The Energy Problem

“World net electricity generation nearly doubles by 2035…a projected average increase of 1.7% per year for OECD electricity generation.”

- International Energy Outlook 2010
U.S. Energy Information Administration

Without Renewables, Growth Will Be Fueled By Burning Coal & Gas
Why Renewable Energy?

- Increase energy security
- Reduce pollution
- Minimize carbon footprint
- Security
- Stability
- Growth
- Promote domestic job growth

Focused on Making Renewable Energy a Reality
**Pacific Fossil Fuel Dependence**

**Hawaii**
- >96% of Hawaii’s oil and coal is a foreign import
- 90% of Hawaii’s electricity from burning oil
- 40% Renewable Portfolio Standard by 2030

**Guam**
- 80MW Renewable Energy Goal by 2013
- Burn 10,620 barrels/day
- 100% of Guam’s electricity from burning oil

**Marshall Islands**
- Nearly 100% dependence on imported oil
- Burn 13,571 barrels/day
- US Gov’t pays $0.392 per kWh

**Japan**
- “Green Alliance” would consider ways to introduce renewable energy technology into U.S. bases in Japan and under development in Guam, including a Component of Host Nation Support.

**Oil is a Large Energy Driver in the Pacific**
Security Interests a Key Driver for Green Energy

DoD – Largest Energy Consumer in US

- DoN plans to cut oil consumption by 50% by 2015
- Air Force to use 50% alternative jet fuel by 2016
- USDA/Navy team to develop biofuels and renewable energy systems
- Army to generate 25% alternative energy by 2025
- LM MS2 requested to brief the SECNAV’s Advisory Panel (SNAP) on energy

Federal/Presidential Policy

- “…the transition to clean energy has the potential to grow our economy and create millions of jobs — but only if we accelerate that transition.”
  President Obama, Oval Office Address 6/15
- “We must harness the power of the sun, wind, soil, and our natural resources to fuel our future.” – President Obama, Oval Office Address 6/15

Japan

- United States and Japan have formed a “Green Alliance.”
- Cooperate in developing eco-friendly energy technology like OTEC
- Introduce renewable energy technology into U.S. bases in Japan
- Japan and Guam looking to Hawaii as an Island Leader for Renewable Energy

Hawaii

- Hawai’i Clean Energy Initiative – goal of 70% clean energy by 2030
- OTEC, Solar, Biomass, Wind, Smart Grid
- Currently generates 90% of it’s power from imported oil
- Pacific Missile Range Facility on Kauai CSP and Biomass project ties into Aegis Ashore
State of the Commercial Market

- Renewable Energy has a higher cost than fossil fuels
  - Incentives / enabling legislation required
    - 30% US Federal Investment Tax Credit (ITC) and grant in lieu
    - Feed-In Tariff policies used in Canada, Spain, Germany
    - Pending Federal Renewable Portfolio Standard (RPS)
- Renewable Energy market dominated by Special Purpose Vehicles (SPVs)
  - Lack of large balance sheets
- Limited System Engineering
  - Each small energy technology company only offering their product for every solution regardless of fit
- Project financing slow to start
  - Global capital market slow down has not helped
  - Banks will not take a technology risk
    - Bankable company required to wrap technology
  - Long term PPAs required for bank financing

Incentives and Enabling Legislation Required for Renewable Energy Market Growth
Favor or oppose including requirements that utilities produce more energy from renewable sources?

- Favor: 87%
- Oppose: 7%
- Unsure: 4%

Which one of the following should be the more important priority for U.S. energy policy?

- Energy Price: 37%
- Environment: 56%
- Unsure: 8%

Public Opinion Is Shifting to Support Renewable Energy Regardless of Cost

Source: A Pew Research/National Journal Congressional Connection Poll, sponsored by the Society for Human Resource Management conducted June 10-13, 2010 of 1,010 adults nationwide (MoE ± 4.)
Making Green Jobs a Reality…

| Market Research & Development | • Design engineering  
|                              | • Technology trades (R&D)  
|                              | • System integration and test  
|                              | • Verification  
|                              | • Validation  

| Engineering Assembly | • Procurement  
|                      | • Manufacturing  
|                      | • Commercialization  
|                      | • Process optimization  
|                      | • Quality assurance  

| Construction | • Environmental surveys  
|             | • Electrical  
|             | • Heavy machinery  
|             | • Bulk construction  
|             | • Precision assembly  

| Energy Efficiency Services | • Consulting  
|                            | • Energy strategy planning  
|                            | • Demand response  
|                            | • Performance contracting  
|                            | • Advanced metering  

| Agricultural, Feedstock Processing | • Farming  
|                                    | • Advanced feedstock dev.  
|                                    | • Supply chain management  
|                                    | • Waste remediation  
|                                    | • Algal feedstock growth  

LM is Emerging a Leader in Green Energy Jobs
LM Energy & Environmental Goals

• 2009 absolute reduction targets (vs. 2007 baseline):
  – Reduce carbon emissions by 8%
  – Reduce waste to landfill by 14%
  – Reduce water usage by 16%

• Absolute reduction targets for 2012:
  – Reduce carbon emissions by 25%
  – Reduce waste to landfill by 25%
  – Reduce water usage by 25%
LM Energy Business Portfolio

IS&GS
- Efficiency Business
- Utility Technical & Engineering Services
- IT & Business Services
- Smart Grid
- Hanford Site M&O
- Savannah River Labs

Electronic Systems
- Sandia National Labs
- Solar (CSP & PV)
- Ocean Thermal
- Wave
- Biomass/Biofuels
- Fuel Cells
- Nuclear Command & Control Systems
- Microgrids
- Storage & Advanced Material Technologies

Aeronautics
- Aircraft Energy Technology
- Military Fuel Efficiency
- Advanced Biofuels
- Skunk Works® Advanced R&D

Space Systems
- Space Based Climate Monitoring Exploration
- Terrestrial-Based Climate Monitoring
- Space Solar Power Exploration
- Advanced Concepts R&D
LM Energy Generation

**Technology R&D**

**Systems Engineering & Program Management**

**Modeling & Simulation**

**Sourcing / Procurement**

**Information Systems**

**Process Optimization**

Tools to Partner with Industry to Deliver Affordable Renewable Energy
Portfolio Approach to Energy Generation

- Each technology best suited for different conditions resulting in minimal overlap in deployment areas

- Our wide portfolio of energy solutions allow us to provide the best technologies and approaches to achieve the customer’s energy goals
Ocean Thermal Energy Conversion (OTEC)

The Resource

- Large Renewable Energy Source
  - At least 3-5 Terawatts (~30% Global Energy)*

- Energy Security
  - A Secure Energy Source

- Base Load Power
  - Available 24/7

- Climate Friendly
  - No Emissions

A New Clean Renewable 24/7 Energy Source..
Ocean Resources Match Critical DoD Assets

OTEC Team Members

G Noland & Assoc

NAVATEK

OCEES
Ocean Engineering & Energy Systems

FAU
Center for Ocean Energy Technology
College of Engineering & Computer Science
Florida Atlantic University

LOCKHEED MARTIN

J Halkyard & Assoc

Houston Offshore Engineering

THE GLOSTEN ASSOCIATES
Consulting Engineers Serving the Maritime Community

E³Tec

University of Hawaii at Manoa
Hawaii National Energy Institute

SBM Atlantis

CELLULÀ ROBOTICS

STRESS ENGINEERING SERVICES INC.

geo marine
## OTEC Commercialization Roadmap

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<th>Risk Reduction</th>
<th>Pilot Plant</th>
<th>Utility Scale DOD Plants</th>
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<td><strong>Cold Water Pipe Fabrication</strong></td>
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<td><strong>Heat Exchanger Performance &amp; Design</strong></td>
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### Industry Investments, Funding
- Government (CRAD, Grants, SBIRs, ...)
- + Government (Not Funded Yet)

### Public / Private Financing
- Power Purchase Agreements

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Working with DOD on OTEC Demonstration Facility
Lockheed Martin - Solar Energy

Concentrated Solar Power

Making Concentrated Solar Power a Reality
- Working with development partners
- Extensive pipeline of potential projects
- Extensive research focused on risk reduction
- Prototype completed in Moorestown, NJ
- Team of experienced suppliers

Photovoltaic Solar Energy

Branching into Modular Photovoltaic Generation
- Quickly expanding pipeline of potential projects
- Customer-funded study underway
- Developing prototype installation of utility-scale PV in Moorestown, NJ
Full Scale Prototype Developed: SolSTES

SolSTES (Solar System Test and Evaluation Site) is a 100M Solar Collector Assembly installed at the LM MS2 facility in Moorestown NJ.

- Commissioned April 2009
- SolSTES was developed to provide risk reduction for:
  - Validate component level performance
  - Validation of system level performance
  - Integration / constructability
  - Alignment tolerances

SolSTES Prototype Provides Risk Reduction
LM Biofuels Focus

- *Next-generation biomass/waste fuel and power for the DoD*
  - Modular systems producing green syngas, low or zero emissions
  - Pathway to efficient JP-5, JP-8 production
  - Wide variety of feedstocks (non-food) can be used
  - Supports waste remediation, Forward Operating Bases
- Advanced gasification process prototype underway, commercial plant in 2011
  - Combined steam gasification
  - Fully compatible with existing infrastructure
- Advanced Feedstock Research on-going (Algal, Energy Crops)
- Objective to work with the DoD to test/certify biofuels

Next Gen Biomass Fuel and Power: Baseload, Clean, Renewable
Small Scale Biomass Energy Systems

**Modular Biopower**
- Converts a range of biomass feedstock materials on-site into clean power, heat and fuels.
- Feedstocks include: Woodchips, agricultural residues, energy crops

**Waste to Energy**
- Converts virtually all wastes into clean burning fuel gas and inert slag.
- Wastes include: MSW, mixed debris, medical waste, tires
- No water effluent
Biomass Steam Generation Facility

- **Biomass Co-Generation System**
  - Twin 350 Hp Biomass Boilers (35 MMBtu, 25,000 pph saturated steam)
  - 425 kW Steam Turbine
  - Integrated feedstock and ash handling
  - Electrostatic precipitator
    - Emissions <0.3 lb/MMBtu

- **Based on biomass Co-gen System at Lockeed Martin facility in Owego, NY**
  - Twin 600 Hp Biomass Boilers
  - Lessons Learned to lower risk and lower cost
Wave Energy

- Estimated accessible global wave energy resource:
  - 2500 TWh per year
  - Predictable Available Energy
  - Equivalent to global nuclear or hydroelectric generation
- Lockheed Martin working with several industry leaders in the emerging wave energy industry including Ocean Power Technologies (OPT) and Wavebob
  - OPT has several buoys deployed throughout the world
  - Wavebob is developing unique technology to harness the energy of the ocean

Tidal Energy

- Wave energy harnesses the vertical motion of waves, while tidal current technology extracts energy from the high tide bulge moving horizontally across the Earth’s surface
- Tidal power is highly predictable
- Lockheed Martin is providing engineering services and manufacturing design for Atlantis Resources Corporation

Partnering with Emerging Technology Companies to Provide Innovative Energy Solutions
Evaluating a 10MW CSP Solar Power plant with Pacific Light and Power, a local Kauai energy developer

Located near the Pacific Missile Range Facility

Pacific Missile Range Facility is making significant missile defense upgrades in the next few years that will drive increase power consumption

Aegis Ashore being installed on PMRF

Key element of President’s Phased Adaptive Approach for Ballistic Missile Defense

Potentially the Largest CSP Project in Hawaii

Ideal opportunity to combine renewable energy, energy security and grid stability to PMRF and Kauai for a key National Security asset

Opportunity to Introduce Renewable Energy to a Key USN Asset with a Local Hawaiian Partner
Conclusion

- **Energy security is a driver in making renewable energy a reality**

- **A diverse energy portfolio is the best approach for ensuring renewable energy is deployed quickly, efficiently and cost effectively**

- **Lockheed Martin uniquely positioned to provide a diverse energy portfolio to commercial and DoD customers.**

- **Lockheed committed to working with local partners for job creation**