REPORT

OF THE

DEFENSE SCIENCE BOARD TASK FORCE ON DOD ENERGY STRATEGY

October 22, 2008
NDIA Systems Engineering Meeting
Mr. Chris DiPetto

Task Force Leadership

- Study Co-Chairmen
  - Dr James Schlesinger
  - Gen Michael Carns, USAF Ret

- Policy Panel Chairman
  - Mr. James Woolsey, BAH
  - Ms. Gueta Mezzetti, Consultant

- Platform Panel Co-Chairs
  - ADM Greg Johnson, USN
  - GEN Greg Martin, USAF

- Facilities Panel Chairman
  - VADM Al Konetzni, USN

- R&D Panel Co-Chairs
  - Dr. Ed Reedy, GTRI
  - Dr. Jeff Tester, MIT

- Executive Secretaries
  - Mr. Chris DiPetto ODUSD (A&T)
  - Mr. Jack Taylor ODUSD (S&T)

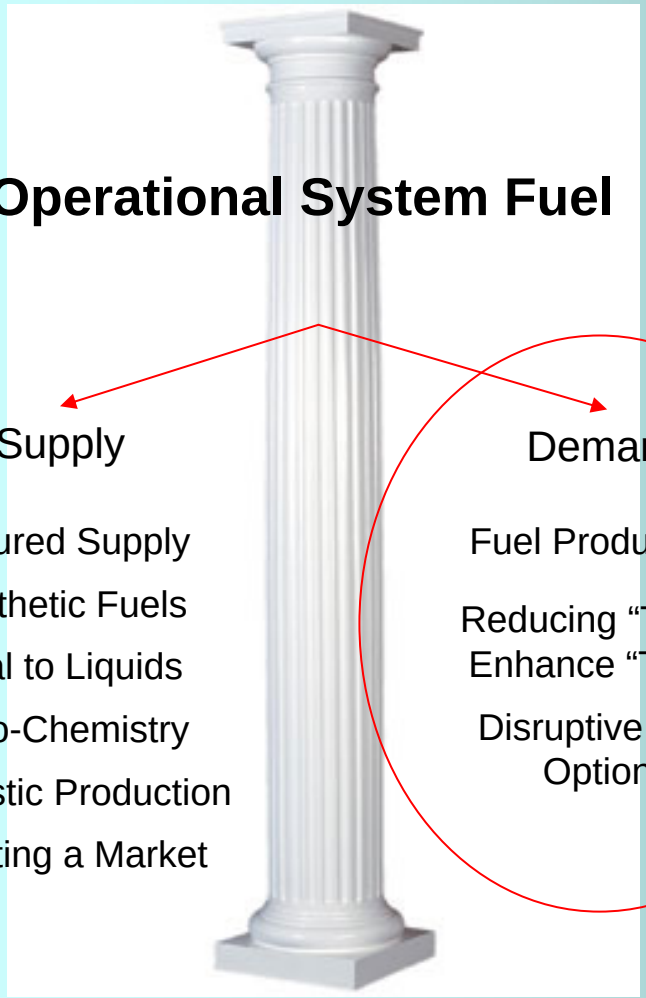
77 Task Force members and government advisors
May 2006 to March 2007: 10 months, 37 meetings, 143 briefings
March 2007 to February 2008: 11 months of deliberations and writing

Key Findings

- Two primary energy risks to DoD
  - **Unnecessarily high and growing operational fuel demand increases mission risk**
  - Critical missions at fixed installations are at unacceptable risk from extended power loss
- DoD lacks the strategy, policies, metrics, information, and governance structure necessary to properly manage its energy risks
- There are technologies available now to make DoD systems more energy efficient, but they are undervalued, slowing their implementation and resulting in inadequate S&T investments.
- There are many opportunities to reduce energy demand by changing wasteful operational practices and procedures.

DoD Energy Space

Grand Strategy View – preserving US interests, resource competition, climate impact, etc.



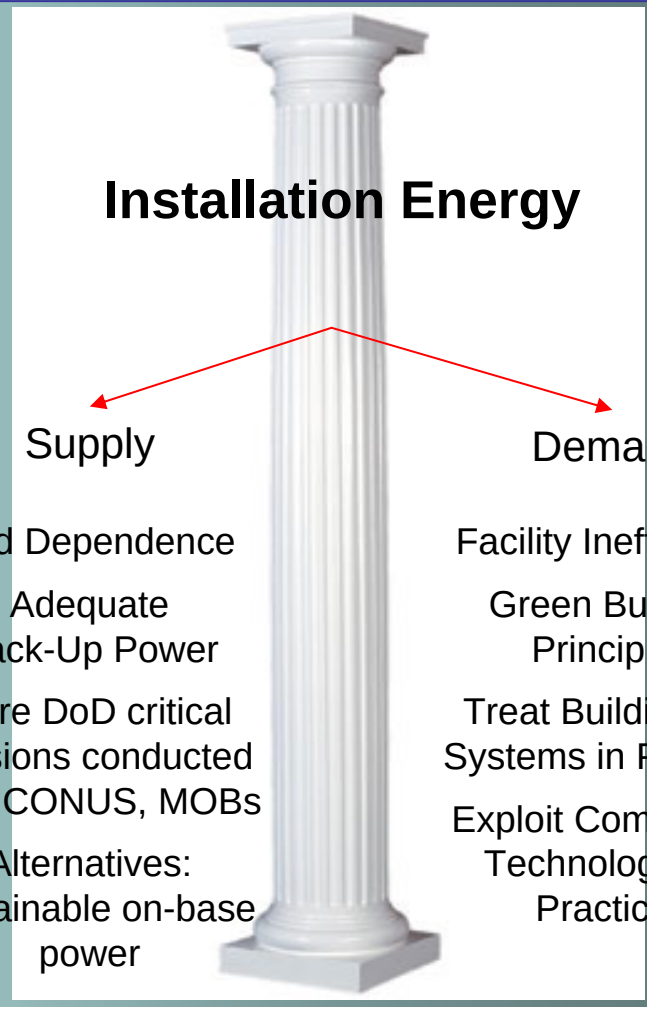
Operational System Fuel

Supply

- Assured Supply
- Synthetic Fuels
- Coal to Liquids
- Agro-Chemistry
- Domestic Production
- Creating a Market

Demand

- Fuel Productivity
- Reducing “Tail” to Enhance “Tooth”
- Disruptive Tech Options



Installation Energy

Supply

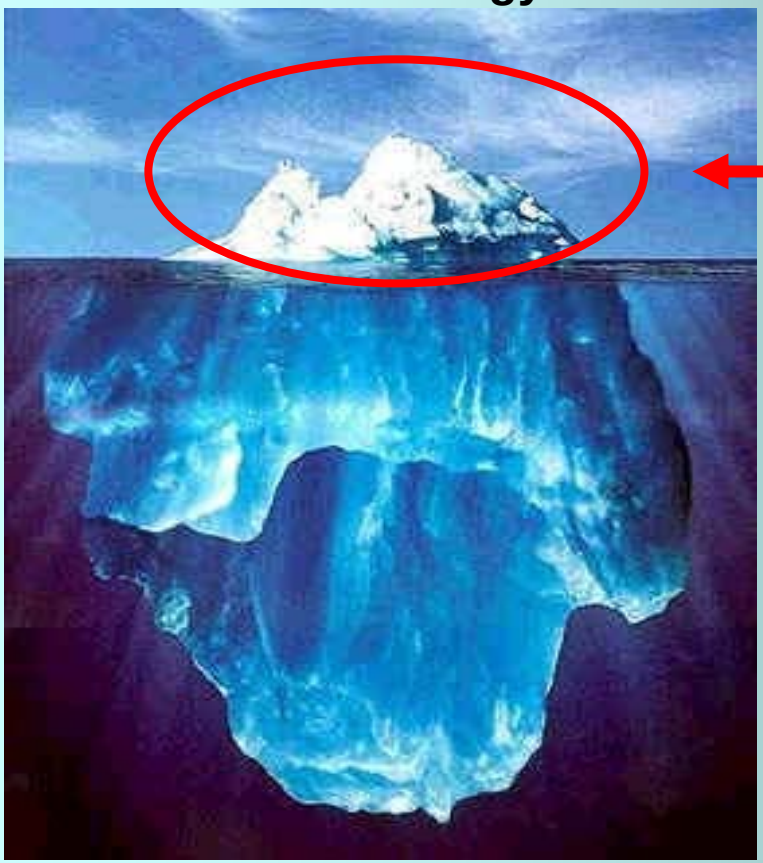
- Grid Dependence
- Adequate Back-Up Power
- More DoD critical missions conducted from CONUS, MOBs
- Alternatives: sustainable on-base power

Demand

- Facility Inefficiency
- Green Building Principles
- Treat Buildings as Systems in Planning
- Exploit Commercial Technologies & Practices

Out of Sight, Out of Mind

Fuel for Forces
~75% of DoD energy demand



But, no one in charge above or below the waterline

vs.

Energy for Installations
~25% of DoD energy demand

No Invisible Tail

- 4-Star Equivalent in charge
- Facilities are easy to count
- Virtually no invisible tail
- Clear focus
  - Energy Policy Act of '05
  - Executive Order 13423
- ~$3B to purchase in FY06
- Numerous award programs - incentives
- Easy COTS solutions to exploit

We're not managing the bigger Energy bill and tradespace

DoD Fuel Supply Chain

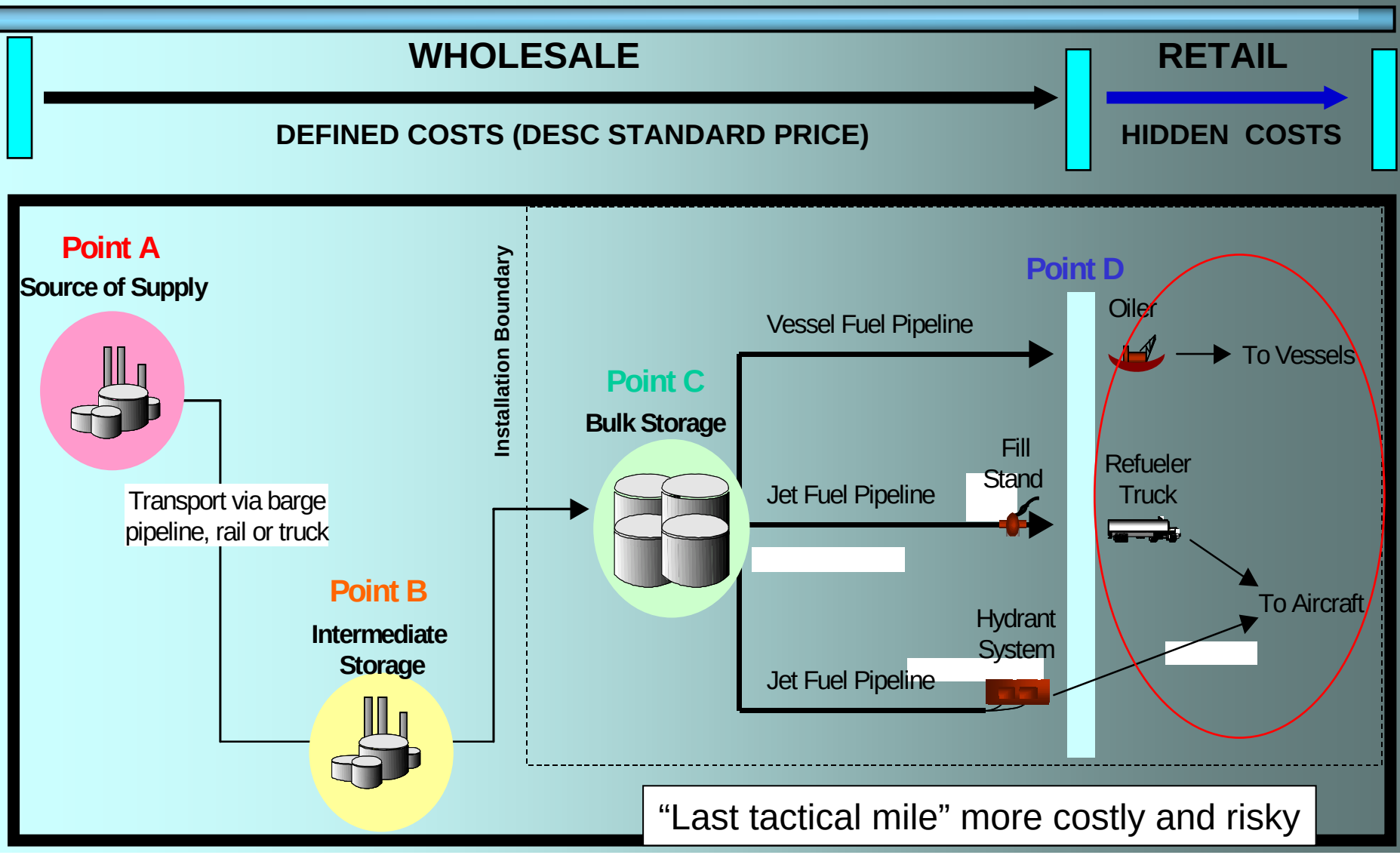
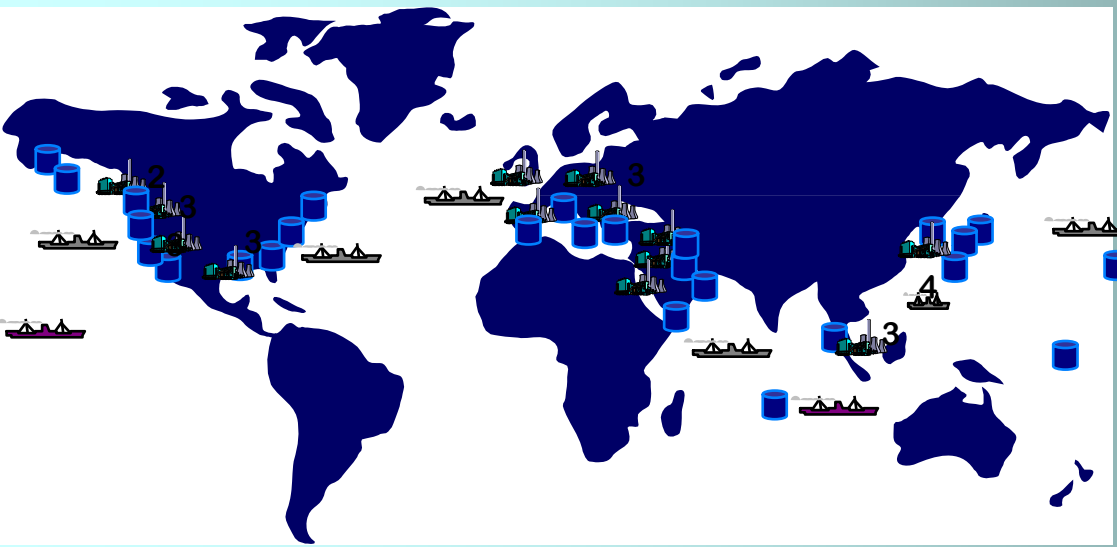


*Chart based on 2004 DoD Energy Management Study

Perspective on Fuel for DoD

- Petroleum-based fuels will remain the primary energy source for DoD mobile platforms for the next 25+ years
- DoD use: ~ 0.3million barrels per day (bpd) compared to >80m bpd globally and ~21m bpd domestically
- DoD has eminent domain over fuel contracts
- DESC maintains robust global network of supply points and sources for all types of DoD fuels



MILSPEC Petroleum Products

Worldwide Tanker Supply Chain

DoD has very low strategic fuel supply risk – focus elsewhere

…and its unrecognized burdens

- Impairs Operational Effectiveness
  - Vulnerability to forces and mission
  - Increases casualties
  - Constrains maneuver, limits endurance
  - Dilutes combat effectiveness by increasing force protection demands
- Increases Cost
  - Increases budget effects of volatile energy prices
  - Funds used for energy are not available to buy capability
- Skews Force Structure Toward Support

High Operational Fuel Demand

Gen James Mattis, USMC

- “Unleash us from the tether of fuel”

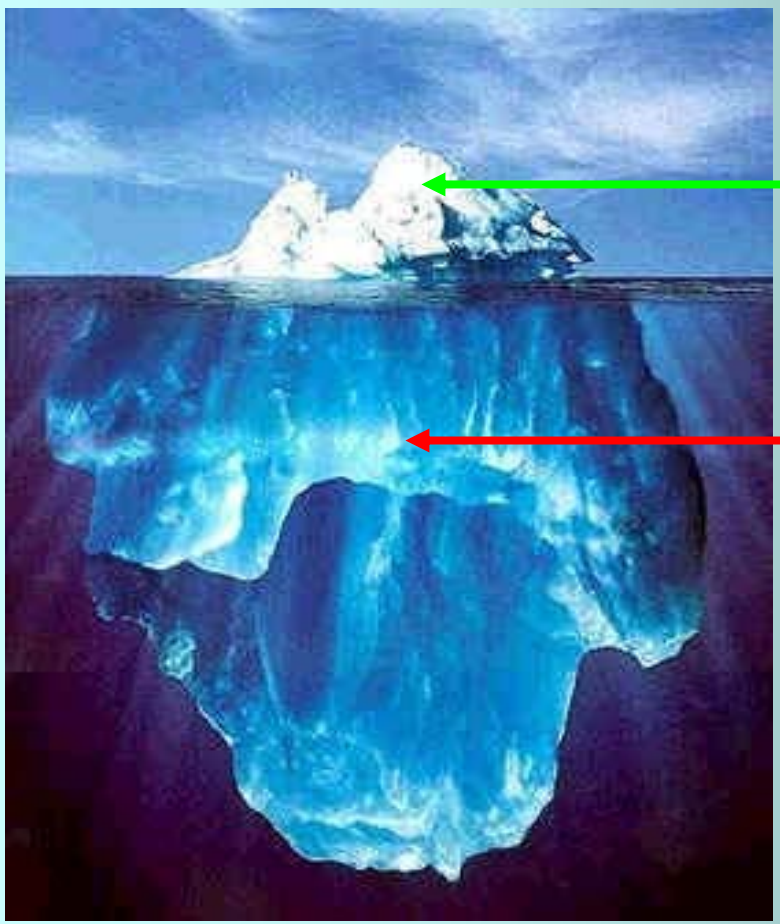
Lt Gen Richard Zilmer, USMC, Al-Anbar Commander

- Urgent request to reduce military dependence on fuel*
- Road-bound convoys, supply lines vulnerable to insurgent attack by ambush and IEDs
- Personnel loss rates, continued casualty accumulation can to jeopardize mission success

* Defense News, August 2006

"Price" is not "Cost"

Fuel for DoD *Operations*



Direct Price

~$12B to purchase in FY07

Indirect Costs

Huge "tail" to deliver

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

Fiscal and Operational Costs from DoD's fuel demand are orders of magnitude bigger than we appreciate

…delivery is the real cost

$3.04/gal *or* $42/gal*

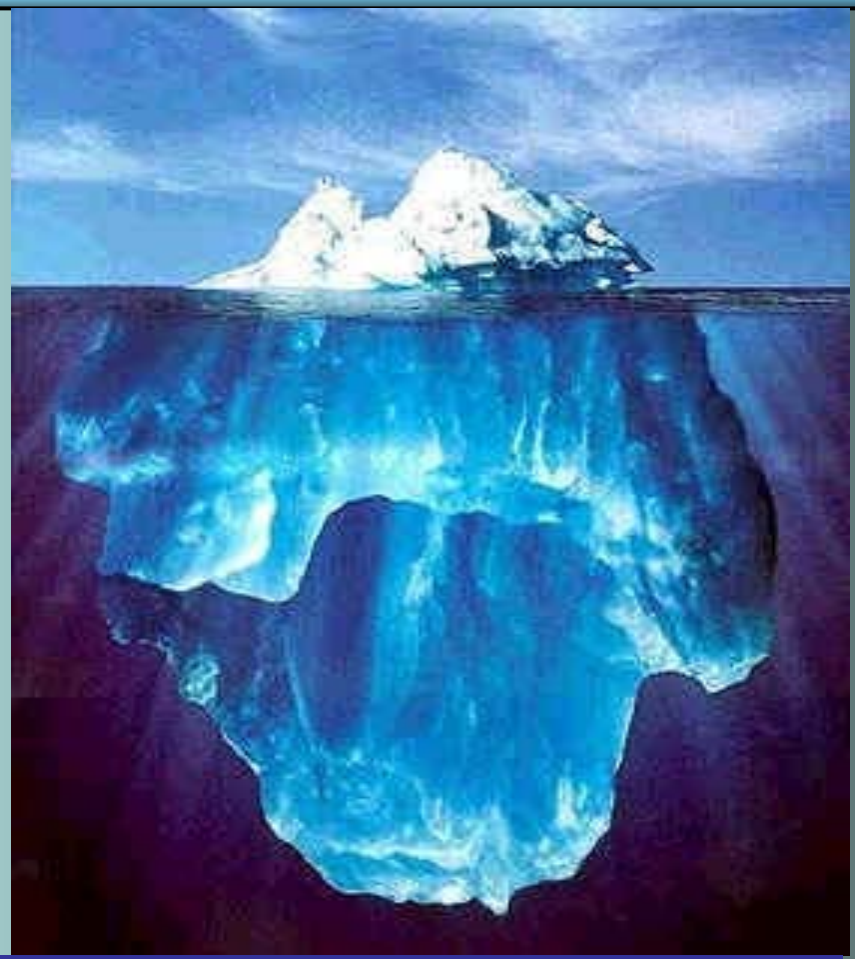
$3.04 or $15* or ???/gal w/ escorts & helo protection?

~$3.04 or ???/gal

**** Consistent FBCF results from 2001 DSB task force, PA&E, JASONs and IDA***

The Fully Burdened Cost of Fuel

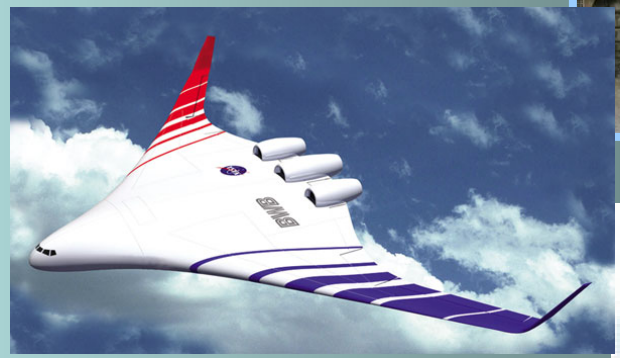
FBCF is the commodity price plus the total life-cycle cost of all people and assets required to move and protect fuel from the point of sale to the end user.

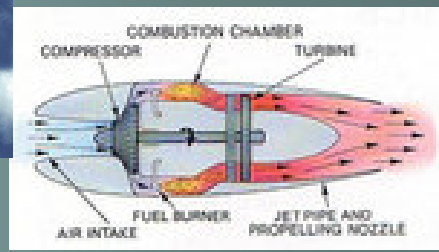


FBCF is a decision tool for giving delivered fuel due consideration in the operational & risk tradespace

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





DoD just not valuing the combat and fiscal value appropriately

And it's not just combat systems

Today's Top 10 Battlefield Fuel Users

SWA scenario using current Equipment Usage Profile data

Of the top 10 Army battlefield fuel users, only #5 and #10 are combat platforms

1. **Truck Tractor: Line Haul C/S 50000 GVWR 6X4 M915**
2. **Helicopter Utility: UH-60L**
3. **Truck Tractor: MTV W/E**
4. **Truck Tractor: Heavy Equipment Transporter (HET)**
5. ***Tank Combat Full Tracked: 120MM Gun M1A2*** ← Shooter
6. **Helicopter Cargo Transport: CH-47D**
7. **Decontaminating Apparatus: PWR DRVN LT WT**
8. **Truck Utility: Cargo/Troop Carrier 1 1/4 Ton 4X4 W/E (HMMWV)**
9. **Water Heater: Mounted Ration**
10. ***Helicopter: Attack AH-64D*** ← Shooter

Source: CASCOM study for 2001 DSB using FASTALS for SWA.

So, with all these great technologies, why don’t our platforms produce more “effect” for less “effort?

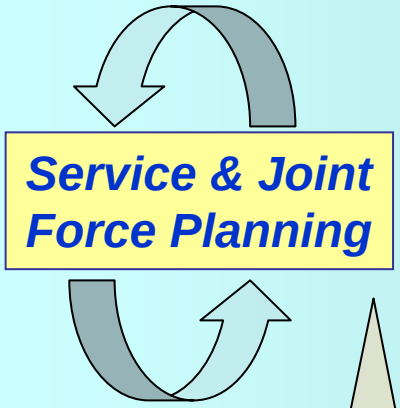
Because….

DoD Planning ***Processes*** Undervalue Fuel
And Its Delivery Costs

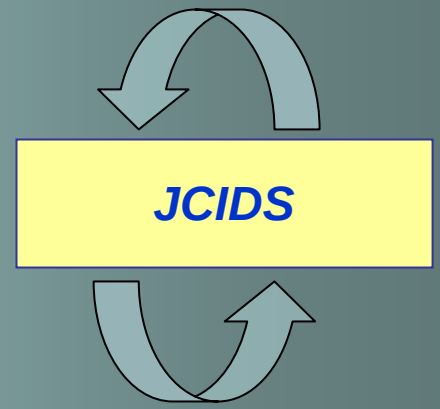
and

DoD Business ***Practices and Culture***
Disincentivize Strategic Investment or Savings

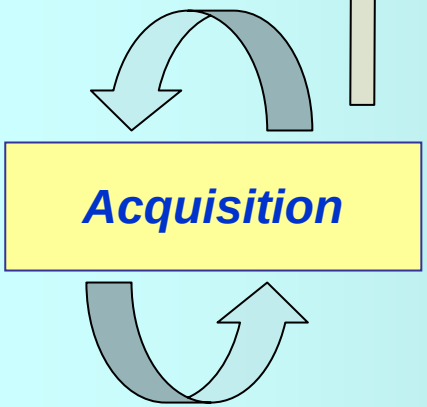
What We Want DoD to *Change* – *3 Processes*



- Build fuel, delivery, protection and vulnerability risk into Service & Joint campaign models, wargame, Defense Planning Scenario build (DPS') and force planning build (MSFDs)
- Set targets for reducing the fuel delivery burden within the force plans

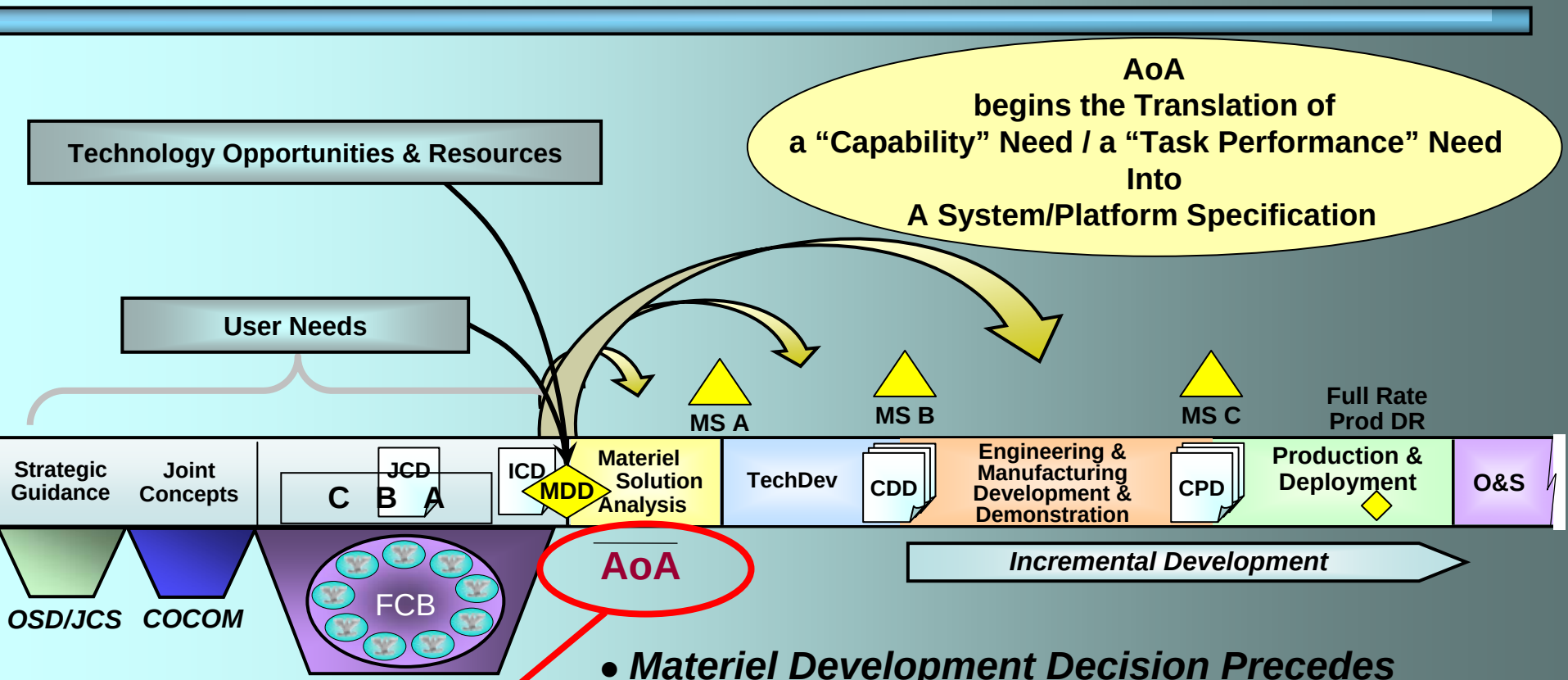


- Limit operational fuel demand to improve capability and reduce mission risk – frame the efficiency/effectiveness trade-off accurately
- Develop the scalable methodology for the Energy KPP for all Requirements (CJCSI 3170)



- Set programs'/platforms' fuel demand limits within scenario-based force packages
- Build relationship between the analysts, loggies and PM officers
- Require SAEs-PEOs-PMs to demonstrate achieved fuel demand targets at milestone reviews

New Acquisition Procedures – MDD - Where AoA Is Done



Where Requirements meets Acquisition

- ***Materiel Development Decision Precedes Entry Into Any Phase Of The Acquisition Framework***
- ***Entrance Criteria Met Before Entering Phase***
- ***Evolutionary Acquisition Or Single Step To Full Capability***

RESET/Upgrade Opportunities

- Large Cost: Army estimates its RESET requirement at **~$85 Billion***…but
- Army RESET program is also an upgrade program
  - Abrams & Bradleys stripped to the bolts – opportunity to reduce energy demand & support req.
  - Current RESET include tank gun, targeting & sensor upgrades – to defeat what threat? When?
- Up-armoring HMWVV to reduce combatant vulnerability shifts attacks to the "tail"
  - Added weight increases fuel and fuel logistics demand, roll-over deaths, reduces mobility
  - Fuel trucks can't be armored – combat forces must diverted to protect – reducing combat capability
- What is it worth to ground forces to reduce the fuel demand of legacy equipment?
  - Was unit, theater or enterprise (fuel) risk considered when deciding on investments?
  - Were modern diesel engines considered for M1 upgrades?
  - Are APU upgrade programs aggressive enough?
  - What demand reduction steps are underway on combat support assts?
- Revisit operational & development risks - play operational energy demand reduction in the RESET tradespace

* CSA & CMC Testimony before House Armed Services Committee, as reported by Army News Service, 26 January 07

Current Actions

- Implementing FBCF
  - 3 Pilot programs: (CG(X), Next Generation Strike, Joint Lightweight Tactical Vehicle (JLTV))
  - Defense Acquisition Guidebook revision expected this fall
  - Workshops with OSD, Services, Industry & OSD PA&E to develop methodology
- Integration of energy into Analytic Baseline
  - DPS and MSFD deliberations
  - Service Title 10 wargames
  - Development of methodology for formulating Energy KPP
  - Other studies like MCRS and the Shaping Study
- DoD-wide Strategic Plan under development
  - Briefed to DAWG on Sep 3
  - 2 Volumes: Strategy and Implementation
  - Broad agreement on Strategy
  - Specific tasks yet to be vetted

For More Information

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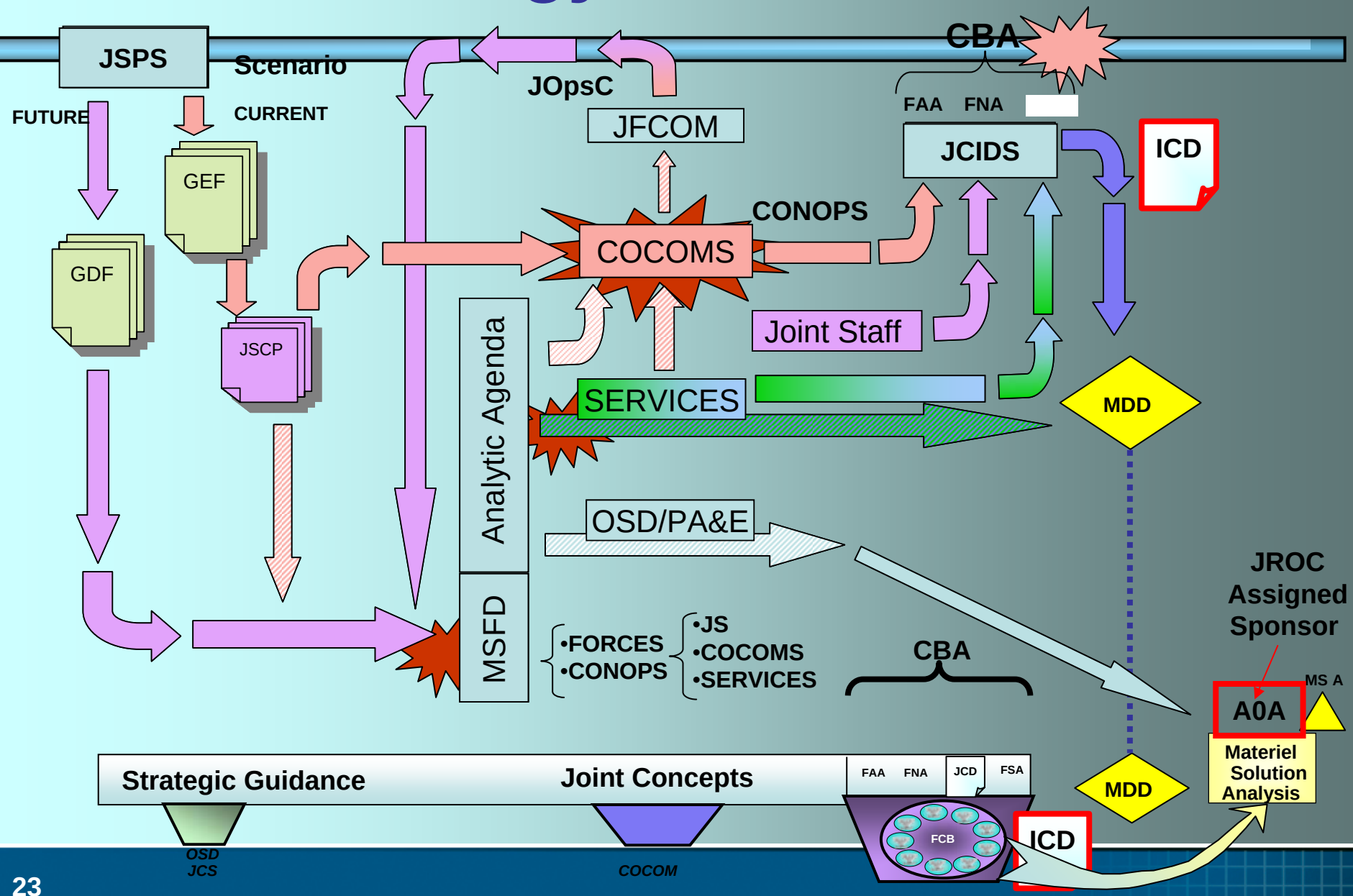
Backup

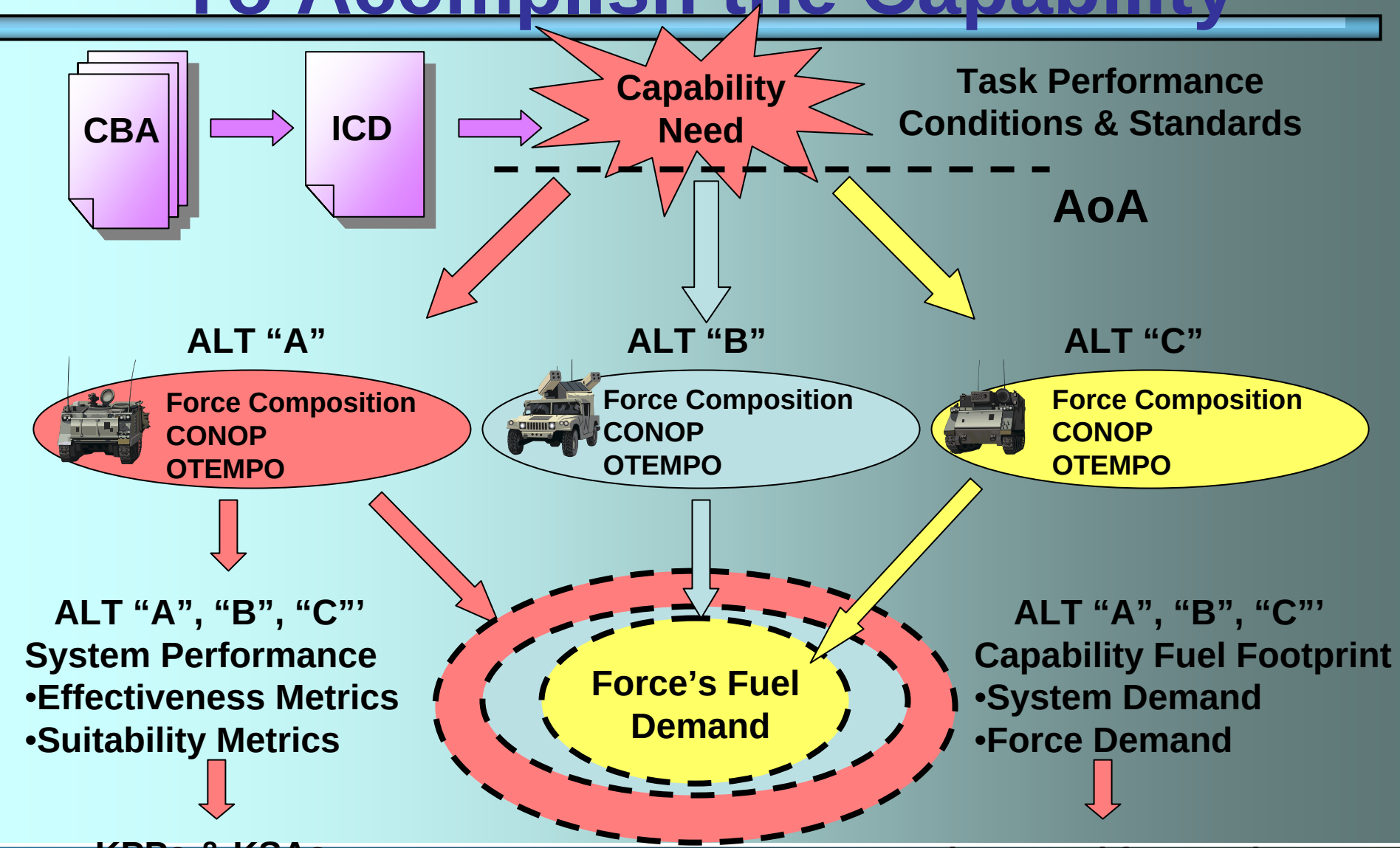
Changing How Fuel Demand Informs Acquisition Choices and Tradespace

Details on Calculating FBCF

Fuel & Energy AoA Touchstones



FBCF: Fuel to "USE" the System To Acomplish the Capability



FBCF: Fuel Cost for USE

Q: Why would the Force's demand for Fuel vary by alternative?

A: The Presence of the Alternative in the Force may change:

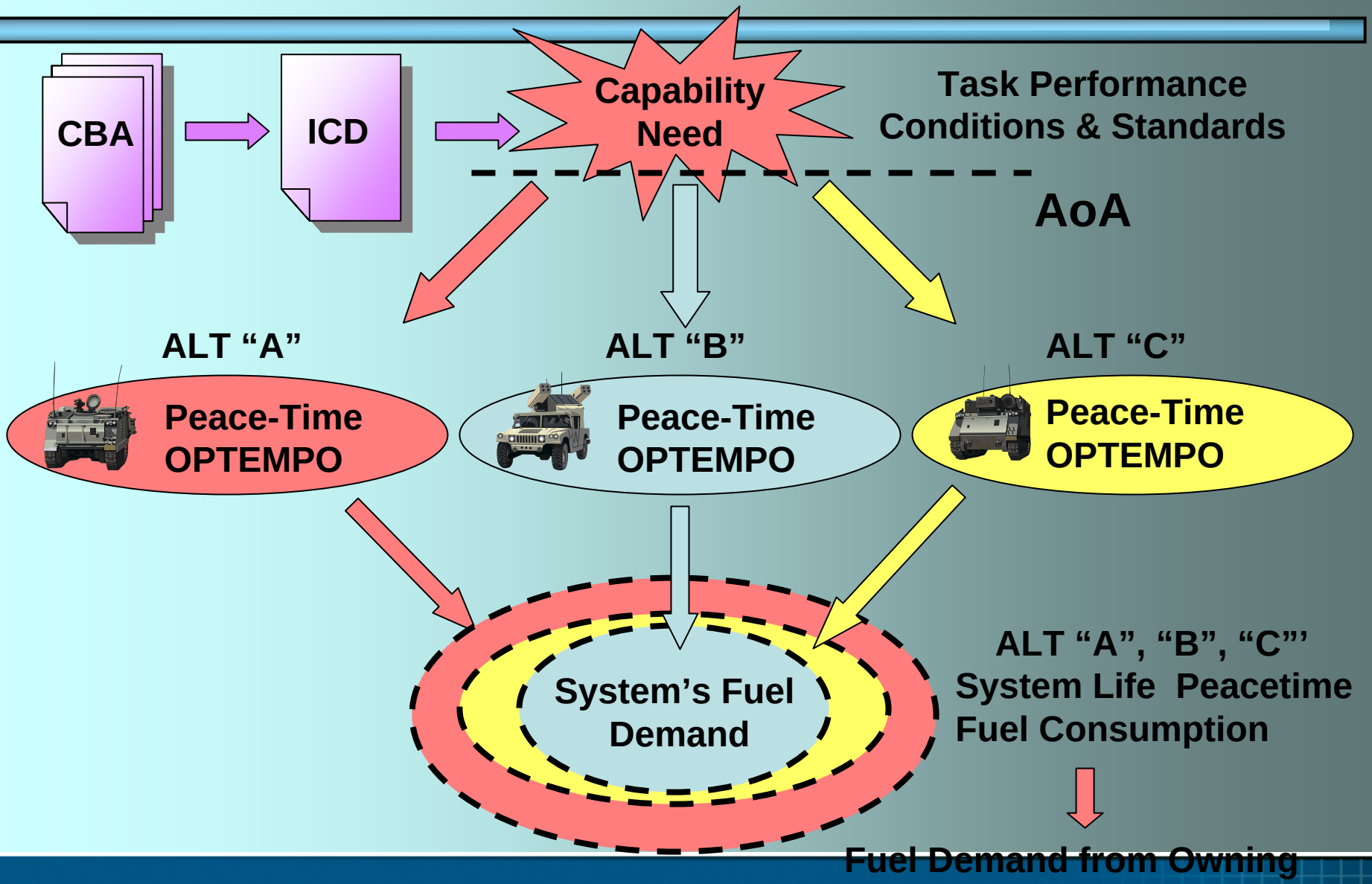
- **Force Composition**
  - **Improve tooth to tail ratio in the scenario (free up MOG, speed arrival in theater, reduce timeline, etc.)**
- **CONOPS**
  - **Reduce the total number of forces (esp. non-combatants) needed for mission completion**
- **OTEMPO**
  - **Duration of mission reduced**
  - **Long-term scenarios put less stress on total force**

Each of which affect the amount of fuel needed by the involved Force to wield the capability

AND

the logistics and protection needed to provide that fuel.

FBCF: Fuel to "OWN" the System



AoA Calculation of FBCF

FBCF refers to the comprehensive Cost of Fuel when using the Alternative to accomplish the ICD specified Capability

- **FBCF for an AoA Alternative =**
  - **Fuel Cost of OWNING the System Alternative**
    - **Life time, Peace-Time OPTEMPO Fuel Consumption**

    +
  - **Fuel cost of USING the Alternative to provide the needed Capability**
    - **The Cost of field delivered Fuel: Fuel Cost to the Force (with the system embedded) performing the Needed Capability**
      - **Includes the Cost of Distribution AND Protection of the Distribution of Fuel to the involved Mission Force**

    +
  - **Cost of fuel consumed by the involved Force (with the system in it) while accomplishing the Capability**

FBCF

Fuel to OWN the System + **Fuel to USE it in the Force**

BASELINE

Force Without an Alternative Fuel Demand to accomplish the Task

ALT "A"

System's Fuel Demand Peace-Time OPTEMPO + **Force's Fuel Demand to Accomplish Capability**

ALT "B"

+

ALT "C"

+

AoA FBCF Method

INITIALLY

- Cost of Owning:
  - Peace time OPTEMP Life-cycle fuel demand

+

- Cost of Using:
  - A “FIXED” CONOP, OTEMPO and Force Composition for calculating a Fuel Distribution and Protection cost.

EVENTUALLY

- JROC may determine when a variable CONOP is to be used
  - Analytic processes need to be developed:
    - Mission Scenario description
    - CONOP description
    - Fuel consumption analysis methodology
    - Process for authoritatively altering CONOP, Force Composition as a consequence of the presence of the Alternative in the Force.