



# Context for Energy

**U.S. AIR FORCE**

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# Context for AF Energy Issues

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- **Market Forces**
  - Drive prices
  - Affect international competition for resources
  - Geo-strategic and economic forces
  - New Resource Finds (e.g., Arctic)
- **Direct Threats to Energy Infrastructure**
  - Natural Events (storms, climate change)
  - Physical Threats
    - ◆ Oil Fields
    - ◆ Pipelines
  - Protecting SLOCs
- **Preserving tactical options by assuring our ability to sustain forces in theater**
- **Critical missions at fixed installations are at unacceptable risk from extended power loss**



# QDR on Energy

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- Energy security ... means having assured access to reliable supplies of energy and the ability to protect and *deliver sufficient energy to meet operational needs.*
- Energy efficiency can serve as a **force multiplier**, because it
  - increases the range and endurance of forces in the field
  - can reduce the number of combat forces diverted to protect energy supply lines, which are vulnerable to both asymmetric and conventional attacks and disruptions.
- We must continue incorporating geostrategic and operational energy considerations into force planning, requirements development, and acquisition processes.
- ...reform is imperative in energy security and climate change



# Operational Problem Statement

## ■ Growing operational energy demand in all Services

- Increasing fuel intensity

## ■ Increasing footprint

- No safe rear areas anymore
- Anti-access threats growing
- Planning assumes fuel delivery (DPS', Service wargames, etc.)

## ■ Underappreciated risk

- Commodity cost growth
- Tooth-to-tail imbalance
- Bigger tail reduces flexibility, mobility, theater capability and commander options
- Fuel infrastructure risk from RED is growing at low and high ends of conflict



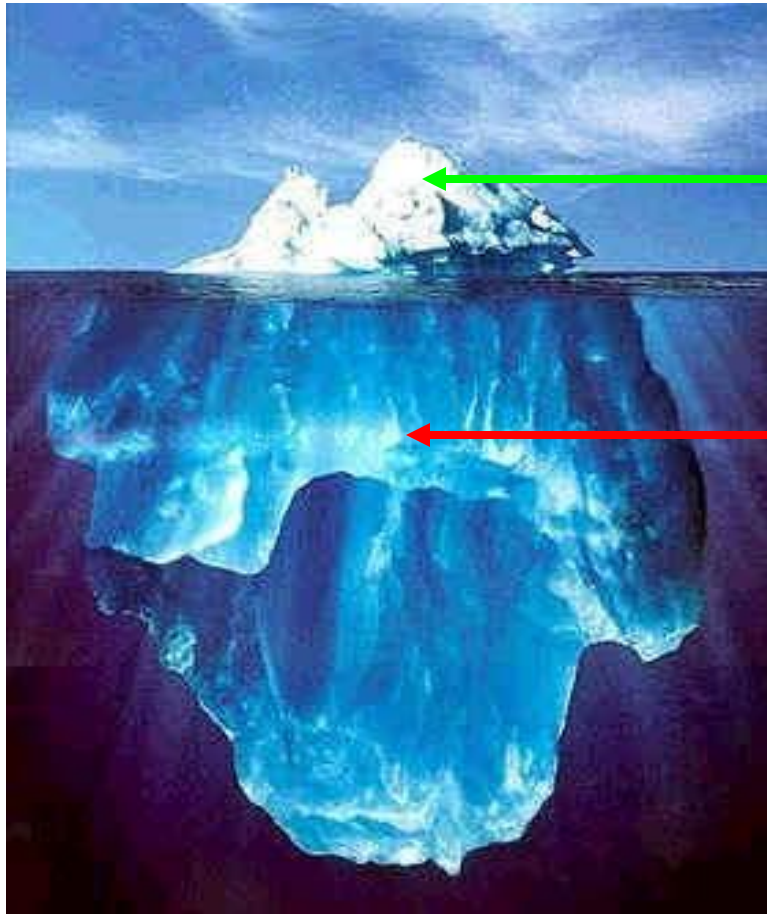
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*Logistics is a both an enabler and a growing liability to the force; and fuel is the "biggest" part of logistics*



# “Price” is not “Cost”...

## Fuel for DoD Operations



### *Direct Price*

~\$16B to purchase in FY08

### *Indirect Costs*

Huge “tail” to deliver

- Airborne tanking
- Refueling trucks & helos
- Navy oilers
- Personnel
- Force Protection



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# New “Energy” Technologies

## ■ Land Systems

- Lighter, more resilient materials
- Control systems
- Innovative design concepts
- More efficient propulsion systems
  - ◆ Stirling cycle opposed engine
  - ◆ Hybrid drive
  - ◆ Electric drive



## ■ Fixed Wing Systems

- Blended wing body
- Lightweight materials
- Novel actuator technologies
- Populated flatwire
- Adaptive propulsion systems



## ■ Soldier Systems

- Higher density batteries
- Power starved electronics designs
- More efficient solar charging



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*Think broadly about “energy” technologies*



# Problem with Electricity - Resilience

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- **Installations Almost Entirely Dependent on Grid**
  - Built for efficiency, not resilience
  - Reserve capacity greatly reduced since de-regulation
  - Remarkably fragile and an attractive target...
- **Critical Missions**
  - Increasing in criticality
    - ◆ C4ISR / Reach-back
    - ◆ Homeland Defense (Police, Medical, Disaster relief, etc)
  - Increasing in load size
- **Duration and reliability of gen-sets is inconsistent with risk of long duration grid outage and criticality of loads**



# Addressing Grid Resiliency

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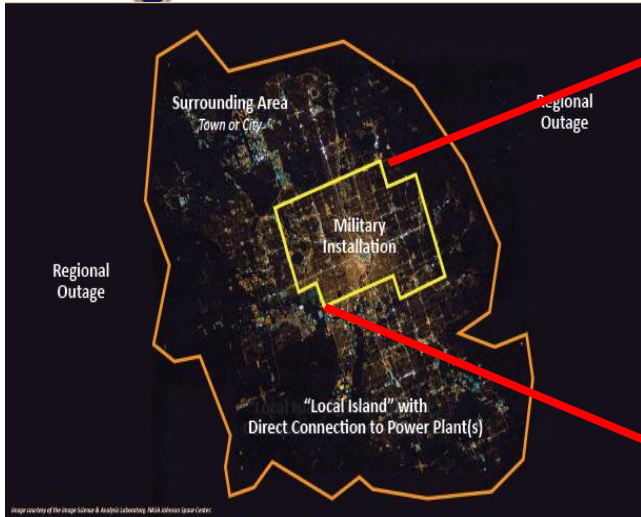
- **“it is time for us to adapt our approach to installation energy management from one that is primarily focused on compliance to one focused on long-term cost avoidance and mission assurance.”**
  - -- Dr. Dorothy Robyn, House Armed Services Comm. Testimony, February 24th, 2010
- **Apply compliance mandates for increased efficiency and more renewables to energy security purposes**
  - Diverse and varying loads
  - Diverse and varying supplies
  - Need: secure, stable micro grid that links all supplies to critical loads and minimizes energy production needs





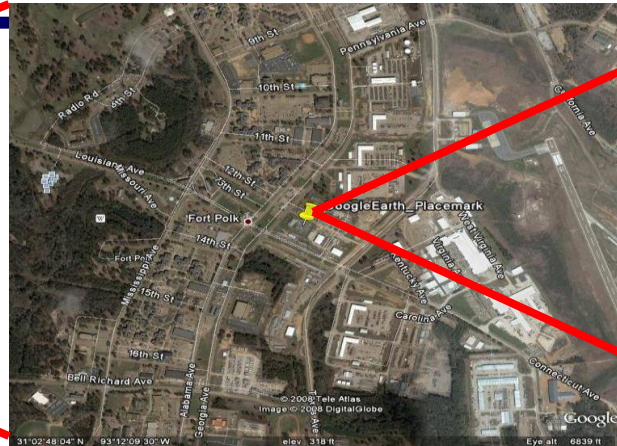
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# Scale Matters



## Commercial Scale

Hundreds of MW  
Very Expensive  
Highly Complex



## Industrial Scale

Tens of MW  
Expensive  
Complex



## Facility Scale

Tens/Hundreds of KW  
Low Cost  
Simple

### ■ Recommendation

- Inform conversation - understand issues / costs at each scale

### ■ Quick Study

- Legal Issues
- Policy issues
- Equities
- Cost of Operations
- Workforce requirements
- Mission Contribution (HD, HS, National Security)
- Capital cost

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Where does DoD responsibility end and others begin?



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# Backup



# KPP & FBCF Common Basis

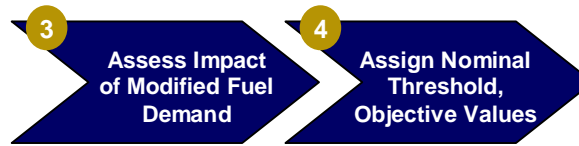
## Similarities

- Operational scenario or context
- Fuel Logistics CONOPS

## Differences

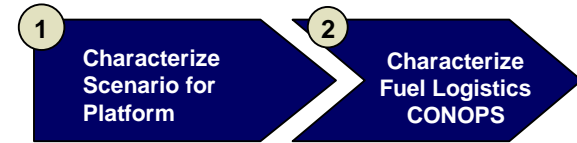
- FBCF Monetizes the LOG footprint
- Energy Efficiency KPP assesses the operational impact of the LOG footprint

Processes specific to Energy Efficiency KPP



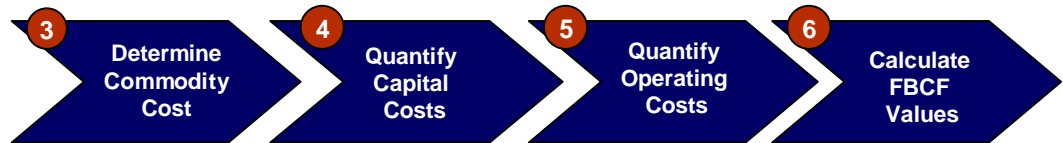
*Focus is on Force Capability and Operational Risk*

*Focus is on Life-Cycle Cost*



Processes shared by FBCF and KPP

Processes specific to FBCF



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## Apportionment Across DAG 7 Burden Categories

- |  |  |
|--|--|
| <ul style="list-style-type: none"> <li>• Commodity Cost of Fuel</li> <li>• Direct Fuel Infrastructure O&amp;S and Recapitalization Costs</li> <li>• Indirect Fuel Infrastructure O&amp;S Cost</li> <li>• Primary Fuel Delivery Asset O&amp;S Cost</li> </ul> | <ul style="list-style-type: none"> <li>• Depreciation Costs of Primary Fuel Delivery Asset</li> <li>• Environmental Costs</li> <li>• Other Service &amp; Platform-Specific Delivery Costs</li> </ul> |
|--|--|

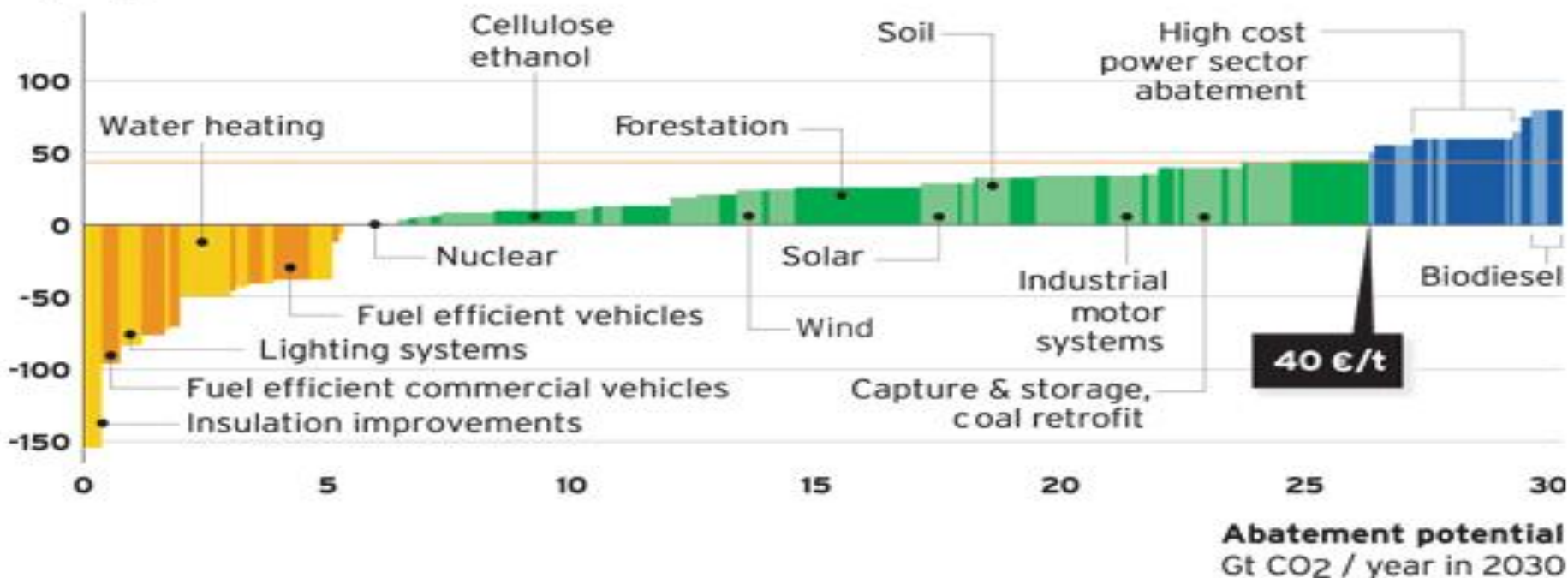



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# Biggest Bang for the Buck


## Global cost curve

Marginal cost of abatement - examples  
€/t CO<sub>2</sub>



 Negative abatement marginal cost

 Abatement marginal cost below €40/t

 Abatement marginal cost above €40/t



# Legislative Direction

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- **FY09 NDAA Section 335: Mitigation of Power Outage Risks for DoD Facilities.**
- **SECDEF shall conduct a comprehensive technical and operational risk assessment to mission critical installations, facilities and activities from extended power outages (extent not specified) resulting from failure of the commercial supply or grid and related infrastructure.**
- **SECDEF shall develop integrated, prioritized risk mitigation plans.**
- **Report due annually along with budget justification materials for FY2010 and after.**