DEPARTMENT OF THE NAVY
HEADQUARTERS UNITED STATES MARINE CORPS
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WASHINGTON, DC 20350-3000

IN REPLY REFER TO
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MROC

SEP 02 2011

MROC DECISION MEMORANDUM 46-2011

Subj: UNITED STATES MARINE CORPS EXPEDITIONARY ENERGY, WATER AND WASTE (E2W2) INITIAL CAPABILITIES DOCUMENT (ICD)

Ref: (a) MROCSM 25-2011 of 18 Jul 11

Encl: (1) E2W2 ICD Executive Summary
(2) E2W2 ICD
(3) E2W2 ICD Comment Resolution Matrix

1. Purpose. To obtain MROC approval of the United States Marine Corps Expeditionary Energy, Water and Waste ICD.

2. MROC Staffing Results. The E2W2 ICD and supporting documentation were electronically staffed to the MROC via the reference. All MROC members concurred with the E2W2 ICD.

3. Decision. The MROC approves the United States Marine Corps Expeditionary Energy, Water and Waste ICD.

JOSEPH F. DUNFORD, JR

Pre-Decisional
MROC Executive Summary
Colonel Robert J. Charette, Jr.
30 Jun 2011
Initial Capabilities Document for USMC Expeditionary, Energy, Water, and Waste

Purpose

To secure MROC approval of the USMC Expeditionary Energy, Water, and Waste (E2W2) Initial Capabilities Document (ICD) and an MROC decision on pursuing joint ICD designation.

Background Information

Over 70 percent of the logistics required to sustain Marine Corps expeditionary forces ashore is liquid fuel and water. Since the mid-1980s, the Marine Corps' tactical power demand has increased over 470% from a managed 65 Megawatts (MWs) to over 303 MWs. This demand for energy and water increases the logistics sustainment requirements of the operating forces and limits the operational reach of Marines on the battlefield. Driving the demand for "liquid logistics" is the ability and necessity for Marines to distribute throughout the battle-space while bringing increasingly effective capabilities to bear at smaller unit levels. This ability is enabled by increased capability and capacity in precision weapons, force protection, and command, control, communications, computer, intelligence, surveillance, and reconnaissance (C4ISR) technology.

Military Problem

Marine infantry companies in 2011 have more equipment and use more fuel and batteries than infantry battalions did 10 years ago. Changes in the Marine Air Ground Task Force (MAGTF) include:

- 250% increase in radios
- 300% increase in IT/computers
- Introduction of new types of systems (e.g. counter-IED jammers, persistent surveillance, position location/reporting and situational awareness, etc.)

To move throughout the distributed area of operations Marine infantry battalions have increased the number of vehicles on-hand:

- 200% increase in the number of vehicles

To protect those vehicles armor has been added, which directly decreases vehicle miles per gallon (MPG):

- 75+% increase in vehicle weight
- 30% decrease in MPG across the tactical vehicle fleet

The Marine Corps today consumes in excess of 260,000 gallons of fuel per day in Afghanistan. Each of the more than 100 forward operating bases in Afghanistan requires a daily minimum of 300 gallons of diesel fuel. This equates to approximately 8 gallons of fuel per day per Marine. Adding to this demand is the fact that II MEF (FWD) consumes 103,458 bottles, or 83 trucks worth, of bottled water per day. Finally, a single OEF infantry battalion today uses approximately 6,000 pounds of non-rechargeable batteries per month. This demand for liquid fuel, batteries, and bottled water has become a soft underbelly to the enemy and drives the volume of convoy re-supply. Marines in Afghanistan today average one casualty for every 50 convoys.

Capability Sought

Reducing "liquid and battery logistics" demand requires focused participation in the requirements, acquisition, and technology development processes. To this end, the CMC's Expeditionary Energy Office (E2O) and the Deputy Commandant for Combat Development and Integration (Capabilities Development Directorate) initiated Joint Capabilities Integration and Development System (JCIDS) planning by jointly sponsoring the Capabilities Based Assessment (CBA) documented in this ICD.

This ICD codifies the E2W2 CBA and describes E2W2 capability needs, gaps, and solution approaches that support Marines across the range of military operations (ROMO) through 2025. The ICD forms the intellectual foundation for deliberate, capabilities-based planning to achieve the mission set forth in the USMC Expeditionary Energy Strategy:

> *"By 2025 we will deploy Marine Expeditionary Forces that can maneuver from the sea and sustain C4I and life support systems in place; the only liquid fuel needed will be for mobility systems which will be more energy efficient than systems are today."*

Implementation

The ICD identifies **152 gaps** across **29 tasks** and six E2W2 capability areas (***Planning, Production, Storage, Distribution, Disposal, Management***) that affect every Warfighting consumer or producer of energy, water, and waste. The ICD also identifies **160** non-materiel and **87** materiel solution approaches.

Approval of this ICD enables follow-on materiel and non-materiel combat development to close the identified gaps as prioritized in this document. Once approved, the ICD provides a JCIDS source document that will drive new requirements, re-examination of existing requirements, and materiel development decisions that seek to optimize expeditionary capabilities across all Warfighting functions.

Recommendation

Approve the E2W2 ICD and forward to the Joint Staff for consideration as a Joint Integration ICD.

INITIAL CAPABILITIES DOCUMENT

FOR

UNITED STATES MARINE CORPS

Expeditionary Energy, Water and Waste

Validation Authority: Deputy Commandant, Combat Development and Integration

Approval Authority: Marine Requirements Oversight Council

Milestone Decision Authority: N/A

Designation: Joint Integration

1 August 2011

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Executive Summary

> "*The current and future operating environment requires an expeditionary mindset geared toward increased efficiency and reduced consumption, which will make our forces lighter and faster. We will aggressively pursue innovative solutions to reduce energy demand in our platforms and systems, to increase our self-sufficiency in our sustainment, and reduce our expeditionary foot print on the battlefield. Transforming the way we use energy is essential to rebalance our Corps and prepare it for the future.*"[1]

In response to the growing strategic risk of energy dependence, the Commandant of the Marine Corps declared energy a top priority. On 1 October 2009, he created the USMC Expeditionary Energy Office (E2O), with the mission to "analyze, develop, and direct the Marine Corps' energy strategy in order to optimize expeditionary capabilities across all Warfighting functions." Further, E2O's role is to "advise the Marine Requirements Oversight Council (MROC) on all energy and resource related requirements, acquisition, and programmatic decisions."[2]

Reducing "liquid and battery logistics" demand requires focused participation in the requirements,[3] acquisition,[4] and technology development processes. To this end, E2O chartered the Expeditionary Energy, Water and Waste (E2W2) Capabilities Based Assessment (CBA) to serve as the analytical basis for requirements that will drive development and fielding of a comprehensive E2W2 capability set that supports the CMC 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."*** [5]

This Initial Capabilities Document (ICD) codifies the CBA and describes E2W2 capability needs, gaps, and solution approaches that support Marines across the range of military operations (ROMO) through 2025. The ICD seeks to resolve the military problem presented by current and future operational energy, water, and waste logistics requirements and the resulting maneuver limitations and vulnerability to attacks on ever more critical and extended supply lines. Nowhere is the problem more evident than in current, distributed operations or in applying the future Enhanced Marine Air Ground Task Force (MAGTF) Operations (EMO) concept; thus, the intent is for capabilities identified in this ICD to:

- Achieve resource self-sufficiency on the battlefield
- Reduce energy demand in platforms and systems
- Reduce the overall footprint in current and future expeditionary operations.

The ICD identifies 152 gaps across 29 tasks and six E2W2 capability areas (***Planning, Production, Storage, Distribution, Disposal, Management***) that affect every warfighting consumer or producer of energy, water, and waste. E2W2 capabilities are inherent to all aspects of MAGTF operations;

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[1] *United States Marine Corps Expeditionary Energy Strategy and Implementation Plan*, (Washington, DC: CMC, 2011), 23 Feb 2011, 3

[2] Assistant Commandant of the Marine Corps, US Marine Corps, Memorandum 11/09, 19 Nov 2009, "Establishment of the Marine Corps Expeditionary Energy Office."

[3] Chairman of the Joint Chiefs of Staff, *Joint Capabilities Integration and Development System (CJCSI 3170)*, (Washington, DC: CJCS, 2009), 1.

[4] DoDI 5000.02, USD(AT&L), dated 2 December 2008

[5] *United States Marine Corps Expeditionary Energy Strategy and Implementation Plan*, (Washington, DC: CMC, 2011), 23 Feb 2011, 17

thus, solutions span the range of materiel and non-materiel approaches. Changes to policy, doctrine, procedures, organization and personnel structure, and training will significantly improve E2W2 planning, employment, and oversight. Many of these non-materiel approaches can be implemented in the near term without materiel development or new technology. Nevertheless, non-materiel approaches will not completely close the E2W2 gaps and many gaps can only be adequately mitigated by incorporating materiel solutions.

The USMC Expeditionary Energy Strategy is the first key policy step, and provides the commander's intent to focus capability development on increasing E2W2 efficiency and self-sufficiency, reducing logistics vulnerabilities and enabling a lighter, more maneuverable, EMO-capable force. ICD recommendations build on this intent and provide the capabilities development path.

The E2W2 CBA validated the premise that achieving the USMC Expeditionary Energy Strategy objectives, and conducting EMO, requires a change to the way Marines and their leaders value energy and water resources in training and on the battlefield. Policy, doctrine, training and leadership approaches can have the most immediate impact and it is recommended that these be applied without delay. Several next steps are recommended upon approval of this ICD:

- Begin policy issuance and leadership engagement immediately.
- Convene a cross-functional DOTMLPF working group to plan and synchronize DOTMLPF changes.
- Begin doctrine changes by creating an overarching E2W2 publication and continue by incorporating E2W2 elements into existing publications during scheduled doctrine reviews.
- Implement updates to entry level, MOS, and PME school curricula that are coordinated with doctrine writing to ensure unity of effort.
- Conduct a detailed E2W2 organizational structure and manpower analysis to define necessary changes, and to schedule funding and implementation.

Non-materiel approaches will need to be coordinated with materiel solution development to create the necessarily robust and efficient E2W2 capabilities. Current efforts are applying new E2W2 materiel capabilities to support forces conducting Enhanced Company Operations (ECO) on a distributed battlefield in Afghanistan. The Marine Corps should continue these efforts and build upon them through materiel development decisions focused on improvements across all energy, water, and waste producing and consuming systems. This ICD identifies 87 materiel solution approaches with applicability to 27 of the 29 E2W2 tasks and across three categories***: information technology (IT), evolutionary development,*** and ***transformational***.

This ICD is the foundation for dramatically reducing the Marine Corps' need for liquid and battery logistics, and increasing energy and water self-sufficiency, in order to increase combat effectiveness. Marines and MAGTFs will travel lighter and move faster through reductions in bulk supply weight, footprint, distribution, and the individual load.

1 Concept of Operations Summary

1.1 Background

Over 70 percent of the logistics required to sustain Marine Corps expeditionary forces ashore is liquid fuel and water. Since the mid-1980s, the Marine Corps' required tactical power production has increased over 470%, from a managed 65 Megawatts (MW) to over 303 MWs in the Table of Equipment.[6] This demand for energy and water increases the logistics sustainment requirements of the operating forces and limits the operational reach of Marines on the battlefield. Driving the demand for "liquid logistics" is the ability and necessity for Marines to distribute throughout the battle-space while bringing increasingly effective capabilities to bear at smaller unit levels. This ability is enabled by increased capability and capacity in precision weapons, force protection, and command, control, communications, computer, intelligence, surveillance, and reconnaissance (C4ISR) technology. Marine infantry companies in 2011 have more equipment and use more fuel and batteries than infantry battalions did 10 years ago. Changes in the Marine Air Ground Task Force (MAGTF) include:[7]

- 250% increase in radios
- 300% increase in IT/computers
- Introduction of new types of systems (e.g. counter-IED jammers, persistent surveillance, position location/reporting and situational awareness, etc.)

To move throughout the distributed area of operations Marine infantry battalions have increased the number of vehicles on-hand:

- 200% increase in the number of vehicles

To protect those vehicles armor has been added, which directly decreases vehicle miles per gallon (MPG):

- 75+% increase in vehicle weight
- 30% decrease in MPG across the tactical vehicle fleet

The upward trend in energy required to fight America's wars is not new. Since Vietnam, there has been a 175 percent increase in gallons of fuel consumed per U.S. Soldier, Sailor, and Marine per day, for an average annual increase of about 2.6 percent in the last 40 years. That ratio could increase by 15.6 percent by 2017 at an expected annual growth rate of 1.5 percent.[8] The Marine Corps today consumes in excess of 260,000 gallons of fuel per day in Afghanistan.[9] Each of the more than 100 forward operating bases in Afghanistan requires a daily minimum of 300 gallons of diesel fuel.[10] This equates to approximately 8 gallons of fuel per day per Marine. Adding to this demand is the need to transport 103,458 bottles, or 83 truckloads, of water per day.[11] Finally, a single OEF infantry battalion today uses approximately 6,000 pounds of non-rechargeable batteries per month.[12]

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[6] Program Manager, Expeditionary Power Systems, Marine Corps Systems Command, April 2010.

[7] Director, Energy Systems, Systems Engineering Interoperability, Architectures and Technology, Marine Corps Systems Command, July 2010.

[8] Deloitte, LLC, "Energy Security, America's Best Defense," December 2009. This increase "has been driven by several factors: the increasing mechanization of technologies used in wartime, the expeditionary nature of conflict requiring mobility over long distances, and the rugged terrain and the irregular warfare nature of operations."

[9] Commanding General, Regional Command (Southwest) Statement on Expeditionary Energy, 2 June 2011..

[10] Defense Management, DoD Needs to Increase Attention on Fuel Demand Management at Forward-Deployed Locations, February 2009, GAO Report to the Subcommittee on Readiness, Committee on Armed Services, House of Representatives.

[11] Commanding General, Regional Command (Southwest) Statement on Expeditionary Energy, 2 June 2011.

[12] Marine Corps Logistics Command Master Data Repository data for 3d Battalion, 1st Marines, June 2009 - March 2011.

Today, Marines in Afghanistan average one casualty for every 50 convoys.[13] The demand for liquid fuel, batteries, and bottled water has become a soft underbelly to the enemy. To reverse the growth in liquid and battery logistics demand, reduce risk to Marines, and enable the force envisioned in the *Marine Corps Vision and Strategy 2025* the Commandant of the Marine Corps (CMC) stated that the Marine Corps will:

- Achieve resource self-sufficiency in our battlefield sustainment
- Reduce energy demand in our platforms and systems
- Reduce our overall footprint in current and future expeditionary operations. [14]

Translating the CMC's vision into future operating concepts, the *Marine Corps Operating Concepts 2010* states:

> "*As requirements to fight in more austere conditions and in a dispersed manner become more frequent, a central enhancement required across elements is reducing energy consumption. Less dependency on energy allows the MAGTF to travel lighter—with less fuel and batteries. It allows us to move faster, through the reduction in bulk supplies and the reduction in size and amount of equipment. New technologies and techniques that reduce our cube and weight as well as our dependency on energy allow the MAGTF the ability to conduct operations in the most austere of environments—where excess and luxury is not practical.*" [15]

Further, the CMC took the following actions:

- Established the Expeditionary Energy Office[16]
- Established the Experimental Forward Operating Base
- Signed the USMC Expeditionary Energy Strategy (E2 Strategy)

In response to the military and institutional challenge, and leadership direction described above the CMC's Expeditionary Energy Office (E2O) and the Deputy Commandant for Combat Development and Integration (Capabilities Development Directorate) initiated Joint Capabilities Integration and Development System planning by jointly sponsoring the Capabilities Based Assessment (CBA) documented in this Initial Capabilities Document (ICD). The CBA was conducted by a cross-functional Integrated Planning Team (IPT), which included participants from the other Services and across the Marine Corps operating forces, Headquarters Marine Corps, and the Supporting Establishment. CBA details and results are documented in Appendices D through G.

1.2 Objective

This ICD forms the intellectual foundation for deliberate, capabilities-based planning to achieve the mission set forth in the USMC Expeditionary Energy Strategy:

> *"By 2025 we will deploy Marine Expeditionary Forces that can maneuver from the sea and sustain C4I and life support systems in place; the only liquid fuel needed will be for mobility systems which will be more energy efficient than systems are today."*

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[13] Analysis of Logistics Related Casualties for Marine Forces in Afghanistan," Current Operational Analysis Support Team, Operations Analysis Division (OAD), Marine Corps Combat Development Command, Quantico VA, September 2010.

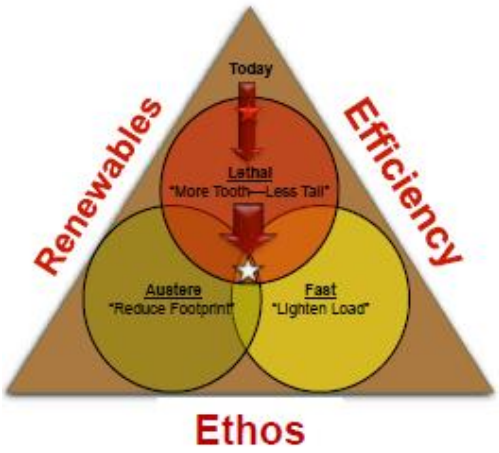
[14] 35th Commandant of the Marine Corps, Commandant's Planning Guidance 2010. p.9.

[15] Marine Corps Operating Concepts, Third Edition 2010.

[16] Assistant Commandant, U.S. Marine Corps, Memorandum 11/09, 19 November 2009, "Establishment of the Marine Corps Expeditionary Energy Office."

The non-materiel and materiel approaches proposed in this ICD outline a means for achieving the overarching E2 Strategy goal, a 50% increase in operational energy efficiency on the battlefield by 2025, while increasing operational water self-sufficiency and more effectively managing waste. The approaches represent solution paths to achieving these goals by guiding planners, advocates, and combat developers in defining requirements and adapting or developing enabling programs along three lines of operation:

- Procurement of more efficient equipment and efficiency upgrades to legacy equipment.
- Increased renewable energy use.
- An ethos that equates energy and water efficiency with combat effectiveness. [17]



Most importantly, application of these approaches is necessary to increase operational effectiveness and reduce the risk to Marines. Increasing self-sufficiency and lightening the individual and MAGTF load will shrink the threat-exposure created by logistical demands and increase maneuverability at all levels. These improvements are imperatives to the future operating concepts and will save lives.

1.3 Scope

Expeditionary energy, water, and waste (E2W2) refers to the capabilities that produce or consume energy or water, or could benefit from the ability to better manage waste or use waste to produce energy. This definition inherently includes the associated materiel and non-materiel support required to organize, train, equip, and deploy a force that uses energy and water efficiency and self-sufficiency to increase combat effectiveness in all phases of operations and to levels demanded by future expeditionary operations as described in the *Marine Corps Operating Concepts (Third Edition, June 2010)*. An efficient E2W2 capability is defined as self-sufficient C4ISR and life support capabilities, and energy efficient mobility and weapons systems that minimize the need for external (higher and adjacent unit) energy (fuel and batteries) and water logistics support.

E2W2 capabilities are inherently cross-functional. As such, this ICD considers E2W2 enabling capabilities as they apply across the Warfighting functions (WFFs) and the full range of expeditionary capabilities from individual Marine to Marine Expeditionary Forces (MEFs). E2W2 capabilities are considered in the context of Joint concepts and USMC Expeditionary Energy Strategy objectives, and across the ROMO, as represented by appropriate operational scenarios and the Marine Corps' expeditionary missions within those scenarios.

While capabilities addressed in the ICD have application across all operational phases, the identified gaps and solution approaches are focused on expeditionary capabilities that support operations from the sea during the first 120 days of operations ashore. This temporal limit drives metrics and measures that ensure approaches are consistent with the Marine Corps' expeditionary ethos and naval character and distinguish capabilities having unique MAGTF considerations from those in a complementary ICD being prepared by the U.S. Army. The Army's Operational Energy ICD is

[17] *United States Marine Corps Expeditionary Energy Strategy and Implementation Plan*, (Washington, DC: CMC, 2011), 23 Feb 2011, 16

focused on sustained operations ashore. The E2W2 IPT reviewed this document in its draft form and included several subject matter experts (SMEs) that participated in both assessments. Although it is assumed that the joint force will provide theater sustainment ashore after the first 120 days of operations, compatibility with joint capabilities and the ability to smoothly transition to sustained operations is within the ICD scope.

1.4 E2W2 Capability Contributions

As the Marine Corps develops the force to conduct highly dispersed MAGTF operations in austere environments, reduced energy consumption and more efficient, more decentralized energy and potable water production are key capability enhancements required across the MAGTF Command, Ground, Aviation, and Logistics Combat Elements (CE, GCE, ACE, and LCE). Less energy demand allows the MAGTF to travel lighter and faster through less fuel, battery, and water load, and less dependence on theater- and MAGTF-level resupply. Less demand also reduces the MAGTF footprint by reducing bulk storage and distribution requirements and the size and quantity of power production and energy storage equipment. Establishing more effective and efficient E2W2 capabilities provides the commander an increased ability to respond to changes in dynamic and often chaotic operational environments, increases task organization alternatives, increases his operational reach for unit of energy consumed and reduces the exposure of his supply lines to attack. Enhancements in energy, water, and waste capability sets increase MAGTF capacity to support coalition partners and host nations in operations other than war, such as humanitarian assistance and disaster relief efforts, by creating unique capabilities that can be directly applied to these missions while minimizing the footprint ashore and the impact to host nation resources.

1.5 Operational Outcomes

The USMC Expeditionary Energy Strategy envisions a self-sufficient expeditionary force, instilled with an ethos that considers the efficient use of vital resources to be essential for combat effectiveness.

Developing an E2W2-efficient capability set provides several desirable operational outcomes:

- A lighter, faster, more maneuverable, and more resilient maneuver force
- Increased ability for the MAGTF to operate in austere environments
- Reduced operational risk through reduced logistics footprint and threat exposure
- Increased autonomy and tactical mobility, particularly at the Company-level and below
- Increased MAGTF agility, reach, endurance, freedom of action, and operational tempo

1.6 Operational Effects

Achieving the desired operational outcomes demands several key operational effects:

- Decreased energy demand across the force and its materiel
- Increased ability to provide power and life support at fixed bases and on-the-move through sufficient quantities of smaller, lighter systems that demand less power
- Ability to maximize the use of available materials (e.g. waste) and renewable (e.g. solar) sources for energy
- Increased efficiency in mobility systems and associated subsystems (e.g. radios, sensors)
- Better visibility to resource usage to aid in planning and enable efficient energy, water, and waste management.

1.7 Complementing the Joint Force

Marine Corps enhancements in E2W2 capabilities support and complement the Joint Warfighter by reducing the USMC demand for naval ship-to-shore sustainment and joint theater sustainment. Reduced demand for joint resources enables greater logistics flexibility, adaptability, and responsiveness, which enables significant increases in operational effectiveness. A MAGTF that more efficiently provides and uses energy and water and more efficiently manages waste gives the Joint force commander more options and increased agility to operate across the ROMO. The MAGTF ensures Joint force interoperability through common systems, supplies, standards, and procedures by leveraging the other Services' enhancements to power, water production and distribution, and waste management capabilities.

1.8 Required Enabling Capabilities

Near- and Far-term improvements in overall E2W2 efficiency and unit self-sufficiency rely on establishing a permanent ethos throughout the Marine Corps that considers energy and water to be constrained resources and key combat enablers with operational "costs." As a result; awareness, education, and training form a center of gravity to this capability set. Materiel and non-materiel improvements must apply to all WFFs and MAGTF elements as they affect or are affected by enabling capabilities in six E2W2 capabilities areas:

1) Energy, Water and Waste Planning - The ability to plan all aspects of operational energy, water, and waste, to include planning for their efficient production, distribution, storage, consumption, and disposal. This capability includes the means to ensure adequate oversight through policy, efficiency planning guidelines, and materiel standards (e.g. Operational Energy Performance Key System Attributes and Key Performance Parameters); and adequate standardization through doctrine and tactics, techniques, and procedures (TTPs).

2) Production of Energy and Water - The ability to produce energy and water, to include the use of alternative and renewable energy production capabilities. Production includes the generation of power to meet both unit and individual requirements, and the purification and testing of potable water. Production shall maximize self-sufficiency.

3) Energy, Water and Waste Storage - The ability to store energy, water, and waste. Storage includes systems to store potential energy until needed. Storage also includes the disinfection and testing of stored water and energy monitoring for quality control.

4) Energy and Water Distribution - The ability to deliver energy and water resources to the proper location, at the required time, in support of the MAGTF Commander. Distribution operations establish, manage and integrate distribution services associated with the functions of movement and delivery of materiel, personnel and services in order to support the MAGTF while not hampering the MAGTF's inherent speed, flexibility and agility.

5) *Waste Disposal* - The ability to dispose of liquid and solid waste generated in the production and consumption of energy and water. Disposal includes packaging, handling, and transport of refuse, waste water, sewage, and contaminated POLs. Sewage and waste treatment and recycling are elements of disposal.

6) *Energy, Water and Waste Management* - The ability to manage all aspects of operational energy, water, and waste, to include efficient production, distribution, storage, consumption, and disposal. This process employs policy, doctrine, and TTPs to ensure efficient use of E2W2 capabilities.

DOTMLPF improvements in these six capability areas require synchronization by supporting E2W2 architectures and standards that ensure interoperability and a system of systems approach. Supporting capabilities must comply with applicable DOD, joint, national, and international policies and regulations. Materiel solutions should make use of international industrial standards to the maximum extent practical.

2 Joint Capability Area

2.1 Relevant Joint Capability Areas

The table below identifies the JCAs supported by the E2W2 tasks outlined in this ICD.

Table 2-1. JCAs Relevant to USMC E2W2 Capabilities

Tier 1	Tier 2
Force Application	Maneuver, Engagement
Command & Control	Organize, Understand, Planning, Decide, Direct, Monitor
Battlespace Awareness	Intelligence, Surveillance, & Reconnaissance (ISR), Environnent
Net-Centric	Information Transport, Enterprise Services, Net Management, Information Assurance
Protection	Prevent, Mitigate
Logistics	Deployment & Distribution, Supply, Maintain, Logistics Services, Engineering
Force Support	Force Management, Force Preparation, Human Capital Management, Health and Readiness

2.2 Relevant Combatant Commander- Identified Capabilities

Through the Senior Warfighter' Forum, combatant commanders identified and prioritized the following Joint Logistics capability attributes that are relevant to the E2W2 capability set:

- Deployment and Distribution - Visibility, Reliability, Velocity, Precision, Capacity
- Supply - Responsiveness, Sustainability, Flexibility, Survivability, Attainability, Economy
- Maintain - Sustainability, Responsiveness, Attainability, Flexibility, Economy, Survivability
- Logistics Services - Responsiveness, Attainability, Sustainability, Flexibility, Economy, Survivability

2.3 Timeframe

This ICD examines capability gaps and potential solutions to support the USMC Expeditionary Energy Strategy and Implementation Plan through 2025.

2.4 Relevant Defense Planning Scenarios

Defense Planning Scenarios approved by the Marine Requirements Oversight Council for Programming Objective Memorandum 14 (POM-14) use were used in the CBA Mission and Capabilities Identification described in Appendix E:

- (U) Major Combat Operation-1
- (U) Irregular Warfare-1
- (U) Four Steady State Security Postures – Non-combatant Evacuation Operation, Foreign Internal Defense, Security Institution Building and Reform, Humanitarian Assistance / Disaster Relief

The E2W2 capability set also aligns with several relevant Multi-Service Force Deployments (MSFD) for associated Defense Planning Scenarios:

- (U) Major Combat Operation-1, 2014
- (U) Conventional Campaign (CC)-2, 2016
- (U) Conventional Campaign (CC)-3, 2016

2.5 Capability Attributes

The following JCA attributes are prioritized as they support USMC E2W2 capabilities in an expeditionary environment:

Expeditionary. The Marine Corps is an expeditionary, sea-based force. To the Marine Corps, expeditionary means being *fast, lethal, and austere*. Marine forces require capabilities that allow rapid global deployment to a wide range of environments and a high degree of self-sufficiency for operations in ungoverned spaces. The desired outcome is to employ task organized MAGTFs with E2W2 capabilities that increase combat effectiveness by reducing the need for logistics support to forces ashore and the logistics burden on those forces within their area of responsibility. Measures include reduction in the amount of energy required to sustain a MAGTF ashore, and time to gain and maintain water self-sufficiency.

Agile. Expeditionary forces must adapt to dynamic combat situations and physical environments, and exercise control through a flexible, adaptable decision process. E2W2 capabilities that reduce the MAGTF load, minimize the logistics burden, and maximize autonomy provide commanders the ability to quickly exploit opportunities in multifaceted and ever-changing environments. Measures include energy considerations factoring into materiel requirements and planning and operations, reduction in individual equipment using unique power sources, improved fuel efficiency, and doctrine and policies that incorporate energy efficiency as an enabler of combat effectiveness.

Interoperable. Interoperable systems and doctrine are critical to joint operations. The Marine Corps must build E2W2 capabilities that can efficiently transition from organic expeditionary operations to joint and commercial operational energy capability sets in enduring operations, and/or to host nation support. The desired outcome is continuity of operations and unity of effort when transitioning from early to later operational phases, which is accomplished through the development of both an interoperable mindset and technologies. Measures include coordinated, scalable planning and design to supply conventional, renewable and alternative energy, waste-to-energy, and water capabilities that optimize inter- and intra-Service capabilities.

Scalable. Highly decentralized operations demand mobile forces that employ scalable E2W2 systems, and that provide commanders the ability to adjust up or down the capability scale depending on the size and application of the force, or the specific operational environment. The desired outcome is an E2W2 capability set that possesses task organized, multi-purpose capabilities with sufficient capacity to accomplish the broad range of tasks across the ROMO. Measures include the ability to rapidly transition across the ROMO and to efficiently employ E2W2 capabilities at all levels of the MAGTF, the flexibility to adjust those capabilities to changes in task organization and operational plans, and the versatility to utilize multiple power sources and indigenous energy and water sources.

Lethal. Marine forces must deliver precise lethal and nonlethal effects in all operating environments in order to dictate combat effects with minimized collateral damage. Systems that provide situational awareness, targeting data, and weapon precision consume power. Water sustains the life and performance of working dogs and the Marine Corps' most lethal weapon, the individual Marine. Measures include the ability to: efficiently power weapon systems from the individual to the MEF level, lighten the individual and MAGTF energy and water load (equipment and consumables), provide commanders increased visibility on E2W2 to enhance operational speed, agility and freedom to apply maneuver principals at all levels of warfare.

3 Threat and Operational Environment

3.1 General

While the potential for conventional conflict remains, threats in the 21st century will most-likely be unconventional, unforeseen, and unpredictable state and non-state adversaries using asymmetric approaches and irregular warfare. Potential adversaries will be adaptive, creative, and increasingly sophisticated using lessons learned from encounters with American weapons and tactics. They will apply those lessons learned with complexity, adaptability, and skill using non-linear, irregular TTPs.

3.2 Threat Capabilities

Potential adversaries possess increasingly sophisticated sensors, C2 systems, platforms, and weapons capable of inflicting losses and impacting how MAGTF E2W2 capabilities are distributed and protected. Asymmetric tactics are being combined with threat weapons that are increasingly accurate easy to employ. This makes it more difficult for the MAGTF commander to protect and position C4ISR and life support assets at optimal locations to support maneuver.

3.3 Threats to E2W2 Capabilities

Threats to E2W2 capabilities may range from irregular and asymmetric to conventional force attacks on E2W2 production, distribution, and storage materiel and personnel, as well as cyber-attacks on networked E2W2 systems. Low-technology weapons continue to pose significant threats to air- and ground-based resupply. The proliferation, and innovative use, of mines and IEDs increases that threat, especially in counter-terrorist and -insurgency operations where small units operate autonomously and tactical logistics missions are employed. Future E2W2 systems will leverage real- and near-real-time information to monitor and accelerate logistics support and decision-making. This information may be vulnerable to interception and exploitation.

3.4 Operational Environment

Events of today and projections of the future require Marine forces to operate in widely varying hostile, often access-denied, environments across extended battlefields. This places an emphasis on gaining access to contested areas and providing persistent presence with expeditionary maneuver forces that engage in decisive maneuver and conduct concurrent and subsequent stability operations. In many cases, these operations require forces to project from a joint seabase and to be self-sustained for extended periods. Crisis responses are likely to occur in areas that present challenges due to distance, rough terrain, and climatic extremes. These environments will not only vary in climate and size but in access to energy and water resources and infrastructure.

3.5 Threat Documents

This analysis used the MCIA Marine Corps Long Range Threat Assessment: 2008-2025, 2008 (U/FOUO), produced by the Marine Corps Intelligence Activity, Quantico, Virginia.

4 Required Capability

4.1 Capability Overview

In order to foster a common understanding of enhanced E2W2 capabilities and tasks and to guide actions along the three E2 Strategy lines of operation (ethos, efficiency, renewable energy), the following section describes the operational relationships between the E2W2 enabling capabilities and tasks, and their application to each WFF. Appendices D through G describe the E2W2 CBA methodology and the resulting capability to task to gap hierarchy. These relationships provide a means to focus effort, identify mutually supportive solutions, and monitor progress.

The E2W2 CBA defined 29 constituent tasks to the six E2W2 capability areas and the standards necessary to achieve E2 Strategy goals and enable current and future operating concepts. The tasks comprise necessary institutional and operational E2W2 actions, to include the procedures, policies, and materiel systems. **Table E-1** provides task descriptions and the association to E2W2 thrust areas (energy, water, or waste), capability areas, and the WFFs.

4.2 Enhanced E2W2 Capabilities and Tasks

Figure A-1 (Appendix A) depicts the future operational view (OV-1) of an E2W2-efficient MAGTF. In this OV-1, enhanced E2W2 capabilities are employed concurrently and sequentially through all operational phases and across the MAGTF elements:

Energy, Water and Waste Planning. E2W2 requirements must be thoroughly addressed in mission planning in order to ensure efficient employment of E2W2 assets in a manner that supports MAGTF combat effectiveness. Effective planning requires inclusion of appropriate, experienced and trained SMEs in order to identify requirements and efficient solutions across the MAGTF elements and appropriate to each operational phase. Production is planned to occur as close to the point of use as technically feasible and operationally practical. Planning includes combat development efforts to plan and design energy efficient expeditionary systems within each WFF to include legacy and new equipment, vehicles, and aircraft.

Production of Energy and Water. With planning complete, close coordination is established between MAGTF elements to meet energy and water demands throughout mission execution. Critical tasks involve harvesting energy and water as close as practical to the intended point of use and efficiently producing power for C4ISR, mobility, and life support systems; and potable water production.

Energy, Water and Waste Storage. As energy, water and waste are produced by efficient and distributable systems, metering, monitoring, testing and certification, or other quality assurance mechanisms coupled with procedures enable scalable storage and quality preservation.

Energy and Water Distribution. Fuel and other sources of stored energy, and water are distributed over the minimum distance necessary and with minimal exposure to the threat. Effective distribution is critical to maintaining operational tempo. Tactical electrical distribution occurs efficiently through detailed load assessments; right-sized power sources; adequate distribution equipment; “smart” power systems that integrate and autonomously control multiple power sources, storage devices, and loads; and prudent power conservation measures. Fuel is efficiently distributed for mobility systems and smaller, more efficient power sources that are capable of integrating with renewable sources. Distribution and consumption are measured. Water is distributed locally using efficient packaging that is tailorable to mission requirements.

Waste Disposal. The force generates waste products as it executes the mission within the operational environment. Packaging enables reuse, recycling, or conversion to energy to the maximum extent practical and technically feasible in order to minimize disposal and waste retrograde requirements. Expeditionary systems that convert waste to usable energy are deployed with the MAGTF and positioned where most effective as determined by mission analysis.

Energy, Water and Waste Management. Energy and water system status and usage data are continually collected, analyzed, and provided to commanders in order to enable timely decisions that ensure efficient management. Sensors and data management systems automate collection and reporting from the unit to enterprise levels. Visibility and decision support tools enable timely intervention that optimizes logistics support and enables operational decision making.

E2W2 capabilities are often viewed as exclusively logistics functions; however, decentralized MAGTF operations that demand more energy-intensive technology and self-sufficiency within human, technological, and operational constraints make it clear that every WFF is affected. **Table 4-1** summarizes the distribution of the 29 E2W2 tasks as they apply to each capability area and WFF. A task is considered applicable to a WFF if systems whose primary mission supports that WFF either conduct the task or receive direct support through the task. This summary provides an indication of the need for DOTMLPF integration across functions and a systems design approach that includes both energy consumer and producer systems. Improved operational energy performance in all WFF capabilities will decrease battlefield fuel and battery demand and contribute to increased MAGTF effectiveness.

Table 4-1. E2W2 Task Cross-Reference by Task Number

		Supporting Warfighting Function					
		Fires	**Maneuver**	**Command & Control (C2)**	**Intelligence (Intel)**	**Logistics (Log)**	**Force Protection (FP)**
E2W2 Capability Area	**Planning**	4, 6, 18	4, 6, 18	1, 4, 5, 6, 9, 18	4, 6, 9, 18	1, 4, 5, 6, 9, 18, 19, 26	4, 6, 9, 18
	Production	3, 13, 15	3, 11, 13, 15, 22	3, 13, 15	3, 13, 15	3, 11, 13, 15, 22, 27	3, 11, 15
	Storage	24	16, 24, 25	17, 24	24	16, 17, 24, 25, 28, 29	16, 17, 24
	Distribution	12	12	12	12	12	12
	Disposal					20, 21	
	Management	14	14	2, 7, 14, 23	14	2, 7, 14, 23	14

Note: See Table E-1 for Task Descriptions

Fires. Fires capabilities consume energy through direct and indirect fire weapons, supporting mobility systems, and aircraft. Integrating E2W2 improvements will increase the mobility and sustainability of sensor- and fire-control system-supported fires, and increase aircraft range, endurance, and power options. Future fires capabilities must enable:

- Energy efficient fire support that minimizes fuel use and battery resupply requirements.

- Increased employment flexibility and mobility for weapons systems that function in both mounted and dismounted modes.
- Energy source flexibility, to include alternative fuels.

Maneuver. Maneuver capabilities consume energy and water for individual equipment, life support and mobility systems. Integrating E2W2 improvements will contribute to assured mobility and freedom of maneuver. Future maneuver capabilities must enable:

- Greater dismounted endurance and mobility through the elimination of battery resupply associated with communication, sensors, optics, and weapons to the squad level.
- Individual water purification capabilities that further reduce the water load for the dismounted Marine and free maneuver units from water resupply.
- Greater vehicle endurance, reach, and protected mobility while increasing fuel efficiency and reducing fuel consumption.
- More efficient and scalable power supplies to onboard and off-board systems.
- Greater aircraft fuel efficiency and more economical employment to increase time-on-station, range, and reduce the need for fuel logistics.

Command and Control (C2). Requirements to power and cool C2 systems drive the battlefield demand for generated power and stored energy. Improving C2 system energy efficiency will increase individual and unit mobility, range and endurance. Future C2 capabilities must enable:

- Effective operational energy planning and data collection.
- Real-time monitoring and decision support to commanders and staff in all MAGTF elements for E2W2 planning, management, and operational decision-making.
- Self-sufficient, organic C2 without requirements for fuel and battery resupply.
- Renewable and alternative power sources and rapidly rechargeable, high endurance energy storage to sustain man portable equipment and reduce battery resupply requirements.

Intelligence (Intel). Intel capabilities consume energy through ISR collection, processing and dissemination systems. Integrating E2W2 improvements will increase autonomy and endurance of ground and airborne ISR systems. Future Intel capabilities must enable:

- Static ISR collection, processing, and dissemination, to include persistent surveillance and unattended ground sensors, without the need for battery or fuel resupply.
- Self-sufficient ISR operations by dismounted, small unit patrols
- Self-sufficient ISR operations at platoon and above operating bases

Logistics (Log). Logistics operations affect all E2W2 capabilities. Future logistics capabilities must enable:

- Expeditionary logistics and sustainment for individuals, small units (company and below), and larger forces up to the BN level.
- Efficient, scalable power generation, storage and distribution that support all C4ISR and life support requirements.
- Scalable renewable power that can be tailored to the needs of all non-mobility systems.
- Scalable, autonomous potable water production, packaging, storage, and distribution from the individual Marine to the Marine Expeditionary Force.
- Optimal energy, water and waste planning and management that minimizes operational risk and operational energy performance costs (e.g. combat load and resupply).

- Efficient growth and contraction of base camp sustainment power.

Force Protection (FP). FP systems consume energy through ground and air defense, persistent surveillance, counter-IED, and explosive ordnance disposal systems, and are also a means of preserving precious energy and water assets on the battlefield. Integrating E2W2 improvements will increase FP system mobility and decrease risk to vital energy and water assets. Future FP capabilities must enable:

- Elimination of fuel requirements for static FP and sensor systems through efficiency increases and integration with renewable power sources.
- Protection for energy and water sources and distribution mechanisms.
- Increased self-sufficiency and mobility of mobile FP systems through reduced fuel and battery requirements.

5 Capability Gaps and Overlaps or Redundancies

5.1 Capability Gap Overview

The growth in energy demand and the need for self-sufficiency related to the Marine concept of operations in Operation Iraqi Freedom (OIF) and Operation Enduring Freedom (OEF) is consistent with the Marine Corps' future Enhanced MAGTF Operations (EMO) concept and an indicator of the associated materiel and non-materiel requirements. This future concept, OIF and OEF lessons learned, and the goals and objectives of the E2 Strategy were applied in determining standards for gap and risk assessment. The E2W2 CBA Gap and Risk Assessment method and results are detailed in Appendix F. The CBA identified **152** capability gaps. **Table F-1** lists the capability gaps by their Gap Priority and lists the applicable JCAs, attributes, and standards. Each gap is categorized as policy, sufficiency, proficiency, lack of (i.e. absence of) capability, or as the need for replacement or recapitalization of an existing capability.

The WFFs work together to achieve effects. Likewise, E2W2 efficiency improvements must be integrated within and across the functions in a system of systems approach. **Table F-1** describes the overarching gaps associated with each E2W2 task. More specific tasks within each WFF that cannot be performed or are unacceptably limited are noted below.

Fires. The force lacks sufficient capability to:

- Deliver lethal and non-lethal fires using highly energy efficient weapon systems and sub-systems that also integrate renewable energy sources as part of an energy efficient system of systems architecture.

Maneuver. The force lacks sufficient capability to:

- Provide efficient, individual power and water, which reduces the dismounted Marine combat load and is sustainable at the tactical level.
- Adapt and scale small unit E2W2 capabilities that provide mission versatility and flexibility to the small unit commander.
- Extend the range and endurance of mobility systems through efficient energy consumption, while maintaining the protection of speed, maneuverability, and materials.
- Efficiently provide power to on-board vehicle systems and exportable power for off board systems.

Command and Control. The force lacks the sufficient capability to:

- Operate command, control, communication, and computer equipment without fuel and battery resupply in expeditionary environments.
- Employ command and control systems that are part of a highly energy efficient system of systems architecture.
- Conduct decentralized, on the move communications without battery and fuel resupply and with a minimal battery combat loadout.
- Provide commanders with adequate visibility, analysis, and management tools to control expeditionary energy, water and waste usage.

Intelligence. The force lacks sufficient capability to:

- Plan for the use of existing energy and water (to include micro-terrain water sources) capability within the operations area.
- Conduct intelligence functions using highly energy efficient information, network, and communications systems that also integrate renewable energy sources as part of an energy efficient system of systems architecture.
- Conduct energy self-sufficient intelligence collection, processing, and dissemination in distributed operations.

Logistics. The force lacks sufficient capability to:

- Establish and maintain self-sufficiency in meeting energy and water needs.
- Efficiently harvest renewable energy and efficiently generate, store, and distribute power.
- Provide scalable expeditionary shelter systems with energy efficient components that minimize heating, cooling, and other electrical power demands and enable the integration of renewable power sources.
- Conduct in-place, small unit (Company and below) potable water production, certification, storage, and quality monitoring for long-term consumption.
- Provide integrated, renewable and hybrid (renewable + non-renewable) energy to support small unit and spot-generation power requirements.
- Provide commanders with adequate visibility to, and management controls for, expeditionary energy, water and waste usage.
- Provide planners with adequate planning tools for efficient, effective expeditionary energy, water and waste operations.

Protection. The force lacks sufficient capability to:

- Reduce convoy exposure events through reduced bulk liquid logistics requirements.
- Employ highly energy efficient force protection systems (e.g. surveillance, electronic countermeasures, surface-based air defense) that also integrate renewable energy sources as part of an energy efficient system of systems architecture.
- Protect highly decentralized, small unit water sources.
- Conduct energy self-sufficient biometric collection in distributed operations.

6 Ideas for Non-Materiel Approaches (DOTMLPF Analysis)

6.1 General Comments

Significant non-materiel solutions to E2W2 gaps exist. If implemented, these solutions would partially mitigate many of the **152** E2W2 capability gaps but would not completely eliminate any of them. Appendix G describes the E2W2 CBA Solutions Assessment method and results. The following sections describe the proposed non-materiel approaches.

6.2 Policy

All of the gaps require some degree of policy as part of a solution strategy. Much of this policy will be provided by the USMC Expeditionary Energy Strategy and Implementation Planning Guidance and the doctrine approaches suggested below. Still the assessment identified several key areas that require additional policy or guidance:

a) Publish guidance on the inclusion of Energy Key Performance Parameters and Key System Attributes in all requirements documents for systems that produce or consume energy, water, or waste.

b) Publish guidance on applying energy considerations to acquisition life cycle cost estimates and analyses of alternatives.

c) Publish a formal battery policy to guide requirements, engineering, and acquisition decisions and to standardize operating forces' battery procurement and management. This policy should focus on increasing battery commonality and the use of rechargeable media in order to maximize renewable energy storage and to lighten the individual and MAGTF load.

d) Publish a formal water policy that reinforces doctrine and provides commanders with clear intent to reduce the current dependency on bottled water on the battlefield and return to organic, more self-sufficient potable water production.

e) Develop an evolutionary technology roadmap that addresses potential technological solutions to E2W2 in the near-, mid-, and far-term to inform requirements and acquisition.

f) Publish guidance directing the inclusion of energy efficient technologies where applicable during legacy equipment upgrades, during reset, recapitalization, and planned product improvements.

g) Require Program Managers to review and update the Total Force Management System data base to accurately capture power requirements of all USMC equipment.

6.3 Doctrine

The non-materiel assessment identified a lack of sufficient energy-, water-, and waste -specific doctrine to enable MAGTF E2W2 planning and employment to the standards required by future concepts and scenarios. Several doctrine approaches to resolving this gap were identified:

a) Develop a Marine Corps Reference Publication that addresses MAGTF E2W2 operations across WFFs and MAGTF elements and provides comprehensive guidance to commanders, planners, and SMEs on efficient expeditionary Forward Operating Base (FOB) design.

b) Integrate E2W2 capabilities into existing and emerging Marine Corps doctrinal publications. Address E2W2 efficiencies and best practices and include updates to bulk liquid logistics doctrine that addresses small unit water self-sufficiency in support of EMO.

c) Develop standard procedures for employing utility planners at the MEB level and above.

d) Add renewable energy and waste-to-energy considerations and planning factors to existing logistics, engineering and utility doctrine and TTPs.

e) Promote development of joint E2W2 doctrine and standards.

6.4 Organization

Updates to organizational structure are necessary to ensure that E2W2 is properly considered in mission planning and decision making, and to provide operational flexibility and self-sufficiency on the distributed battlefield. Approaches center on conducting manpower and training analysis to identify changes in structure and organization that allow E2W2 capabilities to be integrated throughout the MAGTF most effectively:

a) Review all organizational structure that supports E2W2 capabilities.

- Include evaluation of Tables of Organization (T/O) requirements for utility planners to support planning at the MEF and Major Subordinate Command (MSC) levels and ensure adequate quantities and appropriate assignment of utility planners to support integrated E2W2 throughout MAGTF planning processes.

b) Evaluate Tables of Equipment (T/E) for opportunities to increase energy efficiency by "right-sizing" the T/E for energy producing or consuming equipment and to support integration and expanded use of energy efficient equipment.

- Include evaluation of T/E to support water self-sufficiency from the MEF to the rifle squad level.

6.5 Training

Training is essential to shaping the E2W2 ethos, planning and management and to ensuring efficient employment of current and future E2W2 capabilities. Other than individual E2W2 systems training, there is no current formal or informal instruction that establishes a culture of awareness for E2W2. Approaches include training that spans across administrative and operational requirements:

a) Develop a flexible (entry to career level), scalable (individual to collective training standards) training continuum that addresses E2W2 ethos, planning and management.

b) Modify officer and enlisted military occupational specialty (MOS) training, as determined by the Course Content Review Board (CCRB) and Training and Readiness (T&R) Manual Review processes, to reflect knowledge and skills required to understand, plan, coordinate, integrate, and maintain E2W2 capabilities.

- Include training on efficient and scalable power and water production and distribution, renewable and alternative energy, and waste-to-energy systems.

c) Integrate E2W2 planning and execution (e.g. scalable FOB design) into standardized pre-deployment training and other training exercises to increase the proficiency and sufficiency of the deploying expeditionary energy, water and waste operational capability.

d) Increase preventive medicine training for Corpsman for testing, certifying and maintaining water standards at the small unit level.

e) Train personnel in expeditionary energy best practices and conduct expeditionary energy use reviews during training exercises and deployments to identify and close training and awareness gaps.

f) Include resource (fuel/water) -limited and -constrained training events.

6.6 Leadership

Instilling an ethos that values energy and considers E2W2 efficiency to be critical to combat effectiveness requires behavior change at all levels of the Marine Corps. The magnitude of this change requires strong and consistent leadership. Educating leadership spans the full range of instruction at the formal schools from entry level to career and command level courses:

a) Educate every Marine in several areas - awareness of their individual and collective energy footprint; observing, analyzing, and acting on information regarding energy use; understanding the first, second and third order effects of energy and water use on operations; and, tradeoffs in the operational decision space.

b) Develop and integrate E2W2 material into officer and enlisted professional military education (PME) that is tailored for entry, intermediate and advanced level programs.

- Include efficient employment of assets to reduce energy consumption.
- Include familiarization with water capabilities and employment best practices.
- Include familiarization with expeditionary power operations and alternative power systems and benefits to reducing demand and the overall logistical footprint.
- Emphasize the importance of planning for and using organic water resources.
- Emphasize the importance of reducing and minimizing waste.
- Include planning and management of organic equipment/resources for appropriate billets/planners.

6.7 Personnel

Personnel approaches address changes in end-strength and assignment within applicable MOSs:

a) Evaluate rank, MOS, and population requirements to provide adequate numbers of trained planners at the MEFs and MSCs to enable effective E2W2 planning, to include efficient FOB utilities design, and management.

b) Evaluate rank, MOS, and population requirements to support revised T/Os that support training on, and management of, E2W2 capability sets across the USMC operating forces.

c) Evaluate supporting establishment rank, MOS, and population requirements to manage E2W2 programs and provide initial user, maintainer, and train-the-trainer training.

d) Assess the need for additional utilities water technicians to conduct water system operation, testing, and maintenance and additional Corpsmen to conduct water sampling, field testing, certification, and preventive medicine training in direct support to the battalion level and below.

e) Evaluate the requirement for additional utilities MOS Marines and additional personnel trained in waste and hazardous waste management and storage in an expeditionary environment.

Modifications to existing manning will support materiel, organization, and training changes and must be synchronized with the planning in these areas.

6.8 Facilities

This ICD is predicated on the Marine Corps' expeditionary focus and, as such, limits discussion of permanent or base camp facilities. The only recommendation in this area was to establish core design models that support scalable FOBs and Forward Arming and Refueling Points (FARPs) to support different mission requirements and enable efficient transitions to enduring operations and joint force sustainment. The Marine Corps will partner with Army programs and with the other Services to

ensure interoperability and assurance of USMC capabilities for enduring energy, water and waste sustainment and base camp operations.

7 Final Recommendations

Establishing or changing policy, doctrine, TTPs, organization and personnel structure and training will significantly improve E2W2 planning, employment, and oversight. With a concerted effort, many of these non-materiel approaches can be implemented in the near term without materiel development or new technology. Nevertheless, no combination of non-materiel approaches will completely close E2W2 capability gaps, and there are significant gaps that can only be adequately mitigated through new or enhanced materiel. Increasing battlefield energy efficiency and integrating renewable energy systems demands a coordinated, system of systems approach to achieve maximum operational energy performance within resource constraints.

The USMC Expeditionary Energy Strategy and Implementation Plan is the first key policy step, and it provides the Commandant's intent to focus materiel and non-materiel capability development on increasing E2W2 efficiency and self-sufficiency, reducing logistics vulnerabilities, and enabling a lighter, more maneuverable MAGTF that is ready to respond across the ROMO. The E2W2 ICD recommendations build on this intent and provide the path to capabilities development.

The E2W2 CBA validated the premise that achieving the USMC Expeditionary Energy Strategy objectives, and conducting EMO, requires a change to the way Marines and their leaders value energy and water resources in training and on the battlefield. Policy, doctrine, training and leadership approaches can have the most immediate impact and it is recommended that these be applied without delay. Several next steps are recommended upon approval of this ICD:

- Begin policy issuance and leadership engagement immediately.
- Convene a DOTMLPF working group, consisting of the MAGTF and Functional Advocates, program offices, operating forces, and MOS and PME school participants, to plan and synchronize DOTMLPF changes.
- Begin doctrine changes by creating an overarching E2W2 publication and continue by incorporating E2W2 elements into existing publications during scheduled doctrine reviews.
- Implement updates to entry level, MOS, and PME school curricula. Training development must be coordinated with doctrine writing to ensure unity of effort and curricula must be updated as new materiel solutions are fielded.
- Conduct a detailed E2W2 organizational structure and manpower analysis to define necessary changes, and to schedule funding and implementation.

Non-materiel approaches will need to be coordinated with materiel solution development to create the necessarily robust and efficient E2W2 capabilities. For example, policy will change the way energy is considered in requirements and acquisition processes, and changes to training and organization will affect equipping needs. Materiel solutions will, in turn, produce new non-materiel requirements that require synchronization.

Current efforts are applying new E2W2 materiel capabilities to support forces conducting Enhanced Company Operations (ECO) on a distributed battlefield in Afghanistan. The Marine Corps should continue these efforts and build upon them through materiel development decisions focused on improvements across all energy, water, and waste producing and consuming systems. Materiel

solution approaches are categorized into three groups: ***information technology (IT)***, ***evolutionary development***, and ***transformational approaches***. Recommended materiel solution approaches are described below.

7.1 Information Technology

– Develop interoperability software for existing logistics systems and metering systems to provide commanders with real-time accessible, visible, and understandable information regarding their energy and water usage.

– Establish an energy Community of Interest (COI) to develop a common data structure and taxonomy.

– Develop Service-Oriented Architecture (SOA) tools to support planning.

7.2 Evolutionary Development

– Develop equipment modified from Commercial-Off-The-Shelf technology to meet expeditionary requirements across expected operating environments.

– Develop ruggedized, lightweight, deployable alternative/renewable (e.g. solar harvesting) power systems for unit level and individual use that do not require climate control to operate effectively.

– Apply a SOA data structure and taxonomy to current Programs of Record.

– Update the AutoDISE software with power requirements associated with fielded equipment loads and operational use as a utility planning tool.

– Develop deployable FOB modules in self-sustainable capability sets designed to provide efficient utilities support (power, water, Heating, Ventilation, & Air Conditioning), and which are inter-connectable for expansion and reduction.

– Provide additional funding for advanced battery development to include standardized high energy, rechargeable batteries and increased battery commonality.

– Evolve current communication systems to improve energy efficiency.

- Develop all systems to be compatible with rechargeable batteries
- Improve efficiency and compatibility of man-packable alternative power sources. (e.g. more efficient man-packable/wearable solar)
- Develop or procure C4ISR systems with the most efficient internal power and cooling technology available.

– Evolve legacy system requirements to include operational energy performance parameters and system attributes.

– Fund and accelerate fielding of the Advanced Medium-Sized Mobile Power Source (AMMPS), Enhanced Efficiency Environmental Control Unit (E3CU), and Integrated Trailer-Environmental Control Unit- Generator (Generation II) [ITEG II] families.

– Develop and field vehicle on board exportable power / auxiliary power systems.

– Increase tactical vehicle and aircraft energy efficiency.

– Develop and field water test kits or expand or modify existing kits to enable expanded long- and short-term potability sampling and analysis capability.

7.3 Transformational Approach

– Evaluate new technologies to improve efficiency beyond current Mobile Electric Power (MEP) and planned AAMPS, E3CU, and ITEG II capability.

– Develop a modular rapidly assembled/disassembled energy common operating post capability.

– Develop "hybrid" fuel burning generator sets that include renewable power and power storage to significantly reduce the need for liquid fuels. Storage capability must support fully renewable operations for non-mobility systems.

– Develop component parts and systems that reflect a holistic utility systems relationship for power, water, waste, and force protection.

– Develop expeditionary waste-to-energy systems for all terrains and climates.

– Develop technology that enables future systems to be powered by the most efficient power sources with a footprint that is consistent with mission requirements and is embarkable aboard L-Class shipping.

– Develop technologies with alternative energy functionality at the required scale (e.g. containerized energy power generation and storage system; solar laminates, photovoltaic solar, renewable energy systems; transportable hybrid electric power station).

– Develop an integrated individual power production, management and monitoring system that uses common power sources and interfaces to power all individual equipment and allow users to accurately determine remaining battery life and selectively distribute power based on mission needs.

– Develop technologies to provide enhanced water capabilities (e.g. atmospheric water-from-air technologies, waste water reuse systems, water from exhaust systems; collapsible water containment carriers), including man-portable and -packable systems.

– Develop technology that integrates with common hardware, minimizing the requirement for specialized equipment for computers, and other such devices.

USMC E2W2 capabilities support an expansive and dynamic mission set. The near- to mid-term approaches described above include systems that focus on expanding information technology for improved planning and management (e.g. monitoring and metering) and the evolutionary development of existing E2W2 capabilities to improve MAGTF operational energy and water performance. Transformational technology breakthroughs in the mid- to far-term are necessary to achieve the USMC Expeditionary Energy Strategy and Implementation Plan goals and to enable effective enhanced MAGTF operations across the range of military operations.

Appendix A

E2W2 Operational Overview-1

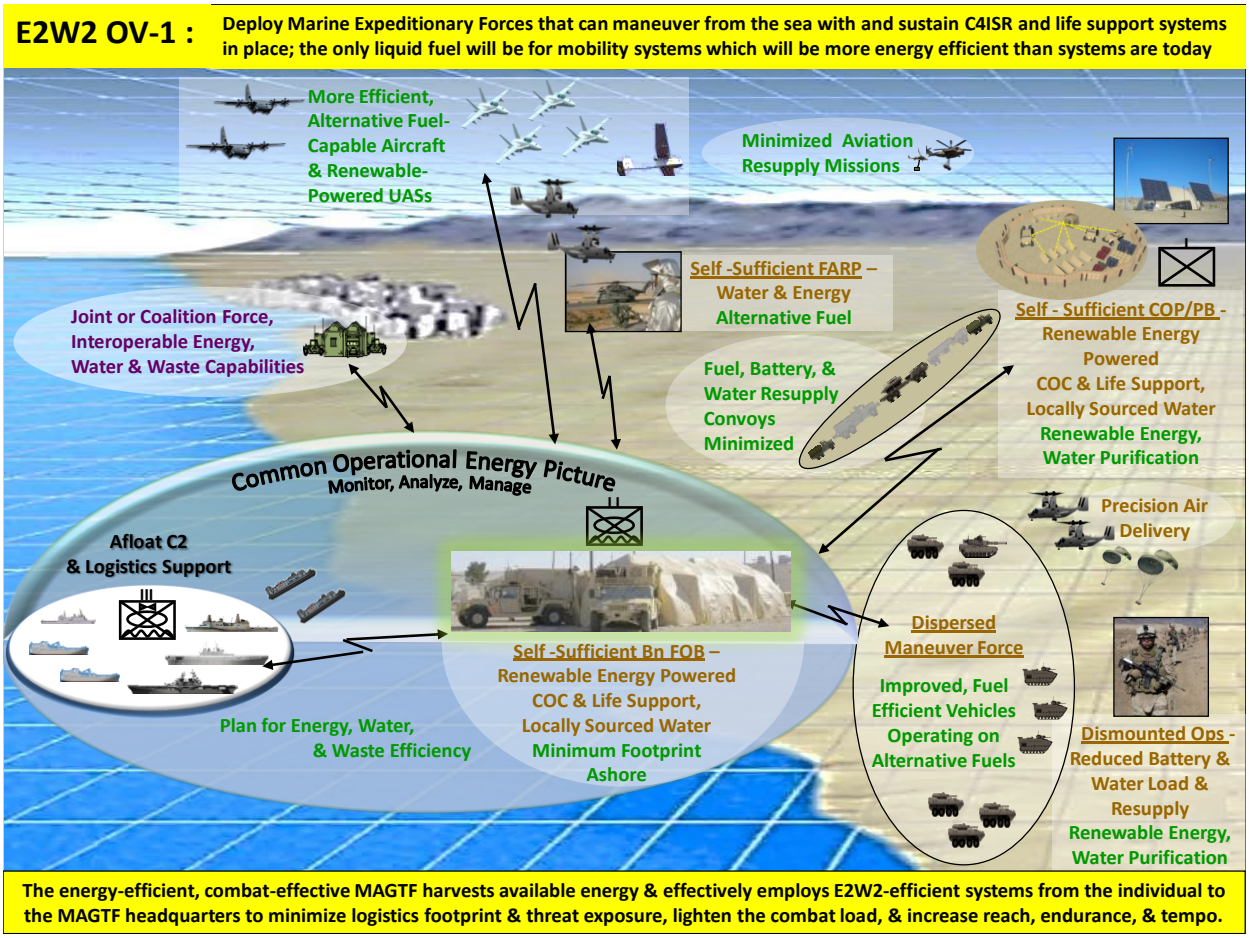


Figure A-1. USMC E2W2 OV-1

Figure A-1 depicts an operational view (OV-1) of a MAGTF employing the full complement of efficient Expeditionary Energy, Water and Waste (E2W2) capabilities in 2025. The MAGTF arrives from the sea, receives sea-based sustainment logistics support, and operates with only essential forces ashore. The force is distributed, with self-sufficient forward operating bases (FOBs), combat outposts (COPs), patrol bases (PBs), and Forward Arming and Refueling Points (FARPs). The OV-1 characterizes key operational nodes in terms of their E2W2 efficiency attributes and depicts the interactions between E2W2 architecture, the environment, and joint capabilities. The MAGTF effectively employs E2W2-efficient systems from the individual to the MAGTF headquarters level to enable operational node self-sufficiency and minimize ground and aviation resupply; increasing mobility, reducing exposure events, and freeing transportation assets for other missions. Self-sufficient operational nodes harvest all available energy (solar, thermal, kinetic, etc) to power energy-efficient C4ISR and life support equipment, and to produce potable water from local sources wherever available. Vehicles and individuals harvest and store energy on-the-move and share energy to power weapons and C4ISR systems, and to augment fixed-base renewable power.

Realizing this "self-sufficient MAGTF" operational view will provide several desired outcomes:

- A lighter, faster, more maneuverable, and more resilient maneuver force
- Increased ability for the MAGTF to operate in austere environments

Appendix A

E2W2 Operational Overview-1

- Reduced operational risk through reduced logistics footprint and threat exposure
- Increased autonomy and tactical mobility at the Battalion-level and below
- Increased MAGTF agility, freedom of action, endurance, reach, and operational tempo

Appendix B
Glossary

BA	Battlespace Awareness
CBA	Capabilities Based Assessment
CBA&P	Capability-Based Assessment and Planning
CCJO	Capstone Concept for Joint Operations
CJCSI	Chairman of the Joint Chiefs of Staff Instruction
CJCSM	Chairman of the Joint Chiefs of Staff Manual
COCOM	Combatant Command
CONOPS	Concept of Operations
COP	Combat Outpost
CRD	Capstone Requirements Document
C/S/A	COCOM / Service / Agency
C4I	Command, Control, Communications, Computers, and Intelligence,
C4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance
DCR	DOTMLPF Change Recommendation
DOD	Department of Defense
DOTMLPF	Doctrine, Organization, Training, Materiel, Leadership and Education, Personnel, Facilities
DPG	Defense Planning Guidance
DPS	Defense Planning Scenario, also Defense Planning Strategy
DSCA	Defense Support to Civilian Authorities
E2O	Expeditionary Energy Office
E2W2	Expeditionary Energy, Water and Waste
EEA	Essential Elements of Analysis
ESC	Executive Steering Committee
FARP	Forward Arming and Refueling Point
FCB	Functional Capabilities Board
FOB	Forward Operating Base
ICD	Initial Capabilities Document
IOC	Initial Operational Capability
IPT	Integrated Process Team
ISR	Intelligence, Surveillance and Reconnaissance
JCA	Joint Capability Area
JCB	Joint Capabilities Board
JCD	Joint Capabilities Document
JCIDS	Joint Capabilities Integration and Development System
JFC	Joint Force Commander or Joint Functional Concept
JFCC	Joint Force Component Commander
JFCOM	Joint Forces Command

Appendix B
Glossary

JIC	Joint Integrating Concept
JMETL	Joint Mission Essential Task List
JOC	Joint Operating Concept
JOpsC	Joint Operations Concept
JROC	Joint Requirements Oversight Council
JROCM	Joint Requirements Oversight Council Memorandum
MAGTF	Marine Air Ground Task Force
MCO	Major Combat Operations
MOE	Measures of Effectiveness
MOS	Military Occupational Specialty
MRB	Marine Requirements Board
NDS	National Defense Strategy
OV	Operational View
PB	Patrol Base
POI	Program of Instruction
POM	Program Objective Memorandum
QDR	Quadrennial Defense Review
RCC	Regional Combatant Commanders
ROMO	Range of Military Operations
SASO	Stability and Support Operations
SOF	Special Operations Forces
SPG	Strategic Planning Guidance
T/C/S	Tasks, Conditions and Standards
UCC	Unified Combatant Commands; Unified Combatant Commander
UCP	Unified Command Plan
UJTL	Universal Joint Tasks List
USA	United States Army
USAF	United States Air Force
USCG	United States Coast Guard
USMC	United States Marine Corps
USN	United States Navy

Appendix C
References

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- Army Energy Security Implementation Strategy, Office of the Deputy Assistant Secretary of the Army for Energy and Partnerships, DASA(E&P), 13 Jan 2009
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Appendix D
E2W2 Capabilities Based Assessment Overview

D.1 Objective

The E2W2 CBA initiated the deliberate, capabilities-based planning to achieve the mission set forth in the USMC Expeditionary Energy Strategy:

> *"By 2025 we will deploy Marine Expeditionary Forces that can maneuver from the sea and sustain its C4I and life support systems in place; the only liquid fuel needed will be for mobility systems which will be more energy efficient than systems are today."*

E2W2 CBA outputs provide a foundation for meeting the Marine Corps' energy goals: forging an ethos that equates energy efficiency with combat effectiveness; increasing energy efficiency of expeditionary systems; and increasing the use of renewable energy in battlefield operations.[18] The non-materiel and materiel approaches identified within this assessment establish a means for achieving the overarching USMC Expeditionary Energy Strategy goal, a 50% increase in operational energy efficiency on the battlefield, while increasing operational water self-sufficiency and more effectively managing waste. Most importantly, application of these approaches is necessary to increase operational effectiveness and reduce the risk to Marines. By increasing self-sufficiency and lightening the individual and MAGTF load, the MAGTF will shrink its threat-exposure, as created by logistical demands, and increase maneuverability at all levels. These improvements are imperatives to future Marine operating concepts and will save lives.

D.2 Scope

E2W2 capabilities are inherently cross-functional. As such, this CBA considered E2W2 enabling capabilities as they apply across the Warfighting Functions (WFFs) and the full range of expeditionary capabilities from individual Marine to Marine Expeditionary Forces. Capabilities are assessed in the context of Joint concepts and the E2 Strategy, and across the Range of Military Operations (ROMO) as represented by appropriate operational scenarios and the Marine Corps' expeditionary missions within those scenarios. Specifically considered are capabilities that produce or consume energy or water, or could benefit from the ability to better manage waste or use waste to produce energy.

The E2W2 CBA focused on operations from the sea during the first 120 days of operations ashore in order to focus on expeditionary capabilities and to deconflict with a complementary assessment being conducted by the U.S. Army that is focused on sustained operations ashore. The E2W2 IPT reviewed the Army's draft Operational Energy Initial Capabilities Document (ICD) and included several subject matter experts (SMEs) participating in both assessments.

D.3 Task

The E2W2 CBA applied a collaborative capabilities-based planning approach:

- to identify gaps in the ability of current, and projected future, E2W2 capabilities to adequately support the future Marine Corps missions in the context of the E2 Strategy;
- to assess risk;
- to recommend materiel and non-materiel solution approaches to closing identified gaps.

[18] *United States Marine Corps Expeditionary Energy Strategy and Implementation Plan*, (Washington, DC: CMC, 2011), 23 Feb 2011

Appendix D
E2W2 Capabilities Based Assessment Overview

D.4 Assumptions

- Equipment to support Enhanced MAGTF Operations (EMO) will continue to increase MAGTF energy and weight demands.
- EMO implementation requires an increase in energy and water self-sufficiency.
- Marines will continue to operate in austere environments, with no E2W2 infrastructure, and be exposed to complex, hybrid threats.
- Funding will be available to fully implement the non-material and material solutions identified in this CBA to include the necessary research and development.
- Renewable, alternative, and energy efficient technologies will evolve to meet future MAGTF demands.

D.5 Constraints

- The USMC will meet all SECNAV Goals for alternative energy consumption by 2020.
- The USMC will support DON "Green Strike Group" deployment by 2016.

D.6 Methodology Overview

The E2W2 CBA was guided by the CJCSI 3170.01G (*Joint Capabilities Integration and Development System)*, the *Manual for the Operation of the Joint Capabilities Integration and Development System*, and the *Joint Staff Capabilities-Based Assessment (CBA) User's Guide* and applied a three-phase, six-step process (Figure D-1):

- Phase 1: Mission and Capabilities Identification (Steps 1 & 2)
- Phase 2: Gap and Risk Assessment (Steps 3 & 4)
- Phase 3: Solution Assessment and Recommendations (Steps 5 & 6)

Based on available time and resources the E2W2 IPT conducted the assessment using a consensus based methodology. This approach leveraged SME understanding of the varied and complex issue(s) associated with E2W2 capabilities and used collaborative decision support, multi-criteria decision making (MCDM) and an analytical hierarchy process (AHP) tools.

Appendix D

E2W2 Capabilities Based Assessment Overview

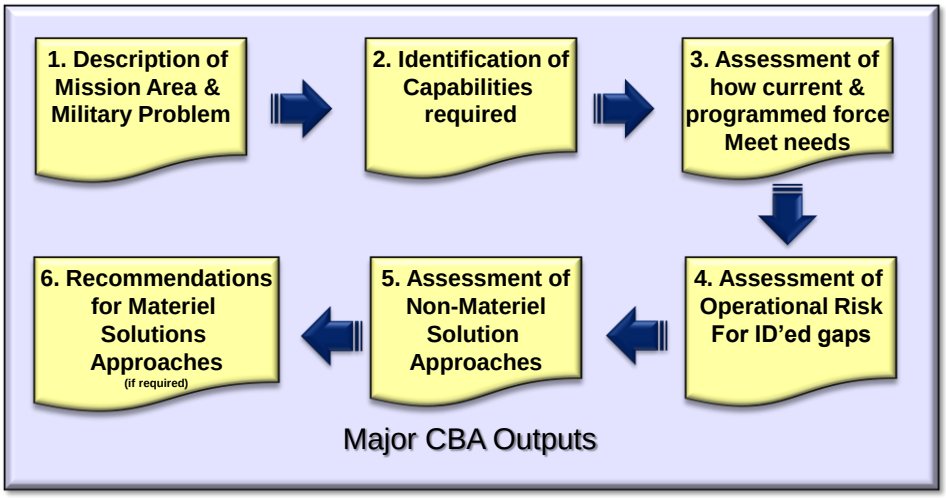

Figure D-1. CBA Process Flow

Appendix E
E2W2 CBA Mission and Capabilities Identification

E.1 Assessment Method

During Mission and Capabilities Identification, the IPT examined MAGTF missions in reference to a set of defense planning scenarios approved by the Marine Requirements Oversight Council for Programming Objective Memorandum 14 (POM-14) use. These scenarios include:

- MCO-1
- IR-1
- Steady State Security Postures – NEO, FID, SIBR, HA/DR

In order to identify relevant E2W2 capabilities and the associated Tasks, Conditions, and Standards (T/C/S), the IPT referenced numerous joint and Service strategy documents, concepts and doctrine. See Appendix A for a comprehensive list of references.

In order to represent the logical relationships between E2W2 capabilities and the flow of E2W2 activities in the operational environment, and to ensure a systems view of potential gaps, the IPT defined and prioritized six functional capability areas in which to group tasks (in priority order):

1) *Energy, Water and Waste Planning* - The process of planning all aspects of operational energy, water, and waste, to include planning for their efficient production, distribution, storage, consumption, and disposal. This process establishes policies, tactics/techniques/procedures (TTPs) and efficiency/effectiveness guidelines and provides a means to ensure adequate oversight.
2) *Production of Energy and Water* - The process of producing energy and water, to include the use of alternative and renewable energy production capabilities. Production includes the generation of power to meet both unit and individual requirements, and the purification and testing of potable water. Production should maximize self-sufficiency.
3) *Energy, Water and Waste Storage* - The process of storing energy, water, and waste. Storage includes systems to store potential energy until needed. Storage also includes the disinfection and testing of stored water and energy monitoring for quality control.
4) *Energy and Water Distribution* - The process of delivering required energy and water resources to the proper location, at the required time, in support of the MAGTF Commander. Distribution operations establish, manage and integrate distribution services associated with the functions of movement and delivery of materiel, personnel and services in order to support the MAGTF while not hampering the MAGTF's inherent speed, flexibility and agility.
5) *Waste Disposal* - The process of disposing of liquid and solid waste generated in the production and consumption of energy and water. Disposal includes packaging refuse, trash/garbage, waste water, sewage, and contaminated POLs. Sewage and waste treatment and recycling are elements of disposal.
6) *Energy, Water and Waste Management* - The process of managing all aspects of operational energy, water, and waste, to include management of their efficient production, distribution, storage, consumption, and disposal. This process establishes policies, TTPs and efficiency/effectiveness guidelines and provides a means to ensure adequate oversight.

Appendix E

E2W2 CBA Mission and Capabilities Identification

By decomposing the capability areas and examining the Universal Joint Task List (UJTL), Universal Naval Task List (UNTL), Marine Corps Task List (MCTL), joint and Service doctrine, and through IPT discussion, 29 tasks were identified as critical to the expeditionary mission across all scenarios. All 29 tasks were aligned to a task from the current MCTL and to applicable Joint Capability Areas (Tier I and II). The IPT prioritized tasks according to the perceived degree of importance to achieving the E2 Strategy goals and objectives and enabling future (Enhanced MAGTF) operations.

Vision and Strategy 2025, Marine Corps Operating Concepts (Third Edition, June 2010), the *USMC Expeditionary Energy Strategy and Implementation Plan* goals and objectives, and the *Center for Naval Analyses Report on Reducing Energy Footprint on the Battlefield* were consulted in order to identify appropriate metrics and measures, which were then refined through IPT input and discussion.

E.2 Results

Table E-1 lists the 29 E2W2 tasks, with description, in priority order from highest to lowest. This task list represents the institutional and operational imperatives (policies, procedures, and systems) for developing a more effective and efficient E2W2 capability set.

Appendix E

E2W2 CBA Mission and Capabilities Identification

Table E-1. E2W2 Task Descriptions in Task Priority Order

Task Number	Thrust Area	E2W2 Capability Area	Supporting Warfighting Function(s)	Task	Task Description
1	Energy	Planning (Deployed)	C2 Log	Plan to supply/harvest Energy (conventional, renewable, alternative) to the MAGTF; integrated throughout the supply chain and with Joint/Coalition and HNS	Develop plans for the supply/harvest of conventional, renewable, alternative energy, waste-to-energy, with joint, coalition, and HNS in the Joint Operations Area. Plan for integration of energy systems, to include bulk liquid energy, into the supply chain to point of use in order to sustain expeditionary operations.
2	Energy, Water, & Waste	Management	C2 Log	Provide the capability to Manage Energy, Water, and Waste Resources in an Expeditionary Environment	Manage the supply, demand, and usage of energy and water in the operating environment. Assess usage data to determine energy efficiency. Employ sensors, software data management systems to process, analyze, and report E2W2 demand and consumption information at the unit and enterprise level.
3	Energy	Production	All	Conduct Combat Operations across the MAGTF with minimal energy and energy related logistics requirements	Reduce the need for fuel resupply by harvesting the required energy, in place, from natural and manmade sources, to power command, control, computer, and communications, intelligences and surveillance systems, and life support systems.
4	Energy	Planning	All	Plan for reductions in energy demands of current and future capability sets without reducing combat/mission effectiveness	Employ tailored T/O and T/E to achieve mission objectives, and optimize T/E using an energy system of systems approach. Provide the right personnel with the right equipment to optimize energy employment across the ROMO.
5	Water	Planning (Deployed)	Log C2	Develop Plans to Support Efficient, Scalable Expeditionary Water Systems and Hygiene Service	Develop plans to provide water and hygiene support. Includes provision for tactical water support to create, recycle, purify, certify, store, surveillance, and distribution of water; includes billeting, messing, shower, and laundry services, and incorporate waste water required to support expeditionary operations.
6	Energy	Planning	All	Design Efficient, Scalable, and Interoperable, Expeditionary Energy Producing and Consuming Warfighting Capabilities	Plan and design energy efficient expeditionary systems to include efficient shelter design, energy harvesting, power distribution systems, and all energy consuming equipment to minimize energy consumption to the degree possible without impacting operational effectiveness. Require an Energy Performance Key Performance Parameter in new and upgraded legacy equipment and vehicles.
7	Energy, Water, & Waste	Management	C2 Log	Provide the capability to Measure Energy, Water, and Waste Resources in an Expeditionary Environment	Employ sensors, meters, and other monitoring technology to gather real time /near real time data on energy, fuel, and water demand and consumption, and waste management processes. Include software data management systems to process, analyze, and report E2W2 demand/consumption information at the unit and enterprise level.
8	Energy	Distribution	Log	Conduct "smart" expeditionary Electrical Distribution	Conduct efficient tactical electrical distribution operations and provide electric distribution to expeditionary units through a tactical distribution grid system that could be metered and monitored from a central location. This distribution system will have the capability to integrate AC/DC generation and loads to include renewables.
9	Energy	Planning	Log, C2, Intel, FP	Plan to produce all C4ISR energy and power requirements organically in place	Operate and sustain C4ISR with harvested energy and power resources from natural and manmade sources.
10	Water	Distribution	Log	Conduct Expeditionary Water Distribution	Distribute water to operating locations as necessary to support expeditionary operations in all environments. Includes certification, surveillance, metering and monitoring. Water support may be provided to U.S. Forces, other nation armed forces or civilians as directed.

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E2W2 CBA Mission and Capabilities Identification

Task Number	Thrust Area	E2W2 Capability Area	Supporting Warfighting Function(s)	Task	Task Description
11	Water	Production	Log Maneuver FP	Provide efficient production of Potable/Non-Potable water in an expeditionary environment	Produce potable and non-potable water on site. Maintain water generation and distribution, including purification, certification, and quality surveillance of water. Include the ability to cool and heat water as required for health and comfort needs. These systems shall be energy efficient and where possible leverage renewable energy sources.
12	Energy	Distribution	All	Conduct Expeditionary Bulk Fuel Distribution	Expeditionary bulk fuel distribution operations includes support for forward arming and refueling point (FARP) for aircraft and vehicles at locations near or beyond the forward edge of battle area (FEBA); Aviation-Delivered Ground Refueling (use of aircraft to deliver fuel to austere, remote expeditionary locations); and distributing fuel in an expeditionary environment; and the ability to monitor and meter distribution.
13	Energy	Production	C2, Intel, Maneuver, Fires, Log	Provide a Power Source appropriate to the individual user's required capability	Produce power for individual Warfighting systems that includes common power sources and energy harvesting systems.
14	Energy, Water, & Waste	Management	All	Provide the capability to Analyze data on Energy, Water, and Waste Resources in an expeditionary environment	Employ operational energy management data and analyses at the unit level to optimize logistic support and operational decision making.
15	Energy	Production	All	Produce Energy Efficient Climate Control environments to maintain Personnel and Equipment operating efficiency	Provide energy efficient climate control to provide comfort sensation for personnel and maintains operating temperature for equipment.
16	Water	Storage	Log, Maneuver, FP	Provide Expeditionary Water Storage	Water storage includes metering, purification, certification, and quality surveillance of water. Man portable containers or the storage system must be capable of distributing water into man pack containers (camel backs, canteens, etc).
17	Energy	Storage	Log, C2, FP	Provide Expeditionary Bulk Fuel Storage	Storage includes metering, monitoring, testing, and certification and quality assurance.
18	Waste (Operations)	Planning	All	Develop Plans to Manage, recycle and dispose of Waste (Water, Solid, Biological) and Hazardous Waste	Develop plans to reduce waste and hazardous materials: develop plans to minimize the generation of pollution, waste, and hazardous waste to minimize operational impact, avoid exposing friendly personnel to human health hazards, and minimize impact on host nation populations and environment, and plans to use waste for the production of onsite energy generation.
19	Energy	Planning	Log	Develop migration plan for FOB to transition from expeditionary to enduring base	Develop migration plans for the transition from FOBs to enduring bases that account for energy, water and waste requirements associated with a more enduring presence.
20	Waste	Disposal	Log	Provide Efficient/Effective Disposal of Non Reusable Solid Waste in an Expeditionary Environment	Provide waste management for disposal of solid waste in expeditionary base camp environment. Disposal includes recycling where feasible. Includes wastewater collection and treatment systems, refuse collection, and disposal.
21	Waste	Disposal	Log	Provide Efficient/Effective Disposal of Non Reusable Hazardous Waste in an Expeditionary Environment	Provide waste management for disposal of hazardous waste in expeditionary base camp environment. Disposal includes recycling where feasible.

Appendix E

E2W2 CBA Mission and Capabilities Identification

Task Number	Thrust Area	E2W2 Capability Area	Supporting Warfighting Function(s)	Task	Task Description
22	Water	Production	Log Maneuver	Provide for the efficient production of recycled Potable/Non-Potable water in an expeditionary environment	Produce potable and non-potable water on site. Maintain water generation and distribution, including purification, certification, and quality surveillance of water. Include the ability to cool and heat water as required for health and comfort needs. These systems shall be energy efficient and where possible leverage renewable energy sources.
23	Energy, Water & Waste	Management	Log C2	Management of additional tasks to comply with higher guidance (i.e. DODI regarding burn pits, etc.) in an expeditionary environment	Manage guidance related to the use of energy, water and waste from higher, adjacent and joint commands, when required.
24	Energy	Storage	All	Provide Storage for Collection of Energy Sources Other than Liquid Fuels	Provide storage for harvested energy sources, other than liquid fuel and POL, to include the storage of solar, thermal, kinetic, ect. energy sources that provide for lightweight mobile energy storage in an expeditionary environment.
25	Water	Storage	Log Maneuver	Provide Expeditionary Water Packaging	Water packaging includes metering, purification, certification, & quality surveillance. Man portable containers or the storage system must be capable of distributing water into man pack containers (camelbacks, canteens, etc).
26	Energy & Waste	Planning	Log	Plan and Design Waste-to-Energy Systems	Plan and design expeditionary waste systems: Plan and design systems that recycle waste to include energy harvesting and safe removal of hazardous waste streams from the battlefield.
27	Energy & Waste	Production	Log	Convert waste products into energy during expeditionary operations	Produce energy from various waste streams that can be harvested in expeditionary operations.
28	Waste	Storage	Log	Provide Hazardous Waste Storage in an expeditionary environment	Provide storage for hazardous waste that cannot be converted to useable energy on the battlefield until it can be disposed of or recycled.
29	Waste	Storage	Log	Provide Waste Storage in an expeditionary environment	Provide storage for waste that cannot be converted to useable energy on the battlefield, until it can be disposed of or recycled.

Appendix F
E2W2 CBA Gap and Risk Assessment

F.1 Assessment Method

During the **Gap and Risk Assessment**, the IPT considered the ability of the expeditionary MAGTF, through existing or currently programmed capabilities, to perform the E2W2 tasks to the measures established in the **Mission and Capabilities Assessment**, and assessed the resulting unmitigated operational and institutional risk of any gaps. The IPT identified current capabilities and known gaps using Marine Corps Center for Lessons Learned (MCCLL) documentation and information on current materiel and non-materiel programs (e.g. acquisition requirements and program documentation, USMC Training and Readiness (T&R) Manuals, Military Occupational Specialist (MOS) Manual), Urgent and Deliberate Universal Need Statements (U-UNS and D-UNS), Joint Urgent Operational Needs (JUONs) and subject matter expert experience.

The IPT then compared current and programmed capabilities to the T/C/S identified in the **Capabilities Assessment** in order to identify E2W2 capability gaps and shortfalls. If MAGTF assets were determined to be unable to meet all (or a portion) of the task to the identified standard under the specified conditions then a capability gap (or shortfall) was identified. Gaps and shortfalls were characterized as policy, sufficiency, proficiency, lack of (i.e. absence of) capability, or as the need for replacement or recapitalization of an existing capability and were prioritized in relation to their associated E2W2 task priority. Given the characterized gaps, the Gap Severity (impact on the MAGTF's ability to effectively and efficiently meet E2W2 requirements) for each of the 29 tasks was then rated by each IPT member on a one to nine scale (**Table F-1**). The Gap Severity provided an estimate of the size of the gap in completing the E2W2 task, which was then combined with the Task Priority and Gap Severity to establish a Gap Priority and also applied as a weighting factor in the risk assessment.

Table F-1. Gap Severity Assessment

Criteria \ Gap	Low	Moderate	Significant	High
Rating	2	4	6	8
Gap Severity Measured against identified standards in the context of the Gap Characterization	No identified capability gap that would preclude mission execution to E2W2 Standards	Moderate gap in capability; does not preclude mission execution, but may not achieve E2W2 Standards	Significant gap in capability that adversely effects mission execution, and Fails to achieve E2W2 Standards	Significant gap in capability that precludes mission execution and Fails to achieve E2W2 Standards

Finally, the IPT performed a **Risk Assessment** to identify the operational and institutional risk of not closing the identified E2W2 capability gaps and shortfalls to identified standards. Risk assessment scores provide decision makers with the impact of not mitigating the highest priority gaps. Since this assessment began with already-determined gaps, the probability of the gap not being closed was assumed to be 100% (P = 1.0). First, each IPT member ranked five risk categories by relative importance: risk to mission, risk to force, risk to other resources, risk to institutional capacity, risk to operational timelines. This prioritization combined with Gap Severity provided weights for the ensuing risk rating. Every IPT member then rated each task for risk to each of the five risk categories. Table F-2 depicts the risk definitions applied to this assessment. The previously identified

weights were then applied to these risk ratings to determine the weighted relative risk of the 29 E2W2 tasks. In other words:

[*Probability that a gap occurs*] **x** [*Relative severity of a task's gaps*]

x [*(Relative importance of risk categories)* **x** *(Relative importance of a task to a risk category)*]

= *Weighted relative risk of not closing a specific E2W2 task's gaps.*

Table F-2. E2W2 Risk Assessment Matrix.

Criteria \ Risk	Low	Moderate	Significant	High
Rating	2	4	6	8
Risk to Mission	Near certain achievement	Very likely achievement	Likely achievement	Significant risk of non-achievement
Risk to Force	Full capacity to source requirements	Sourcing requires limited duration capability gaps	Sourcing requires extended duration capability gaps	Requires full mobilization to cover capability gaps
Risk to other Resources	As planned	Requires resources from other plans or operations	Requires resources that create significant shortfalls	Requires resources that preclude other plans or operations
Risk to Institutional Capacity	Full capacity to source requirements	Requires shifts within DOD components to meet requirements	Requires shifts among DOD components to meet requirements	Requirements exceed capacity of the Joint force
Risk to Operational Timeline	As Planned	Minor Extension	Significant Delay	Delays with significant risk of non-achievement

F.2 Results

Several critical Lessons Learned documents and operational after action reports revealed known gaps in current energy, water and waste activities. These identified gaps provided the foundation for conducting the gap assessment and are listed below.

- Most Marines have limited to no awareness of their energy and water demands and the impacts on logistics support.
- There is increasing demand and reliance on fossil fuel for expeditionary forces.
- The force is too heavy; must lighten the combat load.
- Overall footprint has become too large in current and future expeditionary operations
- USMC units cannot achieve energy self-sufficiency in expeditionary environments with today's technology and current TTPs.
- The Marine Corps has not fostered a mindset that recognizes energy and water efficiency as a critical combat enabler.
- The Marine Corps is more lethal today, but has deviated from its center (i.e., fast and austere) in the way it employs energy and resources.
- Legacy equipment was not developed with energy efficiency as a requirement.
- Marine Expeditionary forces cannot organically produce or adequately harvest their own energy and water required for C4ISR and sustainment.

- There is no automated organizational ability to track expeditionary energy and water use.
- Waste is not considered a in the planning process nor is considered a potential source of energy.
- Local sources of energy and water are seldom considered in planning.
- Training regarding employment of energy for combat effectiveness for deployed forces is insufficient.
- Marines are at risk hauling fuel and water.

The gap assessment identified 152 E2W2 capability gaps distributed across the E2W2 functional capability areas:

- Planning (38 gaps)
- Production (38 gaps)
- Storage (20 gaps)
- Distribution (15 gaps)
- Disposal (10 gaps)
- Management (31 gaps)

Table F-2 lists the gap descriptions in Gap Priority order with the associated tasks and standards.

Appendix F
E2W2 CBA Gap and Risk Assessment

Table F-3. E2W2 Capability Gaps by Gap Priority

Gap Priority	E2W2 Functional Area	Task	Joint Capability Area (Tier I / •Tier II)	Attribute	Metric	Measure	Gap Statements	Gap ID (Pri.Cat.#)
1	**Planning**	**Plan to supply Energy (conventional, renewable, alternative) to the MAGTF; integrated throughout the supply chain and with Joint/Coalition and HNS**	**Command & Control** • Organize • Understand • Planning • Decide • Direct • Monitor **Battlespace Awareness** • Intelligence • Environment **Net-Centric** • Information Transport • Information Assurance **Protection** • Prevent • Mitigate **Force Support** • Force Management • Force Preparation	Agile	Units / Commanders have visibility into resource and equipment energy requirements.	Yes / No	**Sufficiency: Lack of sufficient utilities planners involved in the overall planning process.**	**1.S.1**
							Policy: Lack of doctrine requiring utility planners in the in the Operations Department for planning.	**1.P.1**
							Policy: Lack of standardization of the location of planners at the MEF level.	**1.P.2**
				Expeditionary	Energy considerations factor into planning and operations.	Yes / No	**Sufficiency: Lack of sufficient utilities planners involved in the overall planning process.**	**1.S.1**
							Policy: Lack of doctrine requiring utility planners in the in the Operations Department for planning.	**1.P.1**
							Policy: Lack of standardization of the location of planners at the MEF level.	**1.P.2**
				Expeditionary	Fuel considerations factor into planning and operations.	Yes / No	**Sufficiency: Lack of sufficient utilities planners involved in the overall planning process.**	**1.S.1**
							Policy: Lack of doctrine requiring utility planners in the in the Operations Department for planning.	**1.P.1**
							Policy: Lack of standardization of the location of planners at the MEF level.	**1.P.2**
				Interoperable	Energy considerations factor into training and education curriculum.	Yes / No	**Policy: Insufficient training and PME on alternative and renewable energy.**	**1.P.3**
2	**Management**	**Provide the capability to Manage Energy, Water, and Waste Resources in an Expeditionary Environment**	**Command & Control** • Organize • Understand • Planning • Decide • Direct • Monitor **Battlespace Awareness** • Intelligence • Environment **Net-Centric** • Information Transport • Enterprise Services • Net Management • Information Assurance **Logistics** • Deployment & Distribution • Supply • Logistics Services • Engineering **Force Support** • Force Management • Human Capital Management	Interoperable	% units at Battalion / Squadron level and above with an E2W2 data management system enabled	100% (T = O)	**Lack of capability: No existing E2W2 data management system capability**	**2.LC.1**
							Policy: No existing E2W2 data management doctrine and policy	**2.P.1**
				Scalable	Usage and monitoring and metering controls established	Yes / No	**Proficiency: Lack of training of personnel in optimum energy employment**	**2.PR.1**
							Lack of capability: No existing E2W2 monitoring and metering capability	**2.LC.2**
							Policy: No existing E2W2 monitoring and metering doctrine and policy	**2.P.2**
				Expeditionary	Units/ Commanders have visibility into resource use, efficiency and requirements through the use of monitoring and tracking technologies	Yes / No	**Proficiency: Lack of training of personnel in optimum energy employment**	**2.PR.1**
							Lack of capability: No existing E2W2 data management system capability	**2.LC.1**
							Policy: No existing E2W2 monitoring and metering doctrine and policy	**2.P.2**
							Proficiency: Lack of training to conduct expeditionary energy use reviews	**2.PR.2**
				Scalable	Monitor amount of waste (energy harvestable and non-energy harvestable including hazardous) generated per Marine per day during expeditionary ops	Yes / No	**Lack of capability: No existing waste monitoring capability**	**2.LC.3**
							Policy: No existing waste monitoring doctrine and policy	**2.P.3**
				Scalable	Energy capabilities are aligned with energy requirements	Yes / No	**Policy: No existing doctrine and policy for alignment of energy capabilities with energy requirements.**	**2.P.4**
							Policy: Lack of a MAGTF sustainment energy baseline	**2.P.5**
				Interoperable	% of equipment certified to run on alternative fuels/energy	100% (T=O)	**Policy: No existing doctrine or policy regarding equipment alternative fuel use**	**2.P.6**
				Scalable	% of units managing energy demand	100% (T=O)	**Policy: No existing E2W2 management doctrine and policy**	**2.P.7**

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Gap Priority	E2W2 Functional Area	Task	Joint Capability Area (Tier I / •Tier II)	Attribute	Metric	Measure	Gap Statements	Gap ID (Pri.Cat.#)
				Expeditionary	Doctrine and policies incorporate E2W2 efficiency as a Warfighting enabler	Yes / No	**Proficiency: Lack of training of personnel in optimum energy, water, and waste employment**	**2.PR.1**
							Policy: No existing doctrine on optimizing energy, water, waste employment	**2.P.8**
				Expeditionary	MAGTF units have documented waste management plans	Yes / No	**Policy: Lack of policy regarding expeditionary waste management plans**	**2.P.9**
				Agile	% of personnel trained in E2W2 management and awareness	100% (T=O)	**Proficiency: Lack of training of personnel in optimum energy, water, and waste employment**	**2.PR.1**
							Policy: No existing E2W2 management doctrine and policy	**2.P.7**
3	**Production**	**Conduct Combat Operations across the MAGTF with minimal energy and energy related logistics requirements**	**Force Application** • Maneuver • Engagement **Command & Control** • Organize, • Understand • Planning • Decide • Direct • Monitor **Battlespace Awareness** • Intelligence • ISR • Environment **Net-Centric** • Information Assurance Protection • Prevent • Mitigate **Logistics** • Deployment & Distribution • Supply • Logistics Services • Engineering **Force Support** • Force Management	Scalable	% reduction of individual equipment using unique power source	75% (T) / 100% (O)	**Lack of capability: Lack of existing capability to automatically match load to demand.**	**3.LC.1**
							Lack of capability: Lack of a standardized individual power source	**3.LC.2**
							Policy: Lack of standardized procedures and doctrine	**3.P.1**
							Policy: No established individual energy production baseline	**3.P.2**
				Scalable	% reduction of MAGTF equipment using unique power source	75% (T) / 100% (O)	**Lack of capability: Lack of existing capability to automatically match load to demand.**	**3.LC.1**
							Policy: Lack of standardized procedures and doctrine	**3.P.1**
							Policy: No established MAGTF energy production baseline	**3.P.3**
				Expeditionary	Number of days a MAGTF is power self sufficient for C4ISR and life support systems	120 days (T) Indefinite (O)	**Policy: No established MAGTF energy consumption baseline**	**3.P.4**
							Lack of capability: Lack of existing capability to automatically match load to demand.	**3.LC.1**
							Lack of capability: Lack of capability to harvest energy from renewable or waste sources in place to power C4ISR and life support systems	**3.LC.3**
				Agile	% reduction in the amount of energy required to sustain a MAGTF ashore	50% (T=O)	**Lack of capability: Lack of existing capability to automatically match load to demand.**	**3.LC.1**
							Policy: Lack of standardized procedures and doctrine	**3.P.1**
							Policy: No established MAGTF energy consumption baseline	**3.P.4**
4	**Production**	**Produce Energy Efficient Climate Control environments to maintain Personnel and Equipment operating efficiency**	**Force Application** • Maneuver • Engagement **Command & Control** • Organize • Understand • Planning • Decide • Direct • Monitor **Battlespace Awareness** • Intelligence • ISR • Environment **Protection**	Expeditionary	Adequate heating and cooling to optimize personnel performance and endurance with zero fuel requirements across operating climates.	Yes / No	**Policy: No doctrine for climate control for personnel**	**4.P.1**
							Policy: No energy baseline for individual cooling	**4.P.2**
							Policy: No defined requirement for personnel heating and cooling	**4.P.3**
							Lack of capability: No capability to optimize personnel performance across operating climates	**4.LC.1**
				Expeditionary	Adequate heating and cooling to optimize equipment performance with zero fuel requirements across operating climates.	Yes / No	**Policy: No doctrine for climate control for equipment**	**4.P.4**
							Policy: No energy baseline for equipment heating and cooling	**4.P.5**

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Gap Priority	E2W2 Functional Area	Task	Joint Capability Area (Tier I / •Tier II)	Attribute	Metric	Measure	Gap Statements	Gap ID (Pri.Cat.#)
			• Prevent• Mitigate **Logistics** • Deployment & Distribution • Supply • Logistics Services • Engineering **Force Support** • Force Management • Human Capital Management				**Lack of capability: No capability to optimize equipment performance across operating climates**	**4.LC.1**
				Expeditionary	MAGTF shelters are thermally efficient across operating climates	Yes / No	**Need to replace: Replace existing shelters with energy efficient capability**	**4.NR.1**
							Policy: No established standard for shelter thermal efficiency	**4.P.6**
5	**Management**	**Provide the capability to Measure Energy, Water, and Waste Resources in an Expeditionary Environment**	**Command & Control** • Organize • Understand • Planning • Decide • Direct • Monitor **Battlespace Awareness** • Intelligence • Environment **Net-Centric** • Information Transport • Enterprise Services • Net Management • Information Assurance **Logistics** • Deployment & Distribution • Supply • Logistics Services • Engineering **Force Support** • Force Management	Expeditionary	Units / Commanders have visibility into resource use, efficiency and requirements through the use of monitoring and tracking technologies	Yes / No	**Proficiency: Lack of training of personnel in optimum energy employment**	**5.PR.1**
							Policy: No existing E2W2 measurement doctrine and policy	**5.P.1**
				Agile	% of equipment that is metered for power production and consumption	100% (T=O)	**Lack of capability: Power producing and consuming equipment not metered**	**5.LC.1**
							Policy: No existing E2W2 measurement doctrine and policy	**5.P.1**
				Agile	% of equipment that is metered for fuel consumption	100% (T=O)	**Sufficiency: Fuel consumption not monitored on all fuel dispensing or fuel-consuming equipment**	**5.S.1**
							Policy: No existing E2W2 measurement doctrine and policy	**5.P.1**
				Agile	% of equipment that is metered for water production and consumption	100% (T=O)	**Lack of capability: All water production and storage equipment not metered**	**5.LC.2**
							Policy: No existing E2W2 measurement doctrine and policy	**5.P.1**
				Agile	% of equipment that is metered for waste generation and reuse	85% (T) / 100% (O)	**Lack of capability: No existing waste-metering capability**	**5.LC.3**
							Policy: No existing E2W2 measurement doctrine and policy	**5.P.1**
6	**Distribution**	**Conduct "smart" expeditionary Electrical Distribution**	**Force Application** • Maneuver • Engagement **Command & Control** • Organize • Understand • Planning • Decide • Direct • Monitor **Battlespace Awareness** • Intelligence • ISR • Environment **Net-Centric** • Information Transport • Enterprise Services	Scalable	Energy production is aligned with energy consumption	Yes / No	**Policy: No baseline**	**6.P.1**
				Scalable	% continuous power produced matched to consumption	85%(T) / 100%(O)	**Lack of capability: Lack existing capability to autonomously and automatically match power production to consumption**	**6.LC.1**

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Gap Priority	E2W2 Functional Area	Task	Joint Capability Area (Tier I / •Tier II)	Attribute	Metric	Measure	Gap Statements	Gap ID (Pri.Cat.#)
			• Net Management • Information Assurance **Protection** • Prevent • Mitigate **Logistics** • Deployment & Distribution • Supply • Logistics Services • Engineering	Scalable	Energy distribution enables efficient integration of multiple energy sources.	Yes / No	**Lack of capability: Lack existing capability to efficiently integrate multiple energy sources**	**6.LC.2**
7	**Planning**	**Develop Plans to Support Efficient, Scalable Expeditionary Forward Operating Base Water Systems and Hygiene Service**	**Command & Control** • Organize • Understand • Planning • Decide • Direct • Monitor **Battlespace Awareness** • Intelligence • ISR • **Environment** **Net-Centric** • Information Transport • Enterprise Services • Net Management • Information Assurance **Protection** • Prevent • Mitigate **Logistics** • Deployment & Distribution • Supply • Logistics Services • Engineering	Expeditionary	Water considerations factor into planning and operations	Yes / No	**Proficiency: Lack of ability to scale FOB water systems and Hygiene Service.**	**7.PR.1**
							Sufficiency: Lack of sufficient utilities planners involved in FOB planning & design.	**7.S.1**
							Sufficiency: Lack of appropriate trained personnel.	**7.S.2**
							Lack of capability: Planning and design tools for scalable FOB design.	**7.LC.1**
							Policy: Insufficient doctrine and policy on the planning for scalable FOB design.	**7.P.1**
							Policy: Lack of standardized training across the MAGTF on scalable FOB design.	**7.P.2**
							Sufficiency: Insufficient training and PME on scalable FOB design.	**7.S.3**
				Expeditionary	Planners factor waste management (biological and non-biological) into mission planning	Yes / No	**Sufficiency: Lack of sufficient utilities planners involved in the overall planning process.**	**7.S.4**
							Policy: Lack of doctrine requiring utility planners in the in the Operations Department for planning.	**7.P.3**
							Policy: Lack of standardization of the location of planners at the MEF level.	**7.P.4**
8	**Planning**	**Design Efficient, Scalable, and Interoperable, Expeditionary Energy Producing and Consuming Warfighting Capabilities**	**Force Application** • Maneuver • Engagement **Command & Control** • Organize • Understand • Planning • Decide • Direct **Battlespace Awareness** • Intelligence • Environment **Net-Centric** • Information Transport • Enterprise Services • Net Management	Agile	% of personnel trained in energy effectiveness	100% (T = O)	**Sufficiency: Lack of appropriately trained personnel.**	**8.S.1**
							Proficiency: Lack of ability to use renewable or alternative power sources on the battlefield.	**8.PR.1**
							Lack of capability: No existing planning and design tools for alternatives and renewables.	**8.LC.1**
							Policy: Insufficient training and PME on alternative and renewable power sources.	**8.P.1**
				Scalable	Scalability and energy performance considered in planning and design	Yes / No	**Sufficiency: Lack of sufficient utilities planners involved in the FOB scalability planning & design.**	**8.S.2**
							Lack of capability: No existing planning and design tools for alternatives and renewables.	**8.LC.1**
							Policy: Insufficient doctrine and policy on planning and design for scalability and interoperable energy performance in warfighting capabilities.	**8.P.2**

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Gap Priority	E2W2 Functional Area	Task	Joint Capability Area (Tier I / •Tier II)	Attribute	Metric	Measure	Gap Statements	Gap ID (Pri.Cat.#)
			• Information Assurance **Logistics** • Deployment & Distribution • Supply • Logistics Services • Engineering **Force Support** • Force Preparation				**Policy: Lack of standardized training across the MAGTF on scalability and energy performance .**	**8.P.3**
				Expeditionary	Trained personnel available and on hand to support plan and design of efficient FOBs at the unit/HQ level	Yes / No	**Sufficiency: Lack of appropriate trained personnel.**	**8.S.3**
							Policy: Lack of standardized training across the MAGTF on scalability and energy performance in FOB design.	**8.P.3**
				Expeditionary	Appropriate doctrine and training provided for scalable FOB design	Yes / No	**Sufficiency: Lack of appropriate trained personnel.**	**8.S.4**
							Policy: No existing doctrine on scalability and energy performance in FOB design.	**8.P.4**
							Policy: Lack of standardized training across the MAGTF on scalability and energy performance in FOB design.	**8.P.3**
9	**Planning**	**Plan for reductions in energy demands of current and future capability sets without reducing combat / mission effectiveness**	**Command & Control** • Organize • Understand • Planning • Decide • Direct • Monitor **Battlespace Awareness** • Intelligence • Environment **Net-Centric** • Information Transport • Enterprise Services • Net Management • Information Assurance **Logistics** • Deployment & Distribution • Supply • Logistics Services • Engineering **Force Support** • Force Preparation	Agile	Requirements reduce MAGTF equipment using unique power sources	Yes / No	**Policy: No established standard for power sources**	**9.P.1**
				Scalable	Power generation equipment systems are scalable and interoperable	Yes / No	**Policy: No established standard for power sources**	**9.P.1**
				Lethal	Requirements increase energy performance of fielded powered equipment	Yes / No	**Policy: No established standard for power sources**	**9.P.1**
				Expeditionary	Energy performance is incorporated as an analysis criteria early in the requirements process	Yes / No	**Policy: No established energy performance requirements criteria**	**9.P.2**
10	**Planning**	**Plan to produce all C4ISR energy and power requirements organically in place**	**Command & Control** • Organize, • Understand • Planning • Decide • Direct **Battlespace Awareness** • Environment **Net-Centric** • Information Transport • Enterprise Services • Net Management • Information Assurance **Logistics** • Deployment & Distribution • Logistics Services • Engineering **Force Support** • Force Preparation	Expeditionary	Number of days a MAGTF is power self sufficient for C4ISR and sustainment systems	120 days	**Sufficiency: Lack of sufficient utilities planners involved in planning**	**10.S.1**

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Gap Priority	E2W2 Functional Area	Task	Joint Capability Area (Tier I / •Tier II)	Attribute	Metric	Measure	Gap Statements	Gap ID (Pri.Cat.#)
11	**Distribution**	**Conduct Expeditionary Water Distribution**	**Force Application** • Maneuver • Engagement **Command & Control** • Organize • Understand • Planning • Decide • Direct • Monitor **Battlespace Awareness** • Intelligence • ISR • Environment **Protection** • Prevent • Mitigate **Logistics** • Deployment & Distribution • Supply • Logistics Services • Engineering **Force Support** • Force Management • Human Capital Management	Scalable	Autonomous and automatic capability to monitor water distribution across the MAGTF	Yes / No	**Lack of capability: No autonomous and automatic capability**	**11.LC.1**
							Sufficiency: Limited capabilities exist to efficiently distribute water	**11.S.1**
							Need to replace: Replace/upgrade existing water distribution capability	**11.NR.1**
				Agile	Grey wastewater reclaimed / reused as potable water	Yes / No	**Lack of Capability: No capability to reclaim and reuse grey water**	**11.LC.2**
							Sufficiency: Limited capabilities exist to efficiently distribute water	**11.S.2**
							Need to replace: Replace/upgrade existing capability to manage grey water	**11.NR.2**
							Policy: No policy exists for reclaim and reuse of grey water.	**11.P.1**
				Lethal	Self-sufficient water distribution conducted at the Battalion / Squadron level and below	Yes / No	**Policy: Limited doctrine for water distribution at the Battalion / Squadron level and below**	**11.P.2**
							Sufficiency: Limited capabilities exist to efficiently distribute water	**11.S.1**
							Need to replace: Replace/upgrade existing water distribution capability	**11.NR.1**
				Scalable	Adequate water distribution equipment on hand to enable water self-sufficiency at the Battalion / Squadron level and below	Yes / No	**Policy: Limited doctrine for water distribution at the Battalion / Squadron level and below**	**11.P.2**
							Sufficiency: Limited capabilities exist to efficiently distribute water	**11.S.1**
							Need to replace: Replace/upgrade existing water distribution capability	**11.NR.1**
12	**Management**	**Provide the capability to Analyze data on Energy, Water, and Waste Resources in an expeditionary environment**	**Command & Control** • Understand • Decide • Direct • Monitor **Battlespace Awareness** • Intelligence **Net-Centric** • Information Transport • Net Management • Information Assurance **Logistics** • Deployment & Distribution • Engineering **Force Support** • Force Management	Interoperable	% units at the Battalion / Squadron level and above with an E2W2 data management system enabled	100% (T=O)	**Proficiency: Lack of trained personnel to analyze E2W2 data.**	**12.PR.1**
							Lack of capability: No existing E2W2 data management capability	**12.LC.1**
							Policy: No existing E2W2 data management doctrine or policy	**12.P.1**
				Expeditionary	Units have adequate analytical / decision support tools for assessment of energy, water and waste management	Yes/No	**Proficiency: Lack of training of personnel in optimum energy employment**	**12.PR.2**
							Lack of capability: No existing E2W2 analysis or decision support capability	**12.LC.2**
							Policy: No existing E2W2 analysis doctrine or policy	**12.P.2**
							Policy: Lack of an E2W2 baseline for all MAGTF variants	**12.P.3**
				Expeditionary	Units / Commanders have visibility into waste and hazardous waste streams	Yes/No	**Policy: Insufficient doctrine and policy for expeditionary recycling and disposal of non-hazardous waste**	**12.P.4**
							Policy: Insufficient doctrine for monitoring amount of waste generated	**12.P.5**
13	**Production**	**Provide for the efficient production of Potable/Non-Potable water in an expeditionary environment**	**Force Application** • Maneuver • Engagement **Command & Control** • Organize, • Understand	Scalable	Distributed potable water production capability to the Company level and below	Yes/No	**Sufficiency: Lack of small unit water purification assets**	**13.S.1**

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Gap Priority	E2W2 Functional Area	Task	Joint Capability Area (Tier I / •Tier II)	Attribute	Metric	Measure	Gap Statements	Gap ID (Pri.Cat.#)
			• Planning • Decide • Direct • Monitor **Battlespace Awareness** • Intelligence • ISR • Environment **Net-Centric** • Information Assurance **Protection** • Prevent • Mitigate **Logistics** • Deployment & Distribution • Supply • Logistics Services • Engineering **Force Support** • Force Management				**Proficiency: Lack of trained personnel to conduct distributed potable water production to the Company level and below**	**13.PR.1**
							Policy: No doctrine or policy exists regarding small unit (Company and below) water purification systems	**13.P.1**
				Expeditionary	Days a MAGTF is able to sustain water self-sufficiency at the individual Battalion / Squadron unit level and below	120 days	**Lack of capability: Minimal capability to allow units to obtain and maintain water self-sufficiency**	**13.LC.1**
							Sufficiency: Lack of small unit water purification assets	**13.S.1**
							Proficiency: Lack of trained personnel to conduct distributed potable water production to the Company level and below	**13.PR.1**
							Policy: No doctrine or policy exists regarding small unit (Company and below) water purification systems	**13.P.1**
				Expeditionary	Dismounted water self-sufficiency at the squad level	7 days (T) / 21 days (O)	**Lack of capability: No ability to maintain dismounted water self-sufficiency**	**13.LC.2**
							Policy: No policy or doctrine addressing dismounted rifle squad level water self-sufficiency	**13.P.2**
							Policy: Military testing and preventive medicine policy does not address use of small unit water purification systems (e.g. low pressure reverse osmosis), that meet short-term (<30 days) potability standards, for repeated short intervals that may aggregate to greater than 30 days over some time period	**13.P.3**
14	**Production**	**Provide a Power Source appropriate to the individual user's required capability**	**Force Application** • Maneuver • Engagement **Command & Control** • Organize • Understand • Planning • Monitor **Battlespace Awareness** • Environment **Logistics** • Deployment & Distribution • Supply • Logistics Services • Engineering **Force Support** • Force Management	Agile	Reduction of individual personal equipment using unique power source	Yes / No	**Lack of capability: Lack of common and/or renewable power source**	**14.LC.1**
							Need to replace: Need to replace/modify legacy equipment to accept common power source	**14.NR.1**
							Policy: No established standard for individual power sources	**14.P.1**
							Policy: No doctrine or policy exists for individual power sources (e.g. batteries)	**14.P.2**
				Lethal	% of energy requirements met with renewable sources	100% (T=O)	**Lack of capability: Lack of individual renewable power systems**	**14.LC.2**
							Need to replace: Need to replace/modify legacy equipment to accept renewable power source	**14.NR.2**
							Policy: No policy requiring individual renewable power source	**14.P.3**
				Expeditionary	Power and energy requirements aligned with operational requirements	Yes / No	**Policy: No established standards for individual power sources**	**14.P.1**
15	**Distribution**	**Conduct Expeditionary Bulk Fuel Distribution**	**Force Application** • Maneuver **Command & Control** • Decide • Direct • Monitor Protection • Prevent • Mitigate **Logistics**	Expeditionary	Units/ Commanders have visibility into fuel use, efficiency, energy performance, and requirements at the unit and end item level through the use of monitoring and tracking technologies	Yes / No	**Proficiency: Some capability exists to meter but lack of raining to conduct metering and maintain data**	**15.PR.1**
							Policy: No policy for comprehensive fuel data management across the MAGTF and to the MARFOR and HQMC level	**15.P.1**
							Sufficiency: Inadequate / Incomplete monitoring and data management tools	**15.S.1**
				Agile	Equipment is metered for fuel consumption	Yes / No	**Sufficiency: Incomplete metering capability**	**15.S.2**
				Expeditionary	Fuel distribution is tailored to demand in operations	Yes / No	**Policy: No policy for assessing unit fuel demand profiles**	**15.P.2**

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Gap Priority	E2W2 Functional Area	Task	Joint Capability Area (Tier I / •Tier II)	Attribute	Metric	Measure	Gap Statements	Gap ID (Pri.Cat.#)
			• Deployment & Distribution • Supply • Logistics Services • Engineering **Force Support** • Force Management				**Policy: No established standard fuel demand planning profiles**	**15.P.2**
				Agile	% reduction in the requirement to transport fuel in an expeditionary environment	25% (T) / 50% (O)	**Proficiency: Lack of training to conduct tailored fuel planning and distribution**	**15.PR.2**
							Proficiency: Lack of training to mitigate distribution with allocation of renewable energy assets	**15.PR.3**
							Policy: No MAGTF fuel consumption baseline	**15.P.2**
16	**Storage**	**Provide Expeditionary Water Storage**	**Force Application** • Maneuver • Engagement **Command & Control** • Organize • Understand • Planning • Decide • Direct • Monitor **Protection** • Prevent • Mitigate **Logistics** • Supply • Logistics Services • Engineering **Force Support** • Force Management	Expeditionary	Water usage, monitoring and metering established	Yes / No	**Lack of capability: No autonomic metering capability on existing storage equipment**	**16.LC.1**
							Policy: No policy that directs adherence to Service and Joint water doctrine	**16.P.1**
				Expeditionary	Units / Commanders have visibility into resource use, efficiency and requirements through the use of monitoring and tracking technologies	Yes / No	**Lack of capability: No autonomic metering capability on existing storage equipment**	**16.LC.1**
				Expeditionary	Product water storage considerations factor into planning and operations	Yes / No	**Policy: No policy that directs adherence to Service and Joint water doctrine**	**16.P.1**
				Agile	% of bulk storage equipment that is metered for water consumption	100% (T=O)	**Lack of capability: No autonomic metering capability on existing storage equipment**	**16.LC.1**
				Agile	Self-sufficient water storage conducted at the Battalion / Squadron level and below	Yes / No	**Policy: Lack of doctrine regarding water self-sufficiency at the Battalion / Squadron level and below**	**16.P.2**
							Lack of capability: Lack of capability to efficiently heat or cool product water	**16.LC.2**
				Expeditionary	Number of days for a MAGTF ashore to transition to locally purified water	30 days (T) 0 days (O)	**Policy: No policy that directs adherence to Service and Joint water doctrine**	**16.P.1**
							Policy: Lack of doctrine regarding water self-sufficiency at the Battalion / Squadron level and below	**16.P.2**
							Sufficiency: Limited expeditionary water capabilities at the Battalion / Squadron level and below	**16.S.1**
17	**Production**	**Provide for the efficient production of recycled Potable/Non-Potable water in an expeditionary environment**	**Force Application** • Maneuver • Engagement **Command & Control** • Organize, • Understand • Planning • Decide • Direct • Monitor **Battlespace Awareness** • Intelligence • ISR • Environment **Net-Centric** • Information Assurance **Protection** • Prevent • Mitigate **Logistics** • Deployment & Distribution	Expeditionary	Grey wastewater reclaimed / reused as potable water	Yes / No	**Need to replace: Current capability inefficient and limited in ability to reclaim and purify grey water**	**17.NR.1**
							Policy: No policy directing grey water reclaim and reuse	**17.P.1**
				Lethal	Water self-sufficiency achieved to the Battalion / Squadron level and below	Yes / No	**Need to replace: Current capability inefficient and limited in ability to reclaim and purify grey water**	**17.NR.1**
				Agile	Hygiene and laundry equipment is metered for water recycling	Yes / No	**Lack of capability: No metering capability for recycled water**	**17.LC.1**

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Gap Priority	E2W2 Functional Area	Task	Joint Capability Area (Tier I / •Tier II)	Attribute	Metric	Measure	Gap Statements	Gap ID (Pri.Cat.#)
			• Supply • Logistics Services • Engineering **Force Support** • Force Management					
18	**Disposal**	**Provide Efficient/Effective Disposal of Non Reusable Solid Waste in an Expeditionary Environment**	**Command & Control** • Organize • Understand • Planning • Decide • Direct • Monitor **Battlespace Awareness** • Environment **Logistics** • Supply • Logistics Services • Engineering **Force Support** • Force Management	Agile	Reduced weight of solid waste generated per day	25% (T) 50% (O)	**Policy: No solid waste generation baseline**	**18.P.1**
							Policy: Lack of doctrine regarding expeditionary non-reusable solid waste management	**18.P.2**
							Policy: Lack of policy regarding documented expeditionary non-reusable solid waste management plans	**18.P.3**
							Lack of capability: Lack of materiel capabilities to reduce non-reusable solid waste	**18.LC.1**
19	**Planning**	**Develop Plans to Manage, recycle and dispose of Waste (Water, Solid, Biological) and Hazardous Waste**	**Command & Control** • Organize • Understand • Planning • Decide • Direct • Monitor **Battlespace Awareness** • Intelligence • ISR • Environment **Logistics** • Deployment & Distribution • Supply • Logistics Services • Engineering **Force Support** • Force Management • Human Capital Management	Expeditionary	Planners factor waste management (biological and non-biological) into mission planning	Yes / No	**Policy: Lack of policy on employment of utilities planners in the planning process to adequately address recycling and waste disposal**	**19.P.1**
							Policy: Insufficient doctrine and policy for recycling and disposal of non-hazardous waste	**19.P.2**
							Policy: Lack of standardization of the location of planners at the MEF level.	**19.P.3**
				Expeditionary	MAGTF units have documented waste management plans	Yes / No	**Policy: Lack of policy regarding expeditionary waste management plans**	**19.P.4**
				Scalable	Waste streams monitored and measured	Yes / No	**Lack of Capability: No capability to monitor and measure waste production and to manage waste data**	**19.LC.1**
							Policy: Insufficient doctrine for waste generation monitoring	**19.P.5**
20	**Planning**	**Develop migration plan for FOB to transition from expeditionary to enduring base**	**Force Application** • Maneuver • Engagement **Command & Control** • Organize • Understand • Planning • Decide	Scalable	Personnel trained in scalable FOB transition planning	Yes / No	**Policy: Lack of policy on employment of utilities planners in the transition planning process**	**20.P.1**
							Policy: Insufficient doctrine and policy on transitioning from an expeditionary to an enduring base	**20.P.2**

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Gap Priority	E2W2 Functional Area	Task	Joint Capability Area (Tier I / •Tier II)	Attribute	Metric	Measure	Gap Statements	Gap ID (Pri.Cat.#)
			• Direct • Monitor **Logistics** • Deployment & Distribution • Supply • Logistics Services • Engineering **Force Support** • Force Management • Human Capital Management	Agile	Trained personnel available and on hand to support plan and design of efficient FOBs at the Battalion / Squadron headquarters level and above	Yes / No	**Policy: Lack of policy on employment of utilities planners in the transition planning process**	**20.P.1**
							Policy: Insufficient doctrine and policy on transitioning from an expeditionary to an enduring base	**20.P.2**
				Expeditionary	Appropriate doctrine and training provided for scalable FOB design	Yes / No	**Policy: Insufficient doctrine and policy on scalable FOB planning and design**	**20.P.3**
21	**Storage**	**Provide Expeditionary Bulk Fuel Storage**	**Force Application** • Maneuver • Engagement **Command & Control** • Organize • Understand • Planning • Decide • Direct • Monitor **Protection** • Prevent • Mitigate **Logistics** • Supply • Logistics Services • Engineering **Force Support** • Force Management	Scalable	Fuel usage, monitoring and metering established	Yes / No	**Lack of capability: Need for autonomic metering capability on bulk fuel storage systems**	**21.LC.1**
				Expeditionary	Units / Commanders have visibility into fuel use, efficiency, energy performance, and requirements at the unit and end item level through the use of monitoring and tracking technologies	Yes / No	**Lack of capability: Need for fuel data management and decision support capabilities**	**21.LC.2**
				Expeditionary	Fuel storage and consumption factor into operational	Yes / No	**Policy: Lack of doctrine and policy requiring fuel planning that efficiently matches ground power demands through optimized storage**	**21.P.1**
				Agile	% of fuel storage equipment that is metered	100% (T=O)	**Lack of capability: Need for autonomic metering capability on bulk fuel storage systems**	**21.LC.1**
22	**Storage**	**Provide Storage for Collection of Energy Sources Other than Liquid Fuels**	**Force Application** • Maneuver • Engagement **Command & Control** • Organize • Understand • Planning • Decide • Direct • Monitor **Protection** • Prevent • Mitigate **Logistics** • Supply • Logistics Services • Engineering **Force Support** • Force Management	Scalable	Scalable energy storage matched to demand	Yes / No	**Lack of capability: No scalable expeditionary energy storage capability**	**22.LC.1**
							Policy: No policy established for harvesting and storing energy sources other than liquid fuel	**22.P.1**
				Expeditionary	Energy harvesting and storage factored into planning and operations	Yes / No	**Policy: No policy established for harvesting and storing energy sources other than liquid fuel**	**22.P.1**
				Agile	Units have the ability to harvest and store energy from available sources	Yes / No	**Lack of capability: No current capability to harvest available potential and kinetic energy**	**22.LC.1**

Appendix F
E2W2 CBA Gap and Risk Assessment

Gap Priority	E2W2 Functional Area	Task	Joint Capability Area (Tier I / •Tier II)	Attribute	Metric	Measure	Gap Statements	Gap ID (Pri.Cat.#)
23	**Storage**	**Provide Expeditionary Water Packaging**	**Force Application** • Maneuver • Engagement **Command & Control** • Organize • Understand • Planning • Decide • Direct • Monitor **Protection** • Prevent • Mitigate **Logistics** • Supply • Logistics Services • Engineering **Force Support** • Force Management	Agile	Adequate water packaging equipment available to enable water self-sufficiency at the Battalion / Squadron level and below	Yes / No	**Lack of capability: No capability to package water at the Battalion / Squadron level and below**	**23.LC.1**
							Policy: Lack of doctrine for water packaging at the Battalion / Squadron level and below	**23.P.1**
				Scalable	Scalable water packaging from the MEF to individual scale	Yes / No	**Lack of capability: Lack of bulk water packaging capability at all MAGTF levels**	**23.LC.2**
							Policy: Lack of policy on small unit (Company and below) and individual water packaging	**23.P.2**
24	**Management**	**Management of additional tasks to comply with higher guidance (i.e. DODI regarding burn pits, etc.) in an expeditionary environment**	**Command & Control** • Organize • Understand • Planning • Decide • Direct • Monitor **Logistics** • Deployment & Distribution • Supply • Logistics Services • Engineering **Force Support** • Force Management • Human Capital Management	Scalable	% of operational units conducting annual expeditionary energy use reviews	100% (T=O)	**Policy: Lack of policy on expeditionary energy use reviews**	**24.P.1**
				Expeditionary	Fuel and energy procedures are integrated across the MAGTF	Yes / No	**Policy: Lack of doctrine on expeditionary energy use**	**24.P.2**
					Doctrine and policies incorporate energy efficiency as a warfighting enabler	Yes / No	**Policy: Lack of doctrine on expeditionary energy use**	**24.P.2**
				Interoperable	USMC Expeditionary Energy requirements are synchronized with Joint and Coalition operations	Yes / No	**Policy: Lack of doctrine on expeditionary energy use**	**24.P.2**
25	**Planning**	**Plan and Design Waste-to-Energy Systems**	**Command & Control** • Organize • Understand • Planning • Decide • Direct • Monitor **Battlespace Awareness** • Intelligence • ISR • Environment	Expeditionary	Units / Commanders have visibility into waste streams	Yes / No	**Policy: Lack of doctrine and policy on measuring waste generation**	**25.P.1**
							Lack of Capability: No capability to monitor and measure waste production and to manage waste data	**25.LC.1**

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E2W2 CBA Gap and Risk Assessment

Gap Priority	E2W2 Functional Area	Task	Joint Capability Area (Tier I / •Tier II)	Attribute	Metric	Measure	Gap Statements	Gap ID (Pri.Cat.#)
			Protection • Prevent • Mitigate **Logistics** • Deployment & Distribution • Supply • Logistics Services • Engineering **Force Support** • Force Management • Human Capital Management	Expeditionary	Planners factor waste management (biological and non-biological) into mission planning	Yes / No	**Policy: Insufficient doctrine and policy on expeditionary waste planning and management**	**25.P.1**
				Scalable	Expeditionary waste-to-energy systems available	Yes / No	**Policy: No waste generation or composition baseline**	**25.P.2**
							Lack of capability: No material capability to convert waste-to-energy	**25.LC.2**
26	**Disposal**	**Provide Efficient/Effective Disposal of Non Reusable Hazardous Waste in an Expeditionary Environment**	**Command & Control** • Organize • Understand • Planning • Decide • Direct • Monitor **Battlespace Awareness** • Environment **Logistics** • Supply • Logistics Services • Engineering **Force Support** • Force Management	Expeditionary	Unit has developed a plan for hazardous waste management	Yes / No	**Need to replace: Need to upgrade current capabilities to meet policy requirements**	**26.NR.1**
							Policy: Lack of doctrine regarding expeditionary hazardous waste management	**26.P.1**
				Agile	Reduced weight of hazardous waste generated per day	Yes / No	**Policy: No hazardous waste generation baseline**	**26.P.2**
							Policy: Lack of doctrine regarding expeditionary hazardous waste management	**26.P.3**
							Policy: Lack of policy regarding documented expeditionary hazardous waste management plans	**26.P.4**
							Lack of capability: Lack of materiel capabilities to reduce expeditionary hazardous waste	**26.LC.1**
27	**Production**	**Convert waste products into energy during expeditionary operations**	**Force Application** • Maneuver • Engagement **Command & Control** • Organize • Understand • Planning • Decide • Direct • Monitor **Battlespace Awareness** • Intelligence • ISR • Environment **Protection** • Prevent • Mitigate **Logistics** • Deployment & Distribution • Supply	Agile	Battlefield materials designed to maximize waste-to-energy conversion	Yes / No	**Lack of capability: No capability to convert waste products into energy**	**27.LC.1**
							Policy: No waste generation or composition baseline	**27.P.1**
							Policy: No established standards for battlefield materials to enable waste-to-energy conversion	**27.P.2**
				Agile	% of unit waste used to generate power	10% (T) / 25% (O)	**Lack of capability: No capability to convert waste products into energy**	**27.LC.1**
							Policy: No waste generation or composition baseline	**27.P.1**
				Scalable	Monitor amount of energy-convertible waste generated per Marine per day during expeditionary ops	Yes / No	**Lack of Capability: No capability to monitor and measure waste production and to manage waste data**	**27.LC.2**
							Policy: No existing waste monitoring doctrine and policy	**27.P.3**

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E2W2 CBA Gap and Risk Assessment

Gap Priority	E2W2 Functional Area	Task	Joint Capability Area (Tier I / •Tier II)	Attribute	Metric	Measure	Gap Statements	Gap ID (Pri.Cat.#)
			• Logistics Services • Engineering **Force Support** • Force Management	Scalable	Monitor amount of energy-convertible waste generated per Marine per day during expeditionary ops	Yes / No	**Lack of Capability: No capability to monitor and measure waste production and to manage waste data**	**27.LC.2**
28	**Storage**	**Provide Hazardous Waste Storage in an expeditionary environment**	**Force Application** • Maneuver • Engagement **Command & Control** • Organize • Understand • Planning • Decide • Direct • Monitor **Battlespace Awareness** • Intelligence • ISR • Environment **Protection** • Prevent • Mitigate **Logistics** • Deployment & Distribution • Supply • Logistics Services • Engineering **Force Support** • Force Management	Expeditionary	MAGTF units have a documented plan for expeditionary hazardous waste management	Yes / No	**Policy: Lack of policy for expeditionary hazardous waste management plans**	**28.P.1**
							Sufficiency: Lack of trained personnel in expeditionary hazardous waste management	**28.S.1**
				Scalable	Scalable expeditionary hazardous waste storage equipment that meets regulatory requirements is available	Yes / No	**Lack of capability: Lack of scalable expeditionary hazardous waste storage equipment**	**28.LC.1**
29	**Storage**	**Provide Waste Storage in an expeditionary environment**	**Command & Control** • Organize • Understand • Planning • Decide • Direct • Monitor **Battlespace Awareness** • Intelligence • ISR • Environment **Protection** • Prevent • Mitigate **Logistics** • Deployment & Distribution • Supply • Logistics Services • Engineering **Force Support** • Force Management	Agile	Scalable expeditionary waste storage equipment available	Yes / No	**Lack of capability: Lack of scalable expeditionary waste storage equipment**	**29.LC.1**
							Policy: Lack of policy for expeditionary hazardous waste management plans	**29.P.1**
				Expeditionary	MAGTF units have a documented plan for expeditionary waste management	Yes/No	**Policy: Lack of policy for expeditionary waste management plans**	**29.P.2**
							Sufficiency: Lack of trained personnel in expeditionary hazardous waste management	**29.S.1**

Appendix G
E2W2 CBA Solutions Approach Assessment

G.1 Assessment Method

During the **Solutions Approach Assessment** the IPT examined the **Gap and Risk Assessment** results and identified non-materiel and materiel solution approaches to mitigate E2W2 gaps in order to make solution recommendations. The IPT first reviewed the previously defined E2W2 tasks and gaps and through iterative idea generation and group discussion identified non-materiel approaches across doctrine, organization, training, leadership and education, personnel, and facilities (DOTLPF). Using the same methodology, the IPT then identified materiel solution approaches to those gaps for which non-materiel solution approaches would not fully mitigate the gap. These proposed materiel solutions were further categorized as *Evolutionary*, *Transformational* (e.g. breakthrough technology), or *Information Technology (IT)*. A wide range of potential approaches were identified and prioritized based on the highest ability to fill a gap and/or mitigate a risk.

G.2 Results

The **Solutions Approach Assessment** determined that non-materiel solutions are particularly important for both near-term mitigation and to guide mid- to long-term materiel solution development. 160 non-materiel approaches or solution alternatives were recommended for inclusion in the full analysis effort. Establishing doctrine and policy, updating Tactics, Techniques, and Procedures, developing and providing appropriate training, and minor organization and personnel adjustments can provide significant near-term mitigation of multiple gaps. Per JCIDS guidance, the best approach to integrating possible non-materiel and materiel approaches is to start with those non-materiel solutions that can have immediate impact on improving overall capability, and that is also the recommendation of the E2W2 IPT. However, taken alone, non-materiel solutions are insufficient to achieve the robust E2W2 capability directed by the E2 Strategy or demanded by expected future operational scenarios.

Research identified over 22 relevant materiel programs, systems or approaches. Along with these potential programs, the IPT identified 87 materiel solution approaches across all three categories (IT, Evolutionary, Transformational) and applicable to 27 of the 29 tasks. The assessment indicates that the majority of materiel solution approaches are within the Evolutionary (Recapitalization) and Transformational (Breakout) categories. This suggests that current and programmed capabilities can support gap mitigation, but in several key areas new technology is needed. For Evolutionary approaches, system proficiency (how well a capability performs) and sufficiency (how much of a capability is required) need to be assessed further. The need for improved information technology to support mission planning, execution and management is evident by the number of tasks requiring a solution approach within the IT category.

There are programmed efforts underway in each of the materiel approach categories, but they are not comprehensive enough to mitigate future gaps and are not focused by a common requirements and acquisition strategy or materiel standards architecture across the Warfighting functions.

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E2W2 CBA Solutions Approach Assessment

Table G-1: Solution Approaches Material and Non-Material

Task Information			Non-Materiel Solution Approaches						Materiel Solution Approaches		
Gap Priority	Function	Task	Doctrine	Organization	Training	Leadership & Education	Personnel	Facilities	IT	Evolutionary	Transformational
1	Planning	Plan to supply Energy (conventional, renewable, alternative) to the MAGTF; integrated throughout the supply chain and with Joint/Coalition and HNS	1. Develop E2W2 doctrinal publication and implement in MCPP and MSTP. Address E2W2 efficiencies and best practices and include updates to bulk liquid logistics doctrine that addresses small unit water self-sufficiency in support of EMO. 2. Develop standardized TTPs for utility planners at the MEF level. 3. Establish renewable energy and waste-to-energy doctrine within existing logistics, engineering and utility doctrine and TTPs. 4. Promote the development of joint E2W2 doctrine and standards. 5. Publish guidance on applying energy considerations to acquisition life cycle cost estimates and analyses of alternatives. 6. Establish policy for energy as a risk factor in planning, similar to ORM.	1. Establish appropriate T/O and T/E requirements for utility planners to support planning at all the MEF/MSC levels. 2. Assess organizational capabilities to support E2W2 initiatives and doctrine.	1. Develop a flexible (entry to career level), scalable (individual to collective training standards) training continuum that addresses E2W2 ethos, planning and management. 2. Modify officer and enlisted military occupational specialty (MOS) training, as determined by the Course Content Review Board (CCRB) and Training and Readiness (T&R) Manual Review processes, to reflect knowledge and skills required to understand, plan, coordinate, integrate, and maintain E2W2 capabilities.	1. Develop and incorporate E2W2 considerations in POIs for planning education activities into entry and career level schooling (boot camp-to-war college level). 2. Incorporate E2W2 planning considerations across the MAGTF within in the PME continuum. 3. Develop POIs for war gaming and sand table scenarios to train Marines on E2W2 initiatives and capabilities.	1. Evaluate personnel requirements to support E2W2 planning requirements.		1. Interoperability software for existing logistics systems and metering systems. 2. Energy COI to determine proper data structure and taxonomy.	1. Develop Energy Planning Tools. 2. Apply common data structure and taxonomy via a Service-Oriented Architecture (SOA) to current Programs of Record (POR). 3. Develop means to supply energy by reducing the power demand via more energy efficient equipment (reduced power requirements on computers/AC's/plasma/comm).	1. Evaluate new technologies to move beyond current Mobile Electric Power (MEP) capability.

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Task Information			Non-Materiel Solution Approaches						Materiel Solution Approaches		
Gap Priority	**Function**	**Task**	**Doctrine**	**Organization**	**Training**	**Leadership & Education**	**Personnel**	**Facilities**	**IT**	**Evolutionary**	**Transformational**
2	Management	Provide the capability to Manage Energy, Water, and Waste Resources in an Expeditionary Environment	1. Develop doctrine and policy regarding E2W2 data management systems. 2. Develop doctrine and policy regarding E2W2 monitoring and metering. 3. Establish baseline for amount of energy to sustain a MAGTF. 4. Develop doctrine and policy regarding alternative fuels/energy usage. 5. Establish baseline for the reduction of fossil fuel use. 6. Doctrine and policy regarding alignment of logistics and operational requirements for fuel and energy efficiency. 7. Develop policy concerning the management of waste. 8. Develop doctrine and policy regarding incorporation of energy efficiency as a warfighting enabler and a mission risk factor.		1. Train personnel in optimum energy, water, and waste employment. 2. Train personnel to conduct expeditionary energy use reviews.	1. Incorporate E2W2 considerations in planning and education at all levels. 2. Educate leadership in: holistic management of E2W2 resources; appropriate staffing/use of MOSs to achieve efficient/combat effective operations; T/O and T/E requirements to achieve efficiency and optimize resources to reduce logistic requirements; systems approach to managing sustainment operations 3. Develop small and large unit award incentives for expeditionary energy performance.	1. Evaluate approaches to optimize the use of trained MOS personnel to achieve efficient resource use.			1. Develop the capability to remotely monitor MEPDIS-R current readings to allow for re-wire / repower in low usage areas. 2. Develop “smart” power controls that automatically match power load to demand.	

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Task Information			Non-Materiel Solution Approaches						Materiel Solution Approaches		
Gap Priority	**Function**	**Task**	**Doctrine**	**Organization**	**Training**	**Leadership & Education**	**Personnel**	**Facilities**	**IT**	**Evolutionary**	**Transformational**
3	Production	Conduct Combat Operations across the MAGTF with minimal energy and energy related logistics requirements	1. Develop standardized procedures and doctrine on power use, power production, and usage of renewable energy from the individual to the MAGTF level. 2. Establish a MAGTF energy production and consumption baseline.		1. Develop and conduct training at all levels to conduct combat operations with minimal energy requirements. 2. Develop training materials for unit energy coordinators once this collateral duty is defined.	1. Education at all levels to conduct combat operations with minimal energy requirements. I\ 2. Educate Marines to know and be aware of their individual and collective energy footprint, and should include education on how to observe, analyze and act on information regarding energy use, and understand the first, second and third order effects of energy use on operational options, and trade-offs in the operational decision space.				1. Increase efforts to field the Advanced Medium-Sized Mobile Power Source (AMMPS). 2. Provide more Mobile Electric Power Distribution System - Replacement (MEPDIS-R) equipment. 3. Increase commonality of power equipment and batteries. 4. Develop more efficient and fewer battery types with an emphasis on rechargeable batteries. 5. Evolve current program of record systems with energy performance improvements.	1. Develop "smart" power distribution technologies with alternative energy functionality at the required scale (e.g.: Micro Grid Remote Hybrid Power Solutions; solar fields and lighting systems; containerized energy power generation and storage system; solar laminates, photovoltaics, renewable energy systems; transportable hybrid electric power station). 2. Develop Family of Systems (light, medium, heavy) approach for procuring equipment. 3. Better packaging, load configuration capability to maximize vehicle lift in fuel, water, cargo. Consider bustle racks, other racks. 4. Develop lighter tactical wheeled vehicle capabilities.
4	Production	Produce Energy Efficient Climate Control environments to maintain Personnel and Equipment operating efficiency	1. Develop doctrine and policy regarding climate control for personnel and equipment. [Doctrine should incorporate guidance on managing energy needed for completing missions, and associated QOL implications.]	1. Evaluate T/E for climate control equipment to ensure standardization and appropriate level of capability.	1. Include efficient climate control measures in appropriate training materials.	1. Educate leadership on the effective use of climate control systems / solutions.				1. Develop and field tent liners to reduce Environmental Control Units (ECU) load and duty cycle; durable, better insulated shelters. 2. Employ the same concept that solar paneled homes use; attach solar panel to each ECU to help off-set power draw on the grid.	1. Explore other technologies beyond A/C powered ECUs.
5	Management	Provide the capability to Measure Energy, Water, and Waste Resources in an Expeditionary Environment	1. Establish doctrine and policy regarding E2W2 data management systems. 2. Establish doctrine and policy regarding E2W2 monitoring and metering.		1. Train personnel in optimum energy employment. 2. Train personnel to conduct expeditionary energy use reviews.					1. Develop metering capability for all devices and power sources to more effectively deploy energy, water and waste assets. 2. Evolve current systems and create new systems with the ability to measure and transmit the data.	

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Task Information			Non-Materiel Solution Approaches						Materiel Solution Approaches		
Gap Priority	**Function**	**Task**	**Doctrine**	**Organization**	**Training**	**Leadership & Education**	**Personnel**	**Facilities**	**IT**	**Evolutionary**	**Transformational**
6	Distribution	Conduct "smart" expeditionary Electrical Distribution	1. Establish baseline for expeditionary electrical distribution (should include scalability and interoperability). 2. Publish guidance on best practices for power distribution grid design, and water and hygiene services, and waste-to-energy operations.	1. Evaluate T/O and T/E to meet requirements for expeditionary electrical distribution planning.		1. Educate leaders to create awareness of expeditionary power systems operations and benefits to reducing logistical footprint and overall requirements.	1. Evaluate the requirement for additional Utility Marines to support small units.			1. Develop ”smart” power systems that automatically match load to demand at different scales. 2. Provide additional MEPDIS-R in the OPFOR. 3. Adapt available load management technology to generator sets to allow the small unit leaders to monitor output/usage. 4. Establish metering systems in all power production equipment. 5. Power management and monitoring system to allow small unit leaders to make energy decisions and allow logisticians to more accurately predict future requirements.	1. Develop a smart power controller. 2. Develop power storage and distribution solutions that integrate with common hardware, reducing the requirement for specialized equipment for computers, and other such devices.
7	Planning	Develop Plans to Support Efficient, Scalable Expeditionary Forward Operating Base Water Systems and Hygiene Service	1. Develop doctrine and policy on the scalability planning of FOB design specific to water systems and hygiene services. 2. Integrate all facets of E2W2 planning and execution into pre-deployment training and other training exercises to increase the proficiency and sufficiency of the deploying expeditionary energy, water and waste operational capability.	1. Evaluate T/O and T/E requirements for utility planners to support scalable FOB planning, and design specific to water and hygiene services. This includes examination of 1171 MOS and PMT requirements.	1. Develop a flexible (entry to career level), scalable (individual to collective training standards) training continuum that addresses E2W2 ethos, planning and management. 2. Modify officer and enlisted military occupational specialty (MOS) training, as determined by the Course Content Review Board (CCRB) and Training and Readiness (T&R) Manual Review processes, to reflect knowledge and skills required to understand, plan, coordinate, integrate, and maintain E2W2 capabilities. 3. Incorporate alternative and renewable energy and waste management training in appropriate courses. 4. Evaluate PMT training at the small unit level associated with water storage.	1. Incorporate water quality, safety, and considerations for sustainment across the ROMO within Professional Military Education. [Objective: to provide leadership the knowledge to direct Marines to use locally sourced/purified water.]	1. Evaluate personnel requirements to support E2W2 planning and FOB utilities design.	.	1. Common planning tool for water and waste that is application independent and can be added to DOD IT SOA		

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Task Information			Non-Materiel Solution Approaches						Materiel Solution Approaches		
Gap Priority	**Function**	**Task**	**Doctrine**	**Organization**	**Training**	**Leadership & Education**	**Personnel**	**Facilities**	**IT**	**Evolutionary**	**Transformational**
8	Planning	Design Efficient, Scalable, and Interoperable, Expeditionary Energy Producing and Consuming Warfighting Capabilities	1. Develop doctrine and policy on the scalable (define) power planning and design. [Note: energy employment doctrine that incorporates, or synchronizes with, expeditionary logistics doctrine.] 2. Develop and implement joint standards. 3. Develop standards for efficient FOB design. 4. Publish guidance on the inclusion of operational energy performance parameters and system attributes in all requirements documents for systems that produce or consume energy, water, or waste.	1. Evaluate Tables of Equipment (T/E) for opportunities to increase energy efficiency by "right-sizing" the T/E for energy producing or consuming equipment and to support integration and expanded use of energy efficient	1. Integrate E2W2 planning and execution (e.g. scalable FOB design) into standardized pre-deployment training and other training exercises to increase the proficiency and sufficiency of the deploying expeditionary energy, water and waste operational capability.	1. Develop and integrate E2W2 material into officer and enlisted professional military education (PME) that is tailored for entry, intermediate and advanced level programs.	1. Evaluate rank, MOS, and population requirements to provide adequate numbers of trained planners at the MEFs and MSCs to enable effective E2W2 planning, to include efficient FOB utilities (including distributed power systems).design, and management.	1. Establish core FOB design models for planners to support with additive elements related to mission requirements.	1. Utilize AutoDISE as a planning tool: update with power requirements of fielded loads. 2. Use SOA tools to support planning.	1. Develop a deployable FOB module in self-sustainable capability sets designed to make max use of utilities support (power, water, HVAC) and that are interconnectable for expansion and/or reduction. 2. Develop ruggedized lightweight, deployable alternative/renewable (solar, wind, geo-thermal, nuclear) power systems for unit level and individual use. 3. Provide additional funding for advanced battery work - new standardized high energy batteries. 4. Evolve current systems to improve energy efficiency. 5. Continue development of vehicle exportable power systems.	1. Develop "smart" systems that provide renewable power, power storage, and power control. 2. Develop component parts and systems that reflect the holistic utility systems relationship for power, water, waste, and force protection. 3. Develop future C4ISR and weapon systems with the most energy efficient internal components and that do not require heating or cooling. 4. Develop technologies that create the power required C4ISR systems in place.
9	Planning	Plan for reductions in energy demands of current and future capability sets without reducing combat/mission effectiveness	1. Establish baseline doctrine and policy for energy efficiency. 2. Publish guidance on the inclusion of operational energy performance parameters and system attributes in all requirements documents for systems that produce or consume energy, water, or waste.	1. Evaluate T/O and T/E structures and employment options for increases in energy efficiency.	1. Modify officer and enlisted military occupational specialty (MOS) training, as determined by the Course Content Review Board (CCRB) and Training and Readiness (T&R) Manual Review processes, to reflect knowledge and skills required to understand, plan, coordinate, integrate, and maintain E2W2 capabilities.	1. Education at all levels to reduce energy usage, when applicable, without impact to mission. 2. Educate planners and leaders to consider moving only the capabilities forward necessary for operations and leave "non-shooters" in the rear with the gear.	1. Evaluate options for removing "non-shooters" (contractors) from battlespace - operating from non-restricted environments.			1. Evolve current systems to include energy performance parameters. 2. Adapt energy-saving technologies to legacy systems. 3. Replace lighting and backlit systems with more efficient solutions (e.g. LED lights, screens, etc.) 4. Develop systems that tie in efficient equipment, renewable energy and generator sets.	1. Develop transformational technologies that are powered by most efficient power source and reduce demand for energy. 2. Examine potential for vehicles to efficiently harvest, store, and efficiently share mobile power to onboard and offboard systems.

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Task Information			Non-Materiel Solution Approaches						Materiel Solution Approaches		
Gap Priority	**Function**	**Task**	**Doctrine**	**Organization**	**Training**	**Leadership & Education**	**Personnel**	**Facilities**	**IT**	**Evolutionary**	**Transformational**
10	Planning	Plan to produce all C4ISR energy and power requirements organically in place	1. Develop a Marine Corps Reference Publication that addresses MAGTF E2W2 operations across WFFs and MAGTF elements and provides comprehensive guidance to commanders, planners, and SMEs on efficient expeditionary Forward Operating Base (FOB) design. 2. Integrate E2W2 capabilities into existing and emerging Marine Corps doctrinal publications. Address E2W2 efficiencies and best practices and include updates to bulk liquid logistics doctrine that addresses small unit water self-sufficiency in support of EMO. 3. Develop standard procedures for employing utility planners at the MEB level and above. 4. Add renewable energy and waste-to-energy considerations and planning factors to existing logistics, engineering and utility doctrine and TTPs.	1. Review all organizational structure that supports E2W2 capabilities. 2. Evaluate Tables of Organization (T/O) requirements for utility planners to support planning at the MEF and Major Subordinate Command (MSC) levels. 3. Ensure adequate quantities and appropriate assignment of utility planners to support integrated E2W2 throughout MAGTF planning processes. equipment.	1. Establish training requirements on organic power production approaches and systems, including integrating across multiple power sources as well as load management.	1. Develop and integrate E2W2 material into officer and enlisted professional military education (PME) that is tailored for entry, intermediate and advanced level programs.	1. Evaluate rank, MOS, and population requirements to provide adequate numbers of trained planners at the MEFs and MSCs to enable effective E2W2 planning, to include efficient FOB utilities design, and management.		1. Develop interoperability software for existing logistics systems and metering systems to provide commanders with real-time accessible, visible, and understandable information regarding energy and water usage.		
11	Distribution	Conduct Expeditionary Water Distribution	1. Develop doctrine for water distribution (metering, reuse, self-sufficiency).	1. Evaluate T/E to support water self-sufficiency from the MEF to the rifle squad level.	1. Conduct training down to the small unit level to support capability and to instill confidence and habits of thought and action for water self-sufficiency.	1. Educate leadership and Marines to "drink what we make." Expeditionary water distribution should be distribution of water production not just trucking bottled water from point to point. 2. Develop and integrate E2W2 material into officer and enlisted professional military education (PME). Include familiarization with water capabilities and employment best practices. Emphasize the importance of planning for and using organic water resources.	1. Assess the need for additional utilities water technicians to conduct water system operation, testing, and maintenance 2. Assess the need for additional Corpsmen to conduct water sampling, field testing, certification, and preventive medicine training in direct support to the battalion level and below.		1. Develop systems that support autonomous and automatic monitoring of water distribution.	1. Develop small unit and individual water purification systems that increase the ability to distribute water production and decrease the demand for water distribution.	1. Develop man-portable small unit and individual water purification and testing technology that can be powered by renewable energy sources, is robust enough for long-term consumption and able to be operated and maintained with minimal training or specialization.

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Task Information			Non-Materiel Solution Approaches						Materiel Solution Approaches		
Gap Priority	**Function**	**Task**	**Doctrine**	**Organization**	**Training**	**Leadership & Education**	**Personnel**	**Facilities**	**IT**	**Evolutionary**	**Transformational**
12	Management	Provide the capability to Analyze data on Energy, Water, and Waste Resources in an expeditionary environment	1. Establish doctrine and policy regarding E2W2 data management systems. 2. Establish baseline for amount of fuel, batteries, and water to sustain a MAGTF.		1. Train personnel in optimizing energy performance. 2. Train personnel to conduct expeditionary energy use reviews.	1. Incorporate E2W2 considerations in planner education.				1. Develop metering capability for all devices and power sources to more effectively deploy energy, water and waste assets. 2. Evolve current systems and create new systems with the ability to measure and transmit the data.	
13	Production	Provide for the efficient production of Potable/Non-Potable water in an expeditionary environment	1. Establish baseline for the production of potable & non-potable water. 2. Develop policy specific to use of non-organically produced water (i.e. bottle water). 3. Develop TTPs for small unit water purification during pre-deployment training. 4. Publish a formal water policy that reinforces doctrine and provides commanders with clear intent to reduce the current dependency on bottled water on the battlefield and return to organic, more self-sufficient potable water production.	1. Assess MLG T/O and MAGTF T/O for appropriate alignment of 1171's. 2. Evaluate T/E to support water self-sufficiency from the MEF to the rifle squad level.	1. Develop training below the MAGTF level to support the production and distribution of water at the company and below level to augment the bulk water capability. 2. Increase preventive medicine training for Corpsmen for testing, certifying and maintaining water standards at the small unit level.	1. Develop and integrate E2W2 material into officer and enlisted professional military education (PME). Include familiarization with water capabilities and employment best practices. Emphasize the importance of planning for and using organic water resources.	1. Assess the need for additional utilities water technicians to conduct water system operation, testing, and maintenance 2. Assess the need for additional Corpsmen to conduct water sampling, field testing, certification, and preventive medicine training in direct support to the battalion level and below.			1. Vehicle and man-transportable, small unit water purifier that supports Platoon level operations. 2. Improve ruggedization (MIL-STD-810) of existing Commercial Off The Shelf (COTS) small unit water purifiers for military suitability. 3. Modify and expand availability of existing field testing kits and ruggedize for use by any MOS and without the need for field calibration.	1. Develop man-portable small unit and individual water purification and testing technology that can be powered by renewable energy sources, is robust enough for long-term consumption and able to be operated and maintained with minimal training or specialization.
14	Production	Provide a Power Source appropriate to the individual user's required capability	1. Establish policy on common power sources (define) for individual personal equipment. 2. Publish a formal battery policy to guide requirements, engineering, and acquisition decisions and to standardize operating forces' battery procurement and management. This policy should focus on increasing battery commonality and the use of rechargeable media in order to maximize renewable energy storage and to lighten the individual and MAGTF load.		1. Develop and conduct training on common power sources capability and usage.	1. Educate personnel on planning factors on how and when to resupply power sources for individual users need; should be included in leader's PME at the company level and below.				1. Developed equipment and systems that require less power. 2. Increase commonality across power source (battery). 3. Develop man-portable battery chargers (more efficient flexible solar panels, fuel cells) to reduce the individual battery load and need for resupply. 4. Provide individuals the ability to obtain power from vehicles and other mobility and non-mobility sources.	1. Power source (battery) duration needs to be measured in days or weeks rather than hours - might involve mechanical energy or alternative source such as nuclear/isotopes. 2. Future systems need to be constrained on the number of battery types. 3. Future systems must be forward compatible with future power sources. Requires common connector and/or interface. 4. Develop individual power management and monitoring capability that would allow user to accurately determine remaining battery life and selectively distribution of power based on mission needs.

Appendix G

E2W2 CBA Solutions Approach Assessment

Task Information			Non-Materiel Solution Approaches						Materiel Solution Approaches		
Gap Priority	**Function**	**Task**	**Doctrine**	**Organization**	**Training**	**Leadership & Education**	**Personnel**	**Facilities**	**IT**	**Evolutionary**	**Transformational**
15	Distribution	Conduct Expeditionary Bulk Fuel Distribution	1. Develop and establish policy for the use of fuel monitoring and tracking applications. Policy that specifically states which distribution mediums should be metered and recorded. Policy should be to drive toward a common, reconcilable database for tracking fuel use, which is accessible to both planners and programmers. 2. Establish baseline for fuel usage metering.	1. Evaluate T/O and T/E requirements for Bulk Fuel support current/future missions.	1. Conduct training to properly conduct fuel usage metering.	1. Educate leadership on the direct linkage between fuel efficiency and combat effectiveness.				1. Expand family of tactical fuel flow metering systems. 2. Expand Embedded Platform Logistics System (EPLS). 3. Improve air delivery methods from seabases.	
16	Storage	Provide Expeditionary Water Storage	1. Evaluate current policy concerning bottled-to-bladder and bottle vice purified water. 2. Publish a formal water policy that reinforces doctrine and provides commanders with clear intent to reduce the current dependency on bottled water on the battlefield and return to organic, more self-sufficient potable water production, packaging, and storage.		1. Conduct training at the unit level regarding water storage, disinfection and potability requirements, and considerations.	1. Educate leaders to allow them to educate (teach) subordinates to safely use packaged /stored water that is organically produced / purified.	1. Assess the need for additional Corpsmen to conduct water sampling, field testing, certification, and preventive medicine training to store bulk water at the battalion level and below.				1. Develop a transformational capability that any MOS can employ to potable water standards.
17	Production	Provide for the efficient production of recycled Potable/Non-Potable water in an expeditionary environment	1. Establish policy for reclaim reuse of grey water.	1. Evaluate the T/O and T/E requirements associated with reclaiming and reusing gray water in an expeditionary operation environment.		1. Establish specific guidelines for leaders to routinely educate units on the use/reuse of gray water.					1. Consider development of technologies to provide the capabilities for waste water reuse systems; shower water reuse systems; laundry water reuse systems; supercritical Water Purification Units (WPUs); member bioreactor to ultraviolet disinfection WPUs; hollow-fiber membrane bioreactors to ultraviolet disinfection WPUs; membrane filtration WPUs; photo catalytic oxidation WPUs; membrane bioreactor WPUs; immobilized cell bioreactor WPUs; water from air; and water from exhaust systems.

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E2W2 CBA Solutions Approach Assessment

Task Information			Non-Materiel Solution Approaches						Materiel Solution Approaches		
Gap Priority	Function	Task	Doctrine	Organization	Training	Leadership & Education	Personnel	Facilities	IT	Evolutionary	Transformational
18	Disposal	Provide Efficient/ Effective Disposal of Non Reusable Solid Waste in an Expeditionary Environment	1. Develop doctrine and policy regarding non-reusable solid waste management. Doctrine and policy should be focused on source reduction and disposal of non-reusable solid and hazardous waste in expeditionary environment. 2. Establish baseline for lbs/tons of solid waste/day disposed. 3. Waste management plans should be developed. This should cover all waste categories.		1. Conduct training at the small units on disposal of non-reusable solid and hazardous waste in expeditionary environment.	1. Educate leaders to incorporate planning for non-reusable solid and hazardous waste management (to include disposal) into mission planning.				1. Redesign packaging and nonmilitary materiel to be recyclable.	
19	Planning	Develop Plans to Manage, recycle and dispose of Waste (Water, Solid, Biological) and Hazardous Waste	1. Develop doctrine and policy on recycling and disposal of non-hazardous waste, and monitoring the amount of waste generated. [Consider 'greener' sustainable products that can be composted, reused, recycled or safely disposed.] 2. Evaluate current standards for determining what is hazardous.	1. Evaluate T/O and T/E requirements to enable planning for waste recycling, reuse, and disposal.	1. Evaluate, and if required, develop POIs on the recycling and disposal of waste and hazardous waste. [Integrate recycling, waste management at level of individual Marine in basic training.]		1. Evaluate incorporating recycling responsibilities and oversight into HAZMAT MOS.		1. Develop common IT data structure IAW with DOD SOA. 2. Develop systems to monitor and manage waste data.	1. Develop TO&Es for solid and hazardous (water, solid, biological, and hazardous) waste collection, segregation, recycling, packaging /crushing/baling, back loading, spill cleanup, and disposal equipment.	1. Packaging should be either muti-use (reusable box / container), compostable or if disposable-made of material which has a high energy return when burned (e.g. through gasification).
20	Planning	Develop migration plan for FOB to transition from expeditionary to enduring base	1. Develop doctrine and policy on transitioning from an expeditionary to an enduring (define) base that incorporates master planning in all operations and includes an annex with a checklist of standards and policies for Relief-in-Place / Transfer-of-Authority	1. Evaluate T/O and T/E to meet requirements for base transition planning process. 2. Coordinate all joint RDT&E efforts in this area.	1. Develop training materials for training individuals on planning for transitions from an expeditionary to an enduring base.	1. Include planning factors for transition of FOBs to enduring bases in PME at Officer and SNCO level schools.				1. Develop capability to tie in/transfer to another service's power production and distribution without loss of power - examine Joint implications and commonality of equipment issues.	
21	Storage	Provide Expeditionary Bulk Fuel Storage								1. Develop, optimize, and increase use of seabased bulk fuel as we become more energy independent.	
22	Storage	Provide Storage for Collection of Energy Sources Other than Liquid Fuels	1. Establish policy for the collection of energy sources outside liquid fuels.							1. Adapt existing storage technology to increase endurance and commonality with interfaces for tactical system application.	1. Develop rugged, high-energy density storage that can adapt to multiple system form factors and acceptable weight and size requirements.

Appendix G

E2W2 CBA Solutions Approach Assessment

Task Information			Non-Materiel Solution Approaches						Materiel Solution Approaches		
Gap Priority	**Function**	**Task**	**Doctrine**	**Organization**	**Training**	**Leadership & Education**	**Personnel**	**Facilities**	**IT**	**Evolutionary**	**Transformational**
23	Storage	Provide Expeditionary Water Packaging	1. Develop policy concerning expeditionary water packaging systems.			1. Educate leaders to allow them to educate (teach) subordinates to safely use packaged water that is organically produced / purified.				1. Develop a quick disconnect for water bull to 5 Gal jug to Camelback. Ease and speed of use promotes usage.	1. Develop rugged, lightweight collapsible water containment carriers (hold 400 - 500 gallons) used during the production and distribution. The container is folded up and put away.
24	Management	Management of additional tasks to comply with higher guidance (i.e. DODI regarding burn pits, etc.) in an expeditionary environment	1. Establish policy and doctrine on compliance with higher guidance in an expeditionary environment. 2. Support development on a joint policy on expeditionary energy use reviews. 3. Develop doctrine and policy regarding incorporation of energy efficiency as a warfighting enabler. 3. Develop doctrine and policy regarding USMC E2W2 requirement synchronization with Joint and Coalition operations. 4. Develop doctrine and policy regarding reduction of greenhouse gas emissions. 5. Establish policy for reducing solid waste packaging either by weight or volume.		1. Modify officer and enlisted military occupational specialty (MOS) training, as determined by the Course Content Review Board (CCRB) and Training and Readiness (T&R) Manual Review processes, to reflect knowledge and skills required to understand, plan, coordinate, integrate, and maintain E2W2 capabilities.	1. Incorporation of E2W2 considerations in planning education. 2. Educate leaders to incorporate waste, water and energy guidance into mission planning, implementation, and evaluation activities.				
25	Planning	Plan and Design Waste-to-Energy Systems	1. Develop doctrine and policy on converting waste to energy.	1. Additional utility planners involved in the overall planning process for energy production. 2. Additional utility planners involved in the overall planning process for energy production	1. Establish training requirements to support the changes in doctrine for converting waste to energy.					1. Develop equipment modified from Commercial-Off-The-Shelf technology to meet expeditionary requirements in all types of terrains and climates.	1. Develop kits with expeditionary waste-to-energy systems for all types of terrains and climates.
26	Disposal	Provide Efficient/Effective Disposal of Non Reusable Hazardous Waste in an Expeditionary Environment	1. Develop doctrine and policy regarding hazardous waste management.								

Appendix G

E2W2 CBA Solutions Approach Assessment

Task Information			Non-Materiel Solution Approaches						Materiel Solution Approaches		
Gap Priority	**Function**	**Task**	**Doctrine**	**Organization**	**Training**	**Leadership & Education**	**Personnel**	**Facilities**	**IT**	**Evolutionary**	**Transformational**
27	Production	Convert waste products into energy during expeditionary operations	1. Establish baseline for weight and volume per day of re-usable solid waste produced by different units under different conditions. 2. Identify waste-to-energy conversion potential for different units under different conditions.							1. Develop means to conduct deliberate packaging (change of materials) for greater opportunity to maximize this strategy.	1. Develop capabilities to turn waste to energy for use during expeditionary operations.
28	Storage	Provide Hazardous Waste Storage in an expeditionary environment			1. Develop POIs and conduct training for Marines in hazardous waste storage in an expeditionary environment. 2. Develop POIs and conduct training and skills to reclaim HAZMAT.	1. Educate leaders to evaluate hazardous waste management plans and inspect storage sites.	1. Evaluate the requirement for additional personnel trained in hazardous waste storage in an expeditionary environment.			1. Develop scalable, expeditionary hazardous waste storage equipment.	1. New technologies in waste-to-energy will drive likely solutions in this area.
29	Storage	Provide Waste Storage in an expeditionary environment	1. Develop policy concerning the management of waste. This policy needs to address types of waste to be stored, length of storage, and procedures for disposal or conversion to energy.				1. Evaluate the need for the creation of an MOS to handle waste disposal and recycling.			1. Develop scalable, expeditionary waste storage equipment.	

Consolidated Action Officer & O-6 Level Comment Resolution Matrix

ITEM	#	SOURCE	TYPE	PAGE	LINE	COMMENT	RATIONALE	DECISION (A/R/M)
1	1	CD&I/CDD/CYID Robert A. Gearhart, GS-15, Deputy Director CYID, 703-432-8581.	n/a	n/a	n/a	Concur no comment.	n/a	N/A
2	1	CD&I/CDD/TFSD Sgt Wells, 703-784-6253	n/a	n/a	n/a	This is not within TFSD's realm of expertise dealing with Manpower or Structure.	n/a	N/A
3	1	CD&I/CDD/C2ID	n/a	n/a	n/a	Concur. The ICD thoroughly analyzes the energy issues facing the Marine Corps and articulates a path to support Vision and Strategy 2025.	Energy KPPs and KSAs were one of the policy recommendations in this ICD. As C2ID develops JCIDS documentation for new capabilities we should consider energy efficiencies as a KPP or KSA (until created).	N/A
4	1	CD&I/CDD/IID Maj Norris, 432-8290	n/a	n/a	n/a	Concur without comment.	n/a	N/A
5	1	CD&I/CDD/FPID Maj Ryan Hansen, 432-8462	n/a	n/a	n/a	Concurs without comment	n/a	N/A
6	1	CD&I/CDD/FMID LtCol Christopher Woodburn, (703)784-6219	n/a	n/a	n/a	That FMID support the ICD as written.	The ICD is in line with current MERS activities, and Maneuver Branch recommends concurring with the document as written. No changes are recommended.	N/A
7	1	CD&I/CDD/MID Milton Staton, (703) 784-4969, milton.staton@usmc.mil	A	7: 1.1:		In the sentence that reads: "To project those vehicles… the number of vehicles", recommend striking the word "project" and insert the word "protect"	The recommended insertion best describes how the addition of the armor relates to the decrease in miles per gallon	A
8	2	CD&I/CDD/MID Milton Staton, (703) 784-4969, milton.staton@usmc.mil	S	20: 6.2:		Recommend inserting a subparagraph c) to read as follows: "Publish guidance on how amortization scales/tables should be considered in replacing legacy equipment"	If such boundaries are not considered, there is a huge potential to pursue solutions that may have miniscule return on investment relative to the extent of gap mitigation that is achieved. For example, with respect to fuel consumption improvements, if a proposed capability yields a "one mile per gallon improvement" over an existing capability, yet the outlay for the procurement will take 15 years to realize a net savings from fewer gallons of fuel purchased. One should be asking if the relative benefit justifies the procurement.	R

ITEM	#	SOURCE	TYPE	PAGE	LINE	COMMENT	RATIONALE	DECISION (A/R/M)
9	3	CD&I/CDD/MID Milton Staton, (703) 784-4969, milton.staton@usmc.mil	S	23: 7:		Recommend inserting the following paragraph in the "Final Recommendations" paragraph: "A well-integrated, "system of systems approach" will be absolutely critical in determining whether or not the metrics in Appendix F are met. The "measures" and "metrics" in this appendix are designed to quantify the extent to which the gap's attribute, relative to the task, has been achieved. Individual capabilities developed under this construct are subsets that lend themselves to holistic system required. Without a well-devised, systems integration approach, the potential exists for the pursuit of "disparate solutions" without any discernable measure of the extent to which the "solution sought" actually mitigates the gap."	The current and future architects/authors of the concepts, policies, doctrine, and capability documents that will result from this ICD, must be reminded of the critical role that the system of systems approach will play in ensuring that the right solutions are sought. The insertion of this paragraph is an attempted means towards that end.	A
10	4	CD&I/CDD/MID Mr. Ray Romero (703) 784-1386, ray.m.romero@usmc.mil	S			The E2 implementation plan has been applied to critical capabilities, therefore identifying potential energy inefficiencies as gaps in each WFF, and not as a result of a sound operational CONOPS.	MAGTF CBA findings may conflict with E2W2 Implementation Plan and ICD . Energy efficiency in of itself is not a capability but rather an attribute to be applied during materiel development as a result of policy. Priority of materiel solutions during the POM process may need integration.	A
11	5	CD&I/CDD/MID Mr. Ray Romero (703) 784-1386, ray.m.romero@usmc.mil	S			Recommendation: Address materiel gaps as current systems become obsolete and or reach end of the systems life cycle, thereby allowing for prioritizing as part of a near, mid, long term funding strategy.	A thorough business case analysis to determine cost and efficiency benefits may justify cost/resources associated with development of appropriate requirements documentation. Procurement of materiel solutions may NOT be cost effective and or beneficial, due consideration of all associated cost to include risk and or trade-offs which could preclude a solution from coming reality.	A
12	1	DC CD&I /TECOM G-3				TECOM (G-3) Overall Comment: "Concur with Comment. TECOM will incorporate E2W2 material solutions as part of the normal acquisition process and the respective programs Manpower, Personnel, and Training Plan Process. Non Material solutions will be incorporated into the Training and Education continuum based on validated requirements via the Course Content Review Board (CCRB) and Training and Readiness (T&R) Manual Review process. For E2W2 material and non-material solutions incorporation within the Pre-Deployment Training Program, recommend the Expeditionary Energy Office engage DC PP&O on the Force Generation Process (MCO 3502.6). Commanding General, Training and Education Command directed incorporating energy efficiency and facilitation of E2Os endstate within the TECOM Campaign Plan, currently under development."		N/A
13	2	DC CD&I /TECOM michael.bowman@usmc.mil	A	7	1.1	Marine Corps Combat Service Support Schools To project protect those vehicles armor has been added, which directly decreases vehicle miles	Typo?	A
14	3	DC CD&I /TECOM LtCol A. L. Petway,	S	6.5, p 21		TECOM (LPD) The MOSs primarily affected will be log (04XX) and Engineering (13XX		N/A

ITEM	#	SOURCE	TYPE	PAGE	LINE	COMMENT	RATIONALE	DECISION (A/R/M)
		TECOM (GTD) (703) 635-6478; AUSTIN.PETWAY @USMC.MIL				and 11XX). The T&R manuals will reflect larger level tasks (i.e., plan general engineering). Specific E2W2 aspects will likely be captured in T&R event performance steps rather than as a stand alone E2W2 event.		
15	4	DC CD&I /TECOM LtCol A. L. Petway, TECOM (GTD) (703) 635-6478; AUSTIN.PETWAY @USMC.MIL	S	6.6b, p 22		Inclusion of E2W2 instruction into all levels of T&E may be inappropriate. Entry level training should focus on making Marines and training proficiency in essential skills. E2W2 training and education should be tailored to a the specific audience.		P
16	5	DC CD&I /TECOM Capt Andrew Snyder, Andrew.c.snyder@ usmc.mil	M	6.5.a		Remove the word “highly”	“highly” is an abstract term meaning different things to different people. The flexibility should be defined by the Objective and Threshold in the Capabilities Production Document	A
17	6	DC CD&I /TECOM Capt Andrew Snyder,	M	6.5.a		Replace the word “training curriculum” with “training continuum, Entry Level to Career,”	The flexibility should reside in the skills the Marine receives throughout their career, not the individual curriculum	A
18	7	DC CD&I /TECOM Capt Andrew Snyder, Andrew.c.snyder@ usmc.mil	M	6.5b		Remove entire paragraph “Include Programs of Instruction and advocate… and alternative energy, and waste-to-energy systems”	This gets into the weeds and tells TECOM and the advocates “how to train”. All skills reside within T&R Manuals. However, neither the requirement nor the capability exists to train all Events within Programs 8of Instruction. Where the training resides will be determined by the Course Content Review Board (CCRB) and T&R Manual Review Processes.	P
19	8	DC CD&I /TECOM Capt Andrew Snyder, Andrew.c.snyder@ usmc.mil	M	6.5.c		Remove entire line “Include standardized training across the MAGTF on scalable FOB design”	Addresses specifics which should be scoped by the CPD, not explicitly levied in an ICD	P
20	9	DC CD&I /TECOM Capt Andrew Snyder, Andrew.c.snyder@ usmc.mil	M	6.5.e		Remove or define “energy use reviews”	What specifically is being reviewed? What are the metrics? What is the endstate?	A
21	10	DC CD&I /TECOM Andrew.c.snyder@ usmc.mil	M	App G	Gap 1; Trng	Remove #’s 1 and 2 completely. Replace with “1.) Develop a flexible (entry to career level), scalable (individual Marine to battalion sized units) training continuum that addresses E2W2 ethos, planning and management. 2. Modify officer and enlisted military occupational specialty (MOS) training, as determined by the Course Content Review Board (CCRB) and Training and Readiness (T&R) Manual Review processes, to reflect knowledge and skills required to understand, plan, coordinate, integrate, and maintain E2W2 capabilities. “	Aligns verbiage with Section 6.5 of main body and more accurately articulates USMC service level training.	A
22	11	DC CD&I /TECOM	M	App G	Gap 1;	1. Develop and incorporate E2W2 considerations in POIs for planning	Aligns verbiage with Section 6.5 of	A

ITEM	#	SOURCE	TYPE	PAGE	LINE	COMMENT	RATIONALE	DECISION (A/R/M)
		Andrew.c.snyder@usmc.mil			Ldr/ Ed	education activities into entry and career level schooling (boot camp-to-war college level). 2. Incorporate E2W2 planning considerations across the MAGTF within in the PME continuum.	main body and more accurately articulates USMC service level training	
23	12	DC CD&I /TECOM Andrew.c.snyder@usmc.mil	M	App G	Gap 3; Trng	Remove "2. Develop POIs and training plans for energy coordinators at the unit level."	The billet or collateral duty of "Unit Energy Coordinator" does not exist. If it did, TECOM (G-3) response would be "develop training materials for unit Energy Coordinators"	A
24	13	DC CD&I /TECOM Andrew.c.snyder@usmc.mil	M	App G	Gap 4; Trng	Spell out acronym KPP		A
25	14	DC CD&I /TECOM Andrew.c.snyder@usmc.mil	M	App G	Gap 4; Ldr/ Ed	Replace "Develop POIs for" with "Educate"	More accurately articulates USMC service level Education for/ of leadership	A
26	15	DC CD&I /TECOM Andrew.c.snyder@usmc.mil	M	App G	Gap 7; Trng	Remove Para 1 and Para 2. Replace with "1.) Develop a flexible (entry to career level), scalable (individual Marine to battalion sized units) training continuum that addresses E2W2 ethos, planning and management."	Aligns verbiage with Section 6.5 of main body and more accurately articulates USMC service level training	A
27	16	DC CD&I /TECOM Andrew.c.snyder@usmc.mil	M	App G	Gap 7; Ldr/ Ed	Rewrite para 1 to read, "Incorporate water quality, safety, and considerations for sustainment across the ROMO within Professional Military Education. [Objective….]"	More accurately articulates service level Education for/ of leadership	A
28	17	DC CD&I /TECOM Andrew.c.snyder@usmc.mil	M	App G	Gap 8; Trng	Replace para 1 with, "Integrate E2W2 planning and execution into standardized pre-deployment training and other training exercise to increase the proficiency and sufficiency of the deploying expeditionary energy, water and waste operational capability."	Aligns verbiage with Section 6.5 of main body and more accurately articulates USMC service level training	A
29	18	DC CD&I /TECOM Andrew.c.snyder@usmc.mil	M	App G	Gap 8; Ed/ Ldr	Replace para 1 with "Develop and integrate E2W2 material into officer and enlisted professional military education (PME) that is tailored for entry, intermediate and advanced level programs"	Aligns verbiage with Section 6.6 of main body and more accurately articulates USMC service level Education	A
30	19	DC CD&I /TECOM Andrew.c.snyder@usmc.mil	M	App G	Gap 9; Trng	Remove para 1 in its entirety. Replace with "1. Modify officer and enlisted military occupational specialty (MOS) training, as determined by the Course Content Review Board (CCRB) and Training and Readiness (T&R) Manual Review processes, to reflect knowledge and skills required to understand, plan, coordinate, integrate, and maintain E2W2 capabilities."	Aligns verbiage with Section 6.5 of main body and more accurately articulates USMC service level training	A
31	20	DC CD&I /TECOM Andrew.c.snyder@usmc.mil	M	App G	Gap 13; Trng	Remove Para 1 and Para 2 in their entirety. Replace them with, "1. Increase preventive medicine training for Corpsman for testing, certifying and maintaining water standards at the small unit level. "	Note: in order for this additional Corpsman training to occur, coordination with the US Navy will need begin. They establish training standards and requirements for Corpsmen.	P
32	21	DC CD&I /TECOM Andrew.c.snyder@usmc.mil	M	App G	Gap 15; Ed/ Ldr	Remove Para 1 in its entirety. Replace it with, "Educate leadership on the direct linkage between fuel efficiency and combat effectiveness"	Change more accurately reflects the problem.	A
33	22	DC CD&I /TECOM Andrew.c.snyder@usmc.mil	M	App G	Gap 16; Trng	Move Para 2 from "Training" to "Personnel"	The requirement for additional Marines or Corpsman is a Personnel/ Manpower issue, not	A

ITEM	#	SOURCE	TYPE	PAGE	LINE	COMMENT	RATIONALE	DECISION (A/R/M)
							training issue	
34	23	DC CD&I /TECOM Andrew.c.snyder@usmc.mil	M	App G	Gap 20; Trng	Replace, "Establish POIs for training individuals" with "Develop training materials "	More accurately articulates USMC service level training	A
35	24	DC CD&I /TECOM Andrew.c.snyder@usmc.mil	M	App G	Gap 24; Trng	Remove Para 1 in its entirety. Replace with, "1. Modify officer and enlisted military occupational specialty (MOS) training, as determined by the Course Content Review Board (CCRB) and Training and Readiness (T&R) Manual Review processes, to reflect knowledge and skills required to understand, plan, coordinate, integrate, and maintain E2W2 capabilities"	Aligns verbiage with Section 6.5 of main body and more accurately articulates USMC service level training	A
36	25	DC CD&I /TECOM Andrew.c.snyder@usmc.mil	A	22	6.5 Trng, 1st	Reword 1st sentence as follows: Training is essential to shaping the E2W2 ethos, planning and management as well as ensuring efficient employment of current and future E2W2 capabilities.	It makes it easier to read and understand the idea being presented.	A
37	26	DC CD&I /TECOM Andrew.c.snyder@usmc.mil	S	22	6.5 Trng, a)	Replace "(individual Marine to battalion sized units)" with the following: (individual to collective training standards)	In order to match the language used on the SAT Manual and T&R Manuals. This recommendation also applies to: Appendix G, Trng. Column, Gaps 1 and 7.	A
38	27	DC CD&I /TECOM Andrew.c.snyder@usmc.mil	M	23	6.6 Ldr., c)	Remove sentence as a separate sub-paragraph. Modify and add it as another bullet under sub-paragraph "b", as follows: Include planning and management of organic equipment/resources for appropriate billets/planners.	E2W2 Planning responsibilities are not delegated down to the individual Marine. In addition, Education (Officer PME) for E2W2 Planning does not require a separate POI. This information can be incorporated into the appropriate existing PME courses, e.g.: School of Advanced Warfighting (SAW).	A
39	1	B. Albrecht, CETO 703-795-0449 bruce.albrecht.ctr@usmc.mil	S	vi	40-41	in order to increase ~~Warfighting capabilities~~.combat effectiveness	Complies w/ CMC vision of "increased combat effectiveness."	A
40	2	CETO	A	7	20	Replace "project" with "protect"	Word substitution	A
41	3	CETO	A	10	36-37	"vital resources to be essential for combat effectiveness. Replace with, "vital resources to be an essential element to improve combat effectiveness.	Readability and correctness	R
42	4	CETO	A	14	34	"unpredicatable adversaries" Replace with "unpredictable state and non-state adversaries"	Improved accuracy and clarity	A
43	5	CETO	A	15	1-2	"weapons that are increasingly easy to employ." Replace with "weapons that are increasingly accurate and easy to employ."	Accounts for the increasing acquisition of precision weapons by state and non-state actors.	A
44	6	CETO	S	15	18	"These operations require forces to project from a joint seabase"	Not always the case. Statement	A

ITEM	#	SOURCE	TYPE	PAGE	LINE	COMMENT	RATIONALE	DECISION (A/R/M)
							needs a qualifier, such as “In many cases.”	
45	7	CETO	S	15	23	This analysis used the MCIA Marine Corps Midrange Threat Estimate: 2005-2015, 1 July 2005	Update required. The most recent MCIA product is 2008.	A
46	8	CETO	A	17	24	associated with individual and small unit communication, sensors, optics, and weapons	“small unit” needs further amplification, i.e., fire team, squad, platoon???	A
47	9	CETO	S	18	1-2	• Greater vehicle endurance and mobility through increased fuel efficiency, integration of renewable power, and more efficient power supplies to onboard and off-board systems. Replace with, “Greater vehicle endurance and efficiency through increased fuel efficiency, lighter armor, integration of renewable power….	Improved accuracy and clarity	A
48	10	CETO	S	18	3-4	Greater aircraft efficiency and employment to increase. Replace with “Greater aircraft fuel efficiency and more economical employment”	Improved accuracy and clarity	A
49	11	CETO	A	18	9	decision support to commanders and staff in ~~and~~ all MAGTF	Grammatical change	A
50	12	CETO	S	20	31	All of the gaps require some degree of policy as part of a mitigation strategy.	Mitigation needs to be replaced. Wrong connotation. Implies an inability to fix something. Suggest it be replaced with something like “as part of an overall E2W2 strategy.	A
51	13	CETO	S	22	28-29	a) Increase preventive medicine training for Corpsman for testing and maintaining water standards at the small unit level.	Should this include certification? Considering the nature of EMO and distributed operations, this may become a requirement.	A
52	14	CETO	S	27	Fig A-1	Operational Overview-1	Figure does not account for nor does it include the use of UAS’s in the operational E2W2 employment.	A
53		DC I&L	n/a	n/a		No Comment		N/A
54	1	DC, I&L, LPC Richard Hicks 571-256-7101 Richard.hicks@usmc.mil				LPC has reviewed and concurs without comment.		N/A
55	1	DC M&RA, MM	n/a	n/a		MM concurs without comment. This was staffed to MMOA without comment.		N/A
56	1	DC M&RA/MPP	n/a	n/a		Concur w/no comment.		N/A
57	1	DC PP&O/PO Col. Rogers 703-614-3554.	n/a	n/a		Task has been reviewed by all PO sections. PO concur's without comment.		N/A
58	1	DC AVN/APP GS-15 Stan Coerr	n/a	n/a		Concur as written.		N/A
59	1	DC P&R/PAE LtCol Donovan P&R, PA&E 703-692-5172	n/a	n/a		Concur as written		N/A
60	1	Dir, C4 POC: LtCol	n/a	n/a		Concur, no comment.		N/A

ITEM	#	SOURCE	TYPE	PAGE	LINE	COMMENT	RATIONALE	DECISION (A/R/M)
		Richard Stones, richard.stones@usmc.mil, 703-693-9970						
61	1	Dir, Intel Mr. Mark Silver 703-614-2522.	n/a	n/a		Intelligence Department concurs with subject document as written.		N/A
62	1	OLA_MCATS@hqmc.usmc.mil	n/a	n/a		No Comment.		N/A
63	1	HQMC, PA 1stLt Greg Wolf 703-614-4309	n/a	n/a		DivPA concur w/o comments.		N/A
64	1	IGMC; POC: Readiness Division at 703-695-3090.	n/a	n/a		Concur as written.		N/A
65	1	MCSC	n/a	n/a		No Comment		N/A
66	1	MARFORCOM G4 LtCol Ference 757-836-1555 anthony.ference@usmc.mil	A	7 1.1		~~Excluding manpower,~~ Marine infantry companies in 2010 have more equipment and use more fuel than infantry battalions did 10 years ago.	Clarification. Relationship between Bn/Co-level manpower and fuel/equipment is unclear and not needed.	A
67	2	MARFORCOM G4	A	7 1.1		To ~~project~~ protect those vehicles armor has been added, which directly decreases vehicle miles per gallon (MPG):	Correction to typo needed.	A
68	3	MARFORCOM G4	A	8 1.1		Further the CMC directed the following ~~initiatives~~ actions to put words into action: • Established the Expeditionary Energy Office[1] • Established the Experimental Forward Operating Base • Signed the USMC Expeditionary Energy Strategy (E2 Strategy)	List is of accomplished actions not initiatives.	A
69	4	MARFORCOM G4	A	11 1.8		As a result, awareness, education, and training are ~~a center~~ centers of gravity to this capability set.	Sum of “awareness, education, and training” is plural.	A
70	5	MARFORCOM G4	A	15 3.4		Crisis responses are likely to occur in areas that present challenges due to distance, rough terrain, and climatic extremes. These environments will not only vary in climate and size but in access to energy, water, ~~and~~ waste resources and infrastructure.	Edits required for readability and clarity.	A
71	6	MARFORCOM G4	A	17 4.2		Table 4-1 summarizes the applicability of the E2W2 tasks by capability area and WFF.	Statement is followed by table and discussion of the Warfighting Functions. However, the order of discussion and listing within the table do not match. Recommend that text or table be modified to aid in readability.	A
72	7	MARFORCOM G4	S	22 6.4		b) Evaluate Tables of Equipment (T/E) for opportunities to increase energy efficiency by “right-sizing” the T/E for energy producing or	Even during distributed operations, it is not feasible to field water	R

P

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						consuming equipment and to support integration and expanded use of energy efficient equipment. • Include evaluation of T/E to support water self-sufficiency from the MEF to the rifle ~~squad~~ platoon level.	purification assets and manpower to the infantry squad level. The task will be manpower intensive and take away from firepower availability when tasked to a 13-man squad. Assets and task should remain a task for the engineer unit supporting the infantry wherever it operates.	
73	8	MARFORCOM G4	S	23 6.7		6.7e) Assess the need at the engineer battalion level and below for additional utilities water technicians to operate, test, and maintain water systems and additional Corpsmen to conduct water sampling, field testing, and preventive medicine training, to support EMO.	Assets should remain within engineer community to ensure continuity and quality of services and equipment maintenance required to provide the services. The water production/ hygiene support mission can be accomplished at each FOB/COP/PB via Marines assigned to provide Direct Support to the unit. Agree that assessment of required personnel is necessary but personnel and assets should not be directly assigned or attached to infantry battalions.	P
74	9	MARFORCOM G4	S	25 7		• Evolutionary Development: Provide the operating forces with more Mobile Electric Power Distribution Systems and associated Marines	Current operations in Afghanistan have shown that there is a shortage of utilities Marines needed to provide Mobile Electric Power as well as Environmental Control (heat & A/C).	R
75	10	MARFORCOM G4	S	66 App G 5 Pers		1. Evaluate the requirement for additional Utility Marines to support small units.	Concur with need to evaluate requirement for additional utility Marines to support. However, utility Marines should remain within engineer community as discussed in comment 8.	A
76	11	MARFORCOM G4	S	67 App G 6 Org		1. Evaluate T/O and T/E to support necessary requirements for utility planners to support FOB scalability, planning, and design specific to water and hygiene services. This includes examination of 1171 MOS and PMT requirements.	Concur with need to evaluate requirement for additional utility Marines to support. However, utility Marines should remain within engineer community as discussed in comment 8.	A
77	12	MARFORCOM G4	S	72 App G 16 Trng		2. Evaluate the need for additional Corpsman and Marines PMT to store bulk water at the small unit.	Concur with need to evaluate requirement for additional utility Marines to support. However, utility Marines should remain within engineer community as discussed in comment 8.	A
78	1	MARFORPAC CWO5 Hernandez/ MGySgt Quick	n/a	n/a		Reviewed the Initial Capabilities Documents for USMC Expeditionary Energy, Water and Waste . Also reviewed all Supporting War fighting Functions¿(Logistics) E2 W2 Capability Area and tasks and concur as written.		N/A
79	1	MARCENT/G4	n/a	n/a		Concur		N/A

ITEM	#	SOURCE	TYPE	PAGE	LINE	COMMENT	RATIONALE	DECISION (A/R/M)
80	1	MARFOREUR, Maj Chris Stegge, G-4 Operations, 314-431-3147, Christopher.stegge@mfe.usmc.mil	n/a	n/a		No Comment		N/A
81	1	MARFORAFRICA	n/a	n/a		MFA G-4 has reviewed the E2W2 ICD and concurs with the content. No recommended changes.		N/A
82	1	MARFORNORTH	n/a	n/a		MFN G4 reviewed and found no substantive issues w the ICD		N/A
83								
84	1	MARFORRES	n/a	n/a		Concur. Recommend fully funding facilities infrastructure new construction, modernization, & base operating costs to support fielding of all E2W2 Capabilities goals. LGC		A
85	1	MARSOC_MCATS @marsoc.usmc.mil	n/a	n/a		MARSOC SMEs reviewed the document and found no flaws in direction or logic. Concur with no comment.		N/A
86	1	MARFORK	n/a	n/a		No Comment		N/A
87	1	II MEF G4 Engr DSN 751-1840	A	vi	3	Replace “curricula” with “curriculum” here and throughout document.	Correct spelling	R
88	2	II MEF G4 Engr DSN 751-1840	A	25	7.2	Replace “Auto-DISE” with “AutoDISE.	Correct spelling no (-) in word.	A
89		III MEF	n/a	n/a		No Comment		N/A
90	1	Marine Corps Logistics Command (MCLC) Marine Corps Logistics Command (MCLC) POC: Col Jay Montgomery 229-639-7026 j.b.montgomery@usmc.mil	A	1.8	3	Semi-colon needed after “As a result”	Use punctuation before beginning to list items	A
91	2	MCLC	A	1.8.1	5	No comma after “and”		A
92	3	MCLC	M	Pg 18		Need to mention “change in how we do business”. Reduction in C2 requirements.	Eliminate nonessential equipment.	R
93	4	MCLC	S	Pg 19		Eliminate Non-logistic Commands “adequate visibility”. Maybe display in Consolidated Operational Picture (COP)	Who needs this visibility?	R
94	5	MCLC	A	Pg 20		Add policy to “influence Naval Air System Command” concerning support equipment – this includes electrical generation for maintenance activities and weight/transportation limitations.	Need to influence aviation element to reduce support issues: not just fuel to operation but impact on transportation – NC 10 weighs 4000 lbs to provide ground power to aircraft.	A
95	6	MCLC	A	Pg 30		Add “Consolidated Operational Picture” to Appendix B if used.		R
96	7	MCLC	A	vi	Para 3 Bullet	Run on sentence, “and…and…and…”	Separate ideas or list points.	A

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97	8	MCLC	A		Para 4	"Non-material…will guide material" makes no sense?!		A
98	9	MCLC	A		Para 4	Enhanced Company?	Obscure reference.	P
99	10	MCLC	A		Para 5	And, and, and	See #7	A
100	11	MCLC	A	Pg 7	Para 4	Second sentence there is a comma before "at"	Correct punctuation	A
101	12	MCLC		Pg 8	Para 1	"excess and luxury" are…	Plural of "is" (to be)	A
102	13	MCLC			Para 2	Vulnerability vice "underbelly"		A
103	1	MCI West BEB Bruce Burris 760-763-7455	A	vi	5th para-graph 4th bullet	and PME school curricula that is coordinated	and PME school curricula that are coordinated	A
104	2	MCI West	A	7	1st 2nd para-graph	Marine infantry companies in 2010 have more equipment	Marine infantry companies in 2011 have more equipment	A
105	3	MCI West	A	8	2nd para-graph	200% increase in # of vehicles	200% increase in number of vehicles	A
106	4	MCI West	A	9	Figure	Too small to read the small font	Enlarge font or figure	A
107	5	MCI West	A	10	2nd para-graph	deconflict	Odd word, consider choosing another	A
108	6	MCI West	A	15	Last para-graph	4.2 Enhanced E2W2 Capabilities and Tasks	Widow heading on last line, move to next page	A
109	7	MCI West	A	17	1st para-graph	Table 4-1 summarizes the applicability of the E2W2 tasks by capability area and WFF. Improved operational energy performance in all WFF capabilities will decrease battlefield fuel and battery demand and contribute to increased MAGTF effectiveness	Make clearer what table shows and where the detail on this comes from	A
110	8	MCI West	A	19	1st para-graph	Operation Enduring Freedom (OEF) is consistent with	Is this from Afghanistan?	N/A
111	9	MCI West	A	23	Para-graph 6.8	Forward Arming and Refueling Point (FARPs)	Forward Arming and Refueling Points (FARPs)	A
112	10	MCI West		24	1st para-graph	Nevertheless, no combination of non-materiel approaches will completely close E2W2 capability gaps and there are significant gaps	Nevertheless, no combination of non-materiel approaches will completely close E2W2 capability gaps, and there are significant gaps…	A
113	11	MCI West	A	25-26		Headings Information Technology: Evolutionary Development; & Transformational Approach:	Bold headings- Information Technology: Evolutionary Development; & Transformational Approach:	A
114	12	MCI West	A	p.28	App. B	Define C41	Add to App. B glossary	A
115	13	MCI West	A	p.41		Gaps were then rated by the IPT	Provide more detailed explanation of how the Gap study was done.	A

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							With a tangible example	
116	14	MCI West	A	p.41	App. F	The weighted risk assessment scores *[(Probability that a gap occurs) x (Severity of not mitigating the gap)*]	Probability in Asset Mgt is a large concept, not enough explaining here what it means, give a simple example.	A
117	15	MCI West	A	p. 50 & 51	App. F Multiple times	: No policy for reclaim reuse of grey water	No policy exists for use of recycled grey water	A
118	16	MCI West	A	p.52	Multiple times	: No baseling doctrine established	Baseline	A
119	1	US Army MSCoE	S	16	Para 5, Line 3	Tactical electrical distribution occurs efficiently through in-depth load assessments, properly-sized power sources, adequate electrical distribution equipment, smart power management, and enforcement of prudent power conservation measures.	Properly Sized Power Sources are not obtained without and in-depth load assessment.	A
120	2	US Army MSCoE	S	16	Para 5, Line 6	Fuel is efficiently distributed for mobility systems and smaller, more efficient power sources that are capable of integrating with renewable sources and have the ability to monitor and meter production, distribution and consumption.	Production and consumption must be monitored as well as distribution.	A
121	3	US Army MSCoE	S	22	Para 7, Line 1	Include Programs of Instruction (POIs) and advocate support to training on efficient power production and distribution, scalable potable and non-potable water distribution, renewable and alternative energy, and waste-to-energy systems.	Training must be conducted on production as well as distribution.	A

Additional CDIB Review Comments

Name / Organization	Comment
Maj Christopher S. White Manpower Plans & Policy	This O6 review came out in MCATS back in March. M&RA comment is as follows: "Within M&RA, the E2W2 ICD was staffed to MP division, MM division, and MR division; all concurred without comment." Recommendation: Concur without comment
Darnell Shegog Naval Treaty Implementation Program	The Naval Treaty Implementation Program (NTIP) conducted an arms control compliance assessment of the Urgent Universal Needs Statement United States Marines Corps Expeditionary Energy Water and Waste. NTIP concludes that the UUNS United States Marines Corps Expeditionary Energy Water and Waste as described in the provided documentation raises no reasonable compliance concerns with any Arms Control Treaties, International Agreements or U.S. policies.
MGySgt Crawford D. Quick MARFORPAC	RECOMMEND CONCUR WITH COMMENT ON THE PREMISE OF THIS DOCUMENT. - Additional research, development and acquisition of energy efficient equipment/generators is required. - The Marine Corps as in Institution must train Marines to properly employ existing/new equipment in order to efficiently decrease dependence of fuel. - Development of wind and solar power will reduce the need for fossil fuels on the battlefield, however they may become "valued targets" to the enemy and therefore require the weighing of risk prior to incorporating wind/solar farms into the Marine Corps deployable arsenal. - Recommend review of TB MED 577 and further study on the recycling of waste water through the Tactical Water Purification System (TWPS), in order to exploit the potential recycling of laundry and shower water in the battlefield for use as a "non potable" water source. G4 POC: MGySgt Crawford D. Quick, 477-8534
GS15 Enrico G. Deguzman, MARFORPAC	CONCUR with comments. Wholeheartedly agree with the concept and if the goals outlined are achieved, it will posture the Marine Corps as the middleweight force of choice for the nation. CD&I should work with P&R and perhaps ONR to find funding for the solutions proposed. G3 POC is GS15 Enrico G. Deguzman, 477-8631
Major Ian C Fletcher Reconnaissance Advocate (POG-40) Parachuting / Combatant Diving / HRST Proponency Lead GCE Branch, Operations Division, PP&O	I have completed a review of the subject document for PP&O GCE Branch. We concur without additional comment with the ICD's DOTMLPF recommendations.
Max Hipsher/OAD, MCCDC	Page 14, para 3.2, second sentence: Add “and” between accurate and easy.
Max Hipsher/OAD, MCCDC	Page 43, bullet 4: Remove “a” between considered and in.
Mr. Pat O’Bryan, MCSC	MCSC concurs in the ICD. Energy and C-IED Systems administrative remarks provided separately. MCSC POC is Mr. David Karcher.
Sally Amberger DC I&L	I&L has reviewed the subject document and concurs without comment.