

GE Energy Power Conversion

7th Annual University of Pittsburgh Electric Power Industry Conference

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12 Nov 12



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US Navy Energy Challenges

Great Green Fleet



“OUR SHIPS - THE SYSTEMS THAT WE USE AND THE POWER REQUIREMENTS THAT THEY HAVE ARE GETTING BIGGER ALL THE TIME. EVERY SYSTEM WE’RE PUTTING

ON A SHIP NOW OR IN AN AIRCRAFT IS IN SOME WAYS SORT OF A POWER HOG... WE HAVE TO FIND A DIFFERENT WAY TO POWER THE THINGS WE NEED TO POWER.”

**- HONORABLE RAY MABUS
SECRETARY OF U.S. NAVY**



“OVER THE NEXT 10 TO 15 YEARS, THE NAVY WILL EVOLVE AND REMAIN THE PREEMINENT MARITIME FORCE. THE REACH AND

EFFECTIVENESS OF SHIPS AND AIRCRAFT WILL BE GREATLY EXPANDED THROUGH NEW AND UPDATED WEAPONS, UNMANNED SYSTEMS, SENSORS, AND INCREASED POWER.”

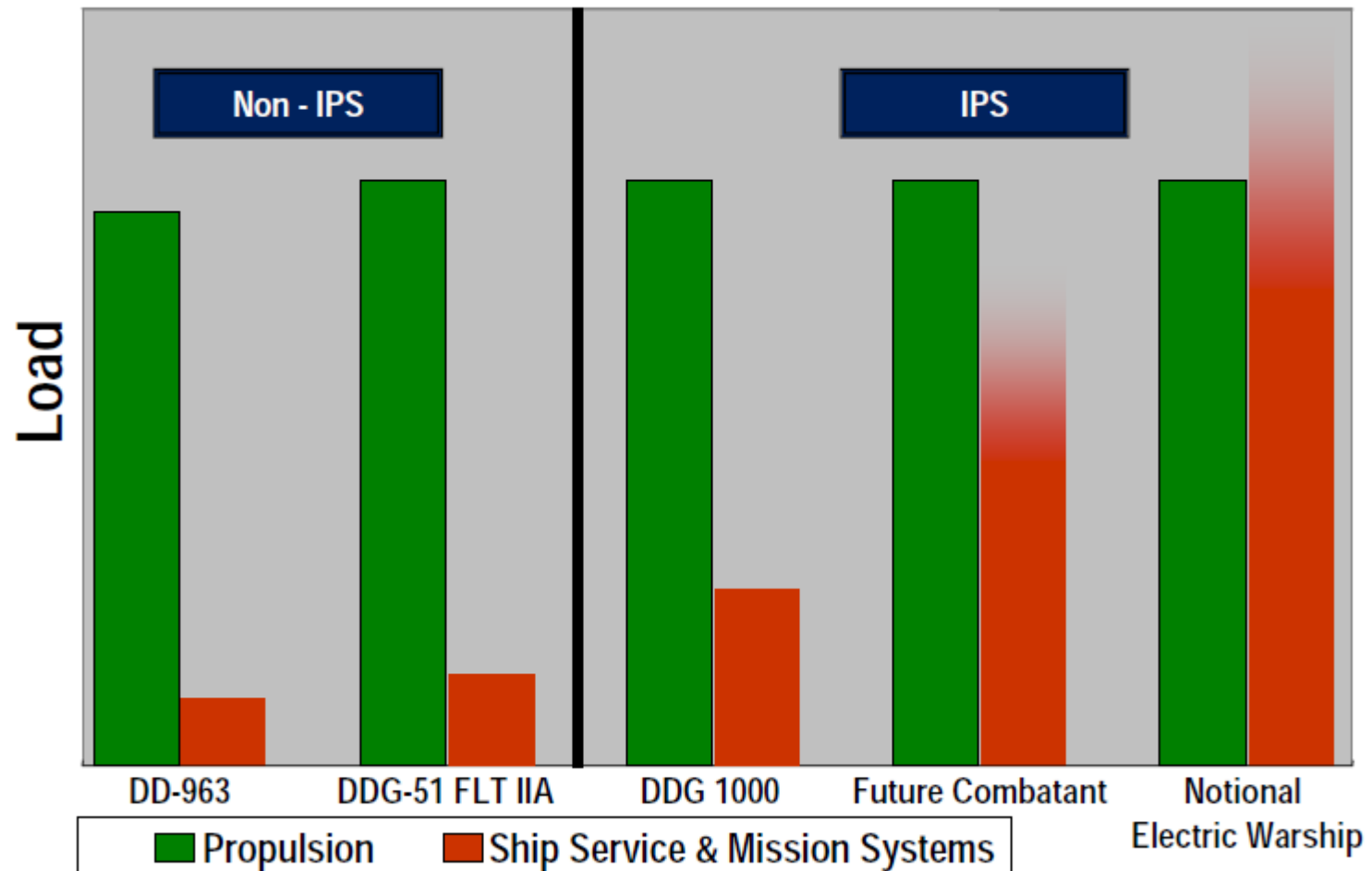
**- ADMIRAL JONATHAN GREENERT
CHIEF OF NAVAL OPERATIONS**

Fundamental Shift Required for Future Acquisition Programs

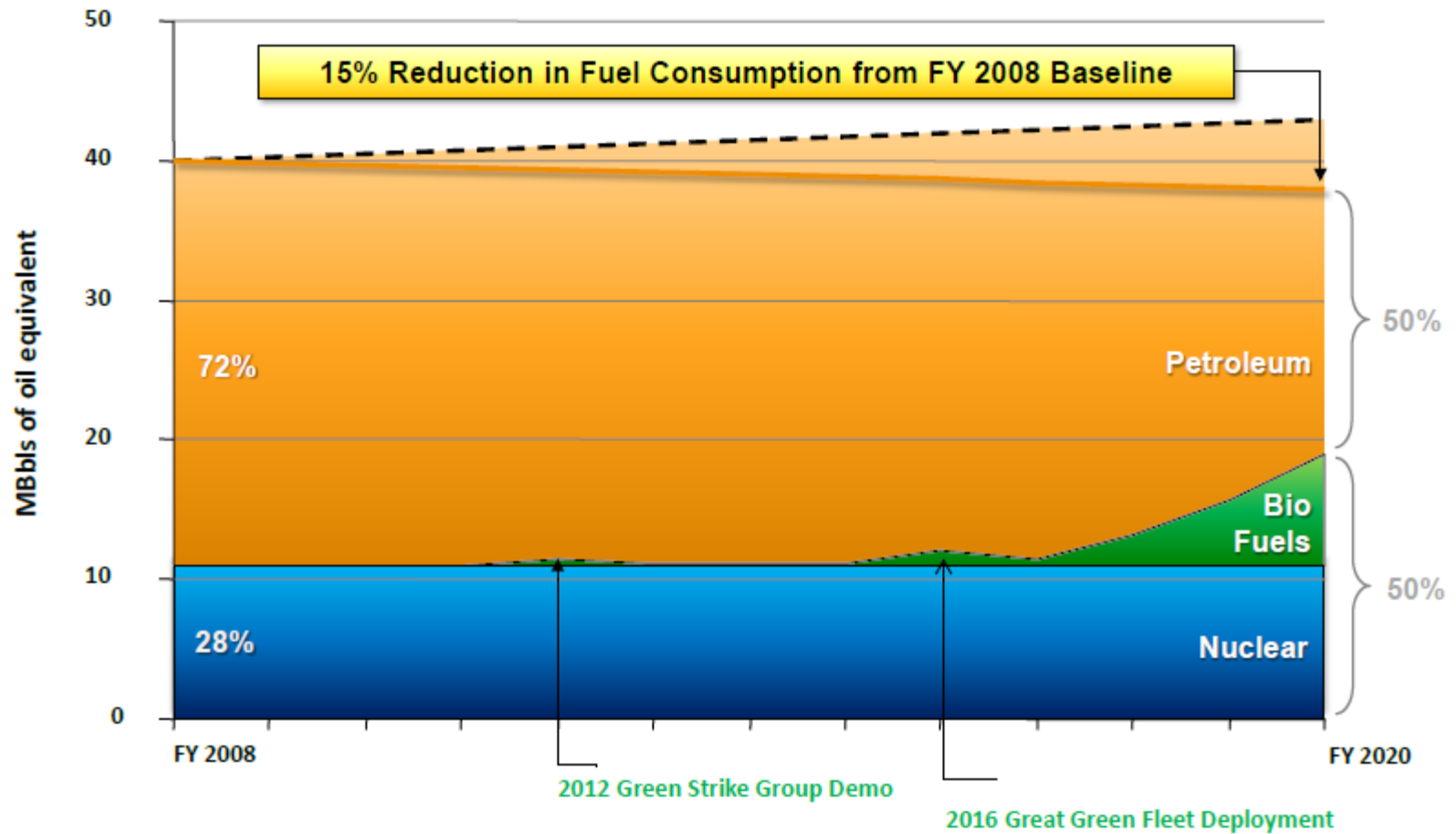


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Increased Electrical Demand

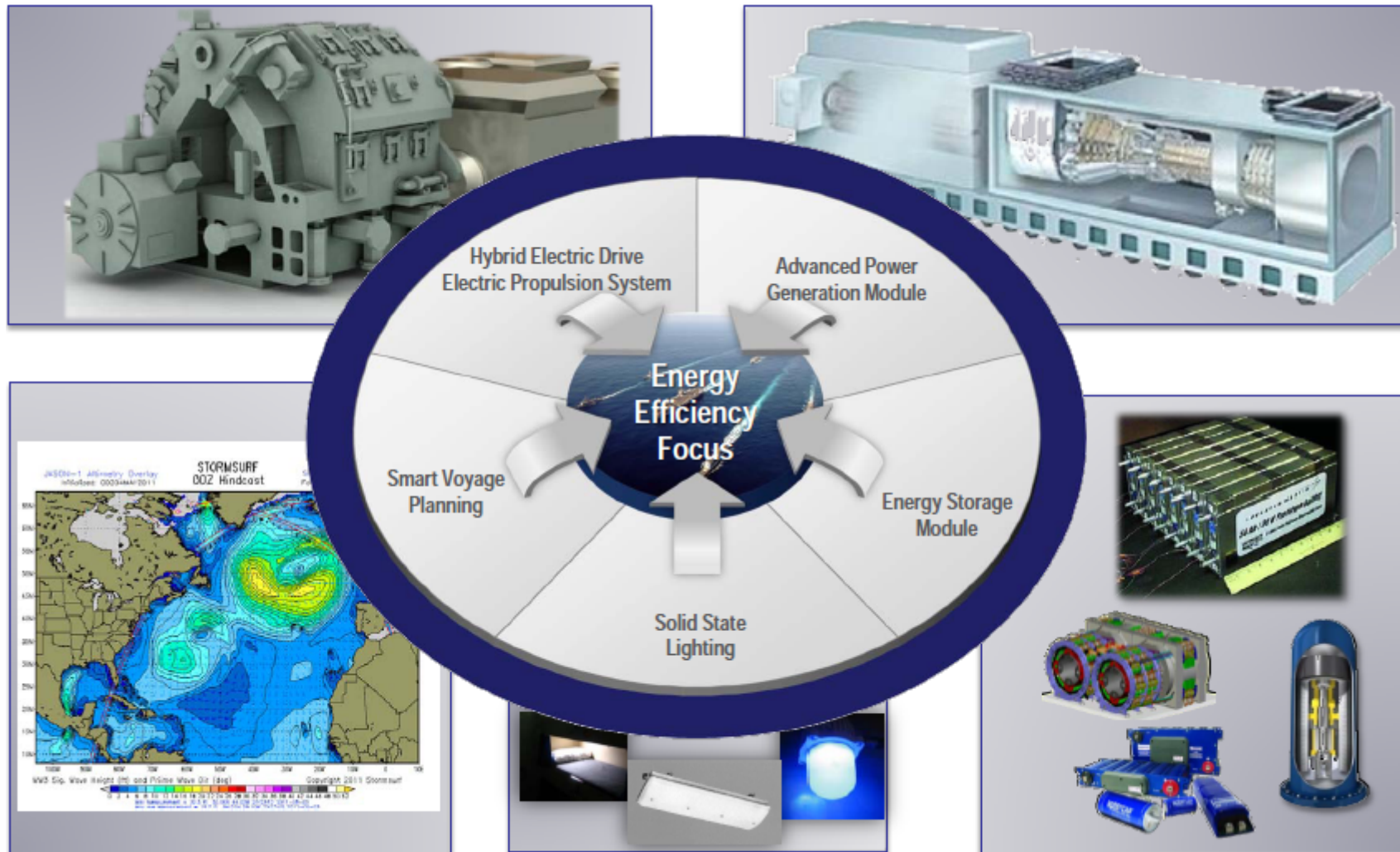


Fuel Consumption

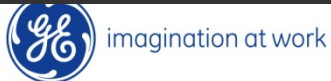


Reduce Consumption Through Conservation and Efficiency

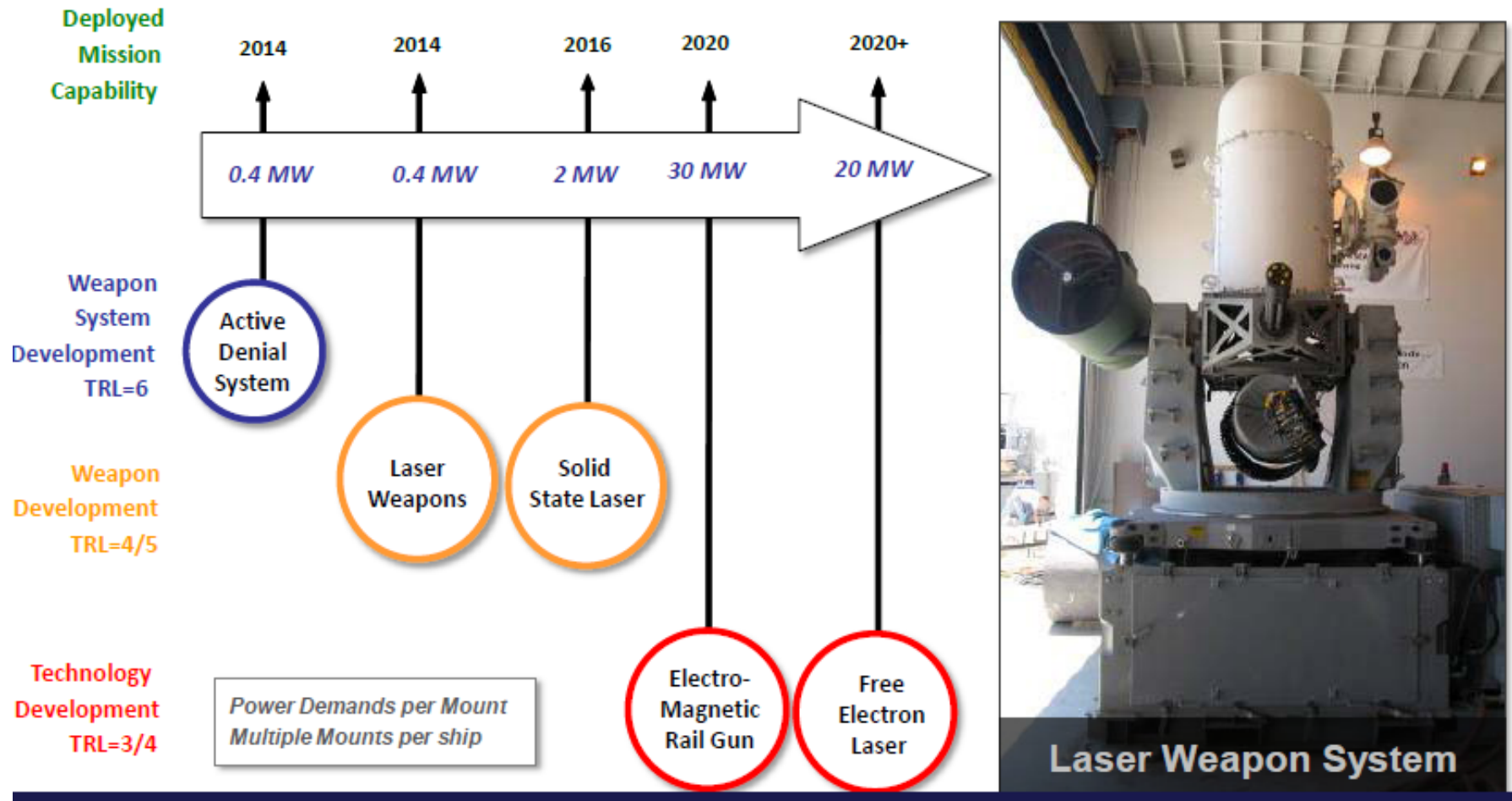
US Naval Energy Uses



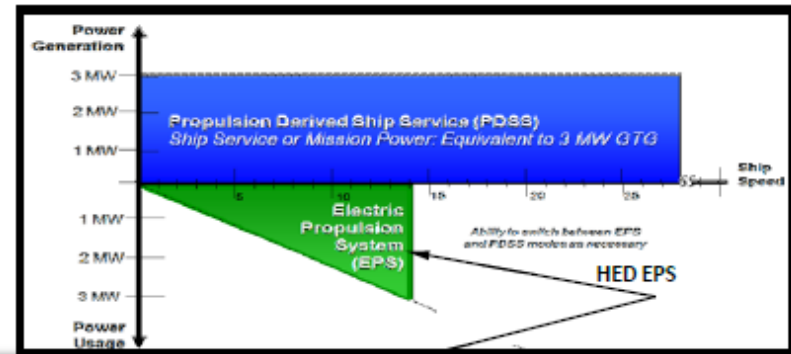
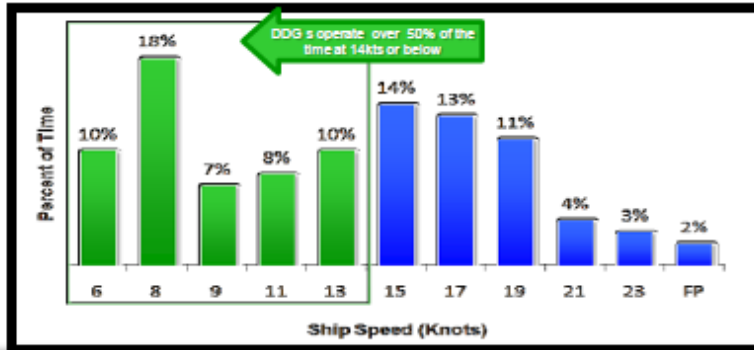
Distro A: Approved for Public Release. Distribution is unlimited



Increasing Electrical Power Demands



Hybrid Electric Drive



Converter

Motor

Electric Motor

COTS Switchboard

8,000 bbls of fuel saved per ship






Distro A: Approved for Public Release. Distribution is unlimited

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Customer Key Drivers

- Cost (Acquisition)
- Footprint (modular, retro-fit, new construction)
- Connections
- Reliability
- Auxiliaries (Thermal Management, minimal losses)
- Life Cycle
- Installation/Commissioning Time
- Energy Use Flexibility/Increase Capabilities

US Navy Energy Initiatives

PLATFORM	RESULTS
	<p>Amphibious Assault (LHD 8 and LHA 6)</p> <ul style="list-style-type: none"> The first U.S. Navy amphibious ship built with Gas Turbine Engines and Hybrid Electric Drive resulting in <u>significant fuel savings compared with steam driven LHD</u>
	<p>Combat Logistics Force (T-AKE)</p> <ul style="list-style-type: none"> T-AKE is powered by a commercial Integrated Power System, realizing <u>reduced acquisition and life cycle costs</u>
	<p>Surface Combatants (DDG 51)</p> <ul style="list-style-type: none"> USS TRUXTUN (DDG 103) Hybrid Electric Drive (HED) and USS PREBLE (DDG 88) Energy Storage Module (ESM) to <u>demonstrate significant reductions in fuel usage</u>. HED acquisition program underway to backfit Flight IIA ships

Solar/Renewables

Solar Energy Overview

Description

PhotoVoltaic (PV)

- Simplest of all forms of power generation
- No moving part in these **solid state devices**
- Can be deployed easily for both distributed and utility generation applications

Thermal / CSP (Concentrated Solar Power)

- Sunlight treated as a source of heat used to drive a turbine in a power plant similar to fossil-fuel fired power plants
- In order to provide heat of sufficient quality for power generation, sunlight must first be concentrated

Size of power plants (as of today)

Up to 550MW

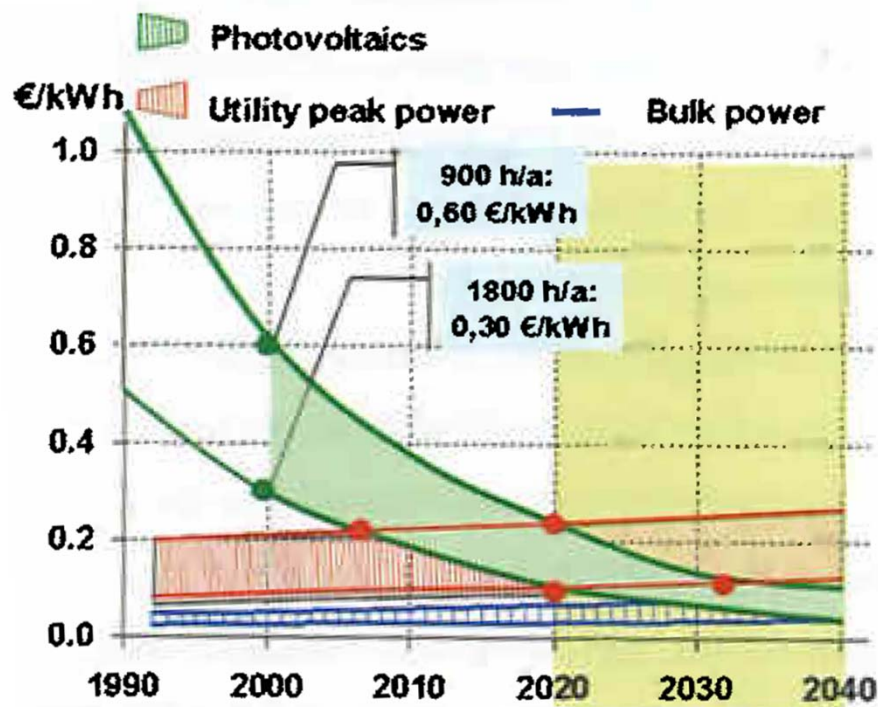


Up to 40MW / 110 ha



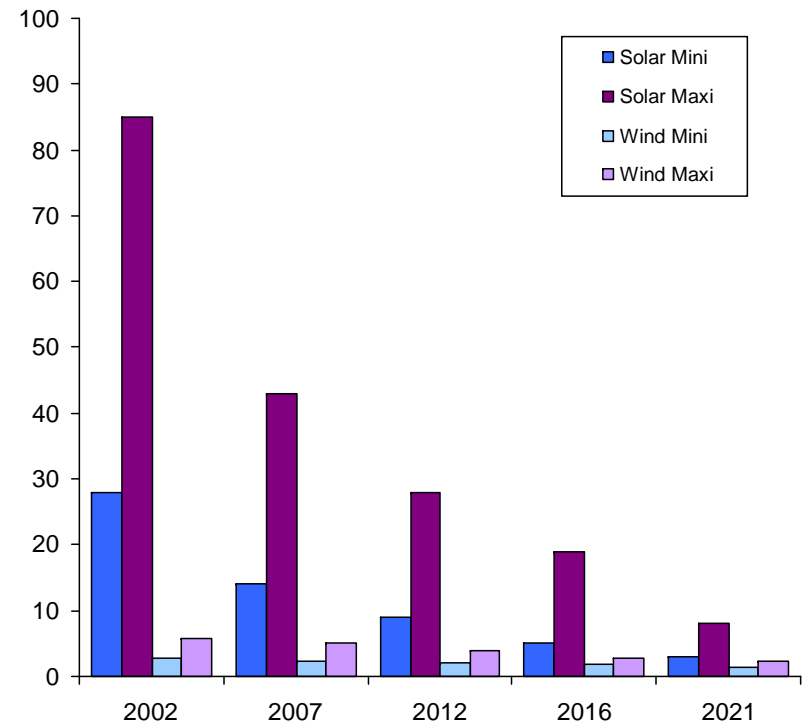
Grid Parity is Critical Element

Competitiveness of PV solar vs. electricity



Comparison of wind vs. solar

€cts/kWh



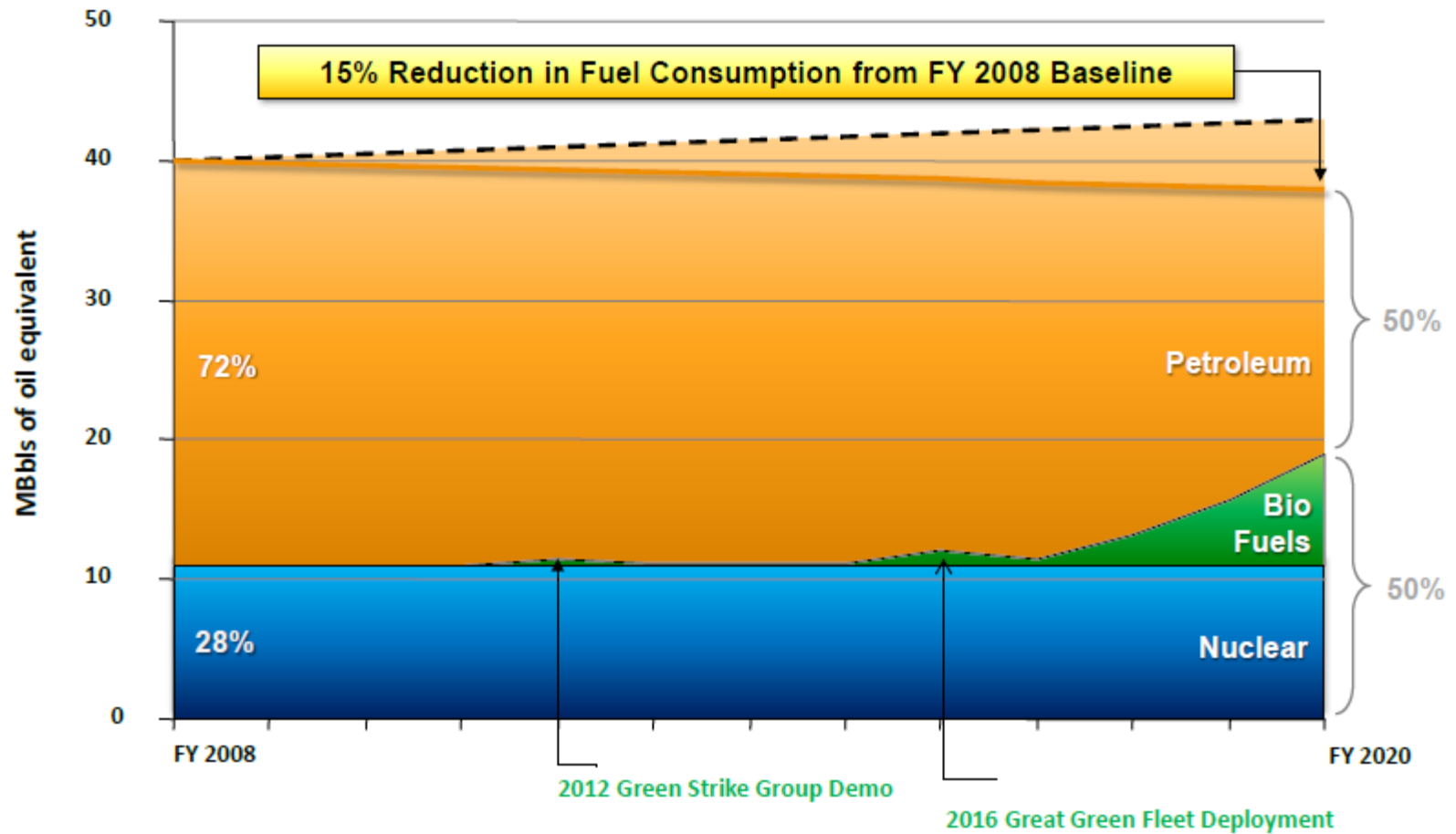
Solar Industry Challenges

Solar Power Market: Impact of Top Five Industry Challenges (Global), 2011-2017

Challenge	1-2 Years	3-4 Years	5-7 Years
Low cost of PV module	High	Medium	Medium
High electricity prices	High	Medium	Low
Dependence on government support	Medium	Low	Low
Shortage of solar panels	Medium	Low	Low
Global financial crisis	Low	Low	Low

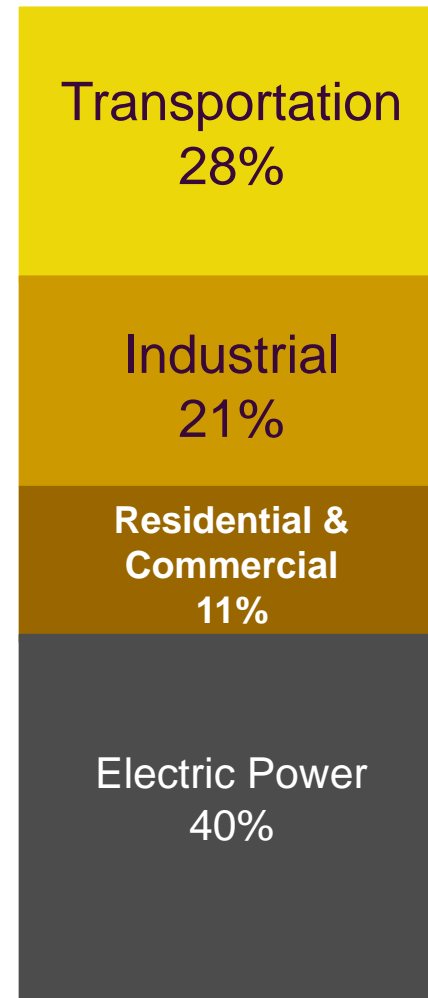
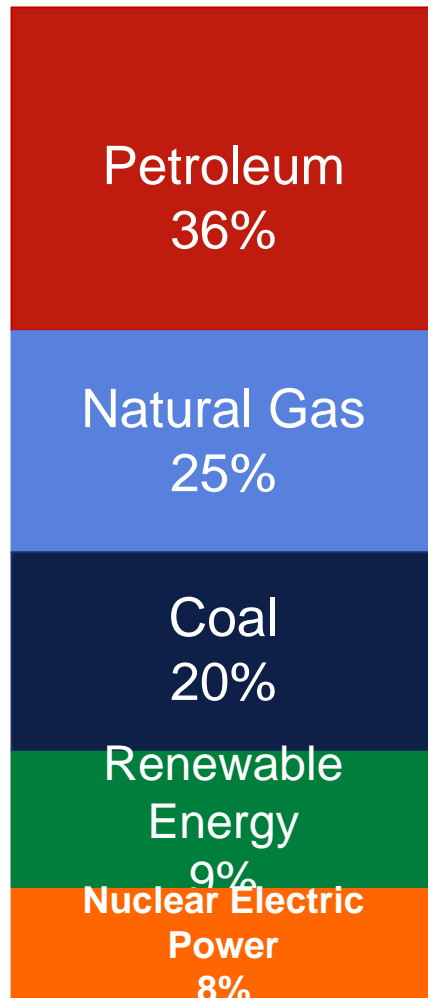
Source: Frost & Sullivan analysis.

Fuel Consumption

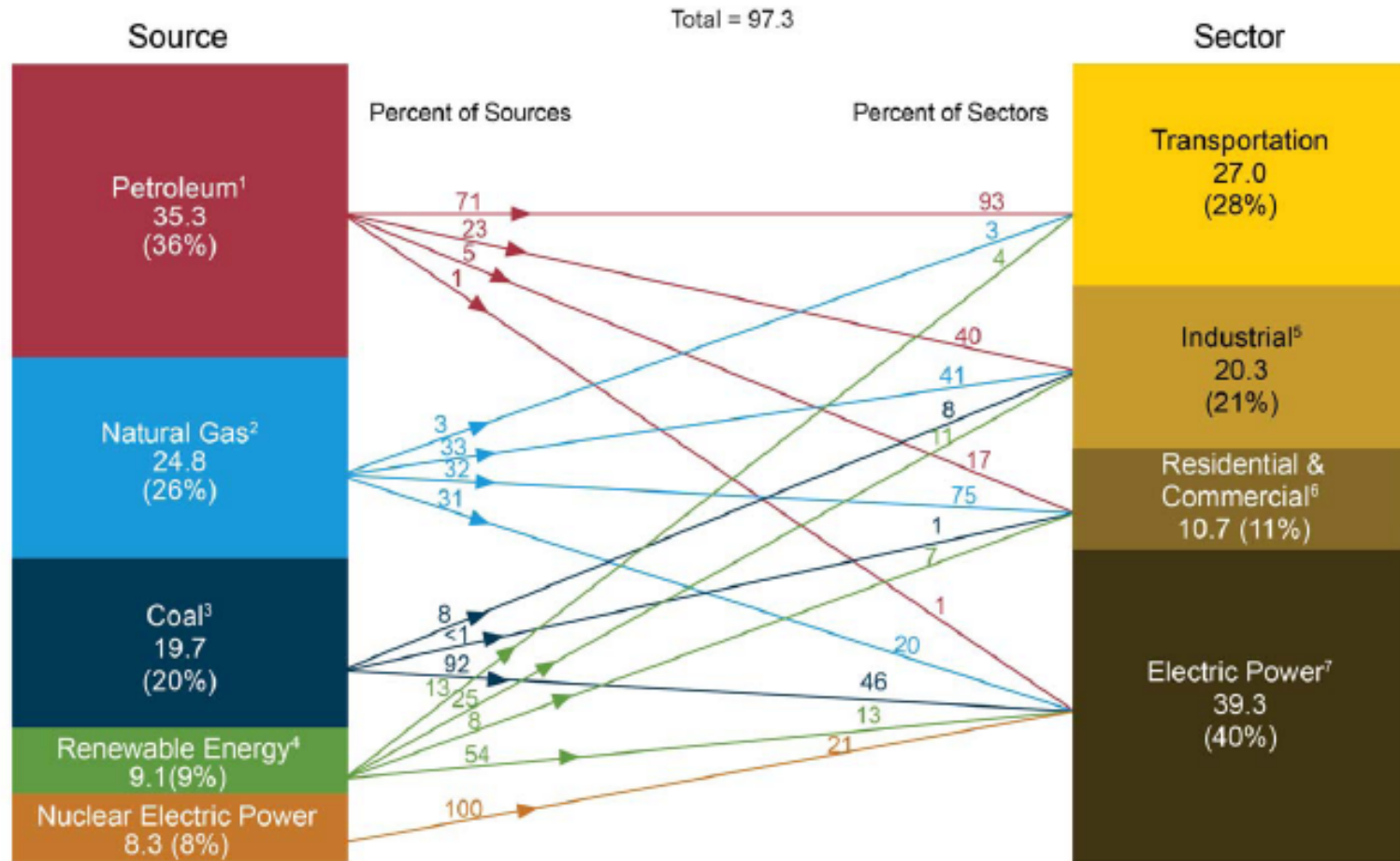


Reduce Consumption Through Conservation and Efficiency

Energy Source/Energy Use



Energy Source/Energy Use



¹ Does not include biofuels that have been blended with petroleum—biofuels are included in "Renewable Energy."

² Excludes supplemental gaseous fuels.

³ Includes less than 0.1 quadrillion Btu of coal coke net imports.

⁴ Conventional hydroelectric power, geothermal, solar/photovoltaic, wind, and biomass.

⁵ Includes industrial combined-heat-and-power (CHP) and industrial electricity-only plants.

⁶ Includes commercial combined-heat-and-power (CHP) and commercial electricity-only plants.

⁷ Electricity-only and combined-heat-and-power (CHP) plants whose primary business is to sell electricity, or electricity and heat, to the public. Includes 0.1 quadrillion Btu of electricity net imports not shown under "Source."

Notes: Primary energy in the form that it is first accounted for in a statistical energy balance, before any transformation to secondary or tertiary forms of energy (for example, coal is used to generate electricity). • Sum of components may not equal total due to independent rounding.

Sources: U.S. Energy Information Administration, *Annual Energy Review 2011*, Tables 1.3, 2.1b-2.1f, 10.3, and 10.4.

Key Take Away - Summary

- The US Should Continue its Objective for Reduced Foreign Fuel Dependency as Energy Needs Are Continuously Rising
- Need for Energy Flexibility is Required
- Renewables WILL Become a Larger Factor in Years to Come
- Grid Parity is a Key Enabler
- Cultural Change is Also Required

