THE NATIONAL ACADEMIES

DIVISION ON ENGINEERING AND PHYSICAL SCIENCES

"…the Academy shall, whenever called upon by any department of the Government, investigate, examine, experiment, and report upon any subject of science or art…"

—Charter of the National Academy of Sciences, 1863

A unique national resource for ensuring independent, objective, and authoritative advice about science and technology policy.

National Academy of Sciences
National Academy of Engineering
Institute of Medicine
National Research Council

THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine

ABOUT THE NATIONAL ACADEMIES

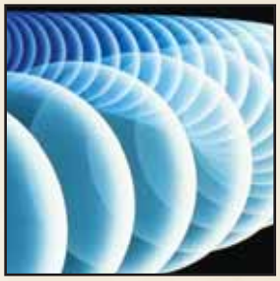
For independent, objective, and authoritative advice on issues of science, technology, and medicine, the nation's leaders turn to the National Academy of Sciences, the National Academy of Engineering, the Institute of Medicine, and their organization of advisory committees, the National Research Council. As a private, nonprofit organization located in Washington, D.C., the National Academies provide a unique public service by enlisting the nation's foremost scientists, engineers, health professionals, and other experts in studies that address the most challenging issues facing the nation.

Most studies are requested by the federal government—either directly by an agency or mandated by Congress—although private industry, foundations, state and local governments, and the Academies themselves may sponsor activities. For each study, the National Research Council identifies the expertise needed and independently appoints the nation's best experts to serve on the study committee.

Experts from academia, business, and government volunteer their services on study committees to provide independent, objective advice that is published in reports made available electronically and in print. Rigorous investigation, continuous oversight, and formal review ensure each report's objectivity, quality, and adherence to the highest scientific standards. As a result, National Academies' reports are often highly influential in public policy making.

DIVISION ON ENGINEERING AND PHYSICAL SCIENCES

MISSION



The mission of the Division on Engineering and Physical Sciences (DEPS) is to provide independent and authoritative science, technology, engineering, and related policy advice to the federal government and to the nation and to promote communications between the science and technology community, the federal government, and the interested public.

DEPS seeks to assess the role of science and technology in important public policy issues and to advance science and engineering, identifying needed research as well as improvements in data and research methods. In these ways, it fosters better science and technology and their use to support decisions on public policies and programs.

The work of DEPS is organized around four broad areas:

- Unique government missions in defense, space, and aerospace
- National infrastructure challenges such as energy and environmental systems, information and telecommunications, manufacturing and engineering design, civil engineering, and the constructed environment
- Science and engineering disciplines such as physics, astronomy, computer science and engineering, materials science and engineering, and the mathematical sciences and their applications
- Continuing assessments of federal government laboratories and research programs

DEFENSE, INTELLIGENCE,NATIONAL SECURITY, SPACE, AND AEROSPACE

The **Air Force Studies Board (AFSB)** serves as a convening authority for the discussion of science and technology issues of importance to the Air Force and oversees independent ad hoc studies conducted by National Research Council (NRC) committees. It works with the Air Force leadership to develop study projects. AFSB also reviews committee member nominations, and board members sometimes participate in study activities as committee members.

The **Board on Army Science and Technology (BAST)** serves as a convening authority for the discussion of science and technology issues of importance to the Army and formulates independent Army-related studies conducted by the National Academies. In coordination with the Army, BAST works to focus issues for meetings and studies and statements of task and reviews committee membership nominations. Its members sometimes serve on the ad hoc committees that conduct the studies.

The mission of the **Naval Studies Board (NSB)**, created in 1974 at the request of the Chief of Naval Operations, is to be a source of independent, long-range, scientific and technical planning advice for the Naval Forces. The NSB's charter also has been endorsed by the Assistant Secretary of the Navy (Research and Development), and accepted without modification by the president of the National Academy of Sciences and chair of the National Research Council.

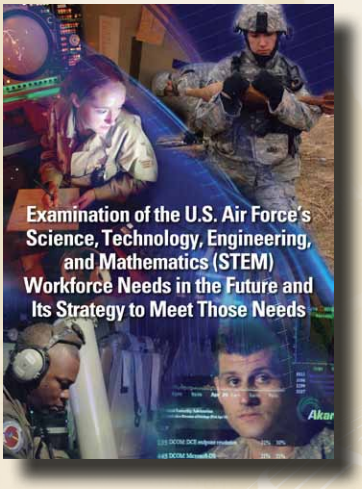
The **Aeronautics and Space Engineering Board (ASEB)** was established to bring the knowledge and expertise of the aerospace engineering community to bear on significant aerospace policies and programs. ASEB examines and reports on problems and issues involving various aspects of aeronautics and space technology such as aerodynamics, materials, structures, fuels, avionics, propulsion, human-machine integration, safety, and priorities for future technology development.

The **Space Studies Board (SSB)** provides an independent, authoritative forum for information and advice on all aspects of space science and applications, and it serves as the focal point within the National Academies for activities on space research. SSB conducts advisory studies and program assessments, facilitates the coordination of international research, and promotes communications on space science and space policy between the research community, the federal government, and the interested public.

AIR FORCE STUDIES BOARD (AFSB)

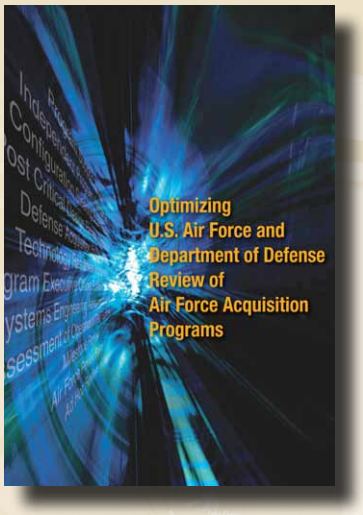
The AFSB serves as a convening authority for the discussion of a diversity of subjects of importance to the Air Force. In collaboration with Air Force leadership, the board develops studies related to the development and application of science and technology to be carried out by the National Research Council. Recently, these in-depth studies have addressed critical issues such as fuel efficiency, acquisition processes, and assuring the future scientific and technical qualification of Air Force personnel.

Selected Recent Reports



Examination of the U.U.S. Air Force's Science, Technology, Engineering, and Mathematics (STEM) Workforce Needs in the Future (2010)

In the past, the United States Air Force has been an attractive career destination for individuals educated in science, technology, engineering, or mathematics (STEM) disciplines. However, force reductions, budget pressures, and ongoing military operations are creating new challenges to the Air Force's ability to recruit and retain personnel with the necessary technical expertise. The growing complexity of missions is also placing new demands on education, training, career development, system acquisition, platform sustainment, and the development of operational systems. In response to these changing circumstances, the Deputy Assistant Secretary of the Air Force for Science, Technology, and Engineering asked that the National Research Council conduct a study to assess the STEM capabilities the Air Force needs to meet the goals set forth in its strategic plan, and identify and evaluate options for meeting those needs. This report, the result of that study, discusses the role that STEM capabilities play in the achievement of the Air Force's vision and strategy and assesses the current STEM requirements for positions within the Air Force, paying particular attention to the need for STEM expertise within the acquisition workforce.



Optimizing U.S. Air Force and Department of Defense Review of Air Force Acquisitions Programs (2009)

The Department of Defense (DoD) and Air Force acquisitions programs often experience large cost overruns and schedule delays, leading to a loss in confidence in the defense acquisition system and its personnel. The response by DoD and Air Force has been to increase the number of required program and technical reviews, leading to increased administrative burden and further increases in program cost. This report examines the reviews that U.S. Air Force acquisition programs are required to undergo and poses a key question: Can changes in the number, content, or sequence of reviews help Air Force program managers more successfully execute their programs? The report makes five recommendations that together form a gold standard for conduct of acquisition reviews. If implemented and rigorously managed by Air Force and DoD acquisition executives, these guidelines will increase the effectiveness and efficiency of program reviews.

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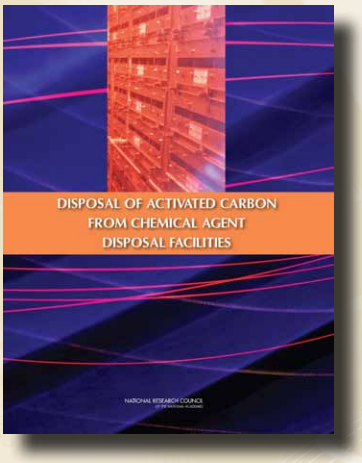
BOARD ON ARMY SCIENCE AND TECHNOLOGY (BAST)

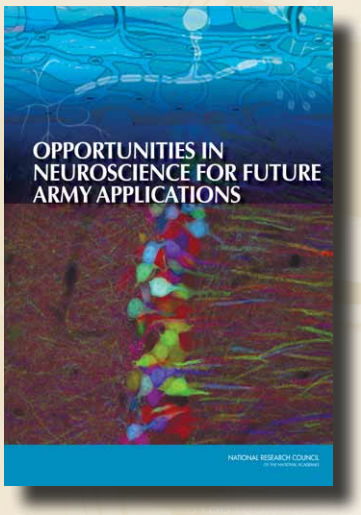
The BAST serves as a convening authority for the discussion of science and technology issues of importance to the Army and formulates independent Army-related studies conducted by The National Academies. In coordination with the Army, the BAST focuses study issues and statements of task and reviews committee membership nominations. BAST committee members are also encouraged to participate in ad hoc committees.

Selected Recent Reports



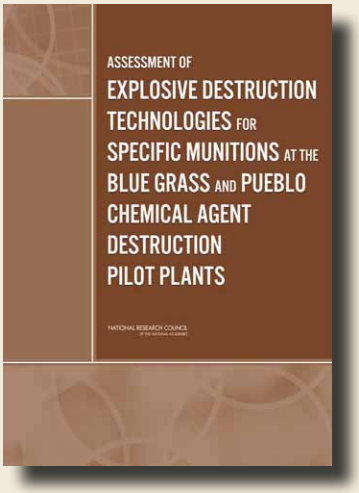
The Disposal of Activated Carbon from Chemical Agent Disposal Facilities (2009)

For the last two decades, the United States has been destroying its entire stockpile of chemical agents. At the facilities where these agents are being destroyed, effluent gas streams pass through large activated carbon filters before venting to ensure that any residual trace vapors of chemical agents and other pollutants do not escape into the atmosphere in exceedance of regulatory limits. All the carbon will have to be disposed of for final closure of these facilities to take place. In March 2008, the Chemical Materials Agency asked the National Research Council to study, evaluate, and recommend the best methods for proper and safe disposal of the used carbon from the operational disposal facilities. This volume examines various approaches to handling carbon waste streams from the four operating chemical agent disposal facilities.



Opportunities in Neuroscience for Future Army Applications (2009)

Advances and major investments in the field of neuroscience can enhance traditional behavioral science approaches to training, learning, and other applications of value to the Army. Neural-behavioral indicators offer new ways to evaluate how well an individual trainee has assimilated mission critical knowledge and skills, and can also be used to provide feedback on the readiness of soldiers for combat. This report makes 17 recommendations that focus on utilizing current scientific research and development initiatives to improve performance and efficiency, collaborating with pharmaceutical companies to employ neuropharmaceuticals for general sustainment or enhancement of soldier performance, and improving cognitive and behavioral performance using interdisciplinary approaches and technological investments. An essential guide for the Army, this book will also be of interest to other branches of military, national security and intelligence agencies, academic and commercial researchers, pharmaceutical companies, and others interested in applying the rapid advances in neuroscience to the performance of individual and group tasks.



Assessment of Explosive Destruction Technologies for Specific Munitions at the Blue Grass and Pueblo Chemical Agent Destruction Plants (2009)

The Army's ability to meet public and congressional demands to destroy expeditiously all of the U.S. declared chemical weapons would be enhanced by the selection and acquisition of appropriate explosive destruction technologies (EDTs) to augment the main technologies to be used to destroy the chemical weapons currently at the Blue Grass Army Depot (BGAD) in Kentucky and the Pueblo Chemical Depot (PCD) in Colorado. The Army is considering four EDTs for the destruction of chemical weapons: three from private sector vendors, and a fourth, Army-developed explosive destruction system (EDS). This book updates earlier evaluations of these technologies, as well as any other viable detonation technologies, based on several considerations including process maturity, process efficacy, process throughput, process safety, public and regulatory acceptability, and secondary waste issues, among others. It also provides detailed information on each of the requirements at BGAD and PCD and rates each of the existing suitable EDTs plus the Army's EDS with respect to how well it satisfies these requirements.

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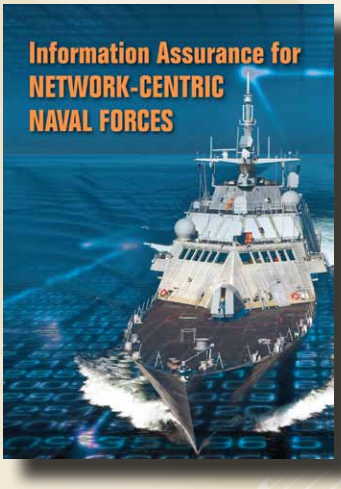
NAVAL STUDIES BOARD (NSB)

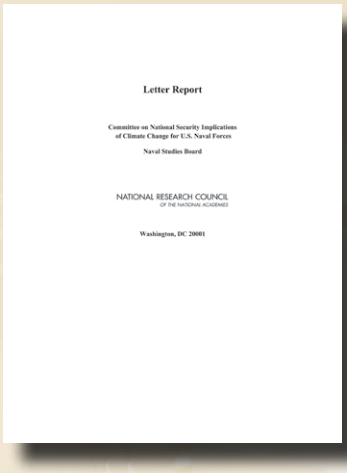
The mission of the NSB, created in 1974 at the request of the Chief of Naval Operations, is to be a source of independent, long-range, scientific and technical planning advice for the naval forces. The NSB's charter was endorsed by the Assistant Secretary of the Navy (Research and Development), and accepted without modification by the president of the National Academy of Sciences and chair of the National Research Council.

Selected Recent Reports



Information Assurance for Network-Centric Naval Forces (2010)

Owing to the expansion of network-centric operating concepts across the Department of Defense (DOD) and the growing threat to information and cybersecurity from lone actors, groups of like-minded actors, nation-states, and malicious insiders, information assurance is an area of significant and growing importance and concern. Because of the forward positioning of both the Navy's afloat and the Marine Corps expeditionary forces, information assurance issues for naval forces are exacerbated, and are tightly linked to operational success. Broad-based information assucrance success is viewed by the NRC's Committee on Information Assurance for Network-Centric Naval Forces as providing a central underpinning to the DOD's network-centric operational concept and the Department of the Navy's (DON's) FORCEnet operational vision. Accordingly, this report provides a view and analysis of information assurance in the context of naval mission assurance.



National Security Implications of Climate Change for U.S. Naval Forces: Letter Report (2010)

The leaders of the U.S. Navy, Coast Guard, and Marine Corps have recognized the potential impact of climate change on naval forces' missions and have positioned their organizations to make adaptive changes. This report is the first component of a study to assess the implications of climate change for the U.S. Naval Services. Specifically, this report highlights issues that could have potential near-term impacts, impose a need for near-term awareness, or require near-term planning to ensure that longer-term naval capabilities are protected. The final report of this study will address all of the elements in the study's terms of reference and explore many potential implications of climate change not covered in this letter report.

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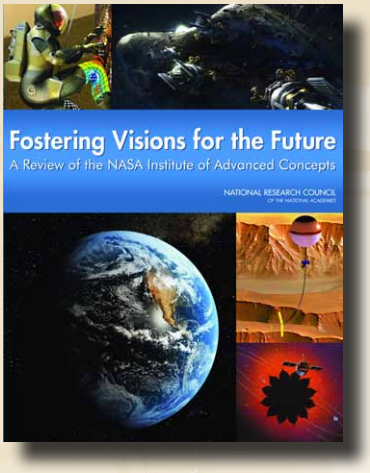
AERONAUTICS AND SPACE ENGINEERING BOARD (ASEB)

The ASEB was established in 1967 "to focus talents and energies of the engineering community on significant aerospace policies and programs." In undertaking its responsibilities, the ASEB oversees ad hoc committees that recommend priorities and procedures for achieving aerospace engineering objectives and offers a way to bring engineering and other related expertise to bear on aerospace issues of national importance. Among these issues are the research and development aspects of the Next Generation Air Transportation System (NextGen); NASA's aeronautics research program; national aeronautics R&D policy and its implementation; space policy and programs, with a focus on human spaceflight and space operations; commercial space activities; and other aerospace engineering topics.

Selected Recent Reports

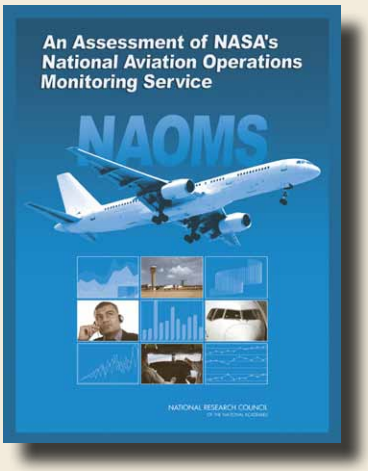
Advancing Aeronautical Safety: A Review of NASA's Aviation Safety-Related Research Programs (2010)

Advancing the state of aviation safety is a central mission of the National Aeronautics and Space Administration (NASA). Congress requested this review of NASA's aviation safety-related research programs, seeking an assessment of whether the programs have well-defined, prioritized, and appropriate research objectives; whether resources have been allocated appropriately among these objectives; whether the programs are well coordinated with the safety research programs of the Federal Aviation Administration; and whether suitable mechanisms are in place for transitioning the research results into operational technologies and procedures and certification activities in a timely manner. Advancing Aeronautical Safety contains findings and recommendations with respect to each of the main aspects of the review sought by Congress. These findings indicate that NASA's aeronautics research enterprise has made, and continues to make, valuable contributions to aviation system safety, but it is falling short and needs improvement in some key respects.



Fostering Visions for the Future: A Review of the NASA Institute for Advanced Concepts (2009)

The NASA Institute for Advanced Concepts (NIAC) was formed in 1998 to provide an independent source of advanced aeronautical and space concepts that could dramatically impact how NASA develops and conducts its missions. Until the program's termination in August 2007, NIAC provided an independent open forum, a high-level point of entry to NASA for an external community of innovators, and an external capability for analysis and definition of advanced aeronautics and space concepts to complement NASA's advanced concept activities. As requested by Congress, this report reviews the effectiveness of NIAC and makes recommendations concerning the importance of such a program to NASA and to the nation as a whole. Key findings and recommendations include that in order to achieve its mission, NASA must have, and is currently lacking, a mechanism to investigate visionary, far-reaching advanced concepts. Therefore, a NIAC-like entity should be reestablished to fill this gap.



An Assessment of NASA's National Aviation Operations Monitoring Service (2009)

The National Aeronautics and Space Administration (NASA) asked the National Research Council to perform an independent assessment of NASA's National Aviation Operations Monitoring Service (NAOMS) project, a survey administered to pilots from April 2001 through December 2004. This report presents the results of that review, including an examination of the survey methodology, and analyzes the publicly available survey data.

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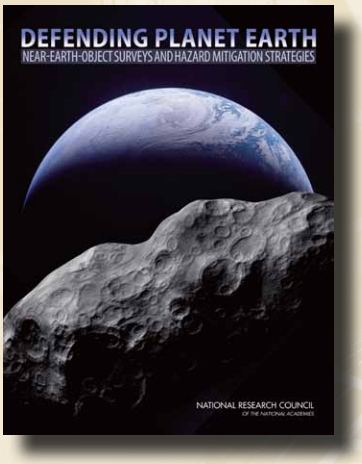
SPACE STUDIES BOARD (SSB)

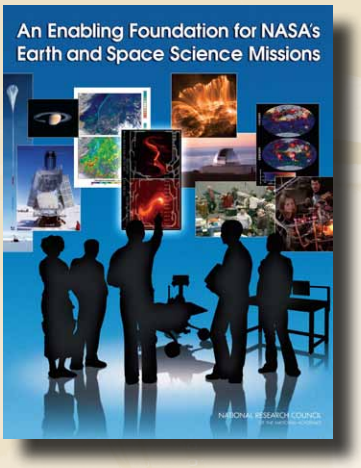
The SSB was established in 1958 to serve as the focus of the interests and responsibilities in space research for the National Academies. It provides an independent, authoritative forum for information and advice on all aspects of space science and its applications. It oversees advisory studies and program assessments, facilitates international research coordination, and promotes communications on space science and science policy between the research community, the federal government, and the interested public. The SSB also serves as the U.S. National Committee for the International Council for Science (ICSU) Committee on Space Research (COSPAR).

Selected Recent Reports



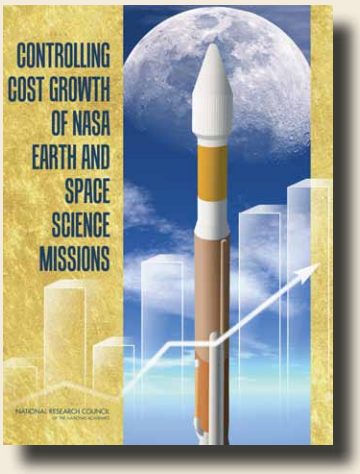
Defending Planet Earth: Near-Earth Object Surveys and Hazard Mitigation Strategies (2010)

The United States spends approximately $5.8 million each year searching for near-Earth objects (NEOs) that may collide with Earth. Most of this funding supports the operation of observatories that scan the sky for NEOs. A significantly smaller amount of funding supports ways to mitigate a potential collision with Earth. In 2005, Congress mandated NASA to achieve detection of 90 percent of NEOs with diameters of 140 meters of greater by 2020. *Defending Planet Earth: Near-Earth Object Surveys and Hazard Mitigation Strategies* describes dangers associated with objects as small as 30 to 50 meters in diameter and identifies a need to expand detection to include these. The report also explores four main types of mitigation, including civil defense, "slow push" or "pull" methods, kinetic impactors, and nuclear explosions. It also asserts that responding effectively to hazards posed by NEOs requires national and international cooperation.



An Enabling Foundation for NASA's Earth and Space Science Missions (2010)

The extraordinary accomplishments of NASA's space and Earth science missions during the past 50 years would not be possible without a strong dedication to supporting research and analysis. NASA's mission-enabling activities frame the scientific questions on which plans for flight missions are based; develop advanced technologies that make new, complex missions feasible; and translate the data from spaceflight missions into new scientific understanding. While it has long been recognized that these activities are essential to the achievement of NASA's goals, defining their appropriate scale has posed a challenge. As requested by Congress, this report examines the balance between spaceflight missions and their supporting activities at NASA, with the goal of assessing whether levels of support for mission-enabling activities are appropriate.



Controlling Cost Growth of NASA Earth and Space Science Missions (2010)

Unplanned growth of project cost and timeline is a problem experienced in many fields of endeavor, and NASA's Earth and space science missions are no exception. Based on prior studies of cost growth in NASA and Department of Defense projects, this report identifies specific causes of cost growth associated with NASA missions and provides guidance on how NASA can overcome these specific problems. Its recommendations focus on changes in NASA policies that would directly reduce or eliminate cost growth and achieve the goal of ensuring frequent mission opportunities for NASA Earth and space science.

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NATIONAL INFRASTRUCTURE

The **Board on Energy and Environmental Systems (BEES)** conducts studies and other activities to provide independent advice to the executive and legislative branches of government and the private sector on energy and environmental technology and related public policy issues. BEES directs expert attention to the technologies and systems involved in energy supply, distribution, and demand. It also addresses related issues in defense and homeland security such as protection of critical energy infrastructure against potential terrorist attacks.

The **Board on Infrastructure and the Constructed Environment (BICE)** advises the executive and legislative branches of government and the private sector on questions of technology, science, and public policy and on the relationship between the constructed and natural environments and their interaction with human activities. BICE brings together in an independent forum experts from a wide range of scientific, engineering, and social science disciplines to address problems and issues in these areas.

The **Board on Manufacturing and Engineering Design (BMED)** provides guidance, primarily to the federal government, on technical issues in engineering design and manufacturing and their implications for national policy. BMED focuses on issues related to supply chain integration, manufacturing and engineering systems linkages, advanced industrial practices, manufacturing infrastructure, manufacturing processing and fabrication, and computer-based tools.

The purpose of the **Computer Science and Telecommunications Board (CSTB)** is to provide a base of expertise in the fields of telecommunications, computer science and engineering, and computing technology; monitor and promote the health of these fields; initiate studies involving these fields as critical resources and sources of national economic strength; respond to requests for advice from government agencies, nonprofit organizations, and private industry; and foster interaction between these fields and other fields of science and technology.

BOARD ON ENERGY AND ENVIRONMENTAL SYSTEMS (BEES)

The BEES conducts program-specific studies and provides authoritative and independent advice to the executive and legislative branches of government and the private sector on energy and environmental technology issues and related public policy. The board directs expert attention to energy supply, distribution, and demand technologies and systems. It also addresses related issues in national security, defense and homeland security, such as protection of critical energy infrastructure against potential terrorist attacks.

Selected Recent Reports

Technologies and Approaches to Reducing the Fuel Consumption of Medium- and Heavy- Duty Vehicles (2010)

Medium- and heavy-duty vehicles, such as tractor trailers, transit buses, and work trucks account for about 26 percent of the transportation fuel used in the United States. Currently there are no fuel consumption standards for such vehicles, which have been targeted for regulation by the Energy Independence and Security Act of 2007. This report evaluates various technologies and methods that could improve the fuel economy of this class of vehicles, and recommends approaches that federal agencies could use to regulate their fuel consumption. For example, using advanced diesel engines in tractor-trailers could lower their fuel consumption by up to 20 percent by 2020, and improved aerodynamics could yield an 11 percent reduction. Hybrid powertrains could lower the fuel consumption of vehicles that stop frequently, such as garbage trucks and transit buses, by as much 35 percent in the same time frame.

Review of the Research Program of the FreedomCAR and Fuel Partnership: Third Report (2010)

The FreedomCAR (Cooperative Automotive Research) and Fuel Partnership is a research collaboration among the U.S. Department of Energy, U.S. automakers, major energy companies, and electric utility companies. It seeks to advance the technologies that are needed to produce affordable, clean, energy-efficient cars and light trucks. Until recently, the partnership primarily focused on developing technologies that would allow U.S. automakers to make production and marketing decisions by 2015 on hydrogen fuel cell-powered vehicles. These vehicles have the potential to be much more energy-efficient than conventional gasoline-powered vehicles, produce no harmful tailpipe emissions, and significantly reduce petroleum use. In 2009, the partnership changed direction and stepped up efforts to advance technologies that will produce shorter-term results including modifications of existing combustion engines, biofuels, and batteries for hybrid or all-electric vehicles. This report, the third volume in the FreedomCAR series, states that while such a shift is warranted, continued research on hydrogen and fuel cell technologies are also needed in order to ready them for adoption.

Assessment of Technologies for Improving Light Duty Vehicle Economy (2010)

Commercially available technologies could greatly reduce fuel consumption in passenger cars, sport-utility vehicles, minivans, and other light-duty vehicles without compromising vehicle performance or safety. This report estimates the potential fuel savings and costs to consumers of available technology combinations for three types of engines: spark-ignition gasoline, compression-ignition diesel, and hybrid. According to estimates within the report, adopting the full combination of improved technologies in medium and large cars and pickup trucks with spark-ignition engines could reduce fuel consumption by 29 percent at an additional cost of $2,200 to the consumer. Replacing spark-ignition engines with diesel engines and components would yield fuel savings of about 37 percent at an added cost of approximately $5,900 per vehicle, and replacing spark-ignition engines with hybrid engines and components would reduce fuel consumption by 43 percent at an increase of $6,000 per vehicle.

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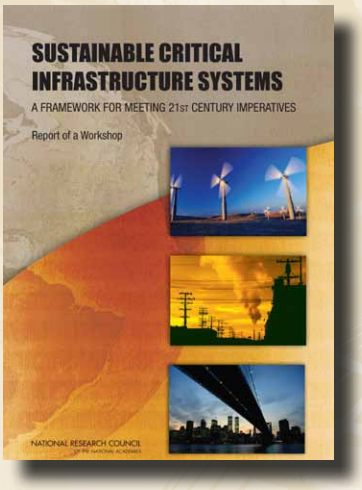
The National Research Council: http://sites.nationalacademies.org/NRC/

BOARD ON INFRASTRUCTURE AND THE CONSTRUCTED ENVIRONMENT (BICE)

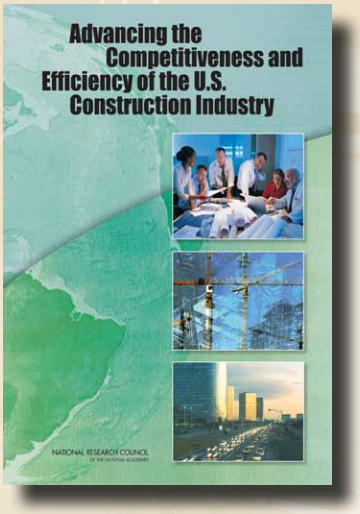
The BICE addresses questions of technology, science, and public policy applied to the relationship between the constructed and natural environments and their interaction with human activities. Focus areas include infrastructure investment and community building, facilities asset management, physical security and multi-hazard vulnerabilities, and building design and construction. The BICE brings together expertise from a wide range of scientific, engineering, and social science disciplines to address problems and issues in these areas.

Selected Recent Reports



Sustainable Critical Infrastructure Systems: A Framework for Meeting 21st Century Imperatives (2009)

In the United States, critical infrastructure systems such as water, wastewater, power, transportation, and telecommunications have become so much a part of modern life that they are taken for granted, and demand is only expected to increase. Large segments and components of these systems are now 50 to 100 years old, however, and their performance and condition are deteriorating. Improvements are clearly necessary. Continued use of the same processes, practices, technologies, and materials that were developed in the 20th century will likely yield unsatisfactory results: increasing instances of service disruptions, higher operating and repair costs, and the possibility of catastrophic, cascading failures. If the nation is to meet some of the important challenges of the 21st century, a new paradigm for the renewal of critical infrastructure systems is needed. This book discusses the essential components of this new paradigm, and outlines a framework to ensure that ongoing activities, knowledge, and technologies can be aligned and leveraged to help meet multiple national objectives.



Advancing the Competitiveness and Efficiency of the U.S. Construction Industry (2009)

Construction productivity--how well, how quickly, and at what cost buildings and infrastructure can be constructed--directly affects prices for homes and consumer goods and the robustness of the national economy. Industry analysts differ on whether construction industry productivity is improving or declining. Still, advances in available and emerging technologies offer significant opportunities to improve construction efficiency substantially in the 21st century and to help meet other national challenges, such as environmental sustainability.

This report identifies five interrelated activities that could significantly improve the quality, timeliness, cost-effectiveness, and sustainability of construction projects, and recommends that the National Institute of Standards and Technology work with industry leaders to develop a collaborative strategy to fully implement and deploy the five activities.

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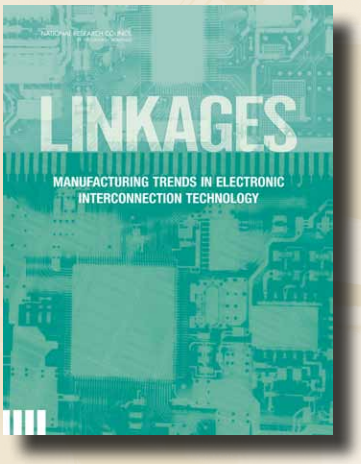
BOARD ON MANUFACTURING AND ENGINEERING DESIGN (BMED)

The BMED provides guidance, primarily to the federal government, on technical issues in engineering design and manufacturing with implications for national policy. The focus of Board activities include issues related to supply chain integration, manufacturing and engineering systems linkages, advanced industrial practices, manufacturing infrastructure, manufacturing processing and fabrication, and computer-based tools.

Selected Recent Reports

A Path to the Next Generation of U.S. Banknotes—Keeping Them Real (2007)

The rapid pace at which digital printing is advancing poses a very serious challenge to the U.S. Department of the Treasury's Bureau of Engraving and Printing (BEP), whose job it is to protect U.S. currency from counterfeiting. To help meet that challenge, the BEP asked the NRC to undertake an assessment of technologies and methods to produce designs to enhance the security of U.S. Federal Reserve notes (FRNs). This report presents the results of a systematic investigation of the trends in digital imaging and printing and how they enable emerging counterfeiting threats; the identification and analysis of new FRN features that could provide effective countermeasures to these threats; and an overview of a requirements-driven development process that could be adapted to develop an advanced-generation currency.



Linkages: Manufacturing Trends in Electronics Interconnection Technology (2005)

Over the past two decades, the Department of Defense has been moving toward commercial-military integration for manufacturing, while at the same time, the printed circuit board industry has been moving steadily offshore. Today, many lack a clear understanding of the importance of high-quality, trustworthy printed circuit boards (PrCBs) for properly functioning weapons and other defense systems and components. To help develop this understanding, DOD asked the NRC to identify and assess the key issues affecting PrCBs for military use. This report presents an assessment of how to ensure DOD's access to reliable printed circuits; an assessment of its vulnerability to the global printed circuit supply chain; and suggestions about ways to secure the design and manufacture of printed circuits. In addition, this report offers recommendations to help DOD preserve existing systems' capabilities, improve the military's access to currently available PrCBs, and ensure access to future PrCB technology.

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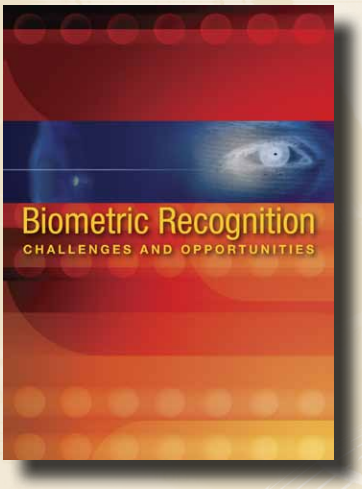
COMPUTER SCIENCE AND TELECOMMUNICATIONS BOARD (CSTB)

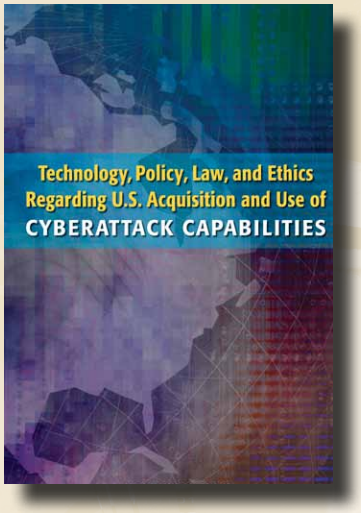
The CSTB'S purpose is to provide a base of expertise in the fields of computer science, information technology, and telecommunications; monitor and promote the health of the these fields; initiate studies involving these fields as critical resources and sources of national economic strength; respond to requests for advice from government agencies, nonprofit organizations, and private industry; and foster interaction among computer science, telecommunications, and other fields of science and technology.

Selected Recent Reports



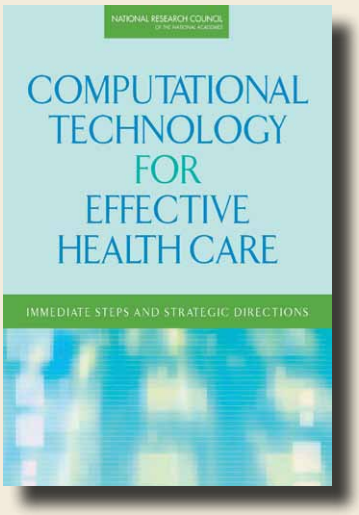
Biometric Recognition: Challenges and Opportunities (2010)

Biometric recognition __ the automated recognition of individuals based on their behavioral and biological characteristics--is promoted as a way to help identify terrorists, provide better control of access to physical facilities and financial accounts, and increase the efficiency of access to services and their utilization. Biometric recognition has been applied to identification of criminals, patient tracking in medical informatics, and the personalization of social services, among other things. In spite of substantial effort, however, there remain unresolved questions about the effectiveness and management of systems for biometric recognition, as well as the appropriateness and societal impact of their use. Now, as biometric technologies appear poised for broader use, increased concerns about national security and the tracking of individuals as they cross borders have caused passports, visas, and border-crossing records to be linked to biometric data. This report addresses the issues surrounding broader implementation of this technology, and examines current capabilities, future possibilities, and the role of government in technology and system development.



Technology, Policy, Law, and Ethics Regarding U.S. Acquisition and Use of Cyberattack Capabilities (2009)

Cyberattacks--actions intended to damage adversary computer systems or networks--can be used for a variety of military purposes. But they also have application to certain missions of the intelligence community, such as covert action. They may be useful for certain domestic law enforcement purposes, and some analysts believe that they might be useful for certain private sector entities who are themselves under cyberattack. This report considers all of these applications from an integrated perspective that ties together technology, policy, legal, and ethical issues. Focusing on the use of cyberattack as an instrument of U.S. national policy, *Technology, Policy, Law and Ethics Regarding U.S. Acquisition and Use of Cyberattack Capabilities* explores important characteristics of cyberattack. It describes the current international and domestic legal structure as it might apply to cyberattack, and considers analogies to other domains of conflict to develop relevant insights. Of special interest to the military, intelligence, law enforcement, and homeland security communities, this report is also an essential point of departure for nongovernmental researchers interested in this rarely discussed topic.



Computational Technology for Effective Health Care: Immediate Steps and Strategic Directions (2009)

Despite a strong commitment to delivering quality services, persistent problems involving medical errors and ineffective treatment continue to plague the health care industry. Many of these problems are the consequence of poor information and technology (IT) capabilities, and most importantly, the lack cognitive IT support. Clinicians spend a great deal of time sifting through large amounts of raw data, when, ideally, IT systems would place raw data into context with current medical knowledge to provide clinicians with computer models that depict the health status of the patient. *Computational Technology for Effective Health Care* advocates re-balancing the portfolio of investments in health care IT to place a greater emphasis on providing cognitive support for health care providers, patients, and family caregivers; observing proven principles for success in designing and implementing IT; and accelerating research related to health care in the computer and social sciences and in health/biomedical informatics.

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The National Research Council: http://sites.nationalacademies.org/NRC/

Physical Science, Engineering Disciplines, and Assessment of Laboratory Research Programs

The mission of the **Board on Mathematical Sciences and Their Applications (BMSA)** is to support and promote the quality and health of the mathematical sciences and their benefits to the nation. BMSA addresses four key areas where the mathematical sciences interface with public policy: responsible and effective use of computational models; creation of knowledge from large amounts of data; mathematical and statistical underpinnings of risk analysis; and leadership for the mathematical sciences.

The **Board on Physics and Astronomy (BPA)** seeks to inform the government and the public about important scientific opportunities and issues as well as the changing nature of science. It builds bridges between physics and astronomy and other areas of science and between the evolving subdisciplines of physics and astronomy. BPA is successful if it helps science organizations and the science community at large understand what is needed to advance physics and astronomy and why such advancement is important.

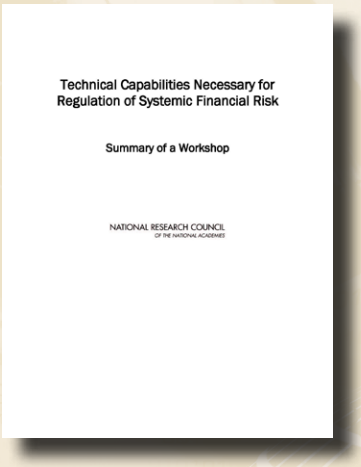
The **National Materials Advisory Board (NMAB**) provides a national forum for the U.S. government, universities, and industry that focuses on scientific and technical problems and opportunities; policy issues related to engineering, industrial, structural, electronic, infrastructural, and biomedical materials; the technical and economic impacts of materials; and cooperation in research, at home and abroad, to concentrate effort, minimize duplication, and stimulate progress.

The **Laboratory Assessments Board (LAB)** oversees NRC review and assessment of the technical quality of research conducted at laboratories, including laboratories established by federal agencies at national laboratories and at government-owned, contractor-operated facilities. Assessments are performed by NRC-appointed committees under the auspices of LAB and established separately for each institution and/or laboratory to be reviewed. The *Army Research Laboratory Technical Assessment Board* (ARLTAB) performs annual peer assessments of the scientific and technical quality of the Army Research Laboratory (ARL). The *Committee on the National Institute of Standards and Technology Technical Programs* (CNISTTP) oversees technical assessments of the National Institute of Standards and Technology (NIST) laboratories conducted by eight separately appointed panels established for that purpose, one for each of the institute's laboratories.

BOARD ON MATHEMATICAL SCIENCES AND THEIR APPLICATIONS (BMSA)

The mission of the BMSA is to support and promote the quality and health of the mathematical sciences and their benefits to the nation. The board addresses four key areas at the interface of mathematical sciences and public policy: responsible and effective use of computational models; creation of knowledge from large amounts of data; mathematical and statistical underpinnings of risk analysis; and leadership for the mathematical science.

Selected Recent Reports

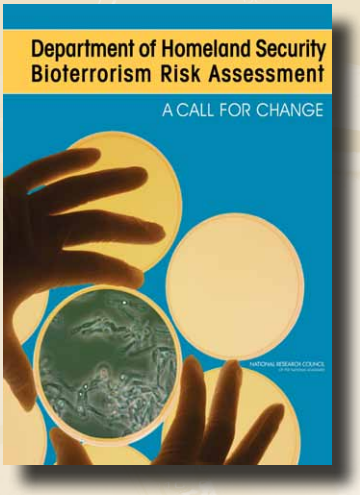


Technical Capabilities Necessary for Regulation of Systemic Financial Risk (2010)

The financial reform plans currently being implemented in the United States recognize the need for monitoring and regulating systemic risk in the financial sector. To inform planning, the National Research Council held a workshop on November 3, 2009, to identify the major technical challenges to building such a capability. The workshop, summarized in this volume, addressed the following key issues as they relate to systemic risk:

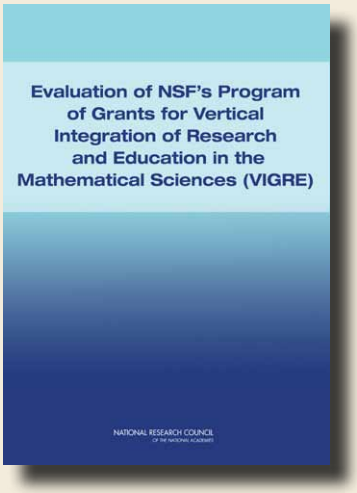
- What data and analytical tools are currently available to regulators to address this challenge?
- What further data-collection and data-analysis capabilities are needed?
- What specific resource needs are required to accomplish the task?
- What are the major technical challenges associated with systemic risk regulation?
- What are various options for building these capabilities?

Rather than addressing specific scenarios, the workshop focused on the issues listed above for systemic risk in general. More than 40 experts representing diverse perspectives participated in the workshop.



Department of Homeland Security Bioterrorism Risk Assessment: A Call for Change (2008)

This report aims to independently and scientifically review the methodology that led to the 2006 Department of Homeland Security report, *Bioterrorism Risk Assessment* (BTRA), and provide a foundation for future updates. It identifies a number of fundamental concerns with the BTRA of 2006, ranging from mathematical and statistical mistakes that have corrupted results, to unnecessarily complicated probability models and models with fidelity far exceeding existing data, to more basic questions about how terrorist behavior should be modeled. Rather than merely criticizing the BTRA of 2006, this new report proposes alternatives, developed in consultation with outside experts, that could improve DHS's ability to assess potential terrorist behavior as a key element of risk-informed decision making, and it explains these alternatives in the specific context of the BTRA and the bioterrorism threat.



Evaluation of NSF's Program of Grants and Vertical Integration of Research and Education in the Mathematical Sciences (VIGRE) (2009)

In 1998, the National Science Foundation (NSF) launched a program of Grants for Vertical Integration of Research and Education in the Mathematical Sciences (VIGRE). These grants were designed for institutions with PhD-granting departments in the mathematical sciences, for the purpose of developing high-quality education programs, at all levels, that are vertically integrated with the research activities of these departments. To date, more than 50 departments at 40 institutions have received VIGRE awards. As requested by NSF, the present volume reviews the goals of the VIGRE program and evaluates how well the program is designed to address those goals. The book considers past and current practices for assessing the VIGRE program; draws tentative conclusions about the program's achievements based on the data collected to date; and evaluates NSF's plans for future data-driven assessments. In addition, critical policy and programmatic changes for the program are identified, with recommendations for how to address these changes.

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Neal Glassman, Senior Program Officer
Beth Dolan, Financial Manager
Barbara W. Wright, Administrative Assistant
Katie Hines, Senior Program Assistant

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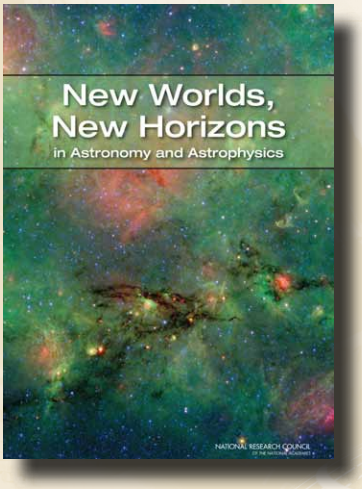
BOARD ON PHYSICS AND ASTRONOMY (BPA)

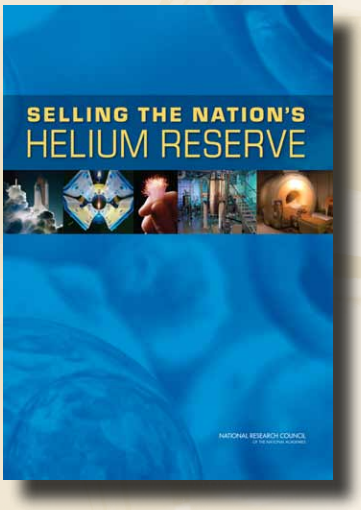
The BPA seeks to inform the government and the public regarding important scientific opportunities and issues as well as the changing nature of science. It builds bridges between the evolving sub-disciplines of physics and astronomy and with other areas of science. We are successful if we help both the science community and society understand what is needed to continue the advance of physics and astronomy, and why doing so is important.

Selected Recent Reports



New Worlds, New Horizons in Astronomy and Astrophysics (2010)

Driven by discoveries, and enabled by leaps in technology and imagination, our understanding of the universe has changed dramatically over the course of the last few decades. Based on a broad and comprehensive survey of scientific opportunities, infrastructure, and organization in a national and international context, *New Worlds, New Horizons in Astronomy and Astrophysics* outlines a plan for ground- and space-based astronomy and astrophysics for the decade of the 2010's. It recommends a balanced and executable program that will support research surrounding the most profound questions about the cosmos. The discoveries ahead will facilitate the search for habitable planets, shed light on dark energy and dark matter, and aid our understanding of the history of the universe and how the earliest stars and galaxies formed. The book is a useful resource for agencies supporting the field of astronomy and astrophysics, the Congressional committees with jurisdiction over those agencies, the scientific community, and the public.



Selling the Nation's Helium Reserve (2010)

Helium has long been the subject of public policy deliberation and management, largely because of its many strategic uses and its unusual source —it is a derived product of natural gas and its market has several anomalous characteristics. At the beginning of the last century, the U.S. government recognized helium's potential importance to the nation's interests and placed its production and availability under strict governmental control. Cold War-era policies resulted in the accumulation of a large reserve of helium owned by the federal government. The latest manifestation of public policy is expressed in the Helium Privatization Act of 1996 (1996 12 Act), which directs that substantially all of the government reserve be sold off by 2015 at prices sufficient to repay the federal government for its outlays associated with the helium program. *Selling the Nation's Helium Reserve* assesses whether the interests of the United States have been well served by the 1996 Act and, in particular, whether selling off the helium reserve has had any adverse effect on U.S. scientific, technical, biomedical, and national security users of helium.

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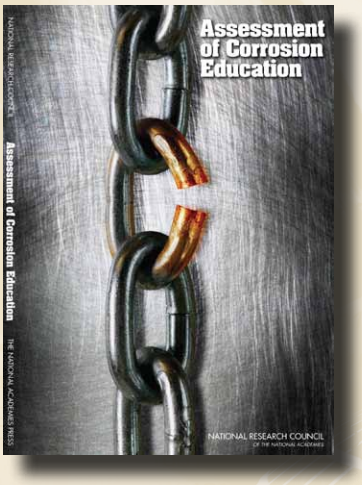
NATIONAL MATERIALS ADVISORY BOARD (NMAB)

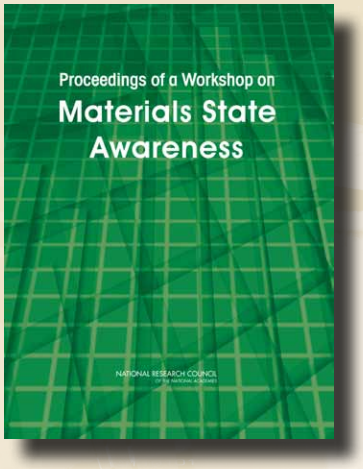
The NMAB provides a focus for understanding the value of materials for the Federal Government, economic and industrial development and the national well-being. The board seeks to inform government and the public about the needs and prospects for materials, within the various purposes that they serve. As such, the NMAB seeks to be the preeminent source of information and advice from which effective and valid materials based policy can be made.

Selected Recent Reports



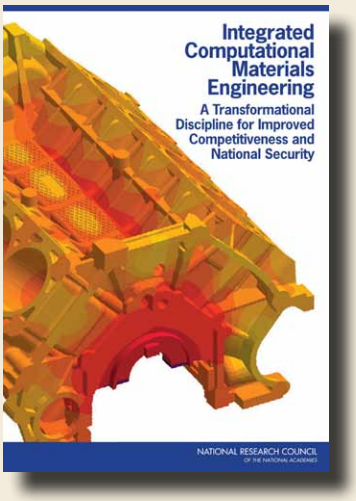
Assessment of Corrosion Education (2009)

The threat from the degradation of materials in the engineered products that drive our economy, keep our citizenry healthy, and keep us safe from terrorism and belligerent threats has been well documented over the years. Yet little effort appears to have been made to apply the nation's engineering community to developing a better understanding of corrosion and the mitigation of its effects. The engineering workforce must have a solid understanding of the physical and chemical bases of corrosion, as well as an understanding of the engineering issues surrounding corrosion and corrosion abatement. At this time, corrosion engineering is not a required course in many materials engineering curricula, and most bachelor-level graduates of materials- and design-related programs have an inadequate background in corrosion engineering principles and practices. To combat this problem, the book makes a number of short- and long-term recommendations to industry and government agencies, educational institutions, and communities to increase education and awareness, and ultimately give the incoming workforce the knowledge they need.



Proceedings of a Workshop on Materials State Awareness (2010)

The functionality and integrity of military equipment is critical to effective military operations and warfighter safety. For the past several years, the Nondestructive Evaluation Branch at the Air Force Research Laboratory (AFRL) has worked to develop embedded sensing technologies for the real-time monitoring of damage states in aircraft, turbine engines, and aerospace structures. These sensors must be able to operate in extreme environments, confronting researchers with the need to understand issues involving reliability, wireless telemetry, and signal processing methods. Additionally, there is a need to develop science and technology that will detect a material state at the microstructure level, precursor damage at the dislocation level, and fatigue-crack size population. To address these issues, the National Research Council convened a workshop at which speakers presented vareid perspectives on technological approaches to understanding materials state and described potential challenges and advances in technology. This book consists primarily of extended abstracts of the workshop presentations.



Integrated Computational Materials Engineering: A Transformational Discipline for Improved Competitiveness and National Security (2008)

Integrated computational materials engineering (ICME) is an emerging discipline that can accelerate materials development and unify design and manufacturing. Developing ICME is a grand challenge that could provide significant economic benefit. To help develop a strategy for development of this new technology area, DOE and DoD asked the NRC to explore its benefits and promises, including the benefits of a comprehensive ICME capability; to establish a strategy for development and maintenance of an ICME infrastructure, and to make recommendations about how best to meet these opportunities. This book provides a vision for ICME, a review of case studies and lessons learned, an analysis of technological barriers, and an evaluation of ways to overcome cultural and organizational challenges to develop the discipline.

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NMAB Staff Roster

Dennis Chamot, Interim Director
Heather Lozowski, Financial Associate
Erik Svedberg, Senior Program Officer
Ricky D. Washington, Administrative Coordinator
Laura Toth, Senior Program Assistant

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The National Research Council: http://sites.nationalacademies.org/NRC/

LABORATORY ASSESSMENTS BOARD (LAB)

The LAB oversees activities of the National Research Council (NRC) activities involving review and assessment of the technical quality of internal research conducted at laboratories. This includes those laboratories established by federal agencies at national laboratories and at government-owned, contractor-operated facilities, but may include others as well. Assessments are performed by NRC committees appointed under the auspices of the board and established separately for each institution or laboratory. The LAB also oversees the activities of the Army Research Laboratory Technical Assessment Board (ARLTAB) and the Committee on National Institute of Standards and Technology Technical Programs (CNISTTP).

Selected Recent Reports

Capabilities for the Future: An Assessment of NASA Laboratories for Basic Research (2010)

Over the past 5 years or more, there has been a steady and significant decrease in NASA's laboratory capabilities, including equipment, maintenance, and facility upgrades. This adversely affects the support of NASA's scientists, who rely on these capabilities, as well as NASA's ability to make the basic scientific and technical contributions that others depend on for programs of national importance. The fundamental research community at NASA has been severely impacted by the budget reductions that are responsible for this decrease in laboratory capabilities, and as a result NASA's ability to support even NASA's future goals is in serious jeopardy.

An Assessment of the National Institute of Standards and Technology, Fiscal Year 2010

The National Institute for Standards and Technology (NIST) promotes U.S. innovation and industrial competitiveness by promoting equitable standards across a spectrum of mediums used in a broad range of industries. Building on more than a half century of cooperation with the National Research Council (NRC), NIST requested that the NRC perform an overall assessment of five of its laboratories for the fiscal year 2010: building and fire research, materials science and engineering, manufacuring engineering, center for neutron research, and physics. Five specialized panels addressed the technical merit of each laboratory in comparison with the current state-of-the-art; the adequacy of budgets, facilities, equipment, and human resources; and the degree to which pertinent programs achieve their stated objectives and are able to have impact. The conclusions and recommendations of the assessment panels for each laboratory are available for download or purchase from the National Academies Press.

LAB Member Roster

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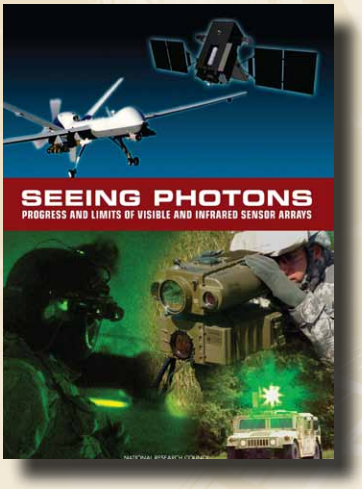
STANDING COMMITTEE FOR TECHNOLOGY INSIGHT-GAUGE, EVALUATE AND REVIEW (TIGER)

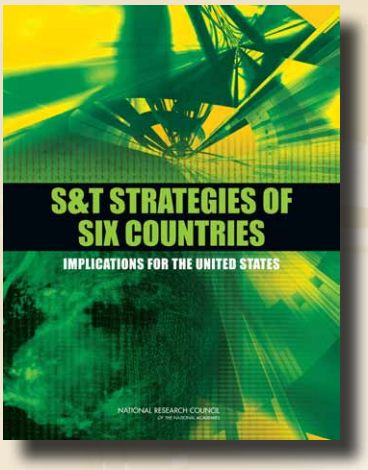
The TIGER standing committee was established in 2005 at the request of the Defense Intelligence Agency (DIA) to conduct discussions of trends in science and technology of interest to the DIA and the intelligence community in general, with an emphasis on technological breakthroughs that could affect U.S. warfighting capabilities. The committee convenes four times annually to identify new challenges in the field of science and technology forecasting, research, and development; develop pertinent investigation strategies; and formulate statements of task for prospective studies.

Selected Recent Reports



Seeing Photons: Progress and Limits of Visible and Infrared Sensor Arrays (2010)

The Department of Defense has recently highlighted intelligence, surveillance, and reconnaissance (ISR) capabilities as a top priority for U.S. warfighters. Contributions provided by ISR assets in the operational theaters in Iraq and Afghanistan have been widely documented in press reporting. While the United States continues to increase investments in ISR capabilities, other nations not friendly to the United States will continue to seek countermeasures to U.S. capabilities. This report discusses key visible and infrared detector technologies with potential military utility that are likely to be developed in the next 10-15 years. The report is intended to provide insight to policymakers on developments that may impact future U.S. warfighting capabilities.



S&T Strategies of Six Countries: Implications for the United States (2010)

An increase in global access to goods and knowledge is transforming world-class S&T by bringing it within the capability of an unprecedented number of global parties who must compete for resources, markets, and talent. In particular, globalization has facilitated the success of formal S&T plans in many developing countries. Centers for technological research and development are now globally dispersed, setting the stage for greater uncertainty in the political, economic, and security areas. These changes will have a potentially enormous impact for U.S. national security policy. The report compares and contrasts science and technology plans of Japan, Brazil, Russia, India, China, and Singapore (JBRICS), predicts their likelihood of achieving national S&T goals, identifies nation-specific cultural issues as significant to prediction of S&T achievements and evaluates implications for U.S. national security strategy.

Persistent Forecasting of Disruptive Technologies - Report 2 (2010)

The term "disruptive technology" describes a technology that results in a sudden change affecting already established technologies or markets. Disruptive technologies cause one or more discontinuities in the normal evolutionary life cycle of a technology, which may lead to opportunities for new competitors to displace incumbents. Frequently cited examples include digital photography and desktop publishing. This report is the second of a two-part series on disruptive technology forecasting. The first report discussed how technology forecasts were historically made, assessed various existing forecasting systems, and identified desirable attributes of a next-generation persistent forecasting system for disruptive technologies. This second book attempts to sketch out high-level forecasting system designs. In addition, it provides further evaluation of the system attributes defined in the first report, and evidence of the feasibility of creating a system with those attributes. Together, the reports are intended to help the Department of Defense and the intelligence community identify and develop a system that will assist in detecting and tracking global technology trends and characterizing their potential impact on future U.S. warfighting and homeland defense capabilities.

For more information, visit our websites:
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The Division on Engineering and Physical Sciences: http://sites.nationalacademies.org/DEPS/
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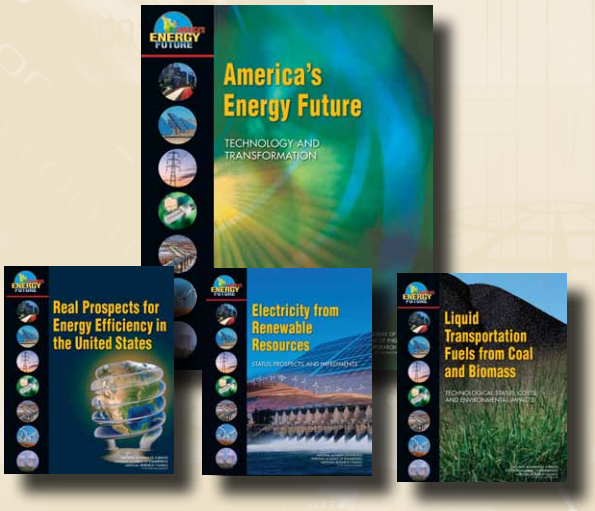
AMERICA'S ENERGY FUTURE

There is a growing sense of urgency about the role of energy in long-term U.S. economic vitality, national security, and climate change. Resources exist to solve energy-related problems; the dilemma is to identify which solutions will be right for the United States, and to face the massive technological and social challenges that lie ahead. This task is further complicated by the often contradictory results of studies on technological solutions to energy use problems, particularly in areas such as biomass, energy efficiency, renewable electric power, nuclear power, and advanced coal technologies.

Sensible decision-making requires a credible and widely accepted analysis of technology options and their costs and impacts. To fulfill this need, the National Academies launched the America's Energy Future study, a project that explores energy technologies, providing authoritative estimates and analysis of the current and future supply of and demand for energy; new and existing technologies to meet those demands; their associated impacts; and their projected costs.

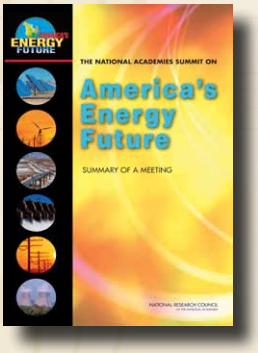


Informing the Public Debate

The project's keystone report, titled *Technology and Transformation,* provides a critical, balanced assessment of the impacts and costs of current and projected technologies for energy supply, storage, and end use. The findings of three specialized panels are also contained in supplementary reports: *Real Prospects for Energy Efficiency in the United States*, *Electricity form Renewable Resources*, and *Liquid Transportation Fuels from Coal and Biomass.* All can be downloaded or purchased from the National Academies Press (www.nap.edu).

The Summit on America's Energy Future

The two-day Summit on America's Energy Future brought together policymakers, technical experts, and members of the Americas Energy Future panels to begin the conversation on the future of energy technologies. This event provided a critical overview of recent influential energy studies and related initiatives, stimulating discussion among participants with diverse points of view on energy issues. A summary of the proceedings is available for purchase or download, and audio and video recordings of the summit can be accessed online at http://sites.nationalacademies.org/Energy/Energy_043332.

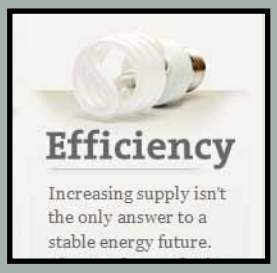


Strategies for the Future

Together, the America's Energy Future publications are a comprehensive guide to the latest research in energy technologies and their feasibility in the near- and mid-term. They provide a valuable foundation for further inquiry into the reduction of greenhouse gas emissions, transportation policy, the prospects for major increases in the use of biofuels and other alternative fuels in the U.S., energy research and development priorities, strategic energy technology development, policy analysis, and many other related subjects.

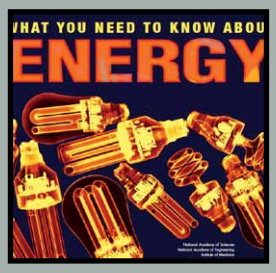
Additional Resources

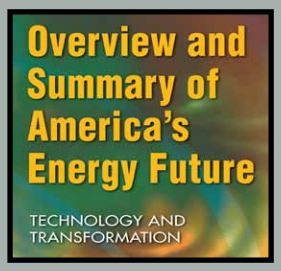
Learn more about America's Energy Future:
http://sites.nationalacademies.org/energy/
or visit our interactive website:
http://needtoknow.nas.edu/energy/



Free downloadable booklets at www.nap.edu:

What You Need to Know About Energy
Overview and Summary of America's Energy Future





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