



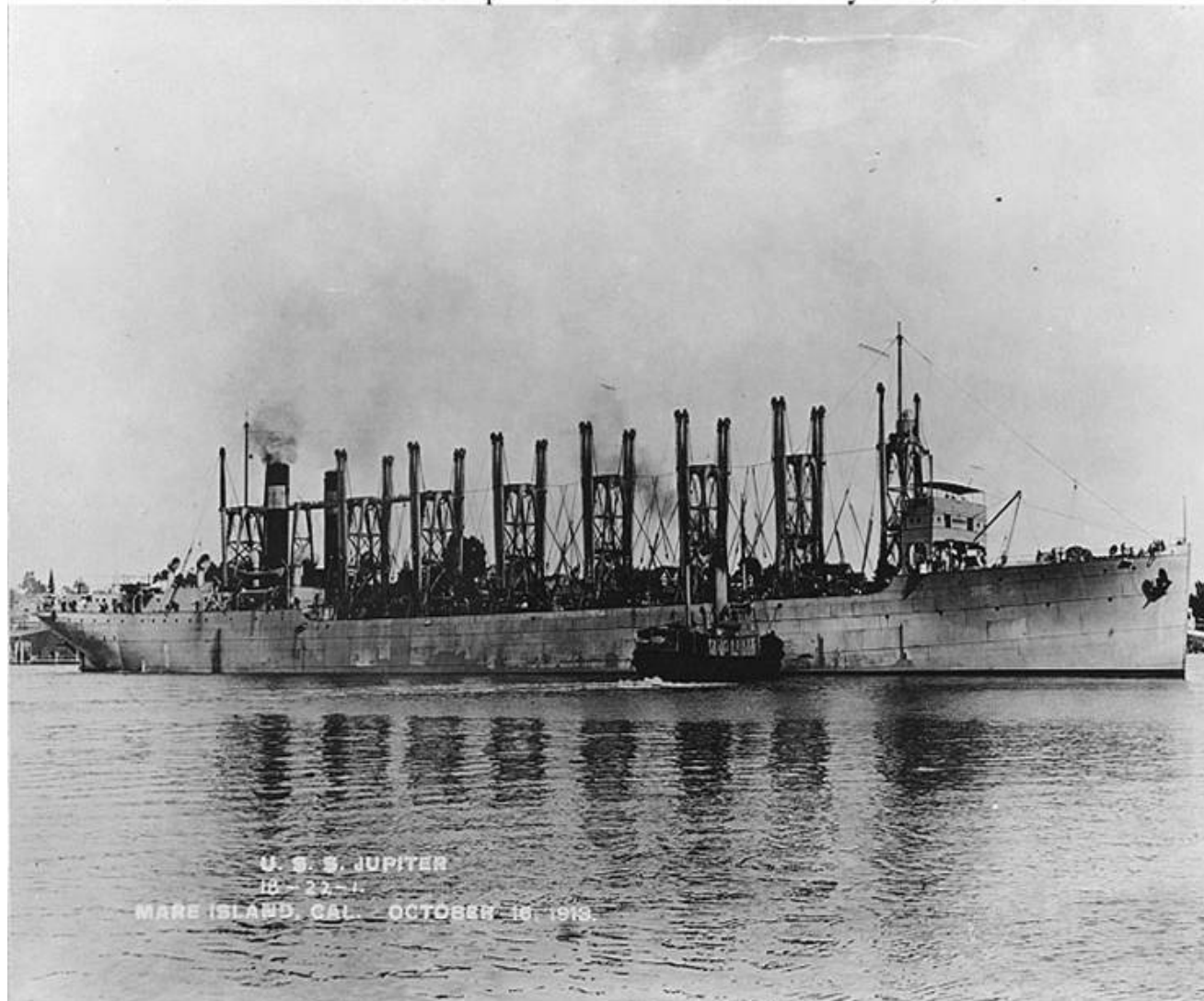
Advanced Capability Electric Systems

April 2006

Scott Littlefield
Office of Naval Research

USS Jupiter- 1913

Early example of Electric Drive



Navy is going electric

- T-AKE (Cargo Ship) – Diesel-electric system, with in-hull electric motors.
 - Enabled improved internal arrangements, with room for more cargo.
- LHD-8 (Amphibious Ship) – Hybrid system, with diesel-electric low speed mode and gas turbine mechanical drive at higher speeds.
 - Enables very efficient low-speed cruise.
- DD(X) Destroyer
 - First attempt at a power-dense, modern, militarized electric drive system.

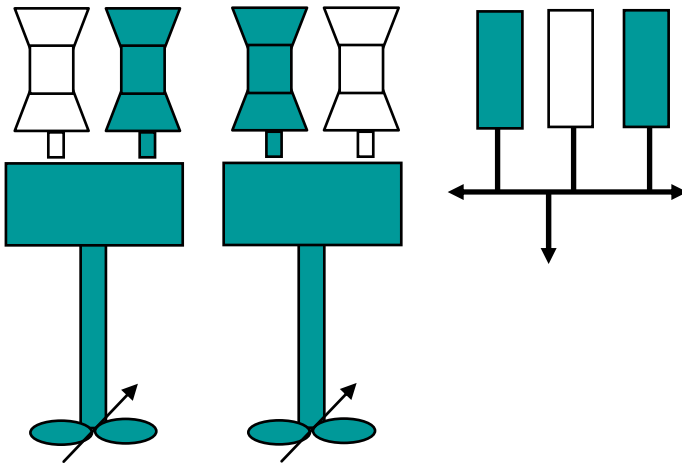
Why is the Navy Going Electric?

- **Enable Transformational Weapons Systems**
 - Electromagnetic Guns
 - Shipboard Laser Systems
 - Advanced Sensors
- **Improve Survivability**
 - Rapid and anticipatory Reconfiguration of Power and systems
- **Reduce Signatures**
 - Eliminates propulsion gear noise
 - Enables lower speed propellers
 - Enables silent watch capabilities
- **Reduce Life Cycle Costs**
 - Reduction in Number of Prime Movers
 - Significantly Greater Fuel Efficiency
 - Eliminate high maintenance hydraulic systems



Integrated Power System leads to Reduced Number of Prime Movers

Mechanical Drive

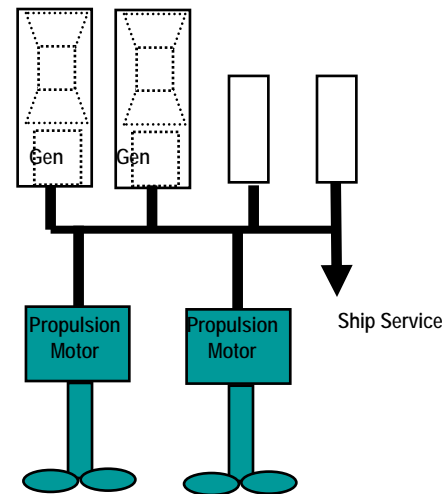


Current DDG-51 class has **seven** gas turbines

Life Cycle Cost Drivers:

- Initial Acquisition Cost
- Manning
- Maintenance
- Fuel Consumption

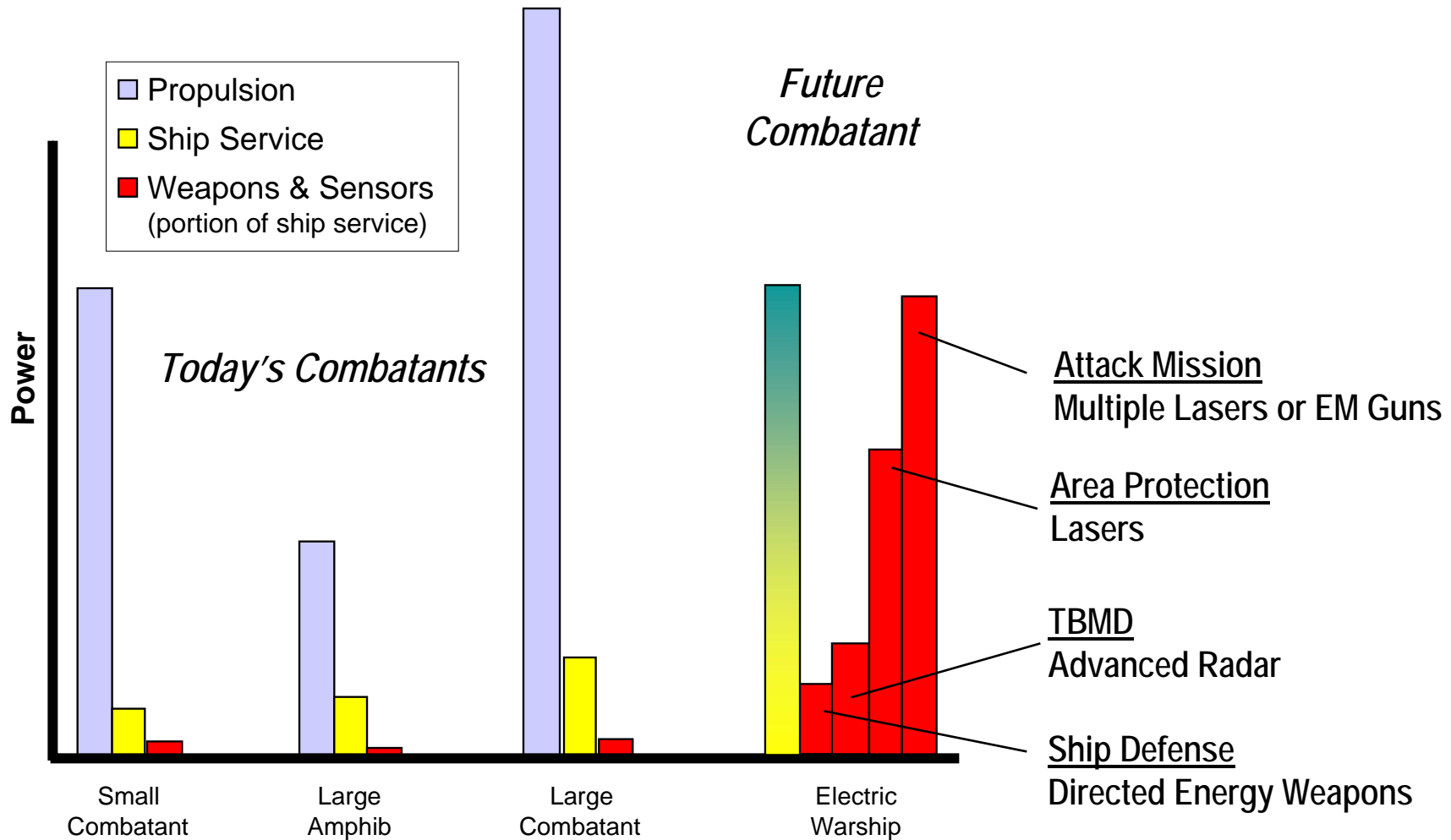
IPS



DD(X) will have **four** gas turbines

Thus lower Life Cycle Costs!

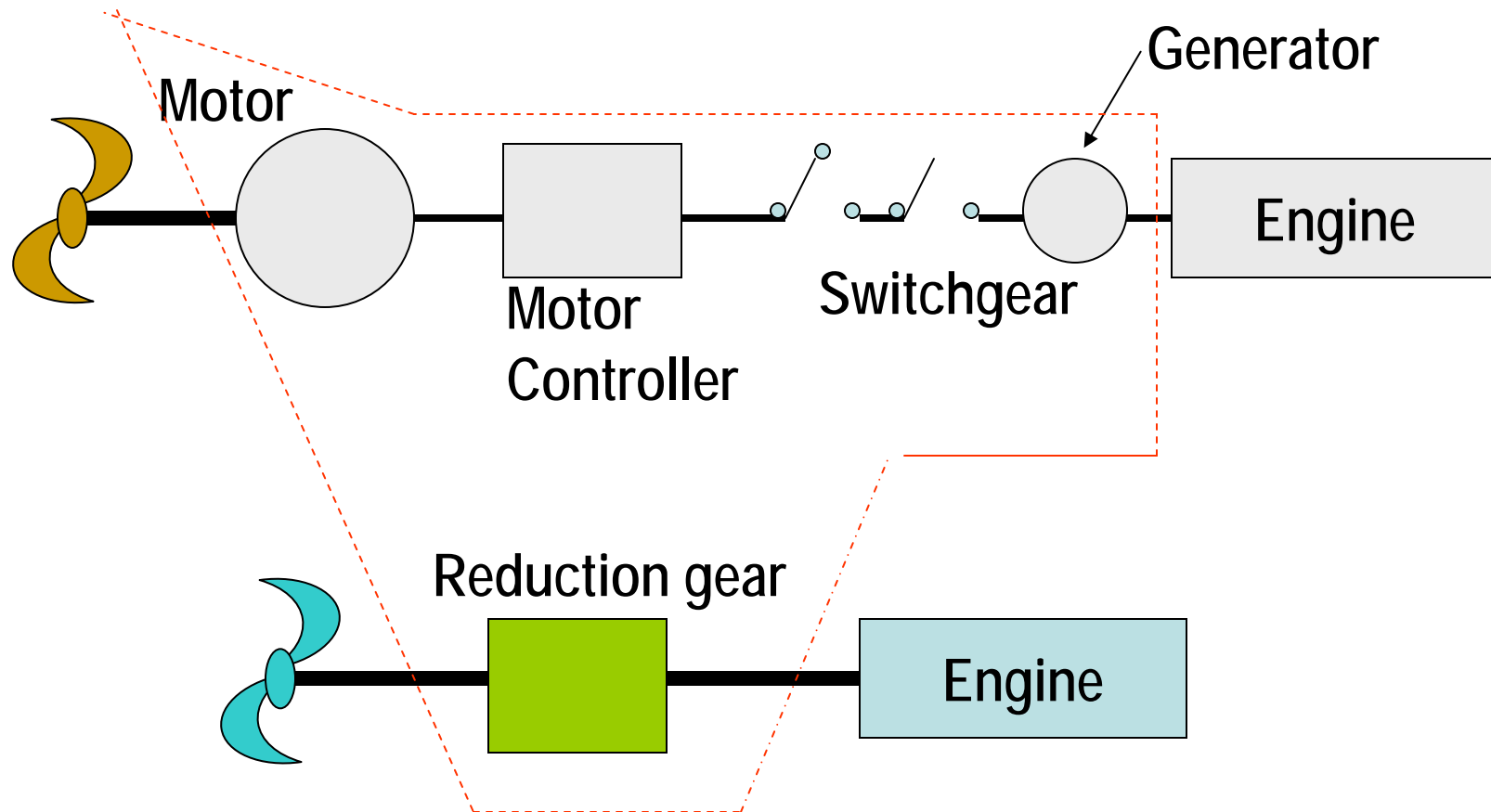
Expected Growth in Power Requirements



Key Issues for Navy

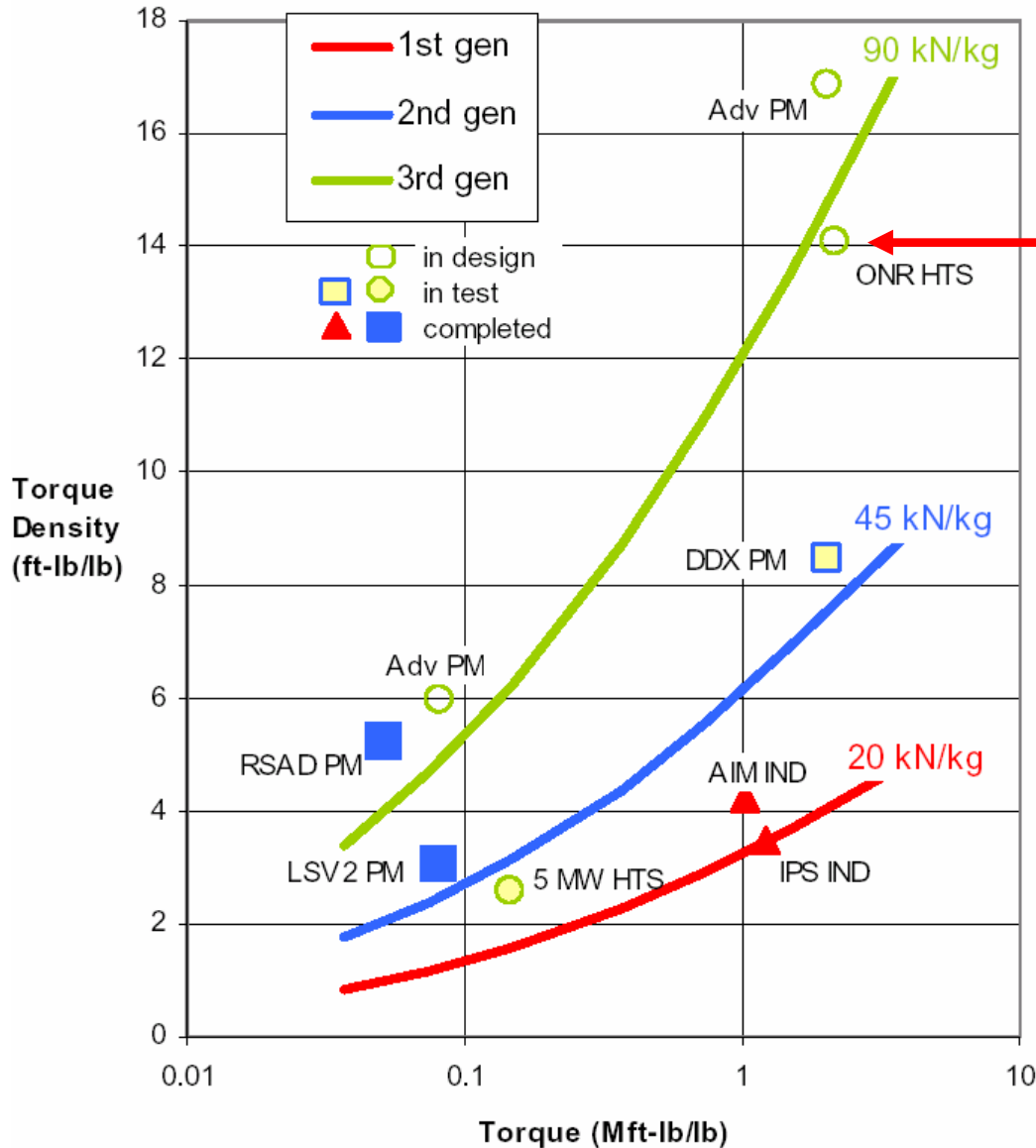
- Power Density
 - Components
 - Distribution Architecture
- Fuel Efficiency
- Pulsed Power
- Signatures

Power Density Issue



Mechanical Drive still beats Electric Drive on Power Density.

Motor Torque Density



To be demonstrated at full scale in 2007.

Figure courtesy of Peter Mongeau,
ASNE Electric Machines
Technology Symposium,
Philadelphia PA, January 2004

NRAC Summer Study – Future Fuels

- National Petroleum Usage – 16M BPD
- DOD Usage – 300K BPD (about 2% of national usage).
- DOD Usage:
 - Aircraft 73%
 - Ground 15%
 - Ships 8%
 - Installations 4%
- Recommendation – DOD catalyze manufactured hydrocarbon liquid fuels infrastructure through long term purchase contracts.

Future S&T Directions:

- High Speed / High Frequency Generators
- Advanced Distribution Architecture
- Innovative Ship Propulsion
- Compact Power Electronics and Energy Storage to Support Pulsed Power Weapons and Sensors.



Questions?