Portable Micro-Grid Case Studies

Improved Power Reliability and Availability
through Intelligent Management

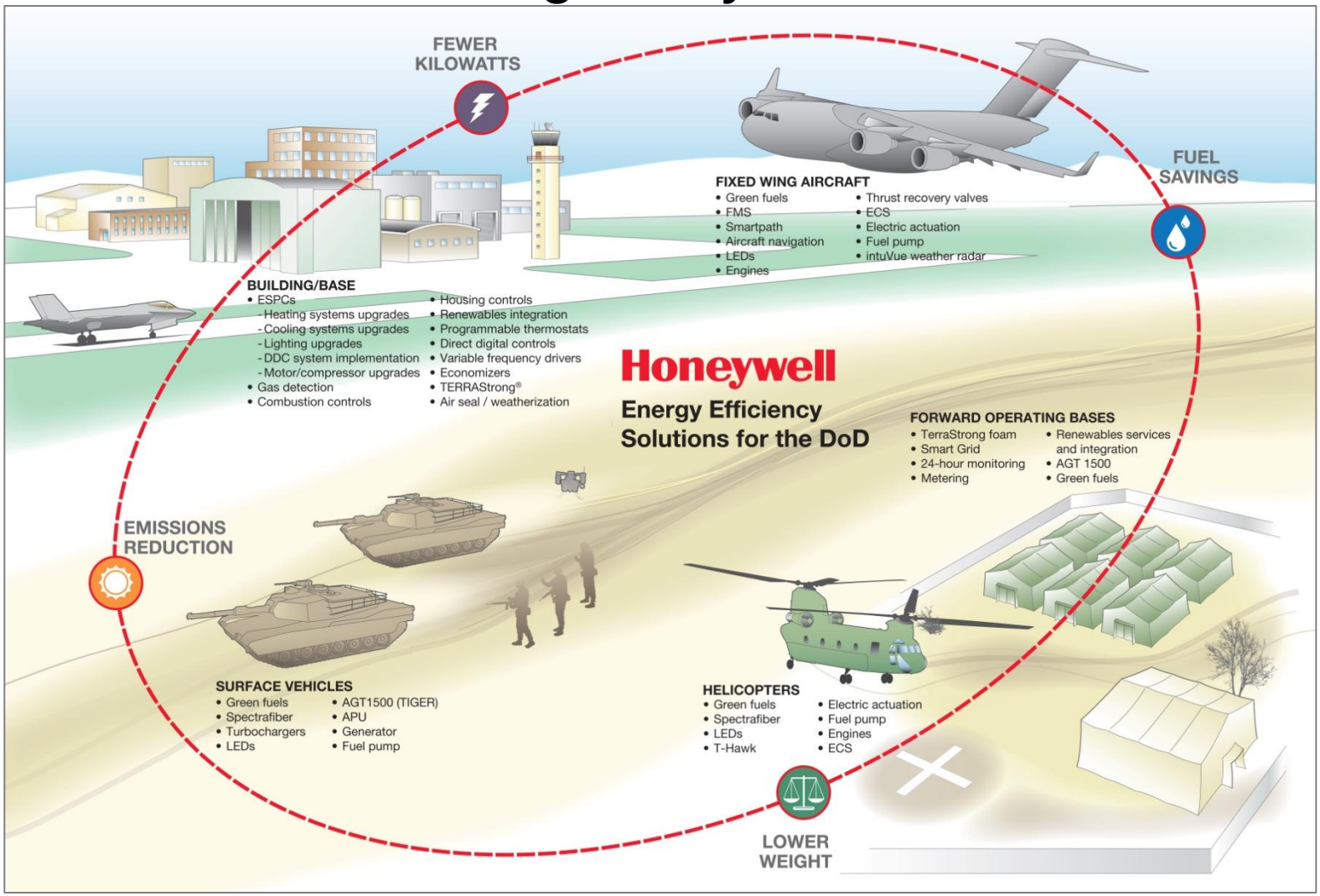
Honeywell

Case Study Overview

- Honeywell Energy Strategy
- Programs
  - TARDEC Smart Charging Micro-Grid
  - Mobile Micro-Grid Management System
  - SAIC TARDEC “Aloha” system
- Future/Recommendations

Note: Will not be covering Honeywell base/campus central power plant projects with integrated micro-grids

Part of Overall DoD Energy Efficiency Initiative – Touching Every DoD Mission



Honeywell Energy Strategy - DoD

FIXED AND FORWARD OPERATING BASES

•The Department of Defense energy spend is growing at 20% CAGR (‘03 – ’08) – in 2008 the Department spent $20 billion.

•DoD energy use and cost drove establishment of the DoD Energy Security Plan to address: Demand Reduction, Assurance of Supply

•Honeywell’s integrated energy efficiency offerings support the DoD plan across platforms, at installations and across Service operations.

•Honeywell’s offerings could result in annual savings for DoD of more than $4 billion.

Honeywell Smart-Charging Micro-Grid (SCMG)

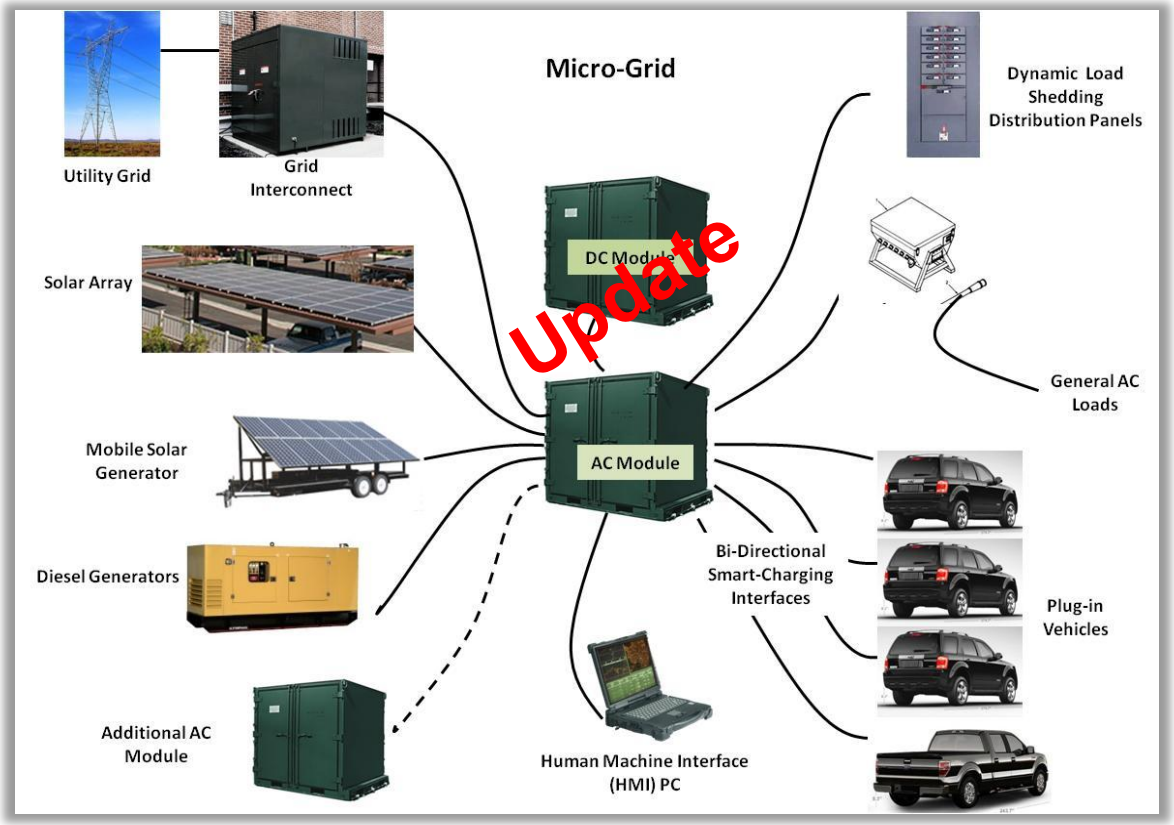
PROGRAM OVERVIEW

- US Army TARDEC funded
- Competitive bid, Cost Plus Fixed Fee
- Teamed with PowerSecure, Inc
- Coordination with TARDEC, Garrison Hawaii, HECO, State of HI
- Scope:
  - 250kW Portable intelligent micro-grid controller
  - Inputs: Utility Grid, Diesel Generators, Fixed Solar, Mobile Solar
  - Loads: Buildings and hanger including two data centers
  - Storage: 200kWh Li-Ion Batteries
  - Vehicles: 4 custom converted Bi-Directional PEV Ford Escapes
- Program start Feb 2010, Delivery/Install Oct 2010, Go-Live Nov 2010

TARDEC Smart Charging Micro-Grid

CONCEPT AND FEATURES

- "Hybrid" architecture synchs AC inputs with DC storage
- Automated control of sources, loads, priorities, islanding
- Management of 4 PEVs
- Intuitive operator interface
- Field reconfigurable
- NEC, IEC, UL compliant
- Fork lift and sling load portable
- Remote monitoring and control
- Cyber Secure
- Fast Demand Response if building loads



Fully Integrated with Multi-Layer Standby Power

Wheeler Army Airfield Installation

Bi-Directional Vehicle Charging

- Developed with Rapid Electric Vehicles, Vancouver, BC
- Plug-in electric vehicles
  - SAE J1772 bi-directional vehicle charging
  - 3 Hours full charge
  - Up to 100 mile range
- 4 Ford Escapes
- Coulomb ChargePoint Stations
- "Emergency" 120VAC chargers provided with each vehicle
- Performance data collected for analysis (Miles, charge times/levels, platform data, etc)
- Mobile solar generator "remote charging station"

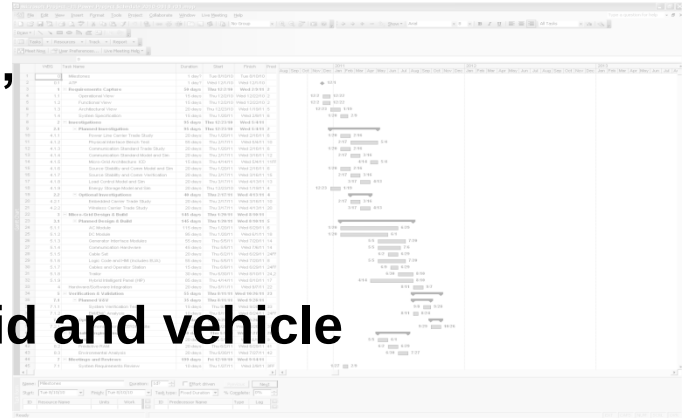
Honeywell Smart-Charging Micro-Grid (SCMG)

BENEFITS AND LESSONS LEARNED

- Benefits
  - Mission duration in island mode extended from about 72hrs without micro-grid to 7days+ with SCMG
  - System has bridged multiple blackouts/brownouts
  - Proof of concept for fully integrated, multi-layer micro-grid
- Lessons Learned
  - Energy Storage
    - Advanced controls required to fully utilize for renewable energy storage
    - Effective UPS and bridge for generator starts
  - Cyber Security
    - Access control and intrusion detection
    - Straight forward implementation – physical security longer term concern
  - Energy Surety/Grid Stability – Significantly improved for receiving base

Successful Proof of Concept – Operational System

TARDEC SCMG



- Complete installation and “Go Live”
- System Verification Test
- One year Evaluation
  - Continuous data collection on grid and vehicle performance
  - Monthly “drill” to exercise systems and perform maintenance
  - Grid performance
  - Battery performance
  - Vehicle performance
  - Lessons learned and design recommendations

Mobile Micro-Grid Management System (M3S)

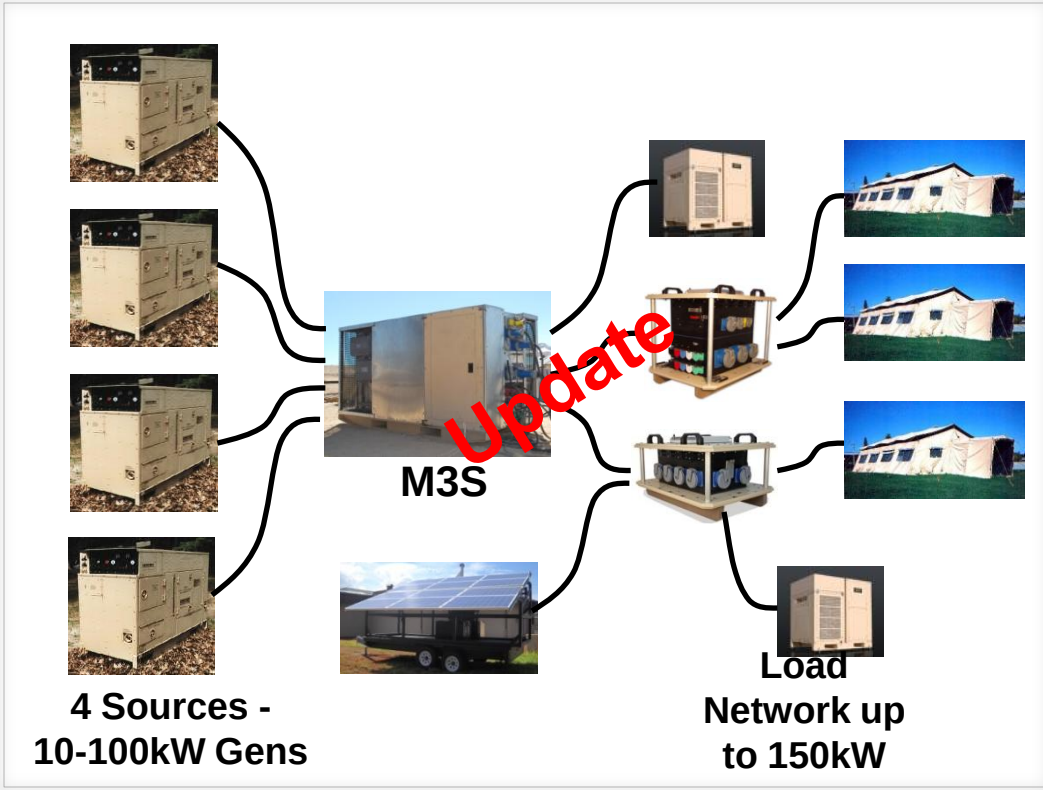
PROGRAM OVERVIEW

- Honeywell internally funded in response to USMC needs
- Teamed with PowerSecure, Inc
- Demonstrated at Twenty-Nine Palms, Camp Lejeune, Cairwent South Wales, then modified for UK MOD requirements and demonstrated in Cyprus
- Scope:
  - Portable intelligent micro-grid controller
  - Inputs: Utility Grid, unmatched MIL STD or commercial diesel generators
  - Loads: Military loads with PDISE, MEPDIS-R, or Smart Load Panels
- Program start May 2010, Demo at 29 Palms Aug 2010

Mobile Micro-Grid Management System (M3S)

CONCEPT AND FEATURES

- DC architecture with input and output inverters
- Automatically manages sources and loads up to 180kVA
- Multi freq/voltage inputs and outputs
- Automatically balances phases
- Saves fuel by matching sources to loads
- Intuitive User Interface for setup and operation
- Designed for transport on M353 Trailer
- NEC, IEC, UL Compliant



ExFOB Demonstration

Mobile Micro-Grid Management System (M3S)

LESSONS LEARNED

- Benefits
  - Automatically selects and controls generators
  - Sheds and restores low priority loads to bridge generator starts
  - Prevents grid crash when loads exceed sources
  - Based on verified functionality, fuel savings of 17% using only 2 sources. Much more possible with more sources.
  - 40% reduction in generator run hours
  - No damage from transportation or environment
- Lessons learned
  - Filtering and grounding are major challenges overcome
  - Generator start/stop controls required – customized, always possible
  - Organizational challenges to fielding systems

Successful Proof of Concept – Operational System

Honeywell/SAIC (Aloha) Micro-Grid

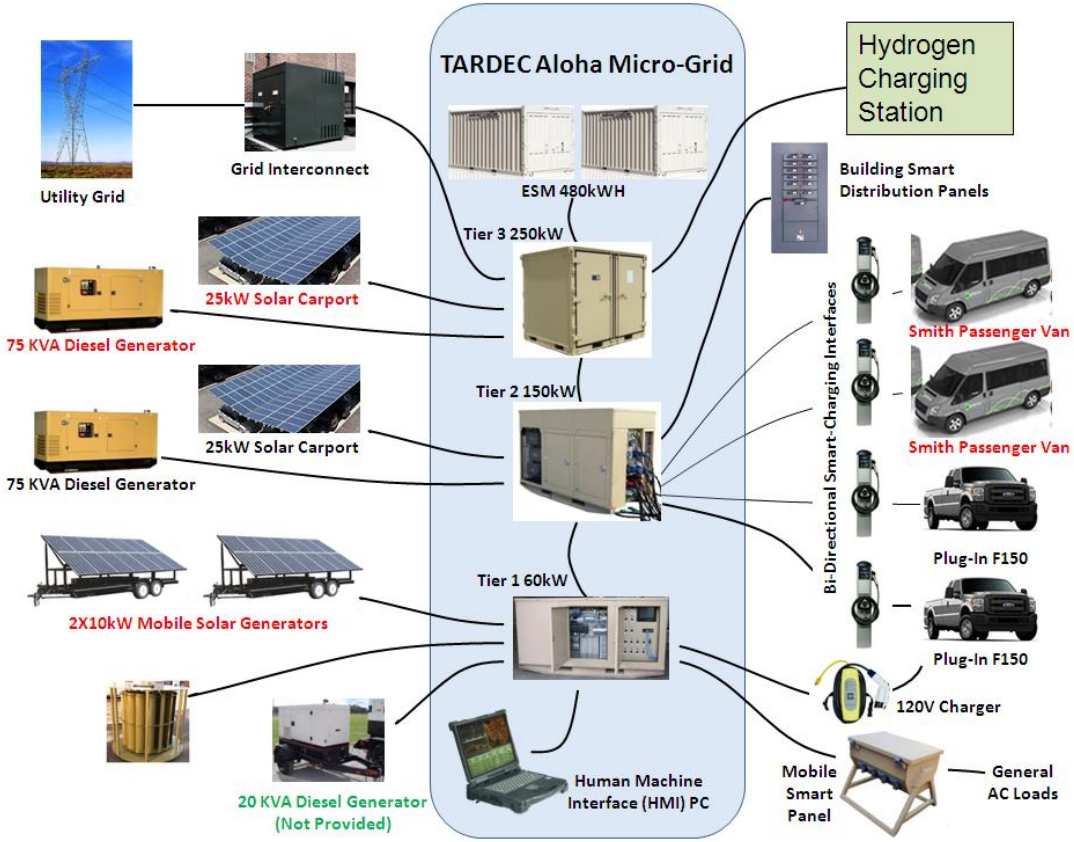
PROGRAM OVERVIEW

- US Army TARDEC funded
- Competitive bid, Cost Plus Fixed Fee
- Teamed with SAIC and PowerSecure, Inc
- Coordination with TARDEC, Garrison Hawaii, HECO, State of HI
- Scope:
  - Portable intelligent micro-grid controller - 3-Tier DC 400kW.
  - Inputs: Utility Grid, Diesel Generators, Fixed Solar, Mobile Solar
  - Loads: Hydrogen charging station and nearby buildings
  - Storage: 480kWh Li-Ion Batteries
  - Vehicles: 4 custom converted Bi-Directional PEVs
- Program start June 2011, Deliver/Install Dec 2011 (26 weeks ARO)

Mobile Micro-Grid Management System (M3S)

CONCEPT AND FEATURES

- 3-tier DC architecture with input and output inverters
- Automatically manages sources and loads up to 400kVA
- Multi freq/voltage inputs and outputs
- Automatically balances phases
- Tiers cooperate via DC Link
- Intuitive User Interface for setup and operation
- Fixed and portable elements
- NEC, IEC, UL Compliant



Future/Recommendations

- Won subsequent TARDEC program to field 3-Tier DC micro-grid at Schofield Barracks, HI
- SCMG good candidate for CERL SPIDERS program
- Applicable to fixed bases, campuses, and islanded grids (ie mining, remote villages, islands, etc)
- Looking for opportunities to install additional systems to enhance energy surety for critical facilities and loads.