



THE CLEAN ENERGY MANUFACTURING AND MANUFACTURING COMPETITIVENESS POLICY LANDSCAPE

Memorandum Prepared for

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I. Introduction

For well over the past decade, U.S. manufacturing competitiveness and technological leadership in the global economy has been steadily eroding. Over six million American manufacturing workers have lost their jobs and nearly 60,000 (net) manufacturing plants (of all sizes) have been lost since 1998. Most of these losses occurred before the “Great Recession,” which continued to exacerbate this downward trend. At the same time, the United States has suffered from huge trade deficits and a steady increase in foreign import penetration into U.S. markets.

During the Bush Administration, there was little effort to address the growing erosion of U.S. manufacturing competitiveness, despite calls by industry, labor and policy makers for policies to revitalize American manufacturing and restore its leadership in global markets. On the other hand, the Obama administration has shown a substantially greater interest in supporting American manufacturing. In particular, to address the twin goals of stimulating economic growth and fostering environmental sustainability, it adopted a strategy that ties the revitalization of U.S. manufacturing to policies that promote a clean energy economy in the stimulus package passed as the American Recovery and Reinvestment Act (ARRA) of 2009.

Most of the clean energy policies in ARRA and other legislative proposals (including climate bills) were designed to stimulate and support the growth of clean energy (renewable energy sources and energy efficiency) markets. Of course, increasing the demand side of clean energy generation is critical for driving up the demand for manufacturing clean energy products and technologies. However, although the United States has pioneered many important renewable energy technologies, its major trade competitors—China, Germany, and Japan—are increasingly more likely to fill that demand than American manufacturers. Therefore, strengthening America’s manufacturing capacity to once again be competitive in supplying the growing demand for clean energy products, both domestically and globally, has also become an important policy goal.

This briefing memo, produced by High Road Strategies, LLC at the request of the Apollo Alliance, was motivated by the latter concern, and attempts to examine the scope and extent to which U.S. policies at the federal level are encouraging and supporting investments in domestic manufacturing capacity to manufacture clean energy products. First, it provides a broad overview of U.S. manufacturing policy, which has roots going as far back as the 1980s, when U.S. manufacturing competitiveness first emerged as a major policy concern. It then reviews of a wide range of clean energy manufacturing policies and programs, including but not solely ARRA related, which in reality, needs to be understood as a subset and an extension of general manufacturing policy.

II. Manufacturing Policy Overview

Legislation and federal policies aimed at promoting innovation and manufacturing competitiveness over the past three decades, while significant, have largely been ad hoc and uncoordinated. These include:

Technology Development and Industrial Innovation Policy—Technology advancement is critical for U.S. economic growth, productivity, and international competitiveness. Laws enacted to promote this goal include both direct and indirect measures to facilitate technological innovation.

- Direct measures involve budget outlays and provision of services by government agencies (federal funds for research, development, demonstration, testing and evaluation (R&D) of new technologies, products and processes).
- Indirect measures include financial incentives (e.g., R&D tax credits) and legal changes (e.g., intellectual property protections; liability or regulatory reform; new antitrust arrangements).
- Most of these efforts support the mission requirements of federal departments and agencies, which nevertheless have had significant commercial spillovers.
- Some agency initiatives are explicitly targeted to strengthen manufacturing.
- Key areas of direct and indirect R&D support include:
 - *Basic Research*—There is broad consensus that basic research provides the foundation for innovations and can generate high returns to society.¹ There usually has been strong bipartisan support for basic research programs supported by the National Science Foundation (NSF) and the basic research programs of major mission agencies (Department of Defense (DOD), National Institutes of Health, Department of Energy (DOE), National Aeronautics and Space Administration (NASA)).²
 - *Technology Innovation R&D*—The mission agencies also fund R&D activities aimed at fostering technology innovations that lead to new applications and commercial products. Major agencies and programs include the Defense Advanced Research Projects Agency (DARPA), the Department of Commerce (DOC)/National Institute of Standards and Technology's (NIST) Technology Innovation Program (TIP)³ and the DOE's Industrial Technology

¹ Wendy H. Schacht, *Industrial Competitiveness and Technological Advancement: Debate Over Government Policy*. CRS Report for Congress [RL33528]. Washington, DC: Congressional Research Service (CRS), November 5, 2009: 2.

² This includes the research agencies of the military services (Army Research Office (ARO), Air Force Office of Scientific Research (AFOSR), and Office of Naval Research (ONR)), and to some extent, the defense-wide research agency, the Defense Advanced Projects Research Agency (DARPA).

³ TIP replaced the Advanced Technology Program (ATP)—created by The Omnibus Trade and Competitiveness Act of 1988 (P.L. 100-418) at the Department of Commerce's NIST. ATP provided seed funding, matched by private sector investment, for companies or consortia of universities, industries, and/or government laboratories to accelerate development of generic technologies with broad application across industries. By the time ATP was terminated in 2007, 824 projects had been funding representing approximately \$1.6 billion

Program (ITP; see below) and the Advanced Research Projects Agency-Energy (ARPA-E).⁴

- *Cooperative R&D*—Cooperative academic and industry efforts aimed at increasing the potential for the commercialization of technology were initially enabled in the 1980s by the “Bayh Dole Act” and the National Cooperative Research Act (P.L. 98-462).⁵ Amendments to the latter in 1993 extended the original law’s provisions to joint manufacturing ventures.⁶
- *Technology Transfer*—Commercialization of technology involving the transfer of technology from federal laboratories and contractors to the private sector for commercialization was enabled by the Stevenson-Wydler Technology Innovation Act of 1980 (P.L. 96-480), as amended. The Federal Technology Transfer Act (P.L. 99-502) amended Stevenson-Wydler to allow government-owned, government-operated laboratories to enter into cooperative R&D agreements (CRADAs) with universities and the private sector.⁷
- *Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR)*—SBIR programs within the major federal R&D agencies are designed to increase participation of small, innovative companies in federally funded R&D. Extended several times, it requires a set percentage of each agency’s applicable extramural R&D budget. The STTR encourages firms to work with universities or federal laboratories to commercialize the results of research.⁸

in federal dollars matched by \$1.5 billion in private sector financing. Although TIP is similar to ATP in its intent to promote high-risk R&D with potential broad-based economic benefit to the nation, there are several differences in its operation. For example, TIP funding is limited to small and mid-sized business whereas ATP grants were available to companies regardless of size. Schacht, *Industrial Competitiveness*, 5-6.

⁴ Both TIP and ARPA-E were created by the America’s COMPETES Act of 2007.

⁵ This law is intended to use patent ownership as an incentive for private sector development and commercialization of federally supported R&D. Title to inventions made by contractors receiving federal research funds is to be vested in the contractor if they are small businesses, universities, or not-for-profit institutions. The National Cooperative Research Act (P.L. 98-462) clarifies antitrust laws, enabling and encouraging companies to undertake joint research. Wendy H. Schacht, *Cooperative R&D: Federal Efforts to Promote Industrial Competitiveness*. CRS Report for Congress [RL33526]. Washington, DC: Congressional Research Service (CRS), November 4, 2009.

⁶ National Cooperative Production Amendments Acts of 1993 (P.L. 103-42). Schacht, *Industrial Competitiveness*, 8; See also Schacht, *Cooperative R&D*.

⁷ This authority was extended to government-owned, contractor-owned laboratories by the Department of Defense FY 1990 Authorization Act (P.L. 101-189). See Schacht, *Industrial Competitiveness*. 9. The National Defense Authorization Act for FY1991 (P.L. 101-510) amended Stevenson-Wydler Technology Innovation to allow government agencies and laboratories to develop partnership to augment the transfer of laboratory technology to the small business sector. Schacht, *Ibid.* 9-10. The Technology Transfer Commercialization Act (P.L. 106-404) amended Stevenson-Wydler and Bayh-Dole, making it easier for federal agencies to license inventions with government held patents. See also Schacht, *Cooperative R&D*.

⁸ SBIR was initially funded by a 0.15 percent, phased in set-aside. The set-aside was increased to 0.3 percent in FY 2004. The program was supposed to sunset at the end of FY 2009, but has been temporarily extended. Schacht, *Industrial Competitiveness*, 5.

Financial Assistance—Various financial instruments (e.g., loan guarantees) and tax incentives can spur, aide, and supplement private sector investment in the development and commercialization of new product and process technologies. Key measures include:

- *Research and Experimentation Tax Credit*—A temporary tax credit, renewed repeatedly by Congress, to foster R&D spending by private firms. The 1981 Economic Recovery Tax Act (P.L. 97-34) provided a 25 percent tax credit for the increase in a firm’s qualified research costs above the average expenditures for the previous three tax years. Most recently, P.L. 110-343 retroactively extended the credit through the end of calendar year 2009.⁹
- *The Small Business Administration (SBA)*—As part of the White House’s Startup America initiative to accelerate high-growth entrepreneurship throughout the nation, SBA recently initiated a \$1 Billion Impact Investment Fund and a \$1 Billion Early-Stage Innovation Fund, as a match to private sector investment over the next five years in promising high-growth companies.¹⁰

Technical Assistance—Several federal agencies provide assistance to private sector firms (especially targeted to small manufacturers) for technology modernization, business development, and modernization. Major initiatives include:

- *NIST Hollings Manufacturing Extension Partnership (MEP)*—MEP works with small and mid-sized U.S. manufacturers to help them create and retain jobs, increase profits, and save time and money. Its nationwide network of over 400 centers, field offices and partners, provides a variety of services, such as helping firms adopt innovation strategies, make process improvements, and introduce green manufacturing practices. MEP works with partners at the state and federal levels on programs that put manufacturers in position to develop new customers, expand into new markets and create new products. Sustainability has become an important focus of MEP’s activities. This includes helping companies gain a competitive edge by reducing environmental costs and impact by developing new environmentally-focused materials, products and processes to gain entry into new markets.¹¹
- *DOE Industrial Technology Program (ITP) Industrial Assessment Centers (IACs)*—The ITP Industrial Technical Assistance program provides a number of

⁹ Qualified costs included in-house expenditures such as wages for researchers, material costs, and payments for use of equipment; 65% of corporate grants towards basic research at universities and other relevant institutions; and 65% of payments for contract research. Schacht, *Ibid*.

¹⁰ <http://www.sba.gov/startupamerica> and <http://www.sba.gov/content/impact-investment-initiative>.

¹¹ As of July 2010, NIST MEP had completed over 50 sustainability-related projects, with a goal of completing 100 by the end of the year. The Economy, Energy, and Environment (E3) program is one of several partnerships through which MEP works to meet these targets. NIST MEP, “Economy, Energy and Environment: Going Green in the Black. Press Release. July 21, 2010. http://www.nist.gov/mep/mep_072110.cfm.

services and activities that support private sector firms in their efforts to reduce their energy use and carbon footprints. This includes the IACs, a network of 26 university-based centers that help industrial firms make energy-efficiency improvements (see below).

Workforce Development—The Department of Labor (DOL)’s Employment and Training Administration (ETA) supports workforce training and development programs some of which are tailored to develop the skilled workforce needed by modern, advanced manufacturers. Most ETA programs targeted to manufacturing are for worker adjustment and rapid response programs triggered by mass plant closures and layoffs, mainly due to trade-related factors. DOL ETA, however, has been involved in partnerships with other federal agencies in initiatives to promote economic development and clean energy manufacturing, such as regional innovation clusters (see below). The America COMPETES Act is a major recent initiative that includes programs that promote science, technology, engineering and mathematics (STEM) education with a focus on competitiveness.

Economic Development—The DOC’s Economic Development Administration (EDA) is the primary federal economic development agency, established in 1965 to aid efforts of communities suffering from long-term economic distress and sudden dislocations, to help them grow their economies, and respond to economic shocks. The Obama Administration has engaged EDA as a key agency in promoting innovative economic development strategies, which include projects with an emphasis on fostering economic growth, industrial innovation and competitiveness.

- *EDA’s Regional Innovation Clusters (RICS)* program is an important initiative designed to support industrial cluster efforts across the nation. RICs are defined as geographically-bounded, active networks of similar, synergistic or complementary organizations which leverage their region’s unique competitive strengths to create jobs and broader prosperity.¹² The Obama administration’s FY2011 budget request included several proposals to support regional industry or innovation “clusters” through multiple federal departments (EDA, DOL, SBA, and the Department of Agriculture), which could put the U.S. on par with other nations in providing support to these systems of business development.¹³

¹² Economic Development Administration, “Regional Innovation Clusters Initiative Overview.” Slideshow presentation. March 1, 2010. See also <http://www.eda.gov/AboutEDA/RIC/>.

¹³ In this proposal, EDA’s Regional Innovation Clusters program (a \$75 million request) would provide regional planning and matching grants focused on leveraging regions’ competitive strengths to boost job creation and economic growth; The Department of Labor (DOL) would use its programs (an estimated \$108 million) to help ensure that the workforce development system aligns with regional cluster growth; The Small Business Administration would direct \$11 million toward promoting greater small business participation in regional clusters; and the US Department of Agriculture would align federal resources to promote economic opportunities in rural communities. See Mark Muro, “Budget 2011: Industrial Clusters as a Paradigm for Job Growth.” *Brookings Up Front Blog*, Washington, DC: The Brookings Institution, February 3, 2010. Accessed April 5, 2011. http://www.brookings.edu/opinions/2010/0202_fy11budget_cluster_muro_rahman.aspx.

Trade and Export Policies—Policies aimed at leveling the playing field for U.S. manufacturers in global markets are beyond the scope of this analysis, but nonetheless critical to U.S. manufacturing competitiveness. These include policies addressing currency manipulation, unfair trade practices, lax labor and environmental standards, etc. of international competitors, as well as Buy America/domestic content provisions and policies to support U.S. exports. Many of these policies are hotly debated and are proposed but not enacted.

III. Major Enabling Legislation for Clean Energy Manufacturing

Specific clean energy manufacturing and related programs and policies fall within the general manufacturing policy framework above. Most of these were established or enabled by several major authorization or appropriation bills enacted over the past half decade. These bills and the main provisions relevant to clean energy, and especially clean manufacturing include:

- ***Energy Policy Act of 2005 (EPACT, P.L. 109-58)***—*EPACT* authorized several new programs and spending for renewable energy, many of which, however were unfunded or funded below authorized levels—though several were finally funded by *American Recovery and Reinvestment Act (ARRA) of 2009* (see below). For example, it authorized a DOE *Loan Guarantee Program* (Title 17), which gives DOE broad authority to guarantee loans that support early commercial use of advanced technologies. It also established the structure of the *Alternative-Fueled Vehicles* program which provides grants to states, localities and metropolitan transit agencies, that can be used for the purchase of alternative fuel and advanced technology vehicles. Both were later funded by *ARRA*.¹⁴
- ***Energy Independence and Security Act of 2007 (EISA, P.L. 110-140)***—*EISA* expanded the renewable fuel mandate in *EPACT 2005*, and significantly tightened federal fuel economy (CAFE) standards. Its *Title VI* directed DOE to conduct several new programs to accelerate the development of renewable and hydrogen technologies, though the FY2009 continuing appropriations bill (P.L. 110-329) did not include new funding for these programs. *EISA* also expanded the range of facilities for DOE loan guarantees: *section 134* amended *EPACT Title 17* to establish a loan program for facilities that manufacture fuel efficient vehicles or parts of those vehicles and *section 135* allows DOE, under certain conditions, to establish a loan guarantee program for the construction of facilities that manufacture advanced vehicle batteries and battery systems. *EISA Title 10* expanded the Workforce Investment Act (WIA) of 1998 to include a new *Energy Efficiency and Renewable Energy Worker Training Program (§17[e])*.¹⁵
- ***Emergency Economic Stabilization Act of 2008 (P.L. 110-343)***—The Energy Improvement and Extension Act (EIEA) of 2008, enacted as Division B of

¹⁴ Fred Sissine, *Renewable Energy: Background and Issues for the 110th Congress*, CRS Report for Congress [RL34162]. Washington, DC: Congressional Research Service, December 10, 2008.

¹⁵ *Ibid.*

this bill, contained several clean energy tax incentives, including renewable electricity production tax credit (PTC), solar investment tax credits (ITC), Clean Renewable Energy Bonds (CREBs) and Energy Conservation Bonds (ECBs).¹⁶

- ***America Creating Opportunities to Meaningfully Promote Excellence in Technology, Education, and Science (COMPETES) Act of 2007 (P.L. 110-69)***—A response to concerns about the potential erosion of U.S. industrial competitiveness and global technological leadership, the COMPETES Act provides for investments in science and engineering research and science, technology, engineering, and mathematics (STEM) education. This includes increased support for the DOE’s *STEM* and its *Office of Science*. The act also authorized within DOE the establishment of the Advanced Research Projects Agency-Energy (ARPA-E). Many programs have subsequently been funded by the ARRA and other appropriations bills, some at authorized levels, some not.¹⁷
- ***American Recovery and Reinvestment Act (ARRA) of 2009 (P.L. 111-5)***—ARRA includes a number of clean energy appropriations and tax incentive provisions. These include several DOE Office of Energy Efficiency and Renewable Energy (EERE) programs (renewable energy RDD&D, energy efficiency and conservation block grants, state energy grant program, and advanced battery/battery component manufacturing facilities and electric vehicle technologies grants); DOE’s Office of Science, ARPA-E, and the innovative technology loan guarantee program (created by EPACT 2005). ARRA’s energy tax provisions include CREBs, ECBs, and tax credits for advanced energy manufacturing facilities (Section 48C) and alternative fuels and vehicles.¹⁸
- ***America Competes Reauthorization Act of 2010 (P.L. 111-358)***—This law authorizes the continued growth of the budgets (FY2011-FY2013) of three key agencies that are incubating and generating the technological breakthroughs, including the R&D development activities of the Department of Energy’s Office of Science, the laboratories NIST, and NSF. COMPETES also bolsters this Administration’s activities to enhance STEM education. It further authorizes NIST grants within the Hollings MEP support energy efficiency, and green jobs and business solutions, and authorizes ARPA-E to support energy technology projects which identify and promote revolutionary advances in applied sciences. This includes R&D of advanced manufacturing process, technologies for the

¹⁶ Ibid.

¹⁷ John E. Sargent Jr. *America COMPETES Act and the FY 2010 Budget*. CRS Report for Congress [R40519]. Washington, DC: Congressional Research Service, June 15, 2009.

¹⁸ Outside DOE, ARRA funded DOD energy efficiency technology demonstration and research programs (including energy-efficient manufacturing enhancements), and DOL’s Training and Employment Services for research, labor exchange, and job training programs that prepare workers for careers in energy efficiency and renewable energy. Fred Sissine, Anthony Andrews, Peter Folger, et al. *Energy Provisions in the American Recovery and Reinvestment Act of 2009 (P.L. 111-5)*. CRS Report for Congress [R40412]. Washington, DC: Congressional Research Service, March 12, 2009.

domestic manufacturing of novel energy technologies, and for accelerating transformational technological advances.¹⁹

IV. Clean Energy Manufacturing Programs and Policies

Most clean energy legislation and policies have been oriented towards promoting and expanding the demand for clean energy production, rather than to build up the capacity of U.S. manufacturers to produce technologies, equipment, and processes used in clean energy generation. Nevertheless, there are a number of U.S. federal policies and programs relevant to the development and promotion of clean energy manufacturing.

Technology Development and Innovation Policy:

- *DOE's Office of Science (SC)*—The purpose of this office is to deliver scientific discoveries and major scientific tools to transform our understanding of nature and to advance the energy, economic, and national security of the nation. SC is the largest federal sponsor of basic research in the physical sciences, supporting about 27,000 investigators at about 300 U.S. academic institutions and at all of the DOE laboratories, for which it has oversight responsibility. It also manages DOE's SBIR/STTR program. SC received an appropriation of \$4.96 billion in FY 2010, \$4.90 in the FY2011 continuing resolution, and \$5.42 billion in the administration's proposed FY 2012 budget.
- *DOE Office of Energy Efficiency and Renewable Energy (EERE) RDD&D*—EERE manages R&D programs on the development of a wide range of renewable energy technologies. The administration is requesting a large (73 percent) increase in funding for the EERE's renewables RDD&D program for technology development in FY 2012 (\$2.96 billion) over FY 2010 funding levels (\$1.72 billion). Substantial increases are proposed for solar, wind, geothermal, biomass and vehicles (batteries, EV) technologies R&D in FY 2012 over the FY 2010 levels, though cuts are proposed for water power and hydrogen and fuel cell technologies.²⁰
 - *DOE Energy Innovation Hubs*—Hubs are major multidisciplinary, multi-investigator, multi-institutional integrated research centers bringing together top researchers from academia, industry and government laboratories to make transformative advances in clean energy technology. The first three Hubs, with initial awards in 2010 of \$22 million, are focused on building efficiency, fuels from sunlight, and nuclear energy.²¹ Three new

¹⁹ See Congressional Budget Office, "Budget Report: H.R. 5116 [111th]: America COMPETES Reauthorization Act of 2010." As ordered by the House Committee on Science and Technology on April 28, 2010." May 6, 2010.

<http://www.govtrack.us/congress/billreport.xpd?bill=h111-5116&type=cbo>. See also <http://www.govtrack.us/congress/bill.xpd?bill=h111-5116&tab=summary>.

²⁰ Henry Kelly, *The FY 2012 Budget Request*. Slideshow. DOE EERE, March 2011.

²¹ U.S. Department of Labor, "Energy Innovation Hubs." See <http://www.energy.gov/hubs/index.htm>.

Energy Hubs are proposed in the FY 2012 budget, on critical materials and rare earth minerals, energy storage and batteries, and new Smart Grid technologies.

- *DOE Industrial Technology Program (ITP)*—A major program within EERE, ITP’s mission is to significantly reduce the intensity of energy use (energy per unit of output) by the U.S. industrial sector through research, development, and demonstration (RD&D) of next-generation manufacturing technologies. ITP provides cost-shared funding to develop transformational technologies for industry, which offer large energy savings. Its R&D portfolio targets energy intensive industries and crosscutting technologies that benefit multiple industries. ITP received \$94.3 million in FY 2010, and the Administration requested \$100.0 million in FY 2011 and \$319.8 million in FY 2012. ITP’s long-standing (specific) Industries of the Future (IOF) program, which involved collaborative R&D partnerships in eight critical energy intensive industries, received \$11.9 million in FY 2010, but was zeroed out in the FY 2012 budget. Instead, three new initiatives have been proposed:²²
 - *Next Generation Materials* (request of \$100.8 million in FY 2012)—Competitively selected R&D projects that focus on innovations in materials and materials processing technologies. Establishes an *Energy Innovation Hub for Critical Materials* to fund R&D on novel approaches to reducing our dependence on critical materials and R&D leading to material and technology substitutes to meet the material needs of the clean energy economy.²³
 - *Next Generation Manufacturing Processes* (\$129.0 million)—Competitively selected R&D projects that focus on innovation in manufacturing processes to achieve step-change reductions in energy and carbon footprints. This program involves a refocusing of the *IOF Crosscutting* activities of the ITP. It aims to develop a suite of advanced manufacturing technologies that provide pathways for doubling the energy productivity of U.S. industry.²⁴
 - *Manufacturing Energy System Partnerships* (\$15.0 million)—Would support three knowledge development and dissemination centers to help solve critical manufacturing issues and accelerate emergence of the most promising clean energy technologies into full-scale manufacturing.²⁵
- *Advanced Research Projects Agency-Energy (ARPA-E)*—Modeled on DARPA, ARPA-E supports transformational energy technology research projects. Congress established ARPA-E within DOE in August 2007, as part of the *America COMPETES Act*, authorizing \$300 million for the new agency, but appropriating

²² Kelly, *FY 2012 Budget*. U.S. DOE Office of Chief Financial Officer (CF), *Department of Energy FY 2012 Congressional Budget Request*. DOE/CF-0059, Volume 3. February 2011, 251-266.

²³ Both the *Next Generation Materials* subprogram and *Energy Innovation Hub for Critical Materials* received no funding in FY 2010. The Hub FY 2012 request is \$20 million. U.S. DOE CF, *Ibid*.

²⁴ The IOF Crosscutting program received \$51.6 million in FY 2010. The FY 2012 request for this subprogram includes a request for \$3.6 million for SBIR/STTR. U.S. DOE CF, *DOE FY 2012 Budget Request*, Volume 3, 258.

²⁵ U.S. DOE CF, *DOE FY 2012 Budget Request*, Volume 3, 264.

no funds for FY 2008. The Bush Administration requested no funds for ARPA-E in FY2009 and took no actions to begin its operations. In ARRA, however, Congress provided ARPA-E initial funding of \$400 million that supplemented FY2009 funds of \$15 million.²⁶ Funding dropped to zero in FY2010, but the Administration has requested \$300 million for FY 2011 and \$550 million for FY 2012. Of the \$387 million appropriated for ARPA-E in ARRA, only \$92 million has been obligated or spent thus far.²⁷

- *Advanced Battery Manufacturing Grants*—ARRA established a new program of nearly \$2.0 billion for facility funding grants to manufacturers of advanced battery and battery system components. Covered activities include the production of lithium ion batteries, hybrid electrical systems, system components, and software.²⁸ In the first wave of awards in early 2010, 48 projects were announced to develop and deploy batteries and EV components in the United States.²⁹ Out of the \$1.99 billion appropriated in ARRA \$566.8 million has been obligated or spent for this programs so far.³⁰

Financial Assistance

- *Advanced Energy Manufacturing Tax Credit (MTC; Sec. 48 C)*—Established by ARRA, the provision provides a 30 percent tax credit for investments in new, re-equipped, or expanded advanced energy manufacturing facilities designed to make equipment to produce renewable energy equipment and technologies.³¹

²⁶ Deborah D. Stine, *Advanced Research Projects Agency-Energy (ARPA-E): Background, Status, and Selected Issues for Congress*. CRS Report for Congress [RL34497]. Washington, DC: Congressional Research Service, April 29, 2009.

²⁷ U.S. Department of Energy (DOE), *Energy.gov/Recovery Table*. Excel Spreadsheet. Data is as of March 18, 2011. <http://www.energy.gov/recovery/data.htm>.

²⁸ Barbara Somson. *Testimony of Barbara Somson, Legislative Director, International Union, United Automobile, Aerospace & Agricultural Implement Workers of America (UAW), on the subject of Clean Air Act and Jobs, before the Senate Committee on Environment and Public Works, Subcommittee on Clean Air and Nuclear Safety and the Subcommittee on Green Jobs and the New Economy*, March 17, 2011. This project promotes domestic manufacturing of advanced batteries and electric drive-trains through competitive grants. The project will support overall program goals of: 1) reduce the cost of Plug-In Hybrid Electric Vehicle (PHEV) battery to \$300/kWh by 2014 and 2) reduce the cost of PHEV electric drive systems to \$14/kWh by 2014. Somson testified that in 2009, the United States had only two factories manufacturing advanced vehicle batteries and produced less than two percent of world's advanced batteries. With matching grants under ARRA, we will have 30 plants operational by 2012, producing 20 percent of world's advanced batteries. By 2015 this share is projected to grow to 40 percent.

²⁹ Alan Baum and Daniel Luria, *Driving Growth: How Clean Cars and Climate Policy Can Create Jobs*. Report prepared for the Natural Resources Defense Council, United Auto Workers and Center for American Progress. March 2010.

³⁰ DOE, *Energy.gov/Recovery Table*.

³¹ These include solar, wind, geothermal, and other), fuel cells, microturbines, energy storage systems for electric/hybrid vehicles, certain electric grid equipment, renewable fuels property, energy efficiency technologies, smart grid equipment, plug-in hybrid vehicles, carbon capture and sequestration equipment, and other kinds of equipment. "Fact Sheet: \$2.3 Billion in New Clean Energy Manufacturing Tax Credits." ENERGY.GOV. January 8, 2010. <http://www.energy.gov/news/8503.htm>. See also The White House, Office of the Press Secretary, "President Obama Awards \$2.3 Billion for New Clean-Tech Manufacturing Jobs." Press

ARRA allowed up to \$2.3 billion in credits to be allocated, which will support total capital investments of almost \$7.7 billion in new renewable and advanced energy manufacturing projects. This funding was exhausted after less than a third of the 418 projects deemed eligible received the tax credits. It is estimated that more than \$5.8 billion in eligible applications remain unfunded, indicating a deep pipeline of high quality clean energy manufacturing opportunities in the United States. Credits were approved for total 183 manufacturing facilities for clean energy products across 43 states. The Administration has requested an additional \$5 billion for MTC in FY2012.³²

- *DOE Advanced Technology Vehicles Manufacturing Loan Program (ATVMLP)*—Established under Section 136 of EISA, the ATVMLP provides direct loans to support the development of advanced technology vehicles and associated components in the United States. Specifically, it provides loans to automobile and automobile parts manufacturers for the cost of reequipping, expanding, or establishing manufacturing facilities in the United States to produce advanced technology vehicles or qualified components, and for associated engineering integration costs. In 2010, Section 136 was amended to include ultra-efficient vehicles within the definition of advanced technology vehicles. ARRA appropriated \$10 million for the ATVMLP, of which \$8.3 million has been spent. The FY 2010 appropriations and FY 2011 Continuing Resolution provided \$20 million for the program, but only \$6 million was requested for FY 2012.³³
- *DOE Section 1705 Temporary Loan Guarantee Program*—EPACT 2005 Title 17 established a loan program to encourage early, commercial use of new or significantly improved technologies in energy projects. Section 1703 of the Act authorized DOE to provide loan guarantees for innovative clean energy projects.³⁴ ARRA (Section 406) amended Title 17, establishing Section 1705 as a temporary program to provide loan guarantees for renewable energy manufacturing projects or facilities located in the United States, which

release. January 8, 2010. <http://www.whitehouse.gov/the-press-office/president-obama-awards-23-billion-new-clean-tech-manufacturing-jobs>

³² Senators Sherrod Brown (D-OH) and Maria Cantwell (D-WA) have (or plan to?) reintroduce the Security in Energy and Manufacturing (SEAM) Act, which authorizes an additional \$5 billion for the MTC. In addition, it allows for grants in lieu of tax credits, which enables the program to reach additional companies that otherwise would be unable to utilize the program. This is especially true for new companies that do not yet have tax liability or companies that struggle to find credit in today's tight financial market. The legislation is being backed by the USW, NRDC, CAP, Solar Energy Industries Association (SEIA), AFL-CIO, and the Great Lakes Wind Network. "Security in Energy and Manufacturing (SEAM) Act." Summary Sheet. Email communication. March 16, 2011.

³³ DOE, *Energy.gov/Recovery Table*; Dept. of Energy Budget by Organization. Statistical table; U.S. Department of Energy, FY 2012 Statistical Tables by Appropriation (OMB Scoring). Statistical Table. February 12, 2011; Downloaded from Energy.gov.

³⁴ These include renewable energy systems, advanced nuclear facilities, coal gasification, carbon sequestration, and various other types of projects. U. S. DOE Office of Chief Financial Officer (CF), *Department of Energy FY 2012 Congressional Budget Request*. DOE/CF-0058, Volume 2. February 2011, 244. The FY 2012 request for this program is \$200 million.

manufacture commercial technology products that support the generation of electricity or thermal energy from renewable resources. ARRA has appropriated \$2.45 billion³⁵ to cover credit subsidy costs for all projects, potentially leveraging from \$17 to \$50 billion of loan guarantees.³⁶ However, so far, only \$393 million has been obligated, and \$96.6 billion spent in the program. There are no new funds proposed in the FY 2012 budget request.³⁷

Technical Assistance

- *DOE ITP Industrial Technical Assistance (ITA)*—In addition to supporting R&D programs, ITP provides assistance to and works in partnership with industries to achieve energy savings and carbon reductions. Its activities include disseminating energy tools, and training to state, utility, and local partners; identify plant-wide opportunities for energy savings and process efficiency; training and engaging students and manufacturing delivery activities; and promoting a culture of energy efficiency and carbon management throughout industry. ITA received \$31 million in the FY 2010 appropriations. The FY 2012 budget proposes \$75.0 million. It manages the following sub-programs:³⁸
 - *Industrial Assistance Centers (IACs)*—Established at 26 universities across the nation, employing local teams of engineering faculty and students, the IACs provide no cost energy assessments to small-and-medium-sized manufacturers. IACs received \$3.9 million in the FY 2010 appropriations. The FY 2012 budget proposes \$11.0 million, to conduct up to 300 energy audits of small and medium-sized manufacturing plants while providing training to 200 engineering students in energy efficiency, continue development of and launch an industrial energy efficiency certification program, and initiate a partnership with NIST’s MEP to help American manufacturers upgrade existing energy efficient technologies.
 - *DOE ITP SaveEnergyNow (SEN) LEADER Partnerships*—ITP partners with industrial companies, plants, and supply chains to reduce their energy

³⁵ ARRA originally allocated \$6 billion to the loan guarantee program, but government budget rescissions slowly cut the total to the lower level. Richard Caperton, “Invest in America’s Clean Energy Future, Congress Should Embrace the DOE Loan Guarantee Program.” Washington, DC: Center for American Progress, March 2011: 3. DOE, *Energy.gov/Recovery Table*.

³⁶ An average project has a credit subsidy cost in the range of 5 percent to 15 percent of the total value of the loan guarantee, which yields this range of loan guarantees. Credit subsidy costs refer to the amount the federal government allocates to cover the risks of borrowers not paying back their loans when it issues a loan guarantee. Caperton, “Invest in America’s Clean Energy Future,” 3.

³⁷ Capperton warns that a House proposal would take back the \$2 billion that has not yet been ‘obligated’ to specific projects. He notes that “[g]uarantees whose funds have been ‘obligated’ are now ‘closed’ in DOE parlance. Fewer than 20 projects have closed to date and less than \$500 million in funds has been ‘obligated.’ But a robust pipeline of projects is set to close by September 2011. Many projects were given ‘conditional commitments’ which include specific terms and are expected to eventually close. But funds set aside for “conditional commitments” have not been ‘obligated’ in the technical sense.” Caperton, “Invest in America’s Clean Energy Future,” 3-4.

³⁸ DOE FY 2012 Budget Request, Volume 3, 261-264.

intensity by at least 2.5 percent annually over 10 years.³⁹ SEN helps energy-intensive plants implement cost-effective energy-saving and carbon reducing technologies through dissemination of energy tools, information, and training. ITP continues to provide industrial process application tools for evaluating major energy systems (e.g., steam, pumping, process heating, etc.). SEN received \$27 million in the FY 2010 appropriations and \$10 million is requested for FY 2012.

- *Energy Efficiency Partnerships*—A newly proposed program, with a \$50 million request in the Administration’s FY 2012 budget request, supports a partnership between DOE and NIST. The program would accelerate development of advanced technologies that allow existing manufacturing facilities to access energy efficient technologies including, but not limited to, cogeneration, and waste heat recovery.⁴⁰
- *ISO/ANSI Standards Certification*—The FY 2012 ITP budget request includes \$4 million (it received nothing in FY 2010) to continue development and launch of a “credible, transparent industrial efficiency certification program that uses recognized standards (ISO 50001 Energy Management Standard, Measurement and Verification (M&V) protocol, and system assessment standards).⁴¹
- *Economy, Energy and Environment (E3) Program*—Evolving out of the EPA’s Green Suppliers Network program, *E3* (established September 25, 2010) is a coordinated federal and local technical assistance initiative to help manufacturers adopt sustainability practices. A collaboration of 5 federal agencies—EPA, DOC (NIST MEP), DOE (ITP), DOL (ETA) and SBA—, state and local governments, utilities and manufacturers, *E3* provides technical assessments of production processes (reviews, audits, evaluations, and post-assessment recommendations) and training in the areas of lean production, clean production, energy, and greenhouse gas emissions. A key goal is to create incumbent workers certified in emerging green industries. It is currently completing two pilot projects in Columbus, OH—working with six manufacturers, the city government, the Solid Waste Authority of Central Ohio, and American Electric Power, to conduct technical assessments and provide training—and San Antonio, TX—working with CPS Energy, the city government and six manufacturers. A new *E3 Initiative* in Milwaukee, WI, was announced on February 17, 2011.⁴²

³⁹ DOE FY 2012 Budget Request, Volume 3, 262. As of December 2010, 104 firms had signed a SEN LEADER Pledge to reduce their energy intensity by 25 or more in 10 years.

⁴⁰ Ibid., 261.

⁴¹ Ibid.

⁴² See <http://www.epa.gov/greensuppliers/e3.html>. For information about the Milwaukee E3 (ME3) Program see <http://city.milwaukee.gov/ME3>

Workforce Development

- *DOE ITP BestPractices*—Funded as part of the ITP’s Industrial Technical Assistance programs, the DOE’s *ITP BestPractices* program provides tools, training and resources for plant managers to assess and utilize efficient, new technology to achieve energy savings at their plants. This includes helping managers conduct energy audits and assessments, which entail collecting energy and facility data and performing an analysis of opportunities, as well meet their training needs. The program also makes available Qualified Specialists, trained in *BestPractices* assessment and analysis software tools, to help facilities identify ways to improve system efficiently. In addition, *BestPractices* offers system-wide and component-specific training programs to help managers run their plants more efficiently.⁴³
- *Training Grants for Green Jobs and Emerging Industry Sectors (ARRA High Growth and Emerging Industries Grant)*—ARRA appropriated \$750 million to the DOL ETA for competitive training grants for worker training and placement in green jobs and high growth and emerging industry sectors, with emphasis on careers in energy efficiency and renewable energy (i.e., “clean energy”). Of this, \$500 million was provided for research, labor exchange and job training projects that prepare workers for “green jobs,” or careers in clean energy. The remainder of the money is to prepare workers for careers in health care. DOL awarded a total of 244 grants. This includes over \$48.5 million in labor market research to assess economic activity in the energy efficiency and renewable energy industries, and identify occupations within those industries,⁴⁴ \$5.8 million for building the green training capacity of current DOL grantees, and \$435.5 million for training projects preparing workers to enter the clean energy industries, as well as green occupations within other industries.⁴⁵

Economic Development

- *i6 Green Challenge*—In March 2011, the DOC’s EDA and Office of Innovation and Entrepreneurship announced, \$12 million in funding for this initiative, in partnership with the DOE, EPA, EPA, NIST/MEP, USDA, NSF and the U.S. Patent and Trademark Office.⁴⁶ *i6 Green* is designed to encourage innovative,

⁴³ See <http://www1.eere.energy.gov/industry/bestpractices/conducting.html>.

⁴⁴ According to the DOL Recovery Plan, these grants invest in state and consortium models designed to collect, analyze, and disseminate labor market information, and enhance the labor exchange infrastructure for careers within” these industries. U.S. Department of Labor (DOL), “II. Program Specific Recovery Plan for Recovery.gov (Q. 2.8 of Guidance). Training Grants for Green Jobs and Emerging Industry Sectors.” <http://www.dol.gov/recovery/plans.htm#DOL>.

⁴⁵ These grants were provided to partnerships made up of diverse set of stakeholders including labor organizations, public or private employers in the clean energy industries, and the workforce system. DOL, “II. Program Specific Recovery Plan.”

⁴⁶ EDA will award up to \$1 million to each of six teams around the country with the most innovative ideas to drive technology commercialization and entrepreneurship in support of a green innovation economy,

groundbreaking ideas that accelerate technology commercialization, new venture formation, and job creation across the United States. This year's challenge focuses on both regional economic development and environmental sustainability. *i6 Green* will reward communities that utilize "Proof of Concept Centers" to accelerate technology-led economic development in pursuit of a vibrant, innovative clean economy. These centers will be supported by regional partnerships that draw upon a wide range public, corporate, university, non-profit, and philanthropic stakeholders.⁴⁷

- *EDA Energy-Regional Innovation Clusters (E-RICs)*—E-RICs are RICs oriented around energy technologies and industries within a region. August 24, 2010, the Department of Energy announced the selection of the Greater Philadelphia Innovation Cluster (GPIC), a team led by Pennsylvania State University, to run the DOE-supported *Energy-Efficient Buildings System Design Hub*, which will anchor the cluster. Seven federal agencies will provide a combined \$129.7 million over 5 years to support the cluster. These include the DOE, DOC/EDA, DOC/NIST MEP, SBA, DOL, NSF, and Department of Education (ED).⁴⁸ Although this cluster award was for a regional project focused on green buildings and construction, it is possible to conceive later ones that could be focused on regional clean energy manufacturing clusters.

Trade and Export Assistance

- *Export-Import Bank of the United States (Ex-Im Bank): Environmental Exports Program*—The Ex-Im Bank is the official export credit agency of the United States. The Bank provides a variety of financing products, including working capital guarantees, export-credit insurance, medium-to long-term loan guarantees, long-term direct loans and other financing to help foreign buyers purchase U.S. capital goods and services. The Bank's Environmental Exports Program⁴⁹ helps mitigate risk for U.S. environmental companies and offers competitive financing terms to international buyers for the purchase of U.S.-made environmental goods—such as renewable energy equipment, energy-efficiency technologies, air pollution technologies, and the like.⁵⁰

increased U.S. competitiveness and new jobs. Its partner agencies will award more than \$6 million in additional funding to *i6 Green* winners. <http://www.eda.gov/i6>.

⁴⁷ U.S. Economic Development Administration, "i6 Challenge Bring Innovative Ideas to Market." <http://www.eda.gov/i6>

⁴⁸ GPIC will be located at the Philadelphia Navy Yard. The E-RIC will integrate this Hub into a broader regional economic development initiative by linking it with complementary federal and non-federal investments in business development and support, public infrastructure, workforce development, and education. <http://www.energy.gov/hubs/eric.htm>. More information on GPIC can be found here: <http://www.gpichub.org>

⁴⁹ See <http://www.exim.gov/products/policies/environment/>.

⁵⁰ See for example: Chris Meehan, "Export from First Solar, Infinia provide force behind U.S. loans," *CleanEnergy Authority.com*, April 4, 2011, <http://www.cleanenergyauthority.com/solar-energy-news/first-solar-opening-manufacturing-plant-in-az-032911/>; Linda Formelia, "Gamesa Is Named Ex-Im Bank's Renewable-Energy

V. Conclusion

Although some very good policies have been applied to generally supporting U.S. manufacturing competitiveness and, in particular, promoting the growth of clean energy manufacturing, especially over the past few years, these initiatives have largely been ad hoc and uncoordinated. Unlike most of its major trade competitors, the United States lacks a comprehensive, coordinated industrial strategy to promote American manufacturing competitiveness, much less to support a robust, competitive clean energy manufacturing sector. Recently, however, the Obama Administration appears to be taking steps towards crafting a more coordinated manufacturing policy and for the first time, there are serious proposals,⁵¹ including legislation introduced in Congress,⁵² for establishing a national manufacturing strategy.

A few important clean energy manufacturing initiatives were enacted during the Bush years—including critical enabling legislation. However, ARRA and other measures introduced after Obama Administration took power, are very promising, as they reflect a stronger, more focused effort to encourage investment in clean energy technology innovation and manufacturing than ever before (for example, the ARRA manufacturing tax credit (Section 48C)). Unfortunately, ARRA initiatives were designed as temporary measures, though there remains a great deal of ARRA funding still unspent. As indicated in the FY 2012 Congressional Budget request, the administration appears to remain interested in promoting both clean energy production and clean energy product manufacturing capacity in the United States, which it sees as key to restoring U.S. manufacturing competitiveness in general. However, in the current political environment, the fate of these initiatives remains uncertain.

Exporter Of The Year.” *News from the Export-Import Bank of the United States*, March 29, 2011, <http://www.exim.gov/pressrelease.cfm/032C7631-BE53-FF36-5BDBAFD2E3943DA8/>.

⁵¹ See for example: Stephen J. Ezell and Robert D. Atkinson, *The Case for a National Manufacturing Strategy*, Washington, DC: The Information Technology & Innovation Foundation, April 2011; “Manufacturing Our Way to a Stronger Economy,” Testimony of Leo W. Gerard, International President, United Steel, Paper and Forestry, Rubber Manufacturing, Energy, Allied Industrial and Service Workers International Union (USW), AFL-CIO, Before the Senate Committee on Commerce, Science and Transportation, May 11, 2011.

⁵² U.S. Rep. Dan Lipinski (D-IL)’s bipartisan National Manufacturing Strategy Act passed the house in 2010 379-38. Lipinski and U.S. Senate Sherrod Brown (D-OH) announced in April 2011 announced bills to require the development of a national manufacturing strategy to boost both traditional and high-tech manufacturing. Meanwhile, the America COMPETES Act, passed December 2010, includes a National Economic Competitiveness Strategy that echoes the Lipinski proposal. See IW Staff, “Will the U.S. Finally Get a National Manufacturing Strategy?” *Industrial World*, April 7, 2011. http://www.industryweek.com/articles/will_the_u_s_finally_get_a_national_manufacturing_strategy_24330.aspx?SectionID=23.