Our County

Energy Briefing

July 2018

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Introduction

The L.A. County Chief Sustainability Office in partnership with BuroHappold Engineering and UCLA is hosting an energy and equity workshop to inform Our County, the countywide sustainability plan. Our County is an effort to outline a bold, inclusive vision for growth that balances the co-equal values of environment, equity, and economy.

We are thrilled that the Liberty Hill Foundation will be facilitating this workshop at which we will be discussing energy issues and opportunities for the region, and will take a deep dive into where and how energy intersects with equity, public health, labor, housing, and other issues.

Energy is essential for the economic, social, and environmental vitality of Los Angeles County. The existing system is aging, inefficient, and vulnerable to system-wide outages. In addition, our reliance on fossil fuels produces greenhouse gas emissions, air pollution, negative land use impacts and significant resilience issues.

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Where and How We Get Our Energy

Electricity Generation

Energy generation is distributed throughout Los Angeles County, with concentrations in Long Beach and Lancaster (Figure 1). L.A. County is a leader in solar generation, producing and using more renewable energy than ever before. While utility-scale wind facilities are currently prohibited in all unincorporated areas within the county, utility-scale solar generation increased by over one million Megawatt Hours (MWh) between 2012 and 2015 and reached over 575 MW of capacity in 2015[i]. A total of 475 MW of rooftop solar was installed in the County as of 2015, mainly in Southern California Edison (SCE) territory (Figure 2).[ii] Overall, approximately 14% of the County's electricity generation came from renewable energy sources in 2015. While this represents an increase from years prior, it is equivalent to less than 5% of the County's electricity consumption.[iii] Utilities serving L.A. County show a gravitation towards renewable energy purchases with some cities representing nearly 35% of energy consumption with renewable energy purchasing (Figure 3).

Electricity is largely imported from outside L.A. County and a significant proportion of the energy consumed in the County comes from outside the State. Electricity derived from coal is still relied on throughout the County despite its general decline in use across L.A. County. As of 2016, 64% of Azusa's electricity, 40% of Pasadena's electricity, 30% of Burbank's electricity and 19% of LADWP's electricity was derived from coal sources.[iv]

Distributed Energy Resources

Locally produced renewable energy benefits L.A. County through reduced transmission losses and disruptions, reduced GHGs and air pollution and increased resilience for local communities. According to estimates by the California Energy Commission,[v] the technical potential of Los Angeles County's residential and commercial rooftop PV capacity is almost 5 GW, suggesting a valuable role for distributed energy resources in the county's renewable energy future.

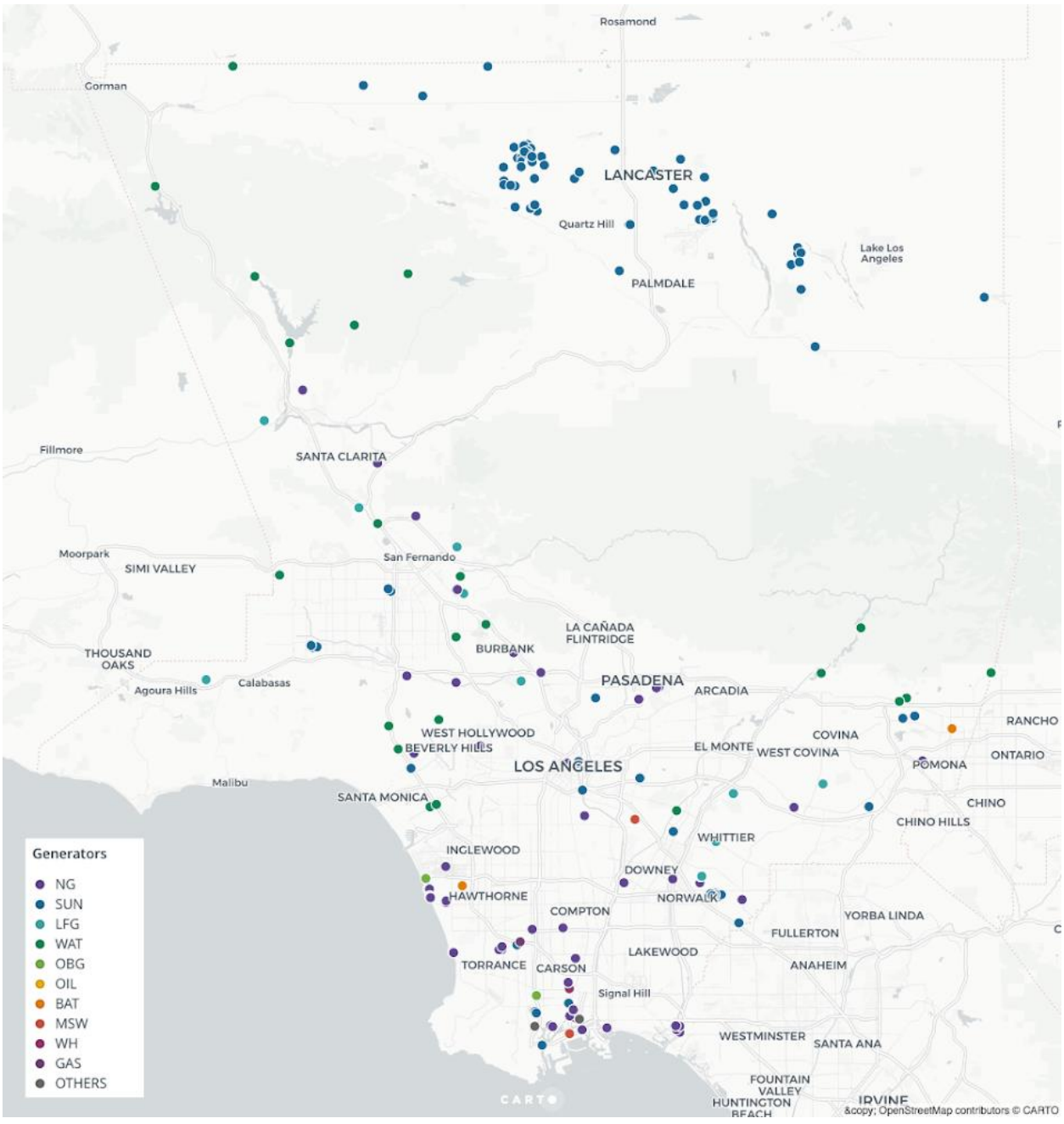

Figure 1. Generators in L.A. County.[1]

[1] Source: UCLA California Center for Sustainable Communities (E Fournier, based on data from the California Energy Commission accessed on June 22, 2018)

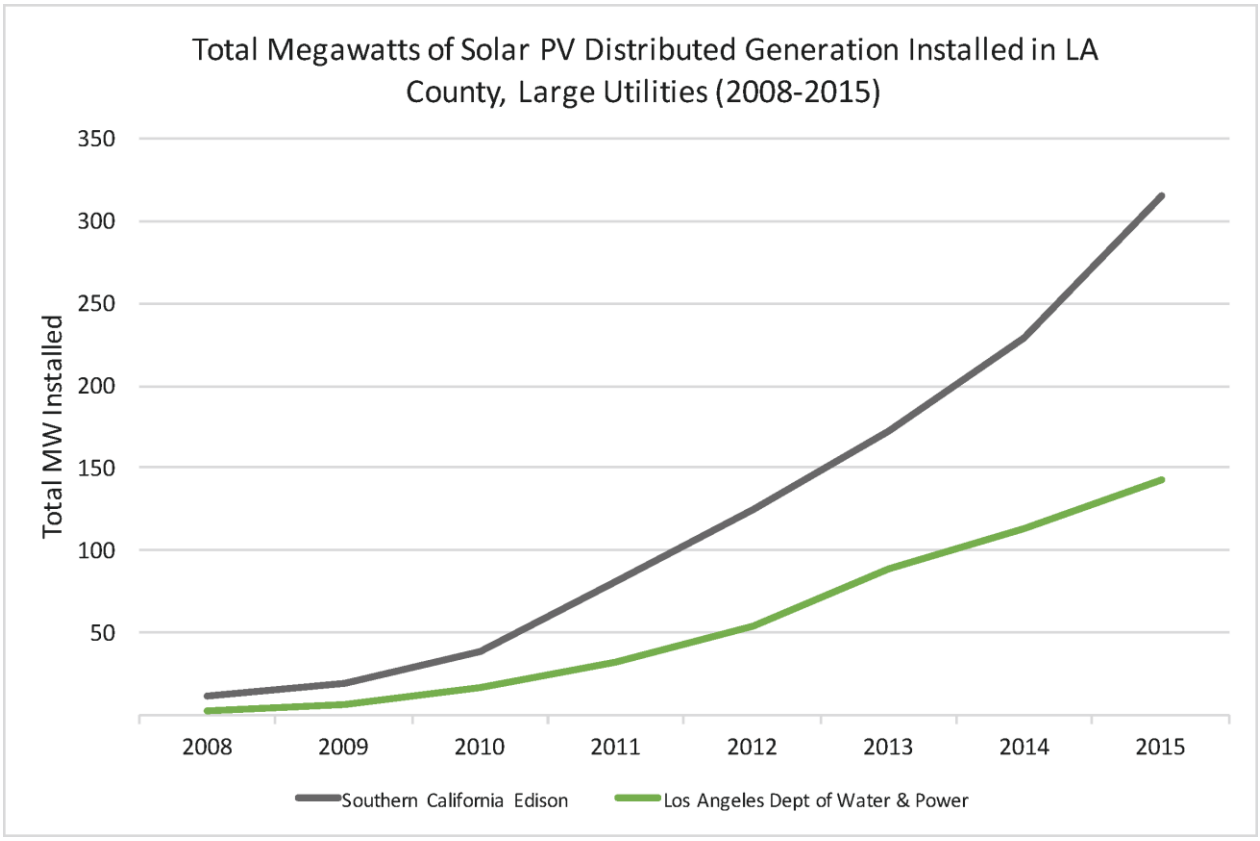

Figure 2. Total MW of Solar PV Distributed Generation Installed in L.A. County, Large Utilities (2008 – 2015).[2]

[2] Federico, F., Rauser, C., & Gold, M. (2017). *2017 Sustainable LA Environmental Report Card for Los Angeles County: Energy & Air Quality*, p. 51.

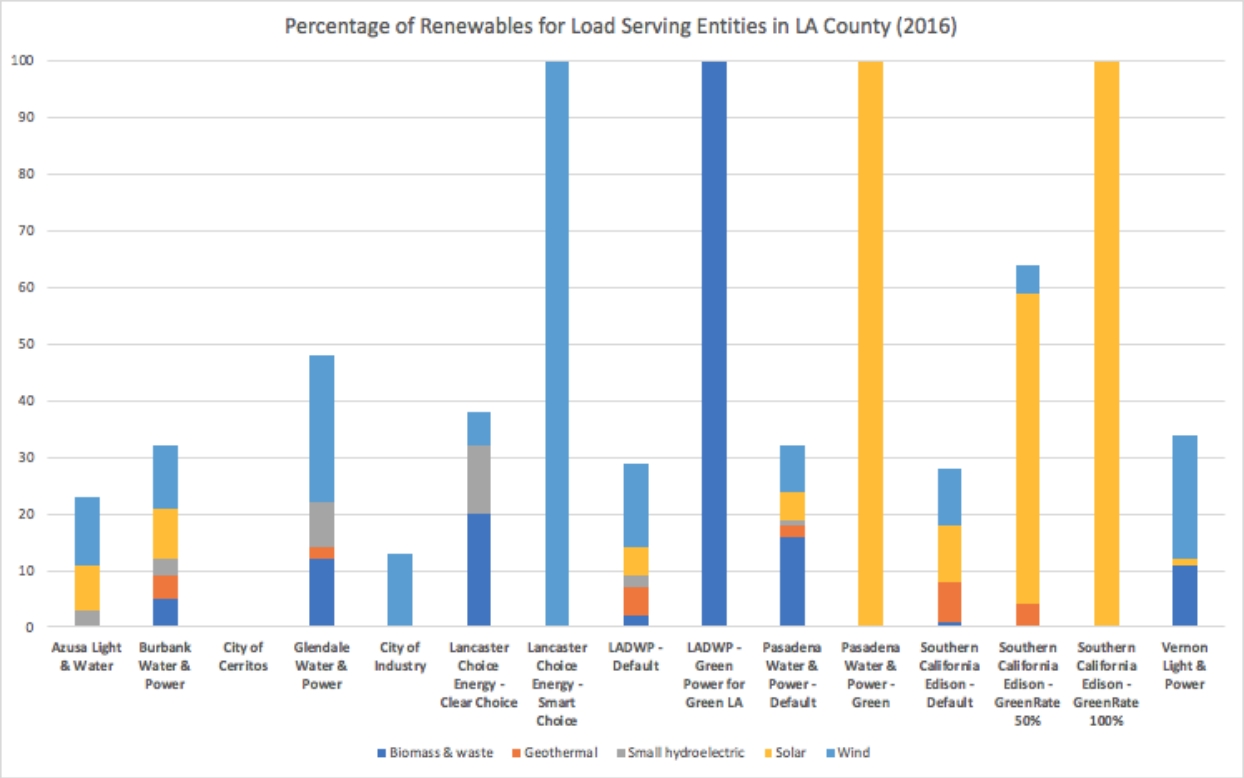

Figure 3. Breakdown of Renewables for Utilities Serving L.A. County (2016).[3]

Oil and Natural Gas

L.A. County's relationship with oil – dating back to the late 1800s – continues to have a profound influence on the economy and environment of the region. L.A. County remains a major energy producer - the second largest oil producing county in California after Kern County. There are currently 68 active oil fields in the Los Angeles Basin, and thousands of active and inactive oil and gas wells countywide.[vi] L.A. County is also home of the two largest refineries in California (the Chevron Refinery in El Segundo and the Tesoro Refinery in Carson), as well as others (e.g., Torrance Refinery). Although these facilities generate significant employment, they also pose significant health and safety risks to communities in South Bay.

[3] Federico, F., Rauser, C., & Gold, M. (2017). *2017 Sustainable LA Environmental Report Card for Los Angeles County: Energy & Air Quality*, p. 44.

L.A. County's reliance on natural gas for manufacturing, heating, cooking, and other uses provides employment in the region but similarly threatens public health and creates greenhouse gas (GHG) impacts of the County. The natural gas transmission and distribution system is prone to leaks due to the number of components within the system such as compressors, valves, pumps, flanges, gauges and pipe connectors, and the age and corrosiveness of some of the pipes. Also, the storage of natural gas poses a threat to communities. For example, the 3.5-month long Aliso Canyon gas leak in 2015-2016 emitted 2.7 million metric tons (MT) CO2e – an amount equal to about 13% of 2015 emissions from all refineries and electricity generators in L.A. County.[vii] The leak also led to the temporary displacement of residents, the relocation of schools and health impacts.[viii,ix,x]

Electricity Service Providers

L.A. County's electricity grid is a complex system that transmits power generated at a variety of facilities and distributes it to end users, often over long distances. The grid provides electricity to buildings, industrial facilities, schools, and homes every minute of every day, year-round. Depending on a consumer's location, electricity in L.A. County was provided by one of eight electricity retailers in 2017 (Figure 4). This began to change as community choice energy programs were launched in Lancaster, Pico Rivera, and through the Clean Power Alliance. The Clean Power Alliance includes 3 million residents in 31 jurisdictions across Los Angeles and Ventura counties.

Structural barriers exist that limit access to clean energy for low-income customers such as low home ownership rates and complex ownership structures relating to multi-family housing, insufficient access to capital and building age. Through the Clean Power Alliance, L.A. County and other Southern California jurisdictions will be receiving guaranteed renewable content ranging from 36% to 100% renewable energy. The Clean Power Alliance has already begun service for municipal and commercial customers in unincorporated L.A. County, with service expanding to all customers beginning in early 2019.

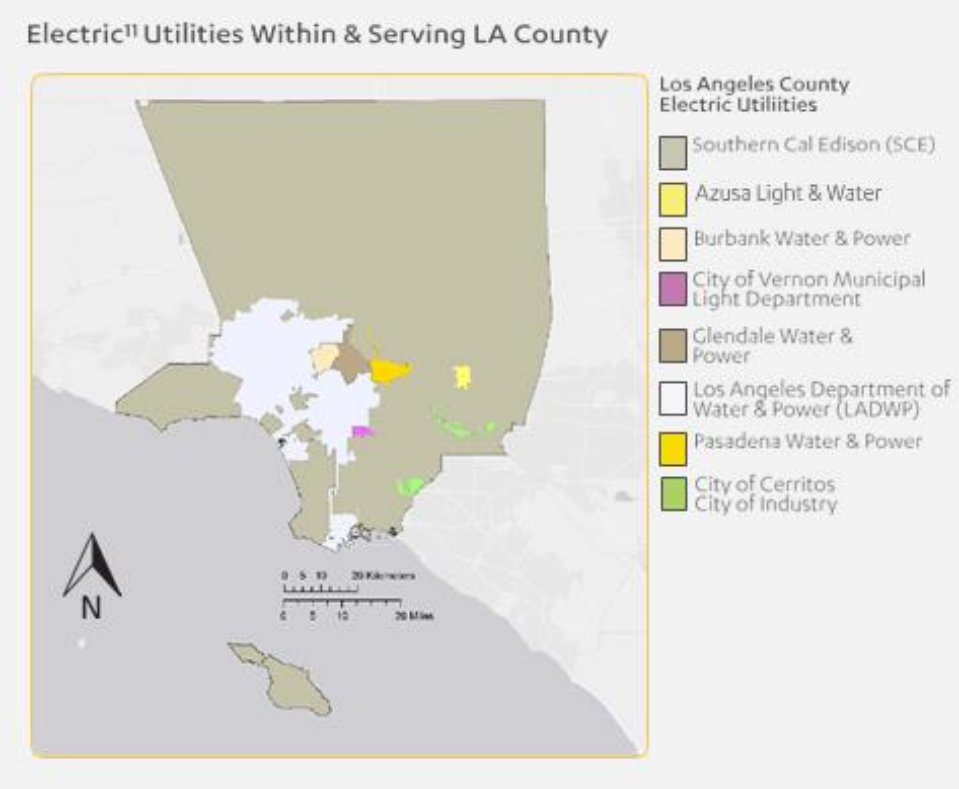

Figure 4. Electric Utilities Within & Serving L.A. County (2015).[4]

Energy Storage

Energy storage facilities are essential for effectively integrating intermittent energy sources such as solar and wind into the grid. However, energy storage has not increased at the same rate as new renewable energy generation. The majority of energy storage (approximately 98.4%) in L.A. County comes from a utility-scale, pumped-hydro storage facility in Castaic Lake[xi] while the remaining 1.6% is sources from small projects including batteries, flywheel and ice thermal storage.[xii]

[4] Federico, F., Rauser, C., & Gold, M. (2017). *2017 Sustainable LA Environmental Report Card for Los Angeles County: Energy & Air Quality*, p. 12.

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Current Energy Consumption and Recent Trends

Building Energy Usage

California continues to lead the country through its ambitious energy efficiency policies. The State's building energy efficiency standards (Title 24) for new construction are one of the most ambitious in the nation. The California Energy Commission requires all new residential buildings to be zero net energy by 2020, and by 2030 for all new commercial buildings. California is also committed to doubling the energy efficiency of existing buildings by 2030 with the passage of SB 350 (de León, 2015). While L.A. County is making progress toward these targets (per capita consumption of L.A. County residents is decreasing), 40% of its carbon footprint comes from existing buildings and it must continue accelerating energy efficiency improvements to meet the aggressive goals.

	Electricity Use			**Natural Gas Use**			**Combined Consumption (Electricity + Nat. Gas)**		
	(Thousand GWh)		Change from 2006-2010	(Billion Therms)		Change from 2006-2010	(Trillion BTU)		Change from 2006-2010
	2006	2010		2006	2010		2006	2010	
All Building Types	55.6	53.4	-4.2%	2.39	2.47	3.0%	428.9	428.6	-0.1%
Residential	20.3	20.0	-1.6%	1.31	1.24	-5.7%	200.4	191.8	-4.3%
Commercial	15.4	14.5	-5.5%	0.25	0.29	18.6%	77.0	78.8	2.2%
Industrial	11.4	10.2	-10.2%	0.59	xx	xx	98.0	xx	xx
Institutional	2.53	2.42	-4.6%	0.086	xx	xx	17.2	xx	xx
Other / Uncategorized / Mixed Use	6.02	6.23	3.5%	0.16	xx	xx	36.2	xx	xx

Figure 5. Energy Use in L.A. County (2006 – 2010).[5]

[5] Federico, F., Rauser, C., & Gold, M. (2017). *2017 Sustainable LA Environmental Report Card for Los Angeles County: Energy & Air Quality*, p. 15. Data derived from Pincetl, S., et al., 2015. LA Energy Atlas: http://www.energyatlas.ucla.edu/

Despite significant energy efficiency improvements across L.A. County, total electricity consumption has remained fairly consistent over the past ten years with only a 2% net decrease between 2006 and 2015 (a decrease of <1% for residential and 3% for non-residential)[xiii]. While this trend can be explained in part by sustained increases in population and economic growth[xiv], an increase in size of single family homes, particularly in more affluent areas of the County, has served to limit the reductions in energy consumption resulting from energy efficiency improvements.[xv] The California Energy Commission has set net zero energy requirements for new residences by 2020 and commercial properties by 2030. However, few initiatives are set for the largest component of the building stock – existing buildings.

Transportation Energy Usage

Transportation, and the fuels that power it, significantly contributes to GHGs (on-road transportation accounted for 33.5% of L.A. County's GHG emissions in 2010) and poor air quality across the Los Angeles basin. Electrification of the transportation system, combined with an overall reduction in the miles traveled per person, will reduce some of the negative impact of our car culture most notably reductions in air and climate pollution. The transition of the transportation system to electricity may create both potential opportunities (additional revenue streams, load balancing, etc.) and threats (increased demands, higher electricity prices, etc.) to the power grid.

Gasoline sales for vehicles are on the decline while diesel fuel sold has increased between 2010 and 2015. Generally, electric vehicles (EV) are on the rise, but ownership is concentrated in wealthier neighborhoods. In order to facilitate the growth of EV adoption, EV charging infrastructure needs to be expanded. As of 2015, there was only one charging station for every 195 plug-in EVs in L.A. County (Figure 6).[xvi]

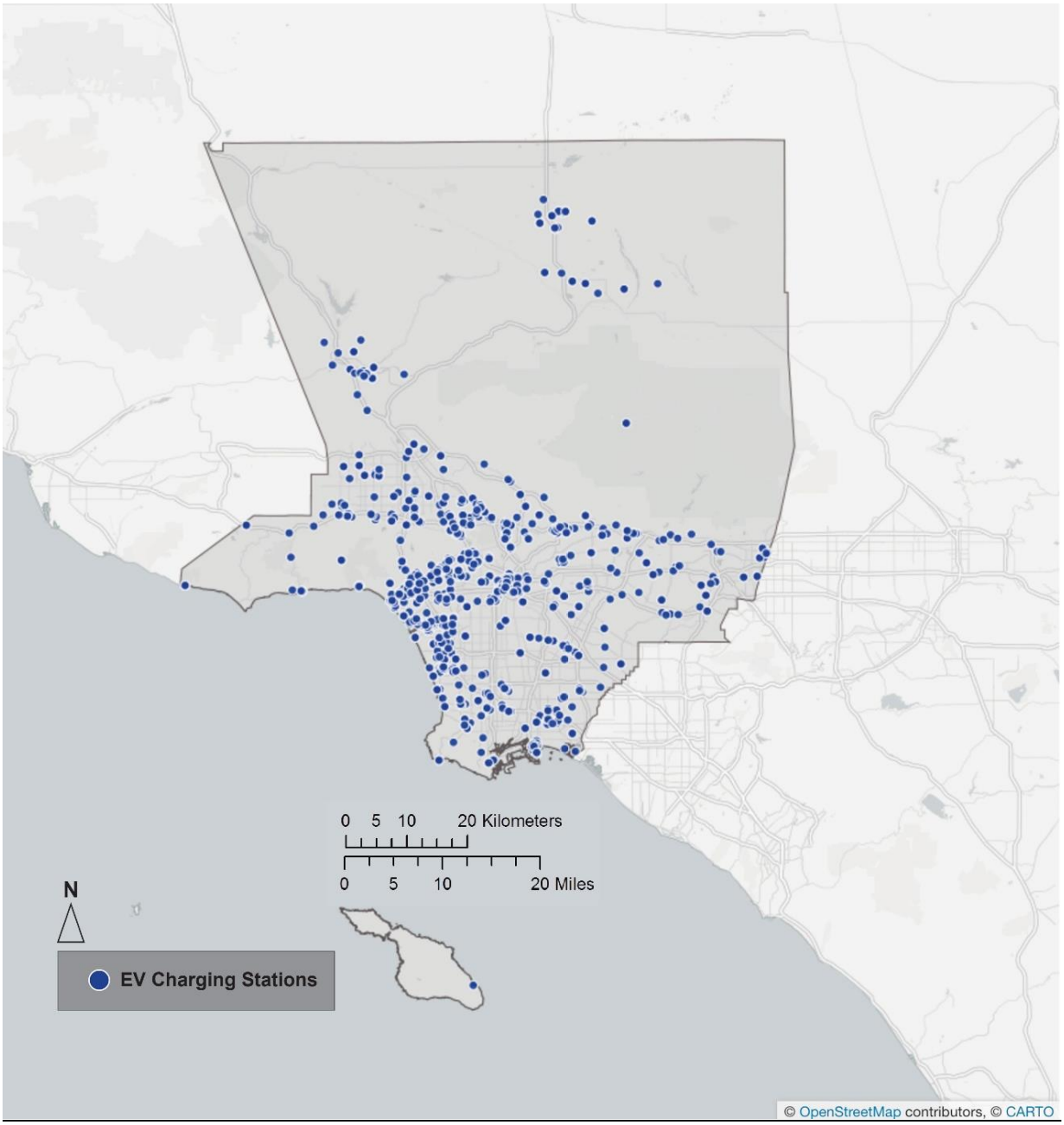

Figure 6. Electric Vehicle Charging Stations in L.A. County (2015)

How Climate Change Will Affect Energy

Climate projections predict that air temperatures will increase by 1.8 - 7.2°F across the region, with the greatest average increases and increases in numbers of extreme heat days (> 95 °F) occurring in Palmdale, Lancaster, and the San Gabriel Valley.[xvii] Additionally, population forecasts suggest L.A. County will become home to an additional 1.2 million residents by 2060, with the largest projected increases occurring in the peripheral cities of Palmdale, Lancaster, and Santa Clarita.[xviii] Combined, these factors are expected to result in higher summertime peak electricity demand and average energy usage due to more buildings, with a higher percentage of installed air conditioners, creating a significant strain on existing grid infrastructure serving the entire region.[xix]

Other climate change projections that will impact energy include three to five more heat waves per year by 2050 (12 to 14 by 2100) and a decline in annual precipitation of two inches by 2050 in low-lying, coastal areas (four to five inches in high elevation areas). This will create significant stress on the energy system. Additionally, sea level rise of up to 66 inches by 2100 will expose energy system assets.[xx]

Other potential climate impacts to energy include:

- Reduction in water storage leading to less hydropower resources
- Heat impacts on power lines, transformers and other infrastructure
- Diminished output of solar panels at higher temperatures
- Changing wind patterns
- Wildfire impacts on energy production (efficiency and generating capacity), transmission and distribution lines and other electricity assets[xx]
- Less demand for natural gas for space heating
- Less water availability and higher water temperatures for power plants
- Sea level rise impacts on coastal fuel deliveries and storage, and energy assets

Twenty-five percent of California's total population lives in L.A. County; at the same time, L.A. County is home to 40% of the state's disadvantaged communities. Vulnerable populations, particularly the County's significant homeless population and those living in poor housing conditions without access to air conditioning, weatherized buildings, or quality transportation to escape harsh conditions may be at greater risk of health impacts from rising temperatures and potential system outages. Meeting future energy demand while limiting GHGs will require new and retrofitted electricity infrastructure, but also serious attention to patterns of urban development and its quality – including housing location, type, and size – in order to minimize potential vulnerabilities in the context of a changing climate.

Draft Goals, Potential Strategies and Indicators

The following are major goals and some of the potential strategies in support of energy reliability and resilience. While there are hundreds of possible strategies related to energy, we have focused on those that will benefit most from collaborative planning and implementation across the County. We also intend for each goal to center equity, so as to reduce disparate outcomes experienced by disadvantaged communities, particularly low income communities of color, with respect to benefits, resources, and impacts, related to energy. Additionally, energy goals and strategies must take resilience into consideration, including but not limited to the impacts of a changing climate. Economic benefits and risks are also key concerns. Please note that these goals and strategies are presented as a basis for discussion at the Energy and People workshop; our intention is that they be edited, removed, or added to as a result of stakeholder input.

Draft Goals and Potential Strategies

Goal A: Reduce health related impacts of energy on disadvantaged communities.

Potential Strategies:

- Accelerate the adoption of light, medium, and heavy duty EVs.
- Provide low-cost, reliable, and clean mobility alternatives to privately owned vehicles.
- Ensure adequate buffers between residents and energy extraction and production facilities to reduce or eliminate exposure to harmful air pollutants.

Goal B: Support access to clean and affordable energy.

Potential Strategies:

- Ensure all eligible rate-support (CARE, etc.) customers are enrolled.
- Focus energy efficiency programs on rate-support customers.
- Implement energy efficiency measures in existing building stock, and ensure that disadvantaged communities are given affordable access to such improvements.
- Improve the adoption of PACE financing and community solar for eligible properties.

Goal C: Decarbonize our fuel sources.

Potential Strategies:

- Transition to renewable energy resources.
- Diversify the energy supply to reduce climate vulnerability and GHG emissions.
- Advocate for the continued adoption of clean renewable energy through the Clean Power Alliance.
- Deploy EV charging stations throughout L.A. County, especially in disadvantaged communities.
- Develop and support zero emission vehicle technology.

- Support the development of clean energy technology businesses

Goal D: Modernize the energy system and infrastructure.

Potential Strategies:

- Deploy distributed energy resources in the built environment of Los Angeles as a first priority.
- Support the retrofitting and installation of smart technologies to improve energy infrastructure in L.A. County.
- Provide workforce training and development for energy sector jobs, including electric transportation manufacturing and maintenance.

Goal E: Reduce energy consumption and improve demand management.

Potential Strategies:

- Promote demand-side measures, particularly in the commercial, industrial, and institutional sectors, and energy conservation that support resilience and thermal comfort, and reduce GHG emissions.
- Favor the development of more energy efficient, multi-family dwellings throughout L.A. County.

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Potential Indicators

Energy Generation and Supply	Renewable Energy Portfolio for L.A. County
	Energy Sourcing within and outside California and L.A. County
	Distributed Renewable Energy Generation within L.A. County
	Population Covered by Clean Power Alliance in L.A. County (CCA)
	Power Outages throughout L.A. County
Energy Consumption	Electricity Consumption (GWh) in L.A. County
	Natural Gas Consumption (billion therms) in L.A. County
	Population Receiving CARE/ FERA Rates in L.A. County
	Gasoline and Diesel Fuel Sold in L.A. County
	Energy Consumption at the Energy - Water Nexus
	Building Electricity Use (GWh) in L.A. County
	Building Natural Gas Use (billion therms) in L.A. County
	Cost of Energy/ Affordability
Energy Conservation	Cool Communities (Cool Pavement and Cool Roofs)
	Energy Efficiency Financing and Investments
	Number of EV charging stations (cross listed in transportation)
	Street Light Conversions to LED
	Jobs Related to Renewable Energy & Energy Efficiency Investments

Our County

Cross-Cutting Themes

Economy & Workforce Development

- Overall, L.A. County households spend 2.9% of income on energy, which is 32% higher than the average Californian household, despite lower electricity and natural gas usage by L.A. County residents. The higher percentage is due to both higher energy costs, as well as a lower median household income.[xxi]
- Climate policies need to include social and employment dimensions to ensure a "just" transition. This transition should increase opportunities for fair-paid and decent jobs, economic prosperity and social justice.
- Total energy use per capita is highest in many wealthier communities, resulting from larger homes.[xxii]
- Investments in renewable energy, energy efficiency and community choice aggregation can all generate jobs to boost local economies. Investments in these programs should consider ways to maximize economic and workforce development opportunities.

Public Health & Safety

- Vulnerable populations, particularly the County's significant homeless population and those living in poor housing conditions without access to air conditioning, weatherized buildings, or quality transportation to escape oppressive conditions may be at greater risk for health impacts from these events. Increased energy demand during heat events can cause brownouts and blackouts, which creates additional vulnerability.
- Oil and gas development in the Los Angeles Basin presents public health and safety concerns because some oil and gas reserves lie beneath densely populated urban areas. While some facilities have been subject to stricter design and mitigation measures, others have not been required to conduct health risk assessments or other environmental studies. In some neighborhoods, such as South Los Angeles, residences are located only several feet away from the boundary of a drilling site and as close as 60 feet
- Air quality has improved significantly in the Los Angeles region since the early 1990s but the region continues to exceed Federal air quality standards and localized toxic air pollution remains a serious health threat. In particular, heavy-duty transportation sources such as trucks, trains, ships and aircraft have not seen the kinds of improvements as light-duty vehicles. Additionally, many energy-related facilities are a major source of toxic air pollution. For example, oil refineries rank in the top three of toxic emissions from stationary sources in L.A. County.[xxiii] Creating alternatives to fossil-fuels, strengthening regulations and enforcement will promote continued improvement in air quality.
- Energy intensive and/or polluting facilities such as refineries, railyards, factories, as well as highways are often located in close proximity to low-income communities of color in Los Angeles County. These communities face elevated health risks from pollutant exposure.

Housing

- While square footage and lot size vary across the County, single-family homes consume more energy per square foot (an average of 44,876 BTU per square foot) than multi-family homes (at 41,652 BTU per square foot) and condos (30,060 BTU per square foot). This relationship, however, varies across geographies and in some cities and neighborhoods the multifamily sector consumes more per square foot.[xxiv]
- Multiple family dwellings -- common wall buildings -- will be the most energy efficient and reduce unequal exposure to heat in neighborhoods that are walkable.
- Since new buildings make up a very small percentage of buildings throughout the state, the real potential for energy efficiency savings come from retrofits to existing buildings. California committed to doubling the energy efficiency of existing buildings by 2030 with the passage of SB 350 (de León, 2015), and the state's Energy Commission has an Action Plan for how that might happen over the next 10 years in residential, commercial, and public buildings.[xxv]

Land Use

- Patterns of urban development have a profound impact on energy usage and GHG emissions. Los Angeles County's long history of decentralized development – characterized by a preference for single-family homes located a significant distance from places of employment and other amenities – has contributed significantly to energy use and GHG emissions in both the building and transportation sectors.
- The region's abundance of relatively inexpensive parking and polycentric land use patterns have contributed to the rise of energy consumption[xxvi] and public health issues, as well as solo car trips.
- Current patterns of land use and development draw extensively on materials that require a significant amount of energy to produce. While these production processes and their associated energy consumption often occur beyond the County boundaries, considering such relationships is vital to ensuring that continued patterns of urban expansion do not lead to negative consequences elsewhere.

Water

Water is imported regularly from areas outside of L.A. County to provide to residents. This effort represented approximately 2,272 GWh of energy consumption in 2015, which is equivalent to just over 3% of the County's total electricity consumption (Figure 7). Water imports create four times more GHG Emissions per acre-feet of supplied water than utilizing groundwater and more than 13 times as high as from stormwater. While recycled water emissions are twice as high as groundwater, they are still less than half of imported water GHG emissions.[xxvii]

Required Energy and GHG Emissions of Water Supply Portfolio (2015)					
Water Source	LA County Water Supply (AF)	Energy use (GWh)	Required Energy (kWh/AF)	MT of CO2e	MT of CO2e per AF
MWD Imported Water	State Water Project: 443,617	1,150	2,593	695,758	0.89
	Colorado River Aqueduct: 341,263	683	2,000		
LADWP - LA Aqueduct	26,828	0	-	0	0
Groundwater	514,904	299	580	113,368	0.22
Recycled Water	120,320	138	1,150	52,526	0.44
Stormwater	12,799	2	174	842	0.07
TOTAL	1,459,731	2,272		862,495	0.59

Figure 7. Required Energy and GHG Emissions of Water Supply Portfolio.[6]

[6] Federico, F., Rauser, C., & Gold, M. (2017). *2017 Sustainable LA Environmental Report Card for Los Angeles County: Energy & Air Quality*, p. 65.

Local/Regional, State, National and International Targets

A number of regional planning efforts and state have established strategies and set targets around energy efficiency and energy sources. These include:

Local/Regional

L.A. City Council	The city council has charged LADWP with studying the possibility of reaching 100% renewable energy.
L.A. City Cool Roof Ordinance	Since 2014, Los Angeles Green Building Code requires that cool roofing material be used in residential buildings. Cool roofs lower roof temperatures on hot sunny days and therefore keep homes cooler inside, saving energy by reducing the need for running air conditioning systems.
Santa Monica Sustainable City Plan (updated 2014)	Santa Monica committed to a **10 percent reduction in overall energy use by 2020** in addition to its targets of **50% renewable energy production** and installation of **7.5 MW of local solar generation** in the same period.
LADWP Coal Divestiture	L.A. Department of Water and Power (LADWP) pledged to source **no energy from coal by 2025.**
LADWP Feed-in Tariff	LADWP operates a feed-in tariff program that pays small solar producers, including building owners who can produce between 30 kW and 3 MW from rooftop installations, for each kilowatt hour they generate
LADWP Consumer Rebate Program	LADWP offers rebates through its Consumer Rebate Program to promote energy-efficient housing installations, such as cool roofs.
San Jose Green Vision	Goal is for 2022. **Reduce per capita energy use by 50 percent**. Receive **100 percent of electrical power from clean renewable sources.** Reduce per capita energy use by 50 percent. Install 1.6 MW of solar on municipal sites.
San Francisco	Former mayors Gavin Newsom and Ed Lee issued a challenge to the City: to have 100% of San Francisco's electricity demand be met with renewable energy. Current goal date is 2030.
San Diego Climate Action Plan	Increase the number of **zero emissions vehicles in the municipal fleet to 50 percent by 2020 and 90 percent by 2035**. Add additional renewable electricity supply to achieve **100 percent renewable electricity city wide by 2035.**

State

Senate Bill 350 (De León, 2015)	Aims to ensure that the state's annual CO2 emissions are 40% below 1990 levels by 2030. To help accomplish this, SB 350 increases the goal for purchasing renewable energy from 33 percent by 2020 to 50 percent by 2030 and 80 percent by 2050. The bill charges the state with a doubling of energy efficiency savings in electricity and natural gas end uses by 2030, which includes targeting existing buildings for a doubling in energy efficiency by 2030. In 2017, the California State Senate passed SB 100 a measure to aim for 50 percent renewable energy production by 2026 and 100% renewable energy production by 2045, but the measure did not clear the Assembly.
Governor Brown's 4th Inaugural Address, 2015	Stated goals of (1) cutting **use of petroleum in cars and trucks in half;** (2) **50% of energy production from renewables**; and **doubling the energy efficiency of buildings**, all by 2030.
California Energy Commission Standards	The CEC requires new residential buildings to be **zero net energy by 2020**, and by 2030 for all new commercial buildings, and recently approved a rule to require a**ll new single-family homes, and many multi-family ones, to have solar panels beginning in 2020.**
Executive Order B-48-18	Governor Brown set a target of 5 million electric vehicles on the road by 2030.

National and International Targets

Hawaii Renewable Portfolio Standard	Hawaii set a target of 100% renewable electricity sales by 2045.
Vermont Renewable Energy Standard	Vermont's target is **55 percent by 2017** and **75 percent by 2032**.
Energy Portfolio Standard	Aims for **25 percent renewables by 2025,** with a 6 percent annual requirement for solar for 2016-2025. The state has a credit multiplier for photovoltaics and on peak energy savings.
European Parliament	Current 2030 target is 20% renewable energy production. EU is currently discussing targets for renewables production. The European Parliament has backed a 2030 **renewable energy target of 35%**, while the EU Council offered to back a **target of 30-31% or 32-33%**.

Denmark	Denmark, with ample wind energy, is looking to reach **50 renewable generation by 2030 and 100% by 205**0. Denmark also aims to **cut its greenhouse gas emissions by 34% by 2020 compared to 1990 levels** and **decrease energy consumption by more than 12% compared to 2006**.
Costa Rica	Costa Rica also has a goal of producing 100% of its energy from renewables, but without a timeline. In 2017 it concluded almost 300 days when the country ran entirely on renewables, relying primarily on hydropower.
Nicaragua Plan for Electric Generation Expansion	Nicaragua—already at 47% generation from biomass, geothermal, solar, small hydro, and wind—has made a non-binding resolution to hit **73% by 2030**.

[i] Federico, Rauser, and Gold, "2017 Sustainable LA Environmental Report Card for Los Angeles County: Energy & Air Quality."

[ii] Federico, Rauser, and Gold.

[iii] Federico, Rauser, and Gold.

[iv] Federico, Rauser, and Gold.

[v] Simons & McCabe, 2005, "California Solar Resources"

[vi] Los Angeles County Department of Public Health, "Public Health and Safety Risks of Oil and Gas Facilities in Los Angeles County."

[vii] Federico, Rauser, and Gold.

[viii] Abram S (December 19, 2015). "Two months in, Porter Ranch gas leak compared to BP Gulf oil spill". Los Angeles Daily News. Retrieved June 29, 2018

[ix] Paul Blake: How many cars and burping cows equal the California gas leak?, BBC News, Washington, January 11, 2016

[x] Maddaus G (December 22, 2015). "What went wrong at Porter Ranch?". LA Weekly. Retrieved June 29, 2018

[xi] Federico, Rauser, and Gold.

[xii] Federico, Rauser, and Gold.

[xiii] Federico, Rauser, and Gold.

[xiv] Federico, Rauser, and Gold.

[xv] Pincetl and LA Energy Atlas Development Team. "LA Energy Atlas."

[xvi] Federico, Rauser, and Gold.

[xvii] Burillo et al., "Climate Change in Los Angeles County: Grid Vulnerability to Extreme Heat."

[xviii] Burillo et al.

[xix] Burillo et al.

[xx] California Department of Public Health (2017), Climate Change and Health Profile Report Los Angeles County. Centers for Disease Control and Prevention (CDC) Cooperative Agreement 5UE1EH001052

[xxi] Federico, Rauser, and Gold, "2017 Sustainable LA Environmental Report Card for Los Angeles County: Energy & Air Quality."

[xxii] Pincetl and LA Energy Atlas Development Team. "LA Energy Atlas."

[xxiii] Federico, Rauser, and Gold.

[xxiv] Pincetl and LA Energy Atlas Development Team. "LA Energy Atlas."

[xxv] California Energy Commission, 2016. *CEC Existing Buildings Energy Efficiency Action Plan*: Retrieved from http://docketpublic.energy.ca.gov/PublicDocuments/16-EBP-01/TN214801_20161214T155117_Existing_Building_Energy_Efficency_Plan_Update_Deceber_2016_Thi.pdf. City of Los Angeles Sustainable City

[xxvi] Southern California Association of Governments (2016). The 2016-2040 Regional Transportation Plan/Sustainable Communities Strategy: A Plan For Mobility, Accessibility, Sustainability And A High Quality Of Life. Retrieved from http://scagrtpscs.net/Documents/2016/final/f2016RTPSCS.pdf

[xxvii] Federico, Rauser, and Gold.