Naval Energy Forum

Information Exchange
Energy S&T Topics

Energy Science & Technology

What is Energy Science & Technology?

Energy S&T will increase Naval capabilities through advancements in fuels, renewable energy, power generation, storage, distribution and power loads.

Energy S&T is an enabling factor for the goals and objectives of the emerging Department of the Navy Energy Strategy.

Why does it matter?

Naval energy S&T will increase Navy and Marine Corps capabilities and enhance energy security through advanced power sources/management, energy efficiency technologies and reduced carbon footprint.

What will the Navy do?

Advance energy security through alternative and renewable sources.

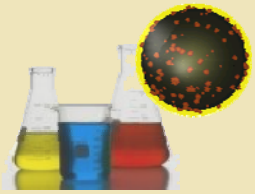
Develop efficient power and energy systems.

Meet high energy and pulse power requirements to shape future naval forces and enable warfighting concept.

Naval Power & Energy S&T

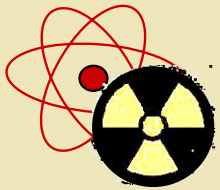
Technology Investment Areas

Fuel



Fuels Chemistry

Alternative Fuels

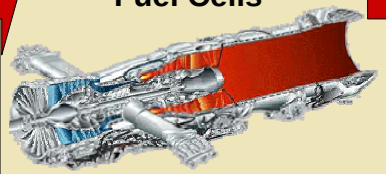


Nuclear

Power Generation

"Ion Tiger" UAV Fuel Cell

Fuel Cells

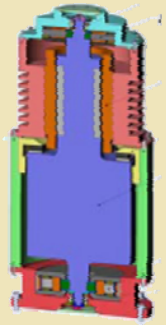


Aircraft Engines

Gas Turbine Generators

Energy Storage

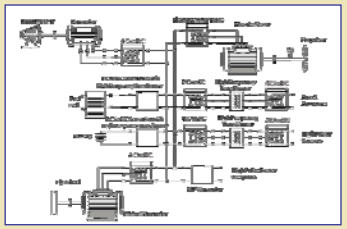
Batteries



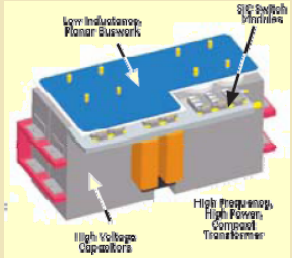
Flywheels

Capacitors

Distribution & Control



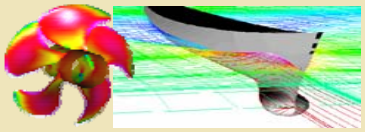
Electrical Architectures & Pulse Forming Networks



High Voltage Silicon Carbide (SiC) Switches

Power Loads

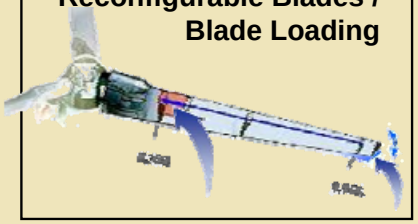
Electric Weapons



Powering & Resistance

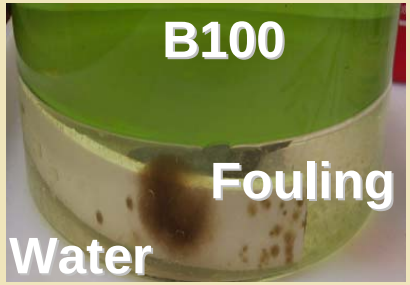
UV Sensor Loads

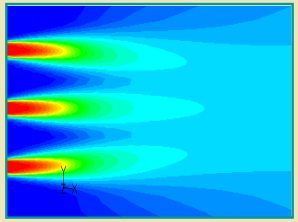
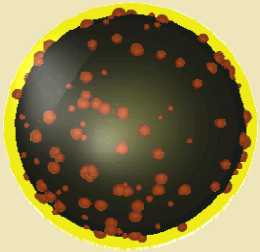
Reconfigurable Blades / Blade Loading



Fuels S&T

Fuels
Fuels Chemistry
Material & Engine Effects
Alternative Fuel Sources

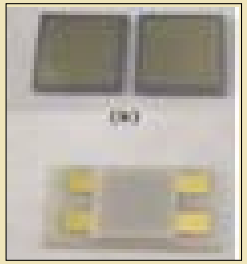


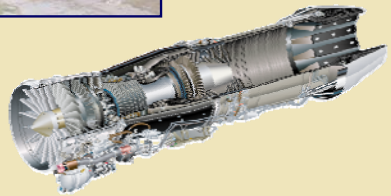
Objectives	• Investigate and expand the science to understand Naval-specific impacts from alternative fuels and how these impacts may be mitigated • Increase engine efficiency, reduce fuel costs, and reduce adverse emissions • Analyze the combustion process of current Navy engines with alternative fuels
Approach	• Concentrate on Naval-specific issues – sea salt ingestion, seawater bio-contamination, materials, and synthetic fuel operational effects on engines • Leverage research from DOE, DOD and other services, academia and industry • Explore viability of alternative fuels derived from biomass and waste sources
Products	• Model to predict critical fuel properties of alternative fuels • Design rules/tools to provide operational assurance of future alternative fuels • Assured gas turbine and diesel engine operations with alternative fuel blends

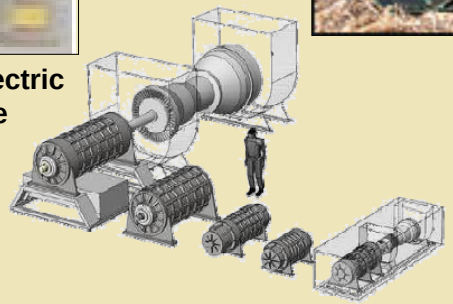
Power Generation S&T

Power Generation
Gas Turbine Engines
Fuel Cells
Advanced Generators
Direct Conversion
Photovoltaics



Thermo-electric Module

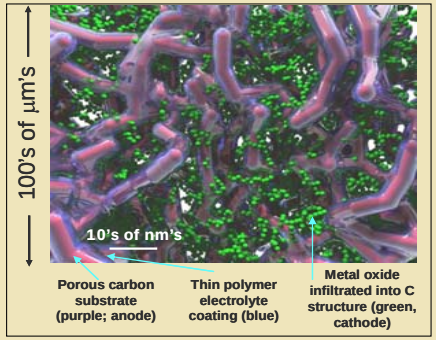




Objective	• Develop fuel efficient, affordable shipboard and off-board power generation technologies for Marine Corps personal power, autonomous vehicles, and shipboard power systems • Develop fuel efficient, affordable engines for Naval aircraft
Approach	• Understand fundamental chemistry & physics • Identify & investigate novel materials that may enable energy transformation processes • Develop physics-based models to aid development and design processes
Products	• Reduced specific fuel consumption and life cycle costs • Increased installed power density of electrical systems • Flexible distribution frequencies • Affordable, efficient aircraft engines

Energy Storage S&T

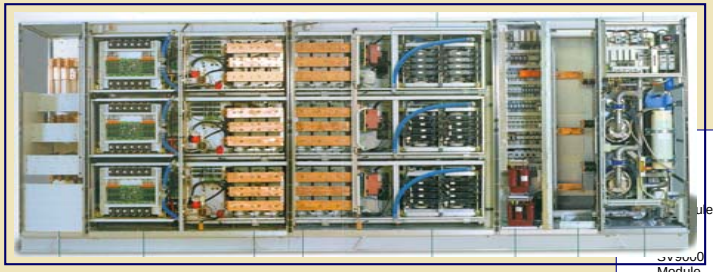
Energy Storage
Batteries
Capacitors



Objective	• Develop and demonstrate energy storage options that support both constant and intermittent duty cycles for Naval applications
Approach	• Conduct fundamental research to identify and investigate suitable materials • Determine the effects of scale • Conduct research to improve operating characteristics of novel devices
Products	• Fundamental technology to design a broad range of batteries • Advanced polymer and composite dielectric films for pulsed power capacitor systems • Design of a multilayer glass-ceramic composite capacitors for high temperature conditioning applications

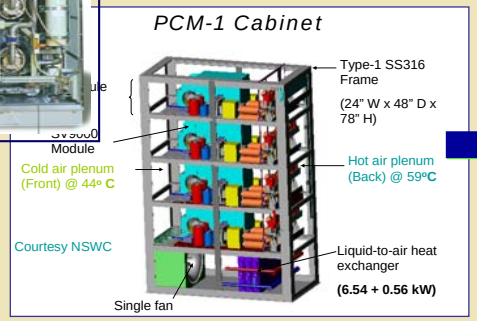
Distribution & Control S&T

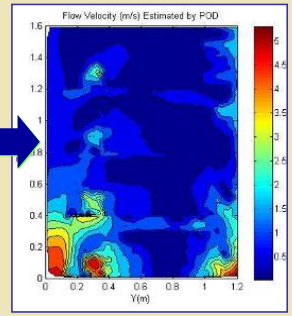
Distribution & Control
Architecture
Switching & Conditioning
Thermal Management



Switching & Conditioning

Thermal Management

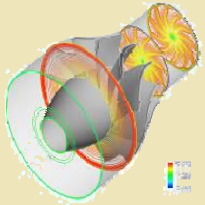


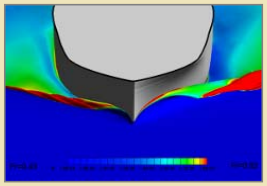
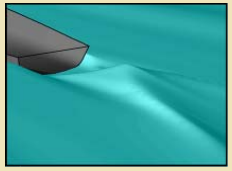
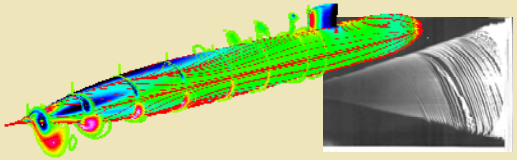
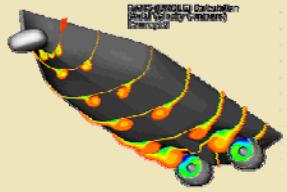


Objective	• Electrical system architectures based on optimum power processing concepts to yield reduced size, weight, and cost – enabling >2x increase in available power for future ship loads and >2x reduction in fuel consumption. • Control & stability hierarchy to manage high-levels of power and energy for all operational conditions. • High efficiency technologies to reject, reuse and store waste heat
Approach	• Investigate & develop new distribution concepts, & design concepts based on multifunctional power controllers; electronic decoupling concepts, adaptive and reconfigurable power technology, & high power switching & pulse forming networks • Investigate and develop advanced heat transfer materials, fluids and techniques
Products	• Control, switching & protection system requirements • Thermal management system requirements • Robust M&S, evaluation & design capability • Design guidance for a notional DC distribution system

Power Loads S&T

Resistance & Drag
Hull Forms
Propulsors



Objective	• Provide design tools for high performance, efficient, low signature hull forms and propulsors • Optimized integration of the hull-propulsor as a system
Approach	• Develop understanding of the governing physics, processes, prediction and control of ship and submarine motion • Develop a knowledge-base through fundamental experiments to understand the independent and coupled roles of roughness, various geometry complexities, drag reduction technologies, hydroacoustic sources, separated flows, unsteadiness, etc. on turbulent flows • Develop knowledge base of the governing physics, and accurate, reliable and robust predictive/simulation tools and methods for design and behavior of propulsors
Products	• Performance prediction and design tools to permit high performance, low signature hull forms and propulsors • Improved systems efficiency thru optimization of hull-propulsor hydrodynamics