



Energy Systems Technology Evaluation Program (ESTEP)

Marissa Brand
Naval Information Warfare Center- Pacific
Program Management

Arthur Rubio
Naval Information Warfare Center- Pacific
H4D Lead/Trainer

Dr. Richard Carlin
Office of Naval Research
Department Head Sea Warfare & Weapons

Susan Adams
Office of Naval Research
Program Officer



ESTEP Program



- **Command Personnel**
- **NPS Energy Students**
- **Veteran STEM Interns (CSUSM, SDSU, and others)**

NIWC- Pacific

Marissa Brand Program Management
Arthur Rubio H4D Trainer
Info/Network Security Expertise
Technical & Business Training

**Mentor Veteran Interns
on ESTEP Projects**

**ONR Oversight &
Funding**



Naval Information
Warfare Center



PACIFIC



NPS

Energy ROI Research
Student Project Participation
Technical & Business Education

NAVFAC/EXWC

Facility Expertise
Technical & Business
Training



<http://www.aptep.net/partners/estep/>

<https://www.youtube.com/watch?v=Ck-xjIC0NF8>

<https://veteranstoenergycareers.org/>

UNCLASSIFIED

Program Description



Derisk product prototype to evaluate and transition on military bases while engaging base personnel.



Evaluate and investigate nascent energy technologies to accelerate the introduction and adoption of advanced innovative products for the Department of the Navy (DoN).



Conduct advanced technology demonstrations to evaluate emerging & innovative products using Navy and Marine Corps operations as test beds.

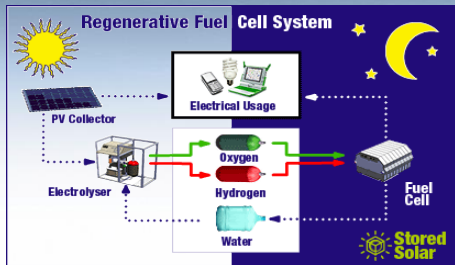


Engaging stakeholder and user throughout the curation process to design a successful transition plan.



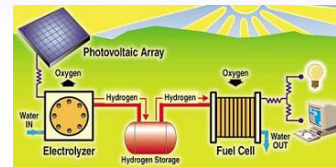
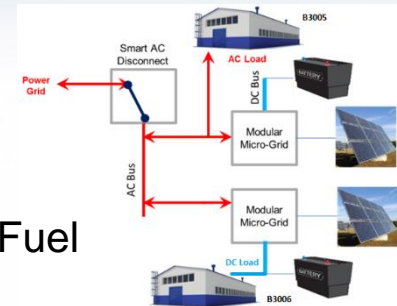
Providing opportunities for professional development for veteran interns on the full range of ESTEP energy projects

All Things Microgrids!!!!



Decentralized Microgrid With PEM Fuel Cell, H₂ Production and Storage, and PV Feasibility

Networked Building-level Micro-grid Demonstration



Micro-grid Installation with Fuel Cell/Electrolyzer Hydrogen Storage

Supercapacitor Based Microgrid for Renewable Augmented Circuits

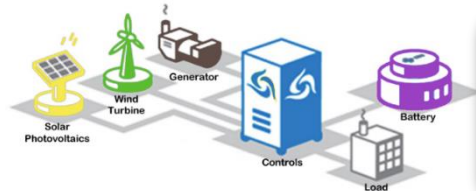
Design and Simulation of Micro-grids Using Real-Time Simulation



Modular Microgrid (M2G)



Model-based Control for Energy System Planning & Adaptive Control Management



Evaluation of Smart Microgrid Controllers for Distributed Energy Resources



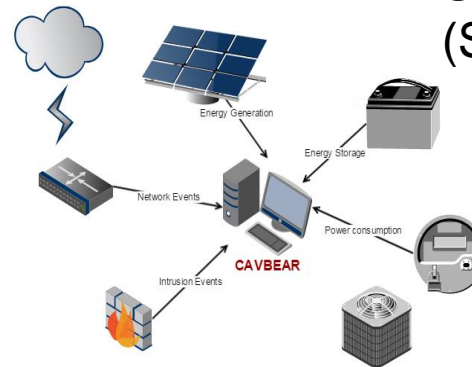
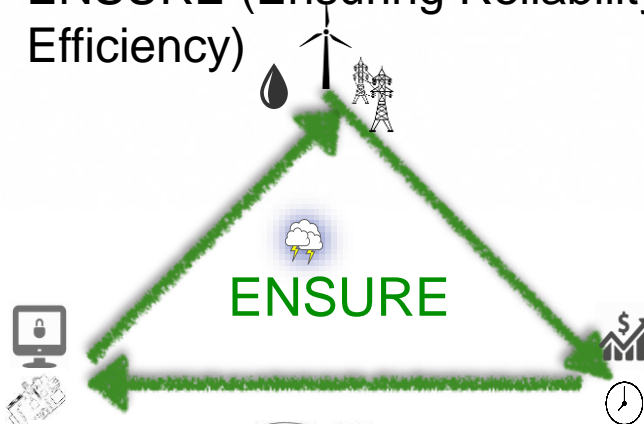
Cyber-SCADA Evaluation Capability (C-SEC) On The Move (OTM)



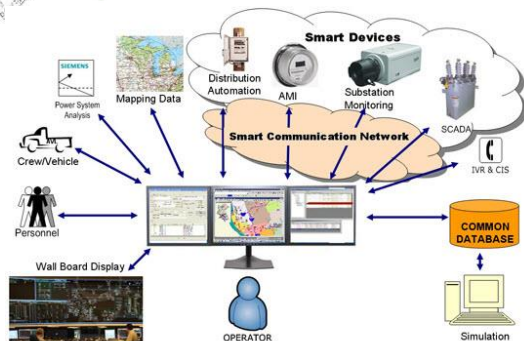
Resilient Critical Infrastructure (ReClist)



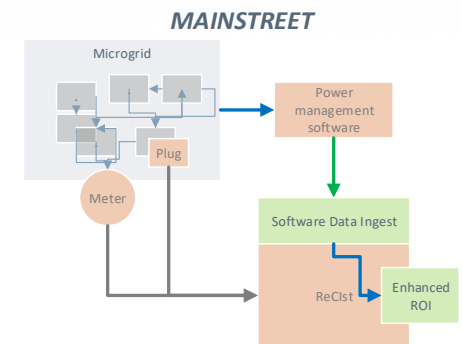
ENSURE (Ensuring Reliability and Efficiency)



Correlation And Visualization Between Energy, Attacks, & Risks (CAVBEAR)



Smart Plug Side Channel Analysis (SPAMSANDWICH)



Microgrid Application Integration & Software Tap for the ReClist Energy Efficiency Tool (MAINSTREET)

Labs & Boot Camps



Non-Intrusive Load Monitoring for Load Disaggregation and Power Quality Analysis
-Collaboration with ASU



Joint XENDÉE Training with NIWC/ASU



Joint Cyber/SCADA Lab Workforce Development w/ UHWO



Cyber SCADA Educational/Hands-On Training

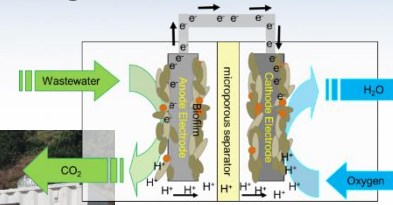


Mobile Power Supply, Storage, & Drones

Modular Microgrid (M2G)



Waste to Energy Hydrogen Generation

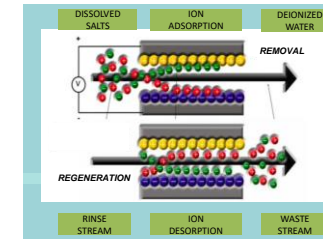


UAV Solar Charging Station for Facility Energy Monitoring

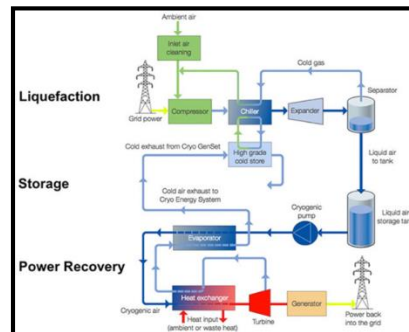


Energy & Water Recovery by Microbial Fuel Cells

Next-Generation, Energy- Efficient Water Treatment (NEWT)



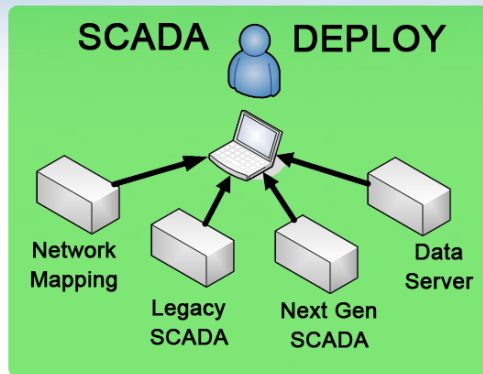
Energy, Utility, and Emergency Response Solutions using Unmanned Aircraft Systems



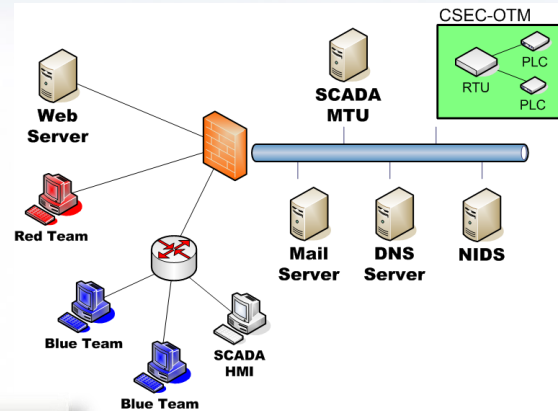
Reengineering & Integrating a Building-Scale Liquid Air Energy Storage (LAES) System

Industrial Control Systems & Supervisory Control and Data Acquisition

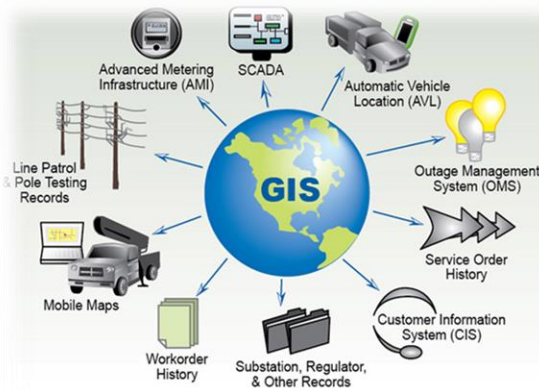
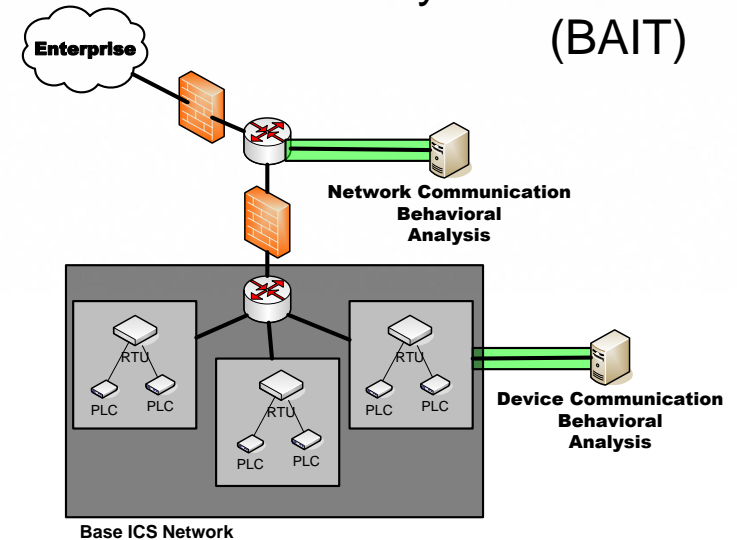
SCADA Deploy



Cyber Aware SCADA Energy Systems (CASES)



Behavioral Analysis of Industrial Control System Traffic (BAIT)

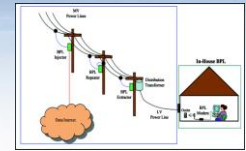


Geographic Information Systems: “Data Synchronization from GIS to ETAP”



NIWC -Energy Management Circuit Breaker

NIWC -Voltage Optimization Devices at Grid Edge



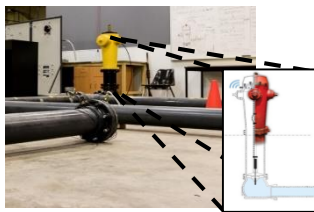
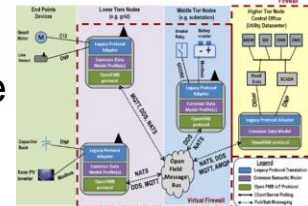
NIWC/MCH -Water Harvesting in Austere Locations & Environments (WHALE)

NIWC/MCAS Miramar -5G-enabled Next Generation Secure Energy Communications (5G NGSEC) – Leverage CRADA/ESTCP



EXWC/NIWC/MCAS Miramar -Cyber & Autonomy Resilience for Naval Installation Transportation Appliances (CARNITAS)

EXWC/NIWC -Optimizing Network Edges for Grid Resilience On Utility Network Distribution (ONE GROUND)

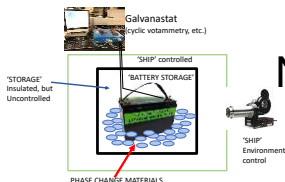


EXWC -AI Enhanced Water Distribution Sys. Leak Detection

NPS -Cybersecurity Analytics for the Smart Grid (CyAn-SG)



NPS -Thermal Management of New Battery Systems



Optimal Real Time Power Sharing with Different Size Generators at Forward Operating Bases



- Mobility

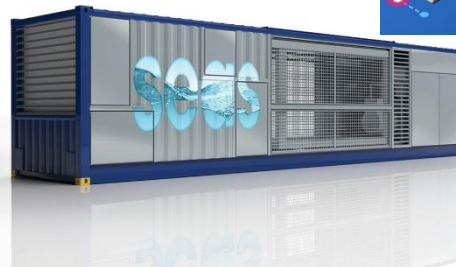
- Autonomous Shuttle Miramar Pilot

- CARNITA Cyber Component – NIWC-PAC
 - Market Research – NAVFAC/EXWC



- Resilience

- 5G CRADA/ESTEP – NIWC-PAC
 - WHALE – NIWC-PAC
 - SEAS



Cyber and Autonomy Resilience for Naval Installation Transportation Appliances (CARNITA)

Lawrence Kerr, lkerr@spawar.navy.mil, 619-553-7907

Problem Statement (Problem Curation)

- Navy forces need safe, resilient, and secure autonomous mobility platforms in order to improve safety, mitigate adverse traffic effects, and alleviate parking congestion.

Stakeholders (Beneficiaries)

- LtCol Brandon Newell, I-werX West Marine Corps Installations Command
- David Cook, NAVFAC EXWC

Proposal (Value Proposition)

- A number of potential benefits of autonomous transportation systems make these an appealing technology for moving personnel on Navy installations. These benefits come with a number of risks in cyber and adversarial AI that must be mitigated to ensure a safe, secure, and resilient transportation system.



Metrics (Mission Achievement)

- Wide coverage of penetration test
- Insight from cyber and adversarial AI to feed into ULS CONOPS

Buy-In & O&M: (Buy-In/Support)

- Jose Romero-Mariona, NIWC 71770 branch head
- LtCol Brandon Newell, I-werX West Marine Corps Installations Command
- NAVFAC Transportation Director

Objective (Deployment)

- In collaboration with the AMIS demonstration project, examine the cyber footprint and impact of unmanned transportation platforms. Our objective is to ensure the vehicle safe, secure, and resilient for deployment in a wide range of environments while highlighting potential cyber and AI limitations.

Deliverables (Key Activities)

- Q1- Virtualized Olli autonomous vehicle for testing
- Q2- Penetration test on virtualized and real platform.
- Q3- Initial report on adversarial AI targeted at autonomous driving system.
- Q4- Report to accompany demonstration of findings.

Commercial Partners (Key Partners)

- Local Motors
- Automated Unmanned Vehicle Systems Intl.
- ESTEP Veteran to Engineers Program

Team Members (Key Resources)

- Lawrence Kerr, NIWC
- Chris Weeden, NIWC
- Kimberly Ferguson-Walter, NSA
- Alexander Wassel, NIWC
- AMIS team

Autonomous Mobility Installation Services (AMIS)

David Cook, david.j.cook@navy.mil, NAVFAC EXWC, 805-982-3477

Problem Statement (Problem Curation)

- NAVFAC Transportation requires a technology that enables predictable and cost effective base mobility services.

Stakeholders (Beneficiaries)

- David Bailey (NAVFAC Transportation Director)

Proposal (Value Proposition)

- Base operations could benefit greatly from reduced single occupancy vehicle travel through deployment of efficient and dynamic base mobility services. The AV technology would enable 24/7 base shuttle services, mitigate traffic, address parking constraints, and improve safety.



Metrics (Mission Achievement)

- The project will monitor the cost and reliability of AV shuttle technology versus the conventional shuttle technology, considering driver resource constraints.

Buy-In & O&M: (Buy-In/Support)

- NAVFAC Transportation Director has a high interest in the project, with influence on future budgetary resourcing that would pay for deploying the technology across the Navy enterprise.

Objective (Deployment)

- Conduct initial feasibility study in Year 1 consisting of the following: 1) Market Research: cost, performance, and operating requirements for the AV technology, 2) Candidate Sites Review: local site support, application description, road and facilities profile, sensitivities, permits required, 3) Feasibility Assessment: AV technology capabilities, vs. site requirements, 4) Recommendations Report: Identify a minimum of three favorable sites for a six-month deployment in Year 2.

Deliverables (Key Activities)

- Q1- Market Research Report
- Q2- Candidate Sites Review
- Q3- Feasibility Assessment
- Q4- Recommendations Report

Commercial Partners (Key Partners)

- Local Motors
- Automated Unmanned Vehicle Systems Intl.
- ESTEP Veteran to Engineers Program

Team Members (Key Resources)

- Brendan Casey (NAVFAC Atlantic)
- Paula Saenz-Ancheta (NAVFAC SW)
- Daniel McMoore (NAVFAC Hawaii)



5G-enabled Next Generation Secure Energy Communications (5G NGSEC)

Jose Romero-Mariona & Isaí Michel Lombera, NIWCPAC, jromero@spawar.navy.mil & imichel@spawar.navy.mil, 619-553-8119 & 760-468-2828



Problem Statement (Problem Curation)

5G technology promises much more energy savings, flexibility, dynamism, scalability, and ultimately security for enabling improved communications. There is little to none work that has been done to understand its applicability to energy systems communications and ultimately DoD applications. Energy-focused commands, like MCAS Miramar, need information on the applicability of new communication technologies, like 5G, in order to better support the future of DoD installations.

Stakeholders (Beneficiaries)

- LtCol Brandon Newell, MCAS Miramar Director Installations-werX West
- Mick Wasco, MCAS Miramar energy SME
- Marine Corps Base Hawaii

Proposal (Value Proposition)

Current lack of information, and more importantly, demonstrated installations of 5G technologies on DoD facilities, are a major hindrance to determining the usability and applicability of next-generation communication capabilities. The proposed study will develop a 5G-focused mobile network design experience for DoD personnel with academia and industry organizations.



Metrics (Mission Achievement)

- Range of coverage/number of transmitters per area, power requirements, network layout
- Interference with other equipment / operational signals
- Security level of 5G protocols, 4G and 5G integration and delineation of services

Buy-In & O&M: (Buy-In/Support)

- LtCol Brandon Newell, MCAS Miramar Director Installations-werX West
- Mick Wasco, MCAS Miramar energy SME
- Tarek Abdallah, US Army Corps of Engineers

Objective (Deployment)

DoD personnel will partner with MCAS Miramar's eWOC laboratory, as well as Verizon's 5G team, to demonstrate a limited installation and demonstration of 5G technologies and their enabling capabilities for providing next generation efficient and secure communications.

Deliverables (Key Activities)

- FY20 Q1 – FY21 Q1: Cyber defense evaluation
- FY21 Q2 – FY22 Q1: Protocol 4G/5G networks
- FY22 Q2 – FY22 Q4: Integration with services

Commercial Partners (Key Partners)

- Laurie Mulligan, Verizon 5G team
- Qualcomm Cyber Security Solutions

Team Members (Key Resources)

- Jose Romero-Mariona, PhD
- Isaí Michel Lombera, PhD
- ESTEP BS/MS Interns



Water Harvesting in Austere Locations and Environments (WHALE)



Lewis Hsu, NIWC-Pac, lewis.hsu@navy.mil

Problem Statement (Problem Curation)

- Units and facilities need clean, potable water during operations and in remote locations in order to sustain health and safety of personnel

Stakeholders (Beneficiaries)

- Amy Bevan, MCBH
- LtCol Brandon Newell, I-weX West, MCICOM

Proposal (Value Proposition)

- In direct support to Installation neXt Ecosystem Marine Corps Resilience pathway.



Objective (Deployment)

In austere and remote locations, delivery of water for hygiene and health is an intensive logistical process consuming manpower and fuel. Alternatively, local geography may allow for filtration but still requires an electrical power source, usually in the form of a generator. This proposal is intended to provide generation of clean water at the point of use without the need for utilities in a rugged or austere environment. The system takes advantage of recent advances in materials science for water harvesting of ambient water vapor in the air.

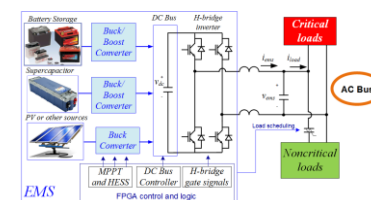
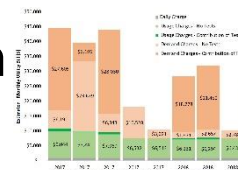
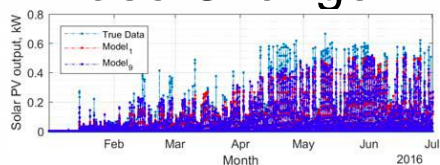
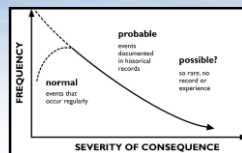
Commercial Partners (Key Partners)

- Zero Mass Water

Team Members (Key Resources)

- Amy Bevan, MCBH
- Lance Lee, MCBH

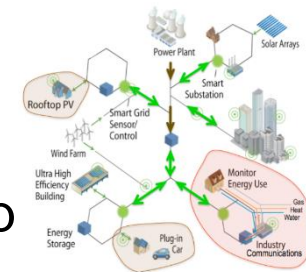
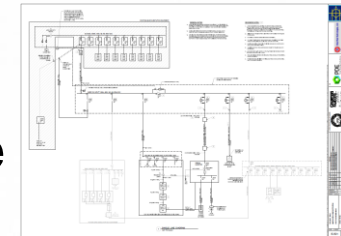
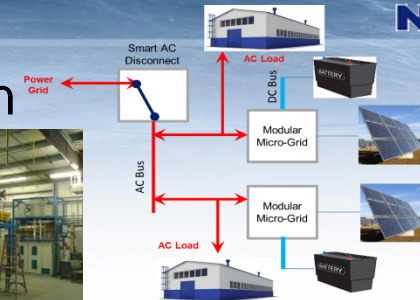
- Resilience Assessment for Emerging Energy Technologies
- Solid State Transformer (SST)
- Renewable Energy Microgrid Optimization (REMO) Study of Phase Change Materials for Passively Cooling Building Spaces
- Study of Phase Change Materials for Passively Cooling Building Spaces
- Integration of CAES and Supercapacitor Microgrid
- Waste Heat Recovery from Gas Turbine Exhaust
- Self Contained Hydrogen to Electrical System
- ESTEP Cost-Benefit Analysis
- Energy Management System for Department of Navy Microgrids
- Re-engineering & Integrating a Building Scale Liquid Air Energy Storage System



NAVFAC/EXWC

Facility Expertise, Technical Business & Training

- Networked Building Level Micro-grid Demonstration
- Waste to Hydrogen
- Nanolubricant HVAC Refrigerant
- Re-locatable Microgrid with Storage
- Design and Simulation of Microgrids Using Real-Time Simulation
- Energy, Utility, and Emergency Response Solutions using Unmanned Aerial Systems
- Modular Microgrid (M2G)
- Multi-Agent Systems for Power Control & Optimization (MAS)
- CA Energy Commission (CEC) Adaptive Microgrid Partnership



- Evaluation of Hardware-In-the-Loop Capabilities
- Cyber Aware SCADA Energy Systems (CASES)
- Deployable SCADA Architecture for Non-Intrusive Energy System Evaluation (SCADA Deploy)
- Next-Generation, Energy-Efficient Water Treatment (NEWT)
- Botnet Malware Detection and Classification in Smart Buildings and Cyber-Physical Systems using Nonparametric Bayesian Methods(Smart Building Botnets)
- Cyber SCADA Educational/Hands-On Training
- Resilient Critical Infrastructures through Secure and Efficient Microgrids (ReCIST)
- Non-Intrusive Load Monitoring for Load Disaggregation & Power Quality Analysis
- Wireless IoT Long Range Cyber Evaluation (WiLoRaCE)
- Decepti-SCADA: Cyber Deception for Securing SCADA Energy Systems
- Energy & Water Recovery by Microbial Fuel Cells
- Micro-grid Adversary Design and Mentality MADMen

