building Momentum and Field Ready team to edit, if needed, for different scenarios
- Various shapes and modifications can be made to the physical structure in situ by the Field Ready team from a provided design using reclaimed wood/plywood and metal
- The Field Ready team on St. Thomas has two 3D printers capable of producing parts if needed in the design, they just need a .stl file
- There is a workshop on St. Thomas that has laser cutters, wood working equipment, and other fabrication tools including welders that can be leveraged in the final solution
- A solution that is easily transported via plane/jeep is preferred
- There is some access to materials as there are hardware stores with limited supplies