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<td><strong>Docket Number:</strong></td>
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Over the next 15 years, LADWP will replace over 70% of its generation infrastructure used to reliably deliver power to its customers.
Eliminate Coal from LADWP’s Power Supply

Reach 33% RPS by 2020 and 50% by 2030

Achieve 15% Energy Efficiency by 2020

Once-through Cooling Repowering

Invest in Power System Reliability Program (KPIs)

Support Electric Vehicle Expansion
## 2016 Major Accomplishments

<table>
<thead>
<tr>
<th>Project/ Program</th>
<th>Accomplishment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Renewable Portfolio Standard</td>
<td>25% RPS in 2016</td>
</tr>
<tr>
<td>Sale of Navajo to Salt River Project</td>
<td>Sold 477 MW share of Navajo Generating Station to Salt River Project</td>
</tr>
<tr>
<td>Moapa Southern Paiute Solar</td>
<td>250 MW in-service</td>
</tr>
<tr>
<td>Springbok 1 and 2 Solar</td>
<td>105 MW and 155 MW solar in-service</td>
</tr>
<tr>
<td>RE Cinco Solar</td>
<td>60 MW in-service</td>
</tr>
<tr>
<td>Springbok 3 Solar</td>
<td>City Council approved 90 MW solar project (COD 2019)</td>
</tr>
<tr>
<td>Electric Vehicle Charger Program for Home, Workplace, and Public Charging: “Charge-up LA!!!”</td>
<td>$21.5 million budgeted program through June 30, 2018 for residential and commercial customers</td>
</tr>
<tr>
<td>Barren Ridge Renewable Transmission Project</td>
<td>1,750 MW of added transmission capacity in-service</td>
</tr>
</tbody>
</table>
2016 IRP Case Scenarios

1. Intermountain Power Plant (IPP) 2027* (base)
2. IPP 2025*

3. 50% RPS, Low Local Solar, Low Storage, Low EV*
4. 50% RPS, Low Local Solar, Low Storage, High EV
5. 50% RPS, High Local Solar, Low Storage, High EV
6. 50% RPS, High Local Solar, High Storage, High EV
7. 65% RPS, High Local Solar, High Storage, High EV
8. 65% RPS, Low Local Solar, High Storage, High EV
8LLS. 65% RPS, Low Local Solar, High Storage, High EV
8MLS. 65% RPS, Med Local Solar, High Storage, High EV
8SF. 65% Solar Focus RPS, High Local Solar, High Storage, High EV
(high local solar and storage in accordance to LA Sustainability Plan goals)

*Expected, Low, and High Fuel Cost Sensitivity Analysis was performed
Resource Adequacy Methodology

Net Load (Load minus Solar and Wind)

Typical Summer Day

MW

Peak Load (2017)
Solar (2017)
Wind (2017)
Net Load (2017)
Peak Load (2032)
Load - Solar (2017)
Net Load (2017)
Load - Solar (2032)
Net Load (2032)

Hour Ending

Peak Hour Shift
<table>
<thead>
<tr>
<th>Resource Type</th>
<th>Levelized Cost ($/MWh)$^1$</th>
<th>Capacity Factor</th>
<th>Peak Load Dependable Capacity (3 to 5 PM)</th>
<th>Net Load Dependable Capacity$^2$ (7 to 9 PM)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solar Photovoltaic – PPA</td>
<td>$67</td>
<td>28% - 35%</td>
<td>27% - 38%</td>
<td>0 - 2%</td>
</tr>
<tr>
<td>Solar Photovoltaic – LA Solar</td>
<td>$176</td>
<td>19% - 23%</td>
<td>27%</td>
<td>3% - 5%</td>
</tr>
<tr>
<td>Solar Feed-in-Tariff</td>
<td>$175</td>
<td>20%</td>
<td>27%</td>
<td>3% - 5%</td>
</tr>
<tr>
<td>Wind</td>
<td>$106</td>
<td>24% - 33%</td>
<td>10%</td>
<td>0%</td>
</tr>
<tr>
<td>Wind Firmed and Shaped</td>
<td>$106 to $122</td>
<td>24% - 33%</td>
<td>45% - 100%</td>
<td>45% - 100%</td>
</tr>
<tr>
<td>Geothermal</td>
<td>$81</td>
<td>91% - 95%</td>
<td>90%</td>
<td>90%</td>
</tr>
<tr>
<td>New Combined Cycle Gas</td>
<td>$61-70</td>
<td>47-52%</td>
<td>96%</td>
<td>96%</td>
</tr>
<tr>
<td>New Simple Cycle Gas</td>
<td>$400-500</td>
<td>3-5%</td>
<td>96%</td>
<td>96%</td>
</tr>
<tr>
<td>Castaic Improvement</td>
<td>$53</td>
<td>25%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Valley Thermal</td>
<td>$31</td>
<td>28%</td>
<td>100%</td>
<td>99%</td>
</tr>
<tr>
<td>Battery</td>
<td>$554</td>
<td>5%</td>
<td>43-61%</td>
<td>21 to 100%</td>
</tr>
<tr>
<td>CAES</td>
<td>$56</td>
<td>44%</td>
<td>92%</td>
<td>92%</td>
</tr>
</tbody>
</table>

$^1$Net Present Value (annual costs, 2016-2036) / NPV of Energy Produced

$^2$Net Load represents the hour when the net energy for load minus variable energy resources is maximum
Resource Adequacy – 50% RPS
Resource Adequacy – 65% RPS
Achieving 50% RPS by 2030
Achieving 65% RPS by 2036
Electric Vehicle (EV) Charging Forecast

Cumulative Number of EVs in Los Angeles

- **Base Case Transportation Electrification (IEPR):**
  - 145,000 EVs by 2020
  - 580,000 EVs by 2030 = 2,344 GWh

- **High Case Transportation Electrification (Double IEPR Forecast):**
  - 145,000 EVs by 2020
  - 580,000 EVs by 2030 = 2,344 GWh
Electrification of the transportation sector will significantly reduce overall GHG emissions.

- **1990 Emission Level**: 17.9 MMTons
- **80% below 1990 Emissions Level**: 3.6 MMTons
- **40% below 1990 Emission Level**: 10.7 MMTons

**Case 5 after CO2 savings**
- **Case 5_50%_HighEV (Early)**
- **Case #5 after CO2 savings**

**Case 8 after CO2 savings**
- **Case 8_MLS**
- **Case #8_MLS after CO2 savings**

**Business as Usual (No RPS No EE)**
- **80% below 1990 Emission Level**: 3.6 MMTons
Transmission Upgrade Challenges

- Increased capacity from 450 to 2,200 MW
- Renewable interconnection requests of 3,773 MW from wind and solar developers
- New Haskell Canyon Switching Station (SS)
- New double-circuit 230 kV transmission line from Barren Ridge SS to the new Haskell Canyon SS.
- New 230-kV circuit on existing structures from the new Haskell Canyon SS to the Castaic Power Plant.
- Reconductoring of existing 230 kV transmission line from Barren Ridge to the existing Rinaldi Receiving Station
- Expand the existing Barren Ridge SS
• Leverage DER program efforts and resources
• Minimize duplications and increase system efficiency
• Achieve optimal DER deployment
• Achieve a common objective
Energy Storage Plan for 50% RPS

**GENERATION**
Gas Fired + Thermal Energy

**TRANSMISSION**
Battery Energy Storage System

**DISTRIBUTION**
Battery Energy Storage System

**CUSTOMER**
Battery, Thermal Energy Storage System

**JFB ES**
Battery Energy Storage System

- **Location:** Valley Generating Station
- **Capacity:** 60 MW or greater
- **Key Applications:**
  - Increase CT output during hot weather 10%-20%
  - Peak Shifting
  - Ramping regulation capacity
  - May eliminate need for added capacity
- **Schedule:** Completion by December 2017

- **Location:** Beacon & Springbok Area Solar
- **Capacity:** 50 MW or greater
- **Key Applications:**
  - Regulation Service (ramping up and down)
  - Solar Power Output Leveling
  - Peak Shaving
- **Schedule:** Completion by September 2020

- **Location:** Distributing and Receiving Stations
- **Capacity:** 4 MW or greater
- **Key Applications:**
  - Permanent Load Shifting
  - Distributed PV Solar Integration
  - Deferring Distribution Infrastructure Upgrades
- **Schedule:** Completion by March 2019 for DS and September 2020 for RS

- **Location:** Customers
- **Capacity:** 40 MW
- **Key Applications:**
  - Permanent Load Shifting
  - Dispatchable Peak Shifting
  - Deferring Distribution Infrastructure Upgrades
  - Demand Response
  - Energy Efficiency
- **Schedule:** Completion by July 2020

- **Location:** John Ferraro Building Parking lots
- **Capacity:** 300KW/1MWh
- **Key Applications:**
  - Demand Response
  - Dispatchable Peak Shifting
  - Energy Management System
  - Research and Development
- **Schedule:** Completion by June 2016
Summary – Challenges

• Limited available Transmission Capacity for Renewable Projects
  Increased RPS Category 2 and 3 percentages may be needed
• Disposition of grandfathered RPS power purchase agreements at the end
  of the contract term or when purchased (Category 0 or 1?)
• Cap and Trade Allocations Post 2020, as currently proposed at 82% below
  2020 levels by 2030 or double the 40% required by SB32, will divert a
  minimum of $500 Million of revenue from LADWP over 10 years that
  could otherwise support EV charging and clean energy programs
• PV Solar and Wind adds little to no dependable capacity to effect the Net
  Peak Load without energy storage
• Residential TOU, CPP, RTP effectiveness at reducing Net Peak Load
  uncertain. Concerns about IT infrastructure and AMI having high cost and
  short life cycles.
• Local distributed generation deployment is challenging especially within a
  dense urban environment (i.e., permitting, safety, underground wiring).
Summary – Opportunities

• Improved coordination, cooperation, and flexibility among Agencies and POU’s recognizing past and future investments and good faith efforts made by POU’s to reach State goals.
• Continue to recognize existing grandfathered RPS projects beyond the original contract term to continue meeting 50% RPS
• CEC forecasts, especially electrification, can be very helpful for IRP planning
• Committed certification process timelines to assist development
• Increased research funding for new RPS and long term energy storage technologies (i.e., Enhanced Geothermal Systems, Hydrogen) to achieve AB32 emissions goals.
• Promote batteries to be included with net metered PV systems
• Energy Storage needs should be based on control area/utility operational requirements to integrate renewables (Optimization, not Prescription)
Resource Adequacy Methodology

Net Load (Load minus Solar and Wind)

Typical Summer Day

- Peak Load (2017)
- Solar (2017)
- Wind (2017)
- Load - Solar (2017)
- Net Load (2017)

Traditional Peak Hour

Hour Ending

MW

MW

0 1000 2000 3000 4000 5000 6000 7000 8000

1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
Net Load (Load minus Solar and Wind)

Typical Summer Day

- Peak Load (2032)
- Solar (2032)
- Load - Solar (2032)
- Wind (2032)
- Net Load (2032)

Peak Hour Shift
Local Solar Cases (Low vs. High)

Case 8 LLS (Low Local Solar):

- Local Solar (1200 MW by 2035)
- Large Scale Projects / PPAs (2,600 MW by 2035)

800 Megawatts (MW) by 2025 and 1,200 MW by 2035

Case 8 (High Local Solar):

- Local Solar (1800 MW by 2035)
- Large Scale Projects / PPAs (2,200 MW by 2035)

1,200 Megawatts (MW) by 2025 and 1,800 MW by 2035