

APPENDIX 8

SAN DIEGO:

Green Economic Potential

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INTRODUCTION

The San Diego metropolitan area is the second largest region in California and the 17th largest in the country. San Diego enjoys excellent climate and beautiful natural attractions such as beaches, mountains, and deserts. Geographically, the region also benefits from a large harbor with a dynamic port and close location to the Mexican border, which gives San Diego a prime location for export and import activities. In the last few decades, the area has experienced a big expansion in its real estate sector with the redevelopment of its downtown, one of the largest increases of median home prices in the country, and a continuous expansion into the east and northeast areas of the county. The region's combination of expensive real estate and an attractive natural environment oftentimes is dubbed the "sunshine tax." However, beyond this label, a closer look at the region evidences a dynamic economy that has reconfigured itself in the last 20 years from a federal spending-dependent defense industry base to a diversified biotech, business services, and tourism-led economy.

Industrial restructuring and real estate booms allowed San Diego to sustain economic growth during the last decade at rates consistently higher than the rest of the country. However, the region's labor market has polarized and presents a high contrast between those employed in the biotech and communication industries at the top, and a large pool of low-wage workers in the tourism and entertainment industry with wages considerably below the minimum necessary to meet the costs of living. A recent report ranks San Diego 20th place in the nation in average wage per cost of living (SANDAG, 2008). Despite a worrying scenario of increasing costs of living, traffic congestion and sprawl, San Diego is a global and innovative economy with several elements that make it an excellent candidate for the growth in green economy sectors. Among the most relevant elements to thrive in the emerging green economy is the past collaboration between government, schools and private sectors in the development of a high tech cluster around the University of California San Diego campus in the 1990s. San Diego also has a solid amount of high-skilled workers and several areas of light manufacturing and machining that can sustain the requirements of the early stages of the product cycle associated with innovation.

The following pages will describe areas of the green economy that might experience greater growth locally and how the region is utilizing already existing networks of innovation to develop a cleantech cluster. Primary data and secondary sources provide information when necessary. Most of these data is dated from 2008 and earlier; therefore, we are not considering data that might reflect more accurately the current condition of economic and financial crisis.

Figure 1: Map of San Diego County



Source: US Census 2000

GEOGRAPHY & RESOURCES

CLIMATE AND WATER

San Diego’s climate is famous for its warm days that average around 75° in the summer and about 44° in the winter. This is especially true in the coastal areas that enjoy the effects of the sea breeze while the rest of the county, extending from the coast into the desert valley’s inland areas, experiences slightly warmer summers and colder winters. Another well- known trait of San Diego’s climate is its sunny days, which provide 3,200 hours of sunshine a year, or 73 percent of the maximum possible (Pryde 1976: 31). This fact is very important as it shows the potential of adopting extensive use of solar power technologies.

Precipitation in the area is rather seasonal and variable. The region is considered semi-arid and usually receives about three and four million acre-feet of rain per year, mainly between the months of December and March (Pryde 1976: 113). However, the area is known for its high precipitation variance and irregular alternation between droughts that span over several years and excessively wet years that bring floods, landslides and even reservoir and dam overflows. The region has historically struggled to secure reliable water supplies (SDCWA 2008). Currently 75 percent of the water supply for the region comes from the Metropolitan Water District (MWD), an entity that manages the Colorado aqueduct. The San Diego County Water Authority is working on diversifying

these sources and by 2020 hopes to purchase only 29% of its supply from the MWD and secure the rest locally by improving water treatment, desalination, recycling, conservation and concrete lining of existing canals. This is another element that might place San Diego, whether by choice or necessity, as a leader in sustainable infrastructure.

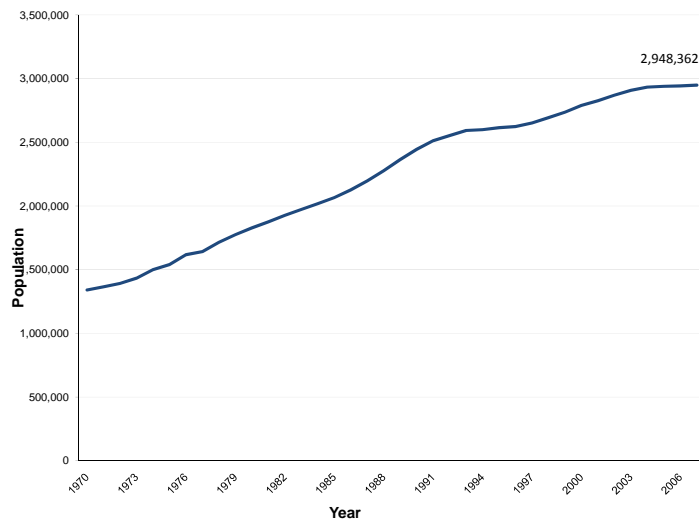
Another characteristic of the region's climate is the seasonal wildfires that spread through the region. This phenomenon is the result of a combination of dry weather, dry winds coming from the north, and poor management of the density of pines and trees. While these fires are a natural phenomenon and a necessary element in the local ecosystem, in recent years they have proven catastrophic in ecologic and monetary terms due to the fact that San Diego's urban growth has reached open space in the mountains and valleys of the area.

DEMOGRAPHICS

POPULATION

Population and income levels are key initial data for framing broad trends in the local economy. As Figure 2 shows, San Diego’s population has more than doubled in the last 30 years, climbing from 1.3 million in 1970 to nearly 3 million in 2006. This tremendous growth came more in the 1970s and 1980s when growth average around 3 percent annually. Since the 1990s, population growth has slowed to around 1 percent annually, with growth slowing even more since 2002.

Figure 2: San Diego County Population Growth, 1970-2006



Source: Bureau of Economic Accounts CA1-3, Population

RACE AND ETHNICITY

Race and ethnicity demographics are also critical for contextualizing the San Diego economy. Table 1 compares the race and ethnic makeup of San Diego with the state of California as a whole. San Diego County is majority white by a slim margin of 51 percent, higher than the state. The Black and Asian populations are both slightly smaller in percentage terms than in California overall. Despite the region’s border location, the Hispanic population makes up a significantly smaller percentage of the population (29.9%) than in the state average (35.7%).

Table 1: Population by Race and Ethnicity, 2005-2007 ^(*)

	San Diego County		California	
	Number	Percentage	Number	Percentage
White	1,525,155	51.6%	15,593,822	43.0%
Black	147,056	5.0%	2,205,637	6.1%
Asian	307,878	10.4%	4,369,567	12.0%
Other	92,584	3.1%	1,140,906	3.1%
Hispanic	882,287	29.9%	12,954,535	35.7%
Total	2,954,960	100.0%	36,264,467	100%

(*) Represents the average characteristics over the 3-year period of time (2005-2007)

Other: American Indian and Alaska Native, NHOPI, some other race, 2 or more races

Source: US Census Bureau 2005-2007 American Community Survey

EDUCATIONAL ATTAINMENT

Overall educational attainment in San Diego increased from 1990 to 2000. As showed in Table 2, the largest increases came in the highest attainment categories. In ten years, the percent of residents with bachelor’s degrees grew by 13 percent, those with graduate or professional degrees by 23 percent. At the same time, those on the lowest end of the educational spectrum - less than a 9th grade education -also grew as a percent of the whole. The percent with intermediate levels of education shrank.

Table 2: Educational Attainment in San Diego County, 1990-2000

	1990	2000	% Change
Less than 9th grade	7.6%	7.9%	5%
9th-12th grade, no diploma	10.5%	9.5%	-10%
High school graduate	22.8%	19.9%	-13%
Some college, no degree	25.6%	25.6%	0%
Associate degree	8.2%	7.6%	-8%
Bachelor's degree	16.5%	18.7%	13%
Graduate or professional degree	8.8%	10.9%	23%

Source: US Census 1990 and 2000.

However, specific subpopulations vary in their educational makeup. Table 3 provides one example of this variation with data on educational attainment of the immigrant population. In 2007, San Diego’s immigrants also boasted high representation in the bachelor’s and graduate degree categories. However, immigrants were much more likely than the population as a whole to have low levels of educational attainment. A full 20 percent of immigrants have less than a 9th grade education as compared to about 8 percent of all residents in 2000.

Table 3: Educational Attainment of Immigrants in San Diego County, 2007

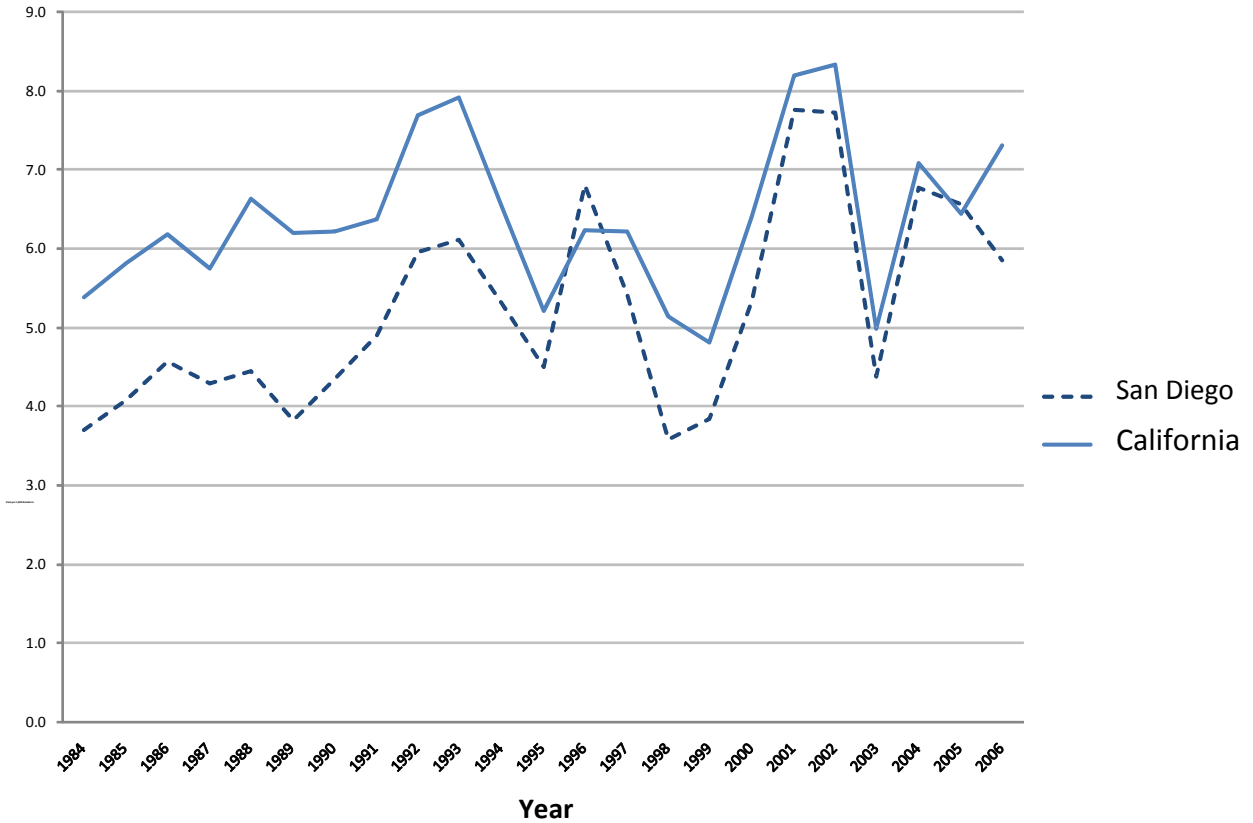
Less than 9th grade	20.0%
9th-12th grade, no diploma	13.1%
High school graduate	20.6%
Some college, no degree	14.2%
Associate degree	5.8%
Bachelor's degree	16.4%
Graduate or professional degree	9.9%

Source: US Census IPUMS 2007 American Community Survey.

IMMIGRATION

San Diego County shares its southern border with Mexico. Trade with Mexico and migration of workers across the border play important roles in the local and regional economy. However, as Figure 3 indicates, for much of the 1980s and early 1990s legal immigration rates were well below the state average. More recently, local immigration levels have risen, but still have not generally exceeded that of California as a whole. The US Census does not record illegal or undocumented immigration rates.

Figure 3: Legal Immigration Rate per 1,000 Residents in San Diego, 1984-2006



Source: U.S. Citizenship and Immigration Services and the California Department of Finance, Demographic Research Unit.

ECONOMIC HISTORY

BRIEF REGIONAL HISTORY

San Diego is considered the birthplace of California. The area that now occupies San Diego has been home to several cultures over the course of history: Native Americans, Spanish, Mexican and Algo-American. The area has long been inhabited by the Kumeyaay Indians and several other tribes. The first European to visit the region was Juan Rodrigues Cabrillo sailing under the Spanish Flag. In 1769, Gaspar de Portolà established the Fort Presidio of San Diego. Around the same time, Mission San Diego de Alcalá was founded by Franciscan friars under Father Junípero Serra. By 1797, the San Diego mission had the largest native population in Alta California, with over 1,400 natives living in and around the mission proper.

In 1821 Mexico gained its independence from Spain and California became part of the new country. The secularization of government brought decline to San Diego. The territory became part of the United States at the end of the Mexican-American War in 1846. In 1848 San Diego was designated the seat of the newly established San Diego County and was incorporated as a city in 1850. The period spanning from the late 19th century to the first decade of the 20th century is considered the Victorian “boom”. Significant U.S. Naval presence began in 1908 with the arrival of the Great White Fleet and the establishment of the Navy Coaling Station, which gave further impetus to the development of the town. San Diego hosted two World's Fairs, the Panama-California Exposition in 1915, and the California Pacific International Exposition in 1935.

The so called San Diego's Air and Sea period spanned into 1945 and was characterized by the expansion of commercial and military navigation. Among the most famous episodes is that of Charles Lindbergh, whose famous plane “The Spirit of St. Louis” was built in San Diego (Pryde, 1976). Shortly after World War II, the county reached a population of half a million. The following decades, considered the contemporary boom period, witnessed great population and physical growth that propelled San Diego from the 31st largest city in the nation to the seventh. All throughout this time the military played an increasing role in the local economy, both in terms of direct employment in the several bases and facilities, but also on local defense and aerospace industries.

Since the 1980s, San Diego has experienced changes in its economy. While the military bases and shipbuilding are still an important part of the economy, other industries have risen in importance, namely the tourism and the professional service sectors. These developments have made San Diego a global city that attracts people from all over the country and the world to work in its largest industries and enjoy its natural amenities.

TRANSPORTATION & LAND USE

TRANSPORTATION

The San Diego region is served by a complex network of highways, railroads, airports, a port and two international border crossing stations. San Diego currently faces several challenges in all of these areas. Within the region growing highway congestion is becoming extremely problematic. As the commuter shed expanded east and northeast bound, new stress has been put on interstate highways 8, 15 and 805. On the other hand, the use of rail transit options is still rather small as most of the areas are not served by the Coaster, Sprinter and Trolley Services. The main highways in the region are Interstates 8, 5, 805, and 15 that connect the region with Orange County, the Inland

Empire and Arizona; and state routes 54, 163, 52, 78 and 215, and 905 that form an internal network.

San Diego-Lindbergh International Airport (SAN) is located in the harbor and surrounded by downtown and residential zones; expansion of its facilities and landing strip is impossible and the airport is a known source of air and noise pollution for more than 100,000 San Diegans. This is a problem that became evident about 30 years ago, but so far all plans to find new locations in the region have failed.

The Port of San Diego is also an important gateway and an asset for international trade. The port has two main cargo terminals and one passenger terminal. Most of the activity takes place in the National City terminal that handles containers and a great amount of incoming automobile shipments from Japan and Korea (www.portofsandiego.com). The passenger terminal, located in the downtown area of the harbor, has seen an increase in travelers in the last decade. The terminal currently serves several cruise lines that travel to diverse national and international destinations on the Pacific Ocean. In recent years the Port of San Diego has implemented a series of green initiatives to reduce the environmental impact of its operations. Among the most important are the retrofitting of equipment, the use of shore power to reduce idling of boats, and stricter rules for the treatment of water. All these measures are scheduled to be instated by late 2009 (Port of San Diego, 2008)

San Diego is also connected to the rest of the state and the country via railroad. Several short and long line companies move cargo from the port to the Los Angeles area and into the east of the state and Arizona. Amtrak also offers passenger service between San Diego and Los Angeles. The Los Angeles metropolitan train system, Metrolink, also serves the area with one stop in Oceanside.

The region also is served by three international border crossings, two in the San Diego metropolitan area and one in the east county in Tecate. These ports of entry serve tourists and international freight and are open 24 hours a day. While in the last few years expanded security measures have increased the wait at the border for both passengers and truckers, programs are being implemented to make the process more efficient.

LAND USE

In 2004, the San Diego Association of Governments (SANDAG) determined that the current growth patterns of the region were not sustainable. Among the main issues they identified were reduced open space, a housing shortage, a jobs and housing spatial mismatch, and environmental degradation. To address these issues, all the cities in SANDAG have signed a Regional Comprehensive Plan that is based on smart growth and that encompasses issues from transportation, water and waste management to urban form and energy conservation (SANDAG 2004). The cost and accessibility of land with industrial use is also very important for the green economy. A 2007 report prepared for the City of San Diego City Planning and Community Investment Department reported that the city has 1,400 acres available for development with industrial use and the County an additional 4,500 acres. The report also cites the high cost of land and strict permitting as an issue that might affect the region in terms of competitiveness.

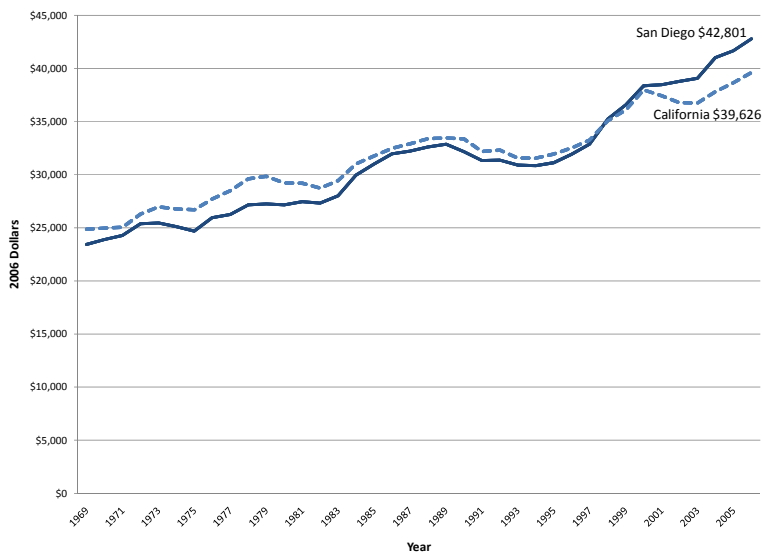
CURRENT ECONOMIC STRUCTURE

ECONOMIC INDICATORS

INCOME

Figure 4 shows real per capita personal income growth in San Diego and California. Real per capita personal income has grown in San Diego County by an impressive 83 percent between 1969 and 2006. Income growth figures were highest in the 1980's, fell in the 1990s and they began to climb back up more recently.

Figure 4: Personal Real Income per Capita in San Diego and California, 1969-2006 (in 2006\$)

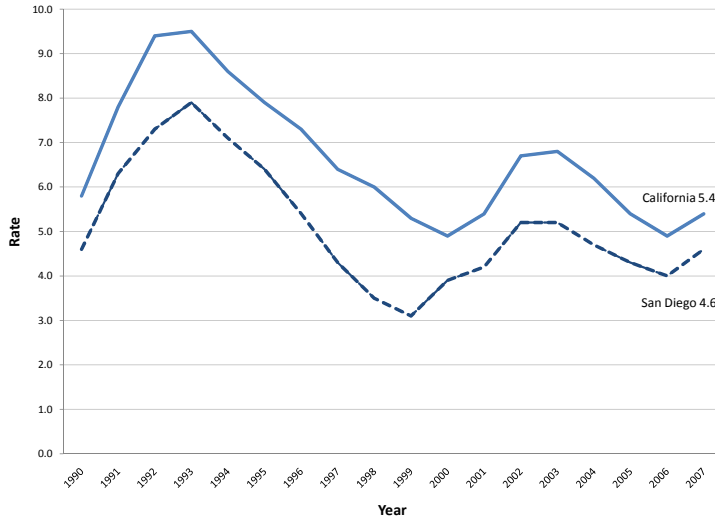


Source: Bureau of Labor Statistics (Personal Real Income) and Bureau of Economic Accounts (CA1-3 Population)

POVERTY AND UNEMPLOYMENT

Figure 5 below compares the unemployment rate over time in San Diego and California. In general the trend lines show remarkable similarities between county and state figures. San Diego's unemployment has remained about one percent below the California average. San Diego actually performed better relative to the state as a whole, with a 1.5 percent gap in the early 1990s when military base closures threatened the basis of the local economy.

Figure 5: Unemployment in San Diego and California, 1990-2007



Source: US Bureau of Labor Statistics

SHIFT-SHARE ANALYSIS

Before addressing specific details of the green economy in San Diego County, it is important to establish a general understanding of the regional economy more broadly. In order to do so, this section uses two instruments widely used in regional economic analysis: location quotients and shift-share analysis. In order to do so, this section resorts to two instruments widely used in regional economic analysis: location quotients and shift-share analysis.

- *Location Quotient* (LQ). This report calculated location quotients for all economic sectors in order to determine whether or not San Diego County has a relatively greater ($LQ > 1$) or lesser ($LQ < 1$) concentration of that sector than California averages. Although LQ are useful for showing the sectors in which the region specializes, they do not explain the sources of change over time. They do not describe either how the performance of the regional economy differs from that of the state. Shift-share analysis indicators address some of these issues better.
- *Shift-share Analysis* is a technique used in regional economics to measure the performance of a region compared to a larger geographic entity (state or nation, for instance). This section compares the performance of the regional economy with that of California. The shift-share analysis featured in Table 5 below decomposes changes in employment levels in three categories in order to identify whether the sources of employment growth or decline in the region are specific to the state's average employment growth trend (Economic Growth Factor), the sector performance (Proportional Shift), or the region's competitiveness (Differential Shift). Because sector effects and California growth rate are subtracted, the Differential Shift (DS) gives us a measure of the share of employment growth that is specific to the region's competitive advantage. The higher the DS, the more competitive is the region in that specific sector.

Location quotients (LQs) and Differential Shifts (DS) are therefore indicators of the specialization and competitiveness, respectively, of the region in specific economic sectors (2-digit NAICS industries) or sub-sectors (3-digit NAICS industries).

Table 4 below presents a shift-share analysis for 2-digit NAICS industry sectors for San Diego County. Employment growth and decline in the different industries will give us a broad picture of San Diego's economy and will point at economic sectors that could provide competitive advantages in the emerging green economy.

Table 4: San Diego County Economic Structure: Location Quotients and Shift-Share Analysis, 1990-2008

Industry Title (2-digit NAICS)	San Diego Employment			San Diego Location Quotient			California Employment			Shift-Share 1990-2000				Shift-Share 2000-2008			
	1990	2000	2008	1990	2000	2008	1990	2000	2008	Econ. Growth Factor	Prop. Shift	DS	Job Growth	Econ. Growth Factor	Prop. Shift	DS	Job Growth
11 Agriculture, forestry, fishing and hunting	10,021	10,710	10,218	0.48	0.42	0.40	280,936	319,020	306,727	11.6%	1.9%	-6.7%	6.9%	5.7%	-9.6%	-0.7%	-4.6%
21 Mining, quarrying, and oil and gas extraction	608	336	363	0.22	0.19	0.17	37,455	22,025	25,678	11.6%	-52.8%	-3.5%	-44.7%	5.7%	10.9%	-8.5%	8.1%
22 Utilities	7,238	5,816	6,821	1.46	1.28	1.38	66,502	56,791	58,584	11.6%	-26.2%	-5.0%	-19.6%	5.7%	-2.6%	14.1%	17.3%
23 Construction	64,351	66,768	78,032	1.25	1.23	1.16	692,291	682,072	799,846	11.6%	-13.1%	5.2%	3.8%	5.7%	11.6%	-0.4%	16.9%
31-33 Manufacturing	127,586	121,844	102,945	0.83	0.83	0.86	2,059,262	1,830,809	1,423,273	11.6%	-22.7%	6.6%	-4.5%	5.7%	-28.0%	6.7%	-15.5%
42 Wholesale trade	32,764	38,592	45,104	0.71	0.76	0.75	618,668	636,648	709,499	11.6%	-8.7%	14.9%	17.8%	5.7%	5.7%	5.4%	16.9%
44-45 Retail trade	117,886	131,045	143,470	1.06	1.08	1.03	1,495,330	1,527,619	1,650,261	11.6%	-9.5%	9.0%	11.2%	5.7%	2.3%	1.5%	9.5%
48-49 Transportation and warehousing	16,420	22,861	22,094	0.67	0.65	0.61	330,565	438,163	429,401	11.6%	20.9%	6.7%	39.2%	5.7%	-7.7%	-1.4%	-3.4%
51 Information	22,260	37,882	38,177	0.73	0.91	0.98	412,306	519,849	463,001	11.6%	14.5%	44.1%	70.2%	5.7%	-16.7%	11.7%	0.8%
52 Finance and insurance	44,788	43,412	47,174	0.97	1.02	0.96	617,510	532,039	584,404	11.6%	-25.5%	10.8%	-3.1%	5.7%	4.1%	-1.2%	8.7%
53 Real estate and rental and leasing	24,140	27,088	29,184	1.25	1.31	1.26	259,926	259,876	274,938	11.6%	-11.6%	12.2%	12.2%	5.7%	0.1%	1.9%	7.7%
54 Professional and technical services	66,922	88,576	114,186	1.23	1.21	1.26	733,850	918,781	1,079,218	11.6%	13.6%	7.2%	32.4%	5.7%	11.7%	11.5%	28.9%
55 Management of companies	4,440	18,691	15,168	1.28	0.71	0.87	46,728	329,758	207,230	11.6%	594.1%	-284.8%	320.9%	5.7%	-42.9%	18.3%	-18.8%
56 Administrative and waste services	45,868	82,121	86,789	0.97	1.08	1.09	636,334	950,818	949,066	11.6%	37.8%	29.6%	79.0%	5.7%	-5.9%	5.9%	5.7%
61 Educational services	10,771	14,234	22,810	0.86	0.88	0.99	169,118	202,073	273,063	11.6%	7.9%	12.7%	32.1%	5.7%	29.4%	25.1%	60.3%
62 Health care and social assistance	71,926	96,538	110,709	1.05	1.05	0.94	916,984	1,150,609	1,394,541	11.6%	13.8%	8.7%	34.2%	5.7%	15.5%	-6.5%	14.7%
71 Arts, entertainment, and recreation	19,197	21,321	23,871	1.27	1.23	1.16	202,532	216,414	243,156	11.6%	-4.8%	4.2%	11.1%	5.7%	6.6%	-0.4%	12.0%
72 Accommodation and food services	93,338	106,781	134,092	1.33	1.23	1.23	942,753	1,086,367	1,293,794	11.6%	3.6%	-0.8%	14.4%	5.7%	13.4%	6.5%	25.6%
81 Other services, except public administration	36,084	42,773	55,143	1.07	0.97	0.90	451,706	554,226	723,092	11.6%	11.1%	-4.2%	18.5%	5.7%	24.8%	-1.5%	28.9%
99 Unclassified			5,819	N/A	N/A	0.99			69,714	11.6%	N/A	N/A	N/A	5.7%	N/A	N/A	N/A
Total, all industries	817,324	977,867	1,092,171	1.00	1.00	1.00	10,980,978	12,257,882	12,958,485	11.6%	0.0%	8.0%	19.6%	5.7%	0.0%	6.0%	11.7%

Source: US Bureau of Labor Statistics, Quarterly Census of Employment and Wages, 2008. Calculations by UC Berkeley Center for Community Innovation

In 2008, the largest providers of employment in San Diego County by sector were Retail Trade (143,470 jobs), Accommodation and Food Services (134,092), Professional and Technical Services (114,186), Health Care and Social Assistance (110,709), and Manufacturing (102,945). Although still a major sector in the region, these figures reflect the declining trend of manufacturing in San Diego - the largest employer sector in the region in 1990 - in favor of professional, service, health and tourism related activities. Among the sectors that created more jobs in the region, five stand out: Professional and Technical Services (with 47,264 more jobs in 2008 than in 1990), Administrative and Waste Services (+40,920 jobs), Accommodation and Food Services (+40,754 jobs), Health Care and Social Assistance (+38,783 jobs), and Retail Trade (+25,584 jobs). Despite the loss of 24,641 jobs since 1990, manufacturing keeps a positive Differential Shift in San Diego, suggesting that manufacturing activities are still more competitive in the region than in the state as a whole.

The sectors that showed higher concentration in San Diego compared to California in 2008 (LQ 2008 > 1) are: Utilities (1.38), Professional and Technical Services (1.26), Real Estate (1.26), Accommodation and Food Services (1.23), Arts, Entertainment and Recreation (1.16), Construction (1.16), Administrative and Waste Services (1.09) and Educational Services (0.99). Among them, Educational Services shows the best competitive performance in the region with a Differential Shift of 25.1%. Regarding job growth, Professional and Technical Services, Accommodation and Food Services, Real Estate, and, to a lesser degree, Administrative and Waste services are all large growing sectors in San Diego.

The Utilities sector is also among the fastest growing and most concentrated sectors, although small in terms of total employment (6,821 jobs in 2008). In this sector we can find Sempra Energy, the parent company of San Diego Gas and Electric, So. Cal Gas and other utility companies such as Sempra Generation, a company that produces wind powered energy.

Educational Services, Management, and Information are all fast growing sectors, but with lower concentrations and small total employment. IT had an outstanding performance in the 1990-2000 period with 70% in job growth and a 44.1% DS; the figures for 2000-2008 are less impressive (0.8% job growth) but still promising in terms of competitiveness (11.5% DS). Construction and Health Care are large sectors that did not, however, performed competitively in San Diego in 2000-2008 (negative DS).

Table 5 below shows the top five industry sectors sorted by different criteria. We consider that these sectors are important either for their amount of jobs created, differential shift or growth. These figures make evident that Professional and Technical Services, Accommodation and Food Services, and Recreation sectors are consistently at the top, regardless of the metrics used. This does not come as a surprise given the shift in the economic base mentioned before. These data also show the massive polarization of the industries when taking into consideration that most of the sectors listed have grown in terms of jobs with the exception of manufacturing that presents a decline for the 2000-2008 period in all metrics.

Table 5: Top 5 Economic Sectors in San Diego County (2-digit NAICS), 1990-2008

Rank	San Diego	Employment			San Diego Location Quotient			San Diego Employment Change		California			Shift-Share 1990-2000				Shift-Share 2000-2008		
		1990	2000	2008	1990	2000	2008	Emp. Change (90-08)	% Emp. Change (90-08)	1990	2000	2008	Econ. Growth Factor	Prop. Shift	DS	Job Growth	Econ. Growth Factor	Prop. Shift	DS
<i>Top 5 Sectors by Total Employment in 2008</i>																			
1	Retail trade	117,886	131,045	143,470	1.06	1.08	1.03	25,584	22%	1,495,330	1,527,619	1,650,261	11.63%	-9.47%	9.00%	11.16%	5.72%	2.31%	1.45%
2	Accommodation and Food Services	93,338	106,781	134,092	1.33	1.23	1.23	40,754	44%	942,753	1,086,367	1,293,794	11.63%	3.61%	-0.83%	14.40%	5.72%	13.38%	6.48%
3	Professional and Technical Services	66,922	88,576	114,186	1.23	1.21	1.26	47,264	71%	733,850	918,781	1,079,218	11.63%	13.57%	7.16%	32.36%	5.72%	11.75%	11.45%
4	Health Care and Social Assistance	71,926	96,538	110,709	1.05	1.05	0.94	38,783	54%	916,984	1,150,609	1,394,541	11.63%	13.85%	8.74%	34.22%	5.72%	15.48%	-6.52%
5	Manufacturing	127,586	121,844	102,945	0.83	0.83	0.86	-24,641	-19%	2,059,262	1,830,809	1,423,273	11.63%	-22.72%	6.59%	-4.50%	5.72%	-27.98%	6.75%
<i>Top 5 Sectors by Total Employment Change (1990-2008)</i>																			
1	Professional and Technical Services	66,922	88,576	114,186	1.23	1.21	1.26	47,264	71%	733,850	918,781	1,079,218	11.63%	13.57%	7.16%	32.36%	5.72%	11.75%	11.45%
2	Administrative and Waste services	45,868	82,121	86,789	0.97	1.08	1.09	40,920	89%	636,334	950,818	949,066	11.63%	37.79%	29.62%	79.04%	5.72%	-5.90%	5.87%
3	Accommodation and Food Services	93,338	106,781	134,092	1.33	1.23	1.23	40,754	44%	942,753	1,086,367	1,293,794	11.63%	3.61%	-0.83%	14.40%	5.72%	13.38%	6.48%
4	Health Care and Social Assistance	71,926	96,538	110,709	1.05	1.05	0.94	38,783	54%	916,984	1,150,609	1,394,541	11.63%	13.85%	8.74%	34.22%	5.72%	15.48%	-6.52%
5	Retail Trade	117,886	131,045	143,470	1.06	1.08	1.03	25,584	22%	1,495,330	1,527,619	1,650,261	11.63%	-9.47%	9.00%	11.16%	5.72%	2.31%	1.45%
<i>Top 5 Sectors by % Total Employment Change (1990-2008)</i>																			
1	Management of Companies	4,440	18,691	15,168	1.28	0.71	0.87	10,728	242%	46,728	329,758	207,230	11.63%	594.07%	-284.77%	320.93%	5.72%	-42.87%	18.31%
2	Educational Services	10,771	14,234	22,810	0.86	0.88	0.99	12,039	112%	169,118	202,073	273,063	11.63%	7.86%	12.66%	32.15%	5.72%	29.42%	25.12%
3	Administrative and Waste Services	45,868	82,121	86,789	0.97	1.08	1.09	40,920	89%	636,334	950,818	949,066	11.63%	37.79%	29.62%	79.04%	5.72%	-5.90%	5.87%
4	Information	22,260	37,882	38,177	0.73	0.91	0.98	15,917	72%	412,306	519,849	463,001	11.63%	14.45%	44.09%	70.18%	5.72%	-16.65%	11.71%
5	Professional and Technical Services	66,922	88,576	114,186	1.23	1.21	1.26	47,264	71%	733,850	918,781	1,079,218	11.63%	13.57%	7.16%	32.36%	5.72%	11.75%	11.45%
<i>Top 5 Sectors by Location Quotient in 2008 (Sectors with more than 10,000 employees only)</i>																			
1	Real Estate and Rental and Leasing	24,140	27,088	29,184	1.25	1.31	1.26	5,045	21%	259,926	259,876	274,938	11.63%	-11.65%	12.23%	12.21%	5.72%	0.08%	1.94%
2	Professional and Technical Services	66,922	88,576	114,186	1.23	1.21	1.26	47,264	71%	733,850	918,781	1,079,218	11.63%	13.57%	7.16%	32.36%	5.72%	11.75%	11.45%
3	Accommodation and Food Services	93,338	106,781	134,092	1.33	1.23	1.23	40,754	44%	942,753	1,086,367	1,293,794	11.63%	3.61%	-0.83%	14.40%	5.72%	13.38%	6.48%
4	Arts, Entertainment, and Recreation	19,197	21,321	23,871	1.27	1.23	1.16	4,674	24%	202,532	216,414	243,156	11.63%	-4.77%	4.21%	11.06%	5.72%	6.64%	-0.39%
5	Construction	64,351	66,768	78,032	1.25	1.23	1.16	13,681	21%	692,291	682,072	799,846	11.63%	-13.10%	5.23%	3.76%	5.72%	11.55%	-0.40%
<i>Top 5 Sectors by Differential Shift (DS) in 2008 (Sectors with more than 10,000 employees only)</i>																			
1	Educational Services	10,771	14,234	22,810	0.86	0.88	0.99	12,039	112%	169,118	202,073	273,063	11.63%	7.86%	12.66%	32.15%	5.72%	29.42%	25.12%
2	Management of Companies	4,440	18,691	15,168	1.28	0.71	0.87	10,728	242%	46,728	329,758	207,230	11.63%	594.07%	-284.77%	320.93%	5.72%	-42.87%	18.31%
3	Information	22,260	37,882	38,177	0.73	0.91	0.98	15,917	72%	412,306	519,849	463,001	11.63%	14.45%	44.09%	70.18%	5.72%	-16.65%	11.71%
4	Professional and Technical services	66,922	88,576	114,186	1.23	1.21	1.26	47,264	71%	733,850	918,781	1,079,218	11.63%	13.57%	7.16%	32.36%	5.72%	11.75%	11.45%
5	Manufacturing	127,586	121,844	102,945	0.83	0.83	0.86	-24,641	-19%	2,059,262	1,830,809	1,423,273	11.63%	-22.72%	6.59%	-4.50%	5.72%	-27.98%	6.75%

Source: US Bureau of Labor Statistics, Quarterly Census of Employment and Wages, 2008. Calculations by UC Berkeley Center for Community Innovation

Table 6 below narrows the analysis to 3-digit NAICS code to emphasize more specific sub-sectors over broader industries.

Table 6: Economic Sub-sectors (3-digit NAICS) with Higher LQs in San Diego County¹, 1990- 2008

Industry Title	San Diego Total Employment			San Diego Location Quotient			Shift-Share 2000-2008			
	1990	2000	2008	1990	2000	2008	Econ. Growth Factor	Prop. Shift	DS	Job Growth
517 Telecommunications	6,872	15,709	18,835	0.70	1.37	1.86	5.7%	-21.9%	36.1%	19.9%
721 Accommodation	24,739	25,358	30,483	1.69	1.66	1.74	5.7%	3.3%	11.2%	20.2%
339 Miscellaneous manufacturing	10,015	12,620	11,510	1.58	1.56	1.54	5.7%	-18.6%	4.1%	-8.8%
336 Transportation equipment manufacturing	32,517	14,649	15,423	1.54	1.17	1.46	5.7%	-26.4%	25.9%	5.3%
531 Real estate	19,011	19,570	22,611	1.40	1.40	1.35	5.7%	7.7%	2.1%	15.5%
812 Personal and laundry services	11,340	13,236	15,314	1.17	1.29	1.28	5.7%	4.9%	5.0%	15.7%
541 Professional and Technical Services	66,922	88,576	114,186	1.23	1.21	1.26	5.7%	11.7%	11.5%	28.9%
238 Specialty trade contractors	41,363	43,779	50,687	1.31	1.23	1.15	5.7%	11.6%	-1.5%	15.8%
236 Construction of buildings	14,352	15,136	18,538	1.11	1.19	1.15	5.7%	14.8%	2.0%	22.5%
448 Clothing and clothing accessories stores	13,718	13,630	18,116	1.12	1.11	1.14	5.7%	16.1%	11.1%	32.9%
813 Membership associations and organizations	8,105	10,063	14,244	0.91	0.95	1.14	5.7%	6.3%	29.5%	41.5%
722 Food services and drinking places	68,599	81,422	103,609	1.23	1.14	1.13	5.7%	15.5%	6.0%	27.2%

Source: US Bureau of Labor Statistics, Quarterly Census of Employment and Wages, 2008. Calculations by UC Berkeley Center for Community Innovation

We have highlighted four 3-digit NAICS sub-sectors that merit further consideration as they relate to the green economy and excel in total employment, location quotient or differential shift: Transportation Equipment Manufacturing, Miscellaneous Manufacturing, Professional and Technical Services, and Waste Management and Remediation.

Transportation Equipment Manufacturing had one of the highest differential shifts of any sector from 2000 to 2008, rebounding strongly after a rough spell in the 1990's. Today the sector employs over 15,000 workers and has one of the highest location quotients of any sector in San Diego. Transportation manufacturing can include the production of green products such as hybrid automobiles, as well as mass transit vehicles and bicycles.

Miscellaneous Manufacturing is a sector that can potentially thrive. Although the current job growth and differential shift have decreased, it still has a high location quotient. This shows that the region could take advantage of the variety of small firms that manufacture a diversity of products such as medical equipment, toys, sporting goods, jewelry, fasteners, and office supplies, among others. These are small firms that are not characterized by the predominance of the use of one single process or material. This speaks to the region's pool of manufacturing labor with diverse skills and the existence of plenty of lightweight manufacturing zones.

Professional and Technical Services is a sector where human capital is the major input. This is the largest sector of our group in terms of employment. The establishments classified in this sub-sector sell expertise, and include legal services, architecture and design, technical and scientific consulting and

¹ Sub-Sectors with 10,000 employees or more in 2008 only

research, graphic and industrial design, and other related services. These firms are high paying as we observed before and are well established in the region. This might be one of the strongest assets of the region, as San Diego is well experienced in promoting innovation, high tech and biotech research, and the establishment of company headquarters. The region also has a large labor pool of individuals with the skills necessary for the creation, service, and management of new companies.

The industries in the Waste Management and Remediation sub-sector, although not included in the table due to the small number of employees (2,965 jobs in 2008), can play an important role in San Diego's green economy. It includes companies in the business of collection, treatment, and disposal of waste materials such as the hauling of waste materials; operating materials recovery facilities (i.e., those that sort recyclable materials from the trash stream); providing remediation services (i.e., those that provide for the cleanup of contaminated buildings, mine sites, soil, or ground water); and providing septic pumping and other miscellaneous waste management services. Although this sector is not highly concentrated in the region with respect to the rest of the state, it has experienced notable growth since the 1990s and is expected to continue to grow as environmental impact regulations continue to be implemented.

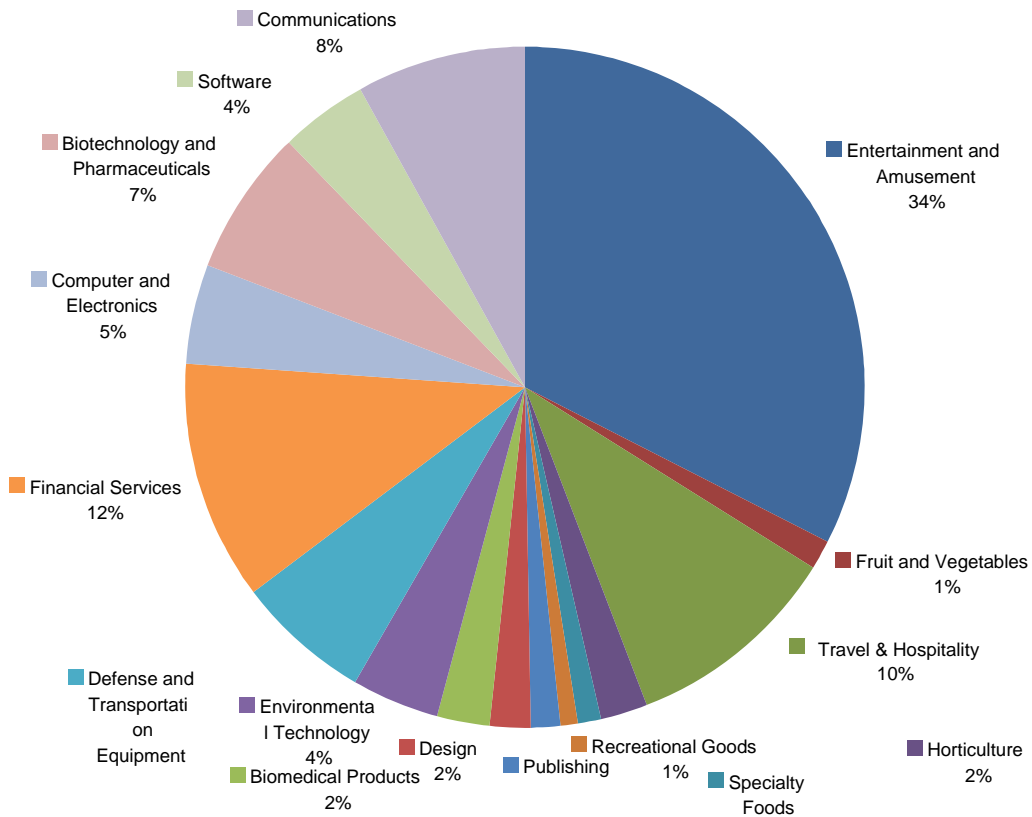
CLUSTER ANALYSIS

San Diego economic base has experienced a notable change since the 1990s. Traditionally, the main economic force of the region had been the defense industry, encompassing aerospace, space systems and shipbuilding, which together with the existence of several large military facilities in the area gave San Diego the motto of a "military town". The reduction of government expenditures in these rubrics in recent decades brought the loss of 79,200 highly skilled and highly paid manufacturing and aerospace jobs in the first five years of the 1990s (SANDAG, 2006).

San Diego Regional Planning Agency (SANDAG) reports that most of these jobs had been recuperated by the end of that decade through the expansion of the service industry in two main groups: a high paying group, that includes business services, health services, engineering and management; and a low paying group that includes tourism, lodging, and bar and restaurant jobs.

Figures 6 and 7 provide data on total cluster employment and wages respectively. As San Diego's economy diversified, several export industry clusters rose in importance both in number of firms and in number of employees. These new industry clusters replaced the defense industries as a main engine of growth. SANDAG (2006) has used the California Employment Department's data to identify 16 main clusters that employ 326,067 workers and make up 24% of the region's jobs.

Figure 6: Employment by Cluster in San Diego Region, 2005



Source: SANDAG

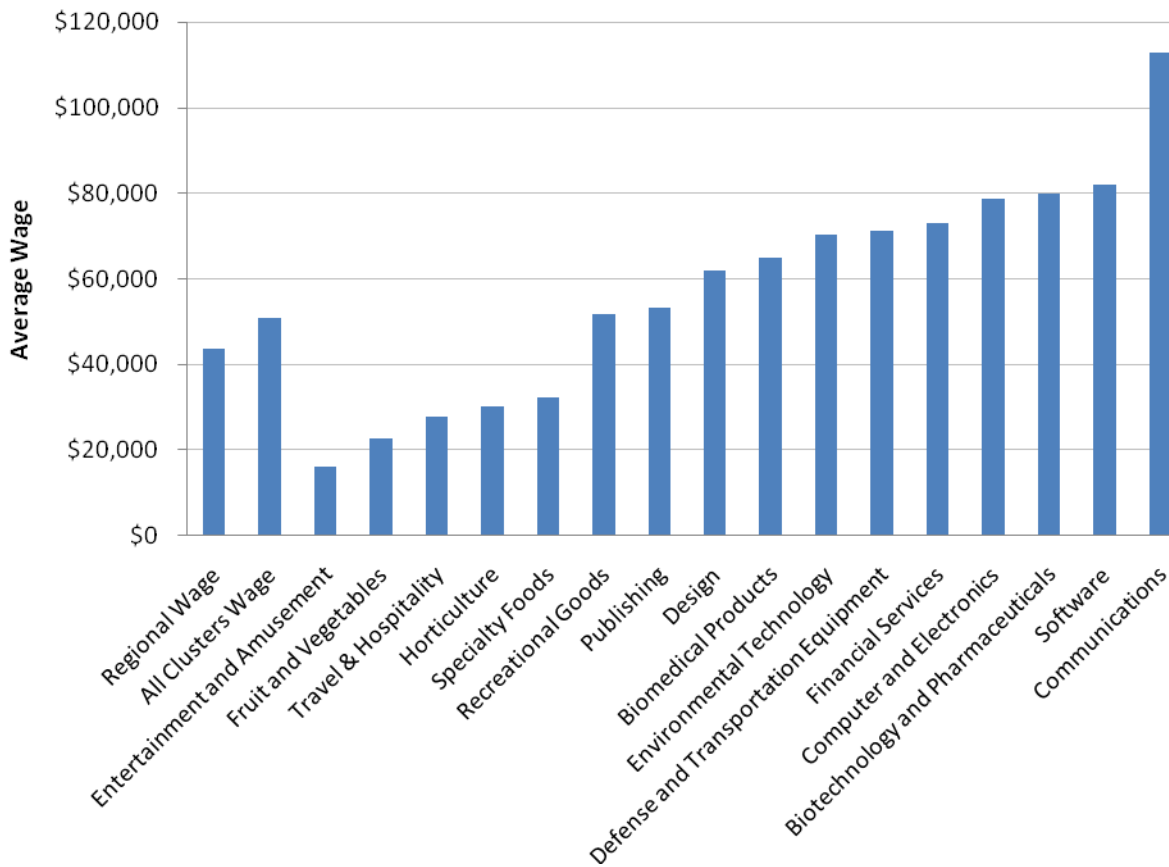
In the next paragraphs we present a brief description of the clusters that could be directly or indirectly related to the green economy:

- **Biotechnology and Pharmaceuticals:** San Diego is the national leader in venture capital for this sector and this figure represented more than one third of the venture capital invested in the region. Most of the activities are concentrated in research and development and manufacturing of substances. In 2006 this sector had 21,776 jobs with an average wage of \$80,022.
- **Communications:** This cluster includes the manufacturing, research, and development of equipment. Several global companies are headquartered in the region and venture capital is also of notable size in this area. The cluster reported 25,469 jobs in 2006, with an average income of \$112,825.
- **Design:** This is part of the professional and technical services industry (NAICS 541). This cluster incorporates architecture, engineering, industrial design and others. This cluster has 6,510 employees with an average income of \$61,831.

- *Fruit and Vegetables*: Although this is not a major industry of the region, Pryde (2007) reports that there has been a growth of organic farms in the region. The most commonly produced crops are avocado, citrus, strawberries and tomatoes. This cluster had 3,702 employees in 2006, with an average income of \$22,647.
- *Recreational Goods*: The region has a very high concentration of golf equipment, surfboards, skateboards, and other recreational goods. This is a highly export oriented cluster with 3,188 employees and an average wage of \$51,904.

The same data reports that the average income for jobs in these clusters was \$51,018, against \$43,801 for the non-cluster employment. A detailed look at the Figure 6 shows that this results from very high-paying jobs in the communications, high tech and biotech sectors, with average wages over \$80,000, and in the case of communications, of \$112,000. On the other hand, the largest cluster in terms of number of jobs (34%) is the entertainment and amusement cluster, with at total of 104,354 employees and an average wage of \$16,143.

Figure 7: Average Wage for Main Clusters in San Diego Region, 2005



Source: SANDAG

THE GREEN ECONOMY IN NUMBERS

GREEN EMPLOYMENT AND ESTABLISHMENTS

This report considers the green economy in broad terms as economic activity that reduces energy consumption and/or improves environmental quality. This study is interested in finding what green industries are already established in the region, but also what are those sectors of the economy that can promote green innovation and subsequently become a pole for green industrial growth. As noted earlier, San Diego has diversified its economic base aided by nurturing biotech and high-tech innovation and we can assume that some of the research done in this field can promote green technologies. However, paying attention to all sectors that can produce green goods and services will allow consideration of the green economy more holistically.

This section provides figures on green employment and establishments in San Diego County for 1990, 2000, and 2008. For each year, employment levels, average annual growth rates (AAGR), and location quotients (LQ) are presented for six different green sectors: energy research and services, environmental services, green building, green transportation, green manufacturing, and recycling/remediation.

Table 7: Green Economy Summary for San Diego, 1990, 2000, 2008

	Green Employment						Green Establishments										
	1990		2000		2008		1990		2000		2008						
	LQ		LQ		LQ		LQ		LQ		LQ						
						Region AAGR 90-08	State AAGR 90-08					Avg. Est. Size, 2008	Region AAGR 90-08	State AAGR 90-08			
Energy Research and Services	398	0.3	740	0.5	950	0.5	5.0%	1.7%	39	1.5	75	1.4	94	1.4	10.1	5.3%	4.7%
Environmental Services	2,570	1.8	4,179	1.6	5,109	1.5	3.9%	3.9%	140	1.1	360	1.0	438	1.0	11.7	6.9%	5.9%
Green Building	902	1.2	776	1.0	917	0.7	0.1%	2.3%	71	1.1	61	1.0	92	1.0	10.0	1.5%	1.4%
Green Manufacturing	5,056	3.3	5,653	2.9	5,076	2.8	0.0%	0.0%	68	1.3	94	1.3	106	1.3	47.9	2.6%	2.0%
Green Transportation	1,611	0.7	2,989	0.9	4,227	1.3	5.5%	0.8%	38	0.9	81	0.9	139	1.0	30.4	7.9%	5.8%
Recycling / Remediation	1154	0.6	1569	0.5	1941	0.7	2.9%	1.1%	100	0.7	183	0.8	223	0.8	8.7	4.8%	3.3%
Total Green	11,691		15,906		18,220		2.5%	1.6%	456		854		1,092		16.7	5.3%	4.2%

Source: NETS; UCB Center for Community Innovation

In 2007, there were almost 1,100 green businesses in San Diego.² Green sectors in 2008 employed a total of 18,220 people in San Diego County.³ This represents 11% of all green employment in California. San Diego's green employment has experienced slightly more rapid growth than the state, with an average annual growth of 2.5% from 1990 until 2008. The rates are more favorable for the county when taking the number of green establishments as unit of analysis, which yields an average annual growth of 5.3% compared to the state rate of 4.2%.

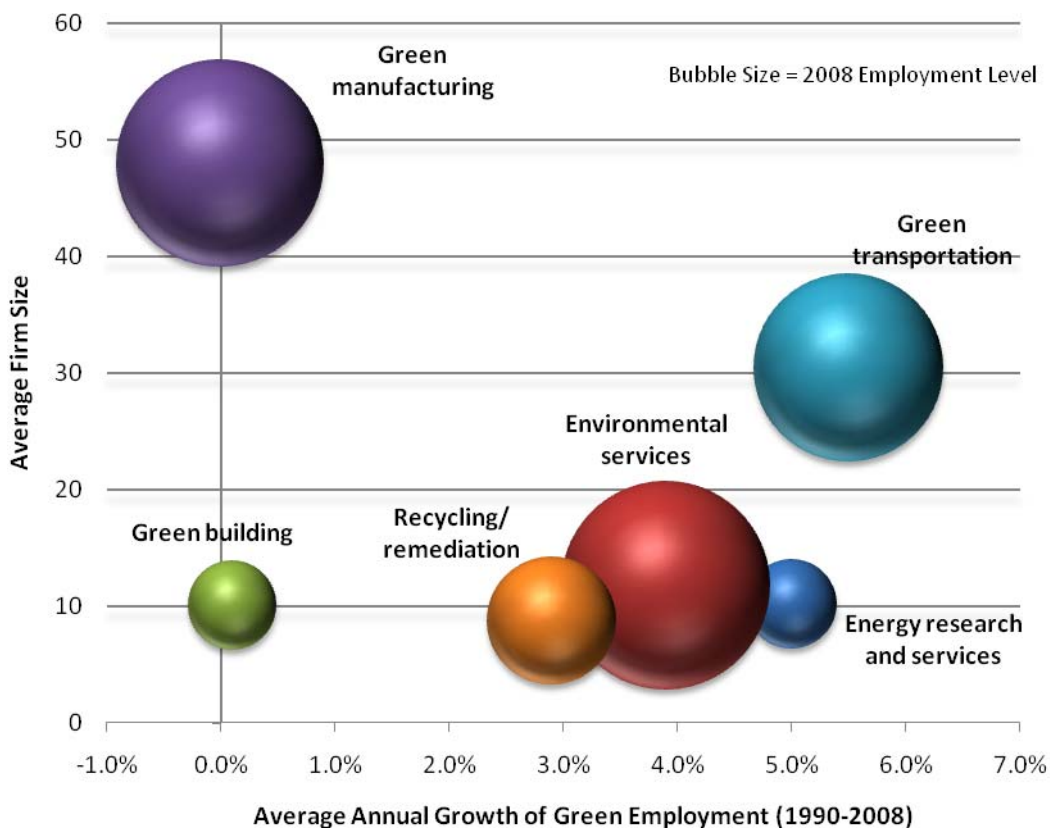
² Data compiled from multiple databases including the National Establishment Time Series (Dun & Bradstreet) database; the Build it Green directory; and the Cleantech San Diego database

³ National Establishment Time Series (Dun & Bradstreet) data

Environmental Services is the green sector that provided the most jobs in San Diego in 2008 with a total of 5,109 jobs. From 1990 to 2008, the highest employment growth rates in San Diego were in Green Transportation (5.5%) and Energy Research and Services (5%); Green Transportation, along with Environmental Services, also led in terms of growth of establishments. Green Manufacturing and Building experienced little or no growth. However, Green Manufacturing continues to be the most concentrated green sector in the region in terms of employment (highest location quotient).

Figure 8 offers a glimpse into the relationship between firm size, total sector employment and the growth of each green sector from 1990 to 2008. The largest sector by employment level, Environmental Services, was also one of the fastest growing in the region. Green Transportation and Energy Research and Services stand out for particularly rapid growth rates. Meanwhile, Green Manufacturing, though a very large sector with large firms, was essentially stable.

Figure 8: San Diego Green Economic Growth and Firm Size by Sector, 1990-2008



Source: NETS: UCB Center for Community Innovation.

GREEN INNOVATION AND INVESTMENT INDICATORS

While the presence of green establishments is one indicator of a strong green economy, patents and venture capital funding sources are another way to measure the green economy’s presence. Table 8 summarizes the San Diego’s green innovation and investment rankings mentioned in previous sections of this report. To date, businesses in San Diego hold 97 cleantech patents. Additionally, the region has

received almost \$130 million in cleantech from 2000 until 2008. According to the composite innovation ranking elaborated for this report, the region ranks number 4 in green innovation in California after Los Angeles, Silicon Valley, and the East Bay.

Table 8: Innovation and Venture Capital Indicators for San Diego County, 2000-2008

Patent Activity, 2000-08 ¹			Venture Capital Investments 2000-08 (\$millions) ²			SBIR/STTR Grants, 2000-08 ³			Green Startups, 2000-06 ⁴			Green Gazelles 2007 ⁴		
Clean-tech	% of State Overall	% of State Clean-tech	Clean-tech (\$)	% of State Overall	% of State Clean-tech	Clean-tech Grants	% of State Overall	% of State Clean-tech	Green Start-ups	% of State Overall	% of State Green	Green Start-ups	% of State Overall	% of State Green
97	7.7	9.2	129.8	8.8	4.8	8.3	20.6	17.8	622	9.0	8.6	330	9.1	9.0

Sources: 1) USPTO, 2) VentureExpert; 3) US Small Business Administration, 4) NETS. CCI Calculations

THE GREEN ECONOMY ON THE GROUND: INSTITUTIONS, NETWORKS, AND INITIATIVES

The success of the region in modifying its industrial base in the 1990s is the result of several factors. However, this was not the result of a master strategic plan but rather the work of different institutions and actors within the region. Specifically, the San Diego Regional Economic Development Corporation (EDC) played a remarkable role. The EDC promoted collaboration between the private sector and the education sector after the region lost bids for several research facilities. Among the most notable actions include better networking among business leaders, a closer working relationship between the University of California at San Diego (UCSD) and the business community, and improved communication between the public, academic, and private sectors. Other initiatives also took place in the region, such as the Financial Forum, the San Diego chapter of the Massachusetts Institute of Technology Enterprise Forum, and UCSD's CONNECT program. Some of these efforts also attracted federal funding from the U.S. Economic Development Administration, which seeded entrepreneurial initiatives at San Diego State University, and small business incubation at the Center for Applied Competitive Technology, San Diego City College. (Innovation Associates for SBA, 2000)

One of the most notable successes of the early era of high tech in the region is Qualcomm, Inc., a company that began serving the defense industry and moved to the commercial sector after a few years. The research and development base left behind by the defense industry provided fertile ground for new technology growth and several spin-offs of other companies or of research centers appeared. Of great importance also are the world renowned research institutions of the area: — Scripps Research Institute and the Salk Institute for Biological Studies as well as UCSD. According to UCSD, most of the high-technology firms in the San Diego region were based on technology developed at the University or founded by its faculty or graduates (Innovation Associates for SBA, 2000).

Of the programs mentioned before UCSD CONNECT was the most crucial to creating the high-tech cluster and eventually the currently thriving bio-tech cluster. CONNECT was a program instituted by UCSD's Chancellor Richard Atkinson. Atkinson established a school of engineering, involved local firms in funding faculty and infrastructure and established cooperation with local companies. This program is credited for the increase in the University's research capacity, engineering education and research, the transfer of technologies to the private sector and the development of new technology enterprises. Other organizations that are credited for the development of the high tech and biotech clusters are:

- Massachusetts Institute of Technology Enterprise Forum. Started in the early 1980's, it has provided advice and education services companies.
- Regional Technology Alliance. It is a state-sponsored program that promoted technology industries in the San Diego region.
- BIOCOM, a local trade association representing biotechnology, pharmaceutical, and medical device industries that continues to provide advocacy and acts as a networking forum for those industries.
- San Diego Manufacturing Extension Center. Supported by federal and state funds, it has provided help upgrading technologies to small manufacturers in the region.

RELEVANT LOCAL AND REGIONAL INSTITUTIONS

Several other institutions are important for attracting and developing new industry sectors in addition to the well-established biotech cluster. These include the California Center for Sustainable Energy, CLEANTECH, San Diego the Chamber of Commerce, SANDAG, and venture capital angel networks.

CLEANTECH San Diego is a new non-profit organization that is promoting the growth of San Diego as a world leader in green energy. This organization is, in fact, a spin-off of CONNECT that is expected to take a parallel role but with a focus on clean technologies. According to their website, CLEANTECH is developing the following strategies:

- Brand San Diego as a world destination for all things clean tech. Attract green jobs, green talent and green money to the region while exporting our green products throughout the world.
- Policy: Work with regional, state and federal policy makers to adopt rules supporting clean technology innovation and commercialization. Focus on products, services and solutions that are particularly effective in the American Southwest.
- Innovation: Work to bring clean technology research efforts to the region; coordinate with established research facilities to identify both synergies and gaps.
- Capital: Bring additional private capital, both strategic and financial to the region. Position San Diego as a major source of quality deal flow among green investors.
- Connective Tissue: Serve as a hub for the many but disparate stakeholders in the clean energy community.

CLEANTECH's support encompasses from the incubation of startup enterprises to policy advocacy for well-established companies. The organization's joining fees are of \$10,000 and more. If its efforts succeed at creating a green energy cluster, it is expected to initiate a trickledown of technology and jobs into smaller size companies that would have the role of suppliers and service providers.

Some of the current members of CLEANTECH are:

- *Kai Bioenergy Corp.*, a company that can produce 91-octane gasoline from algae and that is planning to commercialize the product in five years.
- *Energy Eye*, a company that designs and manufactures energy efficiency technology for increased control of building heating, ventilation & air conditioning systems. !

While the area does not have a strong presence of Angel networks of investors (only one was identified in the data and fieldwork: Tech Coast Angels), there is a history of collaboration and spin-offs in other industries that imply that the overall climate would be favorable to the growth of this kind of capital investment into green startups.

The California Center for Sustainable Energy (CCSE) is a non-profit organization founded in 1996 after the energy companies reduced their public functions after the deregulation of the energy sector. Its main goals are to foster public policies and provide programs, services, information and forums that

facilitate the adoption of clean, reliable, renewable, sustainable, and efficient energy technologies and practices.⁴ CCSE provides expertise and it's the only organization in the state that is independent from regulators and providers that currently administers green energy rebate programs. Some of the areas that CCSE is involved with are solar energy panels, solar water heating, multifamily affordable solar housing and rebates for alternative fuel vehicles. CCSE also hosts the San Diego Sustainability Fair, a public event that showcases about forty exhibitors showcasing solar, lighting, recycling, composting, and water conservation products for homes.⁵ CCSE also has a permanent showroom for the general public in its Balboa Avenue offices.

Different cities in the region are also taking an active role in capturing green innovating businesses. For instance, the San Diego Mayor office has a Cleantech Initiative office that is in charge of assisting new startups—usually generated from research in the local centers—to establish their operations inside San Diego city limits.

The San Diego Chamber of Commerce is the region's largest small and medium size businesses organization, with more than 3,000 members (sdchamber.org). The chamber is involved in the promotion of policies that benefit the local business climate. Their Technology Committee aims to link and promote technology and biotech companies and provide access to its resources for the rest of its membership.

SANDAG (San Diego Regional Planning Agency) is the council of governments in the region that includes all the cities in the metropolitan area, as well as other institutions such as the Port Authority, the Water Authority, Airport, Caltrans, and others. SANDAG is a regional planning agency that influences the region on several issues, from transportation to land use, environmental regulation, regional competitiveness and other issues. In addition to promoting and monitoring the economic prosperity of the region, SANDAG is committed to smart growth and fighting the growing pollution and traffic congestion problems in the region. SANDAG's plans will promote the green economy as they implement state regulation and stricter local regulations on land use, waste management, and use of public transportation.

SAN DIEGO HIGHER EDUCATION INSTITUTIONS

The region is home to several public world-class universities, colleges, and higher education centers. Among the most important are the University of California, San Diego (UCSD), San Diego State University (SDSU), California State University San Marcos (CSUSM) and the San Diego Community College District, which includes San Diego City College, San Diego Mesa College, and San Diego Miramar College. Other smaller and private universities and higher education centers are: Alliant International University (AIU), Fashion Institute of Design & Merchandizing's San Diego campus, New School of Architecture and Design, The Art Institute of California, San Diego, Point Loma Nazarene University (PLNU), and the University of San Diego (USD).

UCSD is at the forefront of the green innovation in the region and is considered the greenest campus in the country. Some of the centers affiliated with this school are responsible for a large amount of research and innovation that fuels the biotech cluster of La Jolla. A year ago, UCSD also announced the creation of the Sustainability Solutions Institute, with the intention bringing together UCSD's intellectual resources to contribute to policy guidance, decision-making, and solutions development driven by

⁴ www.sdenergy.org

⁵ <http://www.sustainablecalifornia.org/>

research in high impact science and technology, economic development, education and outreach, and global discourse.⁶

San Diego State University Extension has developed two online green professional certificates. One is a professional green building construction program that trains professionals such as designers, contractors, builders, planners and engineers in the implementation of sustainable building tools and strategies. The other one is a professional certificate in renewable energy and green energy management with environmental engineers, architects, contractors and subcontractors, in mind. These programs are sponsored by the City of San Diego, who is implementing extensive “greening” of its building stock. The community college system also provides training at technician levels. For instance, Miramar College houses the Advanced Transportation Technology Center, a program that promotes use of clean fuels. The Community College District also has apprenticeship programs for green construction and energy generation professions.

San Diego possesses all the elements of a regional innovation network, and is particularly good at technology transfers from universities (Walcott, 2002). While the innovation in the area nowadays mainly takes place in the biosciences field, some of the research is trickling into the field of the green economy, especially in the fields of clean energy, compounds, and environmental technology. In the same way, the area will likely continue to be attractive for new firms trying to enjoy the already established networks of service providers and suppliers, pool of highly skilled labor, R&D space availability and desirable weather, environment and quality of life.

POTENTIAL FOR GREEN MARKETS

In general San Diego is not a region that is characterized by its “green culture”. A recent study profiled in a local newspaper ranked San Diego as 12 in a green economy national study (*The SustainLane 2006, US City Rankings, in “Green eyes on Future” San Diego Union Tribune, July 8, 2008*). As with several other Southern California areas, sprawl and car dependency are one of its most obvious characteristics.

While the coastal zones are relatively better protected by environmental conservation agencies such as Wild Coast, the Coastal Coalition and others, the inland areas have not received the same attention. As mentioned before, sprawl has reduced open space and advanced into the forests that surround the metropolitan area.

On the other hand, San Diego is famous for its sports lifestyles, especially those related to water sports and the outdoors. As the region continues to be a pole for innovation it can expect more of the “creative class” (Florida 2002) to settle in the area, attracted by San Diego’s environment and industry composition. Should this be the case, San Diego could experience a change in its consumption culture and habits to reflect the values of the population and the efforts of legislation and planning efforts to promote sustainability.

A factor that will be decisive in changing patterns of consumption and use of resources will be the development of government programs such as LEED, financial incentives for green building and retrofitting of commercial and residential structures, tax credits and rebate policies. A key component will be the implementation of California AB 32 Act that will require the State to reduce its greenhouse gas emission to 1990 levels. This and other strict limits on energy consumption and pollution are part of

⁶ <http://research.ucsd.edu/documents/orus/CSIWGSsummary.pdf> and
<http://esi.ucsd.edu/esiportal/images/ssi/ssi%20brochure%201.13.09.pdf>

a regulatory framework that is expected to exponentially increase the market for green products and services. In fact, this is the most important factor that will shape the green economy in the near future and that both local and external firms in the green sector are actively promoting.

THE SAN DIEGO GREEN INNOVATION NETWORK: GREEN MARKETS AND THE ROLE OF REGULATION

“Environmental regulation is an unknown territory. I don’t know how we are going to do it. As new ideas come we need information about safety, other environmental risks of these technologies. I can argue pretty soundly that if we had tried to do solar plants in the middle of the desert many years ago there would have been a big uprising but now it’s acceptable. It’s a perverse way that man looks at these technologies. Everything has its time. In the past you could have been a pioneer and try to set up photovoltaic cells in a neighborhood and they will call you a madman and run you out of town. These are the kind of perception changes that happen out of new concerns.”

Representative of a San Diego Economic Development Agency

The following section presents an analysis of San Diego’s network of green innovation. The fieldwork stage for this report included interviewing representatives from nine organizations, institutions and green companies in San Diego County.

THE REGIONAL ECONOMY

In the San Diego region there is awareness about the existence of specific local advantages for the development of green innovation. This advantage mostly stems from two facts: first, the successful creation of a cluster of biotech and high tech industries in the past; second, the fact that the knowledge base and application of technologies from those fields are a natural fit for the development of sustainable and alternative energy products. In addition to these networks, comprised of research institutions, business organizations and universities, the area also benefits from natural resources that are ideal for the development of alternative energy technologies, such as plenty of sunlight for solar panels, seawater for algae used in biofuels and open space for wind power generation.

San Diego has a solid story of economic restructuring that borrowed from the existing defense and aerospace industry to create a cluster of bio-tech and wireless-high-tech industries in the 1990’s. In similar fashion, San Diego is currently using existing resources to develop a cleantech cluster as a spin-off of the existing innovation networks. The interest in the development of a cluster of cleantech technologies is shared both by the local institutions as well as big firms, such as Qualcomm, Kyocera, and Sempra Energy.

In terms of the local business culture, this research found that San Diego is a region that has successfully instituted an “entrepreneurial culture” of failure and risk taking. This was described in several interviews as an “agnostic culture” of combining research and commercialization for any purpose that might make financial sense. This culture is exemplified in the work of UCSD’s Von Liebig center of technology commercialization. However, in comparison to regions such as the Bay Area, San Diego still relies too much on external flows of venture capital, usually coming from Silicon Valley or New York.

“There is no real demand for green. We have climate change deniers. At the mayor’s office water is important, but they talk about cleantech from an economic perspective, it’s the latest trend and we should be part of this. But I’m not so sure that the mayor [...] is committed.”

Representative of a Research Institute on Green Innovation in San Diego

The political climate of the region is one of the greater challenges for the green economy. There is a need to brand green activities as financially sound. This issue presents an unusual setting for a region that has been traditionally Republican, business focused, and not interested in environmental issues. This became clear from several interviewees that expressed that in San Diego it is important to call this industry *cleantech* and not *greentech* to avoid the green connotation that evokes ideals that conflict with strict profit-making and raise skepticism from the local business community in broad terms.

GREEN PRODUCTS, SERVICES, AND PROCESSES

“I tend to define [as cleantech] the companies *that actually produce products*. For instance, there are many law firms, IT, but those are the peripheral aspects.”

Representative of San Diego Cleantech Initiative

The main actors involved in the existing clusters have a very clear understanding of how green industries can benefit the economic development of the region. Moreover, a distinction is made between green businesses in general, and a *cleantech* industry. According to several of the organizations and institutions approached for this project, there is a difference between the high tech, highly innovative, research-intense production of new technologies and the expansion of business activities that can be generally labeled green. For example, while the first kind can be exemplified by the creation of firms developing new photovoltaic panel technology, the latter could be described as the growth of solar installation companies. This distinction is important and frames this analysis insofar as it helps identify how institutions, private sector and governmental regulation interact at different levels and in particular ways under the greater umbrella of the “green economy.” The most relevant activities identified as *green* are:

- Waste management
- Building retrofitting
- Solar panel installation
- Environmental constructing
- Green construction
- Solar water heating
- Alternative fuel transportation
- Organic food production

The activities that fall into the innovation intensive *cleantech* categories are:

- Micro-technologies and bio-remediation
- Air filtration and pollution reduction compounds
- Development of energy management systems
- Photovoltaic cell production and development

- Alternative fuel technology development
- Energy storage
- Advanced packaging and chemical management services.
- Water filtration and metering systems.

“Suddenly ideas that five years ago had no value whatsoever and now you have a greener technology that’s going to be a marketing advantage. Computers, batteries, wireless. Not because the cost reduction but because it’s the right thing to do.”

Representative of a San Diego Economic Development Agency

In terms of the cleantech industries, it is also important to note that these are areas that are closely interrelated and it is impossible to narrow them to specific technologies. Consequently, cleantech becomes a marketing tool that can be used for many activities and technologies that might not be considered “green” at first sight. The following example illustrates this:

“The company is Biometrix. [Do you remember] the seahorses that you buy and pour water and they come to life again? They picked up that technology and found a way to keep laboratory material and organisms without freezing. Now they are cleantech because they are replacing the freezer that consumes a lot of energy. Their marketing now defines them as cleantech.”

Representative of a San Diego Economic Development Agency

“The biotech sector has been focused on enzyme and bacteria and the same principles are used for algae fuel. Also bioconversion, for example: using bacteria to breakdown cardboard and turn it into field. That might be 10 years away but that’s how it is.... Same with high-tech, real time data of energy consumption. For example there is a whole set of people looking at low power sensors that can be applicable for buildings. The other area is green building materials. Its also very large but steams from the green building movement.”

Representative of San Diego Cleantech Initiative

The most commonly mentioned technologies being developed in the region are: low emission vehicles and bio-fuels (especially those derived from algae); and energy management software and technology (mainly used in buildings and originating the conversion in telecom of wireless technologies applicable to energy management).

NETWORKS

This report identifies 3 major areas interacting closely: research institutes and universities; business incubation and promotion, and government regulation and incentives.

“The CLEANTECH board talks about clusters a lot so they want to do that. They have the head of the Biotech cluster on the board. The reason he’s there is they want to replicate that for CLEANTECH. They have the universities involved, the industry involved

and government, the cities involved. And the goal is to attract manufacturing, well not manufacturing but the industry [in general]. My problem is that wherever I go people want manufacturers. And you can't physically put a factory in every city you do business in. I don't know how it is going to shake out. You have Texas, New Jersey... every state in the nation trying to attract solar. Austin has a cleantech program as well. Los Angeles has one. So it's kind of hard to figure out what's going to happen. It all depends on the market. We tell CLEANTECH that if the market is here then companies will come."

Representative of a solar module manufacturer

A clear example of the reconfiguring of the existing network of innovation is the creation of CLEANTECH, a spin-off of CONNECT, the main technology transfer organization in the biotech cluster. For example, Springboard is one of CONNECT's programs that provides financial assistance to researchers that want to develop technologies with the intention of commercialization. CLEANTECH is an organization that is instituting the best practices that have worked for CONNECT in the past, such as Springboard, but with a focus on clean technologies.

"Our role is to attract and create new businesses. The ultimate role is to accommodate fiscal revenue for the city. Cleantech is the new kid on the block and we have large industries [clusters] in defense aerospace biotech, hi-tech.... Cleantech is a good fit and we already have about 220 [cleantech] companies."

Representative of San Diego Cleantech Initiative

In a similar way, other collaboratives are emphasizing the development and commercialization of cleantech applications. The local interest in the development of a cleantech cluster is also present at the city level. The office of the mayor of San Diego recently created a cleantech initiative that focuses on supporting firms that seek to establish their offices in San Diego. The role of this office is to collaborate with other institutions such as the Von Liebig Center at UCSD to support researchers that want to become entrepreneurs. As Figures 9 and 10 below show, the office of the city is inserting itself in an existing network of innovation. As a representative from this office expressed, the most important issue lays in the need for all actors to find a way to "add value" in order to make the cleantech effort work. In the case of the office of the Mayor, adding value translates into support for special permitting, access to financial incentive programs and, in some cases, allocation of land and real estate.

"We are behind pushing the City of San Diego to adopt the AB811 policy to allow cities to lend money to solar PV projects. We are working with SANDAG to also promote that policy. We are helping cities implement energy efficiency and renewables and do an assessment of their carbon footprints."

Representative of a solar module manufacturer

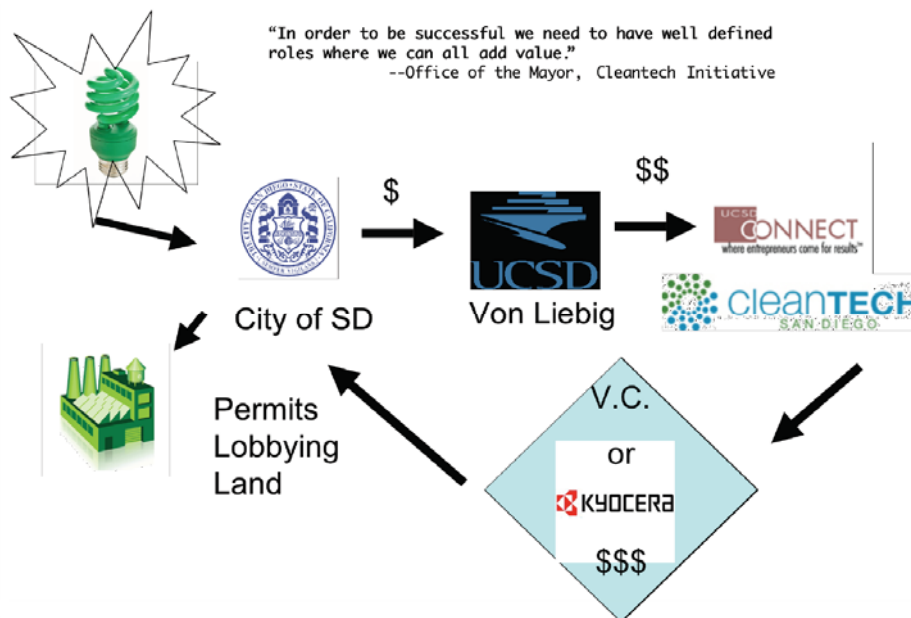
"There are a lot of groups that are very active. *The beauty of San Diego is that it's very small. And I love LA, but the beauty of San Diego is it's very easy to meet people and get to know people.* In a LA it's a lot more challenging because it's so big. There's a lot of enthusiasm on Cleantech in San Diego to improve to make things better. Try to get companies that do fuel cells and alternative energy for cars. The Chamber of Commerce

is very involved in energy matters [...] *Once a month we talk about what bills should we support.*"

Representative of San Diego Cleantech Initiative

Big firms are also playing an important role in promoting the expansion of a market that can benefit the growth of a cleantech cluster. The case of a solar company, for instance, is especially interesting because they are the largest producer of solar panels in the region. While their manufacturing takes place in Tijuana, the manufacturer expressed that they are thinking that eventually they might move operations to the U.S., however, this will only happen once production standardization and automation allows for the transition from labor intensive to capital intensive production. This might also be the case for any other solar panel manufacturing planning to locate in the region.

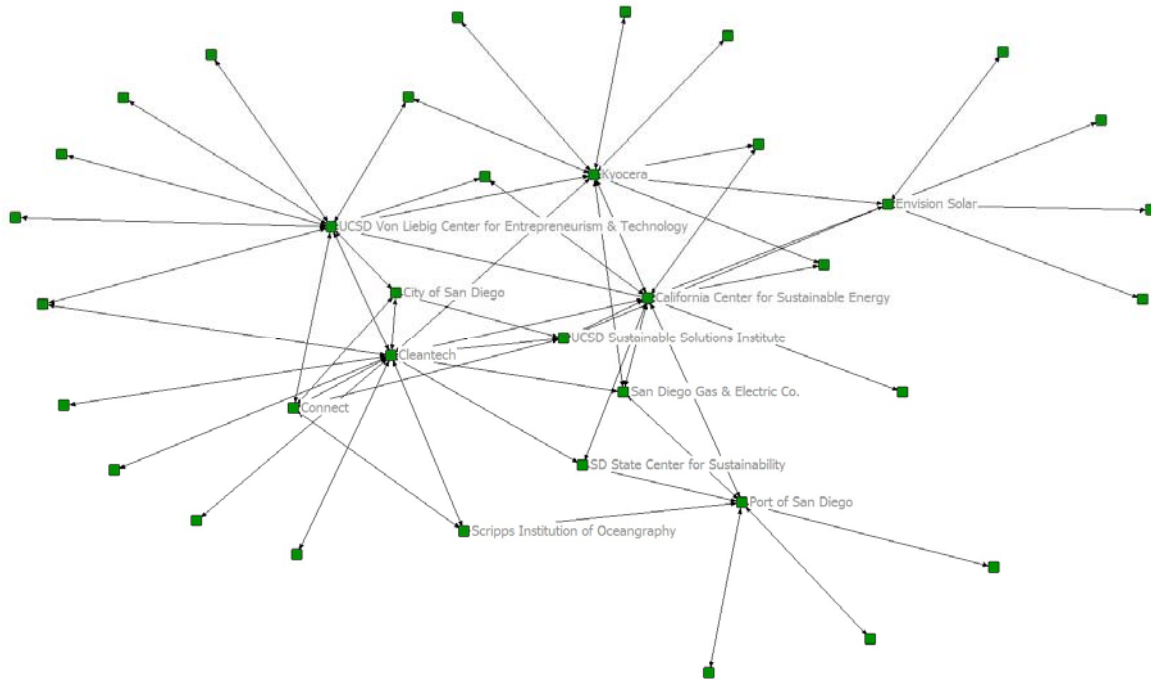
Figure 9: San Diego Regional Network at Ground Level



Source: Own Elaboration based on interviews with key informants in San Diego County

Figure 10 below maps networks of social relationships among relevant persons and organizations in the region's green economy. The social network map is based on the names of individuals and organizations that came up in the different interviews conducted for this project.

Figure 10: Social Network Map of the Green Economy in San Diego



Source: UC Berkeley Center for Community Innovation based on responses of interviewees in this project

INNOVATION

The universities and research centers are at the center of the regional network and they are the institutions actively producing innovative ideas and assisting researchers throughout the early stages prior to commercialization. The von Liebig Center at UCSD , an early stage technology commercialization program that offers business mentoring and pre-seed funding for prototype development to faculty and researchers from universities, is collaborating with the City of San Diego in demonstrating market relevance of university technologies around cleantech that can be translated to the private sector in the form of startup companies or products. CONNECT and Cleantech San Diego take a follow on or subsequent role to what the von Liebig Center provides. They assist early stage companies and their entrepreneurs with acquiring early stage capital, business plan development or management talent that helps them grow and succeed. The City of San Diego is also trying to capture new firms by assisting with permits, representing companies in front of other stakeholders (local authorities, community, NGOs) and potentially offering economic incentives and or land.

A great deal of innovation is also originating in the several research centers of the region. The most relevant for the green economy/cleantech sector are:

- The Salk Institute of Biological Studies
- The San Diego Center for Molecular Agriculture
- UCSD’s Jacobs School of Engineering
- UCSD’s Sustainability Solutions Institute
- Scripps Institution of Oceanography
- California Institute for Telecommunications and Information Technology

An interesting example of how these centers collaborate and generate innovation is the example of the Institute for Sustainable Solutions at UCSD. This center was recently founded with the intention of promoting green practices in the campus and the region by promoting collaboration among different academic areas. An example given by one of the directors of this center is that of collaboration between engineering, economics and business and cognitive science faculty to develop better systems to measure water consumption in residential buildings for the local water district. Under this project, the economist would develop consumption metrics, the engineer would develop technology to measure consumption and the business and cognitive science researchers would develop the campaign to promote new water consumption patterns among the dwellers of such buildings.

GREEN POLICIES

Regulation is setting the pace for the development of the green economy, both at the green business/consumer sector and at the innovation and research end. Large corporations selling green products are also expecting market expansion and more firms to establish themselves in the region as a result of policy changes. In the view of some green non-profits in San Diego, there is more to be done in terms of making these businesses competitive against companies selling traditional technologies and processes. A representative of a green energy non-profit in San Diego explains it in terms of energy consumption:

“That’s where I think the US is in general: You have innovators and early adopters. But if you want to get to the mass market and you can’t get the masses to understand that you have a value case you are going to have a hard time. You need a playfield that makes those products look good. *It’s all about the value...* maybe about making carbon more expensive, natural gas more expensive. Policy plays a huge role on it.”

Representative of a Green Energy Non-profit Organization in San Diego

The institutions and private actors involved in cleantech innovation are also expecting a positive impact from stricter regulation. In San Diego there is a sense that venture capital and investment are being extremely careful not to invest in ideas that will not make business sense under market conditions that do not allow new technologies to be competitive.

“The models for biotech are not functional anymore. Biotech, high-tech, internet, they were funded with billions of dollars because the excitement was high and over time most [companies] failed. Now venture capital is more cautious. *We need to create a more sustainable model* of how we do benching, especially in the early stage. We are a country of ideas not labor and that’s our own competitive advantage and we need to take advantage of this.”

Representative of a San Diego Economic Development Agency

Stricter environmental regulations, such as those associated with AB32 are bringing competitiveness to industries that otherwise would not be commercially viable. As an innovative community strongly identified with the commercialization of new technologies, this becomes of utmost importance:

“[Because of AB32], suddenly ideas that 5 years ago had no value whatsoever now mean green technology and that’s going to be a marketing advantage.”

Representative of a San Diego Economic Development Agency

Environmental regulation is directly affecting the area in terms of competitiveness against other regions in the country such as Silicon Valley, Austin and Boston. From the standpoint of green products and services marketing, the lack of coherent regulation between different cities and agencies, as well as the lack of adequate industry standards adds unnecessary transaction costs for companies. One example mentioned is that of solar water heaters. In the words of a representative of a green energy non-profit in San Diego: “the existing differences between cities in terms of requirements for the installation of solar water heaters make it very problematic to operate in cities that might be adjacent, but with different laws.” In another example, a solar module manufacturer expressed that there are regulatory limits on the amount of energy that can be sold back to the power grids, which makes installing solar panels less attractive for the average consumer. These restrictions are considered to restrain the growth of a market for technologies that are already available and only in need of regulatory “priming.”

There are other factors that are considered to be slowing the development of green innovation as well. As the CLEANTECH representative argued, there is a disconnection in people’s understanding between the creation of innovation and the conversion into jobs. Governments put money into research, but do not think about how to convert that innovation into jobs. There needs to be more effort put into commercialization.

From the standpoint of regional academic development, a similar argument was expressed by several of the actors interviewed. In general, inadequate regulation of cleantech industries is making the region lose ground in terms of competitiveness against other regions that might have regulation that is more flexible. The quote below perfectly illustrates the complexity of this issue and reflects the view of the cleantech network and green economy stakeholders:

“What I want to say is: “the biggest issue is government”. The government is in the way of making cleantech the biggest industry in California. We need to go to Sacramento and change rules or write new rules. We lose jobs because places like New Mexico that are willing to say... And I am not saying that we need to get rid of environmental laws, I am an advocate of environmental laws. But we need to consider cleantech to be in a different category. If the environmental benefit [of new tech] is better than the offset and what the law says today we need to have two sets of rules.”

CONCLUSION

San Diego as a region is well positioned to become a pole of green industries. The region enjoys well-established networks of innovation, public-private collaboration, and a diverse and well-trained labor force. The main colleges are already acknowledging the need to focus in green solutions and are providing solutions at the research, policy and job training level. But there several issues that should be taken into account when analyzing the potential of green industries in the region. San Diego has experienced labor job market polarization, rise in the cost of living, and increasing traffic congestion in the last few decades. These issues can reduce San Diego's competitiveness against other regions that might offer comparable social and physical resources but at lower costs.

Efforts such as those of CLEANTECH have great potential for success. While most innovation clustering is tied to the biotech field, it is very possible that these clusters will be successful at attracting firms interested in clean technologies or that the same industries will diversify to green activities that provide business potential. The defense industry also left a legacy of specialized manufacturing of turbines and other transportation technologies that can be adapted to green standards. The same can be said for the miscellaneous manufacturing sector, which can potentially adapt to supply new industries. Although it is not yet clear how labor intensive this sector will become, an increase in manufacturing and other blue collar green jobs will be very welcomed by a region that lost most of its working class jobs in the years following the Cold War. A less discussed benefit of the region is the proximity to the Mexican border. Should the cluster of green energy consolidate it can be expected that firms will try to benefit from manufacturing facilities south of the border.

San Diego's governments are giving great emphasis to the greening of its infrastructure. The local utility companies are working closely with the authorities in educating the general public and partnering with consumers for the adoption of sustainable technologies and processes. The California Center for Sustainable Energy (CCSE) is also taking a leading role at administering rebate programs and expanding the use of commercial, residential and transportation green technologies. In this regards, potential for new jobs can be found in the construction sectors, especially if the efforts to "green" existing buildings continue to grow.

While the region's green culture is not well established, this can change through new consumption patterns of the "creative class" and by the implementation of programs and legislations like AB 32 and urban development directives of SANDAG and other state regulations.

In general, the development of green energy technologies - both at the research and development and the manufacturing and consumer ends of the process - has the potential to bring the most economic development to the region. Another sector of increased importance is that of environmental and waste management. This sector is well localized, has shown steady growth, and most likely will continue this same pattern. Finally, the implementation of a solid regulatory framework that primes and sustains the current push for adoption of green infrastructure and expands green market can translate into job creation in sectors that go from green construction, to cleantech research.

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