Transformative Reductions in OPerational Energy Consumption Update

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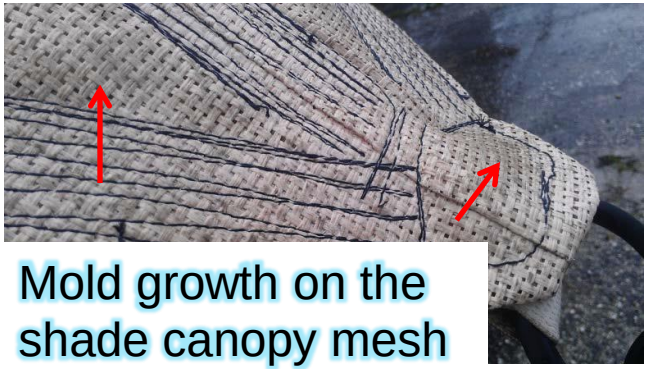
What is TROPEC?

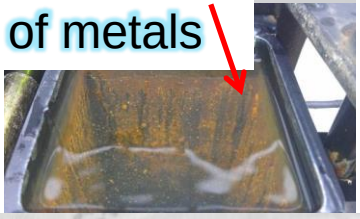
- Expeditionary energy technology identification, assessment, and transition program
- Entirely tropical-environment focused (USPACOM AOR)
- Scope is POR, mil-ready, and COTS technologies

Why Tropical? Differing Challenges!

- Tropical Environment Necessitates Unique Approach to Solutions
  - Technology not Suitable to Tropical Climate
    - Leads to degradation of infrastructure
      - High wind from tropical storms
      - Water infiltration and condensation
      - Hot, humid climate



Mold growth on the shade canopy mesh

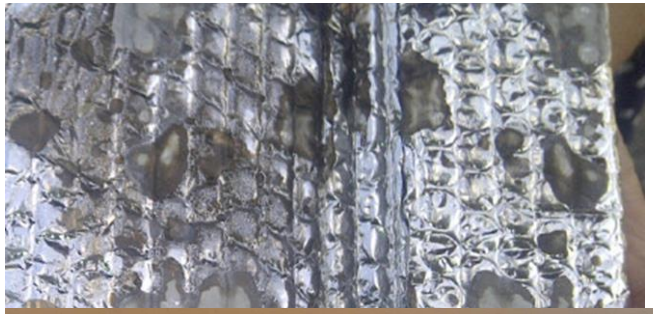


Corrosion of metals

Significant water Infiltration

Overworked and faulty ECU/HVAC

Heat/moisture-induced degradation of radiant barrier



Adhesives failing and corrosion on surfaces

TROPEC Process

Solutions identification

Innovators submit energy-saving technologies through Innovations Network (I-NET)

- 122 submitted to date and reviewed for relevance, readiness, and results
- 76 accepted for evaluation

Solutions evaluation

High-impact technologies are first assessed in controlled environments, then assessed in field environments

- 30 accepted for lab assessment
  - 3 Currently underway
- 31 accepted for field assessment
  - 10 Currently underway
- 2 Accepted for lab and field assessment

Program transition

Working with partners and services in the field to provide sites with permanent solutions

- Example:
- 8 Area Light Carts purchased by REF
- 8 Purchased by the 94th AAMDC

Program partnerships

Potential transition partners are identified and opportunities within and beyond DoD are explored

8 Signed MOA PARTNERS:

- PEO Soldier
- PM-MEP
- PM-SFSS
- AFCEC
- 249th Prime Power
- U of Hawaii
- 94th AAMDC
- NSRDEC

Partners in tropical tech assessments:

- NSRDEC
- PM-FSS
- MCSC
- NSWC Carderock
- CWP
- DOE
- NAVFAC EXWC
- SPAWAR
- NECC
- USMC E2O
- PEO Soldier

TROPEC Targets - Camp Op Energy Improvements

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

ECUs: Variable-capacity, constant speed

Lighting: LED

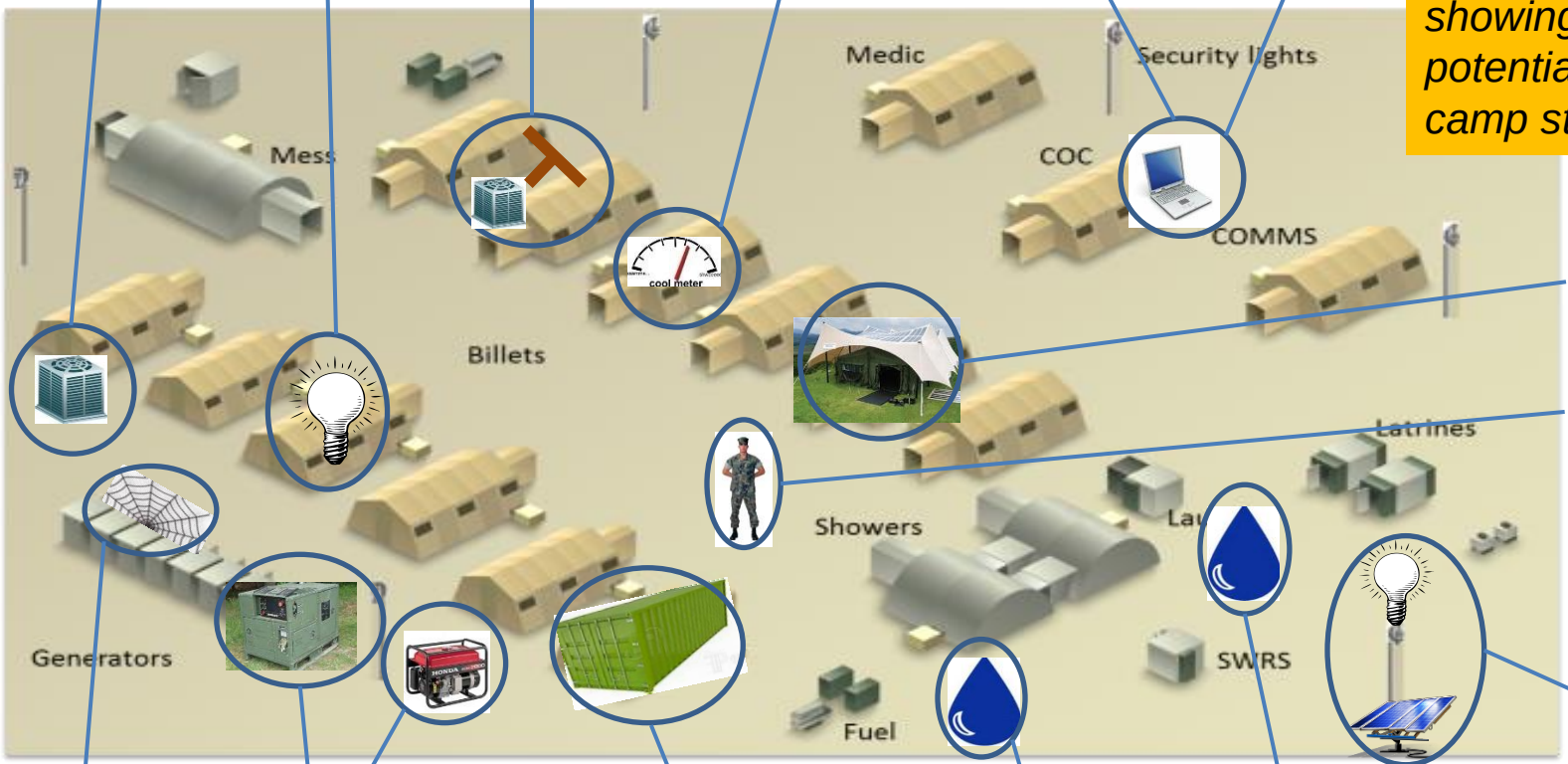
Space conditioning: Duct Tee - 2 tents/ECU

Controls: Occupancy controls

Electronics: High-temp servers

Electronics: Efficient server cooling

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



Shelters: Shade/radiant barrier/insulation

'Soldier' Power

Lighting: High efficiency area lighting + solar power

Microgrids

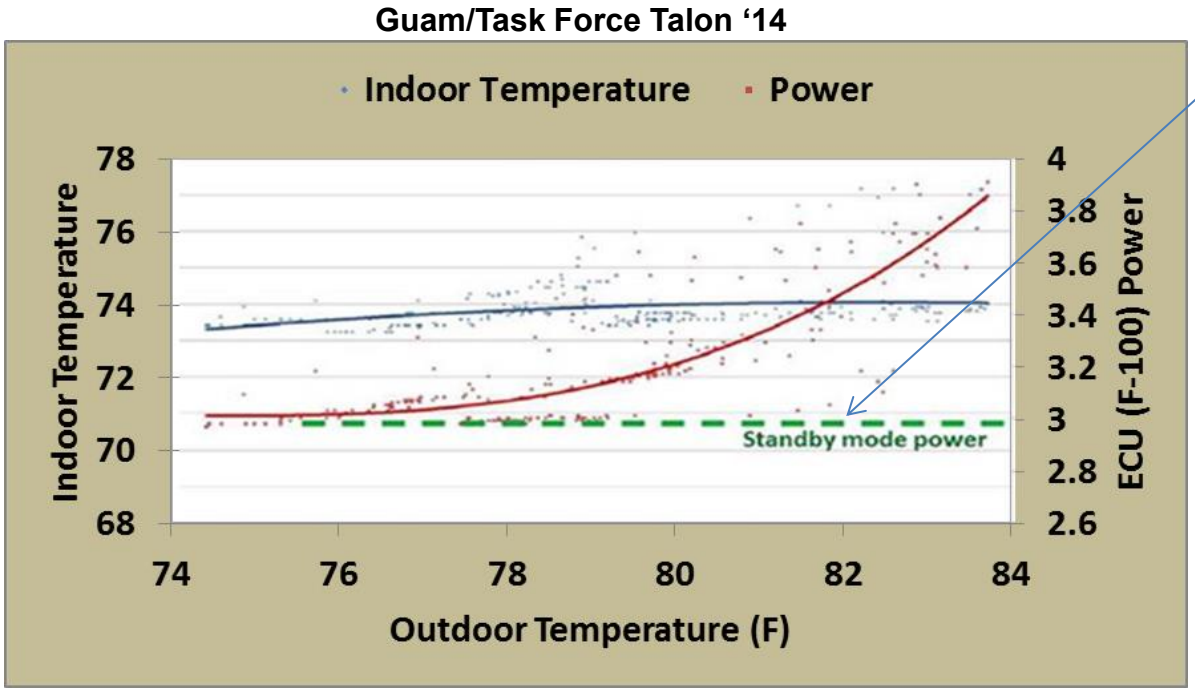
Generators: More efficient & flex fuel

Shelters: Rigid-walled

Water: Water generation

Water: Water reuse

Target: ECUs - Reducing Standby Power is Critical



ECU standby power required is approximately 3kW.

Based on NSRDEC STO-D 300-PAX Baseline Camp: Fuel Use of ECU's While Running in the Non-Cooling (Standby) Mode Equals =

~75,000 gal JP8/yr*

Tent Configuration (unoccupied)	ECU Cooling Hours (hr/yr)	ECU Non-Cooling Hours (hr/yr)	% Of Year ECU Is Not Cooling
Unimproved	3,068	5,692	65
Insulation & radiant liner	1,331	7,429	85

Conclusion:
Over 1 year, ECU fuel use while running in standby mode (not cooling) equals an extra 2 months of camp-wide operations without fuel resupply.

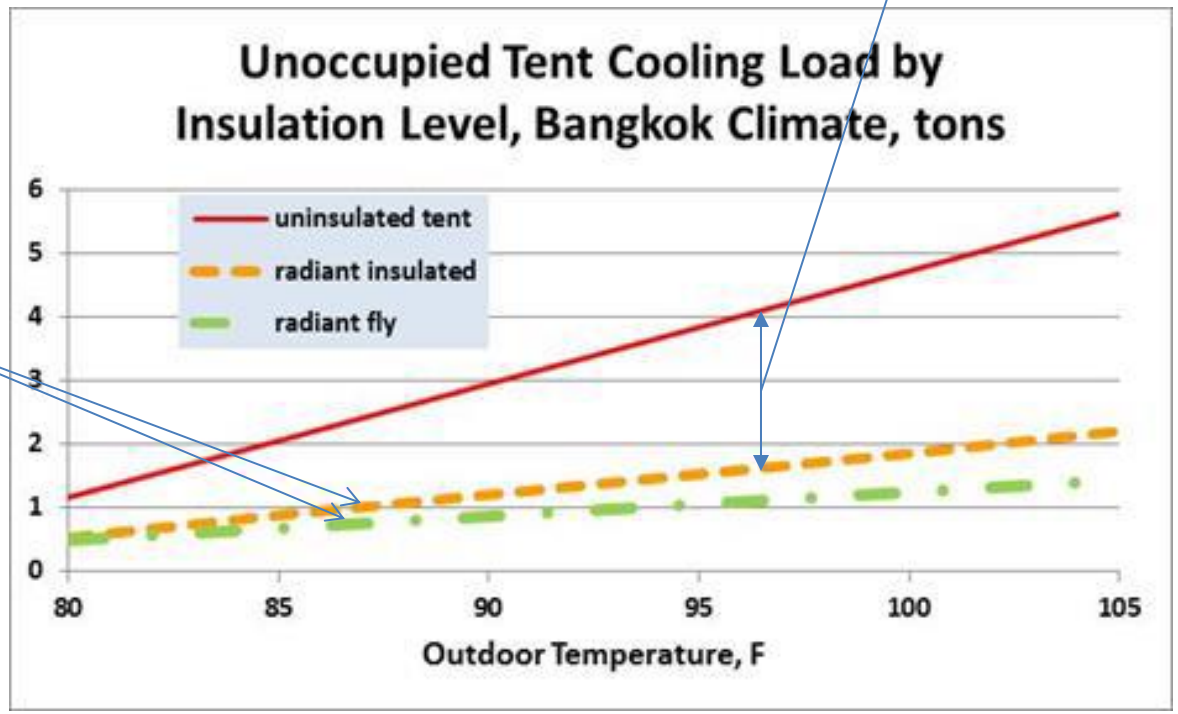
***75,000 gal JP8/yr = (3kw x 8760hrs /yr x .65 x 33 ECUs x 1 gal/7.5 kWh)**

Target: Shelters - Addressing Cooling Load

- **What is important:**
  - Stopping solar load
  - Reducing thermal load

Impact of internal radiant shielding and thermal insulation on tent cooling load.

Solar loading can be blocked via internal or external radiant shielding with nearly the same effectiveness.



Target: Controls and Electronics

- **Thermostats**
  - Primitive
  - High thermal mass (slow to respond)
  - Opportunities: Occupancy control, far better comfort, fuel savings
- **IT Equipment**
  - Opportunities:
    - High-temperature servers
    - Dedicated cooling (rejecting heat outside; non-DX cooling)
    - Limited fuel savings

Impacts: Single Solutions vs Integration*

Solution →

	Tent Configuration	Use More Efficient ECU		
		F-100 ECU (MWh/yr)	IECU (MWh/yr)	Energy Use Reduction
Improve Structure	Uninsulated tent, 5-ton ECU	38.5	19.4	50%
	Insulation, radiant liner, 5-ton ECU	32.8	11.2	66%
	Energy Use Reduction	15%	42%	71%

← Value of Integrating the Two Solutions

Notes:
1. Results are for unoccupied tents (occupancy would increase consumptions but savings percents would likely be similar).
2. Existing camps are dominated by legacy ECUs which are much more inefficient than either the F-100 or IECU. Thus, expected reduction percentages at existing camps would be even larger when the legacy ECU is replaced.

*Results for tropical climate (Bangkok)

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Solution →

Right-Size ECU	IECU (MWh/yr)
Insulation, radiant liner, 5-ton ECU	11.2
Insulation, radiant liner, 3-ton ECU	7.2
Energy Use Reduction	36%

Value

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Reduction From Integrating All Three Solutions:	81%

RESULT: Over one year, this amount provides an extra 5 months of camp-wide operations without fuel resupply.

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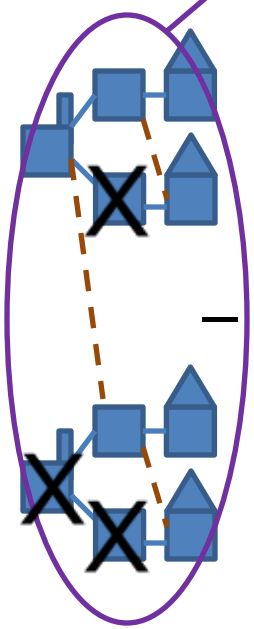
What Can I Do In The Field Today?

(without buying new generators, ECUs, or tents)

- For legacy ECUs with very high standby (non-cooling) mode energy use (these ECUs dominate existing camps; ECUs like the TAMCN: B0008, 5-ton ECU)
  - Tandem tents on 5-ton ECUs (insulating and using shades or radiant barriers on tents enables tandeming)
    - Results: 17% camp-wide fuel savings (1 of every 2 ECUs go off; 1 of every 2 generators go off; ~1 in 5 fuel resupply trucks no longer needed)



  - Operate ECUs in lead/lag mode (where configured with two ECUs per generator; minor controls modification is required)
    - Results: Lagging ECU powered down 65+% of time; 8% camp-wide fuel savings (1 in 12 fuel resupply trucks unneeded)

TROPEC Field Assessment Venues

Country	Venues	Technologies Being Assessed by TROPEC	Status
1. Guam	Task Force Talon	- Air Beam Maintenance Enclosure - Air Beam w/F100 - Dehumidifier ECU - Wide-area light cart - Renewable energy area lighting system - Multi-fuel generator - SuperCLU (w/ NAVFAC EXWC) - Shelter systems (w/ NSRDEC)	Final Reports Complete

Country	Venues	Technologies Being Assessed by TROP
2. Japan, Okinawa	JWTC	- Squad power harvester with PV - Flexible solar panels/blanket

Country	Venues	Technologies Being Assessed by TROPEC	Status
3. Philippines	Balikatan CWP S&T Center	- Hybrid Power Technologies - Renewable energy system	Final Reports

Country	Venues	Technologies Being Assessed by TROPEC	Status
4. USA, HI	Kilauea Military Camp Schofield Barracks	- Waste to energy - Wearable power	Ongoing Phase 2

Country	Venues	Technologies Being Assessed by TROPEC	Status
5. Philippines	Balikatan 2016	- Micro grid - Micro grid/hybrid power	March 2016

Country	Venues	Technologies Being Assessed by TROPEC	Status
6. USA, CA	Twentynine Palms	- Fuel mgmt. prototype - BEYOND: Behavioral Energy Operations Demonstration - E2C Fuel Study	March 2016 In Development In Development

Technologies in Past TROPEC Assessments

Technology Area	Assess Type	Scope of Technology
Controls	Operational	Programmable Thermostat/Occupancy Control
Controls	Operational	Battery Charging
Data Center	Lab	Air Conditioning of Electronic Enclosures
Data Center	Lab	Liquid Cooling of IT Equipment
ECUs	Operational	ECU with Modulating Scroll Compressor
ECUs	Lab	High Efficiency, Ductless Split Heat Pump System
ECUs	Lab	Solar Powered DC Air Conditioner
Generator	Operational	Hybrid and Multi-Fuel Generators
Lighting	Operational	Lighting Controls
Lighting	Operational	Portable External Lighting Solar Power
Power Dist & Gen	Operational	Hybrid Power System
Power Dist & Gen	Lab	Hybrid Power Microgrid
Shelters	Operational	Radiant Barrier Insulation Liner
Shelters	Operational	Inflatable Modular Shelter
Shelters	Operational	Energy-Efficiency Expeditionary Shelter
Water	Lab	Water Production from Air System

TROPEC Field Assessment Results (sample)

Technologies Tested	% Reduction In End Use Energy Consumption	% Reduction In Fuel Consumption
Task Force Talon 2013-2015		
SuperCLU	32%-65.5%	
Solar Wide-Area Lighting Trailer	Potential to reduce	
Renewable Energy Area Lighting System	Potential to reduce	
Balikatan 2013 (BK13)		
Programmable Thermostat	12.86%	
Radiant Barrier	9.9%	
5-ton ECU (F-100)	27.1%	
Crimson Viper 2012 (CV12)		
AC Unit with Stage-2 Compressor	60%	
Insulating Radiant Barrier	21%	
LED Lighting	25%	
Hybrid Occupancy Manual Lighting Controls	48%	

TROPEC Lab Assessment Results

Technology Tested	% Reduction in Energy Consumption	% Reduction in Fuel Consumption
Hybrid Power System		24%-89%
DC Air Conditioning Unit	32%	30%
Hybrid Tactical Microgrid		64%
Heat Reflecting Coatings	4%-16%	6%-8%
SuperCLU	10%-43%	
Liquid Server Cooling	5,400kWh	500 gallons
Dedicated IT Cabinet Cooling System	5%-10%	
Plasma Lighting	15%-25%	

TROPEC Publication Repository on DTIC

www.dtic.com

- BALIKATAN 2013 TRANSFORMATIVE REDUCTIONS IN OPERATIONAL ENERGY CONSUMPTION (TROPEC) LIMITED OPERATIONAL ASSESSMENT REPORT
- TRANSFORMATIVE REDUCTIONS IN OPERATIONAL ENERGY CONSUMPTION (TROPEC) LIMITED OPERATIONAL ASSESSMENT REPORT
- TRANSFORMATIVE REDUCTIONS IN OPERATIONAL ENERGY CONSUMPTION (TROPEC) PAPER ASSESSMENT REPORT BUILDING-
- COALITION WARFARE PROGRAM HYBRID POWER INITIATIVE LIMITED OPERATIONAL EVALUATION FINAL REPORT REPUBLIC
- TRANSFORMATIVE REDUCTIONS IN OPERATIONAL ENERGY CONSUMPTION (TROPEC) ENERGY CONSUMPTION SURVEY
- TRANSFORMATIVE REDUCTIONS IN OPERATIONAL ENERGY CONSUMPTION (TROPEC) LIMITED OPERATIONAL EVALUATION FINAL REPORT

Field and lab assessment summaries are available at Tropec.net under Assessments

Other Relevant Thoughts and Summary

- TROPEC invites stakeholders to partner in tropical technology assessments
- TROPEC currently will share in the cost of assessments up to 50%
- TROPEC assessments occur year-round so technology insertion is available most times
- Technologies are readily available that reduce camp fuel use to the point of nearly doubling operational endurance without fuel resupply
- Existing camps do not have to wait on new energy technologies to significantly improve capabilities

Questions?

www.TROPEC.net

Access the website to find:

- *Description of solution areas of interest*
- *Short summaries of field assessments*
- *Short summaries of lab assessments*
- *Links to DOD operational energy partners*

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