



# **S&T and Maneuver Warfare: A Current Success and a Future Challenge**

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# S&T and Maneuver Warfare

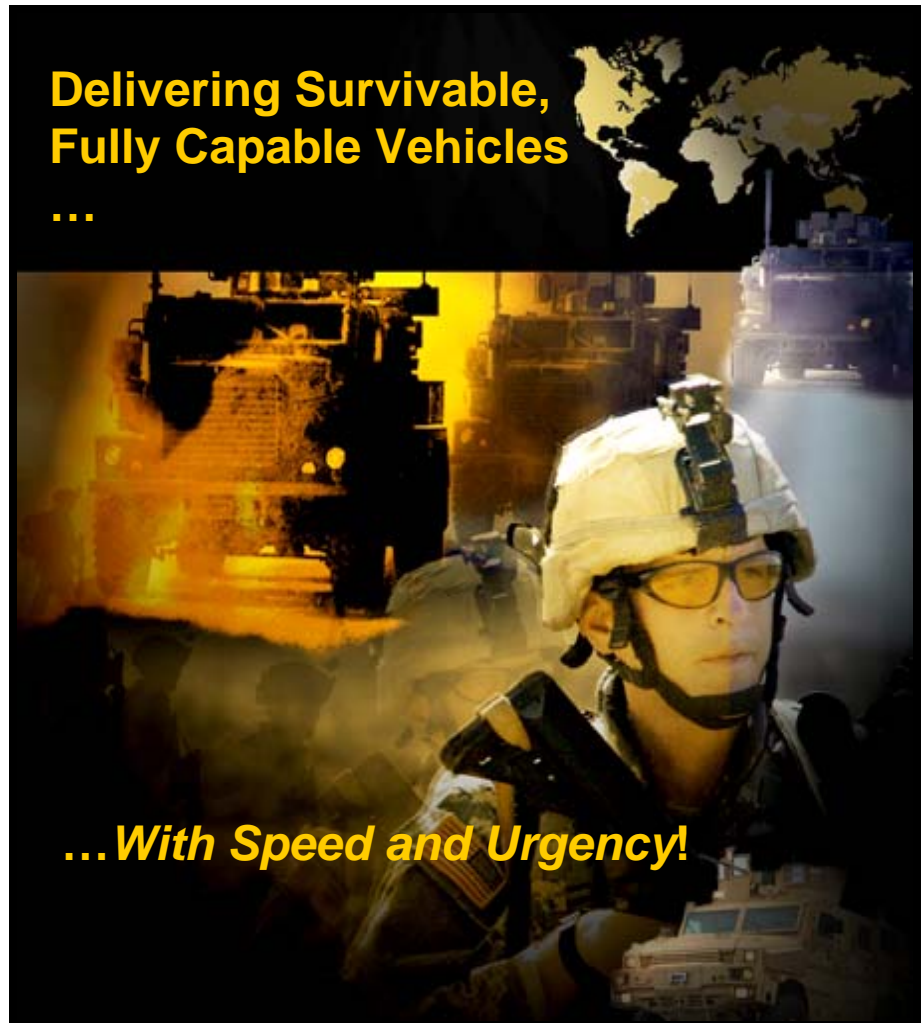
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- **Success Story**
- S&T Challenge



# MRAP – A Present Day Success Story

- Change in enemy tactics generated an urgent Warfighter need for:
  - Mine Resistant Ambush Protected Vehicle
  - Large quantities
  - Required ASAP
- MRAP Program is the response to this urgent need
  - Unprecedented effort
  - Unprecedented speed
  - Unprecedented Gov / Industry Teamwork





# MRAP – CAT I



**GDLS-C - RG-31 MK 5E CAT I**



**FPII - Cougar CAT I**



**BAE RG-33 - USSOCOM CAT I**



**MRAP II BAE TVS Caiman CAT I**



**MRAP II I-3 Bull CAT I**



**IMG MaxxPro CAT I**



**BAE TVS Caiman CAT I**



# MRAP – CAT II and III



**BAE – RG-33L CAT II**



**FP II – Cougar CAT II**



**BAE RG-33L - HAGA CAT II**



**FP II - Buffalo CAT III**

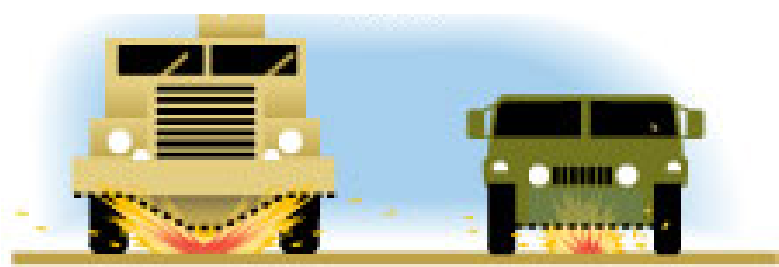


# MRAP v. HMMWV

How the Cougar 4x4 Mine Resistant Ambush Protected (MRAP) vehicle compares to the up-armored Humvee M1114:



MRAP		Humvee	
108 inches	<b>Width</b>	91 inches	
104 inches	<b>Height</b>	75 inches	
233 inches	<b>Length</b>	196.5 inches	
38,000 lbs.	<b>Maximum weight</b>	12,100 lbs.	
5-10	<b>Crew</b>	4	
330 hp	<b>Engine</b>	190 hp	
65 mph	<b>Maximum speed</b>	78 mph	
5,000 lbs.	<b>Payload capacity</b>	2,300 lbs.	
600 miles	<b>Range</b>	275 miles	



V-shaped hull deflects force of blast away from crew.

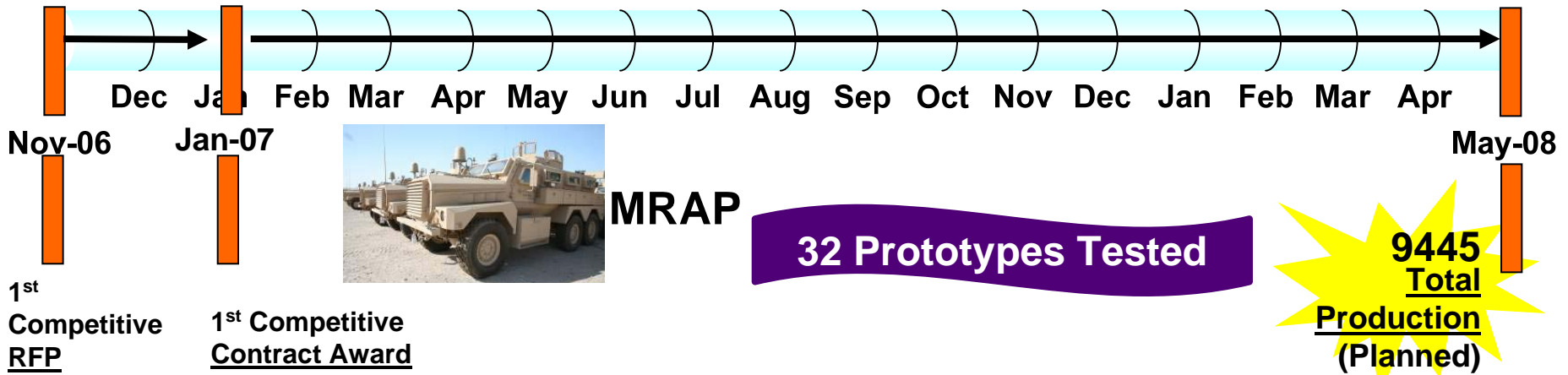
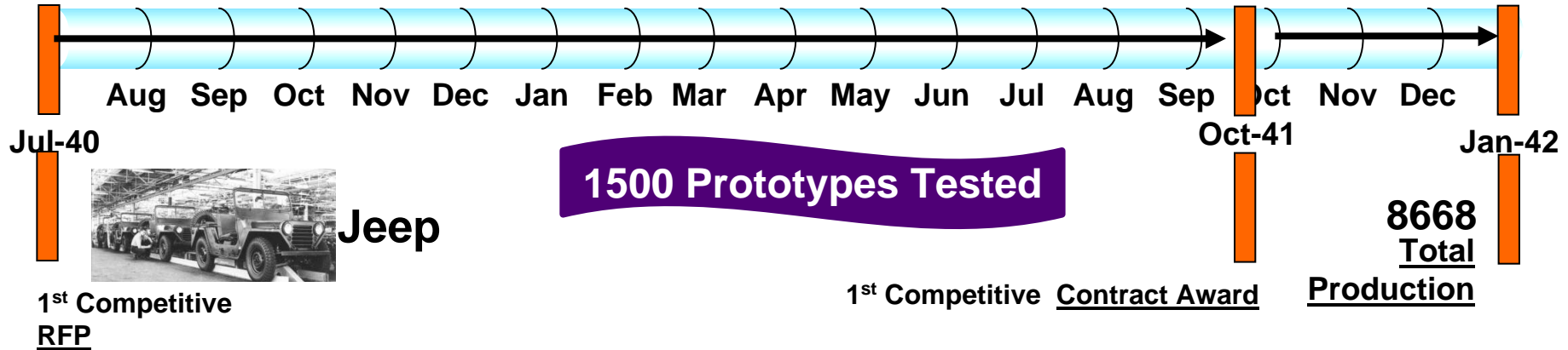
Flat underside catches full force of blast through the floor.

Sources: Credit Suisse; Force Protection Inc. (forceprotection.net); globalsecurity.org; insidedefense.com; janes.com  
By Frank Pompa and Karl Gelles, USA TODAY

Source: USAToday at <[http://www.usatoday.com/news/military/2007-07-15-ied-cover\\_N.htm?csp=34](http://www.usatoday.com/news/military/2007-07-15-ied-cover_N.htm?csp=34)>



# MRAP – Compared to a Legend



*MRAP vehicles are significantly more complex!*



# The MRAP Team - Production

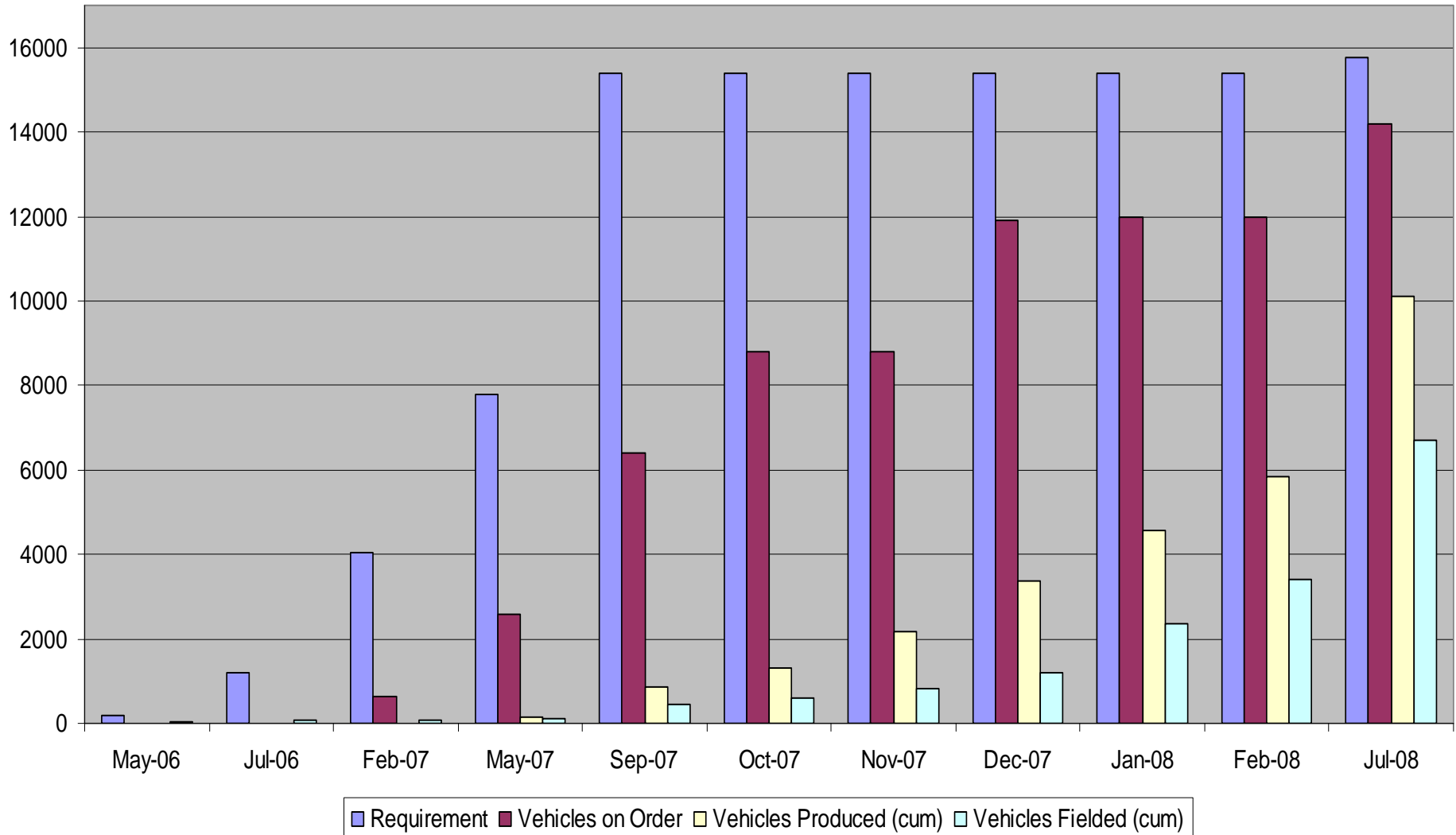
- 62 Major Tier 2 vendors for 15 critical sub-assemblies, for example:
  - **Armor (8)**
  - **Diesel Engines (3)**
  - **Suspension components (9)**
- Defense Contract Management Agency (DCMA)
- Testing and Evaluation Commands







# MRAP – The Numbers



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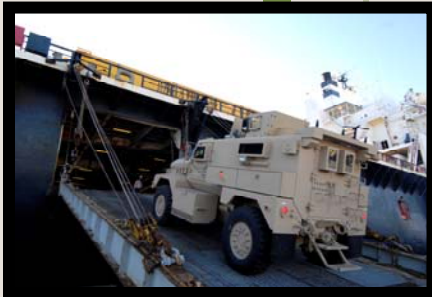
# MRAP Team - Transportation

- **TRANSCOM**

Shipping Totals as of January 24, 2008



**Airlift 1683**



**Sealift 1048**





# Making MRAP Happen

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- Cost
  - *Defining Long-term Sustainment Requirements and Controlling Costs*
- Schedule
  - *Meeting Accelerated Acquisition, Production and Fielding Requirements*
- Performance
  - *Implications of Engineering Change Proposals and Spiral Development*
- Technical
  - *Stressing the industrial Base (Axle, Steel and Tire Availability)*

***Aggressive Risk Management Pays Off for the Warfighter***



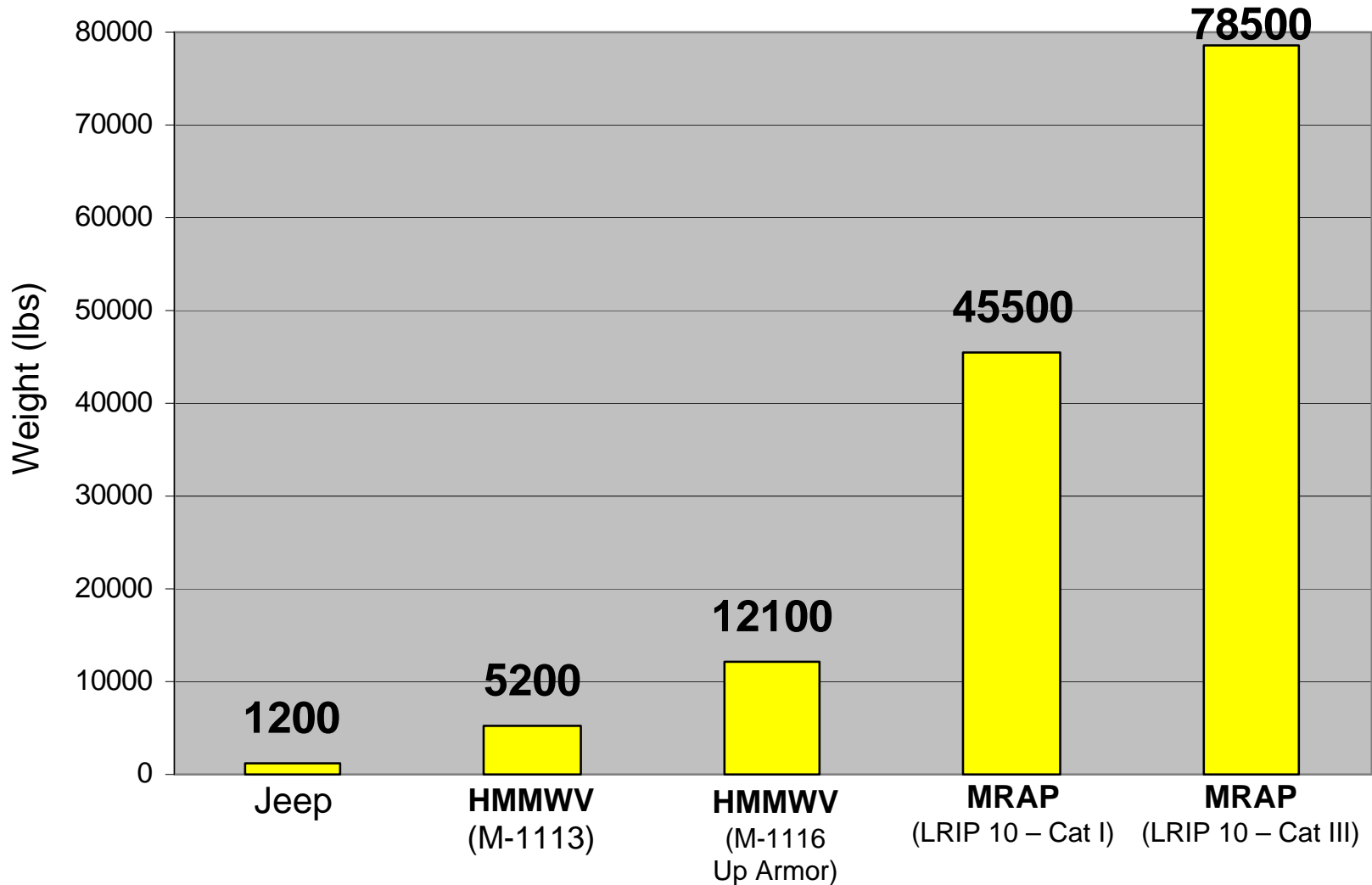
# S&T and Maneuver Warfare

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- Success Story
- **S&T Challenge**



# Military Vehicle Weights



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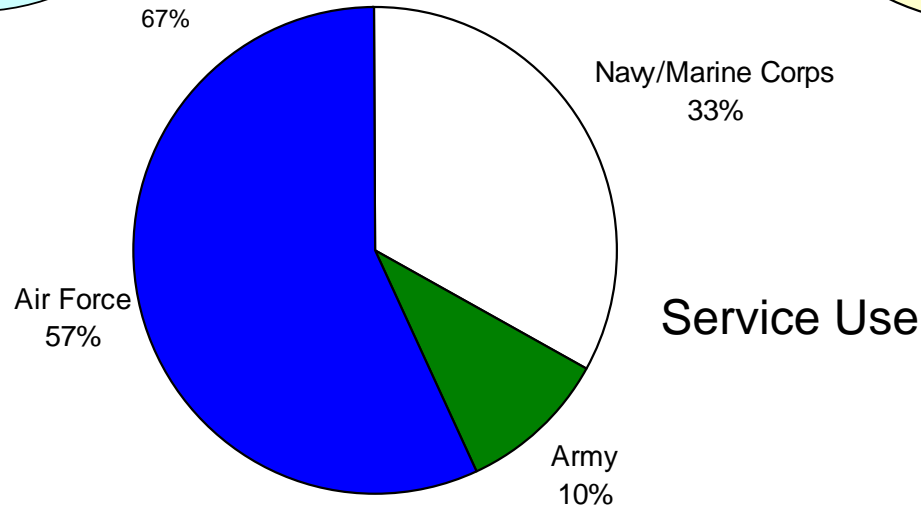
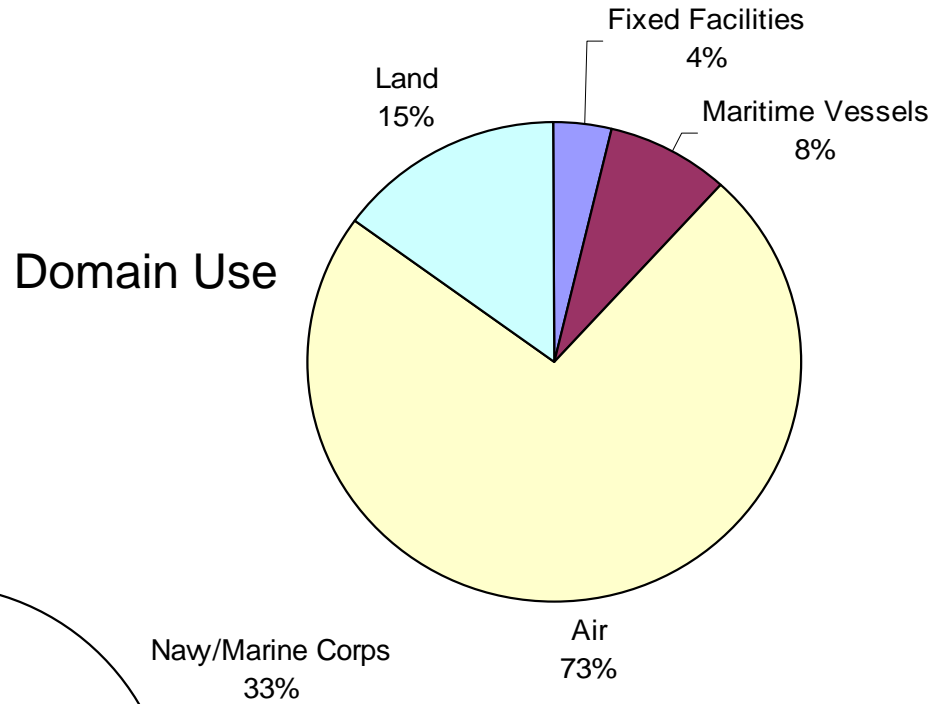
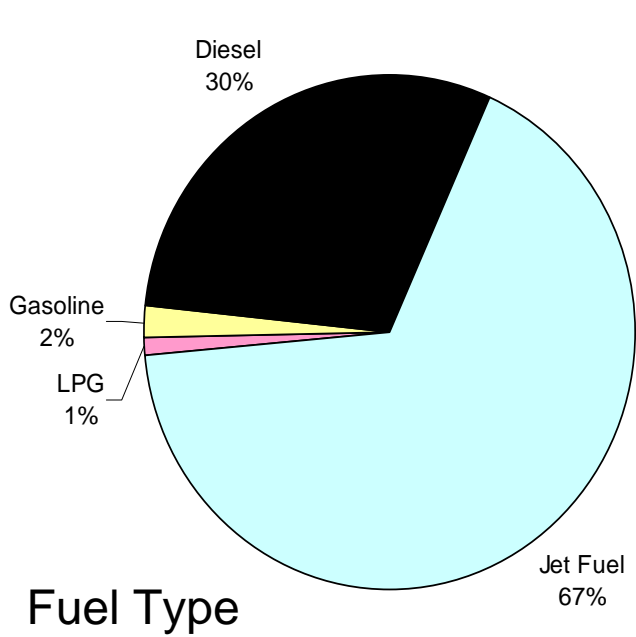
# Fuel Logistics: DoD's Soft Underbelly

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- Logistics consumes roughly half of DoD's personnel and a third of DoD's budget
- ~70% of the tonnage moved (when the Army deploys) is fuel
- About half the current casualties in theater are associated with convoys
  - We loose a lot of people moving fuel around



# Approx. Fuel Use by DoD in FY05





# Fuel Savings: Enormously Valuable

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- More-fuel-efficient platforms offer major warfighting, logistics, and budget benefits
- Force protection: far fewer convoys at risk of attack
- Force multiplier: trigger-pullers can win battles without the deadly distraction of protecting fuel
- Force enabler: unprecedented persistence (dwell), agility, mobility, maneuver, range, reliability, and autonomy—at low cost, so many small units can cover large areas—needed for asymmetrical, dispersed, elusive, remote, irregular adversaries
- Can unlock vast transformational gains (multidivisional tail-to-tooth realignment, 10s of \$B/year)





# Challenge to S&T Community

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- How do we make our platforms more fuel efficient while retaining existing capabilities?
- How do we make lightweight armor that is at least as effective as our current steel based solutions?
- How do we do maneuver warfare, while protected, without the weight?



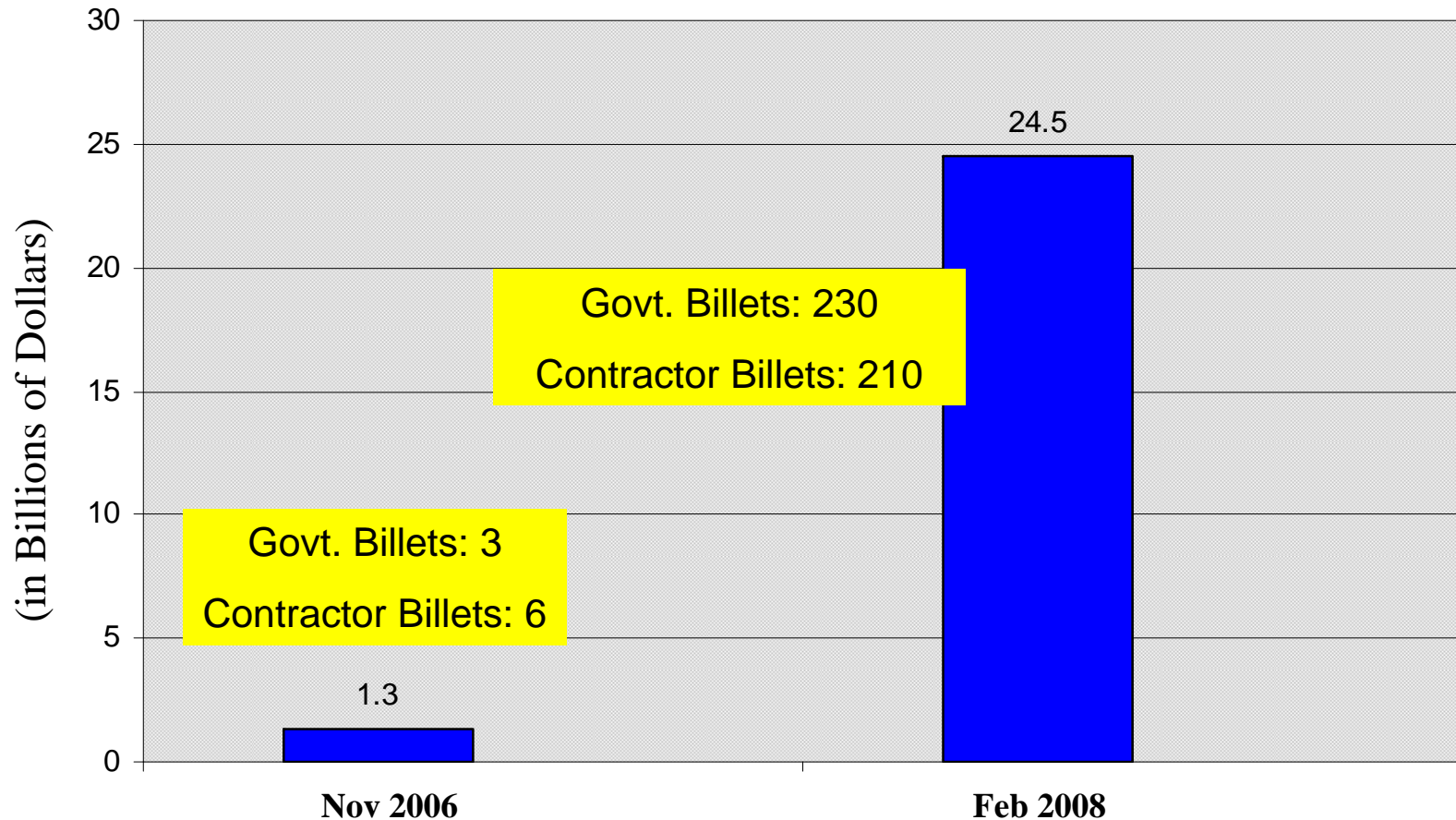
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# Back-Ups



# Team Growth: Joint Program Office

## Total Program Funding



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# Big Picture: DoD Investment in Advanced Materials Can Achieve DoD and US Goals

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- DoD S&T investment in ultra-light materials, high-volume/low-cost manufacturing, and advanced propulsion
  - Enable DoD transformational tenets
  - Strengthen warfighting capability
  - Cut DoD fuel costs by \$multi-B/year
  - Cut fuel logistics cost many-x more
  - Huge realignment potential



# Common DoD Views on Energy

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- We exist to be *effective*, not *efficient*, so platform performance always trumps fuel cost—and rightly so
- DoD energy technology and innovation will be driven by the civilian marketplace, and need no attention from us
- DoD has no rewards for energy efficiency\*, no penalties for energy inefficiency†, and sparse energy-use data; that’s OK
- We don’t “do” energy; we buy it
- Energy is a necessary expense, not an investment issue
- Energy’s supporting infrastructure is not a major factor in requirements and procurement choices
  - Fuel logistics is invisible, free, and invulnerable
  - Its burden can be ignored when we make decisions that determine DoD’s fuel use
  - Existing KPPs like range, speed, and payload implicitly include all worthwhile energy goals, so “energy KPPs” would be superfluous

\*With one modest but effective Navy exception

†However, Congressional and Executive mandates drove ~30% drops in Service facilities’ J/m2-y



# Where to Find Winners

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1. The most total *fuel* can be saved in aircraft: Since aircraft use 73% of DoD oil, a 35% saving in aircraft would equal the total fuel use by all land and maritime vehicles plus facilities
  - Improvements in aerodynamics, materials, systems, and propulsion all needed
2. The greatest gains in *combat effectiveness* will come from fuel-efficient ground forces (land and vertical-lift platforms, land warriors, FOBs)
3. Savings *downstream*, near the spear-tip, save the most total fuel: delivering 1 liter to Army spear tip consumes ~1.4 *extra* liters in logistics
4. Savings in aerially refueled aircraft and forward-deployed ground forces save the most *delivery cost* and thus *realignable support assets*



# Non-Trivial Oil Facts

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- In WWII, heavy steel forces “floated to victory on a sea of oil,” and 6/7ths of oil to defeat Axis came from Texas; today, Texas is a net importer of oil
- In WWII, the average fuel consumption per service member was about 1.67 gallons/day. In Iraq, it is 27.3 gallons/day
- Each \$10/bbl increase in oil price directly costs AF ~\$0.8B/year, DoD ~\$1.3B/year



# Batteries

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- Today's soldiers average 5.9 kgs of batteries for a 72 hour mission and 7.9 kgs of batteries for a 96 hour mission—based on 10.3 watts/hours
- TRADOC's goal (10-15 years into future) is 50 watts/hour
- Clearly something has got to change





# Conclusion

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- “Amateurs talk tactics, professionals talk logistics”
- We accept that we can’t recapitalize everything at once, but...
- It is time for the professionals to start talking about energy



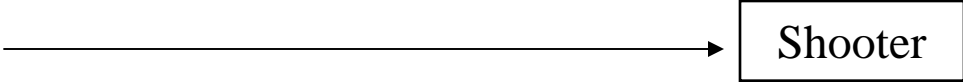
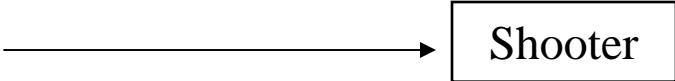
# It's Not Just Combat Systems

## 1st Gulf War'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**
6. Helicopter Cargo Transport; CH-47D
7. Decontaminating Apparatus: PWR DRVN LT WT
8. Truck Utility: Cargo/Troop Carrier 1 ¼ Ton 4x4 W/E (HMMWV)
9. Water Heater: Mounted Ration
10. **Helicopter: Attack AH-64D**



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Source: CASCOM study for 2001 DSB using FASTALS for SWA



# Dramatic Gains in Combat Effectiveness and Energy Efficiency are Available:

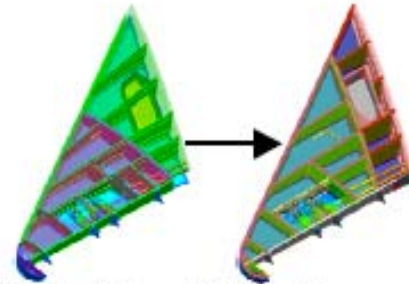


(scaled-down wind-tunnel model)

BWB quiet aircraft:  
range & payload  $\times$   
 $\sim 2$ , sorties  $\div$  5–10,  
fuel  $\div$  5–9 ( $\Sigma$  2–4)



Re-engine *M1* with  
modern diesel, range  
 $\times \geq 2$ , fuel  $\div$  3–4



25% lighter, 30% cheaper  
advanced composite  
structures; aircraft can  
have  $\sim 95\%$  fewer parts,  
weigh  $\geq 1/3$  less, cost less



Hotel-load retrofits  
could save  $\sim 40\text{--}50\%$   
of onboard electricity  
(thus saving  $\sim 1/6$  of the  
Navy's non-aviation fuel)



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**DoD must slash its fuel-logistics dependence and increase its energy resilience for its own mission effectiveness & continuity...**

**...and can thus be the key technological catalyst and government leader in getting the U.S. forever off oil**



# Key Findings

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- Primary energy risk to DoD
  - Unnecessarily high and growing operational fuel demand increases mission risk
- 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



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So, with all these great technologies, why don't our platforms produce more "effect" for less "effort"?



# Because...

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DoD planning *processes* undervalue fuel and  
its delivery costs

and

DoD business *practices and culture*  
disincentivize strategic investment or savings

SO

***We don't yet do what we know we must***



# RESET Opportunities

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- Net effect of current approach is to refurbish yesterday's equipment buys to yesterday's vehicle technology baseline...back to the future...
  - A refurbished HUMVEE is still a HUMVEE
- Cost is sobering: US Army estimates RESET funding to be: ~\$85 billion\*
- Shouldn't we be far more aggressive and innovative and actively pursue current and near term technologies, at least in part?
  - Resilience and endurance issues bit us hard: Fuel burden penalty, troop protection
  - Up-armorings, additional equipment etc. overburden current power trains & chassis...significant re-engineering and up-engining probable
- RESET, as now envisioned, needs serious OSD reconsideration...
  - Locks in FYDP's worth of investment at expense of exploiting new R&D
- Take development risk now...**get ready for tomorrow, not yesterday**





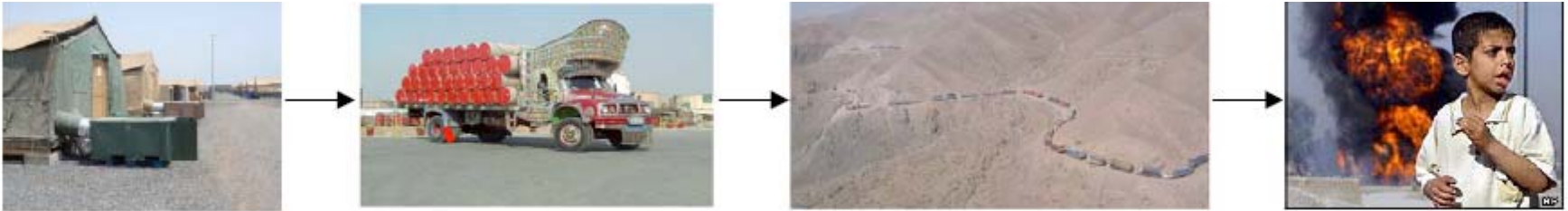
# Five Recommendations

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1. Accelerate efforts to implement energy efficiency Key Performance Parameters (KPPs) and use the Fully Burdened Cost of Fuel (FBCF) as recommended by the 2001 DSB report.
2. Reduce the risk to critical missions at fixed installations from loss of commercial power and other critical national infrastructure.
3. Establish a Department-wide strategic plan that establishes measurable goals, achieves the business process changes recommended by the 2001 DSB report and establishes clear responsibility and accountability.
4. Invest in new energy technologies to a level commensurate to their value to the Department.
5. Change operational procedures to reduce energy demand — policies and incentives.



# Is This Trip Necessary?



One inefficient 5-ton a/c uses ~1 gal/h of genset fuel. Truck's 68-barrel cargo can cool 120 uninsulated tents for 24 h. This 3-mile convoy invites attack. (Photos aren't all in the same place.)

- COL Dan Nolan (USA Ret.) on fuel convoys: “We can up-gun or down-truck. The best way to defeat an IED is...don't be there.” Breed a Manx force: no tail
- In above example, the task (comfort) can probably be done with *no* oil. No gensets, no convoys, no problem. Turn tail into trigger-pullers. Multiply force. Grow stronger by eating our own tail.
- Of Clausewitz's three conditions for success in war—government decision, military capacity, and the will of the people—current adversaries are attacking mainly the third, but are figuring out that the second is fragile too. How soon will they bring that tactic to CONUS? COL Nolan:
  - “We are in crisis now, and if we don't fix it, we'll be in catastrophe in five years.”
- The “endurance” strategic vector is at least as vital for stability as for combat ops (they now have comparable priority: DoDD Memo 3000.05, §4.1), because stability ops may need even more persistence, dispersion, and affordability
- Some Iraq overlays suggest that areas with reliable electricity have substantially less violence, 34 reducing risks to forces and likelihood