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## NAVY ENERGY FORUM

***“Seapower Repowered: Energy as a Force Multiplier and Strategic Resource”***

**Washington, DC**

**12 - 13 October 2010**

### Agenda

**Tuesday , October 12, 2010**

-  
**PANEL: BUILDING A FOUNDATION FOR THE GREEN FLEET**

- RADM Thomas J. Eccles, Chief Engineer and Deputy Commander for Naval Systems Engineering, Naval Sea Systems Command
- RDML David Boone, Director, Shore Readiness Division (N46), Office of the Chief of Naval Operations and Vice Commander, Navy Installations Command
- RDML Randolph L. Mahr, Commander, Naval Air Warfare Center Aircraft Division and Assistant Commander for Research and Engineering, Naval Air Systems Command

**DEFENSE ENERGY POLICY**

- Honorable Sharon Burke, Director, Operational Energy Plans and Programs, Office of the Secretary of Defense

**PANEL: ENABLING AN ENERGY TRANSFORMATION THROUGH DROP-IN ALTERNATIVE FUELS**

- Dr. Srin Mirmira, Associate Director for Commercialization, Advanced Research Projects Agency - Energy
- Dr. Jim Rekoske, Vice President and General Manager for Renewable Energy and Chemicals, Honeywell UOP
- Dr. Jeffrey Steiner, National Program Leader for Biomass Production Systems, USDA Agricultural Research Service
- Mr. Timothy Vinopal, Chief Engineer for the Environment, Boeing Defense Space and Security

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**Wednesday, October 13, 2010**

-  
**PRESENTATION OF THE NAVY ENERGY VISION**

- RADM Philip Cullom, Director, Energy and Environmental Readiness Division (OPNAV N45), Director, Navy Task Force Energy

**PANEL: THE WAY AHEAD FOR REDUCING LIFECYCLE ENERGY COSTS**

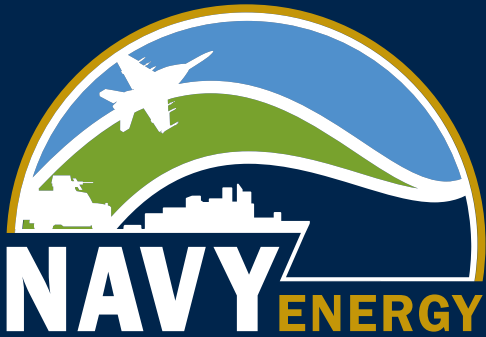
- RADM Nevin P. Carr, Jr., Chief of Naval Research, Director, Test and Evaluation and Technology Requirements
- RDML David H. Lewis, Program Executive Officer Ships

**PANEL: MISSION ASSURANCE, RENEWABLES AND THE SMART GRID**

- Mr. Tom Bowe, Executive Director, Reliability Integration Division, PJM Interconnection
  - Mr. Arthur “Chip” Cotton, Program Manager Energy R&D, General Electric Global Research
  - Mr. Mark Wagner, Vice President Government Relations, Johnson Controls, Inc.
-

# NAVY ENERGY FORUM

Seapower Repowered: Energy as a Force Multiplier and Strategic Resource



## FORUM HIGHLIGHTS:

- ▶ Presentation of the “Navy Energy Vision”
- ▶ Keynote Addresses by Secretary Ray Mabus, Admiral Gary Roughead, and other Distinguished Guests
- ▶ Panel Discussions on Progress to Energy Goals, Alternative Fuels, Lifecycle Costs, and Grid Security
- ▶ Opportunities to Engage with Navy Task Force Energy Working Groups and Industry Representatives



## A WELCOME MESSAGE

On behalf of Navy Task Force Energy, I would like to welcome you to the 2010 Navy Energy Forum.

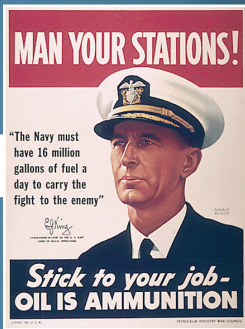
The past year has been exciting for the Navy in our efforts to achieve greater energy security for the Navy and the Nation. Last year, the Secretary of the Navy announced ambitious energy goals, and we will discuss the significant progress that has been made toward meeting those goals. This year, we will present the Navy Energy Vision, which brings together the efforts of Task Force Energy to define ends, ways, and means for energy security. Fundamental to this quest for greater energy security remains our focus on enhancing combat capability or enabling greater resilience of our shore support infrastructure. No investment or effort is made unless it supports these foundational requirements.

As the N4, I am also particularly concerned with reducing the total ownership costs of our ships, aircraft and buildings. One of the most important aspects of managing these costs is mitigating the risk of increased energy prices. I'm proud to say that we have budgeted for investments in technology and culture change initiatives that will help bend that curve. We will hear from our own officers on how the Navy will seek to reduce lifecycle costs in the current and future fleet. These actions will ensure that we can maintain readiness in the face of an evolving global security environment.

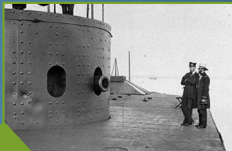
We have set a high bar for ourselves. More and more people are talking about energy challenges and what needs to be done to address them. Most important, people are taking action. However, we need to keep working. Whether you are a scientist, engineer, entrepreneur, policymaker, communicator, or executive, you have a role to play as we pursue our Navy Energy Vision. I encourage you to take advantage of breaks in the program to exchange information with our Task Force Energy Working Group representatives.

*Vice Admiral Bill Burke, USN*





Energy security has always been key to completing the mission...



Past



Present



Future



...and the Navy has always been a leader in energy innovation for strategic and tactical advantage.

The Secretary of the Navy Energy Goals set a course for the next energy transformation.

**Increase Alternatives Afloat**

By 2020, 50% of total DON energy consumption will come from alternative sources

**Increase Alternatives Ashore**

By 2020, DON will produce at least 50% of shore-based energy requirements from alternative sources; 50% of DON installations will be net-zero

**Sail the "Great Green Fleet"**

DON will demonstrate a Green Strike Group in local operations by 2012 and sail it by 2016

**Reduce Non-Tactical Petroleum Use**

By 2015, DON will reduce petroleum use in the commercial fleet by 50%

**Energy Efficient Acquisition**

Evaluation of energy factors will be mandatory when awarding contracts for systems and buildings

## POLICY & PARTNERSHIPS

### TUESDAY, OCTOBER 12, 2010

- 7:15am - 8:15am Registration Open - Atrium Hall Foyer Ground Level  
*Continental Breakfast Available in Hall Foyer Concourse Level*
- 8:00am - 8:15am **PRESENTATION OF COLORS**  
*Naval Medical Research Center and Walter Reed Army Institute of Research Honor Guard*
- 8:15am - 8:45am **WELCOME & OPENING REMARKS** - Atrium Hall  
▶ RADM Philip Cullom, *Director, Energy and Environmental Readiness Division (OPNAV N45), Director, Navy Task Force Energy*
- 8:45am - 9:15am **OPENING KEYNOTE**  
▶ ADM Gary Roughead, *Chief of Naval Operations*
- 9:15am - 10:15am **PANEL: BUILDING A FOUNDATION FOR THE GREEN FLEET**  
Moderated by Mr. Tom Hicks, *Deputy Assistant Secretary of the Navy (Energy)*  
▶ RADM Thomas J. Eccles, *Chief Engineer and Deputy Commander for Naval Systems Engineering, Naval Sea Systems Command*  
▶ RDML David Boone, *Director, Shore Readiness Division (N46), Office of the Chief of Naval Operations and Vice Commander, Navy Installations Command*  
▶ RDML Randolph L. Mahr, *Commander, Naval Air Warfare Center Aircraft Division and Assistant Commander for Research and Engineering, Naval Air Systems Command*
- 10:15am - 10:30am **BREAK - VISIT DISPLAYS IN ATRIUM**  
*Refreshments Available in Atrium Hall Foyer Concourse Level*
- 10:30am - 11:15am **DEFENSE ENERGY POLICY**  
▶ Honorable Sharon Burke, *Director, Operational Energy Plans and Programs, Office of the Secretary of Defense*
- 11:15am - 12:00pm **NATIONAL ENERGY SECURITY**  
▶ Honorable Daniel B. Poneman, *Deputy Secretary of Energy*
- 12:00pm - 1:00pm **LUNCH IN THE ATRIUM - VISIT DISPLAYS**
- 1:00pm - 1:30pm **ENERGY SECURITY KEYNOTE**  
▶ Former Senator John Warner (R-VA)
- 1:30pm - 2:30pm **PANEL: ENABLING AN ENERGY TRANSFORMATION THROUGH DROP-IN ALTERNATIVE FUELS**  
Moderated by RDML Kurt Kunkel, *SC, USN, Commander, Defense Logistics Agency - Energy*  
▶ Dr. Srimi Mirmira, *Associate Director for Commercialization, Advanced Research Projects Agency - Energy*  
▶ Dr. Jim Rekoske, *Vice President and General Manager for Renewable Energy and Chemicals, Honeywell UOP*  
▶ Dr. Jeffrey Steiner, *National Program Leader for Biomass Production Systems, USDA Agricultural Research Service*  
▶ Mr. Timothy Vinopal, *Chief Engineer for the Environment, Boeing Defense Space and Security*
- 2:30pm - 3:00pm **BREAK - VISIT DISPLAYS**  
*Refreshments Available in Atrium Hall Foyer Concourse Level*
- 3:00pm - 3:45pm **ENERGY SECURITY AND FLEET READINESS**  
▶ VADM Bill Burke, *Deputy Chief of Naval Operations for Fleet Readiness & Logistics (N4)*
- 3:45pm - 4:30pm **THE FUTURE OF ENERGY**  
▶ Dr. George Friedman, *CEO and Founder, STRATFOR*
- 4:30pm - 5:30pm **RECEPTION IN THE ATRIUM - VISIT DISPLAYS**

## TECHNOLOGY & CULTURE CHANGE

### WEDNESDAY, OCTOBER 13, 2010

- 7:00am - 8:00am Registration Open - Atrium Hall Foyer, Ground Level  
*Continental Breakfast Available in Atrium Hall Foyer, Concourse Level*
- 8:00am - 8:30am **TECHNOLOGY KEYNOTE**  
▶ Honorable Sean J. Stackley, *Assistant Secretary of the Navy (Research, Development & Acquisition)*
- 8:30am - 9:15am **PRESENTATION OF THE NAVY ENERGY VISION**  
▶ RADM Philip Cullom, *Director, Energy and Environmental Readiness Division (OPNAV N45), Director, Navy Task Force Energy*
- 9:15am - 9:30am **BREAK - VISIT DISPLAYS**
- 9:30am - 10:30am **PANEL: THE WAY AHEAD FOR REDUCING LIFECYCLE ENERGY COSTS**  
Moderated by RADM Philip Cullom, *Director, Energy and Environmental Readiness Division (OPNAV N45), Director, Navy Task Force Energy*  
▶ RADM Nevin P. Carr, Jr., *Chief of Naval Research, Director, Test and Evaluation and Technology Requirements*  
▶ RDML Donald Gaddis, *Program Executive Officer Tactical Air*  
▶ RDML David H. Lewis, *Program Executive Officer Ships*  
▶ RDML James P. McManamon, *Deputy Commander for Surface Warfare, SEA 21, Naval Sea Systems Command*
- 10:30am - 11:00am **BREAK - VISIT DISPLAYS**  
*Refreshments Available in Atrium Hall Foyer Concourse Level*
- 11:00am - 12:00pm **PANEL: MISSION ASSURANCE, RENEWABLES AND THE SMART GRID**  
Moderated by RDML David Boone, *Director, Shore Readiness Division (N46), Office of the Chief of Naval Operations and Vice Commander, Navy Installations Command*  
▶ Mr. Tom Bowe, *Executive Director, Reliability Integration Division, PJM Interconnection*  
▶ Mr. Arthur "Chip" Cotton, *Program Manager Energy R&D, General Electric Global Research*  
▶ Mr. Mark Wagner, *Vice President Government Relations, Johnson Controls, Inc.*
- 12:00pm - 1:00pm **LUNCH IN THE ATRIUM - VISIT DISPLAYS**
- 1:00pm - 1:30pm **GRID SECURITY POLICY**  
▶ Honorable Patricia A. Hoffman, *Assistant Secretary, Electricity Delivery and Energy Reliability, U.S. Department of Energy*
- 1:30pm - 2:15pm **ENERGY AND THE GLOBAL FUTURE ECONOMY**  
▶ Dr. Daniel Yergin, *Chairman, IHS Cambridge Energy Research Associates*
- 2:15pm - 3:00pm **DISTINGUISHED SPEAKER**  
▶ Honorable Ray Mabus, *Secretary of the Navy*
- 3:00pm - 3:30pm **CLOSING REMARKS**  
▶ RADM Philip Cullom, *Director, Energy and Environmental Readiness Division (OPNAV N45), Director, Navy Task Force Energy*



## HONORABLE RAY MABUS, SECRETARY OF THE NAVY

Ray Mabus is the 75th United States Secretary of the Navy. As Secretary, he leads America's Navy and Marine Corps and is responsible for an annual budget in excess of \$150 billion and almost 900,000 people. Prior to joining the administration of President Barack Obama, Mabus served in a variety of top posts in government and the private sector. In 1988, Mabus was elected Governor of Mississippi. As the youngest governor of Mississippi in more than 100 years at the time of his election, he stressed education and job creation. He passed B.E.S.T. (Better Education for Success Tomorrow), one of the most comprehensive education reform programs in America, and was named one of Fortune Magazine's top ten education governors. He was appointed Ambassador to the Kingdom of Saudi Arabia for the Clinton Administration in 1994. Prior to becoming Governor he was elected State Auditor of Mississippi and served as a Surface Warfare Officer in the U.S. Navy aboard the cruiser USS Little Rock. Secretary Mabus is a native of Ackerman, Miss., and received a Bachelor's Degree from the University of Mississippi, a Master's Degree from Johns Hopkins University, and a Law Degree from Harvard Law School.

## ADMIRAL GARY ROUGHEAD, CHIEF OF NAVAL OPERATIONS



Admiral Roughead is a 1973 graduate of the United States Naval Academy. Among his six operational commands, Admiral Roughead was the first officer to command both classes of Aegis ships, having commanded USS Barry (DDG 52) and USS Port Royal (CG 73). As a flag officer, he commanded Cruiser Destroyer Group 2, the George Washington Battle Group; and U.S. 2nd Fleet/NATO Striking Fleet Atlantic and Naval Forces North Fleet East. Ashore, he served as Commandant, United States Naval Academy, the Department of the Navy's Chief of Legislative Affairs, and as Deputy Commander, U.S. Pacific Command. Admiral Roughead is one of only two officers to have commanded the fleets in the Pacific and Atlantic, commanding the U.S. Pacific Fleet and Joint Task Force 519, as well as U.S. Fleet Forces Command, where he was responsible for ensuring Navy forces were trained, ready, equipped and prepared to operate around the world, where and when needed. Admiral Roughead became the 29th Chief of Naval Operations Sep. 29, 2007. He and his wife, Ellen, have an adult daughter, Elizabeth.

## HONORABLE DANIEL B. PONEMAN, DEPUTY SECRETARY OF ENERGY



Daniel B. Poneman was nominated by President Obama to be Deputy Secretary of Energy on April 20, 2009, and was confirmed by the United States Senate on May 18, 2009. Mr. Poneman also serves as Chief Operating Officer of the Department. Mr. Poneman first joined the Department of Energy in 1989 as a White House Fellow. The next year he joined the National Security Council staff as Director of Defense Policy and Arms Control. From 1993 through 1996, Mr. Poneman served as Special Assistant to the President and Senior Director for Nonproliferation and Export Controls at the National Security Council. After leaving the White House, Mr. Poneman served as a member of the Commission to Assess the Organization of the Federal Government to Combat the Proliferation of Weapons of Mass Destruction and a number of other federal advisory panels. Prior to assuming his responsibilities as Deputy Secretary, Mr. Poneman served as a principal of The Scowcroft Group for eight years, providing strategic advice to corporations on a wide variety of international projects and transactions. Mr. Poneman received A.B. and J.D. degrees with honors from Harvard University and an M.Litt. in Politics from Oxford University. He has published widely on national security issues. Mr. Poneman lives in Virginia with his wife, Susan, and their three children.

## FORMER SENATOR JOHN WARNER

During his 30 years in the Senate, John Warner served on the Senate Armed Services Committee, including three periods as Chairman, and was viewed as one of the most influential senators on military and foreign policy issues. Most recently, he was the lead co-sponsor with Senator Joseph Lieberman (I-Conn.) on climate change legislation. The Senator volunteered for two periods of active military duty: the first as an enlisted sailor in the final years of World War II (1945-46), and the second as a Lieutenant in the U.S. Marines during the Korean War (1950-52). After completing his law degree at the University of Virginia School of Law, he clerked for The Honorable E. Barrett Prettyman, U.S. Court of Appeals for the District of Columbia Circuit. From 1955 to 1960, the Senator was an Assistant U.S. Attorney for the District of Columbia. He was appointed, and confirmed by the Senate, as Under Secretary, and later as Secretary, of the U.S. Navy, positions he served in for a total of more than five years during the Vietnam War. He won election to his first of five Senate terms in November 1978. On January 3, 2009, he completed his fifth consecutive term and retired, establishing a record of being the second longest-serving U.S. Senator in the history of the Commonwealth of Virginia.



## DR. GEORGE FRIEDMAN, CEO, STRATFOR

George Friedman is the Chief Executive Officer of STRATFOR, a company he founded in 1996 that is now a leader in the field of global intelligence. Dr. Friedman guides STRATFOR's strategic vision and shapes the firm's long-range geopolitical forecasts. Dr. Friedman is also the author of numerous articles and books on international affairs, warfare and intelligence. His most recent book, *The Next 100 Years: A Forecast for the 21st Century*, is a *New York Times* Best Seller. In this book Dr. Friedman draws on an exploration of history and geopolitical patterns dating back hundreds of years to explain where and why future wars will erupt and how they will be fought, which nations will gain and lose economic and political power, and how new technologies and cultural trends will alter the way we will live in the new century. Dr. Friedman received his bachelor's degree from the City College of the City University of New York and holds a Ph.D. in government from Cornell University.



## DR. DANIEL YERGIN, CHAIRMAN, IHS CAMBRIDGE ENERGY RESEARCH ASSOCIATES

Daniel Yergin is a highly respected authority on energy, international politics, and economics. Dr. Yergin is a Pulitzer Prize winner and recipient of the United States Energy Award for "lifelong achievements in energy and the promotion of international understanding." He is both a world-recognized author and a business leader, as chairman of Cambridge Energy Research Associates (CERA), one of the world's leading consulting and research firms in its field. He is also executive vice president of IHS, the parent company of CERA. Dr. Yergin received the Pulitzer Prize for his work *The Prize: The Epic Quest for Oil, Money and Power*. Dr. Yergin plays a leadership role in the global energy industry. He chaired the US Department of Energy's Task Force on Strategic Energy Research and Development. He is a member of the Board of the United States Energy Association, and a member of the US National Petroleum Council. He recently served as Vice Chair of the new National Petroleum Council study, *Facing the Hard Truths about Energy*. He also has become the only foreign member of the Russian Academy of Oil and Gas. He is one of the "Wise Men" of the International Gas Union. Dr. Yergin holds a BA from Yale University and a PhD from Cambridge University, where he was a Marshall Scholar.



# JACOBS®

JACOBS is one of the country's leading DoD contractors and one of the world's largest engineering and construction firms focusing on energy services, A/E design, engineering, planning, asset management, commissioning and retro-commissioning, operations and maintenance, environmental remediation, program integration, construction management and design/build. For more than 60 years we have supported the DoD and the Intelligence Community with technical competence and expertise across all major military programs worldwide. Our global network includes more than 160 offices in over 20 countries, with over 52,000 employees and exceeding \$11 billion in revenue. We have operations in North America, the United Kingdom, mainland Europe, India, Australia, the Pacific Rim, and Asia.

Founded in 1947, we are a major corporation dedicated to growth and professional excellence through a commitment to quality. Our consistent performance is a result of our commitment to our core values and building long-term client relationships. The combination of a loyal client base and steady growth enables us to attract and retain industry's top talent. In addition to delivering superior value to our DOD and Intelligence community clients, we also serve markets including refining, infrastructure, pharmaceuticals and biotechnology, buildings, food, beverage, forest and consumer products, automotive and industrial, chemicals and basic resources, environmental programs, oil and gas, aerospace and defense, power and utilities and mission critical facilities.

Our energy portfolio can be viewed on the following link: <http://www.jacobs.com/energyportfolio/energyPowerPortfolio.htm>



Despite 65 years of research beginning in World War II, algal biofuels have been stymied by the "Dirty Dozen." These challenges include nutrients costs, pumping, harvesting, etc. Algae's energy balance has been negative because an acre of algae may contain 200,000 Kwh of energy but require 300,000 Kwh to pump and process it.

Nor does that include the cost of growing the algae, which requires 5x the phosphorus fertilizer of terrestrial crops to fix the same amount of carbon. Phosphate shortages may prove to be the biggest handicap for algal biofuels because the U.S. has an estimated 30 years of phosphorus reserves left. Food crops cannot be grown without phosphorus and the U.S. already imports 10% of annual consumption from Morocco.

Thus the coming phosphorus shortage poses a real threat to U.S. agriculture and could limit biofuels as well.

LiveFuels was founded in 2006 as a "mini-Manhattan Project" to solve these problems. Our vision was an alliance of scientists, and we began by working with Sandia and NREL.

Four years later, LiveFuels is commercializing truly sustainable aquaculture. We use bio-mimicry to enhance algae production in marine ecosystems. Our process grows algae together with fish, which can be converted to fish oil and used as biocrude.

LiveFuels cultivates native algal species in saltwater and uses planktivorous fish such as clupeids – fatty fish which are members of the herring family – to eat the algae. Clupeids have never been grown commercially but can filter algae as small as 6 microns. This eliminates the need for expensive harvesting techniques like membrane filtration and centrifuges. Also, clupeids consume algae predators – rotifers, copepods, mysids, tintinnids – which can decimate algae crops in a matter of hours and require pumping or pesticides for eradication.

LiveFuels' approach capitalizes on naturally occurring trace minerals, carbon dioxide and agricultural runoff which would otherwise cause hypoxic areas in marine waters ("dead zones"). This method assimilates phosphorus from seawater and can be deployed in or near marine areas. And because the U.S. controls the largest EEZ on earth, the U.S. has the potential to replace all imported petroleum by using LiveFuels' process.



NDIA WOULD LIKE TO THANK OUR  
**PROMOTIONAL PARTNERS!**

**JACOBS<sup>®</sup>**

**LiveFuels<sup>™</sup>**

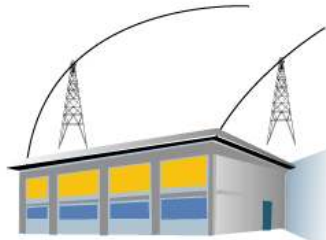


# MISSION ASSURANCE, RENEWABLES and the SMART GRID

Tom Bowe  
Executive Director Reliability Integration  
PJM Interconnection  
610-666-4776  
[bowet@pjm.com](mailto:bowet@pjm.com)

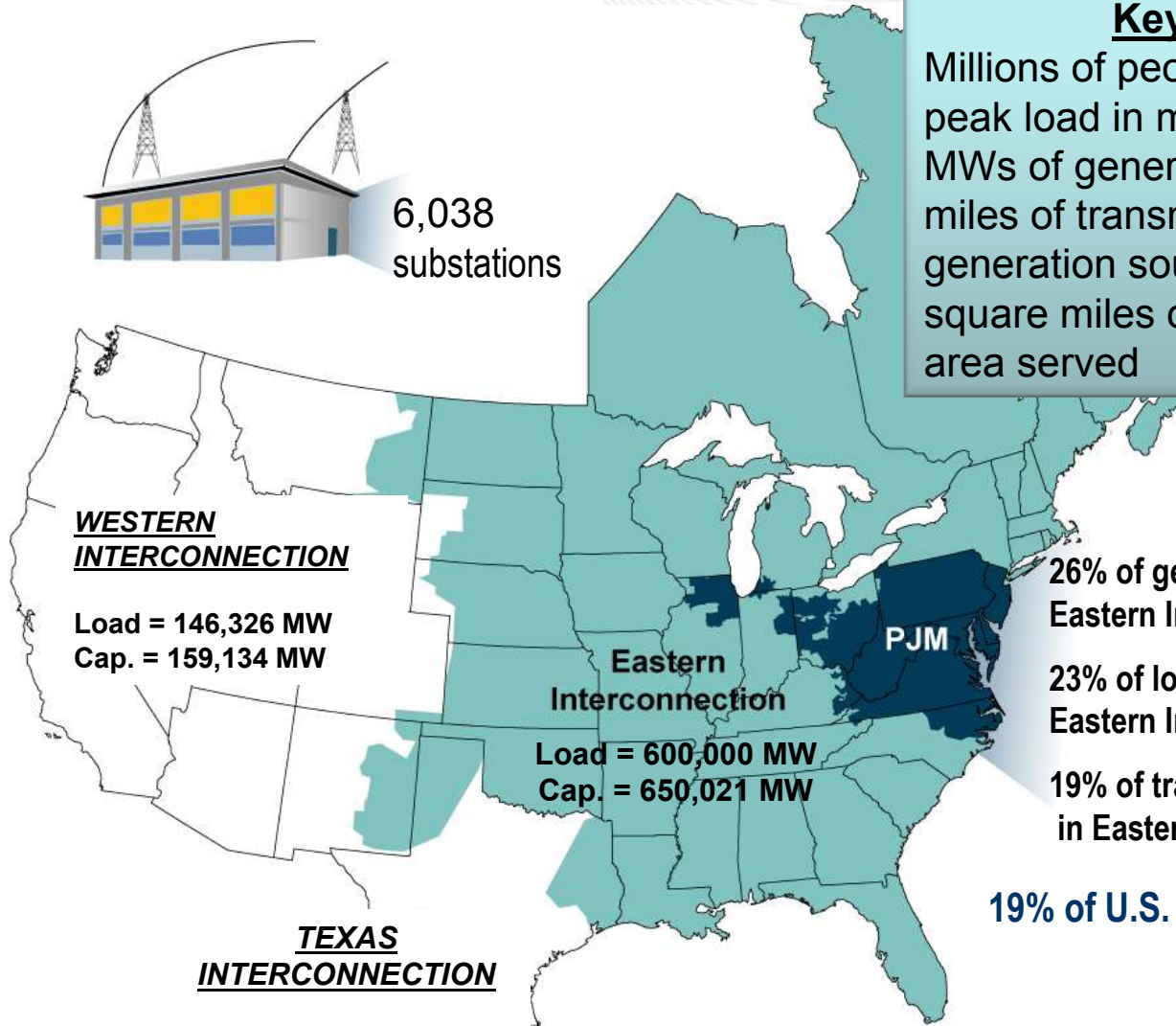


# PJM as Part of the Eastern Interconnection



6,038  
substations

<b>Key PJM Statistics</b>	
Millions of people served	51
peak load in megawatts	144,644
MW of generating capacity	164,634
miles of transmission lines	56,251
generation sources	1,271
square miles of territory	164,260
area served	13 states + DC



**WESTERN INTERCONNECTION**

Load = 146,326 MW  
Cap. = 159,134 MW

**Eastern Interconnection**

Load = 600,000 MW  
Cap. = 650,021 MW

**PJM**

26% of generation in Eastern Interconnection

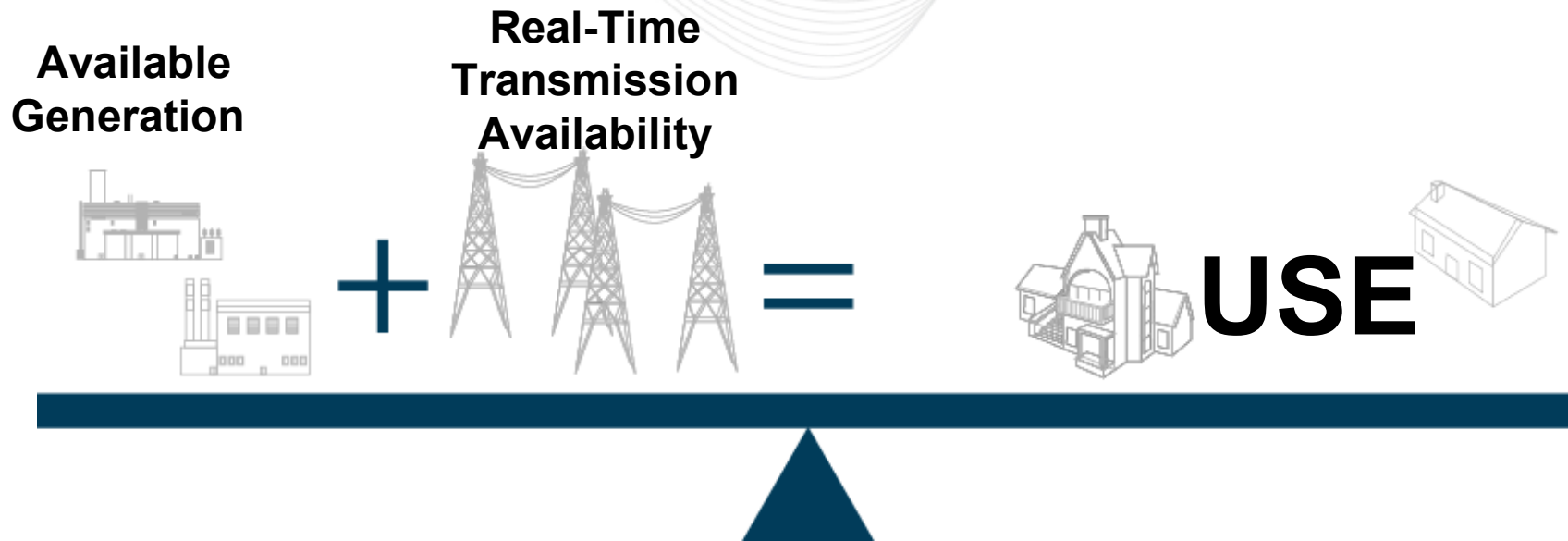
23% of load in Eastern Interconnection

19% of transmission assets in Eastern Interconnection

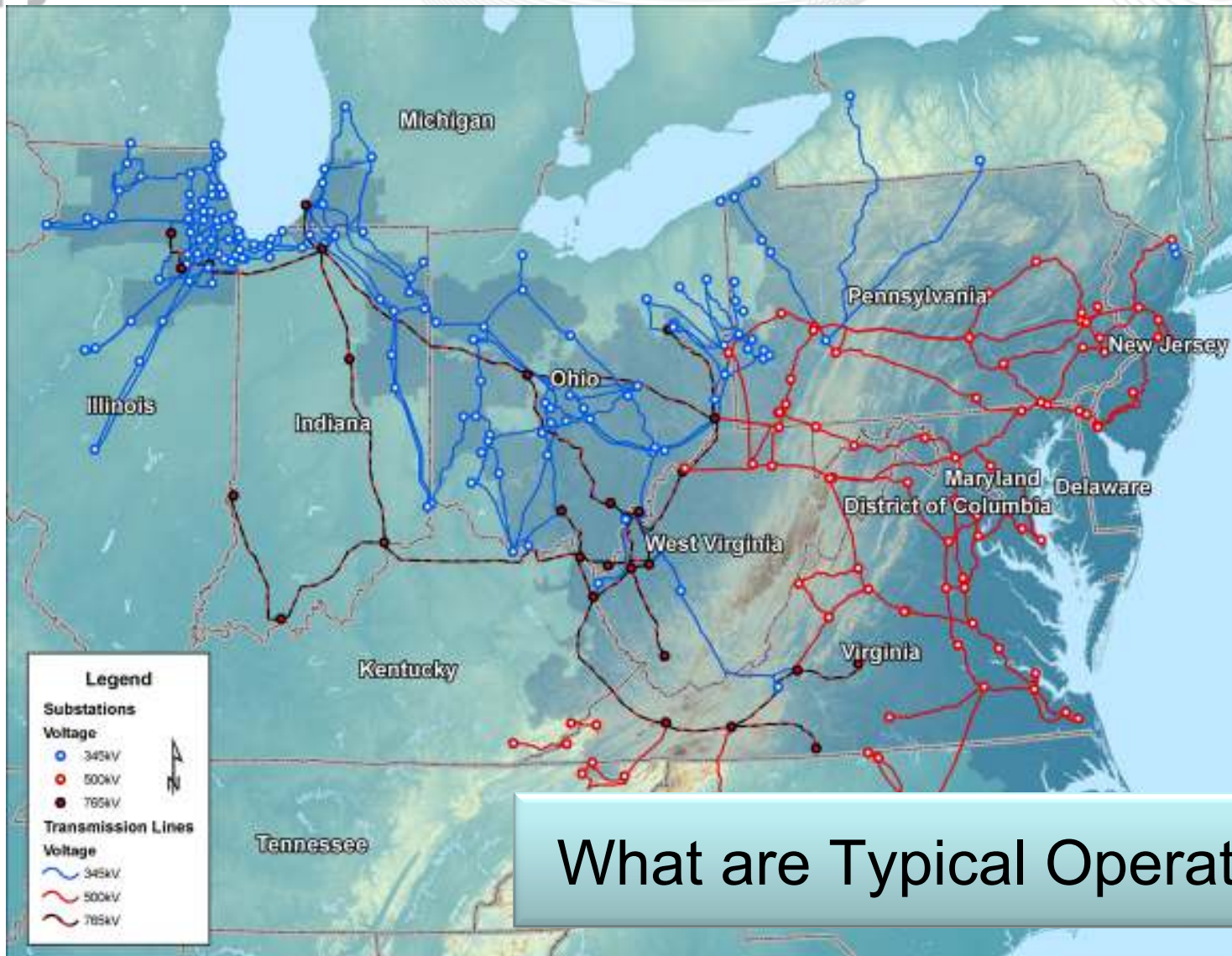
19% of U.S. GDP produced in PJM

**TEXAS INTERCONNECTION**

Load = 54,493 MW  
Cap. = 61,751 MW



Central Question - How does the paradigm or Operational Balance change with the integration of Renewables and SMART GRID technologies?

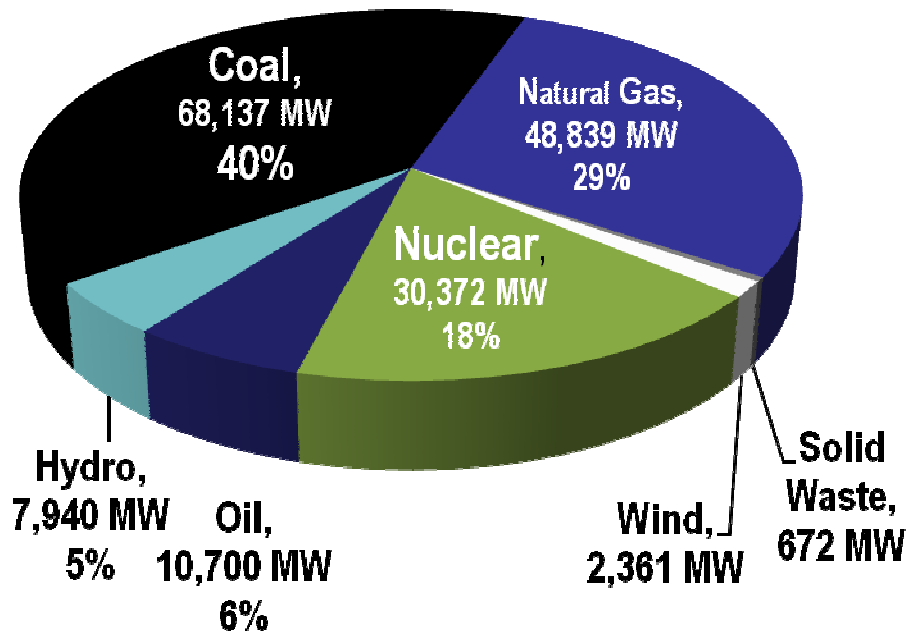


What are Typical Operations?



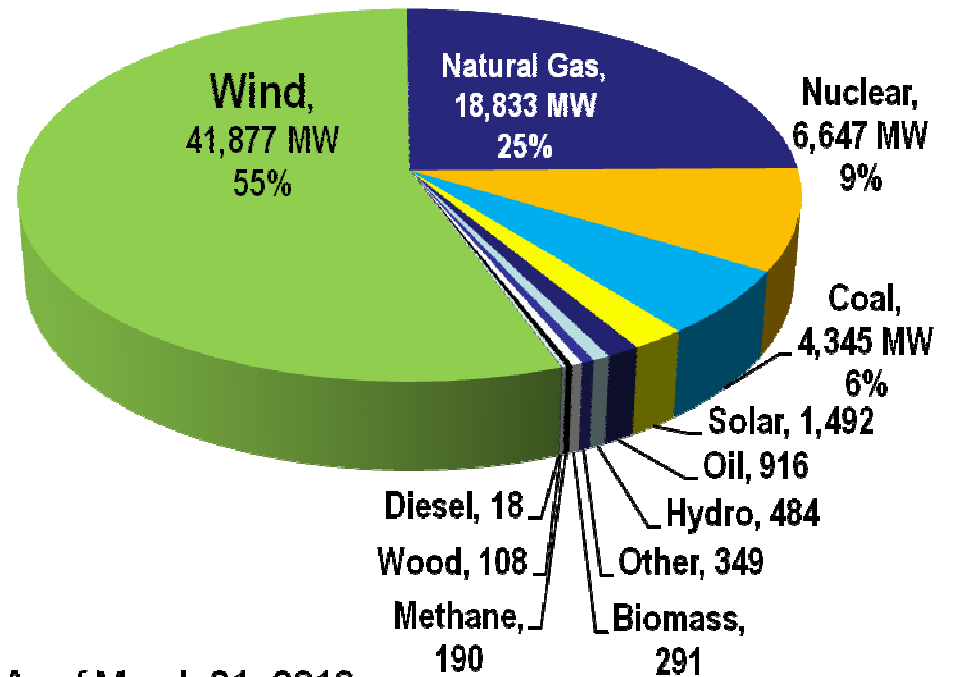
# Generation To Be Built in PJM?

## Existing



As of 12/31/2009

## Proposed Queue



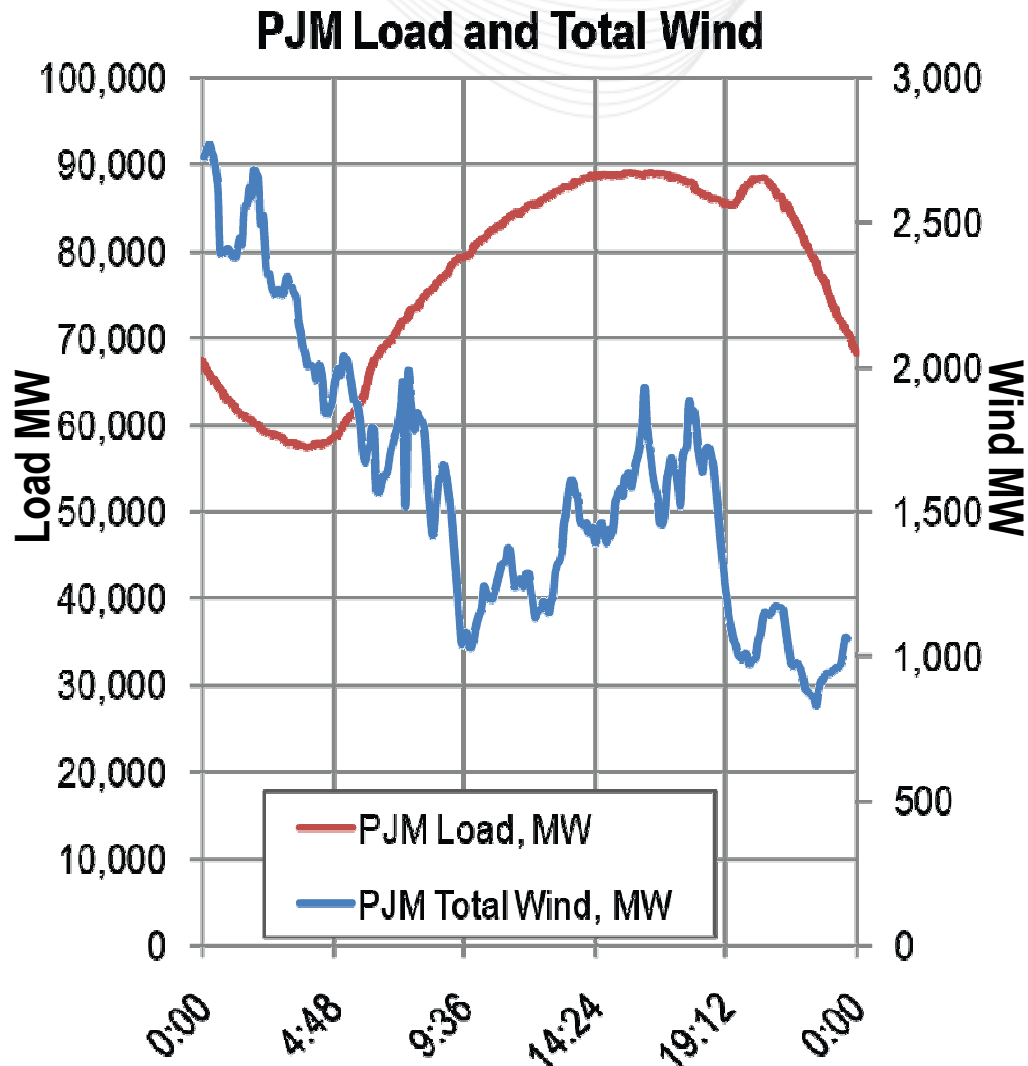
As of March 31, 2010

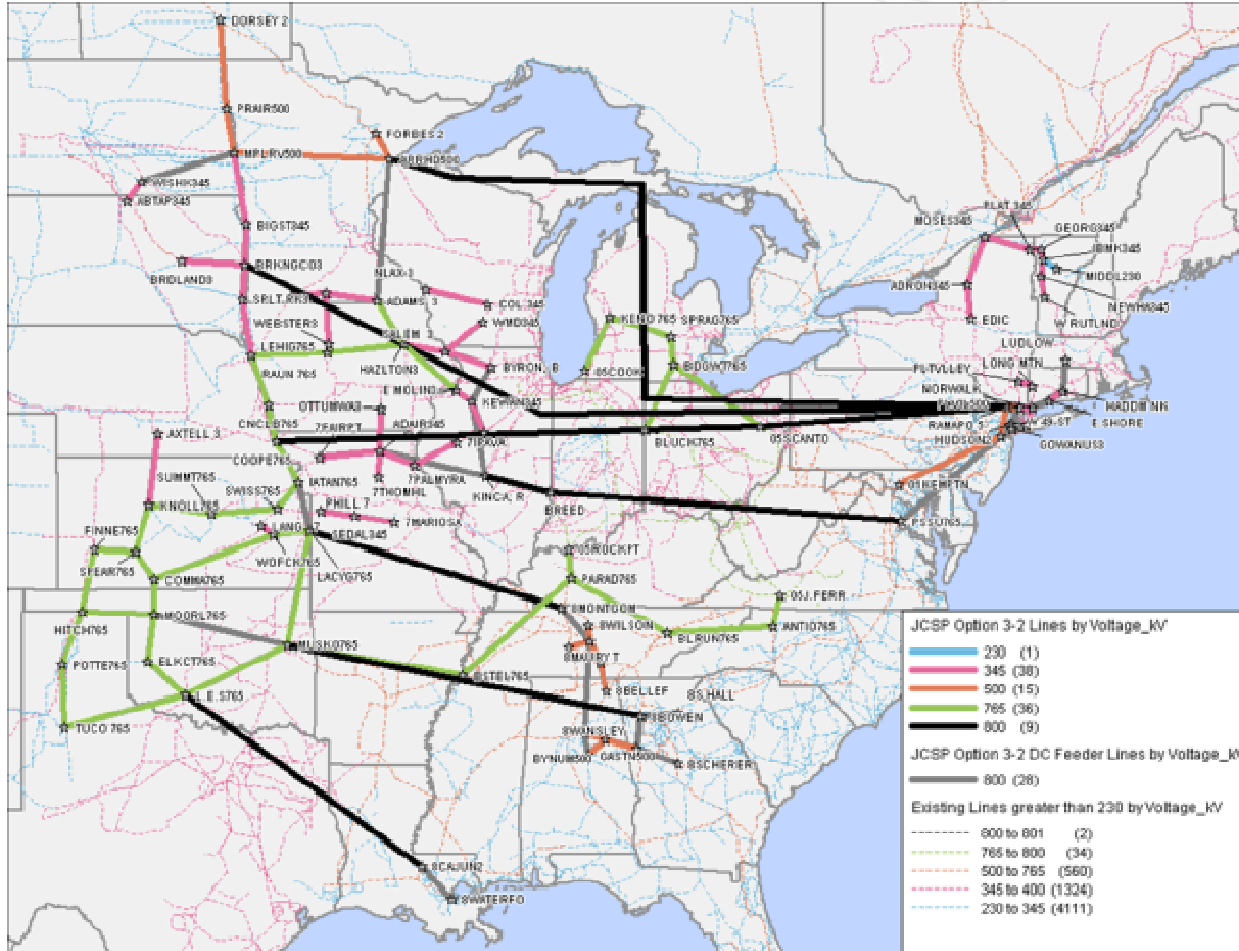


- Renewables – referred to as “Intermittent” or “Variable” Gen
- Wind is coming, but not on the peak hours
  - (in the East - 13% available at the time of peak)
- Energy Storage is needed to ensure renewables achieve their potential



# PJM Load and Wind Resources – April 7, 2009





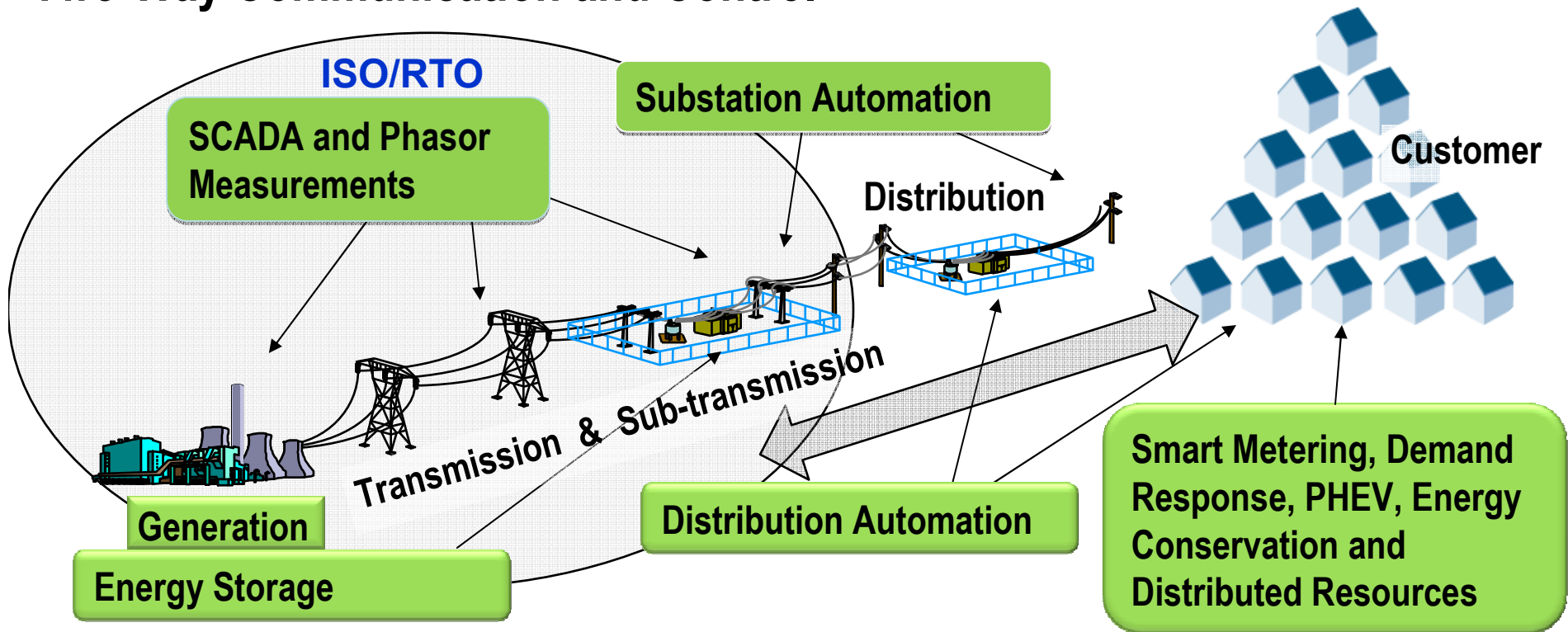
20% Wind - \$80B in Transmission

# 54 GW Potential of Off Shore Wind



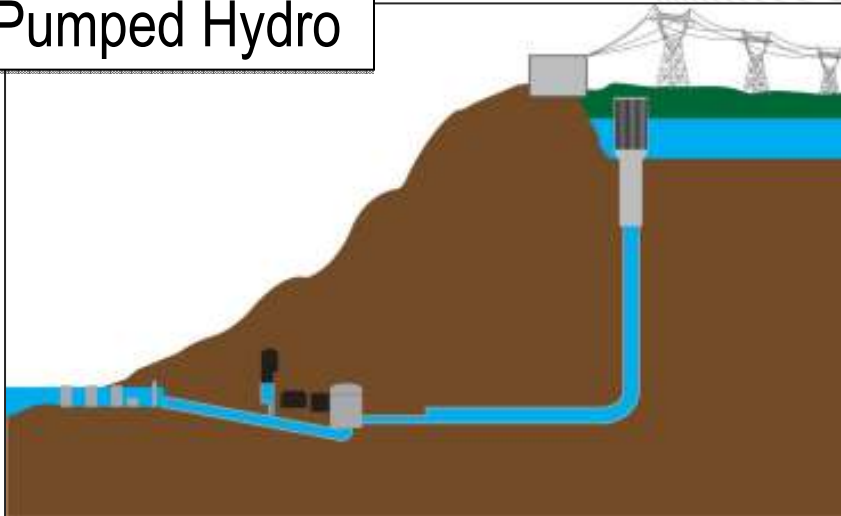
The Smart Grid is realized by merging data to achieve a total end-to-end systems view by integrating information technology and operational technology.

## Two-Way Communication and Control

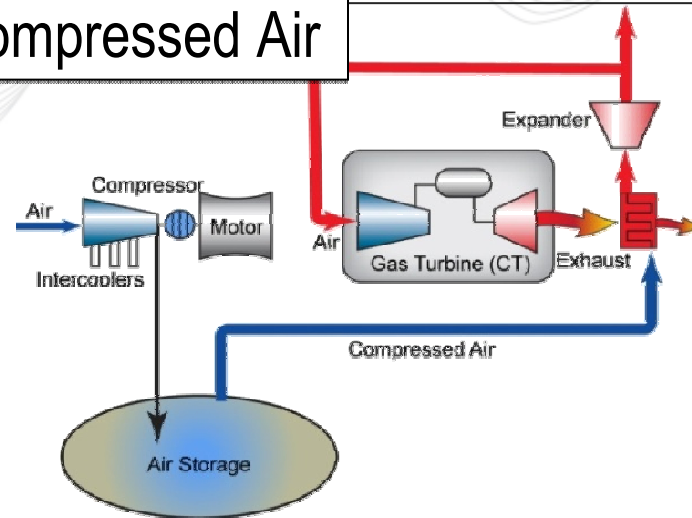


# Grid Storage Types

Pumped Hydro



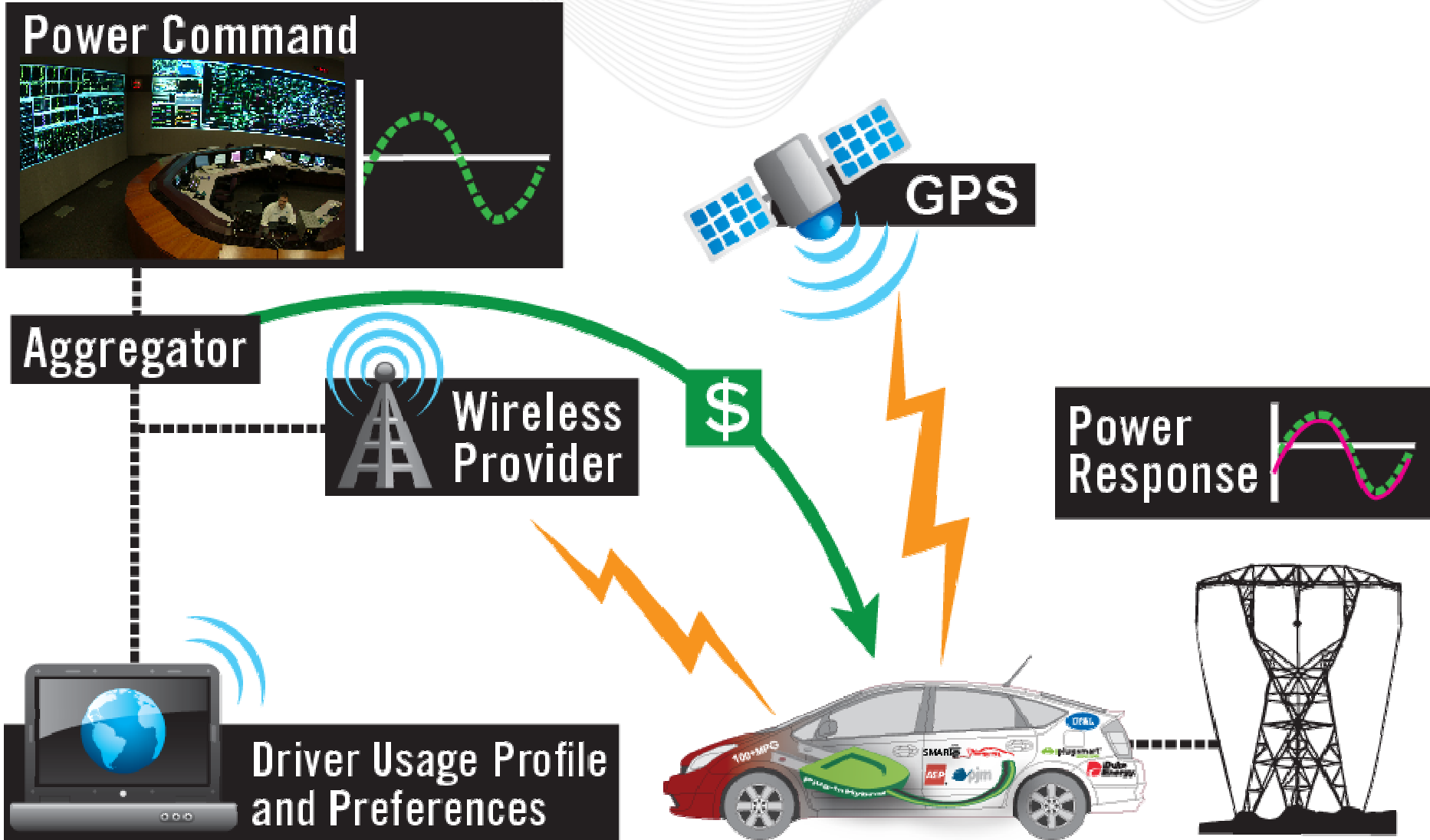
Compressed Air



Stationary Battery



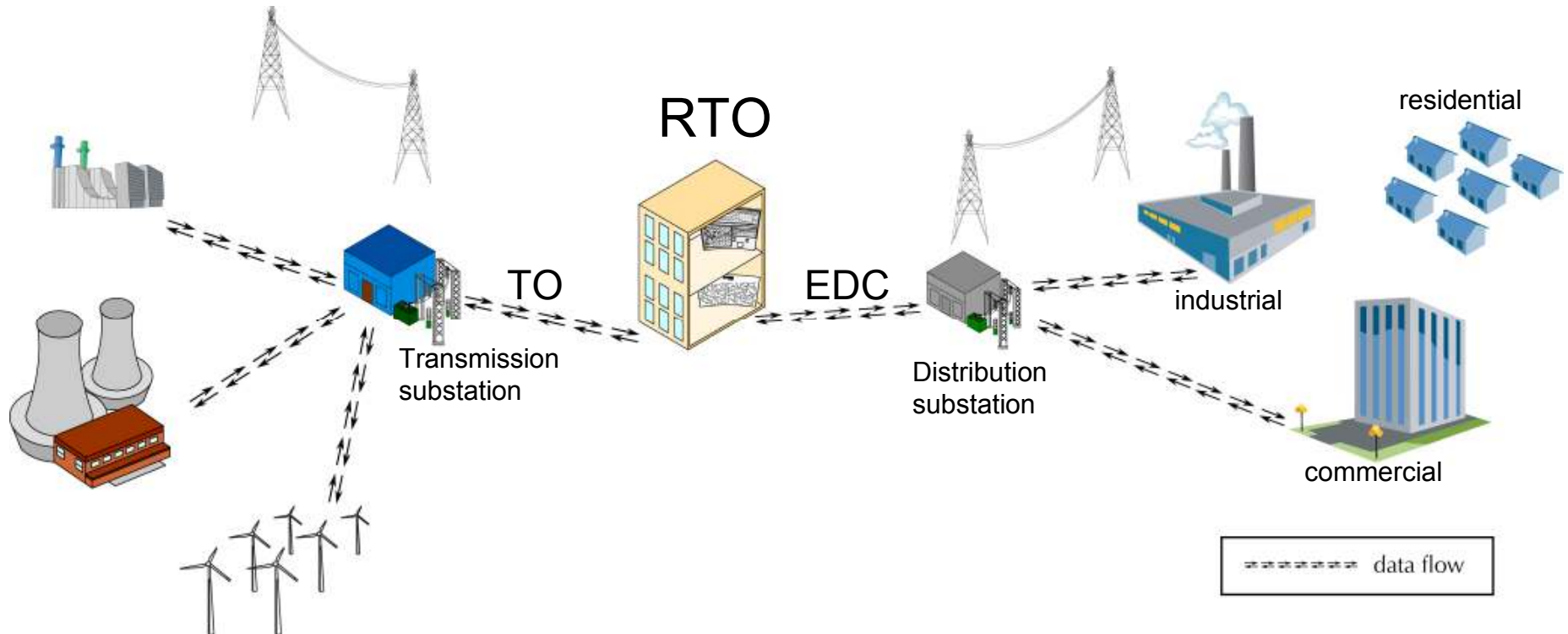
Flywheels

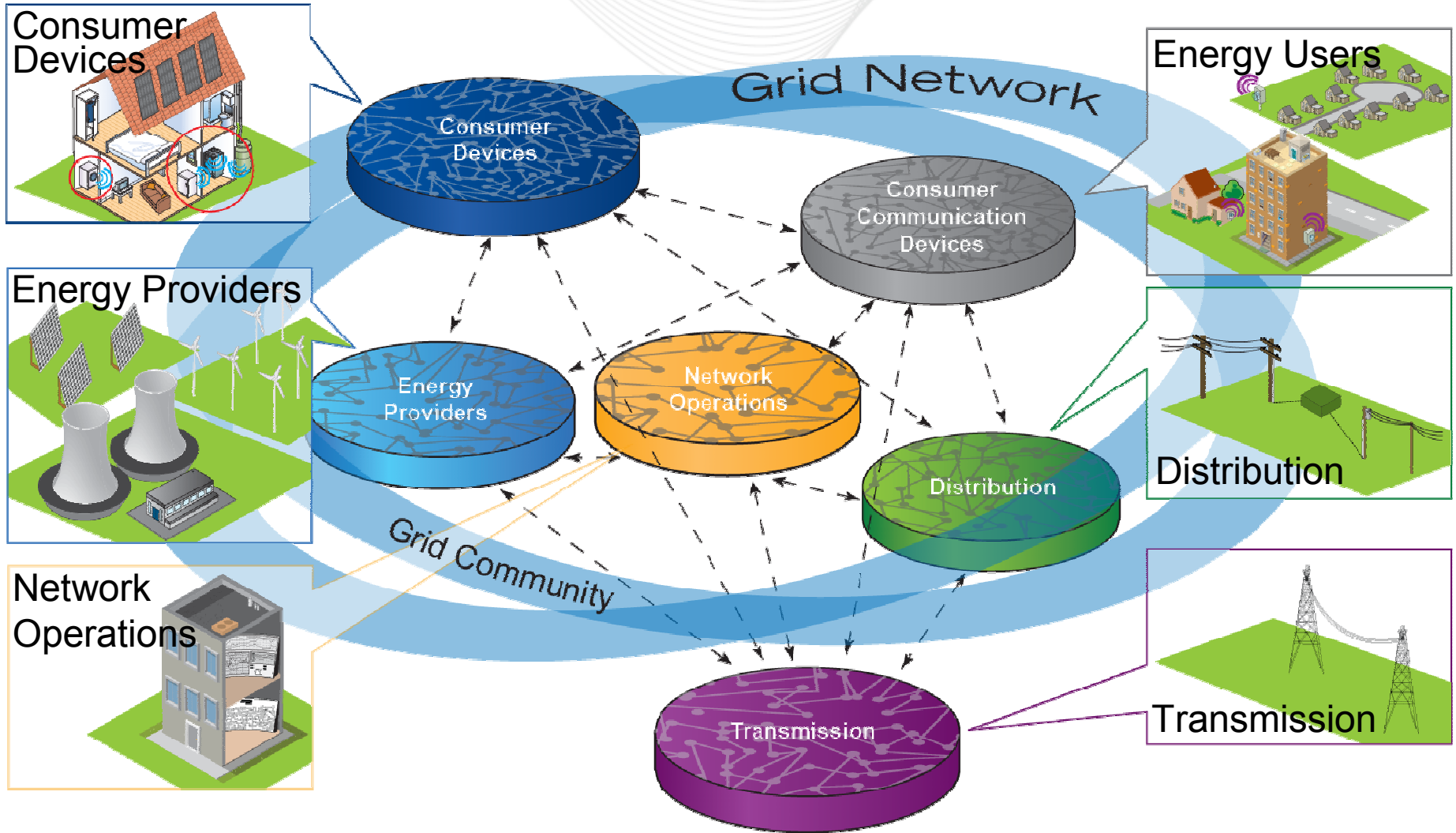


# Information Flow for Today's Grid

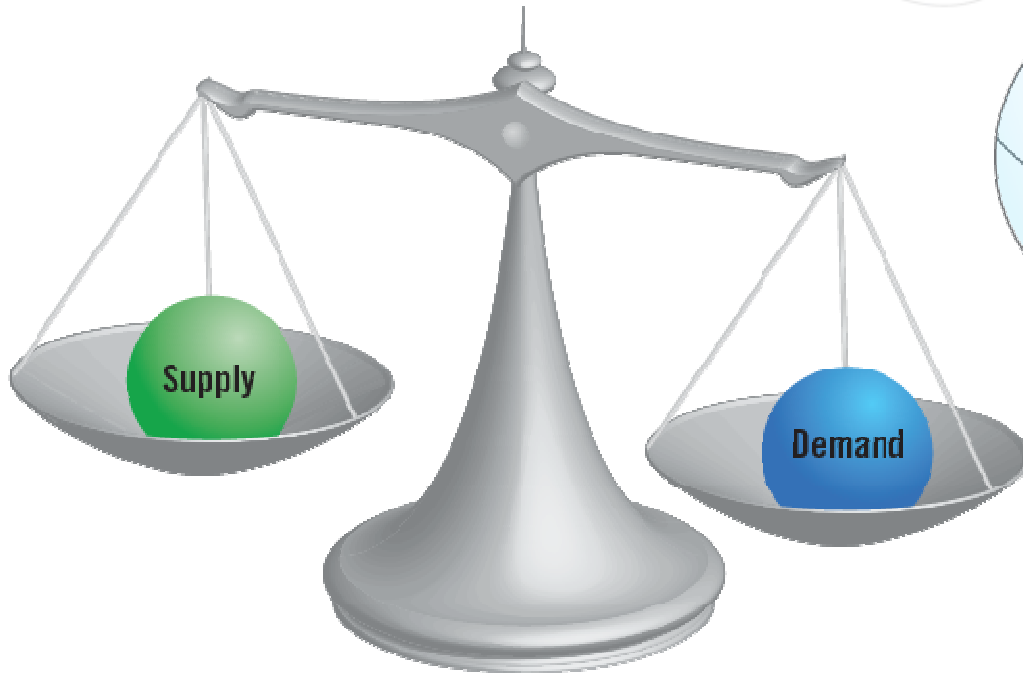
Generation

Load

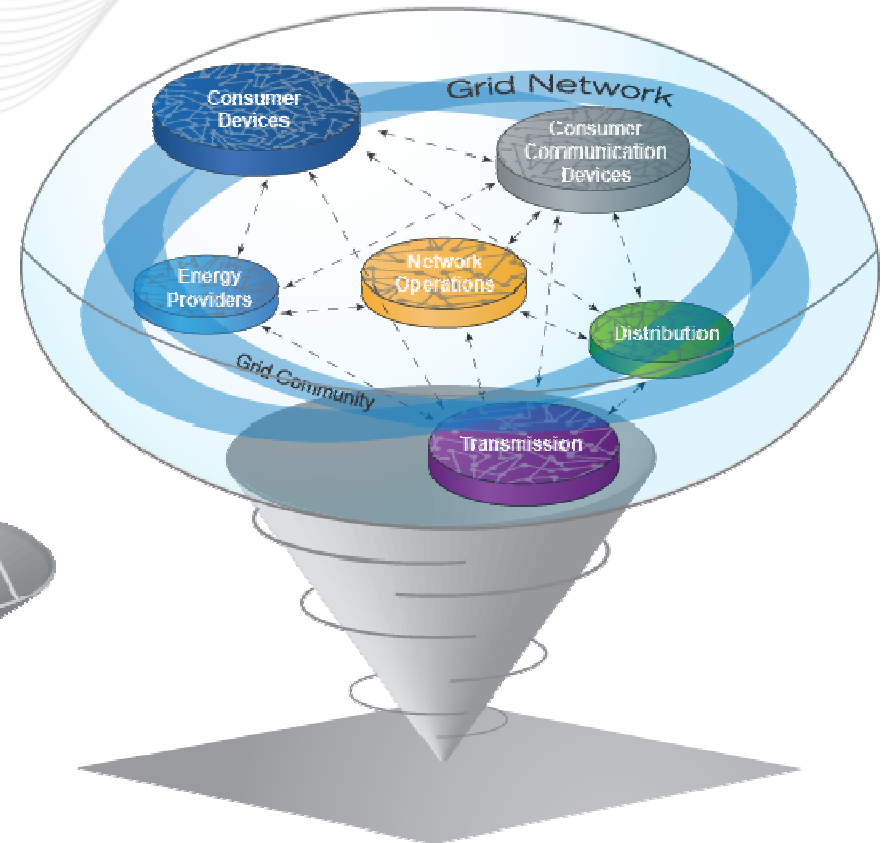




# A New Paradigm of Operational Balance



Reliability in  
Historic Grid Operations



Reliability in  
Future Grid Operations



# MISSION ASSURANCE, RENEWABLES and the SMART GRID

Tom Bowe  
Executive Director Reliability Integration  
PJM Interconnection  
610-666-4776  
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## NAVY ENERGY FORUM REMARKS

Tuesday, 12 October, 2010



HONORABLE SHARON E BURKE

Admiral Cullom – it’s always great to follow you -- to the podium, but also along the path you’ve been blazing for the Navy and for the Department of Defense through Task Force Energy. Thank you so much, for both the lead in and the leadership. He has guidance from another great trailblazer – Secretary of the Navy Ray Mabus. Secretary Mabus has become an important voice not just in the Department of Defense but for the whole nation when it comes to energy security. Secretary Mabus was fortunate to come into office with a like-minded partner, Admiral Gary Roughead, who has been very shrewd in looking ahead to the Navy and the nation’s future.

Of course, the Navy has a long tradition of leadership – that has been true for 235 years tomorrow. And I am delighted to have this opportunity to say Happy Birthday to the United States Navy – you certainly don’t show your age.

That’s a great picture – I can appreciate it even more now that I’ve actually been on the deck of an aircraft carrier.

It was just a few months ago – one of the first things I did in my new job. Thanks to Admiral Cullom and another great energy visionary, Vice Admiral Bill Burke, I had the opportunity to visit with the sailors aboard the U.S.S. Enterprise. It was quite a privilege – there’s nothing like seeing thousands of men and women, from the Admiral up in the tower to the recruit below decks, all working together in an intricate and common mission – you can see right away that every person on that ship knows the part he or she plays is of great significance to the mission.

Indeed, the Enterprise is fitting a reminder of what's at stake when we talk about energy security at the Department of Defense. The very first nuclear carrier... it was the first time we harnessed that new form of energy for mobility, to power a critical national security mission. And indeed, that ship played a very important part in keeping our country safe throughout the Cold War.

And it's still playing an important part, 50 years later. It's extraordinary, isn't it? 50 years ago, when another Admiral Burke launched the Enterprise – a lot of Burkes around, no? We're not related, I assure you – I don't think that Admiral Burke would have imagined a future in which the Enterprise has to be ready for anything from pirates to terrorists to nations armed with nuclear weapons.

That is the reality of our times. And while it is just as hard to predict the future as it was 50 years ago. It is safe to say that energy security is part of the changing nature of war and will be one of the great challenges in this century. It will shape our national security – it already does -- both in terms of the global strategic landscape and in terms of the ability of our men and women in uniform to defend the country. Today, it is essential that the US Navy and the other armed forces once again harness the energy we use to execute critical national security missions.

That is what I want to talk to you about today – harnessing energy for national security. Today, about 70 percent of the energy the Department of Defense consumes goes to military operations – simply put, when we exercise our core mission to defend the country, we use a great deal of energy. Our supplies are by no means secure: in our current operations, the amount of fuel we use presents vulnerabilities, as we saw last week in Pakistan. At home, our military bases rely

on the civilian electric grid, which can be challenged by anything from computer viruses to tree branches, as happened in the great blackout of 2005. In the longer term, the overall energy supply and demand picture gets more complicated.

And that's the reason Congress and the President created the Office of Operational Energy Plans and Programs in the Office of the Secretary of Defense. We are brand new – less than three months old, but the mission is clear: we need to make sure the Department of Defense has the energy it needs to operate. That means delivering more capability to the warfighters of today and tomorrow at less risk and lower cost.

So today, I want to talk to you about how we intend to go about doing that. Let me start with some general thoughts about the nature of the challenge, and then preview for you the main elements we're considering for the Department's forthcoming operational energy strategy.

For the Department of Defense, the nature of this challenge is very broad – it covers geostrategic and strategic concerns, but also operational and tactical concerns.

First, energy – and particularly oil – is a geostrategic concern. From the growth in the global demand for oil and natural gas, to the increasing concentration of supplies, and the transfer of billions of dollars to countries such as Iran – the geopolitics of energy are shaping our national security.

At the same time, oil is also a strategic concern. Earlier this summer, the White House released the National Security Strategy, which noted that: “As long as we

are dependent on fossil fuels, we need to ensure the security and free flow of global energy resources.” The document goes on to say “without significant and timely adjustments, our energy dependence will continue to undermine our security and prosperity. This will leave us vulnerable to energy supply disruptions and manipulation and to changes in the environment on an unprecedented scale.” The clear message is that energy shapes and will shape U.S. military missions in a variety of ways.

I think most Americans understand the geostrategic and strategic risks of our oil dependence, but the operational and tactical risks – the particular focus for my – are perhaps less familiar.

Energy or supply lines more generally have always been a target in times of war – that’s not really new. But in the asymmetric wars we are fighting today and the anti-access threats we see in the future, much of our logistics force is in the battlespace. And our total force is far more energy intense than has historically been the case.

That energy intensity can be a constraint on the range, endurance, and maneuverability of our forces. It hampers operational effectiveness and increases risk. Fuel convoys are more at risk today, at great cost to our logistics forces and contractors, but those convoys also draw combat forces away from other missions for escort duty. It was in the papers yesterday that NATO forces have increased their presence on the supply lines coming across the border with Pakistan.

In addition to reducing operational effectiveness and increasing risk, our energy-intensive force structure also has a financial impact. The money spent to purchase

the fuel and the assets needed to move and protect it siphons resources away from other military priorities. Those funds are not available to buy new weapon systems or other equipment for our troops. It is not available to support military missions. This was really brought home in 2008, when the dramatic spike in fuel prices required the Department to shift funds from other priorities to pay our energy bills. The more energy our forces demand, the more the Department's budget and programs will be subject to these sorts of volatile energy prices. It is time to reassess the way we value energy.

Now, Congress has charged my office to produce an operational energy strategy for the Department to do just that – to help the Department value energy differently. That strategy isn't due until December 22, but I wanted to preview for you today what I expect the main themes of that strategy to be.

And I want to emphasize that as we develop this strategy, we have great partners not just in the Navy and the Marine Corps, but also in the Army and the Air Force. All of the Services are already doing so much in this area, and I am confident we will be able to build on that momentum and get to a strategy that establishes common goals that are flexible enough to fit each Service's unique roles and missions.

The overall goal of the strategy is to put better energy solutions in the hands of today's and tomorrow's warfighters. We will do that by improving the productivity of energy – or reducing demand – and by increasing our range and surety of supply, including by promoting innovation. In the near-term, we believe that will mean focusing on current operations; in the mid-term, it will mean mid-life upgrades to legacy platforms; and in the long-term, it means changing the way

we get and use energy for the nation's defense, across air, land, and sea domains and a range of operations.

In the near term, the strategy will focus how to reduce in-theater fuel demand. In order to do that, however, we need to better understand the Department's operational energy baseline. Today we know that operational fuel represents 70 percent of DoD's Energy costs, but further down the supply chain we have less visibility to see where those demand signals are originating. As we all know, it is difficult to manage what we don't fully understand ; we need to know where to apply our efforts if we are to make a difference. Implementing credible energy measurement tools in theater will shed valuable light on how we can limit vulnerabilities and capitalize on opportunities.

Next, we need to decrease unneeded energy demand across our platforms, expeditionary bases, and individual soldiers in order to improve mission capability. We can look to initiatives like the Marine Corps Expeditionary FOB and the NetZero Joint Capability Technology Demonstration at the Army's National Training Center to see how a range of activities —from insulated tents to LED lights to more efficient generators – can reduce the energy needs of a FOB. When demand management is coupled with renewable power generation, such as solar and wind, expeditionary bases will further reduce their need for fuel resupply. Longer range and endurance, less frequent supply convoys, the ability to withstand disruption, and lighter rucksacks all translate into more operational agility and flexibility. Such improvements will allow us to shift resources from tail to tooth over time, while also increasing resilience to disruption. This is an immediate improvement in the operational agility for our deployed forces, and is a priority for me and my team over the coming year. Over the long term, further research and

development of energy technologies will continue to yield improved capabilities on the battlefield.

While not immediately reflected in current operations on the ground, we also need to broaden and accelerate the great progress made across our ships and aircraft. We've already seen how optimized cargo loads, revised cruising speeds, and the removal of excess weight can make seemingly small changes that add up to substantial reductions in the fuel needed to deploy and sustain our expeditionary forces through the air. We need to extend these changes in tactics, techniques, and procedures across all training and operational activities, and move beyond our cargo and refueling jets to maximize the energy performance of these essential tools of power projection. At sea, we need to extend many of the initiatives you're hearing about in the course of this conference -- stern flaps, hull coatings, and hybrid electric drives. These can add up to meaningful improvements in energy performance and eventually scale up to large reductions in the energy needed to operate an expeditionary military.

In the mid-term, DoD is identifying opportunities to further improve the energy performance of our legacy fleet and the resilience of our critical missions at installations to power outages.

For the legacy fleet, we should take advantage of the opportunities afforded by depot maintenance and ongoing reset and reconstitution efforts. In some cases, our current force will be with us for decades, and we need to leverage improvements in design, propulsion, and mission planning tools to increase those capabilities through improved use of energy.

In order to acquire these energy efficient systems and platforms, the Department will need to change a broad range of planning, programming, and budgeting practices to appropriately value energy as an operational capability. Secretary Mabus has shown great leadership on this issue, as he described the need to “make energy reform a way of doing business.” This trend needs to spread across the Services, defense agencies, and OSD to expedite the deployment of proven energy solutions in current operations – whether incorporating energy performance in rapid fielding or near-term contracting for logistics and base operating support services.

Over the long-term, we need to incorporate energy into our core force planning processes. Joint Concepts of Operation should reflect the rise of anti-access weapons and the threats posed to not just our combat forces but the extensive constellation of bases and logistics nodes needed to sustain this force. I commend the Air Force and Navy for their work on AirSea Battle, and the Marine Corps for their revised Operating Concepts. Both of these efforts reflect the growing need to revise our operational level concepts of warfare to reflect the opportunities and risks that result from our energy footprint. The Services have also made substantial headway in the integration of operational energy considerations in war games and campaign models. Far from the dogmatic inclusion of energy as a standalone variable, war games like Navy Global and Air Force Futures are actually reflecting more realistic assumptions about how future warfare will actually unfold, and we are learning lessons here that will shape the composition of future capabilities and the ways they are integrated across future scenarios and threats.

In the coming years, analytic tools like the Fully Burdened Cost of Fuel and energy as a Key Performance Parameter will ensure energy is included in major

acquisition and requirements decisions. These tools will allow us to better support Secretary Gates' efficiency initiatives by promoting improved energy productivity in our systems and platforms—meaning greater performance at a lower operating cost.

All of that will be important to making sure the military can conduct its missions -- using less energy -- increasing our energy productivity -- is going to be critical for the Department's energy security. But ultimately, it won't be enough.

President Obama has called on the country to “transform the way that we use energy—diversifying supplies, investing in innovation, and deploying clean energy technologies.” The Department similarly has to emphasize innovation, including partnerships with the private sector, and this will be an important focus for my office -- not just for rapid fielding, but for our mid and long-term challenges. The Navy is really leading the way in this effort, as you just heard in the discussion about the Great Green Fleet. This investment in fuel flexibility is an important insurance policy for the Department -- it's an important part of our portfolio of investments against an uncertain future, and against the certainty that our energy supply picture will change.

I know it's a bit daunting -- to consider how to improve current operations when we're busy fighting wars and also argue that we need to change the way we're preparing for the future. In fact, a Marine officer who came to see me -- a great guy, 31 years of service, with combat time in at least three of the nation's wars -- well, he expressed some skepticism about my office and its mission. “It's just a fad,” he said. “It'll pass.” He also suggested we might be a group of latte-sipping

ideologues – I want to assure you that I have put together a terrific team of very experienced national security experts. We might have the occasional latte, though.

But it's not a fad, and I'll tell you why. It's a new office, but it's not really a new challenge at all.

At the end of the Second World War, a young American naval officer traveled to Tokyo to collect information on the course of the war from the Japanese perspective. That officer, Thomas Moorer, would go on to become Chief of Naval Operations and Chairman of the Joint Chiefs of Staff, but he never forgot what he learned on that fact-finding mission.

He interviewed a number of key Japanese leaders, including the former commander of the Imperial fleet. "The war was just over," Admiral Moorer said years later. "Less than a year before [he] had been in command of the largest fleet that was ever put together, and there he was out there [in his garden] chopping potatoes."

In fact, the story that Japanese Vice Admiral told him told him was partly **about** potatoes – and rice, and pine needles – all the things the Japanese had tried to turn into fuel for their ships, but nothing was sufficient. As a friend of mine once said, nothing beats dead dinosaurs. The great Japanese Navy was largely defunct by 1945 –and the lack of fuel was one reason.

"The lesson I learned was never lose a war," Admiral Moorer noted. And, he added: "The way to lose a war is to run out of oil."

Indeed, from biofuels to today's battlefields in Afghanistan, the lessons we've learned about the Department's energy challenges are already shaping the way we protect the nation. Energy affects program costs of the weapons we buy. The logistics of energy supply affects our force security. Our energy use affects the effectiveness and capability of our total force. Our energy use keeps us reliant on unstable suppliers. It is costly for our taxpayers and war fighters. And as we remember the USS Cole, we know that it can be costly in ways that are not acceptable.

We think about this problem as not just about military capabilities, but also about the strategic environment - how DOD trains and equips its forces to defend the nation against the range of threats we face now and in the future.

As President Obama told the cadets at the Naval Academy last year: "history teaches us that the nations that grow comfortable with the old ways and complacent in the face of new threats, those nations do not long endure." In the 21st century, the Department of Defense is not complacent: we are preparing for a full spectrum of challenges -- asymmetric and unconventional, anti-access and traditional; the nation-state and the terrorist network; the spread of deadly technologies and the spread of hateful ideologies; 18th century-style piracy and 21<sup>st</sup>-century cyber threats. And energy security will play an important part in how we meet all of these challenges.

Thank you very much.

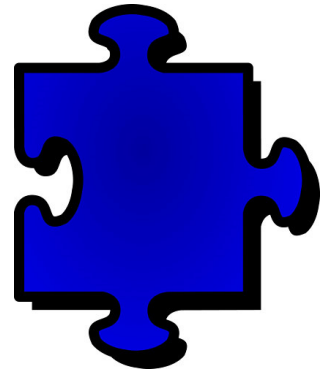
# Between the Building and the Grid

Mission Assurance, Renewables, and the Smart Grid

Chip Cotton  
Program Manager, Energy R&D  
General Electric, Global Research



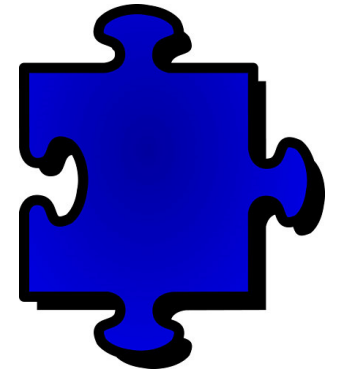
# Mission Assurance...



Energy security for the Department means having assured access to **reliable supplies** of energy and the ability to **protect** and **deliver sufficient** energy to meet **operational needs**



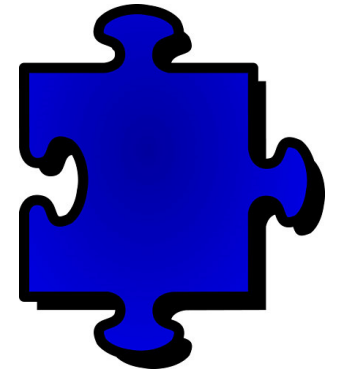
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# Mission Assurance...



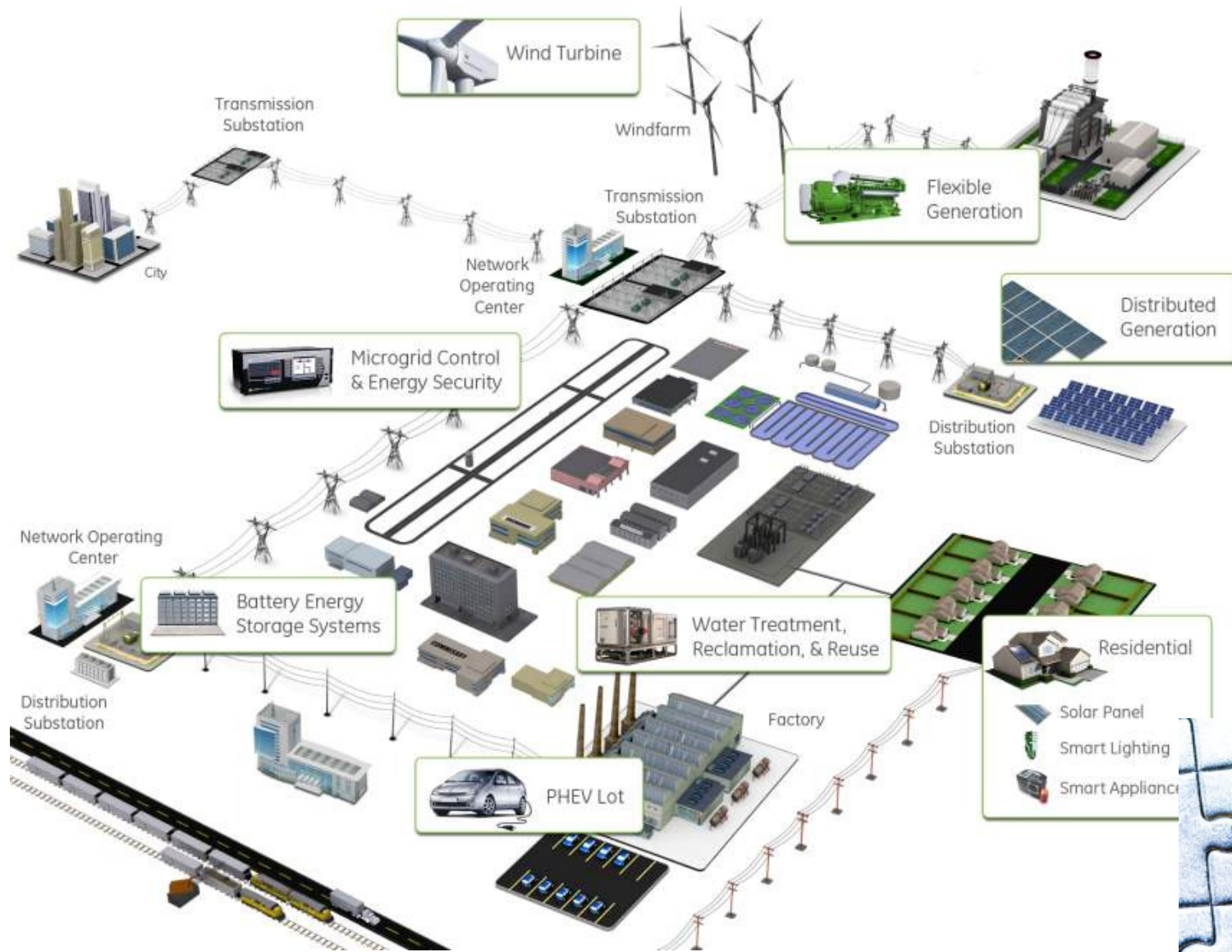
Energy security for the Department means having assured access to **reliable supplies** of energy and the ability to **protect** and **deliver sufficient** energy to meet **operational needs**



# Technology...



# Putting the Technologies together...



# Strategy/Vision...



## Net Zero Energy Installations

Where you are  
Where you can go  
What paths you can take to  
get there



# ecomagination



## Commitments 2010-2015

Double R&D to \$10B

Grow 2X of GE's growth

Reduce GE's energy intensity by 50%

Reduce water consumption 25%

Inspire a competitive energy future

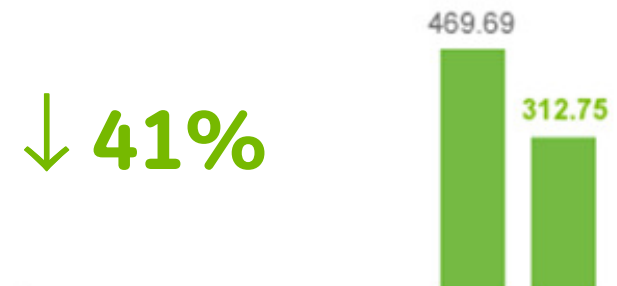
### GE OPERATIONAL ENERGY INTENSITY

(MMBtu per

\$ million revenue)

2004

2008



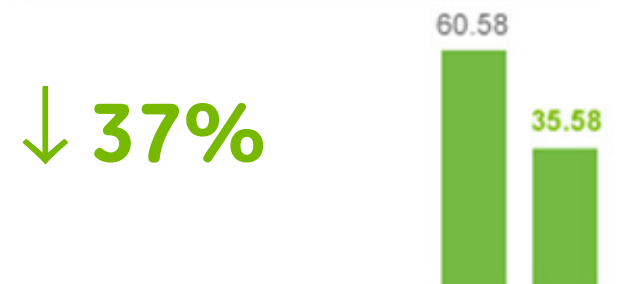
### GE OPERATIONAL GHG INTENSITY

(Metric tons per

\$ million revenue)

2004

2008



GE is committed to solve your and our energy and environmental challenges



imagination at work

# Putting it together...



# A Navy Energy Vision for the 21<sup>st</sup> Century



RADM Philip H. Cullom  
Director, Energy and Environmental Readiness Division  
OPNAV N45

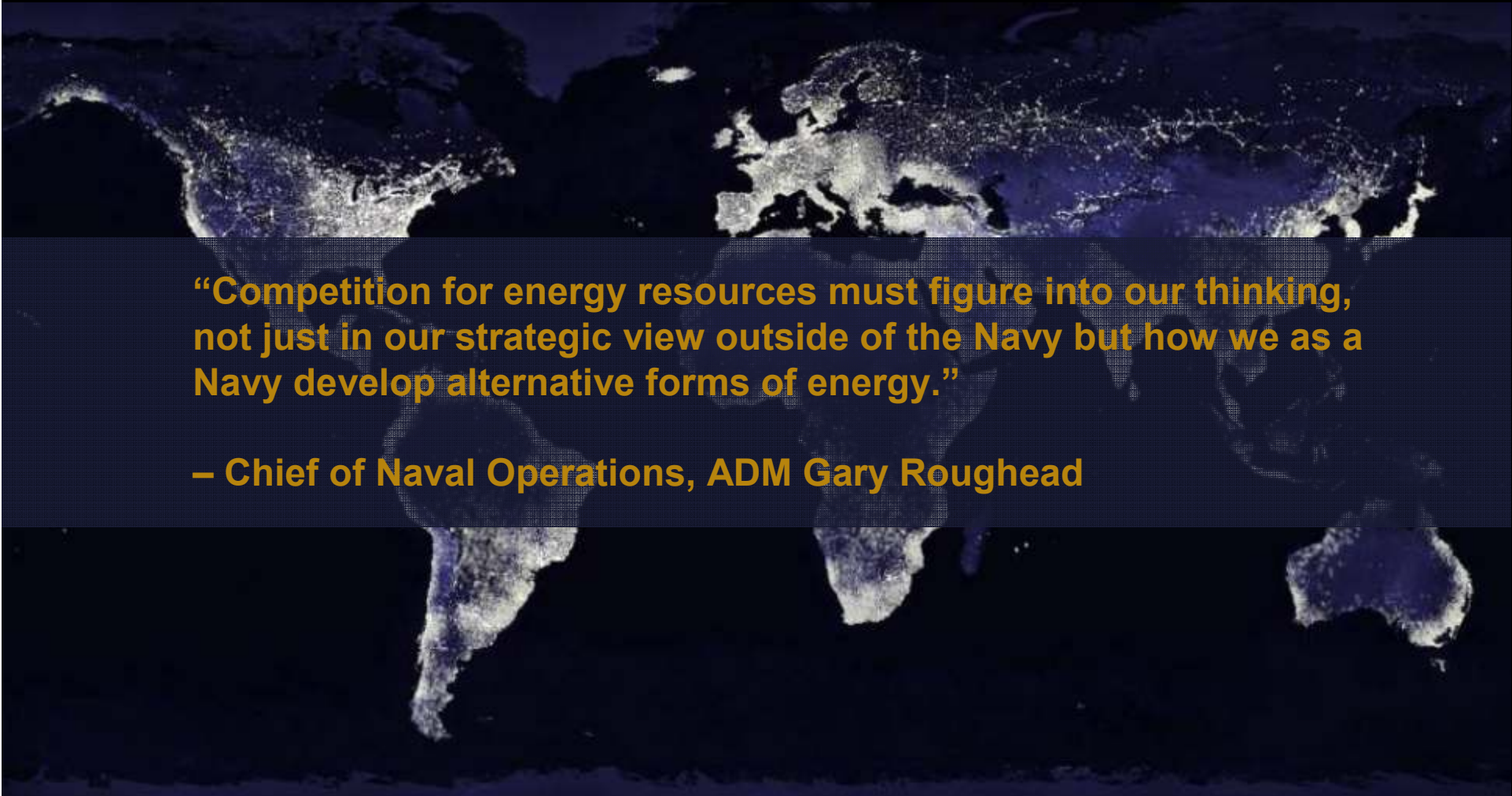
13 October 2010

**Global energy consumption is growing...**



**Today**

**... to unprecedented levels**



**“Competition for energy resources must figure into our thinking, not just in our strategic view outside of the Navy but how we as a Navy develop alternative forms of energy.”**

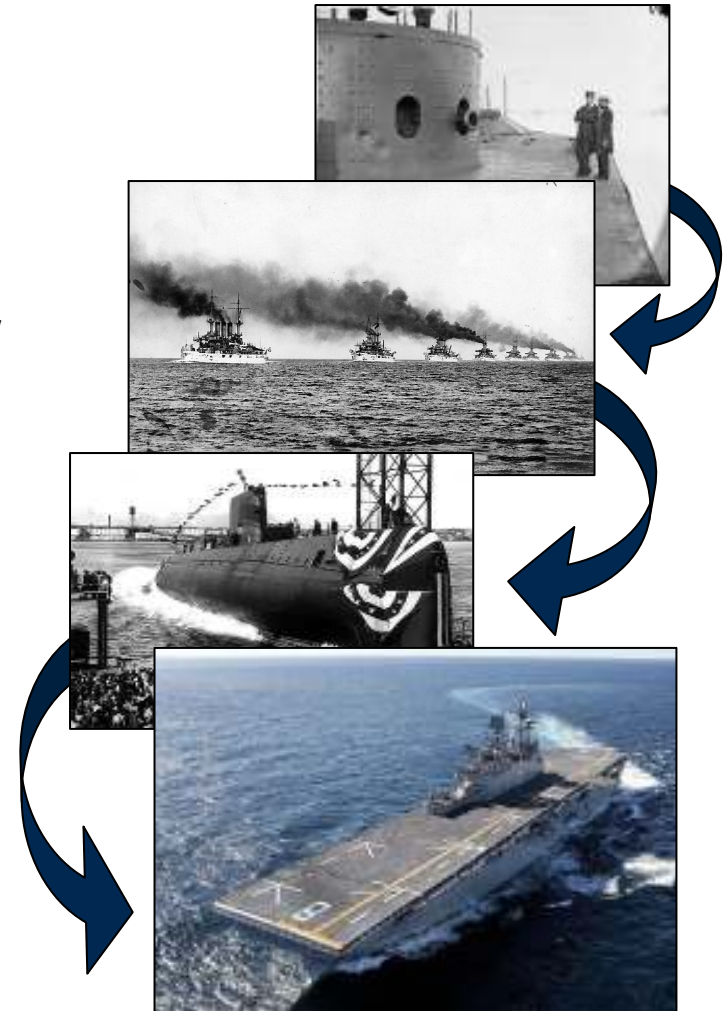
**– Chief of Naval Operations, ADM Gary Roughead**

**2030**



# Navy Leadership in Energy

- The Navy has been a pioneer of technical advancements from conversion of sail to steam to coal, oil and finally nuclear
- In recent years the Navy has successfully pursued many energy initiatives:
  - Alternative energy sources (China Lake geothermal)
  - Culture change (shipboard i-ENCON program)
  - Improved efficiencies (USS Makin Island APS)
- The CNO directed Task Force Energy to create a strategy to guide future Navy energy policy and investments



**Toward a Navy Energy Vision for the 21<sup>st</sup> Century**



# Navy Energy Vision

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

Ends	Ways		Means
Vision	Strategic Imperatives	Targets	Enablers
<ul style="list-style-type: none"> <li>• A Navy that values energy as a strategic resource</li> <li>• A Navy that understands energy security as fundamental to executing the Navy mission afloat and ashore</li> <li>• A Navy resilient to any potential energy future</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Assure Mobility</b></li> <li>• <b>Protect Critical Infrastructure</b></li> <li>• <b>Lighten the Load</b></li> <li>• <b>Expand Tactical Reach</b></li> <li>• <b>Green Our Footprint</b></li> </ul>	<ul style="list-style-type: none"> <li>• Increase Alternatives Afloat</li> <li>• Sail the Great Green Fleet</li> <li>• Increase Alternative Energy Ashore</li> <li>• Reliable Power for Critical Infrastructure</li> <li>• Reduce Non-Tactical Petroleum Use</li> <li>• Increase Efficiency Afloat</li> <li>• Increase Efficiency Ashore</li> <li>• Energy Efficient Acquisition</li> </ul>	<ul style="list-style-type: none"> <li>• <b>Leadership</b></li> <li>• <b>Technology</b></li> <li>• <b>Policy</b></li> <li>• <b>Strategic Partnerships</b></li> <li>• <b>Culture Change</b></li> </ul>

**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 needs**



# Ends: The Vision



- 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



# Ends: The Vision



- **Protect access to energy sources for our Nation and our Allies**
- **Consider energy requirements in strategic planning**
- **Incorporate energy requirements in all phases of systems development and acquisition**
- **Employ energy efficiency as a force multiplier for enhanced combat capability and a reduced logistics tail**
- **Spearhead early testing and adoption of viable alternative energy sources**
- **Rapidly adopt energy efficient technology and operating procedures**
- **Partner closely with other Services, government, industry, and academia to strengthen energy security at Navy, Joint, and National levels**
- **Receive wide recognition for energy leadership**
- **Lead Federal efforts to reduce greenhouse gas emissions**
- **Maintain a long-term perspective regarding energy security**



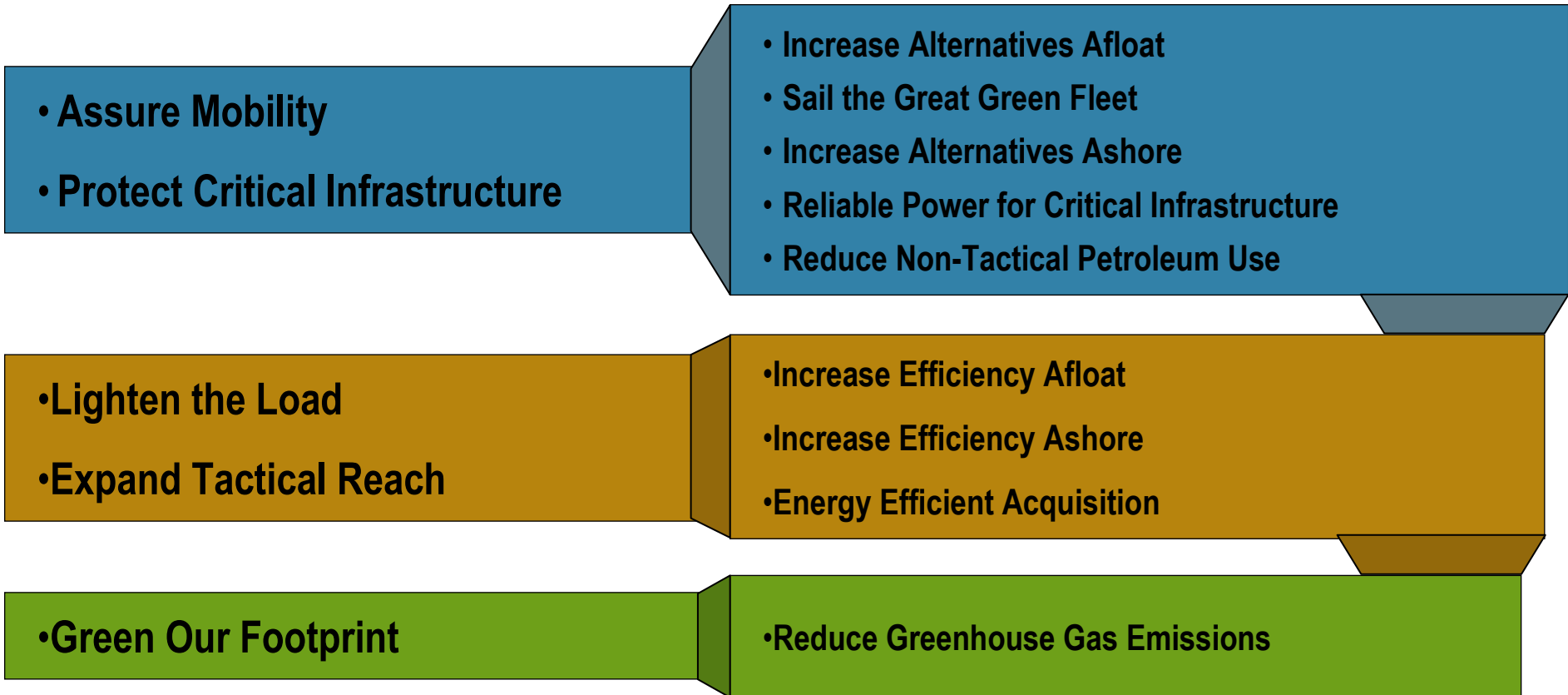
# Ways: Strategic Imperatives for Energy



- Assure Mobility
- Protect Critical Infrastructure
- Lighten the Load
- Expand Tactical Reach
- Green Our Footprint



# Ways: Energy Targets





# Ways: Alternative Energy Afloat

- **Although Navy consumes a large amount of fuel, it cannot move the market but can act as an early adopter to signal demand for biofuel development**
  - Alternatives currently under evaluation are derived from hydro-processed renewable non-food plant and algal feedstocks which could be supplied domestically
  - Achieving 50 percent alternatives afloat depends on a robust industry to provide an economical supply, an agile approval process to enable Navy procurement, and basic research into promising technologies
- **Investment in efficiency will reduce overall fuel consumption and increase percentage of alternatives**

**By 2020, half of the Navy's total energy consumption afloat will come from alternative sources**



# Ways: Great Green Fleet

## Fleet Composition



## 2012 Green Strike Group

- All ships and aircraft in demo group certified to run on 50/50 biofuel blend
- One destroyer will contain full load out of biofuel or fuel will be split among CG/DDG
- Carrier will contain one tank of aircraft biofuel
- CSG will feature fuel saving technologies, e.g. GT improvements, solid state lighting
- CSG will conduct exercise in local operations

## 2016 Great Green Fleet

- Each ship will contain full load out of biofuel
- Carrier will contain full load out of aircraft biofuel
- GGF will include at least one Destroyer featuring Hybrid Electric Drive
- CSG will feature additional fuel saving technologies
- CSG will go on deployment

By 2016, the Navy will sail the Great Green Fleet, a carrier strike group composed of nuclear ships, hybrid electric ships running biofuel, and aircraft flying on biofuel



# Ways: Alternative Energy Ashore

- Federal and DOD mandates require a significant increase in the use of alternative energy sources
- Navy shore community has already made notable achievements in renewable energy
- Such investments, along with advanced grid and energy storage technologies, will:
  - Reduce reliance on the commercial grid
  - Increase resilience of supply
  - Reduce greenhouse gas emissions
  - Spur national energy innovation



**By 2020, half of the Navy's total energy consumption ashore will come from alternative sources; the Navy will make half of its installations net-zero energy consumers**



# Ways: Critical Infrastructure

- **The loss of critical assets ashore, even temporarily, would seriously hinder Navy operations**
- **Many Navy critical assets and shore installations face vulnerabilities related to the commercial electrical grid**
  - Natural disaster
  - Accident
  - Physical and cyber attack
- **Installations must develop sufficient backup power systems and redundant power capacity to maintain mission effectiveness in the event of an outage**
- **The Navy will explore viable alternative energy solutions for backup and base power generation systems to protect critical infrastructure assets**



**By 2020, all of the Navy's critical infrastructure will have reliable backup power systems and redundant power systems where viable**



# Ways: Non-Tactical Vehicles

- **As the Navy looks to alternative liquid fuels for tactical platforms, the Department of the Navy is also dramatically reducing fossil fuel use by the non-tactical vehicle fleet by:**
  - Reducing the number of vehicles
  - Purchasing or leasing more efficient vehicles
  - Converting the majority of the fleet to alternative fuel vehicles
- **In addition to procuring alternative fuel vehicles, the Navy is committed to:**
  - Developing infrastructure and distribution systems to support them
  - Adapting policies which minimize barriers to using alternative fuel in the non-tactical vehicle fleet



**By 2015, the Navy will cut in half the amount of petroleum used in its commercial vehicle fleet through phased adoption of hybrid, electric, and flex fuel vehicles**



# Ways: Efficiency Afloat

- **The Navy must aggressively pursue initiatives that increase fuel efficiency and reduce overall fuel consumption afloat while maintaining or enhancing our ability to fight**
- **Successful implementation of efficiency initiatives will rely on continuously improved technologies and policies adapted to ensure effective use**
  - Maritime
  - Aviation
  - Expeditionary
- **Expanding tactical reach through efficiency emphasizes the contribution of energy security to combat capability**



**By 2020, the Navy will increase efficiency and reduce overall fuel consumption afloat by 15 percent**



# Ways: Efficiency Ashore

- **The shore community has decreased the energy consumption of its facilities over the past three decades in accordance with Federal and DOD mandates:**
  - Efficient building technologies
  - Repairs and modernization
  - Sustainable design principles
- **The Navy will seek to further reduce pressure on infrastructure and reduce backup generation requirements through:**
  - Energy awareness programs
  - Advanced data and control systems
  - Energy audits
  - Re-commissioning of energy systems
- **The Navy will continue to adopt leading-edge technologies at the right time, balancing maturity risk**

**By 2020, the Navy will increase efficiency and reduce overall energy consumption ashore by 50 percent**



# Ways: Acquisition

- **Expanding tactical reach and lightening the load must be prominent aims of reforming how the Navy and DOD do business**
  - Develop and implement an energy KPP and energy figure of merit
  - Define and incorporate a fully burdened cost of fuel
  - Require high-performance buildings
  - Enforce energy efficiency requirements for the defense industry
- **The naval industrial base can lead the private sector in methods to lighten the load and increase the energy security of the Nation, while lowering our dependence on fossil fuels**

**Evaluation of energy factors will be mandatory when awarding contracts for systems and buildings; industry will be held contractually accountable for meeting energy efficiency targets**



# Means: Enablers for the Vision



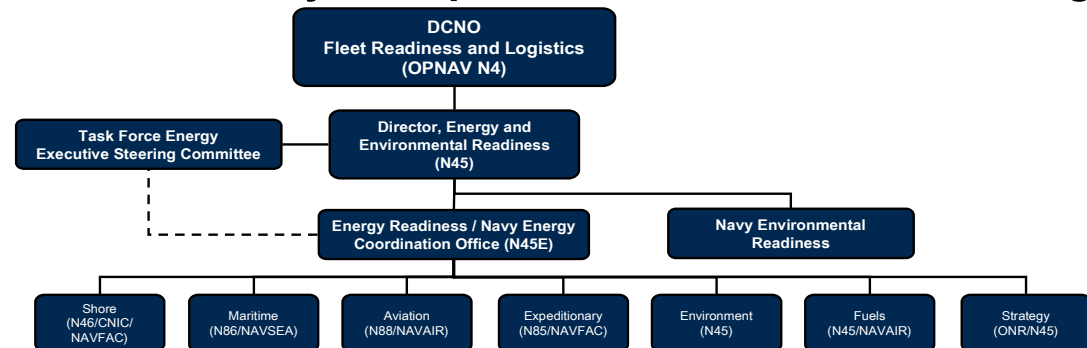
- Leadership
- Technology
- Policy
- Strategic Partnerships
- Culture Change



# Enablers: Leadership

- Decisions that indicate a cardinal heading for all energy efforts ultimately rest with Navy leadership
- The CNO will maintain a Navy Director of Operational Energy responsible for overall leadership of Navy energy efforts afloat and ashore
- The Director will continue to report to a Senior Energy Council with high-level representation from across the Navy
- The Director and operational energy staff will work with stakeholders to ensure that energy considerations are seamlessly incorporated in the decision-making process

- Resource sponsors
- System commands
- Fleet

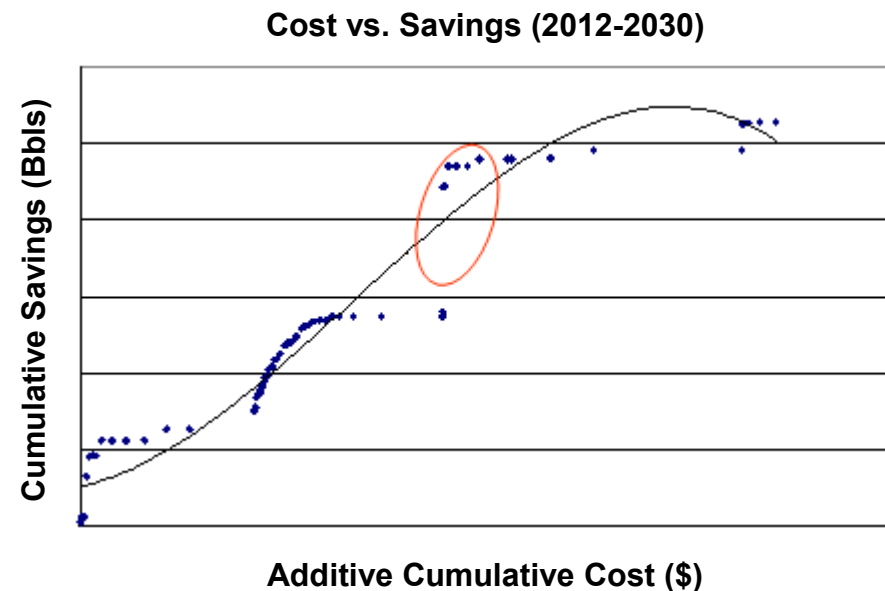


Even as leadership changes, energy must remain a priority



# Enablers: Technology

- Realizing the Energy Vision will require sustained Navy investment at all levels of technology development
- Although payback periods will vary, many investments will provide net savings to the Navy by lowering the total ownership cost of systems
- The Nation may benefit from Navy's investment in energy technologies which are likely to have civilian applications
  - Energy storage
  - Biofuels
- Proposed energy investments will be rigorously analyzed to provide the greatest possible return on investment in capability and in savings



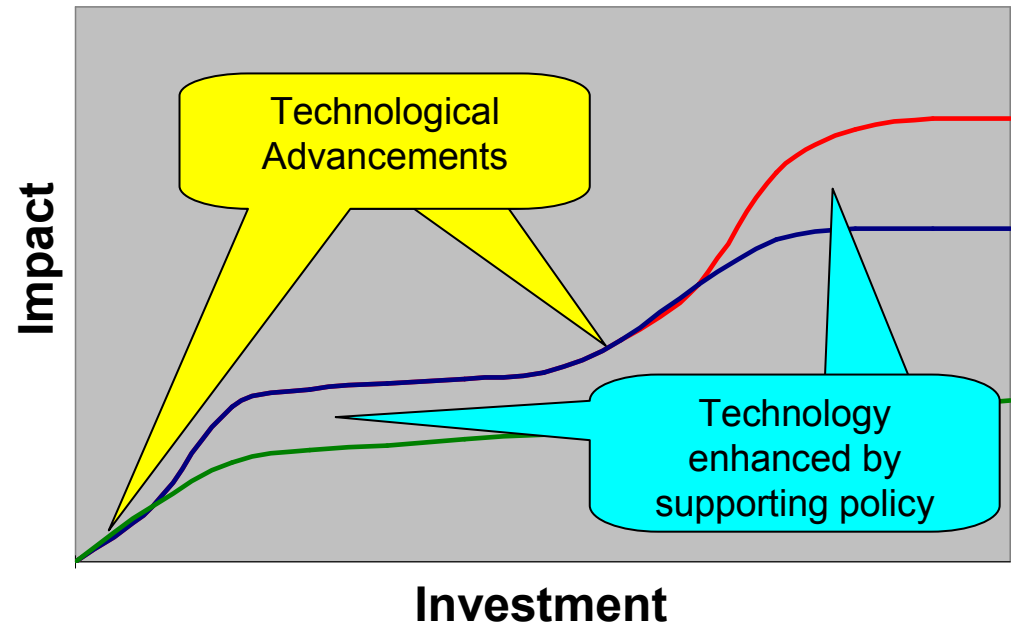
Some technologies will be evolutionary; others may be revolutionary



# Enablers: Policy

- Some of the most cost-effective energy initiatives will derive from policies that encourage energy efficient operations
  - Best practices
  - Incentives
- The Navy may have to adapt policy to ensure the full realization of advantages derived from new technologies
- Navy business processes will similarly reflect the high priority of energy

## The Value of Energy Awareness



Where a policy change will enhance energy security without negatively impacting readiness, the Navy will favor energy efficient operations



# Enablers: Strategic Partnerships

In pursuing energy initiatives, the Navy will seek to leverage the knowledge and resources of inter-service, interagency, and international partners:

- Services
- Federal agencies
- State/local organizations
- Industry
- Utilities
- Non-profits
- Academia
- Allies



**Strong collaboration on energy issues is essential to minimize redundancy in the face of constrained budgets and maximize return for the Nation and Allies**



# Enablers: Culture Change



- Although Navy leadership sets the course, realizing the Energy Vision requires the dedication of all members of the Navy organization
- Even the most efficient technologies and comprehensive policy support do not guarantee efficient operations
- Whether uniformed or civilian, officer or enlisted, every individual must contribute to a culture that values energy as a strategic resource
- Energy awareness training will ensure that every Sailor has the necessary knowledge to act

**Changing the culture means that everyone, down to the deck plate, understands how energy security is fundamental to executing our mission**



# Final Thoughts

- **Successful implementation of the Energy Strategy and realization of the Energy Vision will depend on a variety of factors**
  - Future mission requirements
  - Force structure
  - Operating tempo
- **While today's fight is ongoing, and the character of tomorrow's is uncertain, the Navy must maintain the long-term perspective required for investing in a new energy posture**
- **Despite the challenges, the Navy is committed to an energy transformation that will provide strategic and operational advantages**

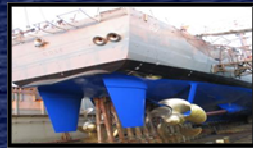
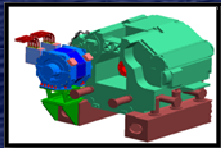
**The Navy will serve as a model of energy security for the Nation**



# REDUCING ENERGY COSTS

*RDML David H. Lewis*  
*RDML James P. McManamon*

*13 October 2010*





# ENERGY IN SHIP

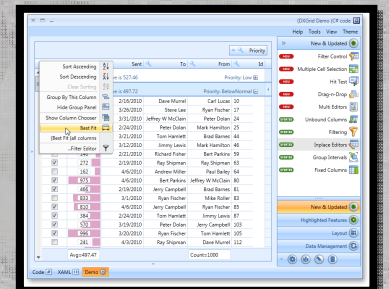
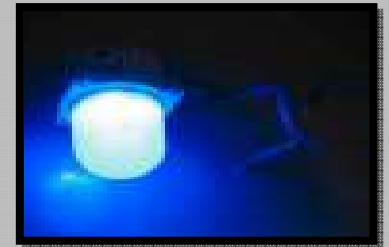
## ■ The Past

- Stern Flap
- Solid State Lighting

## ■ Gaining Knowledge

- AC units fighting space heaters
- Integrated Condition Assessment System (ICAS)

## ACQUIS



# Energy Efficiency Enabling Technologies

**2012**

Hybrid Electric Drive

Alternate Fuels

Solid State Lighting

Foul Release Coatings

Online GT Water Wash

GTG Efficiency Improvements

Combustion Trim Loop

Smart Voyage Planning Decision Aid

Stern Flaps

Variable Speed Drives

Low Solar Absorption Coatings

**2016**

Hull Hydrodynamic Mods

Generator Mods

Heat Energy Recovery

High Efficiency Chillers

Energy Dashboard

Propulsion Mods

Degaussing Mods

Modular Refrigeration Units

Advanced RO Desalinators

Electric Meters

Energy Storage Module

**Future**

New Engines and Generators

Fuel Cells

Wind Energy Harvesting

Solar Energy Harvesting

Air Film Hull Drag Reduction



# Energy Security Sailing Direction

- Leverage investments in Energy Efficiency Enabling Technologies
  - Reduce Fuel Consumption
  - Improve Power Conversion Efficiency
  - Increase Installed Power Generation
  - Increase/Maintain Combat Capability
- Implement TOC based approaches to ensure affordability
  - Modeling
  - Methodical Technology Development



DEPARTMENT OF THE NAVY  
Team Ships  
1333 ISAAC HULL AVE, SE  
WASHINGTON NAVY YARD, DC 20376-0001

5000  
Ser Team Ships/185  
19 Aug 10

WHILEY REFER TO

## MEMORANDUM

From: Team Ships  
To: All Hands, Team Ships

Subj: TEAM SHIPS SAILING DIRECTION #3 - ENERGY SECURITY

Encl: (1) Team Ships Energy Security Principles and Practices

1. Energy has a direct impact on warfighting effectiveness, and energy security has become a strategic as well as an operational imperative for the U.S. Navy. Operating in today's fiscally constrained environment magnifies the impact of our dependence on foreign and non-renewable sources of energy.

2. For every \$10 increase in the price of a barrel of oil, U.S. Navy annual fuel costs rise by nearly \$300 million. While the global financial crisis has driven oil prices down from the record levels reached during the summer of 2008, we cannot lose momentum in our efforts to field an energy-secure Fleet of the future.

3. In October 2009, the Secretary of the Navy outlined a set of specific objectives supporting U.S. Navy energy reform, including several aimed at significantly increasing energy efficiency while accelerating the adoption of renewable energy sources. An integrated approach across Team Ships will be required to address increasing shipboard power demands and high operational tempo while improving energy efficiency and expanding the adoption of renewable energy sources. We recognize that technology development and system integration challenges increase with the need to reduce fuel consumption, balance mission requirements, and increase available electrical power. However, the adoption of energy efficiency enabling technologies will be required to transform our energy posture while continuing to pace the threat.

4. Consistent with our previous Sailing Directions, to reduce the total ownership cost of the Fleet we will need a constructive culture of innovation to reduce energy usage - including, but not limited to, investments in technologies capable of reducing fuel consumption, improving power conversion efficiency, and increasing installed power generation while maintaining or increasing combat capability. Insertion opportunities for energy efficient enabling technologies exist

# Energy Surveys

**Baseline shipboard energy consumption and identify major energy consumers on ships.**

**Sponsorship:**

- PEO Ships for 1 survey (New Construction)
- CPF-NAVSEA 21 for 2 surveys (In-Service)

**Survey Phases:**

- Pre-Survey Research and Data Collection
- At sea Data Collection (during multiple operational scenarios)
- Data Analysis

**Ships:**

- DDG 111
- DDG 51 Class
- LSD 41/49 Class



# Energy Technologies Currently in the Fleet



## Combustion Trim Loop

USS PELELIU (LHA 5)



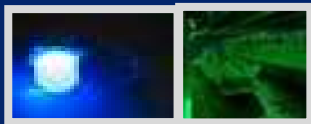
## GT Online Water Wash

USS PREBLE (DDG 88)



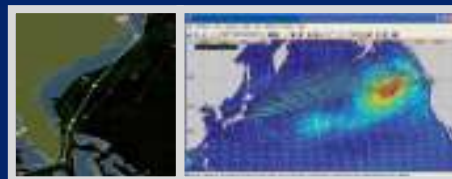
## Auxiliary Propulsion System

USS MAKIN ISLAND (LHD 8)



## Solid State Lighting

USS WASP (LHD 1)  
USS IWO JIMA (LHD 7)  
USS PEARL HARBOR (LSD 52)  
USS CHAFFEE (DDG 90)  
USS WAYNE E MEYER (DDG 108)



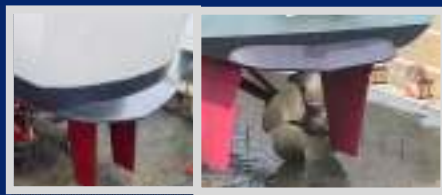
## Smart Voyage Planning Decision Aid

USN CARL BRASHEAR (T-AKE 7)  
Naval Maritime Forecast Center



## Hull & Propeller Coatings

USS PORT ROYAL (CG 73)  
USS COLE (DDG 67)  
USS GUNSTON HALL (LSD 44)



## Stern Flaps

FFG 7 Class  
DDG 51 Class  
CG 47 Class

LPD 17 Class  
LHD, LSD Classes  
PC 1 Class



## Alternate Fuels

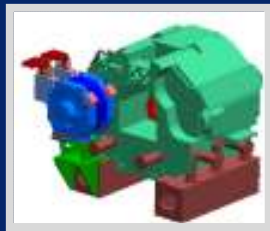
RHIB



## Variable Speed Drive Motors

Various

# Upcoming Energy Technologies in the Fleet



## Hybrid Electric Drive

---

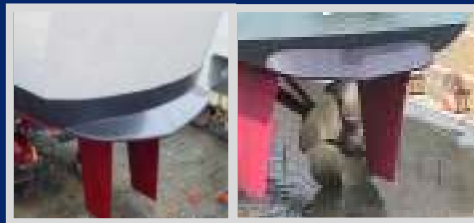
USS TRUXTUN (DDG 103)



## Alternate Fuels

---

RCB-X | LCAC | YP | SDTS | GSG



## Stern Flaps for In-Service L Ships

---

USS WHIBDEY ISLAND (LSD 41)

USS KEARSARGE (LHD 3)

# Collaboration

## Military Sealift Command

- Smart Voyage Planning Decision Aid
- Model Development
- Energy Surveys
- Maritime Working Group Member



## International

- Royal Australian Navy
- International Frigate Working Group



## Oceanographer of the Navy

- Smart Voyage Planning Decision Aid
- Physical Environment Authority MOU



## Coast Guard

- Maritime Working Group Member



## COMPACFLT

- Energy Surveys
- ICAS
- Maritime Working Group Member



## Maersk

- Consulting on Commercial Shipping Best Practices



## Office of Naval Research

- Maritime Working Group Member



## Department of Energy

- MOA
- Leveraging Technology Investments





# **ARPA-E Overview and Funding Opportunity Summary**

**Navy Energy Forum**

**Washington D.C.**

**October 12, 2010**

**By**

**Srini Mirmira, Ph.D.**

**[www.arpa-e.energy.gov](http://www.arpa-e.energy.gov)**

# The strategic need for ARPA-E stemmed from “Rising Above the Gathering Storm” report



## Rising Above the Gathering Storm, 2006 (National Academies)

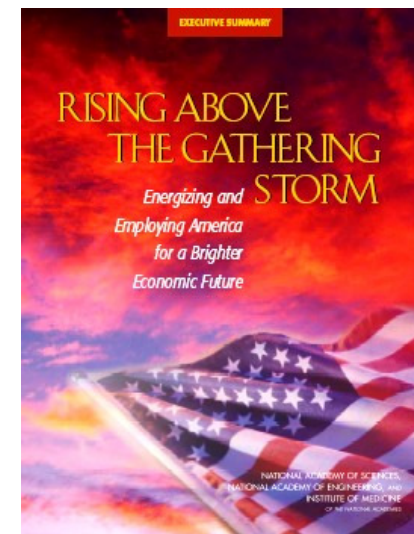
- Establish an Advanced Research Projects Agency for Energy (ARPA-E)
- “Creative, out-of-the-box, transformational” energy research
- Spinoff Benefit – Help educate next generation of researchers
- Secretary Chu (then Director of Berkeley National lab) on committee

## America COMPETES Act, 2007

- Authorizes the establishment of ARPA-E

## American Recovery and Reinvestment Act of 2009 (Recovery Act)

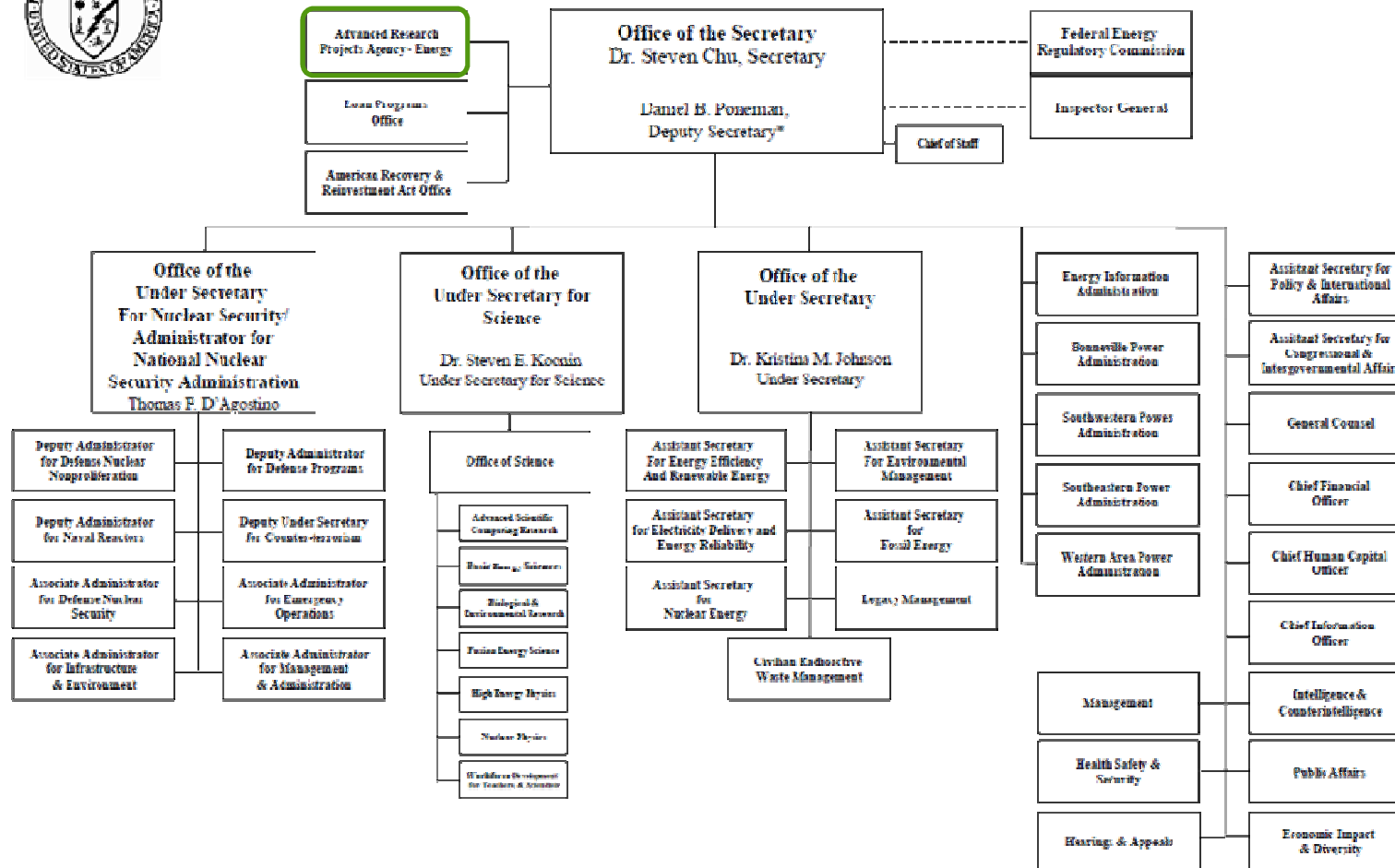
- \$400M appropriated for ARPA-E
- President Obama launches ARPA-E in a speech at NAS on April 27, 2009



# ARPA-E's director reports directly to the Secretary of Energy



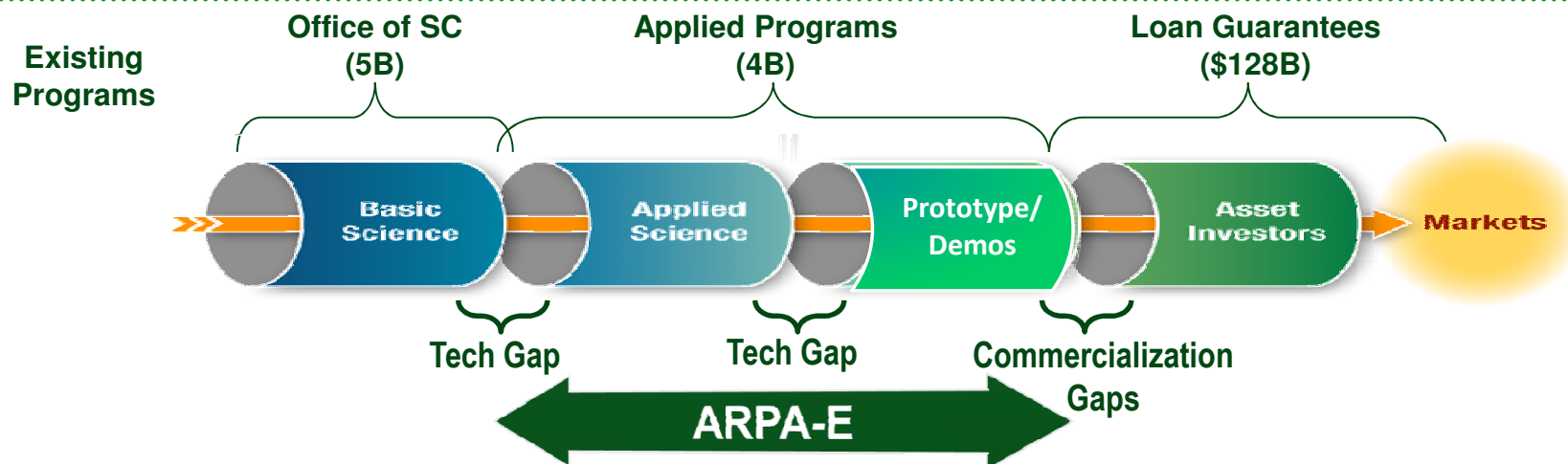
## DEPARTMENT OF ENERGY



\* The Deputy Secretary also serves as the Chief Operating Officer



# ARPA-E was created with a vision to bridge gaps in the energy innovation pipeline



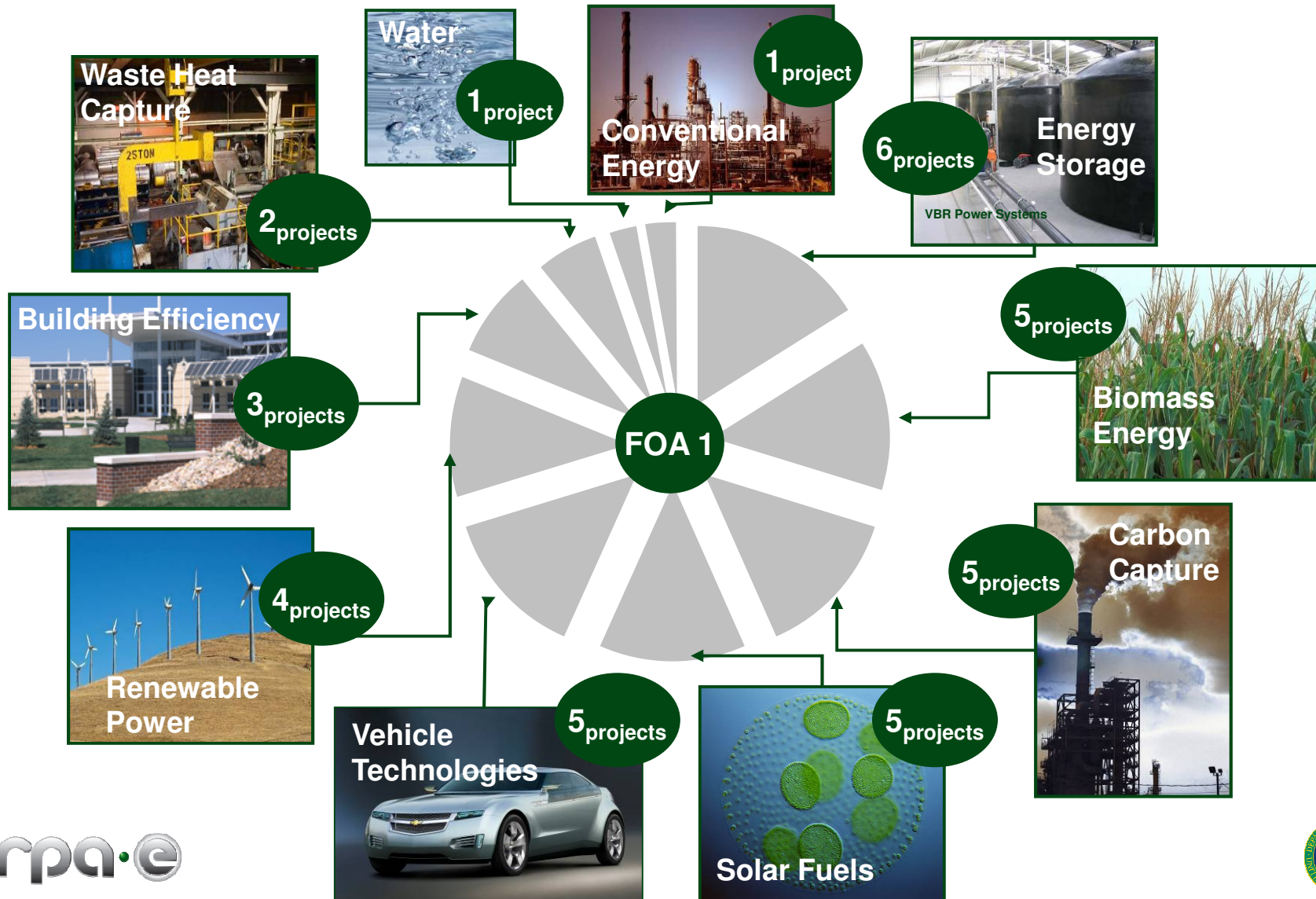
## what ARPA-E will do

- Seek high impact science and engineering projects
- Invest in the best ideas and teams
- Will tolerate and manage high technical risk
- Accelerate translation from science to markets
- Proof of concept and prototyping

## what ARPA-E will NOT do

- Incremental improvements
- Basic research
- Long term projects or block grants
- Large-scale demonstration projects

# ARPA-E FOA 1 projects can be categorized into one of ten energy technology areas

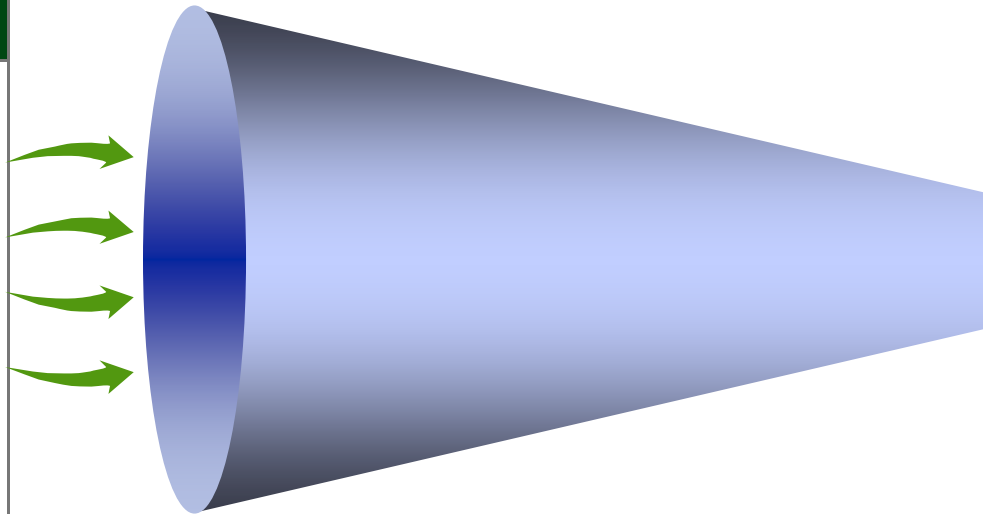


# ARPA-E has transitioned away from the wide-open FOA1 to more focused energy technology programs



## Inputs to Focused FOA Development

- FOA 1: Unprecedented Snapshot of U.S. Energy Technology Landscape
- 550 Responses to ARPA-E's "Request for Information" Suggesting High Impact Program Areas
- 7 Focused Workshops



**FOCUSED  
FUNDING  
OPPORTUNITIES  
(\$30-\$35M  
programs)**

## Round 1

- Wide-open "Early Harvest" solicitation
- Seeking to support the best U.S. energy technology concepts across the board



## Round 2 & Round 3 FOAs

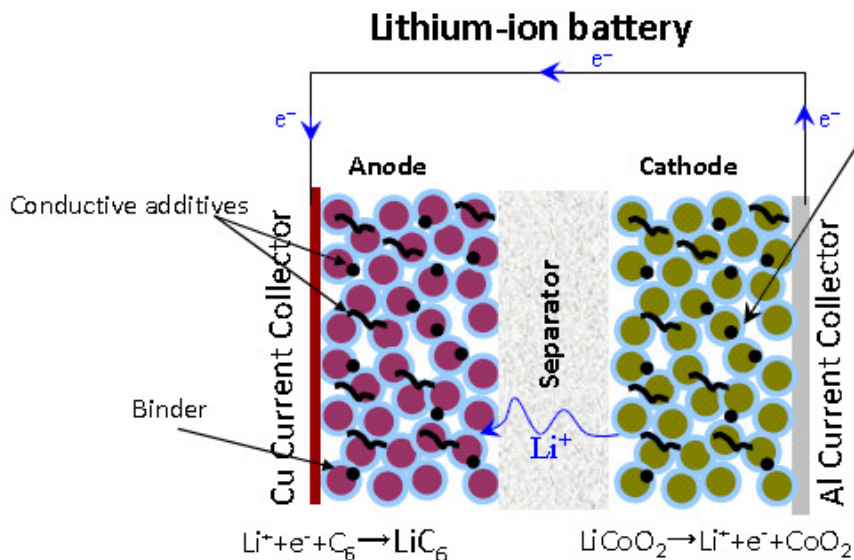
- Focused funding opportunities around specific markets or technical challenges
- Metrics driven programs with clear "over the horizon" cost and/or performance metrics

# Batteries for Electrical Energy Storage for Transportation (BEEST)



**The Need:** Development of novel battery storage technologies beyond carbon-based anode/Li-intercalation cathode systems and slurry coating based coating processes that enable U.S. manufacturing leadership in the next generation of high performance, low cost EV batteries.

**The Goal:** Develop advanced battery chemistries, architectures, and manufacturing processes with the potential to provide EV battery system level specific energies exceeding 200 Wh/kg and 300 Wh/l at system level costs < \$250/kWh.



## Example areas of interest

- Advanced Lithium-ion batteries that exceed energy density of traditional Li-ion systems
- Li-sulfur battery approaches that address the low cycle life and high self-discharge of existing state of the art technology
- Metal air battery approaches that address the low cycle life, low power density, and low round trip efficiency of current approaches

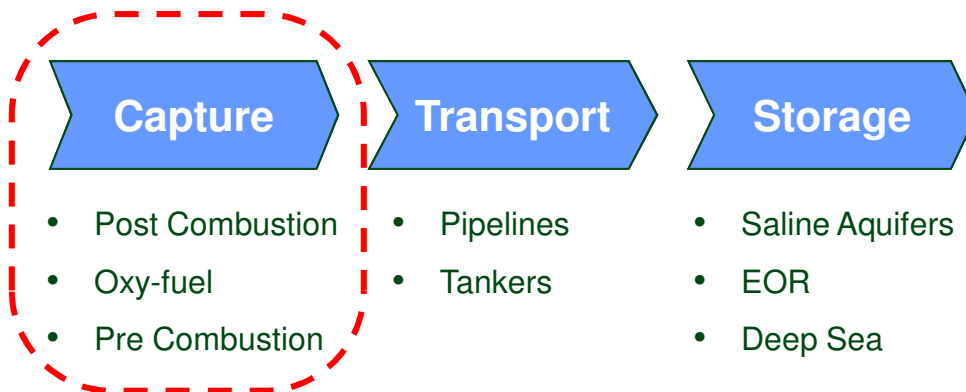
# Innovative Materials and Processes for Advanced Carbon Capture Technologies (IMPACCT)



**The Need:** The state-of-the-art CO<sub>2</sub> capture technology, aqueous amine solvents, imposes a ~25-30% parasitic power load on a coal-fired power plant, increasing levelized cost of electricity by ~80%

**The Goal:** Develop *materials* and *processes* that drastically reduce the parasitic energy penalty required for CO<sub>2</sub> capture from a coal-fired power plant

Approx. 80% of the capital costs of carbon capture and storage arise from the capture process



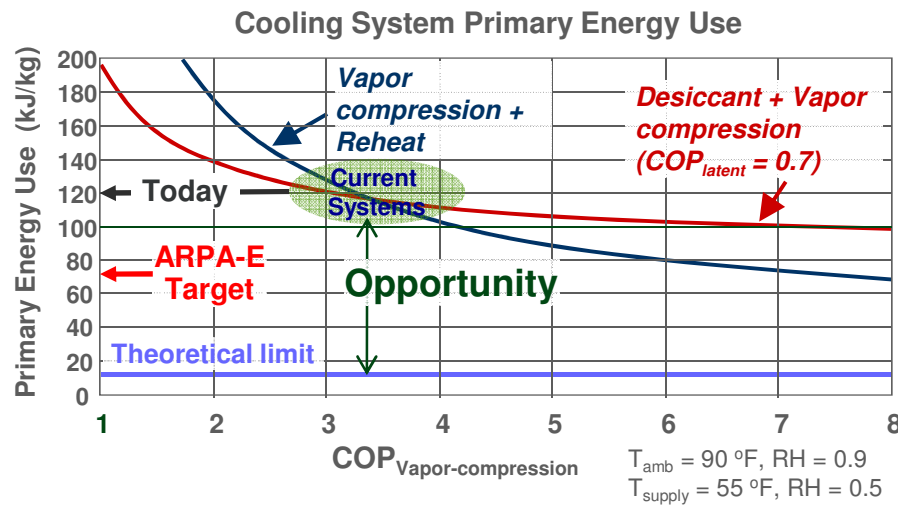
## Example areas of interest

- Low-cost catalysts to enable systems with superior thermodynamics that are not currently practical due to slow kinetics
- Robust materials that resist degradation from caustic contaminants in flue gas
- Advanced capture processes, such as processes that utilize thermodynamic inputs other than temperature or pressure

# Building Energy Efficiency Through Innovative Thermodevices (BEETIT) – Building Cooling

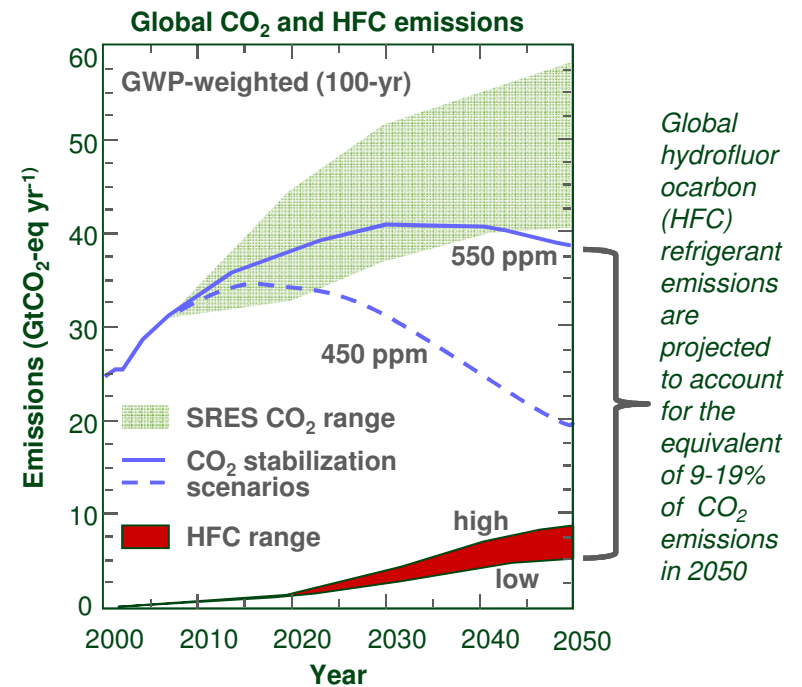


- Building cooling is responsible for ~5% of U.S. energy consumption & CO<sub>2</sub> emissions
- Majority of the systems are air cooled



- Achieve effective COP equivalent to water cooled chiller *without* loss of water for:
  - Warm & humid climate
  - Hot and dry climate
- This will cut cooling energy consumption & GHG emissions by 25-40%

- Current refrigerants have a Global Warming Potential (GWP) over 1000 x greater than CO<sub>2</sub>



Achieve 1 Ton of cooling using refrigerants with GWP ≤ 1

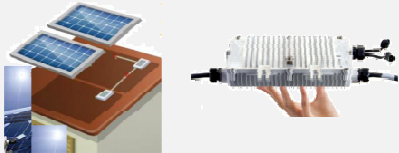
# Agile Delivery of Electrical Power Technology (ADEPT)



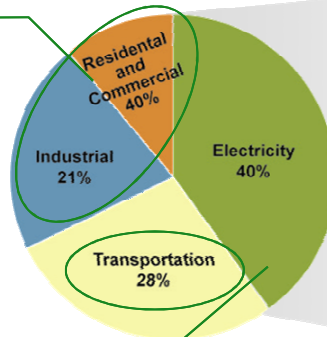
## Photovoltaics

Goal: Levelized Energy Cost for photovoltaic (PV) systems of \$0.05 - 0.10 / kWh

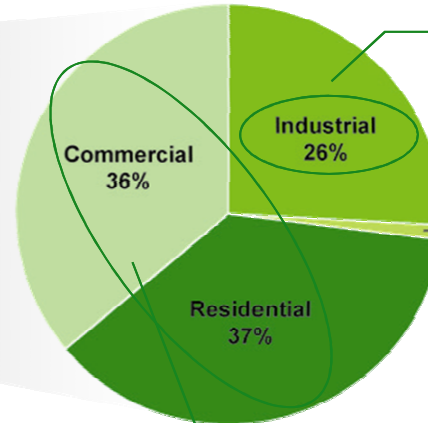
Approach: Reduce inverter cost by factor of 3



Primary Energy Use by Sector, 2008



Share of Electricity Consumed by Major Sectors of the Economy, 2008



## Industrial

Goal: Improve energy efficiency of industrial motors [65% of industrial electricity consumption]

Approach: Power electronics for variable speed drive electric motors (88% more efficient than constant drive)

## Automotive

Goal: Increase of inverter specific power density & temp. from 5.5kW/L at 85C to greater than 9kW/L at 105 C.



Approach: Package integrated high-temperature converters with high-frequency switches and magnetics.



## Lighting

Goal: Substantially reduce energy consumption of lighting [nearly 1/5 of commercial and residential electricity use]



Approach: Power electronics to facilitate so state lighting (20-40% more efficient than state-of-art LEDs)



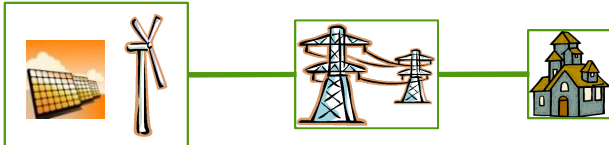
**Advanced power electronics for  
12% reduction in total US energy consumption**



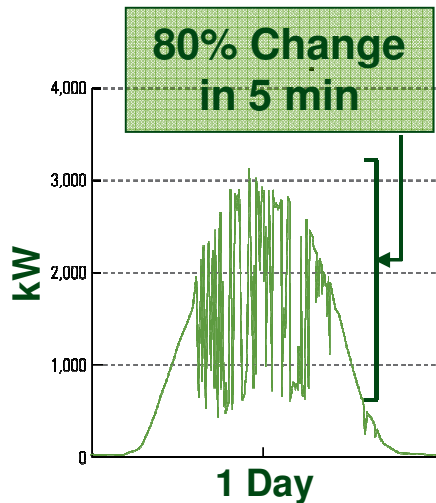
# Grid-Scale Rampable Intermittent Dispatchable Storage (GRIDS)



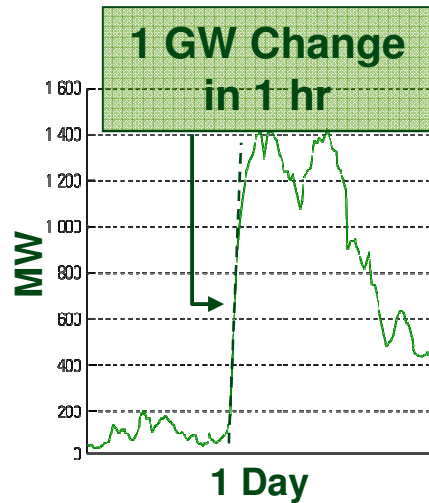
## Renewables Today



Solar PV in AZ (TEP)

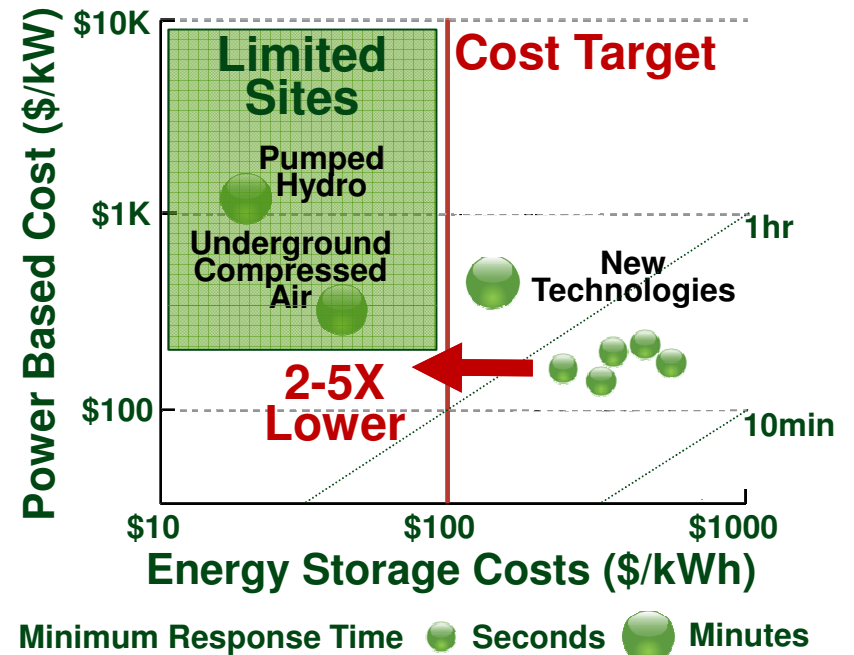


Wind in OR (BPA)



**Problem:**  
Minutes-to-Hours Changes in Power

## Storage for Renewables Tomorrow



**Need:** Innovative Technologies for Cost-Effective Energy Storage

**Goal:** Grid storage that is dispatchable and rampable  
**ARPA-E Focus:** Transformational approaches to energy storage to enable wide deployment at very low cost

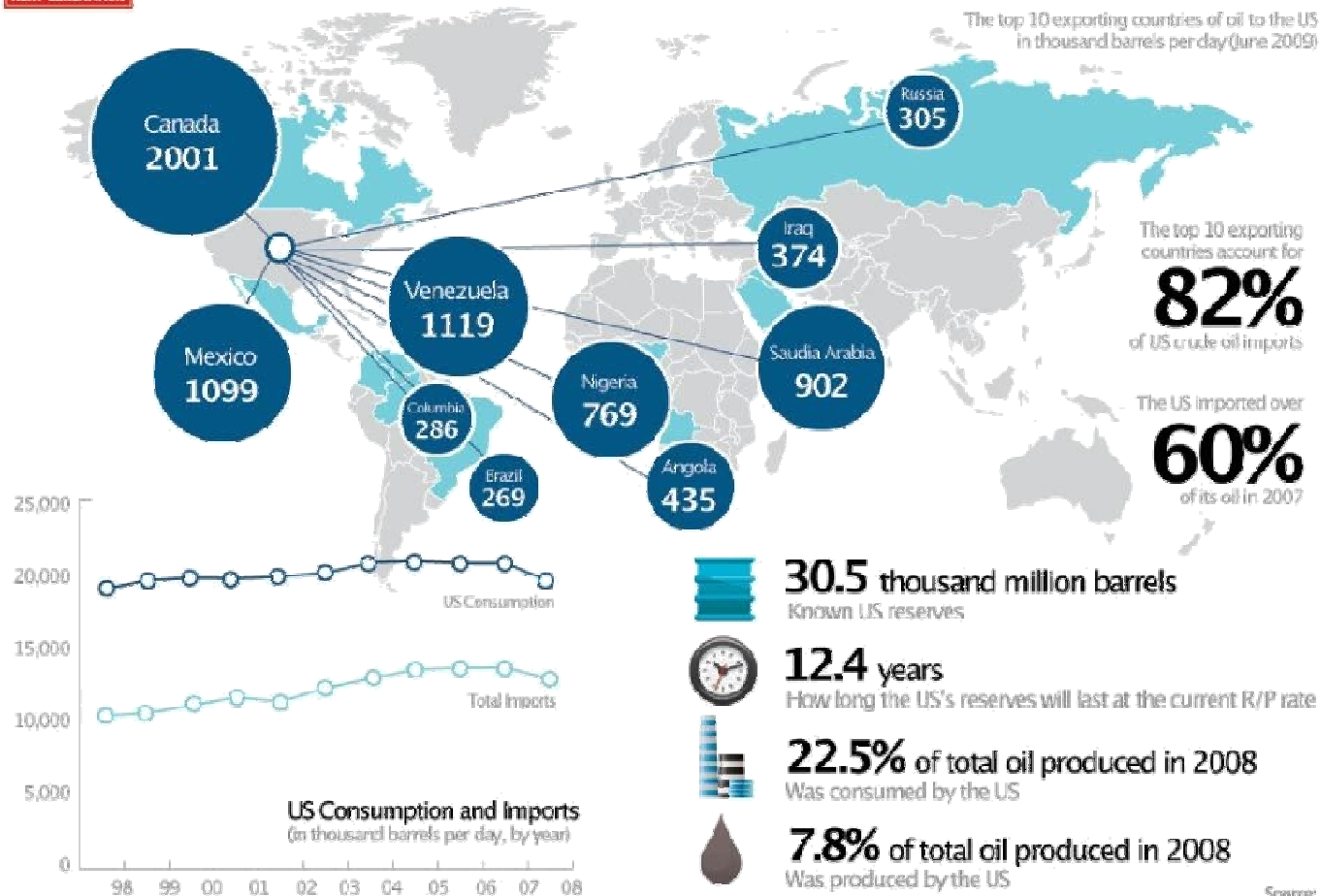


# The U.S. dependence on imported oil is an economic weakness as well as a political and environmental challenge



## Oil Imports to the US

Is the US too reliant on foreign oil?



In 2007, with oil at \$70 per barrel, the U.S. trade deficit in petroleum products was **36%** of the total of \$819 billion deficit.

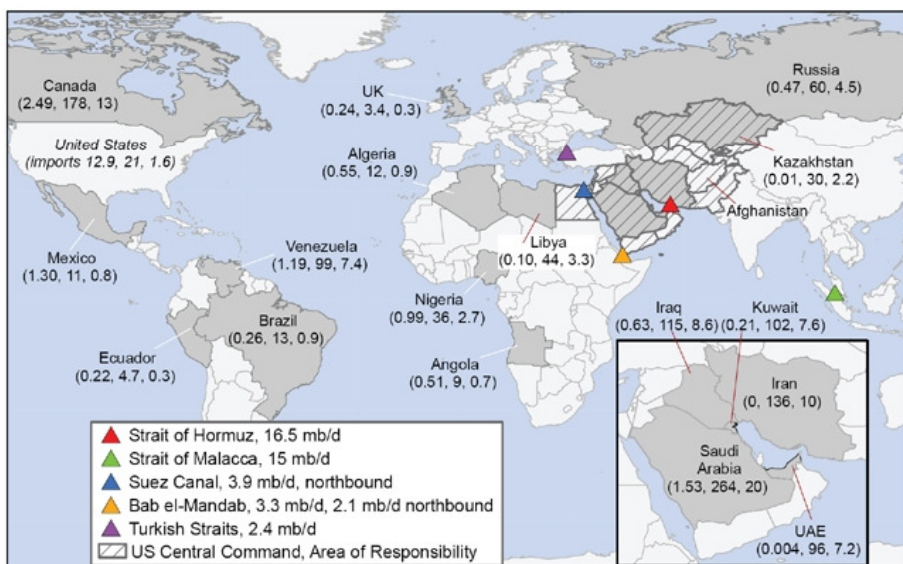
Source:  
Energy Information Administration  
BP



# The U.S. dependence on imported oil has driven U.S. military positioning and consumed significant military resources

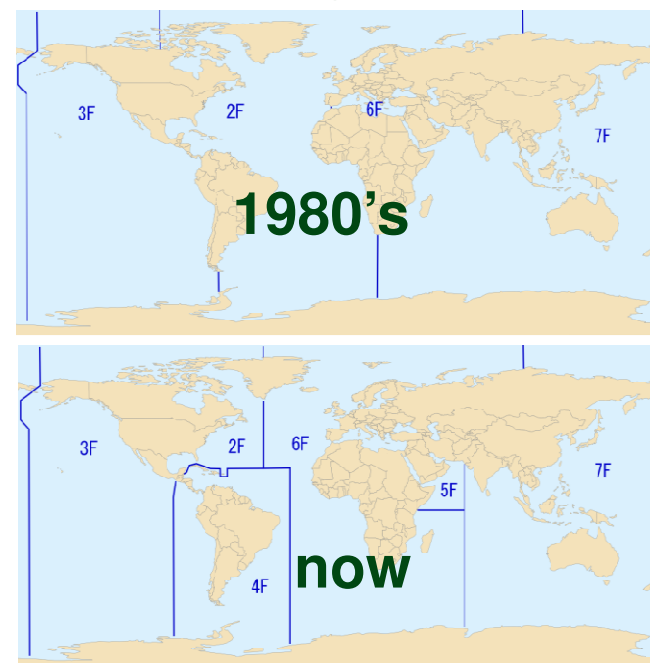


The U.S. Navy has reorganized in the last 20 years as a result of the U.S. dependence on oil. From 1976 to 2007 the cost of keeping U.S. aircraft carriers in the Persian Gulf (securing oil shipments) totaled \$7.3 trillion<sup>1</sup>



Countries in gray export oil to the U.S. at >0.2 mb/d or have >20 billion barrels of oil reserves. Country labels in parentheses indicate: 1) U.S. imports designated in mb/d, 2) oil reserves in billion barrels, and 3) the percentage of global reserves. 2006 data

## U.S. Navy Fleets

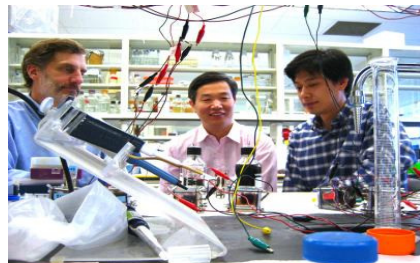
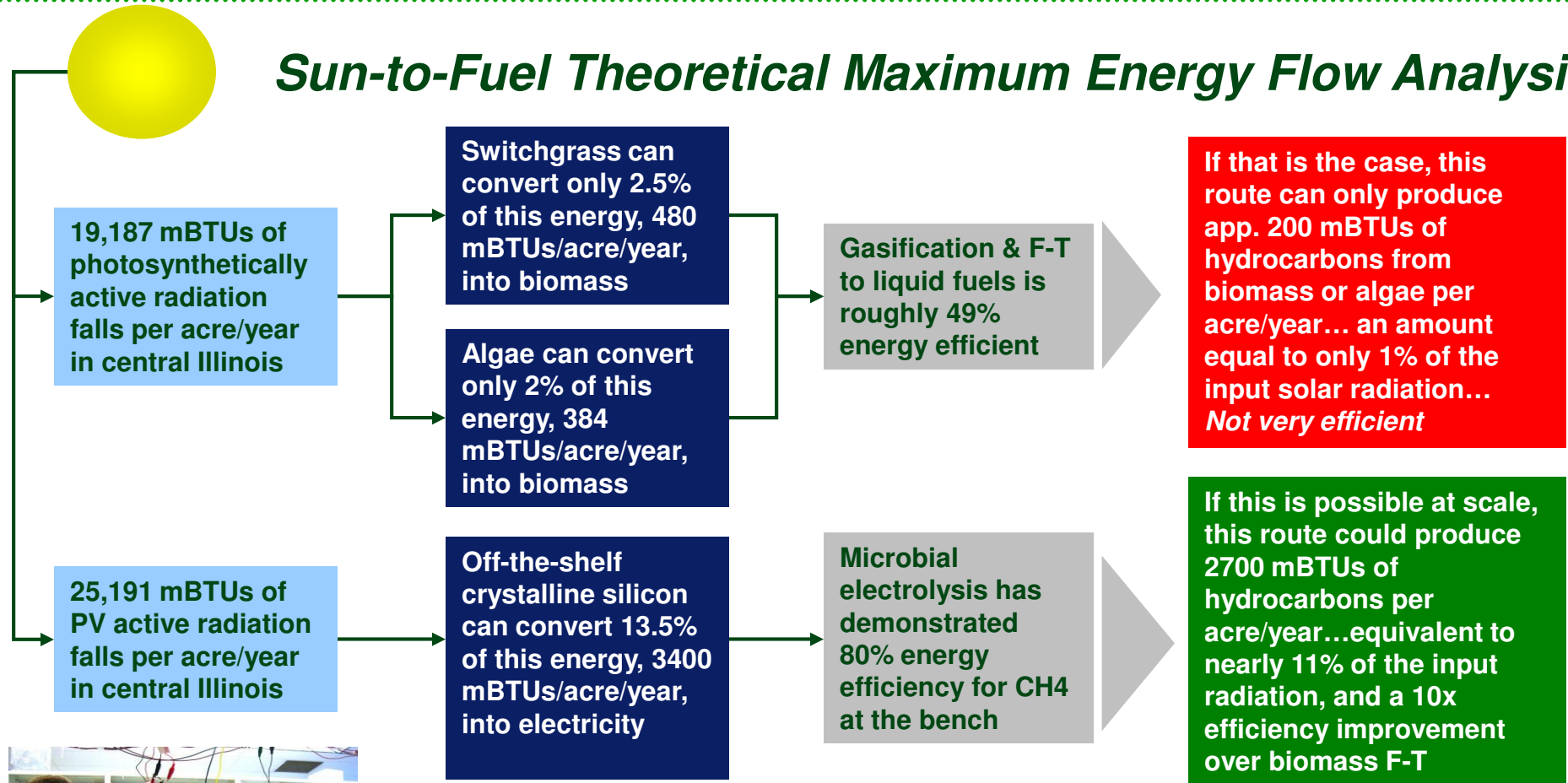


1: Stern, R.J. United States cost of military force projection in the Persian Gulf, 1976–2007, Energy Policy, 2010.

# Electrobiofuels is a potentially high-efficiency paradigm for the production of liquid fuels from solar energy



## Sun-to-Fuel Theoretical Maximum Energy Flow Analysis



***“We have a microbe that is self-perpetuating that can accept electrons directly, and use them to create methane.”***

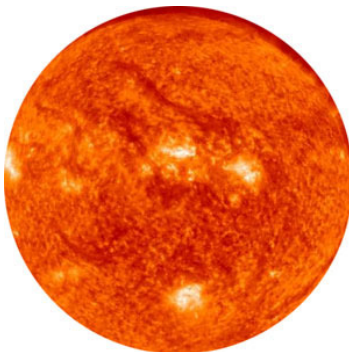
- Dr. Bruce Logan, Kappe Professor of Environmental Engineering, Penn State



# ARPA-E's Electrofuels program seeks to address U.S. oil dependence with significantly more efficient biofuels



The Electrofuels program is anticipated to open up a new area of research and path to biofuels



Photosynthesis



Electrons/  
Reducing equivalents

Biomass

Algae

Chemical  
Catalysis

Biological  
Catalysis

EtOH  
Advanced  
biofuels

Pyrolysis  
oils

Biodiesel  
Advanced  
biofuels

Syngas  
CH<sub>3</sub>OH  
CH<sub>4</sub>  
Advanced fuels?

Advanced  
Fuels



# Electrofuels approach is non-photosynthetic, modular, and solutions can be mixed- and- matched



Assimilate Reducing Equivalents

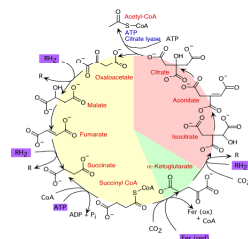


Reducing equivalents: *other than reduced carbon or products from Photosystems I & II*

$H_2S$        $H_2$       Direct Current       $NH_3$        $Fe^{2+}$



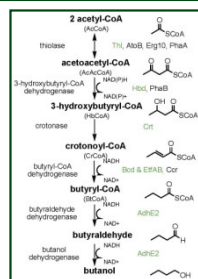
Fix  $CO_2$  for Biosynthesis



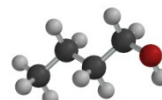
Pathway for carbon fixation: *reverse TCA, Calvin- Benson, Wood-Ljungdahl, hydroxpropionate/hydroxybutyrate, or newly designed biochemical pathways*



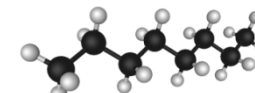
Generate Energy Dense Liquid Fuel



Fuel synthesis *metabolic engineering to direct carbon flux to fuel products*



butanol



alkanes

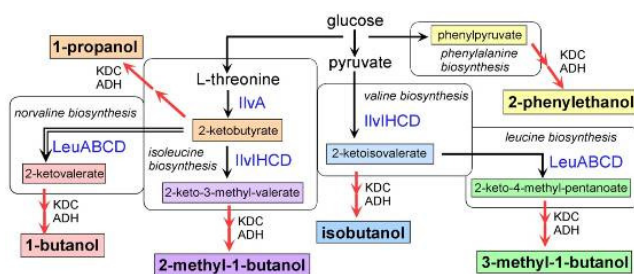
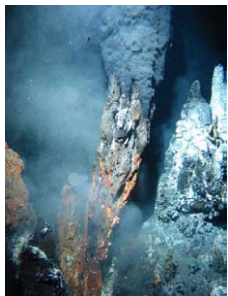
+ numerous possibilities

# “Electrofuels” FOA - Can we develop non-photosynthetic, autotrophic systems to directly reduce CO<sub>2</sub> to complex liquid fuels?

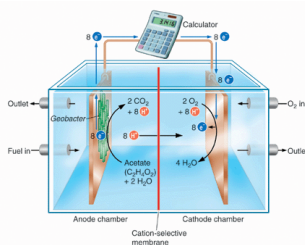


**The Proposal:** Utilize metabolic engineering and synthetic biological approaches for the high efficiency conversion of CO<sub>2</sub> to liquid transportation fuels in organisms capable of extracting energy from hydrogen, from reduced earth-abundant metal ions or/and organic cofactors, directly from electrical current, or other sources other than reduced carbon (e.g. sugars).

## Foundational R&D has been demonstrated to support the concept.....*what's next?*



- Autotrophic organisms (e.g. extremophiles, acetogens, methanogens,) utilize energy inputs other than photons or reduced carbon
- Synthetic biology and metabolic engineering have demonstrated a remarkable capacity to create an astonishing array of molecules, including fuel precursors.



### Direct Biological Conversion of Electrical Current into Methane by Electromethanogenesis

SHAOAN CHENG, DEFENG XING, DOUGLAS F. CALL, AND BRUCE E. LOGAN\*  
 Engineering Environmental Institute and Department of Civil and Environmental Engineering, 212 Sackett Building, The Pennsylvania State University, University Park, Pennsylvania 16802

Received December 12, 2008. Revised manuscript received March 5, 2009. Accepted March 6, 2009.

- Many microorganisms communicate electrically with their surroundings, the basis for the development of microbial fuel cells, funded by DOE, DoD, & DARPA
- Reverse microbial fuel cells are feasible and can fix CO<sub>2</sub> using electrical current as an energy input

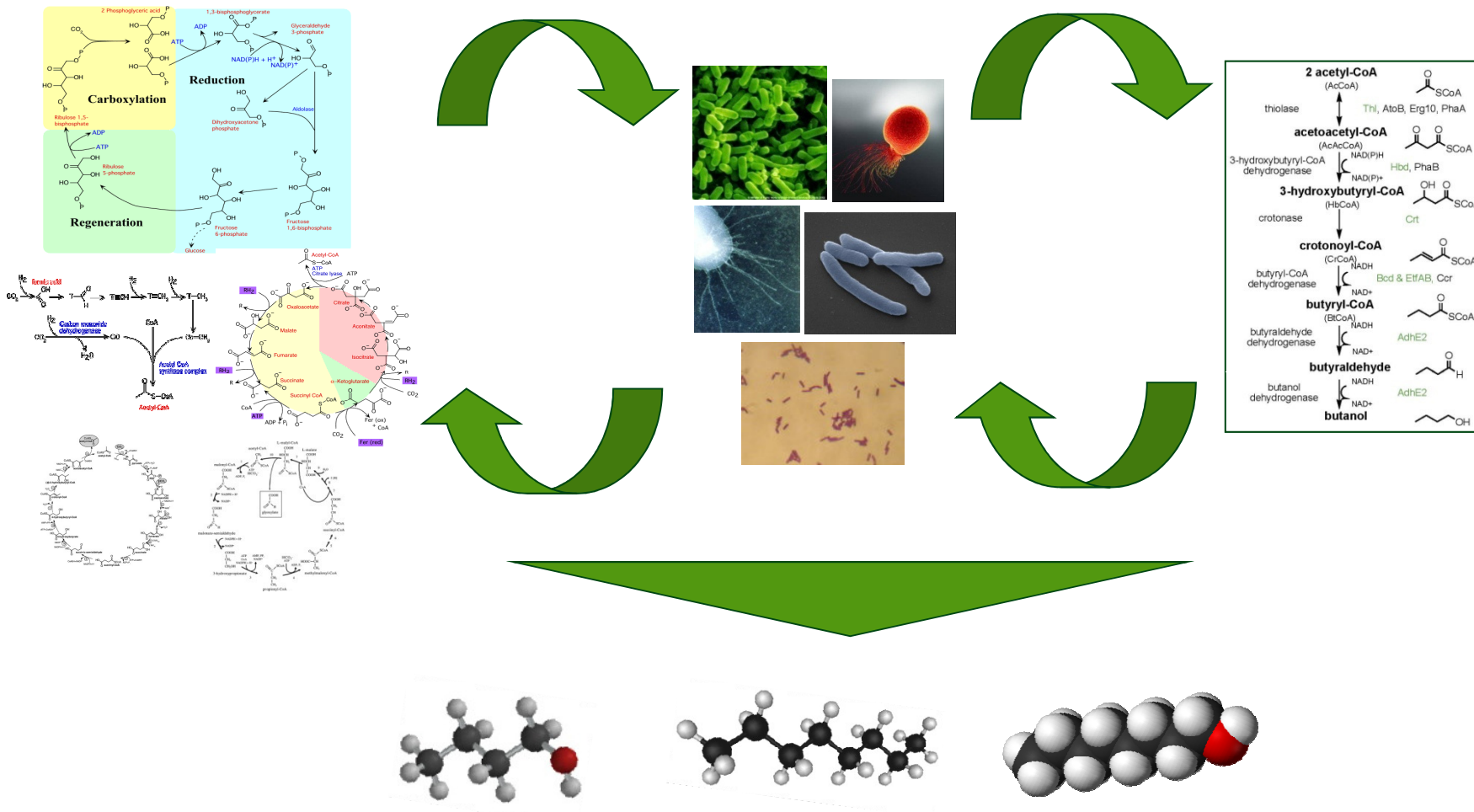
## ARPA-E's investment should be considered both high-risk and very early stage



To achieve the intent of the Electrofuels FOA, all projects must address the following components:

- Specify liquid fuel type (diesel fuel, JP-8 aviation fuel, and/or high octane fuels for four-stroke internal combustion engines); liquid fuels 85 research octane or 40 cetane are desirable
- Anticipated liquid fuel energy density 32 MJ/Kg is desired
- Anticipated liquid fuel heat of vaporization  $< 0.5$  MJ/Kg is desired
- Anticipated liquid fuel-energy-out to photon/electrical energy-in of the envisioned system; an overall energy efficiency  $> 1\%$  is required
- Rare earth elements or organic redox shuttles that cannot be deployed economically at scale should be avoided

# Electrofuels concepts explores many carbon fixation pathways, state-of-the art synthetic biology & metabolic engineering



The 13 projects selected create a program which includes a diverse portfolio of approaches



	Reducing Equivalents				CO <sub>2</sub> Fixation Pathways				Organism Platforms						
	H <sub>2</sub>	E-	NH <sub>3</sub>	NADH	CB	WL	4HB	rTCA	Ral-stonia	E-coli	Clost-ridium	Geo-bacter	Rhodo-bacter	Shew-anella	Pyro-coccus
		●				●	●				●	●			
	●				●								●		
	●				●				●				●		
	●				●				●	●					
				●				●							
		●			●									●	
	●	●				●					●				
	●						●			●					●
	●				●				●						
		●			●			●		●	Synechocystis		Rhodopseudomonas		
		●				●					●	Acetobacterium			
			●		●										
	●				●				●						

# ARPA-E selected Full Applications from leading scientists



## Biochemists



### Dr. David Baker (Washington)

- New computational techniques for protein structure prediction and design
- Design of proteins for fuel-cell catalysis,
- Solar hydrogen production and nanopatterning of materials



### Dr. Greg Stephanopoulos (MIT)

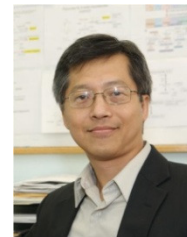
- Metabolic Engineering
- Metabolomics
- Novel approaches to intracellular flux determination.



### Dr. Anthony Sinskey (MIT)

- Engineering biodegradable polymers
- Turning environmental contaminants into pharmaceuticals with *Rhodococcus*
- Biosynthesis of essential amino acids in *Corynebacterium glutamicum*

## Synthetic Biologists



### Dr. James Liao (UCLA)

- Metabolic engineering, synthetic biology, and systems biology principles to produce next generation biofuels



### Dr. Pamela Silver (Harvard)

- Cell-based machines, developing protein-based logic for design of novel therapeutics, and engineering cells as sources of bio-energy and optimization of carbon dioxide fixation



### Dr. George Church (Harvard)

- Synthesizing bacterial genomes with new genetic codes, new protein types, and thereby immune to all existing viruses

# ARPA-E selected Full Applications from leading scientists



## Microbiologists



### Dr. Mike Adams (Georgia)

- Physiology, metabolism, enzymology, bioinorganic chemistry, and functional and structural genomics of anaerobic microorganisms, particularly archaea and particularly those growing near and above 100 °C, hyperthermophiles



### Dr. Derek Lovley (UMass Amherst)

- Physiology and Ecology of Anaerobic Microorganisms.
- Microbial Fuel Cells
- Directed and Natural Evolution of Anaerobic Respiration
- Anaerobic Biofilms
- Extracellular Electron Transfer Mechanisms



### Dr. Robert Kelly (NCSU)

- Biochemical engineering
- Biocatalysis at extremely high temperatures
- Microbial physiology
- Enzyme engineering

Thank you



**Srini Mirmira, ARPA-E Program Director for  
Commercialization**

**[Srinivas.mirmira@hq.doe.gov](mailto:Srinivas.mirmira@hq.doe.gov)**



# NR

Revolutionary Research . . . Relevant Results

## Sharpening the Edge

Serving the Next Generation Warfighter ... Now



**Navy Energy Forum**  
**RADM Nevin P. Carr, Jr.**  
**Chief of Naval Research**

*Presented by*

**Dr. John Pazik, Director**  
**Ship System & Engineering Research Division**  
**Office of Naval Research**

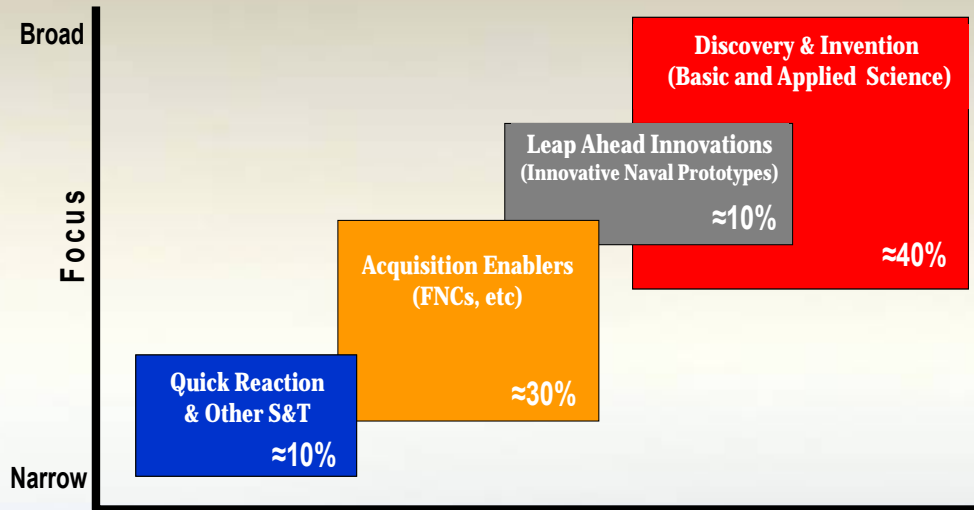
O F F I C E O F N A V A L R E S E A R C H

# Naval S&T Strategic Plan



## Focus Areas

- Power and Energy
- Operational Environments
- Maritime Domain Awareness
- Asymmetric & Irregular Warfare
- Information Superiority and Communication
- Power Projection
- Assure Access and Hold at Risk
- Distributed Operations
- Naval Warfighter Performance
- Survivability and Self-Defense
- Platform Mobility
- Fleet/Force Sustainment
- Total Ownership Cost



**Solid State Lights for Submarines**



**Advanced Materials**



**EMRG**



**D&I**

# Power & Energy Technologies

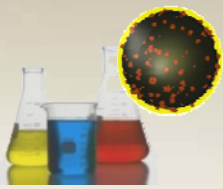
## Fuel

## Power Generation


## Energy Storage

## Distribution & Control

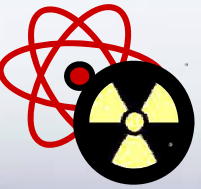
## Power Loads




**Fuels Chemistry**




**Alternative Fuels**




**Nuclear**




**"Ion Tiger"  
UAV Fuel Cell**




**Fuel Cells**



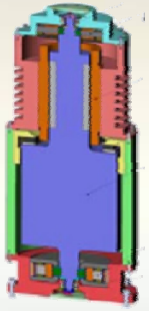
**Aircraft Engines**




**Gas Turbine Generators**



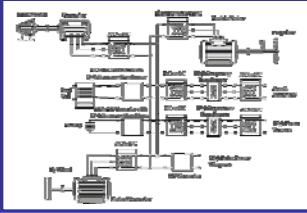
**Batteries**



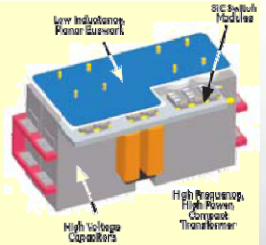
**Flywheels**




**Capacitors**




**Electrical Architectures  
& Pulse Forming  
Networks**



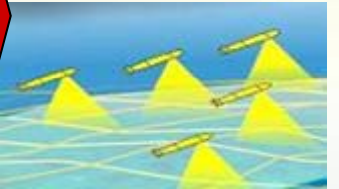
**High Voltage Silicon  
Carbide (SiC)  
Switches**




**Electric  
Weapons**



**Powering & Resistance**



**UV Sensor Loads**



**Reconfigurable Blades /  
Blade Loading**

# S&T Energy Investments

**Power Loads**



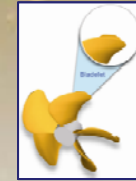
**Solid State Lighting**



**Advanced Sensors**



**Coatings & Cleaning**



**Advanced Propellers**



**Electric Weapons**

**Distribution and Control**



**SiC Devices**

**Bi Directional Power Converters**

**Power Management Controllers**

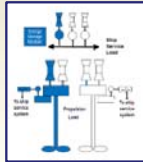


**Medium Voltage Direct Current Architecture**

**HTS Power Transmission Cables**



**Energy Storage**

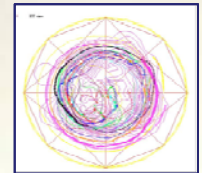


**Hybrid Electric Drive**



**High Density Energy Storage Advanced Batteries**

**Antimatter/ Particle Storage**



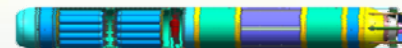
**Power Generation**



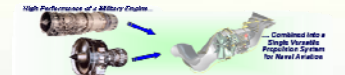
**UAV Fuel Cells**



**Mobile Power Fuel Cells**



**UUV Power**



**Variable Cycle Advanced Technology (VCAT)**

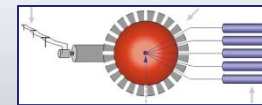
**Fuel**



**50-50**



**100**



**Laser Fusion**

**Near**

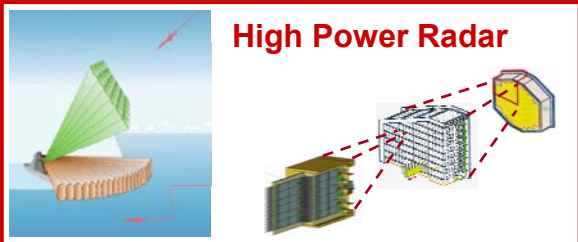
**Far**

# Advanced Electric Warship Next Generation Integrated Power System (NGIPS)

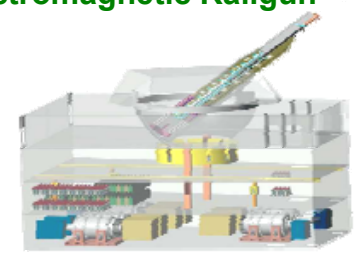
**Laser  
Self-Defense  
System**



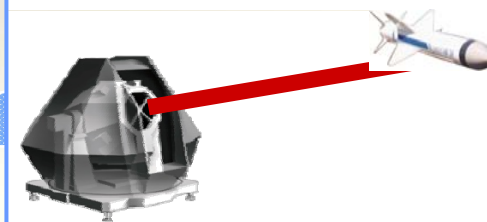
**High Power Radar**



**Electromagnetic Railgun**



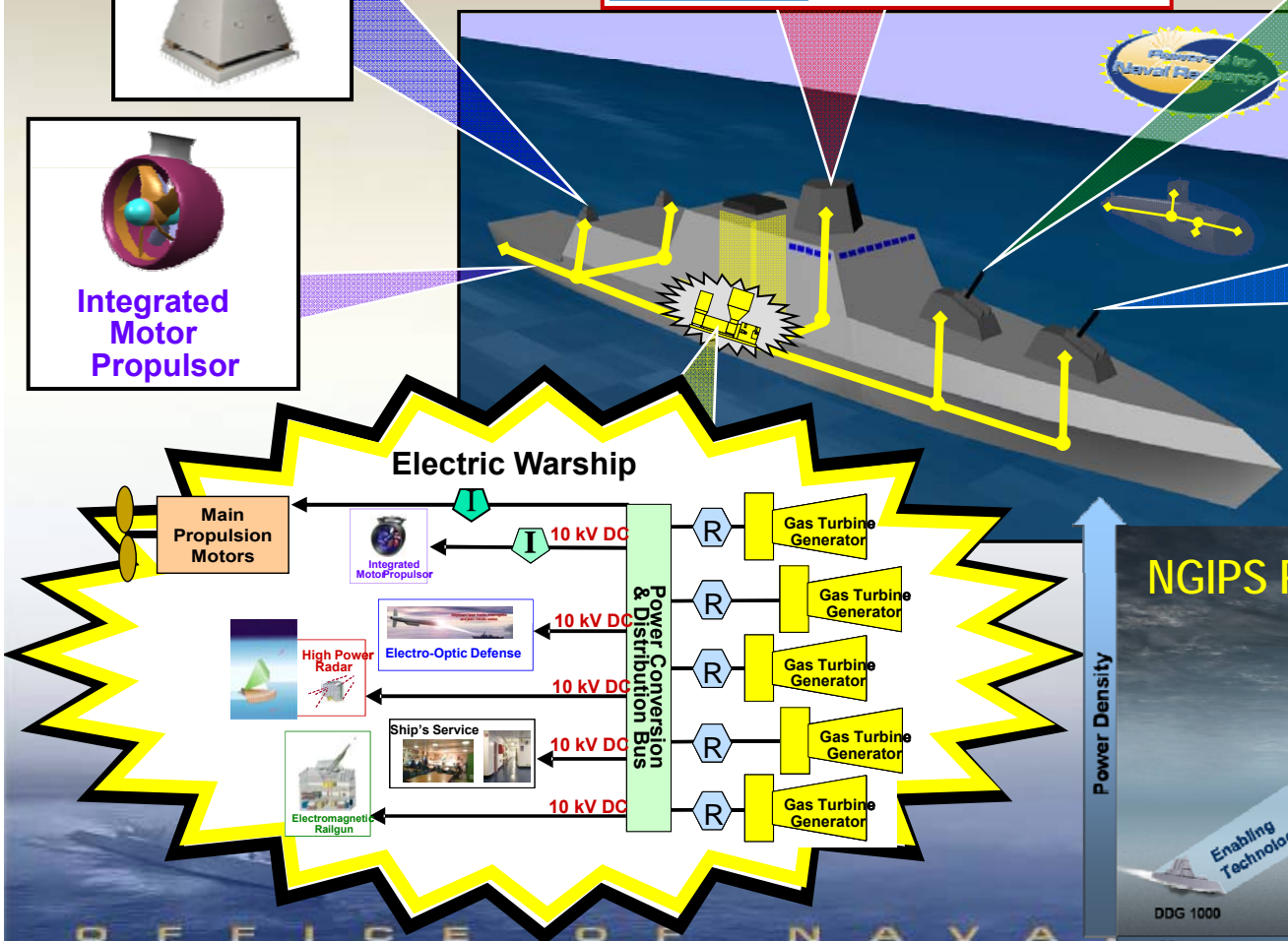
**Free Electron Laser System**



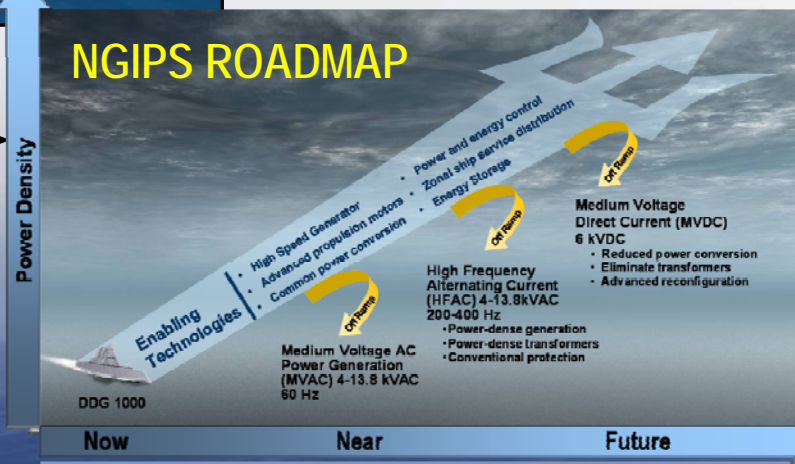
**Integrated  
Motor  
Propulsor**



**Electric Warship**



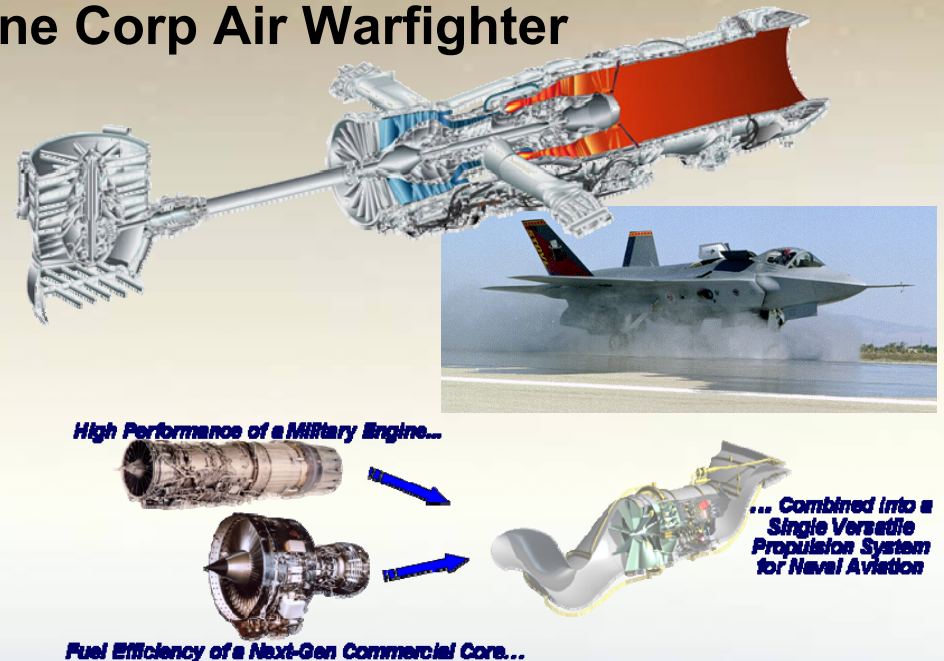
## NGIPS ROADMAP



# Advanced Aerospace Propulsion Science and Technology

Develop and transition advanced airbreathing propulsion technology to the Navy and Marine Corp Air Warfighter

- Engine materials, coatings and processing techniques
- Critical propulsion system component technologies
- Modeling and Simulation
- Propulsion Health Management



## Payoffs:

Reduced fuel consumption

Lower life cycle costs

Higher performance and increased durability

Improved environmental compliance

# Additional Slides

# Expeditionary Portable Power

## Solid Oxide Fuel Cell for Tactical Vehicle APU and Towable Generator

Efficient, low emission, and low signature



Solid Oxide Fuel Cell

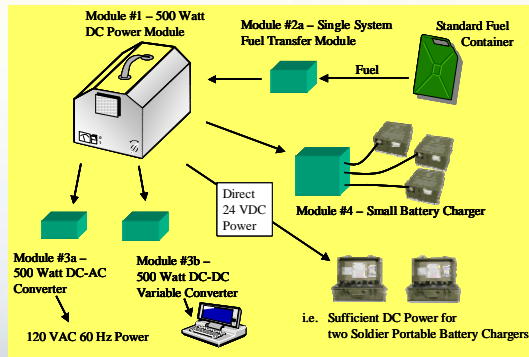


Vehicle Based

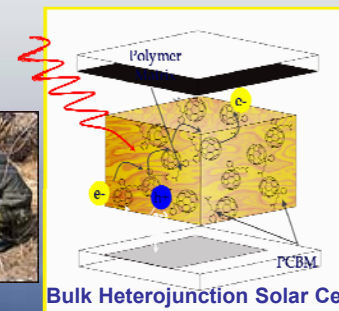


Towable Power

## Man-Portable Power Generation



### GREENS – Ground Renewable Expeditionary Energy System



Bulk Heterojunction Solar Cell

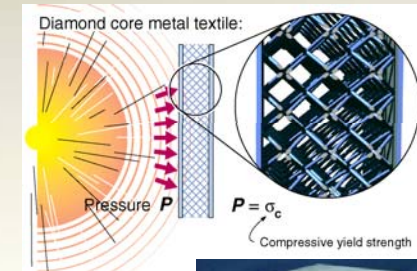
- **Anti-Biofouling Coatings & Hull Husbandry**
- **Lightweight Structural Materials**
- **HTS Degaussing Cable**
- **Turbine Engine Materials Systems**
- **Corrosion Prevention and Mitigation**
- **Advanced Shipboard Water Desalination**
- **Nano-Ceramic Coatings for Life-of-System Wear Surfaces**



Hull Bug



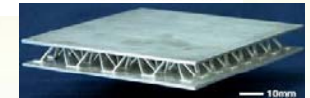
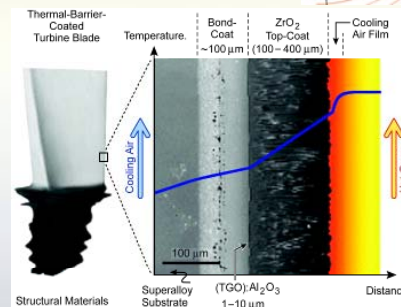
HTS Degaussing Cable



➤ **Corrosion Prevention and Mitigation**

➤ **Advanced Shipboard Water Desalination**

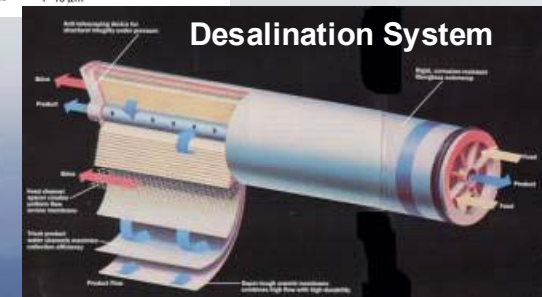
➤ **Nano-Ceramic Coatings for Life-of-System Wear Surfaces**



Al-alloy formed pyramidal core

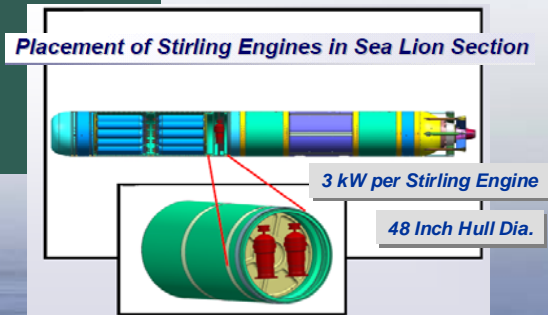
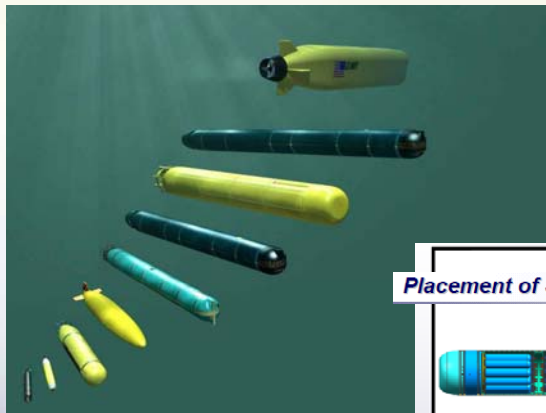


No wear after 4 yrs in in-service



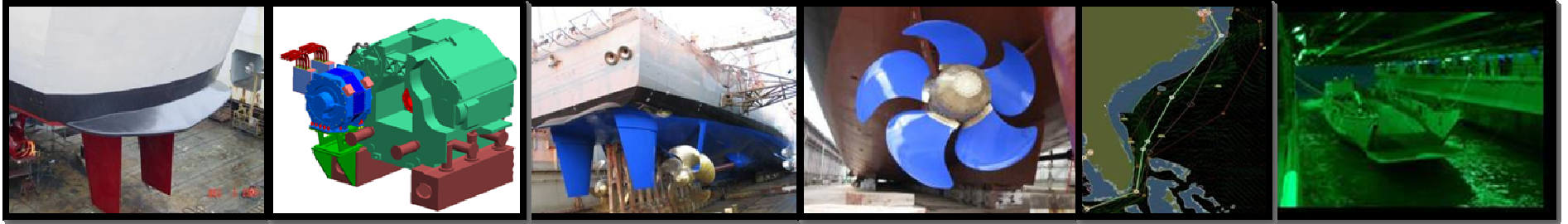
## Unmanned Air Vehicle Power

- Long endurance fuel cell power (26hr flight Nov 2009)
- Low noise & heat signature
- Affordable



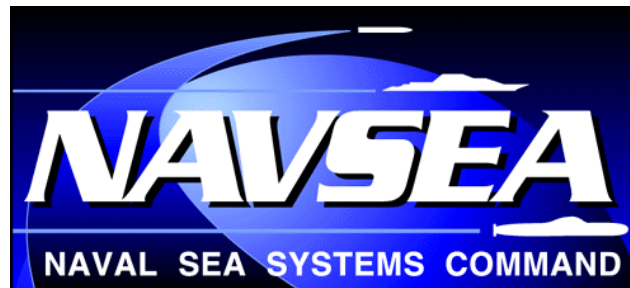
## Unmanned Undersea Vehicle Power

- Lithium-ion battery safety
- Long endurance , air independent power systems



# *Building a Foundation for the Green Fleet*

**Rear Admiral Tom Eccles  
Chief Engineer  
Naval Sea Systems Command**



***12 October 2010***

# Ship Energy Initiatives – the Quick Wins



Name / Description (Cost Avoidance includes fuel and maintenance)	Cost Avoidance (CA)			Status/Notes
	Pay Back Period		10yr ROI	
<b>Online Gas Turbine Waterwash for GTM and GTG (Ships)</b> ~ 800 bbls / \$136K Per ship per year	< 1yr	DDG51 & CG47	7:1 ROI	Installed on USS PREBLE in Oct 08. Interim Report issued July 2010 on GTG results, which indicated ~ 0.3% fuel savings. GTM report will be issued 4 <sup>th</sup> qtr FY-11, due to ships ops.
<b>Advanced Underwater Hull Coating System</b> ~ 1880 bbls / \$320K Per ship per year	1yr	DDG51 & CG47	4:1 ROI	Applied to USS PORT ROYAL – data collection started 09-Oct. This data will be compared to control ship USS BUNKER HILL Applied to USS COLE – data collection started 09-Oct, in-process results favorable but waiting for full year of data to compare results to control ship USS GONZALEZ. Final Report due 11-Sept
<b>Stern Flaps (LHD, LSD Ship Classes)</b> ~ 5500 bbls / \$935K Per LHD per year ~ 2083 bbls / \$354K Per LSD per year	< 1yr < 2yrs	LHD LSD	6:1 ROI 3:1 ROI	LHD- Installed on USS KEARSARGE Nov 09 availability— Ship trial planned 11-June LSD- Installed on USS WHIDBEY ISLAND Nov 09 availability – Ship trial schedule is being identified by 2 <sup>nd</sup> Fleet and Ship.
<b>Combustion Trim Loop</b> ~ 3060 bbls / \$520K Per ship per year	< 1yr	LHD & LHA	30:1 ROI	Installed in USS PELELIU—testing completed and report issued 10-Aug addressing fuel savings. Data indicates a 2% fuel savings as estimated.
<b>Propeller Coating</b> ~ 1860 bbls / \$316K Per ship per year	< 1yr	LHA, LHD & LSD	17:1 ROI	Applied to USS GUNSTON HALL – data collection started 09-Apr; awaiting data from USS ASHLAND, control ship, to determine the increase in propulsion efficiency, scheduled for 10-Nov. Final Report due 11-Mar
<b>SSL Lighting Systems (Amphibs)</b> ~ 500 bbls/\$1.6M Per ship per year	2 yrs	LSD	3:1 ROI	Procurement for Well Deck and Passageway and Berthing Light fixtures underway with delivery Nov 2010. Lights installed on USS IWO JIMA for well deck catwalk. Testing is satisfactory. Demo on LSD 52 scheduled 4 <sup>th</sup> Qtr FY11
<b>SSL Lighting Systems (CruDes)</b> ~335 bbls/\$1.6M Per ship per year	2 yrs	DDG	3:1 ROI	Installed in USS WAYNE E MEYER data collection underway.
<b>Directional Stability (L-Ships)</b> ~ 4500 bbls/\$900K Per ship per yr	< 1yr	LSD	7:1 ROI	Model testing completed. Drawings and FEA completed and have been submitted to NNSY for approval. Still preparing for installation early FY 11 on planned test ship USS BONHOMME RICHARD.
<b>Smart Voyage Planner</b> ~2-4% fleetwide	< 1yr	All Ships	45:1 ROI	Working with MSC and METOC. Installing at METOC watch station.
<b>High Efficiency Chiller (R-134a)</b> ~ 600 bbls/ship yr	New Construction Only			Continuation of ARRA start - fabrication and demonstration of production capability of military spec high efficiency small capacity chiller
<b>Hybrid Electric Drive</b> ~ 8000 bbls/ship yr	5-10yrs	DDG51 Class	1.5:1 ROI	Motor in final assembly. Converter under unit testing. SCD initiated for USS TRUXTON. Land based testing in mid-2011. At-sea demo in 2012.

# DDG 51 Hybrid Electric Drive Proof of Concept

- ✓ Design Complete – December 2009
- ✓ Released for Manufacture – March 2010
- ✓ Motor Testing – August 2010
- ❑ Converter Testing – October 2010
- ❑ Motor-Converter Testing – November 2010
- ❑ System Factory Testing – March 2011
- ❑ Navy Hot Plant Integration Testing – June 2011
- ❑ USS TRUXTUN Installation – January 2012



***Risk Reduction for BackFit Production for the Great Green Fleet***

# Alternate Fuel Testing





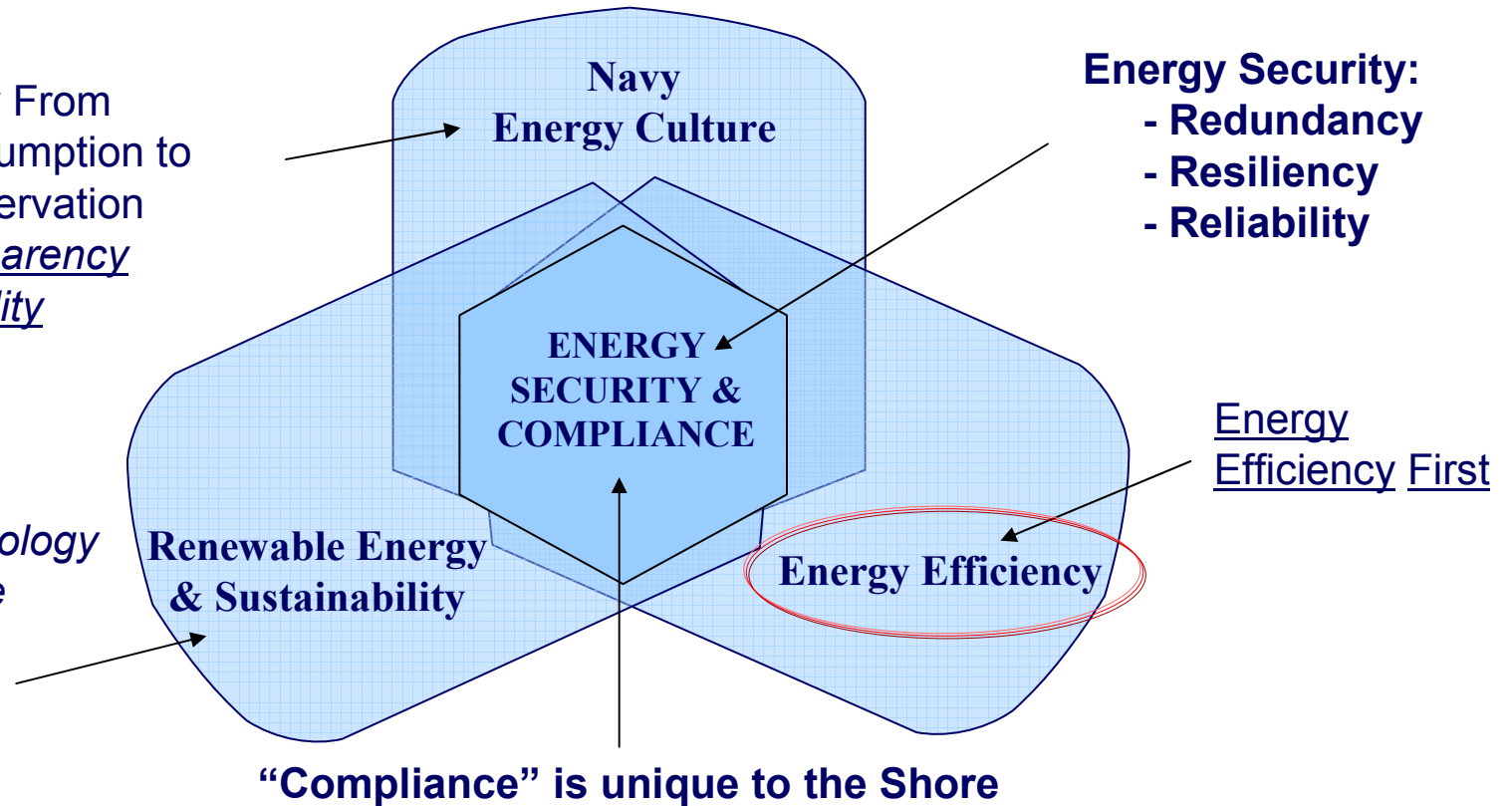


# Navy Shore Energy Program

Transform Navy From  
Culture of Consumption to  
Culture of Conservation  
Through Transparency  
and Accountability

The *Right Technology*  
at the *Right Time*

- Watch
- Partner
- Lead





# *Building A Foundation For The Green Fleet: Sustainable/Renewable Fuels*



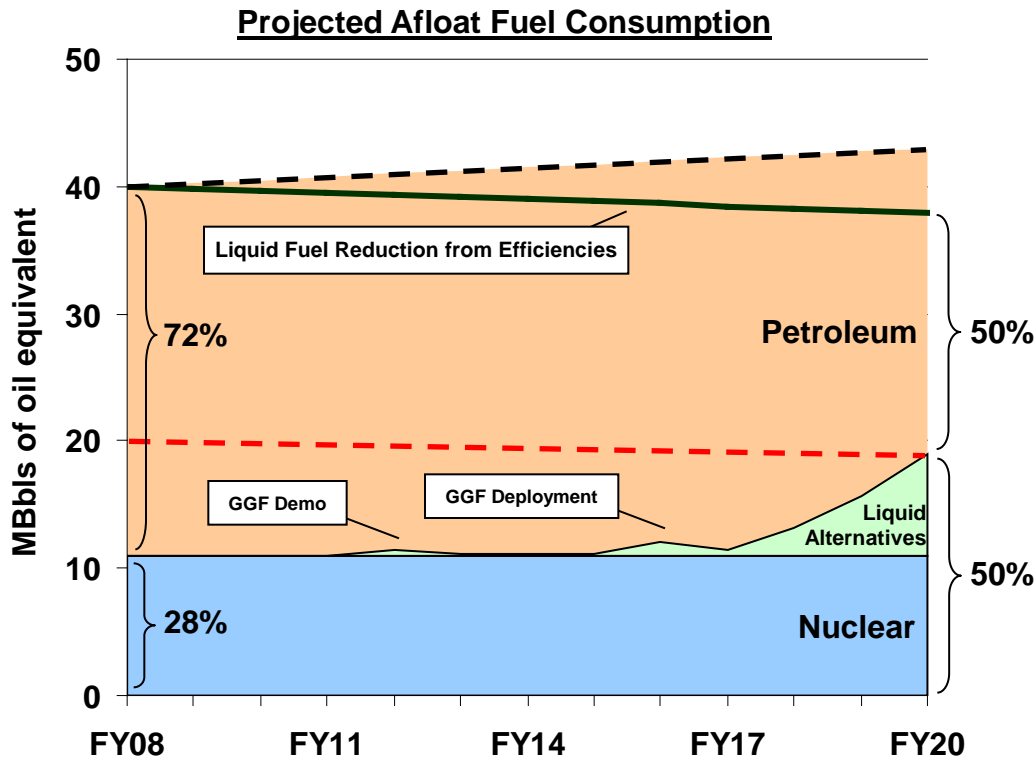
12 October 2010

Prepared For: **Navy Energy Forum**

Presented By: **RDML Randy Mahr**  
**Naval Air Systems Command**

# 50% Alternative Fuel Afloat

- Reduce liquid fuel consumption through conservation and efficiency
- Increase use of alternative fuels (with liquid fuel from renewable sources)



## Navy gets to 50% alternatives in 2020 by:

- Reducing the requirement for liquid fuel from projected 32M bbl to 27M bbl
- Replacing 8M bbl of petroleum-based fuel with liquid alternative fuel

## Biofuel requirement:

- 2012 Demo – 8K Bbls
- 2016 Sail – 80K Bbls

# Alternative Fuels Strategy

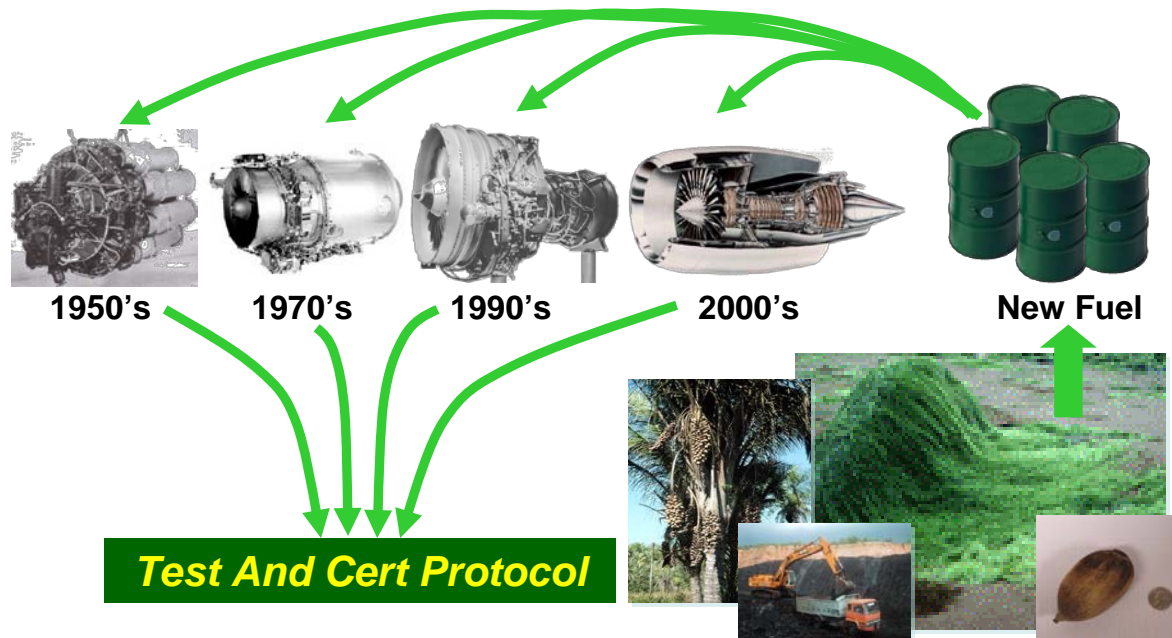
## Primary Assumption:

Alternative fuel must be a **drop-in replacement, invisible to the operator**

- ✓ Meets fuel performance requirements
- ✓ Can be mixed or alternated with petroleum fuel
- ✓ Requires NO change to aircraft or ship
- ✓ Requires NO change to infrastructure

## Challenge:

Existing Engines

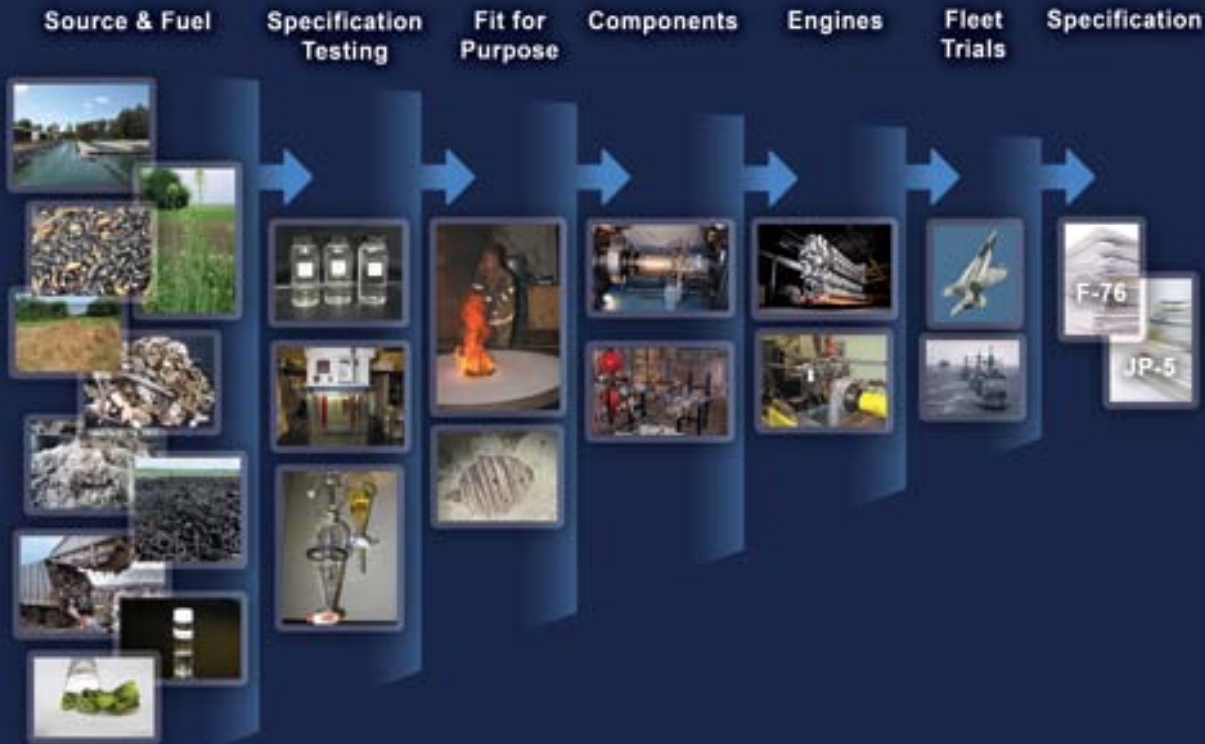


Engineer the fuel, not the platform



# FROM FIELD TO FLEET

Certifying Drop-In Replacements



## Phase 1:

- Chemical And Physical Property Similarity
  - Specification
  - Fit For Purpose

## Phase 2:

- Performance Similarity
  - Materials
  - Components
  - Propulsion/Fuel Systems
  - Distribution Systems

## Phase 3:

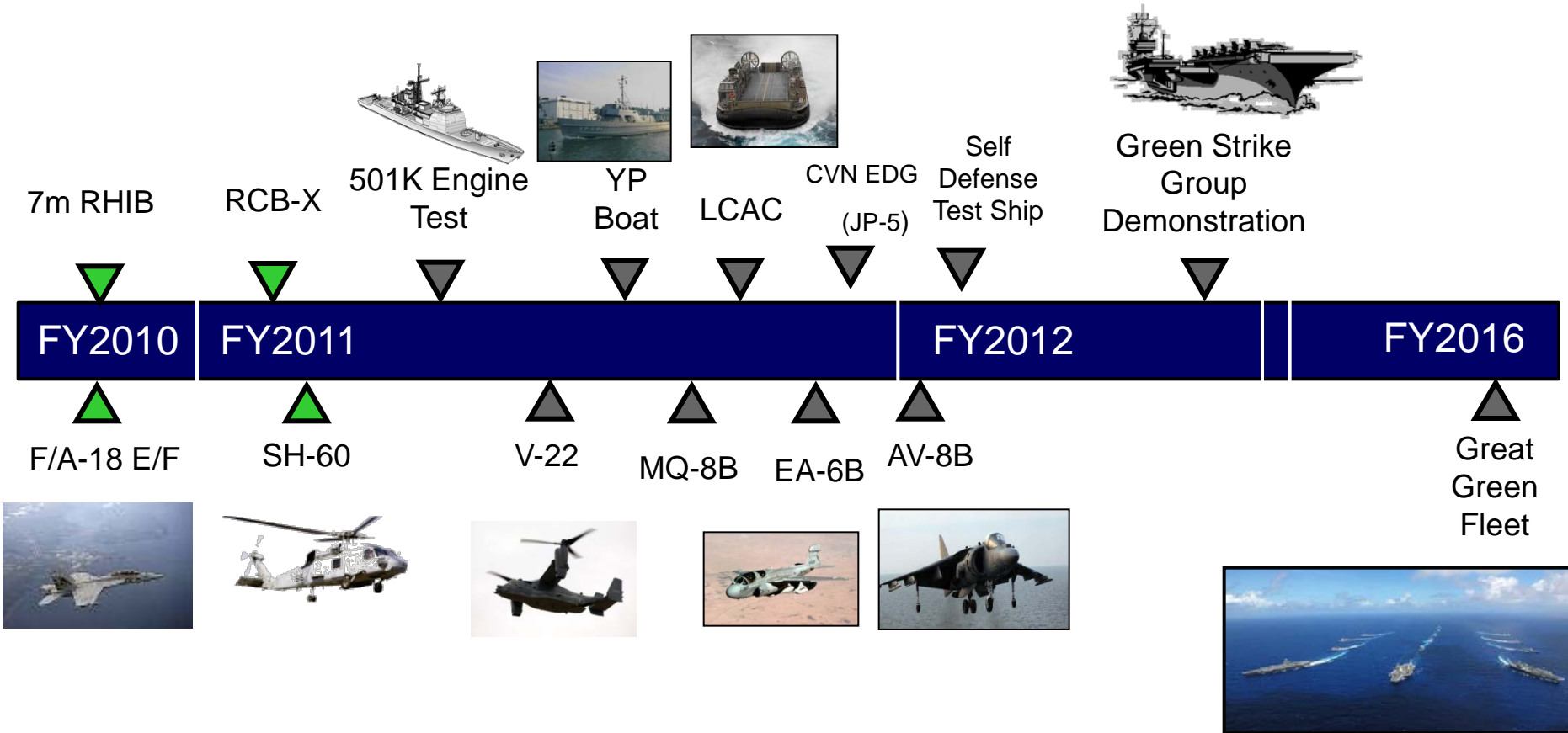
- Operational Similarity
  - Weapon System Trials

## Phase 4:

- Long Term Operability
  - Field Trials

# 50/50 Renewable Fuel Testing

## Ship Progress



## Aviation Progress

# Strategic Partnerships

- Continue to leverage the knowledge and resources of many partners
  - Inter-service
  - Interagency
  - State/Local
  - Industry
  - Academic
  - International



Strong Collaboration is Essential to Meeting the Navy's Energy Goals

# Honeywell's UOP

## Renewable Fuels from Sustainable Sources: Beyond Potential to Production

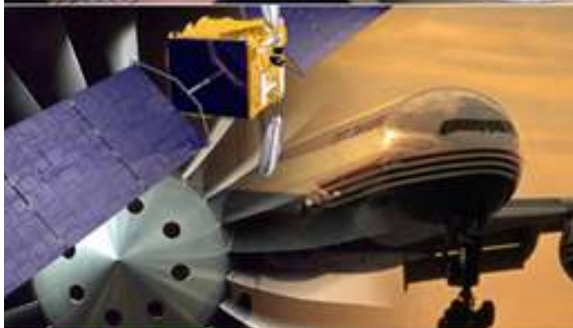
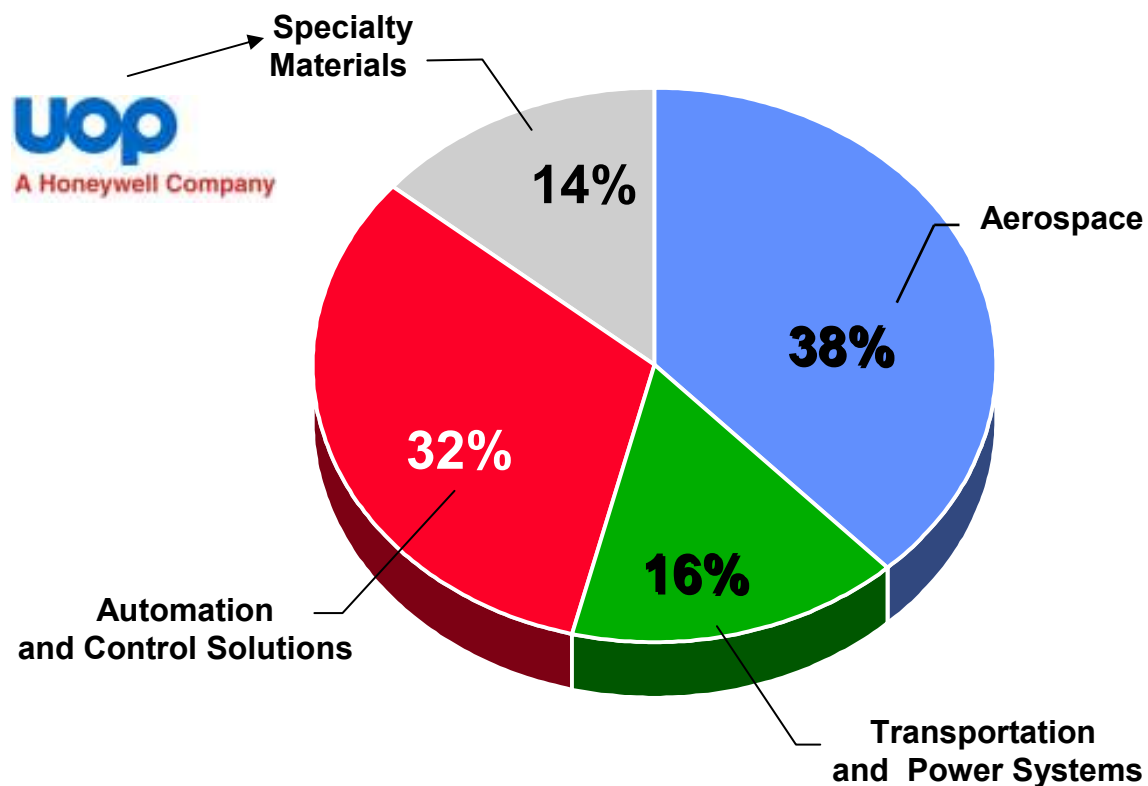


Jim Rekoske, Vice President & General Manager  
UOP Honeywell

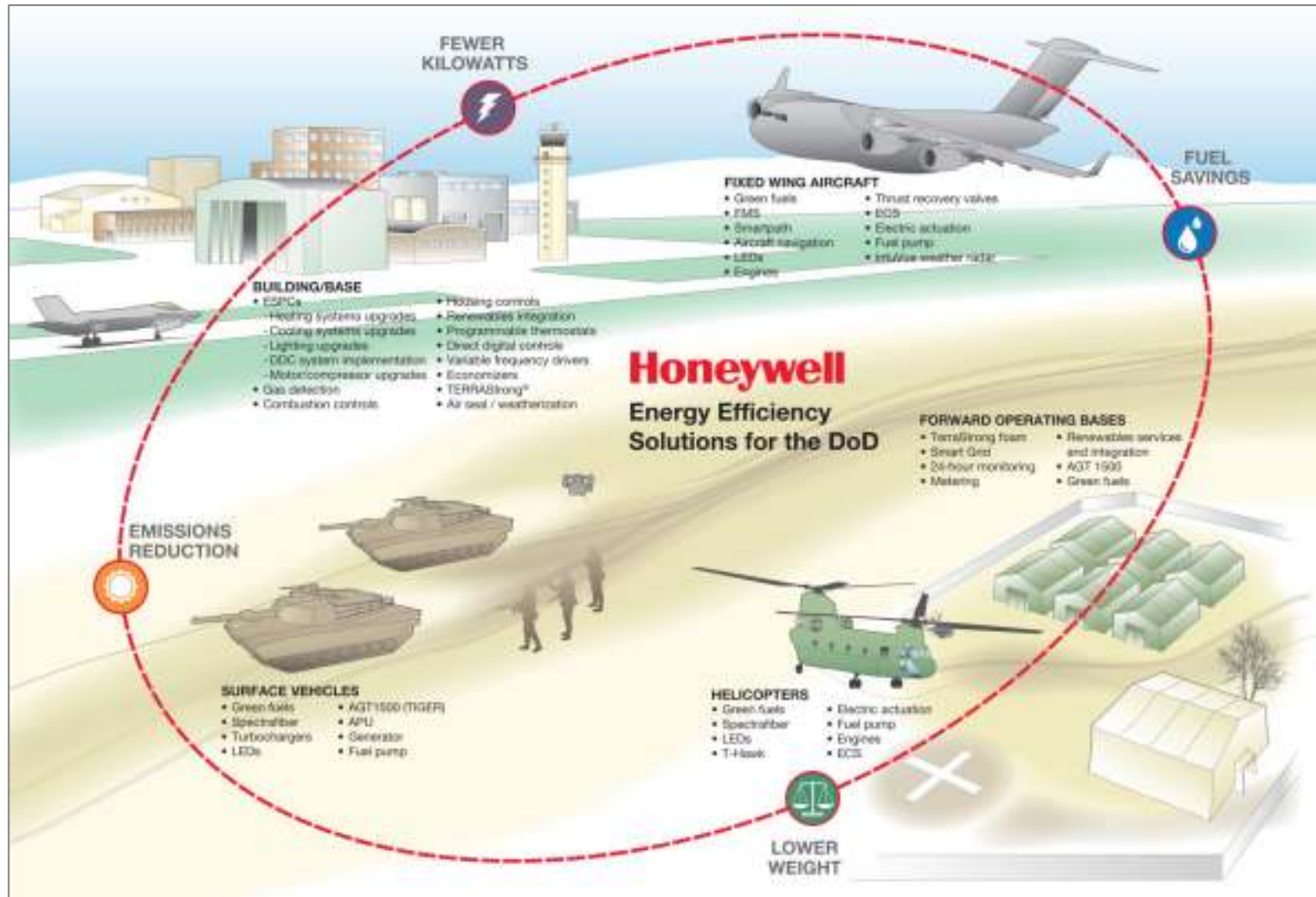


# Honeywell Overview

***\$33 B Broad and Diverse Businesses,  
Technologies and Products***



## DoD Energy Efficiency – Touching Every DoD Mission



## Green Fuels for Energy Security

### GREEN FUELS

#### Honeywell Solutions

- Green Fuels – diesel, jet, bunker fuel



Green Diesel in tanks and ground vehicles



Green Diesel in Ships



Green Jet in all DOD aircraft



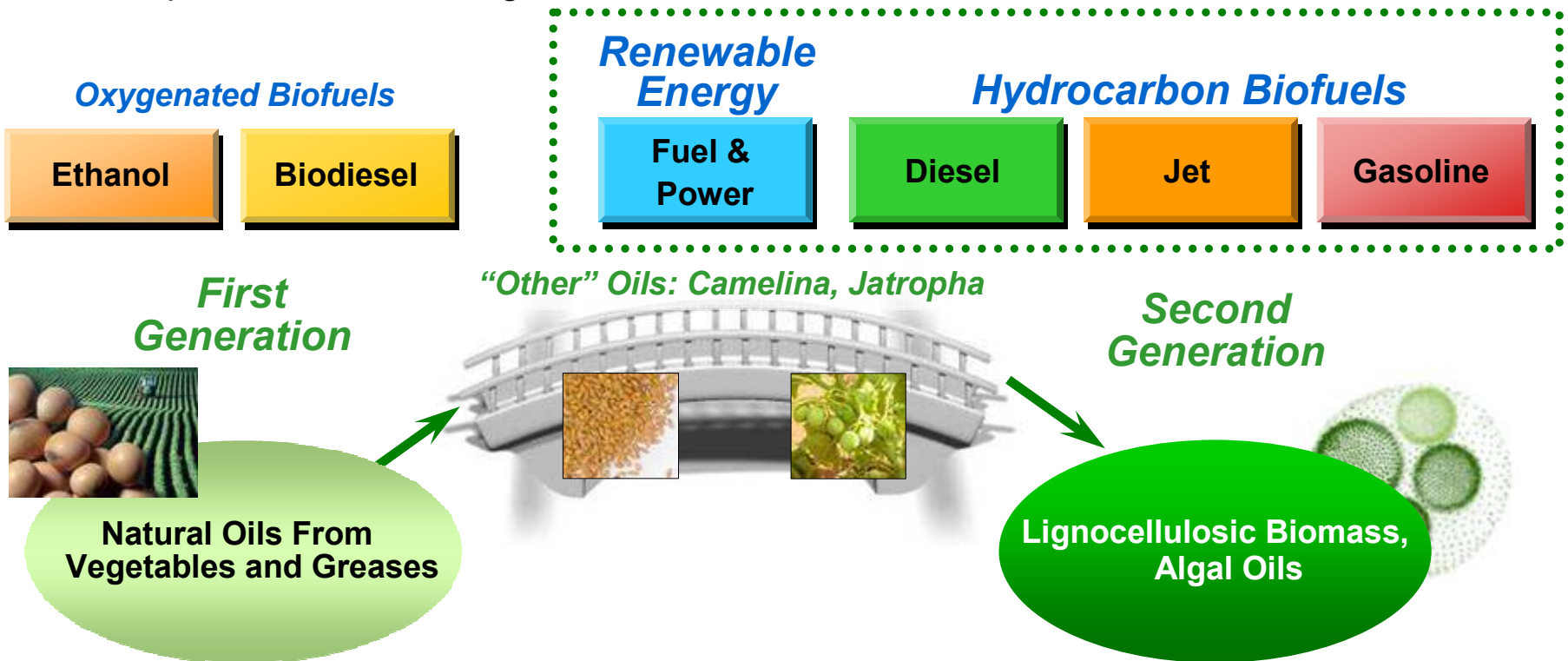
Pyrolysis Oil for installation and Forward Operating Base Power – DOE grant

#### Energy Efficiency Savings

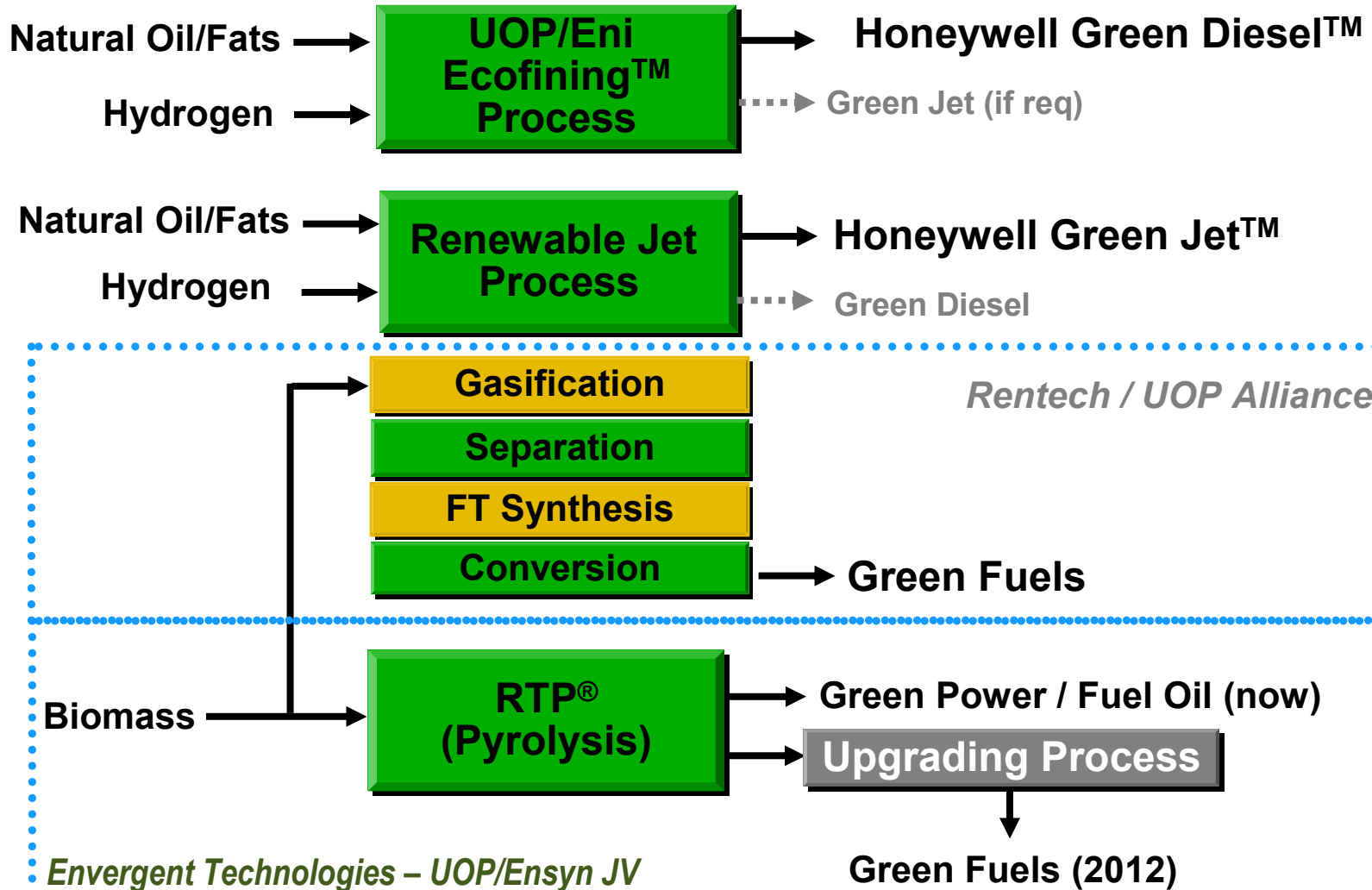
- Green fuels certification and use across land, sea, air installations and platforms
- Fuel (Gallons) – Impact 3 billion gallons per year DOD fuel use
- Emissions – ~6M MT CO2 annual savings with 25% Green Jet and Diesel in fuel stocks
- Assures domestic fuel supplies
- Lowered GHG
- Enhanced DOD Energy Security Requires government scale up for high rate production

# Honeywell Renewable Fuels Vision

- Building on 96 years of petrochemical industry technology and expertise
- Produce real “drop-in” fuels instead of fuel additives/blends
- Leverage existing refining, transportation, energy, biomass handling infrastructure to lower capital costs, minimize value chain disruptions, and reduce investment risk
- Focus on path toward second generation feed stocks and chemicals



## UOP Renewable Fuels Technologies



**Sustainable Technologies – Feedstock Flexible / 2<sup>nd</sup> Generation**

## Completed Flight Demonstrations



AIR NEW ZEALAND



Feedstock:  
Jatropha oil



- Successful ANZ Flight Demo Date: Dec. 30, 2008



Feedstock:  
Jatropha and algal oil



- Successful CAL Flight Demo Date: Jan. 7, 2009



Feedstock: Camelina,  
Jatropha and algal oil



- Successful JAL Test Flight: January 30, 2009



- KLM European Test Flight: November 23, 2009



# Recent Service Bio Jet Fuel Demos



USAF A-10C Bio Jet Test  
25 March 2010  
Eglin AFB

Navy Green Hornet Bio  
Jet Test  
22 April 2010  
Pax River NATC



Royal Netherlands Air Force  
16 June 2010  
Gilz Rijen Air Base Netherlands



## DoD Renewable Fuel Delivery Status

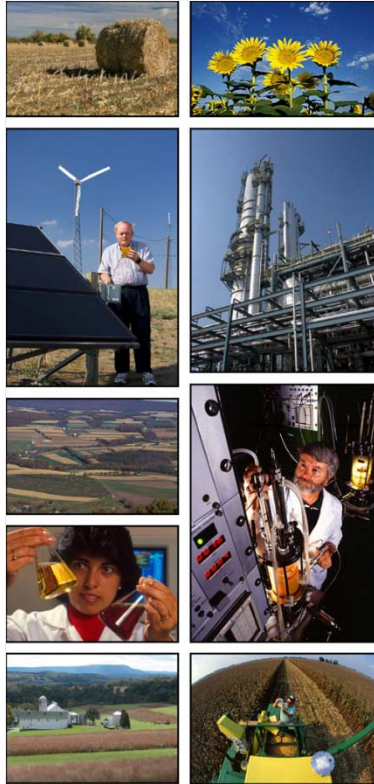
Customer	Fuel Type	Awardee	Producer	Quantity	Status
Navy	HRJ-5 (camelina)	Sustainable Oils	UOP	40,000	Produced
Air Force	HRJ-8 (tallow)	UOP	UOP	100,000	Produced
Air Force	HRJ-8 (camelina)	Sustainable Oils	UOP	100,000	Produced
Navy	HRJ-5 (algae)	Solazyme	UOP	1,500	Produced
Navy	HRF-76 (algae)	Solazyme	UOP – Pilot Plant	50	Produced
Navy	HRF-76 (algae)	Solazyme	UOP	20,000	Produced
Air Force	HRJ-8 (tallow)	UOP	UOP	100,000	TBD – DESC
Air Force	HRJ-8 (camelina)	Sustainable Oils	UOP	100,000	TBD-DESC
Navy	HRJ-5 (camelina)	Sustainable Oils	UOP	100,000	TBD-DESC
Army	HRJ-8	TBD	TBD	18,450	Produced

***Actual Production – Not Just Potential***

## Summary

- Honeywell's UOP has production-proven technologies for renewable fuels
  - Available for license today
  - Demo capacity in operation
- Our technologies are feedstock flexible
  - Camelina, tallow, triglycerides from algae, other oil seed crops
  - Actively developing full biomass conversion processes
- Our technologies deliver real, drop-in fuels
  - No compromises needed; chemically and physically indistinguishable from petroleum-derived fuels
  - No changes to delivery, consumption infrastructure

***Real Biofuels are part of the future...  
but they also part of the fuel mix today!***



# Enabling An Energy Transformation Through Drop-In Alternative Fuels

Navy Energy Forum  
October 12, 2010  
Washington, D.C.

Jeffrey J. Steiner, Ph.D.  
Office of National Programs  
USDA-Agricultural Research Service

# A Few Thoughts for Today's Panel

## Policy and Biofuels

### Limitations on Regional Production Systems

### Integrating Bioenergy into Existing Agricultural and Forestry Systems



# Growing America's Fuels Strategy



The next 21 billion gallons:

- 38.8 million acres
- *Represents 0.2-12% of total regional crop and pastureland production areas*
- 527 new advanced bio-refineries at a cost of \$168-billion

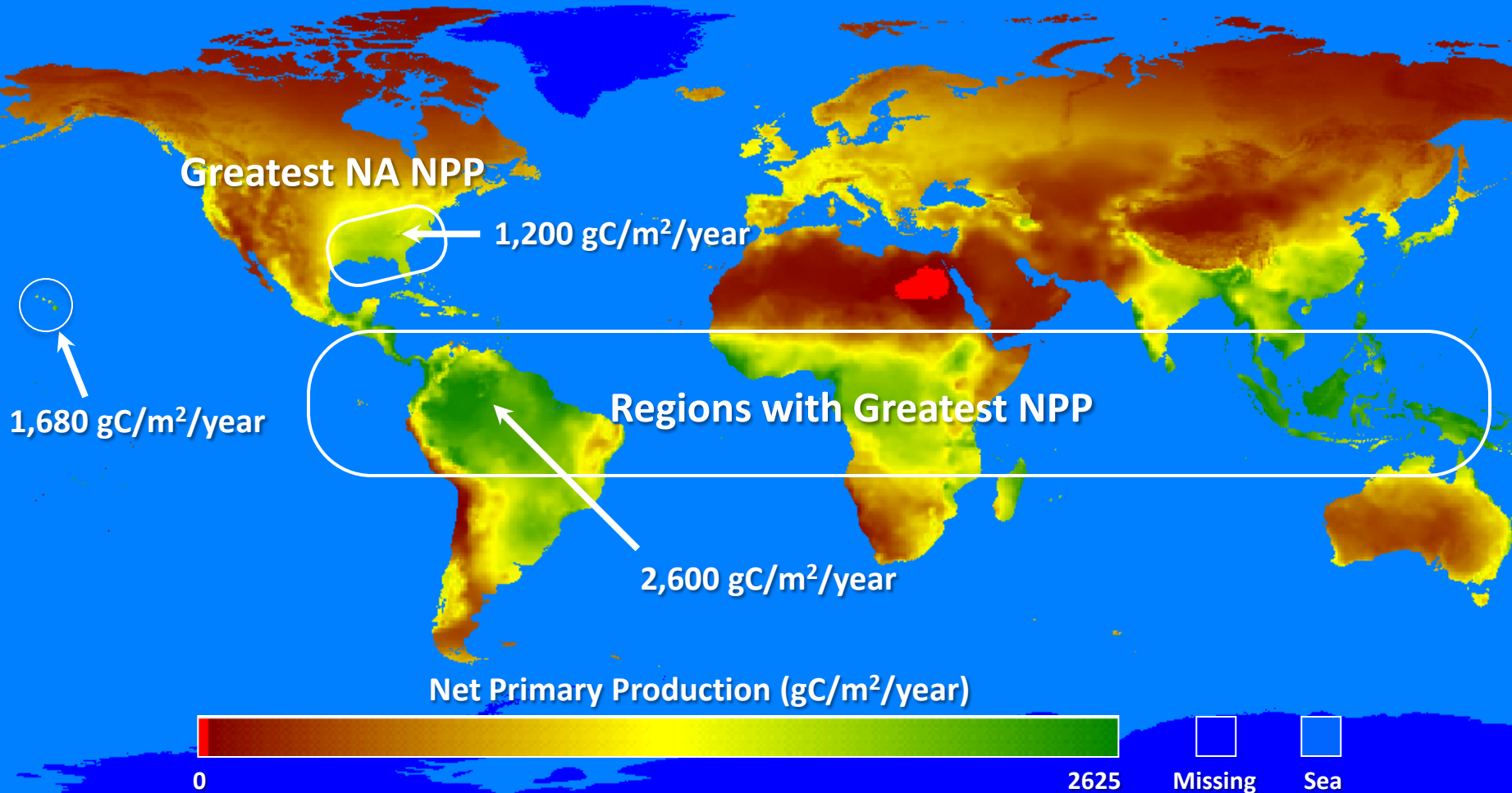
*Biofuels Strategic Production Report – A USDA Roadmap to Meeting the Biofuels Goals of the Renewable Fuels Standard by 2022, June 23, 2010*

# Much is Expected from Rural Lands

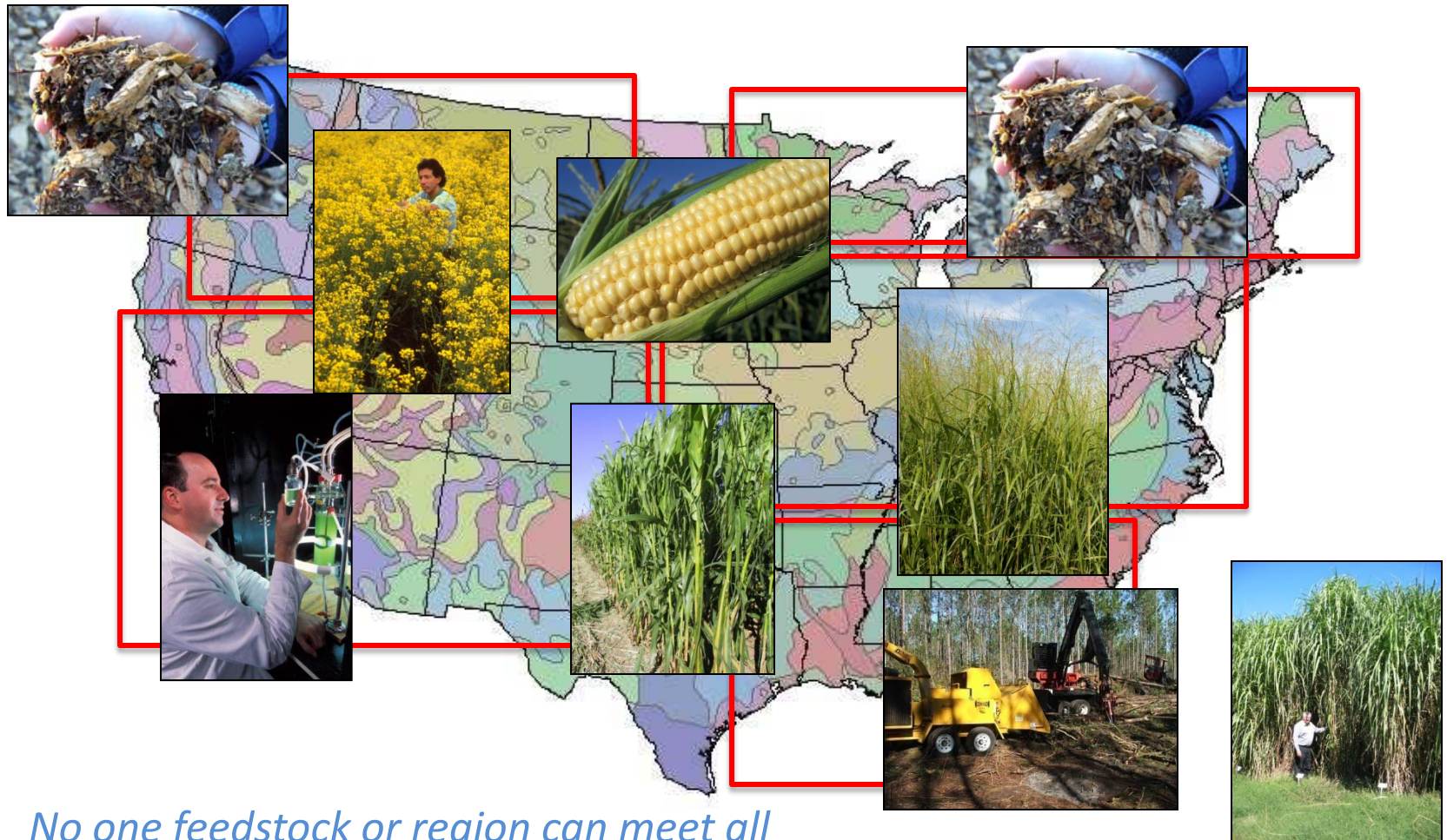
- Ecosystem services: water, air, wildlife habitat & C-sequestration
- Income derived from farms and forests that supports rural communities
- High quality, nutritious, and safe food products
- New bio-based consumer products, including bioenergy



# Natural Biophysical Limitations



# Regionally Adapted Bioenergy Feedstocks



*No one feedstock or region can meet all  
of the nation's needs*

## Not All Feedstocks Are Equal

Energy Crop	Ethanol yield	Drop-in fuel yield
	gallons/acre	gallons/acre
Energy cane	1900	950
Woody biomass	1040	520
Perennial grasses	480	240
Biomass sorghum	480	240
Corn grain starch	430	215
Oil seed crops	0	70
Algae oil	0	1,000-100,000*

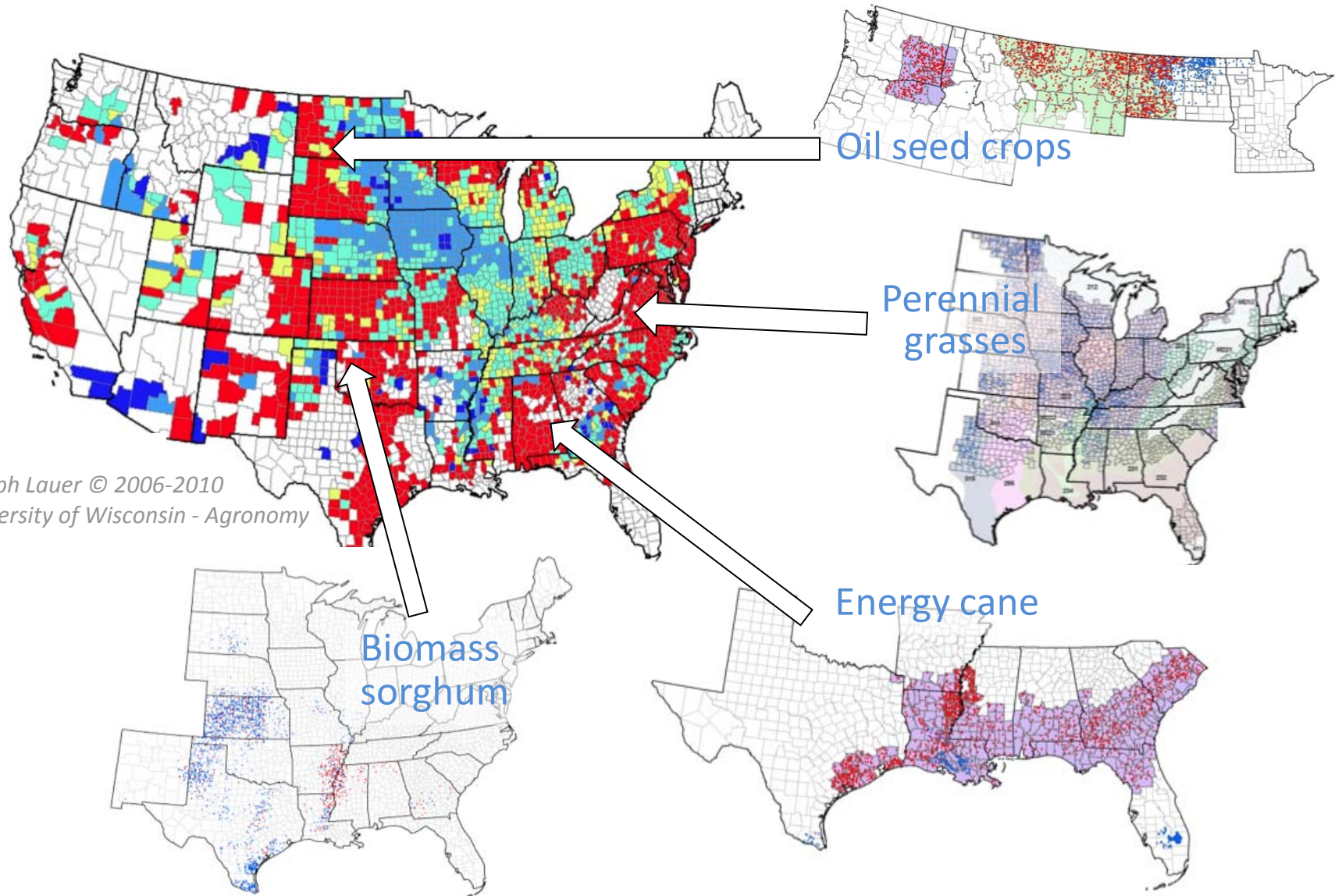
*\* Algae yields have not been demonstrated at scale*

# ARS Science for Sustainable Biofuels

## Integrating Bioenergy into Existing Agricultural-based Systems



# Integrating Different Feedstocks into Existing Systems



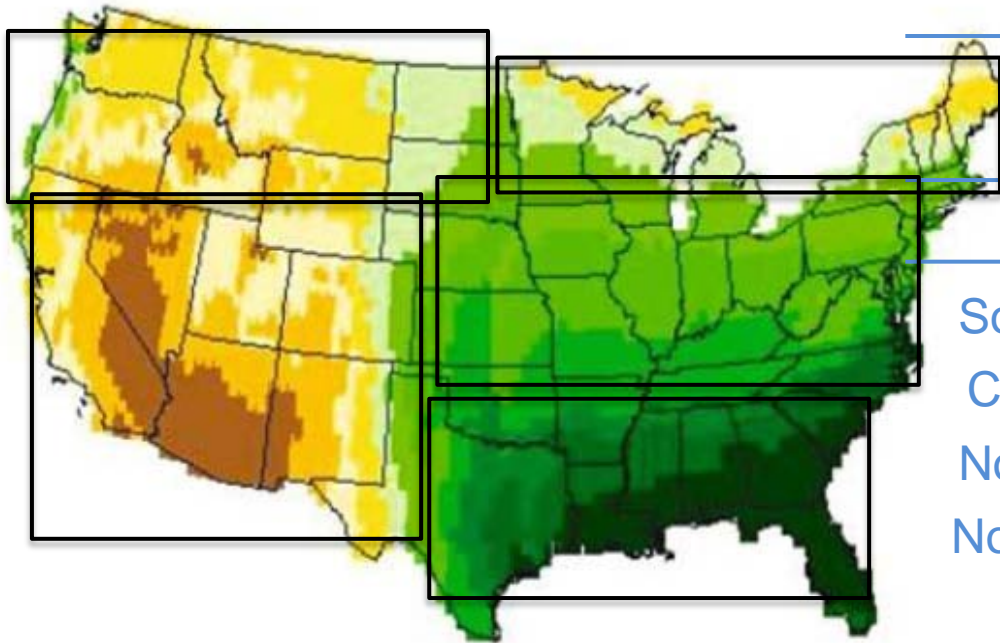
Joseph Lauer © 2006-2010  
University of Wisconsin - Agronomy

# Achieving the RFS2 Biofuels Mandate

Energy Crop	Annual biofuel production	Needed new area
	billion gallons	million acres
Dedicated biomass crops	13.4	21.2
Woody biomass	2.8	10.8
Oil seed	0.5	6.8
Crop residues	4.3	-
Corn grain starch	15.0	-
Total	36.0	38.8

*Represents 0.2-12% of total regional crop and pastureland production areas*

# Achieving the Next 21 Billion Gallons



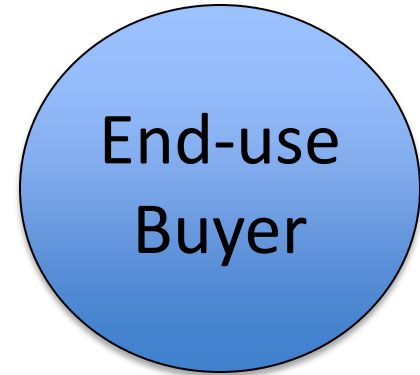
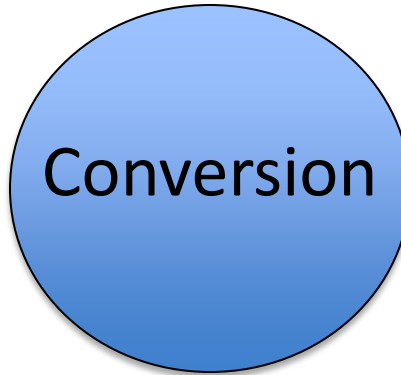
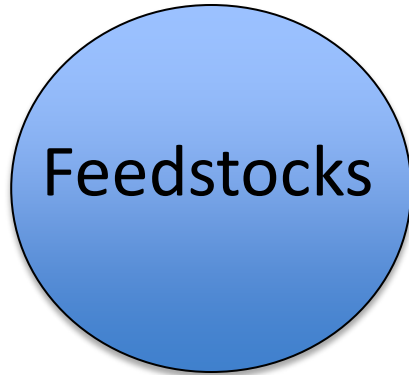
Region	Potential capacity Billion gallons	National contribution %
Southeastern	10.4	49.8
Central-East	9.1	43.3
Northwestern	1.0	4.6
Northern-East	0.4	2.0
Western	0.1	0.3

Net Primary Production (g Carbon/m<sup>2</sup>/yr)



# Growing America's Fuels Strategy

A complete supply chain systems approach



A whole-government effort to accelerate commercial development of advanced biofuels

*USDA & DOE  
research & grant  
programs*

*USDA  
conservation  
programs*

*USDA biomass &  
risk assistance  
programs*

*DoD & DOE  
research programs*

*USDA & DOE  
commercial  
programs*

*Fuel  
purchase  
guarantees*

# Enabling An Energy Transformation Through Drop-In Alternative Fuels

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*USDA Regional Biomass Research Centers*

*To accelerate the establishment of a commercial advanced biofuels industry*





# Boeing's Approach to Biofuels

## 2010 Navy Energy Forum

*12 October, 2010*

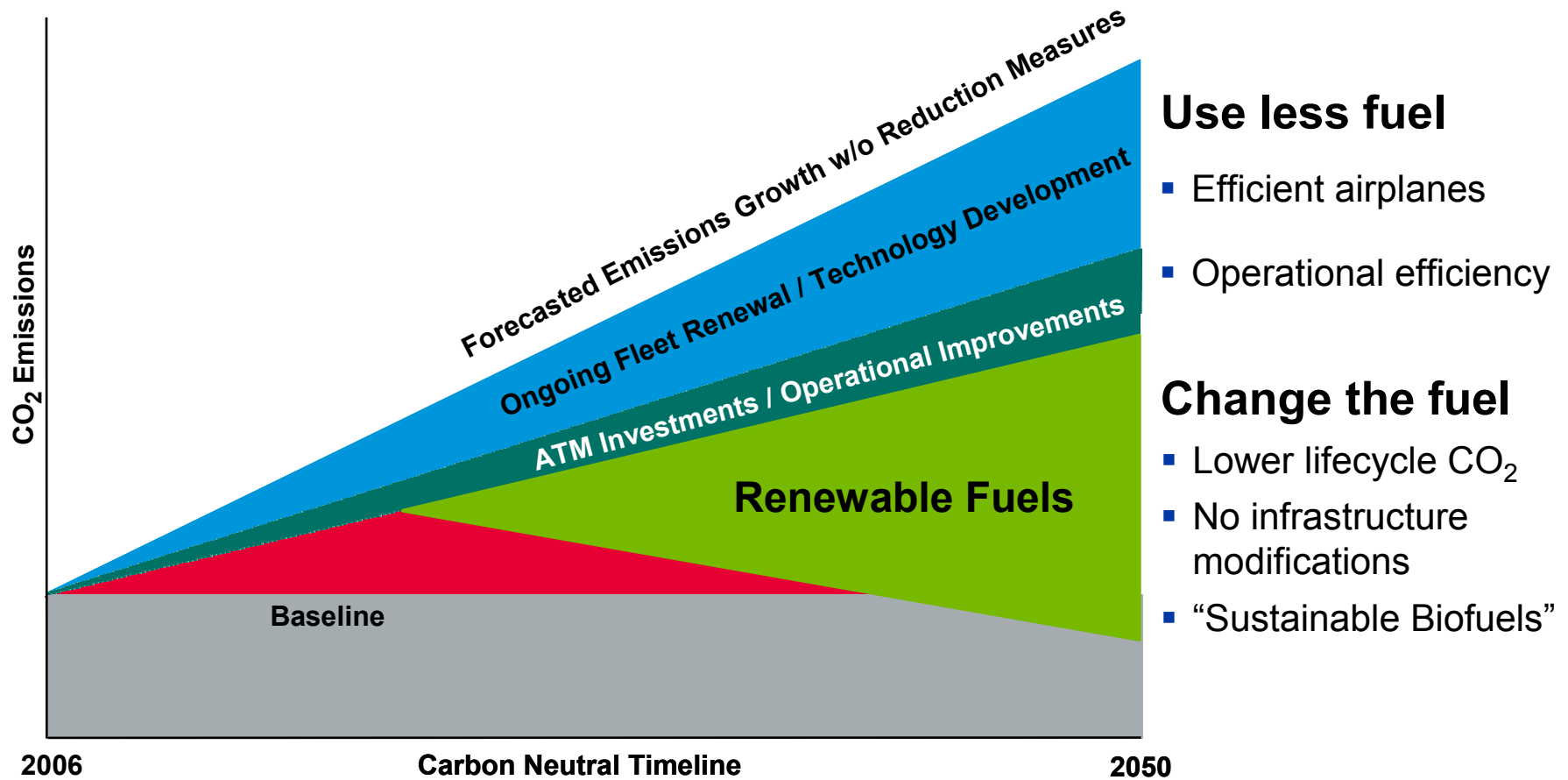
**Tim Vinopal**  
**Chief Engineer – Environment,**  
**Boeing Defense, Space & Security**

The statements contained herein are based on good faith assumptions and provided for general information purposes only. These statements do not constitute an offer, promise, warranty or guarantee of performance. Actual results may vary depending on certain events or conditions. This document should not be used or relied upon for any purpose other than that intended by Boeing.

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# The Commercial Aviation Challenge

## Carbon-Neutral Growth

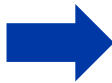


Presented to ICAO GIACC/3 February 2009 by Paul Steele on behalf of ACI, CANSO, IATA and ICCAIA

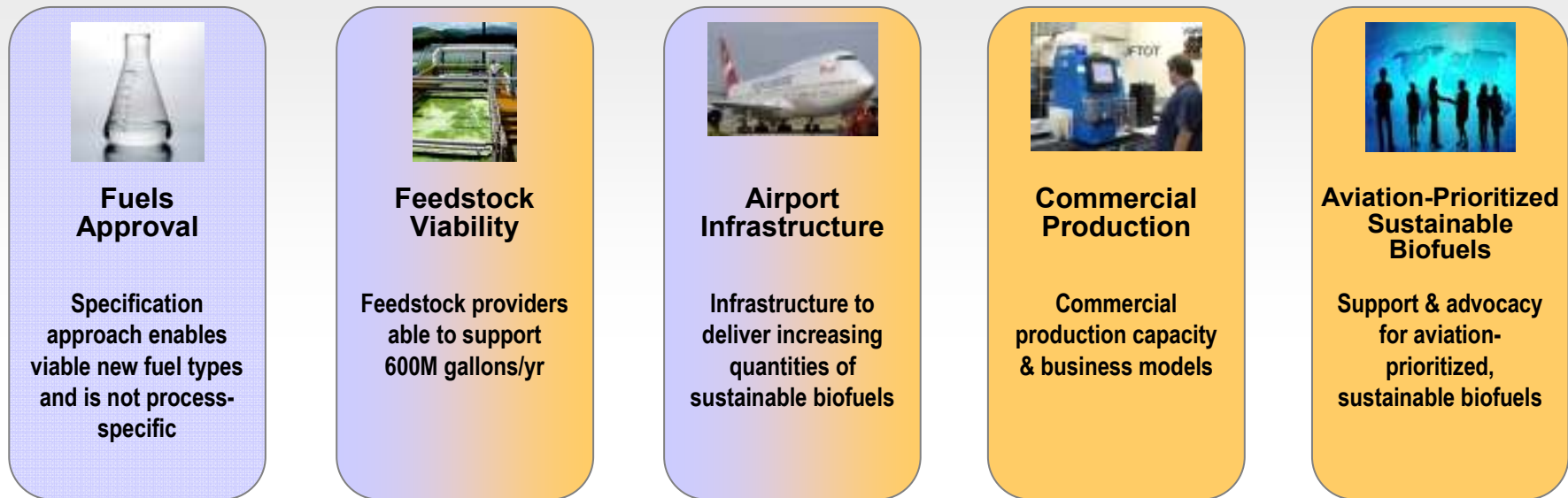
## *Sustainable Biofuels Enable Continued Growth*

# Boeing pursuing sustainable biofuel strategy

## *Enable the industry to achieve market viability – by 2015*

- Success Criteria 
- 600+ million gallons/yr of bio content
  - 5-10 feedstock/fuel production projects

### Five Focus Areas



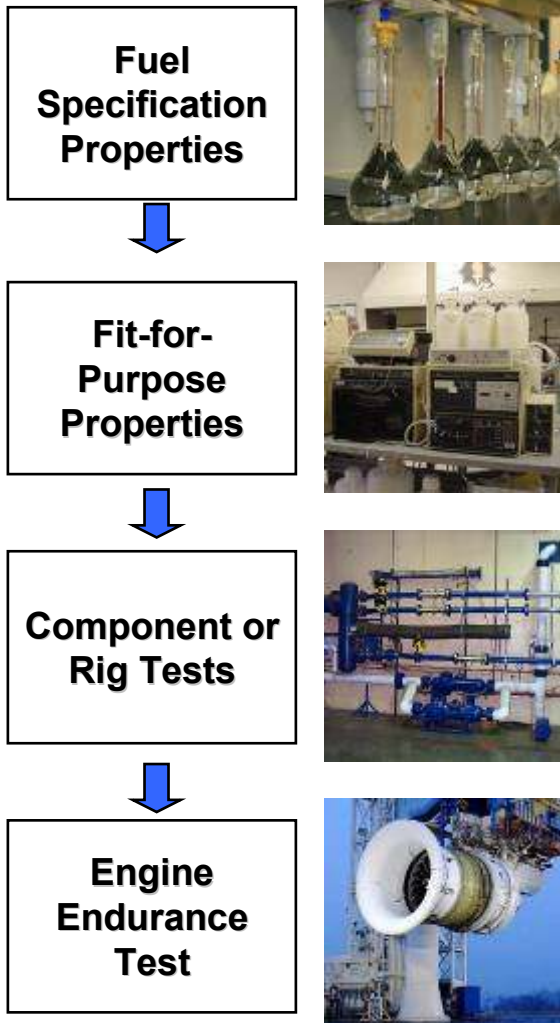
 Technical focus

 Strategic & commercial focus

## ***Boeing Acting as a Catalyst to Accelerate Commercialization***

# Boeing Leading ASTM Fuels Subcommittee – Certifying aviation synthetic and biofuel

## Test Program

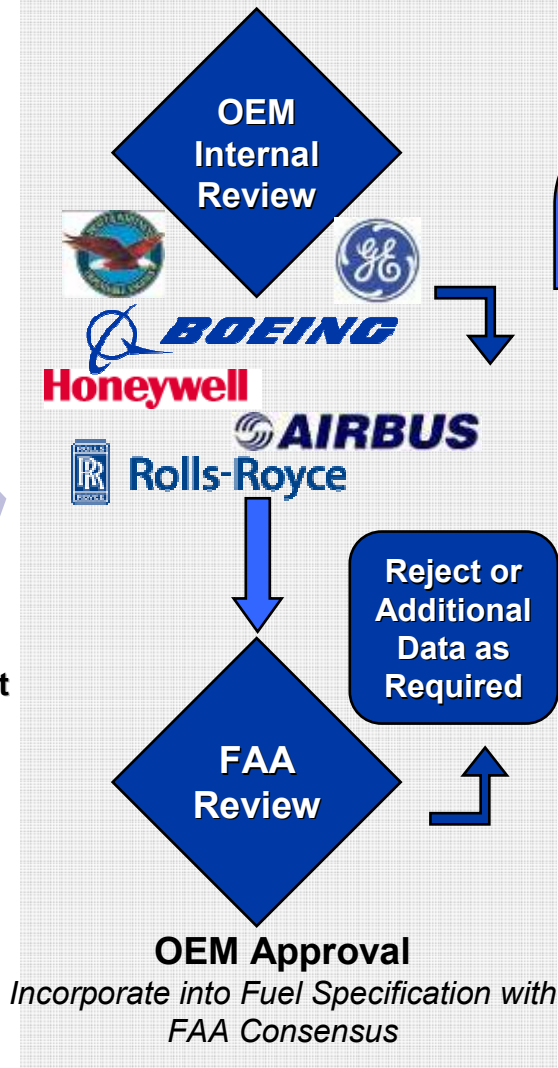


Now ASTM D7566 as well

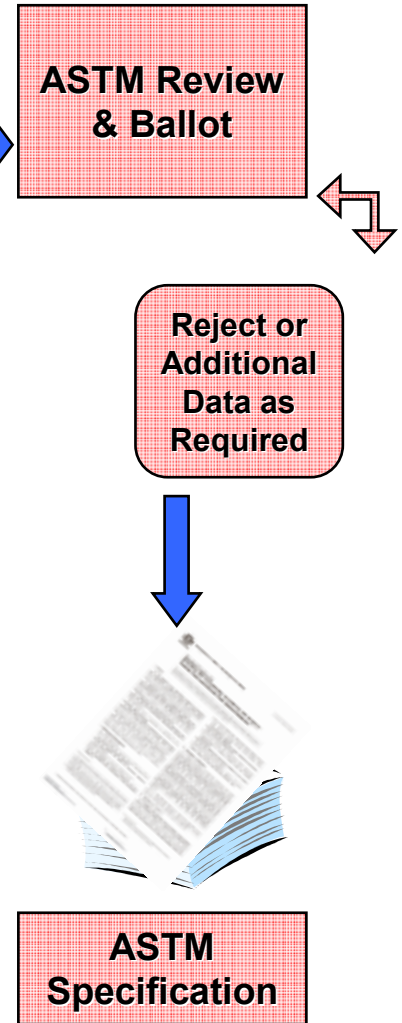


Research Report (Boeing lead author)

## OEM Internal Review



## Specification Change



# Candidate sustainable biofuel feedstocks

*Current technology – hydroprocessing triglycerides (fats & oils)*

## Camelina Ready Now



### Challenges

- Limited total yield
- Tied to grain markets

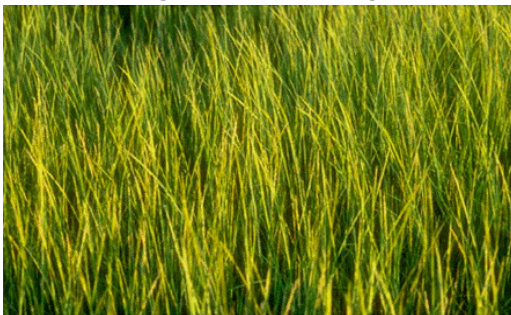
## Jatropha Ready in 2 to 4 years



### Challenges

- Warm climates only
- Still manual harvest

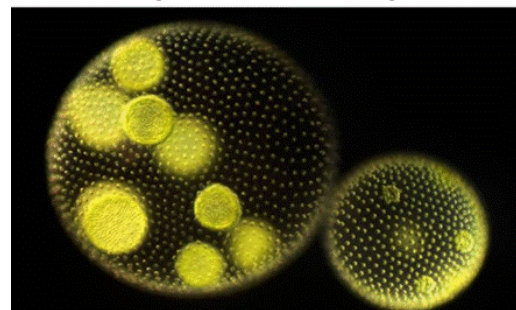
## Halophytes Ready in 2 to 4 years



### Challenges

- Prove at scale
- Optimize agronomy

## Algae Ready in 8 to 10 years



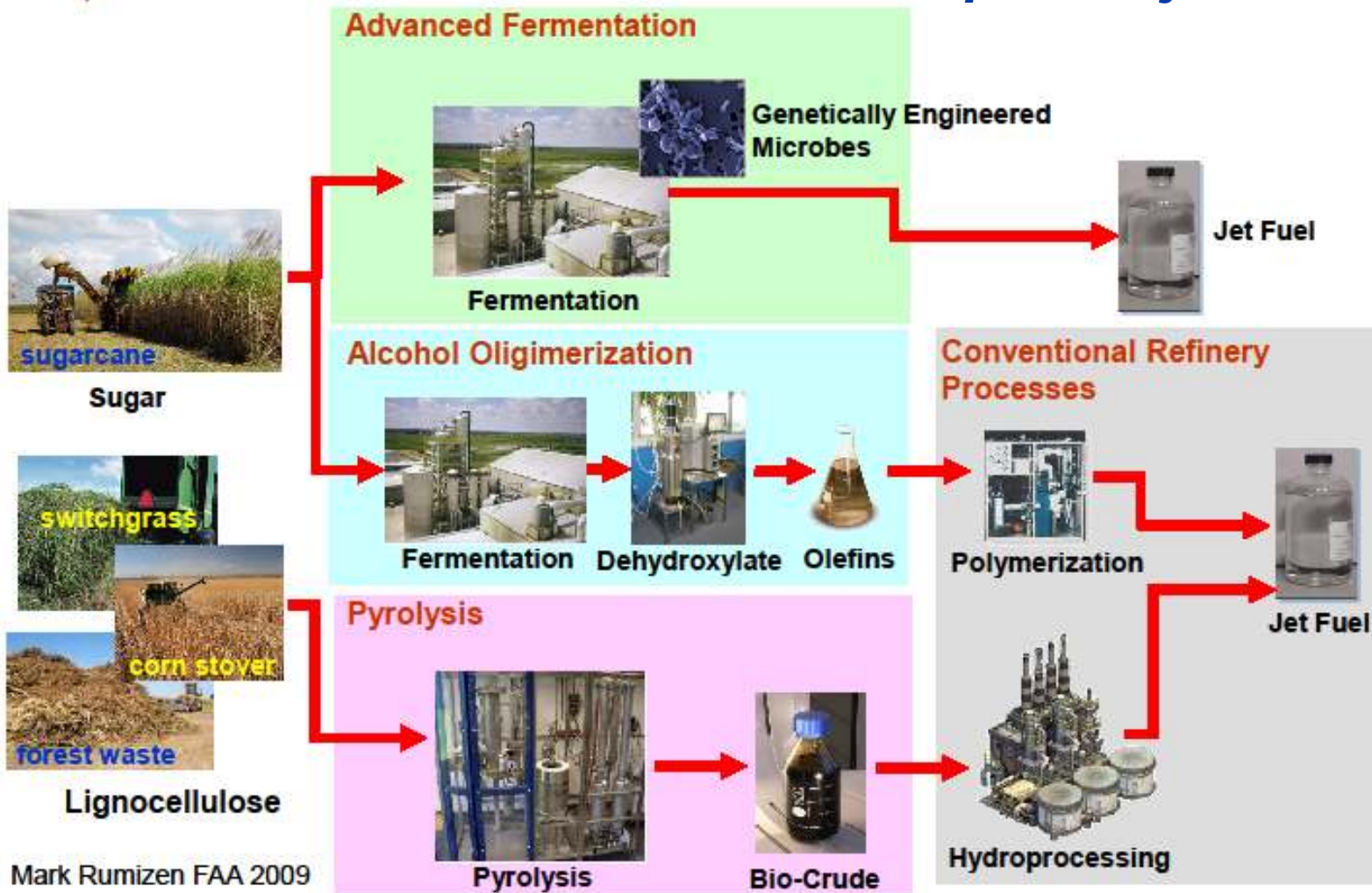
### Challenges

- Bio-optimization
- Competing approaches
- Processing costs

***Viability Based on Timing, Technology, and Local Resources***

# Other sustainable pathways still needed

*Much more biomass available to other pathways*



*Technology and sustainability issues to be addressed*

# Sustainable Aviation Biofuel Projects by Region



# Sustainable Biofuels – Progress Report



## Progress

- Low lifecycle CO<sub>2</sub> sustainable bio-based fuels
- Flight tests – met / exceeded expectations
- Excellent fuel – ASTM approval expected 1Q11
- Comprehensive regional assessments underway
- Stretch goal: market quantities by 2015

## Action Required

- Continued emphasis on sustainability
- Research in expanded feedstock and processing pathways
- Long term contract authority
- Continued engagement with USDA

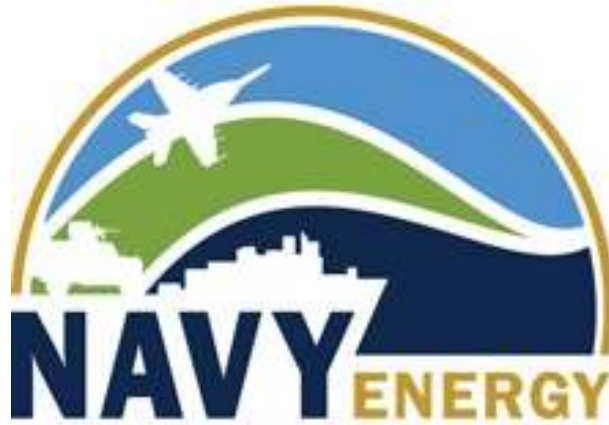


***Clean Energy AND Energy Security***



# Mission Assurance, Renewables and the Smart Grid

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Mark Wagner  
Vice President Government Relations  
Johnson Controls, Inc.

October 13, 2010

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# Agenda

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- 1. The Art of the Possible: 29 Palms ESPC Project**
- 2. A Day in the Life of a Smart Building**
- 3. Section 2841 – FY10 Defense Authorization Bill**

# **U.S. Marine Base – 29 Palms in Southern California Energy Savings Performance Contract (ESPC)**

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- ***Renewable Energy:*** 8 acre photovoltaic farm – Over 1 MW of power
- ***Energy Savings:*** Building Management System & lighting upgrades
- ***Improved Quality of Life & future MilCon Savings:*** New central chillers
- ***Energy Security:*** Cogeneration plant – 7 megawatt / dual fuel
- ***\$65M Investment*** – No upfront cost to Navy



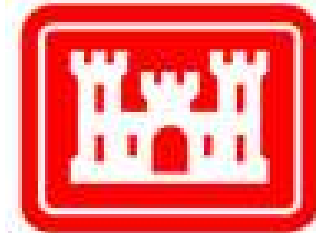
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# Energy Savings Performance Contracts (ESPC)

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- A powerful tool for financing energy efficiency projects
- Many energy service companies (ESCOs) available
- Working with you, the selected ESCO designs, constructs, finances and services the project
- Examples of the many technologies available:
  - Lighting improvements
  - Building Automation Systems
  - HVAC Upgrades & Controls
  - Water Efficiency
  - Boilers & Chillers
  - Electric Motors and Drives
  - Cogeneration systems
  - Renewable energy
- Department of Energy & Army Corps of Engineers have IDIQ contracts

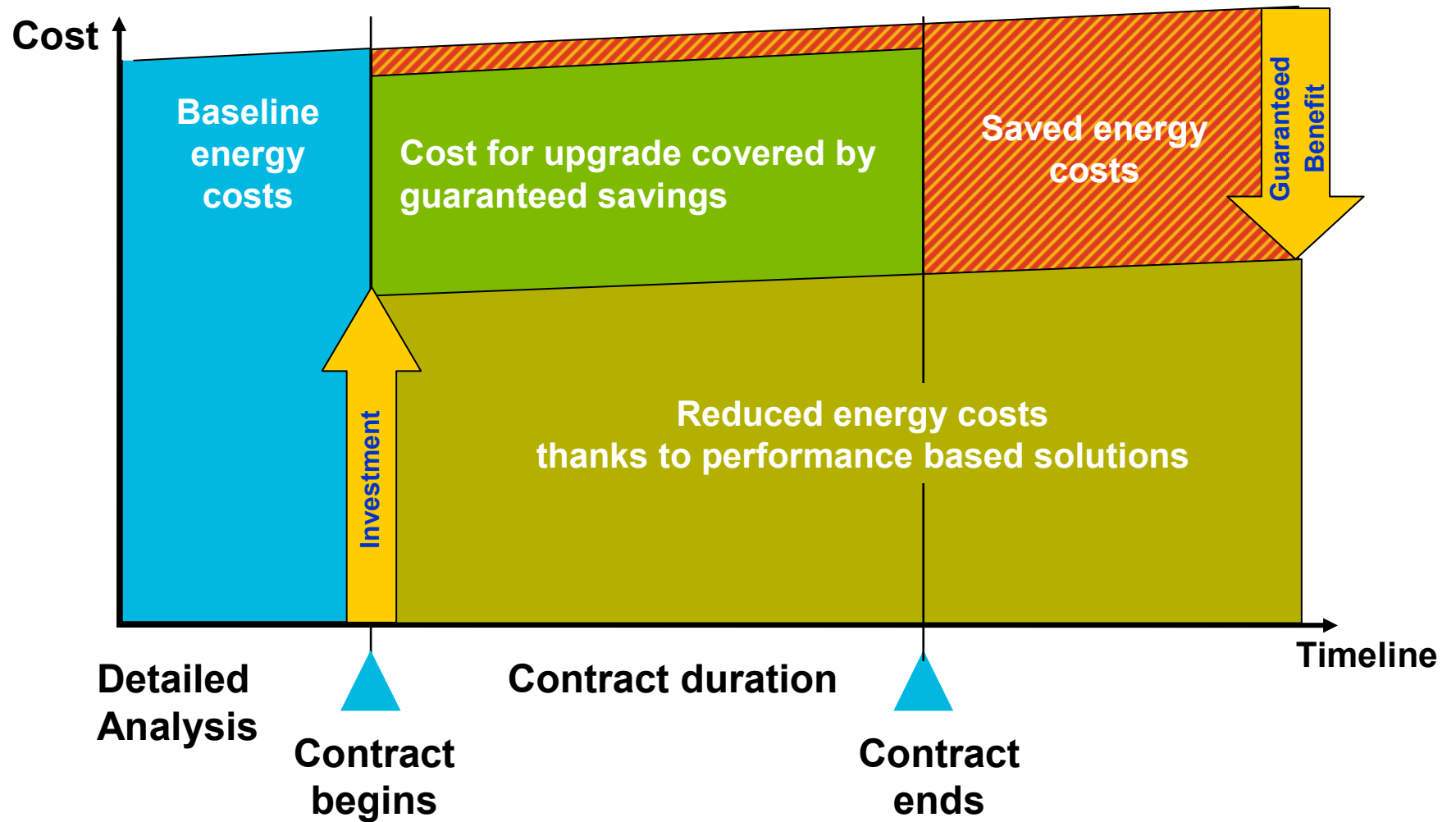


# Benefits of ESPCs

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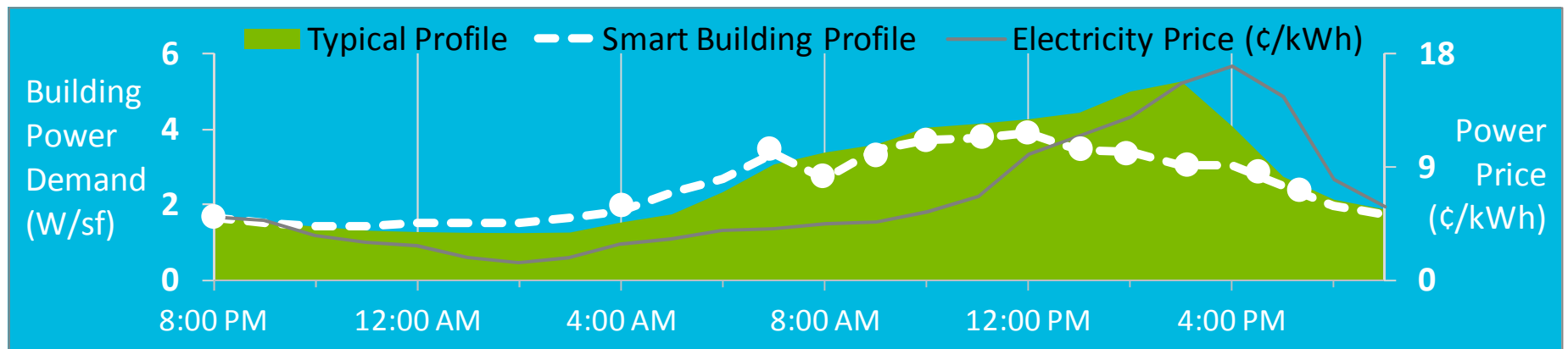
- No upfront investment by facility owner
  - Investment is paid back over time with energy savings
  - Energy savings are guaranteed
  - Performance of new equipment is guaranteed
  - Rigorous Measurement & Verification of savings
  - Reduced energy consumption & smaller carbon footprint
  - Enhanced indoor environment
  - DOE & Army ESPC IDIQ's to streamline process
  - Stimulates local economy and jobs
-

# ESPC Model: How it Works



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# A Day in the Life of a Smart Building

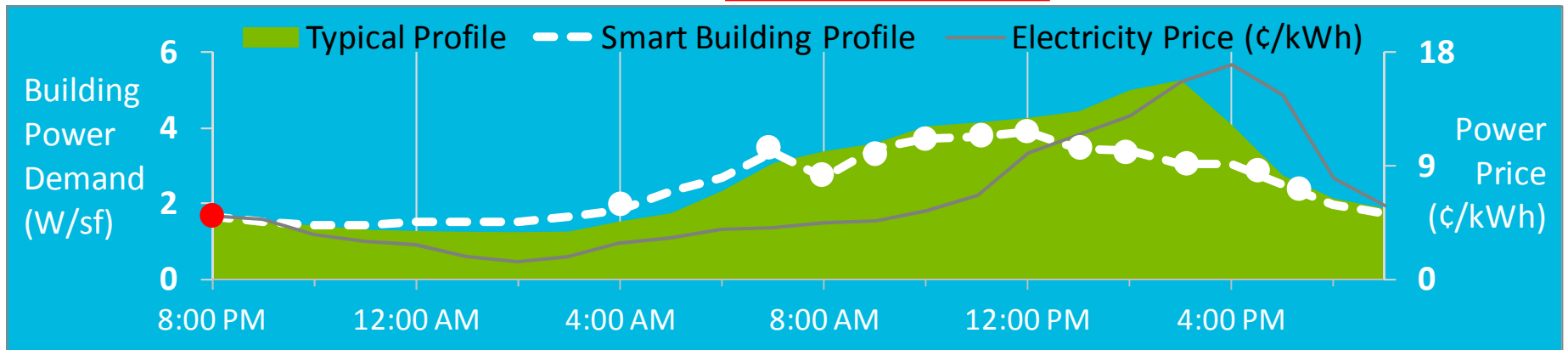


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8:00 pm

## Smart planning for tomorrow

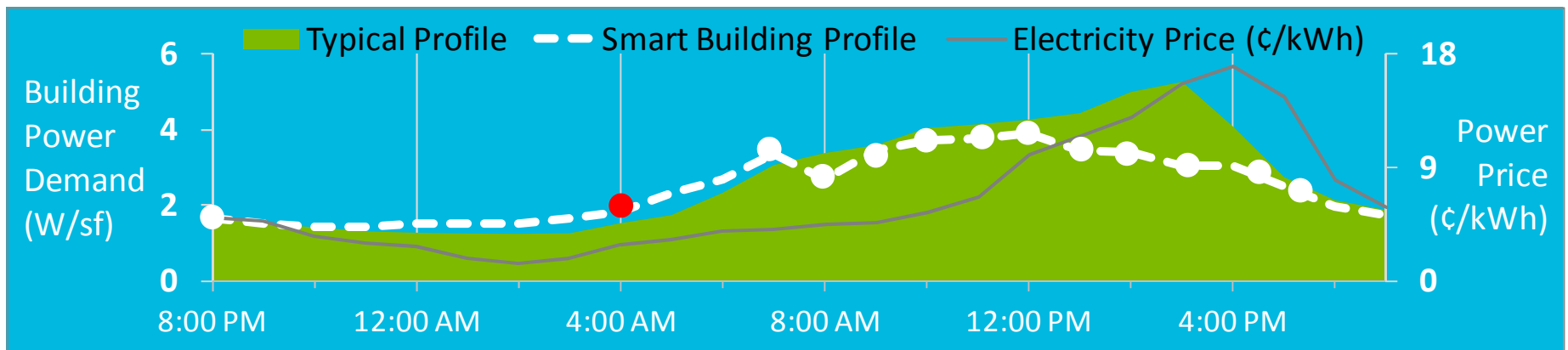
- System accesses tomorrow's weather forecast
- Real time price forecasts are received from the electric utility
- System schedules night time ice storage generation



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## 4:00 am Chiller fault detected

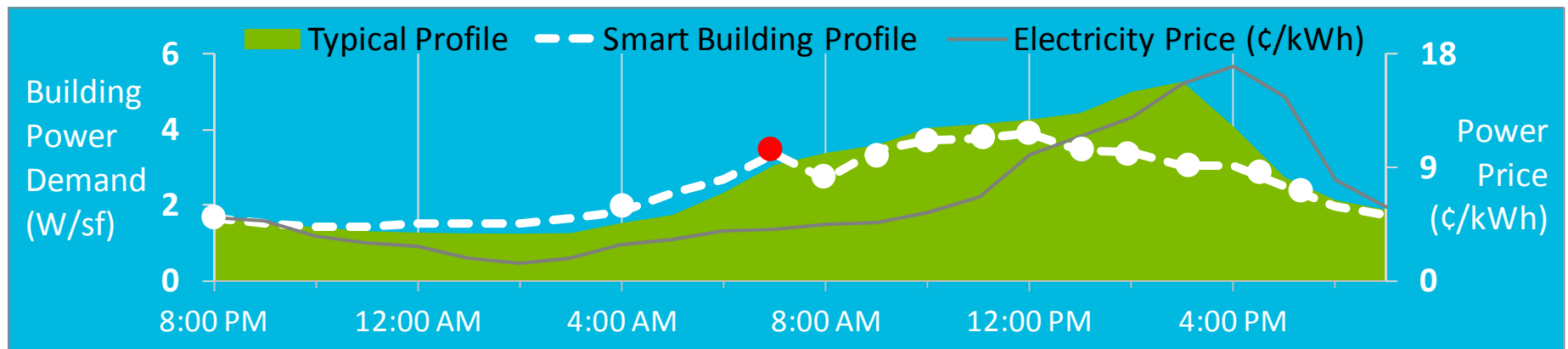
- On-board diagnostics determines a chiller valve has failed
- System calculates costs associated with this fault based on real time price forecasts
- System auto-generates a work order and notifies facility manager by smart phone



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## 7:00 am Chiller repaired

- Service technician arrives after being dispatched automatically
- Technician quickly fixes problem knowing the source and the new parts required
- Repair allows system to generate enough ice prior to spike in prices anticipated later in the afternoon

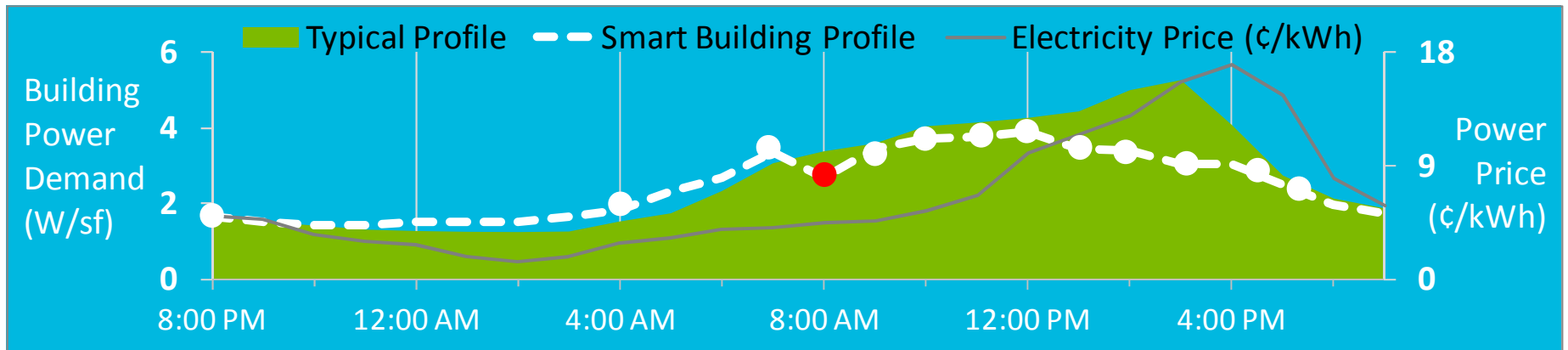
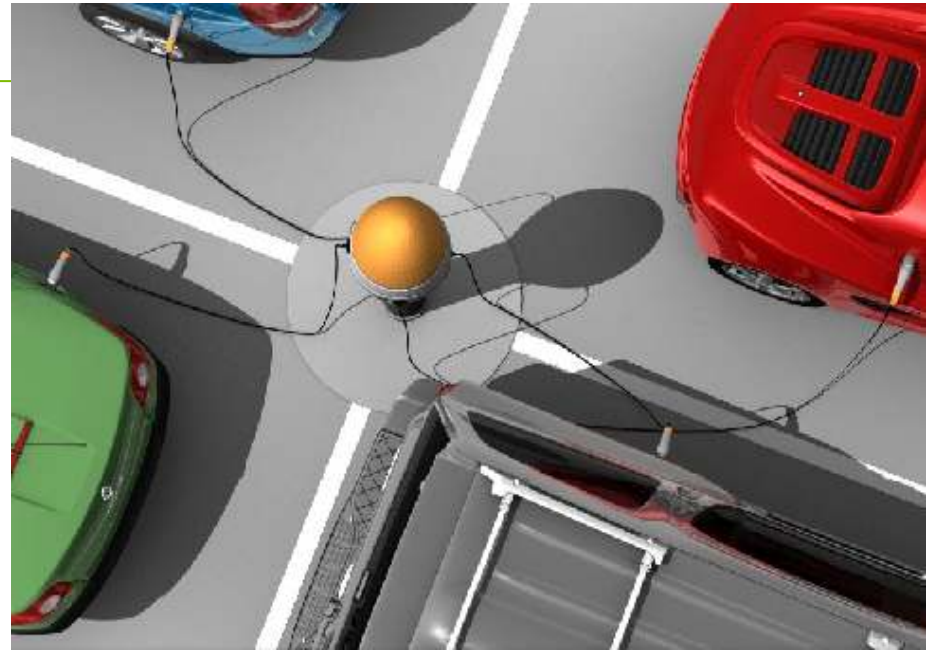


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**8:00 am**

**Employees plug in vehicles at work**

- Electric or plug-in hybrid vehicles recharge when real time price of electricity is low
- Smart charging supports voltage regulation for the local utility
- Purchase or sale of power to building is automatically factored into payroll system

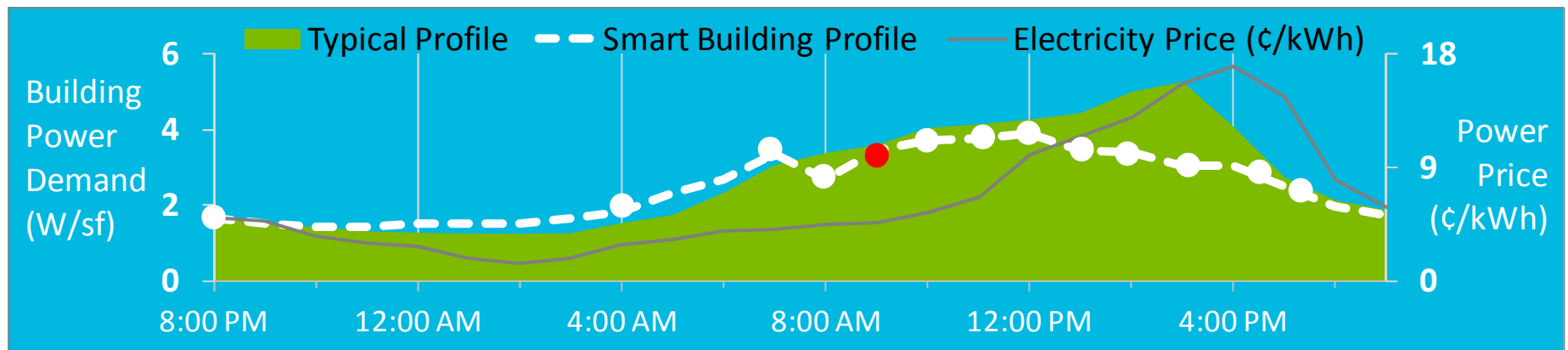


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9:00 am

## Meeting space is ready to go

- The building management system prepares the conference room for a meeting with 15 people
- Occupancy and CO<sub>2</sub> sensors provide an override in the case less or more people attend the meeting

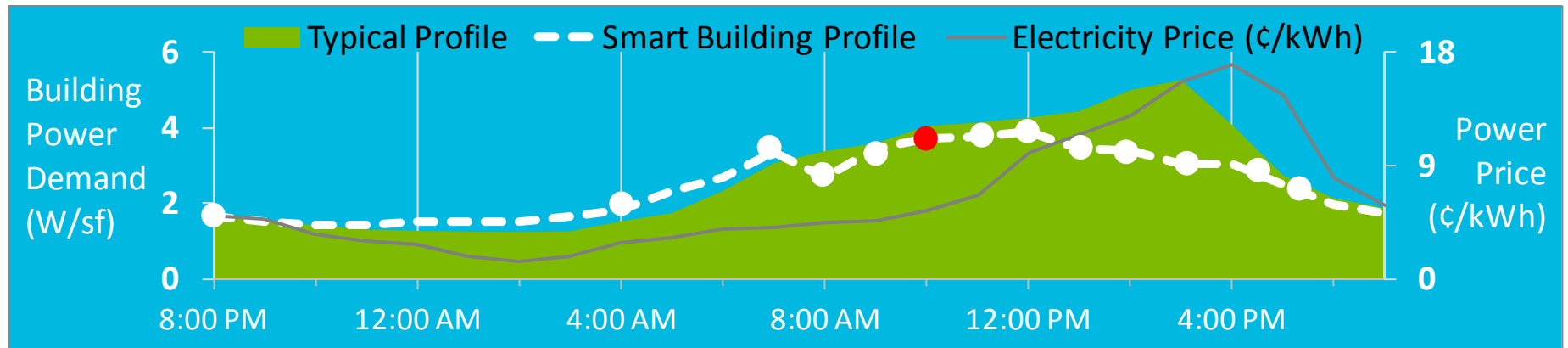
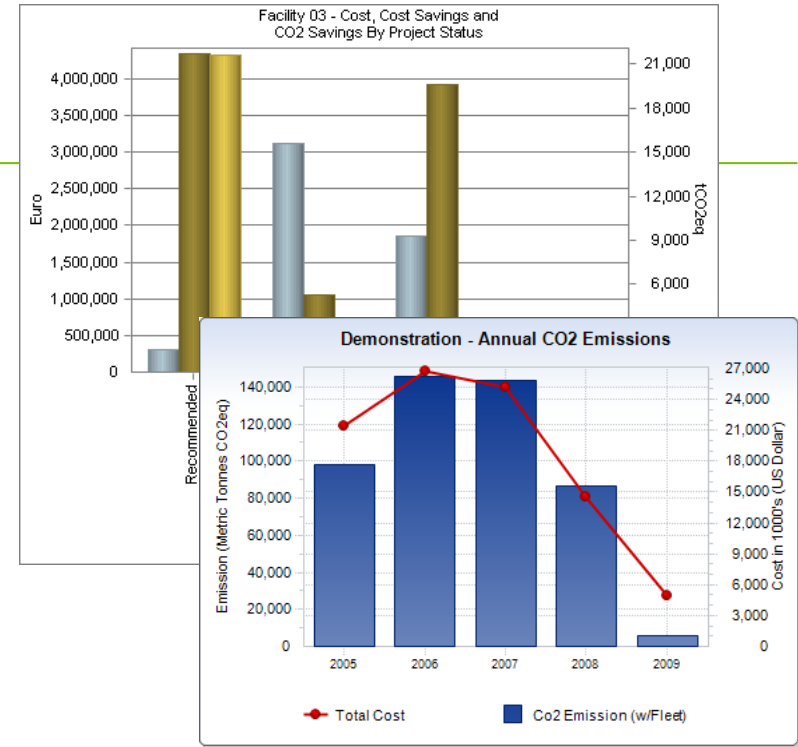


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10:00 am

## Call for carbon reporting data

- OFEE calls and asks the Sustainability Manager about the base's carbon management strategies
- Enterprise dashboard provides access to carbon emissions data for the most recent quarter and annual carbon reductions

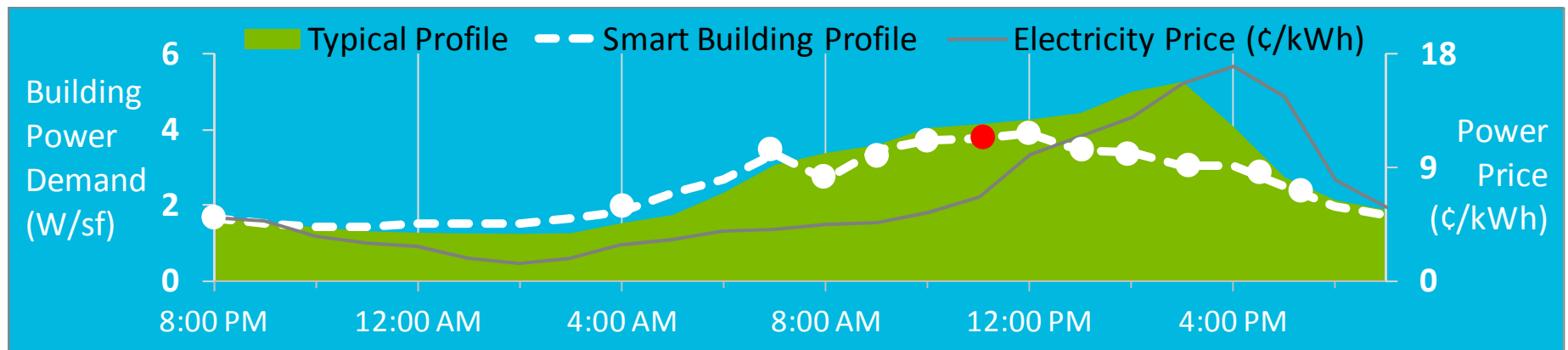


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11:00 am

## Utility power price triggers automatic demand reduction

- The price for electricity from 12pm-2pm exceeds the threshold pre-defined by the base
- The following actions to reduce power demand are taken:
  - reset space temps by 2°F
  - slowly dim lighting 20% in occupant spaces
- Actions and impact reported back to utility

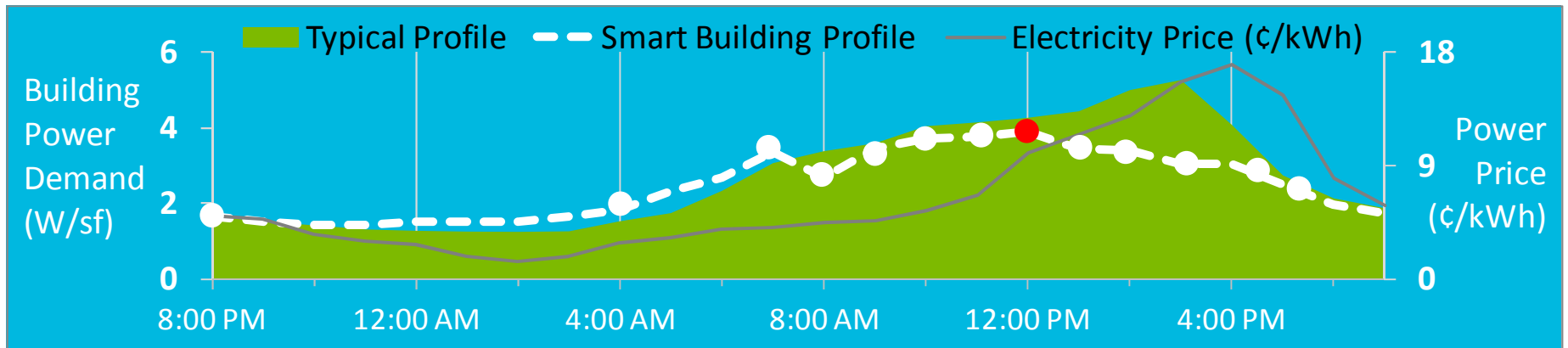


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**12:00 pm**

**Power price triggers automated demand reduction for the building**

- The building management system also takes action in common areas:
  - dispatch ice storage cooling
  - increase chilled water set point
  - dim lighting in common areas by 20%
- Actions and impact are reported back to utility

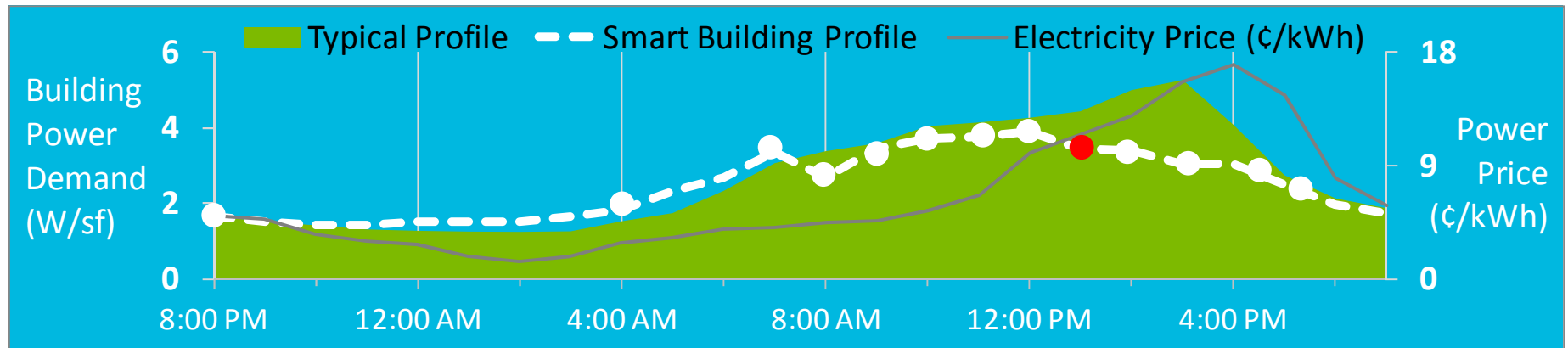


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1:00 pm

## Higher price triggers more aggressive automated reductions

- Dim lighting by 40%
  - Reset space temps by 4°F
  - Throttle non-production servers
- Actions and impact are reported back to the utility

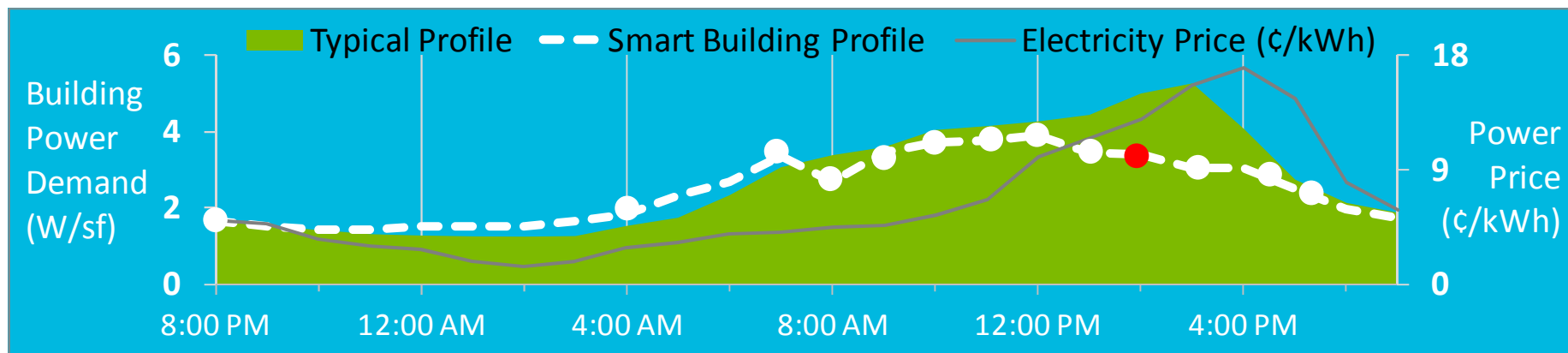


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2:00 pm

## Automated demand reductions leverage IT system integration

- System alerts employees via email or text message to unplug their laptops and run on battery power from 2-4pm

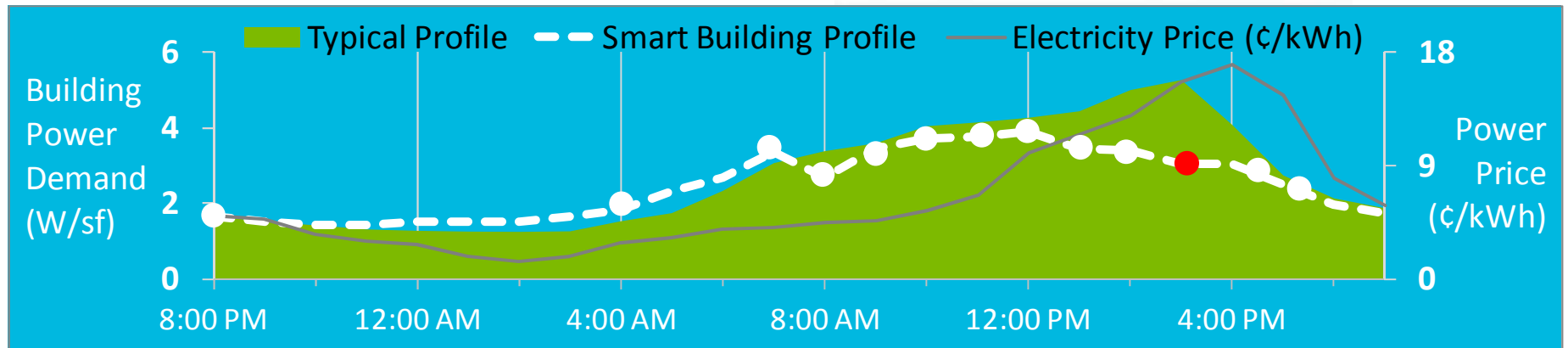


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**3:00 pm**

## Cloud cover causes solar photovoltaic generation to drop

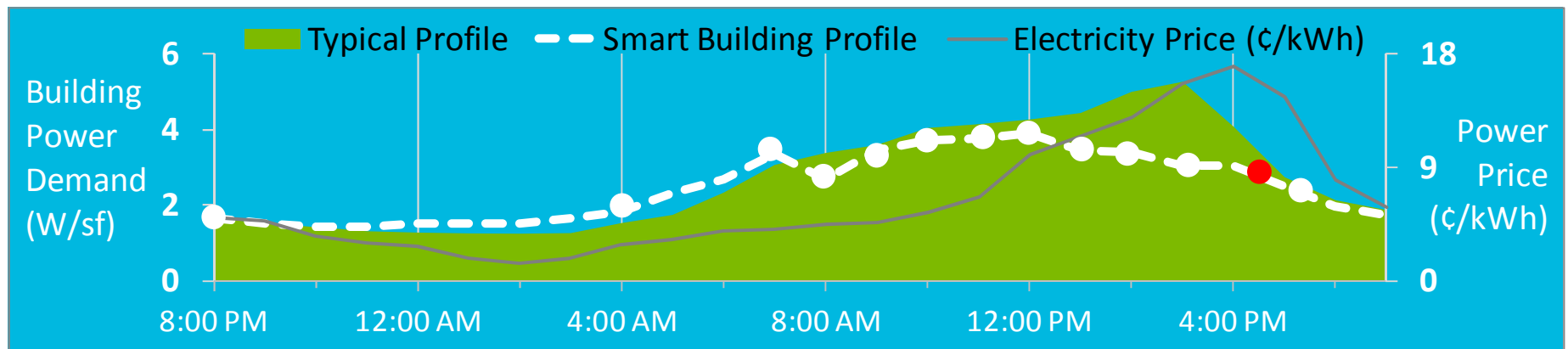
- Building receives a demand limiting signal from utility during the 2pm - 5pm period
- When cloud cover causes solar production to drop, system uses on-site electric storage to meet demand reduction goal



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## 5:30 pm Leaving the office

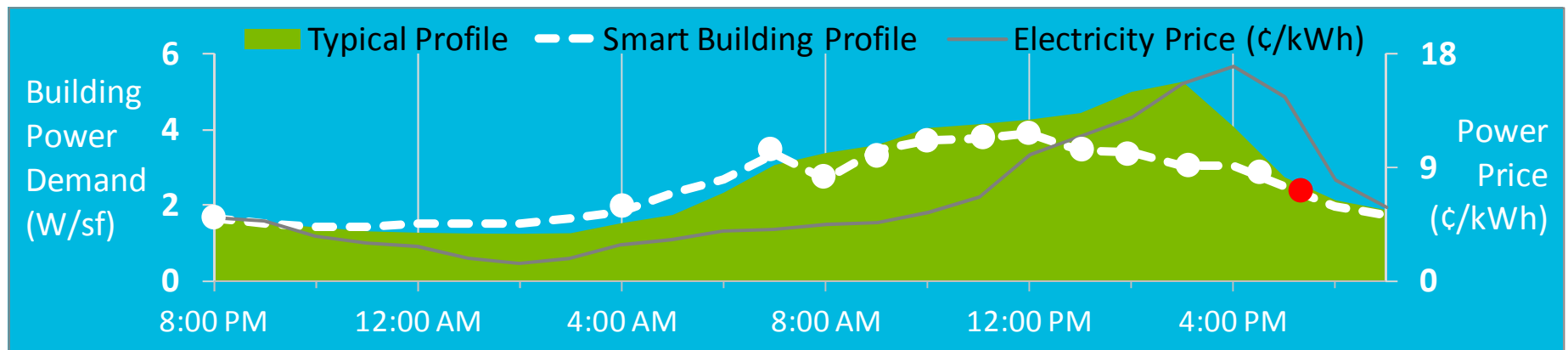
- As employee badges out, the system automatically turns off the lights and puts the computer into stand-by
- When he arrives to parking deck, his plug-in electric vehicle has been charged just enough for him to get home



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## 6:30 pm End of the workday

- System controls lighting and HVAC to follow the janitorial staff throughout the building
- Video surveillance system counts occupants remaining after hours and adjusts temperature points and lighting



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# The 2010 Defense Authorization Act added a future goal for installation-wide energy monitoring and control systems...

H. R. 2647—490

Relocation of the III Marine Expeditionary Force Personnel and their Dependents from Okinawa to Guam<sup>1</sup>.

**Subtitle D—Energy Security**

**SEC. 2841. ADOPTION OF UNIFIED ENERGY MONITORING AND UTILITY CONTROL SYSTEM SPECIFICATION FOR MILITARY CONSTRUCTION AND MILITARY FAMILY HOUSING ACTIVITIES.**

(a) ADOPTION REQUIRED.

(1) IN GENERAL.—Subchapter III of chapter 169 of title 10, United States Code, is amended by inserting after section 2866 the following new section:

“§ 2867. Energy monitoring and utility control system specification for military construction and military family housing activities

“(a) ADOPTION OF DEPARTMENT-WIDE, OPEN PROTOCOL, ENERGY MONITORING AND UTILITY CONTROL SYSTEM SPECIFICATION.—(1) The Secretary of Defense shall adopt an open protocol energy monitoring and utility control system specification for use throughout the Department of Defense in connection with a military construction project, military family housing activity, or other activity under this chapter for the purpose of monitoring and controlling, with respect to the project or activity, the items specified in paragraph (2) with the goal of establishing installation-wide energy monitoring and utility control systems.

“(2) The energy monitoring and utility control system specification required by paragraph (1) shall cover the following:

“(A) Utilities and energy usage, including electricity, gas, steam, and water usage.

“(B) Indoor environments, including temperature and humidity levels.

“(C) Heating, ventilation, and cooling components.

“(D) Central plant equipment.

“(E) Renewable energy generation systems.

“(F) Lighting systems.

“(G) Power distribution networks.

“(b) EXCLUSION.—(1) The energy monitoring and utility control system specification required by subsection (a) is not required to apply to projects carried out under the authority provided in subchapter IV of chapter 169 of this title.

“(2) The Secretary concerned may waive the application of the energy monitoring and utility control system specification required by subsection (a) with respect to a specific military construction project, military family housing activity, or other activity under this chapter if the Secretary determines that the application of the specification to the project or activity is not life cycle cost-effective. The Secretary concerned shall notify the congressional defense committees of any waiver granted under this paragraph.”.

H. R. 2647—491

(2) CLERICAL AMENDMENT.—The table of sections at the beginning of subchapter III is amended by inserting after the item relating to section 2866 the following new item:

“2867. Energy monitoring and utility control system specification for military construction and military family housing activities.”.

(3) DEADLINE FOR ADOPTION.—The Secretary of Defense shall adopt the open protocol energy monitoring and utility control system specification required by section 2867 of title 10, United States Code, as added by paragraph (1), not later than 180 days after the date of the enactment of this Act.

(b) REPORTING REQUIREMENT.—Not later than 180 days after the date of the enactment of the Act, the Secretary of Defense shall submit to the congressional defense committees a report containing the following items:

(1) A contract specification that will implement the open protocol energy monitoring and utility control system specification required by section 2867 of title 10, United States Code, as added by subsection (a).

(2) A description of the method to ensure compliance of the Department of Defense information assurance certification and accreditation process.

(3) A plan and expected timetable for integration of the standard with the energy monitoring and utility control systems.

(4) A list of the justifications and authorizations provided by the Department, pursuant to Federal Acquisition Regulation Chapter 6.3, relating to Other Than Full and Open Competition, for energy monitoring and utility control systems during fiscal year 2009.

**SEC. 2842. DEPARTMENT OF DEFENSE GOAL REGARDING USE OF RENEWABLE ENERGY SOURCES TO MEET FACILITY ENERGY NEEDS.**

(a) FACILITY BASIS OF GOAL.—Subsection (e) of section 2911 of title 10, United States Code, is amended—

(1) by redesignating paragraphs (1) and (2) as subparagraphs (A) and (B), respectively;

(2) in subparagraph (A) (as so redesignated)—

(A) by striking “electric energy” and inserting “facility energy”;

(B) by striking “and in its activities”; and

(C) by striking “(as defined in section 203(b) of the Energy Policy Act of 2005 (42 U.S.C. 15852(b)))”; and

(3) in subparagraph (B) (as so redesignated), by striking “electric energy” and inserting “facility energy”.

(b) DEFINITION OF RENEWABLE ENERGY SOURCE.—Such subsection is further amended—

(1) by striking “It shall be” and inserting “(1) It shall be”; and

(2) by adding at the end the following new paragraph:

“(2) In this subsection, the term ‘renewable energy source’ means energy generated from renewable sources, including the following:

“(A) Solar.

“(B) Wind.

“(C) Biomass.

“(D) Landfill gas.

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## Section 2841

### Unified Energy Monitoring and Utility Control System Specification

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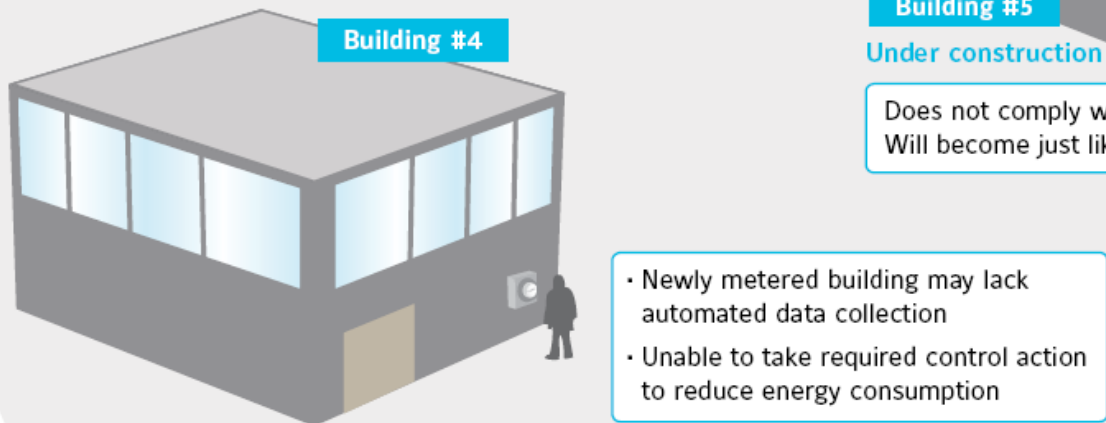
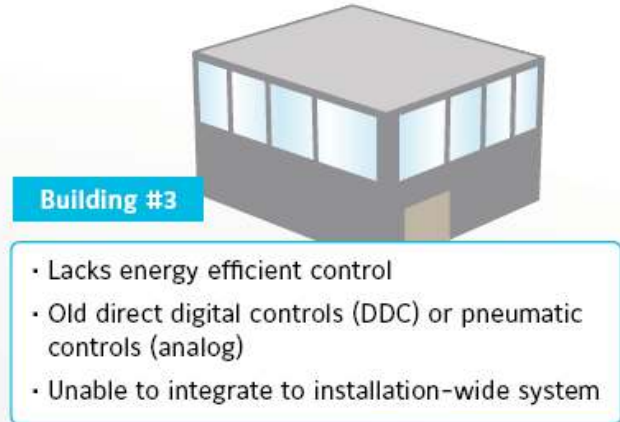
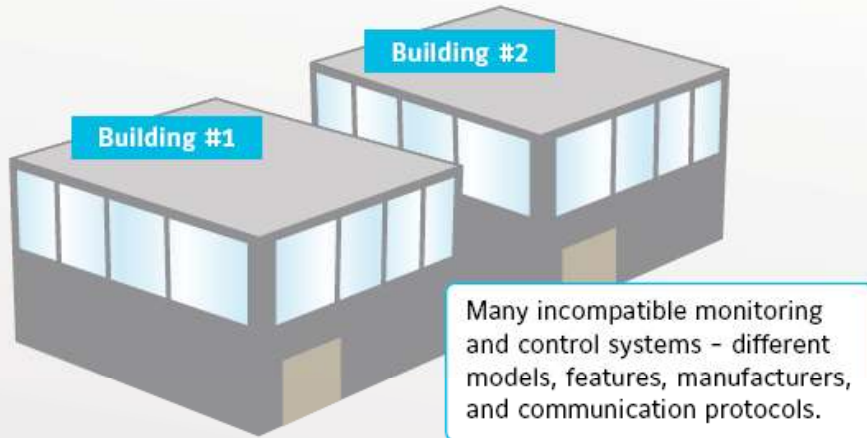
Adopt an energy and utility monitoring control system specification for use throughout DOD for the purpose of monitoring and controlling:

- A) Utilities and energy use**
- B) Indoor environments**
- C) HVAC components**
- D) Central plant equipment**
- E) Renewable energy generation systems**
- F) Lighting**
- G) Power distribution networks**

With the **goal** of establishing installation-wide energy monitoring and utility control systems.

# Today's Installations

Lack Installation-wide Energy Monitoring and Utility Control Systems



# Vision for Tomorrow

Installation-wide Energy Monitoring and Utility Control System

