

CLEAN TECH JOB TRENDS 2010

BY RON PERNICK
AND CLINT WILDER
WITH TREVOR WINNIE

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THE CLEAN-TECH MARKET AUTHORITY

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INTRODUCTION:

By almost all measures, the global economy continues to be in historically dire shape – and some still fear a double-dip recession. This economic malaise doesn't bode well for those seeking decent, high-paying jobs. Overall unemployment rates in the United States and Europe hover around 10 percent, with rates much higher if you count those who have stopped looking for jobs altogether. Globally, the youth unemployment rate (defined as active youth between the ages of 15 and 24) is at a record high, according to the United Nations International Labour Organization, climbing from 11.9 percent in 2007 to 13 percent in 2009. At the same time, many regional and national governments continue to experience massive budget shortfalls and some are taking drastic actions with regards to public staffing. California Governor Arnold Schwarzenegger, for example, facing an unprecedented \$19 billion budget shortfall in his state, started furloughing public workers earlier this year, forcing mandatory, unpaid days off for many public employees in a battle that has landed the state in court. These are just some of the devastating realities coming out of The Great Recession.

Against this backdrop, clean energy continues to fuel the plans of many cities, states, nations, investors, and companies as they look for the next wave of innovation and growth. And on many counts, the clean-energy sector is delivering new job and economic opportunities, as it moves from a once-marginalized niche to an increasingly cost-competitive, mainstream offering. There are many challenges facing the sector, but clean energy and more broadly, clean tech, offer some of the largest growth opportunities on the global economic horizon. As we highlight in this report, green jobs can pay well and span the spectrum from “green-collar” trade jobs to Ph.D.-level engineers.

Green-job naysayers often question the validity of green jobs, stating that there's no clear definition for what constitutes a green job and that any new jobs in clean tech simply displace jobs from other sectors, creating no new net jobs. But clean-tech jobs are not amorphous as these critics claim, and instead represent some of the most dynamic sectors in the technology landscape, including electric vehicles (cars, trucks, and rail), energy storage, green-building materials, advanced lighting, solar power, wind energy, and the smart grid. A Political Economy Research Institute report released in late 2008, *Green Recovery*, estimated that \$100 billion spent on clean energy over a 10-year period could create two million new jobs, compared to just 500,000 jobs if the money were invested in oil and gas-related industries. The Center for American Progress, in a related *Green Jobs 101* fact sheet, states that “renewable energy and efficiency improvements create twice as many jobs per unit of energy and per dollar invested than traditional fossil fuel-based generating technologies.” In other words, money invested in clean energy, based on these estimates, creates two to four jobs for every one job created if the money were spent on fossil fuel industries.

Clean energy continues to fuel the plans of many cities, states, nations, investors, and companies

Top Clean-Tech Job Sectors

<p>Energy</p> <ul style="list-style-type: none"> Renewable Energy (e.g., Solar, Wind) Energy Storage Energy Conservation and Efficiency Smart Grid Devices and Networks Electric Transmission and Grid Infrastructure Biomass and Sustainable Biofuels 	<p>Transportation</p> <ul style="list-style-type: none"> Hybrid-Electric Vehicles All-Electric Vehicles Electric Rail Hydrogen Fuel Cells for Transport Advanced Transportation Infrastructure Advanced Batteries for Vehicles
<p>Water</p> <ul style="list-style-type: none"> Energy-Efficient Desalination UV and Reverse-Osmosis Filtration Membranes Drip & Smart Irrigation Systems Automated Metering and Controls Water Recovery and Capture 	<p>Materials</p> <ul style="list-style-type: none"> Biomimicry Bio-Based Materials Reuse and Recycling Green Building Materials Cradle-to-Cradle Systems Green Chemistry

Industrial leaders in the U.S., China, South Korea, Germany, Japan, and other nations, responding to this opportunity, are now vying for clean-tech leadership and the jobs that come with it. According to Clean Edge research, the solar PV industry alone now represents approximately 300,000 direct and indirect jobs globally, while the wind-power sector includes more than 500,000 direct and indirect jobs worldwide. The *Renewables 2010 Global Status Report*, the highly-regarded annual publication from global research group REN21, shows that total jobs in renewable energy industries exceeded three million globally in 2009. According to the report, Brazil and China account for the largest share of renewables employment globally, representing more than 700,000 and 250,000 respectively in the bioethanol and solar hot water industries alone. According to the report's findings, many of these jobs can't be exported, as they are based heavily on local jobs in installation, operations, and maintenance.

As clean energy becomes increasingly embedded in nations' economies, how will it impact job growth? According to an August 2010 article in the *New York Times*, Portugal is on track to get 45 percent of its grid electricity from renewables this year. Clean-energy research firm IHS Emerging Energy Research projects that other countries will soon join this club, with Ireland, Denmark, and Britain on pace to getting 40 percent or more of their electricity from renewable sources by 2025. While this alone doesn't guarantee massive job creation (Portugal's unemployment rate stands at around 11 percent), it does represent a significant opportunity for business creation and long-term competitiveness. Portugal, for example, is now home to a number of large global renewable-energy companies as a result of its clean-energy push, including publicly traded EDP Renováveis, one of the world's largest producers of wind-generated electricity – and the nation is weaning itself off of expensive and volatile foreign sources of energy.

Three Million Jobs and Counting

In the following pages of this year's *Clean-Tech Job Trends* report, we highlight:

- where clean-tech jobs are being created, including the Top 15 U.S. metro areas for clean-tech job activity;
- how much clean-tech jobs pay, including our annual survey of compensation levels for dozens of job titles (completed in collaboration with compensation specialist PayScale);
- global manufacturing hotspots, and how nations are vying for clean-tech leadership;
- five major trends that we see reshaping the clean-tech jobs landscape;
- how China, the U.S., and other nations can compete effectively for clean-tech job creation.

Finally, at the end of the report, we provide an online resource guide for clean-tech job seekers and employers alike – with references to clean-tech books, reports, web sites, jobs boards, job fairs, networking organizations, educational programs from trade schools to MBAs, and more. We hope that our second annual *Clean-Tech Job Trends* report is a useful guide for investors, economic developers, policy makers, employers, and job seekers as the transition to a clean-tech economy moves forward.

CLEAN-TECH JOB ACTIVITY – HOTTEST SECTORS, CITIES, AND EMPLOYERS

The top five sectors for clean-tech job activity in the U.S. – based on Clean Edge research of job placements, job postings, and public and private investments – are solar power; biofuels and biomaterials; smart grid and energy efficiency; wind energy; and advanced transportation/vehicles. Solar power and biofuels and biomaterials retained their top spots from the sector ranking in our *Clean Tech Job Trends 2009* report, and new to the list this year, in fifth place, is advanced transportation/vehicles.

Where Are the Jobs?

Top 5 Sectors for Clean-Tech Job Activity (U.S.)

Rank	Sectors
1	Solar Power
2	Biofuels & Biomaterials
3	Smart Grid & Energy Efficiency
4	Wind Power
5	Advanced Transportation/Vehicles

Source: Clean Edge, Inc., 2010

**Sector rankings are based on Clean Edge research of job placements, job postings, and public and private investments*

For the second straight year, we have also ranked the Top 15 metropolitan areas for clean-tech job seekers in the U.S., based on a range of metrics including current and historical job postings, early-stage and public-market investment activity, clean-tech job presence, and clean-energy patent activity. Not surprisingly, the San Francisco Bay Area/Silicon Valley repeats as the top area for clean-tech jobs, with Los Angeles second. Even in its challenging economic times, California continues to see fairly robust job activity in clean-tech startups and established players, with the state's high-tech giants like Cisco, Intel, and Google aggressively expanding their smart-grid initiatives. San Diego (seventh) and Sacramento (15th) give California four cities in the Top 15, but the Golden State faces an uncertain clean-tech future if the state's voters pass a November ballot measure, Proposition 23, that would suspend the state's landmark greenhouse gas reduction laws. Boston (third) and New York City (fourth) swapped places from 2009, with Denver moving up one notch to No. 5, displacing Washington/Baltimore (sixth this year).

Clean-Tech Job Activity – Top 15 U.S. Metro Areas*

Rank	Metro Area
1	San Francisco-Oakland-San Jose, CA
2	Los Angeles-Long Beach-Riverside, CA
3	Boston-Cambridge-Quincy, MA-NH
4	New York-Northern New Jersey-Long Island, NY-NJ
5	Denver-Aurora-Broomfield, CO
6	Washington-Arlington-Baltimore, DC-VA-MD
7	San Diego-Carlsbad-San Marcos, CA
8	Houston-Sugar Land-Baytown, TX
9	Chicago-Joliet-Naperville, IL-IN-WI
10	Austin-Round Rock-San Marcos, TX
11	Seattle-Tacoma-Bellevue, WA
12	Atlanta-Sandy Springs-Marietta, GA
13	Dallas-Fort Worth-Arlington, TX
14	Portland-Vancouver-Hillsboro, OR-WA
15	Sacramento-Arden-Arcade-Roseville, CA

Source: Clean Edge, Inc., 2010

*Job rankings are based on a proprietary weighting of job postings, investment activity, job presence, and patent activity collected from the following datasets:

- Job postings including historical data from executive recruiter Hobbs & Towne and from Clean Edge Jobs and other leading job boards
- Investment activity provided by Bloomberg New Energy Finance, including early-stage investments (number of deals, money invested) and public-market investments (number of deals, money invested) by U.S. metro region
- State-level business & job presence published in a number of research reports including Pew Center's "The Clean Energy Economy" (based on data from the National Establishment Time Series database by Walls & Associates)
- Patent activity – Clean Energy Patent Growth Index published by Heslin Rothenberg Farley & Mesiti P.C.

Houston made the most significant leap, jumping seven places from 15th to eighth. This reflects the Texas oil capital's broader jobs boom; a *Bloomberg Businessweek* poll ranked Houston the No. 1 U.S. city in 2010 for recent college grads starting careers. Biofuels and wind are Houston's strongest clean-tech sectors, and the city government is the nation's top municipal purchaser of green power, all of it Reliant Energy wind power. San Diego, which is aggressively developing biofuels and other clean-tech sectors, jumped four places from 11th to seventh. Newcomers to the Top 15 are Atlanta (12th) and Dallas (13th).

Cities whose rankings dropped from 2009 include Pacific Northwest clean-tech stalwarts Portland, which fell six places from No. 8 to 14, and Seattle, which dropped from seventh to 11th. Both moves likely reflected the overall economic downturn in the Northwest. Dropping off the Top 15 were Phoenix (13th in 2009) and Detroit (14th).

China Dominates List of Pure-Play Clean-Tech Employers

This year's list of top clean-tech pure-play employers continues to reflect the international nature of the clean-tech industry, but also points to the emerging dominance of China. Last year's assessment of the top publicly traded pure plays, in terms of total employment, included three with headquarters in China. This year, China dominates the list, with six of the top companies (including

one in Hong Kong), followed by the U.S. with two companies, and one each in Spain and Denmark. China's lower overall worker productivity, lower employment costs, and incentives for employment over automation account for much of China's larger employment count, but that doesn't lessen the impact of China's exuberant rise. Barring any significant policy changes by other nations, China-based companies are poised to increasingly dominate as clean-tech employers both domestically and abroad – unsettling news for other nations looking for their companies to gain a competitive clean-tech advantage.

Top 10 Clean-Tech Employers (Publicly Traded Pure Plays)

Rank	Company	Headquarters	Sector/Activity	Employees
1	Vestas Wind Systems	Randers, Denmark	Wind	20,730
2	LDK Solar	Xinyu, China	Solar	13,464
3	Suntech Power Holdings	Wuxi, China	Solar	12,548
4	Itron	Liberty Lake, WA	Smart Grid	9,000
5	China BAK Battery	Shenzhen, China	Energy Storage	8,200
6	Trina Solar	Changzhou, China	Solar	7,891
7	Baldor Electric Company	Fort Smith, AR	Electric Motors	7,250
8	Gamesa Corporacion Tecnologica	Vitoria, Spain	Wind	6,721
9	Neo-Neon Holdings	Hong Kong	LED Lighting	6,505
10	Yingli Green Energy	Baoding, China	Solar	5,813

Source: Clean Edge, Inc., 2010

Based on companies' reported claims and publicly available Q2 2010 financial filings/most recent annual reports

It's not just national governments and pure plays that are active in clean tech; corporate giants continue to embolden their clean-tech activities via investments, new divisions, and M&A activity. Below is a sampling of recent headlines that demonstrates the activity, and commitment, of many key multinationals.

ABB to Buy Utility Software Firm Ventyx for More Than \$1 Billion

BP Buys Verenum's Cellulosic Biofuel Business for \$98.3 Million

BYD, Daimler to Form Electric-Car Venture in China

Ford Invests \$135 Million, Adds 220 Electric-Car Jobs

GE Launches \$200 Million Innovation Contest for Smart Grid

MEMC Buys Solar Silicon Producer Solaicx for More Than \$66 Million

Samsung Said to Invest \$21 Billion in Clean Tech over Next Decade

**Recent
Headlines:
Corporations and
Clean-Tech Jobs
in the News**

CLEAN-TECH JOB COMPENSATION SURVEY

For *Clean Tech Job Trends 2009*, Clean Edge teamed up with compensation data specialist PayScale to compile the first survey of global clean-tech salaries. Results showed that clean-tech jobs exist across a wide range of sectors, activities, salaries, and job levels, offering rewarding career paths for fledgling job seekers as well as battle-tested career veterans.

This year, our second annual clean-tech compensation survey, also in partnership with PayScale, returned similar results. Data compiled from thousands of survey respondents exposed the diverse nature of employment in clean tech. The data confirms that clean-tech occupations deliver reasonable wages for new workers in the field, while also offering financially rewarding opportunities for senior-level operatives.

A four-year college degree is not a prerequisite for entry to the clean-tech playing field. Those with high school or associate degrees can pursue positions in many popular fields like green building, solar power, and wind energy. HVAC Service Technicians (\$48,600), Insulation Workers (\$33,600), Solar Energy System Installers (\$37,700), and Wind Turbine Technicians (\$48,300) are only a few of the industry posts offering living-wage median pay to entry-level workers without a bachelor's degree. For higher-ranking, more educated or experienced hands, positions like LEED Architect (\$57,100), Wind Construction Superintendent (\$76,700), Senior Electrical Engineer (\$95,400), and Environmental Engineering Manager (\$106,000) are all profitable career choices.

Highlighting results of the 2010 Clean Edge/PayScale Clean-Tech Compensation Survey, the next two pages show salary results for a selection of jobs from a variety of industry sectors. See the following definitions for a better understanding of the reported data:

Median Pay: *The median pay is the national median (50th percentile) annual total cash compensation (TCC). TCC combines base annual salary or hourly wage, bonuses, profit sharing, tips, commissions, overtime pay (when typical for a given job), and other forms of cash earnings, as applicable. It does not include equity (stock) compensation, cash value of retirement benefits, or value of other non-cash benefits (e.g., health care). Half the people doing the job earn more than the median, while half earn less.*

Range in pay for a specific job can vary widely depending upon years of experience, scope of responsibility, number of employees, etc. For example, pay can be higher than the stated median pay if workers have higher levels of experience and responsibility or they work at a larger company.

Typical Job Level: *There are three categories: 1) Entry-Level Positions where workers typically have less than 5 years of experience, 2) Mid-Level Positions where workers typically have between 5 and 10 years of experience, and 3) Senior-Level Positions where workers typically have more than 10 years of experience. Years of experience refers to the number of years the respondent has spent in the field/career. Years of experience includes a worker's years in all applicable jobs in the field, not just the current job.*

Typical Degree Level: *This is the degree held by the majority of respondents.*

Data compiled from thousands of survey respondents exposed the diverse nature of employment in clean tech

Clean-Tech Compensation Overview

Job Title	Industry	Median Pay	Typical Job Level	Typical Degree Level
Boiler Operator	Biofuels/Biomaterials	\$65,700	Mid-Level	High School / Associate's Degree
Molecular Biology Research Associate	Biofuels/Biomaterials	\$42,200	Entry Level	Bachelor's Degree
Geothermal Power Engineer	Clean Energy Sources	\$75,100	Entry Level	Engineering Bachelor's Degree
Power Plant Manager	Clean Energy Sources	\$112,000	Senior Level	Bachelor's Degree
Power System Operator	Clean Energy Sources	\$82,200	Mid-Level	High School / Associate's Degree
Renewable Energy / Renewable Power Project Developer	Clean Energy Sources	\$97,700	Mid-Level	Bachelor's Degree
Renewable Energy / Renewable Power Project Engineer	Clean Energy Sources	\$69,400	Entry Level	Bachelor's Degree
Senior Chemical Engineer	Clean Energy Sources	\$98,300	Senior Level	Engineering Bachelor's Degree
Senior Electrical Engineer	Clean Energy Sources	\$95,400	Senior Level	Engineering Bachelor's Degree
Conservation Program Officer	Environmental Consulting/Research	\$44,500	Mid-Level	Bachelor's Degree
Environmental Engineer	Environmental Consulting/Research	\$60,800	Entry Level	Engineering Bachelor's Degree
Environmental Engineering Manager	Environmental Consulting/Research	\$106,000	Senior Level	Engineering Bachelor's Degree
Environmental Non-Profit Organization Program Coordinator	Environmental Consulting/Research	\$37,500	Entry Level	Bachelor's Degree
Policy Analyst	Environmental Consulting/Research	\$54,600	Entry Level	Bachelor's Degree
Research Scientist	Environmental Consulting/Research	\$65,900	Mid-Level	Ph.D
Sustainability Director	Environmental Consulting/Research	\$92,000	Mid-Level	Bachelor's Degree
Business Development Manager	General Business Operations	\$93,300	Mid-Level	Bachelor's Degree
Financial Analyst	General Business Operations	\$58,700	Entry Level	Bachelor's Degree
Marketing Coordinator	General Business Operations	\$38,200	Entry Level	Bachelor's Degree
Architect (LEED Certified)	Green Building	\$57,100	Mid-Level	Bachelor's Degree
Energy Efficiency Finance Manager	Green Building	\$107,000	Mid-Level	Bachelor's Degree
Energy Field Auditor	Green Building	\$43,700	Entry Level	Bachelor's Degree
HVAC Mechanical Engineer (LEED Certified)	Green Building	\$64,300	Mid-Level	Engineering Bachelor's Degree
HVAC Service Technician	Green Building	\$48,600	Mid-Level	High School / Associate's Degree
Insulation Worker	Green Building	\$33,600	Entry Level	High School / Associate's Degree

Clean-Tech Compensation Overview

Job Title	Industry	Median Pay	Typical Job Level	Typical Degree Level
Electrical / Electronic Equipment Assembler	PHEV/EV	\$30,300	Mid-Level	High School / Associate's Degree
Hybrid Systems Engineer	PHEV/EV	\$61,100	Entry Level	Engineering Bachelor's Degree
Mechanical Engineer	PHEV/EV	\$62,900	Entry Level	Engineering Bachelor's Degree
Powertrain Control Systems Engineer	PHEV/EV	\$81,100	Mid-Level	Master's Degree
Senior Mechanical Engineer	PHEV/EV	\$91,500	Senior Level	Engineering Bachelor's Degree
Embedded Systems Engineer	Smart Grid	\$76,500	Mid-Level	Engineering Bachelor's Degree
Hardware Design Engineer	Smart Grid	\$85,200	Mid-Level	Engineering Bachelor's Degree
Information Systems Security Engineer	Smart Grid	\$84,500	Mid-Level	Bachelor's Degree
Network Operations Center Technician	Smart Grid	\$45,100	Entry Level	High School / Associate's Degree
Smart Grid & Grid Infrastructure Field Technician	Smart Grid	\$39,500	Entry Level	High School / Associate's Degree
Utility Program Manager	Smart Grid	\$77,900	Mid-Level	Bachelor's Degree
Research and Development Lab Technician	Solar PV	\$40,900	Entry Level	Bachelor's Degree
Solar Energy / Solar Power Project Developer	Solar PV	\$62,300	Entry Level	Bachelor's Degree
Solar Energy System Installer	Solar PV	\$37,700	Entry Level	High School / Associate's Degree
Solar Fabrication Technician	Solar PV	\$45,800	Entry Level	High School / Associate's Degree
Solar Installation Foreman	Solar PV	\$49,200	Entry Level	Bachelor's Degree
Wafer Process Engineer	Solar PV	\$82,500	Mid-Level	Engineering Bachelor's Degree
Water Conservation Specialist	Water	\$43,400	Mid-Level	Bachelor's Degree
Construction Superintendent	Wind Power	\$76,700	Senior Level	High School / Associate's Degree
Electrical-Transmission Engineer	Wind Power	\$70,000	Entry Level	Engineering Bachelor's Degree
Sheet Metal Worker	Wind Power	\$51,500	Mid-Level	High School / Associate's Degree
Wind Business Development Manager	Wind Power	\$92,300	Mid-Level	Bachelor's Degree
Wind Field/Plant Operations Manager	Wind Power	\$83,400	Mid-Level	Bachelor's Degree
Wind Turbine Mechanical Engineer	Wind Power	\$63,300	Entry Level	Engineering Bachelor's Degree
Wind Turbine Technician	Wind Power	\$48,300	Entry Level	High School / Associate's Degree

Source: PayScale and Clean Edge, Inc., 2010

CLEAN-TECH MANUFACTURING

Without question, clean-tech manufacturing is proving to be a robust jobs creator when viewed on a global basis. Hard-charging Asian economies, primarily China but also others including South Korea, Japan, Taiwan, and Singapore, are hiring thousands of factory workers to crank out solar panels, lithium-ion batteries, and a wide range of wind-turbine components. At the same time, traditional European clean-tech leaders like Germany and Denmark continue to expand their clean-energy manufacturing capacity as well [see table below]. In the U.S., advocates from President Obama on down have anointed clean tech as a major hope to revive America's hard-hit manufacturing infrastructure, and some \$50 billion of the \$800 billion federal stimulus package, in the form of grants, tax credits, or loan guarantees, is devoted to the development of clean-tech factory jobs. But results of this attempted manufacturing revival in the U.S. are decidedly mixed.

Clean-Tech Manufacturing Jobs Grow, but Most Remain Outside the U.S.

Highlighting Job Creation: Recent Global Clean-Tech Facility Openings, Expansions, and Announcements

Company	Location	Technology	Annual Production Capacity	Expected Number of Jobs	Date Opened/ Announced
OCI	Gunsan, South Korea	Solar: Polysilicon	10,000 Metric Tons	500	Target Opening December 2010
Canadian Solar	Guelph, Canada	Solar: PV Modules	200 MW	500	Targeted Opening Early 2011
Bosch Solar Energy	Arnstadt, Germany	Solar: Crystalline Solar Cells	420 MW	1,100 by 2012	Commissioned August 2010
Gamesa	Da'an, China	Wind: Turbine Manufacturing	500 MW	Gamesa employs more than 1,000 at four Chinese facilities.	Targeted Opening 2011
Acciona	Lumbier, Spain	Wind: Turbine Manufacturing	450 Wind Turbine Blades	148	Commissioned June 2010
A-Power Energy Generation Systems	Southern Nevada	Wind: Turbine Assembly	1.1 GW	1,000	Targeted Opening 2011
Dow Chemical/TK Advanced Battery	Midland, Michigan	Lithium-Ion Batteries for EVs	1.2 GW-Hours	800	Targeted Opening 2011
A123 Systems	Livonia, Michigan	Lithium-Ion Batteries for EVs	600 MW-Hours	300	Commissioned September 2010
Tesla Motors	Fremont, California	EV Assembly (Model S)	20,000 vehicles	1,000 in next few years	Targeted Opening 2012
General Motors	Shanghai, China	EV Technology Center (R & D)	n/a	300	Targeted Opening 2011

Source: Clean Edge, Inc., 2010

First the good news: clean-tech manufacturing jobs are being created around the U.S. Colorado-based Abound Solar is retooling a shuttered auto transmission factory near Kokomo, Indiana, into one of the nation's largest PV plants, aiming to employ up to 850 people in the next three years. A \$400 million U.S. Department of Energy (DOE) loan guarantee (plus another \$25 million in state and county incentives) helped make it happen. Other hard-hit Rust Belt areas have successfully courted offshore manufacturers. Spanish wind-turbine generator company Ingeteam will employ about 270 workers at a new plant announced in March outside Milwaukee, while Spain-based Talgo plans to hire 125 employees to build high-speed rail cars at a former auto parts factory in North Milwaukee.

Nine advanced electric-vehicle battery plants have opened in the U.S. thanks partially to stimulus dollars, with \$2.4 billion allocated for that sector alone. Michigan, with a state unemployment rate of more than 13 percent, has received \$1.4 billion of that pie. In July, President Obama attended the groundbreaking for a new Compact Power battery factory in Holland, Michigan, that will employ 300 workers making lithium-ion batteries for the Chevy Volt and electric Ford Focus starting in 2012.

As we highlighted in *Clean Tech Job Trends 2009*, some previously shuttered, old-line plants continue to be reborn with workers making clean-tech products. In addition to the Milwaukee plants noted above, one of the highest-profile examples is Tesla Motors' acquisition of Toyota's New United Motor Manufacturing Inc. (NUMMI) factory in Fremont, California. The NUMMI plant, a ballyhooed joint venture between Toyota and General Motors, shut down in April after 26 years, laying off 4,700 workers. The following month, Tesla and Toyota announced plans to build Tesla's all-electric Model S sedan at the plant, with Tesla aiming to produce the first models in 2012. But here as in other manufacturing plants, the clean-tech revival does not always replace the same number of jobs previously lost. The Tesla-Toyota plant plans to employ about 1,000 people or less than a quarter of the original workforce, reflecting both increased automation, fewer moving parts in electric vehicles, and lower production targets compared to NUMMI's heyday of Chevy Prizms, Pontiac Vibes, and Toyota Corollas and Tacomas.

And the mantra voiced by some advocates that U.S. clean-tech jobs are "outsource-proof" has proven, at least in manufacturing, to be more myth than reality. The dictum may hold true for construction, installation, and maintenance of clean-energy generation capacity, as well as on-site work like building-efficiency retrofits. But installation and maintenance of solar panels and wind turbines account for less than 30 percent of the total labor involved, according to the Renewable Energy Policy Project think tank in Washington, D.C.

So it's no surprise that the Apollo Alliance estimates that some 70 percent of the content of U.S. clean-energy installations is manufactured overseas. Essentially, clean-tech manufacturing has run up against the same economic realities as countless industries that came before, from clothing to computer chips to cell phones: it's very hard for the U.S. to compete with overseas labor costs, particularly in the developing world – as well as with heavy subsidies for clean-tech manufacturing in nations such as China. Trade statistics tell the tale. The U.S. trade deficit in renewable-energy products soared 1,400 percent to almost \$5.7 billion between 2004 and 2009, according to a January

2010 report from the office of U.S. Sen. Ron Wyden (D-Oregon).

In the U.S. solar industry, falling prices for solar cells have put even more pressure on high labor costs, putting the financial squeeze on manufacturers' payrolls. United Solar Ovonic (Uni-Solar) cut 80 jobs at its Greenville, Michigan plant in December 2009, and in March 2010, BP Solar closed its PV plant in Frederick, Maryland, moving some of those 320 jobs overseas.

But looking forward, the global landscape for clean-tech manufacturing jobs won't always be a clear-cut 'us vs. them' search for the cheapest labor costs. Unusual cross-border partnerships, which may be the wave of the future, are starting to form. In August, Chinese wind-turbine maker A-Power Energy Generation Systems and wind developer partner Shenyang Power Group said they will work with the United Steelworkers, America's largest industrial union, to supply the steel for components at a 615 MW Shenyang wind farm in west Texas. Shenyang will also employ up to 1,000 U.S. workers at a new wind-turbine factory in Nevada.

Political pressure likely played a role; some U.S. Senators objected to federal stimulus dollars subsidizing a foreign-owned project that originally was slated to create more jobs in China than the U.S. Nonetheless, the deal helps establish the concept of a U.S.-based manufacturing supply chain for offshore competitors, a concept that could boost manufacturing jobs across a wide range of clean-tech sectors in the future. That deal followed a late 2009 agreement between the United Steelworkers and Spain-based Mondragon Internacional, the world's largest workers' cooperative, to help establish manufacturing cooperatives in the U.S. and Canada. The agreement grew out of United Steelworkers members working for Spanish manufacturer Gamesa, making wind turbine components at formerly shuttered steel plants in Pennsylvania.

But as if to underscore how contentious the issue of global clean-tech job competition is and will remain, in September 2010 the United Steelworkers filed a complaint accusing China of violating World Trade Organization free-trade rules by unfairly subsidizing Chinese-made solar and wind product exports. As our report went to press, the Obama Administration had not yet decided whether to pursue the complaint.

The mantra voiced by some advocates that U.S. clean-tech jobs are "outsource-proof" has proven to be more myth than reality

FIVE JOB TRENDS TO WATCH

1. Clean-Tech Jobs Sprout South Of the Border

As discussed in the previous section, cost-cutting is king in the world of clean-tech manufacturing. For developed countries, this often means moving jobs to emerging markets with lower labor costs. While China's early lead as a low-cost manufacturer has been well documented, a similar, quieter story is being written in Mexico.

With a combination of cheap labor and geographic proximity, the United States' third-largest trading partner is attracting attention from those looking for low-cost access to the North American clean-tech market. So far, the early leader in Mexico's clean-tech supply chain development is end-assembly activities for the solar photovoltaic (PV) industry.

In late 2009, Japan-based Sanyo completed expansion of its Monterrey, Mexico module assembly plant, more than doubling output capacity to 50 MW annually. Two months later, BP Solar and American electronics manufacturer Jabil Circuit announced an agreement to assemble 45 MW worth of solar modules at Jabil's plant in Chihuahua. And in August 2010, U.S. thin-film solar manufacturer Energy Conversion Devices revealed plans to shift final assembly operations to its Tijuana facility, essentially outsourcing 140 jobs from the company's Auburn Hills, Michigan campus.

Solar isn't the only industry setting up shop in Mexico. German equipment manufacturer Liebherr recently constructed a production facility in Monterrey where it will employ 180 and make drive-line components for the North American wind-energy market.

Mexico's wage costs will not be as low as in the cheapest Asian countries, but as demand spikes in North America for all things clean tech, the nation's fortuitous proximity could solidify its permanent foothold in the industry's labor landscape.

Top Headlines

Jabil to Manufacture BP Solar Panels in Mexico

Is Mexico the New China?

Photovoltaics Maker ECD Moving 140 Jobs to Mexico

Sanyo Ups Solar Module Production Capacity in Mexico

Liebherr's Mexico Factory to Serve North American Wind Power Market

2. Feed-In Tariffs Whet Renewable Energy Appetites, Spur Job Growth

Government policy is always an important factor in determining where companies, and jobs, gather. For clean tech this is doubly true, as many newer clean technologies are not yet cost-competitive with much more mature and long-subsidized fossil-fuel technologies. One policy known for creating world-leading markets is the performance incentive known as a feed-in tariff, or FIT.

FITs – policy mechanisms offering stable payment to generators of renewable electricity through long-term purchase agreements – are responsible for approximately 75 percent of global PV and 45

percent of global wind power deployment, according to a 2010 report by the U.S. DOE's National Renewable Energy Laboratory. It's no wonder that this policy tool is also lauded for its ability to attract companies and create jobs.

The most prominent example of a FIT's industry-creating power is Germany, where a country with less than stellar solar resources became a world leader in PV production and deployment. In the United Kingdom, a newly enacted FIT is being noted as the cause for job growth. British solar project developer Solarcentury said in August that it witnessed sustained job growth in the first six months following the government's implementation of a FIT program. The company's workforce, which stood at 200 in January 2010 and reached 350 by August, is expected to reach well over 500 by 2011. Ontario, Canada is another example of FITs' industry magnetism. The province has attracted major investment promises from companies like Canadian Solar and Siemens since its aggressive FIT was enacted last year, with much credit given to domestic content requirements included in the legislation.

Successful implementation of a FIT is a difficult achievement – appropriate payment levels are often elusive and any abrupt rate adjustment can invite a boom-and-bust scenario. Nevertheless, this policy mechanism has proven powerful and will continue to play an integral role in clean-tech job creation and product deployment.

*Tripling of Solar Jobs in the UK This Year Due to FIT?
Feed-In Tariffs Responsible for Three-Quarters of World's Solar PV
Feed-In Tariff Sparks Ontario Solar Boom
Ontario Solar Plant to Create 500 Jobs
New Czech Renewable Energy Policy to Bust the Solar Boom with a 50% Subsidy Cut*

**Top
Headlines**

3. Tomorrow's Auto Industry: Where Does American Labor Stand? Obama Spending Billions to Keep U.S. in the Game

As efficient and clean transportation methods replace the inefficient, mostly fossil fuel-powered vehicles of today, the spoils of tomorrow's auto industry will be won by those on the forefront of advanced transportation technology development and product manufacturing. For the U.S., the birthplace of modern automobile production and home of the "Big 3," there is much to be lost here in terms of profits, and more importantly, jobs.

Understanding this risk, the Obama Administration has injected billions to beef up research and manufacturing efforts, hoping to ensure U.S. companies a seat at the table in the 21st century auto industry. The nine U.S. stimulus-funded EV battery plants mentioned earlier are only the tip of the iceberg. By 2012, the White House hopes to have 30 factories in the U.S. accounting for 20 percent of the world's output of high-performance auto batteries, up from just two factories producing two percent of global supply in 2009.

The government has also become a major funder of up-and-coming electric car companies. In January, the DOE closed a \$465 million loan to electric-car maker Tesla Motors. Three months later,

the DOE closed a \$528.7 million loan with Fisker Automotive, a startup developing plug-in hybrid electric vehicles. These loans are intended to create several thousand U.S. manufacturing jobs and save or create thousands more jobs for domestic parts suppliers.

It can be assumed that developing nations, with large amounts of cheap labor, will claim the driver's seat in manufacturing tomorrow's advanced transportation technologies. But from the billions of government dollars spent on development of electric cars and related products, the Obama administration hopes to at least earn the U.S. a spot riding shotgun.

Top Headlines

Tesla Motors Finalizes DOE Loan for Model S

Fisker Automotive Lands \$529 Million White House Loan

Coda to Build Big Plant in Ohio - if Grants Come Through

Biden Boosting Battery Power in Midland at Dow Kokam Groundbreaking

President Obama Takes Chevy Volt Electric Car for a Test Drive

4. Energy Efficiency - Clean Energy's Better Half

In the U.S., with annual electricity consumption at approximately 14,000 kWh per capita – roughly double the consumption rate in the European Union and five times the world average – energy efficiency measures should be the first thing on the mind of each and every clean-energy advocate. In *Clean Tech Job Trends 2009*, we examined energy efficiency's role in avoiding the need for new generating capacity, and how efficiency is also the most cost-effective way to create jobs on a dollar investment basis.

Eager supporters of clean energy, however, sometimes overlook the easy efficiency fixes and instead channel enthusiasm – and dollars – towards the generation of renewable energy. This is likely to change as renewable-generation companies like U.S.-based solar project developer SolarCity in Foster City, California, begin to embrace efficiency improvements as a cheap and productive way to reduce and clean up energy consumption.

In May, the company acquired Building Solutions, a developer of home energy audit software. SolarCity will use Building Solutions' technology to offer energy audits to its residential solar customers, allowing for amplified energy-saving benefits. The marriage of these two services is likely to prove fruitful and could usher in an era in which solar project designer and home energy auditor exist in the same job description.

Framingham, Massachusetts-based Ameresco is another dual player in energy efficiency and renewable energy. The company, which went public on the New York Stock Exchange this July, helps large clients improve facility energy performance through efficiency services and onsite generation projects. Ameresco, looking to expand upon 2009's revenue total of \$428.5 million, in August acquired energy-efficiency service provider Quantum Engineering and Development. Quantum's workforce will join Ameresco's 650 employees to strengthen its combined offering of efficiency and renewables.

Ameresco Acquires Quantum Engineering in Northwest Expansion
SolarCity Acquires Building Solutions, Integrates Solar Power and Energy Efficiency Services
Weatherization Plan Covers Solar, Efficiency Tech
California Rolls Out Zero Net Energy Plan for Buildings
First Passive Retrofit in U.S. Receives Certification

5. Global Competition Heats Up For Emerging Offshore Wind Industry

In the summer of 2010, all eyes were fixed on the Gulf of Mexico as BP's Deepwater Horizon well leaked more than 200 million gallons of crude oil into the ocean – a reminder that the true cost of energy is never captured by prices at the pump or on utility bills. But elsewhere on the high seas, the offshore wind industry was picking up steam, showing every indication that 2010 would be a record-breaking year for the blossoming industry.

In 2009, annual installed capacity for offshore wind grew 72%, reaching more than 2 GW cumulative global capacity. Europe, the clear offshore wind leader, upped the pace in the first half of 2010 and installed 333 MW through June – well over half of the continent's 577 MW 2009 total.

From the UK to Denmark, China, New Jersey, and even Great Lakes states such as Ohio, regions are positioning themselves to capture winnings – and jobs – from the continued expansion of offshore wind installations and increased turbine manufacturing demand. The UK, with more than 1 GW installed, understands the industry's job-creating power – a 2010 Scottish Renewables report estimated that offshore wind could create 28,000 jobs by 2020 in Scotland alone.

China and the U.S. are also hoping to carve out spots in this traditionally Europe-dominated sector. China installed its first offshore project in 2009, while the U.S. has finally given the green light to its first offshore project – the highly controversial Cape Wind installation off the coast of Massachusetts. New Jersey also made waves recently by passing a law calling for development of offshore wind energy.

Offshore wind energy has excited many for its ability to deliver clean electrons, provide jobs, and attract investment. As the sector grows, rich wind resources and industry-attracting tenacity will be essential for regions hoping to capture the valuable rewards lingering above coastal horizons.

Offshore Wind Can Provide Electricity, Jobs
GE Announces Major European Offshore Wind Expansion with a Planned €340 Million Investment
New Jersey to Take Lead in Offshore Wind Energy?
Scotland's Offshore Wind Industry Could Create 28,000 Jobs by 2020
Offshore Wind Energy on Pace for Record Growth in 2010

MOVING FORWARD

As we highlight throughout this report, no other country comes close to matching the active role being taken by China to supercharge its clean-tech initiatives. Recent indicators point to China's rising dominance, including the fact that China, which passed Japan this year to become the world's second-largest economy, now outspends both the U.S. and Europe on clean energy. Clean-energy investments in China reached \$34.6 billion last year, more than any other country and almost double the U.S. investment of \$18.6 billion, according to a Pew Environment Group report, *Who's Winning the Clean Energy Race*. It may seem contradictory that the world's largest consumer of iron, steel, cement, oil, coal, and meat – and now the world's largest emitter of global greenhouse emissions – is also a clean-tech champion, but that's exactly what's playing out. The following table highlights some of the significant disparities between the world's two largest economies, the U.S. and China, and their clean-tech initiatives.

A Contrast in Nations – U.S. and China Clean-Tech Activities

	China	United States
Domestic Content Rules	Yes – extremely aggressive rules. National “Indigenous Innovation” programs push WTO rules to the legal limit by aggressively promoting domestic clean-tech companies. The programs establish favorable terms related to IP, trademarks, land use, and more – such as, until last year, requiring that 80 percent of solar content be made in China.	Yes, but moderate. The Buy American Act provides a basic framework for U.S. federal procurement. However, particularly compared to China, this legislation is not very aggressive. The Act has been criticized by some because it's limited to government projects and doesn't incorporate private enterprise.
Feed-in Tariffs (FIT)	Yes, for wind and biomass. Chinese wind producers have a program that provides between Yuan 0.51/kWh and 0.61/kWh. Biomass producers receive a Yuan 0.35/kWh premium. A solar FIT program is being negotiated.	No. Several U.S. states currently have modest FIT programs (mostly for solar) and others are considering similar legislation, but there is no national program.
Federal Renewable Portfolio Standards (RPS)	Yes. China has clear national targets for renewable electricity (15 percent of primary energy from non-fossil fuels by 2020) and energy efficiency (45 percent decrease in energy intensity by 2020, relative to 2005 levels).	No. More than two dozen states and the District of Columbia have their own targets, but there is currently no national guidance or required minimum federal target.
Cap on Carbon Emissions	No. China has aggressive targets for decreasing carbon intensity and recently announced plans for a domestic carbon trading program, but China continues to voice no intentions of setting upper limits on greenhouse gases.	No. Many states have established statewide caps on carbon emissions, the federal government has set carbon reduction targets for federal buildings and operations, and several regional initiatives are underway, but there is no national standard or policy.
Strong Financial Commitments	Yes – the world's strongest. For the first time, China captured the top rank in overall clean-energy investment and finance with more than \$34 billion in 2009.	Yes, but pushed into second place. For the first time in five years, the U.S. was bumped into second place in total clean-energy investments with a 40 percent decline to \$18.6 billion in 2009.
Fuel Economy Standards	Yes. In 2009, China implemented an improved plan requiring corporate fleet averages of 42.2 mpg by 2015.	Yes – though less aggressive than China. A more aggressive national fuel economy program was implemented in May 2009. The standards, covering model years 2012-2016, require a 42 percent increase in average fleet fuel economy to 35.5 mpg by 2016.
Favorable Legal and Regulatory Climate	No. China has shown some flexibility and progress, but frustration with lack of sufficient intellectual property protection, failure to protect foreign investments, potentially illegal means of protectionism, and more, recently pushed GE CEO Jeff Immelt to question if China “want[s] any of us to win.”	Yes. The U.S. regulatory framework is comparatively open, flexible, and dynamic. Patent law, one critical example, has greater scope, greater transparency, greater enforcement, a special IP Appeals Court, and more efficient judicial procedure.

Source: Clean Edge, Inc., 2010

BUILDING A CLEAN-TECH JOBS FUTURE: FIVE KEY STEPS

As competition heats up for the jobs of the future, what policies and initiatives make the difference between success and failure? Below is a list of five national policies and initiatives that we believe play a critical role in ensuring a nation's clean-tech growth and job creation. These aren't by any means the only national policies that matter, but they represent some of the most important and promising initiatives based on Clean Edge research and analysis.

1. Deploy aggressive national renewable portfolio standards with "teeth."

As noted above, there are currently more than two dozen states with RPSs. Certainly not all RPSs are created equal, but robust RPSs tend to call for at least 25 percent renewables by 2025 or 30 percent by 2030 – and the strongest of them provide penalties for not meeting stated goals. While approximately 30 countries currently have national RPSs, the U.S. isn't one of them. We believe that the lack of a strong and robust RPS puts countries like the U.S. at a significant disadvantage. Nations that want to lead in the coming decades, and ensure their national security, will need to have aggressive RPSs that use both carrots and sticks to guarantee that their country moves from carbon-intensive energy streams to low-carbon and zero-carbon options.

2. Support green infrastructure development.

National governments often play a central role in supporting the build out of required infrastructure by being ardent investors, customers, and regulators. Think of what the Internet industry might look like if the U.S. government hadn't invested in the build out of its predecessor – ARPANET. The clean-tech sector relies similarly on the deployment of new infrastructure, like a smart grid with enhanced, modernized grid infrastructure to carry green electrons and incorporate charging stations to support all-electric and plug-in hybrid vehicles. National governments need to take strong roles in supporting such build outs by ensuring that they walk the walk – with regulatory and policy support to build out critical infrastructure, and to be at the forefront of procuring clean-tech products and services.

3. Implement – and be sure to enforce – efficiency, fuel, and emissions rules and standards.

We've said it before: no energy industry on the planet is regulatory or subsidy free. Nuclear power, decades into its existence, still needs significant regulatory and financial support including billions in loan guarantees and government-backed insurance plans – private insurers won't take on the liability of nuclear facilities without them. Oil and coal live off the backs of cheap government money and emissions policies that don't accurately account for the externalities inherent in operating polluting fossil fuel plants. Utilities are basically regulated monopolies, operating their businesses and taking actions in ways supported or discouraged by regulators and their policies. If nations are going to shift their economies to cleaner burning fuels and energy sources, then countries will need to shift their regulatory framework in support of low-carbon technologies and energy sources.

Efficiency, fuel, and emissions standards are all strong tools in this approach. In the U.S., for example, without any real comprehensive carbon-reduction program in place, the EPA could begin to take regulatory actions into its own hands. Indeed, the Supreme Court has already stated that the EPA has the right to enforce clean-air act restrictions on carbon emissions as it does on other forms of pollutants. Barring any highly unlikely, last-minute legislative-backed carbon regime from the current Congress, we expect that day may not be far off.

4. Establish green banks, bonds, and funds.

In 2009, we published a companion report with *Clean Tech Job Trends 2009* that looked at five emerging public financing models for clean-tech deployment. The ideas outlined in the report included such financing innovations as green banks, victory bonds, and revolving loan funds. States like Connecticut and Massachusetts and countries like China and Germany have developed unique funding mechanisms, including state-backed venture and equity funds, and the U.S. needs to do more to support the creation of new financing models that capture the benefits of clean energy and efficiency deployment, while paying for up-front capital costs. The key point here is we can't simply rely on innovative technologies like new high-efficiency solar PV or algal-based biofuels; we also need innovative financing models to enable the growth of these and many other emerging clean energy technologies.

5. Implement carbon taxes.

It's clear that cap-and-trade, at least for the foreseeable future in the U.S., is dead. But we don't necessarily see that as a bad thing. At Clean Edge we've warned of the dangers of a potential cap-and-trade system, with its pricing fluctuations and uncertainty, potential for market gaming, and rampant loopholes.

Microsoft founder Bill Gates, in a recent interview with MIT's *Technology Review*, voiced similar support for a tax over cap-and-trade, stating "it's ideal to have a carbon tax, not just a price on carbon, which is this fuzzy term that includes cap-and-trade. ...Which is more likely: a [hidden] carbon tax with all sorts of markets and options and uncertainties about prices, and traders in the middle, and confusion about who initially gets the most advantage? Or a regulatory thing that says you mark every coal plant in the country with when it has to be retired, and a 2 percent tax to fund the R&D so that utilities know they can buy a plant that's emitting hardly any CO₂?" The Breakthrough Institute estimates that a carbon tax of \$5 per ton of CO₂ emissions, a price far below most cap-and-trade regime projections, would result in \$30 billion a year in the U.S. This could be used for R&D funding, project development, and other clean-tech supports, including a potential rebate for consumers initially hit with higher energy costs in some regions. Historically, taxes have been verboten in U.S. policy circles, but with the failure of cap-and-trade, we believe, like many economists and a growing chorus of business leaders, that a carbon tax is a preferable vehicle.

It's clear that cap-and-trade, at least for the foreseeable future in the U.S., is dead

RESOURCE GUIDE

Job Reports

Check out the reports below to learn more about clean-tech job growth potential and associated economic benefits (titles link to the report PDFs).

[The Clean Energy Economy](#)

The Pew Charitable Trusts - June 2009

Pew's exploration of America's clean-energy economy includes a look at the growth of clean-energy jobs from 1998 to 2007. States are ranked by job and business presence, investment totals, patent activity, and rate of growth.

[Low Carbon Jobs For Europe: Current Opportunities and Future Prospects](#)

WWF - June 2009

The international NGO uses its environmental expertise to analyze the potential for labor gains from development of a low-carbon economy in Europe. Renewable electricity, advanced transportation, and energy efficiency are the reports' three main areas of focus.

[The Economic Benefits of Investing in Clean Energy](#)

Center for American Progress and PERI - June 2009

This paper looks at how the American stimulus and proposed climate legislation will affect jobs, income, and the clean-energy economy.

[How to Revitalize America's Middle Class With the Clean Energy Economy](#)

Blue Green Alliance - June 2009

This policy brief is an update of a 2006 analysis and is designed to highlight the economic benefits that renewable energy development can bring to regions throughout the country.

[U.S. Metro Economies: Current and Potential Green Jobs in the U.S. Economy](#)

Global Insight - October 2008

This report examines the economic benefits of the 'Green Economy'. Current green jobs are discussed, along with potential future job growth in areas like renewable power generation, energy efficiency, and renewable transportation fuels.

[Wind Energy and Green Jobs](#)

Governors' Wind Energy Coalition - February 2009

GWEC profiles the economic benefits of wind energy and provides policy recommendations which it believes will help states meet the full economic potential from wind energy.

Books

These books are a useful way to navigate the clean-tech industry and find the best strategies to land a job.

[Careers in Renewable Energy](#)

Gregory McNamee - PixyJack Press, 2008

With overviews of several renewable energy sectors and information about different career opportunities, this book is a good starting point for anyone looking for a job in the industry.

[The Clean Tech Revolution](#)

Ron Pernick and Clint Wilder - Collins Business, 2007 (Paperback 2008)

Provides an excellent overview of the key drivers behind the shift to clean technology and highlights eight emerging clean-tech opportunities. A business-oriented crash course in clean technology.

[The Complete Idiot's Guide to Green Careers](#)

Barbara Parks, Jodi Helmer - Alpha, 2009

The popular book series tackles green jobs with this book that explores opportunities in several sectors in the clean-tech industry.

[Green Careers: Choosing Work for a Sustainable Future](#)

Jim Cassio - New Society Publisher, 2009

This book provides several sector overviews, information on career opportunities, job search resources, and case studies on environmental jobs.

[Green Careers - WetFeet Insiders Guide](#)

Frank Marquardt - WetFeet.com, 2008

Marquardt, who more recently authored The Solar Job Guide e-book, looks at how to land a job in emerging green industries.

[Green Careers for Dummies](#)

Carol L. McClelland - For Dummies, 2010

McClelland's 2010 Green Book Festival award winner introduces readers to the variety of jobs in the clean-tech universe and provides resources for job seekers.

[Green Careers in Energy](#)

Peterson's - 2010

This recent publication highlights the best opportunities in several clean-tech sectors including solar, wind, geothermal, marine, biofuel, and hydrogen. It also covers training and education programs that are helpful in landing a clean-tech job.

[Jobs in Sustainable Energy](#)

Corona Brezina - Rosen Publishing Group, 2010

This book offers introductions to various jobs in each field, discusses education and experience required, and provides estimates of expected earning levels.

RESOURCE GUIDE

Blogs

Blogs are a great way to keep up with the latest news and gather insight from some of the brightest minds following the industry. Below is a sampling of what we feel are some of the best clean-tech blogs. To track these and other industry blogs, visit www.cleantech.com/blogs.

Apollo Alliance Blog	Blue Green Blog
Clean Technica	Clean Techies
earth2tech	EcoGeek.org
Green Career Central	Green for All Blog
Green Tech – CNET	Green Tech Pastures – ZDNet
Green – NYT	Greentech Media
R-Squared Energy Blog	Venture Beat – Green Beat

Conferences/Career Fairs

Here are a few of the best events at which to explore clean-tech opportunities and support the clean energy economy.

Good Jobs, Green Jobs	Green Professionals’ Conference	Intersolar North America – Job & Career Forum
Massachusetts Green Career Conference	WINDPOWER Job Fair	

Networking Organizations & Nonprofits

Job postings aren’t the only way to find jobs. Often times the best career opportunities are found through someone you know. Check out these organizations and events to make sure you’re meeting the right people.

Networking	Nonprofits
CleanLinks	Apollo Alliance
Clean Economy Network	BlueGreen Alliance
Eco Tuesday	Energy Action Coalition
Net Impact	Green For All
Green Drinks	

RESOURCE GUIDE

Education/Training

As the clean-tech industry scales up, the number of job opportunities will grow significantly. Education and training programs will provide the necessary workforce to satisfy this growth. The collection below, while not a comprehensive list, is a sampling of existing clean-tech training and education programs.

Undergraduate Education

Appalachian State University (Boone, NC) – Bachelor of Science Degree in Appropriate Technology
 Illinois State University (Normal, IL) – Renewable Energy Degree
 Oregon Institute of Technology (Klamath Falls, OR) – Bachelor of Science Degree in Renewable Energy Engineering

Community College/Continuing Education/Training

Amarillo College (Amarillo, TX) – Associate in Applied Science, Renewable Energy
 Bronx Community College (Bronx, NY) – Center for Sustainable Energy
 Coconino Community College (Flagstaff, AZ) – Associate of Applied Science in Alternative Energy Technology
 Columbia Gorge Community College (The Dalles, OR) – Associate of Applied Science Degree in Renewable Energy Technology
 Indian Hills Community College (Ottumwa, IA) – Associate in Advanced Technologies – Renewable Energy Technology
 Lane Community College (Eugene, OR) – Northwest Energy Education Institute
 Laramie Community College (Cheyenne, WY) – Associate of Applied Science Degree in Wind Energy
 Oakland Community College (Bloomfield Hills, MI) – Environmental Systems Technology Program
 San Juan College (Farmington, NM) – Associate of Applied Science Degree in Renewable Energy
 Solar Living Institute (Hopland, CA)

Graduate Education

Antioch University (Keene, NH) – MBA in Organizational and Environmental Sustainability
 Arizona State University (Tempe, AZ) – School of Sustainability
 Bainbridge Graduate Institute (Bainbridge Island, WA) – MBA in Sustainable Business
 Denmark Technical University (Copenhagen, Denmark) – MSc in Wind Power
 Dominican University of California (San Rafael, CA) – MBA in Sustainable Enterprise
 Duquesne University (Pittsburgh, PA) – MBA in Sustainability
 Humboldt State University (Arcata, CA) – Bachelor of Science and Masters of Science in Environmental Resources Engineering
 Illinois State University (Normal, IL) – Renewable Energy Program
 Marylhurst University (Marylhurst, OR) – MBA in Sustainable Business
 Oregon State University (Corvallis, OR) – Northwest Marine Renewable Energy Center (Coastal and Ocean Engineering Program)
 Portland State University (Portland, OR) – MBA with Sustainability Concentration
 Presidio Graduate School (San Francisco, CA) – MBA and MPA in Sustainable Management
 Slippery Rock University (Slippery Rock, PA) – M.S. in Sustainable Systems
 Stanford University (Palo Alto, CA) – MS/MBA Environment & Resources
 Texas Tech University (Lubbock, TX) – PhD in Wind Science and Engineering
 University of Michigan (Ann Arbor, MI) – MBA/MS Program in Global Sustainable Enterprise
 University of Nebraska (Lincoln, NE) – Center for Energy Sciences Research
 University of Washington (Seattle, WA) – Bioresource-Based Energy for Sustainable Engineering Laboratory
 University of Wisconsin (Madison, WI) – Solar Energy Laboratory
 Yale University (New Haven, CT) – Center for Business and the Environment: MBA, MEM, MF, MFS, MeSc

European Master in Renewable Energy (Core curriculum providers):

- Ecole des Mines de Paris, France
- Loughborough University, UK
- University of Zaragoza, Spain
- Oldenburg University, UK

Specializations for European Master in Renewable Energy:

- Hybrid Systems Specialization – Kassel University, Germany
- Wind Specialization – National Technical University of Athens, Greece
- Photovoltaics Specialization – University of Northumbria, UK
- Bioenergy –Specialization – University of Zaragoza, Spain
- Grid Integration Specialization – University of Zaragoza, Spain

JOB RESOURCE GUIDE

Social Media

Social media websites are becoming a popular way for companies to find employees and job seekers to find jobs. LinkedIn, in particular, is a useful tool for anybody searching for the latest available clean-tech employment opportunities.

LinkedIn Groups:		
Clean Edge Jobs	Clean Technology Job Network	CleanTechies Around the World
Cool Climate Jobs	Energy Professionals	Green Jobs & Career Network
Greenfoot Jobs	Green Tech	Power Generation Careers
Renewable Energy Jobs	Renewables Job Market	Utility Jobs

Job Boards

The number of clean-tech specific job websites seems to be increasing exponentially, but there are some clear leaders. Listed below are twenty of the best online job boards where you can find the latest clean-tech job opportunities

Careers in Wind (AWEA)	Grist Jobs
Clean Edge Jobs	Green Job Spider
CleanLoop	RenewableEnergyWorld.com
CleanTechies	SolarJobs.com
CleanTechRecruits	StartUpHire.com
Going Green Jobs	Low Carbon Jobs
Green Dream Jobs	TreeHugger: Job Board
GreenBiz.com	U.S. Green Building Council
GreenJobs.com	ECO Canada
GreenJobsSearch.org	RenewableEnergyJobs.com

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To learn more contact:

Scott Smith
Partner and Leader
US Clean Tech Practice
Deloitte & Touche LLP
+1 415 783 4226
ssmith@deloitte.com

Brian Goncher
Director
US Clean Tech Practice
Deloitte Services LP
+1 408 704 4553
bgoncher@deloitte.com

www.deloitte.com

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With 7 partners and over 20 recruiters spread across 3 offices in Valley Forge, PA and both New York, NY and San Francisco, CA, HTI has successfully performed critical CEO, Board and other C-Level and senior executive searches across all functional disciplines. HTI has worked closely and partnered with many of the leading investors and technology companies in the industry.



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Low Memorial Library, Columbia University
(116th and Broadway)

Environmental and Sustainable
Development Programs

**OPEN
HOUSE**

Interested in studying the environment or sustainable development? Columbia University and the Earth Institute have many programs that address these issues.

At the Environmental and Sustainable Development Programs Open House, learn how our programs can help you reach your educational goals.

Learn More About Our Two New Programs > Undergraduate Major in Sustainable Development
> M.S. in Sustainability Management

Undergraduate Programs

- Areas of Study:
- > Sustainable Development
 - > Earth Science
 - > Environmental Science
 - > Earth and Environmental Engineering
 - > Environmental Biology
 - > Environmental Policy
 - > Summer Ecosystem Experience for Undergraduates (SEE-U)

Postbaccalaureate Programs

- > Postbaccalaureate Program in Environmental Biology
- > Postbaccalaureate Program in Ecology, Evolution and Environmental Biology

Graduate Programs

- > M.S. in Sustainability Management
- > M.A. Conservation Biology
- > M.S. Earth Resources Engineering
- > M.A. Climate and Society
- > M.P.H. Environmental Health Sciences
- > M.P.A. Environmental Science and Policy
- > M.P.A. in Development Practice
- > M.I.A./M.P.A. Energy and Environment

Doctoral Programs

- > Ph.D. in Sustainable Development
 - > Ph.D. Earth and Environmental Engineering
 - > Ph.D. Earth and Environmental Sciences
 - > Ph.D. Atmospheric and Planetary Science (APS)
 - > Ph.D. Environmental Health Sciences
- Ph.D. Programs, Department of Ecology Evolution and Environmental Biology (E3B):
- > Ph.D. Ecology and Evolutionary Biology
 - > Ph.D. Evolutionary Primatology

Certificate Programs

- > Environmental Policy Certificate
- > Conservation Biology Certificate
- > Certificate in Conservation and Environmental Sustainability

Fellowships

- > Earth Institute Fellows Program

Other Graduate Credit-Bearing Programs

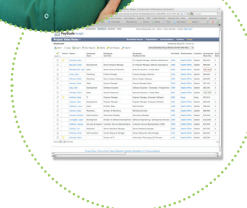
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AUTHORS

Ron Pernick, co-founder and managing director of Clean Edge, is an accomplished market research, publishing, and business development entrepreneur with more than two decades of high-tech experience. He is also the co-author of the highly acclaimed book *The Clean Tech Revolution* (Collins, 2007).

Clint Wilder, senior editor at Clean Edge, is an award-winning technology and business journalist. His book *The Clean Tech Revolution* (with co-author Ron Pernick), has been called "the best clean-tech book" by ClimateProgress.org and has been translated into seven languages.

Trevor Winnie, research and marketing associate, is involved in a range of activities at Clean Edge including the firm's stock index products and work related to reports and consulting projects.

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