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Good morning, Mr. Chairman and Members of the Committee, I am honored to appear before you today to discuss the U.S. Environmental Protection Agency's green chemistry and engineering research and development activities, the subject of the draft Green Chemistry Research and Development Act of 2004. The U.S. Environmental Protection Agency (EPA) welcomes the interest of the Committee on green chemistry and engineering. The subject of this bill represents a critical part of EPA's focus on environmental and human health protection. EPA historically has and continues to address the goals in the proposed legislation. I will highlight today some of our ongoing efforts in green chemistry and engineering.

Every day decisions are made at local, state, and regional levels that affect our quality of life. To the extent possible, each of these decisions, from new building construction, highway development or ecosystem management, should be based on the best available scientific information and scientific tools available. Industry leaders are also making decisions on chemical, product, and process design that will have significant environmental and economic impacts. Sustainability draws on sound science to support these decisions to protect our natural systems, to provide a higher quality of life for people, and to further a competitive economy.

By building on traditional "command-and-control" regulations, EPA has been refocusing its efforts by conducting and funding research in areas such as green chemistry and engineering, global change, economics and decisions sciences, watershed management, industrial ecology, environmental justice, ecological forecasting, and emerging technologies. In the future, EPA will continue to focus on rigorous science as a better way to advance EPA's mission of protecting human health and the environment.

INTRODUCTION

Administrator Leavitt has outlined EPA's strategy to achieve its mission quickly and efficiently based on four key components: science and technology innovation, market mechanisms, results, and collaborative networks. Science and technology innovation provides new, cost-effective alternatives that better protect human health and the environment. Results ensure that our programs and processes achieve environmental and human health results. Collaborative networks serve to solve problems through partnerships and open dialogues among private and public stakeholders.

EPA's next step in achieving its mission is to apply this framework to specific environmental and human health challenges. Traditionally, environmental protection programs have focused on a particular medium or problem through command-and-control regulations. These programs have been very effective at reducing point source pollution and improving environmental quality over the past three decades. However, the environmental challenges we face today involve several media types and diffuse sources that are less amenable to command-and-control programs. EPA is looking for solutions that seek to address the various causes of environmental problems and understand the interrelationships between human behavior and the environment in specific areas.

A place-based approach is one example that supplements and complements the traditional environmental protection approach by focusing on the health of an ecosystem and the behavior of the humans who live within the boundaries of the ecosystem, instead of concentrating on a specific medium or particular problem. This strategy, therefore, moves beyond media-based or issue-based strategies to a holistic perspective that will lead to comprehensive, long-term, sustainable solutions.

FOCUS ON SCIENCE AND TECHNOLOGY THROUGH GREEN CHEMISTRY AND ENGINEERING

EPA is focusing on science and technology programs that incorporate the principles of green chemistry and engineering. The concept of green chemistry and engineering is a very real and specific component of our science and technology. The goals of green chemistry and engineering move us towards innovation and collaboration for the mutual benefit of human health and the environment while furthering economic competitiveness. Green chemistry and engineering are unique in that they focus on inherently benign alternatives for chemical products and processes that can address many challenges in a broad, multi-media framework. The advances of green chemistry and engineering have demonstrated results that provide cost-effective environmental and human health improvements. For these reasons, green chemistry and engineering represent the kind of science on which EPA is focusing to move to the next level of environmental and human health protection.

Before I discuss EPA's specific programs in green chemistry and engineering, I want to describe the broader context of EPA's focus. Three approaches are underway that cut across Administrator Leavitt's framework of science and technology innovation, , results, and collaborative networks including: the "Collaborative Science and Technology Network for Sustainability," the Sustainability Portal, and the P3 Award: A National Student Design Competition for Sustainability.

Collaborative Science and Technology Network for Sustainability (CSTNS)

At the cornerstone of EPA's focus on sustainability is the "Collaborative Science and Technology Network for Sustainability" (CSTNS). Through CSTNS, EPA will be funding innovative, regional-scale projects that address the high-priority

challenges. These projects will be a testing ground for developing and applying tools while drawing on scientific understanding of the consequences of decisions and actions. CSTNS will provide an opportunity for communities, states, the private sector, EPA, and other government agencies to explore new approaches to environmental protection that are systems-oriented, forward-looking, and preventative.

EPA is developing a number of pilot projects that illustrate the potential for this approach. One pilot project that is under development in EPA's Region 3 (Pennsylvania, West Virginia, Virginia, Delaware, Maryland, and the District of Columbia) is sustainable watershed management in the Delaware River Basin. This project will develop and implement strategies for sustainable water resource management in a watershed threatened by high population growth. EPA will work in cooperation with the United States Geological Survey; Delaware River Basin Commission (DRBC); the Commonwealth of Pennsylvania; local municipalities; the Brodhead Watershed Association and other stakeholders to evaluate the effects of growth and land use on groundwater, stream flows, and ecology in Pocono Creek. Tools will be developed to determine the appropriate ground water withdrawal limits considering environmental, economic, and social concerns. Those limits will be implemented by Monroe County, Pennsylvania to maintain the high quality of life in the watershed as future growth occurs. Research findings and results will be transferred to other parts of the Delaware River Basin as well as to other regions of the country. As evidenced by this project, CSTNS will transcend traditional regulatory approaches for air, water and land and rely on a more place-based perspective that takes a long-term view while measuring short-term outcomes.

A second project, in collaboration with the Canaan Valley Institute; local communities; state and local governments of the Mid-Atlantic Highlands area (portions of Maryland, Pennsylvania, Virginia, and West Virginia); West Virginia University; and other stakeholders, will develop and evaluate sustainable restoration technologies. Methods for stream restoration, which address the problems of sedimentation, riparian habitat loss and biological degradation will be included. In addition to the environmental benefits, it is expected that there will be increased potential for job creation as a result of restoration activities. Research findings and results will be transferred throughout the Mid-Atlantic Highlands area as well as to other regions of the country.

We envision that these projects, as well as those funded under the upcoming competitive solicitation for the next phase of CSTNS projects, will serve to integrate the many existing EPA programs, identify gaps and demonstrate how such practices can be applied in the real world.

Sustainability Portal

EPA has dozens of programs and activities that support elements of science and technology for sustainability. To provide better access to these programs and work to

integrate them, EPA is developing a web portal (www.epa.gov/sustainability). This portal will provide easy access to EPA tools and programs that can help individuals, communities, and institutions achieve their sustainability goals. Links are provided to EPA programs and research for planning and practices, scientific and technical tools, measuring results and evaluating progress. The programs and research presented under "planning and practices" promote the integration of existing social, economic and environmental policies while anticipating new programs. Long-range, integrated planning and educating the next generation in sustainability practices are also included. The "scientific and technical tools" section highlights the development of underlying scientific and engineering knowledge needed to develop sustainability tools and techniques. "Measuring results and evaluating progress" focuses on providing a science-based foundation for monitoring and assessing trends in the environment and providing support for decision-making in businesses, communities, and across government. The website provides a "one-stop" portal to EPA's programs and research appropriate to advancing the goal of sustainability.

P3 Award: A National Student Design Competition for Sustainability

To encourage the integration of sustainability into higher education and training, EPA launched the P3 Award competition in November 2003. "P3" was chosen to highlight people, prosperity and the planet – the three pillars of sustainability. The P3 Award is a partnership between the public and private sectors to achieve the mutual goals of economic prosperity while protecting the natural systems of the planet and providing a higher quality of life for its people. The P3 Award program (www.epa.gov/P3) will provide up to 50 grants to interdisciplinary teams of college students to research, develop, and design sustainable solutions to environmental challenges in both the developed and the developing world. A panel convened by the National Academy of Engineering will select the P3 Award winners at an event on the National Mall. The winner(s) of the P3 Award will be eligible for additional funds from EPA to match contributions from the private sector for further development, implementation and placement in the marketplace. This will ensure that EPA is supporting the research and development of innovative, inherently benign, integrated scientific and technical solutions that will advance the goal of sustainability.

EPA'S ONGOING PROGRAMS SUPPORTING GREEN CHEMISTRY AND ENGINEERING

The framework for EPA's ongoing programs is also based on Administrator Leavitt's four components that the Agency is adopting to better and more quickly achieve its mission: science and technology innovation, market-based mechanisms, results, and collaborative networks. Focusing on research, development, and implementation in this Agency-wide framework is one mechanism that EPA will use to move to the next level of environmental and human health protection.

While the approaches previously discussed were developed to address all of the framework's components, current EPA activities can also be classified using this model. The following sections highlight EPA's activities in green chemistry and engineering, and more broadly, based on science and technology innovation, market mechanisms, results, and collaborative networks.

Science and Technology Innovation

Green chemistry and engineering are a critical part of EPA's current activities on science and technology. Research, development, and implementation of green chemistry and engineering are components of both the extramural Science to Achieve Results (STAR) grant program as well as intramural activities.

The Green Chemistry Research and Development Act of 2004 will build upon the active and successful research and development traditionally supported and conducted by the EPA. Since the mid-1990's EPA has partnered with the National Science Foundation on a grants program called Technology for a Sustainable Environment (TSE) that focuses on green chemistry and engineering. In addition, , EPA's intramural research program is centered on innovative scientific and technical advances in alternative energy sources, alternative reactor design, alternative solvent and catalyst strategies, and green metal finishing.

EPA has supported green chemistry and engineering research in both its intramural and extramural research programs. Including support for personnel, approximately $6.9 million is included in the FY 04 budget for green chemistry and engineering activities. Of this amount, research is about $5.1 million, including about $1.9 of personnel costs. About $2.4 million of the extramural funding is for competitive grants through the TSE program. (Approximately 70 percent of the research under TSE – which was $3 million in FY 04 – is focused on green chemistry and engineering.) Due to a redirection of funds within EPA, funding for EPA's portion of the TSE program was not provided in the President's FY05 budget request. However, grants funded with prior year resources will continue.

EPA's Small Business Innovation Research (SBIR) program is another funding mechanism for innovative science and technology with economic and environmental benefits. EPA has also concentrated on the potential for innovative technologies to move us to the next level of environmental protection. Efforts include third-party environmental technology verification (ETV), an environmental technologies opportunity web portal (ETOP), and the creation of the Environmental Technology Council (ETC). These programs focus on researching and developing a knowledge base to support the development sustainable alternatives, through green chemistry and engineering, to enhance or replace current designs that present environmental and human health challenges.

Except for the SBIR and ETV, program, EPA's research is pre-competitive. The research under TSE is relatively more fundamental and the in-house research is

somewhat more applied. However, in both cases, the priorities for the research are driven by EPA's goals and the research is in support of those goals.

Technology for a Sustainable Environment (TSE)

Since 1995, EPA and the National Science Foundation (NSF) have been partners in the Technology for a Sustainable Environment (TSE) program, a grants program designed to support research in pollution prevention. TSE (http://www.epa.gov/greenchemistry/tse.html) is an integral part of EPA's research program to support Agency program offices and regions and demonstrates leadership in addressing emerging environmental issues and advancing science and technology. TSE strongly encourages the collaboration of interdisciplinary academic researchers with industrial investigators who represent the eventual customers for the products of this research.

Together, EPA and NSF have funded over 200 TSE grants totaling approximately $56 million for applied and fundamental research in the physical sciences and engineering that will lead to the discovery, development, implementation and evaluation of innovative environmentally benign molecules, products and processes. Due to a redirection of funds within EPA, funding for EPA's portion of the TSE program was not provided in the President's FY05 budget request. However, grants funded with prior year resources will continue. TSE research focuses on ideas that advance the development and use of innovative science, technologies, and approaches directed at avoiding or minimizing the generation of pollutants at the source. As such, TSE focuses primarily on green chemistry and green engineering research.

Green Chemistry. The goal of the green chemistry research portion, similar to the Green Chemistry Research and Development Act of 2004, is to develop safer commercial substances and environmentally benign chemical syntheses to reduce risks posed by the manufacture, use and disposal of commercial chemicals. By preventing pollution at its source and designing inherently benign chemicals and processes, green chemistry has the potential to reduce environmental risks while providing more cost-effective products.

Green Engineering. The green engineering supported by TSE focuses on developing novel engineering approaches for preventing or reducing pollution from industrial manufacturing activities. The scope of green engineering includes equipment and technology modifications, reformulation or redesign of products, substitution of alternative materials, and in-process changes. Although these methods are often linked to the chemical, biochemical, and materials process industries, they can be utilized in many other industries, such as semiconductor manufacturing systems.

Quantifying Benefits. TSE also encourages research in physical sciences and engineering that will lead to the development of novel measurement and

assessment techniques for green chemistry and engineering, and pollution prevention. Activities in this area include life cycle analysis, computational simulations, and process design algorithms as well as the development of appropriate measurement methods to quantify outcomes in terms of direct benefits to human health and the environment

Environmental Benefits. To better demonstrate these benefits, research proposals for a grant under TSE must include a section entitled "potential impacts." While the research supported by this program may be related to an individual reaction, unit operation or unit process, the investigators must address the environmental benefits or impacts of the research in the broader context of the industrial system of which it is a part. In this regard, the proposal must contain a discussion of expected potential environmental benefits or impacts in the broadest systems sense, which could include considerations of the efficient use of natural resources and energy and materials flows in manufacturing, product use, recycling, recovery or ultimate disposal. In this section, it is strongly recommended that the investigator address issues such as: the pollutant or class of pollutants the research proposes to prevent or minimize; the seriousness and importance of the environmental problem; and how the proposed technology or method is more economical and more environmentally benign than current technologies or methods.

Results. The goal of the TSE program is the discovery of innovative chemical alternatives with economic and environmental benefits through the design of inherently benign chemicals, materials, and energy for reduced risks, liabilities, accidents, and vulnerabilities. The first 64 of the 211 research grants funded under the TSE program produced 347 peer-reviewed journal articles, 25 book chapters, and six patents. In addition, one of the investigators funded under TSE was awarded the 2001 Nobel Prize in Chemistry.

Examples of research conducted through TSE (Appendix 1) highlight the potential for green chemistry and engineering research supported by the federal government to move from the laboratory to the marketplace. This research demonstrates mutual benefits to the economy and the environment in a wide array of industrial processes from alternative solvents to renewable and biodegradable materials to benign alternatives for oxidation.

All the TSE products that moved to commercialization had an important feature in common. These scientific and technical advances met or exceeded current cost and performance criteria, were competitive in the marketplace, and benefited human health and the environment. While it is extraordinary that there are TSE examples (Appendix 1) that have moved from the bench to commercialization in such a short timeframe (less than ten years), it demonstrates the potential for scientific and technical innovation in green chemistry and engineering to mutually achieve environmental and economic goals in the long-term. These innovations provide a basis for science and technology for

sustainability by achieving the mutual goals of economic prosperity while protecting the natural systems of the planet and providing a higher quality of life for its people.

Green Chemistry Program

EPA's Green Chemistry Program (www.epa.gov/greenchemistry), in collaboration with EPA's Office of Pollution Prevention and Toxic Substances, is directed at preventing pollution by promoting the design of less toxic chemical substances and identifying alternative chemical pathways that involve less toxic reagents or solvents and generate fewer toxic products or co-products. As part of this program, EPA initiated the Green Chemistry Challenge that includes an award to recognize those in industry and academia that have met the objectives of Green Chemistry in an exemplary way. The Challenge also includes TSE as a research component to enhance support for innovative, inherently benign alternative chemical products and processes.

The Presidential Green Chemistry Challenge Awards Program (http://www.epa.gov/greenchemistry/presgcc.html) is an opportunity for individuals, groups, and organizations to compete for annual awards that recognize innovations in cleaner, cheaper, and smarter chemistry. The Awards Program provides national recognition of outstanding chemical technologies that incorporate the principles of green chemistry into chemical design, manufacture, and use, and that have been or can be utilized by industry in achieving their pollution prevention goals.

Award nominations are invited that describe the technical benefits of a green chemistry technology as well as its human health and environmental benefits. The Awards Program is open to all individuals, groups, and organizations, both nonprofit and for profit, including academia, government, and industry. The nominated green chemistry technology must have reached a significant milestone within the past five years in the United States; e.g., been researched, demonstrated, implemented, applied, patented, etc.

To date, the Award winning technologies alone are responsible for the following cumulative green chemistry benefits since 1996: eliminating 326,000,000 pounds of hazardous substances from commercial and industrial products and processes; saving 390,000,000 gallons of water; and preventing 120,000,000 pounds of carbon dioxide emissions.

EPA's Intramural Science and Technology for Sustainability Research

The mission of EPA's intramural sustainability research (http://www.epa.gov/ORD/NRMRL/std/index.html) is to advance the understanding, development, and application of technologies and methods of prevention, removal, and control of environmental risks to human health and

ecology. This research can be categorized by key areas including: alternative energy sources, alternative reactor design, alternative solvent and catalyst strategies, and green metal finishing. As a result of this research, several significant scientific and technical advances in green chemistry and engineering have been developed and implemented. In addition, the researchers have developed software tools to enable inherently benign design and measure environmental and human health benefits of scientific and technological advances (Appendix 2).

Alternative Energy Sources. This research involves the use of new energy sources, such as microwaves and ultrasonic waves, as a means to enhance reaction conditions. The primary benefits of this approach include the reduction of reaction times from hours to minutes, a significant reduction of by-product or undesirable product formation, an overall increase in conversion of feedstocks, and the elimination of harmful solvents.

Alternative Reactor Design. This research focuses on the use of new reactor designs to increase reaction efficiency and decrease energy consumption. These designs include a corona ozone generating reactor, a titanium dioxide (TiO_2) ultraviolet (UV) reactor, and a spinning tube-in-tube reactor. The first two designs are considered advanced oxidation technologies that are best suited for use in oxidation-type reactions. They provide benefits such as increased conversion to desired products and minimal solvent or catalyst usage. The third reactor design is used for process intensification, a step that minimizes the time required to complete a given reaction. This in turn significantly reduces or completely eliminates by-product formation and increases overall conversion of the feedstock.

Alternative Solvents and Catalysts. This research uses novel solvents and catalysts to increase reaction efficiency while minimizing the use of more traditional and harmful solvents. Strategies include using supercritical CO_2 as a reaction medium; using room-temperature ionic liquids as a reaction media; using benign hydrogen peroxide (H_2O_2) to replace traditional catalysts (oxidants) such as magnesium permanganate (KMnO4) and chromium trioxide/sulfuric acid (CrO3/H2SO4); and using nonvolatile, alternative, polyethylene glycol (PEG) to replace traditional solvents.

Green Metal Finishing. EPA is working cooperatively with industry leaders in the metal finishing sector to provide green solutions to their most critical issues. The program has investigated the use of less toxic process alternatives for various metal finishing systems that are both energy efficient and cost effective, and in the end, more sustainable. The program has identified greener chemical replacements to several metal finishing processes, including hexavalent chromium. Presently, the program is evaluating green chemistry alternatives to chlorinated solvents and alkaline cleaners for degreasing operations in the metal finishing industry.

Additional Research. Additional intramural research focuses on industrial multimedia and systems analysis. The industrial multimedia research includes mine waste technology, metal finishing pollution prevention, metal forming, fuel cell applications, lead paint abatement, and base catalyzed dechlorination for contaminated soil remediation. The objective of the sustainable environments research is to construct a strategy for sustainable environmental management using economics approaches, water resource and land use planning, physical and ecological theory, and technological methods and knowledge implemented through computer-based tools, field data, and human experience to reduce risks to human health and the ecology. The main research efforts under systems analysis focus on life cycle assessments, cost engineering and cost benefit, chemical simulation and measurement, and pollution prevention at federal facilities.

Small Business Innovation Research (SBIR)

The EPA is one of 11 federal agencies that participate in the SBIR Program established by the Small Business Innovation Development Act of 1982. The SBIR program (http://www.epa.gov/ncer/sbir) supports research in cutting-edge environmental technologies. EPA issues annual requests for applications for Phase I and Phase II research proposals from science- and technology-based firms. Through this phased approach to SBIR funding, EPA can determine whether the research idea – often on high-risk advanced concepts – is technically feasible, whether the firm can conduct high-quality research, and whether sufficient progress has been made to justify a larger Phase II effort.

Historically, EPA has solicited projects on pollution prevention through SBIR. In 2004, however, EPA is focusing a significant portion of the program on pollution prevention and hazardous waste minimization. Working across EPA program and regional offices, we are soliciting highly relevant proposals to address pressing environmental challenges. These solicitations specifically request green chemistry and engineering innovations for alternatives to high-priority chemicals and environmental challenges ranging from inherently benign flame-retardants to lead and mercury alternatives to green building design. These newly solicited projects will become part of a legacy of pollution prevention science and technology successful developed under SBIR (Appendix 3).

Environmental Technology Verification

In October 1995, EPA established the Environmental Technology Verification (ETV) Program (http://www.epa.gov/etv). The goal of ETV is to provide credible performance data for commercial-ready environmental technologies in order to speed their implementation for the benefit of vendors, purchasers, permitters, and the public. Because the level of potential environmental risk reduction for a technology is directly related to its level of performance and effectiveness, EPA verifies the performance of innovative,

private-sector environmental technologies. It is important to note that private-sector technology developers produce almost all of the new technologies purchased in the United States and around the world. ETV offers purchasers and permitters of environmental technology an independent, objective, and high-quality source of performance information for informed decision-making.

Processes. EPA's ETV Program develops testing protocols and verifies the performance of innovative technologies that have the potential to improve how we protect human health and the environment. The ETV Program operates as a public/private partnership through agreements between EPA and private testing and evaluation organizations. These ETV verification organizations work with EPA technology experts to create efficient and fully quality-assured testing procedures that verify the performance of innovative technologies in air, water, soil, ecosystems, pollution prevention, waste, and monitoring. All quality assurance plans and protocols are developed with participation of technical experts, stakeholders, and vendors and are available prior to testing, peer reviewed by other experts, and updated after testing, as appropriate.

Results. Since ETV's inception in 1995, more than 200 environmental technologies have been verified and more than 70 protocols for technology testing have been developed. A 2001 survey of participating vendors indicated that 73% of the vendors were using ETV information in product marketing and 92% of those surveyed responded that they would recommend ETV to other vendors. To date, more than 25 vendors have returned to ETV for additional product verification.

Environmental Technology Opportunities Portal (ETOP)

The Environmental Technology Opportunities Portal (ETOP) (www.epa.gov/etop) is a web network designed to promote programs that foster the development of new, cost-effective environmental technologies and relay existing EPA environmental technology information (such as best available technologies for air, water and waste treatment and control).

ETOP highlights funding opportunities, information, and links to EPA and other programs that assist in development and commercialization and others that foster the use and acceptance of innovative technologies through collaborative recognition and incentive, and advocacy and information programs. Links are also provided to other agencies and groups outside EPA that offer environmental technology information.

ETOP was established as a result of a Congressional mandate through the FY 2003 House Appropriations Conference Report 108-10, page 1438. Congress directed EPA to develop a “one-stop-shop” office to coordinate similar programs that foster private and public sector development of new, cost-effective, environmental technologies. As part of the requirement to establish the “one-

stop-shop" office, EPA established ETOP as an Internet portal page. ETOP was designed to clearly outline and highlight all of EPA programs as well as others that foster the development of environmental technologies, giving users direct access to funding and other incentive programs.

ETOP, while not specifically focused on science and technology for sustainability, provides a means to search on advances and opportunities at EPA in the areas of green chemistry and green engineering. ETOP provides a much-needed mechanism to raise awareness and increase communication between the public and private sectors in developing and commercializing new technologies that benefit human health and the environment.

Environmental Technology Council (ETC)

EPA is presently establishing the Environmental Technology Council with members from all Agency technology programs, offices and regions. The ETC will enhance the communication and coordination of all EPA technology activities, especially for priority environmental problems. This will improve results of core regulatory, enforcement, and voluntary programs and will facilitate innovative technology solutions to environmental challenges, particularly challenges with multi-media or place-based elements. The challenges addressed will be clearly related to the Agency's strategic plans, advance the Agency's mission of protecting human health and the environment, and contribute to moving the Agency to sustainability – the next level of environmental protection.

Results

A focus on science and technology for sustainability will enable EPA and the nation to more cost-effectively attain the ultimate environmental results of clean air, pure water, and protected land. Pollution prevention, achieved through the research, development, and market-adoption of green chemistry and engineering tools and technologies, is the foundation of such an approach. Green chemistry and engineering, along with environmentally benign manufacturing and industrial ecology, enable United States industries to design environmental benefits into their processes, products, and systems so that pollution and environmental hazards are avoided. These fields also enable United States industry to more effectively use benign materials and resources that are have the potential to benefit national security as well as the environment. Finally, these fields enable United States industry to remain economically competitive in the global marketplace by reducing risks, vulnerabilities, and the potential for accidents.

Future Plans. To better address outcomes and the recommendations of the Administration's Program Assessment Rating Tool (PART) analysis, EPA is making a strategic shift in its goals for Pollution Prevention and New Technologies (P2NT). The shift reflects the growing recognition that the goals of pollution prevention are the first steps in moving to the next level of environmental and human health

protection. EPA is now focused on improving practices and approaches through P2NT. We are also developing a new research program, Science and Technology for Pollution Prevention and Sustainability (STPPS) that will be both intramural and extramural.

Intramural Program. Three overarching issues have been established to guide the direction and measure the progress of the new intramural STPPS program: identifying and defining sustainable systems; identifying metrics to measure progress towards sustainability; and developing methods, technologies, and approaches that can contribute to sustainability-based policies. This represents a shift to place-based environmental challenges that can be diffuse and have multi-media elements.

EPA's green chemistry and engineering research is currently focused on pollution prevention activities. These scientific and technical advances will now be quantified in terms of sustainability metrics and focused on the highest priority environmental challenges for the Agency and industry. For example, research will be conducted on designing tradable credits programs for storm-water runoff control and developing sustainability criteria for critical ecosystem restoration. By refocusing the modeling and simulation strength of P2NT to a long-term goal of computational environmental protection, research outcomes will create simulated "ecological-economic-social" systems. Environmental decision-support tools and methods will deliver results on applying, calibrating, and validating current life-cycle models and applying them to sustainable technologies, policies, products and processes. This will lead to an intramural research program that is not only working toward EPA's mission and sustainability, but to one that can be quantified in terms of clear benefits to economic, environmental, and social systems.

Extramural Research. EPA's extramural research program is also refocusing its efforts towards sustainability with quantifiable results in terms of the Agency's mission. Primary research will support research to use materials and energy more effectively while shifting to more inherently benign materials and energy sources. The most significant way to move to inherently benign material and energy flows is to advance green chemistry and engineering and to demonstrate these advancements in terms of economic and environmental improvements. It is important to recognize multiple benefits of an extramural STPPS research program. Such a program develops underlying scientific and engineering expertise; stimulates broader adoption of principles and practices in an academic community such as in chemical sciences and engineering; and helps to educate the next generation of scientists and engineers.

EPA recognizes the importance of demonstrating quantifiable, meaningful outcomes from our intramural and extramural research programs. The work to date has resulted in significant benefits to human health and the environment and future directions will build upon this legacy. By integrating these results into new research activities, EPA will be in a position to establish that economic and environmental goals can be achieved simultaneously and sustainably.

Collaborative Networks

EPA consistently uses collaborative networks to advance its mission of protecting human health and the environment. EPA's focus on science and technology sustainability also depends on working within EPA, across the government, and throughout the private sector to bring the most relevant science to all stakeholders to improve the economy and the environment for social benefit. These networks include EPA's program offices and regions, working through the National Science and Technology Council's Committee on Environment and Natural Resources (CENR), and collaborating with other Agencies including the Department of Energy (DOE), National Science Foundation (NSF), and the National Institute of Standards and Technology (NIST). EPA also reaches out to state, local, and tribal governments as well as the private sector and non-governmental organizations (NGOs) on issues of sustainability.

EPA's Program Offices and Regions

EPA's research and development activities are intimately related to activities in the program offices and regions. While these relationships exist throughout the Agency and across the Agency's mission, the following examples will focus on collaborations of EPA's Office of Research and Development with the EPA's Office of Solid Waste and Emergency Response and Office of Water as well as the regional offices that are advancing science and technology for sustainability.

Resource Conservation Challenge, Office of Solid Waste. The Resource Conservation Challenge (RCC) (www.epa.gov/rcc) is a major national effort to find flexible, yet more protective ways, to conserve our valuable resources through waste reduction and energy recovery activities. The RCC extends across EPA programs and media to include waste, water, air, toxics, pollution prevention, pesticides, and compliance, as well as activities in the regions, states, and tribes. The RCC identifies areas of program focus, or "challenges" that are ready for voluntary partnerships. Each of these challenges works to resolve national environmental problems by finding environmentally acceptable solutions that are long-term, preventative, comprehensive, and sustainable. One of the key areas of the RCC is "targeted chemicals." EPA has targeted 30 chemicals that are potential environmental hazards and challenged American industries to cutback on the use of these agents. As part of the RCC, EPA has pledged to support projects that help eliminate chemicals from the waste stream. The Agency's primary focus will be to secure commitments from the highest volume generators, sectors, and their related industry associations to reduce these chemicals in products, emissions, and waste. Clearly, green chemistry and engineering represents a vital area of research in meeting the RCC's targeted chemical challenge in a long-term, sustainable manner.

Smart Growth, Office of Water; Office of Policy, Economics, and Innovation; and Regional Offices. Smart growth (http://www.epa.gov/livability/) is development that serves the economy, the community, and the environment. It changes the terms of the development debate from the traditional growth/no growth question to "how and where should new development be accommodated." Smart growth answers these questions by simultaneously achieving healthy communities that provide families with a clean environment, balancing development and environmental protection, encouraging economic development and jobs, and promoting strong neighborhoods and transportation choices. Much research has been conducted to determine if a more balanced pattern of growth could benefit the environment. Preliminary results from these studies indicate that smart growth developments can minimize air and water pollution, facilitate brownfields cleanup and reuse, and preserve open space. Research must also be conducted to address how development patterns are influenced by market forces and by local, state, and federal policies and initiatives. Smart growth aims to minimize development's impact on the environment through sound site decisions and finding a sustainable balance of economic, social and environmental systems.

Interagency Collaboration

Critical to EPA advancing its mission and the goal of sustainability is close coordination and interaction with other government agencies. While EPA has many bilateral agreements with other agencies, such as the partnership with NSF for the TSE program and the Department of Energy through a formal Memorandum of Understanding, EPA also coordinates with other agencies through the Committee on Environment and Natural Resources (CENR) under the National Science and Technology Council. The CENR addresses science policy matters and research efforts that cut across agency boundaries and provide a formal mechanism for interagency coordination relevant to domestic and international environmental and natural resources issues. The CENR recently discussed the addition of an Interagency Working Group on sustainability, clearly a crosscutting issue that EPA welcomes. The CENR has been an effective mechanism for working with other agencies and will serve as an excellent model for the new Interagency Working Group on Green Chemistry established under this bill. The CENR has played a role in significantly advancing collaboration with other agencies, specifically on issues related to sustainability, including advancing the mutual goals of economic growth and environmental protection.

State and Local Governments

Strong partnerships between EPA and the states achieve better environmental results. EPA has always worked with states to plan, set priorities, and encourage innovation to solve environmental problems. Most recently, EPA has begun to work with states to determine the most effective and appropriate ways for EPA to bring sound science to state-level decision-makers for environmental protection. At the same time, EPA is working with the

Environmental Council of States (ECOS) to assess the sustainable development programs underway in the states and determine how states address their scientific needs in the context of meeting environmental goals. This project entails compiling a compendium of state sustainability activities, research needs, and existing means by which states access sound science. The compendium will include information about flagship sustainability projects in the states as well as an inventory of legislative, regulatory, and non-regulatory programs and tools. This represents one way in which EPA is working with states for improved environmental and human health protection as well as advancing the goal of sustainability.

Tribes

The American Indian Environmental Office (AIEO) coordinates the Agency-wide effort to strengthen public health and environmental protection in Indian Country, with a special emphasis on building tribal capacity to administer their own environmental programs. AIEO oversees development and implementation of the Agency's Indian Policy and strives to ensure that all EPA headquarters and regional offices implement their parts of the Agency's Indian Program in a manner consistent with Administration policy. One aspect of this relationship is the National EPA-Tribal Science Council, commonly referred to as the Tribal Science Council (TSC). The TSC was created in partnership with tribal representatives to help integrate Agency and tribal interests, specifically with respect to environmental science issues. The TSC provides a forum for tribes and EPA to identify priority environmental science issues and collaboratively design effective solutions to environmental concerns. Through this partnership, EPA and Indian Country are moving towards improved sustainable, comprehensive, long-term approaches to environmental and human health protection.

Beyond Government

EPA has extensive collaborations and partnerships beyond the government with non-governmental organizations (NGOs) and industry. Because these activities are so numerous, they cannot be included here. While many of the EPA's programs focused on sustainability -- including the Collaborative Network for Sustainability and the P3 Award -- encourage partnerships across a range of stakeholders, there are several existing examples that demonstrate collaborations specific to advancing science and technology for sustainability. The examples shown in Appendix 4 represent current ongoing activities in terms of green chemistry, green engineering, pollution prevention and sustainability with the American Chemical Society and other activities with the private sector through the National Environmental Performance Track.

CONCLUSION

By conducting research, developing green alternatives, implementing solutions, and measuring results, EPA will achieve its mission more quickly and more cost-effectively. Green chemistry and engineering are at the core of science and technology, and represent a critical component for EPA's move to the next level of environmental protection. Through science and technology innovations, demonstrated results, and collaborative networks, EPA continues to bring strong science to federal, state, local, and tribal governments as well as the private sector for catalyzing action in protecting human health and safeguarding the environment. While we look forward to working with the Committee to meet the goals of this legislation, the Administration believes that it is unnecessary to enact this legislation at this time.