Los Angeles 100% Renewable Energy Study

Advisory Group Meeting #4
Thursday, February 15, 2018, 8:45 a.m. to 1:15 p.m.

SUMMARY

Location

City of Los Angeles Department of Water and Power (LADWP)
John Ferraro Building
111 Hope St., Room 1514
Los Angeles, CA 90012

Attendees

Advisory Group Members
Adam Lane, Los Angeles Business Council
Alex Morris, California Energy Storage Alliance
Alexandra Nagy, Food and Water Watch
Allison Mannos, Los Angeles Alliance for a New Economy
Allison Smith, Southern California Gas Company
Andrea Leon-Grossman, Food and Water Watch
Angela Johnson Meszaros, Earth Justice
Armando Flores, Valley Industry and Commerce Association
Bahram Fazeli, Communities for a Better Environment
Camden Collins, Office of Public Accountability (Rate Payer Advocate)
Carlos Baldenegro, Port of Los Angeles
Christina Angelides, Natural Resources Defense Council
Christos Chrysiliou, Los Angeles Unified School District
Erica Blyther, Los Angeles World Airports
Ernesto Hidalgo, Neighborhood Council Sustainability Alliance
Evan Gillespie, Sierra Club
Fred Pickel, Rate Payer Advocate
Graciela Geyer, Sierra Club
Irene Burga, Environmental Defense Fund
Jack Durland, Valero Wilmington Refinery
Jack Humphreville, Greater Wilshire Neighborhood Council
Jean Claude Bertet, Los Angeles City Attorney, LADWP
Jim Caldwell, Center for Energy Efficiency and Renewable Technology
Kendal Asuncion, Los Angeles Chamber of Commerce
Lauren Faber O'Connor, Office of the Mayor
Loraine Lundquist, California State University, Northridge
Matt Gregori, SoCal Gas

Matt Hale, Council District 2
Matthew Thomas, Los Angeles Unified School District
Michelle Kinman, Environment California Research & Policy Center
Molly Deringer Croll, California Energy Storage Alliance
Nurit Katz, University of California, Los Angeles
Rafael Prieto, Chief Legislative Analyst
Russell Greene, Council District 5
Shane Phillips, Central City Association
Shaouki Aboulhosn, Port of Los Angeles
Ted Beatty, Southern California Public Power Authority
Tyler Aguirre, Neighborhood Council Sustainability Alliance

LADWP Commissioners
Aura Vasquez

LADWP Staff
Antique Rahman
Anton Sy
Ashkan Nassiri
Carol Tucker
Dan Scorza
Dawn Cotterell
Eric Montag
James Barner
Joe Ramallo
Joseph Avila
Julie Van Wagner
Stephanie Spicer

Consultants
Aaron Bloom, National Renewable Energy Laboratory (NREL)
Daniel Steinberg, NREL
Paul Denholm, NREL
Ramin Faramarzi, NREL
Robin Newmark, NREL
Scott Haase, NREL
Ana Nolan, Kearns & West
Jenna Tourje, Kearns & West
Joan Isaacson, Kearns & West
Taylor York, Kearns & West

Welcome and Introductions

Joan Isaacson, Lead Facilitator from Kearns & West, welcomed Advisory Group for the Los Angeles 100% Renewable Energy Study (Study), gave an overview of the agenda (Appendix A), and explained that the purpose of this meeting was to review the Advisory Group Meeting Plan, gather initial feedback on the preliminary clean energy scenarios and sensitivities, and continue expansion of the Advisory Group knowledge base.

Joan noted that time would be given for questions and answers at various points and added that that there may not be time during this meeting to hear all comments but that Advisory Group members are encouraged to submit any comments to the project team within two weeks following the meeting.

In his welcoming remarks, Eric Montag, Senior Manager of Planning & Strategic Initiatives for LADWP, offered his extended thanks to the Advisory Group members for their dedication, time, and passion. He also offered his thanks to the LADWP Board of Commissioners and noted that the Study is addressed by the Board somewhat regularly.

Robin Newmark, Executive Director for Strategic Initiatives for NREL, also welcomed Advisory Group members and noted that LADWP is showing leadership with this study.

Anton Sy, LADWP 100% Renewable Energy Study Project Manager, welcomed the Advisory Group and emphasized the importance of stakeholder input in the Study process. He noted that this meeting will build on comments heard at the November meeting.

Slides from all presentations are contained in Appendix B.

Update Exchange

Joan Isaacson invited attendees to participate in the Update Exchange agenda item and introduced Eric Montag, who provided an update presentation on the Once-Through Cooling Study (OTC). The following is a summary of the OTC presentation, as well as one other update received from an Advisory Group member.

OTC Update

The Once-Through Cooling (OTC) Study began in 2017 with the purpose of providing a comprehensive system reliability assessment and will be used to determine the need for the scheduled repowering of LADWP's in-basin, once-through cooling units. Through the OTC Study, LADWP will consider a set of viable options for repowering three OTC facilities. It is important to note that options considered will not compromise system reliability, and will be the subject of a cost-benefit analysis.

The OTC Study is being conducted by an independent, third-party team of consultants. This consultant team will develop a set of scenarios for addressing repowering at the Harbor, Haynes, and Scattergood Generating Stations. These scenarios represent a combination of 'repower' or 'don't repower' options for each of these facilities. The consultant team is led by Worley Parsons and includes Navigant, Energy + Environmental Economics, DNV GL, and Energeia. Members of this team are familiar with the LADWP system. Eric noted that a stakeholder outreach effort may occur in July or August 2018 but that this date range had not been confirmed.

The Advisory Group asked several questions pertaining to why LADWP initiated the OTC Study, future stakeholder involvement, incorporation of demand response, mix of sources in the scenarios, and the filters.

Proposed Site Tour

The Advisory Group is invited to a full day site tour of several LADWP facilities, including: Pine Tree Wind and Solar Station, Beacon Solar and Battery Energy Storage Station, Barren Ridge Switching Station, and Haskell Canyon Switching Station.

The tour is scheduled for Thursday, April 26, 2018. Participants are asked to meet at the Valley Generating Station in Sun Valley, where they will board a bus. Meals and snacks will be provided. Participants should wear appropriate attire; causal and comfortable clothes are fine. Closed-toed walking shoes, sunscreen, a hat, sunglasses, long pants, and a light jacket are encouraged. Participants should also bring identification with them.

Bus space is limited, and Advisory Group members should RSVP by March 15 to Anton Sy. More information, including meeting time and address details, will be send by email in the coming weeks.

Advisory Group Meeting Plan

Advisory Group members have, in the past, expressed interest in learning how their input can meaningfully inform the work that NREL is doing for the 100% Renewable Energy Study. In response, the Project Team discussed and organized the Advisory Group Meeting Plan (see Appendix C). This plan provides a visual representation of the overall arc of the Study process, as well as expectations for the Advisory Group. The Plan presents a high level of information but is the result of detailed discussion.

The Plan is organized into a series of phases representing different stages of the project and these phases are outlined below.

- Phase 1: Launch and Organization (2017)
- Phase 2: Scenarios (2018)
- Phase 3: Analysis and Modeling (2019)
- Phase 4: Final Report (2020)

Questions and Comments from Advisory Group Members

Question:

What is the process for developing white papers – will they be embargoed, and are we able to share them? Will papers be peer reviewed?

Answer:

We give you information with the expectation that you may share it within your organization but we may sometimes indicate that something is not ready for public consumption because it is still in a working form and subject to change depending on feedback and additional analysis. We will make these instances clear. All papers will be peer reviewed according to NREL's strict review procedures for technical reports. Journal papers will be subject to traditional peer review and white papers and other activities will be augmented with industry

peer review from the Utility Variable-Generation Integration Group (UVIG) and other venues. The next UVIG meeting will take place in March in Tucson, AZ. Also, the Advisory Group is another important form of peer review.

Question:
Are the 2018 meeting dates confirmed?

Answer:
Yes, they are firm. The next meeting will occur on June 7, 2018

Question:
You are currently distributing materials in advance of the meeting, discussing the materials at the Advisory Group meeting, and then providing a two week window for submitting comments. Will this be standard practice moving forward?

Answer:
Generally yes, but there may be some exceptions. Please direct all comments/feedback to Anton Sy, and he will forward them on to appropriate members of the team. It is appropriate to note that Advisory Group members will always be given a reasonable amount of time to respond to materials and discussion.

Question:
Has there been discussion on an accelerated pathway for the study? Is it possible to complete the study on a shortened timeline?

Answer: This has been part of the discussion. There are many complex factors to consider, including computational limitations on how many scenarios can be done at one time. There are also timing considerations related to completion of the Once-Through Cooling study, as these results will be rolled into the 100% Renewable Energy Study. The study team recognized the value in completing this study on a shorter timeline and there is a possibility that some analysis will be completed faster than expected. However, in the interest of producing quality results, it is important that the study not be rushed.

Question:
Has the project team determined who will be conducting the jobs and economic analysis? Will the Advisory Group be given the opportunity to provide input?

Answer: Yes, the group will be given an opportunity to understand metrics that drive the analysis and to participate in interpreting the results. The University of Southern California (USC) will be participating in the analysis as well as experts at the NREL.

Question:
Will location of jobs and economic impacts be considered? How will LADWP ensure that jobs will be created equitably?

Answer: Yes, there will be a special component to the analysis. The work that USC will be doing will address employee Full-Time-Equivalents, wages, job sectors, etc. Detailed models will be used to relate these factors to different job categories within the utility sector. What is not in NREL's scope; however, is recommending policy to achieve certain outcomes. It is important to note that this phase of the project is a study which will be used to inform policy discussion in subsequent efforts.

Comment:
The project team is urged to consider how this Study relates to the LADWP Equity Metrics program.

Question:
Who will be conducting the environmental analysis?
Answer: USC.

Preliminary Clean Energy Scenarios and Sensitivities

At the November Advisory Group meeting, members were presented with a draft memo that provided context on how renewable energy has been defined in California as well as nationally and internationally. Advisory Group members were asked to provide input on inclusion of different renewable energy resources into the study, as well as considerations that come along with them. They identified several perceived tradeoffs for each resource and discussed goals, advantages, and constraints of the LADWP system. Compiled input from this activity can be found in Appendix B of the November 2017 Advisory Group Meeting Summary, available on the LADWP 100% Renewable Energy website and summarized in the presentation materials located in Appendix B of this meeting summary.

The following drivers guided the development of preliminary scenarios. These goals are derived from the City Council motion and from Advisory Group input. NREL's presentation focused on three areas:

- Start with the City Council Motions and Advisory Group Comments
- Consider full set of opportunities
- Produce results that are robust to a broad set of future conditions/uncertainties

Below is a recap of the preliminary scenarios and the questions raised by the Advisory Group. Refer to Appendix B for the presentation materials on the preliminary scenarios and sensitivities.

Preliminary Clean Energy Scenarios

NREL has developed the following scenarios under two types of cases:

- Reference Cases – LADWP follows California and National Policy, including strategies in the 2018 LADWP Integrated Resource Plan (IRP) and draft Senate Bill 100. This provides a base case against which other approaches will be measured.
- LA Leads Cases – LADWP takes the lead by adopting more aggressive approach.

Each scenario contains candidate technologies that might be included but are not necessarily required, as well as a set of sensitivities.

100% Carbon Neutral

This scenario is considered to be the most flexible of the LA Leads approaches. Its focus is on carbon reduction accomplished through any technology or set of technologies. This scenario

reflects the Advisory Group's desire for a diverse set of options and can be a more affordable path to clean energy. This is a common practice today.

100% Renewable
This scenario represents the strictest interpretation of renewables and assumes zero combustion. Sources of generation in the scenario might include wind, solar, geothermal, existing hydropower, and energy storage. This scenario is driven by comments from the Advisory Group and from the industry that accomplishing 100% carbon neutral may not seem as much of an accomplishment as 100% renewable. This scenario will provide a set of detailed metrics and to help understand the real challenges and benefits of 100% renewable.

Carbon Neutral – Accelerated
This scenario is nearly identical to the Carbon Neutral scenario with its focus on carbon reduction. It is accomplished through any technology, or set of technologies, but aims to accomplish its goals sooner. Considering that most California policies are setting a goal of reaching target renewables by 2050, this scenario aims to reach them five years sooner, by 2045. This will likely be a more expensive scenario.

Load Modernization
This scenario is based on the 100% Renewable scenario but also enables a large amount of demand-side representation with a large emphasis on distributed energy resources, high growth in electric vehicles to reflect policy and consumer adoptions, aggressive targets for energy efficiency, and aggressive goals for demand response resource. It also considers using the "New Paths" case when referring to transmission, as this case may require increased transmission resources. The cost for this scenario may be lower, as many people will be adopting simultaneously thereby spreading costs out – for example, assuming many people have smart homes and solar panels.

Question:
How do you mathematically model sensitivities?
Answer: NREL will model sensitives through a suite of tools called capacity expansion modeling. These tools essentially co-optimize expansion of generation, transmission, and retirement of resources, and consider about 4,000 different constraints. One of the models NREL will be using is called Resource Planning Model. The main focus of this modeling is to answer the question of resource adequacy: Do I have enough generation for my expected long-term conditions? For example, in terms of electric vehicles, analysis would modify the shape of the load to reflect different charging scenarios (charging at home during the night, vs. charging in town during the day). NREL will also consider different scenarios for building new transmission infrastructure which could include no new transmission infrastructure, expansion of existing infrastructure, or new transmission paths.

Question:
If we cannot build new transmission infrastructure, do we have enough existing resources?
Answer: There are a number of ways to address this, including consideration of transmission paths which currently connect generation resources that may be retired or replaced with renewables.

Question:
How is NREL factoring in what the rest of the State is doing in terms of renewable energy resources?

Answer: NREL has developed a detailed regional representation by focusing first on LADWPs system and how it connects with the broader Western system and then considering aspects of other systems in the region at a broader level. When analyzing energy policy in all of these areas, NREL focuses only on legislation that has been passed and not necessarily laws that are proposed.

Research Approach
The research approach undertaken by NREL will be based on 4 different building blocks which inform certain objectives. These building blocks, which feed into one another in respective order, are Electric Load Modeling, Electricity Analysis, Environmental Analysis, and Economic analysis.

- Electric Load Modeling – Forecasts future demand and the load this demand will place on the electric system. It accounts for the various ways demand could change in the future.
- Electricity Analysis – Consists of a full-scale power systems analysis, including transmission, and considers a possible near complete transformation of the LADWP system. This process involves analysis of system expansion, future system operations, and reliability and frequency response. This represents a majority of the modeling analysis for the project.
- Economic Analysis – Designed to understand how environmental justice communities are impacted by this transformation and inform how jobs and the broader economy might be impacted. This analysis will help quantify economic impacts, including jobs, capital, and variable costs of the energy transition.

Small Group Discussions
In small groups, Advisory Group members directly asked questions to the NREL team and provided initial feedback on the preliminary scenarios and sensitivities. The feedback portion of this activity was guided by the following prompt:

"Do these preliminary scenarios and sensitivities provide the framework for a study that 1) Meets the directives of the City Council motion and related amendments, and 2) Reflects the input themes from the November Advisory Group meeting?"

Results of this activity can be found in Appendix D of this summary.

Power Strategic Long Term Resource Plan
During lunch, Advisory Group members were given an opportunity to learn about LADWPs Power Strategic Long-Term Resource Plan (SLTRP). James Barner, LADWP Manager of Integrated Resource Planning, gave a presentation on the SLTRP. Presentation materials are provided in Appendix E.

Senate Bill 350 requires that the LADWP Power Integrated Resource Plan (IRP) be an official document, approved by the LADWP Governing Board and submitted to the California Energy

Commission by January 2019. The IRP will be based on the recommendations from the SLTRP and including information and data specific to addressing the CEC IRP Guidelines with a 20 year outlook. The purpose of the SLTRP is to guide long term power resource planning for the LADWP system, looking beyond the traditional 20-year term of the Power Integrated Resource Plan (IRP) by extending the planning horizon to 2050. The SLTRP will include a variety of LADWP resource scenarios, goals, recommendations, updates on Power System programs, and updates from special studies including the 100% Renewable Energy study and the Once-Through cooling study. The IRP will be submitted to the LADWP Board of Commissioners in August, 2018 for approval consideration.

Questions and Comments from Advisory Group Members
The following comments were received from Advisory Group members in response to presentations given during the "2017 Power Strategic Long-Term Resource Plan" portion of the meeting.

Question:
What is the process for approving the SLTRP? Does it only need the LADWP General Manager's signature?

Answer: The recommended case from the SLTRP will be included in the Integrated Resource Plan which will be approved by the LADWP Board of Commissioners in August and then submitted to the California Energy Commission in January 2019.

Question:
The time frame for the SLTRP is 2037, but the reference case is 2050. What is the difference?

Answer: The 2017 SLTRP is currently a 20-year plan and will be extended to 2050 next year for the 2018 SLTRP. LADWP would like to incorporate results from the 100% Renewable Energy Study within the extended 2050 timeframe of the SLTRP.

Conclusions and Next Steps

As always, Advisory Group members are encouraged to provide comments or questions to Anton Sy, Project Manager at anton.sy@ladwp.com or (213) 367-2332.

The next quarterly meeting is scheduled for June 7, 2018. The remaining meetings are on August 16 and November 15, 2018.

Advisory Group members are encouraged to send additional comments on the preliminary scenarios and sensitivities to Anton by March 1, 2018 and are asked to RSVP to the site tour by March 15, 2018.

Los Angeles Department of Water and Power
100% Renewable Energy Study

Advisory Group Meeting #4
Thursday, February 15, 2018, 8:45 a.m. to 1:15 p.m.

Appendix A
Agenda

City of Los Angeles 100% Renewable Energy Study

Thursday, February 15, 2018
8:45 am –1:15 pm
Los Angeles Department of Water and Power, Room 1514

8:45 – 9:00 am	**Arrive at LADWP / Networking / Continental Breakfast**
9:00 – 9:05 am	**Call to Order and Agenda Overview** Joan Isaacson, Facilitator
9:05 – 9:20 am	**Welcome and Introductions** Eric Montag, Scott Haase, Anton Sy
9:20 – 9:30 am	**Update Exchange** • Once-Through Cooling Study Eric Montag, All
9:30 – 9:45 am	**Proposed Site Tour on April 26, 2018** • Haskell Switching Station • Barren Ridge Switching Station • Beacon Solar and Battery Storage • Pine Tree Wind & Solar **RSVP to Anton.Sy@ladwp.com by March 15, 2018** Joan Isaacson, Anton Sy, Dawn Cotterell • **Discussion Question:** What are you looking forward most on the site tour? Aaron Bloom, Joan Isaacson
9:45 – 10:30 am	**Study Approach and AG Meeting Plan** • Q&A Aaron Bloom**,** Joan Isaacson
10:30 – 10:40 am	**Break**

10:40 – 12:00 pm	**Preliminary Clean Energy Scenarios and Sensitivities**
	• Recap of input on considerations from November 16, 2017 meeting
	• Preliminary Clean Energy Scenarios
	  o 2018 IRP
	  o Draft SB100
	  o 100% Carbon Neutral
	  o 100% Renewable
	  o 100% Carbon Neutral-Accelerated
	  o Load Modernization

- Preliminary Sensitivities

- **Discussion Question:** Do these preliminary scenarios and sensitivities provide the framework for a study that meets the directives of the City Council motion, related amendments, and the input themes from the November Advisory Group meeting?

Aaron Bloom, Joan Isaacson

12:00 – 12:15 pm **Lunch Served**

12:15 – 1:00 pm **Power Strategic Long-Term Resource Plan**

- Overview
- Q&A

James Barner

1:00 – 1:15 pm **Wrap-up and Next Steps**

- Send additional comments and input on Preliminary Scenarios and Sensitivities to Anton by March 1, 2018
- Site Tour Thursday April 26, 2018
- Next meeting date: Early June (TBD)
- Other 2018 meeting dates: August 16, 2018 and November 15, 2018

Los Angeles Department of Water and Power
100% Renewable Energy Study

Advisory Group Meeting #4
Thursday, February 15, 2018, 8:45 a.m. to 1:15 p.m.

Appendix B
Presentation Slides

Los Angeles 100% Renewable Energy Study
Advisory Group Meeting #4
February 15, 2018

Focus of Today's Meeting

- Advisory Group Meeting Plan
- Advisory Group feedback on:
  - Preliminary Clean Energy Scenarios and Sensitivities
- Continued expansion of Advisory Group knowledge base

Today's Agenda

- 9:00 – 9:05 am Call to Order and Agenda Overview
- 9:05 – 9:20 am Welcome and Introductions
- 9:20 – 9:30 am Update Exchange
- 9:30 – 9:45 am Proposed Site Tour on April 26, 2018
- 9:45 – 10:30 am Study Approach and AG Meeting Plan
- 10:40 – 12:00 pm Preliminary Clean Energy Scenarios and Sensitivities
- 12:00 – 12:15 pm Lunch Served
- 12:15 – 1:00 pm Power Strategic Long-Term Resource Plan
- 1:00 – 1:15 pm Wrap-up and Next Steps

Welcome and Introductions

www.nrel.gov

NREL

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Update Exchange

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Proposed Site Tour

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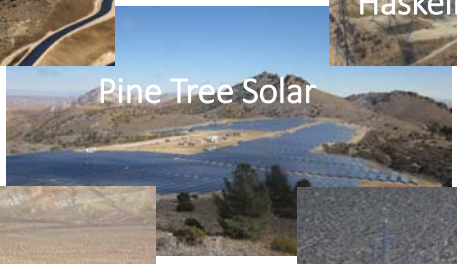
LADWP Facilities



Site Tour!

A Sampling of the LADWP Power System

- Thursday, April 26th, 8 am to 6 pm
- Meet at the Valley Generating Station in Sun Valley to board bus
- Meals and snacks provided
- Closed-toe walking shoes, sunscreen, hat, light jacket, sunglasses, long pants, etc.
- RSVP required by March 15th – please watch for more info via email

- RSVP to Anton.Sy@ladwp.com by March 15, 2018

  Joan Isaacson, Anton Sy, Dawn Cotterell

Quick Mixer!

- In pairs
- Introductions
- Share what you are looking forward to the most on the site tour

Advisory Group Meeting Plan

www.nrel.gov

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

LA 100% Renewable Energy Study-Advisory Group Meeting Plan

Preliminary Clean Energy Scenarios and Sensitivities

Aaron Bloom, Paul Denholm, and Daniel Steinberg

February 15th, 2018

Outline for Scenario and Sensitivities Discussion

- Review Memo on Definitions of Renewable Energy
- Discussion Activity 1, November 14
  - What we heard
  - Preliminary Clean Energy Scenarios and Sensitivities
- Discussion Activity 2, November 14
  - What we heard
  - Research Design

Renewable Energy Definitions from November

Resource	California RPS	New Jersey RPS	Colorado RPS	Austin, Texas RPS	IEA	EIA	Renewable Energy Certificates	REN 21	RE100
Wind and Solar	√	√	√	√	√	√	√	√	√
Hydro	√*	√	√	√	√	√	√	√	√
Bioenergy	√*		√ (biomass)*	√ (biomass or biomass-based waste products)	√	√ (biomass)	√ (biomass)	√ (biopower)	√ (biomass and biogas)
Landfill Gas	√	√		√					
Fuel Cell	√	√		√					
Geothermal	√	√	√	√	√	√	√	√	√
Municipal Solid Waste Conversion	√								
Ocean Thermal	√*				√	√			√
Ocean Wave	√*	√		√	√	√			√
Tidal Current	√*	√		√	√	√			√
Other Minor Technologies	√	√	√						√
Tradable Renewable Energy Credits	√		√						

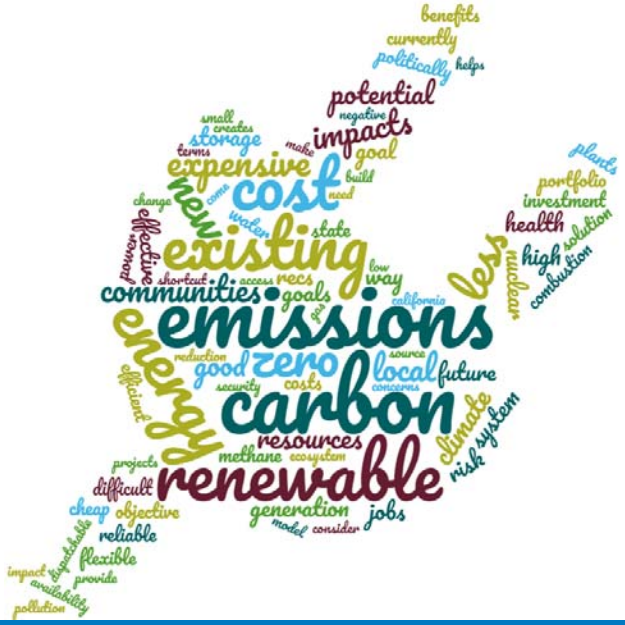
November 14 Discussion Activities

- Input on **advantages** and **disadvantages** of incorporating various technologies into the study
- Brainstorm: "What types of **questions**, **issues**, **topics**, and **ideas** should be **considered** as part of the study?"

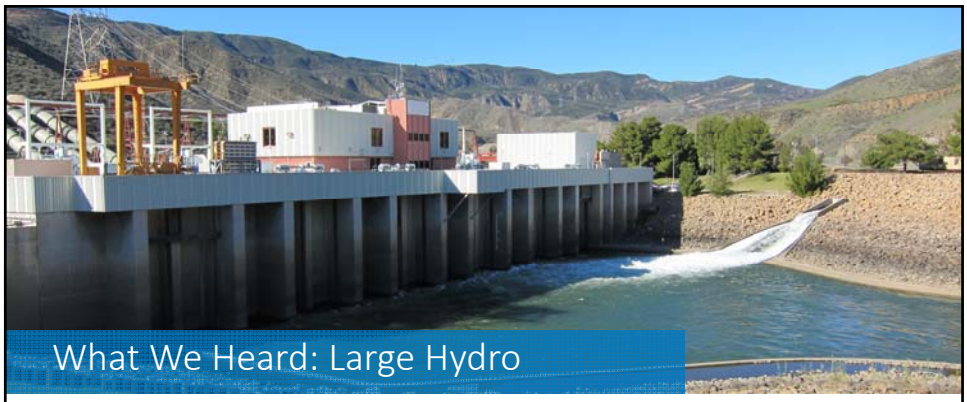
What we Heard

- Discussed trade-offs in technologies
- Discussed goals for the LADWP system
- Informed how the study should be structured
- Identified which study results are important
- Full input in Appendix B Handout

Discussion Activity #1

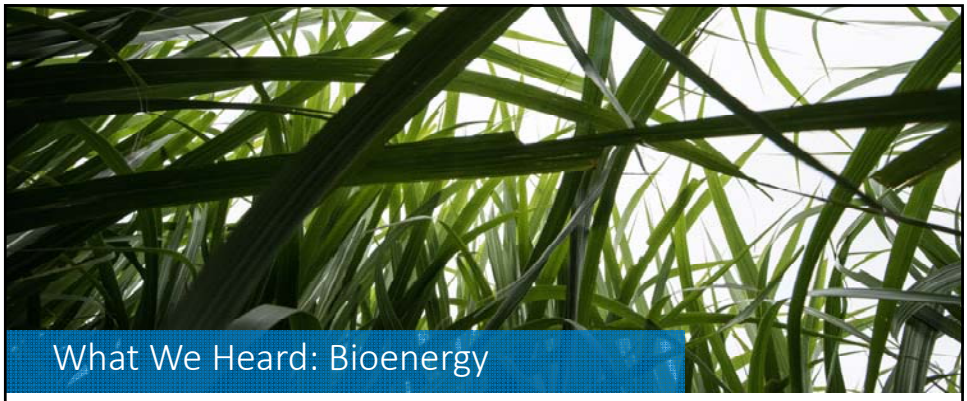


Discussion Activity #2



What We Heard: Large Hydro

- **Positives:** Flexible, cheap, existing, zero emissions, reliable*
- **Negatives:** Old, ecological impact, seasonality, drought
- **Themes:** Existing hydro should be grandfathered. How much new hydro resource is available?



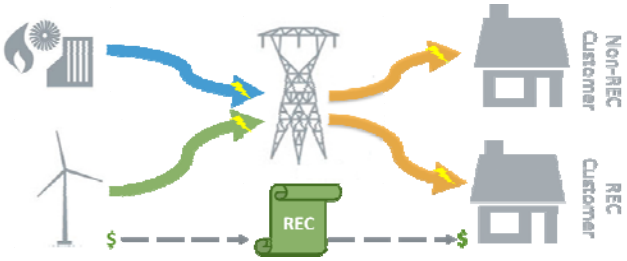
What We Heard: Bioenergy

- **Positives:** Flexible, uses existing waste, carbon neutral, reliable
- **Negatives:** Emissions, carbon accounting, resource availability, state limits
- **Themes:** What are the costs and benefits of allowing bioenergy? Can we differentiate between waste energy, biomass, and biofuels? Will resource availability limit resource potential?

What We Heard: Nuclear Energy

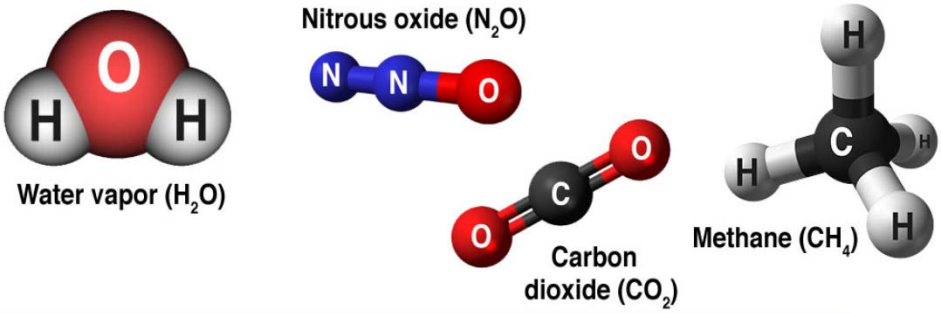
- **Positives:** Zero carbon, baseload, inertia, cost, existing units, reliable
- **Negatives:** Cost, nuclear waste, security, public health, ownership/risk
- **Themes:** Input ranged from grandfathering existing nuclear, to assessing the costs and benefits of allowing new nuclear and avoiding all nuclear.

The LADWP capacity at Palo Verde is scheduled to have a staggered retirement from 2045-2047.



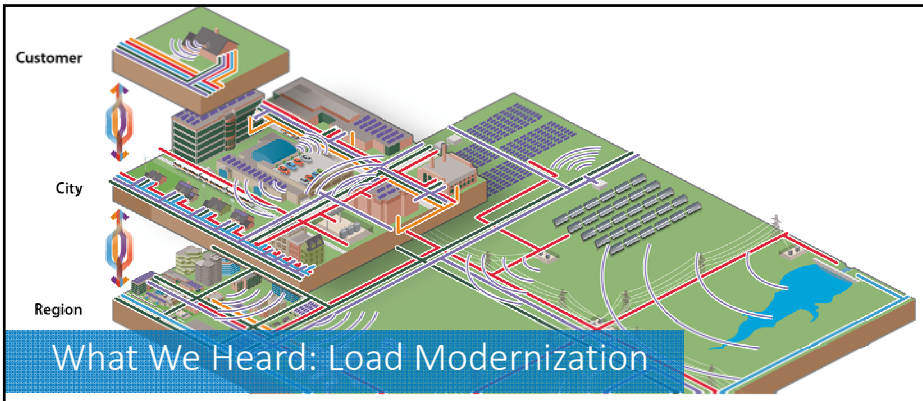
What We Heard: Credits and Allowances

- **Positives:** Cheap, balance margins, fast, practical for the last 10-20%
- **Negatives:** Beneficiaries don't pay, shortcut, credibility
- **Themes:** RECs may be an effective strategy, but there is concern about the legitimacy of RECs. Another concern is that environmental justice neighborhoods will not receive any benefits.



What We Heard: Zero Carbon Emissions Objective

- **Positives:** Significant support, addresses climate goals, easier to define than "renewable"
- **Negatives:** What about other greenhouse gases?
- **Themes:** Picking technologies can get complicated quickly; focusing on carbon sounds straightforward.



What We Heard: Load Modernization

- Topic identified in Discussion Activity 2
- **Positives:** Focus on local resources, energy efficiency, EVs, storage, local beneficiaries
- **Negatives:** Potentially expensive new tech, insufficient natural resource
- **Themes:** Distributed resources and energy efficiency

Preliminary Clean Energy Scenarios and Sensitivities for Advisory Group Input

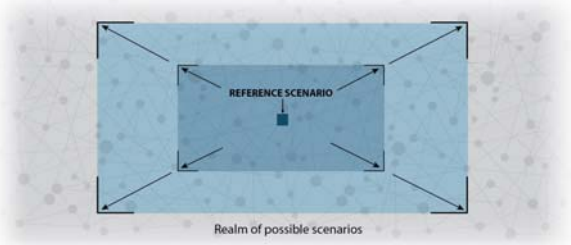
NREL Goals for Scenario Development

- Start with the City Council Motions and Advisory Group Comments:
  - Identify least-cost pathway(s) to a clean energy future by 2050
  - Determine what investments are necessary to reach a clean energy future
  - Identify the potential economic and environmental impacts of a clean energy future on LADWP ratepayers
- Consider full set of opportunities:
  - Demand-side (demand response, end-use efficiency, and electrification)
  - Supply-side (renewable generation, nuclear, carbon capture and storage)
  - Financial mechanisms (allowances, offsets, and credits)
- Produce results that are robust to a broad set of future conditions/uncertainties:
  - Changes in load—quantity, flexibility, and efficiency
  - Balance between centralized and distributed supply
  - Ability to develop additional transmission
  - Evolution of key technologies (e.g., batteries, PV, wind)

Scenario and Sensitivity Definitions

Scenarios: Identify the overarching policy or technological driver for achieving a clean energy future

Sensitivities: Under a given scenario, explore how changes in future conditions could alter the pathway and outcomes for that scenario



Preliminary Clean Energy Scenarios

		Reference Cases		LA Leads			
	Candidate Technologies	2018 IRP	Draft SB 100	100% Carbon Neutral	100% Renewable	100% Carbon Neutral – Accelerated	Load Modernization
Scenarios	Natural Gas	●	●	●		●	
	Wind, Solar, Geothermal	●	●	●	●	●	●
	Existing Nuclear	●	●	●		●	
	New Nuclear			●		●	
	Bioenergy	●	●	●		●	
	Carbon Capture and Sequestration			●		●	
	Existing Hydro	●	●	●	●	●	●
	New Hydro	●	●	●		●	
	CO2 Allowances	●	●	●		●	
	RECs	●	●	●		●	
	Storage	●	●	●	●	●	●
Sensitivities	Electric Vehicles	Expected	Expected	Expected	Expected	Expected	HIGH
	Energy Efficiency	Expected	Expected	Expected	Expected	HIGH	HIGH
	Demand Response	Expected	Expected	Expected	Expected	HIGH	HIGH
	Transmission Feasibility	Expected	Expected	Expected	Expected	NEW PATHS	NEW PATHS
	Decentralization	Expected	Expected	Expected	Expected	Expected	HIGH
	Technology Cost	Expected	Expected	Expected	Expected	Low	Low
	Timeframe	2020-2050*	2020-2050*	2020-2050*	2020-2050*	2020–2045*	2020–2050*

*We will wait until May 2018 to finalize the scenario timeframe and sensitivities to give opportunity for further legislative development.

Preliminary Clean Energy Scenario: 2018 Integrated Resource Plan

- ***Definition*** – The evolution of the LA power system is influenced by existing policies (local, state, and federal). Current LADWP policy is driven by SB 350, aspirational city targets, and the Once-Through Cooling study. This definition will be similar with the 2018 LADWP PSLTRP process but not identical.
- ***Justification*** – A base case is essential to measure the costs and benefits of future scenarios.

	Candidate Technologies	2018 IRP
Scenarios	Natural Gas	●
	Wind, Solar, Geothermal	●
	Existing Nuclear	●
	New Nuclear	
	Bioenergy	●
	Carbon Capture and Sequestration	
	Existing Hydro	●
	New Hydro	●
	CO2 Allowances	●
	RECs	●
	Storage	●
Sensitivities	Electric Vehicles	Expected
	Energy Efficiency	Expected
	Demand Response	Expected
	Transmission Feasibility	Expected
	Decentralization	Expected
	Technology Cost	Expected
	Timeframe	2020–2050*

Preliminary Clean Energy Scenario: DRAFT SB 100

- ***Definition*** – The evolution of the LA power system is driven by policies that extend existing policies to obtain 100% renewable energy.
- ***Justification*** – This scenario is intended to be a proxy for last year's S.B. 100. It extends existing statutory resource constraints to create a 100% RPS.

	Candidate Technologies	DRAFT SB 100
Scenarios	Natural Gas	●
	Wind, Solar, Geothermal	●
	Existing Nuclear	●
	New Nuclear	
	Bioenergy	●
	Carbon Capture and Sequestration	
	Existing Hydro	●
	New Hydro	●
	CO2 Allowances	●
	RECs	●
	Storage	●
Sensitivities	Electric Vehicles	Expected
	Energy Efficiency	Expected
	Demand Response	Expected
	Transmission Feasibility	Expected
	Decentralization	Expected
	Technology Cost	Expected
	Timeframe	2020–2050*

Preliminary Clean Energy Scenario: 100% Carbon Neutral

- ***Definition*** – LA achieves a net-zero carbon emissions power system. This scenario is a technology-agnostic pathway to achieving a net-zero emissions future. A carbon cap-and-trade program is implemented that ramps to zero-carbon.
- ***Justification*** – Reflects Advisory Group input to study a diverse set of resource options. This approach is proposed because of the urgent need to reduce carbon dioxide emissions, as described by the Advisory Group. It is the most flexible scenario to reaching a decarbonized electricity system.

	Candidate Technologies	100% Carbon Neutral
Scenarios	Natural Gas	●
	Wind, Solar, Geothermal	●
	Existing Nuclear	●
	New Nuclear	●
	Bioenergy	●
	Carbon Capture and Sequestration	●
	Existing Hydro	●
	New Hydro	●
	CO2 Allowances	●
	RECs	●
	Storage	●
Sensitivities	Electric Vehicles	Expected
	Energy Efficiency	Expected
	Demand Response	Expected
	Transmission Feasibility	Expected
	Decentralization	Expected
	Technology Cost	Expected
	Timeframe	2020–2050*

Preliminary Clean Energy Scenario: 100% Renewable

- ***Definition*** – LA achieves a power system in which 100% of load is met with generation from a limited selection of renewable resources.
- ***Justification*** – This scenario is the strictest interpretation of 100% renewable energy. As per discussions with the Advisory Group, this case does not include any generation that uses combustion. This scenario is less flexible than the 100% Carbon Neutral.

	Candidate Technologies	100% Renewable
Scenarios	Natural Gas	
	Wind, Solar, Geothermal	●
	Existing Nuclear	
	New Nuclear	
	Bioenergy	
	Carbon Capture and Sequestration	
	Existing Hydro	●
	New Hydro	
	CO2 Allowances	
	RECs	
	Storage	●
Sensitivities	Electric Vehicles	Expected
	Energy Efficiency	Expected
	Demand Response	Expected
	Transmission Feasibility	Expected
	Decentralization	Expected
	Technology Cost	Expected
	Timeframe	2020–2050*

Preliminary Clean Energy Scenario: 100% Carbon Neutral – Accelerated

- ***Definition*** – LA achieves a power system that has net-zero emissions. This scenario is identical to the *Carbon Neutral* scenario but is on an accelerated timeline.
- ***Justification*** – This scenario reflects the Advisory Group's interest in rapidly reducing the impact of LADWP on carbon dioxide emissions. It allows the model to select from a full range of options to find the cheapest options for rapidly decarbonizing the electricity system.

	Candidate Technologies	100% Carbon Neutral – Accelerated
Scenarios	Natural Gas	●
	Wind, Solar, Geothermal	●
	Existing Nuclear	●
	New Nuclear	●
	Bioenergy	●
	Carbon Capture and Sequestration	●
	Existing Hydro	●
	New Hydro	●
	CO2 Allowances	●
	RECs	●
	Storage	●
Sensitivities	Electric Vehicles	Expected
	Energy Efficiency	HIGH
	Demand Response	HIGH
	Transmission Feasibility	NEW PATHS
	Decentralization	Expected
	Technology Cost	Low
	Timeframe	2020–2045*

Preliminary Clean Energy Scenario: Load Modernization

- ***Definition*** – This scenario aims to reach the 100% renewable goals by leveraging distributed energy resources. It includes very high levels of electric vehicles, energy efficiency, and demand response. This scenario focuses on leveraging local resources.
- ***Justification*** – The Advisory Group expressed strong preferences for a strategy that leveraged local resources to meet climate goals.

	Candidate Technologies	Load Modernization
Scenarios	Natural Gas	
	Wind, Solar, Geothermal	●
	Existing Nuclear	
	New Nuclear	
	Bioenergy	
	Carbon Capture and Sequestration	
	Existing Hydro	●
	New Hydro	
	CO2 Allowances	
	RECs	
	Storage	●
Sensitivities	Electric Vehicles	HIGH
	Energy Efficiency	HIGH
	Demand Response	HIGH
	Transmission Feasibility	NEW PATHS
	Decentralization	HIGH
	Technology Cost	Low
	Timeframe	2020–2050*

Preliminary Clean Energy Scenarios

		Reference Cases		LA Leads			
	Candidate Technologies	2018 IRP	Draft SB 100	100% Carbon Neutral	100% Renewable	100% Carbon Neutral – Accelerated	Load Modernization
Scenarios	Natural Gas	●	●	●		●	
	Wind, Solar, Geothermal	●	●	●	●	●	●
	Existing Nuclear	●	●	●		●	
	New Nuclear			●		●	
	Bioenergy	●	●	●		●	
	Carbon Capture and Sequestration			●		●	
	Existing Hydro	●	●	●	●	●	●
	New Hydro	●	●	●		●	
	CO2 Allowances	●	●	●		●	
	RECs	●	●	●		●	
	Storage	●	●	●	●	●	●
Sensitivities	Electric Vehicles	Expected	Expected	Expected	Expected	Expected	HIGH
	Energy Efficiency	Expected	Expected	Expected	Expected	HIGH	HIGH
	Demand Response	Expected	Expected	Expected	Expected	HIGH	HIGH
	Transmission Feasibility	Expected	Expected	Expected	Expected	NEW PATHS	NEW PATHS
	Decentralization	Expected	Expected	Expected	Expected	Expected	HIGH
	Technology Cost	Expected	Expected	Expected	Expected	Low	Low
	Timeframe	2020-2050*	2020-2050*	2020-2050*	2020-2050*	2020–2045*	2020–2050*

*We will wait until May 2018 to finalize the scenario timeframe and sensitivities to give opportunity for further legislative development.

Discussion Activity #2: Considerations for Study

- Study must show the system is:
  - Reliable
  - Healthy
  - Just
  - Affordable

Research Approach

	Objective	Informs
ECONOMIC ANALYSIS:	Determine the economic and jobs impact of select study scenarios	
ENVIRONMENTAL ANALYSIS:	Identify and quantify the air quality, GHG, and environmental justice impacts of select study scenarios	
ELECTRICITY ANALYSIS:	Conduct a suite of engineering and economic studies to determine the future composition of the LADWP system and how it might operate. Considers all time scales on both the transmission and distribution networks.	
ELECTRIC LOAD MODELING:	Develop a range of load forecast and profiles for use in electric system modeling	

What could future **Demand** look like?

- Takes into consideration a variety of ways demand could change in the future
- Includes detailed accounting for energy efficiency, demand response, electrification

ECONOMIC ANALYSIS:	Jobs & Economic Development
ENVIRONMENTAL ANALYSIS:	Air Quality, GHG, & Public Health
ELECTRICITY ANALYSIS:	AC Power Flow
	Operations
	Expansion
ELECTRIC LOAD MODELING:	Demand Forecast

Are the scenarios **Reliable**?

- Full-scale power systems analysis
- Integrated transmission and distribution modeling
- Near complete transformation of the LADWP system

ECONOMIC ANALYSIS:	Jobs & Economic Development
ENVIRONMENTAL ANALYSIS:	Air Quality, GHG, & Public Health
ELECTRICITY ANALYSIS:	AC Power Flow
	Operations
	Expansion
ELECTRIC LOAD MODELING:	Demand Forecast

How could the scenarios impact **Public Health** and the **Environment**?

- Detailed analysis of impact of changes in air quality and their impact on public health, as well as changes to GHG emissions
- Designed to identify comparative environmental impacts of selected scenarios
- Relies on data from electricity analysis and demand forecasts

ECONOMIC ANALYSIS:	Jobs & Economic Development
ENVIRONMENTAL ANALYSIS:	Air Quality, GHG, & Public Health
ELECTRICITY ANALYSIS:	AC Power Flow
	Operations
	Expansion
ELECTRIC LOAD MODELING:	Demand Forecast

Are the scenarios **Just?**

- Designed to understand how environmental justice communities are impacted by the transformation in terms of changes in public health outcomes.
- Informs how jobs and the broader economy could be impacted by a 100% renewable future.

ECONOMIC ANALYSIS:	Jobs & Economic Development
ENVIRONMENTAL ANALYSIS:	Air Quality, GHG, & Public Health
ELECTRICITY ANALYSIS:	AC Power Flow
	Operations
	Expansion
ELECTRIC LOAD MODELING:	Demand Forecast

Are the scenarios **Affordable**?

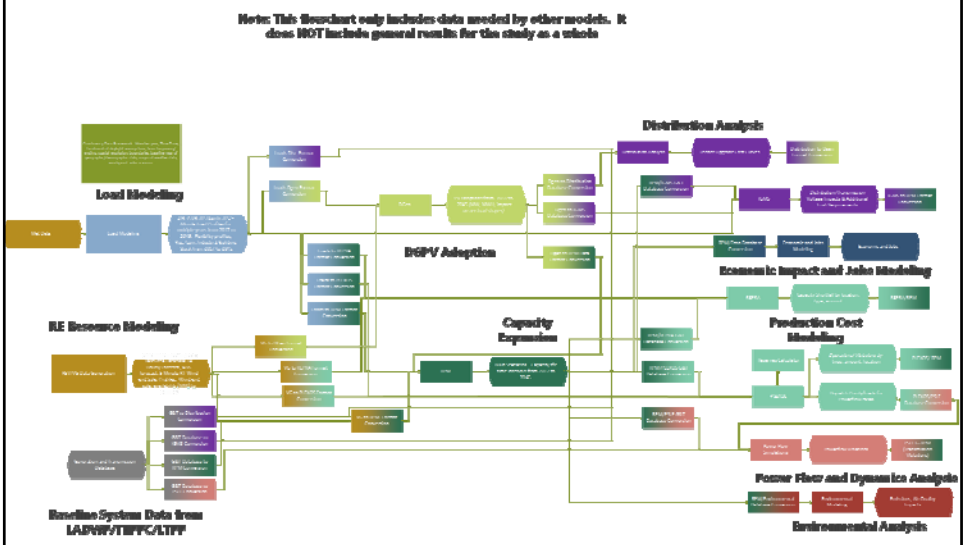
- Study will provide detailed capital and variable costs for the electricity sector
- Study will quantify the economic impact of the energy transition
- Study will analyze the jobs and economic impact of a 100% future

+ RATEPAYER ADVOCATE

ECONOMIC ANALYSIS:	Jobs & Economic Development
ENVIRONMENTAL ANALYSIS:	Air Quality, GHG, & Public Health
ELECTRICITY ANALYSIS:	AC Power Flow
	Operations
	Expansion
ELECTRIC LOAD MODELING:	Demand Forecast

What does this mean from a technical perspective?

Modeling Flow Chart



Discussion Activity – Roundtable Input

"Do these preliminary scenarios and sensitivities provide the framework for a study that 1) Meets the directives of the City Council motion and related amendments, and 2) Reflects the input themes from the November Advisory Group meeting?"

Tips for Productive Discussions

- Let one person speak at a time
- Help to make sure everyone gets equal time to give input
- Keep your input concise so others have time to participate
- Actively listen to others and seek to understand their perspectives

Lunch

www.nrel.gov

NREL

NREL is a national laboratory of the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, operated by the Alliance for Sustainable Energy, LLC.

Power Strategic Long-Term Resource Plan

during lunch

www.nrel.gov

Wrap Up and Next Steps

www.nrel.gov

Los Angeles Department of Water & Power

Once Through Cooling Study (OTC) Update

Third Party Engineering Assessment

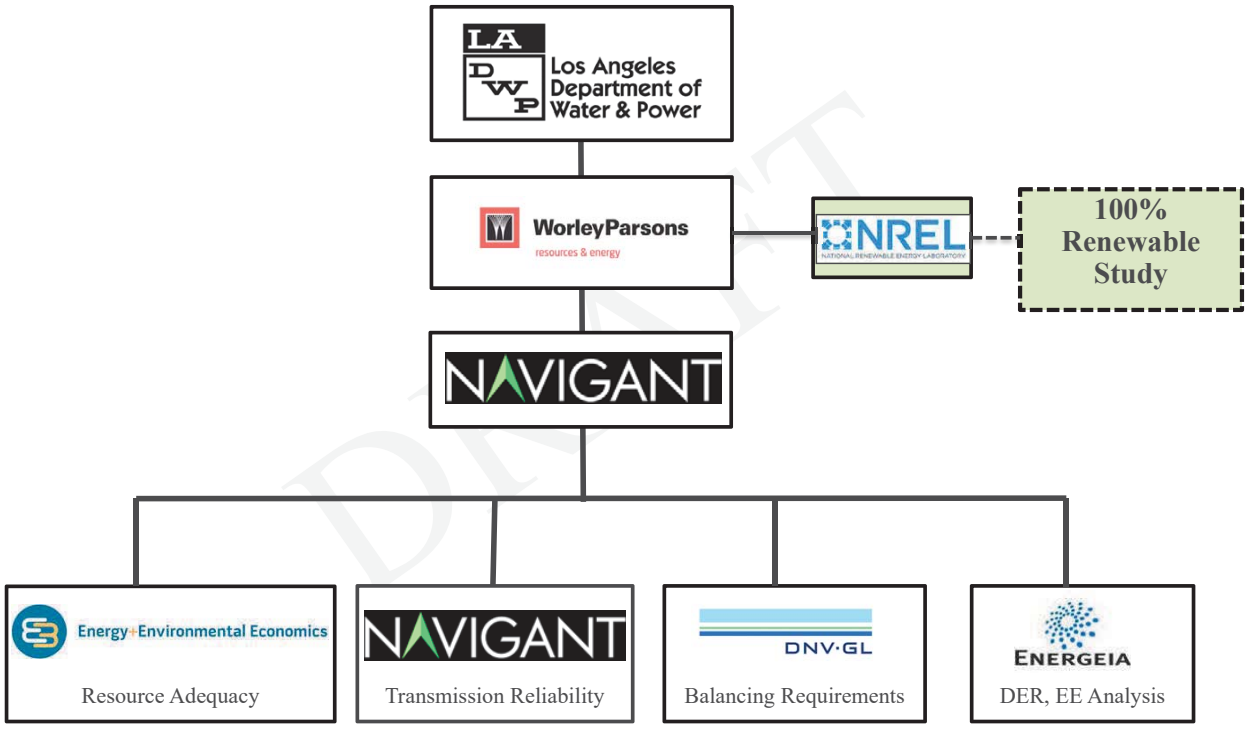
Draft

Putting Customers First

Objectives / Goals

- Independent, third-party evaluation of potential scenarios and select alternatives to modernizing once-through-cooling (OTC) units
  - Scenarios: Various OTC retirement combinations
  - Alternatives include: renewables, energy storage, EE, DER, transmission, reduced repowering, & other viable options
- Develop recommendations

Consulting Team



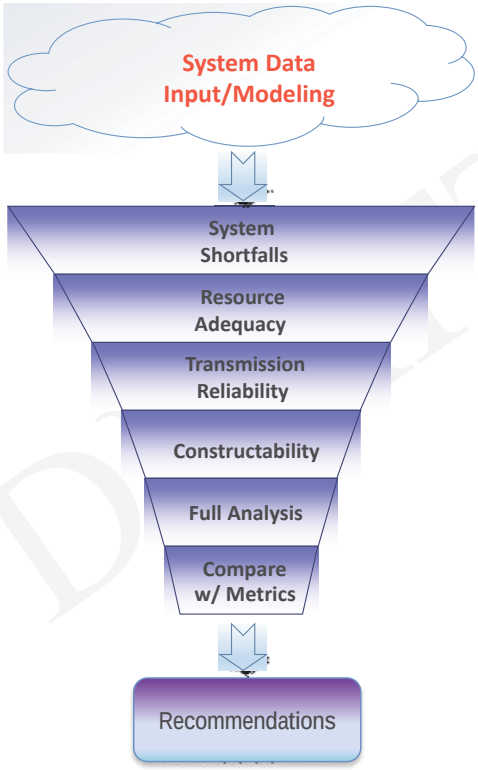
Scenarios

Scattergood	Haynes	Harbor
Retire – 2024	Retire – 2029	Retire - 2029
Retire – 2024	Repower	Repower
Retire – 2024	Repower	Retire - 2029
Retire – 2024	Retire – 2029	Repower
Repower	Retire – 2029	Retire - 2029
Repower	Repower	Repower
Repower	Repower	Retire - 2029
Repower	Retire – 2029	Repower

Alternatives

Renewable Energy Only (RE)
Energy Storage Only (ES)
Distributed Energy Resources (DER)/Energy Efficiency (EE)
RE/ES Only
Transmission Improvements only (Tx)
Tx/ES only
Ts/ES/RE
Tx/ES/RE/DER/EE
Partial Repower +Alternatives

Study Filters



Study Status

- Gather System data - Completed
- Develop system model – Competed
- Model validation – Completed
- Perform Study - Ongoing
  - RMR Transmission analysis
  - Resource Adequacy Analysis
  - Loss of Load Expectation Analysis
  - Balancing Area Assessment
- Summarize results – Ongoing
- Assess alternatives – Ongoing
- Stakeholder Outreach – July/Aug 2018

QUESTIONS?

Scenario/Alternative Matrix

Scenarios and Alternatives		Retirement Scenarios	All Repowered Baseline	All Retired	Scattergood Retired Scenario	Haynes Retired Scenario	Harbor Retired Scenario	Haynes & Harbor Retired Scenario	Scattergood & Haynes Retired Scenario	Scattergood & Harbor Retired Scenario
			All Repowered Baseline	None Repowered	Haynes & Harbor Repowered	Scattergood & Harbor Repowered	Scattergood & Haynes Repowered	Scattergood Repowered	Harbor Repowered	Haynes Repowered
		Mitigation Alternatives	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**
No Repower Options	1	Renewable Energy (RE) Only	n/a							
	2	Energy Storage (ES) Only	n/a							
	3	Distributed Energy Resources (DER) , EE Only	n/a							
	4	Renewable Energy, Storage	n/a							
	5	Transmission Improvement (Tx) Only	n/a							
	6	Tx, ES	n/a							
	7	Tx, ES, RE	n/a							
	8	Tx, ES, RE, DER, EE	n/a							
Partial Repowering	9	Repowering OTC Units with Requisite Capacity (ReqCap)	n/a							
	10	ReqCap, ES	n/a							
	11	ReqCap, Tx, ES, RE	n/a							
	12	ReqCap, Tx, ES, RE, DER, EE	n/a							
	13	ReqCap, DER, EE	n/a							
Full Repowering	14	Re-powering OTC units as Planned	Baseline	n/a	n/a	n/a	n/a	n/a	n/a	n/a

Los Angeles Department of Water and Power
100% Renewable Energy Study

Advisory Group Meeting #4
Thursday, February 15, 2018, 8:45 a.m. to 1:15 p.m.

Appendix C

Advisory Group Meeting Plan

LA 100% Renewable Energy Study-Advisory Group Meeting Plan

QUARTER	Phase 1 | 2017 LAUNCH AND ORGANIZATION		Phase 2 | 2018 SCENARIOS		Phase 3 | 2019 ANALYSIS AND MODELING	Phase 4 | 2020 FINAL REPORT
Q1	■ COMPLETED MEETINGS/TASKS ■ PLANNED MEETINGS/TASKS		• Advisory Group Meeting Plan • Preliminary Scenarios and Sensitivities • Field Trip Itinerary • Power Strategic Long-Term Power Resources Plan • Once-Through Cooling Study Update	FEBRUARY 15	• Capacity Value • Electricity Operations Modeling II • Jobs & Economic Analysis II	• White Papers on Electricity Modeling Results • Final Results 1) Jobs & Economic Analysis and 2) Environmental Analysis • Final Visualization of Electricity Operations
Q2	• Advisory Group Launch • City Council Motion: 100% Renewable Energy Study	JUNE 23	FIELD TRIP April 26 • Draft 100% Papers: Framing, Data, Methods • Final Scenarios and Sensitivities • Once-Through Cooling Study Update • LADWP Financial Basics	EARLY JUNE	• Planning Reserves • Operating Reserves • Load Modernization • Environmental Analysis II • Publication Plan	• Final Report • Final Presentation
Q3	• Advisory Group Charge and Operating Protocols • Introduction to NREL and 100% Renewable Energy Study	AUGUST 3	• Final 100% Papers • Electricity Operations Modeling I • Jobs & Economic Analysis I • Environmental Modeling I • Once-Through Cooling Study Update	AUGUST 16	• Final Scenarios and Sensitivities Results • Final Visualization of Scenarios • Initial Electricity Operations Modeling Results	
Q4	• Defining Clean Energy and Renewable Energy • Considerations for Study • Once-Through Cooling Study Overview • Public Outreach Overview	NOVEMBER 16	• Initial Scenario Results • Draft Visualizations of Scenarios • Once-Through Cooling Study Results	NOVEMBER 15	• Final Electricity Operations Modeling Results and Draft Visualizations • Draft results on Jobs and Economic Development • Draft results on Environmental Analysis	

Los Angeles Department of Water & Power

NREL
NATIONAL RENEWABLE ENERGY LABORATORY

As of January 23, 2018

Los Angeles Department of Water and Power
100% Renewable Energy Study

Advisory Group Meeting #4
Thursday, February 15, 2018, 8:45 a.m. to 1:15 p.m.

Appendix D
Discussion Activity Results

Los Angeles Department of Water and Power
100% Renewable Energy Study

Advisory Group Meeting #4
Thursday, February 15, 2018, 8:45 a.m. to 1:15 p.m.

Discussion Activity Results

Discussion Question: Do these preliminary scenarios and sensitivities provide the framework for a study that meets the directives of the City Council motion and related amendments, and the input themes from the November Advisory Group meeting?

GROUP 1
Q & A
Regarding the sensitivities - Will there be ranges?
There isn't a big difference between 2050 and 2045. Those goals may not influence people now.
Front load vs. back load. Concentrate on near-term decisions
What is goal? Can there be percentage scenarios? 60% 70% 80% 100%
Can we get to 100% by 2030?
Can we do a model with a really aggressive timeline for comparison?
What are the cost trade-offs?
100% carbon neutral could be a stepping stone to 100% renewable
Are you spending money in the short-term that could be used for long-term benefits?
Financial constraints vs. technical constraints?
How can we un-bundle impacts of cost constraints and engineering constraints?
What will it cost and how can we understand these costs? Use a lowest-cost filter. What does that mean? Artificially constraining the problem.
Is there consideration of waste treatment?
Debt capacity over-leveraged
Are RECS a scam? Trading and local impacts
Are you looking at economic benefits to public health?
DISCUSSION QUESTION
Faster
100% Renewable case are in everybody's heart and minds
Front loaded ideas
Study needs to be relevant for the next 5 years. Front end.
How much should we care about 100% Renewable sensitivities?
Factor in debt service
EV is restricted - say something about the rest of transportation, building, etc. Electrification
Don’t like 100% Carbon Neutral. Allowances in cap and trade
Be careful about costs on rate payers throughout the whole system

GROUP 2
Q & A
How do you set 2050 Targets?
Will Optimal Trajectory be faster than SB100?
Assumptions about future carbon markets?
How optimize?
Are different technologies "included" or "required"?
Consider front-loading of carbon reduction?
Scenario that focuses on ET (EJ?) impacts while maintaining all options?
Carbon feels like pure cost-effectiveness, Does also consider equity? Needs to be an active consideration
DISCUSSION QUESTION
Naming the "100% Renewable" as such when it does not include bio-gas is a framing issue
Why no other, faster options? The purpose of the motion was to study "Can we do it faster than SB100?" 2030?
Accelerated initial pathway
Is the intention to look into transmission in detail?
How do separate models consider the different % of generation?
Date: helpful to have a broader date range
Stages to get to "final outcome" REC.
Keep in mind: working within existing policies. Have opportunity to consider/inform future policy
Time sensitivity: What is the cost of doing it faster?
Hybrid: 100% ultimately, but what happens in interim?
Yes, (consistent?)
Goal: optimal solution - cost, supply, price
Diverse scenarios lets policy-makers optimize
Consider scenario that reduces carbon through entire timeframe, not just at the end

GROUP3
Q & A
Grid regionalization - value. If this doesn't happen, will 100% Renewable happen? Test sensitivities?
Considering updated building codes?
Will we see more detail before comments are due?
Will there be sensitivities to inform policy? EV specific
DISCUSSION QUESTION
What is NREL's definition of the City Council's directive? Some organizations see the directive as more narrow. - Transition plan
How is "least cost" being defined?
Is the Advisory Group representative of diverse communities? Additional input mechanisms
Surprise that LA heads goes to 2050 instead of 2045
Are we establishing short-term goals or just long-term goals?
Mix Scenarios to find something new
Deviating from 100% Renewables goes against City Council directive
Will offshore wind be included?
Where will there be environmental justice impacts and are we engaging those communities
What materials will be given to the group?
Why not have regionalization be a scenario instead of sensitivity?
If SB100 includes natural gas, will we be able to meet our goals - If we build natural gas now?
Describe rationale for including nuclear?
Why does accelerated version have lower technology costs?

Advisory Group Meeting #4
Thursday, February 15, 2018, 8:45 a.m. to 1:15 p.m.

Appendix E

2017 Power Strategic Long-Term Resource Plan Presentation

Los Angeles Department of Water and Power
100% Renewable Energy Study

Los Angeles Department of Water & Power

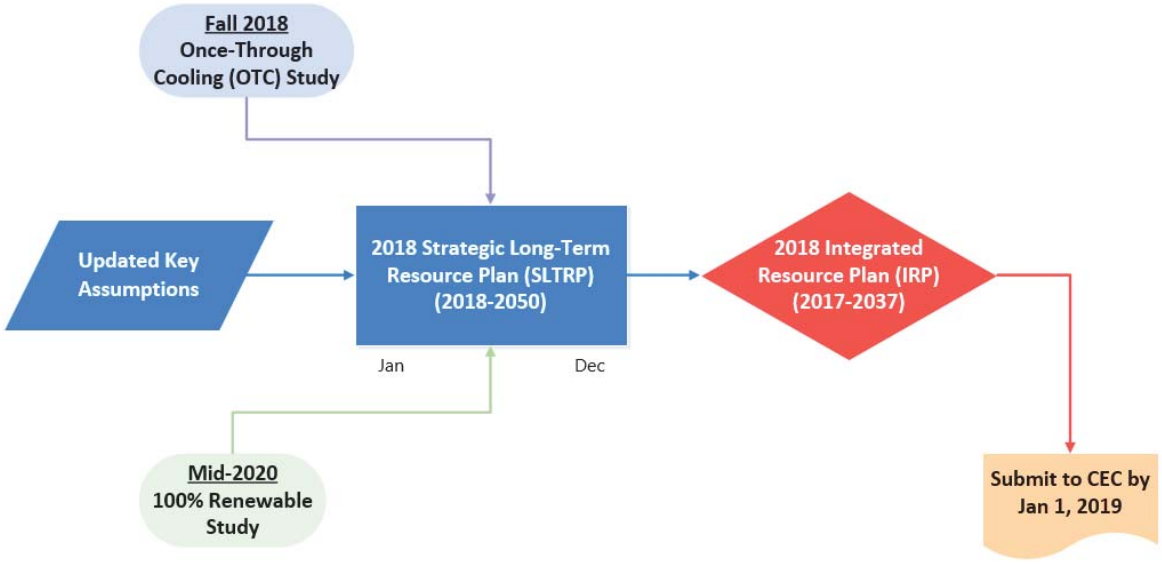
2017 Power Strategic Long-Term Resource Plan

Presentation to 100% Renewable Energy Study Advisory Group

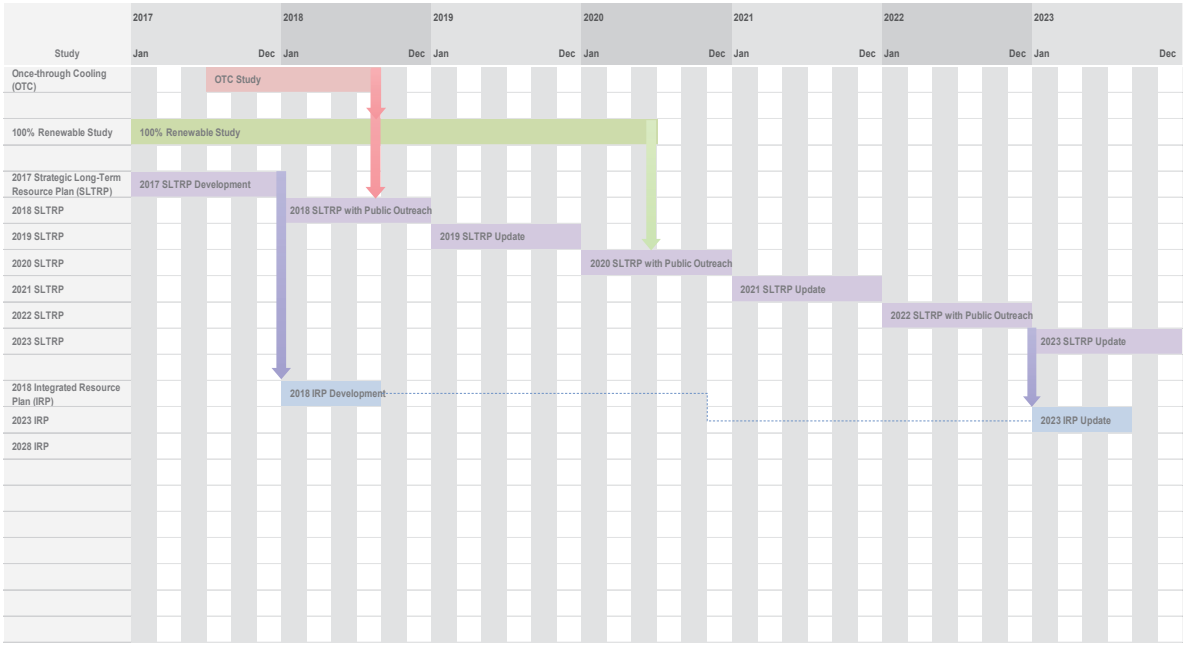
Website: www.ladwp.com/cleanenergyfuture

Putting Customers First

2018 Strategic Planning Process



Strategic Planning Timeline



2017 Power Strategic Long-Term Resource Plan

Eliminate Coal from LADWP's Power Supply

Reach 33% RPS by 2020, 55% by 2030, 65% by 2036

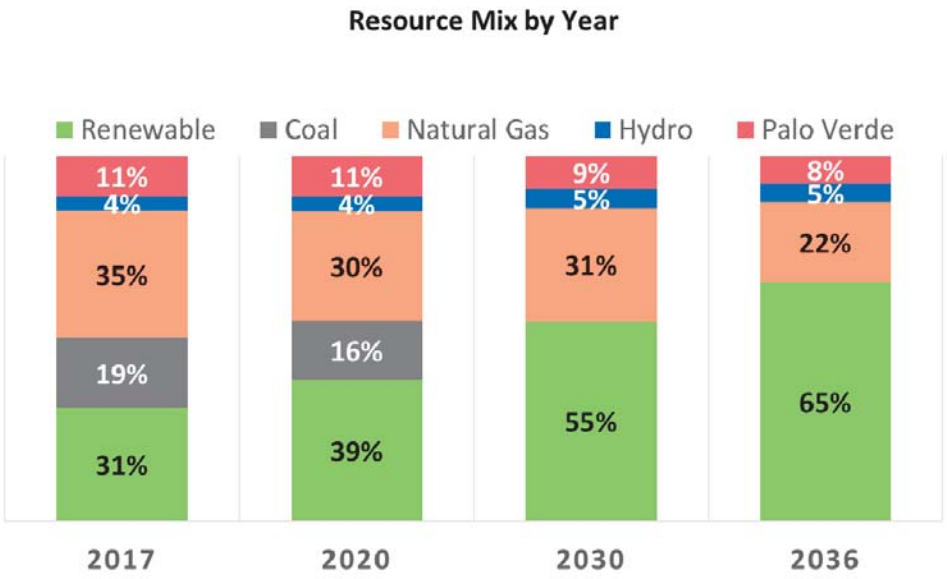
Double Energy Efficiency by 2030

Develop Hybrid Energy Projects

Accelerate Electric Vehicle Expansion

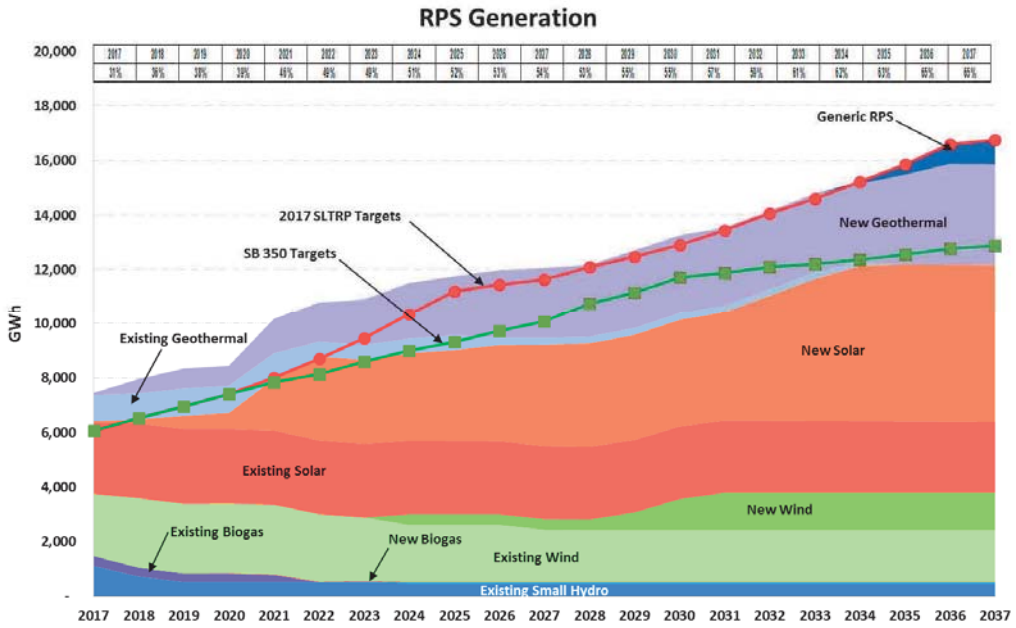
Invest in Power System Reliability Program

Transformation of Energy Resources

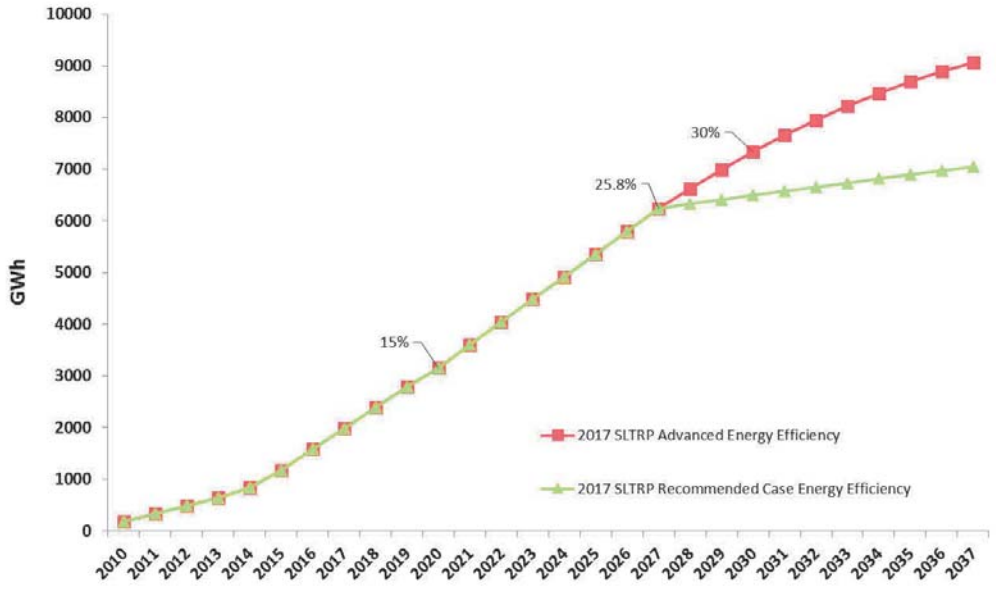


Note: Includes a doubling of energy efficiency by 2030

Renewable Portfolio Standard Growth

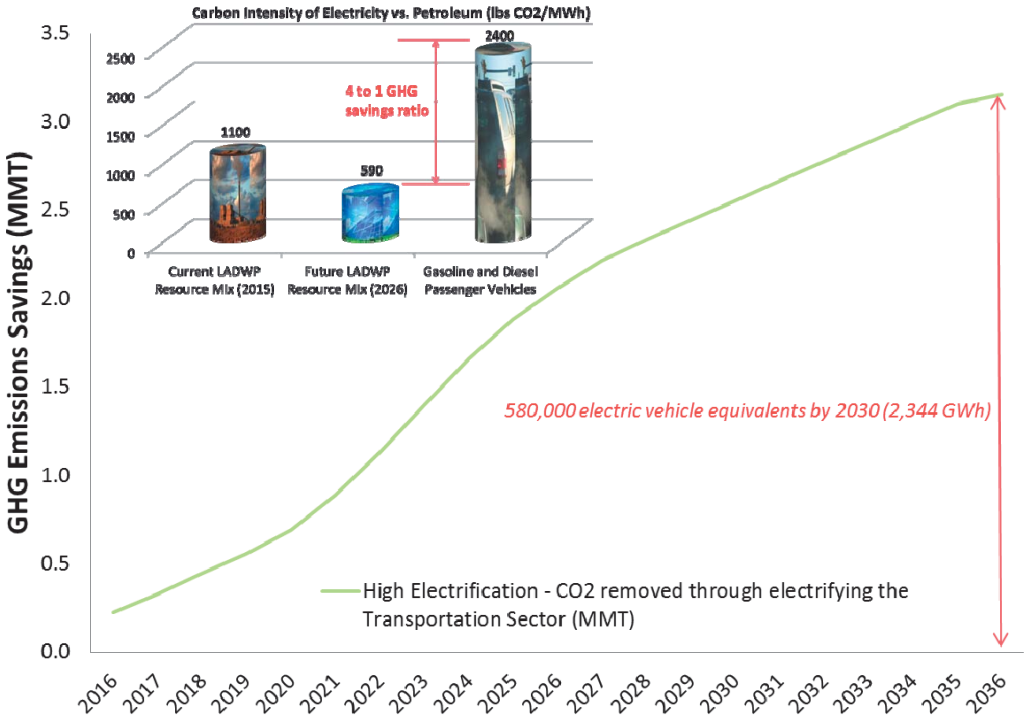


Energy Efficiency Cumulative Savings



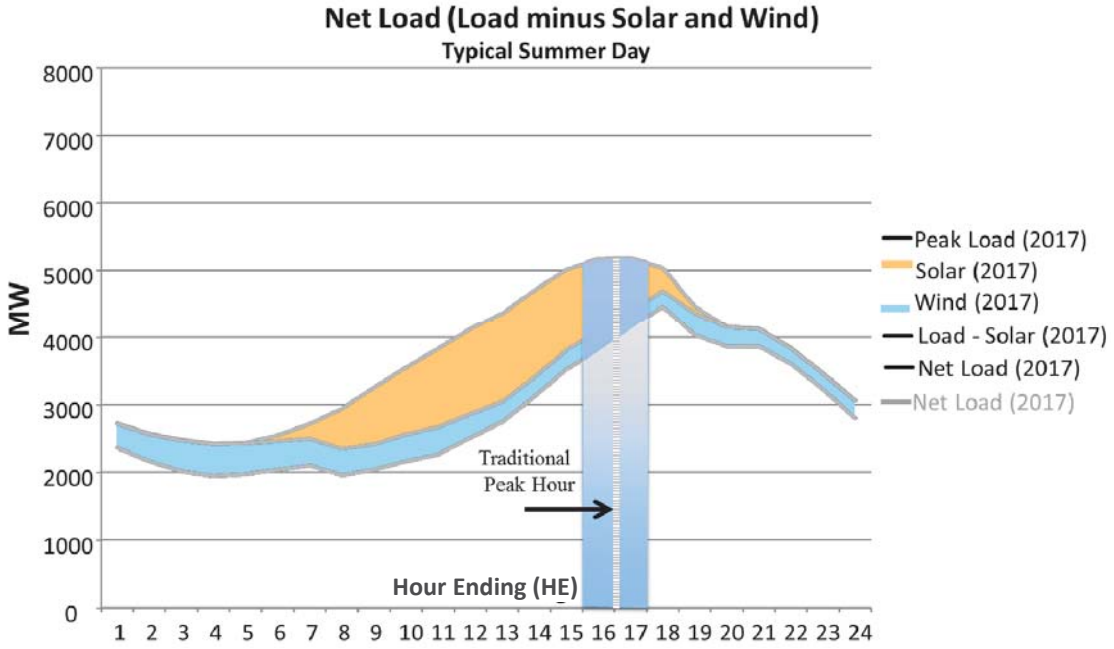
Note: Estimated energy efficiency cumulative savings including codes & standards

Transportation Electrification



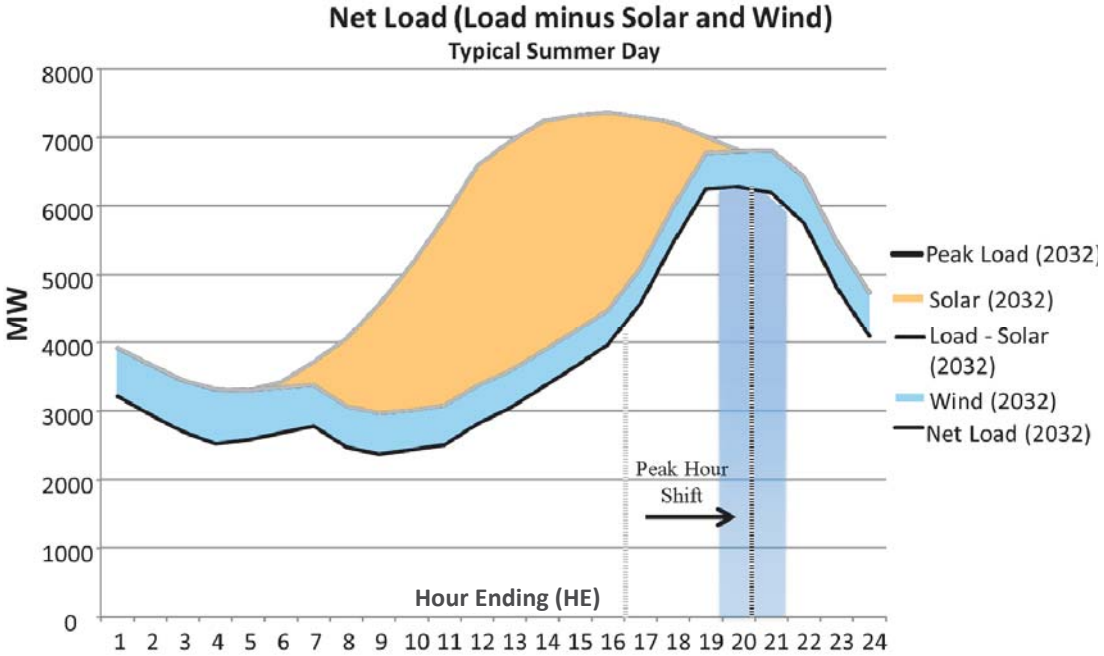
Dependable Capacity

Definition: *A generating plant's maximum output it can reliably produce with 95% certainty when required during the net peak hour (load minus variable energy resources)*

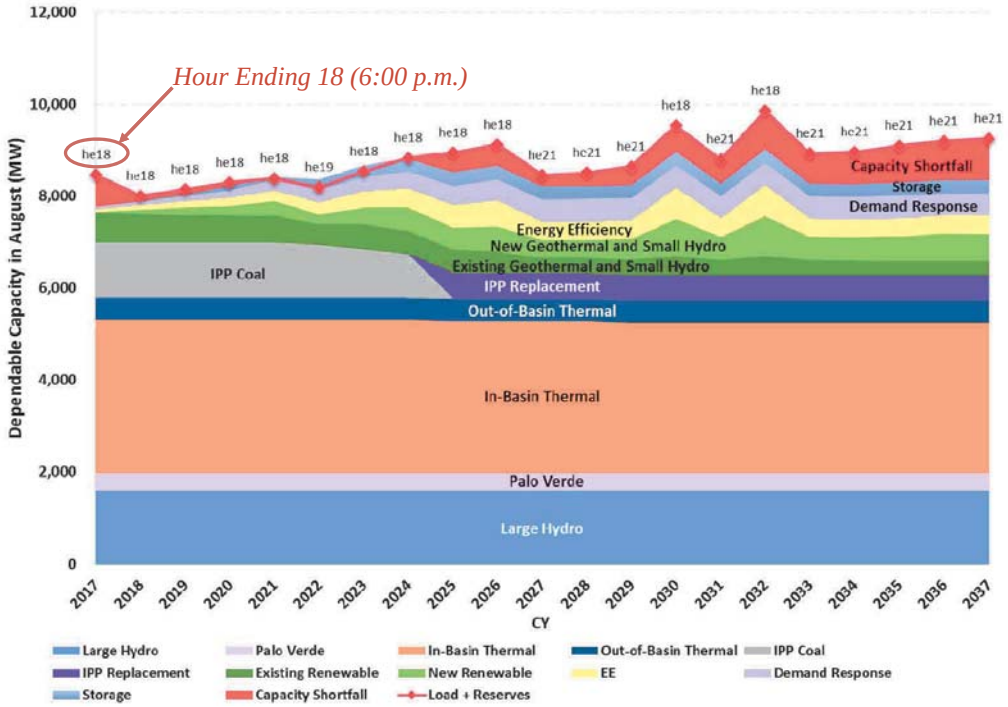


Dependable Capacity

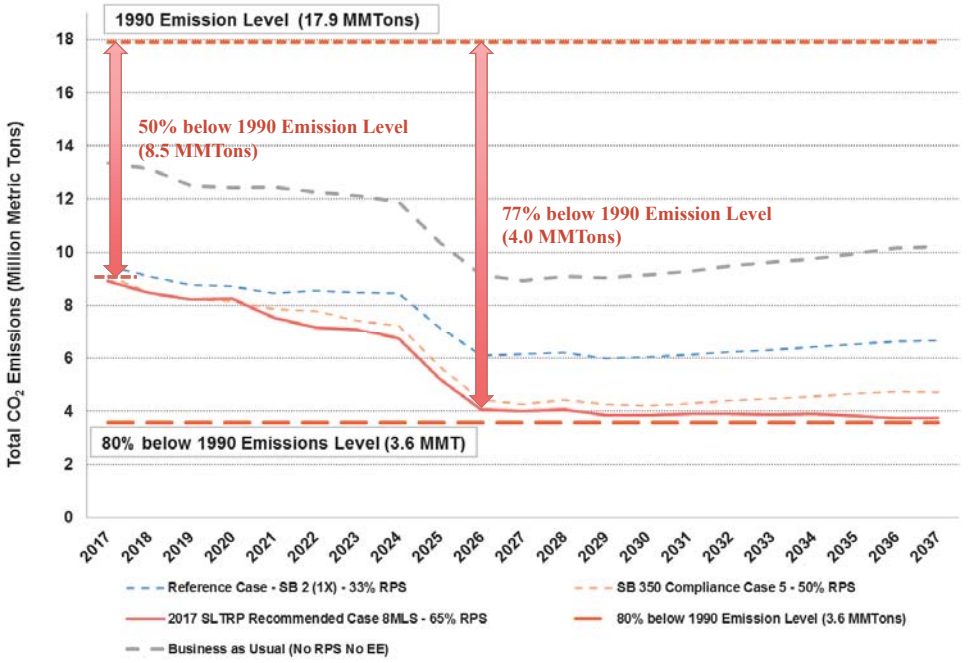
Definition: *A generating plant's maximum output it can reliably produce with 95% certainty when required during the net peak hour (load minus variable energy resources)*



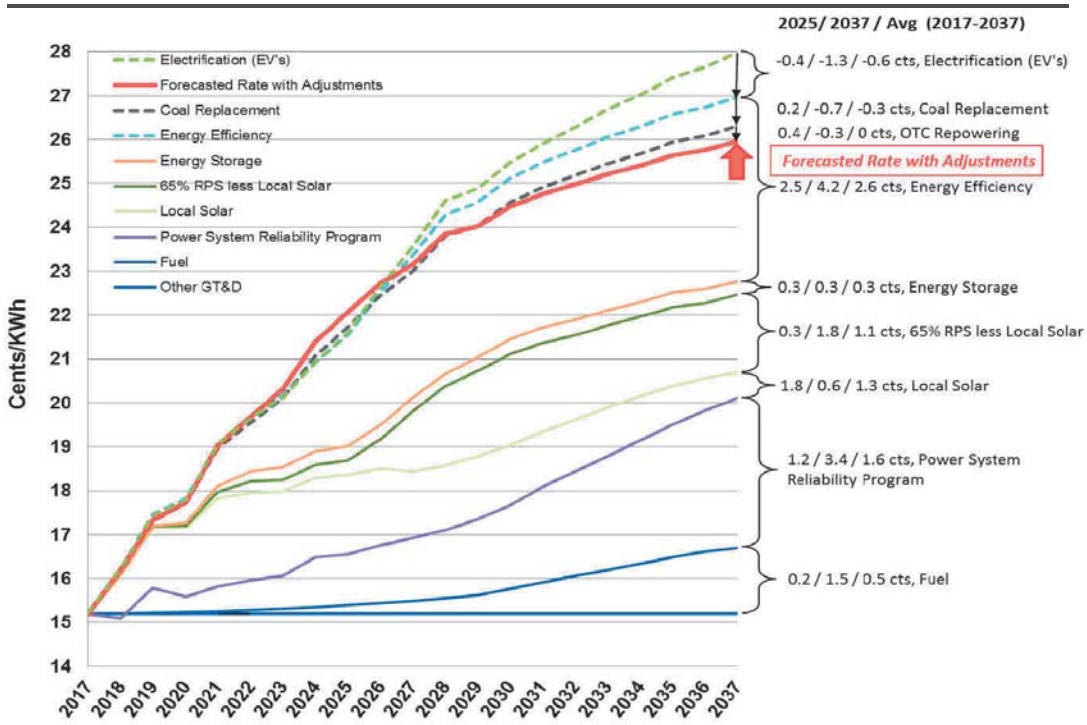
Dependable Capacity Profile



Greenhouse Gas Emissions Forecast



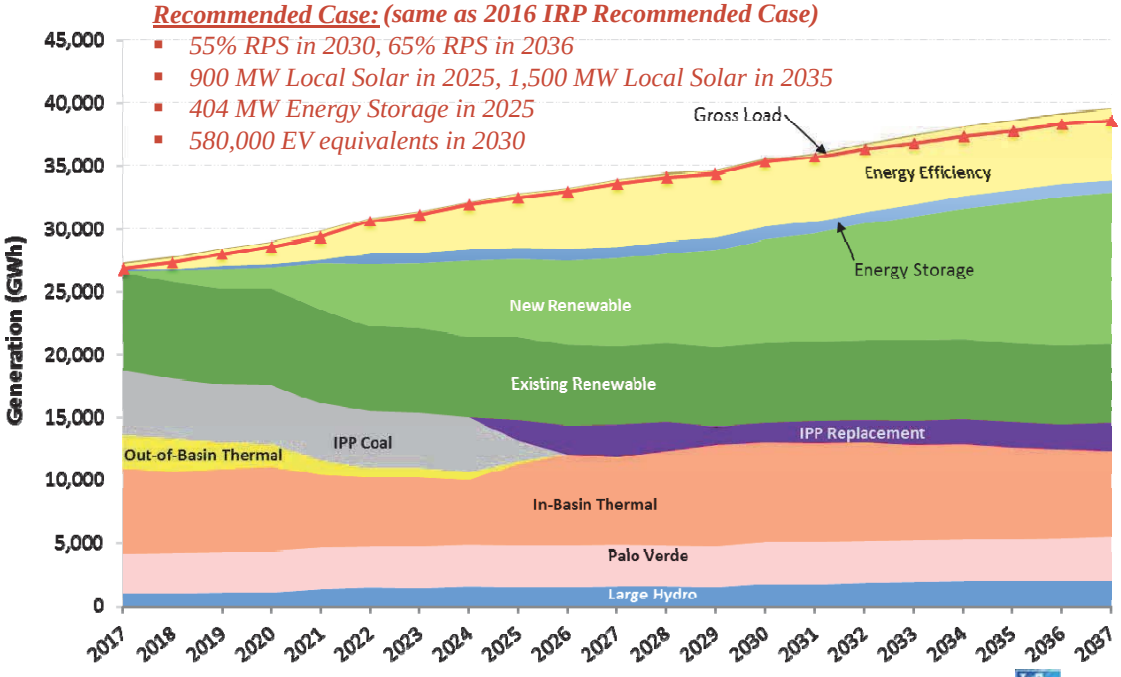
Rate Layer Diagram



2017 SLTRP Resource Timeline

***Recommended Case:* (same as 2016 IRP Recommended Case)**

- *55% RPS in 2030, 65% RPS in 2036*
- *900 MW Local Solar in 2025, 1,500 MW Local Solar in 2035*
- *404 MW Energy Storage in 2025*
- *580,000 EV equivalents in 2030*



For more information, visit:
www.ladwp.com/powerSLTRP

Questions?