Portable Solar Energy: A Renewable Energy Source For Forward Operating Bases
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Portable Solar Energy To Reduce Resupply Missions
Forward Operating Bases (FOBs) are essential to support tactical operations. A FOB is highly dependent on fuel based generators to provide operational energy. Forward Operating Bases
• Consume approximately 300 gallons of fuel daily
• Resupply convoy’s can require up to 2100 gallons
• Conveys are highly vulnerable to attack
• Attacks account for the largest number of fatalities

Development of a portable photovoltaic unit reduces resupply conveys by introducing a sustainable and reliable energy source.

Design Constraints And Operation
The unit is designed to be easily set-up and transported. To achieve this, mobility, versatility, and durability were considered:
• Parts must be readily available, for cost-effectiveness and easy repair
• Compactable for packaging and deployment
• Provide sufficient energy to decrease fuel use at various FOBs

The solar power unit is grid-tied to preexisting fuel generator sets on FOBs. The solar power unit is also designed to decrease the fuel use of heating, ventilating and air conditioning (HVAC) systems. HVACs consume 30-40% of total FOB energy.

Results For Modeled Energy Optimization
The National Renewable Energy Laboratory’s PVWatts Calculator models the estimated energy production of a photovoltaic system based on its geographical location and aggregated weather patterns. In order to maximize AC energy output, a single unit’s fixed angle is determined. A fixed angle of 20° is determined to be the optimal AC energy producer.

Results For Overall Solar Performance
SOLAR SYSTEM PERFORMANCE
A single solar system’s performance is modeled monthly for a year at a fixed orientation of 20°. Correlation between amount of solar radiation and energy output is consistent with optimal energy results.

HOURLY SOLAR DC ARRAY OUTPUT
A single solar system’s DC Array Output is modelled throughout a single day, June 21, at a fixed orientation of 20°. Peak energy output is consistent with peak solar radiation

ENERGY OFFSET
Total maximum portable energy produced by 16 units, one filled tricon, is 38112 kWh/yr. Annually, this offsets approximately 3450 gallons of fuel consumed on base and 24150 gallons of fuel consumed on route. (Modellled in Djibouti, Africa)

PROTOTYPE
Materials
• Solaria Power XT-355R-AC Panels
• Enphase IQ7 Micro-Inverter
• Anodized Aluminum Framing (corrosion resistance and light weight)

Features
• Preassembled, “All-in-One”
• Fixed Panel Orientation
• Foldable Panels
• “Slide-In/Out” Repair

Conclusion
Modelled Data
• Optimal energy output occurs with panels at a 20° angle
• Configuration with two panels facing west and two facing east
• Solar System Performance and Hourly Solar DC Array Output support this optimization

Prototype Increases Mission Capability
• Simple to set-up due to its preassembled features
• Easily stored by folding the four panels in half
• “Slide in” allows for panels to be removed for repair without complex disassembling
• Aluminum framing keeps units light in weight for easy lifting and carrying

Introduction of a portable photovoltaic unit supplies sufficient energy to decrease HVAC load on preexisting fuel generators, thus decreasing overall fuel use. Renewable energies provide a reliable and sustainable future for Forward Operating Bases.