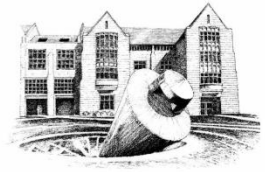


\$2.1 M Campus uGrid Addresses Sustainability Goals Outlined by Pope

Greg Mowry, Professor

Director **REAL**: Renewable Energy & Alternatives Laboratory
Director MSEE: Power & Magnetics/Electric-Machine Emphasis

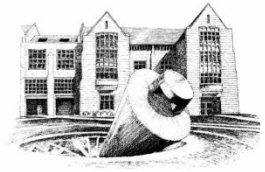
June 2016



The University Mission

Inspired by Catholic intellectual tradition, the University of St. Thomas educates students to be morally responsible leaders who think critically, act wisely, and work skillfully to advance the common good.

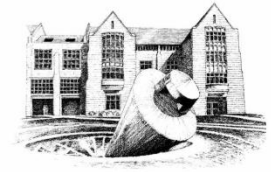
<http://www.stthomas.edu/mission/>



The Engineering Mission

We provide an applied, values-based learning experience that produces well-rounded, innovative engineers and technology leaders who have the technical skills, passion, and courage to make a difference.

<http://www.stthomas.edu/engineering/about/mission/>



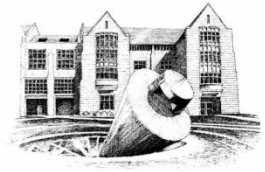
LETTERA ENCICLICA

LAUDATO SI'

DEL SANTO PADRE

FRANCESCO

SULLA CURA DELLA CASA COMUNE

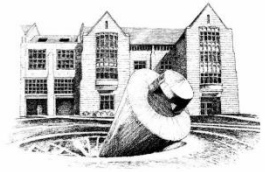


Excerpts from the Environmental Encyclical by Pope Francis, 24 May 2015

My appeal

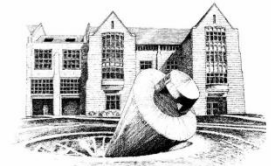
13. The urgent challenge of protecting our common house ... unite the whole human family in search of ... sustainable development ...

161. The rate of consumption of waste and environmental changes has exceeded the possibilities of the planet, in such a way that the current lifestyle, being unsustainable, may only result in disaster, as in fact is already happening periodically in different regions.

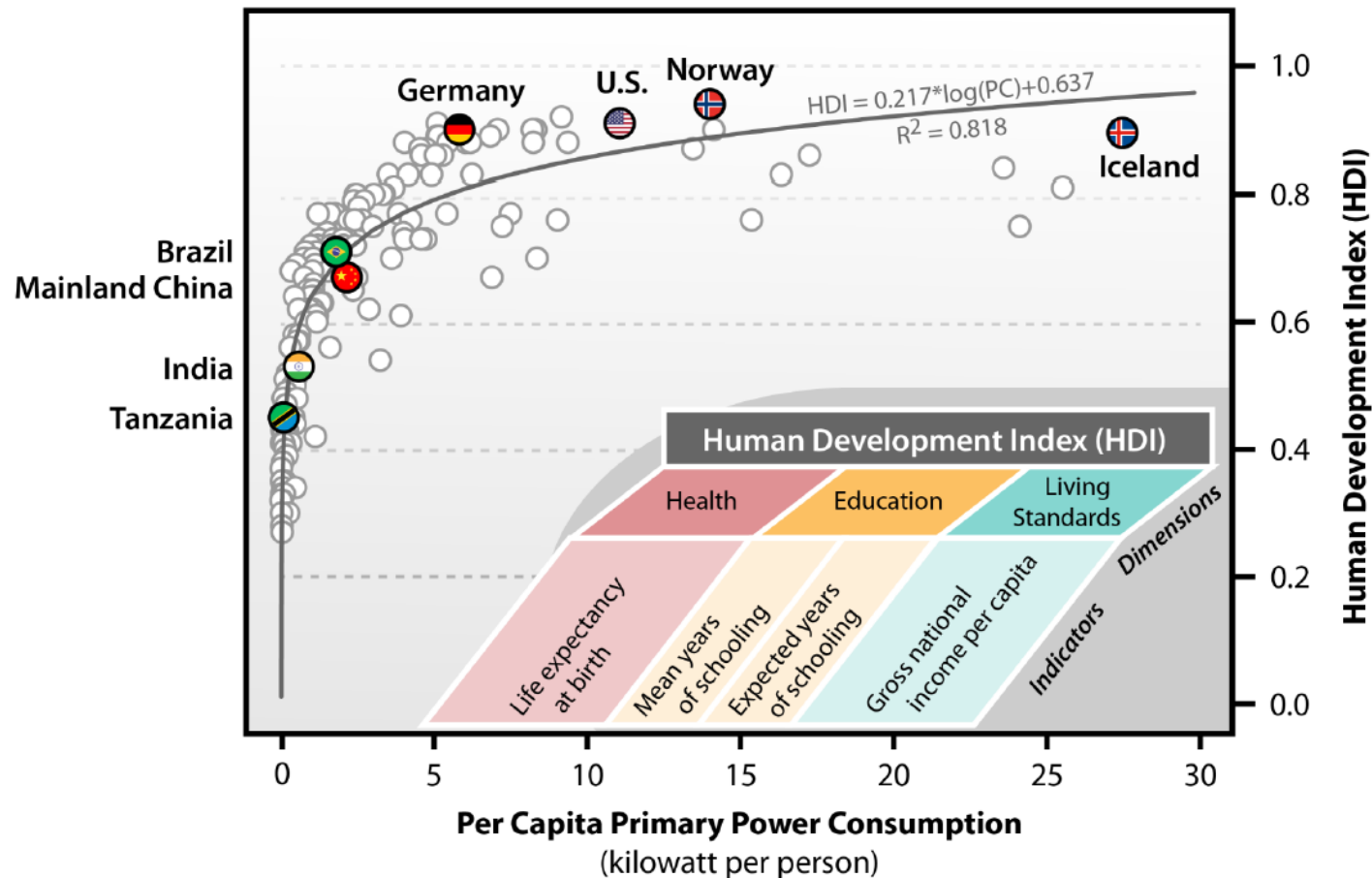


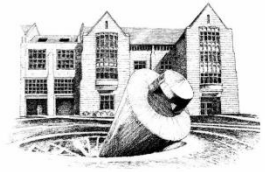
Human Development Index (HDI)

- The HDI was created to emphasize that people and their capabilities should be the ultimate criteria for assessing the development of a country, not economic growth alone.
- The Human Development Index (HDI) is a summary measure of average achievement in key dimensions of human development: a long and healthy life, being knowledgeable and have a decent standard of living. The HDI is the geometric mean of normalized indices for each of the three dimensions.



Energy Consumption & Human Well Being are Linked

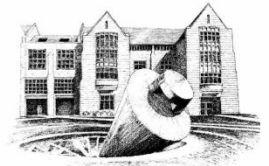




Modern Civilization

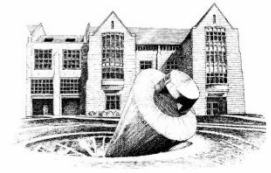
- Depends on energy
- Energy is produced by burning 'stuff'
- Burning 'stuff' generically pollutes
- Energy systems are scalable by virtue of Faradays' Law:

$$V = \frac{d\phi}{dt}$$

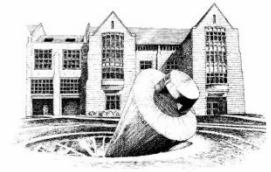


∴ Our Current Civilization

Is NOT Sustainable!!

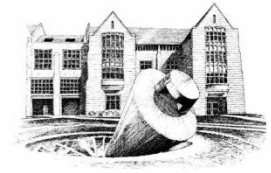


The UST uGrid



The UST uGrid

- Made possible through the Xcel Energy RDF program
- Functional part of REAL
- Strong support from the UST administration and the School of Engineering



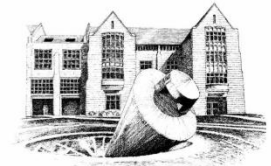
The UST uGrid

➤ Big Picture:

- ❖ Phase-I Island mode operation
- ❖ Phase-II Grid Connection
- ❖ Phase-III Full R&D/development mode
- ❖ Phase-IV UST Campus uGrid

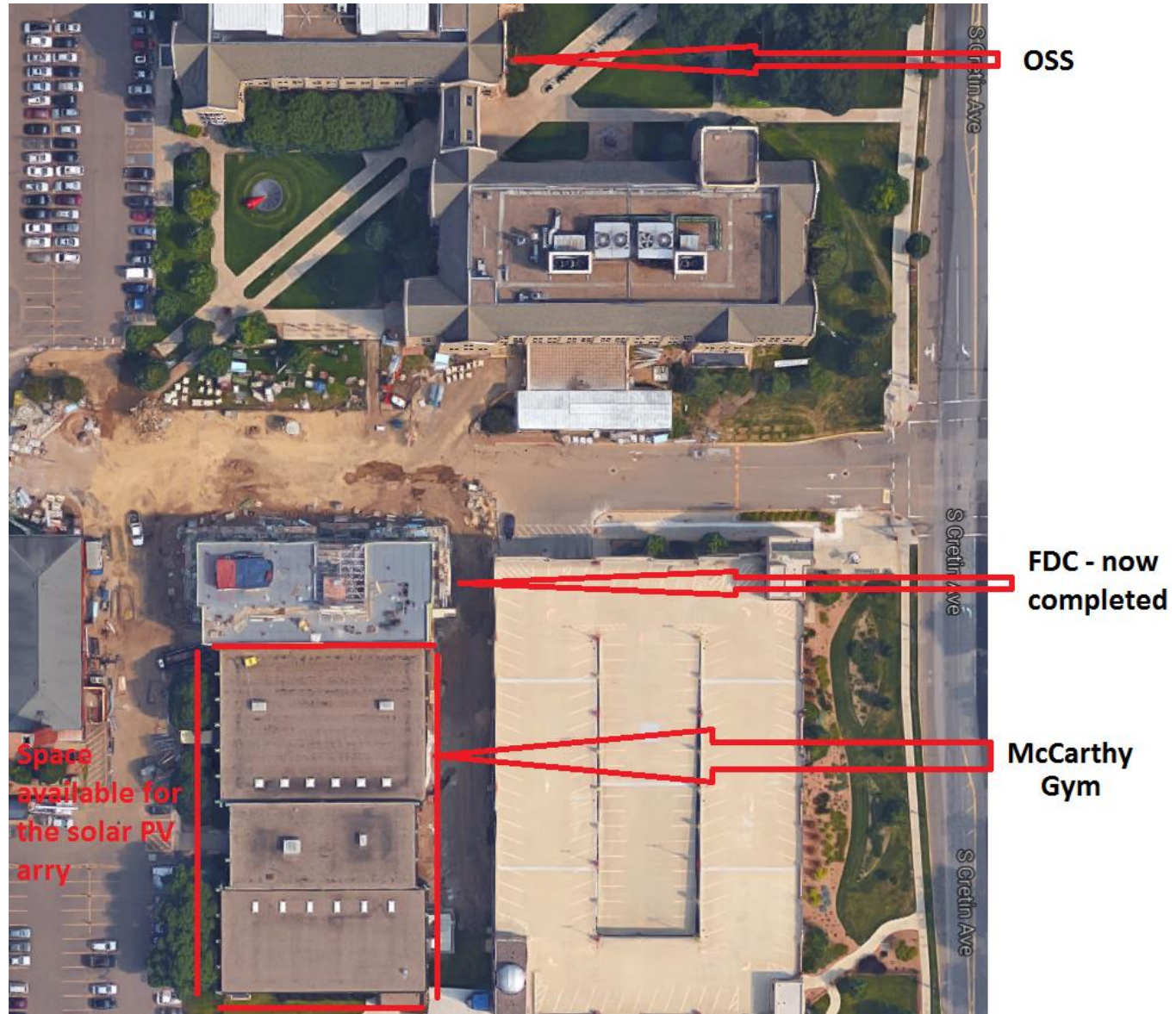
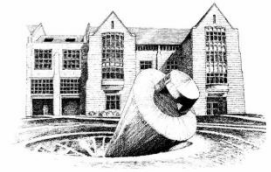
➤ Part of on-going education at UST: Grad & Undergrad

➤ Outreach, responsibility, and 'for the common good'

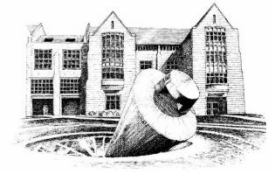


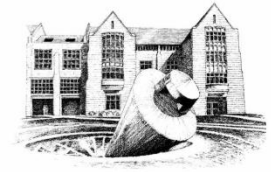
UST St. Paul Campus





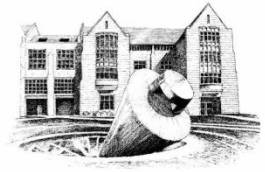
Facilities and Design Center





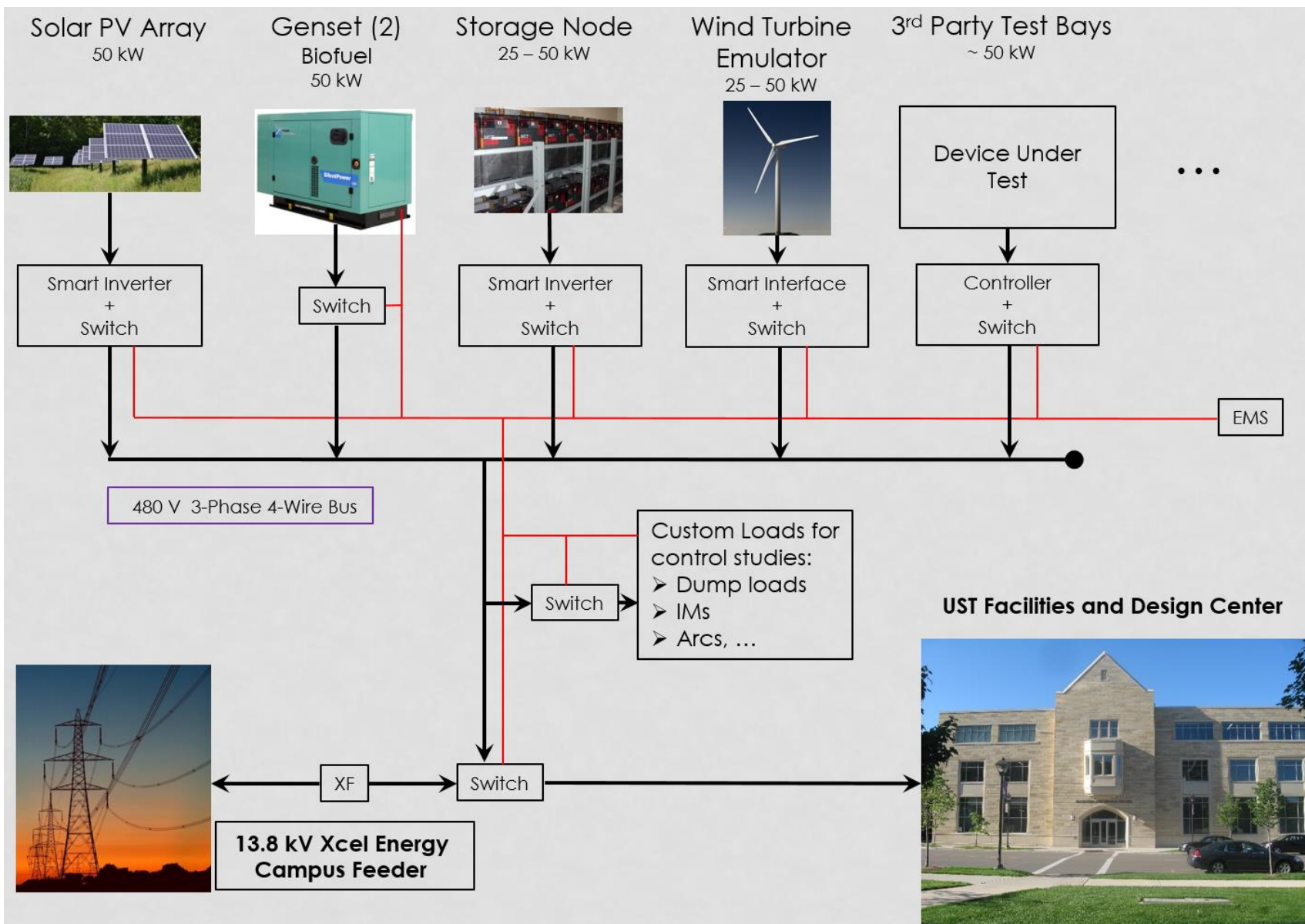
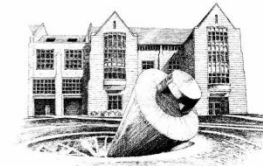
uGrid Program Goals

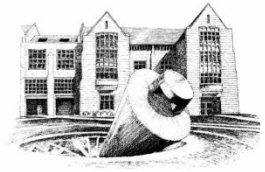
1. Establish a research and testing platform for microgrid and microgrid-subsystem R&D for academic and industry collaboration
2. Engage Minnesota industry partners at the microgrid facility in design/build/test and validation of projects of near-commercial distributed-energy-resource technologies through a RFP process
3. Execute research and publish findings involving design, control, and power electronics of the base facility
4. Modify Electrical Engineering undergraduate and graduate curriculum to incorporate real scale distributed energy resource and microgrid modeling experience
5. Develop an educational portal and curriculum for the K-12 grades showcasing sustainability and alternative energy systems in action.



Intellectual Property

- Founded in 1885, the historic mission of UST was to:
 - Train people with skills that help them get jobs in the new world
 - Help businesses succeed
- Today the historic mission manifests itself via: **UST does not own IP.**
- R&D work-product and associated IP **ARE OWNED BY THE FUNDING SPONSOR** so long as the research engages UST students.
- Corporate R&D has little or no overhead with ~ 100% of the funding going to the research. There are also potential tax benefits for such directed research.





Schedule

2016 – Begin; ~ August

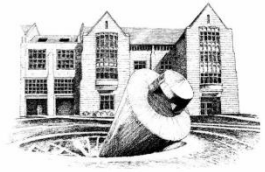
- Vendor identification and selection
- Preliminary site preparation
- Preliminary construction

2017 – Island mode operation

- uGrid construction
- Operation in island mode
- Grid connection studies
- 3rd party R&D
- Campus expansion

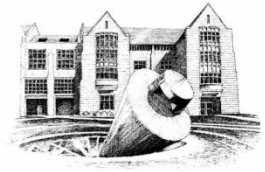
2018 – Full Grid-connect/Island-mode operation

- Grid tie
- R&D
- 3rd party R&D



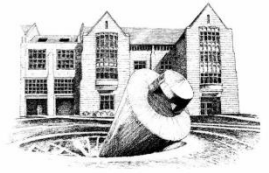
Companies Involved in the UST uGrid

- Xcel Energy
- Many Minnesota companies
- Several main-stream power & power-related companies
- Many others; names not given to avoid offending ☺

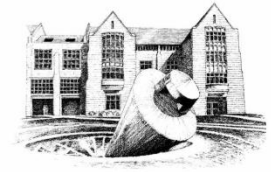


Anticipated/On-going Research Projects

- Peer-to-peer DER communications
 - ❖ distributed vs. centralized
- uGrid control
- Smart inverters
- Specialized power electronics
- Safety and grid interactive controls



Other uGrid Projects



Humanitarian uGrid Projects

1. 2005 – 2008: Microgrids in Moldova

- 5 – 10 kW low-head hydro and wind
- Moldova lost its grid; interconnected microgrids is one-way to rebuild a grid
- Many small villages and rivers with low-head hydro potential

2. 2007 – 2010: Hospital Power in Dodoma, Tanzania

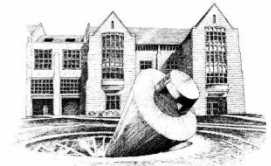
- 20 MW combined wind, diesel, storage
- 150 bed energy neutral hospital design in Dodoma, TZ
- LEED type hospital building design – both done by REAL teams

3. 2010 – 2014: Village Power/Energy in Uganda & Mali

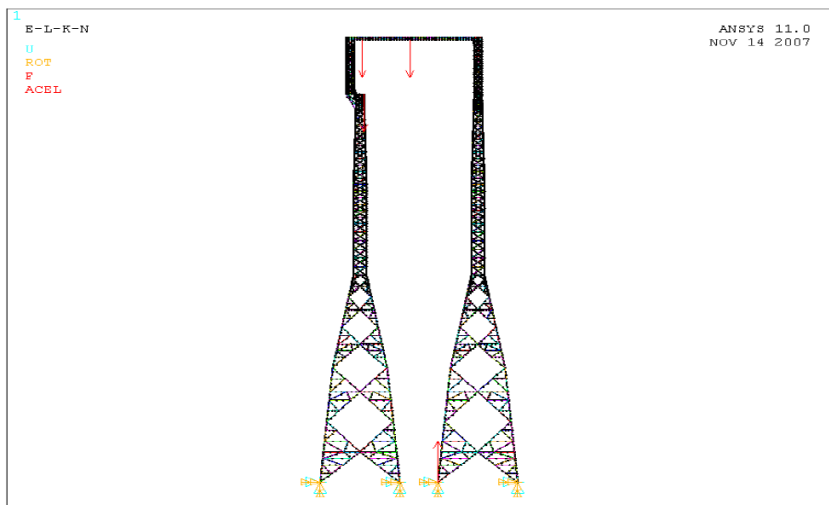
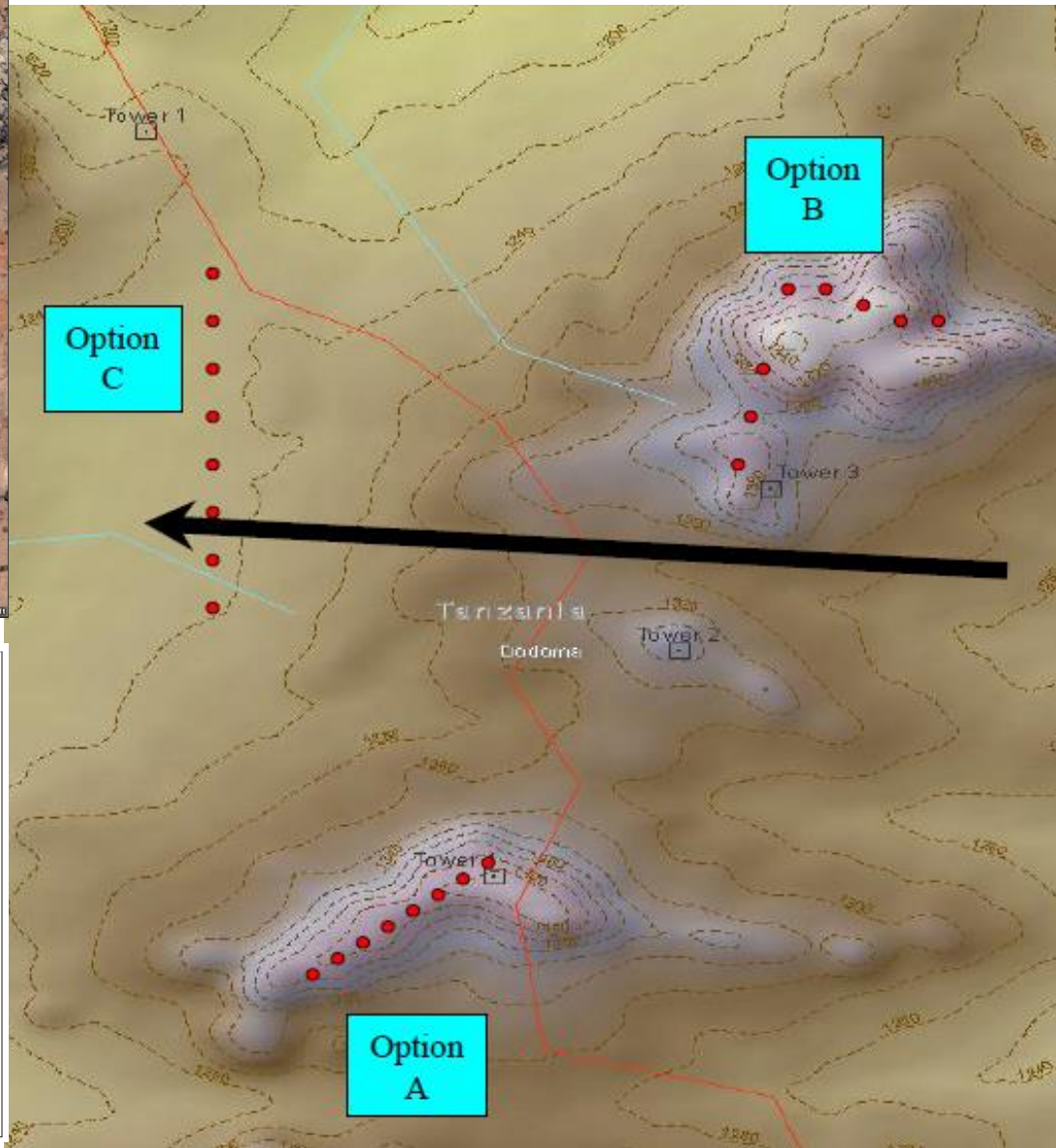
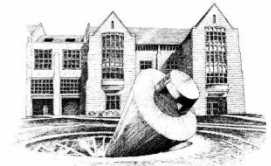
- 2 kW split-power microgrid
- Energy systems for living and farming
- Education

4. 2015 – 2016: Liberia & Will Steger uGrid Projects

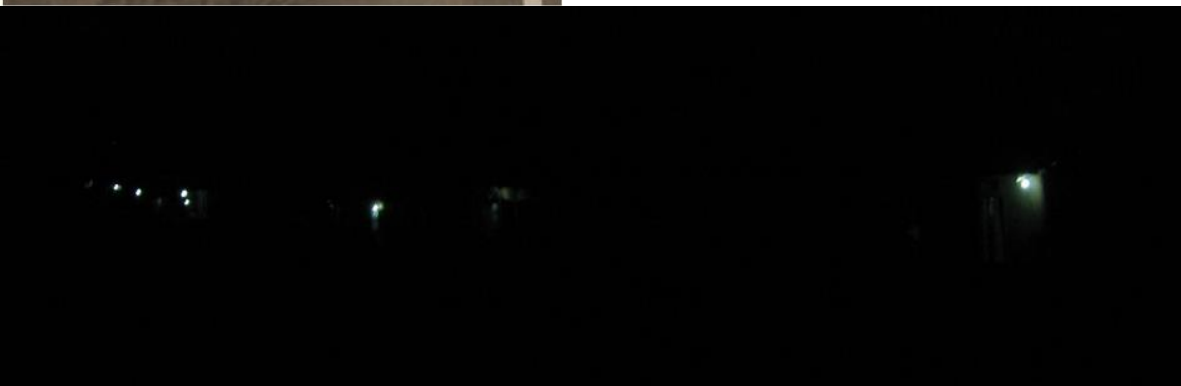
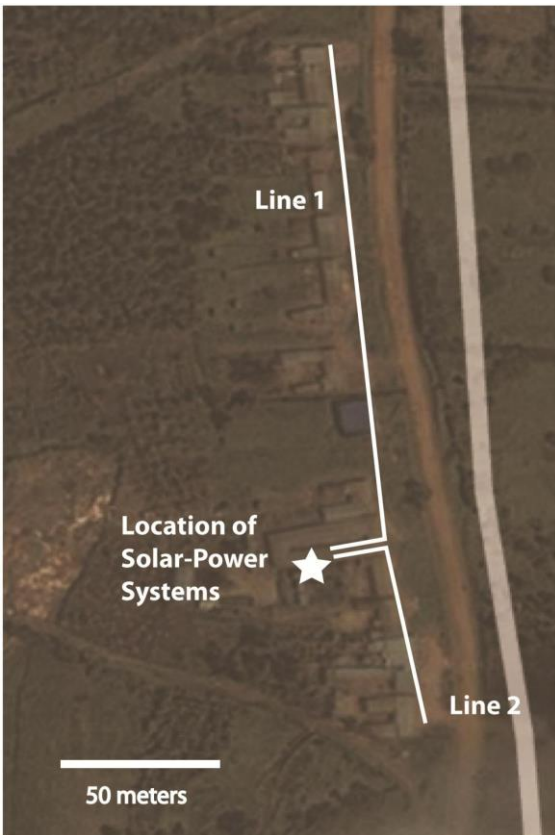
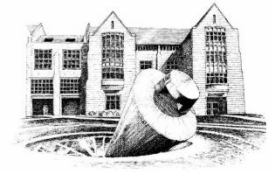
Moldova



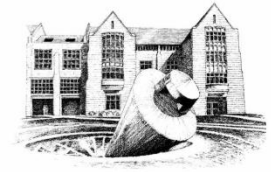
Tanzania



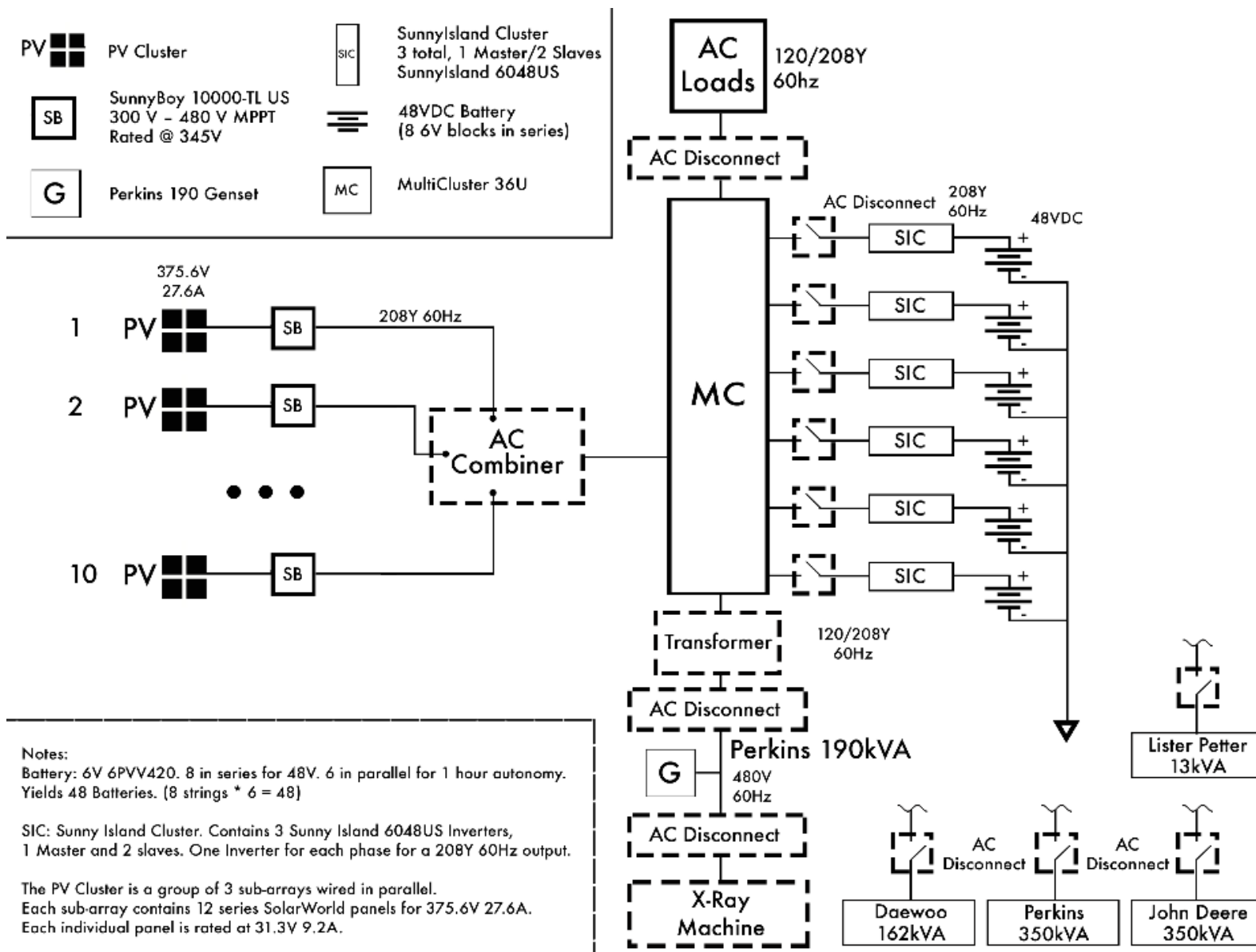
Uganda



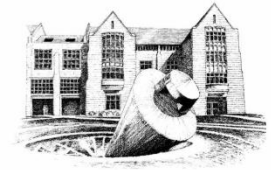
Phebe, Liberia



Phebe, Liberia

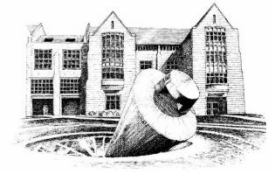


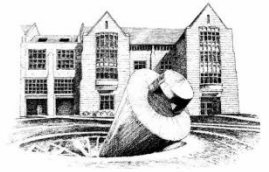
Will Steger – Ely, MN



The Steger Wilderness Center is made of glass, native timber and stone, and recycled wood.

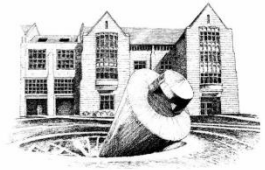
Will Steger – Ely, MN





uGrid Projects, e.g.

Corporate Sponsored



Cell-Phone Tower-Power

Juha Rouvinen, President & CEO

www.windstrip.com

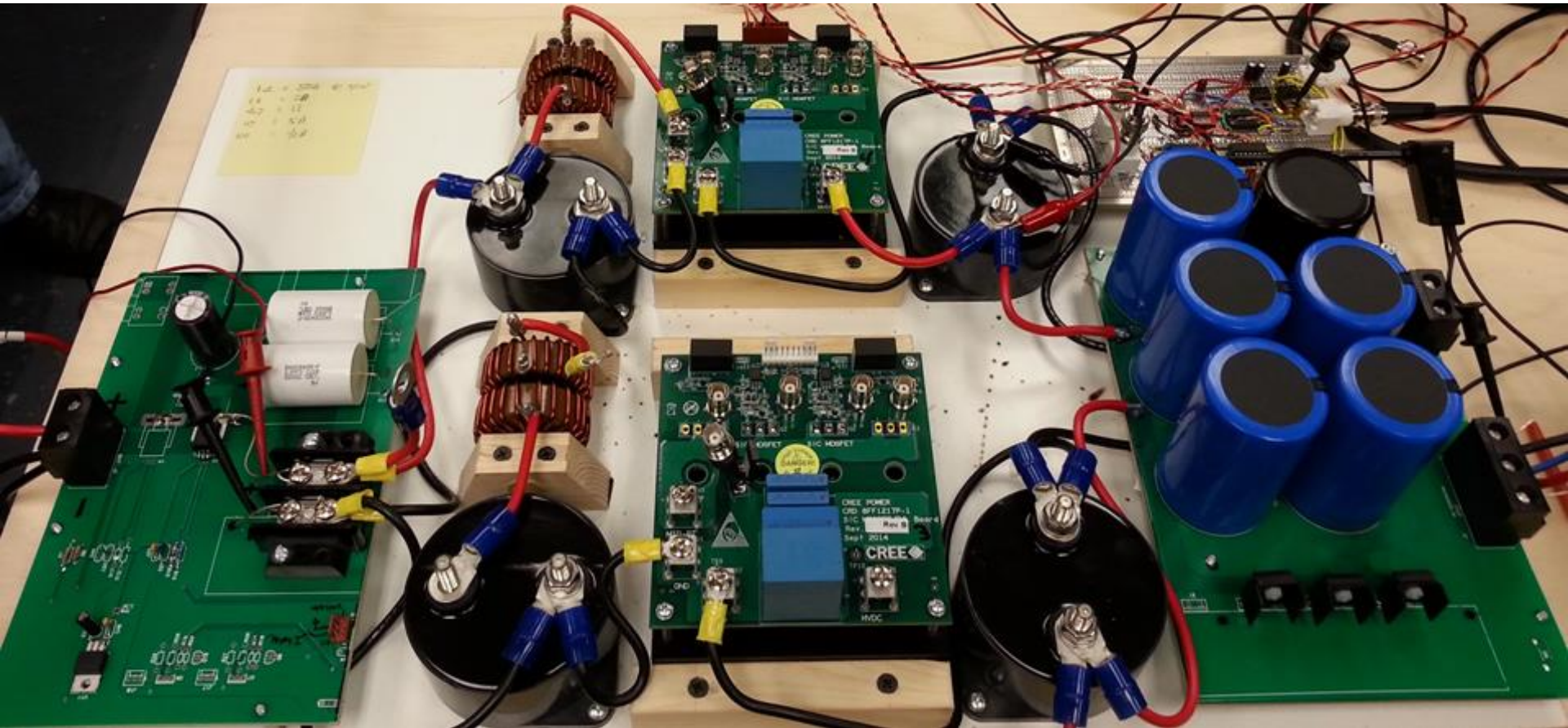
651-260-8363

➤ Hybrid Power System (HPS) for Windstrip, LLC

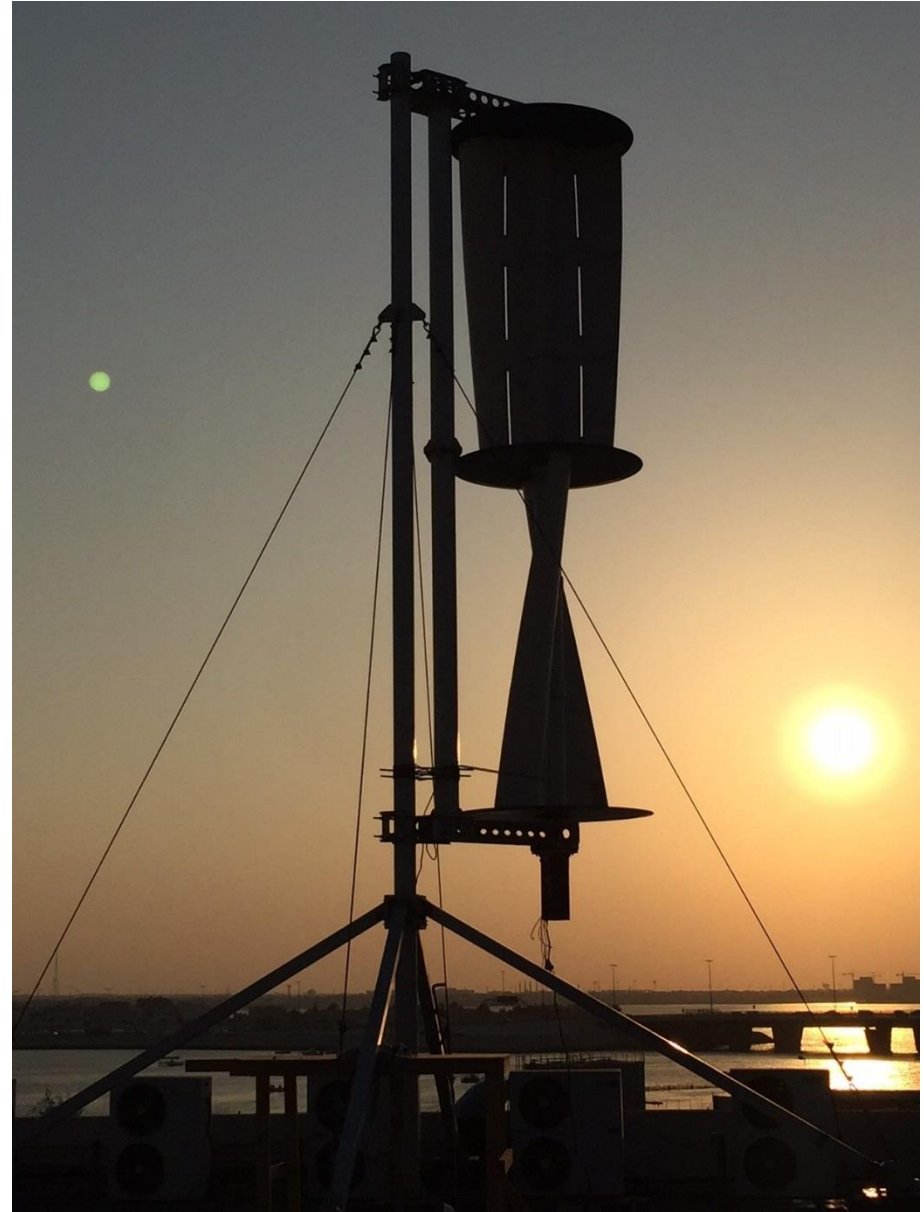
- ❖ DC/AC bus design and development
- ❖ Power electronics design and development; MISO, ...
- ❖ Controls system modeling, design, development, and test
- ❖ Wind turbine modeling, design, development, and test

Cell-Phone Tower-Power

Gen-1 SiC HPS Electronics, 98%+ @ 4 kW



Cell-Phone Tower-Power





REAL

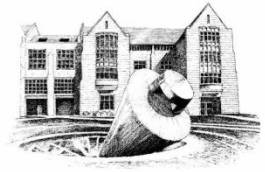
Renewable Energy & Alternatives Laboratory

Dr. Greg Mowry

Director **REAL**

Director MSEE: Power & Magnetics/Electric-Machine Emphasis

June 2016



Are you Reddy to get REAL?



For additional information contact: Dr. Greg Mowry
gsmowry@stthomas.edu, 651-962-5749