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The Shortcut to Fully Burdened Cost of Fuel Analysis

Calculating the Cost of Aerial Refueling

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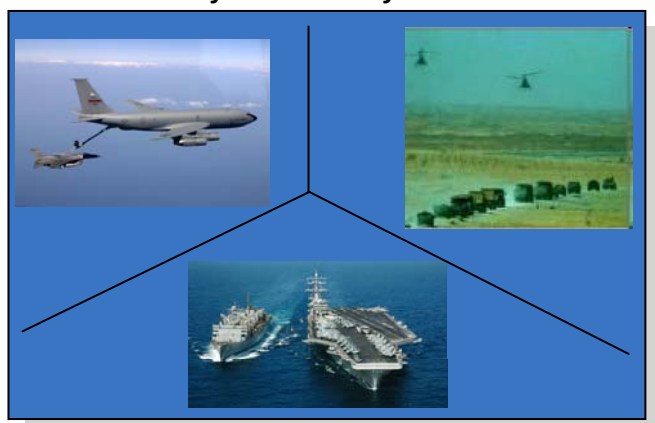
Introduction

- The intensity of fuel demand in Iraq and Afghanistan is greater than in any war in history
  - 2007: DoD energy bills exceeded $13B
  - 2008: An additional $5B requested just to cover increased fuel costs
- DoD's long-term goal is to improve energy efficiency of tactical systems
  - Current military acquisition process undervalues technologies that can improve energy efficiency
- Efforts are underway to enforce policies that require consideration of system energy consumption before acquisition
  - Fully Burdened Cost of Fuel (FBCF) analysis can help but tools are not ready
- The DoD needs a parametric model capable of applying the analytic constructs of FBCF methodology to various modes of fuel delivery

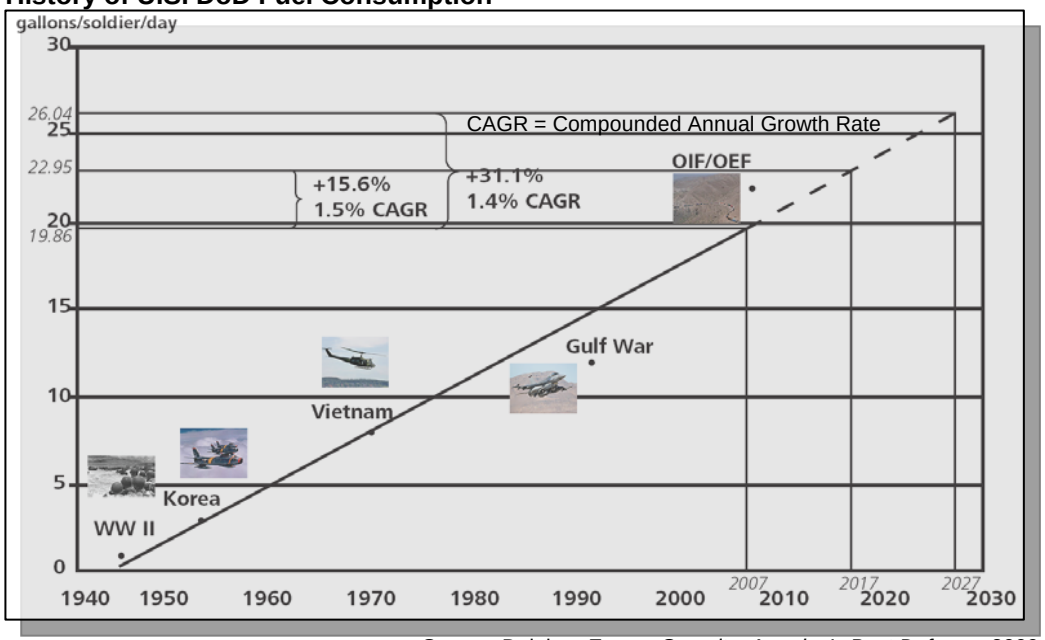
Modes of Military Fuel Delivery



Military Energy Demands are Rising

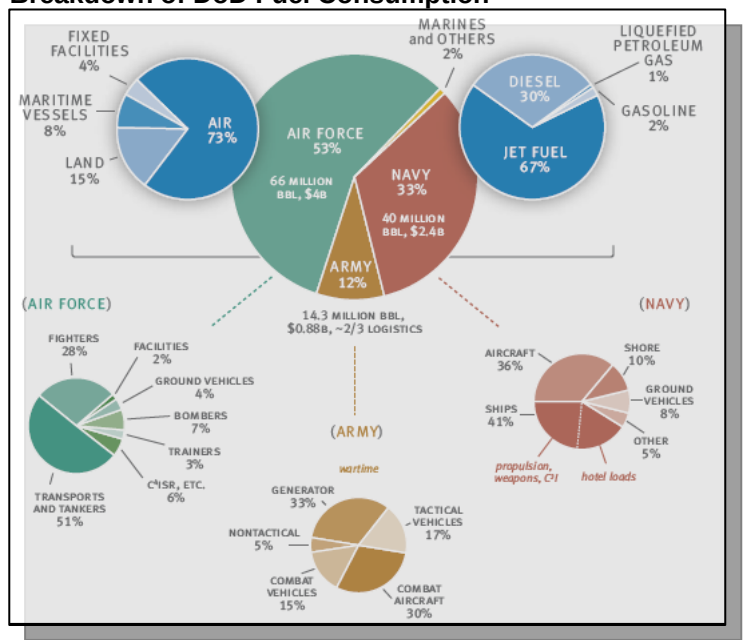
- Today, warfighting is 16 times more energy-intensive than WWII
  - 22 gal/soldier/day
- Oil intensity per warfighter is projected to rise 1.5% per year through 2017
- USAF accounts for more than half the consumption of petroleum by all government agencies
  - Heavy use of jet fuel
  - Half that fuel goes toward transports and tankers

History of U.S. DoD Fuel Consumption



Source: Deloitte, *Energy Security: America's Best Defense*, 2009

Breakdown of DoD Fuel Consumption



Source: Lovins, *DoD's Energy Challenge as Strategic Opportunity*, 2010

Military must reduce its energy demands and reduce logistics tail

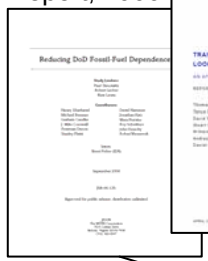
Acquisition Policy Calls for Change

- The DoD is incorporating energy considerations in its planning and business processes

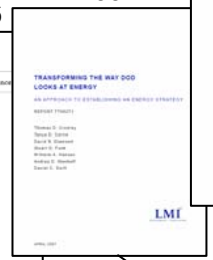
These reports found the DoD lacked the strategy, policies, metrics, information, and governing structure to properly manage its energy risks

DSB Report, 2001

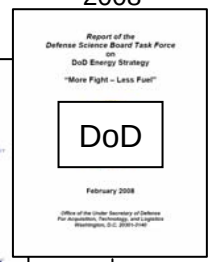
JASONS Report, 2006



LMI Report, 2007



DSB Report, 2008



Sharon Burke appointed to DoD Director of Operational Energy and vows to promote using FBCF throughout the defense acquisition bureaucracy

2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011

"The Secretary of Defense shall require that the life-cycle cost analysis for new capabilities include the fully burdened cost of fuel during analysis of alternatives and evaluation of alternatives and acquisition program design trades
Public Law 110-47, Signed Oct 14, 2008

"The lifetime energy cost of a building or a system, and the fully burdened cost of fuel in powering those, will be a mandatory evaluation used when awarding contracts."
Ray Mabus, Sec. of the Navy, Oct 2009

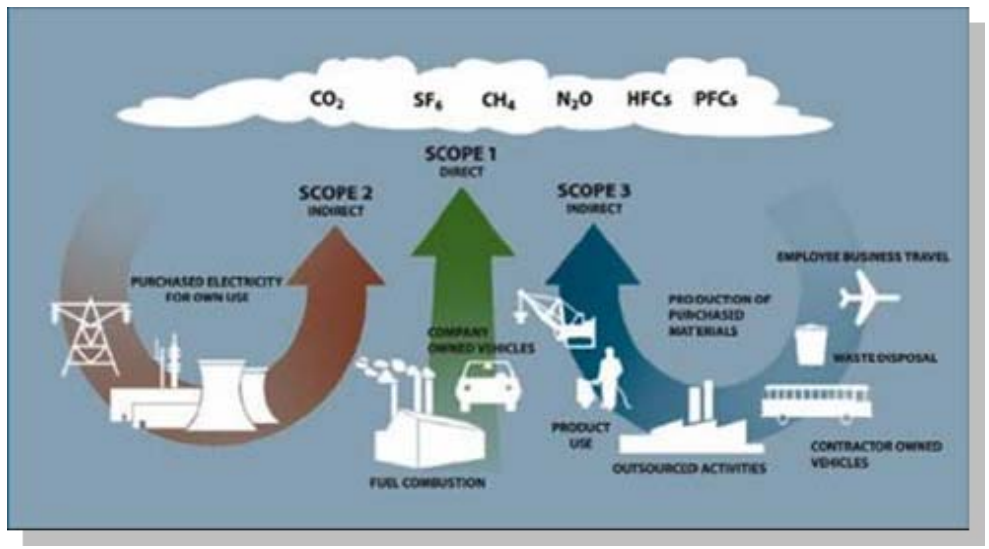
Under Secretary of Defense (AT&L) signs policy memorandum to use FBCF as a basis for pre-MS B decision making and systems engineering tradeoff analysis Nov 2010

DoD and its contractors must be prepared for policy implementation

Energy Reduction Mitigates Greenhouse Gases

- Consuming less energy results in fewer greenhouse gas (GHG) emissions
- Executive Order 13514 calls for agency-wide reduction of GHG emissions
  - Signed by President Obama on Oct. 5, 2009
  - Requires a 34% reduction of scope 1 and 2 emissions by FY2020 relative to a 2008 baseline
    - Scope 1 emissions: directly attributable to sources owned or controlled by the government
    - Scope 2 emissions: indirect emissions from the generation of electricity, heat, or steam offsite but purchased by the government

Acquisition of systems with greater fuel efficiency is required to meet GHG goals



Source: Environmental Protection Agency

FBCF Analysis is a Bridge to Solutions

- FBCF analysis can ensure a system's fuel efficient benefits, are valued when making trades between cost, schedule, and performance in the acquisition process

- Analytical work started by the Defense Science Board, in 2001, led to interim guidelines for calculating FBCF
  - Added as a supplement to the Defense Acquisition Guidebook
  - Intended to be broad and open to alternative methods

Seven Step OUSD(AT&L) FBCF Guidance

Step	Element	Burden Description
1	Commodity Cost of Fuel	DESC standard price for the appropriate type or types of fuel
2	Primary Fuel Delivery Asset O&S Cost*	Cost of operating service-owned fuel delivery assets including the cost of military and civilian personnel dedicated to the fuel mission.
3	Depreciation Cost of Primary Fuel Delivery Assets*	Measures the decline in value of fuel delivery assets with finite service lives using straight-line depreciation over total service life
4	Direct Fuel Infrastructure O&S and Recapitalization Cost*	Cost of fuel infrastructure that is not operated by DESC and directly tied to energy delivery
5	Indirect Fuel Infrastructure*	Cost of base infrastructure that is shared proportionally among all base tenants
6	Environmental Cost*	Cost representing carbon trading credit prices, hazardous waste control and related subjects.
7	Other Service & Platform Delivery Specific Costs*	Includes potential cost associated with delivering fuel such as convoy escort, force protection, regulatory compliance, contracting and other costs as appropriate.

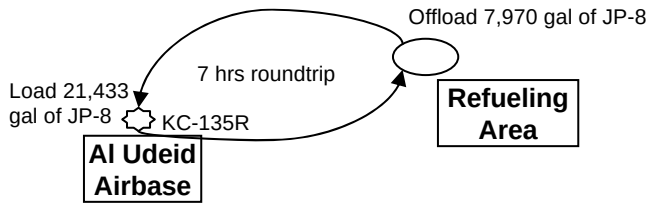
Condensed 5 Component Method

Transport	Operation cost of fuel delivery assets within the mission. Includes personnel to operate the vehicles, fuel, spare parts, maintenance, other consumables, and asset depreciation.
Protection	Cost to protect fuel resupply vehicles in the mission. Includes personnel to operate the vehicles, fuel, spare parts, routine maintenance, other consumables, and asset depreciation.
Support	Direct and indirect cost of operation and maintenance and recapitalization for infrastructure used to store and dispense fuel in the mission including personnel.
Environmental Tax	Costs related to the environmental impact of fuel consumption.
Commodity	Fixed price military services pay worldwide at any retail point of sale owned and operated by the Defense Energy Support Center (DESC).

This method can be used to show impact of operational cost on logistics tail value

FBCF Analysis: The Long Way

- This scenario is an aerial refueling sortie flown by the 340th EARS out of Al Udeid Airbase in 2008
  - KC-135 is the most common tanker in the USAF
- Data Gathering (all open source info)
  - Vehicles
    - Operational costs for aircraft were found on government websites and in publicly released assessments[1,2]
  - Activities
    - The 340th EARS is the largest tanker squadron in the USAF
    - USAF keeps tanker activity reports documenting all tanker sorties
  - Support Infrastructure
    - General Accounting Office document provided operations and maintenance costs for several airbases worldwide
  - Commodity
    - DESC sets worldwide military price for fuel
  - Allocation
    - Entire fuel load is not always delivered to one user
    - Determines what proportion of logistics tail is attributable
- This scenario would cost an estimated $16.55/gal
  - FBCF is scenario dependent
    - The 340th EARS flew >9,000 different refueling sorties in 2008
    - Analyzing a sortie per minute would take 150 hours or 6.25 days



Summary of Data Gathered Adjusted to FY08$

	KC-135R	A330	B767
Storage Capacity (gal)	31,275	37,025	31,493
Burn Rate (gal/hr)	1,600	2,139	1,722
O&M Rate minus fuel ($/hr)	$7,332.64	$5,528.81	$5,012.80
Crew Pay ($/hr)	$188.04	$188.04	$188.04
Asset Utilzation ($/hr)	4% of O&M including Fuel+Crew Pay		
Commodity Cost of JP-8	$4.07/gal		
Environmental Tax	$0.10/gal		
Airbase Support Infrastructure	$2.28/gal		

Results

Transport Cost = $80,438
Protection Cost = No Protection
Support Cost = $18,211
Envir. Tax = $797
Commodity Cost = $32,438
Total Mission Cost = $131,884

We need a model capable of automating the FBCF analysis process

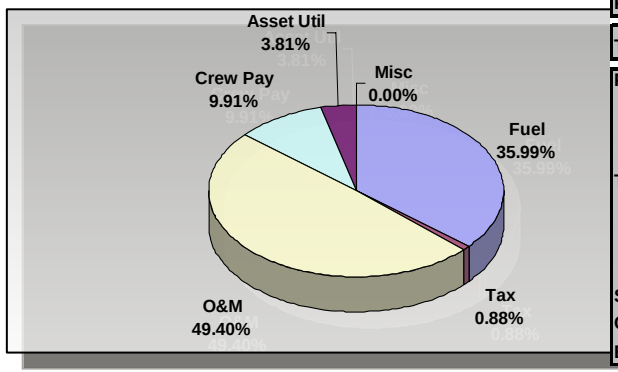
1. Fuel Consumption Analysis of the Boeing 767-200ER and Airbus 330-200, Conklin & Decker Aviation Information, 2007
2. An Assessment of the Life-Cycle Cost of the Boeing 767 and Airbus A330, AeroStrategy Management Consulting, 2010

FBCF Analysis: The Short Way

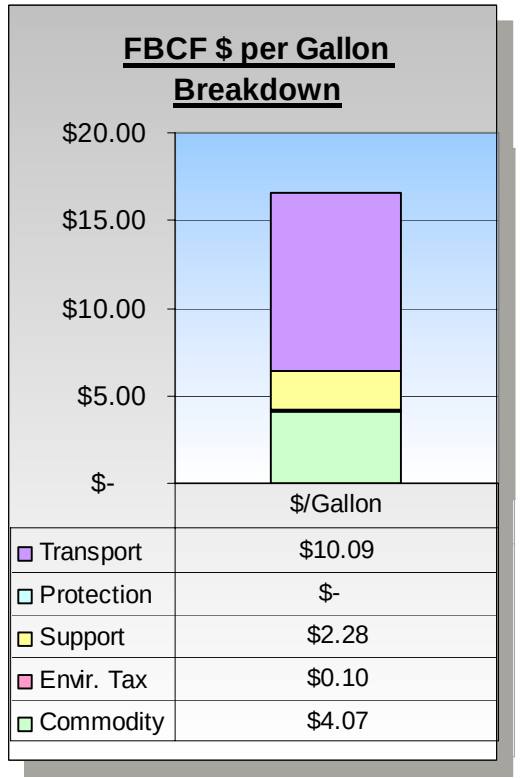
- Boeing's Total Price of Fueling Forces (ToPOFF) Model
  - Developed by Boeing Research & Technology in 2009
  - Parametric model using an activity-based costing method
  - Database driven with options for user defined entries
    - Users only need knowledge of delivery activities
  - Can support analysis across the services

- Model was used to analyze same scenario
  - Cost summary displays total mission costs
  - Pie chart shows percentage contributions of the operational costs that comprise mission cost

- ToPOFF is deterministic and when linked with external tools, performs trade studies and probabilistic analyses

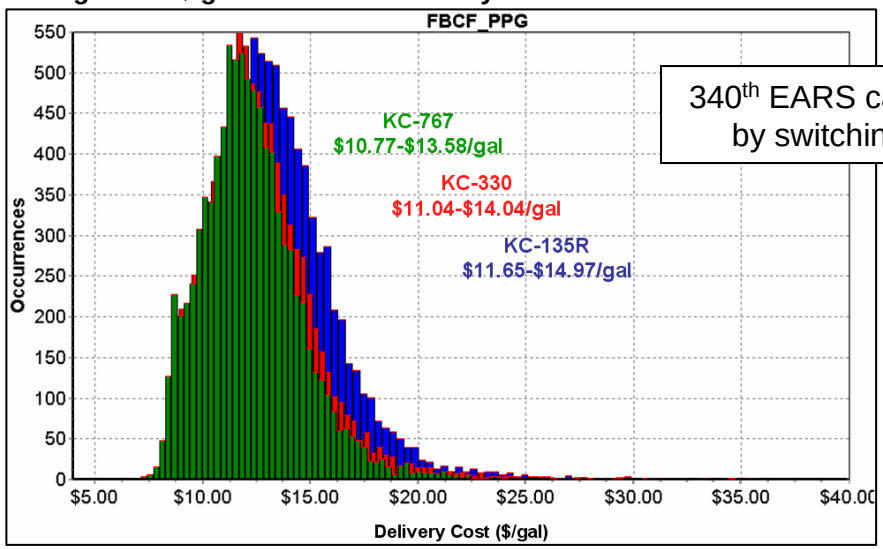


FBCF ($/gal)	**$**	**16.55**
Total Cost	**$**	**131,885.90**
Protection	**$**	**-**
Air	*$*	*-*
Ground	*$*	*-*
Sea	*$*	*-*
Transport	**$**	**80,440.17**
Air	*$*	*80,440.17*
Ground	*$*	*-*
Sea	*$*	*-*
Support	**$**	**18,210.83**
Commodity	**$**	**32,437.90**
Envir. Tax	**$**	**797.00**

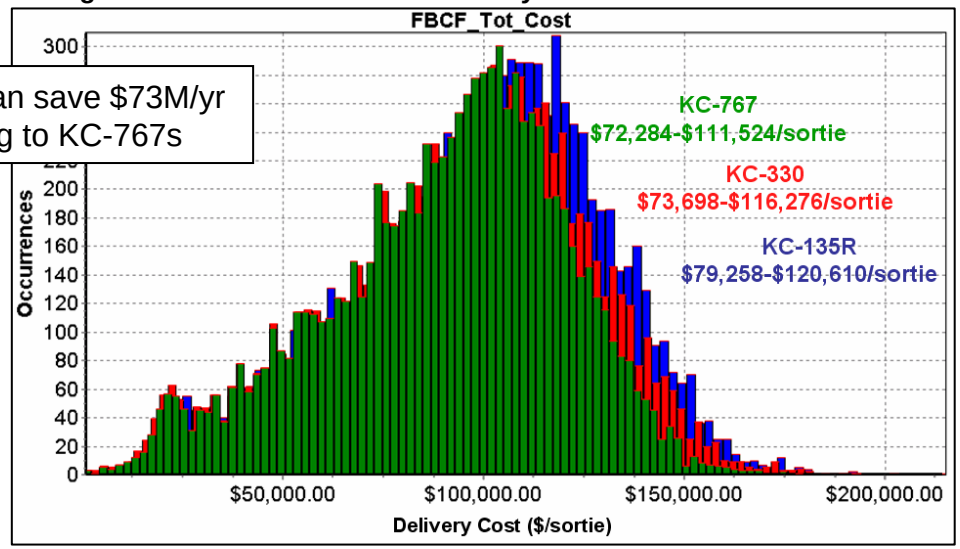


ToPOFF Expanded Analysis

Histogram of $/gal cost of fuel delivery for 340th EARS



Histogram of $/sortie cost of fuel delivery for 340th EARS



340th EARS can save $73M/yr by switching to KC-767s

- ToPOFF was paired with Model Center to analyze 9,000+ sorties flown in 2008
  - KC-135 was analyzed, as well as possible cost avoidances with a A330 or B767 replacement
- Results show the 340th EARS added $11.65-$14.97/gal or $79,258-$120,610/sortie to logistics tail costs of combat aircraft in 2008
  - A330: $11.04-$14.04/gal or $73,698-$116,276/sortie
  - B767: $10.77-$13.58/gal or $72,284-$111,524/sortie
- FBCF is just one dimension of many discriminators to be used in measuring net capability of competing alternatives

Substitution of KC-135s with next gen tankers can yield significant cost savings

Summary and Conclusions

- Summary
  - Military must reduce energy demands
  - DoD and its contractors must be prepared for policy changes
  - Energy reduction is necessary to meet GHG goals
  - FBCF analysis is a bridge towards addressing these issues
  - The ToPOFF model can simplify the process of conducting FBCF analysis
- FBCF analysis will be required in all future military platform acquisitions
  - The DoD and its contractors need a parametric model capable of applying the analytic constructs of FBCF methodology to various modes of fuel delivery
- ToPOFF is ready to support the DoD's energy goals

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