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Docket Number:	18-IEPR-06		
Project Title:	t Title: Integrating Renewable Energy		
TN #:	TN #: 225784		
Document Title:	Presentation - NREL LADWP 100% Renewable Energy Study Advisory Group Meeting #5		
Description:	Description: N/A		
Filer:	System		
Organization:	Southern California Gas Company		
Submitter Role:	Public		
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Docketed Date:	11/2/2018		

DOCKETED				
Docket Number:	18-IEPR-06			
Project Title:	Integrating Renewable Energy			
TN #:	225784			
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Description:	Description: N/A			
Filer:	System			
Organization:	NREL and LADWP			
Submitter Role:	Public			
Submission Date:	11/2/2018 2:39:08 PM			
Docketed Date:	11/2/2018			

Comment Received From: Edith Moreno

Submitted On: 11/2/2018 Docket Number: 18-IEPR-06

NREL LADWP 100% Renewable Energy Study Advisory Group Meeting

Please find attached a presentation by the National Renewable Energy Laboratory produced for Los Angeles Department Water of Power's 100 % Renewable Energy Study Advisory Group Meeting #5 (held on June 7, 2018). It presents a simulation of LADWP supply/demand under increasing renewables load. NREL highlights the need tor seasonal storage and NREL explicitly recommends Power-to-Gas and hydrogen to provide that resource.

Additional submitted attachment is included below.













Los Angeles 100% Renewable Energy Study Advisory Group Meeting #5 June 7, 2018

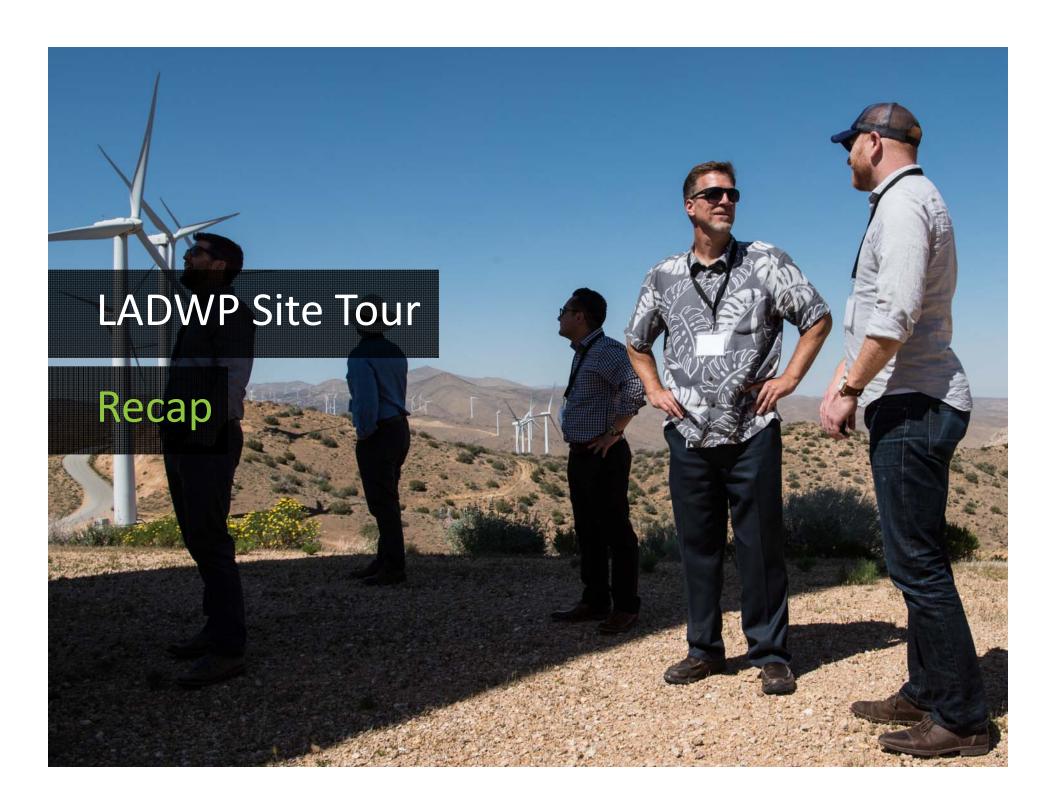
Agenda

Call to Order and Agenda Overview	
Welcome and Introductions	
Update Exchange	
Considerations for Planning a 100% Electric Power	System
Lunch Served	
Revised Scenarios and Sensitivities	
Wrap-up and Next Steps	

Advisory Group Schedule



QUARTER	Phase 1 2017 LAUNCH AND ORGANIZATION	Phase 2 2018 SCENARIOS	Phase 3 2019 ANALYSIS AND MODELING	Phase 4 2020 FINAL REPORT
Q1	COMPLETED MEETINGS/TASKS PLANNED MEETINGS/TASKS	Advisory Group Meeting Plan Preliminary Scenarios and Sensitivities Field Trip Itinerary Power Strategic Long-Term Power Resources Plan Once-Through Cooling Study Update	 Capacity Value Electricity Operations Modeling II Jobs & Economic Analysis II 	 White Papers on Electricity Modeling Results Final Results 1) Jobs & Economic Analysis and 2) Environmental Analysis Final Visualization of Electricity Operations
Q2	Advisory Group Launch City Council Motion: 100% Renewable Energy Study	Draft 100% Papers: Framing, Data, Methods Final Scenarios and Sensitivities Once-Through Cooling Study Update	 Planning Reserves Operating Reserves Load Modernization Environmental Analysis II Publication Plan 	Final Report Final Presentation
Q3	Advisory Group Charge and Operating Protocols Introduction to NREL and 100% Renewable Energy Study	Final 100% Papers Electricity Operations Modeling I Jobs & Economic Analysis I Environmental Modeling I Once-Through Cooling Study Update	 Final Scenarios and Sensitivities Results Final Visualization of Scenarios Initial Electricity Operations Modeling Results 	LA Los Angeles Department of Water & Power
Q4	Defining Clean Energy and Renewable Energy Considerations for Study Once-Through Cooling Study Overview Public Outreach Overview	Initial Scenario Results Draft Visualizations of Scenarios Once-Through Cooling Study Results	 Final Electricity Operations Modeling Results and Draft Visualizations Draft results on Jobs and Economic Development Draft results on Environmental Analysis 	NATIONAL RENEWABLE ENERGY LABORATORY As of June 2018





2018 Tour Dates

- Fri., Jun. 22 Sat., Jun. 23
- Fri., Sep. 21 Sat., Sep. 22
- Fri., Oct. 19 Sat., Oct. 20
- Fri., Nov. 2 Sat., Nov. 3

- Tour the 233-mile route that the city's water travels to arrive at the tap.
- Two-day tour
- Learn about delivering water and power safely and reliably to the City of Los Angeles.







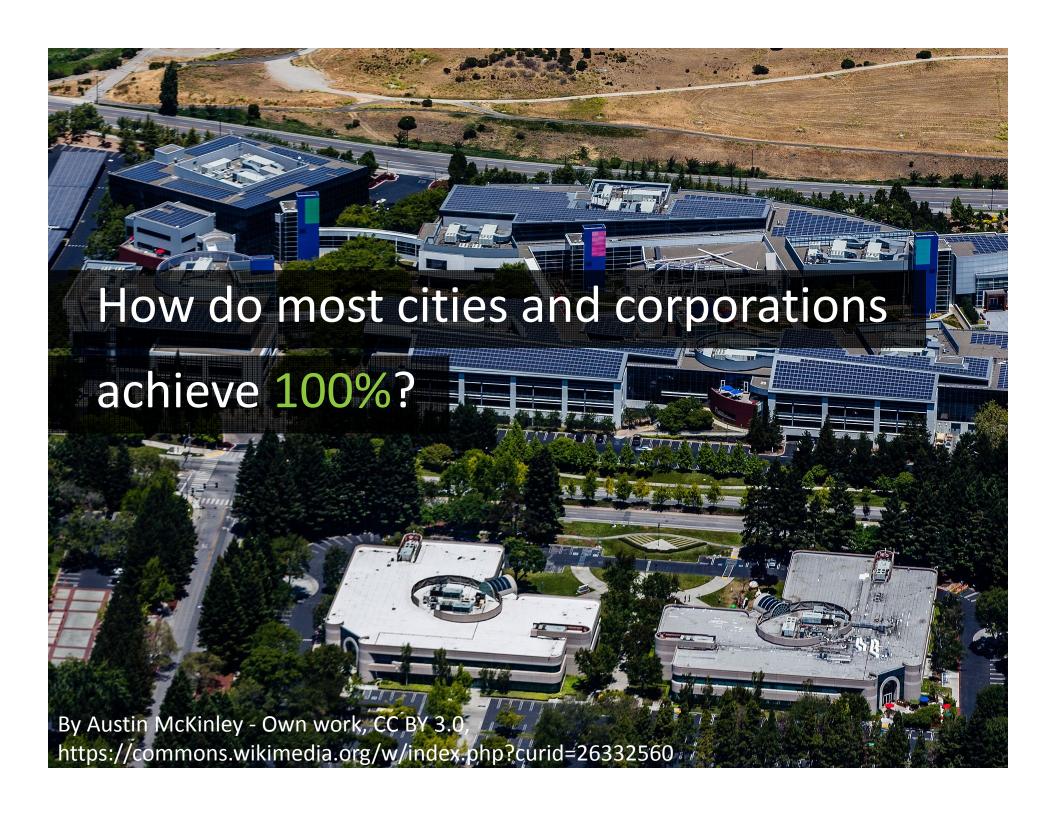


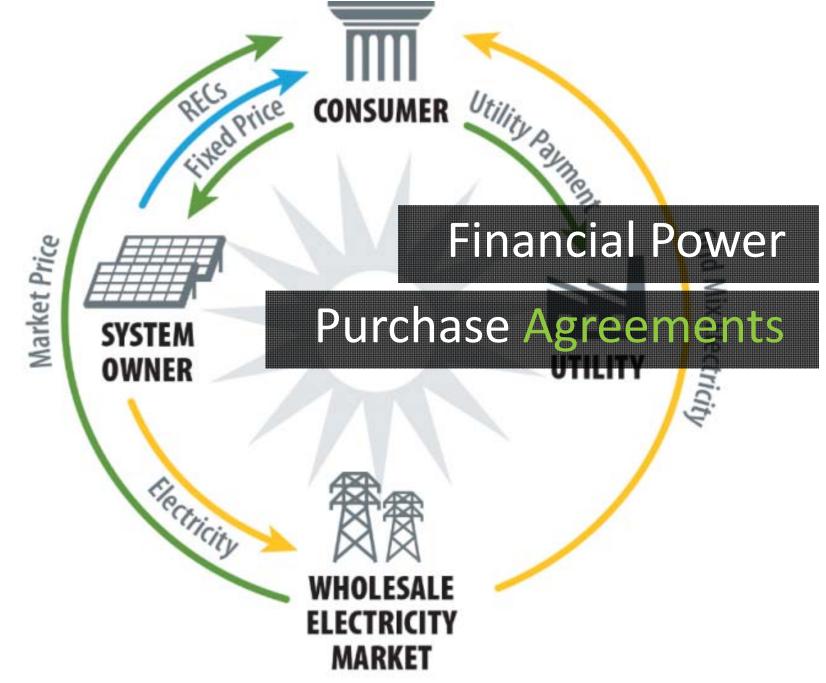




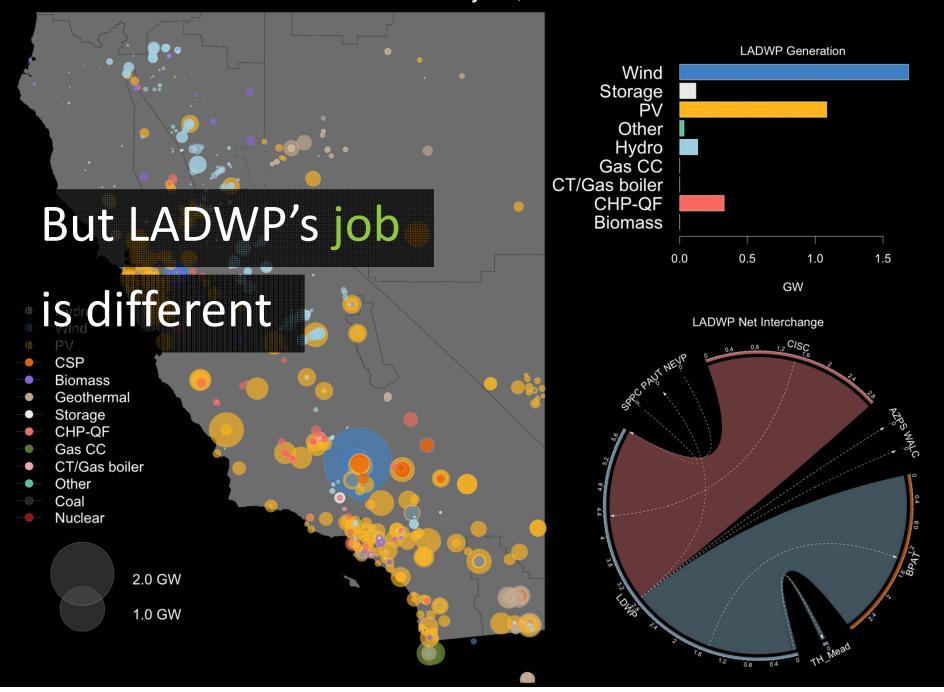
Considerations for Planning a 100% Electric Power System

P. Denholm

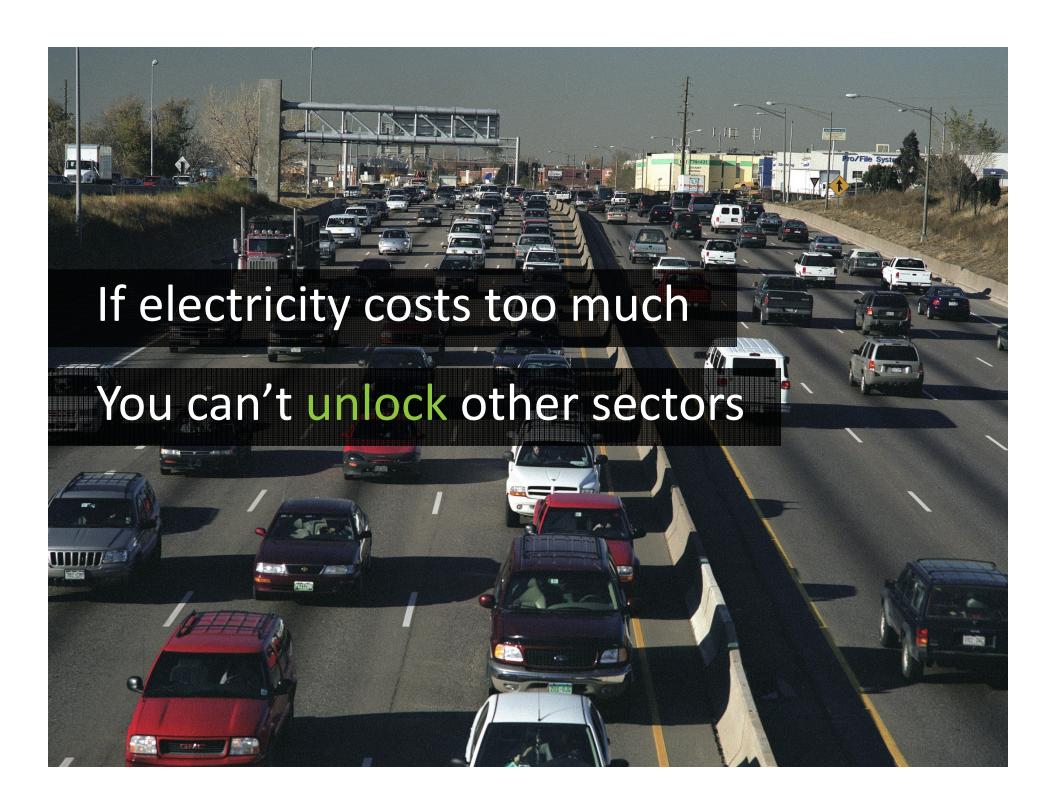




May 10, 2024 15:00







The Two Topics



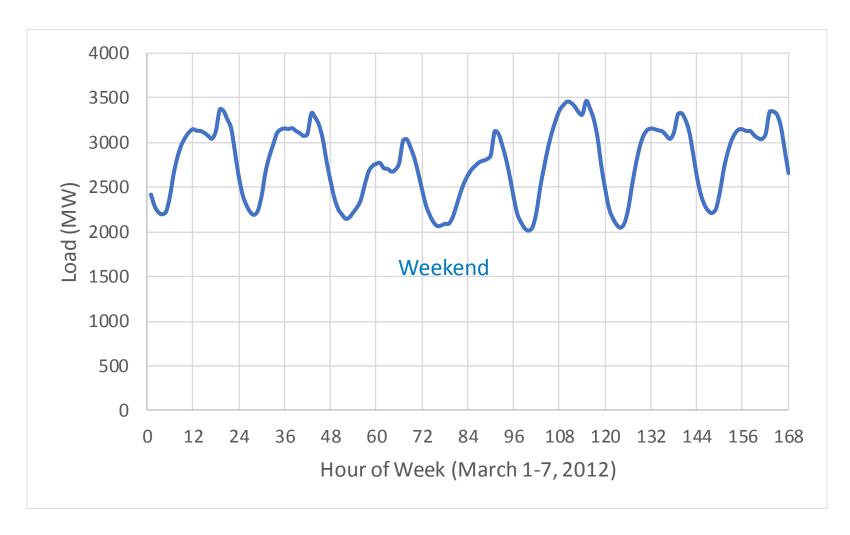
- Maintaining economic generation of Variable Generation (VG) due to supply/demand mismatch
- Maintaining resource adequacy overall time scales without the "backup" of fossil generators

Important Topics We Will Not be Talking about Here



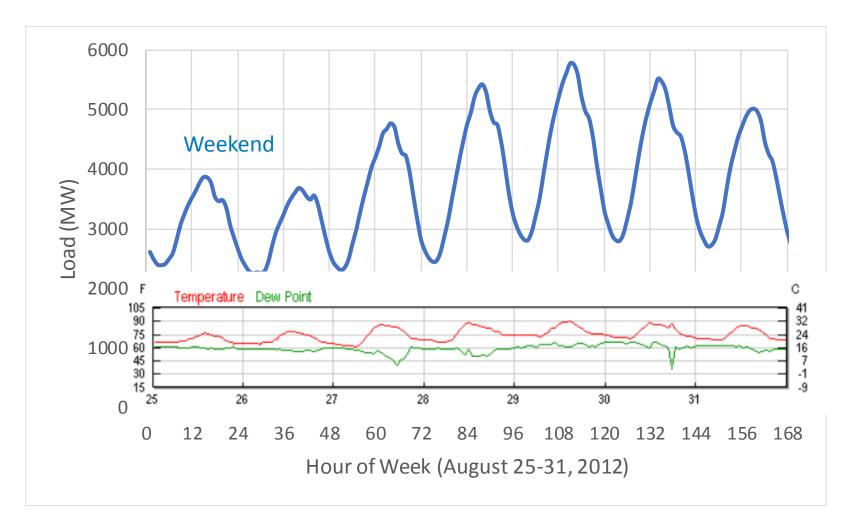
- 1. Transmission upgrades
- 2. Wind and Photovoltaic (PV) siting





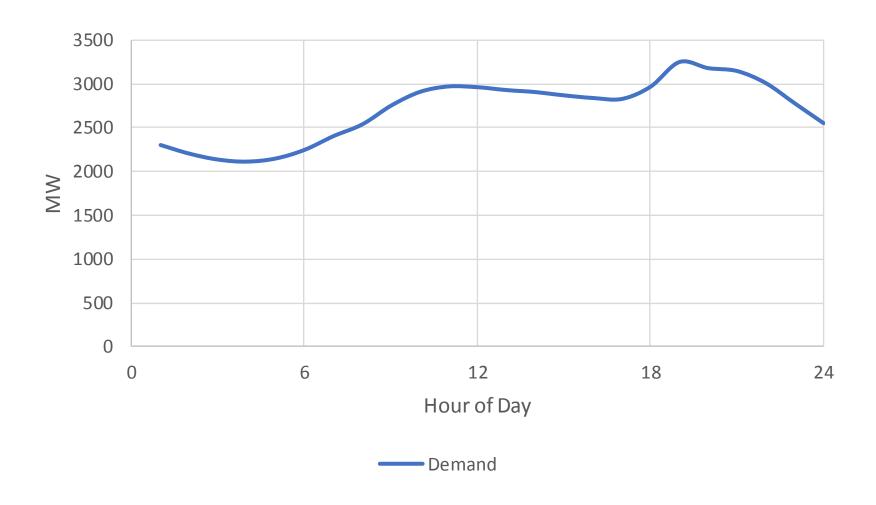
Here is there demand from March 1-7 (a low demand week).





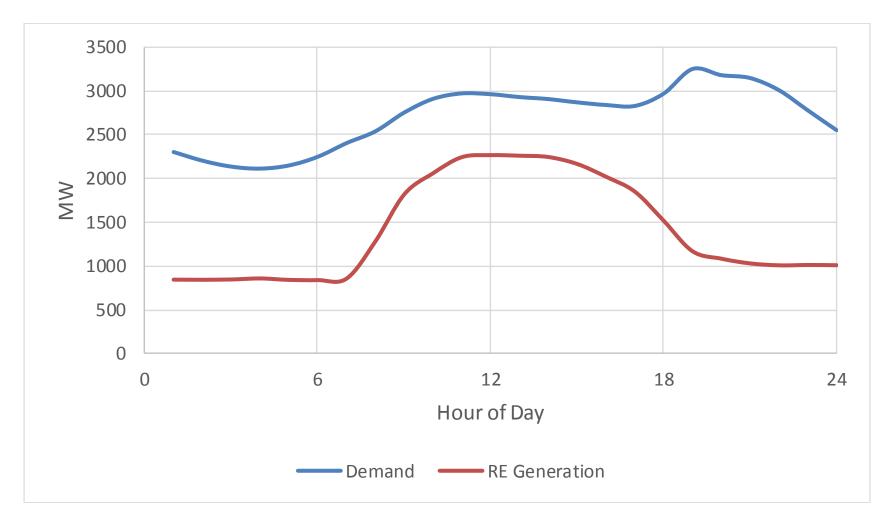
Here is there demand from August 25-31 (the week with highest demand).





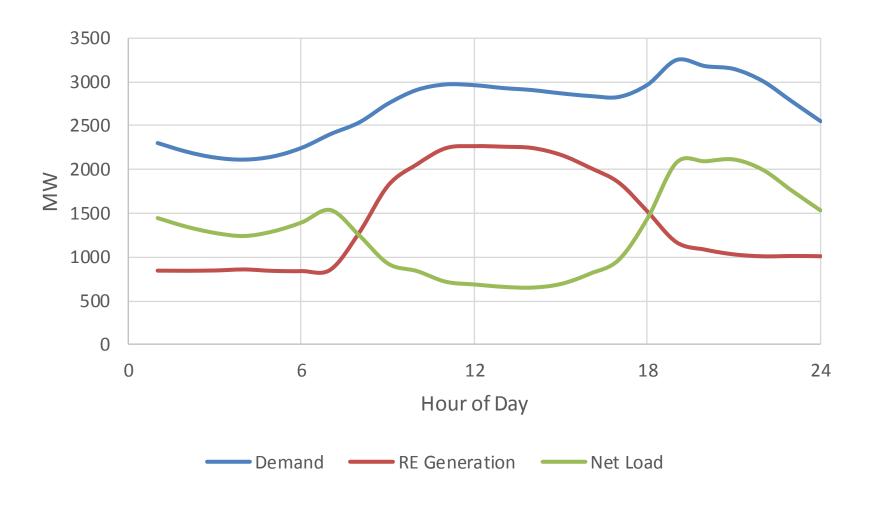
Here is the demand for electricity on Feb 20. This is a typical "low demand" period we see in the spring, or other periods with mild weather.





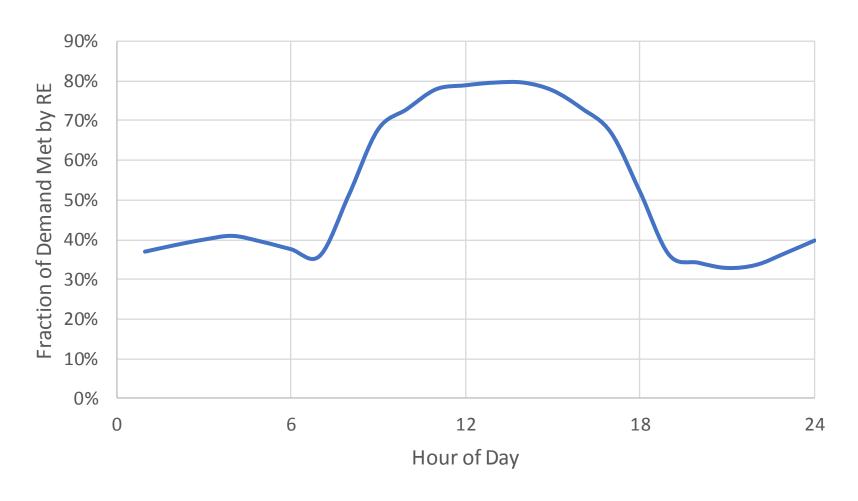
Here is the supply of renewable energy for this day.





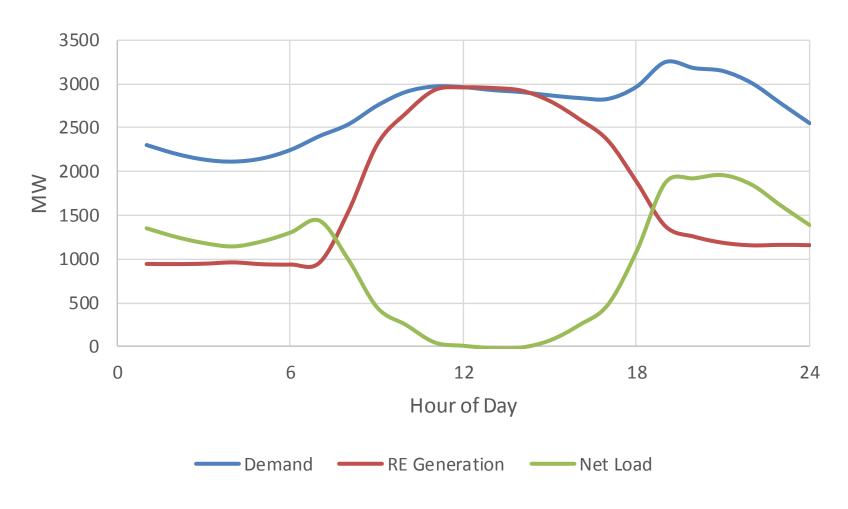
And here is the net demand, or the demand that LADWP must meet with other resources.





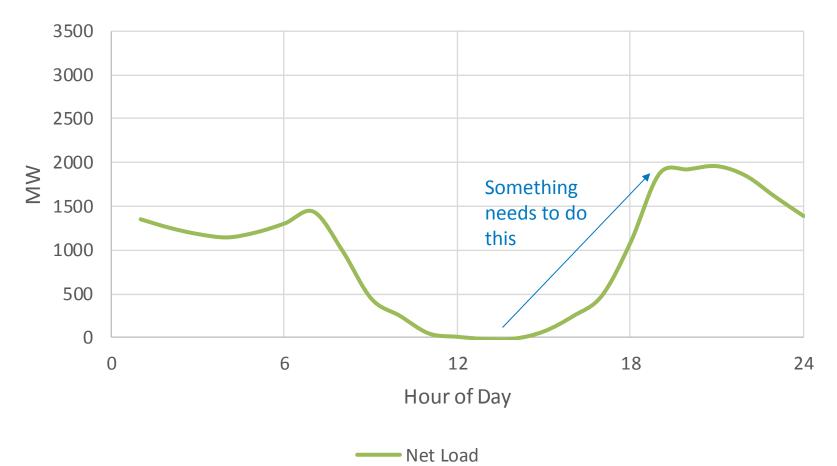
Because the mismatch of supply and demand, the fraction of demand met by RE in each hour varies considerably. Overall the fraction of demand met by RE on this day is 54% (compared to annual average of 40%).





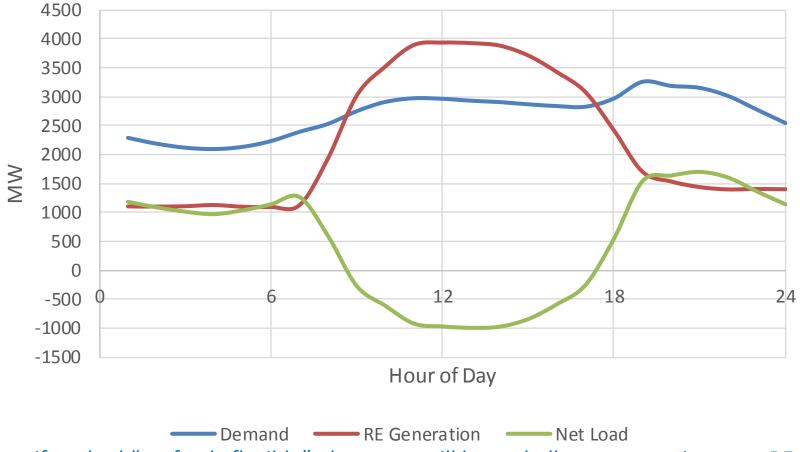
Adding another 300 MW of wind and 600 MW of solar gets us here. We are up to just under 50% annual energy from Renewable Energy (RE). During 1 hour of the day RE now provides 100% of the systems total demand.





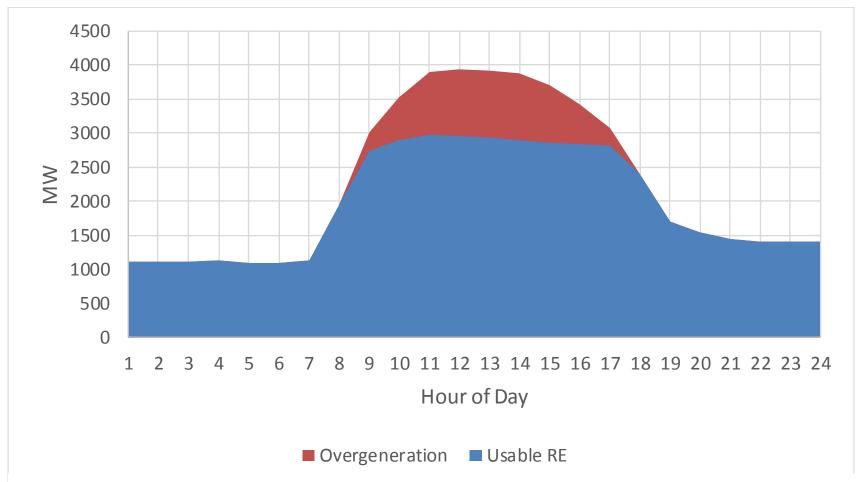
This presents some problems as we transition from a hydro/thermal based system to an all RE based system. Meeting this net load curve would require turning off all of LADWP's power plants for an hour, then turning them back on, and quickly ramping them back up. This isn't really possible, so we probably couldn't accommodate all this RE generation.





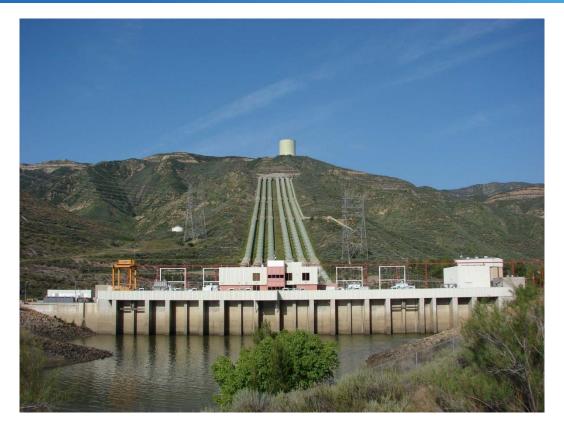
Even if we had "perfectly flexible" plants, we still have challenges as we increase RE penetration. Here is a case where we try to get 60% of LADWP's energy from RE (including 1,800 MW of wind and 2,700 MW of solar). On this day the supply of RE exceeds demand.





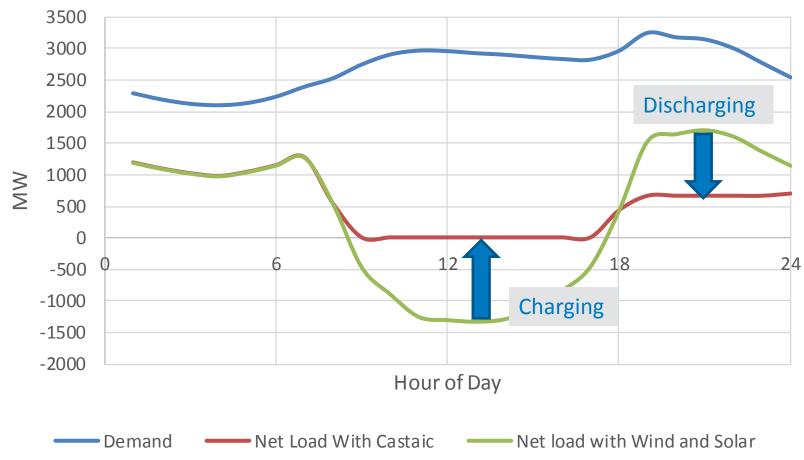
Even if LADWP could reduce the output of all its other generators to zero, it would still need to curtail or sell this surplus energy. This excess supply is sometimes called "overgeneration".





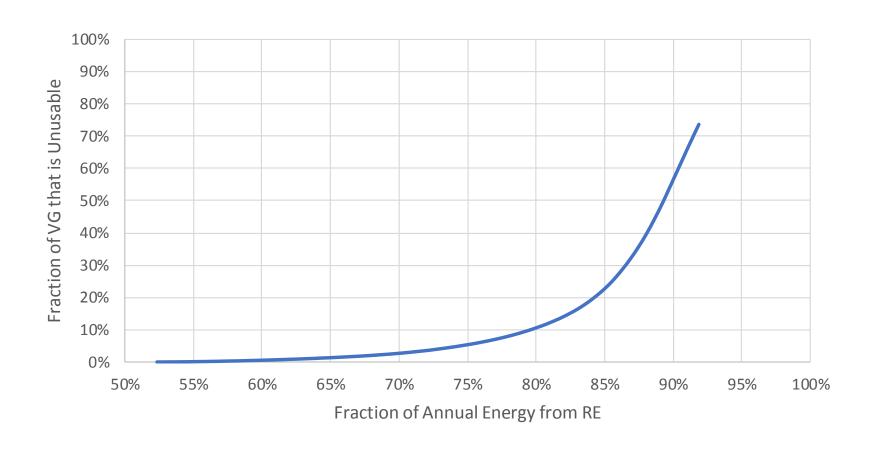
Currently deployed options to deal with overgeneration including storing energy in the Castaic pumped storage plant or selling the energy to its neighbors. Castaic is rated at about 1,175 MW of capacity and is about 70% efficient, meaning it throws away 30% of the energy it stores. Selling energy to neighboring utilities is an important options, but what happens when LA's neighbors are saturated with RE?





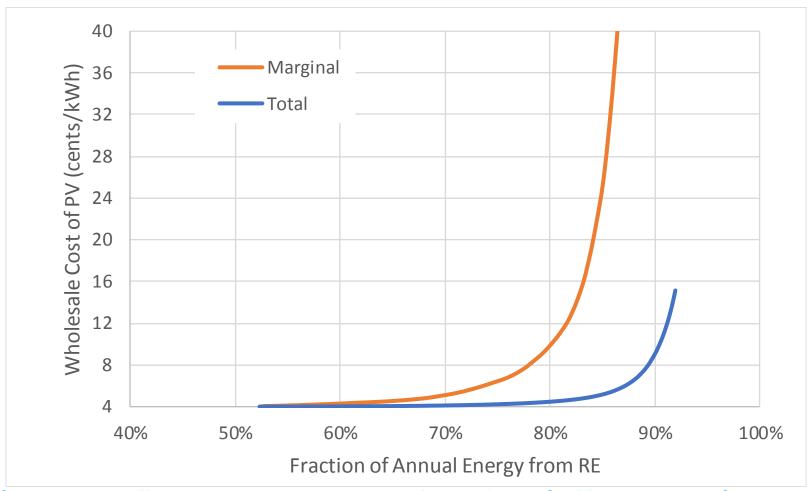
Adding in Castaic eliminates curtailment on Feb 20. But we have just about saturated the power capacity of this storage plant. More solar on this day will create more overgeneration.





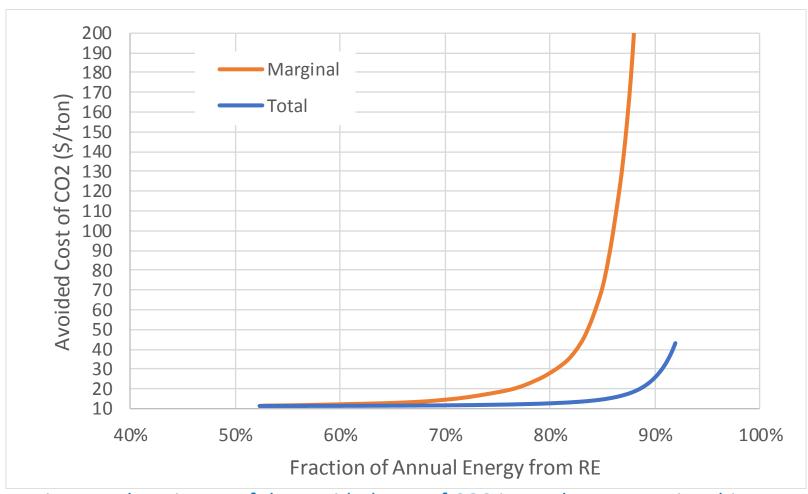
So without more storage or some other mechanism to improve the coincidence of supply and demand, the amount of unusable energy just keeps going up...





If we cannot sell overgeneration to surrounding utilities, find better ways of using RE, or build more storage, here is a rough estimate of what LADWP would have to pay for PV as it moves towards 100% RE.





Here is a rough estimate of the avoided cost of CO2 in our base scenario. This assumes that RE avoids \$4/MMBTU gas at a 7,500 BTU/kWh average heat rate.

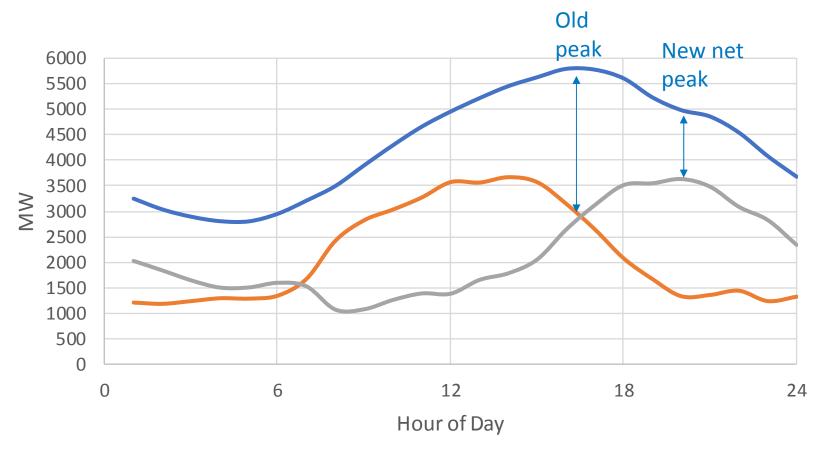
Before we start talking about solutions....



We need to talk about resource adequacy. Because topic two is closely related to topic one. So bear with us and we will get to the fun stuff.....

Topic #2: Resource Adequacy

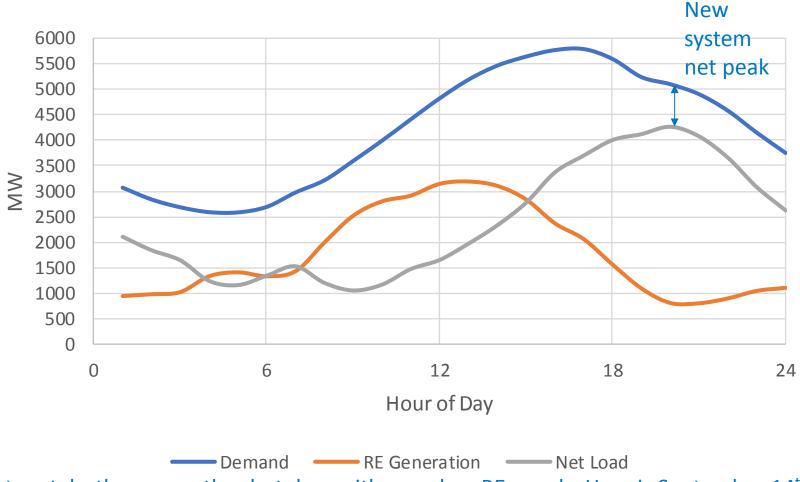




Here is LADWPs peak demand on August 29th in a 65% RE scenario. During the hour of peak demand, we got a decent amount of sun and wind. But the PV shifts the peak demand to later in the day after the sun has set and we still need about 3500 MW of something else.

Topic #2: Resource Adequacy

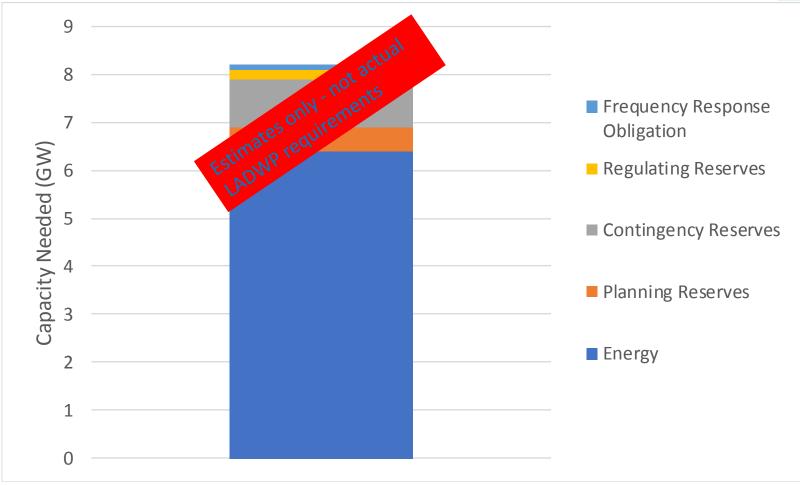




Unfortunately, there are other hot days with even less RE supply. Here is September 14th. We have less wind, slightly earlier sunset, and a slightly later peak. Our 5,000 MW of wind and solar capacity is producing less than 500 MW and our net peak demand is over 4,000 MW. Even with Castaic, we need about 3,000 MW of additional capacity.

Topic #2: Resource Adequacy





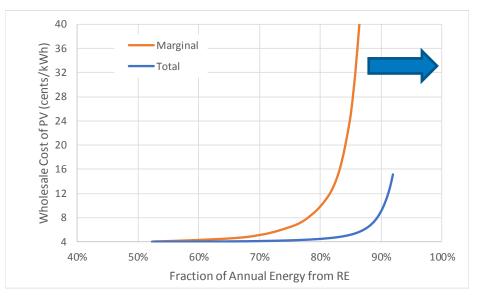
And LADWP also needs to plan around outages of their transmission network and generation resources. This means even more "firm" capacity is needed during the hours of peak demand. This capacity is unlikely to be provided from wind and solar, because as we have shown, there is relatively little solar and wind available during the hours of peak demand.

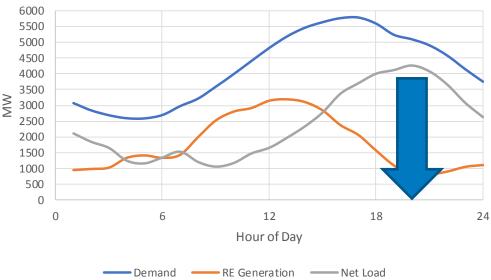
Finding Solutions



This study is about finding solutions and understanding the technical and economic challenges of 100%. We need to find a mix of resources that shift the cost curve and meet the economic challenges...

And find a mix of resources that will meet the demand for reliable energy during all hour of the year.







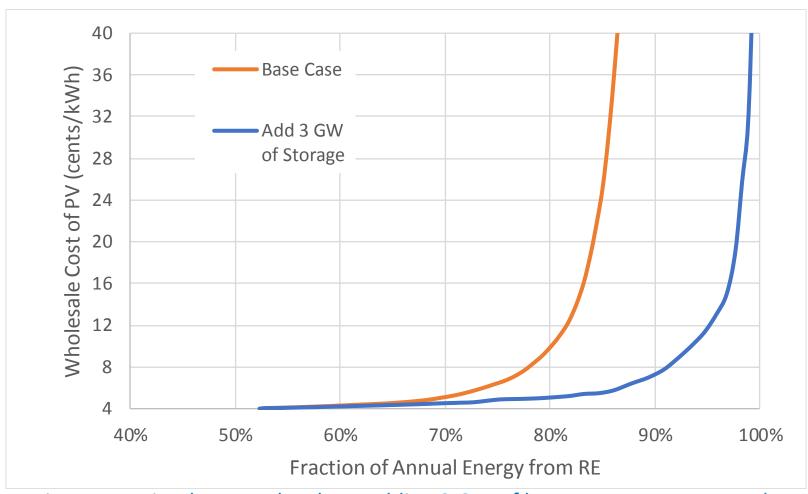
Possible Solutions



- Dispatchable renewables
- Spatially diverse wind and solar resources
- Demand response/load shifting
- Energy storage
- Net energy exchanges
- Controlled Electric Vehicle (EV) charging

Example: Storage and Load Shifting





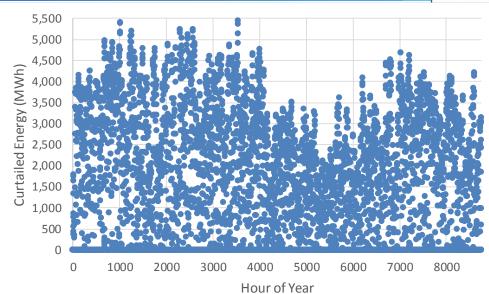
Here is an very simple example where adding 3 GW of battery storage gets us along way. But it doesn't get us all the way, and adding more batteries has very rapidly diminishing returns due to the seasonal mismatch problem.

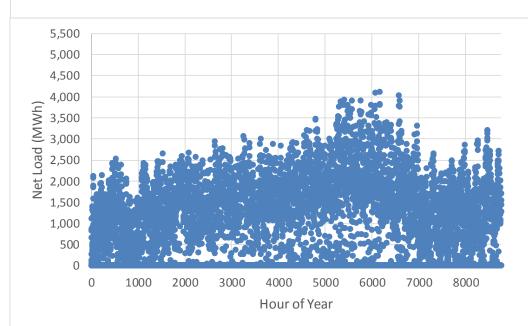


Here is the curtailed energy in a system where we have built enough RE capacity to meet 100% of annual demand. We haven't added any storage or included Castaic.

Here is the net load (the amount of demand left over that would need to be met with storage or something else).

Now lets see what happens when we ad Castaic and another 3 GW of batteries....



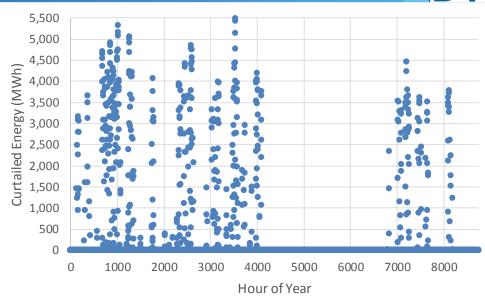


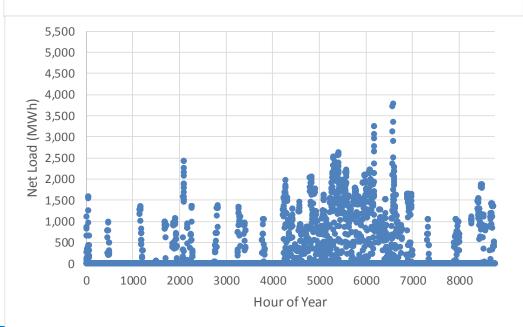


We have completely absorbed all the curtailed energy in the summer. We still have some left in the spring.

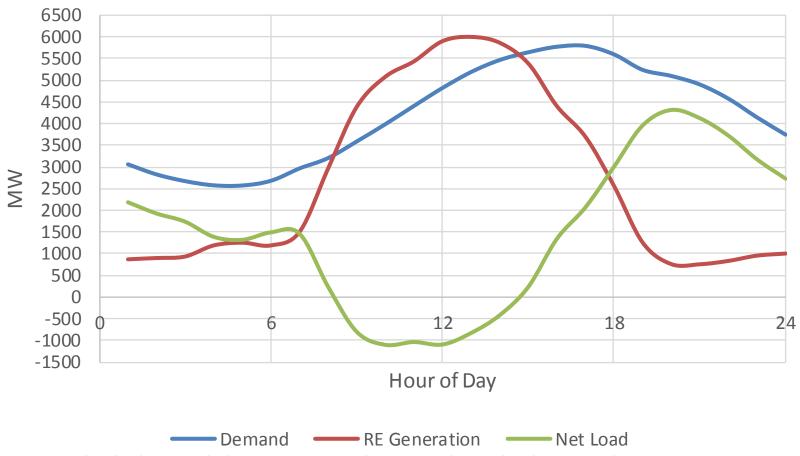
And we still have significant demand left in the summer.

So more short duration storage won't help. Let's look at a peak day to look at this another way.



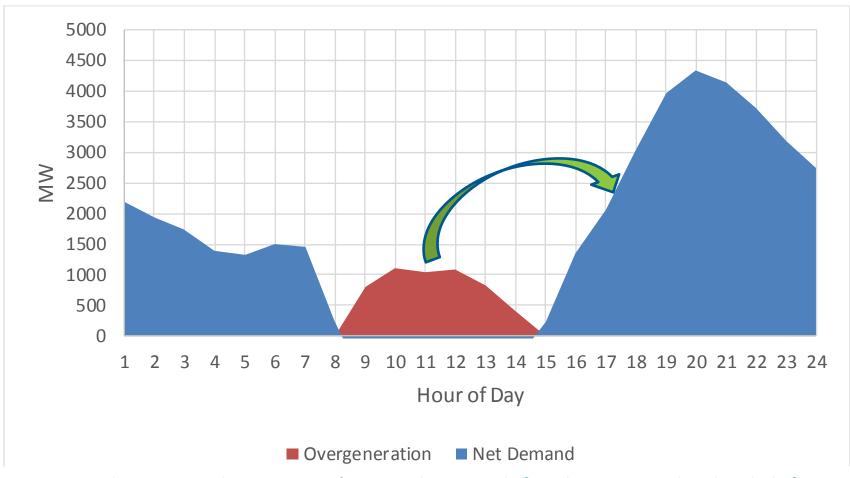






Here is a very high demand day in a case where we have built enough RE to meet 100% of demand. Our net load peaks at about 4,300 MW. So our storage case (Castaic plus 3 GW of batteries) could provide us almost enough capacity to meet the energy requirements. This ignores reserve requirements, so we do NOT have a reliable system.





But even with storage, there just isn't enough RE to shift. This means that load shifting doesn't solve the problem either. We simply have too much demand overall on this day. We could build more solar, but we don't need more energy during most of the year, so it would just be wasted during fall through spring.

Possible Solutions



- Energy efficiency (targeted towards summer loads)
- Power to gas, hydrogen or other fuel production
- Bioenergy
- Net energy exchanges

Key Take-aways



- There are fundamental economic and technical considerations for achieving a 100% power system.
- These are mostly centered around the mismatch of renewable supply and demand.
 - We need to address both the daily mismatch AND the seasonal mismatch.
- This study will examine the host of flexibility options which can minimize the cost impacts of achieving very high levels of RE.
- This overview has ignored many of the technical and engineering issues
 associated with designing, modeling and analyzing a 100% RE power system.
 However the study will address them in detail, and we will be doing a deep dive
 on many of them at future meetings.

Discussion

Thank you!



www.nrel.gov



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













LA100: Draft Scenarios May 15, 2018

Revisiting the Motions: March 2nd, 2016



"The city has an opportunity to re-create its utility in a way that recognizes the **potential for a fossil-free future**, demonstrates **global leadership** in its commitment to clean energy, and **protects ratepayers** from the increasing costs of carbon-based fuels."

"[T]he Council request that Los Angeles Department of Water and Power report with a program to develop and implement a research partnership...with the objective of determining what investments should be made to achieve a 100% renewable energy portfolio for the LADWP."

Revisiting the Motions: September 16th, 2016



"[T]he Council request that the LADWP....examine, over the course of the research into a 100% renewable portfolio, the potential for high quality careers and equitable local economic development, including local hiring programs for work that must be performed to modernize the electric system infrastructure.."

Revisiting the Motions: August 1st, 2017



- "...incorporate into its research efforts the following:
 - a. An analysis by the Rate Payer Advocate on how each scenario fits within the current rate structure to include the impact, if any, each scenario would have on low income customers.
 - b. Incorporation of the CalEnviro Screen into each research area, and as the context for any analysis, study, and/or recommendation.
 - c. The prioritization of environmental justice neighborhoods as the first immediate beneficiaries of localized air quality improvements and greenhouse gas reduction."

Goals of Scenarios

Address full suite of questions and issues raised in the City Council Motions



- Broad objective: determine what investments should be made to achieve a 100% renewable energy
- Examine the impacts on local jobs and economic development
- Understand the electricity rate, air quality, and health impacts
 of achieving a 100% renewable system; identify environmental
 justice neighborhoods to be first beneficiaries of improvements

Consider the full suite of options for achieving 100%



Demand-side:

Demand response, end-use efficiency, and electrification

Supply-side:

 Renewable generation (utility scale and distributed), existing nuclear, fossil with carbon capture and storage, existing hydro

Financial mechanisms:

 Renewable energy credits (RECs), greenhouse gas allowances

Robust



- To current trends, plans, policies, and regulations...
- To a broad set of future conditions/uncertainties
 - Evolution of load—efficiency, flexibility (DR), and electrification
 - o Balance between centralized and distributed supply
 - Ability to develop additional transmission & distribution

Incorporates AG Feedback on Preliminary Scenarios



	Referen	ce Cases			Leads			
Candidate Technologies	2018 IRP	Draft \$8.100	100% Carbon Neutral	100% Renewable	100% Carbon Neutral – Accelerated	Koad Modernizatio		
Watural Gas	• (1)		•					
Wind, Solar, Geothermal	• 11	11/19/11/1	•	• 111				
Existing Nuclear	•		•		•			
New Nuclear			•					
Bioenergy			•		*			
EXISTING FIXOLO	1 1001111 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1				ne Februa	ry .		
New Hydro 15th	h, 20:	18.Ad	visory	Group	Meeting			
ÆEÇs	•	•	•		y			
Storage	(· ///		•		* * * * * * * * * * * * * * * * * * * *			
Electric Véhicles	Expected	Expected	Expected	Expected	Expected	Нюн		
Énergy Efficiency	Expected	Expected	Expected	Expected	ніє́н	MEH		
Demand Response	Expected	Expected	Expected	Expected	HIGH	MIGH		
Transmission Feasibility	Expected	Expected	Expected	Expected	NEW PATHS	NEW PATHS		
Decentralization	Expected	Expected	Expected	Expected	Expected	изан		
Technology Cost	Expected	Expected	Expected	Expected	Kow	Color		
#imeframe	2020-2050*	2020-2050*	2020-2050*	2020-2050*	2020-2045*	2020-2050*		



- Accelerated compliance
- Financial vs physical compliance
- Carbon neutral, combustion free, or 100% renewable
- Detailed reporting of assumptions and exogenous inputs
- Current policies, plans, and initiatives reflected in load forecasts
- Interim targets—when do we reach 70, 80, 90%?
- Equity implications
- Environmental impacts beyond CO₂
- Regionalization/further participation with the Western EIM and CAISO



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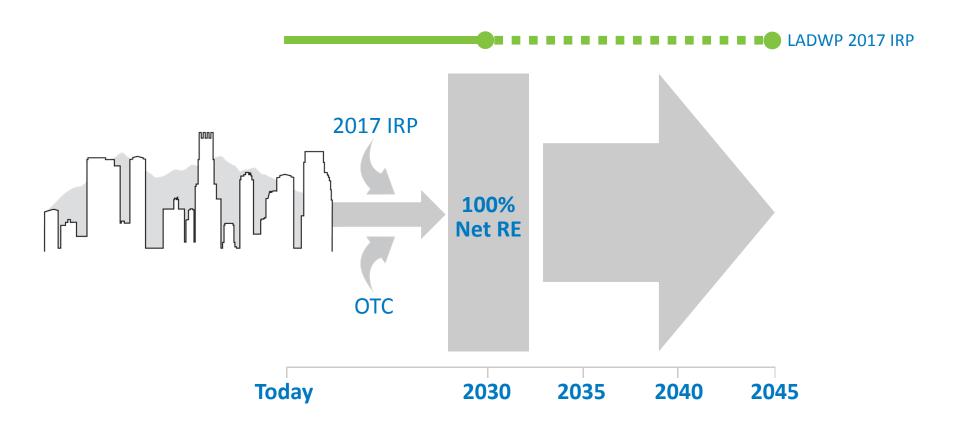
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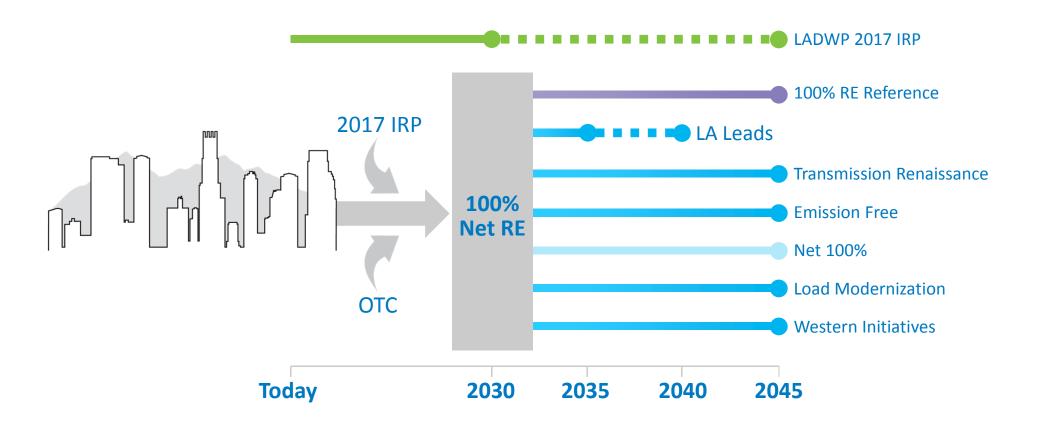
Scenario Framework





Scenario Framework





Revised Scenarios—Comment Mapping



	Scenarios									
Comment	LADWP 2017 IRP Recommended Case	100% Renewable Reference Case	LA-Leads	Transmission Renaissance	Limited Transmission	Emissions Free	Net 100%	Load Modernization	Western Initiatives	
Accelerated Compliance			٧							
Interim Targets	٧	٧	٧	٧	٧	٧	٧	٧	٧	
Financial vs Physical Compliance		٧					٧			
Current Policies, Plans, and Intiatives	٧	٧	٧	٧	٧	٧	٧	٧	٧	
Detailed Reporting	٧	٧	٧	٧	٧	٧	٧	٧	٧	
Current Policies, Plans, and Intiatives	٧	٧	٧	٧	٧	٧	٧	٧	٧	
Equity Implications	٧	٧	٧	٧	٧	٧	٧	٧	٧	
Environmental Impacts Beyond CO2	٧	٧	٧	٧	٧	٧	٧	٧	٧	
Regionalization, EIM, CAISO									٧	

^{*}All scenarios achieve net 100% renewable by 2030

Scenario Matrix



		LADWP 2017 IRP Recommended Case	100% RE Reference	LA-Leads	Transmission Renaissance	Limited Transmission	Emissions Free	Net 100%	Load Modern- ization	Western Initiatives
	Compliance Year:	m m	2045	P40ES7#4024(0)	2045	2045	2045	2045	2045	2045
	Biomass		Υ	Υ	Υ	Y	N	Υ	Υ	Y
	Biogas		Υ	Y	Υ	Υ	N	Υ	Υ	Y
Technol-	Electricity to Fuel (e.g. H2)		Υ	Υ	Y	Υ	Υ	Υ	Υ	¥
	Fuel Cells		Υ	Y	Υ	Υ	Y	Y	Υ	Y
ogies	Hydro - Existing	Matches 2017	Υ	Y	Υ	Y	Υ	Y	Υ	Y
Eligible in	Hydro - New	IRP Technology	N	N	N	N	N	N	N	N
the	Hydro - Upgrades	Mix	Y	Y	Υ	Y	Y	Υ	Y	Y
Compliance	Natural Gas		N	N	N	N	N		N	N
Year	Nuclear - Existing		N	Y	N	N	Y		N	N
	Nuclear - New		N	N	N	N	N	N	N	N
	Wind, Solar, Geo		Y	Y	Y	Y	Υ	Υ	Y	Y
	Storage		Υ	Y	Y	Y	Y	Y	Y	Y
DG	Distributed Adoption	Reference	Balanced				Balanced	Balanced	Balanced	Balanced
RECS	Financial Mechanisms (RECS/Allowances)	u.	P.E.	the state of the s	N	N	N	Yes	N	N
	Energy Efficiency	Reference	Moderate	Fligh	Moderate	High	Moderate	Moderate	High	Moderate
Load	Demand Response	Reference	Moderate	High	Moderate	High	Moderate	Moderate	Figt	Moderate
	Electrification	Reference	Moderate	High	Moderate	High	Moderate	Moderate	High	Moderate
Trans- mission	New or Upgraded Transmission Allowed?	Matches 2017 IRP	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors	New Corridors Allowed	No New Transmission	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors
WECC	WECC VRE Penetration	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	High

^{*}All scenarios achieve net 100% renewable by 2030

Scenario Matrix



		LADWP 2017 IRP Recommended Case	100% RE Reference	LA-Leads	Transmission Renaissance	Limited Transmission	Enrissions Free	Net 100%	Load Modern ization	Western Initiatives
	Compliance Year:		arks	7,038,7,720,230	2045	2045	2045	2045	2045	2045
	Biomass		Y	Υ	γ	Υ		Y	Y	Y
	Biogas		Y	Y	Υ	Υ	N	Y	Υ	γ
Technol-	Electricity to Fuel (e.g. H2)		Υ	Y	Υ	γ	Y	Y	Υ	γ
	Fuel Cells		Υ	Y	Υ	γ	Υ	Y	γ	γ
ogies	Hydro - Existing	Matches 2017	¥	Υ	Υ	Y	Y	Υ	٧	Y
Eligible in	Hydro - New	IRP Technology	N	14	ħ	N	N	N	N	N
the	Hydro - Upgrades	Mix	Y	Υ	Υ	Y	Y	ΥΥ	Y	γ
Compliance	Natural Gas		N	N	N	N	M	Y	På	N
Year	Nuclear - Existing		N	Y	N	N	7	Y III	N	N
	Nuclear - New		N	Pd	N	N	N	N	N	N
	Wind, Solar, Geo		¥	Υ	Υ	Y	Y	Y	Y	¥
	Storage		Y	Y Y	Υ	Y	Y	Y	v	Y
DG	Distributed Adoption	Reference	Balanced	High	kow	High	Balanced	Balanced	Balanced	Balanced
RECS	Financial Mechanisms (RECS/Allowances)	-	N	PJ	ħį	N	N	Hes	N	N
	Energy Efficiency	Reference	Moderate		Moderate		Moderate	Moderate	1121	Moderate
Load	Demand Response	Reference	Moderate	High	Moderate	431	Moderate	Moderate	-1191	Moderate
	Electrification	Reference	Woderate	High	Moderate	Har	Moderate	Moderate	Higi	Moderate:
Trans- mission	New or Upgraded Transmission Allowed?	Matches 2017 IRP	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corndors	New Corridors Allowed	No New Transmission	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors
WECC	WECC VRE Penetration	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Migh

^{*}All scenarios achieve net 100% renewable by 2030

Scenario Matrix



		LADWP 2017 IRP Recommended Case	100% RE Reference	LA-Leads	Transmission Renaissance	Limited Transmission	ereatstearts Ereatstearts	Net 100%	inad Modern- ization	Western
	Compliance Year:		2045	mirja e Estarja tira ilin	2045	2045	2045	2045	2045	2045
	Biomass	Matches 2017 IRP Technology Mix	Υ	Y	Y	¥		¥	¥	¥
	Biogas		Υ	Y	Y	¥		Υ	Y	¥
Technol-	Electricity to Fuel (e.g. H2)		Υ	Υ	Y	Y	Y	Y	¥	¥
	Fuel Cells		Υ	Y	¥	Y	Ť	Ą	¥	¥
ogies	Hydro - Existing		Υ	Y	Y	Ý	Ý	Ý	Ý	Y
Eligible in	Hydro - New		N	N	N	N	N	N	N	N
the	Hydro - Upgrades		Υ	Y	Y	¥	¥	Y	Y	¥
Compliance	Natural Gas		N	N	N	N	N	Y	N	N
Year	Nuclear - Existing		N		N	N		111111111111111111111111111111111111111	Ņ	N
	Nuclear - New		N	N	P.I	RJ	N	N	P.I	P.J.
	Wind, Solar, Geo		Y	Y	Y	Y	1	¥	Y	¥
	Storage		Υ	Ÿ	Y	Y	Ý	Å	Ä	Ā
DG	Distributed Adoption	Extra 8 dos \$ dos \$ 3 d dos Extra 8 dos \$ dos \$ 3 d dos	Balanced				Salanced	Balanced	Balanced	Balanced
RECS	Financial Mechanisms (RECS/Allowances)	-	N	N	N	N	N	Yes	N	N
	Energy Efficiency	Reference	Moderate		Moderate		Moderate	Moderate		Moderate
Load	Demand Response	Reference	Moderate		Moderate		Moderate	Moderate		Moderate
	Electrification	Majorana Majorana	Moderate		Moderate		Moderate	Moderate		Moderate
Trans- mission	New or Upgraded Transmission Allowed?	Matches 2017 IRP	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors	New Corridors Allowed	No New Transmission	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors
WECC	WECC VRE Penetration	masucan	Reference	Reference	Reference	Reference	Reference	Reference	Reference	

^{*}All scenarios achieve net 100% renewable by 2030



		LADWF 2017 IRP Recommended Case	100% RE Reference	LA-Leads	Transmission Renaissance	limited	Emissions Free	Net 100%	Load Modern- ization	Western initiatives
	Compliance Year:		TIVIT	2035/2040	2045	2045	2045	2045	2045	2045
	Biomass		\ <u>\</u>	Υ	Y	Y	7	¥	Y	¥
	Biogas		¥	Υ	Y	Y		Υ	Y	¥
Technol-	Electricity to Fuel (e.g. H2)		¥	Υ	Y	Y	Y	Y	Y	Y
ogies	Fuel Cells		E	Υ	Y	Ÿ	Ť	¥	Y	¥
	Hydro - Existing	Watches 2017	¥	Υ	Y	Y	¥	Y	Y	Á
Eligible in	Hydro - New	my Tachnology	N	N	N	N	N	N	N	N
the Compliance Year	Hydro - Upgrades	îvîik	¥	Υ	¥	4	Y	¥	Y	¥
	Natural Gas		N	N	14	1/1	N		N	N
	Nuclear - Existing		N	Υ	Ņ	N			PV	N
	Nuclear - New		N.	N	V.	M	N	N	A)	N
	Wind, Solar, Geo		T V	Y	Y	Y	Ť V	¥	Y	V
	Storage		¥	Ť	¥	7	Ţ	Ĭ.	I	ř.
DG	Distributed Adoption	nafaman neferen	Palacas al Delenaras	High	1,100.		Balanced	Balanced	Balanced	Balanced
RECS	Financial Mechanisms (RECS/Allowances)	÷	2. W	N	5 \ 5 x \ 4	N	N	Yeld	K.5	N
	Energy Efficiency	Reference	Moderate	High	Moderate	Her	Moderate	Woderate		Moderate
Load	Demand Response	Reference	Moderate	High	Moderate	Flight	Moderate	Moderate	i i i i i i i i i i i i i i i i i i i	Moderate
	Electrification	Rafaranca	Mariorata	High	Moderate	High	Moderate	Moderate	1.5.	Moderate
Trans- mission	New or Upgraded Transmission Allowed?	Matches 2017 IRP	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors	New Corridors Allowed	No New Transmission	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors
WECC	WECC VRE Penetration	ne for a ne professioner	Reference	Reference	Reference	Reference	Reference	Reference	Reference	2 3 4 9 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5 5

^{*}All scenarios achieve net 100% renewable by 2030



		LADWP 2017 IRP Recommended Case	100% RE Reference	LA-Leads	Transmission Renaissance	Limited Transmission	Emissions Free	Net 110%	Load Modern- ization	Western Initiatives
	Compliance Year:		2045	mpiersypianiem	2045	2045	2045	2045	2045	2045
	Biomass		¥	Y	Υ	Y	Ŋ	¥	¥	ų,
	Biogas		Å	¥	Υ	¥	7	Y	¥	¥
Technol-	Electricity to Fuel (e.g. H2)		¥	Υ	Υ	Υ	Υ	Y	Y	¥
	Fuel Cells		***	Ŷ	Υ	Ť	Ÿ	¥3	Ŷ	Į.
ogies	Hydro - Existing	Matches 2017	¥	¥	Υ	Ÿ	Y	¥	Ý	¥
Eligible in	Hydro - New	in Telinology	N	N	N	N	Ŋ	N	N	N
the	the Hydro - Upgrades	iviisi	¥	Y	Υ	¥	¥	¥	Y	Ŷ
Compliance	Natural Gas		84	N	N	N	N	Y,	N	N
Year	Nuclear - Existing		P.B	¥7	N	N	The state of the s	57/	N	N
	Nuclear - New		81.8 8 19	N	N	A.1	N	M	N	N
	Wind, Solar, Geo		Y	Y	Υ	Υ	J.	Ÿ	Y	Y
	Storage		Ą	Y	Υ	Y	Y	Y	¥	Å
DG	Distributed Adoption	ET and discussion and another Fine ESS Report Report Brighter	Dalanced		Low		Salanced	Balanced	Balanced	Balanced
RECS	Financial Mechanisms (RECS/Allowances)		9\.B 	N.	N	1 \1	P.F	V-10	N	Pul
	Energy Efficiency	ncicica	Moderate		Moderate	TIĘC .	Moderate	Moderate		Moderate
Load	Demand Response	Reference	Moderate		Moderate		Moderate	Moderate		Moderale
	Electrification	Reference	Motorate		Moderate		Moderate	Moderate		Moderate
Trans- mission	New or Upgraded Transmission Allowed?	Matches 2017 IRP	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors	New Corridors Allowed	No New Transmission	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors
WECC	WECC VRE Penetration	The fire was sure as FREE ET ET ET ET ET ET	FREE SECTIONS	Reference	Reference	Reference	Reference	Reference	Reference	

^{*}All scenarios achieve net 100% renewable by 2030



		LADWF 2017 IRF Recommended Case	100% RE Reference	LA-Loads	Transmission Renaissance	Limited Transmission	Emissions Free	Net 100%	Load Modern- ization	Western
	Compliance Year:		2045	murio e a vario 770 o mo	2045	2045	2045	2045	2045	2045
	Biomass		¥	¥	Y	Υ		¥	¥	¥
	Biogas		¥	¥	Y	Υ		Å	Y	A
Technol-	Electricity to Fuel (e.g. H2)		Y	Υ	Y	Υ	¥	Y	Y	Y
	Fuel Cells		*.*	Y	Y	Υ	¥	Ý	¥	Ą
ogies	Hydro - Existing	Matches 2017	¥	Ý	Ý	Υ	Y	Υ	¥	Y
Eligible in	Hydro - New	IRP Technology	N	N	N	N	ŅĒ	N	N	N
the	, ,	ivii k	¥	¥	Y	Υ	¥	Υ	¥	¥
Compliance	Natural Gas		N	N	N	N	N	The state of the s	Ŋ	N
Year	Nuclear - Existing		N	1	Ň	N	.,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		N	Ņ
. cai	Nuclear - New		3\3 1 vs	M	P. I	N	PLI F.*	P.I	N	N
	Wind, Solar, Geo		¥	Y	Y	Y	Y	Y	ř.	Y
	Storage		Ť	¥	Ÿ	Υ	Y	¥	¥	¥
DG	Distributed Adoption		nalena d Politika		F3.0	High	Balanced	Balanced	Balanced	Balanced
RECS	Financial Mechanisms (RECS/Allowances)		75 - 75 5 - 75 5 - 75	N	ĄĮ	N	P.E		N	N
	Energy Efficiency	mengana	Randaunia		Moderate	High	Moderate	Moderate		Moderate
Load	Demand Response	Reference	Moderate		Moderate	High	Moderate	Moderate		Moderate
	Electrification	Roference	Mariorata		Moderate	High	Moderate	Moderate		Moderate
Trans- mission	New or Upgraded Transmission Allowed?	Matches 2017 IRP	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors	New Corridors Allowed	No New Transmission	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors
WECC	WECC VRE Penetration	neference	Trofoson er en Trofoson er en	Reference	Reference	Reference	Reference	Reference	Reference	

^{*}All scenarios achieve net 100% renewable by 2030



		LADWP 2017 IRP Recommended Case	100% RE Reference	lA-Leads	Transmission Renaissance	Limited Transmission	Emissions Free	Net 100%	Load Modern- ization	Western Initiatives
	Compliance Year:		2045	mojertyojeniem	2045	2045	2045	2045	2045	2045
	Biomass		¥	¥	_F 3	Y	N	¥	Y	V
	Biogas		¥	¥	¥	Y	N	Y	Υ	Y
Technol-	Electricity to Fuel (e.g. H2)		Y	Υ	Y	Y	Υ	Y	Y	Y
	Fuel Cells		i i	Y	E.V.	Y	Υ	Y	Ϋ́	Y
ogies	Hydro - Existing	Affatohae 2017	¥	¥	Ý	Y	Υ	Y	¥	Y
Eligible in	Hydro - New	IRP Technology	N	N	N	N	N	N	N	N
the	Hydro - Upgrades	iviix	¥	¥	_J 3	¥	Υ	Y	¥	Y
Compliance	Natural Gas		îú	N	N	N	N	· ·	N	N
Year	Nuclear - Existing		Pui		N	N	Υ		N	M
. ca.	Nuclear - New		P.4	1.1	N	N	N	1.3	N.	N.
	Wind, Solar, Geo		ter T	Y	\frac{1}{2}	Y	Y	Y	Y	¥
	Storage		Ā	Ÿ	¥	Y	Υ	Y	Y	Y
DG	Distributed Adoption	ETS on A see a series on an one		111111111111111111111111111111111111111			Balanced	Balanced	Balanced	Balanced
RECS	Financial Mechanisms (RECS/Allowances)	-	N	N	N	N	N		5\ 5 2\ 4	N
	Energy Efficiency	neferenc	RACACCAC		Moderate		Moderate	Moderate		Moderate
Load	Demand Response	Reference	Moderate		Moderate		Moderate	Moderate		Moderate
	Electrification	Fotorores	Marinen		Moderate		Moderate	Moderate	EIEE	Moderate
Trans- mission	New or Upgraded Transmission Allowed?	Matches 2017 IRP	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors	New Corridors Allowed	No New Transmission	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors
WECC	WECC VRE Penetration	reiticics	Reference	Reference	Reference	Reference	Reference	Reference	Reference	

^{*}All scenarios achieve net 100% renewable by 2030



		LADWP 2017 IRP Recommended Case	100% RE Reference	LA-Leads	Transmission Renaissance	Limited Transmission	Emissions Free	Net 100%	Load Modern- ization	Western Initiatives
	Compliance Year:		Jan	morjeristavjevis	2045	2045	2045	2045	2045	2045
	Biomass		¥	¥	¥	Y		Υ	¥	Y
	Biogas		Ť	Ą	Y	Y		Υ	Å	¥
Technol-	Electricity to Fuel (e.g. H2)		¥	¥	Y	Y	Y	Υ	¥	Y
	Fuel Cells		Ĭ,	¥	Y	Ÿ	Ŷ	Υ	¥	Y
ogies	Hydro - Existing	Natches 2017	¥	Å,	Ý	Y	Υ	Υ	¥	Y
Eligible in	Hydro - New	IRP Technology	N	N	N	Ŋ	N	N	Ņ	N
the	Hydro - Upgrades	īviix	¥	Ÿ	¥	Ÿ	Y	Υ	Y	Y
Compliance	Natural Gas		îvi	N	N	N	N	Y	N	N
Year	Nuclear - Existing		På		N	N	201000000000000000000000000000000000000	Υ	ÞÍ	Ņį
	Nuclear - New		P.I	N	hi 17	N	N	N	P. I	Pul F W
	Wind, Solar, Geo		10	Y	Ÿ	1	Y	Y	Y	Y
	Storage		¥	Ā	Ÿ	Y	Y	Υ	Ā	Y
DG	Distributed Adoption	173 m. E es ucos me ucos 174m l ez a sen 234, en	Balancei				Balanced	Balanced	Balanced	Balanced
RECS	Financial Mechanisms (RECS/Allowances)		EQ. 25 2. 10 2. 10	N	51.03 1.72	E. 1	N	Yes	N	N
	Energy Efficiency	ra Sa oceasos Referencias	RECEICECE		Moderate		Moderate	Moderate		Moderate
Load	Demand Response	Meference	Moderate		Moderate	1121	Moderate	Moderate		Moderate
	Electrification	Rafaranca	Musicrate		Moderate	FIER	Moderate	Moderate		Moderate
Trans- mission	New or Upgraded Transmission Allowed?	Matches 2017 IRP	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors	New Corridors Allowed	No New Transmission	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors
WECC	WECC VRE Penetration	ES an E an occur and accur. ESSER EST EST ESTELLED	recent of the	Reference	Reference	Reference	Reference	Reference	Reference	

^{*}All scenarios achieve net 100% renewable by 2030



		LADWF 2017 IRP Recommended Case	100% RE Reference	LA-Leads	Transmission Renaissance	Limited Transmission	Emissions Free	Net 100%	Load Modern- ization	Western Initiatives
	Compliance Year:		2045	mpjarezypjania	2045	2045	2045	2045	2045	2045
	Biomass		*±*	Y	Y	Y	N	Y	Υ	Υ
	Biogas		Ā	¥	¥	Ϋ́	7.1111	Υ	Υ	Y
Technol-	Electricity to Fuel (e.g. H2)		¥	Υ	Y	Y	Y	Y	Υ	Y
ogies	Fuel Cells		**	Ŷ	¥	Y	¥	¥3	Υ	Y
	Hydro - Existing	Matches 2017	¥	Ý	¥	¥	Y	¥	Υ	Å
Eligible in	Hydro - New	IFF Touringsy	Ē\Ē	N	N	N	N	N	N	N
the		iviisi	A.	Y	¥	Y	Y	¥	Υ	Y
Compliance			818	N	N	N	N		N	N
Year	Nuclear - Existing		Ē4		Ņ	N	111111111111111111111111111111111111111	740000000000000000000000000000000000000	N	N
	Nuclear - New		8\B 8 ***	N.E	P.I	R1	NJ	N	N	N
	Wind, Solar, Geo		¥	Y	Y	Y	Å.	Ÿ	Y	Y
	Storage		Ā	Ϋ́	Ÿ	Y	Υ	Ÿ	Υ	Y
DG	Distributed Adoption	ETS and officer accurations are uncom- property a form a long of a SQL form	Palancoi			######################################	Salanced	Balanced	Balanced	Balanced
RECS	Financial Mechanisms (RECS/Allowances)	-	814.B 3.44	50 G	Pul	FV 5	N		N	N
	Energy Efficiency	Plan for some or store Plan I will be I was	Harte con		Moderate		Moderate	Moderate	High	Moderate
Load	Demand Response	Reference	Moderate		Moderate		Moderate	Moderate	High	Moderale
	Electrification	Roforence	Moderate	- E1660	Moderate	- E3515	Moderate	Moderate	High	Moderate
Trans- mission	New or Upgraded Transmission Allowed?	Matches 2017 IRP	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors	New Corridors Allowed	No New Transmission	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors
WECC	WECC VRE Penetration	Fredericans	ENCIENTE EN IELE	Reference	Reference	Reference	Reference	Reference	Reference	

^{*}All scenarios achieve net 100% renewable by 2030



		LADWP 2017 IRP Recommended Case	100% RE Reference	i A. Loade	Transmission Renaissance	Limited Transmission	Emissions Free	Net 100%	Load Modern- ization	Western Initiatives
	Compliance Year:	www.	2045	norie Edvarie 7de no	2045	2045	2045	2045	2045	2045
	Biomass		ā.	Y	¥	Y	N. C.	¥	Y	Υ
	Biogas		¥	Y	Y	¥	Ŋ	Y	¥	Υ
Technol-	Electricity to Fuel (e.g. H2)		¥	Y	Y	¥	Y	Υ	Y	Υ
	Fuel Cells		14. F	Y	Y	Ĭ	Y	Ť	Ý	Υ
ogies	Hydro - Existing	Natches 2017	. Pr	¥	Y	¥	¥	Y	Y	Υ
Eligible in	Hydro - New	ine Technology	N	N	N	N	N	N	N	N
the	Hydro - Upgrades	Mix	a A	Y	Y	Ÿ	Y	¥	¥	Υ
Compliance	Natural Gas		N	ħi	816	1/1	N		N	N
Year	Nuclear - Existing		N	111111111111111111111111111111111111111	P.E	N	The state of the s	Y	Ņį	N
	Nuclear - New		N.	M	N.E	P.I	R.1	N	Pul.	N
	Wind, Solar, Geo		TLF H	Y	Y	Y	Υ	Ĭ	Y	Y
	Storage		¥	Ý	Y	¥	Y	Ť	¥	Υ
DG	Distributed Adoption	Fill on the second section of the second section of the second se	palmosd		7377		Balanced	Balanced	Balanced	Balanced
RECS	Financial Mechanisms (RECS/Allowances)	-	3,73	71, 3 2 vii	A.E.	Pu E E val	74.5 4. W		N	N
	Energy Efficiency	nciente.	Maderate		Moderate		Moderate	Moderate		Moderate
Load	Demand Response	Reference	Moderate		Moderate		Moderale	Moderate		Moderate
	Electrification	Doforman	Mariarata		Moderate	Alga	Moderate	Moderate	91/33	Moderate
Trans- mission	New or Upgraded Transmission Allowed?	Matches 2017 IRP	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors	New Corridors Allowed	No New Transmission	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors
WECC	WECC VRE Penetration	file for the pro-	neference	Reference	Reference	Reference	Reference	Reference	Reference	High

^{*}All scenarios achieve net 100% renewable by 2030



		LADWP 2017 IRP Recommended Case	100% RE Reference	LA-Leads	Transmission Renaissance	Limited Transmission	Emissions Free	Net 100%	Load Modern- ization	Western Initiatives
	Compliance Year:		2045	2035/2040	2045	2045	2045	2045	2045	2045
	Biomass		Υ	Υ	Υ	Υ	N	Υ	Υ	Υ
	Biogas		Υ	Υ	Υ	Υ	N	Υ	Υ	Υ
Technol-	Electricity to Fuel (e.g. H2)		Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ
	Fuel Cells		Υ	Υ	Υ	Υ	Υ	Υ	Υ	Υ
ogies	Hydro - Existing	Matches 2017	Υ	Υ	Υ	Υ	Υ	Y	Υ	Υ
Eligible in	Hydro - New	IRP Technology	N	N	N	N	N	N	N	N
the	Hydro - Upgrades	Mix	Y	Υ	Υ	Υ	Υ	Y	Υ	Υ
Compliance	Natural Gas		N	N	N	N	N	Y	N	N
Year	Nuclear - Existing		N	Y	N	N	Υ	Υ	N	N
	Nuclear - New		N	N	N	N	N	N	N	N
	Wind, Solar, Geo		Y Y	Y	Y	Y	Y	Y	Y	Y Y
	Storage		Ť	Υ	Υ	Y	Υ	Y	Υ	Y
DG	Distributed Adoption	Reference	Balanced	High	Low	High	Balanced	Balanced	Balanced	Balanced
RECS	Financial Mechanisms (RECS/Allowances)	-	N	N	N	N	N	Yes	N	N
	Energy Efficiency	Reference	Moderate	High	Moderate	High	Moderate	Moderate	High	Moderate
Load	Demand Response	Reference	Moderate	High	Moderate	High	Moderate	Moderate	High	Moderate
	Electrification	Reference	Moderate	High	Moderate	High	Moderate	Moderate	High	Moderate
Trans- mission	New or Upgraded Transmission Allowed?	Matches 2017 IRP	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors	New Corridors Allowed	No New Transmission	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors	Only Along Existing or Planned Corridors
WECC	WECC VRE Penetration	Reference	Reference	Reference	Reference	Reference	Reference	Reference	Reference	High

^{*}All scenarios achieve net 100% renewable by 2030

Revised Scenarios—Comment Mapping



		Scenarios							
Comment	LADWP 2017 IRP Recommended Case	100% Renewable Reference Case	LA-Leads	Transmission Renaissance	Limited Transmission	Emissions Free	Net 100%	Load Modernization	Western Initiatives
Accelerated Compliance			٧						
Interim Targets	٧	٧	٧	٧	٧	٧	٧	٧	٧
Financial vs Physical Compliance		٧					٧		
Current Policies, Plans, and Intiatives	٧	٧	٧	٧	٧	٧	٧	٧	٧
Detailed Reporting	٧	٧	٧	٧	٧	٧	٧	٧	٧
Current Policies, Plans, and Intiatives	٧	٧	٧	٧	٧	٧	٧	٧	٧
Equity Implications	٧	٧	٧	٧	٧	٧	٧	٧	٧
Environmental Impacts Beyond CO2	٧	٧	٧	٧	٧	٧	٧	٧	٧
Regionalization, EIM, CAISO									٧

^{*}All scenarios achieve net 100% renewable by 2030

Scenario Descriptions



Scenario Name	Scenario Abbreviation	Final Target Year	Scenario Description
LADWP 2017 IRP Recommended Case	DWP-IRP	-	The DWP-IRP scenario matches the planned generation, tranmission, and distribution system investments, as well as the planned end-use initiativesenergy efficiency, demand response, and electrificationfrom LADWP's 2017 IRP <i>Recommended Case</i> . In addition, this scenario will incorporate relevant results from the OTC Study. Under this scenario, renewable generation comprises 65% of load by 2036.
100% Renewable Reference Case	100-RE	2045	By 2030, a net-100% portfolio is achieved through a balanced mix of both distributed and utility scale renewable resources, implementation of energy efficiency, demand response, and electrification programs, as well as purchased RECs. By 2045 the use of RECs is phased out through further investments in both supply and demand side resources.
LA-Leads	LA-Leads	2035/2040*	Through more aggressive pursuit of both energy efficiency, demand response, and electrification initiatives, as well as rapid deployment of both distributed and utility-scale resources, a 100% clean energy system is achieved by 2035. Importantly, the Palo Verde Nuclear Plant continues to provide generation through the early 2040s, but is retired by and offset with new renewable sources by 2045.
Transmission Renaissance	New-Trans	2045	Identical to the 100-RE case, but new transmission corridors (along with upgrades to existing corridors) are allowed; adoption of distributed generation is decreased relative to the 100-RE case, due to the decreased barriers to importing utility scale renewable generation from out-of-basin.
Limited Transmission	No-Trans	2045	Identical to the 100-RE case, but only planned transmission upgrades (from the LADWP IRP) are allowed; adoption of distributed generation is substantially higher than the 100-RE case to make up for decreased ability to import out-of-basin renewable generation; similarly, energy efficiency, demand response, and electrification are rapidly implemented.
Emissions Free	No-Emis	2045*	Identical to the 100-RE case, but compliance must be achieved without any combustion-based generation (including biomass and biofuels), and nuclear generation is allowed to contribute towards compliance.
Net 100%	Net-100	2045*‡	Identical to the 100-RE case, but renewable energy credits (RECs), both bundled and unbundled, and nuclear can be used as a source of compliance
Load Modernization	Load-Mod	2045	Identical to the 100-RE case, but energy efficiency measures, demand response measures, and electrification are rapidly implemented through robust incentives, programs, and technology breakthroughs
Western Initiatives	WECC	2045	Identical to the 100-RE case, but variable renewable generation achieves high penetration in the rest of WECC

^{*} Nuclear generation is allowed to contribute towards the 100% target

[‡] RECs can be used as a component of compliance

Summary



- Revised scenarios address the spectrum of comments and perspectives from the Advisory Group.
- There are a broad set of pathways that could be pursued to achieve 100% renewable power system.
- All pathways will impact the investment and operational costs, emissions, air quality, jobs and economic development, and electricity rates in different ways.
- The revised suite of scenarios explore a broad set of pathways to 100% that will enable NREL, LADWP, and the AG to understand the tradeoffs between costs and the environmental, economic, equity outcomes.

Thank you!



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Discussion

Advisory Group Schedule



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

Wrap up and next steps



- Next Advisory Group Meeting
 - o August 16
- Meeting Summary Posted online:
 - o July 9th
- Owens Valley Tour
 - o Fri., Jun. 22 Sat., Jun. 23
 - o Fri., Sep. 21 Sat., Sep. 22
 - o Fri., Oct. 19 Sat., Oct. 20
 - o Fri., Nov. 2 Sat., Nov. 3
 - o RSVP: <u>owensvalleytour@ladwp.com</u>