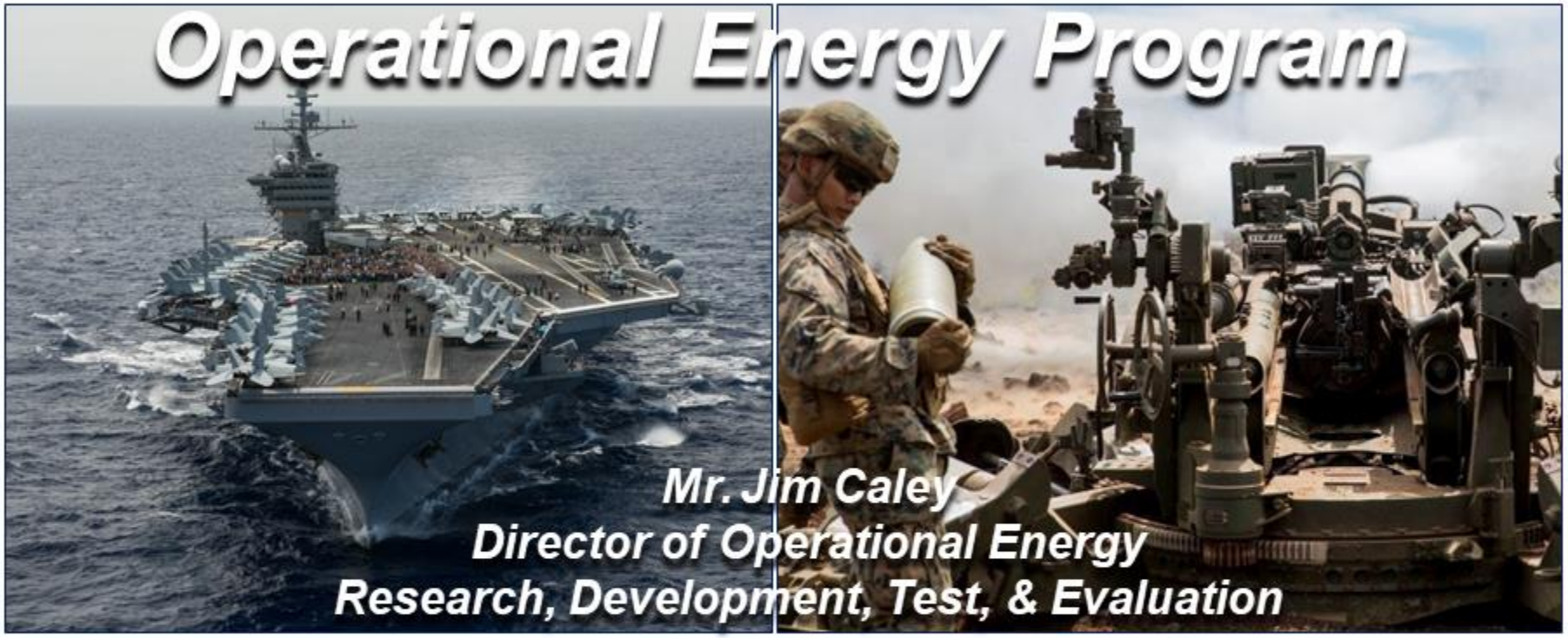
Department of the Navy



AMERICA'S NAVY

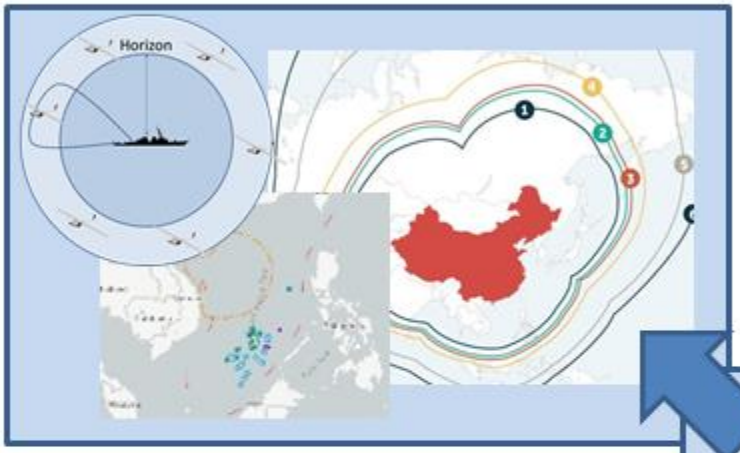
Marines

DON Operational Energy Goals

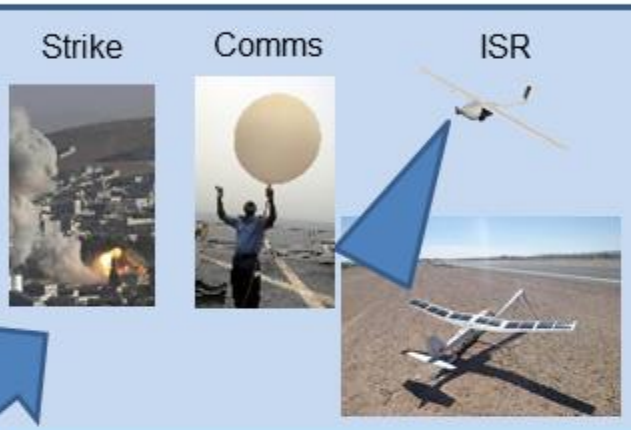
1. *Extend operational reach of current and future weapons systems through more effective use of energy*
2. *Reduce energy consumption and external energy logistics requirements to forward deployed strike groups*
3. *Increased energy resilience of forward bases, supply depots, and cooperative security locations – Get more energy to the warfighter*
4. *Increase the effective use, conversion, storage, distribution, and control of energy to enable integration of future weapons and sensors onto platforms*
5. *Foster and guide an energy culture in our sailors and marines through policy, training and education*

Weapons Systems and Platforms of the Future

Extended Ranges

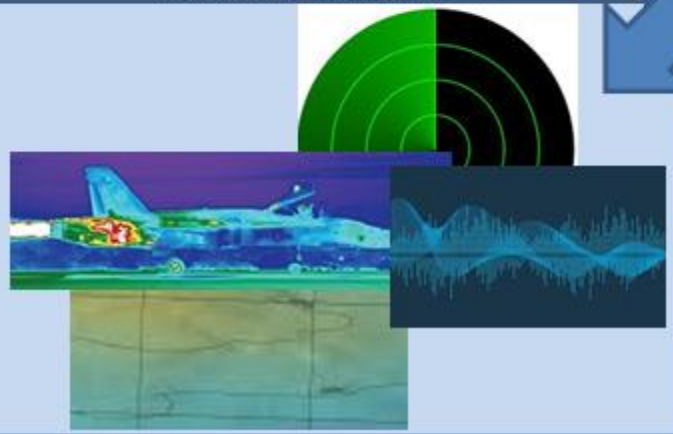


Persistence



Hydrogen & Fuel Cells

Reduced Signature & Silent Watch



Unmanned Swarm

Hybrid Tiger" Multi-Day Endurance of a Group 2 UAS

U.S. NAVAL RESEARCH LABORATORY

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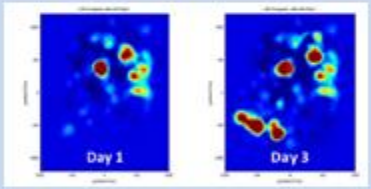

Solar Wings **Hydrogen Fuel Cell** **Soaring Algorithms**

Hydrogen Powered ISR with 2+ days of endurance

Gaps to getting Hydrogen on Ship (Enabling Ship based UxV H2 Swarm)

Design Tools

- ❑ Gas dispersion modeling
- ❑ Gas leakage modeling
- ❑ Design Criteria Manual for hydrogen generation, storage distribution and utilization
- ❑ Material selection for marine operating environment

System Specifications and resulting qualification testing

- ❑ Standardized UxV Fuel Cell System designs and specification
- ❑ Standardized Composite Over Wrap Pressure Vessel (COPV) designs and qualification
- ❑ Refueling and Support Package (RASP) electrolyzer for hydrogen generation
- ❑ Hydrogen and Hydrogen Fire sensors/detectors specifications, marinization and qualification

Technical Manuals/ Operation Procedures / Training

- ❑ Update SWBS 550 / NSTM 550 (Industrial gasses)
- ❑ Update SWBS 550 / NSTM 555 (firefighting)
- ❑ Damage Control training and qualification
- ❑ Hydrogen system operator and maintainer training and qualification

Deployment and Testing Options

Interagency Demonstration

- Details: Collaboration between DOE, NOAA, NASA, Coast Guard, ONR, NRL Monterey, University of Hawaii to generate hydrogen and fill weather balloons from a research vessel.
- Pros: Immediate need. Meets enduring needs for weather research and replaces Helium. Specialized research ships with fewer missions than military ships. Shows capability to Navy.
- Cons: Will still need Naval wartime hardening and Navy safety certification

Gray Hull

- Details: Deploy H_2 for balloons and fuel cell UAVs for ISR network in GPS denied environment
- Pros: Responds to emerging need to have organic communication network on ships and pushes Navy to certify use of hydrogen on board ships for tactical vehicles.
- Cons: Navy path for hydrogen fuel certification onboard ships not yet established.