



2022-23



Power Infrastructure Plan



Solar project on Westmont Drive, San Pedro

Introduction

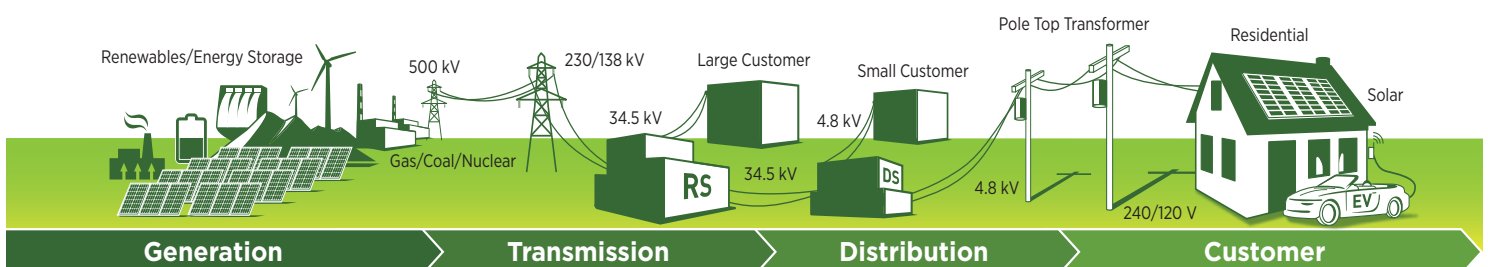
LADWP is the nation's largest municipal electric utility. We maintain a vast Power System that includes generation, transmission and distribution, and provide electricity to about 4 million people in Los Angeles via thousands of miles of overhead conductors and underground cables. The Power Infrastructure Plan includes the recent accomplishments and future goals being implemented through the Power System Reliability Program (PSRP). The PSRP budget for fiscal year 2022-23 is \$1 billion.

Background

The PSRP evaluates and prioritizes maintenance and replacement of major power infrastructure components to maintain reliable electricity service to our customers now and in the future. LADWP initially launched the Power Reliability Program (PRP) in response to major heat storms in 2006 and 2007 that caused widespread and prolonged power outages with the loss of more than 800 transformers. The program targeted replacing overloaded transformers and other distribution equipment. In 2014, the program transitioned to the PSRP to encompass all Power System infrastructure, including generation, transmission, substation, and distribution equipment. In 2021, we updated the PSRP with expanded and accelerated goals to lay the foundation for our transformation to 100% clean energy.

Objectives

- Improve reliability of Power System, including generation, transmission, substation, and distribution infrastructure.
- Provide proactive replacement and maintenance.
- Minimize operational and repair costs.
- Standardize materials and processes.
- Address overloads and increase grid capacity.
- Evaluate and revamp distribution system targets to achieve LADWP's goal of 100% clean energy.





Reliability

Challenges Related to 100% Clean Energy Goals

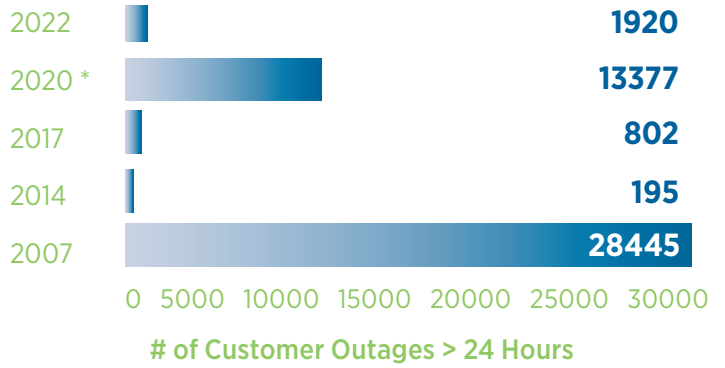
Following the results of the Los Angeles 100% Renewable Energy Study (LA100), City of Los Angeles and LADWP leaders established the goal of achieving 100% clean energy by 2035, which is 10 years earlier than state legislated targets. Senate Bills 100 and 350 have mandated that electric utilities in California provide 100% clean energy by 2045.

We anticipate a need to significantly increase investments in staff and infrastructure to support the rapid buildout of renewable energy, and expanded electrification of buildings and transportation to meet our city's accelerated clean energy target. Comparable investments will also be required to meet the state mandates over the long term.

Reliability Accomplishments from Proactively Replacing Aging Infrastructure

Planned and sustained infrastructure replacement is a cost-efficient and highly effective approach to maintaining reliability. This is clearly evident when comparing the outages experienced by customers during the 2007 heat storm with heat storms in 2014, 2017, and 2022, following a period of sustained investment in infrastructure replacement. The number of customer outages lasting more than 24 hours dropped significantly when comparing the 2007 to the 2014, 2017 and 2022 heat storms.

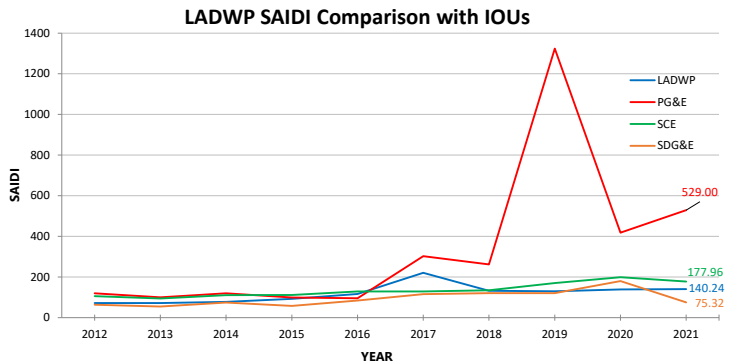
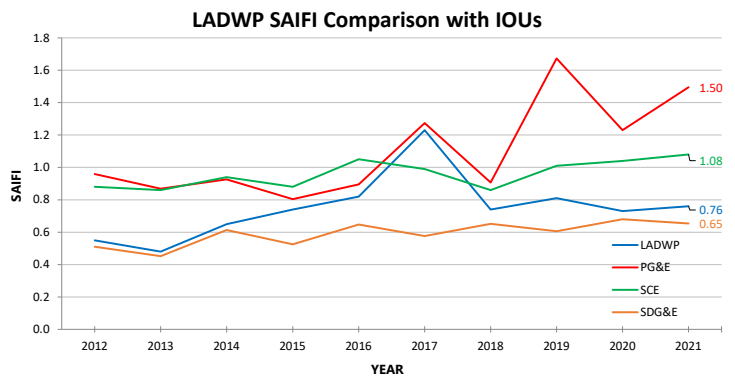
Comparison of Heat Storms



* Outages occurring during the 2020 heat storm were over 50% less than in 2007 but higher than other recent heat storms due to the impact of COVID-19 on staffing resources and the California wildfires.

Reliability Benchmarking

LADWP's power reliability performance metrics are better than most of our peer utilities in the state. The electric utility industry uses standard measures of reliability: System Average Interruption Frequency Index (SAIFI) and the System Average Interruption Duration Index (SAIDI). SAIFI represents the number of times the average LADWP customer experienced a sustained power interruption (over five minutes) in a given year. SAIDI measures the number of minutes of sustained interruptions the average LADWP customer experienced in a given year. LADWP uses SAIFI and SAIDI to compare our reliability performance to that of the state's investor-owned utilities, based on information provided to the California Public Utilities Commission. These utilities are more similar in size to LADWP than the publicly owned utilities in California.





Distribution

LADWP’s distribution infrastructure is the backbone of the city’s power grid and crucial for maintaining neighborhood power reliability. Key components include:

- 310,750 poles
- 807,950 crossarms
- 130,919 transformers
- 7,265 miles of overhead distribution lines
- 3,807 miles of underground distribution cables



Infrastructure Replacement	2021-22 Achievements	2022-23 Goals
Poles	3,799	3,500
Crossarms	11,087	12,000
Transformers	1,183	1,150
Underground Cable (Miles)	51.9	60
Vaults	22	22

Long-Term Goals

- Replace 4,000 poles, 13,892 crossarms, 1,340 transformers, and 60 miles of lead and synthetic cables annually by fiscal year 2025-2026.
- Resolve 11,000 “fix-it” tickets annually to reduce backlog to an acceptable level in 10 years.
- Expand 4.8kV system capacity by 800 megawatts (MW) and 34.5kV system capacity by 1,700 MW by 2040 to address overloads and accommodate growth of electrification.

Key Points:

- There are over 120,000 “fix-it” tickets in the queue. These are job orders for permanent repairs on circuits that were fixed temporarily to resolve an outage, but

need further engineering work, design or construction for long-term reliability.

- The challenges facing our distribution system vary by location. For example, higher temperatures in the San Fernando Valley have different effects on transformer performance as they age when compared to equipment in the coastal areas.
- We use infrared inspections to assess the condition of overhead and underground distribution systems to identify potential failure points.
- Components are prioritized for replacement based on inspections, performance record, age, location, engineering assessments of overloads and other factors.



Cerrise Gabion, Electric Station Operator, inspects the Receiving Station at Fletcher Drive

Substations

Transformers and circuit breakers are considered the most critical assets within the LADWP Power System’s three converter stations (CS), 12 switching stations (SS), eight switchyards (SY), 22 receiving stations (RS), 128 distributing stations (DS), and 50 pole-top distributing stations. Keeping thousands of transformers and circuit breakers functioning at their best is at the heart of substation reliability. Key substation components include:

- 68 RS, CS, and SS banks (line bank, bus bank, and converter banks)
- 90 receiving station banks (load bank, line bank, bus bank)
- 876 distribution level load bank transformers
- 542 transmission level substation circuit breakers
- 2,108 34.5 kV sub-transmission level circuit breakers
- 2,698 4.8 kV distribution circuit breakers

Key Points

- LADWP has plans to automate 170 substations at a rate of 10 to 12 substations per year to improve operational capabilities and communications while reducing operations and maintenance costs. Currently, 96 substations have been automated. This accounts for 56% of all substations when excluding converter stations, large customer stations, and pole-top distributing stations.
- LADWP prioritizes substation transformers to replace based on specialized tests, critical location, and age.
- Priorities for circuit breaker replacement are based on outage history, maintenance record, and location.
- Circuit breakers have a 36-year design life but many are older than that. More than 50% (3,182) of the breakers are older than 36 years and about 43% (2,550) of the breakers are older than 50 years, underscoring the need to ramp up investment in replacing critical infrastructure.

Infrastructure Replacements	2021-22 Achievements	2022-23 Goals
Transformer Banks	6 Transformer Banks (5 SS and 1 RS)	5 Transformer Banks (2 SS and 3 RS)
Circuit Breakers	5 Distribution (4.8 kV) 13 Sub-Transmission (34.5 kV) 7 Transmission (>100 kV)	75 Distribution (4.8 kV) 59 Sub-Transmission (34.5 kV) 15 Transmission (>100 kV)
Automation	3 Substations	12 substations
Station Batteries	3	15
Distribution Transformers	16	29

Long-Term Goals:

- Standardize major assets such as transformers and circuit breakers within each substation to allow for more efficient maintenance, inventory of spare parts, and training of personnel.
- Upgrade or replace aging substations and construct 10 new facilities by 2045 to accommodate load growth and maintain reliability.



Cable replacement project



Pacific DC Intertie Transmission

Transmission System

LADWP maintains 4,175 miles of overhead and underground transmission circuits that are part of a vast transmission system spanning five Western states. Of these, LADWP’s wholly owned and operated in-basin transmission network includes the following key components:

- 4,040 miles of overhead circuits (115 kV to 500 kV)
- 135 miles of underground circuits (138 kV and 230 kV)
- 15,452 towers
- 514 maintenance holes (138 kV)
- 156 maintenance holes (230 kV)
- 1,215 joints (138 kV and 230 kV)

2021-2022 Achievements

- Retrofitted 15 maintenance hole covers
- Completed upgrade on 15-mile, Valley-Rinaldi 230 kV Line 1 and Line 2
- Installed conductors from Eland Pole 1-2 to Barren Ridge H-Frame to facilitate Eland Solar Power Plant
- Reinforced 5 towers on Lugo-Victorville 500 kV Line 1

2022-2023 Goals

- Complete construction of Castaic - Haskell 230 kV Line 3
- Complete construction of Haskell Sylmar 230 kV Line 2

Long-Term Goals

- Upgrade Victorville-Rinaldi 500 kV Line 1
- Reroute Victorville-Rinaldi 500kV Line for Adelanto Switchyard Expansion
- Complete tower raising on Lugo-Victorville 500 kV Line 1
- Upgrade Adelanto-Rinaldi 500 kV Line 1
- Upgrade Adelanto-Toluca 500 kV Line 1
- Upgrade Barren Ridge-Haskell 230 kV Line 1
- Upgrade Rinaldi-Tarzana 230 kV Line 1 & 2
- Upgrade Valley-Toluca 230 kV Line 1 & 2
- Convert Tarzana-Olympic Line 1 to double circuit
- Tarzana-Olympic 230 kV Line 1 & 2
- Reroute Barren Ridge-Haskell Line 1, 2, and 3 into Rosamond Station

Key Points

- Priorities for replacements are based on inspections and outage history.
- Inspection of transmission towers is currently done on a one- to five-year basis, depending on criticality.
- Existing 230 kV underground circuits have a high degree of reliability for the next 20 years.
- All LPOF cables have been replaced with XLPE insulated cable.

Generation

LADWP's generation system assets are either wholly or jointly owned, and provide a diverse portfolio of power that is supplemented by long-term power purchase agreements and spot market purchases. LADWP's wholly owned and operated in-basin generation sources include:

- 29 units of thermal electricity (located at Harbor, Haynes, Scattergood, and Valley Generating Stations)
- 7 units of large hydroelectricity (located at Castaic Power Plant)
- 26 units of small hydroelectricity (located at 14 individual plants)
- 169 generation transformers

2021-2022 Achievements

- Completed 5 major inspections (San Fernando Unit 1, Upper Gorge Power Plant, Harbor Generating Station Units 2 and 5, and Haynes Generating Station Unit 9)
- Completed replacement of one station service transformer at Castaic Power Plant.

2022-2023 Goals

- Replace two generator transformers (step-up and auxiliary)
- Complete two major inspections of generating units
- Complete repair of Castaic Unit 5 and upgrade parts for GE LMS100 engines

Long-Term Goals

- Replace four generator transformers (step up and auxiliary) per year
- Complete six major inspections of generating units per year

Key Points

- Inspections determine the need for overhauls or replacements of generating units. Replacements are typically multi-year projects.
- 26 small hydroelectric units are performing beyond their design life of 50 years, which is a testament to the hard work of LADWP maintenance personnel.



Scattergood Generating Station



Castaic Pumped Storage Hydroelectric Plant



2022-23



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