Los Angeles 100% Renewable Energy Study

Advisory Group Meeting #15

March 3, 4, 11, 19, 25, and April 1, 2021

Meeting Summary[1]

Meeting Notes Compiled by Kearns & West

Location

Virtual Meeting

Table of Contents

Virtual Session #1

Wednesday, March 3, 2021, 10:00 a.m. to 12:00 p.m.

[1] This summary is provided as an overview of the meeting and is not meant as an official record or transcript of everything presented or discussed. The summary was prepared to the best of the ability of the note takers.

Virtual Session #1 Attendees

Advisory Group Members

Aaron Ordower, Council District 2
Allison Smith, Southern California Gas
Andrea Rojas, Sierra Club
Andy Shrader, Council District 5
Armando Flores, Valley Industry Commerce Association
Bruce Tsuchida, The Brattle Group
Camden Collins, Office of Public Accountability (Ratepayer Advocate)
Dan Kegel, Neighborhood Council Sustainability Alliance
Fred Pickel, Office of Public Accountability (Ratepayer Advocate)
Jack Humphreville, DWP Advocacy Committee
Jasmin Vargas, Food & Water Action
Jean-Claude Bertet, City of Los Angeles Attorney
Jim Caldwell, Center for Energy Efficiency and Renewable Technologies
Kendal Asuncion, Los Angeles Chamber of Commerce
Loraine Lundquist, California State University, Northridge
Luis Amezcua, Sierra Club
Rebecca Rasmussen, Office of Mayor Eric Garcetti
Tony Wilkinson, Neighborhood Council

LADWP Staff

Aaron Guthrey
Andrea Villarin
Ann Santilli
Ashkan Nassiri
Bang Phung
Carol Tucker
Cindy Parsons
Dawn Cotterell
Ellen Cheng
Eric Montag
Faranak Sarbaz
Gregory Huynh
James Barner
James Lin
James Talavera
Jason Rondou
Jay Lim
Jeremiah Valera
Julie Van Wagner
LeiLani Johnson Kowal

Lisa Yin
Louis Ting
Nicholas J. Matiasz
Paul Habib
Robert Dang
Scott Moon
Stephanie Spicer
Steve Ruiz
Steve Swift

Project Team

Garvin Heath, NREL
George Ban-Weiss, University of Southern California
Jaquelin Cochran, NREL
Paul Denholm, NREL
Ramin Faramarzi, NREL
Scott Cary, NREL
Alyson Scurlock, Kearns & West
Jack Hughes, Kearns & West
Jasmine King, Kearns & West
Joan Isaacson, Kearns & West
Vikram Ravi, NREL
Yun Li, University of Southern California

Observers

Bill Engels, Water and Power Associates
Lauren Harper, Los Angeles Cleantech Incubator
Liz Gill, California Energy Commission
Mayte Sanchez, Los Angeles Cleantech Incubator
Salem Afeworki, City of Costa Mesa

Call to Order and Agenda Overview

Joan Isaacson, LA100 Advisory Group meeting facilitator from Kearns & West, welcomed the virtual meeting attendees to the first of six virtual sessions for Meeting #15 of the Advisory Group for the City of Los Angeles 100% Renewable Energy Study (LA100). Isaacson said NREL had completed the modeling and analysis, and the Advisory Group would now hear the final study results. Advisory Group input received during the Meeting #15 sessions will help NREL fine-tune the approach for reporting and communicating the results to the broader public.

Welcome Remarks

Greg Huynh, LADWP Manager of the 100% Clean Energy Innovation Group, thanked the Advisory Group members for attending. He said he was excited to hear what NREL would present today as the end of the LA100

study nears. He expressed appreciation to Advisory Group members for their flexibility over the past year and thanked the NREL team for its dedication and the public outreach conducted in conjunction with Kearns & West. He noted that LADWP continues to focus on expanding renewable energy and energy-saving programs.

Jaquelin Cochran, NREL LA100 Principal Investigator, noted that the NREL team was excited to be presenting the results today. Draft chapters are currently available online for review, and each one has a summary at the beginning. Sections on methodology and assumptions are also included. The LA100 study website will be published in several weeks, so Advisory Group members should send any comments as soon as possible.

Cochran reviewed the meeting agenda, noting that today's session would focus on the final air quality and public health results. The next session on March 4 would cover environmental justice. Subsequent sessions will discuss the economic impact analysis and workforce analysis (March 11) and the key findings syntheses (March 18). Cochran noted that the LA Leads scenarios were renamed to Early & No Biofuels.

Impact of Selected LA100 Scenarios on Air Quality in Los Angeles

George Ban-Weiss, professor from the Viterbi School of Engineering at the University of Southern California, led the air quality analysis for the NREL team and presented on the final air quality results. The overarching question for the air quality analysis was: How could future scenarios of renewable energy adoption by LADWP change Los Angeles' air pollutant emissions and concentrations? The LA100 scenarios that were chosen aim to identify the sectors and source types affected by the LA100 scenarios that could contribute most to overall air pollutant reductions and subsequent health effects and their monetization. The focus pollutants for this analysis were ozone and fine particulate matter ($PM_{2.5}$), two regional air pollutants with National Ambient Air Quality Standards for which the city is out of compliance. Ozone is not directly emitted and is a secondary pollutant formed via chemical reactions of directly emitted "precursor" pollutants (e.g., nitrogen oxides (NOx)). $PM_{2.5}$ is both directly emitted and formed in the atmosphere via chemical reactions from precursor emissions (e.g., NOx).

Through evaluating impacts of the selected LA100 scenarios, the team aimed to identify the LA100-influenced sectors and source types that could contribute most to overall air pollutant changes in Los Angeles. They looked at how NOx, a precursor to ozone, and $PM_{2.5}$ emissions from buses, light-duty vehicles, commercial buildings, residential buildings, the Ports of Los Angeles and Long Beach, and LADWP-owned power plants in the South Coast Air Basin compared across the LA100 scenarios as measured against the 2012 Baseline scenario. The four LA100 study scenarios that NREL used for comparison were SB100 Moderate Electrification, SB100 High Electrification, Early & No Biofuels Moderate Electrification, and Early & No Biofuels High Electrification. The team chose these specific scenarios because they allowed identification of the sectors with greatest contributions to overall pollution changes.

Nitrogen Oxide Emissions

Ban-Weiss reported on results for changes in NOx emissions. The analysis shows that in the LA100 study scenarios, light-duty vehicles are the primary cause of emission reductions from the 2012 Baseline scenario to the selected future LA100 scenarios. These decreases in NOx emissions are due to both electrification from LA100 and policies outside of the LA100 study. Changes to LADWP-owned power plants located in the South Coast Air Basin are one of the smallest contributors to NOx emission changes, however, all scenarios showed

significant reduction in annual NOx emissions from LADWP-owned power plants located in the South Coast Air Basin as compared to the 2012 Baseline scenario. The assumptions underlying these results were that NOx emissions of hydrogen combustion turbines in 2045 (the Early & No Biofuels scenario) would comply with current South Coast Air Quality Management District regulations of a natural gas combustion turbine limit of 2.5 parts per million volume. The assumptions also include zero emissions of primary particulate matter, carbon monoxide, sulfur dioxides, and organic gas emissions from hydrogen combustion turbines.

Fine Particulate Matter Emissions and Concentrations

Ban-Weiss then presented the findings on changes in $PM_{2.5}$ emissions. Annual-average daily $PM_{2.5}$ concentrations also would decrease across Los Angeles between 2012 and 2045 in all four LA100 study scenarios used for this analysis. He compared the scenarios in year 2045 to tease out the contributions of the individual sectors. Reductions in citywide $PM_{2.5}$ concentrations in 2045 are predominantly due to increases in electrification levels. Differences between scenarios in 2045 regarding LADWP-owned power plants (fuel use and type) have a small impact at the regional scale in 2045. It is important to note that all scenarios have little combustion from LADWP-owned power plants in 2045.

Ozone Concentrations

Ban-Weiss next explained the unique way ozone concentrations would change in response to the LA100 scenarios. All selected LA100 scenarios show increases in summertime ozone concentrations in 2045 for most parts of Los Angeles as compared to the 2012 Baseline scenario, despite NOx emission reductions. He noted that this can be thought of as temporary "growing pains". Once NOx emissions are sufficiently low, further emissions decreases will lead to ozone reduction. These ozone increases could be avoided by having commensurate reductions in emissions of volatile organic compounds (VOCs). The response of ozone to emissions decreases is highly dependent on the scenarios investigated and the baseline used. Comparing among the 2045 scenarios shows that changes in citywide ozone concentrations are predominantly due to increases in electrification levels. Differences between scenarios in 2045 regarding LADWP-owned power plants (fuel use and type) does not have a noticeable impact.

Conclusions

Ban-Weiss then summarized the conclusions for the final results for air quality. Relative to the 2012 Baseline scenario, the evaluated LA100 scenarios reduce annual NOx and $PM_{2.5}$ emissions from LA100-influenced sectors in 2045. Reductions in air pollutant emissions lead to simulated reductions in $PM_{2.5}$ concentrations across Los Angeles in 2045. These same emission decreases lead to simulated increases in ozone concentrations for most parts of Los Angeles. Citywide average ozone concentration increases by five percent from the 2012 Baseline scenario to the SB100 Moderate Electrification scenario and the Early & No Biofuels High Electrification scenario.

Changes in air pollutant emissions and concentrations from the LA100 scenarios as compared to the 2012 Baseline scenario are predominantly from increases in electrification for light-duty vehicles. Electrification of the ports and building appliances also contribute. By 2045, differences in emissions between LADWP-owned power plants using natural gas versus hydrogen had a very small impact on city-scale air pollution since little of either would be used. This conclusion is driven in part by the fact that fuel consumption in 2045 for both the

SB100 scenario (natural gas) and the Early & No Biofuels scenarios (hydrogen) is very low (as predicted by power sector modeling). Reductions in $PM_{2.5}$ concentrations induced by the LA100 study are beneficial for the city, such as in helping to meet National Ambient Air Quality Standards. Increases in ozone concentrations despite decreases in NOx emissions can be thought of as temporary "growing pains" that are necessary to ultimately reduce ozone based on further reductions in NOx and VOC emissions in Los Angeles.

Caveats

Ban-Weiss spoke of important caveats to these final results. The air quality results were highly dependent on the scenario definitions. It is also important to note that including additional emissions reduction policies beyond what was covered in the LA100 study, such as policies targeting medium and heavy-duty trucks, will lead to greater emissions reductions. Some relevant policies already exist, and the LA100 study can inform future policy design to further air pollution co-improvements with reduction of greenhouse gas emissions. The analysis focused on changes to city-scale air quality for two federally regulated regional pollutants; however, it is not an exhaustive environmental hazards analysis.

Major Themes from Advisory Group Member Questions and Discussion

- If liquid air energy storage is possible, it could be used to store the oxygen from electrolysis, and then when burning the hydrogen, the stored oxygen could be used to both generate energy by expansion and burn the hydrogen without emitting NOx.
- Does vehicle electrification reduce VOC emissions and does the modeling show those decreasing in 2045?
- It would be helpful to see the air quality maps expanded from Los Angeles to a regional scale, since emissions move beyond the city.
- Will there be ozone reductions after the year 2045?
- Would ozone increase regardless of whether Los Angeles transitioned to 100% renewable energy?
- How will the Port of Los Angeles reduce emissions by 2045?
- Does NREL have specific policy suggestions for air quality improvements?
- These reductions might be significantly underestimated since the LA100 study does not include heavy-duty vehicle emissions as LA100-influenced sectors. Is NREL going to include some qualitative analysis on this since the data is not available for modeling?
- The emissions change maps seem to suggest that the LA100 study will drive reductions, but it seems that the assumed outside actions will also influence emissions reductions. Many people would not read the note about assumptions below the map and would assume that the LA100 scenarios are driving that change.
- NREL should provide maps that only show emission reductions from the elimination of gas-fired power for comparison.
- How do these air quality results compare to the National Ambient Air Quality Standards?

Impact of LA100 Scenarios on Public Health

Garvin Heath, Senior Scientist at NREL, presented on the impact of the LA100 scenarios on public health. Specifically, the analysis was meant to answer the following question: How could changes in ozone and $PM_{2.5}$ concentrations improve negative health consequences from air pollution exposure within the City of Los

Angeles? This is especially important since the South Coast Air Basin is out of compliance with the National Ambient Air Quality Standards for ozone and $PM_{2.5}$.

Avoided Deaths and Annual Morbidity Benefits

Heath explained that for this analysis, both mortality and morbidity health effects were examined. The health effects assigned the greatest monetary damages are premature mortality from long-term exposure to $PM_{2.5}$ primarily and ozone secondarily. This is because collectively the society is willing to pay more for avoiding the risk of a death and thus death is valued more than other effects. Important, but less severe effects include "morbidity" effects, which are health effects not including death, such as asthma, heart attacks, and respiratory diseases.

NREL used the Benefit Mapping and Analysis Program – Community Edition (BenMAP), a U.S. EPA developed software, to estimate the health impacts and economic valuation from exposure changes to $PM_{2.5}$ and ozone pollution. Using BenMAP, NREL translated the changes in air quality concentration to health impacts. Net premature deaths from exposure to $PM_{2.5}$ and ozone decreased in all future LA100 scenarios. The largest number of avoided premature deaths are associated with increased electrification in end-use sectors (transportation, residential and commercial buildings, and ports) as compared to changes to the power sector.

Annual cardiovascular-related hospital admissions in the city in 2045 decrease in all scenarios compared. However, since ozone concentration increases due to the LA100 study scenarios (despite a decrease in NOx emissions), asthma cases increase in the Early & No Biofuels High Electrification scenario and the SB100 Moderate Electrification scenario compared to the 2012 Baseline scenario. The largest benefits to annual cardiovascular-related hospital admissions are associated with high electrification in end-use sectors as compared to changes associated with the power sector.

In terms of estimates of annual avoided morbidity (non-death) outcomes in 2045, high electrification levels are associated with better outcomes as compared to those at moderate electrification levels. Changes to LADWP-owned power plants (fuel use and type) in 2045 do not change results significantly. Ultimately, transitioning the City of Los Angeles to 100% renewable energy in the power sector and associated electrification of end-use sectors could yield nearly $1 billion, and up to $1.4 billion, of avoided health impacts in 2045 alone as compared to current air pollution. More than 90% of this dollar value comes from avoided deaths.

Conclusions

Heath offered some conclusions from what NREL learned about the impact of the LA100 scenarios on public health. All future scenarios provide health benefits to Los Angeles residents, but the level of benefit varies. In terms of power plant eligibility, the difference in air quality between the SB100 scenario and the Early & No Biofuels scenario at similar load levels in 2045 did not seem to provide significant health benefits. For instance, the difference would avoid only one premature mortality when summed over the city. The largest health benefits are driven by high electrification in end uses. For example, the Early & No Biofuels High Electrification scenario saves 150 lives in 2045 as compared to the 2012 Baseline scenario and saves 53 lives as compared to the SB100 Moderate Electrification scenario in 2045 alone. The greatest differences in annual monetized value of the health benefits could reach nearly $500 million when comparing future scenarios in 2045 (between high

and moderate electrification levels), and up to $1.4 billion compared to the 2012 Baseline scenario (Early & No Biofuels High Electrification scenario) for the year 2045 alone.

Caveats

Heath concluded the presentation with notes on important caveats. The LA100 air quality modeling focused on regional air pollutants and CalEnviroScreen's health impacts plus premature deaths. This implies several limitations and a likely underestimation of benefits since near-source impacts like power plants and major roads are not modeled at a neighborhood level but are modeled at a 2 km × 2 km air quality grid level. Other health effects (like chronic bronchitis) are not considered. In addition, because these public health changes are only modeled for a single year, cumulative benefits from various LA100 study scenarios are likely to be much higher. Potential additional benefits are likely to occur from emission reductions in other sectors not considered here, such as a shift from heavy-duty diesel trucks to electric or zero-emission vehicles.

Heath noted that power system capital costs are cumulative and health benefits are annual and therefore they cannot be directly compared in a cost-benefit analysis. Also, potential changes to climate were not considered. This ensured NREL could reduce the number of variable parameters to isolate changes due to the LA100 study scenarios. Climate change could lead to multiple effects such as increased evaporative emissions or changing atmospheric reaction rates. Without further research, it is impossible to say on net what effect a changing climate would have on the LA100 study results.

Major Themes from Advisory Group Member Questions and Discussion

- Why is NREL only examining avoided health impacts in the year 2045? Carbon dioxide emissions have long-term effects and what matters is not how much is emitted in any given year but the cumulative amount released into the atmosphere over the years.
- Electrification is key to decarbonizing other sectors in addition to the grid. Without decarbonizing the grid, fossil fuel use to serve other sectors will increase.
- The LA100 study might not include greenhouse gas emissions; could NOx be a proxy for greenhouse gas reductions?
- There seems to be a tradeoff between achieving the last ten percent of renewable energy generation and the ability to achieve greater level of electrification.
- As part of the caveats, NREL should consider indicating that the LA100 study does not look at the localized benefits to reducing emissions at in-basin gas plants like the Valley Generating Station. This is important and policy decisions like air monitoring will help better understand local benefits.
- The health benefits, like emission, are mostly affected by factors external to the LA100 study, but the implication is that only eliminating fossil fuel power generation saves lives.

Wrap-up and Next Steps

In wrapping up the meeting, Isaacson reminded Advisory Group members that the next session would take place the following day on Thursday, March 4, 2021.

Virtual Session #2

Thursday, March 4, 2021, 10:00 a.m. to 12:00 p.m.

Virtual Session #2 Attendees

Advisory Group Members

Allison Smith, Southern California Gas
Andrea Rojas, Sierra Club
Armando Flores, Valley Industry Commerce Association
Bonny Bentzin, University of California, Los Angeles
Bruce Tsuchida, The Brattle Group
Camden Collins, Office of Public Accountability (Ratepayer Advocate)
Dan Kegel, Neighborhood Council Sustainability Alliance
Duane Muller, University of California, Los Angeles
Fred Pickel, Office of Public Accountability (Ratepayer Advocate)
Jasmin Vargas, Food & Water Action
Jean-Claude Bertet, City of Los Angeles Attorney
Jim Caldwell, Center for Energy Efficiency and Renewable Technologies
Kendal Asuncion, Los Angeles Chamber of Commerce
Liz Anthony Gill, California Energy Commission
Matt Hale, Council District 2
Nurit Katz, University of California, Los Angeles
Rebecca Rasmussen, Office of Mayor Eric Garcetti
Tony Wilkinson, Neighborhood Council

LADWP Staff

Andrea Villarin
Ann Santilli
Armen Saiyan
Ashkan Nassiri
Bang Phung
Carol Tucker
Cindy Parsons
David Rahimian
Dawn Cotterell
Faranak Sarbaz
James Barner
James Lin
Jay Lim
Jeremiah Valera
Julie Van Wagner

LeiLani Johnson Kowal
Lisa Yin
Louis Ting
Luis Martinez
Nicholas J. Matiasz
Paul Schultz
Scott Moon
Stephanie Spicer
Steve Ruiz
Steve Swift

Project Team

Doug Arent, NREL
Dylan Hettinger, NREL
Garvin Heath, NREL
Jaquelin Cochran, NREL
Paul Denholm, NREL
Ramin Faramarzi, NREL
Scott Haase, NREL
Vikram Ravi, NREL
Alyson Scurlock, Kearns & West
Jasmine King, Kearns & West
Joan Isaacson, Kearns & West
Emma Tome, Contractor

Observers

Bill Engels, Water and Power Associates
Jacquelyn Badejo, Watts Clean Air & Energy Committee
Kate Pynoos, Council District 11
Lauren Harper, Los Angeles Cleantech Incubator
Mayte Sanchez, Los Angeles Cleantech Incubator
Storm Hopkins, Watts Clean Air & Energy Committee

Call to Order and Agenda Overview

Joan Isaacson, LA100 Advisory Group meeting facilitator from Kearns & West, welcomed the virtual meeting attendees. She explained that this was the second of six virtual sessions for Meeting #15 of the Advisory Group for the City of Los Angeles 100% Renewable Energy Study (LA100). This session provided an update on the final results for the environmental justice analysis.

Welcome Remarks

Jaquelin Cochran, NREL LA100 Principal Investigator, welcomed everyone and reviewed the meeting agenda, noting that today's session would include updates on the environmental justice results and build on the previous

session focused on air quality and public health. Draft Chapter 10 addresses the environmental justice analysis and is available for Advisory Group review.

Environmental Justice: Final Results

Cochran gave an overview of the environmental justice results presentation, including procedural justice, distributional justice (such as customer rooftop solar, air quality, and public health), and actions that could prioritize benefits to environmental justice neighborhoods. She noted that environmental justice is a core component of the LA100 study and is one of the components identified in the August 2017 City Council motion that directs the LA100 study. The motions called for CalEnviroScreen to be incorporated into each research area and used as context for all LA100 analyses, and for environmental justice neighborhoods to be prioritized as the first immediate beneficiaries of localized air quality improvements and reduction in greenhouse gas emissions.

Cochran presented definitions for environmental justice, clean energy justice, procedural justice, distributional justice, and recognition justice. Environmental justice is defined as the fair treatment and meaningful involvement of people of all races, cultures, and incomes with respect to the development, adoption, implementation, and enforcement of environmental laws, regulations, and policies. Clean energy justice focuses on the inequities in the energy system that may persist or worsen after sustainable energy becomes a driving goal. Cochran noted that procedural justice, distributional justice, and recognition justice are all tenets of energy justice. Procedural justice is the ability of people to be involved in decision-making procedures around energy system infrastructures and technologies, while distributional justice refers to the distribution of benefits and burdens across populations. Lastly, recognition justice is understanding the historical and present basis for social inequalities and the acknowledgment or dismissal of marginalized and deprived communities in relation to energy systems. Procedural justice and distributional justice are addressed in today's presentation and in Chapter 10 of the report, while recognition justice is only acknowledged and not directly addressed.

Procedural Justice

Cochran explained why procedural justice is included in the LA100 study. Justice and equity are often cited as objectives but have a wide range of definitions. Procedural justice is included as an acknowledgment that how justice and equity are defined, how goals and decisions are made, how community engagement is organized, and who is represented can have a profound impact on outcomes. The LA100 study has played a role in that process so far. Cochran reviewed an example definition for procedural justice—the justice as a parity of participation framework. Parity of participation is defined as social arrangements that permit all (adult) members of society to interact with one another as peers. This framework recognizes the economic, political, and cultural dimensions of and potential obstacles to participation and includes recognition (who is included and heard), representation (how it is decided who gets what), and redistribution (who gets what). Cochran noted that these issues are complex and although not addressed to this extent in the LA100 study, a lot of information exists on this topic.

Cochran discussed procedural justice during the LA100 study beginning with the Advisory Group. First, the role of the Advisory Group has been to provide input and feedback on the LA100 study. Advisory Group members have been involved in critical actions related to environmental justice including supporting the development of scenarios and definitions of technology eligibility, expressing desired outcomes for the study (which helped guide NREL's analysis), and expanding the scope of evaluation. Advisory Group members have also expressed frustrations about the lack of prioritization of environmental justice including insufficient representation of

environmental justice communities on the Advisory Group, scenarios not representing goals for environmental justice, and the need for expanded community outreach.

Cochran next reviewed NREL's role in developing the LA100 analyses. NREL has provided objective information based on the scenarios and scope developed with LADWP and the Advisory Group. Critical actions related to environmental justice that NREL has completed include: analysis of a broad but not comprehensive range of scenarios, supplementing of core scenarios with sensitivities to capture a wider range of scenario ideas, decision-making early on about data and analytical approaches that affect what questions can be addressed regarding environmental justice, outreach with environmental justice groups and the community to provide information and receive feedback, creation of materials designed to be accessible to different audiences, and adjustment of its approach and analyses to reflect Advisory Group and community discussions.

Cochran provided an overview of four public feedback themes that have emerged during the LA100 study and NREL's actions in response to feedback. The first theme revolves around vision and how the LA100 study should be or should have been framed. In response to public feedback, NREL has updated its approach for modeling spinning reserves to reduce local health impacts and has encouraged discussions of vision during community outreach meetings for documentation for LADWP. The second theme involved the decision-making process and included feedback on having broad, diverse, and robust engagement to facilitate deeper understanding of the LA100 study. In response, NREL has evaluated scenario blends and has identified sources of risk/greatest uncertainty and possible alternatives to maintain optionality. The third theme was community engagement and included feedback suggestions for outreach. In response, NREL has revised communications materials to incorporate suggestions and has requested timely, community outreach meetings to support procedural justice. Lastly, the outcomes theme included feedback about affordable electricity rates, low-income efficiency programs, and distribution grid upgrades, among many others. In response, NREL has documented the outcomes requested by the public in Chapter 10, section 3.2 of its report.

Cochran reviewed the three procedural justice efforts that will occur after the LA100 study has been completed: Strategic Long Term Planning (SLTRP) decisions on investments, City and LADWP policy and program development, and implementation. After the LA100 study is complete, LADWP and the City of Los Angeles will determine how to continue to engage the public in choosing among the energy transition pathways and will design programs and policies to meet community needs. Cochran provided examples of potential approaches to community participation such as through educative forums (community meetings and presentations), a participatory advisory panel (Advisory Group), participatory problem-solving collaborations (community partnership grant programs, neighborhood councils), and participatory democratic governance. She noted that there are many ways to create a thoughtful approach for conducting community engagement after the LA100 study.

Major Themes from Advisory Group Member Questions and Discussion

- Concern about environmental impacts of batteries was expressed.
- How are spinning power and reserves incorporated into the scenarios?
- Community assemblies were not listed as a way to receive community feedback. The Climate Emergency Mobilization Office is considering community assemblies as a parallel path to the neighborhood councils.

- Neighborhood councils are only a proxy for the general public. It is important for the community to have access to resources to make informed decisions. Education is also an important component for providing an understanding of the issues to those who have not participated in the discussions.
- We need to provide information to the public but providing too much information up front may deter people from engaging. Polls could be offered on social media that include an option to learn more or provide more feedback when a person responds. There are also communities that will still be facing impacts of Covid-19 and may not be able to attend virtual meetings due to lack of Wi-Fi and electronic devices. Tabling outside of a grocery store in a lower-bandwidth community should be considered during outreach.
- Are there dates for the next round of community outreach?
- People will want answers to, "What will it cost and what will I get?" and “Will this slow the climate catastrophe?”
- Will there be contracts for grassroots organizations to participate in the dissemination of information? Education is important and often times these organizations can connect more effectively to the population.
- Socially-distanced outdoor meetings may be allowed if we wait a few months —they should be considered for outreach.
- The LA100 study should not be delayed any further. LADWP needs to step up and make sure they have a robust SLTRP process in partnership with community organizations.

Distributional Justice – Customer Rooftop Solar

Cochran next addressed distributional justice focused on customer rooftop solar. She first displayed maps for the local solar technical potential and local solar customer rooftop generation potential in Disadvantaged Community (DAC) census tracts identified by CalEnviroScreen. Cochran next presented the LA100 scenario outcomes regarding customer rooftop solar adoption. In 2020, 35% of customer solar adoption takes place in DAC census tracts. In 2045, customer rooftop solar adoption experiences growth in all scenarios. In summary, modeling in the LA100 study found strong potential for growth across all communities. The physical infrastructure, and economic value could support large growth by 2045. However, the LA100 modeling does not capture real-world experiences and barriers to adoption. She noted that differentiation between customer income levels, homeownership, access to financing, timing of electricity demand, access to competitive bids, and required coupling with other upgrades (e.g., roof, home electric system) does not currently exist. Low-income retail rates are also not included, and therefore economic potential is overestimated.

Cochran noted the importance of policy design after the LA100 study is complete. Policy actions to prioritize environmental justice neighborhoods could focus on lowering barriers to realizing economic benefits. She mentioned that significant research exists on this topic. Cochran also discussed the importance of monitoring and tracking. It will be important to establish stakeholder representation in monitoring and tracking program success, metrics for success, and a process to course-correct.

Cochran concluded by discussing examples of improvements that could be made to NREL’s modeling approach to reduce research gaps that contribute to clean energy injustice. First, city averages could be shifted to neighborhood averages in NREL’s buildings modeling. Currently, household demographics (average size of household, owner vs. renter, income) and the age and types of buildings, appliances, and vehicles and how their

usage might vary are not captured in the modeling. Second, NREL's modeling could better characterize the benefits that especially impact lower-income neighborhoods. These benefits include the ability to maintain power supply through outages and extreme weather events and improved indoor air quality, particularly with more information on degradation of existing equipment. Lastly, policy designs that especially affect lower-income neighborhoods could be improved in NREL's modeling. These could include impacts of the prioritization of benefits on potential for gentrification and complementary city-level policies to address the potential implications for regressive cross-subsidies and stranded costs for lagging adopters (e.g., electrification, rooftop solar).

Major Themes from Advisory Group Member Questions and Discussion

- It is unreasonable to use public capital to fund low-payoff local solar when it would result in higher overall rates for low-income communities. Rooftop solar should be placed in areas where people can afford it. More affluent people will install rooftop solar and so rates in lower-income communities will be lower.
- Many rooftops in DAC census tracts are in poor condition. Ground solar is also effective.
- LADWP should include a neighborhood bill impact analysis for its coming proposal(s).
- Electrification of heating and cooking with its high payoff in emissions means that electricity needs to be cheaper to replace low-cost natural gas. This is why hesitancy exists in paying for the "last 10%."

Distributional Justice – Air Quality and Health

Garvin Heath, NREL Senior Scientist, presented about distributional justice focused on impacts to air quality and health. Heath began by reviewing the methods, which included analyzing air quality and related public health impacts in relation to DAC census tracts designated by the CalEnviroScreen tool. Because half of the census tracts in the City of Los Angeles are designated as DAC, there are about 600 data points each for the DAC and non-DAC groups. Heath said that NREL's analysis could not recreate or adjust CalEnviroScreen scores like originally planned due to methodological incommensurability between CalEnviroScreen and NREL's air quality-health impacts modeling (for instance, the former is retrospective while the latter is prospective). Heath next discussed the independent t-test that NREL performed to determine if there was a statistically significant difference between the values of each health endpoint and each pollutant concentration in DAC and non-DAC census tracts. Statistically significant difference in the LA100 study is defined as a greater than 95% likelihood that the result seen is not due to random chance. Lastly, Heath reminded that concentrations are reported in absolute values, but should be understood as being designed in a comparative context to other scenarios, and not as a prediction of concentrations in the future. The Benefit Mapping and Analysis Program – Community Edition (BenMAP) assesses health impacts resulting from changes in pollutant concentration between a scenario and a control scenario. Thus, the health endpoints reported estimate a change in the incidence of the selected health endpoints and are not absolute incidences.

Heath reported the results for fine particulate matter ($PM_{2.5}$) concentrations in DAC and non-DAC census tracts. Lower $PM_{2.5}$ concentrations are achieved in all evaluated LA100 scenarios compared to the 2012 Baseline scenario. High electrification levels result in lower $PM_{2.5}$ concentration for both DAC and non-DAC census tracts when compared to moderate electrification levels. In the 2012 Baseline scenario and all future scenarios, DAC census tracts are exposed to higher concentrations of $PM_{2.5}$ compared to non-DAC census tracts. When

comparing the change in $PM_{2.5}$ distributions in 2045 relative to 2012, the average decrease is larger in DAC census tracts compared to non-DAC census tracts in all evaluated future scenarios, although average DAC census tract concentrations are higher initially.

Heath discussed the spatial distribution of $PM_{2.5}$. $PM_{2.5}$ concentrations decrease in all LA100 scenarios in 2045 across the city with the largest decreases being centered in downtown Los Angeles, the Port of Los Angeles, and some northern tracts, where the majority of census tracts are designated as DAC. Spatial distribution remains the same across both the 2012 Baseline scenario and all future scenarios, with $PM_{2.5}$ concentrations being highest in tracts in South and Central Los Angeles in all scenarios. All scenarios show a statistically significant difference between DAC and non-DAC census tracts and the concentration in DAC census tracts is higher than in non-DAC census tracts in all scenarios.

Heath next recapped the results for ozone. In the LA100 study, ozone concentrations increase despite NOx emissions reductions because the response of ozone to emissions decreases is highly dependent on the scenarios investigated and the baseline used. In all evaluated scenarios, DAC census tracts have lower mean concentrations of summertime ozone compared to non-DAC census tracts. The concentration of ozone increases citywide by 10–12% in all evaluated LA100 scenarios in 2045. Ozone concentration in DAC census tracts increases slightly more compared to that for non-DAC census tracts.

Heath discussed the change in spatial distribution of ozone for DAC and non-DAC census tracts. Higher ozone concentrations are found in the northern part of Los Angeles due to geography, meteorology, and chemistry. Changes from the 2012 Baseline scenario to future scenarios are relatively small but do show an increase in all census tracts across the city with the largest increases centered on downtown Los Angeles. DAC census tracts see the greatest increases in ozone concentration in all evaluated LA100 scenarios in 2045.

Heath then presented the results for mortality. All evaluated LA100 scenarios indicate improvements in premature mortality in 2045 over the 2012 Baseline scenario. Changes in mortality from the 2012 Baseline scenario to future scenarios are spatially diverse, but differences average out over the city and impacts are evenly distributed between DAC and non-DAC census tracts. Comparisons of the 2012 Baseline scenario to the Early & No Biofuels High Electrification scenario show the largest decreases in mortality. All LA100 scenarios indicate improvements in premature mortality with the end-use electrification changes showing the greatest improvement for both DAC and non-DAC census tracts. Changes in premature mortality are experienced approximately equally between DAC and non-DAC census tracts except in the SB100 Moderate Electrification scenario versus the Early & No Biofuels Moderate Electrification scenario where the power sector change is isolated. Regarding the estimates of citywide annual avoided mortality in 2045, both DAC and non-DAC census tracts benefit from reduced deaths owing to air pollution. Compared to the 2012 Baseline scenario, there is a slightly greater benefit to non-DAC census tracts in 2045, although the benefits are nearly equal with DAC census tracts among the 2045 scenarios.

Heath discussed the distribution effects on morbidity related to emergency room visits for asthma. Changes in the incidence of asthma-caused emergency room visits are statistically significantly different between the DAC and non-DAC census tracts for both the 2012 Baseline scenario to the LA100 scenario comparisons. DAC census tracts experience greater increases between the 2012 Baseline scenario and future scenarios. Comparison of the 2012 Baseline scenario versus the Early & No Biofuels High Electrification scenario shows an overall

increase in emergency room visits among DAC census tracts compared to non-DAC census tracts. For future comparisons, changes in the incidence of asthma-caused emergency room visits are statistically significantly different between the DAC and non-DAC census tracts for most scenario comparisons, with DAC census tracts experiencing greater reductions. In addition, the comparisons isolating end-use electrification changes have much larger differences, while the comparisons isolating power sector changes show smaller differences. Regarding the estimates of annual avoided asthma-related emergency room visits in 2045, the LA100 scenarios show an increase in the incidence of asthma compared to the 2012 Baseline scenario because of increased ozone concentrations. However, in the LA100 scenarios, there is slightly larger improvement for DAC census tracts with high electrification compared to moderate electrification levels.

Heath discussed estimates of annual avoided heart attacks in 2045, which is an example of one health effect driven by $PM_{2.5}$ concentration changes. He noted that heart attack reductions accrue approximately equally between DAC and non-DAC census tracts and are largely driven by differences in electrification projections. Lastly, Heath provided a qualitative assessment of environmental justice related changes at the LADWP thermal generation sites under the LA100 scenarios in 2045 and environmental justice related changes resulting from other sectors under the LA100 scenarios.

Conclusions

To wrap up his presentation, Heath summarized the air quality and public health-related environmental justice conclusions. First, all future scenarios provide health benefits to Los Angeles residents citywide on average, but the level of benefit varies. Second, patterns of ozone and $PM_{2.5}$ concentrations in DAC versus non-DAC census tracts remain consistent from the 2012 Baseline scenario through all future scenarios. Ozone increases in all future scenarios, with slightly higher increases in DAC census tracts, although the concentration in non-DAC census tracts remains higher than the concentration in DAC census tracts. $PM_{2.5}$ decreases in all future scenarios, with the largest decreases in DAC census tracts in central Los Angeles and areas surrounding the Port of Los Angeles. $PM_{2.5}$ concentration in DAC census tracts is higher than non-DAC census tracts. Third, all comparisons between the future LA100 scenarios yield higher health benefits for DAC census tracts compared to non-DAC census tracts for all of the endpoints investigated. Often the 95% confidence level was not reached, however, meaning the difference might have occurred by chance. Lastly, the differences between scenarios are relatively smaller than the changes seen from the 2012 Baseline scenario to 2045. Among evaluated LA100 scenarios in 2045, changes are highest between electrification levels and are negligible for changes to the power sector (holding the other constant).

Caveats

Heath summarized the caveats provided earlier in the presentation. First, this study underestimates the potential health benefits of LA100 and its monetary benefits, especially for nearby residents and neighborhoods. There are many other pollutants and environmental health endpoints affected by them that are not modeled in this study. Yet qualitatively, NREL's analysis suggests that there are potentially significant additional benefits to citizen health and quality of life to neighborhoods local to LADWP facilities, the Ports of Los Angeles and Long Beach, major roadways, and inside of homes where energy efficiency and electric appliance upgrades are implemented. Second, the health modeling documented in Chapter 9 of the report indicates that the city as a whole benefits from emission reduction measures. Third, NREL's air quality-health impacts modeling could not follow the approach used in CalEnviroScreen since CalEnviroScreen is a retrospective tool based on sparsely

measured data whereas LA100 looks toward the future. With the addition of premature mortality, the environmental health endpoints modeled in the LA100 study align with those used in CalEnviroScreen, even if slightly different metrics are used than those defined in CalEnviroScreen. Lastly, NREL's estimates of concentrations are not predictions of future concentrations in an absolute sense and should only be used in the context of comparing results between the evaluated LA100 scenarios.

Major Themes from Advisory Group Member Questions and Discussion

- This appears to be similar to former Commissioner Funderburke's "Equity Metrics" for LADWP operations where some results turn out to be not sufficiently different for guiding policy. The differences before and after for some are trivial.
- Will the report include a note about the volatile organic compound reductions needed to follow Path B?
- The asthma reduction appears to not be statistically significant [LA100 results showed they were].
- The caveats slide should also point out that excluding heavy-duty vehicles from modeling leads to significant underestimation of health benefits and should be added qualitatively.
- A simple narrative that ties together the electrification, health benefits, and renewable increases accurately and without bias is going to be important.
- The assumption that all docked ships are cold ironing with their engines shut down is not realistic. Some consideration needs to be given to using this "generating capacity" as a major fraction of the hydrogen combustion turbines during the rare contingency events by fueling them with existing stored biodiesel, for example.
- Regarding the earlier comment about renters and multifamily buildings not being included, there is a big oversight in considering impacts on energy efficiency. The City of Los Angeles is 64–67% renters, and the study is missing a huge part where environmental justice can be increased to create a more resilient and reliable grid that could cost less overall. Accessible energy efficiency programs and solar programs for renters should be prioritized.
- LADWP and the city should consider an incentive program for energy efficiency retrofits that benefits renters with their initial proposal. It is important to include benefits to renters and at the very least, highlight programs that are getting started or already exist.

Actions That Could Help Prioritize Benefits

To conclude the presentation, Cochran presented example actions that could support the prioritization of environmental justice. First, participation in decision-making could be improved. Second, data collection for energy infrastructure could be improved to make better projections for adoption of energy efficiency, electrification, demand response, and solar, and to design incentives or regulations to improve target projections to policy goals. There could be a more comprehensive representation of benefits and improved metrics for forward-looking modeling for energy infrastructure. Third, programs specific to hard-to-fill and other high-quality jobs could be expanded. Lastly, in regard to health, analysis of interaction of costs of decarbonization, pace of electrification, and rate design could determine pacing of electricity demand/supply change that optimizes health benefits. An analysis of positive and negative neighborhood-level impacts could help to establish expectations and revise protocols as needed.

Major Themes from Advisory Group Member Questions and Discussion

- Everyone wants lower bills, and the Clean Grid LA presentations should discuss what is being done to lower bills for vulnerable communities. It would also be useful to discuss the total energy bills rather than just electricity. Bills are more important than rates, practically speaking.
- Another place in the LA100 study that can include more environmental justice components is local solar. The study established an assumed adoption rate of 31% by Los Angeles residents in 2045. That is destined to be in affluent single-family neighborhoods if increasing adoption is not coupled with better LADWP solar programs and smart meter technology.
- Rate impacts, reliability, and resilience will be very important factors for our business community.
- It would be helpful to have one place where all of the statistically significant findings are listed and cross-referenced in the report.
- With more energy efficiency and electrification coupled with bill stabilization, we can ensure that rate increases can be mitigated, and that bill payments will not be an unintended burden.

Wrap-up and Next Steps

Isaacson noted that the next session would focus on the economic impacts and job analysis and will take place on Thursday, March 11, 2021.

Virtual Session #3

Thursday, March 11, 2021, 10:00 a.m. to 12:00 p.m.

Virtual Session #3 Attendees

Advisory Group Members

Aaron Ordower, Council District 2
Adam Lane, Los Angeles Business Council
Allison Smith, Southern California Gas
Andrea Rojas, Sierra Club
Andy Shrader, Council District 5
Armando Flores, Valley Industry Commerce Association
Bonny Bentzin, University of California, Los Angeles
Bruce Tsuchida, The Brattle Group
Camden Collins, Office of Public Accountability (Ratepayer Advocate)
Christos Chrysiliou, Los Angeles Unified School District
Dan Kegel, Neighborhood Council Sustainability Alliance
Dan Reeves, Council District 14
Fred Pickel, Office of Public Accountability (Ratepayer Advocate)
Jasmin Vargas, Food & Water Watch
Jean-Claude Bertet, City of Los Angeles Attorney
Kendal Asuncion, Los Angeles Chamber of Commerce
Loraine Lundquist, California State University, Northridge
Luis Amezcua, Sierra Club
Matt Hale, Council District 2
Michael Webster, Southern California Public Power Authority
Priscila Kasha, City of Los Angeles Attorney
Rebecca Rasmussen, Office of Mayor Eric Garcetti
Tony Wilkinson, Neighborhood Council

LADWP Staff

Andrew Kendall
Ann Santilli
Ashkan Nassiri
Bang Phung
Bernie Perez
Bingbing Zhang
David Rahimian
Dawn Cotterell
Faranak Sarbaz
Greg Huynh

James Barner
James Lin
Jason Rondou
Jay Lim
Jeremiah Valera
Jim Kemper
Joseph Ramallo
Julie Van Wagner
LeiLani Johnson Kowal
Lisa Yin
Louis Ting
Luis Martinez
Nicholas J. Matiasz
Paul Habib
Paul Schultz
Reiko Kerr
Robert Hodel
Scott Moon
Steve Ruiz
Steve Swift

Project Team

David Keyser, NREL
Doug Arent, NREL
Jaquelin Cochran, NREL
Rachel Saxon, NREL
Scott Haase, NREL
Alyson Scurlock, Kearns & West
Jasmine King, Kearns & West
Joan Isaacson, Kearns & West
Adam Rose, University of Southern California
Dan Wei, University of Southern California

Observers

Alex Jasset, Physicians for Social Responsibility-Los Angeles
Amy Blumenthal, University of Southern California
Bill Engels, Water and Power Associates
Emily Gersema, University of Southern California
Gary Polakovic, University of Southern California
Mayte Sanchez, Los Angeles Cleantech Incubator

Call to Order and Agenda Overview

Joan Isaacson, LA100 Advisory Group meeting facilitator from Kearns & West, welcomed the virtual meeting attendees. She explained that this was the third virtual session for Meeting #15 of the Advisory Group for the City of Los Angeles 100% Renewable Energy Study (LA100). This session provided an update on the final results for the economic impact and workforce analyses.

Welcome Remarks

Greg Huynh, LADWP Manager of the 100% Clean Energy Innovation Group, welcomed the Advisory Group members and acknowledged the one year marker of the Covid-19 pandemic. He then stated that NREL would be highlighting the jobs and economic impacts of the LA100 study during the session and how the energy sector can provide opportunities. LADWP will continue to innovate by training and hiring a diverse workforce, providing economic growth and jobs for the City of Los Angeles and its communities. The assistance of NREL, the LA100 study, and feedback from the Advisory Group has provided guidance down that path.

Doug Arent, NREL Executive Director, thanked the Advisory Group members for their continued engagement. NREL has been working very hard and is excited for the final phase of sharing briefings and gaining insights from the Advisory Group as well as discussing next steps with colleagues in Los Angeles and the Department of Energy. He noted that NREL's lab director will join a future Advisory Group meeting.

Jaquelin Cochran, NREL LA100 Principal Investigator, welcomed everyone and reviewed the meeting agenda, noting that the today's session would include updates on the economic impact and workforce analyses. The next session – the final session at which NREL presents – will focus on the key findings across the LA100 study. Cochran noted that the next session will now be on Friday, March 19 instead of Thursday, March 18. A question-and-answer session will be held on March 25. The final session (April 1) will be hosted by LADWP and will address the rate analysis. Cochran reminded Advisory Group members that NREL is finalizing the content of the report chapters, which are available for review on the LA100 study website.

LA100: Jobs and Economic Impact Modeling

David Keyser, NREL Senior Economist, introduced his co-presenters for the presentation: Adam Rose and Dan Wei, professors in the University of Southern California Sol Price School of Public Policy. Keyser then gave an overview of the presentation, which covered the types of impacts included in the economic analysis. These impacts include the net impacts on employment and household income within the City of Los Angeles, the in- and out-basin workforce needs, and types of jobs categorized by technology. Keyser encouraged Advisory Group members to ask questions about the models and assumptions and provide feedback on the results.

Keyser reviewed the two models used in the economic impact and workforce analyses. The Computable General Equilibrium (CGE) model was used for the net impact analysis, while the NREL Jobs and Economic Development Impacts (JEDI) suite of models was used for the gross impact analysis. He noted that both models share underlying data sets and are parameterized in a similar way, but the models use the data differently. The CGE model estimates the scenarios' net impacts within the City of Los Angeles and considers potential positive impacts (investment, operation, and price decreases) and potential negative impacts (price increases and electricity displacement elsewhere in the economy). The JEDI model estimates in- and out-basin gross impacts

from increased activities in the power sector and accounts for positive changes such as jobs created and supported by the LA100 scenarios. The JEDI model captures workforce needs and the associated economic activity.

Keyser previewed the net impacts resulting from the CGE model. First, the net modeling of power sector expansion estimates the impacts on employment and income by household group within Los Angeles. Some LA100 scenarios have slightly positive impacts and others are negative, but the negative impacts are very small when compared with the size of the Los Angeles economy. Lower-income households are more affected by changes because, while they spend less on electricity than higher income households, electricity represents a larger proportion of their income. Lastly, some scenarios slightly increase income inequality in the City of Los Angeles when compared with the SB100 scenario, while others do not.

Keyser then previewed the gross impacts resulting from the JEDI model. First, all scenarios have associated workforce needs that vary with the levels of expenditure and technologies deployed. Construction and installation expenditures under the Early & No Biofuels scenarios support the greatest number of in-basin jobs, while in the SB100 Stress Electrification scenario these expenditures support the most jobs out-basin. Conversely, operations and maintenance expenditures support the greatest number of in-basin jobs under the SB100 Stress Electrification scenario and the least number of out-basin jobs under the Early & No Biofuels scenarios. Lastly, most jobs supported by these expenditures earn wages that are higher than average earnings in the City of Los Angeles.

Keyser lastly reviewed inputs for data and energy efficiency. He said that both models are parameterized with both capital and operations and maintenance expenditures from rooftop solar and capacity planning models. The CGE model additionally uses estimated cost data (translated to changes in electricity prices), which includes existing debt. This is determined by taking the difference between the 2017 Integrated Resources Plan, which includes debt, and the LA100 study results using the 2017 Integrated Resources Plan, which does not include debt. Energy efficiency is not included in these impacts as economic modeling in the LA100 study requires inputs to be monetized, which were not for energy efficiency. Neither costs of implementing measures nor savings from reduced energy use are monetized. Keyser noted that other studies have looked at this and shown that economy-wide impacts of efficiency would likely be positive, thereby keeping power sector impacts in the LA100 study in the lower bounds. Gross (JEDI-type) impacts would show the workforce needed to build, install, and maintain efficiency investments.

Computable General Equilibrium Model

Computable General Equilibrium Model – Impact on Jobs

Rose next expanded on the CGE analysis and results. The CGE model characterizes the economy as a set of interrelated supply chains and mimics the role of markets and prices. He explained that the commercial producing sectors generate output using labor, capital (buildings, equipment), and intermediate inputs purchased from other industries (inputs used in production). Households earn income, in the form of wages and capital income, to purchase goods and services, purchase or rent housing, and purchase electricity. Rose noted that electricity expenditures generally increase with household income. The analysis forecasts impacts additional to changes that would otherwise occur.

Rose described the LA100 scenarios included in the analysis, noting that the electricity infrastructure and prices will not remain stagnant in the future. It is known that some facilities will have to be replaced and maintenance costs will increase. Some basic changes are already set in motion and holding prices constant at the 2020 values would be misleading. Rose said that the SB100 Moderate Electrification scenario was used as a minimal compliance, or reference scenario and impacts were also calculated in relation to 2020 constant prices in the report.

Rose summarized the range of annual average employment impacts during the 2026–2045 time period. When compared to the SB100 Moderate Electrification scenario, average annual impacts range from a decrease of 3,600 jobs under the Early & No Biofuels Moderate Electrification scenario to an increase of 4,700 jobs under the SB100 Stress Electrification scenario. These impacts are affected by cost changes relative to the SB100 Moderate Electrification scenario. Higher costs result in lower (or negative) impacts, while lower costs result in higher (or positive) impacts. The stress and high electrification scenarios have the highest positive impacts, whereas the Early & No Biofuels Moderate and High Electrification scenarios and the moderate electrification scenarios have negative impacts relative to the SB100 Moderate Electrification scenario.

Rose said the key overarching takeaway is that regardless of the pathway, economic impacts to the city from changes in electricity rates and renewable energy investments are projected to be small relative to the overall size of the Los Angeles economy. While the transition to 100% renewable energy could create thousands of clean energy jobs annually, the clean energy investments alone are not anticipated to notably impact the Los Angeles economy.

Rose lastly compared the changes in per unit costs for the LA100 scenarios with cost changes (from 2020) for the SB100 Moderate Electrification scenario. Higher-cost scenarios include Early & No Biofuels with Moderate and High Electrification and all moderate electrification scenarios. Lower-cost scenarios include the SB100 Stress Electrification scenario and all high electrification scenarios except the Early & No Biofuels High Electrification scenario. Rose reviewed the net employment impacts of the LA100 scenarios relative to the SB100 Moderate Electrification scenario in a given year. The SB100 Stress Electrification scenario projects the largest increase in jobs, while the Early & No Biofuels Moderate Electrification scenario projects the largest decrease in jobs. The percentage changes are relatively small.

Computable General Equilibrium Model – Impact on the Economy

Wei expanded on the income distribution impacts of the LA100 scenarios, highlighting the SB100 High Electrification and the Early & No Biofuels Moderate Electrification scenarios. Wei displayed the distribution of income changes for two of the time periods across the nine income groups and noted that the comprehensive time periods studied are included in the report. For the SB100 High Electrification scenario, all numbers are positive, indicating that all household groups are projected to experience increased income as compared to the SB100 Moderate Electrification scenario. The results show that lower-income households receive a higher proportion of increased income and are projected to have relatively smaller absolute levels of income gains but relatively larger percentage increases of total income. Wei noted that the pattern of increased income is very similar between the two time periods presented (2026–2030 and 2041–2045).

For the Early & No Biofuels High Electrification scenario, Wei described that income losses are experienced across all income brackets in the 2026–2030 time period when compared to the SB100 Moderate Electrification

scenario. During the 2026–2030 time period, lower-income households are more adversely impacted and experience relatively smaller absolute levels of income losses but relatively larger percentage decreases of total income. During the 2041–2045 time period, more income gains are distributed to higher-income households and the lowest-income households are estimated to have income losses.

Wei said that the results from some scenarios are easier to interpret than others. Wei introduced the Gini coefficient, a widely-used one-parameter estimate of income inequality, which is a better metric for determining welfare effects than looking at household income changes by level. The Gini coefficient is a value between 0 and 1, with higher values indicating greater income inequality. Wei noted that the baseline Gini coefficient for the City of Los Angeles is 0.4582, which is close to the national average.

Wei described the Gini coefficient results for the LA100 scenarios. All scenarios contribute towards greater income inequality in absolute terms, but when compared with the SB100 Moderate Electrification scenario, there are increases and decreases. Scenarios that project increased earnings relative to the SB100 Moderate Electrification scenario result in a more equal income distribution, while scenarios that project decreased earnings relative to the SB100 Moderate Electrification scenario increase income inequality. However, all impacts remain small in absolute and relative terms.

Conclusions

Keyser concluded the first presentation by summarizing the overall conclusions of the CGE modeling. Compared to the SB100 Moderate Electrification scenario, employment impacts of the LA100 scenarios vary from nearly 3,600 average annual job-year losses in the Early & No Biofuels Moderate Electrification scenario to about 4,700 average annual job-year gains in the SB100 Stress Electrification scenario in the 2026–2045 time period. Time-paths of the changes in economic impacts are affected by three causal factors: capital investments, operations and maintenance, and costs/prices. Keyser noted that changes in capital investments over time are most variable across the scenarios. Although many of the aggregate impacts are large in terms of absolute levels, they are relatively small compared to the overall Los Angeles economy. Almost all impacts are less than 0.5% compared with the SB100 Moderate Electrification scenario.

Major Themes from Advisory Group Member Questions and Discussion

- How were the cost/kWh values calculated?
- Annual average employment impacts of the accelerated scenario would be expected to be higher in earlier years due to higher electricity costs. How would the recovery from the pandemic be impacted by the accelerated scenario?
- How does the model capture power cost, and can it be shown in the tables?
- It would be helpful to include an asterisk or footnote when numbers are very small to indicate if they are statistically significant.
- Does the analysis include costs to government, and therefore taxpayers, of cleaning up ongoing and worsening climate disasters and addressing worsening health impacts, like from Los Angeles' increased smog pollution related to heat increases?
- Having the cost/kWh assumptions in an appendix would be helpful.
- Does the increase in electrification also increase LADWP's expected revenue stream and thus its ability to finance the new construction needed to serve that load?

- Public policy decisions will be heavily focused on capital costs over time periods and should be the main focus of the impact. These slides only consider the low overall impact on the economy.

Jobs and Economic Development Impacts Model

Keyser provided a recap of the JEDI model which is used for the gross impact jobs analysis. First, the JEDI model uses much of the same underlying data as the CGE model, but the data is used differently. The gross impact analysis only considers power-sector expenditures that support jobs and associated economic activity such as earnings, gross domestic product, and output (overall economic activity/sales revenue). Keyser used an example of solar panels and asked questions pertaining to who installs solar panels, supplies racking hardware, provides design services for various installation projects, and where these workers spend their money (ripple effect). He noted that JEDI only factors in job location and does not factor in where employees live or the associated commuting time.

Keyser then first overviewed key findings across all LA100 scenarios. There are about 8,600 jobs supported by construction and installation annually. During the 2026–2045 time period, about 2,000 jobs are supported annually by operations and maintenance and this employment is expected to continue after 2045 for the life of the installed infrastructure. Transmission and solar support the most construction and installation jobs while geothermal, wind, natural gas, and renewable energy combustion turbines support the most operations and maintenance jobs.

Keyser reviewed estimated employment supported by construction and installation in-basin and out-basin across the LA100 scenarios. More employment is generally projected in-basin in all scenarios. However, the Early & No Biofuels High and Moderate Electrification scenarios tend to have steady employment supported by in-basin investments with an increase after 2040 out-basin. Keyser noted that the Early & No Biofuels scenarios peak in-basin by 2035 and out-basin by 2030. They then have the fewest jobs by 2045 due to early buildout for construction and installation. The Transmission Focus High and Moderate Electrification scenarios have the most in- and out-basin jobs by 2045. SB100 High and Moderate Electrification scenarios are lowest in-basin and among the highest out-basin until 2040.

Keyser reviewed employment supported by operations and maintenance in-basin and out-basin across the LA100 scenarios. He noted that the Early & No Biofuels High and Moderate Electrification scenarios do not support as many jobs from in-basin operations and maintenance investments. This is affected by the installed technology. Solar does not require as much operations and maintenance support while out-basin wind and geothermal do. The SB100 High and Moderate Electrification scenarios support the most jobs in-basin over time due to natural gas.

Keyser then displayed the data for aggregate jobs supported by construction and installation expenditures during the 2026–2045 time period. The Early & No Biofuels High and Moderate Electrification scenarios support the highest number of jobs followed by the Limited New Transmission and Transmission focus scenarios. These are grouped by electrification levels with high electrification providing more jobs than moderate electrification. He then reviewed the aggregate jobs supported by operations and maintenance expenditures during the 2026–2045 time period. In general, the high electrification and stress electrification levels support the most operations and maintenance job-years with the exception of the Early & No Biofuels Moderate Electrification scenario.

Keyser next went into detail about two scenarios for all of the time periods studied: Early & No Biofuels High Electrification and SB100 High Electrification. First, the Early & No Biofuels High Electrification scenario supports jobs from construction and installation expenditures. This scenario contributes substantially to in-basin solar jobs across all time periods and hydrogen jobs during the 2031–2035 time period. Out-basin, there is an early investment in geothermal mixed with mostly transmission and wind jobs. For jobs supported by operations and maintenance expenditures, in the Early & No Biofuels High Electrification scenario, jobs are mostly solar in-basin, but numbers are relatively low. Out-basin, there are early geothermal and wind jobs. Natural gas jobs also exist but are phased out by 2035.

In the SB100 High Electrification scenario, for jobs supported by construction and installation expenditures, the investments are primarily seen with solar in-basin, although levels vary over time. Out-basin wind and geothermal will contribute to higher numbers of operations and maintenance jobs; there is no operations and maintenance from transmission and lower operations and maintenance from solar. For jobs supported by operations and maintenance expenditures, in-basin there is continued operation of existing natural gas with slight increases in storage. Out-basin, there is continued but ramped down operation of natural gas with increased wind over time. Geothermal employment remains level from early capital investments.

Keyser reviewed the scenario averages. Across all scenarios, there was an average of 8,600 jobs supported by construction and installation, which is associated with $856 million in value added, or gross domestic product. There was an average of 2,000 workers associated with operations and maintenance, with $201 million annually in value added. There are 2,700 jobs associated with operations and maintenance by 2045 with $270 million in gross domestic product. The average annual earnings from jobs due to construction and installation are $67,000 per worker and the average earnings due to investments in operations and maintenance are $65,000 per worker. Keyser reviewed the average earnings across the LA100 scenarios and noted that the annual average earnings in the City of Los Angeles are $60,000 per worker. In general, renewable energy combustion turbine and natural gas operations and maintenance jobs are below this average while all others are above this average.

Keyser provided context for the results. First, the workforce needs results can help inform opportunities, but this does not mean that positions will be readily filled. For example, in the wind industry, NREL found that employers report difficulty finding qualified workers across most occupations. Trade workers is the largest occupational group within the industry and the second most difficult for employers to find, and all employers do not have the means to fill those positions. Keyser said that many utilities have in-house workforce training programs and there are also state-certified apprenticeships. Lastly, he mentioned that there may be workers in existing occupations who are able to fill those vacant positions by moving into emerging technologies.

Conclusions

Keyser recapped the conclusions. All the LA100 scenarios will have workforce needs. Generally, solar is among the largest drivers of construction and installation jobs but a smaller driver for operations and maintenance jobs. Transmission can also be a significant driver during the construction phase but not for operations and maintenance. Geothermal, wind, and renewable energy combustion turbines support more operations and maintenance workers. Lastly, for most technologies, the average earnings for workers across all LA100 scenarios are higher than the average for Los Angeles workers as a whole.

Major Themes from Advisory Group Member Questions and Discussion

- Concern was expressed about not having sufficient transmission to support geothermal production and the associated jobs (outside of Imperial County). If the study relies on geothermal jobs, new transmission will need to be built. The specifics and timeframe for the added geothermal transmission from Imperial County should also be included.
- In the jobs analysis, are automation effects on reducing workforce needs considered?
- Is manufacture of new technologies assumed to occur in the LADWP area?
- Did the LA100 team research how LADWP recruited its wind team?
- Can efficiency jobs and economic benefits from energy efficiency be inferred from the models?

Wrap-up and Next Steps

Cochran reminded the Advisory Group of the date change for the next session and that the Friday, March 19 session would be the last one at which NREL would present. Isaacson noted that the next session would focus on NREL's reporting on key findings. She thanked the Advisory Group and LA100 project team for the great discussion.

Virtual Session #4

Friday, March 19, 2021, 10:00 a.m. to 12:00 p.m.

Virtual Session #4 Attendees

Special Guest

Mayor Eric Garcetti

Advisory Group Members

Aaron Ordower, Council District 2
Adam Lane, Los Angeles Business Council
Allison Smith, Southern California Gas
Andrea Rojas, Sierra Club
Andy Shrader, Council District 5
Armando Flores, Valley Industry Commerce Association
Austin Eriksson, California State University, Northridge
Bruce Tsuchida, The Brattle Group
Camden Collins, Office of Public Accountability (Ratepayer Advocate)
Carlos Baldenegro, Port of Los Angeles
Carter Atkins, Los Angeles World Airports
Christos Chrysiliou, Los Angeles Unified School District
Dan Kegel, Neighborhood Council Sustainability Alliance
Duane Muller, University of California, Los Angeles
Fred Pickel, Office of Public Accountability (Ratepayer Advocate)
Jack Humphreville, DWP Advocacy Committee
Jasmin Vargas, Food & Water Watch
Jean-Claude Bertet, City of Los Angeles Attorney
Liz Crosson, Office of Mayor Eric Garcetti
Liz Anthony Gill, California Energy Commission
Loraine Lundquist, California State University, Northridge
Luis Amezcua, Sierra Club
Michael Webster, Southern California Public Power Authority
Priscila Kasha, City of Los Angeles Attorney
Rebecca Rasmussen, Office of Mayor Eric Garcetti
Tony Wilkinson, Neighborhood Council

LADWP Staff

Ann Santilli
Armen Saiyan
Ashkan Nassiri
Bang Phung

Bingbing Zhang
Carol Tucker
David Rahimian
Dawn Cotterell
Ellen Cheng
Greg Huynh
James Barner
James Lin
Jason Rondou
Jay Lim
Jeremiah Valera
Joseph Ramallo
Julie Van Wagner
LeiLani Johnson Kowal
Lisa Yin
Lister Yu
Louis Ting
Luis Martinez
Luke Sun
Martin Adams
Nicholas J. Matiasz
Paul Habib
Paul Lee
Paul Schultz
Reiko Kerr
Scott Moon
Steve Ruiz
Steve Swift
Wayne Tseng

Project Team

Daniel Steinberg, NREL
Devonie McCamey, NREL
Doug Arent, NREL
Garvin Heath, NREL
Jaquelin Cochran, NREL
Martin Keller, NREL
Meghan Mooney, NREL
Paul Denholm, NREL
Vikram Ravi, NREL
Alyson Scurlock, Kearns & West
Jack Hughes, Kearns & West
Jasmine King, Kearns & West

Joan Isaacson, Kearns & West
George Ban-Weiss, University of Southern California
Yun Li, University of Southern California

Observers

Bill Engels, Water and Power Associates
Jovy Kroh, Southern California Gas
Megan Ross, LA Mayor's Office of Sustainability
Marta Segura, Grassroots Organizational Leadership and Development
Randolph Krager, Southern California Public Power Authority

Call to Order and Agenda Overview

Joan Isaacson, LA100 Advisory Group meeting facilitator from Kearns & West, welcomed the virtual meeting attendees. She explained that this was the fourth virtual session for Meeting #15 of the Advisory Group for the City of Los Angeles 100% Renewable Energy Study (LA100). This session provided an update on the LA100 study synthesis and summary of the key findings.

Opening Remarks

Eric Garcetti, Mayor of Los Angeles, thanked everyone for participating in making history in the unprecedented LA100 study. He said that each Advisory Group member has brought a unique perspective and noted that many are inspired by the work going into the LA100 study. Mayor Garcetti expressed excitement about the LA100 study and said that Los Angeles' future grid will be reliable and resilient. It will be important to find ways for other cities to start on a path to 100% renewable energy to reduce costs and increase health benefits. Mayor Garcetti thanked LADWP for its active leadership and willingness to be bold, noting that LADWP has started investments in utility-scale renewables, transmission lines, advancing technology, storage, and green hydrogen. Mayor Garcetti said it is tough to go first but he would much rather fail forward and figure out solutions. He thanked the NREL team members for their work, guidance, and commitment to excellence. He said the last 10-15% of renewable energy will be tough to achieve but it can be done. Mayor Garcetti noted that the LA100 study is a good model for the United States and that he would rally behind NREL and for the funding that will contribute to this important work. Lastly, he invited everyone to attend the LA100 study virtual press event on Wednesday, March 24.

Dr. Martin Keller, NREL Laboratory Director, thanked LADWP, Mayor Garcetti, and the Advisory Group members for their leadership and deep thinking to make the LA100 study a reality. Keller said that looking back in 20 years, he thinks the LA100 study will be in history books and used as guide. He thanked all of the staff from NREL who have worked on the LA100 study over the years and expressed excitement for how it has all come together. He highlighted that the LA100 study integrates the important elements of energy justice and environmental justice throughout. Keller said it would take a team to share and bring the LA100 study across the whole United States and that many communities will need to follow a similar path to make the 2035 and 2050 goals from the Biden administration a reality. He noted that Los Angeles can also take leadership on a global scale and extended an invitation for all to come and visit the NREL campus in Colorado at any time.

Reiko Kerr, LADWP Senior Assistant General Manager of Power System Engineering, greeted the Advisory Group and said that today marks a milestone in Los Angeles' journey on the road to clean energy. She noted the incredible technical modeling by NREL and continued engagement by the Advisory Group, which includes a wide and diverse set of stakeholders, over the last 3 years. The key findings of the LA100 study demonstrate that clean energy can be achieved by LADWP's industry-leading workforce in a way that is reliable, economical, equitable, and replicable by other utilities. She provided examples of how Los Angeles has continued to transform the power system throughout the LA100 study with the recent city council approval of the Eland solar and storage project, the Red Cloud Wind project, and expansion of local solar programs. Kerr noted that the journey to a clean energy future will not stop here and that a lot of work remains ahead to implement strategically what LADWP has learned through the LA100 study. As the LA100 study results emerge, LADWP will start laying the foundation and restart its Strategic Long-Term Resource Plan (SLTRP) efforts and community engagement to continue to lead the way. She acknowledged all the contributions to the LA100 study from Mayor Garcetti and council district staff members, NREL, Kearns & West, and staff from various departments at LADWP.

Jaquelin Cochran, NREL LA100 Principal Investigator, welcomed everyone and reviewed the meeting agenda, noting that NREL would present the LA100 study synthesis and summary of key findings during the session. She noted that NREL will release the report with the LA100 study virtual press event on March 24. The next Advisory Group session (March 25) will be an open question and answer session. The Advisory Group members will have all materials prior to the question and answer session. The final session (April 1) will be hosted by LADWP and will address the rate impact analysis and next steps.

LA100: Synthesis

Cochran presented the LA100 study synthesis and summary of key findings. She provided an overview of the major trends across the pathways to 100% renewable energy, distinctions among the pathways, and a look ahead at addressing uncertainty.

Major Trends Across Pathways to 100%

Cochran first reviewed major trends across the pathways to 100% renewable energy. She said peak demand and energy consumption increase over time; however, high levels of energy efficiency help offset load growth due to building electrification, with transportation driving the load growth over time. Additionally, the timing of peak electricity consumption is dependent on the timing of electric vehicle charging. In the future, there will be increased daytime charging if workforce charging grows.

Cochran then detailed some customer-oriented actions that can complement the transition to renewable energy: energy efficiency, greater electrification, and customer demand flexibility. She noted that energy efficiency helps offset climate- and electrification-driven load growth and potentially higher electricity rates. Energy efficiency also lowers the energy burden for low-income residents. Greater electrification provides for higher public health and greenhouse gas (GHG) emissions benefits and helps reduce per-unit electricity costs. Lastly, customer demand flexibility helps both contain the costs of adding electrification and achieving 100% renewable energy and support reliability.

Cochran next addressed customer rooftop solar trends in the LA100 study. She noted that by 2045, rooftop solar was found to be an economical choice for nearly all households and businesses. The LA100 study found that customers are projected to adopt 34–40% of the total economic potential for rooftop solar capacity with new billing and net metering across all scenarios. Future adoption would occur on 22–38% of all existing single-family homes compared to 6% in 2020.

Cochran next stated that reliable, 100% renewable energy is achievable and provides significant greenhouse gas emissions, air quality, and public health benefits if coupled with electrification of other sectors. In the LA100 study, nitrogen oxide (NOx) and fine particulate matter ($PM_{2.5}$) reductions were shown for all scenarios across the following sectors: buses, light-duty vehicles, commercial and residential buildings, the Ports of Los Angeles and Long Beach, and LADWP-owned power plants. Electrification, especially of transportation, is a large driver of air quality and health benefits. Cochran reviewed a chart that ties together many of the data points for all scenarios and electrification levels, noting that discount rates of 2.5% and 5% were added to the column for present value of cumulative costs. This allows for easy comparison with the cumulative monetized emissions cost of greenhouse gas emissions column.

Cochran stated that in all scenarios, wind and solar provide 69–87% of future load, and new renewable firm capacity is built in the Los Angeles basin to maintain reliability. Cochran reviewed the annual generation mix in 2045 for all high load scenarios compared to 2020. She noted that there are commonalities across all scenarios in meeting the 100% renewable energy target in 2045 including wind, solar, geothermal, and combustion turbines.

Cochran reviewed another key finding, which is that all communities will share in the benefits of the clean energy transition, but that improving equity in participation and outcomes would require intentionally designed policies and programs. She described examples of actions that could support prioritization of environmental justice. First, participation in decision-making is important. Second, data collection for energy infrastructure could be improved to make better projections for adopting energy efficiency, electrification, demand response, and solar and for designing incentives and regulations to better target projects to policy goals. Energy infrastructure could also have a more comprehensive representation of benefits and better metric-tracking tools for tracking against projected change. Third, specific programs could be supported for hard-to-fill and other high-quality jobs. For maintaining support for electrification, an analysis of the interaction among the costs of decarbonization, pace of electrification, and rate design could identify the pacing of electricity demand and supply change that optimizes health benefits. Lastly, an analysis of positive and negative neighborhood-level health impacts could establish expectations and be used to revise protocols as needed.

Cochran stated that while the transition to 100% renewables could create thousands of clean energy jobs annually, overall, clean energy investments alone are not anticipated to notably impact Los Angeles' economy. Los Angeles can get started now, with many no-regrets options that achieve significant emissions reductions (76–99%) by 2030. Cochran then reviewed the minimum power generation across all scenarios: 4,300 MW for wind, 5,700 MW for solar, and 2,600 MW for storage. She noted that the distribution system will be upgraded over time as there is more demand on the system and that transmission is important for maintaining reliability. In the future, combustion turbines could be used to help manage severe events. Fuel will be used infrequently and is assumed to cost more than it does today.

Distinctions Among Pathways

Cochran next reviewed distinctions among the pathways to 100% renewable energy. She stated that the pathways diverge going from 90% to 100% renewable energy and that the last 10% is needed for reliability during periods of very low wind and solar generation, extremely high demand, and unplanned events like transmission outages. Cochran described the capacity mix in 2045 for all high-load scenarios compared to 2020. She noted that natural gas is used today and will continue to be used in the SB100 scenario in addition to renewable energy combustion turbines. Renewable energy combustion turbines assume a market supply of fuel, which would not require dedicated infrastructure to be built, while hydrogen combustion turbines assume self-production of fuel, which would require building of infrastructure. She noted that producing hydrogen rather than buying commercially available renewable energy fuels adds 20% to the cumulative costs.

Cochran stated that the combination of higher energy efficiency, electrification, and demand flexibility offers both greater benefits and reduced per-unit electricity costs compared to alternative scenarios. Cochran reviewed the Early & No Biofuels scenario with high and moderate electrification levels and the SB100 scenario with high, moderate, and stress electrification levels. The Early & No Biofuels High Electrification scenario has lower cumulative costs, larger reductions in annual life cycle greenhouse gas emissions and emissions from LA100-influenced sources (NOx and $PM_{2.5}$), and a higher value of avoided health impacts compared to the Early & No Biofuels Moderate Electrification scenario. Cochran noted that the SB100 scenario follows a similar pattern when comparing high and moderate electrification levels. For the SB100 Stress Electrification scenario, there is a higher annual load and higher peak compared to the SB100 High Electrification scenario. She noted that the combination of efficiency and flexibility of demand reduces cumulative costs by 13% by 2045.

Cochran stated another key finding, which is that accelerating the target date to 2035 increases both the costs and benefits of the transition. She explained that the Early & No Biofuels scenario has an earlier accumulation of costs and benefits. Using a 2035 target date increases costs by 7–8% in the Transmission Focus and Limited New Transmission scenarios and would likely result in similar greenhouse gas emissions as the Early & No Biofuels scenario.

Next, Cochran stated that technology restrictions result in higher costs when it comes to meeting the last 10–20% of energy demand, but there are almost no additional air-quality or health benefits among benefits studied. Cochran reviewed the annualized costs and annual life cycle greenhouse gas emissions from the power sector for all scenarios and electrification levels. There are significant cost differences over the last 10% but emissions benefits are similar and plateau after 90% renewable energy is achieved. All scenarios show reductions in combustion (and associated pollutants) due to both renewable energy buildout and use of inverter-based resources for reserves.

Cochran said that the costs for the last 10% diverge but benefits remain similar among paths. Natural gas plant operations associated with the SB100 scenarios in 2045 do not affect regional air quality significantly compared to not allowing their use, and thus this change alone does not produce significant public health benefits. However, the costs then diverge approaching 100% renewable energy while the benefits plateau. Cochran said that the potential benefits not captured in the analysis include neighborhood-level pollutants, global leadership of 100% renewable energy without renewable energy credits or biofuels, and the sustainability concerns of biofuels.

Cochran lastly described the cost sensitivities on technology eligibility analyzed in the LA100 study. A cost sensitivity was completed for the SB100 scenario that removed eligibility of natural gas by not allowing renewable electricity credits and setting the target based on generation rather than retail sales. This increased cumulative costs by 2.5% through 2045 and 18% through the financial lifetime (2074). Another cost sensitivity was completed for the Early & No Biofuels scenario that allowed market purchase of renewable fuels. This reduced cumulative costs by 21% through 2045 and 26% through the financial lifetime (2074).

Major Themes from Advisory Group Member Questions and Discussion

- The colors representing the moderate and high electrification levels are too similar in some of the charts. The slides should be able to be understood when viewed in black and white.
- Is the cost of rooftop solar for single-family homes included in the cost estimates?
- Where is the analysis on a billing basis?
- Does the “Percent Value of Cumulative Costs at Alternative Discount Rates” column on slide 13 include information in the “Cumulative Monetized Emissions Costs of GHG Gas Emissions" column?
- Consider not using the term biofuel as shorthand for renewable fuel.
- Are costs shown in today’s dollars?
- How can costs of rooftop solar be included when it was stated the cost of customer actions is not included?
- Does slide 32 assume a zero inflation rate? Is the discount rate on top of inflation, or is inflation a part of the discount rate when discussing costs?
- Are all cost results now shown as discounted dollars?
- When the benefits of the last 10% were discussed, greenhouse gas emissions reductions were mentioned but a slide was not included with the additional social cost of carbon emissions reductions.
- Is the 2,600 MW for renewable energy combustion turbines for the last 10% of peak capacity or emergency use, or is that for generation beyond any of these needs?

Looking Ahead: Addressing Uncertainty

Cochran concluded the presentation by addressing uncertainty. Looking ahead, she stated that identifying alternative options for firm, in-basin capacity likely represents the largest opportunity to reduce the transition costs and points to the highest priorities for research and development: hydrogen and extended demand response. She described how in the LA100 study scenarios new renewable energy generation such as wind and solar are rapidly built in the next decade on the pathway to 100% renewable energy. This growth allows Los Angeles to delay building new renewable energy combustion turbines because of certain assumptions. These assumptions include the following: (1) energy efficiency measures help reduce needed supply investments, (2) LADWP deploys new technologies and techniques to increase capacity of existing transmission, (3) planned new transmission can be built, and (4) LADWP and customers build local solar and storage. Cochran noted that this combination of options is considerably cheaper than building new capacity.

Cochran next described what would occur if all the assumptions do not happen. More in-basin capacity than the amount planned in the LA100 study would be needed. She said that biofuels are commercially available today and can serve as a transition fuel, but there is a risk that competition from transportation may limit availability. When hydrogen fuels will be commercially available, or whether they will be part of a larger, economy-wide

transition, is unknown. Cochran said uncertainty also exists about the infrastructure needed for hydrogen production, storage, and delivery.

Cochran reminded that maintaining reliability at 100% renewable energy was discussed in a previous Advisory Group meeting and noted that technologies with specific characteristics are needed for the last 10%. Specific characteristics include technologies that can be sited in-basin, can be sited in specific locations in-basin, and can operate for extended periods (days or longer). This will help avoid dependencies on transmission from out-of-basin and will direct more capacity to the southern part of Los Angeles, where it is needed.

Cochran reviewed how to maintain optionality of scenarios going forward. Having fuel flexibility with renewable electricity credits and biofuels can delay committing to hydrogen infrastructure until technologies advance further. If biofuels are not in sufficient supply or if hydrogen infrastructure is infeasible, an example alternative would be to allow renewable energy credits, but to limit the amount to a few percent of generation. This would still gain most of the greenhouse gas emissions, air quality, and health benefits. Another option would be to have voluntary and equitable multi-day demand response where customers could be compensated for reducing their electricity usage significantly.

To wrap up the presentation, Cochran said if the city wanted to pursue a 2030 target, the focus would be on how to do it reliably. She noted that a national push to solve the last 10% and a national or regional push to expedite transmission could be game changers. The LA100 study marks an important but not final analysis in Los Angeles' pivot towards a clean and equitable energy future. She said the next steps lie with the communities in Los Angeles and noted that Chapter 12 in the report outlines many actions that could assist the effort.

Major Themes from Advisory Group Member Questions and Discussion

- In-basin renewable hydrogen generation and storage are of great interest. Underground storage fields are close to two existing power plants.
- Have the parts of Los Angeles that would need to make the voluntary energy reductions been mapped as part of consideration of demand response options?
- Does the report explore automated, shallow demand response that is not multi-day?
- Have customer costs (electric panel upgrades, renovation upgrades when installing new appliances, etc.) been estimated roughly since they were not included in the analysis?
- The appendix on transportation indicates that there could be significant impacts on distribution system costs depending on where charging takes place and if all charging occurs at the same time. Will LADWP further examine this topic since it could increase costs?
- The best measure of equity is not the price of power; it is the total monthly energy bill.
- If we follow the accelerated scenarios, we should seek federal assistance.
- To address the need for customer participation, what should be shared with the public from the analysis of demand response and energy efficiency?
- Building on the cost questions of achieving the energy efficiency assumed in the study, has LADWP considered how much or by what order of magnitude it would expand customer energy efficiency incentives?
- Southern California Gas may have some information on demand response and smart thermostats, but it does take standardization of appliances worldwide to be successful with demand response.

- Use of induction stoves vs. gas stoves would reduce indoor pollution and the health issues that come with using natural gas indoors without good ventilation. Southern California Gas' product requires them to have a Proposition 65 carcinogen warning on their website. This is an environmental justice issue.
- Regarding induction stoves, environmental justice organizations are doing an analysis of the Sierra Club research study conducted with UCLA, which seems to not be based on actual scientific air monitoring. Environmental justice organizations are questioning the reliability of the study because it could affect affordable housing and tenants.
- We should have some sessions to tease out issues and arguments on each side before the public presentations. Even if we have different perspectives, we should be together in supporting the reports.
- Will the synthesis numbers change from the draft report to next week's final report?
- Several Advisory Group members thanked the project team for the impressive effort.
- These future discussions would fit perfectly with the new Climate Emergency Mobilization office.

Wrap-up and Next Steps

Doug Arent, NREL Executive Director, provided closing remarks. He thanked the Advisory Group, saying it was a pleasure to wrap up this meeting with them and to have participated in many others. He said the consistent engagement of Advisory Group members has been outstanding and has set a benchmark for NREL's approach and stakeholder engagement with other cities. He said he was looking forward to the report's release next week and to ongoing efforts. He expressed the hope that everyone stay safe and perhaps celebrate completion of the LA100 study in person sometime later in the year.

Isaacson reminded Advisory Group members of the press event on March 24 and the question and answer session on March 25. She noted that the final session on April 1 would focus on LADWP's rate analysis.

Q&A Session

Thursday, March 25, 2021, 10:00 a.m. to 12:00 p.m.

Q&A Session Attendees

Advisory Group Members

Aaron Ordower, Council District 2
Adam Lane, Los Angeles Business Council
Allison Smith, Southern California Gas
Andrea Rojas, Sierra Club
Bonny Bentzin, University of California, Los Angeles
Bruce Tsuchida, The Brattle Group
Camden Collins, Office of Public Accountability (Ratepayer Advocate)
Carlos Baldenegro, Port of Los Angeles
Christos Chrysiliou, Los Angeles Unified School District
Dan Kegel, Neighborhood Council Sustainability Alliance
Fred Pickel, Office of Public Accountability (Ratepayer Advocate)
Jack Humphreville, DWP Advocacy Committee
Jasmin Vargas, Food & Water Watch
Kendal Asuncion, Los Angeles Chamber of Commerce
Loraine Lundquist, California State University, Northridge
Nurit Katz, University of California, Los Angeles
Rebecca Rasmussen, Office of Mayor Eric Garcetti
Tony Wilkinson, Neighborhood Council

LADWP Staff

Ann Santilli
Armen Saiyan
Ashkan Nassiri
Bang Phung
Bernie Perez
Bingbing Zhang
Carol Tucker
David Rahimian
Dawn Cotterell
Faranak Sarbaz
Greg Huynh
James Barner
James Lin
Jason Rondou
Jay Lim

Jeremiah Valera
Julie Van Wagner
LeiLani Johnson Kowal
Lisa Yin
Louis Ting
Luis Martinez
Matt Hone
Nancy Sutley
Nicholas J. Matiasz
Paul Habib
Robert Dang
Robert Hodel
Scott Moon
Stephanie Spicer
Steve Ruiz
Steve Swift

Project Team

Daniel Steinberg, NREL
David Keyser, NREL
Garvin Heath, NREL
Jaquelin Cochran, NREL
Paul Denholm, NREL
Ramin Faramarzi, NREL
Scott Haase, NREL
Alyson Scurlock, Kearns & West
Jack Hughes, Kearns & West
Jasmine King, Kearns & West
Joan Isaacson, Kearns & West

Observers

Bill Engels, Water and Power Associates
Mayte Sanchez, Los Angeles Cleantech Incubator

Call to Order and Agenda Overview

Joan Isaacson, LA100 Advisory Group meeting facilitator from Kearns & West, welcomed the virtual meeting attendees, noting that it was a question-and-answer session. She explained that this was the fifth virtual session for Meeting #15 of the Advisory Group for the City of Los Angeles 100% Renewable Energy Study (LA100). This session provided an opportunity for Advisory Group members to ask questions and discuss material presented during the previous four sessions.

Welcome Remarks

Jaquelin Cochran, NREL LA100 Principal Investigator, thanked Advisory Group members for attending the question-and-answer session. She identified the additional NREL team members in attendance for addressing specific LA100 questions and topics: Paul Denholm, Garvin Heath, David Keyser, and Daniel Steinberg.

Major Themes from Advisory Group Member Questions and Discussion

Appreciation for the Project Team

- An Advisory Group member thanked LADWP, NREL, and Kearns & West for the amazing job they have done with the Advisory Group throughout the LA100 study, noting that the project team has shown a lot of patience in walking through things multiple times.
- Other Advisory Group members thanked all who worked on the LA100 study and said the study was well done.

Community Engagement

- A group of retired LADWP engineers has had several discussions about the LA100 study. They would be a good group to engage with to help spread the word about the LA100 Study and results.
- Holding community meetings before completing the rate analysis will not be useful.

Costs and Rates

- When will the Ratepayer Advocate conduct their analysis?
- Once the Ratepayer Advocate's analysis is complete and LADWP has looked through the data, what will LADWP report out on? Will LADWP be reporting out on rates for a handful of the scenarios highlighted in the LA100 study, the rates expected in certain years, or more generalized comments?
- While LADWP was developing its cost estimates, did NREL provide contingency costs, especially for cost overruns?
- Was a base case used in the rate analysis?
- What are LADWP's perspectives on bonding capacity and how much of the costs address rates vs. bonded indebtedness?

Greenhouse Gas Emissions

- What are the considerations for analyzing greenhouse gas emissions from biofuels and are they net-carbon-neutral?
- Corn ethanol is typically not considered greenhouse gas neutral, and the state's analysis said there were insufficient supplies of dairy methane for widescale use in California.
- Some sources may not contribute a lot of greenhouse gas emissions, but all sources are treated as "dirty" in this discussion and it might force us into economically inefficient approaches.

Hydrogen

- What are the risks in developing the hydrogen ecosystem, which is critical to all nine scenarios? Was it considered in the reliability analysis?

LA100 Study Website

- The executive summary is difficult to find on the website.
- Does the "how-to-handle-cloudy-and-shady-November" assume once-through-cooling coastal turbines are offline after 2030?
- This is a groundbreaking study. I think the NREL team perspectives video is a great addition on the website.

Reliability

- My team is concerned with grid reliability once the system has transitioned to 100% renewable energy. How confident is NREL that the percentage of reliability included in the LA100 study will support the functioning of the entire city on a bad day? Do we need to be more aware as a city that one of the scenarios may not support keeping the lights on during a month where production is low?
- Are there any sources for communicating about LA100 and achieving 100% renewables?
- I am concerned that the restriction on use of in-basin capacity of combustion generation in providing operating reserves has created an unreasonable limitation on reliability design [NREL allows the use of these assets in providing reserves, but minimizes them when other sources of reserves are available, such as from batteries].
- The focus on eliminating carbon going into the LA100 study limited how the problem could be approached. The only way to speed the pacing of the study is to maintain combustion generation as emergency backup since certain technologies cannot be invented on the spot. Gaining perspective from engineers on this particular challenge might be helpful and could result in the need for a policy discussion.

Unexpected Results

- What unexpected results with respect to tradeoffs has the LA100 team observed?
- The way NREL analyzed and characterized local solar potential and completed the spatial/economic analysis was impressive. The difference between economic potential and what can be deployed is an important part of the study that others in the state need to understand.
- Can NREL say more about being surprised by the difficulty of serving loads in November?

Other Questions and Discussion

- Regarding the upward and downward reserves figure in the executive summary, how were the timing issues of the downward reserve (heavily solar and wind) handled in the LA100 study?
- Has a "battery focus" scenario been evaluated in which LADWP overbuilds renewable portfolio standard with a minimal amount of battery storage that cycles every day with natural gas as a backup for reliability?

- What were the transmission assumptions for the geothermal energy? Essentially all existing geothermal sourced power seems to belong to Southern California Edison.
- Is it possible to say more about the aggressive demand response programs? NREL noted these have not yet been discussed but are worth discussing. Are there any existing demand response programs that are long-term?

Wrap-up and Next Steps

Isaacson reminded Advisory Group members of the sixth and final session on Thursday, April 1 at which LADWP will present the rates analysis.

Virtual Session #6

Thursday, April 1, 2021, 10:00 a.m. to 12:00 p.m.

Virtual Session #6 Attendees

Advisory Group Members

Aaron Ordower, Council District 2
Adam Lane, Los Angeles Business Council
Armando Flores, Valley Industry Commerce Association
Bruce Tsuchida, The Brattle Group
Camden Collins, Office of Public Accountability (Ratepayer Advocate)
Carlos Baldenegro, Port of Los Angeles
Dan Kegel, Neighborhood Council Sustainability Alliance
Fred Pickel, Office of Public Accountability (Ratepayer Advocate)
Jack Humphreville, DWP Advocacy Committee
Jim Caldwell, Center for Energy Efficiency and Renewable Technologies
Kendal Asuncion, Los Angeles Chamber of Commerce
Luis Amezcua, Sierra Club
Michael Webster, Southern California Public Power Authority
Priscila Kasha, City of Los Angeles Attorney
Tony Wilkinson, Neighborhood Council

LADWP Staff

Andrea Villarin
Ann Santilli
Armen Saiyan
Ashkan Nassiri
Bernardo Perez
Bingbing Zhang
Carol Tucker
David Rahimian
Dawn Cotterell
Dennis Hou
Douglas Tripp
Greg Huynh
James Barner
James Lin
Jason Rondou
Jay Lim
Jeremiah Valera
Joseph Ramallo
Julie Van Wagner

Kitsan Lai
LeiLani Johnson
Lisa Yin
Louis Ting
Luis Martinez
Luke Sun
Marty Adams
Matt Hone
Nancy Sutley
Nicholas J. Matiasz
Paola Adler
Paul Habib
Paul Schultz
Robert Hodel
Scott Moon
Stephanie Spicer
Steve Swift
Theodore Zeiss
Vida Daneshmand

Project Team

Daniel Steinberg, NREL
Garvin Heath, NREL
Jaquelin Cochran, NREL
Paul Denholm, NREL
Scott Haase, NREL
Alyson Scurlock, Kearns & West
Jack Hughes, Kearns & West
Jasmine King, Kearns & West
Joan Isaacson, Kearns & West
Zelinda Welch, University of Southern California

Observers

Bill Engels, Water and Power Associates
Bruce Hamer, Burbank Water and Power
Grant Hoag, Office of Public Accountability
Jovy Kroh, Southern California Gas
Kayla Koerting, Valley Industry Commerce Association
Lauren Harper, Los Angeles Cleantech Incubator
Mary Leslie, Los Angeles Business Council
Mayte Sanchez, Los Angeles Cleantech Incubator
Sylvia Tang

Call to Order and Agenda Overview

Joan Isaacson, LA100 Advisory Group meeting facilitator from Kearns & West, welcomed the virtual meeting attendees. She explained that this was the sixth and final virtual session for Meeting #15 of the Advisory Group for the City of Los Angeles 100% Renewable Energy Study (LA100). This session provided an update on LADWP's rate impact analysis and next steps after the LA100 study.

Opening Remarks

Marty Adams, LADWP General Manager and Chief Engineer, thanked Advisory Group members for their participation in the LA100 study over the years. He stated that Los Angeles now has a road map to 100% renewable energy due to the many Advisory Group members and participants. He noted that this has been a truly collaborative effort and thanked the Advisory Group, NREL, Kearns & West, and LADWP staff for all of the time committed to the study. Many LADWP staff members from various departments have put their heart and soul into the LA100 study over the last few years. He noted the many articles that are emerging about Clean Grid LA and Los Angeles' plan for 100% renewable energy. He said he hoped this last meeting was great and there is more work ahead. This has concluded a fantastic effort that the city can now move forward with.

Rate Impact Analysis

Ann Santilli, LADWP Chief Financial Officer, provided an overview of the presentation objectives and components. The objectives of the presentation were to examine the high-level rate impacts of the LA100 study scenarios and how electrification drives retail energy sales and rates. She noted that she would cover LADWP's assumptions related to costs, retail energy load, and financial modeling as well as the 2017 Strategic Long-Term Resource Plan (SLTRP) resource mix that was included as a reference case in addition to NREL's scenarios. Comparison of scenarios in terms of retail energy load, fuel cost, CO_2 emissions, and average rate impacts, as well as LADWP's financial next steps would be provided.

Santilli first described the assumptions for the rate impact analysis. LADWP staff used NREL's resource transformation costs to analyze LADWP's costs to serve customers. LADWP staff also used NREL's end-use (retail sales) projections for the moderate, high, and stress load scenarios. She noted that NREL's projections are higher than LADWP's current forecasted retail sales. Lastly, LADWP staff added the projected energy efficiency costs on top of its current budget for capital expenditures and operations and maintenance.

Santilli next reviewed the cost reconciliation process. LADWP staff reviewed NREL's costs and reconciled them with LADWP's costs by adjusting the budgeted capital and fuel/purchased power expenses to include the LA100 estimated costs and to avoid double counting. NREL provided constant dollar cumulative capital cost and operations and maintenance estimates for 5-year periods ending in 2025, 2030, 2035, 2040, and 2045 for all scenarios without financing costs. LADWP staff then formatted cumulative costs as annual expenses and converted them into nominal dollar estimates before adding the existing renewable portfolio standard purchase power agreement expenses, debt service, and other ongoing budgeted costs. Finally, LADWP staff performed modeling of the current rate structure and planning criteria metrics. The financial model calculated system average rates for all customers.

Santilli explained LADWP's financial planning criteria and noted that LADWP exists by and for its customers. LADWP works to maintain cost competitive rates by meeting key financial metrics to maintain its strong bond

credit ratings. LADWP is required to maintain a minimum full obligation ratio of 1.7, a minimum operating cash reserve of 170 days, and a maximum capitalization ratio of 68%.

Santilli reviewed the four LA100 study scenarios that were analyzed: SB100 (moderate, high, and stress loads), Early & No Biofuels (moderate and high loads), Transmission Focus (moderate and high loads), and Limited New Transmission (moderate and high loads). In addition, the 2017 SLTRP was included as a reference case. Santilli noted that the analysis is based on expenditures used to prepare the preliminary fiscal year 2022 budget modified with the 2017 SLTRP system configuration. This includes the Intermountain Power Project repowered with natural gas, once-through cooling units being repowered, and natural gas units continuing to be used past 2045. For rate comparison purposes, the reference case retail sales were modified to reflect higher load forecasts (high and moderate loads) from NREL's scenarios. The reference case also included low load, which is equivalent to LADWP's current forecasted retail sales.

Santilli then reviewed NREL's cumulative costs as presented in the LA100 published report, which include financing costs through 2045 but do not include some LADWP costs such as those for the power system reliability program, energy efficiency, demand response, and electric vehicles. She next displayed the LA100 estimated capital and operations and maintenance expenditures for all moderate, high, and stress load scenarios for fiscal year 2021 to 2045 used in the financial model. To generate these estimates, LADWP staff ran NREL's annual costs which had been converted to nominal dollars through their model, which assumes a 2.5% inflation rate for capital spending and fuel. She noted that the resulting costs do not include financing costs and have similar trends as NREL's.

Santilli next reviewed which LADWP capital and operations and maintenance expenditures are included in all scenarios. These include capital expenditures for energy efficiency, information technology infrastructure, infrastructure, operating support, and the power system reliability program. She noted that all the capital expenditures have corresponding operations and maintenance costs that have been added consistently to each scenario.

Santilli highlighted the three largest costs to serve customers and load on an annual basis: fuel, operations and maintenance, and interest debt expense. She provided an example of the SB100 scenario and noted that annual costs for LADWP are around $3 billion in 2020 and grow to about $6.5 billion by 2045. She next displayed a graph of the LA100 study annual fuel, operations and maintenance, and interest debt expenses for the moderate load scenarios, including the reference case. Under the moderate load scenarios, costs grow over time at different rates with increased load growth and costs are dependent on the scenario. She next showed a similar graph for the high and stress load scenarios, including the reference case with high load, and noted that the Transmission and Limited New Transmission scenarios have increased annual expenditures after 2040, which is a result of late capital expenditures seen in the modeling. Lastly, she showed a graph with all scenarios and load levels, including the reference case with low load, which is equivalent to current costs. Regardless of what scenario is chosen, costs will increase due to aging infrastructure and the need for LADWP to invest in storage and generation. By 2045, annual costs are expected to increase to approximately $6 billion under the current case (reference case with low load).

Santilli next covered the retail sales results. Currently, LADWP's retail sales are at 21,128 gigawatt hours. In general, there is large growth across all scenarios, and growth is expected to happen quickly. She then discussed

CO_2 emissions for the LA100 study scenarios under moderate loads and the reference case with low load and noted that the Early & No Biofuels scenario shows the fastest reduction in CO_2 emissions. When comparing the high and stress load scenarios and the reference case with high load, the Early & No Biofuels scenario also shows the fastest declines while CO_2 emissions for the reference case scenario with high load grow slightly before declining. She noted that current CO_2 emissions are around 7.8 million tons. This is much lower than prior levels due to LADWP's active efforts reducing CO_2 emissions in the power system.

Santilli then compared the retail rates between loads for all LA100 study scenarios and noted that the retail rate starts at approximately 19 cents/kilowatt-hour in 2020 and drops to 18 cents in 2021 before increasing again for all scenarios. For the SB100 scenario with moderate load, the retail rate grows to approximately 26 cents by 2030 and 28 cents by 2045. The average retail rate for the SB100 scenario with high and stress loads is approximately 26 cents by 2030 and stays the same until 2045. For the Early & No Biofuels scenario with moderate load, the retail rate grows to approximately 30 cents by 2030 and 36 cents by 2045 while the retail rate for the high load grows to approximately 29 cents by 2030 and 32 cents by 2045. For the Transmission Focus scenario with moderate load, the retail rate grows to approximately 27 cents by 2030 and 34 cents by 2045 while the retail rate for the high load grows to approximately 27 cents by 2030 and 31 cents by 2045. Lastly, for the Limited New Transmission scenario with moderate load, the retail rate grows to approximately 28 cents by 2030 and 36 cents by 2045. The retail rate for the Limited New Transmission scenario with high load grows to approximately 27 cents by 2030 and to 30 cents by 2045.

Santilli then compared the retail rates for all moderate load cases including the reference case. She noted that rates drop early for all scenarios and then increase fairly consistently. The SB100 scenario and the reference case with moderate loads both end at approximately 28 cents by 2045. She then compared all scenarios with high and stress loads, including the reference case, noting that the reference case uses natural gas and has higher CO_2 emissions in early years. The system average rate for the reference case under high load scenario is approximately 24 cents by 2030 and 25 cents by 2045. Lastly, Santilli displayed all of the different scenarios including the reference case under high, moderate, and low loads. The SB100 scenario with low load was also compared to show what the expected rates would be in 2021 without an increase in sales. Retail rates for the SB100 scenario with low load would be approximately 34 cents by 2030 and 36 cents by 2045.

Santilli next compared retail rates with 2.5% and 3.5% inflation rates applied. By 2045, retail rates would grow to approximately 36 cents with the 2.5 inflation rate. Applying a 3.5% inflation rate results in retail rates growing to approximately 45 cents by 2045. She then overlaid the retail rates with the 2.5% inflation rate over a graph displaying retail rates for all scenarios and loads including the reference case with low load. She noted that except for the Early & No Biofuels scenario with moderate load, the 2020 retail rates with 2.5% inflation are higher than the retail rates for all scenarios by 2045.

Santilli then showed the average 5-year rate increases for the different scenarios and loads. She said that rate increases stay under 6% for all moderate load scenarios when looking at the 5-year averages but noted that rates do exceed 6% for the Early & No Biofuels scenario when considering individual years. Rate increases also stay under 6% for the high and stress load scenarios when looking at the 5-year averages. Depending on the scenario chosen, LADWP staff will use available tools to smooth rate changes.

Santilli lastly provided some conclusions and next steps for the rate impact analysis. First, early investments will trigger increased rates within the first 10 years, but rates will stabilize after that. Second, electrification offers an opportunity to maintain steady system average rates. Santilli noted that rates could be lower for the high load scenarios but achieving the lower rate was contingent on achieving the high electrification assumptions. Third, among all scenarios, the rate impact analysis reveals a rate range between 25 cents and 36 cents in fiscal year 2045. Lastly, the SB100 scenario with high load offers the lowest rate in 2045 while the Early & No Biofuels scenario with moderate load shows the highest rate in 2045. In addition, Santilli noted that in fiscal year 2045, rates for all but one scenario are lower than the fiscal year 2020 rate inflated at 2.5% annually. Next steps include LADWP working with the Office of Public Accountability to review the rate impact analysis and continuing to refine the analysis as LADWP staff move forward and evaluate the different pathways to 100% renewable energy.

Next Steps

Jason Rondou, LADWP Director of Clean Grid LA Strategy Division, discussed LADWP's next steps following the conclusion of the LA100 Study. LADWP will next pursue the "no regrets" actions that will keep on track for achieving 100% renewables and ensure flexibility in meeting environmental justice goals. The "no regrets" projects will be based on common findings of the LA100 scenarios. Additionally, LADWP will conduct another round of public outreach in April and kickoff off the 2021–2022 SLTRP during the summer. Rondou noted that community and stakeholder input will be incorporated throughout the SLTRP process.

Major Themes from Advisory Group Member Questions and Discussion

- Are there any renewable or other grid improvement projects that could qualify for Biden's proposed infrastructure stimulus and how might that reduce rate impacts?
- We have four pathways to achieve 100% renewable energy and the city still needs to adopt a plan after discussing the options that we know can work.
- What is a "nominal dollar"? Are the retail rates in slide 22 in nominal cents? In the slides, is a negative percentage a rate decrease?
- The NREL analysis did not include heavy-duty electrification (such as movement of port goods) due to the lack of data at the time, but NREL did a qualitative analysis of the impact of including heavy-duty electrification. Can LADWP do a similar qualitative analysis of rates impacts from heavy-duty electrification?
- This rates presentation should be included in the April public outreach meetings.
- Household energy insecurity (sum of all energy sources) should be added to the LADWP equity metrics.
- How are the costs of rooftop solar and batteries factored into the rate impact analysis?
- Will LADWP recommend one of the scenarios as the focal point of its plan after the public outreach meetings in April and the summer?
- What is the timeline for the "no regrets" projects that will be implemented and do they keep LADWP on track for all four scenarios?
- The growth in rates is lower than anticipated because of the assumption that large amounts of money would not be able to be financed over time and are therefore financed in real time through rates. Do these rate increases assume only modest financing, recognizing that high sales cover some of the need to finance?

- Could a bill analysis that includes electric, natural gas, and gasoline be prepared?
- How are the cash requirements for capital expenditures factored into the rate impact analysis?
- The 5-year average rate increases showed that the largest increases will take place in the next 10 years, which are very high increases in the short term.
- Will a higher level of electrification require upgrading the distribution network and how much will it cost?
- Limited transmission availability for Imperial County geothermal could result in more geothermal being sourced in Nevada. Does the LA100 study account for these costs?
- I saw that LADWP joined the Energy Imbalance Market. Does this impact the results?
- Being on the Advisory Group the last 3 years has been a very good experience and a big investment for us all but entirely worth it.
- This is truly a groundbreaking national study, and to be a part of it is an honor.
- Several Advisory Group members thanked everyone and expressed appreciation for the work put into the LA100 study.

Wrap-up

In wrapping up the session, Isaacson noted how much that she enjoyed working on the LA100 study and appreciated the relationships she grew with Advisory Group members during the process.

Rondou thanked the many Advisory Group members who have been involved in the process the last several years. He noted that many have dedicated a large amount of their professional careers to this study and have strongly advocated for what they believe in and find important. He thanked NREL staff for the value they brought to the City of Los Angeles, LADWP's financial service team for pulling together the rate impact analysis so quickly, LADWP's community affairs team for its involvement, and the power system team for all of its hard work behind the scenes. He acknowledged that rates are important and many people in Los Angeles will be impacted by the work being done here. Los Angeles now has a plan for getting to 100% renewable energy equitably, economically, and reliably and can do so in a way that inspires other cities and utilities across the state, country, and world. He said it has been an honor to work with Advisory Group members and that he was looking forward to the next steps.