GREENER PATHWAYS

Jobs and Workforce Development in the Clean Energy Economy

A REPORT BY

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CENTER ON WISCONSIN STRATEGY • THE WORKFORCE ALLIANCE • THE APOLLO ALLIANCE

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Across the country people are talking
about the economic promise of clean energy.

Greener Pathways puts jobs
at the heart of this conversation.

EXECUTIVE SUMMARY

The Need

Across the country—in the media; in boardrooms, think tanks, and community organizations; in local and state government; in Congress and on the campaign trail—people are talking about the economic promise of clean energy. *Greener Pathways* puts jobs at the heart of this animated national conversation. This report provides information on the kind and quality of jobs in the clean energy economy; the skills needed to fill these jobs; and how existing plants and their workers—especially those in the beleaguered industrial heartland—can move to the center of the clean energy economy. These nuts and bolts issues bring labor, business, community, and education together as partners in the new industrial revolution.

The Context

Building a competitive and equitable green economy means investing in the backbone of America's labor force: workers with more than high school, but less than a four-year degree.[1] Beyond the cadre of highly skilled engineers and innovators who catalyze change, and a limited number of green-collar workers in just-invented jobs, the new energy economy will be built and sustained by middle-skill workers in traditional occupations. Indeed, many skills of the greener future are closely related to the skills of today. And most of the jobs in the industries examined in this report—e.g., electricians retrofitting buildings for energy efficiency, lab technicians ensuring quality control in ethanol plants, machinists crafting wind turbine components and technicians maintaining them—do not require advanced degrees. Thus the greener pathways of this report lead to middle-skill jobs in the clean energy future.

The Report

Broadly defined, "green jobs" is not a salient category for policy innovation or workforce training. To make real progress on economic and workforce development in the new energy economy, we must focus more carefully on key clean energy sectors. *Greener Pathways* does just that, by detailing current economic and workforce development opportunities in three leading industries: energy efficiency, wind, and biofuels. The report also examines federal resources that can support state green jobs initiatives, including programs in the Departments of Energy and Labor, and the Green Jobs Act included in the 2007 Energy Independence and Security Act. We conclude by outlining a plan of action for state policymakers, highlighting policy, program, and system reform opportunities to embrace the greener and more equitable promise of the new energy economy.

POLICY PRINCIPLES FOR GREEN JOBS INITIATIVES

Greener Pathways provides information to help states craft clean energy agendas that simultaneously meet emerging industry demand; train and support workers; and create good, family-supporting jobs. A series of key principles helps focus and animate green jobs policy:

Get smarter about green jobs

The energy, enthusiasm, and investment in "green opportunity" sometimes runs ahead of careful thinking. Careful thinking, however, is the foundation of successful policies and projects. Of key importance here is focusing the approach, and then building on a solid foundation of labor market data and analysis.

Target specific sectors within the "green jobs" universe
Use good data on labor market opportunities and skill gaps to drive green jobs initiatives
Measure and evaluate green jobs programs and make them better

Sustain good jobs through green partnerships

The green jobs promise is realized when smart economic development links with thoughtful workforce training. That happens when green jobs partnerships are founded, supported, and sustained to ensure the linkage.

Employ energy standards as green job creation tools
Promote green industry clusters
Design green jobs initiatives to both save existing jobs and create new ones
Link green economic and workforce development
Construct green industry partnerships
Integrate green jobs initiatives into existing workforce systems

Make sure green jobs pay off for workers and communities

The greatest promise of green jobs will be realized only if we are smart about generating good jobs that are accessible to the people who need those jobs. To realize this potential requires focused attention on job quality, strong access for all, and upward mobility in the green economy.

Maximize community benefits by requiring them
Build greener career pathways
Extend green ladders to build real pathways out of poverty

HIGHLIGHTS

Jobs: Green-Collar Prospects in Three Industries

A greener American economy can and will create jobs. Just how many depends on the scale and terms of future investment, and on how states define "green jobs," an evocative but ambiguous term. For the purposes of this report, green jobs are family-supporting, middle-skill jobs in the primary sectors of a clean energy economy—efficiency, renewables, and alternative transportation and fuels.

We offer a snapshot of such jobs for three key green industries in the "at-a-glance" charts on pages 16, 26 and 38.

Energy efficiency may be the fastest, cheapest way for states to address global warming, reduce energy costs for their poorest citizens, and create and sustain good jobs. We look at building retrofits, one sector in a broader field that includes residential and commercial retrofits, green building, and green manufacturing.

We examine the **wind sector** because of its rapid and high-profile growth in the U.S. and abroad, its potential as an economic driver in both urban and rural areas, and its capacity for job creation in manufacturing as well as installation and operations. Component part manufacturing for wind turbines holds particular promise.

Evidence mounts that **biofuels**, at least in their current state, are not particularly good for either the environment or the job market. Yet the industry has taken root, is growing rapidly, and generates increasing policy interest and investment, particularly, but not exclusively, in the Midwest. We look at jobs in ethanol and biodiesel production.

Training: Greener Pathways Across The Country

The dual promise of environmental health and community prosperity can only be answered by green jobs and green job training *at scale*. But we should not start from scratch. The most efficient and effective way to prepare a green-collar workforce is to build on the existing foundation of state and local workforce development systems. More time should be spent embedding green skills training within current curricula, and less energy inventing new programs. Retrofitting American cities, for example, requires not "green construction workers," but rather workers with traditional construction skills who also have up-to-date training on energy-efficient construction. And even those employers who focus more narrowly on a particular green technology, say solar installation and maintenance, require certified electricians who are thoroughly grounded in electrical theory and practice. The new energy economy will create some brand new industries and many brand new jobs. But even more of it will involve transforming the industries and jobs we already have.

Beyond skills training, green jobs initiatives must address access and upward mobility. To help workers advance from unemployment, disconnection, or dead-end poverty-wage work into family-sustaining green jobs, states need to build and support career pathways. These pathways are not new ones, necessarily, but greener ones—developed in collaboration with employers, workforce agencies, community organizations, labor unions, and community and technical colleges.

Green partnerships provide the leadership to build greener workforce development pathways. The report profiles some of the best examples in the nation where such work is underway, including:

Building Greener Construction Careers in California • Iowa's Bio-Fuels Job-Training Bonds • Training Turbine Techs in Oregon Pennsylvania's Green Reindustrialization

Equity: A Greener Future

Massive green investment and policy innovation need to be joined with an opportunity agenda that extends the greener pathways to all. The new energy economy will not simply emerge and generate good jobs; strategic state policy initiatives must hasten and direct the growth. States that build green-collar job training partnerships will be at the forefront of the new energy economy, and in a prime position to reap the benefits of the new Green Jobs Act. And as states construct greener pathways, workers will build a more green and prosperous future for their families and communities.

INTRODUCTION

THE CHALLENGE

The green vision beckons: clean, vibrant cities, robust rural communities, a revitalized industrial heartland. Rustbelts become greenbelts and wastelands of poverty become communities of hope, as the middle-class archipelago is knit once again into a bedrock American dream.

The promise of America's new energy economy is a compelling antidote to sobering news on two national fronts: the environment and the economy.

In the environmental theatre, the consequences of business as usual comprise a now-familiar litany of carbon-centric woes: the declining health of individuals, communities, and ecosystems; the escalating perils of global warming; and an unsustainable dependence on imported fossil fuels.

On economic terrain—where erosion is equally alarming and a recession appears imminent—persistent and increasing inequality demonstrates that a growing, globalizing economy has not benefited all. Despite significant boosts in worker productivity over recent decades, median wages remain stagnant. The decline in manufacturing jobs over the last decade gathered steam with an 18 percent national job loss after the 2001 recession, plummeting with particularly devastating consequences in the industrial heartland, which bore up to a third of the national job loss recorded between 2000 and 2005.[2] Nationally, median family income has not recovered to the pre-recession levels of 2000, and job insecurity threatens workers at all levels.[3]

The green vision beckons: clean, vibrant cities, robust rural communities, a revitalized industrial heartland.

Anchoring the low end of the labor market, more than one in five (22 percent) working Americans hold poverty wage jobs.[4] Those without post-secondary education can no longer earn their way out by dint of hard work, and social supports are inadequate to close the gap. Close to one out of three (29 percent) working families in this country are low income.[5] Living below 200 percent of the federal poverty line—a bar that often serves as a proxy for self-sufficiency—these families face serious and increasing problems making ends meet. Factoring in race highlights further inequality: a breathtaking 42 percent of minority working families are low income.[6]

At the same time, a significant number of high-demand, good-paying jobs in this country are going unfilled because there are not enough skilled workers to meet the demand, particularly in industry sectors that are central to creating a new energy economy. For example, in a 2005 survey by the National Association of Manufacturers, 90 percent of respondents indicated a moderate to severe shortage of qualified skilled production employees such as machinists and technicians.[7] This challenge will only get more severe as baby-boomers retire. In a recent power sector survey, nearly half of respondents said that more than 20 percent of their work force—mostly skilled tradespeople—would retire within the next five to seven years.[8] Many of these current and future jobs require a significant amount of postsecondary education, but not a four-year degree. This makes them a great opportunity for marginally attached, low-skilled workers—for whom a college degree may not be a realistic or desired option—to move into living wage jobs.

The new energy economy will not solve all of the problems of economic inequality, environmental degradation, and energy insecurity. But it can contribute mightily to a resurgence of the American middle class and a sustainable environmental ethos. By expanding existing industries and creating new ones, the emerging green sector can retain and create significant numbers of domestic jobs in three areas: research and development, manufacturing and construction, and maintenance and operations. There are many ways to count them, none perfect. In the most ambitious estimates, the

renewable and efficiency sectors may account for as many as one in four jobs by 2030.[9] Whatever the relative merits of such approximations—and we evaluate some of these elsewhere in this paper—even the most modest modeling indicates that the green economy holds much promise for urban and rural revitalization.

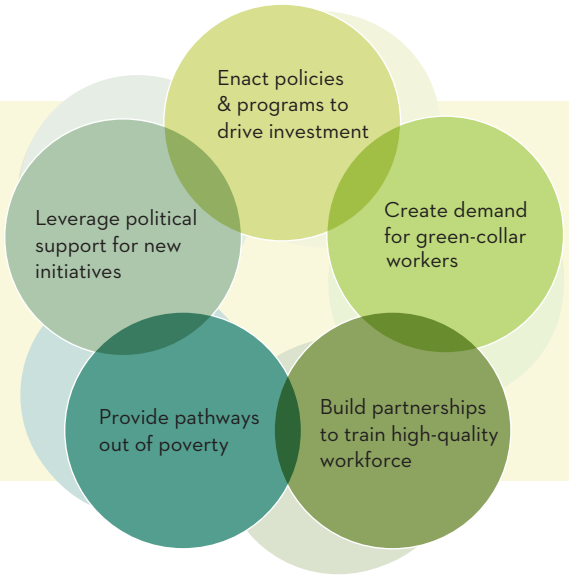
To realize that promise—to ensure that the shift from a petro- to green economy is at once viable and equitable—states must make every effort to intentionally direct the transition. Green economic and workforce development efforts should aim to:

Spur regional, sector-based economic development that is locally sustainable and designed to promote broad-based community development, including the creation of family-supporting jobs with decent benefits.
Invest in the workforce intermediaries and labor market institutions that can best guide such development, bringing all players—labor, industry, education, government, and community—to the table and locating all efforts in data-driven strategies.
Develop demand-driven career pathways to ensure that prospective and incumbent workers have clear and accessible training paths to better jobs with higher wages and benefits, and that the least fortunate among us have unobstructed pathways out of poverty.

THE RESPONSE

New energy technologies will depend on a workforce that is prepared and trained to build and implement them. But the skilled workers for these industries will not emerge from a vacuum, nor will the benefits of the new energy economy automatically spread to the workers and communities with the greatest economic needs. This report aims to provide critical information to policymakers, practitioners, and advocates: the potential for living-wage job growth in selected alternative energy and energy efficiency industries, the possible career pathways within those industries, and emerging best practices to prepare workers for green-collar careers.

We recommend a demand-driven policy and practice model that links economic and workforce development:



Adapted from Apollo Alliance

To better understand which green sectors offer the greatest potential for community transformation, the report investigates elements of this cycle in three industries: energy efficiency, biofuels, and wind. We sketch a basic picture of each industry; discuss related economic development practices; present examples of available labor market information on current jobs, wage and benefit ranges, and projected job growth; review education and skill requirements; and profile effective workforce development programs, where they exist.

The report also examines federal resources that can support state initiatives, including programs in the Departments of Energy and Labor, and the Green Jobs Act included as Title X of the 2007 Energy Independence and Security Act (EISA). Finally, aware that forward-thinking communities are leaping ahead of the federal government to initiate green jobs programs in their states and regions, we lay out a series of core policy principles to undergird these efforts.

We see this report as a first step in helping states craft clean energy initiatives that simultaneously meet emerging industry demand, train and support workers, and create good, family-supporting jobs.

THE TERMS: A GREEN JOBS GLOSSARY

In order to help states develop green jobs, we must first define them. We must also describe the building blocks that create and sustain them. For just as we find that green jobs are not necessarily new jobs, but often traditional occupations in industries reinventing themselves for the new energy economy, we argue here and elsewhere that related employment and training programs should be integrated into existing economic and workforce development systems. Advocates, practitioners and policy-makers in the coming decade will need to use those systems to connect workers to the emerging green economy, and link alternative energy employers to a trained—and where necessary, green-skilled—workforce. To help them do so, the following glossary attempts to clarify the sometimes vague or obscure terms that define a high-road approach to green job development.

Green Jobs

"Green jobs" and "green-collar jobs" are evocative and potentially galvanizing terms; they are also notoriously ambiguous. For the purposes of this report, "green jobs" or "green-collar jobs" are family-supporting jobs that contribute significantly to preserving or enhancing environmental quality. Defined more by industry than occupation, they reside primarily in the sectors that make up the clean energy economy—efficiency, renewables, alternative transportation, and fuels.[10]

Some of these jobs seem intuitively green: solar panel installers, wind tower mechanics, biofuel technicians. Many do not. A machinist punching parts for wind turbines may also punch parts for decidedly less green purposes, and her work may not look different from a job across town producing components for an oil refinery. As this report seeks to make clear, creating a new energy economy will involve creating some brand new industries and many brand new jobs. But even more of it will involve transforming the industries and jobs we already have. From a workforce development perspective this means less focus on creating courses of study and curricula from scratch, and more on embedding green curricula for green skills into existing programs.

Most green-collar jobs are and will be middle-skill jobs requiring more than high school, but less than a four-year degree. Clearly many PhDs, financial analysts, and engineers hold green jobs and directly contribute to the building of a green economy. But publicly-funded workforce development projects should promote green-collar jobs accessible to those with less than a BA. These jobs represent the bulk of employer demand and range from entry-level to high-wage jobs in a multitude of industries, including renewable energy, energy efficiency, and biofuels. Within these industries, green-collar work includes building, construction, assembly, installation, operation, maintenance, transportation, and manufacturing.

Green jobs thus defined can be significantly affected by state policy and meaningfully supported by established workforce development systems. Given the exploding interest in green jobs, and the real potential for their development, we need to consider where the lack of a trained workforce might hinder the regional development of a given industry, where state policies might be effective in shaping related employment and training programs, and where the potential size of the industry merits sustained public efforts to leverage private investment.

Good Jobs

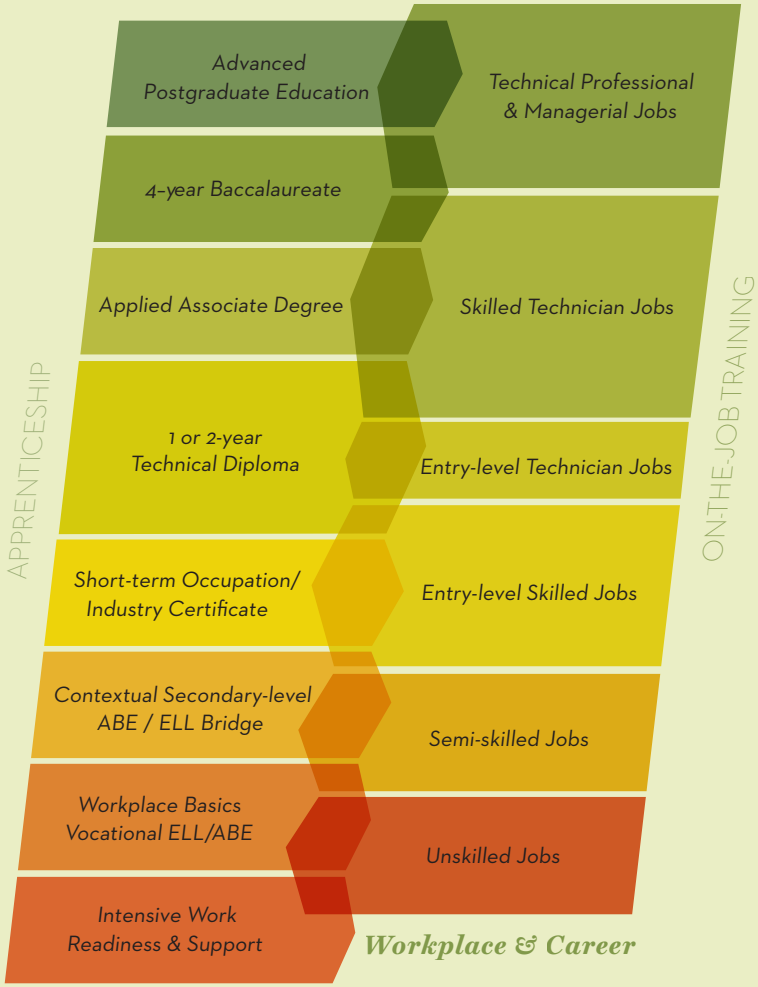
A green job is a good job. Throughout this report, and indeed we hope, infused in all discussions of the clean energy economy is a green vision of a stronger environment and a stronger American middle class. If we focus only on environmental content, to the exclusion of job quality, we risk affirming day laborers installing solar panels without job security or proper training, minimum wage workers toiling in a clean tech manufacturing facility without healthcare or the right to organize, and youth pushing brooms at a green building site without training or opportunity for advancement.

A good job pays more than a poverty wage, or more than about $10 an hour.[11] But there is more to it than that. Good jobs offer benefits, at least health-care and ideally pensions, paid sick leave, safe working conditions, reasonable schedules, organizing rights, and a modicum of job security. And because low-road economic practice condemns a substantial number of Americans not just to short-term, low-wage jobs, but also to long-term poverty traps, a good job is one with an accessible pathway to advancement.[12]

Career Pathways

To the extent possible and relevant, green job training should be developed in a career pathways framework. This strategy provides stepping stones through short-term, occupationally contextualized training programs that help workers at any level gain skills and advance in a high-wage, high-growth industry. At the same time, pathways increase the supply of trained workers for industries important to regional economic success. In a typical pathways program, community or technical colleges work with employers to figure out what skills workers need, then break up traditional curricula into smaller, manageable sets of courses, leading to an entry-level job or job-advancement. Good pathways offer more than guideposts: workers and students may need career coaching and case management; links to community services, like child care and transportation; and more accessible training, like night and weekend classes at job sites or community centers. As a system, a pathways approach targets demand in regional labor markets, linking employers, incumbent and prospective workers, community organizations, educational institutions, and workforce agencies.[13] Every pathway begins with a partnership.

Pathways increase the supply of trained workers for industries important to regional economic success



Adapted from Wisconsin RISE

This schema is adapted from a career pathways model developed by the Wisconsin Technical College System in partnership with the Wisconsin Department of Workforce Development.

The model anchors the state's Regional Industry Skills Education (RISE) initiative.[14] While RISE focuses on building stronger state policies to support the middle rungs, the chart illustrates the many entry and exit points, as well as the critical educational bridges, that career ladders provide for workers and job seekers at all levels.

A pathways out of poverty approach would focus on the lower half of the diagram, with particular attention to work readiness, English language learning (ELL) and adult basic education (ABE).

Workforce Intermediaries

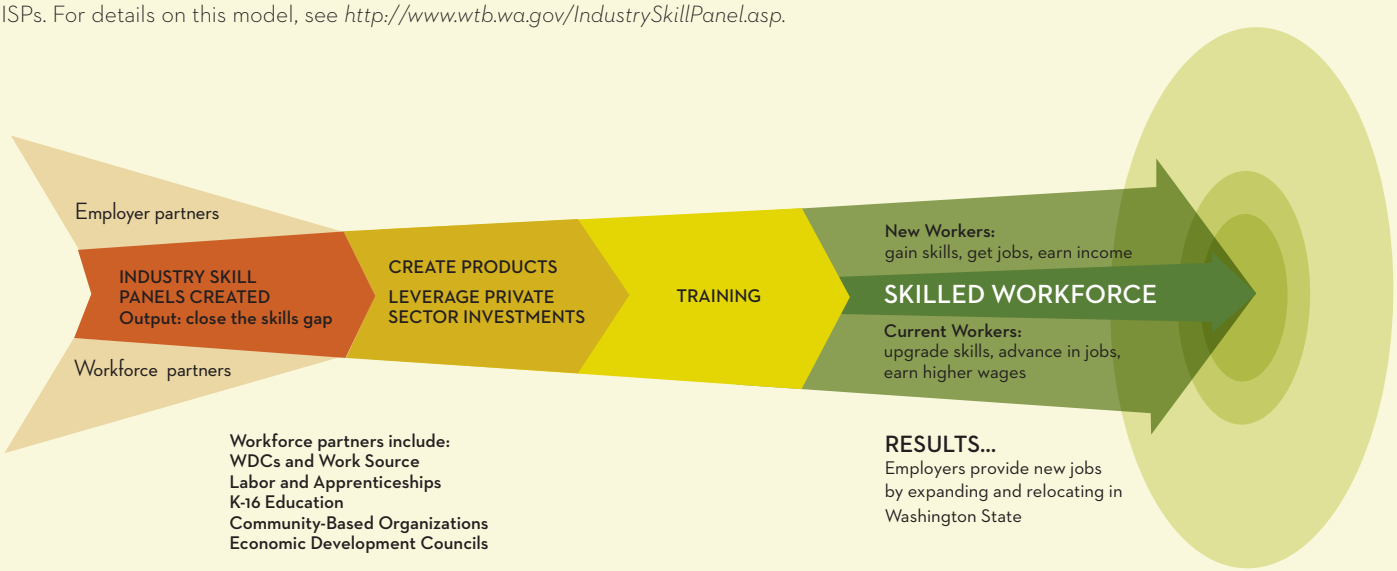
Workforce partnerships rely on workforce intermediaries. Intermediaries have in-depth knowledge of the targeted industry and bring everyone in a regional economy to the table: labor, business, education, government, community. They might be established labor market institutions, like a local workforce investment board, or innovative public-private enterprises like a regional training partnership. They can troubleshoot labor exchange, align post-secondary curricula with industry demand, broker or provide worker training, and leverage new sources of funding.

Prominent examples include the Wisconsin Regional Training Partnership, Washington State Industry Skill Panels, and Michigan Regional Skill Alliances (see *box*).[15] These and countless other intermediaries help states in the difficult but essential 21st-century task of constructing competitive, integrated, and equitable workforce and economic development systems. Green jobs initiatives need to include the funding and vision to bring workforce intermediaries to scale, and to engage existing intermediaries in building green industry partnerships.

Models for Green-Collar Job-Training Partnerships

WASHINGTON'S INDUSTRY SKILL PANELS

Industry Skill Panels (ISPs) bring business, labor, and education together in public-private partnerships to build a skilled workforce in key industry sectors. Energy is a targeted sector, but there is no dedicated clean energy panel. New legislation described on pages 48–49 plans to green the ISPs. For details on this model, see *http://www.wtb.wa.gov/IndustrySkillPanel.asp*.



Adpted from Washington Work Force Training and Education Coordinating Board

MICHIGAN'S REGIONAL SKILL ALLIANCES

Michigan Regional Skill Alliances (MiRSAs)—industry-based coalitions of employers, educational institutions, training providers, economic development organizations, and public workforce agencies—offer an integrated local response to skill shortages and related obstacles to competitive regional development. Last year the Corporation for a Skilled Workforce produced an "Alternative Energy Industry Knowledge Development Guidebook," designed to help MiRSA staff in the Department of Labor and Economic Growth become expert information brokers for the emerging green sector. See *http://www.michigan.gov/rsa*. The Guidebook is available at *http://www.skilledwork.org/pdfs/Alt%20Energy%20Guidebook.pdf*.

Sectors, Clusters & Regional Development

Sectors and clusters are as often confused as they are discussed. In the broadest terms, the sector is an organizing concept for workforce development, while clusters pertain to economic development.[16]

In workforce terms, a sector strategy targets a specific industry, like manufacturing or construction, linking education and training to the demand in a regional labor market.[17] In economic development terms, an industry cluster is a geographically and functionally related group of companies, typically with shared or complementary expertise, services, resources, suppliers, and labor.[18] Information technology in Silicon Valley is perhaps the most famous; notable new examples are the emergent Clean Tech clusters in California, the Northeast, and the Midwest.[19]

Cluster strategies build on a region's native strengths—education, infrastructure, and natural resources—rather than trying to retain or attract individual firms.[20] By promoting cluster development, states can propel entrepreneurs and workers into "virtuous circles" of competition, expansion, and innovation. Tied to sectoral workforce initiatives designed to advance low-wage workers, they can generate a green wave that lifts all boats.

A Clean Energy Sector? Classification and its discontents.

How do we classify clean energy and its related jobs? The answer is not academic; successful workforce initiatives are data-driven. An **industry** groups employers in terms of their products and services; an **occupation** groups workers together on the basis of the sort of work they do, regardless of industry. It is difficult to effectively disaggregate data for either in the new energy economy. Standard industry classifications do not always reveal cluster relationships or adequately define emerging sectors. Most green industries, like wind and solar, don't have their own census bureau classification codes, and few green occupations are explicitly described as such. In an effort to more accurately assess industrial capacity, investment returns, and job growth in the green economy, a number of states and organizations are attempting to customize local labor market analyses, and to develop industry-specific economic impact models. We will review some of the more promising efforts in the following sections.

GREENER PATHWAYS: THREE KEY INDUSTRIES AND THEIR JOBS

Defining Efficiency

Energy efficiency typically refers to reductions in energy demand by, say, insulating houses or developing cars that get more miles per gallon. Such measures raise the ratio of benefit to cost—economic or environmental. Defined this way, energy efficiency is distinct from two related terms:

Energy conservation. Like efficiency, conservation relates to the demand side, but conserving energy simply means using less. Turning down the heat in a house during the winter is a conservation measure, while installing a furnace that produces more heat per unit of fuel is an efficiency measure.

Green generation. Shifts from conventional (e.g., coal and oil) to renewable (e.g., wind and solar) supply-side measures are generally considered separately from energy efficiency, which is demand-related. Analysts are increasingly calling for policies that exploit the synergies between renewables and efficiency, rather than pursuing them along separate tracks.[23]

Green building refers to a structure that is generally environmentally friendly in a variety of ways, including its use of energy. In the United States, the best-known standards for assessing whether a building is green are called LEED, for Leadership in Energy and Environmental Design. Established by the nonprofit U.S. Green Buildings Council, LEED standards cover both new construction and existing buildings, and residential, office, retail, school, and healthcare uses. LEED standards address energy use along with a host of other qualities, including the toxicity of building materials, bike/pedestrian access, and stormwater controls.

This section investigates the potential for living-wage jobs in three clean energy sectors: **efficiency**, **wind** and **biofuels**. We offer these emerging industries as instructive snapshots from the vast landscape of the new energy economy. Each has been the focus of state and federal policy—and politics. Energy efficiency has been described as the "first fuel," and may be the fastest, cheapest way to address global warming. We look at building retrofits, one sector in a broader field that includes residential and commercial efficiency retrofits, green building, and green manufacturing. In the related realm of renewable energy, we chose wind, but could easily have looked at another waking giant—solar—as well as smaller but potentially significant players like geothermal and biomass. Another critical clean energy sector is alternative fuels and transportation. Evidence mounts that biofuels, at least in their current state, are not particularly good for either the environment or the job market.[21] Yet the industry has taken root, and is growing rapidly. And because economic developers, particularly but not exclusively in Midwest, have made such strong claims for the bioeconomy as an engine of regional economic prosperity, biofuels merit a closer look.

For each industry, we offer an industry overview; a survey of economic development and key state policy levers; a review of employment and training prospects; and a detailed case study. Each study makes clear that the green economy can create many decent middle-skill jobs. Just how many depends on the scale and terms of future investment, both public and private. And for workers entering those jobs, the route out of poverty and into career advancement will be a greener pathway that modernizes training in traditional occupations.

ENERGY EFFICIENCY

Overview

Substantially reducing waste of energy through systematic retrofitting and upgrading of residential and commercial buildings is a key area where environmental and equity agendas can come together to create good jobs. The work requires a multi-skilled, local workforce that cannot be outsourced, and it feeds a building-materials industry that is still largely domestic.

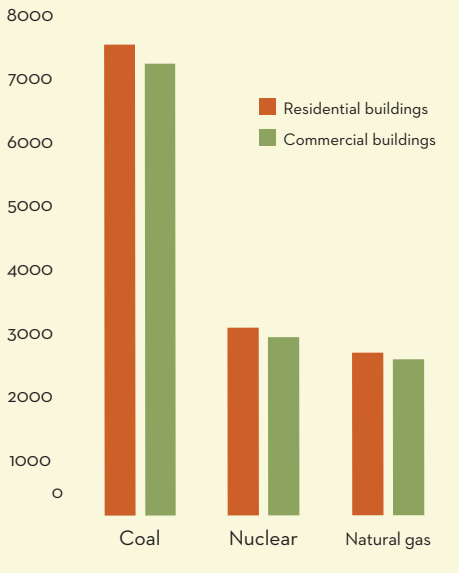
Retrofitting existing buildings for improved efficiency is already a substantial economic activity. In the U.S. "MUSH" sector—municipalities, universities, schools, and hospitals—energy service companies performed $12 billion to $16 billion in retrofit work between 1990 and 2003.[22] But there are many more buildings that could benefit from retrofits. And building owners will take advantage of the economic benefits of efficiency improvements, without special subsidies, if well-designed policies can make efficiency a readily available commodity.

Any activity that involves energy, from industrial processes to traffic control by stoplights, can benefit from efficiency improvements. We focus here on building energy because of its magnitude—buildings account for some 40 percent of U.S. energy use—and its potential to create green jobs.

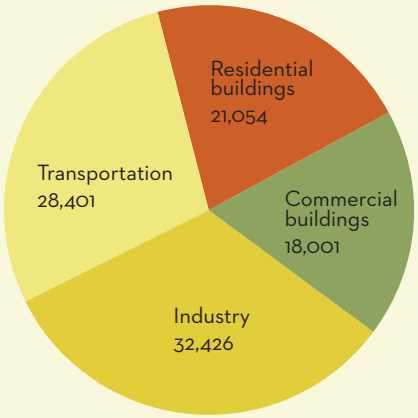
The United States' building stock varies widely, with every home and commercial structure representing a unique combination of building shell and energy systems. And this stock evolves continuously in ways that affect energy use. Between 1978 and 1993, for example, the number of U.S. homes with air

Efficiency projects create greener jobs and cleaner communities by installing technologies that will reduce the energy consumption of the nation's 101 million households and 4.6 million commercial structures. These buildings account for about 40 percent of energy use in the United States, with homes using somewhat more energy than commercial structures. At the moment the vast majority of energy consumed by buildings comes from coal and natural gas, which are burned on-site and at electrical generating plants, and from electricity generated at nuclear power plants.

U.S. building energy consumption (trillions of BTU) by primary fuel source, 2006



U.S. energy consumption (trillions of BTU), 2006



Source: Energy Information Administration

conditioning rose from 18 million to 43 million.[24] With millions of unique buildings situated in a broad range of regional eco-systems, and with tastes, technologies, and prices in constant flux, efficiency has been difficult to mass merchandise. Operators of very large buildings frequently take advantage of energy service companies, or ESCOs, to have their facilities upgraded on the basis of individual audits. The ESCO industry performed about $2 billion in projects in 2000 and estimates more than $5 billion for 2008.[25] Comparing energy savings and project costs, a 2002 study determined that ESCO work yielded median benefit–cost ratios of 2.1 to 1 for private projects and 1.6 to 1 for government projects.[26]

Yet in 2002 ESCOs were undertaking only about 1,000 projects per year—a tiny fraction of the millions of buildings in the country.[27] ESCOs rarely address small buildings, such as houses, which do not require specialized consulting work for efficiency improvements. Instead, a patchwork of government- and utility-run programs provide subsidies for residential efficiency upgrades.[28] The biggest of these, the Weatherization Assistance Program, uses a combination of federal, state, and utility funds to retrofit homes of low-income residents. It has upgraded 5.5 million homes since 1976.[29] This achievement should not be dismissed, but it is a small fraction of the nation's homes. And efficiency improvements "decay" over time as changes are made to buildings, equipment fails, and new technologies appear.

In 2000 and 2005, the Energy Center of Wisconsin undertook two detailed studies to assess the opportunities for efficiency measures with payback periods of 10 years or less in the state's housing stock.[30] Applying the results of those surveys to Milwaukee and adjusting for inflation suggests that a $243 million retrofit of the city's housing would cut energy costs by $83 million per year.[31] That figure is conservative, because energy prices have increased since the surveys were conducted, making more measures cost-effective. And it accounts just for housing, not commercial buildings, in just one medium-sized American city of 600,000 residents.

If a central goal of building a green economy is to revitalize America, spreading the benefits of clean energy to communities most in need, it is important to target older cities like Milwaukee. They can realize more savings than newer cities with better housing stock, putting money back into public coffers by retrofitting city buildings, or, in the case of residential retrofits, putting money in residents' pockets.

Building a Stronger Energy Efficiency Sector

What's stopping property owners and the contractors they employ from maximizing the economic benefits of energy efficiency? One significant barrier is lack of information. While large, well-capitalized enterprises can call on ESCOs or other technical experts to assist in reducing energy bills, most building owners cannot afford to hire consultants. They are left to navigate the many and conflicting claims of various vendors.

In the residential market, notes Jennifer Thorne of the ACEEE, "capturing the energy savings potential in existing homes has proven to be quite a challenge. Homeowners face a daunting array of decisions and competing priorities when investing in home improvements," and can be overwhelmed by the diversity and number of specialized contractors.[32]

The economic and environmental logic of building upgrades is not by itself enough to drive large-scale retrofitting. Challenges include:

Short time-horizons. Property owners may forgo efficiency improvements if they worry they will sell the property before they realize net gains from energy savings.

Lack of access to capital. Though efficiency can be cost-effective, it requires an upfront investment.

"Split incentives." In rental housing and commercial space, often the tenant pays the energy bill, giving the landlord scant incentive to spend money on efficiency.

Transaction costs. Because buildings vary so much in their use, structure, and systems, efficiency cannot be easily mass-marketed. Instead, efficiency measures must be tailored and financing found one building at a time.

A number of promising efforts are underway to surmount such obstacles and seize the opportunities offered by energy efficiency—opportunities to counter the triple threat of climate change, rising energy costs, and the decline of decent jobs.[33]

In New York, Mayor Michael Bloomberg's new plan to green the city by 2030 envisions an energy-efficiency authority that will coordinate efforts to reduce energy use in residential buildings through a series of incentives and mandates.[34]

In Cambridge, MA, the Henry P. Kendall Foundation and the city have set up a $100 million program to reduce the city's greenhouse gas emissions 10 percent by providing funding and expertise for efficiency improvements in all building sectors.[35]

In Chicago and other major cities around the world, the William J. Clinton Foundation's Climate Initiative is working with municipal governments, ESCOs, and major banks to spur activity in efficiency retrofitting.[36]

In Milwaukee, COWS is working with the city and a wide range of stakeholders to develop a program that would provide funding and expertise for retrofits, and also let owners repay loans out of their energy savings.[37] (*See Me2 Sidebar*)

State Policy Initiatives to Strengthen the Sector

States lead the way in advancing energy efficiency, outspending the federal government on related programs by three to one as they turn to efficiency as "the 'first fuel' in the race for clean and secure energy resources."[39] The returns can be enormous. The National Resource Defense Council's David B. Goldstein, arguing that "energy efficiency is the biggest, cheapest, and fastest new energy resource available to the nation," explains the remarkable payback calculus in just one state:

Me2

In 2007, COWS and the city of Milwaukee launched a project that promises to both overcome important consumer barriers to energy efficiency and leverage large sums of private capital for the work—thus providing many new jobs.[38]

Milwaukee Energy Efficiency, or Me2, will let building owners and managers—from homeowners to large commercial and institutional enterprises—pay for needed retrofitting with no money upfront and with no fear of losing their investment if they move before realizing the energy savings. And it will aggregate lots of little projects into an attractive package with low default rates in order to attract private financing.

The program will work like this: building owners will contact Me2, or vice versa, to initiate a building efficiency project. Me2 will coordinate an assessment and installation of efficiency measures. The measures will save customers more on their energy bills over some reasonably short period—no more than 10 years—than they will cost to install. Me2 will use pre-arranged private financing to pay for the measures. Building owners will pay back the loaned funds, with interest, in monthly installments on their utility bills. Me2 will protect building owners who sell the property from losing money, through an innovative utility tariff: payment responsibility stays with the building, not the owner. Because the net of loan payments and energy savings result in a benefit, the current owner and any subsequent owner will profit through the life of the loan and beyond.

The Me2 project promises to raise very large sums for efficiency work. At present, it is limited to the city of Milwaukee, but for illustration, consider

California has held its energy electricity consumption per capita constant since 1975, compared to 60 percent growth for the rest of the country. Considering that the rest of the country was also improving efficiency, this result means that California now derives ***more than half of its electricity supply from energy efficiency****.*[40]

Efficiency is not just for Californians; opportunities are distributed across the country. Unlike renewables, which depend on place-based resource development, offering a comparative advantage to states with, say, more wind or biomass, efficiency is an equal-opportunity resource: every community has building stock requiring heat and power.[41]

Beyond brokering the sort of retrofit programs described in the previous section, states can promote building-related energy efficiency in several ways:

Update residential and commercial building codes to the most recent International Energy Conservation Codes (IECC). The Building Codes Assistance Project tracks state building energy codes at *http://www.bcap-energy.org/home.php*. American Council for an Energy-Efficient Economy (ACEEE) cites California, Washington and Texas as leaders in this area.

Lead by example. New York, California and Wisconsin are undertaking energy audits and retrofits of existing state buildings, adopting green building LEED standards for new public construction, and implementing green procurement standards for common equipment, like computers.

Encourage LEED building and operating standards in the private sector through carefully designed tax incentives. Credits for commercial and residential green building can be structured to effectively promote large-scale implementation of high-efficiency technologies.

States can also build the industry and its attendant economic benefits, including jobs, through two of the most promising policy levers that drive energy efficiency investment: public benefits funds (PBFs) and energy efficiency and resource standards (EERS).

PUBLIC BENEFITS FUNDS

Public benefits funds (PBFs) are ratepayer-funded programs established by many states in the wake of utility deregulation in the 1990s. Designed in part to manage energy demand by promoting efficiency, PBFs come in many stripes: they may or may not be administered by utilities, and their emphases may include, in addition to energy efficiency initiatives, low-income energy assistance, renewable energy programs, and research and development.

About half of states have PBFs. Nearly three quarters of the $1.8 billion in these funds is spent on efficiency.[42] This level of investment has tremendous green job potential: ACEEE calculates that a dollar invested in Energy Efficiency (EE) creates significantly more jobs than a dollar invested in the petro-economy, because efficiency-related construction, manufacturing and services are more labor-intensive than fossil-energy production.[43]

A recent ACEEE report lauds California, Massachusetts and New York for exemplary PBFs supporting energy efficiency in concert with renewables. The 2006 State Energy Efficiency Scorecard, which ranks states on EE program spending per capita, finds the top 10 states—led by Vermont, Oregon and Massachusetts—in the Northeast, the Midwest, and the West Coast.[44]

Me2 will provide funding and expertise for retrofits, and let building owners repay the loans out of their energy savings.

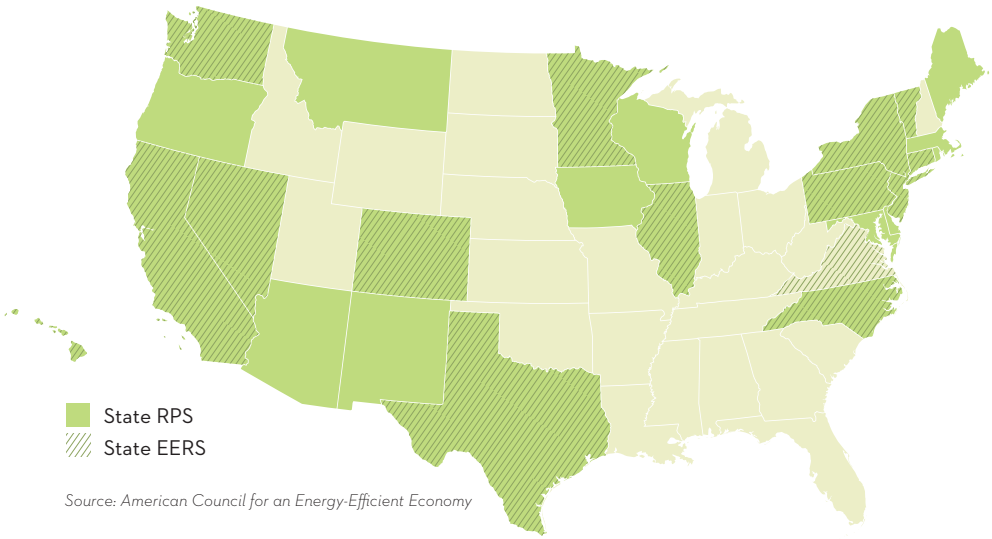
the state of Wisconsin, for which energy consumption data is readily available. In the residential market, if an Me2-style project can save the average household 20 percent of their energy costs—a realistic figure for all but very efficient homes—that would allow the average household to pay up to $33.83 per month for the efficiency measures. Assuming eight percent interest for seven years, those payments would support loans of $2,171 for the efficiency work. If every Wisconsin household participated, that would yield $4.9 billion for retrofitting work. Commercial and government buildings would add billions more to that total. Of course, not all building owners will participate, but even a 50 percent uptake still generates billions of dollars for retrofitting if undertaken across the state, and hundreds of millions of dollars just in the city of Milwaukee.

All this activity promises to create thousands of jobs for insulation, air-leak sealing, lighting, appliance replacement, HVAC upgrades, and other retrofit-related efforts. If Milwaukee were to take full opportunity of the city's residential retrofit potential—investing a minimum of $243 Million, according to estimates described in the overview—Me2 could create thousands of local jobs installing efficiency measures. And by lowering costs for energy, it would allow consumers and businesses to spend more on other goods and services, creating jobs across the economy.

ENERGY EFFICIENCY RESOURCE STANDARDS

Energy efficiency resource standards (EERS) are market-based mechanisms that encourage both transmission and consumption efficiencies in gas and electric power.[45] They mandate efficiency levels by setting *savings* targets. Utilities can meet efficiency goals through direct savings or in a credit-trading system; compliance measures vary by state. In combination with renewable portfolio standards (RPS), which direct utilities to tap renewably generated electricity, EERS can moderate demand enough to allow renewable development to keep up.[46] As of August 2007, 13 States had efficiency resource standards, with two more—New York and New Jersey—pending.

To guarantee that states enter the new energy economy on the high road, efficiency standards and incentives should be linked to measures ensuring that workers and communities benefit. This can be done effectively by tying incentives, subsidies and standards to project labor agreements, job quality standards, best-value contracts, and community benefit agreements.[47]



Source: American Council for an Energy-Efficient Economy

Energy Efficiency Policy Resources

STANDARDS

The Pew Center for Climate Change tracks state energy efficiency resource standards (EERS) at *http://www.pewclimate.org/what_s_being_done/in_the_states/efficiency_resource.cfm*. The American Council for an Energy-Efficient Economy (ACEEE) surveys state utility regulation policies in greater detail, including their intersection with renewable portfolio standards (RPS), at *http://aceee.org/energy/state/index.htm*. The ACEEE site also reviews building and appliance standards.

INCENTIVES

The Interstate Renewable Energy Council and the North Carolina Solar Center maintain an excellent Database of State Incentives for Renewables and Efficiency (DSIRE) at *http://www.dsireusa.org/*. A comprehensive resource searchable both by state and by program, DSIRE catalogues federal, state, local and utility initiatives with current links to related rules, regulations and policies. RPS and efficiency policies, such as building and appliance standards, along with Public Benefits Funds, are included as well.

STATE MODELS

The Regulatory Assistance Project publishes a *Policy Toolkit* of state legislation designed to promote efficiency through electric and gas utility regulation, focusing on energy efficiency as a resource and related financial incentives.[48] See *http://www.raponline.org/Pubs/Efficiency_Policy_Toolkit_1_04_07.pdf*.

State policy approaches to most of the measures described in this section are explained and evaluated in the COWS/Apollo *New Energy* series[49] available at *http://www.cows.org/pdf/rp-new_energy_states.pdf*; a more detailed policy picture emerges from the state rankings and success stories compiled in ACEEE's indispensible *State Scorecard*,[50] available at *http://www.aceee.org/pubs/e075.htm*.

Energy Efficiency Jobs

As new approaches to providing efficiency develop, the prospect for workers is bright. Energy efficiency not only offsets more greenhouse gas emissions than renewables and alternative fuels combined, it is a new energy strategy that generates significant numbers of domestic jobs.[51] The New York State Energy Research and Development Authority (NYSERDA) estimates that for every giga-Watt hour saved, the agency's programs create or retain 1.5 jobs.[52] A recent report for the American Solar Energy society counts 8 million jobs created in the U.S. energy efficiency industry in 2006 alone (3.7 million directly in efficiency); modeling one state, ACEEE predicts a more modest increase in Florida jobs by 14,000 over 15 years if the state were to expand energy efficiency programs as planned.[53]

Energy efficiency not only offsets more greenhouse gas emissions than renewables and alternative fuels combined. It is a new energy strategy that generates significant numbers of domestic jobs.

The most dramatic models cast a broad net, gathering a variety of indirect economic impacts into job projections. We are most interested in the direct job creation of building retrofits, and in the sorts of accessible middle-skill jobs that can transform troubled communities.

Construction and building operations workers provide the essential, measurable labor of energy efficiency retrofits. Importantly, these jobs are community-based: the building trades cannot be outsourced. Because construction workers can be imported from out of state, however, states and regions may want to include local hire language in EE policies related to larger industrial or commercial retrofits, and to include apprenticeship programs tied to local labor unions for publicly funded programs.

This type of work offers ample opportunity for entry level labor with potential advancement into solid middle-skill employment; the Jobs-At-A-Glance table on page 16 offers a representative selection of related occupations and their wage ranges.

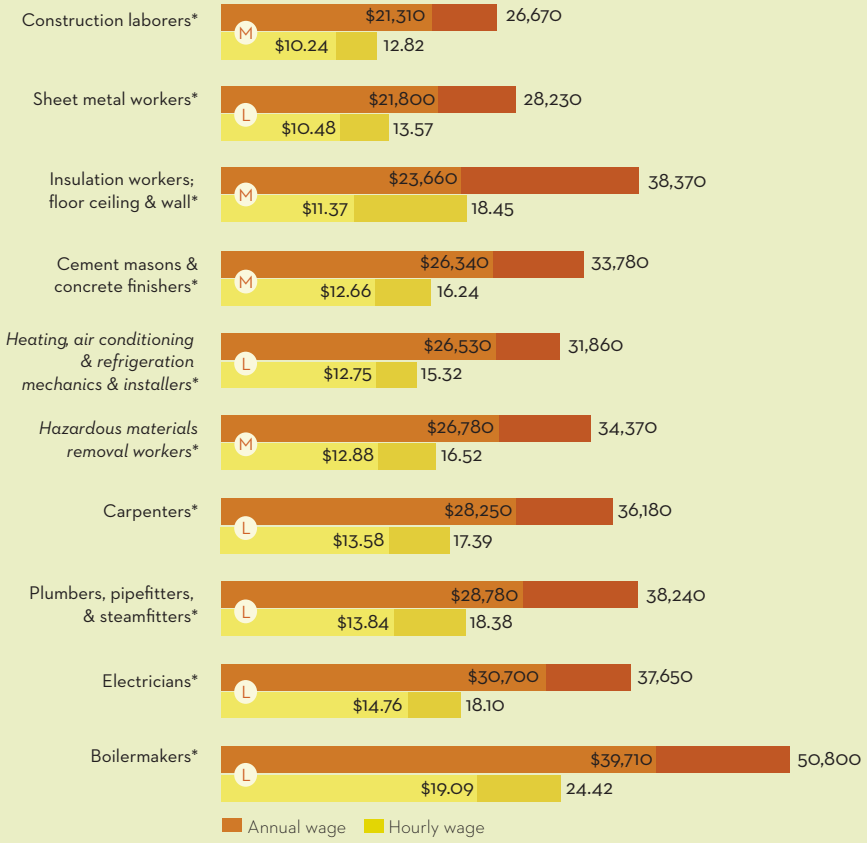
As for scale, it is hard to estimate exactly how many jobs retrofitting creates, because every building, and every region, is different. Most credible estimates calculate eight to eleven direct jobs per $1 million invested. A 2004 Apollo Alliance paper counted roughly 10 jobs per $1 million invested in high-performance buildings; a forthcoming study by COWS and the University of Florida's Powell Center for Construction and Environment projects 10 on-site jobs per $1 million invested in a typical owner-occupied residential efficiency retrofit in Wisconsin.[55]

These estimates do not include additional jobs created from indirect economic activity as the dollars spent on—and, eventually, saved by—retrofitting flow through the local economy. And we do not yet have any detailed data documenting manufacturing demand, which will create or retain jobs producing building materials, like ductwork and insulation; energy efficient appliances, like refrigerators and lighting; or environmental controls, like meters and thermostats.

What does a green-skilled construction worker do? Energy efficiency measures range from installing insulation under a mobile home to fine-tuning the HVAC controls in a skyscraper, demanding a wide range of skills. Typical efficiency measures in residential-building retrofits include:[54]

- Wall insulation
- Ceiling insulation
- Rimjoist insulation
- Air-leak sealing
- Furnace replacement
- Boiler replacement
- Boiler controls
- Boiler pipe insulation
- Hot water heater replacement
- Hot water temperature reduction
- Hot water heater wrap
- Low-flow showerheads
- Pipe insulation
- Refrigerator replacement
- Washer replacement
- Fluorescent lighting
- LED exit signs
- Outdoor lighting controls

ENERGY EFFICIENCY JOBS AT-A-GLANCE



NOTES

This chart depicts national wage data for selected middle-skill occupations in the residential building construction industry.

The 25th percentile describes wages at the lower end of the labor market.

Median wage marks the center of the wage distribution in a given occupation.

Italics indicate that BLS projects faster than average growth for this occupation across all industries over the next decade.

* In-Demand occupation per DOL, regardless of overall occupational growth levels, because the work is central to a high-growth industry, like energy or construction.

Regional wage ranges and more precise occupational projections by industry can be run on a state-by-state basis.

Typical education and training path:

Ⓜ Moderate-term on-the-job training: Requires from one to twelve months of training, which typically occurs at the workplace.

Ⓛ Long-term on-the-job training: Requires more than one year of on-the-job training, or combined work experience and classroom instruction, and may include apprenticeships of up to five years.

These are general indicators; there may be other pathways into the occupation, as well as additional educational, training or licensing requirements.

Source: U.S. Bureau of Labor Statistics

Key Points

- Jobs in energy efficiency retrofitting look a lot like traditional construction jobs.
- While only two of these occupations show faster than average projected growth, the Department of Labor (DOL) identifies all 10 as "in-demand" because they are critical to high-growth industries.
- Every $1 million invested in efficiency retrofits generates eight to eleven on-site jobs. Job numbers rise if we include indirect economic effects.
- State and municipal retrofitting programs will need to be tied to regional training programs, as the construction and building trades face imminent shortages of skilled workers.
- A good place to start greening career pathways in the building trades is through union apprenticeship and related programs, some of which are currently constructing workable pathways out of poverty.
- Some construction jobs have high wages, but offer only seasonal employment.

Jobs to Watch

Some high-demand energy-efficiency jobs are relatively new; we do not have good wage and employment data because they are not yet tracked by the U.S. Bureau of Labor Statistics (BLS). Local research is the most fruitful source of information about these sorts of jobs.

The New York State Energy Research and Development Authority, for example, is in the process of standardizing job titles and skill requirements for energy auditors. And the Regional Economic Development Institute at Los Angeles Trade-Technical College identifies several emerging middle-skill occupations among green construction jobs with highest employment potential:

Energy and indoor air quality auditor • Deconstruction worker HVAC operations and maintenance technician • Systems technician • Solar installer and technician

Energy Efficiency Jobs Could Help Build Tomorrow's Construction Workforce

Energy efficiency and massive retrofits of housing and commercial stock could create thousands of jobs in the United States. And it is worth emphasizing that these are not jobs that are unheard of or require unknown skills. Indeed, employers from the infrastructure industries poised to retrofit American cities are not demanding 'green construction workers' but workers with traditional construction skills who also have the most up-to-date training on energy efficient construction. And those employers who more narrowly focus on delivering a service centered around a particular green technology, say solar installation and maintenance, will require certified electricians who have received a thorough grounding in broadly-based electrical theory and practice.

Also, as the skilled construction workforce ages, contractors and the building trades increasingly pursue new connections to a future workforce. Massive EE retrofits linked to strong workforce development could provide a launching pad into the trades. Done well, this could require the greening of traditional career pathways in construction. In the building trades, this would include apprenticeship and related community college programs, many of which are currently constructing workable pathways out of poverty, like the Big Step program of the Wisconsin Regional Training Partnership.[58]

Los Angeles offers a good example of how this might look in action.

Case Study:

Green Training in Los Angeles[59]

California presents a model for how synergistic state and city policies can create markets for renewable energy, and opportunities—for policymakers, practitioners and advocates—to drive green job and workforce development that addresses issues of economic and racial equity.

California has long been in the national forefront of the transition to a new energy economy. In 2002 California passed an RPS—the nation's most stringent at the time—requiring the state to generate 20 percent of its electricity from renewable energy no later than 2017. In 2006, the state passed the landmark Global Warming Solutions Act (AB 32), setting an emissions cap on greenhouse gases to be met by 2020, and the Million Solar Roofs Initiative (SB1), an effort to enable the construction of a million solar roofs in California in 10 years.

Los Angeles, California's biggest city and the heart of its largest economic region, adopted LEED standards for all Department of Public Works building projects 7,500 square feet or larger, effective 2003. (California followed LA, adopting LEED as the standard for all state funded buildings in 2005.) The city is also in the process of expanding its solar incentive program to align with the state Million Solar Roofs Initiative, having committed $150 million to the effort.

The scope and scale of LA's policy efforts to promote renewable energy and energy efficiency are driven by a mayor, Antonio Villaraigosa, and a City Council who recognize the environmental and economic necessity of greening their city. But the related challenge of ensuring that the green economic development resulting from these efforts benefits workers and communities has by no means been a top-down process. Indeed, a remarkable cross-section of community leaders and stakeholders, have forced this issue to center stage by organizing the Green Jobs Campaign, an ambitious effort to retrofit city buildings and other infrastructure while at the same time creating jobs for low-income communities of color.

The Campaign is spearheaded by the Los Angeles Apollo Alliance, a coalition that includes community-based organizations, labor unions, and environmental groups, and which is convened and led by SCOPE (Strategic Concepts in Organizing and Policy Education), a grassroots organizing and research organization based in South Los Angeles. The campaign kicked off in August of 2006 when over 500 residents came together at a church in South LA to applaud Mayor Antonio Villaraigosa, City Council President Eric Garcetti, and local Councilman Herb Wesson as they signed the "Apollo Challenge," commiting to work with the Alliance to shape green workforce and economic development strategies. In June of 2007, the city council established a City Retrofit Jobs Task Force that includes council members, city agencies, and LA Apollo Alliance representatives to coordinate and lead the city's building retrofit efforts, which include identifying workforce needs and financing mechanisms for the work.

Running on a parallel track has been the development of a Green Careers Training Initiative, with the inter-related goals of (1) connecting low-income inner-city residents to union apprenticeship and community college training programs that prepare them for living wage jobs in building trades and energy-utility industries and (2) providing upgrade training to workers within those industries.

The focus on infrastructure jobs responds to a reality shaped by both investment and demographics. It's estimated that over the next decade $100 billion will be invested in construction in LA County (much of this will be with public funds and thus little affected by the present and possible future contraction of private capital markets). Utilities will simultaneously be transitioning to cleaner sources of energy and water conservation. Over this period, much of the incumbent workforce that builds and maintains LA's infrastructure will retire. Half of the Los Angeles Department of Water and Power's (LADWP) workforce is eligible to retire in the next five years. The obvious danger is that in just a few years time LA won't have the skilled workers necessary to build and maintain its sewers, pipelines, and buildings, let alone green them; the equally obvious opportunity is that LA's low-income population, the vast majority of whom are people of color, can move into these good, living-wage jobs, as long as more accessible *career* pipelines and a more aligned and effective *employment and training* infrastructure is constructed.

The Green Careers Training Initiative is being designed by the Los Angeles Infrastructure and Sustainable Jobs Collaborative, a public-private partnership of key stakeholders led by the Regional Economic Development Institute (REDI), an intermediary based at Los Angeles Trade-

Technical College (LATTC). The collaborative includes SCOPE/LA Apollo; the Mayor's Office; the LADWP; the Los Angeles Unified School District; California State University Los Angeles (CSULA) College of Engineering, Computer Science, and Technology; the IBEW Local 18-LADWP Joint Training Institute; the Southern California Gas Company; Metropolitan Water District of Southern California; and the Southeast-Crenshaw Worksource (WIA one-stop) Center.

REDI's intermediary role of convening these disparate stakeholders and taking the lead on strategic planning and labor market analysis is by no means a natural act within the world of publicly funded workforce development. Unlike states like Pennsylvania and Washington, California provides no state funding for the intermediary function that is essential to broad-based workforce partnerships focused on particular industry sectors. REDI has had to pull together various public and private funding sources in order to finance its role, raising over $1.5 million in grants from Bank of America, LADWP, and the Los Angeles Community Development Department/Workforce Investment Board.

Recognizing the complexity of program design and implementation, the Collaborative has broken its work down into phases over a three year period: Phase 1, most of which is completed, has focused on strengthening the Collaborative's governance structure and initiating various unexciting yet necessary tasks, like putting in place management information and administrative systems and memoranda of understanding among partners; identifying career pathways, for which labor market analysis of short and long-term labor industry demand for traditional and green jobs has been critical; and developing a training plan. Phase 2, which is ongoing, is focusing on curricula and program development and piloting job training and placement programs.

The Collaborative's Green Careers Training Initiative is being developed within a career pathways framework. Elements will include:

Recruitment of participants from low-income communities, who will be given case management and support services through WorkSource Centers and community-based organizations. Intensive basic skills and remedial classes will be offered at LATTC. • **Pre-screening** via a new industry-specific, intensive workforce readiness class. • **Contextualized learning** that integrates basic skills into utility-energy curricula • **A pre-apprenticeship program** with classroom and hands-on training/work experience in a cross-section of construction-related careers. • **The development of career pathways** to align with work in construction, public sector, public and private power companies and emerging energy industries. • **Articulation** of LATTC sustainable energy programs to California State University for Los Angeles' Bachelor of Science in Industrial and Technical Studies programs. • **Career counseling and mentoring** so participants can identify the area that most appeals to their aptitude and interest, and advance up the career ladder within the industry.

One of the most exciting components of this effort is the LA Infrastructure Academy, an independent non-profit organization, focused on moving young people into a career pipeline for greener infrastructure jobs. The Academy draws on the full range of partners within the Collaborative. It will use an after-school/summer school/ Saturday school model, targeting high school juniors and seniors. The curriculum design is built upon innovative approaches to career technical education, including contextualized and thematic education in small learning communities that prepare youth for multiple pathways to both post-secondary education and careers. Following a six-month pilot that started January 2008 at LATTC, the full program will begin in summer 2008 with four sites including LATTC and the College of Engineering at California State University, Los Angeles.

While the Academy focuses on youth and the entry-level workforce, entry-level adult and incumbent workers will also be the beneficiaries of the strategies detailed above, such as more clearly articulated career pathways, courses allowing them to gain certifications in new technologies, and more readily available guidance and supportive services. Other elements tailored to incumbent workers will be education and training programs structured in "just-in-time," online/hybrid, and accelerated delivery formats to meet the needs of working adults.

The Collaborative's design of these strategies recognizes that green workforce development must be embedded in traditional industries and occupations.

An illustration of this approach can be found at the joint Electrical Training Institute of Southern California (ETI). ETI is a labor-management partnership jointly sponsored by IBEW Local 11 and the LA County Chapter of the National Electrical Contractors Association. Private labor-management funds pay for most of the training they do (only about 7-8 percent comes from public sources). ETI offers electrical construction apprenticeship training. A full apprenticeship requires 1,100 hours of classroom training and 8,000 hours of OJT, which typically takes 5 years. Tuition is free and apprentices receive a wage and benefit package of roughly $20 per hour while on the job (and in excess of $50 per hour when they graduate to journey status). ETI also offers regular upgrade training for journey level electricians because of the constant technological advances within the electrical industry. It's here that "green-collar job training" is part of a broader continuing education curriculum, in the form of a thirty hour course on photovoltaics that includes instruction on everything from design principles to the specifications of panels to installation. Since ETI started offering the course over 600 journeymen (and some apprentices) have completed the training.

So the challenge for the Collaborative is significant but achievable: to develop and implement a holistic workforce development framework that integrates training for traditional and green occupations and skill sets, while simultaneously serving the needs of both entry-level and incumbent workers and a larger community demanding greater economic opportunity and justice. How they achieve that challenge may provide a model—and a greener pathway—for cities across the nation.

We examine the wind sector because of its rapid and high profile growth in the United States and abroad, its potential as an economic driver in both urban and rural areas, and its promise of job creation in manufacturing as well as installation and operations.

WIND INDUSTRY

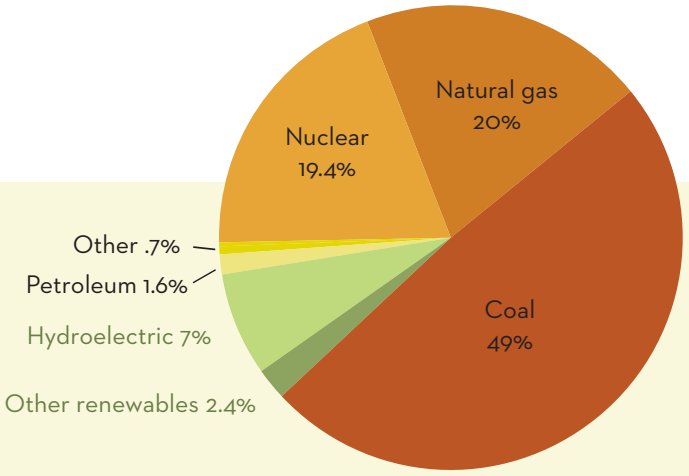
Overview

Renewable energy is a tiny but rapidly growing segment of U.S. energy production as a whole. In the electric industry, coal is still king. Non-hydro renewables account for less than 3 percent of U.S. net generation; bringing them to scale is critical for mitigating climate change.[60]

Wind is a zero-emission source of energy. It does not produce carbon dioxide, sulfur dioxide, nitrogen oxides or particulate matter—the emissions associated with global warming and acid rain. A recent study by the American Solar Energy Society (ASES) sees wind as second only to energy efficiency in an aggressive but achievable scenario that has renewables providing 50 percent of the nation's energy—and stabilizing its carbon footprint—by 2030.[61]

The promise of green power is as much economic as environmental. Turbine and component part production can re-energize flagging economies, particularly in states with a strong manufacturing base. With natural gas prices veering upward and wind technology advancing rapidly, wind power is increasingly cost-effective.[62] And while wind fuels less than 1 percent of U.S. electricity consumption, demand is strong, and growing.[63] Indeed, we examine the wind sector because of its rapid and high profile growth in the United States and abroad, its potential as an economic driver in both urban and rural areas, and its promise of job creation in manufacturing as well as installation and operations.

U.S. ELECTRIC POWER INDUSTRY NET GENERATION, 2006



Source: U.S. Energy Information Administration

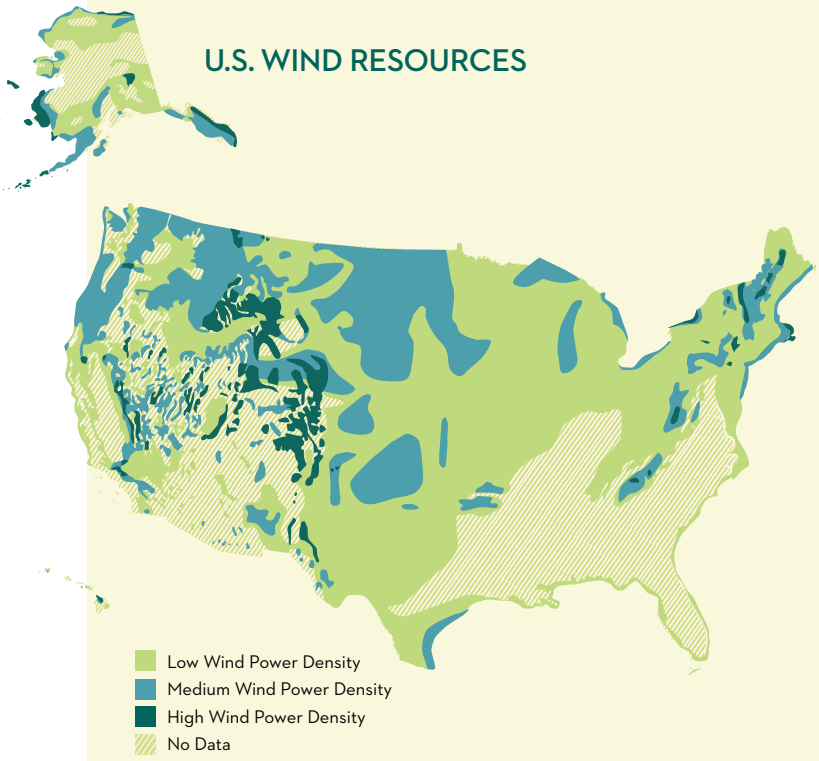
The global wind industry has been expanding at a rate of at least 30 percent per year for nearly a decade.[64] According to the U.S. Department of Energy, wind could meet 15 times the existing world energy demand.[65] The United States has led the world in annual wind power installation—or incremental capacity—for three years in a row. A 2007 surge added over 5,000 MW in wind power capacity, expanding the nation's cumulative generating capacity by 45 percent.[66] With total installed capacity of 16,800 MW, the United States has nosed ahead of wind powerhouse Spain, and is expected to overtake the current world leader, Germany, by the end of 2009.[67] It also hosts the world's largest wind farm—FPL Energy's 735 MW Horse Hollow Wind Energy Center in Texas.

The American Wind Energy Association (AWEA) estimates that U.S. wind energy facilities will generate 48 billion kilowatt-hours next year—enough to power 4.5 million American households. The utility-scale wind farms that provide most of this electricity can be huge job generators, creating work in manufacturing, installation, operations and maintenance. Moreover, some of the most fertile wind regions are found in the nation's center, which could be a boon to the depopulating Great Plains (see wind resources map).[68]

But wind doesn't drive economic development; markets do. This becomes clear when looking at a map of actual wind project development across the country.[69] Though the Plains states have the fastest and most consistent on-shore wind speeds in the country, they lag behind many others in wind project development (see wind resources map). And Michigan, despite good wind speeds, significant industrial capacity, and skilled workers, has only 3 MW of installed capacity. In 2007, Texas led all states in annual growth at 1,618 MW, followed by Colorado, Illinois, Oregon, and Minnesota. Texas extended its lead over California in the top spot for total capacity, though the two still play in a league of their own as the only states with over 2,000 MW of installed capacity.[70]

There is a simple explanation for the disparity between wind speeds and wind projects: state policy. Market-creation policies such as renewable portfolio standards and feed-in tariffs provide certainty for companies looking to move into particular states. Such policies build on the federal production tax credit (PTC) for wind development. These sorts of government programs have been critical to wind power expansion across the globe, and we describe them in more detail below.

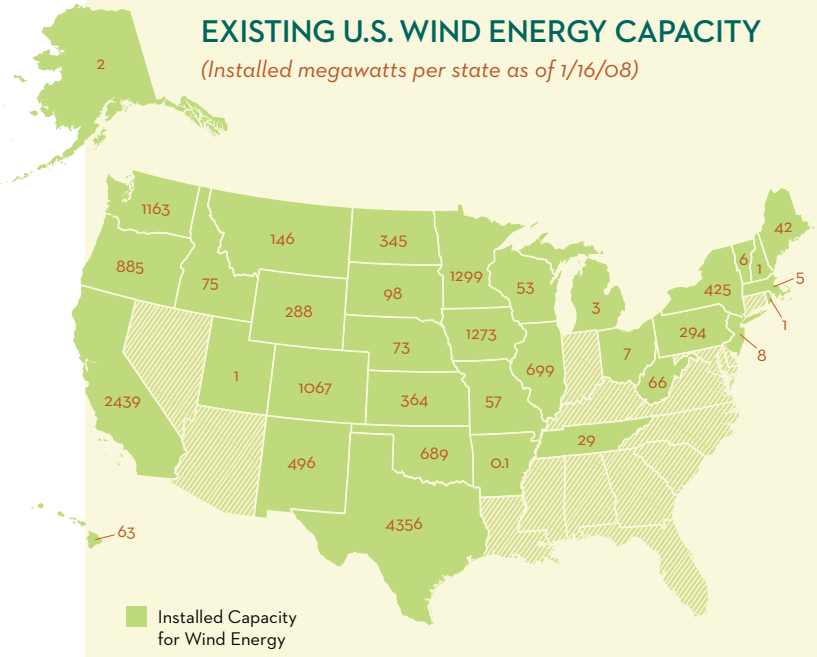
U.S. WIND RESOURCES



Source: U.S. Department of Energy, National Renewable Energy Laboratory

EXISTING U.S. WIND ENERGY CAPACITY

(Installed megawatts per state as of 1/16/08)



Source: American Wind Energy Association.

Policies to Grow the Wind Industry

FEDERAL PRODUCTION TAX CREDIT (PTC)

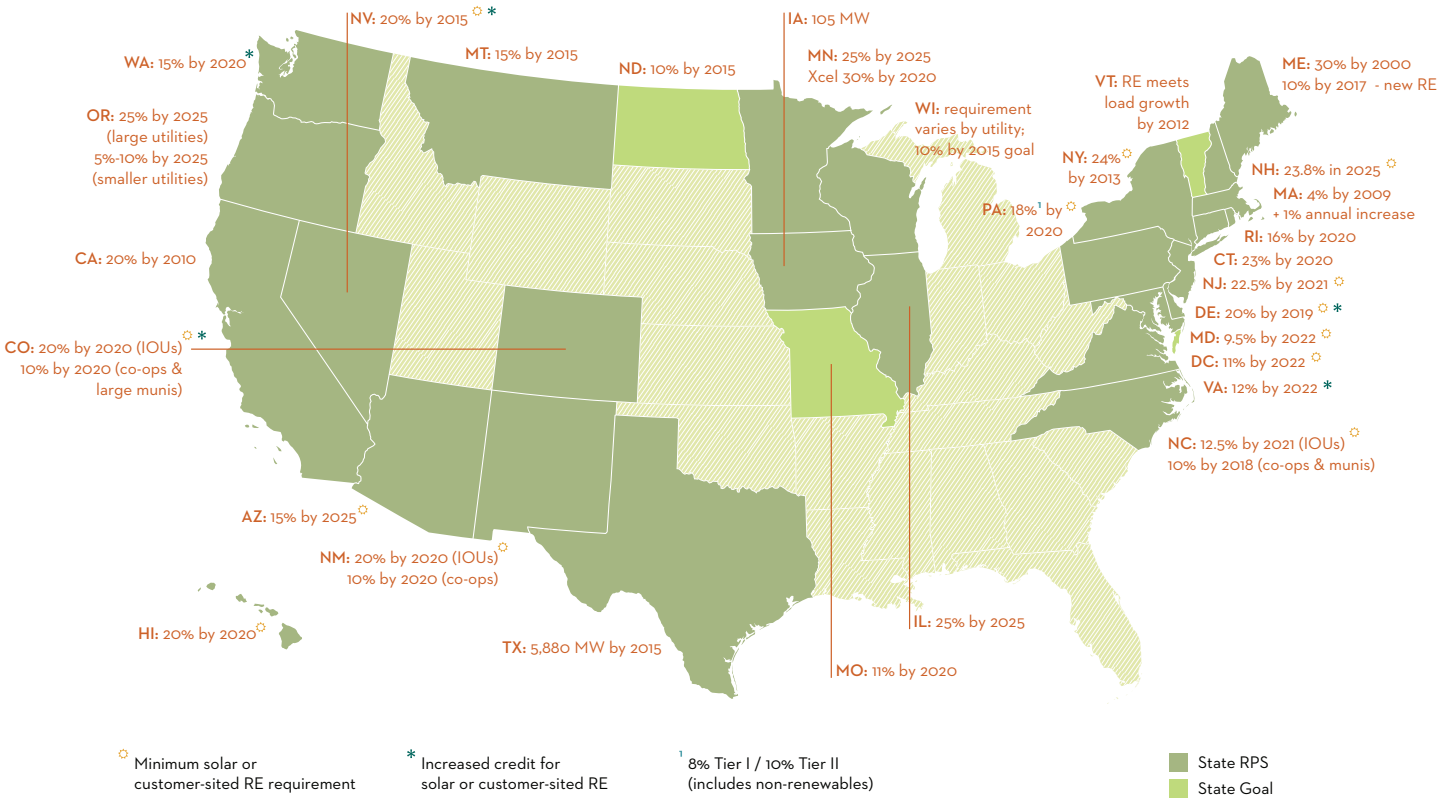
The most important federal driver of wind installation has been the production tax credit (PTC), which provides power generators with a tax credit per kilowatt of renewable energy produced. Since its inception in 1992, the PTC has expired and been renewed several times, causing installation to fluctuate: when the PTC lapses, new installation plummets; when it is reinstated, wind projects proliferate. This boom-bust cycle not only slows wind development and increases supply costs, it also discourages investment in domestic manufacturing infrastructure. Recent research suggests that a single, 10-year extension could more than double the U.S. manufacturing share of wind turbines and components.[71] The 2007 Energy Independence and Security Act failed to renew the credit, which expires Dec. 31, 2008.

RENEWABLE PORTFOLIO STANDARDS (RPS)

Lawrence Berkeley National Laboratory estimates that state renewable portfolio standards inspired nearly half the wind power capacity built in the United States between 2001 and 2006, and this proportion continues to grow.[72]

The most common type of RPS requires retail electricity suppliers to include fixed percentages of renewable energy in their portfolio. Compliance measures vary by state, but many employ some form of tradable renewable energy certificates. Twenty-five states as well as Washington, D.C., have adopted such standards, some with ambitious targets of over 20 percent of electricity from renewable sources by 2020. These include Oregon, California, Nevada, Minnesota, New Mexico, Maine, New Hampshire, Connecticut, and New Jersey.

STATE RENEWABLE PORTFOLIO STANDARDS AS OF JANUARY 2008



Source: Database of State Incentives for Renewables and Efficiency

Some versions of the 2007 federal energy bill would have introduced a national portfolio standard, aligning the United States and the United Kingdom, Japan, Australia, and some Canadian provinces, but the measure was not included in the final version signed into law as the Energy Independence and Security Act.[73] Political support for a nationwide renewable energy standard may be growing. Governor Chet Culver of Iowa, whose state ranks third in U.S. wind energy production, and the American Wind Energy Association (AWEA) have called on the 2008 presidential candidates and Congressional leaders to set a national standard at 15 percent.[74]

FEED-IN TARIFFS

The feed-in tariff is Europe's preferred method for building a reliable renewable energy market. Under this system, the government sets a price at which utilities must purchase renewable energy that comes into the grid. According to a recent report from the Lawrence Berkeley National Laboratory, a well designed feed-in tariff may be the best way to send a signal of future market stability to wind investors.[75] Companies in Germany, Spain and Denmark—global leaders in wind production—all benefited from these policies domestically before expanding outward; in North America, Ontario in 2006 adopted this policy as well. Feed-in tariffs have not gained traction in the United States, though Michigan has begun to explore this option as an alternative to an RPS, and advocates in Minnesota are pushing for its adoption.[76]

From Wind Towers to Component Manufacturing: The Potential for a Green Reindustrialization

Wind projects large and small can generate local wealth—and power—in rural regions with reliable wind resources. Wind production boosts farm and ranch income through leases and royalties, improves the local property tax base, and provides valuable community ownership opportunities.[77] It also creates local jobs in construction and maintenance. But a host of recent research suggests that the wind industry can be an economic boon to all states, regardless of wind geography.

The Renewable Energy Policy Project (REPP) has published a series of reports identifying the potential for states with existing industrial infrastructure and skilled labor to become component manufacturing leaders for the wind industry.[78] More than the construction or operation of wind farms, component manufacturing delivers wind industry jobs.[79] If the country can muster the $62 billion investment required to expand wind capacity by 125,000 MW over the next 10 years—the amount needed to stabilize U.S. carbon emissions—the wind energy sector could create nearly 400,000 domestic manufacturing jobs. And the top 20 states that stand to benefit are some of the most populous, and hardest hit by recent manufacturing job loss. California and Texas lead the list, followed by the Great Lakes states: New York, Pennsylvania, Ohio, Indiana, Illinois, Michigan, and Wisconsin.[80]

Industrial capacity and transportation networks are key assets to turbine production. Wind turbines are massive and extremely heavy machines. The towers alone are up to 250 feet tall and 16 feet in diameter, and weigh more than 100 tons. An assembled "nacelle"—the fiberglass case that sits on top of the tower and houses the gearbox and generator—weighs about 70 tons, and the rotor assembly with blades, each of which can be up to 200 feet long, weighs in at about 40. It is no surprise that most new facilities in the United States are sited close to water and rail, like the Gamesa plant on the Delaware River in Fairless Hills, PA, or the Siemens factory on the Mississippi in Fort Madison, Iowa.

Transporting huge turbines from overseas plants is unsound from a carbon perspective; with oil periodically breaching $100/barrel, it is financially irrational as well.[81] Soaring shipping costs and a

State Policy Models

STANDARDS

The Union of Concerned Scientists offers a renewable standards toolkit, including authorizing legislation and regulation, which is sortable by state, target and other criteria at *http://go.ucsusa.org/cgi-bin/RES/state_standards_search.pl*.

INCENTIVES

The Interstate Renewable Energy Council and the North Carolina Solar Center maintain an excellent Database of State Incentives for Renewables and Efficiency (DSIRE) at *http://www.dsireusa.org/*. A comprehensive resource searchable both by state and by program, DSIRE catalogues federal, state, local, and utility initiatives with current links to related rules, regulations and policies.

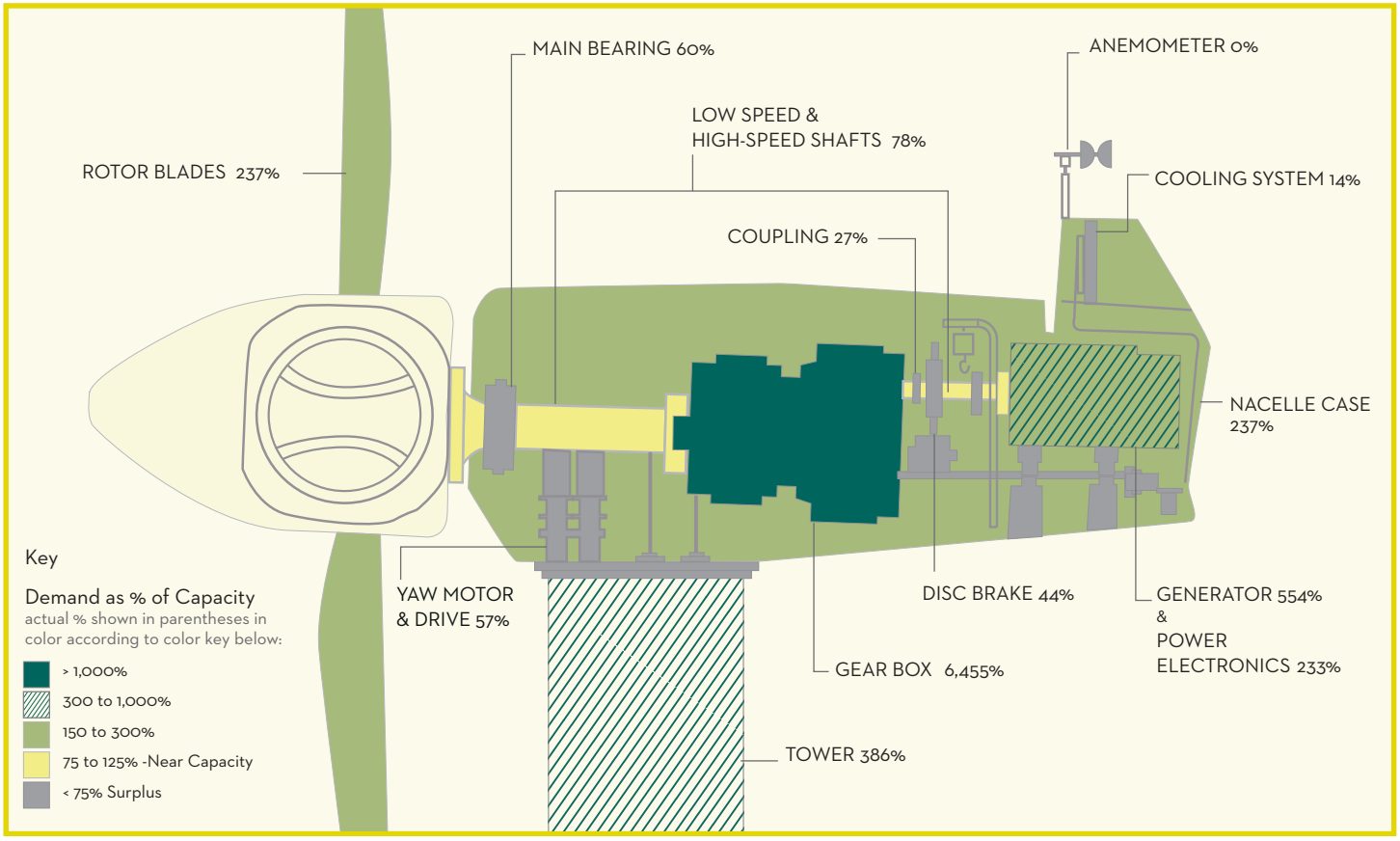
foundering dollar may motivate more domestic production. Some of the key wind turbine manufacturers serving the U.S. market–Vestas (Denmark), Siemens (Germany), Gamesa (Spain), Mitsubishi (Japan) and Suzlon (India)–have already started to produce turbines locally.[82] Together with General Electric, which manufactures both at home and abroad, and California's rapidly expanding Clipper Windpower, these companies produce most of the world's turbines. But until guaranteed a market by some of the major policies discussed above, they will continue to do so, in large measure, overseas.

States should not simply focus on wooing large firms. Eight thousand component parts flow into a complex supply chain that supports every turbine produced. REPP has identified over 16,000 manufacturing firms around the country with the potential to join that chain. And the wind industry is in desperate need of suppliers.

SUPPLYING COMPONENT PARTS

The supply chain for turbines has not been able to keep up with intensifying demand. Wait-time for some component parts can now extend up to 18 months.[83] If the United States expands wind production to the levels required to stabilize carbon emissions, REPP estimates that demand for seven major component parts would immediately exceed existing production capacity–by over 6,400 percent for gearboxes, over 500 percent for generators, nearly 400 percent for towers, and over 200 percent for nacelle cases and rotor blades.[84]

WIND TURBINE COMPONENTS: SUPPLY CHAIN BOTTLENECKS



Adapted from Renewable Energy Policy Project

Into Plowshares

Upstart Tower Tech Holdings Inc. is now fabricating steel sheets into wind turbines in Manitowoc, WI, in an old factory once used to build military submarines. The story is emblematic of the region's potential to reorient its industrial capacities to make products for the new energy economy. Not only does the company benefit from the existing facility, but it also draws on the area cluster's history of manufacturing heavy and sophisticated machinery. The conversion from submarine to tower production was not "a radical change," according to Jerry Murphy, executive director of New North, a regional development agency for northeast Wisconsin. "It is an excellent adaptation of what we do really well."

Accessing capital was also critical to the company's success. It drew on both wealthy investors and public markets to get the project off the ground. Tower Tech merged with publicly traded Blackfoot Enterprises Inc. of Las Vegas, and received large investments of capital, through the purchase of shares and debt, from Tontine Capital Partners, a Connecticut hedge fund. This has allowed it to purchase production equipment as well as two companies, RBA Inc. of Manitowoc, a manufacturer of large, energy-related metal products, and Brad Foote Gear Works of Cicero, Ill., a producer of turbine components.

Company performance has been astounding. Its share value in November 2007 stood at roughly $10, up from a low of $1.20 in August 2006. In the same period it doubled its workforce of 70.[90]

Current component parts shortages stem from a number of factors, not least the jump in world demand as the United States and Europe—and, increasingly, Asia—implement policies to ramp up renewable energy capacity.[85] Wind turbine manufacturing is fairly new in this country, and supply chains are not nimble. Component part specifications have shifted as turbine technology evolves. At the same time, despite two years of remarkable wind industry growth, there has not been a predictable U.S. market for turbines. Without stable demand, capital-intensive investments are too risky for small and medium-sized suppliers, particularly when the lead time for major retooling can be as much as two years.[86] Finally, and of particular importance, an optimized production pipeline requires both updated factories and equipment and a ready supply of skilled workers, a challenge we examine more closely in the Pennsylvania example below.

If states can effectively organize their links in the supply chain, and upgrade their manufacturing workforce, wind can help revitalize the declining industrial heartland.[87] The new energy economy is not just about creating new jobs, but holding onto existing ones.

PENNSYLVANIA'S APPROACH TO BUILDING THE SUPPLY CHAIN

The benefits of a rapidly expanding wind sector are not automatic: firms have to take advantage of this opportunity, and states need to help them (with, for example, local labor market studies, cluster development, and workforce training). An effort under way in Pennsylvania is instructive.

The Regional Economic Development District Initiatives (REDDI), one of the Commonwealth's eight economic development districts, is working to develop a renewable energy industry cluster across eight counties in south-central Pennsylvania.[88] In a study funded by the local Workforce Investment Board (WIB) and the U.S. Economic Development Administration, REDDI staff met with individual companies, mostly small manufacturers, to lay out the opportunities in wind turbine components production.

Many firms told REDDI they wanted detailed industry information upfront and were less concerned about securing a workforce than ensuring a market. Who will buy the components? How can a small supplier break into a market with large European turbine producers? What quality benchmarks must be demonstrated? This is the kind of supply chain work at the ground level with which states can help. It is why we recommend that states follow Pennsylvania's lead and do their regional homework, assessing demand, if not outright building it, before jumping into green workforce development.

Scott Sheely, the WIB Director in Lancaster, a county identified by REPP as a potential hotspot for wind component production, suggests that technical transitions to prepare a 21st-century supply chain are already under way. A deep bench of metal and plastic fabricators provides a strong skill base, and many shops have begun the shift from traditional machining to state-of-the-art computer numerical control production. However, echoing his colleagues at REDDI, Sheely cautioned that renewable energy opportunities would have to be sold to local manufacturers. Workforce demand, and the appropriate state training response, will depend on how many are takers.[89]

WIND INDUSTRY JOBS

With continued growth, the American wind industry can be a tremendous jobs driver. How many jobs? Daniel Kammen argues convincingly that renewable energy "generates more jobs per megawatt of power installed, per unit of energy produced, and per dollar of investment," than fossil fuel energy.[99] But it is tricky to determine exactly how many are employed, and will or could be employed, in the wind industry.

The industry does not have its own North American Industry Classification System (NAICS) codes. Nor do the employees who are manufacturing, installing, and maintaining wind turbines have data flags to set them off from their co-workers producing parts for oil refineries or pouring foundations for nuclear reactors. So it is hard to accurately measure and project labor market dynamics.

Many stirring claims will be made in the name of "green jobs." Some of the most optimistic figures serve primarily to create political will and spur economic development. This can be useful for both workers and their planet. But it is important to remember that many of these green jobs do not yet exist. And economic models that project job creation are to be used with caution; they typically count indirect and induced jobs, which includes a lot of low-wage jobs neither green in environmental effect nor good in quality. [100]

At the other end of the occupational continuum, the wind industry will create work for scientists and engineers; analysts and forecasters; lawyers, financial analysts and marketing gurus.[101] But we are concerned, primarily, with the sorts of middle-skill jobs that require less than a B.A., and have the capacity to lift the working poor into decent jobs with good benefits, and to keep the struggling middle class from tumbling backward. These jobs will be found in wind power installation (construction and transportation), wind farm maintenance and operations, and, above all, in wind turbine manufacturing. Wind manufacturing jobs, which look a lot like traditional manufacturing jobs, are summarized in the Jobs-At-A-Glance table on page 26. Ranging from welders and machinists to customer service representatives and production clerks, these are green jobs hiding in plain sight.

Converting Latent Industrial Capacity

In its 2004 report, the Renewable Energy Policy Project forecast the employment effects of large-scale investments in wind manufacturing. The report predicted that 50,000 MW of added capacity across 25 states could generate well over 100,000 jobs in manufacturing generators, rotors, towers. and other components. This projection is based on an assessment of firms' capacities to retool their factories to produce wind products. [91] States have yet to fully realize this potential, but examples of successful conversion are quickly mounting. Wind Power listed a sample of 37 utility-scale wind turbine manufacturers and suppliers around the country in 2007.[92] These are a few of their stories:

Texas-based **Trinity Structural Towers** reconfigured an idle manufacturing facility in Clinton, IL, with help from a $2 million investment package put together by Governor Rod Blagojevich in January 2007. Shuttered for five years, the old freight car plant began shipping 100-ton towers to Midwest wind farms last July. Trinity plans to train and employ 140 people.[93]

Spain's **Acciona Windpower** converted a former hydraulics facility into a turbine-generator manufacturing plant in West Branch, IA, last year. The retooled plant, which opened its doors in January 2008, will employ 110 workers by June. [94]

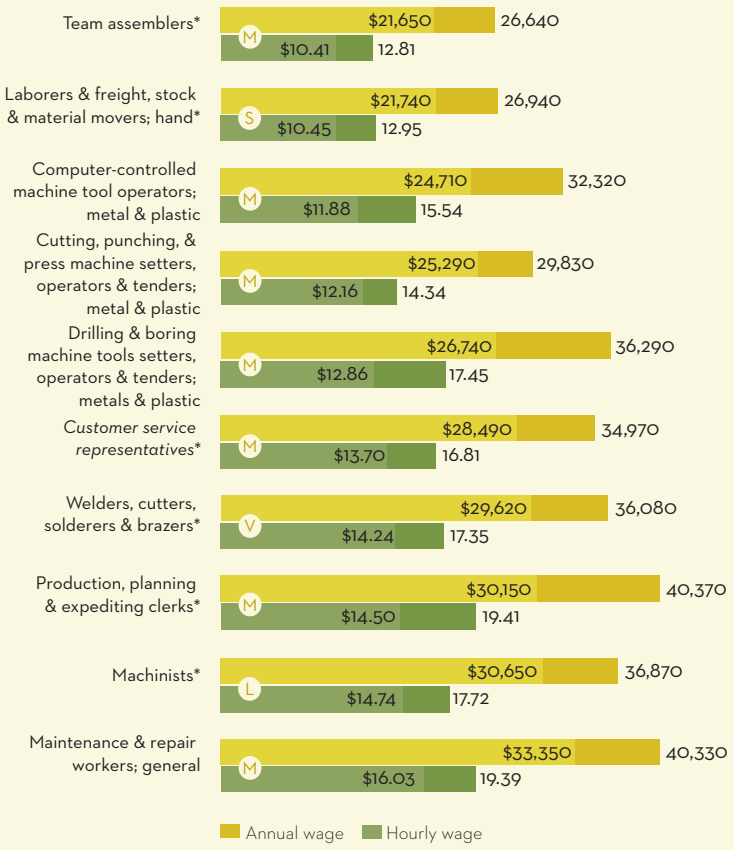
Cast-Fab Technologies, a traditional foundry with deep roots in Oakley, OH, now casts some 15 different component parts for wind turbines. The company, which faced grim times in the late 1990s, employs more than 300 workers and estimated that wind manufacturing would provide nearly a quarter of its $50 million business in 2006. [95]

Diab Inc. in Desoto, TX, originally a manufacturer for the marine and aerospace industries, now employs 230 workers producing foam and balsa wood cores for 200-foot wind turbine blades. [96]

TECO-Westinghouse, a producer of electric motors and generators in Round Rock, TX, recently struck a partnership to assemble nacelles—the 72-ton main power components—for Composite Technology's DeWind turbines. It also produces rotor hubs for turbines. [97]

Advance Manufacturing Corporation in Ohio invested in a $6 million upgrade in order to supply precision gearboxes for Clipper Wind. A tool and die shop founded in the 1930s, Advance watched its workforce dwindle to 22 at the turn of the century. The Clipper contract was a shot in the arm. In just four years the company has modernized production and doubled its workforce, a fourth of which is dedicated to machining the 22,000-pound windmill parts.[98]

WIND JOBS AT-A-GLANCE



NOTES

This chart depicts national wage data for selected middle-skill occupations in turbine and power transmission equipment industry, which includes producers of critical component parts for wind turbines, such as generators and gearboxes.

The 25th percentile describes wages at the lower end of the labor market.

Median wage marks the center of the wage distribution in a given occupation.

Italics indicate that BLS projects faster than average growth for this occupation across all industries over the next decade.

* In-Demand occupation per DOL, regardless of overall occupational growth levels, because the work is central to a high-growth industry, like energy or construction.

Regional wage ranges and more precise occupational projections by industry can be run on a state-by-state basis.

Typical education and training path:

Ⓢ Short-term on-the-job training: Requires no more than a month of workplace-based training.

Ⓜ Moderate-term on-the-job training: Requires from one to twelve months of training, which typically occurs at the workplace.

Ⓛ Long-term on-the-job training: Requires more than one year of on-the-job training, or combined work experience and classroom instruction, and may include apprenticeships of up to five years.

Ⓥ Postsecondary vocational award: Requires credentials earned in training programs lasting from a few weeks to more than a year, typically offered at vocational or technical schools.

These are general indicators; there may be other pathways into the occupation, as well as additional educational, training, or licensing requirements.

Source: U.S. Bureau of Labor Statistics

Key Points

- Jobs in wind turbine production look a lot like traditional manufacturing jobs.
- While only customer service shows faster than average projected growth, the Department of Labor (DOL) identifies six of these jobs as "in-demand" because they are critical to high-growth industries.
- Total employment in U.S. manufacturing is declining. Public and private investment in renewables can help connect the industrial base to a more sustainable future, thereby preserving domestic manufacturing jobs.
- To stabilize carbon emission levels, the United States needs to add 185,000 MW of renewable energy in ten years. The Renewable Energy Policy Project calculates wind power's share to be roughly 125,000 MW, which would support close to 400,000 domestic manufacturing jobs.
- The American wind industry is growing at an astonishing 45 percent per year. State and federal policy should encourage its continued expansion, and ensure that its benefits are shared with the communities and workers that manufacture, install, and operate its wind turbines.

Jobs to Watch

While the majority of well-paid wind industry jobs requiring less than a bachelor's degree will likely stem from component manufacturing, there will also be good jobs in installation and operations. Some of these, like Wind Technicians, are relatively new; we do not have good wage and employment data for such occupations because they are not yet tracked by the U.S. Bureau of Labor Statistics (BLS).

Local industry research is the most reliable source of specific information about emerging occupations. In Oregon's Columbia River Gorge, for example, a forward-thinking workforce partnership started training wind technicians after assessing demand in the regional labor market. Similarly, Minnesota West Community and Technical College found that employers wanted graduates of three related tracks:

Wind energy technician • Wind energy mechanic • Windsmith

Greener Pathways in Diverse Wind Sectors

There are three training pathways for three kinds of middle-skill wind industry jobs.

Installation. The skilled workers who install wind turbines do many familiar tasks: driving trucks to deliver heavy industrial equipment; pouring concrete to build massive foundations; operating cranes—though this part is clearly more exhilarating than your garden-variety lift assignment—to hoist the turbine towers onto the foundations, the nacelles onto the towers, and the rotors onto the nacelles. These are green jobs. They are construction and transportation jobs, and the training will follow traditional pathways for occupations in these industries.

Operations and Maintenance. The wind technician is a new green job with both fresh knowledge and traditional skill sets. Some community and technical colleges steer potential clean energy technicians through engineering, industrial, and technological science pathways, while others are experimenting with dedicated renewable energy training programs.

The most ambitious envision a multi-track alternative energy pathway that can carry workers into careers in a variety of renewable sectors. In Wisconsin, for example, the Madison Area Technical College's Consortium for Education in Renewable Energy Technology (CERET) is working with educators in several states to develop classroom and online curricula that enhances existing degree and apprenticeship programs. Developed with a National Science Foundation grant, CERET attempts to match the needs of an emerging industry with non-traditional students and incumbent workers. Training is integrated into traditional associate degrees, e.g., electronics, electrical engineering technology, industrial maintenance technician, construction and remodeling. The program also offers shorter-term certificates in five areas: photovoltaics, solar thermal, wind, transportation, and biomass. In spring 2007 the pilot enrolled 37 students from 17 states. A similar program in Oregon is described in some detail below.

With a clearly defined job description, wind technician programs are sprouting up around the country in response to industry demand. They range from a two-day Wind Energy Course for Technicians put on by the California Wind Energy Collaborative, to a two-year Wind Energy and Turbine Technology Program at Iowa Lakes Community College, which confers an associate in applied science degree. Other states with wind mechanic training include Texas, New Mexico, Wisconsin, Minnesota, Massachusetts, and Oregon. The U.S. Department of Energy maintains a list of linked training opportunities on its Wind Powering America website, available at *http://www.eere.energy.gov/windandhydro/windpoweringamerica/*.

Manufacturing. In wind turbine manufacturing, recommended skills include mathematics, blueprint reading, computer programming, metalworking, and drafting. Jobs require a wide range of on-the-job and vocational training.

In Pennsylvania's emerging wind manufacturing sector, where the promise of component production jobs depends on the commitment of a still-wary supply chain, workforce professionals believe the most practical strategy is to train workers with a broad skill set in traditional metal manufacturing. That said, finding candidates is a critical problem for a state with the second-oldest workforce in the country.[103] Many of Pennsylvania's skilled industrial workers will soon retire, and the state's bumper crop of high-school graduates shows little interest in blue-collar careers—no matter how green. Incumbent worker training is one logical solution. As Workforce Investment Board (WIB) Director Scott Sheely observes, "If you offer to move a lower level machine operator up a ladder, and tie it to a raise, you'll get plenty of takers."

Because there is no magic bullet, no single green curriculum for tomorrow's workforce, and because public resources are increasingly scarce, the first thing any city, county, or state should do to prepare its workforce is to understand the lay of the land. Basic labor market studies can identify occupations and skills in demand and the training resources in place—or not—to supply them. In metal and plastic manufacturing, this might include union apprenticeship and pre-apprenticeship programs, state-sponsored workforce initiatives in advanced manufacturing, or an intermediary's path to manufacturing standards certification.

Indeed, green workforce development cannot occur in isolation from traditional industries and skill sets for occupations within those industries. Employers from the manufacturing industries poised to build America's wind infrastructure are not demanding "green manufacturing workers," but workers with traditional machining skills who also have the most up-to-date training in advanced manufacturing techniques. Even employers who more narrowly focus on delivering a service centered on a particular green technology, say wind turbine operation and maintenance, will require certified electrical or engineering technicians who have received, in addition to wind-specific mechanics, a thorough grounding in mathematics, computer systems, hydraulics, and electrical circuitry.[104]

Similarly, career pathways, which need to be developed locally in collaboration with employers, workforce agencies, unions and technical schools, should be situated in current industry efforts to this end. Some promising efforts are being made to develop pathways specific to renewable energy technology, like the Oregon program described on page 28. But for the vast majority of job trajectories made possible by the growing wind industry, we are not talking about the establishment of green career pathways so much as the greening of traditional career pathways.

Two cases from opposite sides of the country offer good examples of how this might look in action.

CASE STUDY:
Training Turbine Techs for Oregon's Windy Columbia River Gorge[105]

In 2006 a partnership of wind energy businesses, local workforce and economic development agencies, and education providers convened in the Columbia River Gorge region of Oregon, a rural area that had struggled economically as timber and aluminum industries declined. The partnership was catalyzed by the dramatic growth of the wind industry in the area, and concerns by local wind farm employers that there would not be a sufficient number of trained wind turbine technicians to meet the industry's accelerating demand.

The partnership received immediate assistance from Oregon's Department of Community Colleges and Workforce Development (ODCCWD), which funds Workforce Response Teams in the state's 15 workforce regions. Workforce Response Teams involve the key economic and workforce development stakeholders and proactively work with groups of workers or businesses in key industries to address workforce development and training needs. They receive financial support for incumbent worker training and consortia building from the state's Employer Workforce Training Fund, which was created by executive order of the governor in 2003, and which draws on Workforce Investment Act statewide activities funds and rapid response funds (used for this purpose by virtue of a waiver received from the U.S. Department of Labor).

The partnership used a Consortia Building Project Grant to perform a comprehensive needs assessment of the wind industry's workforce and training requirements, conducted by the Mid-Columbia Council of Governments (MCCOG) and the local Workforce Investment Board. At that time there were 55 wind turbine technicians employed by the region's wind industry. The assessment estimated that an additional 300 to 430 technicians would be required in the next couple of years. The nearest wind turbine technician training programs were in Minnesota and Iowa.

In response, the partnership's Columbia Gorge Community College (CGCC) worked with wind industry and workforce development allies to review its existing curriculum, develop new curriculum recommended by industry, and identify alternative training delivery systems. In order to test the curriculum being developed and to produce technicians for industry to immediately hire and assess skill levels, the college developed a six-month, non-credit pilot program that was held January-June 2007.[106]

Twenty-four students enrolled in the first class. Nine of the twenty-four were dislocated workers

CURRENT AND PROPOSED WIND PROJECT INTERCONNECTIONS TO BPA TRANSMISSION FACILITIES

Source: Bonneville Power Administration

from local aluminum plants and certified as eligible for the Trade Adjustment Assistance program, which, even in an era of dwindling federal support for workforce development, offers tuition assistance, income support, and tax credits toward health care insurance.

At the end of the program, 22 of the 24 graduates were immediately employed, after receiving multiple job offers, at entry-level wages of $20-24 per hour, with some receiving full health care benefits and as much as four weeks of paid vacation.

In September 2007, the community college started a one-year certificate program in renewable energy technology (RET), with a cohort of 34 students. The RET curriculum—54 credits over three quarters—is designed to provide workers with a basic skill set necessary to be a wind turbine technician, particularly a core knowledge of electrical circuits and wind turbine mechanics. But the curriculum is also intended to provide a broader academic grounding that will enable students to pursue the two-year associate's RET degree, which, as the RET label suggests, will prepare students for career pathways in various renewable energy industries, including hydro-generation and manufacturing. The second year is 48-49 credits.[107]

When Columbia Gorge Community College began the program in fall 2007, its assumption was that most of the students completing the one-year program would immediately seek employment at local wind farms and not continue into the two-year degree program. However, a number of these students have indicated that they will complete the two-year program, and some have expressed interest in linking after that to a B.S. level program at Oregon Institute of Technology.

CGCC's development of this program within a career pathways framework reflects the commitment of the institution, and the state of Oregon, to career pathways as a vehicle for changing systems and service delivery. Oregon's Pathways to Advancement Initiative, started in 2005 and guided by ODCCWD, is an ambitious effort launched across all of the state's community colleges to adapt to the changing needs of students and employers and two fundamental realities of the job market: for most adults, postsecondary education is about blending work and education over time; for employers, getting the qualified workers they need requires a rapid education and training delivery cycle to meet dynamic labor market demands. Pathways to Advancement focuses on easing the transitions for all students across the education continuum. To that end, Oregon's community colleges are developing model programs that address both employer and student needs by realigning curricula, providing alternative delivery methods, and offering the flexibility necessary for adults to gain skills and advance in the labor market more quickly. This systemic approach is reflected in Columbia Gorge Community College's integration of the one-year certificate program within the two-year RET degree and the way in which both of these programs prepare students for multiple pathways to careers in renewable energy industries. The RET program requires good preparation in science and math, which many of the region's high school graduates lack. To address this problem, the community college is working with area high schools, using Project Lead the Way, a nationally recognized model for preparing high school students for further education and careers in math, science and technology.

Despite these efforts, and the initial success of responding so quickly to the wind industry's explosive growth, CGCC and the broader industry partnership of which it's a part, face significant challenges. The capital-intensive development of this program has required the college to draw on Carl D. Perkins (federal monies for vocational education) and other funding sources, and to aggressively seek additional financial support.[108] At the same time, the initial assessment that estimated the need for an additional 300 to 430 technicians has been revised up to 500 or even 600 as planned wind projects continue to multiply (see *map on page 28*). This is an enormous opportunity for the region, of course, but only if it can train the skilled workers needed by industry.

CASE STUDY:
Gamesa's Green Reindustrialization in Pennsylvania[109]

The successful efforts of the Rendell Administration to lure the Gamesa Corporation, the Spanish wind turbine manufacturer and wind farm developer, to the Commonwealth of Pennsylvania have been well documented. Those efforts involved the passage of an aggressive renewable portfolio standard and the use of the state's purchasing power to guarantee a market for renewable energy, tax incentives, and a willingness to work closely with Gamesa.

Less well known is the story of Gamesa's selection in early 2005 of Ebensburg, a town in Cambria County in the southern Alleghenies, as the site of its first manufacturing plant in the state. There were some obvious reasons for the location, most notably the high ridgelines of the Alleghenies, ideal for wind farm siting. (This led to a debate within the community about the effect of wind towers on the area's "view shed," which won't be examined here—except to note the comment of a local resident: "I'd rather look at wind turbines on a hilltop than a strip mine.")

But the selection of Ebensburg had more to do with the efforts of a highly effective regional partnership of workforce development, economic development, and local government actors. The collaboration was led by Johnstown Area Regional Industries (JARI),

the area's lead economic development agency, and PA CareerLink Cambria County, the area's one-stop center for workforce services. The goal of the partnership is to operate a truly integrated workforce and economic development system that presents both employers and workers with a single user-friendly locus for services.

One of Gamesa's primary goals in selecting a site was the availability of a workforce with well-defined manufacturing skill sets. Production operators in its plants require skills that include assembling and fabrication, using power tools, reading gauges, and using measuring devices for product specification.

The local partnerships could provide information regarding the skills of its workforce due to an aggressive approach to economic upheaval and worker displacement. Given the long decline of the region's once dominant steel industry, the region developed a detailed profile of the jobs skills of dislocated workers. This information was then entered in a centralized database administered by CareerLink, which allowed the regional partnership to demonstrate to Gamesa that workers in the area possessed the manufacturing skill sets they were seeking.[110]

When Gamesa committed to Ebensburg, JARI and CareerLink took the lead in helping the company find a workforce for its plant, which was yet to be built. Gamesa needed to fill 240 positions, most of them production jobs in the $10-$12 per hour range. JARI's website posted job descriptions and received resumes for the first month after Gamesa started its search for employees. CareerLink categorized the resumes by job description, helped to schedule job interviews, and allowed Gamesa to use its one-stop center to conduct interviews.

Gamesa first hired 30 employees for key positions, then sent them to Spain to be trained. When they returned to the United States, they helped train the employees who were hired later, assisted by some trainers whom Gamesa transferred from Spain. (Staff at JARI and CareerLink estimate that more than half of the employees ultimately hired at the plant were dislocated workers who had been served by the area's workforce development system.) Gamesa hired its first Ebensburg employees in December 2005. The plant produced its first blade in March 2006. The plant now has 276 employees, and job turnover has been minimal.

Gamesa's process of hiring for a second Pennsylvania manufacturing plant was not nearly as smooth as the Ebensburg experience. Later in 2005 the company selected Fairless Hills to produce not only rotor blades, but also nacelles and towers. Production began in spring 2006. The Fairless Hills facilities are located on the site of former U.S. Steel operations, now called the Keystone Industrial Port Complex, on the Delaware River. As with Ebensburg, location mattered: the site's proximity to a deep water port was essential for transportation of the manufactured components.[111]

Location mattered for hiring workers as well, though in this respect the effect was not positive. Fairless Hills' proximity to the Philadelphia area had two interrelated consequences: the size and economic activity of the area meant that the plant's opening drew little attention, and thus no rush of job applicants, and the competition for workers that characterizes the labor market in the area made it harder to find and hire skilled employees.

The difficulty of hiring a qualified workforce for the Fairless Hills plant collided with over-extended demand for wind turbine component parts: before the plant ran its first production shift, Gamesa had sold out its product for the next three years. It was essential for the plant to be running at full capacity as soon as possible to meet these obligations. When Gamesa encountered difficulty in hiring a workforce, it resorted to temporary-workforce agencies. This decision produced more workers, but not necessarily qualified ones. Job turnover became a serious problem. Reportedly, the plant's ability to hire and retain workers is now improved, and it rarely uses temp agencies. But the experience at Fairless Hills illustrates what will no doubt be ongoing challenges in matching workforce supply with industry demand as the manufacturing of components parts expands in Pennsylvania and other states.

During the period when Gamesa located and began production in Ebensburg and Fairless Hills the company told the governor's office that it would remain neutral with respect to the unionization of its employees. In fall 2006 the United Steel Workers (USW) informed Gamesa that a majority of its employees at both the Ebensburg and Fairless Hills plants had signed USW authorization cards, which led to a contract that ratified on June 1. The agreement included wage increases that average 10 percent over three years and lower family health insurance premiums. The starting wage for production workers at the Ebensburg site is now $12.36; at Fairless Hills it's $13.25.

As the USW and Gamesa look ahead to the next contract, there are already discussions about tying wage incentives to incumbent worker training. At present, production employees are trained to work on the manufacturing of specific blade parts. What's likely to be negotiated is the cross-training of workers in different departments—roots, spars, shells, and finishing—and linking expanded skill sets to an increased hourly wage rate. The USW is also looking at more clearly discerning career pathways for production workers into higher-skilled and higher paid positions, such as quality control.

BIOFUEL PRODUCTION

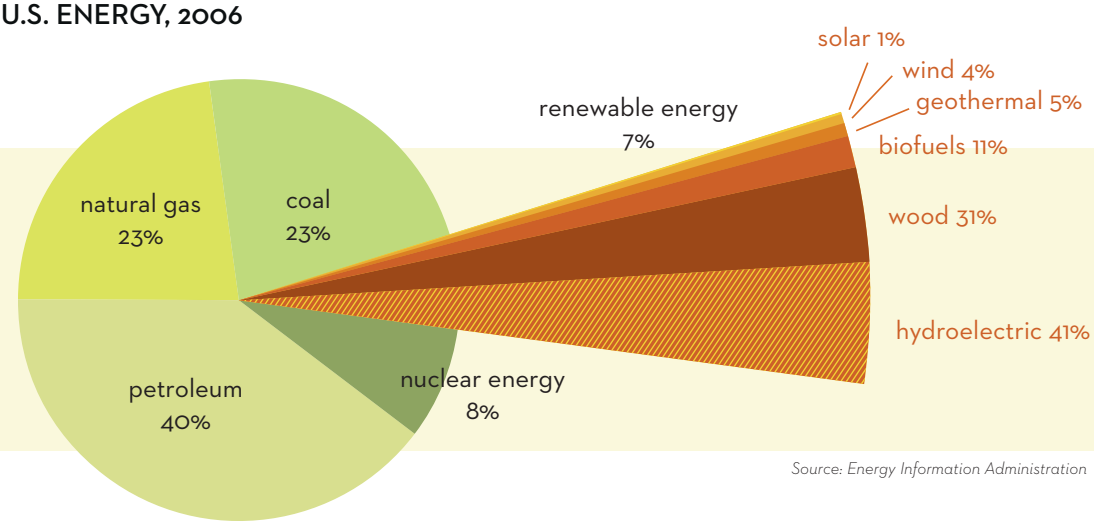
Overview

Gasoline-powered vehicles are driving us down the road to environmental ruin. According to the Worldwatch Institute, "transportation, including emissions from the production of transport fuels, is responsible for about one-quarter of energy-related greenhouse gas emissions."[112] Biofuels might open a pathway to greater energy security by reducing our dependence on foreign oil, but ethanol as we know it is not our ticket to climate stabilization. Whether we can bring environmentally sound and energy efficient biofuel production to commercial scale, at a cost competitive with fossil fuels, is the critical question facing the industry—and the country.

Made largely from plant material, ethanol and biodiesel are renewable, non-petroleum transportation fuels that promise to reduce energy imports and possibly carbon emissions. But these two predominant biofuels are not typically used in a pure state. They come to market as additives. Most policy conversations involve two commercial options: 1) 85 percent ethanol blended with gasoline (E85), which requires a flex-fuel vehicle; and 2) 20 percent biodiesel mixed with petroleum diesel (B20), which runs in conventional diesel engines.[113] Right now they supply less than two percent of total U.S. transportation fuels.[114] The young biofuels industry, however, has been growing at rates of up to 50 percent per year.

RENEWABLE ENERGY, INCLUDING BIOFUELS, AS A SHARE OF TOTAL U.S. ENERGY, 2006

In the total U.S. energy pie, including fuel &electricity, biofuels are a small but growing component (11%) of the small but growing renewable energy slice (7%)



Source: Energy Information Administration

Biodiesel is a clean-burning fuel derived from vegetable oils or animal fats. Soybeans supply most U.S. commercial production, with canola and other oils predominant in Europe. While less controversial than corn-ethanol in this country, with a positive net-energy balance, it is produced at much smaller scale, and faces its own technological limitations, like cold temperature sensitivity—a particular problem in the Northern states that produce much of the nation's feedstocks.[115]

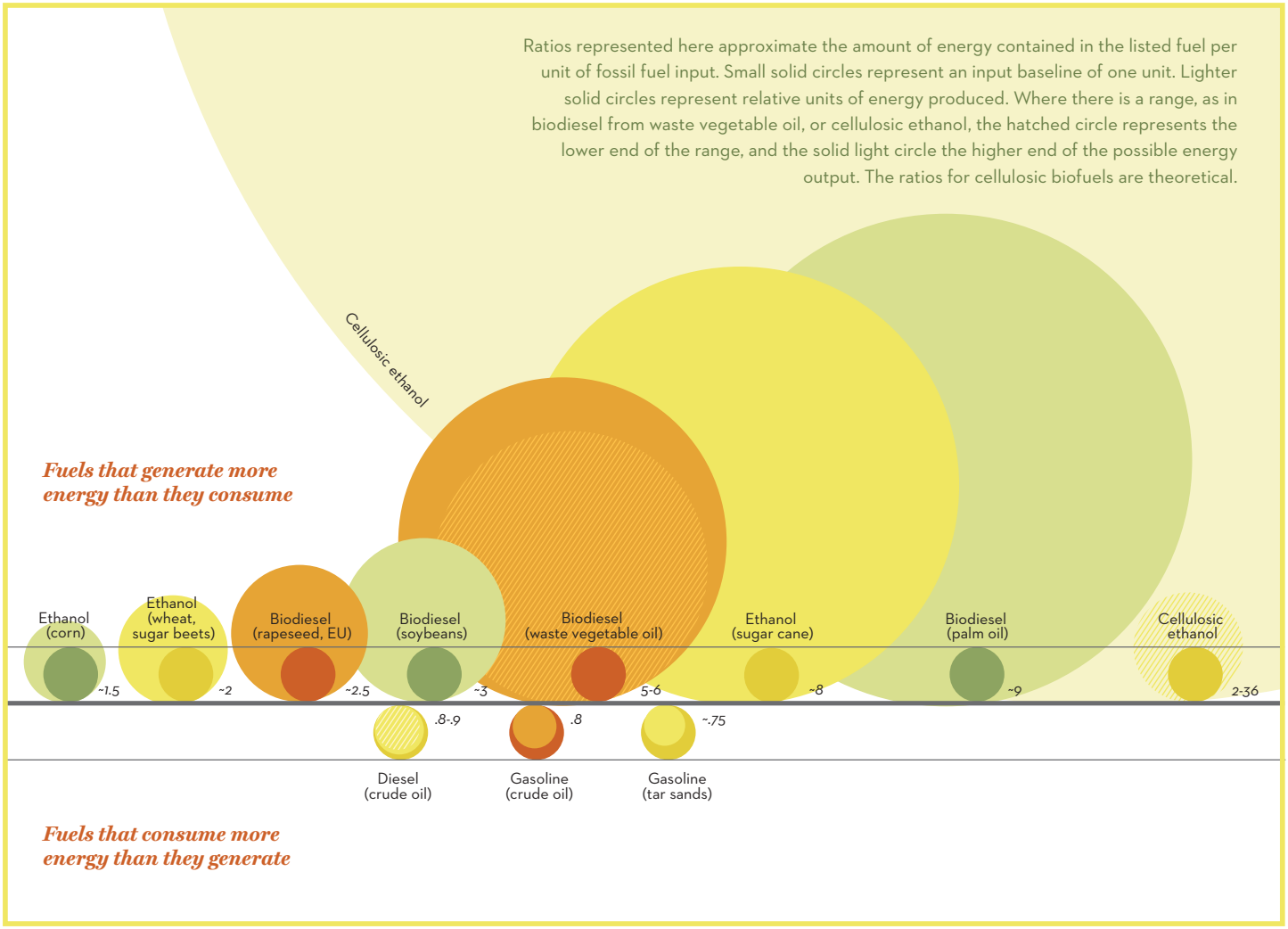
And while biodiesel production has expanded dramatically over the past decade, and in regions beyond the Midwest (see map on page 34), projected capacity, including facilities under construction, is still only 1.4 billion gallons per year (BGY) to ethanol's 11.4 BGY.[116] Part of this is simply production scale: an average ethanol plant makes 40 million gallons per year (MGY), and new plants are now coming online at 100 MGY. The average commercial biodiesel operation, in contrast, produces just 6 MGY.[117]

Ethanol is the fermented and distilled product of sugars derived from plant feedstock. In the United States, the feedstock is primarily corn (90 percent), with some wheat, barley and sorghum; sugarcane is the feedstock of choice abroad. Variations in production method to some extent determine the nature of jobs, equipment, and byproducts; the primary distinction is dry-milling (75 percent of U.S. production) vs. wet-milling (25 percent), which rely, respectively, on initial-phase grinding or chemical processing.

Ethanol's primary advantage as a fuel is local production—energy independence. Nearly three-quarters of the ethanol consumed in the United States is produced domestically.[118] Ecologically, ethanol as currently produced is better than gasoline, but not by much (see figure below for ethanol's negligible net energy balance).[119] Only if biofuel refining can become energy efficient, using biomass rather than fossil power, will grain-ethanol become a significant contributor to carbon reduction.[120]

NET ENERGY BALANCE OF BIOFUELS

Net Energy Balance (NEB), sometimes calculated as Greenhouse Gas Balance, indicates whether production of a particular alternative fuel requires more energy than is ultimately contained in the biofuel itself.[121] Such measures clearly indicate that the future must be cellulosic. Corn ethanol offers a minimal, if positive, NEB. And some potentially more productive biofuels, like biodiesel derived from palm oil, promise to generate international food/fuel crises along with their higher NEBs.



Based on data from Worldwatch Institute

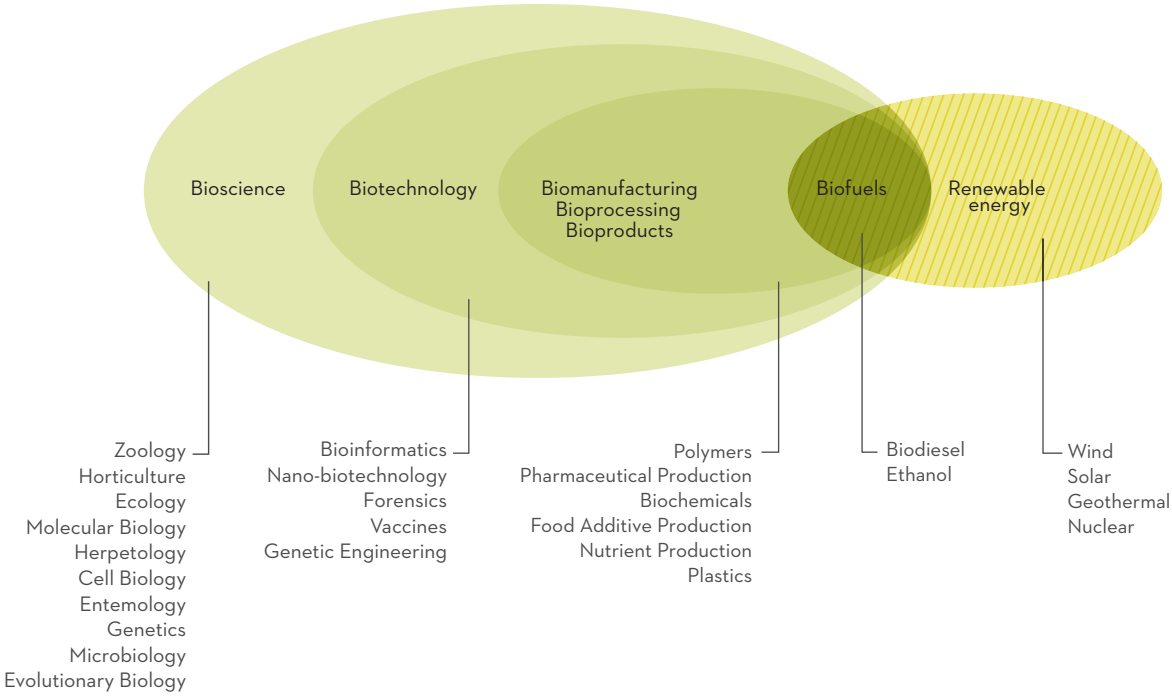
Indeed, industry expansion has met increasing resistance from communities as ethanol plants have come to be seen less as an engine of local wealth and job creation than as a producer of noxious odors and emissions and a threat to clean water resources. On a global scale, purportedly eco-friendly fuels—including bio-diesel, which is much more prevalent in Europe—seem less green when the biomass required to produce them inspires habitat destruction through deforestation, drainage, or mono-cropping.[122] European Union officials recently proposed banning imports of biofuels produced from feedstocks grown in threatened ecosystems, like forests, wetlands and grasslands.[123]

The real hope for the future lies beyond grain-ethanol in "lignocellulosic" fuel—ethanol produced with non-food biomass ranging from native perennial grasses to wood, crop, and municipal waste. Natural Resources Defense Council research suggests that **cellulosic ethanol** could reduce GHG emissions by 88 percent compared to a gallon of gasoline.[124] The problem is that the technology is not ready for market. Despite a mandate for cellulosic in the new federal renewable fuel standard discussed below, the new ethanol is not yet commercially available. We have the science. Researchers know how to extract the requisite sugars from wood chips and corn stover and switchgrass, but no one yet has done it at scale. It is still simply too expensive.[125]

Until cellulosic is ready for commercial production, related jobs will be in biotech rather than biofuels per se. And while some of the associated research and development may offer middle-skill jobs, it is not in scope of this paper to examine the immense range of bio-industry's life-science, agricultural, and engineering occupations.

THE BIOECONOMY: SORTING OUT SECTORS

Relationship between & examples of
Bioscience, Biotechnology, Biomanufacturing/Bioprocessing, Biofuels & Renewable Energy

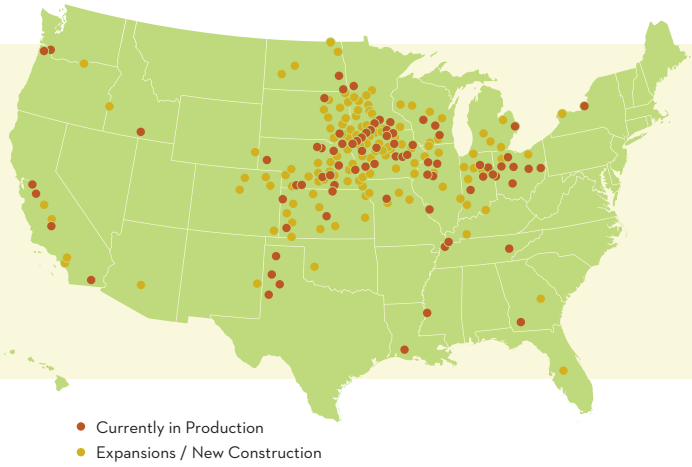


Adapted from Iowa BioDevelopment

The Potential Economic Impact of Biofuels

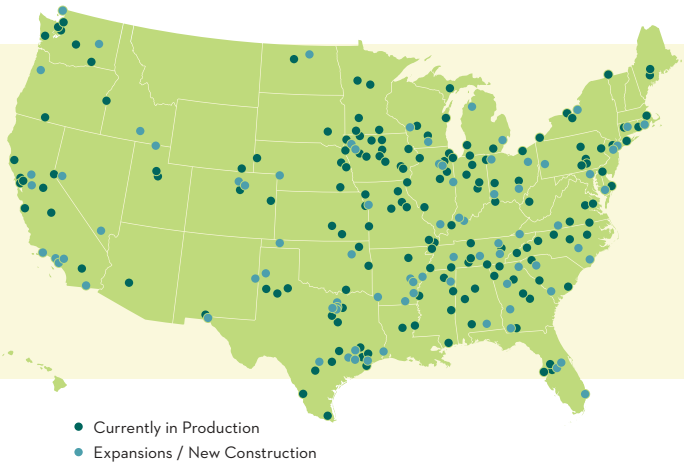
The Corn Belt has maximized its comparative advantage in grain-ethanol production: The Midwest, home to the vast majority of both existing facilities and plants under construction, supplies 94 percent of U.S. ethanol.[126]

DISTRIBUTION OF ETHANOL PLANTS



Source: ISU Center for Agricultural and Rural Development

DISTRIBUTION OF BIODIESEL PLANTS



Source: ISU Center for Agricultural and Rural Development

The Midwest will continue to enjoy regional advantages as biofuels production (and biopower, which uses biomass to create energy) moves into cellulosic feedstocks like perennial grasses, stover, straw, and woody forest scrap. The U.S. departments of agriculture and energy estimate that the Midwest has some 50 percent of the nation's total biomass.[127]

Now, however, with cellulosic in its infancy, states' comparative advantage lies in research universities and technology clusters, although there is no guarantee that technology developed locally will be implemented locally.[128] In any case, the industry is so new that economic development may have to precede workforce development, with states encouraging entrepreneurs to develop and commercialize related technology, rather than rushing to train workers for advanced biofuel production jobs that do not yet exist.

The middle-skill biofuels jobs that do exist, as we shall see shortly, are few. But absolute numbers obscure the particularities of rural economic development. Three-quarters of all ethanol plants are in non-metro counties, which typically have lower median incomes and higher poverty rates than metro areas. And the U.S. Department of Agriculture (USDA) calculates that the majority of these facilities are in rural communities plagued by significant outmigration.[129] The biggest economic issue facing main street in middle America is the nearly complete lack of decent jobs. Biofuel operations might not bring many jobs, but they tend to pay well. And when the next generation of biofuels comes online, developed in conjunction with biopower, the payoff for states with nimble—and integrated—economic and workforce development programs can be enormous.

Indeed, the most significant development opportunities for states, and particularly rural areas, lie in the bioeconomy as a whole—an agglomeration of industries and technologies that turn organic matter into energy, fuel, and chemical or plastic products.[130] Rather than importing new industries into a region, a bioindustry strategy capitalizes on existing resources and infrastructure, converting a region's crops and waste streams into higher-value products. Beyond turning locally grown biomass into alternative fuels, a major economic driver will be converting domestic feedstocks into alternative energy. Public policies designed to promote such development should aim to create local ownership opportunities as well as high-quality rural and urban jobs.

State Policy Investments in Biofuels

Some would say that the corn ethanol economy is doing just fine, thank you, and will not require significant public intervention to expand to full production capacity. Industry drivers are certainly in place. The USDA offers a host of biofuel production subsidies, and the 2007 renewable fuel standard in the Energy Security and Independence Act mandates significant national increases in the production of grain ethanol, biodiesel, and cellulosic biofuels.[131]

States, too, are banging the biofuel drum. In November 2007, 11 Midwestern governors—from Wisconsin, Minnesota, Illinois, Iowa, Michigan, Kansas, Indiana, Ohio, South Dakota, Nebraska and North Dakota—adopted an Energy Security and Climate Stewardship Platform. The platform establishes regional clean energy goals, including increased biofuels production and use.[132] Specifically, it calls on signatories to:

Produce commercially available cellulosic ethanol and other low-carbon fuels in the region by 2012; expand the retail distribution system for E85 and help convert the existing fueling infrastructure to dispense it; reduce the amount of fossil fuel that is used in the production of biofuels by 50 percent by 2025; and see that at least 50 percent of all transportation fuels consumed by the Midwest in 2025 come from regionally produced biofuels or related low-carbon sources.

Two broader policy matters merit additional attention and creative thinking by states and clean energy advocates.

First, we need to make sure that the new market for cellulosic ethanol includes and encourages community involvement. The corn-ethanol industry transitioned rapidly, and probably irrevocably, from a local to an absentee corporate ownership model. States should focus now on developing policies to ensure that the benefits of a cellulosic future, when it comes, are shared locally.[133]

Second, in the bioeconomy, as in green energy sectors generally, states need to think about transformative, system-wide approaches to economic and workforce development. Some states have started to experiment with innovative approaches to this challenge.

In Wisconsin, Governor Jim Doyle created the Office of Energy Independence (OEI) by executive order in April 2007.[134] The impetus came from the Governor's Consortium on BioBased Industry, which proposed that a single group facilitate the collaborative development of a promising, and potentially vast, bioeconomy.[135] The consortium's 2006 recommendation to create a bioindustry partnership gained momentum and became OEI, funded at $1.3 million in the state's 2007-2009 biennial budget.

OEI's mission is to make Wisconsin a leader in bioindustry, simultaneously creating "good jobs, new sources of revenue for farmers and woodland owners, overall economic growth, and environmental benefits." The office is working to facilitate the public/private partnerships necessary to achieve ambitious clean energy goals: obtaining 25 percent of the state's energy and fuel needs from renewable sources by 2025, and capturing 10 percent of the emerging bioindustry and renewable energy market by 2030. While OEI wants to cultivate green jobs, and its executive director is charged to work with all related state agency heads, including the secretary of Workforce Development, the office does not have an articulated employment and training mandate. One of OEI's most valuable functions at this point in new industry development is to serve as Wisconsin's single-point of contact for citizens, businesses, local units of government, and non-governmental organizations pursuing biofuels development, as well as other clean energy solutions.

Perhaps the most ambitious state policy and funding model has been developed by Iowa under the administration of Governor Chet Culver. It supports an aggressive renewable portfolio standard of 80 percent by 2050. In May 2007 Governor Culver signed into law H.F. 918, which established the Office of Energy Independence (OEI) and the Iowa Power Fund (IPF), and its companion H.F. 927, which appropriated $100 million over four years from the state's general fund to the OEI to create an Iowa Power Fund. Of that amount, $2.5 million is to be allocated each year ($10 million total) to the Iowa Department of Economic Development for deposit into the Workforce Training and Economic Development Fund which can be used by Iowa's community colleges for a variety of existing job training and career and technical education programs, career academies, and workforce development programs.

The director of the OEI, appointed by the governor, is charged with:

Leading outreach and public education efforts concerning renewable energy, renewable fuels, and energy efficiency.

Pursuing new research and investment funds from federal and private sources.

Coordinating and monitoring all existing state and federal renewable energy, renewable fuels, and energy efficiency grants, programs, and policies.

Advising the Governor and General Assembly concerning renewable energy, renewable fuels, and energy efficiency policy and legislation.

Establishing performance measures for determining effectiveness of renewable energy, renewable fuels, and energy efficiency efforts.

Developing an Iowa energy independence plan.

The legislation intends the energy independence plan to "provide for achieving energy independence from foreign sources of energy by the

Biodiesel plant in Iowa

year 2025." It specifies that the plan should identify strategies that will allow the state to accomplish a number of goals, which include retaining and creating "high-quality jobs that provide good wages and benefits" and enhancing "the development of the state's bioeconomy."

The OEI complied with a legislative mandate to hold public hearings around the state and then issued the first of its annual energy independence plans on December 14, 2007. The plan is available online at *http://www.energy.iowa.gov/OEI/plan.html*.

In the plan the OEI articulates its vision to be "Iowans creating an economically viable and environmentally sound energy future." Accordingly, it places great emphasis on using state policy and the example and purchasing power of state government to increase energy efficiency and the use of renewable energy, with the goal of dramatically reducing the state's greenhouse gas emissions. The various standards recommended in the plan, if acted on, will greatly expand Iowa's green energy economy and the job opportunities that accompany such an expansion.

The plan has relatively little to say about economic and workforce development strategies and policies that could shape green job creation and the recruitment and training of workers to fill those jobs. But this first plan had to be written in six weeks, and there is reason to believe that future plans will address such strategies. Regardless, OEI's first plan illustrates some of the challenges inherent in developing a policy framework broad enough to give equal attention to both energy efficiency and environmental protection, on the one hand, and economic and workforce development, on the other. No doubt this tension will continue to play out as the work of the OEI advances.

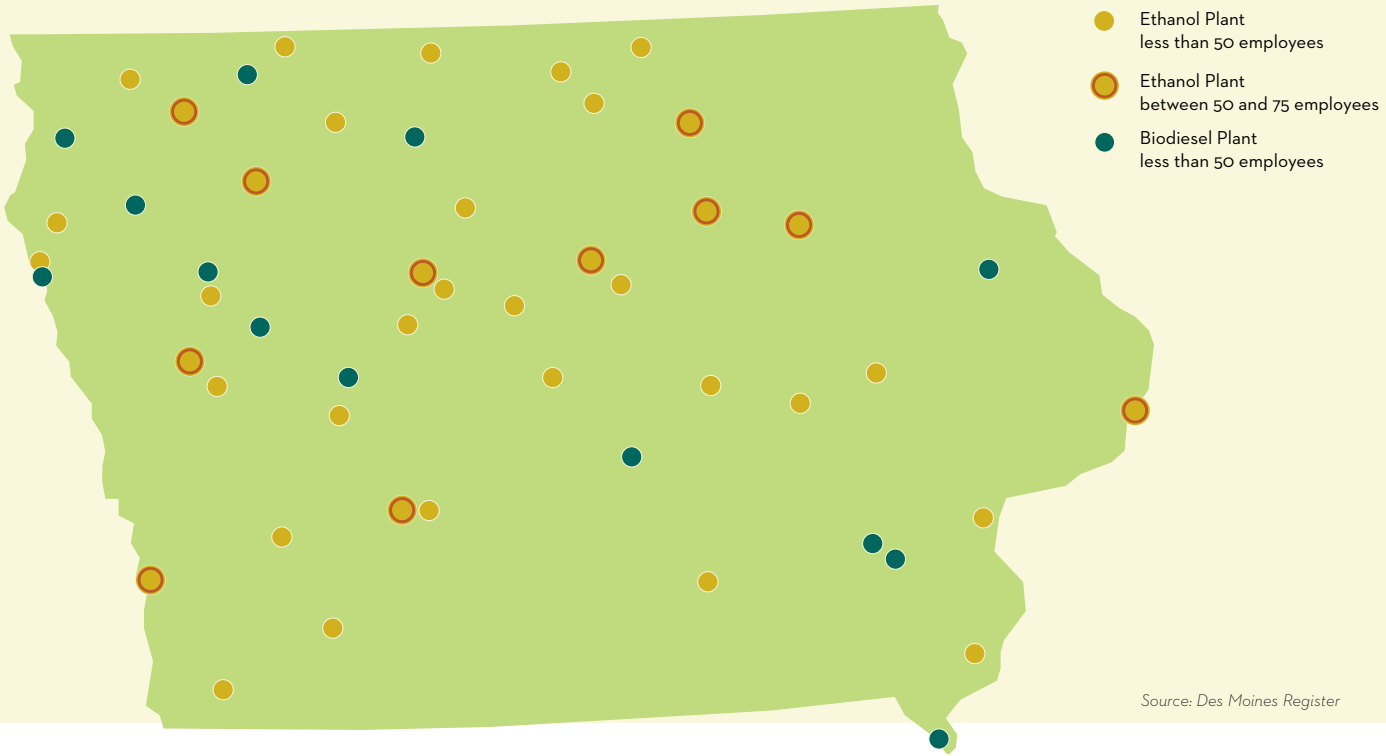
The Biofuels Workforce

Advocates of the emerging bioeconomy seek both clean fuel and green jobs. In a 2006 survey by the Institute for Agricultural and Trade Policy, 57 percent of respondents said they expected to see more rural jobs—a benefit deemed second only to increased energy independence, and ranked ahead of "better prices paid to farmers" and "less GHG emission."[136]

How many jobs will the biofuels industry create? Private biofuel developers and their public supporters in job-hungry rural areas have promised exhilarating numbers. This is not a bad strategy to generate political will, but it is a terrible guide for workforce development.

We know that the average biofuel plant employs about 35 workers. And because of the economies of scale associated with ethanol and biodiesel production, increased capacity does not necessarily translate into job expansion. A plant can double its output without doubling its

EMPLOYMENT LEVELS IN IOWA'S BIOFUEL PLANTS



Source: Des Moines Register

labor force. An ethanol plant that grows from 40 MGY to 100 MGY might grow from 35 to 50 workers.[137] A biodiesel plant expanding from 4 MGY to 10 MGY could operate at the same general staffing levels—12—with some anticipated additions to marketing personnel.[138]

Biofuels jobs look much like traditional jobs in chemical manufacturing. We outline typical occupations, which range from truck drivers and shipping clerks to chemical technicians and electronics repairers, in the Jobs-At-A-Glance table on page 38.

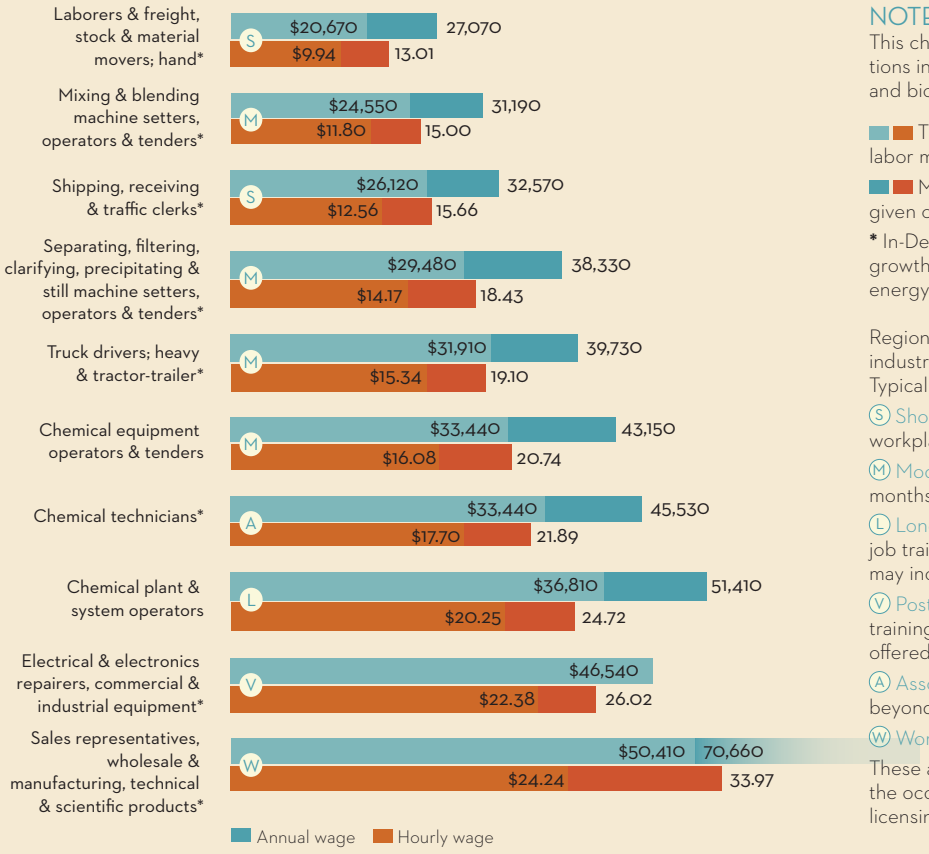
Beyond direct production—and this is where the numbers get funny—jobs multipliers have run amok. Inaccurate use of input-output models have inflated job creation numbers, often to ridiculous extent. (The farmers were already growing corn!) Reputable studies have now demonstrated that the biofuel industry jobs multiplier is a modest three to four, rather than the 18-51 claimed by a variety of promoters across the Midwest.[139] This means that as plants pull in capital goods and feedstocks, and workers and investors spend their wages and dividends, three or four additional jobs may be generated in the local economy for every direct job created at the plant. And the good news is that local ownership increases the biofuel jobs multiplier.[140]

But there is no guarantee that this multiplier is a *green* jobs multiplier. The problem with economic development models is that projected indirect and induced jobs offer no guarantee of quality. We simply don't know what they look like. And if jobs created by local dollars flowing through the community from local biofuel plants do not pay family-supporting wages and offer decent benefits, they are not green jobs.

One as yet undocumented area of potential job creation—or retention—lies in component manufacturing. Biofuel operations need tanks, boilers, centrifuges, control systems, gauges, heat exchangers, and a long list of related parts. No one has catalogued the supply chain as yet, much less begun to organize it. Anecdotal information suggests strong demand. Wisconsin metal fabricators that build equipment for the dairy industry, for example, report brisk sales to ethanol plants.[141]

Another source of demand for capital goods is the building or retrofitting of biofuel distribution networks. Ethanol, in particular, is highly corrosive, and cannot be transported by traditional means. Stainless steel equipment must be designed and commissioned to carry biofuels from production to blending facilities, requiring an entire new fleet of tanker trucks and railcars. Much of the fossil fuel pipeline in this country—figuratively and literally—is designed to bring fuel in and up through the country. A Midwest-based biofuels industry needs to reverse that flow, transporting product out to the coasts and down the Mississippi. Midwest manufacturers could be brought online to lead the effort.

BIOFUELS JOBS AT-A-GLANCE



NOTES

This chart depicts national wage data for selected middle-skill occupations in the basic chemical manufacturing industry, which includes ethanol and biodiesel production.

The 25th percentile describes wages at the lower end of the labor market.

Median wage marks the center of the wage distribution in a given occupation.

* In-Demand occupation per DOL, regardless of overall occupational growth levels, because the work is central to a high-growth industry, like energy or construction.

Regional wage ranges and more precise occupational projections by industry can be run on a state-by-state basis.
Typical education and training path:

Ⓢ Short-term on-the-job training: Requires no more than a month of workplace-based training

Ⓜ Moderate-term on-the-job training: Requires from one to twelve months of training, which typically occurs at the workplace.

Ⓛ Long-term on-the-job training: Requires more than one year of on-the-job training, or combined work experience and classroom instruction, and may include apprenticeships of up to five years.

Ⓥ Postsecondary vocational award: Requires credentials earned in training programs lasting from a few weeks to more than a year, typically offered at vocational or technical schools.

Ⓐ Associate degree: Requires two years of full-time academic work beyond high school.

Ⓦ Work experience in related occupation.

These are general indicators; there may be other pathways into the occupation, as well as additional educational, training, or licensing requirements.

Source: U.S. Bureau of Labor Statistics

Key Points

- Jobs in biofuels often look like traditional chemical manufacturing jobs.
- While none of these occupations shows faster than average projected growth, the Department of Labor (DOL) identifies all but two as "in-demand" because they are critical to high-growth industries.
- Jobs in biodiesel and ethanol production pay decent wages, but offer few jobs: a 50 million gallon per year (MGY) plant employs on average 35 workers. A few good jobs, however, can bring significant benefits to rural communities.
- Increasing the scale of production does not significantly increase employment. An ethanol operation that grows from 40MGY to 100MGY might grow from 35 to 45 or 55 workers; a biodiesel plant expanding from 4 to 10MGY could potentially operate at the same general staffing level—12 employees.
- The job creation potential of biofuel refineries has been greatly exaggerated. Reliable studies now suggest that the jobs multiplier is a modest 3-4, depending on local markets. Local ownership demonstrably boosts indirect economic impacts.
- Metal manufacturing jobs will likely be in demand as the biofuels industry matures. While no empirical studies yet exist on the nature and scale of the requisite supply chains, we do know that the biofuel infrastructure needs capital goods—tanks, boilers, centrifuges, etc. As traditional shops step up to produce them, skilled labor will be in high demand.

Jobs to Watch

As with some efficiency and wind sector jobs, biofuels jobs are relatively new. We do not have good wage and employment data because they are not yet tracked by the U.S. Bureau of Labor Statistics (BLS). In the absence of solid labor market data, local research can provide critical information to workforce development partners.

Indian Hills Community College in Iowa, for example, surveyed the regional ethanol industry and developed job guides for shift maintenance and plant operator positions, which became the basis of its Ethanol Plant Technician A.A.S. program. The college is now working to codify biodiesel occupations.
Related jobs include:

Ethanol plant technician • Ethanol plant operator • Ethanol maintenance mechanic • Biodiesel laboratory technician • Biodiesel maintenance mechanic • Biodiesel process control technician

Greener Pathways for the Biofuels Workforce

The skill set for the bulk of employees in biofuels production—most of whom have some post-secondary training—is a classic middle-skill portfolio.[142] Biofuel producers look for workers with basic reading, writing and communication skills; math and computer literacy; and preferably some specific training in, e.g., laboratory techniques, process control, industry-specific software, occupational safety and health, and waste and wastewater management. These are the primary skill sets employed inside the plants now sprouting up across the Midwest and beyond.

To train local workers in southern Iowa, related courses are developed and taught at the Iowa Bioprocess Training Center, a $2M facility developed by the Indian Hills Community College in partnership with a cluster of international corporations doing business in the area, like Cargill and Wacker; utility companies like Alliant Energy; state and regional economic development offices; and federal agencies, including the departments of Agriculture and Commerce. The center offers both customized training and a bioprocess technology degree program. The community college further links economic and workforce development through the broader consortium of Iowa BioDevelopment, an industry training and education outreach program serving both biotech and biofuels companies.[143]

One of the consequences of the relative newness and rapid growth of the biofuels sector is the lack of industry-recognized credentials for occupations and related skill standards. The industry itself has not stepped forward to address this gap. In Iowa, community colleges, far more organized than the nascent industry itself, are again taking the initiative.[144] Kirkwood Community College and Indian Hills Community College recently formed Iowa Biofuels Training International to make "IBTI certification" the industry standard for biofuels training programs and occupations, develop curriculum based on documented industry needs, and lead research on its evolving education and training requirements.

Indian Hills has already surveyed the ethanol industry and developed job guides for ethanol shift maintenance and ethanol plant operator positions, which became the basis of its ethanol plant technician associate degree program. It is now in the process of developing job guides for key positions in the biodiesel industry, including laboratory technician, laboratory manager, maintenance mechanic, and process control technician. This work will be the foundation of IBTI's curriculum development, but it plans to do more than develop training programs; it will also coordinate and deliver "IBTI-certified" training through an array of partners. The training will be delivered onsite at either the training provider or biofuels company, or via web-based online options.

Skills Certification

The efforts of Iowa's community colleges to develop nationally recognized certifications for biofuel occupations illustrates the importance that the certification of emerging occupational skills will play in the evolution of clean energy industries.

Developing and conferring regulatory standards for occupational skills provides benefits for workers, employers, and consumers alike. For workers it provides a credential that allows them mobility and bargaining power, and thus higher wages, in the marketplace. For employers it provides assurance that job applicants meet necessary skill standards. And for consumers it provides critical information for contracting decisions.

Definitions are important. "Certification" refers to a voluntary system of standards, usually set by key stakeholders and subject matter experts, that practitioners can choose to meet in order to demonstrate accomplishment or ability in their profession. Unlike "licensure," a form of regulation, this system is not mandatory and does not vary on a state-by-state basis (a great benefit to workers, who then don't need to gain a new certification if they move to a new state). It is conferred to the individual and should not be confused with "accreditation," which is awarded to educational institutions for programs or courses of study that meet instructional standards.[145]

The process of developing certifications for renewable energy and energy efficiency occupations is probably most advanced for the solar sector. In 2002 the North American Board of Certified Energy Practitioners (NABCEP) released a task analysis for photo-voltaic system installers. A formal task analysis, which identifies an occupation's critical tasks, knowledge and skills, functions as a foundational document for credentialing assessment and provides the learning objectives for curriculum development. NABCEP used its task analysis to build and launch a certification program that provides credentials to a broad range of journeymen, contractors, and foremen.[146]

As in the other clean energy industries considered in this report, in biofuels green skills may be a more significant marker than green jobs. A laboratory technician is not a green-collar worker per se, but with ethanol-specific skills, she can be. The same can be said for computer-literate chemical plant operators with specialized training in biofuel processing.

Perhaps the larger question in biofuels is that of advancement. In this regard, we need to consider both the nature and the scale of work. Is the occupational structure amenable to green career ladders? A pathway from grain shoveler to hauler to merchandiser seems unlikely. Perhaps, if a traditional chemical industry worker learns sound water management practices and joins an ethanol plant at a related but higher level, we can point to a greener pathway. But even where the potential for mobility exists, can we reasonably hope to develop career ladders in an industry that directly employs fewer than 10,000 people? Some of this will become clearer as the bio-economy matures and related bio-tech and bio-industry sectors evolve.

In the meantime, the issue in declining rural communities is not so much upward mobility as decent employment, period. Iowans know this. Accordingly, the state is investing resources to train its workers for the small but significant biofuel industry, and many community colleges use a unique method to pay for it.

CASE STUDY: Iowa's Bio-Fuels Job-Training Bonds[147]

The growth of the biofuels industry in Iowa is supported by an existing program—the New Jobs Training Program (NJTP)—that positions human capital investment at the center of the state's economic development efforts. As such, it represents a striking departure from the more typical state job creation strategy of using tax subsidies to attract and retain businesses.

The NTJP was created in the early 1980s when an agricultural crisis hit the state and policymakers recognized the need to broaden and diversify the base of the state's economy. It was designed as an economic development incentive to stimulate job creation in businesses bringing new money into the state.

The NJTP provides funding to support the cost of training new employees in new business startups or the expansion of existing firms, using a unique financing mechanism. The program authorizes Iowa's 15 community colleges to issue bonds for up to 10 years on behalf of a business that is creating jobs. The proceeds of the bond sale support the training required for the new jobs and related program administrative expenses. The bonds are paid off by diverting to the college 1.5 or 3 percent of the increased payroll tax revenues resulting from the creation of jobs. Local property tax receipts resulting from new capital investment made to support the new jobs can also be encumbered for up to 10 years through the use of tax increment financing (TIF), although TIF is seldom used anymore.

The final project agreements are approved by the community college board of trustees. There is no statutory limit on the bonds that can be issued annually. The program currently has a revenue-neutral impact on

the state budget because the colleges are retiring bonds at a rate equal to the issuance of new bonds. When the bonds are retired, the payroll taxes revert to the general fund.

The use of the NJTP by Iowa Central Community College to support the biofuels industry illustrates how the program works. Over the last three years the community college has sold tax-exempt bonds to support the training of new employees at five start-up biofuel plants *(see table).*

The bonds were purchased by local banks and investors at variable interest rates—5.62 percent for the most recent sale. The principal and interest payments on the bonds are paid by diverting directly to the college 3 percent of the payroll tax revenue on the new employees' wages. Strict accountability is built into this financing mechanism. By virtue of the withholding tax diversion, the college knows exactly what the payroll of the company is and number of jobs created, thus ensuring that the wage levels promised by the businesses to receive the support of the NJTP are paid. A business that fails to meet its hiring and salary projections is subject to default and not eligible for reimbursement of training expenses, or must repay any reimbursements made.

Businesses can be reimbursed for many kinds of training, including on-the-job training (OJT), basic education and customized training at a community college or another educational institution, and training services purchased from a private trainer. The five biofuel companies have apparently hired employees with lower education and skills than they projected when applying for support from the NJTP. This may be a function of the industry's newness. In the words of a leader at another Iowa community college, "I am sure they would prefer to hire someone with more training, but the industry is so new, if they require it, they wouldn't have any applicants."

For example, Western Iowa Energy (WIE), a biodiesel plant that generates 30 MGY, and which received support from a 2006 bond issue, ultimately hired 28 employees. Sixteen of those workers are in operations, where feedstock, primarily soybean, is treated to remove impurities and processed into biodiesel. The company hired high school graduates for these positions, doing so about six to eight weeks before the plant's start-up. They received a brief two weeks of classroom training on the basics of operations, safety, environment, and the chemical process itself. They were then sent to other plants in the state, where they job-shadowed experienced operators as their OJT, while receiving full wages. WIE's lab technologist and quality assurance supervisor, however, required more pre-employment training than the operators. Based on the demand from WIE and other area plants, Iowa Central Community College in 2006 began a 65 credit, two-year biofuel tech program. Graduates receive associate degrees. The first cohort is now in its second year. The program, like the shorter-term training, is paid for by NJTP funds.

The bonds issued by Iowa Central Community College to support the region's biofuels industry extend what has become a lengthy track record of linking public support for job creation with worker skill advancement. From 1983 to 2005, Iowa's community colleges used the NJTP to issue $503 million in bonds through 1,900 training agreements, helping to support the pledged creation of 126,341 jobs in Iowa.

IOWA'S NEW JOBS TRAINING PROGRAM (NJTP)

Iowa Central Community College recently used NJTP to support five start-up biofuel plants. The companies sought skilled and experienced workers, preferably with two-year degrees; the community college issued bonds to support training programs for the new jobs. This table shows projected jobs and wages at the start-ups, as well as training funds leveraged and invested by NJTP.

Year	*Company*	*Jobs*	*Average Wage /Hr.*	*Total Bond Issue*	*Training*
2005	Vera Sun	42	$14.00	$285,000	$190,323
2005	Corn LP	31	$14.00	$285,000	$190,323
2006	Western Iowa Energy	26	$15.50	$205,000	$132,307
2006	US Bio Energy	47	$16.24	$405,000	$259,362
2007	Tate & Lyle	84	$24.00	$1,115,000	$690,366

Source: Iowa Central Community College

PROGRAMS

Resources–Employment and Training

Integrating green-jobs initiatives into the nation's established workforce development system, which we argue here and elsewhere is essential to the success of such initiatives, brings green career pathways into the contested federal labyrinth of the 1998 Workforce Investment Act (WIA). WIA aimed to rationalize employment and training programs through a national one-stop career center system. In practice, states have struggled to bring together siloed programs with disparate funding streams, constituencies, performance measures, and service cultures, including WIA Title I (adult, dislocated worker, and youth programs), Wagner-Peyser, adult education and literacy, post-secondary vocational training (Carl D. Perkins), vocational rehabilitation, veterans employment and training, Trade Adjustment Assistance, and others. In an increasingly constrained federal funding environment—the Bush administration has been particularly vigorous in its attempts to cut key workforce education and training programs—green jobs will need to be integrated into existing programs, rather than launched as stand-alone projects competing for scarce resources.[148] This makes sense from a systems perspective too, as we articulate in the declaration of policy principles below.

Outside of standard workforce funding streams, which green jobs initiatives can and should leverage, the Department of Labor's Employment and Training Administration has in recent years launched a number of discrete grant programs for regional workforce development. Few of them to date have focused on renewable energy, but some have, and more could.

Green jobs initiatives need to be integrated into existing workforce programs, rather than launched as stand-alone projects competing for scarce resources

RECENT JOB TRAINING INITIATIVES

The President's High Growth Job Training Initiative (HGJTI) identifies energy as a critical industry sector for labor market intervention, including the development of career ladders.[149] But of the 157 grants made to date through the HGJTI, just 11 went to energy projects, and none of those support renewables or efficiency.[150]

Taking a small step in the right direction, the 2008 Department of Labor (DOL) grant solicitation addresses regional workforce development challenges in the energy industry—*including the renewable energy sector*—by targeting related occupations in the construction and the building trades. The current round will distribute some $10 million in grants to strategic regional partnerships. Successful models will bring together public and private stakeholders to address industry skill shortages and prepare workers for good jobs expanding the nation's energy infrastructure. How many of those jobs will be dedicated to building a *clean* energy infrastructure remains to be seen.

To further address skill shortages in high growth industries, the Bush Administration targeted community colleges, with their close ties to local labor markets, as a key conduit for demand-driven workforce training. Unfortunately, the ensuing Community-Based Job Training (CBJT) grants offered little to the burgeoning clean energy sector.

In 2005, DOL awarded $125 million in Community-Based Job Training grants to 70 community and technical colleges in 40 states. In 2006, 72 institutions in 34 states received a total of $125 million in grants. Of the 141 currently active programs, 13 target energy, and just two of those renewables.[151]

A $2 million grant to Mesalands Community College in New Mexico will fund the instruction of over 1,200 individuals in wind energy careers, the development of a curriculum and certification programs for wind energy technicians, as well as the acquisition of a wind power turbine that will serve as both a training tool for workers and a research tool for North American Wind Research and Training Center partners.

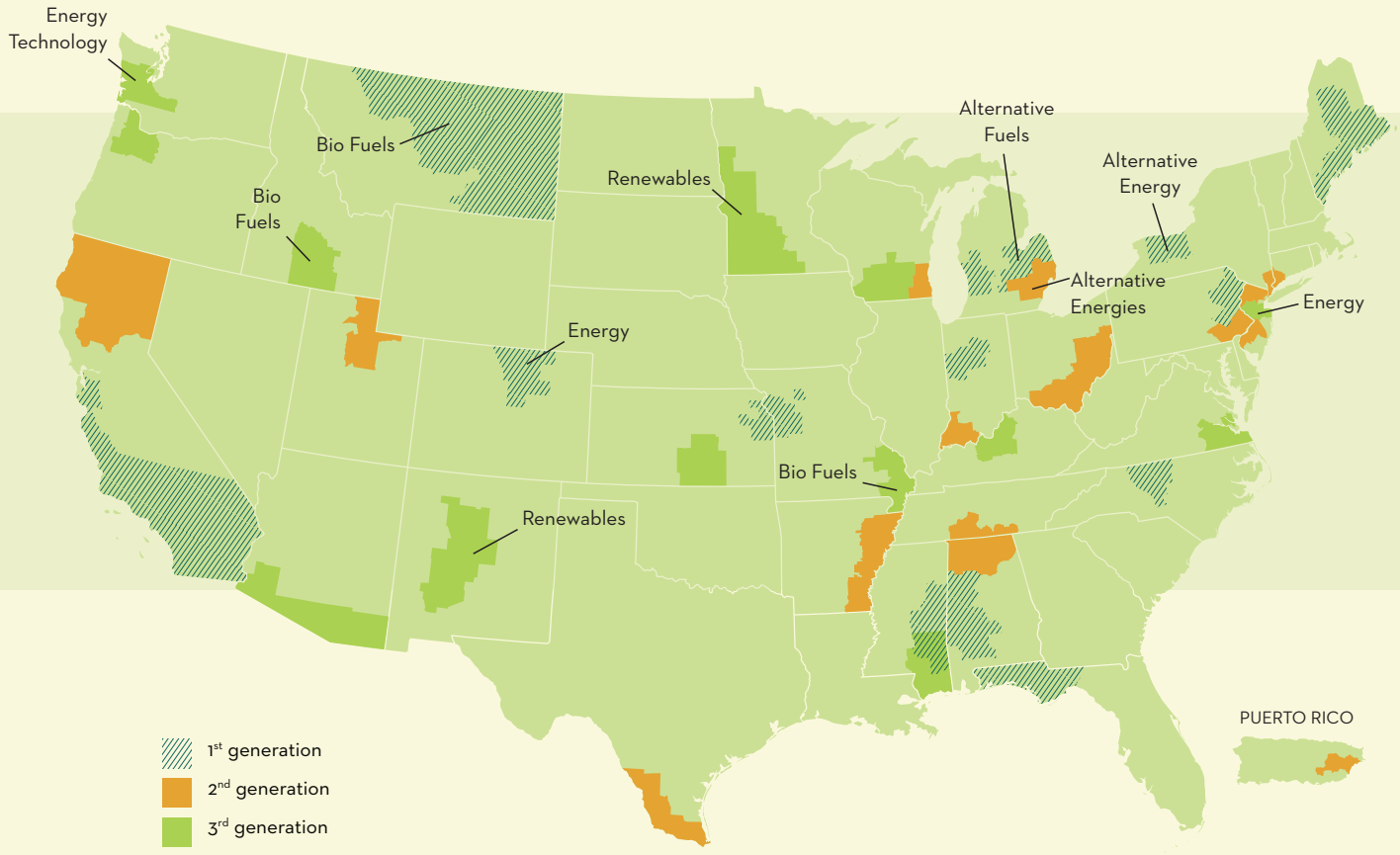
Northeast Community College in Norfolk, NE, will use $2 million in CBJT funds to train incoming and incumbent workers in biofuels. The College and its partners plan to implement a statewide initiative establishing career pathways in the ethanol industry. According to their projections, the program will train 1,380 participants, support opportunities for secondary school students to obtain dual credits and explore careers in the ethanol industry, and develop an associate degree in ethanol production and management, with potential links to a related bachelor's program.

WORKFORCE INNOVATION THROUGH REGIONAL ECONOMIC DEVELOPMENT

DOL's Workforce Innovation through Regional Economic Development (WIRED) initiative promotes the sorts of regional partnerships we advocate in this paper.[152] Launched in 2006 and now in its third generation of grants, WIRED aims to revitalize local economies by integrating economic and workforce development strategies. Thirty-nine multi-county and multi-state regions are currently pursuing WIRED approaches with three-year seed grants of $5 million (second and third generation) to $15 million (first generation).[153]

Of the 11 WIRED regions that focus on energy, eight target emerging clean energy clusters.[154]

Other WIRED regions include biotech and bioindustry, and some, like New Mexico, are working in green building and green manufacturing (aerospace and aviation). Still others, not focused on energy sectors per se, are implementing industrial efficiency measures. Northern central Indiana's "Energy Efficiency Technology and Knowledge Transfer Program," for example, plans to identify 28 companies in the state's manufacturing cluster—two per WIRED county—in which to create teams of employees trained and certified as "energy efficiency practitioners."



Adapted from the Council for Adult & Experiential Learning and Energy Providers Coalition for Education

Resources–Energy & Economic Development

State energy agencies can and should serve as a clearinghouse of federal opportunities. A good example is the list maintained by Wisconsin's Office on Energy Independence, which also includes federal incentives and private funding opportunities. See: *http://power.wisconsin.gov/section.asp?linkid=1127&locid=131*.

Navigating the federal labyrinth can be daunting. While state commerce departments are a logical place to troll for worker training incentive funds, things are different in Washington. A Kansas Federal Reserve study counts 180 federal economic development programs scattered in "virtually every corner of the government, including the Department of Defense." With no single coordinator, they are united only by a decidedly 20th-century focus: building physical infrastructure in a homogenous economic landscape.[155]

The most direct way to research current funding opportunities related to green job development is the federal government grant website, *http://www.grants.gov*. The site includes all 26 federal grant-making agencies, and searches can be conducted by category, such as energy, natural resources, or regional development.

While few programs outside the purview of the federal government's big three for employment and training—DOL, Health and Human Services, and Education—focus explicitly on worker training, many can drive the development of green jobs, particularly in the Department of Energy (DOE).

DOE's federal laboratories promote the efficiency and wind industries through a variety of grants, from the development of large fuel cell systems to providing home weatherization assistance for low-income individuals. In addition, the DOE Office of Energy Efficiency and Renewable Energy provides financial opportunities for business, industry, and universities.[156] These have included, for instance, funding for a national accreditation and certification program for photovoltaic system installation, but there appears to be little sustained effort to include employment and training provisions in such grants.

The DOE also co-sponsors funding opportunities—primarily for research and development—with the U.S. Department of Agriculture (USDA) for bio-industry development. Grants have focused primarily on improving production of biomass-based products, bioenergy, and biofuels, in order to make them economically competitive with fossil fuels. Given the state of ethanol, it makes sense that current funding focuses on genomic-based research to improve biomass and plant feedstocks for fuel production. The USDA is also offering funding directed towards the sustainability of all components of U.S. agriculture; while this grant may not explicitly identify bio-industry development as its aim, it could support research on bio-based products and bioenergy production.

DOE has also partnered with the National Science Foundation (NSF) in funding green development. These grant programs are designed to build states' capacity to conduct competitive, energy-related research and to cultivate talent in science and engineering. The Energy for Sustainability program, for example, supports research and education in renewable energy production, conversion, and storage. NSF grants come in many guises, and are the only ones that appear to regularly include workforce development projects.

NEW LEGISLATION: THE GREEN JOBS ACT OF 2007

On December 19, 2007, President Bush signed into law the Energy Independence and Security Act (EISA). The EISA is a broad-ranging piece of legislation that will have major implications for green job development in the United States in coming decades. Although it is beyond the scope of this report to summarize the EISA in detail, some of its provisions that will most significantly affect employment in renewable energy and energy efficiency sectors include:

Increased fuel economy standards for cars and trucks, new incentives for the domestic development and production of advanced technology vehicles, vehicle batteries, and plug-in hybrid vehicles.

An increased renewable fuels standard, which sets annual requirements for the amount of renewable fuels produced and used in motor vehicles, while ensuring that biodiesel and cellulosic sources are a significant proportion of that increase.

The creation of a new Solar Energy Curriculum Development and Certification Grant Program within the DOE, authorized at $10 million per year, for competitive grants to create and strengthen solar industry workforce training and internship programs in the installation, operation, and maintenance of solar energy products.

A new Energy Efficiency and Conversation Block Grant Program within the Department of Energy, authorized at $2 billion per year, to be allocated to state and local governments to be used for innovative best practices to reduce fossil fuel emissions and energy use and to achieve greater energy efficiency in the building, transportation, and other appropriate sectors. These grants could be used for building and home energy conservation programs, energy audits, fuel conservation programs, planning and zoning to promote energy efficiency, and the use of renewable energy resources for government buildings. In addition, subgrants could be made to nonprofit organizations and governmental agencies for the purpose of performing energy efficiency retrofits.

A requirement for improved federal and commercial building energy efficiency.

The subtitle of the legislation that is most explicitly focused on employment in green energy sectors is the Green Jobs Act (GJA).

Approved in December 2007 as Title X of the EISA and authorized at $125 million per year, the Green Jobs Act creates an Energy Efficiency and Renewable Energy Worker Training Program as an amendment to the Workforce Investment Act. GJA targets a broad range of populations for eligibility and a host of energy efficiency and renewable energy industries, including clean-energy jobs in areas such as energy efficient building, construction and retrofits; renewably generated electric power; energy efficient vehicles; biofuels; and manufacturing that produces sustainable products and uses sustainable processes and materials. Authorized at $125 million per year, the program will be administered by DOL in consultation with DOE, and includes both national and state-level components.

The Green Jobs Act: National Components

National Research Program. DOL, acting through the Bureau of Labor Statistics, will collect and analyze the labor market data necessary to track workforce trends in energy efficiency and renewable energy, and provide technical assistance and capacity building to partnerships. Ten percent of the amount appropriated for the GJA will be dedicated to this program ($12.5 million if fully funded). As we've said elsewhere in this paper, there's a lot we don't know about these jobs and the labor markets; this investment could help fill the vacuum.

National Energy Training Partnership grants. DOL will award competitive grants to nonprofit partnerships to carry out training that leads to economic self-sufficiency and to develop an energy efficiency and renewable energy industries workforce. The partnerships must include the equal participation of industry and labor, and may include related stakeholders such as local workforce investments boards, educational institutions, and community-based organizations. Thirty percent of the amount appropriated for GJA will be dedicated to these grants ($37.5 million if fully funded).

The Green Jobs Act: State Components

State Labor Market Research, Information, and Labor Exchange Research Program. DOL will award competitive grants to states to administer labor market and labor exchange information programs, in coordination with the one-stop delivery system. Activities will also include the identification of job openings; the administration of skill and aptitude testing; and counseling, case management, and job referrals. These programs will be administered by the state agency that administers the employment service and unemployment insurance (UI) programs and services can only be delivered by state merit staff. Ten percent of the amount appropriated for GJA will be dedicated to this program ($12.5 million if fully funded).

State Energy Training Partnership Program. DOL will award competitive grants to states to enable them to administer renewable energy and energy efficiency workforce development programs via the state agency that administers employment service and UI programs. It will award grants to partnerships that essentially mirror the national partnerships. Priority will be given to states that demonstrate that their activities meet state and national policies associated with energy efficiency, renewable energy, and reduction of emissions. Thirty percent of the amount appropriated for GJA will be dedicated to this program ($37.5 million if fully funded).

Pathways Out Of Poverty Demonstration Program. DOL will award at least 10 competitive grants to training partnerships that serve individuals living at under 200 percent of poverty or a locally defined self-sufficiency standard.[157] The partnerships must include community-based organizations, educational institutions, industry, and labor; demonstrate experience implementing training programs and recruiting and supporting participants to the successful completion of training; and coordinate activities with the WIA system. In awarding grants priority will be given to partnerships that target low-income adults and youth and plan to implement various strategies that enable access to, and successful completion of, training, including ensuring that supportive services are delivered by organizations with direct access to and experience with targeted populations. Twenty percent of the amount appropriated for GJA will be dedicated to this program ($25 million if fully funded).

The national and state partnership grant programs, and the pathways out of poverty demonstrations, all give priority to applicants (whether the state or partnerships) that can leverage additional public and private resources. For this reason, state and local governments and private-sector partners that have already invested in their own green jobs initiatives will be in a more competitive position to be awarded GJA grants.

It is important to note that while funds were authorized for the GJA, they were not appropriated, so full funding will have to be secured in the next appropriations cycle. However, the legislation does require that DOL, in consultation with DOE, establish the Energy Efficiency and Renewable Energy Worker Training Program by May 2008. It remains unclear how DOL will respond to this requirement. Because the GJA amends WIA's Section 171 for Demonstrations, Pilots, and Research, DOL could draw on funds from this budget line, which in the 2008 Labor-HHS-Education Omnibus Appropriations bill was funded at $48.5 million. Although much of that money is already committed to earmarks, DOL could presumably allocate some of the funds toward preliminary grant-making for the GJA. Alternatively, DOL could focus on creating a regulatory framework and developing a bare bones program in anticipation of dedicated funding in the future.

WHAT STATES CAN DO

POLICY PRINCIPLES FOR GREEN JOBS INITIATIVES

We offer the following green jobs precepts not as a one-size-fits-all formula, but as a set of key policies and practices that should underpin state efforts to secure the better environment/better economy/better opportunity promise. While written for state policymakers, the guidelines could be easily adapted for cities or regions.[158]

Despite the recent policy advances at the national level represented by the passage of the Green Jobs Act, states cannot afford to wait for federal policymakers to take the lead in developing policy and investment strategies that help to create green-collar jobs and train workers to fill them. Indeed, states are in an ideal position to develop models now to build a strong and equitable green economy that can catalyze and inform future federal policymaking. The principles below, together with the Washington state example that follows, are intended to suggest a framework for building and implementing such a model.

1 Define and target specific green jobs

Any green jobs initiative will need to identify the green jobs on which to focus. Without definition—a list of green industries and/or a list of high-demand occupations—initiatives will be too diffuse and success impossible to determine.

Definition and focus can be established by the state, or determined by local stakeholders within parameters prescribed by current labor market information. Targets might be identified as key occupations that directly respond to climate action plans, or occupations that support the development of new green industry. But remember, there is an enormous range of green industry—from clean tech to renewables and efficiency, to alternative fuels, and beyond. And cross-cutting these, research, manufacturing, construction, maintenance, and many other sectors. States need to determine their comparative advantage, focus their initiatives on clusters that make most sense for a particular region, and use that to guide tightly focused workforce development efforts, keeping in mind not only the economic, but the political dimensions of green jobs.

2 Use good data to drive green jobs initiatives

When targets are defined, the work is just beginning. Successful workforce and economic development demands detailed labor market analysis. States need to understand targeted green industries at the level of regional economies: what are the occupations, wage and benefit structures, and projected job growth? What are the education and skills requirements of these jobs? Further, they need to evaluate the employment and training delivery system at a regional level, identifying training gaps for identified jobs, curriculum development needs, and potential pathways in green careers.[159]

3 Plan up front to measure green jobs programs and make them better

Green job training is new. We need to figure out what works and what does not. And because demonstrated results build both economic success and political credibility, states need to build meaningful performance measures and a serious evaluation component into every green jobs initiative.

4 Employ energy standards as green job creation tools

The alphabet soup of standards discussed throughout this report is a key state policy lever in building green markets. RPS, EERS, LEED, and the like should be advanced—and, indeed, marketed politically—as economic development and job-creation strategies. They are fundamental to the orderly development of markets for renewable energy and energy efficiency industries. But they cannot single-handedly promote the development of regional green economies, or offer any guarantee of job quality. To nurture the creation of sustainable, high-road jobs, states need to pursue the sort of intentional growth strategies outlined below.

5 Maximize green and community benefits by requiring them

The prevailing state economic development strategy of firm-by-firm recruitment is well under way for green industries, and it seems unlikely that this hoary policy approach will go away anytime soon. But tax subsidies for new energy industries should be connected to prevailing wage/benefit, job creation, and other labor standards; linked to community benefit agreement provisions, like first-source hiring and funded apprenticeship programs; and contingent on transparency and reporting requirements, with clawback agreements if necessary.[160]

6 Promote green industry clusters

Beyond subsidies and smokestacks, a complete green jobs strategy will employ a broad range of economic development levers: venture capital funds, business incubators, and loans or grants targeting clean energy clusters. Clusters, as opposed to individual firms, will be the engine of 21st-century economic growth. States can help generate "virtuous circles" of innovation and growth by supporting networks of complementary and competing firms through investments in joint marketing, the commercialization and diffusion of new technologies, and workforce training partnerships.[161]

7 Save existing jobs and create new ones through green innovation

Not all green jobs are new jobs, per se. Current jobs can be saved, and new ones created, by helping industries retool for the new energy economy. Manufacturing conversion underlies a key aspiration of the new energy economy: revitalizing the industrial heartland in a manner both equitable and green, re-extending its promise of worker advancement while reversing its legacy of environmental degradation. Supply chains in declining industries can be realigned to feed green ones. The Renewable Energy Policy Project has convincingly documented the jobs potential for component part manufacturing, particularly in wind and solar, but no one is quite sure how to realize this potential.[162] States will need to partner with labor and local intermediaries to determine an appropriate role in this transformation.

8 Link green economic and workforce development

As local leaders step forward to champion green jobs and green economies, it is critical that states develop concrete plans to connect the two. Worker training programs for renewable energy and energy efficiency industries must be explicitly linked to economic development and job-creation programs. The danger is that communities will rush to create green workforce development programs, producing skilled workers for jobs that do not yet exist in sufficient number or permanence. A green career pathway has a job at the end of the road.

9 Construct green industry partnerships

Green jobs initiatives should create or expand on regional partnerships organized by industry sector.[163] Including management and labor, technical colleges, workforce investment boards, community-based organizations, and economic development agencies, such partnerships can undertake infrastructure and market analyses critical to green industry development and, at the level of regional labor markets, the sorts of workforce capacity analysis called for above. Indeed, green-sector partnerships will be critical in directing scarce training resources to efficiently narrow the substantial and growing gaps between workforce supply and workforce demand.

10 Integrate green jobs initiatives into existing workforce systems

Just as green jobs programs must take close note of the particular economic landscape they inhabit, it is essential that green-collar job training initiatives not develop as stand-alone, "boutique" programs divorced from broader workforce development efforts. The best way to prepare a green-collar workforce is to build on the full breadth of the state and local workforce development system through partnerships that leverage and align existing employment and training programs and resources toward green job ends.

11 Build greener career pathways

Working through the industry partnerships mentioned above, green workforce development should seek to develop career pathways—or add green skills to existing ones—whenever possible. Green jobs programs should support workers entering the industry with basic skills, but also serve workers at any stage in their career, helping them advance in pay and skills. This systemic framework is called career ladders or career pathways and, when fully realized, it allows workers with relatively low skills to combine work and learning in an accessible path upward to secure and sustainable employment.[164]

12 Extend green ladders to build real pathways out of poverty

When greening career pathways, states should focus explicitly, though not exclusively, on first steps and early bridges from basic skills to better paying jobs. Indeed, an anti-poverty emphasis should be central to any state green jobs initiative—one that includes the un- and under-employed, the poor who are dissociated from labor markets, and incumbent low-wage workers in need of advancement. This is a high-road approach, at once just and instrumental. Given the nation's persistent racial and economic inequities, some portion of limited funds should be targeted to those who need assistance the most.

POLICY INNOVATION IN ACTION: GREENING COMMUNITIES IN WASHINGTON STATE

Background

Over the last several years, Washington has been a leader in pioneering policies that drive investment in the clean energy economy. The state has a renewable electricity standard—passed by a voter initiative in 2006 (I-937)—mandating that by 2020, 15 percent of the state's electricity needs must be met with renewable energy and energy efficiency. The state also has a renewable fuels standard to increase the amount of biofuels and wean the state off foreign oil imports.

In 2007, Governor Christine Gregoire issued an executive order, later affirmed by the state legislature in SB 6001, creating goals to reduce Washington's global-warming pollution and increase the number of green jobs in the state to 25,000 by 2020. This important policy is in line with the governor's commitment to establish Washington as a leader in clean energy technology and ensure the state's workforce is trained and ready to meet this opportunity. The state now must create the infrastructure necessary to ensure that these goals will be met—including establishing a comprehensive program to meet the global-warming pollution reduction goals and workforce development strategies to put workers on pathways to high-wage, clean energy careers.

Washington's proposed linkage between climate protection and green jobs is an exemplary model that makes both policy and political sense

Fortunately, Washington is widely recognized as a national leader in designing and implementing workforce programs and holding those programs accountable via rigorous evaluation that tracks their outcomes over time.[165] Washington's State Workforce Training and Education Coordinating Board (SWTECB) serves as the state workforce investment board for the purposes of WIA, but it has far greater capacity and authority to lead the state's workforce efforts than virtually any other state workforce board in the country. One program it administers, Industry Skill Panels (ISPs), has become a model for state-supported sectoral workforce development strategy: ISPs (see *page 8*) are regional partnerships of education, business, labor, and local workforce investment boards tasked with identifying skills gaps within particular industry clusters and developing proactive solutions to benefit multiple employers within industries—not just a single employer, as with the more traditional economic development and business recruitment practice—that offer career ladder jobs and that drive the state's regional economies, such as healthcare, manufacturing, and aerospace. Energy is a targeted sector, but as of 2007 there had been no skill panels dedicated to clean energy.

In late 2007 the Washington State Apollo Alliance, Climate Solutions, Solid Ground, and The Workforce Alliance led an effort to develop a proposal that would link a green-collar jobs training initiative and greenhouse gas reduction strategies in a single piece of legislation. They engaged a broad range of stakeholders, including the Washington State Labor Council, the SWTECB, the Washington Workforce Association, and the State Board for Community and Technical Colleges, to help craft the green jobs component of the proposal.

The proposal that was ultimately developed by this collaboration was included by Governor Gregoire as a high-profile part of her governor-request legislation for 2008's short session in Olympia—in no small part because of the broad cross-section of stakeholders that developed and supported the proposal.

Key elements of the Washington State legislation

The legislation directs the Department of Ecology to reduce emissions of greenhouse gases consistent with the goals established in ESSB 6001. This effort will include: **Tracking and coordinating** work throughout the state to meet the pollution reduction goals • **Designing a market-based system** for limiting emissions at the lowest cost • **Designing principles** to consider when entering the state into a market-based, greenhouse gas reduction program • **Scientific review** of the pollution reduction goals established in SB 6001 to determine if the goals meet what scientists say is necessary to avoid the worst impacts of climate change; and • **Mandatory reporting** for major sources of global warming pollution.

Workforce development for green jobs

The green jobs provisions of the legislation include a number of components. The legislation:

Directs the Employment Security Department (ESD), in consultation with other states agencies, to analyze the labor market and projected job growth in green energy sectors, the current and projected recruitment and skill requirement of green industry employers, the wage and benefits ranges of jobs within green energy sectors, and the education and training requirements of entry-level and incumbent workers within those sectors. Based on this research, ESD will propose which industries should be considered high-demand green industries, based on current and projected job creation and their strategic importance to the development of the state's clean energy economy, and which jobs within those industries should be considered high-wage occupations and occupations that are part of career pathways to the same, based on family-sustaining wage and benefit ranges.

Directs the SWTECB to create and pilot Green Industry Skill Panels (GISPs), funds for which will be distributed on a competitive basis. Like regular ISPs, the GISPs will be organized around broad partnerships: business representatives from industry sectors related to renewable energy or energy efficiency; labor unions representing workers in those industries or labor affiliates administering joint apprenticeship programs or labor-management partnership programs that train workers for these industries; employer associations; educational institutions; and local workforce investment boards within the region that the GISP proposes to operate; and other key stakeholders. Any of these stakeholder organizations are eligible to receive the grant and serve as the intermediary that convenes and leads the GISP. Panel applicants will need to provide labor market and industry analysis that demonstrates high demand, or demand of strategic importance to the development of the state's clean energy economy, for high-wage occupations, or occupations that are part of career pathways to them, within the relevant industry sector. The panel will conduct ongoing labor market and industry analysis, in consultation with ESD and drawing on the findings of its research when available; plan strategies to meet the recruitment and training needs of the industry; and leverage and align other public and private funding sources.

Authorizes the creation of a Green-Collar Job Training Fund for the purpose of training workers for high-wage occupations, or occupations that are part of career pathways to the same, in high-demand industries related to clean energy. Funds will be appropriated beginning in 2009, administered by the State Board for Community and Technical Colleges (SBCTC) in consultation with the SWTECB, and informed by the labor market research of the ESD and the GISPs. The SBCTC will distribute grants from the fund on a competitive basis. Applicants eligible to receive these grants may be any organization or a partnership of organizations that has demonstrated expertise in implementing effective education and training programs that meet industry demand and recruiting and supporting to successful completion targeted populations of workers.

In awarding grants priority will be given to applicants that demonstrate the ability to: draw on the labor market analysis of ESD and the GISPs, utilize strategies developed by the GISPs, work in collaboration with a range of stakeholders, leverage and align other public and private resources, link basic education with skills training, involve employers and unions in the development and validation of career pathways, and integrate support services.

Target populations for use of the fund are: low-income adults and youth in families under 200 percent of the federal poverty guidelines or a locally defined self-sufficiency standard; entry-level or incumbent workers in high-demand green industries who are in, or are preparing for, high-wage occupations; or dislocated workers in declining industries who can be re-trained for high-wage occupations in high-demand green industries.

Governor Gregoire announced the legislation on January 14, 2008.[166] Two days later it was introduced in the Senate and House (SB 6516 and HB 2815) with 25 Senate sponsors and 33 House sponsors. On March 5 the Legislature approved the bill and sent it to the Governor for her signature. While there were many efforts to weaken the bill or defeat it outright—and changes made to the original legislation summarized above—the unprecedented linkage it establishes between climate protection and green jobs is a model that makes both policy and political sense, and serves as an instructive example for policymakers in other states to emulate.

CONCLUSION

America can and should unite behind a green vision, building a clean energy economy that lifts up all workers and communities. We have the requisite grit and ingenuity; we need only the political will and the civic wherewithal. Massive public and private investment—and the policy to drive it—will be needed to effectively green the nation. Innovating states can lead the way.

States need to think strategically about green economies, and not just assume that energy programs will generate jobs, or that they will be good jobs. Three imperatives should guide green jobs initiatives: be smart, build partnerships, deliver equity. Governors and legislatures who position their states and regions accordingly through green-collar job training alliances can attract and retain businesses, and will be in a prime position to reap the benefits of the new Green Jobs Act. And American workers will once again have the opportunity to build stronger futures—both green and prosperous—for their families and regions.

[1] See Harry J. Holzer & Robert I. Lerman, "America's Forgotten Middle-Skill Jobs: Education and Training Requirements in the Next Decade and Beyond" (The Workforce Alliance, November 2007).

[2] Howard Wial & Alec Friedhoff, "Bearing the Brunt: Manufacturing Job Loss in the Great Lakes Region, 1995-2005" (The Brookings Institution, July 2006).

[3] Center on Wisconsin Strategy "State of Working Wisconsin: Update 2007" (September 2007).

[4] We define poverty-wage jobs as those jobs paying a wage insufficient to lift even a full-time, year-round worker to the poverty line for a family of four with two children. In 2006 dollars, the "poverty wage" was $9.91 an hour or less; if someone worked full time for the entire year at this wage, their annual earnings would be $20,615.

[5] Working Poor Families Project, data generated by the Population Reference Bureau from American Community Survey (2005).

[6] Ibid.

[7] National Association of Manufacturers et al., "2005 Skills Gap Report—A Survey of the American Manufacturing Workforce," 2005.

[8] American Public Power Association, "Workforce Planning for Public Power Utilities: Ensuring Resources to Meet Projected Needs" (2005).

[9] Roger Bezdek, "Renewable Energy and Energy Efficiency: Economic Drivers for the 21st Century" (American Solar Energy Society, 2007). This and other job estimates, along with the analytic models that support them, are discussed elsewhere in this paper.

[10] We should not lose sight of the fact that there exist other green-collar jobs, which we do not examine in this report, that are not energy related but essential to improving environmental quality and health.

[11] It might be argued that a good job pays at least $14.87, or 1.5 times the poverty wage in 2006—just slightly higher than the median wage ($14.81). But by this standard, better than half of all U.S. jobs in 2006 were poverty- or low-wage. Some analysts set the bar still higher, at $17 per hour (the inflation-adjusted median male earnings in 1979), but tie the recent decline in good jobs less to wage stagnation than to deteriorating health and pension benefits. See John Schmitt, "The Good, the Bad, and the Ugly: Job Quality in the United States over the Three Most Recent Business Cycles" (Center for Economic and Policy Research, November 2007). Of course, the two are related, since low wage jobs are more likely to have poor benefit structures.

[12] See Pablo A. Mitnik & Matthew Zeidenberg, "From Bad To Good Jobs? An Analysis of the Prospects for Career Ladders in the Service Industries" (Center on Wisconsin Strategy, January 2007), and Elizabeth Lower-Basch, "Opportunity at Work: Improving Job Quality" (Center for Law and Social Policy, September 2007).

[13] Some of the best pathways work in recent years has emerged in Pennsylvania, Kentucky, Washington and Oregon. For these and other examples, see Amy-Ellen Duke, et al., "Wising Up: How Government Can Partner with Business to Increase Skills and Advance Low-Wage Workers" (Center for Law and Social Policy, April 2006); and Davis Jenkins & Christopher Spence, "The Career Pathways How-To Guide" (Workforce Strategy Center, October 2006).

[14] Wisconsin's RISE project is part of the Joyce Foundation's Shifting Gears Initiative, which supports Midwest states in reorganizing adult education for effective career pathways. See *http://www.joycefdn.org/Programs/Employment/ViewSubProgram.aspx?SubProgId=10*. More information on the Wisconsin partnership is available at *http://www.risepartnership.org/default.htm*.

[15] Much has been written about evolving state efforts to grow beyond low-wage economies by investing in workforce intermediaries. For a recent survey, see Heath Prince & Jerry Rubin, "Building New Labor Market Institutions: State Policies that Support Workforce Intermediaries" (Jobs for the Future, November 2006). David Jason Fisher's "Workforce Intermediaries: Powering Regional Economies in the New Century" (Center for an Urban Future, May 2005) offers case studies of three intermediaries funded by the Annie E. Casey Foundation, including the WRTP. And an excellent introduction from the labor side is Annette Bernhardt, et al., "Taking the High Road in Milwaukee: The Wisconsin Regional Training Partnership," in *Partnering for Change: Unions and Community Groups Build Coalitions for Economic Justice*, David Reynolds, ed. (New York: M.E.Sharpe, 2004).

[16] On this distinction and the use of sectors as workforce strategy, see Maureen Conway, et al., "Sectoral Strategies for Low-Income Workers: Lessons from the Field" (The Aspen Institute, Summer 2007).

[17] A recent report on "sustainable" industries identified the ten sectors that most merit focus for workforce development. The "clean/renewable energy" industry tops the list, with solar and wind as the leading sectors. See Brian Tell, "Overview of Sustainable Industries and the 'Clean" Ten: Recommended Sustainable Sectors to Target" (Corporation for a Skilled Workforce, 2007).

[18] Stuart Rosenfeld, "Cluster-Based Strategies for Growing State Economies" (National Governors Association and Council on Competitiveness, 2007). For a plain-English review of the academic literature on clusters, see Joseph Cortright, "Making Sense of Clusters: Regional Competitiveness and Economic Development" (The Brookings Institution Metropolitan Policy Program, March 2006).

[19] Patrick R. Burtis, et al., "Creating Cleantech Clusters: 2006 Update" (Environmental Entrepreneurs and Cleantech Venture Network, LLC, May 2006).

[20] This is critical in a competitive global economy where nimbleness is a primary virtue, and the region, whether multi-county or multi-state, is the optimal organizing unit for economic growth. For an excellent bird's eye view of regional economic development and related federal policy, see Mark Drabenstott, "Rethinking Federal Policy for Regional Economic Development," Economic Review, First Quarter (2006).

[21] As we discuss in the pertinent section below, a recent research makes a fairly damning case against biofuels. The future—for jobs and the environment—more likely lies in biotechnology and bioindustry, as well as developing forms of cellulosic ethanol.

[22] Nicole Hopper, et al., "Public and Institutional Markets for ESCO Services: Comparing Programs, Practices and Performance" (Lawrence Berkeley National Laboratory, 2005).

[23] See, e.g., Bill Prindle, et al., "The Twin Pillars of Sustainable Energy: Synergies between Energy Efficiency and Renewable Energy Technology and Policy" (American Council for an Energy-Efficient Economy, May 2007).

[24] Richard C. Diamond, "An Overview of the U.S. Building Stock" (Lawrence Berkeley National Laboratory, 2001).

[25] Nicole Hopper, et al., "A Survey of the U.S. ESCO Industry: Market Growth and Development from 2000-2006" (Lawrence Berkeley National Laboratory, May 2007).

[26] Julie Osborn, et al., "Assessing U.S. ESCO Industry: Results from the NAESCO Database Project" (Lawrence Berkeley National Laboratory, August 2002).

[27] Ibid.

[28] See NC State University-NC Solar Center, "Database of State Incentives for Renewables and Efficiency" (November 9, 2007): available at *http://www.dsireusa.org/*.

[29] U.S. Department of Energy, "Weatherization Assistance Program" (June 2007).

[30] Scott Pigg & Monica Nevius, "Energy and Housing in Wisconsin: A Study of Single-Family Owner-Occupied Homes" (Energy Center of Wisconsin, 2000); Scott Pigg & Andrew Price, "Energy and Rental Housing: A Wisconsin characterization study" (Energy Center of Wisconsin, 2005).

[31] Center on Wisconsin Strategy, "Milwaukee Retrofit: Capturing Home Energy Savings in Milwaukee" (2007).

[32] Jennifer Thorne, "Residential Retrofits: Directions in Market Transformation" (American Council for an Energy-Efficient Economy, 2003).

[33] For a more detailed discussion of local efforts and possibilities, see Kate Gordon & Jeremy Hays, "Local Green-Collar Jobs: Pathways Out of Poverty, Careers in the Clean Energy Economy" (Apollo Alliance, March 2008).

[34] City of New York "PlaNYC: A Greener, Greater New York" (2007). See also: Jack Dafoe, "Growing Green Collar Jobs: Energy Efficiency" (Urban Agenda and The NYC Apollo Alliance, December 2007).

[35] Cambridge Energy Alliance, "Cambridge Energy Alliance" (2007).

[36] William J. Clinton Foundation "Clinton Climate Initiative" (2007).

[37] Center on Wisconsin Strategy, "Milwaukee Energy Alliance" (2007).

[38] Joel Rogers examines both the challenges and opportunities in building energy retrofits, and deconstructs the E2 model upon which the Milwaukee project is based, in "Seizing the Opportunity (For Climate, Jobs, and Equity) In Building Energy Efficiency" (Center on Wisconsin Strategy, November 2007).

[39] Maggie Eldridge, et al., "The State Energy Efficiency Scorecard for 2006" (American Council for an Energy-Efficient Economy, June 2007).

[40] David B. Goldstein, Statement for the Record, House Committee on Ways and Means, April 24, 2007.

[41] Talking about significant public and private investment, however, means talking about energy projects that can be brought to scale, and the advantage here clearly belongs to urban areas over rural.

[42] $1.3 billion or 72%. See Prindle, et al., "Twin Pillars of Sustainable Energy."

[43] Ibid. Goldstein makes a related argument in his April 2007 testimony.

[44] Eldridge, et al., "State Energy Efficiency Scorecard;" Prindle, et al., "Twin Pillars of Sustainable Energy." For limits to PBFs, also described as System Benefit Charges, and related state legislation, see Cheryl Harrington, et al., "Energy Efficiency Policy Toolkit" (The Regulatory Assistance Project, January 2007).

[45] Steve Nadel explains EERS policies, and their interaction with PBFs, in an excellent ACEEE report on market mechanisms that promote efficiency in power generation, transmission and use: "Energy Efficiency Resource Standards: Experience and Recommendations" (American Council for an Energy-Efficient Economy, February 2006).

[46] Prindle, et al., "Twin Pillars of Sustainable Energy."

[47] For an overview of such policies, including links to related articles, model contracts and legislation, see *www.goodjobsfirst.org*. On their application in a green context, see Joanna Lee, et al., "Green Cities, Green Jobs" (Los Angeles: CIPHER/SCOPE, May 2007).

[48] Harrington, et al., "Energy Efficiency Policy Toolkit."

[49] The Apollo Alliance & Center on Wisconsin Strategy, "New Energy for States: Energy-Saving Policies for Governors and Legislators" (2006).

[50] Eldridge, et al., "State Energy Efficiency Scorecard."

[51] See David B. Goldstein, Statement for the Record, House Committee on Ways and Means, April 24, 2007.

[52] Christopher Hall, personal communication with COWS (June 7, 2007).

[53] Bezdek, "Renewable Energy and Energy Efficiency;" R. Neal Elliott, et al., "Potential for Energy Efficiency and Renewable Energy to Meet Florida's Growing Energy Demands" (American Council for an Energy-Efficient Economy, June 2007). Bezdek casts a much broader EE net, including direct and indirect jobs in both public and private sectors, with the largest concentrations in manufacturing, followed by recycling and construction. Whether one agrees with this counting method or not, Bezdek's discussion of selection criteria highlights many of the trickier aspects of analyzing green jobs data.

[54] Pigg & Nevius, "Energy and Housing in Wisconsin;" Pigg & Price, "Energy and Rental Housing."

[55] The Apollo Alliance, "New Energy for America" (2004). The COWS-Powell model provides estimates of the labor content in various typical efficiency retrofit scenarios. The Wisconsin example is based on a survey of houses that determined frequency of opportunity for installing efficiency measures that paid for themselves in energy savings in less than 10 years: Pigg & Nevius, "Energy and Housing in Wisconsin." In this scenario, for every $1 million invested, $542,000 would go for insulation, $150,000 for mechanicals, $110,000 for upgraded appliances, $108,000 for leak sealing, and $90,000 for replacing light bulbs. To determine on-site labor content of such a project, materials, profit, and overhead are backed out, and typical wage, benefit, and tax rates applied.

[56] The sheer variety of skill levels needed by auditors for different types of building projects, and the work underway to codifying them, is addressed by NYC Apollo in Dafoe, "Growing Green Collar Jobs."

[57] 2007 survey data from BW Research, commissioned by Los Angeles Trade-Technical College's Regional Economic Development Institute in conjunction with the Los Angeles Infrastructure and Sustainability Jobs Collaborative.

[58] WRTP is described above in the Introduction. For more information on the BIG STEP apprenticeship preparation program, see *http://www.wrtp.org/About_Us.html*.

[59] Based in part on materials written by Marcy Drummond, LATTC, and Jennifer Ito, SCOPE, as well as interviews with Drummond and Don Davis, ETI.

[60] Energy Information Administration, "Electric Power Annual" (October 2007).

[61] Charles F. Kutscher, ed., "Tackling Climate Change in the U.S.: Potential Carbon Emissions Reductions from Energy Efficiency and Renewable Energy by 2030" (American Solar Energy Society, January 2007).

[62] The cost of utility-scale wind dropped dramatically over the last two decades, from nearly 30 cents per kilowatt-hour in the 1980s to around 5 cents/kWh today, thanks to advances in the scale and technology. A Wind Task Force convened by the Western Governors' Association projects that a wind—once the industry is brought to scale by the sorts of policies described elsewhere in this paper —"may be the lowest cost generating resource in West when considering total costs including environmental impacts." Western Governors' Association, "Clean and Diversified Energy Initiative: Wind Task Force Report" (March 2006). For a detailed cost-benefit assessment of wind power, see Ryan Wiser & Mark Bolinger, "Annual Report on U.S. Wind Power Installation, Cost, and Performance Trends: 2006" (U.S. Department of Energy, May 2007).

[63] Wiser & Bolinger, "Annual Report on U.S. Wind Power."

[64] Global Wind Energy Council, "Global Wind: 2006 Report" (2006).

[65] Kari M. Walworth, "The Wind Energy Industry," Michigan Wind Energy Manufacturing Group Meeting (Thompsonville, MI, 2007).

[66] American Wind Energy Association, "2007 Market Report" (January 2008).

[67] European Wind Energy Association, accessed 2/1/08, *http://www.ewea.org/index.php?id=60&no_cache=1&tx_ttnews[tt_news]=574&tx_ttnews[backPid]=1&cHash=e5d463e5a2* .

[68] See Larry Flowers, "Wind Energy Update" (National Research Energy Laboratory, Wind Powering America, 2007). State wind resource maps are available at *http://www.eere.energy.gov/windandhydro/windpoweringamerica/wind_maps.asp*.

[69] AWEA offers clickable maps, linked to detailed state wind project information, at: *http://www.awea.org/projects/*.

[70] American Wind Energy Association, "2007 Market Report." For full description of earlier trends and state rankings, see Ryan Wiser & Mark Bolinger, "Annual Report on US Wind Installation, Cost, and Performance Trends: 2006" (U.S. Department of Energy, 2007).

[71] Ryan Wiser, et al., "Using the Federal Production Tax Credit to Build a Durable Market for Wind Power in the United States" (Lawrence Berkeley National Laboratory, November 2007).

[72] Ryan Wiser, et al., "Renewables Portfolio Standards: A Factual Introduction to Experience from the United States" (Lawrence Berkeley National Laboratory, April 2007). Wiser surveys state policy design and implementation, together with the wide-ranging stakeholder estimates of RPS impact on market development.

[73] The House bill required utilities to produce 15% of their electricity from renewable sources by 2020, part of which could be met through energy efficiency savings. See Bill Prindle, et al., "Assessment of the House Renewable Electricity Standard and Expanded Clean Energy Scenarios" (American Council for an Energy-Efficient Economy, December 2007).

[74] State of Iowa Office of the Governor, "Culver Challenges 2008 Presidential Candidates and Congress to Support a National Renewable Portfolio Standard" (Des Moines IA, Nov. 6, 2007).

[75] Joanna Lewis & Ryan Wiser, "Fostering a Renewable Energy Technology Industry: An International Comparison of Wind Industry Policy Support Mechanisms" (Lawrence Berkeley National Laboratory, November 2005).

[76] John Farrell, "Minnesota Feed-In Tariff Could Lower Cost, Boost Renewables and Expand Local Ownership" (Institute for Local Self-Reliance, January 2008).

[77] As America's wind infrastructure advances, it is becoming easier for individuals and communities to participate in wind projects for either self-consumption or sale. As of March 2007, community wind projects accounted for just 400MW of the nation's total wind power. Promising community ownership models include behind-the-meter wind projects at public schools and limited liability corporations established by teams of local farmers and investors. For more information, see *http://www.windustry.org*. An excellent survey of related policy initiatives is Mark Bolinger, "A Survey of State Support for Community Wind Power Development" (Lawrence Berkeley National Laboratory and The Clean Energy States Alliance, March 2004). See also: Jessica A. Shoemaker & Christy Anderson Brekken, "Community Wind: A Review of Select State and Federal Policy Incentives" (Farmers Legal Action Group, August 2006).

[78] The original REPP roadmap is George Sterzinger & Matt Svrcek, "Wind Turbine Development: Location of Manufacturing Activity" (Renewable Energy Policy Project, September 2004). This national analysis was followed by a series of detailed state reports, including Wisconsin, Ohio, Pennsylvania and Massachusetts, in which Sterzinger and his colleagues expand the wind model to include job estimates for component manufacturing in other renewable energy technologies. The Blue-Green Alliance is working with REPP to reproduce the state studies in accessible 4-page summaries, available at *http://www.bluegreenalliance.org*.

[79] REPP estimates that every 1000 MW of wind power has the potential to support 3,000 jobs in manufacturing, 700 in installation, and 600 in operations and maintenance.

[80] George Sterzinger & Jerry Stevens, "Component Manufacturing: Massachusetts's Future in the Renewable Energy Industry" (Renewable Energy Policy Project, August 2007).

[81] Turbine shipping alone created 5-10% of wind project costs in 2003, and transportation costs are rising. See Lewis & Wiser, "Fostering a Renewable Energy Technology Industry."

[82] For market share, see American Wind Energy Association, "2007 Market Report."

[83] European Wind Energy Association "Supply Chain: The race to meet demand," Wind Directions (January/February 2007).

[84] George Sterzinger & Matt Svrcek, "Component Manufacturing: Massachusetts's Future in the Renewable Energy Industry."

[85] An unrequited spike in turbine demand brings financial challenges to industry expansion as costs escalate, either because, as some observers suggest, shortages provide opportunities for

profiteering, or because inputs are increasingly dear as emerging markets snap up the raw materials critical to turbine production—steel for towers and gearboxes, copper for generators, and carbon for blades. Certainly, if American manufacturing can get out in front of demand, a virtuous circle will ensue as turbine prices drop, encouraging further wind installation.

[86] For details, see European Wind Energy Association "Supply Chain."

[87] For a fresh take on the issue of re-industrialization in the clean energy economy, see: Susan Helper, "Renewing U.S. Manufacturing: Promoting a High-Road Strategy" (Economic Policy Institute, 2008); and George Sterzinger, "Energizing Prosperity: Renewable Energy and Re-Industrialization" (Economic Policy Institute, 2008).

[88] To position the region to take advantage of the emerging market for renewable energy, REDDI plans to broker an intentional, data-driven economic and workforce development strategy among industries, intermediaries and government. Their approach includes cluster and regional innovation analyses, early steps of which are described here.

[89] For a wide-ranging discussion of policy strategies related to manufacturing job creation in Pennsylvania's renewable energy sector, see Steve Herzenberg, "Invest in Good Jobs Through Economic Development for the 21st Century, Background Report to Prescription for Prosperity: An Economic Agenda for Pennsylvania's Future" (Keystone Research Center, 2007).

[90] Avrum D. Lank, "From military might to wind power: Former submarine manufacturing plant now turns out windmill towers," Journal Sentinel (Milwaukee: Nov. 20, 2007).

[91] Sterzinger & Svrcek, "Wind Turbine Development."

[92] American Wind Energy Association, "Wind Power Outlook 2007."

[93] State of Illinois Office of the Governor, "Governor Blagojevich announces almost $2 million investment package to bring wind tower manufacturer to Dewitt County" (January 31, 2007). The package included Economic Development for a Growing Economy (EDGE) corporate income tax credits over ten years based on job creation; Employer Training Investment Program (ETIP) job training funds to help the company enhance the skills of its workforce; and a wind energy grant provided through Department of Commerce and Economic Opportunity's Renewable Energy Resource Program.

[94] Gregory R. Norfleet, "Acciona Dedicates West Branch Plant," The West Branch Times Online (January 23, 2008). Governor Chet Culver has made renewable energy an economic development priority, and Iowas's economic and workforce development agencies worked together at state and local levels to attract wind manufacturing.

[95] Mike Boyer, "Windmill parts in big demand," Cincinnati Enquirer (January 17, 2006). Cast-Fab is one of many Ohio suppliers riding the green wave. See Erin Bowser, et al., "Energizing Ohio's Economy: Creating Jobs and Reducing Pollution with Wind Power" (Environment Ohio Research and Policy Center, August 2007).

[96] Jim Fuquay, "Wind Power Generates Jobs Across Texas," Star-Telegram.com (Oct. 9, 2007).

[97] Ibid.

[98] John Funk, "Strickland Tours Advance Manufacturing To See Environment-Economy Link," The Plain Dealer (October 25, 2007). Governor Ted Strickland, a staunch advocate of renewable portfolio standards, has championed the wind industry in Ohio, to good result.

[99] Daniel M. Kammen, et al., "Putting Renewables to Work: How Many Jobs Can the Clean Energy Industry Generate?" (RAEL: University of California, Berkeley April 2004/Revised December 2006).

[100] Most job creation models for wind and other renewables rely on some form of input-output model. Such models can be extremely useful, if used correctly, but projections are only as good as their inputs, and these can be notoriously difficult to get right especially in emerging industries. Much of the literature on these shortcomings is reviewed in the biofuels section below. In the wind sector, the main model is the JEDI model, available at *http://www.eere.energy.gov/windandhydro/windpoweringamerica/filter_detail.asp?itemid=707*. For an example of the model in action and a description of the methodology, see Nikhil Mongha, et al., "An Analysis of the Economic Impact on Box Elder County, Utah, from the Development of Wind Power Plants" (USDOE August 2006). An example of such models used thoughtfully and to good effect is Bowser, et al., "Energizing Ohio's Economy." See also: Robert Scott & Brian Siu, "Clean Energy Development for a Growing Economy: Employment Impacts of the Clean Edge" (Apollo Alliance, 2006).

[101] Recent bold projections offered by the American Solar Energy Society include all of these sorts of jobs, calculated for a variety of investment and expansion scenarios. See Bezdek, "Rernewable Energy and Energy Efficiency."

[102] George Sterzinger & Matt Svrcek, "Component Manufacturing: Massachusetts's Future in the Renewable Energy Industry."

[103] Again, much depends on local labor markets. When Siemens converted a closed trailer manufacturing plant to a wind turbine facility in Fort Madison, Iowa, 2600 people showed up at a job fair to apply for 200 jobs. Mason City Globe Gazette (December 11, 2006).

[104] The Windsmith Certificate offered by Minnesota West Community and Technical College, for example, requires six courses: four in electrical circuitry and hydraulics, one on OSHA, and one in wind energy fundamentals. A similar spread holds true for more intensive training, like the Wind Energy Mechanic Diploma. See *http://www.mnwest.edu/programs/program-type/certificate/windsmith/*.

[105] Based on interviews with Susan Wolff, CGCC, and Martin Miller, MCCOG, as well as materials developed by CGCC and MCCOG.

[106] In previous years, MCCOG, the region's service provider for WIA programs, might have been able to cover the costs of the pilot, but its WIA allocation had been cut by almost half between fiscal years 2001 and 2006. With no financial support, CGCC nevertheless proceeded with implementation of the non-credit pilot program, using funds from two other program areas to develop and offer the pilot and develop the credit programs. The pilot bought time to develop the curriculum for a one-year credit certificate and a two-year AAS degree in Renewable Energy and to secure college and state approval for the program.

[107] The course offerings, and other information about the RET program, can be found at: *http://www.cgcc.cc.or.us/Academics/RenewableEnergyTechnology.cfm*.

[108] The wind industry has begun to make modest contributions to training programs, but will need to ramp up commitments if cash-strapped states are to develop effective career pathways. In October 2007, Scottish windpower company PPM Energy, which earlier in the year donated $100,000 to the Iowa Lakes Community College wind technician program (IA), announced a grant of $50,000 a year for three years to support faculty for the CGCC renewable energy training program.

[109] Based on interviews with Susan Whisler, Southern Alleghenies Workforce Investment Board , Debra Balog, JARI, Dennis O'Leary, CareerLink, and Rob Witherell, USW, as well as materials written by Marco Trbovich, USW.

[110] It should be noted that the Commonwealth as a whole learned similar lessons from the state's economic transformation in the 80s and 90s. Pennsylvania's Department of Labor and Industry (DLI), the administrator of the state's rapid response program, places 'rapid response coordinators' throughout the state. In effect, these coordinators are viewed and used as community organizers and are responsible for mobilizing communities in their region and aligning programs and resources in response to layoffs. On a related note, DLI also invests a portion of its federal WIA allocation in what is perhaps the nation's most comprehensive early warning and layoff aversion system.

[111] One of Pennsylvania's strategic advantages as a site for wind turbine manufacturing is its extensive system of rivers and barges for shipping goods. What was critical to the commonwealth's economic growth in the 19th century may become so again in the 21st.

[112] Worldwatch Institute, "Biofuels for Transporation: Global Potential and Implications for Sustainable Agriculture and Energy in the 21st Century" (2006).

[113] 10% ethanol blends (E10) can be used in any gas-powered car, and are used around the country, but carbon offsets are minimal. E10 was used as a replacement for MTBE, an earlier additive found to be a carcinogen. Blends higher than 10% ethanol require flex-fuel vehicles.

[114] U.S. Energy Information Administration, "Annual Energy Review 2006" (June 2007).

[115] European biodiesel imports, particularly those derived from palm oil, are generating food and environmental crises in producer countries. And recent research suggests that the net carbon balance of such biofuels may turn out to be negative. See Joseph Fargione, et al., "Land Clearing and the Biofuel Carbon Debt," Science (February 2008).

[116] Data is from the Sierra Club's September 2007 Biofuel Chart, which provides a useful thumbnail comparison of transportation fuels, available online at *http://www.sierraclub.org/sierra/200709/biofuels%20chart.pdf*.

[117] The Center for Agricultural and Rural Development at Iowa State University maintains a database of ethanol and biodiesel plants by state, including company, feedstock and capacity. See: *http://www.card.iastate.edu/research/bio/tools/*

[118] In 2006, the U.S. consumed 130 million barrels of ethanol; 93 were produced domestically. U.S. Energy Information Administration, "Annual Energy Review 2006."

[119] All of which begs the question, again, of definition: is a job in a coal-fired biorefinery a green job? We have a good idea of what job quality should be, but it is harder to define environmental quality thresholds for green jobs. It is not in the scope of this paper to do so. But the question will continue to harry domestic and international policy discussions, and, if not settled, can render meaningless—by either breadth or exclusivity—the very concept of a "green. job."

[120] The Natural Resources Defense Council is a clear strong voice for advancing biofuels in ecologically sound ways. See Natural Resources Defense Council, "Getting Biofuels Right: Eight Steps for Reaping Real Environmental Benefits from Biofuels" (May 2007). Beyond a greener refiner's fire, the real solution, of course, is to use less carbon-intensive feedstocks than corn.

[121] Based on fossil energy balance data from Worldwatch Institute, "Biofuels for Transportation."

[122] See, e.g., Fargione, et al., "Land Clearing and the Biofuel Carbon Debt."; Timothy Searchinger, et al., "Use of U.S. Croplands for Biofuels Increases Greenhouse Gases Through Emissions from Land Use Change," Science (February 2008).

[123] James Kanter, "Europe May Ban Imports of Some Biofuel Crops," The New York Times (January 15, 2008).

[124] National Resources Defense Council, " Move Over, Gasoline: Here Come Biofuels" (November 27, 2007).

[125] In 2007 USDOE invested more than $1 billion in biofuels research and development, including $385 million to develop six commercial-scale cellulosic ethanol plants.

[126] As of November 2007, the Midwest claimed 115 of 131 existing plants and 65 out of 82 facilities under construction. MGA estimates that the region will continue to produce some 88% of US ethanol once new plants come online. See Midwestern Governors Association, "Midwest Energy Picture at a Glance" (2007).

[127] What's more, the challenge of efficiently aggregating and transporting feedstock to production facilities has been solved, in many cases, by generations of middle-American farmer cooperatives. Robert D. Perlack, et al., "Biomass as Feedstock for a Bioenergy and Bioproducts Industry: The Technical Feasibility of a Billion-Ton Annual Supply" (USDOE and USDA, April 2005).

[128] This may change as states step in to help manage the process. Part of the mission of Wisconsin's Office on Energy Independence, described in the policy section that follows, is to help the state become "a national leader in groundbreaking research that will make alternative energies more affordable and create new, good-paying jobs in Wisconsin." Whether the two aims—research leadership and job creation—will be directly linked in practice remains to be seen.

[129] USDA Economic Research Service, "Rural America At A Glance," Economic Information Bulletin No. 31 (2007).

[130] One of the best recent state-based studies of the bioeconomy—its economic opportunities and technical features as well as the sorts of policies that can best promote it—is a three part Wisconsin paper prepared for the Governor's Consortium on Biobased Industry: Kate Gordon, et al., "Wisconsin's Biobased Industry: Opportunities and Advantages Study" (Energy Center of Wisconsin, May 2006). The report not only contains a wealth of economic development information for states, but provides a model for the sort of studies they can and should produce to systematically guide rational and integrated economic and workforce development strategies for the new energy economy.

[131] The EISA mandates that 36 billion gallons of renewable fuel be used annually by 2022, and specifically states that 21 billion gallons of that goal must come from advanced biofuels, including cellulosic ethanol. A comprehensive database of current state and federal incentives designed to promote biofuels is available at *http://www.eere.energy.gov/afdc/incentives_laws.html*.

[132] The full platform is available online at *http://www.midwesterngovernors.org/resolutions/Platform.pdf*.

[133] A good source on local ownership in the clean energy economy is David Morris at the Institute on Local Self-Reliance. See, e.g., David Morris, "Energizing Rural America: Local Ownership of Renewable Energy Production Is the Key" (Center for American Progress, January 2007). See also: Midwest Ag Energy Network, "Locally-Owned Ag Energy: An American Energy Solution" (The Minnesota Project, July 2006).

[134] Governor Jim Doyle "Executive Order #192 Relating to the Creation of the Office of Energy Independence" (Madison, WI: Office of the Governor, April 7, 2007). Visit OEI online at *http://power.wisconsin.gov/index.asp?locid=131*.

[135] Gordon, et al., "Wisconsin's Biobased Industry."

[136] Institute for Agriculture and Trade Policy, "Assessing the Bioeconomy: October 2006 Survey Results" (October 2006).

[137] John Farrell, "Wind and Ethanol: Economies and Diseconomies of Scale" (New Rules Project, July 2007); Dave Swenson & Liesl Eathington, "Determining the Regional Economic Values of Ethanol Production in Iowa Considering Different Levels of Local Investment" (Iowa State University, Department of Economics, July 2006.

[138] T. Randall Fortenbery, "Biodiesel Feasibility Study: An Evaluation of Biodiesel Feasibility in Wisconsin" (University of Wisconsin-Madison, Department of Agricultural and Applied Economics, March 2005).

[139] For a summary and and clear-eyed analysis of common job-creation claims in the ethanol industry, see Dave Swenson, "Input-Outrageous: The Economic Impacts of Modern Biofuels Production" (Iowa State University: Department of Economics, 2006). Randall Fortenbery at the University of Wisconsin developed an independent, county-based impact model for bio-diesel in Wisconsin, and came up with similar figures (personal communication with COWS, November 1, 2007).

[140] Swenson & Eathington, "Determining the Regional Economic Values of Ethanol Production." Swenson recently cautioned about making too much of the local ownership bonus in determining appropriate levels of public investment in the industry as a whole. See Dave Swenson, "The Economic Impact of Ethanol Production in Iowa" (Iowa State University Department of Economics, January 2008).

[141] Rick Barrett, "Ethanol ties up metal fabricators," Milwaukee Journal Sentinel (January 1, 2006). Similar stories of metal fabricators firing up to produce renewable technologies can be found around the country; in Portland, Oregon, for example, traditional machine shops are turning out buoys to capture wave energy. Bioindustry as a whole, more than simply the biofuels sector, may prove to be a boon for domestic manufacturing. It will be up to states to figure out ways to help regional industries take advantage of these new opportunities.

[142] We are concerned here with the workers directly involved in biofuels production and transportation at local plants. The industry as a whole describes itself in much broader terms, claiming that nearly three-quarters of employees have a bachelor's degree or higher. "2006 U.S. Ethanol Industry Salary Survey Report," Ethanol Producer Magazine (December 2006).

[143] See *http://www.iabiodevelopment.com/*. IBD embodies the goals of a related project led by Indian Hills Community College: the federally-funded Biotechnology/Bioprocessing Workforce Development Model. This statewide demonstration (2004-2007) was funded through the Biotech branch of DOL's High-Growth Job Training Initiative; related Energy sector projects are described below in the Federal Resources section. Renewable fuels are not a typical piece of biotech training programs (see Venn diagram in introduction).

[144] The same dynamic is at play in Minnesota, where Minnesota West Technical and Community College developed an early Renewable Energy Base Certificate program in conjunction with the state's ethanol producers, and is now working to deliver its Renewable Energy Technology training program online.

[145] Wendy L. Parker, et al., "Costs and Benefits of Practitioner Certification or Licensure for the Solar Industry" (IEEE Photovoltaic Specialists Conference, 2002).

[146] Jane M. Weissman, "Defining the Workforce Development Framework & Labor Market Needs for the Renewable Energy Industries" (Interstate Renewable Energy Council, 2004).

[147] Based on interviews with Carolyn Cochran, ICCC, and Larry Breeding, WIE, as well as data provided by Cochran.

[148] Between 2002-2006, the Bush Administration proposed 28% cumulative cuts in DOL employment and training programs, and 72% for Education Department adult and vocational education programs. The Workforce Alliance, "Not Ready to Compete: Declining federal investment in a skilled, competitive U.S. workforce, 2002-2007" (2007).

[149] The other sectors are Advanced Manufacturing, Aerospace, Automotive, Biotechnology, Construction, Financial Services, Geospatial Technology, Health Care, Homeland Security, Hospitality, Information Technology, Retail, and Transportation. See *http://www.doleta.gov/BRG/JobTrainInitiative/*.

[150] While some grants made through the biotech category could cover biofuels job training, they are primarily targeted at the biotech (see n.142).

[151] See *http://www.doleta.gov/BRG/CBJTGrants/*.

[152] The funding streams for these sorts of DOL grants, however, are frustratingly disconnected from the nation's workforce development infrastructure, and often redirect resources destined for—and urgently needed by—existing programs.

[153] See *http://www.doleta.gov/WIRED/*.

[154] To build synergies among these grantees, NREL hosted a WIRED Institute on Alternative Energy in May 2007. A map of all 39 WIRED regions, with links to program details for each, can be found at *http://www.doleta.gov/wired/regions/*. DOLETA also publishes links to individual WIRED plans at *http://www.doleta.gov/usworkforce/WIA/planstatus.cfm*.

[155] Mark Drabenstott, "A Review of the Federal Role in Regional Economic Development" (Center for the Study of Rural America May 2005).

[156] The Bush Administration's FY2009 budget calls for a 27% cut in DOE/EERE funding.

[157] There appears to have been a drafting error in preparation of the final bill, such that this targeting now refers to "...families with income of less than 200 percent of the sufficiency standard."

[158] Indeed, the principles align with those in a companion report on local green jobs initiatives produced by the Apollo Alliance and co-authored by COWS, Green for All, and the Center for American Progress: Gordon & Hays, "Local Green-Collar Jobs."

[159] A number of states have already begun this work, though none as yet has produced a comprehensive overview. The Energy Policy Office in Washington State's Department of Community, Trade and Economic Development conducted an initial review of renewable energy and energy efficiency industries in 1998, and produced a 2005 follow-up survey of markets, firms, jobs and wages: Catherine Suter, "A 2005 Look at the Renewable Energy, Energy Efficiency, and Smart Energy Industries in Washington State" (Energy Policy Office, Washington State Department of Community, Trade and Economic Development, 2005). In 2007 they compiled a statewide directory of RE and EE companies. Good work is being done at a local level too. Los Angeles stakeholders, for example, have generated a number of excellent studies, including Lee, et al., "Green Cities, Green Jobs;" and Patrick Burns & Daniel Flaming, "Jobs in L.A.'s Green Technology Sector" (Economic Roundable, 2006).

[160] For an overview of these policies, including links to model contracts and legislation, see *www.goodjobsfirst.org*. CBAs are legally enforceable contracts between community groups and project developers. See Julian Gross, et al., "Community Benefits Agreements: Making Development Projects Accountable" (Good Jobs First and the California Partnership for Working Families, 2005). This is an excellent opportunity for states to start improving subsidy disclosure, revealing both past performance on environmental and workplace issues as well as current outcomes for job creation and job quality. Good Jobs First just released its state disclosure scorecard along with related policy recommendations: Philip Mattera, et al., "The State of State Disclosure: An Evaluation of Online Public Information About Economic Development Subsidies, Procurement Contracts and Lobbying Activities" (November 2007). On attaching "green strings"—e.g., energy efficiency and "smart growth" requirements—to existing tax subsidies for any industry, see Greg LeRoy, *The Great American Jobs Scam* (Berrett-Koehler Publishers, 2005).

[161] For an excellent proposal outlining this strategy in Pennsylvania, see: Herzenberg, "Invest in Good Jobs." More information on cluster development is included in the glossary and related notes at the start of this paper. A useful survey of the sorts of policies that best support green venture capital is Burtis, et al., "Creating Cleantech Clusters."

[162] The most recent of the Renewable Energy Policy Project studies is Sterzinger & Stevens, "Component Manufacturing: Massachusetts." The REPP reports are now being distributed in accessible 2-page state summaries by the Blue-Green Alliance, a partnership of the United Steel Workers and the Sierra Club. See *http://www.sierraclub.org/energy/bluegreenjobs/*. For a discussion of component manufacturing and additional resources, see the wind industry section; it is not within the scope of this report to discuss the potential for saving both energy and jobs through green manufacturing processes.

[163] Highlights from the voluminous literature on industry partnerships can be found in the glossary entry for workforce intermediaries in the Introduction to this report. For a short policy brief summarizing regional strategies for assessing and capitalizing on emerging green industries, see Paul Ong & Varisa Patraporn, "The Economic Development Potential of the Green Sector" (The Ralph and Goldy Lewis Center for Regional Policy Studies, UCLA School of Public Affairs, 2006).

[164] For details on career ladder approaches, see the glossary and related notes in the Introduction. Examples of current pathways practice within green jobs initiatives can be found in the case studies that conclude the wind and efficiency sections of this report.

[165] The SWTECB publishes a report every two years that evaluates the outcomes of all of the state's major workforce education programs. The most recent report, Workforce Training Results 2006, is available at *http:/www.wtb.wa.gov/Documents/wtr06.pdf*.

[166] A headline in the following day's Seattle Post-Intelligencer framed the legislation exactly as its crafters had hoped, in a clear departure from more typical 'jobs vs. the environment' framing: "Gov. Gregoire announces bill to fight climate change, create jobs." (Seattle Post-Intelligencer, January 15, 2008).

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COWS

Center on Wisconsin Strategy (COWS), based at the University of Wisconsin, is a national policy center and field laboratory for high-road economic development—a competitive market economy of shared prosperity, environmental sustainability, and capable democratic government. COWS' work is collaborative, experimental, and evidence-driven. Working with business, government, labor, and communities, we try out new ideas, test their effectiveness, and disseminate those with promise. We believe that the best way to predict the future is to start making it, particularly in our states and metro regions.

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THE WORKFORCE ALLIANCE

The Workforce Alliance (TWA) is a national coalition of community-based organizations, community colleges, unions, business leaders, and local officials advocating for public policies that invest in the skills of America's workers so they can better support their families and help American businesses better compete in today's economy. TWA pursues this mission by seeking reforms of federal and state policies that could expand access to education and training for U.S. workers at all levels of the labor market; engaging larger political debates that address the need for a greater national investment in America's workers as part of any 21st century economic policy; and empowering local stakeholders—including workforce development practitioners—to effectively weigh in on these larger policy and political debates.

For more information visit www.workforcealliance.org

THE APOLLO ALLIANCE

The Apollo Alliance is a coalition of business, labor, environmental, and community leaders working to catalyze a clean energy revolution in America to reduce our nation's dependence on foreign oil, cut the carbon emissions that are destabilizing our climate, and expand opportunities for American businesses and workers. Inspired by the vision and technological achievements of the Apollo space program, we promote policies and initiatives to speed investment in clean energy technology and energy efficiency; put millions of Americans to work in a new generation of well-paid, green collar jobs; and make America a global leader in clean energy products and services.

For more information visit www.apolloalliance.org

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