

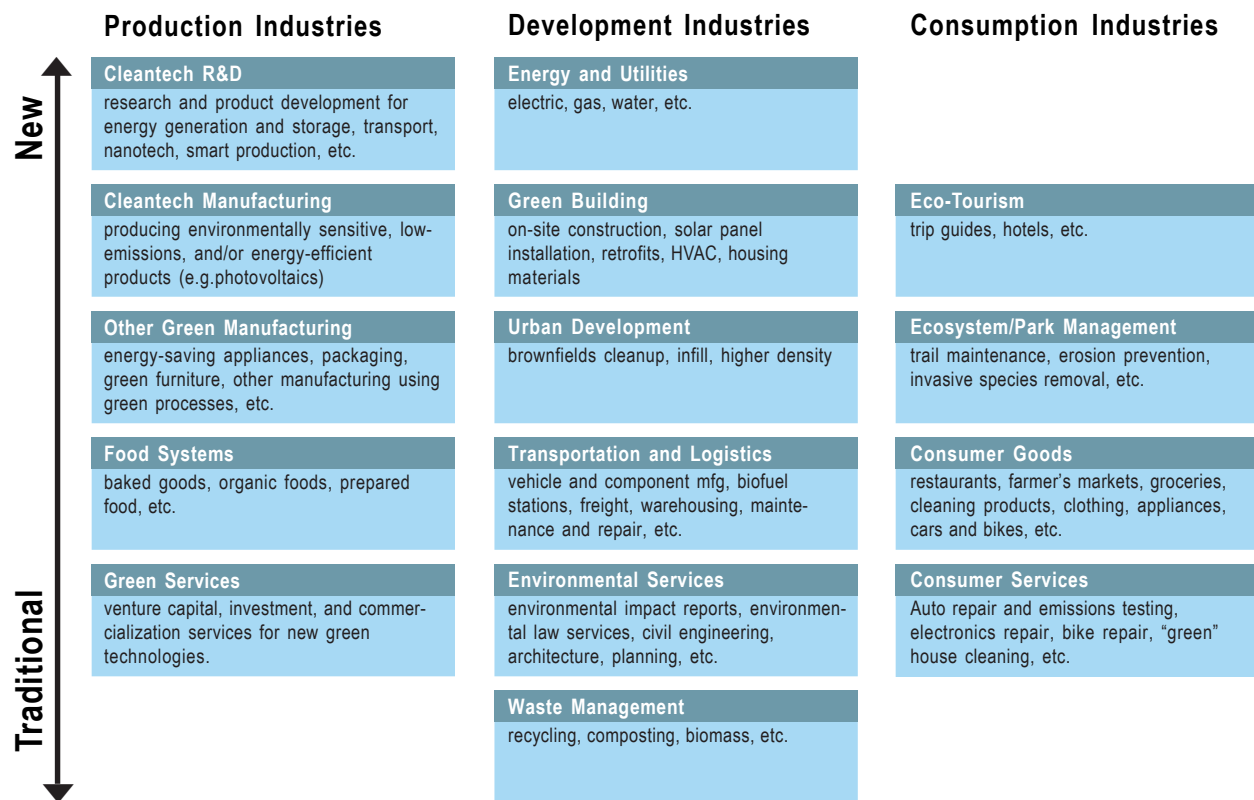
# ECONOMIC DEVELOPMENT AND THE GREEN ECONOMY

## A PRELIMINARY INVESTIGATION

The “green economy” has become the newest catch-phrase to grow out of the larger “green” movement in recent years. It has gained significant momentum as celebrities, Presidential campaigns and industry have clamored to support its ideals and its potential. But what does the “green economy” really mean? And what does its growth mean for our economy, given its possibilities of environmental improvements and job creation?

An explicit definition of the nature and potential of green industries is only now developing. However, at its broadest level the green economy is underpinned by the emergence of the clean energy industry and a reduction in our national dependence on foreign oil. Nevertheless the green economy now encompasses a broad array of sectors, including everything from clean manufacturing, energy efficiency and the greening of the built environment, to the consumption-oriented sectors such as eco-tourism and organic retail products (Figure 1).<sup>1</sup>

Figure 1



<sup>1</sup> Chart is drawn primarily from: Chapple, Karen. *Defining the Green Economy: A Primer on Green Economic Development*. University of California Center for Community Innovation, November 2008.

Positive projections for the growth of the green economy abound. The renewable energy and energy efficiency (RE&EE) industries represented more than 9 million jobs and \$1,045 billion in U.S. revenue in 2007. By 2030 domestic employment in RE&EE industries is expected to grow to 37 million jobs.<sup>2</sup> In 2008, the United Nations published a report estimating that the current \$1,37 trillion-a-year global market for environmental products and services is expected to grow to \$2,74 trillion by 2020.<sup>3</sup> Despite strong public support for the green economy, the economics of the industry sectors—for example the cost differentials between green and conventional products and services—are a key factor in their development trajectory. This paper explores the economic dimensions of the green economy.

## *Drivers of the Green Economy*

The industrial revolution that produced our modern economy has brought innumerable advances to humanity. However, in recent decades the downsides of industrialization—pollution, environmental degradation, deforestation and global warming—have become significant public policy concerns. The burning of fossil fuels such as coal and oil have caused concentrations of heat trapping “greenhouse gases” to increase significantly in our atmosphere, causing global temperatures to rise. If greenhouse gases continue to increase, climate models predict that the average temperature at the Earth’s surface could increase by 3.2 to 7.2° F above 1990 levels by the end of this century<sup>4</sup> creating impacts on sea level, biodiversity, diseases and other critical human living conditions.

Confounding these factors are rapid development and urbanization occurring in developing

countries across the globe. Sixty percent of the world’s population, 4.9 billion people by 2030, are expected to live in urban areas.<sup>5</sup> Urban populations create an energy consumption hike, and the intense concentration of population and industries often lead to increased local pollution and environmental degradation.

Our country’s economic and national security is also threatened by our dependence on oil and other fossil fuels. It is predicted that we will reach the maximum rate of global petroleum extraction, after which the rate of production enters terminal decline in the foreseeable future. Our current dependence on oil and gas (60% of total energy consumption; coal accounts for another 25%) leads to high-level uncertainties in oil prices and oil production, which is detrimental to the economy.<sup>6</sup>

## *Green Economy Viability*

The crises of global warming and environmental degradation have created a strong desire to develop the green economy among policy makers, the business community and the environmental community. However, just like other businesses, green businesses must be profitable and competitive in the free market to survive.

Historically, innovation has driven the U.S. economy. The development of the integrated circuit, personal computer and the Internet produced high-value new sectors in our economy.<sup>7</sup> However, what is less well recognized is the role of government in providing the funding for research that led to these developments. AnnaLee Saxenian shed light on these relationships when she mapped the regional growth of Silicon Valley’s

<sup>2</sup> The American Solar Energy Society and Management Information Services, Inc. *Defining, estimating and forecasting the renewable energy and energy efficiency industries in the U.S. and Colorado*. December 2008.

<sup>3</sup> The United Nations: *Green Jobs: Towards decent work in a sustainable, low-carbon world*. 2008

<sup>4</sup> IPCC: *A report of Working Group I of the Intergovernmental Panel on Climate Change Summary for Policymakers*. 2007

<sup>5</sup> The United Nations: *World Urbanization Prospects: The 2005 Revision*. 2005

<sup>6</sup> The Economist. *The Power and Glory*. June 2008

<sup>7</sup> California Green Innovation Index, 2008 Inaugural Issue, Next 10, 2008.

### Historical Clean Technology VC Investment by Year (North America, Europe & Israel, China, India)

Year	Investment	% Increase
2001	\$506,780,774	N/A
2002	\$883,269,409	74.3%
2003	\$1,258,565,762	42.5%
2004	\$1,398,256,823	11.1%
2005	\$2,077,524,074	48.6%
2006	\$4,520,208,949	117.6%
2007	\$6,087,179,844	34.7%
2008*	\$8,414,259,610	38.2%

\* (preliminary)

Source: The Cleantech Group

technology industry to a combination of federal defense research funding and a supportive, risk-taking regional business culture.<sup>8</sup>

In a similar fashion today, Federal, state and local governments are creating green standards and regulations and offering significant incentives for green businesses. President Barack Obama has committed to helping the private sector create five million new green jobs by investing \$150 billion over the next ten years in the clean energy industry. The Obama Administration also plans to put one million plug-in hybrid cars in use by 2015, and to ensure that these cars are built in the United States.<sup>9</sup> Many states have produced their own green regulations and investments to foster green industry sectors or green-collar jobs. Local economic development incentives including fee exemptions, low-cost loans and in-kind donations of land or facilities

have also been targeted towards green businesses across the country. States and municipalities are also greening local regulations, particularly by adopting green building regulations.<sup>10</sup>

In addition to supportive public policies and incentives, access to private capital is essential for the green economy to grow. In 2008, total clean technology venture investments reached \$8.4 billion despite the broadening global economic recession, and 41% of total new venture capital investment reported went into clean technology related ventures.<sup>11</sup>

The top clean technology sectors in 2008 were solar, biofuels, transportation, and wind. Solar kept its leading sector status, and accounted for almost 40% of total cleantech investment, led by mega-investment rounds in thin-film solar, concentrated solar thermal and solar service provider companies. Investors also continued to migrate from first-generation ethanol and biodiesel technologies to next-generation biofuels technologies, led by algae and synthetic biology companies. Other sectors with healthy investor interest included

### Top Venture Capital Clean Technology Sectors in 2008

Selected Technology Sector	Amount Invested	% of total
Solar	\$3.3 billion	40.0%
Biofuels (including ethanol, biodiesel, synthetic biology, algae)	\$904 million	11.0%
Transportation (including electric vehicles, advanced batteries, fuel cells)	\$795 million	9.5%
Wind	\$502 million	6.0%
Smart Grid	\$345 million	4.1%
Agriculture	\$166 million	2.0%
Water	\$148 million	1.8%

Source: The Cleantech Group

<sup>8</sup> Saxenian, AnnaLee. *Regional Advantage: Culture and Competition in Silicon Valley and Route 128*, Harvard University Press (March 1996).

<sup>9</sup> Chapple, Karen. *Defining the Green Economy: A Primer on Green Economic Development*. University of California Center for Community Innovation, November 2008.

<sup>10</sup> *ibid.*

<sup>11</sup> Global Corporate Venture Capital Survey 2008, Ernst & Young, 2008.

smart grid companies, small-scale wind turbines, plastics recycling, green buildings and agricultural technologies.

Behind this staggering growth in investment was the advance of clean technologies and a rapidly dropping cost of renewable energy. According to one analyst, Pacific Crest's Mark Bachman, thin-film solar firm First Solar reached "grid parity" in 2008: the point where photovoltaic electricity is as cheap as conventional electric power measured by cost per unit energy. Although his calculation was challenged by other analysts, it is fair to say that the costs are coming close. The U.S. Department of Energy's Energy Information Administration has concluded that there is little difference between the cost of new power plants using wind, compared to other traditional fuels such as nuclear, coal and natural gas, taking into account a broad array of expenses. In 2007, the wind power electricity retail market price ranged from \$5/MWh to more than \$10/MWh in different domestic regional markets, which is similar to conventional carbon fossil sources.<sup>12</sup>

## *Green Collar Jobs*

Currently, renewable energy (excluding biomass) accounts for 5% of the entire energy market, which is about one tenth of the world's economic output at about \$6 trillion per year.<sup>13</sup> As technology developments lower the cost of renewable energy to the parity point, the share of renewable energy could be expected to grow exponentially in the overall energy market. Additionally these fundamental changes in economics are also accompanied by a change in social mindset: environmentally conscious owners, consumers, managers and ultimately,

individuals are modifying their daily behavior and routines to support a greener society.

Jobs in these new green economy sectors are often referred to as green jobs or green-collar jobs. The Apollo Alliance, a leading coalition of business, labor, environmental, and community leaders that advocates for the development of clean energy green jobs, defines green-collar jobs as those that are "well-paid, career track jobs that contribute directly to preserving or enhancing environmental quality. Like traditional blue-collar jobs, green-collar jobs range from low-skill, entry-level positions to high-skill, higher-paid jobs and include opportunities for advancement in both skills and wages."<sup>14</sup> Green-collar jobs include entirely new professions, such as renewable energy technicians, but also include traditional professions that have adapted green practices, such as car mechanics that can fix electric engines as well as internal combustion engines. Green-collar jobs tend to be local jobs that are not vulnerable to outsourcing.<sup>15</sup> Unless otherwise noted, this paper defines green jobs as those directly related to the design, manufacturing and installation of products and services that reduce our fossil fuel energy consumption or environmental degradation.<sup>16</sup>

The core industry sectors of the green economy include: renewable energy generation, green buildings, energy efficient transportation and logistics and environmental services. The influence, as mentioned earlier, has gone beyond core industry sectors, and has extended to consumer goods, traditional industries and many supporting services and institutions. In general, we see the following industry sectors leading the green economy:

<sup>12</sup> U.S. Department of Energy. Annual Report on U.S. Wind Power Installation, Cost, and Performance Trend: 2007.

<sup>13</sup> Renewable Energy Network for the 21st Century. Global Status Report: 2007. 2008

<sup>14</sup> Apollo Alliance and Green For All. Green-Collar Jobs in America's Cities. Building Pathways Out of Poverty and Careers in the Clean Energy Economy. 2008.

<sup>15</sup> Green for All. Green Collar Jobs Overview. <http://www.greenforall.org/resources/green-collar-jobs-overview>. Accessed January 28, 2009.

<sup>16</sup> Environmental Defense Fund. Green Jobs Guidebook. 2008.

## Industry Sectors and Example Jobs and Businesses of the Green Economy

Industry Sector	Green Businesses	Green-Collar Jobs <sup>17</sup>
Renewable energy and energy efficiency (RE&EE)	Renewable energy: hydropower, geothermal, fuel cells, hydrogen, wind, solar  Energy efficiency: Energy conservation and energy efficiency products, electric and hybrid vehicles, energy-smart design, smart power grid	Solar energy systems designer, solar panel installation technician, wind turbine machinist, geothermal electrical engineer, battery design engineer, battery manufacturing technician
Green buildings	Design of green buildings, recycled or local building materials, solar panel R&D and manufacturing, green roof installation	Lighting and HVAC engineer, landscape architect, home improvement retrofit technician, insulation installer, residential air sealing technician, machinist
Transportation and logistics	Hybrid, hydrogen-powered or electric cars, mass transportation	Fuel efficient car design and manufacturing, public transportation system design and vehicle manufacturing and operations
Environmental services	Brownfield remediation, waste control, recycling, pollution control technologies R&D and manufacturing	Brownfield remediation technician, recycling center operator,
Consumer goods	Organic food and clothing, farmer's markets, ecotourism	Manufacturing of green consumer goods, organic goods retailer
Greened traditional industries	Introduction of energy saving or environmentally friendly practices into traditional industries	
Business and professional services, non-profits and associations	Environmental services consulting, climate change policy think tank,	Economist, air quality specialist, environmental services consultant, urban planner, conservation policy analyst, climate change advocate

*(Green-Collar Jobs—Under an approach that defines the green economy as any business that increases environmental sustainability, green-collar jobs could include any job function (i.e. payroll clerk, HR specialist), that is in such a firm.)*

In the following paragraphs, we examine the first three core sectors and analyze their associated growth patterns.

### *Renewable energy generation and related technology*

Renewable energy is energy generated from natural resources, which can also be naturally replenished. In

2006, about 18% of global final energy consumption came from renewables, with 13% coming from traditional biomass, such as wood burning. Hydroelectricity was the next largest renewable source, providing 3% (15% of global electricity generation), followed by solar hot water/heating, which contributed slightly more than 1%. Modern technologies, such as geothermal energy, wind power, solar power and ocean energy together provided some 0.8% of final energy consumption.<sup>18</sup>

<sup>17</sup> Renewable Energy Network for the 21<sup>st</sup> Century. Global Status Report: 2007. 2008

<sup>18</sup> The Economist. *The Power and Glory*. June 2008.

Wind and solar are the two fastest growing areas in renewable technology. Currently, wind counts for one percent of electricity generation, but it is growing at 30% a year (GE sold about \$6 billion worth of wind turbines in 2008). Solar power generates around 0.01% of electricity generation, but is growing at more than 50% a year. As mentioned previously, the solar sector alone accounted for 40% of total venture capital investment in the clean technology, followed by biofuels (11%) and wind (6%). Four out of five top funding rounds in 2008 took place in solar companies.

#### Five Largest Clean Technology Venture Funding Rounds in 2008

Company	Description	Amount Raised
NanoSolar (USA)	Thin-film solar (CIGS)	\$300 million
Solyndra (USA)	Thin-film solar (CIGS)	\$219 million
SoloPower (USA)	Thin-film solar (CIGS)	\$200 million
WinWinD Oy (Finland)	Wind Turbines	\$177 million
Solar Reserve (USA)	Concentrated Solar Thermal	\$140 million

Source: *The Cleantech Group*

Biomass and waste is another important area of consideration. The U.S. Departments of Energy and Agriculture suggest that even with only small changes to existing practice, 1.3 billion tons of plant matter could be collected from American soil without affecting food production. If these were converted into ethanol using the best technology available today, it would add up to the equivalent of 65% of the country's current petrol consumption.<sup>19</sup> Government and private money has been heavily invested in experimenting with various biochemical processes to transform biomass into energy. BP has recently funded the Energy Biosciences Institute with \$500 million; the U.S. Department of

Energy has invested \$125 million in Great Lakes Bioenergy Research Center in Wisconsin, just to name a few examples.

Along with the generation of renewable energy, smart grid technology has developed quickly to monitor energy usage patterns and to smooth out spikes. In the third quarter of 2008, a record \$202 million flowed into the sector compared to \$30 million in the ten prior quarters. Grid Point, a young Arlington, Virginia company pioneering smart grid technology, received \$120 million in venture capital funding in September 2008 in its fifth round offering.

## Green Buildings

Buildings take up land and consume resources, energy, water and materials. As of 2006, buildings used 40% of the total energy consumed in both

the U.S. and European Union. In the U.S., 54% of that was consumed by residential buildings and 46% by commercial buildings.<sup>20</sup> Green building aims to improve the efficiency of using these resources, while reducing the impact on human health and the environment during the building's life cycle through siting, design, construction, operation, maintenance and removal.

The Green Building Council's research in 2007 concluded that there is no significant difference in average costs for green buildings as compared to non-green buildings.<sup>21</sup> Another recent study compared the value of 694 certified green

<sup>19</sup> U.S. Department of Energy. *Annual Energy Review*. 2007

<sup>20</sup> Langdon, Davis. *The Cost of Green Revisited: Reexamining the Feasibility and Cost Impact of Sustainable Design in the Light of Increased Market Adoption*. July 2007.

<sup>21</sup> John Quigley, Piet Eichholtz, and Nils Kok. *Doing Well by Doing Good? Green Office Building*, April 2008.

buildings (Energy Star and LEED) with 7,489 other office buildings located within a quarter mile of the certified green buildings. The research revealed systematic evidence that rents for green buildings are about 2% higher than rents for comparable buildings located nearby. Effective rents, or those adjusted for the occupancy levels in the building, are about 6% higher in green buildings than in comparable office buildings nearby.<sup>22</sup> In fact, 42% of architects surveyed in 2008 by The American Institute of Architects reported clients asking for green building elements on a majority of their projects, with 47% of clients actually implementing green building elements on their projects, an increase of 15% from 2007.<sup>23</sup>

On January 15, 2009, House Democrats proposed to invest \$31 billion to modernize federal and other public infrastructure with the goal of long-term energy cost savings; \$16 billion to repair public housing and retrofit them for energy efficiency, and another \$6 billion to weatherize modest income homes.<sup>24</sup> Currently, the federal government is the world's largest single consumer of energy in the world, spending approximately \$14.5 billion on energy consumption in FY 2008. Advocates of these programs say that they can lead to jobs for people with only moderate skills, and that the jobs created would be in the same areas of employment that people already work in today, both in terms of specialty and geographic locations. For example, increasing the energy efficiency of buildings through retrofitting requires roofers, insulators and building inspectors, and will absorb hundreds of thousands of construction workers who have lost work as the real estate industry has slowed.

## *Transportation and logistics*

In the transportation area, much attention is paid to energy efficient vehicles and our public transportation network. Energy efficient vehicles include hybrid electric vehicles, battery electric vehicles and fuel cell vehicles. A hybrid car is essentially a vehicle powered by two different sources: an electric motor and an internal combustion engine which propels the car. The hybrid recaptures energy through a process known as regenerative braking, where the energy normally lost through braking or coasting goes to power the electric motor. In 2007, hybrids claimed 2.15% share of the new vehicle market, a 38% increase over 2006 to almost 350,000 units.<sup>25</sup> Mass production of battery electric vehicles, or plug-ins, is not that far away, as General Motors (GM) intends to launch a plug-in hybrid called the Volt by 2010 and Toyota also plans a plug-in version of the Prius, awaiting breakthroughs in battery technology. Honda and Mercedes are more inclined to fuel cell technology, which converts hydrogen and oxygen into water, and produces electricity in the process. In terms of cost, clean cars still have a long way to go: GM estimated the price tag of the Volt at \$40,000, as the lithium-ion battery costs \$10,000 to \$15,000 a car. David Cole, chairman of the Center for Automotive Research, in Ann Arbor, MI, estimated that the battery price could someday fall to one third as much, dropping the car's price closer to \$30,000.<sup>26</sup>

Mass transportation, especially different forms of commuter rail and transit oriented development, have been of increasing importance in recent years as the public realizes the social and economic value of mixed-use high-density

<sup>22</sup> The American Institute of Architects. *The 2008 Autodesk/AIA Green Index*, 2008.

<sup>23</sup> *The House Appropriations Committee. American Recovery and Reinvestment*, January 2009

<sup>24</sup> **Green Car Congress. Reported US Hybrid Sales Up 36% In December, 38% for 2007. January 2008**

<sup>25</sup> The New York Times. *G.M.'s Latest Great Green Hope Is a Tall Order*. November 21, 2008.

<sup>26</sup> The National Bureau of Economic Research. "Cycles" <http://www.nber.org/cycles/>. Accessed January 29, 2009.

development within walking distance of transit stations. Getting cars off the road, coupled with energy efficient buildings, provides the greatest environmental benefit of perhaps any development related actions. In the January 2009 House Democrats stimulus package proposal, a \$30 billion budget was proposed to be devoted to highways and bridges and \$10 billion for public transit and rail, which shows improvement from the usual 20% share of the public transportation. It is expected that the American Recovery and Reinvestment Plan, as well as the reauthorization of the surface transportation bill later in 2009, will increase the proportion of transportation funding spent on transit.

### *The Next Wave of Innovation*

The United States officially entered into recession in December 2007,<sup>27</sup> amid a housing market correction, the subprime mortgage crisis and the declining value of dollar. At the end of 2008, the

Standard and Poor's Index slipped by 37% compared to the beginning of the year, and domestic unemployment rate jumped to 7.2%, its highest level since early 1993. In the fourth quarter of 2008 the U.S. economy shed 1.9 million jobs.<sup>28</sup>

In December 2008, in the same week as General Motors and Chrysler received \$17.4 billion from taxpayers to stave off collapse, Hemlock Semiconductor Corp, a solar photovoltaic panel maker 80 miles north of Detroit, announced a \$3 billion expansion that could create hundreds of jobs. This is an excellent example of the new industries being developed in the heart of America's dilapidating rust belt. Evidence suggests that the green economy has arrived, as the cost of renewable energy rapidly drops and the technologies advance. There will be twists in the development of the green economy, with uncertainties such as the mounting government deficit, volatile oil prices and faltering financial system, but the direction is set.

*This study was prepared by Isabelle Xu, a Regional Economist with Arlington (VA) Economic Development, and Shana Johnson, an independent planning consultant.*

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<sup>27</sup> Bureau of Labor Statistics. The Employment Situation: December 2008. <http://www.bls.gov/news.release/empsit.nr0.htm>. Accessed January 29, 2009. hybrids claimed 2.15% share of the new vehicle market