OTAY RANCH VILLAGE SIX SPA
AIR QUALITY IMPROVEMENT PLAN

On November 14, 2000, the City Council adopted the Carbon Dioxide (CO_2) Reduction Plan, which included implementing measures regarding transportation and energy efficient land use planning and building construction measures for new development. In this Plan, it was recognized that the City's efforts to reduce carbon dioxide emissions from new development are directly related to energy conservation and air quality efforts. As a result, the City is initiating a pilot study effort to develop a program to be implemented in new SPA Plans through updating the guidelines for preparation of required Air Quality Improvement Plans (AQIPs). In summary, the pilot study involves the development of a computer model to evaluate the relative effectiveness of applying various site design and energy conservation features in new development projects. The pilot study will analyze the Otay Ranch Village Six SPA project (and two other pending SPA projects), and result in the preparation of an AQIP for Otay Ranch Village Six which should be considered in conjunction with actions on the project's Tentative Subdivision Map. A final, approved AQIP will be placed in this section of the SPA document upon adoption.

Final Report

INDEX PILOT TEST: SPA AIR QUALITY IMPROVEMENT PLANS

June 2002

Prepared by the
CITY OF CHULA VISTA CALIFORNIA
DEPARTMENT OF PLANNING & BUILDING
and

CRITERION
PLANNERS
ENGINEERS

CONTENTS

		Page
Executive Summary		1
1.	Overview	4
2.	INDEX Modeling System	5
	2.1 Introduction	5
	2.2 Action Measures	6
	2.3 Indicators	17
	2.4 Baselines	18
	2.5 Proposed SPA Plans	24
3.	Pilot Test	26
	3.1 Baseline Values	26
	3.2 Original SPA Proposals	26
	3.3 Modified SPA Proposals	35
	3.4 Final Results	39

EXECUTIVE SUMMARY

A pilot test has been conducted of an innovative technique for preparing Sectional Planning Area SPA Plan air quality improvement plans as required by the City's growth management ordinance. In the pilot test, three SPA plans were compared to older "baseline" neighborhoods to gauge the SPAs' relative energy efficiency and air quality characteristics. The baseline neighborhoods were selected to reflect land development practices prior to any special consideration of energy efficiency. The objective was to determine how much energy is being saved by current SPA design practices in comparison to the older baseline neighborhoods and in turn, how much lower the SPAs' air pollutant emissions are in comparison to the baseline. The test SPAs were compared to the baseline twice: first, as originally submitted to the City; and second, as voluntarily modified to further improve energy efficiency and air quality.

Baseline Neighborhoods

To establish a baseline of energy efficiency, three neighborhoods constructed in the 1970s and 80s were modeled: Terra Nova, College Estates I, and College Estates II. When combined on a weighted average basis, these neighborhoods have a total baseline energy use of 76 million Btu/yr/capita.

Original SPA Proposals

The three test SPAs were modeled as originally submitted to the City and found to be notably more energy efficient than the baseline. Their total energy use and comparison to the baseline value are as follows:

SPA	MMBtu/Yr/Capita	% Change From Baseline
OR Village Six	69.05	-8.6
OR Village Eleven	67.39	-10.8
EastLake III	71.94	-4.8

A majority of the SPA energy savings come from residential densities that are higher than the baseline neighborhoods. Higher densities reduce space conditioning energy use due to more common walls and ceilings that reduce energy losses from the buildings. Higher densities also encourage travel energy savings through greater walking, biking, and transit use.

Modified SPA Proposals

The next step in the pilot test was an invitation to the SPA developers to modify their plans to achieve even greater energy efficiency and air quality improvements. Because the three test SPAs were at an advanced stage of their approval process, it was not feasible to make major changes in their land-use and circulation designs. This left the following three action measures as the developers' principal choices if additional energy efficiencies were to be achieved:

- *Building Construction Standards.* SPA developers could opt for a commitment to reduce building energy use by exceeding California Code of Regulations Title 24, Part 6. Developers could propose the amount of Title 24 exceedence per building type and the number of buildings that will participate in such exceedence.

- *Solar Systems.* SPA developers could opt to reduce grid-supplied energy by installing solar thermal or PV systems and buildings. Developers could propose the type and capacity to be used, and the number of structures that will receive such systems.

- *Tree Planting.* This measure allowed SPA developers to commit to additional tree planting that will offset greenhouse gas emissions. Selection of this option will not improve a SPA's energy efficiency or air pollutant emissions, but will help mitigate climate change.

After considering these options, the SPA developers voluntarily elected to add the following action measure commitments:

- *EastLake III.* 72 single-family homes will achieve a 15% Title 24 exceedence through the ComfortWise, SDG&E California Energy Star Program or equivalent program; 255 single-family homes will achieve a 15% Title 24 exceedence through the SDG&E California Energy Star Program; and an additional 855 trees will be planted.

- *Otay Ranch Village Six.* 482 single-family homes will achieve a 10% Title 24 exceedence through energy-efficient building design and construction techniques to be selected by home designers/builders; and 792 additional trees will be planted.

- *Otay Ranch Village Eleven.* No additional action measures were selected by this developer.

The addition of these measures reduced Village Six total energy use to 68.25 million Btu/yr/capita or approximately a 1% reduction from the original SPA proposal; and EastLake III dropped to 71.19 million Btu/yr/capita or approximately a 1% reduction from its original proposal. Also, the additional tree planting in Village Six and EastLake III resulted in beneficial CO2 uptake increases of 22% and 25%, respectively.

Final Results

Based on the modified SPA plans, the pilot test's final results for energy savings, air quality improvements, and greenhouse gas reductions are as follows:

	Baseline	Village Six	Village Eleven	EastLake III
Total energy use (MMBtu/yr/capita)	75.56	68.25	67.39	71.19
% energy reduction	---	9.70	10.80	5.80
Total air pollutant emissions (lbs/yr/capita)	544.85	543.68	543.59	544.75
% air pollutant emissions reduction	---	0.21	0.23	0.01
Total greenhouse gas emissions (lbs/yr/capita)	10,493.00	9,873.00	9,833.00	10,404.00
% greenhouse emissions reduction	---	5.90	6.29	0.85

1. OVERVIEW

The City of Chula Vista is experiencing rapid growth, particularly in the eastern territories. The City's adopted Growth Management Ordinance requires that all major development projects (50 dwelling units or greater) prepare an Air Quality Improvement Plan (AQIP). There have been no formal, adopted guidelines to-date, and developers have prepared the required AQIPs based largely on State and Federal mandates. The City Council recently adopted the Carbon Dioxide (CO_2) Reduction Plan which provides for further consideration of land-use and energy efficient measures in new development to reduce CO_2 emissions, energy consumption and air pollution. It is now the expectation of the City Council that the required AQIP will include implementation of applicable measures identified in the CO_2 Reduction Plan. As a result, the City is undertaking an effort to prepare and adopt formalized guidelines for the preparation and implementation of required AQIPs.

The City contracted with Criterion Planners/Engineers to use the INDEX model to analyze the relative effectiveness and costs of applying various design and energy conservation features in new development projects. One of the goals is to exceed existing mandates wherever possible such as the Title 24 Energy Code, and reduce air pollutants and CO_2 emissions. The INDEX model can be used as a tool to assist in the efficient design of master planned communities.

There are three major SPA Plans (EastLake III, Otay Ranch Village Six and Village Eleven) under preparation. The developers of these projects participated in the INDEX pilot study to assess the benefits of specific project design features and energy conservation measures. By doing so the developers satisfy the AQIP requirement for these SPA Plans and the City can obtain the necessary data for developing future AQIP guidelines and amendments to the Growth Management Ordinance.

The SPA Plan project analysis occurred in two stages. The first stage evaluated the SPA Plans as proposed, assessing the benefits of the project's design and other features in comparison to the baseline project by means of the computer model. The model analyzed and quantified emissions reductions and energy savings for the individual SPA projects.

Stage two involved a comparative assessment of making project design amendments and adding construction-level features identified by Criterion's evaluation to further air quality improvements, CO_2 reduction and energy conservation. The model was re-run using the selected design amendments and construction level features.

2. INDEX MODELING SYSTEM

2.1 Introduction

INDEX is a GIS-based planning support system that uses indicators to measure the attributes and performance of community plans. For each community where it is applied, INDEX is customized to address issues of interest or high priority. This is accomplished with the selection of indicators that measure conditions related specifically to those issues. The objective is to support decision-making by using indicators to benchmark existing conditions, evaluate alternative courses of action, select goals, and monitor change over time.

In Chula Vista, INDEX is being focused on the related issues of energy efficiency, climate change, and air quality. The City has improvement goals in each of these areas and is interested in helping achieve them when large parts of the community are first planned for development. For this reason, the sectional planning area (SPA) process was selected as an appropriate application opportunity for INDEX. The City's growth management ordinance requires air quality improvement plans (AQIPs) as part of the SPA process, and INDEX was seen as an AQIP tool for quantifying the emission characteristics of SPA plans.

The application of INDEX was conducted as a pilot test under a U.S. Environmental Protection Agency grant to the City for climate change activities. The pilot test included the following major steps:

- *Selection of action measures.* A menu of action measures for SPAs was taken from the City's CO_2 Reduction Plan. Twelve measures were selected from the CO_2 Plan's action categories of land-use, transportation, and buildings.

- *Selection of indicators.* Indicators were configured to quantify key characteristics of the twelve action measures. A total of 52 indicators were selected and programmed in INDEX.

- *Establishment of baselines.* Calculating SPA air quality, CO_2 emissions, and energy efficiencies required that baselines be established for the SPAs to be measured against. These baselines were set for each indicator using three older, existing neighborhoods that were developed without special considerations.

- *Scoring of SPA plans.* A test sample of three SPA plans were selected for two rounds of indicator scoring. First, the SPA plans were scored as originally submitted by their developers. Second, the plans were voluntarily modified by the developers to increase their efficiencies and then rescored.

- *Incorporation of results into AQIPs.* The energy, air quality, and climate change improvements measured between the baselines and the modified SPA plans were translated into AQIPs for the SPAs.

2.2 Action Measures

The first step in customizing INDEX for Chula Vista was selection of action measures that would be available to SPA developers. As part of the City's CO_2 Reduction Plan preparation, several hundred measures were analyzed extensively. From that universe of measures, the most appropriate ones for Chula Vista were prioritized according to local feasibility and included as action measures in the final Plan. From this group of action measures, the following twelve were selected for the INDEX pilot test:

Land-Use

1. *Compact development.* This is concerned with land and natural resource conservation generally by minimizing sprawl. Compact development saves energy and reduces emissions by reducing travel and infrastructure-related energy consumption.

2. *Density.* This is the intensity of land-use as measured by the density of structures and persons. Higher densities reduce travel and infrastructure-related energy use and emissions, and also reduce building energy demand as a consequence of more common-wall construction.

3. *Diversity.* This measure is concerned with the mix and variety of land-uses that constitute "complete" neighborhoods. Greater diversity or "completeness" in an area reduces travel-related energy consumption and emissions.

4. *Orientation toward pedestrian and bicycles.* This measure is focused on land planning that facilitates pedestrian and bicycle travel, both of which offer energy and emission savings over motor vehicles.

5. *Orientation toward transit.* This measure addresses land development design that facilitates transit travel, which can be highly energy-efficient with sufficient ridership.

Buildings

6. *General energy design and equipment.* This measure encompasses building design, materials, and equipment that improve efficiency generally.

7. *Solar use.* This includes solar thermal applications such as domestic hot water heating and pool heating, and solar power generation using photovoltaic (PV) technology.

8. *Vegetation.* This measure recognizes the use of vegetation that cools ambient air temperatures, reduces building energy use for cooling, and uptakes air pollutants and greenhouse gases.

Transportation

9. *Pedestrian facilities.* This measure addresses transportation system design and improvements specifically for walking.

10. *Bicycle facilities.* This measure focuses on transportation system design and improvements for bicycle travel.

11. *Transit facilities.* This measure includes transportation system design and improvements dedicated to transit service.

Infrastructure

12. *Water use.* This measure is concerned with land planning that reduces water consumption. Less water consumption translates into reduced energy use for water distribution.

The characteristics of these measures are further summarized in Table 1 according to type of energy savings, general cost-effectiveness, technological maturity, durability, support for business and job creation, and notable non-energy community benefits. The Table 1 assessment is a qualitative characterization of the measures based on Criterion's experience and professional judgment, including preparation of the 1994 Regional Energy Plan for SANDAG. Terms used in Table 1 are defined as follows:

- *Type of energy savings.* These are the end-use or supply sectors affected by a given action measure.

- *Near-term and long-term competitiveness.* This represents generalized cost-effectiveness within 3-5 years for near-term measures, and 5-10 years for long-term measures.

- *Stability.* This refers to potential volatility in a measure's ongoing operating and maintenance costs.

- *Technological maturity.* This is the degree of proven commercial reliability in a measure.

- *Durability.* This characterizes the relative length of a measure's useful life, which is the length of time it fulfills its intended functions. In the case of land-use measures, useful life is the length of time that the built feature exists after construction, e.g. an area's density would exist for the life of the neighborhood's buildings. Most land-use measures have high durability because they exist for several decades, e.g. 60-100 years.

- *Support for regional jobs.* This notes those measures whose implementation would create jobs in the region.

- *Non-energy community benefits.* These measures have notable non-energy benefits, such as transportation measures that reduce traffic congestion and pollutant emissions while also savings energy.

- *High and moderate ratings.* Implementation cost, technological maturity, and durability are rated with "high" and "moderate" terms that represent qualitative judgment based on resource evaluations in the San Diego Regional Energy Plan and current technical literature. It is worth noting that all action measures are rated favorably under all criteria.

Table 1

ACTION MEASURE CHARACTERISTICS

Action Measures	Type of Energy Savings				Implementation Cost Competitiveness			Technological Maturity	Durability	Support for Regional Jobs	Non-Energy Community Benefits
	Buildings	Transportation	Municipal Infrastructure	Energy Supply Grid	Near Term	Long Term	Stability				
Compact development		✔	✔	✔	High	High	High	NA	High		✔
Land-use density	✔	✔	✔	✔	High	High	High	NA	High		✔
Land-use diversity		✔	✔	✔	High	High	High	NA	High		✔
Land-use orientation toward pedestrian/bicycles		✔			High	High	High	NA	High		✔
Land-use orientation toward transit		✔			High	High	High	NA	High		✔
General building energy design/equipment	✔			✔	High	High	High	High	High	✔	✔
Solar use	✔			✔	Moderate	High	High	High	High	✔	
Vegetation use	✔				Moderate	High	High	NA	High	✔	✔
Pedestrian facilities		✔			High	High	High	NA	High	✔	✔
Bicycle facilities		✔			High	High	High	NA	High	✔	✔
Transit facilities		✔			High	High	High	NA	High	✔	✔
Water conservation			✔		High	High	High	NA	High	✔	✔

All of the measures in Table 1 have been feasibly implemented to varying degrees in projects throughout the San Diego region over the past 5-10 years. In fact, most of the land-use and transportation measures have gained acceptance as standard features in regional land development. The same is true for water conservation measures.

Of the 12 action measures available to SPA developers, the building construction and solar measures are notable for two reasons:

- They are the only measures whose implementation will be passed from the SPA developers onto merchant builders.

- They are the only measures that have notable economic sensitivities.

Therefore, any decision to choose these measures will be based on their economic and financial implications for developers and builders, and to some degree the positive marketing implications of having "environment-friendly" features in a project. Key variables on the economic side of this equation include:

- *Timing of efficiency investment.* Because energy economics are constantly changing, the feasibility of a particular investment will be affected by the timing of that investment. For SPA developers choosing building or solar measures, the actual capital outlay by builders for the measures will not occur until some undefined point in the future.

- *Cost of energy.* The basic hurdle for any efficiency measure is to produce energy savings at a cost beneath current energy prices. For example, any measure displacing electricity in Chula Vista today should be feasible if the cost of conserved energy is roughly 7¢/kWh or less. However, recent events have shown how volatile energy prices can be and any investment decision has to take such uncertainty into consideration.

- *Applicable incentives.* At any given point in time there are various government and utility financial incentives available for efficiency measures. However, the scope, amount, and eligibility requirements of these incentives change periodically and need to be monitored along with energy prices.

- *Investment criteria.* Each developer and builder will have their own set of criteria for determining whether an investment is financially acceptable. Factors such as interest rates, required return on investment, and possible cost-sharing will vary among developers and builders.

Considerations on the intangible marketing side of the equation include:

- *Public perception of energy and environmental issues.* Public opinion research shows consistent and growing support for energy efficiency. To the extent that a land development is perceived as energy conscious, its public reputation in the marketplace should be enhanced accordingly.

- *Ability to distinguish a product in the competitive market.* Recent experience has also shown that land developments incorporating environment-friendly features are able to successfully distinguish themselves among competing products in the marketplace, and achieve faster sales at premium prices in the process.

Because of the variability in all of these factors, both economic and intangible, it is not possible to specify with certainty which building construction and/or solar measures will always be feasible. However, there is ample evidence that developers and builders are finding such measures increasingly feasible given the growing amount of investment in the measures. The latest energy crisis in California has only accelerated this trend.

Building Measures

This elective action category gave SPA developers two options for reducing energy use in buildings that will ultimately be constructed in the SPAs:

- *Title 24 exceedence.* The SPA developer works with the City to commit that a certain percentage of structures will exceed Title 24 energy standards by a certain amount. Both the percent of structures and amount of Title 24 exceedence are elective choices of the SPA developer. Measures to achieve the exceedence can include any combination of building design, construction materials, or equipment for space conditioning, water heating, or lighting.

- *Energy efficient building program participation.* The SPA developer works with the City to commit that a certain percentage of structures will participate at a specified level in a formal building energy efficiency program sponsored by a utility or comparable organization. Both the percent of structures and level of participation are elective choices of the SPA developer. Program participation would include the same types of measures described for Title 24 exceedence.

Local developers and builders are already taking such actions with increasing regularity. San Diego Gas and Electric reports that standard building practices in the region consistently exceed Title 24 by approximately 5%. Similarly, utility-sponsored efficiency incentive programs are often fully subscribed. Even before the recent energy price shocks in California, energy-efficient construction techniques and equipment were making good economic sense. Table 2 summarizes the latest national survey of energy-saving measures for the residential and commercial building sectors. As shown in the column entitled "Cost of Conserved Energy-$/kWh," there are a wide variety of highly cost-effective measures available in today's market. In fact, 62 of the 66 measures listed are cost-effective in the San Diego region at present where Table 2 indicates their cost of conserved energy at or below $0.07/kWh.

The Table 2 survey is consistent with general rules-of-thumb among building energy design professionals that most new residential and commercial construction can cost-effectively exceed Title 24 by as much as 10-20 percent. In fact, being able to cost-effectively achieve these levels has been confirmed by the exceedence terms of efficiency programs administered by SDG&E and organizations such as ConSol. Examples of components in these programs include engineered HVAC design, tight ducts, spectrally selective glass, third-party inspections and diagnostics, and home energy ratings.

If SPA developers select one or both of the building measure options, and merchant builders are called upon to implement the commitment, one technical resource for evaluating the feasibility of specific packages of measures is the California Energy Commission (CEC) Database for Energy Efficient Resources (DEER). DEER is an electronic database of over 250 building energy measures with the latest information on measure capacities, efficiencies, useful lives, installed costs, and savings. DEER can be downloaded from the CEC's website (www.energy.ca.gov/deer). The CEC and San Diego Regional Energy Office (SDREO) also both operate databases of building measure financial incentives with the latest information on amounts and eligibilities.

Table 2

REPRESENTATIVE BUILDING MEASURE COSTS OF SAVINGS

Measure	Category	Cost of Conserved Energy /kWh	/MMBtu
High Priority			
High-Efficiency Vertical-Axis Clothes Washers	Appliance	Negative	N/A
Aerosol-Based Duct Sealing	HVAC	$0.02	$2.00
Commissioning Existing Commercial Buildings	HVAC	$0.03	N/A
Dual Source Heat Pumps	HVAC	$0.02	N/A
Improved Ducts and Fittings	HVAC	$0.00	$0.00
Improved Heat Exchangers	HVAC	$0.01	N/A
Integrated Lighting Fixtures and Controls	Lighting	$0.02	N/A
Reduced-Cost and/or Higher Efficiency CFLs	Lighting	$0.00	N/A
Metal Halide Replacements for Incandescents	Lighting	$0.00	N/A
Integrated New Home Design	Practice	$0.03	$2.80
Integrated Commercial Building Design	Practice	$0.03	$3.00
Integrated Gas- and Oil-Fired Space/Water Heating Systems	DHW	N/A	$2.30
Medium Priority			
"Low-leak" Home Electronics	Appliance	$0.02	N/A
One kwh/day Refrigerator/Freezers	Appliance	$0.05	N/A
High-Efficiency Dishwashers	Appliance	Negative	Negative
Improved Efficiency Air Conditioning Compressors	Appliance	$0.06	N/A
Improved Efficiency Refrigeration Compressors	Appliance	$0.02	N/A
Advanced Clothes Washer and Dishwasher Controls	Appliance	$0.06	$4.40
Switched Reluctance Drives	Drive	$0.05	N/A
Commercial Distribution System Air Sealing	HVAC	$0.02	$1.70
Indirect-Direct Evaporative Coolers	HVAC	$0.05	N/A
Evaporative Condenser Air Conditioning	HVAC	$0.04	N/A
Advanced Metering/Billing Systems	Information	$0.00	N/A
Improved Fluorescent Dimming Ballasts	Lighting	$0.04	N/A
One-Lamp Fixtures and Task Lighting	Lighting	$0.03	N/A
Compact Fluorescent Floor and Table Lamps	Lighting	$0.01	N/A
Fuel Cells	Power	$0.05	N/A
Microturbines	Power	$0.04	N/A
Dry-Type Distribution Transformers	Power	$0.03	N/A
Heat Reflecting Roof Coatings	Shell	$0.04	N/A
High R (>4) Windows	Shell	N/A	$4.00
Integrated Elec. Space Conditioning/Water Heating Systems	DHW	$0.02	N/A
Residential Heat Pump Water Heaters	DHW	$0.04	N/A
Lower Priority			
Laundry Microfiltration Wastewater Recovery	Laundry	N/A	Negative
Ozonated Commercial Laundering	Laundry	N/A	Negative
Copper Rotor Motors	Drive	$0.00	N/A
Electronically Commutated Permanent Magnet Motors	Drive	$0.04	N/A
Premium Lubricants	Drive	Negative	N/A
Written Pole Motors	Drive	$0.08	N/A
Motor Systems Performance Optimization	Drive	Negative	N/A
Residential Absorption Heat Pumps	HVAC	N/A	$3.10
Ductless Thermal Distribution Systems	HVAC	$0.04	$4.20
High-Efficiency Commercial Packaged Acs	HVAC	$0.04	N/A
Condensing Commercial Boilers and Furnaces	HVAC	N/A	$4.40
Cool Storage Roof	HVAC	$0.05	N/A
Engine Driven Vapor Compression Heat Pumps	HVAC	$0.07	N/A
Geothermal Heat Pumps	HVAC	$0.06	N/A
Transpired Solar Collectors for Preheating Ventilation Air	HVAC	N/A	$2.00
Smart Residential HVAC Controls	HVAC	$0.04	N/A
Integrated Chillers with Heat Recovery	HVAC	$0.05	$4.90

Table 2 *Continued*

Measure	Category	Cost of Conserved Energy /kWh	/MMBtu
Modulating Gas Furnaces	HVAC	N/A	$4.40
Indirect Lighting	Lighting	$0.03	N/A
Electrodeless Lamps, Power Supplies and Luminaires	Lighting	$0.04	N/A
Sulphur Lighting	Lighting	$0.04	N/A
General Service Halogen Infrared Reflecting Lamps	Lighting	$0.03	N/A
Improved Daylighting Controls	Lighting	$0.03	N/A
Daylighting Devices	Lighting	$0.05	N/A
Advanced Lighting Distribution Systems	Lighting	$0.04	N/A
Plastic Downlight Luminaires	Lighting	$0.00	N/A
LED Lighting	Lighting	$0.08	N/A
ENERGY STAR® Multifunction Devices	Office Eq	$0.00	N/A
High-Efficiency Packaged Refrigeration Equipment	Refrigeration	$0.01	N/A
Electrochromic Glazing	Shell	$0.06	N/A
Low-e Spectrally Selective Retrofit Window Films	Shell	$0.07	N/A
GFX Drain Water Heat Recovery Device	DHW	$0.03	N/A
Very Low-Flow Showerheads	DHW	$0.00	$0.00
Thermosiphon/Free Siphon Solar Water Heaters	DHW	$0.07	N/A
Commercial Heat Pump Water Heaters	DHW	$0.03	N/A
Not a Priority			
Residential Heat Pump Clothes Dryers	Appliance	$0.09	N/A
Ultrasonic Clothes Washers	Laundry	$2.04	$416.40
Photovoltaic Roofing (2,000 sqft home)	Power	$0.14	N/A
Photovoltaic Roofing (12,000 sqft com. bldg.)	Power	$0.14	N/A
Low-e Interior Surfaces	Shell	$0.05	$4.90

Note: This table is intended to be an illustrative sampling of building efficiency measures rather than an exhaustive inventory. Costs of savings for specific measures and bundles of measures will vary based on site-specific conditions.

Source: Energy Saving Technologies & Practices for the Building Sector, American Council for an Energy-Efficiency Economy, 1998.

Solar Measures

This category gave SPA developers two elective options for reducing grid-supplied energy demands from the buildings that will be constructed in the SPAs:

- *Solar thermal applications.* The SPA developer would work with the City to make a commitment that a certain percentage of structures will be equipped with solar thermal systems of a certain capacity. The percentage of structures and size of systems are elective choices of the SPA developer. Such systems may include domestic water heating and pool heating.

- *Solar power applications.* The SPA developer would work with the City to make a commitment that a certain percentage of structures will be equipped with solar photovoltaic (PV) power generation systems. The percent of structures and size of systems are elective choices of the SPA developer.

The following examples provided by the SDREO give a snapshot of current residential economics for both types of solar applications:

- *Solar water heating in new home construction.* Using Shea Home's pricing for the SunSystem CopperSun ($2,250/dwelling installed), the $750 State rebate, today's natural gas prices ($1.60/therm), 200 therms/month of consumption (CEC data), and a 40% solar fraction, the homeowner is in positive cash flow from day one.

- *Photovoltaic (PV) power generation in new home construction.* Using AstroPower's pricing quote for buildings ($4,200 for a 1.2 kW system, includes the 50% State rebate), $0.15/kWh cost of electricity, 7% loan rate for 30 years, 31% tax bracket, PV output of 1500 kWh/kW/year, and maintenance costs of $0.02/kWh, the homeowner comes out about breakeven over the length of the mortgage assuming electric rates remain high. This feasibility would improve proportionately as the number of involved homes and PV systems increase, e.g. 100 homes being equipped in one project. It should be noted that the initial cost of the PV system is considerably less for new construction than to retro-fit an existing house. Builders dealing directly with the manufacturers for large volumes of product obtain better prices.

There are currently four financial incentives available to homeowners who are installing PV systems in California:

- *The Renewable Energy Buy-Down Program.* This CEC program offers cash rebates on eligible renewable energy electric generating systems of up to $4,500 per kilowatt or 50% of an eligible system purchase price (whichever is less).

- *The California Property Tax Exemption for Solar Systems.* Exempts the additional value of PV systems vs. conventional systems from property tax assessments.

- *Battery Rebate Program (SB-1345).* A CEC grant program that supports the purchase and installation of solar energy systems including back up batteries for PV systems.

- *The California Tax Credit (SB-17).* Effective October 9, 2001, allows a tax credit of either 15% of the purchase and installation of a solar energy system or 7.5% of the net cost after the buy-down rebate (whichever is less).

As with energy-efficient construction generally, the solar cost/benefit equation has steadily improved in recent years. California's recent energy crises has further underscored the attractiveness of this option. A prominent regional example is the Scripps Ranch project being constructed by Shea Homes, where 297 homes will reportedly have solar water heating systems and 100 homes will have PV systems.

Although large-scale projects such as the Scripps Ranch project are demonstrating that residential solar PV is increasingly feasible, the cost-effectiveness of this option continues to be sensitive to economies of scale for equipment purchases and the competing price of grid-delivered electricity. If local electric rates begin to increase again and solar PV systems can be purchased in quantity, then this option deserves serious consideration. At a minimum, it warrants close ongoing monitoring of relevant conditions.

The feasibility of PVs in commercial buildings is even better than residential because businesses can take advantage of state and federal incentives not available to households. For example, a 100 kW system would cost an estimated $235,000 after all incentives and be able to generate electricity for approximately 10¢/kWh (source: SDREO). Financial incentives currently available for solar PV in general include:

- *San Diego Self-Generation Program.* This SDREO program offers rebates of $4.50/watt up to 50% of eligible project costs for PV systems between 30 kW and 1 MW. This incentive program can be used or the CEC Emerging Renewable Buy-Down Program, but not both.

- *California Energy Commission Emerging Renewable Buydown Program.* The CEC, through its Emerging Renewable Buydown Account, offers rebates of up to $4.50/watt or 50% of the cost for eligible renewable energy generation equipment, including solar PV.

- *California Property Tax Exemption.* This law exempts the additional value of solar systems versus conventional systems from property tax assessments.

- *Federal Tax Incentives.* There are two federal tax incentives available to commercial entities to encourage private investment in solar energy equipment and systems: a 10% investment tax credit and a 5-year accelerated depreciation schedule.

If SPA developers select one or both of the solar options, and builders are called upon to implement the commitment, they can receive valuable technical assistance from SDREO and CEC solar programs, along with resources provided by the California Solar Energy Industries Association.

2.3 Indicators

The second step in customizing INDEX to Chula Vista was the selection of indicators to gauge key characteristics of the 12 action measures. Indicators are quantitative measurements of community characteristics or conditions. They focus on small pieces of larger systems to give people insight into the larger situation. In community planning, indicators are usually focused on conditions related to key goals and policies. The premise is that plan preparation and implementation can be valuably informed by a standard set of policy based measurements that are used to gauge planning actions.

Criterion's INDEX software is designed to support community planning by applying indicators geographically to current conditions and proposed changes. Figure 1 illustrates the integration of INDEX indicators into a typical community planning process. In the case of Chula Vista, the software has been focused on implementation of the CO_2 Reduction Plan through energy efficient land-use planning.

Given this objective, project participants selected 52 indicators to address the energy and emission aspects of proposed land developments. The indicators are given in Table 3 with definitions, units of measurement, and applicable land-uses. These indicators were used to score the baseline and SPA energy values, and quantify the amount of air quality and climate change benefits embodied in the final SPA plans.

2.4 Baselines

The next step in the pilot test was calculation of the baseline values that SPA plans would be judged against. The baseline represents "pre-efficiency" approaches to land development without any special effort to reduce energy use or emissions. To set the baseline, a group of three Chula Vista neighborhoods built in the 1970s and 80s was measured with the INDEX indicators, and a weighted average score was calculated for each indicator to constitute a baseline value for that indicator.

In choosing baseline neighborhoods, the City staff looked for areas that would be comparable to those areas currently being developed in the community. The baseline areas needed to have land-use mixes with individual design features similar to current SPA proposals. The selected baseline neighborhoods included Terra Nova, and two neighborhoods in the College Estates area, all shown in Figure 2. For purposes of the pilot study, these neighborhoods are referred to as College Estates I and II.

These neighborhoods were not considered to be practical baselines for three action measures: building construction, solar use, and vegetation. This is because no records exist to document these conditions at the time of the neighborhoods' original development. Instead, these measures were addressed as follows:

- *Building efficiency.* This category includes Title 24 exceedence and participation in building efficiency programs sponsored by utilities or similar organizations. The baseline was set at zero exceedence and zero program participation under the assumption that no extra efforts were made to achieve higher efficiencies at the time of original development in the 1970s and 80s.

Figure 1

SUPPORT OF COMMUNITY PLANNING WITH INDEX

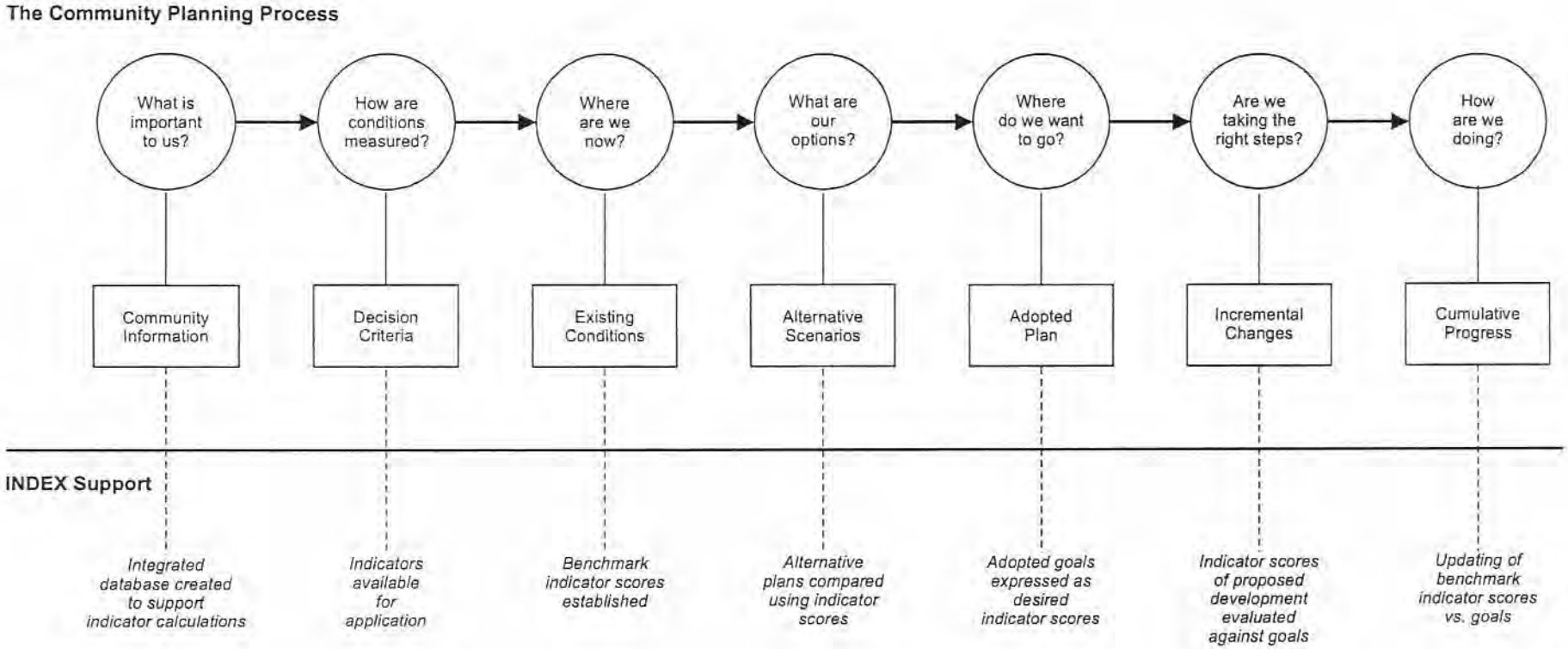


Table 3

CHULA VISTA INDICATORS

Indicator	Indicator Definition	Applicable Land-Use	
		Residential	Non-Residential
1. Population	Total residents.	✔	
2. Households	Total dwelling units.	✔	
3. Employment	Total jobs.		✔
4. Land area	Total area in acres.	✔	✔
5. Development footprint	Total developed acres (exclusive of open space) divided by total residents.	✔	✔
6. Street network extent	Total street centerline distance divided by total residents.	✔	✔
7. Amenity proximity (retail)	Average travel distance from all dwellings to closest amenity (retail) in ft.	✔	
8. Single-family dwelling density	Single-family dwelling units per net acre of residential land.	✔	
9. Multi-family dwelling density	Multi-family dwelling units per net acre of residential land.	✔	
10. Average residential density	Dwelling units per net acre of residential land.	✔	
11. Employment density	Number of employees per net acre of nonresidential land.		✔
12. Commercial building density	Average commercial floor area ratio.		✔
13. Use mix	Proportion of dissimilar land uses among adjacent one-acre grid cells (scale of 0 - 1).	✔	✔
14. Use balance	Proportions of land uses, by land area, within total area (scale of 0 - 1).	✔	✔
15. Neighborhood completeness	Percent of key uses present or adjacent (see footnote 1).	✔	✔
16. Block size	Average size of blocks in acres.	✔	✔
17. Pedestrian orientation of buildings	Average non-residential building set-back from sidewalks in ft.		✔
18. Sidewalk and trail connectivity	Ratio of sidewalk and trail intersections vs. intersections and dead-ends (scale of 0-1).	✔	✔
19. External access for pedestrians	Average ft. between pedestrian access points on area boundary in ft.	✔	✔
20. External access for vehicles	Average ft. between vehicle access points on area boundary in ft.	✔	✔
21. Street connectivity	Ratio of street intersections vs. intersections and cull-de-sacs longer than 150 ft. (scale of 0 - 1).	✔	✔
22. Street network density	Length of street centerlines in miles per sq.mi.	✔	✔

Table 3 *Continued*

Indicator	Indicator Definition	Applicable Land-Use	
		Residential	Non-Residential
23. Housing proximity to transit	Average travel distance from all dwellings to closest transit stop.	✔	
24. Employment proximity to transit	Average travel distance from all businesses to closest transit stop.		✔
25. Transit-oriented residential density	Average number of dwellings per net residential acre within 1/4 mi. walk of transit stops.	✔	✔
26. Transit-oriented employment density	Average number of employees per net non-residential acre within 1/4 mi. walk of transit stops.	✔	✔
27. Title 24 exceedence	Percent of structures committed to exceeding Title 24 (see footnote 2).	✔	✔
28. Building efficiency program participation	Percent of structures committed to building efficiency program participation (see footnote 3).	✔	✔
29. Solar thermal applications	Percent of structures committed to solar thermal applications (see footnote 4).	✔	✔
30. Solar power applications	Percent of structures committed to solar power applications.	✔	✔
31. Vegetative CO_2 uptake	Total CO_2 uptake from street trees in lbs/yr.	✔	✔
32. Pedestrian network coverage	Ratio of total pedestrian network centerline distance vs. total street centerline distance.	✔	✔
33. Pedestrian crossing distance	Average street width curb-to-curb in ft.	✔	✔
34. Pedestrian route directness	Average ratio of shortest walkable distance from multiple origins to designated nodes vs. straight line distance between same points.	✔	✔
35. Bicycle network coverage	Percent of streets bikeable (total secondary street centerline distance plus centerline distance of major streets with designated routes.	✔	✔
36. Transit service coverage	Miles of transit routes divided by total acres.	✔	✔
37. Daily auto driving	Vehicle miles traveled/capita/day.	✔	
38. Residential water use	Indoor and outdoor residential water consumption in gals per day per capita, including effects of xeriscaping.	✔	
39. Park space supply	Acres of park per 1,000 residents.	✔	
40. Park proximity	Average distance from all dwellings to closest park in ft.	✔	
41. Open space supply	Percent of total land area dedicated to open space (see footnote 5).	✔	✔
42. Open space contiguity	Proportion of adjacent open space designations among a grid of one-acre cells (scale of 0 - 1).	✔	✔
43. Housing energy use	Total energy use in residences in MMBtu/capita/year.	✔	

Table 3 *Continued*

Indicator	Indicator Definition	Applicable Land-Use	
		Residential	Non-Residential
44. Household transportation energy use	Total energy use in household travel in MMBtu/capita/year.	✔	
45. Nonresidential building energy use	Total energy use in nonresidential buildings in MMBtu/capita/year.		✔
46. Total energy use	Total residential and nonresidential energy use in MMBtu/capita/year.	✔	✔
47. NOx emissions	NOx emissions in lbs./capita/year.	✔	✔
48. SOx emissions	SOx emissions in lbs./capita/year.	✔	✔
49. HC emissions	HC emissions in lbs./capita/year.	✔	✔
50. CO emissions	CO emissions in lbs./capita/year.	✔	✔
51. PM emissions	PM emissions in lbs./capita/year.	✔	✔
52. CO_2 emissions	CO_2 emissions in lbs./capita/year.	✔	✔

1. Key uses for "neighborhood completeness" include: fire/police station, library, park, school, and/or general commercial/retail uses.

2. Title 24 exceedence can include building design, construction material, space conditioning, water heating, and lighting measures for buildings not participating in a formal energy efficiency program sponsored by utilities or comparable organizations.

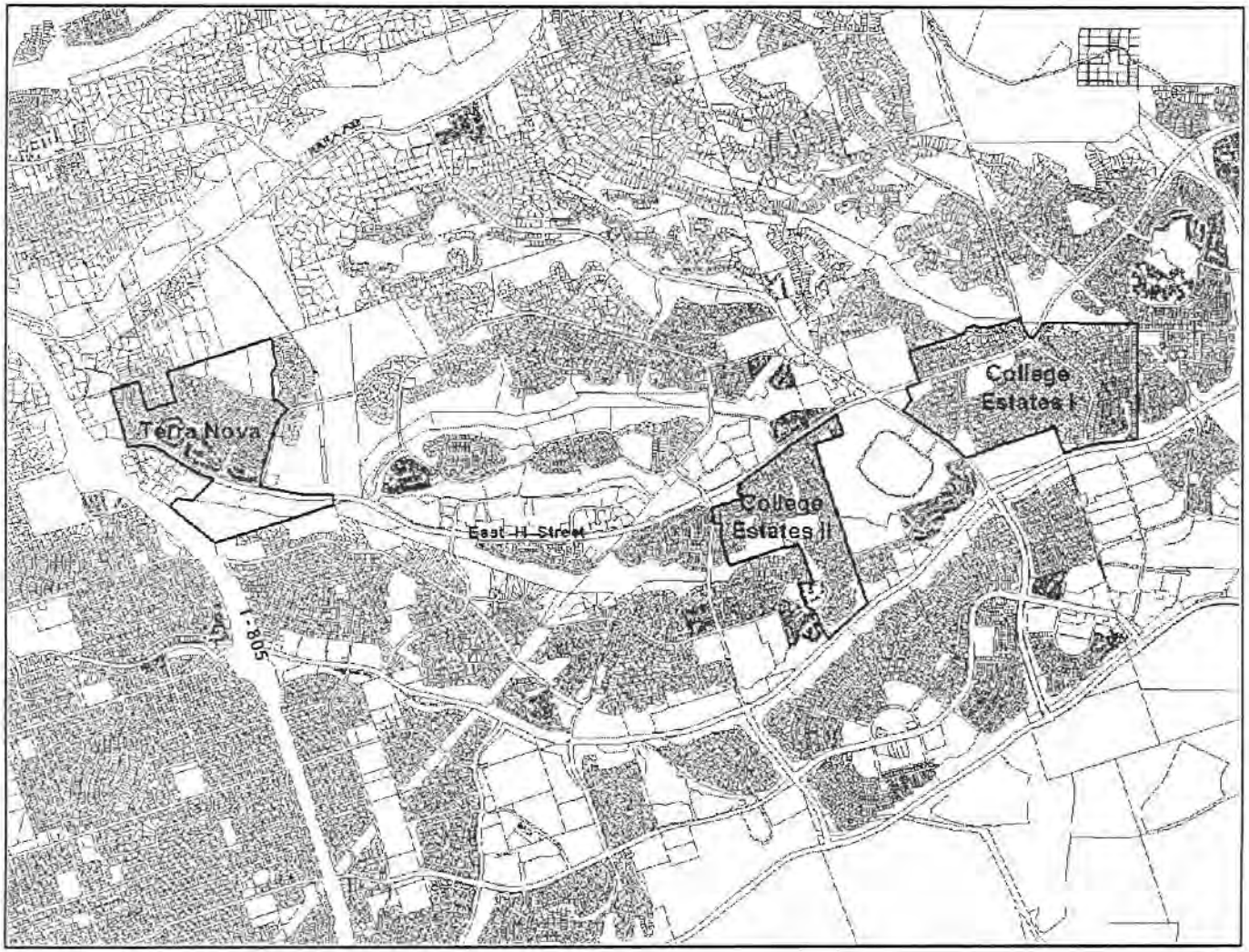
3. Building energy efficiency program participation through utilities or comparable organizations can include space conditioning, lighting, water heating, and appliance measures.

4. Solar thermal applications can include domestic hot water heating and pool heating.

5. Land area to be included in open space calculation includes any off-site open space associated with a specific SPA plan.

Figure 2

BASELINE NEIGHBORHOODS



- *Solar use.* This includes thermal applications for domestic water and pool heating, and PV power generation applications. In both cases the baseline was set at zero under the assumption that very little solar was installed in the 1970s and 80s in such developments.

- *Vegetation.* This category includes the use of street trees to accomplish air pollution and greenhouse gas uptake. The baseline was set at zero to reflect limited tree planting practices at the time of original development.

2.5 Proposed SPA Plans

The final component of the pilot test was the group of proposed SPAs being modeled for air quality improvement purposes. As shown in Figure 3, the SPAs selected by City staff for the pilot test included:

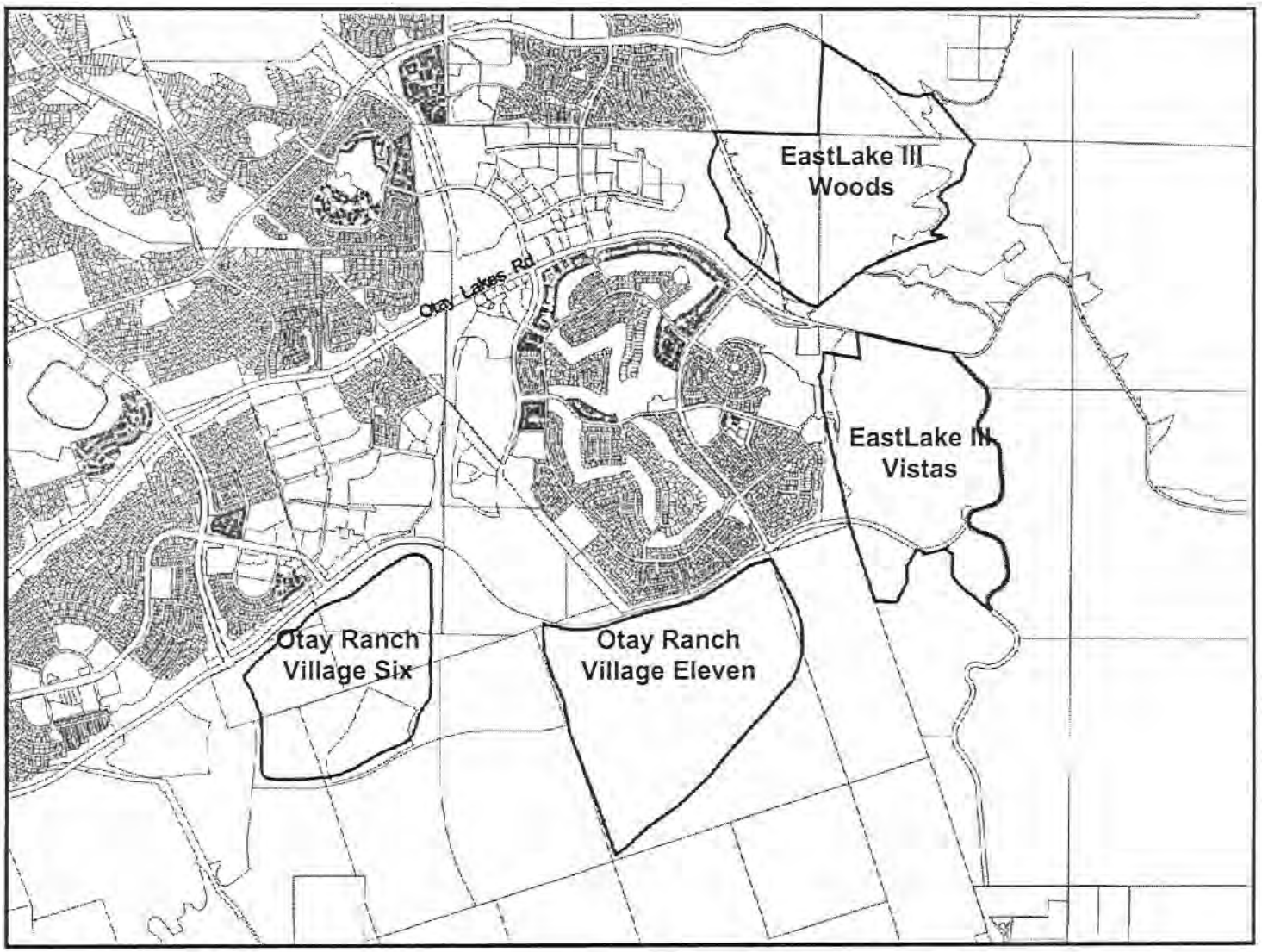
- *Otay Ranch Village Six.* This is a 386-acre project containing approximately 2000 dwellings and a mix of commercial and public uses.

- *Otay Ranch Village Eleven.* This 489-acre project includes about 2300 dwellings and commercial and public uses.

- *EastLake III.* This is a 748-acre project that includes a 259-acre component known as the Woods with approximately 660 dwellings; and the Vistas, a 229-acre area of about 1400 dwellings and a mix of commercial and public uses.

As originally proposed, these SPAs already contained some level of energy-efficient features that improve air quality and reduce CO_2 emissions. The challenge of the pilot test was to determine if additional benefits can be identified and achieved.

Figure 3
SPA LOCATIONS



3. PILOT TEST

3.1 Baseline Values

Having assembled the components of the pilot test, the first step in INDEX modeling was the calculation of the baseline values. As described in the previous section, these are "pre-efficiency" indicator scores representative of land development practices in the 1970s and 80s. These scores form a baseline that current SPA proposals can be judged against.

As shown in Table 4, baseline values were computed by measuring the three pre-efficiency neighborhoods and then calculating a weighted average score for each indicator. Exceptions to the weighted average occur with six indicators as noted in Table 4, where anomalous conditions in the neighborhoods produced scores that could not be considered typical. In these instances, City staff adjusted the values to more common or practical levels (see Table 4 footnotes). To assist in interpreting the baseline scores, Table 4 also includes comments on the scores' relationship to common principles of energy-efficient land-use planning.

3.2 Original SPA Proposals

Having set baseline values, the next step was INDEX modeling of the original SPA proposals to obtain their indicator scores. Those SPA scores were then compared to the baseline values as shown in Table 5.

The principal finding from the first round of INDEX modeling is that all three original SPA plans are more energy-efficient than the baseline. Village Six is about 9% more energy-efficient than the baseline, Village Eleven is about 11% more efficient, and EastLake 3 is about 5% better.

Table 4

BASELINE INDICATOR SCORES

			Pre-Efficiency Neighborhoods					
Element	Indicator	Units	Terra Nova	College Estates I	College Estates II	*Weighted By*	Weighted Average	Comments
Demographics	1. Population	residents	3482	3249	1839	*NA*	- - -	
	2. Households	dwelling units	1159	1083	613	*NA*	- - -	
	3. Employment	employees	40	245	40	*NA*	- - -	
	4. Land Area	acres	199	242	141	*NA*	- - -	
Land-Use	5. Development Footprint	acres/resident	0.06	0.07	0.06	*residents*	0.064	Typical scores for suburban residential.
	6. Street Network Extent	street mi./capita	2.43	2.76	2.66	*residents*	2.604	Typical scores for suburban residential.
	7. Amenity Proximity (retail)	ft. to closest amenity	2363	3491	4240	*dwelling units*	3193.902	Distances over 2,640 ft. are pedestrian unfriendly.
	8. Single-Family Dwelling Density	DU/acre	8.22	5.51	6.94	*dwelling units*	6.917	Typical results for suburban residential.
	9. Multi-Family Dwelling Density	DU/acre	16.66	NA	NA	*staff adjusted (1)*	16.000	Terra Nova score is favorable; lack of MF in CE 1 & 2 unfairly drags weighted average too low.
	10. Average Residential Density	DU/acre	9.98	5.51	6.94	*dwelling units*	7.632	Comments above will ripple here.
	11. Employment Density	employees/acre	2.51	12.01	4.08	*staff adjusted (2)*	12.000	TN & CE2 scores are understandable because of schools only; CE1 is at low end of transit feasibility.

Table 4 *Continued*

Element	Indicator	Units	Pre-Efficiency Neighborhoods: Terra Nova	Pre-Efficiency Neighborhoods: College Estates I	Pre-Efficiency Neighborhoods: College Estates II	*Weighted By*	Weighted Average	Comments
Land-Use *Continued*	12. Commercial Building Density	avg. floor area ratio	NA	0.08	NA	*staff adjusted* ***(3)***	0.350	Baseline projects not sufficiently commercial to calculate reasonable baseline of 0.25-0.50; adjusted to conform with applicable development standard.
	13. Use Mix	0 to 1 index	0.33	0.27	0.36	*land area (acres)*	0.312	Typical suburban residential scores; generally 0.4 or higher denotes high mix areas.
	14. Use Balance	0 to 1 index	0.52	0.34	0.34	*land area (acres)*	0.402	Typical suburban residential scores; generally 0.75 or higher is desired.
	15. Neighborhood Completeness	% of key uses	40	40	40	*residents*	40.000	Coincidental identical scores, all favorable; generally 50 or higher is desired.
	16. Block Size	acres	23.48	9.08	10.75	*land area (acres)*	14.407	Blocks larger than 4-5 acres are pedestrian unfriendly.
	17. Pedestrian Orientation of Buildings	avg. setback ft.	NA	103	NA	*feet of setback*	103.000	Pedestrian friendly setbacks are 0-30 ft.
	18. Internal Connectivity for Pedestrians	0 to 1 index	0.73	0.81	0.75	*no. of ped. intersections*	0.764	All favorable scores; generally 0.75 or higher is desired.
	19. Internal Connectivity for Vehicles	0 to 1 index	0.77	0.79	0.66	*no: of street intersections*	0.742	All favorable except CE2; generally 0.75 is desired.
	20. External Access for Pedestrians	ft. between access points	1138	804	1983	*study perimeter (ft.)*	1298.648	Scores below 1,200 ft. are favorable.

Table 4 *Continued*

			Pre-Efficiency Neighborhoods					
Element	Indicator	Units	Terra Nova	College Estates I	College Estates II	*Weighted By*	Weighted Average	Comments
Land-Use *Continued*	21. External Access for Vehicles	ft. between access points	1934	2011	2644	*study perimeter (ft.)*	2184.007	Scores below 1,200 ft. are favorable.
	22. Street Network Density	centerline miles/sq. mi.	15.37	19.71	18.83	*land area (acres)*	18.013	Typical scores for suburban residential.
	23. Housing Proximity to Transit	ft. to closest stop	1439	1667	861	*dwelling units*	1401.385	Scores below 1,200 ft. are favorable.
	24. Employment Proximity to Transit	ft. to closest stop	2819	445	984	*employees*	803.523	Scores below 1,200 ft. are favorable.
	25. Transit-Oriented Residential Density	DU/acre w/i 1/4 mi. stop	11	5	7	*staff adjusted* ***(4)***	10.000	TN score is favorable, others are not; minimum should be 10.
	26. Transit-Oriented Employment Density	emps./acre w/i 1/4 mi. stop	3	12	4	*employees w/in 1/4 mi.*	11.252	CE1 score is minimum favorable.
Buildings	27. Title 24 Exceedence	% structures	0	0	0	*structures*	0	
	28. Building Efficiency Program Participation	% structures	0	0	0	*structures*	0	
	29. Solar Thermal Applications	% structures	0	0	0	*structures*	0	
	30. Solar Power Applications	% structures	0	0	0	*structures*	0	
	31. Vegetative CO2 Uptake	lbs./yr.	0	0	0	*land area (acres)*	0.000	
Transportation	32. Pedestrian Network Coverage	ped. routes/streets ratio	1.41	1.19	1.31	*total street miles*	1.284	All favorable scores (anything above 1.0)
	33. Pedestrian Crossing Distance	avg. curb to curb ft.	45	41	39	*no. of street intersections*	41.726	Pedestrian friendly crossing distances are 30 ft. or less.
	34. Pedestrian Route Directness	walk ft./straightline ft. ratio	1.62	1.76	1.45	*dwelling units*	1.637	Scores above 1.5 are unfavorable.

Table 4 *Continued*

			Pre-Efficiency Neighborhoods					
Element	Indicator	Units	Terra Nova	College Estates I	College Estates II	*Weighted By*	Weighted Average	Comments
Transportation *Continued*	35. Bicycle Network Coverage	% of streets bikeable	100	100	100	*staff adjusted (5)*	90.000	
	36. Transit Service Coverage	stops/sq. mi.	8	11	23	*land area (acres)*	12.873	10-20 is favorable range.
	37. Daily Auto Driving	veh-mi./day/capita	22	22	22	*residents (6)*	22.000	Typical suburban value; generally 20 or less is desirable.
Infrastructure	38. Residential Water Use	gal./day/capita	128	171	153	*residents (7)*	149.667	
Environment	39. Park Space Supply	acres/1000 residents	11.20	3.62	7.89	*staff adjusted (8)*	3.000	TN score is abnormally high.
	40. Park Proximity	ft. to closest park	2090	2732	1266	*dwelling units*	2156.611	Distances above 1,200 ft. are unfavorable for pedestrians.
	41. Open Space Supply	% of land area	19	2	6	*land area (acres)*	8.779	TN score again unusually high; however, weighted average may be reasonable.
	42. Open Space Contiguity	0 to 1 index	0.72	0.53	0.58	*open space acres*	0.679	Scores above 0.5 are favorable.
	43. Housing Energy Use	MMBtu/yr./capita	28	28	36	*residents*	31.084	Typical scores.
	44. Household Transportation Energy Use	MMBtu/yr./capita	47	47	47	*residents*	46.800	Typical suburban score; generally 40 or less is desirable.
	45. Nonresidential Building Energy Use	MMBtu/yr./emp.	N/A	18	N/A	*employees*	18.026	CE1 score representative of strip malls; generally 12 or less is desirable.
	46. Total Energy Use	MMBtu/yr./person	74	75	81	*residents & employees*	75.561	Typical suburban residential scores for San Diego region.
	47. NOx Emissions	lbs./yr./person	33.01	33.45	33.82	*residents & employees*	33.349	Derived from energy scores.
	48. SOx Emissions	lbs./yr./person	0.72	0.83	0.92	*residents & employees*	0.805	Derived from energy scores.

Table 4 *Continued*

Element	Indicator	Units	Pre-Efficiency Neighborhoods: Terra Nova	College Estates I	College Estates II	*Weighted By*	Weighted Average	Comments
Environment *Continued*	49. HC Emissions	lbs./yr./person	58.43	58.44	58.44	*residents & employees*	58.435	Derived from energy scores.
	50. CO Emissions	lbs./yr./person	452.06	452.13	452.23	*residents & employees*	452.133	Derived from energy scores.
	51. PM Emissions	lbs./yr./person	0.13	0.14	0.16	*residents & employees*	0.140	Derived from energy scores.
	52. C02 Emissions	lbs./yr./person	10238	10566	10846	*residents & employees*	10492.572	Derived from energy scores.

1. Terra Nova score was consistent with citywide average east of I-805; rounded to 16.0.
2. Terra Nova and College Estates 2 scores are for school employment only and do not include any retail or commercial; College Estates 1 score is typical for suburban strip commercial employment; rounded to 12.0.
3. Adjusted value is based on allowable development standard.
4. College Estates 1 and 2 scores are beneath transit minimum; adjusted value is typical minimum for feasible transit service.
5. All three neighborhood scores are considered unusually high; adjusted value reflects likelihood of less-than-full coverage.
6. Estimated by Criterion and Fehr & Peers based on SANDAG regional data.
7. Water use estimated by INDEX and confirmed with City data.
8. Value adjusted to be consistent with adopted City standard.

Table 5

ORIGINAL SPA PLAN INDICATOR SCORES

Element	Indicator		Units	Baseline	SPAs		
					OR Village Six	OR Village Eleven	EastLake III
Demographics	1. Population		residents	--	6261	6,974	6173
	2. Households		dwelling units	--	2086	2,304	2,061
	3. Employment		employees	--	241	305	792
	4. Land Area		acres	--	386	489	744
Land-Use	5. Development Footprint		acres/capita	0.064	0.038	0.039	0.071
	6. Street Network Extent		street mi./capita	2.604	1.78	2.05	1.38
	7. Amenity Proximity (retail)		ft. to closest amenity	3193.902	2205	2806	6,224
	8. Single-Family Dwelling Density	*	DU/acre	6.917	8.14	7.07	4.50
	9. Multi-Family Dwelling Density	*	DU/acre	16.000	24.98	15.80	17.25
	10. Average Residential Density		DU/acre	7.632	12.26	10.39	5.77
	11. Employment Density	*	employees/acre	12.000	5.05	6.80	11.25
	12. Commercial Building Density		avg. floor area ratio	0.350 (a)	0.35 (a)	0.35 (a)	0.35 (a)
	13. Use Mix	*	0 to 1 index	0.312	0.37	0.31	0.32
	14. Use Balance	*	0 to 1 index	0.402	0.48	0.49	0.44
	15. Neighborhood Completeness	*	% of key uses	40.000	60	60	80
	16. Block Size		acres	14.407	6.14	9.29	18.43
	17. Pedestrian Orientation of Buildings		avg. setback ft.	103.000	15.000 (a)	15.000 (a)	15.000 (a)
	18. Internal Connectivity for Pedestrians		0 to 1 index	0.764	0.99	0.97	0.920
	19. Internal Connectivity for Vehicles	*	0 to 1 index	0.742	0.91	0.91	0.740
	20. External Access for Pedestrians		ft. between access points	1298.648	1279	619	2595
	21. External Access for Vehicles		ft. between access points	2184.007	1512	1599	4672
	22. Street Network Density	*	centerline miles/sq. mi.	18.013	17.86	19.37	15.59
	23. Housing Proximity to Transit		ft. to closest stop	1401.385	944	1560	1327
	24. Employment Proximity to Transit		ft. to closest stop	803.523	1064	1040	1077
	25. Transit-Oriented Residential Density		DU/acre w/l 1/4 mi. stop	10.000	12.26	10.40	6.05
	26. Transit-Oriented Employment Density		emps./acre w/l 1/4 mi. stop	11.252	4	6	10
Buildings	27. Title 24 Exceedence		% structures	0	0	0	0
	28. Building Efficiency Program Participation		% structures	0	0	0	0
	29. Solar Thermal Applications		% structures	0	0	0	0
	30. Solar Power Applications		% structures	0	0	0	0
	31. Vegetative CO2 Uptake		lbs./yr.	0.000	179300	163,350	169,950

Table 5 *Continued*

					SPAs	
Element	**Indicator**	**Units**	**Baseline**	**OR Village Six**	**OR Village Eleven**	**EastLake III**
Transportation	32. Pedestrian Network Coverage *	ped. routes/streets ratio	1.284	2.18	2.25	1.82
	33. Pedestrian Crossing Distance	avg. curb to curb ft.	41.726	35	34	52
	34. Pedestrian Route Directness *	walk ft./straight-line ft. ratio	1.637	1.51	1.38	1.610
	35. Bicycle Network Coverage	% of streets bikeable	90.000	95	100.000	97
	36. Transit Service Coverage	stops/sq. mi.	12.873	16	5	18
	37. Daily Auto Driving	veh-mi./day/capita	22.000 (b)	22.000 (b)	22.000 (b)	23.00 (b)
Infrastructure	38. Residential Water Use	gal./day/capita	149.667	150	160	193
Environment	39. Park Space Supply	acres/1000 residents	3.000	1.50 (c)	2.65 (c)	3.08
	40. Park Proximity	ft. to closest park	2156.611	1357	1626	1804
	41. Open Space Supply	% of land area	8.779	10	13	16
	42. Open Space Connectivity	0 to 1 index	0.679	0.61	0.35	0.67
	43. Housing Energy Use	MMBtu/yr./capita	31.084	24.352	22.563	28.890
	44. Household Transportation Energy Use	MMBtu/yr./capita	46.800 (d)	46.801 (d)	46.801 (d)	46.801 (d)
	45. Nonresidential Building Energy Use	MMBtu/yr./emp.	18.026	14.189	22.364	42.719
	46. Total Energy Use	MMBtu/yr./person (capita + emp)	75.561	69.045	67.392	71.942
	47. NOx Emissions	lbs./yr./person (capita + emp)	33.349	32.659	32.507	33.353
	48. SOx Emissions	lbs./yr./person (capita + emp)	0.805	0.634	0.596	0.806
	49. HC Emissions	lbs./yr./person (capita + emp)	58.435	58.432	58.431	58.435
	50. CO Emissions	lbs./yr./person (capita + emp)	452.133	451.983	451.950	452.134
	51. PM Emissions	lbs./yr./person (capita + emp)	0.140	0.110	0.104	0.140
	52. C02 Emissions	lbs./yr./person (capita + emp)	10492.572	9,942.781	9,832.839	10,470.883

Notes:

a) Values are assumed based on applicable development regulations.

b) Typical suburban value; generally 20 or less is desirable.

c) Additional park acreage is provided off-site to meet the City requirement of 3 acres/1000 residents.

d) Typical suburban value; generally 40 or less desirable.

* "Top ten" indicators of urban design-based energy efficiency.

Notable characteristics of the SPAs and differences between their scores and the baseline are summarized below by element category:

- *Demographics.* Villages Six and Eleven are relatively similar, each with about 350–500 acres of land accommodating 6,000–7,000 residents, and a relatively small amount of non-residential uses equating to 250–300 jobs. EastLake III is notably larger in land area at approximately 750 acres, and in employment at about 800 jobs.

- *Land-use.* Villages Six and Eleven generally score better than EastLake III in comparison to baseline values. Villages Six and Eleven have favorable residential densities, neighborhood completeness, circulation connectivity, and proximity to transit. EastLake III enjoys better employment density and the highest neighborhood completeness, but unfavorable scores in residential density and some circulation features, e.g. walk distance to retail and transit-oriented residential density. In general, all three SPAs achieve their energy and emissions advantage over the baseline in this element primarily through higher total population densities, which reduces space conditioning, travel, and infrastructure energy use.

- *Transportation.* There was little change between SPA scores and baseline values in this element, except for significant increases in pedestrian network coverage in all three SPAs, and a drop in transit service coverage in Village Eleven.

- *Infrastructure.* Villages Six and Eleven residential water use scored close to the baseline, while EastLake III was notably higher due to its lower density, larger lots whose greater amount of landscaping is estimated to consume more water.

- *Environment.* Village Six has a park space supply score notably below the City standard (but is nonetheless meeting its park demand through the provision of a seven-acre neighborhood park on-site consistent with City requirements, and the community park acreage is being met off-site pursuant to the Otay Ranch General Development Plan). Villages Six and Eleven improved park proximity for their residents in comparison to the baseline, but that distance worsened in EastLake III. Village Eleven's open space contiguity score is unusually low, suggesting unfavorable fragmentation of spaces (generally 0.5 or higher is desirable). This element also contains the energy and emission scores that summarize the combined effects of land-use, buildings, transportation, and infrastructure. Of the ten energy and emission indicators, the principal indicator is total energy use per year by residents and employees combined. All three SPAs exceed the baseline in efficiency terms, largely due to higher

population densities. The SPAs' favorable energy scores are mirrored by similar reductions in pollutant and greenhouse gas emissions.

3.3 Modified SPA Proposals

The next step in the pilot test was an invitation for developers to submit modified SPA plans that achieved even greater energy efficiency and air quality than the original proposals. SPA developers had the following options available for modifying their plans in ways that further increased energy efficiency and improved air quality:

- *Land-use density.* This is the intensity of use on properties measured in dwelling units per acre for residential uses and employees per acre for non-residential uses. Extensive research nationally and internationally has conclusively demonstrated that the strongest urban planning technique for increasing energy efficiency is increasing land-use density. Density increases produce significant energy savings in building space conditioning, travel, and infrastructure operations. Although it may have been too late for major density changes in the three test SPAs, this option should be examined in future SPA processes because of its sizable benefits.

- *Land-use diversity.* This is the mix of residential and non-residential uses in an area. Research has also demonstrated that another important technique for increasing energy efficiency is increasing the diversity of land-uses. Greater diversity produces energy savings in the same space conditioning, travel, and infrastructure end-uses as density does through better use of system capacities. Again, it may have been too late to consider diversity changes in the three test SPAs, but the option warrants future consideration in other SPAs.

- *Multimodal circulation design.* Another strong technique for saving energy in land development is designing an efficient and convenient multimodal circulation system. Such a system is composed of features that allow walking, biking, and transit use in addition to auto driving. Important components include relatively dense street networks, completeness of sidewalks, and relatively direct routes from common origins to popular destinations. As with density and diversity, it may have been too late for significant circulation changes in the test SPAs.

- *Building construction standards.* SPA developers may opt for a commitment to reduce building energy use by exceeding Title 24. Developers could propose the amount of Title 24 exceedence per building type and the number of buildings that will participate in such exceedence. A developer could exercise this option by committing to a utility or comparable energy efficiency

program that offers beyond-code services, or by simply committing that merchant builders will achieve the stipulated exceedence by means of their own choosing.

- *Solar systems.* SPA developers could opt to reduce grid-supplied energy by installing solar thermal or PV systems in buildings. Developers could propose the type and capacity of systems to be used, and the number of structures that will receive such systems.

- *Tree planting.* This category allowed SPA developers to offer additional tree planting that will offset greenhouse gas emissions. Selection of this option will not improve a SPA's energy efficiency or air pollutant emissions, but will help mitigate climate change.

After consideration of these options, the test SPA developers voluntarily selected the following action measures to improve their projects' energy efficiency and air quality:

- *EastLake III.* 72 single-family homes will achieve a 15% Title 24 exceedence using ComfortWise, SDG&E California Energy Star Program, or equivalent program; 255 single-family homes will achieve a 15% Title 24 exceedence using the SDG&E California Energy Star Program; and an additional 855 trees will be planted.

- *Otay Ranch Village Six.* 482 single-family homes will achieve a 10% Title 24 exceedence using designer/builder-selected measures; and an additional 792 trees will be planted.

- *Otay Ranch Village Eleven.* No additional measures selected.

With these modifications, the SPA plans were modeled again to recalculate indicator scores and identify final energy savings and air quality improvements. These results are shown in Table 6 indicating an approximate 1% energy use reduction for EastLake III and Village Six between original and modified plans. Also, the additional tree planting in EastLake III and Village Six resulted in beneficial CO2 uptake increases of 25% and 22%, respectively.

Table 6

MODIFIED SPA PLAN INDICATOR SCORES

Element	Indicator	Units	Baseline	Original Village Six	Modified Village Six	Original EastLake III	Modified EastLake III
Demographics	1. Population	residents	--	6261	6261	6173	6173
	2. Households	dwelling units	--	2086	2086	2061	2061
	3. Employment	employees	--	241	241	792	792
	4. Land Area	acres	--	386	386	744	744
Land-Use	5. Development Footprint	acres/resident	0.064	0.038	0.038	0.071	0.071
	6. Street Network Extent	street mi./capita	2.604	1.78	1.78	1.38	1.38
	7. Amenity Proximity (retail)	ft.	3193.902	2205	2205	6224	6224
	8. Single-Family Dwelling Density	DU/acre	6.917	8.14	8.14	4.50	4.50
	9. Multi-Family Dwelling Density	DU/acre	16.000	24.98	24.98	17.25	17.25
	10. Average Residential Density	DU/acre	7.632	12.26	12.26	5.77	5.77
	11. Employment Density	emps./acre	12.000	5.05	5.05	11.25	11.25
	12. Commercial Building Density	ratio	0.350	0.35	0.35	0.35	0.35
	13. Use Mix	0 to 1 index	0.312	0.37	0.37	0.32	0.32
	14. Use Balance	0 to 1 index	0.402	0.48	0.48	0.44	0.44
	15. Neighborhood Completeness	% of key uses	40.000	60	60	80	80
	16. Block Size	acres	14.407	6.14	6.14	18.43	18.43
	17. Pedestrian Orientation of Buildings	ft.	103.000	15.000	15.000	15.000	15.000
	18. Internal Connectivity for Pedestrians	0 to 1 index	0.764	0.99	0.99	0.920	0.920
	19. Internal Connectivity for Vehicles	0 to 1 index	0.742	0.91	0.91	0.740	0.740
	20. External Access for Pedestrians	ft. between points	1298.648	1279	1279	2595	2595
	21. External Access for Vehicles	ft. between points	2184.007	1512	1512	4672	4672
	22. Street Network Density	miles/sq. mi.	18.013	17.86	17.86	15.59	15.59
	23. Housing Proximity to Transit	ft. to closest stop	1401.385	944	944	1327	1327
	24. Employment Proximity to Transit	ft. to closest stop	803.523	1064	1064	1077	1077
	25. Transit-Oriented Residential Density	DU/acre w/i 1/4 mi.	10.000	12.26	12.26	6.05	6.05
	26. Transit-Oriented Employment Density	emps./acre w/i 1/4 mi.	11.252	4	4	10	10

Table 6 *Continued*

Element	Indicator	Units	Baseline	Original Village Six	Modified Village Six	Original EastLake III	Modified EastLake III
Buildings	27. Title 24 Exceedence	% structures	0	0	46	0	23
	28. Building Efficiency Program Participation	% structures	0	0	0	0	0
	29. Solar Thermal Applications	% structures	0	0	0	0	0
	30. Solar Power Applications	% structures	0	0	0	0	0
	31. Vegetative CO2 Uptake	lbs./yr.	0.000	179300	218900	169950	212700
Transportation	32. Pedestrian Network Coverage	ped. routes/streets ratio	1.284	2.18	2.18	1.82	1.82
	33. Pedestrian Crossing Distance	ft. curb to curb	41.726	35	35	52	52
	34. Pedestrian Route Directness	walk ft./straightline ft. ratio	1.637	1.51	1.51	1.610	1.610
	35. Bicycle Network Coverage	% of streets bikeable	90.000	95	95	97	97
	36. Transit Service Coverage	stops/sq. mi.	12.873	16	16	18	18
	37. Daily Auto Driving	veh-mi./day/capita	22.000	22.000	22.000	23.000	23.000
Infrastructure	38. Residential Water Use	gal./day/capita	149.667	150	150	193	193
Environment	39. Park Space Supply	acres/1000 residents	3.000	1.50	1.50	3.08	3.08
	40. Park Proximity	ft. to closest park	2156.611	1357	1357	1804	1804
	41. Open Space Supply	% of land area	8.779	10	10	16	16
	42. Open Space Contiguity	0 to 1 index	0.679	0.61	0.61	0.67	0.67
	43. Housing Energy Use	MMBtu/yr./capita	31.084	24.352	23.529	28.890	28.040
	44. Household Transportation Energy Use	MMBtu/yr./capita	46.800	46.801	46.801	46.801	46.801
	45. Nonresidential Building Energy Use	MMBtu/yr./emp	18.026	14.189	14.189	42.719	42.719
	46. Total Energy Use	MMBtu/yr./person	75.561	69.045	68.254	71.942	71.189
	47. NOx Emissions	lbs./yr./person	33.349	32.659	32.574	33.353	33.272
	48. SOx Emissions	lbs./yr./person	0.805	0.634	0.613	0.806	0.786
	49. HC Emissions	lbs./yr./person	58.435	58.432	58.431	58.435	58.435
	50. CO Emissions	lbs./yr./person	452.133	451.983	451.964	452.134	452.116
	51. PM Emissions	lbs./yr./person	0.140	0.110	0.110	0.140	0.140
	52. C02 Emissions	lbs./yr./person	10492.572	9942.781	9873.000	10470.883	10403.764

3.4 Final Results

Based on the modified SPA plans, the pilot test's final results for energy savings, air quality improvements, and greenhouse gas reductions are as follows:

	Baseline	Village Six	Village Eleven	EastLake III
Total energy use (MMBtu/yr/capita)	75.56	68.25	67.39	71.19
% energy reduction	---	9.70	10.80	5.80
Total air pollutant emissions (lbs/yr/capita)	544.85	543.68	543.59	544.75
% air pollutant emissions reduction	---	0.21	0.23	0.01
Total greenhouse gas emissions (lbs/yr/capita)	10,493.00	9,873.00	9,833.00	10,404.00
% greenhouse gas emissions reduction	---	5.90	6.29	0.85

OTAY RANCH VILLAGE SIX

SECTION II.7 AIR QUALITY IMPROVEMENT PLAN

II.7.1 Introduction

Chula Vista's Growth Management Ordinance requires all major development projects (50 dwelling units or greater) to prepare an Air Quality Improvement Plan (AQIP). On November 14, 2000, the City Council adopted the Carbon Dioxide (CO2) Reduction Plan, that included twenty action measures intended to promote clean fuel vehicles, alternatives to driving, transportation efficient land use planning and energy efficient building construction. Twelve of the action measures directly relate to land use planning and air quality improvements. The AQIP includes implementation of applicable measures identified in the CO2 Reduction Plan.

The City is developing guidelines for the preparation and implementation of required AQIP's. A pilot study was initiated to identify and evaluate the relative effectiveness and costs of applying various design and energy conservation features in new development projects. One of the goals of the study is to identify implementation measures that reduce air pollutants and CO2 emissions and exceed existing mandates wherever possible including the Title 24 Energy Code. The INDEX computer model, developed by Criterion Planners/Engineers, was used in the pilot study to analyze the project.

The twelve land use measures identified in the CO2 Reduction Plan were translated into action measures for the pilot study as follows:

Land-Use

1. Compact development – minimize sprawl.
2. Density – intensity of land use.
3. Diversity – mix and variety of uses.
4. Orientation toward pedestrian and bicycles.
5. Orientation toward transit.

Buildings

6. General energy design and equipment – improve efficiency.
7. Solar Use – solar thermal applications and power generation.
8. Vegetation – uptakes air pollutants and greenhouse gases.

Transportation

9. Pedestrian Facilities – system design and improvements.
10. Bicycle facilities – system design and improvements.
11. Transit facilities – system design and improvements.

Infrastructure

12. Water Use – land planning that reduces water consumption.

The *INDEX Pilot Test: SPA Air Quality Improvement Plans* report prepared by Criterion Planners/Engineers identifies various options available to improve energy efficiency and air quality. See Appendix.

II.7.2 Purpose

The purpose of the Otay Ranch Village Six Air Quality Improvement Plan (AQIP) is to reduce emissions and energy use and to fulfill the requirements of the Growth Management Ordinance. The AQIP addresses design methods to reduce vehicle trips, maintain or improve traffic flow, and reduce vehicle miles traveled. It also identifies a means of reducing emissions (direct or indirect) from the project, and defines a program to monitor compliance.

II.7.3 Regulatory Framework

Federal, state and local agencies share responsibilities for developing and implementing air quality regulations and improvement plans. The federal and state agencies have established air quality standards and requirements for compliance. The local agencies focus on adopting strategies and regulations to achieve compliance with the state and federal mandates. Specific air quality analysis for the project is included in the Environmental Impact Report prepared for the Otay Ranch Village Six SPA Plan. As mentioned earlier, the City of Chula Vista's Growth Management Ordinance requires preparation and implementation of an Air Quality Improvement Plan (AQIP) for those projects with 50 dwelling units or greater.

II.7.4 Project Description

The Project encompasses approximately 386.4 acres located within the Village Six SPA of the Otay Ranch GDP. Land uses include single-family residential, multi-family residential, mixed-use commercial and residential, parks, schools, Community Purpose Facilities (CPF), and open space. Proposed land uses for the planning area are summarized in Figure 1 based on gross acreages.

McMillin's portion consists primarily of single-family and multi-family residential construction, a 0.8-acre common usable open space area, a 32.5-acre private high school, and an 11.5-acre church site. The lots being developed by McMillin are located in the northwestern and southeastern most sections of Village Six.

The Otay Ranch Company's portion of Village Six includes single-family and multi-family residential construction, a 7.6-acre neighborhood park, a 10-acre elementary school, mixed-use commercial and residential development, two CPF sites, and open space. The lots being developed by Otay Ranch Company are located in the northeastern and southwestern most sections of Village Six.

Otay Ranch Village Six has been designed as a neo-traditional transit-oriented urban village. It contains higher density development, a pedestrian friendly path and trail network and provision of transit services. As was indicated by the initial INDEX scores, the design of the Otay Ranch Village Six SPA contains energy-efficient features that improve air quality and reduce CO2 emissions beyond levels that are found in traditional suburban communities.

II.7.4 Air Quality Indicators

As described in the attached INDEX pilot test report, twelve action measures identified in the Carbon Dioxide (CO2) Reduction Plan were used to select 52 key indicators. The indicators gauge the key characteristics of the twelve action measures and focus on the goals of the pilot study. The 52 indicators were selected to address the energy efficiency and emission reduction aspects of the proposed land development.

Site Utilization Plan

RESIDENTIAL

Neigh.	Land Use	Acres	du/ac	DU
R-1	Single Family	26.2	4.0	105
R-2a	Single Family	19.7	4.4	87
R-2b	Single Family	21.3	5.4	115
R-3	Single Family	35.6	4.5	159
R-4	Single Family	20.4	4.5	92
R-5	Single Family	16.6	6.7	111
R-6	Single Family	20.4	6.2	126
R-7a	Single Family	12.9	6.8	88
Sub-total Single Family		*173.1*	*5.1*	*883*
R-7b	Multi-family	5.8	28.4	165
R-8	Multi-family	11.7	28.8	337
R-9a	Multi-family	21.8	7.5	163
R-9b	Multi-family	12.7	25.7	326
R-10	Multi-family	12.1	17.5	212
Sub-total Multi-family		*64.1*	*18.8*	*1203*
TOTAL RESIDENTIAL		237.2	8.8	2086
R-11	*SF Resid. Alt. To S-2*	32.5	4.5	*146*
Total with Alternative to S-2		269.7	8.3	*2232*

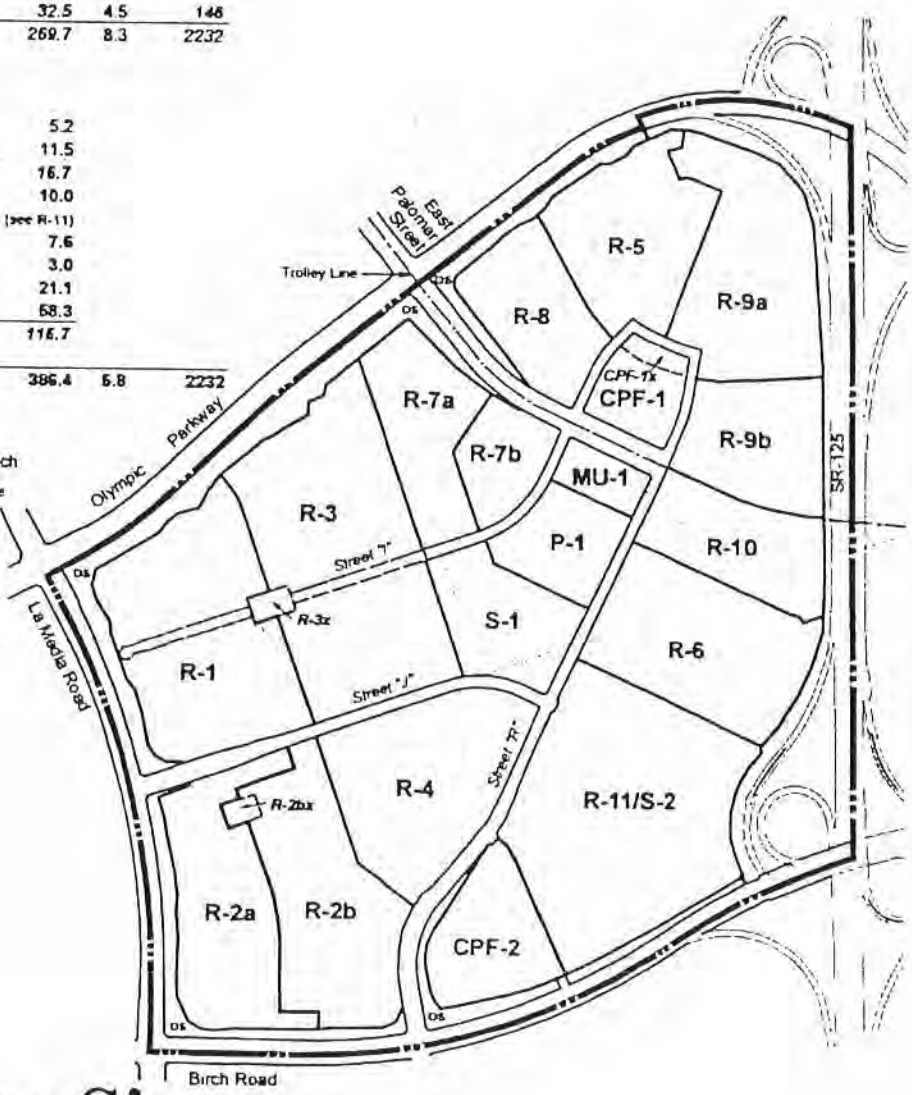
NON-RESIDENTIAL

CPF-1	CPF Site	5.2
CPF-2	CPF Site	11.5
Sub-total CPF		*16.7*
S-1	Elem. School Site	10.0
S-2	Private High School	(see R-11)
P-1	Public Park	7.6
MU-1	Commercial	3.0
OS	Open Space	21.1
CIR	Major Circulation	58.3
NON-RESIDENTIAL TOTAL		*116.7*

PROJECT TOTAL	386.4	6.8	2232

Notes:

1. An "x" following a Neighborhood, such as R-3x, indicates a sub-parcel that may be converted to CPF use as an alternative for purposes of providing a landscaped community gathering/meeting area.
2. R-11 is the base land use, which permits the intended private high school. The boundary between CPF-2 and R-11 may be refined during future detailed planning applications.
3. Subject to being in substantial conformance, acres may be refined during the subdivision process.



CITY OF CHULA VISTA

Village Six
OTAY RANCH

FIGURE 1

II.7.5 Project Evaluation

Baseline Values

The first step in INDEX modeling was the calculation of the baseline values. These are "pre-efficiency" indicator scores representative of land development practices in the 1970s and 80s. These scores form a baseline that the Village Six proposal was judged against.

As shown in Table 1, baseline values were computed by measuring the three pre-efficiency neighborhoods and then calculating a weighted average score for each indicator. Exceptions to the weighted average occur with six indicators as noted in Table 1, where anomalous conditions in the neighborhoods produced scores that could not be considered typical. In these instances, City staff adjusted the values to more common or practical levels (see Table 1 footnotes). To assist in interpreting the baseline scores, Table 1 also includes comments on the scores' relationship to common principles of energy-efficient land-use planning.

Original Village Six Proposal

Having set baseline values, the next step was INDEX modeling of the original Village Six proposal to obtain its indicator scores. Those Village Six scores were then compared to the baseline values as shown in Table 2.

The principal finding from the first round of INDEX modeling was that Village Six is about 9% more energy-efficient than the baseline. Notable characteristics of Village Six and differences between its scores and the baseline are summarized below by element category:

- *Land-use.* Village Six has favorable residential densities, neighborhood completeness, circulation connectivity, and proximity to transit. In general, Village Six achieves its energy and emissions advantage over the baseline in this element primarily through higher total population densities, which reduces space conditioning, travel, and infrastructure energy use.

- *Transportation.* There was little change between Village Six scores and baseline values in this element, except for significant increases in pedestrian network coverage.

- *Infrastructure.* Village Six residential water use scored close to the baseline.

Table 1

BASELINE INDICATOR SCORES

			Pre-Efficiency Neighborhoods					
Element	Indicator	Units	Terra Nova	College Estates I	College Estates II	*Weighted By*	Weighted Average	Comments
Demographics	1. Population	residents	3482	3249	1839	*NA*	- - -	
	2. Households	dwelling units	1159	1083	613	*NA*	- - -	
	3. Employment	employees	40	245	40	*NA*	- - -	
	4. Land Area	acres	199	242	141	*NA*	- - -	
Land-Use	5. Development Footprint	acres/resident	0.06	0.07	0.06	*residents*	0.064	Typical scores for suburban residential.
	6. Street Network Extent	street mi./capita	2.43	2.76	2.66	*residents*	2.604	Typical scores for suburban residential.
	7. Amenity Proximity (retail)	ft. to closest amenity	2363	3491	4240	*dwelling units*	3193.902	Distances over 2,640 ft. are pedestrian unfriendly.
	8. Single-Family Dwelling Density	DU/acre	8.22	5.51	6.94	*dwelling units*	6.917	Typical results for suburban residential.
	9. Multi-Family Dwelling Density	DU/acre	16.66	NA	NA	*staff adjusted* ***(1)***	16.000	Terra Nova score is favorable; lack of MF in CE 1 & 2 unfairly drags weighted average too low.
	10. Average Residential Density	DU/acre	9.98	5.51	6.94	*dwelling units*	7.632	Comments above will ripple here.
	11. Employment Density	employees/acre	2.51	12.01	4.08	*staff adjusted* ***(2)***	12.000	TN & CE2 scores are understandable because of schools only; CE1 is at low end of transit feasibility.

Table 1 *Continued*

Element	Indicator	Units	Pre-Efficiency Neighborhoods: Terra Nova	College Estates I	College Estates II	*Weighted By*	Weighted Average	Comments
Land-Use *Continued*	12. Commercial Building Density	avg. floor area ratio	NA	0.08	NA	*staff adjusted (3)*	0.350	Baseline projects not sufficiently commercial to calculate reasonable baseline of 0.25-0.50; adjusted to conform with applicable development standard.
	13. Use Mix	0 to 1 index	0.33	0.27	0.36	*land area (acres)*	0.312	Typical suburban residential scores; generally 0.4 or higher denotes high mix areas.
	14. Use Balance	0 to 1 index	0.52	0.34	0.34	*land area (acres)*	0.402	Typical suburban residential scores; generally 0.75 or higher is desired.
	15. Neighborhood Completeness	% of key uses	40	40	40	*residents*	40.000	Coincidental identical scores, all favorable; generally 50 or higher is desired.
	16. Block Size	acres	23.48	9.08	10.75	*land area (acres)*	14.407	Blocks larger than 4-5 acres are pedestrian unfriendly.
	17. Pedestrian Orientation of Buildings	avg. setback ft.	NA	103	NA	*feet of setback*	103.000	Pedestrian friendly setbacks are 0-30 ft.
	18. Internal Connectivity for Pedestrians	0 to 1 index	0.73	0.81	0.75	*no. of ped. intersections*	0.764	All favorable scores; generally 0.75 or higher is desired.
	19. Internal Connectivity for Vehicles	0 to 1 index	0.77	0.79	0.66	*no. of street intersections*	0.742	All favorable except CE2; generally 0.75 is desired.
	20. External Access for Pedestrians	ft. between access points	1138	804	1983	*study perimeter (ft.)*	1298.648	Scores below 1,200 ft. are favorable.

Table 1 *Continued*

			Pre-Efficiency Neighborhoods					
Element	Indicator	Units	Terra Nova	College Estates I	College Estates II	*Weighted By*	Weighted Average	Comments
Land-Use *Continued*	21. External Access for Vehicles	ft. between access points	1934	2011	2644	*study perimeter (ft.)*	2184.007	Scores below 1,200 ft. are favorable.
	22. Street Network Density	centerline miles/sq. mi.	15.37	19.71	18.83	*land area (acres)*	18.013	Typical scores for suburban residential.
	23. Housing Proximity to Transit	ft. to closest stop	1439	1667	861	*dwelling units*	1401.385	Scores below 1,200 ft. are favorable.
	24. Employment Proximity to Transit	ft. to closest stop	2819	445	984	*employees*	803.523	Scores below 1,200 ft. are favorable.
	25. Transit-Oriented Residential Density	DU/acre w/i 1/4 mi. stop	11	5	7	*staff adjusted* ***(4)***	10.000	TN score is favorable, others are not; minimum should be 10.
	26. Transit-Oriented Employment Density	emps./acre w/i 1/4 mi. stop	3	12	4	*employees w/in 1/4 mi.*	11.252	CE1 score is minimum favorable.
Buildings	27. Title 24 Exceedence	% structures	0	0	0	*structures*	0	
	28. Building Efficiency Program Participation	% structures	0	0	0	*structures*	0	
	29. Solar Thermal Applications	% structures	0	0	0	*structures*	0	
	30. Solar Power Applications	% structures	0	0	0	*structures*	0	
	31. Vegetative CO2 Uptake	lbs./yr.	0	0	0	*land area (acres)*	0.000	
Transportation	32. Pedestrian Network Coverage	ped. routes/streets ratio	1.41	1.19	1.31	*total street miles*	1.284	All favorable scores (anything above 1.0)
	33. Pedestrian Crossing Distance	avg. curb to curb ft.	45	41	39	*no. of street intersections*	41.726	Pedestrian friendly crossing distances are 30 ft. or less.
	34. Pedestrian Route Directness	walk ft./straightline ft. ratio	1.62	1.76	1.45	*dwelling units*	1.637	Scores above 1.5 are unfavorable.

Table 1 *Continued*

			Pre-Efficiency Neighborhoods					
Element	Indicator	Units	Terra Nova	College Estates I	College Estates II	*Weighted By*	Weighted Average	Comments
Transportation *Continued*	35. Bicycle Network Coverage	% of streets bikeable	100	100	100	*staff adjusted (5)*	90.000	
	36. Transit Service Coverage	stops/sq. mi.	8	11	23	*land area (acres)*	12.873	10-20 is favorable range.
	37. Daily Auto Driving	veh-mi./day/capita	22	22	22	*residents (6)*	22.000	Typical suburban value; generally 20 or less is desirable.
Infrastructure	38. Residential Water Use	gal./day/capita	128	171	153	*residents (7)*	149.667	
Environment	39. Park Space Supply	acres/1000 residents	11.20	3.62	7.89	*staff adjusted (8)*	3.000	TN score is abnormally high.
	40. Park Proximity	ft. to closest park	2090	2732	1266	*dwelling units*	2156.611	Distances above 1,200 ft. are unfavorable for pedestrians.
	41. Open Space Supply	% of land area	19	2	6	*land area (acres)*	8.779	TN score again unusually high; however, weighted average may be reasonable.
	42. Open Space Contiguity	0 to 1 index	0.72	0.53	0.58	*open space acres*	0.679	Scores above 0.5 are favorable.
	43. Housing Energy Use	MMBtu/yr./capita	28	28	36	*residents*	31.084	Typical scores.
	44. Household Transportation Energy Use	MMBtu/yr./capita	47	47	47	*residents*	46.800	Typical suburban score; generally 40 or less is desirable.
	45. Nonresidential Building Energy Use	MMBtu/yr./emp.	N/A	18	N/A	*employees*	18.026	CE1 score representative of strip malls; generally 12 or less is desirable.
	46. Total Energy Use	MMBtu/yr./person	74	75	81	*residents & employees*	75.561	Typical suburban residential scores for San Diego region.
	47. NOx Emissions	lbs./yr./person	33.01	33.45	33.82	*residents & employees*	33.349	Derived from energy scores.
	48. SOx Emissions	lbs./yr./person	0.72	0.83	0.92	*residents & employees*	0.805	Derived from energy scores.

Table 1 *Continued*

Element	Indicator	Units	Pre-Efficiency Neighborhoods: Terra Nova	Pre-Efficiency Neighborhoods: College Estates I	Pre-Efficiency Neighborhoods: College Estates II	*Weighted By*	Weighted Average	Comments
Environment *Continued*	49. HC Emissions	lbs./yr./person	58.43	58.44	58.44	*residents & employees*	58.435	Derived from energy scores.
	50. CO Emissions	lbs./yr./person	452.06	452.13	452.23	*residents & employees*	452.133	Derived from energy scores.
	51. PM Emissions	lbs./yr./person	0.13	0.14	0.16	*residents & employees*	0.140	Derived from energy scores.
	52. C02 Emissions	lbs./yr./person	10238	10566	10846	*residents & employees*	10492.572	Derived from energy scores.

1. Terra Nova score was consistent with citywide average east of I-805; rounded to 16.0.
2. Terra Nova and College Estates 2 scores are for school employment only and do not include any retail or commercial; College Estates 1 score is typical for suburban strip commercial employment; rounded to 12.0.
3. Adjusted value is based on allowable development standard.
4. College Estates 1 and 2 scores are beneath transit minimum; adjusted value is typical minimum for feasible transit service.
5. All three neighborhood scores are considered unusually high; adjusted value reflects likelihood of less-than-full coverage.
6. Estimated by Criterion and Fehr & Peers based on SANDAG regional data.
7. Water use estimated by INDEX and confirmed with City data.
8. Value adjusted to be consistent with adopted City standard.

Table 2

ORIGINAL SPA PLAN INDICATOR SCORES

Element	Indicator		Units	Baseline	Village 6
Demographics	1. Population		residents	–	6,261
	2. Households		dwelling units	–	2,086
	3. Employment		employees	–	241
	4. Land Area		acres	–	386
Land-Use	5. Development Footprint		acres/capita	0.064	0.038
	6. Street Network Extent		street mi./capita	2.604	1.78
	7. Amenity Proximity (retail)		ft. to closest amenity	3193.902	2205
	8. Single-Family Dwelling Density	*	DU/acre	6.917	8.14
	9. Multi-Family Dwelling Density	*	DU/acre	16.000	24.98
	10. Average Residential Density		DU/acre	7.632	12.26
	11. Employment Density	*	employees/acre	12.000	5.05
	12. Commercial Building Density		avg. floor area ratio	0.350 (a)	0.35 (a)
	13. Use Mix	*	0 to 1 index	0.312	0.37
	14. Use Balance	*	0 to 1 index	0.402	0.48
	15. Neighborhood Completeness	*	% of key uses	40.000	60
	16. Block Size		acres	14.407	6.14
	17. Pedestrian Orientation of Buildings		avg. setback ft.	103.000	15.000 (a)
	18. Internal Connectivity for Pedestrians		0 to 1 index	0.764	0.99
	19. Internal Connectivity for Vehicles	*	0 to 1 index	0.742	0.91
	20. External Access for Pedestrians		ft. between access points	1298.648	1279
	21. External Access for Vehicles		ft. between access points	2184.007	1512
	22. Street Network Density	*	centerline miles/sq. mi.	18.013	17.86
	23. Housing Proximity to Transit		ft. to closest stop	1401.385	944
	24. Employment Proximity to Transit		ft. to closest stop	803.523	1064
	25. Transit-Oriented Residential Density		DU/acre w/l 1/4 mi. stop	10.000	12.26
	26. Transit-Oriented Employment Density		emps./acre w/l 1/4 mi. stop	11.252	4
Buildings	27. Title 24 Exceedence		% structures	0	0
	28. Building Efficiency Program Participation		% structures	0	0
	29. Solar Thermal Applications		% structures	0	0
	30. Solar Power Applications		% structures	0	0
	31. Vegetative CO2 Uptake		lbs./yr.	0.000	179,300

Table 2 *Continued*

Element	Indicator		Units	Baseline	Village 6
Transportation	32. Pedestrian Network Coverage	*	ped. routes/streets ratio	1.284	2.18
	33. Pedestrian Crossing Distance		avg. curb to curb ft.	41.726	35
	34. Pedestrian Route Directness	*	walk ft./straight-line ft. ratio	1.637	1.51
	35. Bicycle Network Coverage		% of streets bikeable	90.000	95
	36. Transit Service Coverage		stops/sq. mi.	12.873	16
	37. Daily Auto Driving		veh-mi./day/capita	22.000 (b)	22.000 (b)
Infrastructure	38. Residential Water Use		gal./day/capita	149.667	150
Environment	39. Park Space Supply		acres/1000 residents	3.000	1.50 (c)
	40. Park Proximity		ft. to closest park	2156.611	1357
	41. Open Space Supply		% of land area	8.779	10
	42. Open Space Connectivity		0 to 1 index	0.679	0.61
	43. Housing Energy Use		MMBtu/yr./capita	31.084	24.352
	44. Household Transportation Energy Use		MMBtu/yr./capita	46.800 (d)	46.801 (d)
	45. Nonresidential Building Energy Use		MMBtu/yr./emp.	18.026	14.189
	46. Total Energy Use		MMBtu/yr./person (capita + emp)	75.561	69.045
	47. NOx Emissions		lbs./yr./person (capita + emp)	33.349	32.659
	48. SOx Emissions		lbs./yr./person (capita + emp)	0.805	0.634
	49. HC Emissions		lbs./yr./person (capita + emp)	58.435	58.432
	50. CO Emissions		lbs./yr./person (capita + emp)	452.133	451.983
	51. PM Emissions		lbs./yr./person (capita + emp)	0.140	0.110
	52. C02 Emissions		lbs./yr./person (capita + emp)	10492.572	9,942.781

Notes:

a) Values are assumed based on applicable development regulations.

b) Typical suburban value; generally 20 or less is desirable.

c) Additional park acreage is provided off-site to meet the City requirement of 3 acres/1000 residents.

d) Typical suburban value; generally 40 or less desirable.

* "Top ten" indicators of urban design-based energy efficiency.

- *Environment.* Village Six has a park space supply score notably below the City standard (but is nonetheless meeting its park demand through the provision of a seven-acre neighborhood park onsite consistent with City requirements, and the community park acreage requirement is being met off-site pursuant to the Otay Ranch General Development Plan). Village Six improved park proximity for residents in comparison to the baseline. This element contains the energy and emission scores that summarize the combined effects of land-use, buildings, transportation, and infrastructure. Of the ten energy and emission indicators, the principal indicator is total energy use per year by residents and employees combined. Village Six exceeded the baseline in efficiency terms, largely due to higher population densities. Favorable energy scores are mirrored by similar reductions in pollutant and greenhouse gas emissions.

Modified Village Six Proposal

The next step in the pilot test was an invitation for developers to submit modified SPA plans that achieved even greater energy efficiency and air quality than the original proposals. SPA developers had the following options available for modifying their plans in ways that further increased energy efficiency and improved air quality:

- *Land-use density.* This is the intensity of use on properties measured in dwelling units per acre for residential uses and employees per acre for non-residential uses. Extensive research nationally and internationally has conclusively demonstrated that the strongest urban planning technique for increasing energy efficiency is increasing land-use density. Density increases produce significant energy savings in building space conditioning, travel, and infrastructure operations. Although it may have been too late for major density changes in the three test SPAs, this option should be examined in future SPA processes because of its sizable benefits.

- *Land-use diversity.* This is the mix of residential and non-residential uses in an area. Research has also demonstrated that another important technique for increasing energy efficiency is increasing the diversity of land-uses. Greater diversity produces energy savings in the same space conditioning, travel, and infrastructure end-uses as density does through better use of system capacities. Again, it may have been too late to consider diversity changes in the three test SPAs, but the option warrants future consideration in other SPAs.

- *Multimodal circulation design.* Another strong technique for saving energy in land development is designing an efficient and convenient multimodal circulation system. Such a system is composed of features that allow walking, biking, and transit use in addition to auto driving. Important components include relatively dense street networks, completeness of sidewalks, and relatively direct routes from common origins to popular destinations. As with density and diversity, it may have been too late for significant circulation changes in the test SPAs.

- *Building construction standards.* SPA developers may opt for a commitment to reduce building energy use by exceeding Title 24. Developers could propose the amount of Title 24 exceedence per building type and the number of buildings that will participate in such exceedence. A developer could exercise this option by committing to a utility or comparable energy efficiency program that offers beyond-code services, or by simply committing that merchant builders will achieve the stipulated exceedence by means of their own choosing.

- *Solar systems.* SPA developers could opt to reduce grid-supplied energy by installing solar thermal or PV systems in buildings. Developers could propose the type and capacity of systems to be used, and the number of structures that will receive such systems.

- *Tree planting.* This category allowed SPA developers to offer additional tree planting that will offset greenhouse gas emissions. Selection of this option will not improve a SPA's energy efficiency or air pollutant emissions, but will help mitigate climate change.

After consideration of these options, Village Six voluntarily selected the following action measures to improve their projects' energy efficiency and air quality: 482 single-family homes will achieve a 10% Title 24 exceedence using designer/builder-selected measures; and an additional 792 trees will be planted.

With these modifications, Village Six was modeled again to recalculate indicator scores and identify final energy savings and air quality improvements. These results are shown in Table 3 indicating an approximate 1% energy use reduction for Village Six between original and modified plans. This is in addition to the 8.6% energy use reduction between the original Village Six plan and the baseline.

Table 3

MODIFIED SPA PLAN INDICATOR SCORES

Element	Indicator	Units	Baseline	Original Village Six	Modified Village Six
Demographics	1. Population	residents	--	6261	6261
	2. Households	dwelling units	--	2086	2086
	3. Employment	employees	--	241	241
	4. Land Area	acres	--	386	386
Land-Use	5. Development Footprint	acres/resident	0.064	0.038	0.038
	6. Street Network Extent	street mi./capita	2.604	1.78	1.78
	7. Amenity Proximity (retail)	ft. to closest amenity	3193.902	2205	2205
	8. Single-Family Dwelling Density	DU/acre	6.917	8.14	8.14
	9. Multi-Family Dwelling Density	DU/acre	16.000	24.98	24.98
	10. Average Residential Density	DU/acre	7.632	12.26	12.26
	11. Employment Density	emps./acre	12.000	5.05	5.05
	12. Commercial Building Density	avg. floor area ratio	0.350	0.35	0.35
	13. Use Mix	0 to 1 index	0.312	0.37	0.37
	14. Use Balance	0 to 1 index	0.402	0.48	0.48
	15. Neighborhood Completeness	% of key uses	40.000	60	60
	16. Block Size	acres	14.407	6.14	6.14
	17. Pedestrian Orientation of Buildings	avg. setback ft.	103.000	15.000	15.000
	18. Internal Connectivity for Pedestrians	0 to 1 index	0.764	0.99	0.99
	19. Internal Connectivity for Vehicles	0 to 1 index	0.742	0.91	0.91
	20. External Access for Pedestrians	ft. between points	1298.648	1279	1279
	21. External Access for Vehicles	ft. between points	2184.007	1512	1512
	22. Street Network Density	miles/sq. mi.	18.013	17.86	17.86
	23. Housing Proximity to Transit	ft. to closest stop	1401.385	944	944
	24. Employment Proximity to Transit	ft. to closest stop	803.523	1064	1064
	25. Transit-Oriented Residential Density	DU/acre w/i 1/4 mi.	10.000	12.26	12.26
	26. Transit-Oriented Employment Density	emps./acre w/i 1/4 mi.	11.252	4	4

Table 3 *Continued*

Element	Indicator	Units	Baseline	Original Village Six	Modified Village Six
Buildings	27. Title 24 Exceedence	% structures	0	0	46
	28. Building Efficiency Program Participation	% structures	0	0	0
	29. Solar Thermal Applications	% structures	0	0	0
	30. Solar Pow er Applications	% structures	0	0	0
	31. Vegetative CO2 Uptake	lbs./yr.	0.000	179300	218900
Transportation	32. Pedestrian Netw ork Coverage	ped. routes/streets ratio	1.284	2.18	2.18
	33. Pedestrian Crossing Distance	ft. curb to curb	41.726	35	35
	34. Pedestrian Route Directness	w alk ft./straightline ft. ratio	1.637	1.51	1.51
	35. Bicycle Netw ork Coverage	% of streets w /route	90.000	95	95
	36. Transit Service Coverage	stops/sq. mi.	12.873	16	16
	37. Daily Auto Driving	veh-mi./day/capita	22.000	22.000	22.000
Infrastructure	38. Residential Water Use	gal./day/capita	149.667	150	150
Environment	39. Park Space Supply	acres/1000 residents	3.000	1.50	1.50
	40. Park Proximity	ft. to closest park	2156.611	1357	1357
	41. Open Space Supply	% of land area	8.779	10	10
	42. Open Space Contiguity	0 to 1 index	0.679	0.61	0.61
	43. Housing Energy Use	MMBtu/yr./capita	31.084	24.352	23.529
	44. Household Transportation Energy Use	MMBtu/yr./capita	46.800	46.801	46.801
	45. Nonresidential Building Energy Use	MMBtu/yr./emp	18.026	14.189	14.189
	46. Total Energy Use	MMBtu/yr./person	75.561	69.045	68.254
	47. NOx Emissions	lbs./yr./person	33.349	32.659	32.574
	48. SOx Emissions	lbs./yr./person	0.805	0.634	0.613
	49. HC Emissions	lbs./yr./person	58.435	58.432	58.431
	50. CO Emissions	lbs./yr./person	452.133	451.983	451.964
	51. PM Emissions	lbs./yr./person	0.140	0.110	0.110
	52. C02 Emissions	lbs./yr./person	10492.572	9942.781	9873.000

Final Results

Based on the modified Village Six plan, the final results for energy savings, air quality improvements, and greenhouse gas reductions are as follows:

	Baseline	Village Six
Total energy use (MMBtu/yr/capita)	75.56	68.25
% energy reduction	---	9.7
Total air pollutant emissions (lbs/yr/capita)	544.85	543.68
% air pollutant emissions reduction	---	0.21
Total greenhouse gas emissions (lbs/yr/capita)	10493	9873
% greenhouse gas emissions reduction	---	5.9

II.7.6 Implementation Measures

The following Air Quality Measures will be implemented in Otay Ranch Village Six:

1. Title 24 Exceedence:

McMillin Land Development

- Construction of 482 single-family detached homes to exceed Title 24 by 10%.

Otay Ranch Company

- Encourage all merchant builders to participate in a building efficiency program.

2. Additional Tree Planting to offset Greenhouse Gas Emissions.

In addition to the 3,586 street trees proposed, another 792 trees will be planted as follows:

McMillin Land Development – 20% increase in street trees (244 trees based on GIS data submitted) to be planted in parkways and medians.

Otay Ranch Company – 548 trees to be planted in front yards of single family detached homes.

The McMillin Land Development shall obtain certification by a Registered Landscape Architect that 244 additional trees have been included on the Master Landscape Plan for their portion of Otay Ranch Village Six.

The Otay Ranch Company shall obtain certification by a Registered Landscape Architect that 548 additional trees have been planted on the single-family lots located in their portion of Otay Ranch Village Six.

3. Comply with Section 5.11.5 Mitigation Measures, in Otay Ranch Village Six Sectional Planning Area (SPA) Plan Environmental Impact Report 98-01, December 2001.

II.7.7 References

Otay Ranch Village Six Sectional Planning Area (SPA) Plan Final Second Tier Environmental Impact Report 98-01; December 2001, prepared by RECON.

II.7.8 Appendix

Criterion Planners/Engineers, INDEX Pilot Test: SPA Air Quality Improvement Plans, June 2002.