# IEEE Central Texas Section (CTS)
# Humanitarian Project Proposal 2017-2018

## 1. BACKGROUND

Established in 1963, the Institute of Electrical and Electronics Engineers (IEEE) has grown to become the world's largest professional organization with more than 420,000 members in over 160 countries. Through the work done in its various technical societies, IEEE has been a driving force of innovation in all aspects of electrical and electronics engineering, ranging from nanoelectronic devices that drive today's digital age to communication systems that connect every corner of the world. Being whole-heartedly committed to its motto of "Advancing Technology for Humanity", IEEE is heavily involved in diverse humanitarian and philanthropic programs all over the world thanks to the talent, effort and commitment of its wide network of volunteers. The IEEE Foundation, for example, is committed to enabling IEEE programs that improve access to technology, enhance technological literacy, ad support technical education. It strives to fulfill its purpose by soliciting and managing donations, recognizing the donors for their generosity, and supporting high-impact programs that address societal needs. Similarly, the IEEE Special Interest Group on Humanitarian Technology (SIGHT) is a network of volunteers around the globe that partners with underserved communities and local organizations to leverage technology for sustainable development. The IEEE Smart Village program seeks to bring basic electrical services and educational opportunities to more than 50 million people living in remote communities around the world by 2025.

One of the core missions of IEEE is to foster technological innovation and excellence for the benefit of humanity. In light of this mission, the Central Texas Section (CTS) of the IEEE seeks to address some of the major challenges and recurrent issues faced by communities in this part of the world. Together with a large group of motivated volunteers, we at the CTS seek to aid and improve the lives of millions of people whenever the need arises by leveraging our technical expertise and local resources, and by being adequately prepared for adverse situations – such as hurricanes, floods and tornadoes – that constantly mar Texas and the Gulf/Caribbean regions.

## 2. The CHALLENGE of NATURAL DISASTERS

We're all aware of the massive destruction caused by the slew of hurricanes that hit the coastal region of Texas as well as other parts of Florida and the Caribbean Islands this past August and September. In the United States, Hurricane Harvey devastated Houston and other coastal cities of Texas with record amounts of rain and flooding while Irma slammed Florida and other southeastern coastal areas. Specifically, in Texas, Harvey dumped more than 60 inches of rainfall in two spots – Nederland and Groves, Texas – and more than 20 inches across most of southeastern Texas. While the situation in bigger cities such as Houston was constantly covered by the national media, smaller regions such as Port Aransas hardly enjoyed any national media attention at all. In Port Aransas, about 75 to 85 percent of the town's homes were damaged or destroyed and several residents left the town in the aftermath of the disaster and will probably never return. A lot of the rebuilding efforts will depend upon the availability of labor which will be a challenge since there were already mounting labor shortages in both

Texas and Florida before these storms. It is anticipated that most of the rebuilding will be completed by the end of 2018 in these areas. Analytic firms estimate Irma's damages to cost about $100 billion and Harvey's $190 billion for a total damage cost of $290 billion – that is comparable to the costs from Hurricane Katrina that hit New Orleans in 2005. That is a staggering economic loss for the United States.

In remote Caribbean islands such as Puerto Rico, the hurricane damages were far more serious. Hurricane Maria swept through the island on September 20th last year, leaving transmission lines in a tangled mess and knocking over all the power lines. It cut off entire towns from each other and left the 3.4 million inhabitants without water to drink or bathe in. Patients in hospitals lost access to clean water. More than 472,000 homes across the nation were damaged. Wind power and solar power farms were heavily impacted. One of the nation's largest and poorest school systems (a district of about 347,000 students) was devastated and the normal day-to-day operation of several schools is still affected. Such was the impact of the hurricane that 21 schools were closed just this past month due to damages and/or flagging enrollment, and about one-third of the 1,110 schools that remained open still have no power. The island is enduring the longest power outage in modern U.S. history, with every aspect of the school day affected on campuses that remain without power. Students and teachers alike have been fleeing the island to come to the US in search of better resources and more stable schooling, but for the majority who have stayed behind in Puerto Rico, the future seems dimmer. In this helpless situation, children who have stayed behind are being taught lessons in how to catch mountain water for their daily needs instead of classwork. Life without electricity is hard and there's no question that Hurricane Maria devastated Puerto Rico. Figure 1 gives a glimpse of the dire situation in Puerto Rico.

**Figure 1**: Dire situation in Puerto Rico (a) A powerless home with fallen trees in the backyard (b) Children studying in a classroom without lights (c) Extensive damage to power lines after Hurricane Maria (d) Kids playing video games powered by generators in a public plaza

As of this past month, about a third of Puerto Rico remains without power that has left the local people still struggling. Electricity isn't expected to fully return for months as the local electric utility is struggling with the most basic recovery tasks. Although Puerto Rico's local Electric Power Authority claims that its system is generating at around 70% of normal, but the island's electricity distribution monitoring system remains dysfunctional and, hence, there's no way of knowing how widely the current generated power is being distributed. Latest news speculates that, at the very least, it likely won't be until this summer that all of Puerto Rico is electrified. In this extremely dire situation, Puerto Ricans are trying to cope up by lighting up their spaces with any alternative sources they can find, from candles, diesel generators and small solar lamps to hooking up car batteries to inverters to power their electronics. However, the current state of affairs in Puerto Rico is far from normalcy and completely unimaginable in any state on the mainland. Until power is fully restored, various local industries and hundreds and thousands of Puerto Ricans remain in limbo. The situation demands an urgent remedy.

## 3. HOW WE CAN MAKE AN IMPACT & VALID DIFFERENCE

As highlighted above, one of the biggest and most important hurdles faced by the affected people in the immediate aftermath of these hurricanes, floods as well as earthquakes is loss of access to some of the quintessential necessities for day-to-day functioning, such as electricity and clean water. As the numbers indicate, the infrastructure damage is often of the scale that it can take anywhere from several weeks to a few months to restore just a fraction of these quintessential amenities that is just about enough to mobilize the masses and get them going temporarily. The problem is much graver for remote areas and islands such as Puerto Rico that are physically harder to reach. While loss of access to clean potable water puts the life of thousands of people at elevated health risks, loss of electricity access effectively paralyzes several activities and can cut off communication to the rest of the world within days if not hours. We, at the IEEE – CTS, seek to alleviate this precarious situation and mitigate some of the heightened risks that can arise, especially in regions and islands that are not as well-connected, by being logistically prepared in terms of engineered solutions and availability of volunteers.

In the past, IEEE members at Nextek Power Systems have raised funds and innovated solutions for off-grid power and clean water. Nextek, a Detroit based renewable energy equipment manufacturer with offices in Long Island, NY, has been designing and building custom prototype systems for IEEE Global Humanitarian Technology Conference (GHTC) and the IEEE Smart Village initiative since 2010. Named 'Sunblazers', these portable power generation systems are solar-powered and have water purification facility. Between mid-2011 and mid-2012, 15 such Sunblazer units along with 1200 LED-based home lighting kits were built and shipped from Long Island to Haiti as part of the recovery efforts after the disastrous earthquake in 2010 [to read more, click here and here]. Figure 2 below shows images of a prototypical home lighting kit, deployed Sunblazer systems in Haiti, and IEEE volunteers setting up a prototypical Sunblazer unit. Following the success of the initial Sunblazer design, Nextek went on to develop a series of such prototypical systems – Sunblazer II and III, and the latest STAR (Stationary or Transportable Available Resource) system – with an emphasis on cost reduction, ease of

assembly and transportation. The main difference between STAR and the Sunblazers is the ability to quickly move the STAR after it has been deployed with minimal disassembly.

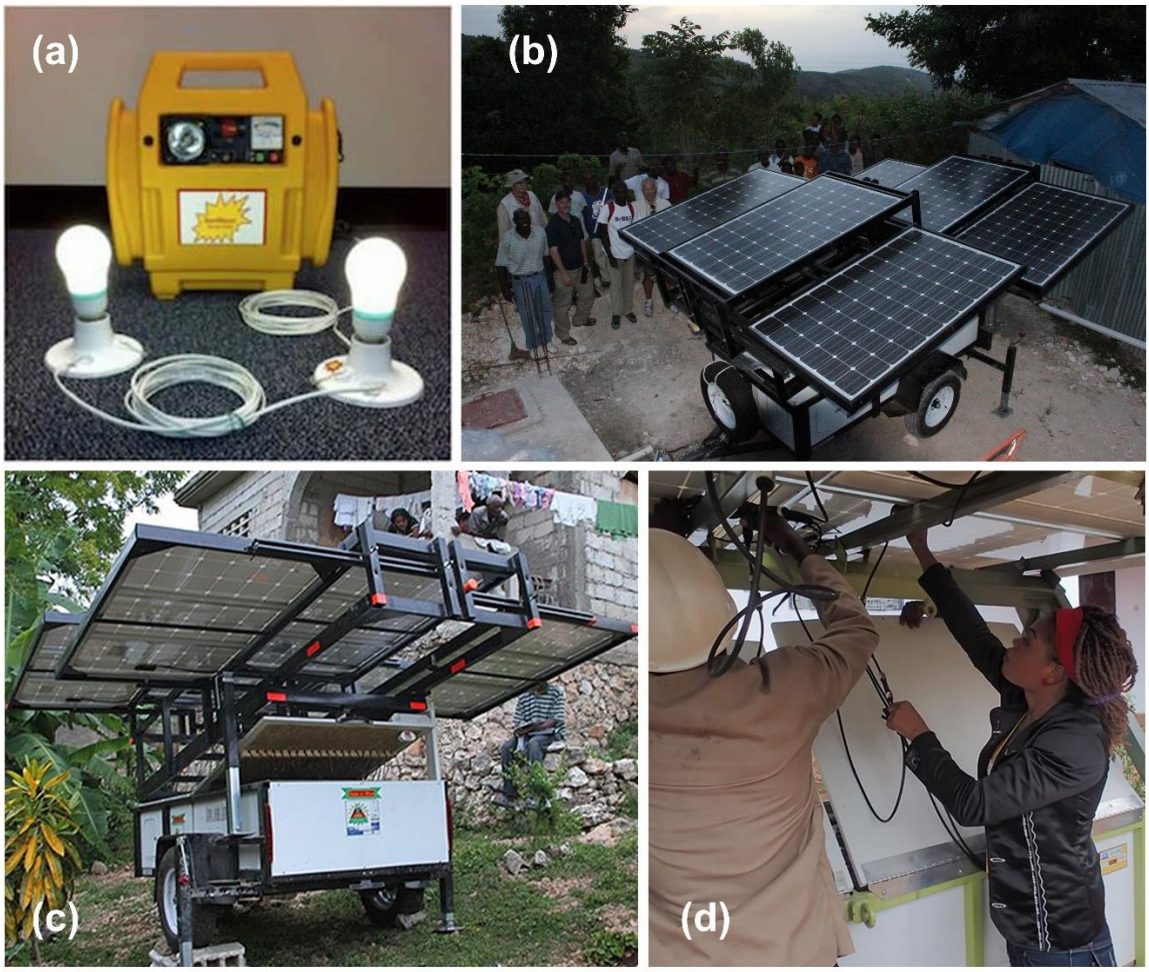


**Figure 2**: (a) A Sunblazer home lighting kit (b, c) Deployed Sunblazer units serving different areas in Haiti (d) A Sunblazer unit being assembled by local IEEE volunteers in Haiti

Recently, Nextek Power Systems sold the manufacturing rights of their STAR system to Dynamic Supplier Alignment (DSA), a Selden-based business-development services provider in Long Island, New York. The IEEE CTS is collaborating closely with DSA and our immediate focus is on providing relief efforts in Puerto Rico. In addition to the STAR mobile trailers, DSA is also partnering with Riverhead-based Hunter Shelters in New York to provide an emergency-housing system that can quickly provide needed shelter, especially for relief workers, in disaster zones. These two local US technologies, the Hunter Shelter and the STAR system, the latter being a flexible and fully scalable integrated Battery Energy Storage System (BESS), form the core technologies that we at the IEEE CTS seek to support and deploy to Puerto Rico through our strong collaboration with DSA.

The STAR system can be configured with various solar arrays from 6 to 12 panels (1.9 kW to 3.8 kW). It can support the solar home lighting kits and various AC/DC loads can be operated directly from the system. 200 Ah station batteries ranging from 6 to 20 kWh store energy during the day for nighttime operation and 120/240 AC supply capability is available. Another feature available on the STAR system is

on-site water purification. It has a three-stage purification system that can remove particulates and kill bacteria/viruses (>99.99%) from water sourced from a well or a stream. This system operates from the onboard battery system and can provide around 100 liters/hour as presently configured from a single STAR system. The Hunter Shelter, on the other hand, is an eco-friendly (with zero carbon footprint) and a fully customizable temporary housing solution, each unit of which can be setup by just 4 people in 4 hours. The one-bedroom base unit is about 300 sq. ft. and is equipped with a bathroom/shower and kitchen. It can readily be assembled, disassembled and shipped whenever required and is resistant to insects, vermin and mold. Moreover, the Hunter Shelter and the STAR system can be integrated together such that each STAR system can be configured to provide clean water as well as power to 4 shelters as a microgrid. Figure 3 illustrates a Hunter Shelter together with Nextek's STAR system and its water purification unit. For reference, the average cost of a STAR mobile system with 2.8 kW solar generation, 16 kWh storage and 4.4 kW inverter operation would be around $28,000. Whereas, pricing for a complete off-grid power solution, i.e. a STAR system capable of supporting four (4) 2-bed room Hunter Shelters, would be around $60,000.

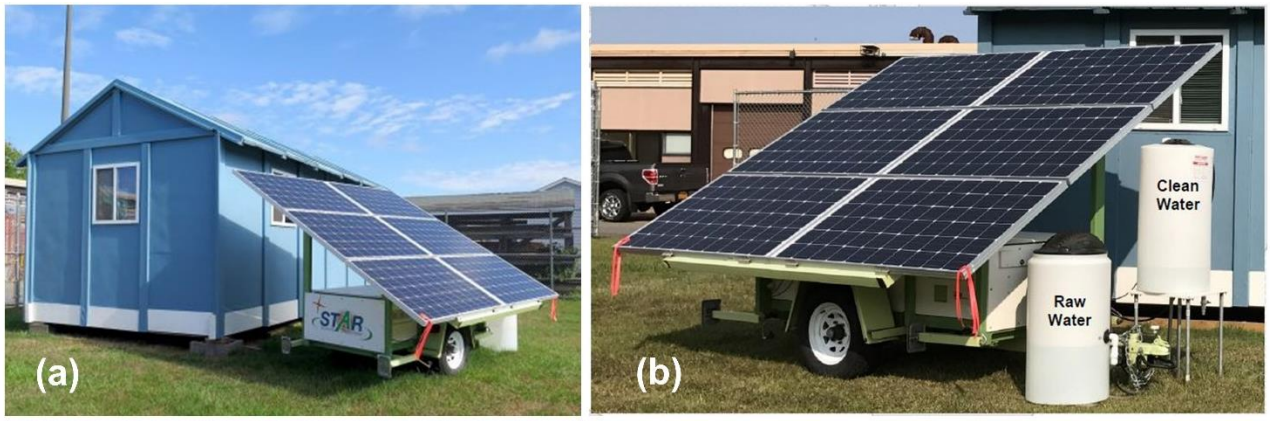


**Figure 3**: (a) A Hunter Shelter unit connected to a STAR mobile system (b) View of the STAR mobile unit together with its water purification system

DSA is already in talks with their local county's Industry Development Agency, as well as federal agencies such as FEMA, to discuss business incentives that will drive down the production and transportation costs of both the Hunter Shelters and the STAR systems in order to make them easily accessible to people not only in Puerto Rico, but most of the world population in disaster-stricken areas. Moreover, DSA recently demonstrated their core technologies of STAR solar trailers and Hunter Shelters to an audience comprising state and town legislators, and various organizations, at a technology demonstration summit organized by the New York State Board of Cooperative Educational Services (BOCES) last month. DSA and BOCES have a partnership under which they are already training a large workforce to manufacture, sell, install and service these technology products. Furthermore, since Puerto Rico is our immediate target, DSA is already partnering with The Windmar Group, the largest renewable energy company on the island, to develop a supply chain and workforce training program similar to what they currently have in New York. Volunteers at The Windmar Group will also serve as our local 'first-responders' helping to deploy the shelters and the STAR trailers once they arrive to the various affected regions on the island.

Our goal at IEEE CTS is to raise funds not only to help kick start the STAR system and the Hunter Shelter production lines so we can immediately fast-track the systems to Puerto Rico, but to enable production at a high volume and low cost to establish similar humanitarian projects across the world in support of IEEE's Smart Village model. Our initial goal is to raise $2 million. We, therefore, are on a mission to motivate and join hands with Austin-based tech companies so we can all collectively be a part of this extremely noble cause of helping those in abject conditions through technological innovations. Our long-term vision at IEEE CTS is to establish deep-rooted connections with DSA and other US-based local manufacturers in New York, with the wide base of global IEEE volunteers, as well as with all our potential industrial partners to establish a support system so we are ready to tackle adversity in the wake of such natural disasters. Currently, we have the right products, right manufacturers and the right workforce, and all we need is funding to execute our plans and get things moving. Moreover, the funds we raise through our collaboration with industry will go directly into creating a new manufacturing industry and hundreds of jobs in New York, directly in support of the 'Create Local, Make Local' initiative. With these locally made products (the STAR system and Hunter Shelters), we can collectively tap into an estimated $10 billion disaster-relief market and help make a BIG difference.

## 4. CONTACT

We at the IEEE CTS would love to come and talk in-person to your company representatives about our humanitarian project. If you have any questions, please contact:


- **Kenny Rice**, IEEE Region-5 Humanitarian Project Chair (krice@ieee.org)
- **Leslie Martinich**, IEEE CTS Past Chair (lmartinich@ieee.org)
- **Jasmin Kulba**, IEEE CTS Humanitarian Project Consultant (jasmin.kulba@gmail.com)
- **Amritesh Rai**, IEEE Graduate Student Member (amritesh557@utexas.edu)


## 5. WEB References [Note: all facts, figures and images highlighted in this article have been sourced from these web links]


https://www.ieeefoundation.org/

http://sight.ieee.org/

http://ieee-smart-village.org/

http://sites.ieee.org/ctx/

http://abcnews.go.com/US/hurricanes-harvey-irma-cost-us-economy-290-billion/story?id=49761970

https://weather.com/storms/hurricane/news/2017-11-03-hurricane-200-billion-dollar

https://weather.com/news/news/2017-11-13-port-aransas-texas-hurricane-harvey-recovery

http://www.cnn.com/2017/10/20/us/puerto-rico-one-month-santiago/index.html

https://qz.com/1120412/six-weeks-after-hurricane-maria-most-puerto-ricans-have-had-to-make-their-own-light/

https://www.washingtonpost.com/local/education/why-cant-i-have-my-life-back-in-puerto-rico-living-and-learning-in-the-dark/2018/01/29/09120c4e-fed9-11e7-bb03-722769454f82_story.html?utm_term=.99f4915f8072

https://www.washingtonpost.com/graphics/2017/national/puerto-rico-life-without-power/?utm_term=.b85e2d609c80

https://www.washingtonpost.com/national/ny-governor-ashamed-at-failure-of-us-to-help-puerto-rico/2018/02/03/8f4a675c-093d-11e8-aa61-f3391373867e_story.html?utm_term=.19071e31866a

https://www.nextekpower.com/

http://www.renewableenergyworld.com/ugc/articles/2017/03/28/ieee-smart-village--advancing-technology-for-all-of-humanity.html

http://theinstitute.ieee.org/members/ieee-groups/lighting-up-haiti

http://dynamicsupplieralignment.com/

http://huntershelters.com/

http://www.innovateli.com/tiny-houses-big-hopes-lis-manufacturing-future/

http://www.windmarpv.com/