

PREPARING AMERICA'S WORKFORCE FOR JOBS IN THE GREEN ECONOMY: A CASE FOR TECHNICAL LITERACY

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I. INTRODUCTION

The emerging clean energy economy is already creating millions of jobs and generating trillions of dollars in economic activity across the globe.¹ One characteristic of these jobs is that they span industries and occupations and provide opportunities for low-, middle-, and high-skill workers.²

As with other industries, though, the highest-quality jobs in this new clean energy sector will be in more knowledge-intensive occupations. These jobs run the gamut from research and development to engineering, architecture, advanced manufacturing, construction, and operations and maintenance. Despite their differences, though, these jobs all have two things in common: they require workers to have a solid foundation in basic technical skills, including both academic and practical skills;³ and they often require post-secondary credentials that are specific to the particular clean energy job in question.⁴

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1. See RON PERNICK ET AL., CLEAN EDGE, INC., CLEAN ENERGY TRENDS 2011 2-4 (2011) (detailing market trends of biofuels, wind power, and solar power).

2. ROBERT POLLIN ET AL., CTR. FOR AM. PROGRESS, THE ECONOMIC BENEFITS OF INVESTING IN CLEAN ENERGY: HOW THE ECONOMIC STIMULUS PROGRAM AND NEW LEGISLATION CAN BOOST U.S. ECONOMIC GROWTH AND EMPLOYMENT 31 (2009), http://www.americanprogress.org/issues/2009/06/pdf/peri_report.pdf.

3. The idea of technical literacy is not new. An increasing number of companies and universities are realizing that students coming out of traditional K-12 education are not equipped with the basic technical skills they need to survive and thrive in a computer-driven, knowledge-based economy. National Instruments has been a leader here. See *Improving the World Through Technical Literacy*, NAT'L INSTRUMENTS, http://www.ni.com/citizenship/technical_literacy.htm (last visited Feb. 23, 2010) (articulating National Instruments' mission to "create a more technically literate society"). However, we believe we are the first to specifically tie this term to the needs of the emerging clean energy sector, which is particularly reliant on technical skills for invention, production, and installation/operation of new technologies for energy efficiency, renewable energy, and renewable fuels.

4. See generally SARAH WHITE ET AL., CTR. ON WIS. STRATEGY, GREENER SKILLS: HOW CREDENTIALS CREATE VALUE IN THE CLEAN ENERGY ECONOMY (2010) (arguing for an organized credentialing system for energy efficiency and renewable energy occupations, and cataloging the current state of the clean energy credential system).

In this paper, we discuss the current successes and future opportunities that go along with the transition to a cleaner, more sustainable energy economy. We then highlight the need for workers to better prepare for this emerging economy and the failure of our current education and workforce system to provide for adequate and appropriate training—with the exception of a few innovative community college–industry partnerships, which we argue can and should play a major role in green job preparation.

Ultimately, we recommend that federal, state, and local policymakers direct workforce and economic development dollars and policies toward promoting innovation and more applied research into the best practices in community college and clean energy industry partnerships. In addition, we recommend that federal Perkins Career and Technical Education dollars be directed toward large-scale experimentation with these partnerships. And finally, we caution that all the workforce preparation in the world will not matter if the federal policymakers in the U.S. Congress continue to refuse to get on board with the transition to a cleaner, lower-carbon energy future.

II. JOBS IN THE EMERGING CLEAN ENERGY SECTOR

Over the past decade or so, a near-consensus has emerged among global policymakers, NGOs, investors, and business leaders that the world must undergo a serious transition from its current status as a fossil-fuel-driven, high-energy consuming, inefficient, and unstable economy to a more sustainable economic growth model.⁵ There are many different reasons given for the urgency of this transition. Developing countries probably feel the greatest need for them: the impacts of climate change are most severe and the specter of eventual food and water shortages is most frightening.⁶ For rapidly growing countries like China and India, the urgency is driven by the sheer need for new energy sources to meet exploding demand.⁷ These countries, along with more industrialized countries like the United States and EU states, are also interested in the economic opportunities that go along with a transition to a cleaner energy economy. In particular, despite skepticism among some vocal politicians in the United States and some entrenched fossil fuel interests, the world is looking ahead to the future promise of a new energy economy⁸ and to the new green jobs that will go

5. See, e.g., Richard Kerr, *Do We Have the Energy for the Next Transition?*, SCI. MAGAZINE, Aug. 13, 2010, at 780 (arguing that “Never has the world so self-consciously tried to move toward new sources of energy,” and that the transition will be daunting). See also the rise of global fora specifically dedicated to the clean energy transition (for example, the Clean Energy Ministerial, a “high-level global forum to promote policies and programs that advance clean energy technology, to share lessons learned and best practices, and to encourage the transition to a global clean energy economy.”). *About the Clean Energy Ministerial*, CLEAN ENERGY MINISTERIAL, <http://www.cleanenergyministerial.org/about/index.html> (last visited Feb. 23, 2012).

6. See U.N. FRAMEWORK CONVENTION ON CLIMATE CHANGE, CLIMATE CHANGE: IMPACTS, VULNERABILITIES, AND ADAPTATION IN DEVELOPING COUNTRIES 5 (2007), <http://unfccc.int/resource/docs/publications/impacts.pdf>.

7. See Sascha Müller-Kraenner, *China’s and India’s Emerging Energy Foreign Policy*, GERMAN DEV. INST. DISCUSSION PAPER no. 15, at 4–5 (2008), <http://www.yale.edu/worldfellows/fellows/documents/DIEChinasandIndiasEmergingEnergyForeignPolicy.pdf>.

8. See Kate Gordon, *Power for the People: Energy for the 99 Percent*, CTR. FOR AM. PROGRESS (Nov. 8, 2011), available at http://www.americanprogress.org/issues/2011/11/energy_99_percent.html

along with it.

It is one thing to talk about the general need to become more sustainable and efficient, and another to actually define what is meant by the “green” or “clean” economy. Dozens of papers have been published on this subject and have approached it in myriad ways, from outlining the broad characteristics that underpin a greener economy, to attempting to catalogue the kinds of economic activities and occupations that might be created if the United States were to embrace this kind of economic transition.⁹ Two major reports published in 2011 illustrate many of these different approaches. The United Nations Environment Program, in a report coauthored by the International Labor Organization (ILO), gives us this very broad definition that incorporates both environmental and equity concerns:

In its simplest expression, a green economy is low carbon, resource efficient, and socially inclusive. In a green economy, growth in income and employment should be driven by public and private investments that reduce carbon emissions and pollution, enhance energy and resource efficiency, and prevent the loss of biodiversity and ecosystem services.¹⁰

The Brookings Institution has a narrower definition, focused more on the occupations and industries associated with the green economy than with its overarching goals: “The clean economy is economic activity – measured in terms of establishments and the jobs associated with them – that produces goods and services with an environmental benefit or adds value to such products using skills or technologies that are uniquely applied to those products.”¹¹

One reason for the wide variation in green economy and green jobs definitions is that at the moment, there is no “official” list of the industries and occupations making up this category. Therefore, those cities, states, companies, and green jobs advocates that have tried to define or quantify green jobs have each made up their own parameters and definitions. This has resulted in a myriad of papers that generally cannot be aggregated or easily compared to one another. The Brookings Institution, for example, includes a wide variety of industries such as low-carbon transportation, land reclamation, and conservation,¹² whereas other reports have stuck to more conservative counts of

(outlining the differences between a fossil-fuel-driven energy future and one powered by sustainable and efficient energy sources).

9. See, e.g., MARK MURO ET AL., METRO. POLICY PROGRAM AT BROOKINGS, SIZING THE CLEAN ECONOMY: A NATIONAL AND REGIONAL GREEN JOBS ASSESSMENT (2011) (analyzing employment statistics for clean economy industries in the United States); THE PEW CHARITABLE TRUSTS, THE CLEAN ENERGY ECONOMY: REPOWERING JOBS, BUSINESSES AND INVESTMENTS ACROSS AMERICA (2009) (arguing the clean energy economy has experienced considerable growth over the last decade); APOLLO ALLIANCE, THE NEW APOLLO PROGRAM: CLEAN ENERGY, GOOD JOBS (2008) (outlining economic investment strategy for building a new clean energy economy); ROBERT POLLIN & JEANNETTE WICKS-LIM, POLITICAL ECON. RESEARCH INST., JOBS OPPORTUNITIES FOR THE GREEN ECONOMY: A STATE-BY-STATE PICTURE OF OCCUPATIONS THAT GAIN FROM GREEN INVESTMENTS (2008) (detailing the jobs necessary to build a green economy).

10. U.N. ENV'T PROGRAM, TOWARDS A GREEN ECONOMY: PATHWAYS TO SUSTAINABLE DEVELOPMENT AND POVERTY ERADICATION 16 (2007), available at [http://www.unep.org/greeneconomy/GreenEconomyReport/ tabid/29846/Default.aspx](http://www.unep.org/greeneconomy/GreenEconomyReport/tabid/29846/Default.aspx).

11. MURO, *supra* note 9, at 13–14.

12. *Id.* at 16.

energy efficiency and renewable energy jobs.¹³ Complicating matters even more, a number of reports try to include an overall count of green jobs based on projections and economic modeling tools like Input-Output models, which include not only direct jobs (for example, wind turbine technicians), but also indirect jobs (for example, truck drivers bringing the turbine parts to the assembly plant), and induced jobs (for example, the 7-11 worker selling Slurpees to the truck driver) in their job counts.¹⁴ Other reports rely solely on survey data, which tends to capture direct jobs only, and then only from the companies responding to the survey.¹⁵

Luckily for data nerds, all this will soon change, as the U.S. Bureau of Labor Statistics plans to come out with its own measurement of the “green economy,” which will likely be taken as the authoritative definition, at least for U.S. authors.¹⁶

All of this is to say that, while advocates know we want a greener economy, we are not always sure exactly how to describe what that economy looks like. Here is what we do know: across the world, the green economy is growing, as are the jobs associated with it. The growth has been astounding in the past decade. According to Clean Edge, a global research firm dedicated to watching the clean energy economy, the wind and solar markets alone have surged from \$6.5 billion in 2000 to \$131.6 billion in 2010.¹⁷ There are thirty hybrid vehicle models on the market today, whereas in 2000 there were only two.¹⁸ And in 2010, clean tech venture capital investments made up nearly a quarter of the total venture investments in the United States—still the global leader in these kinds of investments.¹⁹

We also know, based on countless studies, surveys, and reports, that moving to a more efficient, less resource-intensive energy system will require workers from a broad range of occupations²⁰—from inventors and manufacturers to installers and operations and maintenance workers. This is clear from the data but it is also intuitively obvious. If decisionmakers in the United States want to rebuild this country’s entire energy system to be more efficient and more reliant on renewable resources, this transition will create work in nearly every sector of the economy, from changes in how utilities generate that energy, to how it gets to consumers, to the buildings and vehicles that consume it. By default, many of

13. See, e.g., DANIEL M. KAMMEN ET AL., UNIV. OF CAL. BERKELEY, PUTTING RENEWABLES TO WORK: HOW MANY JOBS CAN THE CLEAN ENERGY INDUSTRY GENERATE? (2004); SARAH WHITE & JASON WALSH, CTR. ON WIS. STRATEGY, GREENER PATHWAYS: JOBS AND WORKFORCE DEVELOPMENT IN THE CLEAN ENERGY ECONOMY (2008).

14. See, e.g., POLLIN, *supra* note 2, at 14.

15. This is a common approach in state- or city-level reports. See, e.g., ICF INTERNATIONAL, GREEN DATA FOR A GROWING GREEN ECONOMY: THE ECONOMIC IMPACT OF GREEN ACTIVITY IN THE DISTRICT OF COLUMBIA, MARYLAND, AND VIRGINIA 7 (2011), <http://www.dllr.state.md.us/greenjobs/greenreports/gjeconimpact.pdf>.

16. *Measuring Green Jobs*, BUREAU OF LABOR STATISTICS, <http://www.bls.gov/green/> (last visited Feb. 25, 2012).

17. PERNICK ET AL., *supra* note 1, at 2.

18. *Id.*

19. *Id.* at 4.

20. MURO, *supra* note 9, at 4.

these jobs will be local because clean energy is often locally generated and energy efficiency cannot be outsourced.²¹ Contrast this to, for instance, the high-tech industry, which generally creates U.S. jobs at the invention stage (design and engineering), but not again until the sales and operations and maintenance stages (sales and IT specialists), while production often happens overseas.²² Similarly, the biotech industry creates invention and sales jobs but lacks the large-scale infrastructure and manufacturing potential of clean energy.²³ The domestic, high-quality job generation potential of the movement to a clean energy economy simply cannot be matched by these other industries.

The clean energy economy also generates more jobs than the more traditional, fossil-fuel-driven industry sectors. The Political Economy Research Institute (PERI), which has done some of the most comprehensive economic analysis of the impact of direct and indirect government investment in the clean energy economy, has found that clean energy investments tend to generate more than three times as many jobs per dollar spent than equivalent investments in the fossil fuel industries.²⁴ A joint PERI and Center for American Progress report from 2009 explains this phenomenon, demonstrating that clean energy industries are relatively more labor intensive than fossil fuel industries; rely more often on economic activities taking place within the United States rather than overseas (for example, retrofitting houses); and produce more types of jobs at more pay levels, including far more entry-level and middle-skill jobs.²⁵

Table 1: Representative Jobs in Major Green Industries²⁶

Green investments and jobs	
Major areas for green investment agenda	Representative jobs
Building retrofitting	Electricians, heating/air conditioning installers, carpenters, construction equipment operators, roofers, insulation workers, carpenter helpers, industrial truck drivers, construction managers, building inspectors.
Mass transit/freight rail	Civil engineers, rail track layers, electricians, welders, metal fabricators, engine assemblers, bus drivers, dispatchers, locomotive engineers, railroad conductors.
Smart grid	Computer software engineers, electrical engineers, electrical equipment assemblers, electrical equipment technicians, machinists, team assemblers, construction laborers, operating engineers, electrical power line installers and repairers.
Wind power	Environmental engineers, iron and steel workers, millwrights, sheet metal workers, machinists, electrical equipment assemblers, construction equipment operators, industrial truck drivers, industrial production managers, first-line production supervisors.
Solar power	Electrical engineers, electricians, industrial machinery mechanics, welders, metal fabricators, electrical equipment assemblers, construction equipment operators, installation helpers, laborers, construction managers.
Cellulosic biofuels	Chemical engineers, chemists, chemical equipment operators, chemical technicians, mixing and blending machine operators, agricultural workers, industrial truck drivers, farm product purchasers, agricultural and forestry supervisors, agricultural inspectors.

21. See VAN JONES, *THE GREEN-COLLAR ECONOMY* 11–16 (2009) (discussing that green job creation is a local endeavor).

22. See Greg Linden et al, *Innovation and Job Creation in a Global Economy: the Case of Apple's iPod 2–3* (Jan. 2009) (unpublished paper), <http://pcic.merage.uci.edu/papers/2008/InnovationAndJobCreation.pdf> (detailing job creation inside and outside the United States spurred by Apple's iPod).

23. See generally JOSEPH CORTRIGHT & HEIKE MAYER, *THE BROOKINGS INST., SIGNS OF LIFE: THE GROWTH OF BIOTECHNOLOGY CENTERS IN THE U.S.* (2002) (detailing the nature of job creation in the biotech industry, which predominantly includes invention and sales).

24. POLLIN ET AL., *supra* note 2, at 31.

25. *Id.* at 31.

26. *Id.* at 31.

Because the clean energy revolution will be more capital intensive and labor intensive than the high-tech or biotech revolutions, it will require more workers—and as the above chart shows, more of these workers will require technical skills in traditionally “middle-skill” jobs like construction, engineering, and manufacturing.²⁷ But because new clean energy technologies are knowledge intensive—meaning that capital investments deeply embed information technology into the facilities and equipment with which employees work—the clean energy revolution will also require new high-skilled workers with skills in math, engineering, and advanced technologies.²⁸ Taken together, these workforce trends point to the overall need for America’s workers to have solid technical skill grounding, otherwise known as technical literacy.²⁹

The above trends are not true of the clean economy alone. Global competition has forced American businesses to find new and innovative models for growth, which rely increasingly on a workforce of technicians and mid-level employees with higher-level skills than were necessary in the twentieth century economy.³⁰ The Georgetown Center on Education and the Workforce has estimated that the U.S. economy will grow by 14.4 million jobs between 2008 and 2018.³¹ A vast majority of these new jobs will be in advanced industries that will rely on workers with post-secondary credentials or degrees.³² As a result, job opportunities available to workers with only high school educations are bound to stagnate. Opportunities for workers with college degrees or some kind of post-secondary credentials, however, will grow.³³

Unfortunately, most American workers currently lack the technical literacy necessary to do the kind of jobs, both at the middle- and high-skill levels, that will be the foundation of the greener economy and the economy as a whole.³⁴ It is to this problem we now turn.

27. *Id.*; see also WHITE & WALSH, *supra* note 13, at 1.

28. See U.S. DEP’T OF EDUC., TRANSFORMING AMERICAN EDUCATION: LEARNING POWERED BY TECHNOLOGY 14 (2010) (detailing the International Society for Technology in Education’s National Education Technology Standards for Students that encompass a full range of technology competencies).

29. See Louis Soares & Kip Bergstrom, *Opportunity New England: A Plan to Build Regional Success on Innovative Individuals*, 20 CONNECTION: NEW ENGLAND’S J. OF HIGHER EDUC. & ECON. DEV. 21, 22 (2006) (“[An integrated understanding of science, technology, engineering and math], of course, alludes to our need for people trained in the hard sciences and engineering but also speaks to a broad need for ‘scientific literacy’ on the part of those in other disciplines.”).

30. See Louis Soares & Susan Schurman, *Connecting The Dots: Creating A Post-secondary Education System for A 21st Century Workforce*, in LABOR & EMPLOYMENT RELATIONS ASS’N ANNUAL RESEARCH VOL. 131 (David Finegold et al. eds., 2010).

31. ANTHONY P. CARNEVALE ET AL., GEORGETOWN UNIV. CTR. ON EDUC. & THE WORKFORCE, HELP WANTED: PROJECTIONS OF JOBS AND EDUCATION REQUIREMENTS THROUGH 2018 26 (2011), <http://www9.georgetown.edu/grad/gppi/hpi/cew/pdfs/FullReport.pdf>.

32. LOUIS SOARES & STEPHEN STEIGLEDER, CTR. FOR AM. PROGRESS, BUILDING A TECHNICALLY SKILLED WORKFORCE: PARTNERSHIPS BETWEEN COMMUNITY COLLEGES AND INDUSTRIES ARE THE KEY 3 (2012), http://www.americanprogress.org/issues/2012/01/pdf/dww_sp_scitechworkforce.pdf.

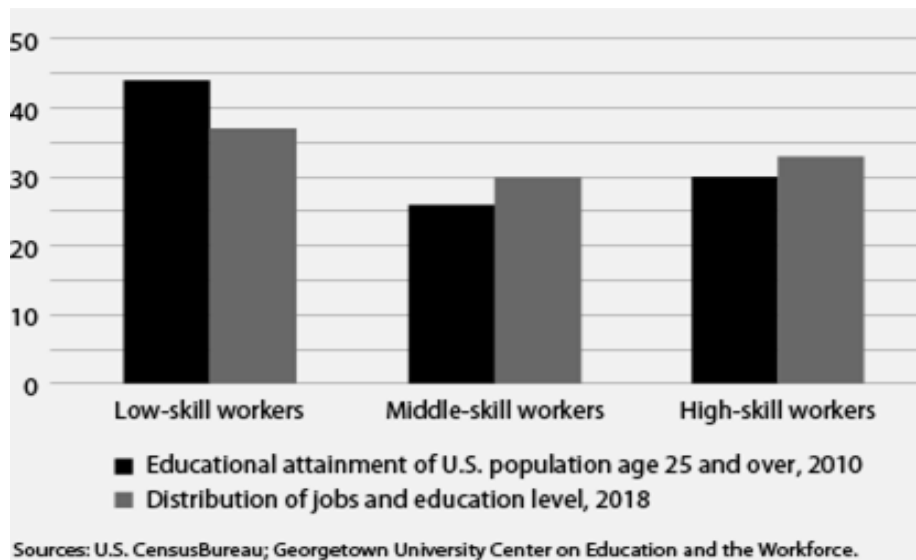
33. *Id.*

34. See CARNEVALE ET AL., *supra* note 31, at 16 (explaining how new economic growth centers require a technological understanding for which “too few American workers are equipped”).

III. THE SKILLS MISMATCH BETWEEN TODAY’S WORKFORCE AND THE FUTURE WORKFORCE

By any reasonable measure, our current education and workforce training system is not meeting the demand that will be generated by a transition to a greener and more sustainable economy, or indeed to a more generally competitive economy. Approximately 44% of American workers do not have any education beyond a high school diploma, while 26% have some college education or an associate’s degree and 30% have a bachelor’s degree or higher.³⁵ These figures fall short of the needs of our increasingly knowledge-based economy. By 2018, only 36% of jobs will be open to workers with a high school diploma, while 30% of jobs will require some form of post-secondary education and 33% of jobs will require at least a bachelor’s degree.³⁶ With 44% of the nation’s workers having only a high school diploma or less, Americans run the risk of consigning a generation to low-skill, low-wage jobs, or, even worse, to poverty.³⁷ Right now the U.S. workforce is too concentrated at the low end of the education spectrum. To maintain our economic competitiveness and begin transitioning to a green energy economy, policymakers, advocates, and industries need to provide more opportunities for workers to move from the low- and middle-skill categories into the middle- and high-skill categories.

Table 2: Educational Attainment in 2010 vs. Projected Distribution of Jobs by Education Level in 2018



35. See U.S. CENSUS BUREAU, EDUCATIONAL ATTAINMENT OF THE POPULATION 25 YEARS AND OVER, BY SELECTED CHARACTERISTICS: 2010 (2010), available at <http://www.census.gov/hhes/socdemo/education/data/cps/2010/tables.html> (charting educational attainment of population).

36. CARNEVALE ET AL., *supra* note 31, at 13 (percentages may not sum to 100 due to rounding).

37. U.S. CENSUS BUREAU, *supra* note 35.

High-growth science and technology industries, including many clean energy industries, are raising the bar for workplace readiness, looking beyond academic learning to a more practical mix of academics, actual work experience, and adaptability.³⁸ Going forward, education and workforce training will need to include hands-on work experience to ensure that technical workers are proficient in up-to-date technologies and ready to hit the ground running.

The utility industry, for example, is currently experiencing this problem.³⁹ The industry employs a broad range of workers, from meter readers to linemen to wind turbine technicians.⁴⁰ Overall more than half a million Americans are employed by utilities.⁴¹ But as of 2008, about fifty-three percent of the industry's workforce was age forty-five or older,⁴² and industry experts project that they will lose nearly half of this workforce to retirement in the next ten years.⁴³ This is potentially a huge opportunity for U.S. workers, but utilities are very concerned they will not be able to find replacement workers with the grounding in math and science, along with the practical technical knowledge, that they need.⁴⁴

In 2005, the industry publication *Public Power* argued that the shortage was primarily due to: (1) a decline in the number of students taking trade- or industry-related technical courses in high school; (2) the fact that utility jobs now require some kind of post-secondary education due to the increasingly technical nature of the jobs; and (3) the fact that students coming out of high school lack the academic skills, particularly in science and math, to either go into utility work or to go into post-secondary technical coursework.⁴⁵

The utility industry is currently requiring skill increases across the workforce in order to meet its twenty-first century needs. To achieve these increases, federal and state policymakers need to reorient our education and workforce training systems toward greater achievement of college degrees and industry-recognized credentials. At the higher end of the spectrum, that means increasing the number of college students completing bachelors, masters,

38. See ERIN LAMOS ET AL., NAT'L GOVERNORS ASS'N CTR. FOR BEST PRACTICES, A SHARPER FOCUS ON TECHNICAL WORKERS: HOW TO EDUCATE AND TRAIN FOR THE GLOBAL ECONOMY 7, 10 (2010) (detailing the skills required of technical workers); see also John Alic, *Technical Knowledge and Experiential Learning: What People Know and Can Do*, 20 J. TECH. ANALYSIS & STRATEGIC MGMT. 427, 427 (2008) (discussing the need for experiential learning in the workforce).

39. See generally Michael Ebert, *An Emerging Issue we Cannot Ignore: Meeting the Twin Challenges of Education and an Aging Workforce in the Electric Power Industry*, THE CIP REPORT, Nov. 2006, at 2, http://www.cewd.org/media/pdf/cipreport_nov2006.pdf (discussing the education-workforce gap, which is especially acute in the electric power industry).

40. *Career Guide to Industries, 2010-11 Edition: Utilities*, BUREAU OF LAB. STAT. (Dec. 17, 2009), <http://www.bls.gov/oco/cg/cgs018.htm>.

41. *Industries at a Glance: Utilities*, BUREAU OF LAB. STAT., <http://bls.gov/iag/tgs/iag22.htm> (last visited Mar. 13, 2012).

42. *Career Guide to Industries, 2010-11*, *supra* note 40.

43. Tom Zeller, *Utilities Seek Fresh Talent for Smart Grids*, N.Y. TIMES, Dec. 30, 2010, at B1.

44. See *id.* (detailing efforts by utility companies to recruit young students); Ebert, *supra* note 39, at 4 (describing the necessary steps to prevent a pending labor shortage).

45. William Atkinson, *Confronting the Coming Labor Shortage*, PUBLIC POWER (Nov.-Dec. 2005), <http://www.publicpower.org/Media/magazine/ArticleDetail.cfm?ItemNumber=14824>; see generally CTR. FOR ENERGY WORKFORCE DEV., THE CEWD GET INTO ENERGY CAREER PATHWAYS PROJECT (2011), available at <http://www.cewd.org/pathways/appendix%20final%20report.pdf> (closely examining labor workforce gap, especially for young workers, in six states).

doctoral, and professional degrees—especially in science and technology fields. But that only addresses part of our workforce shortage. The need for skill increases also means redoubling our efforts to ensure that the entire American workforce has access to a post-secondary education with tangible labor market value.⁴⁶ To guarantee that access, we argue, students and workers need to achieve a basic level of technical literacy.

A. The Need for Technical Literacy

What do we mean by technical literacy? Essentially, we mean not only a foundational education in math, science, and engineering but also a basic grounding in how to apply those academic concepts to real-world technical problems. This idea goes beyond traditional “STEM” education, which stands for Science, Technology, Engineering, and Mathematics, and is the basis for most science and math curriculum efforts in the K-12 education policy realm.⁴⁷ Technical literacy includes these concepts, but layers on practical experience as well. As the National Center for Technological Literacy points out:

The key to educating students to thrive in this competitive global economy is introducing them early to the engineering design skills and concepts that will engage them in applying their math and science knowledge to solve real problems. This is the way to harness the creativity of young minds. This is also the process that fuels innovation of new technologies.⁴⁸

Achieving technical literacy prepares students for a broad range of occupations, which is why this concept is so integral to the extremely varied green economy of the future. A student or worker with this kind of academic plus practical training might be prepared to enter, for example, a wind turbine

46. A critical point, but one we will not address in depth in this paper, is the fact that even in a knowledge-based economy, only thirty-three percent of jobs will require a bachelor’s degree. Currently our K-12 education policy is heavily geared toward preparing students for four year college, but the vast majority of our workforce will likely not attain, or need, that particular type of education. As a country, we need to take a serious look at both our K-12 education and our post-secondary education and workforce training goals and how they interact with our actual workforce needs; however, this paper will deal only with the specific issue of technical literacy and targeted post-secondary credentials, and not focus on K-12 education reform. *See generally* LOUIS SOARES, CTR. FOR AM. PROGRESS, *WORKING LEARNERS: EDUCATING OUR ENTIRE WORKFORCE FOR SUCCESS IN THE 21ST CENTURY* (2009), available at http://www.americanprogress.org/issues/2009/06/working_learners.html [hereinafter SOARES, WORKING LEARNERS] (detailing inadequacies in our education system to meet the need of the American workforce).

47. *See generally* JEFFREY J. KUENZI ET AL., CONG. RESEARCH SERV., RL 33434, *SCIENCE, TECHNOLOGY, ENGINEERING, AND MATHEMATICS (STEM) EDUCATION ISSUES AND LEGISLATIVE OPTIONS* (2006), available at <http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA474889&Location=U2&doc=> (analyzing the state of STEM education, examining the federal role in promoting STEM education, and discussing the selected legislative options being considered to improve STEM education).

48. *Our Nation’s Challenge*, NAT’L CTR. FOR TECHNOLOGICAL LITERACY, http://www.mos.org/nctl/our_nations_challenge.php (last visited Mar. 13, 2012); *see also* Kevin Craig, *Transformational Engineering Education*, MICH. ST. U. COLLEGIATE EMP. RES. INST. (2010), <http://www.ceri.msu.edu/wp-content/uploads/2010/07/Transformational-Engineering-Education.pdf> (discussing the importance of teaching engineering and what it means to be an engineer from an early age).

manufacturing plant, where the student would build on his or her existing knowledge of applied engineering while learning specific plant operations. The student might also be prepared to go into a four-year engineering program, and potentially on to a graduate degree in engineering, which would prepare the student for more high-skilled research and development jobs—a job designing new and innovative wind turbines at a lab like the National Renewable Energy Laboratory, for example.⁴⁹ Another student with basic technical literacy might be able to immediately start weatherizing houses with very limited additional skill development. Or that student could instead go into a construction trades apprenticeship program to learn specific technical skills, like electrical work, required to do more skilled “whole-home” retrofits of commercial and industrial buildings.⁵⁰ The same student also might choose to use this technical literacy as a foundation for a more academic career.

As the above examples illustrate, technical literacy is fundamentally about choice. In this way it is diametrically opposed to traditional vocational training of the kind found in the United States in the 1970s when occupationally oriented education was seen as an adjunct to comprehensive education delivered in high schools.⁵¹ Critics of those programs were usually focused on the fact that educators would designate certain students for vocational education versus academic education, ultimately “tracking” students into future careers based, in many cases, on the students’ race or income level.⁵² In contrast, our vision of technical literacy is one in which all students are given a foundational education that is both academic and practical, allowing them to choose a multitude of paths from that point onward. It does not privilege one student over another, nor does it unfairly stigmatize the more hands-on careers like manufacturing and construction, which are not currently presented as a valid or valuable option to high school students looking at career opportunities.⁵³

Just as a commitment to a green economy future will create more middle-skill and middle-class jobs, a commitment to technical literacy will allow students and workers an access portal to jobs that are a cut above the low-wage, low-skill retail and service occupations that are currently presented as the only choice to millions of unemployed Americans.⁵⁴ Ideally, technically literate

49. See *Wind Research*, NAT’L RENEWABLE ENERGY LAB., <http://www.nrel.gov/wind/> (last visited Feb. 2, 2012) (describing the wind research lab).

50. See, e.g., *Green Collar Jobs*, CAL APPRENTICESHIP, <http://www.calapprenticeship.org/> (last visited Mar. 13, 2012) (describing union apprenticeships in the area of green collar jobs).

51. See JAMES A. KULIK, U.S. DEP’T OF EDUC., CURRICULAR TRACKS AND HIGH SCHOOL VOCATIONAL EDUCATION (1994), available at <http://www2.ed.gov/pubs/VoEd/Chapter3/Part3.html> (discussing the state of vocational education during the 1970s, 1980s, and 1990s).

52. See, e.g., Theodore Lewis & Shih-Yu Cheng, *Tracking, Expectations, and the Transformation of Vocational Education*, 113 AM. J. EDUC. 67, 67 (2006).

53. See MFG. INST., UNWAVERING COMMITMENT: THE PUBLIC’S VIEW OF THE MANUFACTURING INDUSTRY TODAY 3, 9 (2011), available at <http://www.themanufacturinginstitute.org/Research/Public-Perception-of-Manufacturing/2011-Public-Perception-Report/Selected-Charts/Selected-Charts.aspx> (finding that “Americans want manufacturing jobs—for someone else,” in that the public strongly supports the concept of American manufacturing but rank manufacturing very low as a career choice for themselves or their children).

54. See, e.g., Rebecca M. Blank, *Economic Change and the Structure of Opportunity for Less-Skilled Workers*, 26 FOCUS 16, 16 (2008) (discussing the decline in jobs with decent pay for lower-skilled

workers would be able to plug into the entire range of green jobs, from innovation, to production, to commercialization, to installation, to operations and maintenance, and to related jobs in sales, legal and accounting services, transportation, and so on.

B. The Mismatch Between Training Needs and Training Systems

Unfortunately, the various components of our post-secondary education and workforce training system are not working together to provide the combination of skills training and hands-on experience so critical to a sustainable clean energy economy.⁵⁵ There are four main reasons why.

First, our post-secondary system of two- and four-year colleges is designed for a full-time student working toward a degree over a fixed and continuous period of time. This lack of flexibility is a huge impediment for the majority of Americans who have already begun their working lives. In reality, according to 2010 Census data, sixty-one percent of adults age twenty and over do not have a college degree or post-secondary credential, including seventy-five million Americans between the ages of twenty-five and fifty-four.⁵⁶ But many of those adults could improve their skills in a reasonable amount of time if offered a flexible program leading to a better career. In fact, thirty-four million of them already have a high school diploma and an additional twenty-two million have

workers, especially in the manufacturing sector, and pointing to the increase in lower-paid retail and clerical jobs as well as home health care).

55. The needs of working learners are now in the public eye because of President Barack Obama's aggressive post-secondary attainment goals. The President wants every American to attain at least one year of post-secondary education and for the nation to produce five million additional college degrees by 2020. Barack Obama, Address to Joint Session of Congress (Feb. 24, 2009), http://www.whitehouse.gov/the_press_office/Remarks-of-President-Barack-Obama-Address-to-Joint-Session-of-Congress; Barack Obama, Remarks on the American Graduation Initiative (July 14, 2009), <http://www.whitehouse.gov/blog/Investing-in-Education-The-American-Graduation-Initiative>. But we cannot just count on graduating more high school students and having them enroll in college. The Aspen Institute in a recent report finds that about two-thirds, or sixty-five percent, of our 2020 workforce is already beyond the reach of our elementary and secondary schools. THE ASPEN INST., SECTOR INITIATIVES AND COMMUNITY COLLEGES: WORKING TOGETHER TO PROVIDE EDUCATION FOR LOW-WAGE WORKING ADULTS 1 (2007), <http://www.aspeninstitute.org/sites/default/files/content/docs/07-009.pdf>. Even if we assumed perfect performance from high schools in graduating students, the numbers simply are not there to meet the President's goals. Even if they were, we are not doing a good job graduating college students, either. Since 1991, we have fallen from third to sixth place among developed countries for the percentage of our population with an associate's degree or above. Further, the National Center for Higher Education Management Systems estimates that for the United States to retake the global lead for the proportion of its adults with a post-secondary credential it will need to enroll, at a minimum, ten million individuals who would be considered nontraditional students, or in our parlance, working learners. Without the enhanced skills of these individuals, the United States will lack the productivity boost to move us through economic recovery to growth. Patrick Kelly, National Center for Higher Education Management Systems, Mounting Pressures Facing the U.S. Workforce and the Increasing Need for Adult Education and Literacy (Presentation) (2007), *available at* <http://www.nchems.org/pubs/search.php?title=&subject=&author=Kelly%2C+Patrick+J.&date=2007> (specifically referring to a presentation made at the 2009 National Forum on Education Policy, Nashville, Tenn., July 10, 2009).

56. U.S. CENSUS BUREAU, EDUCATIONAL ATTAINMENT IN THE UNITED STATES: 2010, *available at* <http://www.census.gov/hhes/socdemo/education/data/cps/2010/tables.html> (last visited Feb. 22, 2012).

spent some time in college or post-secondary training.⁵⁷ To increase the level of education of these individuals, we believe that community colleges, given their historic dual mission of both university transfer and occupational education, have the potential to be lead actors in modeling new instructional approaches for all stakeholders in the post-secondary system.

Second, the Perkins Career and Technical Education program—our largest federal program specifically focused on creating a workforce with technical skills—lacks sufficient scale to meet the growing need for skilled workers.⁵⁸ Its meager budget of \$1.1 billion, after an eleven percent cut in Fiscal Year 2011 ending in September, is distributed to states through a population-based formula and then further divided between high school and post-secondary education programs.⁵⁹ This investment is ultimately spread among fifteen million CTE students across the country—which is far too diffuse to have a significant impact on the development of technically skilled workers.

Furthermore, the Obama administration has proposed an additional eleven percent cut to the Perkins Career and Technical Education program in Fiscal Year 2012.⁶⁰ The administration suggests that it “has been difficult to determine whether the program has been effective.”⁶¹ But that does not mean post-secondary education and training is not a vital component of building a technically literate workforce. It simply means that policymakers need to fund programs that are more effective at combining technical skills and hands-on experience, are closely connected to regional employers, and have the potential to induce investment from the private sector—or, in other words, policymakers need to reallocate funding to community college-industry partnerships.

Third, our Workforce Investment Act, or WIA system, which is the primary federal program dedicated to providing employment and job training assistance, is underfunded and too focused on offering short-term crisis intervention rather than building long-term technical skills that impart recognizable value in the labor market.⁶² Annual funding for the Department of Labor’s Training and Employment Service—the location of most WIA funding—was reduced to \$3.3 billion in FY 2011, a cut of approximately thirteen percent. To put that funding level into perspective, it is less than \$135 for each of the twenty-five million

57. SOARES, WORKING LEARNERS, *supra* note 46.

58. According to Secretary of Education Arne Duncan, there are more than fifteen million high school and post-secondary students enrolled in CTE courses—which means that the Perkins Career and Technical Education program provides approximately \$75 per CTE student. This investment is insufficient to develop the additional 4.7 million new workers with post-secondary certificates that the Georgetown Center on Education and the Workforce estimates will be needed by 2018. *See* Arne Duncan, *The New CTE: Secretary Duncan’s Remarks on Career and Technical Education*, ED.GOV (Feb. 2, 2011), <http://www.ed.gov/news/speeches/new-cte-secretary-duncans-remarks-career-and-technical-education>.

59. Carl D. Perkins Career and Technical Education Improvement Act of 2006, §§ 111–12, 20 U.S.C. § 2301 (2006).

60. The administration requested a total of \$1,007,860,000 for Career and Technical Education in fiscal year 2012, a reduction of \$123,643,000 in comparison to fiscal year 2011. *See* S. Rep. No. 112-84, at 236–77 (2011).

61. U.S. DEP’T OF EDUC., CAREER, TECHNICAL, AND ADULT EDUCATION FISCAL YEAR 2012 BUDGET REQUEST N-16 (2012).

62. SOARES, WORKING LEARNERS, *supra* note 46.

Americans who are currently unemployed or underemployed.

In addition, the WIA system is too focused on conducting crisis management, as opposed to offering long-term skills training. This is understandable, however, since the system is primarily evaluated by the number of workers who are quickly returned to employment and whether those workers are still employed six months later.⁶³ While rapid employment is a worthwhile goal, it is not particularly helpful for building a workforce with the type of science and technology skills that will serve as a foundation for the knowledge-based economy. According to the Department of Labor, only 200,000 individuals earn a credential each year through WIA job training programs.⁶⁴

And fourth, none of the above systems are particularly well-integrated with the two other major technical job training providers: individual companies that provide on-the-job training to new and incumbent workers, and union and non-union apprenticeship programs that provide targeted training and certification for specific trades. These providers are a critical part of the clean energy economy. In a series of papers commissioned and co-authored by the Apollo Alliance in 2010, the authors found that in Michigan, Wisconsin, and Ohio, the construction trades are training for green jobs primarily through apprenticeships and targeted community college programs, whereas the manufacturing sector still often relies on incumbent worker training.⁶⁵ In all three states, though, employers consistently found that students coming out of high school, and workers coming out of unemployment often lacked the technical skills necessary to even consider entering one of these training programs⁶⁶—bringing us back again to the overall need for technical literacy as a gateway to multiple training avenues and career pathways.

What all the above points underscore is that a more successful clean energy workforce training system looks very much like a more successful workforce training system in general, albeit with slightly more emphasis on technical training and specific post-secondary skill development. What the United States does not need, most experts agree, is a radically different system that focuses only on green jobs. Instead, we need better funding, more flexibility, and better integration between the various parts of our current post-secondary workforce and education system.⁶⁷

IV. USING SCALABLE MODELS TO MOVE TOWARD A NEW SYSTEM

The key to creating a better aligned post-secondary education system that

63. Workforce Investment Act of 1998, 20 U.S.C. § 9201 (1998).

64. U.S. DEP'T OF LABOR, FY 2012 CONGRESSIONAL BUDGET JUSTIFICATION EMPLOYMENT AND TRAINING ADMINISTRATION, ETA-3 (2012).

65. TARYN MACFARLANE ET AL., APOLLO ALLIANCE & CORP. FOR A SKILLED WORKFORCE, MAPPING GREEN CAREER PATHWAYS: JOB TRAINING INFRASTRUCTURE AND OPPORTUNITIES IN MICHIGAN (2010); PIET VAN LIER ET AL., APOLLO ALLIANCE & CORP. FOR A SKILLED WORKFORCE, GREEN CAREER PATHWAYS: JOB TRAINING INFRASTRUCTURE AND OPPORTUNITIES IN OHIO (2010); SARAH WHITE & KATE GORDON, APOLLO ALLIANCE & CORP. FOR A SKILLED WORKFORCE, GREEN CAREER PATHWAYS: JOB TRAINING INFRASTRUCTURE AND OPPORTUNITIES IN WISCONSIN (2010). All three papers are available at <http://apolloalliance.org/reports>.

66. *Id.*

67. WHITE & WALSH, *supra* note 13.

delivers academic and applied skills with embedded technical literacy is for business and education leaders to build collaborations that leverage their combined knowledge of labor markets, skills, pedagogy, and students to build new curriculum and instructional models.⁶⁸ This hybrid model combines the educational rigor of higher education with the flexibility and labor-market focus of industry-based workforce training.

Community colleges, situated as they are at the crossroads of higher education and workforce training, are an ideal starting point to model the hybrid instructional and curricula innovations that can develop middle-skill clean energy economy jobs. Community colleges serve an estimated 12 million for-credit and noncredit students.⁶⁹ They dwarf other post-secondary education providers, including four-year schools and workforce training programs, in terms of access to education and affordability.⁷⁰

Community colleges also serve a more diverse student body than four-year colleges, including a significant percentage of older students, first-generation college students, and full-time workers.⁷¹ Further, community colleges serve as training providers in the workforce training system,⁷² and they have experience working directly with private-sector employers to design and adapt programs to address specific labor market needs.⁷³

Based on this solid foundation, community colleges have begun to build industry partnerships that can serve as models for creating a better aligned post-secondary education system capable of delivering the skills necessary for good jobs in a clean energy economy. Community college–industry partnerships combine public and private resources to create alternative college education programs that are tightly linked to regional economic development. The emerging best practices include industry partners contributing direct funding, human resources, facilities, equipment, and expertise to the community college’s programs.⁷⁴

Successful community college–industry partnerships meet the needs of three important constituencies: (1) students and workers who obtain post-secondary credentials that prepare them for skilled careers paying middle-class wages; (2) local businesses, who gain employees with specific skills to match their needs; and (3) regional economies, which gain a competitive advantage over their global competitors.

The focus on regional economies is, in particular, growing in importance. A

68. LOUIS SOARES, *CMTY. COLL. & INDUS. P'SHIPS*, CONFERENCE PAPERS 7 (2010) [hereinafter SOARES CCIP].

69. U.S. DEP'T OF EDUC., NAT'L CTR. FOR EDUC. STAT., ENROLLMENT IN POST-SECONDARY INSTITUTIONS, FALL 2007; GRADUATE RATES, 2001 & 2004 COHORTS; AND FINANCIAL STATISTICS, FISCAL YEAR 2007 11 (2009), <http://nces.ed.gov/pubs2009/2009155.pdf>.

70. *Id.*

71. BRIAN PUSSEY & JOHN LEVIN, CTR. FOR AM. PROGRESS, *RE-IMAGINING COMMUNITY COLLEGES IN THE 21ST CENTURY: A STUDENT-CENTERED APPROACH TO HIGHER EDUCATION*, 13 (2009).

72. SOARES, *Working Learners*, *supra* note 46.

73. SOARES CCIP, *supra* note 68, at 13.

74. See Carrie B. Kisker & Rozana Carducci, *UCLA Community College Review: Community College Partnerships with the Private Sector Organizational Contexts and Models for Successful Collaboration*, 31 *CMTY. COLL. REV.* 55, 63 (2003) (discussing private partnerships with California community colleges).

recent Wall Street Journal report on Austin, Texas used regional metrics to assess why the city was creating good, middle-skills jobs at a much quicker pace than the national average.⁷⁵ The reporter postulated that cross service industry partnerships formed in the larger metro region economy for a variety of purposes, including worker training, are playing a key role in the region's enhanced competitiveness.⁷⁶

A recent article in *Businessweek Magazine* provided a specific example of one of the nation's most successful college-industry partnerships.⁷⁷ The article describes the reciprocal relationship between Macomb Community College and the automotive industry in Macomb County, Michigan:

The county is home to both a GM transmission plant and the GM Technical Center, the company's main design and engineering complex. Because of its location, the college has long had a symbiotic relationship not only with GM—Macomb Community College President James Jacobs estimates that 40 percent of the designers there studied at Macomb—but with most of the local manufacturing sector, providing companies with graduates while drawing on them for funding, faculty, and even state-of-the-art equipment. Haas Automation, the country's largest machine tool maker, supplies the college with CNC mills and lathes. All of the Big Three have outsourced training for their own employees to the college over the years, collaborating to design curricula and tests. Macomb has a deep familiarity with the workforce needs of those companies and connections with the people who do the hiring. The result is an informal system that quickly matches workers with the labor needs of companies.⁷⁸

While the programs themselves are helpful, we believe that programs should also always lead to a post-secondary credential such as an associate's degree, occupational license, or technical certification. Such credentials are portable and provide an additional level of stability for middle-skill workers. Over the long term, it would be preferable to have nationally recognized credentials to ensure the highest degree of flexibility for skilled workers, but current industry-recognized credentials and state certifications are a good place to start.

There are a few examples of nationally recognized credentials to draw on to help shape the development of a system for clean energy education and training. Among the most prominent is the Manufacturing Institute's Manufacturing Skills Certification System.⁷⁹ The Institute's system was developed with

75. Conor Dougherty, *Texas May Hold Key to Middle-Class Jobs*, WALL ST. J. (video) (Oct. 18, 2011), <http://online.wsj.com/video/texas-may-hold-key-to-middleclass-jobs/937D5156-2923-4084-BD7D-9BB516E249CD.html?KEYWORDS=CONOR+DOUGHERTY>.

76. *Id.*

77. Drake Bennett, *Can Retraining Give the Unemployed a Second Chance?*, BUSINESSWEEK, (Sept. 14, 2011), <http://www.businessweek.com/magazine/can-retraining-give-the-unemployed-a-second-chance-09142011.html>.

78. *Id.*

79. See *NAM-Endorsed Manufacturing Skills Certification System*, MFG. INST., <http://www.themanufacturinginstitute.org/Education-Workforce/Skills-Certification-System/Skills-Certification-System.aspx> (last visited Feb. 20, 2012); see also *The Manufacturing Institute and NAM Announce Goal to Credential Half-a-million Students for the Manufacturing Workforce*, TRADE & INDUS. DEV., June 10, 2011,

employers and educators working together to identify national level competencies required to succeed in the twenty-first century manufacturing economy. The system contains educational resources to teach and assessments to measure skills common across all manufacturing, as well as occupation-specific competencies for drafting technicians, welders, and machinists, to name just a few.

A. Columbia Gorge Community College and the Wind-Energy Industry in Dalles, Oregon

Many community college-industry partnerships begin with a workforce need expressed by an individual employer. Other partnerships begin with a community college that recognizes a regional economic sector challenge and calls upon businesses to help it meet the challenge. These sector initiatives can be hugely beneficial to both the college and the industry, but it takes initiative on the part of the community college to recognize a change in the workforce and act upon it.

The chief academic officer at Columbia Gorge Community College (CGCC) in Dalles, Oregon,⁸⁰ took such initiative in 2006, when he noted the emergence of the wind energy industry around the college.⁸¹ As windmills went up, turbine companies needed a local workforce to service them. CGCC saw an opportunity to not only fulfill a workforce need, but also to work with existing resources at the college to create a post-secondary credential in the wind energy field.⁸²

CGCC, with help from workforce development representatives, identified an immediate need for more than 300 wind turbine technicians in the area – and increased that estimate to 700 by 2010.⁸³ The community college partnered with industry and workforce development representatives, including Acciona Energy North America, Black and Veatch, Intel, and the Army Corps of Engineers, to develop a pilot curriculum for a renewable energy technology program. These partnerships produced input from industry representatives as well as professional development opportunities for college faculty. CGCC faculty spent time visiting wind turbine sites and learning firsthand the skills that they would need to impart to students.

CGCC relied upon donations from the industry, but it also drew upon the college's existing resources to shape its new Renewable Energy Technology Program (RET). The college built on existing courses in hydropower and the expertise of its faculty rather than starting anew.⁸⁴ The college now offers one-

<http://www.tradeandindustrydev.com/industry/manufacturing/the-manufacturing-institute-and-nam-announce-goal-5244>.

80. COLUMBIA GORGE CMTY. COLL., <http://www.cgcc.cc.or.us> (last visited Mar. 15, 2012).

81. See *Columbia Gorge Community College Leads Nation in Wind Training*, SUSTAINABLE EDUC. AND ECON. DEV., <http://www.theseedcenter.org/Colleges-in-Action/Success-Stories/Columbia-Gorge-Community-College-Leads-Nation-in-W> (last visited Feb. 20, 2012).

82. *Id.*

83. See Suzanne Burd, *Columbia Gorge Community College: Renewable Energy Technology – Industry Designed and Driven*, GREEN JOBS (Apr. 28, 2010), https://greenjobs.workforce3one.org/command/view.aspx?look=Columbia_Gorge_Community_College_Renewable_Energy&mode=&pparams=.

84. See *Columbia Gorge Community College Leads Nation in Wind Training*, *supra* note 81.

and two-year programs that prepare students to work in wind-generation, hydro-generation, automated manufacturing, and engineering technician work.⁸⁵

The RET program at CGCC is still young, but it has already been a success. The program is filled to capacity, with approximately 106 students enrolled each year. It has produced sixty-six one-year certificates and twenty-three Associate of Applied Science graduates since 2007. The college reports that eighty percent of their graduates who want to work in a wind plant are hired.⁸⁶

B. Why it Works⁸⁷

CGCC has been successful in part because community college officials recognized the growth in the wind turbine sector earlier than other colleges; many other community colleges caught on to the trend much later. The program has also benefited from significant investment on the part of industry and workforce development representatives. The wind turbine industry donated expertise in curriculum development, an opportunity for professors to observe the wind turbine industry firsthand, equipment for use in classes, and \$4.9 million in cash grants. The Department of Labor also provided grant funding for the program that enabled its expansion. The cost per student for the RET program is not known, and individual students bear the tuition costs.

Another element to the program's success is the fact that it built upon existing resources. CGCC created the RET program by drawing on courses that prepared students for hydropower jobs as well as a defunct program aimed at training students for the computer chip manufacturing field. This interdisciplinary beginning helps RET prepare students for a number of energy generation fields, which makes its graduates more employable.

V. RECOMMENDATIONS

The community college–industry partnership models discussed in the previous section hold the key to scaling a post-secondary education system that aligns the elements of higher education, workforce training, and workplace based learning programs. In this section, we outline two recommendations to hasten the scaling of these models, in preparation for a transition to a greener economy. But we also caution that all the workforce preparation in the world will not be enough if the United States does not develop the political and policy leadership to prioritize a shift away from dirty fossil fuels.

On the workforce training side, we recommend two approaches intended to help promote, and scale up, innovative community college–industry partnerships. The first is to use existing federal, state, and local funds to promote

85. See *Renewable Energy Technology Program Information Packet for Spring 2011*, COLUMBIA GORGE CMTY. COLL. (2010), <http://www.cgcc.cc.or.us/Academics/documents/RETProgramInfoPacketsSpring2011.pdf>.

86. Ross Courtney, *Columbia Gorge CC Teaching Wind Farm Worker Skills*, YAKIMA HERALD - REPUBLIC (Mar. 8, 2010, 9:15 AM), http://seattletimes.nwsources.com/html/localnews/2011288557_apwawindschool.html.

87. See generally LOUIS SOARES, CTR. FOR AM. PROGRESS, *THE POWER OF THE EDUCATION-INDUSTRY PARTNERSHIP* (2010), http://www.americanprogress.org/issues/2010/09/pdf/community_colleges.pdf.

innovation and more applied research into the best practices in community college–industry partnerships. The second is to promote large scale experimentation with these partnerships using a federal grant program to demonstrate that a new hybrid system is achievable.

A. Use Existing Funds to Spur Innovation and Promote Research

To promote systematic innovation, policymakers should review federal, state, and local financing streams and economic and workforce development policies to ensure they facilitate “good practice” innovations. To this end, federal and state policymakers can:

- Ensure that formula funding streams and regulations do not stifle good practice when partners are building an alternative education program.
- Use competitive grant funds to promote partnerships that emphasize sustainable, systemic change.
- Continue to emphasize desired student outcomes to keep community colleges and partners focused on innovation.

To promote systematic research, policymakers should look at what tools and information are necessary to accurately measure the value of good community college–industry partnerships, and should gather data to fill those gaps. Initial research questions should include:

- What tools are necessary to develop a typology of community college–industry partnerships that fosters systematic research and innovation?
- Do community colleges have the requisite data systems to track community college–industry partnership participant outcomes?
- What are the demographics of students who participate in community college–industry partnerships?
- Is it possible to calculate the return on investment to community college–industry partnerships?⁸⁸

B. Redirect Perkins Money to Support Industry Partnerships

At the same time that policymakers are studying ways to make these partnerships more effective and accountable, they need to put serious dollars into helping to create the partnerships in the first place. To build a more competitive and technically skilled workforce, we recommend redirecting \$300 million to \$400 million from the Perkins Career and Technical Education program and using those funds to create a competitive Community College–Industry Partnerships Grant program that integrates higher education with real-life experience.

The purpose of these partnerships is to develop alternate pathways to post-secondary credentials that are explicitly linked to the labor market. By partnering with private industry, these programs ensure that academic credentials are

88. SOARES CCIP, *supra* note 68, at 8.

directly linked to current job requirements and that program expansion is based on future job openings. This is particularly important for individuals who are not on a traditional college track.

Community college–industry partnerships are ideally positioned to act as a model of an aligned education and training system designed to meet the challenges of building a skilled technical workforce. Our recommendations would spur integration across the higher education, workforce training, and workplace-based learning systems to leverage these innovations to promote better outcomes for workers and the economy.

C. Deal with the Demand Side: Fully Commit to the Green Economy

Community colleges sit at a key intersection of academic and technical education and can anchor a strategy to build the technical literacy of the American workforce. In turn, a technically literate workforce will be much better suited for the kinds of jobs that characterize the green energy economy. For that training to translate into jobs, however, America needs to make a clear commitment to get on the path toward a more sustainable energy future and away from its current fossil-fuel-driven path. Without that commitment, policymakers risk putting training dollars into programs that will prepare workers for jobs that simply do not exist.

The Obama Administration is already under fire for supposedly doing this very thing. In a recent editorial,⁸⁹ the Wall Street Journal criticized the Administration for committing \$500 million in funds for green jobs training through the American Reinvestment and Recovery Act (ARRA).⁹⁰ The article noted that the program was supposed to train 125,000 workers, but “only 53,000 have been ‘trained’ so far, only 8,035 have found jobs, and only 1,033 were still in the job after six months.”⁹¹

The article can be criticized on a number of counts, not least because it identifies only those workers who have already been fully trained, and not those who are currently going through a training program or are about to enter an ARRA-funded program.⁹² The article also does not count incumbent workers, who made up about forty percent of those trained through these programs. But its underlying criticism—that many workers trained for green jobs have not found green jobs—needs to be taken seriously. The recession is partly to blame for this situation: workers in the construction industry in particular were hard hit by the housing market collapse, which also decimated the green building and home retrofit industries.⁹³

89. Editorial, *Green Jobs Brown Out*, WALL ST. J., Oct. 11, 2011, at A16, available at <http://online.wsj.com/article/SB10001424052970204524604576611191286160766.html>.

90. American Reinvestment and Recovery Act of 2009, Pub. L. No. 111-5 (2009) [hereinafter ARRA].

91. *Green Jobs Brown Out*, *supra* note 89.

92. Kate Gordon, *Debunking Another Green Jobs Attack by Murdoch’s Wall Street Journal*, CLIMATE PROGRESS (Oct. 11, 2011, 1:58 PM), <http://thinkprogress.org/romm/2011/10/11/340735/debunking-another-green-jobs-attack-by-murdochs-wall-street-journal/>.

93. See Bracken Hendricks & Matt Golden, *Taking on the Tool Belt Recession: Energy Efficiency Retrofits Can Provide a Real Help for Construction Unemployment*, CTR. FOR AM. PROGRESS (Mar. 3, 2010),

The larger problem, though, is that federal policymakers, particularly in Congress, simply have not committed themselves to the policies and programs that are necessary to achieve the President's campaign promise of five million green jobs over ten years.⁹⁴ When the President made that speech, he did so with the expectation that Congress would put some kind of price on carbon, which would even out the playing field for renewable energy technologies and create major incentives for energy efficiency investments.⁹⁵ The carbon price was also supposed to provide the seed funding for a significant investment, on the order of \$15 billion per year over ten years, in clean energy research, development, and deployment.⁹⁶

But the 111th Congress failed to pass that bill and the 112th Congress—in particular the Republican majority in the House of Representatives—has been vocal in its desire to attack clean energy programs wherever possible.⁹⁷ Meanwhile, other countries, most notably China and Germany, are ramping up their own policies and programs to fight global warming, while at the same time making sure they are leaders in the fast-growing global clean energy economy.⁹⁸

As those other countries have discovered, public policy plays a critical role in spurring the clean energy future. The market alone cannot bring the United States into this global race or allow us to realize the job and economic growth potential of the transition toward more sustainable and efficient energy sources. A host of market failures and distortions have inhibited the deployment of clean, renewable energy.

First, a century of subsidies and infrastructure investments to support the provision of carbon-based energy has severely tilted the playing field.⁹⁹ Second, the hidden costs associated with greenhouse gas emissions and other pollutants have typically been treated as negative externalities and never factored into the market price that consumers pay for traditional energy.¹⁰⁰ These costs affect our public health, national security, and our environment. In fact, Sir Nicholas Stern famously labeled climate change “the greatest market failure the world has ever

http://www.americanprogress.org/issues/2010/03/tool_belt_recession.html.

94. *Obama Proposes \$210 Billion for New Jobs*, ASSOC. PRESS (Feb. 13, 2008, 2:35 PM), http://www.msnbc.msn.com/id/23148959/ns/politics-decision_08/t/obama-proposes-billion-new-jobs.

95. See *Agenda: Energy & Environment*, CHANGE.GOV, http://change.gov/agenda/energy_and_environment_agenda/ (last visited Feb.20, 2012) (featuring the original Obama-Biden energy plan, including both a cap and trade program and a Renewable Energy Standard).

96. OFFICE OF MGMT. & BUDGET, *A NEW ERA OF RESPONSIBILITY: RENEWING AMERICA'S PROMISE* (2009); see also Deborah Zabarenko & Ayesha Rascoe, *Obama Budget Realistic on Climate Revenue*, REUTERS, Feb. 26, 2009, <http://www.reuters.com/article/2009/02/26/us-obama-budget-climate-idUSTRE51P4Q920090226>.

97. See DANIEL J. WEISS & KATE GORDON, CTR. FOR AM. PROGRESS, *LOSING THE FUTURE: HOUSE REPUBLICAN BUDGET CUTS WOULD STRANGLE INNOVATION* (2011).

98. See KATE GORDON ET AL., CTR. FOR AM. PROGRESS, *OUT OF THE RUNNING? HOW GERMANY, SPAIN, AND CHINA ARE SEIZING THE ENERGY OPPORTUNITY AND WHY THE UNITED STATES RISKS GETTING LEFT BEHIND* (2010); KATE GORDON ET AL., CTR. FOR AM. PROGRESS, *RISING TO THE CHALLENGE: A PROGRESSIVE U.S. APPROACH TO CHINA'S INNOVATION AND COMPETITIVENESS POLICIES* (2011).

99. See JONATHAN PERSHING & JIM MACKENZIE, *REMOVING SUBSIDIES: LEVELING THE PLAYING FIELD FOR RENEWABLE ENERGY TECHNOLOGIES 1-2* (2004).

100. *Id.* at 16-17.

seen.”¹⁰¹ And third, clean-energy solutions face major market barriers specific to their sector. The fact that landlords often do not pay their own utility bills hinders energy efficiency investments in buildings. The lack of distribution infrastructure inhibits the availability of ethanol and other alternative fuels. Further, our outdated transmission grid poses major obstacles to deploying greater quantities of utility-scale renewable energy.¹⁰² A comprehensive policy approach will help us to overcome these numerous market failures and increase demand for clean energy.¹⁰³

As we at the Center for American Progress have argued, this policy approach must include three key elements:

1. Policies must help create a **strong market** for renewable and efficient energy. The most important of these is a price and cap on global warming pollution, such as a carbon tax or a cap and trade system. Other important national policies in creating a strong market include a Clean Energy Standard, which would require a certain amount of the country’s power to be produced using low-carbon and renewable energy sources, and stronger building and appliance codes to spur greater energy conservation.
2. Policies must provide **financing support** for clean energy technologies across the value chain, from research and development, to production and commercialization, to installation and deployment. The American Reinvestment and Recovery Act¹⁰⁴ included many of these types of supports, but its programs are coming to an end and there is strong debate in the current Congress about whether to reauthorize many of them.¹⁰⁵
3. Policies must strengthen and upgrade the nation’s **energy infrastructure**, including our power grid and transportation systems, but also including our workforce.

This last point brings us full circle. To have a strong and competitive clean energy system, America needs a strong and technically literate workforce. But to ensure that that workforce is not trained for jobs that do not exist, Americans need to commit ourselves to the clean energy transition.

101. SIR NICHOLAS STERN, *THE STERN REVIEW: REPORT ON THE ECONOMICS OF CLIMATE CHANGE* viii (2006).

102. *Barriers to Renewable Energy Technologies*, UNION OF CONCERNED SCIENTISTS, http://www.ucsus.org/clean_energy/technology_and_impacts/energy_technologies/barriers-to-renewable-energy.html (last visited Feb. 20, 2012).

103. John Podesta et al., *The Clean-Energy Investment Agenda: A Comprehensive Approach to Building the Low-Carbon Economy*, CTR. FOR AM. PROGRESS (2009), available at http://www.americanprogress.org/issues/2009/09/clean_energy_investment.html.

104. ARRA, *supra* note 90.

105. See, e.g., Andrew Restuccia, *House GOP: Where are the ‘green jobs’?*, THE HILL, Sept. 22, 2011, <http://thehill.com/blogs/e2-wire/e2-wire/183243-house-republicans-where-are-the-green-jobs>; Matthew L. Wald, *Republicans Attack on Handling of Stimulus Money and Green Jobs*, N.Y. TIMES, Sept. 22, 2011, <http://www.nytimes.com/2011/09/23/science/earth/23energy.html>.

V. CONCLUSION

To realize the promise of the clean energy economy, America needs to make a commitment to passing the policies and programs that will spur that economy. Americans also need to commit to building a workforce with the basic technical literacy, and the specific technical skills, to excel at the myriad occupations that this economy will produce. These needs mean moving beyond our traditional education and workforce system toward a more flexible, more integrated, and more industry-focused training system. Only by moving our workforce into the twenty-first century can Americans move our economy, and our climate, into a greener future as well.