# A Few Words First

**Audio Connection – Please mute phone (*6 toggle) – or your GM left-side name**

**All phone connections will be muted during the presentation. Save your comments and questions for Q&A and/or put them in the GlobalMeet chat window.**

**Upcoming Meetings:**

- **Dec ??: No Traditional December Holiday Social is Scheduled (We are lacking a social event coordinator/producer, and you didn't step up)**
- **Jan 9: Risk and Opportunity Management & V&V Using SysML Brian Selvy, CEO, CTO, and Co-founder of Nymbysys LLC**
- **Jan 16: Free Chapter-Sponsored SEP Exam at UTEP (El Paso), Registration: http://events.constantcontact.com/register/event?llr=gklfvycab&oeidk=a07efs3cy4e187e027a**
- **Feb 13: TBD – Winter Social or (will move to March if Social occurs): Evidence-Based Approach to Implementing the New INCOSE Systems Engineering Competency Framework – Don Gelosh, Chair, Competency WG**

**CSEP Courses by *Certification Training International:***
**Course details (with more locations and dates)**
**Upcoming Course Schedule (somewhat nearby):**
**2019 Feb 11-15 | San Francisco, CA**
**2019 Aug 12-16 | Austin, TX**

**Chapter SEP mentors: Ann Hodges alhodge@sandia.gov, Heidi Hahn hahn@lanl.gov**

First slide, not recorded but retained in pdf presentation.

**And Now - Introductions**

# Enchantment Chapter Monthly Meeting

**14 November 2018 – 16:45-18:00 MT**

## An SE Approach to Providing PV in Ghana

Marlene Brown, Sandia National Labs, Systems Engineer, mbwildwoman@gmail.com

**Abstract:** The presentation portrays the evolution of the Boko Bed Net System for a Malaria ridden area in Ghana. It is the result of analyzing a serious problem, understanding the environment and limited local resources, and then finding the right technologies and partners to design and implement a simple and elegant solution. The Boko Bed Net System consists of a LED light and fan powered by a small photovoltaic (PV) system inside of a bed net. The system is simple enough, but the project was created out of need. It comes from personal stories of Malaria, cultural communication issues and taboos, and genuine compassion for trying to combat something as common and devastating as Malaria. This is a real project that I worked on, mentored and guided. A Systems Engineering approach was used throughout this project.

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**NOTE: This meeting will be recorded**

# Today's Presentation

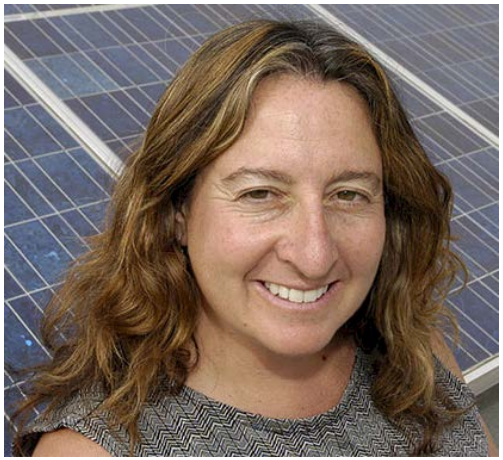
## Things to Think About

**How can this be applied in your work environment?**

**What did you hear that will influence your thinking?**

**What is your take away from this presentation?**

# Speaker Bio



**Marlene Brown has had multiple careers at Sandia. She is currently doing high level strategic planning, facilitation, problem solving along with System Engineering activities.**

**She has worked evaluating systems and components and as a Quality Engineer.**

**She has also worked in an On-Orbit Satellite Analysis Group working with satellite sensors and detectors.**

**Marlene has worked with photovoltaic applications for over 25 years doing analysis, testing components and teaching hands-on classes.**

**Marlene has a Master's degree in Electrical Engineering from the University of New Mexico. She also has a 2nd Engineering Master's degree in Systems Engineering from the Stevens Institute of Technology where she recently graduated in May 2014.**

**Her technical and personal passions have inspired her to start a much-needed business incorporating immediate and short-term disaster preparedness and relief.**

**When Marlene is not working or playing with solar, she likes to African dance, bike, play with bees, hike in the mountains and ski. She has been on the corporate ski team for Sandia National Laboratories for over 10 years and is active in the Sandia Singers group.**

# A SE Approach to Providing PV in Ghana
# The Boko Bed Net Project


*Marlene Brown*

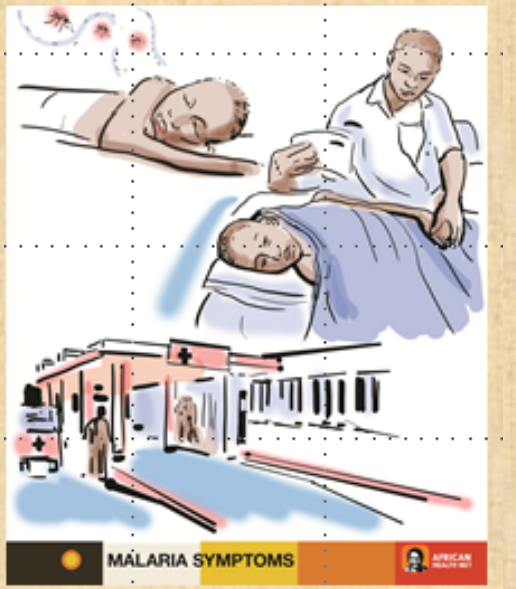
# Background

- This project resulted in the evolution of the Boko Bed Net System, for a malaria ridden area in Ghana with no available power.
- It is the result of analyzing a serious problem, understanding the environment and limited local resources and then finding the right technologies and partners to design and implement a simple and elegant solution.
- The Boko Bed Net System is an LED light and fan powered by a small photovoltaic (PV) system inside of a bed net. The system is simple enough, but the project was created out of need. It comes from personal stories of Malaria, cultural communication issues and taboos and genuine compassion for trying to combat something as common and devastating as Malaria.

# Outline

- Background
- Problem Definition
- Challenge
- Requirements
- Critical Design Elements
- Create the System Design
- Model the Problem
- Inventory Resources
- Logistics
- Systems Support and Training
- Implementation
- Connection between PV and Malaria
- Summary and Conclusions

# Problem Definition




- Malaria is the number one killer of children in Africa.
- Approximately 1 million people die from Malaria every year in Africa.
- The annual economic burden of malaria is estimated 1-2 per cent of the Gross Domestic Product in Ghana.
- Three and a half million people contract malaria every year in Ghana.
- Malaria kills 20,000 children in Ghana, 25 per cent under the age of five.
- Even if a child survives, the consequences from severe malaria such as convulsions or brain dysfunction can hamper long-term development and schooling.

# Challenge


•Most mosquito bites occur between during sunset and sunrise in this part of the world.

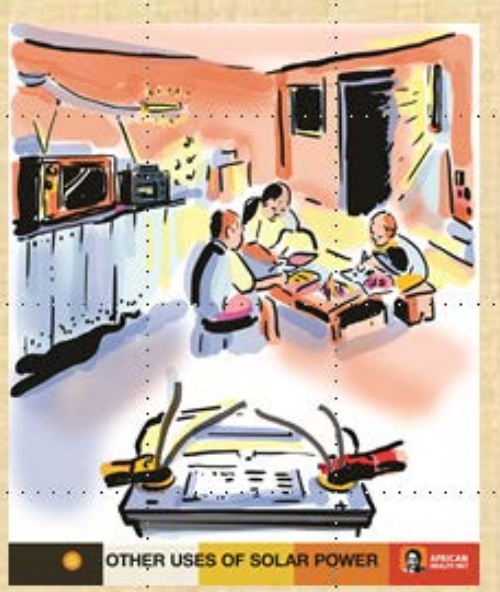
•There have been many studies where data supports bed net use will significantly reduce the onset of malaria.

•Mosquito nets drastically cut air circulation, which is a main cause of low mosquito bed net use.

• It is reasoned that if it were more comfortable inside the barrier, people would use the mosquito nets. A fan to provide circulation would make it more comfortable.

• If a light for reading was provided, it would also contribute to increased bed net use. Providing much needed "clean" light has many additional health benefits.

# Requirements




• Encourage people to use bed nets (which are essentially free) to reduce and mitigate Malaria

•Make the bed nets comfortable so people will use them.

- •Add a fan
- •Add a light

•Use local materials first

•Reduce impact of foreigners

- •Teach
- •Empower
- •Create industry
- •Create revenue

•Make instead of buy

•Customize

# Critical Design Elements


- The system design shall be simple, inexpensive, and reliable, with a renewable power source.

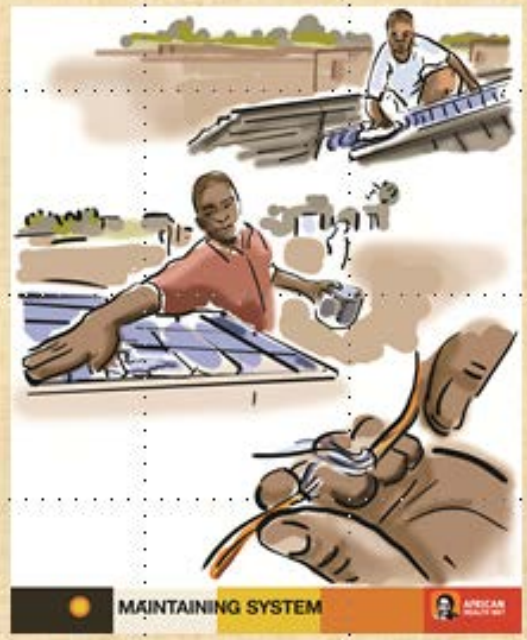
- The system designer conservatively estimated 7 hours a day usage for 3 LED lights and one fan.

- Instead of using the night sensor to turn the fan on and off, the design uses separate manual switches to control the fan and the lights.

- The system uses a rechargeable motorcycle battery since there are more motorcycles in the developing world than cars.

- The system is balanced and does not require the use of a regulator (also referred to as a charge controller).

# Create the System Design




- The system is a fan/light combination system inside of the bed net, powered by a photovoltaic (PV) system.

- How will the system be used inside the bed net?

- What are the parts of the system?

- How will it be constructed?

- How will the system be placed in the bed net?

- What are the skills of the local people and how can the system coincide?

# Model the Problem

Model the problem virtually and physically

Determine:

- Calculate the amount of power needed
- How the power will be delivered based on availability of power?
- How the PV panel be mounted?
- What materials will be used?
    - How much can be purchased locally?
    - What needs to be purchased and brought to Ghana?

# Model the Problem Cont.

- Reduce the cost by customizing parts instead of buying all COTS parts?
  - What parts?
  - Determine skills and training needed to make instead of buy
- Continuous improvement
  - Use education and good ideas throughout the project

- Set up a system locally in the US with familiar equipment in a mock system that resembles the environment in Ghana
  - Tweak to maximize efficiency and match power with need

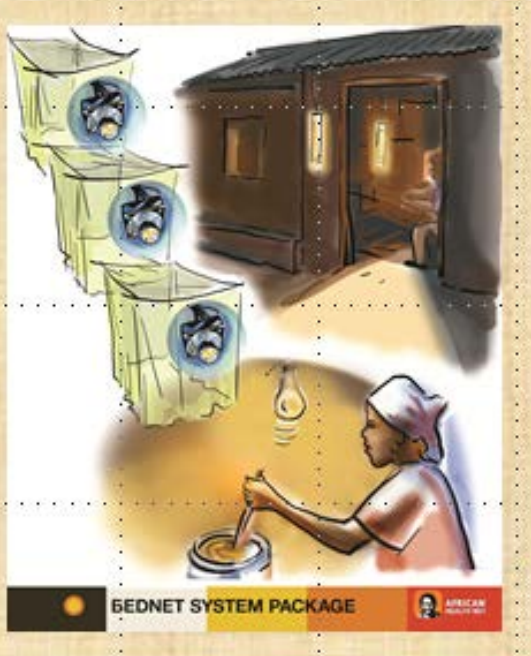
# Inventory Resources

•Utilize locally available materials to greatly reduce the cost of the system while empowering local people with new skills, technology, while creating a great local business.

•Available locally
- •Rebar
- •Muffin fans from computers
- •Motorcycle batteries
- •Solder and soldering irons
- •Wire
- •Switches
- •Metal for mounting structure

•Purchased and brought to Ghana
- •PV cells
- •Strings of LEDs

# Logistics




- The conceptual model is to take manufacturing of the combination fan/light unit and bring PV and LED lighting technology to Ghana

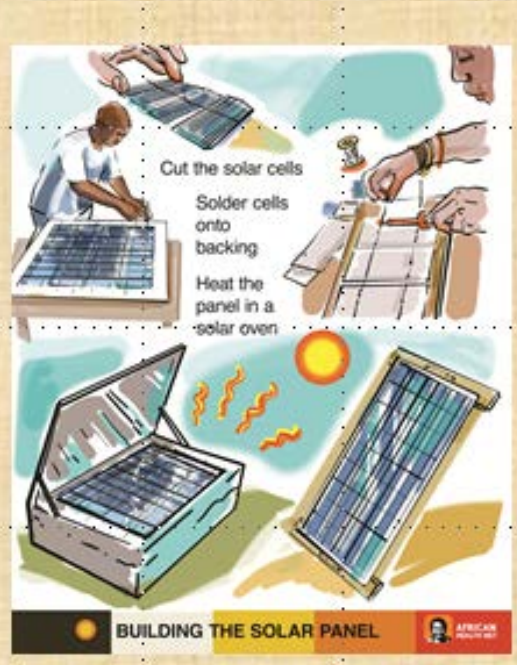
- How many systems are needed?

- Are the parts readily available?

- Are the parts affordable?

- What skills exist and what needs to be added for local people to purchase, build and store the systems?

# System Support and Training




•Train local people to make photovoltaic modules, LED lights and assemble the apparatus.

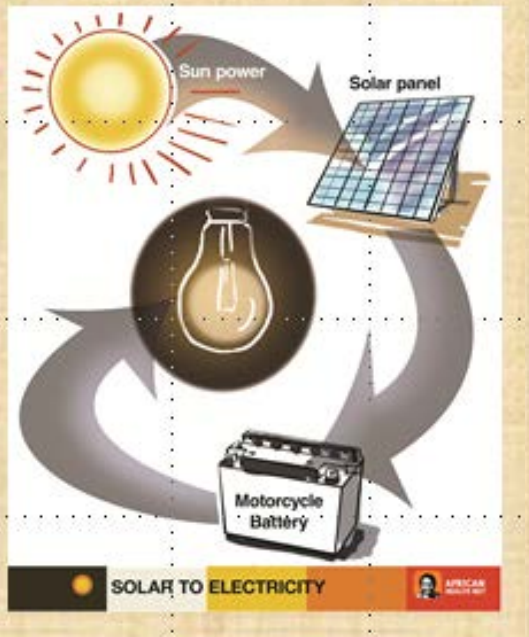
• Project success will come from the transfer of technology from the project team to the local people. By training local people to build their own PV modules and LED lights they can learn new skills and cottage industries can be created.

• The project team trained local people to build cell phone chargers as well as PV modules. Cell phone charges are already in high demand.

•The team trained 15 people in the village to build PV modules and cell phone chargers.

• The villagers trained ranged in age from late teens to about 30 years old.

# Implementation




- A team of doctors, nurses and PV and LED design professionals went to Ghana on a first trip for this project in September 2012.

- Most, over 90%, of the approximately 60 homes in the village of Ketakro are thatched huts with mud walls and they still cook with collected firewood.

- One of the tasks for the team was to choose the first 10 houses and determine which workers in the village would learn how to install the systems and provide maintenance when needed.

- The team and people from the village installed the first 3 systems. The next 2 were installed entirely by local people. The final 5 systems for the first phase were installed by local trained people from the village.

# Connection Between PV and Malaria


- Two different teams connected to this project had to work together for its success.

- The health care workers concentrated on a baseline malaria study and tracked that aspect of the work.

- The project team built and installed each PV system and LED lights and transferred the technology to the local people.

- The two teams worked together. Each added significant value to the project.

- Having technical people on all aspects of the project helped to legitimize the work and attract investors and donations to continue and enhance the work and the project.

# Summary and Conclusions

- The Boko Bed Net system (BBNS) is a viable and economic option, which will allow communities in Ghana to locally fabricate and install bed net, fans, and lights powered by renewable solar electric or photovoltaic power.

- A team of dedicated and knowledgeable professionals came together to analyze the problem statement and then execute a plan to design, test, and install the system. They then trained the local people to do much of the assembly and installation work themselves.

- The long-term success of this project will be monitored and studied.

- Bringing power and light to a region without power can change people's lives.

- There are special logistical considerations when working in third world countries: including language, travel for non local experts, spare part and tooling availability, and permission to go where desired and needed.

# Thank You

# Questions?

# Today's Presentation

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# Please

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