

GLOBAL COMPETITIVENESS, CHINA AND CALIFORNIA'S EMERGING CLEAN ENERGY ECONOMY

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Global Competitiveness, China and California's Emerging Clean Energy Economy

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Executive Summary

Continuing its record of policy and technology innovation, California has taken center stage as a national and global leader in energy and climate policy, and in cutting edge clean energy technology development. In doing so, it has become the dominant U.S. state for venture capital investment in cleantech, with a growing lead over the rest of the nation. In the second quarter of 2010, cleantech investment in California totaled more than \$1 billion, accounting for 70% of total U.S. cleantech investment, and 50% of global investment in the sector.

California's public policy framework provides continuity that is important to investors. That framework includes measures to reduce the emission of greenhouse gasses and promote the deployment of renewable energy and energy efficiency technologies, including the Global Warming Solutions Act of 2006 (AB 32), the Sustainable Communities and Climate Protection Act (SB 375), a Low Carbon Fuel Standard, building and appliance efficiency standards, large-scale energy efficiency programs, a Renewable Portfolio Standard and, more recently, a Renewable Electricity Standard for electrical generation and the California Solar Initiative.

The passage of AB 32 in 2006 marked the beginning of a sustained rise in venture investment in California. Though not the only causal factor, AB 32's implementation standards and programs have been taken by investors to reflect a sustained commitment by the state to the shift from a carbon-based to a clean energy economy, incentivizing both entrepreneurs and venture capitalists to make long-term investments. While other components of California's suite of energy and climate policies play important roles, as California's comprehensive climate framework, AB 32 anchors state policy, providing the stability and continuity that investors need. It does this by providing confidence in the state's market for renewable energy technology over a 5–9 year time frame, the critical period for most venture investment. This is important because a predictable long-term framework helps mitigate market risk.

Entrepreneurs who are on the receiving end of venture or other investment, and are also making long term bets, share this concern with risk reduction and market stability. There is a clear link between public policy, the standards it sets, and the incentives it provides for the development of cleantech industries. These policies are particularly important in the early stages of a sector's development, when commercial markets are growing but not yet fully developed.

California's success to date, however, needs to be seen in a global context, as other nations are adopting policies and providing governmental financial support that are in some cases equally or more aggressive and, in the process, are creating globally competitive cleantech sectors. The bar is being set by Germany, which is a global leader in solar and wind, and China, which has emerged as a major global producer of solar, wind, battery and other cleantech products. China's strong position in particular raises policy and economic issues for California.

This paper examines three key issues: (1) The link between state energy and climate policy and cleantech sector development, (2) global competition for cleantech leadership and its consequences for California's economy, and (3) the particular challenges and opportunities presented by China's emergence as a major player in global cleantech markets.

A global perspective is critical, since the sector is in its early stage of development and California's long-term leadership is by no means assured. Should California fail to produce cleantech companies that aggressively compete in both domestic and global markets, other countries will readily fill the void, costing California jobs and growth.

While many countries around the world are adopting policies to reduce fossil fuel consumption and increase energy efficiency and renewable energy production, China is the most important:

- ◆ China is already the world's leading supplier of solar photovoltaic panels, accounting for 30% of world production. It is currently tied with the U.S. for installed renewable energy capacity but is growing its capacity three times faster. China is also poised to emerge as a significant global player in wind turbine, lithium battery and electric vehicle production.

China also presents California with an opportunity, however—as a market for California products and services and as a source of investment:

- ◆ Its growing demand for energy efficiency and renewable energy products—spurred by clear governmental policies and strong funding—is transforming China into an important market for cleantech goods and services. For example, China has emerged as a major market for the equipment used to make solar cells, and Chinese producers will likely turn to California's superior technology to improve their solar panels' efficiency. China's market for electric vehicles also presents significant opportunities.
- ◆ On the investment side, solar, wind, battery and electric vehicle companies from China are seeking a foothold in the U.S. and California markets. Nine Chinese solar companies, including China's three largest, have recently opened offices in San Francisco, and China's leading battery producer has established its North American headquarters in Southern California. This presence is primarily focused on sales and service, which in itself can be a significant source of jobs. Some of these companies will eventually manufacture in the U.S., much as Japanese auto manufacturers did starting

in the 1970s and 80s. California will have to compete aggressively for these facilities, as neighboring states have crafted targeted tax and regulatory policies to attract cleantech production and are having early success.

- ◆ California-China research and cooperation in fields such as energy efficiency can address new markets and meet shared objectives of lower GHG emissions and reduced dependence on fossil fuels.

While still in its infancy, the cleantech market will over time produce a diverse range of companies, jobs and opportunities. Even with strong domestic and international competition, California can capture a significant share of those jobs and opportunities by leveraging its market and by competing based on its capacity to generate entrepreneurial companies and innovative technologies. According to Next 10, green businesses in California grew 45% in number and 36% in employment from 1995–2008, and from 2007–2008, as total employment in California fell 5%, green jobs grew 5%. There are currently an estimated 500,000 clean energy jobs in the state.

The state's R&D base, its venture community and its track record of innovation suggest that California can be a strong international partner and competitor. Capturing the full extent of this opportunity will require a sustained commitment to AB 32 and other policies that help make California a leader in the new clean energy economy, support the nascent cleantech market, and provide a more stable long-term environment for cleantech investors and entrepreneurs. The opportunity and challenge for California is to lead the systemic worldwide shift toward a clean energy economy and, in the process, create a California-based, globally competitive energy efficiency and renewable energy industry.

Introduction

The transition from a fossil-fuel-based economy to one increasingly based on energy efficiency and renewable, low CO₂-emitting energy sources is underway. While dependence on fossil fuels will remain high for at least several decades, measures are being taken worldwide through both government policy and private action to begin the shift. While the degree of policy focus and the resources available to pursue them varies, this trend is shared across developed (OECD) economies and is increasingly shared by major emerging economies as well.

A core motivating factor is the need to reduce dependence on oil imports (i.e., increasing energy security and lowering energy import costs). For some larger economies, support for the emerging energy efficiency and renewable sector is also an important component of national economic policy. Cleantech development is becoming central in economic strategies aimed at both national security and global competitiveness. By setting goals and standards, as well as incentives and disincentives, public policy is a core driver of these strategies, influencing both markets and behavior.

With an economy equivalent in size to many larger nations (California ranks eighth among world economies, just behind Italy and ahead of Russia and Spain), California and its policies are fixed in this global setting. This is a function not just of the size of its economy, but also its leadership as a global center of technology and innovation. It is also reflected in California's status as the second largest exporting state in the nation (just behind Texas), particularly for high technology.¹

The development of an alternative energy industry is therefore a promising focus for California's policy and economic development. California's policies need to be seen in a global context, however, as other governments are making similar policy commitments, providing major long-term financial support, and private companies are investing in alternative energy R&D and production, in some cases more aggressively and on a larger scale than in the United States. This trend can be seen in much of Europe,

¹ TechAmerica, 2010.

but is particularly noteworthy in China, which has launched a concerted effort to develop a globally competitive alternative energy sector. China's growing strength in this field presents distinct challenges for California, as well as opportunities.

The analysis that follows is not designed to present a comprehensive compendium or detailed analysis of California, Chinese, or global energy and climate change policies, nor does it present policy prescriptions. What it does do is present California's climate and energy policies in a global setting, asking whether there is a clear linkage between policy and the development of energy efficiency and renewable energy industries.

California Climate Policy

That assessment starts with current California policy. State energy policy engages a complex set of measures, some dating back more than 60 years. The earliest focus was on energy efficiency and conservation, while more recent policies aim at climate change and reducing greenhouse gas (GHG) emissions. While California has a diverse portfolio of initiatives designed to meet energy and climate goals (see www.energy.ca.gov), climate, transportation, efficiency, electrical generation, buildings, investment and manufacturing are its core components.

Climate

AB 32 (Global Warming Solutions Act of 2006)

The first and most aggressive state-level climate law in the nation, AB 32 seeks to limit greenhouse gas (GHG) emissions to 1990 levels by 2020 and targets an 80% reduction by 2050. As the state's comprehensive law, AB 32 provides the strategic framework for California's many other energy and climate initiatives.

Transportation

Low Carbon Fuel Standard (Executive Order S-01-07)

Under the AB 32 mandate, in 2007 California created the world's first carbon standard for transportation fuels, requiring that the carbon intensity of transportation fuels sold in California be reduced at least 10% by 2020.

SB 375 (the Sustainable Communities and Climate Protection Act of 2008)

SB 375 requires the California Air Resources Board (CARB) to set regional emissions goals in concert with the state's 18 Metropolitan Planning Organizations (MPOs). Targets will be set for 2020 and 2035, against a 2005 baseline year. To meet them, regions are each required to develop a Sustainable Community Strategy (SCS) to be incorporated in their regional transportation plans. The objective is to make travel more efficient, reducing vehicular emissions. Regional targets are being developed in concert with the CARB, which is also responsible for administering the provisions of AB 32.

Targets must be adopted by September 30, 2010, and must be updated every four years.

Efficiency

California began the nation's energy efficiency efforts over thirty years ago. Since then, it has been the worldwide leader in energy efficiency, through both mandatory codes and standards and in voluntary, ratepayer-funded programs. In 2008, it adopted the California Long-term Energy Efficiency Strategic Plan (www.californiaenergyefficiency.com), which is now the state's roadmap for energy efficiency. The Plan is the most comprehensive document in the world for describing how to pursue energy efficiency in all sectors of the economy and provides a long-term signal to investors of the types of energy efficiency programs and technologies that policy makers are pursuing. The following standards are key examples.

Building Efficiency Standards (2008)

The current standards, effective January 2010, require an average 15% increase in energy savings over standards set in 2005.

Appliance Efficiency Standards (2009)

The latest appliance efficiency standards, effective August 2009 for general purpose lighting, target a phased 50% increase in efficiency for residential general service lighting by 2018.

Electrical Generation

Loading Order for Electricity Resources

California has adopted a unique "load order" for energy, calling for meeting new electricity needs first with energy efficiency and demand response; second with new generation from renewable energy and distributed generation; and third from clean fossil-fueled generation and transmission infrastructure improvements.

Renewable Portfolio Standard (2002)

The standard requires retail sellers of electricity to provide 20% of their power from renewable sources for electricity by 2010.

Executive Order S-06-06

The order requires the state to meet 20% of the Renewable Portfolio Standard with biofuels.

Executive Order S-14-08 (2009)

This order accelerates the Renewable Portfolio Standard requirement to 33% by 2020 and was adopted as a regulatory standard by the California Air Resources Board in September 2010.

California Solar Surplus Act of 2009 (AB 920)

As of January 2011, AB 920 allows residential and business customers of utilities to sell excess electricity from installed solar photovoltaic and wind systems back to the grid.

Buildings

California is the nation's leader in building efficiency. Current standards target the reduction of energy consumption in state and commercial buildings by 10% per square foot by 2010 and 20% by 2015.

The California Solar Initiative, overseen by the California Public Utilities Commission (CPUC) with \$2.9 billion in funding, subsidizes residential solar installation and makes solar power a standard option in new housing developments.

Investment

Ratepayer-Funded Efficiency Programs (administered by utilities, local governments and third parties)

By law, California sets long-term energy efficiency goals and uses ratepayer funds to assist in meeting them. The current CPUC program provides \$3.7 billion

in funding for 2010–2012. Key initiatives include commercial building benchmarking, a statewide education campaign, launch of the nation’s largest home retrofit program, and a “zero net energy” effort.

CalPERS and CalSTRS

Since 2004, California’s largest public pension fund, CalPERS, has invested in private equity funds and partnerships that focus on cleantech and in the stocks of public companies that produce environmentally beneficial technologies or employ business strategies that reduce environmental degradation. The state’s other large public pension fund, CalSTRS, has invested in cleantech and clean energy through private equity partnerships and co-investments. The two investment funds together have allocated approximately \$500 million.

Public Interest Energy Research Program (PIER)

Administered by the California Energy Commission, PIER leverages funds from electricity and natural gas ratepayer surcharges (\$86.5 million in 2009) to fund research on energy efficiency and demand response, renewable energy, advanced generation, transmission and distribution, and energy-related environmental applications. Recent funding has included climate change, smart grid, renewable resource integration, advanced fuel technologies, zero net energy homes, and carbon capture and storage.

Manufacturing

In March 2010, Governor Schwarzenegger signed SB 71, which provides solar, wind and other clean energy technology firms an exemption from the state’s 8.25% sales tax for the purchase of manufacturing equipment. Designed to encourage cleantech production in California, the carve-out is an exception to state law which taxes such purchases in other industries. California is currently one of only three U.S. states to tax the purchase of manufacturing equipment, a policy that has been criticized as discouraging manufacturing and related employment in the state. SB 71 supplements the California Energy Commission’s Clean Energy Manufacturing Program, which provides \$90 million in financing for

the production of energy efficiency and renewable energy components, systems and technologies; alternative and renewable fuels; and energy-efficient vehicles and vehicle components. The small size of the financing increments available under the program, however, limits its utility.

These policies remain works-in-progress, with standards being increased or target dates moved forward in order to meet accelerated energy savings or GHG reduction goals. Executive Order S-14-08 is a case in point. The California Energy Commission is also considering additional building and appliance standards targeting zero net energy residential buildings by 2020 and zero net energy commercial buildings by 2030.

A number of these policy measures have generated, or are likely to generate, a range of public benefits. For example, energy conservation and efficiency enables businesses to become more competitive by reducing energy costs and saves consumers money. It also serves to reduce air pollution and increase grid reliability by lowering demand at peak generation times, reducing the need for new power plants and transmission infrastructure. Due to the state's efficiency policies and programs, California's per capita energy use over the last 30 years has remained flat, even as its population has increased and its economy has grown. The U.S. Department of Energy ranks California 47th out of the 50 U.S. states in per capita energy consumption. The state's record contrasts with the national pattern of energy consumption, which has seen a sustained per capita increase.

California's Emerging Clean Energy Economy

California businesses are also responding to the combination of state policy and federal stimulus, led by entrepreneurs and investors who are betting that the inevitable transition from a fossil-fuel- to a renewable-energy-based economy will offer major opportunities. Reflecting the state's history of entrepreneurship and innovation, California has secured a leading national position in cleantech sector development. By setting goals and standards and by providing financial resources, state and federal policies are playing an important role in defining and creating future markets.

Cleantech Patents

Reflecting its historic strength in innovation, California leads the country in cleantech patents and is the top state for advanced batteries, solar and wind. California had a total of 458 patents registered in the 2007–2009 period, ahead of New York (307), Michigan (295), Texas (135) and Massachusetts (110).²

Cleantech Investment

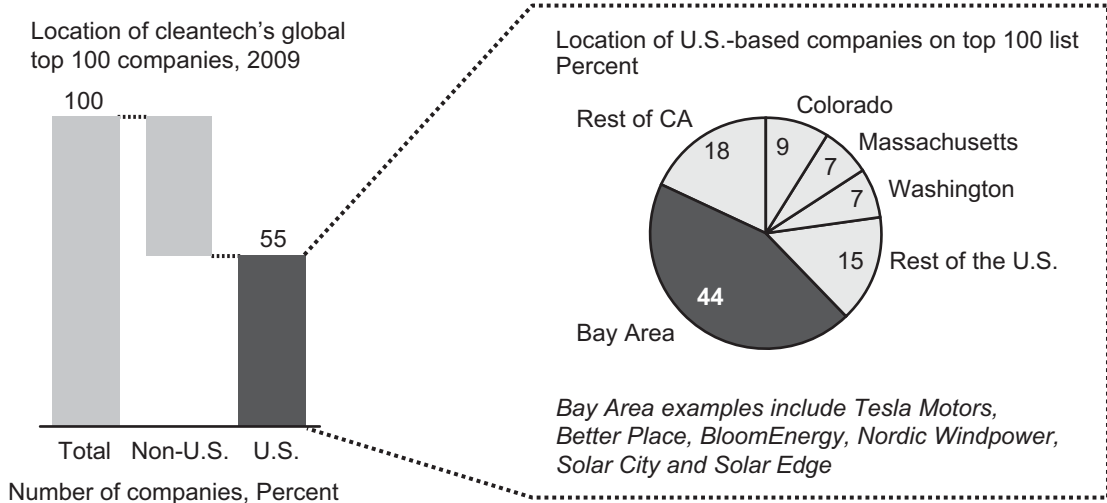
California has become the dominant state for cleantech venture investment in the U.S. In every quarter since 3Q 2006, when AB 32 was signed, California cleantech companies have attracted critical venture finance, with the gap between California and other states growing over time.

From 1998 to 2007, California led all U.S. states in venture capital invested in clean energy technology companies (\$6.58 billion—ahead of Massachusetts at \$1.27 billion and Texas at \$717 million), and in the number of clean technology patent registrations (1,400—ahead of New York's 90 and Michigan's 749).³

² Next 10, *California Green Innovation Index*, October 2010, pp. 24–26.

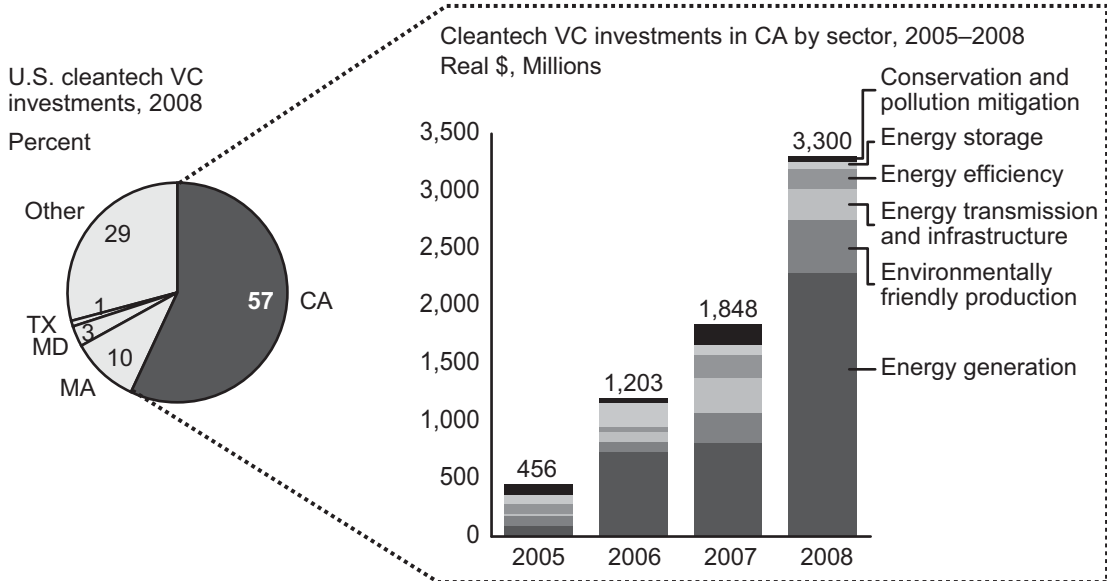
³ Pew Charitable Trusts, *The Clean Energy Economy: Repowering Jobs, Businesses and Investments Across America*, June 2010, pp. 3–8.

From a global perspective, more than half (55%) of the world's most promising cleantech companies are in the United States.⁴ Of those, nearly two-thirds (62%) are in California.



Source: Cleantech Group's global top 100 cleantech companies; 2009, BACEI/McKinsey analysis

Viewed from a national perspective, California received over 57% of U.S. venture funding going into cleantech in 2009 (\$3.3 billion). Most was invested in solar, wind and biofuels.



Source: CA Innovation Index 2009 Next 10; Cleantech Group; Collaborative Economics; BACEI/McKinsey analysis

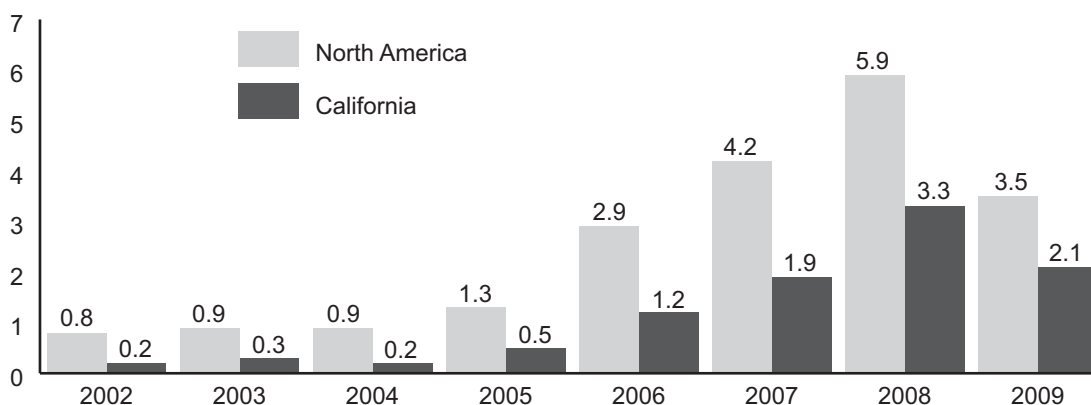
⁴ Non-U.S. companies (and number of companies) include: UK (13), Germany (10), Israel (5), Sweden (4), France (3), India (3), Denmark (2), and one company each in Norway, Canada, Italy, Luxembourg, and Switzerland.

The Cleantech Group reports that worldwide in 2009 there were 557 venture investments in cleantech worth \$5.6 billion. These were concentrated in North America, Europe, Israel, China and India. Approximately one-quarter of venture investment worldwide went into cleantech—more than into software, biotech or any other traditionally dominant sectors. This suggests cleantech’s imminent emergence as an industry and investors’ belief that cleantech markets will grow.

Investment levels in 2009 were 33% below 2008, reflecting the general decline in the national and global economies. Cleantech investment, however, declined less than investment in other sectors. California was the leading state, with \$2.1 billion invested in 116 deals (a 38% decline from 2008), followed by Massachusetts (\$356 million in 27 deals, an increase of 21% from 2008) and Texas (\$170 million invested in 19 deals, an increase of 93% from 2008).⁵

Cleantech venture investment rebounded in the first half of 2010, up 53% from the same time a year earlier. California companies such as Better Place, BrightSource Energy and Miles Electric Vehicles were major recipients. In the second quarter, venture investment in cleantech in California totaled more than \$1 billion, accounting for 70% of U.S. investment and 50% of global investment in the sector.⁶

Cleantech Venture Investments in North America and California (\$ billion)



Source: Cleantech Group

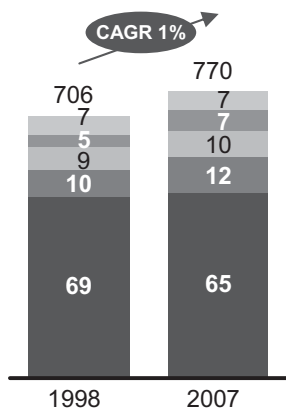
⁵ Cleantech Group, “Clean technology venture investment totaled \$65.6 billion in 2009 despite non-binding climate change accord in Copenhagen, finds the Cleantech Group and Deloitte,” January 6, 2010.

⁶ Cleantech Group, Cleantech Investment Monitor, August 23, 2010.

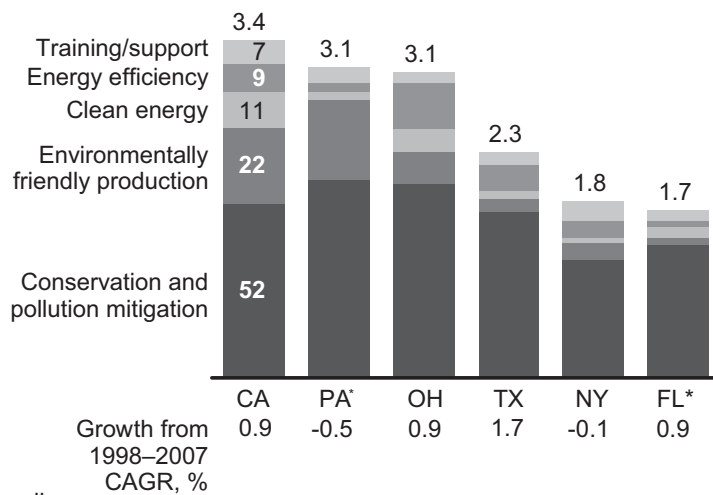
This investment directly correlates to employment, as venture capital has proven to be a rapid and effective source of job creation. Nationally, 11% of private sector employment can be traced to venture investment.⁷ A Cleantech Group analysis estimates that 2,700 jobs are directly created for every \$100 million in venture investment, at an average of \$37,000 per job.⁸

Cleantech is creating jobs, especially in California where clean energy accounts for a larger share of jobs and in the U.S. overall.

U.S. cleantech jobs, 1998–2007
Percent, thousands of jobs



Cleantech jobs by top U.S. states, 2007
Percent, cleantech jobs per 1,000 population



Note: not all numbers add due to rounding

* Estimated values for PA energy efficiency and environmentally friendly production and for FL clean energy and environmentally friendly production, estimates based on known totals

Source: Pew’s The Clean Energy Economy Report, 2009; BACEI/McKinsey analysis

Though still modest, employment generated by energy efficiency and cleantech companies is growing, with California accounting for the highest proportion of cleantech jobs of any U.S. state. This spans a range of disciplines, including conservation, efficiency and manufacturing. Estimates of the number of cleantech or clean energy jobs in California vary, with different organizations using different methodologies for what constitutes a green job. The Pew Charitable Trusts finds that from 1998–2007, clean economy employment in California grew faster than employment in the economy as a

⁷ HIS Global Insight, “Venture Impact,” 2009.

⁸ Cleantech Group, “Cleantech thriving in California under AB 32, shows data,” April 5, 2010.

whole, accounting for approximately 125,000 jobs across 10,000 companies.⁹ Pew defines the clean energy economy as including clean energy, energy efficiency, environmentally friendly production, conservation and pollution mitigation, and training and support. The state's Employment Development Department (EDD) finds 300,000 Californians engaged in jobs relating to green products or green services, or 3.8% of the state's workforce.¹⁰ This is a higher proportion than in other states such as Washington, Oregon and Michigan, where similar surveys were conducted. EDD defines these job categories as generating and storing renewable energy; recycling; energy-efficient manufacturing, distribution, construction, installation and maintenance; education, compliance and awareness; and natural and sustainable product manufacturing. Next 10 puts the number at 500,000.¹¹ Next 10 estimates that from 1995 to 2008, California green businesses grew 45% in number and 36% in employment, and that from 2007 to 2008, as the economy slowed, total employment fell 5% but green jobs grew 5%. Green job growth from 1995–2008 was spread across California regions, with Sacramento at 87%, San Diego 57%, the Bay Area 51%, and Orange County and the Inland Empire 50%. This growth spanned jobs from energy efficiency and generation, to environmental consulting, transportation and logistics.

Clean Edge's Clean Tech Job Trends 2010, which ranks the top 15 metropolitan areas in the U.S. for cleantech jobs (based on metrics such as job postings, early stage investment activity, job presence and patent activity), ranks the San Francisco Bay Area #1, Los Angeles-Long Beach-Riverside #2, San Diego-Carlsbad-San Carlos #7, and Sacramento-Roseville #15. This indicates both the extraordinary strength of cleantech in the Bay Area and the impressive spread of cleantech activity across all of California's major metropolitan regions.

Expanding cleantech activity spans established companies (such as Cisco, Hewlett Packard and Google, which are building business lines based on IT and smart grid applications) as well as new entrepreneurial businesses. As recent examples of

⁹ Pew Charitable Trusts, "The Clean Energy Economy: Repowering Jobs, Businesses and Investments Across America," June 2009.

¹⁰ State of California Employment Development Department Press Release, "State Survey Identifies Over 300,000 Jobs in California With Major Emphasis on Green Practices," April 21, 2010.

¹¹ Next 10 press release, "CA Green Job & Business Growth significantly Outpace Rest of CA Economy," December 9, 2009.

expanding cleantech production, thin film solar panel manufacturer Solyndra expects to employ 1,000 workers when its recently opened Fab 2 plant in Fremont is fully operational. Tesla's new manufacturing facility, also in Fremont, is expected to support 1,000 jobs, partially offsetting the more than 5,000 jobs lost in the 2010 closing of the GM-Toyota NUMMI (New United Motor Manufacturing Inc.) plant, which Tesla will now occupy. Fisker Automotive, a producer of plug-in hybrid cars located in Irvine, has received a \$528 million DOE loan. Serious Materials, a producer of energy-efficient building materials and windows, has a workforce of 400, 120 of which are in California. Bloom Energy, a producer of fuel cells for distributed power generation, will employ 700 at its Sunnyvale facility.

With a raft of California clean energy companies and projects moving toward commercial production, federal stimulus funds are sending more resources to the state. Solyndra received a \$535 million loan guarantee from the Department of Energy for its new 600,000 square foot manufacturing facility in Fremont; Tesla Motors received a \$465 million federal loan guarantee to support manufacturing at the closed NUMMI plant, also in Fremont. Green Volts (solar cells), and Amyris Biotechnologies (biodiesel) have also received stimulus funds. Projects in the pipeline include BrightSource's Ivanpah Solar Project (in San Bernardino County) and Solar Millenium's Palen Solar Project (in Riverside County). Other innovative California companies such as Envia Systems (lithium batteries) and PAX Streamline (wind turbines) are being funded through ARPA-E, which invests in high risk/high return companies.

California in Perspective: Global Energy and Climate Policies

“The U.S. needs to be paranoid about losing ground to other countries [in cleantech]. Some of them are just able to spend more money. It’s not just China—it’s other countries as well. Europe always leads on policy, China has the market.”

—Jeffrey Immelt, CEO, General Electric

Notwithstanding the ambitious nature of California’s energy and climate policies, and positive developments in its renewable energy sector, California is not alone in its climate focus, or in its goal to encourage the development of cleantech as a sector. To varying degrees, nations throughout the world are devising policies to increase energy efficiency, reduce dependence on oil, and support the development and deployment of renewables.

The Pew Charitable Trusts finds that virtually all G-20 countries have seen investment in the sector grow by more than 50% in the last five years.¹²

As of early 2010, more than 100 countries have enacted policy targets and/or supportive policies relating to renewable energy, up from 55 countries in early 2005. Common measures include feed-in tariffs and targeted shares of electricity production from renewable sources. Globally, this has generated an estimated 3 million direct jobs in renewable energy industries.¹³ Recognizing the business opportunity, leading economies are supporting in a focused manner the development of energy efficiency and renewable energy as a new industrial sector. Denmark and India are major players in wind power, and Germany and Spain in solar. While it is beyond the scope of this analysis to identify all of these countries and their policies, because of its size, economic momentum and ties with California, China offers a useful reference point for California business and policymakers when considering strategies for climate policy and cleantech sector development.

¹² Pew Charitable Trusts, “Who’s Winning the Clean Energy Race? Growth, Competition and Opportunity in the World’s Largest Economies,” May 2010, pp. 4.

¹³ Renewable Energy Policy Network for the 21st Century (REN21), *Renewables 2010 Global Status Report*, 2010, pp. 9–11.

China

“We should see scientific and technological innovation as an important pillar and make greater effort to develop new industries of strategic importance. Science and technology is an important engine of economic growth... We will make China a country of innovation... We will accelerate the development of a low-carbon economy and green economy so as to gain an advantageous position in the international industrial competition.”

—Premier Wen Jiabao, World Economic Forum, September 2009

China’s sustained economic growth rates (averaging 10% per year for more than three decades), its large bilateral trade surplus with the U.S., and its foreign exchange reserves totaling more than \$2.4 trillion have captured global attention. As part of its role as a global manufacturing platform and export powerhouse, China is also rapidly developing as both a producer and consumer of renewable energy technology. This transformation is driven by several factors: the need to meet the energy requirements of a rapidly growing economy; a desire to reduce dependence on potentially vulnerable oil and gas imports (since the early 1990s China has been a net oil importer); environmental pollution that already poses a major health challenge and at some point could become a destabilizing political issue as well (across China, less than 44% of seriously polluted water is treated and 59% of cities suffer from severe air pollution); and global pressure to address climate change.¹⁴ The seriousness with which China takes these challenges is reflected in the fact that national, provincial and local government officials, who in the past were evaluated almost solely based on their success in meeting investment or production targets, are now also evaluated based on their success in meeting energy and environmental goals.

Recent reports point to the negative environmental impacts of recent economic growth, adding pressure on China’s government to revise its policy priorities. The first official report on vehicular pollution by the Ministry of Environmental Protection, released in November 2010, points to vehicle exhaust emissions as the principal contributor to worsening air pollution in China’s big cities. It directly links deteriorating air quality with China’s recent explosion in automobile sales. According to the

¹⁴ Deloitte, “Cleantech in China,” 2009, pp. 7.

Ministry, the number of vehicles in China rose 9.3% to 170 million in 2009, 25 times the number in 1980. Automobile sales in 2009 reached 13.64 million, a 46% annual increase.¹⁵ Another 2010 analysis, by Chinese Academy of Agricultural Sciences deputy dean Tang Huajun, predicts that China will suffer a 5–10% crop loss by 2030 if climate change continues. Tang estimates that output of the country's three main foods—rice, wheat and corn—could decline by as much as 37% by the latter part of the century.¹⁶

The global recession of 2007–09 accelerated China's commitment of resources to energy. Its \$586 billion stimulus program committed \$177 billion to clean energy technology deployment, with a large segment targeted on energy infrastructure and preference given to domestically produced products. Prominently included in the plan is the build-out of a national high-speed rail network. A highly successful route that has effectively supplanted air travel has been completed between Beijing and Tianjin, and a second has opened between Shanghai and Hangzhou. The world's fastest train service (194 mph) began operation in 2009 between Wuhan and Guangzhou.

In July 2010, the Ministry of Railways upped the ante, announcing plans to double the national high-speed rail network from 7,000 to 13,000 km by 2020. This stimulus commitment came on top of a prior commitment of \$200 billion to energy and environmental protection under the 11th Five Year Plan. Recent reports indicate that China is planning to invest an additional \$739 billion in “newly developing energy industries” through 2020.¹⁷

China's renewable energy policy is also motivated by a fifth factor with implications for California and the United States—the goal of creating a globally competitive renewable energy industry. To understand this drive it is first necessary to recognize the magnitude of China's energy and environmental challenges. The International Energy Agency (IEA) reports that in 2009 China overtook the United States to become the world's largest energy consumer. A decade ago China's consumption

¹⁵ Wang Qian, “Car Sales Blamed for Pollution,” *China Daily*, November 5–7, 2010.

¹⁶ Jin Zhu, “Climate Change ‘Takes Toll’ on Grain Harvest,” *China Daily*, November 5–7, 2010.

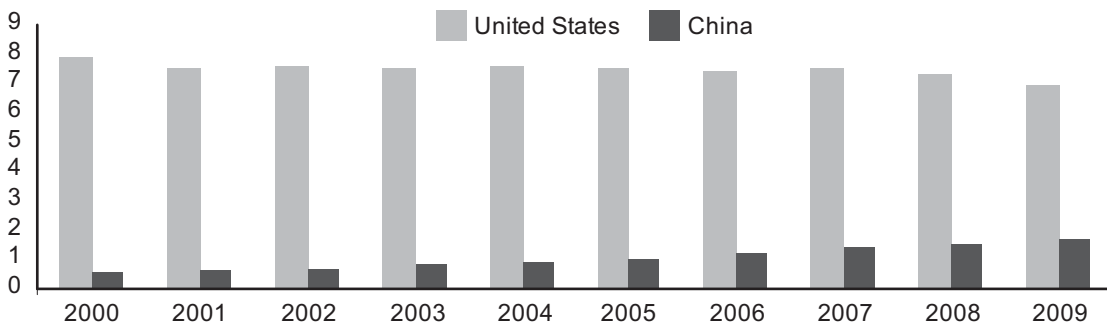
¹⁷ *Inside Cleantech*, September 3, 2010.

was only half that of the U.S. Looking ahead, to sustain its economic expansion, China, over the next 15 years, will need to massively build new generation capacity equal to the entire current generation capacity of the United States.

This surging demand lies behind China’s global push to secure the oil and gas supplies. It also explains a more problematic benchmark: in 2007 China passed the United States to become the world’s largest emitter of greenhouse gasses. This is largely rooted in coal. China is currently the world’s largest producer and consumer of coal, a major source of GHG emissions. Coal consumption doubled from 2000 to 2007 and is expected to double again by 2015. In 2008, Chinese coal consumption alone accounted for more than 17% of all energy-related CO₂ emissions globally.

While China resisted pressure (from the U.S. and developed economies at the 2009 Copenhagen climate conference) to commit to a formal cap on GHG emissions and opposed international verification, it agreed to target a reduction in carbon intensity—the amount of carbon produced per unit of GDP—at 40–45% of 2005 levels by 2020. Since per capita energy consumption is far below U.S. levels, this reflects a strategy that, while improving efficiency and supporting new technologies, still allows for increased energy consumption and emissions in absolute terms. Chinese officials active in the negotiations have stated that national interests take priority over global frameworks and that as a developing nation, China will not commit to measures that would constrain its growth.¹⁸

Total Primary Energy Consumption per Capita (metric tons of oil equivalent)



Sources: International Energy Agency; BP Statistical Review.

¹⁸ “China’s interests must come first”, *China Dialogue*, August 27, 2010.

Nevertheless, China is making a substantial commitment to energy efficiency and the development of renewables. Its Medium-to-Long-Term Science and Technology National Plan, which sets innovation policy through 2020, identifies “energy, water resources and environmental protection” as one of five areas for priority technology development. This science and technology focus connects to a suite of specific energy policies. The foundation is established in the 11th Five Year Plan (2005–2010), which has been supplemented by a number of key policy pronouncements, including the National Climate Change Programme (2007), a more recent white paper on climate policy by the State Council, and a carbon reduction target announced in the aftermath of the 2009 Copenhagen climate conference. With this framework, China has established a range of energy and climate policy benchmarks:¹⁹

- ◆ a *clean energy standard* mandating that 15% of China’s primary energy come from non-fossil sources by 2020 (China currently gets approximately 9% of its energy from these sources);
- ◆ an *energy efficiency target* mandated by the 11th Five Year Plan, requiring that energy intensity (energy use per unit of GDP) drop to 20% below 2005 levels by the end of 2010;
- ◆ a *carbon target* to reduce carbon intensity (greenhouse gas emissions per unit of GDP) to 40–45% below 2005 levels by 2020;
- ◆ a *generation target* which requires power generators with capacity over 5 MW to have installed non-hydro renewable energy capacity accounting for 3% of total capacity by 2010 and 8% by 2020.

¹⁹ National Development Reform Commission, People’s Republic of China, “Medium and Long-Term Development Plan for Renewable Energy in China,” September 2007; Sandalow, David, Assistant Secretary of Energy for Policy and International Affairs. Statement to U.S.-China Economic and Security Review Commission Hearing April 8, 2010; Gordon, Kate, Julian Wong and JT McLain, “Out of the Running? How Germany, Spain, and China are Seizing the Energy Opportunity and Why the United States Risks Getting Left Behind,” Center for American Progress, March 2010, pp. 8–9.

These broad goals and targets are supported by an array of technology and sector-specific policies, targets and incentives that are achieving impressive results.

Efficiency

China's 2005 Medium and Long-term Energy Conservation Plan sets detailed targets for energy and resource efficiency across more than twenty industrial sectors and equipment types and identifies ten priority energy conservation projects in coal, oil, buildings, lighting, transportation and other areas. Aggressive efficiency targets have been set for China's 1,000 most energy-intensive industrial enterprises, and many smaller sub-scale, energy-inefficient enterprises have been closed. These targets have stimulated both government and other investment, and preliminary indications are that the goals in the plan will largely be met.

Approximately \$1.3 billion was invested by the central government in energy conservation in 2007, \$3.5 billion in 2008, and \$5.1 billion in 2009. This came on top of \$8.5–14.2 billion invested directly by enterprises and energy service companies.²⁰

In November 2010, China's government enacted national demand side management (DSM) regulations requiring utilities to use energy efficiency to reduce electricity sales by .3% per year over the previous year's sales volume, with full cost recovery for DSM programs.

Wind

China's wind generation capacity has grown exponentially. From 2.6 MW in 2006, capacity more than doubled to 6 GW in 2007 and doubled again to 12 GW in 2008 with an additional 9 GW added in 2009. In the process, the initial 2010 target of 5 GW was met ahead of schedule, and the 2020 target has been tripled from 30 GW to 100 GW. As this has occurred, China has recently overtaken Spain to become the world's third-largest site for installed wind power.

²⁰ Mark Levine, "Energy Efficiency Investments in China," U.S.-China Clean Energy Forum on Financing Energy Efficiency in China, February 23, 2010.

The National Development and Reform Commission's Wind Power Concession Project, established in 2004, promotes the creation of large-scale wind farms by calling on utilities to enter into long-term power purchase agreements with developers, with the agreement covering the forecast operational period of the farm. End users pay a higher tariff to reflect the cost. Under this program, a series of "Three Gorges in the Air" mega-wind farms generating ten or more GW are being constructed. The feed-in tariff, coupled with government's protective measures, has been credited with the wind industry's formidable expansion. As much as one-third of this power is still unconnected to the grid, but in 2009 China amended its renewable energy law to require grid operators to purchase all renewable power produced by generators, develop transmission capacity and invest in smart grid technologies.

Solar

China is the world's largest supplier of solar photovoltaic (PV) panels, accounting for one-third of global production. More than 90% of that production is currently exported, primarily to European countries with established feed-in tariffs, such as Germany and Spain. Recent cuts to those tariffs have cooled European demand, leading China to place increased emphasis on growing its domestic market. It is also looking to new markets, including the United States. The Medium and Long-Term Plan for Renewable Energy targeted 300 MW of solar power by 2010 and 1.8 GW by 2020. With the rapid development of the sector, however, the 2020 target is being moved forward to 2011.

The government has proposed a feed-in tariff for solar, and has announced that it will pay up to 70% of the cost of solar PV projects designated by provincial governments. A Solar Roofs program announced by the Ministry of Finance in March 2009 subsidizes large-scale roof-mounted solar PV systems above 50KW with a \$2.93 per watt subsidy covering up to half the cost of installation. At the residential level, China's domestic market for solar water heaters is already large; 10% of households have solar heaters, with 30% targeted by 2020. China is currently home to more than 75% of the world's solar hot water systems.

Transmission

China plans to install 4,000 miles of advanced, ultra-high voltage (UHV) lines, doubling its network of these lines that lose up to 30% less energy in transit than conventional lines. State Grid, China's largest utility, will invest \$44 billion through 2010 and \$88 billion through 2020 in UHV transmission.

Vehicles

Chinese policy on vehicle emissions is driven by concern with worsening pollution, and by the goal of creating a globally competitive electric vehicle industry. China's fuel economy standard is 36.7 miles per gallon, higher than in the United States, and regulations are being considered that would raise this to 42.2 MPG by 2015. Differential tax rates for vehicles with different engine displacements (higher rates for vehicles with larger engine displacement and much lower rates for vehicles with smaller displacement) are, in combination with high fuel efficiency standards, attempting to shift consumer purchases toward smaller vehicles. A draft law, adopted by the State Council in October and expected to be finalized in the spring of 2011 will accelerate this policy by further reducing taxes on cars with fuel efficient, clean energy and small displacement engines, while significantly raising taxes on vehicles with larger engine capacity (above 2.5 liters).

China's stimulus package included \$3 billion in funding for electric vehicle pilot projects in 13 cities, including rebates for buses and municipal government and taxi fleets; a June 2010 package of incentives announced by the Ministry of Finance provides subsidies for the purchase of pure electric and plug-in hybrid vehicles. The Automobile Industry Adjustment and Stimulus Plan, announced in March 2009, aims to expand the production and sale of hybrid or all-electric vehicles to 500,000 per year by 2012 and to double that figure by 2015.²¹ A further plan by the Ministry of Science and Technology sets the target of having 10% of all new vehicles be low-carbon by 2012.

²¹ Zhu, Shenshen, "Charge of 'New wave' of Electric Cars to Roll", *Shanghai Daily*, June 18, 2010.

To accelerate the production of electric vehicles, an alliance of 16 of China's largest state-owned companies (operating under the supervision of the State Council) was announced in August 2010. Participants include China's three major oil companies, two grid operators and two automobile companies, with \$14.7 billion targeted for investment by 2012. In addition to R&D on vehicles, the alliance will focus on fuel cells, charging stations and standards. Achieving these goals will stimulate China's growing market for advanced batteries, benefiting other companies such as BYD, a battery and automobile producer that unveiled its first battery-powered car in 2008 and recently formed an electric vehicle joint venture with Germany's Daimler. Warren Buffett is another BYD investor.

Transportation

China will spend \$1 trillion to expand its railway system from 49,000 miles currently to 75,000 miles by 2020, of which 8,000 miles will be high-speed rail.

Biofuel

From a 2008 level of 3.6 GW, the Medium and Long-Term Development Plan for Renewable Energy targets installed generation capacity from biomass at 5.5 GW in 2010 and 30 GW by 2020. From 1.5 million tons of bio-ethanol in 2008, the plan targets an additional 2 million tons of bio-ethanol from non-food-grain feedstock in 2010 and 10 million tons by 2020. Biodiesel, at .08 million tons in 2008, is targeted to reach 200,000 tons by 2010, and 2 million tons by 2020. In the aggregate, meeting these goals will permit China to replace 10 million tons of petroleum-based fuels annually. China currently has five companies producing fuel ethanol, with a collective capacity of 1.72 million tons. While most of this comes from crops such as corn and wheat, a transition is underway toward cellulosic (non-food) feedstock.

Coal

To improve efficiency and safety, China has closed more than 55 GW of small coal plants since 2006, exceeding its 2010 target several years early. All new coal plants are required to use state-of-the-art technology, as a result of which the average efficiency of China's coal-fired generation base is higher than in the U.S. Carbon capture and storage (CCS) pilots are underway at a number of locations.

To help carry out these policies, the National Development and Reform Commission (NDRC) has designated 13 cities and provinces as pilot low-carbon areas, where practices and policies can be identified and tested, to help reach the government's carbon intensity target. Cities within this group can choose their targets and the methods for reaching them. Hangzhou, for example, has targeted a 35% reduction in carbon intensity by 2015 and 50% by 2050. Baoding (in North China) is targeting a 48% reduction by 2020, and Guiyang (in South China) a 45% reduction. In some cities, new tools such as carbon inventories are being developed. Shenzhen, another pilot city, is deploying electric taxis, with 50 currently on the road.

China is believed to have largely met the energy targets in its 11th Five Year Plan, including those for efficiency and energy intensity.²² However, due to rapid economic growth, industrialization and accelerating urbanization, total CO₂ emissions will continue to rise. Reflecting the government's growing emphasis on energy efficiency and low carbon energy, Chinese officials predict that the 12th Five Year Plan, due for release in early 2011, will downplay the historic emphasis on economic growth, and elevate the importance of reaching carbon intensity targets, through strengthened policies to encourage the development of alternative energy sources and new energy vehicles.

²² Levine, Mark D., Lynn Price, Nan Zhou, David Fridley, Nathaniel Aden, Hongyou Lu, Michael McNeil, Nina Zheng, Qin Yining and Ping Yowargana, "Assessment of China's Energy-Saving and Emission-Reduction Accomplishments and Opportunities During the 11th Five Year Plan," Lawrence Berkeley National Laboratory, 2010.

China is now tied with the U.S. for the world's largest installed capacity for renewable power generation and will soon surpass it, due to a growth rate three times that of the U.S. (79% vs. 24%).

Top 10 in Renewable Energy Capacity (GW)		Top 10 in Five-Year Growth in Installed Capacity	
United States	53.4	South Korea	249%
China	52.5	China	79%
Germany	36.2	Australia	40%
Spain	22.4	France	31%
India	16.5	India	31%
Japan	12.9	United Kingdom	30%
Rest of EU-27	12.3	Turkey	30%
Italy	9.8	United States	24%
France	9.4	Canada	18%
Brazil	9.1	Rest of EU-27	17%

Source: The Pew Charitable Trusts, "Who's Winning the Clean Energy Race?" 2010.

A similar trend is evident in clean energy investment, where China took the top slot in 2009, surpassing the United States. The growth rate for China's investment in this sector is significantly higher (148% vs. 103%).

Five-Year Growth in Investment		Top 10 in Investment Intensity	
Turkey	178%	Spain	0.74%
Brazil	148%	United Kingdom	0.51%
China	148%	China	0.39%
United Kingdom	127%	Brazil	0.37%
Italy	111%	Rest of EU-27	0.26%
United States	103%	Canada	0.25%
France	98%	Turkey	0.19%
Indonesia	95%	Germany	0.15%
Mexico	92%	Italy	0.14%
Rest of EU-27	87%	Mexico	0.14%

Source: The Pew Charitable Trusts, "Who's Winning the Clean Energy Race?" 2010.

China's investment comes primarily through asset finance, with relatively little from venture capital. Though still small in absolute terms, venture and private equity

investment in cleantech began flowing to China in 2005 and continued to grow in 2006, 2007 and 2008, driven largely by government policies and growth in the solar PV sector; most is focused on later stage deals. Both China and the U.S. draw on public markets and have a roughly similar allocation of investment between wind, solar and other renewables, but with a significantly greater focus in the U.S. on efficiency and biofuels.

At \$331 million, cleantech venture investment in China was flat from 2008 to 2009, with an increase in the number of deals from 24 to 28. Merger and acquisition activity in cleantech, however, rose to an historic high, with 29 transactions totaling \$5.5 billion. China accounted for 72% of global IPO proceeds (\$3.4 billion raised by 17 companies) in the sector. Almost half of the companies (47%) that went public in the sector were in China.²³ As one indicator of growing interest by the investment community in China's cleantech sector, Vantage Point Venture Partners, a leading Bay Area cleantech investor, announced in June 2010 the creation with a Chinese partner of the China Low Carbon Index, a 35-company index of publicly traded Chinese companies in the low-carbon sector.

Reflecting this potent combination of policy and investment, China has taken an increasingly dominant position in global renewable energy markets. Over time, its cleantech sector can be expected to achieve economies of scale that will attract additional investment and further solidify its global lead in production. As noted above, China is already the world's leading supplier of solar PV panels, accounting for 30% of global production. Suntech, China's largest solar company, is poised to overtake Germany's Q-Cells as the world's largest manufacturer of solar panels. Two other Chinese companies, Trina and Yingli, rank among the world's largest solar PV producers. All three are publicly traded and listed on the NYSE and NASDAQ.

Wind manufacturing capacity is also growing rapidly, but with a greater focus on China's domestic market. As of 2008, China had 70 wind manufacturers. Total capacity may reach 20 GW in 2010. Sensing the market opportunity, multinationals

²³ Cleantech Group, "Clean technology venture investment totaled \$5.6 billion in 2009 despite non-binding climate change accord in Copenhagen, finds the Cleantech Group and Deloitte," January 6, 2010.

are investing in production, the most recent being Denmark's Vestas, which recently opened the world's largest wind turbine manufacturing facility in Northeast China. With a well-established domestic market and growing production capacity, Chinese wind technology firms such as Goldwind are now starting to follow their solar counterparts in seeking overseas markets.

While a powerhouse in production, China is not yet a major source of innovation in the renewables area. But market scale and manufacturing capacity, both of which China has in abundance, will lead over time to increased R&D and ultimately to innovation. This trend is supported by government policies to promote "indigenous innovation," with more than 1,600 government-supported incubators—many of which host cleantech enterprises and a range of direct and indirect subsidies.

Significantly, California's Applied Materials, the world's largest producer of solar manufacturing equipment, recently opened a major R&D facility in China and is relocating its Chief Technology Officer there. Another U.S. company, First Solar, has announced plans to build a 2 GW thin-film solar generating facility in Inner Mongolia (China), based in part on the prospect of generous feed-in tariffs. As part of that arrangement, it has agreed to help develop local supply chains. For California, developments such as these are a two-edged sword. On the one hand, they strengthen research and production capacity in China. California companies are increasingly global, however, and capturing global markets often requires localization. California, its companies and their employees still benefit by producing and selling superior technology. A relevant example comes from the semiconductor industry, where high-volume lower-end production is done elsewhere while California continues to produce superior technology and is a major exporter of capital equipment.

The Chinese Renewable Energy Industries Association estimates that employment in Chinese renewable energy industries reached 1.2 million in 2008, and is growing by 100,000 per year.²⁴

²⁴ Bradsher, Keith, "China Leading Global Race to Make Clean Energy," New York Times, January 30, 2010.

Challenges and Opportunities for California: China in Perspective

“For cleantech investors in China, the future is bright. There is an almost optimal alignment of government policy and commitment, consumer awareness, domestic and foreign capital, land, technical expertise, and entrepreneurs to create and sustain a very long run of successful investments.”

—Deloitte, Cleantech in China, 2009

“China’s steady rise to pole position has been underpinned by strong and consistent government support for renewable energy. This, together with substantial commitment from industry, and the sheer scale of its natural resources, means that its position as top spot for renewable energy investment is well merited.”

—Ben Warren, Environment and Energy Infrastructure Manager, Ernst & Young

China presents the United States and California with both a competitive challenge, and opportunities for exports, inbound foreign investment, and research and other partnerships to address shared energy objectives. Opportunities exist on at least three levels.

One is exports, as California companies enter China’s growing domestic market. This is not an easy prospect, as China attempts to protect its own companies through policies favoring “indigenous innovation and other protective measures.” Chinese renewable energy companies also benefit from government support in the form of land provided at subsidized rates and inexpensive loans, benefits not easy for foreign competitors to match. Other issues of concern to U.S. companies—where China is making progress but problems remain—include intellectual property exposure and contract enforcement.

But the scale of China’s market suggests that California companies able to gain a foothold there stand to benefit. Profits at Applied Materials, for example, are being driven in part by growing demand for the equipment used to make solar cells; much of that market growth is now coming from China. Santa Clara-based National Semiconductor is also looking to sell its products to Chinese solar firms. According to Executive Chairman Brian Halla, “It will be the electronics that come out of Silicon

Valley companies that will improve the efficiencies of these panels. Suntech and others will be customers for National Semiconductor.”²⁵ Generally speaking, larger, more experienced U.S. and California companies seem best positioned to navigate China’s current market.

LED lighting, energy efficiency (industrial/commercial/residential), smart grid technologies, green IT, and advanced solar technologies (that can be integrated into systems made in China) are all areas where Chinese demand and California’s capabilities are a potential match.

The market for electrical vehicles is another. Zap Inc., a Santa Rosa-based manufacturer of electric vehicles, merged this year with Jonway Automotive, a subsidiary of China’s Jonway Group. The new company, Zap Jonway, is 51% owned by Zap, the first foreign majority-owned enterprise in China’s automotive sector. Manufacturing will take place both in a 3.6 million square foot plant in China’s Zhejiang Province and in the United States, with the likelihood that electric vehicles will eventually be exported from the U.S. to top-tier Chinese cities. With access to high-quality production facilities and to consumer markets through Jonway’s 500 existing auto dealerships, Zap is now positioned to compete in China’s emerging market for electric vehicles. In partnership with Jonway, the Zap Taxi was displayed at the April 2010 Beijing Auto Show. Zap also plans to develop a demonstration electric vehicle program in Shanghai’s Yangpu district, deploying Zap vehicles in bus, taxi and government fleets.

The second opportunity is for inbound investment to California. For some Chinese companies, gaining access to technology will be a driver. In 2009, for example, China-based Singyes Solar Technologies bid to purchase OPTI, a Palo Alto producer of cells that generate electricity. Singyes has installed solar curtain walls in airports, railway stations and high rise towers throughout China and was looking to acquire OPTI’s technology—which was considered superior to technology available in China—for incorporation into glass panels used in high-rise buildings, with manufacturing in the U.S. and sales back to China. Singyes lost the bid to a U.S. company but is reportedly still in the hunt for a suitable U.S. partner.

²⁵ John Boudreau, “Silicon Valley faces fierce global competition,” *Mercury News*, February 1, 2010.

In other cases, investment is a step toward establishing a foothold in the U.S. and California markets. In 2010, BYD—the Chinese battery and vehicle manufacturer—was invited by Alameda County’s East Bay Economic Development Association to establish an electrical vehicle production facility in the region, initially focusing on the closed NUMMI facility in Fremont; manufacturing is also a possibility at the former Mare Island Naval Shipyard. BYD has opened a North American headquarters in Southern California and a smaller office in Cupertino and has purchased land in Southern California that could eventually accommodate manufacturing. The company is being courted due not only to its focus on batteries, electric vehicles and other green products, but also because of its scale, having grown from 20 employees in 1995 to more than 200,000 today, with 11 industrial parks across China and an expanding global presence.

Investment by solar PV companies is also ramping up. China’s three leading companies—Suntech Power Holdings, Trina Solar and Yingli—have opened their North American headquarters in San Francisco; as of this writing, nine Chinese solar companies have established a presence in San Francisco. Employment in these offices is presently small, ranging from 5 to 50, but is expected to grow. While this initial presence is for marketing and customer support, one Chinese solar company has announced plans to manufacture in the United States and others are likely to follow over time. Other states are aggressively competing for those facilities, and California will need to develop new strategies to capture the jobs and production associated with what will be a large and growing market.

More Chinese solar companies such as ET Solar are reportedly considering investment in the U.S. For companies like these, California, Arizona and New Mexico are the first stop in the U.S. and a preferred location. The U.S. market is a draw, particularly as markets in Europe are slowing. There is also some concern that the “made in China” label may eventually prove a liability—a problem circumvented by assembling products locally. Another draw is Silicon Valley’s technology base, as Chinese companies join others from around the world in seeking a presence near the heart of California’s innovation engine. This can happen through mergers and

acquisitions (exemplified by the attempted Singyes acquisition referenced above), or by establishing an independent R&D presence.

These trends are likely to continue, as China's government opens the door further for increased international investment by Chinese enterprises, and as China's new multinationals seek to expand their brand and global footprint. This is analogous to the move in the past several decades by Japanese car manufacturers to develop local production—and hiring—in the U.S.

California and Global Cleantech Markets

“Within the G-20, our research finds that domestic policy decisions impact the competitive positions of member countries. Those nations—such as China, Brazil, the United Kingdom, Germany and Spain—with strong, national policies aimed at reducing global warming and incentivizing the use of renewable energy are establishing stronger competitive positions in the clean energy economy.”

—Pew Charitable Trusts, *Who’s Winning the Clean Energy Race?*

The potential for cleantech expansion is reflected in trade. Global exports of environmental goods more than doubled to \$215 billion between 2004 and 2008. Renewable energy-related products accounted for 70% of that total. Germany is the largest exporter, accounting for 16% of the worldwide market, China is second at 13%, followed by Japan (9%), the United States (9%) and Italy (6%). China has seen the most dramatic growth in global sales, with exports increasing almost 500% in the same period (up \$22.7 billion), followed by Germany (up \$19.6 billion), the United States (up \$7.7 billion), Italy (up \$5.5 billion) and Japan (up \$4.4 billion).

On the import side, the U.S. is now the world’s largest import market for environmental goods. A study by the New America Foundation found that in 2008 the U.S. ran an overall green trade deficit of \$8.9 billion, including \$6.4 billion in the category of renewable energy, where growing U.S. demand has primarily been met by imports—particularly wind and solar components—from Europe and China.²⁶ U.S. environmental goods exports are strong, increasing 70% from 2004 to 2008, to \$18.4 billion, three-quarters of which was in renewable energy products.²⁷ But exports by other countries are growing faster and, at the moment, the U.S. market is being largely met by products produced elsewhere.

The increasing scale of global trade in renewable energy products and the current imbalance suggest both the magnitude of the opportunity for California and the competitive global environment in which California operates. Policies that sustain a strong California market and encourage cleantech business growth within the state will be critical to ensuring that California companies can expand domestically and compete in increasingly dynamic global markets.

²⁶ Samuel Sherraden, “Green Trade Balance”, New America Foundation, June 22, 2009.

²⁷ Ron Wyden, U.S. Senate, “Major Opportunities and Challenges to U.S. Exports of Environmental Goods,” 2009.

Competition, Public Policy and the Cleantech Sector in California

“Delays in this transition [to a renewable energy economy] will have a disproportionate negative impact on the start-ups that are developing the technologies to meet the standard [established by AB 32], because they do not have the balance sheets to weather through a delay.”

—Josh Green, General Partner, Mohr Davidow Ventures

“Getting hold of our energy future is a really important thing to do—for the strength of our economy, for energy security, just for being sure that we have access to the fuels that we need to grow.... Today, China’s cars are one-third more efficient than ours. China is investing ten times as much as the United States on new, clean energy, as a percent of their GDP. China’s growth in renewables is, for me, astounding. Now I believe, as a red-blooded American capitalist, we can’t just sit back and let the next great global industry not be developed. My conclusion is China is winning. My conclusion is we’re barely in the race today and we’d better double down on this.”

—John Doerr, partner, Kleiner Perkins Caulfield & Byers

There is a clear link between public policy, the standards it sets and the incentives it provides, with the development of cleantech industries. This is particularly the case in the early stages of a business sector’s development, when commercial markets are not yet fully developed.

While optimism abounds—shared widely by businesses and state and local government—that the state is a leader in energy efficiency and renewable energy and is on the threshold of developing a world-leading clean energy industry, holding and expanding that lead will require focused policies and strategies. California is an important market for these technologies, and with its strong base in R&D, it has a significant technology advantage. But other states are competitive, and the commercial production of cleantech products is growing faster outside the United States—producing competitive companies and generating jobs. The opportunity and challenge for California is to lead the systemic worldwide shift toward a clean energy economy and create a California-based, globally competitive energy efficiency and renewable energy industry.

While the transition to a clean energy economy has begun, the shift from fossil fuels may not be complete for at least several decades. In the meantime, global energy efficiency and renewable energy markets are gaining momentum: biofuel (ethanol and biodiesel) production, valued at \$44.9 billion in 2009, is projected to grow to \$112.5 billion by 2019; wind power (spending for new installed capital equipment) is projected to grow from \$63.5 billion in 2009 to \$114.5 billion in 2019; solar photovoltaics (including modules, system components, and installation) is projected to grow from \$36.1 billion to \$116.5 billion in the same period. This is happening as increasing scales of production, anchored by government targets and financial incentives, are resulting in declining unit costs that make these technologies more financially attractive. The market is being driven to a significant degree by government policies in energy-consuming countries. Despite the non-binding nature of the 2009 agreement in Copenhagen to restrain greenhouse gas emissions, climate change is a shared motivation. Another more immediate concern, however, is the need for economies to reduce dependence on potentially insecure sources of fossil fuels. Yet another is the goal of developing nationally and globally competitive energy efficiency and renewable energy industries and capturing the jobs, revenues and economic leadership that go with that. This trend is most evident in Europe, with Germany perhaps the prime example, and in Asia, where China's policy focus and market scale make it a formidable competitor—as well as a potentially important market and partner in addressing climate change.

For California, the rapid progress of these economies in developing cleantech sectors with global scale poses a competitive challenge. China, in particular, has highly focused public policies and the advantage of both scale and very strong public investment. For California, then, the strength and continuity of state policies that support a growing market and incentivize cleantech industries becomes particularly important. The state holds an important advantage in both venture investment and R&D but should also seek to capture a larger share of the value produced by these early-stage investments. While it may not be realistic to expect that all the products derived from its R&D and venture funding will be manufactured in California, or that all of the jobs that result will be located here, creating a world-leading industry will

require a healthy mix of capabilities, ranging from research and management to production and installation.

It is particularly important that California sustain a policy focus that provides clarity and predictability for cleantech entrepreneurs and investors. The state has deployed a suite of policies designed to reduce GHG emissions and improve energy efficiency. An ancillary benefit, however, has been the development in California of a nationally and globally competitive cleantech sector. Its policies provide a framework that draws on California's strong R&D base and its entrepreneurial community to create world leading companies. And its high concentration of venture investment in cleantech is indicative of the confidence of investors in the future of the cleantech market and California's capacity to meet it. China's government-backed investment in renewable energy and energy efficiency is on a much larger scale than venture investment in California, but venture's focus on innovation and advanced technology provides offsetting advantages that align with California's strengths.

A clear link exists between government policy, such as AB 32's implementation standards and programs, and the development in the industry. A 2007 survey of 41 cleantech investors, controlling approximately \$3 billion in committed capital, found that:

- ◆ 84% of respondents (27 of 32) believed that a proactive environmental public policy can be a driver in attracting new cleantech businesses and jobs to a state or region;
- ◆ 65% (19 of 29) said that state renewable portfolio standards had been important or critical to their investment decisions;
- ◆ 69% (25 of 36) cited California as having done the best job of encouraging cleantech start-up companies.²⁸

The passage of AB 32 in 2006 marked the beginning of a sustained rise in cleantech venture investment in the state. Though not the only causal factor, and while other

²⁸ Cleantech Investor Network and E2, "Cleantech Venture Capital: How Public Policy has Stimulated Private Investment," May 2007.

energy policies play an important role, AB 32 with its related standards and programs has been taken by investors to reflect a long-term commitment by the state to GHG gas reduction and to a sustained move away from a carbon-based economy. By providing the stability and continuity investors require over a 5–9 year time frame, the critical period for most venture investment, this alleviates risk and incentivizes entrepreneurs and venture capitalists to make long-term investments. Entrepreneurs, who receive venture or other investment and are also making long term bets, share the same concerns. This, in turn, will require a focus on both policies that support the cleantech market and policies that address issues of cost that impact the location of cleantech production.

California's reputation and track record for technology development, innovation and entrepreneurship, and its popular support for environmental protection, give it a clear advantage in the race to develop competitive cleantech industries. And its market scale is a draw for investors. With this base, California companies can be significant players in national and global cleantech markets. But global competition for market share in the cleantech sector is growing, and neighboring states are developing targeted programs to attract cleantech production. If California wants to secure a position of global leadership and generate the jobs and investment that go with it, it must sustain both its forward-looking policy focus and a business climate that supports cleantech business formation and growth.

Sources

- Abate, Tom. "Made in Livermore." *San Francisco Chronicle*, September 20, 2010.
- Abate, Tom. "Tesla Workers Start Trickling in at Old NUMMI Plant." *San Francisco Chronicle*, October 2, 2010.
- Agence France Press. "China Plans 440 Billion Dollar Stimulus for Green Energy." May 29, 2009.
- Baker, David. "GE strives to be a green-tech leader." *San Francisco Chronicle*, July 18, 2010.
- Boudreau, John. "Silicon Valley faces fierce global competition in cleantech." *San Jose Mercury News*, February 1, 2010.
- Bradsher, Keith. "China Leading Global Race to Make Clean Energy." *New York Times*, January 30, 2010.
- Bradsher, Keith. "On Clean Energy, China Skirts Rules." *New York Times*, September 9, 2010.
- Brown, Steven. "Chevron Gets OK For World's Biggest Solar Power project." *San Francisco Business Times*, September 15, 2010.
- California Air Resources Board, California Environmental Protection Agency. *ARB Staff Release, Draft Regional Greenhouse Gas Reduction Targets for Automobiles and Light Trucks Pursuant to Senate Bill 376*. June 30, 2010.
- California Employment Development Department. "State Survey Identifies Over 300,000 Jobs in California with Major Emphasis on Green Practices." News release, April 21, 2010.
- California Energy Commission. *2009 Integrated Energy Policy Report*. December 2009 (Publication # CEC-100-2009-003-CMF).
- ChinaSF. *2008–2009 Year-End Report*, 2010.
- Cleantech Group. "Clean technology venture investment totaled \$5.6 billion in 2009 despite non-binding climate change accord in Copenhagen, finds the Cleantech Group and Deloitte." January 6, 2010.
- Cleantech Group. "Cleantech thriving in California under AB 32, shows data." April 5, 2010.
- Cleantech Group. *Cleantech Investment Monitor*. August 23, 2010.
- Cleantech Group. *Cleantech Investment in China*. September 2010.
- Cleantech Investor Group and E2. *Cleantech Venture Capital: How Public Policy Has Stimulated Private Investment*. May 2007.

- DeWoskin, Ken and Jim Mahoney. *Cleantech in China, the 2009 Research Agenda*. Deloitte, 2009.
- Finamore, Barbara, Director, China Program, NRDC. *Talking Points for California-China VIP Luncheon, Governor's Global Climate Summit 3, Davis, California, November 15, 2010*.
- Galante, Joseph and Ian King. "Europe, China rev solar machinery demand." *San Francisco Chronicle*, July 14, 2010.
- Gordon, Kate, Julian Wong and JT McLain. "Out of the Running? How Germany, Spain, and China are Seizing the Energy Opportunity and Why the United States Risks Getting Left Behind." Center for American Progress, March 2010.
- Howell, Thomas, Of Counsel, Dewey & LeBoeuf LLP. *Testimony before the US-China Economic & Security Review Committee Hearing on China's Green and Environmental Policies, Washington, D.C., April 10, 2010*.
- Information Technology & Innovation Foundation. *Rising Tigers, Sleeping Giant: Asian Nations Set to Dominate the Clean Energy Race by Out-Investing the United States*. November 2009.
- Inside Cleantech, "Special Edition: The Chinese Cleantech Market." September 3, 2010.
- Jacobson, Mark, and Mark Delucchi. "Evaluating the Feasibility of a Large-Scale Wind, Water and Sun Energy Infrastructure." *Energy Policy*, 2009.
- Joint Venture: Silicon Valley Network. "Climate Prosperity: A Greenprint for Silicon Valley." February 2009.
- Lan, Lan. "Green stimulus spurs cellulosic ethanol makers." *China Daily*. July 27, 2010.
- Levine, Mark D., Lynn Price, Nan Zhou, David Fridley, Nathaniel Aden, Hongyou Lu, Michael McNeil, Nina Zheng, Qin Yining and Ping Yowargana. "Assessment of China's Energy-Saving and Emission-Reduction Accomplishments and Opportunities During the 11th Five Year Plan." Lawrence Berkeley National Laboratory, 2010.
- Levine, Mark. "Energy Efficiency Investment in China." U.S.-China Clean Energy Forum on Financing Energy Efficiency in China, February 28, 2010.
- Levy, Ari. "Venture Capital: Cleantech, biotech help funding soar 53 percent." *San Francisco Chronicle*, July 17, 2010.
- Li, Fangfang and Wang Xiaotian. "Car Tax Law Part of Drive to promote Clean Energy." *China Daily*, October 26, 2010.

- Li, Jing. "Industrial Zones Come Clean Due to Green Drive." *China Daily*, November 11, 2010.
- Murray, Alan. "Where the Smart Money Is." *Wall Street Journal*, March 8, 2010.
- National Development and Reform Commission (NDRC), People's Republic of China. "Medium and Long-Term Development Plan for Renewable Energy in China." September 2007.
- National Foreign Trade Council. *China's Promotion of the Renewable Electric Power Equipment Industry*. March 2010.
- National People's Congress. "The Renewable Energy Law of the People's Republic of China." *Beijing Review*, July 21, 2005.
- Next 10. *California Green Innovation Index*. 2009.
- Next 10. *California Green Innovation Index*. October 2010.
- Next 10. *CA Green Job & Business Growth Significantly Outpace Rest of CA Economy*. Press release, December 9, 2009.
- Next 10. *Energy Efficiency, Innovation and Job Creation in California*. October 2008.
- Oster, Shai. "Green Firms From China Get an Index." *Wall Street Journal*, June 8, 2010.
- Pernick, Ron and Clint Wilder. "Clean Energy Trends 2010." Clean Edge, April 2010.
- Pernick, Ron, Clint Wilder and Trevor Winnie. "Clean Tech Job Trends 2010." Clean Edge, October 2010.
- Pew Charitable Trusts. *The Clean Energy Economy: Repowering Jobs, Businesses and Investments Across America*. June 2009.
- Pew Charitable Trusts. *Who's Winning the Clean Energy Race? Growth, Competition and Opportunity in the World's Largest Economies*. 2010.
- Wang, Qian. "Car Sales Blamed for Pollution." *China Daily*, November 5–7, 2010.
- Radazzo, Ryan. "Solar Company Will Bring 350 Jobs to Phoenix." *Arizona Republic*, September 9, 2010.
- REN21. *Renewables 2010 Global Status Report*. 2010.
- Riddell, Lindsay. "Stimulus fuels energy startups." *San Francisco Business Times*, November 6, 2009.
- Riddell, Lindsay. "Bay Area biofuels companies get \$72M." *San Francisco Business Times*, December 11, 2009.

- Riddell, Lindsay. "Solar firms facing Dec. 31 deadline for stimulus cash." *San Francisco Business Times*. March 12, 2010.
- Ross, Andrew. "Zap Merges with China's Jonway," *San Francisco Chronicle*, July 8, 2010.
- Sherradan, Samuel. "Green Trade Balance." New America Foundation. June 22, 2009.
- Stack, James. *Cleantech Venture Capital: How Public Policy Has Stimulated Private Investment*. Cleantech Venture Network LLC and E2. May, 2007.
- Sandalow, David. "China and the Clean Energy Opportunity." Testimony before the U.S.-China Economic and Security Review Commission. April 8, 2010.
- Swartz, Spencer and Shai Oster. "China Tops U.S. in Energy." *Wall Street Journal*, July 20, 2010.
- Torres, Blanca. "Solyndra: Solar panel maker sealed lease, land deal." *San Francisco Business Times*. March 26, 2010.
- Turner, Jennifer. "China's Energy and Environmental Policies." Testimony before the U.S.-China Economic and Security Review Commission. April 8, 2010.
- Wyden, Ron, U.S. Senate. *Major Opportunities and Challenges to U.S. Exports of Environmental Goods*. December 2009.
- United States Department of Energy. "California Recovery Act Snapshot." www.energy.gov/recovery/ca.htm.
- U.S. Department of Energy, Energy Information Administration. *State Energy Profiles*, July 1, 2010.
- Wan, Zhihong and Fangfang Li. "Alliance drives promotion of electric cars." *China Daily*, August 2010.
- Xie, Andy. "Government to promote renewable energy sources." *China Daily*, March 17, 2005.
- Xin, Dingding. "High-speed rail links to be doubled by 2012." *China Daily*, July 29, 2010.
- Yu, Qingtai. "China's interests must come first." *China Dialogue*, August 27, 2010.
- Zhu, Jin. "Climate Change 'Takes Toll' on Grain Harvest." *China Daily*, November 5–7, 2010.
- Zhu, Shenshen. "Charge of 'new wave' of electric cars to roll." *Shanghai Daily*, June 18, 2010.

Appendix

Selected U.S. and California Energy Cooperation Programs with China

A range of U.S.-China energy cooperation programs have been created to address the mutual goals of improved energy efficiency, reduced GHG emissions, and increased generation from renewable sources.

National

The *U.S. China Clean Energy Research Center (CERC)*, announced by President Obama and Chinese President Hu Jintao in November 2009, is a \$150 million initiative for joint research and development on clean energy technology, jointly conducted by U.S. and Chinese scientists and engineers. Early in 2010, Secretary of Energy Steven Chu announced the availability of \$37.5 million in U.S. government funding for CERC over the next five years, an amount to be matched by grantees for a total of \$75 million in U.S. research. This will be matched by an equal amount on the Chinese side. U.S. funding will be used to support work by U.S. scientists and institutions, some portion of which is likely to be performed in California.

The *U.S.-China Renewable Energy Partnership and the U.S.-China Energy Efficiency Action Plan* involve technical and analytical work to accelerate deployment of renewable energy, speed grid modernization, and improve energy efficiency in buildings, industry and appliances. Planning is currently under way for forums to bring together U.S. and Chinese companies in a way that could increase demand for U.S. and California clean energy products and services.

The *U.S.-China Energy Cooperation Program* is an industry-led initiative focused on engaging the private sector in commercial project development related to clean energy and energy efficiency in both the U.S. and China. Activities include a Clean Energy Exchange Program to introduce Chinese energy officials and project sponsors to U.S. clean energy technologies through a series of visits structured around

topics such as green building and green cement production. With its leading national position in clean energy technology development, California is strongly positioned to participate in this process.

California

California is playing a leading role in US-China energy cooperation through work at Lawrence Berkeley National Laboratory (LBNL) on energy efficiency, with support from the San Francisco-based Energy Foundation. LBNL's China Energy Group, established in 1988, focuses on understanding the dynamics of energy use in China, enhancing the ability of Chinese institutions to promote energy efficiency, creating links between Chinese and international institutions, and supporting energy efficiency improvements in China through the development of energy efficiency standards. Cement being a highly energy intensive industry, with China the world's largest cement producer, staff at nearly 300 Chinese cement plants have been trained in the use of energy efficiency benchmarking tools developed by LBNL. The lab has supported implementation of the Top 1000 Energy Consuming Enterprises Program and assisted with a pilot program in the steel sector. Staff has worked particularly closely and effectively with Chinese counterparts to develop efficiency standards for appliances, labeling programs, and building codes.

In 2010, the U.S. Department of Energy awarded \$12.5 million to a consortium led by LBNL to work on green buildings in China over the next five years. The consortium will match the federal grant and Chinese counterparts will contribute another \$25 million.

In 2005, with support from NDRC and the U.S.-China Energy Alliance, the California Public Utilities Commission and the Jiangsu Province Economic and Trade Commission agreed to cooperate on energy efficiency. Significant funding has been provided by the Energy Foundation. Since then, Jiangsu has used demand side management (DSM) to avoid the need to build 600 MW of new generating capacity. Based on the success of the California-supported pilot in Jiangsu, in November 2010 DSM policies were enacted nationally.

In 2009, California Governor Arnold Schwarzenegger announced a further agreement with Jiangsu for cooperation relating to greenhouse gas emissions, energy efficiency and related technology development. The agreement to cooperate on GHG reduction was the first by a Chinese sub-national entity with an international partner.



The Bay Area Council Economic Institute is a public-private partnership of business, labor, government and higher education that works to support the economic vitality and competitiveness of California and the Bay Area. Its work builds on the twenty-year record of

fact-based economic analysis and policy leadership of the Bay Area Economic Forum, which merged with the Bay Area Council in January 2008. The Association of Bay Area Governments is a founder and key institutional partner. The Economic Institute also supports and manages the Bay Area Science and Innovation Consortium (BASIC), a partnership of Northern California's leading scientific research institutions and laboratories. Through its economic and policy research and partnerships, the Economic Institute addresses major issues impacting the competitiveness, economic development and quality of life of the region and the state, including infrastructure, globalization, science and technology, and governance. Its Board of Trustees, which oversees the development of its products and initiatives, is composed of leaders representing business, labor, government, higher education, science and technology, and philanthropy.



The Bay Area Council is a business-sponsored, public-policy advocacy organization for the nine-county Bay Area. The Council proactively advocates for a strong economy, a vital business environment, and a better quality of life for everyone

who lives here. Founded in 1945, as a way for the region's business community and like-minded individuals to concentrate and coordinate their efforts, the Bay Area Council is widely respected by elected officials, policy makers and other civic leaders as the regional voice of business in the Bay Area. Today, more than 275 of the largest employers in the region support the Bay Area Council and offer their CEO or top executive as a member.



The Association of Bay Area Governments (ABAG) is the official comprehensive planning agency for the San Francisco Bay Area region. ABAG's mission is to strengthen cooperation and coordination among local

governments. ABAG addresses social, environmental, and economic issues that transcend local borders, such as land use, growth management, housing, and economic competitiveness. All nine counties and 101 cities within the Bay Area are voluntary members of ABAG, representing nearly all of the region's population.



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