Energy Security Analysis in Support of DOD Missions

Army Installation Energy Security and Independence Conference
December 12-13, 2006

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Energy and Security Group

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
DEC 2006		**00-00-2006 to 00-00-2006**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Energy Security Analysis in Support of DOD Missions	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **National Defense University,Center for Technology and National Security Policy (CTNSP),260 5th Avenue, SW,Washington,DC,20319**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES
also presented at the Optimizing Investments in Critical Infrastructure Protection, 15?18 Nov 2010; ANSER Conference Center, Arlington, VA.

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**	**Same as Report (SAR)**	**22**	

Topics

- Examples of energy security analysis in support of DOD missions:
  - Installations
  - Operations
  - Strategic

- Energy Cost-Benefit Analysis for DOD missions: A Conceptual Framework with Examples

Bottom Line Points Up-Front

- Energy technologies must work
- Energy security cost-benefit analyses should be done in conjunction with field testing
- Energy security analyses should integrate costs and benefits within and across installation, operational, and strategic mission areas
- Information exchange of energy security analyses should occur across Services on a recurring basis.

Energy Security Analysis: Installations

Renewables and Energy Efficiency Planning (REEP)

REEP (1993) → AIESP (2002) → WHIX (2002→)

- Mission: Analytical methodology for evaluating the economic potential for investments in energy efficiency and renewable energy at major Army installations.

- Goals: Save energy, save money, improve environment, promote health, and strengthen national security.

- Key Metrics—in 1993 evaluated 49 major Army installations in CONUS:
  - Cost Savings: $249,446,020/year
  - Energy Savings: 16,823,804 Mbtu/year & 724,128 kW (demand reduction)
  - Pollution Prevention: 2,415,337 STONs/year (Greenhouse Gases)

- Status: Used for policy analysis, programming, and budgeting by the Army (and OSD) in the 1990s.

Army Installation Energy Security Planning (AIESP)

REEP (1993) → **AIESP (2002)** → WHIX (2002→)

- Mission: Analytic capability to generate investment strategies for a more secure energy supply using distributed generation (DG) for key missions in garrison and training base.

- Metrics:
  - Energy security: days of supply
  - Ease of implementation and appeal to personnel
  - Economics (payback/life cycle cost savings)
  - Energy savings (kW/kWh)
  - Pollution prevention (lbs of pollutants)

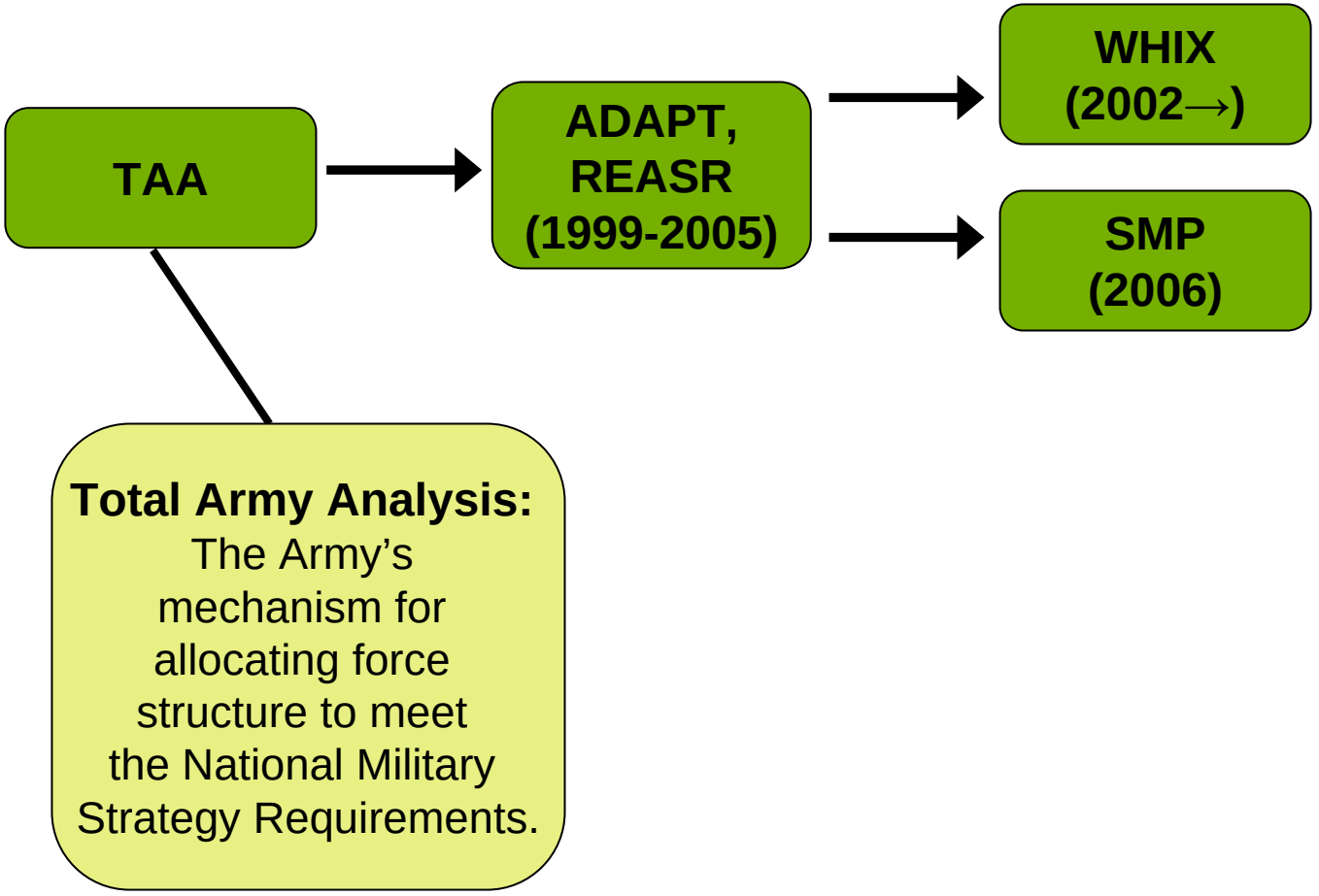
- Findings for three case study Army installations:
  - DG options available that are economically competitive.
  - Utilities expressed interest in owning and operating DG at Army sites.
  - Smaller, mobile DG technologies, though more costly, can support garrison and training base missions as well as homeland security and other deployments.

Western Hemisphere Information Exchange (WHIX)

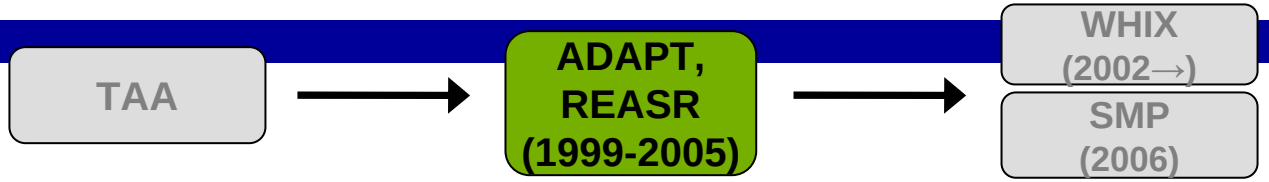
REEP (1993) → AIESP (2002) → **WHIX (2002→)**

- Mission: WHIX is a joint Army/SOUTHCOM Program to facilitate information exchange through technology demonstrations between U.S. and Latin American/Caribbean militaries in energy security and sustainability.
- Metrics:
  - Deployability and agility
    - Logistics footprint (lbs and cubic feet)
    - Ease of set-up and break-down
  - Life-cycle costs
  - Technical performance
  - Operation and maintenance
  - Durability
- Current activities: Energy security analysis in conjunction with field technology demonstrations in SOUTHCOM AOR:
  - Installation energy security: Two 50 kW biomass energy systems that generate electricity from local agricultural waste (FY2006-07)
  - Military operational missions: Four mobile potable water treatment systems powered by thin-film photovoltaic units—5 to 15 kW (FY2007)

Energy Security Analysis: Operations



Analysis of Deployable Applications of Photovoltaics in Theater (ADAPT); Renewable Energy Analysis for Strategic Responsiveness (REASR 1/2/3)



- Mission: Analyses and field assessments to evaluate the costs and benefits of using flexible, thin-film photovoltaic systems to support the energy needs of deployable Army forces.
- Goals: Meet energy needs, reduce logistics footprint for training and operational missions, reduce number of fuel convoys.
- Field assessments by 82nd Airborne between 1999 and 2005 at Fort Bragg and other sites such as National Training Center (NTC) in Fort Irwin and Hanau, Germany.

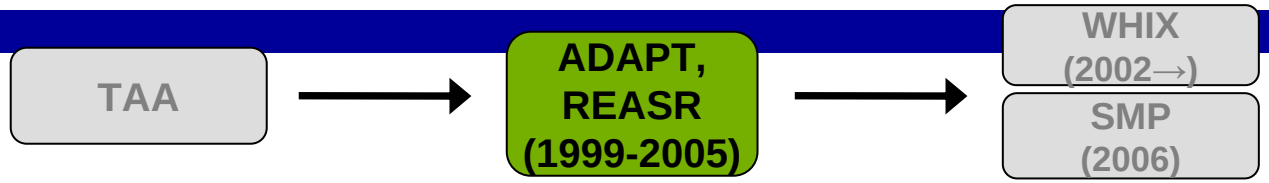
Field Assessment Measures (as assessed by troops):

- Signature (noise, visibility, heat)
- Ease of use
- Delivery of required power
- Mobility and Flexibility
- Supportability and Maintainability
- Reliability and Durability

Metrics for Quantitative Analysis:

- Economic (payback and life-cycle cost savings)
- Pollution Reduction (pounds of pollutants)
- Energy Savings (pounds of fuel)

Mobile Photovoltaics Demonstration: 504th Parachute Infantry Regiment, 82nd Airborne Division



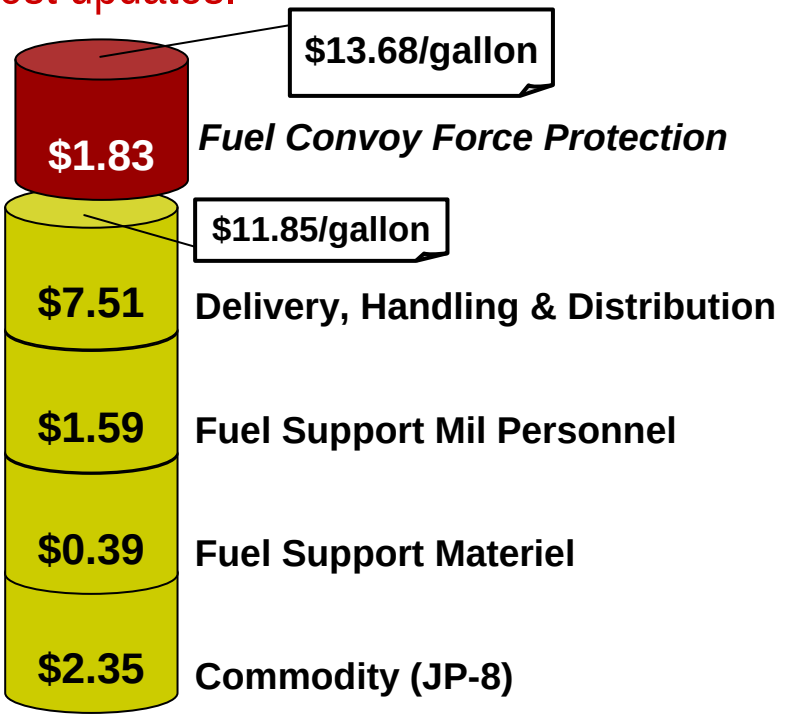
- "This unit examined a photovoltaic power station in a field and simulated field environment. The bottom line is this system with some modifications *can be used to provide the primary power source* for a Battalion sized Airborne Infantry Tactical Operation Center" (from Commo Platoon AAR - 21 APR 99).
- Status: Demonstration systems are still being used at NTC and in Germany, Afghanistan, and Iraq.

Sustain the Mission Project (SMP)

TAA → ADAPT, REASR (1999-2005) → WHIX (2002→) / SMP (2006)

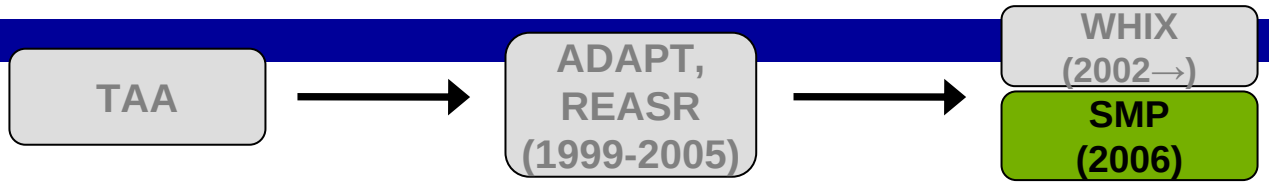
Mission: Calculate the full ownership costs of energy and water to sustain Army training and contingency operations using existing authoritative Army and DOD sources of data that readily allow for cost updates.

- Development of full costs of delivered energy required integration across mission areas including combat operations and logistics, training and readiness, programming and budgeting, cost and economics, and installation management.
- Case study Stryker Brigade Combat Team (SBCT) in SWA theater (*high range for CONOPS shown at right*).



SMP energy costs are provided in the Army FORCES Cost and Factors Handbook.

Sustain the Mission Project (SMP)



- Mission: Cost-benefit analysis of thin-film photovoltaic systems for training and contingency operations (SBCT) with conventional generator back-up.
- Metrics:

	Life Cycle Impacts:
➢ Cost Avoidance/Savings ($)	1,201,488
➢ Payback (years)	13
➢ Logistics footprint:	
– Reduction in STON	4,995
– Reduction in Cubic Feet	220,632
➢ Energy Savings (gallons)	1,472,693
➢ Pollution Reduction (lbs)	3,547,525

- Decrease in number of fuel convoys required to support contingency operations.

Energy Security Requirements from the Battlefield

"To improve the security posture of the al-Anbar province of Iraq, [Multi-National Force-West] requires a renewable and self-sustainable energy solution to support forward operating bases, combat outposts and observation posts throughout MNF-W's battlespace," a Joint Staff Rapid Validation and Resourcing Request certified by MNF-W leaders states.

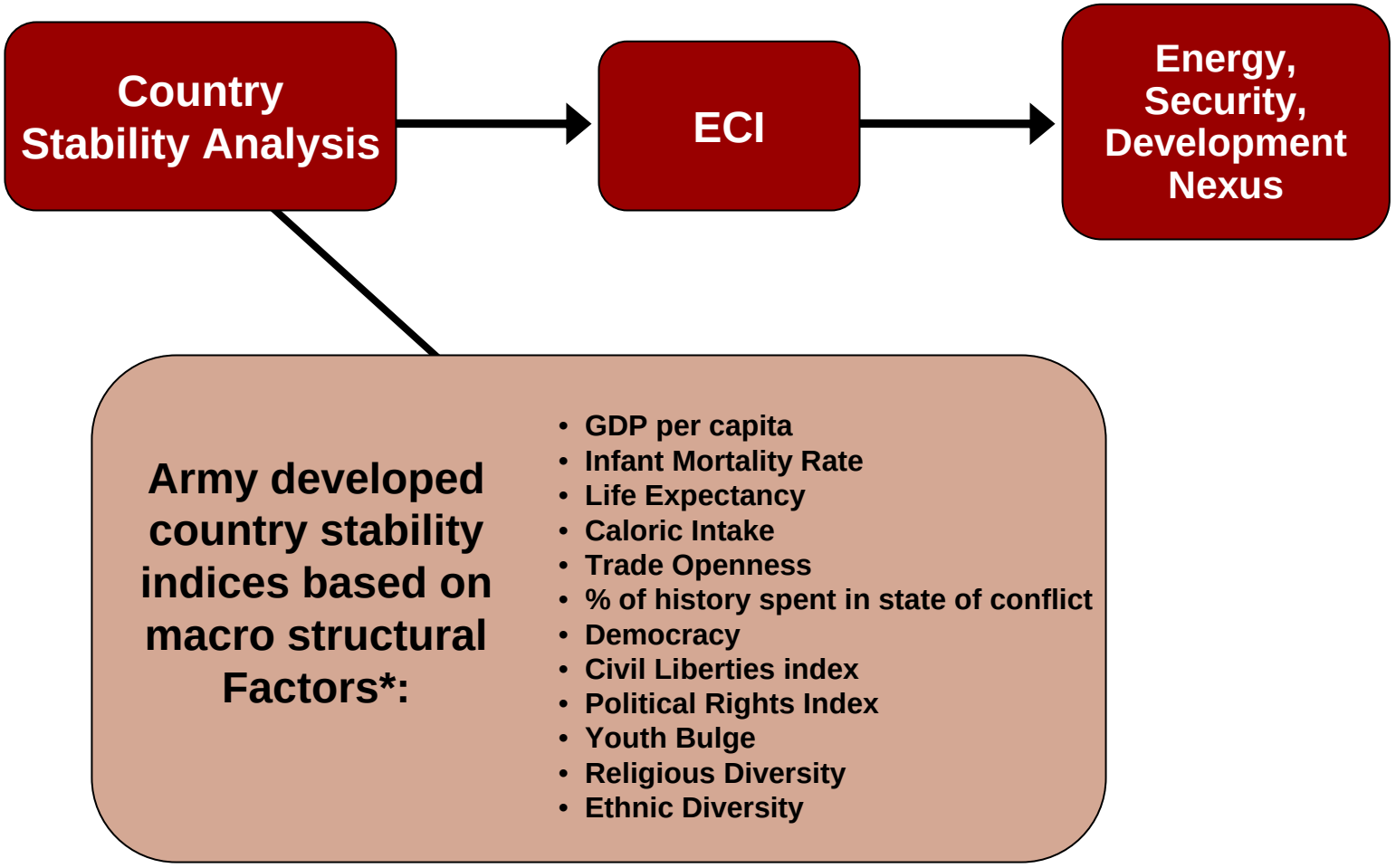
Command officials certified the request on July 25 on behalf of Marine Corps Maj. Gen. Richard Zilmer, the MNF-W chief. The request is categorized as a "priority 1" need.

In the document, the region's U.S. military leaders call on the Pentagon to send more renewable energy systems to the country because they could leverage resources like sunlight or wind to produce power for bases and outposts. Commanders assert that tapping renewable energy sources would lessen dependence on fossil fuels—a move that could save lives.

"A proposed alternate solution—one that reduces the number of convoys while providing an additional capability to outlying bases—is to augment our use of fossil fuels with renewable energy, such as photovoltaic solar panels and wind turbines, at our outlying bases," the request states. "By reducing the need for [petroleum-based fuels] at our outlying bases, we can decrease the frequency of logistics convoys on the road, thereby reducing the danger to our Marines, soldiers, and sailors."

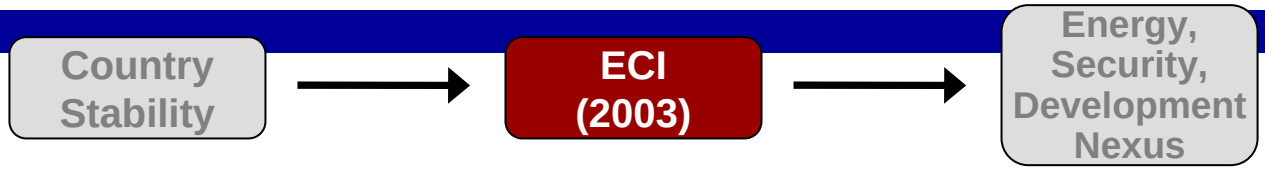
—From *Inside the Pentagon* (10 August 2006)

Energy Security Analysis: Strategic



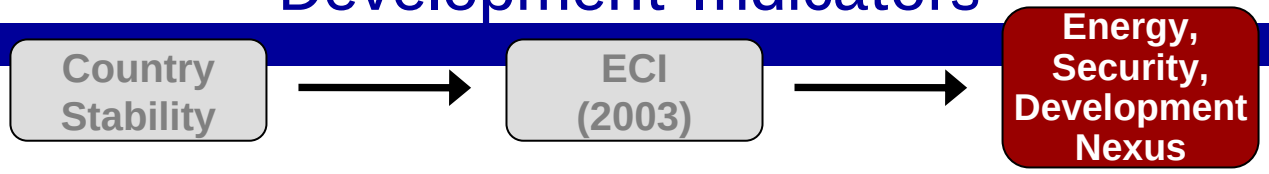
* Analyzing Complex Threats for Operations and Readiness (ACTOR)

Energy and Country Instability Report (ECI)



- Purpose: To study the effects of access to energy on country stability, quality of life, and social and economic development.
- Metrics:
  - Country stability (Army index)
  - GDP per capita
  - Life expectancy
  - Energy consumption per capita
- Findings: Energy supply and access have a positive effect on:
  - Public health (life expectancy)
  - Economic development (GDP per capita)
  - Country stability

Comparison of Country Stability and Development Indicators



Country Stability Indicators*

1. GDP per capita
2. Infant Mortality Rate
3. Life Expectancy
4. Caloric Intake
5. Trade Openness
6. % of history spent in state of conflict
7. Democracy
8. Civil Liberties index
9. Political Rights Index
10. Youth Bulge
11. Religious Diversity
12. Ethnic Diversity

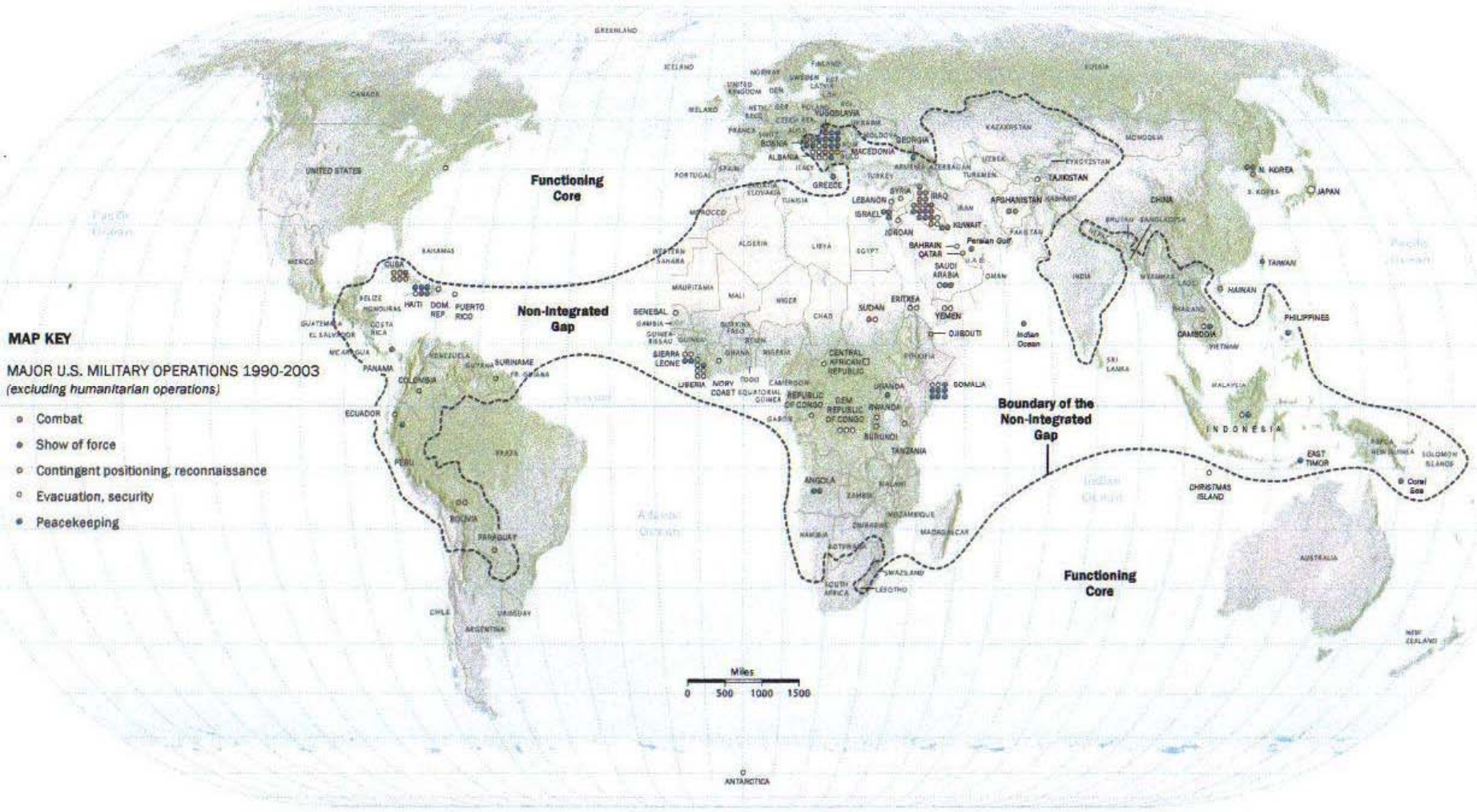
* from ACTOR

Development Indicators**

1. GDP per capita
2. Infant Mortality Rate
3. Life Expectancy
4. Caloric Intake
5. Trade Openness
6. Democracy
7. Civil Liberties index
8. Political Rights Index
9. Youth Bulge

** from World Bank: World Development Indicators (WDI)/Millennium Challenge Corporation (MCC) Indicators

The Pentagon's New Map:
War and Peace in the Twenty-First Century

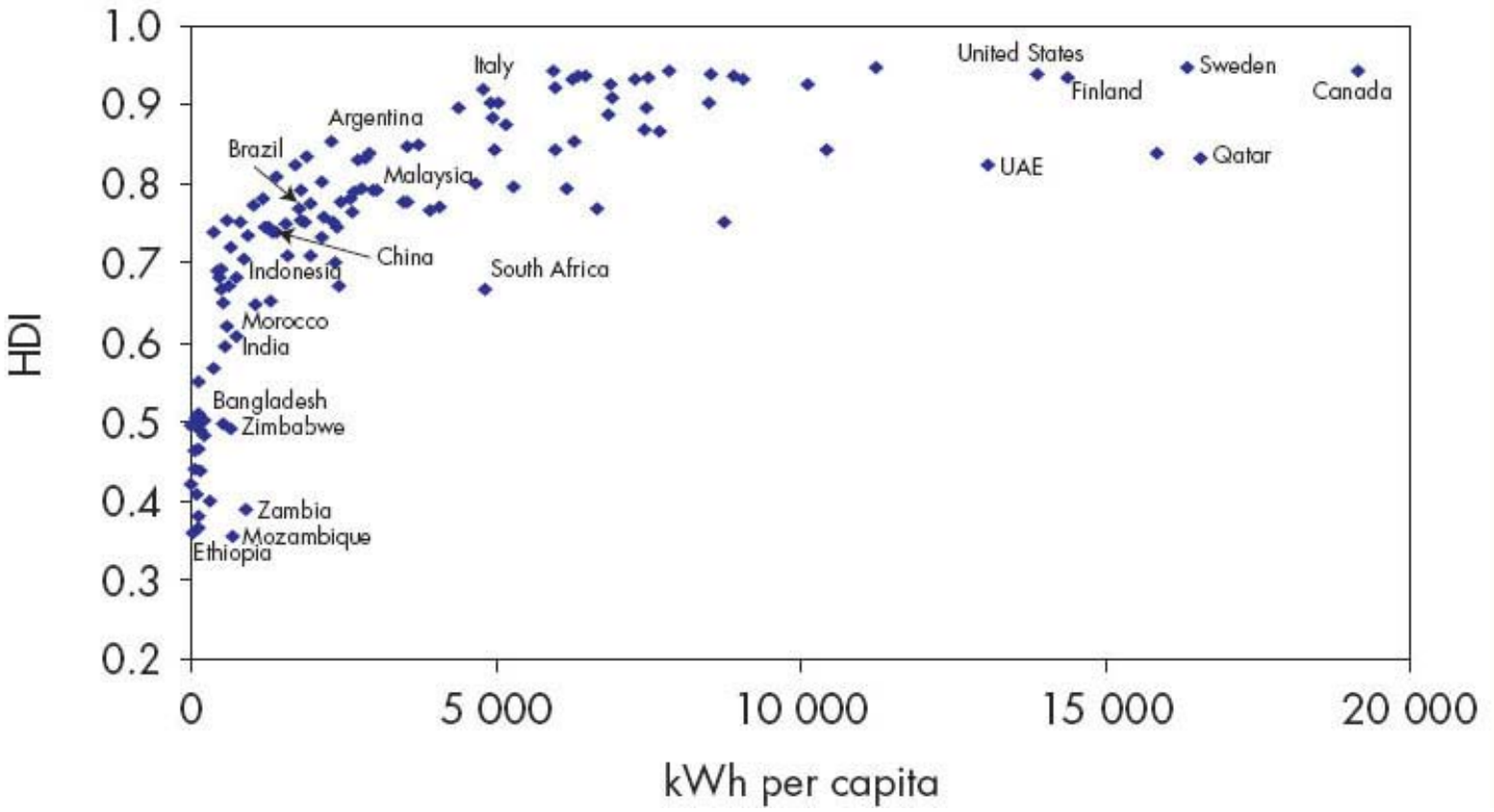


Response data source: U.S. Military Services via
Dr. Henry Gaffney Jr. / The CNA Corporation

Link Between Energy Security and Development

Country Stability → ECI (2003) → **Energy, Security, Development Nexus**

Human Development Index (HDI) and Electricity Consumption per Capita, 2002



*From International Energy Agency. 2004. World Energy Outlook.

Energy, Security, and Development Nexus

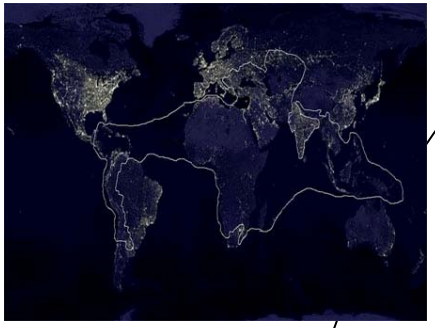
Country Stability → ECI (2003) → **Energy, Security, Development Nexus**

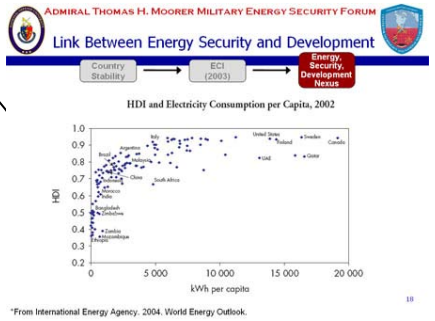
ENERGY

(from ECI)

improves country stability

improves life expectancy, GDP/cap





SECURITY

DEVELOPMENT

Examples of Externalities to Keep on the Radar

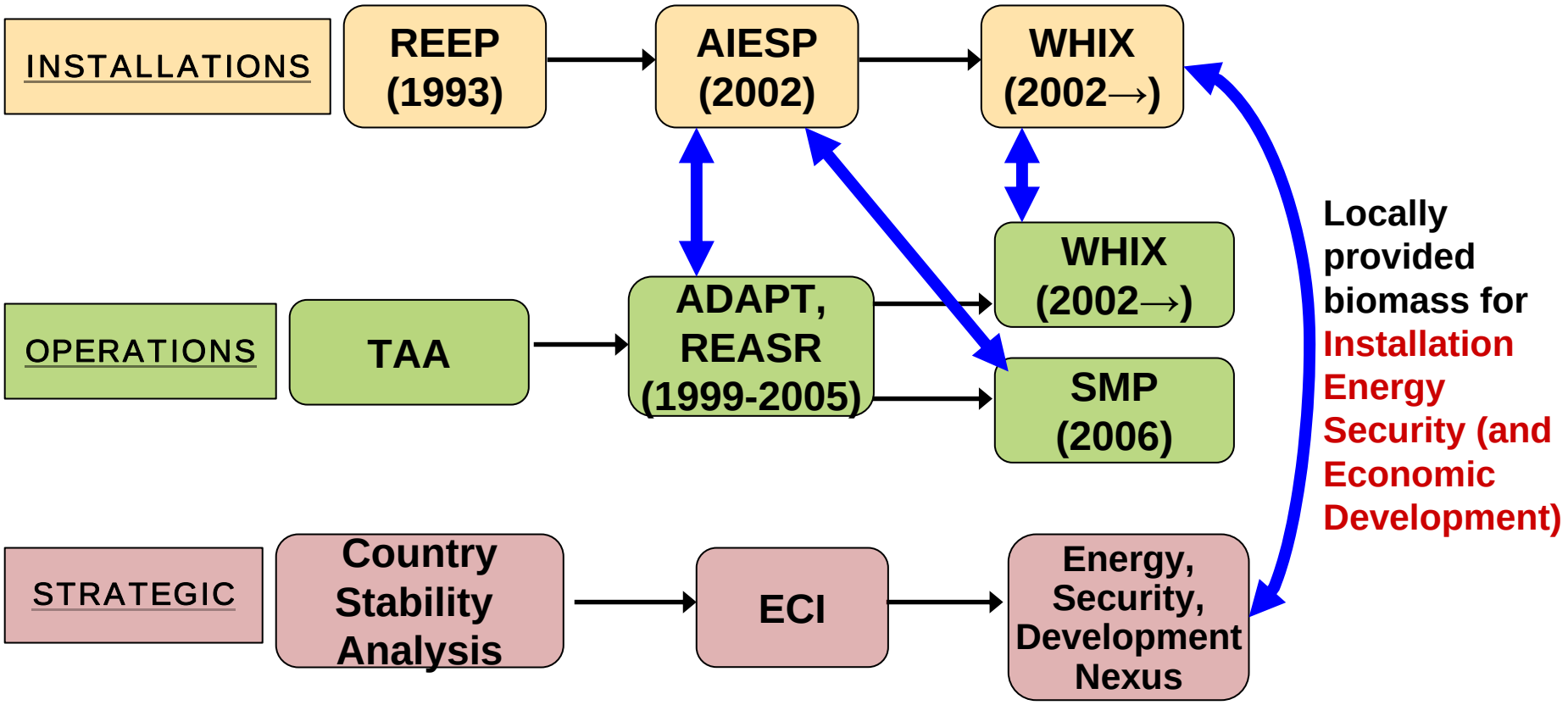
DEFENSE:
Importing oil from the Persian Gulf—region with highest defense expenditures—is equal to adding $7.41 to each gallon of gasoline consumers buy at the pump.
(Testimony of Milton R. Copulos before Senate Relations Committee, March 2006)

HEALTH:
Annual U.S. health costs associated with auto air emissions estimated at $34.2-$79.8 billion per year.
(Delucchi, Murphy & McCubbin. 2002., *J. Environ. Manag.* 64.)

ENVIRONMENT:
Socioeconomic and environmental costs of 42,860 oil spills (≥ 50 gal.) occurring 1980-2002 in U.S. (EPA jurisdiction) cost $63.2 billion ($2.7 billion/year).
(Etkin DS. 2004. Modeling Oil Spill Response and Damage Costs.)

CLIMATE CHANGE:
An estimated 160,000 deaths were attributable to climate change in 2000.
(World Health Organization, 2003.)

Energy Cost-Benefit Analysis for DOD Missions: A Conceptual Framework with Examples



Bottom Line Points

- Energy technologies must work—lives are at stake
- Energy security cost-benefit analyses should be done in conjunction with field testing—increases defensibility
- Energy security analyses should integrate costs and benefits within and across installation, operational, and strategic missions—full costs and benefits
- Information exchange on energy security analysis should occur across Services on a recurring basis—institutionalize the process.