



TROPEC: Transformative Reductions in Operational Energy Consumption

2014 Update

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TROPEC Deputy PM
July 2014





Outline

- **About TROPEC**
- **TROPEC Mission/Goals/Scope**
- **Results: Technology Intake**
- **Results: Assessments & Other**
- **Transition**

About TROPEC-



- ***Mission: Build enduring program to identify and assess technologies to reduce expeditionary energy use in “tropical” environments***
- ***Target: CB solutions for energy, water, waste, ...***
- ***Role: Technology seekers/assessors***
- ***Build 2012-15; Sponsor: ASD OEPP***
- ***Transition 2015; Sustain: Assessment partnerships***
- ***Partners: PACOM, NAVFAC; DOE-ORNL & LBNL***





TROPEC Goals

Specific Program Objectives

- Identify, demonstrate, assess, and help facilitate transition of energy-saving innovations capable of achieving the following:*
 - *25% reduction in total energy use by 2014*
 - *85% reduction in HVAC energy use by 2015*
- Transition to an enduring program*
- Expand efforts to:*
 - *address supply side as well and*
 - *increase benefit beyond DOD*



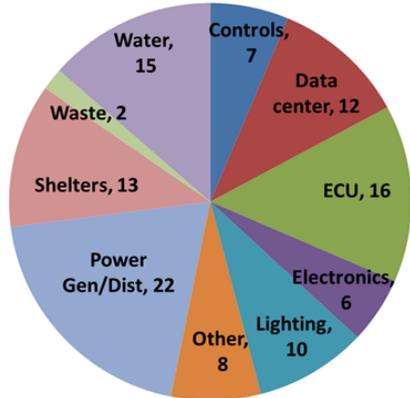
TROPEC Scope

- **Space Thermal Conditioning:**
 - Efficient HVAC/ECU
 - Efficient Ducting
 - Personal cooling
 - HVAC/ECU controls
 - Efficient dehumidification (desiccant, thermally activated, etc.)
 - Cooling through air movement
 - Passive cooling (thermal mass, etc.)
 - Other
 - **Shelters:**
 - Shelter
 - Liner (insulation or radiant barrier)
 - Solar control (exterior shading or high-albedo tent surface)
 - Moisture Control
 - Ventilation
 - Other
 - **Electronics Cooling:**
 - Efficient electronics cooling systems
 - **Conditions:**
 - Other
 - **Electronics:**
 - Efficient servers or computing equipment
 - Electronics power management
 - Efficient other electronics
 - Other
 - **Lighting:**
 - Shelter lighting
 - Outdoors lighting
 - Lighting controls
 - Other
 - **Power distribution and generation:**
 - Energy savings through power distribution (e.g., voltage control, DC power distribution)
 - Hybrid or renewable generation
 - More efficient generation
 - Other
 - **Water:**
 - Water re-use
 - Water generation
 - **Other loads:**
 - Water conservation
 - Other
 - Kitchens
 - Laundry
 - Water heating/cooling
 - Pumping
 - Security systems
 - Other
 - **Energy monitoring and management systems**
 - **Demand response (end-device power control based on power-generation conditions)**
 - **Reduction in camp logistics energy**
 - Lighter equipment
 - Reduction in amount of equipment
 - Other
 - **Other non-materiel solutions**
 - **Other**
- Applications will be invited to select one as Primary area of impact and one as

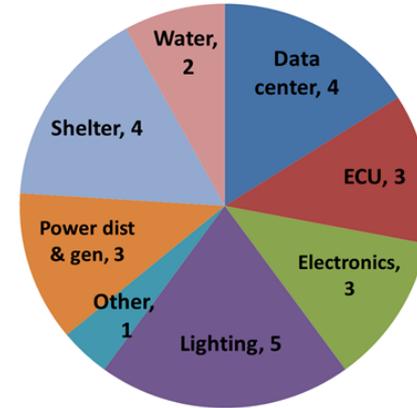
Results: Technology Intake Snapshot



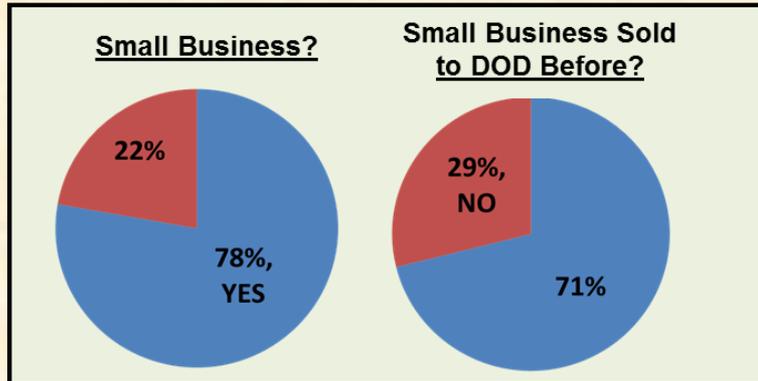
Applications Reviewed by Technology Type-111



Applications Accepted for Lab Assessment-25

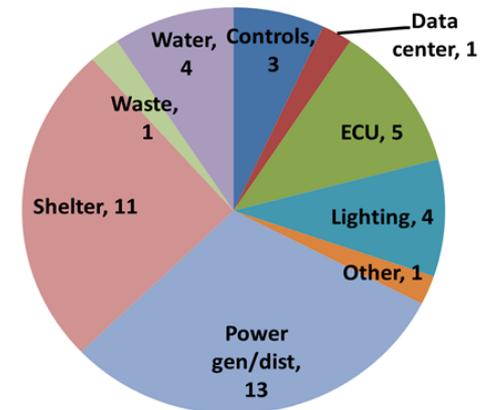


Submissions by Small Business



*Based only on "Accepted" applications

Applications Accepted for Field Assessment-43



TROPEC Results: INFORMATIVE PRODUCTS

POTENTIAL

WORKS

Quad Chart

FOUO//PKY Revision: Oct 2, 2013
I-NET# 1768431575, 1.5 Ton Single Phase ECU, HDT Global

System Description:
Ruggedized small capacity ECU with 115V single phase power connection, with soft-start and true on/off compressor operation.
Specs: 18000 btuh/gross cooling capacity at 95F, +20Amps - 115V single phase power (30A breaker reqd); 275 lbs; foam-filled wheels and forklift slots; std 12" duct connections; low ambient cooling to 50F; on-board thermostat control; R-410a refrigerant; able to operate on 10 deg incline; remote thermostat ctrl available

Metrics:
Unit cost: \$10,000 each Simple Payback: 0.4 years
% Lighting/ECU/etc.) energy savings: 50% per unit
% JP-8/yr savings: 150-man camp: 18% of annual camp JP-8 usage
Pros/Cons compared to competing technologies:
Pros: Soft-start limits inrush current to generator; compressor shuts off when thermostat is satisfied.
Cons: Smaller capacity means a typical shelter would likely need to have a radiant barrier insulation blanket installed. For 30S billeting tent cooling, two of these ECUs may be required per tent.

Innovation Readiness:
TRL: 9 MRL: 7
Details: Military-ready prototype was demonstrated at the October 2012 ExFOB at Camp Pendleton. A version is now available for purchase.
Known testing to date and results:
First prototype demonstrated at fall 2012 ExFOB at Camp Pendleton.
MILTECH evaluation noted some minor changes to improve unit but characterized it as "well packaged with heavy components mounted well, proper finishes, etc."
Eval Date: 18 Sept 2013

Sponsorship:
No known military sponsorship yet. E30 recently purchased two units in July 2013 for further evaluation.

Recommendation:
High level lab assessment then field testing in a tropical environment. Existing field demonstrations have been in a hot/dry climate and did not demonstrate dehumidification capabilities in a wet climate.
Lab reviewer: Heather Buckberry, buckberryh@omni.gov; 865.576.2109
DoD reviewer: Rosalie Barang, rosalia.barang@navy.mil; 805.382.3498



Lab Assessment Reports

Transformative Reductions in Operational Energy Consumption (TROPEC) Laboratory Assessment Report

ASETEP Seal October, 2013

Transformative Reductions in Operational Energy Consumption (TROPEC) Laboratory J

ASETEP Seal October, 2013

Transformative Reductions in Operational Energy Consumption (TROPEC) Laboratory Assessment Report

ASETEP Sealed Server October, 2013

Imagined Pump & Cool Pads
Liquid to Air HEX
Return Air Guide
Sealed Air Guide
Airflow

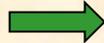


TRANSFORMATIVE REDUCTIO OPERATIONAL ENERGY CONSU (TROPEC)
LIMITED OPERATIONAL ASSESSME TECH SUMMARY - HDT

BALIKATAN 2013 (BK13) CROW VALLEY, PHILIPPIN
OCTOBER 2013

TRANSFORMATIVE REDUCTIONS IN OPERATIONAL ENERGY CONSUMPTION (TROPEC)
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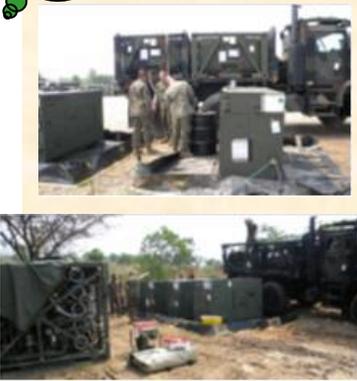
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PERFORMS



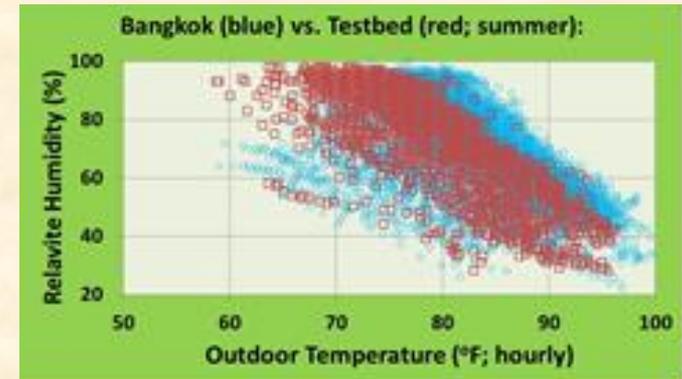
Field Assessment Quick-Looks

Field Assessment Mini & Full Reports



Technology Assessments: Lab-Based

- **Purpose:**
 - Validate performance
 - Quantify impact
 - Assess field readiness
 - ID improvement opportunities



**Weather mapping:
Outdoor testbed vs Bangkok**



Chamber testing (lab)



Testing at vendor site



Outdoor testing (CONUS)



Lab Technology Assessments

- 22 complete, 3 in progress
- Cross Data Centers, ECUs, Structures, etc.
- Full listing available

TROPEC Laboratory Technology Assessments		
Technology Area	Name of Technology	Technology Description
Data Center	Small Scale Air Conditioning for Electronic Enclosures	Miniature air conditioning/dehumidification unit for cooling electronics enclosures.
Data Center	Direct Liquid Cooling of IT Equipment	Sealed server liquid cooling to cool electronic equipment and push the heat to the outside environment.
ECUs	High Efficiency, Ductless Split Heat Pump System	High efficiency ductless split heat pump system with 18 SEER inverter driven precharged compressor package.
ECUs	Solar Powered DC Air Conditioner	DC powered high efficiency ductless split cooling unit
Electronics	Electronic Voltage Regulation	Regulate line to neutral voltage on 120/240 V split phase services to improve efficiency and reliability of motors.
Generator	Portable Hybrid Power Systems	Hybrid power systems using portable solar and generator power sources to provide operational continuity and reduce fuel use.
Lighting	Portable External Lighting Solar Power	Portable solar power charged battery system for outdoor lighting fixtures to replace trailer mounted deisel generators.
Shelters	Tent Liner Low-Emittance Surface Coatings	Low emittance interior surface coating that reduces radiation heat exchange from heated surface to interior space.



FY14/15 Field Assessments



Country	Venues	FY14	FY15	Technologies Being Assessed by TROPEC
1. Guam	Task Force Talon	Q2 thru	Q2	Structures (air supported, rigid), ECUs, Wide-Area Lighting, Generator
2. Japan, Okinawa	JWTC	Q3		Power management system
3. Philippines	Balikatan CWP S&T Center	Q2 Q3/Q4 TBD	TBD	Lighting Renewable energy system
4. Australia	Talisman Saber		Q4	Structures (semi-rigid, rigid), Generator, Hybrid Power/MicroGrid Systems, Server Cooling
5. Thailand	Cobra Gold Crimson Viper	Q3	TBD TBD	
6. USA, HI	RIMPAC Lava Viper	Q4 TBD	TBD	

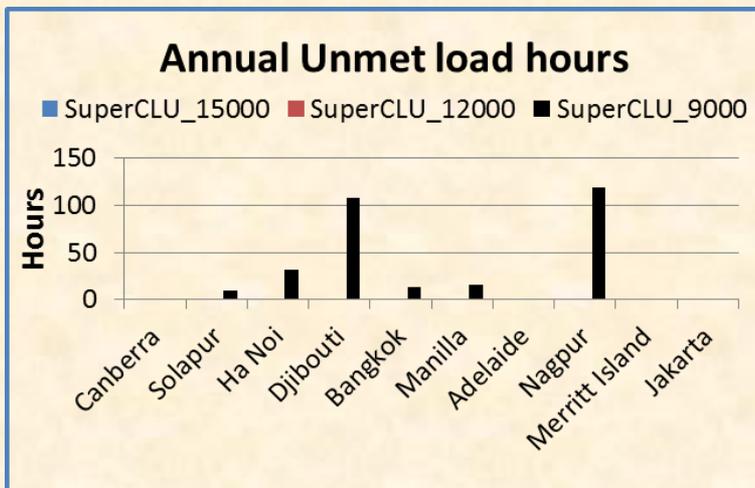
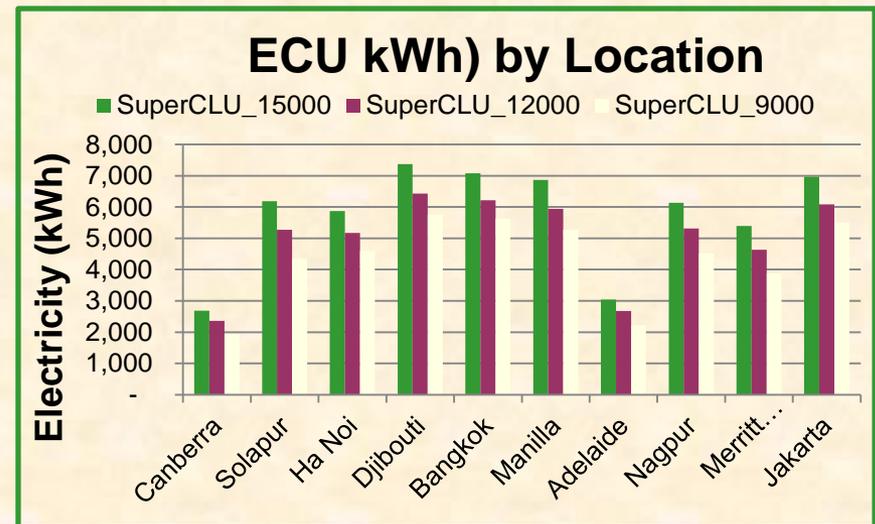
Field (User) Technology Assessments

- 20+ completed/in progress, 20+ additional candidates
- Cross multiple technology areas

TROPEC Field Technology Assessments		
Technology Area	Name of Technology	Technology Description
Controls	Programmable Thermostat with Passive Occupancy Sensor	Self-programming thermostat with passive occupancy sensing
Controls	Battery Charging	Provides sequential and multiple power source charging; linking of power managers in a network; and direct powering of man-packable devices.
ECUs	ECU with Modulating Scroll Compressor	ECU with soft start capacity and modulating scroll compressor
Generator	Multi-Fuel Generators	Lightweight, low noise, modified COTS portable generator capable of starting and running on JP-8 and other heavy fuels.
Lighting	Portable, Highly Efficient Lighting	Portable, solar-powered, high efficiency, high beam lumination for flood or spotlight application conditions.
Power Gen	Hybrid Power System	Auto-start hybrid power system that has options for use with wind or solar panels.
Shelters	Inflatable Modular Shelter	Inflatable modular shelter allowing for multiple configurations and large-scale applications.

TROPEC: SuperCLU Shelter Modeling and ECU Analysis for Navy

- Modeling effort
- Three different possible ECU sizes
- 10 Locations
 - 8 PACOM AOR, 1 AFRICOM (Djibouti), 1 CONUS
- Goals:
 - Minimize ECU energy
 - Minimize ECU capacity to avoid humidity issues from short-cycling
 - Minimize unmet load hours



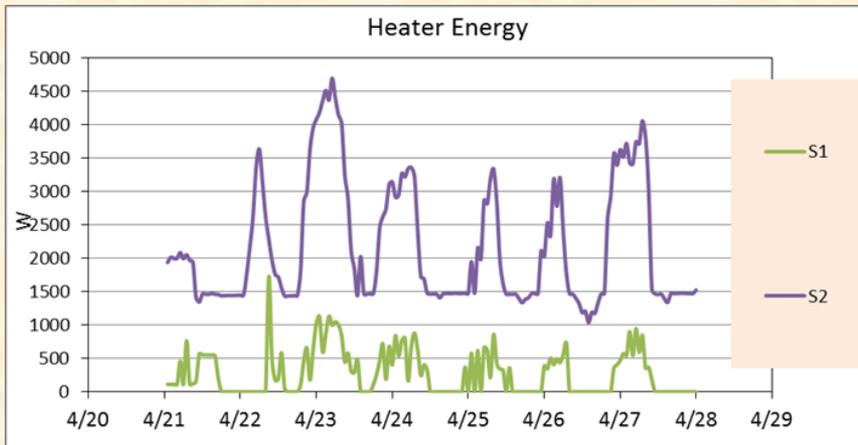
TROPEC/ORNL: Improved B-HUT/ SIP-HUT Initiatives for Army/CERL

- Modeled baseline & improved B-Huts, SIP Hut
- Instrumented huts for performance measurements/remote data collection
- Data analysis
- Goals:
 - Minimize energy use
 - Develop improved B-Hut and advanced SIP Hut designs

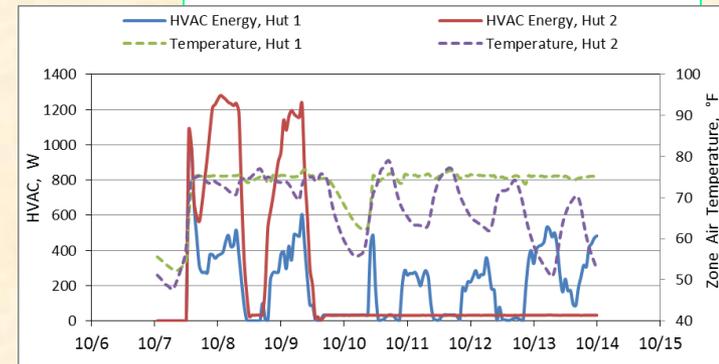


Improved Hut (Hut 1 or S1)

- Continuous air barrier-15# asphalt-based organic felt
- R-13 fiberglass batt insulation on wall cavities
- R-25 fiberglass batt insulation on floor cavities
- R-39 fiberglass bat insulation on attic floor
- R-15 XPS insulation on doors
- R-15 XPS insulation on the crawl space skirting panels
- Attic baffles to ventilate the unconditioned attic space



April: 80%+ space conditioning energy savings



Oct: 60%+ space conditioning energy savings



Guam 2014: Task Force Talon “Tropical” Field Assessment



Solar Panel Shade Testing



Shelter/ECU Testing



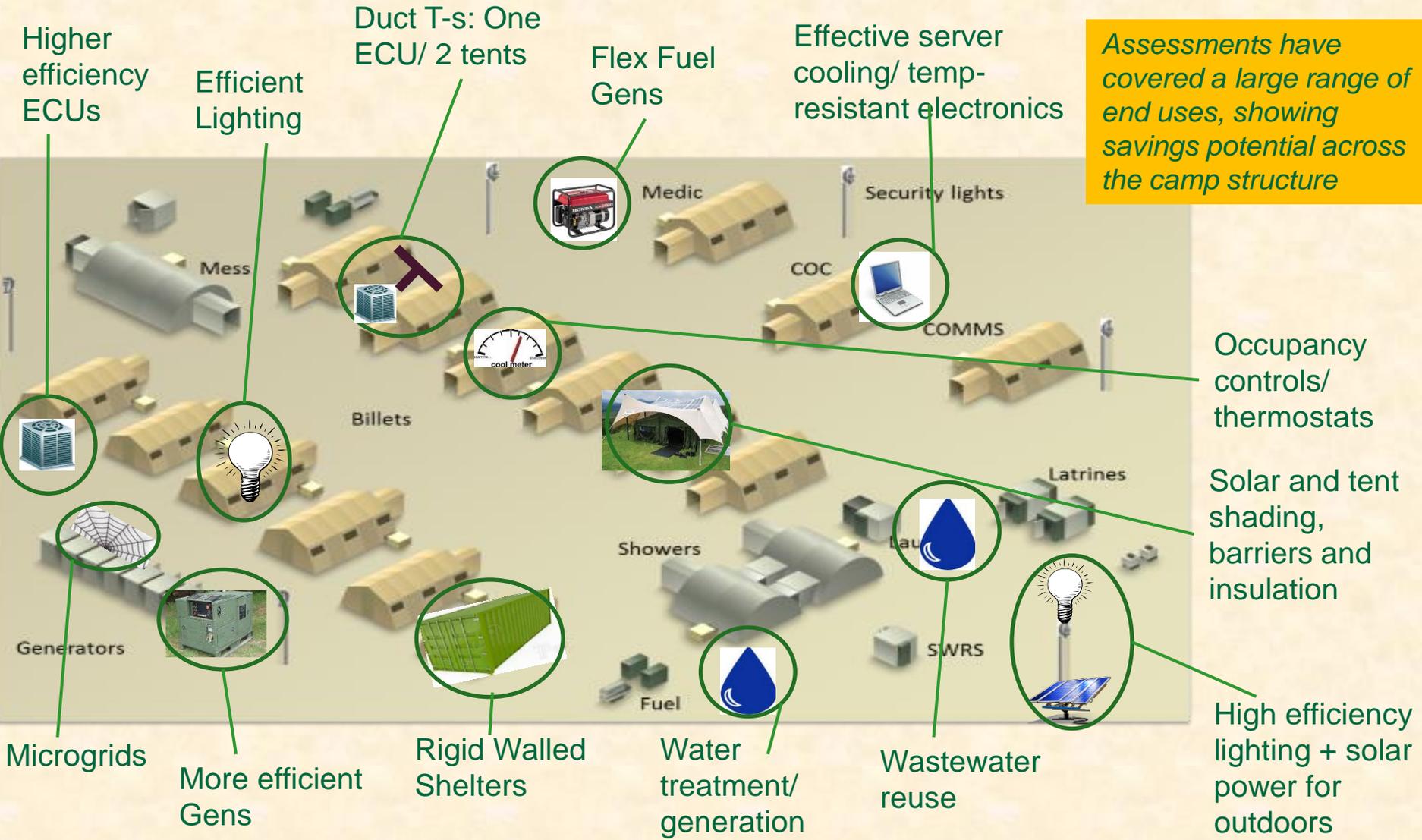
AirBeam Maintenance Shelter Testing

Camp Op Energy Improvements



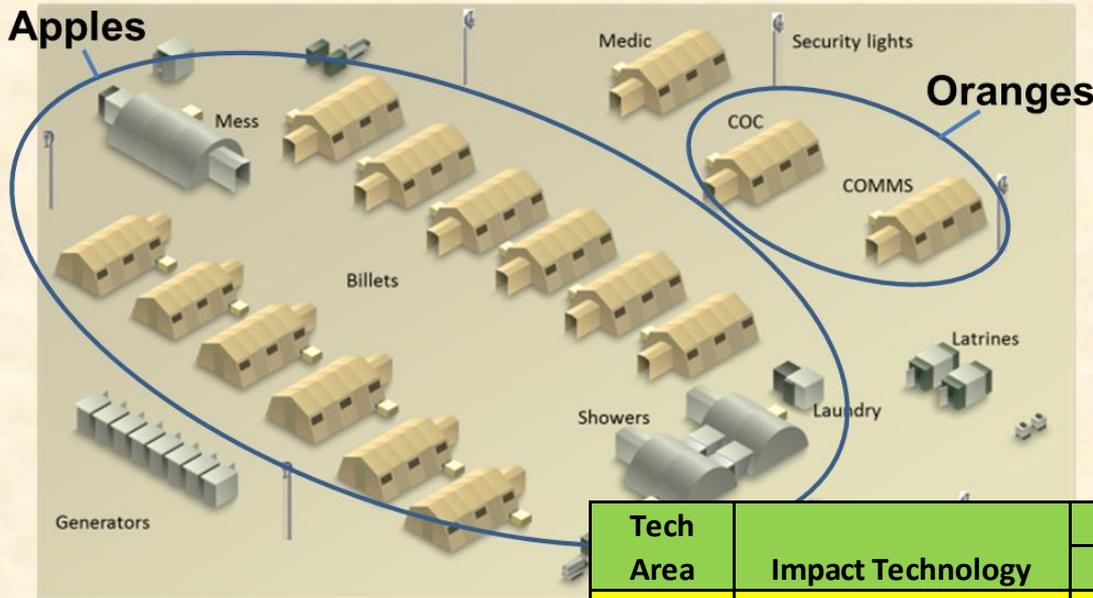
TROPEC-ASSESSED SOLUTIONS HAVE SHOWN WAYS TO IMPROVE CAMP ENERGY CONSUMPTION.

Assessments have covered a large range of end uses, showing savings potential across the camp structure





“Impact Technologies”



- a. Insulation*
- b. Shading or radiant barrier (all)
- c. Tandem tents*
- d. Alternative ECUs (all structures)
- e. Tandem ECUs (alternative or MILSTD)
- f. Occupancy control*

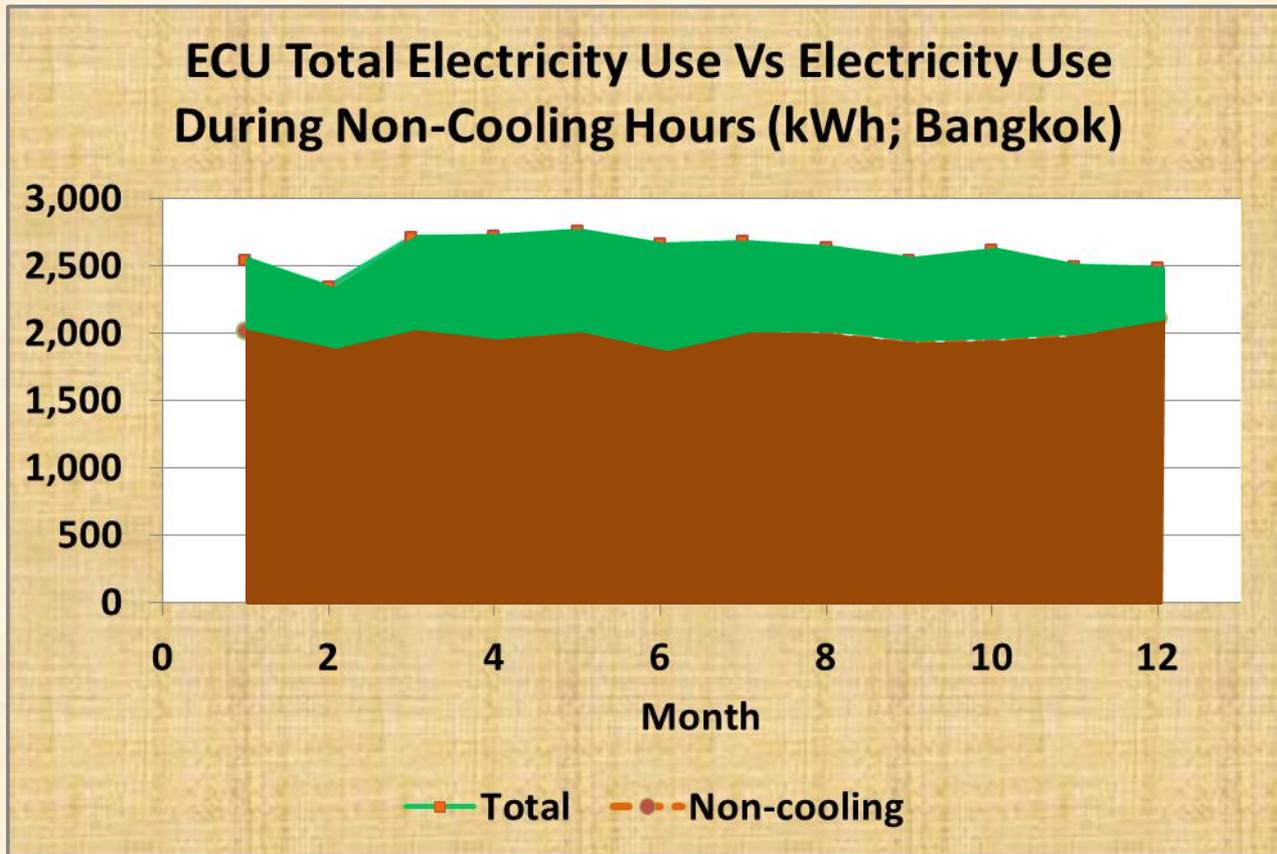
*Excl. COC/COMMS

*Oranges-24/7 occupancy, high internal loads
 Apples-Periodic occupancy, low internal loads

Tech Area	Impact Technology	SOS Solution Set						Assessment
		1	2	3	4	5	6	
Shelters	Insulation	X	X	X	X	X	X	Field
Shelters	Reflective barrier	X	X	X	X	X	X	Field
Shelters	Tents-Tandem		X					Lab/Field
ECUs	ECU-Variable capacity	X						Field
ECUs	ECU-Split			X				Lab
ECUs	ECU-Small capacity				IP			Lab
ECUs	ECU-Tandem					X		Lab
Controls	ECU-Occupancy control						X	Field

MILSTD ECUs

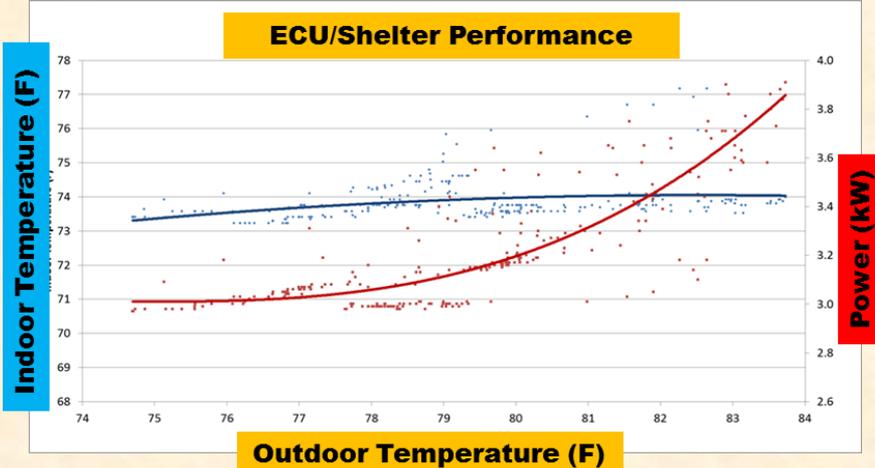
ECU Electricity Use in Non-Cooling Hours is 80% of the Problem -- Get Them Off!



*ECU (3 ton) on radiant, insulated tent (450sf)

ECUs (cont.)

Low/No Load Power Remains a Concern



ECUs: Near Term

ECU	Maturity - Mil/Comm	Performance Validated
Modulating capacity (full)	M/C	IP
Modulating capacity (2-stage)	C	NA
Small capacity	M/C	IP
Split-system	C	Y/IP
Direct current	C	N
Heat pump-air source	C	N
Heat pump-air, cold-climate	C	N
High-efficiency AC	C*	N

Mil/M-military, Comm/C-commercial, IP-in progress, NA-not applicable
 *Design complete, but not commercialized.

ECUs: Modulating Capacity



- Pros:
 - May be off when unneeded
 - Soft-start: pack more on generator
 - Energy use ~ load
 - More comfort
- Cons:
 - Much more complex than current MILSTD

ECUs: Small Capacity (<=1.5 ton)

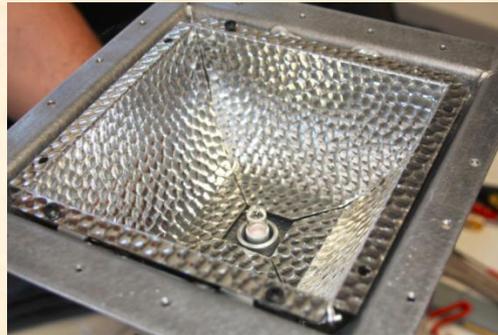
- Pros:
 - Off when unneeded
 - Low power, softer-start: pack more on generator
 - More comfort
 - Small weight/cube
- Cons:
 - Balancing generators (1-phase)
 - Capacity sometimes too small



TROPEC's Cross-Camp Look Can Add Value: Partnered Vendors for Synergistic Product

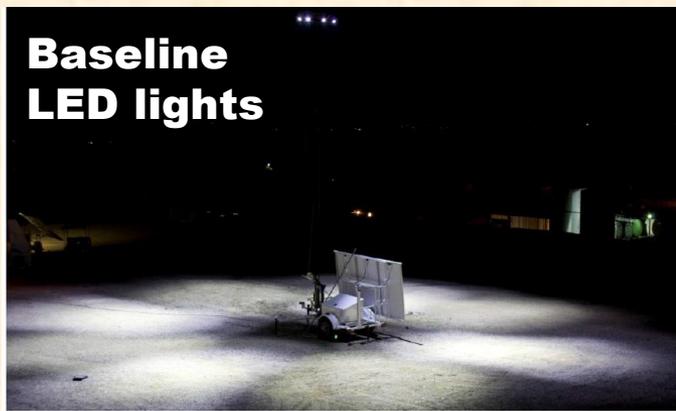


Plasma Light Fixture



RESULTS:

- Brighter, more uniform security lighting
- No fossil fuel use in most PACOM areas



Improved



Lighting





Transition: Next Steps for Working with JACOTAS & Other Partners

- **Get working agreements in place and build working relationships**
 - PM FSS, PM SWAR, E2O, NSRDEC, E2S2, MARCORSYSCOM, AFCEC, SOCPAC, ...
- **Build on current success to conduct additional assessments aligned with DOD's turn toward Pacific/tropical locations**
 - Cost-share assessments currently
- **Extend value**
 - DOE (EERE/OE)
 - DHS, FEMA, First Responders (military and non-military)



Questions?

www.tropec.net

TROPEC POCs:

- **Technology Assessment Partnering**
 - Melissa Burns (PACOM, J81), melissa.burns.ctr@pacom.mil
- **Field Assessments**
 - Rosalie Bareng (NAVFAC EXWC), rosalie.bareng@navy.mil
- **Lab Assessments**
 - Terry Sharp (ORNL-ECUs, Structures, Other), sharptr@ornl.gov, 865-574-3559
 - Rich Brown (LBNL-Data Centers, Electronics, Lighting), rebrown@lbl.gov