Science, Technology, and Innovation Policy Initiatives during the Second Obama Administration

A Report to NEDO

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EXECUTIVE SUMMARY

Introduction

This report examines important science, technology, and innovation (STI) policy initiatives in the United States, particularly in manufacturing, climate and energy, and brain science. In 2013, most initiatives in these areas come from President Obama and his administration. Few are coming from members of Congress, in part because of budget limitations and in part because of political deadlock. A few important initiatives come from U.S. state governments, particularly in the climate and energy fields.

All of the initiatives face a harsh political environment. While President Obama won decisively in 2012 and Democrats kept their majority in the U.S. Senate, Republicans continue to control the U.S. House of Representatives. The United States continues to have a "divided government."

A very important development occurred earlier this year, when Congress – both Democrats and Republicans – accepted the "sequester" and its deep automatic cuts to all programs. The automatic cuts reduce defense and non-defense spending in FY 2013 to a level $80.1 billion below FY 2012 levels. For defense, this is about a 7 percent annual cut, and a little over 4 percent for non-defense programs. The impacts on R&D will be significant. NSF, for example, plans to cut nearly 1,000 research grants and cut $35 million in contracts for research facilities that already are under construction.

Manufacturing

Manufacturing is one of President Obama's top priorities, part of his overall effort to maintain and expand the number of good jobs for middle-class Americans.

The President's manufacturing strategy has several key elements: (1) it focuses on "advanced manufacturing;" (2) it mainly uses existing agency funds and existing agency legal authority to create new programs and centers; and (3) beyond general support for advanced manufacturing, it also helps specific industrial sectors that have broad political appeal, including nanotechnology, "clean" manufacturing, and assistance to small manufacturing firms.

The Administration has not tried to promote major changes in the financial environment for manufacturing via the tax code or investment incentives, and it has not generally employed trade policy to create advantages for U.S. manufacturers.

The Administration's flagship manufacturing initiative is the National Network for Manufacturing Innovation (NNMI). This program creates a series of R&D institutes to develop advanced manufacturing technologies for American industry. The first center, the National Additive Manufacturing Innovation Institute, was established in 2012 in Youngstown, Ohio, using money that federal agencies already had received from Congress. Recently, the White House announced a competition for three more manufacturing institutes, also using money already appropriated by Congress.

The President's budget for fiscal year 2014 – the budget year that begins on October 1, 2013 – requests an appropriation of one billion dollars to the Department of Commerce in "mandatory funding" (a type of funding that is separate from regular annual Congressional appropriations) to provide the federal support for up to fifteen new NNMI's. These funds would be spent over a period of nine years, beginning with outlays of $38 million in the first year and $112 million in the second. This program will require new legislative authority to be put in place.

The President's budget also requests funds for two other programs. The first is a new Advanced Manufacturing Technology Consortia Program to help industrial consortia to develop "road-maps" (R&D strategy documents) as well as to fund facilities, equipment and research at universities and government laboratories to meet these needs. The second is the Materials Genome Project, a proposed multi-agency effort to improve advanced materials. The budget also asks for funding to continue several existing programs that help specific industrial sectors, such as the National Nanotechnology Initiative, various "clean" energy R&D programs, and the Hollings Manufacturing Extension Partnership (MEP).

Overall, the new advanced manufacturing initiatives are small and modest programs – with the exception of the request for $1 billion for additional NNMI institutes.

The Administration's manufacturing initiatives are also confusing. The White House has announced several programs with overlapping responsibilities and similar names, and also has announced these programs before asking Congress to approve and fund them. As a result, it is difficult (1) to distinguish

among the various programs and (2) to decide which ones represent real programs with real resources, which only provide advice or government-industry consultation but are not funding real activities, and which are based on good intentions but are not yet functioning.

In the current budget and political environment, it is unlikely that the President's initiatives will receive much new funding, although existing programs are likely to continue. However, if the new Congress that takes office after the 2014 elections is more supportive of the President's initiatives than the current Congress, then today's modest manufacturing proposals could be the beginning of a larger and more ambitious program.

Climate and Energy

President Obama, in his Second Inaugural Address, gave more prominence to climate change and sustainable energy than any other issue, vowing that it would be a centerpiece of his new Administration's agenda. Nevertheless, as recently as May 11, Vice President Biden admitted that progress in crafting laws to prevent and cope with climate change has been frustratingly slow.

The Obama Administration has a three-part science and technology strategy regarding climate and energy: (1) it is asking for funds to continue existing scientific research on climate change and to provide technical information; (2) it has requested funding for existing and new R&D on energy efficiency and renewable energy; and (3) it has issued new regulations to improve U.S. energy efficiency and reduce greenhouse gas emissions. Some members of Congress and some U.S. state governments also trying to expand regulation in order to reduce emissions.

Climate research. The Administration supports scientific research and technical assistance at the Environmental Protection Agency (EPA) and through the multi-agency U.S. Global Change Research Program (USGCRP).

Energy R&D. President Obama's fiscal year 2014 budget request seeks funds for several existing and new energy R&D programs. The budget asks for $2.8 billion for the Energy Efficiency and Renewable Energy (EERE) programs at the Department of Energy (DOE). Included in this request are funds for the existing Better Buildings Initiative as well as existing and new initiatives for electric vehicles, clean manufacturing, solar panels, grid integration, and power-conversion semiconductor chips. The largest and most controversial request asks

for $2 billion in one-time money for a new Energy Security Trust that would fund research on new transportation technologies.

Obama Administration regulations. President Obama has two major regulatory initiatives. First, his Administration has issued new regulations to improve energy efficiency for motor vehicles. In July 2011 President Obama announced an agreement with large automakers, environmentalists, and California regulators to increase average fuel economy to 54.5 miles per gallon (23.2 kilometers per liter) by 2025, and his Administration officially issued the regulations in August 2012.

Second, under legal authority contained in the U.S. Clean Air Act, the Environmental Protection Agency is moving to reduce GHG emissions. In 2008, as a presidential candidate, Mr. Obama supported the idea of enacting a cap and trade law to regulate greenhouse gases – which Congress ultimately did not do.. As a result, the Obama Administration's main policy tool is to regulate under the existing Clean Air Act.

Important legal decisions clarified EPA's regulatory stance. Following a major U.S. Supreme Court decision that directed EPA to consider whether greenhouse gases endanger human health and welfare, the agency "found" (in the sense of making a formal legal finding) that carbon dioxide and five other greenhouse gases do indeed endanger humans. Following this, EPA issued regulations to limit GHG from new sources of pollution, including vehicles, oil refineries, and electric power plants, including power plants that use coal. Whether similar regulations will be applied to existing plants is still undetermined.

Congressional initiatives. Some members of Congress would still prefer to enact a new law regulating greenhouse gas emissions rather than relying on EPA to write regulations. Today the legislative possibilities for a cap and trade system seem quite dim. Nevertheless, a diverse coalition of forces is beginning to support another idea, a carbon tax. One of the most interesting initiatives has support from Congressman Bob Inglis, a Republican from South Carolina. Mr. Inglis also has helped launch an "Energy and Enterprise Initiative" at George Mason University. A more typical legislative approach is contained in the "Boxer-Sanders bill." This bill, introduced in February 2013, would establish a carbon tax at the rate of $20 per ton of CO_2, with rates increasing by 5.6 percent each year until the 12th year.

State and local initiatives. In the U.S., states and local governments often function as public policy innovators, from which the Federal government later

takes its cue. Conversely, the states and localities also offer a counter-weight to the Federal government, where progress can still be made to attack a problem when the Federal government refuses to act.

While it is not feasible to survey today's state and local initiatives, three new developments stand out: the Regional Greenhouse Gas Initiative (RGGI), a cooperative effort among nine states in the U.S. northeast and mid-Atlantic regions; actions in New York City; and California's new cap-and-trade system.

International regulation. The second Obama Administration may become more active in international climate negotiations. For example, EPA now is considering a petition to enlarge the scope of its rulemaking to take the international context explicitly into account when setting future standards on GHG emissions, which is a novel and important legal concept.

The international climate change treaty apparatus continues to present more opportunities for heightened U.S. involvement. The next (19th) meeting of the Conference of the Parties to the UN Convention on Climate Change (COP) will take place in Poland in November, 2013. The U.S. also may engage more with non-UN multilateral organizations, such as the Major Economies Forum on Energy and Climate.

Secretary of State Kerry has been consistent in his commitment to both U.S. international engagement and to environmentalism. On Earth Day 2013, he gave a speech signaling his intention to position the U.S. much more forcibly in the international community devoted to climate change issues. Thus, U.S. policy in this regard may be poised to take a new turn.

The BRAIN Initiative

On April 2, 2013, President Obama announced his BRAIN Initiative – the "Brain Research through Advancing Innovative Neurotechnologies" Initiative. The initiative includes existing and proposed new research at three federal agencies and four private-sector research organizations, and the primary focus of the initiative will be an effort to develop new tools for understanding the brain.

For fiscal year 2014 the President is requesting $110 million for this initiative: $40 million at the National Institutes of Health (NIH), $50 million at the Defense Advanced Research Projects Agency (DARPA), and $20 million at the National Science Foundation (NSF). The four private-sector partners are the Allen Institute for Brain Science, the Howard Hughes Medical Institute, the Kavli Foundation, and the Salk Institute for Biological Sciences.

NIH has appointed a "working group" of senior scientists to analyze which types of new imaging technologies and other technologies will be most useful in studying the brain. For NIH, the BRAIN Initiative is still a "work in progress" that needs further study and planning. If the working group and NIH's leaders can create an exciting plan, it is possible that in the future Congress will provide more money for the initiative. But in the 2013 budget environment, with the sequester and continued deadlock between the President and Congressional Republicans, finding new money for this and other research initiatives will be difficult.

Other New U.S. Science and Technology Policy Initiatives

Several other new S&T policy initiatives are important. Most, but not all, come from the Obama Administration.

Big Data. On March 29, 2012, the White House announced a multi-agency initiative to fund research on the analysis of very large databases. So far, agencies have used money already appropriated by Congress to fund this work. The Big Data initiative is part of the larger and older multi-agency Networking and Information Technology Research and Development Initiative. The NITRD office has not yet released details about its proposed FY 2014 budget, so we do not yet know what portion of the President's NITRD budget request is for R&D on big data.

Cybersecurity. The Obama Administration does not have a public cybersecurity R&D plan or proposal. However, the President's National Security Council has issued an overall cybersecurity policy document, which it calls "The Comprehensive National Cybersecurity Initiative." Along with steps to protect federal computer networks, improve counter-intelligence and deterrence, and work with critical private-sector computer infrastructure, the document also discusses R&D and advanced technology. However, the White House has provided only a few details on budgets for these programs. It is likely that much of the work in this area is conducted in secret programs whose budgets are not public.

A possible NASA asteroid mission. NASA's FY 2014 budget request "includes a plan to robotically capture a small near-Earth asteroid and redirect it safely to a stable orbit in the Earth-Moon system where astronauts can visit and explore it."

This proposed program is NASA's most recent attempt to find an affordable and politically acceptable "next step" for its human spaceflight program. NASA, members of Congress with NASA centers in their states, and aerospace contractors all want to continue the human spaceflight program. However, the Bush and Obama Administrations ended the Space Shuttle program, and President Obama rejected President Bush's very expensive – and unfunded – proposal to return to the Moon and then go to Mars. The Obama Administration's new proposal is to send a space capsule with humans to a point near the Moon, robotically tow a small asteroid to that capsule, and then let astronauts explore the capsule and gain skills they could use on a possible future mission to Mars.

Republican proposals to change policies at NSF. Most of this year's STI policy proposals come from President Obama and his administration. However, Republican members of the U.S. House of Representatives have made two policy proposals concerning the National Science Foundation. The first initiative places restrictions on NSF's support of research in political science; it has already become law. The second, proposed by the Republican chairman of the House Science, Space, and Technology Committee, would replace traditional peer review at NSF with a set of funding criteria chosen by Congress. Both initiatives are controversial, particularly with scientists who believe that these steps will lead to political interference in research agencies.

Conclusion

President Obama sees science, technology, and innovation initiatives as important investments in the nation's future – investments that he believes will improve public health, help create new industries, and provide good middle-class jobs for Americans.

However, the President faces very difficult budget constraints and a Republican opposition that appears to want to stop almost every one of his proposals. And in the case of manufacturing, he may have hurt his own position by having many, and sometimes confusing, proposals.

In this political environment, the President will have a very hard time securing "new" money for his projects. He may be able to use some money in existing budgets to provide modest funding for a few manufacturing institutes and some additional research in brain science and "big data."

Even if President Obama's main STI initiatives do not receive full funding, they still are politically important. They make the argument that investments in

new areas of science and technology can help the country, and they help define the public debate about what U.S. science and technology policy should do. Even if there is not money now for all of these proposals, the fact that the President has made them lays the foundation for possible funding in the future.

TABLE OF CONTENTS

PREFACE

The study underlying this report was commissioned by the Washington, D.C., office of Japan's New Energy and Industrial Technology Development Organization (NEDO.

The report's authors, working together as the firm of Technology Policy International (TPI), have undertaken the study as independent consultants, although it should be noted that each has other professional affiliations and activities (see "About the Authors"). The opinions expressed in this report do not necessarily reflect the views of NEDO or the institutions with which the authors are affiliated.

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1. INTRODUCTION

1.1 U.S. STI Initiatives in 2013

This paper examines several important science, technology, and innovation (STI) policy initiatives in the United States. In 2013, most of these proposed programs come from President Obama and his administration. Few are coming this year from members of Congress, in part because of budget limitations and in part because of political deadlock. A few important initiatives come from U.S. state governments, particularly in the climate and energy fields.

This paper focuses on President Obama's initiatives in three areas: manufacturing, climate and energy, and brain science. The paper examines the origins of these initiatives, their details, and whether they are likely to receive funding. This report also briefly discusses several other Presidential initiatives – including those in the fields of "big data," cybersecurity, and space exploration – and two initiatives from Congressional Republicans to change the peer review process at the National Science Foundation.

U.S. presidents often propose dramatic STI initiatives, believing that they show leadership and enhance their popularity. President Kennedy proposed a manned mission to the Moon. President Nixon launched a "war on cancer." President Carter offered several major energy technology initiatives. President Reagan was very fond of STI projects; he supported the space station, the superconducting super-collider particle accelerator (later cancelled), and the Strategic Defense Initiative, popularly known as his "star wars" program. The first President Bush created a major multi-agency initiative to study climate

change, a program that continues to this day. Also continuing today is President Clinton's National Nanotechnology Initiative.

Because presidents are often interested in offering STI proposals, "policy entrepreneurs" both in and outside the government offer ideas that they hope presidents and Congress will endorse. Therefore, one major theme in this paper is the idea that new initiatives result from a combination of policy entrepreneurs who lobby for new or expanded programs and presidents and other leaders who are looking for initiatives and sometimes these proposals.

Congress decides whether to provide money for new presidential STI initiatives that require R&D funds. Congress also examines new agency regulations, and those regulations are another method that presidents use to influence which technologies are developed and deployed. In past years, some presidential proposals enjoyed strong bipartisan support in Congress – particularly basic research programs such as the "war on cancer" or nanotechnology. Other initiatives proved more controversial, such as President Reagan's Strategic Defense Initiative, but even they received substantial funding. Today, however, President Obama faces a particularly difficult budget and political situation.

1.2 Key Factors Shaping the 2013 U.S. Political Environment

1.2.1 Divided Government and Major Disagreements about the Federal Budget

President Obama decisively won the 2012 presidential election, and in his Second Inaugural Address and 2013 State of the Union speech he outlined an active agenda intended to create middle-class jobs and opportunity. Investing in STI programs is a key part of that agenda, on the theory that STI investments will

help create new innovation-based industries and jobs. He also continues to support alternative energy and other steps to reduce global warming.

However, while the President won decisively and Democrats kept their majority in the U.S. Senate, Republicans continue to control the U.S. House of Representatives. And, the Democratic majority in the Senate is not large enough to prevent the Republicans from using the filibuster to stop Democratic initiatives there. Thus, the United States continues to have a "divided government" – that is, power is divided between Democrats and Republicans. Moreover, the two parties have deep ideological and political differences.

In particular, most House Republicans continue to push for large reductions in government spending. A very important development occurred earlier this year, when House Republicans accepted the "sequester" and its deep cuts in defense spending, an area of the budget that they have long supported.

In the U.S. budget process, a sequester is a type of budget cut. If Congress and the President cannot agree, in annual spending laws, to reduce spending to an overall level specified in a sequester law, then that sequester law requires that automatic budget cuts take effect.

In 2011, President Obama and Congressional Republicans enacted the Budget Control Act, which said that if they could not agree on other ways to reduce budget deficits in the future then automatic cuts would take place during fiscal year 2013 (October 2, 2012, to September 30, 2013). (Pensions, some medical care, military salaries, and a few other federal programs were exempt from the cuts; the Medicare program for older Americans receives a 2 percent reduction.) Further automatic cuts would occur in later fiscal years if Congress and the

President could not agree on reduced federal spending. The goal of the Budget Control Act is to reduce federal spending by $1.2 trillion over 10 years.

The 2011 law said that cuts would apply to both defense and non-defense programs, and President Obama and other Democrats assumed that Republicans would agree to a new, second deficit-reduction law on terms favorable to the President because Republicans would not want major cuts in defense spending. While some Republicans, particularly in the U.S. Senate, did seek a new agreement to prevent large defense cuts, House Republicans did not. Congress and the President did not agree on a second budget law, and the sequester for fiscal year 2013 took effect on March 1, 2013.

The automatic cuts reduce defense and non-defense spending in FY 2013 to a level $80.1 billion below FY 2012 levels. Because the sequester cuts took place in the middle of FY 2013, the cuts must be made in the last six months of the year. For defense, this is about a 7 percent annual cut, and a little over 4 percent for non-defense programs. The impacts on R&D will be significant. NSF, for example, plans to cut nearly 1,000 research grants and cut $35 million in contracts for research facilities that already are under construction.[1]

If Congress and the President do not agree on a new, second overall budget law this year, then the 2011 law requires that FY 2014 spending be $117 billion below the already-reduced FY 2013 level. The law requires further cuts in future years.

The political situation facing the President is very difficult not only because of the "anti-spending" attitude among Republicans but also because of two other major political factors. One is that many Republicans seem determined

[1] "How is the sequester affecting federal agencies?" *The Washington Post,* May 8, 2013, http://www.washingtonpost.com/wp-srv/special/politics/sequestration-federal-agency-impact/.

to prevent the President from achieving any major successes. The other is a subtle point related to both the anti-spending and anti-Obama attitudes. In past decades, presidents often had great influence over Congress because members of Congress wanted help from those presidents. They wanted presidential support for their legislative priorities; or they wanted support for individual projects in their states or Congressional districts; or they wanted other favors, such as a presidential visit to their home states or appointment to a special commission. Under these circumstances, a considerable part of the power of the President was derived from his ability to deny such favors or support to Members of Congress. But the newly conservative Republicans do not want to appear to be seeking favor from President Obama, whom many of their constituents feel very negatively about. Furthermore, they do not want favors or projects for their districts or states from the federal government in general. As a result many of the traditional powers of the President over Congress are not available to President Obama so that he has less influence with individual Members of Congress and less leverage in negotiating agreements with Congressional leaders than other Presidents have had.

1.2.2 Erosion of Public and Congressional Support for Investments in Science, Technology, and Innovation

How much does this overall Republican opposition to government spending affect their attitudes towards R&D spending?

Historically, Congressional Republicans generally have supported most basic research programs, such as those at the National Institutes of Health and the National Science Foundation. They may criticize some research findings,

such as those from climate studies.[2] But usually they have supported funding for basic research, including climate work. They also have strongly supported R&D programs at the Department of Defense, including basic research, applied research, and technology development activities. They have supported some civilian applied research and technology development programs (such as nuclear power R&D) while opposing other civilian programs (such as renewable energy investments or public-private technology partnerships to help general U.S. industry).

In the past year, though, we have seen some erosion in Republican support for R&D programs. First, of course, R&D has been cut through the sequester. So far, we have seen no new Republican effort to cut overall federal R&D spending explicitly, but at the same time there has been no Republican effort to prevent the sequester from cutting every department and agency's R&D budget indirectly.

Second, we now also see efforts by some Senate and House Republicans to further cut specific types of research and to limit the independence of science agencies and researchers. In particular, Congressional Republicans have placed new restrictions on political science research projects funded by the National Science Foundation (NSF), and now the new Republican chairman of the House Committee on Science, Space, and Technology has proposed further restrictions on NSF. Section 3.5 of this paper provides details on these Republican initiatives.

[2] See, for example, Chris Mooney, *The Republican War on Science,* New York: Basic Books, 2005.

1.3 Implications for STI Programs and Initiatives

This harsh political and budget situation has three implications for President Obama's STI initiatives.

First, the President will have difficulty getting additional money ("new money") for R&D programs. The President's fiscal year 2014 budget request asks for an overall R&D amount slightly larger than FY 2012 ($142.8 billion, as opposed to FY 2012's $140.9 billion). But of course the FY 2013 figure will be lower than FY 2012 because of the sequester,[3] and many Republicans will want an even lower R&D total in FY 2014.

Not surprisingly, President Obama's new STI initiatives are, in most cases, less expensive that initiatives offered by past presidents. The main exceptions are a one-time request for $1 billion for manufacturing institutes and a $2 billion request for an Energy Security Trust, but, as discussed later in this report, it is unlikely that Congress will provide these monies.

Second, and related, many of the President's initiatives rely on using "existing" money (money already in agency budgets). Either the President proposes to take money from other existing programs to pay for the new projects, or he has said that existing programs are now part of his new initiatives. In this environment, any proposal to cut existing R&D to pay for new initiatives may run into opposition from interest groups and from members of Congress who want to protect those existing programs. Already, for example, some

[3] The President's Office of Management and Budget (OMB) has not yet released information on FY 2013 R&D spending after the sequester. But the reduction will be around $7 billion. And, again, the existing sequester law will cut the FY 2014 R&D total even more.

biomedical scientists worry that the new brain science initiative will take money away from funds intended for making grants from existing NIH programs.

Finally, the initiatives that are most likely to receive money are those that at least some Republicans support, usually because they will provide money to their states. For example, important Republicans as well as Democrats support NASA spending because it supports jobs in their states. Initiatives that do not provide specific benefits to Republican states are likely to have much less political support.

While we cannot predict exactly what will happen in the future, these three factors suggest that the President will have a difficult time persuading Congress to fund his new science and technology related initiatives during this year and next.

2. THREE MAJOR ADMINISTRATION INITIATIVES: MANUFACTURING, CLIMATE AND ENERGY, AND BRAIN SCIENCE

2.1 Chapter Introduction

This chapter examines three sets of initiatives proposed this year by President Obama. All of them build on existing programs but also contain new proposals.

- Manufacturing initiatives, including a proposal to fund a National Network for Manufacturing Innovation (NNMI).
- Climate and energy initiatives, including initiatives for climate science, energy technology, and the regulation of energy efficiency and greenhouse gas emissions. This set of initiatives includes a proposed new Energy Security Trust to fund additional R&D.
- The Brain Research through Advancing Innovative Neurotechnologies (BRAIN) Initiative. This initiative would combine existing and new projects to develop improved technologies to image the brain and treat brain injuries and disease.

2.2 Manufacturing

2.2.1 Presidential Focus on Manufacturing

In a report to NEDO in 2012, TPI pointed out the critical importance of manufacturing to President Obama's 2012 re-election campaign.[4] We noted that the President needed to win the electoral votes of a number of "swing states," and we further noted that manufacturing employment is unusually high in several of them. As we anticipated, the President devoted considerable campaign resources and time to campaigning in the swing states, and he called

[4] George R. Heaton, Jr., Christopher T. Hill and Patrick Windham, "Manufacturing Issues in the 2012 United States Presidential Campaign," A report to NEDO by Technology Policy International, June 30, 2012, 19 pages.

attention to the need to improve manufacturing performance by holding high-profile campaign events in a number of manufacturing facilities.

The President went on to win *all* of the swing states in the election in November 2012, including those with both high and low levels of manufacturing employment. As a result of his campaign focus on manufacturing, President Obama entered his second term with a clear commitment to take action to help strengthen U.S. manufacturing.

As we also noted in our report to NEDO on manufacturing, the array of policies that are potentially relevant to manufacturing is quite broad, including R&D, innovation, human resource development, tax and regulatory policy, government procurement, standards setting, trade policy and many others. However, owing to the general gridlock affecting national politics and policy making in the United States today, it has not been feasible for policymakers to address many of these topics in any depth.

In response to the need to stimulate manufacturing growth and jobs combined with the great difficulty in making progress in any complex arena of public policy, the Obama Administration has adopted what can be seen as a three-pronged approach to manufacturing policy.

First, the Administration has chosen to focus on "advanced manufacturing." While the definition of "advanced manufacturing" is elusive, it generally suggests a focus on those aspects of manufacturing that involve applications of new and highly-sophisticated technologies in manufacturing, such as new high-performance materials; digital control, data management and simulation; and machine intelligence, including robotics. Advanced manufacturing typically suggests that the technologies to be used are close to the

R&D stage, where it is relatively straightforward to establish a rationale for government engagement.

Second, the Administration has chosen to address advanced manufacturing largely through modest re-purposing of existing federal programs, in such agencies as the Department of Energy (DOE), NASA, the Department of Defense (DOD), the Commerce Department's National Institute of Standards and Technology (NIST), and the National Science Foundation (NSF). As discussed below, both individually and collectively, these agencies have been assigned responsibilities for aspects of advanced manufacturing.

Third, the Administration has promoted sector-specific programs in certain manufacturing sectors that have political appeal, such as nanotechnology, "clean" manufacturing, and assistance to small manufacturing businesses.

What the Administration has not tried to do is to promote major changes in the financial environment for manufacturing via the tax code or investment incentives, and it has not generally employed trade policy to create advantages for U.S. manufacturers.[5]

2.2.2 Promoting Advanced Manufacturing

The Administration's flagship manufacturing initiative, the National Network for Manufacturing Innovation (NNMI), is described in detail in a report issued in January 2013.[6] Here is the summary statement about the NNMI from that report:

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[5] The President's budget proposals for Fiscal Year 2014, set to begin on October 1, 2013, do include proposed actions on taxes and trade policies favorable to manufacturing. At this juncture, they seem unlikely to be embraced by the current Congress. See: "Making America a Magnet for Manufacturing Jobs," U.S. Office of Management and Budget, undated. On the Web at: http://www.whitehouse.gov/omb/budget/factsheet/making-america-a-magnet-for-manufacturing-jobs

[6] Executive Office of the President, National Science and Technology Council, Advanced Manufacturing National Program Office, "National Network for Manufacturing Innovation: A Preliminary Design," January 2013, 44 pages. http://manufacturing.gov/docs/NNMI_prelim_design.pdf

> The Federal investment in the National Network for Manufacturing Innovation (NNMI) serves to create an effective manufacturing research infrastructure for U.S. industry and academia to solve industry-relevant problems. The NNMI will consist of linked Institutes for Manufacturing Innovation (IMIs) with common goals, but unique concentrations. In an IMI, industry, academia, and government partners leverage existing resources, collaborate, and co-invest to nurture manufacturing innovation and accelerate commercialization.
>
> As sustainable manufacturing innovation hubs, IMIs will create, showcase, and deploy new capabilities, new products, and new processes that can impact commercial production. They will build workforce skills at all levels and enhance manufacturing capabilities in companies large and small. Institutes will draw together the best talents and capabilities from all the partners to build the proving grounds where innovations flourish and to help advance American domestic manufacturing.

The first NNMI, the National Additive Manufacturing Innovation Institute, was established in 2012 in Youngstown, Ohio. It is a pilot project but also is a full-fledged manufacturing institute, although at a somewhat smaller scale as compared with the contemplated future NNMI's.[7]

The President's FY 2014 budget requests an appropriation of one billion dollars to the Department of Commerce in "mandatory funding" to provide the federal portion of funding for up to fifteen new NNMI's.[8] These funds would be spent over a period of nine years, beginning with outlays of $38 million in the first year and $112 million in the second. This program will require new

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[7] "Additive manufacturing" is a somewhat more general name for a family of production technologies often referred to more popularly by the name of one of its manifestations as "3D Printing."

[8] The President's FY2014 budget proposal refers to this one billion dollar request as "mandatory funding." See: http://www.whitehouse.gov/sites/default/files/omb/budget/fy2014/assets/commerce.pdf. Apparently, what is intended is that funding levels for the first ten years of this program would be set in the proposed law that would authorize the program. This would provide funding for it independent of annual appropriations. This approach is rarely used in federal program funding except to create entitlement programs. In the details of the budget on page 226, NNMI funding is shown at a level of $38 million for FY 2014 See: http://www.whitehouse.gov/sites/default/files/omb/budget/fy2014/assets/appendix.pdf. In Table S-9 of the budget appendix, funding levels are shown for a nine-year period beginning in FY 2014 that total to one billion dollars over the nine years. See: http://www.whitehouse.gov/sites/default/files/omb/budget/fy2014/assets/budget.pdf p.203.

legislative authority to be put in place; that is, in addition to the requested appropriation, Congress would have to agree to pass a new law authorizing creation of the program with its unusual approach to funding.[9]

On May 9, 2013, the White House announced that the Department of Defense and the Department of Energy are launching competitions for three new Manufacturing Innovation Institutes, with NSF, NASA, and the Department of Commerce also contributing money.[10] A total of $200 million will be committed to the three new institutes. Despite the similarity in name and purpose to the proposed NNMI in the Department of Commerce, these three new institutes will be funded outside the proposed NNMI framework and will not have to wait for Congressional approval of the NNMI initiative.

The President's budget also calls for a new Advanced Manufacturing Technology Consortia Program, to be funded at a level of $21 million in FY 2014. This program would provide grants to industry consortia to develop "road-maps" (strategy documents) of critical long-term industrial research needs as well as to fund facilities, equipment, and research at universities and government laboratories to meet these needs.

Another manufacturing-related initiative is the Materials Genome Project, a multi-agency effort to improve tools for simulating the performance of new advanced materials, new experimental methods for testing and deploying new materials, a comprehensive data base of materials properties, and educational programs in materials. The overriding concept of the Materials Genome Project is that advances in materials science and engineering have made it possible to design and engineer specialized materials with highly-tailored properties to meet

[9] http://www.whitehouse.gov/sites/default/files/omb/budget/fy2014/assets/appendix.pdf, p.226.
[10] http://www.whitehouse.gov/the-press-office/2013/05/09/obama-administration-launches-competition-three-new-manufacturing-innova

advanced applications needs. The Initiative is supported by several federal agencies as well as industry and academia.[11]

To support longer-term research related to manufacturing, the Administration has requested $160 million for the National Science Foundation to support fundamental research on new manufacturing technologies, largely in universities. This includes some $42 million to help support the Materials Genome Initiative discussed above as well as $32 million for a National Robotics Initiative.[12]

The various manufacturing initiatives discussed above, and others, are being coordinated by a new Advanced Manufacturing National Program Office located in the National Institute of Standards and Technology (NIST).[13] Policy development and oversight for manufacturing has been assigned to the Advanced Manufacturing Partnership, a private sector-led group with federal participation intended to help chart a course for development of future manufacturing technology in America.[14]

2.2.3 Support for Specific Sectors of Manufacturing

In addition to the broad programmatic support of advanced manufacturing, especially manufacturing technology development, described above, the Obama Administration is also committed to supporting manufacturing through a variety of sector-focused activities.

For example, the Administration continues to support the Hollings Manufacturing Extension Partnership Program (MEP) operated by NIST. This

[11] Executive Office of the President, "Fact Sheet: Progress on Materials Genome Initiative," May 14, 2012. See: http://www.whitehouse.gov/sites/default/files/microsites/ostp/mgi_fact_sheet_05_14_2012_final.pdf
[12] http://www.nsf.gov/funding/pgm_summ.jsp?pims_id=503641&org=CISE
[13] http://manufacturing.gov/amnpo.html
[14] http://manufacturing.gov/amp.html

program, which was set up in the late 1980s, supports some 60 centers that are organized as Federal-State-industry partnerships to help small U.S. manufacturers get access to technology, resources, and manufacturing expertise. Small business is generally a favorite in Congress, and the Hollings Program enjoys substantial congressional support. The Administration has requested $153 million to support the MEP in FY 2014.

The Department of Energy supports research in advanced energy-efficient technologies to strengthen domestic manufacturing. The President has asked Congress for $365 million for FY 2014 to expand efforts on innovative manufacturing processes and advanced industrial materials. In addition, the Administration continues to support research, development, and production related to advanced vehicle development, batteries and lower cost production methods for electric vehicles.[15] The DOE also operates the Clean Energy Manufacturing Initiative.[16] These activities are carried out through DOE's Advanced Manufacturing Office.[17] Their ties to clean energy and climate change give these programs an extra appeal in Congress.

2.2.4 Observations on Obama Administration Manufacturing Initiatives

Manufacturing assumed increasing importance to the Obama Administration during the President's first term (2009-2013), to the point that restoring manufacturing jobs became a central theme in his re-election campaign in 2012. As he has moved toward and into his second term, he has put forth a variety of initiatives in support of manufacturing. Most of them are focused on advanced manufacturing technologies (generously defined) and most are organized as relatively modest programs conducted by re-designating existing

[15] FY2014 Federal Budget, page 87-88.
[16] http://www1.eere.energy.gov/energymanufacturing/
[17] http://www.eere.energy.gov/topics/manufacturing.html

funds in single agencies or in multi-agency coordinated programs. New or renamed organizational units in departments and agencies have been tasked with operating and/or coordinating manufacturing programs. Collaboration with the private sector is a common feature of many of the initiatives, and states, universities, and non-profits are frequently partners in them.

Because of their overlapping responsibilities, similarities in program names, and the tendency of the Administration to announce new initiatives well in advance of asking Congress to authorize and/or appropriate funds for them, it is increasingly difficult to (1) distinguish among the various programs and (2) decide which ones represent real programs with real resources that are operating now, which are sources of consultation and advice to industry rather than actual R&D programs, and which are based on good intentions but are not yet functioning.

To some extent, the President's array of relatively modest manufacturing initiatives can be seen as laying the groundwork for a more ambitious program of action in support of manufacturing should the 2014 congressional mid-term elections result in a Congress that is more favorable to the President's programs than is the current Congress.

The partisan divisions in Congress and between strong factions in Congress and the President have acted so far to stymie any very large scale approach to enhancing manufacturing, even in national defense, space, and energy, where manufacturing programs have usually been deemed acceptable by most political leaders. Actions such as reform of the corporate tax code or of basic corporate governance are simply off the table for political reasons. The result has been the continuing definition and pursuit of the kinds of smaller manufacturing initiatives discussed here.

2.3 Climate and Energy: Research and Development

2.3.1 Introduction

Over the last decade or so, the perception of global climate change among the American public has moved from skepticism to a now-widespread recognition of the critical nature of the problem. Surveys of public opinion show almost universal awareness, and indicate that a solid majority – a figure higher than ever before – accepts the reality of anthropogenic causality. [18] President Obama, in his Second Inaugural Address, surely reflected this public mood, as he gave more prominence to climate change and sustainable energy than any other issue, vowing that it would be a centerpiece of his new Administration's agenda[19]. Nevertheless, as recently as May 11, Vice President Biden admitted that progress has been frustratingly slow in crafting policy measures consistent with the need to prevent, abate or cope with climate change. [20]

The political situation remains difficult, as many Congressional Republicans continue to oppose new legislation to deal with greenhouse gas emissions. So the Obama Administration has adjusted its strategy. It is now pursuing a three-part science, technology, and innovation policy for dealing with climate change:

- Continued scientific research on climate change and related technical assistance to states and companies.

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[18] Americans' Global Warming Beliefs and Attitudes in September 2012, Yale Project on Climate Change Communication, School of Forestry and Environmental Affairs, September 2012.

[19] This conclusion, advanced by *The New York Times*, is based on an analysis of the number of words devoted to different topics in the Inaugural Address. "Climate Change Given Prominence," *The New York Times,* Jan 21, 2013.

[20] "Joe Biden Talks Climate Change in Rolling Stone Interview," http://www.huffingtonpost.com/2013/05/11/joe-biden-climate-change-rolling-stone_n_3251827.html?view=print&comm_ref=false,The Huffington Post, Nick Visser, May 11, 2013.

- Expanded support for R&D on energy efficiency and on new, less polluting forms for energy. This year the President's budget request asks not only for funding to continue existing energy R&D programs but also proposes new initiatives, particularly a new "Energy Security Trust" – a special funding mechanism to support the development of new transportation technologies.

- Expanded use of environmental regulations, under the existing laws, to require improved energy efficiency and reductions in greenhouse gas emissions – measures that require industry to adopt new technologies.

This section of this report focuses on Obama Administration initiatives in the research and energy technology areas. The next section examines regulatory initiatives, especially from the Obama Administration but also proposals from some members of the U.S. Congress, several U.S. states, and others.

2.3.2 Climate Science and Technical Assistance

The Obama Administration is pursuing several initiatives in climate science and technical assistance. Administration officials are using programs already exist, both in the U.S. Environmental Protection Agency (EPA) and in the multi-agency U.S. Global Change Research Program (USGCRP).

In June of 2012, EPA submitted a report to Congress on its overall activities to "reduce carbon pollution." That report, updated to April 2013, addresses the following topics:[21]

- Collecting Emissions Data
  - The Inventory of U.S. Greenhouse Gas Emissions and Sinks,
  - Greenhouse Gas Reporting Program
- Getting Reductions
- Evaluating Policy Options, Costs and Benefits
- Advancing the Science

[21] See, for full text and links to all programs, "What the EPA is Doing About Climate Change," http://www.epa.gov/climatechange/EPAactivities.html

- Partnering Internationally
- Partnering With States, Localities, and Tribes

The U.S. Global Change Research Program (USGCRP) was created by an act of Congress in 1990. It supports comprehensive scientific monitoring and the analysis of many aspects of global environmental change, even beyond those that are climate-based. Thirteen agencies of the government are now participants, with a yearly budget of $4.6 billion. While this figure might seem large, it is important to realize that it represents, in large part, funds for many purposes that are "self-identified" by the agencies as part of the program, rather than funding that is specific to it.[22]

One of the Congressionally-mandated aspects of the USGRCP is a ten-year strategic plan. This has just been released. [23] The major agencies participating in the plan – in budgetary terms – are NASA, the Department of Commerce (primarily DOC's National Oceanic and Atmospheric Administration), and NSF. The Obama Administration has made the USGRCP a priority, and its budget for fiscal year 2012 was about 6 percent over the FY 2011 figure. How the USGCRP will fare in the current budget climate remains to be seen, but it has been an important continuing element of the informational infrastructure for climate change policy to date.

2.3.3 Energy Technology

President Obama's fiscal year 2014 budget request for the Department of Energy (DOE) proposes $2.8 billion for the Office of Energy Efficiency and Renewable Energy (EERE); $379 million for the Advanced Research Projects

[22] See programmatic and budgetary information at the program's web site: http://www.globalchange.gov/
[23] National Global Change Research Plan 2012-2021: A Strategic Plan for the U. S. Global Change Research Program.

Agency-Energy (ARPA-E); $735 million for the Office of Nuclear Energy (NE); and $638 million for the Office of Fossil Energy (FE). Each of these supports R&D and technology development related to clean energy.

The President has requested funding for several existing and proposed EERE initiatives. One is an older DOE program, the Better Buildings Initiative, funded by the 2009 economic stimulus law, the American Recovery and Reinvestment Act. The President requests $365.5 million in FY 2014 for this program.[24] In addition, DOE is emphasizing several other energy technology initiatives. Box 1 on the next page quotes DOE's summary of its budget request for five EERE "cross-cutting initiatives" – that is, for initiatives that involve more than one EERE office.

[24] http://energy.gov/better-buildings.

Box 1. "Cross-Cutting Initiatives" in DOE's Fiscal Year 2014 Budget Request for the Office of Energy Efficiency and Renewable Energy

In addition to supporting aggressive RDD&D in each of EERE's technology-specific offices, the FY 2014 Budget Request reflects increased focus on high-impact, new cross-cutting efforts that are breaking down the silos between EERE's technology-specific offices. These cross-cutting initiatives include:

• **EV Everywhere Grand Challenge —** a DOE-wide, cross-cutting initiative focused on breakthroughs in plug-in electric vehicle technology to achieve the goal of making the U.S. the first country in the world to invent and produce plug-in electric vehicles that are as affordable and convenient as gasoline-powered vehicles by 2022.

• **Clean Energy Manufacturing Initiative** – a new cross-cutting EERE initiative focused on dramatically improving U.S. competitiveness in the manufacturing of clean energy products (like solar modules, LED's, batteries, and wind blades) and strengthening U.S. competitiveness across multiple manufacturing industries through increased energy productivity.

• **SunShot Grand Challenge** – a DOE-wide initiative focused on achieving directly cost-competitive solar power by 2020.

• **EERE Grid Integration Initiative —** a cross-cutting and integrated initiative in which EERE's vehicles, solar, and buildings programs, working in coordination with DOE's Grid Tech Team, to address grid integration barriers and opportunities associated with variable, distributed renewable energy generators, electric vehicle charging, and building efficiency and controls. These activities seek to develop and validate technologies, tools, and approaches that overcome grid integration barriers associated with EERE technologies, so that key stakeholders achieve the confidence within their risk tolerance necessary to install high penetration of clean energy technologies while maintaining grid reliability.

• **Wide Bandgap Semiconductors for Clean Energy Initiative —** Wide bandgap semiconductor technology, which was initially developed for military and solid-state lighting uses, is a key next-generation platform for semiconductor devices that offers the potential for high-power-conversion electronics that are much

more compact and efficient and can operate at much higher temperatures and voltages. This revolutionary technology has the potential to be a platform for the next generation of electric drivetrains, solar inverters, high-efficiency motors, solid-state transformers for the grid, and many other critical, clean energy applications.

Source: Quoted from Department of Energy, *FY 2014 Congressional Budget Request: Budget Highlights,* pages 29-30. Available through: http://energy.gov/cfo/downloads/fy-2014-budget-justification

In addition to these EERE initiatives, the President has proposed two other new programs.

The first is an initiative called the "Race to the Top for Energy Efficiency and Grid Modernization." The President is requesting $200 million in FY 2014 for this new program. It would provide competitively-awarded grants to states to improve energy efficiency and is similar in design to an earlier Obama Administration program that gave education money to states. DOE has provided this description of its initiative, saying that it does the following things:

> Challenges States to Cut Energy Waste, Support Energy Efficiency, and Modernize the Grid: the FY 2014 Budget Request includes one-time funding for a new Race to the Top that challenges States, tribes, local governments with public power authorities, and co-operatives to implement effective policies to cut energy waste and modernize the grid.
>
> Key opportunities for states and other eligible applicants include: modernizing utility regulations and adopting policies to encourage cost-effective investments in efficiency, including combined heat and power and demand response resources; clean distributed generation; enhancing customer access to data; investments that improve the reliability, security and resilience of the grid; and enhancing the sharing of information regarding grid conditions.

This initiative supports the President's goal of doubling energy productivity above 2010 levels by 2030.[25]

Second, President Obama also is requesting $2 billion to establish an "Energy Security Trust." In the U.S. Government, a trust fund is a special "bank account" that is separate from regular annual Congressional appropriations. The President proposes to fund this new program with revenues that oil companies pay the government when they pump oil from federally-owned lands. The trust fund would support research on electric and biofuel vehicles.[26]

Will Congress endorse these various energy initiatives? The President wants to restore funding for most energy R&D programs to the amounts they were before the sequester, and, as we have discussed, he also wants funds for several new initiatives. Given that many Congressional Republicans want deeper cuts in federal spending and object to most new programs, getting funds above the FY 2013 post-sequester level will be difficult. In addition, his proposal to fund the Energy Security Trust from oil revenues is controversial and may not succeed.[27]

2.4 Energy and Climate: Regulatory Initiatives

2.4.1 Obama Administration Regulatory Initiatives

On taking office in 2009, President Obama inherited a mix of environmental laws, court decisions, and policy actions regarding energy and climate that had come from Congress, the Supreme Court, and the Bush Administration. As a candidate in 2008, he argued that existing policies were not

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[25] Department of Energy, *FY 2014 Congressional Budget Request: Budget Highlights,* page 38. Available through: http://energy.gov/cfo/downloads/fy-2014-budget-justification

[26] Colleen Curtis, "What You Need to Know About the Energy Security Trust," The White House, March 15, 2013, http://www.whitehouse.gov/blog/2013/03/15/what-you-need-know-about-energy-security-trust.

[27] For a discussion of the politics surrounding the proposed Energy Security Trust, see Andrew Restuccia, "Energy Security Trust faces big sticking point," *Politico,* March 20, 2013, http://www.politico.com/story/2013/03/offshore-drilling-energy-plan-faces-roadblock-89098.html.

enough and endorsed the idea of a new law to create a "cap and trade" system to limit greenhouse gas emissions, but by 2010, the White House had backed away from this position.[28] The reasons include Senate opposition to cap-and-trade legislation, a preoccupation with the nation's economic problems, and possibly even some disenchantment with the idea of a cap-and-trade system.

Once he could not get a new law, the President and his Administration had to work within the confines of the existing mix of older laws, court decisions, and Bush Administration actions. This situation both constrained the President and offered him some opportunities.

The major constraint – and also a potential opportunity – stemmed from an important U.S. Supreme Court ruling in 2007, in the case of *Massachusetts v. EPA*.[29] Massachusetts and other states had sued EPA during the Administration of President George W. Bush, arguing that the existing federal Clean Air Act required EPA to consider whether greenhouse gases (GHGs) should be regulated. The Bush Administration argued that the law did not require it to consider regulating these gases. The Supreme Court agreed with Massachusetts. Although the Bush Administration did undertake some action to comply with this directive, it seems fair to say that they had neither the time nor the enthusiasm to do much.

A second issue also confronted the Obama Administration during its early days: motor vehicle fuel efficiency. Since 1975, U.S. law has required the government to issue regulations concerning Corporate Average Fuel Economy (CAFE) – regulations to improve the average fuel economy of car and light trucks sold in the U.S. Congress amended the law in 2007, but federal agencies must determine the precise regulatory standards. In 2009, the new

[28] "White House: "Cap and Trade" is Out ," Stephanie Condon, CBS News/ March 31, 2010.
[29] *Massachusetts v. Environmental Protection Agency*, 549 U.S. 497 (2007).

Administration had to decide whether to issue strict regulations that would require significant improvements to fuel efficiency, a move that would please environmentalists, or write less strict rules, which would make compliance easier for a U.S. auto industry that faced a deep recessions and possibly bankruptcies.

The Obama Administration took the Clean Air Act and fuel efficiency issues seriously and began issuing major regulations in both areas.

In the case of greenhouse gases and the Clean Air Act, the Obama EPA has made some major decisions. First, it complied with the 2007 Supreme Court ruling and issued a major "finding" – that is, a formal legal determination of fact – that greenhouse gases are indeed pollutants that "endanger" public health under the Clean Air Act. This finding was made in late 2009, and upheld by the courts in mid-2012.[30]

Next, the EPA under President Obama moved to regulate GHG emissions from all new sources of air pollution (i.e., newly constructed or significantly modified plants), including oil refineries and electric power stations. The purpose of these "new source performance standards" (NSPS's) is to achieve as much emissions reduction as possible from new plants and equipment, whose technology makes them better able to make the reductions than old plants. In addition, EPA may force new plants to "prevent significant deterioration" in areas where air quality is high. EPA has great discretion in determining which kinds of emissions in which industries should be limited, where, and to what extent.

The several pivotal decisions taken by the Obama Administration on **N**SPS and "significant deterioration" pertaining to the electric power industry

[30] *Coalition for Responsible Regulation v. EPA,* United States Court of Appeals for the District of Columbia Circuit, June 26, 2012.

occurred in 2010 and 2011.[31] What they do, in combination, is to establish a new regime of GHG monitoring and emissions control for electric power plants and other energy facilities. They have been extremely controversial, due both to their overall cost and to their presumed competitive impact on new coal-fired plants (or other "dirtier" fuels), in comparison to natural-gas fired facilities. (The extent of the controversy may be indicated by EPA's tally that there have been two million comments submitted to it on the rule.) Indeed, some opponents – even Senate Democrats – have asserted that the combination of EPA rules represents "an effective ban" of new coal-based plants.[32]

Various industry groups immediately challenged the validity of EPA's regulations in Federal court in 2011. The reverberations of these challenges are still being felt, casting some uncertainty around how EPA's regulatory initiatives will unfold.

As controversial as the new-source rules are, it is likely that any rules to govern existing sources of GHG emissions would be even more controversial. At the moment, however, the Obama Administration seems to be backing away from action on this front.[33] The environmental community has been pressuring EPA for years to issue rules on existing sources, with little success. Within the last few months, the Natural Resources Defense Council, a major American environmental group, increased the pressure by formally petitioning EPA to issue such rules in consideration of the harm that U.S. emissions are causing internationally[34] The need to respond to this idea, coupled with the law suits that are pending on new-source standards, puts EPA into a tenuous and

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[31] The various regulatory actions are well-described in the following article: http://en.wikipedia.org/wiki/Regulation_of_greenhouse_gases_under_the_Clean_Air_Act

[32] Quoting Senator Joe Manchin, Democrat of West Virginia, on March 18, 2013, in a letter to EPA.

[33] See "White House Raises Doubts Over EPA GHG Rules for Power Plants," *Clean Energy Report,* Feb 27, 2013.

[34] This petition comes under Section 115 of the Clean Air Act, which has not been used before. Ibid.

uncertain position over how to proceed. EPA officials have on occasion said that it might be best to leave the attack on existing sources to state action, under such initiatives as the Regional Greenhouse Gas Initiative (RGGI, which is discussed below). The status of regulation of existing-source GHG emissions is thus somewhat in limbo. Senate Republicans are also delaying the confirmation of Gina McCarthy, the President's choice to be the next Administrator of EPA.

The Obama Administration also has issued important fuel efficiency regulations, which are intended to reduce fuel consumption and thus also reduce greenhouse gas emissions. On July 29, 2011, President Obama announced an agreement with large automakers, environmental groups, and California regulators to increase average fuel economy. On August 28, 2012, the National Highway Traffic Safety Administration (NHTSA) issued a final rule that covers fuel economy performance until 2025, bringing up the mandated level by increments to a final level of 54.5 miles per gallon (23.2 kilometers per liter).[35]

Two aspects of this rulemaking stand out. First, it is striking that this rulemaking was undertaken at all, given the economic and political climate of the time, in which such aggressive action is hard to achieve. Second, the automobile industry, which has historically fought interminably over such rules, supports these new fuel efficiency standards. Indeed, the Alliance of Automobile Manufacturers has gone so far as to say that CO_2 emissions standards are among its "top national priorities."[36] Thus, enhanced fuel economy may emerge as one

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[35] Obama Administration Finalizes Historic 54.5 mpg Fuel Efficiency Standards, NHTSA Press Release, Tuesday, August 28, 2012. See also: Bill Vlasic, "Obama Reveals Details of Gas Mileage Rules, *The New York Times*, July 29, 2011, http://www.nytimes.com/2011/07/30/business/energy-environment/obama-reveals-details-of-gas-mileage-rules.html and Bill Vlasic, "U.S. Sets Higher Fuel Efficiency Standards, *The New York Times,* August 28, 2012, http://www.nytimes.com/2012/08/29/business/energy-environment/obama-unveils-tighter-fuel-efficiency-standards.html?_r=0&adxnnl=1&adxnnlx=1368813816-s8OJnQjDj5k8XI5eMotnOw

[36] As reported in *The New York Times*, June 26, 2012, "Court Backs EPA over Emissions Limits Intended to Reduce Global Warming."

of the Obama Administration's main accomplishments in the area of climate change.

2.4.2 Judicial Decisions

The role of the courts – particularly the Federal courts – is extremely important in U.S. public policy. Many public policy decisions are not settled until after litigation, which is nowadays an almost-routine event, given the argumentative nature of the U.S. body politic and the easy entry that the courts grant to opponents of the government. In the environmental context, where strong differences of position are common and the costs as well as the benefits of regulation can be so high, virtually no major decision goes unchallenged by some interest group – and often, by many interest groups. And, while judges do not propose initiatives, in the sense that presidents or Members of Congress do, their decisions do greatly influence U.S. public policy.

This litigious pattern has surely pertained in the area of climate change. Law suits have been mounted both by those who urge action to combat climate change and by those who oppose such action, or dispute the way it is structured. These lawsuits always prolong the decision-process. Sometimes, when the courts invalidate the decisions of government agencies, litigation frustrates or forces changes in public policies developed in the Executive Branch agencies. Nevertheless, it also seems clear that litigation forces a fuller and clearer examination of the premises of public policy and the evidence used to justify it.

With respect to climate change, four judicial decisions stand out as particularly important:

- *Massachusetts v. EPA*, the Supreme Court case from 2007 discussed earlier in this section.

- *American Electric Power v. Connecticut*, a Supreme Court case from 2011.
- *Coalition for Responsible Regulation v. EPA*, a D.C. Circuit case from June 2012.
- *Commonwealth of Virginia v. EPA*, a D.C. Circuit Court case, whose appeal is pending in the Supreme Court as of May 2013.

All of these cases represent complicated and important tests of U.S. environmental law as it relates to climate change.

In *Massachusetts v. EPA*, twelve states sued the Bush Administration EPA, arguing that it had a duty to promulgate regulations to control climate change, as a scientifically demonstrated threat to public health. In response, the Bush Administration argued that the science of climate change was too uncertain to act, and that even if the science evolved into certainty, it did not have the authority under the Clean Air Act to do anything about it. The Supreme Court's rebuttal of the Bush Administration was almost unprecedented for its willingness to read the science on its own and to force the Administration to act. It was a major victory for the proponents of climate change policy, and it set the stage for other victories at the Federal level.

AEP v. Connecticut[37] is a suit that was brought by Connecticut and a number of other states against various electric utilities, arguing that their CO_2 emissions constituted a common law "nuisance" that the courts could stop, even in the absence of Federal regulatory action. This novel theory, which would have thrust much of U.S. decision-making about climate change into the Federal judiciary, was rejected by the Supreme Court. While there are a number of state-court cases still pending, they tend to deal with small-scale, local issues, and thus

[37] 131 S. Ct. 2527 (2011).

the Supreme Court case makes it clear that EPA, not the courts, must take the initiative in climate change control.

The plaintiff in *Coalition for Responsible Regulation v. EPA* was actually a combination of industrial interests who contested the basic "endangerment" finding on which all of the Obama EPA's climate change initiatives rested. The D.C. Circuit Court of Appeals soundly rejected this argument, and strongly upheld EPA's scientific judgments. Although this case was not decided by the Supreme Court, the D.C. Circuit's decisions in such matters are often definitive, especially when, as in this instance, the case did not go to the Supreme Court.

Within the last few weeks, the Commonwealth of Virginia (and a number of other states) decided to appeal to the Supreme Court another decision from the D.C. Circuit. This decision upheld EPA's new source performance standards for greenhouse gas emissions. Until the Supreme Court process is completed, there will be considerable uncertainty about this effort to control GHG. The Supreme Court's initial decision can be expected within the next few months.[38]

Looking at these cases as a whole, it seems clear that Federal law is evolving in a consistent direction on the issue of climate change. The courts have been remarkably accepting of the scientific evidence put forward by EPA and environmental advocates to demonstrate the realities of climate change. They have also been remarkably willing to force the government to do something about it. While the courts have limited power to control the timing or structure of regulations, it is highly unlikely that they will back away from their support of it to date.

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[38] The Supreme Court has two choices in such circumstances: (1) refuse to hear the case, which will effectively uphold EPA's initiative; (2) take the case, which will mean scheduling a full hearing and argument.

It should be noted that the relationship between the courts and the Congress is radically different than the relationship between the courts and the Executive Branch. Congress decides whether and when it wants to take action on an issue such as climate change, and the courts have almost no power to force Congress to pass new laws. Thus, Congressional inaction in the face of climate change is not an appropriate subject for judicial action.

2.4.3 Congressional Initiatives

In a policy area such as climate change, which presents an unprecedented and global problem, we would usually assume that the U.S. Congress would craft a broad response, by enacting new laws. After this, it would normally be the case that an Executive Branch agency, such as EPA, would implement the scheme that Congress had outlined. In fact, this has not occurred with respect to climate change. In a situation that appears somewhat anomalous, Congress has passed no legislation that deals directly with climate change; and thus America's policies that do deal with it are largely the result of other actors' initiatives – principally, the EPA, the states and local governments. It is highly unlikely that Congress will change this pattern in the near future given its current partisan composition. Should the balance of political power shift or should Republicans become convinced that action to combat climate changes is necessary, strong action would become more likely. Neither is expected to happen over the near term.

At the beginning of the first Obama Administration, it was widely assumed that Congress would pass a "cap and trade" bill to attack climate change – an approach that combined limits on maximum aggregate GHG emissions with a trading system among polluters. The Democratic leadership in

Congress, as well as the President, stood behind this legislative initiative, and there was some Republican support as well. In early 2010 the U.S. House of Representatives, then controlled by Democrats, did pass the so-called Waxman-Markey cap-and-trade bill. But Senate never voted on the proposed legislation. Many factors contributed to this failure to enact legislation, but two stand out: (1) the overwhelming importance of fiscal and budgetary matters in the 2010 period, which tended to marginalize many other matters; (2) the fixed opposition to action of many Republicans and of some Democrats, especially those from coal-producing states.

The legislative possibilities for a cap-and-trade system now seem quite dim. Republicans have continued their opposition, and Democrats no longer push the idea. In addition, enthusiasm for the basic idea of cap and trade seems to have waned, as many of its complexities and defects have emerged in policy discussions. The experiences of other countries with cap and trade – notably in Europe – have pointed out the difficulties in fashioning a system that will actually work to reduce GHG emissions.

In this legislative climate, a diverse coalition is beginning to support the idea of a carbon tax – in which production and/or emissions of CO_2 and other greenhouse gases would simply be subject to a tax, and individual producers and consumers in the market would be left to adjust their "carbon footprint" as they chose. One of the most interesting initiatives is being backed by Congressman Bob Inglis, a Republican from South Carolina. Congressman Inglis has helped launch an "Energy and Enterprise Initiative" at George Mason University, in which diverse groups consider various policy alternatives toward climate change. The carbon tax alternative is being openly advocated in this context, with Mr. Inglis making a prediction that it may be enacted by 2015 or

2016. He further says that such legislation would be an "immaculate conception," with nobody claiming "paternity."[39] That means that no one would be particularly blamed for raising taxes.

A more typical legislative approach is contained in the "Boxer-Sanders bill" (named after its sponsors, but formally called the Climate Protection Act of 2013).[40] This bill, introduced in February 2013, would establish a carbon tax at the rate of $20 per ton of CO_2, with rates increasing by 5.6 percent each year until the 12th year. At that point, the EPA Administrator would submit a report to Congress evaluating the carbon tax system's effectiveness. It is estimated that such a system would raise $1.2 trillion in revenues over ten years. Much of this revenue, however, would be funneled back through various rebate programs to those most affected. Some of the revenue would be used to support research funded by ARPA-E. It is also important to note that the Boxer-Sanders proposal would not remove regulatory authority from EPA with respect to greenhouse gases, and thus the carbon tax would be formulated as a complement to rather than a substitute for regulation.

In March 2013 other carbon tax bills began to be proposed in Congress. A Senate bill, sponsored by Sheldon Whitehouse (Democrat from Rhode Island), is one such vehicle. It is less definite than the Boxer-Sanders bill, and its authors are "looking for comment" on the appropriate level of a carbon tax and how much it should increase annually.[41]

The Boxer-Sanders bill has met with immediate and predictable opposition from conservative forces (partly because its sponsors are among the

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[39] "Carbon tax backers quietly forge ahead," E2 Wire, *The Hill*, May 5, 2013.
[40] Climate Protection Act of 2013 (S. 332), www.govtrack.us/congress/bills/113/s332
[41] "Democrats circulate carbon tax bill," *E2 Wire,* Zack Colman, March 12, 2013.

most liberal members of the Senate)[42], and there is little hope of its passage. The other bills being discussed are in early stages of development, and likely to face much of the same opposition. Nevertheless, the level of Congressional activity with respect to a carbon tax puts this option securely on the table for future consideration.

The discussion of carbon taxes has also been included – in the context of broad tax reform – in a major recent report from the House Ways and Means Committee (the committee with jurisdiction over taxation). The report is a compilation of the efforts of several working groups on different aspects of taxation that pertain to energy and the environment. Among other things, it summarizes about 1,300 submissions from various stakeholders interested in both carbon taxes and energy taxation more generally.[43] The report should provide important issues for discussions and hearings in the future.

Among the many interests participating in the carbon tax debate, one has a particularly comprehensive view, The Carbon Tax Center.[44] Founded in 2007, the Carbon Tax Center has been remarkably successful in soliciting support and participation in its wide range of discussions and publications.

It is also worth noting that carbon taxes have been enacted by many countries throughout the world. Japan and France offer two diverse examples.[45]

Lastly, some members of the Congress are also attempting to use aspects of the legislative process to modify already-existing GHG regulations from EPA. In March, for example, four Senate Democrats from coal-producing states wrote to President Obama, requesting that EPA modify the NSPS standards that would

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[42] See Heritage Foundation, Derek Morgan, "Boxer-Sanders Carbon Tax Would Empower EPA to Crush Booming Energy Economy," April 12, 2013.
[43] "U.S. House Ways and Means Panel releases details of energy tax reform plans," May 6, 2012. See discussion at: http://www.platts.com/RSSFeedDetailedNews/RSSFeed/Oil/21014810
[44] http://www.carbontax.org/
[45] These and others are described in a large Wikipedia article, https://en.wikipedia.org/wiki/Carbon_tax

impact coal-fired electric plants.[46] While this initiative has little promise of any action, it nevertheless illustrates the difficulty of fixing secure regulatory policies toward GHG in the current Congressional climate.

2.4.4 State and Local Initiatives

In the U.S., states and localities often function as public policy innovators, from which the Federal government later takes its cue. The states and localities also offer a counter-weight to the Federal government, where progress can still be made to attack a problem when the Federal government refuses to act. Both of these phenomena can be seen in the initiatives taken to curb climate change at the state and local levels.

In 2008 TPI wrote a review of state and local energy and environmental initiatives. It showed a highly dynamic scene at the state and local levels, contrasting with inaction at the Federal level.[47] Since 2008, a significant change in Federal policy has occurred, largely in the context of regulation. At the state and local level, most of the initiatives that had been developed by 2008 are still highly active, and pushing forward perhaps more aggressively – in some areas of the country – than is true of the Nation as a whole.

While it is not feasible to survey today's state and local initiatives, three recent developments stand out: the Regional Greenhouse Gas Initiative, initiatives in New York City, and California's new cap-and-trade system.

The Regional Greenhouse Gas Initiative (RGGI) is the first market-based regulatory program in the United States that seeks to reduce greenhouse gas

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[46] "Senate Group Seeks Amendment of Proposed EPA Regulations," http://breakingenergy.com/2013/03/25/senate-group-seeks-amendment-of-proposed-epa-regulations

[47] George R. Heaton, Jr., Christopher T. Hill, and Patrick Windham, *Addressing Global Climate Change: Grassroots Initiatives and Technology Diffusion in the U.S.*, Technology Policy International, May 2008.

emissions. RGGI is a cooperative effort among the states of Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont to cap and reduce CO_2 emissions from the power sector. States sell nearly all emission allowances through auctions and invest proceeds in consumer benefits: energy efficiency, renewable energy, and other clean energy technologies.[48] RGGI is the prime example of a cap-and-trade program in the United States.

In February, 2013, the RGGI made a major proposal to reduce carbon emissions by 45 percent starting in 2014. The details of this proposal are as follows:

- A reduction of the 2014 regional CO_2 budget, "RGGI cap", from 165 million to 91 million tons – a reduction of 45 percent. The cap would decline 2.5 percent each year from 2015 to 2020.

- Additional adjustments to the RGGI cap from 2014-2020. This will account for the private bank of allowances held by market participants before the new cap is implemented in 2014. From 2014-2020 compliance with the applicable cap will be achieved by use of "new" auctioned allowances and "old" allowances from the private bank.

- Cost containment reserve (CCR) of allowances that creates a fixed additional supply of allowances that are only available for sale if CO2 allowance prices exceed certain price levels ($4 in 2014, $6 in 2015, $8 in 2016, and $10 in 2017, rising by 2.5 percent, to account for inflation, each year thereafter.)

- Updates to the RGGI offsets program, including a new forestry protocol.

- Not re-offering unsold 2012 and 2013 CO2 allowances.

- Requiring regulated entities to acquire and hold allowances equal to at

[48] See http://www.rggi.org/

least 50 percent of their emissions in each of the first 2 years of the 3 year compliance period, in addition to demonstrating full compliance at the end of each 3 year compliance period.

- Commitment to identifying and evaluating potential tracking tools for emissions associated with electricity imported into the RGGI region, leading to a workable, practicable, and legal mechanism to address such emissions.

In 2013 New York City is still traumatized from the ravages of Hurricane Sandy in the fall of 2012. Since the storm, New York has led the way in terms of re-thinking and planning for the reality of climate change impacts. Before Hurricane Sandy, the position of Mayor Bloomberg's Administration was that primary attention should be paid to efforts to prevent global climate change; the need to cope with immediate impacts tended to assume lower priority. Now, the focus has publically shifted, with planning to create an infrastructure of protection against storms and flooding at the top of the agenda.[49] It seems fair to say that this represents a significant change in the mindset toward climate change, which is beginning at the local level.

In 2006, California's legislature and governor enacted Assembly Bill 32, the California Global Warming Solutions Act. It requires California to reduce greenhouse gases. First, emissions in 2020 must the same as 1990's levels, and by 2050 emissions must be only 20 percent of the 1990 levels. Under the law, California is now establishing its own cap-and-trade system, as well as taking other measures to reduce emissions. The California Air Resources Board issued cap-and-trade implementing regulations in April of this year. The state is also working with others: "California is working closely with British Columbia, Ontario, Quebec and Manitoba through the Western Climate Initiative to

[49] Bloomberg: Post-Sandy NYC will lead climate change battle, CBS News, December 2012.

develop harmonized cap and trade programs that will deliver cost-effective emission reductions."[50]

2.4.5 The International Context

Commitment to international action on climate change has not been a hallmark of U.S. policy, in spite of promises to the contrary by many U.S. leaders. To some extent, this has been because of opposition in the Congress to treaties that create multilateral regimes, such as the Kyoto Protocol. Nevertheless, the second Obama Administration may present a new opportunity for U.S. leadership in this area.

As mentioned earlier, the EPA now has under consideration a petition to enlarge the scope of its rulemaking to take the international context explicitly into account when setting future standards on GHG. This is a complicated legal matter, in which the U.S. may be reluctant to engage; nevertheless, a discussion is beginning.

The next (19th) meeting of the Conference of the Parties to the UN Convention on Climate Change (COP) will take place in Poland in November 2013. How the U.S. positions itself toward the future of the Convention is an issue about which discussion is underway.

While some American officials support the UN climate change negotiation process, there are others who feel that the UN process has bogged down and become non-productive, after relatively little progress in Copenhagen (COP 17) and Doha (COP 18). This line of thinking suggests greater U.S. engagement with non-UN multilateral organizations, in which the smaller numbers of countries

[50] California Air Resources Board, "Cap-and-Trade Program," http://www.arb.ca.gov/cc/capandtrade/capandtrade.htm. (The quote is from the "Background Information" section of this Web page.)

whose actions will truly make a difference for the global environment can meet more informally and might act more decisively.[51] One such group is the Major Economies Forum on Energy and Climate, whose most recent meeting was hosted in Washington, D.C., in April 2013.[52]

Secretary of State Kerry has been consistent throughout his career in his commitment to both U.S. international engagement and to environmentalism. On Earth Day 2013, he gave a speech signaling his intention to position the U.S. much more forcefully in the international community devoted to climate change issues. Thus, U.S. policy in this regard may be poised to take a new turn. [53]

2.5 The BRAIN Initiative

On April 2, 2013, President Obama announced his BRAIN Initiative – the "Brain Research through Advancing Innovative Neurotechnologies" Initiative.[54] The initiative includes existing and proposed new research at three federal agencies and four private-sector research organizations, and the primary focus of the initiative will be an effort to develop new tools for understanding the brain.

For fiscal year 2014 – the new fiscal year that begins on October 1, 2013 – the President is requesting $110 million for this initiative: $40 million at the National Institutes of Health (NIH), $50 million at the Defense Advanced

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[51] Council on Foreign Relations, The Global Climate Change Regime, Issue Brief, May 7, 2013.

[52] See Homepage and Chairman's Report, April 12, 2013, MEF, http://www.majoreconomiesforum.org/about.html

[53] John Kerry on climate change: 'Science is screaming' for new energy controls, *Washington Times*, April 23, 2013. http://www.washingtontimes.com/news/2013/apr/23/john-kerry-climate-change-science-screaming-new-en/#ixzz2THsLcUbW

[54] Office of the Press Secretary, the White House, "Remarks by the President on the BRAIN Initiative and American Innovation," April 2, 2013, http://www.whitehouse.gov/the-press-office/2013/04/02/remarks-president-brain-initiative-and-american-innovation. An good description of the NIH part of the initiative is Thomas R. Insel, Sotry C. Landis, and Francis S. Collins, "The NIH BRAIN Initiative," *Science*, 10 May 2013, Vol. 340, pages 687-688.

Research Projects Agency (DARPA), and $20 million at the National Science Foundation (NSF). The four private-sector partners are the Allen Institute for Brain Science, the Howard Hughes Medical Institute, the Kavli Foundation, and the Salk Institute for Biological Sciences.

2.5.1 History of This Initiative

Policy entrepreneurs in the scientific community and in the federal government played important roles in the development of this initiative.

In June 2012, six leading scientists published a paper that called for a new "brain activity map project."[55] They and other scientists developed the proposal at a series of meetings sponsored by the private Kavli Foundation and other organizations. The purpose of the proposed project is to understand the functions of neural circuits – that is, the behaviors and mental states associated with different part of the brain – by "reconstructing the full record of neural activity across complete neural circuits." Most research up until now has focused on understanding the activity and functions of individual brain cells (neurons). But the authors of the paper believe that it is could be possible to "map" (record, measure, and understand) the activity and associated functions of entire regions of the brain – entire neutral circuits that can involve millions of neurons.

The authors have an ambitious idea of what this project would do and the benefits it might produce:

> Such recordings could represent a complete functional description of a neural circuit: a Brain Activity Map (BAM). This mapping would transcend the "structural connectome," the *static* anatomical map of a

[55] A. Paul Alivastos,Miyoung Chun, George M. Church, Ralph J. Greenspan, Michael L. Roukes, and Rafael Yuste, "The Brain Activity Map Project and the Challenge of Functional Connectomics," *Neuron*, volume 74, June 21, 2012, pages 970-974, www.cell.com/neuron/abstract/S0896-6273(12)00518-1.

> circuit. Instead, we propose the *dynamical* mapping of the "functional connectome," the patterns and sequences of neuronal firing [electrical impulses] by all neurons. Correlating this firing activity with both the connectivity of the circuit and its functional or behavioral output could enable the understanding of neuronal codes and their regulation of behavior and mental states. This emergent level of understanding could enable accurate diagnosis and restoration of normal patterns of activity to injured or diseased brains, foster the development of broader biomedical and environmental applications, and even potentially generate a host of associated economic benefits.[56]

In other words, if we could measure all of the electrical and other activity in regions of both healthy and injured or diseased brains and then see what behaviors and mental states (thoughts, emotions, etc.) are associated with these brain activities, then potentially we could understand how to diagnose and restore injured or diseased brains.

The authors say that two things are needed to make these brain maps possible: new tools to study the brain and a well-funded project to support interdisciplinary teams of scientists to develop and use these new tools. Current tools include functional magnetic resonance imaging (fMRI) and magnetoencephalography (MEG); MEG uses sensors placed on the top of the head to measure small changes in magnetic fields caused by electrical activity in the brain. Newer tools are very promising, the authors say. These tools include optical techniques, calcium imaging, voltage imaging, nanoprobes, wireless and synthetic biology approaches, and computational techniques for analyzing the resulting data. The project would develop and use these new tools in three stages: first, the study of a small organism, then imaging the full brain of a fruit fly, and eventually mapping the neuronal activity of the entire neocortex of an

[56] Ibid., page 971.

awake mouse and then of primates. The authors understand that this work will raise ethical issues.

The authors make a direct comparison to the Human Genome Project, which they believe has generated great scientific and economic benefits. They argue that the Brain Activity Map Project might generate similar benefits.

Several of the authors of this paper are well known in Washington, DC, and shared their recommendations with the leaders of federal agencies and White House staff. The next part of the story took place in Washington.

Policy entrepreneurs within the government are interested in new proposals that could lead to valuable new science, build public and Congressional support for science, and help presidents by providing them with attractive initiatives. That is what happened in this case. In particular, two key policy entrepreneurs played important roles: NIH Director Francis Collins and Thomas Kalil, Deputy Director of the White House Office of Science and Technology Policy (OSTP).

Dr. Collins was earlier the director of NIH's Human Genome Project. He supports interdisciplinary projects that develop new tools and new information to advance biomedical science and clinical practice. Somewhat unusually for an NIH person, he is not against large "big science" projects or applied research. The Human Genome Project was an example of a "big science" project, and Dr. Collins' creation of NIH's new National Center for Advancing Translational Sciences shows his support of applied research to convert basic research findings into useful practices and therapies. So it is not surprising that he seems to be a major supporter of the new BRAIN Initiative.

Tom Kalil has been a major science and technology policy advisor in both the Clinton and Obama Administrations. He is known for putting together and proposing new initiatives that will support research and also show that national leaders are using science and technology to benefit the United States. In 1999 and 2000, Kalil was the principal White House staff person behind President Clinton's National Nanotechnology Initiative. More recently, he played a key role in creating President Obama's Big Data Initiative (discussed later in this chapter). Kalil helped to organize the BRAIN proposal and to persuade President Obama to approve it.

2.5.2 Details of the Initiative

The BRAIN Initiative presented by President Obama on 2 April includes both existing and proposed new programs at NIH, DARPA, and NSF.

The proposed fiscal year 2014 budget for BRAIN at NIH is $40 million. According to a White House "fact sheet" on the BRAIN Initiative, NIH will draw the $40 million from its existing NIH Blueprint for Neuroscience Research program, which funds the development of new research tools and training opportunities.[57]

Given that the President is requesting $30.4 billion in fiscal year 2014 for NIH, why is only $40 million requested for this major presidential initiative? We do not know for certain, but there are three possible reasons. First, this is a new initiative and most of the FY 2014 request was prepared long before the President announced the proposal. Second, NIH still needs to work out details for this ambitious program and may want a more detailed plan before it requests more

[57] Office of the Press Secretary, the White House, "Fact Sheet: BRAIN Initiative," April 2, 2013, http://www.whitehouse.gov/the-press-office/2013/04/02/fact-sheet-brain-initiative.

money. In fact, NIH is assembling a high-level working group "to define detailed scientific goals for the NIH's investment, and to develop a multi-year scientific plan for achieving those goals, including timetables, milestones, and cost estimates."[58] Third, the politics within the biomedical community are complicated; this point is discussed further in section 3.4.3 of this chapter.

The largest FY 2014 request -- $50 million – is for DARPA. For several years DARPA has funded research both on brain control of artificial limbs and on the diagnosis and treatment of post-traumatic stress, brain injury, and memory loss. These are all important topics in the treatment of injured soldiers. In the process, DARPA aims to develop new tools to understand and process brain activity. These programs already exist but will expand under the President's BRAIN proposal.[59]

The President's $20 million request for NSF will support the development of molecular-scale probes that record neural activity, data analysis techniques, and "increased understanding of how thoughts, emotions, actions, and memories are represented in the brain."[60]

As mentioned earlier, four private-sector partners have made commitments to support related research. Figure 1 summarizes the proposed federal and private investments for FY 2014. This figure comes from a presentation made recently by NIH Director Francis Collins.[61]

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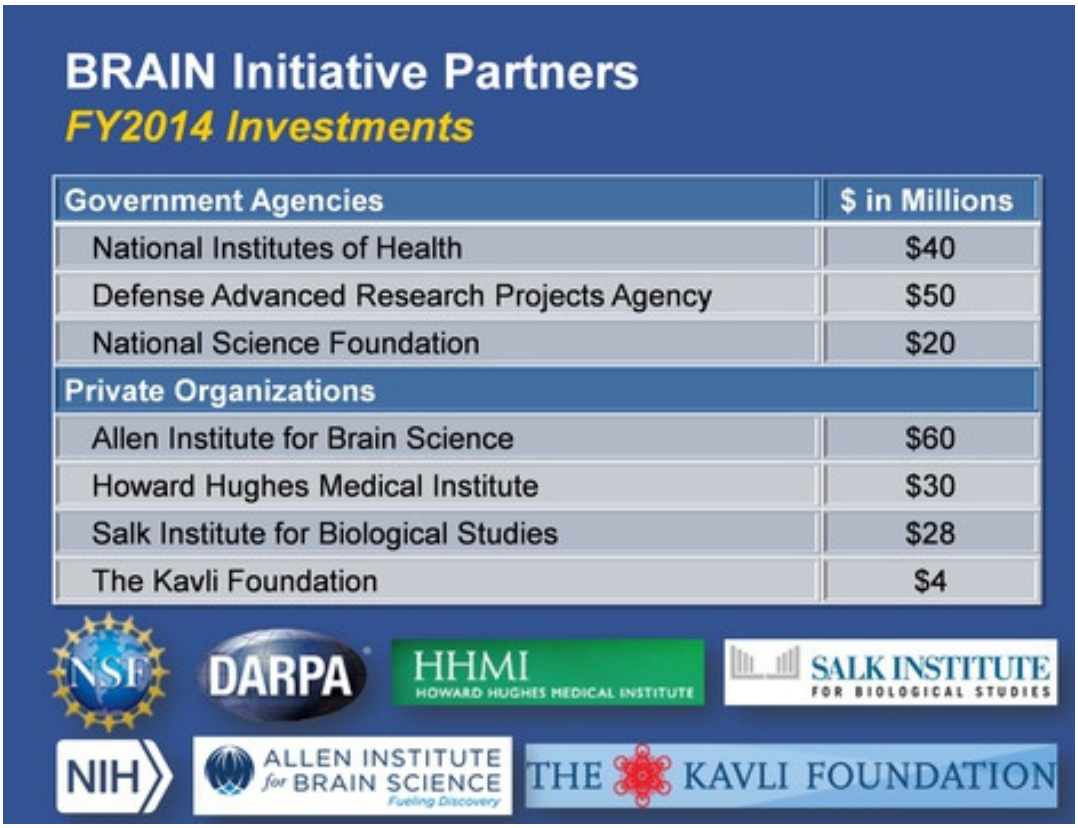
[58] Ibid.
[59] See DARPA's Web site for details about the agency's existing and proposed brain projects. A good place to start is DARPA's press release, "Better Understanding of Human Brain Supports National Security," http://www.darpa.mil/NewsEvents/Releases/2013/04/02.aspx.
[60] "Fact Sheet: BRAIN Initiative."
[61] Francis Collins, "NIH and the BRAIN Initiative," a presentation to the President's Council of Advisors on Science and Technology, May 3, 2013, Webcast available at: http://www.tvworldwide.com/events/pcast/130503/globe_show/default_go_archive.cfm?gsid=2263&type=flv&test=0&live=0.

Figure 1. FY 2014 Investments for the BRAIN Initiative



The initiative announced by the President differs in one important way from the Brain Activity Map Project proposed by Paul Alivisatos and his colleagues. While the scientists proposed a multi-year project that would begin with brain maps of a simple organism and then move to fruit flies, mice, and eventually primates, the President's remarks focused much more on the human brain and the potential for helping with human diseases and injuries; he specifically mentioned Alzheimer's, autism, and traumatic brain injury. While DARPA is working on brain injuries, it is very ambitious to suggest that the BRAIN Initiative will contribute soon to the treatment or cure of diseases such as Alzheimer's or autism.

On May 3, 2013, agency leaders gave a briefing on the BRAIN Initiative to the President's Council of Advisors on Science and Technology (PCAST). A video recording of that briefing is available on the PCAST Web site.[62]

2.5.3 Supporters and Critics

Supporters of the BRAIN Initiative believe that an interdisciplinary effort can develop valuable new technologies for studying the brain. Dr. William Newsome of Stanford University, one of the two co-chairs of the new NIH high-level working group that will recommend a plan for NIH's part of the project, believes that even a small amount of money can be valuable.

> The initiative exists as part of a vast landscape of neuroscience research supported by billions of dollars in federal money. But Dr. Newsome said that he thought a small amount of money applied in the right way could nudge neuroscience in a new direction.
>
> "The goal here is a whole new playing field, whole new ways of thinking," he said. "We are out to catalyze a paradigm shift."[63]

Critics of the proposal have voiced four concerns. First, some critics argue that emphasizing the development of technologies first, before figuring out what needs to be measured, is the wrong way to proceed.[64] Supporters respond that the NIH high-level working group will examine which brain patterns should be examined and what new technologies would help with that task. Second, other critics object to the statements that compare the brain project with the Human Genome Project. The genome project had a very specific objective: identify the

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[62] Francis Collins, Arati Prabhakar, and John Wingfield, "Brain Research through Advancing Innovative Neurotechnologies (BRAIN) Initiative," a presentation to PCAST, May 3, 2013, http://www.tvworldwide.com/events/pcast/130503/globe_show/default_go_archive.cfm?gsid=2263&type=flv&test=0&live=0.

[63] John Markoff and James Gorman, "Obama to Unveil Initiative to Map the Human Brain," *The New York Times*, April 2, 2013.

[64] Ibid.

chemical composition of human chromosomes. It is not clear that there is a similar single objective for the brain program. Third, the White House may be promising more than the project can deliver, at least over the next few years. The initiative is not likely to lead quickly to treatments for Alzheimer's, autism, and other conditions. Fourth, NIH primarily funds individual biomedical researchers, and some of these researchers object to a new, potentially expensive "big science" initiative that might take money away from them.[65] There were similar objections to NIH's support of the Human Genome Project. , supporters argue on the other hand that a dramatic and important new initiative might attract additional funding for neuroscience research.

2.5.4 Prospects

The President's fiscal year 2014 request for the BRAIN Initiative is $110 million – a significant amount of money but much smaller than, for example, the $1.86 billion spent in FY 2012 on the National Nanotechnology Initiative. No one in the administration has said yet how much of that request is "new" money – money in addition to current spending levels – and how much is a continuation of current spending.

Normally, Congress would support this type of health-related initiative. However, 2013 is not a normal budget year. As discussed earlier in this report, the "sequester" has already cut fiscal year 2013 non-defense spending programs,

[65] For example, Corneilia Bargmann, the other co-chair of NIH's high-level working group on the brain project herself earlier voiced concerns about funding. In February 2013, she wrote, "Based on my conversations, there is great concern in the neuroscience community that this sounds like a big central planning project that will take resources away from creative work." This quote is taken from Emily Underwood, "As White House Embraces BRAIN Initiative, Questions Linger," *ScienceInsider*, 3 April 2013. http://news.sciencemag.org/scienceinsider/2013/04/as-white-house-embraces-brain-in.html.

including research and development programs, by over 8 percent, and if Congress and the President do not agree soon on a long-term spending plan then the existing sequester law will cut another $100 billion from FY 2014 defense and non-defense spending, including R&D. In this political environment, finding any new money for research initiatives will be difficult.

3. BRIEF DESCRIPTIONS OF SEVERAL OTHER STI INITIATIVES

3.1 Big Data

The Obama Administration likes what it calls "grand challenges" – research and development programs that set ambitious but achievable goals and may create significant benefits if they succeed. In his remarks announcing the BRAIN Initiative, President Obama seemed to call his brain project one of those challenges. And he mentioned others: making solar energy as cheap as coal or making electric vehicles as affordable as the ones that run on gas.[66] One other grand challenge project is the Big Data initiative, announced by the White House on March 29, 2012.

Tom Kalil, who helped organize this initiative as well as the brain project, announced the data program in a White House blog posting:

> Today, the Obama Administration is announcing the "Big Data Research and Development Initiative." By improving our ability to extract knowledge and insights from large and complex collections of digital data, the initiative promises to help accelerate the pace of discovery in science and engineering, strengthen our national security, and transform teaching and learning.
>
> To launch the initiative, six Federal departments and agencies will announce more than $200 million in new commitments that, together, promise to greatly improve the tools and techniques needed to access, organize, and glean discoveries from huge volumes of digital data.[67]

The Big Data initiative is part of the larger multi-agency Networking and Information Technology Research and Development Initiative (NITRD,

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[66] "Remarks by the President on the BRAIN Initiative and American Innovation."

[67] Tom Kalil, "Big Data is a Big Deal," posted March 29, 2012, www.whitehouse.gov/blog/2012/03/29/big-data-big-deal. Further details are available from a White House fact sheet, "Obama Administration Unveils 'Big Data' Initiative: Announces $200 Million in New R&D Investments." A link to the fact sheet is on the blog posting.

www.nitrd.gov). The NITRD office has not yet released details about its proposed FY 2014 budget, so we do not yet know what portion of the President's NITRD budget request is for R&D on big data.

3.2 Cybersecurity

The Obama Administration has not issued a detailed document on the government's full range of cybersecurity R&D programs. However, the President's National Security Council has issued a general cybersecurity policy document, which it calls "The Comprehensive National Cybersecurity Initiative." Along with steps to protect federal computer networks, improve counter-intelligence and deterrence, and work with critical private-sector computer infrastructure, the document also discusses R&D and advanced technology but provides few details. The document's "Initiative #4" is "Coordinate and redirect research and development efforts." This section of the document says that government is "developing strategies and structures for coordinating all cyber R&D sponsored or conducted by the U.S. government, both classified and unclassified, and to redirect that R&D where needed." This particular document provides no details on current or proposed R&D budgets. "Initiative #9" is "Define and develop enduring 'leap-ahead' technology, strategies, and programs." Again, the document provides no details; it only says that the government will outline "grand challenges" for the research community to help solve.[68]

While there is apparently no public summary of overall U.S. cybersecurity R&D funding, the President's budget request for fiscal year 2014 asks for cybersecurity R&D increases at several agencies. DARPA's cyber technology

[68] National Security Council, "The Comprehensive National Cybersecurity Initiative," undated, http://www.whitehouse.gov/cybersecurity/comprehensive-national-cybersecurity-initiative.

budget would increase from $24.5 million in FY 2012 and $50.0 million in FY 2013 to $60.5 million in FY 2014. The request for the National Institute of Standards and Technology (NIST) asks for $140 million for cybersecurity activities, an increase of $24 million in FY 2014. NSF's budget request does not say exactly how much money the agency is requesting to support cybersecurity research, but NSF is asking for $221.35 million for its overall Advanced Cyberinfrastructure (ACI) Program, which includes cybersecurity work.

In addition, it is likely that there are also large classified (secret) cybersecurity R&D programs within the Department of Defense and the Central Intelligence Agency.

3.3 A Possible NASA Asteroid Mission

A very different initiative is part of the President's FY 2014 budget request for NASA. That NASA request "includes a plan to robotically capture a small near-Earth asteroid and redirect it safely to a stable orbit in the Earth-Moon system where astronauts can visit and explore it."[69]

This proposed program is NASA's most recent attempt to find an affordable and politically acceptable "next step" for its human spaceflight program. NASA, members of Congress with NASA centers in their states, and aerospace contractors all want to continue the human spaceflight program. However, the Bush and Obama Administrations ended the Space Shuttle program, and now Russian vehicles and, in the future, private-sector American

[69] "NASA's Asteroid Initiative Benefits from Rich History," http://www.nasa.gov/mission_pages/asteroids/news/asteroid_initiative.html. Further information is available by going to http://www.nasa.gov/news/budget/index.html and then clicking on the link entitled "Associate Administrator Robert Lightfoot's Presentation on Asteroid Strategy. A detailed magazine article on this possible astronaut-asteroid mission is, Guy Gugliotta, "Beyond the Moon," *Air & Space,* April/May 2013, pages 22-27.

rockets and capsules are the preferred methods for getting astronauts to and from the International Space Station. So what is the next mission for NASA's own human spaceflight program?

President George W. Bush proposed a program called Constellation, which included the construction of a new large rocket (called Ares) and a new space capsule (called Orion) for a return to the Moon and a possible human mission to Mars. The cost of this proposed mission was very high, however, and President Bush never asked Congress to appropriate more than a small portion of the overall cost of the project. President Obama rejected the Constellation plan soon after he took office. In negotiations with Congress, President Obama agreed to build the Orion capsule and a less expensive new rocket (the Space Launch System) and expressed support for eventual missions to an asteroid and Mars. But a Mars mission remains very expensive and unlikely for many years, and few people are enthusiastic about visiting an asteroid.

So NASA is now proposing a mission to a point near the Moon; an Orion capsule with astronauts would park there for perhaps a month and a robot spacecraft would tow a small asteroid to the capsule for the astronauts to explore. This mission would cost less than a Mars trip and would help develop new exploration techniques. President Obama has directed NASA to draw up plans and cost estimates for such a mission, but Congress and the President will decide later whether or not to provide actual funds for the project. Some scientists have criticized the proposal.[70]

[70] See, for example, Richard A. Kerr, "Planetary Scientists Casting Doubt on Feasibility of Plan to Corral Asteroid, *Science,* 10 May 2013, Vol. 340, pages 668-669.

3.4 Other Obama Administration STI Initiatives

For fiscal year 2014 the President is also requesting funds for several other STI initiatives. These include the government's three large existing multi-agency R&D initiatives: the National Nanotechnology Initiative, Networking and Information Technology Research and Development, and the U.S. Global Change Research Program. New, smaller proposals include a $40 million request for a new Advanced Molecular Diagnostics (AMD) initiative at the Centers for Disease Control and Prevention.

3.5 Republican Proposals to Change Policies at the National Science Foundation

Most of this year's STI policy proposals come from President Obama and his administration. However, Republican members Congress have made two policy proposals concerning the National Science Foundation. The first has already become law. Both proposals are controversial.

3.5.1 NSF Funding for Political Science

This year Republicans succeeded in placing restrictions on NSF's support for research in political science.

Republicans have proposed this idea before. In the 1980s and 1990s, there were unsuccessful Republican efforts to cut or eliminate NSF funding for social science research. Then in 2009 Tom Coburn, a very conservative Senator from Oklahoma, introduced an amendment to prohibit NSF from funding research in political science. Critics opposed the amendment,[71] and it failed. In May 2012, the House of Representatives passed a similar amendment, sponsored by

[71] See, for example, Paul Krugman, "The Coburn amendment," *The New York Times,* October 8, 2009, http://krugman.blogs.nytimes.com/2009/10/08/the-coburn-amendment/.

Representative Jeff Flake of Arizona. The Senate did not accept this provision. This year, however, Senator Coburn succeeded in placing a revised version of his amendment into the large appropriations bill that funds government operations for the second half of fiscal year 2013. The revised version restricts NSF funding of political science to only those projects that the NSF Director certifies as "promoting national security and economic interests of the United States."[72]

A number of former presidential science advisors and NSF directors oppose this new provision. They have criticized political interference in what NSF funds. They also point out that the principal projects that NSF funds in political science are the American National Elections Study and the General Social Survey, two of the longest-running and most important public opinion surveys in the U.S.

3.5.2 The Proposed "High Quality Research Act"

The latest Republican proposal regarding NSF research funding comes from Representative Lamar Smith of Texas, the new Chairman of the House Committee on Science, Space, and Technology. A draft of the proposed "High Quality Research Act" would replace traditional peer review at NSF with a set of funding criteria chosen by Congress. According to a media report, "In effect, the proposed bill would force NSF to adopt three criteria in judging every grant," including that it is in the interests of the United States, is of the finest quality, and not duplicative.[73] While these new criteria may sound reasonable, scientists worry the new system would mean that members of Congress could regularly

[72] Jeffery Mervis, "Congress Limits NSF Funding for Political Science," *Science,* 29 March 2013, Vol 339, pages 1510-1511.
[73] Jeffery Mervis, "U.S. Lawmaker Proposes New Criteria for Choosing NSF Grants," *ScienceInsider,* 28 April 2013, http://news.sciencemag.org/scienceinsider/2013/04/us-lawmaker-proposes-new-criteri-1.html?rss=1. Additional information is available at Jeffrey Mervis, "Proposed Changes in Awarding Grants at NSF Spurs Partisan Sniping," *Science,* 10 May 2013, Vol. 340, page 670.

question and try to block any research grant that they felt did not meet these new Congressionally-imposed rules. Currently, peer reviewers at NSF use two criteria to evaluate grant proposals: intellectual merit and the "broad impacts" (benefits) for the scientific community and society.

In a statement from his committee, Congressman Smith argues that his bill would not make Congress "reviewers" of NSF grant proposals. He argues that he wants to add "accountability," although he does not say how the current NSF peer review system is inadequate or has failed.[74]

Several leaders of the U.S. scientific community oppose Mr. Smith's bill. On April 25, three former directors of NSF and three former chairmen of the National Science Board, NSF's board of directors, wrote to Congressman Smith and to the top Democrat on the Science, Space, and Technology Committee. They said, in part:

> We believe that this draft bill and the request to the Foundation will have a chilling and detrimental impact on the merit-based review process and the participation of an estimated 60,000 of the world's most outstanding researchers and educators with relevant scientific and technical expertise who voluntarily assist the nation by reviewing proposals submitted to the Foundation.[75]

Currently, we do not know whether or not Congress will adopt this controversial bill. But Congressional Democrats and the White House will probably oppose it.

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[74] "Chairman Smith's Statement on Draft Legislation," Committee on Science, Space, and Technology, U.S. House of Representatives, April 30, 2013, http://science.house.gov/press-release/chairman-smith%E2%80%99s-statement-draft-nsf-legislation.

[75] Richard M. Jones, "Former NSF Directors and NSB Chairmen Ask House Science Committee to Stop Action on Controversial NSF Legislation and Inquiry," *FYI: The AIP Bulletin of Science Policy News*, American Institute of Physics, Number 86, May 9, 2013, http://aip.org/fyi/2013/086.html.

4. CONCLUSION

President Obama proposes science, technology, and innovation initiatives as important investments in the nation's future – investments that are intended to improve public health, help create new industries, and provide good middle-class jobs for Americans. In particular, he has proposed major STI initiatives in manufacturing, climate and energy, and brain science.

However, President Obama faces very difficult budget constraints and a Republican opposition that appears to want to stop almost every one of his proposals. And in the case of manufacturing, he may have hurt his own position by offering so many different, and sometimes confusing, proposals.

In this political environment, the President will have a very hard time securing "new" (that is, additional) money for his projects. He may be able to use some money in existing budgets to provide modest funding for a few manufacturing institutes and some additional research in brain science and "big data." Using existing laws and funds already appropriated by Congress offers the President a way to launch some new programs even if he cannot persuade Congressional Republicans to pass new laws or give him new funds.

NASA may be a special case. NASA initiatives are driven less by the President's wishes than by a politically powerful coalition of Senators, Congressman, and aerospace contractors who want to maintain the space agency's budget and jobs. The proposed mission to study an asteroid is not exciting but it is more affordable than President Bush's ideas about returning to the Moon and going to Mars. So it may receive bipartisan support in Congress.

Even if President Obama's main STI initiatives do not receive full funding, they still are politically important. They make the argument that investments in new areas of science and technology can help the country, and they help define the public debate about what U.S. science and technology policy should be and do. Even if there is not money now for all of these proposals, the fact that the President has made them lays the foundation for possible funding in the future.