DOCKETED

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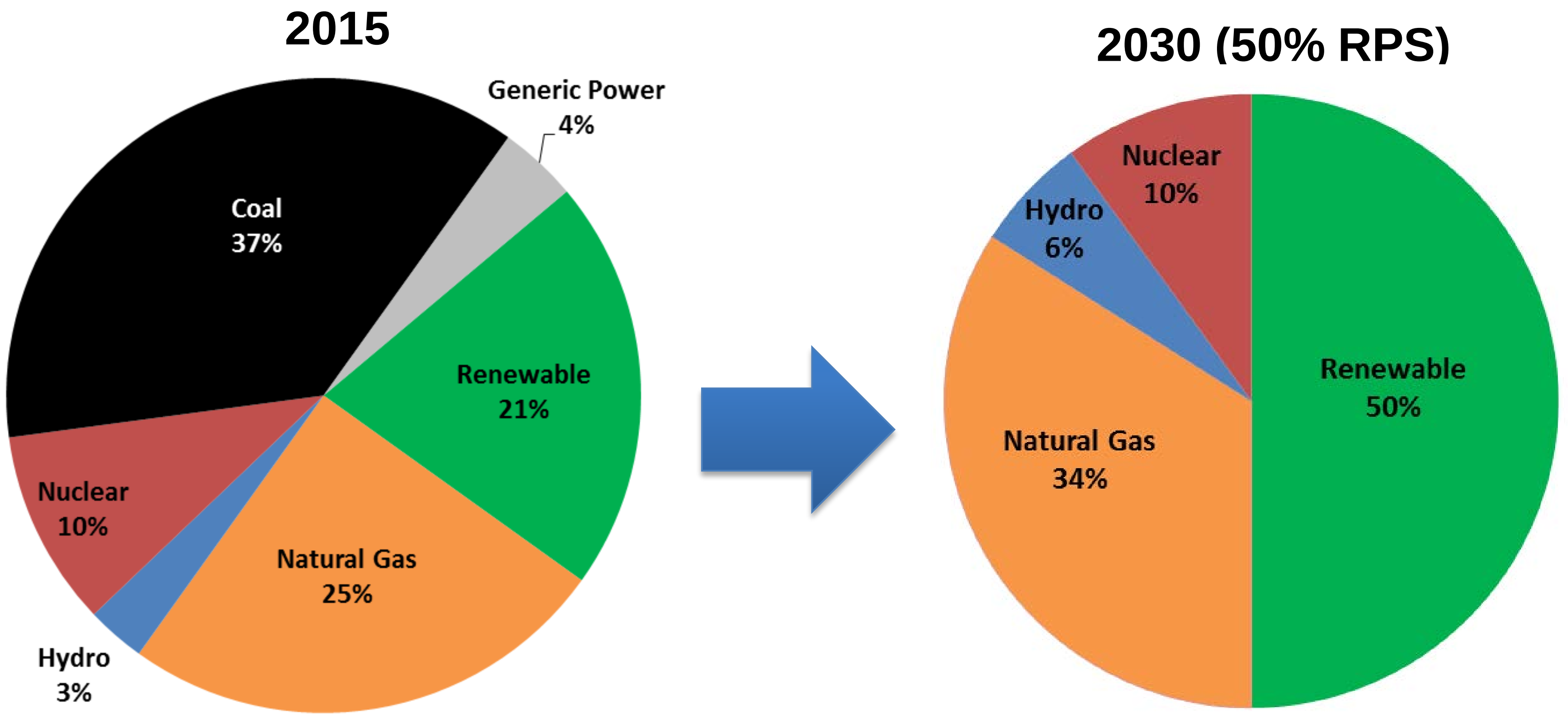
Lead Commissioner Workshop Integrated Resource Plans – Renewable Energy, Pursuant to SB350

December 13, 2016

Energy Transformation



Over the next 15 years, LADWP will replace over 70% of its generation infrastructure used to reliably deliver power to its customers

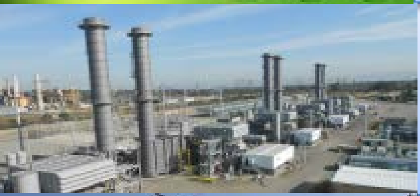
Coal is eliminated and renewables increases

Transformation Elements

Eliminate Coal from LADWP's Power Supply

Reach 33% RPS by 2020 and 50% by 2030

Achieve 15% Energy Efficiency by 2020



Once-through Cooling Repowering

Invest in Power System Reliability Program (KPIs)

Support Electric Vehicle Expansion

2016 Major Accomplishments

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

2016 IRP Case Scenarios

Coal Cases

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

Renewable (RPS), Local Solar, Energy Storage and Electrification (EV) Cases

4. 50% RPS, Low Local Solar, Low Storage, Low EV*
5. 50% RPS, Low Local Solar, Low Storage, High EV
6. 50% RPS, High Local Solar, Low Storage, High EV
7. 50% RPS, High Local Solar, High Storage, High EV
8. 65% RPS, High Local Solar, High Storage, High EV

8LLS. 65% RPS, Low Local Solar, High Storage, High EV

8MLS. 65% RPS, Med Local Solar, High Storage, High EV

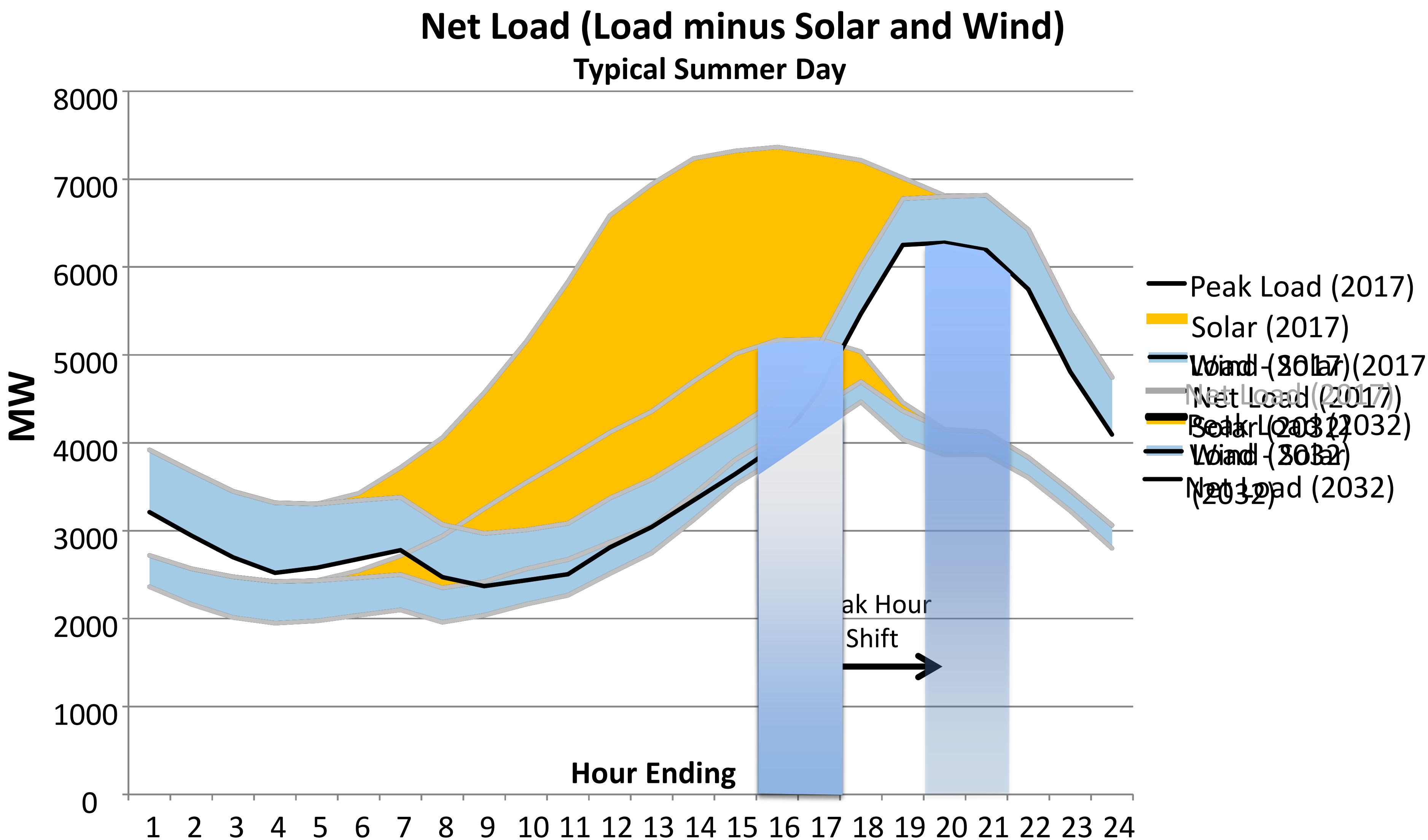
8SF. 65% Solar Focus RPS, High Local Solar, High Storage, High EV

(high local solar and storage in accordance to LA Sustainability pLAn goals)

Recommended Case

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

Resource Adequacy Methodology



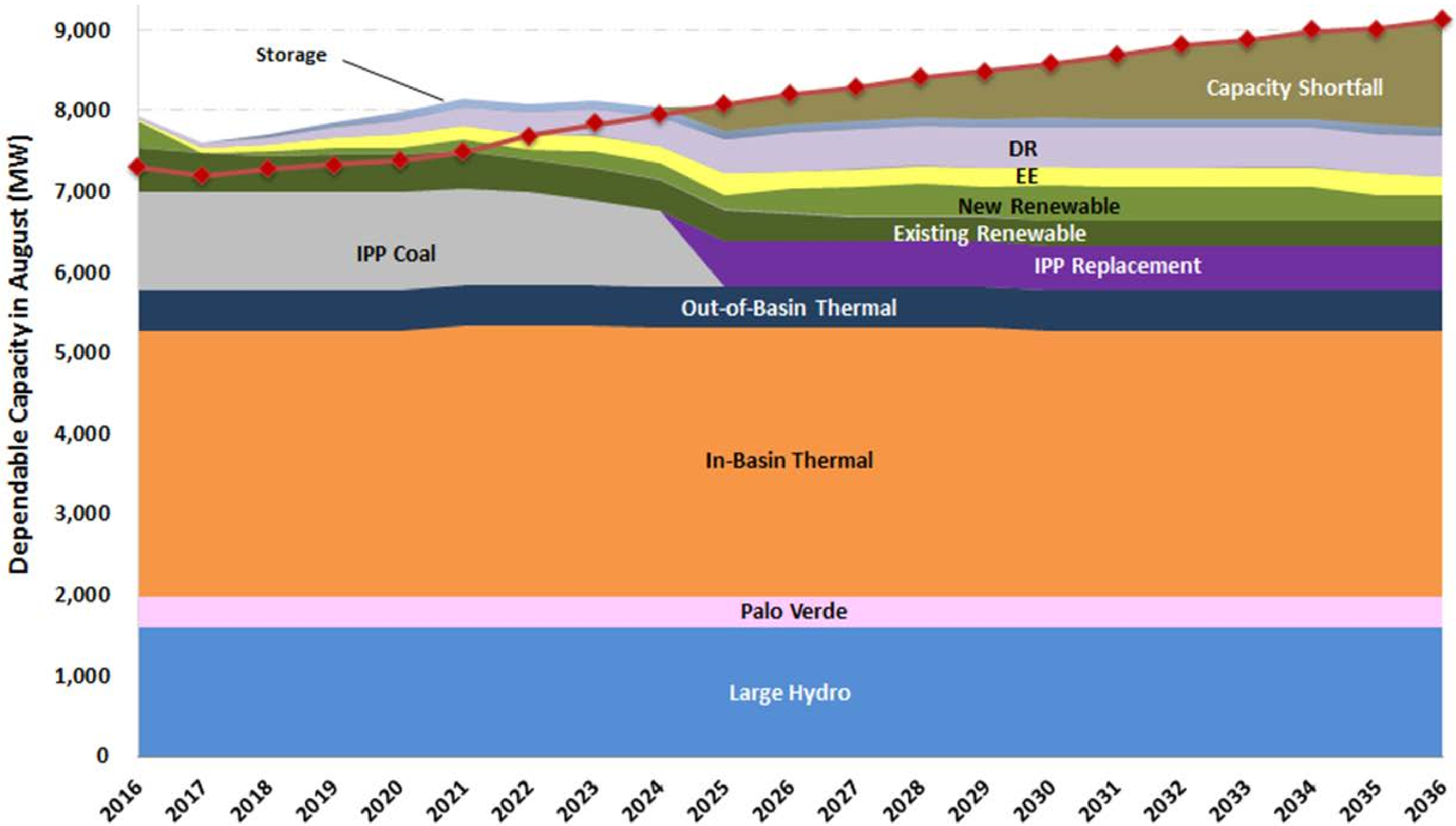
Resource Assumptions

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

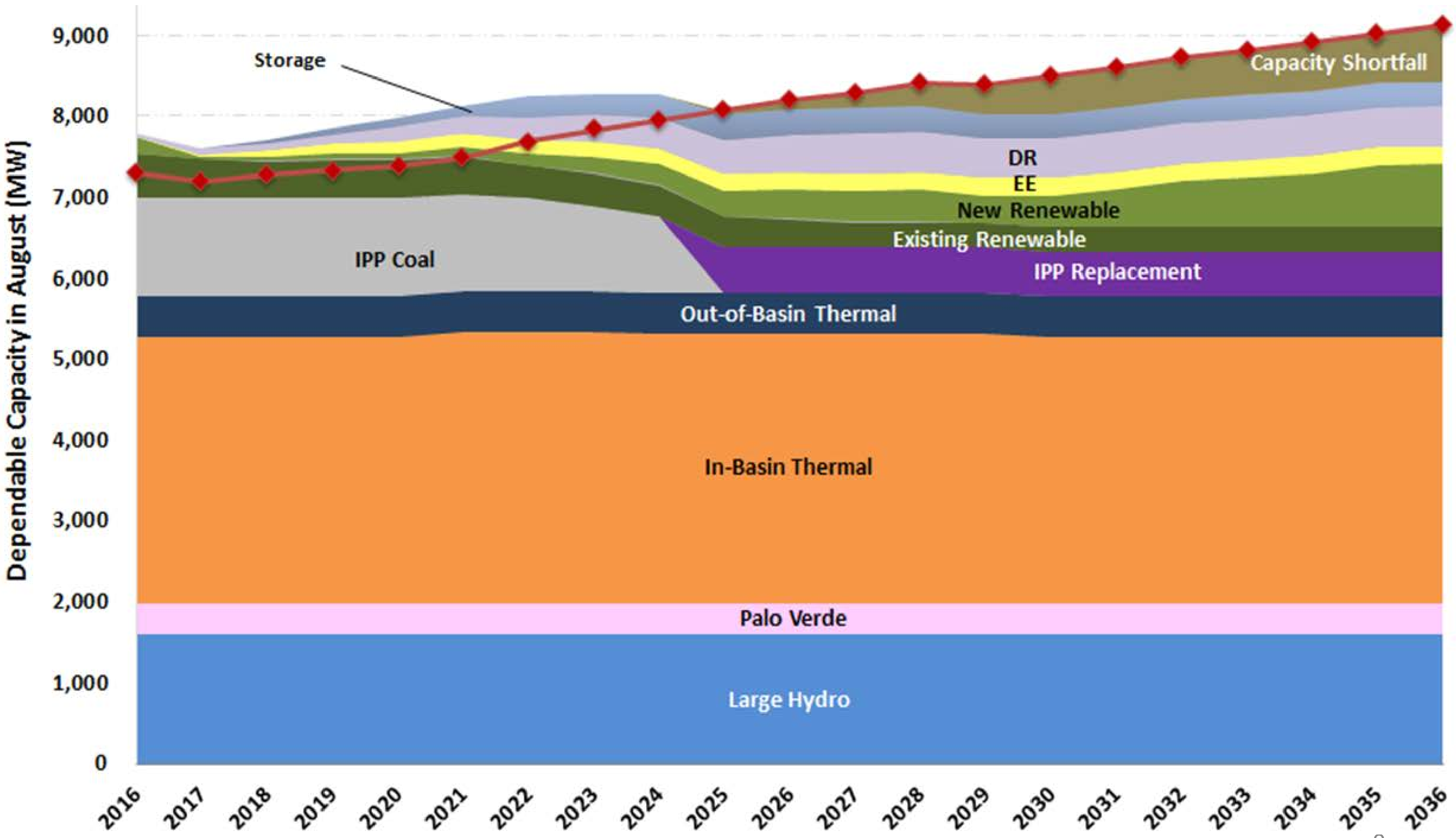
[1]Net Present Value (annual costs, 2016-2036) / NPV of Energy Produced

[2]Net Load represents the hour when the net energy for load minus variable energy resources is maximum

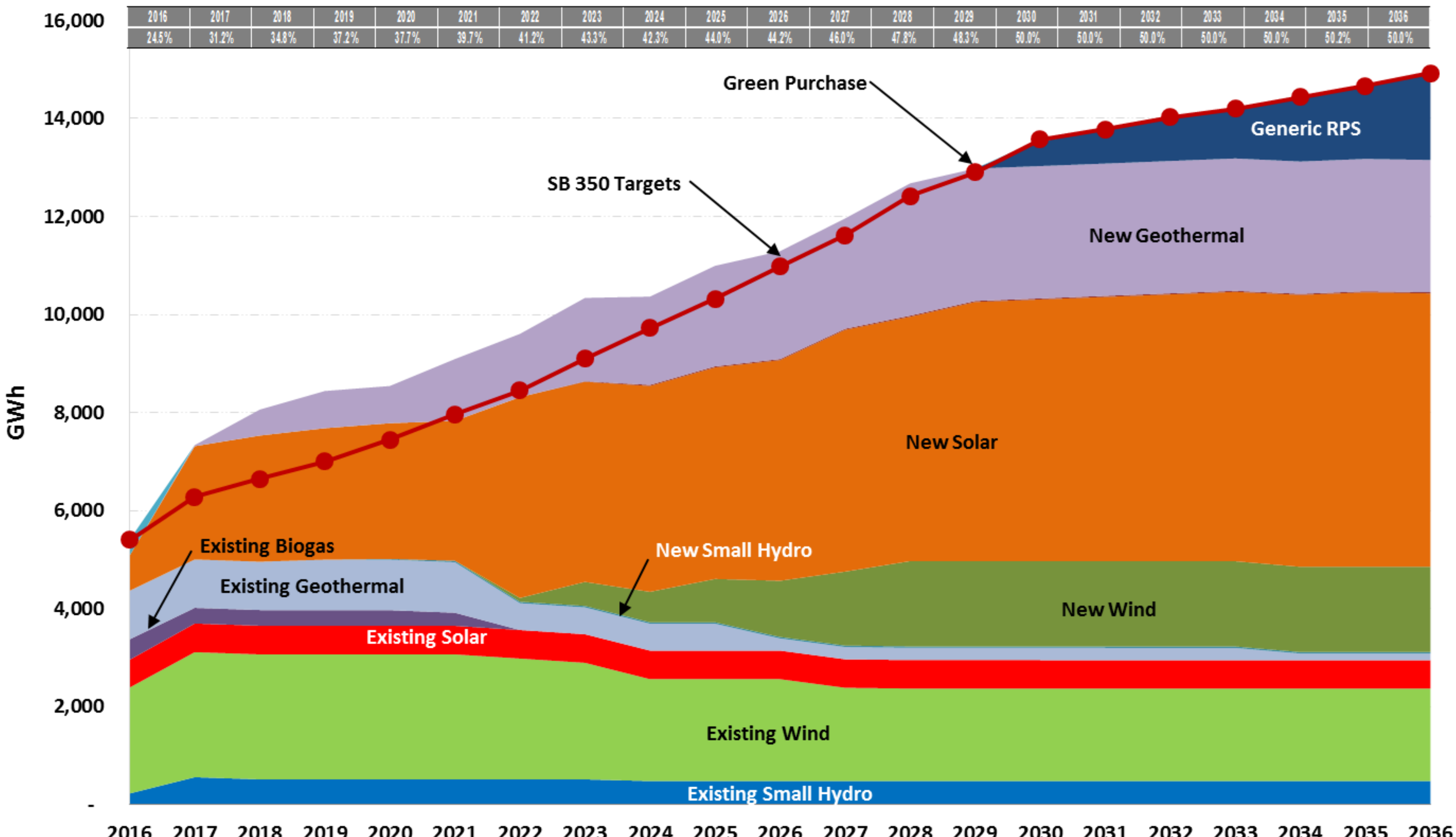
Resource Adequacy – 50% RPS



Resource Adequacy – 65% RPS

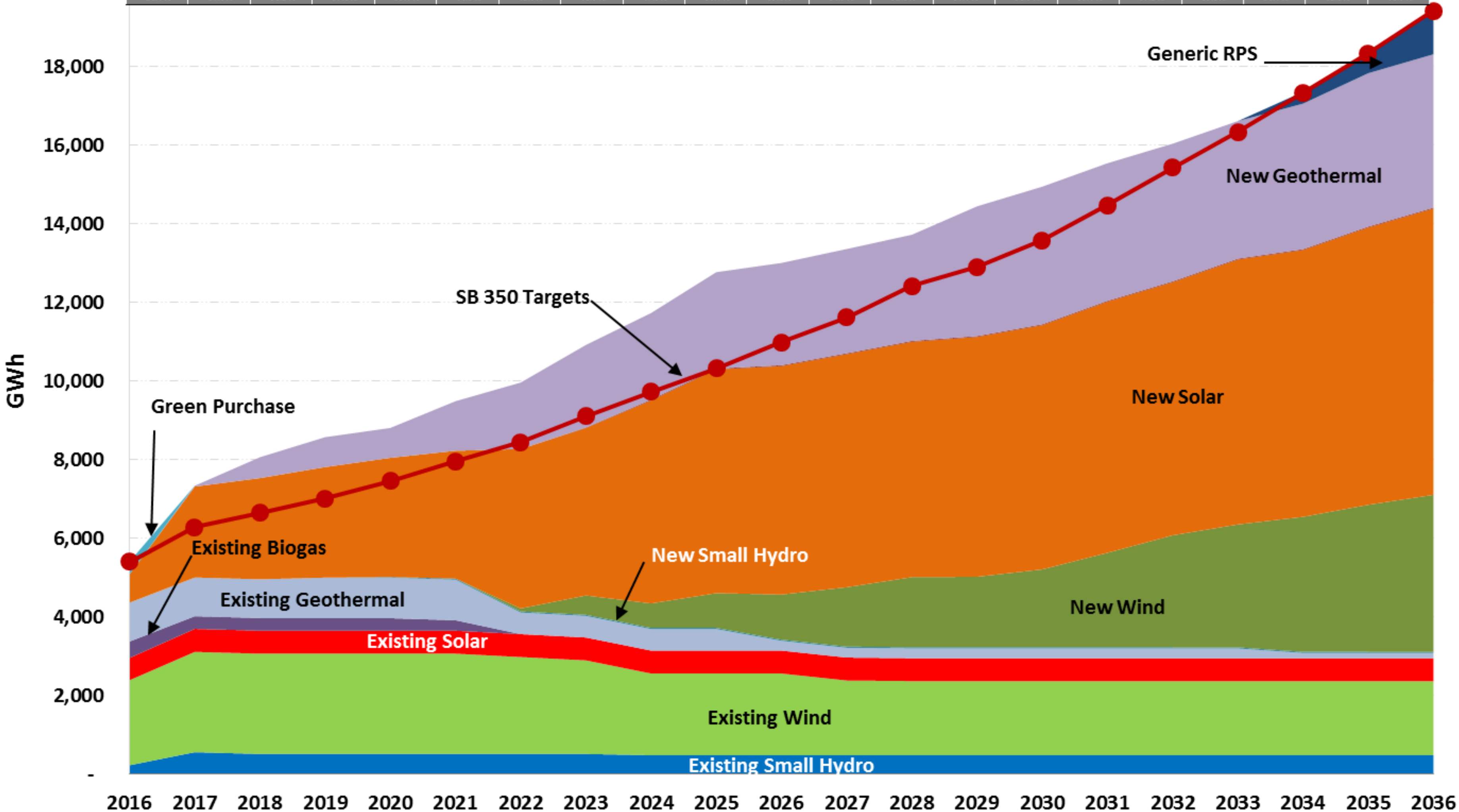


Achieving 50% RPS by 2030

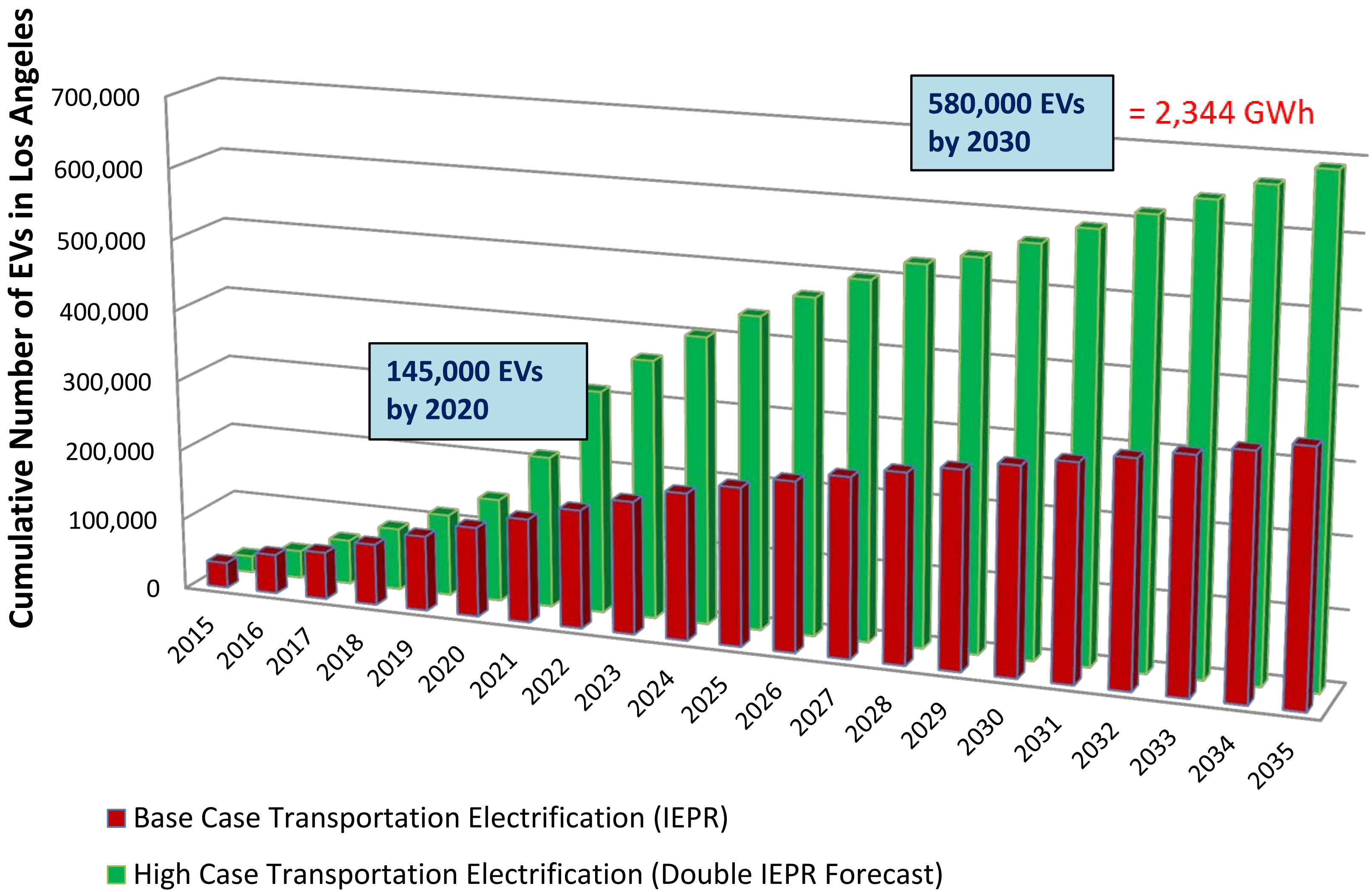


Achieving 65% RPS by 2036

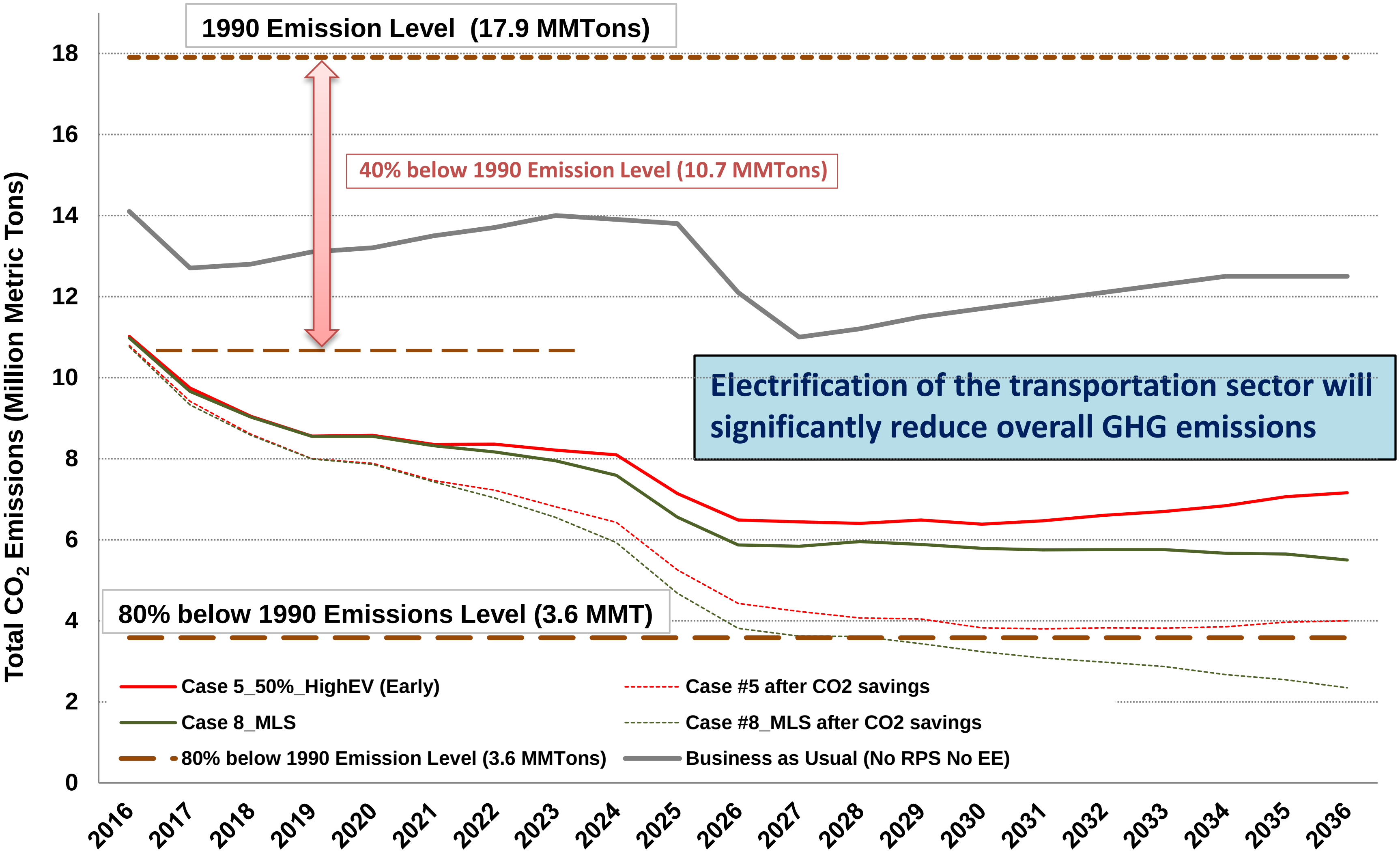
2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036
23.4%	31.6%	35.2%	37.5%	38.4%	41.0%	42.0%	45.0%	47.0%	50.1%	50.6%	51.7%	52.0%	54.1%	55.0%	56.4%	57.2%	58.5%	60.1%	62.5%	65.0%



Electric Vehicle (EV) Charging Forecast



GHG Emissions: 50% vs 65% RPS



Transmission Upgrade Challenges

- Increased capacity from 450 to 2,200 MW
- Renewable interconnection requests of 3,773 MW from wind and solar developers
- New Haskell Canyon Switching Station (SS)
- New double-circuit 230 kV transmission line from Barren Ridge SS to the new Haskell Canyon SS.
- New 230-kV circuit on existing structures from the new Haskell Canyon SS to the Castaic Power Plant.
- Reconductoring of existing 230 kV transmission line from Barren Ridge to the existing Rinaldi Receiving Station
- Expand the existing Barren Ridge SS

DER Integration Study

- Leverage DER program efforts and resources
- Minimize duplications and increase system efficiency
- Achieve optimal DER deployment
- Achieve a common objective

Energy Storage Plan for 50% RPS

GENERATION	TRANSMISSION	DISTRIBUTION	CUSTOMER	JFB ES
Gas Fired + Thermal Energy	Battery Energy Storage System	Battery Energy Storage System	Battery, Thermal Energy Storage	Battery Energy Storage System
				
Location: Valley Generating Station	Location: Beacon & Springbok Area Solar	Location: Distributing and Receiving Stations	Location: Customers	Location: John Ferraro Building Parking lots
Capacity: 60 MW or greater	Capacity: 50 MW or greater	Capacity: 4 MW or greater	Capacity: 40 MW	Capacity:300KW/1MWh
Key Applications: • Increase CT output during hot weather 10%-20% • Peak Shifting • Ramping regulation capacity • May eliminate need for added capacity	Key Applications: • Regulation Service (ramping up and down) • Solar Power Output Leveling • Peak Shaving	Key Applications: • Peak Shaving • Distributed PV Solar Integration • Deferring Distribution Infrastructure Upgrades	Key Applications: • Permanent Load Shifting • Dispatchable Peak Shifting • Deferring Distribution Infrastructure Upgrades • Demand Response • Energy Efficiency	Key Applications: • Demand Response • Dispatchable Peak Shifting • Energy Management System • Research and Development
Schedule • Completion by December 2017	Schedule • Completion by September 2020	Schedule • Completion by March 2019 for DS and September 2020 for RS	Schedule • Completion by July 2020	Schedule • Completion by June 2016

Summary – Challenges

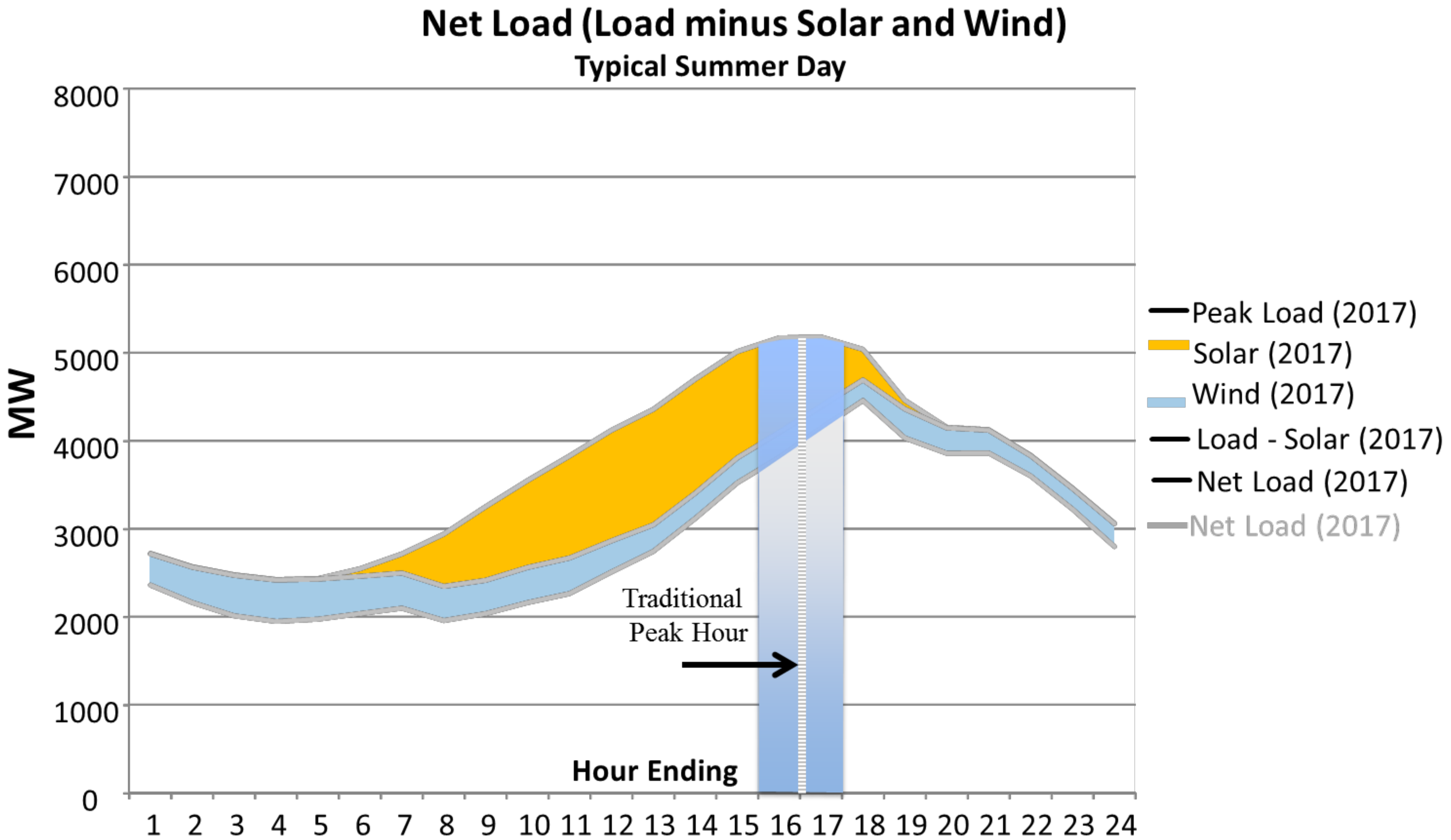
- Limited available Transmission Capacity for Renewable Projects
  Increased RPS Category 2 and 3 percentages may be needed
- Disposition of grandfathered RPS power purchase agreements at the end of the contract term or when purchased (Category 0 or 1?)
- Cap and Trade Allocations Post 2020, as currently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

Summary – Opportunities

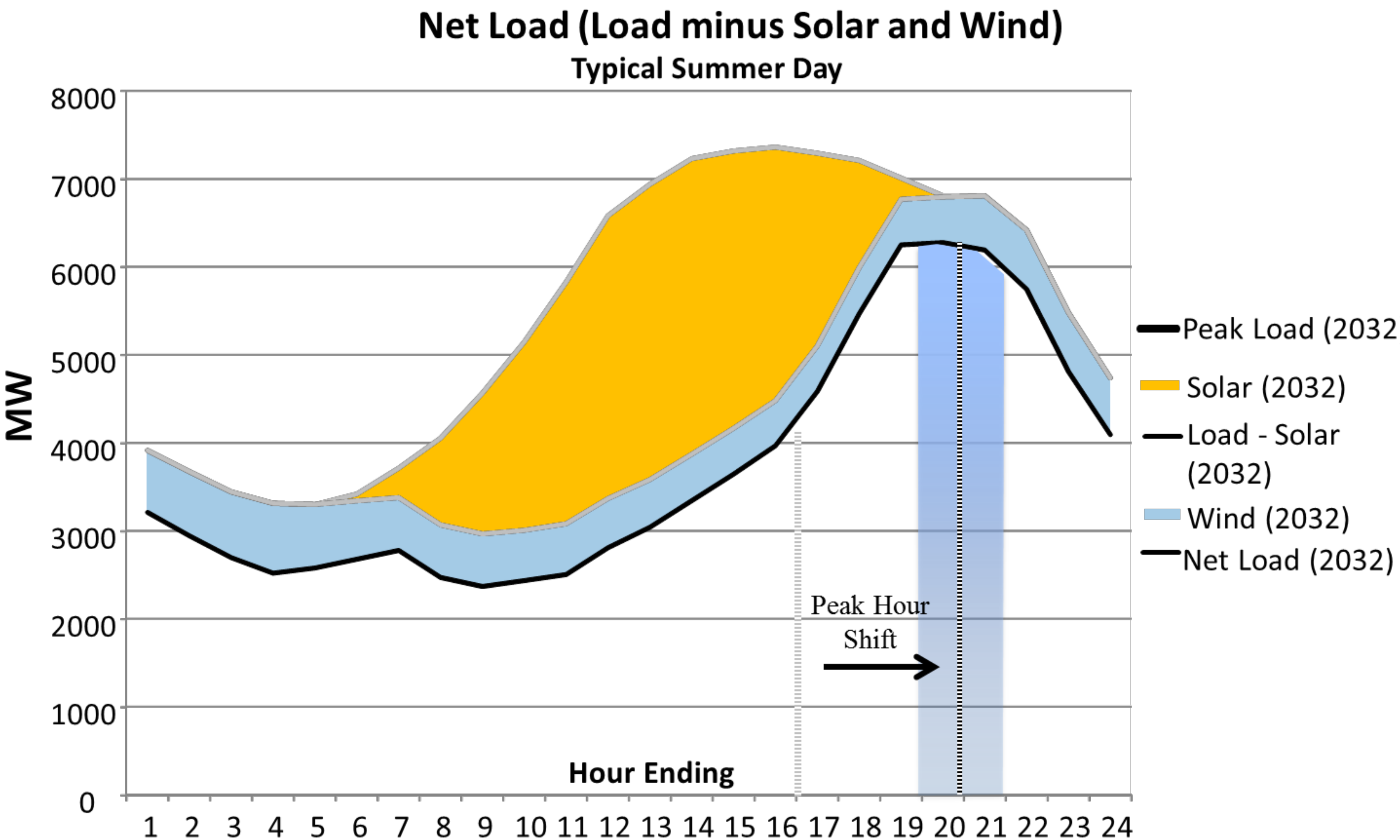
- Improved coordination, cooperation, and flexibility among Agencies and POU's recognizing past and future investments and good faith efforts made by POU's to reach State goals.
- Continue to recognize existing grandfathered RPS projects beyond the original contract term to continue meeting 50% RPS
-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

Appendix

Resource Adequacy Methodology

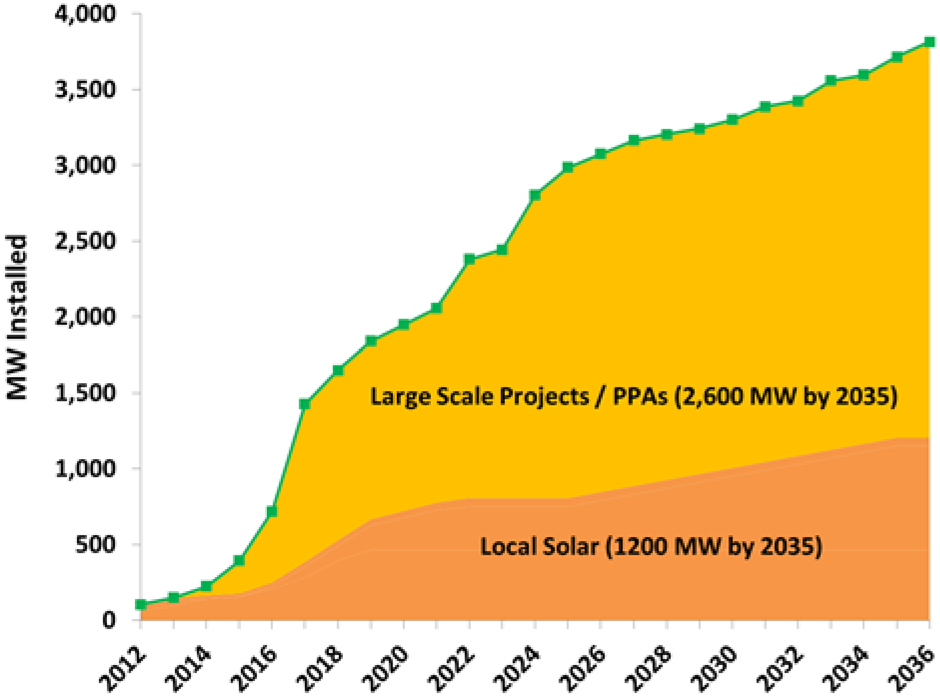


Resource Adequacy Methodology



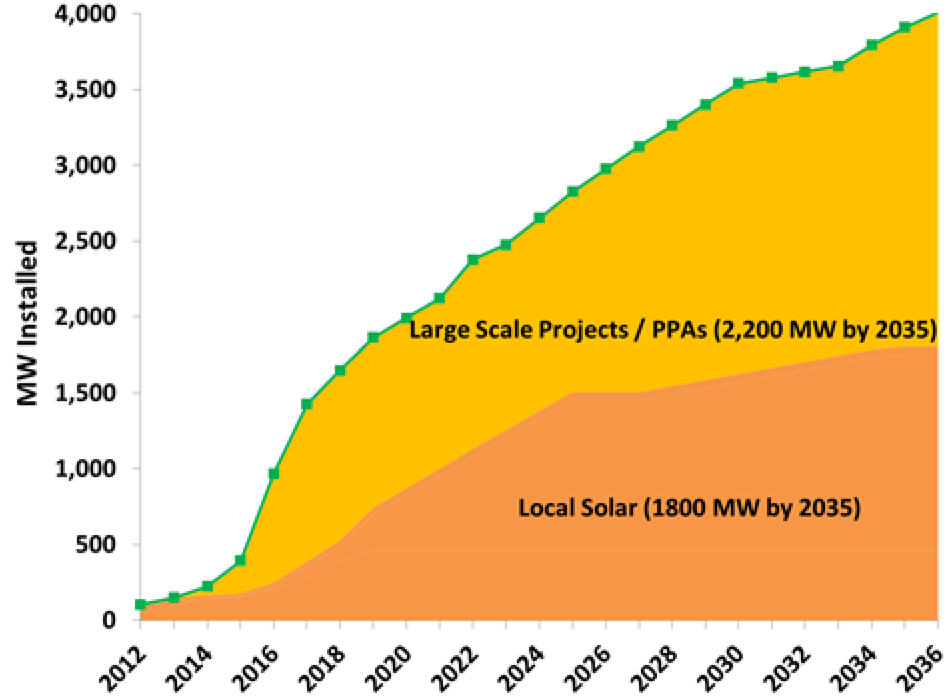
Local Solar Cases (Low vs. High)

Case 8 LLS (Low Local Solar):



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

Case 8 (High Local Solar):



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