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Office, Assistant Secretary of the Army for Installations, Energy and Environment

Methodology & Analysis for Energy Security in Military Operations (MAESMO)

Final Report

January 2011



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METHODOLOGY & ANALYSIS OF ENERGY SECURITY IN MILITARY OPERATIONS

Final Report

January 2011

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TABLE OF CONTENTS

	Page
LIST OF ACRONYMS	III
EXECUTIVE SUMMARY	VI
ACKNOWLEDGEMENTS	XI
1.0 INTRODUCTION.....	1
2.0 STUDY APPROACH AND TASKS	3
2.1 Literature Review and Establishment of Baseline Architecture	3
2.1.1 Literature Review.....	3
2.1.2 Meetings with Representatives from Army Analytical Offices.....	6
2.1.3 Development of a Baseline Architecture	8
2.2 Development of Energy Security Cost-Benefit Analysis Methodology.....	14
2.3 Demonstration of Proposed Energy Security Cost-Benefit Methodology.....	16
2.3.1 Case Study Descriptions and Parameters.....	17
2.3.2 Draft SMP Cost-Benefit Output and Draft Qualitative Assessments for Eight Illustrative Case Studies	20
2.4 Assessment of Methodology Implementation and Documentation of Project	24
2.4.1 Requirements Management	25
2.4.2 Army Posture Statement 2010 and Cost Benefit Analysis Guidance	25
2.4.3 Cost Benefit Analysis (CBA).....	26
2.4.4 Energy Security and Cost Benefit Analysis.....	27
2.4.5 Planning, Programming, Budget, and Execution (PPBE).....	29
2.4.6 Cost Benefit Analysis (CBA) and PPBE: Estimating Quantifiable Benefits	31
2.4.7 CBA: Organizing Cost Data	31
3.0 FINDINGS AND RECOMMENDATIONS	32
APPENDIX A: FINDINGS OF LITERATURE REVIEWS	35
APPENDIX B: SUMMARIES OF MEETINGS.....	38
APPENDIX C: CASE STUDY 5 KILOWATT ADVANCED MEDIUM MOBILE POWER SOURCE (AMMPS).....	46
APPENDIX D: CASE STUDY TACTICAL HYBRID ELECTRIC POWER STATION (THEPS).....	50
APPENDIX E: CASE STUDY 10 KILOWATT ADVANCED MEDIUM MOBILE POWER SOURCE (AMMPS).....	54
APPENDIX F: CASE STUDY 60 KILOWATT ADVANCED MEDIUM MOBILE POWER SOURCE (AMMPS).....	57
APPENDIX G: CASE STUDY TACTICAL GARBAGE-TO-ENERGY REFINERY (TGER).....	60
APPENDIX H: CASE STUDY SOLAR THERMAL WATER HEATING	63

APPENDIX I: CASE STUDY THERMAL RECYCLE DRYER ATTACHMENT	66
APPENDIX J: CASE STUDY SPRAY FOAM TENT INSULATION.....	69
APPENDIX K: KEY POLICY MEMORANDA, BRIEFINGS, AND REPORTS	72

LIST OF FIGURES

Figure 1. Hierarchy of Analytical Responsibilities.....	7
Figure 2. Overview of Baseline Architecture	8
Figure 3. Baseline Architecture: Developing Requirements	9
Figure 4. Baseline Architecture: Acquisition Decision-making	11
Figure 5. G4 SMP Cost-Benefit Analysis Factors	12
Figure 6. What Capabilities does the Army Want?	14
Figure 7: Overview of Proposed Enhanced Architecture	15
Figure 8: Quantitative Technology Rankings and Comparisons	21
Figure 9: Summary of DRAFT Qualitative Assessments for 8 Illustrative Case Studies	23
Figure 10. Cost Benefit Analysis Process.....	26
Figure 11. Proposed Enhanced Architecture for Army Operational Energy Analysis	28
Figure 12. Sample Table for Alternative Solution: Aggregated Cost (by Cost Element and by Year).....	32
Figure 13: Findings and Recommendations	34
Figure C1: Illustrative SMP Cost-Benefit Analysis of 5 kW AMMPS	48
Figure C2: Illustrative 5kW AMMPS Qualitative Assessment	49
Figure D1: Illustrative SMP Cost-Benefit Analysis of THEPS.....	52
Figure D2: Illustrative THEPS Qualitative Assessment.....	53
Figure E1: Illustrative SMP Cost-Benefit Analysis of AMMPS 10kW (for an HBCT in Iraq) ...	55
Figure E2: Illustrative 10 kW AMMPS Qualitative Assessment	56
Figure F1: Illustrative SMP Cost-Benefit Analysis of AMMPS 60kW (for an HBCT in Iraq) ...	58
Figure F2: Illustrative 60 kW AMMPS Qualitative Assessment	59
Figure G1: Illustrative SMP Cost-Benefit Analysis of Tactical Garbage to Energy Refinery (TGER, for an HBCT in Iraq)	61
Figure G2: Illustrative TGER Qualitative Assessment.....	62
Figure H1: Illustrative SMP Cost-Benefit Analysis of Solar Thermal (for a Sustainment Brigade in Iraq)	64
Figure H2: Illustrative Solar Thermal Qualitative Assessment	65
Figure I1: Illustrative SMP Cost-Benefit Analysis of Thermal Recycle (for a Sustainment Brigade in Iraq)	67
Figure I2: Illustrative Thermal Recycle Qualitative Assessment	68
Figure J1: Illustrative SMP Cost-Benefit Analysis of Spray Foam (for a Sustainment Brigade in Iraq)	70
Figure J2: Illustrative Spray Foam Qualitative Assessment	71

LIST OF ACRONYMS

ACM	Army Contingency Operations Cost Model
AEC	Army Evaluation Center
AEPI	Army Environmental Policy Institute
AESIS	Army Energy Security Implementation Strategy
AKO	Army Knowledge Online
AMC	Army Materiel Command
AMMPS	Advanced Medium Mobile Power Source
AMSAA	US Army Materiel Systems Analysis Activity
AoA	Analysis of Alternatives
APC	Army Petroleum Center
APG	Aberdeen Proving Ground
APGM	Army Program Guidance Memorandum
APPG	Army Planning Priorities Guidance
AR	Allocation Rule
AR 5-5	Army Regulation 5-5, Army Studies and Analyses
ASA-ALT	Assistant Secretary of the Army for Acquisition, Logistics, and Technology
ASA-FM&C	Assistant Secretary of the Army – Financial Management & Comptroller
ASPG	Army Strategic Planning Guidance
ATEC	Army Test and Evaluation Command
AWARS	Advanced Warfighting Simulation
BCT	Brigade Combat Team
BTU	British Thermal Unit
CAA	Center for Army Analysis
CASTFOREM	Combined Arms and Support Task Force Evaluation
CO ₂	Carbon Dioxide
COA	Course of Action
CASCOM	Combined Arms Support Command
COMBATXXI	Combined Arms Analysis Tool for the 21st Century
C-B	Cost-Benefit
CBA	Cost-Benefit Analysis
CSS	Combat Service Support
CTC	Concurrent Technologies Corporation
DALO-SUF	Food and Liquids Division
DASA-CE	Deputy Assistant Secretary of the Army for Cost and Economics
DDR&E	Defense Research and Engineering
DESC	Defense Energy Support Center
DLA	Defense Logistics Agency
DoD	Department of Defense
DODI	Department of Defense Instruction
DPAE	Director, Program Analysis and Evaluation
DSB	Defense Science Board
EE	Energy Efficiency
ELIST	Enhanced Logistics Intra-theater Support Tool
EO	Executive Order
EPA	Environmental Protection Agency

ESG	Energy and Security Group
ETF	Enterprise Task Force
FAD	Funding Authorization Document
FBCF	Fully Burdened Cost of Fuel
FCPM	Fuel Consumption Prediction Model
FCM	FORCES Cost Model
FCS	Future Combat System
FLVN	Fort Leavenworth
FM&C	Financial Management & Comptroller
FOB	Forward Operating Base
FORCES	Force and Organizational Cost Estimating System
FORGE	Force Generation
FSB	Field Studies Branch
FY	Fiscal Year
G3	Operations (Army)
G4	Logistics (Army)
G8	Resource Management (Army)
GAO	Government Accountability Office
GCE	Ground Convoy Equivalent
GHG	Greenhouse Gas
GP	General Purpose
HBCT	Heavy Brigade Combat Team
HQDA	Headquarters, Department of the Army
ILS	Integrated Logistics Support
JCTD	Joint Capability Technology Demonstration
KPP	Key Performance Parameter
kW	Kilowatt
LBC	Logistics Battle Command
lbs/yr	Pounds per Year
LEE	Fort Lee
LIA	Logistics Innovation Agency
LOGSA	Logistics Support Activity
MACOM	Major Army Commands
MAESMO	Methodology & Analysis of Energy Security in Military Operations
MEP	Mobile Electric Power
MIDAS	Model for Inter-theater Deployment by Air and Sea
mpg	Miles Per Gallon
MOU	Memorandum of Understanding
MRAP	Mine Resistant Ambush Protected
NDCEE	National Defense Center for Energy and Environment
NPV	Net Present Value
NSN	National Stock Number
O&M	Operation and Maintenance
O&S	Operating and Support
ODASA-CE	Office of the Deputy Assistant of the Army for Cost and Economics
OneSAF	One Semi-Automated Forces

OPLOG	Operational Logistics
OPTEMPO	Operational Tempo
OSD	Office of the Secretary of Defense
OSMIS	Operating & Support Management Information System
OSRAP	Optimum Stock Requirements Analysis Program
PBAS	Program Budget Accounting System
PEGs	Program Evaluation Groups
PF	Planning Factor
PM	Project Manager
POCs	Points of Contact
POL	Petroleum, Oil, and Lubricants
POM	Program Objective Memorandum
PPBES	Planning, Programming, Budgeting and Execution System
R&D	Research and Development
RE	Renewable Energy
REF	Rapid Equipping Force
S&T	Science and Technology
SEC	Senior Energy Council
SED	Sustainment Evaluation Directorate
SMP	Sustain the Mission Project
SOP	Standard Operating Procedure
TAA	Total Army Analysis
TACOM	Tank-Automotive Command
tCO ₂ e	Tons of CO ₂ equivalent
TEMP	Test and Evaluation Master Plan
TGER	Tactical Garbage to Energy Refinery
THEPS	Tactical Hybrid Electric Power Station
TQG	Tactical Quiet Generator
TRAC	TRADOC Analysis Center
TRADOC	Training and Doctrine Command
UAS	Unmanned Aircraft System
U.S.	United States
VCSA	Vice Chief of Staff of the Army
WSMR	White Sands Missile Range

EXECUTIVE SUMMARY

Background

In February 2008, the Defense Science Board (DSB) issued an extensive report, Department of Defense (DoD) Energy Strategy “More Fight - Less Fuel”, which presented a clear case for the Army’s need to establish Key Performance Parameters (KPPs) for operational energy by concluding that DoD faces unnecessarily high and growing battle-space fuel demand which compromised operational capability and mission success; created more risk for support operations than necessary; and increased life cycle operations and support costs of its world-wide contingencies.

In a parallel and almost concurrent assessment of our nation’s energy challenges the Government Accountability Office (GAO) issued a March 2008 report, Defense Management: Overarching Organizational Framework Needed to Guide and Oversee Energy Reduction Efforts for Military Operations. GAO’s study mirrored some of the DSB’s findings and included a recommendation for establishing a governing framework to align and integrate DoD’s energy reduction efforts in military operations.

Given the level of awareness brought on by the DSB and GAO, for DoD’s energy usage as a national security issue, the Secretary of the Army (SECARMY) directed the Assistant Secretary of the Army for Installations and Environment (now the Assistant Secretary of the Army (Installations, Energy and Environment)) to stand up the Army’s first Energy Security Task Force (AESTF) on 15 April 2008. The AESTF was comprised of subject matter experts representing all Principals of Headquarters, Department of the Army (HQDA) who were charged with: addressing both the DSB and GAO reports; the analyses and development of recommendations for necessary strategic/action plans and an Army governing framework to achieve the Army’s energy security vision and goals; and lastly, to ensure its energy policies and practices are aligned to effectively operate our installations and conduct contingency operations world-wide.

Over the next several months the AESTF deliberated on the recommended solutions sets outlined in the 25 September AESTF Report – Army Energy Security Strategy Way Ahead resulting in the establishment of the Army’s first energy security governing body, the Senior Energy Council (SEC)ⁱ which was chartered by the Secretary of the Army and the Chief of Staff of the Army on 28 September 2008.

To institutionalize the oversight and implementation of all energy efforts the AESTF drafted Army Directive (AD) 2008-04, Army Energy Enterprise which was promulgated by the SECARMY on 20 October 2008. This directive is viewed as the Army’s cornerstone in addressing the DSB and GAO report findings by: establishing the senior leadership’s governing framework for energy security – the SEC, with the responsibility to collaboratively develop and submit for SECARMY approval an Energy Enterprise Strategic Plan (Plan) and associated investment strategies to be executed in a manner that is synchronized with the DoD budget formulation process; establishing the Assistant Secretary of the Army (Installations, Energy and Environment) as the lead agent; and within the ASA(I,E&E), creating the new office, the Deputy Assistant Secretary of the Army for Energy and Partnerships (DASA (E&P))ⁱⁱ to serve as the SEC Executive Secretary and additionally serve as the Army’s Senior Energy Executive (SEE) responsible for monitoring and reporting the Army’s progress in achieving the goals and objectives established as part of the approved Plan to the SEC.

It was during this formulation period for the Army's energy security strategic way ahead, the genesis for MAESMO was shaped and influenced by the deliberations between the AESTF and the senior Army leaderships' desire to better understand how the Army currently planned operations (the analytical process) for its world-wide contingencies, and more importantly how could energy security key performance parameters be introduced as one of its pre-decisional planning factors to help mitigate growing battle-space fuel demand; risk for support operations; increased life cycle operations. To that end, the AESTF Deputy formulated the MAESMO study proposal which was presented to the Deputy Chief of Staff/G-8, HQDA Study Program for approval, funding and implementation in FY 09. Key policy memoranda, briefings, and reports which led to the initiation of the MAESMO Project are shown in Appendix K of this report.

MAESMO Project:

The MAESMO study team was headed up by the AESTF Deputy, Mr. Joseph Vallone from the Office, Assistant Secretary of the Army for Installations, Energy and Environment – Army Environmental Policy Institute. The MAESMO project was designed to investigate tools, models, and databases that are currently used or could be used in the Army to analyze energy alternatives in support of operational missions. It was also intended to recommend modifications to existing capabilities and identify new analytical capabilities that should be developed.

Study Objectives

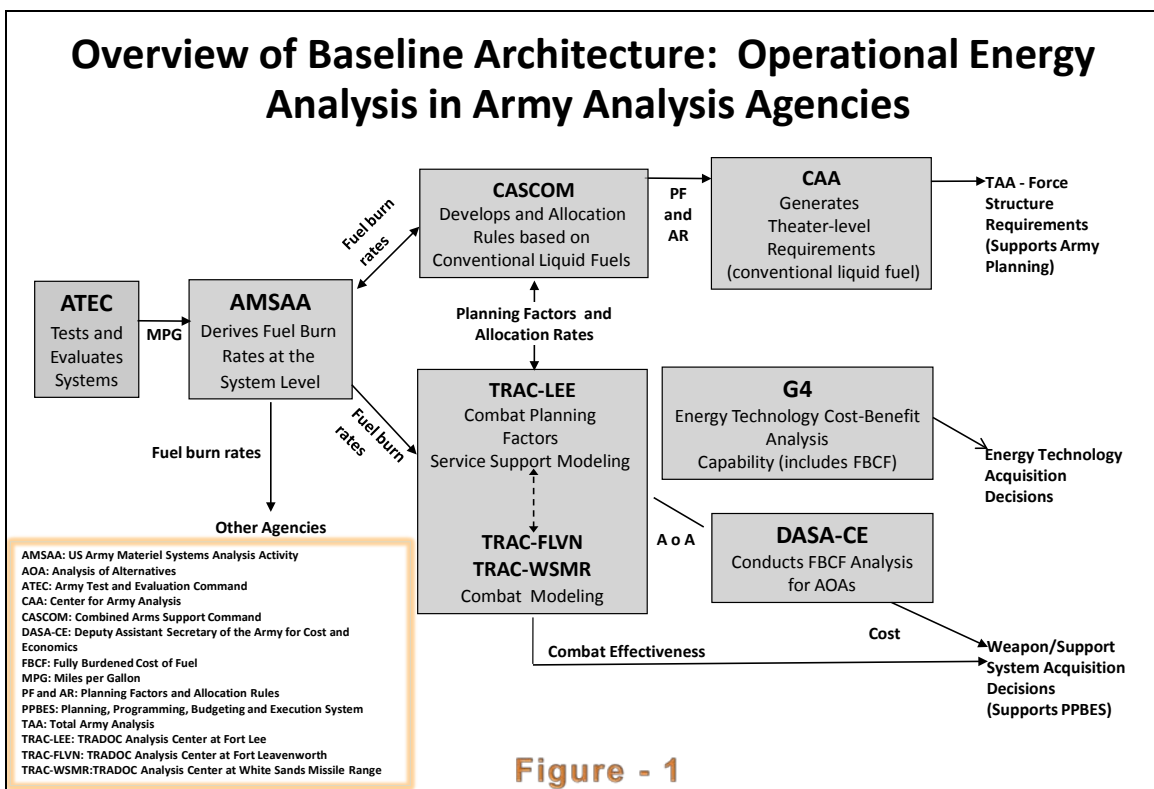
1. Specify and assess a baseline architecture of existing energy-related processes and models in the Army analytical community.
2. Identify areas in the baseline architecture that should be sustained and expanded, and identify where new capabilities should be developed to support operational mission and energy policy requirements.
3. Develop and illustrate a cost-benefit methodology for evaluating energy choices in support of operational missions.

Technical Approach

1. MAESMO project activities encompassed a literature review of studies, processes, policies, tools, models, and databases related to analyzing the costs and benefits of weapon systems and support systems (and units) in Army operations that could be used to evaluate energy choices. As part of this review, the MAESMO study team contacted and met with representatives from Army analytical offices, such as the Center for Army Analysis (CAA), Combined Arms Support Command (CASCOM), Army Test and Evaluation Command (ATEC), G4 - Logistics Innovation Agency (LIA), the Army Training and Doctrine Command (TRADOC) Analysis Center (TRAC), the Army Materiel Systems Analysis Activity (AMSAA), and the Office of the Deputy Assistant of the Army for Cost and Economics (ODASA-CE). Based upon Army stakeholder input from the review and meetings, the MAESMO study team developed a baseline architecture of existing energy-related models in the Army analytical community.
2. Evaluated the feasibility of using existing capabilities in the baseline architecture (see Figure 1) to analyze the costs and benefits of energy choices in support of Army operations. The MAESMO team recommended modifications to the baseline architecture

and new capabilities that should be added to enable the Army to more comprehensively analyze the costs and benefits of its energy choices.

3. Developed a proposed cost-benefit methodology for evaluating energy choices in support of Army operations. To the extent practicable, the methodology was demonstrated for eight emerging energy technologies that could be used in Army brigade combat teams (BCTs) and at forward operating bases (FOBs). Cost and benefit data on the illustrative case study energy technologies being examined were obtained from the Army G4 Sustain the Mission Project (SMP).
4. Assessed existing Planning, Programming, Budgeting, and Execution System (PPBES) process capabilities to incorporate the energy cost-benefit analysis methodology developed through this effort.



Key Findings and Recommendations

This study found that:

- Army analysis agencies have substantive existing and prospective capabilities for:
 - evaluating energy efficiency as a Key Performance Parameter (KPP)
 - calculating and applying the fully burdened cost of fuel (FBCF) for Analysis of Alternatives (AoA) and other cost-benefit analyses
 - modeling energy in combat/combat service support models (to be part of cost-benefit analysis).

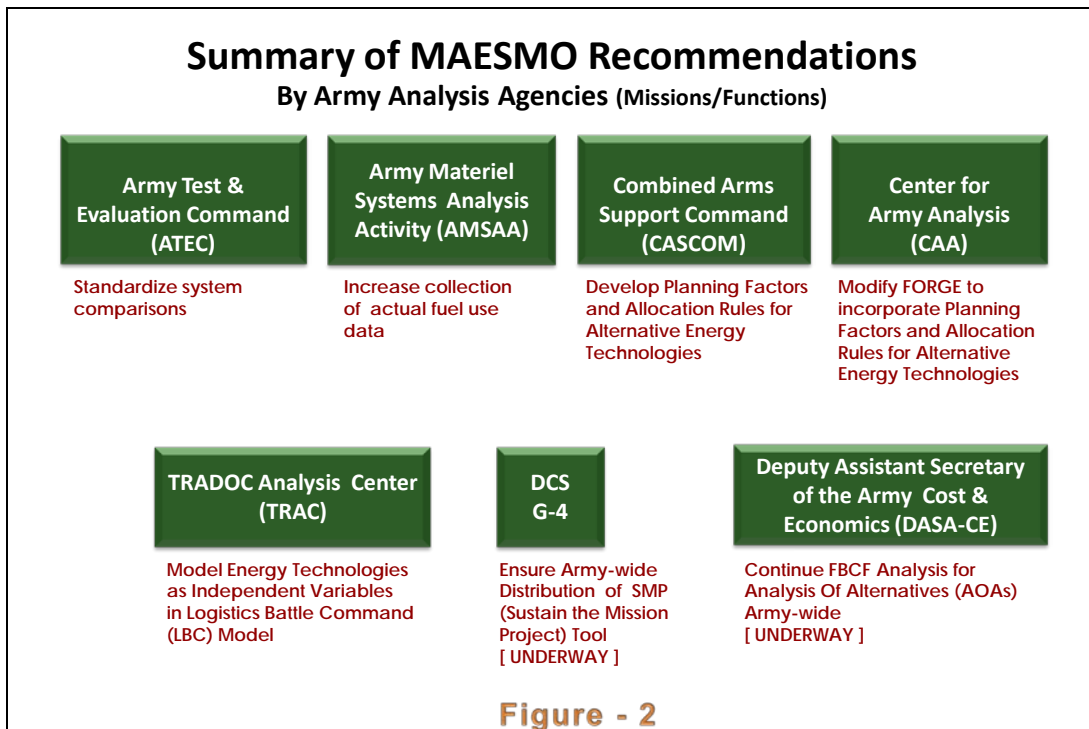
- Standardization in development and application of these capabilities is necessary to effectively implement recently enacted energy policies.
- Proposed enhanced architecture provides a reusable methodology for evaluating the costs and benefits of energy technologies (and technologies which impact energy production and use) in support of Army operational missions.

Recommendations include:

- Expand the AMSAA initiative for collecting actual fuel consumption data (from theaters of operations) to all major energy consuming systems
- CASCOM should develop planning factors and allocation rules for alternative/renewable energy (RE) and energy efficiency (EE) technologies
- Expand TRAC Logistics Battle Command Model to integrate energy logistics and technologies with combat/operations modeling and analysis – model energy as an independent variable
- Standardize Fully Burdened Cost of Fuel (FBCF) development and Army-wide implementation.

Benefits

The principal recommendations of this study leverage existing Army Analytical Hierarchy processes, models, and data (see Figure 2 for summary of recommendations by agency). If implemented, the recommendations would significantly expand the Army’s analytic capabilities in support of strategic and tactical missions, and enable the Army to make better informed energy decisions/investments to support meeting recently enacted DoD energy policy requirements.



Executive Summary Endnotes

- i. Senior Energy Council (SEC) became the Senior Energy and Sustainability Council (SESC), effective 11 February 2011
- ii. DASA-EP (Energy and Partnerships) became DASA-ES (Energy and Sustainability) in December 2010

ACKNOWLEDGEMENTS

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1.0 INTRODUCTION

Background

In February 2008, the Defense Science Board (DSB) issued an extensive report, Department of Defense (DoD) Energy Strategy “More Fight - Less Fuel”, which presented a clear case for the Army’s need to establish Key Performance Parameters (KPPs) for operational energy by concluding that DoD faces unnecessarily high and growing battle-space fuel demand which compromised operational capability and mission success; created more risk for support operations than necessary; and increased life cycle operations and support costs of its world-wide contingencies. In a parallel and almost concurrent assessment of our nation’s energy challenges the Government Accountability Office (GAO) issued a March 2008 report, Defense Management: Overarching Organizational Framework Needed to Guide and Oversee Energy Reduction Efforts for Military Operations. GAO’s study mirrored some of the DSB’s findings and included a recommendation for establishing a governing framework to align and integrate DoD’s energy reduction efforts in military operations.

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and reporting the Army's progress in achieving the goals and objectives established as part of the approved Plan to the SEC.

It was during this formulation period for the Army's energy security strategic way ahead, the genesis for MAESMO was shaped and influenced by the deliberations between the AESTF and the senior Army leaderships' desire to better understand how the Army currently planned operations (the analytical process) for its world-wide contingencies, and more importantly how could energy security key performance parameters be introduced as one of its pre-decisional planning factors to help mitigate growing battle-space fuel demand; risk for support operations; increased life cycle operations. To that end, the AESTF Deputy formulated the MAESMO study proposal which was presented to the Deputy Chief of Staff/G-8, HQDA Study Program for approval, funding and implementation in FY 09. Key policy memoranda, briefings, and reports which led to the initiation of the MAESMO Project are shown in Appendix K of this report. The MAESMO study team was headed up by the AESTF Deputy, Mr. Joseph Vallone from the Office, Assistant Secretary of the Army for Installations, Energy and Environment – Army Environmental Policy Institute.

The development and application of cost-benefit and risk analysis to evaluate energy technologies and practices in the Army has been relatively limited compared to other force parameters such as weapon system lethality. The Army recognizes that the direct impacts of energy efficiency, renewable energy, and other energy choices on combat/operational effectiveness, logistics performance, and environment and safety have been quantitatively addressed on a very limited basis. For example, comprehensive quantitative analysis is a necessary step towards reducing fossil fuel requirements for forward/remote operating bases and units and reducing the number of fuel convoys per resupply period. Key variables such as logistical supportability and sustainability, vulnerability, range, mobility, cost, and effects on tactics and strategy are becoming more interrelated and complex. As the Army transforms its energy policies and strategies, it is necessary to transform its modeling and analysis capabilities to directly account for the costs and benefits of energy resources and the potential risks and benefits of energy decisions in theaters of operation.

Purpose

The purpose of the Methodology and Analysis of Energy Security in Military Operations (MAESMO) project is to develop a reusable analytic methodology for evaluating the costs and benefits of energy technologies in support of Army missions in theaters of operation. This methodology is to facilitate the analysis of key energy parameters in support of decision-making. The MAESMO project was designed to investigate tools, models, and databases that are currently used or could be used in the Army to analyze energy alternatives in support of operational missions. It is also intended to recommend modifications to existing capabilities and identify new analytic capabilities that should be developed.

Objectives

- Specify and assess a baseline architecture of existing energy-related processes and models in the Army analytical community.
- Identify areas in the baseline architecture that should be sustained and expanded, and identify where new capabilities should be developed to support operational mission and energy policy requirements.
- Develop and illustrate a cost-benefit methodology for evaluating energy choices in support of operational missions.

2.0 STUDY APPROACH AND TASKS

2.1 Literature Review and Establishment of Baseline Architecture

The purpose of this activity was to investigate tools, models, and databases that are currently used or could be used in the Army analysis community to comply with recently enacted energy policies in DoD related to operational missions. It is also intended to serve as the basis for recommended modifications to existing capabilities and to identify new analytic capabilities that should be developed to support these policies.

The approach on this effort was to conduct the following:

- Literature review of studies, processes, policies, tools, models, and databases related to analyzing the costs and benefits of weapon systems and support systems (and units) in Army operations that could be used to evaluate energy choices.
- Meetings with representatives from Army analytical offices, such as the Center for Army Analysis (CAA), the Army Training and Doctrine Command (TRADOC) Analysis Center (TRAC), the Army Materiel Systems Analysis Activity (AMSAA), and the Office of the Deputy Assistant Secretary of the Army for Cost and Economics (ODASA-CE).
- Development of a baseline architecture related to existing energy-related activities in the Army analytical community.

2.1.1 Literature Review

The MAESMO study team m conducted a literature review of United States (U.S.) energy consumption, recently enacted laws and DoD energy

policies, and additional literature relative to Army energy use. The findings of these literature reviews are included in Appendix A of this document.

The MAESMO study team reviewed Army analysis agency missions and functions through open internet sources and the Army Knowledge Online (AKO). The MAESMO study team identified the Army analysis agency Points of Contact (POCs) and discussed their agencies' missions and energy-related supporting functions. Other Army agencies are involved with energy functions, but for the purposes of this study, the scope was limited to the following analysis agencies whose missions and energy-related functions are summarized in the following sections.

- U.S. Army Test and Evaluation Command (ATEC)
- U.S. Army Materiel Systems Analysis Activity (AMSAA)
- U.S. Army TRAC at Fort Lee (TRAC-LEE)
- Combined Arms Support Command (CASCOM)
- Center for Army Analysis (CAA)
- Deputy Assistant Secretary of the Army for Cost and Economics (DASA-CE)

ATEC

ATEC Mission: Plans, conducts, and integrates developmental testing, independent operational testing, independent evaluations, assessments, and experiments in order to provide essential information to decision makers.

ATEC Energy Related Functions:

- Operates ATEC Energy Program – energy consumption reduction without mission degradation.
- Conducts sustainability/ supportability evaluation planning, data analysis, evaluation reporting of Army systems.
- Conducts continuous evaluation program for Combat Service Support (CSS) acquisition programs to include operational fuel consumption, as it impacts logistics footprint.
- Uses AMSAA models to evaluate aspects of the Energy Efficiency as a Key Performance Parameter (KPP).

AMSAA

AMSAA Mission: Conduct responsive and effective materiel and logistics systems analyses to support decision making for equipping and sustaining the U.S. Army.

AMSAA Energy-Related Functions:

- Conducts systems analysis and develop item level performance data for ground vehicle mobility and power & energy consumption in support of Army and Joint acquisition programs and fielded systems.
- Develops appropriate models to analyze ground vehicle mobility and power & energy consumption in support of Army and Joint acquisition programs and fielded systems.
- Develops appropriate models to analyze ground vehicle mobility performance and power & energy consumption of developmental and current Army and Joint systems.

TRAC-LEE

TRAC-LEE Mission: Conduct Combat Service Support (CSS) studies, analyses, modeling, and analytical support.

TRAC-LEE Energy-Related Functions:

- Conducts the CSS portion of Analysis of Alternatives (AoAs).
- Develops, maintains, and employs CSS models.
- Integrates CSS into TRADOC materiel acquisition and non-materiel studies, scenarios, and model development.
- Provides direct analytical support to the other TRAC Centers , CASCOM, and other agencies.
- TRAC has two (2) models to conduct force effectiveness analyses – Advanced Warfighting Simulation (AWARS) and Combined Arms Analysis Tool for the 21st Century (COMBATXXI). Part of those analyses involve determining fuel consumption at the operational and tactical level as a part of the logistics footprint analysis.

CASCOM

CASCOM Mission: Provide training and leader development, develop concepts, doctrine organizations, life-long learning, and materiel solutions to assist the CSS to sustain a campaign quality Army with joint and expeditionary capabilities.

CASCOM Energy-Related Functions:

- Develops Logistics Doctrine.
- Develops Logistics Capability Concepts.
- Conducts Logistics Experimentation.
- Identifies and analyzes Logistics Capability Requirements.

CAA

CAA Mission: Conduct analyses of Army forces in the context of joint and combined operations at the theater campaign level of warfare.

CAA Energy-Related Functions:

- Conducts Logistics Modeling and Analysis.
- Conducts Force Generation Model (FORGE) analysis of theater level requirements.
- Conducts Strategic Deployment Modeling and Analysis.

DASA-CE

DASA-CE Mission: Provides the Army decision-makers with cost performance and economic analysis in the form of expertise, models, data, estimates, and analyses at all levels.

DASA-CE Energy-Related Functions:

- Maintains Force and Organizational Cost Estimating System (FORCES) Model and Army Contingency Operations Cost Model (ACM).
- Develops/maintains operating & support cost factors, Operational Tempo (OPTEMPO) rates/associated databases for the Planning, Programming, Budgeting and Execution System (PPBES).
- Manages development/maintenance of Operating & Support Management Information System (OSMIS).
- Provides cost input/certification of cost inputs/validation of cost methodologies for AoAs.
- Performs analytical support for various Army initiatives [e.g., Total Ownership Cost such as the Fully Burdened Cost of Fuel (FBCF)].

2.1.2 Meetings with Representatives from Army Analytical Offices

The MAESMO study team visited and met with representatives from the Army analysis agencies, such as AMSAA, TRAC, and CAA, following the Army's Analytical Hierarchy (see Figure 1 – from CAA) from the platform/systems level of analysis up through unit and then theater-levels of analysis. This approach provided insights into current and potential analytic capabilities that could be accessed to support recently enacted Army energy policies.

Hierarchy of Analytical Responsibilities

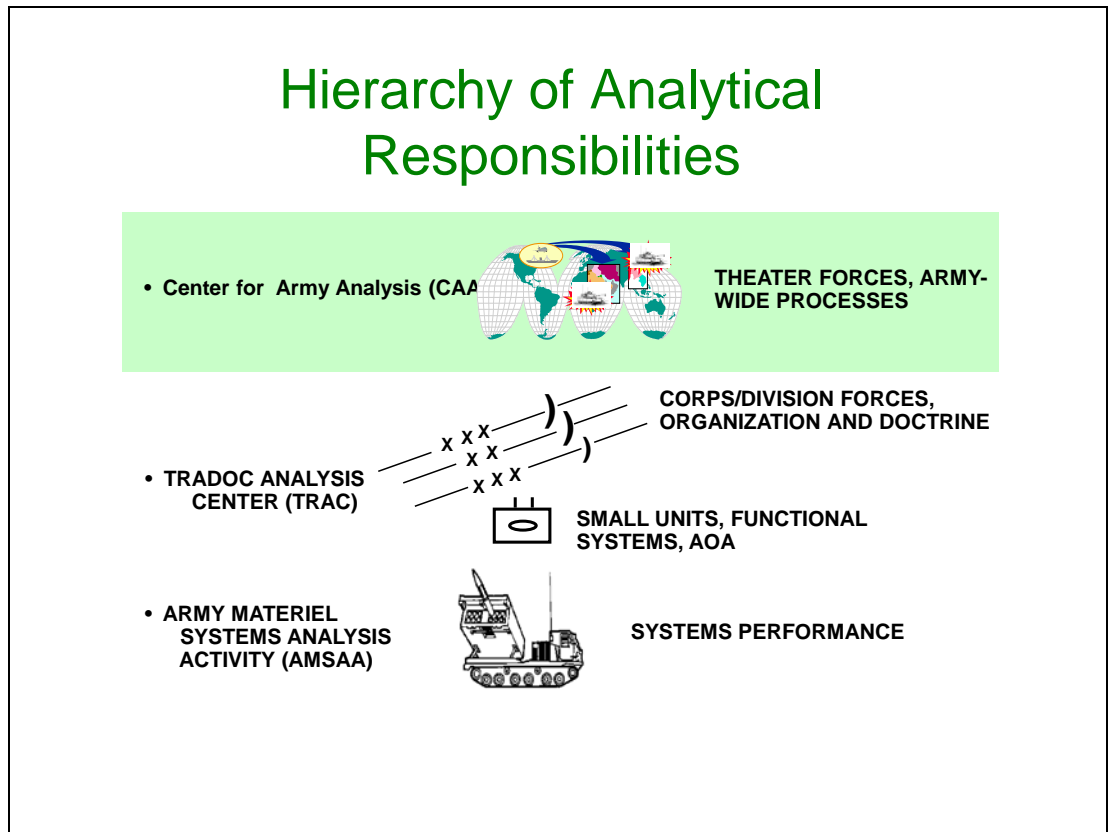


Figure 1. Hierarchy of Analytical Responsibilities

The project team first met with staff from HQDA G4 and DASA-CE before working through the Army’s analytical hierarchy process to gather information to develop a baseline architecture. DASA-CE is involved with energy analysis at different levels across the hierarchy – platform through theater levels to include AoAs (the Army’s process for evaluating the costs and benefits of major system acquisition candidates). During this study, HQDA G4 Logistics Innovation Agency (LIA) became the functional proponent for the Sustain the Mission Project (SMP) which conducts cost-benefit analysis of energy technologies based upon the FBCF.

Summaries of the meetings are included in Appendix B of this document. Meeting Minutes from these meetings have been uploaded to the Army Knowledge Online (AKO) MAESMO site.

2.1.3 Development of a Baseline Architecture

Baseline Architecture

This section provides an overview of a baseline architecture (“as is” view) composed during the project (see Figure 2). It shows Army Analytical Agencies in the boxes and key energy-related data flows and processes from analysis of energy usage at the individual platform level up to calculating fuel requirements for theater-level campaigns; as well as for evaluating weapon and support systems for Army-wide acquisition.

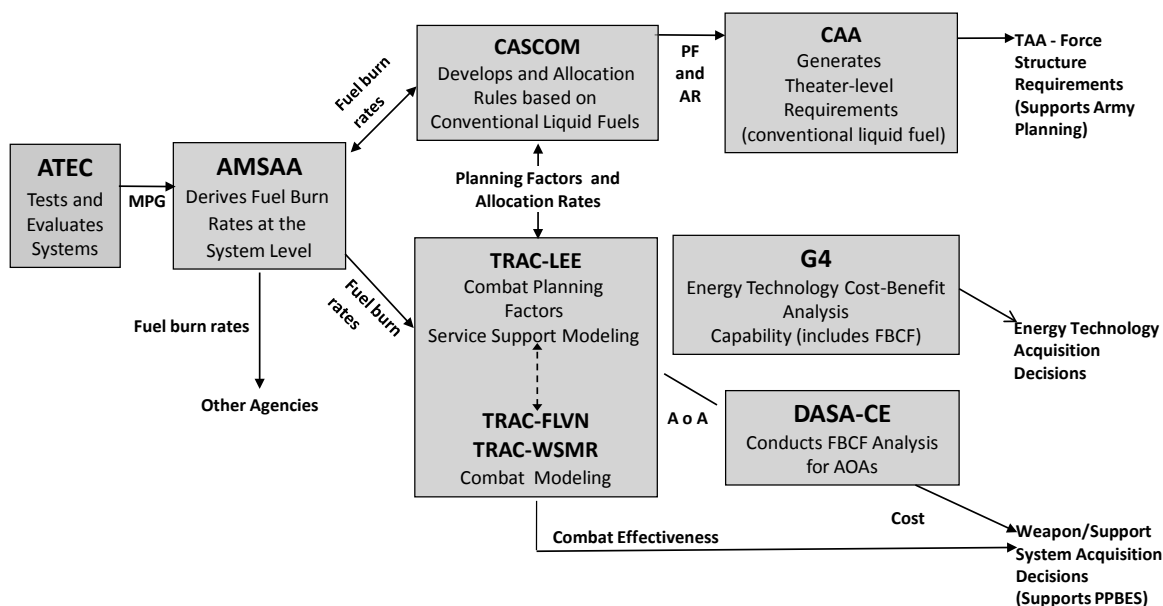


Figure 2. Overview of Baseline Architecture

Beginning at the platform level, ATEC tests the performance of individual items to ensure their effectiveness and safety. One of the outputs of these evaluations is miles per gallon (mpg) for energy consuming items, which is provided to AMSAA for further analysis. ATEC provides mpg numbers for individual items to AMSAA which uses this data to model and develop fuel burn rates (also in terms of mpg for weapon and support systems under various usage profiles, types of terrain covered during a campaign, percent of time idling, etc.) which are provided to numerous Army agencies to include CASCOM. Based on the AMSAA platform-level fuel burn rates, CASCOM develops unit-level fuel consumption Planning Factors (PF) for notional Army units (based on standard requirement codes). These unit-level fuel consumption PFs are provided to numerous Army agencies to include CAA.

Based on the CASCOM unit-level fuel consumption factors, CAA calculates theater-level fuel requirements for a variety of modeled campaigns. Theater-level fuel requirements from CAA support the Army's Total Army Analysis (TAA) process, which generates Army-wide force structure requirements in support of Army planning (G3 lead).

Returning back to the AMSAA box in Figure 2, AMSAA provides platform-level fuel burn rates to TRAC in support of combat modeling [e.g., TRAC – White Sands Missile Range (WSMR) and Fort Leavenworth (FLVN) and combat service support modeling (TRAC-LEE)]. TRAC also uses unit-level fuel consumption PFs from CASCOM in their combat and CSS modeling.

TRAC, DASA-CE, and other Army agencies conduct AoAs that compare the costs and benefits of acquiring a particular system in comparison to other systems which perform similar missions. AoAs are used to support acquisition programming of major weapon and support systems for the Program Objective Memorandum (POM). DASA-CE support of AoAs includes fully burdened cost of fuel analysis. G4 has fully burdened cost of fuel analysis capability through its Sustain the Mission Project (SMP) Decision Support Tool which evaluates costs and benefits of energy technologies in support of operational missions. The SMP Tool also has limited analytic capabilities regarding energy efficiency as a key performance parameter.

Baseline Architecture: Operational Energy Analysis in Army Analysis Agencies – Developing Requirements

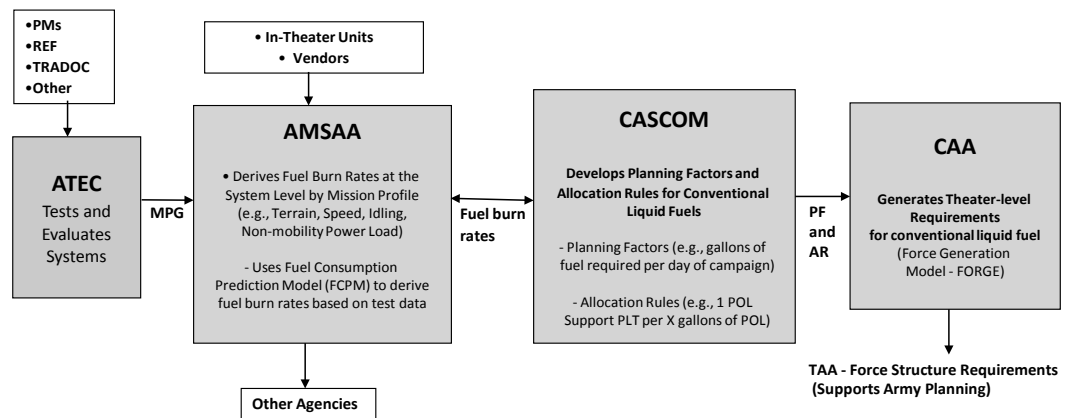


Figure 3. Baseline Architecture: Developing Requirements

Baseline Architecture –Developing Requirements

Figure 3 expands the top portion of Figure 2 and focuses on the models or tools used in the flows from individual platform fuel consumption rates to fuel requirements for a theater-wide campaign. ATEC tests and evaluates an individual item [usually for a Project Manager (PM)]; ATEC does not use a prescribed model or tool in its evaluation. ATEC does provide mpg results from its dynamometer tests to AMSAA which uses the Fuel Consumption Prediction Model (FCPM) to derive fuel burn rates based upon equipment usage profiles (for a mission or campaign) reflecting varying conditions such as terrain, amount of time idling, and non-mobility power loads.

AMSAA's individual item/platform fuel burn rates are provided to CASCOM (among other agencies) which develops unit-level fuel consumption rates as PFs under varying usage profiles. CASCOM also develops allocation rules (AR) that indicate the unit-level force structure required to sustain the fuel required for the mission. PFs and ARs are developed only for conventional liquid fuels. CAA uses CASCOM's fuel PFs (for conventional liquid fuels only) to derive theater-level fuel requirements as well as the ARs to derive theater-level force structure requirements for petroleum, oil, and lubricants (POL) units. CAA uses its FORGE model to derive theater-level fuel requirements and force structure requirements as part of the TAA process – a key component of Army planning.

Key Findings: Developing Requirements

Regarding developing requirements in the Army, the following key findings were identified:

- System energy efficiencies are not compared with the same configurations (varying non-mobility power loads)
- AMSAA collects actual fuel consumption on selected wheeled systems
- Fuel consumption impacts outside the system are not included in energy efficiency analyses (e.g., resupply convoys)
- CASCOM develops planning factors and allocation rules only for conventional liquid fuels
- CAA can only incorporate planning factors and allocation rules based on conventional liquid fuels (Force Generation -FORGE)

Baseline Architecture: Operational Energy Analysis in Army Analysis Agencies – Acquisition Decision-Making

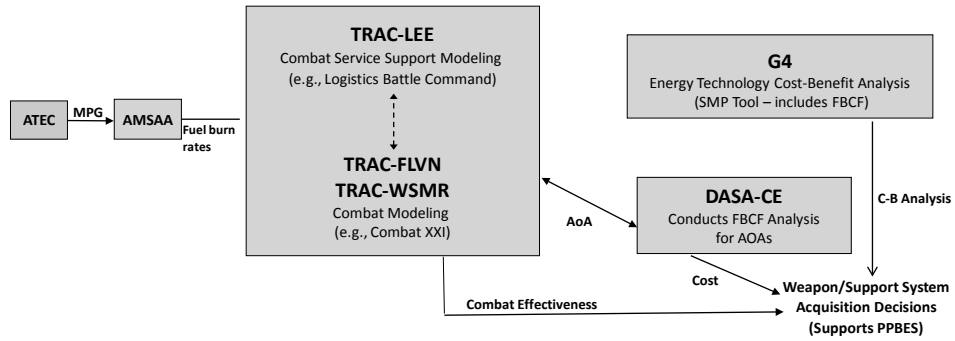


Figure 4. Baseline Architecture: Acquisition Decision-making

Baseline Architecture: Acquisition Decision-making

Figure 4 highlights the bottom portion of Figure 2 from the fuel burn rates generated by AMSAA to weapon/support system acquisition. TRAC-LEE receives platform-level fuel burn rates from AMSAA and uses them in its Logistics Battle Command (LBC) model to represent fuel demands that must be resupplied by support assets. The fuel burn rates are also used in combat models run by TRAC-WSMR and TRAC-FLVN. Currently TRAC’s LBC and combat models do not represent energy technologies as independent variables – that is, the potential impacts of different energy technologies upon combat effectiveness, logistics performance, and safety/environment are not currently evaluated. However, while not currently the focus of LBC development, the potential exists to expand the LBC model to link with combat models to represent these types of impacts.

TRAC’s combat/CSS modeling supports the Army’s AoA process for evaluating the value of a system being considered for acquisition. This evaluation is conducted under a variety of Defense Planning Scenarios (combat and non-combat). DASA-CE also supports AoAs by providing life cycle cost analysis of systems being considered for acquisition – which is compared to the combat value of the system modeled by TRAC. DASA-CE has recently begun to include the FBCF in their cost analysis.

HQDA G4 became the proponent of the SMP Decision Support Tool during the course of the project. In FY10, G4 established an initiative to significantly expand the capabilities of the SMP Decision Support Tool, distribute the SMP Tool for Army-wide use and standardization, and

provide training to users. The SMP Tool enables FBCF analysis, as well as cost-benefit analysis of energy technology applications in support of operational missions. The SMP Tool also enables analysis of factors related to energy efficiency as a KPP.

Figure 5 shows the cost-benefit factors included in G4's SMP Decision Support Tool. The SMP methodology calculates the FBCF resources to sustain Army missions in theaters of operation and the training base – that is, the costs of fuel, equipment, personnel, inter- and intra-theater transportation, force protection, and other costs related to providing fuel to a consuming Army unit.

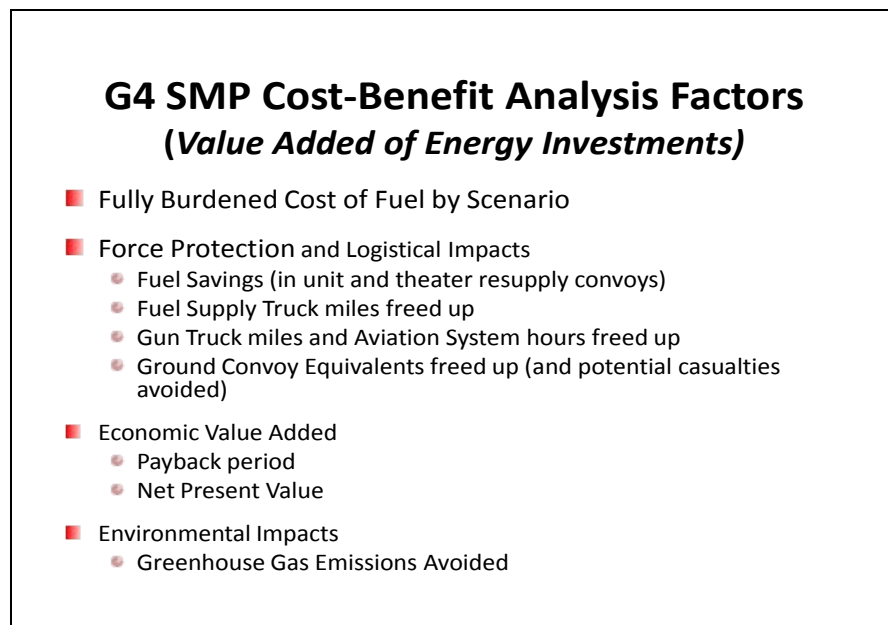


Figure 5. G4 SMP Cost-Benefit Analysis Factors

SMP provides a useful capability for evaluating the costs and benefits of investing in an energy technology for applications in support of operational missions. It does not address key cost-benefit factors such as combat/operational effectiveness (e.g., lethality), logistics performance (e.g., maintainability), and safety/environmental factors (e.g., stealth). What SMP does provide is the potential linkages for some of the benefit factors to be incorporated into a combat/combat support model. For example, an energy technology that consumes less fuel reduces fuel resupply convoys and therefore frees up convoy force protection assets such as gun trucks and Apaches which could then be reapplied to other mission requirements in the combat/combat support model.

Key Findings: Acquisition Decision-Making

Pertinent to acquisition decision making, the following key findings were identified:

- The need exists for standardized FBCF development and implementation. G4 has begun to address this need with the further development and Army-wide implementation of the SMP Decision Support Tool.
- Energy technologies are not currently modeled as independent variables in the TRAC LBC Model. Therefore, contributions by energy technologies to combat effectiveness are not currently evaluated.
- Fuel consumption impacts outside the system are not included in analysis (e.g. resupply convoys)

Figure 6 shows some of the key factors that may be included if an energy technology were treated as an independent variable in a combat/combat support model – that is, the capability to model and evaluate the impacts of an energy technology upon combat/operational effectiveness. If this were implemented through the further development of models, it would enable evaluation of the battlespace costs and benefits of an energy technology application in support of an operational mission. For example, if energy technology “X” were inserted into a force as part of a campaign modeling analysis, how would it contribute to the lethality of the force? In turn, this contributes to the combat effectiveness of the force. Different energy technologies could be played in a model in terms of their impacts on combat effectiveness, logistics, and safety and environmental objectives. This type of analysis should be a key part of the cost-benefit analysis of an energy technology (just like a weapon system is modeled today) and several factors that could be evaluated as part of the analysis are listed in Figure 6 from a slide entitled “What capabilities does the Army want” from a class on Army Transformation at the Army Force Management School (2003).

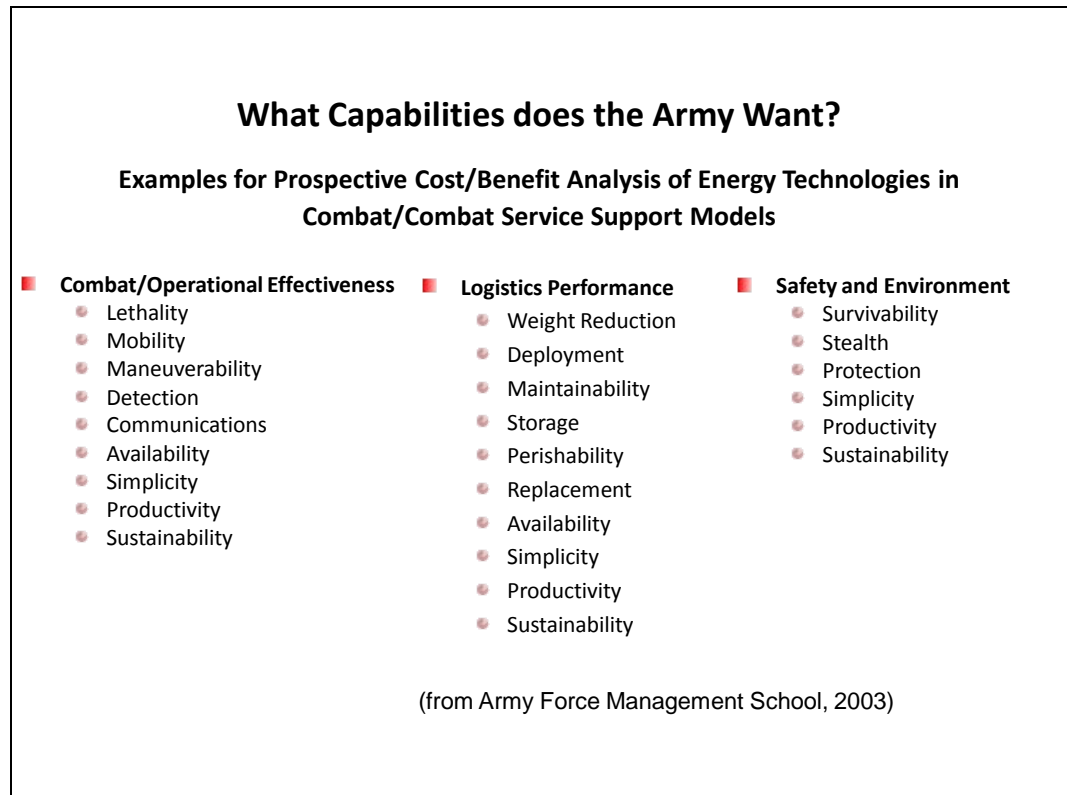


Figure 6. What Capabilities does the Army Want?

2.2 Development of Energy Security Cost-Benefit Analysis Methodology

The MAESMO study team performed the following activities to develop the Energy Security Cost-Benefit Analysis (CBA) Methodology:

- Evaluated the feasibility of using the existing Army analytical capabilities in the baseline architecture model to analyze the costs and benefits of energy choices in support of Army operations.
- Identified modifications to the baseline architecture model and new capabilities that should be added to the existing methodology to enable the Army to directly analyze the costs and benefits of energy choices.
- Identified and developed cost-benefit criteria that should be applied in the evaluation of energy choices in support of Army operations.
- Prepared and briefed the Energy Security CBA Methodology to AEPI and project stakeholders.

This section provides an overview of a proposed enhanced architecture that incorporates the recommendations identified. It shows that the existing analytical

hierarchy in the Army is capable of addressing recently enacted energy policies with some modifications and expansion to existing models and processes. Figure 7 illustrates the proposed enhanced architecture with recommendations highlighted in red.

Overview of Proposed **Enhanced Architecture:** Operational Energy Analysis in Army Analysis Agencies

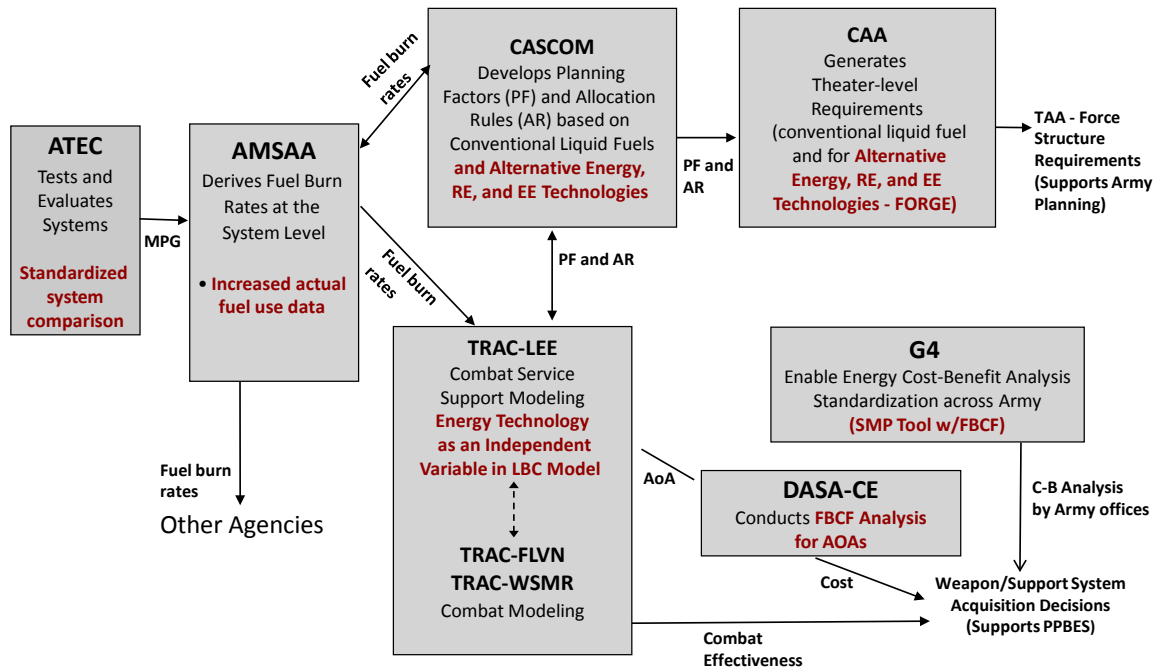


Figure 7: Overview of Proposed Enhanced Architecture

Most of the analytical agencies contacted during this project are cognizant of the analytical requirements resulting from these policies. The proposed enhanced architecture is consistent with and supportive of the individual efforts underway or planned by most of the Army’s analysis agencies to comply with these policies.

Last, a key finding is that if the TRAC’s LBC model continues to be developed and can be linked to combat models, and can play energy technologies as an independent variable in support of combat missions, then cost-benefit factors such as contributions to lethality, stealth, and maintainability can begin to be incorporated in the acquisition decision process. This, when combined with the cost-benefit factors from SMP, will provide the more comprehensive and robust analytical capability desired.

Army analysis agencies have substantive existing and prospective capabilities for:

- Evaluating energy efficiency as a KPP
- Calculating and applying the FBCF for AoAs and other cost-benefit analyses
- Modeling energy in combat/combat support models (to be part of cost-benefit analysis)

Standardization in development and application of these capabilities is necessary to effectively implement recently enacted energy policies. The proposed architecture provides a reusable methodology for evaluating the costs and benefits of energy technologies (and technologies which impact energy production and use) in support of Army operational missions. The following section illustrates the portion of the proposed architecture related to cost-benefit analysis of energy technologies in support of acquisition decision-making.

2.3 Demonstration of Proposed Energy Security Cost-Benefit Methodology

An objective of this study was to develop an energy security cost-benefit methodology in support of acquisition decision-making in the Army. This study proposes a broader architecture of energy-related processes and models, which also includes a proposed process for developing requirements based on different energy technologies. This broader approach is suggested to help ensure consistency between the requirements and acquisition processes related to analysis of energy choices in support of operational missions. Because the focus of the study is on the acquisition process, several case studies were developed to illustrate the types of analysis outputs that could be used to support energy decision-making in the proposed cost-benefit methodology.

The MAESMO study team applied the proposed energy security cost-benefit analysis methodology to eight identified EE technologies as illustrative case studies for applications in theater. Most of the data on these technologies was provided by Army and DoD programs which are examining EE technologies for use in tactical forward operating bases and units. For example, data was collected on energy technologies examined in the Net Zero Plus initiative. Net Zero Plus is an approved FY08 Joint Capability Technology Demonstration (JCTD) initiative led by the U.S. Army Rapid Equipping Force (REF) and the Office of the Secretary of Defense (OSD), Defense Research and Engineering (DDR&E). The purpose of the JCTD initiative is to identify significant military needs and match them to mature technologies or technology demonstration programs, so that military needs can be more rapidly addressed. The Net Zero Plus initiative tests technologies that increase energy independence and security at Forward Operating Bases (FOB) by using sustainable, locally available energy resources

(e.g., solar, waste, wind, etc.) to support military missions, as well as some of the civilian reconstruction and day-to-day needs of nearby communities.

Two case studies are presented in the body of this report: Advanced 5 kilowatt (kW) Medium Mobile Power Sources (AMMPS) and the Tactical Hybrid Electrical Power Station (THEPS). Six additional case studies (AMMPS 10kW, AMMPS 60kW, Solar Thermal Water Heating, Thermal Recycle Dryer Attachments, Spray Foam Shelter Insulation, and Tactical Garbage to Energy Refinery), as well as the 5kW AMMPS and THEPS, are summarized in Appendices C-J.

The MAESMO study team compared the purchase of an EE technology to the new purchase of an existing technology currently deployed in the field. It was assumed the EE technology purchase would replace existing technology in the field under the scenario described for the technology. It was also assumed the technology currently in the field could be deployed elsewhere or be re-built (no assigned salvage value or costs of it were assumed¹). The EE technology identified for potential replacement of the existing energy technology is the more energy efficient technology or one that uses some renewable energy technologies.

The number or amount of the technology required for purchase was also specified. The number specified for purchase depended on how the requirements currently supplied by the technology are being met in the scenario described for the technology.

2.3.1 Case Study Descriptions and Parameters

A description of the technology scenario details two aspects of the utilization of the technology. The first is the location of the technology in terms of *field application* – either sustainment brigade or heavy brigade combat team. The second is the *geographic location* where the technology would be used – e.g., Iraq.

The case study analysis was performed using quantitative and qualitative parameters as described in this section. Appendix C summarizes draft quantitative outputs and qualitative assessments for the AMMPS case study, and Appendix D summarizes that for the THEPS case study.

As discussed in the prior section, the cost-benefit methodology in the proposed architecture is based on the emerging G4 SMP capability and a

¹ All cost metrics shown in the analysis apply to the unit being evaluated in the scenario. The overall impacts for the Army, as opposed to the unit evaluated, might be an actual increase or decrease in costs, fuels used, emissions and related factors due to the deployment elsewhere of the equipment being replaced in the field.

prospective capability in TRAC's LBC model. The case studies include draft quantitative cost-benefit outputs, such as the FBCF, from G4 SMP (as of April 30, 2010). Because the proposed capability to address energy as an independent variable does not currently exist in models, qualitative assessments of the case study technologies were obtained from the ongoing G4 SMP effort as illustrative proxies. The qualitative assessments were not obtained from the SMP Tool.

There are four categories of quantified metrics for cost-benefit analysis presented: Fuel impacts; Economic Value Added; Force Protection and Logistical Impacts; and Environmental Impacts.

- *Fuel Impacts:* Both the FBCF and the fuel savings per year were calculated.
 - *FBCF:* The FBCF is presented on an annualized basis and as a dollar per gallon cost for both the existing technology that is currently being utilized in the field being considered for purchase (as new) and the alternative technology. The FBCF includes the costs of fuel, equipment, personnel, inter and intra-theater transportation, force protection, and other costs related to providing fuel to a consuming Army unit. Some of these costs can be considered "fixed" costs while others can be considered "variable" costs. At times, the FBCF on a dollars per gallon basis may rise from the purchase of the apparently more efficient technology but the overall fuel volume and total expenditures for fuel on a fully burdened basis would go down as noted below. This result is primarily due to the presence of fixed costs in the FBCF calculation which get spread over fewer gallons of fuel (and outweigh the reduction in variable costs). Changes in aggregate FBCFs account for: 1) the annualized capital costs and operational costs for the new technology (replacing the Tactical Quiet Generator [TQG]), 2) increases or decreases in initial deployment cost, and 3) reductions in force protection and transport costs allocated to the unit. These effects are nonlinear, and may be positively or negatively related to the reduction in fuel commodity costs. Therefore, the FBCF calculated based on an existing technology (e.g., TQG) cannot be simply multiplied by the gallons of fuel reduced to obtain the FBCF; each FBCF must be generated based on a unique set of underlying cost components.

- *Fuel savings per year:* This metric is presented as the change in the total volume of fuel consumed in terms of gallons per year.
- *Economic Value Added:* The economic value added is presented on the basis of both net present value and payback. In addition, a commentary is also provided after the quantitative results highlighting points of note.
 - *Net Present Value (NPV):* The NPV is calculated using the incremental costs or savings of the more efficient or renewable asset over the “traditional” asset alternative considering: the assets’ cost, the cost of the fuel consumed by the assets in dollar terms (not the FBCF), operation and maintenance costs, deployment and return costs, and a discount rate of 2.7%². For an asset being replaced in the field, no salvage value or additional costs for re-building are assumed for those assets but the asset is assumed to be available for deployment elsewhere.
 - *Payback:* Payback is presented as the period of time the cost of the asset “pays back.” It is calculated on a cash-flow basis reflecting the initial incremental cost of the asset over the “traditional” alternative; the savings in the cost of the fuel consumed by the asset compared to the alternative in terms of dollar outlays (not the FBCF); incremental operational and maintenance costs or savings; and incremental deployment and return costs or savings.
- *Force Protection and Logistical Impacts per Year:* The force protection and logistical impacts are presented using four figures of merit. These are all calculated on a per year basis.
 - Army Fuel Supply Truck Miles Freed up.
 - Army Gun Truck Miles Freed up.
 - Army Aviation System (Apache) hours Freed up.
 - Ground Convoy Equivalent Freed up (the Ground Convoy Equivalent metric is an indicator of assets made available for other missions and it is indexed to a notional convoy. The notional convoy is defined as one that resupplies fuel 182 times per year over a distance of 100 miles and has a capacity of 128,000 gallons fuel).

² Source: OMB Circular No A-94

- *Environmental Impacts:* The environmental impacts are presented using a single figure of merit – the pounds of greenhouse gas emissions avoided per year.

Illustrative Qualitative Assessment Parameters Regarding Impacts on Army Capabilities

- *Combat/Operational Effectiveness:* Attributes of Combat/Operational effectiveness assessed subjectively include: Lethality, Mobility, Maneuverability, Detection, Communications, Availability, Simplicity, Productivity, and Sustainability.
- *Logistics Performance:* Attributes of Logistics Performance assessed subjectively include: Weight Reduction, Deployment, Maneuverability, Storage, Perishability, Replacement, Availability, Simplicity, Productivity, and Sustainability.
- *Safety and Environment:* Aspects of Safety and Environment assessed subjectively include: Survivability, Stealth, Protection, Simplicity, Productivity, and Sustainability.

The qualitative assessment was made in terms of positive impacts (coded green); neutral impacts, or negative impacts (coded red) – see Figure 9. A commentary is also provided highlighting points of note. The capability factors listed above are from the Army Force Management School, 2003.

2.3.2 Draft SMP Cost-Benefit Output and Draft Qualitative Assessments for Eight Illustrative Case Studies

Figure 8 shows a table of quantitative data highlighting key metrics for each of the eight Illustrative SMP Cost-Benefit Analysis Case Studies. Note that it is important to interpret this quantitative data in the context of the qualitative data also provided in this section. In general, higher gallons of fuel saved lead to greater economic value added and positive related impacts on Carbon Dioxide (CO₂) emissions avoided.

Summary of DRAFT G4 SMP Cost-Benefit Output for 8 Illustrative Case Studies (as of 7 May 2010)					
	Fuel Consumption Avoided (gallons)	NPV (\$)	Payback (years)	Emissions Avoided (tCO ₂ e)	Reduction in FBCF (\$)
5kW AMMPS	9,707	12,306	7.142	194,872	23,018
10kW AMMPS	31,586	1,147,699	immediate	634,092	129,538
60kW AMMPS	16,811	299,182	immediate	337,480	48,308
TGER	53,935	247,157	11.3	1,082,749	119,732
THEPS	138,334	3,153,245	5.32	2,830,704	209,446
Solar Thermal	4,285	16,191	13.48	87,693	17,383
Thermal Recycle	56,827	917,441	2.584	1,162,836	149,702
Spray Foam	275,834	2,987,889	0.818	5,644,355	792,292

Figure 8: Quantitative Technology Rankings and Comparisons

Regarding fuel savings, the technologies that lead to greatest level of fuel savings are grouped in those at the Sustainment Brigade level, Spray Foam, THEPS, and Thermal Recycle. The greatest fuel savings at the HBCT level was found by applying the Tactical Garbage to Energy Refinery (TGER).

Regarding economic value added, all technologies show positive NPV and Payback within the technology's useful life. Two sizes of AMMPS, the 10kW and the 60kW, have lower capital costs than the TQGs they replace and the payback is immediate. Spray Foam also has a fast payback (<1 year), and THEPS has the greatest NPV because commercial cost savings are reaped over a longer useful life for the THEPS (17 years) than that of the Spray Foam applied to General Purpose (GP) Medium tents (5 years). Note that the gallons saved positively relates to the Reduction in FBCF (\$) in all cases (fuel savings result in lower total FBCFs).

Regarding environmental impacts, application of Spray Foam, THEPS, Thermal Recycle, and TGER avoid the greatest levels of CO₂ emissions over their useful lives.

**Summary of DRAFT Qualitative Assessments* for 8 Illustrative Case Studies
(as of 7 May 2010)**

Combat/Operational Effectiveness	AMMPS (5kW, 10kW, 60kW)	TGER	THEPS	Spray Foam	Solar Thermal Water Heating	Thermal Recycle Dryer Attachment
- Lethality	neutral	neutral	neutral	neutral	neutral	neutral
- Mobility	positive	neutral	neutral	neutral	negative	neutral
- Maneuverability	positive	negative	neutral	neutral	negative	neutral
- Detection	positive	positive	positive	positive	positive	neutral
- Communications	neutral	neutral	neutral	neutral	neutral	neutral
- Availability	neutral	neutral	positive	negative	neutral	positive
- Simplicity	neutral	negative	positive	negative	positive	neutral
- Productivity	positive	positive	positive	positive	positive	positive
- Sustainability	positive	positive	positive	positive	positive	positive

Logistics Performance	AMMPS (5kW, 10kW, 60kW)	TGER	THEPS	Spray Foam	Solar Thermal Water Heating	Thermal Recycle Dryer Attachment
- Weight Reduction	positive	negative	negative	negative	negative	negative
- Deployment	positive	negative	negative	negative	negative	neutral
- Maintainability	positive	negative	positive	positive	positive	neutral
- Storage	neutral	neutral	negative	neutral	positive	neutral
- Perishability	neutral	neutral	negative	negative	positive	neutral
- Replacement	neutral	neutral	positive	positive	neutral	neutral
- Availability	positive	neutral	neutral	negative	negative	positive
- Simplicity	positive	negative	positive	negative	positive	positive
- Productivity	positive	positive	positive	positive	neutral	positive
- Sustainability	positive	negative	positive	positive	positive	positive

Safety and Environment	AMMPS (5kW, 10kW, 60kW)	TGER	THEPS	Spray Foam	Solar Thermal Water Heating	Thermal Recycle Dryer Attachment
- Survivability:	positive	neutral	positive	positive	neutral	neutral
- Stealth	positive	positive	positive	neutral	positive	positive
- Protection	neutral	neutral	neutral	positive	neutral	neutral
- Simplicity	positive	negative	positive	negative	positive	positive
- Productivity	positive	positive	neutral	positive	positive	positive
- Sustainability	positive	positive	positive	positive	positive	positive

Acronym:	Definition:
AMMPS	Advanced Medium Mobile Power Source
THEPS	Transportable Hybrid Electric Power System
TGER	Tactical Garbage to Energy Refinery

* From G4 SMP

Figure 9: Summary of DRAFT Qualitative Assessments for 8 Illustrative Case Studies

Figure 9 shows a summary table of qualitative data that highlights key directional impacts for each of the eight Illustrative Case Studies. Note that it is important to interpret this qualitative data in the context of the quantitative data also provided in this section. Also note that all three AMMPS received the same qualitative ratings.

Regarding combat/operational effectiveness, each of the technologies results in more positive ratings than negative.

Regarding logistics performance, the qualitative results are mixed. The AMMPS stands out as positive when compared to the TQGs they replace. TGER stands out as having the most significant negative qualitative impact on logistics performance.

Regarding safety and environment, each of the technologies results in more positive ratings than negative. Again, AMMPS stand out as positive when compared to the TQGs they replace.

2.4 Assessment of Methodology Implementation and Documentation of Project

The MAESMO study team performed the following activities to assess methodology implementation and document this project:

- Assessed the capability of the existing PPBES process to incorporate the energy cost-benefit analysis methodology developed.
- Identified issues related to implementing and institutionalizing the methodology in the Army; recommended how these issues might be addressed.
- Identified the benefits to the Army of implementing the methodology developed; suggested ways the methodology could be improved in the future.
- Prepared this Final Report and Briefing (on all activities completed under this Project).

The purpose of this effort was to assess the capability of the existing Army PPBE process to incorporate the energy cost-benefit analysis methodology developed. This included identifying the benefits to the Army of implementing the methodology developed, suggesting ways the methodology could be improved in the future, identifying issues related to implementing and institutionalizing the methodology in the Army, and recommending how these issues might be addressed.

2.4.1 Requirements Management

Overall, the role of Army planning is made up of functions and supporting activities derived from Executive Orders (EOs), OSD Regulations, Army Directives, and other Army plans and manuals. These activities and responsibilities flow down to the key Army agencies and energy security technology proponents through directions and guidance from these sources and from Senior Army leadership. This flow down process is what defines and guides the requirements for the Army energy security community and what supports the PPBE process.

2.4.2 Army Posture Statement 2010 and Cost Benefit Analysis Guidance

The Army's requirements generation process strives to ensure validated and high-level requirements are aligned with Army programs' respective unfunded requirements drills, Quadrennial Defense Reviews, as well as the Program Objective Memorandum (POM) submissions through the PPBE process. Through this effort, the ability to identify multi-year prioritized essential requirements helps to better align new Army (as well as Joint) Science and Technology (S&T) and Research and Development (R&D) program proposals in meeting long term requirements. An effective cost-benefit analysis is necessary to justify resources and successfully compete for the limited funding available. The 2010 Army Posture Statement states "The Army is developing policies and procedures to require that CBA be incorporated into its resource decision-making, requirements development, and analytical review processes conducted for new and increased requirements." A memorandum dated 01 February 2010 and signed by the Acting Assistant Secretary of the Army (Financial Management and Comptroller) Mr. Robert M. Speer, with the subject "Cost-Benefit Analysis Guidance and Training", includes the current document providing guidance on the content of a cost-benefit analysis (see Figure 10).³

³ U.S. Army Cost Benefit Analysis Guide—v 1.0 (Prepared by the Office of the Deputy Assistant Secretary of the Army (Cost and Economics), 12 Jan 2010.



Figure 10. Cost Benefit Analysis Process

2.4.3 Cost Benefit Analysis (CBA)

CBA provides decision makers with facts, data, and analysis required to make an informed decision. In its most basic form, the CBA is a tool to support resource informed decision making. There is no prescribed length to a CBA. All that is required is that it fully supports the recommendation. Therefore, quality is genuinely more important than quantity.

A CBA is a decision support and planning tool that documents the predicted effect of actions under consideration to solve a problem or take advantage of an opportunity. A CBA also serves as a structured proposal that functions as a decision package for organizational decision makers. It defines a solution aimed at achieving specific Army and organizational objectives by quantifying the potential financial impacts and other business benefits such as:

- Savings and/or cost avoidance
- Revenue enhancements and/or cash-flow improvements
- Performance improvements

An Army CBA considers non-financial or non-quantifiable benefits of a specific course of action (COA). This feature is important because although the financial data may favor one COA over another, there may be situations where the non-financial data/information is considered more important to the analyst or senior decision maker. Furthermore, the non-financial criteria and observations may support something other than what the financial data favors. An Army CBA includes an analysis of business process performance, associated needs or problems, proposed alternative solutions, assumptions, constraints, and a risk

analysis. The CBA is process-oriented, and will not only develop a set of choices that will be analyzed but will also lead the analyst to a recommended choice. An Army CBA provides an evaluation and justification of a proposed solution (including any associated expenditures) before a significant amount of funds are invested. Finally, an Army CBA documents the reasons for the investment and the options available and describes how the investment helps the organization (and the bigger Army) reach its goals. In short, characteristics of a CBA include:

- It must be tailored to fit the problem.
- It will not produce a result that is more valid than the input data.
- It will not make a final decision; that will be the responsibility of the decision-maker and members of senior leadership.
- It will not act as a substitute for sound judgment, management, or control.

2.4.4 Energy Security and Cost Benefit Analysis

The development and application of cost-benefit and risk analysis to evaluate energy technologies and practices in the Army has been relatively limited compared to other force parameters. The Army has recognized that it needs to reduce fossil fuel requirements for forward/remote operating bases and units to reduce the number of fuel convoys per resupply period. As the Army examines various energy efficiency, renewable energy, and other alternative energy technologies, key variables such as logistical supportability and sustainability, vulnerability, range, mobility, cost, and effects on tactics and strategy are becoming more interrelated and complex. Furthermore, as the Army transforms its energy policies and strategies, it is necessary to transform its modeling and analysis capabilities to account directly for the costs and benefits of energy resources and the potential risks of energy decisions in theaters of operation.

In support of the MAESMO project, the MAESMO study team contacted and met with representatives from Army analysis offices. They include:

- CAA
- TRADOC-TRAC
- AMSAA
- ATEC
- CASCOM
- DASA-CE
- HQDA, G4

Based on coordination with these agencies, the MAESMO study team developed an architecture depicting relationships and functions among energy-related processes and tools used by the agencies within the Army analysis community. The MAESMO study team also identified recommended changes to the baseline architecture that could enable the Army analysis community to support recently

enacted energy policies pertaining to FBCF, energy efficiency as a KPP, and energy as an independent variable (contributor to mission effectiveness). Figure 11 shows that the existing architecture in the Army is capable of addressing recently enacted energy policies with some modifications and expansion to existing models and processes. These recommendations include:

- Standardized system comparisons
- Increased actual fuel use data
- Alternative energy technologies
- Energy technologies as independent variables in logistics and combat models
- Standardized measures (e.g., FBCF).

These recommendations related to fuel and energy efficiency can lead to improved and detailed validation data for further justification and support for future validated requirement submissions and associated funding requests through the PPBE process.

Overview of Proposed **Enhanced Architecture:** Operational Energy Analysis in Army Analysis Agencies

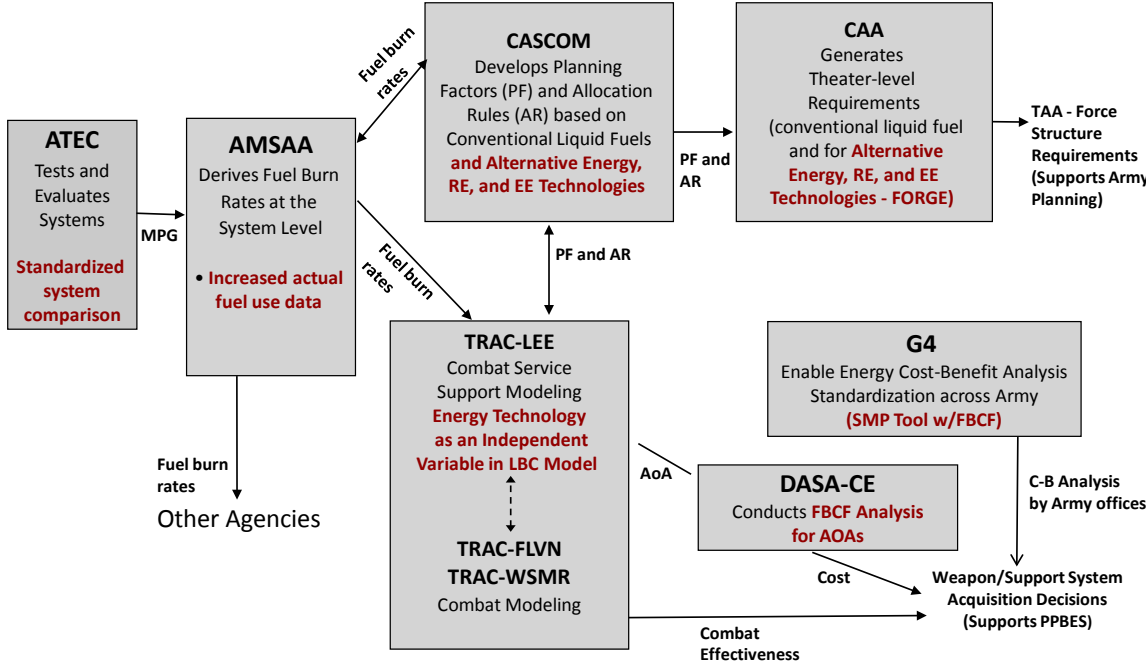


Figure 11. Proposed Enhanced Architecture for Army Operational Energy Analysis

2.4.5 Planning, Programming, Budget, and Execution (PPBE)

PPBE is one of the three decision support systems overseen by OSD to be used to acquire materiel and services. The PPBE process evolved to its present state as a result of internal OSD initiatives to make the system more responsive and as a result of pressures external to OSD to do things differently. Today, the PPBE process includes the full range of activities that support both DoD and Army decision-making concerning the allocation of resources. In essence, the Army PPBE process ties strategy, program and budget all together. It helps build a comprehensive plan in which budgets flow from programs, programs from requirements, requirements from missions, and missions from national security objectives. The patterned flow (from end purpose to resource cost) defines requirements in progressively greater detail.

In this section, the four phases of the PPBE process are described⁴.

- **Planning.** Planning includes the definition and examination of alternative strategies, the analysis of changing conditions and trends, threat, technology, and economic assessments in conjunction with efforts to understand both change and the long-term implications of current choices. It is a process for determining requirements.
- **Programming.** Programming includes the definition and analysis of alternative force structures, weapon systems, and support systems together with their multi-year resource implications and the evaluation of various tradeoff options. It is a process for balancing and integrating resources among the various programs according to certain priorities.
- **Budget.** Budgeting includes formulation, justification, execution, and control of the budget. It is a process for convincing OSD and Congress to provide the necessary resources and then balance the checkbook to ensure resources are spent in accordance with the law. It is important to understand that these general definitions relate to the functions performed and not to a specific organizational element that performs them.
- **Execution.** The Execution phase serves as the real world aspect of the process—the execution of the programs and budgets in the field. Several events must take place before the Army can execute its program after the President signs the Authorization and Appropriations bills passed by the Congress. The Office of Management and Budget must apportion the appropriations providing obligation/budget authority. The Department of the Treasury must issue a Treasury Warrant providing cash. Program authority must be released by the Under Secretary of Defense (Comptroller). Before the Army can execute its program for the FY, all these authorities must be loaded into the Program Budget Accounting

⁴ Department of Defense Planning, Programming, Budget, and Execution (PPBE) Process / Army Planning, Programming, Budget and Execution Process (An Executive Primer)

System (PBAS). Guided by appropriation and fund sponsors at HQDA and via PBAS, ASA Financial Management & Comptroller (FM&C) allocates apportioned funds to Major Army Commands (MACOM) and operating agencies through the Funding Authorization Document (FAD). It is only in the execution of the approved and resourced programs that the Army can evaluate the work that has gone into the earlier three stages of the process and determine if it generated the results for which it paid.

Under the Planning phase, Army Strategic Planning Guidance (ASPG) analyzes DoD strategy in the context of the Army's role in the future global strategic environment and identifies the joint demand for Army capabilities referred to as Army Strategic Imperatives. In addition, Army Planning Priorities Guidance (APPG) prioritizes Army capabilities to support attainment of Army strategic imperatives and to facilitate defining and prioritizing resource tasks to guide the allocation of resources during programming and budgeting. The Army Program Guidance Memorandum (APGM) is then developed and the responsibility of the Director, Program Analysis and Evaluation (DPAE, G8). It guides the POM by providing goals, objectives, sub-objectives and prioritized resource tasks for each of the six Program Evaluation Groups (PEGs).

With regard to Energy Security, the Sustaining PEG includes the following related objectives⁵:

- Readiness Objective: Support Army go to war readiness.
 - Sub-Objective A: Support and sustain critical Army full-spectrum capability and peacetime readiness.
 - Sub-Objective B: Support the goals of enhancing strategic responsiveness and reducing Army/Theater logistic requirements.
 - Sub-Objective C: Ensure key logistics support programs are in place to provide required technical assistance, logistics integration, and industrial preparedness in support of readiness.
- Transformation Objective: Identify, develop, integrate, support, and field Army logistics initiatives.
 - Sub-Objective A: Reduce Combat Zone footprint, to include exploiting advanced technology, common operating picture for logistics, and common platforms.
 - Sub-Objective B: Establish and support requirements for reliability, maintainability, sustainability, continuous process improvement, and life-cycle weapon system management.

Under the Programming phase, resource programmers translate guidance and objectives into action to produce combat capability through the timely and

⁵ Army Program Guidance Memorandum

balanced allocation of resources. A programmer translates the goals and objectives of the planner (i.e., requirements) into finite actions with resources applied. The programmer considers alternatives and tradeoffs but always remains focused on the planner's guidance and objectives. Perhaps the most critical task of the programmer is to integrate all the different requirements into a balanced program. The program balance becomes difficult when the programmer must achieve that balance within constrained resources. Resource planning in the programming phase includes the consideration of the alternatives and tradeoffs to include alternative technologies that have been analyzed or demonstrated to provide a similar capability (or improved capability), but more cost-effective.

2.4.6 Cost Benefit Analysis (CBA) and PPBE: Estimating Quantifiable Benefits

Per the Army Cost Benefit Analysis Guide, every effort should be made to quantify benefits to the maximum extent possible. Sub-divide quantifiable benefits into those that are dollar quantifiable and those that are quantifiable in other terms. The methods of measurement for quantifiable benefits are as follows, in order of desirability:

- Dollar quantifiable terms.
- Physical count of tangible items (for example, units of output).
- Index or ratio (for example, 40 percent or greater).

Data must be collected from appropriate sources and analyzed; relationships among data must be identified; inflation and discounting must be applied to annual dollar values via standard methods. Cost estimates should apply inflation indices and then benefits should be computed by comparing the status quo (with applied inflation indices) with the cost of the alternative(s). The economic life (the period during which the alternative provides benefits) of the alternatives and the FYs when benefits accrue must be carefully considered. Identify all benefits by the appropriation and the FY in which they are expected to occur. Upon decision approval, savings in the year of execution and budget year shall be retained by the command. Savings in the program years are considered in the PPBE process. Savings beyond the POM period, as well as cost avoidances and productivity improvements, are treated differently. Also, one should consider the limitations of benefit analysis carefully when using benefits in the decision making process. During the quantifying and analysis process, assumptions and judgments are made which influence the results. The programming resource analyst must make value judgments and tradeoffs, and any uncertainty that exists about the information must be made clear to the decision maker.

2.4.7 CBA: Organizing Cost Data

Per the Army Cost Benefit Analysis Guide, when a programming resource analyst is organizing and evaluating cost data, it is helpful to build tables for identifying

and aggregating costs. Using tables to display costs also helps identify those costs that will require tradeoffs, particularly costs that appear in the years of execution (current year and budget year before the next POM). These tables may also be used to prepare briefing charts for decision makers. Resource analysts must determine the specific time period the CBA covers (e.g. the execution and POM years or a longer time period). The analyst needs to create a table for each alternative (see sample in Figure 12), to include both the costs and quantifiable benefits for each alternative to facilitate their comparison. The analyst also needs to insert formulas that include the effects of inflation as well as discounting on the cash flows. The structure and content of the table are primarily influenced by the CBA itself and the needs of the decision maker and/or analyst.

Alternative A									
	Time Period								
Cost Elements	FY 2010	FY 2011	FY 2012	FY 2013	FY 2014	FY 2015	FY 2016	FY 2017	Total
Personnel									
Facilities									
Equipment									
Contracts									
Training									
MILCON									
Maintenance									
Supplies									
Etc.									
Etc.									
Etc.									
TOTAL									

The cost elements shown to the left reflect some possible ones/ideas and not what must be used. The analyst should consider using more specific cost elements if possible. For example, if an initiative will be staffed with both military and civilian personnel, then show the break down between them. The cost elements selected will depend on the cost data used in the CBA.

Figure 12. Sample Table for Alternative Solution: Aggregated Cost (by Cost Element and by Year)

3.0 FINDINGS AND RECOMMENDATIONS

This study found that Army analysis agencies have substantive existing and prospective capabilities for:

- Evaluating energy efficiency as a Key Performance Parameter
- Calculating and applying the FBCF for AOA's and other cost-benefit analyses
- Modeling energy in combat/combat service support models (to be part of cost-benefit analysis)

Standardization in development and application of these capabilities is necessary to effectively implement recently enacted energy policies. The proposed enhanced architecture in this study provides a reusable methodology for evaluating the costs and benefits of energy technologies (and technologies which impact energy production and use) in support of Army operational missions.

Enhancing the Army’s analytic capabilities, as recommended by this study, would bolster energy tradeoff analysis in decision-making and raise awareness of opportunities that would only materialize through viewing energy as an independent variable. This would enable the Army to make better informed energy decisions and investments to support recently enacted DoD energy policy requirements. Key findings from this study along with recommended changes in process, expansions in organizational mission, enhancements to existing analytical capabilities, and new strategic communications are described in Figure 13 below.

Finding	Recommendation
System energy efficiencies are not compared with the same configurations (varying non-mobility power loads)	Compare system energy efficiency using the same system configuration to enable consistent comparative analyses
AMSAA collects actual fuel consumption on selected wheeled systems (about 80 currently)	Expand the AMSAA initiative for collecting actual fuel consumption data to all major energy consuming systems
Fuel consumption impacts outside the system are not included (e.g., resupply convoys)	Include fuel consumption impacts outside the system (e.g., G4 SMP Tool includes resupply convoy fuel use)
CASCOM develops PFs and ARs only for conventional liquid fuels	CASCOM should develop PFs and ARs for alternative/renewable energy (RE) and energy efficiency (EE) technologies
CAA can only incorporate PFs and ARs based on conventional liquid fuels	CAA should modify the FORGE model to incorporate new energy PFs and ARs (from CASCOM) for alternative/renewable energy and energy efficiency technologies
Need exists for standardized FBCF development and implementation	Standardize FBCF development and Army-wide implementation

Finding	Recommendation
<p>Energy technologies are not currently modeled as independent variables in TRAC Models. Therefore, contributions by energy technologies to combat effectiveness are not currently evaluated</p>	<p>Expand TRAC LBC Model to integrate energy logistics and technologies with combat/operations modeling and analysis – model energy as an independent variable</p>
	<p>Brief MAESMO analysis findings and recommendations to the Senior Energy Council</p>

Figure 13: Findings and Recommendations

APPENDIX A: FINDINGS OF LITERATURE REVIEWS

A1.0 U.S. ENERGY CONSUMPTION

A review of U. S. energy consumption resulted in the following findings:

- U.S. National Energy Consumption
 - Petroleum is used to produce 37% of the total U.S. national British Thermal Units (BTUs) production

- U.S. Federal Government and DoD Energy Consumption
 - DoD is by far the largest federal Government energy consumer (approximately 80% of U.S. total consumption)
 - Petroleum is used to produce 78% of the total DoD BTUs production
 - Over time, energy consumption declined due to increased efficiency, but wartime demands result in consumption increases
 - U.S. Air Force is the largest consumer as a result of jet fuel use.

- U.S. Army Energy Consumption
 - Army Energy Consumption was 20% (FY07) and 21% (FY08) of total DoD consumption
 - Consumption increased by 8% between FY07 and FY08; cost increased by 40% the in same period

- Army Weapon System Peacetime and Wartime Consumption
 - Total energy consumption during wartime increases to 206.6 total BTUs (approximately two times the peacetime consumption)
 - Liquid fuel consumption in wartime rises in total, and in percentage share of total
 - Installations consume the largest share of energy (37%)
 - Wartime use of generators increases to 22% in comparison to 3% usage during peacetime scenario.

A2.0 RECENTLY ENACTED LAW AND DoD ENERGY POLICY

A review of recently enacted law and DoD energy policy resulted in the following findings.

- National Defense Authorization Act for FY09 (September 2008)
 - “The Secretary of Defense shall develop and implement a methodology to enable the implementation of a fuel efficiency key performance parameter in the requirements development process for the modification of existing or development of new fuel consuming systems.”
 - “The Secretary of Defense shall require that the life-cycle cost analysis for new capabilities include the FBCF during analysis of alternatives and evaluation of alternatives and acquisition program design trades.”

- DoD Instruction (DoDI) 5000.02 (Operation of the Defense Acquisition System) (December 2008)
 - “Alternative ways to improve the energy efficiency of DoD tactical systems with end items that create a demand for energy, consistent with mission requirements and cost effectiveness.”
 - “The fully burdened cost of delivered energy shall be used in trade-off analyses conducted for all DoD tactical systems with end items that create a demand for energy.”
- ASA-ALT Memorandum on Energy Productivity in U.S. Army Weapon Systems– January 7, 2009:
 - “Maximize operational capability and effectiveness by mitigating risks to energy supply”
 - “Fully burdened cost of energy will be estimated for the analysis and evaluation of alternatives.”
- Army Energy Security Implementation Strategy (January 2009) Strategic ESGs:
 - Reduced energy consumption
 - Increased energy efficiency across platforms and facilities
 - Increased use of renewable/alternative energy
 - Assured access to sufficient energy supplies
 - Reduced adverse impacts on the environment.

A3.0 VICE CHIEF OF STAFF OF THE ARMY (VCSA) GUIDANCE (JULY 08 2009)

Additional literature review resulted in the following VCSA guidance:

- “The most senior leaders of the Army’s Generating force need an integrated (cross functional) assessment capability comparable to the Operating Force.”
- “Although the primary focus of the Operating Force and Generating Force are different, they both require a strategic assessment capability that ensure unified, comprehensive, prioritized, and focused assessment support to strategic decision makers This assessment capability must conduct “what if” analysis in support of decision and strategic choices, red team major proposals, gauge and report the Army’s performance, prioritize analysis efforts, and “sense” emerging trends and issues of interest.”
- “The Enterprise Task Force (ETF) will lead the effort to develop options to ensure that a focused analytical capability is in place to provide the right information at the right time so the best resource-information decision can be made.”

APPENDIX B: SUMMARIES OF MEETINGS

B1.0 DEPARTMENT OF THE ARMY (HQDA) G4

Project team representatives met with POCs from the AEPI and HQDA G4 in the Pentagon on August 25, 2009 to discuss the mission and scope of the MAESMO project, and to discuss how the Food and Liquids Division (DALO-SUF) could work with AEPI, as partners, to help guide and successfully implement the project. DALO-SUF is the functional proponent for mobility fuels, water, food, and other commodities required to sustain operational missions. The meeting participants all agreed that it was important to coordinate MAESMO with other Army, and DoD initiatives related to mobility fuels/energy, such as CASCOM Tactical Fuel and Energy Strategy for the Future Modular Force study, with other offices in G4 as well as with the Army Petroleum Center (APC), Tank-Automotive Command (TACOM), Logistics Support Activity (LOGSA) and the LIA. The meeting concluded with Government participants agreeing that DALO-SUF would partner with AEPI on the MAESMO project in support of effective and efficient compliance of recently enacted Army and DoD energy policies and in support of integration with other mobility fuel/energy initiatives.

B2.0 Office of the Deputy Assistant Secretary of the Army for Cost and Economics (DASA-CE)

Project team representatives met with POCs from AEPI and the Unit Mission Costing Division, DASA-CE at the Pentagon on 1 September 2009 to discuss the objectives of the MAESMO project and to learn more about the use of energy related models, tools and databases used in DASA-CE. The discussion centered on the following three DASA-CE models/databases:

- FORCES Cost Model (FCM)
- Army Contingency Operations Cost Model (ACM)
- Operating & Support Management Information System (OSMIS)

The FCM generates operating and support (O&S) costs by notional force unit during peacetime (at installations). POL costs are included in O&S costs. The ACM enables users to adjust FCM-generated O&S costs for units in theaters of operation during wartime. The FCM and ACM can be used for any unit. The FCM (and ACM) use engineering estimates for fuel consumption.

The OSMIS generates detailed OPTEMPO costs (repair parts, spares, and POL) based upon actual OPTEMPO miles or hours in the training base and in contingency operations. OPTEMPO costs are in terms of dollars per mile, per hour, or per system in the case of generators. OSMIS covers about 85% of the OPTEMPO costs (the remaining 15% covers items like small arms) used in preparation of the POM. OSMIS provides input to G3's TRM (Training Resource Model) which is directly used in the POM build. TRM aggregates generator O&S costs in groups by range of kW.

B3.0 ARMY TEST AND EVALUATION COMMAND (ATEC)

Project team representatives met with POCs from AEPI and ATEC at ATEC in Alexandria, Virginia on August 27, 2009. The purpose of this meeting was to discuss the

mission and scope of the MAESMO project, and to initiate the process of visiting Army analytical agencies in support of developing the baseline architecture of energy-related models. The meeting was with the Sustainment Evaluation Directorate (SED) which conducts independent evaluations of DoD acquisition programs at the individual system level. The MAESMO study team representative noted that the development of the baseline architecture of energy-related models would follow the Army's "hierarchy of analysis" approach – which is a process that integrates analysis from the system to the unit to the theater levels. An ATEC representative provided an overview of ATEC and discussed the various missions of the individual centers and offices that compose ATEC. The ATEC representative then provided the following information:

- The Army Evaluation Center (AEC) plans and conducts independent evaluations and assessments of DoD acquisition programs.
- The SED, within AEC, evaluates sustainment, mobility, maneuver support, and chem-bio acquisition programs at the individual system level.
- The requirement to test and evaluate a system usually comes from a Project Manager (PM), such as PM-Mobile Electric Power (MEP) in the case of generators. However, requests for testing and evaluation can also come from other offices such as HQDA G3's REF.
- SED's mission is to ensure that systems work and are safe to operate. Criteria (such as mpg in the case of trucks) are used in the testing and evaluation of various systems; no models are used to evaluate the systems.
- Currently, it is difficult to measure changes in the energy usage/efficiency of a new vehicle being tested compared to a fielded system because the Environmental Protection Agency (EPA) has recently changed their methodology for calculating MPG.
- An Army TRADOC proponent agency generates a Capability Production Document which indicates the technical and performance requirements of the system to be evaluated by ATEC. For example, in the case of support systems like trucks, the TRADOC proponent is CASCOM. The PM develops a Test and Evaluation Master Plan (TEMP) which is an agreement among the PM, ATEC and TRADOC proponent that indicates ATEC's testing and evaluation of a system will be conducted according to the requirements from the TRADOC proponent. After an individual system is tested and evaluated within SED, the TEMP, a system evaluation report, and other information is provided to the Integrated Logistics Support (ILS) Directorate within AEC to evaluate the logistics requirements to support the system evaluated.

B4.0 ARMY MATERIEL SYSTEMS ANALYSIS ACTIVITY (AMSAA)

Project team representatives met with POCs from AEPI, ATEC, and AMSAA at Aberdeen Proving Ground (APG) Aberdeen, Maryland on September 3, 2009. The purpose of the site visit was to provide an opportunity for ATEC and AMSAA to learn more about MAESMO, and for the MAESMO study team to learn more about how ATEC and AMSAA work together and use energy related models/tools and data sources. The Government representatives provided the following information.

- ATEC focuses on energy-related KPP such as materiel capabilities and operational and fleet availability on a life cycle basis. Materiel capability and operational data are regarded as two different sets of metrics. ATEC considers fuel and energy requirements as a post-process in their analyses. Casualties are not considered in ATEC's analysis, but they do consider factors such as life cycle costs, cost savings, and greenhouse gas emissions, in addition to materiel capability and operational performance.
- Most ATEC analyses are performed at the micro-level (e.g., generators). ATEC/ILS form a systems evaluation team (that includes AMSAA) which examines and tests performance, logistics, and survivability against existing KPPs. The ILS Team's report is similar to a consumer report evaluation, i.e., did the item meet criteria for survivability, sustainability, suitability, milestones, etc.
- It is difficult to get new energy sustainability KPPs approved by CASCOM or TRADOC. The PMs for R&D use different criteria relative to the item being evaluated. In Operation and Maintenance (O&M) Standard Operating Procedures (SOPs), there are operational and mission-related profiles; one for peacetime and one for wartime-in-theater. The overall burden of energy to the Army includes "distillation to distribution."
- ILS looks at the impact of exchanging engine technologies using the same fuel but with different efficiencies/capabilities on the basis of measures such as per flight hour, fuel usage, spare parts, maintenance, personnel, materiel and infrastructure support. There is no standard policy for ILS analysis; it is on a system by system basis.
- ATEC has examined the Future Combat System (FCS), but it may not be complete. The operational aspects of the FCS have become more important than logistics analysis.
- Maneuver ground and air systems are assessed by AEC-ILS through analytical support to the warfighting directorates in ATEC which do not run models from a fuel perspective. AEC-ILS and AMSAA have a Memorandum of Understanding (MOU); which is being further formalized.
- AMSAA uses two models in support of analyzing energy efficiency as a KPP; the FCPM and the Optimum Stock Requirements Analysis Program (OSRAP) Model. Analysis is conducted in conjunction with ATEC.
 - The FCPM calculates detailed item and mission level fuel consumption estimates for ground systems. Inputs to FCPM include items such as vehicle characteristics obtained from Army test centers and manufacturers, terrain considerations, speed, percent idle, and non-mobility power loads. AMSAA has recently begun to collect actual fuel consumption and mission profile data by system in theater which can be used in FCPM. The FCPM supports TRAC, PMs, AEC, CAA and CASCOM. FCPM is used to support combat and combat support models such as AWARS, COMBAT XXI, and Combined Arms and Support Task Force Evaluation Model (CASTFOREM). FCPM is also used to create fuel consumption estimates for the Operational Logistics (OPLOG) Planner. FCPM supports TAA) AoA, and special studies.

- The OSRAP Model is a logistics footprint optimization model that calculates stock levels to meet a given readiness objective at the least cost. Though initially designed to determine class IX spares, the model was expanded to include class 3B (Bulk fuel) estimates. It generates data on fuel consumption in terms of gallons, dollars, weight and cube. OSRAP analysis supports PMs, TRAC, Army Materiel Command (AMC), AEC-ILS. OSRAP is used to support combat and combat support models such as AWARS, COMBAT XXI, and CASTFOREM. OSRAP supports TAA, AoAs, and special studies. AMSAA inputs usage rates into OSRAP to predict Class I (e.g., food), II (e.g., clothing), III (e.g., POL), and IV (e.g., construction materials) requirements for AMC LOGSA. OSRAP calculates requirements that maximize readiness and minimize cost. OSRAP is an optimization model that, given a war reserve stock readiness goal of say of 92% per scenario, forecasts the required number of spares, repair parts, and POL in terms of dollars, gallons, weight & cubes (aggregates for units and theater levels are possible but not often requested).
- AMSAA's Field Studies Branch (FSB) collects in-theater systems-level data (e.g., fuel consumption, system speed, and depending on the instrumentation package used, terrain) via the platforms' data bus and additional sensors. Mission profiles can be developed based on these data and can be made available to the TRADOC requirements community and PMs. The AMSAA Power and Energy Team have used these data to develop mission profile and fuel consumption estimates for various Tactical Wheeled Vehicles, Mine Resistant Ambush Protected (MRAP), and Stryker systems. AMSAA works with the TRADOC-TRAC to consider these mission profiles to incorporate increased realism into Army studies.
- AMSAA's Power and Energy Team makes item level fuel consumption predictions for TRAC-WSMR in support of COMBAT XXI and for TRAC-FLVN in support of AWARS. TRAC-LEE can use the AMSAA-collected data for examining energy efficiency, convoys etc. The FBCF methodology that will be used within AoAs is currently under development within the DASA-CE.

The AEPI representative noted a "technology gap" for difficult-to-design multi-fuel engines such as the Unmanned Aircraft System (UAS). It was emphasized the MAESMO project is technology-neutral, and is focused on the models and data used to make energy decisions. The AEPI representative made it known that this project's methodology would be on-paper-testing, not in-the-field-testing.

B5.0 (TRADOC) ANALYSIS CENTER-FORT LEE (TRAC-LEE)

Project team representatives met with POCs from AEPI and TRAC-LEE at Fort Lee, Virginia on November 4, 2009. The purpose of this meeting was to discuss the mission and scope of the MAESMO project, and to learn more about the use of existing energy related models, tools and databases in TRAC-LEE. The Government representatives

provided the following information.

- The LBC Model is a recently initiated effort in TRAC- LEE that builds upon capabilities developed for the Dynamic Maintenance Model. The LBC model will dynamically forecast and represent demand for supplies in a standalone mode or potentially linked to a combat simulation model such as COMBATXXI. Priority of effort is Class III, V, and IX. The LBC model also represents the distribution network including nodes (storage, maintenance, supply, medical, and field services) and arcs (modes of transport and distance). If vehicles in TRAC's combat models run out of fuel, they stop moving. Similarly, if they run out of ammunition, they stop firing. In those models, logistics operations are preplanned and scripted as part of the scenario. During scenario development, if a unit does run out of fuel or ammunition, the logistics operations are adjusted, the script is modified, and the modelers run the scenario again; this is an iterative process. The LBC model is able to modify logistics operations during runtime, and is subsequently able to provide the quantity of supplies and resupply assets required for the scenario after just one run. A potential area for LBC model enhancement is to develop the capability to link LBC to TRAC combat models such as COMBATXXI, AWARS, and the One Semi-Automated Forces (OneSAF) Objective System. For these analyses, fuel burn rates, (based on speed, terrain, OPTEMPO, etc.) are usually provided as inputs by AMSAA. Distribution analysis capability is included in the LBC model. This includes assessments of resupply thresholds or risk tolerance. Resupply thresholds would have a direct impact on the size and frequency of resupply operations and may impact combat effectiveness. LBC can monitor "thresholds", and derive relationships between other related variables such as OPTEMPO. LBC also contains a module that is able to assess maintenance downtime. LBC is scalable and can represent multiple echelons. It can represent items down to the National Stock Number (NSN)/component level or aggregated units in a Corps/Division level scenario. In LBC, the analyst defines the level of representation needed, what an entity is (a component, platform or unit), and the entity's scope. LBC does not provide combat modeling analysis.
- There was a study that looked at medical technologies in the FCS medical vehicles; something very difficult to measure. The study looked at how the additional medical enablers on the vehicles resulted in an increase in the power requirements and the fuel consumption. AEPI added that this is an example of the critical measure, "soldier survivability."
- There is a direct need for resupply to be linked to combat effectiveness, but no direct link exists; this would need to be a high fidelity tool. The MAESMO study team noted that the tools need to examine how a specific energy technology would affect range, lethality, and other variables that affect combat and operational effectiveness.
- It was noted that variables such as convoy interdiction, soldier exposure, on time delivery, change in enemy tactics, survivability, speed to accomplish mission, duration, operational availability, adequacy of force structure, and footprint should be included in further development of the LBC and other logistics models.

B6.0 COMBINED ARMS SUPPORT COMMAND (CASCOM)

Project team representatives met with POCs from AEPI and CASCOM at Fort Lee, Virginia on November 5, 2009. The purpose of this meeting was to discuss the mission and scope of the MAESMO project; and also to learn more about the use of existing energy related models, tools and databases used in CASCOM. The Government representatives provided the following information:

- AR 700-8 (Logistics Planning Factors and Data Management) governs responsibilities regarding logistics planning data, to include fuel burn rates, in support of Army operational missions. CASCOM currently calculates fuel usage for operational phases 1, 2 and 3 (deter, seize initiative, and dominate). Future expansion to other phases could be done. Fuel consumption is expressed in terms of equipment usage profiles (including aircraft) to include how equipment is used, miles travelled, and hours idling. Fuel burn rate data for individual systems is provided by AMSAA. Much of the data referred to in AR 700-8 is in the OPLOG Planner; a tool to assist Army logisticians and planners in estimating resource requirements in support of operations and deployments. OSMIS should change their fuel consumption estimates (peacetime) to HQDA G4 estimates (wartime) for applications such as the FBCF in the Sustain the Mission Project (SMP). The Defense Logistics Agency (DLA) model calculates fuel requirements for all of the services; it uses CASCOM fuel consumption rates for the Army.
- The goal of some recent work at CASCOM was to assess the demand function for various FOB units, and identify ways to mitigate demand (and, implicitly, not detrimentally impact combat operations). The finding so far is that not only are they not hurting combat operations, they are improving redundancy, thereby improving combat operations. They have energy demand data for approximately 70 units. They are looking at operational overlays to help determine the right energy mix. Power distribution is a major issue at the FOBs. Work is being done to assess whether generators are the best means to distribute energy. They are currently only looking at generators, not other technologies. Demand reduction is key, not just displacement (for example, in the form of electric cars which may not use fuel but need electricity generated from some fuel, somewhere). If alternative technologies are used, they ought to be analyzed also in terms of environmental impact (i.e., foaming insulation on tents burn a thick black smoke when ignited).

B7.0 CENTER FOR ARMY ANALYSIS (CAA)

Project team representative met with POCs from CAA at Fort Belvoir, Virginia on November 24, 2009. The purpose of this meeting was to discuss the mission and scope of the MAESMO project, and to learn more about the use of existing energy related models, tools and databases used in CAA. The Government representatives provided the following information.

- The Logistics Analysis division uses the FORGE Model which calculates fuel requirements for theater level mission scenarios in support of TAA and other Army and Joint planning and analysis. FORGE analyzes theater level force

structure requirements (to include fuel support equipment and personnel) based upon CASCOM planning factors and allocation rules. These factors and rules indicate the type and amount of force structure required to support combat and other operational units and their missions. FORGE is currently capable of incorporating force structure-related planning factors and allocation rules solely for bulk and packaged liquid fuel. FORGE could be modified to incorporate different force support structures related to different energy technologies if CASCOM could provide CAA with planning factors and allocation rules that specified new force structure requirements related to different energy technologies.

- CAA does not model fuel or energy systems as independent variables in their combat models, and suggested that combat and operational impacts related to different energy technologies would need to be evaluated at the system and unit level before their impacts (if any) could be assessed at the theater level of combat and operational analysis.
- The Mobilization and Deployment division analyzes strategic mobility requirements in support of TAA and other Army and Joint planning missions. Models used include the Enhanced Logistics Intra-theater Support Tool (ELIST) which models the movements of troops, equipment, and cargo in theaters of operation, and the Model for Inter-theater Deployment by Air and Sea (MIDAS), a strategic sealift and airlift model which can simulate multiple strategic inter-theater deployment scenarios. The division has also included the capabilities and features of the industrial base in its studies.

APPENDIX C: CASE STUDY 5 KILOWATT ADVANCED MEDIUM MOBILE POWER SOURCE (AMMPS)

C1.0 ILLUSTRATIVE SMP COST-BENEFIT ANALYSIS CASE STUDY⁶: ADVANCED MEDIUM MOBILE POWER SOURCE (AMMPS)

This case study CBA addressed replacing eleven 5 kW TQG with eleven 5kW AMMPS. In calculating a FBCF based on an existing technology (e.g., the TQG), the annualized depreciation of capital cost and operational costs associated with use of the TQGs is allocated to the consuming unit. In calculating a FBCF based on use of a new power generation technology (e.g., AMMPS), annualized costs associated with the TQG are removed from the calculation and are replaced with those for the AMMPS.

AMMPS is a third generation mobile power source. It replaces the TQG and offers improved fuel efficiency, increased reliability and survivability, reduced weight, and reduced size compared to the TQG.

The analysis was based on a Heavy Brigade Combat Team (HBCT) in an Iraq base case scenario. The Iraq base case scenario was developed by G4 SMP and represents a typical resupply scenario between Kuwait and a consuming unit near Baghdad. The HBCT in this scenario is located at 150 miles (roundtrip) from a DESC capitalized site. Force protection costs and transport costs are attributed to the HBCT for the 150 miles (roundtrip) convoy that makes use of military assets in this scenario.

Figure C1 displays the illustrative SMP Cost-Benefit Analysis of AMMPS for an HBCT in Iraq, inclusive of fuel impacts, economic value added, force protection and logistical impacts, and environmental impacts. Acronyms used in Figure C2 and not yet defined include Ground Convoy Equivalent (GCE), pounds per year (lbs/yr), and carbon dioxide (CO₂).

⁶ Source: G4 Sustain the Mission Project

Illustrative SMP Cost-Benefit Analysis of AMMPS 5kW (for an HBCT in Iraq)

- **Fuel Impacts**
 - Fully Burdened Cost of Fuel:
 - TQG Base Case (Annualized FBCF Per HBCT) = \$27,604,855
 - AMMPS Case (Annualized FBCF Per HBCT) = \$27,581,837
 - TQG Base Case (Per Gallon) = \$16.29
 - AMMPS Case (Per Gallon) = \$16.37
 - Fuel Savings: 9,707 gallons per year (from HBCT and convoy)
- **Economic Value Added**
 - Net Present Value: \$12,306
 - Payback period: 7.142 years
- **Force Protection and Logistical Impacts (per year)**
 - Army Fuel Supply Truck miles freed up: 538 miles
 - Army Gun Truck miles freed up: 134 miles
 - Army Aviation System (Apache) hours freed up: 1.53 hours
- **Environmental Impacts**
 - Greenhouse Gas Emissions Avoided: 194,872 lbs/yr of CO₂

Figure C1: Illustrative SMP Cost-Benefit Analysis of 5 kW AMMPS⁷

Army assets freed up are low because the eleven 5kW TQGs represent a small fraction of total HBCT fuel consumption; therefore, the reduction in fuel consumption is also low. The HBCT in this scenario is located 150 miles (roundtrip) from a Defense Energy Support Center (DESC) capitalized site. Force protection costs and transport costs are attributed to the HBCT for the 150 miles (roundtrip) convoy that makes use of military assets in this scenario.

There is an increase in FBCF per gallon with the deployment of AMMPS technology. This is because the AMMPS case aggregate FBCF is spread over a reduced number of gallons of fuel consumed (9,707 fewer gallons of fuel consumed due to the addition of AMMPS). Of the 9,707 gallons saved, 743 are from reductions in convoy fuel usage.

There is a net decrease in FBCF for the 11 AMMPS in an HBCT on an aggregate basis of \$23,018 per year⁸ (all costs are in \$FY2010). The capital cost for one AMMPS is \$14,560; 11 AMMPS would cost \$160,160. For comparison, 11 replacement TQGs would cost \$146,316. The NPV and payback are based on a commercial cost avoidance of \$1,939 per year and the difference in capital cost between 11 new THEPS and 11 new TQGs, or \$13,844, and the discount rate used to calculate NPV is 2.7%. The NPV is \$12,306 and payback is 7.142 years.

⁷ Source: G4 Sustain the Mission Project

⁸ Changes in aggregate FBCFs account for: 1) the annualized capital costs and operational costs for the new technology (replacing the TQG), 2) increases or decreases in initial deployment cost (e.g., AMMPS cost less by weight to transport than the TQG), and 3) reductions in force protection and transport costs allocated to the unit. These effects are non-linear. Therefore the FBCF calculated based on an existing technology (e.g. TQG) cannot just be multiplied by the gallons of fuel reduced and a per gallon FBCF to obtain the FBCF based on a new technology; each FBCF must be generated based on a unique set of underlying cost components.

Illustrative 5 kW AMMPS Qualitative Assessment

Combat/Operational Effectiveness	5kW AMMPS	Logistics Performance	5kW AMMPS	Safety & Environment	5kW AMMPS
Lethality	neutral	Weight Reduction	positive	Survivability	positive
Mobility	positive	Deployment	positive	Stealth	positive
Maneuverability	positive	Maintainability	positive	Protection	neutral
Detection	positive	Storage	neutral	Simplicity	positive
Communications	neutral	Perishability	neutral	Productivity	positive
Availability	neutral	Replacement	neutral	Sustainability	positive
Simplicity	neutral	Availability	positive		
Productivity	positive	Simplicity	positive		
Sustainability	positive	Productivity	positive		
		Sustainability	positive		

Figure C2: Illustrative 5kW AMMPS Qualitative Assessment⁹

Figure C2 displays the illustrative AMMPS Qualitative Assessment, which shows that AMMPS would provide positive impacts to about two-thirds of the factors shown in Figure 3 and have neutral impacts on the others. AMMPS does not provide any negative impacts to combat or operational effectiveness, logistics performance, or environment and safety factors.

⁹ Source: G4 Sustain the Mission Project

**APPENDIX D: CASE STUDY TACTICAL HYBRID ELECTRIC POWER STATION
(THEPS)**

D1.0 ILLUSTRATIVE SMP COST-BENEFIT ANALYSIS CASE STUDY¹⁰: TACTICAL HYBRID ELECTRIC POWER STATION (THEPS)

This case study CBA addressed replacing 56 5kW TQGs with 56 THEPS. In calculating a FBCF based on an existing technology (e.g., the TQG), the annualized depreciation of capital cost and operational costs associated with use of the TQGs is allocated to the consuming unit. In calculating a FBCF based on use of a new power generation technology (e.g., THEPS), annualized costs associated with the TQG are removed from the calculation and are replaced with those for the THEPS.

Each THEPS is comprised of a 10kW solar array, 3kW wind turbine, 5kW diesel generator, and a 60 amp-hour battery. The combined solar/wind power generating capacity, battery storage, and attached 5kW generator eliminate need for 5kW TQG. THEPS offers reduced fuel consumption for electrical power, but comes at an increased weight and size relative to 5kW TQG.

The analysis was based on a Sustainment Brigade in an Iraq base case scenario. The Iraq base case scenario was developed by G4-SMP and represents a typical resupply scenario between Kuwait and a consuming unit in Baghdad.

Figure D1 displays the illustrative SMP Cost-Benefit Analysis of THEPS for a Sustainment Brigade in Iraq, inclusive of fuel impacts, economic value added, force protection and logistical impacts, and environmental impacts.

Only Apache hours are freed up in this scenario because they are the only Army assets related to the contractor convoys to a Sustainment Brigade. Fuel savings and environmental impacts (greenhouse gas [GHG] avoided) are positive.

There is an increase in FBCF per gallon with the addition of THEPS technology. This is because the lower THEPS case aggregate FBCF is spread over a reduced number of gallons of fuel consumed (138,334 fewer gallons of fuel consumed due to the addition of THEPS) and the resulting increase in FBCF is \$0.47 per gallon. In the THEPS case, the rate of change in fuel consumption decrease was faster than that for cost components of the aggregate FBCF. Of the 138,334 gallons saved, 6,288 are from reductions in convoy fuel usage.

¹⁰ Source: G4 Sustain the Mission Project

Illustrative SMP Cost-Benefit Analysis of THEPS (for a Sustainment Brigade in Iraq)

- Fuel Impacts
 - Fully Burdened Cost of Fuel:
 - TQG Base Case (Annualized FBCF Per Sust Bde) = \$25,013,696
 - THEPS Case (Annualized FBCF Per Sust Bde) = \$24,804,250
 - TQG Base Case (Per Gallon) = \$10.00
 - THEPS Case (Per Gallon) = \$10.47
 - Fuel Savings: 138,334 gallons per year (from Sust Bde and convoy)
- Economic Value Added
 - Net Present Value: \$3.15 million
 - Payback period: 5.32 years
- Force Protection and Logistical Impacts per year
 - Army Fuel Supply Truck miles freed up: 0 miles
 - Army Gun Truck miles freed up: 0 miles
 - Army Aviation System (Apache) hours freed up: 11.20 hours
- Environmental Impacts
 - Greenhouse Gas Emissions Avoided: 2,830,704 lbs/yr of CO₂

Figure D1: Illustrative SMP Cost-Benefit Analysis of THEPS¹¹

There is a net decrease in FBCF for the Sustainment Brigade on an aggregate basis of \$209,446 per year (all costs are in FY\$10). The capital cost for one THEPS is \$50,000; 56 THEPS would cost \$2.8 million. For comparison, 56 replacement TQGs would cost \$0.7 million. The NPV and payback are based on commercial cost avoidance of \$386,095 per year, and the difference in capital cost between 56 new THEPS and 56 new TQGs, or \$2.1 million, and the discount rate used to calculate NPV is 2.7%. The NPV is \$3.15 million and payback is 5.32 years in this illustrative case.

¹¹ Source: G4 Sustain the Mission Project

Illustrative THEPS Qualitative Assessment

Combat/Operational Effectiveness	THEPS	Logistics Performance	THEPS	Safety & Environment	THEPS
Lethality	neutral	Weight Reduction	negative	Survivability	positive
Mobility	neutral	Deployment	negative	Stealth	positive
Maneuverability	neutral	Maintainability	positive	Protection	neutral
Detection	positive	Storage	negative	Simplicity	positive
Communications	neutral	Perishability	negative	Productivity	neutral
Availability	positive	Replacement	positive	Sustainability	positive
Simplicity	positive	Availability	neutral		
Productivity	positive	Simplicity	positive		
Sustainability	positive	Productivity	positive		
		Sustainability	positive		

Figure D2: Illustrative THEPS Qualitative Assessment

Figure D2 displays the illustrative THEPS Qualitative Assessment, which shows that THEPS would provide positive impacts to a little more than half of all of the factors shown in Figure D2. However, it would provide negative impacts to four of the logistics performance factors, such as weight and set-up time.

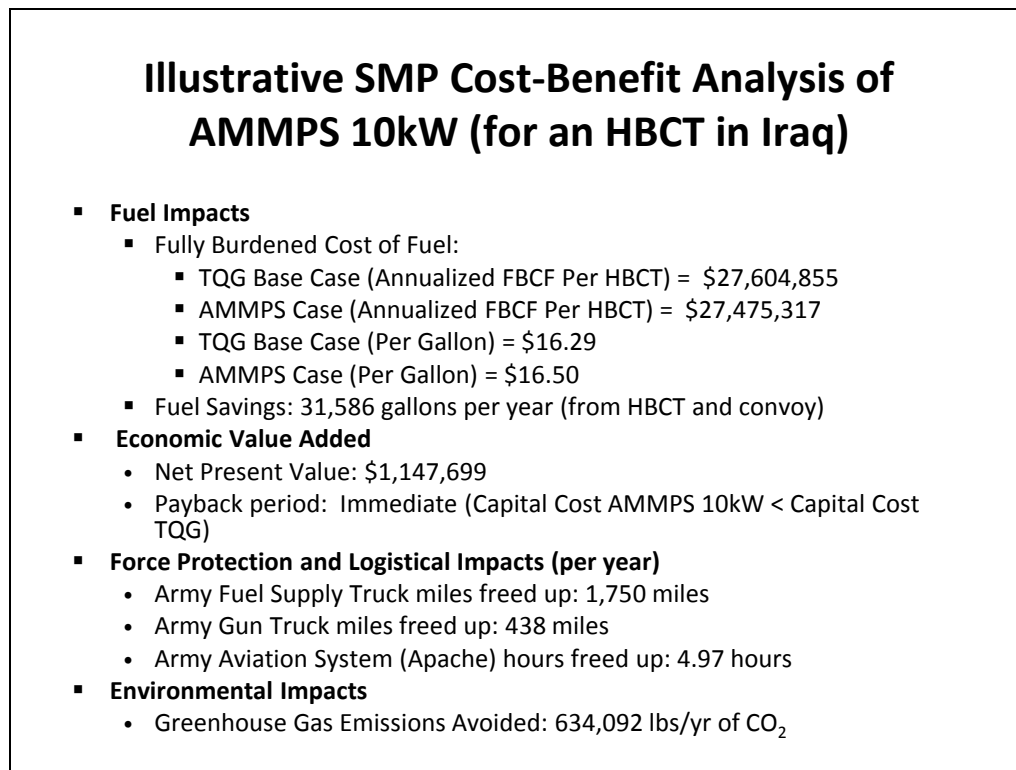
**APPENDIX E: CASE STUDY 10 KILOWATT ADVANCED MEDIUM MOBILE
POWER SOURCE (AMMPS)**

E1.0 10KW AMMPS

This case study CBA addressed replacing thirteen 10 kW TQGs with thirteen 10kW AMMPS. In calculating a FBCF based on an existing technology (e.g. the TQG), the annualized depreciation of capital cost and operational costs associated with use of the TQGs is allocated to the consuming unit. In calculating a FBCF based on use of a new power generation technology (e.g., AMMPS), annualized costs associated with the TQG are removed from the calculation and are replaced with those for the AMMPS.

AMMPS is a third generation mobile power source. It replaces the TQG and offers improved fuel efficiency, increased reliability and survivability, reduced weight, and reduced size compared to the TQG.

The analysis was based on a HBCT in an Iraq base case scenario. The Iraq base case scenario was developed by G4 SMP and represents a typical resupply scenario between Kuwait and a consuming unit near Baghdad. The HBCT in this scenario is located at 150 miles (roundtrip) from a DESC capitalized site. Force protection costs and transport costs are attributed to the HBCT for the 150 miles (roundtrip) convoy that makes use of military assets in this scenario.



**Figure E1: Illustrative SMP Cost-Benefit Analysis of
AMMPS 10kW (for an HBCT in Iraq)**

As Figure E1 shows, Similar to the 5 kW AMMPS case, there is a small reduction (less than 1%) in the total FBCF in the 10 kW AMMPs case and the FBCF per gallon does

increase slightly. The economic value added of the 10 kW AMMPS is much greater than that of the 5 kW AMMPS- the payback is immediate.

Illustrative 10 kW AMMPS Qualitative Assessment					
Combat/Operational Effectiveness	10kW AMMPS	Logistics Performance	10kW AMMPS	Safety & Environment	10kW AMMPS
Lethality	neutral	Weight Reduction	positive	Survivability	positive
Mobility	positive	Deployment	positive	Stealth	positive
Maneuverability	positive	Maintainability	positive	Protection	neutral
Detection	positive	Storage	neutral	Simplicity	positive
Communications	neutral	Perishability	neutral	Productivity	positive
Availability	neutral	Replacement	neutral	Sustainability	positive
Simplicity	neutral	Availability	positive		
Productivity	positive	Simplicity	positive		
Sustainability	positive	Productivity	positive		
		Sustainability	positive		

Figure E2: Illustrative 10 kW AMMPS Qualitative Assessment

As Figure E2 shows, the qualitative ratings for the 10 kW AMMPS are the same as for the 5 kW and 60 kW AMMPS. There are no negative impacts from the 10 kW AMMPS and it is positive on 55% of the Combat/Operational factors; 70% of the logistics performance factors, and 83% of the safety and environmental factors. It is neutral on the others.

**APPENDIX F: CASE STUDY 60 KILOWATT ADVANCED MEDIUM MOBILE
POWER SOURCE (AMMPS)**

F1.0 60KW AMMPS

This case study CBA addressed replacing two 60 kW TQG with two 60kW AMMPS. In calculating a FBCF based on an existing technology (e.g. the TQG), the annualized depreciation of capital cost and operational costs associated with use of the TQGs is allocated to the consuming unit. In calculating a FBCF based on use of a new power generation technology (e.g. AMMPS), annualized costs associated with the TQG are removed from the calculation and are replaced with those for the AMMPS.

AMMPS is a third generation mobile power source. It replaces the TQG and offers improved fuel efficiency, increased reliability and survivability, reduced weight, and reduced size compared to the TQG.

The analysis was based on a HBCT in an Iraq base case scenario. The Iraq base case scenario was developed by G4 SMP and represents a typical resupply scenario between Kuwait and a consuming unit near Baghdad. The HBCT in this scenario is located at 150 miles (roundtrip) from a DESC capitalized site. Force protection costs and transport costs are attributed to the HBCT for the 150 miles (roundtrip) convoy that makes use of military assets in this scenario.

Illustrative SMP Cost-Benefit Analysis of AMMPS 60kW (for an HBCT in Iraq)

- **Fuel Impacts**
 - Fully Burdened Cost of Fuel:
 - TQG Base Case (Annualized FBCF Per HBCT) = \$27,604,855
 - AMMPS Case (Annualized FBCF Per HBCT) = \$27,556,547
 - TQG Base Case (Per Gallon) = \$16.29
 - AMMPS Case (Per Gallon) = \$16.41
 - Fuel Savings: 16,811 gallons per year (from HBCT and convoy)
- **Economic Value Added**
 - Net Present Value: \$299,182
 - Payback period: Immediate (Capital Cost AMMPS 60kW < Capital Cost TQG 60kW)
- **Force Protection and Logistical Impacts (per year)**
 - Army Fuel Supply Truck miles freed up: 931 miles
 - Army Gun Truck miles freed up: 233 miles
 - Army Aviation System (Apache) hours freed up: 2.65 hours
- **Environmental Impacts**
 - Greenhouse Gas Emissions Avoided: 337,480 lbs/yr of CO₂

Figure F1: Illustrative SMP Cost-Benefit Analysis of AMMPS 60kW (for an HBCT in Iraq)

As Figure F1 shows, similar to both the 5 and 10 kW AMMPS case, there is a slight reduction in the FBCF and a minor increase in the FBCF per gallon. The economic payback is immediate.

Illustrative 60 kW AMMPS Qualitative Assessment					
Combat/Operational Effectiveness	60kW AMMPS	Logistics Performance	60kW AMMPS	Safety & Environment	60kW AMMPS
Lethality	neutral	Weight Reduction	positive	Survivability	positive
Mobility	positive	Deployment	positive	Stealth	positive
Maneuverability	positive	Maintainability	positive	Protection	neutral
Detection	positive	Storage	neutral	Simplicity	positive
Communications	neutral	Perishability	neutral	Productivity	positive
Availability	neutral	Replacement	neutral	Sustainability	positive
Simplicity	neutral	Availability	positive		
Productivity	positive	Simplicity	positive		
Sustainability	positive	Productivity	positive		
		Sustainability	positive		

Figure F2: Illustrative 60 kW AMMPS Qualitative Assessment

As Figure F2 shows, the qualitative ratings for the 60 kW AMMPS are the same as for the 5 and 10 kW AMMPS. There are no negative impacts from the 60 kW AMMPS and it is positive on 55% of the Combat/Operational factors; 70% of the logistics performance factors, and 83% of the safety and environmental factors. It is neutral on the others.

**APPENDIX G: CASE STUDY TACTICAL GARBAGE-TO-ENERGY REFINERY
(TGER)**

G1.0 TACTICAL GARBAGE-TO-ENERGY REFINERY (TGER)

This case study CBA addressed replacing one 60 kW TQGs with one 60kW TGER. The TGER converts waste into energy; produces thermal energy which can be used for field sanitation, showers or laundry use; conserves fuel that would otherwise be used power generation, and avoids disposal costs of trash (disposal costs avoided are not monetized in this analysis). In calculating a FBCF based on an existing technology (e.g. the TQG), the annualized depreciation of capital cost and operational costs associated with use of the TQGs is allocated to the consuming unit. In calculating a FBCF based on use of a new technology (e.g. TGER), annualized costs associated with the TQG are removed from the calculation and are replaced with those for the TGER.

The analysis was based on a HBCT in an Iraq base case scenario. The Iraq base case scenario was developed by G4 SMP and represents a typical resupply scenario between Kuwait and a consuming unit near Baghdad. The HBCT in this scenario is located at 150 miles (roundtrip) from a DESC capitalized site. Force protection costs and transport costs are attributed to the HBCT for the 150 miles (roundtrip) convoy that makes use of military assets in this scenario.

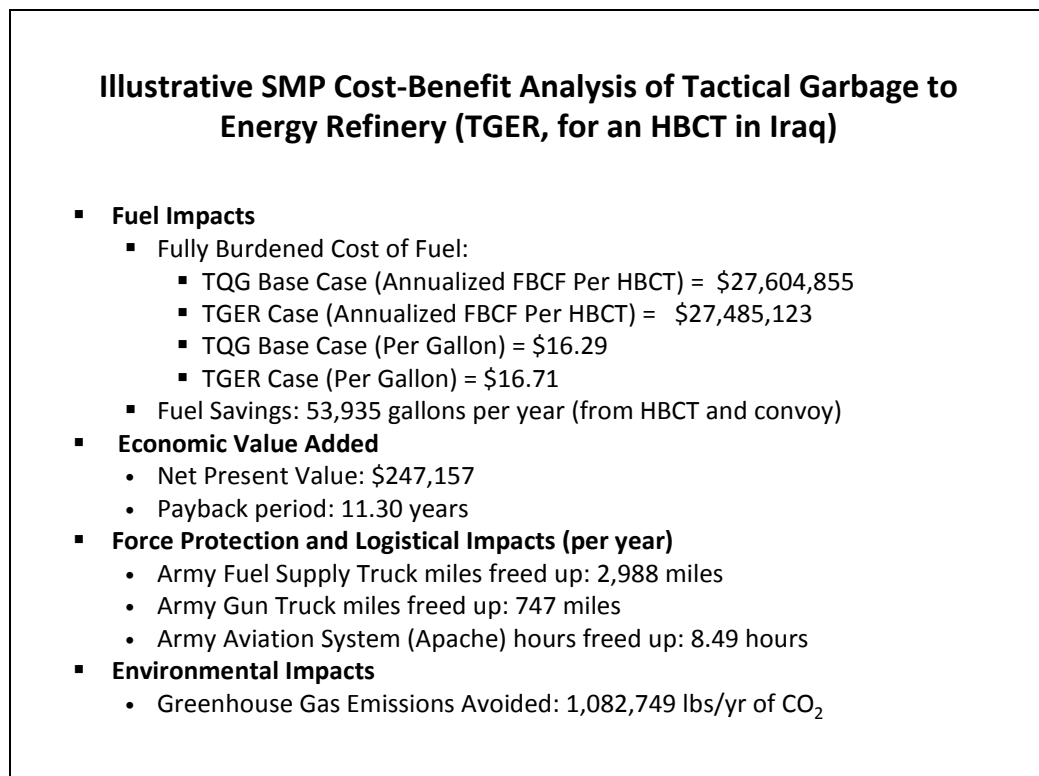


Figure G1: Illustrative SMP Cost-Benefit Analysis of Tactical Garbage to Energy Refinery (TGER, for an HBCT in Iraq)

As Figure G1 shows, the reduction in the FBCF is less than 1% from utilizing the TGER, and the FBCF per gallon rises slightly. The gallons of fuel savings are much larger than in the AMMPS case studies. The payback is fairly long at over 10 years for this

technology but its net present value is only 17% less than the 60 kW AMMPS (which had an immediate payback).

Illustrative TGER Qualitative Assessment

Combat/Operational Effectiveness	TGER	Logistics Performance	TGER	Safety & Environment	TGER
Lethality	neutral	Weight Reduction	negative	Survivability	neutral
Mobility	neutral	Deployment	negative	Stealth	positive
Maneuverability	negative	Maintainability	negative	Protection	neutral
Detection	positive	Storage	neutral	Simplicity	negative
Communications	neutral	Perishability	neutral	Productivity	positive
Availability	neutral	Replacement	neutral	Sustainability	positive
Simplicity	negative	Availability	neutral		
Productivity	positive	Simplicity	negative		
Sustainability	positive	Productivity	positive		
		Sustainability	negative		

Figure G2: Illustrative TGER Qualitative Assessment

As Figure G2 shows, there are many negative assessments of this technology on the qualitative factors. 22% of the Combat/Operational Effectiveness factors are negative; 50% of the logistics performance factors are negative, and 16% of the safety and environmental factors are negative. 33% of the Combat/Operational Effectiveness factors are positive, only 10% of the logistics performance factors are positive, and 50% of the safety and environmental factors are positive. On logistics performance, the negative ratings heavily outweigh the single positive rating. The remainder is neutral.

APPENDIX H: CASE STUDY SOLAR THERMAL WATER HEATING

H1.0 SOLAR THERMAL WATER HEATING

This case study CBA evaluates supplementing 28 existing M-80 water heaters with Solar Genix solar thermal water heaters (2 Solar Genix collectors per M-80). The calculation of FBCF in the M-80 Base Case accounts for fuel consumed by the M-80s, a portion of which is avoided due to the addition of Solar Genix in the Solar Thermal Case. Solar Genix systems circulate water through solar collectors where it is heated and then supplied to existing M-80 on-demand water heater systems. This reduces fuel consumption by raising the inflow water temperature for existing M-80 on-demand water heaters. Annualized costs associated with the new technology (e.g. Solar Genix) are accounted for in calculation of a FBCF and other economic metrics in this case.

The analysis was based on a Sustainment Brigade in an Iraq base case scenario. The Iraq base case scenario was developed by G4 SMP and represents a typical resupply scenario between Kuwait and a consuming unit in Baghdad.

Illustrative SMP Cost-Benefit Analysis of Solar Thermal (for a Sustainment Brigade in Iraq)

- Fuel Impacts
 - Fully Burdened Cost of Fuel:
 - M-80 Base Case (Annualized FBCF Per Sust Bde) = \$25,013,696
 - Solar Thermal Case (Annualized FBCF Per Sust Bde) = \$24,996,313
 - M-80 Base Case (Per Gallon) = \$10.00
 - Solar Thermal Case (Per Gallon) = \$10.01
 - Fuel Savings: 4,285 gallons per year (from Sust Bde and convoy)
- Economic Value Added
 - Net Present Value: \$16,191
 - Payback period: 13.48 years
- Force Protection and Logistical Impacts per year
 - Army Fuel Supply Truck miles freed up: 0 miles
 - Army Gun Truck miles freed up: 0 miles
 - Army Aviation System (Apache) hours freed up: 0.3 hours
- Environmental Impacts
 - Greenhouse Gas Emissions Avoided: 87,693 lbs/yr of CO₂

Figure H1: Illustrative SMP Cost-Benefit Analysis of Solar Thermal (for a Sustainment Brigade in Iraq)

As Figure H1 shows, this case study cost-benefit analysis evaluates supplementing 28 existing M-80 water heaters with Solar Genix solar thermal water heaters (2 Solar Genix collectors supplement 1 M80 on-demand water heater). The FBCF decreases by only \$4,285 per year by applying solar thermal, and there is a penny per gallon increase in the per gallon cost of fuel. This is a small reduction in actual gallons consumed. The net present value is positive but very low and the payback is fairly long at over 13 years. There are virtually no force protection and logistical benefits. Force protection by air costs are attributed to the Sustainment Brigade for the 950 miles (roundtrip) convoy that makes use of contractor assets in this scenario. The Sustainment Brigade in this scenario is located at a DESC capitalized site.

Illustrative Solar Thermal Qualitative Assessment

Combat/Operational Effectiveness	Solar Thermal	Logistics Performance	Solar Thermal	Safety & Environment	Solar Thermal
Lethality	neutral	Weight Reduction	negative	Survivability	neutral
Mobility	negative	Deployment	negative	Stealth	positive
Maneuverability	negative	Maintainability	positive	Protection	neutral
Detection	positive	Storage	positive	Simplicity	positive
Communications	neutral	Perishability	positive	Productivity	positive
Availability	neutral	Replacement	neutral	Sustainability	positive
Simplicity	positive	Availability	negative		
Productivity	positive	Simplicity	positive		
Sustainability	positive	Productivity	neutral		
		Sustainability	positive		

Figure H2: Illustrative Solar Thermal Qualitative Assessment

As Figure H2 shows, Solar thermal has negative impacts on 22% of the Combat/Operational Effectiveness factors, and 30% of the Logistics Performance factors. It has positive impacts on 40% of the Combat/Operational Effectiveness factors; 50% of the Logistics Performance factors, and 66% of the safety and environment factors. It is neutral on the remainder.

APPENDIX I: CASE STUDY THERMAL RECYCLE DRYER ATTACHMENT

11.0 THERMAL RECYCLE DRYER ATTACHMENT

The case study CBA evaluates heat capture and recycle in fifteen 75lb commercial dryers through an attachment applied to an existing dryer. The calculation of FBCF in the Dryer Base Case accounts for energy consumed by existing dryers, a portion of which is avoided due to the use of Thermal Recycle technology in the Thermal Recycle Case. Thermal Recycle technology captures and recycles waste heat from the drying process. These result in a reduction in time to dry per load and a decrease in electricity required to power existing dryers. Annualized costs associated with the new technology (e.g. Thermal Recycle) are accounted for in calculation of a FBCF and other economic metrics in this case.

The analysis was based on a Sustainment Brigade in an Iraq base case scenario. The Iraq base case scenario was developed by G4 SMP and represents a typical resupply scenario between Kuwait and a consuming unit in Baghdad.

Illustrative SMP Cost-Benefit Analysis of Thermal Recycle (for a Sustainment Brigade in Iraq)

- Fuel Impacts
 - Fully Burdened Cost of Fuel:
 - Dryer Base Case (Annualized FBCF Per Sust Bde) = \$25,013,696
 - Thermal Recycle Case (Annualized FBCF Per Sust Bde) = \$24,863,994
 - Dryer Base Case (Per Gallon) = \$10.00
 - Thermal Recycle Case (Per Gallon) = \$10.16
 - Fuel Savings: 56,827 gallons per year (from Sust Bde and convoy)
- Economic Value Added
 - Net Present Value: \$917,441
 - Payback period: 2.584 years
- Force Protection and Logistical Impacts per year
 - Army Fuel Supply Truck miles freed up: 0 miles
 - Army Gun Truck miles freed up: 0 miles
 - Army Aviation System (Apache) hours freed up: 4.6 hours
- Environmental Impacts
 - Greenhouse Gas Emissions Avoided: 1,162,836 lbs/yr of CO₂

Figure I1: Illustrative SMP Cost-Benefit Analysis of Thermal Recycle (for a Sustainment Brigade in Iraq)

As Figure I1 shows, the case study cost-benefit analyses evaluates heat capture and recycle in fifteen 75lb commercial dryer through an attachment applied to an existing

dryer. The FBCF decreases by \$149,702 per year - less than 1%. The FBCF per gallon increases about 16 cents per gallon - 1.6%. There are savings of 56,827 gallons per year in fuel. The payback period is fairly rapid. The only force protection and logistical impacts are for a small number of hours for Apache helicopters. Force protection by air costs are attributed to the Sustainment Brigade for the 950 miles (roundtrip) convoy that makes use of contractor assets in this scenario. Only Apache hours are freed-up in this scenario because they are the only Army assets related to the contractor convoys to a Sustainment Brigade. The Sustainment Brigade in this scenario is located at a DESC capitalized site.

Illustrative Thermal Recycle Qualitative Assessment

Combat/Operational Effectiveness	Thermal Recycle	Logistics Performance	Thermal Recycle	Safety & Environment	Thermal Recycle
Lethality	neutral	Weight Reduction	negative	Survivability	neutral
Mobility	neutral	Deployment	neutral	Stealth	positive
Maneuverability	neutral	Maintainability	neutral	Protection	neutral
Detection	neutral	Storage	neutral	Simplicity	positive
Communications	neutral	Perishability	neutral	Productivity	positive
Availability	positive	Replacement	neutral	Sustainability	positive
Simplicity	neutral	Availability	positive		
Productivity	positive	Simplicity	positive		
Sustainability	positive	Productivity	positive		
		Sustainability	positive		

Figure I2: Illustrative Thermal Recycle Qualitative Assessment

As Figure I2 shows, slightly more than 50% (13 of 25) of the overall qualitative factors are neutral. The only negative factor is on logistics performance for weight reduction. 33% of the Combat/Operational Effectiveness factors are positive; 40% of the Logistics Performance factors are positive, and 66% of the safety and Environment factors are positive.

APPENDIX J: CASE STUDY SPRAY FOAM TENT INSULATION

J1.0 SPRAY FOAM TENT INSULATION

The case study CBA evaluates the benefits of improved insulation from spray polyurethane foam applied to 45 GP Medium tents. The calculation of FBCF in the Unfoamed Tent Base Case accounts for energy consumed by existing, unfoamed GP Medium tents, a portion of which is avoided due to the use of Spray Foam technology in the Spray Foam Case. Spray Foam technology provides more effective insulation than the standard GP Medium tent. Subsequently, air conditioning equipment requires less energy from fuel to maintain ambient conditions within a tent. Annualized costs associated with the new technology (e.g., Spray Foam) are accounted for in calculation of a FBCF and other economic metrics in this case.

Illustrative SMP Cost-Benefit Analysis of Spray Foam (for a Sustainment Brigade in Iraq)

- Fuel Impacts
 - Fully Burdened Cost of Fuel:
 - Unfoamed Tent Base Case (Annualized FBCF Per Sust Bde) = \$25,013,696
 - Spray Foam Case (Annualized FBCF Per Sust Bde) = \$24,221,404
 - Unfoamed Tent Base Case (Per Gallon) = \$10.00
 - Spray Foam Case (Per Gallon) = \$10.82
 - Fuel Savings: 275,834 gallons per year (from Sust Bde and convoy)
- Economic Value Added
 - Net Present Value: \$2,987,889
 - Payback period: 0.818 years
- Force Protection and Logistical Impacts per year
 - Army Fuel Supply Truck miles freed up: 0 miles
 - Army Gun Truck miles freed up: 0 miles
 - Army Aviation System (Apache) hours freed up: 22.3 hours
- Environmental Impacts
 - Greenhouse Gas Emissions Avoided: 5,644,335 lbs/yr of CO₂

Figure J1: Illustrative SMP Cost-Benefit Analysis of Spray Foam (for a Sustainment Brigade in Iraq)

As Figure J1 shows, this case study CBA evaluates the benefits of improved insulation from spray polyurethane foam applied to 45 GP Medium tents. Note that no data was available on spray foam disposal costs and those costs may be significant. The spray foam reduces the FBCF by about 3% - \$792,292 per year. There is an increase of about 8.2% in the per gallon cost of fuel from \$10.00 per gallon to \$10.82 per gallon. The fuel savings per year are over 275,000 gallons. The net present value of this technology investment is almost \$3 million dollars and the payback period is less than one year. The only force protection and logistical impacts each year are the freeing up of 22.3 hours of Apache helicopter time. The amount of greenhouse gas emissions avoided is 5,644,335

pounds per year. Force protection by air costs are attributed to the Sustainment Brigade for the 950 miles (roundtrip) convoy that makes use of contractor assets in this scenario. Only Apache hours are freed-up in this scenario because they are the only Army assets related to the contractor convoys to a Sustainment Brigade. The Sustainment Brigade in this scenario is located at a DESC capitalized site.

Illustrative Spray Foam Qualitative Assessment

Combat/Operational Effectiveness	Spray Foam	Logistics Performance	Spray Foam	Safety & Environment	Spray Foam
Lethality	neutral	Weight Reduction	negative	Survivability	positive
Mobility	neutral	Deployment	negative	Stealth	neutral
Maneuverability	neutral	Maintainability	positive	Protection	positive
Detection	positive	Storage	neutral	Simplicity	negative
Communications	neutral	Perishability	negative	Productivity	positive
Availability	negative	Replacement	positive	Sustainability	positive
Simplicity	negative	Availability	negative		
Productivity	positive	Simplicity	negative		
Sustainability	positive	Productivity	positive		
		Sustainability	positive		

Figure J2: Illustrative Spray Foam Qualitative Assessment

As Figure J2 shows, Spray foam has several negative ratings across all three categories of factors. 22% of the factors for Combat/Operational Effectiveness are negative; 50% of the factors for logistics performance are negative, and 16% of the factors for safety and environment are negative. 30% of the factors for Combat/Operational Effectiveness are positive; 40% of the factors for logistics performance are positive, and 66% of the factors for safety and environment are positive.

APPENDIX K: KEY POLICY MEMORANDA, BRIEFINGS, AND REPORTS

K1.0 MEMORANDUM FOR SEE DISTRIBUTION: ARMY ENERGY SECURITY



SECRETARY OF THE ARMY
WASHINGTON DC 20310

APR 15 2008

MEMORANDUM FOR SEE DISTRIBUTION

SUBJECT: Army Energy Security

1. The Army must act decisively and quickly to ensure its energy policies and practices are aligned to effectively operate our installations and conduct contingency operations world-wide. To accomplish this objective, by my direction, the Assistant Secretary of the Army for Installations and Environment (ASA (I&E)) will oversee the Army's Energy Security Task Force (AESTF) and develop the necessary strategic/action plans that satisfy emerging issues identified in the Defense Science Board and GAO reports, Executive Order 13423, and other associated statutory drivers. Additionally, the AESTF will develop a governance framework for all Army energy security efforts.
2. As this endeavor incorporates activities across a full spectrum of Army missions and functions, I direct the enclosed HQDA Staff elements designate a dedicated energy representative to the AESTF that will brief me with their findings and recommendations by 23 June 2008. Provide your energy representative's name and phone number to OASA (I&E), Mr. Paul Bollinger, (703) 692-9890.
3. I expect the Task Force Report to be the guiding document to reduce Army energy consumption; increase efficiency across platforms and facilities; promote the use of new sources of alternative energy; establish benchmarks for our environmental footprint; and, provide guidance for the creation of a culture of energy awareness across the Army. These energy initiatives shall be produced in a collaborative manner and focus on increasing the ability to implement the Army's four imperatives: Sustain, Prepare, Reset, and Transform. Army Strong!

Enclosure


Pete Geren

SUBJECT: Army Energy Security

1. The Army Energy Security Task Force (AESTF) will be facilitated by the Assistant Secretary of the Army for Installations and Environment (ASA I&E). Its membership will serve at a minimum of three months, and may be augmented as necessary. AESTF members shall be comprised of dedicated (Military/Department of the Army Civilian) representatives from the following Army Staff elements:

Army Energy Security Task Force (AESTF)

1. Assistant Secretary of the Army (Installations and Environment)
2. Assistant Secretary of the Army (Acquisition, Logistics and Technology)
3. Assistant Secretary of the Army (Financial Management and Comptroller)
4. Assistant Secretary of the Army (Civil Works)
5. Deputy Chief of Staff, G-4
6. Assistant Chief of Staff for Installation Management
7. Installations Management Command
8. Office of the Chief of Engineers
9. Office of the General Counsel

2. The AESTF will remain operational until transitioned to an institutionalized Army Energy Security governance framework for the implementation of an Energy Security strategic plan.

**K2.0 MEMORANDUM FOR UNDER SECRETARY OF DEFENSE FOR
ACQUISITION TECHNOLOGY AND LOGISTICS (USD(AT&L)): ARMY ENERGY
SECURITY TASK FORCE**



DEPARTMENT OF THE ARMY
ASSISTANT SECRETARY
INSTALLATIONS AND ENVIRONMENT
110 ARMY PENTAGON
WASHINGTON DC 20310-0110

APR 18 2008

MEMORANDUM FOR UNDER SECRETARY OF DEFENSE FOR ACQUISITION,
TECHNOLOGY AND LOGISTICS (USD(AT&L))

SUBJECT: Army Energy Security Task Force

1. The Army has made significant strides across its energy portfolio of infrastructure and weapon systems and it will be critical to do more in the future. The recent energy reports issued by DSB and the GAO present an opportunity for the Army to create a vision and policy governing our energy programs in the future. Secretary Geren has requested that the Assistant Secretary for I&E stand up the Army Energy Security Task Force (AESTF).
2. As outlined in his enclosed memo, this Army team will develop the necessary strategic/action plans to satisfy emerging issues identified in the Defense Science Board and GAO reports, as well as Executive Order 13423. Their work will encompass the identification of initiatives to decrease energy demand, increase energy efficiency, leverage alternative energy solutions, and create a new Army energy culture.
3. Given the ongoing and parallel energy efforts initiated by your office, the AESTF will serve as the Army's integrated and aligned venue to work with your team to create an overall Army energy program. The point of contact for the AESTF is my Deputy, Mr. Paul Bollinger, (703) 692-9890. Your staff will be contacted by him shortly — I look forward to our valued contribution to this important Defense endeavor.

A handwritten signature in black ink, appearing to read "KEE", is positioned above the name "Keith E. Eastin".

Keith E. Eastin

Enclosure: Secretary of the Army energy memorandum

SUBJECT: Army Energy Security

DISTRIBUTION:

Assistant Secretary of the Army (Acquisition, Logistics and Technology)
Assistant Secretary of the Army (Civil Works)
Assistant Secretary of the Army (Financial Management and Comptroller)
Assistant Secretary of the Army (Installations and Environment)
Assistant Secretary of the Army (Manpower and Reserve Affairs)
General Counsel
Administrative Assistant to the Secretary of the Army
The Inspector General
The Auditor General
Deputy Under Secretary of the Army
Deputy Under Secretary of the Army (Business Transformation)
Chief of Legislative Liaison
Chief of Public Affairs
Director, Small and Disadvantaged Business Utilization
Director of the Army Staff
Sergeant Major of the Army
Deputy Chief of Staff, G-1
Deputy Chief of Staff, G-2
Deputy Chief of Staff, G-3/5/7
Deputy Chief of Staff, G-4
Chief Information Officer/Deputy Chief of Staff, G-6
Deputy Chief of Staff, G-8
Chief, Army Budget Office
Chief, Army Reserve
Chief, National Guard Bureau
Chief of Engineers
The Surgeon General
Assistant Chief of Staff for Installation Management
Chief of Chaplains
The Judge Advocate General



SECRETARY OF THE ARMY
WASHINGTON DC 20310

APR 15 2008

MEMORANDUM FOR SEE DISTRIBUTION

SUBJECT: Army Energy Security

1. The Army must act decisively and quickly to ensure its energy policies and practices are aligned to effectively operate our installations and conduct contingency operations world-wide. To accomplish this objective, by my direction, the Assistant Secretary of the Army for Installations and Environment (ASA (I&E)) will oversee the Army's Energy Security Task Force (AESTF) and develop the necessary strategic/action plans that satisfy emerging issues identified in the Defense Science Board and GAO reports, Executive Order 13423, and other associated statutory drivers. Additionally, the AESTF will develop a governance framework for all Army energy security efforts.
2. As this endeavor incorporates activities across a full spectrum of Army missions and functions, I direct the enclosed HQDA Staff elements designate a dedicated energy representative to the AESTF that will brief me with their findings and recommendations by 23 June 2008. Provide your energy representative's name and phone number to OASA (I&E), Mr. Paul Bollinger, (703) 692-9890.
3. I expect the Task Force Report to be the guiding document to reduce Army energy consumption; increase efficiency across platforms and facilities; promote the use of new sources of alternative energy; establish benchmarks for our environmental footprint; and, provide guidance for the creation of a culture of energy awareness across the Army. These energy initiatives shall be produced in a collaborative manner and focus on increasing the ability to implement the Army's four imperatives: Sustain, Prepare, Reset, and Transform. Army Strong!

Enclosure


Pete Geren

SUBJECT: Army Energy Security

1. The Army Energy Security Task Force (AESTF) will be facilitated by the Assistant Secretary of the Army for Installations and Environment (ASA I&E). Its membership will serve at a minimum of three months, and may be augmented as necessary. AESTF members shall be comprised of dedicated (Military/Department of the Army Civilian) representatives from the following Army Staff elements:

Army Energy Security Task Force (AESTF)

1. Assistant Secretary of the Army (Installations and Environment)
2. Assistant Secretary of the Army (Acquisition, Logistics and Technology)
3. Assistant Secretary of the Army (Financial Management and Comptroller)
4. Assistant Secretary of the Army (Civil Works)
5. Deputy Chief of Staff, G-4
6. Assistant Chief of Staff for Installation Management
7. Installations Management Command
8. Office of the Chief of Engineers
9. Office of the General Counsel

2. The AESTF will remain operational until transitioned to an institutionalized Army Energy Security governance framework for the implementation of an Energy Security strategic plan.

**K3.0 ARMY ENERGY SECURITY TASK FORCE BRIEFING TO SECRETARY
GEREN**

AMERICA'S ARMY:
THE STRENGTH OF THE NATION

ARMY ENERGY SECURITY TASK FORCE



Army Energy Security – “The Way Ahead”

Secretary Geren

19 June 2008

SECARMY BRFG_VALLONEJS_18 SEP 08



Bottom Line Up Front

- **Task Force Recommendation:** Establish Senior Office for Army Energy (Deputy Assistant Secretary of the Army-I&E) for Energy and Partnerships (DASA(E&P)) to achieve the following energy security goals:
 - Create a culture of energy accountability across the Army
 - Reduce Army energy consumption and increase efficiency to enhance operational capabilities
 - Increase use of new/alternative energy sources
 - Establish benchmarks for energy footprint
 - Champion investment strategies supporting Army energy programs





Army Energy Vision

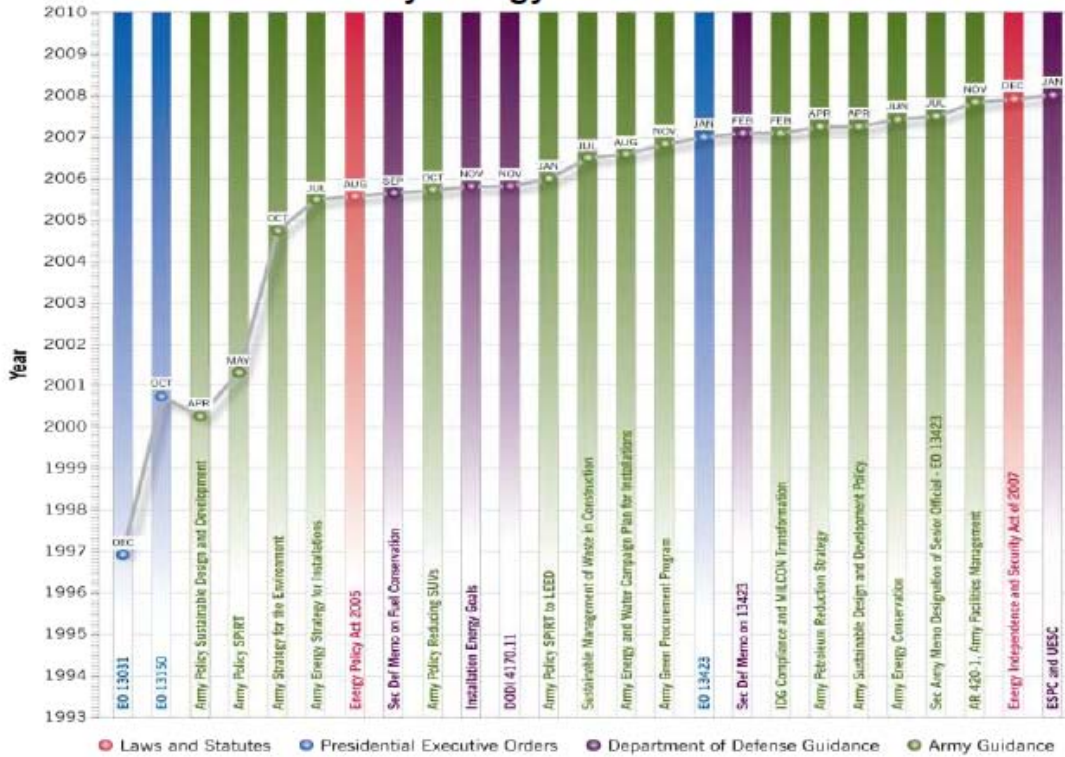


SECARMY BRFG_VALLONEJS_18 SEP 08

Leadership ♦ Partnership ♦ Ownership



Key Energy Directives



SECARMY BRFG_VALLONEJS_10 SEP 08

Leadership



Partnership

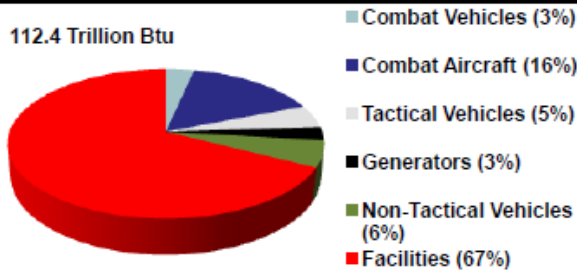


Ownership

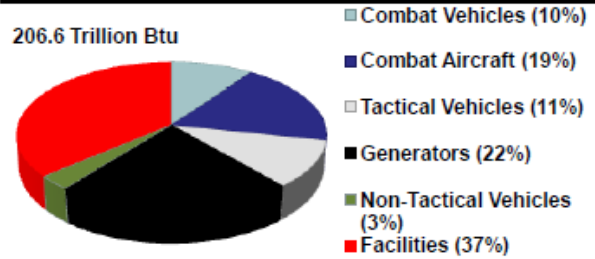


Army Energy Consumption & Cost

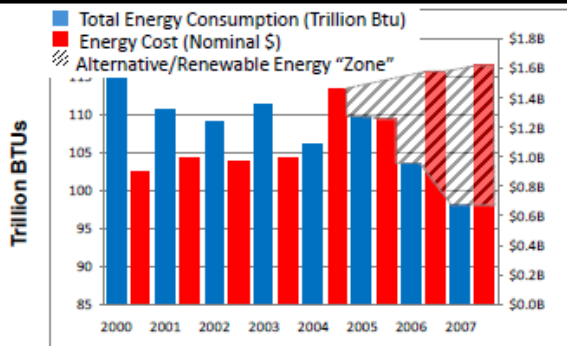
Peacetime Consumption (DSB Report)



Wartime Consumption (DSB Report)



Consumption & Cost Trends



Tactical Fuel Logistics & Protection

Kuwait/OIF/OEF Fuel to FOB (M/gal)..... 431
 Fuel trucks needed.....140,075
 Convoys needed.....9,332
 Soldiers per convoy trip
 (Fuel trucks, protection, other support).....120
 Soldier trips.....644,360
Fewer Soldier trips.....6,444
(Resulting from 1% Fuel Savings)





Defense Science Board Report and GAO Report

DSB GAO FINDINGS	AESTF RECOMMENDATIONS
1 2001 DSB Report, the Lack of Energy Efficiency Performance Parameters and Accounting of the Fully Burdened Cost of Fuel (GAO 4).....	No. 7
2 Critical Missions are at High Risk from the Failure of the Grid.....	No. 3
3 DoD Lacks Strategic Governance Structure to Properly Manage Energy Risks (GAO 1, 2, 3).....	No.'s 1, 2
4 DoD Programs are inadequate with Respect to Power and Energy Technology Investments.....	No.'s 1, 2, 4 and 7
5 Energy Demand Could be Reduced Through Energy Efficient Operations.....	No.'s 4, 5 and 7
6 Operational Risks (Fuel) Require Demand-side Remedies; Mission Risks (Electricity)Require Both Demand-and Supply-side Remedies.....	No.'s 3, 4, 5, 6 and 7





Securing Present Army Infrastructure

- Partner With Industry
- Harden Current Systems/Infrastructure
- Create Redundancies
- DCS G-3/5/7 Has Army Critical Infrastructure Risk Management Strategic Plan Under Development at HQDA





Leadership: "Dedicated Leadership Drives Innovation"

Recommendation 1: *Establish Office of the Deputy Assistant Secretary Of The Army for Energy & Partnerships (DASA(E&P)) Responsible for Development of an Army Enterprise Energy Strategy*

Recommendation 2: *Establish Army Senior Energy Council with DASA(E&P) as the Director*

Installations: "Focus On The Army's Largest Energy Consumer"

Recommendation 3: *Accelerate Use of Renewable Energy Sources to Increase Energy Security in a Cost Effective Manner*

Recommendation 4: *Expedite Utility Metering at All Installations to Reduce Consumption and Increase Efficiency*





Mobility: "Secure Access to Mobile Energy"

Recommendation 5: *Implement Practices and Technologies to Control Forward Operating Base Energy Accountability and Reduce Consumption*

Recommendation 6: *Certify Army Platforms for Alternative Fuels to Ensure Operational Fuel Supply*

Acquisition: "Achieving Power & Energy Effectiveness"

Recommendation 7: *Implement Acquisition and Procurement Practices Requiring Efficient Power and Energy Solutions*





Decisions

- **Establish Army Energy Executive Office within OASA(I&E) – Deputy Assistant Secretary of the Army for Energy & Partnerships, (DASA(E&P))**
- **Establish/Convene First Senior Energy Council (SEC) Within 30 Days**
- **Direct the SEC to Implement Recommendations and Develop the Army's Enterprise Energy Strategy Facilitated by the DASA(E&P)**
- **Announce Model Renewable Energy Projects (e.g., Solar, Wind, Geothermal, Biomass) at Army Installations Within 30 Days**
- **Invite Industry to Partner with the Army to Accomplish the Energy Mission at an HQDA Energy Forum Within 90 Days**
- **Sunset Energy Task Force - Transition Mission to the DASA(E&P)**



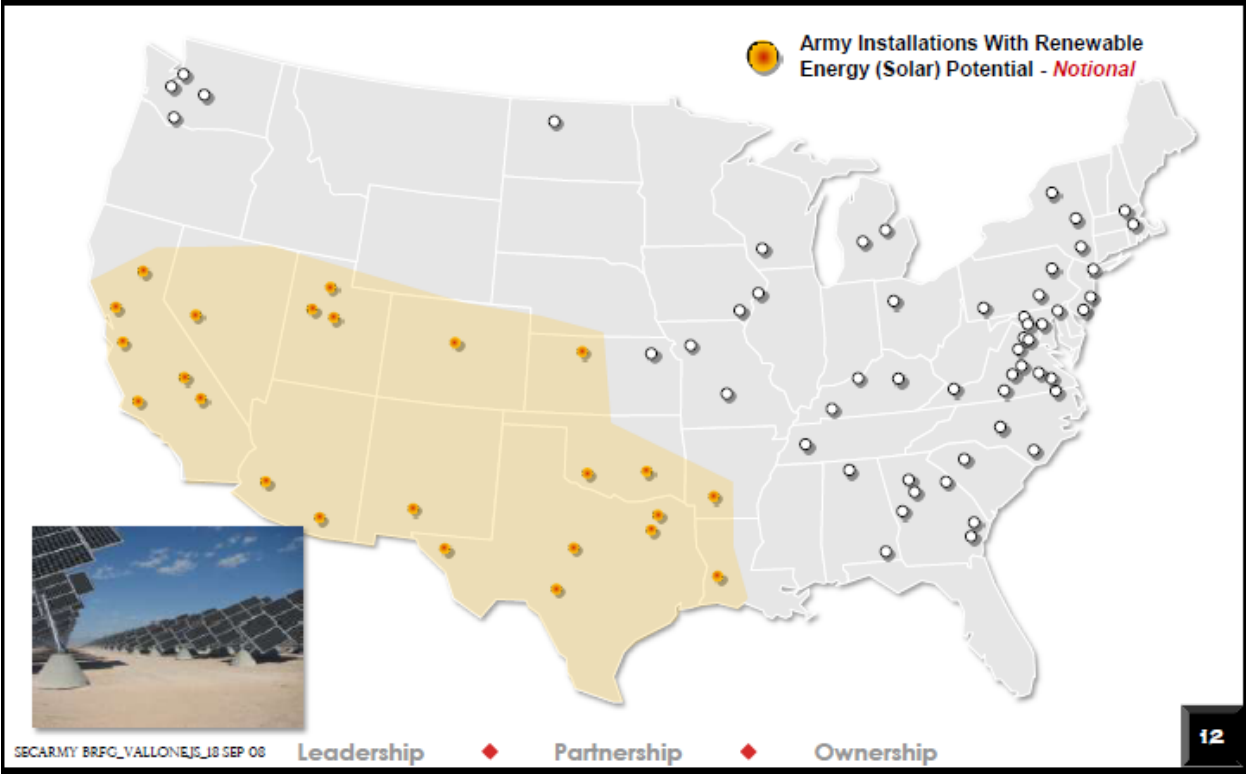


Next Steps - Renewable Energy Assessments



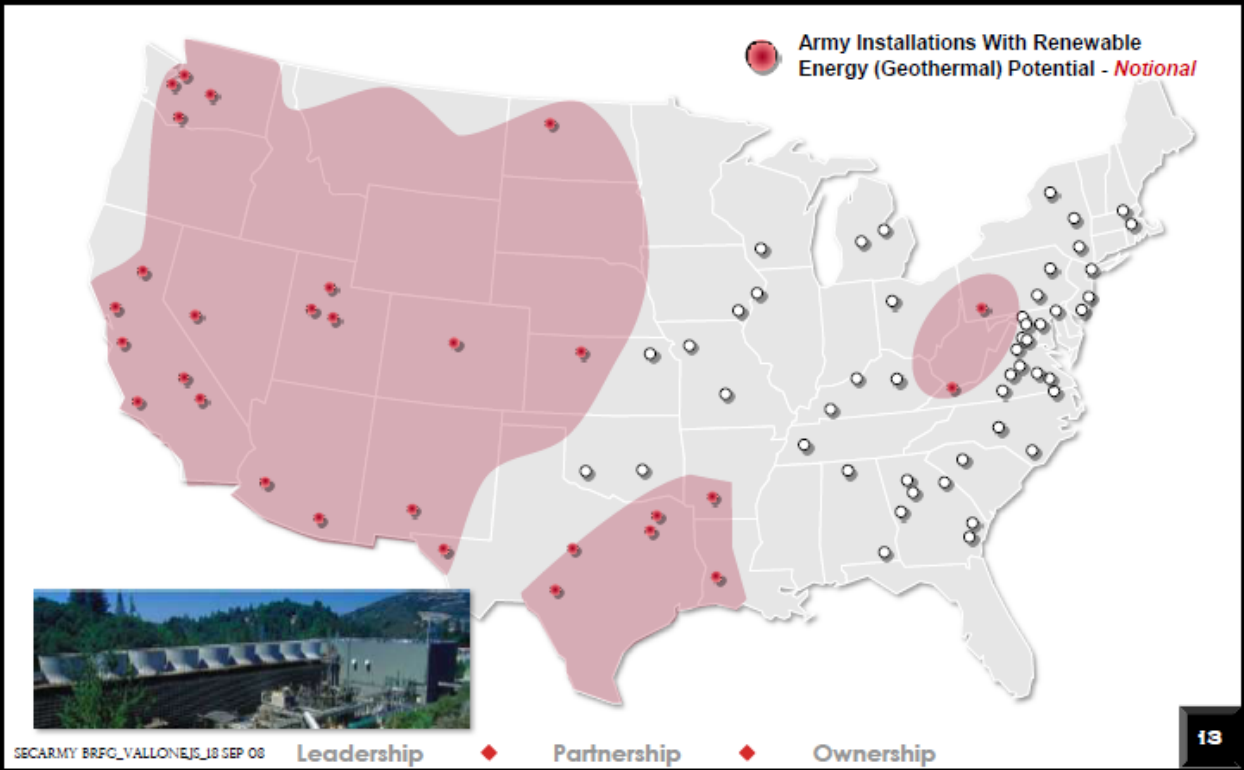


Renewable Energy - Solar



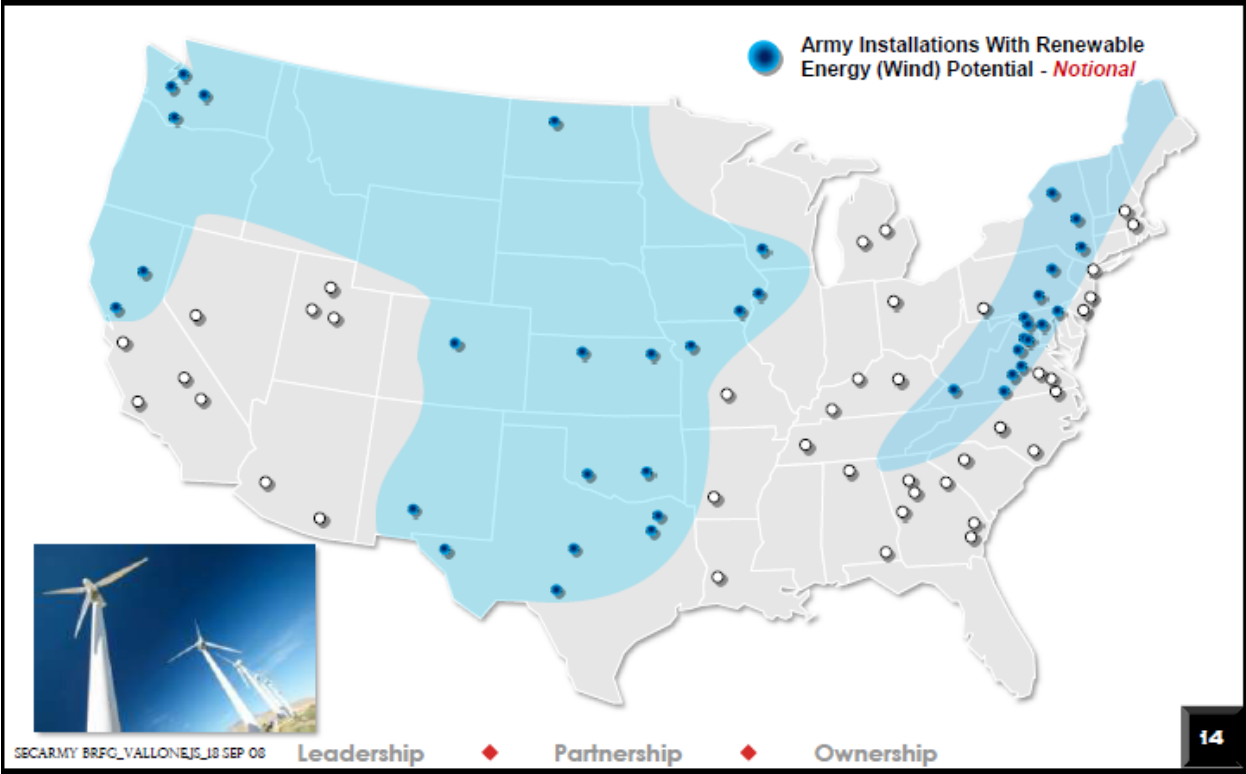


Renewable Energy - Geothermal



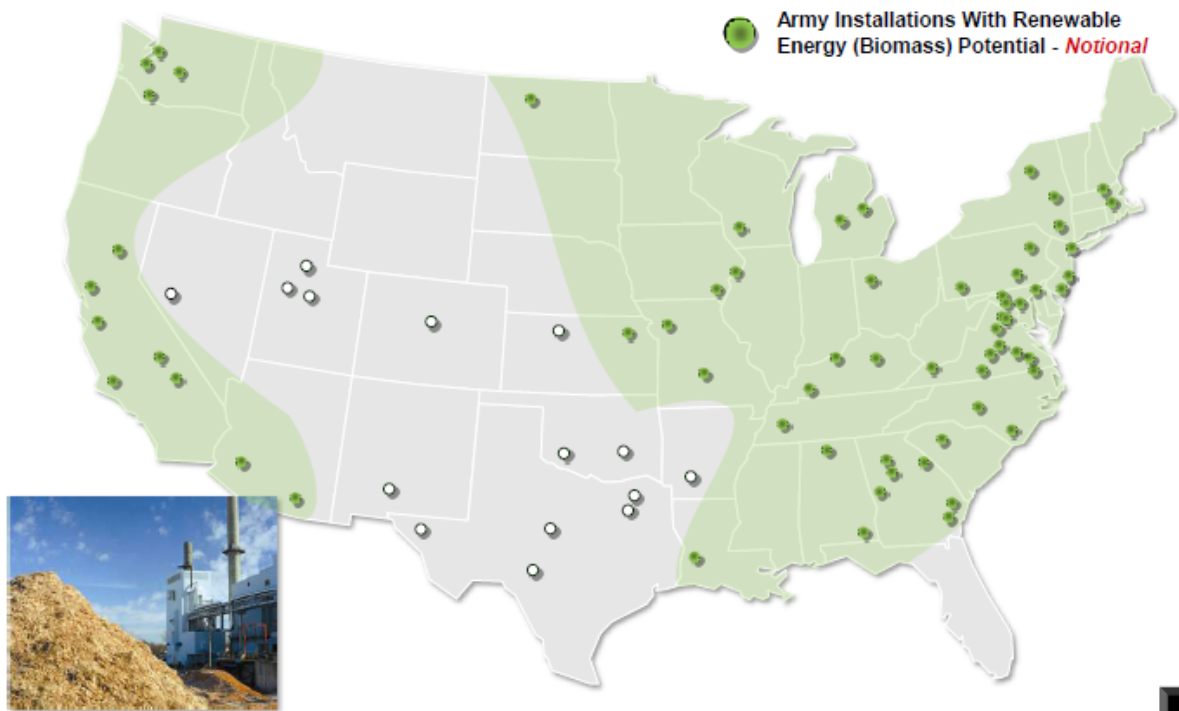


Renewable Energy - Wind





Renewable Energy - Biomass



SECARMY BRFC_VALLONEJS_18 SEP 08

Leadership



Partnership



Ownership

**K4.0 MEMORANDUM FOR SEE DISTRIBUTION: BUILDING AN ENDURING
STRATEGIC ASSESSMENT SUPPORT CAPABILITY**



DEPARTMENT OF THE ARMY
OFFICE OF THE VICE CHIEF OF STAFF
201 ARMY PENTAGON
WASHINGTON DC 20310-0201

JUL 08 2009

MEMORANDUM FOR SEE DISTRIBUTION

SUBJECT: Building an Enduring Strategic Assessment Support Capability

1. Over the past several years, commanders on the ground in both Iraq and Afghanistan have conducted campaign assessments that have served to influence strategy, reallocate limited resources, and communicate progress to both Congress and the American people. Developing these Campaign Assessments, the commanders have not only relied on gut feel or personal observations, but they relied on assessments provided by focused and dedicated teams of analysts. In support of these assessments, analysts have conducted considerable data collection and analysis to gauge progress and determine trends. As the supporting processes for campaign analysis have matured, analysts in theater have endeavored to ensure that analysis of data is conducted with rigor and consistency. This rigor and consistency has provided the ability to achieve a nuanced understanding of the security environment - an understanding that is dependent on collecting and analyzing data in a consistent way over time.
2. The most senior leaders of the Army's Generating Force need an integrated (cross-functional) assessment capability comparable to the Operating Force. The Generating Force consists of those Army organizations whose primary mission is to generate and sustain the Operational Army's capabilities for employment by Joint Force commanders as outlined in FM 1-01.
3. Although the primary focus of the Operating Force and Generating Force are different, they both require a strategic assessment capability that ensures unified, comprehensive, prioritized, and focused assessment support to strategic decision makers. This assessment capability must conduct "what if" analysis in support of decisions and strategic choices, red team major proposals, gauge and report the Army's performance, prioritize analysis efforts, and "sense" emerging trends and issues of interest.
4. The Enterprise Task Force (ETF) will lead the effort to develop options to improve assessment support to strategic decision-making. I need your agencies to actively support the ETF in this endeavor as outlined below:
 - a. Analysts: The Army currently possesses a host of analytical organizations that conduct analysis for the Army based on requirements that have matured over the years. Currently, there is no dedicated, comprehensive assessment capability providing multi-functional analysis to support strategic decision-making and there is no organization responsible for coordinating and prioritizing Army-wide analysis and assessments.

SUBJECT: Building an Enduring Strategic Assessment Support Capability

(1) End-state. Senior leaders supported by a dedicated, objective, and qualified group of analysts and subject matter experts who provide timely and integrated analysis.

(2) Task. ETF will develop options to ensure that a focused analytic capability is in place to provide the right information at the right time so the best resource-informed decision can be made. These options should range from improved coordination of existing capabilities to establishment of a dedicated, focused analytic capability.

(3) Task. G8 (through the Senior Analyst Advisory Board) will partner with the ETF and other key stakeholders to provide recommendations on how the Army can better direct, coordinate, and integrate the Army's analytical efforts supporting ARFORGEN to inform Army policy, planning, programming, resourcing and execution decisions.

b. Content / Metrics: The Army must identify the outcomes, objectives, and metrics that will support the assessment process. Development and identification of this assessment construct will provide a foundation against which the Army's results and effectiveness of strategies, investments and decisions will be assessed.

(1) End-state. Aligned set of outcomes, objectives, and metrics that provide information used to assess the Army's results and the effectiveness of strategies, investments, and decisions.

(2) Task. ETF will support development of aligned outcomes, objectives, and metrics for the Army Enterprise Board, ARFORGEN Synchronization Board, and Core Enterprises.

c. Data: The Army currently maintains disparate sets of information used to gauge performance, conduct assessment, and inform senior leader decisions. In many cases, the Army's disparate sets of information are functionally focused, lack transparency, access can be unnecessarily limited, and in some cases, quality control is inadequate.

(1) End-state. Reliable, cohesive, transparent, and accessible data.

(2) Task. The ETF will seek the advice and counsel from the CIO-G6 in the development of a formal data structure that establishes and identifies authoritative data sources as well as the capability to share that data seamlessly across the Army Enterprise.

d. Tools: The Army currently leverages a wide variety of analytical tools, including commercial off-the-shelf capabilities and Army-developed Modeling and Simulation (M&S) capabilities, to support targeted analysis. The Army has limited visibility on the overall inventory of tools available, the capabilities that those tools provide, and how that set of tools can most effectively and efficiently be integrated into an Army-wide capability to support the broad analytical needs of the Army.

SUBJECT: Building an Enduring Strategic Assessment Support Capability

(1) End-state. Disciplined approach leveraged to ensure alignment and availability of appropriate tools (e.g., business intelligence software, simulation modeling, forecasting) to enable assessment and analysis.

(2) Task. The ETF will partner with G3, G8, CAA, and PEO-EIS and will seek the advice and counsel of the DUSA and CIO G6 to conduct a functional analysis, technical analysis, and Analysis of Alternatives (AoA) to ensure codification of an Enterprise-wide technological solution set that will support the envisioned assessment capability.

5. Today's decisions are incredibly complex and require collaboration to ensure that the decision space is understood and that 2nd and 3rd order effects are considered. We must move quickly and decisively to establish an integrated strategic assessment capability to support our Army's most senior decision makers.



PETER W. CHIARELLI
General, U.S. Army
Vice Chief of Staff

DISTRIBUTION:

ASSISTANT CHIEF OF STAFF FOR INSTALLATION MANAGEMENT
ASSISTANT SECRETARY OF THE ARMY (CIVIL WORKS)
ASSISTANT SECRETARY OF THE ARMY (INSTALLATIONS & ENVIRONMENT)
ASSISTANT SECRETARY OF THE ARMY (MANPOWER & RESERVE AFFAIRS)
ASSISTANT SECRETARY OF THE ARMY (ACQUISITIONS, LOGISTICS & TECH)
ASSISTANT SECRETARY OF THE ARMY (FINANCIAL MANAGEMENT & COMP)
DEPUTY UNDER SECRETARY OF THE ARMY (DUSA)
CHIEF INFORMATION OFFICER, G-6
DEPUTY CHIEF OF STAFF, G-1
DEPUTY CHIEF OF STAFF, G-2
DEPUTY CHIEF OF STAFF, G-3/5/7
DEPUTY CHIEF OF STAFF, G-4
DEPUTY CHIEF OF STAFF, G-8
CHIEF NATIONAL GUARD BUREAU
ASSISTANT CHIEF OF STAFF FOR INSTALLATION MANAGEMENT
CHIEF OF ENGINEERS
CHIEF ARMY RESERVE
JUDGE ADVOCATE GENERAL
DIRECTOR, ENTERPRISE TASK FORCE
DIRECTOR, CENTER FOR ARMY ANALYSIS

K5.0 US ARMY SENIOR ENERGY COUNCIL CHARTER

US Army Senior Energy Council Charter



Leadership



Partnership



Ownership

21 Aug 2008



Army Senior Energy Council Charter

1. **Name of Committee:** Army Senior Energy Council (SEC).
 2. **Date Established:** The effective date of the establishment of the Committee is August 21, 2008.
 3. **Committee Term:** The initial term of the SEC shall be three years.
 4. **Category and Type of Committee:** Intra-Army; Departmental.
 5. **Mission and Purpose:** The SEC shall, in a collaborative manner, develop, for approval by the Secretary of the Army, an Army Enterprise Energy Strategic Plan (Plan) encompassing all aspects of Army consumption and utilization of energy to include energy uses associated with:
 - Installations and Facilities (including Non-tactical Vehicles (NTVs));
 - Weapon Systems (including tactical and combat manned and unmanned ground and air platforms, and soldier/weapons/logistics/C4ISR systems); and
 - Sustainable Contingency Operations Base Camps.
- At a minimum, the Plan developed by the SEC shall:
- Synchronize submission of Energy program resource requirements with the Army Planning, Programming, Budget and Execution (PPBE) process and timeline.
 - Provide guidance for the development of Army power and energy priorities and implementation plans.
 - Promote integration of power and energy strategies for Installations, Weapon Systems and Contingency Operations Base Camps.
 - Leverage innovative technologies for alternative and renewable energy.
 - Provide metrics for monitoring progress of programs and operations intended to facilitate the accomplishment of the Plan's goals and objectives.
6. **Direction and Control:** This Committee will report to the Secretary of the Army and be co-chaired by the Assistant Secretary of the Army (Installations and Environment) and the Vice Chief of Staff of the Army.
 7. **Authority:** This Committee is being formed as part of an initiative directed by the Secretary of the Army.
 8. **Administrative Support and Staff Arrangements:** TBD by the membership of the SEC and as administered by the Senior Energy Executive (SEE).
 9. **Composition:** Members of the SEC will be comprised of senior representatives (*ASA or DCS equivalents*). SEC members who are unavailable to attend an SEC

21 Aug 2008 Leadership ◆ Partnership ◆ Ownership

meeting may send a senior principal deputy (one level down) to attend on their behalf. SEC Advisory Members shall attend SEC meetings at the request of the SEE (after consultation with the SEC members) and will be selected by the SEC based upon the subject expertise needed with respect to the Plan and related Energy Initiatives.

SEC MEMBERSHIP (may be augmented as determined by Senior Leadership)

- a. VCSA – Co-Chair
- b. DUSA
- c. DAS
- d. SMA
- e. AMC
- f. AASA
- g. ACSIM
- h. ASA (M&RA)
- i. ASA(ALT)
- j. ASA (CW)
- k. ASA(FM&C)
- l. ASA (I&E) – Co-Chair
- m. CAR
- n. CIO/G-6
- o. CLL
- p. USACE
- q. CPA
- r. DARNG
- s. DUSA-BT
- t. DCS G-1
- u. DCS G-2
- v. DCS G-3/5/7
- w. DCS G-4
- x. DCS G-8
- y. G-8,PAE
- z. OGC
- aa. TJAG
- bb. TRADOC
- cc. FORSCOM
- dd. SEC Advisory Members (DASA or Two Star equivalents)

10. Committee Level and Other Data:

a. SEC Proceedings

- 1) The DASA(E&P) as the SEE , will be the Executive Secretary of the SEC and facilitate the conduct of all SEC meetings.

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- 2) The SEC will convene not less than two times per year. Meetings of the SEC will be scheduled by the SEE after consultation with SEC members or as directed by the SA.
- 3) To conduct SEC business, a quorum of five members is required.
- 4) Councils and Focus Area Working Groups (FAWGs) established by direction of the SEC shall operate as prescribed by the SEC under the supervision of the SEE.
- 5) The SEE shall monitor the Army's progress in meeting goals and objectives established as part of the Plan developed by the SEC and approved by SA, and report the findings regarding progress in meeting the Plan's goals and objectives to the SEC.

11. **Correspondence:** Official communications should be addressed to the Assistant Secretary of the Army for Installations and Environment, Deputy Assistant Secretary of the Army for Energy and Partnerships, The Pentagon, Room 3D453, 703/692-9890.

12. **Date Charter Filed:** _____
(Date)

26 SEP 2008


 _____ Date: _____
 Pete Geren
 Secretary of the Army

26 SEP 2008


 _____ Date: _____
 George W. Casey, Jr.
 General, United States Army
 Chief of Staff

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**K6.0 MEMORANDUM FOR SEE DISTRIBUTION: ARMY DIRECTIVE 2008-04,
ARMY ENERGY ENTERPRISE**



SECRETARY OF THE ARMY
WASHINGTON

20 October 2008

MEMORANDUM FOR SEE DISTRIBUTION

SUBJECT: Army Directive 2008-04, Army Energy Enterprise

1. The Senior Energy Council (SEC) shall be comprised of the senior leadership of the Army's key energy stakeholders and oversee the Army's Energy Enterprise. The SEC shall collaboratively develop and submit for my approval an Energy Enterprise Strategic Plan (Plan) and associated investment strategies for the Army to execute the Plan in a manner that is synchronized with the DOD budget formulation process. A copy of the SEC charter is attached.
2. The Assistant Secretary of the Army for Installations and Environment (ASA (I&E)) and the Vice Chief of Staff of the Army (VCSA) shall serve as SEC co-chairs. The Deputy Assistant Secretary of the Army for Energy and Partnerships (DASA (E&P)) shall serve as its Executive Secretary and additionally serve as the Army's Senior Energy Executive (SEE) responsible for monitoring and reporting the Army's progress in achieving the goals and objectives established as part of the approved Plan to the SEC.
3. The Assistant Secretary of the Army (Installations and Environment) is the lead agent for this policy.



PETE GEREN

DISTRIBUTION:

HQDA Principal Officials
Commander

U.S. Army Forces Command
U.S. Army Training and Doctrine Command
U.S. Army Materiel Command
U.S. Army Europe
U.S. Army Central
U.S. Army North
U.S. Army South
U.S. Army Special Operations Command
Eighth U.S. Army
U.S. Army Network Enterprise, Technology Command

Army Directive 2008-04
SUBJECT: Army Energy Enterprise

U.S. Medical Command/The Surgeon General
U.S. Army Intelligence and Security Command
U.S. Army Criminal Investigation Command
U.S. Test and Evaluation Command
U.S. Army Corps of Engineers
U.S. Army Military District of Washington
U.S. Army Reserve Command
U.S. Army Installation Management Command
U.S. Army Acquisition Center
Superintendent, U.S. Military Academy

US Army Senior Energy Council Charter



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21 Aug 2008

Army Senior Energy Council Charter

1. **Name of Committee:** Army Senior Energy Council (SEC).
 2. **Date Established:** The effective date of the establishment of the Committee is August 21, 2008.
 3. **Committee Term:** The initial term of the SEC shall be three years.
 4. **Category and Type of Committee:** Intra-Army; Departmental.
 5. **Mission and Purpose:** The SEC shall, in a collaborative manner, develop, for approval by the Secretary of the Army, an Army Enterprise Energy Strategic Plan (Plan) encompassing all aspects of Army consumption and utilization of energy to include energy uses associated with:
 - Installations and Facilities (including Non-tactical Vehicles (NTVs));
 - Weapon Systems (including tactical and combat manned and unmanned ground and air platforms, and soldier/weapons/logistics/C4ISR systems); and
 - Sustainable Contingency Operations Base Camps.
- At a minimum, the Plan developed by the SEC shall:
- Synchronize submission of Energy program resource requirements with the Army Planning, Programming, Budget and Execution (PPBE) process and timeline.
 - Provide guidance for the development of Army power and energy priorities and implementation plans.
 - Promote integration of power and energy strategies for Installations, Weapon Systems and Contingency Operations Base Camps.
 - Leverage innovative technologies for alternative and renewable energy.
 - Provide metrics for monitoring progress of programs and operations intended to facilitate the accomplishment of the Plan's goals and objectives.
6. **Direction and Control:** This Committee will report to the Secretary of the Army and be co-chaired by the Assistant Secretary of the Army (Installations and Environment) and the Vice Chief of Staff of the Army.
 7. **Authority:** This Committee is being formed as part of an initiative directed by the Secretary of the Army.
 8. **Administrative Support and Staff Arrangements:** TBD by the membership of the SEC and as administered by the Senior Energy Executive (SEE).
 9. **Composition:** Members of the SEC will be comprised of senior representatives (*ASA or DCS equivalents*). SEC members who are unavailable to attend an SEC

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meeting may send a senior principal deputy (one level down) to attend on their behalf. SEC Advisory Members shall attend SEC meetings at the request of the SEE (after consultation with the SEC members) and will be selected by the SEC based upon the subject expertise needed with respect to the Plan and related Energy Initiatives.

SEC MEMBERSHIP (may be augmented as determined by Senior Leadership)

- a. VCSA – Co-Chair
- b. DUSA
- c. DAS
- d. SMA
- e. AMC
- f. AASA
- g. ACSIM
- h. ASA (M&RA)
- i. ASA(ALT)
- j. ASA (CW)
- k. ASA(FM&C)
- l. ASA (I&E) – Co-Chair
- m. CAR
- n. CIO/G-6
- o. CLL
- p. USACE
- q. CPA
- r. DARNG
- s. DUSA-BT
- t. DCS G-1
- u. DCS G-2
- v. DCS G-3/5/7
- w. DCS G-4
- x. DCS G-8
- y. G-8,PAE
- z. OGC
- aa. TJAG
- bb. TRADOC
- cc. FORSCOM
- dd. SEC Advisory Members (DASA or Two Star equivalents)

10. Committee Level and Other Data:

a. SEC Proceedings

1) The DASA(E&P) as the SEE , will be the Executive Secretary of the SEC and facilitate the conduct of all SEC meetings.

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- 2) The SEC will convene not less than two times per year. Meetings of the SEC will be scheduled by the SEE after consultation with SEC members or as directed by the SA.
- 3) To conduct SEC business, a quorum of five members is required.
- 4) Councils and Focus Area Working Groups (FAWGs) established by direction of the SEC shall operate as prescribed by the SEC under the supervision of the SEE.
- 5) The SEE shall monitor the Army's progress in meeting goals and objectives established as part of the Plan developed by the SEC and approved by SA, and report the findings regarding progress in meeting the Plan's goals and objectives to the SEC.

11. **Correspondence:** Official communications should be addressed to the Assistant Secretary of the Army for Installations and Environment, Deputy Assistant Secretary of the Army for Energy and Partnerships, The Pentagon, Room 3D453, 703/692-9890.

12. **Date Charter Filed:** _____
(Date)


 _____ Date: _____
 Pete Geren
 Secretary of the Army

26 SEP 2008


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 George W. Casey, Jr.
 General, United States Army
 Chief of Staff

26 SEP 2008

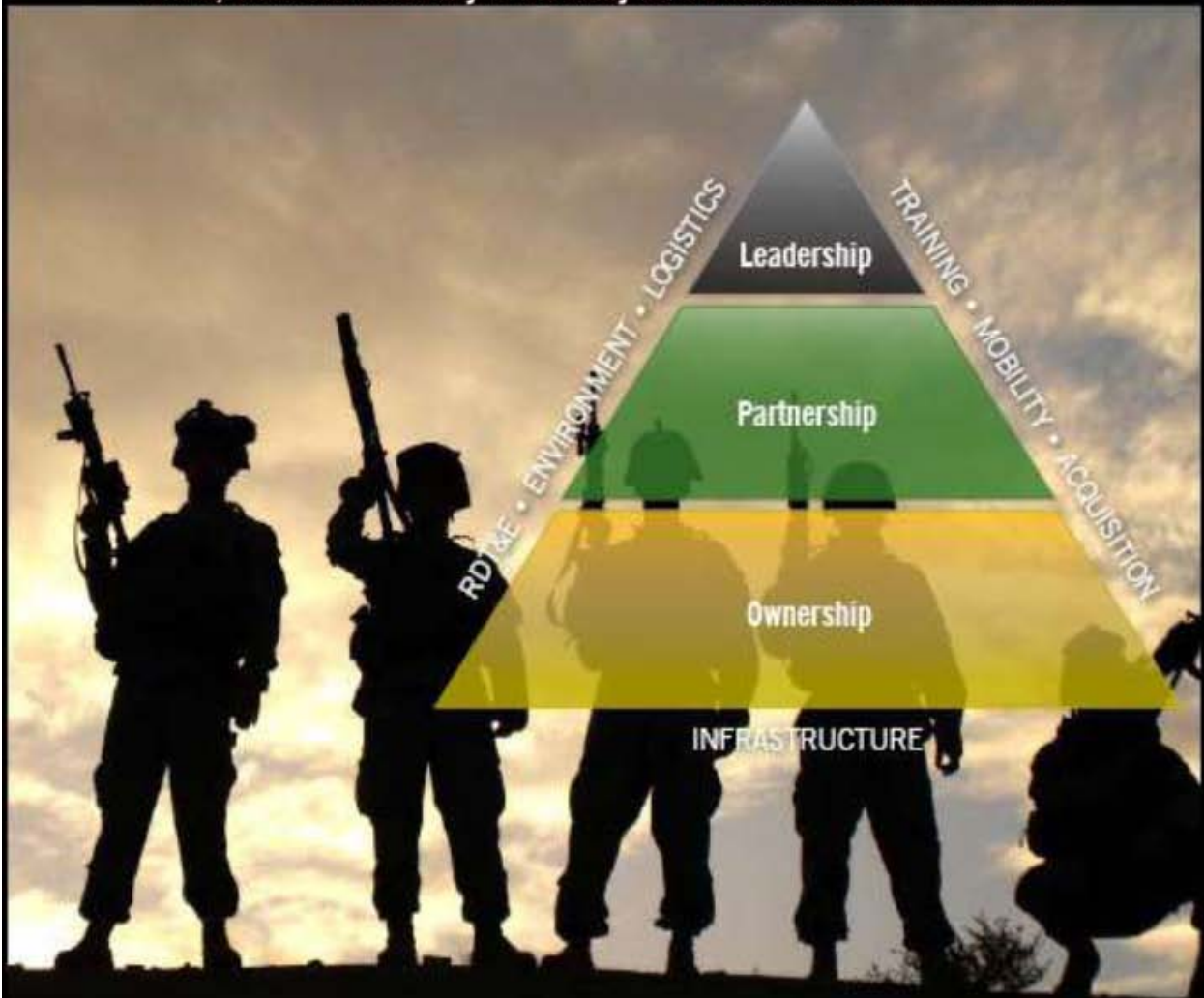
K7.0 2008 ARMY ENERGY ENTERPRISE

2008 Army Energy Enterprise

Predecisional
FOUO



Office, Assistant Secretary of the Army for Installations and Environment



AESTF REPORT: ARMY ENERGY SECURITY AND INDEPENDENCE - STRATEGIC WAY AHEAD 2008 /2009

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TABLE OF CONTENTS

	Page
ACKNOWLEDGEMENTS	iii
EXECUTIVE SUMMARY	v
RESOURCING PROVISIO.....	vii
1.0 BACKGROUND, ORGANIZATION & ACTIVITIES OF THE TASK FORCE	1
1.1 Purpose of the Task Force	1
1.2 Task Force Organization.....	2
1.3 Task Force Activities	3
1.4 Communication and Reporting.....	4
2.0 THE ARMY ENERGY LANDSCAPE	6
2.1 Army Energy Consumption	6
2.2 Energy Directives	8
3.0 A DIRECTION FOR THE FUTURE	9
3.1 The Army's Energy Vision	9
3.2 Energy Mission Statement	11
3.3 Army Energy Goals	11
4.0 RECOMMENDATIONS: CHARTING THE ARMY'S ENERGY FUTURE	11
4.1 AESTF Recommendations.....	12
4.1.1 Recommendation 1: Establish Office of the Deputy Assistant Secretary Of The Army for Energy & Partnerships (DASA(E&P)) Responsible for Development of an Army Enterprise Energy Strategy	12
4.1.2 Recommendation 2: Establish Army Senior Energy Council with DASA (E&P) as Chair	12
4.1.3 Recommendation 3: Accelerate Use of Alternative Energy Sources to Increase Energy Security in a Cost Effective Manner	13

i

Leadership ♦ Partnership ♦ Ownership



4.1.4 Recommendation 4: Expedite Utility Metering at All Installations to Reduce Consumption and Increase Efficiency 13

4.1.5 Recommendation 5: Implement Practices and Technologies to Control Forward Operating Base Energy Accountability and Reduce Consumption 14

4.1.6 Recommendation 6: Certify Army Platforms for Alternative Fuels to Ensure Operational Fuel Supply 15

4.1.7 Recommendation 7: Implement Acquisition and Procurement Practices Requiring Efficient Power and Energy Solutions 15

4.2 Follow up Actions 16

4.3 Responses to the Defense Science Board Findings 16

5.0 CONCLUSION: THE WAY AHEAD 20

LIST OF APPENDICES

Appendix A: Memos A-1

Appendix B: AESTF Membership List B-1

Appendix C: Meeting Minutes C-1

Appendix D: Information Papers D-1

Appendix E: Briefing Slides E-1

Appendix F: Summary of Key Energy Directives F-1

Appendix G: Acronyms G-1

Appendix H: References H-1



Army Energy Security Task Force Report

“Army Energy Security – The Way Ahead”



ACKNOWLEDGEMENTS

The Task Force Leadership acknowledges the exceptional commitment, skill and hard work of the Army Energy Security Task Force (AESTF) members who devoted a significant amount of time and effort to develop and write this report. The AESTF Functional Area Working Groups (FAWGs) identified key topics for recommendations and prepared Information Papers to document the rationale behind their ideas. Numerous individuals, from across the Army, have spent long hours in preparing their background materials and in coordinating them with other relevant organizations. The challenge of integrating these inputs and organizing them into clean coherent strategic recommendations affecting the Army enterprise was due primarily to work by the Deputy, Army Energy Security Task Force (AESTF), the AESTF core members, AESTF support staff and the FAWG subject matter experts/leads.

iii

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Army Energy Security Task Force Report
"Army Energy Security – The Way Ahead"



iv

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Army Energy Security Task Force Report "Army Energy Security – The Way Ahead"



EXECUTIVE SUMMARY

In February of this year, the Defense Science Board (DSB) published a report, "More Fight – Less Fuel", that is critical of how the Department of Defense (DoD) manages its energy supply and consumption activities. This was followed by a similar report from the General Accountability Office (GAO) in March. In response to these reports, Secretary Geren issued a 15 April 2008 memorandum calling for creation of the Army Energy Security Task Force (AESTF) and named Deputy Assistant Secretary of the Army Paul Bollinger as its leader.

The AESTF was charged with preparing recommendations to:

- Reduce Army energy consumption
- Increase energy efficiency across platforms and facilities
- Promote the use of new sources of alternative energy
- Establish benchmarks for the Army's energy footprint
- Provide guidance for the creation of a culture of energy awareness across the Army.

The Secretary designated the Office of the Assistant Secretary of Installations and Environment (DASA(I&E)) to oversee the AESTF and develop the necessary strategic / action plans that address issues identified in the DSB and GAO reports, Executive Order 13423 and other associated statutory drivers. Additionally, the AESTF was assigned to develop a governance framework for all Army energy security efforts.

The AESTF recognized that Army energy policies and practices must be aligned to effectively operate our installations and conduct contingency operations world-wide. The Task Force deliberated for approximately two months with the approach of addressing energy issues from an Army enterprise-wide perspective.

The AESTF briefed the following seven recommendations to the SA on 19 June 2008:

1. Establish Office of the Deputy Assistant Secretary Of The Army for Energy & Partnerships (DASA (E&P)) Responsible for Development of an Army Enterprise Energy Strategy
2. Establish Army Senior Energy Council with DASA (E&P) as Chair
3. Accelerate Use of Renewable Energy Sources to Increase Energy Security in a Cost Effective Manner
4. Expedite Utility Metering at All Installations to Reduce Consumption and Increase Efficiency
5. Implement Practices and Technologies to Control Forward Operating Base Energy Accountability and Reduce Consumption

v

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Army Energy Security Task Force Report

"Army Energy Security – The Way Ahead"



6. Certify Army Platforms for Alternative Fuels to Ensure Operational Fuel Supply
7. Implement Acquisition and Procurement Practices Requiring Efficient Power and Energy Solutions

The Secretary approved these recommendations and several specific action items to initiate their implementation. Several Army energy initiatives were identified to highlight the types of projects that exemplify the Army's new approach to energy planning, investments and operations. As part of the implementation of Army energy strategic planning, the Task Force recognizes that the fully-burdened cost of fuel (FBCF) must be used in all Army analyses.

vi

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RESOURCING PROVISIO

In accordance with Assistant Secretary of the Army for Financial Management and Comptroller (ASA(FM&C)) guidance, the AESTF notes that the findings and recommendations presented in this report have been prepared without fully evaluating the costing and funding implications given the scope and complexity of all Army energy related efforts, and the compressed time schedule under which the Army Energy Task Force (AESTF) prepared this work. The AESTF fully appreciates the critical role adequate funding will play in the successful implementation of a sound and effective energy program. Further, the AESTF recommends that sufficient cost-benefit analyses on all initiatives that the Army leadership endorses for implementation. This report should be considered more of a framework and foundation for the development and implementation of a total Army energy security strategic plan. Under the leadership of the Deputy Assistant Secretary for Energy & Partnerships and the Army Senior Energy Council it is expected that a comprehensive Army Enterprise Energy Strategy will be developed for successful implementation.

vii

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Army Energy Security Task Force Report

"Army Energy Security – The Way Ahead"



1.0 BACKGROUND, ORGANIZATION & ACTIVITIES OF THE TASK FORCE

In February of this year, the Defense Science Board (DSB) published a report, "More Fight – Less Fuel", that is critical of how the Department of Defense (DoD) manages its energy posture with respect to national security. This was followed by a similar report from the General Accountability Office (GAO) in March. In response to these reports, Secretary Geren issued a 15 April 2008 memorandum calling for creation of the Army Energy Security Task Force (AESTF) with the objective of developing recommendations to:

1. Reduce Army energy consumption
2. Increase energy efficiency across platforms and facilities
3. Promote the use of new sources of alternative energy
4. Establish benchmarks for the Army's energy footprint
5. Provide guidance for the creation of a culture of energy awareness across the Army.

The Secretary designated the Office of the Assistant Secretary of Installations and Environment (DASA(I&E)) to oversee the AESTF and develop the necessary strategic / action plans that address issues identified in the DSB and GAO reports, Executive Order 13423 and other associated statutory drivers. Additionally, the AESTF was assigned to develop a governance framework for all Army energy security efforts. Deputy Assistant Secretary of the Army Mr. Paul Bollinger was appointed to lead the Task Force.

This report documents the purpose, organization, activities and recommendations of the Task Force. The report provides information regarding the Army's plans and activities to address the findings from the DSB Energy Report. Specifically, the Secretary asked what the Army should be doing to address these findings.

1.1 Purpose of the Task Force

The main purpose of the Task Force is to address the findings of the energy reports recently issued by DSB and the GAO, as well as Executive Order 13423 and other statutory drivers (e.g., Energy Security and Independence Act of 2007). The Task Force efforts also recognize the importance of rising energy costs throughout the DoD as outlined in the memorandum from Deputy Secretary of Defense England (dated 17 January 2008 – referenced in Appendix A).

1

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"Army Energy Security – The Way Ahead"



The AESTF recommendations were not intended to go into programmatic detail or duplicate efforts already planned or underway by various Army Offices or Commands.

1.2 Task Force Organization

The AESTF was comprised of representatives from Army Staff elements as designated in the memorandums from Secretary Pete Geren and I&E Assistant Secretary Keith Eastin dated 18 April 2008.

To achieve its objectives, the AESTF was divided into several Focus Area Working Groups (FAWGs) to deliberate on assigned topics of concern. The FAWGs and their key topics are shown below:

1. Leadership
 - a. Strategy
 - b. Governance
 - c. Business Transformation
 - d. Lean Six Sigma
 - e. Policy
2. Finance
 - a. ROI
 - b. Budget Process
 - c. Investment Methodology
 - d. Fully burdened cost of fuel/energy
 - e. Reinvestment and Incentivization
 - f. Business Transportation/Lean Six Sigma
3. Installations & Infrastructure
 - a. Construction Standards/Leadership in Energy Efficient Design (LEED)
 - b. Renewable Energy
 - c. Alternative Energy
 - d. Enhanced Use Leases/Energy Savings Performance Contracts, Utility Savings Performance Contracts
 - e. Energy Security and Independence
4. Sustainability & Culture
 - a. Culture and Incentives
 - b. Business Transformation & Processes
 - c. Greenhouse Gas Emissions
 - d. Statutory Drivers
 - e. Executive Orders

2

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5. Forward Operating Bases (FOBs)
 - a. Requirements
 - b. Capabilities-Logistics
 - c. Energy Security
6. Acquisition, Logistics and Technology
 - a. Weapon System Technology
 - b. Acquisition and Procurement Policy
 - c. Logistics
7. Training
 - a. Culture
 - b. Technology
 - c. Classroom to Real World
 - d. Continuing Training and Measurement
8. Mobility and Fuel Logistics
 - a. Technology
 - b. Renewable Energy
 - c. Alternative Energy
 - d. Tactical & Non-Tactical
 - e. Aviation

It was recognized from the outset that each of the FAWGs had areas of overlap with other groups. This is indicative of the Soldier's operating world and the importance of ensuring that the Army Energy Strategy take advantage of the overlap to reinforce and support a comprehensive and synergistic energy program. The overlaps were addressed by the FAWG in their on-going deliberations and in weekly Task Force meetings.

1.3 Task Force Activities

The AESTF was expected to complete its work within 60 days and present recommendations to Secretary Geren no later than 23 June 2008. To meet this schedule, the AESTF held meetings every week during late April, May and early June to draft recommendations that would provide the Secretary of the Army with the necessary information to make policy decisions concerning the future Army energy posture. In addition, several activities were accomplished after 19 June 2008 to close out the Task Force work.

3

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A chronology of the main activities is shown in Table 1.

Table 1. Chronology of Major AESTF Activities

Activity Name	Description	Milestone Date
Request for Review of Army Energy Landscape	The SA requested ASA(I&E) to review the Army energy landscape to prepare a response to DSB report	3 April 2008
Army Energy Leadership Established	Mr. Paul Bollinger appointed to lead the Army Energy Task Force	3 April 2008
Stand up the Army Energy Security Task Force (AESTF)	Establishes the guidelines and charter for AESTF. Calls for Task Force results to be provided within 60 days, 23 June 2008.	15 April 2008
Task Force Meetings	HQDA Staff Offices / SME Meetings	Each Thursday 1300 – 1500
Task Force Briefing to the SA	Mr. Bollinger presented the task force briefing with background and recommendations to Mr. Geren	19 June 2008
SA Army Energy Initiatives	Identify and document several energy project initiatives for a public announcement by SA in late July 2008	5 July – 16 July 2008
Inaugural Senior Energy Council (SEC) Meeting	First meeting of the SEC	21 August 2008

Between Task Force meetings, each of the FAWGs completed considerable research, information compilation, coordination among Army offices and discussions to identify key issues and candidate recommendations back in their organizations.

1.4 Communication and Reporting

The Task Force provided a variety of communications and interim reports throughout the course of its work. In particular, one-on-one pre-briefings of key AESTF findings and preliminary recommendations were provided to the following Army leadership:

4

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Army Energy Security Task Force Report

"Army Energy Security – The Way Ahead"



- AUSA Nelson Ford
- DUSA Tom Kelly
- ASAIE Keith Eastin
- PDASIE Geoff Prosch
- LTG Robert Wilson, ACSIM
- LTG David Huntoon, G-8
- LTG Ross Thompson, ASA(ALT)
- Mr. Tom Edwards, G-4
- MG Bo Temple, USACE
- Dr. Tom Killion, Chief Scientist R&T
- Mr. Donald Tison, G-8
- Mr. Mark Lewis, G-3/5/7

These communications provided an additional avenue for feedback from Army leadership to the Task Force and also represented outreach from the Task Force to key Army stakeholders during the analysis and coordination process.

Concurrence on the AESTF Recommendations was accomplished with the following organizations:

ASA(I&E)	Assistant Secretary of the Army (Installations and Environment)
DASA(ESOH)	Deputy Assistant Secretary of the Army (Environment, Safety and Occupational Health)
DASA(I&H)	Deputy Assistant Secretary of the Army (Installations & Housing)
ASA(FM&C)	Assistant Secretary of the Army (Financial Management and Comptroller)
ASA(ALT)	Assistant Secretary of the Army (Acquisition, Technology and Logistics)
DCS(G-8)	Deputy Chief of Staff, G-8
HQ USACE	Headquarters, US Army Corps of Engineers
PM MEP	Program Manager, Mobile Electric Power
PSTF	Power Surety Task Force
APC	Army Petroleum Center
ACSIM	Assistant Chief of Staff for Installation Management
DCS(G-4)	Deputy Chief of Staff, G-4
DCS(G-6)	Deputy Chief of Staff, G-6
DCS(G-3/5/7)	Deputy Chief of Staff, G-3/5/7

The AESTF briefing was presented to Secretary Geren on June 19, 2008.

5

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"Army Energy Security – The Way Ahead"



2.0 THE ARMY ENERGY LANDSCAPE

The Army is a significant consumer of energy within the Department of Defense and faces a significant set of actions to comply with an increasing array of energy directives.

2.1 Army Energy Consumption

For FY 2007, Army total energy consumption is estimated to be over 112 trillion Btu at a cost of more than \$ 2.9 billion. Army energy consumption falls into the following broad categories:

- Facilities energy use
- Generators (at Forward Operating Bases & Tactical Theatre)
- Mobility energy use
 - Combat vehicles
 - Combat aircraft
 - Tactical vehicles
 - Non-tactical vehicles

The data sources to identify and track consumption and costs for Army energy use are also diverse. Each of the consumption categories above has its own separate data sources. To show differences in consumption in peacetime and wartime, Figures 1 and 2 illustrate 2007 consumption patterns using data from the DSB Report for liquid fuels and the FY07 Federal Energy Management Report (Army Energy & Water Reporting System-AEWS). Total consumption under two scenarios is estimated to be: peacetime (112 trillion Btu) and wartime (206 trillion Btu).

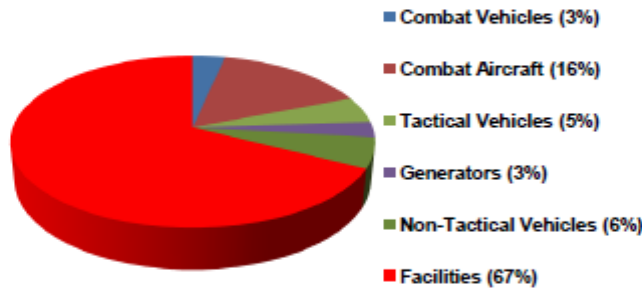
The results show Army end use consumption patterns for peace and wartime OPTEMPO scenarios based on realistic energy consumption performance (energy efficiencies) for Army air and ground vehicle systems in the FY 2006-7 time period. These are macro-level results based on available operational data and metrics. For generators and mobility systems, the peacetime results are based predominantly on CONUS and permanent station OCONUS units. Wartime results were calculated from wartime consumption rates using 2006-7 data and assuming full deployment of Army forces to operational theaters. Facilities results are reported from AEWS.

6

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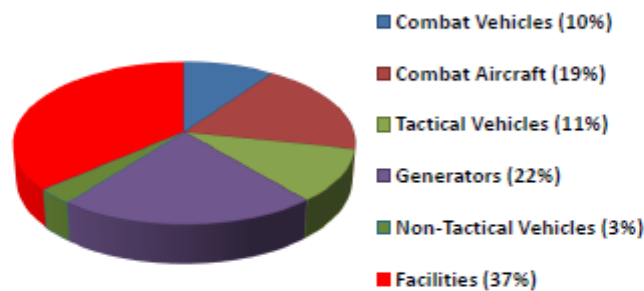
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"Army Energy Security – The Way Ahead"



Sources: Defense Science Board, *More Fight – Less Fuel* (Feb 2008); Army Energy and Water Reporting System (FY 2007).

Figure 1. Estimated Army Peacetime Energy Consumption, 2007

In Figure 1, it is clear that facilities represent the largest energy end-user group during peacetime. However, Figure 2 shows that during wartime the pattern shifts dramatically.



Sources: Defense Science Board, *More Fight – Less Fuel* (Feb 2008); Army Energy and Water Reporting System (FY 2007)

Figure 2. Estimated Army Wartime Energy Consumption

7

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The facility consumption share falls to 37% while generators increase to 22% and air and ground vehicles also gain. During both peacetime and wartime, facilities represent the largest share of Army energy consumption.

2.2 Energy Directives

The Army is faced with a mounting inventory of energy directives that provide a strong set of drivers for change in Army energy practices. Figure 3 shows major directives since 1997 in four categories: Laws and statutes, Presidential Executive Orders, Department of Defense guidance and Army guidance.

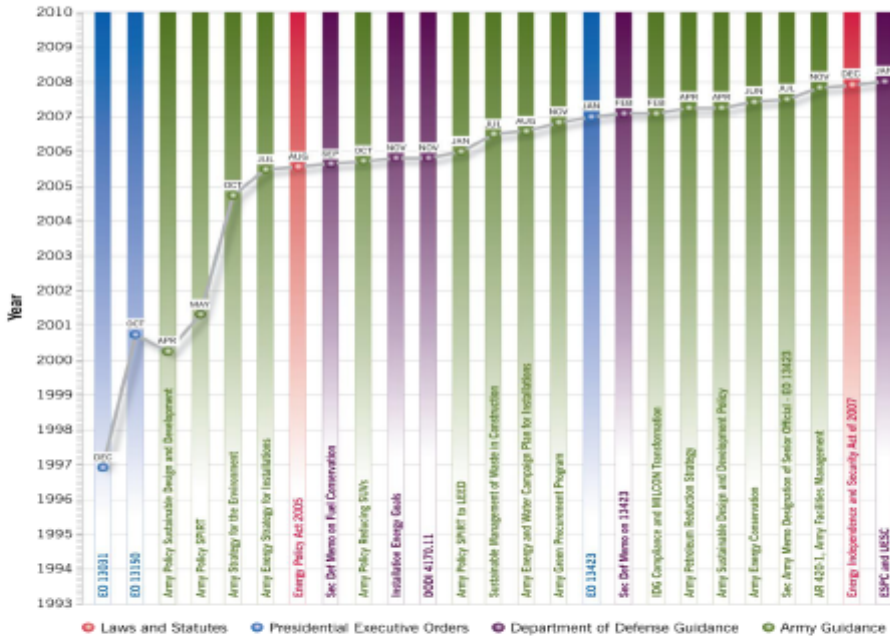


Figure 3. Key Energy Directives

This Figure indicates that the Army faces a substantial set of legislative and policy requirements in moving its energy program forward. And, to

8

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Army Energy Security Task Force Report "Army Energy Security – The Way Ahead"



complicate the picture, most of these directives have taken effect since early 2005. Please refer to Appendix H for detailed Key Energy Directives.

3.0 A DIRECTION FOR THE FUTURE

The Task Force developed an energy vision, mission and goals to set a strategic direction for future Army programs, activities and investments.

3.1 The Army's Energy Vision

The Army's Energy Vision is:

The Army will transform its energy posture and culture to enhance and ensure mission success and quality of life for our Soldiers and their Families while serving as a model for the nation.

Figure 4 presents a visual image to illustrate the three main components of the vision: Leadership, Partnership and Ownership.



Figure 4. The Army Energy Vision

Leadership represents the missing piece of the puzzle. There has been substantial work done by various Assistant Secretaries of the Army (ASAs) and Army Staff (ARSTAF), but the missing element has been leadership at the highest level to bring focus and support to the many initiatives/programs. A successful Army energy program of the future requires centralized leadership with the appropriate authority and support to lead the entire Army energy program. The leadership provided by a

9

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Army Energy Security Task Force Report

"Army Energy Security – The Way Ahead"



focused high level office can serve to galvanize and prioritize the multitude of energy programs in planning or operation. The leadership of the program will extend from the DASA P2E through the ASAs and ARSTAF, down to the Garrison Commanders. This will be the leadership chain of command for the Army energy initiative.

Partnership will be a critical component of the Army initiative because of the need for the effort to be "boundaryless." The issue of energy is much like safety, it knows no boundaries and it impacts all Soldiers in everything they do. In addition, the multitude of energy programs planned or underway in the Army cross over ASAs and ARSTAF organizations and cannot be stove-piped for any level of success. The Army energy initiative must truly be a partnership between everyone in the Army to be effective.

The concept of partnership also applies to the Army and its relationship with the private sector to effectively develop cost-effective energy savings programs. The majority (67%) of Army energy consumption is in infrastructure. In this respect, the private sector has spent billions of dollars to develop new technology to reduce energy consumption and increase efficiency of their buildings. This is knowledge and technology that the Army can use to reduce infrastructure energy demand as well.

In addition, the partnership with the private sector has great potential for the Army if various alternative financing mechanisms are fully utilized to build alternative energy facilities on installations to create more energy secure facilities. This is not a new concept, but it has only been performed in a piecemeal fashion instead of in a comprehensive and coordinated manner.

Last, but not least is the Ownership of the Army energy initiative. Ownership is the most important element of the entire program. To have ownership permeate the Army leadership and partnerships will lead to the eventual accountability by all Army personnel. Ownership comes from knowledge, training, and operational awareness of the importance of energy to the mission be it fighting, working or living.

The success of reaching the Army's energy goals will be highly dependent on the culture of ownership by all Soldiers and their Families. It is a culture that must start immediately upon starting basic training or the first day at the Academy. Specific training and education programs using real

10

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Army Energy Security Task Force Report

"Army Energy Security – The Way Ahead"



world scenarios and history to support the importance of energy to the war fighting effort will be an important tool to create this culture.

Ownership will continue through the Soldier's career by making it an integral part of their evaluation and recognition on an annual basis. The use of electric meters in all Soldier homes and facilities will bring the importance of energy efficiency directly to their pocketbook. Better use of other technologies be it Radio Frequency Identification Systems (RFIDs), operational procedures, or maintenance activities can serve to increase awareness of energy consumption in a non-intrusive manner that will not effect the mission.

With the proper Leadership, Partnership and Ownership of the Army energy initiative the program will become a model for the other Services and the nation.

3.2 Energy Mission Statement

A fundamental Army responsibility is to provide the Soldier with superior capabilities, weapons, and facilities to live, work, and fight. The energy required to power these assets is integral to the success of the mission and quality of life for Soldiers. Energy must be a consideration in all activities to reduce demand, increase efficiency, seek alternative sources, and create a culture of energy accountability for all Soldiers.

3.3 Army Energy Goals

The Army's strategic energy goals are:

- Create a culture of energy accountability across the Army
- Reduce Army energy consumption and increase efficiency to enhance operational capabilities
- Increase the use of new sources of alternative energy - establish appropriate levels for Energy Security and Independence
- Establish benchmarks for and the Army's energy footprint
- Champion investment strategies supporting Army energy programs

4.0 RECOMMENDATIONS: CHARTING THE ARMY'S ENERGY FUTURE

The AESTF developed seven recommendations and presented them to the SecArmy on June 19, 2008. These recommendations and the main follow-up actions initiated by the SA are described in the remainder of this section.

11

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Army Energy Security Task Force Report

“Army Energy Security – The Way Ahead”



4.1 AESTF Recommendations

4.1.1 Recommendation 1: Establish Office of the Deputy Assistant Secretary Of The Army for Energy & Partnerships (DASA(E&P)) Responsible for Development of an Army Enterprise Energy Strategy

As recognized in the DSB Task Force report issued in February 2008, no single person or office in the Army has responsibility for energy and energy programs underway. Due to this situation program support and funding suffers and initiatives are not conducted on an enterprise basis.

For instance, the AESTF identified numerous Army energy related initiatives and programs which are having varying levels of success. Twenty-five major policy documents, regulations, and statutes address energy on installations.

To address the need for senior Army leadership focused on energy, the AESTF recommends that the SecArmy establish the Office of the Deputy Assistant Secretary of the Army for Energy & Partnerships (DASA(E&P)) to be responsible for development of an Army Enterprise Energy Strategy. The DASA(E&P) would be charged with the mission of coordinating the following: 1) Reducing Army energy consumption; 2) Increasing energy efficiency across platforms and facilities; 3) Promoting the use of new sources of alternative energy; 4) Establishing benchmarks for an energy baseline; and 5) Providing guidance for the creation of a culture of energy accountability across the Army. Further, the AESTF recommends that the DASA(E&P) have the authority to provide guidance and direction for all Army energy programs.

4.1.2 Recommendation 2: Establish Army Senior Energy Council with DASA (E&P) as Chair

Energy is an Army enterprise-wide issue, requiring coordination and collaboration among all Army organizations. The AESTF recommends that the SA establish a SEC, chaired by the DASA (E&P), to provide strategic guidance and oversight for the full range of Army energy programs. The SEC would be comprised of leadership from all major Army organizations. The Council would be responsible for conducting quarterly energy program reviews and would, under direction of the DASA (E&P), report Army Energy program performance to SA and CSA semi-annually. An Army SEC would represent a high level body with

12

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Army Energy Security Task Force Report

"Army Energy Security – The Way Ahead"



enterprise-wide responsibility for guiding and reviewing Army energy activities.

4.1.3 Recommendation 3: Accelerate Use of Alternative Energy Sources to Increase Energy Security in a Cost Effective Manner

Enhancing energy security at Army installations is an essential goal for Army energy initiatives. Energy security refers to the idea that Army installations would be able to maintain a full suite of mission critical operations even in the face of a commercial grid loss. Installation "islanding" will allow for energy to be produced and controlled by the installation without dependence on the national grid. To upgrade energy security at all installations, it will be necessary to accelerate implementation of an installation energy security strategic plan that supports the Army mission. The plan should focus on specific actions to make facilities more secure and enable a combination of financing mechanisms. Because of the high capital cost requirements for energy security technologies, it will be important for the Army to maximize use of private sector investment thru use of Enhanced Use Leases (EULs), public/private power purchase agreements (PPAs), Energy Savings Performance Contracts (ESPCs), or Utility Privatization (UP), in combination with Army MILCON, O&M, or Energy Conservation Investment Program (ECIP) funds. By utilizing private capital for the renewable energy initiative, the Army can obtain the energy security it is seeking for installations with little or no up-front capital.

4.1.4 Recommendation 4: Expedite Utility Metering at All Installations to Reduce Consumption and Increase Efficiency

Utility metering is essential at all Army installations to gain visibility & accountability for use of energy resources. Although some metering has been accomplished, budget cuts have slowed progress in this important activity. The AESTF recommends that metering efforts be accelerated beyond existing plans at high priority installations. An accelerated metering program that builds on and expands current facility metering could help the Army more quickly meet utility metering requirements under the Energy Policy Act of 2005 (P.L. 109-58) and the Energy Independence and Security Act of 2007 (P.L. 110-140). The consumption data obtained by newly installed utility meters will better inform better Army decision

13

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Army Energy Security Task Force Report

"Army Energy Security – The Way Ahead"



making on where programs such as the Energy Conservation Investment Program (ECIP) projects should be conducted in the future.

Accelerated metering activities will also provide opportunities for the Army to consider removal of old, energy intensive buildings. The DASA(I&E) Memo of January 2006 set the requirement for the Leadership in Energy and Environmental Design (LEED) of Silver when cost effective. This memo was reissued to make the Silver LEED standard the mandatory and the minimum design for future Army infrastructure (new or renovated). The AESTF believes that Army building design and construction programs should be incentivized to achieve the highest appropriate energy efficient construction standards.

4.1.5 Recommendation 5: Implement Practices and Technologies to Control Forward Operating Base Energy Accountability and Reduce Consumption

Existing tactical level petroleum management processes cannot provide a level of detail that allows for an accurate view of Army fuel consumption, inventory or illegal activities. The lack of an appropriate automated asset visibility tool limits the capability of the Army to determine trends, process failures and needed improvements. To address this need, the AESTF recommends that the Army control fuel accountability in FOB and tactical theatre locations via effective practices and technology, such as on-line reporting and inventory management systems. For instance, the Defense Energy Support Center (DESC) uses an automated inventory and accounting system, Business Systems Modernization-Energy (BSM-E), to manage products throughout their network of Defense Fuel Supply Points. This system can be readily adapted to accommodate Army fuel accountability needs.

By reducing demand, providing efficient distribution, and utilizing alternative energy sources, the future FOB and tactical theatre sites should minimize fuel consumption and ultimately reduce the risk to our Service members in transporting fuel to these locations. The Power Surety Task Force (PSTF) has developed and begun to implement energy demand reduction and energy efficiency improvement initiatives for tactical and operational use. These initiatives include field use of foamed tents for better insulation and micro-grids to improve distribution and control of power.

14

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4.1.6 Recommendation 6: Certify Army Platforms for Alternative Fuels to Ensure Operational Fuel Supply

JP-8 is the primary battlefield fuel used by the Army; diesel is a secondary fuel. Due to rising oil costs and the need to increase energy security, the Army is considering alternative sources of fuel and energy. Based on successful Air Force testing and certification of a 50:50 blend of Jet Propulsion 8 (JP-8) fuel and Fischer-Tropsch Synthetic Paraffinic Kerosene (FT SPK) synthetic fuel, the Army is planning to qualify blends of JP-8 and FT SPK of up to 50% by volume synthetic content for use in all ground and air engines by 2011. The AESTF recommends that the Army qualify synthetic fuel blends for use in tactical air and ground platforms by 2011 in coordination with the Air Force synthetic fuel certification programs.

Certification of alternate fuels may affect the Army's response to the battlefield Single Fuel Policy as documented in Joint Pub 4-03, DoD Dir 4140, and NATO STANAG 3747. The Army is not adhering to policy in OIF/OEF, resulting in a greater fully burdened fuel cost and increased operational risk due to complex supply lines. The AESTF recommends that the Army enforce compliance to the DoD Single fuel on the battlefield for both mobility and LOGCAP support based on the JP-8 specification, which covers synthetic blend initiatives, to eliminate the costly and unnecessary logistic supply chain.

4.1.7 Recommendation 7: Implement Acquisition and Procurement Practices Requiring Efficient Power and Energy Solutions

The acquisition and procurement practices used by Army organizations have a significant impact on current and future power and energy demand. This recommendation emphasizes revising acquisition and procurement policies and practices to more prominently incorporate power and energy considerations in system and materiel development, purchasing and use. For instance, the acquisition process would be modified to explicitly address power and energy as design factors through the Key Performance Parameters and during Analysis of Alternatives efforts. Increased requirements for procurement of energy efficient products (e.g. light bulbs) and services (e.g., subcontract requirements) would be implemented throughout the logistics enterprise.

15

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Army Energy Security Task Force Report

"Army Energy Security – The Way Ahead"



The AESTF also notes that the Army must follow the OSD requirement to use the fully burdened cost of fuel (FBCF) in all acquisition decisions.

4.2 Follow up Actions

The AESTF also identified several follow-up actions to implement the Task Force recommendations. These are summarized below:

- Establish Army Energy Executive Office within OASA(I&E) – Deputy Assistant Secretary of the Army for Energy & Partnerships, (DASA(E&P))
- Establish/Convene First SEC Within 30 Days
- DASA(E&P) and the SEC Implement Recommendations, and Develop the Army's Enterprise Energy Strategy
- Announce Model Renewable Energy Projects (e.g., Solar, Wind, Geo-thermal, Biomass) at Army Installations Within 30 Days
- Invite Industry to Partner with the Army to Accomplish the Energy Mission at an HQDA Energy Forum Within 90 Days
- Sunset Energy Task Force - Transition Mission to the DASA(E&P)

4.3 Responses to the Defense Science Board Findings

The AESTF recommendations provide a direct response to the six findings of the DSB report. Linkages between the recommendations and the Findings are summarized in Figure 5 and discussed further in this section.



Army Energy Security Task Force Report "Army Energy Security – The Way Ahead"



DSB (GAO) FINDINGS		AESTF RECOMMENDATIONS
1 2001 DSB Report, the Lack of Energy Efficiency Performance Parameters and Accounting of the Fully Burdened Cost of Fuel (GAO 4)	7	1 Establish an Office of the Deputy Assistant Secretary of the Army (I&E) for Energy and Partnerships Responsible for Strategic Management, Energy Accountability and Investment Strategy
2 Critical Missions are at High Risk from Failure of the Grid	3	2 Create a Army Senior Energy Council
3 DoD Lacks Strategic Governance Structure to Properly Manage Energy Risks (GAO 1, 2, 3)	1, 2	3 Accelerate Use of Renewable Energy Sources to Increase Energy Security in a Cost Effective Manner
4 DoD Programs are inadequate with Respect to Power & Energy Technology Investments	1, 2, 4, 7	4 Expedite Utility Metering at All Installations to Reduce Consumption and Increase Efficiency
5 Energy Demand Could be Reduced Through Energy Efficient Operations	4, 5, 7	5 Implement Practices and Technologies to Control Forward Operating Base Energy Accountability and Reduce Consumption
6 Operational Risks (Fuel) Require Demand-side Remedies; Mission Risks (Electricity) Require Both Demand-and Supply-side Remedies	3, 4, 5, 6, 7	6 Certify Army Platforms for Alternative Fuels to Ensure Operational Fuel Supply
		7 Implement Acquisition and Procurement Practices Requiring Efficient Power and Energy Solutions

Figure 5. Crosswalk for DSB Findings and AESTF Recommendations

DSB Finding #1: The recommendations from the 2001 Defense Science Board Task Force Report "More Capable Warfighting Through Reduced Fuel Burden" have not been implemented. (NOTE: DSB Finding #1 directly correlates to GAO recommendation 4.)

AESTF Response: AESTF recommendation #7 is focused on enhancing the acquisition and procurement practices to make energy a factor at key decision points (e.g., Analysis of Alternatives [AoA], Key Performance Parameters [KPPs]) in the processes enterprise-wide). This emphasis would require consideration of efficient and effective power and energy solutions. This recommendation also notes that the Army must follow the OSD requirement to use the fully burdened cost of fuel (FBCF) in all acquisition decisions.

DSB Finding #2: Critical national security and Homeland defense missions are at an unacceptably high risk of extended outage from failure of the grid.

17

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Army Energy Security Task Force Report

"Army Energy Security – The Way Ahead"



AESTF Response: The AESTF concurs that an unacceptably high risk of extended outage from failure of the grid exists. At several Army installations critical strategic and tactical missions that must function 24/7 need improved energy security. Therefore, in Recommendation 3, the AESTF stated that accelerating appropriate use of renewable energy sources (and controls) will enhance the energy security posture at these facilities to reduce the risk of failure due to the vulnerable architecture of the grid.

DSB Finding #3: The Department lacks the strategy, policies, metrics, information and governance structure necessary to properly manage its energy risks. (NOTE: DSB Finding #3 directly correlates to GAO recommendations 1, 2 and 3.)

AESTF Response: Recognizing that decisions related to energy are dispersed across the Army-wide organization, the AESTF concurs with the DSB that a unified vision, strategy, metrics and governance structure are needed enterprise wide. Therefore, in Recommendation 1, the AESTF suggests that a DASA for Energy & Partnerships (DASA (E&P)) be established. Additionally, in Recommendation 2, the formation of a SEC comprised of key senior leadership across the Army is proposed by the AESTF. The DASA (E&P) would be responsible for strategic management, energy accountability and investment strategies related to energy security. The DASA (E&P) would chair the SEC and seek guidance from the senior leaders of the Army.

DSB Finding #4: There are technologies available now to make DoD systems more energy efficient, but they are undervalued, slowing their implementation and resulting in inadequate future S&T investments.

AESTF Response: The AESTF concurs that slow implementation of emerging advanced energy technologies is occurring for many Army applications. In order to make informed energy technology investments, a focused, integrated leadership structure is needed to focus strategic S&T programs on high priority future needs, as proposed in AESTF Recommendations 1 and 2. Additionally, baseline energy supply and consumption data is needed to support cost effective decision making. Some necessary data can be gathered at the installation-level by expediting the metering

18

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Army Energy Security Task Force Report

"Army Energy Security – The Way Ahead"



program as detailed in Recommendation #4. Further, as suggested in Recommendation #7, implementing acquisition and procurement practices that make energy a key factor in decision making will also champion informed P&E decisions.

DSB Finding #5: There are many opportunities to reduce energy demand by changing wasteful operational practices and procedures.

AESTF Response: The AESTF agrees that wasteful operational practices and procedures with respect to energy consumption exist. The AESTF advocates increasing accountability with respect to energy at all levels and creating a culture that does not waste energy nor take readily available energy for granted. Specific actions to implement more accountable energy management practices include expedited utility metering (Recommendation #4), enhanced acquisition and procurement practices (Recommendation #7), and better control of energy accountability at FOBs (Recommendation #5). The AESTF believes that changes in the Army energy culture will lead to energy demand reductions.

DSB Finding #6: Operational risks from fuel disruption require demand-side remedies; mission risks from electricity disruption to installations require both demand-and supply-side remedies.

AESTF Response: The AESTF believes that both demand-and supply-side remedies will be necessary to address operational fuel disruption risks. By gaining control over FOB and tactical theatre energy accountability and reducing consumption through management practices and new technology (Recommendation #5), as well as keeping pace with the Air Force in certifying Army platforms for alternative fuels (Recommendation #6), important reductions in operational risks will be achieved. Also, as suggested in Recommendation #7, incorporating energy efficiency into acquisition and procurement processes will lead to reduced consumption.

With respect to mission risks, the AESTF also concurs that both demand-and supply-side remedies are required. As suggested in Recommendation #3, accelerating the appropriate use of renewable energy sources will improve the supply-side power

19

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Army Energy Security Task Force Report "Army Energy Security – The Way Ahead"



reliability and availability for fixed installations. Recommendation #4 advocates expediting the facility metering program, which will enhance energy accountability and lead to reduced demand. Likewise, incorporating energy efficiency into acquisition and procurement processes (Recommendation #7) will result in systems and materiel that reduce energy consumption.

5.0 CONCLUSION: THE WAY AHEAD

The Army Energy Security Task Force has prepared this report for the Secretary to provide necessary information for decisions about the findings contained in the Defense Sciences Board Energy Report and to provide a way forward for the Army's fragmented energy program.

The need for leadership at the highest level is the first and most important recommendation developed by the AESTF. It was unanimously agreed that while the Army has numerous energy programs, initiatives, and research projects underway, it is missing a dedicated leadership to provide the support and synergy required to capitalize on this work across all Army missions and functions.

In this respect, the Army Energy Pyramid that graphically presents leadership at the top followed by partnership and ownership is indicative of the importance of this position in the Army. Without the proper leadership to drive the Army energy efforts, it is likely that the Army will enjoy modest success in the future, but it will continue to be within specific Commands or Offices, and not be expanded in a programmatic process to efficiently and effectively reduce Army energy demand and cost.

The focus on infrastructure is vitally important to the Army because it comprises the vast majority of the energy consumed. The ability to address the DSB recommendations concerning vulnerability to an electrical grid failure and the desire to have more energy secure installations potentially can be addressed in a collaborative initiative with the private sector. Using proven financing mechanisms, such as enhanced use leases, to build energy plants, at no cost to the Army, is viewed as a preferred development tool. This is where partnership in the Army Energy Pyramid comes into play.

Last, but not least is the issue of ownership of energy in the Army. A culture of energy awareness must be created as soon as possible. However, training and education will not suffice. The AESTF members resoundingly agreed that unless

20

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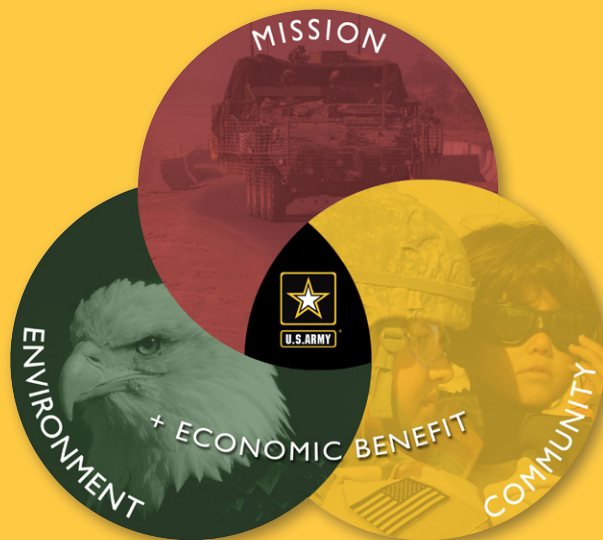
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Soldiers, officers and civilians are held accountable for energy in the future then the initiative will be severely limited. For this reason, the creation of an energy culture, much like a culture for safety, must include metrics and evaluations of individuals and programs in order to be successful.

The Task Force has been meeting for the past eight weeks in order to prepare the information contained in this report. In this short period of time, a lot of dedicated men and women have provided their best knowledge and expertise to develop a thorough yet concise set of recommendations in response to the Secretary's request for a briefing no later than 23 June, 2008.

This report should provide the necessary information to Army leadership to make decisions about the direction it will take with respect to energy and its role in the Army's ability to fight, work and live.



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