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NAVIGANT
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Energy-Environmental Economics
NREL
NATIONAL RENEWABLE ENERGY LABORATORY

LA
DWP

Proposed Aug 16th AG MEETING

August 16, 2018

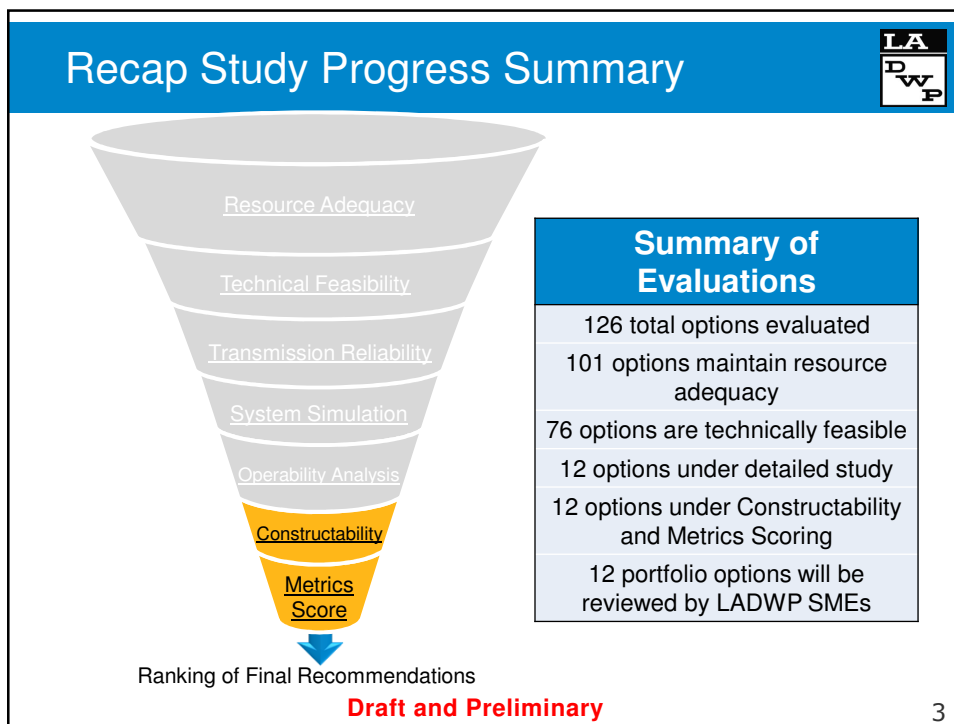
EcoNomics

Agenda


LA
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- ▶ Recap from the Last OTC Update
 - OTC Study Objectives
 - Study Progress Summary
- ▶ Assumptions
 - Load Forecast
 - Transmission/Operations Criteria
 - Alternative Strategy
- ▶ Findings
 - All Retirement Scenario
- ▶ Constructability
 - Methodology
 - Challenges
- ▶ Metrics
- ▶ Next Step

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Assumptions - OTC Repowering Schedule



Current OTC Repowering Schedule

Existing OTC Capacity				Repowered Capacity			
Unit	Nameplate Capacity (MW)	Net Dependable Capacity (MW)	LADWP Draft Target Date	Repowered Unit	Technology	Nameplate Capacity (MW)	Net Dependable Capacity (MW)
Haynes 1	230	217	12/31/2025	Haynes Units 17 (CT), 18 (ST)	1 - CCCT Small F/G Class 1x1 Dry	346	337
Haynes 2	230	217					
Haynes 8, 9 & 10	590	563	12/31/2028	Haynes Units 19 (CT), 20 (ST)	1 - CCCT Small F/G Class 1x1 Dry	346	337
				Haynes Units 21 (CT), 22 (ST)			
Scattergood 1	185	131	12/31/2024	Scattergood Units 8 (CT), 9 (ST)	1 - CCCT Small F/G Class 1x1 Dry	346	337
Scattergood 2	185	131					
Harbor 1, 2 & 5	246	215	12/31/2029	Harbor 15 (CT), 16 (CT), 17 (ST)	1 - CCCT Mid Aero 2x1 Dry	251	245

▶ Repowered / Retired OTC projects on following slides and cases are shown relative to the final repowered units, which are combinations of Scattergood, Harbor, and Haynes (x1, x2, or x3).

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Assumptions - Alternatives Strategy

Renewables

- in-basin utility solar
- out-of-basin solar
- out-of-basin wind
- geothermal

Storage

- battery storage
- long duration storage

DER

- energy efficiency
- demand response
- rooftop solar
- electric vehicles

Transmission

- Increased ability to import renewable power
- in-basin transmission system upgrades

Other resources were considered but excluded due to technology maturity, construction timing, and GHG emissions

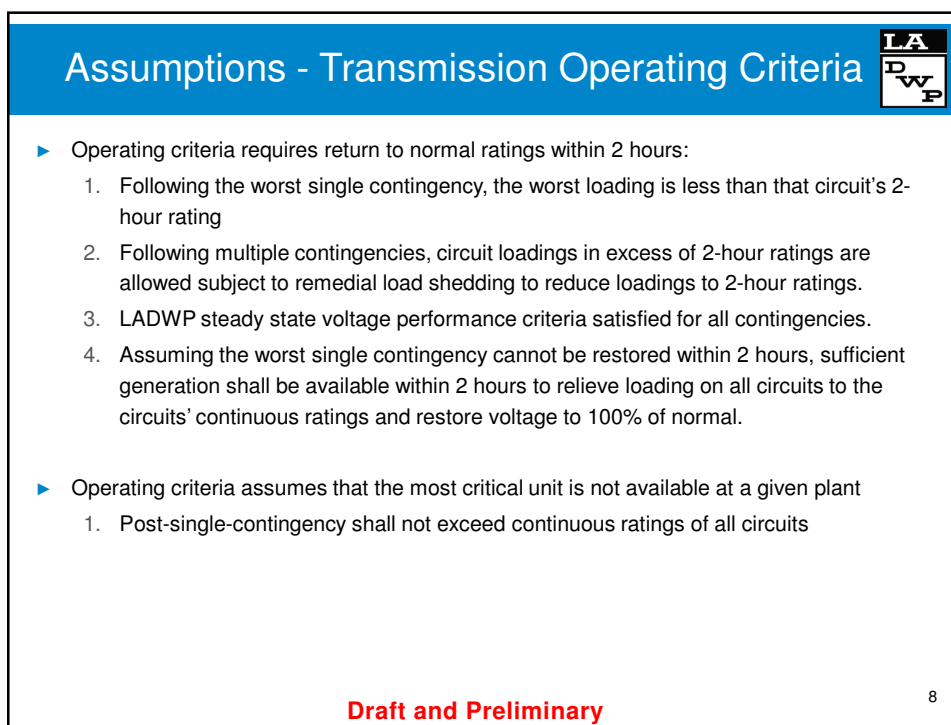
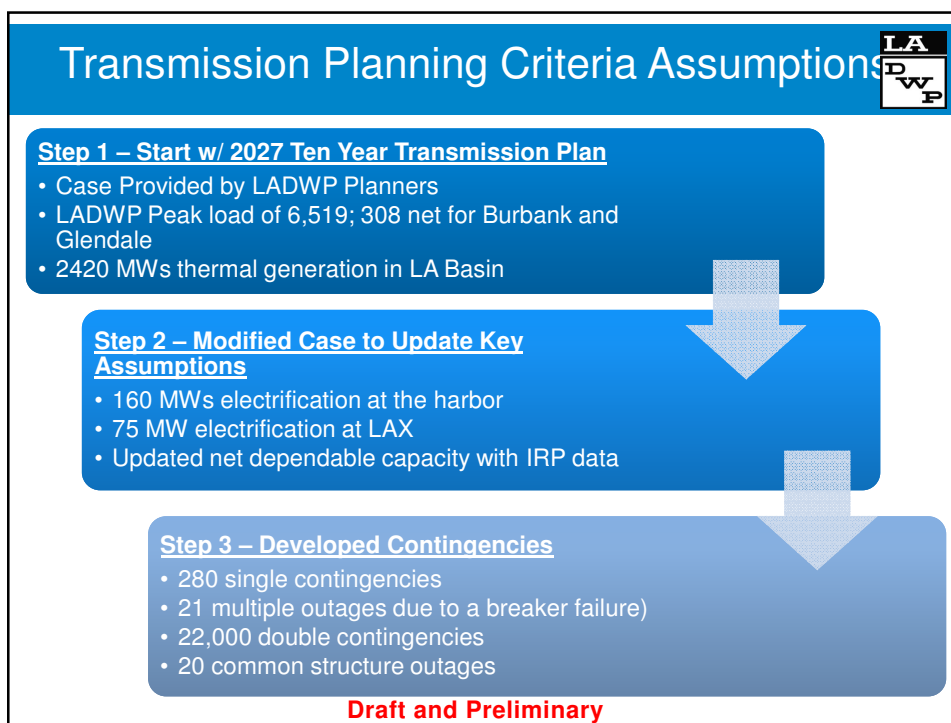
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Assumptions - Load Forecast

Stage	Software	Units	Assumption
Resource Adequacy	RECAP	8760 (MWhs)	Historical
Technical Feasibility	uSim	8760 (MWhs)	2016 IRP
Transmission Reliability	PSLF	Peak (MVA)	2016 IRP / 2016 TYP
System Simulation	ProMOD	8760 (MWhs)	2016 IRP
Operability Analysis	KERMIT	MWhs	Historical

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Assumptions - Technical Feasibility



Mitigation Alternatives		
Resource	Forecasted New Resources in 2016 IRP ¹	Additional Calculated Potential beyond IRP ²
In-Basin Utility-Scale Solar	1000 MW	127 MW
In-Basin Rooftop Solar		600 MW
Out-of-Basin Wind	670 MW	2,070 MW
Out-of-Basin Geothermal	330 MW	430 MW
In-Basin Utility-Scale Storage	160 MW	5,200 MW ³
In-Basin DER Storage		261 MW
Energy Efficiency	227 MW	335 MW ⁴
Demand Response	500 MW	415 MW ⁴

1: Based on page 108 and 159 of the 2016 IRP

2: Maximum Calculated Potential is based on projects identified, publicly announced, or under development. Transmission import capability was also considered. Incremental EE/DR is based on current and past adoption rates

3: Utility Battery Storage will be limited by renewables / over-generation / transmission constraints

4: Dependable capacity at peak

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Assumptions – Mitigation Alternative Costs



- ▶ The study considers a wide range of resource options that LADWP can use to avoid repowering.


OTC Repowering Capital and Operating Costs		
Repowering Unit	Capital Cost (\$/kW)	FOM (\$/kW-year)
Harbor 15 & 16	\$1,500 - \$1,650	\$40
Scattergood 8 & 9	\$1,200 - \$1,350	\$40
Haynes 17 & 18	\$1,300 - \$1,450	\$40
Haynes 19 & 20	\$1,300 - \$1,450	\$40
Haynes 21 & 22	\$1,300 - \$1,450	\$40

Mitigation Alternatives Assumed Capital and Operating Costs		
Resource	Capital Cost (\$/kW)	FOM (\$/kW-year)
Out-of-Basin Solar*	\$1,200 - \$1,400	\$18.50
In-Basin Utility-Scale Solar*	\$1,400 - \$1,600	\$21.60
Rooftop Solar*	\$1,900 - \$2,100	\$12.50
Wind*	\$1,900 - \$2,100	\$50
Storage*	\$1,500 - \$1,700	\$31
Geothermal	\$5,000 - \$6,000	\$117
External Transmission	Varies by line	

*: Includes ITC

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Assumptions - Resource Options Costs



► EE and DR procurement costs are shown below


Demand Response ¹ Marginal Costs	
DR Product	Cost (\$/kW/yr)
EV	\$92
HVAC	\$137
Pool	\$137
Lighting	\$172

Energy Efficiency ² Marginal Costs	
EE Product	Cost (\$/kWh)
Lighting	\$0.180
Fridge	\$0.180
HVAC	\$0.250

1: DR costs based on estimates of equipment and installation costs, equipment lifetime, and correlation of end use with LADWP peak demand
 2: EE costs based on LADWP provided measure costs up to avoidable energy and peak demand costs by end use under the full repowering scenario.

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Findings - Resource Adequacy Required to Prevent Loss of Load



► Objective to create the mitigation alternative portfolio can provide equivalent reliability to OTC repowering

Scenario	Full Repower	HAR Retirement	SCAT Retirement	HAR + SCAT Retirement	HAYNES Retirement	HAR + HAYNES Retirement	SCAT + HAYNES Retirement	All Retirement
MW NDC* Retired	0	245	337	582	1011	1256	1348	1593
LOLE** (hrs / yr)	0.32	0.74	0.93	1.92	5.49	10.65	13.28	32.32

* NDC = Net Dependable Capacity
 **lower LOLE by scenario due to assumption on higher max output from Castaic

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Findings - All Retirement Scenarios LA D W P

► Cost-effective mitigations are required for each retirement scenario

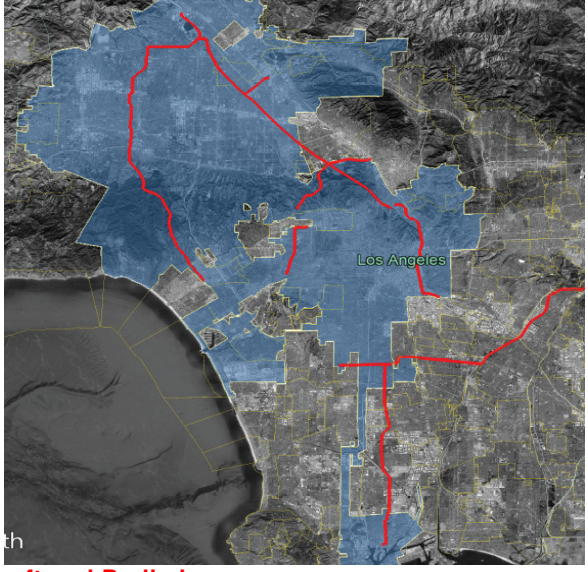
Retirement Scenarios	None Retired: All OTC Repowered as Planned	Scattergood Retired	Haynes Retired	Harbor Retired	All OTC Units Retired
	0 MW Retired	370 MW Retired	1,050 MW Retired	246 MW Retired	1,666 MW Retired
Resource Adequacy	LOLE of 0.32 hrs / year	LOLE of 0.93 hrs / year	LOLE of 5.49 hrs / year	LOLE of 0.74 hrs / year	LOLE of 32.32 hrs / year
Transmission Reliability	None with use of Scattergood Phase-Shifter	15 Transmission Overloads (up to 26.2% Overloaded)	7 Transmission Overloads (up to 30.4% Overloaded)	8 Transmission Overloads (up to 22.0% Overloaded)	24 Transmission Overloads (up to 46.3% Overloaded)
Conclusion	Accepted: Within industry ranges ¹ and no issues.	Unacceptable: Mitigation required	Unacceptable: Mitigation required	Unacceptable: Mitigation required	Unacceptable: Mitigation required

1: ProMOD system simulation and KERMIT operating flexibility benchmarks were also within industry ranges

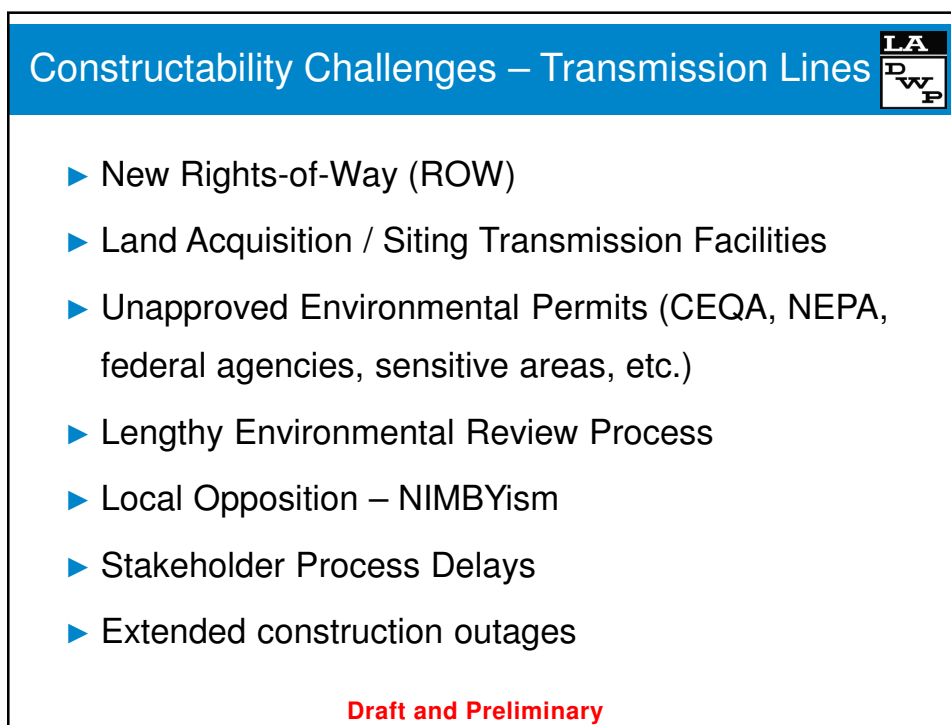
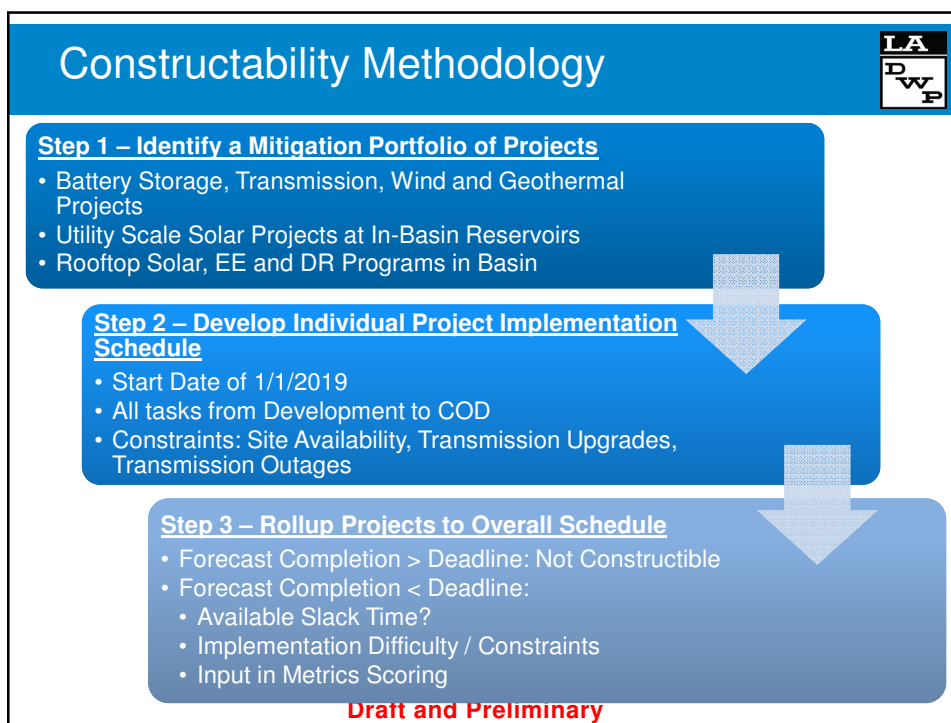
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Findings - Major Transmission Arteries Need Upgrades LA D W P

- Transmission overloads must be mitigated to bring in alternative sources
- Some upgrades require approvals from adjacent cities
- Upgrades of underground transmission lines have another set of issues



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Constructability Challenges – Battery Storage



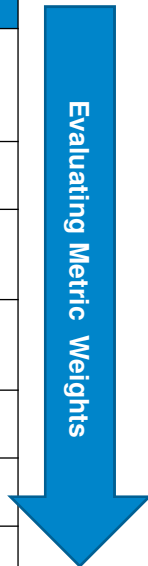
- ▶ Land Acquisition / Siting
- ▶ Local Opposition / Demographic Equity
- ▶ Height Restrictions / Variances
- ▶ Fire Safety Codes / Seismic Concerns
- ▶ Environmental Permits / Reviews
- ▶ Disposal of Chemicals after Lifecycle
- ▶ Degradation of Equipment / Chemical Replacement
- ▶ Cost Justification to Rate Payers
- ▶ Outage Scheduling

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Metrics Scoring Criteria – Ranking Portfolios



Item	
Overall Scoring	Reliability Performance <ul style="list-style-type: none"> • Black Start Support • RMR Requirements • Extreme Disturbance Impacts • Special Operational Requirements
	Cost Impact <ul style="list-style-type: none"> • Net Present Value • Owned Generation vs. PPA
	Environmental Impact <ul style="list-style-type: none"> • Total GHG • Total Natural Gas Usage • Visual Impact
	Development Risk <ul style="list-style-type: none"> • Technology Maturity • Permitting Risk • Construction Outages
	Strategic Alignment <ul style="list-style-type: none"> • Matches 100% Renewable Goals • Organizational Changes
	Social Justice / Equity Metrics <ul style="list-style-type: none"> • Neighborhood Visual Impacts • Local Environmental Impacts
Extra Credit	Policy Alignment <ul style="list-style-type: none"> • Accelerated 100% Timeline



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Next Steps - Drive to Completion



- ▶ Finalize results from 12 cases run through 5 different models (August)
- ▶ Score and rank final mitigation portfolios (September)
- ▶ Confirm top portfolio solutions meet all LADWP reliability requirements (October)
- ▶ Prepare draft report for LADWP review (October)
- ▶ Stakeholder outreach (November)

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