Defense Energy Technology Challenge

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SOLUTION DESCRIPTION

GMI Product

- iESP – Intelligent Energy Services Platform (***iESP***)
  - Central control of all distributed microgrids
    - Energy management of each building or node
    - Realtime Management of each energy resource
  - Continuous forecasting of:
    - Transmission grid demands and pricing
    - Renewable capacity and Cost of fuels
    - Weather and other environmental conditions
  - Aggregate ALL customers excess power and demand response
  - ***Virtual Power Plant*** - automatic arbitrage of energy sales to transmission operators
  - Cyber-security built into each microgrid

Intelligent Energy Services Platform iESP

- iESP is a framework of microgrid-enabling services that integrates and controls distributed energy assets to form a highly responsive and intelligent microgrid. iESP serves as the base platform to build out and operate scalable microgrids which can be cost-optimized and performance-tuned for specific campus, industrial and municipal energy requirements. iESP services are structured for seamless integration with typical public utility IT infrastructure, SCADA EMS/DMS software applications and RTO/ISO systems and policies**.**
- **Demand Response**: Imports and aggregates CIS service account data, meter data and historical climate and outage patterns then computes demand and price forecasting models and optimization alternatives. Performs translation into RTO/ISO based representations of demand responsive resources and ADR programs. iESP's DR Services integrate with AMI systems using Zigbee, OpenHAN and OpenADR signals and protocols.
- **Distributed Generation**: Integrates and controls a variety of renewable and non-renewable energy sources. iESP's DG Integration services include functions for inter-facing, switching and controlling energy assets using a broad range of integration methods and protocols including IEEE P1547, IEC 61850/61400/62445, SCADA/DNP3, GOOSE, CIM and OpenADR.
- **Microgrid Controller**: A multi-agent framework for distributed microgrid control. Includes collaborative control nodes that integrate with the underlying power analytics modules and intelligent substations to orchestrate microgrid switching, load balancing, VAR control and self-healing operations. iESP's control nodes automate demand management, energy price auctioning/arbitrage and coordinates distributed generation and energy storage.
- **Virtual Cloud-Based Services**: Deployed in the cloud as virtual services that dynamic-ally scale up or down to fit cost and performance parameters. Incorporates data node caching, service load balancing, fail-over mechanisms and policy based workflow orchestra-tion that enable high performance scaling for distributed grid transactions and operations.
- **Cyber Security**: Monitors the grid for cyber intruders and malicious code. iESP's security fabric provides enterprise authentication and authorization functions that operate across the cloud and tightly integrate with the underlying operating system and networks.
- **Energy Services Knowledge Portal**: iESP's energy management and decision support tools can be accessed anywhere in the enterprise via a standard web browser. The knowledge portal hosts a family of application dashboards and analysis tools that facilitate demand response management, distributed generation control and microgrid system configuration and administration. iESP's knowledge portal is entirely web based, accessing the microgrid tools will be familiar to any operator that has used web browsers and internet-based applications.

Software Assets

- Software architecture, data model, design and interface specification and functional specification for:
  - Distributed Energy Resources Management System (DERMS)
  - Microgrid controller
  - Cloud-based energy service framework (platform)
  - Web interface for any device
  - Utility operations integration
  - Energy Arbitrage
  - Distributed device controllers
  - Distributed agent policy manager
  - Optimization Engine

Energy Market Expertise

- Expertise:
  - Smart Grid architecture and benefits
  - Utility operations
  - Regulatory policy
  - R&D grant process
  - Standards for process and interoperability
- Relationships:
  - Federal and state legislative
  - Federal and state agencies
  - Utilities – all the big ones and many smaller
  - National laboratories

MILITARY APPLICATION

DOD / Microgrids Market Opportunity

Opportunity size

- 440 Military Bases in the continental US*
- Major bases include:
  - 48 Army Bases
  - 71 Air force Bases
  - 15 Marine Bases
  - 62 Navy Bases
  - 14 Coast Guard

Microgrids

- Advantages of microgrids that can be run independently of the larger grid infrastructure when necessary, isolating themselves to keep electrons flowing when their users would otherwise experience brown outs or black outs.
- For the US, if deployed widely in many if not most communities, it would greatly curtail the threat of large, regional power-loss events.

The need

- DSB 2008 energy report warned, bases have made themselves far too dependent on the often unstable grid.
- The micro grid concept applies when thinking about bases as power islands, being able to run their own critical mission systems during local or regional blackouts
- For DOD, this would help solve the Defense Science Board (DSB)-identified challenge of bases' reliance on the brittle national grid.

*Source: Internet

Typical Issues to Address

- Coordination of Efforts with Subcontractors
- Integration of Distribution Energy Resources (utility and consumer-owned)
- Distribution Automation
- Asset Management
- Security – Cyber & Physical
- Establishing Secure Communications Network
- Development of Appropriate ICT and Control Architecture
- Participation in DG and Demand Response Programs
- Regulatory and Tariff Impacts
- Permitting
- Cross-jurisdictional Issues

Challenges

- Resource integration
- Volt, VAR, variability (VVV) management
- Pricing and DR signal design
- Deployment of distributed control
- Sharing information in real-time (two-way)
- Integration of market influences
- Communication and data security
- Recognize the opportunity for microgrids to provide localized control

Microgrid Solution

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National Energy Technology Laboratory

Utility-scale Energy Storage

Rooftop PV Solar

Switches & Power Electronics

Distributed Generation

Energy Storage

Microturbine

Ground PV Solar Array

PHEVs

Home Energy System

Microgrid Objectives

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Utility Network Management

Microgrid Objectives
Take action to improve reliability
Take action to improve economics
Take action to manage renewables

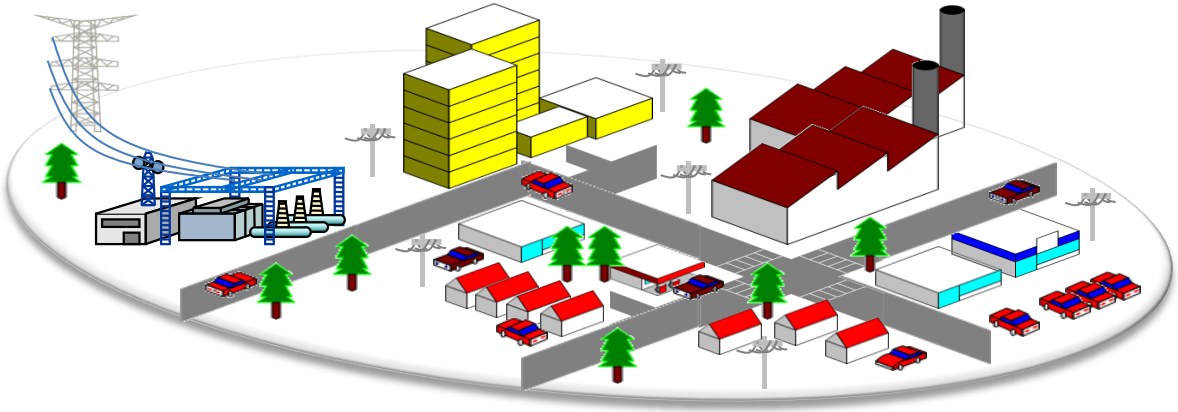
Microgrid Master Controller

SCADA System

Distributed Energy Resources
Utility-scale Energy Storage
Rooftop PV Solar
Micro-turbines
Building Energy Storage
Community Energy Storage
Distributed Generation
Home Energy System
PHEVs
Ground PV Solar Array

Information
Electricity Pricing
DER status
Demand Response Programs
Network status
Community Objectives
Load and Resource Profiles

Grid Resources
Capacitor Banks
Voltage Regulators
Automated Switches
Power Electronics
Communications



STAGE OF DEVELOPMENT

Where are we today?

- Scoping Study at CSUSM
- Software architecture/design/requirements
- Software development bid
- “Balance Energy” trademark
- Project finance opportunities

Corporate Assets

- Brand ownership:
  - Balance Energy
  - General MicroGrids
- Intellectual Property:
  - Microgrid design
  - Energy arbitrage
  - Balance power using optimization

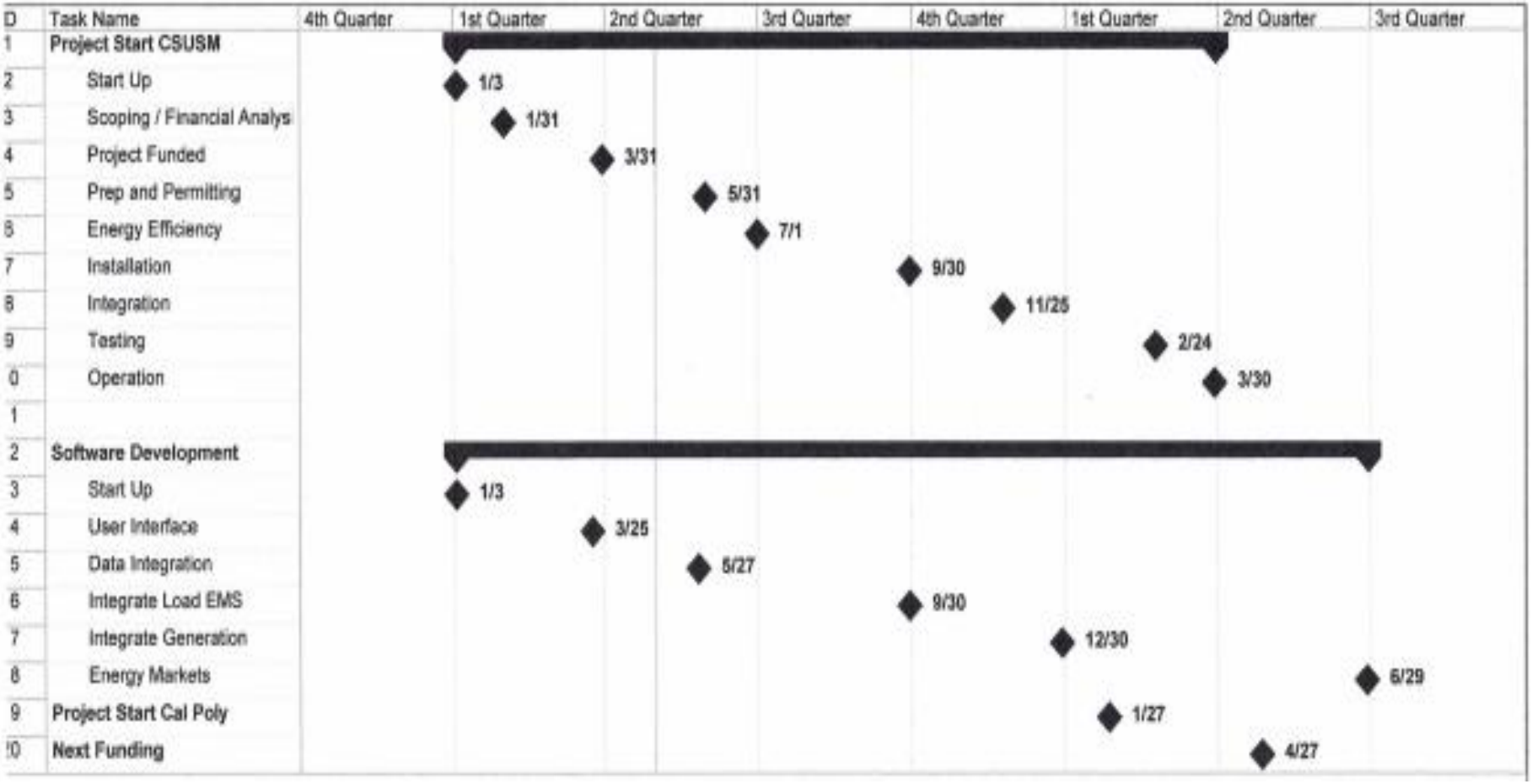
GMI Microgrid Market

- Immediate – CSU Chancellors Office
  - CSUSM, CalPoly, CalPoly Pomona, CSULB
  - CSU 23 campuses (15 realistic)
  - Top 15 = 600MW or over $535M/annual rev
- Pike Research - $3B US Market
  - Hospitality
  - Military
  - C&I
  - Municipalities

Creating a Microgrid

- Milestones
  - Scoping Study / Financial Feasibility Analysis
  - Define project / fund project
  - Energy efficiency improvements
  - Preparation and permitting
  - Generation installation
  - Load integration
  - Balance Energy (iESP) implementation
  - Test, Operation and Maintenance

Project/Software Plan



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BENEFITS TO ADOPTION

Electric Grid

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- 100 year old infrastructure
- Transmission over capacity and expensive to fix or extend
- Distribution designed for one-way delivery and subject to local failure
- Central power production is inefficient and expensive to build, operate, maintain

Value Proposition

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- Balance energy between demand (load) and onsite generation in real-time
- Balance between distribution grid and microgrid
- Ability to island microgrid
- Manage procurement of energy from grid if necessary

What Problem do we Solve?

- From the consumers point of view …
  - Price Stability
    - Protection from market fluctuations
  - Reliability
    - Always available
  - Efficiency
    - Onsite generation, only on when needed
  - Security
    - Protected from external forces and incursions
  - Conservation
    - Renewable resources and **GREEN** footprint

What Problem do we Solve 2

- Distribution and Transmission Grid
  - Integration of Distributed Generation
  - Integration of Renewable Resources
  - Grid Stability – Volt / VAR Services
  - Added Generation Capacity
  - Demand Response
- Building the Smart Grid from the Edges

Generation Types

- Solar
- Wind
- Energy Storage – Batteries
- Fuel Cells – biofuel
- Geothermal
- CHP – biofuel
  - Turbine
  - Diesel

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WHAT IS THE ASK?

Investment Plan $4M

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- Build iESP
  - Execute software development bid
    - UI through microgrid operation
    - Energy Market Integration (second funding)
  - Build out team (key personnel)
    - Ray Piasecki – software architect and lead
    - Electrical engineering (Horizon Energy)
    - CFO
    - Project Manager
- Keep the lights on for 16 months

Financial Incentives

- Self Generation Incentive Program (SGIP)
  - AB 1150 program continuance
- DSIREUSA.ORG
- Investment Tax Credit (ITC) - Grant
- Production Tax Credit (PDT)

Competition

Company	Primary Product	Energy Efficiency	Demand Management	Microgrid Controller	VPP	Generation Controller	Cyber Security	Cloud Computing	Portal
GMI	***iESP***	***Partners***	***Yes***	***Yes***	***Yes***	***Yes***	***Yes***	***Yes***	***Yes***
Honeywell	Atrium	Yes	Yes	No	No	No	No	No	Yes
Johnson Controls	?	Yes	No	No	No	No	No	No	No
Siemens	Many	Yes	Yes (new)	Soon	Yes	Yes	Yes	No	Yes
Cisco	Networking	No	No	No	No	No	Yes	Yes	Yes
IBM	SW/services	No	Yes (new)	No	No	No	Yes	Yes	Yes
Corporate Systems	?	No	Yes	No	No	No	No	No	Yes
Control 4	?	Yes	Yes	No	No	No	Yes	Yes	Yes
Energy Controls	?	Yes	Yes	No	No	No	No	Yes	Yes
J2 Innovation	?	Yes	Yes	No	No	No	Yes	Yes	Yes
Infotility	Grid Agents	No	Yes	No	Yes	Yes	Yes	Yes	Yes
Tendril	?	No	Yes	No	No	No	Yes	Yes	Yes
Comverge	?	No	Yes	No	No	No	No	No	No
EnerNoC	?	No	Yes	No	Yes (new)	Yes (new)	No	Yes	Yes
General Electric	Many	No	Yes	Yes	No	Yes	Yes	Yes	Yes
Viridity Energy	?	No	Yes	No	Yes	No	Yes	Yes	Yes
Pareto	?	No	No	Yes	No	Yes	No	No	No
EDSA / Power Analytics	?	Yes	Yes	Yes	No	No	Yes	Yes	Yes
OATI	?	No	Yes	No	Yes	Yes	Yes	Yes	Yes
UISOL	?	No	Yes	No	Yes	No	Yes	Yes	Yes
Horizon Energy	?	No	No	No	No	No	Yes	Yes	No
Lockheed Martin	IMS	No	Yes	No	Yes	No	Yes	Yes	Yes
ABB	?	Yes	Yes	No	No	Yes	Yes	No	Yes

GMI Team

- ***Doug Hegebarth - CEO***
  - Over 30 years startup, turn-around and operational experience (SAIC) including 12 years in the energy industry. CEO, COO, CTO roles. As CEO sold Anzus (turn-around) to Rockwell Collins, participated in transactions with First Virtual (IPO and sale) and Soflinx.

- ***Terry Mohn - Founder and CSO***
  - 30 years experience in large-scale system architecture and business and technology investment strategy. Nine years with SDG&E. Vice Chairman of the GridWise Alliance

- ***Ray Piasecki – VP Software Development***
  - Software/Systems engineer and architect at BAE (Engineering Fellow). Designed system and software architecture for the Intelligent Energy Services Platform (*iESP*).

- ***Tom Huppert – VP Finance and CFO***
  - Former CFO of the Virtual Group and Prize Capital investment companies. Over 25 years of finance, operations and strategy experience with numerous early stage and startup ventures including one IPO.

- ***John Westerman – Engineering, Design and***
  - Over 2 decades in the development, evaluation, application, and testing of energy technologies. Supported energy technology evaluation activities for the California Energy Commission, EPRI, GRI, and other military, state and utility organizations.

How do we make Money?

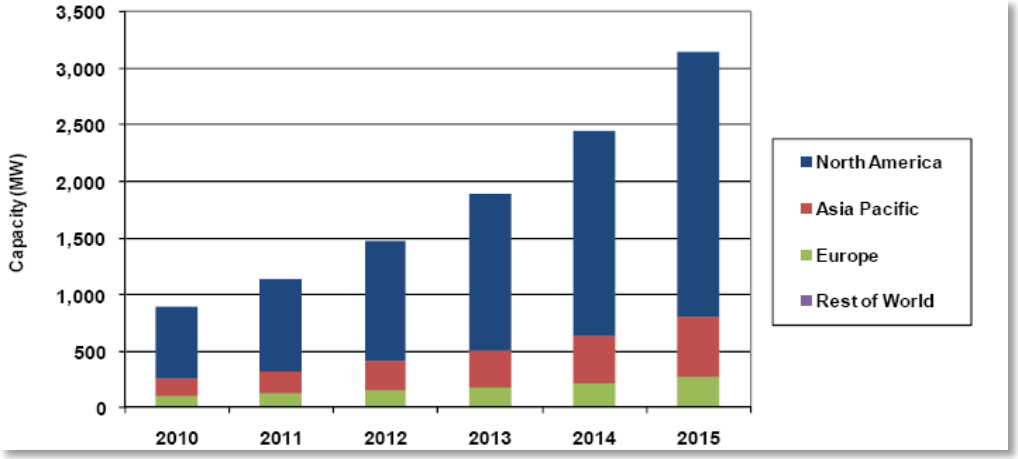
- Microgrid Developer
- iESP License – each project
- Energy sales to customer
- Sale of Excess Generation to Grid
- Distribute free iESP components
  - Aggregate energy sales to ISO

Distributed Generation/Microgrids: Trends

Driving Trends Overview

- Microgrids are an application of distributed energy (DE) devices and control systems.
- Enable a set of generators, storage devices, and load-reduction technologies to reliably supply the entire electricity demand of a grid-isolated group of customers.
- The intersection of renewable and distributed generation is the next frontier in electric generation;
- Minimizing transmission and distribution losses
- Address local reliability challenges
- Address local economic issues (community objective)
- Enable energy arbitrage (community objective)
- Aggregate control of multiple sources (DG, storage, consumer DER, DR, switches, Cap Banks, DA, etc.)

Microgrid Capacity (MW)
World Markets: 2010-2015



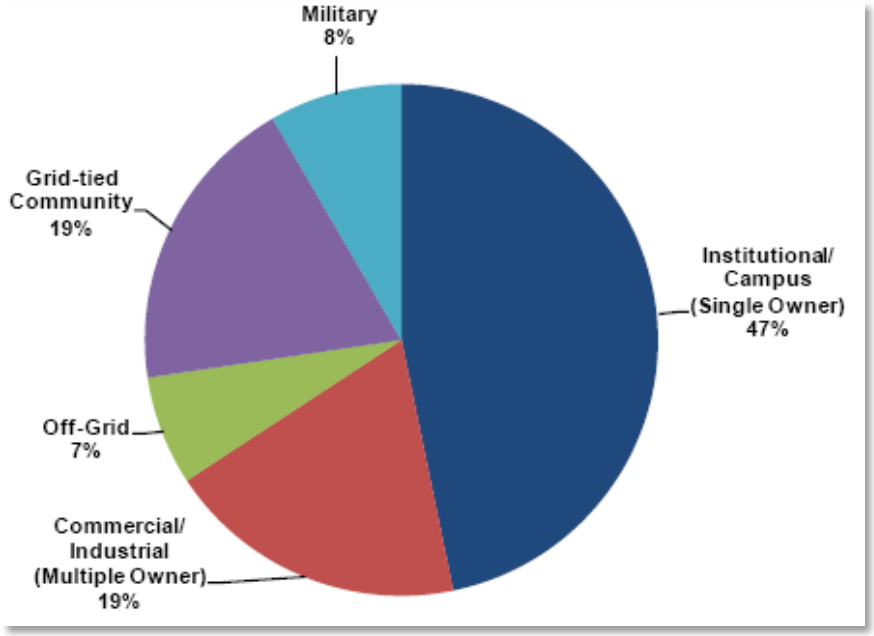
Source: Pike Research

Microgrids: Market Size

Market Size Potential

- Pike Research forecasts that over 3 GW of new microgrid capacity will come on line globally by 2015, representing a cumulative investment of $7.8 billion.
- North America will be the largest market for microgrids during that period, capturing 74% of total industry capacity.
- In North America, the largest category will be institutional microgrids, followed by commercial/industrial and community grids.

Market Sector Revenue Breakdown, North America: 2015



Source: Pike Research

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THANK YOU