THE GRAND CHALLENGE: IN **2050,** LOS ANGELES COUNTY WILL HAVE **1.5 MILLION** MORE RESIDENTS AND TWO TO THREE TIMES AS MANY EXTREME HEAT DAYS. IF LA IS TO THRIVE IN THE NEXT CENTURY IT MUST STRIVE TO ACHIEVE **100% RENEWABLE ENERGY, 100% LOCAL WATER AND ENHANCED ECOSYSTEM HEALTH BY 2050.**

UCLA Sustainable LA Grand Challenge
The NOW Institute
UCLA Department of Architecture and Urban Design

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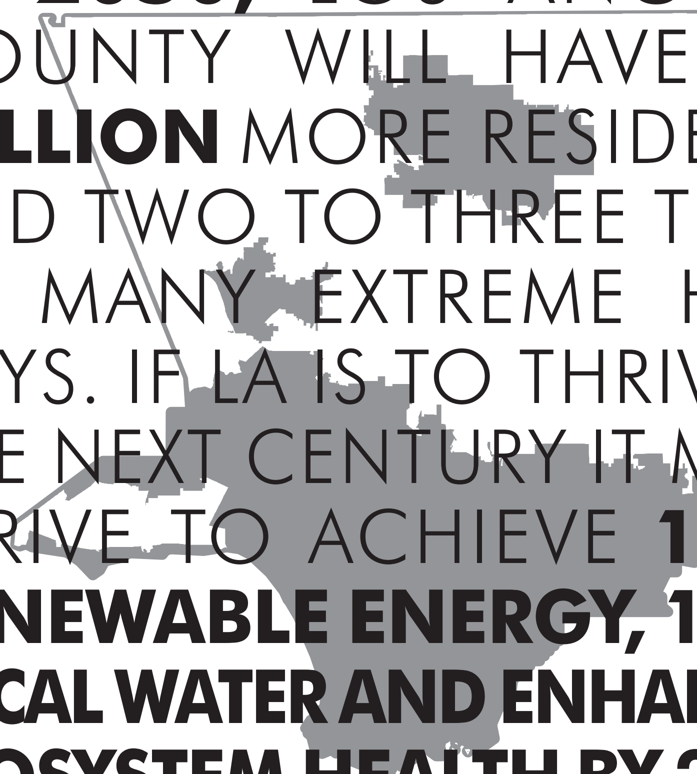

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100% SUSTAINABLE:

STRATEGIES FOR 2050
RENEWABLE ENERGY, LOCAL
WATER, AND ECOSYSTEM HEALTH
IN LOS ANGELES

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GRAND CHALLENGES

Gene Block
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As one of the world's leading public research universities, UCLA is committed to applying its intellectual capital and resources to addressing some of society's greatest challenges. At UCLA, we believe that if we work together, there is no problem that we cannot solve, and this motivates and drives our researchers and scholars to improve the quality of life and wellbeing of people in Los Angeles and beyond.

In 2013, UCLA announced its first Grand Challenge —the Sustainable LA Grand Challenge, Thriving in a Hotter Los Angeles. We seek to transform Los Angeles to the first sustainable megacity through building multi-disciplinary team, facilitating collaborations, producing ground-breaking research and new technologies, and creating and fostering partnerships across sectors and in the community. Our goal is for the Los Angeles region to use exclusively renewable energy and local water by 2050 while protecting biodiversity and enhancing quality of life.

UCLA's Grand Challenge initiatives are among the most prominent and tangible examples of how we are engaging expertise from across our entire campus to solve major societal challenges. They are the biggest research projects UCLA has ever undertaken. The discoveries and scholarship produced are expected to improve the life of Angelenos, and citizens across the globe. We look forward to continued partnership with community and government leaders, other academic institutions, industry, and other stakeholders to ensure a thriving Los Angeles in 2050.

GRAND CHALLENGE
INTRODUCTION

SUSTAINABLE LA: GRAND CHALLENGE

Mark Gold
UCLA Associate Vice Chancellor for Environment and Sustainability

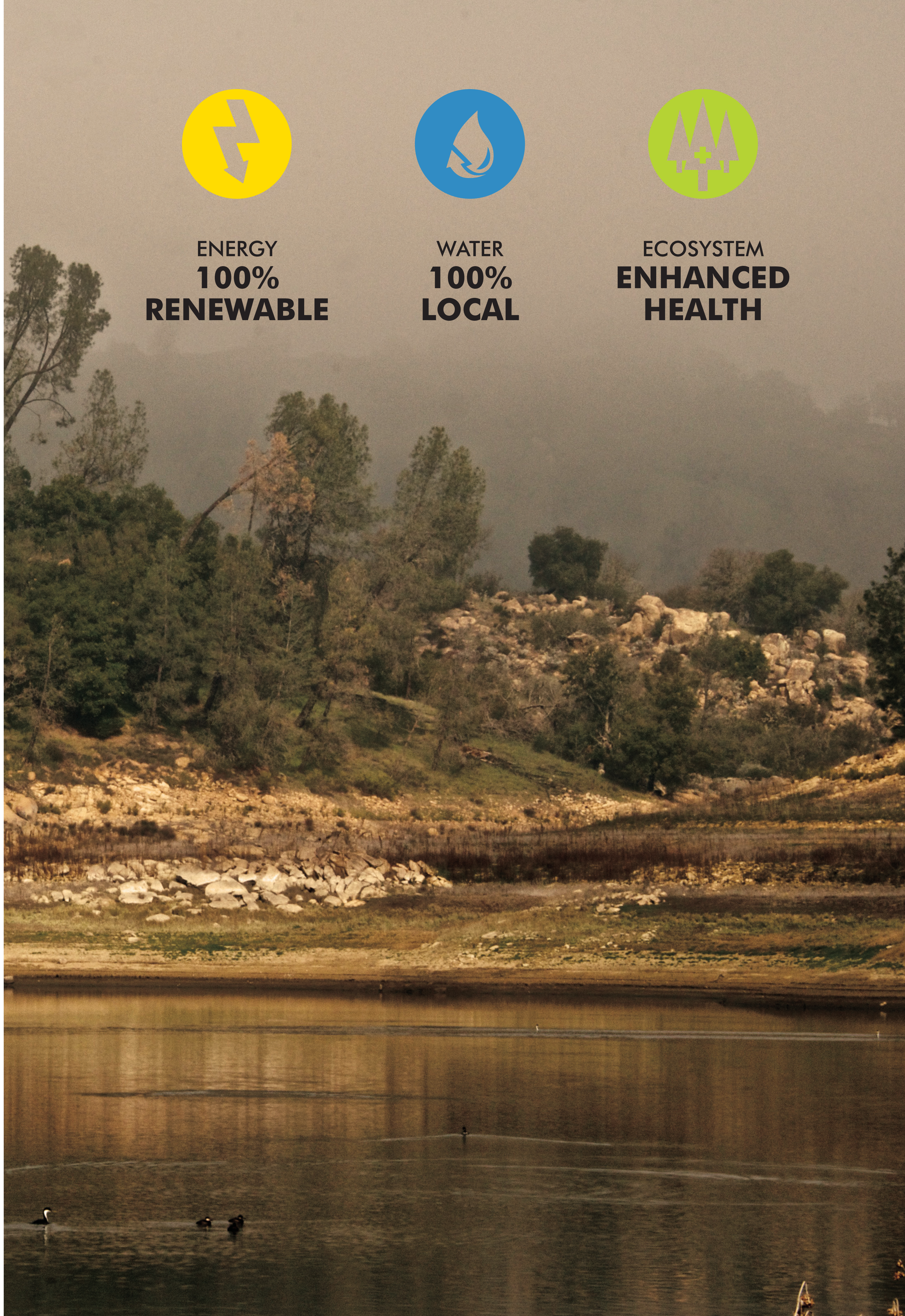
Over the course of the 21st century, Los Angeles faces daunting climate change and urban population growth challenges. By 2050, UCLA researchers predict that climate change will result in increased temperatures of 4-5°F and a doubling or tripling in the number of extreme heat days (days above 95°F) in LA County, while also causing a decrease in the mountain snowpack that feeds our current distant and local water sources. Simultaneously, the County will hold an estimated 1.5 million more people and will face the challenge of providing its citizens with reliable energy and water, and an environment that will enhance their health.

The UCLA Sustainable LA Grand Challenge was developed to address these challenges so that Los Angeles will thrive in a hotter climate. Specifically, Sustainable LA aims to transition LA County to 100% renewable energy, 100% locally sourced water, and enhanced ecosystem and human health by 2050. UCLA will capitalize on its research strengths and lead the development of a blueprint for reaching these audacious goals by 2020 in partnership with local and state government, businesses, community groups, non-government agencies, and other stakeholders.

While the energy, water, and ecosystem health goals all have global applicability, UCLA chose them with the region's most pressing needs and capabilities in mind. Despite years of progress, LA County continues to top the charts as one of the smoggiest regions in the nation. The megacity's growing population continues to place a greater demand on an increasingly scarce water supply, and LA County lies within the only designated biodiversity hotspot in the continental US.

Fortunately, Los Angeles is in one of the most solar-rich regions in the world, and despite the region's reputation as an arid area, LA County has enough local water resources from rainfall, groundwater and recycled water to meet our substantial needs. And, while known for its sprawl, the County's mountainous geography functions as a natural urban limit that ensures the subsistence of the region's rich plant and animal life.

The Sustainable LA Grand Challenge goals are ambitious, but they are undoubtedly achievable. The region is incredibly diverse in population, geography and professional expertise, and it is the creative capital of the nation, if not the world. As such, Los Angeles has the ingenuity and capacity to transform into a truly sustainable megacity. In charting a pathway to sustainability, Los Angeles can lead the way for other megacities across the world.



LOS ANGELES

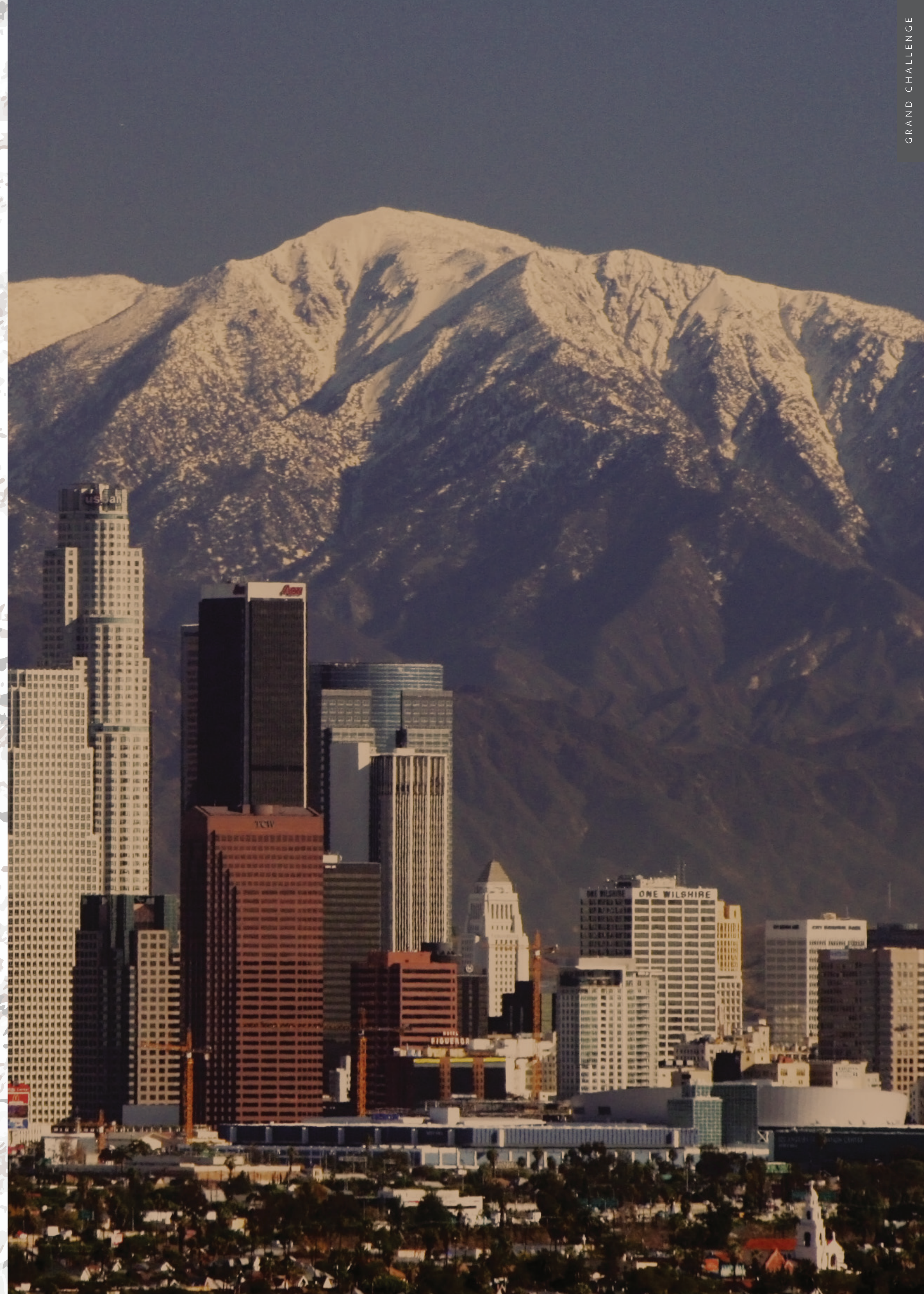
Thom Mayne
Distinguished Professor, UCLA Architecture and Urban Design

In the collective action needed to solve complex social, political, economic, ecological, and cultural problems, architects often play the role of negotiator — between the individual and society, cultural aesthetic and operational function, aspirational ambition and pragmatic realities, nuance and legibility. This negotiation takes place between disparate subjective values, and in some circumstances even subjective interpretations of facts. Such is the case for environmental issues today. In a world in which half of Americans still do not recognize global warming as a critical issue, and the acceptance of urgent environmental issues remains politicized, we seek to define common paradigms for assessing LA County's circumstances and trajectory. As a society, we may not agree on a unified vision but we must at least seek to establish a common reality.

When the NOW Institute embarked upon the UCLA Sustainable LA Grand Challenge two years ago, we found there was a primary task prior to the negotiation of architectural or urban solutions. We first had to create a platform upon which a negotiation could occur, to get our arms around the problem, and to define the framework and terms of the conversation. This preliminary task proved to be an entirely new and rigorous enterprise in and of itself, requiring the coordination of multiple fields and unique intelligences to cohere a common understanding of the complex and specialized interdependent issues which face LA in the 21st century.

This study, the first of two co-publications, provides foundational work that presents the County's energy, water, and ecosystem health challenges within LA's specific context. Here we offer a first-round assessment that defines the scope of the task at hand; it will evolve as research develops and is subject to refutation and reevaluation. The purpose of this initial assessment is not to advocate for a particular answer, but to provide a platform upon which competing research and multiple approaches can cross-pollinate, evolve, and develop, eventually catalyzing into a fully built-out implementation strategy.

The immediate sustainability challenges faced by LA and urban regions throughout the world impose an urgency in addressing the problems posed by the Grand Challenge. There is a responsibility for all of us within the research sphere to do more than simply pursue academic or abstract theoretical digressions, or to take up the task in an indeterminate exploratory way. We live in a time which requires the development of real-world solutions that are ready to implement and effective on a large-scale. This publication precedes a second analysis of regional growth scenarios that takes a holistic view of energy, water, and ecosystem health as they relate to the cultural and physical landscape of Los Angeles.



INSTRUCTIONS [HOW TO READ THIS]

SUPPLY STRATEGIES RELY ON INCREASED PRODUCTION OF RESOURCES

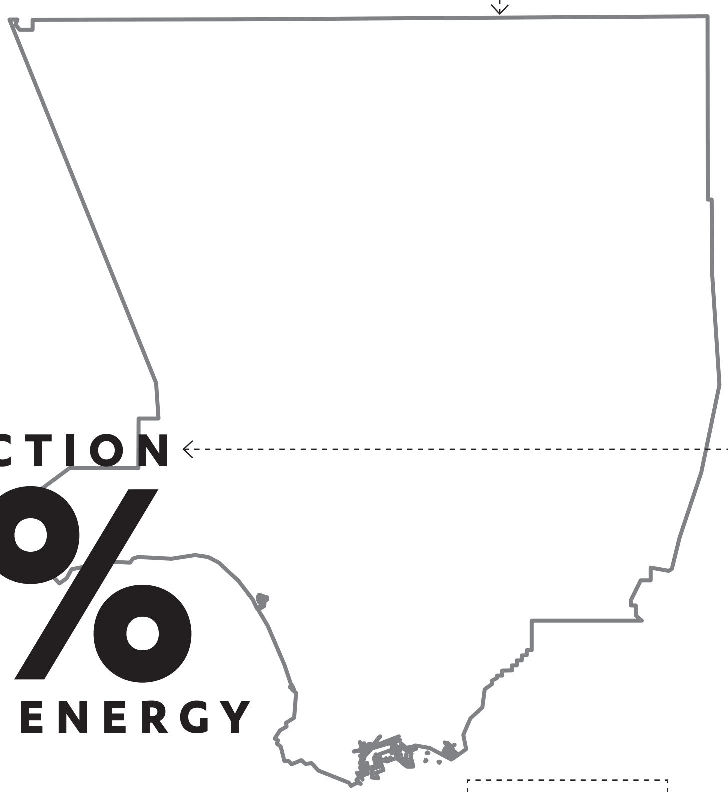
The book is divided into two main parts. The front matter features a short simplified overview of each of the three Grand Challenge goals. The back contains sources, graphs, maps, and, in the digital version, links to further reading of UCLA researchers' work. All reference to "LA" refers to LA County unless specifically stated otherwise. The 2050 scenario at the beginning of each section assumes no action is taken to advance the goal and takes into account a 1.5 million person population increase, but is most likely conservative, since it does not project any potential effects of temperature rise on energy or water consumption.

Each section concludes with a combination of all the listed strategies, which, summarized together, meet the Grand Challenge goal. Strategies are not recommendations nor do they reflect the view or opinions of UCLA. They demonstrate the relative impact of each potential strategy on the overall goal and thus serve to define the scope and scale of the problem at hand. Strategy combinations are one demonstration of how a mix of strategies can be combined to achieve 100% of 2050 goals. These are necessarily simplified and do not include all possible strategies, nor the full potential of each strategy.

TOP-DOWN

TOP-DOWN STRATEGIES REQUIRE SIGNIFICANT CENTRALIZED FINANCIAL INVESTMENT AND IMPLEMENTATION

LA COUNTY OUTLINE



2050 PROJECTION

##%

RENEWABLE ENERGY

PERCENTAGE OF RENEWABLE ENERGY WITHIN THE FEATURED STRATEGY

RELATIVE IMPACT OF THE STRATEGY AGAINST THE 2050 BUSINESS AS USUAL PROJECTION

STRATEGY #1

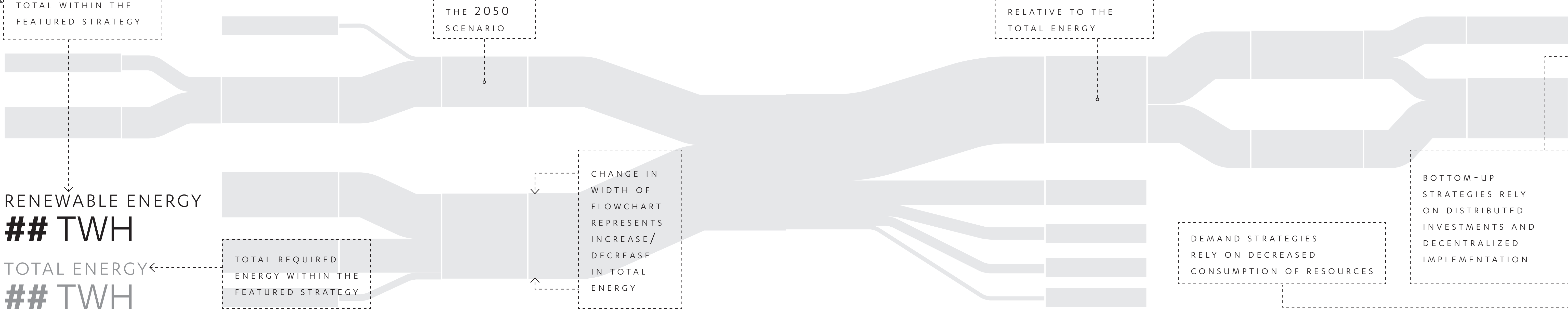
-##%

REDUCED DEMAND

NEW RENEWABLE TOTAL WITHIN THE FEATURED STRATEGY

FLOWCHART FORECASTS THE 2050 SCENARIO

FLOWCHART VALUES ARE CALCULATED RELATIVE TO THE TOTAL ENERGY



BOTTOM-UP

RENEWABLE ENERGY

TWH

TOTAL ENERGY

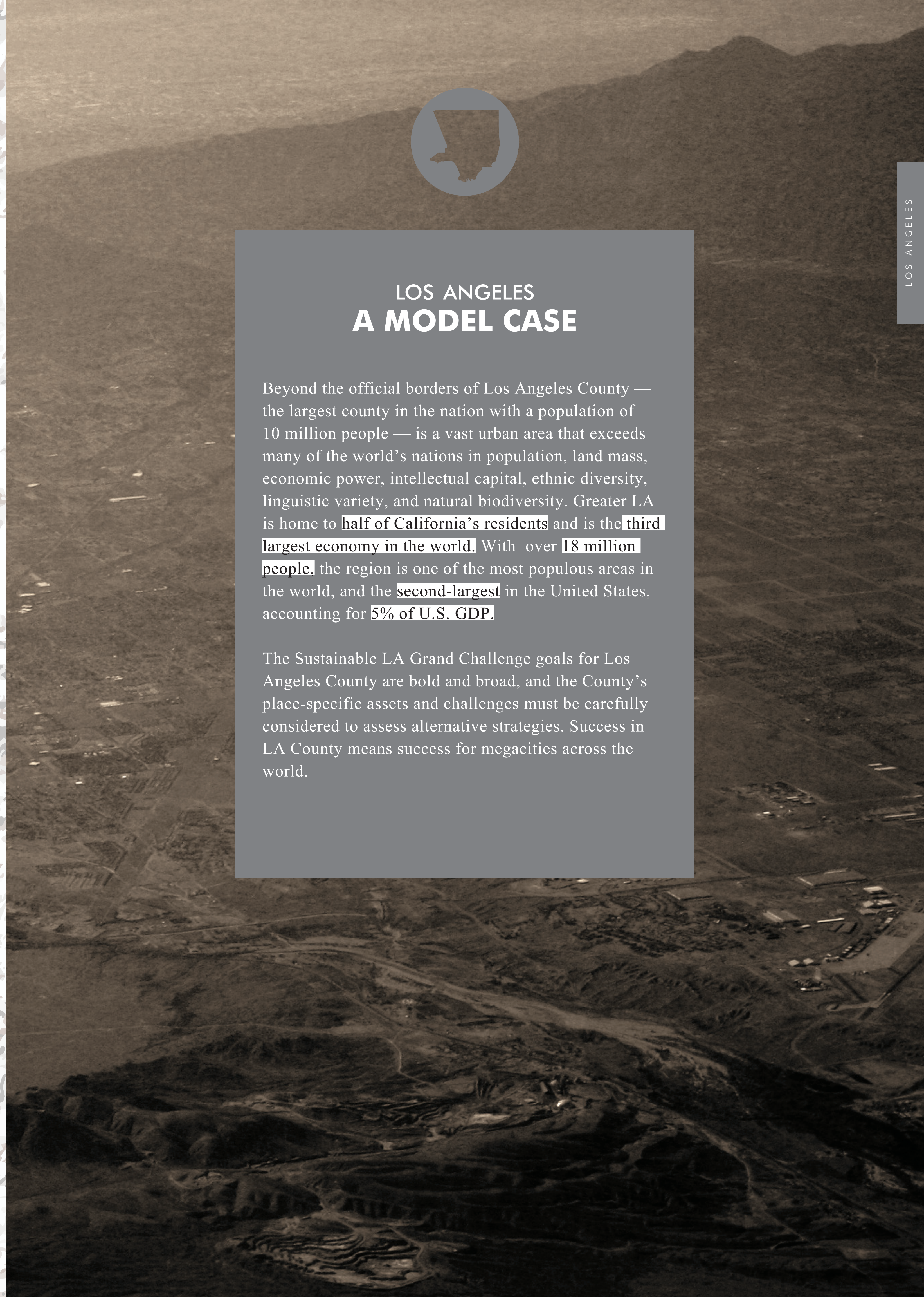
TWH

TOTAL REQUIRED ENERGY WITHIN THE FEATURED STRATEGY

CHANGE IN WIDTH OF FLOWCHART REPRESENTS INCREASE/DECREASE IN TOTAL ENERGY

DEMAND STRATEGIES RELY ON DECREASED CONSUMPTION OF RESOURCES

BOTTOM-UP STRATEGIES RELY ON DISTRIBUTED INVESTMENTS AND DECENTRALIZED IMPLEMENTATION



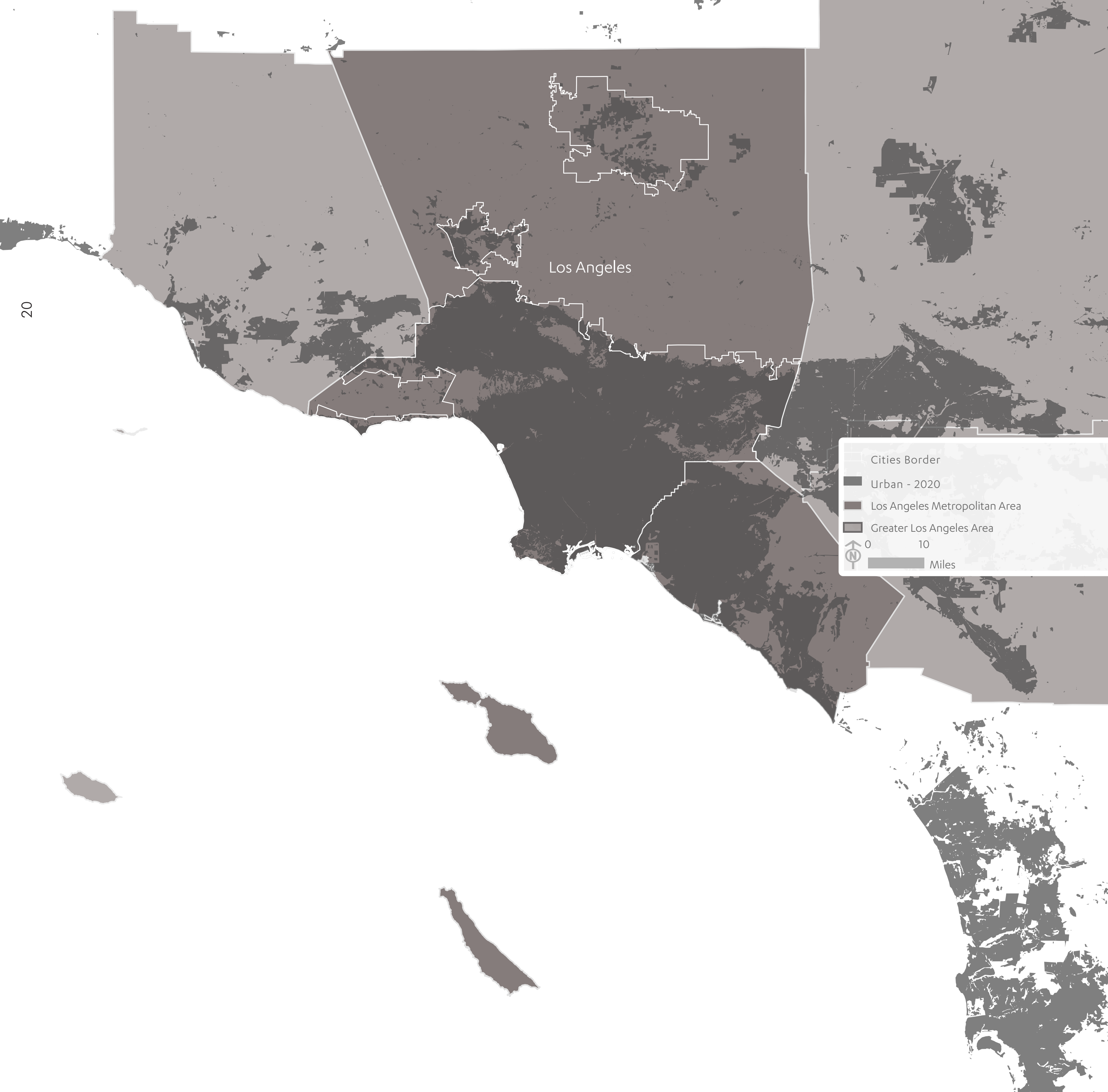
LOS ANGELES
A MODEL CASE

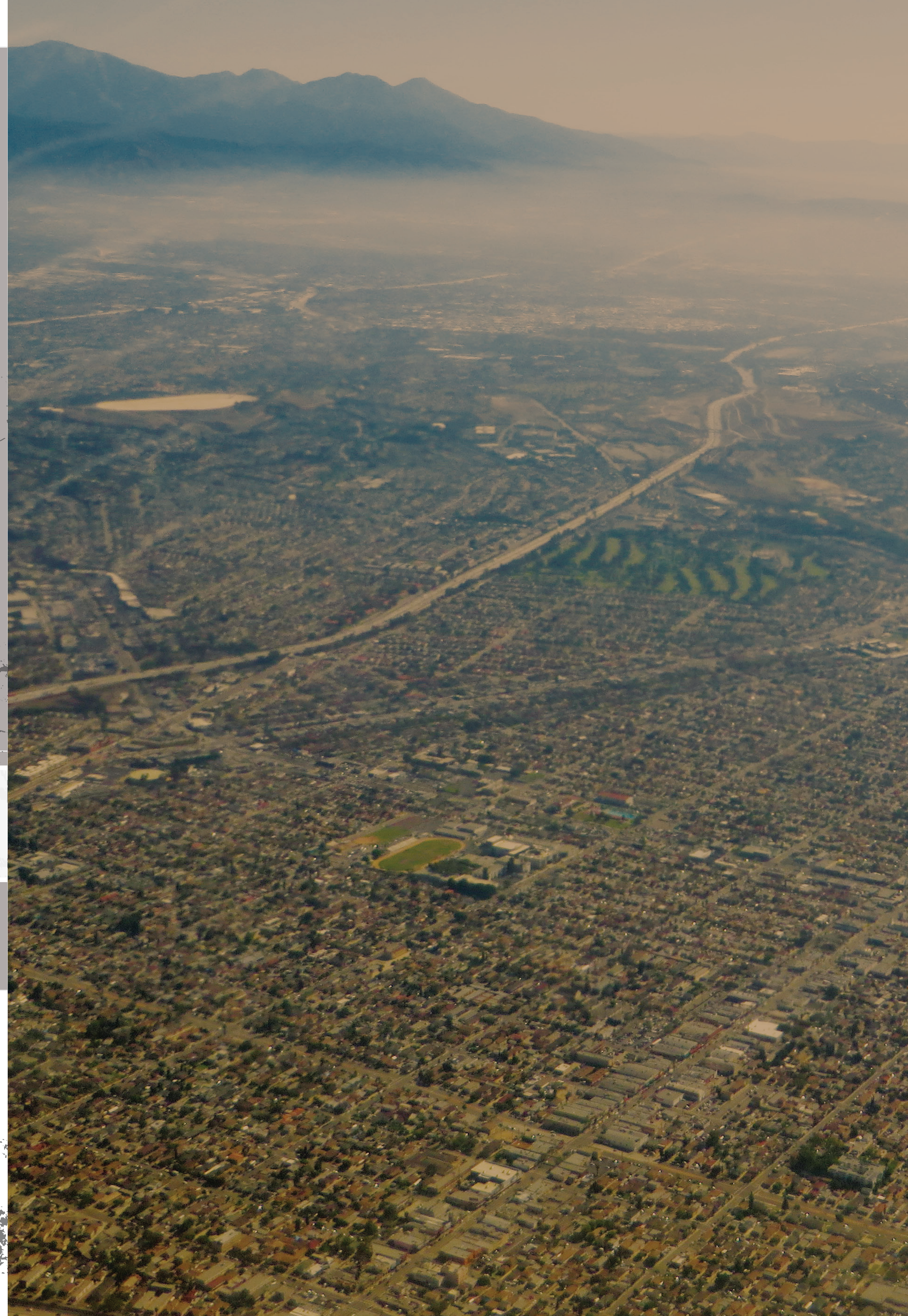
Beyond the official borders of Los Angeles County — the largest county in the nation with a population of 10 million people — is a vast urban area that exceeds many of the world's nations in population, land mass, economic power, intellectual capital, ethnic diversity, linguistic variety, and natural biodiversity. Greater LA is home to half of California's residents and is the third largest economy in the world. With over 18 million people, the region is one of the most populous areas in the world, and the second-largest in the United States, accounting for 5% of U.S. GDP.

The Sustainable LA Grand Challenge goals for Los Angeles County are bold and broad, and the County's place-specific assets and challenges must be carefully considered to assess alternative strategies. Success in LA County means success for megacities across the world.

LOS ANGELES METROPOLITAN AREA CONTAINS 13M PEOPLE WHO WORK, RECREATE, AND COMMUTE TO LA.

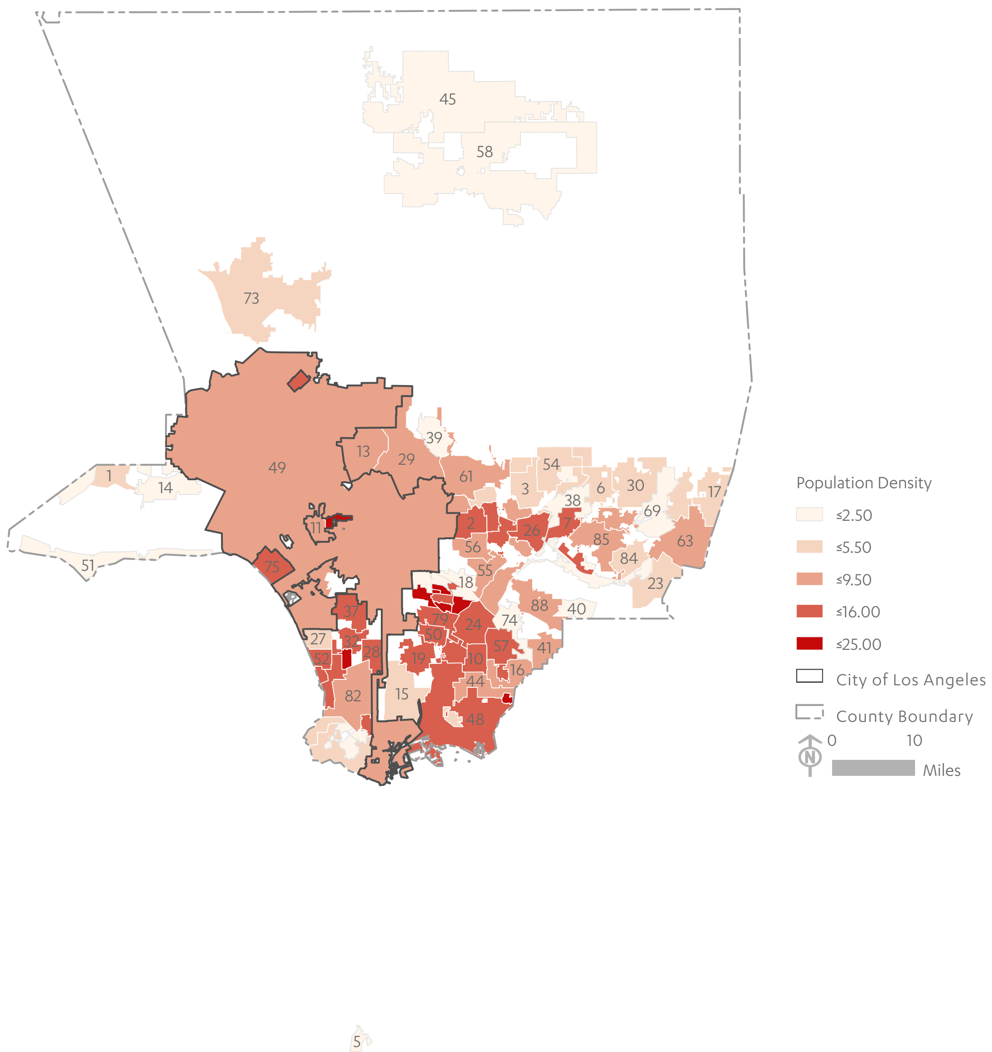
The metropolitan region includes the Los Angeles-Long Beach-Anaheim corridor, an urbanized area defined by commuting patterns. At 4,850 square miles, the metropolitan area is nearly the same size as Los Angeles County although much of it falls outside of County lines. LA County is the focal point of the coastal southwest: Greater Los Angeles (pop. 18 million) encompasses the LA Metropolitan Area (pop. 13 million) which encompasses LA County (pop. 10 million).

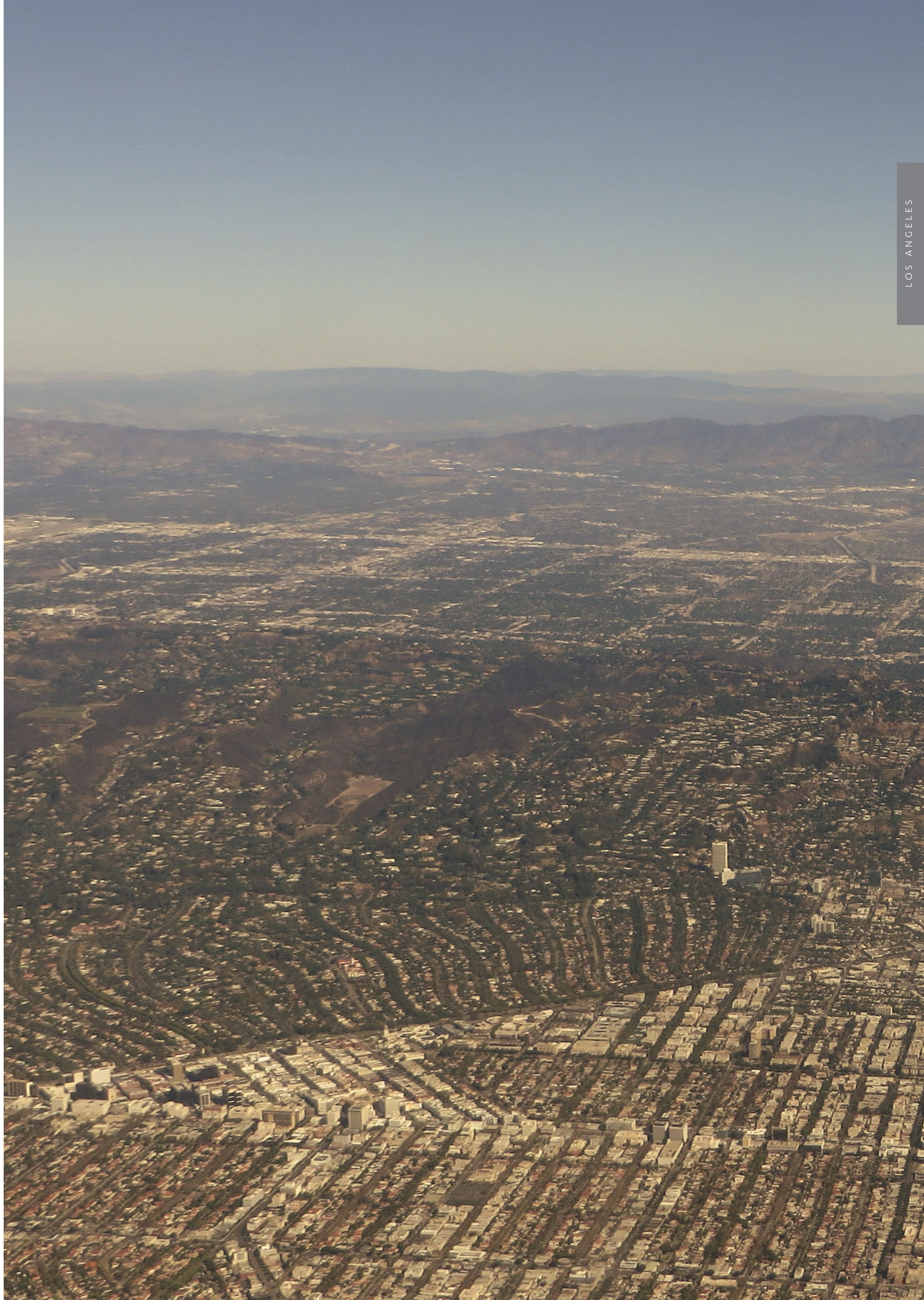




LOS ANGELES COUNTY'S 88 CITIES ARE HOME TO 10 MILLION PEOPLE – 1/4 OF THE STATE'S POPULATION.

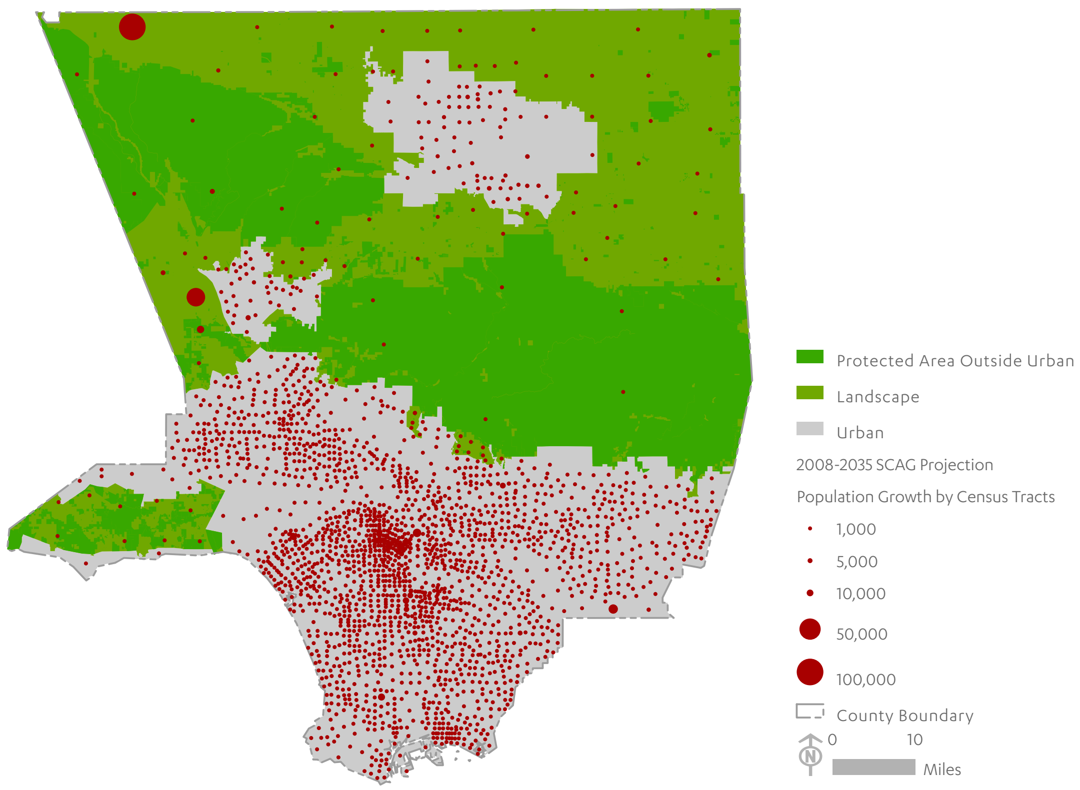
Los Angeles County, the focus of the Sustainable LA Grand Challenge, is the most populous county in the United States by a factor of two. Although it only makes up 3% of California's territory, at 4,752 square miles, it is home to 26% of the state's population.





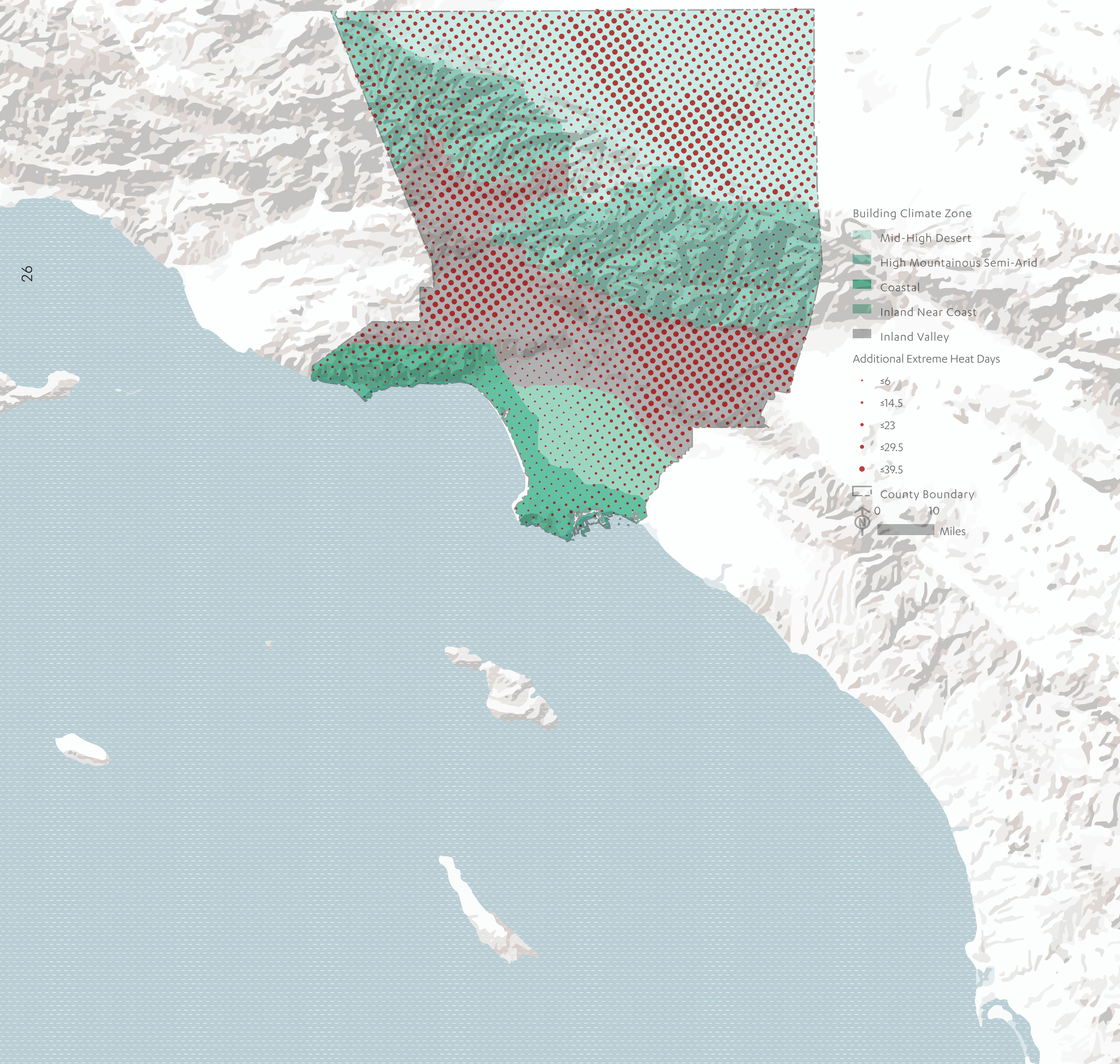
MOST OF LA COUNTY'S CITIES AND PEOPLE ARE CONCENTRATED IN THE BOTTOM HALF OF THE COUNTY.

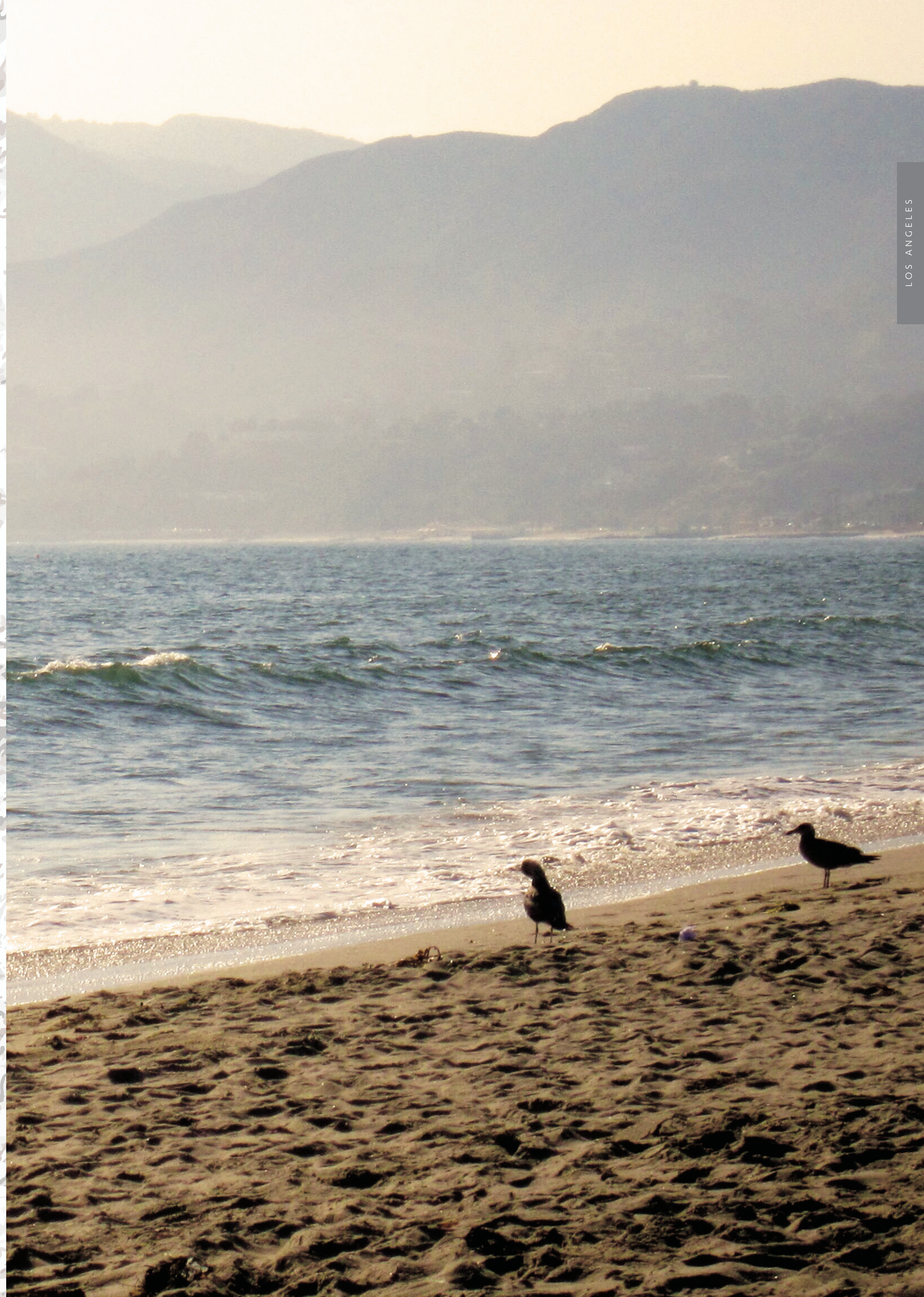
Los Angeles County is unique in that it has a natural geographic division between the 60% non-urbanized area composed of mountainous and largely undeveloped areas, and the 40% urbanized area which includes all developed areas in both the top and bottom halves of the County. Less than 5% of the population lives above the bottom half, and only 1% lives outside the urbanized territory.



LA COUNTY RISES FROM SEA LEVEL TO 10,000 FT AND SPANS 5 CLIMATE ZONES, WHICH REACT TO CLIMATE CHANGE DIFFERENTLY.

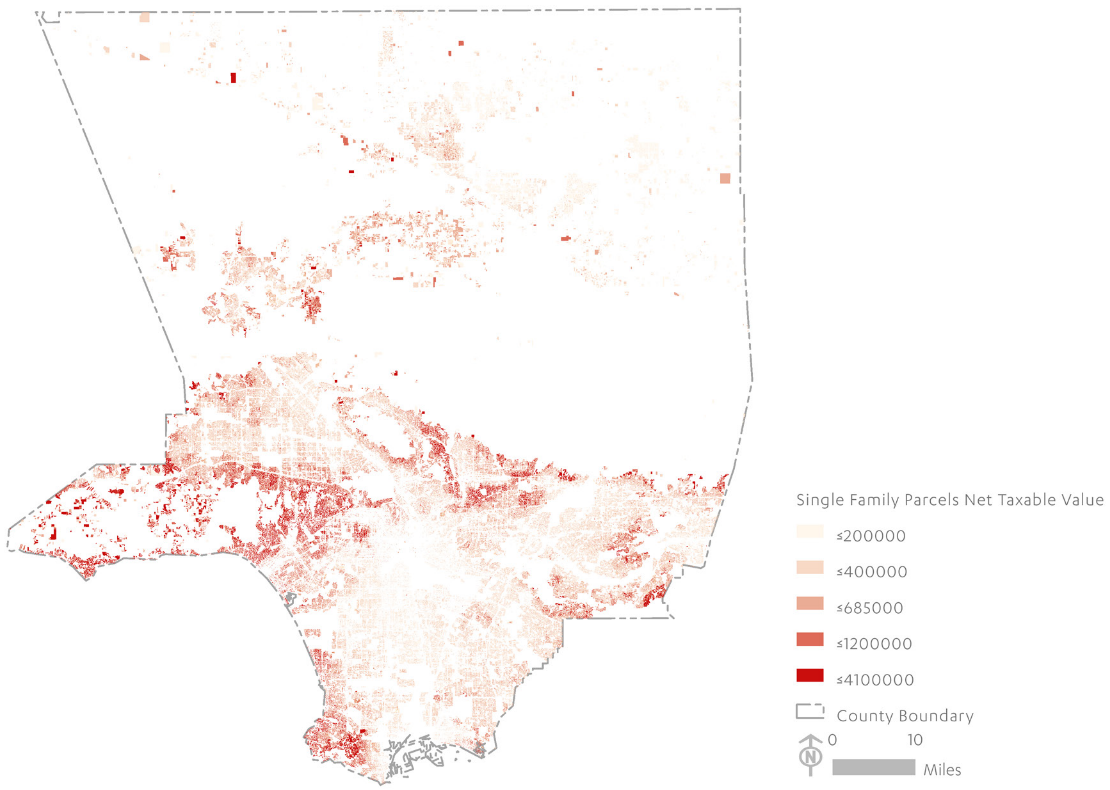
Los Angeles is characterized as a mild, dry subtropical Mediterranean climate. However, on any given day temperatures can vary as much as 36 degrees Fahrenheit between inland valleys and coastal areas. The different climate zones affect energy and water use, among other factors, and differ in their sensitivity to climate fluctuations. The multiple climate zones are in part attributable to the widely varying topography and contribute to the County falling within the only biodiversity hotspot in the contiguous U.S. The urban area alone has three climate zones and many unique species.

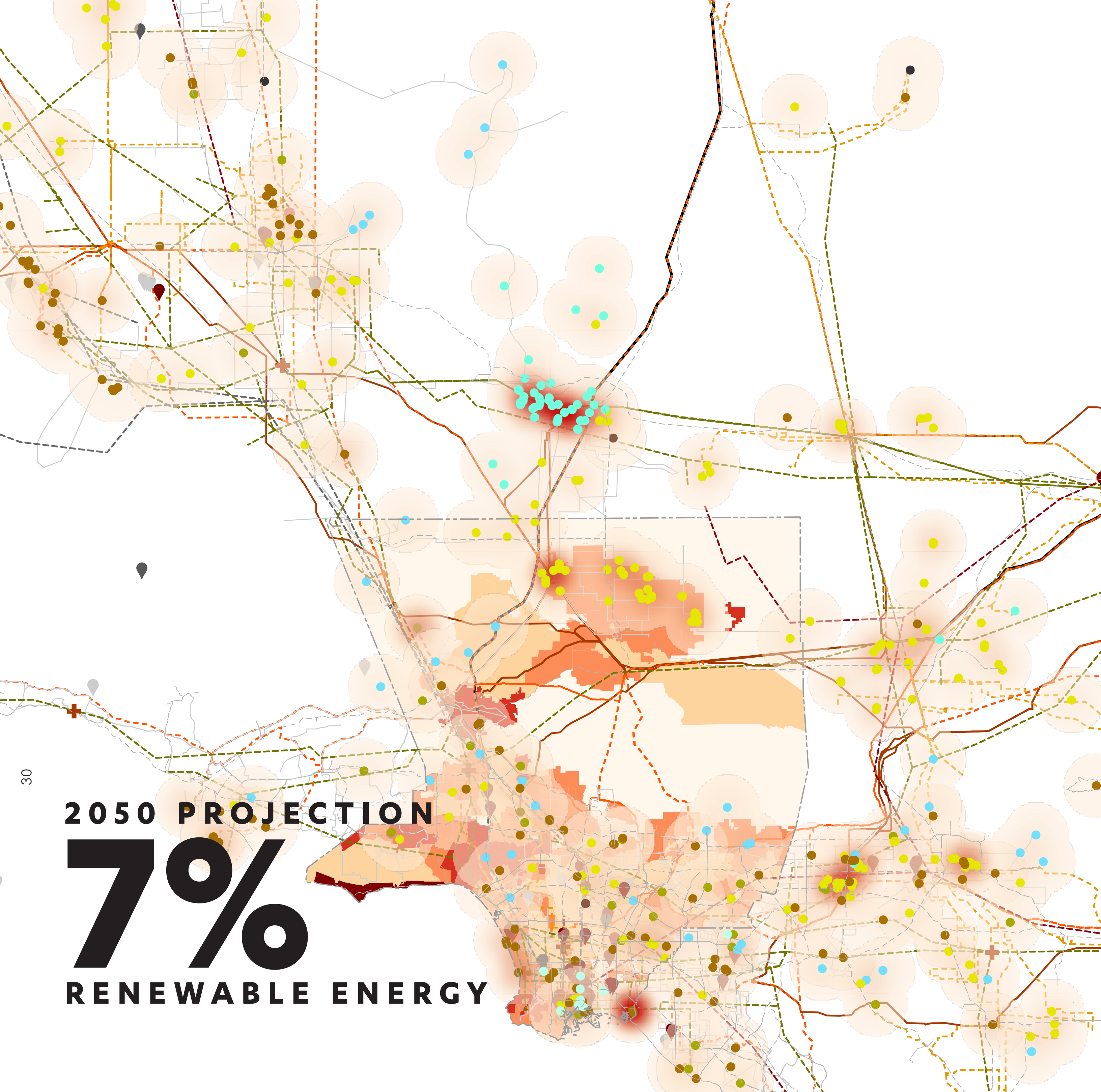




LA IS DOMINATED BY ITS 2M SINGLE-FAMILY HOMES, WHICH REPRESENT VASTLY DIFFERENT INCOMES.

Single-family homes are the biggest consumers of energy, water, and land in LA County. Single family homes occupy as much of LA's land as multifamily, commercial, institutional, and industrial buildings combined. The sprawled urban layout which necessarily accompanies low-rise residences also creates LA's notorious emissions-causing car dependency.

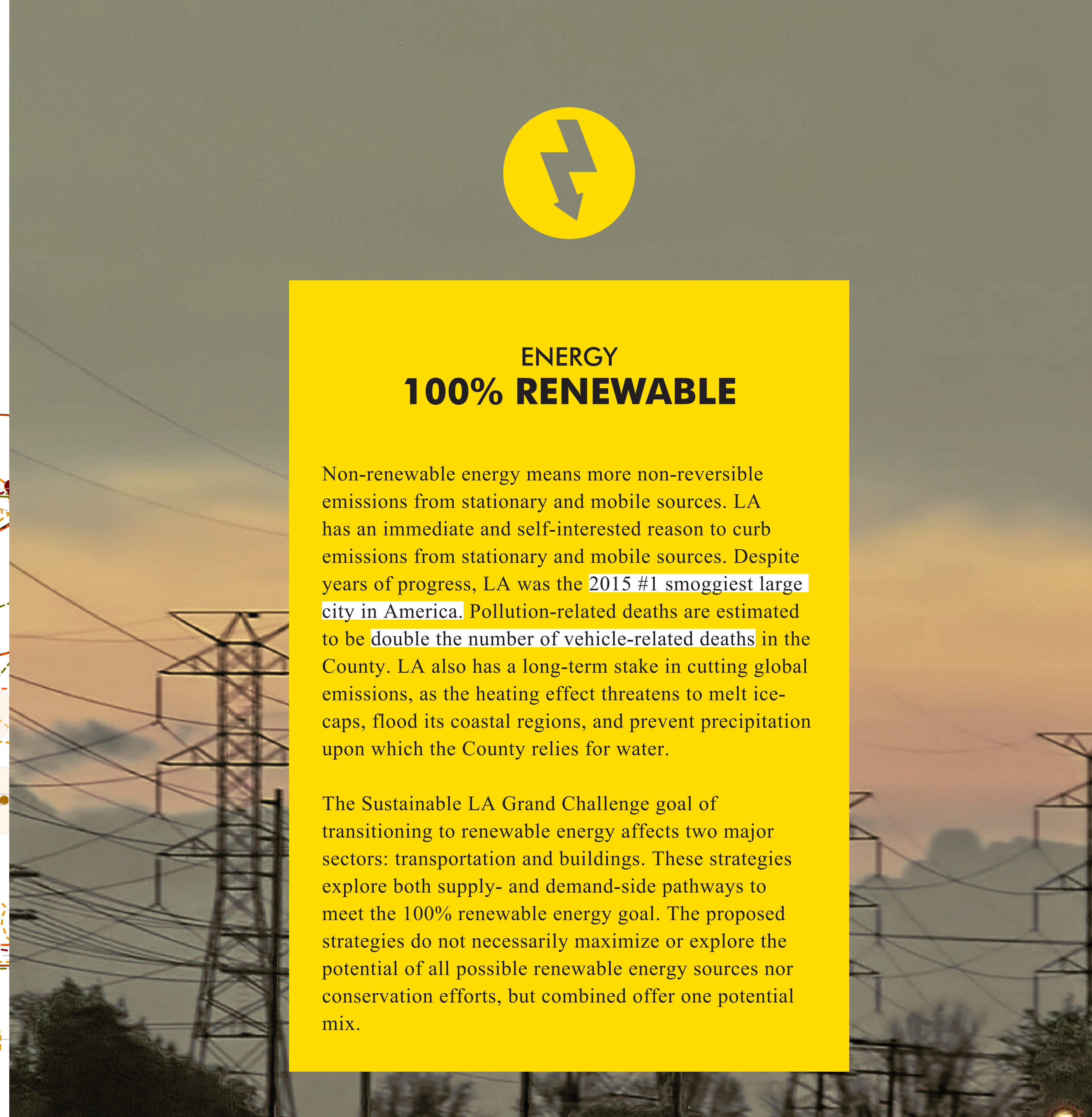




2050 PROJECTION

7%

RENEWABLE ENERGY



ENERGY
100% RENEWABLE

Non-renewable energy means more non-reversible emissions from stationary and mobile sources. LA has an immediate and self-interested reason to curb emissions from stationary and mobile sources. Despite years of progress, LA was the 2015 #1 smoggiest large city in America. Pollution-related deaths are estimated to be double the number of vehicle-related deaths in the County. LA also has a long-term stake in cutting global emissions, as the heating effect threatens to melt ice-caps, flood its coastal regions, and prevent precipitation upon which the County relies for water.

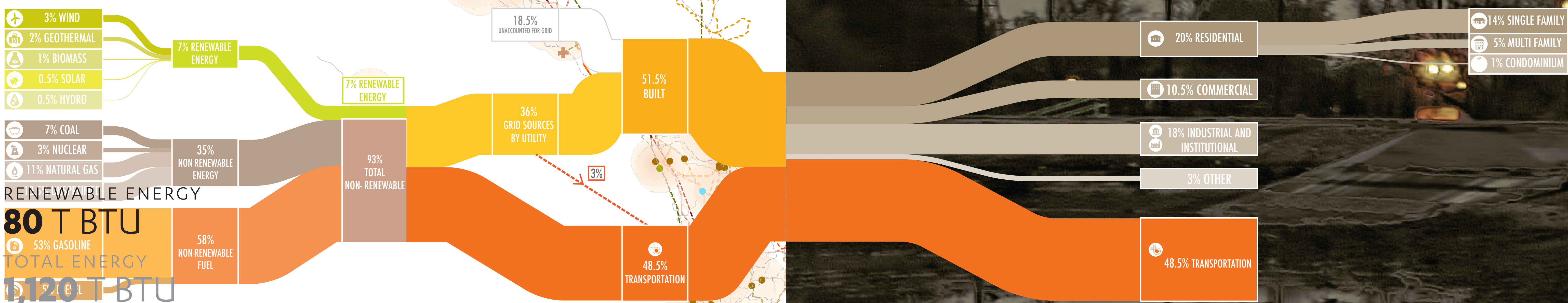
The Sustainable LA Grand Challenge goal of transitioning to renewable energy affects two major sectors: transportation and buildings. These strategies explore both supply- and demand-side pathways to meet the 100% renewable energy goal. The proposed strategies do not necessarily maximize or explore the potential of all possible renewable energy sources nor conservation efforts, but combined offer one potential mix.

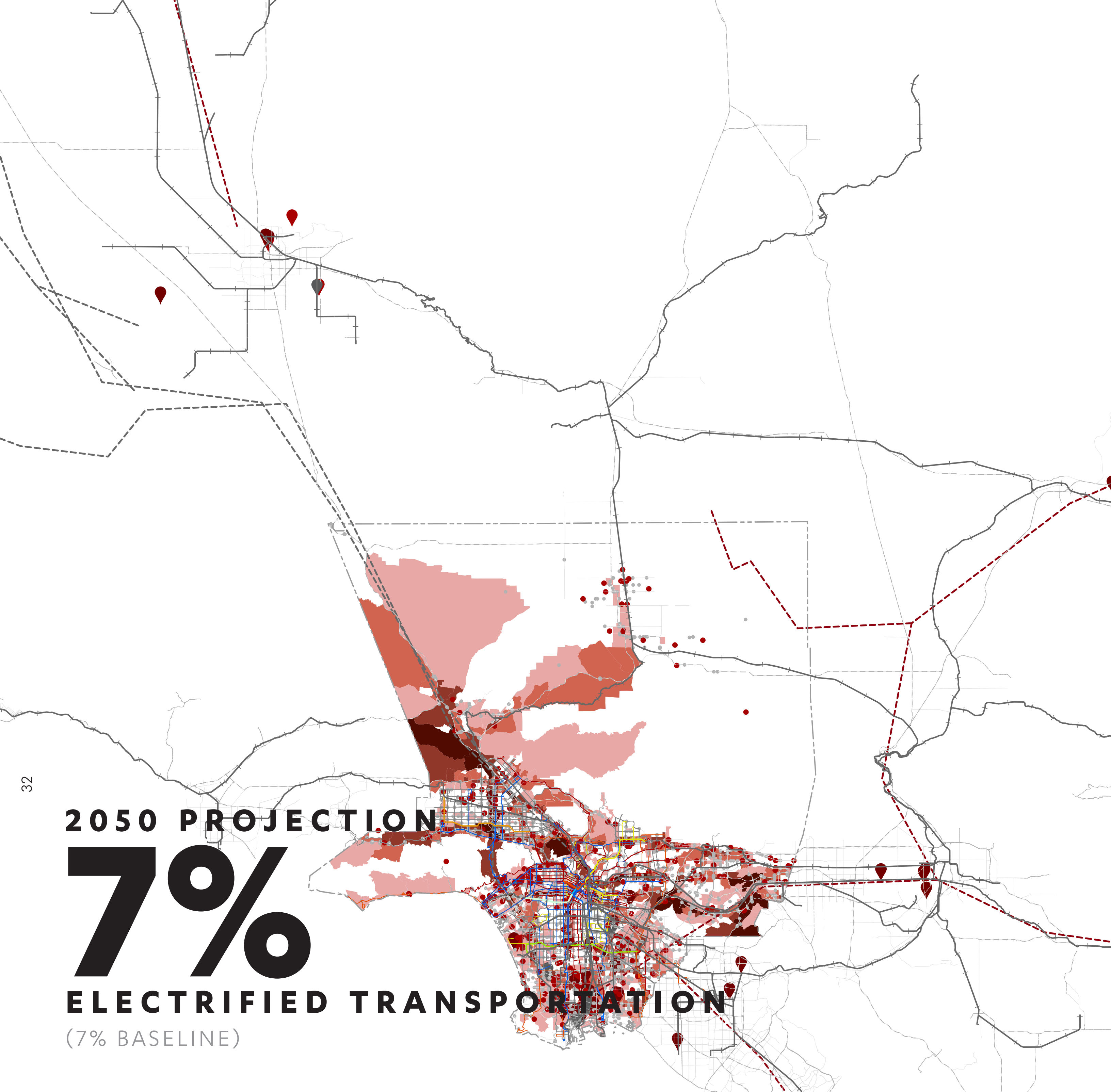
RENEWABLE ENERGY

80 T BTU

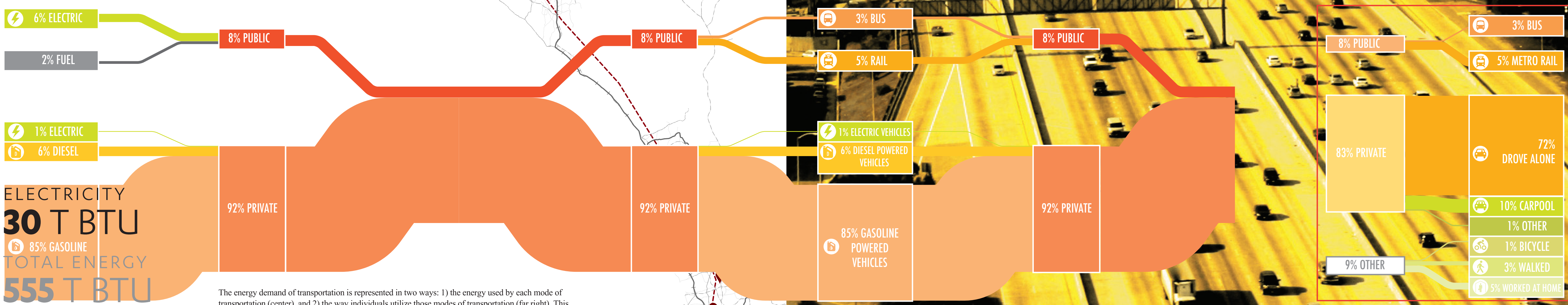
TOTAL ENERGY

1,120 T BTU





2050 PROJECTION
7%
ELECTRIFIED TRANSPORTATION
(7% BASELINE)



The energy demand of transportation is represented in two ways: 1) the energy used by each mode of transportation (center), and 2) the way individuals utilize those modes of transportation (far right). This approach is important to understand the impact of people's choice in their mode of transportation.

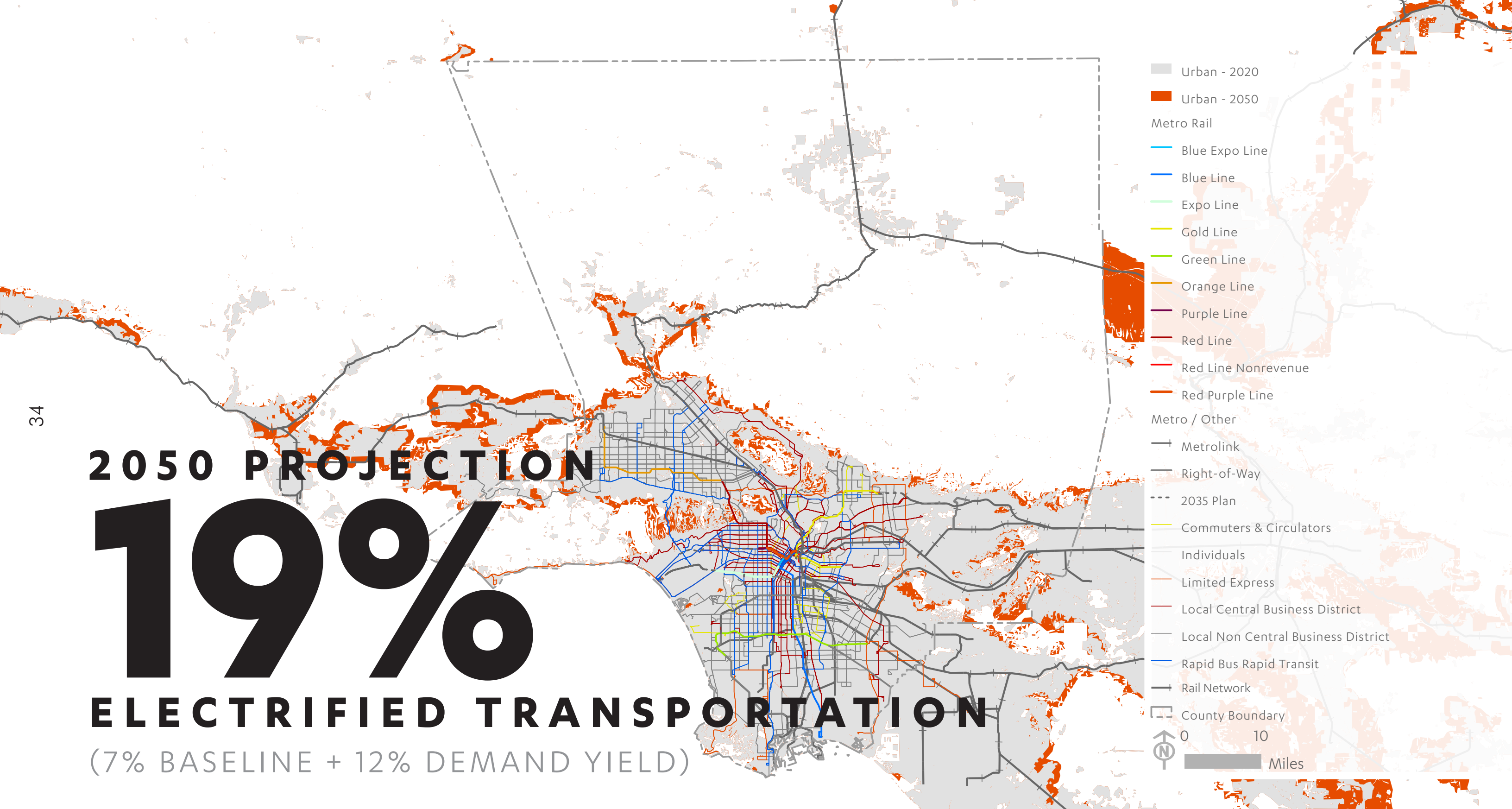
TRANSPORTATION
100% RENEWABLE

If nothing changes, LA County will have 1 million more vehicles by 2050. Cars in 2050 will pump emissions into LA County's most populated areas equal to four coal-burning power plants. This does not take into account the increased congestion or longer commute times associated with the typical sprawled housing of the growing population—adding even more to transportation-related fuel emissions. Additional cars do not have a linear effect on emissions. Rather, their effect on congestion could actually multiply emissions many times over. With congestion, vehicles spend more time on the road, and more time on the road results in higher greenhouse gas emissions.

One way to solve this is 100% electrifying all transportation, public and private. LA County is ranked the #1 best county in America for electric vehicles due to the high cost of smog—LA spends the most on pollution-related health problems of any county in the state—and, due to its relatively clean grid, emits less per kwh produced than most areas.

STRATEGY #1: EVEN IF ALL 1.5M NEW RESIDENTS ARE TRANSIT-RIDERS THERE WOULD ONLY BE A 10% EFFECT ON ENERGY DEMAND.

Instead of all 1.5 million to residents of LA County using public transit and cars at the same rate as today, this thought experiment proposes that all new residents of LA County use public transit and not cars, achieving Metro's goal to convert 20% of the County's population into regular transit riders by taking private vehicles off the road and putting people into public transit. While this doesn't have a significant effect on electrification, it does make metro more efficient and take cars off the road.



2050 PROJECTION

19%

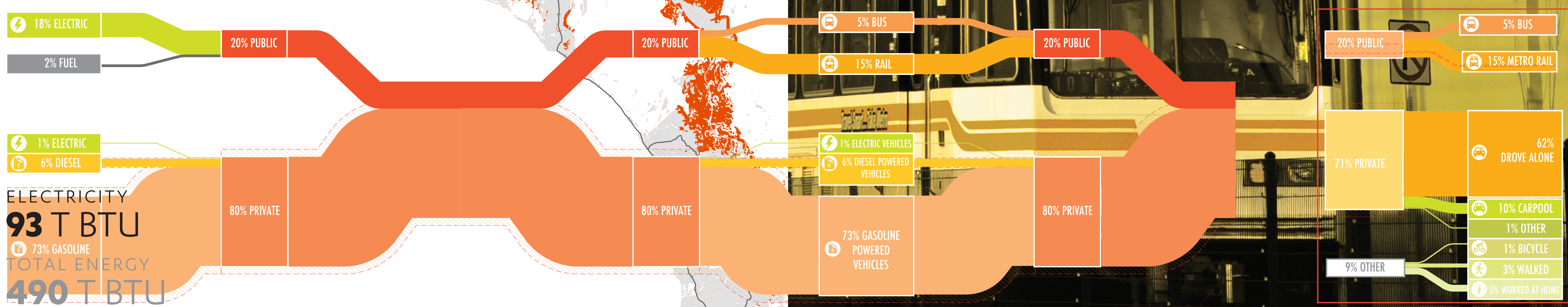
ELECTRIFIED TRANSPORTATION

(7% BASELINE + 12% DEMAND YIELD)

STRATEGY #1

-10%

REDUCED DEMAND

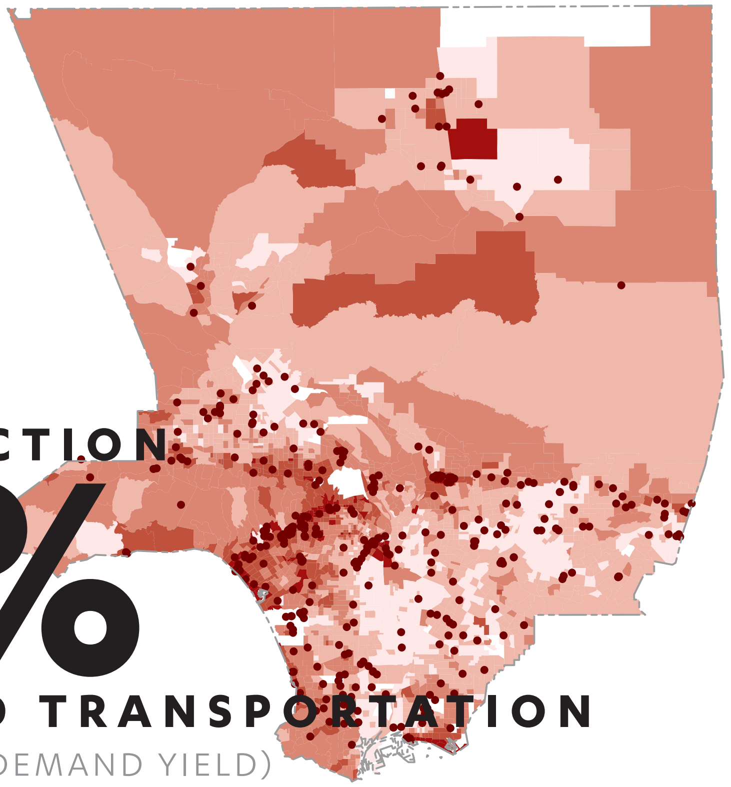


ELECTRICITY
93 T BTU

TOTAL ENERGY
490 T BTU

STRATEGY #2: IF ALL VEHICLES IN LA COUNTY WERE ELECTRIC IN 2050, TRANSPORTATION ENERGY DEMAND WOULD DECREASE 80%

Electric vehicles go the same distance as gasoline cars using far less energy. As electric cars become even more efficient, they will consume less than 1/5 the kWh/mile of today's gas cars. So, while electric vehicles place a greater demand on the electricity grid, they reduce Los Angeles' overall energy demand, and place that demand on potentially-renewable grid sources. Since fossil-fuel burning vehicles are a major source of emissions, adverse health outcomes from polluted air would likely reduce dramatically throughout the basin if all vehicles were electric.

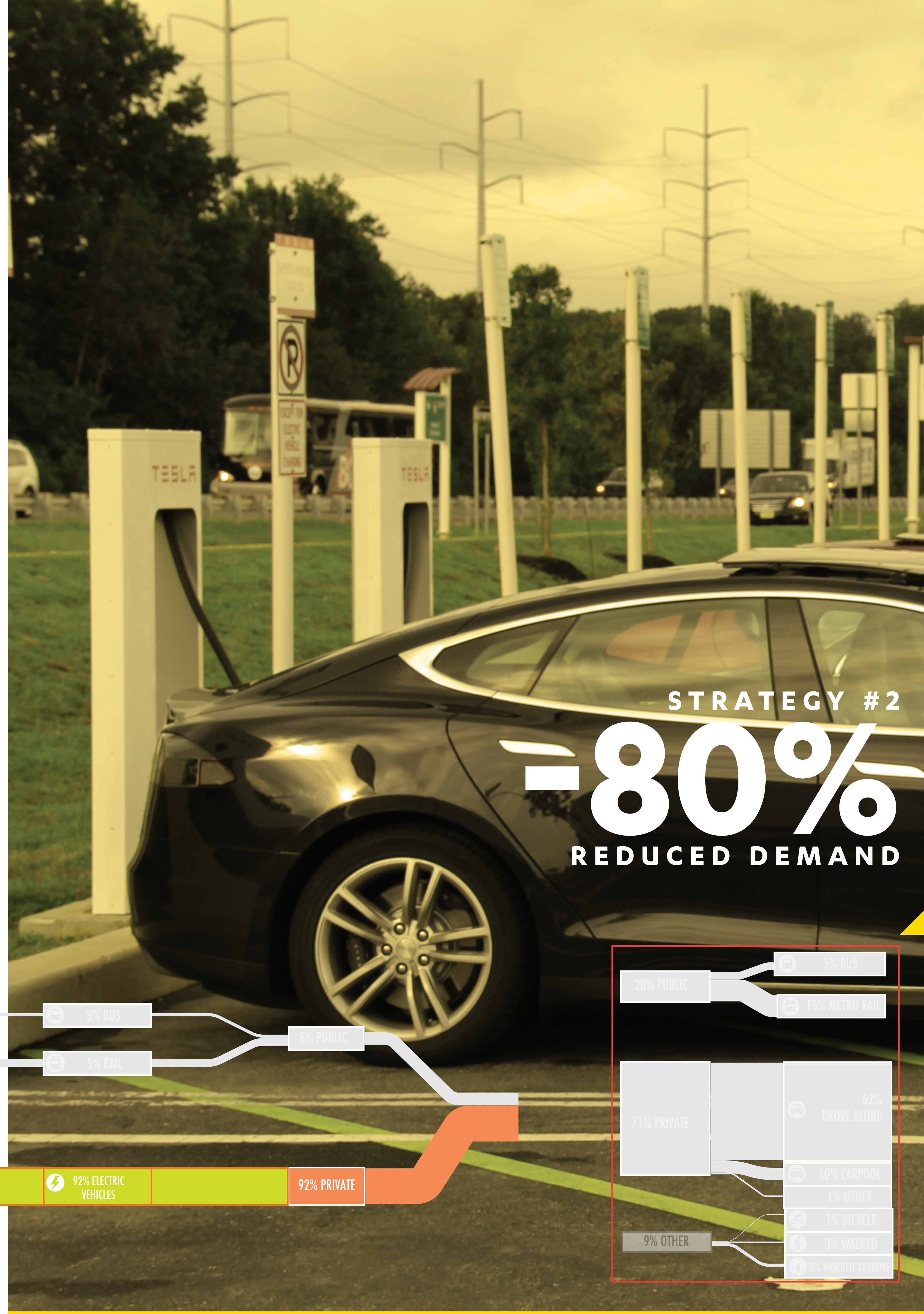


2050 PROJECTION

98%

ELECTRIFIED TRANSPORTATION

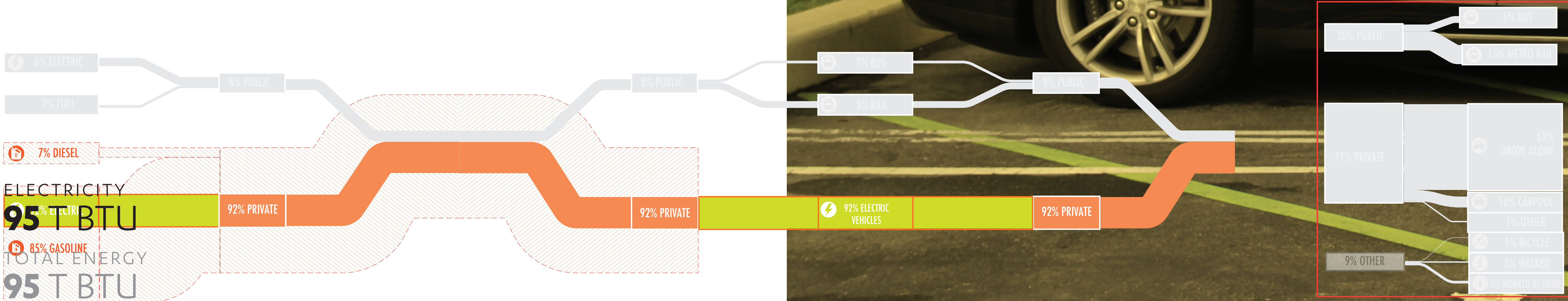
(7% BASELINE + 91% DEMAND YIELD)



STRATEGY #2

-80%

REDUCED DEMAND



ENERGY : TRANSPORTATION

BOTTOM-UP

2050 PROJECTION

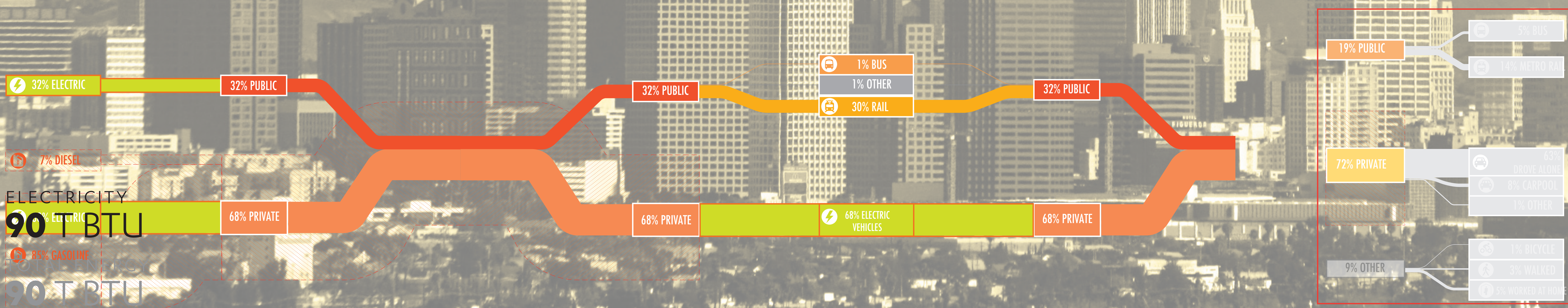
100%

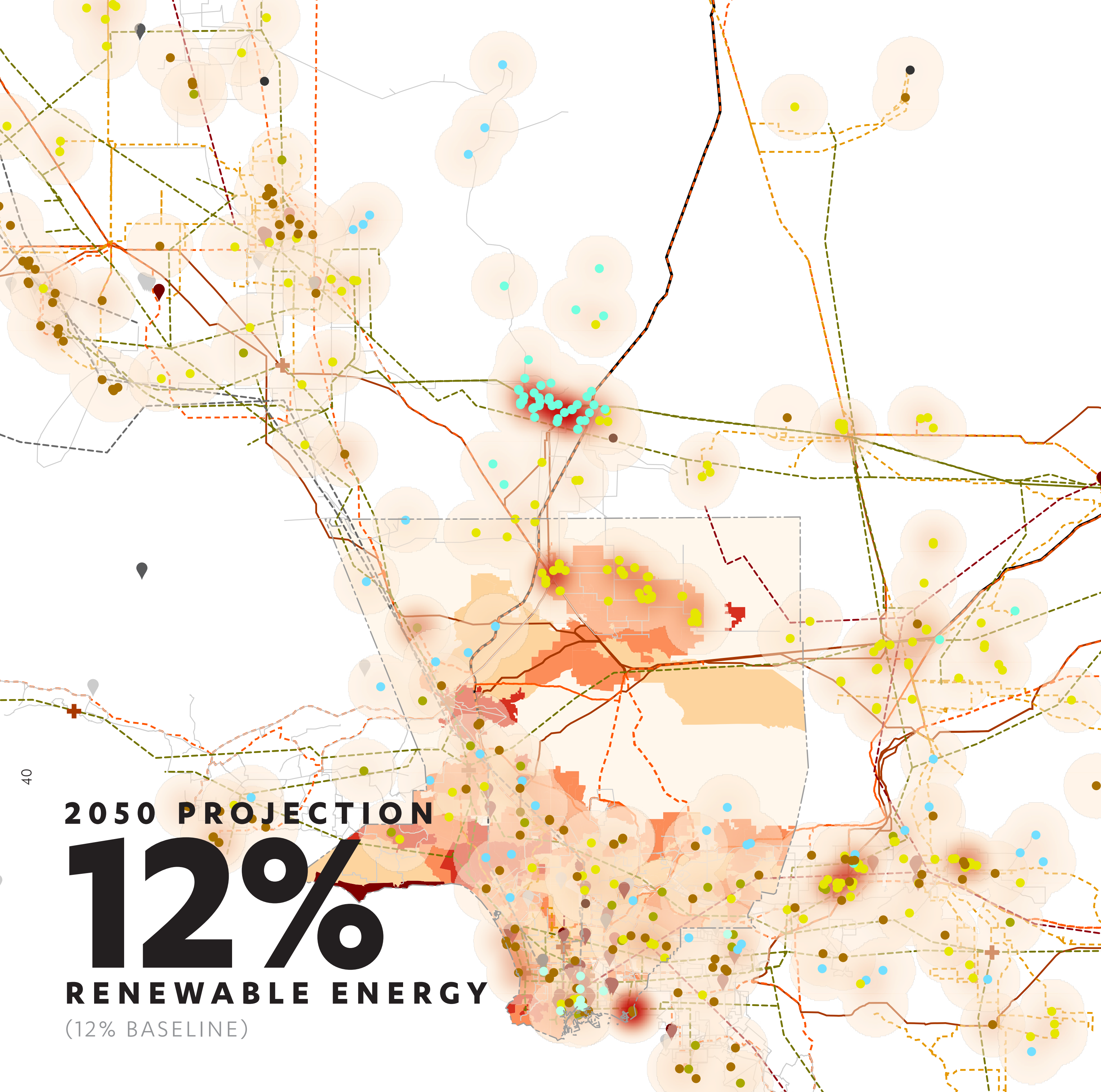
ELECTRIFIED TRANSPORTATION

TRANSPORTATION
2050 STRATEGIES

This combined strategy demonstrates the effect of both increasing the number of riders on public transportation and electrifying transportation. Removing gas & diesel from the transportation supply is possible. Electric vehicles are only one solution. UCLA researchers are also studying low-carbon and renewable biofuels–which could replace gasoline and diesel–as well as autonomous vehicles and ridesharing programs, which could dramatically reduce congestion and parking-related driving that contribute to emissions.

Electrifying transportation is one way to replace current fuel energy sources with renewables. While electrification reduces localized emissions, it results in an increased demand on the electric grid. In order to make public transit and personalized vehicles truly green, an electrified system must obtain its energy from a renewable energy grid.

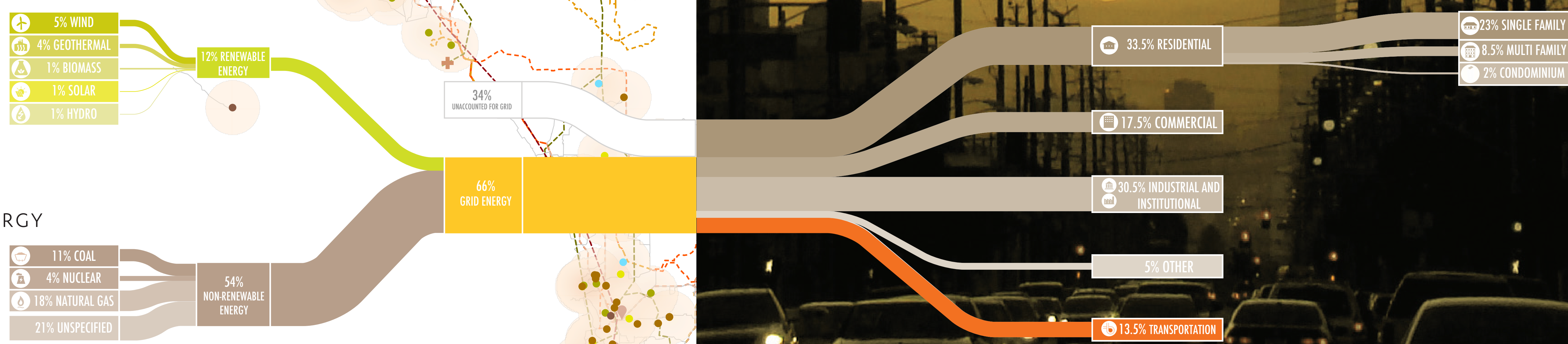




2050 PROJECTION
12%
RENEWABLE ENERGY
(12% BASELINE)

RENEWABLE ENERGY
75 T BTU

TOTAL ENERGY
660 T BTU



BUILDINGS
100% RENEWABLE

If no new renewable generation is installed, building-related emissions in LA County will equal the emissions of at least ten coal-burning power plants in 2050.

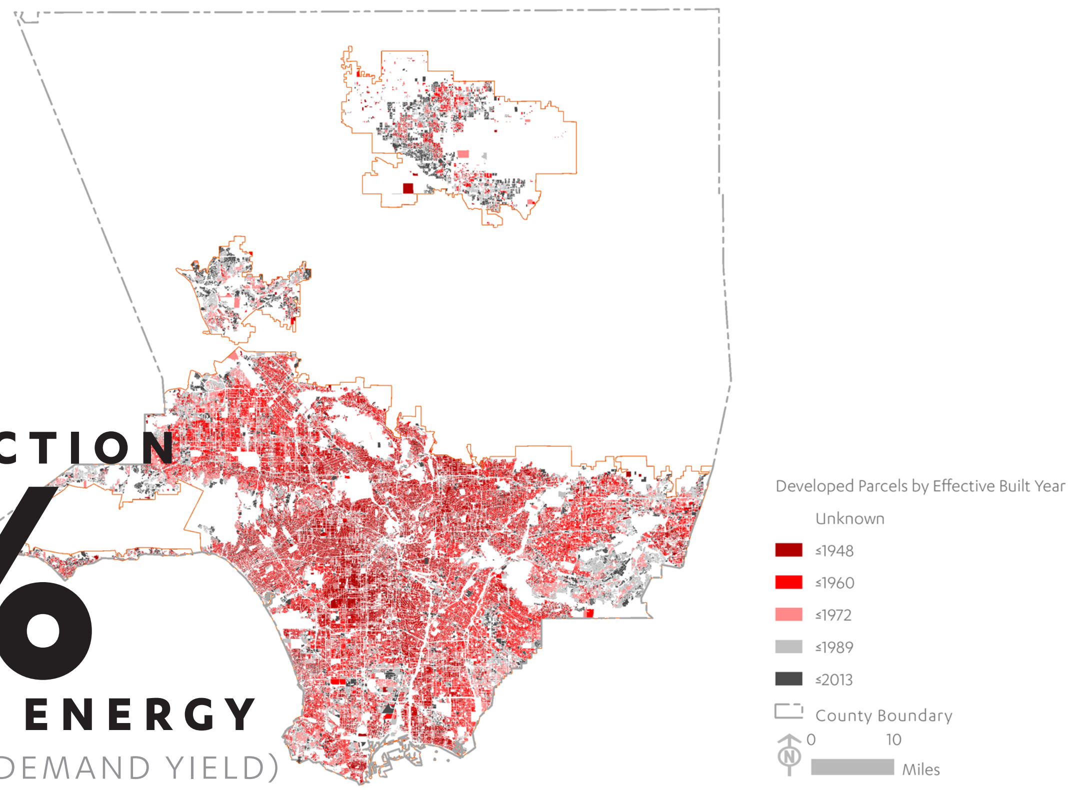
This 2050 emissions forecast is likely an underestimate: it does not factor in the effect of the predicted increase in extreme heat days, which can create up to double the electricity demand in affected areas like the Inland Valley - many of which are the fastest-growing in population.

The addition of electric vehicles will put extra pressure on electricity supply that, combined with the addition of 1.5 million people, will require even larger amounts of renewable energy to meet the County's 2050 energy needs.

This is a more detailed look at the energy supply and demand for the built environment in 2050.

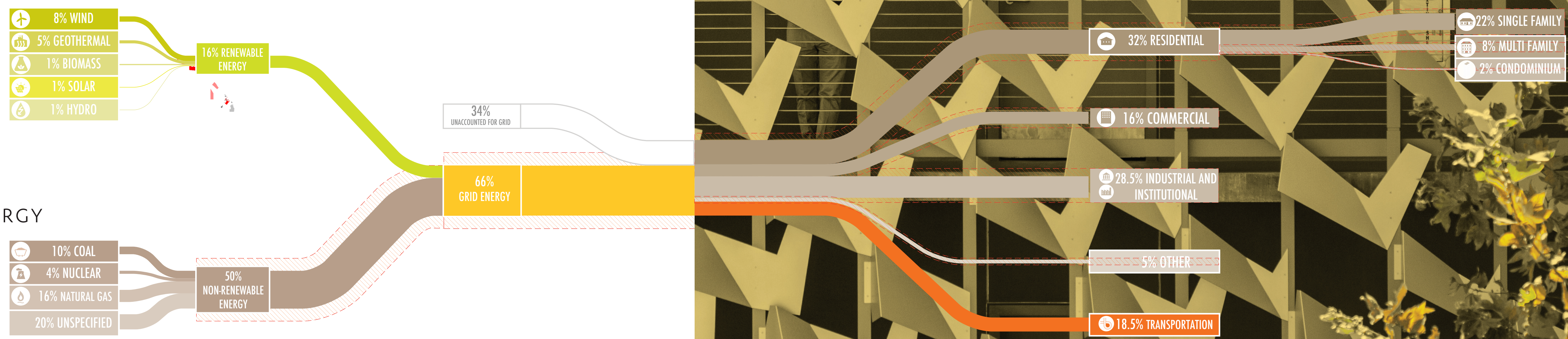
STRATEGY #1: A 30% IMPROVEMENT IN BUILDING ENERGY EFFICIENCY WILL REDUCE ENERGY DEMAND BY 25%

There is a good precedent for improved building energy efficiency – in the last forty years, the energy efficiency of buildings improved by ~25% in Los Angeles County. Energy efficiency in the City of LA is mandated to improve another 30% by 2035 for all building types, an achievable goal with advancing technologies, and modest compared to additional state mandates to double the energy efficiency of buildings by 2030.



2050 PROJECTION
16%
RENEWABLE ENERGY
(12% BASELINE + 4% DEMAND YIELD)

STRATEGY #1
-25%
REDUCED DEMAND

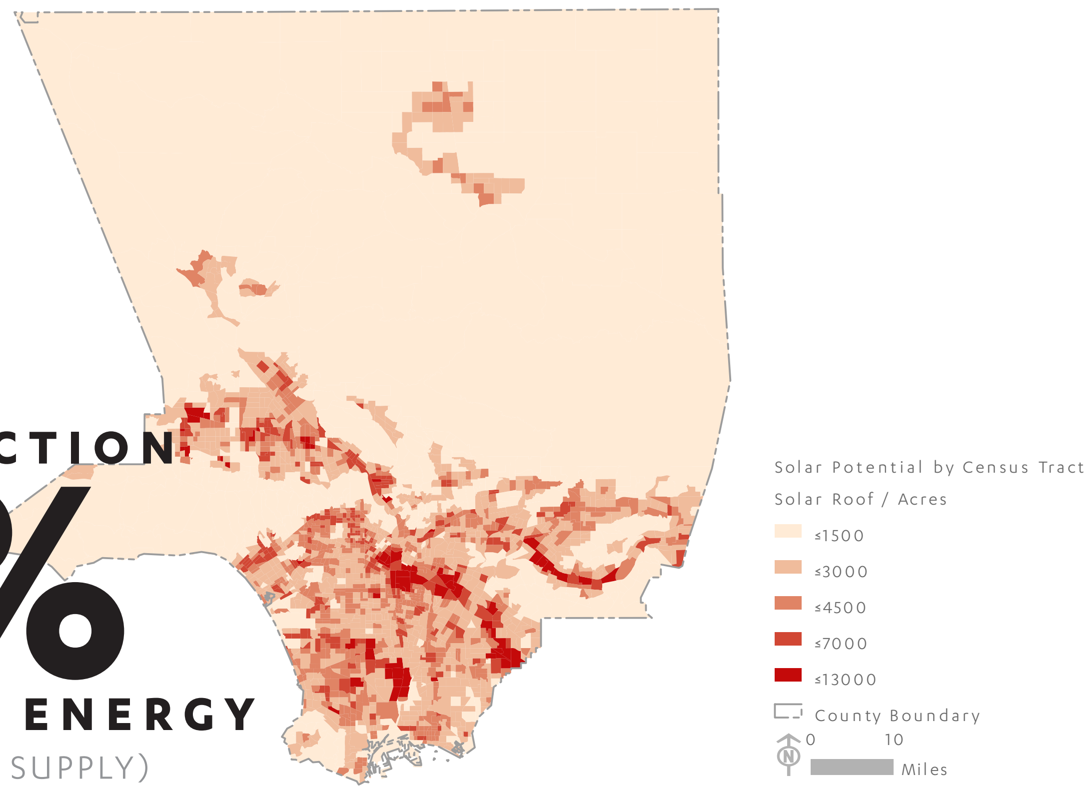


RENEWABLE ENERGY
75 T BTU

TOTAL ENERGY
490 T BTU

STRATEGY #2: IF EVERY COMPATIBLE ROOFTOP IN LA COUNTY HAD SOLAR BY 2050, IT WOULD ADD 25% TO THE ENERGY SUPPLY.

Los Angeles gets 250 days of sun a year. Forty-six cities in LA County are solar net positive, meaning the rooftops can produce more electricity than is currently consumed annually. In LA County, rooftop solar could produce 34,000 GWh of electricity, or 1/4 of future demand. Solar PV pays off in about 9 years, and over its lifespan, owners profit about $35,000 in Southern California.



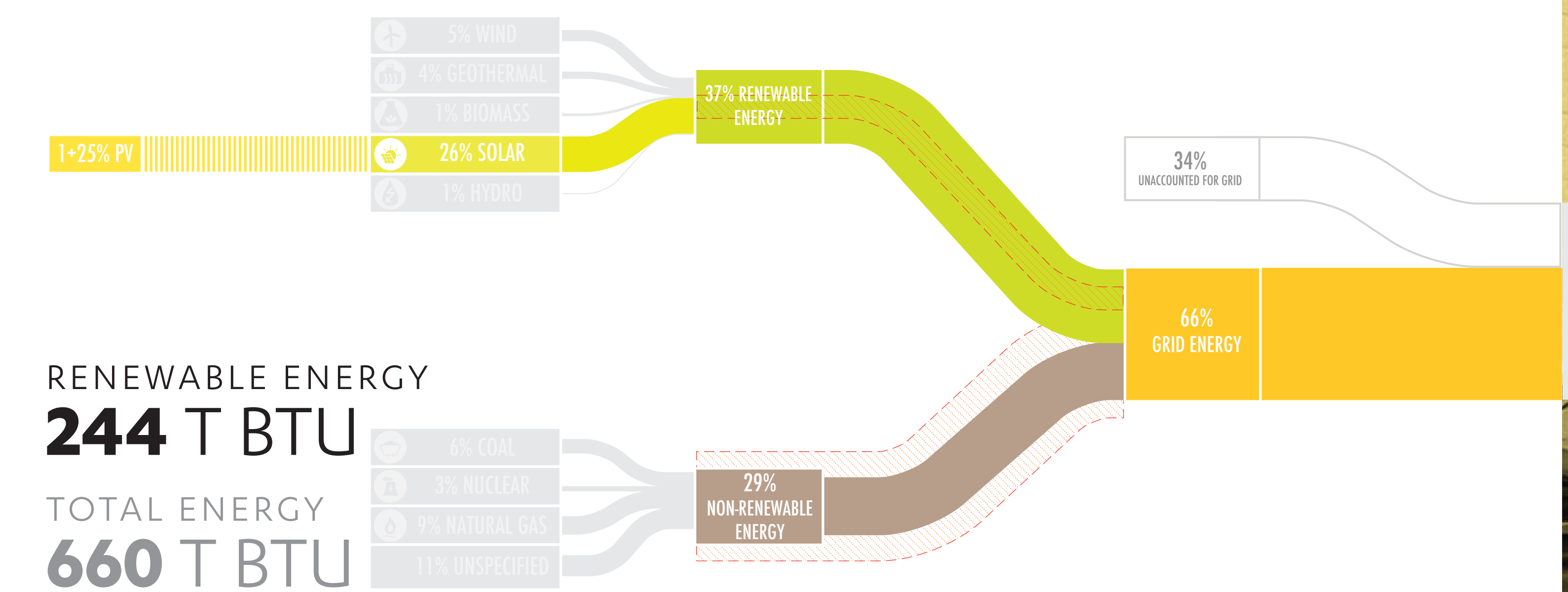
2050 PROJECTION

37%

RENEWABLE ENERGY

(12% BASELINE + 25% SUPPLY)

BOTTOM-UP



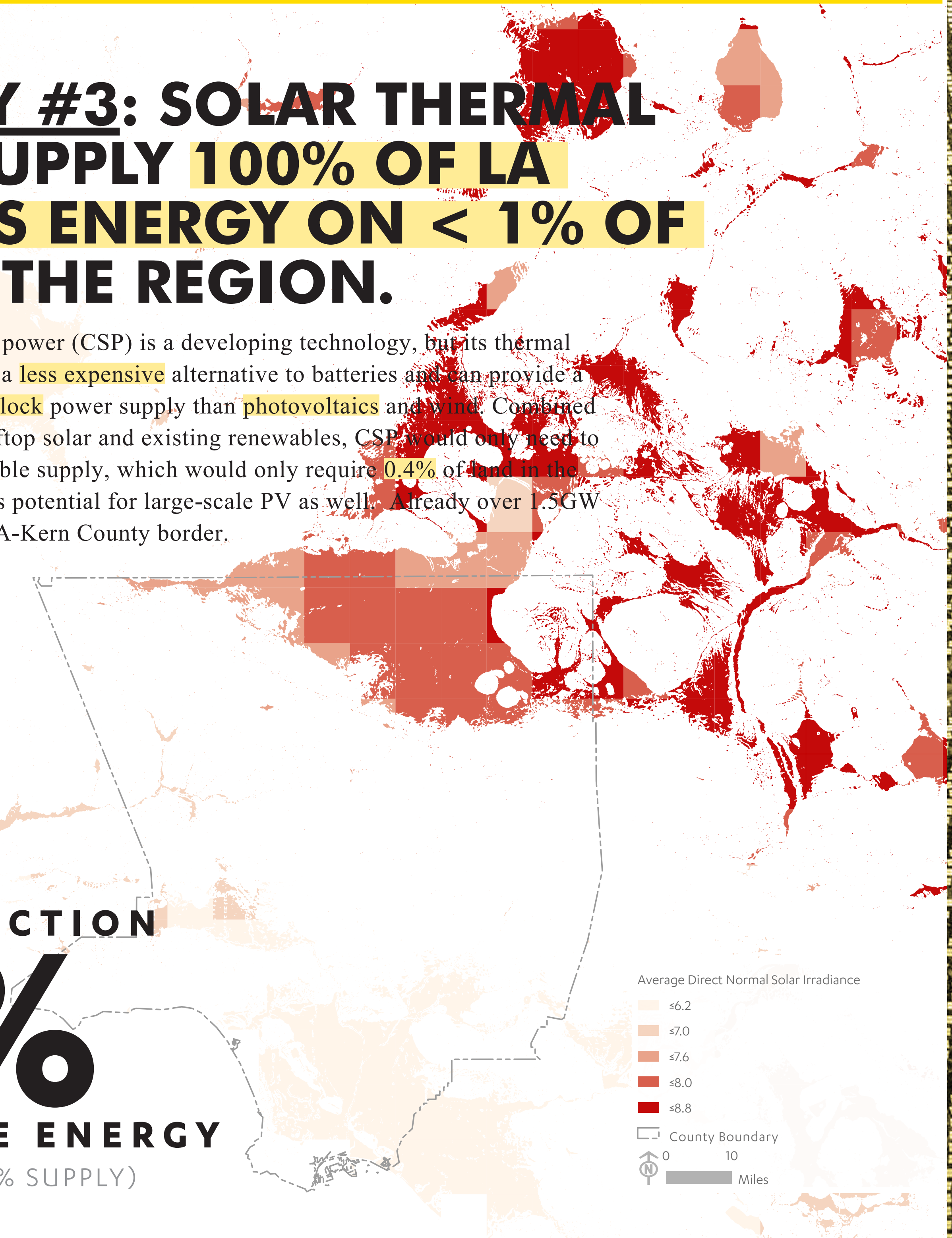
RENEWABLE ENERGY
244 T BTU

TOTAL ENERGY
660 T BTU

SUPPLY INCREASED

STRATEGY #3: SOLAR THERMAL COULD SUPPLY 100% OF LA COUNTY'S ENERGY ON < 1% OF LAND IN THE REGION.

Concentrated solar thermal power (CSP) is a developing technology, but its thermal storage potential is already a less expensive alternative to batteries and can provide a more constant around-the-clock power supply than photovoltaics and wind. Combined with the potential from rooftop solar and existing renewables, CSP would only need to produce 59% of the renewable supply, which would only require 0.4% of land in the region. There is tremendous potential for large-scale PV as well. Already over 1.5GW of PV is located near the LA-Kern County border.



2050 PROJECTION

71%

RENEWABLE ENERGY

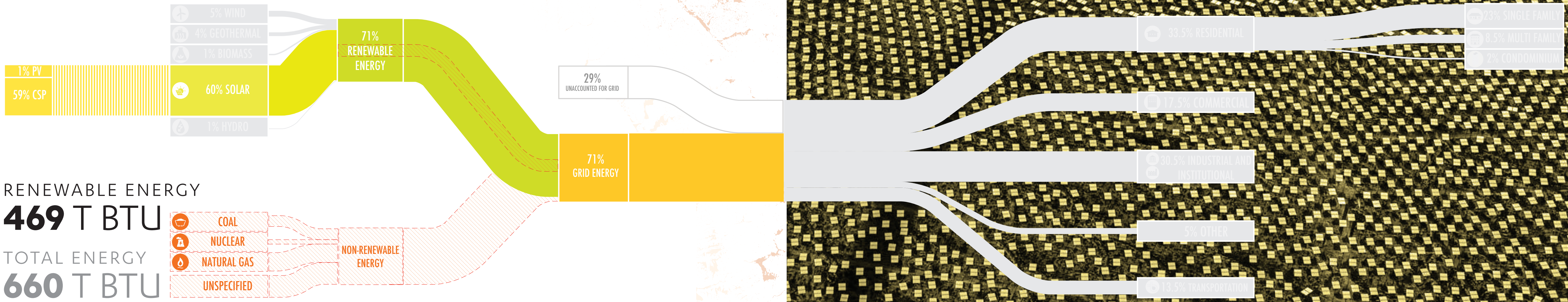
(12% BASELINE + 59% SUPPLY)

RENEWABLE ENERGY

469 T BTU

TOTAL ENERGY

660 T BTU



STRATEGY #3

+59%

INCREASED SUPPLY

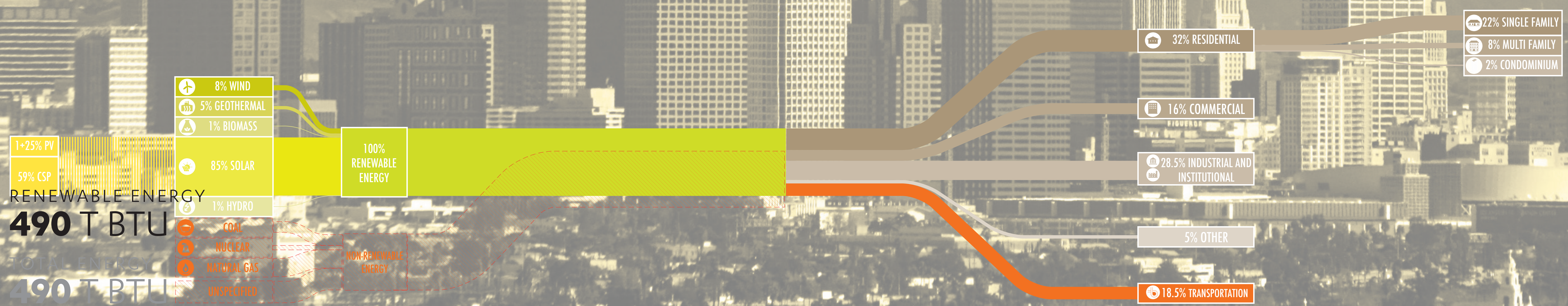
2050 PROJECTION
100%
RENEWABLE ENERGY

BUILDINGS
2050 STRATEGIES

Even with the additional load imposed on the grid from the electrification of transportation, 100% renewable energy is achievable in LA County through increasing building efficiency and harnessing the power of the ever-present sun.

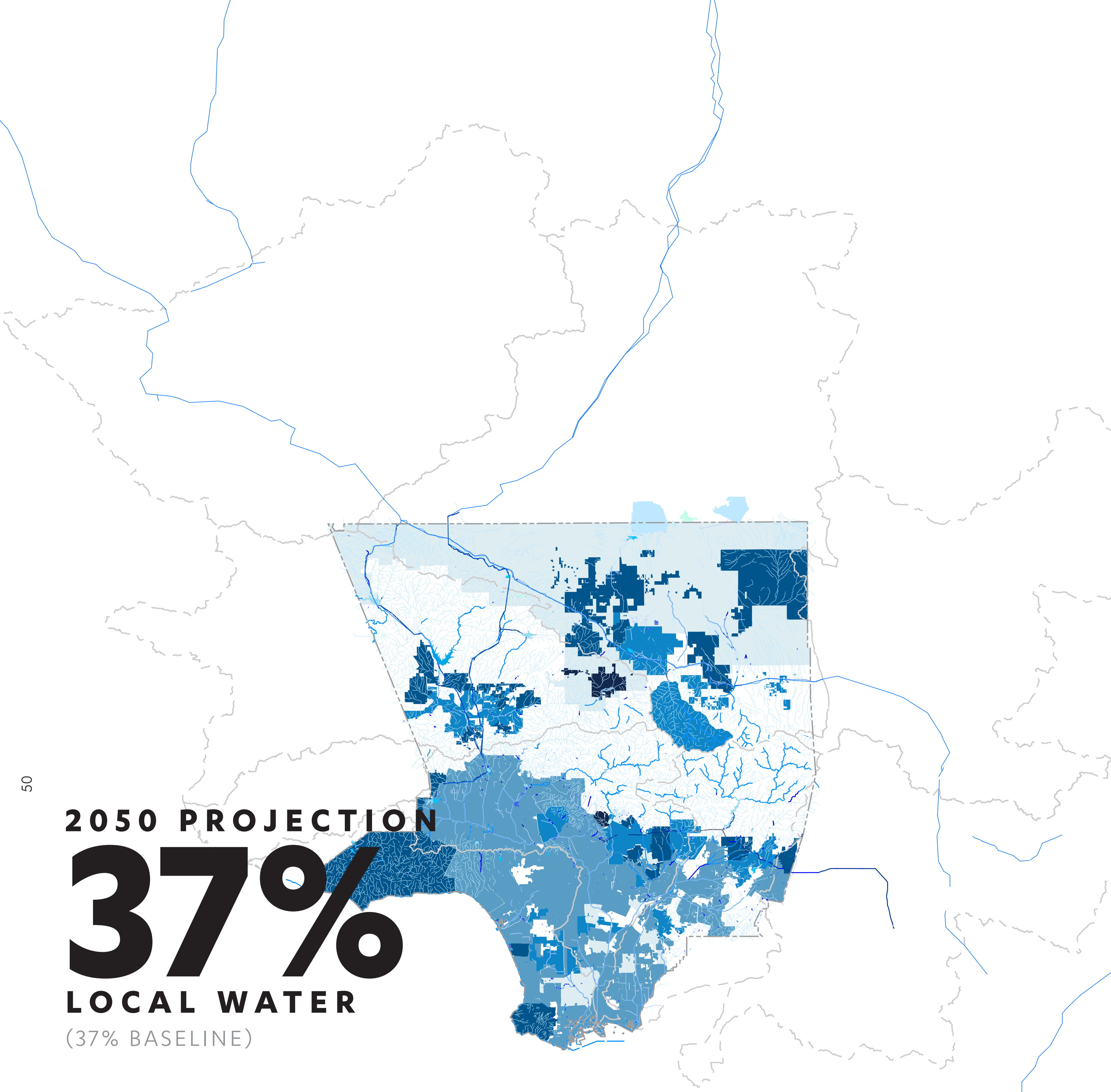
All of this could be done with very little impact on available land in the region. Using only existing buildings' rooftops and 0.4% of regional land would supply more than enough energy for the County.

The LA power portfolio of the future will look very different from today's power portfolio, as the County relinquishes its reliance on fossil fuels and other non-renewable energy sources. The future energy portfolio will include new and existing renewable energy stock, combined with centralized and distributed solar power generation. This renewable portfolio transforms the entire County into a green and self-sufficient power plan, and its residents into producers, not just consumers, of energy.



RENEWABLE ENERGY
490 T BTU

TOTAL ENERGY
490 T BTU



2050 PROJECTION
37%
LOCAL WATER
(37% BASELINE)

LOCAL WATER
0.7 M AF

TOTAL WATER
1.8 M AF

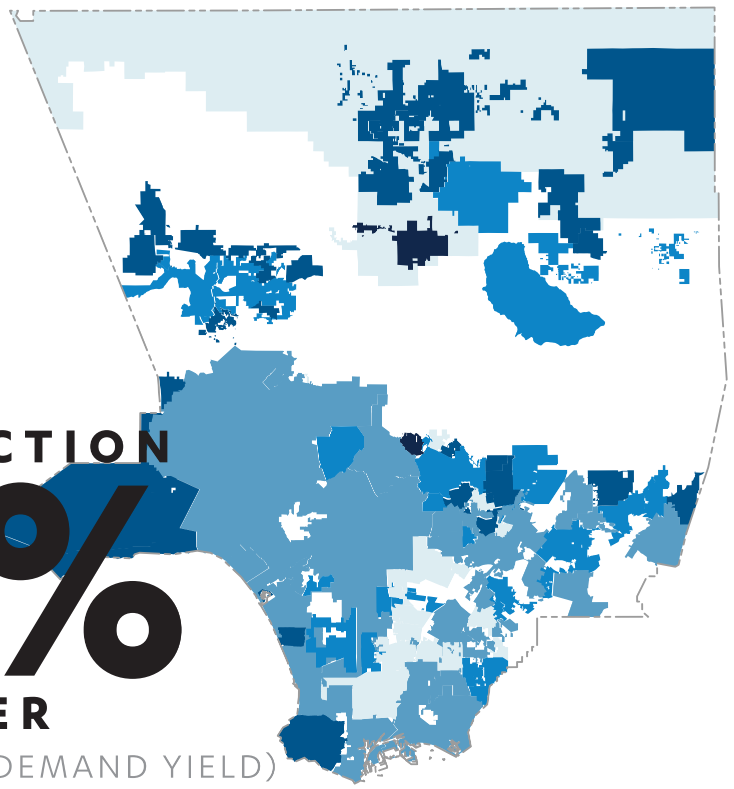
WATER
100% LOCAL

Without change, LA County will continue to depend on imported water sources from hundreds of miles away that may not exist or that will be prohibitively expensive by 2050. At 139 gallons per capita per day, a population increase of 1.5 million will result in a need for an additional 75 billion gallons of water per year by 2050. Increased pressure on groundwater supplies will place greater dependence on imports which, by 2050, will be even less secure due to an increasing population in the West and climate change. The idea of sourcing 100% of LA's water locally may sound like a pipedream, but UCLA researchers have identified several curable inefficiencies in the County's current water practices that, if corrected, could amply provide for 2050's population and beyond.

This section explores both supply- and demand-side pathways to meet the 100% local water goal. The proposed strategies do not necessarily maximize the availability of each supply source nor the full potential for conservation, but combined offer one potential mix.

STRATEGY #1: REDUCING RESIDENTIAL INDOOR WATER USE BY 25% WOULD REDUCE TOTAL DEMAND 10%.

Residential water conservation is already making headway with more efficient appliances and shifting attitudes toward water use. However, Angelenos in 2013 still consumed about 95 gallons per capita per day for residential use (R-GPCD). This is more than three times as much as Berlin, for example, where residents use just 30 gallons per day. Water conservation is key to reaching local water goals and reducing reliance on imported water.

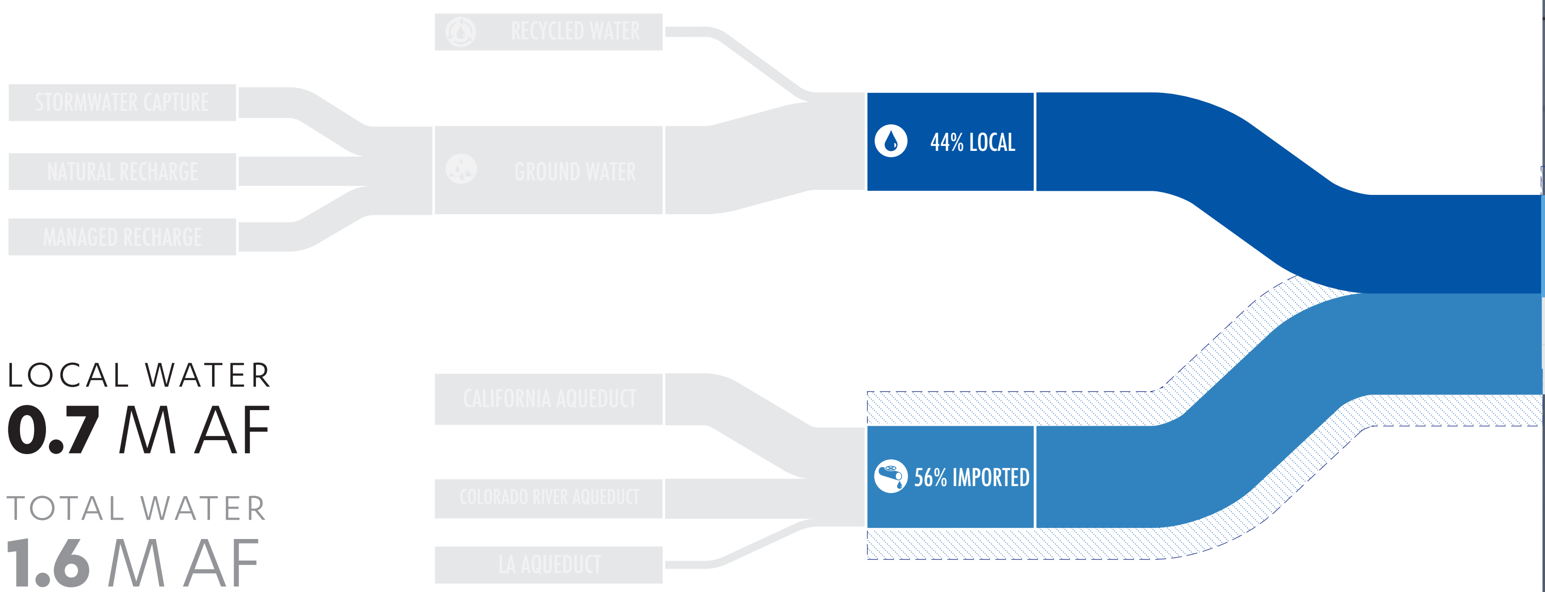


2050 PROJECTION

44%

LOCAL WATER

(37% BASELINE + 8% DEMAND YIELD)



LOCAL WATER

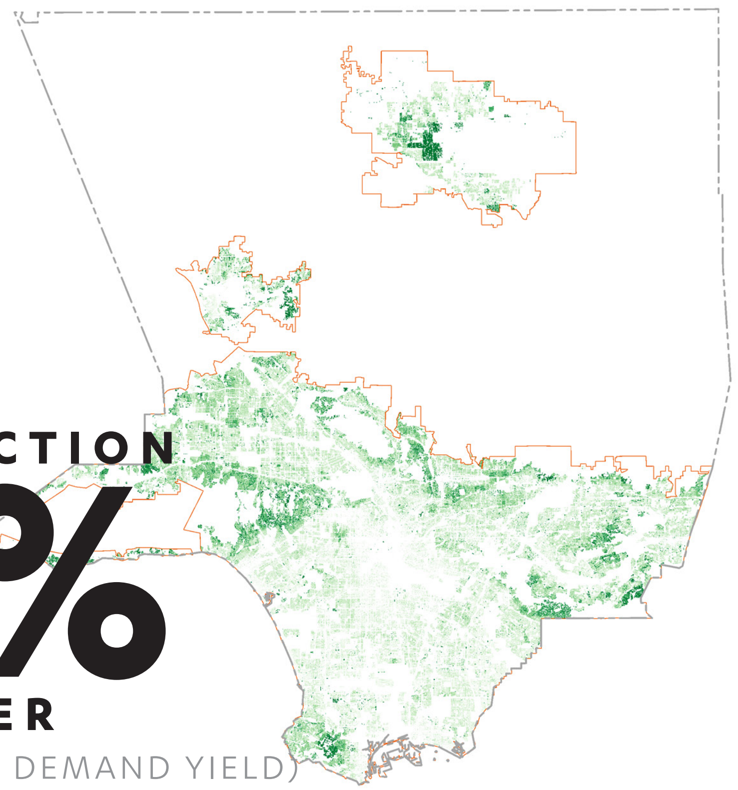
0.7 M AF

TOTAL WATER

1.6 M AF

STRATEGY #2: NATIVE LANDSCAPING WILL MAKE THE BIGGEST IMPACT ON RESIDENTIAL WATER CONSUMPTION.

UCLA researchers estimate over 54% of single-family household water is used for outdoor irrigation. A xeriscaping pilot project in LA County reduced residential water use to an average of 55 gallons per person per day, which is close to half of 2013 residential consumption. This was done by transforming residents' yards with techniques that increase biodiversity, harvest rainwater, add almost more than a million gallons to groundwater, prevent polluted runoff, and mitigate flooding. Changes in landscaping could reduce water demand by 18% or more.



2050 PROJECTION

47%

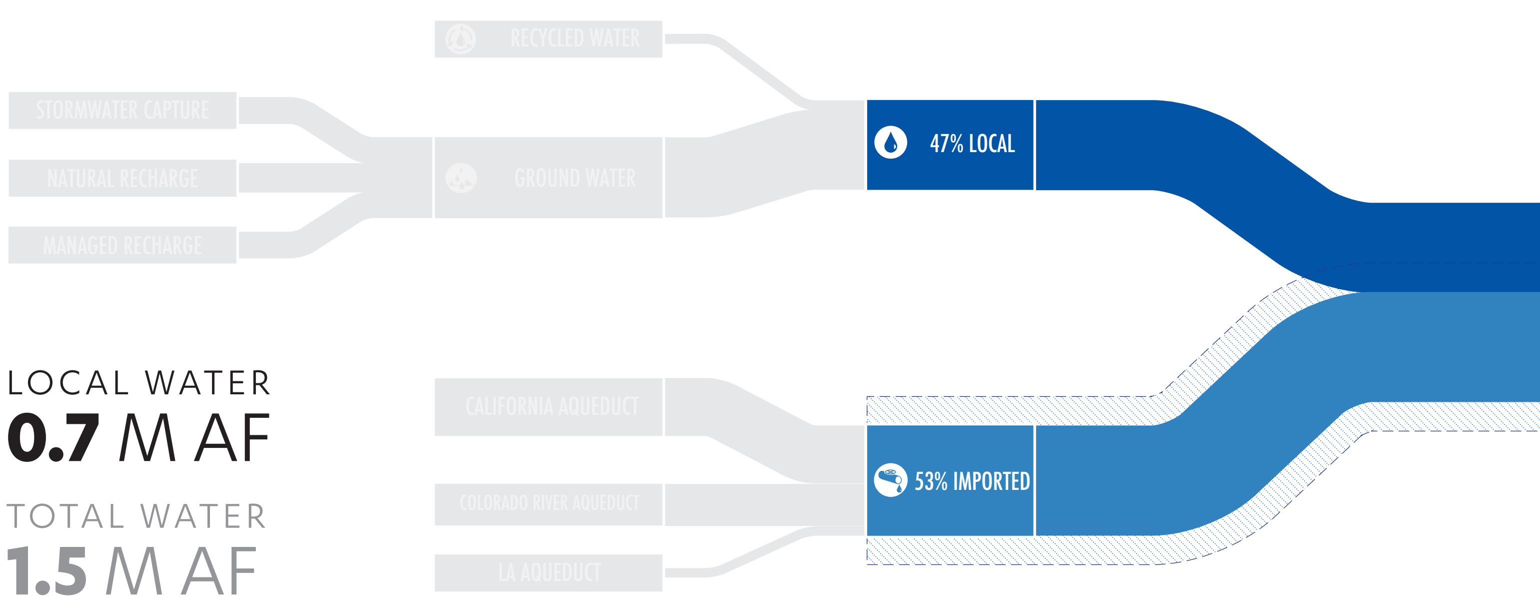
LOCAL WATER

(37% BASELINE + 10% DEMAND YIELD)

STRATEGY #2

-20%

REDUCED DEMAND



LOCAL WATER
0.7 M AF

TOTAL WATER
1.5 M AF

STRATEGY #3: THERE'S ENOUGH LOCAL RAINFALL TO MEET 2X LA'S 2050 NEEDS.

Storms drop more than more than 80 billion gallons of water in Los Angeles County after every inch of rainfall. With LA's average 15 inches of rainfall, that's more than 1 trillion gallons annually, more than twice 2050 annual demand. Not all rainfall contributes directly to the water supply due to geological and governance challenges. But even converting one more inch of this rainwater to usable local water by 2050 would increase the total supply by 10%. Rainwater not only contributes to recharging aquifers, but can be used on site.

TOP-DOWN

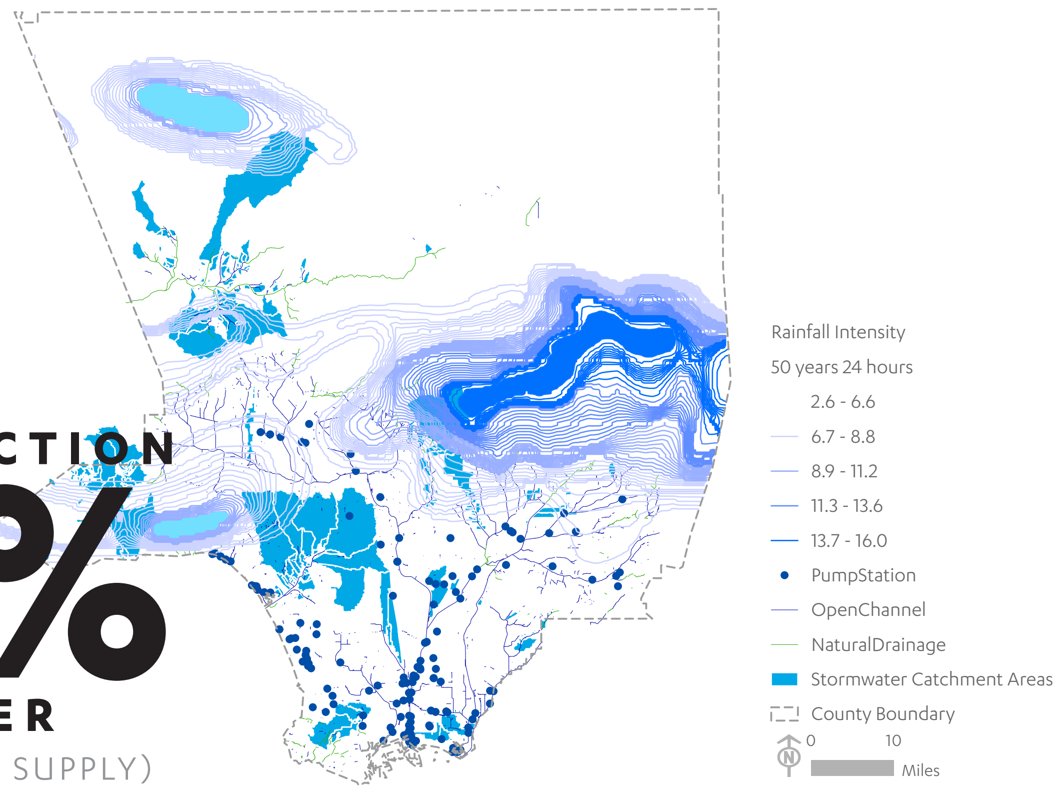
56

2050 PROJECTION

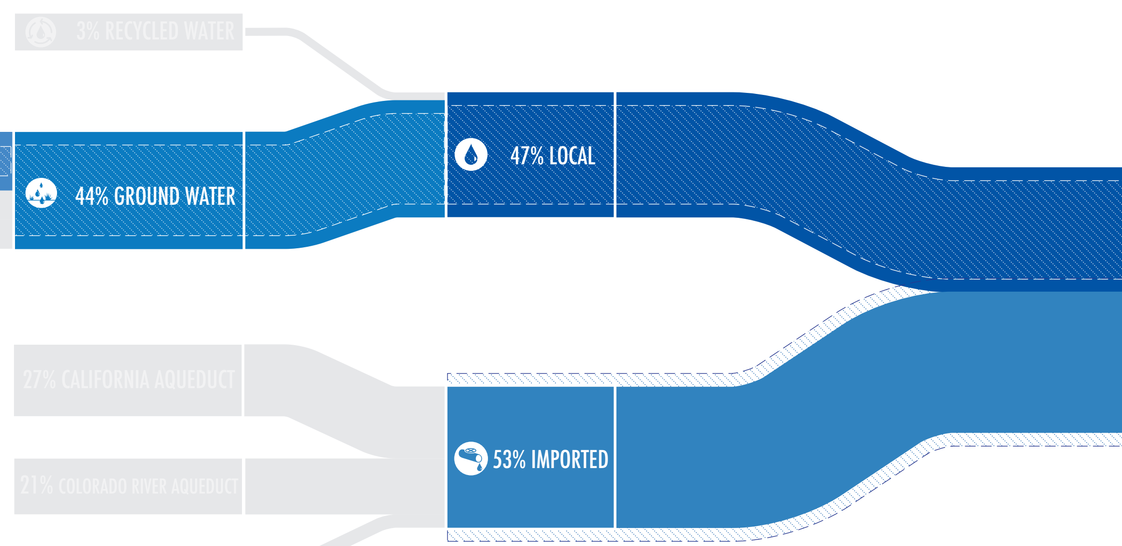
47%

LOCAL WATER

(37% BASELINE + 10% SUPPLY)



BOTTOM-UP



LOCAL WATER
0.9 M AF

TOTAL WATER
1.8 M AF

WATER

STRATEGY #4: RECYCLING CAN RETURN ALMOST 100% OF WATER BACK INTO THE LOCAL SUPPLY.

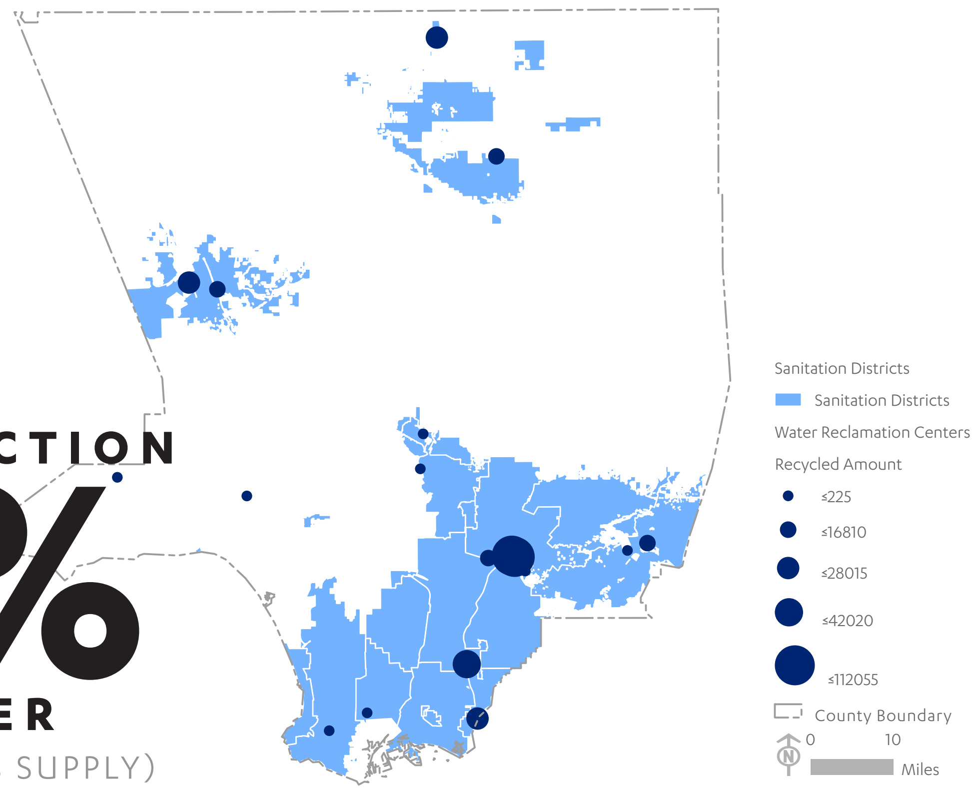
Currently, Los Angeles County recycles only 4% of its water. If the County recycled eight times as much water as it does today, it could eliminate another 30% of its reliance on imported water. While that may seem like a lot, Israel – which also has a limited water supply – recycles 85% of its wastewater.

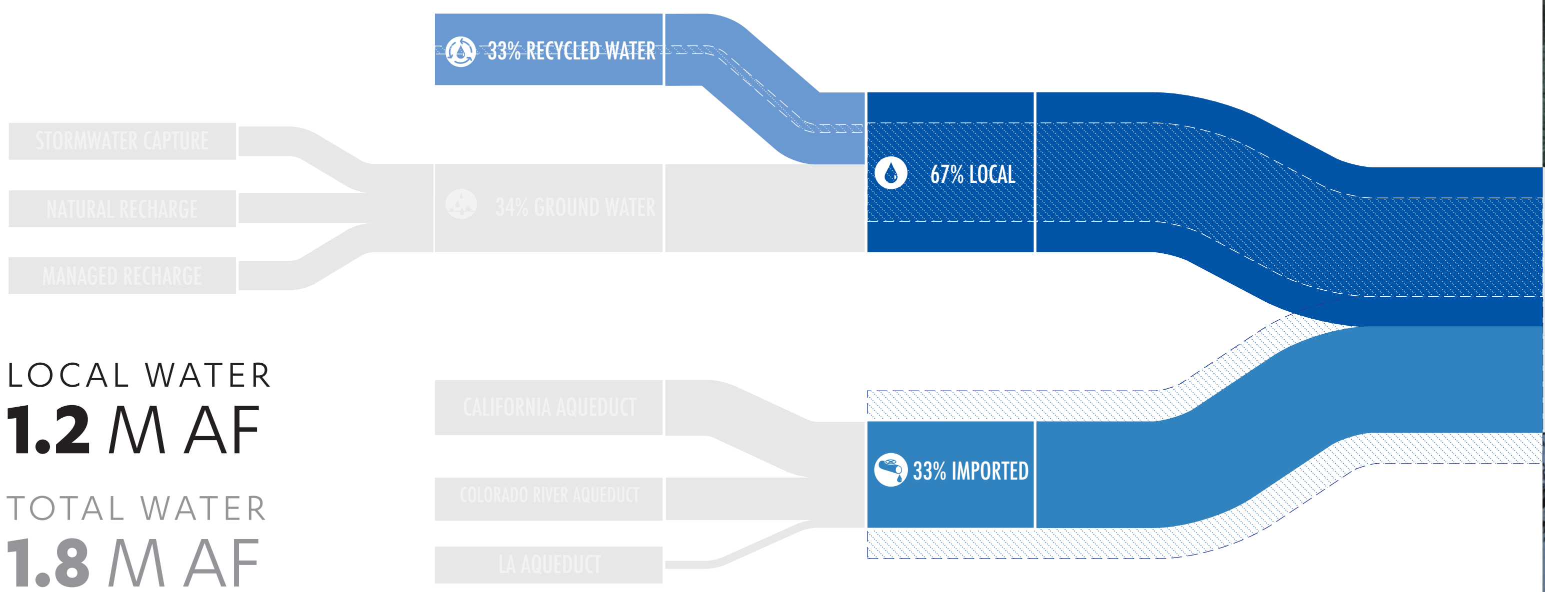
2050 PROJECTION

67%

LOCAL WATER

(37% BASELINE + 30% SUPPLY)



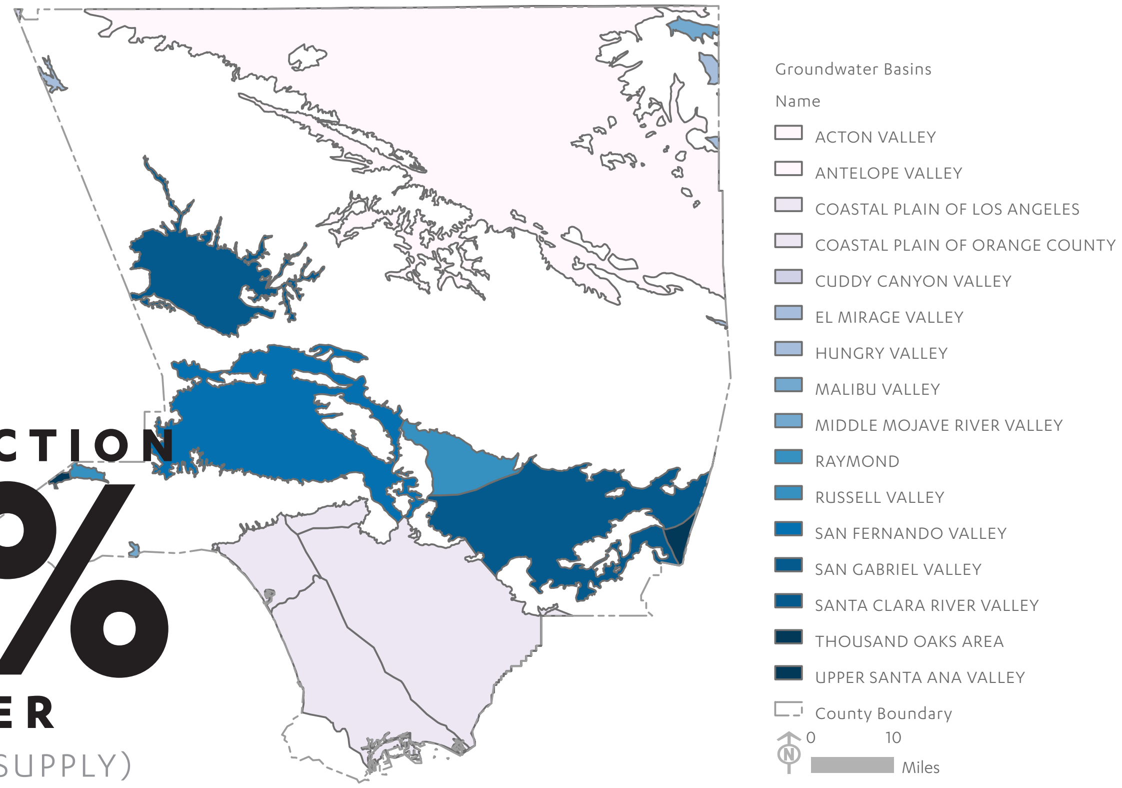


LOCAL WATER
1.2 M AF

TOTAL WATER
1.8 M AF

STRATEGY #5: BETTER GROUNDWATER QUALITY WILL MAKE CURRENTLY UNUSABLE LOCAL WATER AVAILABLE FOR USE

Efforts to clean up historical groundwater contamination, including saltwater and organic pollutants, are occurring in LA County already. An additional 5% of local water supply could be obtained by desalting just 1/6 of the 600,000 acre-feet of brackish groundwater currently present in the West Coast basin underlying LA County. Research groups at UCLA are pursuing additional emerging technologies to clean up groundwater contamination in a way that is less energy-intensive and more cost-effective than imported water.

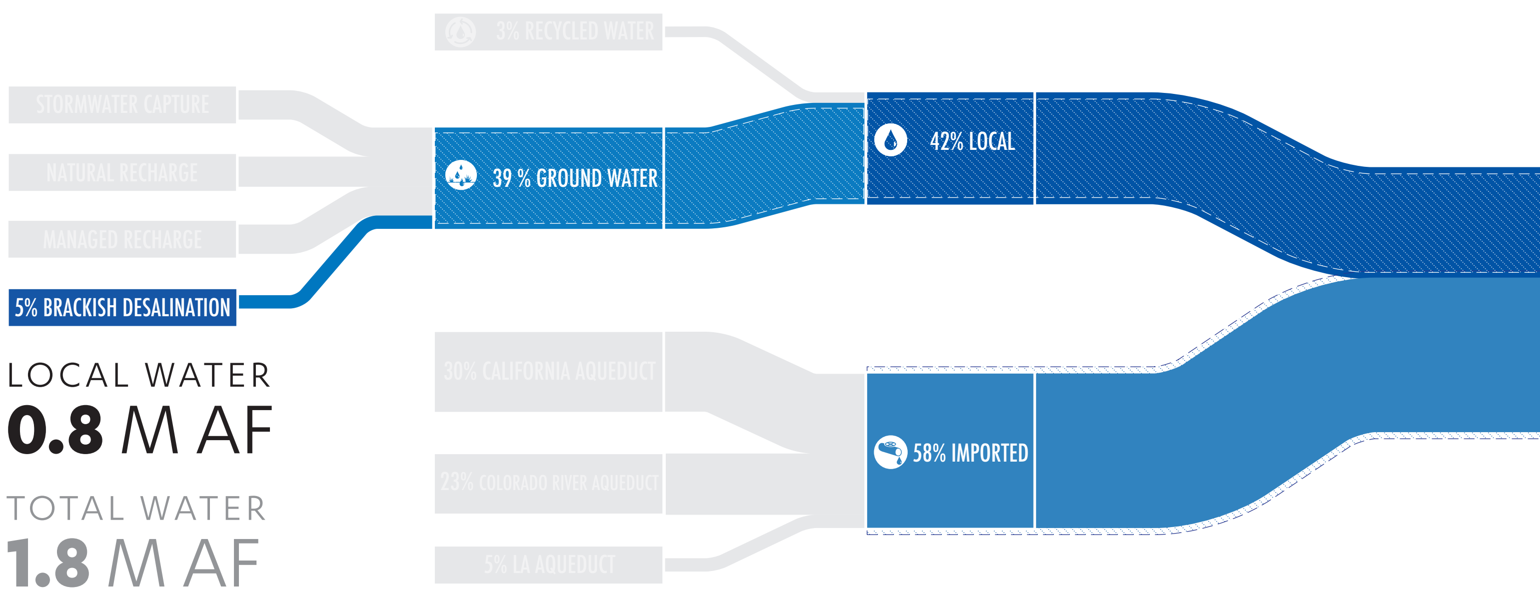


2050 PROJECTION

42%

LOCAL WATER

(37% BASELINE + 5% SUPPLY)



LOCAL WATER
0.8 M AF

TOTAL WATER
1.8 M AF

TOP-DOWN

62

2050 PROJECTION

100%

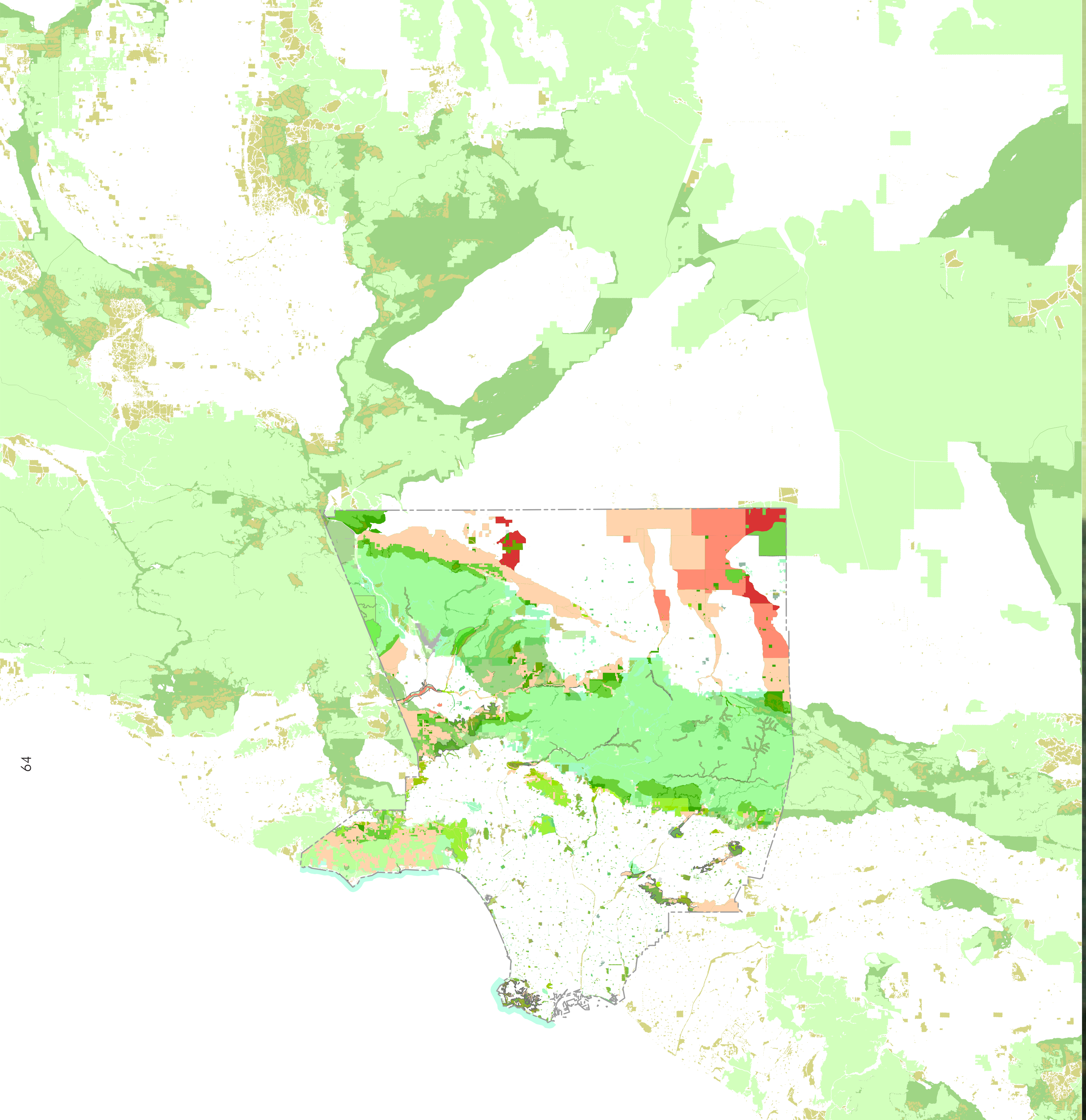
LOCAL WATER

WATER
2050 STRATEGIES

To ensure a secure future and achieve the 100% local water goals, LA County must pursue a combination of strategies that includes decreased demand and increased supply through stormwater capture, recycling, and groundwater remediation. The solution requires a shift in cultural, political, and technical landscape

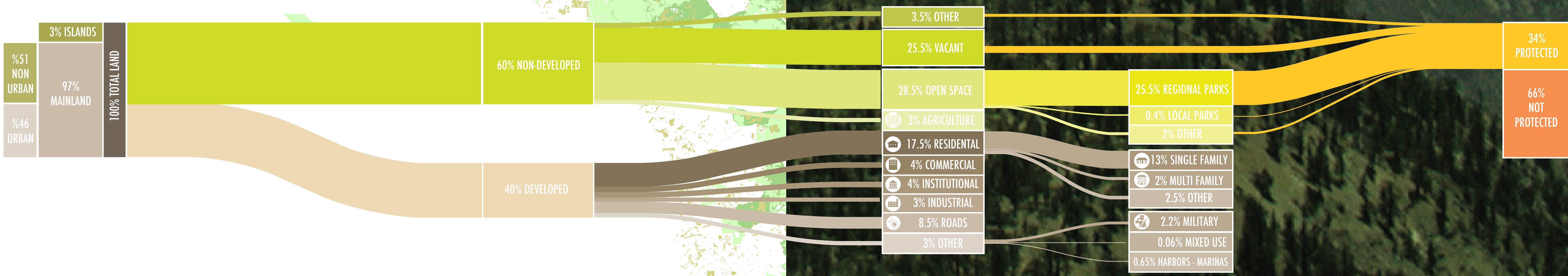
100% local water is an economic and strategic necessity–and is possible. Ensuring a secure future means investing in and advancing policies and technologies that will incentivize appropriate water use and make local water the most energy- and cost-efficient option.

WATER



ECOSYSTEM
ENHANCED HEALTH

LA County lies within the California Floristic Province, globally recognized as one of just 35 biodiversity hotspots in the world - the only one in the continental United States. LA has 4,346 identified species, 92 of which are endangered or threatened. Significant Ecological Areas make up 1/4 of the County, but are largely unprotected and have been affected by development. If LA continues to develop at current densities, LA will lose another 150,000 acres by 2050. That's more than 10X the size of the Wilshire corridor. Moreover, an additional 150,000 acres of urbanized land will need to be served with parks, stretching resources to improve existing park access and quality. An integrated and cross-disciplinary approach is needed to identify how to both protect and incorporate natural environments that define the LA region and contribute to the overall welfare of its citizens.

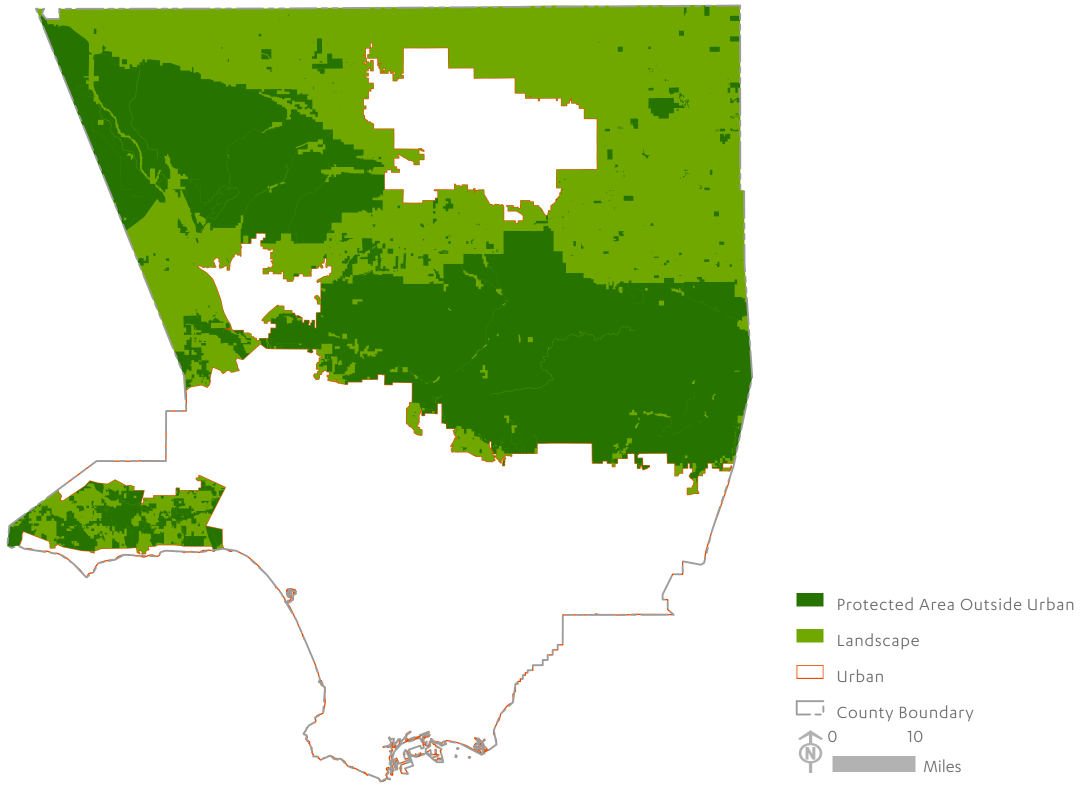


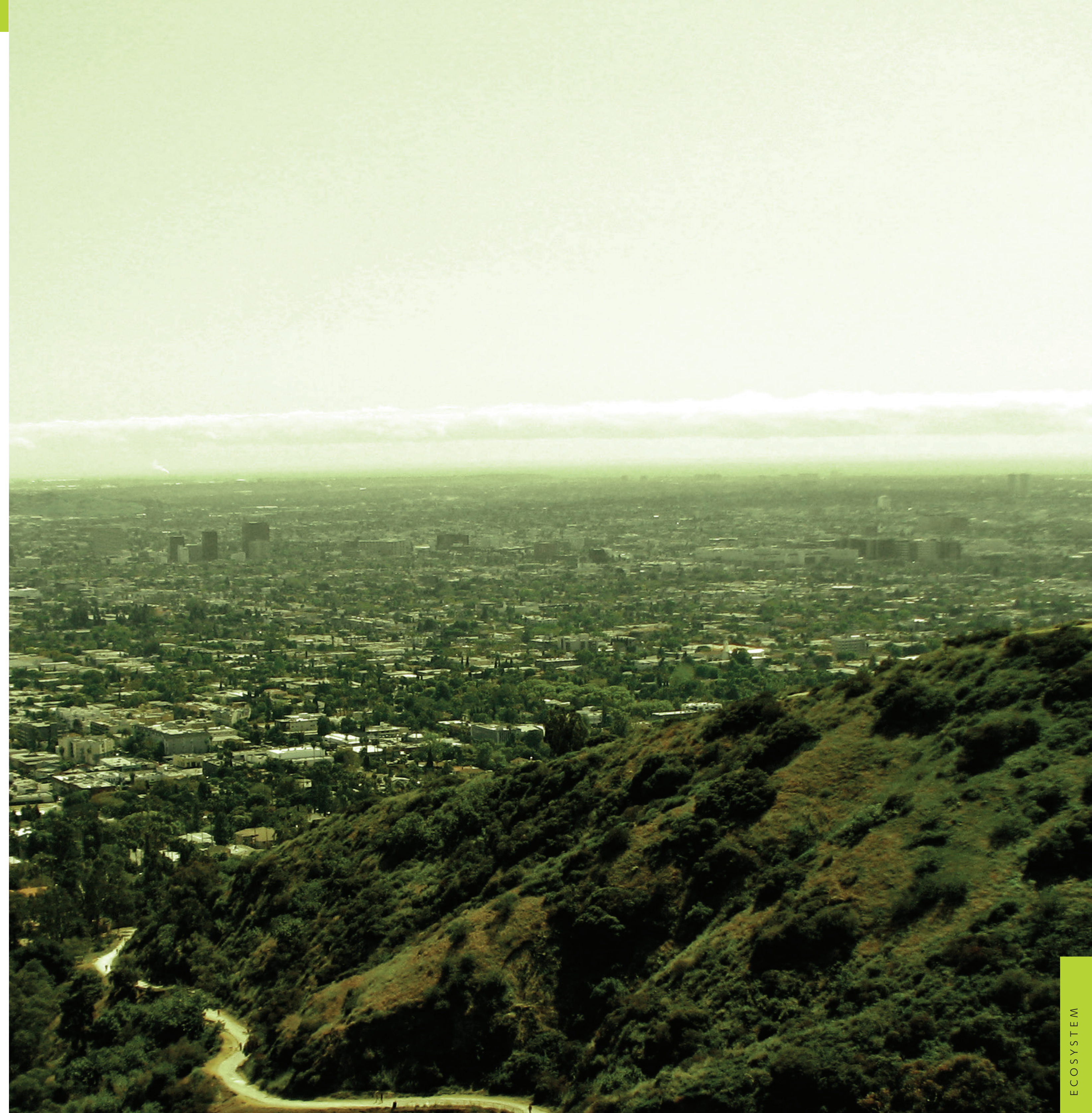
SUPPLY

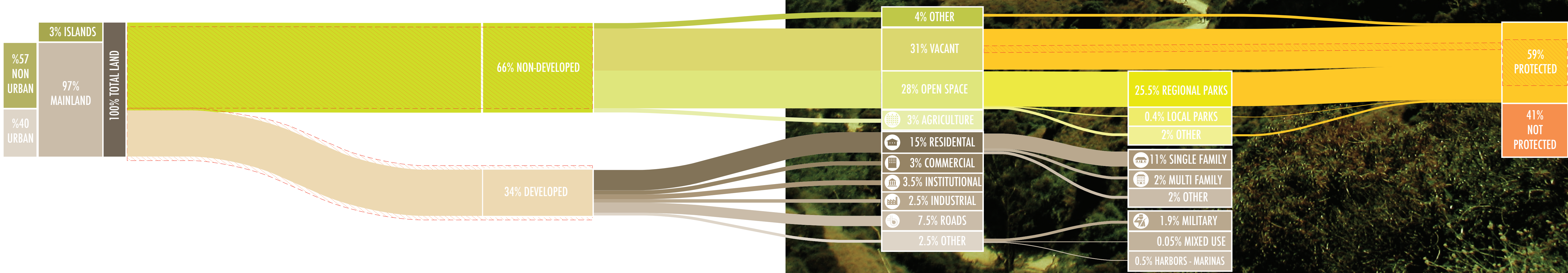
DEMAND

STRATEGY #1: PROTECT ALL NON-URBANIZED LAND BY DOUBLING THE PROTECTED NATURAL LANDSCAPE IN LA COUNTY.

Currently, around 30% of the County's natural land is protected from development, and another 30% of natural land is non-developed but unprotected. By providing greater development opportunities within existing urban areas and discouraging growth outside of these areas, the addition of 1.5 million people in LA County in 2050 may have a limited effect on the natural environment. Protecting every piece of currently unurbanized land is a thought experiment that shows the most extreme possible impact.

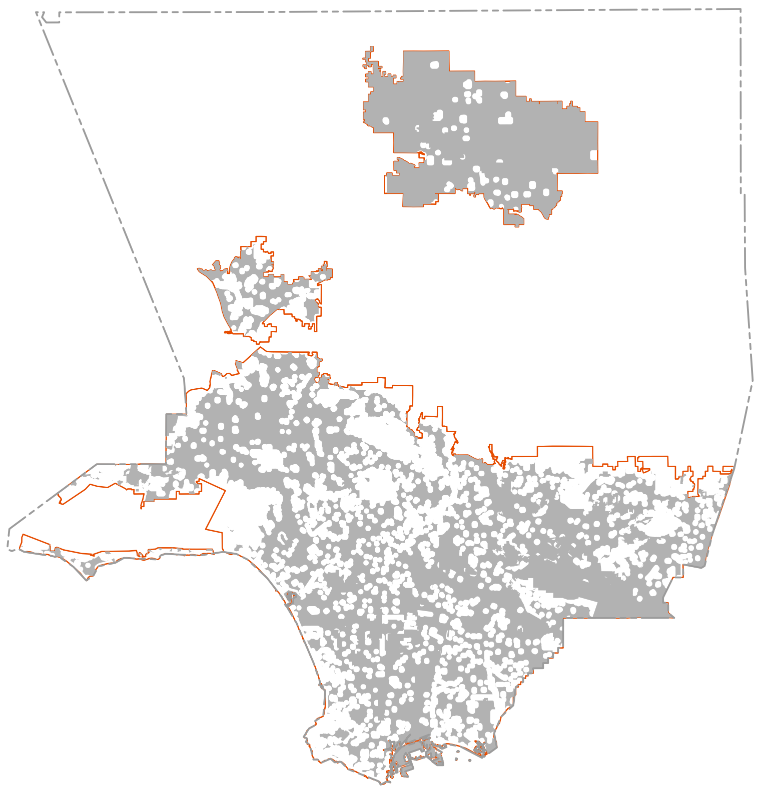






STRATEGY #2: ENSURE EVERY ANGELENO LIVES WITHIN ¼ MILE OF A PARK BY BUILDING 2.5X AS MANY PARKS AS EXIST TODAY.

Less than half the urban area is inside ¼ mile distance to a park. As the urban area expands, municipalities will not only need to enhance park access for existing areas to meet the ¼ mile access to open space goal, but will need to build more parks to accommodate a larger service area.

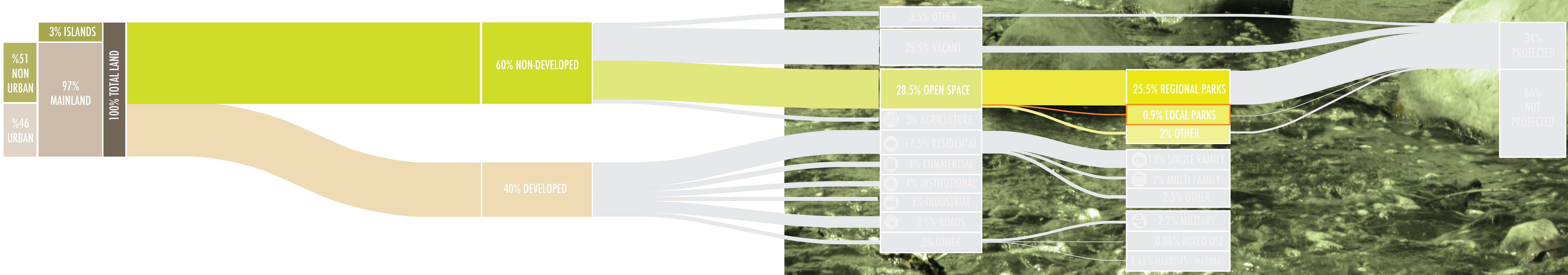


Urban

Area outside 1/4 miles distance to a park

County Boundary

0 10 Miles

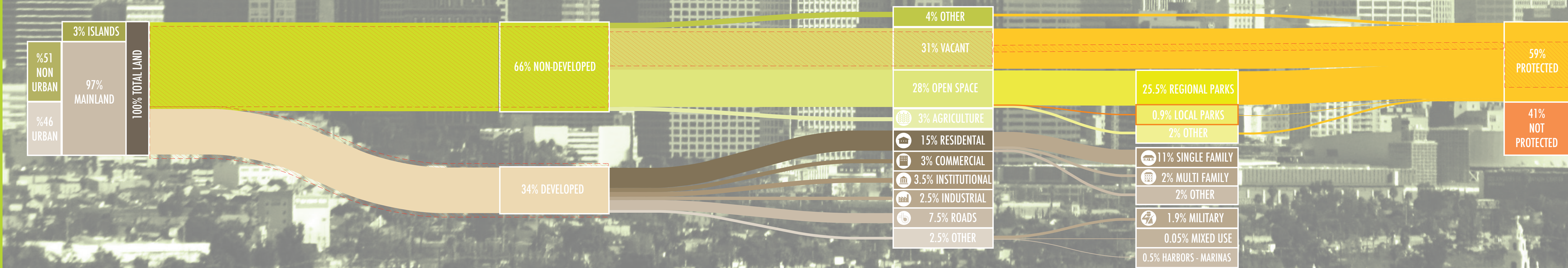


ECOSYSTEM
2050 STRATEGIES

Increasing green space to sustain biodiversity also increases human well-being.

Ecosystem health, as a broad term applied to human, animal, and plant life, requires a corresponding broad-level strategy that considers the urban and natural environments as a part of an interconnected and united ecology. Strategies are not isolated but, rather, holistic and have multiple positive impacts on human and natural life.

Building from the current effort, the ecosystem health characterization will be refined to higher resolutions and finer spatial scales. In urban areas, additional indicators are envisioned to include landscape, tree canopy, open space, and land cover characteristics at neighborhood and finer scales. When complete, indicators and maps will help guide biodiversity, climate change adaptation, ecosystem management, land use, public health, and infrastructure decisions.



CONCLUSION
NEXT STEPS

CONCLUSION

Los Angeles' position as a global economic powerhouse, in conjunction with its diverse cultural milieu, establishes the County as an especially powerfully role-model for managing growth in the 21st century. Its intellectual prowess and business acumen will provide the necessary fertile ground for economic development, guided by the dedication of its public servants, community leaders, and activists. Los Angeles County beats as the heart of the whole metropolitan region — and its leadership has the capacity to transform not only the lives of those within its 88 cities, but the many millions who depend on LA for their careers and dreams.

The UCLA Sustainable LA Grand Challenge seeks to guide LA County's path to sustainability in the face of a growing urban population and the effects of climate change on the region. Specifically, Sustainable LA aims to transition the County to renewable energy, local water, and enhanced ecosystem and human health while creating an even more prosperous and desirable megacity for its anticipated 11.5 million inhabitants by 2050. This study was a first step at looking at this challenge comprehensively from a macroscopic viewpoint - it was an attempt to lay out and thoughtfully consider a variety of strategies and pathways to meet the ambitious Sustainable LA goals. Each of the foregoing strategies and conclusions are only a first glance at what is possible for Los Angeles County in the coming decades. The focus of this approach was to provide a broad overview of the state of affairs in Los Angeles today — and to catalyze a discussion on future directions for further research and development.

By organizing the sustainability challenges in energy, water, and ecosystem health in terms of supply and demand, we were able to better understand the dynamic interchange of resources that shapes LA County's character and nature. This framework allowed us to examine the potential impact of each strategy on reaching the ambitious 2050 sustainability goals by examining its relative contribution compared to complementary and competing strategies. The distinction between "top-down" and "bottom-up" strategies sets the stage for the political and social discussions necessary to make positive change in LA.

100% Renewable Energy by 2050:
Imagining the energy profile of Los Angeles County in 2050 requires first understanding the problems that our rapid consumption of fossil fuels has created. With the deleterious effects of smog and pollution on human health and the direct impact of global warming manifesting in higher sea levels along the coast and higher temperatures throughout the region, our need for renewable and clean sources of energy for buildings and transportation has never been greater.

This study looked at both transportation and building energy consumption and showed that for transportation, a combination of electrification and changes in public transit ridership would have a huge impact on the energy demand imposed by getting around. Currently, LA is synonymous with traffic and congestion — with millions of cars in the region creating not only pollutants and toxic emissions, but countless hours of lost productivity due to inefficient planning and development. By continuing to support the growth of development around public transit hubs, LA can work to encourage new residents to settle in denser neighborhoods where owning a car becomes an option rather than a necessity. Initiatives to promote electric vehicles, ridesharing programs, and autonomous technologies will reduce strain on the freeways and reduce the required space for parking, which currently take 14% of the County's incorporated land. Making our transportation network truly sustainable also means integrating a more sophisticated bidirectional smart grid that allows the built environment and mobile vehicles to work cooperatively with 100% renewable energy sources.

We also explored how improvements in building energy efficiency combined with both distributed and centralized renewable energy generation could change the energy profile of LA County in 2050. Our evaluations show that solar alone can nearly do the trick. Combine solar with conservation and efficiency measures and the added effects of higher temperatures throughout much of the region due to climate change won't seem like such a burden. LA County can expect higher home cooling costs, and the hidden expenses of distributing water and other resources with "business as usual" practices, but the adoption of advanced technologies and practices to improve building efficiency, combined with smart growth and planning will thwart this impending threat.

100% Locally Sourced Water by 2050:
LA County is not unique in its struggles to effectively manage and utilize its water resources — this challenge touches the lives of many billions of individuals around the globe. California's multi-year drought may sadly be a sign of what's to come — an uncertain future rife with potential water-rights conflicts. As much of the County's water supply is currently imported from these very sources at-risk — the time to go local is now.

Our analyses demonstrated that even small changes in behavior and water management could result in a significant shift towards local water. By combining simple water conservation and efficiency strategies, both inside and outside of homes and businesses, the County could reduce the local water demand by around 30%, which would be more in-line with our forward-thinking neighbors in Europe. The capture and reuse of stormwater and other wastewater is an underutilized water management strategy in LA today. Los Angeles is far behind other countries and cities in its policies and practices to permit and facilitate water capture and recycling. These technologies and strategies can be deployed at a variety of scales and in wide-ranging situations. We found that there is in fact plenty of rainfall to feed our local water supply if combined with reuse and other water maximizing strategies. What is needed is the will and attitude to take advantage of what nature is already providing.

Enhanced Ecosystem Health by 2050:
A striking characteristic of LA County is its division into discrete urban and natural regions, bounded by the surrounding mountain ranges and the western sea. Rapid urbanization and unfettered growth have led to many new towns and developments cropping up beyond these natural boundaries. These regions, despite being some of the fastest-growing parts of the County, are also most likely to experience some of the greatest adverse effects of climate change, and therefore bear the increased costs of strained resources more severely than elsewhere.

One way to protect the natural areas throughout the County is to to take a sincere look at the growing boundaries of our urban areas. Many cities around the world are developing plans and policies to restrict wasteful, sprawling growth — seeking to not only consolidate resources but to preserve natural habitats and ecosystems for generations to come. Our strategies as related to enhancing ecosystem health looked at mitigating sprawl and increasing the amount of projected land and park space in the County. Together these strategies would increase the overall amount of land that would be more habitable by the diverse species that share our space, as well as provide more connectivity among the fragmented parcels.

As we begin to imagine what the Los Angeles of 2050 looks like — we understand now more than ever the complexity of the challenge and that we cannot do it alone. Our work has sought to be the impetus behind a new series of shared dialogues and research opportunities that harness the intellectual and creative capacity of many minds, which together are capable of meeting the challenge to conceive of and build a sustainable LA by 2050.

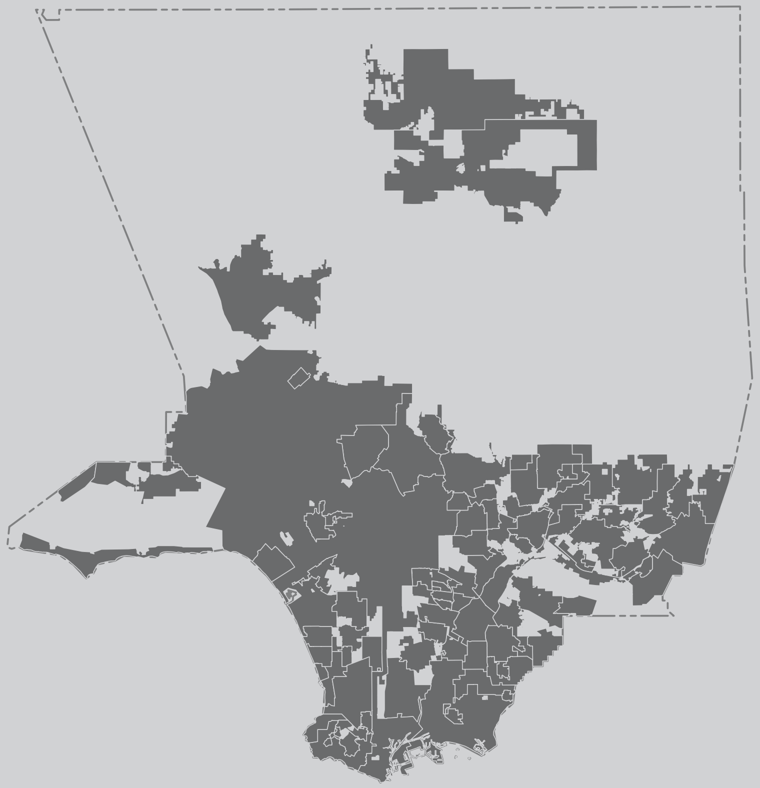
APPENDIX
REFERENCE

LOS ANGELES

CITIES

Los Angeles County
Department of Public Works

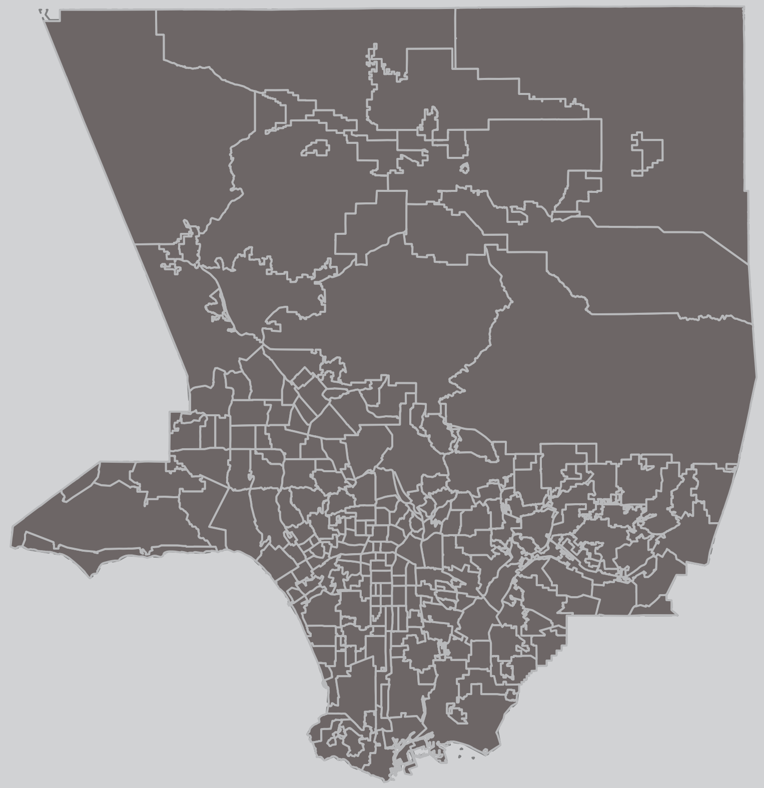
http://egis3.lacounty.gov/dataportal/wp-content/uploads/ShapefilePackages/DPW_CITY_BOUNDARIES.zip



NEIGHBORHOODS

Los Angeles Times

http://boundaries.latimes.com/sets/



GREATER LOS ANGELES

State of California Geoportal

http://www.atlas.ca.gov/download.html#/casil/boundaries

REGIONS

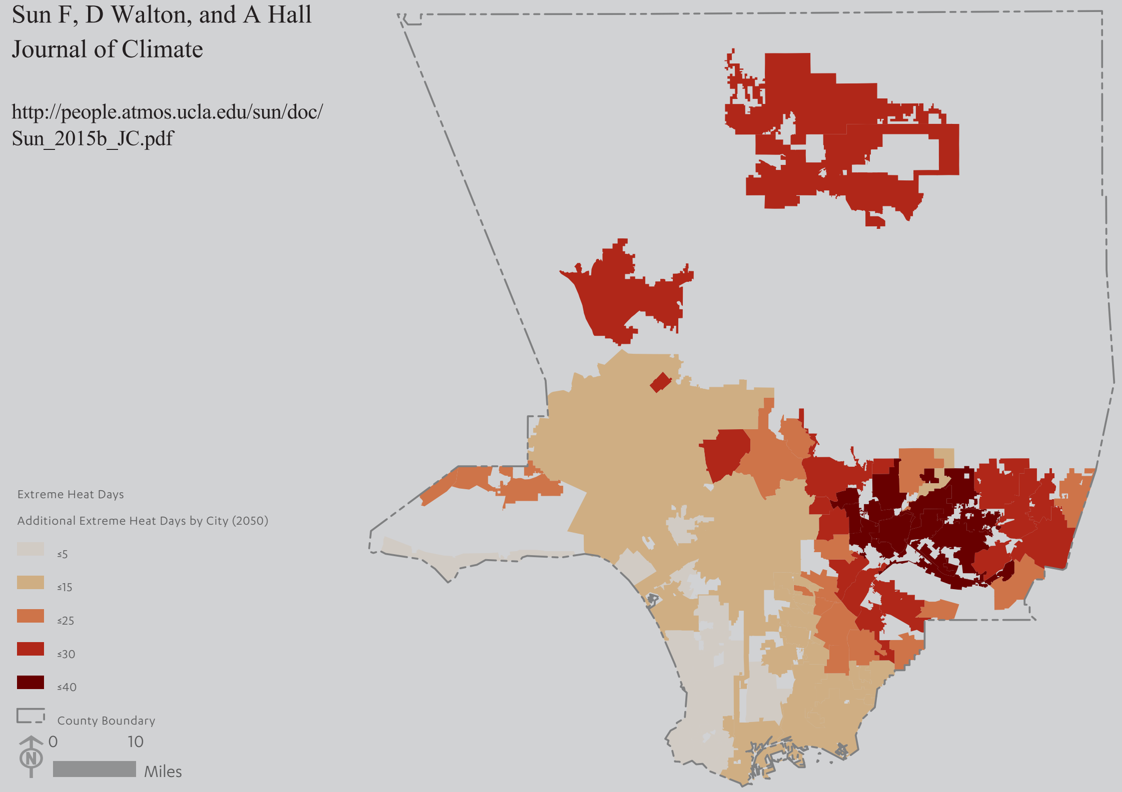
Los Angeles Times

http://boundaries.latimes.com/sets/

EXTREME HEAT DAYS

Sun F, D Walton, and A Hall
Journal of Climate

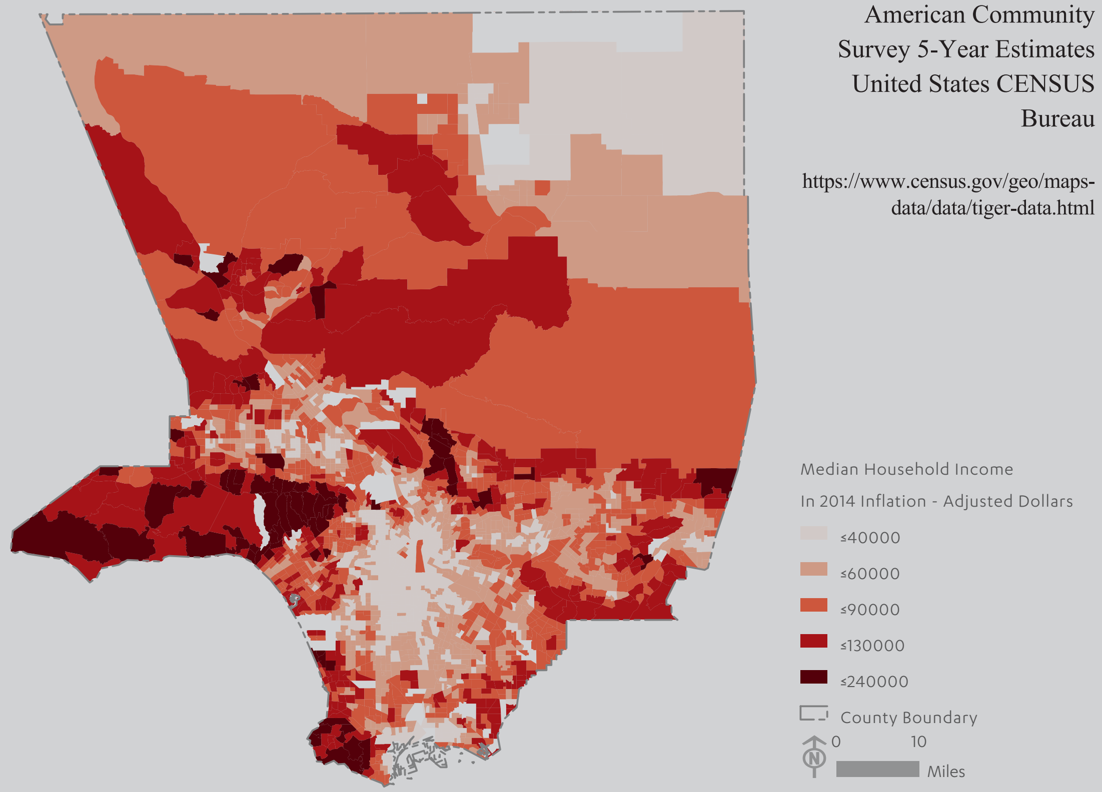
http://people.atmos.ucla.edu/sun/doc/Sun_2015b_JC.pdf



MEDIAN HOUSEHOLD INCOME

American Community Survey 5-Year Estimates
United States CENSUS Bureau

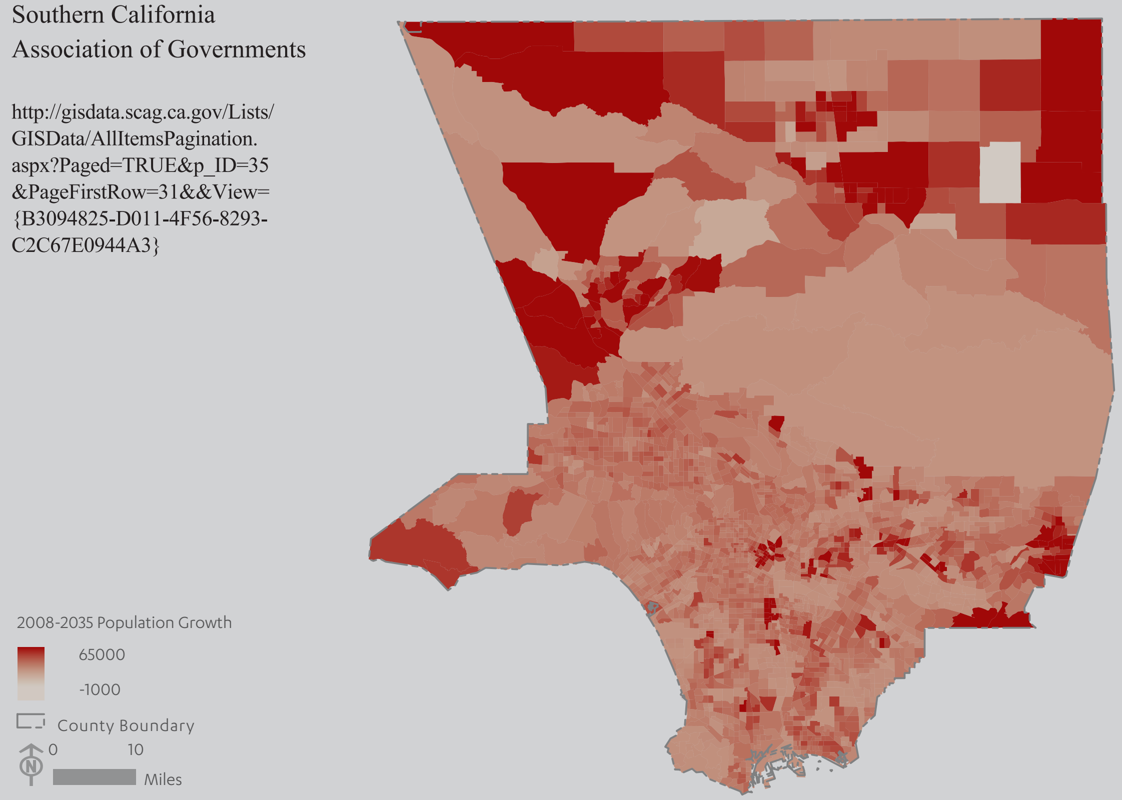
https://www.census.gov/geo/maps-data/data/tiger-data.html



POPULATION GROWTH

Southern California Association of Governments

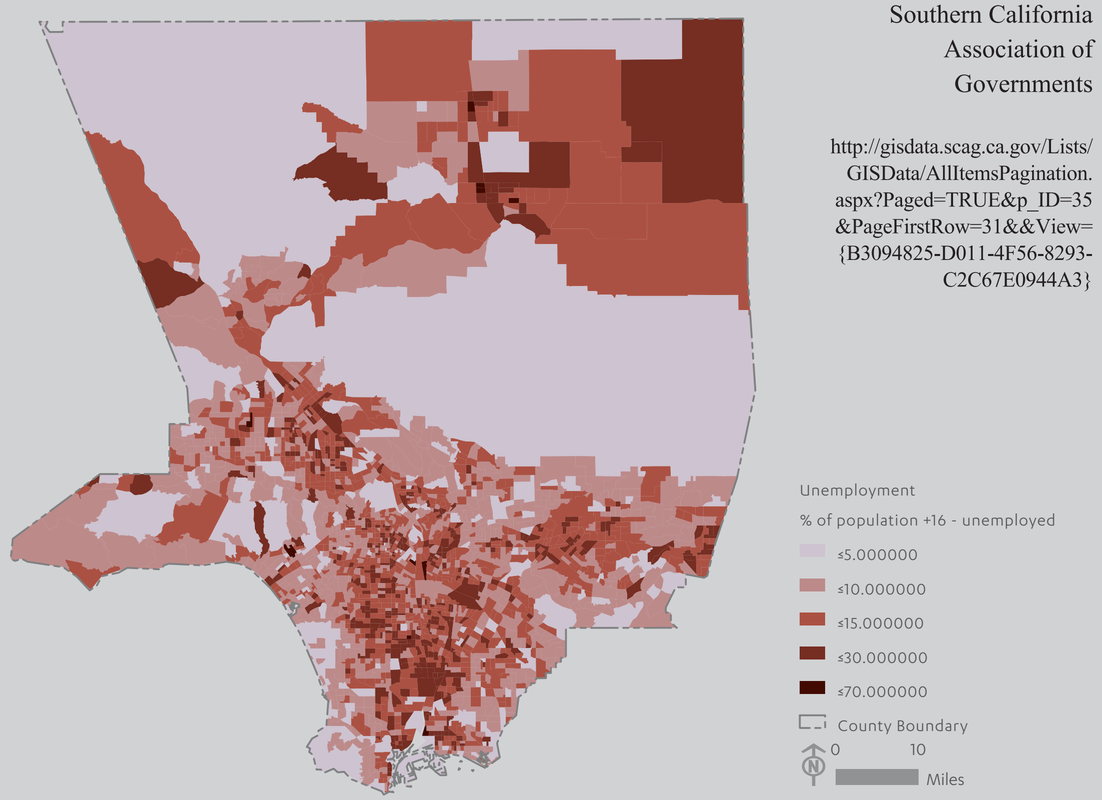
http://gisdata.scag.ca.gov/Lists/GISData/AllItemsPagination.aspx?Paged=TRUE&p_ID=35&PageFirstRow=31&&View={B3094825-D011-4F56-8293-C2C67E0944A3}



UNEMPLOYMENT

Southern California Association of Governments

http://gisdata.scag.ca.gov/Lists/GISData/AllItemsPagination.aspx?Paged=TRUE&p_ID=35&PageFirstRow=31&&View={B3094825-D011-4F56-8293-C2C67E0944A3}



POINTS OF INTEREST

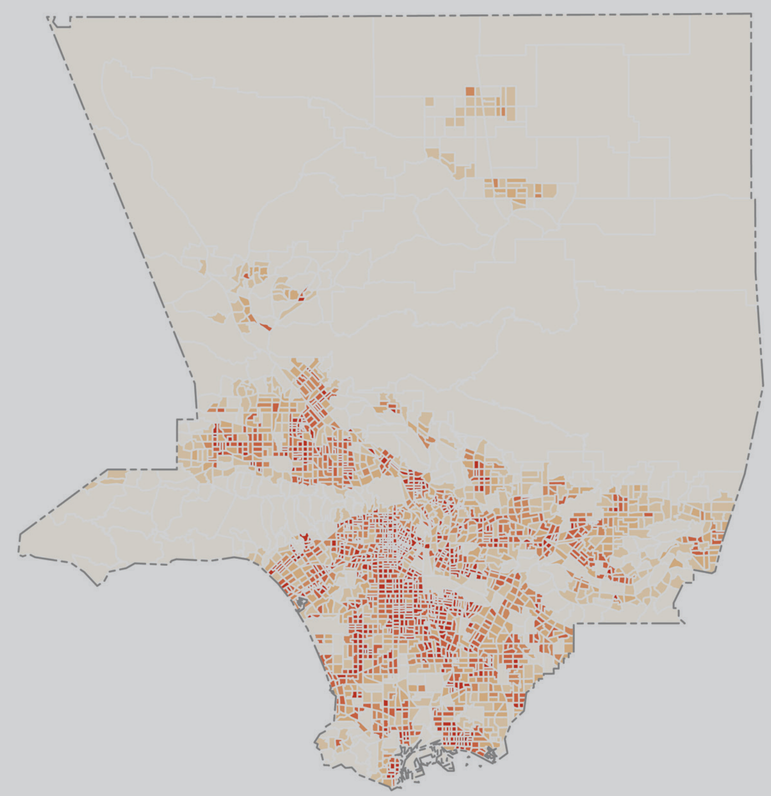
Los Angeles County
Department of Public Works

http://egis3.lacounty.gov/dataportal/2016/01/14/locationspoints-of-interest-lms-data/

POPULATION DENSITY

American Community Survey 5-Year Estimates
United States CENSUS Bureau

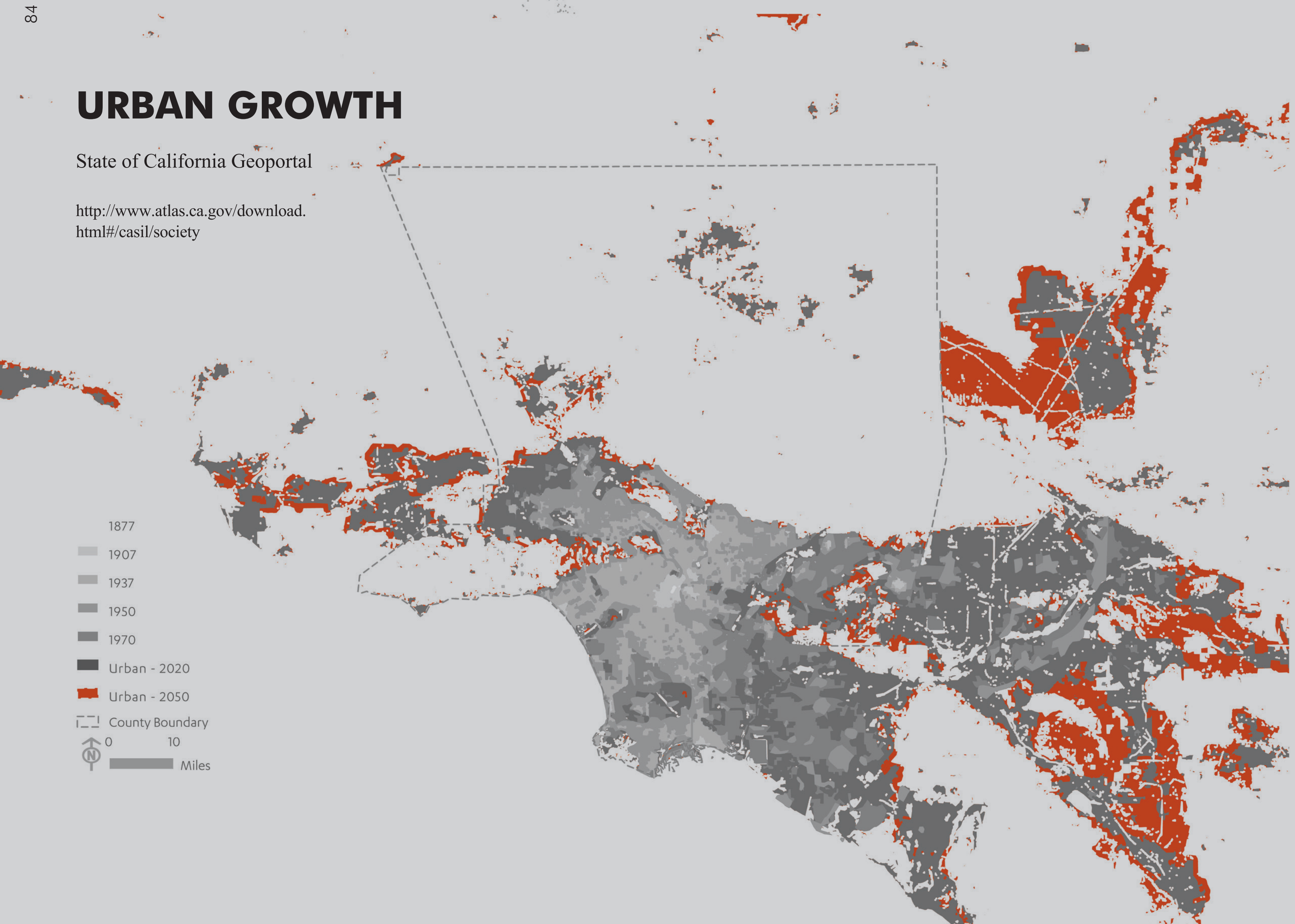
https://www.census.gov/geo/maps-data/data/tiger-data.html



URBAN GROWTH

State of California Geoportal

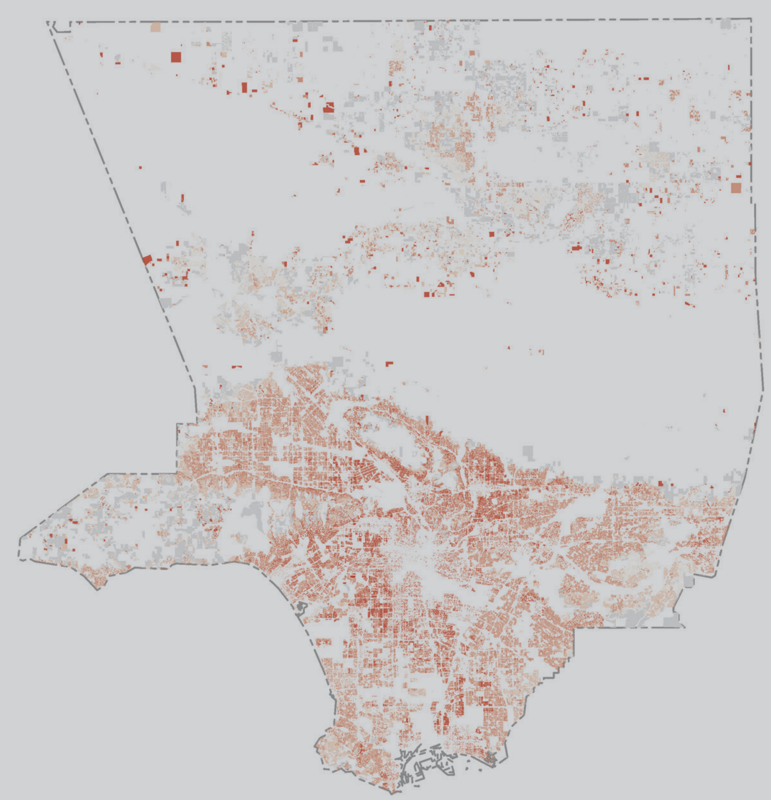
http://www.atlas.ca.gov/download.html#/casil/society



SINGLE-FAMILY HOMES BY YEAR BUILT

Los Angeles County
Department of Public Works

http://egis3.lacounty.gov/dataportal/2015/03/10/assessor-parcel/



TRANSPORTATION

ENERGY: TRANSPORTATION

GASOLINE AND DIESEL MAKE UP HALF OF LA'S DIRTY ENERGY SUPPLY

Gasoline and diesel account for 55% of total energy supply, half of the nonrenewable supply, and are the largest nonrenewable contributors to LA County's dirty energy supply.

FUEL AND EMISSIONS

Los Angeles County burns 3.45 billion gallons of gasoline per year, more than any other county in America and as much as the entire country of Spain.
Transportation emissions in LA County account for 33 million annual tons of CO2. 54% of the County's CO2 emissions that produce smog are caused by transportation.

LA'S PUBLIC TRANSPORTATION USES AS MUCH ENERGY PER MILE AS CARS

Energy efficiency of mass transit depends on high occupancies. But in spite of an investment in new light rail and subway lines, Metro currently has fewer passengers than it did thirty years ago, and transit ridership is shrinking yearly. Only 7% of LA commutes by transit compared to 56% in New York. Higher occupancies would increase per-passenger-mile energy efficiency.

TRANSIT ACCESS

Metro plans to spend more than $12 billion over the next 10 years to build two new rail lines and three extensions, the largest capital investment of any transit agency in the country. However, these improvements to the transit system will only increase energy efficiency if they are met with a live/work/transit lifestyle aided by proper city planning. Currently transit-based commutes take about twice as long as in a car due in part to dispersed housing and workplaces.

DAILY MILES DRIVEN IN LA WOULD CIRCLE EARTH 8000 TIMES

Traffic is so bad in the Los Angeles metro area that each resident loses $2,826 a year twiddling their thumbs in traffic—at a total cost of close to $30 billion. That's enough to build five subway lines, each the scale of the Purple Line extension, every single year.

CAR EFFECTS

The impact of cars goes beyond energy consumption, time wasted, and emissions. Cars are parked 90% of the time. 14% the LA County's incorporated land is devoted to parking lots. That's 40% more land for parking than for roads. 3.3 spaces exist for every car in the city. By eliminating parking, land could be used to increase residential stock, which would drive down housing prices, or could be turned into parks that filter stormwater and provide recreation and habitat.

IF NOTHING CHANGES, LA WILL HAVE 1 MILLION MORE VEHICLES IN 2050

Cars in 2050 will pump emissions into LA County's most populated areas equal to four coal power plants ever year. This does not take into account the increased congestion or longer commute times associated with sprawled housing of the new population, both of which will add even more to transportation-related fuel and emissions.

CO2 IMPACT

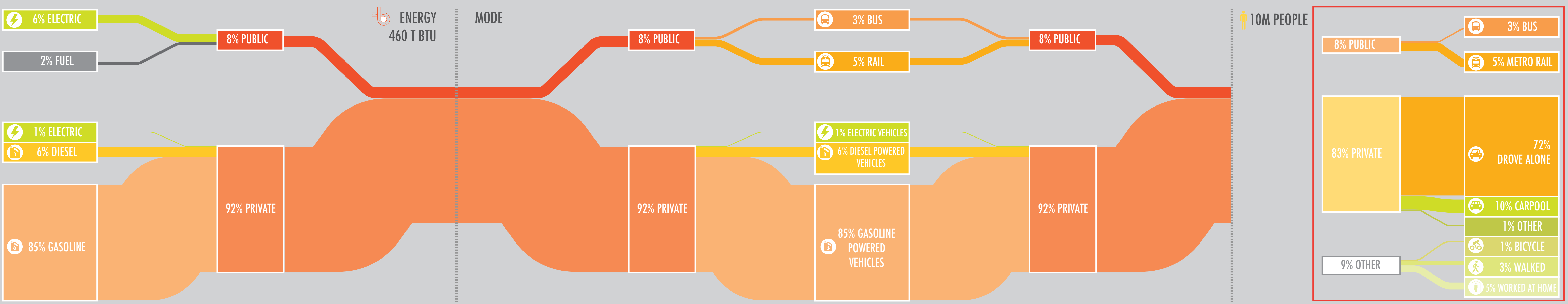
More cars means not only more individual emissions, it could actually multiply emissions from existing cars many times over. If congestion reduces freeway speed below 45 mph, CO2 emissions increase significantly with more vehicles spending more time on the road.

RIDESHARING AND AUTONOMOUS VEHICLES DECREASE ENERGY USE

Decreasing congestion means decreasing energy use. UC Researchers estimate that every carsharing vehicle removes between 9 and 13 other vehicles from the road. Moreover, it eliminates the search for street parking which accounts for 30% of driving in central districts. These services also solve the first-last mile gap which support use of public transportation.

SHARED IMPACT

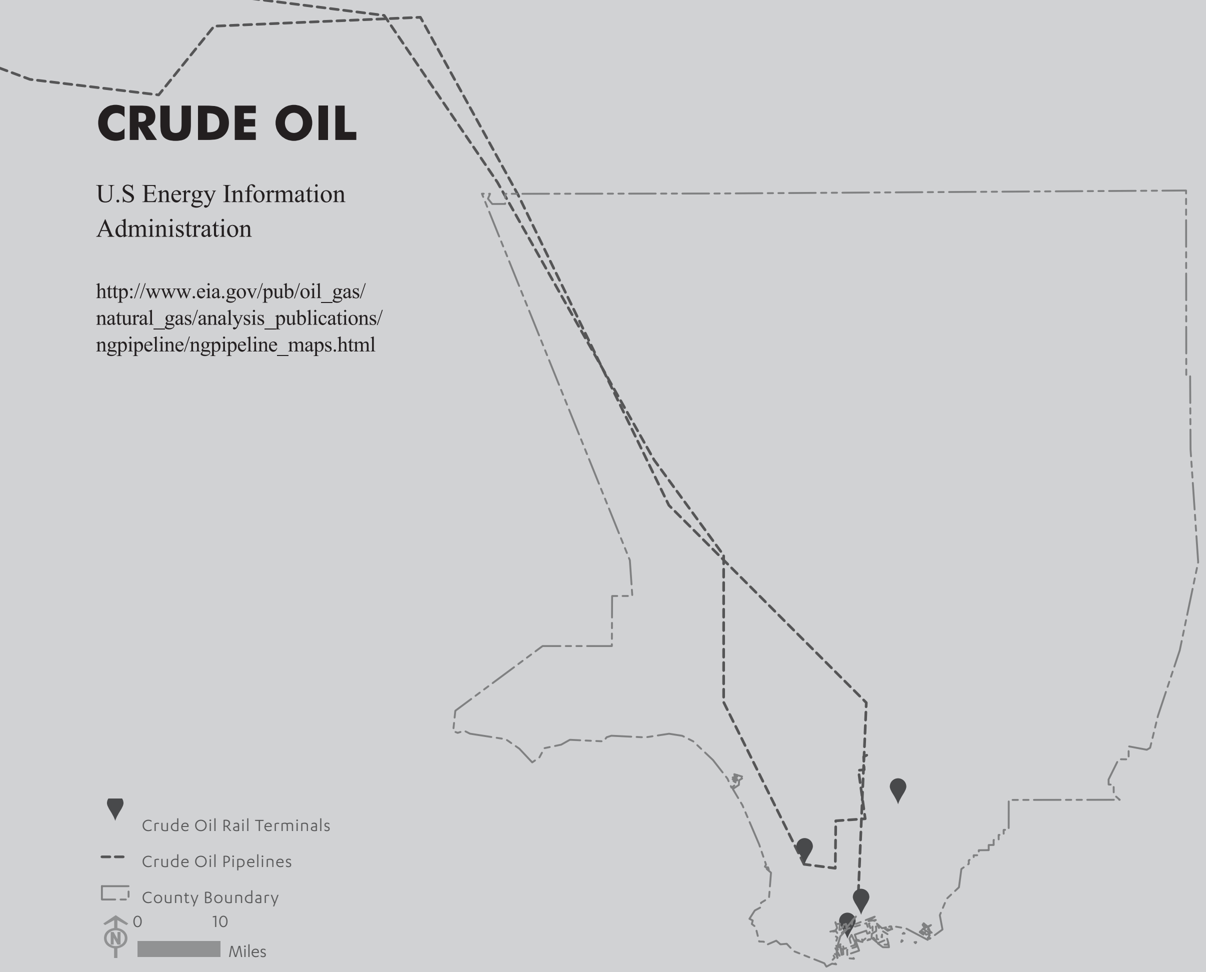
Services that reduce driving time not only reduce energy use of the individual, they alleviate overall congestion which reduced driving time for everyone. In Los Angeles, the most congested city in the US, that can mean saving millions of tons of CO2 caused by idling in traffic and excess vehicle miles circling the block for parking.



CRUDE OIL

U.S Energy Information Administration

http://www.eia.gov/pub/oil_gas/natural_gas/analysis_publications/ngpipeline/ngpipeline_maps.html



Crude Oil Rail Terminals
Crude Oil Pipelines
County Boundary
0 10
Miles

GAS STATIONS

Oil Price Information Service

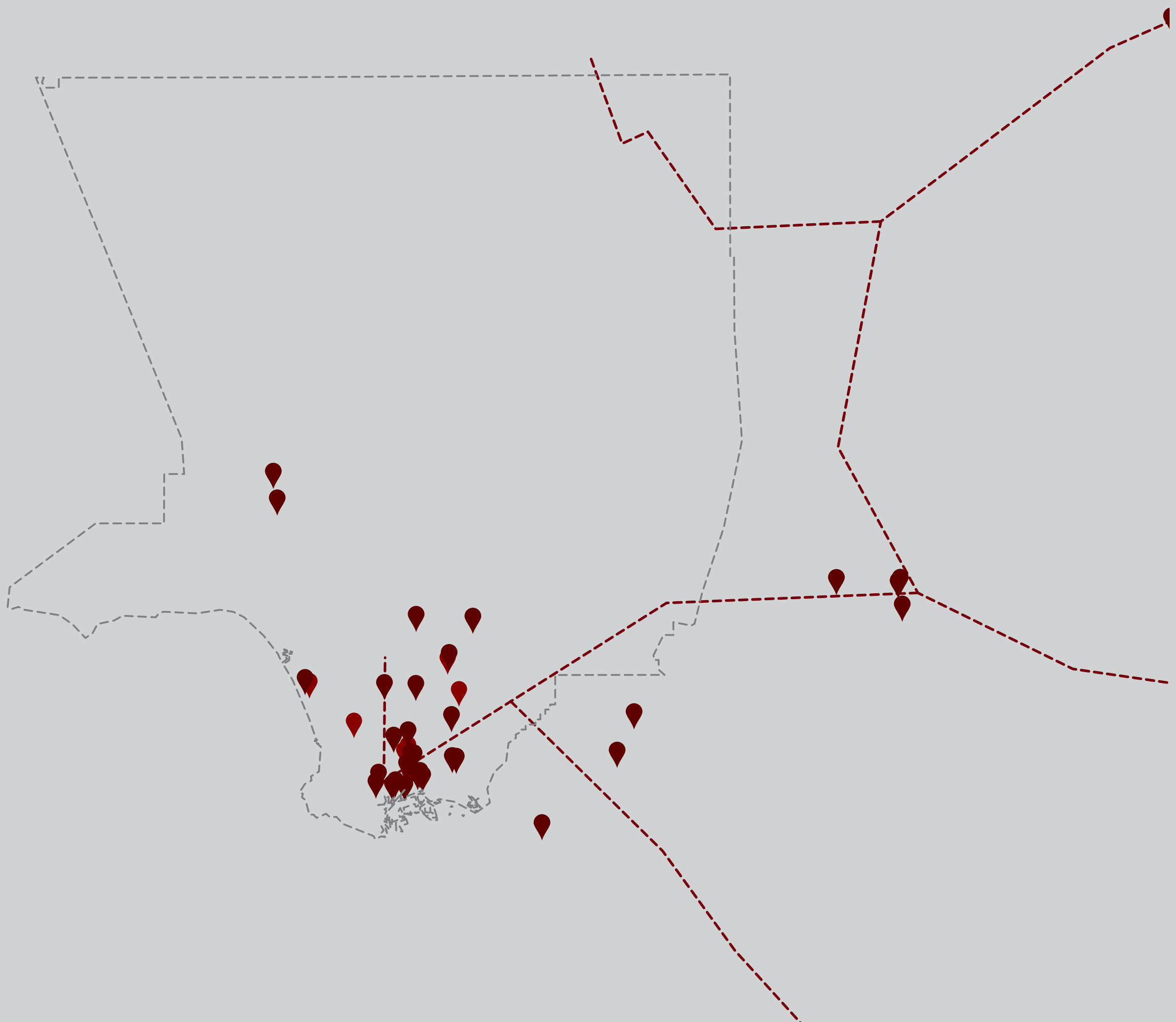
http://www.opisnet.com/

Gas Stations
County Boundary
0 10
Miles

PETROLEUM

U.S Energy Information Administration

http://www.eia.gov/maps/layer_info-m.php

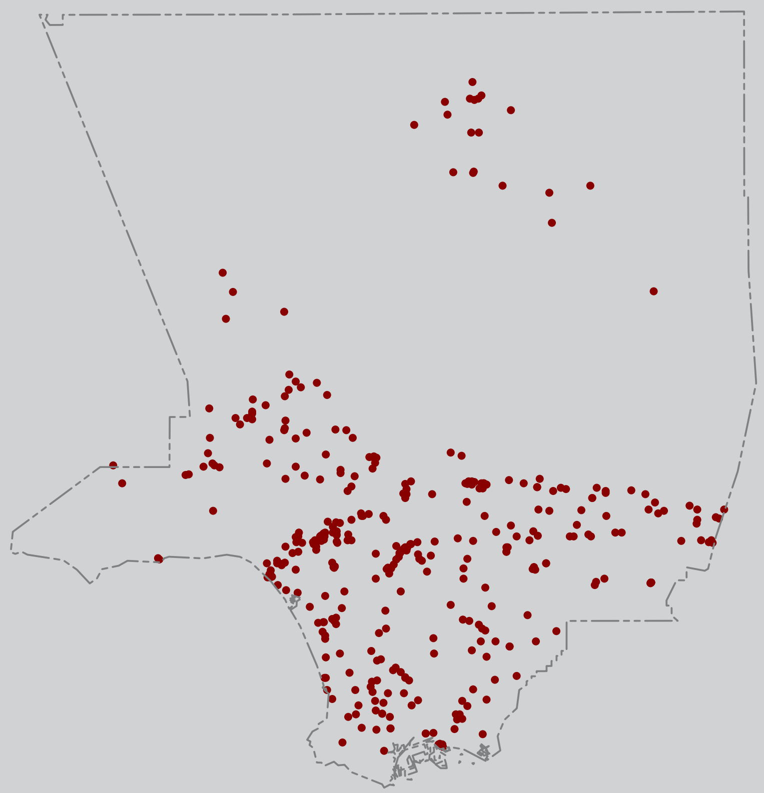


Petroleum Product Terminals
Petroleum Refineries
Petroleum Product Pipelines
County Boundary
0 10
Miles

ALTERNATIVE FUEL STATIONS

Los Angeles County Department of Public Works

http://egis3.lacounty.gov/lms/

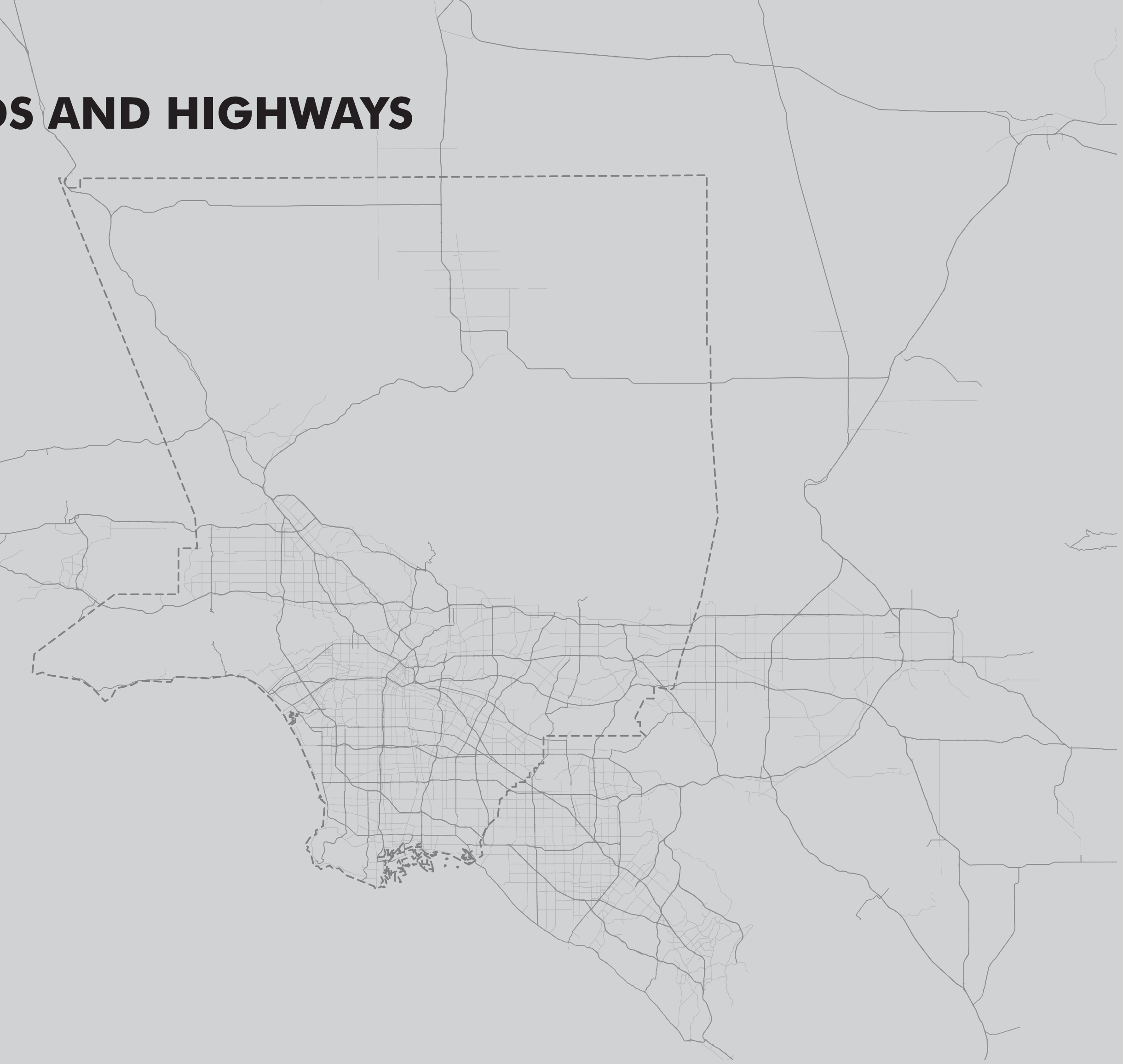


Alternative Fuel Stations
County Boundary
0 10
Miles

MAJOR ROADS AND HIGHWAYS

Los Angeles County
Department of Public Works

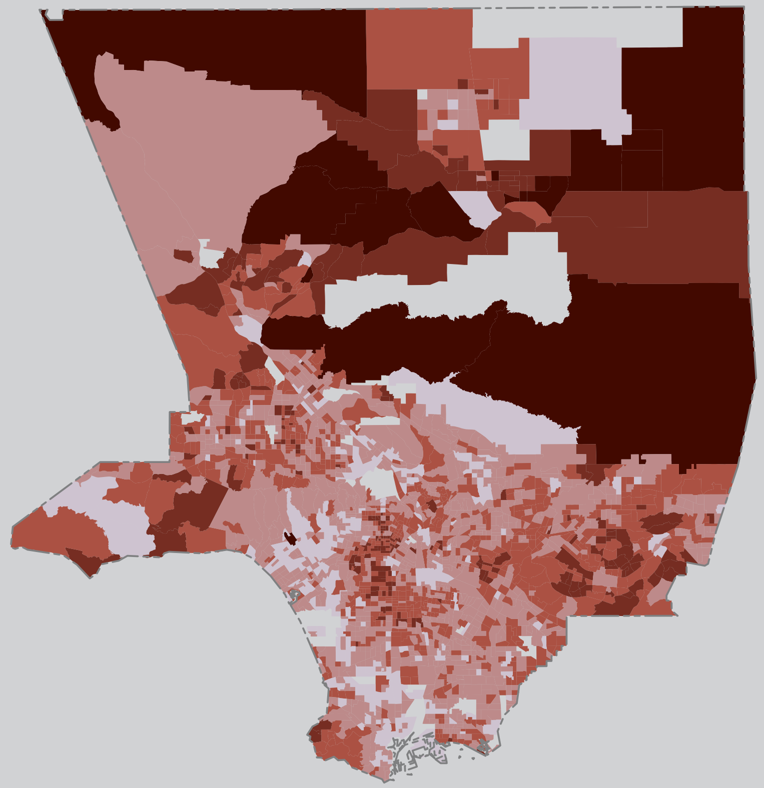
http://egis3.lacounty.gov/dataportal/2011/04/25/2010-tiger-roads/



MEAN TRAVEL TIME TO WORK

American Community
Survey 5-Year Estimates
United States CENSUS
Bureau

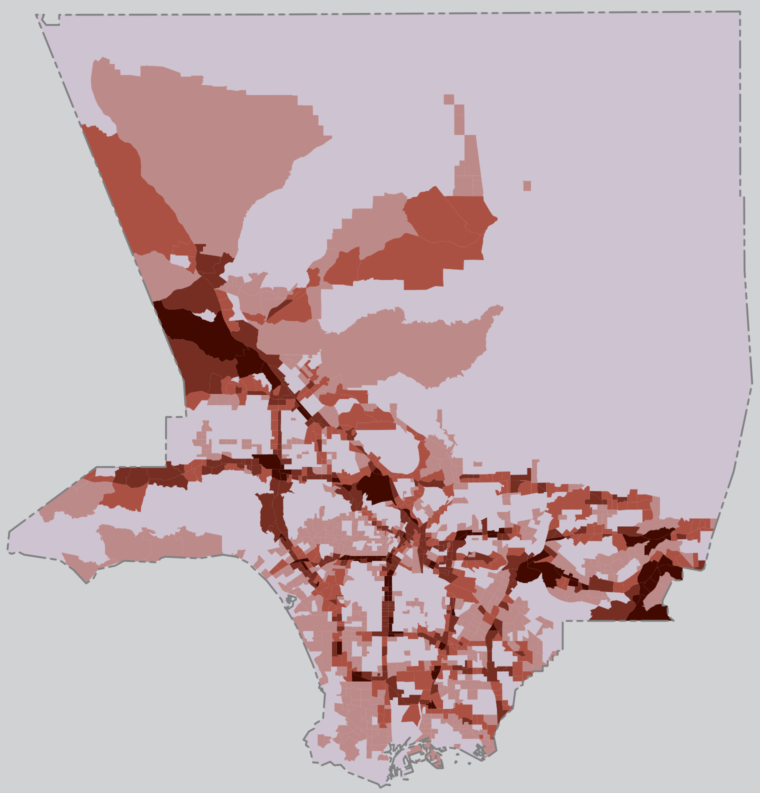
https://project.wnyc.org/commute-times-us/embed.html#9.00/34.0211/-118.4117



TRAFFIC CONGESTION

Office of Environmental
Health Hazard Assessment
CalEnviroScreen

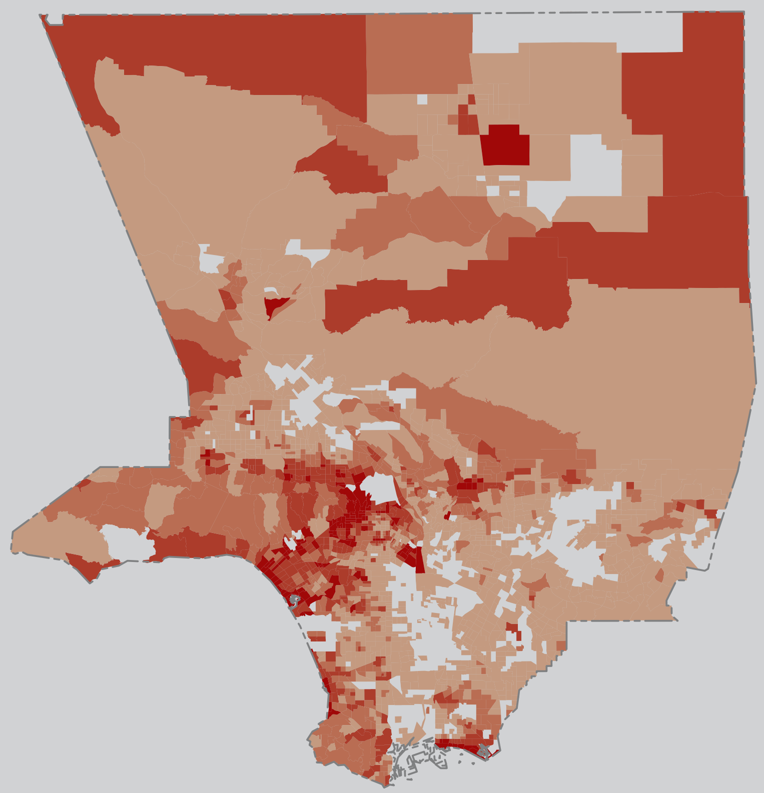
http://oehha.ca.gov/calenviroscreen/indicator/traffic-density



VEHICLES PER PERSON

American Community
Survey 5-Year Estimates
United States CENSUS
Bureau

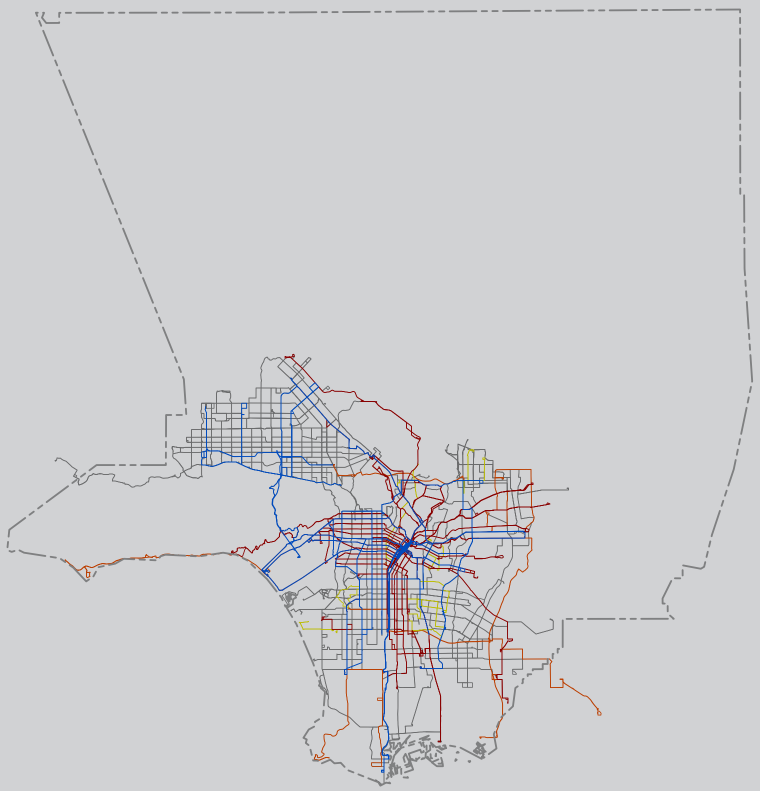
https://www.census.gov/geo/maps-data/data/tiger-data.html



PUBLIC TRANSIT METRO BUS

Los Angeles County
Metropolitan Transportation
Authority

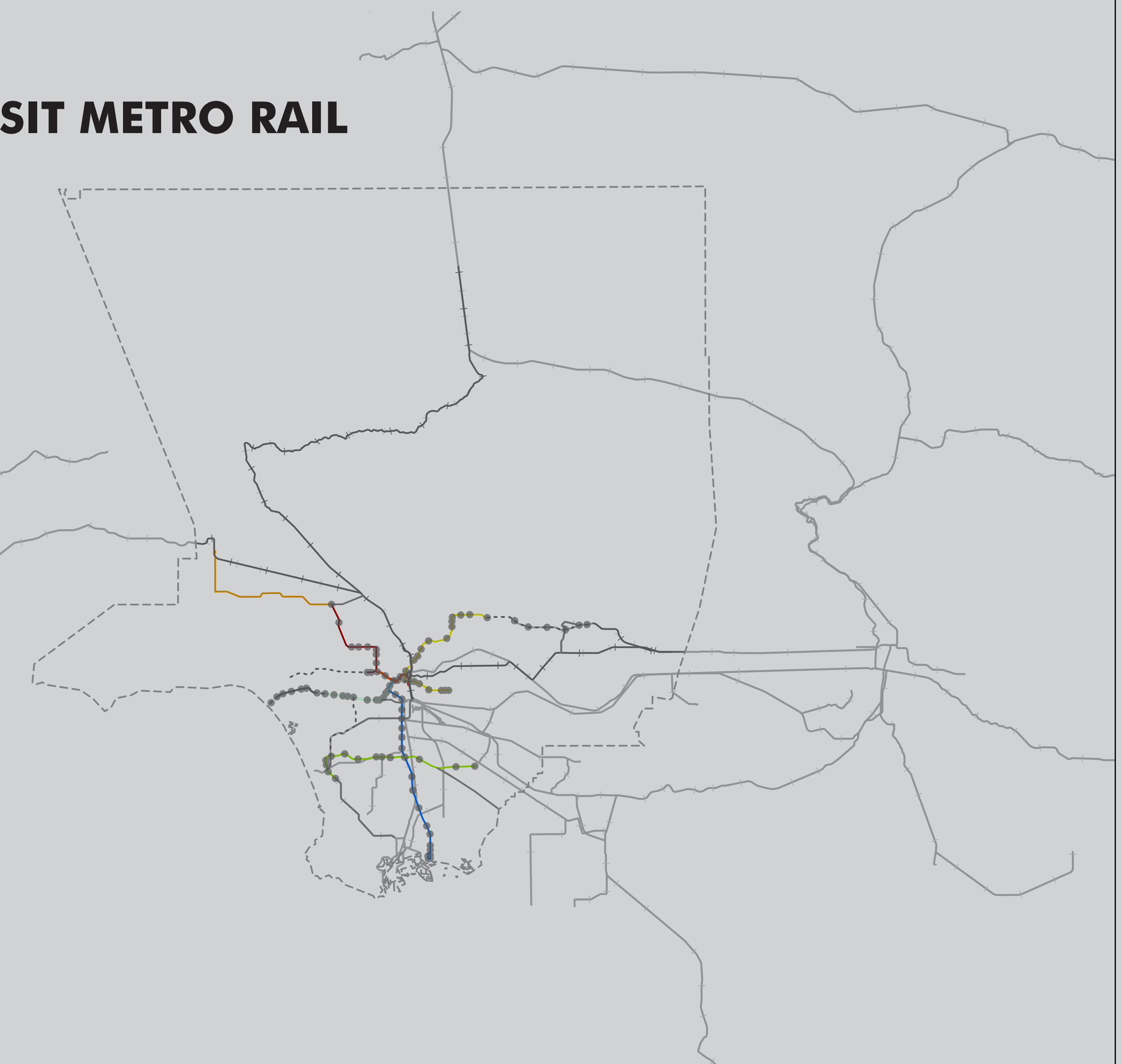
http://developer.metro.net/introduction/gis-data/download-gis-data/



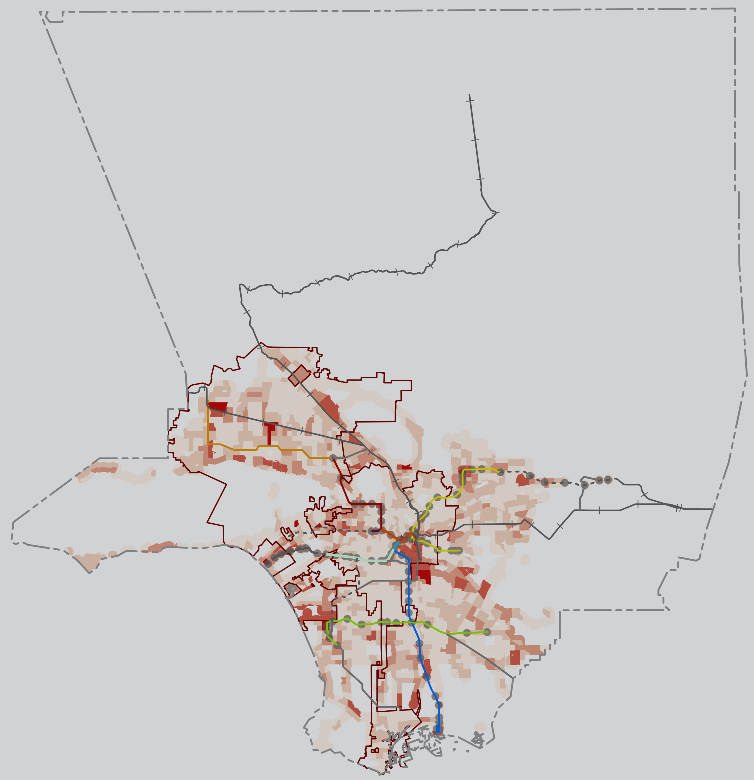
PUBLIC TRANSIT METRO RAIL

Los Angeles County
Metropolitan Transportation
Authority

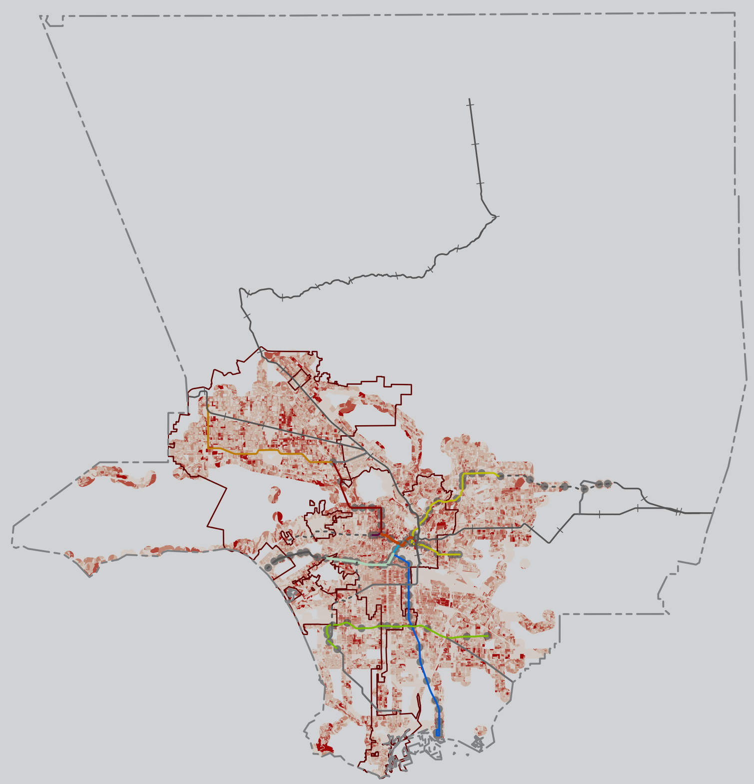
http://developer.metro.net/introduction/gis-data/download-gis-data/



TRANSIT ACCESS: EMPLOYMENT DENSITY



TRANSIT ACCESS: POPULATION DENSITY



BUILDINGS

ENERGY: BUILDINGS

LA CITY'S GRID IS ALREADY 22% RENEWABLE

Over the last decade, LA has been building upon its renewable energy portfolio, which to date includes wind, solar, biogas, small hydro, and geothermal power. At least one utility, LADWP, is on track to supply 25% of its total energy from renewable sources in 2016 and 33% by 2020.

GREEN LEADER

In 2013, the City of Los Angeles became the first city in California to meet 20% of its total energy demand from clean sources, up from 3% in 2005. LA County is keeping pace. Renewables account for close to 20% of the grid energy mix.

DIRTY IMPORTS DOMINATE LA'S 78% NON-RENEWABLE SUPPLY

Much of LA's dirty energy supply is imported from sources outside the state, meaning the emissions from generation are not experienced locally. While there is no direct effect on the LA population, as a conscientious consumer with a global lens, LA is removing or encouraging its dirtiest suppliers to convert to cleaner generation.

COAL FREE BY 2025

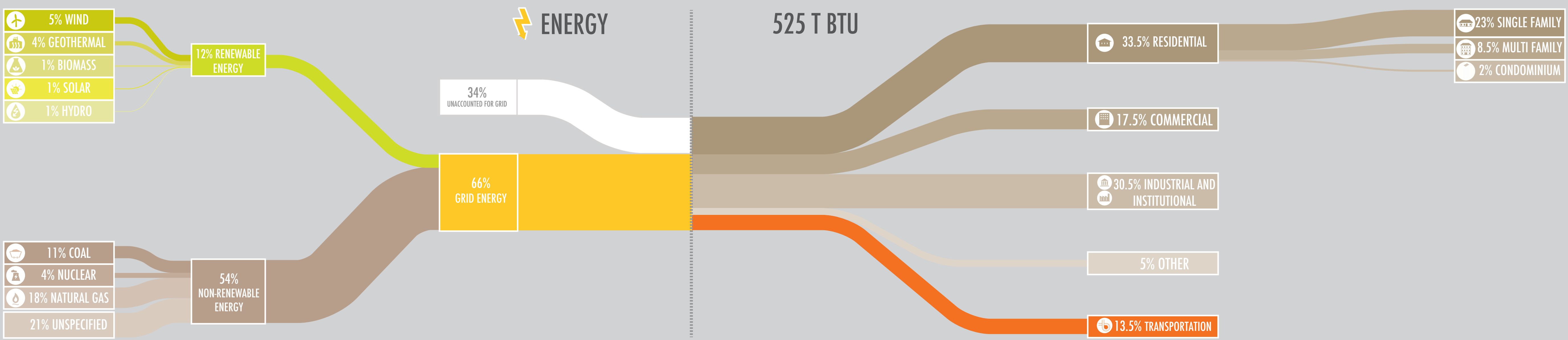
While Los Angeles has a long way to go before reaching emission-free energy portfolio, LA City is making strides to reduce emissions, vowing to eliminate all coal from its portfolio by 2025. Utah's Intermountain Power Project (IPP), which sells about 90% of its power to six Los Angeles municipalities, will convert to burn natural gas instead of coal by 2025.

SINGLE-FAMILY HOMES USE THE MOST ENERGY IN LA COUNTY

Energy consumption in Los Angeles is lower overall than the national average, owing to its temperate climate. The highest per capita energy consumption is exhibited in the least dense and hottest regions.

HOME ENERGY

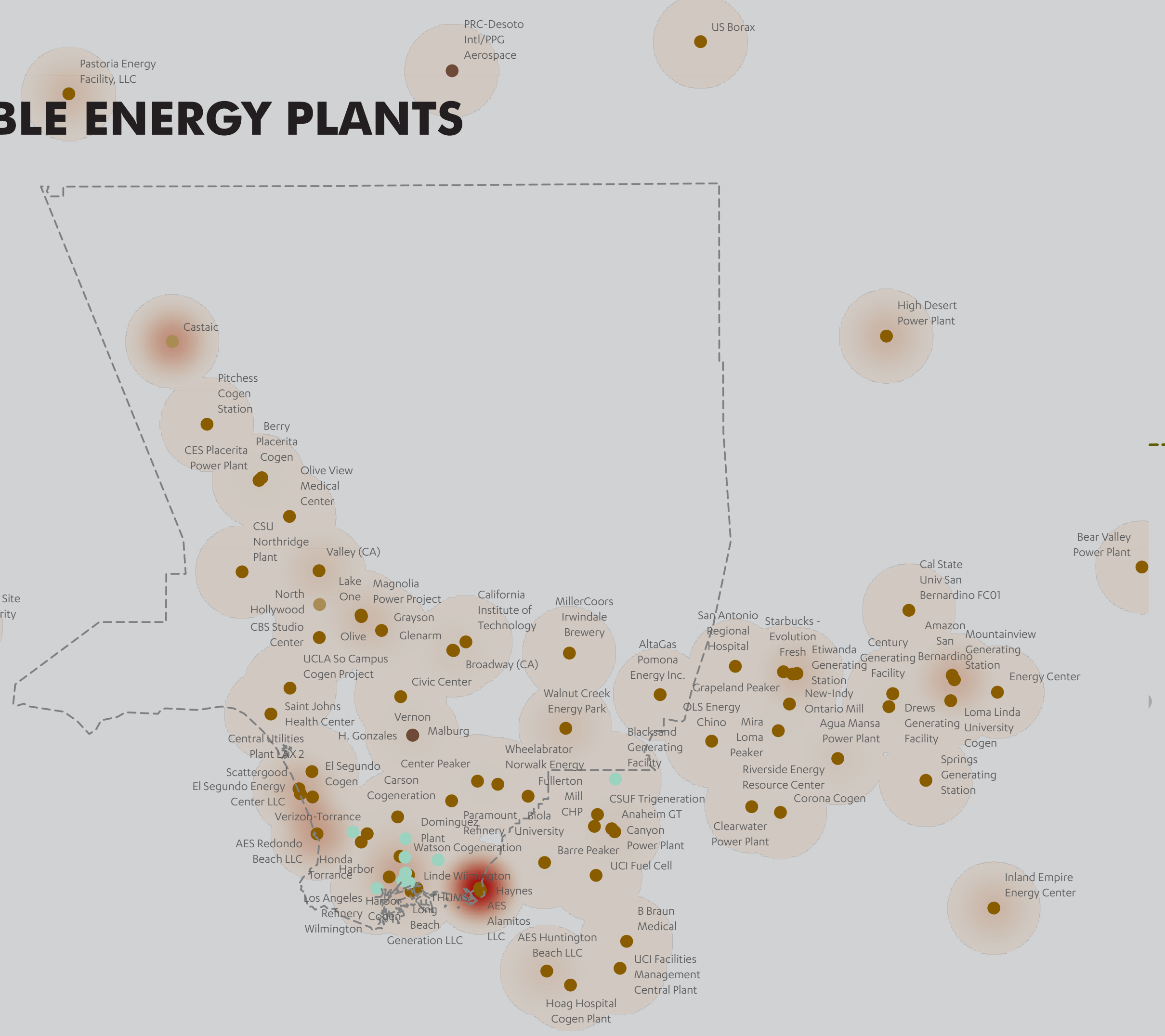
Single family homes consume more energy per square foot (median 44,876 BTU/sq ft) than multi family residences (41,652 BTU/sq ft) and condos (30,060 BTU/sq ft). Moreover, since they have higher square footage, they consume larger amounts per unit. While per capita information does not yet exist, it can be deduced that a person living in a single family homes use more energy than a person living in a multifamily apartment or condo.



NONRENEWABLE ENERGY PLANTS

California Energy Commission Cartography Unit, U.S. Census Bureau, Cal-Atlas

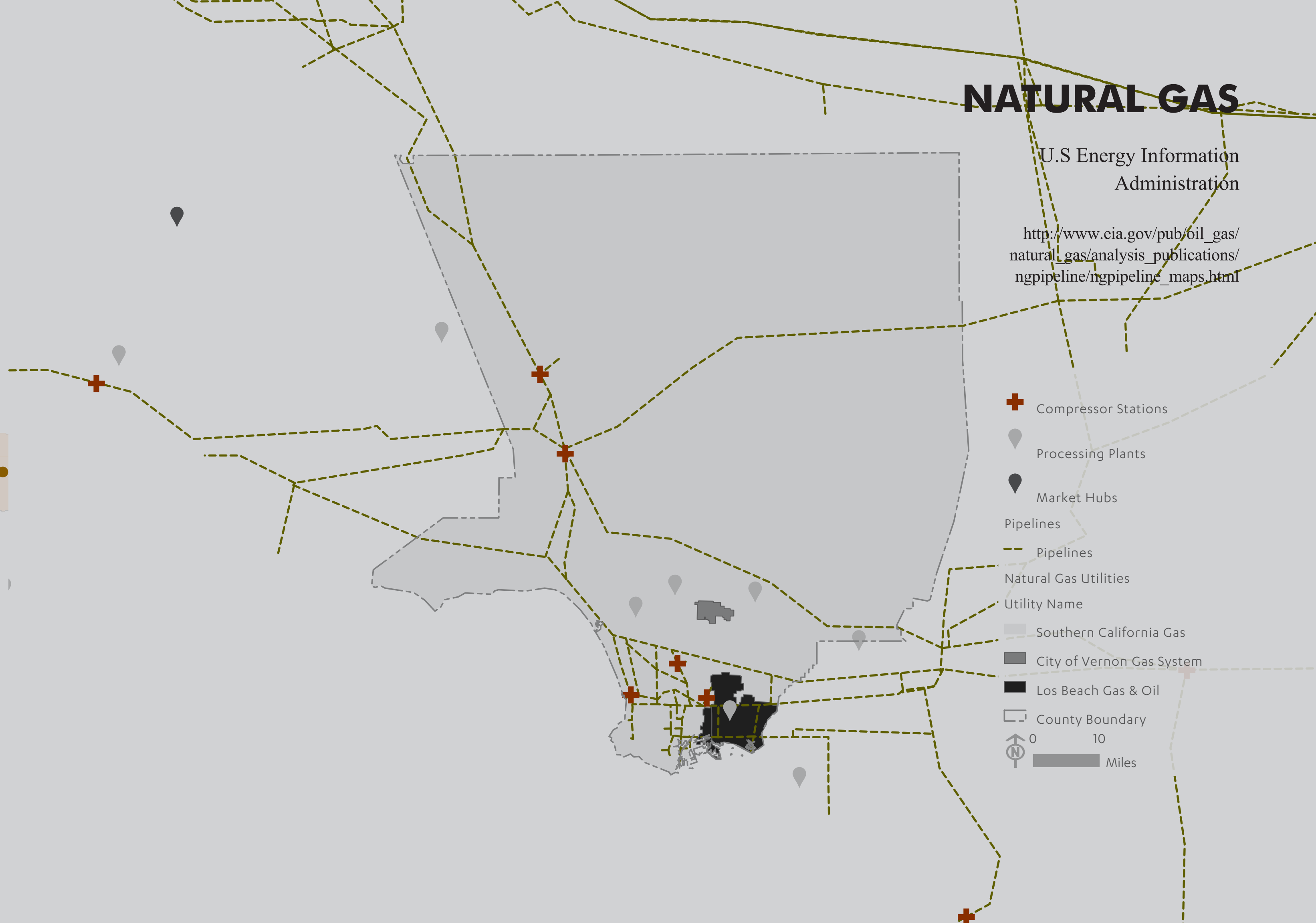
http://www.energy.ca.gov/maps/powerplants/power_plant_statewide.html



NATURAL GAS

U.S Energy Information Administration

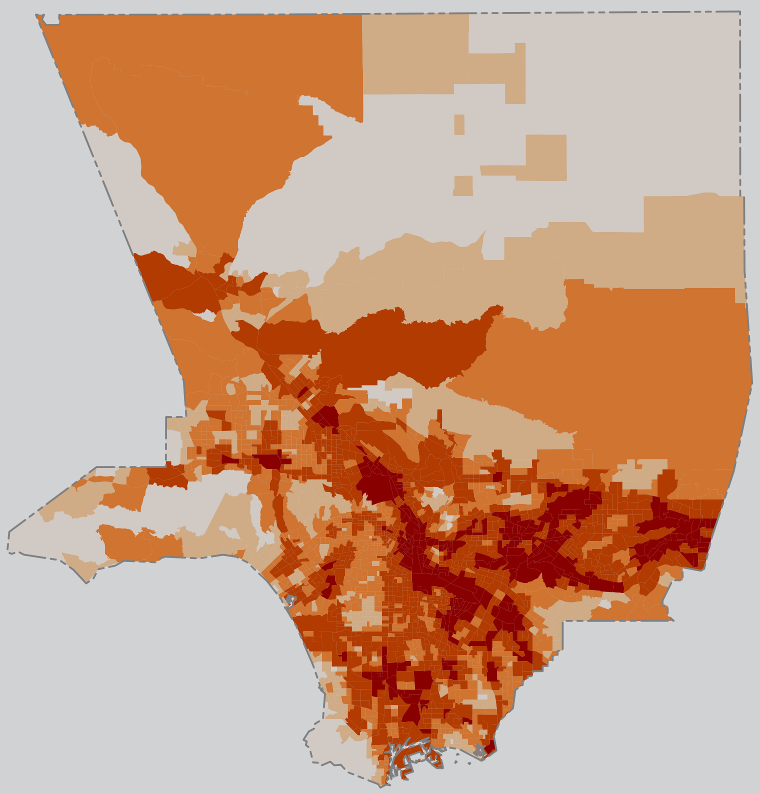
http://www.eia.gov/pub/oil_gas/natural_gas/analysis_publications/ngpipeline/ngpipeline_maps.html



POLLUTION SCORE

Office of Environmental Health Hazard Assessment, CalEnviroScreen

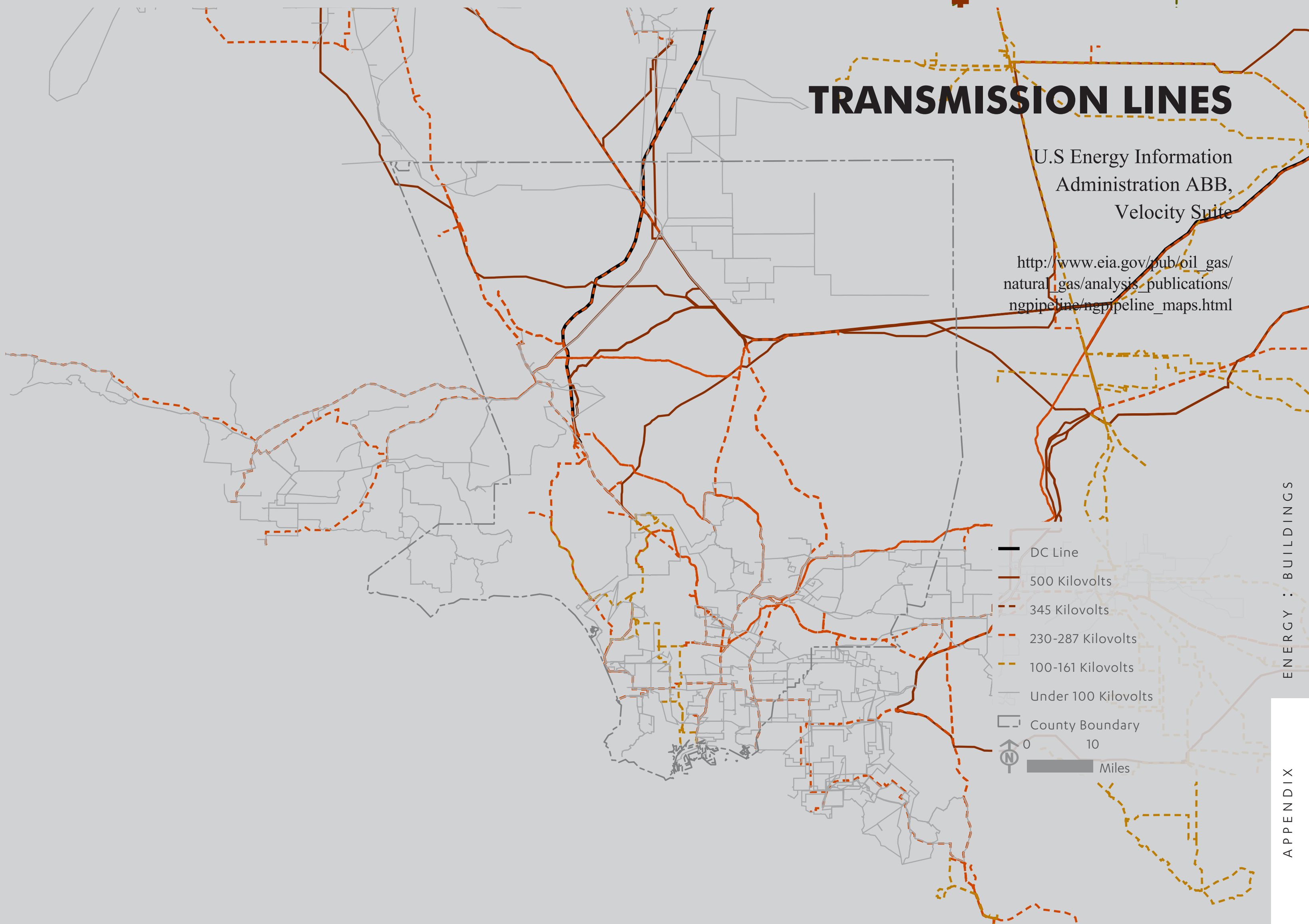
http://oehha.ca.gov/calenviroscreen/report/calenviroscreen-version-20



TRANSMISSION LINES

U.S Energy Information Administration ABB, Velocity Suite

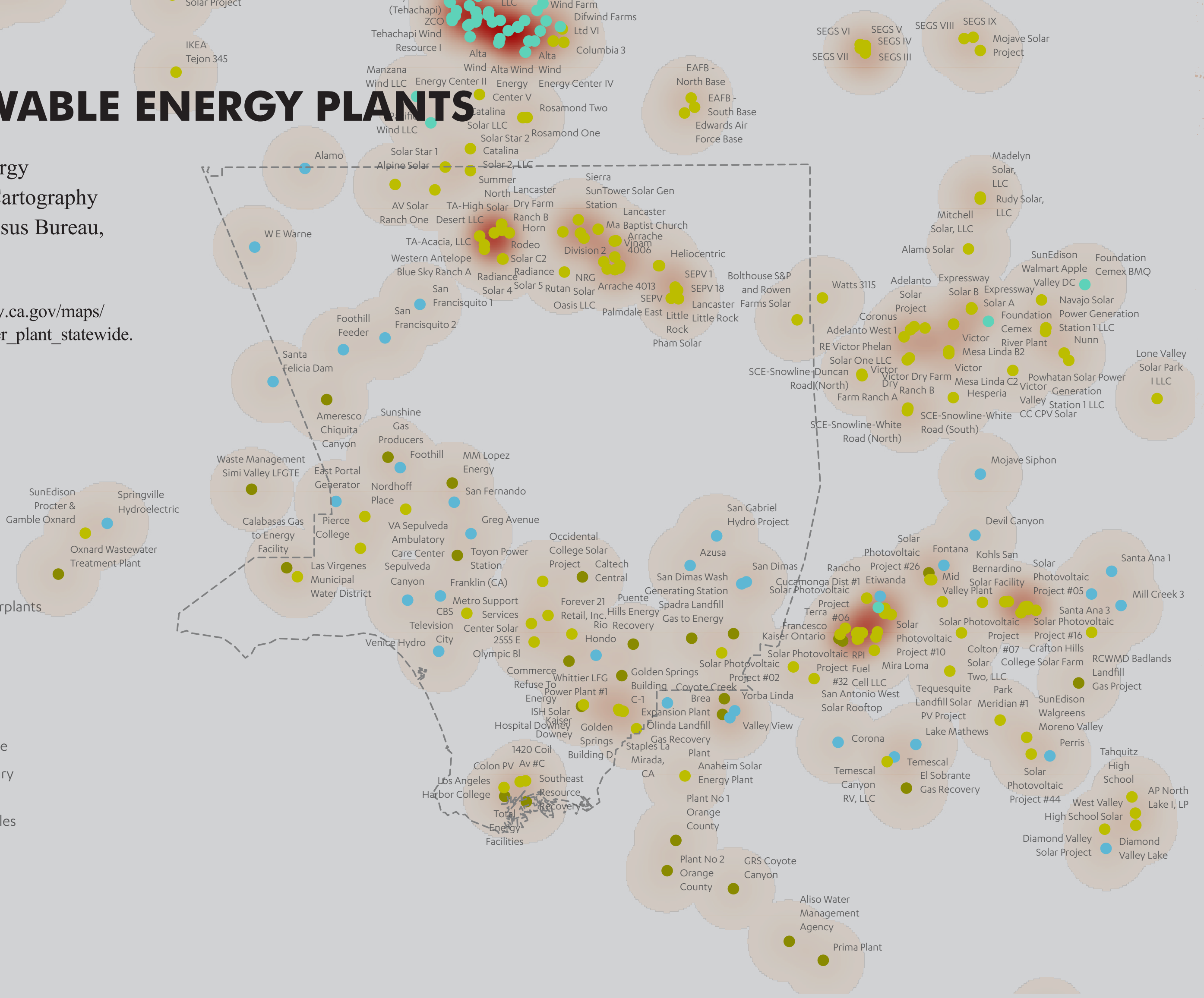
http://www.eia.gov/pub/oil_gas/natural_gas/analysis_publications/ngpipeline/ngpipeline_maps.html



RENEWABLE ENERGY PLANTS

California Energy Commission Cartography Unit, U.S. Census Bureau, Cal-Atlas

http://www.energy.ca.gov/maps/powerplants/power_plant_statewide.html

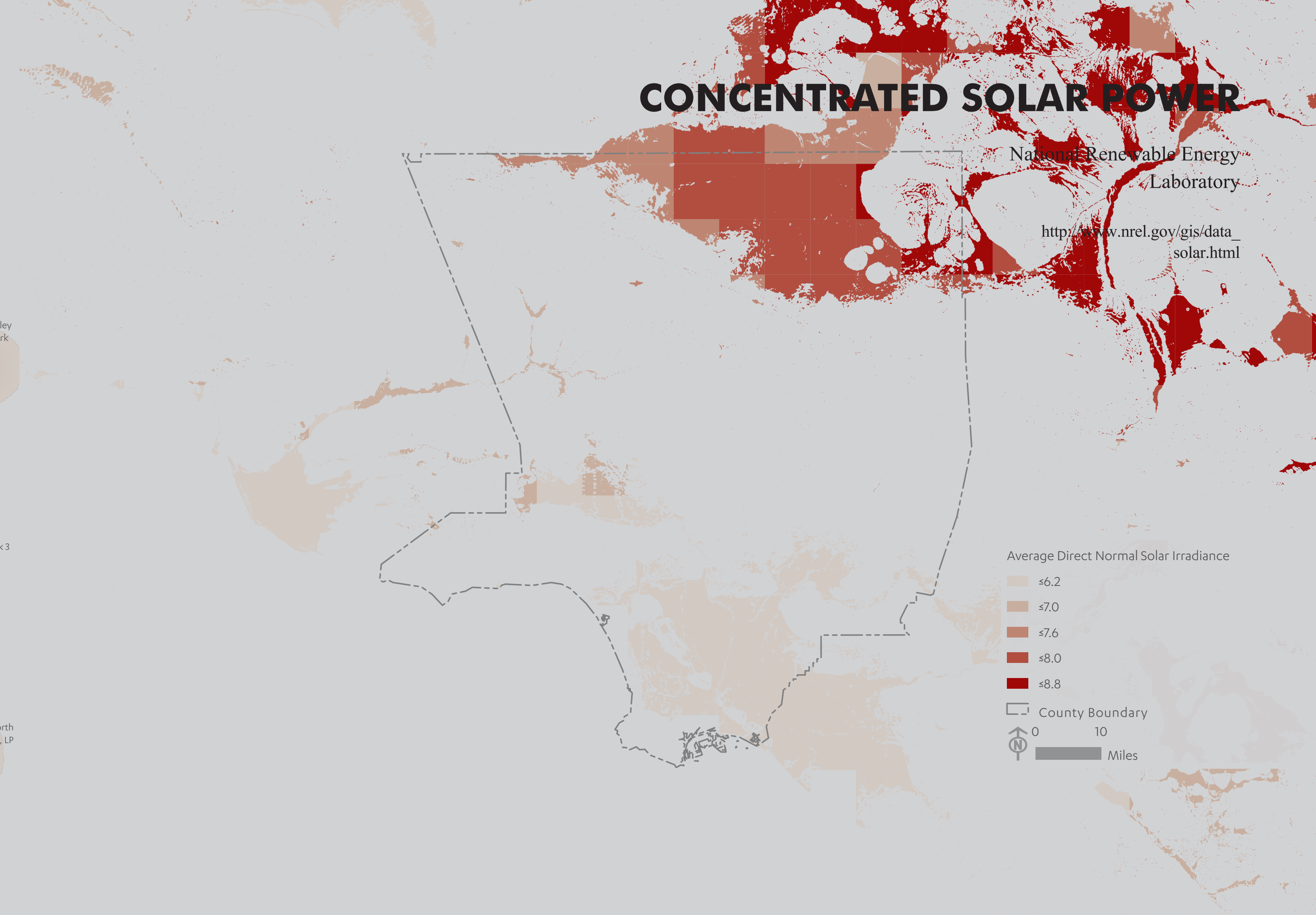


Total MW
Dense
Sparse
Nonrenewable Powerplants
Coal
Natural Gas
other
Petroleum
Pumped Storage
County Boundary
0 10 Miles

CONCENTRATED SOLAR POWER

National Renewable Energy Laboratory

http://www.nrel.gov/gis/data_solar.html

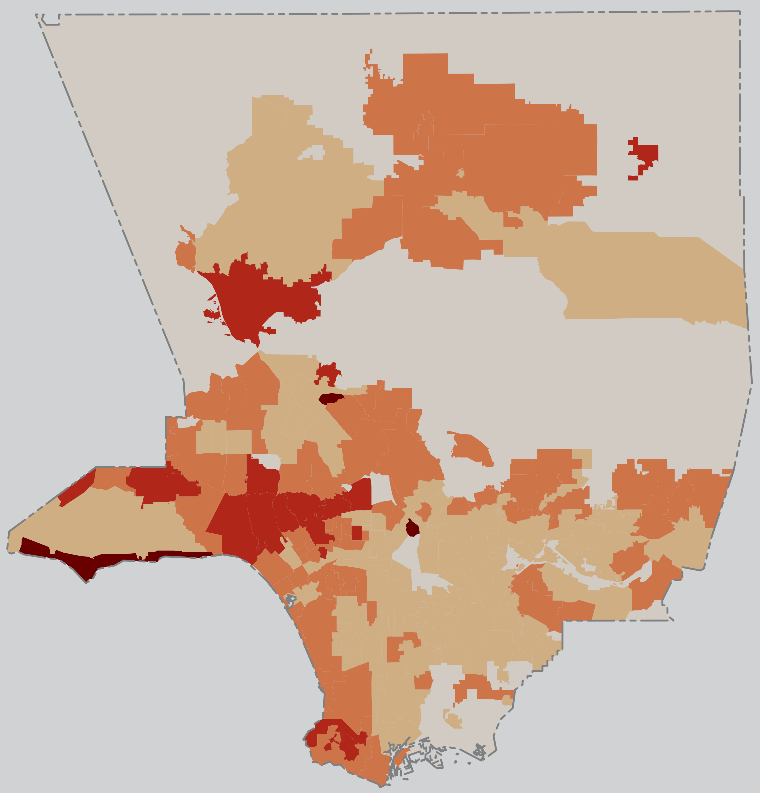


Average Direct Normal Solar Irradiance
≤6.2
≤7.0
≤7.6
≤8.0
≤8.8
County Boundary
0 10 Miles

RESIDENTIAL ENERGY CONSUMPTION

UCLA Energy Atlas

http://www.energyatlas.ucla.edu/

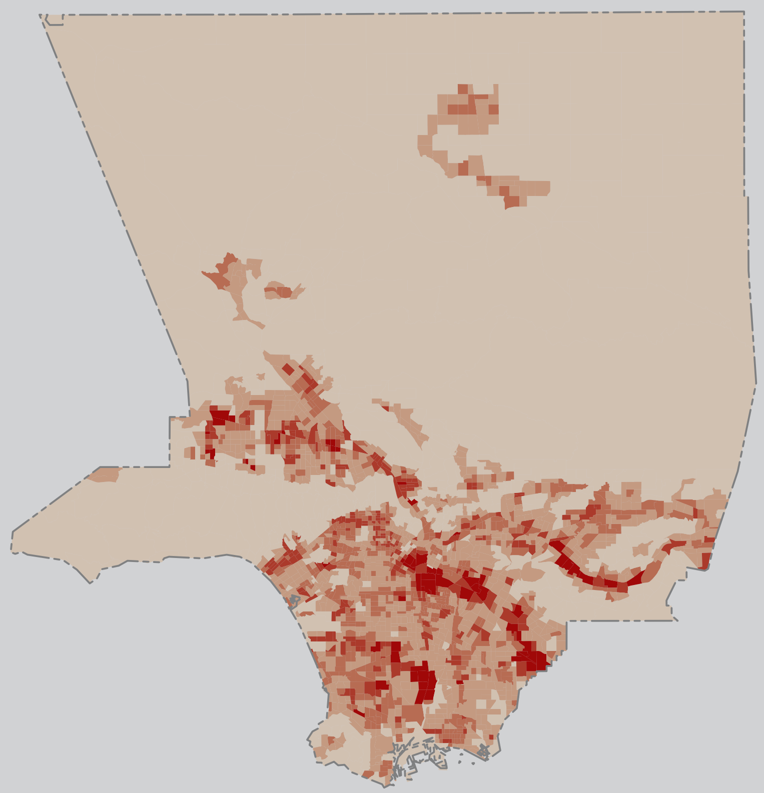


Residential Energy Consumption Per Capita
≤7000000
≤20000000
≤42500000
≤95000000
≤320000000
County Boundary
0 10 Miles

SOLAR EFFICIENCY

Los Angeles County Department of Public Works

http://egis3.lacounty.gov/dataportal/2015/04/07/solar-data-summarized-to-2010-parcels/



Solar Efficiency by Census Tract
Solar Roof / Acres
≤1500
≤3000
≤4500
≤7000
≤13000
County Boundary
0 10 Miles

WATER

WATER

40% OF LOS ANGELES WATER IS SOURCED LOCALLY.

The bulk of LA County's local water comes from groundwater. However, several groundwater aquifers aren't currently producing because they are contaminated with industrial flow, salt, and organic pollutants. Plenty more local water opportunities exist, such as brackish groundwater supplies, stormwater runoff, and recycled water.

LOCAL WATER

Los Angeles County is one of the few counties in the state that monitors its groundwater withdrawals. While its agreements have been exemplary in preventing overdraft, LA County has the highest instances of contaminated groundwater in the state. Approximately 40% of LA County community water providers have drawn water from a groundwater source that was contaminated beyond state-set maximum contaminant levels.

60% OF LA'S WATER IS IMPORTED FROM UP TO 1,400 MILES AWAY

Los Angeles imports depend primarily on three sources: (1) Owens Valley/Mono Lake (Los Angeles Aqueduct), (2) Northern California rivers (California Aqueduct), and (3) the Colorado River (Colorado River Aqueduct). Approximately 90% of the imported water supply is snowpack dependent.

IMPORTED WATER

The Colorado River supplies seven states, 40 million people–more than 1 in 10 Americans–and supports 15% of the nation's food supply. However, a 16-year drought has left the river's aquifers at half of capacity. Such unpredictable fluctuations make imported water supplies unreliable in times of drought.
While 2016 recorded 98% of normal snowpack levels, just the year before, the Sierra snowpack was at its lowest-ever recorded level.

WATERING LAWNS IS LA'S SINGLE MOST WATER-CONSUMING ACTIVITY.

UCLA researchers estimate over 54% of all single-family household water is used for outdoor irrigation. In Los Angeles (city), an estimated 12% of urban land cover is irrigated grass.

A LAVISH HABIT

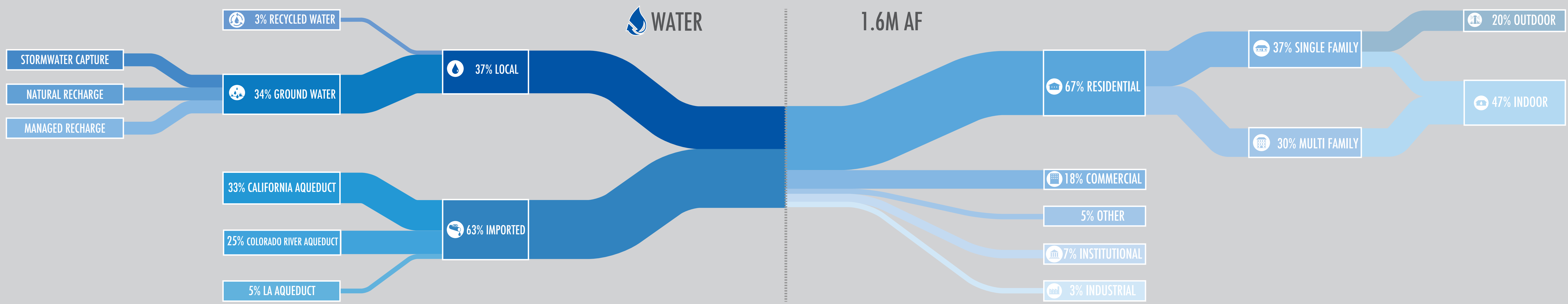
"Not just during drought but even in times of normal precipitation, there is something absurd about taking precious drinking water — imported at great cost from environmentally fragile areas hundreds of miles away, pumped over the mountains using enormous amounts of energy, filtered, treated and tested so as to be safe for human consumption — and spraying it on lawns and flowers. It doesn't make much more sense than sprinkling the garden with Perrier or Fiji water, yet that's how about half of urban water in Los Angeles is used."
-LA Times Editorial

TODAY, LOS ANGELES USES TWICE THE 2050 CONSUMPTION GOALS

Los Angeles average per capita water consumption ranges by neighborhood from 48 to 320 gallons per day. But it is already improving, with 20% reductions in just three years. Thanks to successful conservation efforts, Los Angeles uses about as much water as it did 40 years ago, even after adding a million people.

WATER DEMAND

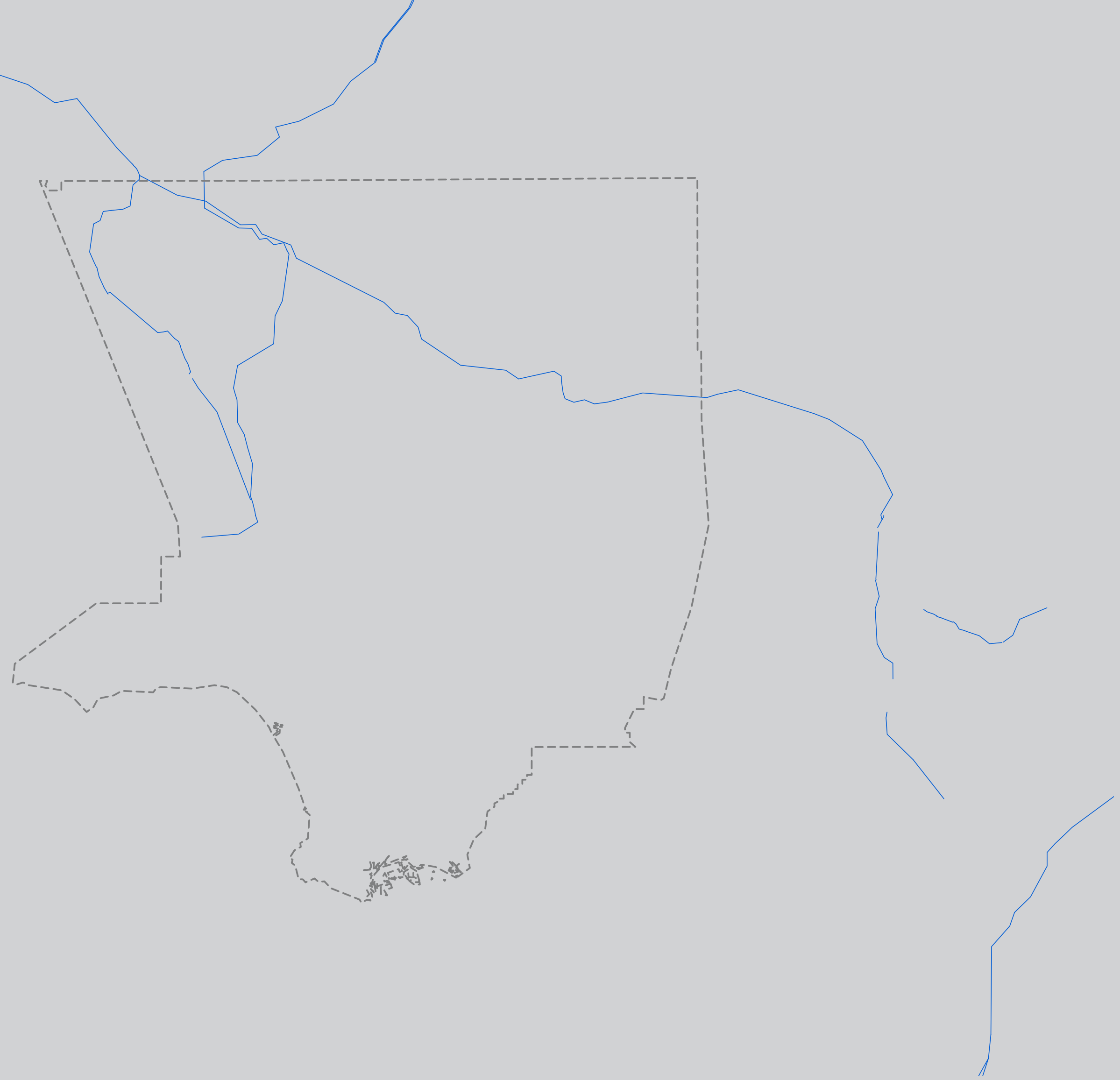
While frequently associated with wealth, water consumption also has to do with density and cultural lifestyle choices. Similar income levels consume vastly different amounts of water based on the culture and density of the neighborhood. A study by UCLA researchers found that large residential lots are most sensitive to fluctuations in temperature and precipitations while dense urban structures are associated with lower demand regardless of climate.



AQUEDUCTS

US Geological Survey

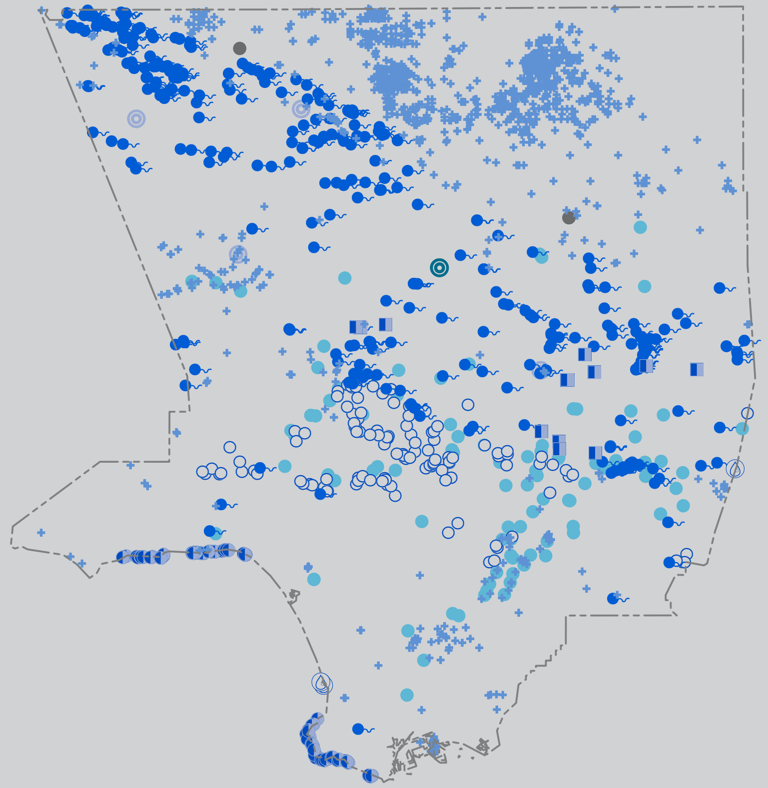
http://nhd.usgs.gov/



HYDROLOGY POINTS

US Geological Survey

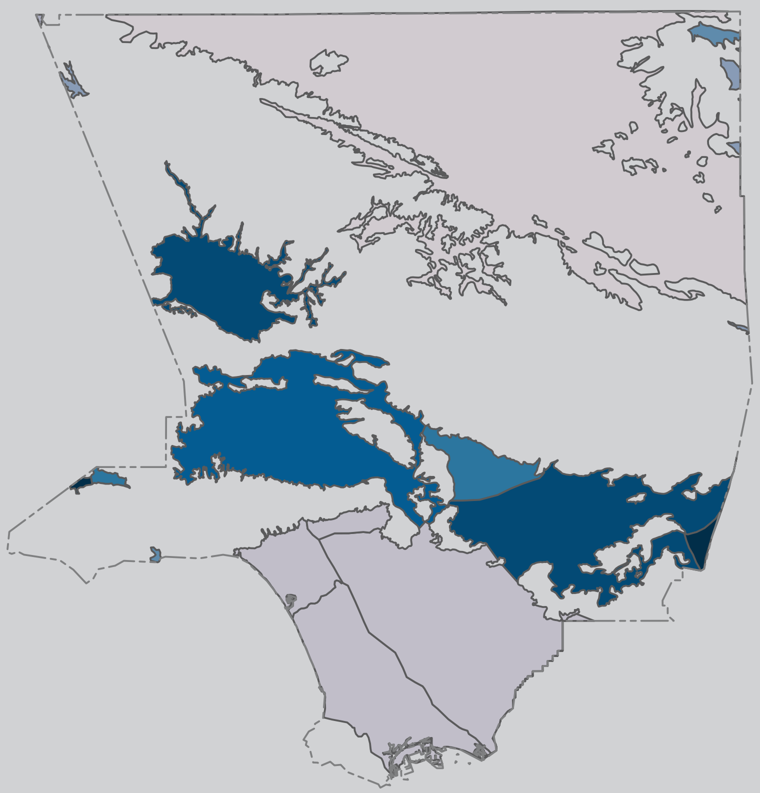
http://nhd.usgs.gov/



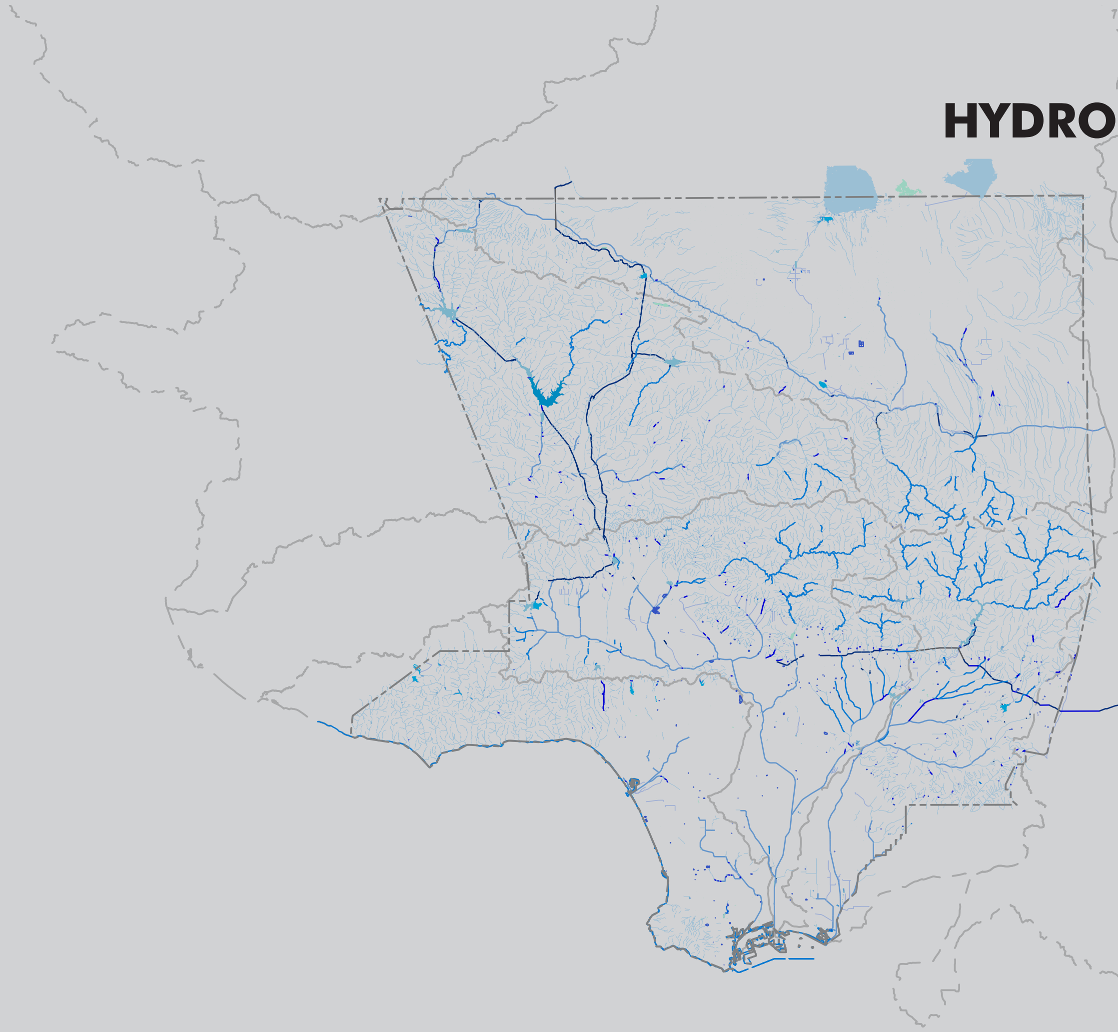
GROUNDWATER BASINS

Los Angeles County
Department of Public Works

http://egis3.lacounty.gov/dataportal/2011/01/27/ground-water-basins/



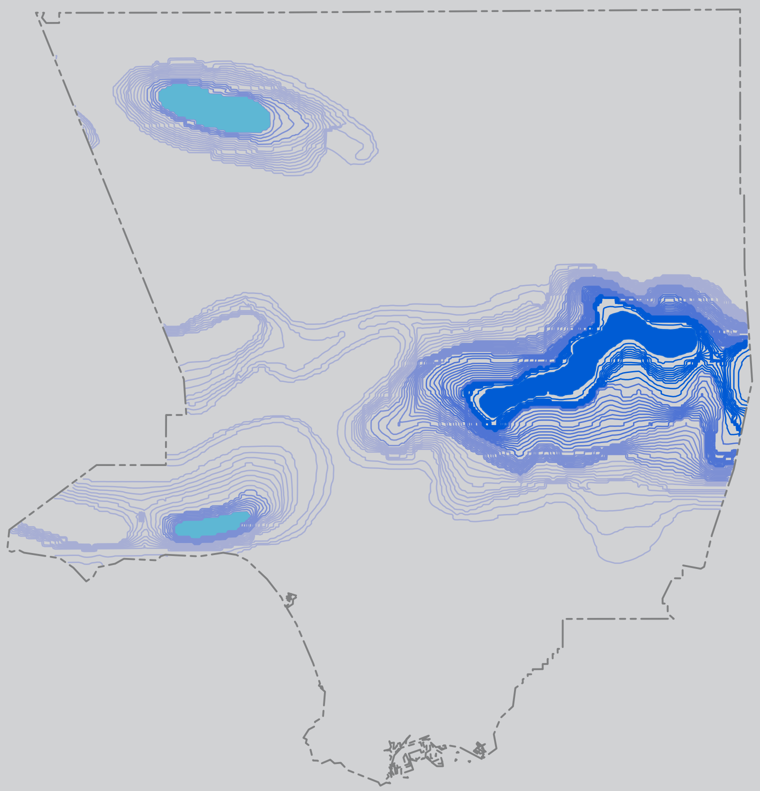
HYDROLOGY FLOWS



RAINFALL INTENSITY

Los Angeles County
Department of Public Works

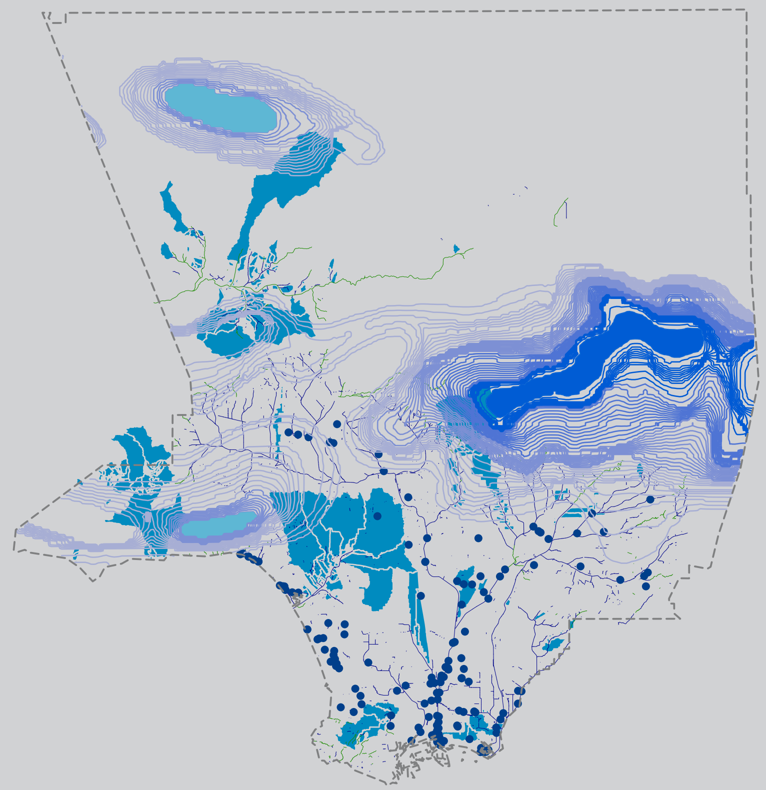
http://egis3.lacounty.gov/dataportal/2011/01/27/rainfall-intensity/



STORMWATER CATCHMENT AND RAINFALL INTENSITY

Los Angeles County
Department of Public Works

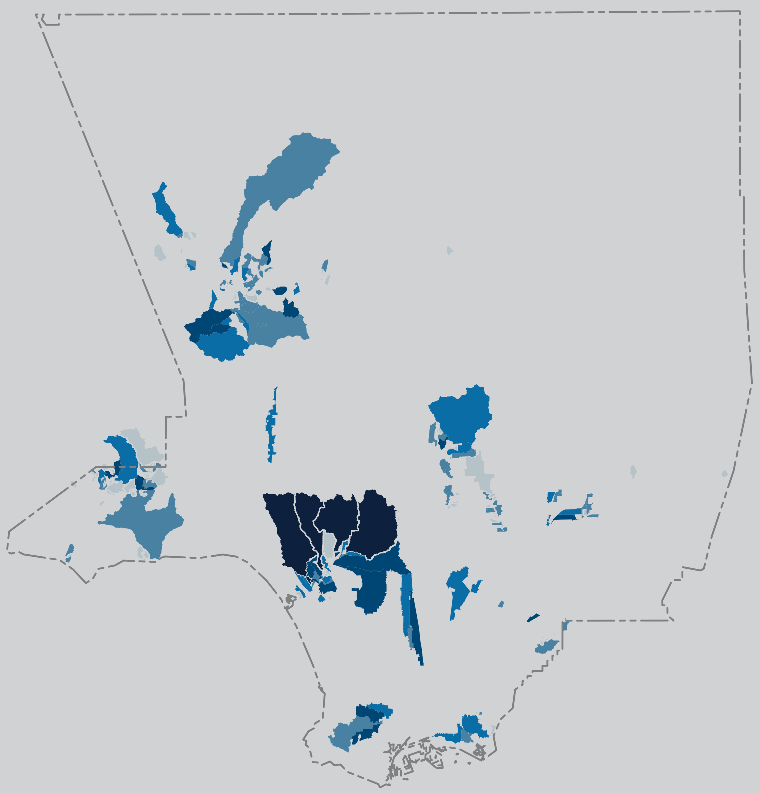
http://egis3.lacounty.gov/dataportal/2014/06/30/stormwater-catchment-areas/



STORMWATER CATCHMENT

Los Angeles County
Department of Public Works

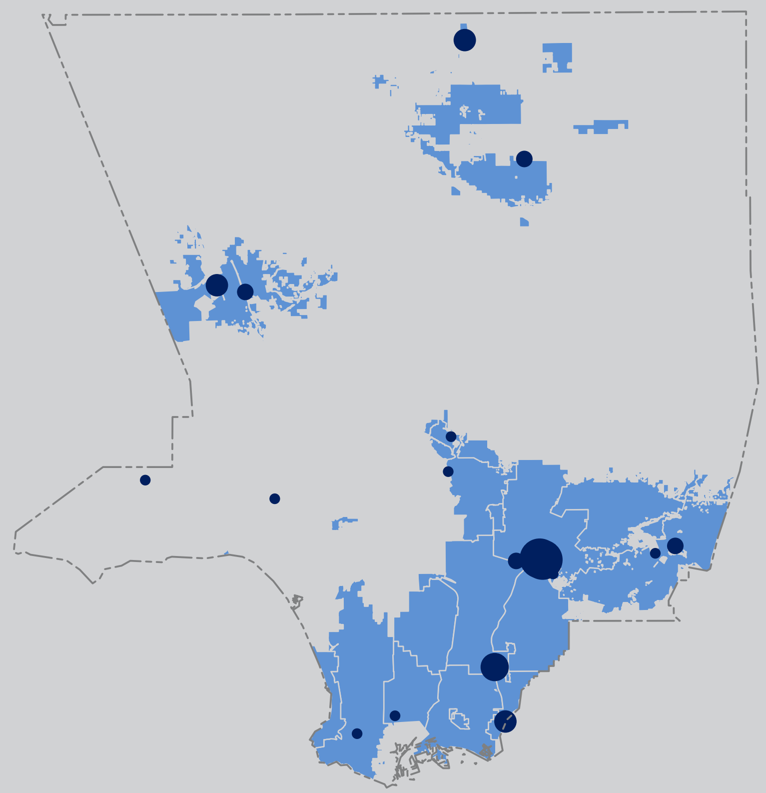
http://egis3.lacounty.gov/dataportal/2014/06/30/stormwater-catchment-areas/



WATER RECLAMATION CENTERS

Sanitation Districts of Los Angeles County

https://www.fws.gov/gis/data/national/

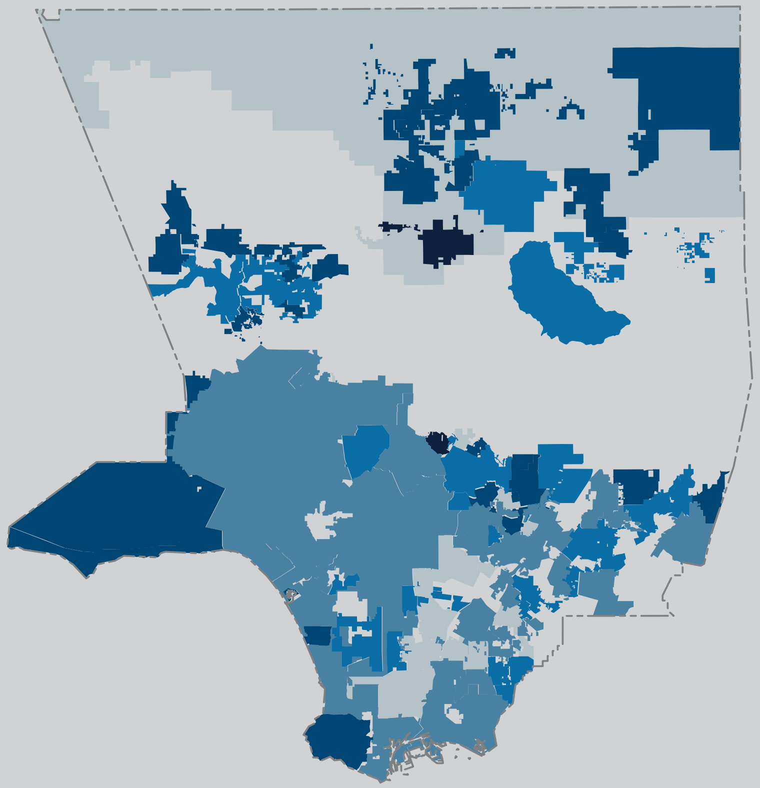


RESIDENTIAL CONSUMPTION (GPCD)

Gallons per capita per day by census districts

California Department of Water Resources
2016

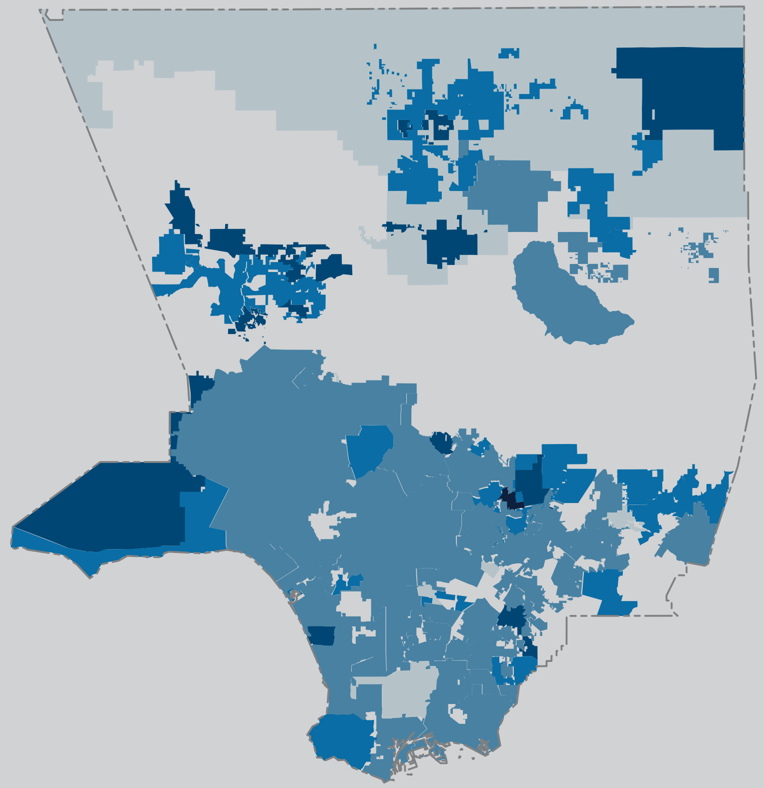
https://gis.water.ca.gov/app/boundaries/



TOTAL CONSUMPTION (GPCD)

California Department of Water Resources

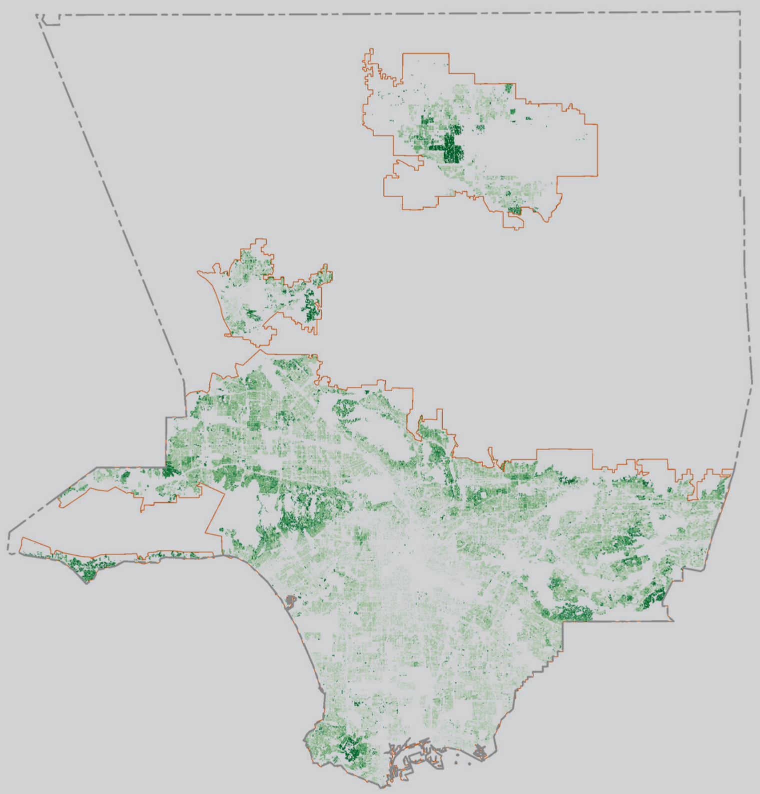
https://gis.water.ca.gov/app/boundaries/



SINGLE-FAMILY PARCEL LANDSCAPING

Los Angeles County Department of Public Works

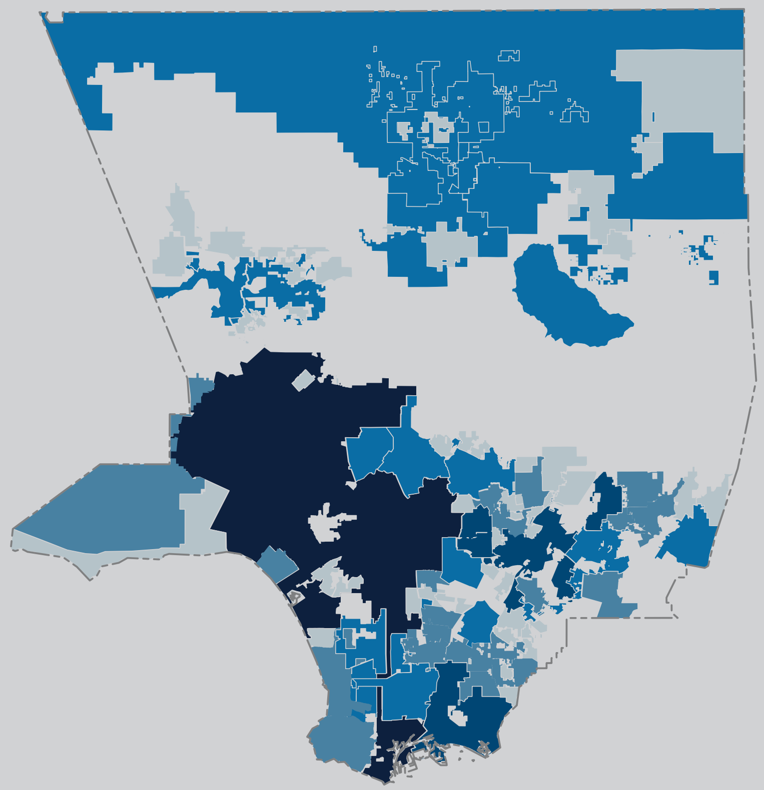
http://egis3.lacounty.gov/dataportal/2015/03/10/assessor-parcel/



WATER DISTRICTS

California Department of Water Resources

https://gis.water.ca.gov/app/boundaries/



ECOSYSTEM

ECOSYSTEM

THE MOST ECOLOGICALLY DIVERSE COUNTY IN THE LOWER 48
L.A. lies within the California Floristic Province, globally recognized as one of just thirty-five biodiversity hotspots in the world, the only one in the continental United States. Los Angeles has 4,346 identified species, 92 of which are endangered or threatened. Significant Ecological Areas make up 1/4 of the County, but are largely unprotected and have been affected by rural development.

NATIVE AND NEW
This wide variety of species is made up of mostly non-native species that have learned to adapt and thrive in the moderate climate. Urban areas have been shown to provide ideal conditions for invasive and exotic species due to high levels of disturbance which tends to favor non-native species at the expense of native species. This highlights the importance of large tracts of contiguous natural land, which provide enough space for macroscale ecosystems and genetic diversity, within particular species and as an ecosystem whole.

1/4 OF NATURAL LAND IS PROTECTED
Another 1/4 is natural but at risk. 98% of LA County's coastal wetlands have been filled in and developed.

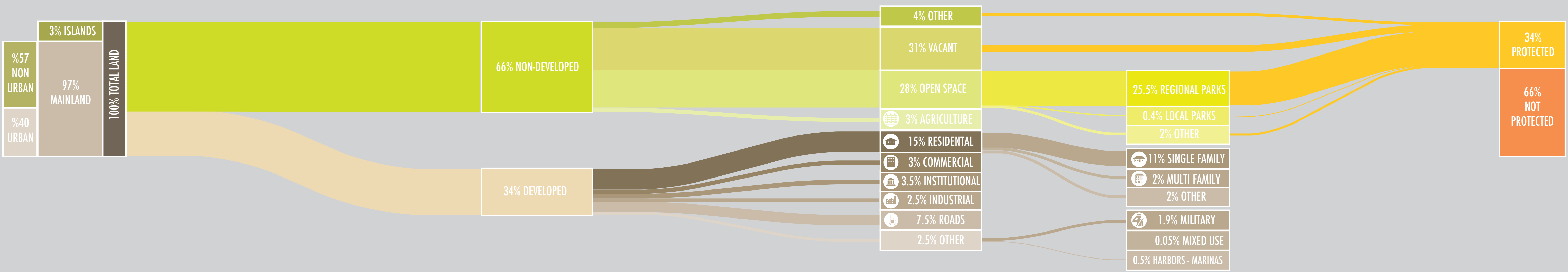
PROTECTING FROM SPRAWL
Some of the potential consequences of urbanization include habitat loss and fragmentation, reduced health of wildlife due to inbreeding because of that habitat fragmentation, exposure to toxins such as pesticides, and exposure to more diseases carried by domestic animals. Vital habitat is destroyed or fragmented into little patches not large enough to support complex, biologically-diverse communities as cities push their way into natural areas.

LA COUNTY DEVELOPS X ACRES PER YEAR. THAT'S X FOOTBALL FIELDS
Development in Los Angeles County continues to push the urban borders. Los Angeles expanded across nearly 400 square miles of undeveloped land from 1970 to 1990. The proportion of natural areas lost each year in Los Angeles County is twice the annual rate of loss in California and four times higher than the annual rate of loss across the West.

COST OF THE DEMAND FOR LAND
As housing prices climb in the more metropolitan regions, homes in the Inland area offer an affordable option. However, the costs compound when negative externalities of sprawl are factored. Rural development not only results in habitat destruction, but longer commutes associated with higher emissions and congestion.

LESS THAN 1/2 THE POPULATION LIVES IN WALKING DISTANCE OF A PARK
Los Angeles is one of the top counties in the nation in terms of total park acreage but it is one of the worst in the nation in terms of park access per capita.

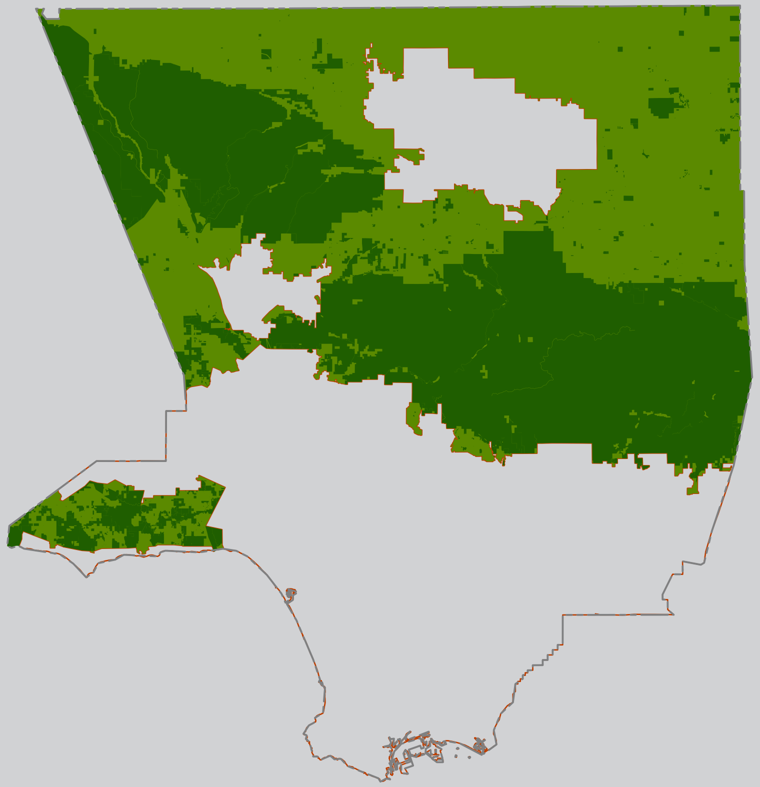
PARKS & URBAN HABITAT
City parks serve a function both for humans and for wildlife, especially when planted with native flora which provides habitat. Urban Los Angeles is surprisingly rich with native fauna. In 2015, the BioSCAN project which analyzed 30 backyards in urban Los Angeles, discovered 30 new insect species, one in each yard, demonstrating the extraordinary level of biodiversity that remains to be discovered even in heavily human-influenced areas.



PROTECTED LAND OUTSIDE URBAN AREA

California Protected Areas
Data Portal

http://www.calands.org/

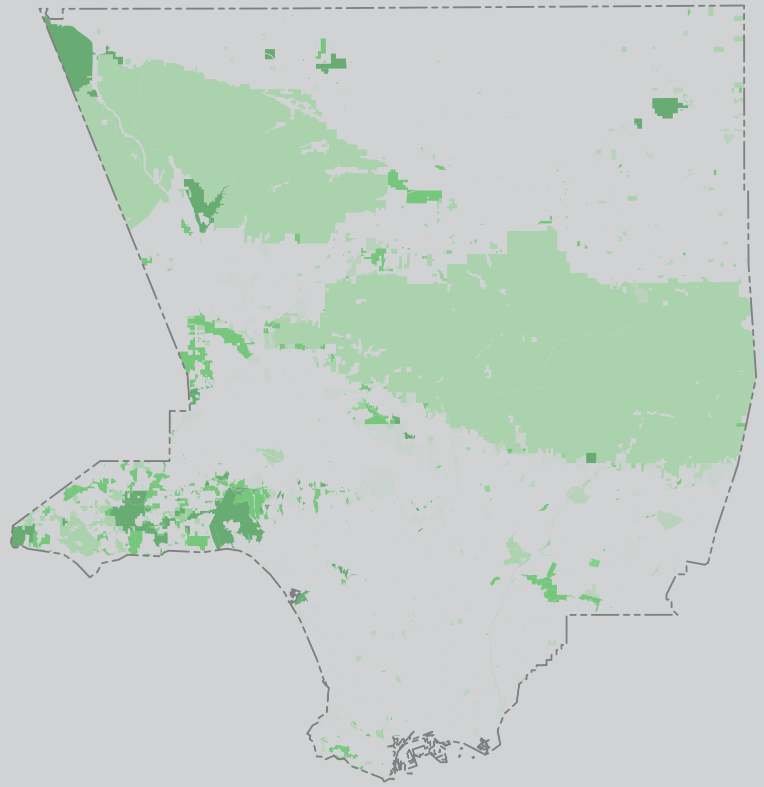


Protected Area Outside Urban
Landscape
Urban
County Boundary
0 10
Miles

PROTECTED LAND OWNERSHIP

California Protected Areas
Data Portal

http://www.calands.org/

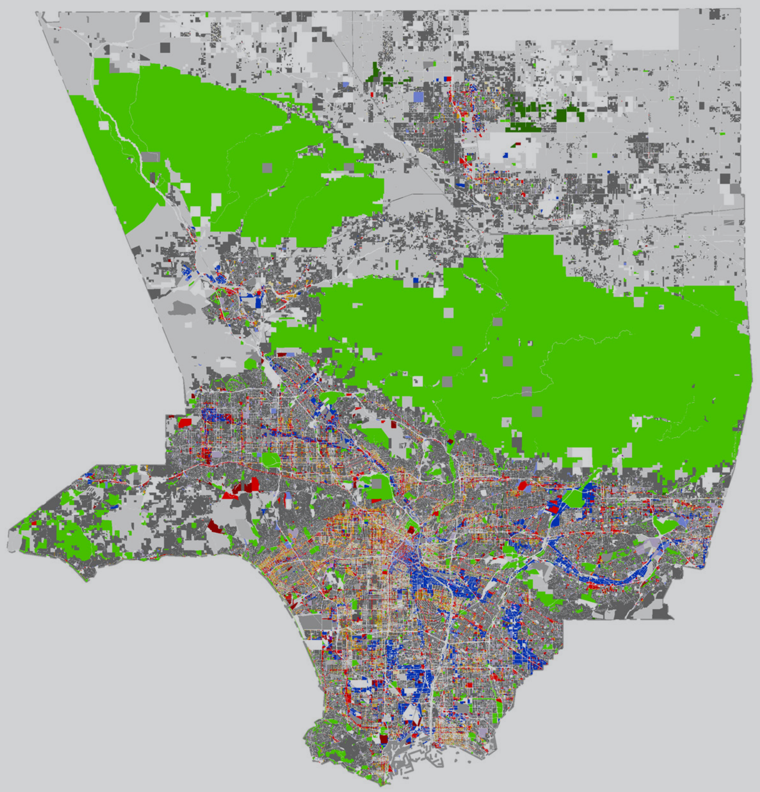


Protected Land by Ownership
City
County
Federal
Non Profit
Private
Special District
State
County Boundary
0 10
Miles

LAND USE

Southern California
Association of Governments

ftp://scag-data:$cag424@data.scag.
ca.gov/SCAG_Land_Use_2012/LU

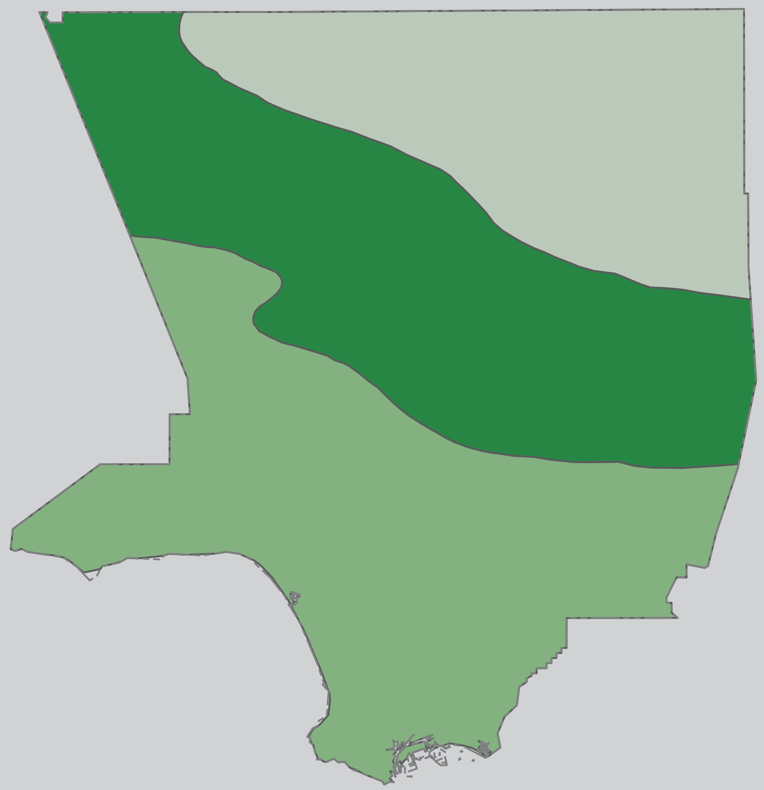


Mixed Residential
Rural Residential
General Office
Commercial and Services
Facilities
Education
Military Installations
Industrial
Transportation, Communications, and Util
Mixed Commercial and Industrial
Mixed Residential and Commercial
Open Space and Recreation
Agriculture
Vacant
Water
Under Construction
Undevelopable
Unknown
County Boundary
0 10
Miles

ECOREGIONS

The Nature Conservancy

http://maps.tnc.org/gis_data.html

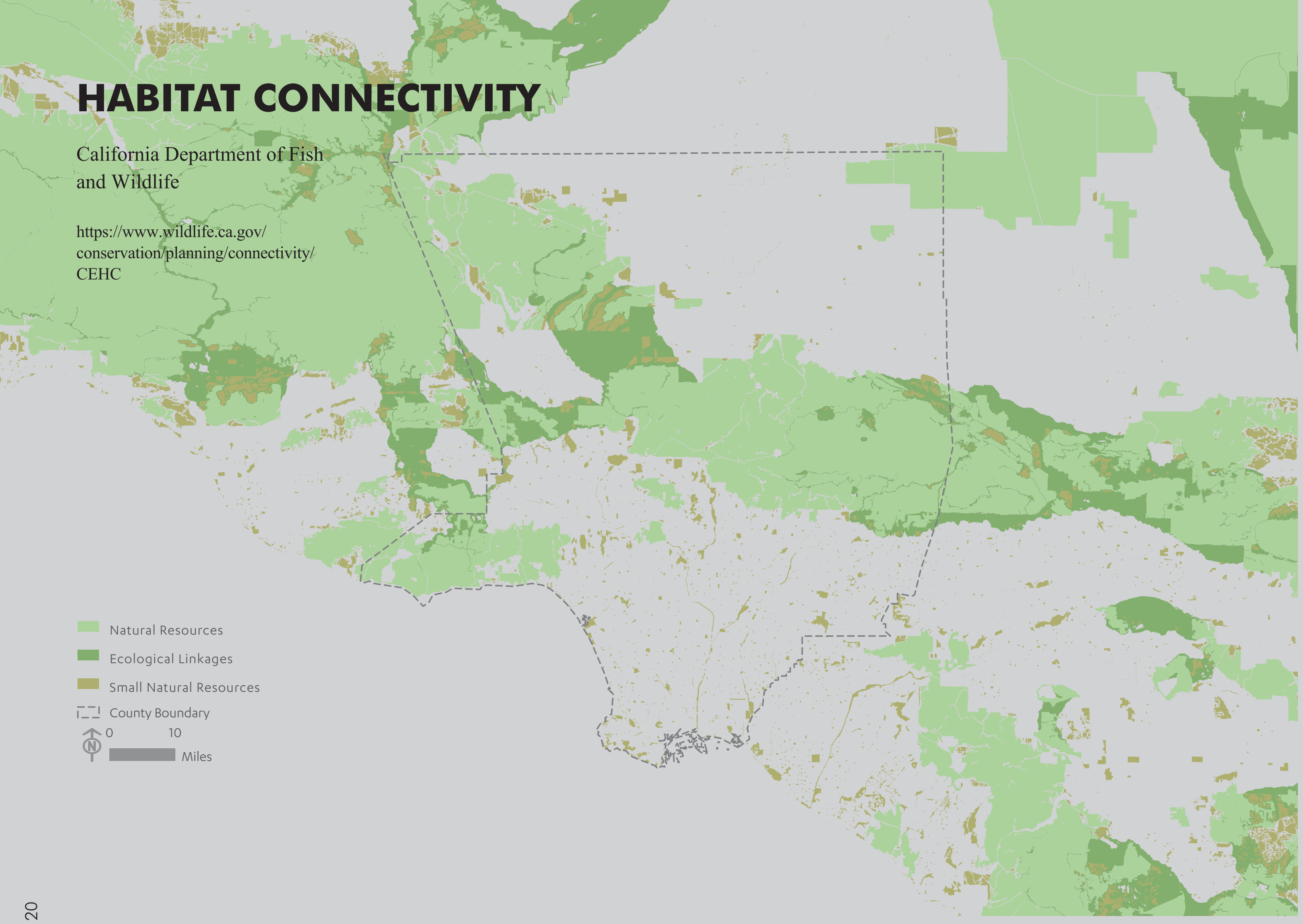


Level 3 Ecoregions
Mojave Basin and Range
Southern California/Northern Baja Coast
Southern California Mountains
County Boundary
0 10
Miles

HABITAT CONNECTIVITY

California Department of Fish and Wildlife

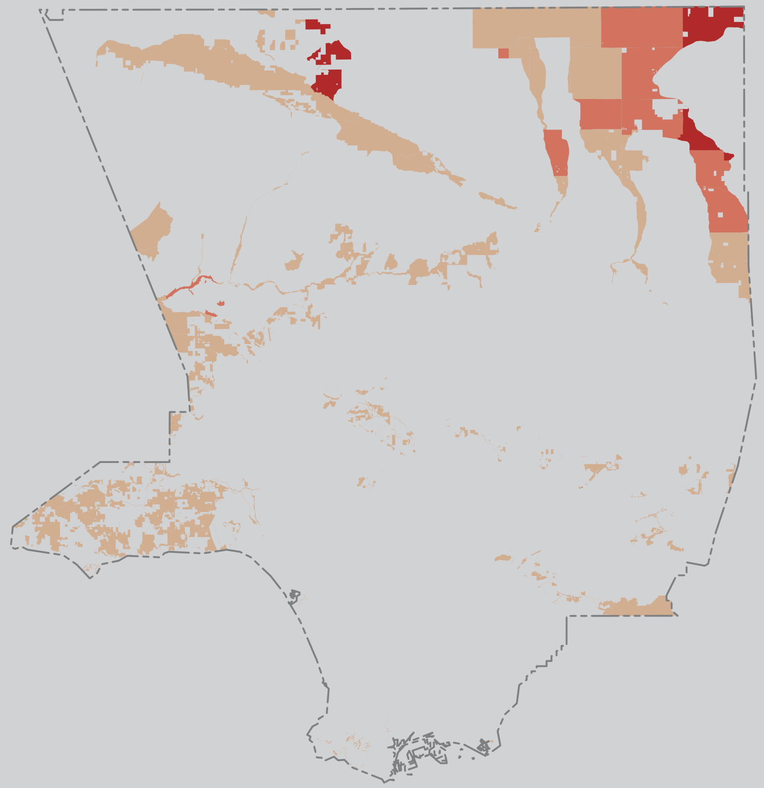
https://www.wildlife.ca.gov/conservation/planning/connectivity/CEHC



SIGNIFICANT ECOLOGICAL AREAS IN DANGER

Los Angeles County Department of Regional Planning, State of California Geoportal

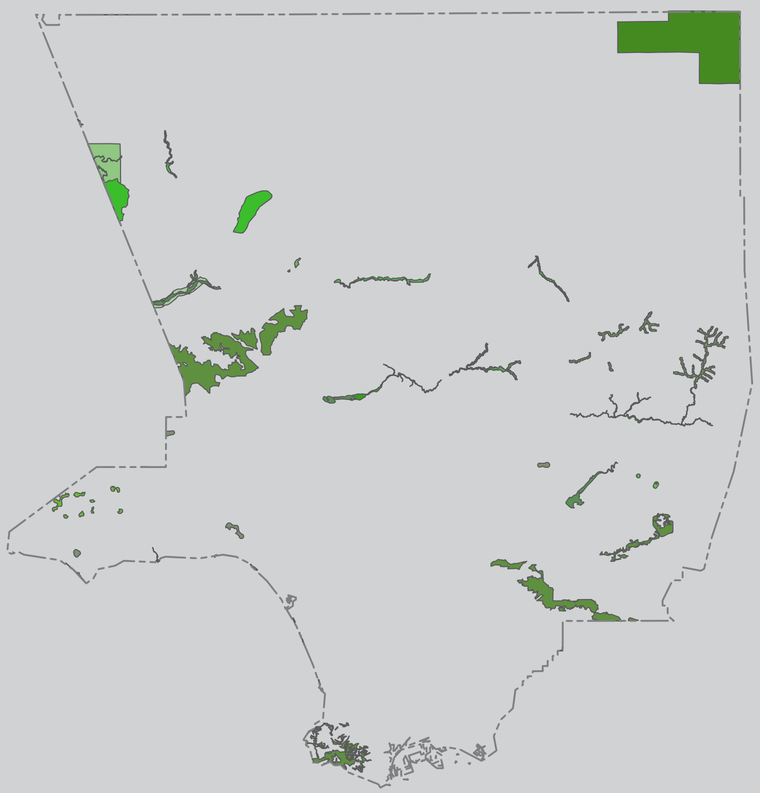
http://planning.lacounty.gov/sea



CRITICAL HABITATS

US Fish and Wildlife Service, Department of the Interior

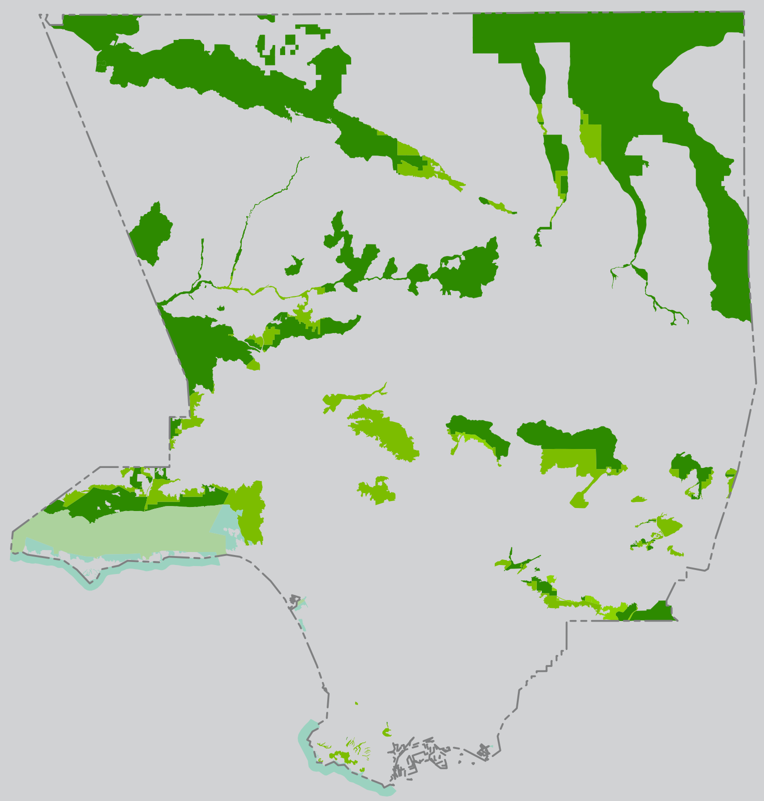
http://catalog.data.gov/dataset/fws-critical-habitat-for-threatened-and-endangered-species-datasetf6b00



SIGNIFICANT ECOLOGICAL AREAS

Los Angeles County Department of Regional Planning, State of California Geoportal

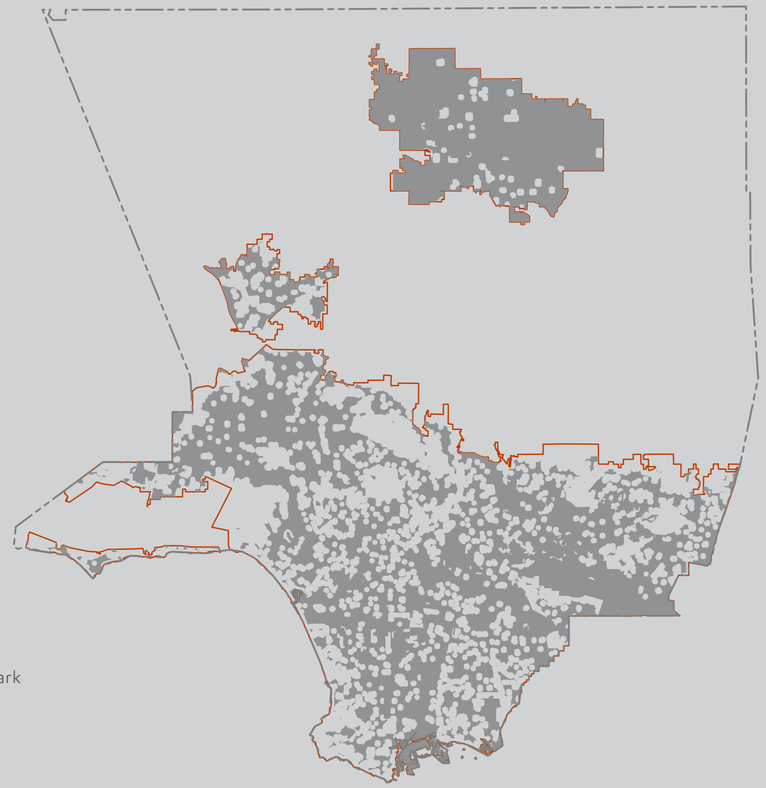
http://planning.lacounty.gov/sea



AREAS NOT SERVED BY PARKS

California Protected Areas
Data Portal

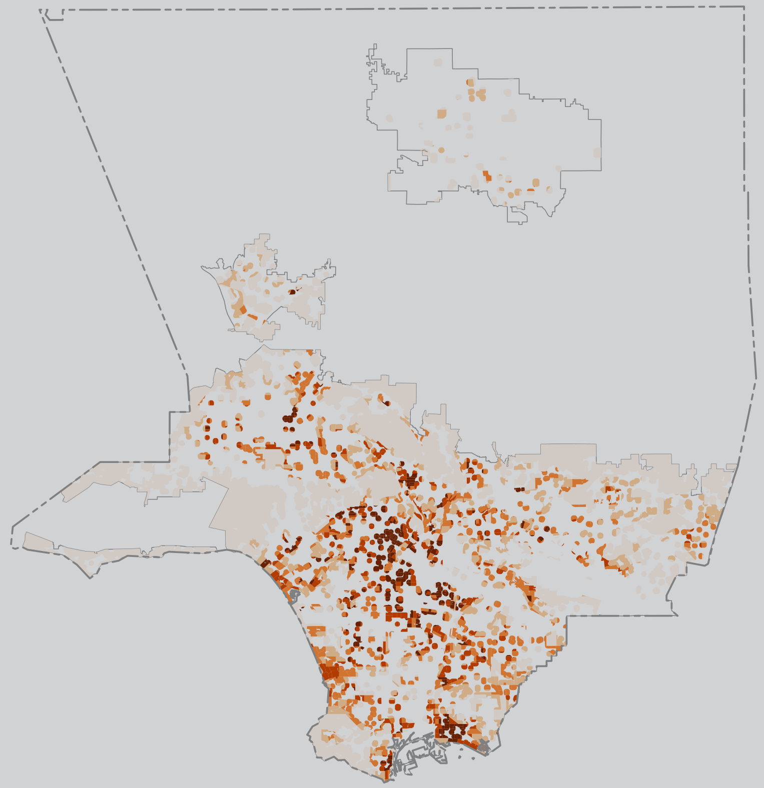
http://www.calands.org/



PARK SERVICE AREAS

American Community
Survey 5-Year Estimates,
United States CENSUS
Bureau

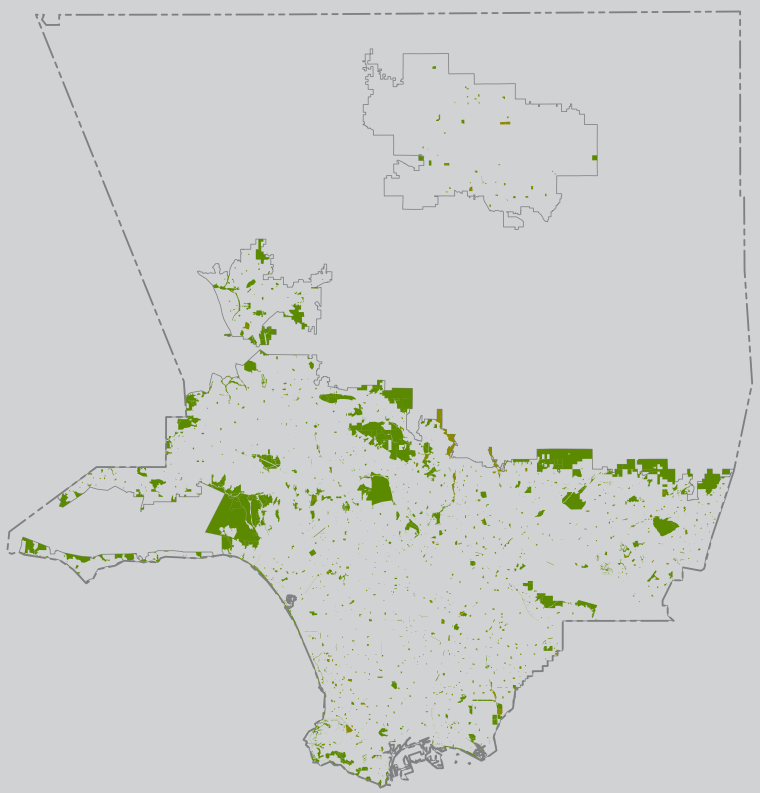
https://gis.water.ca.gov/app/
boundaries/



URBAN PARKS

Southern California
Association of Governments,
California Protected Areas
Data Portal

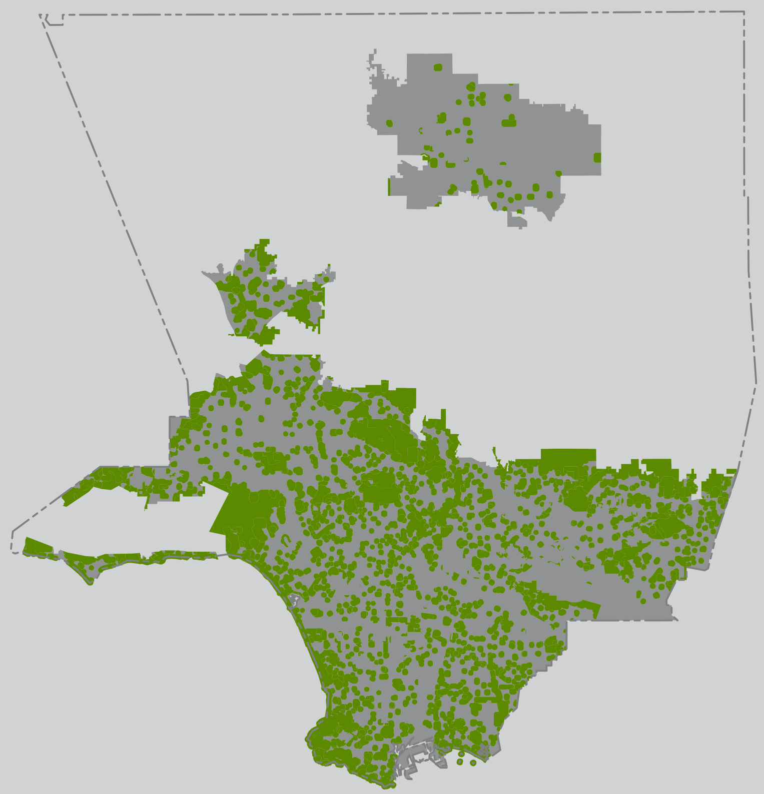
ftp://scag-data:$cag424@data.scag.
ca.gov/SCAG_Land_Use_2012/LU



PARK ACCESS AREAS

American Community
Survey 5-Year Estimates,
United States CENSUS
Bureau

https://gis.water.ca.gov/app/
boundaries/



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REFERENCE CITATIONS

The following references are organized by their respective strategy sections (shown along the left-hand margin). Each subject heading corresponds to the hyperlink within the strategy description.

GRAND CHALLENGE

SUSTAINABLE LA — PAGE 12

INCREASED TEMPERATURES OF 4-5°F / DOUBLING OR TRIPLING IN THE NUMBER OF EXTREME HEAT DAYS
Sun F, D Walton, and A Hall, 2015: A hybrid dynamical-statistical downscaling technique, part II: End-of-century warming projections predict a new climate state in the Los Angeles region. Journal of Climate, 28(12): 4618-4636. DOI: 10.1175/JCLI-D-14-00197.1

1.5 MILLION MORE PEOPLE
“Thriving In A Hotter Los Angeles: Five Year Work Plan” Https://ucla.app.box.com/v/sla-gc-work-plan-full. UCLA, n.d. Web. Oct. 2016. <https://ucla.app.box.com/v/sla-gc-work-plan-full>.

ONE OF THE SMOGGIEST REGIONS IN THE NATION
American Lung Association. (2015). State of the Air 2015. Retrieved from http://www.stateoftheair.org/2015/assets/
“Most Polluted Cities - American Lung Association | State of the Air 2015.” American Lung Association. N.p., n.d. Web. 01 Oct. 2016. <http://www.stateoftheair.org/2015/city-rankings/most-polluted-cities.html>.

LOS ANGELES

A MODEL CASE — PAGE 18

HALF OF CALIFORNIA’S RESIDENTS
18.6 million people in Greater LA / 39 million people in the state of California

The US Census Bureau defines the Greater Los Angeles area to include the entire Los Angeles County, Ventura County, Orange County and the two counties of the Inland Empire, making up the “Los Angeles-Long Beach-Riverside, CA” Combined Statistical Area (CSA). The U.S. Census estimates the 2015 population CSA is 18,679,763.

Data Access and Dissemination Systems (DADS). “American FactFinder - Results.” U.S. Census Bureau. N.p., n.d. Web. Oct. 2016. <http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk>.

“QuickFacts - California.” U.S. Census Bureau. N.p., n.d. Web. Oct. 2016. <http://www.census.gov/quickfacts/table/PST045215/06,00>.

THIRD LARGEST ECONOMY IN THE WORLD
Note: Third largest metropolitan economy

Pricewaterhouse Coopers (PwC): Los Angeles is third (3rd) largest metropolitan economy in the world after Tokyo (1) and New York (2).

Los Angeles’ metropolitan economy is equal to the country of Australia’s economy and to the country of Poland’s economy.

“Global city GDP rankings 2008-2025”. Pricewaterhouse Coopers. Archived from the original on 4 May 2011. Retrieved October 2016. < https://web.archive.org/web/20110504031739/https://www.ukmediacentre.pwc.com/imagelibrary/downloadMedia.ashx?MediaDetailsID=1562>.

18 MILLION PEOPLE
18.6 million people in Greater LA
http://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk

SECOND-LARGEST
http://bea.gov/newsreleases/regional/gdp_metro/2013/pdf/gdp_metro0913.pdf

FIVE-PERCENT OF U.S. GDP
LA Metro Area 2012 GDP: 765,759,000,000
(http://bea.gov/newsreleases/regional/gdp_metro/2013/pdf/gdp_metro0913.pdf)
US 2012 GDP: 16,041,240,000,000
(http://www.bea.gov/iTable/iTable.cfm?reqid=70&step=1&isuri=1&acrdn=2#reqid=70&step=10&isuri=1&7003=200&7035=-1&7004=naics&7005=-1&7006=00000&7036=-1&7001=1200&7002=1&7090=70&7007=2012&7093=levels)
Metro LA % of GDP: 4.8%

LOS ANGELES METROPOLITAN AREA — PAGE 20

13M PEOPLE
2010 12,828,837 people
“Population Change for Metropolitan and Micropolitan Statistical Areas in the United States and Puerto Rico (February 2013 Delineations): 2000 to 2010 (CPH-T-5).” 2010 Census Population and Housing Tables (CPH-Ts). US Census Bureau, n.d. Web. Oct. 2016. <http://www.census.gov/population/www/cen2010/cph-t/cph-t-5.html>.

4,850 SQUARE MILES
4,848 square miles
“Largest Urbanized Areas With Selected Cities and Metro Areas.” U.S. Census Bureau, n.d. Web. Oct. 2016. <https://www.census.gov/dataviz/visualizations/026/508.php>.

LOS ANGELES COUNTY — PAGE 22

88 CITIES
The first of the County’s 88 cities was incorporated in 1850, the last in 1991.
https://www.lacounty.gov/government/about-la-county/incorporated-cities

10 MILLION PEOPLE – 1/4 OF THE STATE’S POPULATION
Los Angeles County has the largest population of any county in the nation, exceeded by only eight states. More than 1 million of the 10.4 million residents live in unincorporated areas, whose municipal services are provided by the County. The other 9.3 million live in 88 cities, located throughout a 4,084-square-mile area. It is a diverse county, with more than 140 cultures and as many as 224 languages.
http://www.lacounty.gov/residents

MOST POPULOUS COUNTY IN THE UNITED STATES
http://www.census.gov/popest/data/counties/totals/2013/CO-EST2013-01.html

3% OF CALIFORNIA’S TERRITORY / 4,752 SQUARE MILES
“Los Angeles County is larger than the combined area of Delaware and Rhode Island, covering 4,752 square miles, including 76 miles of coastline.”

“The Greater Los Angeles Area Is Greater Than You Think.” (2007): n. pag. The Federal Executive Board, Los Angeles. Web. <http://www.losangeles.feb.gov/links/government/media/la_greater_booklet.pdf>.

California’s land area is 155,779.22 square miles
LA County’s land area is 2.6% of california’s land area
http://www.census.gov/quickfacts/table/LFE305214/06037
https://www.census.gov/quickfacts/table/LND110210/06,00

26% OF THE STATE’S POPULATION
http://www.lacounty.gov/residents
http://www.census.gov/quickfacts/table/PST045215/06,00

LOS ANGELES CITIES — PAGE 24

BOTTOM HALF OF THE COUNTY / LESS THAN 5% / ONLY 1%
“California Protected Areas Data Portal.” California Protected Areas Data Portal. N.p., 01 June 2016. Web. 12 Oct. 2016.
“Data Services Home.” Southern California Association of Goverments. N.p., 2012. Web. 12 Oct. 2016.

60% NON-URBANIZED / 40% URBANIZED
“Data Services Home.” Southern California Association of Goverments. N.p., 2012. Web. 12 Oct. 2016.

REFERENCE CITATIONS

CLIMATE ZONES
PAGE 26

SEA LEVEL TO 10,000 FT
Mount San Antonio - 10,064 ft (3,068 m)

5 CLIMATE ZONES
The County is made up of five climate zones. The climate zones are based on energy use, temperature, weather and other factors.

"[climate zones] represent a geographic area for which an energy budget is established. These energy budgets are the basis for the standards... (An) energy budget is the maximum amount of energy that a building, or portion of a building... can be designed to consume per year."
http://www.energy.ca.gov/maps/renewable/building_climate_zones.html

Mid-High Desert - Climate Zone 14 is characterized by wide swings in temperature, both between summer and winter and between day and night. Hot summer days are followed by cool nights; freezing nights are often followed by 60F days. Summers are hot and dry. Winters are cold, especially on the slopes and hillsides where cold air drains off on winter nights, and it does not rain (or snow) more than 1" per month. Zone 14 is a high energy-consuming climate, where cooling and heating is needed to maintain comfort.

High Mountainous Semi-Arid - Climate Zone 16 is a high, mountainous and semiarid region above 5,000 feet in elevation. It covers a large area from the Oregon Border to San Bernadino county. The climate is mostly cold, but seasonal changes are well defined and summer temperatures can be mild. Temperature varies tremendously with the slope orientation and elevation, but cool temperatures and snow cover predominate for more than half of the year. Fortunately, summer temperatures are modest, although the nights are cool. The annual precipitation can between 30-60 inches a year in this large geographic region, 90% of which falls in the winter.Since this zone experiences the most extreme range of temperatures, the energy consumption, especially for heating, is the highest in the state. Climate Design Priorities - Summer: Shade, Evaporative Cooling, High Thermal Mass with Night ventilation / Winter: Insulate, Reduce Infiltration, Passive Solar

Inland Valley - Both coastal and interior weather influences the Southern Californian inland valley climate zone. The inland winds bring hot and dry air, and marine air brings cool and moist air. This area is famous for growing citrus because the summers are hot and winters never frost. Compared to the coast, summers are warmer and winters are cooler. Rain falls in the winter averaging around 2" per month between November and April. More than 50% of the time skies are clear or partly cloudy.

Inland Near Coast - Though inland from the coast, Zone 8 is still influenced by marine air. The ocean influence controls temperature keeping it from being more extreme. Since this zone is not directly on the coast the temperatures in the summer are warmer, and in the winter, cooler. Cooling and heating are necessary in this climate to achieve comfort standards. Most of the rain falls in the winter and frosts are not a threat. Coldest temperatures are experienced in the canyons and near canyon mouths. This is ideal for growing subtropical plants, such as the avocado. Winters are not cold enough to grow apples, peaches or pears. Sunshine is plentiful in this region since it is far from coastal daily fog.

Coastal - Climate Zone 6 includes the beaches at the foot of the southern California hills, as well as several miles of inland area where hills are low or nonexistent. The Pacific Ocean is relatively warm in these longitudes and keeps the climate very mild. Most of the rain falls during the warm, mild winters. Summers are pleasantly cooled by winds from the ocean. Although these offshore winds bring high humidity, comfort is maintained because of the low temperatures. Occasionally the wind reverses and brings hot, dry desert air. Climate Zone 6 is a very comfortable place to live and therefore requires the least energy of any region in California to achieve thermal comfort levels.

http://www.pge.com/includes/docs/pdfs/about/edusafety/training/pec/toolbox/arch/climate/california_climate_zone_14.pdf

VARY AS MUCH AS 36 DEGREES
"Climate of Los Angeles." Wikipedia. Wikimedia Foundation, n.d. Web. Oct. 2016. <https://en.wikipedia.org/wiki/Climate_of_Los_Angeles>.

ENERGY AND WATER USE
http://www.energy.ca.gov/maps/renewable/building_climate_zones.html
http://www.pge.com/includes/docs/pdfs/about/edusafety/training/pec/toolbox/arch/climate/california_climate_zone_14.pdf

MANY UNIQUE SPECIES
In 2015, the BioSCAN project which analyzed 30 backyards in urban Los Angeles, discovered 30 new insect species, one in each yard, demonstrating the extraordinary level of biodiversity that remains to be discovered even in heavily human-influenced areas.

"There is no magic boundary that nature does not come across. And the reality is we don't know a lot about the nature here in LA." Greg Pauly, Natural History Museum of Los Angeles

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SINGLE-FAMILY HOMES
PAGE 28

2M SINGLE-FAMILY HOMES
"Assessor Parcels – 2014 Tax Roll." Los Angeles County GIS Data Portal. N.p., 06 Apr. 2016. Web. Oct. 2016. <http://egis3.lacounty.gov/dataportal/2015/03/10/assessor-parcel/>.
rtal/2015/03/10/assessor-parcel/>.

MULTIFAMILY, COMMERCIAL, INSTITUTIONAL, AND INDUSTRIAL BUILDINGS COMBINED
"Data Services Home." Southern California Association of Goverments. N.p., 2012. Web. 12 Oct. 2016.

ENERGY

TOTAL ENERGY 2050 BASELINE
PAGE 30

2050 TOTAL ENERGY PROJECTION FLOWCHART
This flowchart includes total energy (electricity, consumer natural gas, and transportation-related energy including for both pulic and private transportation.

Since a small amount of transportation is electrified by the grid, a portion of the electricty from the "built environment" goes toward transportation.

18.5% of energy is unaccounted for due to lack of data from the utility companies.

Assumptions:
1) 2050 Projection based on a 1.5M population increase and business as usual
2) Unquantified effects of climate change (e.g. increased indoor temperature control)
3) Increased demand is met by an increase in non-renewables
4) Transporation includes both public and private transportation

Flowchart Data: https://docs.google.com/spreadsheets/d/1_gKx84iZMHC1t3Z-eyfwI0ky1gzJCyoxlrnj1J_pPy4/edit?usp=sharing

2015 #1 SMOGGIEST CITY
American Lung Association. (2015). State of the Air 2015. Retrieved from http://www.stateoftheair.org/2015/assets/
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DOUBLE THE NUMBER OF VEHICLE-RELATED DEATHS
Hall, J. V., & Brajer, V. (2008, November). The Benefits of Meeting Federal Clean Air Standards in the South Coast and San Joaquin Valley Air Basins. Retrieved from http://publichealth.lacounty.gov/mch/AsthmaCoalition/docs/BenefitsofMeetingCleanAirStandards_11_06_08.pdf November 12, 2008 :: No. 091, Institute for Economics and Environmental Studies at Cal State Fullerton and Sonoma Technology Inc. ""The Benefits of Meeting Federal Clean Air Standards in the South Coast and San Joaquin Valley Air Basins"." Dirty Air Costs California Economy $28 Billion Annually.

California State University Fullerton, 12 Nov. 2008. Web. 01 Oct. 2016. <http://calstate.fullerton.edu/news/2008/091-air-pollution-study.html>.

Romley, J. A., Hackbarth, A., & Goldman, D. P. (2010). The Impact of Air Quality on Hospital Spending. Santa Monica, California: Rand Corporation.

REFERENCE CITATIONS

ENERGY: TRANSPORTATION

TOTAL TRANSPORTATION ENERGY 2050 BASELINE PAGE 32

2050 TRANSPORTATION ENERGY PROJECTION FLOWCHART

Each percentage is out of the total (public and private). So, for example, natural gas, gas, and diesel equals ~2% of the total public and private transportation fuel. This distribution (2% non-electric : 6% electric) of public transportation energy accords with a public transportation-only fuel-analysis, which shows electric propulsion accounts for 77.6% of countywide transportation energy use (30.9% from heavy rail, 46.7% from light rail).

Assumptions:
1) 2050 Projection based on a 1.5M population increase and business as usual
2) Does not factor in vehicles becoming more fuel efficient due to federal requirements and increased prevalance of low-carbon fuels
3) Unquantified effects of autonomous vehicles and ridesharing companies

“2014 Annual Database Energy Consumption.” Federal Transit Administration. United States Department of Transportation, n.d. Web. 01 Oct. 2016. <https://www.transit.dot.gov/ntd/data-product/2014-annual-database-energy-consumption>.

“The National Transit Database (NTD).” FTA. N.p., n.d. Web. 01 Oct. 2016. <https://www.transit.dot.gov/ntd>. Directed to transit databases and fuel consumption information by Juan Matute (UCLA)

LA County Transit Agencies 2014 Annual Database Energy Consumption Analysis: https://docs.google.com/spreadsheets/d/1IPHHDtxIl_d0siT1_AOxayAZVw3-u15KPW6uINyEjj0/edit?usp=sharing

Flowchart Data: https://docs.google.com/spreadsheets/d/1_gKx84iZMHC1t3Z-eyfwI0ky1gzJCyoxlrnj1J_pPy4/edit?usp=sharing

1 MILLION MORE VEHICLES

8,663,100.65 cars in 2050 (at current vehicle ownership rates, accounting for 11.5 million population in 2050) based on 2015 data:7,533,131 “Vehicle Registrations (Estimated Fee-Paid).” Registered Vehicles. LA Almanac, 31 Dec. 2015. Web. 01 Oct. 2016. <http://www.laalmanac.com/transport/tr02.htm>.

FIVE COAL-BURNING POWER PLANTS

8,663,100.65 cars create emissions equal to burning 43,762,889,915 pounds of coal. Total = 5.4 Intermountain Power Plants. Intermountain pounds of coal per year: 100 tons of coal per carload, 100 rail-cars per day // Intermountain Power Plant burns ~3,650,000 tons per year = 8,046,872,569.752501 pounds per year “Utah Power Plant Looks to Natural Gas to Fuel the Future | KSL.com.” Utah Power Plant Looks to Natural Gas to Fuel the Future | KSL.com. KSL Broadcasting Salt Lake City UT, 24 Mar. 2014. Web. 01 Oct. 2016. <http://www.ksl.com/?sid=29195273>.
“Greenhouse Gas Equivalencies Calculator.” EPA. Environmental Protection Agency, n.d. Web. 01 Oct. 2016. <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>.

#1 BEST COUNTY IN AMERICA FOR ELECTRIC VEHICLES

“A view from the tailpipe gives EVs a clear edge: no emissions, no pollution, no problem. Shift the view to that of a smokestack, though, and we get a much different picture. The EV that caused no environmental damage on the road during the day still needs to be charged at night. This requires a great deal of electricity generated by a power plant somewhere, and if that power plant runs on coal, it’s not hard to imagine it spewing more emissions from a smokestack than a comparable gas car coughed up from a tailpipe . . . Some places, like Los Angeles, are big EV winners. The city’s air shed traps pollutants from gas cars, leading to local smog; meanwhile, electricity is drawn from a clean grid in places like Nevada, so the environmental damage is both remote and minimal.”
Stephen P. Holland, Erin T. Mansur, Nicholas Z. Muller, Andrew J. Yates. “Environmental Benefits from Driving Electric Vehicles?” NBER. N.p., June 2015. Web. Oct. 2016. <http://www.nber.org/papers/w21291>.

Jaffe, Eric. “Mapping Where Electric Vehicles Actually Cause More Pollution Than Gas Cars.” CityLab. N.p., 29 June 2015. Web. Oct. 2016. <http://www.citylab.com/weather/2015/06/where-electric-vehicles-actually-cause-more-pollution-than-gas-cars/397136/>.

LA SPENDS THE MOST ON POLLUTION-RELATED HEALTH PROBLEMS

Los Angeles County spent the most in the state on air pollution-related ailments
Air pollution led to almost 30,000 hospital admissions and emergency room visits for asthma, pneumonia and other respiratory and cardiovascular ailments from 2005 to 2007. Three quarters of the complaints were related to fine particulate pollution, or small pieces of soot that get trapped in the lungs, and the remainder were caused by ozone.
$192 million in 3 years = $64 million a year
In the Los Angeles metropolitan area the cost exceeds $1,250 per person, which translates into $22 billion in savings if emissions came into compliance with federal standards.
Romley, J. A., Hackbarth, A., & Goldman, D. P. (2010). The Impact of Air Quality on Hospital Spending. Santa Monica, California: Rand Corporation.
“ENN: Environmental News Network -- Know Your Environment.” Air Pollution Costs California Billions. N.p., n.d. Web. Oct. 2016. <http://www.enn.com/top_stories/article/38729>.

TRANSPORTATION ENERGY STRATEGY #1 PAGE 34

TRANSPORTATION ENERGY STRATEGY #1 FLOWCHART

Assumptions:
1) New transit ridership does result in an increase in energy demand for public transit, though in reality transit may be more efficient because a greater percentage of the population is using the existing resource.

Shrank from 494 trillion BTU (2050 Projection) to 429.5 trillion BTU (2050 Projection), which is a decrease of 13% (rounded up to 15%)

The red dotted lines show the 2050 original projection, while the color-filled lines show the new energy requirement with the featured strategy. The proportion of the red dotted lines to the color-filled lines attempts to be proportional to actual amounts, however there is some deviation for purposes of legibility.

10% EFFECT

The 2050 baseline (page 36) assumes choice of transportation mode continues at current rates. Therefore, in the 2050 baseline (page 36) only 7% of the projected 11.5 million LA residents take public transit. Transportation Strategy #1(page page 38) assumes that all 1.5 million new residents are public transit riders, meaning the 1 million more cars (that would have been added to LA) never reach the road. Based on current rates of petroleum consumption, this decreases the total petroleum requirement from its baseline 2050 with-cars scenario to its strategy 1 without-new-cars scenario by ~13% and reduces the total County transportation-related energy requirement by about ~10%. Any additional energy requirements for public transit are not accounted for in this simplified analysis. This is because any additional energy requirement is likely negligible against the total: 1) unlike private vehicles, additional energy consumption in public transit is nonlinear to additional passengers and requires further study; 2) the assumption is based on using existing rail and bus lines, many of which experience low occupancy and could accommodate additional passengers without a significant addition of services, and 3) public transit already gets a significant amount of its energy from electricity which is much more efficient than petroleum.

“2014 Annual Database Energy Consumption.” Federal Transit Administration. United States Department of Transportation, n.d. Web. 01 Oct. 2016. <https://www.transit.dot.gov/ntd/data-product/2014-annual-database-energy-consumption>.

“The National Transit Database (NTD).” FTA. N.p., n.d. Web. 01 Oct. 2016. <https://www.transit.dot.gov/ntd>.
Directed to transit databases and fuel consumption information by Juan Matute (UCLA)
http://energyalmanac.ca.gov/gasoline/retail_fuel_outlet_survey/retail_gasoline_sales_by_county.html
http://energyalmanac.ca.gov/gasoline/retail_fuel_outlet_survey/retail_diesel_sales_by_county.html

Flowchart data sources: https://docs.google.com/spreadsheets/d/1_gKx84iZMHC1t3Z-eyfwI0ky1gzJCyoxlrnj1J_pPy4/edit?usp=sharing

METRO’S GOAL TO CONVERT 20%

“Metro’s goal is to convert 20% to 25% of the county’s population into regular transit riders.”
Nelson, Laura J., and Dan Weikel. “Billions Spent, but Fewer People Are Using Public Transportation in Southern California.” Los Angeles Times. Los Angeles Times, 27 Jan. 2016. Web. 01 Oct. 2016. <http://www.latimes.com/local/california/la-me-ridership-slump-20160127-story.html>.

TRANSPORTATION ENERGY STRATEGY #2 PAGE 36

TRANSPORTATION ENERGY STRATEGY #2 FLOWCHART

Assumptions:
1) All public and private vehicles are electrified.
2) Electric energy projected requirements are based on gasoline gallon equivalent (gge)

Note: While the percentage of public transportation energy increases, this is only because the total energy requirement has shrunk so much. In actuality, public transportation energy requirement shrinks (albeit less drastically than the private transportation energy requrement).

The red dotted lines, as a reminder, show the 2050 original projection, while the color-filled lines show the new energy requirement with the featured strategy. The proportion of the red dotted lines to the color-filled lines attempts to be proportional to actual amounts, however there is some deviation for purposes of legibility.

The 1% of bus, 1% of other, 30% rail can be explained thus: Rail did not increase in BTUs. But out of the new much lower total, those BTUs are now a much larger proportion. Bus and Other decreased by 1/5 so they went from 1% to a fraction of that. Converting the gasoline gallon equivalent to BTUs, the BTUs remain the same from the 2050 projection to this strategy, but they are taken out of a much smaller total.

REFERENCE CITATIONS

DECREASE 80%

The 2050 baseline (page 36) assumes that vehicles continue to rely on petroleum at the same rate they do today, plus assumes an increase of petroleum dependency concurrent with population growth according to current per-person rates of consumption.

Transportation Strategy #2 (page 40) assumes that all vehicles that would otherwise rely on nonrenewable fuel types are now powered by electricity, including public transit vehicles as well as vehicles used for transport of goods and services. In this scenario, every gas station in LA is an electric vehicle charging station.

Flowchart Data: https://docs.google.com/spreadsheets/d/1_gKx84iZMHC1t3Z-eyfwI0ky1gzJCyoxlrnj1J_pPy4/edit?usp=sharing

LESS THAN 1/5 THE BTU/MILE

Gallons multiplied by 21.3mi/gal (according to EPA) and then multiplied by 0.22 KWH/mi (from Wirz) then converted to BTU Wirz, Richard, Karthik Nithyanandam, and Parker Wells. UCLA-NSF Workshop: Food-Energy-Water Nexus in California100% Renewable Energy for Los Angeles...? UCLA Energy Innovation Lab, 2 Dec. 2015. Received from Karthik Nithyanandam.

UCLA RESEARCHERS ARE ALSO STUDYING BIOFUELS

Wirz, Richard, Karthik Nithyanandam, and Parker Wells. UCLA-NSF Workshop: Food-Energy-Water Nexus in California100% Renewable Energy for Los Angeles...? UCLA Energy Innovation Lab, 2 Dec. 2015. Web. Received from Karthik Nithyanandam.

TRANSPORTATION ENERGY 2050 CONCLUSION PAGE 38

TRANSPORTATION ENERGY CONCLUSION FLOWCHART

The red dotted lines, as a reminder, show the 2050 original projection, while the color-filled lines show the new energy requirement with the featured strategy. The proportion of the red dotted lines to the color-filled lines attempts to be proportional to actual amounts, however there is some deviation for purposes of legibility.

The 1% of bus, 1% of other, 30% rail can be explained thus: Rail did not increase in BTUs. But out of the new much lower total, those BTUs are now a much larger proportion. Bus and Other decreased by 1/5 so they went from 1% to a fraction of that. Converting the gasoline gallon equivalent to BTUs, the BTUs remain the same from the 2050 projection to this strategy, but they are taken out of a much smaller total.

ENERGY: BUILDINGS

TOTAL BUILDING ENERGY 2050 BASELINE PAGE 40

2050 BUILDING ENERGY PROJECTION FLOWCHART

1) 2050 Projection based on a 1.5M population increase and business as usual
2) Unquantified effects of climate change (e.g. increased indoor temperature control)
3) Increased demand is met by an increase in non-renewables
4) 2050 demand is compared to 525 T BTU today
5) Assumes increase in grid energy demand due to electrification of transportation

Note: 18% Renewable Energy is 77 T BTU out of known energy, 437 T BTU. 34% of total energy is unknown due to lack of utility data. Rounding may account for difference of +/- 1%.
77 T BTU = 77 trillion BTU / 663 T BTU = 663 trillion BTU

TEN COAL-BURNING POWER PLANTS

Emissions calculated according to today's emissions and 2050 energy forecasts. Emissions data from Environmental Report Card. 99,134,526 metric tons of CO_2 = 105,785,966,760 pounds of coal = 13.14622 Intermountain Power Plants. Multiplied by 1.15 in 2050 = 15 Intermountain Power Plants.
33% of emissions are transportation related so 33% (or 5) Power Plants were removed.

Mark Gold, Stephanie Pincetl, Felicia Federico. "2015 Environmental Report Card for Los Angeles County." UCLA Institute of the Environment and Sustainability (2015): n. pag. Web. < http://www.environment.ucla.edu/perch/resources/files/report-card-2015-2.pdf>.

"Utah Power Plant Looks to Natural Gas to Fuel the Future | KSL.com." Utah Power Plant Looks to Natural Gas to Fuel the Future | KSL.com. KSL Broadcasting Salt Lake City UT, 24 Mar. 2014. Web. 01 Oct. 2016. <http://www.ksl.com/?sid=29195273>.

"Greenhouse Gas Equivalencies Calculator." EPA. Environmental Protection Agency, n.d. Web. 01 Oct. 2016. <https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator>.

EXTREME HEAT DAYS

Sun, Fengpeng, Daniel B. Walton, and Alex Hall. "A Hybrid Dynamical–Statistical Downscaling Technique. Part II: End-of-Century Warming Projections Predict a New Climate State in the Los Angeles Region." Department of Atmospheric and Oceanic Sciences, University of California, Los Angeles, Los Angeles, California, 11 June 2015. Web.
Lin II, Rong-Gong. "L.A. Will Keep Getting Hotter, Scientists Say — a Lot Hotter." Los Angeles Times. Los Angeles Times, 21 June 2016. Web. 01 Oct. 2016. <http://www.latimes.com/local/california/la-me-ln-extreme-heat-la-20160620-snap-story.html>.

DOUBLE THE ELECTRICITY DEMAND

"LADWP Customers Set All-Time Record for Energy Demand of 6,196 Megawatts." LADWP Newsroom. Los Angeles Department of Water and Power, 15 Dec. 2014. Web. <http://www.ladwpnews.com/go/doc/1475/2243054/LADWP-Customers-Set-All-Time-Record-for-Energy-Demand-of-6-196-Megawatts>.

FASTEST-GROWING CITIES

"Fastest Growing Cities in LA County." Fastest Growing Cities in LA County. Los Angeles Almanac, n.d. Web. 01 Oct. 2016. <http://www.laalmanac.com/population/po36.htm>.

BUILDING ENERGY STRATEGY #1 PAGE 42

BUILDING ENERGY STRATEGY #1 FLOWCHART

Assumptions:
1) Demand reduction results in reduction of non-renewables
2) Urban lines because 1% live in non-urban area; only 5% live above metro line

Note: 24% Renewable Energy is 77 T BTU out of 66% known energy (324 T BTU). 34% of total energy is unknown due to lack of utility data. Rounding may account for difference of +/- 1%.

Since many utilities did not provide complete information, the percentage was taken only out of provided energy, not total energy. Total Countywide energy is provided by the County. The discrepancy between the Countywide total and the available energy information leaves 34% unaccounted-for sources for energy. This accords with the disclaimer on the Report Card, which states, "Energy coming into California from out of state is currently not being categorized or tracked by any national requirements or standards, and this "unspecified power" percentage can be as much as 35% of a utility's portfolio, resulting in significant uncertainty in the overall power mix.". Percentages of renewable and non-renewable are taken out of known energy only. This is done in order to make the least amount of assumptions and to re-flect the actual known mix.

Mark Gold, Stephanie Pincetl, Felicia Federico. "2015 Environmental Report Card for Los Angeles County." UCLA Institute of the Environment and Sustainability (2015): n. pag. Web. < http://www.environment.ucla.edu/perch/resources/files/report-card-2015-2.pdf>.

Flowchart Data: https://docs.google.com/spreadsheets/d/1_gKx84iZMHC1t3Z-eyfwI0ky1gzJCyoxlrnj1J_pPy4/edit?usp=sharing

30% IMPROVEMENT

The "Building Energy" section refers to all grid-supplied energy. Improving building efficiency by 30% lowers the overall energy demand by 25%. Since this analysis format assumes that every demand-side reduction correlates to a corresponding elimination of fossil fuels in the supply mix, the proportional amount of renewable energy in the overall energy mix rises with each consumption strategy. This particular consumption-reduction strategy eliminates enough demand on enough fossil fuels to bring renewable energy to 24% of the grid-mix.

30% target chosen because of LA City's plan to "reduce energy use per square foot below 2013 baseline — for all building types — by at least: 14% by 2025 and 30% by 2035"

"Sustainable City PLAn." Sustainable City PLAn. Mayor's Office of Sustainability, 8 Apr. 2015. Web. <https://www.lamayor.org/sites/g/files/wph446/f/landing_pages/files/The%20pLAn.pdf>.

REDUCE ENERGY DEMAND BY 25%

According to the LA County Energy Atlas, buildings in LA County built after 1990 are 26% more efficient than buildings built between 1950 and 1978. According to the Department of Energy, however, a long tradition of ever-larger home sizes have offset these energy efficiency improvements. Analysis from EIA's most recent Residential Energy Consumption Survey (RECS) shows that U.S. homes built in 2000 and later consume only 2% more energy on average than homes built prior to 2000, despite being on average 30% larger. This strategy for improved building efficiency's effect on the overall County energy demand assumes that square-footage per-person stays stable and does not increase. If the total built square footage of LA County increases proportionally with population growth, and if all buildings are 30% more efficient by 2050, it will reduce total Countywide energy demand by 25%. This is feasible not only because buildings will get 30% more efficient but because old building stock will be replaced by new building stock, which is already much more efficient. For example, if a building built prior to 1950 is replaced today, it will already be 40% more efficient. This strategy does, however, assume halting a longterm trend toward larger buildings, particularly residential buildings.

REFERENCE CITATIONS

Flowchart Data Guide: https://docs.google.com/spreadsheets/d/1_gKx84iZMHC1t3Z-eyfwI0ky1gzJCyoxlrnj1J_pPy4/edit?usp=sharing

“Los Angeles County Energy Atlas.” California Center for Sustainable Communities, n.d. Web. 02 Oct. 2016. <http://energyatlas.ucla.edu/>.

“Buildings Energy Data Book.” U.S. Department of Energy: Energy Efficiency and Renewable Energy, n.d. Web. 02 Oct. 2016. <http://buildingsdatabook.eren.doe.gov/ChapterIntro2.aspx>.

“Residential Energy Consumption Survey (RECS).” U.S. Energy Information Administration, n.d. Web. <http://www.eia.gov/consumption/residential/>.

“Newer U.S. Homes Are 30% Larger but Consume about as Much Energy as Older Homes.” U.S. Energy Information Administration (EIA), 12 Feb.

2013. Web. <http://www.eia.gov/todayinenergy/detail.php?id=9951&src=%E2%80%B9%20Consumption%20%20%20%20%20%20Residential%20Energy%20Consumption%20Survey%20(RECS)-f2>.

THE ENERGY EFFICIENCY OF BUILDINGS IMPROVED BY ~25%

“Los Angeles County Energy Atlas.” California Center for Sustainable Communities, n.d. Web. 02 Oct. 2016. <http://energyatlas.ucla.edu/>.

MANDATED TO IMPROVE ANOTHER 30% BY 2035

Extrapolation based on LA City’s goals and net-zero energy (NZE) statewide targets: “California’s recent revisions to Title 24 put in place ambitious performance goals: all residential buildings must be Zero Net Energy (ZNE) by 2020, and all commercial buildings must follow suit by 2030. “NZE does not necessarily mean a reduction in energy consumption since some buildings will generate more on-site power to achieve NZE status. However, it is likely that reduced energy consumption will happen in tandem with more on-site generation.

“California’s Net Zero Energy Building Mandate To Reshape US Construction Industry.” CleanTechnica, 15 Apr. 2014. Web. <http://cleantechnica.com/2014/04/15/californias-net-zero-energy-building-will-reshape-us-construction-industry/>.

“Sustainable City PLAn.” Sustainable City PLAn. Mayor’s Office of Sustainability, 8 Apr. 2015. Web. <https://www.lamayor.org/sites/g/files/wph446/f/landing_pages/files/The%20pLAn.pdf>.

ADVANCING TECHNOLOGIES

“Building Technologies Office.” U.S. Department of Energy Office of Energy Efficiency & Renewable Energy, n.d. Web. 02 Oct. 2016. <http://energy.gov/eere/buildings/building-technologies-office>.

Weiner, Jon. “Lab Project to Drive Increase in Building Efficiency.” University of California Lawrence Berkeley Lab, 10 July 2014.

Web. <http://universityofcalifornia.edu/news/lab-project-drive-increase-building-efficiency>.

Alcorn, Terence. “How BIM Can Improve Building Efficiency - Facilities Management Green Feature.” Facilitiesnet. Trade Press Media Group, Sept.2013. Web. 02 Oct. 2016. <http://www.facilitiesnet.com/green/article/How-BIM-Can-Improve-Building-Efficiency-Facilities-Management-Green-Feature--14297>.

state mandates to double the energy efficiency of buildings by 2030

“SB 350 sets targets for California to double the energy efficiency in the residential, commercial and industrial sectors while also increasing our share of electricity from renewable sources to 50 percent by 2030. . . By our estimates, achieving the level of energy savings set by SB 350 will reduce our total statewide electricity needs by about 25 percent, and reduce our natural gas needs by about 10 percent below the demand projected in 2030. Half of those saving were already in the works through existing policies, while the other half will be mandated by SB 350.”

“California Legislature Doubles Down on Energy Efficiency.” NRDC. N.p., n.d. Web. Oct. 2016. <https://www.nrdc.org/experts/merrian-borgeson/california-legislature-doubles-down-energy-efficiency>.

BUILDING ENERGY STRATEGY #2 PAGE 44

BUILDING ENERGY STRATEGY #2 FLOWCHART

44% Renewable Energy is 193 T BTU out of 66% known energy, 437 T BTU. 34% of total energy is unknown due to lack of utility data. Rounding may account for difference of +/- 1%.

Assumption: An increase in solar supply results in a proportional decrease in all non-renewable supplies. (In reality, we would get rid of coal first.)

EVERY COMPATIBLE ROOFTOP

Wirz, Richard, Karthik Nithyanandam, and Parker Wells. UCLA-NSF Workshop: Food-Energy-Water Nexus in California100% Renewable Energy for Los Angeles...? UCLA Energy Innovation Lab, 2 Dec. 2015. Received from Karthik Nithyanandam. Map Source - Cagdas has ¼ of the energy demand Wirz, Richard, Karthik Nithyanandam, and Parker Wells. UCLA-NSF Workshop: Food-Energy-Water Nexus in California100% Renewable Energy for Los Angeles...? UCLA Energy Innovation Lab, 2 Dec. 2015. Received from Karthik Nithyanandam.

Flowchart Data Guide: https://docs.google.com/spreadsheets/d/1_gKx84iZMHC1t3Z-eyfwI0ky1gzJCyoxlrnj1J_pPy4/edit?usp=sharing

250 DAYS OF SUN

“Sustainable City PLAn.” Sustainable City PLAn. Mayor’s Office of Sustainability, 8 Apr. 2015. Web. <https://www.lamayor.org/sites/g/files/wph446/f/landing_pages/files/The%20pLAn.pdf>.

46 CITIES / SOLAR NET POSITIVE

“Los Angeles County Energy Atlas.” California Center for Sustainable Communities, n.d. Web. 02 Oct. 2016. <http://energyatlas.ucla.edu/>.

25% OF THE ENERGY SUPPLY

34,000 GWh

The Energy Innovation Lab analysis says rooftop solar could account for 1/3 of electricity in 2050. This analysis takes into account today’s electricity and natural gas consumption and forecasts total energy consumption for 2050. When applied toward total energy consumthaption rather than only electricity consumption, rooftop solar’s impact is less than 1/3.

Wirz, Richard, Karthik Nithyanandam, and Parker Wells. UCLA-NSF Workshop: Food-Energy-Water Nexus in California100% Renewable Energy for Los Angeles...? UCLA Energy Innovation Lab, 2 Dec. 2015. Received from Karthik Nithyanandam.

9 YEARS

“Los Angeles Solar Power for Your House - Rebates, Tax Credits, Savings.” N.p., n.d. Web. 02 Oct. 2016. <https://solarpowerrocks.com/california/los-angeles-solar/>.

$35,000

“Los Angeles Solar Power for Your House - Rebates, Tax Credits, Savings.” N.p., n.d. Web. 02 Oct. 2016. <https://solarpowerrocks.com/california/los-angeles-solar/>.

BUILDING ENERGY STRATEGY #3 PAGE 46

BUILDING ENERGY STRATEGY #3 FLOWCHART

93% Renewable Energy is 404 T BTU out of 66% known energy, 437 T BTU. 34% of total energy is unknown due to lack of utility data. Rounding may account for difference of +/- 1%.

100% OF LA COUNTY’S ENERGY ON < 1% OF LAND

Wirz, Richard, Karthik Nithyanandam, and Parker Wells. UCLA-NSF Workshop: Food-Energy-Water Nexus in California100% Renewable Energy for Los Angeles...? UCLA Energy Innovation Lab, 2 Dec. 2015. Received from Karthik Nithyanandam.

LESS EXPENSIVE

Wirz, Richard, Karthik Nithyanandam, and Parker Wells. 100% Renewable Energy for Los Angeles, A Preliminary Assessment. UCLA Department of Mechanical and Aerospace Engineering, n.d. Web. Received from Karthik Nithyanandam.

CONSTANT AROUND-THE-CLOCK POWER

Wirz, Richard, Karthik Nithyanandam, and Parker Wells. 100% Renewable Energy for Los Angeles, A Preliminary Assessment. UCLA Department of Mechanical and Aerospace Engineering, n.d. Web. Received from Karthik Nithyanandam.

PHOTOVOLTAICS

There is tremendous potential for large scale PV as well. Already, over 1.5GW of PV is located near the LA-Kern County border.

59%

Wirz, Richard, Karthik Nithyanandam, and Parker Wells. 100% Renewable Energy for Los Angeles, A Preliminary

REFERENCE CITATIONS

Assessment. UCLA Department of Mechanical and Aerospace Engineering, n.d. Web. Received from Karthik Nithyanandam.

4%
Wirz, Richard, Karthik Nithyanandam, and Parker Wells. 100% Renewable Energy for Los Angeles, A Preliminary Assessment. UCLA Department of Mechanical and Aerospace Engineering, n.d. Web. Received from Karthik Nithyanandam.

BUILDING ENERGY 2050 CONCLUSION PAGE 48

RESIDENTS INTO PRODUCERS
“One startup in the Netherlands is creating an Airbnb-style site for electricity, cutting utilities out of the transaction entirely. “Schiller, Ben. “The Sharing Economy Takes On Electricity, So You Can Buy Your Power From Neighbors.” FactCoExist, 01 Oct. 2014. Web. 02 Oct. 2016. <https://www.fastcoexist.com/3036271/the-sharing-economy-takes-on-electricity-so-you-can-buy-your-power-from-neighbors>.

“The Dutch platform Vandebron [...] has more than 38,000 subscribers. Consumers pay a monthly fee to contract directly with suppliers of clean energy for a set amount of power over a set amount of time. “

Martin, Richard. “Renewable Energy Trading Launched in Germany.” MIT Technology Review. N.p., 29 Dec. 2015. Web. 02 Oct. 2016. <https://www.technologyreview.com/s/544471/renewable-energy-trading-launched-in-germany/>. Vermont’s solar sharing partnership will “democratize access to clean energy; literally bringing power to the people, by the people “

“GMP & Yeloha Announce Solar Sharing Partnership, First of Its Kind With a Utility.” Green Mountain Power, 21 Sept. 2015. Web. 02 Oct. 2016. <http://news.greenmountainpower.com/press-releases/gmp-yeloha-announce-solar-sharing-partnership-f--11g054664-001?feed=d51ec270-a483-4f6ca55e-8e5fbe2238c2>.

WATER

TOTAL WATER 2050 BASELINE PAGE 50

2050 TOTAL WATER PROJECTION FLOWCHART
Assumptions:
1) 2050 Projection based on a 1.5M population increase and business as usual
2) Unquantified effects of climate change (e.g. evapotranspiration, decreased snowpack, and landscaping demand)
3) Increased demand is met by an increase in imports
4) The demand side is LA City consumption patterns extrapolated to the County.

Flowchart Data: https://docs.google.com/spreadsheets/d/1_gKx84iZMHC1t3Z-eyfwI0ky1gzJCyoxlrnj1J_pPy4/edit?usp=sharing

Note: The amount contributed by each groundwater source is unkown. Stormwater Capture, Natural Recharge, Imported/Managed Recharge are presented equally only because there is no available data. Some portion of natural recharge is natural stormwater. Stormwater capture here refers to managed stormwater capture.

139 GALLONS PER CAPITA PER DAY
Progress has been made since the 139 GPCD was measured in 2013. It is used as a baseline with all fluctuations above or below considered against that baseline.
Gold, M., Pincetl, S., & Federico, F. (2015). 2015 Env. Retrieved from http://www.environment.ucla.edu/perch/resources/files/report-card-2015-2.pdf

AN ADDITIONAL 75 BILLION GALLONS
76,102,500,000 additional gallons in 2050
Calculated based on multiplying per capita consumption by 15% population growth

INCREASED PRESSURE ON GROUNDWATER SUPPLIES
Demand doesn’t decrease LA groundwater supply with LA’s groundwater adjudication; however higher populations do place greater pressure on the groundwater supply. And currently imports do recharge the groundwater. All imports come from surface water, not from remote groundwater sources.

INCREASING POPULATION IN THE WEST
By Abrahm Lustgarten, Lauren Kirchner and Amanda Zamora. “Here’s the Only Explainer on California Drought You Need.” Grist. N.p., 27 June 2015. Web. 02 Oct. 2016. <http://grist.org/climate-energy/heres-the-only-explainer-on-california-drought-you-need/>.

WATER STRATEGY #1 PAGE 52

WATER STRATEGY #1 FLOWCHART
All percentages are out of the total water supply / total water demand. So, for example, 20% of water for outdoor use is not 20% of residential use, but out of combined residential, commercial, industrial, institutional use; 20% of the county’s water is used for outdoor use. However, that is likely a conservative estimate. LADWP estimates that 54% of total single-family water use is for outdoor purposes. There is not corresponding information for multi-family water use. Thus, this analyis takes a conservative approach of assuming that only single-family residences use water for outdoor purposes. Single-family water consumption accounts for approximately 35% of Countywide water consumption. 54% of 35% is 18.9%--or approximately 20%. This strategy assumes residential water conservation measure will primarily be achieved through a steep reduction in outdoor water use.

Mini, C., Hogue, T. S., & Pincetl, S. (2014, May). Estimation of residential outdoor water use in Los Angles, California. UCLA: UCLA.

Assumptions:
1) Status quo of institutional management of supply
2) No additional local water supply (increased demand is met by an increase in imports)
3) All demand reduction offsets imported water
4) Dashed line represents original 2050 projection

There are two water districts using 420+ R-GPCD (Los Angeles County Waterworks District 37 - Acton & Valley Water Company). The first one is in unincorporated area. The second one is inside the borders of La Canada Flintridge (City).

25%
This is an extremely modest conservation target. The Sustainable LA 5-Year Work Plan defines goal as 50 T-GPCD (50 gallons per capita per day total), which may requre as little as 25-35 R-GPCD (residential gallons per capital per day). Gold, M., Rauser, C., Herzog, M., & Lueders, J. (2015). Sustainable LA Grand Challenges: Thriving in a Hotter Los Angeles: Five-Year Work Plan 2015-2020. Retrieved from https://ucla.app.box.com/v/sla-gc-work-plan-full

95 GALLONS PER CAPITA PER DAY FOR RESIDENTIAL USE
While this number is estimated based on the Now Institute’s own calculations–93.565 residential gallons per capita per day (R-GPCD), rounded to 95), it very closely approximates to residential water use data provided by utilities for 2012, which reports residential water use at 94.904 R-GPCD .

PWSS Water Agency Spreadsheet: https://docs.google.com/spreadsheets/d/1Chv3GbnPhx3LU38pGVC4P60ATYBhLhlFrepD4ZLj_7I/edit?usp=sharing

THREE TIMES AS MUCH AS BERLIN / 30 GALLONS PER DAY
Berlin: 112 liters per day = 30 gallons per day
Salian, Prit, and Barbara Anton. “Sustainable Urban Water Management: Making Urban Water Management More Sustainable: Achievements in Berlin.” (n.d.): 10. SWITCH □ Managing Water for the City of the Future. ICLEI European Secretariat. Web. <http://www.switchurbanwater.eu/outputs/pdfs/w6-1_gen_dem_d6.1.6_case_study_-_berlin.pdf>.

France: 106 liters per day = 28 gallons per day
Trends. Water Facts and Trends (2005): 7. UN-Water. United Nations. World Business Council for Sustainable Development, 2005. Web. <http://www.unwater.org/downloads/Water_facts_and_trends.pdf>.

WATER STRATEGY #2 PAGE 54

WATER STRATEGY #2 FLOWCHART
All percentages are out of the total water supply / total water demand. So, for example, 20% of water for outdoor use is not 20% of residential use, but out of combined residential, commercial, industrial, institutional use; 20% of the county’s water is used for outdoor use. However, that is likely a conservative estimate. LADWP estimates that 54% of total single-family water use is for outdoor purposes. There is not corresponding information for multi-family water use. Thus, this analyis takes a conservative approach of assuming that only single-family residences use water for outdoor purposes. Single-family water consumption accounts for approximately 35% of Countywide water consumption. 54% of 35% is 18.9%--or approximately 20%.

Both Strategy 1 and Strategy 2 call for an equal reductions of annual gallons of water used for outdoor purposes. However, percentages are dependent upon the total amount of water. Thus the same number divided by different wholes results in different percentages. Because Strategy 1 results in a slightly lower total water requirement than Strategy 2, the percentage of outdoor use is higher in Strategy 1 than in Strategy 2, even though their gallons/acre-feet allotments are equal.

54% OF ALL HOUSEHOLD WATER
“LADWP estimates that 54% of total single-family water use is for outdoor purposes. Previous studies support that these methods likely underestimate actual outdoor use.

“Mini, C., Hogue, T. S., & Pincetl, S. (2014, May). Estimation of residential outdoor water use in Los Angles, California. UCLA: UCLA.

REFERENCE CITATIONS

55 GALLONS PER PERSON PER DAY / MORE THAN A MILLION GALLONS
"The River Project and Water LA's Pilot Program transformed 23 Panorama City residents' yards with techniques that increase biodiversity, harvest rainwater, infiltrate almost 4 acre-feet of water per year to groundwater, help prevent pollution in the LA River, and mitigate local flooding--all while reducing their water use to an average of 55 gallons per person per day."

"Sustainable City PLAn First Annual Report." City of Los Angeles. Mayor's Office of Sustainability, n.d. Web. <https://www.lamayor.org/sites/g/files/wph446/f/landing_pages/files/pLAn%20first%20annual%20report%202015-2016_0.pdf>.

18%
"LADWP estimates that 54% of total Single-family water use is for outdoor purposes." This equates to ~20% of total water use. Outdoor water use is based on available data only. It is likely higher than stated since multi-family outdoor water use is not accounted for here. 20.193%=(582256.837903702 [Total SFR use]*0.54)/1556997.91484288 [Total County Water Consumption]

WATER STRATEGY #3 PAGE 56

WATER STRATEGY #3 FLOWCHART
Flowchart Data: https://docs.google.com/spreadsheets/d/1_gKx84iZMHC1t3Z-eyfwI0ky1gzJCyoxlrnj1J_pPy4/edit?usp=sharing

2X
LA's 2050 water requirement at current consumption rates = 1.8 million acre-feet / ~253,000 acre-feet of water per inch of rainfall x 15 inches =~3.8 million / 1.8 million = 2.11
"The Natural Resources Defense Council has argued that stormwater capture could potentially provide more than 253,000 acre-feet of water for Los Angeles County after every inch of rainfall."

Morin, Monte. "L.A. County's Plan to Capture Stormwater Could Be State Model." Los Angeles Times, 17 June 2015. Web. 03 Oct. 2016. <http://www.latimes.com/local/california/la-me-stormwater-runoff-20150617-story.html>.

MORE THAN 80 BILLION GALLONS / EVERY INCH
"The Natural Resources Defense Council has argued that stormwater capture could potentially provide more than 253,000 acre-feet of water for Los Angeles County after every inch of rainfall."

253,000 acre feet = 82.4 billion gallons
Morin, Monte. "L.A. County's Plan to Capture Stormwater Could Be State Model." Los Angeles Times, 17 June 2015. Web. 03 Oct. 2016. <http://www.latimes.com/local/california/la-me-stormwater-runoff-20150617-story.html>.

15 INCHES
"Los Angeles has had an average rainfall of 14.93 inches over the last 30 years, which is 62% less than the average nationwide, and 9.78 inches fewer than the average in California."
Based on available rainfall data for City of Los Angeles. The next step would be to gather analyze Countywide precipitation data. "Los Angeles,8California Average Rainfall." Weather DB, n.d. Web. 3 Oct. 2016. <https://rainfall.weatherdb.com/l/40/Los-Angeles-California>.

MORE THAN 1 TRILLION GALLONS
14.93 inches multiplied by 253,000 acre-feet multiplied by 325851.4319 (acre-feet to gallons conversion) = 1.23084E+12 gallons of rain

NOT ALL RAINFALL CONTRIBUTES DIRECTLY TO THE WATER SUPPLY
Half the county is north of the valley, which means that water flows the other direction and isn't going into GW basins. Instead, it goes into the Santa Clara River.

10%
400,000 acre-feet stormwater assumes some water is already being captured. The actual amount of stormwater capture needs to be verified by water utilities, and quantifying the amount remains an open research question. The amount of capture-able stormwater also remains an open question, with varying reports on how much stormwater is available. Even without ideal stormwater capture infrastructure, the Public Works Department was able to diver 3.2B gallons to recharge basins to recharge groundwater, enough water for 78,000 people, after just one storm.

"3.2B Gallons Of Rainwater Saved For LA County Recharge Basins." CBS Los Angeles, 8 Jan. 2016. Web. 03 Oct. 2016. <http://losangeles.cbslocal.com/2016/01/08/3-2b-gallons-of-rainwater-saved-for-la-county-recharge-basins/>.

"an estimated 163 billion gallons of water a year — including much that falls from the sky over the flatlands — slips to the sea, enough to fill a large swimming pool for every household in the county . . . Only 65 billion gallons [199,477.41 acre feet = ~200,000 acre feet) is captured and stored in the aquifers."

Mozingo, Joe. "Http://www.latimes.com/local/california/la-me-storm-water-capture-20160311-story.html." Los Angeles Times, 11 Mar. 2016. Web. 03 Oct. 2016. <http://www.latimes.com/local/california/la-me-storm-water-capture-20160311-story.html>.

WATER STRATEGY #4 PAGE 58

WATER STRATEGY #4 FLOWCHART
Assumption:
1) Volumes of recycled water are roughly equivalent to volumes available as water supply
Note: The goal of 500K acre-feet was set by UCLA's Mark Gold.

100%
Up to 100% of the amount of recycled water can be reused after treatment.
"Twenty-Sixth Annual Status Report on Recycled Water Use." Sanitation Districts of Los Angeles County, n.d. Web. 3 Oct. 2016. <http://www.lacsd.org/civicax/filebank/blobdload.aspx?blobid=12648>. TABLE 1: RECYCLED WATER PRODUCED AND REUSED AT WATER RECLAMATION PLANTS FISCAL YEAR 2014-15

ONLY 4%
Gold, M., Pincetl, S., & Federico, F. (2015). 2015 Env. Retrieved from http://www.environment.ucla.edu/perch/resources/files/report-card-2015-2.pdf

EIGHT TIMES
Currently ~62,000 acre-feet of the water supply comes from recycled water. This scenario projects 500,000 acre-feet from recycled water. That's 8.06 times as much as today.

ISRAEL / RECYCLES 85%
"Water Recycling Technologies in Israel." Israel Ministry of Foreign Affairs, 29 Mar. 2016. Web. 3 Oct. 2016. <http://mfa.gov.il/MFA/InnovativeIsrael/GreenIsrael/Pages/Water-recycling-technologies-in-Israel-29-Mar-2016.aspx>.

WATER STRATEGY #5 PAGE 60

WATER STRATEGY #5 FLOWCHART
1) It's already occurring at roughly 5,000-10,000 af/y with a goal of 20,000 acre-feet per year. By 2050, we could pull out 100,000 AF/y at this rate of progress.

5% / 1/6TH
Based on 100,000 more acre-feet of groundwater remediation

600,000 ACRE-FEET OF BRACKISH GROUNDWATER
Another strategy identified in the draft PEIR for the WCBCB Groundwater Master Plan is to shift pumping patterns in WCB and eventually increase groundwater extraction to contain and remove the salt water plume in the Silverado Aquifer. This remediation project is an essential piece of WRD's WIN program.[1] The plume occupies a volume of approximately 600,000 acre-feet and extends from El Segundo, into Manhattan Beach, through Redondo Beach, with the majority in the city of Torrance.[2] Currently, two treatment facilities treat water that is pumped from the saline plume to potable standards: WRD's Goldsworthy Desalter and WBMWD's Brewer Desalter. Currently Goldsworthy Desalter and Brewer Desalter operate at a capacity of and produce 2.5 MGD (2,800 AFY) and 5 MGD (5,600 AFY) of potable water respectively.[3]

WRD has proposed the Goldsworthy Desalter Expansion Project. The project poses an increase of the current 2.5 MGD (2,800 AFY) treated water capacity to 5 MGD (5,600 AFY), the installation of two new supply wells, and the construction of pipelines to convey the pumped groundwater to the expanded desalter.[4] The desalter uses reverse osmosis (RO) as the primary process to treat the brackish groundwater. Because Goldsworthy Desalter was designed with this 5 MGD (5,600 AFY) expansion in mind, it already possesses the physical capacity. The capacity expansion mainly consists of adding a second RO treatment train. The expansion project includes the construction of two new groundwater wells to supply the new desalter. The two wells would each have a production capacity of 2,200 gallons per minute (gpm), or 3.2 MGD (3,584 AFY) in order to supply the new desalter with sufficient water to meet the 4,400 gpm, or 6.3 MGD (7,056 AFY) production demand.[5]

REFERENCE CITATIONS

In order to see complete remediation of the plume, the strategy proposes new extraction wells and the construction of 6 regional desalters to pump and treat 13.4 MGD (15,000 AFY) of saline water to potable standards over a 40-year period.[6] It is expected that the City of Torrance, the City of Los Angeles, and the California Water Services Company (CWSC)-Hawthorne would use up to 13.4 MGD (15,000 AFY) of desalinated water from these new extraction wells. [7] By providing a new potable source of water to these three groundwater pumpers the project will shift the pumping patterns to allow maximum plume containment and remediation. This project will not only create a new local water supply but also create significant groundwater storage volume.[8]

[1] California Water Commission. Water Storage Investment Program Concept Paper: West Coast Basin Brackish Water Reclamation project. https://cwc.ca.gov/Documents/2016/WSIP/WRD_WestCoastBasinBrackishWaterReclamationProject.pdf. Accessed 07/21/16
2 California Water Commission. Water Storage Investment Program Concept Paper: West Coast Basin Brackish Water Reclamation project. https://cwc.ca.gov/Documents/2016/WSIP/WRD_WestCoastBasinBrackishWaterReclamationProject.pdf. Accessed 07/21/16
3 Initial Study Robert W. Goldsworthy Desalter Expansion Project (pdf) CH2MHILL for WRD. 2013 http://www.wrd.org/Goldsworthy-IS.pdf
4 Initial Study Robert W. Goldsworthy Desalter Expansion Project (pdf) CH2MHILL for WRD. 2013 p. 1-1 http://www.wrd.org/Goldsworthy-IS.pdf
5 Initial Study Robert W. Goldsworthy Desalter Expansion Project (pdf) CH2MHILL for WRD. 2013 p. 1-3 http://www.wrd.org/Goldsworthy-IS.pdf
6 California Water Commission. Water Storage Investment Program Concept Paper: West Coast Basin Brackish Water Reclamation project.
7 CBWCB GBMP DPEIR 2015 p. 3-14
8 California Water Commission. Water Storage Investment Program Concept Paper: West Coast Basin Brackish Water Reclamation project.

PURSUING ADDITIONAL EMERGING TECHNOLOGIES

As of March 2016: “The system treats water at a cost of less than 30 cents per 1,000 liters” If 1 acre-foot = 1233481.855 liters, that’s $370.05 per acrefoot. That’s an 80% decrease over the course of just two years. In May 2014, the system treated water for $1,850 per acre-foot ($1.50 per 1,000 liters).

Sahagun, Louis. “UCLA Researchers Unveil a Better Way to Clean Brackish Water.” UCLA Institute of the Environment and Sustainability Newsroom.
N.p., 5 May 2014. Web. 03 Oct. 2016. <http://www.environment.ucla.edu/newsroom/ucla-researchers-unveil-a-better-way-to-cleanbrackish-water/>.

Hewitt, Alison, and Bill Kisliuk. “UCLA Participates in Today’s White House Water Summit.” University of California. University of California, 22 Mar. 2016. Web. 03 Oct. 2016. <http://universityofcalifornia.edu/news/ucla-participates-white-house-water-summit>.

ADVANCING POLICIES

“We have two tiers. The first tier is $6.06 for the first 1,000 to 7,000 gallons. Thereafter, it jumps up to $21.72 for every thousand gallons after that 7,000 gallon initial use . . . Well, back in 1997 when we started, the average use per household was about 162 gallons per person. Today, it’s about 96 gallons per person, per day. And that takes into account our population. We’ve grown by more than 10 percent since we started the tier pricing. And we’ve reduced water consumption by more than 20 percent on the per-person gallon . . .a family of 4 using 100 gallons of water per person, per day in Santa Fe would pay $154. That’s about twice as much they’d pay in Los Angeles.”
“Santa Fe Cuts Water Consumption By Imposing Tiered Pricing Model.” NPR, n.d. Web. Oct. 2016. <http://www.npr.org/2015/05/13/406505133/santa-fe-cuts-water-consumption-by-imposing-tiered-pricing-model>.

Walton, Brett. “The Price of Water: A Comparison of Water Rates, Usage in 30 U.S. Cities - Circle of Blue.” Circle of Blue, 10 Mar. 2010. Web. 03 Oct. 2016. <http://www.circleofblue.org/2010/world/the-price-of-water-a-comparison-of-water-rates-usage-in-30-u-s-cities/>.

ECOSYSTEM

TOTAL ECOSYSTEM 2050 BASELINE PAGE 64

CALIFORNIA FLORISTIC PROVINCE / ONE OF JUST 35 BIODIVERSITY HOTSPOTS IN THE WORLD

“L.A. lies within the California Floristic Province, which is globally recognized as one of just thirty-five biodiversity hotspots in the world -- and the only one in the continental United States.”
https://www.nrdc.org/experts/damon-nagami/los-angeles-launches-biodiversifyla-protect-regions-rare-biodiversity

4,346 IDENTIFIED SPECIES, 92 OF WHICH ARE ENDANGERED OR THREATENED

“L.A. Nature Map.” INaturalist.org. N.p., n.d. Web. Oct. 2016. <http://www.inaturalist.org/projects/l-a-nature-map>.

SIGNIFICANT ECOLOGICAL AREAS

“The objective of the SEA Program is to conserve genetic and physical diversity by designating biological resource areas that are capable of sustaining themselves into the future. However, SEAs are not wilderness preserves. Much of the land in SEAs is privately-held, used for public recreation, or abuts developed areas. The SEA Program must therefore balance the overall objective of resource preservation against other critical public needs. The General Plan goals and policies are intended to ensure that privately-held lands within the SEAs retain the right of reasonable use, while avoiding activities and developments that are incompatible with the long-term survival of the SEAs.” The County relies on the SEA Program to balance preservation of the County’s natural biodiversity with the development rights of property owners located within the SEAs.”
http://planning.lacounty.gov/sea

1/4 OF THE COUNTY

“California Protected Areas Data Portal.” California Protected Areas Data Portal. N.p., 01 June 2016. Web. 12 Oct. 2016.
“Data Services Home.” Southern California Association of Goverments. N.p., 2012. Web. 12 Oct. 2016.

AFFECTED BY DEVELOPMENT

“many of them have been significantly damaged since they were last studied in 1976”
http://articles.latimes.com/1992-04-05/local/me-909_1_significant-ecological-areas

150,000 ACRES BY 2050

Current urbanized area: 1,036,353.27 acres
2050 urbanized area at current density (multiply current acres by 1.15 to account for population growth): 1191806.258 acres
Land lost (subtract current from 2050): 155,452.99 acres

10X THE SIZE OF THE WILSHIRE CORRIDOR

Wilshire Corridor: 14,831.18 acres / 23.1737172 square miles
Land lost (155,452.99 acres) = 10.48 times as many acres as the Wilshire corridor

ECOSYSTEM STRATEGY #1 PAGE 66

PROTECT ALL NON-URBANIZED LAND

NON-URBANIZED LAND	1,493,527.26	57.14% of LA County
PROTECTED NON-URBANIZED	741,668.18	28.37% of LA County
NOT PROTECTED NON-URBANIZED	751,859.08	28.76% of LA County

30% OF THE COUNTY’S NATURAL LAND IS PROTECTED

There are 886,443 acres of protected public lands in Los Angeles County, public lands in Los Angeles County, comprising 34% of the total County land area.
http://www.environment.ucla.edu/perch/resources/files/report-card-2015-ecosystem-health-1.pdf

30% OF NATURAL LAND IS NON-DEVELOPED BUT UNPROTECTED

“California Protected Areas Data Portal.” California Protected Areas Data Portal. N.p., 01 June 2016. Web. 12 Oct. 2016.
“Data Services Home.” Southern California Association of Goverments. N.p., 2012. Web. 12 Oct. 2016.

ECOSYSTEM STRATEGY #2 PAGE 68

¼ MILE OF A PARK

Sustainable LA Grand Challenge Goals: By 2050, Los Angeles County will ensure every resident has access to a green space4 or natural area5 within one-quarter mile.
https://ucla.app.box.com/v/sla-gc-work-plan-full

2.5X AS MANY PARKS

This assumes parks are, on average, the same size as parks today. The number was produced by taking a 1/4 mile radius of all parks within the urbanized area and analyzing the negative space.

ECOSYSTEM 2050 CONCLUSION PAGE 70

LESS THAN HALF THE URBAN AREA IS WITHIN ¼ MILE DISTANCE TO A PARK.

“California Protected Areas Data Portal.” California Protected Areas Data Portal. N.p., 01 June 2016. Web. 12 Oct. 2016.
“Data Services Home.” Southern California Association of Goverments. N.p., 2012. Web. 12 Oct. 2016.

REFERENCE CITATIONS

INCREASES HUMAN WELL-BEING

"Beginning in the 1950s, we emptied our cities, sprawled everyone across the landscape and became dependent on automobiles," Jackson says. "Sitting in our cars rather than living in walkable cities has led to two of our biggest public health problems, obesity and stress. When I give talks in Los Angeles, people say their commute is the hardest part of their day. Not their job – their commute." - Richard Jackson

"Smart-growth communities are an effort to make the landscape denser and more walkable, [and] to ensure that residents have easy access to attractive green spaces and recreational opportunities." — Michael Jerrett

Paris has 55,000 people per square mile. New York has 25,000 people/sm. Atlanta is tough because the city borders are so odd. The density of the overall MSA of 28 counties is 630/sm. People need nature contact, vegetation, water features. To keep natural landscapes open requires quality density that attract residents to urban centers. By quality density I suggest good housing with excellent environmental features (noise reduction, landscaping, energy efficiency, water capture, sightlines), excellent public services (policing, schools, waste removal, transit) and an excellent pedestrian realm (sidewalks, café seating, traffic calming) and of course, good parks. - Richard Jackson

STRATEGIES ARE NOT ISOLATED / INDICATORS AND MAPS WILL HELP GUIDE BIODIVERSITY

Need for Region-Specific Indicators:

"Under the umbrella of sustainability, leading metropolitan regions are using local ecosystem-based indicators to guide projects and policies toward levels of ecological health and benefits beyond traditional regulatory thresholds. The following examples use ecosystem health indicators to ensure that increasing land use intensity is achieved while maintaining and enhancing local ecosystems and the benefits they provide. Singapore's Green Plan(1) is a leading example of embracing "natural capital" while managing intensive urban development needs. The Plan established a comprehensive framework supporting indicators that guide policy and projects at multiple spatial scales to maximize ecosystem health, even in the densest urban settings(2). San Francisco is also optimizing ecosystem health with indicators-based decision support tools as they implement large-scale green infrastructure through their $15B Sewer System Improvement Program(3)." - Isaac Thomas Brown, Isaac Brown Ecology Studio, UCLA Institute of the Environment and Sustainability

What's next:

Building from the current effort, the ecosystem health characterization will be refined to higher resolutions and finer spatial scales. In urban areas, additional indicators are envisioned to include landscape, tree canopy, open space, and land cover characteristics at neighborhood and finer scales. When complete, indicators and maps will help guide biodiversity, climate change adaptation, ecosystem management, land use, public health, and infrastructure decisions. Drawing upon leading edge precedents worldwide and the latest science, this framework will emphasize translation of indicators from regional to site scales, and urban to natural systems. It will provide a comprehensive platform for measuring how well nature is being protected and enhanced in the County, and how well the urban landscape is performing to the benefit of people and ecosystems." - Isaac Thomas Brown, Isaac Brown Ecology Studio, UCLA Institute of the Environment and Sustainability

(1) "The Singapore Green Plan 2012: BEYOND CLEAN AND GREEN TOWARDS ENVIRONMENTAL SUSTAINABILITY." Https://www.mewr.gov.sg/docs/default-source/default-document-library/grab-our-research/sgp2012.pdf. N.p., n.d. Web.

(2) "How Singapore Makes Biodiversity an Important Part of Urban Life." Citiscope. N.p., n.d. Web. Oct. 2016. <http://citiscope.org/story/2015/how-singapore-makes-biodiversity-important-part-urban-life>.

(3) https://infrastructure.sfwater.org/fds/fds.aspx?lib=SFPUC&doc=1000688&ver=1&data=385264880. San Francisco Water Power Sewer, 1 July 2015. Web. Oct. 2016.