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ENERGY OBJECTIVES FOR THE UNITED STATES DEPARTMENT OF DEFENSE

by

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The United States Department of Defense (DoD) has identified energy as a key vulnerability and has made substantial moves to improve its energy profile in the last decade, including establishing a new Assistant Secretary of Defense position for Operational Energy Plans and Programs and integrating energy considerations into its large and complex acquisition process. As part of this process, each military service and the DoD as a whole have issued documents outlining strategic goals and objectives relative to energy. In addition, the Congress and both the Bush and Obama administrations have issued relevant strategic guidance. The strategic guidance conveys the importance and urgency of changing DoD's energy profile. The documents specify a wide range of objectives, which only partially overlap. Moreover, although some terms (e.g., energy security) occur frequently, they are defined in many distinct ways. This points to a need for specific efforts to operationalize the strategic guidance so that DoD decision makers at all levels can implement it effectively.

In this report, we analyze strategy and policy documents from DoD and related organizations, in order to determine an appropriate framework of objectives for energy decisions. We identify and explicitly define a comprehensive set of common objectives and note the language in each document that expresses the pursuit of each objective. This set of objectives and associated definitions clarifies relationships among the strategic documents, and is intended to help communication horizontally (e.g., across services) and vertically, across hierarchical levels. In addition, the objectives we define suggest possible metrics that may be measurable and comparable across services, and may be possible to aggregate across organizational levels.

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The United States Department of Defense (DoD) has identified energy as a key vulnerability and has made substantial moves to improve its energy profile in the last decade, including establishing a new Assistant Secretary of Defense position for Operational Energy Plans and Programs and integrating energy considerations into its large and complex acquisition process. As part of this process, each military service and the DoD as a whole have issued documents outlining strategic goals and objectives relative to energy. In addition, the Congress and both the Bush and Obama administrations have issued relevant strategic guidance. The strategic guidance conveys the importance and urgency of changing DoD's energy profile. The documents specify a wide range of objectives, which only partially overlap. Moreover, although some terms (e.g., energy security) occur frequently, they are defined in many distinct ways. This points to a need for specific efforts to operationalize the strategic guidance so that DoD decision makers at all levels can implement it effectively.

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1. INTRODUCTION

Energy is a critical enabler of military capability, while at the same time energy requirements create a vulnerability and a burden. As expressed in the preface to the Assistant Secretary of Defense for Operational Energy, Plans, and Programs' (ASD[OEPP]) Operational Energy Strategy (OES), "almost every military capability requires energy of some kind" (2011, [18][1]). Energy is an important security issue at the tactical, operational, and strategic levels. At the strategic level, ensuring access to fuel for all military and civilian forces burdens and constrains the United States politically and militarily. The OES states that "the Department's current energy consumption patterns are inconsistent with national strategic goals to build American strength and a stable international order" (p. 1, [18]). As General John Allen, then Commander of the International Security Assistance Force and U.S. Forces in Afghanistan, emphasized in a handwritten addition to a memo in 2011, "Operational energy equates exactly to operational capability" (Allen, 2011).

The Department of Defense's (DoD's) energy use is likely to become even more critical in the future as "the realities of oil markets mean a disruption of oil supplies is plausible and increasingly likely in the coming decades" (ASD[OEPP], 2011, p. 8, [18]). Since a 2001 report by the Defense Science Board documented the lack of consideration of energy in DoD decision processes and the consequences for capability, various organizations within DoD have stated on numerous occasions that energy considerations will play a major role in decision making throughout the foreseeable future. DoD is not unique in requiring energy as a critical input to its operation, nor in giving growing attention to energy during the dramatic fluctuations in fuel prices in recent years. Due to the scale of DoD energy requirements and the long lead time for acquisition decisions that substantially drive those requirements, as well as the challenges of preparing for operations in conflict and under threatened logistics, it is especially important for DoD to have a clear framework for evaluating energy-related decisions.

DoD, the military services, the White House, Congress, and several affiliated organizations have all published documents outlining energy strategies and policies. Many of these documents provide information about objectives, either explicitly or implicitly. The sets of objectives differ significantly among the documents, in both terminology and substance.

The purpose of this report is to develop an appropriate set of objectives for decision making within DoD relating to energy, based on the guidance provided by these documents. Sharing objectives across organizations within DoD supports clearer communication about priorities and can serve as a basis for expressing quantitative information about preferences. Due to the complexity of defense issues and the

[1] Documents reviewed in our search for strategic-level energy objectives appear in Table 1 on pages 5 and 6. Any cited documents that appear in this table will include the document's ID number from Table 1 in brackets in the citation.

importance of managing energy effectively, it is imperative that decision makers understand how alternatives should be evaluated and compared. The work presented in this report constitutes the first steps of that process.

This work is based on the concept of value-focused thinking (Keeney, 1992), which has been widely used to support multiple-objective analyses at many levels in DoD and international defense organizations (Parnell, 2007). In Section 2, we describe the purpose and process of value-focused thinking in the context of managing a large organization.

In Section 3, we describe the source documents, as well as our review process and criteria for identifying objectives. In Section 4, we present our consolidated set of objectives. Several features of the objectives set that we identify may seem counterintuitive—e.g., the obvious objective of maximizing energy efficiency is missing. Therefore, in Section 4 we discuss the reasoning that led to these choices. In Section 5, we offer possible approaches to measuring the achievement of these objectives, and discuss other findings arising from the document review, including differences among the services. We conclude in Section 6.

2. BACKGROUND

Any large organization faces a challenge in managing many decisions such that the choices made are in alignment with its overall strategy, and thus help the organization achieve its goals. One of the primary approaches that organizations use to achieve this alignment is defining and communicating strategic objectives, and cascading these objectives through the organization. The objectives must be defined and measured such that they provide useful guidance for decisions in each part of the organization.

By any measure, DoD is one of the largest organizations in the world, and energy pervades nearly every activity in which it engages. For example, DoD fuel usage accounted for 93% of all U.S. government consumption in 2007 (Lengyel, 2007, [8]). DoD has undertaken many energy strategy-setting exercises, and produced dozens of energy guidance documents. These efforts have been very successful in bringing attention to energy and activating decisions that change—and improve—DoD's energy profile throughout. However, the strategic objectives set forth in the various guidance documents differ substantially. Our work is a response to two major observations:

- difficulties that many in the DoD community have faced in identifying objectives and metrics to guide and justify their decisions as they seek to implement the energy strategies of the DoD and the nation; and
- barriers to communication and alignment created by the use of different terms to describe the same objective, and the use of the same term to mean different things.

DoD's energy profile—energy requirements and the means to meet them—is determined by millions of decisions spread throughout the workforce and pervading all its activities. Energy decisions range from how fast to steam today, to setting flight training requirements, to designing the next generation of vessels, to investing in basic research on propulsion technology, to planning the size of the force.

Communicating quantitative information about preferences and trade-offs across levels of the organizational hierarchy would help in overcoming organizational incentive mismatches and suboptimization problems. By clarifying higher-level objective (utility) functions, we improve the ability of organizations to make decisions consistent with DoD strategic objectives. Eventually, the effort to systematize communication about objectives could support development of standardized metrics that may be compared across organizations.

Specifically, in support of the Energy Systems Technology and Evaluation Program (ESTEP) program, the set of objectives defined in this work can suggest metrics to form the basis for return on investment analyses of energy-technology projects.

We use the term *objective* to refer to an issue of concern in a decision context, plus an associated direction of preference—e.g., minimize energy consumption. The terms "goal," "vision," "strategy," "policy," and even "pillar" are also used in the reviewed

documents to refer to the energy-related objectives and considerations that should be used to evaluate alternatives or to motivate the search for new alternatives.

This study is based on an approach called value-focused thinking (VFT), which is widely used in DoD (see Parnell, 2007, and cited references) and in other public-sector decision contexts (see Keefer, Kirkwood, & Corner, 2004, and cited references). VFT contrasts with alternative-focused thinking in which alternatives for consideration are identified early in an analytic process and criteria for evaluation are determined primarily based on their ease of measurement and differentiation among readily identifiable alternatives.

In VFT, the process of identifying and clarifying decision makers' objectives is given greater emphasis and occurs before detailed alternatives are examined. Among the benefits are more effective communication among stakeholders, the maintenance of focus on the most important considerations in decisions, and, often, the generation of previously unidentified and more innovative alternatives (Keeney, 1992; Parnell, 2007). VFT can also be used in a specific decision context in which there is an obvious need to choose among alternatives (e.g., choosing among preliminary platform designs to move forward in an acquisition process). In that case, measures associated with each objective must be defined so that the achievement of these objectives can be used as a basis of comparison between alternatives.

3. METHODOLOGY

3.1 Sources

We reviewed 44 documents, from several different organizations and suborganizations at many levels. The complete list is shown in Table 1. At the top level, we reviewed White House documents and Congressional documents. Within DoD, strategic documents came from the Secretary of Defense level, and within each of the four services. Figure 1 shows the hierarchical relationships among the documents (refer to Table 1 for document number). It is important to consider information from other major stakeholders, hence many non-DoD publications are included in Table 1, including the Congressional Research Service and nongovernmental organizations, such as the Brookings Institution and Science Applications International Corporation (SAIC). Documents from nongovernmental organizations (documents 8, 9, 22, 23, and 30) and the Congressional Research Service (document 13) are excluded from Figure 1.

Table 1: A list of the 44 documents reviewed in our literature search

ID	Document	Author	Year
1	*Sustain the mission. Secure the future. The Army strategy for the environment*	Office of the Assistant Secretary of the Army for Installations and Environment	2004
2	*Army energy security implementation strategy*	The Army Senior Energy Council and the Office of the Deputy Assistant Secretary of the Army for Energy and Partnerships	2009
3	*Energy security: Army priority and national imperative* [Presentation slides]	Office of the Assistant Secretary of the Army for Installations and Environment	2010
4	*Use of the Army's Strategic Management System (SMS) to track Army Energy Security Implementation Strategy (AESIS) performance* [Information Paper]	Office of the Assistant Secretary of the Army for Installations, Energy, and Environment	2010
5	*Army energy enterprise* [Information Paper]	Office of the Assistant Secretary of the Army for Installations, Energy, and Environment	2010
6	*Supporting the mission with operational energy* [Memorandum]	Headquarters United States Forces-Afghanistan	2011
7	*The proposed change strategy to embed energy stewardship into the Army's culture*	Sweeney, P. J., & Horner, D. H., for Science Applications International Corporation (SAIC)	2012
8	*Department of Defense energy strategy: Teaching an old dog new tricks*	Lengyel, G. J., for the Brookings Institution	2007
9	*Fueling the "balance": A defense energy strategy primer*	Singer, P. W. & Warner, J., for the Brookings Institution	2009
10	Energy Policy Act of 2005	United States Congress[2]	2005
11	Duncan Hunter National Defense Authorization Act for Fiscal Year 2009	United States Congress[2]	2008
12	National Defense Authorization Act for Fiscal Year 2013	United States Congress[2]	2012
13	*Department of Defense energy initiatives: Background and issues for Congress* (CRS: R42558). Washington, D.C.: Congressional Research Service, Library of Congress	Schwartz, M., Blakely, K., & O'Rourke, R., for the Congressional Research Service (CRS)	2012
14	*More capable warfighting through reduced fuel burden*	Defense Science Board	2001

[2] In the Bibliography, these documents are listed by their title instead of the authoring agency.

ID	Document	Author	Year
15	*More fight - Less fuel*	Defense Science Board Task Force on DoD Energy Strategy	2008
16	*Report to Congress on energy security initiatives*	Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics	2008
17	*Quadrennial Defense Review report*	Department of Defense	2010
18	*Energy for the warfighter: Operational energy strategy*	Assistant Secretary of Defense for Operational Energy, Plans, and Programs (ASD[OEPP])	2011
19	*The national military strategy of the United States of America: Redefining America's military leadership*	United States, Joint Chiefs of Staff	2011
20	*Operational energy strategy: Implementation plan*	Assistant Secretary of Defense for Operational Energy Plans and Programs (ASD[OEPP])	2012
21	*Sustaining U.S. global leadership: Priorities for 21st century defense*	Department of Defense	2012
22	Energy Independence and Security Act of 2007: Major provisions of interest to federal energy managers	Federal Energy Management Program (FEMP)	2008
23	*Transforming the way DoD looks at energy: An approach to establishing an energy strategy* (LMI Report FT602T1)	Crowley, T. D., Corrie, T. D., Diamond, D. B., Funk, S. D., Hansen, W. A., Stenhoff, A. D., & Swift, D. C., for Logistics Management Institute (LMI)	2007
24	*Naval energy: A strategic approach*	Naval Energy Office	2009
25	*The Department of the Navy's energy goals*	Secretary of the Navy	2009
26	*A Navy energy vision for the 21st century*	Chief of Naval Operations	2010
27	*Energy evaluation factors in the acquisition process* [Memorandum]	Assistant Secretary of the Navy for Research, Development, and Acquisition	2011
28	*Department of the Navy (DON) objectives for FY 2012 and beyond* [Memorandum]	Department of the Navy	2012
29	Shore energy management (OPNAV Instruction 4100.5E)	Department of the Navy	2012
30	*Reenergizing America's defense: How the armed forces are stepping forward to combat climate change and improve the U.S. energy posture*	The Pew Charitable Trusts	2010
31	*Air Force energy program policy memorandum* [Memorandum]	Secretary of the Air Force	2009
32	*Air Force acquisition & technology energy plan*	Assistant Secretary of the Air Force for Acquisition (SAF/AQ)	2010
33	*Air Force aviation operations energy plan*	Deputy Chief of Staff, Operations, Plans, and Requirements (AF/A3/5)	2010
34	*Air Force energy plan*	Assistant Secretary of the Air Force for Installations, Environment, and Logistics (SAF/IE)	2010
35	*Air Force infrastructure energy plan*	Deputy Chief of Staff, Logistics, Installations, and Mission Support (AF/A4/7)	2010
36	*U.S. Air Force energy strategic plan*	United States Department of the Air Force	2013
37	*35th Commandant of the Marine Corps Commandant's planning guidance*	United States Marine Corps	2010
38	*Marine Corps vision and strategy 2025: Implementation planning guidance*	United States Marine Corps	2008
39	*United States Marine Corps expeditionary energy strategy and implementation plan: Bases to battlefield*	United States Marine Corps Expeditionary Energy Office	2011
40	Exec. Order No. 13423	United States White House[2]	2007
41	Exec. Order No. 13514	United States White House[2]	2009
42	*National security strategy*	United States White House Office	2010
43	*Blueprint for a secure energy future*	United States White House Office	2011
44	*Energy program for security and independence*	United States Department of the Navy	2010

Congress (Legislative)		White House (Executive)	
10	12	40	42
11		41	43
Department of Defense			
	14	18	
	15	19	
	16	20	
	17	21	
Army	**Navy**	**Marine Corps**	**Air Force**
1	24	37	31
2	25	38	32
3	26	39	33
4	27		34
5	28		35
6	29		36
7	44		

Figure 1: A hierarchical representation of the U.S. official documents reviewed

Our primary source of information about stakeholders' preferences with respect to energy decisions is a broad set of DoD strategic guidance documents. Parnell, Conley, Jackson, Lehmkuhl, and Andrew (1998) refer to the formulation of objectives based on stakeholder-approved documents as the "gold standard" (p. 1336) approach to developing multiple-objective value models. In this case, there are many decisions that involve energy, ranging from the highest-level diplomatic decisions that affect risk of conflict and access to energy sources to daily operational decisions such as how fast to drive. We take the perspective that, despite the wide range of decision contexts, the values of individuals within DoD are fundamentally aligned, and differences among objectives definitions are a function of differences in emphasis and expression, due to different roles within the organization as discussed in Section 4.

3.2 Criteria for Identifying Objectives

We develop a comprehensive set of energy objectives relevant to DoD that may be used as the basis for communication and for developing a set of comparable metrics. We do not seek to define a set of objectives to be used in evaluating any specific decision problems, nor to define precisely measurable attributes of specific policy or implementation alternatives. Rather, our primary purpose is to clarify the relationships among issues of concern as defined by various organizations within DoD. We develop qualitative definitions of objectives that capture many issues of concern currently

expressed in different ways and in different contexts. The most important criterion for our set of objectives is that it should be comprehensive, capturing all the energy-related considerations that any of the documents identified as important; i.e., "complete" in Keeney's (1992) terminology.

While many strategy-defining processes in DoD tend to be expansive—identifying important considerations and describing them—the work in this report includes a consolidation and pruning step to develop a set of objectives that is both essential and nonredundant. We ensure that each objective conveys independent information, while keeping the set manageable and meaningful. In addition to completeness and nonredundancy, we want the objectives on our list to be relevant. By relevant, we mean that the objectives are influenced by decisions that may be evaluated using this framework and that they are important to the stakeholders. At this stage, we did not seek to define objectives that are measurable (precisely defined and quantifiable) and operational (measurable in a practical sense). However, there are widely used measures that are associated with some of the objectives, as discussed in Section 5.

3.3 Types of Objectives

While we keep the objectives at a relatively high level and do not attempt to develop metrics suitable to specific decisions, following Keeney (1992), we do distinguish among three types of objectives:

- **means objectives** – objectives that are pursued because they are highly related to more fundamental objectives, but may be easier to influence directly and/or to measure than fundamental objectives;
- **fundamental (ends) objectives** – objectives that are central to a decision context; these define why a decision exists and what the decision maker is trying to achieve in a particular decision context; and
- **strategic objectives** – highest-level objectives that are fundamental to an organization; there are no more-fundamental reasons for the pursuit of these objectives and they cannot be redefined as means objectives by association with any more-fundamental objectives elsewhere in the organizational hierarchy.

Means objectives often reflect influence, by which we do not mean causal influence, but rather a relationship implied by reality trade-offs. The term "trade-offs" is used in two ways: in VFT specifically, and multiple-objective decision analysis more generally, we often refer to preference trade-offs, which are value exchanges that stakeholders or decision makers would be willing to make in choosing an alternative. For example, if a decision maker is willing to reduce an armored vehicle's maximum speed from 70 miles per hour to 55 miles per hour in exchange for increasing its operational range from 300 miles to 400 miles, then that describes a preference trade-off.

A second type of trade-off is imposed by constraints of the real world. If the vehicle designers say that reducing the engine size so that the maximum speed decreases from 70 miles per hour to 55 miles per hour will increase its operational range from 300 miles

to 400 miles, then that is a reality trade-off. Means objectives are often selected based on reality trade-offs—for example, we might care little about a vehicle's weight as a fundamental objective, but we might know that the ability to deploy the vehicle is lower for very heavy vehicles (a reality trade-off) and that the fuel efficiency and operational range are reduced for heavier vehicles (another reality trade-off).

Fundamental objectives describe issues that are of direct concern to the decision makers. Means objectives describe issues that are proxies; they are important to the decision maker primarily because they influence performance on one or more fundamental objective. This distinction becomes crucial in later stages of a decision analysis; quantitative representations of preferences should be developed using fundamental objectives. Keeney (2002) explains that evaluating trade-offs using means objectives rather than fundamental objectives can lead to flawed decisions. See Keeney (1992) for a more detailed discussion of means objectives.

The distinction between fundamental and means objectives depends on the decision context and, therefore, some objectives that might be considered fundamental at one level of an organization for a more limited decision may be simply means objectives at a higher level of the organizational hierarchy where decision problems have a wider scope. At higher levels, decision makers look at longer time horizons for both the impacts and implementation of decisions. They can also influence more decision variables over larger ranges.

For example, at the national level (the president and Congress), the allocation of resources to military capability, diplomacy, and international aid are reasonable decision variables to consider. At DoD level, the size of each service five or ten years in the future are appropriate decision variables. At the Navy level, the number and type of ships are appropriate decision variables. The scope of alternatives under consideration affects which objectives are fundamental to the given decision problem and which are means to influence those more fundamental objectives.

This implies that the categorization of fundamental and means objectives should be expected to differ across the documents we reviewed. Since our purpose is to provide a common set of objectives for DoD across many decision contexts, we take a high-level perspective for distinguishing between fundamental and means objectives. We define as fundamental those objectives that are fundamental at the Secretary of Defense and Service Secretary level.

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4. RESULTS

We identify 12 unique objectives that are of concern to many of the stakeholders. Six are strategic at the national or DoD level, while the rest are means objectives at the DoD level, but may be fundamental at the operational level. Each is included implicitly or explicitly in several of the source documents. Table A.1 in the appendix indicates which objectives are included in which documents, and Table A.2 provides a quote or brief explanation showing where in each document the objective is mentioned.

Following an explanation of each objective, we discuss why others that may appear obvious are not included. Some are redundant or otherwise unnecessary; others are defined as appropriate to higher levels in DoD. Further discussion of how to operationalize these definitions is included in Section 5.

4.1 Relationships Among Objectives

The objectives are organized into a strategic objectives hierarchy and a means-ends objectives network in Figure 2 (see Keeney, 2007, for definitions of objectives hierarchies and networks). There are three tiers in the strategic objectives hierarchy, which reflect the differing perspectives of the national, DoD strategic, and implementation levels. For example, while maximizing assurance is a fundamental objective from an operational perspective, it is a means objective at the more strategic levels, where it is an issue of concern because it is related to capability and vulnerability.

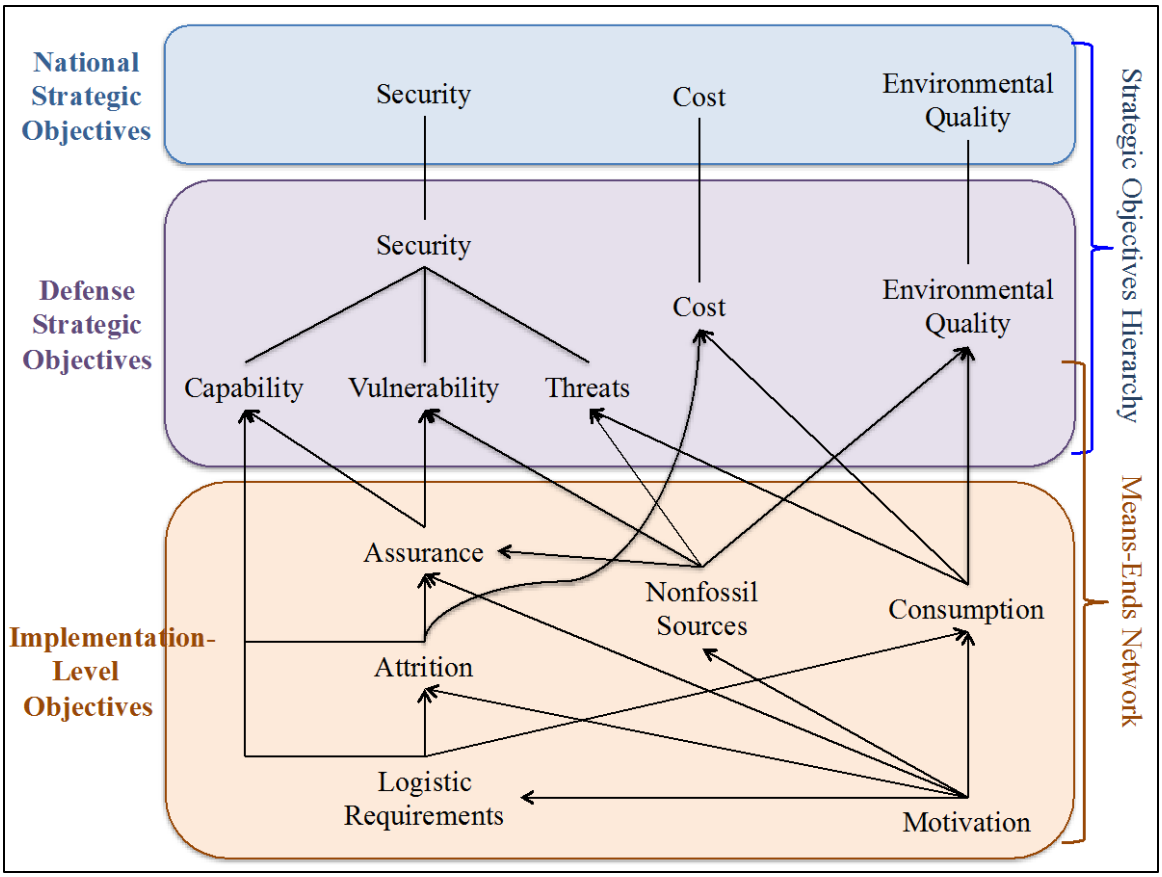

Figure 2: A strategic objectives hierarchy

In this diagram, an arrow indicates that a given objective defines or influences another objective. Similarly, the lack of an arrow between two objectives indicates that there is no significant relationship between the two. For example, maximizing the use of nonfossil sources is desirable because of its impact on two fundamental objectives; it reduces threats by decreasing reliance on foreign sources of fossil fuels and increases environmental quality by reducing combustion of fossil fuels, which releases pollution. While it may affect other fundamental objectives as well, these two objectives are the primary reasons that stakeholders value the use of nonfossil sources.

4.2 National Strategic Objectives

At the national level, three objectives reflect the primary issues of concern with respect to defense energy: maximizing security, minimizing cost, and maximizing environmental quality.

4.2.1 Maximize Security

The term "security" is mentioned in connection with energy in 19 of the 44 reviewed documents; however, none explicitly defines it. We define *security* in terms of the lower-level objectives that compose it (see Figure 2), specifically (as detailed in Section 4.3) *capability*, *vulnerability*, and *threats*.

4.2.2 Minimize Cost

Cost is a summary of resources expended, in this case, to provide energy and, ultimately, capability. Minimizing cost is important because resources expended for one purpose are not available for other purposes within DoD, federal government activities, and the nation as a whole.

4.2.3 Maximize Environmental Quality

Environmental quality refers to health of ecosystems, preservation of ecosystem services, natural land, and limiting toxicity to humans and other animals and plants. Greenhouse gas (GHG) emissions and other pollution are the most relevant to energy-related decisions.

4.3 Defense Strategic Objectives

As indicated in Figure 2, the objectives *cost* and *environmental quality* propagate down from the national level. *Environmental quality* is mentioned frequently in DoD documents, but with no further elaboration beyond that in the national-level documents. The only key difference we would expect with respect to cost is that some types of costs—those not borne by DoD directly—would be excluded from discussions at this level. The objective to maximize security, which is the primary purpose of DoD, however, is defined by decomposition.

4.3.1 Maximize Capability

Capability is the all-encompassing term for the ability to "confront and defeat aggression anywhere in the world," according to DoD (2012, p. 4, [21]). It includes many subcapabilities, and could be defined by breaking it down into objectives such as maximizing rate of airlift transportation, maximizing seaborne missile capability, etc. Not all capabilities relate to combat. For example, humanitarian aid and disaster response is a noncombat capability that enhances national (and global) security. Thus, we did not narrow capability to combat capability only, although combat capability receives more emphasis in DoD. Combat capability objectives such as agility, stealth, endurance, and autonomy are highly related to energy-related objectives, as indicated in Figure 2. We discuss the challenges of defining and measuring capability further in Section 5.

4.3.2 Minimize Vulnerability

Vulnerability refers to both the potential to be subject to attacks or disruptions as well as the magnitude of their impact if they occur. The very first sentence in the Navy Energy Vision indicates that "over-reliance on petroleum is a critical strategic vulnerability for the Navy" (Chief of Naval Operations [CNO], 2010, p. 2, [26]). The importance of sustaining energy supply to maintain capability makes DoD's energy logistics a potential target for attempts to reduce access to sources and thus cause disruptions to the logistic network for fuel and/or electrical power.

4.3.3 Minimize Threats

Threats are sources of conflict or attack on U.S. interests. The reviewed documents indicate that the DoD energy profile directly affects threats with references to the possibility of conflict arising over assuring access to energy supplies, and to the constraints on U.S. foreign policy imposed by a need to maintain access. The National Military Strategy (United States Joint Chiefs of Staff, 2011, p. 3 [19]) explains:

> Energy-state relationships will intersect geopolitical concerns as state-run companies will control an increasing share of the world's hydrocarbon resources and the persistent challenge of resource scarcity may overlap with territorial disputes.

4.4 Implementation-Level Objectives

At the implementation level, we define six additional objectives.

4.4.1 Maximize Assurance

Assurance refers to the availability of energy when and where it is needed for a given mission. It will often need to be defined relative to a given geographic, temporal, or mission scope, but may be quantified in general as the probability that energy demanded by the warfighter is supplied when and where it is needed.

4.4.2 Maximize Nonfossil Sources

This objective refers to the ability to obtain and use energy from sources other than fossil fuels, such as solar, wind, or biofuels, and even nuclear energy. These sources are often termed "alternative" or "renewable" (except nuclear). This objective is important because it diversifies energy sources, and thus reduces vulnerability to supply disruptions and price volatility. It also reduces dependence that may be exploited geopolitically.

4.4.3 Minimize Consumption

Consumption is the total quantity of fuel, power, or energy used. It may be summarized in units of energy or in power units (over some given time period) or may be broken down by location of demand, purpose, or form (e.g., by fuel type).

4.4.4 Minimize Attrition

Attrition is the loss of people and platforms. A good argument could be made for including this objective as part of cost, but it is also relevant in that lost assets cannot be replaced immediately, which negatively affects assurance in the short-term, resulting in decreased capability and increased vulnerability.

4.4.5 Minimize Logistic Requirements

In addition to fuel, logistic activities consume other resources, such as spare parts, food and water for personnel, etc. Logistic operations impose additional organization and management challenges, and are substantial enough in military operations to be considered separately from cost minimization.

4.4.6 Maximize Motivation/Culture

In the context of this report, this objective refers to the awareness of and concern for improving energy-related performance with respect to all of the other objectives. It is emphasized in several of the source documents, especially Air Force and Marine Corps documents, and we believe it is important enough to constitute a separate objective. In a speech in May 2013, Secretary of the Navy (SECNAV) Mabus illustrated the importance of motivation and culture in supporting all other objectives:

> All the technology, all the engineering, all these advances, are terrific but I think the best part is watching how quickly our Sailors and Marines have adapted to this new technology and have embraced this sort of change. There is a culture change that's going on in the Navy and Marine Corps. It is happening 'on the deckplates' as we say in the Navy, as Sailors and Marines come to grips with the fact that these programs help them become better warfighters. That's the reason, in the end, that we are doing this. . . . The main reason [the Engineering Officer] was proud of MAKIN ISLAND was watching the junior Sailors in those engineering spaces innovate and compete to find who could save the most fuel. These Sailors, who live and work in the engine rooms every single day, understand their ship better than anyone else and they were coming to him saying 'Boss, I've got a way we can do this better.' Those Sailors were making that ship a better warfighting platform.

4.5 Redundant Objectives

As discussed earlier, a key criterion for a set of strategic objectives is completeness. We maintain that our chosen set of objectives captures all the essential objectives of energy-related decisions in DoD with minimal redundancy. There are several objectives that were articulated in many of the reviewed documents that are deliberately excluded from this set. In this section, we discuss in more detail the way in which they are still captured by our objectives set.

4.5.1 Energy Security

Most of the documents reviewed include the term "energy security," but do not define it. Those that did defined it in a number of different ways, and each definition is composed of one or more (usually more) of the objectives in our set. For example, the Navy Energy Vision (CNO, 2010, p. 4, [26]) defines energy security as "having assured access to reliable and sustainable supplies of energy and the ability to protect and deliver sufficient energy to meet operational needs."

This definition of "energy security" is very tightly linked to *assurance*. In addition to specifying that security means "assured access," it includes the adjective "reliable," indicating that the reason for being able to protect and deliver energy is to ensure its availability to meet the mission, i.e., ensuring logistics. The means objective to minimize *logistic requirements* also contributes to "energy security" by the above definition.

The Army defines energy security similarly, but explicitly brings in the objective of using fuel from *nonfossil sources*. In the Army Energy Security Implementation Plan (The Army Senior Energy Council and the Office of the Deputy Assistant Secretary of the Army for Energy and Partnerships, 2009, p. 1, [2]), energy security is defined as:

> . . . preventing loss of access to power and fuel sources (surety), ensuring resilience in energy systems (survivability), accessing alternative and renewable energy sources available on installations (supply), providing adequate power for critical missions (sufficiency), and promoting support for the Army's mission, its community, and the environment (sustainability).

Often "energy security" is used to encompass all other values. Roughead, Carl, and Hernández (2012) go so far as to say that "Broadly, across the country, energy security and national security are increasingly being seen as one and the same" (p. viii). "Energy security" might best be interpreted as the highest objective for energy-related decisions in DoD and, therefore, defined by decomposition into the other objectives in each document. In this sense, it is captured by our set of objectives.

4.5.2 Efficiency

Efficiency, which we define as a measure of the ratio of a desired output to inputs, is an objective cited frequently in the reviewed documents. Sometimes it is unitless, as when both numerator and denominator are in units of energy (e.g., British thermal units [BTUs] or gallons of fuel), and the numerator is the energy coming out of a process (e.g., a battery), while the denominator is the energy going in. Sometimes efficiency is a measure of transformation of an input to an output, for example miles covered (output) per unit of fuel consumed (input).

In either case, if both the output (numerator) and input (denominator) are represented in the objectives set, then efficiency would be redundant. Since energy *consumption* (the denominator in energy efficiency measures) is already in the objective set, and other desired outputs (primarily *capability*) are included in the objective set as well, energy efficiency is a redundant objective, and is excluded from the set.

5. DISCUSSION

5.1 Measuring Objectives

In order to compare alternatives in energy-related decisions, it is important to be able to assess each alternative's achievement of the relevant objectives, ideally using unambiguous quantitative measures. Measuring objectives is a prerequisite to communicating effectively about the relative importance of the various objectives, which are often competing—for example, alternatives with higher *capability* (speed, payload, and armor) often require higher fuel *consumption*; hence, the objectives to maximize *capability* and minimize *consumption* are competing. Although stakeholders often make statements about the relative importance of objectives, such as "cost and effectiveness are equally important," without a clear statement of the measurement scales and ranges of trade-offs, such statements are meaningless.

Quantitative measures are particularly important in large organizations with many, distributed decision makers. It is difficult to ensure that preference trade-offs are consistent across decision makers without some kind of quantitative guidance, such as there could be organization-wide guidance about how much money can (and should) be spent per unit of reduction of in consumption. In the absence of specific guidance, one Naval facility could be investing in lighting upgrades that save 100 mega-watt hours (MWh) per year for a cost of $30,000, while another facility passes up the chance to make cooling upgrades that would save 100 MWh per year for a cost of $20,000. One of the drawbacks of qualitative rating scales is that they can be interpreted differently by decision makers within the organization.

Two objectives—maximize *capability* and minimize *threats*—are the most important at the defense strategic level, but are also very difficult to define and, therefore, to measure. Tellis, Bially, Layne, and McPherson (2000) performed a study about measuring national power and emphasized in their results that one or two individual metrics could not capture national power, or military capability. Tellis et al. (2000) stated: "Military threats, geography, and alliances also help shape a country's force architecture and, ultimately, its effective military capabilities" (p. 135).

The general problem of measuring *capability* for defense and security is a long-standing one. We have not solved this problem, nor have we created it. What we have done is documented, using language from the strategic documents themselves, that *capability* is the most important energy-related objective for DoD; many of the others are means objectives intended to support *capability*.

While *capability* is not always explicitly cited as an objective in the documents, it is often mentioned or implied as a constraint on the pursuit of other objectives. For example, the OES (ASD[OEPP], 2011, p. 3, [18]) states: "It is implicit . . . that military energy security enhances and does not sacrifice other operational capabilities."

5.1.1 Decomposition

A useful tool for defining and measuring objectives that are seemingly hard to quantify is decomposition. We illustrated this in Section 4.3 by decomposing the fundamental, but hard-to-define, objective *security* into lower-level objectives *threats*, *capability*, and *vulnerability*, as shown in Figure 2. That means that if we decrease *threats* and *vulnerability*, and increase *capability*, we will have increased *security*.

Other measures that are relatively easier to measure may also benefit from decomposition. For example, *cost* might be broken down based on the types of resources consumed—e.g., consumption of labor or use of logistic platforms in the field might be accounted for separately from monetary expenditures. The field of cost estimation includes quite a bit of work on rational summary measures of cost that capture various cost types.

5.1.2 Natural Measures

The means objectives suggest a few natural-units measures that are relatively straightforward and, in some cases, comparable across organizational units.

Consumption may be the simplest objective to measure, as discussed earlier, in units of energy, such as BTUs or MWh, or barrels (bbl) of fuel. However, the importance of consumption may differ based on where it occurs—e.g., reducing energy consumption in a forward-deployed environment may be substantially more valuable than the same reduction at an installation in the United States. *Consumption* may, therefore, need to be decomposed by type—fuel versus power—and by location, and perhaps by wartime, peacetime, or some other category.

While *attrition* may be measured in natural units—e.g., as a combination of lives and other assets lost—the challenge with respect to this objective is prediction. In retrospect, it may be relatively straightforward to estimate *attrition* to the logistic convoys supplying fuel to North Atlantic Treaty Organization forces in Afghanistan, as in Eady, Siegel, Bell, and Dicke (2009). However, when decisions are made to acquire fuel-consuming assets and to deploy troops to this region, estimating *attrition* and its relationship with assets and resources allocated to force protection is a challenge.

Arguably, a given *attrition* measure—e.g., lives lost—may be comparable across organizational units and decision contexts, and equivalent in terms of preference. This would imply preference trade-offs with respect to other objectives—e.g., if stakeholders believe it is worth 60,000 bbl of F-76 consumption to save one statistical life when choosing an armored vehicle, that same preference relationship should apply to the design of a new amphibious landing craft.

Assurance also suggests a natural-unit measure, along the lines of reliability measures. *Assurance* may be thought of as one minus the probability of failing to meet mission demand over a certain period under given circumstances (to include threats), or the fraction of instances in which demand is met. *Assurance* measures are specific to a

mission and, therefore, while they may be comparable in some sense, they are not equivalent across decision contexts or organizational units, because the importance of the mission and the consequences of failure may differ.

5.2 Targets

In some cases, energy objectives are conveyed implicitly via targets. For example, in October 2009, at the Naval Energy Forum in Washington, D.C., SECNAV Mabus introduced five energy targets for the Department of the Navy (DON) (Mabus, 2009). Briefly, the targets are:

1. **Contracts:** include energy evaluation factors in contracts;
2. **Green Strike Group:** in 2012, sail a strike group on nuclear and biofuel power only, and in 2016, deploy a fleet including aircraft flying on only biofuels;
3. **Consumption:** Reduce petroleum use by 50%;
4. **Alternative Sources:** Half of shore-based energy produced on-installation and from nonfossil sources by 2020; and
5. **Alternative Sources:** Half of all DON energy from nonfossil sources by 2020.

In general, targets are specified with respect to an objective, often a means objective at the strategic level (like *consumption*), which becomes a fundamental objective at the implementation levels. Targets may be defined with respect to multiple objectives—e.g., the SECNAV's Target 4 describes both the source (*nonfossil*) and location (related to *assurance*) of generation of energy.

There is considerable overlap with the objectives set defined in Section 3—in particular, Targets 2, 4, and 5 primarily address the *nonfossil sources* objective and Target 3 clearly addresses a combination of *consumption* and *nonfossil sources*.

Targets are defined in a binary way—either the DON will be successful in meeting each target or it will fall short. There could be different interpretations about details, such as how to measure the baseline for the 50% reduction in Target 3, and, e.g., whether a photovoltaic farm immediately outside an installation can count as "on installation"; but, once these definitions are clarified, success or failure in meeting the targets is binary. Bordley and Kirkwood (2004) discuss assessment of preferences in situations where attributes are defined in this way.

Targets are a policy tool often used by high-level managers in an organization to motivate decision makers at lower levels, thus influencing organizational culture. They also help to focus the attention of lower-level personnel on important objectives. The SECNAV's targets have certainly been effective in this respect.

The key difference between targets and objectives is that targets specify a threshold of achievement and, therefore, the achievement is binary and, in that sense, absolute. In seeking to implement the strategy (meet the targets), there is no guidance about what

other considerations might be balanced against the objectives specified in the target. For example, if running on biofuels requires reducing maximum speed of some vessels in the fleet, or if it contributes more to global warming than fossil fuels, is that a choice that is consistent with the SECNAV's priorities?

Another challenge for the decision makers is that most decisions will not be make-or-break with respect to the targets. That is, most decisions will not individually determine whether or not a target is met. Therefore, it may be hard to evaluate the importance of competing objectives in making each decision. It would be ideal to carry out a further step in the strategic objectives setting process to provide guidelines about appropriate trade-offs among objectives.

5.3 Differences Across Services

In addition to the differences by level discussed earlier, there are noticeable differences in stated objectives among the individual services. We reviewed a total of 23 service-level documents: 7 Army documents, 7 Navy documents, 3 Marine Corps documents, and 6 Air Force documents. The Air Force documents listed 42 energy-related objectives, which is more than the other services. This is perhaps because the Air Force uses more fuel than the rest, consuming 64% of all fuel used by DoD in Fiscal Year 2008, according to the 2010 Air Force Energy Plan (Assistant Secretary of the Air Force for Installations, Environment, and Logistics, [34]). The Navy documents listed 39 objectives, the Army documents listed 26 objectives, and the Marine Corps documents listed 12 objectives. Differences can be seen in Tables 2 and 3, which show the number of service-level documents in which each objective appears.

Table 2: Appearance of national and defense strategic objectives in service-level documents

		National Strategic Objectives			Defense Strategic Objectives		
	# of Documents	Maximize Security	Minimize Cost	Maximize Environmental Quality	Maximize Capability	Minimize Vulnerability	Minimize Threats
All Services	23	8	11	14	10	9	1
Army	7	1	2	2	4	3	0
Navy	7	3	3	6	4	2	0
Marine Corps	3	2	0	1	1	0	0
Air Force	6	2	6	5	1	4	1

Table 3: Appearance of implementation level objectives in service-level documents

		Implementation-Level Objectives					
	# of Documents	Maximize Assurance	Minimize Attrition	Minimize Logistic Requirements	Maximize Nonfossil Sources	Minimize Consumption	Maximize Motivation
All Services	23	10	2	8	17	16	13
Army	7	2	0	3	3	3	3
Navy	7	4	2	3	6	4	2
Marine Corps	3	0	0	1	2	3	2
Air Force	6	4	0	1	6	6	6

While all the services have a high-level focus on maximizing *capability*, it is mentioned most frequently in the documents produced by the Army and the Navy. *Logistic requirements* are also referenced most by the Army and the Navy. The Navy and the Air Force share a focus on *environmental quality* and the use of *nonfossil sources*. The Air Force places more emphasis than the other services on *motivation* and developing a culture of energy awareness and reducing *consumption*. The Marine Corps is particularly focused on a "lean" (frugal) culture, also reducing *consumption*.

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6. CONCLUSION

This report provides a systematic review of a large and broad set of DoD strategic documents that provide guidance for DoD energy decisions. There has been strong top-down support for energy transformation in DoD, as evidenced by these documents. However, the work of translating this guidance into decisions that will produce increasing energy security is ongoing. By explicitly defining a concise, comprehensive, and coherent set of objectives, this report provides an important contribution to that process. This gives analysts and decision makers a common language, and a reference point, for identifying decision-specific objectives and metrics and communicating preference trade-offs.

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APPENDIX. OBJECTIVES MATRICES

Table A1 lists the 12 objectives across the top and the 44 documents reviewed down the left side. If an objective was discussed, explicitly or implicitly, in a given document, there is a check ("√") in the corresponding box.

Table A1: A matrix showing which objectives appear in each document, by ID number

	National Strategic Objectives			Defense Strategic Objectives			Implementation Level Objectives					
Document ID	Maximize Security	Minimize Cost	Maximize Environmental Quality	Maximize Capability	Minimize Vulnerability	Minimize Threats	Maximize Assurance	Minimize Attrition	Minimize Logistic Requirements	Maximize Nonfossil Sources	Minimize Consumption	Maximize Motivation
1	√	√		√					√			√
2		√	√	√	√		√		√	√	√	
3										√	√	
4												
5			√	√			√		√	√	√	√
6					√							
7				√	√							√
8	√	√	√	√	√	√	√		√	√	√	√
9	√			√		√				√	√	
10												
11							√		√	√		
12	√											
13	√	√		√	√	√	√		√	√	√	
14		√	√	√	√				√		√	
15	√				√		√			√		√
16	√				√		√		√		√	√
17	√		√							√		
18	√			√			√			√	√	√
19						√						
20	√			√			√			√	√	
21												
22												
23	√	√	√	√	√	√			√	√		
24			√	√			√	√	√	√	√	
25		√	√	√					√	√		
26	√		√	√			√			√	√	√
27		√										
28			√							√		
29	√		√		√		√			√	√	
30		√							√			
31		√	√							√	√	√
32		√	√	√						√	√	√
33		√			√		√			√	√	√
34	√	√	√		√	√	√			√	√	√
35		√	√		√		√			√	√	√
36	√	√	√		√		√		√	√	√	√
37										√	√	√
38	√		√						√		√	
39	√			√						√	√	√
40										√	√	
41			√							√	√	
42	√		√			√				√		
43		√	√	√		√				√	√	
44	√	√	√	√	√		√	√	√	√	√	√

Tables A2 and A3 are set up the same way as the previous chart, but the cells contain quotes about the objectives from the given document. Table A2 contains National and Defense Strategic Objectives, and Table A3 contains Implementation-Level Objectives.

Table A2: Quotes referring to national and defense strategic objectives, by document

ID	Document	Maximize Security	Minimize Cost	Maximize Environmental Quality	Maximize Capability	Minimize Vulnerability	Minimize Threats
1	Sustain the mission. Secure the future. The Army strategy for the environment	P. 4 "To meet these challenges, we are transforming how we fight, how we train, how we do business, and how we interact with others in order to continually improve and provide for the Nation's security."	P. 9 "Minimize impacts and total ownership costs of Army systems, materiel, facilities, and operations by integrating the principles and practices of sustainability."		P. 8 "Strengthen Army operational capability by reducing our environmental footprint through more sustainable practices."		
2	Army energy security implementation strategy		P. 1 "... increasing efficiencies and lowering corporate demand for energy would save money for the Army and free up both fiscal and personnel resources."	P. ii ESG 5. Reduced adverse impacts on the environment (elaborated on p. 4)	P. ii ESG 2. Increased energy efficiency across platforms and facilities (elaborated on p. 4) P. ii "These (energy security goals) implicitly incorporate the fundamental principle that the improvements achieved shall not lead to reductions in operational capability..."	P. 1 "... disruption of critical power and fuel supplies would harm the Army's ability to accomplish its missions. Such a risk exposes an Army vulnerability that must be addressed by a more secure energy position and outlook." "Reducing [such] energy security risks will continue to be a priority for future contingency operations."	
3	Energy security. Army priority and national imperative [Presentation slides]						
4	Use of the Army's Strategic Management System (SMS) to track Army Energy Security Implementation Strategy (AESIS) performance [Information Paper]						
5	Army energy enterprise [Information Paper]			ESG 5. Reduce adverse impacts on the environment	P. 1 "The Army Energy Security Mission is to ensure energy is a key consideration for all Army activities to reduce demand, increase efficiency, seek alternative sources, and create a culture of energy accountability while sustaining or enhancing operational capabilities." ESG 2. Increase energy efficiency across all platforms and facilities.		
6	Supporting the mission with operational energy [Memorandum]					P. 1 "It's about increasing our forces' endurance, being more lethal, and reducing the number of men and women risking their lives for more fuel."	
7	The proposed change strategy to embed energy stewardship into the Army's culture				P. 4 "The purpose of this culture change initiative regarding energy stewardship is to enhance the Army's ability to project and sustain power to accomplish its current and future missions... End-state goal 3. Empower members to creatively use and leverage energy resources, in conjunction with materiel resources, to increase capability to conduct operations, while also building a capacity to adapt to future demands."	P. 10 "The challenge is to successfully complete missions while reducing operational and tactical vulnerabilities associated with delivering energy resources"	
8	Department of Defense energy strategy. Teaching an old dog new tricks	P. 53 "To improve energy security the DOD needs a comprehensive Energy Strategy that: • Improves National Security by decreasing US dependence on foreign oil • Promotes Research for future energy security"	P. 30 "The DoD needs an Energy Strategy that... • Is fiscally responsible to the American tax payer"	P. 30 "The DoD needs an Energy Strategy that... • Protects the environment"	P. 30 "The DoD needs an Energy Strategy that... • Maintains or improves combat capability"	P. 20 "Implications of the Problem - Vulnerability" See col Q for definition of vulnerability.	P. 30 "The DoD needs an Energy Strategy that... • Improves National Security by decreasing US dependence on foreign oil"
9	Fueling the "balance": A defense energy strategy primer	P. 1 "We must better manage defense energy security by implementing steps to increase energy efficiency and substituting alternative forms of energy to meet the military's fuel needs."			P. 2 "...this effort [to reduce consumption] can be accomplished without reduction of military capability in the resulting force. Indeed, pursuing lower energy consumption and petroleum dependency will ultimately increase the combat and sustainment capabilities of the DoD."		P. 2 "...a significant percentage of the overall reduction in baseline energy will come from the department converting from petroleum to alternative forms of energy and increasing efficiency of use. Moving the DoD away from reliance on petroleum will also ultimately address the long-standing irony of fueling our defense establishment from a system that threatens our nation's security."
10	Energy Policy Act of 2005						

ID	Documents	Maximize Security	Minimize Cost	Maximize Environmental Quality	Maximize Capability	Minimize Vulnerability	Minimize Threats
11	Duncan Hunter National Defense Authorization Act for Fiscal Year 2009						
12	National Defense Authorization Act for Fiscal Year 2013	P. 57 "The Secretary of Defense may use the research and engineering network of the Department of Defense, including the organic industrial base, to support regional advanced technology clusters established by the Secretary of Commerce to encourage the development of innovative advanced technologies to address national security and homeland defense challenges." P. 232 "(2) Establishing policies of the Department of Defense for developing and maintaining the defense industrial base of the United States and ensuring a secure supply of materials critical to national security."					
13	Department of Defense energy initiatives: background and issues for Congress (CRS: R42558). Washington, DC: Congressional Research Service, Library of Congress.	P. 42 "The committee believes that energy security projects are vital to the operational requirements that support national security."	P. 7 "[The FBCF] is intended to be used in the acquisition process as a factor in selecting new equipment, and to illustrate potential systems' logistical footprints." (It is implied that the FBCF needs to be minimized…?)		P. 20 "The Marine Corps' energy goals are to increase the service's overall efficiency by 50% by 2025, and to be able by 2025 to deploy a Marine Corps expeditionary force that can operate self-sufficiently in terms of energy, except for vehicle fuel."	P. 10 "Operational challenges and risks associated with DoD's reliance on fuel relate to: the diversion of resources to the task of moving fuel to the battlefield, the negative impact of fuel requirements on the mobility of US forces and the combat effectiveness of US equipment, and the vulnerability of fuel supply lines to disruption." P. 67 "The operational energy report must also discuss progress on applying energy efficiency measures to logistics support contracts for contingency operations, per Section 315, while Section 342 requires the operational energy report to evaluate practices used in contingency operations to reduce vulnerabilities related to fuel convoys, including improvements in tent and structure efficiency, generator efficiency, and displacement of liquid fuels with on-site renewable generation."	P. 18 "Secretary of the Navy Ray Mabus testified on February 16, 2012, that 'we would be irresponsible if we did not reduce our dependence on foreign oil.'"
14	More capable warfighting through reduced fuel burden		P. ES-6 1. Base investment decisions on the true cost of delivered fuel and on warfighting and environmental benefits. "The task force recommends DoD use the true cost of delivered fuel, rather than the artificially low 'standard price,' when…conducting Assessments of Alternatives for new platforms…and determining total ownership costs." P. 77 3. Provide leadership that incentivizes fuel efficiency throughout the DoD. "Issue a policy memorandum recognizing efficiency at the platform level as an important element of becoming more agile, deployable, sustainable and reducing support costs."	P. ES-6 1. Base investment decisions on the true cost of delivered fuel and on warfighting and environmental benefits. "…there are environmental benefits to improving efficiency, which may have additional operational as well as economic value to the DoD. The DoD should institute a standard practice of conducting assessments comparing the environmental performance of new systems with the systems they replace, with the objective of taking advantage of pollution credits or other available benefits."	P. ES-7 3. Provide leadership that incentivizes fuel efficiency throughout the DoD. "Leadership must begin promoting the message that efficiency at the tactical platform and system level is a clear strategic path to improve performance, reduce logistics burden, …" P. 77 3. Provide leadership that incentivizes fuel efficiency throughout the DoD. "Issue a policy memorandum recognizing efficiency at the platform level as an important element of becoming more agile, deployable, sustainable and reducing support costs."	P. 28 "Fuel efficiency decreases the time required to assemble an overwhelming force."	
15	More Fight - Less Fuel	P. 47 "Overcoming this [the fact that people take energy availability for granted] will require a campaign linking saved energy to national security and strong leadership attention focused on strategy, metrics and accountability." P. 74 "In general, such distributed energy systems, properly designed, should gradually reduce the brittleness and increase the resilience of the nation's energy system, and enhance our national security."				P. 35 "Because DoD faces substantial risks to its missions via grid and other critical infrastructure vulnerability, it must find means to manage these risks." P. 73 "The Renewable Electricity Purchasing and On-Base Development Plan developed in 2004 by the Renewables Assessment Working Group was designed to quickly improve energy reliability and security at installations by working in deregulated states where no utility cooperation is required to make them less vulnerable through islanding, as recommended by the National Research Council."	

ID	Documents	Maximize Security	Minimize Cost	Maximize Environmental Quality	Maximize Capability	Minimize Vulnerability	Minimize Threats
16	Report to Congress on energy security initiatives	P. 21 "Our strategy recognizes the value of energy and puts us on a path to greater energy security."				P. 4 "...Operations Iraqi Freedom and Enduring Freedom have reminded us that energy is tactically relevant, and field commanders are looking to the Department and Services to provide battlefield solutions that reduce vulnerability while increasing capability."	
17	Quadrennial Defense Review Report	P. 111 "To address energy security while simultaneously enhancing mission assurance at domestic facilities, the Department is focusing on making them more resilient."		P. 73 "Energy security and climate change" is listed as an issue			
18	Energy for the warfighter: Operational energy strategy	P. 5 "The mission of the ASD(OEPP) is to promote the energy security of military operations through guidance for and oversight of Department activities and investments."			P. 1 "More capability, less cost: Build energy security into the future force... The Department needs to integrate operational energy considerations into the full range of planning and force development activities. Energy will be, in itself, an important capability for meeting the missions envisioned in the QDR and National Military Strategy."		
19	The national military strategy of the United States of America: Redefining America's military leadership						P. 3 "Energy-state relationships will intersect geopolitical concerns as state-run companies will control an increasing share of the world's hydrocarbon resources and the persistent challenge of resource scarcity may overlap with territorial disputes." We read this to mean that minimizing geopolitical impact of energy consumption should be a strategic objective.
20	Operational energy strategy: implementation plan	P. 7 "Improve Operational Energy Security at Fixed Installations"			Intro says "Our challenge is to make sure US Forces are ready for any threat, anywhere in the world, and meeting that challenge requires us to improve the efficiency of our energy use and the diversity of our energy sources, and, ultimately, to build a military force that uses energy as a strategic advantage rather than bears it as a burden." P. 6 "Strategic Goal: To provide energy security and enhanced warfighting capability for US forces in the future, the Department will consider energy security in strategic planning and force development. To achieve this goal, the Department will incorporate energy security considerations into the requirements and acquisition processes and adapt policy, doctrine, professional military education, and Combatant Command activities."		
21	Sustaining U.S. global leadership: Priorities for 21st century defense						
22	Energy independence and Security Act of 2007: Major provisions of interest to federal energy managers						
23	Transforming the way DoD looks at energy: An approach to establishing an energy strategy (LMI Report FT602T1)	P. iv Identified as an energy actions related to DoD's corporate processes: "Increase global efforts to enhance the stability and security of oil infrastructure, transit lanes, and markets through military-to-military and state-to-state cooperation."	P. iii "DoD seeks to reduce operating costs of the current force to procure new capabilities for the future. But, with increased energy consumption and increased price pressure due to growing global demand for energy, energy-associated operating costs are growing." P. 1-1 "DoD's energy dependence exposes the department to price volatility, forcing it to consume unplanned resources that could be used to recapitalize an aging force structure and infrastructure."	P. iv "In parallel with the increase in the global demand for energy is an increase in concern about global climate change and other environmental considerations. Therefore, when identifying technical solutions to its energy challenges, DoD should also considered a fourth disconnect—environmental." P. 7-7 "More efficient use of energy and the choice of alternative energy options which minimize or mitigate environmental impact will garner the support of the public while acting in concert with national environmental goals."	P. 7-6 "Increasing the energy efficiency of DoD operations has the potential to increase operational flexibility by reducing logistics support requirements, while freeing resources currently dedicated to energy and associated support for recapitalization purposes." P. 7-7 "Incorporating new energy efficient concepts and technologies increases the potential to enhance operational effectiveness through increased reach and agility while reducing the logistics dependence of the force."	P. 6 "Make reducing energy vulnerability a focus area of the next strategic planning cycle and Quadrennial Defense Review."	P. iii "DoD seeks to shape the future security environment in favor of the United States. But, our dependence on foreign supplies of fuel limits our flexibility in dealing with producer nations who oppose or hinder our goals for greater prosperity and liberty." P. 1-1 "DoD shares the nation's reliance on foreign energy sources, which effectively forces the country to rely on potential adversaries to maintain its economy and national security."

ID	Documents	Maximize Security	Minimize Cost	Maximize Environmental Quality	Maximize Capability	Minimize Vulnerability	Minimize Threats
24	Naval energy: A strategic approach			p. 5 (Strategic Approach) and p. 6 & 7 "Reduce Navy's Carbon Footprint"	p. 3 (Vision) "Energy efficiency increases our combat effectiveness" p.5 (Strategic Approach) "The Department of the Navy Energy Strategy establishes a set of aggressive goals to increase combat effectiveness."		
25	The Department of the Navy's energy goals		P. 6 gives an example of a ship that uses an electric motor to power itself at slow speeds, and estimates that it will save the Navy $250M over the lifetime of that ship.	P. 3 "The stakes of status quo extend even further, beyond the military, and cause second and third order effects on the environment. The carbon that's emitted from our ships, aircraft, and vehicles is a contributor to global warming and climate change."	P. 2 "In the drive for energy reform, the goal has got to be increased warfighting capability."		
26	A Navy energy vision for the 21st century	P. 4 "partner closely with other services, government, industry, and academia to strengthen energy security at navy, Joint, and national levels" P. 8 "to lighten the load and expand tactical reach, the maritime community will expand successful technology and operational initiatives, complete testing and evaluation of quick win solutions, and cultivate game-changing technologies for a next navy with substantially increased energy efficiency and improved energy security." P. 15 "partnerships with local utility providers will address common challenges in advancing the deployment of alternative energy and energy security strategies."		P. 11 Strategic Imperative: Green the Footprint "The DOD recently announced the target of a 34 percent reduction in greenhouse gas emissions from a 2008 baseline by 2020. The Navy will pursue this target without compromising core capabilities. Investments in energy efficiency and alternative energy naturally reduce greenhouse gas emissions."	P. 3 "Long-term cost avoidance and reduced reliance on fossil fuels through alignment, standardization, and more efficient operations ashore represent an investment in protection and warfighting capability." P. 5 "In the near-term, the Navy will make significant gains by adjusting policies to enable more energy efficient operations, encouraging awareness and energy-conscious behavior in every Navy setting, optimizing existing technologies to reduce energy consumption, and speeding the implementation of new technologies, all with the intent of enhancing or enabling greater combat readiness."		
27	Energy evaluation factors in the acquisition process [Memorandum]		P. 2 "For all DON platforms and weapons systems that consume energy... ensure that FBCE calculations are included in program planning and specifically in the AoA phase to inform system trade-off decisions and to differentiate between competing systems."				
28	Department of the Navy (DON) objectives for FY 2012 and beyond [Memorandum]			Obj. 3. Lead the Nation in Sustainable Energy d. Advance clean energy			
29	Shore energy management (OPNAV Instruction 4100.5E)	P. 2 "To increase shore energy security, Navy shall: (1) Provide reliable, resilient, and redundant mission-critical energy sources to Navy tier I and II task critical assets (TCA) ashore, per references (a), (h) and (i). (2) Reduce vulnerabilities tied to the electrical grid, including outages from natural disaster, accident, and physical and cyber attack, by lowering energy dependence and integrating energy security technologies which enable greater control of energy supply and distribution, per reference (j)."		P. 3 "Reduce greenhouse gas emissions." (this is within "achieve legal compliance for shore energy and sustainability")		P. 2 "Reduce vulnerabilities tied to the electrical grid, including outages from natural disaster, accident, and physical and cyber attack, by lowering energy dependence and integrating energy security technologies which enable greater control of energy supply and distribution..."	
30	Reenergizing America's defense: How the armed forces are stepping forward to combat climate change and improve the U.S. energy posture		P. 8 "The military's dependence on fossil fuels also has significant financial and budgetary implications. Unexpectedly high oil prices and overreliance on petroleum fuels threaten to divert funds from military operations and procurement, compounding the difficult choices in defense budgeting."				

ID	Documents	Maximize Security	Minimize Cost	Maximize Environmental Quality	Maximize Capability	Minimize Vulnerability	Minimize Threats
31	Air Force energy program policy memorandum [Memorandum]		P. 5 "The Air Force uses energy awareness to keep all personnel focused on energy conservation and efficiency to reduce energy costs."	P. 10 "...where possible, the Air Force will use renewable or green energy to reduce greenhouse gas emissions."			
32	Air Force acquisition & technology energy plan		P. 2 "...the Acquisition and Technology Working Group is charged with developing energy options that increase warfighting capabilities through utilizing reliable alternative energy resources, enhancing energy efficiency, and reducing life cycle costs associated with Air Force acquisitions." P. 2 "...the Acquisition and Technology Working Group is charged with developing energy options that increase warfighting capabilities through utilizing reliable alternative energy resources, enhancing energy efficiency, and reducing life cycle costs associated with Air Force acquisitions."	P. 2 "...since the Air Force purchases fewer new platforms, additional emphasis will need to be placed on technologies that reduce fuel consumption and greenhouse gas emissions, while maintaining or increasing weapon system capabilities in the legacy fleet." P. 7 section 3 is entitled "Reducing Fuel Burn and Greenhouse Gas Emissions in Legacy Systems" P. 8 lists/shows 4 pillars of Acquisition and Technology Energy Plan; 4th one has to do with increasing alternative fuels to increase supply and reduce greenhouse gas emissions	P. 2 "...since the Air Force purchases fewer new platforms, additional emphasis will need to be placed on technologies that reduce fuel consumption and greenhouse gas emissions, while maintaining or increasing weapon system capabilities in the legacy fleet."		
33	Air Force aviation operations energy plan		P. 5 "Aviation operations account for the bulk of the fuel used by the Air Force and rising energy costs are consuming a larger percentage of the Air Force's annual budget. Therefore, fuel efficiency must be incorporated into the standard operating procedures of Air Force aviation operations as a higher priority." P. 17 Pillar 4: Maximize the Use of Technology for Fuel Efficiency "The Air Force mission requires range and persistence in aircraft. To accomplish this, the Air Force must reduce fuel costs and explore technological solutions to increase fuel efficiency."			P. 4 "Aviation operational readiness is contingent upon energy availability, and thus the Air Force must employ comprehensive energy management strategies to minimize energy-related vulnerabilities."	
34	Air Force energy plan	P. 1 "The Air Force is committed to increasing the amount of energy supplies available to enhance our nation's energy security."	P. 9 "The Air Force needs to provide options to manage financial and operational challenges generated by the cost and availability of oil and other forms of energy." P. 22 Overarching goal: Explore, Identify & Analyze Best Financing Approaches (Innovative Financing Advisory Working Group)	P. 17 "The Air Force is identifying alternative sources of energy to reduce the impact of energy use on the environment and is pledging support to achieve DoD and Air Force environmental goals." P. 25 Energy Focus Area: carbon emissions reduction		P. 9 "Enhancements in operational efficiencies will not only save energy and money, but can also extend the lifespan of equipment and reserves of energy supplies, thus reducing the vulnerabilities associated with replenishing our forces and equipment during operational endeavors."	P. 18 Overarching goal: Interoperability with Partner Nation Air Forces (International Working Group) P. 26 Energy Focus Area: energy security, also international energy landscape "The Air Force Energy Plan incorporates energy security considerations to mitigate against energy supply disruptions. The United States is heavily dependent on foreign oil, much of which originates out of politically unstable and volatile regions of the world. Reducing domestic demand of foreign oil by improving energy efficiency and developing domestic energy supplies will enhance the national security of the United States." "To mitigate against energy supply disruptions and to reduce the leverage of countries adverse to U.S. strategic interests, the U.S. will need to simultaneously decrease demand for foreign oil while increasing domestic energy production capabilities."

ID	Documents	Maximize Security	Minimize Cost	Maximize Environmental Quality	Maximize Capability	Minimize Vulnerability	Minimize Threats
35	Air Force infrastructure energy plan		P. 4-5 Consumption and cost trends – although consumption is decreasing, cost is increasing. "Fuel costs have also dramatically increased since FY2003. Since this time, total Air Force ground fuel cost has increased 173 percent despite a 9 percent decrease in total ground fuel consumption over the same period." P. 16 Pillar 4: Manage Cost	P. 2 "The Air Force is committed to reducing its greenhouse gas emissions and carbon footprint through the reduced use of fossil fuels consumed directly through vehicles and facilities or indirectly through the consumption of fossil fuel–generated electricity from the national electrical grids." P. 6 "The Air Force will aggressively seek ways to use new and improved technologies to meet its strategic energy goals, while reducing its carbon footprint and our vulnerabilities to commercial sources of supply."		P. 6 "The Air Force will aggressively seek ways to use new and improved technologies to meet its strategic energy goals, while reducing its carbon footprint and our vulnerabilities to commercial sources of supply."	
36	U.S. Air Force energy strategic plan	P. 25 "Our objective is to develop an integrated master plan by 2015 that optimizes function, security, and efficiency, placing a high priority on energy resiliency and uninterrupted energy and water supplies."	P. 2 "By improving the efficiency of our processes, operations, facilities, and equipment, we increase our effectiveness and generate cost savings."	P. 3 "By reducing our energy consumption and increasing our use of renewable energy, we improve our energy security and reduce greenhouse gas emissions in support of U.S. climate policy initiatives."		P. 25 "Excess power generated during the day or night from renewable sources would be stored and used during high demand periods, and the installation would rely on distributed sources of energy to reduce single point vulnerabilities and rely on energy from the main grid as backup—not the other way around."	
37	35th Commandant of the Marine Corps Commandant's planning guidance						
38	Marine Corps vision and strategy 2025: Implementation planning guidance	P. 6 "The Marine Corps' unique contribution to national defense is its role as the Nation's force in readiness, able to respond rapidly and decisively to crises anywhere in the world."		p. 27 "Also, the Marine Corps will remain responsible stewards of the natural and cultural resources aboard our installations through positive and effective environmental management. Our bases will follow best practices to ensure effectiveness and efficiency. To this end, energy conservation will be a matter of focus to reflect innovative Marine Corps environmental stewardship."			
39	United States Marine Corps expeditionary energy strategy and implementation plan: Bases to battlefield	P. 26 "The National Defense Authorization Act of 2009 and DoD guidance place increasing emphasis on energy security and include directives for operational energy management, planning, requirements development, and acquisition." P. 34 "We will provide commanders the data they need to reinforce awareness, education, and training to increase efficiency, increase energy security, and lower lifecycle operating costs."			P. 17 "Vision – To be the premier self-sufficient expeditionary force, instilled with a warrior ethos that equates the efficient use of vital resources with increased combat effectiveness."		

ID	Document	Maximize Security	Minimize Cost	Maximize Environmental Quality	Maximize Capability	Minimize Vulnerability	Minimize Threats
40	Exec. Order No. 13423						
41	Exec. Order No. 13514			§2(a)(iii)(A). Use low-GHG-emitting vehicles. §2(b)(i). Pursue opportunities with vendors and contractors to reduce GHG emissions.			
42	National security strategy	P. 6 "...our national security strategy must be informed by our people, enhanced by the contributions of the Congress, and strengthened by the unity of the American people." P. 18 "By doing so, we will enhance energy security, create jobs, and fight climate change." P. 41 "U.S. leadership in the G-20 will be focused on securing sustainable and balanced growth, coordinating reform of financial sector regulation, fostering global economic development, and promoting energy security."		P. 10 "We must transform the way that we use energy--diversifying supplies, investing in innovation, and deploying clean energy technologies. By doing so, we will enhance energy security, create jobs, and fight climate change." P. 30 "We must continue to transform our energy economy, leveraging private capital to accelerate deployment of clean energy technologies that will cut greenhouse gas emissions, improve energy efficiency, increase use of renewable and nuclear power, reduce the dependence of vehicles on oil, and diversify energy sources and suppliers. We will invest in research and next-generation technology, modernize the way we distribute electricity, and encourage the usage of transitional fuels, while moving towards clean energy produced at home."			P. 30 "As long as we are dependent on fossil fuels, we need to ensure the security and free flow of global energy resources."
43	Blueprint for a secure energy future		P. 5 "One of the best ways to make our economy less dependent on oil--and save consumers money--is simply to make our transportation more efficient."	P. 3 "We must focus on expanding cleaner sources of electricity, including renewables like wind and solar, as well as clean coal, natural gas, and nuclear power..." More about this on P. 10, 11, 13 -- oversight, effectiveness of regulatory structure, environmental impact of fracking...	P. 5 "One of the best ways to make our economy less dependent on oil--and save consumers money--is simply to make our transportation more efficient."		P. 17 Building strategic relationships with oil producers and promoting energy efficiency abroad are both listed as major bullets in the "moving forward" section
44	Energy program for security and independence	p. 2 "Energy Security is achieved by utilizing sustainable sources that meet tactical, expeditionary, and shore operational requirements and force sustainment functions, and having the ability to protect and deliver sufficient energy to meet operational needs."	not mentioned as an objective, but included in many initiatives, including processes that require consideration of energy costs (p. 12)	p. 6 "Existing statutes and executive orders require reductions in... greenhouse gas emissions." p. 11 "DON will reduce greenhouse gas emissions and other environmental impacts associated with Naval energy consumption"	not explicitly stated as an objective, but implicitly connected to energy, p. 21 "aggressive energy policy and leadership will improve the combat and operational effectiveness of Naval forces"	p. 9 "reducing the operational risks posed by excessive platform energy demand and vulnerable energy supply lines"	

Table A3: Quotes referring to implementation-level objectives, by document

ID	Document	Maximize Assurance	Minimize Attrition	Minimize Logistic Requirements	Maximize Nonfossil Sources	Minimize Consumption	Maximize Motivation
1	Sustain the mission. Secure the future. The Army strategy for the environment			P. 8 "The Army will employ sustainable practices such as water conservation and fuel and energy efficiency to minimize our logistical tail."			P. 8 "Foster and effect within the Army that takes us beyond environmental compliance to sustainability."
2	Army energy security implementation strategy	P. ii ESG 4. Assured access to sufficient energy supplies (elaborated on p. 4)		P. I " ...lower tactical fuel demands would place fewer Soldiers in harm's way during their support of the long logistical fuel tail in theater." Also see p. 1.	P. ii ESG 3. Increased use of renewable/alternative energy (elaborated on p. 4)	P. I " ...increasing efficiencies and lowering corporate demand for energy would save money for the Army and free up both fiscal and personnel resources." P. I " ...lower tactical fuel demands would place fewer Soldiers in harm's way during their support of the long logistical fuel tail in theater." P. ii ESG 1. Reduced energy consumption (elaborated on p. 4)	
3	Energy security: Army priority and national imperative [Presentation slides]				P. 43 S&T Strategy for Power and Energy -Provide energy options (e.g., alternative fuels, solar) -Reduce fossil fuel and battery demand	P. 43 S&T Strategy for Power and Energy -Reduce platform energy consumption – lightweight materials, lower power electronics, and unmanned vs. manned platforms -More efficient power sources – batteries with higher energy/power density, fuel cells, hybrid power sources -Reduce fossil fuel and battery demand	
4	Use of the Army's Strategic Management System (SMS) to track Army Energy Security Implementation Strategy (AESIS) performance [Information Paper]						
5	Army energy enterprise [Information Paper]	ESG 4. Assure access to sufficient energy supplies.		P. 1 "Energy Security is an Operational Imperative and can provide the Army with a tactical advantage… The long liquid fuel logistical tail poses risks to contingency operations and makes deployed Army forces vulnerable."	P. 1 "The Army Energy Security Mission is to ensure energy is a key consideration for all Army activities to reduce demand, increase efficiency, seek alternative sources, and create a culture of energy accountability while sustaining or enhancing operational capabilities." ESG 3. Increase use of renewable/alternative energy supplies.	P. 1 "The Army Energy Security Mission is to ensure energy is a key consideration for all Army activities to reduce demand, increase efficiency, seek alternative sources, and create a culture of energy accountability while sustaining or enhancing operational capabilities." ESG 1. Reduce energy consumption.	P. 1 "The Army Energy Security Mission is to ensure energy is a key consideration for all Army activities to reduce demand, increase efficiency, seek alternative sources, and create a culture of energy accountability while sustaining or enhancing operational capabilities."
6	Supporting the mission with operational energy [Memorandum]						
7	The proposed change strategy to embed energy stewardship into the Army's culture						P. 4 "What is needed is a command-led initiative focused on changing how members view and use energy (culture), which will result in lasting behavior change… Furthermore, the proposed change in culture to energy stewardship provides an opportunity to synchronize all Army energy initiatives under one comprehensive organization change strategy."
8	Department of Defense energy strategy: Teaching an old dog new tricks	P. 30 "The DoD needs an Energy Strategy that… • Ensures access to critical energy requirements"		P. 20 "Implications of the Problem - Vulnerability" See col Q for definition of vulnerability. Oil, electricity, foreign policy, mentions critical infrastructure, too.	P. 45 "This will certainly not eliminate US dependence on foreign oil, but is comparable to a double or triple in the George Shultz baseball analogy cited at the beginning of this chapter. Subsequent actions, such as proving the economic viability of synfuels, or improving upon FT process could "bring these runners home" and further expand domestically produced energy supplies." P. 49 "Renewable energy diversifies energy sources and provides cost effective, environmentally responsible energy to DOD facilities."	P. 38 Reduce demand by increasing platform efficiency – in the case of aviation, modify or re-engine planes	P. 34 Section about leadership and culture change – referring to organizational culture P. 36 "There is little current incentive for DOD personnel to reduce energy consumption. In fact, there are disincentives in place. Most military leaders quickly learn that a 'can do without' attitude is a sure way to lose money or personnel… Commanders should monitor energy consumed at their facilities and set goals for reduction. Energy savings should be rewarded, and excessive consumption should be investigated and corrected."
9	Feeling the "balance": A defense energy strategy primer				P. 1 "The path to continued readiness requires reducing the overall amount of energy that the Department of Defense (DoD) uses and increasingly turning to alternative energy sources to meet fuel needs."	P. 1 "The path to continued readiness requires reducing the overall amount of energy that the Department of Defense (DoD) uses and increasingly turning to alternative energy sources to meet fuel needs." P. 2 "...this effort [to reduce consumption] can be accomplished without reduction of military capability in the resulting force. Indeed, pursuing lower energy consumption and petroleum dependency will ultimately increase the combat and sustainment capabilities of the DoD."	
10	Energy Policy Act of 2005						

ID	Documents	Maximize Assurance	Minimize Attrition	Minimize Logistic Requirements	Maximize Use of Non-Fossil Fuel Sources	Minimize Consumption	Maximize Motivation
11	Duncan Hunter National Defense Authorization Act for Fiscal Year 2009	p. 34 (a) ROADMAP REQUIRED.—The Secretary of Defense, acting through the Director of Defense Research and Engineering, the Deputy Under Secretary of Defense for Industrial Policy, and service acquisition executives, shall, in coordination with the Secretary of Energy, develop a multi-year roadmap to develop advanced energy storage technologies and sustain domestic advanced energy storage technology manufacturing capabilities and an assured supply chain necessary to ensure that the Department of Defense has assured access to advanced energy storage technologies to support current military requirements and emerging military needs.		It does call for "Consideration of fuel logistics support requirements" (section 332, P. 66) and "a comprehensive technical and operational risk assessment ... " and more words on risk (section 335, P. 68)	P. 67 Specifically authorizes a "Study on solar and wind energy for use for expeditionary forces" plus synthetic fuels...		
12	National Defense Authorization Act for Fiscal Year 2013						
13	Department of Defense energy initiatives: background and issues for Congress (CRS: R42558). Washington, DC: Congressional Research Service, Library of Congress.	P. 10 "Operational challenges and risks associated with DoD's reliance on fuel relate to: the diversion of resources to the task of moving fuel to the battlefield, the negative impact of fuel requirements on the mobility of US forces and the combat effectiveness of US equipment, and the vulnerability of fuel supply lines to disruption."		P. 7 "[The FBCF] is intended to be used in the acquisition process as a factor in selecting new equipment, and to illustrate potential systems' logistical footprints."	P. 18 One of the Navy's goals: "Lead the nation in sustainable energy." Discusses use of alternative fuels, biofuels P. 21 "The Army's operational energy efforts focus on reducing energy demand, increasing fuel efficiency, and increasing the use of alternative and renewable energy." P. 28 "Developing a domestic advanced biofuels industry will improve the Navy's (and the nation's) energy security by diversifying the Navy's (and the nation's) sources of energy."	P. 21 "The Army's operational energy efforts focus on reducing energy demand, increasing fuel efficiency, and increasing the use of alternative and renewable energy."	
14	More capable warfighting through reduced fuel burden			P. ES-7 3. Provide leadership that incentivizes fuel efficiency throughout the DoD. "Leadership must begin promoting the message that efficiency at the tactical platform and system level is a clear strategic path to improve performance, reduce logistics burden, ..."		P. ES-8 5. Explicitly include fuel efficiency in requirements and acquisition processes. "Efficiency is a strong component of agility. However, in order for US forces to become more agile and efficient, these qualities must be translated into quantifiable and measurable performance criteria and inserted into the requirements determination processes."	
15	More Fight - Less Fuel	P. 66 "Recommendation #2: Reduce the risk to critical missions at fixed installations from loss of commercial power and other critical national infrastructure."			P. 69 "Recommendation #4: Invest in energy efficient and alternative energy technologies to a level commensurate with their operational and financial value."		P. 65 "DoD must change its energy culture to value efficiency." (this is within finding #5, "there are many ways to reduce energy demand by changing wasteful operational practices and procedures")

ID	Documents	Maximize Assurance	Minimize Attrition	Minimize Logistic Requirements	Maximize Use of Non-Fossil Fuel Sources	Minimize Consumption	Maximize Motivation
16	Report to Congress on energy security initiatives	P.9 Goal 2: Assure Supply		P. 2 "From the Departmental force planning perspective, greater energy efficiency in the force provides the option of either reducing the size of the fuel logistics force structure (move people and investment from the "tail" to the "tooth"), or maintaining more reserve logistics capacity to reduce certain future operational risks."		P. 5 Goal 1: Reduce Demand	P. 1 "Like the nation, DoD must focus on reducing demand through culture change and increased efficiency."
17	Quadrennial Defense Review Report				P. 88 "... vision of deploying a 'green' carrier strike group using biofuel and nuclear power by 2016."		
18	Energy for the warfighter: Operational energy strategy	P. 1 "... the goal ...is to ensure that the armed forces will have the energy resources they require to meet 21st century challenges." P. 1 "More options, less risk: Expand and secure the supply of energy to military operations... The Department needs to diversify its energy sources and protect access to energy supplies in order to have a more reliable and assured supply of energy for military missions." P. 8 "...the Department needs to take steps to improve the security of the energy supply to operational missions at fixed installations, particularly electricity supplies."			P. 1 "More options, less risk: Expand and secure the supply of energy to military operations... The Department needs to diversify its energy sources and protect access to energy supplies in order to have a more reliable and assured supply of energy for military missions." p. 8 "In the long term, alternative fuels have the potential to be an important part of the Nation's energy landscape, and the Department should be prepared to leverage this development through continued RDT&E of alternative fuels."	P. 1 "More fight, less fuel: Reduce the demand for energy in military operations... Reduce the overall demand for operational energy, improve the efficiency of military energy use in order to enhance combat effectiveness, and reduce military mission risks and costs." P. 5 "Reducing the demand for energy must be the most immediate operational energy priority for the Department. In terms of effectiveness, force protection, and cost, a reduced fuel demand in the battlespace means tactical, operational, and strategic benefits."	P. 6 "The DoD Components must invest in new technologies and equipment but also in new practies and behaviours."
19	The national military strategy of the United States of America: Redefining America's military leadership						
20	Operational energy strategy: implementation plan	P. 5 "Strategic Goal: The Department will diversify and secure military energy supplies in order to improve the ability of US Forces to obtain the energy required to perform their missions. To achieve this goal, the Department will identify and remediate energy-related risks to critical assets and establish a Departmental policy for alternative fuels."			Intro says "...meeting that challenge requires us to improve the efficiency of our energy use and the diversity of our energy sources..." P. 5 "Strategic Goal: The Department will diversify and secure military energy supplies in order to improve the ability of US Forces to obtain the energy required to perform their missions. To achieve this goal, the Department will identify and remediate energy related risks to critical assets and establish a Departmental policy for alternative fuels."	P.1 "The Department needs to improve its ability to measure operational energy consumption, reduce demand, and increase the efficiency of energy use to enhance combat effectiveness." (this is one difference from the OES itself) p. 3 "Strategic Goal: The Department will reduce the overall demand for operational energy and improve the efficiency of military energy use in order to enhance combat effectiveness and reduce risks and costs for military missions. To achieve this...the Department will measure its operational energy consumption; improve energy performance in operations and training;, and promote defense energy innovation."	
21	Sustaining U.S. global leadership: Priorities for 21st century defense						
22	Energy Independence and Security Act of 2007: Major provisions of interest to federal energy managers						
23	Transforming the way DoD looks at energy: An approach to establishing an energy strategy (LMI Report FT602T1)			P. iii "DoD's operational concepts seek greater mobility, persistence, and agility for our forces. But, the energy logistics requirements of these forces limit our ability to realize these concepts."	P. 1-2 "...recent technological advances in energy efficiency and alternative energy technologies offer a unique opportunity for DoD to make progress toward reconciling its strategic goals with its energy requirements through reduced consumption of fuel— especially foreign fuel." P. 7-7 "More efficient use of energy and the choice of alternative energy options which minimize or mitigate environmental impact will garner the support of the public while acting in concert with national environmental goals."		

ID	Documents	Maximize Assurance	Minimize Attrition	Minimize Logistic Requirements	Maximize Use of Non-Fossil Fuel Sources	Minimize Consumption	Maximize Motivation
24	Naval energy: A strategic approach	p. 5 (Strategic Approach) "The goals call for… securing critical infrastructure."	p. 6 (Tactical Energy Security) "This reduces exposure to attacks on supply lines, saving lives, equipment , and money."	p. 6 (Tactical Energy Security) "Tactical energy security is protection from vulnerabilities related to the energy requirements of tactical platforms by reducing risk associated with a logistics tail…" "The expeditionary community will work toward lightening the load…"	p. 5 (Strategic Approach) "increase alternative fuel" and "increase reliable and renewable energy"	p. 5 (Strategic Approach) "Reduce tactical fuel consumption." "Reduce shore energy consumption" "increase tactical fuel efficiency" and "increase shore energy efficiency"	
25	The Department of the Navy's energy goals			P. 2 "…fossil fuel consumption has a deep impact upon our forces and our force structure, both in terms of the resources required to get fuel and to move it to the ships, tanks, aircraft, and equipment that need it, and in the Sailors and Marines whose duty it is to protect the ships or convoys moving the gas. We do not have operational independence and we are tied to a vulnerable logistics tail."	Intro says "Increase alternative energy ashore: By 2020, DON will produce at least 50% of shore-based energy requirements from alternative sources; 50% of DON installations will be net-zero."		
26	A Navy energy vision for the 21st century	P. 3 "Energy efficiency, viable alternative energy sources, and smart grid technology for use on-base are key to securing critical infrastructure from an energy standpoint." P. 5 Strategic Imperative: Assure Mobility and Protect Critical Infrastructure			P. 2 "Non-petroleum fuels produced domestically, continued development of alternative power sources, and attention to increasing efficiency and managing total consumption will have a transformative impact on energy security for the Navy and the Nation." P. 5-7 Discusses progress on alternative fuel research, goals for 2016 and 2020…	P. 5 "In the near-term, the Navy will make significant gains by adjusting policies to enable more energy efficient operations, encouraging awareness and energy-conscious behavior in every Navy setting, optimizing existing technologies to reduce energy consumption, and speeding the implementation of new technologies, all with the intent of enhancing or enabling greater combat readiness." P. 7 "As the Navy looks to alternative liquid fuels for tactical platforms, the Department of the Navy is also dramatically reducing the consumption of fossil fuels by the non-tactical vehicle fleet by reducing the number of vehicles, purchasing or leasing more efficient vehicles, and converting the majority of the fleet to alternative fuel vehicles." P. 8 "The Navy must take a two-pronged approach by aggressively pursuing initiatives that increase fuel efficiency and reduce overall fuel consumption afloat while maintaining or enhancing our ability to fight."	P. 5 "In the near-term, the Navy will make significant gains by adjusting policies to enable more energy efficient operations, encouraging awareness and energy-conscious behavior in every Navy setting, optimizing existing technologies to reduce energy consumption, and speeding the implementation of new technologies, all with the intent of enhancing or enabling greater combat readiness." P. 15 Enablers for the success of the Energy Vision and Strategy: leadership, technology, policy, strategic partnerships, and culture change. "Whether uniformed or civilian, officer or enlisted, every individual must contribute to a culture that values energy as a strategic resource."
27	Energy evaluation factors in the acquisition process [Memorandum]						
28	Department of the Navy (DON) objectives for FY 2012 and beyond [Memorandum]				Obj. 3. Lead the Nation in Sustainable Energy a. Increase alternative energy Navy-wide b. Sail the Great Green Fleet d. Advance clean energy		
29	Shore energy management (OPNAV Instruction 4100.5E)	P. 2 "Ensure energy security as a strategic imperative." 2 parts: provide reliable, resilient, and redundant mission-critical energy sources and reduce vulnerabilities tied to the electrical grid.			P. 2 "Reduce consumption of fossil fuel and increase the use of alternative fuels by the Navy's non-tactical vehicle fleet." P. 3 "Produce, procure, and consume renewable energy." (these are within "achieve legal compliance for shore energy and sustainability")	P. 2 "Achieve a 30% facility energy intensity reduction by 2015." (this is within "achieve legal compliance for shore energy and sustainability")	
30	Reenergizing America's defense: How the armed forces are stepping forward to combat climate change and improve the U.S. energy posture			P. 7 "Operationally, modern deployments create heavy logistical requirements such as fuel convoys—the "long tail," in military parlance—that impose costs, burdens and risks to operational effectiveness and the safety of military personnel."			

ID	Documents	Maximize Assurance	Minimize Attrition	Minimize Logistic Requirements	Maximize Use of Non-Fossil Fuel Sources	Minimize Consumption	Maximize Motivation
31	Air Force energy program policy memorandum [Memorandum]				P. 6 AF Energy Strategy. "Increase Supply: By researching, testing, and certifying new technologies, including renewable, alternative, and traditional energy sources, the Air Force can assist in creating new domestic supply sources." P. 10 "The Air Force is committed to increasing the amount of energy supplies available to become more energy independent. Energy independence reduces the amount of energy required from foreign sources and where possible, the Air Force will use renewable or green energy to reduce greenhouse gas emissions."	P. 6 AF Energy Strategy. "Reduce Demand: Increase our energy efficiency through conservation and decreased usage, and increase individual awareness of the need to reduce our energy consumption." P. 9 "The Air Force is committed to reducing aviation, ground fuel, and installation energy demand."	P. 5 "The overarching vision of the Air Force Energy Initiative is 'Make Energy a Consideration in All We Do.'" P. 6 AF Energy Strategy. "Culture Change: The Air Force must create a culture where all Airmen make energy a consideration in everything they do, every day."
32	Air Force acquisition & technology energy plan				P. 2 "...the Acquisition and Technology Working Group is charged with developing energy options that increase warfighting capabilities through utilizing reliable alternative energy resources, enhancing energy efficiency, and reducing life cycle costs associated with Air Force acquisitions." P. 4 lists increased availability goals wrt alternative fuels P. 8 lists/shows 4 pillars of Acquisition and Technology Energy Plan, 4th one has to do with increasing alternative fuels to increase supply and reduce greenhouse gas emissions	P. 1 The AF Energy Plan is built upon 3 goals: -Reduce Demand -Increase Supply -Culture Change P. 2 "...since the Air Force purchases fewer new platforms, additional emphasis will need to be placed on technologies that reduce fuel consumption and greenhouse gas emissions, while maintaining or increasing weapon system capabilities in the legacy fleet." P. 4 lists specific fuel reduction goals P. 7 section 3 is entitled "Reducing Fuel Burn and Greenhouse Gas Emissions in Legacy Systems," and 3 of the 4 pillars described in the Acquisition and Technology Energy Plan for legacy fielded systems have to do with this	P. 1 The AF Energy Plan is built upon 3 goals: Reduce Demand Increase Supply -Culture Change
33	Air Force aviation operations energy plan	P. 1 "Energy is a mission-critical component of aviation operations and, as such, must be managed to ensure sustained mission readiness and responsiveness on a global scale." P. 4 "Aviation operational readiness is contingent upon energy availability, and thus the Air Force must employ comprehensive energy management strategies to minimize energy-related vulnerabilities...The Air Force can work to increase energy security through strategic resilience by shifting reliance toward alternative and renewable sources of energy; reducing dependence on non-assured sources of oil; stabilizing and reducing the Air Force's operational energy demand; and leveraging efforts by other organizations, such as federal agencies, industry, academia, and the international community."			P. 7 "Alternative fuel use will increase by 10% per year..." P. 10 Pillar 1: Provide Leadership in Energy Management, Objective 1.2 -- Facilitate renewable energy and energy efficiency initiatives P. 13 Pillar 2: Fly and Operate Efficiently, Objective 2.4 -- Increase the use of alternatively powered ground equipment/vehicles	P. 1 "As the largest consumer of fuel in the Department of Defense (DoD), the Air Force must ensure that it optimizes energy efficiencies and conservation initiatives across the chain of command." P. 13 Pillar 2: Fly and Operate Efficiently, Objective 2.2 -- Optimize fuel loads for each mission "Optimizing fuel loads on aircraft can reduce fuel dump frequencies and represent a significant potential for fuel conservation."	P. 3 Mentions an "Aviation Fuel Optimization Culture" memo from 2006 P. 4 "By integrating demand-side energy efficiency measures alongside supply-side alternative energy sources, the Air Force will fundamentally change the way it manages energy by encouraging a culture of energy responsibility." P. 8 "Changing the Air Force culture is critical to achieving the Air Force's Vision to 'Make Energy a Consideration in All We Do.'" P. 15 Pillar 3: Instill Energy Awareness Across Aviation Operations (all objectives relate to culture change)
34	Air Force energy plan	P. 19 "The CIP needs to determine what supporting infrastructure (e.g., oil tanks, petroleum pipelines, electrical grids, etc.) is critical in directly supporting military operations." "The Air Force is actively participating in DoD's Working Groups to develop risk mitigation strategies and other responses to protect critical infrastructure." P. 20 Overarching goal: Ensure Availability of Mission-Critical Assets & Infrastructure (Critical Infrastructure Program Advisory Working Group) P. 25 "An assured supply of fuel is critical to sustaining the mission of air superiority, support, and global reach."			Increase supply... P. 17 "The International Energy Plan supports the Air Force Energy Plan by engaging foreign partners in energy partnerships to achieve three main goals: achieve interoperability between air forces as alternative fuel use increases, gain access to global energy technology and best practices, and create a culture among global air forces to address common energy concerns cooperatively." "The Air Force is identifying alternative sources of energy to reduce the impact of energy use on the environment and is pledging support to achieve DoD and Air Force environmental goals." P. 25 Energy Focus Area: alternative fuels, also renewable energy development and deployment	Reduce demand... P. 26 Energy Focus Area: forward operating bases "Minimizing the distance and time travel requirements of AF missions can lead to enhanced responsiveness and reduce energy consumption rates."	Culture change... P. 13 info about culture change working group "Instilling energy awareness across the Air Force is a cornerstone goal of the Culture Change Working Group." P. 14 "Successful implementation of the Air Force Energy Plan is predicated on a culture change whereby Air Force members embrace saving energy as being part of their core competencies." P. 15 Overarching goal: Instill Energy Awareness as Part of Air Force Culture P. 17 "The International Energy Plan supports the Air Force Energy Plan by engaging foreign partners in energy partnerships to achieve three main goals: achieve interoperability between air forces as alternative fuel use increases, gain access to global energy technology and best practices, and create a culture among global air forces to address common energy concerns cooperatively." P. 26 Energy Focus Area: communication ("...will build the foundation for a culture that will continuously reduce energy consumption and identify ways to use energy wisely across AF operational areas."), also model energy base initiative

ID	Documents	Maximize Assurance	Minimize Attrition	Minimize Logistic Requirements	Maximize Use of Non-Fossil Fuel Sources	Minimize Consumption	Maximize Motivation
35	Air Force infrastructure energy plan	P. 4 "Energy must be included in Air Force Critical Infrastructure Program plans, studied during Vulnerability Assessments, exercised during base response activities, and, ultimately, incorporated into full-spectrum operational planning to fully observe and consider the potential deleterious effects."			P. 1 "Our Air Force vision is to reduce demand through conservation and efficiency, increase supply through alternative energy sources, and create a culture where all airmen make energy a consideration in everything we do." P. 6 "The Air Force will aggressively seek ways to use new and improved technologies to meet its strategic energy goals, while reducing its carbon footprint and our vulnerabilities to commercial sources of supply." P. 8 Figure shows infrastructure energy plan, 1 pillar of which is to expand renewables P. 11 Pillar 1: Improve Current Infrastructure, Objective 1.9 – Purchase 100% of alternative/flex-fuel vehicles for LDVs or LSVs (specifics on P. 12, similar goal for future infrastructure on P. 13) P. 15 Pillar 3: Expand Renewables	P. 1 "Our Air Force vision is to reduce demand through conservation and efficiency, increase supply through alternative energy sources, and create a culture where all airmen make energy a consideration in everything we do." P. 11 Pillar 1: Improve Current Infrastructure, Objective 1.10 – Reduce fossil fuel consumption in vehicles (specific amount on P. 12, similar goal for future infrastructure on P. 13)	P. 1 "Our Air Force vision is to reduce demand through conservation and efficiency, increase supply through alternative energy sources, and create a culture where all airmen make energy a consideration in everything we do." P. 19 "Making energy a consideration in all we do requires cultural change and the modifications in behavior and attitude that accompany it. Our strategy for enhancing energy awareness includes four key elements: -Education and Training; -Awards and Incentives -Strategic Communication -Strategic Partnerships"
36	U.S. Air Force energy strategic plan	P. 1 "Transforming the way we use energy--including investing in innovation, and building an energy secure force--is critical to ensuring the Air Force is equipped to sustain the mission priorities of today while planning for the challenges of the future." P. 2 "As it strives to achieve its vision, the AF is integrating energy considerations across the AF enterprise by focusing on 4 priorities: Improve Resiliency, Reduce Demand, Assure Supply, and Foster an Energy Aware Culture." P. 8 "The Air Force Energy Vision is to sustain an assured energy advantage in air, space, and cyberspace."		P. 7 "In expeditionary operations, energy can be a significant vulnerability where the logistics chain for fuel and water remains open to disruption and attack. To address these vulnerabilities, the Air Force is pursuing resilient and reliable energy supplies, improving energy and water efficiency, and diversifying the types of energy in supply chains."	P. 3 "By reducing our energy consumption and increasing our use of renewable energy, we improve our energy security and reduce greenhouse gas emissions in support of U.S. climate policy initiatives."	P. 2 "As it strives to achieve its vision, the AF is integrating energy considerations across the AF enterprise by focusing on 4 priorities: Improve Resiliency, Reduce Demand, Assure Supply, and Foster an Energy Aware Culture." P. 2 "Our approach to energy also includes reducing our consumption of water, as the two are inextricably tied."	P. 2 "As it strives to achieve its vision, the AF is integrating energy considerations across the AF enterprise by focusing on 4 priorities: Improve Resiliency, Reduce Demand, Assure Supply, and Foster an Energy Aware Culture."
37	35th Commandant of the Marine Corps Commandant's planning guidance				P. 13 "Increase the use of renewable energy" (see minimize consumption)	P. 13 "develop a plan to decrease the Marine Corps' dependence on fossil fuels in a deployed environment. Implementation of the plan shall begin during FY 11 and be fully funded in the POM 13 budget cycle. Concentrate on three major areas: (1) increase the use of renewable energy, (2) instilling an ethos of energy efficiency, (3) increase the efficiency of equipment. The objective is to allow Marines to travel lighter — with less — and move faster through the reduction in size and amount of equipment and the dependence on bulk supplies."	P. 13 "Instill an ethos of energy efficiency" (see minimize consumption)
38	Marine Corps vision and strategy 2025: Implementation planning guidance			p. 23 "It is critical that equipment be designed based on how it will be maintained and sustained. These equipment systems must be lighter, easier to maintain, and consume less power than current systems."		p. 23 "Our expeditionary Marine Corps requires a logistics capability that is leaner, lighter, and less energy-intensive than the past."	
39	United States Marine Corps expeditionary energy strategy and implementation plan: Bases to battlefield				P. 17 "... We must increase our use of renewable energy though innovation and adaptation" P. 23 "Meet operational demand with renewable energy," followed by "Increase alternative energy."	P. 23 "Increase energy efficiency of weapons systems, platforms, vehicles, and equipment," and later "Reduce energy intensity," "Reduce water consumption," and "Reduce non-tactical petroleum use."	P. 17 "Achieving success will require no less than institutional change...Finally, and most critically, we must change the way we think about energy—our warrior ethos must equate the efficient use of energy and water resources with increased combat effectiveness." P. 21 Goal 1. "Embed expeditionary energy into the USMC ethos."

ID	Document	Maximize Assurance	Minimize Attrition	Minimize Logistic Requirements	Maximize Nonfossil Sources	Minimize Consumption	Maximize Motivation
40	Exec. Order No. 13423				§2(b). Ensure that 50% of statutorily required renewables comes from "new" (as of 1999) sources. Implement new renewable energy generation projects on agency property for agency use.	§2(a). Reduce building energy intensity 3% annually through FY 2015, or 30% total reduction by FY 2015 (baseline FY 2003). §2(g). Reduce by 2% vehicle petroleum annually through FY 2015 (baseline FY 2005). Achieve 10% increase in non-petroleum fuel consumption annually (baseline FY 2005).	
41	Exec. Order No. 13514				§2(a)(ii). Increase use of renewable energy. Implement renewable energy generation projects on agency property.	§2(a)(i). Reduce energy intensity in buildings to achieve GHG reductions. §2(a)(iii)(C). Reduce fleet's consumption of petroleum products 2% annually through end of FY 2020 (baseline FY 2005).	
42	National security strategy				P. 10 "We must transform the way that we use energy--diversifying supplies, investing in innovation, and deploying clean energy technologies. By doing so, we will enhance energy security, create jobs, and fight climate change."		
43	Blueprint for a secure energy future				P. 6 "By 2035, we will generate 80 percent of our electricity from a diverse set of clean energy sources -- including renewable sources like wind, solar, biomass, and hydropower, nuclear power, efficient natural gas; and clean coal." From Obama's State of the Union address	P. 5 "One of the best ways to make our economy less dependent on oil…is simply to make our transportation more efficient." P. 6 also talks about improving energy efficiency of buildings	
44	Energy program for security and independence	p. 2 "rely only on energy resources that are not subject to intentional or accidental supply disruptions."	p. 21 "reducing the risks from fuel delivery"	P. 2"more energy self-sufficient and less dependent on vulnerable energy production and supply lines"	p. 10, identifies "Alternative Energy" as one of three major strategies. p. 3 "increasing [Navy's] use of alternative energy, including biofuels, solar, wind, hydro, geothermal, and nuclear"	p. 10 identifies Energy Efficiency as one of three major strategies which "reduc[es] the frequency of fuel re-supplies."	p. 21 "DON will engender an ethos whereby all personnel are stewards committed to sustainable energy management practices, and who value the efficient use of clean and secure energy."

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