The Nexus Between Acquisition and Energy Studies at the Naval Postgraduate School

http://nps.edu/energy

ICEAA Workshop
March 2014
Agenda

• Bottom line up front (BLUF)
• EAG Background
• Current SECNAV Guidance and Requirements
• What has been accomplished
  • Curriculum Development and Delivery
  • Research
  • Outreach
• Next steps
  • Curriculum Development and Delivery
  • Research
  • Outreach
The Energy Academic Group (EAG, http://nps.edu/energy) can support you with your energy issues

Curriculum Development and Delivery
• Masters -- 4 graduates, 12 currently enrolled
• Certificate -- 8 completed, 15 currently enrolled
• Seminars -- 32 Completed
• Executive Education -- 2 classes completed; 35 Flags/SES attended; Program formally embedded in Naval Flags curriculum; VERY strong support from ASN and OPNAV senior leadership
• Research
  60+ theses, 40+ research projects
• Outreach
  US Government (defense and nondefense), commercial firms, academic institutions

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EAG mission The overall objective for the EAG is to develop and maintain NPS as a Navy Center of Excellence for Energy Graduate Education and Research. The EAG will also actively explore educational and research partnerships across the full spectrum of Department of Defense (DOD) related organizations, Department of Energy (DOE), as well as other universities, industry, and non-profit sectors.
GOALS

CNO Guidance: Provide a Navy Energy Strategy that treats energy as a strategic resource

<table>
<thead>
<tr>
<th>Ends</th>
<th>Ways</th>
<th>Means</th>
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<tbody>
<tr>
<td>Vision</td>
<td>Strategic Imperatives</td>
<td>Targets</td>
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</table>

- A Navy that values energy as a strategic resource
- A Navy that understands energy security as fundamental to executing the Navy mission afloat and ashore
- A Navy resilient to any potential energy future

Ways

- Assure Mobility
- Protect Critical Infrastructure
- Lighten the Load
- Expand Tactical Reach
- Green Our Footprint
- Increase Efficiency Afloat
- Increase Efficiency Ashore
- Increase Alternative Energy Ashore
- Increase Alternative Energy Afloat
- Sail the Great Green Fleet
- Increase Alternative Energy Afloat
- Reliable Power for Critical Infrastructure
- Reduce Non-Tactical Petroleum Use
- Energy Efficient Acquisition
- Leadership
- Technology
- Policy
- Strategic Partnerships
- Culture Change

Means

- Increase Alternative Energy Department-wide
- Increase Alternative Energy Sources Ashore
- Reduce Non-tactical Petroleum Use
- Sail the “Great Green Fleet”
- Energy Efficient Acquisitions

By 2020, 50% of total Department energy consumption will come from alternative sources
By 2020, at least 50% of shore-based energy requirements will be met by alternative sources; 50% of Department installations will be net-zero
By 2015, Department will reduce petroleum use in vehicles by 50%
Department will demonstrate a Green Strike Group in local operations by 2012 and sail it by 2016
Evaluation of energy factors will be mandatory when awarding contracts for systems and buildings

VISION

Energy Security is having assured access to reliable and sustainable supplies of energy and the ability to protect and deliver sufficient energy to meet operational requirements.

NPS is involved in EVERY aspect

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Navy Energy Strategy

Energy Security
“Secure, Sufficient, Reliable, and Sustainable Energy”

Conservation
- Implement best practices and policies
- Demonstrate energy awareness

Efficiency
- Optimize existing platforms
- Leverage new technologies

Alternatives
- Utilize sustainable sources
- Secure critical infrastructure

Tactical
- Increase tactical energy security
- Reduce tactical fuel consumption
- Increase tactical fuel efficiency
- Increase alternative fuel

Shore
- Increase shore energy security
- Reduce shore energy consumption
- Increase shore energy efficiency
- Increase reliable and renewable energy

Environmental Stewardship
Reduce Navy’s Carbon Footprint

Navy Energy Guidance
Naval Energy – A Strategic Approach
Oct. 2009
SECNAV
The next slides identify accomplishments since EAG was established, in each of three dimensions:

– Curriculum Development and Delivery
– Research
– Outreach
Curriculum Development and Delivery

• **Master’s Degrees**

<table>
<thead>
<tr>
<th>Department</th>
<th>CURRIC #</th>
<th>P-CODE</th>
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</thead>
<tbody>
<tr>
<td>Operations Analysis</td>
<td>358</td>
<td>5603</td>
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<tr>
<td>Naval Mechanical Engineering</td>
<td>563</td>
<td>3213</td>
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<tr>
<td>Electrical and Computer Engineering</td>
<td>593</td>
<td>3113</td>
</tr>
<tr>
<td>Financial Management</td>
<td>838</td>
<td>5311</td>
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</tbody>
</table>

• **Certificates**
  • Science and Technology
  • Policy and Analysis

• **Seminar / Speaker’s Series**
  • NPS Faculty, Academics, National Labs, Industry

• **Executive Education** -- Naval Flag Officers, SES, E9s
### Curriculum Development and Delivery

#### Students enrolled and graduated

<table>
<thead>
<tr>
<th>Dept</th>
<th>Students enrolled</th>
<th>Students graduated</th>
<th>FY14</th>
</tr>
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<tbody>
<tr>
<td>OA</td>
<td>2</td>
<td>0</td>
<td>5</td>
</tr>
<tr>
<td>ME</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>ECE</td>
<td>1</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>FM</td>
<td>9</td>
<td>4 (June 2013)</td>
<td>5</td>
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</tbody>
</table>

#### Certificate (Only)

- 15 enrolled
- 8 completed

#### Seminar / Speaker’s Series

- 32 seminars with speakers from industry, government, and academia

#### Executive Education

- FY13—2 classes; 35 Flags/SES attended
- FY14 --Three classes scheduled. Program formally embedded in Naval Flags curriculum. Very strong support from ASN and OPNAV senior leadership.
<table>
<thead>
<tr>
<th>NPS Student</th>
<th>Projected Graduation Date</th>
<th>Title</th>
<th>NPS Faculty</th>
<th>E20 POC</th>
</tr>
</thead>
<tbody>
<tr>
<td>LT Matthew McClure, USN</td>
<td>June 2013</td>
<td>A Systems Engineering Feasibility Study of Scaled Geothermal Power</td>
<td>Prof Fernando Marquez</td>
<td>Maj Brandon Newell</td>
</tr>
<tr>
<td>LT Ryan Langham, USN</td>
<td>June 2013</td>
<td>Use of Radioisotope Thermoelectric Generators in USMC Expeditionary Unit Equipment</td>
<td>Prof Fernando Marquis</td>
<td>Maj Brandon Newell</td>
</tr>
<tr>
<td>LT Daniel Hogue, USN</td>
<td>June 2013</td>
<td>MEMS-Based Waste Vibrational Energy Harvester</td>
<td>Prof Dragoslav Grbovic</td>
<td>Maj Brandon Newell</td>
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<tr>
<td>LTJG Sarah Gregory, USN</td>
<td>June 2013</td>
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<tr>
<td>Capt Joshua Kapp, USMC</td>
<td>Sept 2013</td>
<td>Analysis of Advanced Battery Technology for USMC Expeditionary Tactical Information Systems</td>
<td>Prof Sebastian Osswald</td>
<td>Capt Anthony Ruple</td>
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<tr>
<td>SE Capstone Students</td>
<td>Sept 2013</td>
<td>SE CAPSTONE I</td>
<td>Prof Gene Paulo</td>
<td>Gayle Von Eckartsberg</td>
</tr>
<tr>
<td>Capt Jason Garcia, USMC</td>
<td>Dec 2013</td>
<td>New Media, Technology Frames, and the Adoption of Sustainable Energy Technologies by the U.S. Marine Corps - Part I: Key Drivers of Marines' Willingness to Adopt Energy Efficient Technologies</td>
<td>Prof Kathryn Allen</td>
<td>Gayle Von Eckartsberg</td>
</tr>
<tr>
<td>LT Dan Eddy, USN</td>
<td>Dec 2013</td>
<td>New Media, Technology Frames, and the Adoption of Sustainable Energy Technologies by the U.S. Marine Corps - Part II: Use of Energy Efficient Technologies - USMC Perceptions to Adoption</td>
<td>Prof Kathryn Allen</td>
<td>Gayle Von Eckartsberg</td>
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<tr>
<td>Capt Matthew Morse, USMC</td>
<td>May 2014</td>
<td>Adaptation of the HOMER Energy Micropower Optimization Model for Marine Corps Logistics</td>
<td>Prof Dan Nussbaum</td>
<td>Capt Anthony Ripley</td>
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<tr>
<td>TBD</td>
<td>TBD</td>
<td>Graphene Research Roadmap In Support of US Marine Corps Expeditionary Energy</td>
<td>Prof Claudia Luftis</td>
<td>Capt Anthony Ripley</td>
</tr>
<tr>
<td>Capt Matthew Morse, USMC</td>
<td>May 2014</td>
<td>Improving Cost/Benefit Assessment for Energy Initiatives using Robust Design</td>
<td>Prof Susan Sanchez</td>
<td>Shawn Charchan</td>
</tr>
<tr>
<td>LT Stan Stimpert, USN</td>
<td>June 2014</td>
<td>Lightening the Load of a USMC Rifle Platoon through Robotic Integration</td>
<td>Prof Andy Hernandez</td>
<td>Capt Anthony Ripley</td>
</tr>
<tr>
<td>Capt Stan Lapp, USMC; Capt Doug Columbus, USMC</td>
<td>June 2014</td>
<td>Development of Advanced High Efficiency, Low Cost Flexible Solar Cells for USMC Expeditionary Energy Applications</td>
<td>Prof Sherif Michael</td>
<td>Capt Anthony Ripley</td>
</tr>
<tr>
<td>LT Mark Boale, USN</td>
<td>June 2014</td>
<td>Improving Energy Efficiency of Diesel Generators by Optimizing Exhaust Duct Designs</td>
<td>Prof Sanjeev Sathe</td>
<td>Capt Anthony Ripley</td>
</tr>
<tr>
<td>LCDR Nomer Gaatchalian, USN; LT Donald McIntyre, USN; and LCDR Matthew Reed, USN</td>
<td>June 2014</td>
<td>New Media, Technology Frames, and the Adoption of Sustainable Energy Technologies by the U.S. Marine Corps: Part III - Investigating Digital and Social Media and Energy Efficient Behavior</td>
<td>Prof Kathryn Aten</td>
<td>Gayle Von Eckartsberg</td>
</tr>
<tr>
<td>N/A</td>
<td>N/A</td>
<td>CERP ITX: Marine Behavior, Perceptions, Decisions, and Energy Management: Phase I</td>
<td>Prof Anita Salem and Prof Michael McGuirey</td>
<td>Maj Anthony (Tony) McNair</td>
</tr>
</tbody>
</table>
• FY 14 Ongoing Energy projects
  – Developing New Paradigm for High Energy Density Capacitive Energy Storage
  – Alternative Fuel Usage Practices
  – Accelerating Navy Energy Culture Change
  – Reduction of Aviation Fuel Consumption Through Slot Management

• Next round – – Began with Requirements Fair at NPS earlier this week
Faculty Research Areas

- Resource Curse in East Asia and the Pacific
- Cost analysis
- Heat Exchangers for Energy Recovery
- Pricing Contracts Under Uncertainty
- Self-Sustaining Logistics Networks
- DoD Energy Objectives
- Petroleum Dependence

FY13 Survey of 10 Faculty Research Projects

- 3 published papers
- 7 projects underway
Student Research

FY13 Survey of 60 Energy Theses

- Engineering & Applied Sciences (34)
- Operational & Information Sciences (17)
- Business & Public Policy (6)
- International Graduate Studies (3)

Thesis areas (sample)

- Hybrid electric grid
- Cost analysis
- Thermal storage
- Flexible solar cells
- Fuel distribution
- Resource burden
- Plug-in electric drive vehicles
- LED lighting
- Power transfer efficiency
- Graphene
- Energy manpower
- Aluminum AUV hull
- Supercapacitors
- Algae Hyperprocessed Renewable Diesel

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Outreach in Support of NPS’s Core Mission

NPS’s core mission is the **Graduate Degree Education** of U.S. Naval Officers.

Sphere 2 is the **Reimbursable Research** performed at NPS which enriches the core mission by providing students and faculty the opportunity to apply their learning and expertise to real-world challenges.

Sphere 3 is **Non-Degree Education** performed by NPS faculty which enriches the core mission by providing expanded teaching opportunities reaching a broader student demographic, which results in deeper knowledge, greater experience of practice, and improved, more dynamic academic rigor in the NPS classroom.
EAG has built relationships to provide...

- Enhancement of NPS's core mission
  - Graduate Education of Naval officers
  - Faculty Research to support that mission
  - Non-degree Education programs to support that mission
- Awareness of NPS's capabilities
- Opportunities to work collaboratively

**USG Stakeholders**
- USN and USMC
- ONR / ONRG
- DOE - HQ and NREL
- OSD - OEPP
- JCS J5
- PACOM / PACFLT
- NATO - HQ and NATO School

**US Academic Institutions**
- USMA, NWC, USNA, NDU
- UT Austin
- SANDIA National Labs

- NPS Representative for OPNAV N45 Navy Energy Training & Education Working Group

Outreach: Defense Seminar Series
Outreach: Defense Seminar Series

- Academic Institutions—NPS, Stanford, CalTech, Bucknell

- Research Laboratories/Institutions--Lawrence Livermore, Sandia, Pacific Northwest National Labs, Monterey Bay Aquarium Research Institute, Electric Power Institute

- Industry / Private Sector
  - Rocky Mountain Institute, IBM Senior Research Division, Babcock & Wilcox, Tesla Motors, Yardney Technical Products, Pathfinder Partners

- Government
  - Director for Operational Energy, DOE
  - Director, Navy Energy Coordination Office (OPNAV N45E)
Next Steps

**Curriculum Development and Delivery**
- Merge two N00F flag level courses, Leading Innovation and Executive Energy Education. Beta class—24-28 Feb—with two more classes to follow
- Curriculum reviews of all four master’s degree programs. First scheduled is ECE, 22–23 Jan. 2014
- Seek demand signal for distance-learning component of curriculum
- Develop Energy Security Exec Ed courses for International Audience
- Develop short courses in Critical Energy Infrastructure Protection and Energy Security in the Supply Chain

**Research**
- Complete FY 13/14 studies and prepare for FY 15 studies
  - N1 Studies Program (4), USMC E20 Studies Program (8), N45 Support, and OSD Operational Energy Program
- Continue structuring and development of NPS – wide energy research enterprise
- Support faculty research interests in, for example:
  - Operationalizing the energy technology gap for expeditionary ops and HA/DR missions
  - Operationalizing solar, wind and fuel cell solution
  - Collaborative research programs in Flexible Solar Cell Technology
Next Steps (cont)

- Outreach
  - Continue developing external relationships, with priority on
    - Other parts of Naval enterprise (e.g., ONR, N45, USNA, NWC, MARFORPAC – MEC)
    - OUSD AT&L – Coalition Warfare Program
    - USA and USAF curriculum and program collaboration
    - Other US Academic Institutions
    - NATO Energy Security initiatives
  - Continue the Seminar / Speaker’s Series
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