

Policy Interests of U.S. Government Agencies in Emerging Energy Technologies

Review for Potential Cold Fusion Contributions

WHITE PAPER

THOMAS GRIMSHAW, PH.D.
RESEARCH AFFILIATE, ENERGY INSTITUTE
THE UNIVERSITY OF TEXAS AT AUSTIN



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Contents

Preface.....	3
1 Introduction.....	4
1.1 Relevant Government Entities	5
1.2 Methods and Information Sources	5
2 Congressional Entities	7
2.1 U.S. Senate Committee on Energy and Natural Resources.....	7
2.2 U.S. House of Representatives Committee on Energy and Commerce	10
2.3 Congressional Research Service (CRS)	11
3 Executive Entities	16
3.1 Executive Office.....	16
3.2 U.S. Department of Energy (DOE)	17
3.2.1 DOE Overall	18
3.2.2 Advanced Research Projects Agency – Energy (ARPA-E).....	20
3.2.3 Office of Energy Efficiency and Renewable Energy (EERE)	21
3.2.4 National Renewal Energy Laboratory (NREL)	23
3.2.5 National Laboratories.....	25
3.3 U.S. Department of Defense (DoD).....	29
3.3.1 DoD Overall	29
3.3.2 Energy & Power Community of Interest (COI).....	30
3.3.3 Defense Advanced Research Projects Agency (DARPA)	34
3.3.4 U.S. DoD Defense Threat Reduction Agency (DTRA).....	37
3.3.5 U.S. Navy	38
3.4 U.S. Department of Commerce – Patent and Trade Office (PTO)	43
3.5 U.S. National Aeronautics and Space Administration (NASA).....	45
3.6 U.S. Environmental Protection Agency (EPA).....	47
4 Government-Supported Research Entities.....	49
4.1 National Science Foundation (NSF)	49
4.2 National Academies of Science, Engineering and Medicine	51
5 Other Agencies.....	55
5.1 Federal Energy Regulatory Commission (FERC).....	55
5.2 U.S. DOE Energy Information Administration (EIA)	56
5.3 U.S. DOE National Energy Technology Laboratory (NETL)	57
5.4 U.S. Intelligence Community (IC).....	58
5.4.1 Director of National Intelligence (DNI).....	59
5.4.2 Central Intelligence Agency (CIA)	60
5.4.3 Defense Intelligence Agency (DIA)	61
5.4.4 Intelligence Advanced Research Projects Activity (IARPA)	62
6 Summary	64
7 List of Citations.....	65

Preface

Many agencies of the U.S. Government have energy policy responsibilities. These responsibilities include both development and realization of emerging energy technologies and dealing with their secondary impacts. A paper has been prepared¹ to describe the potential role that cold fusion may play in helping agencies accomplish their missions in realizing the benefits of new energy sources and mitigating their secondary impacts.

This White Paper serves as an underpinning of the above paper by identifying the most significant energy policymaking agencies of the U.S. Government, describing their overall missions and responsibilities, and delineating their interests specifically in emerging energy technologies. The stage is then set for assessing the potential role of cold fusion. A rigorous attempt is made to characterize the energy interests of the agencies "in their own words" by extensive review of publicly-available information (primarily websites) made available by the agencies themselves.

Thanks go to Dr. David Nagel, co-author of the paper on the potential role of cold fusion in helping agencies meet their energy policy responsibilities, for providing encouragement to prepare this White Paper and for providing feedback along the way. Acknowledgment is also given to the Energy Institute for providing logistical support, such as website downloads and printing for review and analysis, to accomplish this study.

¹ Grimshaw, T.W., and D.J. Nagel, 2006. U.S. Government Agencies Responsible for Research and Exploitation of Energy from Low Energy Nuclear Reactions. Submitted to Proceedings of the International Conference on Cold Fusion (ICCF) 20, October 2 to 7, 2016, Sendai, Japan.

1 Introduction

Energy has become a major topic of concern for human welfare both in the U.S. and worldwide. Many agencies and other entities of the U.S. Government have energy-related responsibilities. These responsibilities cover all phases of the energy "life cycle" – production, conversion, transport, storage, and consumption – and many associated topics, such as human health and environmental protection. Meeting these responsibilities involves actions and decisions that result in formulation of energy policy by each entity. Many agencies have particular energy policymaking obligations for emerging energy technologies.

Cold fusion (referred to here as "low energy nuclear reactions", LENR) is a potential but controversial new source of energy. If LENR's potential could be realized, it would be a major source of abundant, inexpensive, and environmentally benign energy. LENR could therefore contribute substantially to meeting the missions, goals and responsibilities of many government agencies. Many changes have occurred in the LENR field since it was rejected shortly after it was announced in 1989. These changes indicate that LENR's potential may yet be realized, which would be beneficial to human welfare and could help government agencies meet their energy-related responsibilities.

A paper describing the changes in LENR prospects in relation to government agency responsibilities ("LENR Responsibilities") is currently being prepared². The objective of this White Paper is to set the stage for the LENR Responsibilities paper by identifying the most relevant agencies, describing their overall mission and goals, and characterizing their specific energy-related interests and responsibilities. The focus of this White Paper is on agency responsibilities for emerging energy technologies and their secondary impacts generally. The LENR Responsibilities paper can then address LENR specifically for government entities.

² Grimshaw, T.W., and D.J. Nagel, in preparation. U.S. Government Agencies Responsible for Research and Exploitation of Energy from Low Energy Nuclear Reactions.

1.1 Relevant Government Entities

The decentralized character of U.S. energy policy results in an overall policy that is asserted to be the cumulative policies of individual agencies. Many government agencies and other entities have energy-related missions and responsibilities. As noted, these responsibilities encompass the full energy life cycle and the associated impacts on social systems and the environment. Some 30 entities have been identified and characterized. They are shown in Table 1.

1.2 Methods and Information Sources

Readily available information in the public domain has been obtained to accomplish this review of agencies' energy-related obligations. Sources were accessed to characterize the responsibilities of each agency as represented by the agency itself. The main sources were agency websites, online brochures, strategic plans, manuals, procedures, annual reports, and other statements of agency mission, vision, and values. The topics covered for each agency are as follows:

- Overall mission
- Background, origins, and history
- Organization
- Energy interests and responsibilities
- Emerging energy technologies – realization and addressing impacts

These agency descriptions then set the stage for delineating opportunities for LENR to help the agencies accomplish their mission and meet their responsibilities.

Table 1. Selected U.S. Government Entities with Energy Policy Responsibilities

Congressional Entities

- U.S. Senate Committee on Energy and Natural Resources
- U.S. House of Representatives Committee on Energy and Commerce
- Congressional Research Service (CRS)

Entities of the Executive Branch

Executive Office

- Office of Science and Technology Policy (OSTP)
- National Science and Technology Policy Council (NSTP)
- President's Council of Advisors on Science and Technology (PCAST)

U.S. Department of Energy

- DOE Headquarters
- Advanced Research Projects Agency – Energy (ARPA-E)
- Office of Energy Efficiency and Renewable Energy (EERE)
- National Renewable Energy Laboratory (NREL)
- National Laboratories: General
- Los Alamos National Laboratory (LANL)

U.S. Department of Defense

- DoD Headquarters
- Energy & Power Community of Interest (COI)
- Defense Advanced Research Projects Agency (DARPA)
- Defense Threat Reduction Agency (DTRA)
- U.S. Navy
 - Office of Naval Research (ONR)
 - Naval Research Laboratory (NRL)

U.S. Department of Commerce – Patent and Trade Office (PTO)

U.S. National Aeronautics and Space Administration (NASA)

U.S. Environmental Protection Agency (EPA)

Government-Supported Entities

- National Science Foundation (NSF)
- National Academies (NAS/NAE/NAM)

Other Agencies (Having Fewer Opportunities for LENR)

- Federal Energy Regulatory Commission (FERC)
- Energy Information Administration (EIA)
- National Energy Technology Laboratory (NETL)
- U.S. Intelligence Community
 - Director of National Intelligence (DNI)
 - Central Intelligence Agency (CIA)
 - Defense Intelligence Agency (DIA)
 - Intelligence Advance Research Projects Activity (IARPA)

2 Congressional Entities

Both the U.S. Senate and House of Representatives are deeply involved in energy-related concerns. Much of Congress' energy policy work is accomplished by energy-focused committees, the Senate Committee on Energy and Natural Resources and the House Committee on Energy and Commerce. Energy policy development in both houses is supported by the Congressional Research Service (CRS), which develops information to support policymaking and other legislative activities.

2.1 U.S. Senate Committee on Energy and Natural Resources

The principal entity of the Senate with energy-related responsibilities is the Committee on Energy and Natural Resources ("E&R Committee"). Its jurisdiction is broad and includes energy resources and development, regulation, nuclear energy, surface mining, and federal leasing for coal, oil, gas, and other minerals³. The E&R Committee traces its jurisdiction back to 1816, when the Committee on Public Lands, one of the Senate's first standing committees, was formed⁴. Much of the Committee's energy-related work is done by the Subcommittee on Energy ("Subcommittee"). Its jurisdiction is also broad and includes⁵:

- R&D for nuclear, coal, and synthetic fuels
- Department of Energy (and its National Laboratories):
- Global climate change
- New technologies R&D
- Commercialization of new technologies
- Utility policy
- Oil, gas, and coal production and distribution

³ About the Committee. Online. Available: <http://www.energy.senate.gov/public/index.cfm/about-the-committee>.

⁴ History. Online. Available: <http://www.energy.senate.gov/public/index.cfm/history>.

⁵ Energy. Online. Available: <http://www.energy.senate.gov/public/index.cfm/subcommittees?p=Energy>.

The E&R Committee has been active in addressing energy issues under the current leadership. A wide-ranging energy synopsis ("Energy 20/20") was produced in 2013⁶, and a major new energy bill has been introduced (Energy Policy Modernization Act of 2016, EPMCA^{7,8}). Energy 20/20 covers many of the energy issues facing the U.S. in seven sections:

- Producing More
- Consuming Less
- Clean Energy Technology
- Modernizing Energy Delivery Infrastructure
- Effective Government
- Environmental Responsibility
- An Energy Policy that Pays for Itself

The goals set forth in Energy 20/20 are to: 1) provide a basis for conversation about the future direction of energy policy; 2) outline policies leading to U.S. independence from OPEC oil imports by 2020; and 3) fund scientific research critical to continued progress⁹. The report notes a consensus that it is in the national interest to "make energy abundant, affordable, clean, diverse, and secure"¹⁰. The challenge is to "align federal law and policy with that consensus."¹¹ A number of white papers were prepared – apparently related to Energy 20/20 – that address a variety of energy-related topics including the following:

⁶ Murkowski, L., 2013. Energy 20/20 – a Vision for America's Energy Future. Online. Available: <http://www.energy.senate.gov/public/index.cfm/energy-20-20-a-vision-for-america-s-energy-future>.

⁷ A Bill To Provide for the Modernization of the Energy Policy of the United States, and for Other Purposes. Online. Available: http://www.energy.senate.gov/public/index.cfm/files/serve?File_id=56a384df-cffa-44eb-a1f4-540a72ab6b0f.

⁸ S. 2012 – The Energy Policy Modernization Act (EPMA) – A Bipartisan Bill for a New Era of Energy in America. Online. Available: <http://www.energy.senate.gov/public/index.cfm?p=legislation&id=87D9E1CF-1B96-4815-9D05-387798EFAEA7>.

⁹ Murkowski, L., 2013. Energy 20/20 – a Vision for America's Energy Future – Fact Sheet. Online. Available: <http://www.energy.senate.gov/public/index.cfm?p=legislation&id=87D9E1CF-1B96-4815-9D05-387798EFAEA7>.

¹⁰ Murkowski, L., 2013. Energy 20/20 - A Vision for America's Energy Future. Online. Available: http://www.energy.senate.gov/public/index.cfm/files/serve?File_id=c691a024-1004-4d49-8de9-a976ce0d2bf3.

¹¹ Senator Murkowski Letter, February 4, 2013. Online. Available: http://www.energy.senate.gov/public/index.cfm/files/serve?File_id=570b3312-b8ee-4afa-91ec-6f11dafac7c6.

- The Narrowing Window¹²
- The Energy-Water Nexus¹³
- Powering the Future¹⁴
- A Signal to the World¹⁵

In July 2015 the E&R Committee unveiled EMPCA (S2012) as a broad, bipartisan energy bill. The bill is described as follows on the Committee's website¹⁶:

The Energy Policy Modernization Act builds on recent technological breakthroughs and promises to bring substantial benefits to American families and businesses while protecting the environment. It will save energy, expand domestic supplies, facilitate investment into critical infrastructure, protect the grid, boost energy trade, improve the performance of federal agencies, and renew programs that have proven effective. The end result will be more affordable energy, more abundant energy, and more functional energy systems throughout the U.S. to strengthen and sustain our energy renaissance. Best of all, the Energy Policy Modernization Act achieves these goals in a fiscally responsible manner.

The bill includes five titles that include many of the topics in Energy 20/20¹⁷:

- I. Efficiency
- II. Infrastructure
- III. Supply
- IV. Accountability
- V. Conservation Reauthorization.

EMPCA is the first comprehensive energy legislation introduced since enactment of the Energy Independence and Security act in 2007¹⁸.

The broad jurisdiction and span of activities of the E&R Committee make it an excellent forum for promoting emerging energy technologies and dealing with their associated impacts.

¹² The Narrowing Window – America's Opportunity to Join the Global Gas Trade, 2013. Online. Available: http://www.energy.senate.gov/public/index.cfm/files/serve?File_id=d647e1a3-f2fb-42e6-9d0d-d65e23fb058f.

¹³ The Water-Energy Nexus - Interlinked Resources That Are Vital For Economic Growth and Sustainability, 2014. Online. Available: http://www.energy.senate.gov/public/index.cfm/files/serve?File_id=9d529812-659b-43a1-a2d1-ef0e67894636.

¹⁴ Powering the Future – Ensuring That Federal Policy Fully Supports Electric Reliability, 2014. Online. Available: http://www.energy.senate.gov/public/index.cfm/files/serve?File_id=3c485574-7d19-4ee9-ae0e-c7e8f986032e.

¹⁵ A Signal to the World – Renovating the Architecture of U.S. Energy Exports, 2014. Online. Available: http://www.energy.senate.gov/public/index.cfm/files/serve?File_id=546d56f0-05b6-41e6-84c1-b4c4c5efa372.

¹⁶ S. 2012 – The Energy Policy Modernization Act (EPMA) – A Bipartisan Bill for a New Era of Energy in America. Online. Available: <http://www.energy.senate.gov/public/index.cfm?p=legislation&id=87D9E1CF-1B96-4815-9D05-387798EFAEA7>.

¹⁷ Murkowski, L., Chairman, Senate Committee on Energy and Natural Resources. 2015. The Energy Policy Modernization Act of 2015 (S. 2012) - Section-by-Section Analysis. Online. Available: http://www.energy.senate.gov/public/index.cfm/files/serve?File_id=6fc41b34-2dff-4a05-b7bc-8ec912a98e16.

¹⁸ Senate Begins Debate on Comprehensive Bipartisan Energy Bill, New York Times, January 27, 2016. Online. Available: http://www.nytimes.com/2016/01/28/us/politics/senate-bipartisan-energy-legislation.html?_r=0.

2.2 U.S. House of Representatives Committee on Energy and Commerce

The U.S House Energy and Commerce Committee (“E&C Committee”) has the main responsibility for energy policy in the House of Representatives. It has the broadest jurisdiction of any House Committee¹⁹, including national energy policy, energy resources (exploration, production, storage, supply, marketing, pricing, and regulation), energy conservation, energy information, electrical power production, nuclear energy, and oversight of the Department of Energy and Federal Energy Regulatory Commission²⁰. The E&C Committee was created in 1795 and is the oldest standing committee in the House.

The E&C Committee’s Subcommittee on Energy and Power also has broad energy-related jurisdiction, including national energy policy, fossil energy, renewable energy, nuclear energy and facilities, synthetic and alternative fuels, energy conservation, energy information, exploration and production, and energy efficiency²¹.

The E&C Committee’s Oversight Plan²² addresses a number of energy and environment issues, including national energy policy, electricity market, management of the U.S. Department of Energy and its national laboratories, the Nuclear Regulatory Commission, climate change, and investment in the green energy sector. The E&C Committee’s recent “Views and Estimates of the President’s Budget”²³ addressed several items in the budgets for the Department of Energy – Energy Efficiency and Renewable Energy, Electricity Delivery and Energy Reliability, Nuclear Energy, Fossil Energy, and Energy Information Administration. For the Nuclear Regulatory Commission, the items covered were the High-Level Waste Repository Program and Operating

¹⁹ Committee History. <http://energycommerce.house.gov/about/committee-history>.

²⁰ U.S. House of Representatives Committee On Energy And Commerce, 2013. Activity Report for the One Hundred Twelfth Congress Together with Minority Views. Online. Available: <http://www.gpo.gov/fdsys/pkg/CRPT-112hrpt746/pdf/CRPT-112hrpt746.pdf>.

²¹ Energy and Power Subcommittee. Online. Available: <http://energycommerce.house.gov/subcommittees/energy-and-power>.

²² U.S. House of Representatives Committee on Energy and Commerce, 2015. 114th Congress Oversight Plan. Online. Available: <http://energycommerce.house.gov/sites/republicans.energycommerce.house.gov/files/analysis/114OversightPlan.pdf>.

²³ U.S. House of Representatives Committee on Energy and Commerce, 2015. Views and Estimates on the President’s Budget for Fiscal Year 2016. Online. Available: <http://energycommerce.house.gov/sites/republicans.energycommerce.house.gov/files/analysis/ECFY2016ViewsEstimates.pdf>.

and New Reactors. Global Climate Change and greenhouse gas issues were addressed in the Environment section of the Views and Estimates of the Budget document.

Like the Senate E&R Committee, the House E&C Committee is an optimum candidate for supporting emerging energy technologies and dealing with their impacts.

2.3 Congressional Research Service (CRS)

The Congressional Research Service (CRS) is a public policy research entity that “works exclusively for the United States Congress, providing policy and legal analysis to committees and Members of both the House and Senate, regardless of party affiliation.”²⁴ Its mission is to serve “the Congress throughout the legislative process by providing comprehensive and reliable legislative research and analysis that are timely, objective, authoritative and confidential, thereby contributing to an informed national legislature.”²⁵

The CRS works closely with Members of Congress and congressional committees at all stages of the legislative process “from the early considerations that precede bill drafting, through committee hearings and floor debate, to the oversight of enacted laws and various agency activities.”²⁶ CRS does not make policy or legislative recommendations but instead develops information to support policymaking by Members of Congress and their staff.

CRS was created by Congress in 1970 from the former Legislative Reference Service, which had existed since 1946. It is located in Washington, D.C. and has about 600 employees, most of whom are policy analysts, attorneys, and information professionals. The agency is organizationally within the Library of Congress and has five research divisions:²⁷

1. American Law
2. Domestic Social Policy
3. Foreign Affairs, Defense and Trade
4. Government and Finance
5. Resources, Science and Industry

²⁴ Congressional Research Service Careers. Online. Available: <http://www.loc.gov/crsinfo/>.

²⁵ History and Mission. Online. Available: <http://www.loc.gov/crsinfo/about/history.html>.

²⁶ About CRS. Online. Available: <http://www.loc.gov/crsinfo/about/>.

²⁷ Areas of Research. Online. Available: <http://www.loc.gov/crsinfo/research/>.

CRS performs analysis and provides assistance to Congress “in the form of reports, memoranda, customized briefings, seminars, digitally recorded presentations, information obtained from governmental and nongovernmental databases, and consultations in person and by telephone.”²⁸ Its values are to be confidential, authoritative, objective, and nonpartisan.²⁹ Support to Congress includes several categories of services and products³⁰:

- Congressionally Distributed Products Providing Research and Analysis on Legislative Issues
- Electronically Accessible Products and Services
- Responses to Individual Members and Committees
- Seminars, Institutes, and Other Programs
- Outreach
- Legislative Summaries, Digests, and Compilations
- Other Services

CRS work is accomplished at the direction of a member of Congress or one of the congressional committees. Because its research services are focused on Congress, and by statutory mandate in the laws appropriating its funds, CRS does not routinely make its reports available to the public. The lack of complete availability to the public has become somewhat controversial, so the CRS has made its policy clear on access to its reports with several interrelated precepts:³¹

- CRS is a resource dedicated solely to meeting the needs of Congress.
- The confidential relationship with Congress is preserved by restricting access to CRS products.
- Communications from the CRS to Congress are confidential and constitutionally protected.
- The role of CRS staff as “adjunct staff” to the Congress could be altered by speaking directly to the public.

²⁸ Brudnick, I., 2011. The Congressional Research Service and the American Legislative Process. CRS Report for Congress, RL33471. Online. Available: <https://www.fas.org/sgp/crs/misc/RL33471.pdf>.

²⁹ Values. Online. Available: <http://www.loc.gov/crsinfo/about/values.html>.

³⁰ Mazanec, M.B., Director, 2015. Annual Report of the Congressional Research Service of the Library of Congress for Fiscal Year 2014 to the Joint Committee on the Library, United States Congress. March. Online. Available: <https://www.fas.org/sgp/crs/crs10.pdf>.

³¹ Mullhollan, D.P., 2007. Access to CRS Reports. CRS Memo, April 18. Online. Available: <https://www.fas.org/sgp/crs/crs041807.pdf>.

- If the audience becomes the public at large, CRS would no longer be focused on congressional needs.
- Responding to congressional constituents as members of the public could threaten the dialogue between Members of Congress and their constituents.

Over 700 new CRS reports are produced each year; almost 4,000 are in existence.³² Much of CRS research has in recent years apparently been devoted to responses to constituents of Members of Congress, perhaps resulting in less emphasis on policy research.³³

Because energy policy has been an important issue for the U.S. Congress since the major crises in the 1970s, CRS has produced a number of reports to help inform congressional action on energy topics. Energy-related research is conducted in the Resources, Industry and the Environment Division³⁴, whose coverage includes Energy and Minerals as one of six sections. This section addresses seven topics:

- Conventional energy supply, prices and security
- Energy efficiency and conservation
- Renewable and alternative energy
- Emerging energy technology
- Environmental effects of energy production and consumption
- Energy infrastructure, taxation and regulation
- Mineral production and use

One example CRS energy policy report is a recent description of energy in the U.S., which provides broad coverage, including oil, natural gas, coal, electricity, renewables, and conservation and energy efficiency.³⁵ Other energy-related CRS reports address contemporary

³² Congressional Research Reports. Online. Available: https://en.wikipedia.org/wiki/Congressional_Research_Service_reports.

³³ Kosar, K.R., 2015. Why I Quit the Congressional Research Service. Washington Monthly. January/February. Online. Available: http://www.washingtonmonthly.com/magazine/januaryfebruary_2015/features/why_i_quit_the_congressional_r053467.php?page=all.

³⁴ Resources, Science and Industry Division. Online. Available: <http://www.loc.gov/crsinfo/research/div-rsi.html>.

³⁵ Ratner, M., and C. Glover, 2014. U.S. Energy: Overview and Key Statistics. CRS Report R40187. June. Online. Available: <https://www.fas.org/sgp/crs/misc/R40187.pdf>.

energy and water issues^{36,37}, energy tax policy³⁸, loan guarantees³⁹, renewable energy⁴⁰, and energy storage⁴¹. A recent CRS Annual Report⁴² described five energy-specific Resources, Industry, and the Environment topics:

- Crude Oil and Petroleum Products
- Liquefied Natural Gas and Crude Oil Exports
- Electric Utilities
- Propane Storage
- EPA's Proposed Clean Power Plan

This report also listed the Keystone XL Pipeline and hydraulic fracturing as two of the major issues addressed by the CRS in FY2014. Another recent energy policy report outlined three major U.S. policy goals since the oil embargos of the 1970s⁴³:

- Assure a secure supply of energy
- Keep energy costs low enough to meet the needs of a growing economy
- Protect the environment during energy production and consumption

Replacing conventional energy sources was addressed specifically, with emphasis on replacing fossil fuels with biofuels (ethanol and non-food sources) and renewable sources such as wind, solar (concentrating and photovoltaic), and geothermal sources. It is noted that a principal emphasis of past congressional programs has been on environmental concerns, especially

³⁶ Carter, N.T., 2013. Energy-Water Nexus: The Energy Sector's Water Use. CRS Report R43199. August. Online. Available: <https://www.fas.org/sgp/crs/misc/R43199.pdf>.

³⁷ Copeland, C., 2014. Energy-Water Nexus: The Water Sector's Energy Use. CRS Report R43200. January. Online. Available: <https://www.fas.org/sgp/crs/misc/R43200.pdf>.

³⁸ Sherlock, M.F., and J.M. Stupak, 2015. Energy Tax Incentives: Measuring Value Across Different Types of Energy Resources. CRS Report R41953. March. Online. Available: <https://www.fas.org/sgp/crs/misc/R41953.pdf>.

³⁹ Brown, P., 2012. Loan Guarantees for Clean Energy Technologies: Goals, Concerns, and Policy Options. CRS Report R42152. January. Online. Available: <https://www.fas.org/sgp/crs/misc/R42152.pdf>.

⁴⁰ Cunningham, L.J., and B.A. Roberts, 2013. Renewable Energy and Energy Efficiency Incentives: A Summary of Federal Programs. CRS Report R40913. October. Online. Available: <https://www.fas.org/sgp/crs/misc/R40913.pdf>.

⁴¹ Parfomak, P.W., 2012. Energy Storage for Power Grids and Electric Transportation: A Technology Assessment. CRS Report R42455. March. Online. Available: <https://www.fas.org/sgp/crs/misc/R42455.pdf>.

⁴² Mazanec, M.B., Director, 2015. Annual Report of the Congressional Research Service of the Library of Congress for Fiscal Year 2014 to the Joint Committee on the Library, United States Congress. March. Online. Available: <https://www.fas.org/sgp/crs/crs10.pdf>.

⁴³ Yacobucci, B.D., 2015. Energy Policy: 114th Congress Issues. CRS Report R42756. January. Online. Available: <https://www.fas.org/sgp/crs/misc/R42756.pdf>.

greenhouse gas emissions and global climate change. It is also noted that development of new industrial products from increasing renewable energy sources has been a significant theme of past programs. Also, nuclear power is being considered as a viable alternative to fossil energy in spite of its long history as a target of environmental concerns.

If either the Senate or the House chooses to take up energy-related issues, including emerging technologies and their related impacts, the Resources, Industry, and Environment Division of the CRS is well positioned and highly qualified to provide the necessary information and evaluation support for Congressional policymaking.

3 Executive Entities

The President, along with Congress, provides leadership for energy policymaking for the nation. Many agencies and other entities in the Executive branch have energy-related responsibilities and develop energy policy. These entities are within the Executive Office of the President, are Cabinet-level Departments, or function as independent agencies.

3.1 Executive Office

Three entities within the Executive Office have responsibilities for policy development on science and technology, including energy-related topics – the Office of Science and Technology Policy (OSTP), the National Science and Technology Council (NSTC), and the President’s Council of Advisors on Science and Technology (PCAST).

The OSTP mission has three components⁴⁴: 1) provide the President and his senior staff with accurate, relevant, and timely scientific and technical advice on all matters of consequence; 2) ensure that the policies of the Executive Branch are informed by sound science; and 3) be sure that the scientific and technical work of the Executive Branch is properly coordinated so as to provide the greatest benefit to society. It was established in 1976 to advise the President on the effects of science and technology on domestic and international affairs. The OSTP leads interagency efforts to develop and implement sound science and technology policies and budgets, and to work with the private sector, state and local governments, the science and higher education communities, and other nations toward this end⁴⁵. OSTP’s four strategic goals and objectives may be summarized as follows:

1. Maximize the contribution of U.S. investments in science and technology to economic prosperity, public health, environmental quality, and national security
2. Facilitate the processes of government programs in science and technology
3. Sustain core relationships required to understand U.S. scientific and technical efforts, evaluate advances, and identify policy proposals

⁴⁴ About OSTP. Online. Available: <https://www.whitehouse.gov/administration/eop/ostp/about>

⁴⁵ About OSTP. Online. Available: <https://www.whitehouse.gov/administration/eop/ostp/about>.

4. Maintain staff with expertise to provide policy advice to the President on the scientific and technical aspects of government policies and programs.

The National Science and Technology Council (NSTC) and President's Council of Advisors on Science and Technology (PCAST) are also within the Executive Office of the President. The NSTC coordinates science and technology policies among the Federal entities conducting research and development. The NSTC is chaired by the President, and its membership consists of the Vice President, the Director of the OSTP, and Cabinet Secretaries and Agency Heads having significant science and technology responsibilities. The NSTC objective is to establish national goals for Federal science and technology investments. It was established by Executive Order in 1993. Most of its work is accomplished in five committees: Environment, Natural Resources and Sustainability; Homeland and National Security; Science, Technology, Engineering, and Math (STEM) Education; Science; and Technology.

PCAST is an advisory group to the President that includes leading U.S. scientists and engineers that was created in 2009⁴⁶. It is co-chaired by the Director of the OSTP and makes policy recommendations regarding science, technology, and innovation where they are key to strengthening the economy and forming workable policies.

The OSTP, NSTC, and PCAST must be fully engaged in energy-related issues to provide executive leadership and meet their policy advisory responsibilities for science and engineering policy. The U.S. Global Climate Change Research Program, for example, is steered by the NSTC's Subcommittee on Global Change Research and is overseen by the OSTP⁴⁷. Realization of emerging energy technologies and dealing with their impacts are prime candidates for Executive Office energy policy leadership.

3.2 U.S. Department of Energy (DOE)

The U.S. Department of Energy (DOE) is the primary agency dealing with energy-related topics and policymaking. The DOE is a cabinet-level Department whose mission is to ensure America's

⁴⁶ About PCAST. Online. Available: <https://www.whitehouse.gov/administration/eop/ostp/pcast/about>.

⁴⁷ About USGCRP – Organization & Leadership. Online. Available: <http://www.globalchange.gov/about/organization-leadership>.

security and prosperity by addressing its energy, environmental and nuclear challenges through transformative science and technology solutions⁴⁸.

Four components of DOE in particular are relevant to policies and practices for non-fossil emerging energy technologies. The Advanced Research Projects Agency – Energy (ARPA-E), the Office of Energy Efficiency and Renewable Energy (EERE), the National Renewable Energy Laboratory (NREL), and the National Laboratories, with Los Alamos National Laboratory (LANL) as a primary example). The National Energy Technology Laboratory (NETL) is focused on fossil energy technology and is not included in this White Paper. Also, DOE’s Energy Information Agency (EIA) deals more with developing and providing data and less with energy policymaking and is not included. DOE Headquarters is described below first, followed by each of the four selected components.

3.2.1 DOE Overall

The DOE is organized into three principal components headed by Undersecretaries who report to the office of the Secretary – Nuclear Security, Science and Energy, and Management and Performance⁴⁹. In addition, sixteen organizational units also report to the Office of the Secretary, including the Energy Information Administration, four Power Administrations (Western, Southwestern, Southeastern, and Bonneville), Congressional and Intergovernmental Affairs, International Affairs, and Energy Policy and Systems Analysis.

The Secretary of Energy receives advice and recommendations from an advisory board (Secretary of Energy Advisory Board, SEAB) on such topics as basic and applied R&D, economic and national security policy, education issues, and other activities as directed by the Secretary⁵⁰. The SEAB consists of 19 members (including a chair and vice chair) having a broad range of expertise, such as environmental protection, economics, law, medicine, and policy.

The DOE was created under the provisions of the Department of Energy Organization Act of 1977 as the twelfth cabinet-level department. Two long-standing "programmatic traditions"

⁴⁸ Mission. Online. Available: <http://energy.gov/mission>.

⁴⁹ Organization Chart. Online. Available: <http://energy.gov/leadership/organization-chart>.

⁵⁰ Secretary of Energy Advisory Board. Online. Available: <http://energy.gov/seab/secretary-energy-advisory-board>.

within the Federal government were brought together in the reorganization.⁵¹: 1) defense responsibilities that included the design, construction, and testing of nuclear weapons dating from the Manhattan Project; and 2) a loosely knit amalgamation of energy-related programs scattered throughout the government. Two factors brought these traditions together:

- Nuclear energy development and commercialization by the Atomic Energy Commission (the Federal government's most significant energy project of the 1970s)
- Efforts to better coordinate Federal energy policy programs in response to the energy crises of the 1970s

DOE took responsibility for a framework for a national energy plan, long-term and high-risk energy R&D, energy conservation and regulatory programs, the nuclear weapons program, and energy data collection and analysis.

Since its beginnings, the DOE has varied its emphasis in response to changing national needs⁵². Energy development and regulation took priority during the late 1970s. Nuclear weapons research, development, and production were emphasized in the 1980s. After the end of the Cold War, focus was placed on the cleanup of the nuclear weapons complex and nuclear nonproliferation in the 1990s. Since 2000, the DOE has placed priority on ensuring U.S. security and prosperity.

The DOE Strategic Plan⁵³ includes three main goals, one for each of the Undersecretary organizations noted above. The most significant unit for emerging energy technologies is Science and Energy, whose goal includes three Strategic Objectives:

1. Advance the goals and objectives in the President's Climate Action Plan by supporting prudent development, deployment, and efficient use of "all of the above" energy resources that also create new jobs and industries
2. Support a more economically competitive, environmentally responsible, secure and resilient U.S. energy infrastructure

⁵¹ A Brief History of the Department of Energy. Online. Available: <http://energy.gov/management/office-management/operational-management/history/brief-history-department-energy>.

⁵² A Brief History of the Department of Energy. Online. Available: <http://energy.gov/management/office-management/operational-management/history/brief-history-department-energy>.

⁵³ U.S. Department of Energy, 2014, Strategic Plan 2014-2018. Online. Available: http://www.energy.gov/sites/prod/files/2014/04/f14/2014_dept_energy_strategic_plan.pdf.

3. Deliver the scientific discoveries and major scientific tools that transform our understanding of nature and strengthen the connection between advances in fundamental science and technology innovation

The third Strategic Objective in turn encompasses three strategies:

- Conduct discovery-focused research to increase our understanding of matter, materials and their properties through partnerships with universities, national laboratories, and industry
- Provide the nation's researchers with world-class scientific user facilities that enable mission-focused research and advance scientific discovery
- Use the national laboratory system and leverage partnerships with universities and industry to conduct mission-focused research

Particularly at the Headquarters level, DOE is a principal player in developing policy toward and providing support for emerging energy technologies as well as dealing with their secondary impacts.

3.2.2 Advanced Research Projects Agency – Energy (ARPA-E)

Advanced Research Projects Agency – Energy (ARPA-E) is particularly relevant for supporting new technologies as sources of energy. Its mission is to catalyze and accelerate the creation of transformational energy technologies by making investments in the early stages of development⁵⁴. ARPA-E advances high-potential high-impact energy technologies that are too early for private-sector investment. The agency focuses on transformational projects that have the potential to radically improve U.S. economics, prosperity, national security, and environmental well being⁵⁵. The ARPA-E model is based on the successful Defense Advanced Research Projects Agency (DARPA), which is credited with many innovations⁵⁶ and is described below in Section 3.3.3.

⁵⁴ Advanced Research Projects Agency – Energy Strategic Vision 2013. Online. Available: <http://arpa-e.energy.gov/?q=arpa-e-pdf/arpa-e-strategic-vision-2013>.

⁵⁵ About (ARPA-E). Online. Available: <http://arpa-e.energy.gov/?q=arpa-e-site-page/about>.

⁵⁶ The Advanced Research Projects Agency-Energy: Overview. Online. Available: http://arpa-e.energy.gov/sites/default/files/ARPA-E_FactSheet.pdf.

The impetus for creation of ARPA-E was a report by the National Academies, “Rising Above the Gathering Storm”⁵⁷, which recommended an agency similar to DARPA within the DOE. The agency was authorized in 2007 (The America COMPETES Act), and its initial projects were funded in 2009⁵⁸. Over 400 energy technology projects have been funded since 2009.

ARPA-E seeks to streamline the program development and awards process with two models – “focused” programs and “open” solicitations⁵⁹. The focused programs are developed by ARPA-E program directors to address specific program challenges. Open funding opportunities pursue novel approaches to energy innovations that are outside the scope of existing focused programs⁶⁰. ARPA-E's process advances early-stage technologies to market with four strategies⁶¹:

- Strategic Partnerships with private companies to advance along a clear path to market - after their time with ARPA-E
- New Company Formation - to facilitate the commercialization process for technologies
- Public-Development - with other government entities to further advance ARPA-E sponsored projects
- Follow-On Investment - from private investors during and after an ARPA-E award.

By the very nature of its creation, existence, and mission, ARPA-E is a prime entity for researching and realizing emerging energy technologies.

3.2.3 Office of Energy Efficiency and Renewable Energy (EERE)

The Office of Energy Efficiency and Renewable Energy (EERE) is another DOE component whose emphasis is on investigation of emerging energy technologies. Its mission is “to create

⁵⁷ National Academies Committee on Science, Engineering, and Public Policy. 2007. Rising Above the Gathering Storm: Energizing and Employing America for a Brighter Economic Future. National Academies Press. Online. Available: <http://www.nap.edu/catalog/11463/rising-above-the-gathering-storm-energizing-and-employing-america-for>.

⁵⁸ ARPA-E History. Online. Available: <http://arpa-e.energy.gov/?q=arpa-e-site-page/arpa-e-history>.

⁵⁹ Advanced Research Projects Agency – Energy Strategic Vision 2013. Online. Available: <http://arpa-e.energy.gov/?q=arpa-e-pdf/arpa-e-strategic-vision-2013>.

⁶⁰ Advanced Research Projects Agency – Energy Strategic Vision 2013. Online. Available: <http://arpa-e.energy.gov/?q=arpa-e-pdf/arpa-e-strategic-vision-2013>.

⁶¹ The Advanced Research Projects Agency-Energy: Overview. Online. Available: http://arpa-e.energy.gov/sites/default/files/ARPA-E_FactSheet.pdf.

and sustain American leadership in the global transition to a clean energy economy”⁶². This mission includes high-impact research, development, and demonstration to make clean energy as affordable and convenient as traditional forms of energy as well as breaking down barriers to market entry. EERE is “at the center of creating the clean energy economy today. EERE leads the U.S. Department of Energy's efforts to develop and deliver market-driven solutions for energy-saving homes, buildings, and manufacturing; sustainable transportation; and renewable electricity generation”⁶³.

EERE invests in clean energy technologies that strengthen the economy, reduce dependence on foreign oil, and protect the environment⁶⁴. EERE leverages partnerships with the private sector, state and local governments, DOE national laboratories, and universities to transform the nation’s economic engine to one powered by clean energy. The agency was formed in 2001 when it was renamed and reorganized from a predecessor organization, the Office of Conservation and Solar Energy⁶⁵. EERE’s five guiding principles are as follows⁶⁶:

1. High Impact: Is this a high impact problem?
2. Additionality: Will the EERE funding make a large difference relative to what the private sector (or other funding entities) is already doing?
3. Openness: Have we made sure to focus on the broad problem we are trying to solve and be open to new ideas, new approaches, and new performers?
4. Enduring U.S. Economic Benefit: How will this EERE funding result in enduring economic benefit to the United States?
5. Proper Role Of Government: Why is what we are doing a proper high impact role of government versus something best left to the private sector to address on its own?

⁶² EERE FY2016 Budget Request. Online. Available: <http://energy.gov/sites/prod/files/2015/02/f19/FY%202016%20Rollout%20EERE%20Stakeholder%20Presentation.pdf>.

⁶³ Mission. Online. Available: <http://energy.gov/eere/about-us/mission>.

⁶⁴ EERE Fact Sheet, 2011. Online. Available: <http://energy.gov/sites/prod/files/2013/11/f5/51111.pdf>.

⁶⁵ AllGov – EERE History. Online. Available: <http://www.allgov.com/departments/department-of-energy/office-of-energy-efficiency-and-renewable-energy?agencyid=7410>.

⁶⁶ EERE FY2016 Budget Request. Online. Available: <http://energy.gov/sites/prod/files/2015/02/f19/FY%202016%20Rollout%20EERE%20Stakeholder%20Presentation.pdf>.

The Assistant Secretary at the head of EERE reports to DOE's Undersecretary for Science and Energy⁶⁷. The principal organization components are Energy Efficiency, Renewable Energy, Business Operations, and Strategic Programs⁶⁸.

With its principal emphasis on developing new technologies for clean energy, EERE is a prime example of a government agency having emerging energy technology responsibilities.

3.2.4 National Renewal Energy Laboratory (NREL)

The National Renewal Energy Laboratory (NREL) is organizationally within EERE and has a similar emphasis on realizing energy from new technologies. NREL's mission is to develop “clean energy and energy efficiency technologies and practices, advance related science and engineering, and provide knowledge and innovations to integrate energy systems at all scales.”⁶⁹

NREL is the primary “research facility for the Department of Energy’s Office of Energy Efficiency and Renewable Energy (OEERE), Office of Science, and Office of Electricity Delivery and Energy Reliability”. The NREL also provides technical assistance, energy planning and economic development for many organizations and industries in the U.S. The laboratory is managed for the DOE by the Alliance for Sustainable Energy, LLC, a partnership between Battelle Memorial Institute and MRIGlobal (Midwest Research Institute). Roughly 80% of the NREL’s funding comes from the OEERE, with the balance coming from other DOE and outside sources.”⁷⁰ NREL is “the only federal laboratory dedicated to the research, development, commercialization, and deployment of renewable energy and energy efficiency technologies.”⁷¹

NREL performs analysis to inform “policy and investment decisions as energy-efficient and renewable energy technologies advance from concept to commercial application to market penetration. With objective, technology-neutral analysis, NREL aims to increase the understanding of energy policies, markets, resources, technologies, and infrastructure and

⁶⁷ Organization Chart. Online. Available: <http://energy.gov/leadership/organization-chart>.

⁶⁸ EERE Organization Chart. Online. Available: <http://energy.gov/eere/downloads/office-energy-efficiency-and-renewable-energy-organization-chart>.

⁶⁹ Mission and Programs. Online. Available: <http://www.nrel.gov/about/mission-programs.html>.

⁷⁰ National Renewable Energy Laboratory – What it Does. Online. Available: <http://www.allgov.com/departments/department-of-energy/national-renewable-energy-laboratory?agencyid=7406>.

⁷¹ Mission and Programs. Online. Available: <http://www.nrel.gov/about/mission-programs.html>.

connections between these and economic, environmental, and security priorities.”⁷² The agency’s major research topics are as follows:⁷³

Biomass	Geothermal Energy
Biosciences	Hydrogen & Fuel Cells
Buildings Efficiency	Materials Science
Chemistry & Nanoscience	Photovoltaics
Computational Science	Solar
Concentrating Solar Power	Technology Deployment
Electricity Integration	Transportation
Energy Analysis	Water Power
Energy Systems Integration	Wind Energy

Four of the agency’s major components are:

- Energy Systems Integration Facility
- National Biotechnology Center
- National Center for Photovoltaics
- National Wind Technology Center

NREL was initiated “as the Solar Energy Research Institute (SERI) in 1977, spurred by national concern during the 1973 oil embargo. President George H.W. Bush elevated SERI to a national laboratory, and its name was changed to the National Renewable Energy Laboratory. Whereas SERI’s roots were dedicated to harnessing power from the sun, NREL is dedicated to all forms of renewable energy and energy efficiency – and to working with industry to transfer innovative ideas into the marketplace.”⁷⁴

NREL receives about \$380 million a year in funding. It has “a unique, world-class workforce. The staff at NREL is highly educated, with 31% holding doctorate degrees and another 32% with master’s degrees. The staff includes citizens from 55 countries, with the majority (57%) contributing in core research and development.”⁷⁵ Like its parent organization (EERE), NREL

⁷² Mission and Programs. Online. Available: <http://www.nrel.gov/about/mission-programs.html>.

⁷³ Research. Online. Available: <http://www.nrel.gov/research/>.

⁷⁴ Leading the Way to Energy Systems Research. Online. Available: <http://www.nrel.gov/docs/fy15osti/64071.pdf>.

⁷⁵ University of Colorado Leeds School of Business – NREL, National Renewable Energy Laboratory. Online. Available: <http://www.nrel.gov/about/assets/pdfs/nrel-economic-impact-summary-and-case-studies-2015.pdf>.

provides a good example of an agency actively involved in developing emerging energy technologies.

3.2.5 National Laboratories

DOE's National Laboratories are also well positioned to facilitate realization of emerging technologies for energy production. Los Alamos National Laboratory (LANL) in particular has a long tradition of scientific research and technology development for energy applications, including new sources. The National Laboratories are described below overall followed by LANL as a salient example.

3.2.5.1 National Laboratories Overall

DOE's National Laboratories tackle the critical scientific challenges of our time. They address large-scale, complex research and development challenges with a multidisciplinary approach and emphasis on translating basic science to innovation⁷⁶. Specifically, they:

- Conduct research of the highest caliber in physical, chemical, biological, and computational and information sciences that advances our understanding of the world around us;
- Advance U.S. energy independence and leadership in clean energy technologies to ensure the ready availability of clean, reliable, and affordable energy;
- Enhance global, national, and homeland security by ensuring the safety and reliability of the U.S. nuclear deterrent, helping to prevent the proliferation of weapons of mass destruction, and securing the nation's borders; and
- Design, build, and operate distinctive scientific instrumentation and facilities, and make these resources available to the research community.

The National Laboratories were formed during a period of immense investment prior to World War II and have served as the nation's leaders in scientific innovation for over 60 years. The core of the Laboratories is a first-rate workforce of research scientists, engineers, and support personnel. The National Laboratories steward vital scientific and engineering capabilities that are essential to U.S. continued science and technology primacy⁷⁷. They design, build, and operate unique instrumentation and facilities that support tens of thousands of scientists and engineers

⁷⁶ About the National Labs. Online. Available: <http://energy.gov/about-national-labs>.

⁷⁷ U.S. Department of Energy, 2014, Strategic Plan 2014-2018. Online. Available: <http://energy.gov/leadership/organization-chart>.

from academic, government, and industry. They partner with industry and others to integrate fundamental and applied research for the benefit of the economy⁷⁸. There are 17 labs with origins ranging from 1931 to 2005⁷⁹:

The National Laboratories have long been at the forefront of successful scientific research and technology development. Not only are they well positioned and fully capable of realizing the benefits of emerging energy technologies (and dealing with their impacts), they have been doing so for many decades.

3.2.5.2 Los Alamos National Laboratory (LANL)

LANL is a primary candidate among the National Laboratories for realization of emerging energy technologies. Its mission is to “solve national security challenges through scientific excellence”, and its vision is “to deliver science and technology to protect our nation and promote world stability”⁸⁰. The lab has expressed the following six values:

1. Service: Serving our country, our partners, our community, and each other
2. Excellence: Ensuring timely mission execution through scientific, operational, and business excellence
3. Integrity: Building trust through intellectual honesty, ethical conduct, and individual responsibility
4. Teamwork: Collaborating with colleagues and partners, respecting diverse opinions and backgrounds, vigorously debating alternatives, and coming together to achieve the best solutions
5. Stewardship: Being good stewards of the taxpayers’ dollars, the Laboratory, our community, and the environment
6. Safety and Security: Ensuring that safety and security are integral to everything we do

⁷⁸ Eight National Labs Offer Streamlined Partnership Agreements to Help Industry Bring New Technologies to Market, 2012. Online. Available: <http://energy.gov/articles/eight-national-labs-offer-streamlined-partnership-agreements-help-industry-bring-new>.

⁷⁹ U.S. Department of Energy, 2014, Strategic Plan 2014-2018. Online. Available: <http://energy.gov/leadership/organization-chart>.

⁸⁰ Mission, Vision, Values. Online. Available: <http://www.lanl.gov/mission/index.php>.

LANL's four goals are as follows⁸¹:

1. Deliver national nuclear security and broader global security mission solutions; and
2. Foster excellence in science and engineering disciplines essential for national security missions; by
3. Attracting, inspiring, and developing world-class talent to ensure a vital future workforce; and
4. Enabling mission delivery through next-generation facilities, infrastructure, and operational excellence.

LANL has a history of 70 years of science and innovation⁸². It was established in 1943 for the Manhattan Project, in which the atomic bomb was designed and built to achieve victory in World War II. The Laboratory has continued to focus on the U.S. nuclear deterrent but has also expanded and diversified to “solve other emerging national security and energy challenges”⁸³.

LANL has five major components, each headed by a Principal Associate Director, as follows⁸⁴:

- Science, Technology & Engineering
- Weapons Program
- Global Security
- Operations & Business
- Capital Projects.

The Laboratory conducts fundamental science in a number of areas as a foundation to meet its responsibilities, such as energy and infrastructure security, measures to counter nuclear and biological terrorist threats, and nuclear nonproliferation⁸⁵:

- High-Energy and Applied Physics and Theory
- High-Performance Computing
- Dynamic and Energetic Materials Science

⁸¹ Proud Legacy, Bold Future – Los Alamos National Laboratory Strategic Plan 2014. Online. Available: http://www.lanl.gov/newsroom/_assets/pdf/los-alamos-national-laboratory-strategic-plan-2014.pdf.

⁸² Our History. Online. Available: <http://www.lanl.gov/about/history-innovation/index.php>.

⁸³ Proud Legacy, Bold Future – Los Alamos National Laboratory Strategic Plan 2014. Online. Available: http://www.lanl.gov/newsroom/_assets/pdf/los-alamos-national-laboratory-strategic-plan-2014.pdf.

⁸⁴ Organization Chart. Online. Available: <http://www.lanl.gov/about/leadership-governance/organization-chart.php>.

⁸⁵ Los Alamos Overview. Online. Available: http://www.lanl.gov/about/_assets/docs/fact-sheets/los-alamos-overview.pdf.

- Superconductivity
- Quantum Information
- Advanced Materials
- Bioinformatics
- Theoretical and Computational Biology
- Chemistry
- Earth and Environmental Science
- Energy and Infrastructure Security
- Engineering Sciences And Applications
- Nanotechnology

As part of its Energy Security responsibilities, LANL is searching for “energy alternatives to propel the nation towards sustainability by seeking solutions to its dependence on oil and coal and to mitigate the effects of climate change”⁸⁶. The Laboratory applies its expertise “to those areas in which energy security needs intersect with its scientific strengths and capabilities.”

LANL’s strengths in materials science allow it to make advances in sustainable energy generation, transmission, and storage⁸⁷. The Laboratory’s work includes high-temperature superconductivity, biological and solar energy production, fuel cells, advanced hydrogen storage, and smart grid technology. Its work addresses adaptations to increasing energy demands, including the impacts of climate change and the capture, use, and storage of carbon dioxide.

LANL had 10,827 employees in 2015, of which 22% have earned a Ph.D. It is located in northern New Mexico about 35 miles northwest of Santa Fe⁸⁸. It has 1,280 buildings on 36 square miles of property belonging to the DOE.

LANL is a government entity that is well positioned and particularly well qualified to conduct the necessary research and development for emerging energy technologies – and has been doing so successfully since its beginnings over 70 years ago.

⁸⁶ Energy Security Solutions. Online. Available: <http://www.lanl.gov/mission/energy-security.php>.

⁸⁷ Energy Security Solutions. Online. Available: <http://www.lanl.gov/mission/energy-security.php>.

⁸⁸ Facts, Figures. Online. Available: <http://www.lanl.gov/about/facts-figures/>.

3.3 U.S. Department of Defense (DoD)

The mission of the U.S. Department of Defense (DoD) is to provide the military forces needed to deter war and to protect the security of our country⁸⁹. It is America's oldest and largest government agency. The President is the Commander-in-Chief of the U.S. Armed Forces, and the DoD is headed by the Secretary of Defense.

3.3.1 DoD Overall

The principal components of the DoD are the three Departments (Army, Navy, and Air Force), the Unified Combatant Commands (UCCs), the Office of the Secretary of Defense (OSD), and the Joint Chiefs of Staff (JCS)⁹⁰. In general, the three Departments (Services) train and equip the fighting forces, and the nine UCCs have overall command of the forces in military operations.

The JCS consists of senior leaders who advise the Secretary of Defense. The OSD is the executive support organization for the Secretary of Defense. It provides policy development, management of resources, overall planning, and oversight of programs. It is also responsible for managing the DOD Agencies and Field Activities organizations⁹¹.

The DoD is one of the largest single consumers of energy in the world and therefore has a very high interest in energy security. The agency is by far the largest energy consumer in the U.S. government (about 80% of the total)⁹². DoD's energy policy, as established by a 2014 DoD Directive, is "to enhance military capability, improve energy security, and mitigate costs in its use and management of energy"⁹³. The Directive states that the DoD will develop and acquire technologies that meet the agency's energy needs and manage risks.

The critical role of energy in enabling DoD to accomplish its mission has become increasingly recognized in the agency. DoD's energy consumption is managed in two primary categories –

⁸⁹ About the Department of Defense (DoD). Online. Available: <http://www.defense.gov/About-DoD>.

⁹⁰ The United States Government Manual 2013. DEPARTMENT OF DEFENSE. Online. Available: <https://www.gpo.gov/fdsys/pkg/GOVMAN-2013-11-06/pdf/GOVMAN-2013-11-06.pdf>.

⁹¹ DOD 101: Introductory Overview of the Department of Defense. Online. Available: <http://www.defense.gov/About-DoD/DoD-101#Our%20Bottom%20Line>.

⁹² Department of Defense Energy Initiatives: Background and Issues for Congress. Congressional Research Service 7-5700. Online. Available: <https://www.fas.org/sgp/crs/natsec/R42558.pdf>.

⁹³ Department of Defense. DIRECTIVE NUMBER 4180.01. April 16, 2014. Online. Available: http://www.dtic.mil/whs/directives/corres/pdf/418001_2014.pdf.

operations and installations. Energy is basic to assuring military capability and the ability to project and sustain U.S. military power⁹⁴. This recognition led to the creation in 2010 of the position of Assistant Secretary of Defense for Operational Energy and Programs^{95,96}. The 2016 Operational Energy Strategy sets forth the objective of increasing war fighting capability by including energy throughout future force development and reducing risks from operational energy vulnerabilities vulnerability⁹⁷.

Overall responsibility for Operational Energy is in the Office of the Assistant Secretary of Defense for Energy, Installations, and Environment⁹⁸. This Office also has responsibility for Installation Energy, which issues facility energy policy and guidance⁹⁹ and oversees the DoD Facility Energy Program¹⁰⁰. This Program focuses on three primary objectives: 1) expand supply; 2) reduce demand; and 3) adopt future forces and technology¹⁰¹. The fixed installations are critical in ensuring military readiness and account for about 30% of DOD energy use.

Given the large quantities of energy that DoD consumes, and the increasingly recognized importance of energy in accomplishing its mission, the agency maintains a strong position in developing and emerging energy technologies.

3.3.2 Energy & Power Community of Interest (COI)

DoD maintains an extensive research capability to develop the technologies to accomplish its mission, including assuring energy security. The Assistant Secretary of Defense for Research and Engineering (within OSD) provides strategic guidance and coordination of the science and

⁹⁴ Department of Defense 2016 Operational Energy Strategy. Online. Available: <http://www.acq.osd.mil/eie/Downloads/OE/2016%20DoD%20Operational%20Energy%20Strategy%20WEBc.pdf>.

⁹⁵ Fiscal Year 2014 Operational Energy Annual Report June 2015. Online. Available: <http://www.acq.osd.mil/eie/Downloads/OE/FY14%20OE%20Annual%20Report.pdf>.

⁹⁶ Powering the U.S. military: An Interview with the Pentagon's Sharon Burke. McKinsey & Co. Our Insights – Aerospace & Defense. April 2013. Online. Available: <http://www.mckinsey.com/industries/aerospace-and-defense/our-insights/powering-the-us-military#0>.

⁹⁷ Department of Defense 2016 Operational Energy Strategy. Online. Available: <http://www.acq.osd.mil/eie/Downloads/OE/2016%20DoD%20Operational%20Energy%20Strategy%20WEBc.pdf>.

⁹⁸ Office of the Assistant Secretary of Defense for Energy, Installations, and Environment. About Us. Online. Available: <http://www.acq.osd.mil/eie/AboutUs.html>

⁹⁹ About Installation Energy. Online. Available: http://www.acq.osd.mil/eie/IE/FEP_index.html.

¹⁰⁰ Installation Energy Office. Online. Available: http://www.acq.osd.mil/eie/IE/FEP_index.html.

¹⁰¹ Annual Energy Management Report. Fiscal Year 2014. Online. Available: <http://www.acq.osd.mil/eie/Downloads/IE/FY%202014%20AEMR.pdf>.

technology investment across the DoD¹⁰². DOD's "Research and Engineering (R&E) Enterprise" is broad and includes the military departments, DARPA, DTRA, DoD laboratories, other government laboratories, university affiliated research centers, government laboratories of allies, and the industrial base¹⁰³. The R&E Enterprise Guidance outlines three "enduring principles" – eliminate or mitigate technology-based national security threats, enable new or extended military capabilities, and create technology surprise¹⁰⁴. The DoD is a potent engine of technological innovation and has unparalleled energy demands for national defense¹⁰⁵. At the same time, the agency's primary mission is to deter war and protect the country's security, which may pose limitations on its contributions to energy-related technological advances.

Reliance 21 has been set up as an overarching framework for DOD's Science and Technology planning and coordination¹⁰⁶. Under Reliance 21, Communities of Interest (COIs) have been established in 17 areas of focus to review the alignment of R&E programs, identify gaps, and help prioritize funding¹⁰⁷. The role of the COIs is to help deliver maximum science and technology impact with reduced risk by engaging the participants and enhancing collaboration¹⁰⁸. The COIs were established as a mechanism to encourage coordination and collaboration among agencies in cross-cutting technology focus areas. They provide a forum for coordinating science and technology strategies across DoD, sharing new ideas, technical directions, and technology opportunities¹⁰⁹.

¹⁰² Mission History. Online. Available: <http://www.acq.osd.mil/chieftechнологist/mission/history.html>.

¹⁰³ Research & Engineering Enterprise. Online. Available: <http://www.acq.osd.mil/chieftechнологist/index.html>.

¹⁰⁴ Communities of Interest – Collaborating on Technology Challenges. Online. Available: http://www.defenseinnovationmarketplace.mil/resources/ATL-Magazine_COIs_Shaffer_March2015.pdf.

¹⁰⁵ Energy Innovation at the Department of Defense: Assessing the Opportunities. Online. Available: <http://cspo.org/wp-content/uploads/2014/11/Energy-Innovation-at-DOD.pdf>

¹⁰⁶ Reliance 21 Operating Principles. Online. Available: <http://www.acq.osd.mil/chieftechнологist/publications/docs/Reliance21OpPrinciples-Jan2014.pdf>.

¹⁰⁷ Communities of Interest. Online. Available: <http://www.acq.osd.mil/chieftechнологist/COIs.html>.

¹⁰⁸ The Role of the Communities of Interest (COIs). Online. Available: <http://www.dtic.mil/ndia/2015SET/WedStubstad.pdf>.

¹⁰⁹ Defense Innovation Marketplace: Communities of Interest. Online. Available: <http://www.defenseinnovationmarketplace.mil/coi.html>.

In response to DoD's strong interest in energy and development of new energy-related technologies, one of the Reliance 21 COIs is Energy and Power (E&P)^{110,111}. The purpose of the E&P COI is to provide technologies to enable intelligent power and energy management to enhance operational effectiveness¹¹².

The E&P COI is set up to align with the Operational Energy Strategy¹¹³ as well as the energy strategies of the Services. Other drivers are the high cost of fuel, greater power demands of advanced weapons and sensors, and systems that are unique to the military and are not supported by commercial R&D¹¹⁴. The principal areas of focus ("technology taxonomy") are as follows¹¹⁵:

- Power Generation/Energy Conversion
 - Tactical, deployable power systems
 - Conventional, alternative, renewable sources
- Energy Storage
 - Decrease size, weight, cost
 - Increase capabilities in extreme conditions
- Power Control and Distribution
 - Smart energy networks
 - New and improved capability and efficiency
- Thermal Transport and Control
 - Manage heat, enable higher power density
 - Advanced thermal science and technology
- Electrochemical Conversion
 - Increase power density, efficiency, robustness
 - Motors, generators, actuators

¹¹⁰ Energy & Power Community of Interest. Online. Available:
<http://www.defenseinnovationmarketplace.mil/resources/EPCOIPoster.pdf>.

¹¹¹ The Role of the Communities of Interest (COIs). March 25, 2015. Online. Available:
<http://www.dtic.mil/ndia/2015SET/WedStubstad.pdf>.

¹¹² DoD Energy and Power Roadmap. Online. Available:
http://www.defenseinnovationmarketplace.mil/resources/EP_COI_NDIA_BriefingDistA20150325.pdf.

¹¹³ Department of Defense 2016 Operational Energy Strategy. Online. Available:
<http://www.acq.osd.mil/eie/Downloads/OE/2016%20DoD%20Operational%20Energy%20Strategy%20WEBc.pdf>.

¹¹⁴ U.S. Military Energy and Power S&T Presented to: Session 2: Innovative Energy Solutions for the Military: Emerging Technology Challenges Innovative Energy Solutions for Military Applications (IESMA 2014). Online. Available:
[https://www.google.com/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=2&ved=0ahUKewj6i9iwpO7MAhXLJB4KHft2BPsQFggiMAE&url=https%3A%2F%2Fwww.iesma.info%2Fdownload%2F125%2F8\(2\)_shaffer.pdf&usq=AFQjCNEJaj8cGQgO3mnJwepqrqu2LpBPkg&sig2=N0NnedAE6XMecjYyXopwxA](https://www.google.com/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=2&ved=0ahUKewj6i9iwpO7MAhXLJB4KHft2BPsQFggiMAE&url=https%3A%2F%2Fwww.iesma.info%2Fdownload%2F125%2F8(2)_shaffer.pdf&usq=AFQjCNEJaj8cGQgO3mnJwepqrqu2LpBPkg&sig2=N0NnedAE6XMecjYyXopwxA).

¹¹⁵ DoD Energy and Power Roadmap. Online. Available:
http://www.defenseinnovationmarketplace.mil/resources/EP_COI_NDIA_BriefingDistA20150325.pdf.

Within the DoD, the E&P COI is closely engaged with the capabilities and facilities of the three Services – Army (3 labs), Navy (5 labs), and Air Force (2 labs)¹¹⁶. The E&P COI also works closely with DOE National Labs in several areas¹¹⁷, including Oak Ridge's National Transportation Center, Sandia's Distributed Energy Tech Lab, and Pacific Northwest's Energy Infrastructure Operations Center.

With its focus on Operational Energy¹¹⁸, the E&P COI recognizes four major areas – soldiers, forward operating bases (base camps), ground and air vehicles, and tactical operations centers (combat outpost)¹¹⁹. Five areas of opportunity have been identified to support war fighters¹²⁰:

- Tactical Unit Energy Independence
- Autonomous Platform Power
- Electric Weapons and High Power Sensors
- Adaptive Power Networks
- Energy Optimized Platforms

Five gaps have been identified for Operational Energy requirements¹²¹:

- High efficiency energy conversion and harvesting
- Energy integrated system and simulation design and simulation
- High efficiency propulsion and platform design
- Environmental control systems
- Flexible and adaptive power distribution

¹¹⁶ DoD Energy and Power Roadmap. Online. Available:
http://www.defenseinnovationmarketplace.mil/resources/EP_COI_NDIA_BriefingDistA20150325.pdf.

¹¹⁷ U.S. Military Energy and Power S&T Presented to: Session 2: Innovative Energy Solutions for the Military: Emerging Technology Challenges Innovative Energy Solutions for Military Applications (IESMA 2014). Online. Available:
[https://www.google.com/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=2&ved=0ahUKewj6i9iwpO7MAhXLJB4KHft2BPQFggjMAE&url=https%3A%2F%2Fwww.iesma.info%2Fdownload%2F125%2F8\(2\)_shaffer.pdf&usg=AFQjCNEJaj8cGQgO3mnJwepqrcu2LpBPkg&sig2=N0NnedAE6XMecjYyXopwxA](https://www.google.com/url?sa=t&rct=j&q=&esrc=s&frm=1&source=web&cd=2&ved=0ahUKewj6i9iwpO7MAhXLJB4KHft2BPQFggjMAE&url=https%3A%2F%2Fwww.iesma.info%2Fdownload%2F125%2F8(2)_shaffer.pdf&usg=AFQjCNEJaj8cGQgO3mnJwepqrcu2LpBPkg&sig2=N0NnedAE6XMecjYyXopwxA)

¹¹⁸ Department of Defense 2016 Operational Energy Strategy. Online. Available:
<http://www.acq.osd.mil/eie/Downloads/OE/2016%20DoD%20Operational%20Energy%20Strategy%20WEBc.pdf>.

¹¹⁹ DoD Energy and Power Roadmap. Online. Available:
http://www.defenseinnovationmarketplace.mil/resources/EP_COI_NDIA_BriefingDistA20150325.pdf.

¹²⁰ Energy & Power Community of Interest. Online. Available:
<http://www.defenseinnovationmarketplace.mil/resources/EPCOIPoster.pdf>.

¹²¹ DoD Energy and Power Roadmap. Online. Available:
http://www.defenseinnovationmarketplace.mil/resources/EP_COI_NDIA_BriefingDistA20150325.pdf.

Clearly, emerging energy technologies are at the core of the E&P COI purpose and research programs.

3.3.3 Defense Advanced Research Projects Agency (DARPA)

DARPA's mission is to "make the pivotal early technology investments that create or prevent technological surprise for U.S. national security"¹²². Another statement of DARPA's mission is "to identify and pursue high-risk, high-payoff research initiatives across a broad spectrum of science and engineering disciplines and to transform these initiatives into important, radically new, game-changing technologies for U.S. national security".¹²³

DARPA was created in February 1958 as a direct response to the launch by the Soviet Union of Sputnik 1 in 1957 and of the first Intercontinental Ballistic Missile (ICBM) also in that year¹²⁴. Since this traumatic experience of technological surprise, DARPA has owned responsibility for keeping the U.S. out front in cultivating breakthroughs for national security.

The focus of DARPA continues to be on game-changing military capabilities, but its efforts also lead to major technological advances in modern civilian society¹²⁵. As an entity whose primary focus is on technological advances¹²⁶, DARPA seeks to maintain a culture of creativity and risk tolerance. Achieving major impact means for DARPA taking on high-risk in prospect of high payoff¹²⁷. The agency recognizes four factors that define its creative culture and explain its history of innovation – limited tenure and the urgency it promotes, a sense of mission, trust and autonomy, and risk-taking and tolerance of failure¹²⁸.

¹²² DARPA: Creating Breakthrough Technologies for National Security. Online. Available: <http://www.darpa.mil/attachments/CreatingBreakthroughTechnologiesforNationalSecurity%20Update.pdf>.

¹²³ Defense Sciences Office (DSO) Office-wide. Online. Available: https://www.fbo.gov/index?s=opportunity&mode=form&id=028fd5d5bf74f32be40d0528a3b0e5ba&tab=core&_cvi=0.

¹²⁴ Where the Future Becomes Now. Online. Available: <http://www.darpa.mil/about-us/timeline/where-the-future-becomes-now>.

¹²⁵ About DARPA. Online. Available: <http://www.darpa.mil/about-us/about-darpa>.

¹²⁶ DARPA Today: Anticipating and Meeting New Challenges. Online. Available: <http://www.darpa.mil/attachments/DARPATodayAnticipatingandMeetingNewChallenges.pdf>.

¹²⁷ Our Research. Online. Available: <http://www.darpa.mil/our-research>.

¹²⁸ Innovation at DARPA. Online. Available: http://www.darpa.mil/attachments/DARPA_Innovation_2016.pdf.

The Heilmeier questions ("catechism") continues to be an invaluable tool for illuminating the process of refining and judging which are the most promising ideas¹²⁹:

- What are you trying to do? Articulate your objectives using absolutely no jargon.
- How is it done today, and what are the limits of current practice?
- What's new in your approach and why do you think it will be successful?
- Who cares? If you are successful, what difference will it make?
- What are the risks and payoffs?
- How much will it cost?
- What are the midterm and final "exams" to check for success?

DARPA is viewed within DOD as the disruption engine behind the department's technology enterprise¹³⁰. It works on-cutting-edge technologies that are fundamentally changing the future and seeks to bring that future into today. Despite the daunting security challenges that motivate its work, the atmosphere within DARPA is persistently one of excitement and even joy^{131, 132}.

DARPA has no research and development facilities of its own, but it has become known as an incubator of innovation by providing thought leadership, community-building frameworks, research management, funding, and other support elements required to bring transformative ideas to consequential new realities¹³³. The agency is located in Arlington, Virginia, where it has about 220 employees. It pursues its objectives through programs and utilizing a portfolio approach. DARPA has six technology offices¹³⁴ where its 200-plus programs are managed by almost 100 program managers. The budget for FY 2016 was \$2.87 billion¹³⁵. The agency reaches for transformational change rather than incremental advances. It does not perform in isolation, but

¹²⁹ Innovation at DARPA. Online. Available: http://www.darpa.mil/attachments/DARPA_Innovation_2016.pdf.

¹³⁰ DARPA Brings Game-Changing Technology and Its Creators to Pentagon. Online. Available: <http://www.defense.gov/News-Article-View/Article/757279/darpa-brings-game-changing-technology-and-its-creators-to-pentagon>.

¹³¹ Statement by Arati Prabhakar, Director, DARPA, before the Subcommittee on Emerging Threats and Capabilities, Armed Services Committee, U.S. House of Representatives. Online. Available: <http://www.darpa.mil/attachments/HASC-ETC-PrabhakarA-20160224.pdf>.

¹³² Statement by Arati Prabhakar, Director, DARPA, before the Subcommittee on Emerging Threats and Capabilities, Armed Services Committee, U.S. Senate. Online. Available: <http://www.darpa.mil/attachments/DARPA2016SASCTestimony4-1-2016.pdf>.

¹³³ Where the Future Becomes Now. Online. Available: <http://www.darpa.mil/about-us/timeline/where-the-future-becomes-now>.

¹³⁴ DSO Offices. Online. Available: <http://www.darpa.mil/about-us/offices>.

¹³⁵ Budget. Online. Available: <http://www.darpa.mil/about-us/budget>.

works within an “innovation ecosystem that includes academic, corporate, and governmental partners”.¹³⁶

Emphasis is placed at DARPA on transitioning its research results into applicable, real-world domains of military capabilities for the civilian sector¹³⁷. Transitions can follow different paths, such as to one or more Services (e.g., Army, Navy, Air Force) for further development or to an element of the private sector where commercial forces come into play.

By making pivotal early investments in technologies to prevent strategic surprise, DARPA has made a number of notable achievements¹³⁸. These accomplishments include the conceptual basis for the precursor to the Internet, advances supporting speech recognition, touch-screen displays, and wireless capabilities as the core of smartphones and tablets. DARPA has also made advances in aircraft stealth (low observability) technology, infrared night imaging, size reduction of GPS receivers (enabling change of "dumb bombs" to smart munitions, and advances in the use of unmanned aerial vehicles (drones).

Given the increased emphasis of DOD on the role of energy in military capability, such as the creation of the Office of Operational Energy in 2011, DARPA appears to have strong potential interest in energy technologies. The goal of the Materials for Transduction (MATRIX) program in the Defense Sciences Office, for example, is to extend materials breakthroughs for converting energy between different forms, such as thermal to electric energy or electric field to magnetic fields. The MATRIX program seeks to further the transition of games and materials research into new devices and DOD capabilities¹³⁹. DARPA may have the opportunity for future programs that are focused on emerging energy technologies to meet DOD's recognition of the vital importance of energy in accomplishing its mission of deterring war and prepared protecting the security of the US.

¹³⁶ Breakthrough Technologies for National Security. Online. Available: <http://www.darpa.mil/attachments/DARPA2015.pdf>.

¹³⁷ DARPA Transitions: Out of the Laboratory and Into the Field. Online. Available: <http://www.darpa.mil/attachments/DARPATransitionsOutoftheLaboratory.pdf>.

¹³⁸ DARPA Accomplishments: Seminal Contributions to National Security Online. Available: <http://www.darpa.mil/attachments/DARPAAccomplishmentsSeminalContributionstoNationalSecurity.pdf>.

¹³⁹ Materials for Transduction (MATRIX). Online. Available: <http://www.darpa.mil/program/matrix>.

3.3.4 U.S. DoD Defense Threat Reduction Agency (DTRA)

The Defense Threat Reduction Agency (DTRA) works to stop the spread, counter the effects, and prepare for the use of weapons of mass destruction (WMDs)¹⁴⁰. The agency was created in 1998 from a number of previously existing entities to focus their efforts on terrorism, our nuclear surety, and counter-proliferation¹⁴¹. It is co-located at Fort Belvoir, Virginia with two other entities concerned with WMDs, both of which are elements of the U.S. Strategic Command, whereas DTRA is responsible to an Under Secretary of Defense¹⁴². DTRA and the other two entities "work together to leverage our unique authorities in our world-class professional staff to counter the threat posed by weapons of mass destruction"¹⁴³. This three members of the team have unified their individual missions into a single, shared mission: "Safeguard the United States and its allies from global WMD threats by integrating, synchronizing, and providing expertise, technologies, and capabilities¹⁴⁴. The team shares five values: integrity, service, excellence, innovation, and teamwork¹⁴⁵. Their goals are to make the world safer, safeguard the U.S. and its allies from global WMD threats, function as one team, and effectively use resources¹⁴⁶.

DTRA's R&D efforts are in basic and applied science, chemical/biological technologies, counter WMD technologies, and nuclear technologies¹⁴⁷. Its success stories include its efforts to control the Ebola virus, nuclear detection, biosurveillance, and assisting other countries (the Philippines) in building chemical, biological, radiological, and nuclear response capability¹⁴⁸.

¹⁴⁰ Who We Are. Online. Available: <http://www.dtra.mil/Careers/Who-We-Are/>.

¹⁴¹ History. Online. Available: <http://www.dtra.mil/About/History/>.

¹⁴² One Team Leadership. Online. Available: <http://www.dtra.mil/About/One-Team-Leadership/>.

¹⁴³ Strategic Plan. Online. Available:
<http://www.dtra.mil/Portals/61/Documents/Missions/DTRA%20StratPlan%202016-2020%20opt.pdf?ver=2016-03-23-135043-530>.

¹⁴⁴ Strategic Plan. Online. Available:
<http://www.dtra.mil/Portals/61/Documents/Missions/DTRA%20StratPlan%202016-2020%20opt.pdf?ver=2016-03-23-135043-530>.

¹⁴⁵ Our Values Online. Available: <http://www.dtra.mil/About/Our-Values/>.

¹⁴⁶ Strategic Plan. Online. Available:
<http://www.dtra.mil/Portals/61/Documents/Missions/DTRA%20StratPlan%202016-2020%20opt.pdf?ver=2016-03-23-135043-530>.

¹⁴⁷ Research and Development. Online. Available: <http://www.dtra.mil/Research/>.

¹⁴⁸ Success Stories. Online. Available: <http://www.dtra.mil/Success-Stories/>.

DTRA's current research does not appear to emphasize energy in general or on emerging energy technologies specifically¹⁴⁹. Nevertheless, the potential implications for national security if LENR were to be developed by an adversarial nation have apparently caused DTRA to engage in the field. Examples of DTRA-supported LENR research are a 2007 report on high energy science and technology that included a LENR panel¹⁵⁰, a 2012 report of a study utilizing palladium and nickel wires¹⁵¹, and a 2016 report of an investigation of nano-nuclear reactions in condensed matter¹⁵².

3.3.5 U.S. Navy

The mission of the Navy is to maintain, train and equip combat-ready Naval forces capable of winning wars, deterring aggression and maintaining freedom of the seas¹⁵³.

3.3.5.1 U.S. Navy Overall

The Navy (including the Marine Corps that is within the Navy) is one of the three Departments (Services) of the U.S. Department of Defense. The Secretary of the Navy reports to the Secretary of Defense and has reporting to him the Chief of Naval Operations and Commandant of the Marine Corps¹⁵⁴. The Chief of Naval Operations in turn has responsibility for the Operating Force and the Shore Establishment. The Marine Corps commandant has a separate Operating Force. As context for energy-related research, the Navy's Innovation Vision delineates five elements – build the Naval innovation network, manage Navy workforce talent, transform the

¹⁴⁹ Defense Threat Reduction Agency, Broad Agency Announcement HDTRA1-11-21-BRCWMD, Amendment 5: http://www.dtra.mil/Portals/61/Documents/BA%20DocsTemplates/HDTRA1-11-16-BRCWMD-CALL-Amendment%205_published%20version---.pdf.

¹⁵⁰ Sutton, R., and G. Ullrich, 2007. High Energy Science & Technology Assessment. Defense Threat Reduction Agency Contract No. DTRA01-03-E-0017, Task Order 18. Online. Available: <http://lenr-canr.org/acrobat/McKubreMCHcalorimetra.pdf>.

¹⁵¹ McKubre, M. J. Bao, F. Tanzella, and P. Hagelstein, "Calorimetric Studies of the Destructive Stimulation of Palladium and Nickel Fine Wires", Proceedings ICCF17, (2012). Online. Available: <http://lenr-canr.org/acrobat/McKubreMCHcalorimetra.pdf>.

¹⁵² Mosier-Boss, P.A., L.P. Forsley, and P.J. McDaniel, 2016. Investigation of Nano-Nuclear Reactions in Condensed Matter. Defense Threat Reduction Agency, Final Report. Online. Available: <http://lenr-canr.org/acrobat/MosierBossinvestigat.pdf>.

¹⁵³ Mission, Organization of the Navy. Online. Available: <http://www.navy.mil/navydata/organization/org-top.asp>.

¹⁵⁴ An Overview. Online. Available: <http://www.navy.mil/navydata/organization/org-over.asp>.

use of information, accelerate new capabilities to the fleet, and develop game-changing or fighting concepts¹⁵⁵.

The Navy and Marine Corps are significant users of energy within the DOD context, consuming about one-third of the total for the three Services¹⁵⁶. Energy-related topics therefore play a major role in setting the Navy's priorities. For example, the Fiscal Year 2016 Goals and Accomplishments¹⁵⁷ includes four categories – People, Platforms, Power, and Partnerships. The Power category includes five components:

- Increase alternative energy Navy-wide
- Sail the Great Green Fleet
- Leverage 1 gigawatt execution to improve energy security
- Institutionalize resource and energy efficiency throughout the Navy
- Develop an integrated energy security and resiliency.

The Energy Goals of the Department of the Navy (DON) are also set forth as follows^{158,159}:

- Energy Efficient Acquisition: Evaluation of energy factors will be mandatory when awarding contracts for systems and buildings.
- Sail the "Great Green Fleet": DON will demonstrate a Green Strike Group in local operations by 2012 and sail it by 2016.
- Reduce Non-Tactical Petroleum Use: By 2015, DON will reduce petroleum use in the commercial fleet by 50%.
- Increase Alternative Energy Ashore: By 2020, DON will produce at least 50% of shore-based energy requirements from alternative sources; 50% of DON installations will be net-zero
- Increase Alternative Energy Use DON-Wide: By 2020, 50% of total DON energy consumption will come from alternative sources Energy

The Navy has extensive scientific and technological capabilities to meet its future requirements, including its energy needs. For example, a major section of the Navy's 2015 Program Guide¹⁶⁰ is

¹⁵⁵ Department of the Navy Innovative Vision. Online. Available: http://navylive.dodlive.mil/files/2015/04/Module-1_v13_LoRes_3.pdf.

¹⁵⁶ Defense Department Energy Use Falls to Lowest Level Since at Least 1975. Online. Available: <http://www.eia.gov/todayinenergy/detail.cfm?id=19871>

¹⁵⁷ Department of the Navy (DON) Goals and Objectives for Fiscal Year 2016 (FY16). Online. Available: http://www.navy.mil/strategic/DON_Goals_and_Objectives_FY16.pdf.

¹⁵⁸ Navy Energy Environment Climate Change – Energy. Online. Available: <http://greenfleet.dodlive.mil/energy/>.

¹⁵⁹ The Department of the Navy's Energy Goals. Online. Available: http://www.navy.mil/features/Navy_EnergySecurity.pdf.

dedicated to Science and Technology. The Guide includes a section on Energy System Technology Evaluation Program (ESTEP).

The Navy recognizes that "ashore and afloat" its energy efforts cross three functional areas – physical and strategic security, research and development, and policy and doctrine¹⁶¹. Its energy strategy is developed using a governance structure – Task Force Energy – composed of Working Groups, an Energy Transition Office, and an Executive Steering Committee. The Task Force Energy charter calls for setting up processes, tools, metrics, and structure to support the Navy Energy Strategy and establishes seven Working Groups that are involved in the Navy's energy-related activities¹⁶². A Navy Energy Coordination Office (NECO) has been set up to support the Task Force Energy and coordinate the overall Navy Energy Strategy. 8 It is located organizationally in the Energy and Environmental Readiness Division¹⁶³.

In support of its energy goals, the Navy pursues science and technology investments in alternative fuel sources, energy distribution and control, energy storage, and power generation and loads¹⁶⁴. Within power generation, the Navy is exploring the development of technologies to improve fuel efficiency, increased power density, and reduce emissions for air, ground, sea surface, and undersea applications¹⁶⁵. Example research areas are fuel cells, shipboard hybrid drive, high-efficiency aircraft engines, and hybrid photovoltaic devices.

3.3.5.2 U.S. Navy Office of Naval Research (ONR)

The Office of Naval Research (ONR) manages and funds basic and applied science and advanced technology development through the use of grants and contracts with partners in academia, industry, and government in the U.S. and around the world¹⁶⁶. It was established in 1946 as the U.S. Government's first permanent agency devoted to funding civilian research

¹⁶⁰ U.S. Navy Program Guide 2015. Online. Available: <http://www.navy.mil/strategic/top-npg15.pdf>.

¹⁶¹ Task Force Energy. Online. Available: <http://greenfleet.dodlive.mil/energy/task-force-energy/>.

¹⁶² Energy Task Force Charter. Online. Available: http://greenfleet.dodlive.mil/files/2010/10/TFE_Charter.pdf.

¹⁶³ Energy and Environmental Readiness Division. Online. Available: <http://www.navy.mil/local/opnavn45/>.

¹⁶⁴ Science & Technology. Online. Available: <http://greenfleet.dodlive.mil/energy/science-and-technology/>.

¹⁶⁵ Power Generation. Online. Available: <http://greenfleet.dodlive.mil/energy/science-and-technology/power-generation/>.

¹⁶⁶ The Office of Naval Research – Research Guide. Online. Available: <http://www.onr.navy.mil/About-ONR/History/History-Research-Guide.aspx>.

during peacetime. 1020B The head of ONR, the Chief of Naval Research, reports to the Assistant Secretary of the Navy (Research, Development, and Acquisition).

ONR has two-high-level Directorates – Office of Research and Office of Technology – to accomplish its mission¹⁶⁷. The Office of Research makes broad investments in basic and applied research that will increase fundamental knowledge, fosters opportunities for breakthroughs, and provides technology options for future Naval capabilities. This Office includes the SwampWorks Program, which explores innovative, high-risk and disruptive technologies and concepts¹⁶⁸. It provides for short exploratory studies to examine the maturation of a proposed technology before substantial investments are made. ONR's Office of Technology emphasizes transition of programs covering manufacturing methods for Naval warfare systems, stimulating government-industry partnerships, and focusing on requirements from the fleet and acquisition¹⁶⁹.

The ONR's Naval Science & Technology Strategy¹⁷⁰ identifies the strategic approach and adjusts the principles of the strategy to current guidance from naval leaders. It guides ongoing research by Naval scientists and engineers as the Department maintains a broad portfolio of initiatives to build the future force. The 2015 Science & Technology Strategy includes nine Focus Areas 1060, one of which is Power and Energy. This Focus Area has objectives in three categories:

- Efficient Power and Energy Systems
- Energy Security
- High Energy and Pulsed Power

The Energy System Technology Evaluation Program (ESTEP) within ONR is designed to leverage Navy research in combination with the best from commercial sector advances¹⁷¹. ESTEP conducts real-world advanced-technology demonstrations to evaluate emerging energy technologies using Navy and Marine Corps facilities as test beds. The technology focuses on

¹⁶⁷ Office of Research. Online. Available: <http://www.onr.navy.mil/Science-Technology/Directorates/office-research-discovery-invention.aspx>.

¹⁶⁸ SwampWorks. Online. Available: <http://www.onr.navy.mil/en/Science-Technology/Directorates/office-research-discovery-invention/swampworks-innovation.aspx>.

¹⁶⁹ Office of Technology. Online. Available: <http://www.onr.navy.mil/Science-Technology/Directorates/Transition.aspx>.

¹⁷⁰ Naval Science and Technology Strategy. Online. Available: <http://www.onr.navy.mil/About-ONR/science-technology-strategic-plan.aspx>.

¹⁷¹ U.S. Navy Program Guide 2015, Section 7. Online. Available: <http://www.navy.mil/strategic/top-npg15.pdf>.

innovative pre-commercial and nascent commercial energy technologies obtained from open-market sourcing, including companies from within the venture capital and small business communities.

Clearly, ONR places a high priority on emerging energy technologies to meet its energy-related science and technology objectives.

3.3.5.3 U.S. Navy Naval Research Laboratory (NRL)

The mission of the Naval Research Laboratory (NRL) is to conduct a broadly based multidisciplinary program of scientific research and advanced technological development directed toward maritime applications of new and improved materials, techniques, equipment, systems, and ocean, atmospheric, and space sciences and related technologies¹⁷². As the Navy's single, integrated Corporate Laboratory, NRL provides a broad foundation of in-house expertise from scientific to advanced development activity¹⁷³. The creation of NRL in the early 1920s was instigated by Thomas Edison, who conceived the idea of "a great laboratory"¹⁷⁴.

NRL's research is conducted in a Base Program, which consists of Basic Research – with emphasis on scientific study for increasing knowledge and broad fields for long-term Navy needs – and Applied Research, where efforts are directed toward solution of specific Navy problems (short of major development projects)¹⁷⁵. The seven focus areas of the NRL Base Program are:

- Battlespace Environments
- Electronics
- Electromagnetic Warfare
- Information Technology
- Materials & Chemistry
- Space Research and Space Technology
- Undersea Warfare

¹⁷² NRL 2014 Review. Online. Available: http://www.nrl.navy.mil/content_images/2014_NRL_Review.pdf.

¹⁷³ Mission. Online. Available: <http://www.nrl.navy.mil/about-nrl/mission/>.

¹⁷⁴ About NRL. Online. Available: <http://www.nrl.navy.mil/about-nrl/>.

¹⁷⁵ <http://www.onr.navy.mil/Science-Technology/Directorates/office-research-discovery-invention/Laboratory-Research.aspx>.

NRL is organized into two Directorates with emphasis on management – Commanding Officer (Code 1000) and Business Operations (Code 2000) and four technical Directorates¹⁷⁶:

- Systems (Code 5000)
- Material Science and Component Technology (Code 6000)
- Ocean and Atmospheric Science and Technology (Code 7000)
- Naval Center for Space Technology (Code 8000)

Eighteen Divisions and Laboratories with different areas of emphasis are organized within the Directorates¹⁷⁷. Although an emphasis on emerging energy technologies at NRL is not apparent, the laboratory clearly possesses the talent and facilities for their development when required.

3.4 U.S. Department of Commerce – Patent and Trade Office (PTO)

The U.S. Patent and Trade Office (PTO) is a particularly important agency for realization of emerging energy technologies. The PTO “is the federal agency for granting U.S. patents and registering trademarks. In doing this, the USPTO fulfills the mandate of Article I, Section 8, Clause 8, of the Constitution that the legislative branch ‘promote the Progress of Science and useful Arts, by securing for limited Times to Authors and Inventors the exclusive Right to their respective Writings and Discoveries.’ The USPTO registers trademarks based on the commerce clause of the Constitution (Article I, Section 8, Clause 3).”¹⁷⁸

The PTO mission is as follows¹⁷⁹: “Fostering innovation, competitiveness and economic growth, domestically and abroad by delivering high quality and timely examination of patent and trademark applications, guiding domestic and international intellectual property policy, and delivering intellectual property information and education worldwide, with a highly-skilled, diverse workforce”.

The USPTO “advises the president of the United States, the secretary of commerce, and U.S. government agencies on intellectual property (IP) policy, protection, and enforcement; and

¹⁷⁶ Directorates and Divisions. Online. Available: <http://www.nrl.navy.mil/research/directorates-divisions/>.

¹⁷⁷ NRL 2015 Review. Online. Available: <http://www.nrl.navy.mil/research/nrl-review/>.

¹⁷⁸ About Us. Online. Available: <http://www.uspto.gov/about-us>.

¹⁷⁹ USPTO Strategic Plan, 2014-2018. Online. Available: http://www.uspto.gov/sites/default/files/documents/USPTO_2014-2018_Strategic_Plan.pdf.

promotes the stronger and more effective IP protection around the world. The USPTO furthers effective IP protection for U.S. innovators and entrepreneurs worldwide by working with other agencies to secure strong IP provisions in free trade and other international agreements. It also provides training, education, and capacity building programs designed to foster respect for IP and encourage the development of strong IP enforcement regimes by U.S. trading partners.”¹⁸⁰

The PTO is “an agency within the United States Department of Commerce (DOC). The Office is led by the Under Secretary of Commerce for Intellectual Property and Director of the USPTO, who consults with the Patent Public Advisory Committee (PPAC) and the Trademark Public Advisory Committee (TPAC) on Office policies, goals, performance, budget, and user fees.”¹⁸¹

The PTO was formed in 1836 after a lengthy prior history of granting patents by the U.S. as provided in the Constitution. Its headquarters are in Alexandria, Virginia, and offices are being or have recently been set up in Detroit, Dallas, Denver, and the Silicon Valley in California. The PTO has four strategic goals, each of which includes several objectives¹⁸²:

I. Optimize Patent Quality and Timeliness

- Refine Optimal Patent Pendency
- Increase Efficiencies and Patent Capacity to Align with the Optimal Patent Pendency
- Increase International Cooperation and Work Sharing
- Continue to Enhance Patent Quality
- Ensure Optimal Information Technology (IT) Service Delivery to All Users
- Continue and Enhance Stakeholder and Public Outreach
- Maintain the Patent Trial and Appeal Board’s (PTAB) Ability to Provide Timely and High Quality Decisions

II. Optimize Trademark Quality and Timeliness

- Maintain Trademark First Action Pendency on Average Between 2.5-3.5 Months with 12 Months Final Pendency
- Maintain High Trademark Quality
- Ensure Optimal IT Service Delivery to All Users
- Continue and Enhance Stakeholder and Public Outreach
- Enhance Operations of the Trademark Trial and Appeal Board (TTAB)

¹⁸⁰ About Us. Online. Available: <http://www.uspto.gov/about-us>.

¹⁸¹ United States Patent and Trademark Office, Fiscal Year 2016 President’s Budget Submission/Congressional Justification, February 2015. Online. Available: <http://www.uspto.gov/sites/default/files/documents/fy16pbr.pdf>.

¹⁸² USPTO Strategic Plan, 2014-2018. Online. Available: http://www.uspto.gov/sites/default/files/documents/USPTO_2014-2018_Strategic_Plan.pdf.

III. Provide Domestic and Global Leadership to Improve Intellectual Property Policy, Protection, and Enforcement Worldwide.

- Provide Leadership and Education on IP Policy and Awareness
- Provide Leadership and Education on International Agreements and Policies for Improving the Protection and Enforcement of IP Rights

IV. Management: Achieve Organizational Excellence

- Leverage IT Investments to Achieve Business Results
- Continue to Build and Maintain a Flexible, Diverse, and Engaged Workforce
- Enhance Internal and External Relations
- Secure Sustainable Funding to Deliver Value to Fee-Paying Customers and the Public
- Establish Satellite Offices and a Regional Presence

Energy devices, technologies, and products comprise an important component of PTO's intellectual protection responsibilities. Several energy-related categories have been established for both patents and trademarks. Intellectual property protection of emerging energy technologies is essential for PTO to accomplish its mission.

3.5 U.S. National Aeronautics and Space Administration (NASA)

The U.S. National Aeronautics and Space Administration (NASA) is one of the nation's premier organizations for developing emerging technologies, including new sources of energy for a variety of applications. NASA's vision is "to reach for new heights and reveal the unknown for the benefit of humankind"¹⁸³. The mission is to "drive advances in science, technology, aeronautics, and space exploration to enhance knowledge, education, innovation, economic vitality, and stewardship of Earth"¹⁸⁴. NASA's strategic goals are to:

- Expand the frontiers of knowledge, capability, and opportunity in space
- Advance understanding of Earth and develop technologies to improve the quality of life on our home planet
- Serve the American public and accomplish our Mission by effectively managing people, technical capabilities, and infrastructure.

Each of these goals includes a number of objectives that provide more specific guidance. The agency is organized into four "mission directorates": aeronautics research, human exploration

¹⁸³ What Does NASA Do? Online. Available: http://www.nasa.gov/about/highlights/what_does_nasa_do.html.

¹⁸⁴ NASA Strategic Plan, 2014. Online. Available: https://www.nasa.gov/sites/default/files/files/FY2014_NASA_SP_508c.pdf.

and operations, science, and space technologies¹⁸⁵. NASA has missions, programs and projects that ensure “the United States will remain the world's leader in space exploration and scientific discovery for years to come, while making critical advances in aerospace, technology development and aeronautics.”¹⁸⁶ NASA is an independent federal agency (organizationally outside the president’s cabinet). It was established in 1958 as a civilian (rather than military) entity to encourage peaceful applications in space science.

Energy interests at NASA are broad, but three areas are particularly important – propulsion of space probes and planetary exploration, aircraft propulsion, and addressing global climate change. Sources of energy for space probe propulsion are investigated for within and outside the reach of solar radiation as a power source. For example, alternatives to nuclear fission sources (radioisotope thermoelectric generators, RPGs) are sought as power sources for deep space probes. Propulsion research for probes falls within Objective 1.7 (“Transform NASA missions and advance the Nation’s capabilities by maturing crosscutting and innovative space technologies”) of Strategic Goal 1.

NASA also investigates alternative methods of aircraft propulsion, with emphasis on low-carbon propulsion as one of six major research areas of its aeronautics research program¹⁸⁷. This program is included in Objective 2.1 (“Enable a revolutionary transformation for safe and sustainable U.S. and global aviation by advancing aeronautics research”) of Strategic Goal 2. Carbon dioxide emissions from the use of fossil fuels underlie global climate change, another major research focus of NASA. NASA’s Earth Science Research Program seeks to measure global climate change to inform decisions by the government, organizations, and people around the world¹⁸⁸. Climate change is included within Objective 2.2 (“Advance knowledge of Earth as a system to meet the challenges of environmental change, and to improve life on our planet”) of Strategic Goal 2.

¹⁸⁵ NASA Organization and Structure. Online. Available: http://www.nasa.gov/about/org_index.html.

¹⁸⁶ What’s Next for NASA? Online. Available: http://www.nasa.gov/about/whats_next.html.

¹⁸⁷ NASA Strategic Plan, 2014. Online. Available: https://www.nasa.gov/sites/default/files/files/FY2014_NASA_SP_508c.pdf.

¹⁸⁸ NASA Strategic Plan, 2014. Online. Available: https://www.nasa.gov/sites/default/files/files/FY2014_NASA_SP_508c.pdf.

Developing new sources of energy and realization of emerging energy technologies are fundamental for NASA to accomplish its mission as well as its Strategic Goals.

3.6 U.S. Environmental Protection Agency (EPA)

The U.S. Environmental Protection Agency (EPA) has long played a role in dealing with energy-related impacts, including developing new or emerging technologies both for clean energy sources and for dealing with the residuals of existing energy sources, especially fossil fuel based energy. EPA's mission is "to protect human health and the environment".¹⁸⁹ It lists seven purposes, which may be summarized as follows:

1. Protect Americans from risks to human health and the environment
2. Reduce risks based on scientific information
3. Enforce federal environmental laws
4. Assure that environmental protection is considered in U.S. policies
5. Maintain public access to information to participate in managing risks
6. Make communities and ecosystems diverse, sustainable, and economically productive
7. Assure that the U.S. is a leader in protecting the global environment

EPA was created in 1970 in response to increasing public concern about the effects of human activities on the environment. It is an independent agency and is not a part of the President's cabinet. It has 13 organizational offices that cover various aspects of protection of human health and the environment, including water, air and radiation, chemical safety and pollution prevention, research and development, and solid waste and emergency response.

All phases of the energy life cycle have impacts on the natural environment. Because of this close connection, the EPA has a broad range of energy-related interests. The agency has many programs and regulations that deal with fossil energy sources and their residuals, such as coal mines and oil and gas operations. Similarly, EPA regulates emissions and effluents from fossil energy conversion and consumption facilities and operations, including power plants and transportation vehicles. EPA's attempts to address greenhouse gas emissions and global climate change issues emphasize carbon dioxide sources from the use of coal and oil and gas.

¹⁸⁹ Our Mission and What We Do. Online. Available: <http://www2.epa.gov/aboutepa/our-mission-and-what-we-do/>.

EPA's energy efficiency programs seek to reduce pollution by decreasing energy consumption. Many of the EPA's efforts and initiatives fall within the Agency's Clean Energy Programs, which "are designed to help energy consumers in all sectors, state policy makers and energy providers improve their knowledge about Clean Energy technology and policy options..."¹⁹⁰

These programs include the following:

1. Combined Heat and Power Partnership
2. Green Power Partnership
3. State and Local Climate and Energy Program
4. National Action Plan for Energy Efficiency
5. ENERGY STAR (joint program with the DOE)
6. Center for Corporate Climate Leadership

In summary, a major portion of EPA's pollution control and abatement activities deal with energy sources and their environmental residuals. These activities include regulation of energy facilities and reduction of energy use. Support for and realization of emerging technologies are essential for EPA to accomplish its mission – both for clean energy sources and for mitigating impacts of existing sources.

¹⁹⁰ Clean Energy Programs. Online. Available: <http://www.epa.gov/energy/clean-energy-programs>.

4 Government-Supported Research Entities

Two additional entities, the National Science Foundation and the National Academies of Science, Engineering and Medicine, play a strong role in developing emerging energy technologies.

4.1 National Science Foundation (NSF)

As a premier national agency for advancing scientific research, the National Science Foundation (NSF) has a strong role in discovering and developing scientific discoveries and technology for new sources of energy. NSF's vision is “a Nation that creates and exploits new concepts in science and engineering and provides global leadership in research and education”¹⁹¹. Its mission “was established by Congress in legislation that created the agency. The NSF Act of 1950 (Public Law 81-507) sets forth the mission: “to promote the progress of science; to advance the national health, prosperity, and welfare; to secure the national defense; and for other purposes.”¹⁹²

The National Science Foundation (NSF) is an independent Federal agency that supports fundamental research at the frontiers of knowledge, across all fields of science and engineering (S&E), and S&E education. It is the only federal agency whose mission includes support for all fields of fundamental science and technology, except for medical sciences¹⁹³. NSF has three Strategic Goals: 1) transform the frontiers of science and engineering; 2) stimulate innovation and address societal needs through research and education; and 3) excel as a Federal Science Agency. The first two goals illustrate the two main components of NSF’s mission – advancing the progress of science while benefitting the Nation, and they indicate the primary means by which NSF ensures the preeminence of U.S. research and development. Each of the three goals is

¹⁹¹ National Science Foundation Strategic Plan for 2014 – 2018. Online. Available: <http://www.nsf.gov/pubs/2014/nsf14043/nsf14043.pdf>.

¹⁹² Investing in Science, Engineering, and Education for the Nation’s Future. Online. Available: <https://www.nsf.gov/news/strategicplan/nsfstrategicplan20142018flyer.pdf/>.

¹⁹³ Fact Sheet – National Science Foundation. Online. Available: https://www.nsf.gov/news/news_summ.jsp?cntn_id=100595.

expanded with two to three Strategic Objectives. The NSF has seven directorates and two program offices:

- Biological Sciences
- Computer and Information Science and Engineering
- Education and Human Resources
- Engineering
- Geosciences
- Mathematical and Physical Sciences
- Social, Behavioral and Economic Sciences
- Office of International Science and Engineering
- Office of Integrative Activities

Unlike many agencies that conduct research internally, the NSF does not operate its own labs, but instead provides funds for support of other research entities. It is an independent agency that does not fall under any of the President’s Cabinet entities.

Energy-related research comprises a critical element for achieving NSF’s mission, goals, and strategies. Energy is critical to the nation’s health, prosperity, and welfare. Energy research is an essential component of achieving science and engineering advances (Strategic Objective 1- Invest in fundamental research to ensure significant continuing advances across science, engineering, and education – of Strategic Goal 1) and providing world-class research infrastructure (Strategic Objective 3 – Provide world-class research infrastructure to enable major scientific advances – of Strategic Goal 1). Energy must also be included in efforts to connect fundamental research to meeting society’s needs (Strategic Objective 1 – Strengthen the links between fundamental research and societal needs through investments and partnerships – of Strategic Goal 2. NSF supports research to “catalyze breakthroughs in national priorities including clean energy, robotics, nanotechnology, and cyber security”¹⁹⁴.

Clearly, research and development support for emerging energy technologies is essential for NSF to accomplish its mission and realize its Strategic Goals.

¹⁹⁴ About the National Science Foundation, NSF at a Glance. Online. Available: <https://www.nsf.gov/about/>.

4.2 National Academies of Science, Engineering and Medicine

The National Academies of Science, Engineering, and Medicine ("Academies") have a long tradition of developing the basis for making policy for scientific research and technology development. The Academies are therefore well positioned to facilitate development of new and emerging energy technologies as well as deal with their impacts on society and the natural environment. They are “private, nonprofit institutions that provide expert advice on some of the most pressing challenges facing the nation and the world.”¹⁹⁵ The Academies are “the nation's pre-eminent source of high-quality, objective advice on science, engineering, and health matters.”

Although the Academies were founded by the U.S. Government, they are a private entity that seeks to provide advice in its three areas using nationally (and internationally) recognized experts. Membership is by invitation of current members, and advisory services are provided without compensation. The National Academy of Sciences (NAS), National Academy of Engineering (NAE), and Institute of Medicine (precursor to the NIM) were founded in 1863, 1964, and 1975, respectively. The Academies reorganized in 2015 when the NIM changed its name. The National Research Council (founded in 1916), which had been the working arm of the Academies, became the Working Units of the Academies in the reorganization.

The Academies’ work “helps shape sound policies, inform public opinion, and advance the pursuit of science, engineering, and medicine.”¹⁹⁶ Most of the work is performed under seven major programs:

- Behavioral and Social Sciences and Education
- Earth and Life Studies
- Engineering and Physical Sciences
- Institute of Medicine
- Policy and Global Affairs
- Transportation Research Board
- NAS Gulf Research Program

¹⁹⁵ Who We Are. Online. Available: <http://www.nationalacademies.org/about/whoweare/>.

¹⁹⁶ Who We Are. Online. Available: <http://www.nationalacademies.org/about/whoweare/>.

The mission of the Program Units (former National Research Council) is “to improve government decision making and public policy, increase public understanding, and promote the acquisition and dissemination of knowledge in matters involving science, engineering, technology, and health.”¹⁹⁷

About 85% of the Academies’ work is funded by agencies of the U.S. Government, and the remainder by state and local governments, foundations, and nonprofit authorities¹⁹⁸. About 200 reports are produced each year.¹⁹⁹ The Academies’ 2014 report to Congress addressed five areas in Natural Resources and the Environment²⁰⁰:

1. The Gulf Research Program
2. Responding to Oil Spills in the U.S. Arctic Marine Environment
3. Progress Toward Restoring the Everglades
4. Reducing Coastal Risk on the East and Gulf Coasts
5. Reducing the Fuel Consumption and Greenhouse Gas Emissions of Medium- and Heavy-Duty Vehicles

Much of the energy-related work of the Academies is performed by the Board on Energy and Environmental Systems (BEES), which is in the Division on Engineering and Physical Systems (DEPS). BEES “conducts a program of studies and other activities to provide independent advice to the executive and legislative branches of government and the private sector on issues in energy and environmental technology, and related public policy.”²⁰¹. BEES directs expert attention to a number of energy topics:

1. Energy supply and demand technologies and systems, including resource extraction through mining and drilling, energy conversion, distribution and delivery, and efficiency of use
2. Environmental consequences of energy related activities

¹⁹⁷ Our Program Units. Online. Available: <http://nationalacademies.org/nrc/index.html>.

¹⁹⁸ Frequently Asked Questions. Online. Available: <http://nationalacademies.org/about/faq/index.html>.

¹⁹⁹ National Academies of Science, Engineering, and Medicine. Online. Available: https://en.wikipedia.org/wiki/National_Academies_of_Sciences,_Engineering,_and_Medicine.

²⁰⁰ Cicerone, R.J., C.D. Mote, Jr., and V.J. Dzau, 2014. Highlights of Selected Studies – Natural Resources and the Environment in 2014 Report to Congress. Available: <http://www.nationalacademies.org/annualreport/>.

²⁰¹ About BEES. Online. Available: http://sites.nationalacademies.org/DEPS/BEES/DEPS_047053.

3. Environmental systems and controls in areas related to fuels production, energy conversion, transmission, and use
4. Related issues in national security and defense

A major BEES initiative, America's Energy Future (AEF), was started in 2007 "to provide an authoritative analysis of technology options and their costs and impacts to help make sensible decisions about the nation's energy future"²⁰². The tasks of the AEF were to:

- Review the portfolio of recently completed major studies on energy use and technology's potential for improvement and compare their assumptions
- Analyze the currency and quality of information used
- Assess the relative state of maturity of technologies for potential deployment in the next decade to reduce U.S. dependence on oil imports and CO2 emissions while ensuring that affordable energy is available to sustain economic growth.

Key findings of the AEF report addressed the following topics²⁰³:

Technology Deployment Options

Energy Savings from Improved Efficiency

Options for Increasing Electricity Supplies and Changing the Supply Mix

Modernizing the Nation's Power Grid

Continued Dependence on Petroleum

Reducing Greenhouse Gas Emissions

Technology Research, Development, and Demonstration

Barriers to Accelerated Technology Deployment

The Academies have also been deeply involved in global climate change issues. In response to Congress' legislation, "a series of coordinated activities designed to advance the U.S. response to climate change" has been conducted starting in 2009²⁰⁴. These activities are intended to build on an extensive foundation of previous and ongoing work, tap experts and stakeholders from a range of communities (academia, business, government, NGOs, international), analyze options

²⁰² America's Energy Future Initiative. Online. Available: <http://www.kavlifoundation.org/americas-energy-future-initiative>.

²⁰³ America's Energy Future, Technology and Transformation. Online. Available: <http://www.nap.edu/read/12710/chapter/5>.

²⁰⁴ The National Academies, Climate Change, Background. Online. Available: <http://nas-sites.org/americasclimatechoices/sample-page/background/>.

and strategies for dealing with climate change issues, assess short-term and long-term strategies and investments (as well as impediments and needed advances), and produce reports that provide advice to decision makers. A number of GCC-related reports have been prepared covering, for example, the following topics²⁰⁵:

Climate Stabilization Targets	Abrupt Climate Changes
Sea Level Rise	Adaptation to Impacts
Climate Modeling	Social Stress
Arctic Issues	Alternative Vehicles and Fuels
National Security Implications	Tax Policy on Greenhouse Gas Emissions

Current studies address extreme weather events, landscape conservation, seasonal and subseasonal forecasting, and advisory service for research on global change.

Investigation of emerging energy technologies and realizing their benefits – as well as dealing with their secondary impacts – are essential to the Academies to achieve their purpose.

²⁰⁵ The National Academies, Climate Change, Reports. Online. Available: <http://nas-sites.org/americasclimatechoices/other-reports-on-climate-change/>.

5 Other Agencies

Several additional agencies have potential interest in energy issues. However, they are not as salient for the LENR case because emerging energy technologies are not essential to accomplishing their missions or because LENR does not appear to be the type of technology in the profile of their responsibilities. These agencies include the Federal Energy Regulatory Commission, Energy Information Administration, National Energy Technology Laboratory, and member entities of the Intelligence Community, including the Director of National Intelligence, Central Intelligence Agency, Defense Intelligence Agency, and Intelligence Advanced Research Project Activity.

5.1 *Federal Energy Regulatory Commission (FERC)*

The Federal Energy Regulatory Commission (FERC) is an independent federal agency that regulates the interstate transmission of electricity, natural gas, and oil. FERC also reviews proposals to build liquefied natural gas terminals and interstate natural gas pipelines as well as licensing hydropower projects²⁰⁶. It was created in 1977 when its predecessor, the Federal Power Commission, was abolished and most of its regulatory mission was inherited by FERC²⁰⁷.

FERC's mission is to "assist consumers in obtaining reliable, efficient, and sustainable energy services at a reasonable cost through appropriate regulatory and market means"²⁰⁸. The agency lists five guiding principles: organizational excellence, due process and transparency, regulatory certainty, stakeholder involvement, and timeliness²⁰⁹. The strategic plan includes four goals (each of which has two to three specific objectives): ensure just and reasonable rates, terms and conditions; promote safe, reliable, secure, and efficient infrastructure; and mission support

²⁰⁶ What FERC Does. Online. Available: <https://www.ferc.gov/about/ferc-does.asp>.

²⁰⁷ FERC Fiscal Year 2017 Congressional Performance Budget Request and Fiscal Year 2015 Annual Performance Report Online. Available: <https://www.ferc.gov/about/strat-docs/2016/FY17-Budget-Request.pdf>.

²⁰⁸ FERC Strategic Plan, FY 2014–FY 2018. Online. Available: <https://www.ferc.gov/about/strat-docs/strat-plan.asp>.

²⁰⁹ About FERC. Online. Available: <https://www.ferc.gov/about/about.asp>.

through organizational excellence²¹⁰. FERC is led by four Commissioners (only three of which can be from a single political party) and has three main internal functions: regulatory, litigation, and administration, each of which consists of three or more Offices²¹¹.

FERC's responsibilities are primarily regulatory in nature and are focused on conventional energy sources. Although the agency may address emerging energy technologies in the future as they contribute substantially to the nation's energy supply, it does not appear to be significantly involved in their development or in dealing with their secondary impacts.

5.2 U.S. DOE Energy Information Administration (EIA)

The Energy Information Administration (EIA) is the statistical and analytical agency within the U.S. Department of Energy²¹². The agency was created in 1977 as a successor to the Federal Energy Administration. It was set up with independence from other DOE components as well as other government entities²¹³. Its mission is to “collect, analyze, and disseminate independent and impartial energy information to promote sound policymaking, efficient markets, and public understanding of energy and its interaction with the economy and the environment”²¹⁴. The agency’s strategic plan sets forth four goals: transform data operations, increase analytical impact, improve the customer experience, and enable the mission:²¹⁵ “Its values are to deliver results, apply rigor, play as a team and character counts. The agency has an Administrator and is organized into four main areas, each headed by an Assistant Administrator²¹⁶: Energy Statistics, Energy Analysis, Communications, and Resource and Technology Management. The EIA produces periodic reports (daily to annually) primarily on conventional energy sources, including oil, refined products, natural gas, coal, and electricity²¹⁷.”

²¹⁰ FERC Strategic Plan, FY 2014–FY 2018. Online. Available: <https://www.ferc.gov/about/strat-docs/strat-plan.asp>.

²¹¹ Greenfield, L.R., 2010. An Overview of the Federal Energy Regulatory Commission and Federal Regulation of Public Utilities in the United States. Online. Available: <https://www.ferc.gov/about/ferc-does/ferc101.pdf>.

²¹² Mission and Overview. Online. Available: http://www.eia.gov/about/mission_overview.php.

²¹³ Legislative Timeline. Online. Available: http://www.eia.gov/about/legislative_timeline.php.

²¹⁴ About EIA. Online. Available: <http://www.eia.gov/about/index.php>.

²¹⁵ EIA Strategic Plan 2014-2018. Online. Available: http://www.eia.gov/about/strategic_plan.php.

²¹⁶ EIA Organization Chart. Online. Available: http://www.eia.gov/about/organization_chart.php.

²¹⁷ Products, Services, and Tools. Online. Available: http://www.eia.gov/about/products_services.php.

Emerging energy technologies do not appear to be addressed specifically by the EIA. Also, the agency collects energy information rather than supporting or developing new or emerging sources or dealing with their secondary impacts.

5.3 U.S. DOE National Energy Technology Laboratory (NETL)

The National Energy Technology Laboratory (NETL) is a U.S. DOE national laboratory that supports the DOE mission to advance the energy security of the U.S.²¹⁸. It is the only national lab that is owned and operated by DOE²¹⁹. Its history goes back to 1910, when its predecessor, the U.S. Bureau of Mines, was established^{220,221}. NETL's mission is to "discover, integrate, and mature technology solutions to enhance the nation's energy foundation and protect the environment for future generations"²²². The agency's vision is to "be the nation's renowned fossil-energy science and engineering resource, delivering world-class technology solutions today and tomorrow." The agency is organized into four primary Centers – Research & Innovation, Technology Development Integration (these two are under Science & Technology Solutions Plans & Programs), Laboratory Operations, and Finance & Acquisition²²³. NETL's six core competencies help address national energy challenges and include the following²²⁴:

- Computational Sciences & Engineering
- Materials Engineering & Manufacturing
- Geological & Environmental Systems
- Energy Conversion Engineering
- Systems Engineering & Analysis
- Program Evaluation & Integration

²¹⁸ About NETL. Online. Available: <https://www.netl.doe.gov/about>.

²¹⁹ NETL Overview. Online. Available: http://www.netl.doe.gov/File%20Library/Publications/others/NETL_Flyer.pdf.

²²⁰ History. Online. Available: <https://www.netl.doe.gov/about/netl-history>.

²²¹ Mershon, Sherie, and Tim Palucka, 2010. National Energy Technology - A Century of Innovation. Online. Available: https://www.netl.doe.gov/File%20Library/NewsRoom/NETL-A_Century_of_Innovation.pdf.

²²² Mission/Overview. Online. Available: <https://www.netl.doe.gov/about/mission-and-overview>.

²²³ Organization. Online. Available: <https://www.netl.doe.gov/about/organization>.

²²⁴ NETL Annual Report 2015. Online. Available: <http://www.netl.doe.gov/File%20Library/NewsRoom/AR2015.pdf>.

The laboratory maintains a focus on fossil fuels. It contributes to U.S. DOE strategic goals “through cutting-edge research and development focused on efficient energy use and clean energy production from our nation’s domestic fossil fuel resources”²²⁵.

Although NETL pursues emerging energy technologies, they are primarily related to fossil energy sources. LENR therefore may not be able to help NETL to accomplish its mission as much as it can for other agencies. NETL performs work for EERE, but LENR opportunities in helping agencies meet their requirements are likely to be with EERE directly.

5.4 U.S. Intelligence Community (IC)

That IC includes 17 agencies and other entities in the Executive Branch that work independently and collaboratively to meet the nation's intelligence needs with respect to national security and foreign relations²²⁶. It was formed by executive order in 1981, but came into prominence with the passage of the Intelligence Reform and Terrorism Prevention Act (IRTPA) in 2004²²⁷.

IRTPA, which was enacted as a result of the 9/11 act of terrorism, reorganized the configuration of multiple intelligence organizations. The IC strives to exhibit three characteristics that are essential to its effectiveness – integration, agility, and exemplifying American values²²⁸. These values are protection of privacy, report respecting human rights, and retaining the trust of the American people. Six basic sources are used in the IC²²⁹:

- Signal Intelligence
- Imagery Intelligence
- Measurement and Signatures Intelligence
- Human Intelligence
- Open Source Intelligence
- Geospatial Intelligence

²²⁵ Research. Online. Available: <http://www.netl.doe.gov/research>.

²²⁶ DNI Homepage. Online. Available: <https://www.dni.gov/index.php>.

²²⁷ History. Online. Available: <https://www.dni.gov/index.php/about/history>.

²²⁸ ODNI FAQ. Online. Available: <https://www.dni.gov/index.php/about/faq?limitstart=0>.

²²⁹ ODNI FAQ

Three of the IC components – the Director of National Intelligence (DNI), the Central Intelligence (CIA), Defense Intelligence Agency (DIA), and the Intelligence Advanced Research Projects Agency (IAPRA) – are selected for consideration of potential LENR opportunities.

5.4.1 Director of National Intelligence (DNI)

IRTPA created the position of Director of National Intelligence (DNI) that reports directly to the President. In compliance with the law, the DNI:

- Serves as the President's principal intelligence adviser
- Oversees the National Intelligence Program budget
- Establishes IC priorities with clear and measurable goals and objectives
- Sets direction through policies and budgets
- Insures integration of IC personnel, expertise, and capabilities
- Provides leadership on IC cross-cutting issues
- Monitors IC agency and leadership performance

The mission of the DNI is to lead intelligence integration and forge an intelligence community that delivers the most insightful intelligence possible²³⁰. The Office of the DNI (ODNI) has set up eight goals, as follows²³¹:

- Integrate intelligence analysis and collection to inform decisions made from the White House to the foxhole
- Drive responsible and secure information sharing
- Set strategic direction and priorities for national intelligence resources and capabilities
- Develop and implement Unifying Intelligence Strategies across regional and functional portfolio
- Strengthen partnerships to enrich intelligence
- Advance cutting-hedge capabilities to provide global intelligence advantage
- Promote a diverse, highly-skilled intelligence workforce that reflects the strength of America
- Align management practices to best serve the IC

²³⁰ Vision Poster. Online. Available: https://www.dni.gov/files/documents/ODNI_mission_poster_FINAL.pdf.

²³¹ ODNI Fact Sheet. Online. Available: https://www.dni.gov/files/documents/ODNI%20Fact%20Sheet_2011.pdf.

The ODNI is composed of a headquarters element and four national centers as follows²³²:

- National Counterterrorism Center (NCTC)
- National Counterproliferation Center (NCPC)
- National Counterintelligence and Security Center (NCSC)
- Cyber Threat Intelligence Integration Center (CTIIC)

The ODNI also includes the Intelligence Advanced Research Projects Activity (IARPA) and the National Intelligence Council.

The mission and goals of the DNI do not address energy topics or emerging energy technologies specifically, so LENR may not have opportunities to help the DNI meet its responsibilities.

5.4.2 Central Intelligence Agency (CIA)

The CIA traces its roots to the use of intelligence in the early days of the U.S.²³³ Its forerunner was the Office of Strategic Services, which functioned during World War II but was abolished at the end of the war. The CIA was established when the National Security Act was signed by President Truman in 1947²³⁴. A number of changes occurred at the CIA when IRTPA was passed in 2004²³⁵. In particular, the role of the CIA Director as coordinator of the nation's intelligence activities was transferred to the DNI, and the CIA Director was focused on the agency itself.

The CIA gathers foreign (not domestic) intelligence for the benefit of senior U.S. policymakers²³⁶, particularly the President. The CIA's mission is to "preempt threats and further U.S. national security objectives by collecting intelligence that matters, producing objective all-source analysis, conducting effective covert action as directed by the president, and safeguarding the secrets that help keep our Nation safe²³⁷". Its vision is that the "CIA's information, insights, and actions consistently provide tactical and strategic advantage to the US". 257. CIA's officers are guided by a professional ethos "that is the some of the agency's abiding principles, core

²³² Careers at ODNI. Online. Available: <https://www.dni.gov/index.php/careers/careers-at-odni>.

²³³ CIA's Strategy in the Face of Emerging Challenges: Remarks by CIA Director John O. Brennan, 2016. Online. Available: https://www.brookings.edu/wp-content/uploads/2016/06/20160713_cia_brennan_transcript.pdf.

²³⁴ History of the CIA. Online. Available: <https://www.cia.gov/about-cia/history-of-the-cia>

²³⁵ Today's CIA. Online. Available: <https://www.cia.gov/about-cia/todays-cia>.

²³⁶ Members of the IC. Online. Available: <https://www.dni.gov/index.php/intelligence-community/members-of-the-ic>.

²³⁷ CIA Vision, Mission, Ethos & Challenges. Online. Available:

values, and highest aspirations²³⁸: service, integrity, excellence, courage, teamwork, and stewardship. Two of the agency's principle challenges identified by the Director are ungoverned spaces and the digital revolution²³⁹.

Besides the Office of the Director, the CIA is organized into 5 Directorates, 10 Mission Centers, 14 Enterprise Functions, and 10 elements of the Talent Center of Excellence²⁴⁰. The five Directorates are Analysis, Digital Innovation, Operations, Science and Technology, and Support. The Directorates carry out "the intelligence cycle" of collecting, analyzing, and disseminating intelligence information to U.S. Government officials²⁴¹. The Mission Centers were the result of CIA modernization. Six of the centers focus on regions of the world, and four focus on functional issues such as counter terrorism and counter proliferation²⁴². The CIA conducts covert actions at the direction of the President, usually upon the recommendation of the National Security Council.

Examination of the mission and organization of the CIA does not indicate a particular emphasis on energy issues or on emerging energy technologies specifically. LENR may therefore not have significant opportunity to help the CIA accomplish its mission at this time. However, should LENR become an issue of national security, such as if it is achieved in a nation that is an adversary of the US, LENR may become important to the CIA's mission in the future.

5.4.3 Defense Intelligence Agency (DIA)

The DIA is a DoD combat support agency that is a major provider and manager of foreign military intelligence. It provides military intelligence to warfighters, defense policymakers and force planners, in the DoD and the IC, in support of U.S. military planning and operations and weapon systems acquisition²⁴³. The agency was established by Secretary of Defense Robert

²³⁸ CIA Vision, Mission, Ethos & Challenges. Online. Available:

²³⁹ CIA's Strategy in the Face of Emerging Challenges: Remarks by CIA Director John O. Brennan, 2016. Online. Available: https://www.brookings.edu/wp-content/uploads/2016/06/20160713_cia_brennan_transcript.pdf.

²⁴⁰ CIA Organization Chart. Online. Available: <https://www.cia.gov/about-cia/leadership/cia-organization-chart.html>.

²⁴¹ Today's CIA. Online. Available: <https://www.cia.gov/about-cia/todays-cia>.

²⁴² CIA's Strategy in the Face of Emerging Challenges: Remarks by CIA Director John O. Brennan, 2016. Online. Available: https://www.brookings.edu/wp-content/uploads/2016/06/20160713_cia_brennan_transcript.pdf.

²⁴³ Members of the IC – Defense Intelligence Agency. Online. Available: <https://www.dni.gov/index.php/intelligence-community/members-of-the-ic>.

McNamara (under President John Kennedy) in 1961²⁴⁴. Its mission is to “provide intelligence on foreign militaries and operating environments that delivers decision advantage to prevent and decisively win wars”, and its vision is to “be the indispensable source of defense intelligence expertise”²⁴⁵. Both the DIA and CIA are members of the IC, but the DIA is a principal source of foreign intelligence to combat-related missions, whereas the CIA is focused on providing intelligence to the President and his Cabinet²⁴⁶.

DIA has developed a strategy that sets forth five primary lines of effort: leadership and workforce, integrated intelligence, enterprise governance, information and technology, and mission capability security²⁴⁷. The agency is organized into four Directorates (Analysis, Operations Science and Technology, and Mission Services) and four Intelligence Centers: Americas, Asia/Pacific, Europe/Eurasia, and Middle East/Africa²⁴⁸.

Like the CIA, the DIA does not now appear to emphasize energy-related topics or, specifically, emerging energy technologies. LENR may therefore not be able to help the DIA accomplish its mission unless the new energy were to become a technological threat to the defense of the US. That the DIA continues to monitor the status of LENR in the national security context is confirmed by a report issued in 2009²⁴⁹.

5.4.4 Intelligence Advanced Research Projects Activity (IARPA)

IARPA was established in the Office in 2006 with a mandate to conduct cross-community research, target new opportunities and innovation, and generate revolutionary capabilities²⁵⁰. It is organizationally within the Office of the DNI, but its intelligence research supports elements of

²⁴⁴ Defense Intelligence Agency, 35 Years, A Brief History. Online. Available: https://fas.org/irp/dia/dia_history.pdf.

²⁴⁵ DIA Leadership. Online. Available: <http://www.dia.mil/About/Leadership/>.

²⁴⁶ Frequently Asked Questions. Online. Available: <http://www.dia.mil/About/FAQs/>.

²⁴⁷ DIA Strategy. Online. Available: <http://www.dia.mil/About/Strategy/>.

²⁴⁸ DIA Organization. Online. Available: <http://www.dia.mil/About/Organization/>.

²⁴⁹ Defense Intelligence Agency, 2009. Technology Forecast: Worldwide Research on Low-Energy Nuclear Reactions Increasing and Gaining Acceptance. Defense Analysis Report DIA-08-0911-003. November. Online. Available: <http://lenr-canr.org/acrobat/BarnhartBtechnology.pdf>.

²⁵⁰ About IARPA – History. Online. Available: <https://www.iarpa.gov/index.php/about-iarpa>.

the IC, and the results from its programs are expected to transition to its IC customers²⁵¹.

IARPA's mission is to invest in high-risk, high-payoff research programs to tackle some of the most difficult challenges of the agencies and disciplines of the IC²⁵².

The Activity was modeled after DARPA when it was created, and, like DARPA, it utilizes the topics of the Heilmeier Questions for high-level guidance²⁵³: what is going to be done, how it is presently done and by whom, limitations of present approaches, what's new in the proposed

approach and why it can be successful, what difference success will make, time required and cost, and mid-term and final exams. The Activity is organized into four cutting-edge Offices: Anticipatory Surprise, Incisive Analysis, Safe and Secure Operations, and Smart Collection²⁵⁴.

Current Research Areas include computer vision, big data, multilingual speech recognition, satellite image processing, machine learning, geospatial fusion, artificial intelligence, and pattern recognition²⁵⁵. During 2016 IARPA launched 12 new multi-year research programs and had over 250 peer-reviewed publications from its funded research²⁵⁶.

IARPA's research trusts and areas of current research do not appear to emphasize energy topics or emerging energy technologies. However, to the extent that LENR could provide an energy source for IARPA-developed devices, it could in the future potentially contribute to the Activity's accomplishing its mission.

²⁵¹ Intelligence Advanced Research Projects Activity: Who We Are. Online. Available: <https://www.dni.gov/index.php/about/organization/intelligence-advanced-research-projects-activity-who-we-are>.

²⁵² About IARPA. Online. Available: <https://www.iarpa.gov/index.php/about-iarpa>.

²⁵³ Become a Program Manager. Online. Available: <https://www.iarpa.gov/index.php/careers/become-a-program-manager>.

²⁵⁴ What We Do. Online. Available: <https://www.dni.gov/index.php/about/organization/intelligence-advanced-research-projects-activity-what-we-do>,

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6 *Summary*

Emerging energy technologies are increasing in importance as the world's demand for energy increases and as current energy sources become more problematic. LENR is a potential but controversial new energy technology that was rejected when it was introduced in 1989. However, it has continued to be a subject of research and development, so that its prospects appear to have improved considerably.

Many U.S. Government agencies have energy policy responsibilities. Some 30 agencies have been reviewed for their energy-related interests, with emphasis on emerging energy technologies. This review included for each agency its overall mission, background and organization, energy responsibilities, and realization of new technologies as well as addressing their secondary impacts. Emerging energy technologies play a vital role in most of the agencies reviewed in accomplishing their mission. As a promising new energy technology, LENR may help these agencies to meet their responsibilities.

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