Los Angeles Department of Water & Power

2016 Integrated Resource Plan

Public Outreach Workshop

October/November 2016

Putting Customers First

Los Angeles Department of Water & Power

PRESENTATION OVERVIEW

Power Transformation

Power System Integrated Resource Plan Roadmap

Scenarios (Cases)

Coal Cases

Advanced Renewable and Energy Efficiency Cases

Case Comparisons

Feedback and Next Steps

Power Plan Objectives

- High Reliability
  - Power System Reliability Program
  - Integrating Renewables
  - Flexible Generation
- Environmental Policies
  - Reducing Greenhouse Gas emissions
  - Replacing coal power
  - Eliminating ocean cooling
- Competitive Rates
  - Maximizing existing infrastructure (transmission)
  - Cost effective business approaches



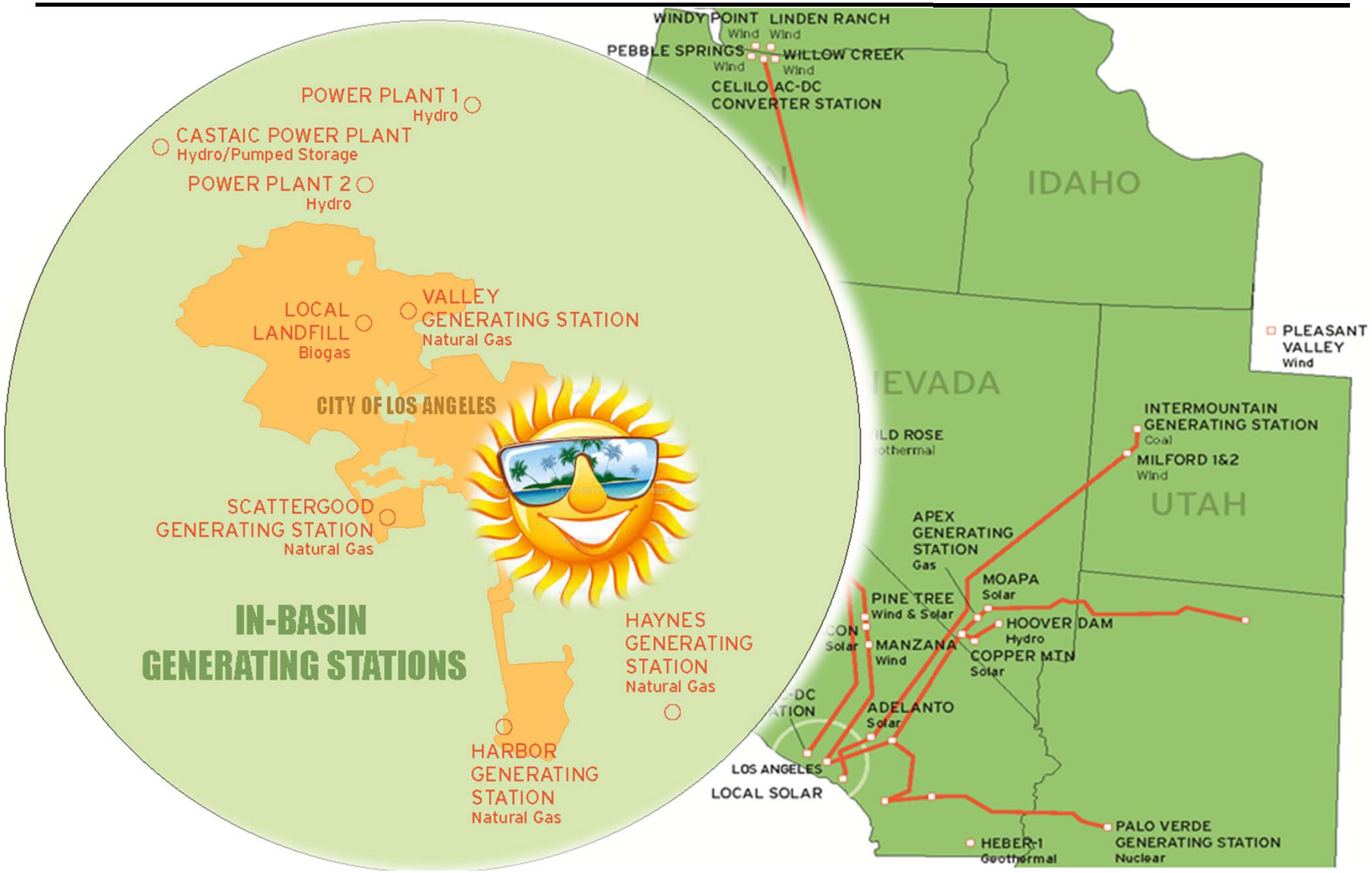
The IRP provides a roadmap to achieving this transformation

- Long-range, 20-year Plan to meet L.A.'s future energy needs
- Addresses regulatory requirements, environmental goals & policies, energy demand forecast & financial needs
- A living document updated yearly
- Public review & feedback every 2 years
- IRP Advisory Committee

How L.A.'s Power Resources Work Together



How L.A.'s Power Resources Work Together



Clean Energy Transformation Elements



Eliminate Coal from LADWP's Power Supply



Reach 33% Renewables (RPS) by 2020 and 50% by 2030



Achieve 15% Energy Efficiency by 2020



Once-through Cooling Repowering



Invest in Power System Reliability Program



Support Electric Vehicle Expansion

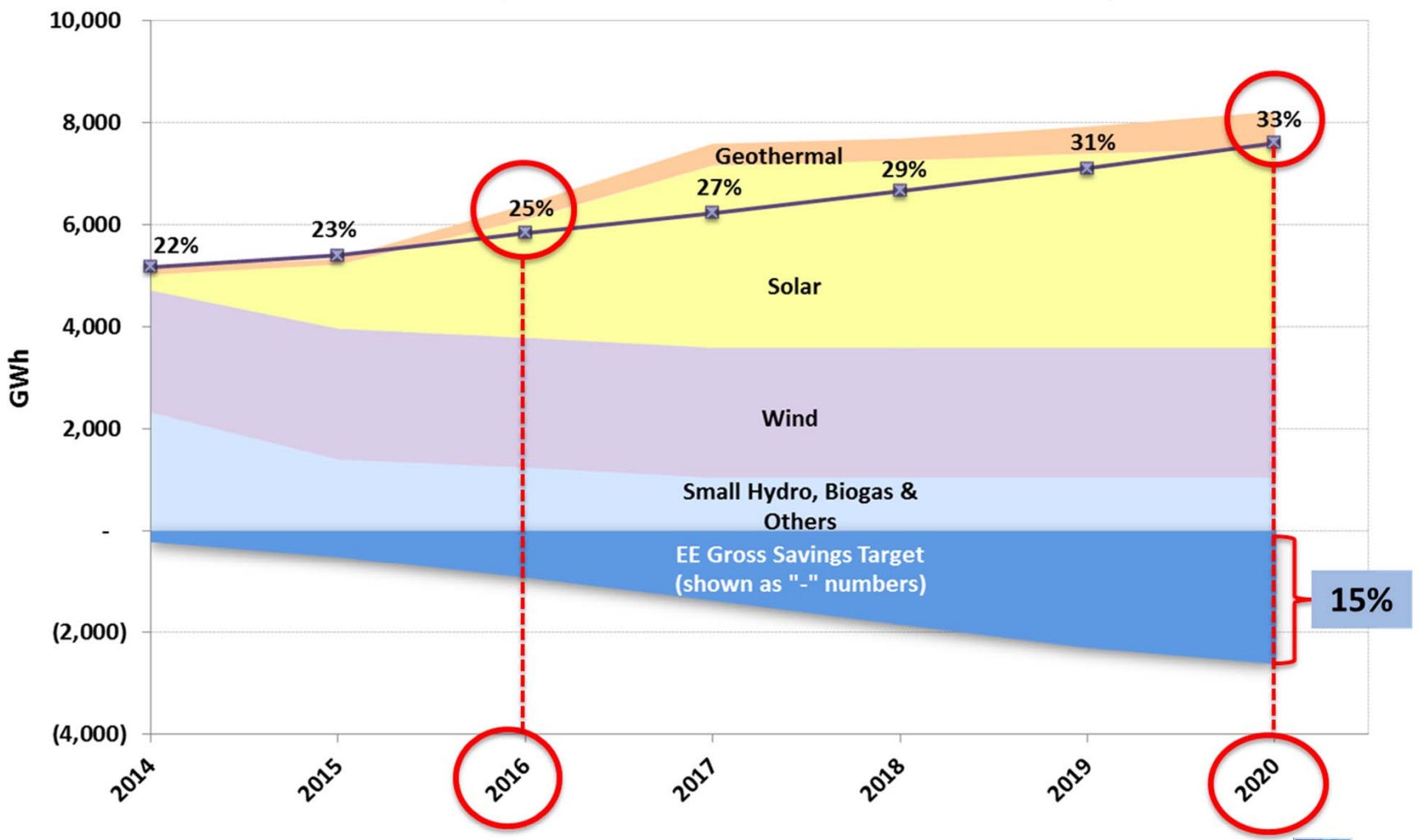
Coal Replacement



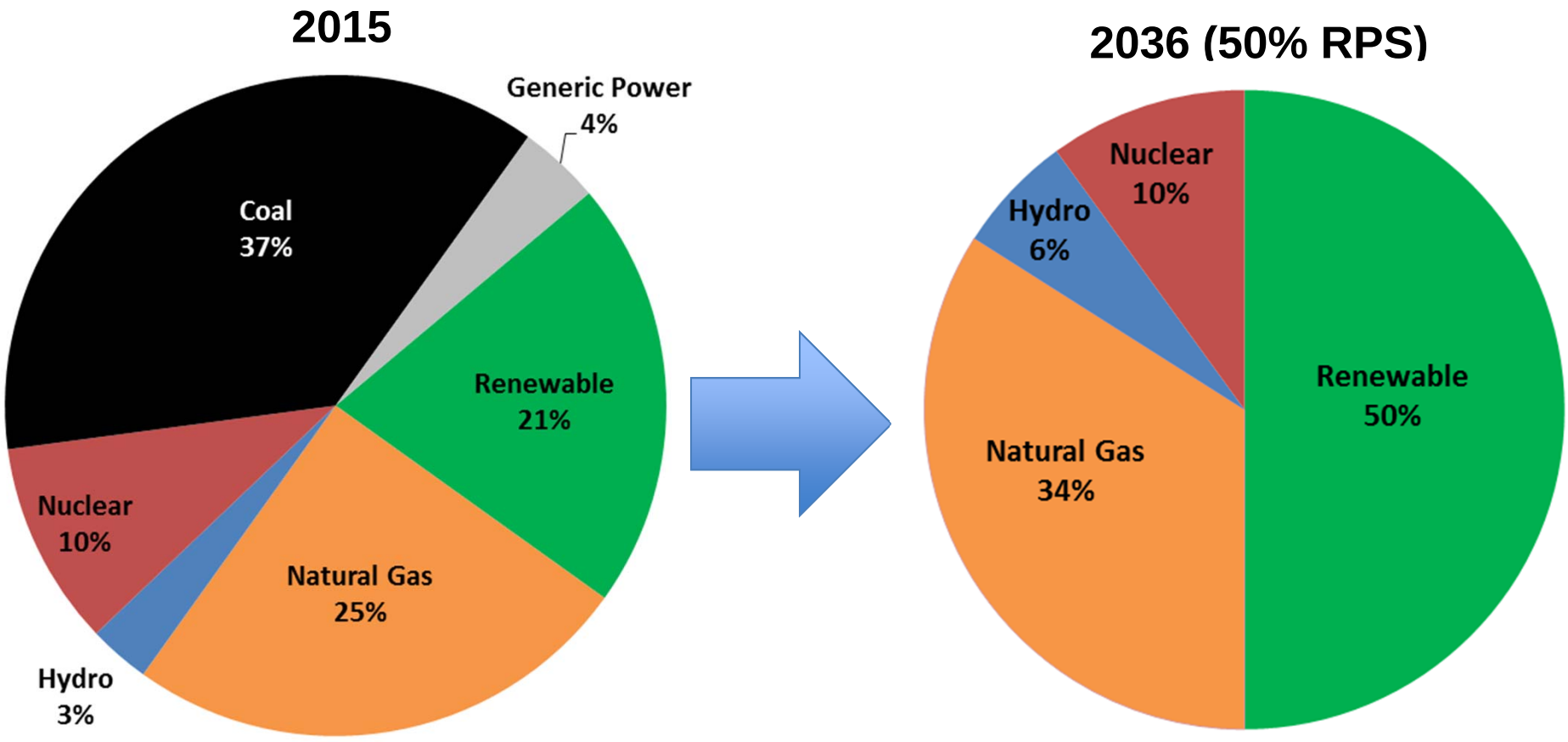
Senate Bill 1368 requires LADWP to stop importing power from coal plants when current contracts expire:

- LADWP sold its share of Navajo in 2015 and the sale closed on July 1, 2016
- Intermountain Power Project (IPP) in Utah: Expires 2027; LADWP plans to exit by 2025

Increasing Renewable Energy and Energy Efficiency



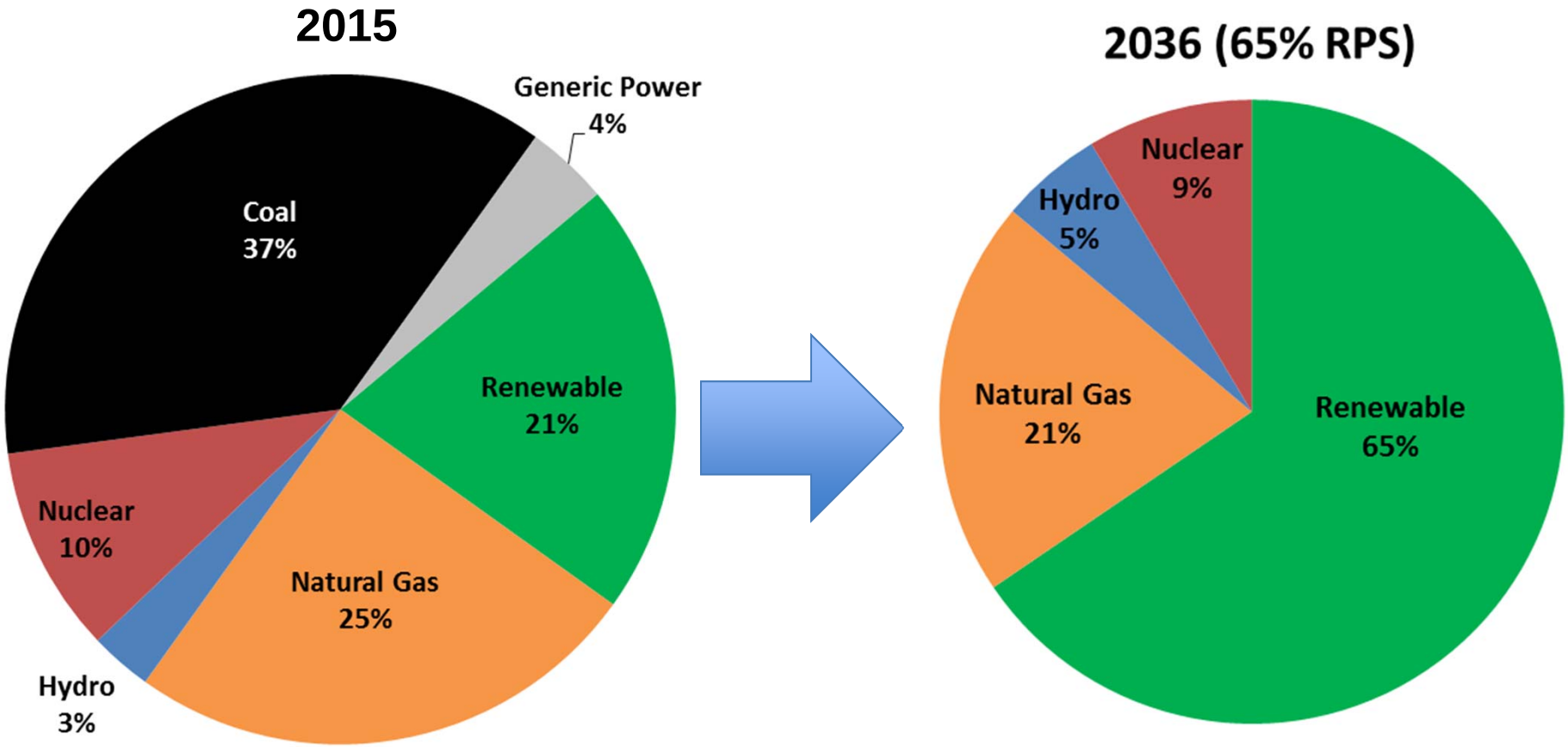
Transformation of Energy Resources



Energy Efficiency increases to 15% by 2020

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

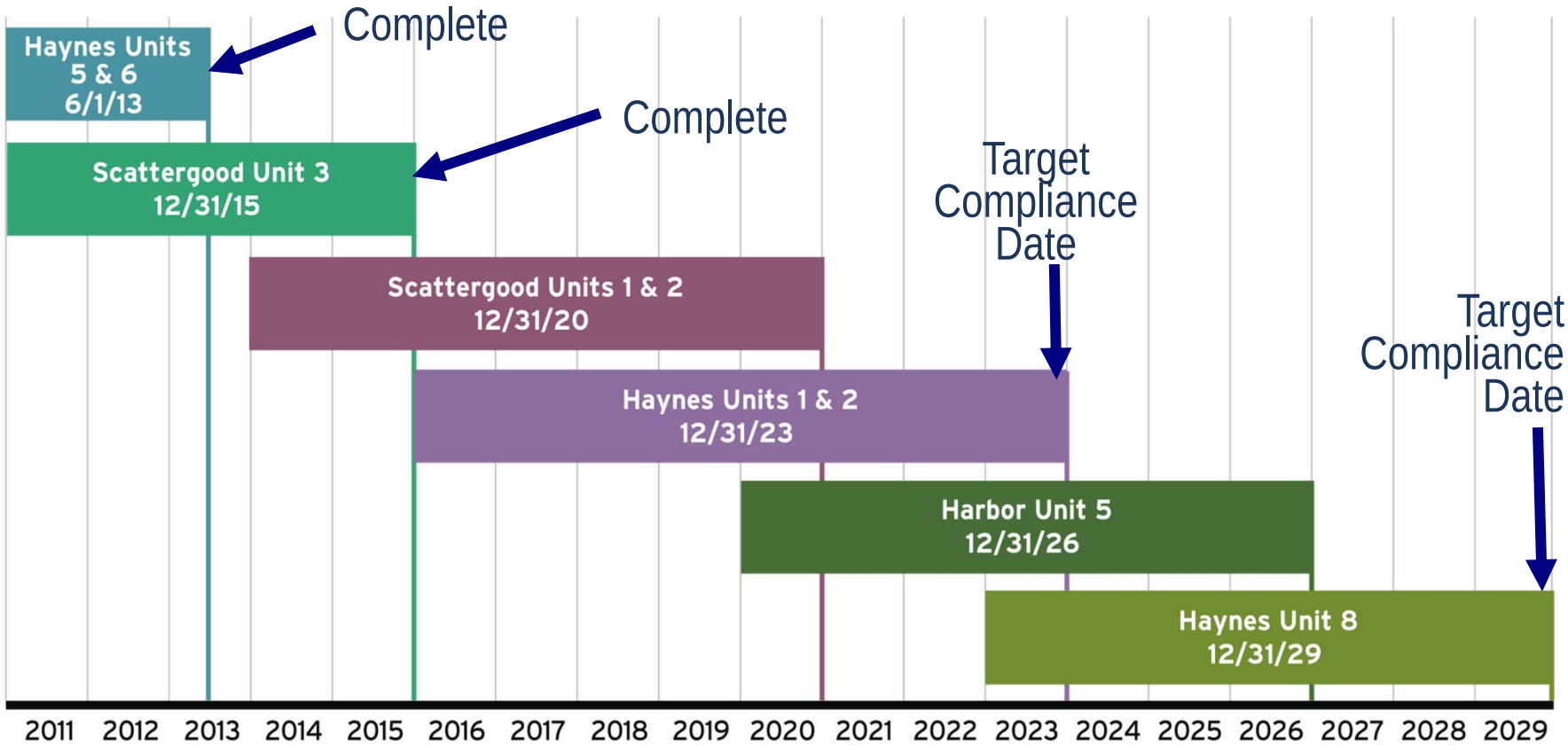
Transformation of Energy Resources



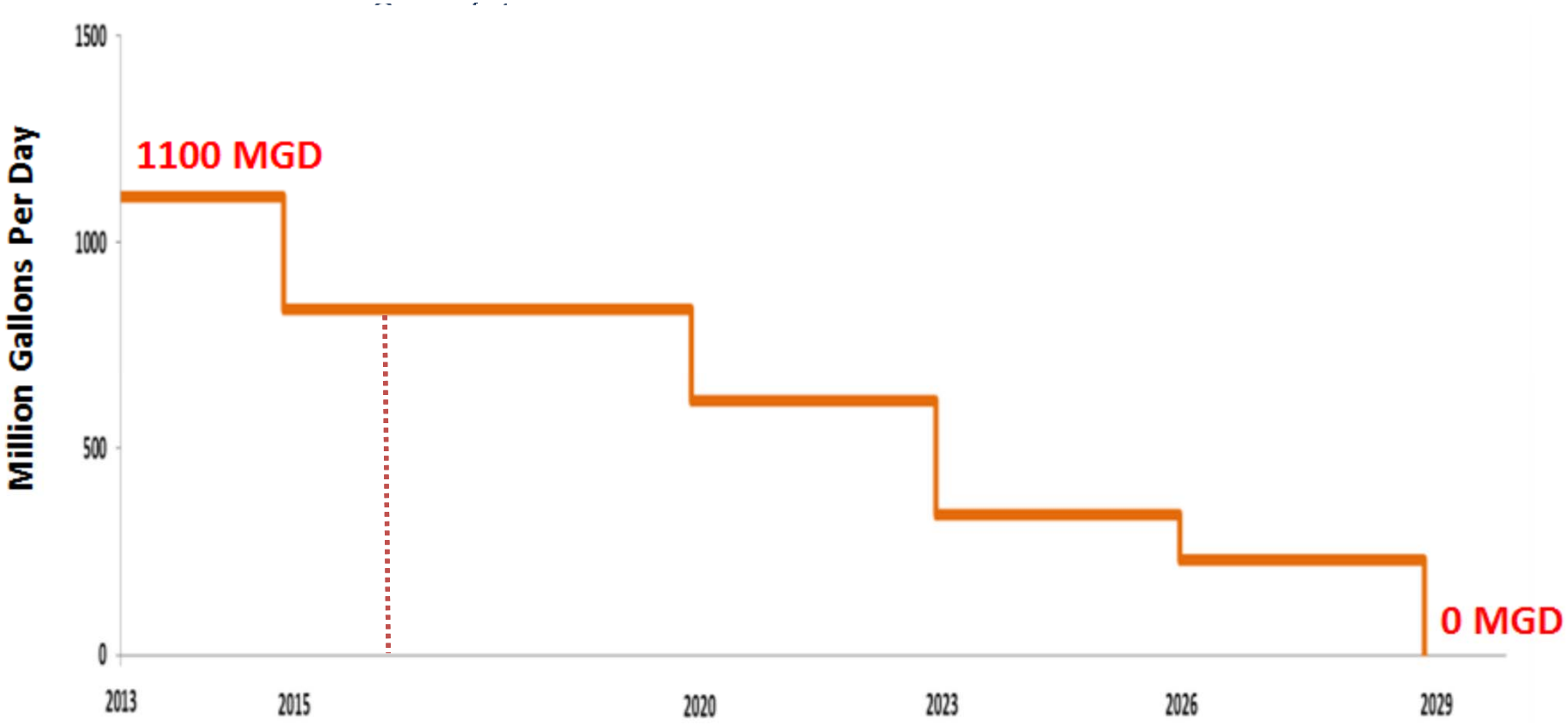
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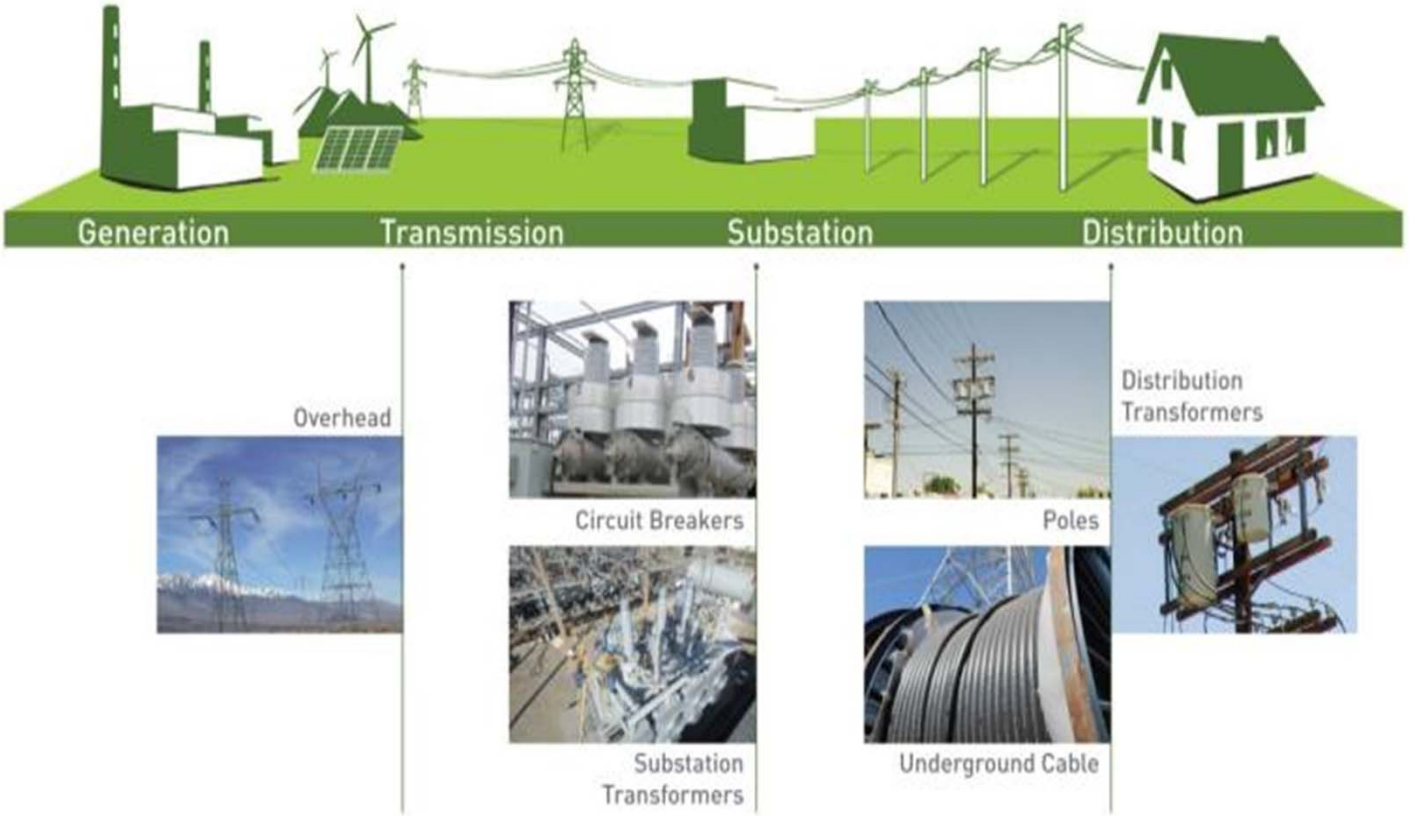
What's Driving the Transformation: Repowering deadlines to eliminate Ocean Water Cooling



What's Driving the Transformation: Repowering deadlines to eliminate Ocean Water Cooling

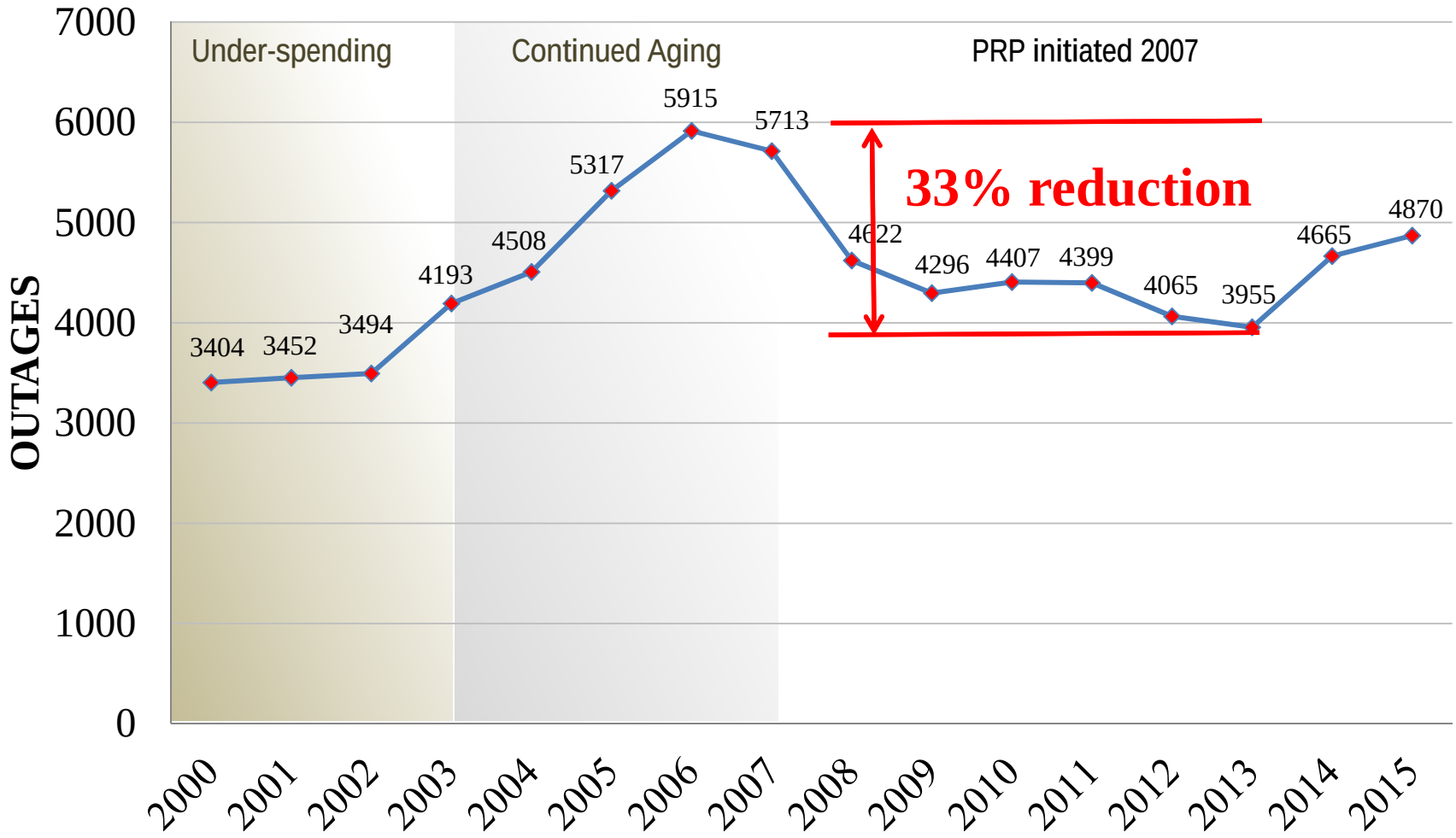


Invest in Power System Reliability Program (PSRP)



2016 PSRP Asset Recommended Replacement List			
Generation	**Transmission**	**Substation**	**Distribution**
Generator Transformer (GSU & AUX)	138kV UG Transmission Circuit	High Side Transformer (RS)	Poles
Major Inspection (Thermal)	138kV Stop Joints	Load Side Transformers (RS)	Crossarms
Major Inspection (Hydro)	Maintenance Hole Restraints	Local Substation Transformers (DS)	Cable (Miles)
Major Inspection (Pump)		>100kV Circuit Breakers	Transformers
		34.5kV Circuit Breaker	Substructures
		4.8kV Circuit Breaker	

Power System Reliability Program



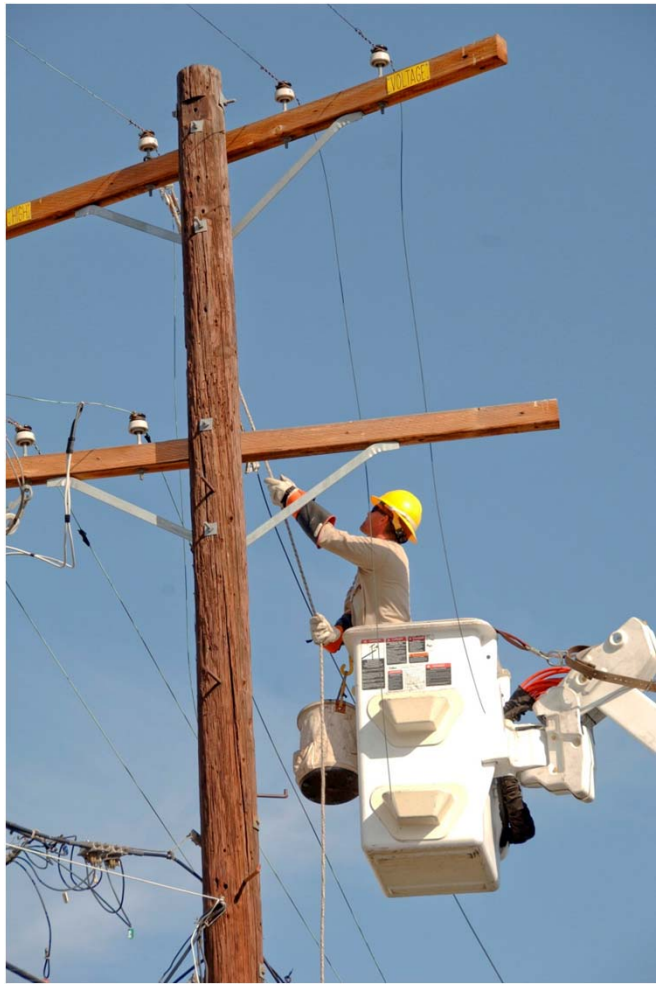
Ensuring Reliability – Asset Replacement

Pole Life

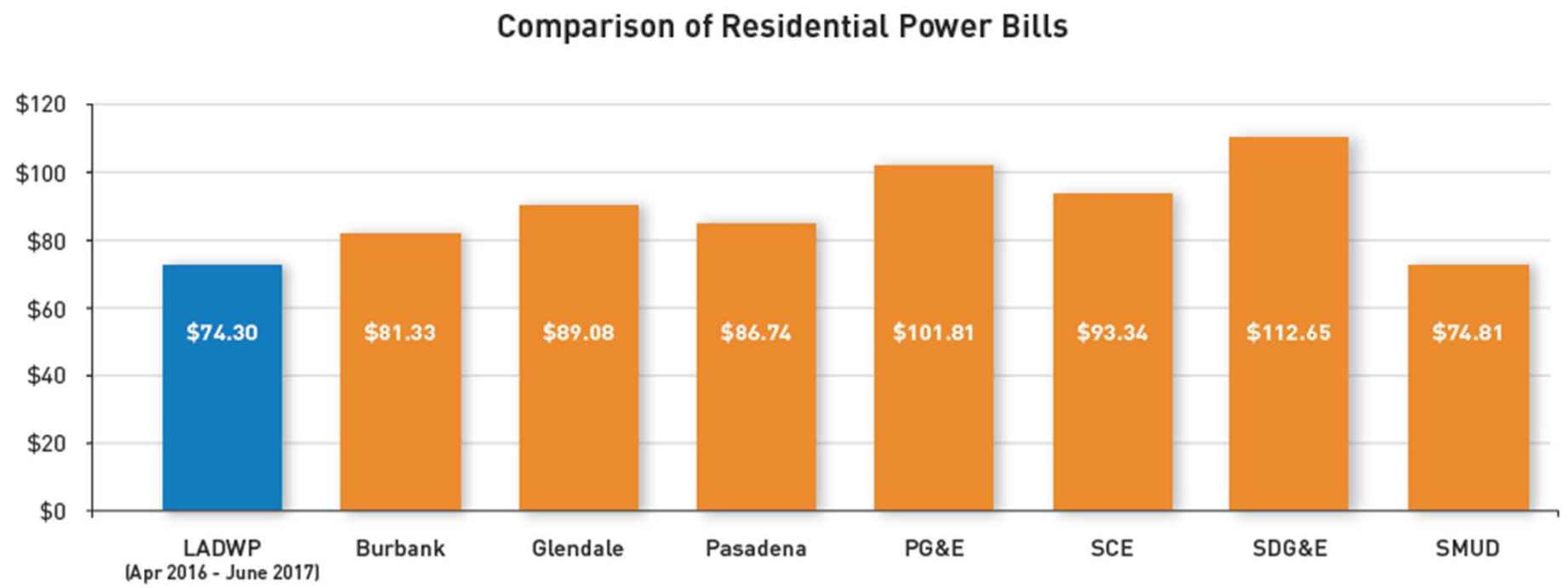
- 27 percent of poles are over 60 years old
- Must replace >5,000 per year to *gradually* reduce average age

Cable Life

- Approximately 4,500 miles throughout system
- Current replacement rate = 32 miles/yr.
- Acceptable replacement rate = 50 miles/yr.



Residential Annualized Power Bill Comparison (500 kWh/month) – March 2016



Based on 500 kWh per Month as of March 2016

Determine Investments to Reach 100% Renewable



Solar Photovoltaic



Wind



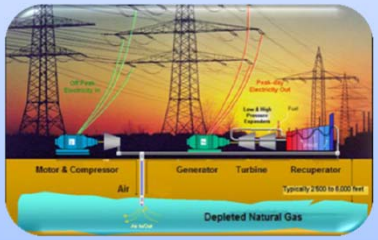
Geothermal



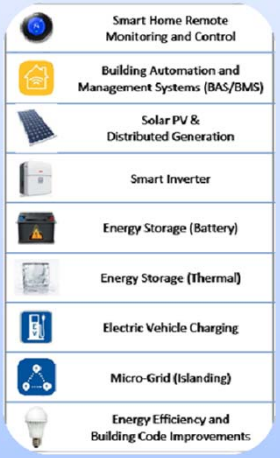
Hydroelectric



Energy Storage - Batteries



Compressed Air Energy Storage



Distributed Energy Resources (DER)



Carbon Neutral Future

Vision for 100% Clean Energy

A Path Forward

2016 IRP Public Outreach Meeting

October 26, 2016

City Council Action

- L.A. City Council Action – September 16, 2016

- LADWP to initiate and implement a research partnership with:
  - Region's Universities;
  - Members of the Southern California Public Power Authority (SCPPA);
  - California Independent System Operator (CAISO);
  - Neighboring Utilities; and
  - Other Stakeholders

  To determine what investments should be made to achieve 100% renewable energy portfolio.

- The research partnership to utilize the resources of the U.S. DOE and its support of "Mission Innovation" and the "Breakthrough Energy Coalition."

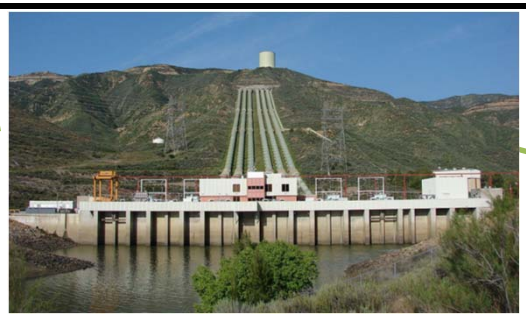
Pathways to 100% Clean Energy

Scenarios	Methodology
100% Fossil-free	• Sources other than Coal, Natural Gas, and Oil • Retire natural gas fired IPP and In-basin plants • Mix of Solar, Wind, Hydro, Geothermal, Nuclear, Hydrogen Turbines, Fuel Cell, Ocean Wave energy, and future emerging fossil-free technologies • Build sufficient capacity to deliver 100% of Customer Peak Demand • Electrification of Transportation
100% GHG Neutral	Achieve “net zero” GHG emissions by offsetting the amount of GHG released into the air through: • Equivalent over-generation of non-GHG emitting energy resources; or • Purchase of GHG credits

LADWP's Current Energy Resources



3,600 MW Nat Gas



2,000 MW Hydro



1,200 MW Coal



380 MW Nuclear

Total Capacity
9,045 MW



1,000 MW Wind



745 MW Solar



120 MW Geothermal

100% Clean Energy – Key Considerations

- Reliability of Electric Power System
- Renewable Generation Resources (Location and Capacity)
- Transmission – Constraints and Upgrades
- Energy Storage – Costs and Capability
- System Integration
- Rebuilding of In-basin Distribution System?
- Expand Energy Efficiency and Demand Response

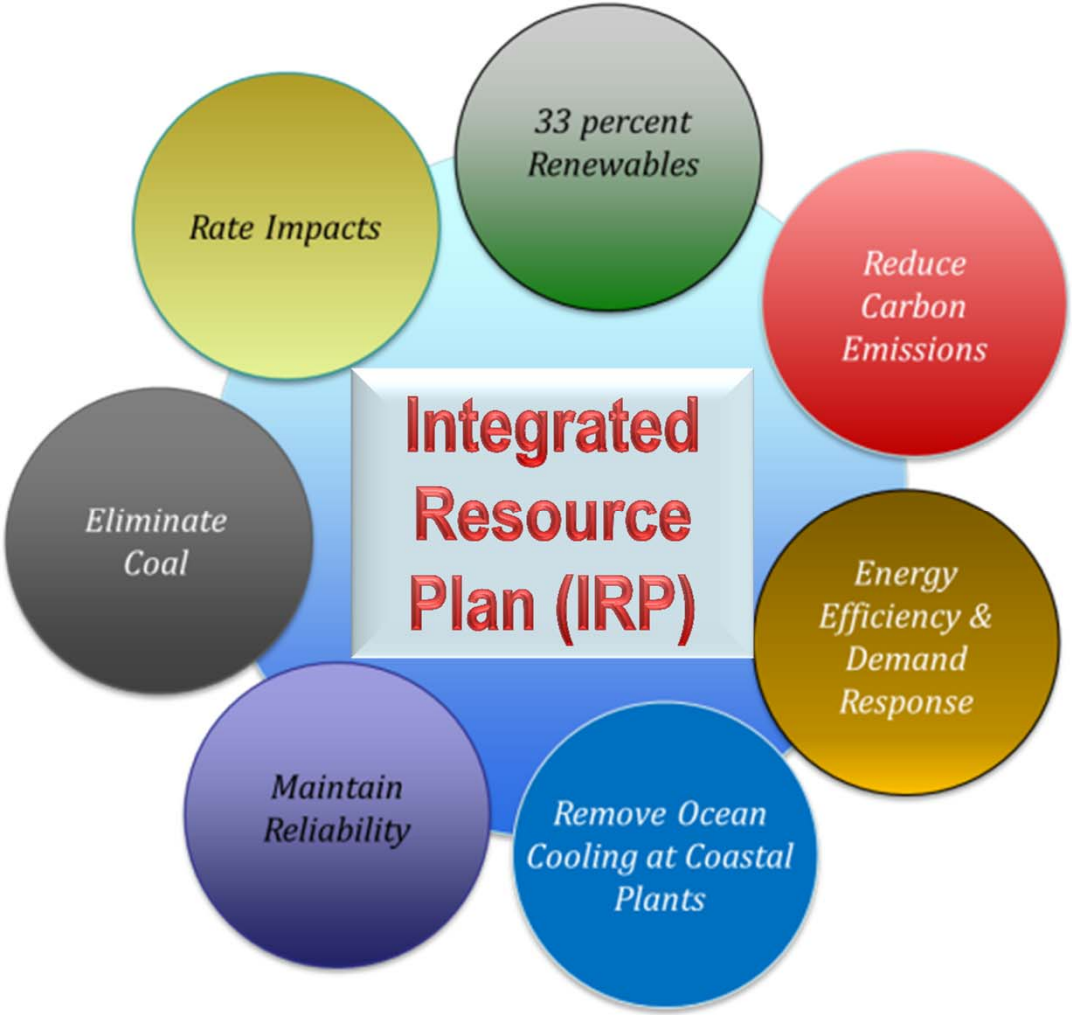
Research and Development

Planning Studies
Feasibility, Cost-effectiveness, Risk, Reliability, and Integration

LADWP Initiatives/Research Partnerships

- Power System – Vision Team
- Independent Consultant
  - Third Party Analysis
  - Targeted Research
  - Targeted Studies
  - Validation of Assumptions
  - Determination of Investments
- Research Partnerships
  (Universities, SCPPA, CAISO, Utilities, and DOE)
- Stakeholder Engagement
- Flexible Planning to facilitate Innovation
- Forward Thinking to Achieve a Clean Energy Future

LADWP's Power System Integrated Resource Plan



2016 IRP Case Analysis – Final Cases

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

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

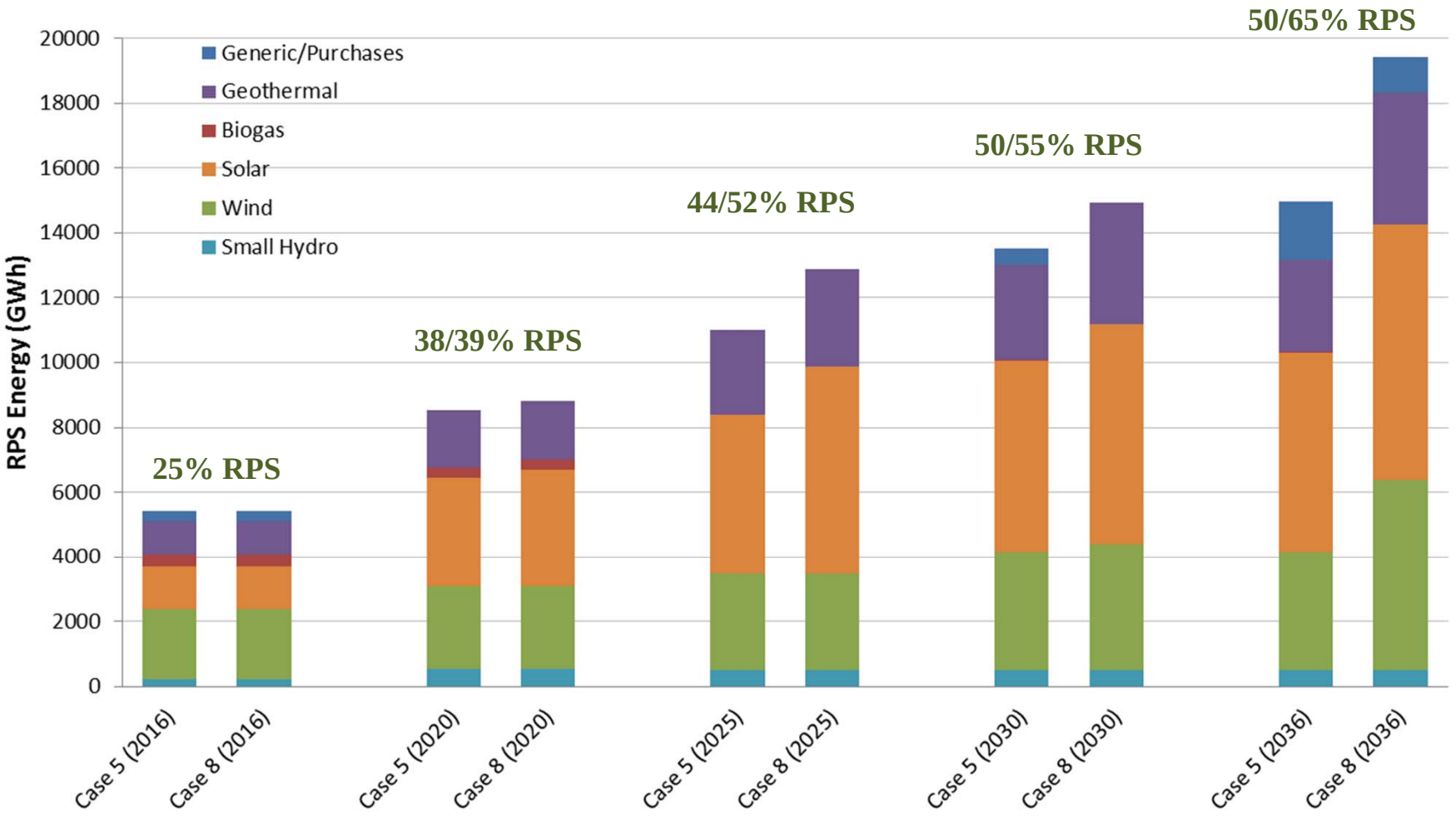
8. 65% RPS, High Local Solar, High Storage, High EV

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

Recommended Case

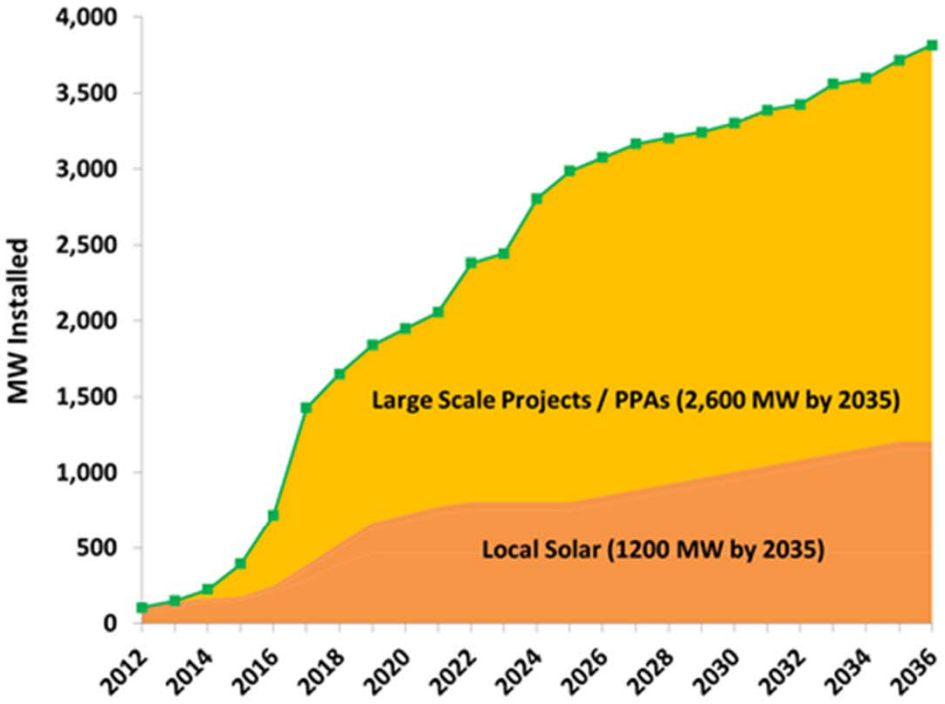
**Expected, Low, and High Fuel Cost Sensitivity Analysis was performed*

Renewables (RPS) Forecast – 50% vs 65%



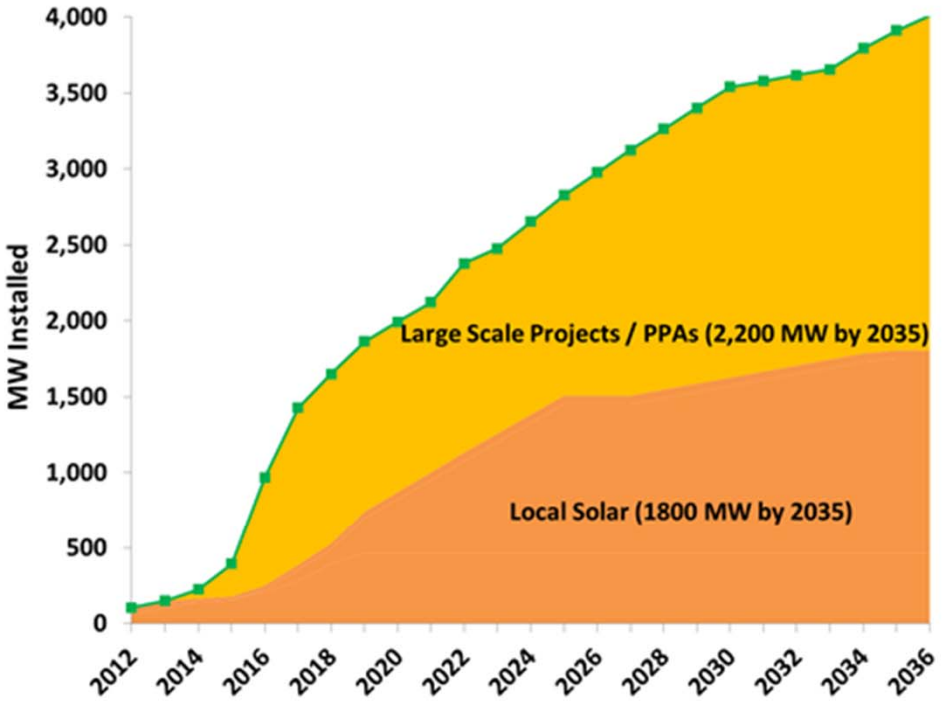
Local Solar Comparison – Low vs. High

Case 8 LLS (Low Local Solar):



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

Case 8 (High Local Solar):

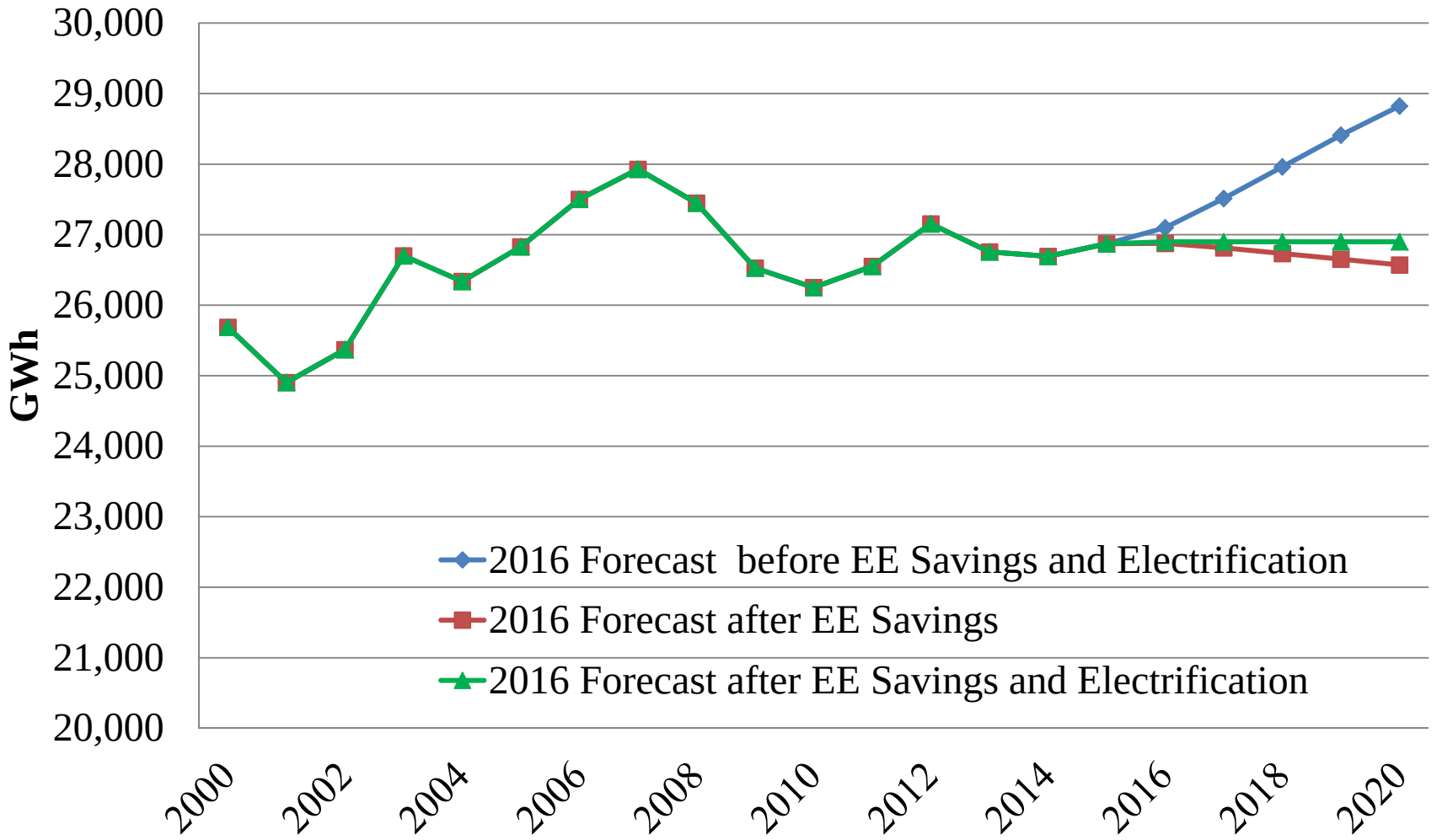


1,200 Megawatts (MW) by 2025 and 1,800 MW by 2035

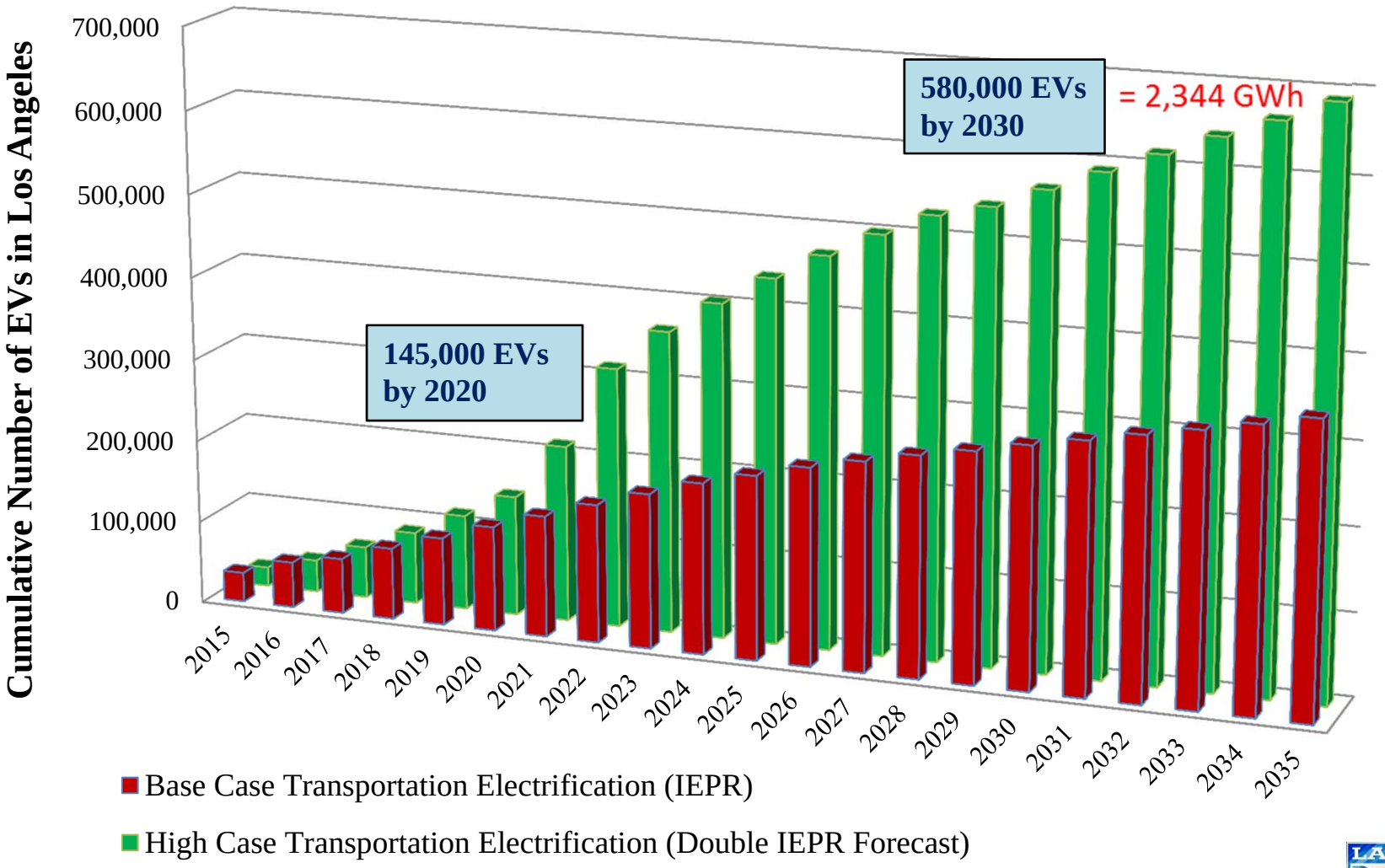
Energy Storage – Low vs. High

Year	Storage Size – Megawatts (MW)	Description	
2016	24	Castaic Improvements, LAX Thermal Energy Storage	Low (178 MW)
2017	20	Beacon Battery	
2018	30	Beacon Battery	
2019	60	Valley Thermal	
2020	40	Customer Distributed Thermal	
2021	4	Distributed Battery	
2022	160	Compressed Air Energy Storage near IPP	High (404 MW)
2023	22	2023 Battery	
2024	22	2024 Battery	
2025	22	2025 Battery	

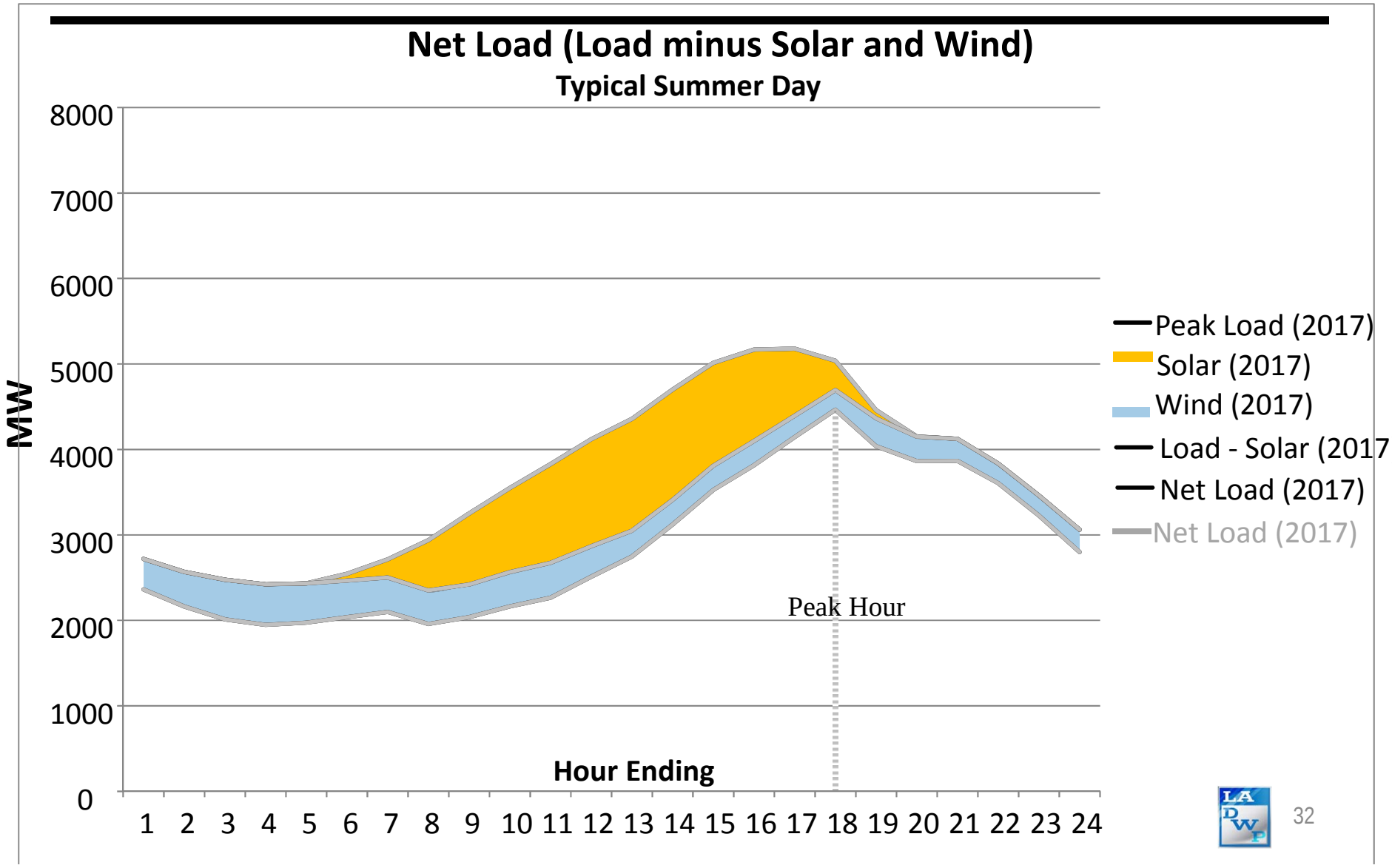
2016 Load Forecast – City of LA



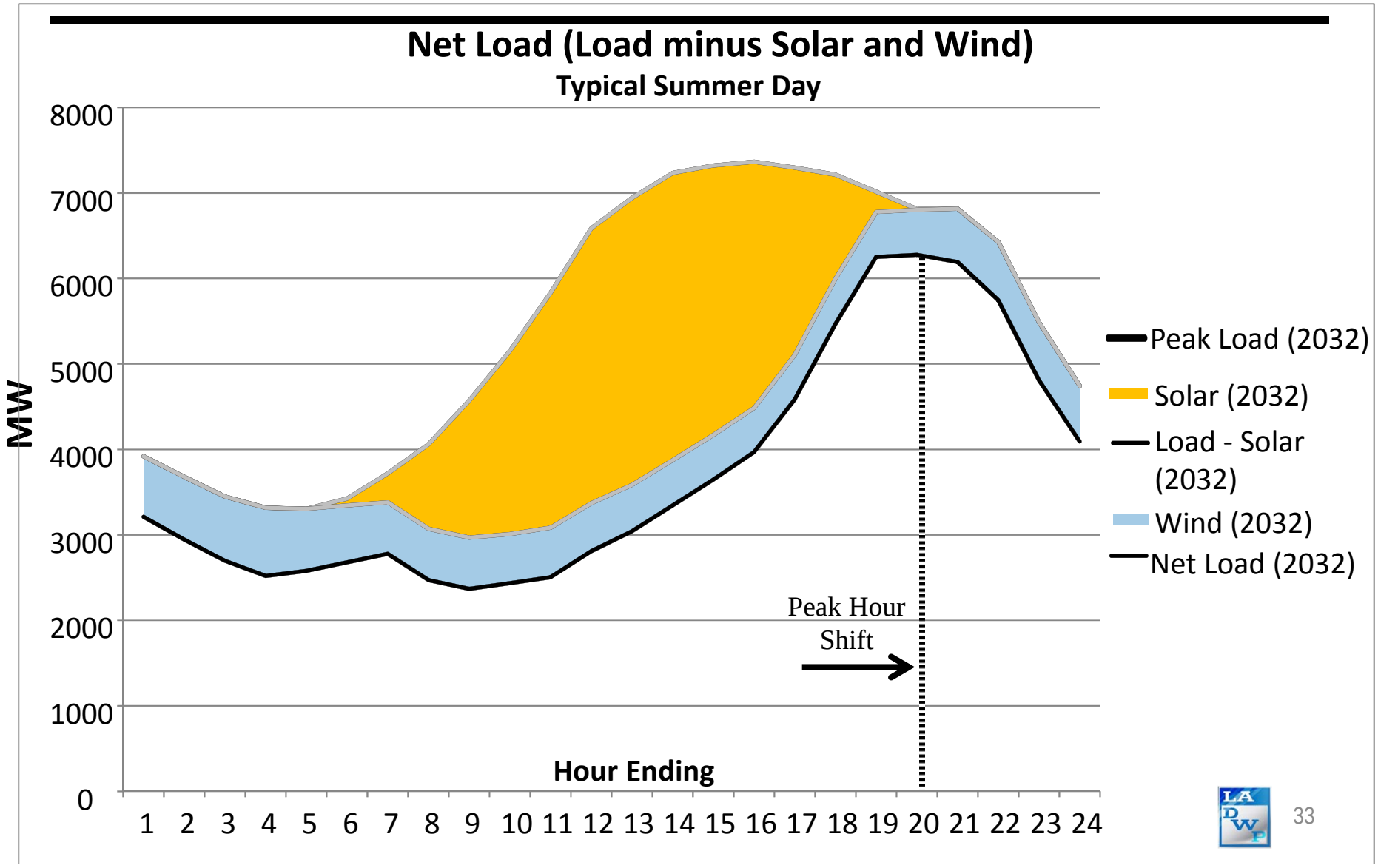
Electric Vehicle (EV) Charging Forecast



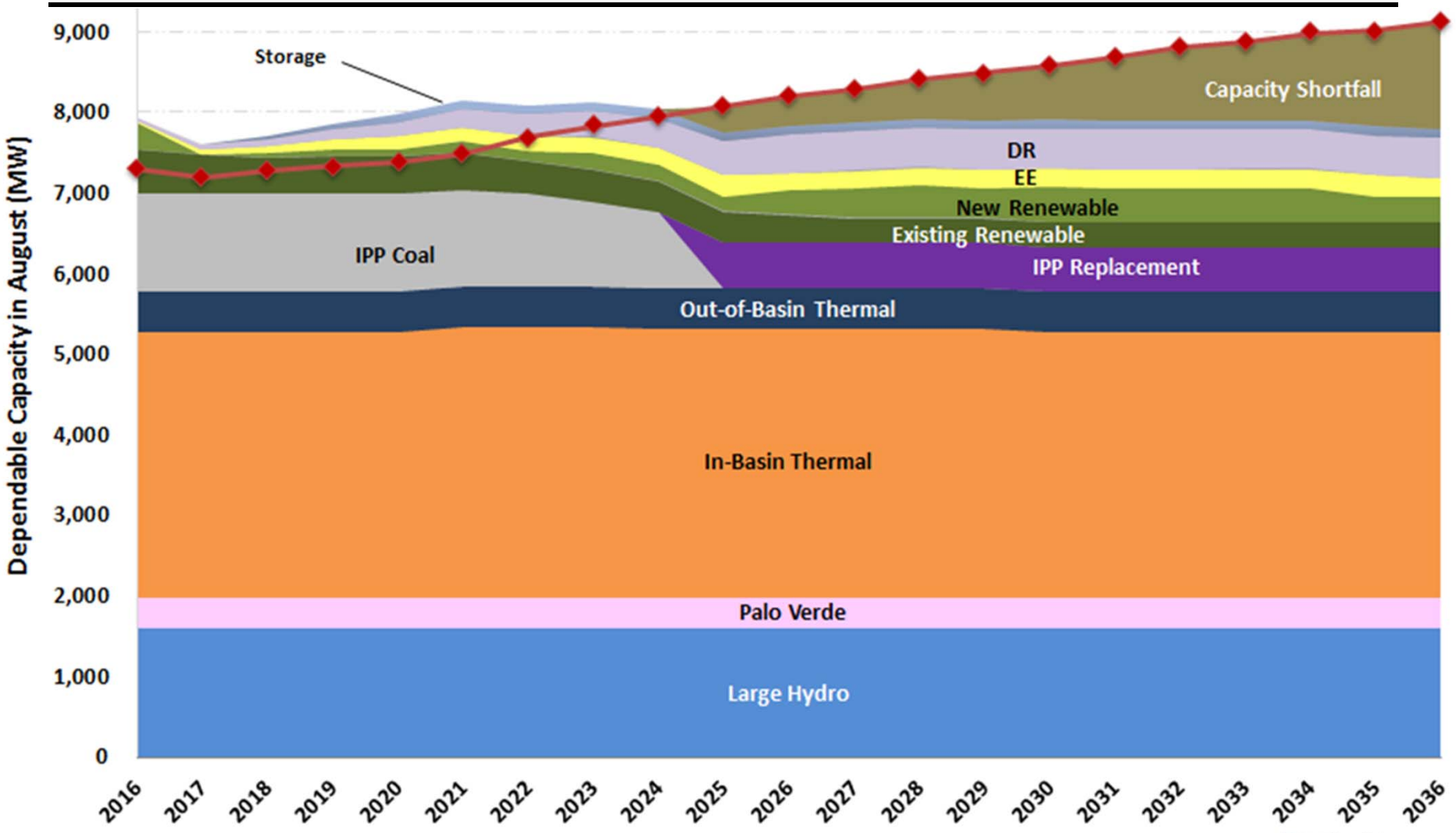
Resource Adequacy Methodology



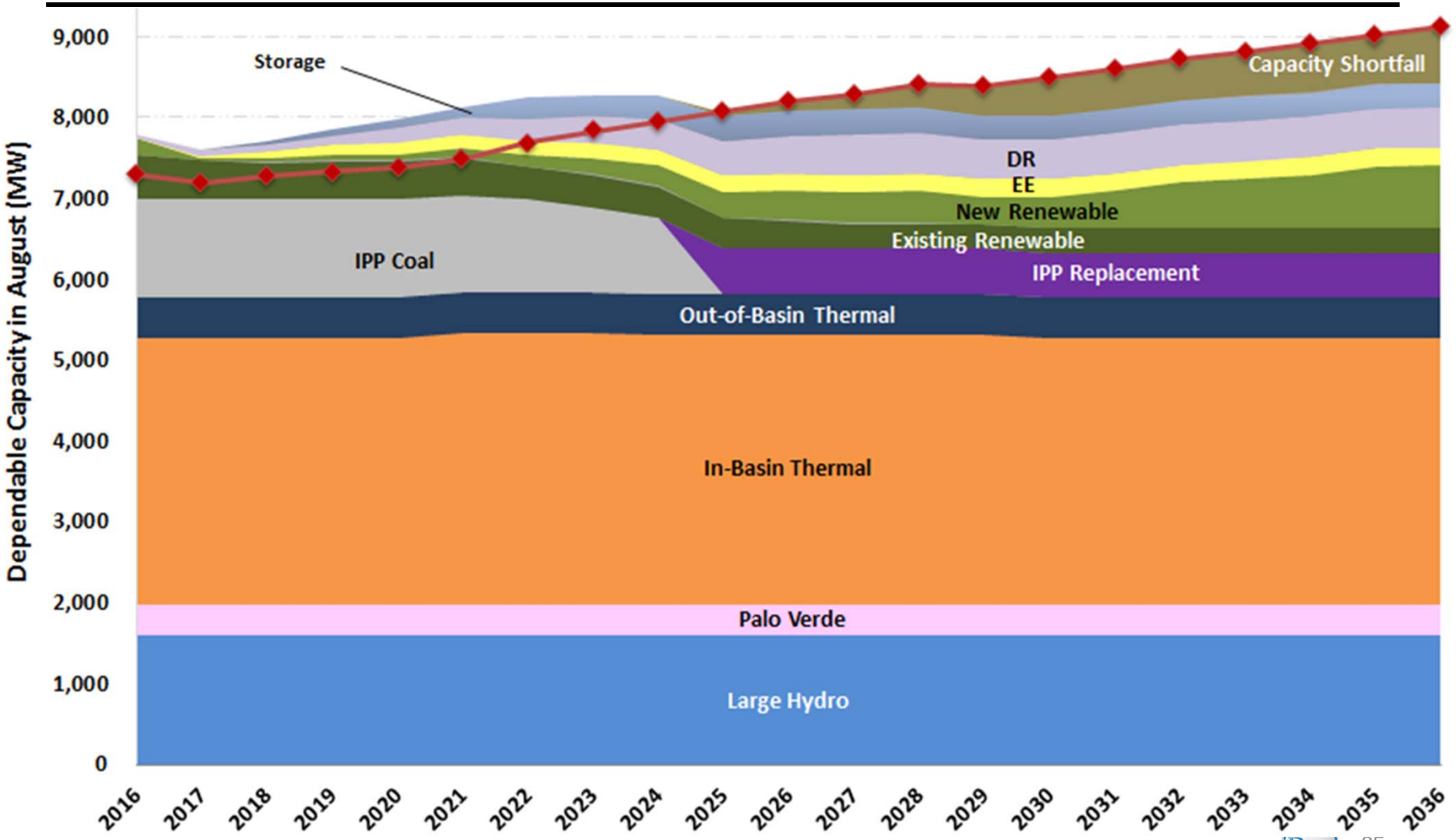
Resource Adequacy Methodology



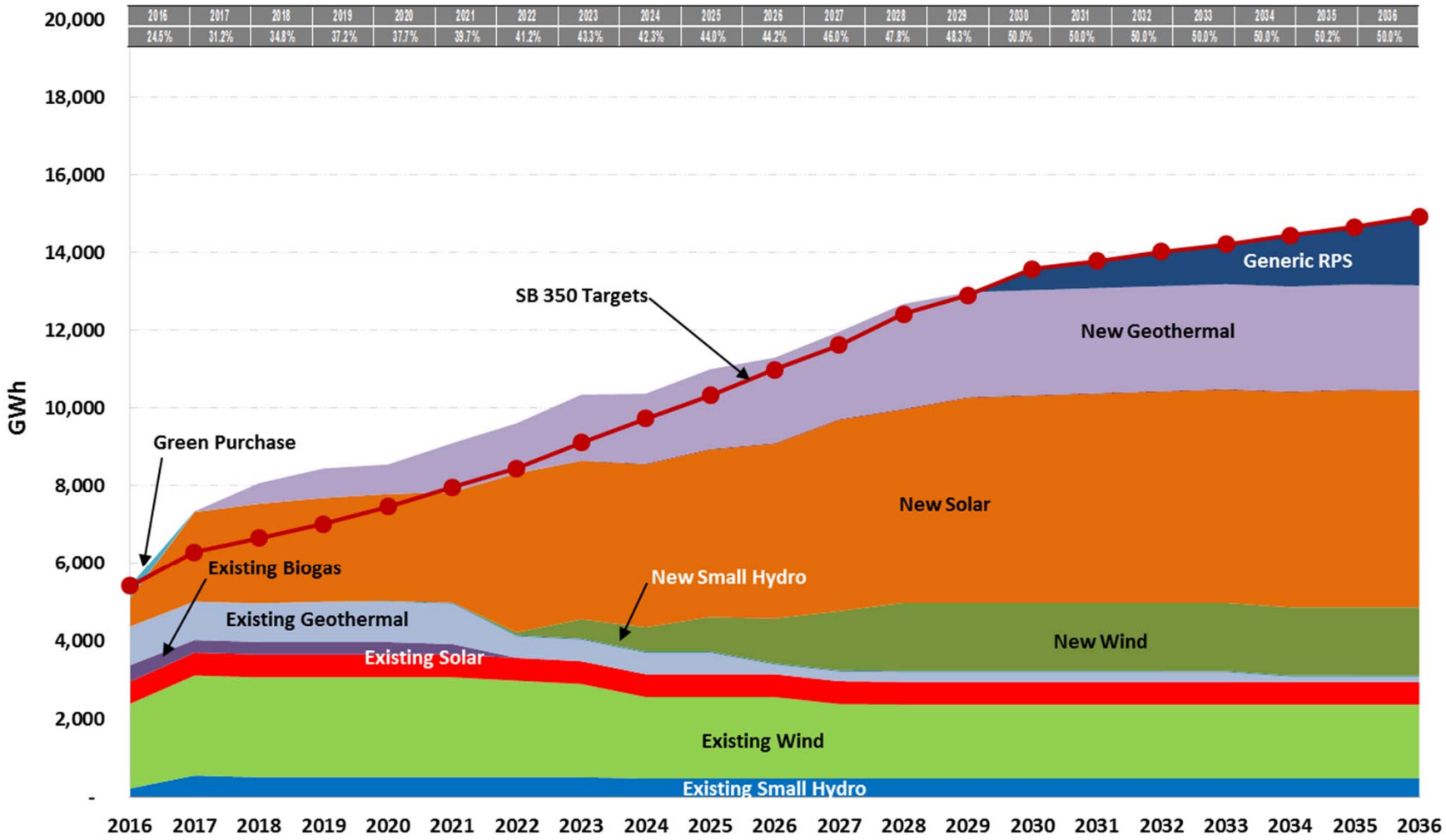
Resource Adequacy – Dependable Capacity (50% RPS)



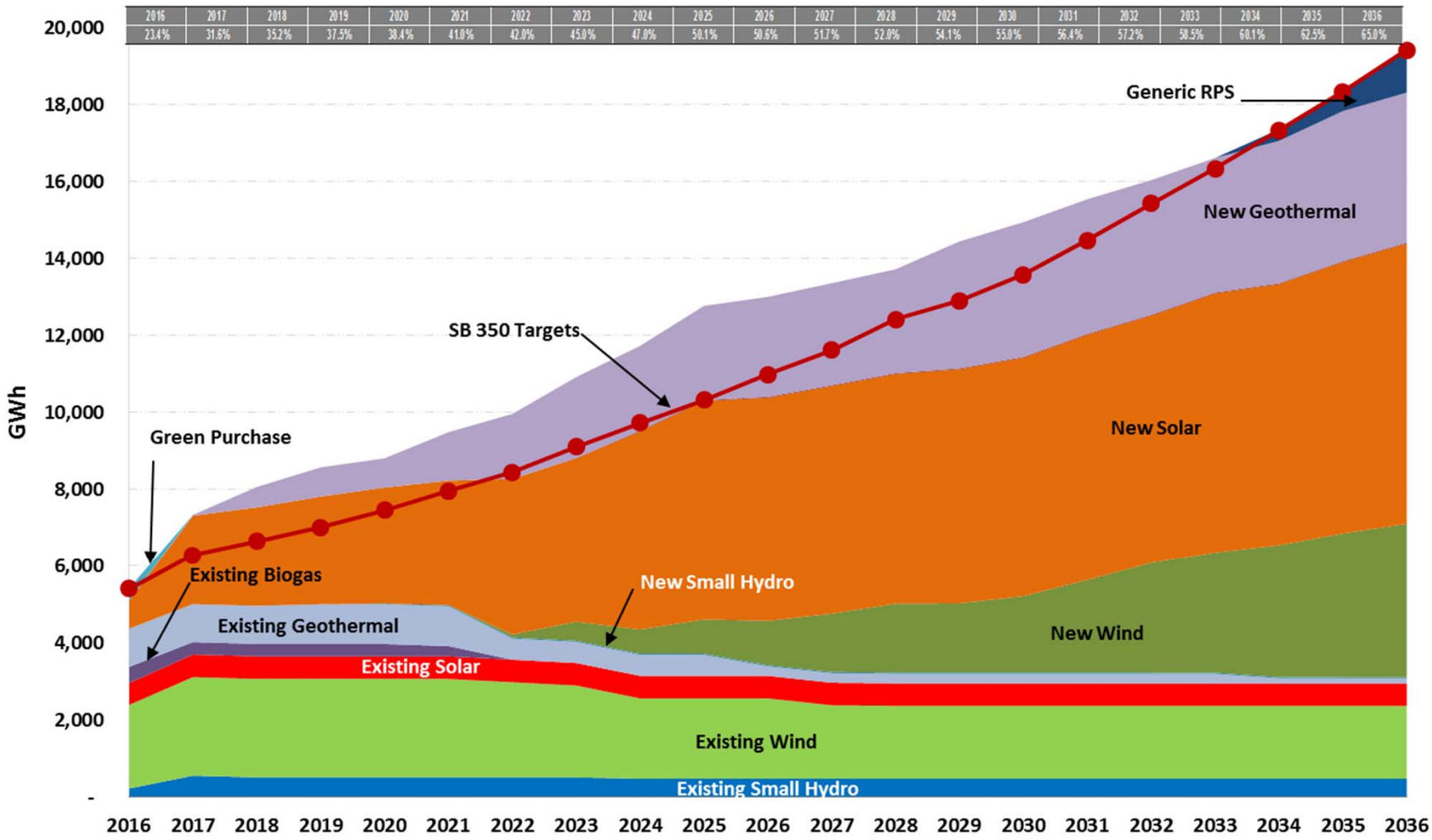
Resource Adequacy – Dependable Capacity (65% RPS)



Renewable Energy Breakdown – 50% RPS



Renewable Energy Breakdown – 65% RPS



Program Investment Cost

Program Revenue Requirement	Timeframe (years)	Net Cost ($)	GHG Removal Cost ($/metric ton)
Early IPP Replacement	2025-2027	$70,000,000	$20
Increase RPS from 50% to 65%	2025-2036	$1,196,000,000	$124
Increase Local Solar from 1200 MW to 1800 MW*	2017-2036	$2,177,000,000	$867 to $918
Increase Energy Storage from 178 MW to 404 MW	2017-2036	$428,000,000	$351
Increase Transportation Electrification from Base to High	2017-2022	$250,000,000	$7**
Solar Focused RPS instead of Diverse	2022-2036	$512,000,000	No GHG benefit

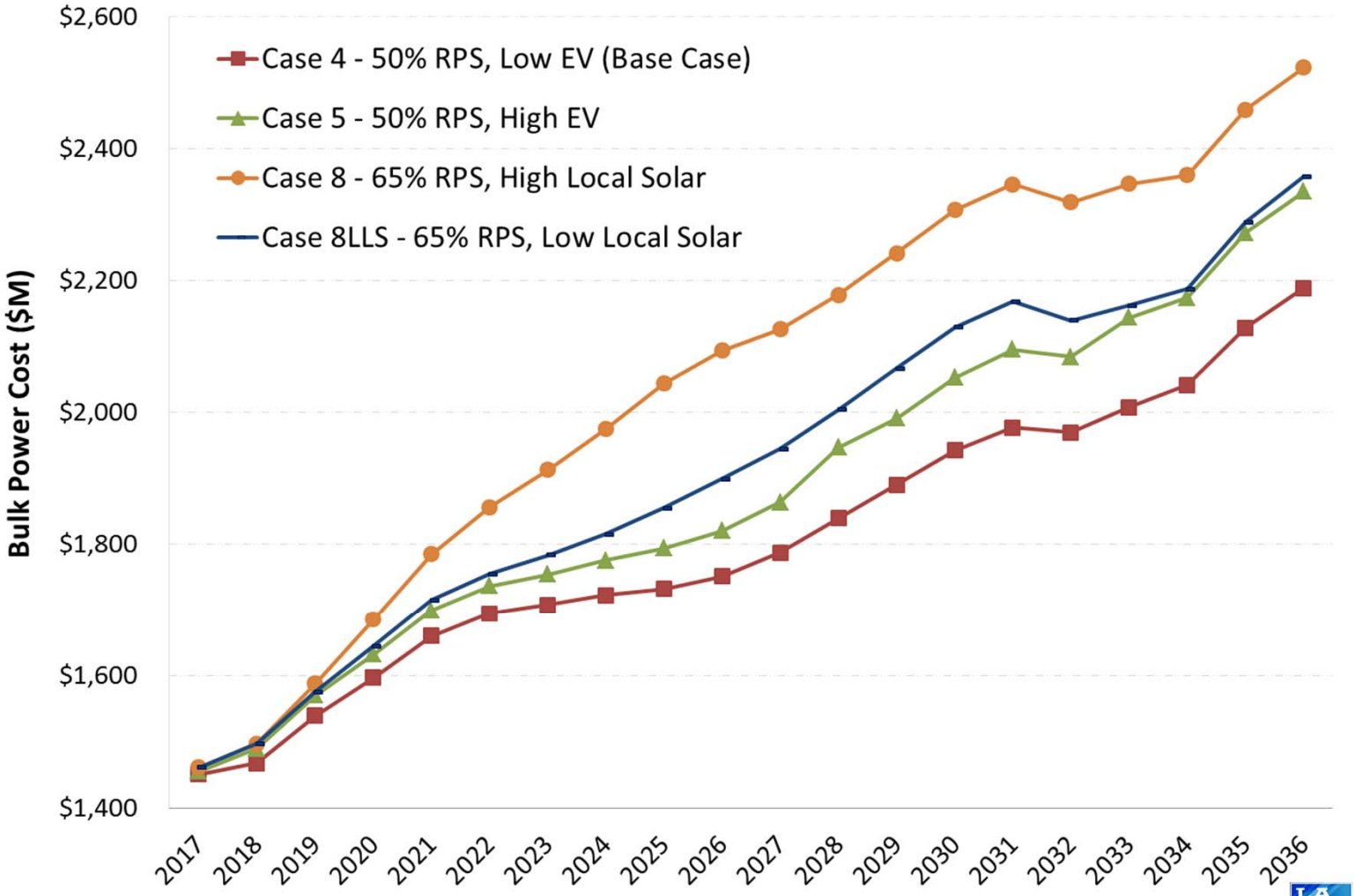
** Higher local solar of 1800 MW by 2035 is compliant with the City of LA's Sustainability Plan Goal.*
***GHG cost assumes full credit (4 to 1 ratio) from California Air Resources Board; LADWP's future resource mix is expected to have the carbon intensity of ¼ that of petroleum fuel*

Summary of Resource Assumptions

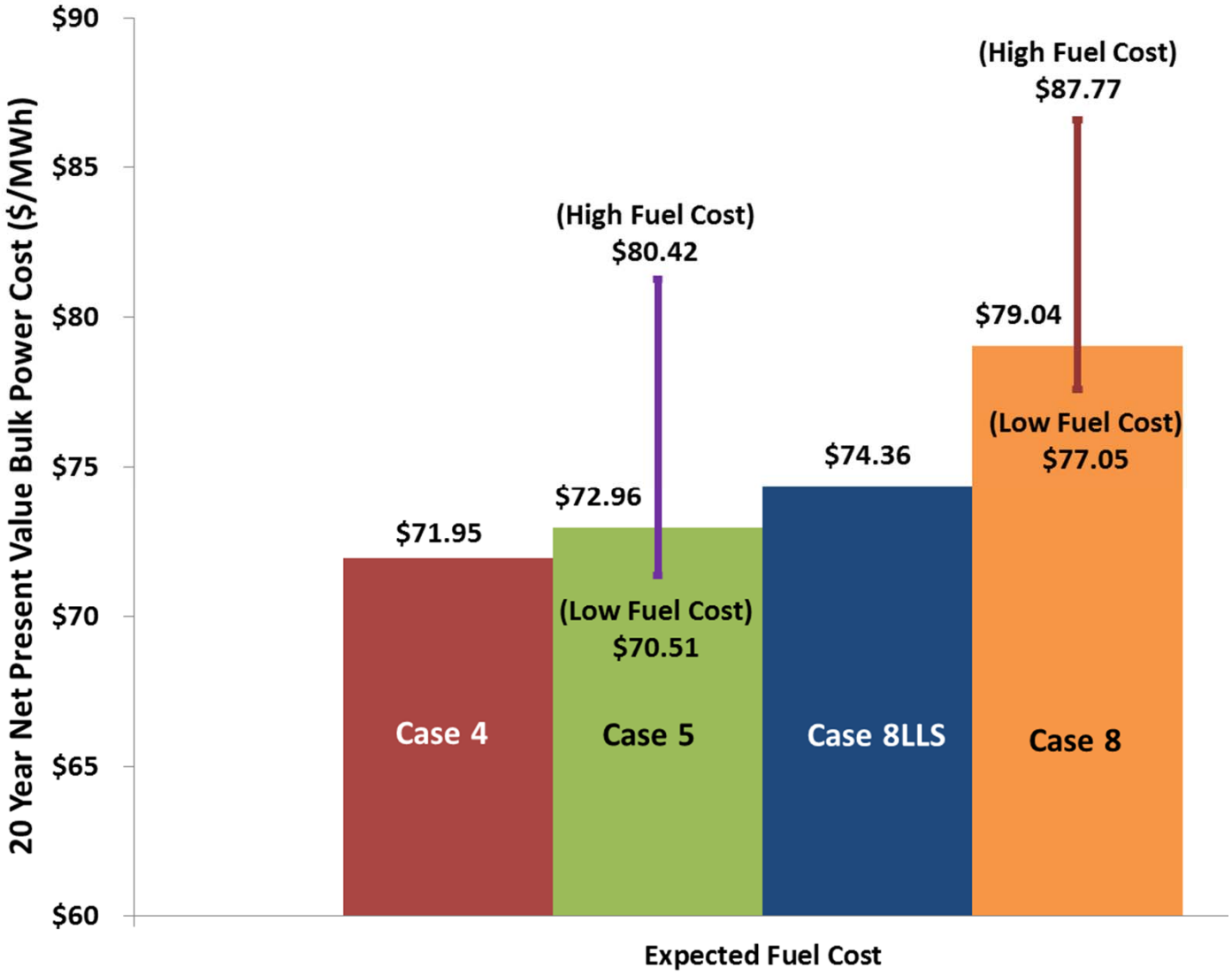
	Levelized Cost ($/MWh)[1]	Capacity Factor	Peak Load Dependable Capacity (3 to 5 PM)	Net Load Dependable Capacity[2] (7 to 9 PM)
Solar Photovoltaic – PPA	$67	28% - 35%	27% - 38%	0 - 2%
Solar Photovoltaic – LA Solar	$176	19% - 23%	27%	3% - 5%
Solar Feed-in-Tariff	$175	20%	27%	3% - 5%
Wind	$106	24% - 33%	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%
Storage [3]	$121	11.4%	80%	43% - 61%
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
[3]Includes combination of thermal energy storage, Castaic upgrades, and batteries

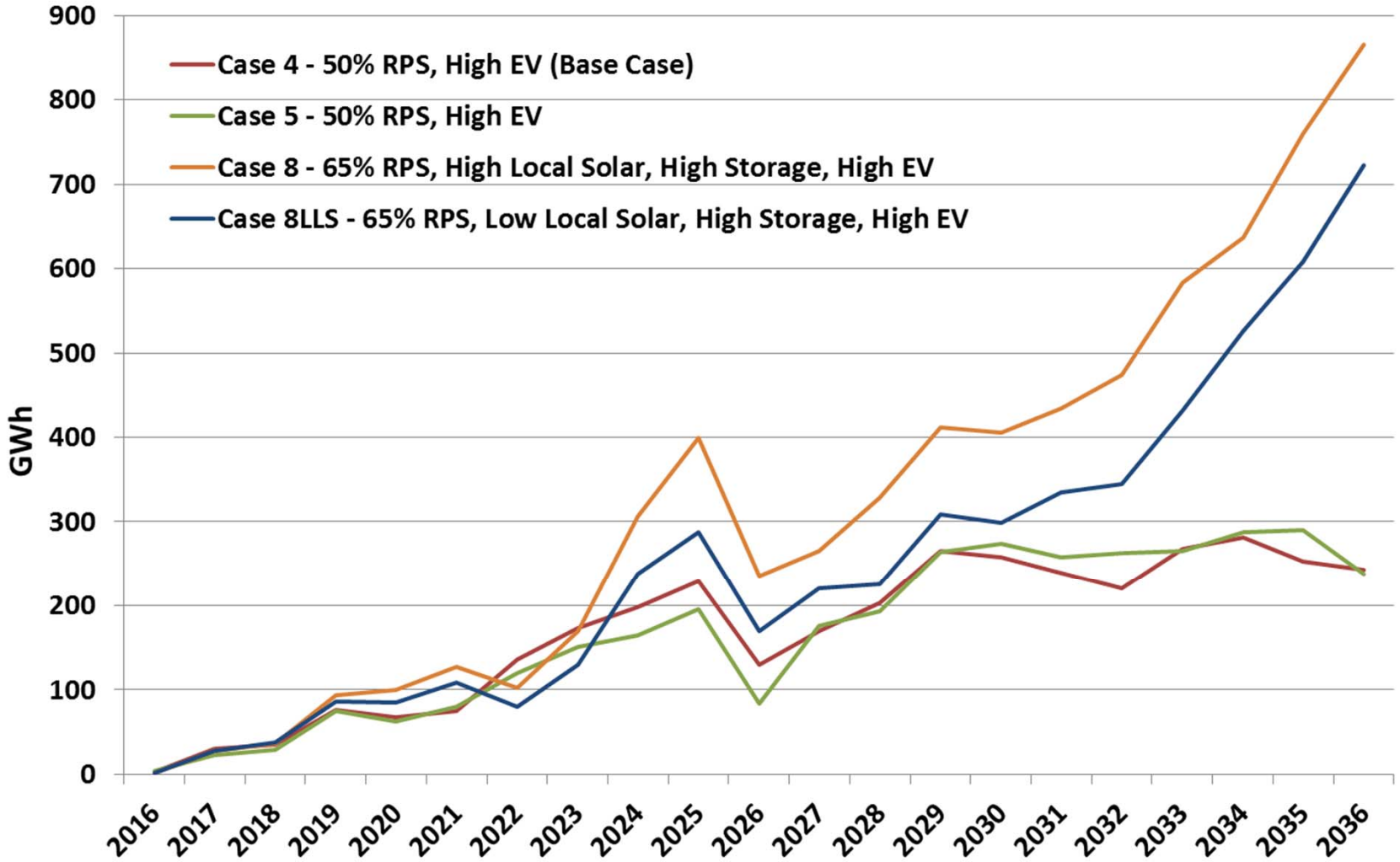
Bulk Power Cost Comparison



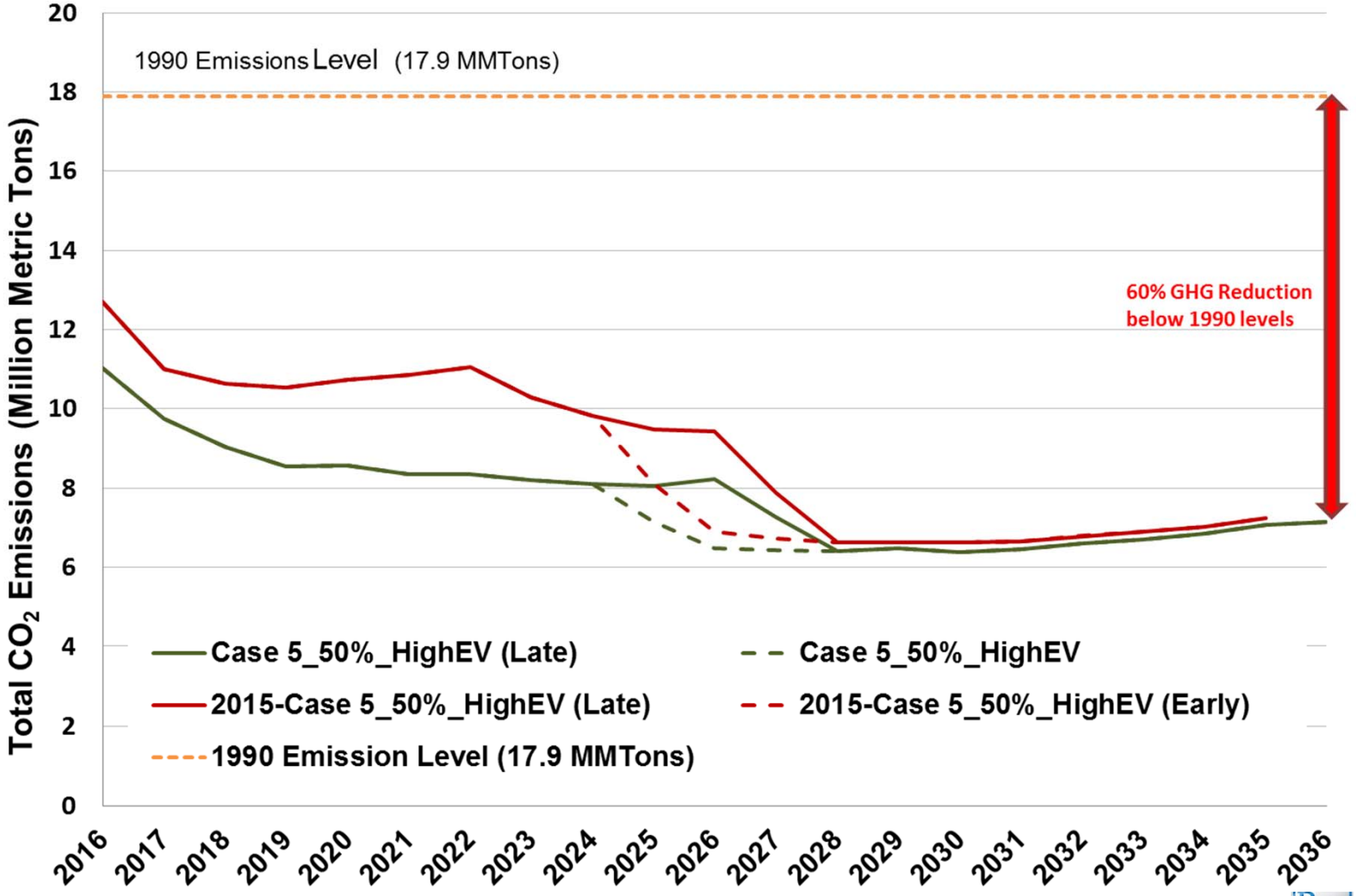
Levelized Cost Comparison



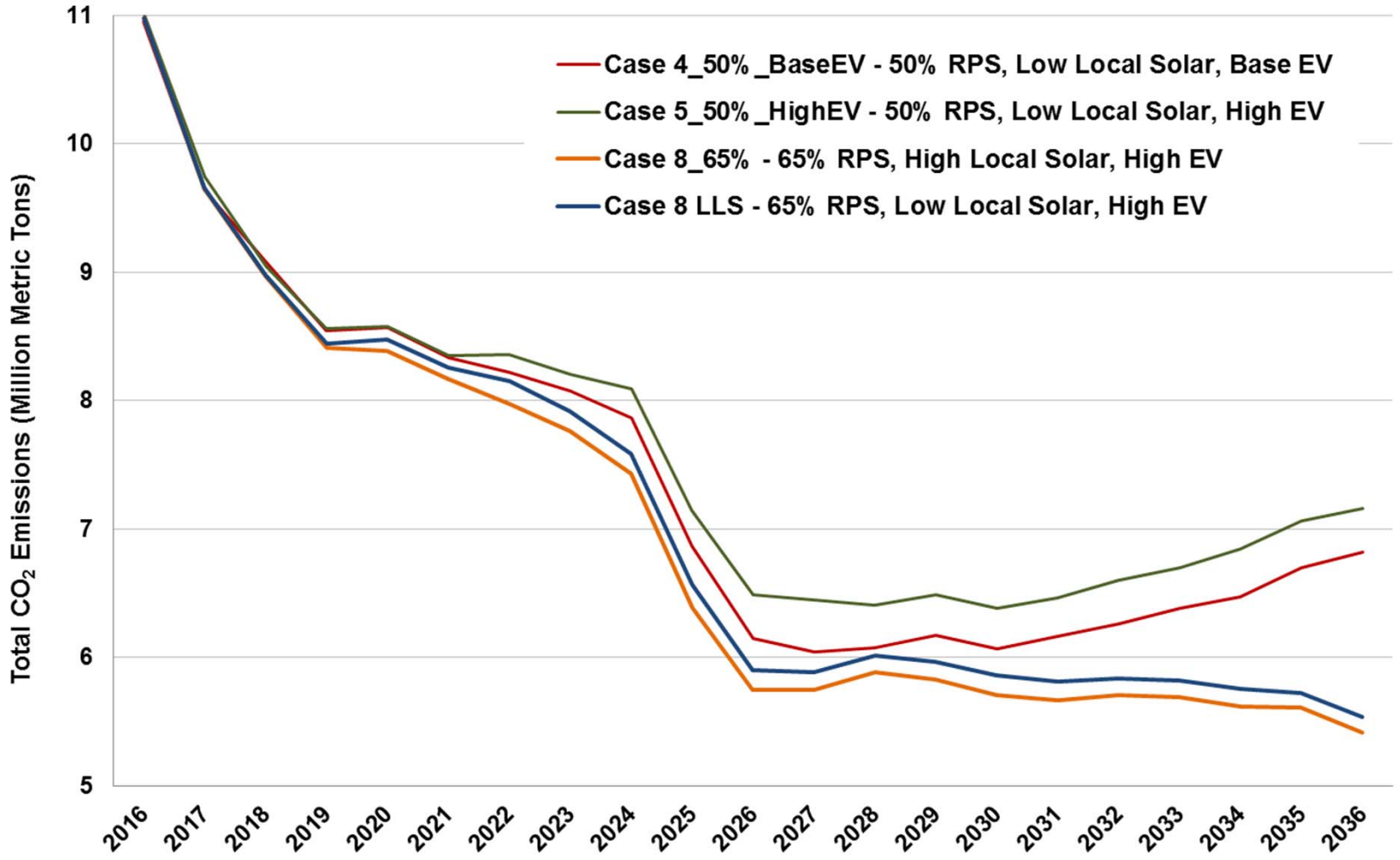
RPS Cases – Over-generation



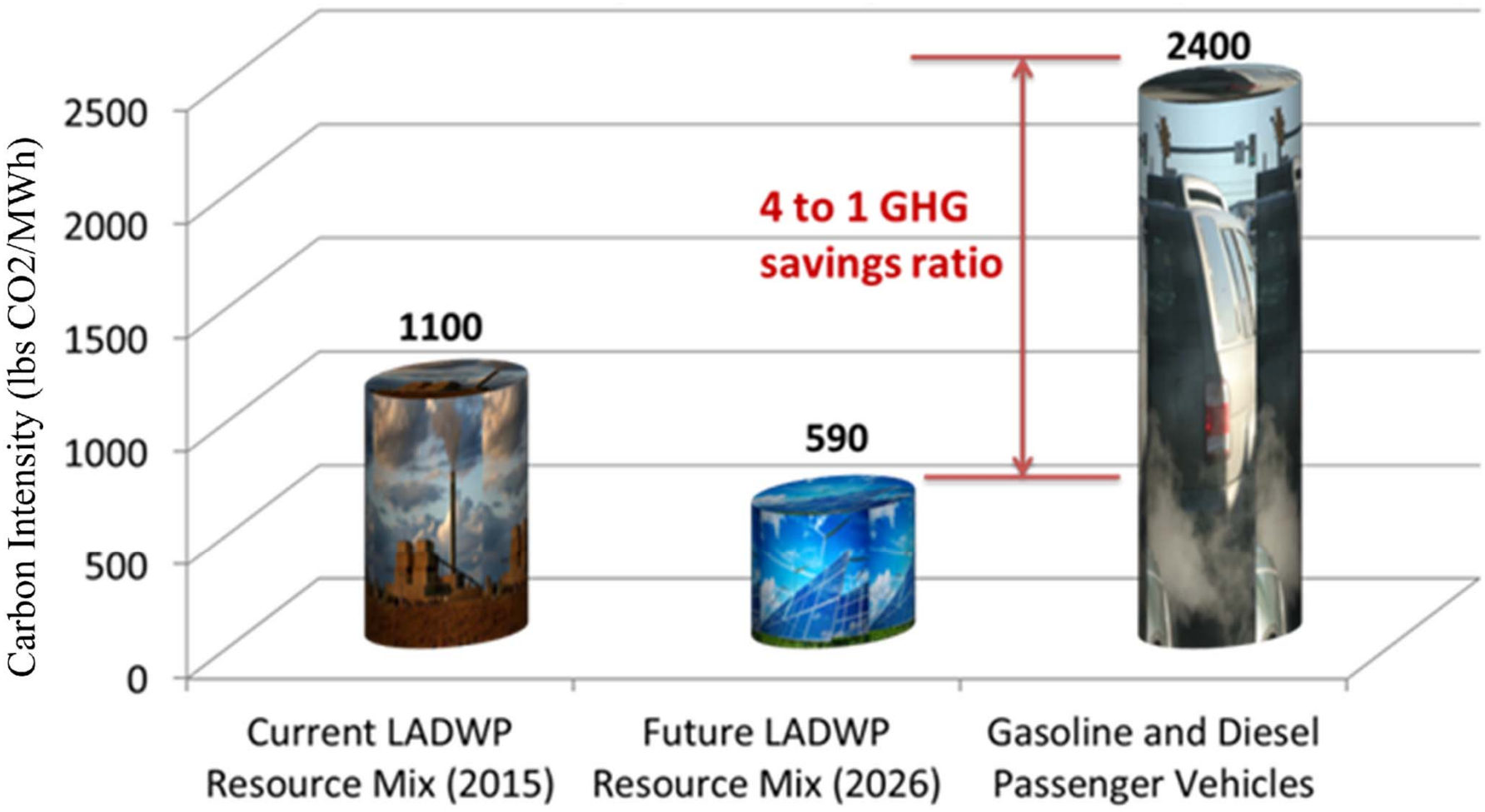
Greenhouse Gas (GHG) Emissions Results Compared to 2015 IRP



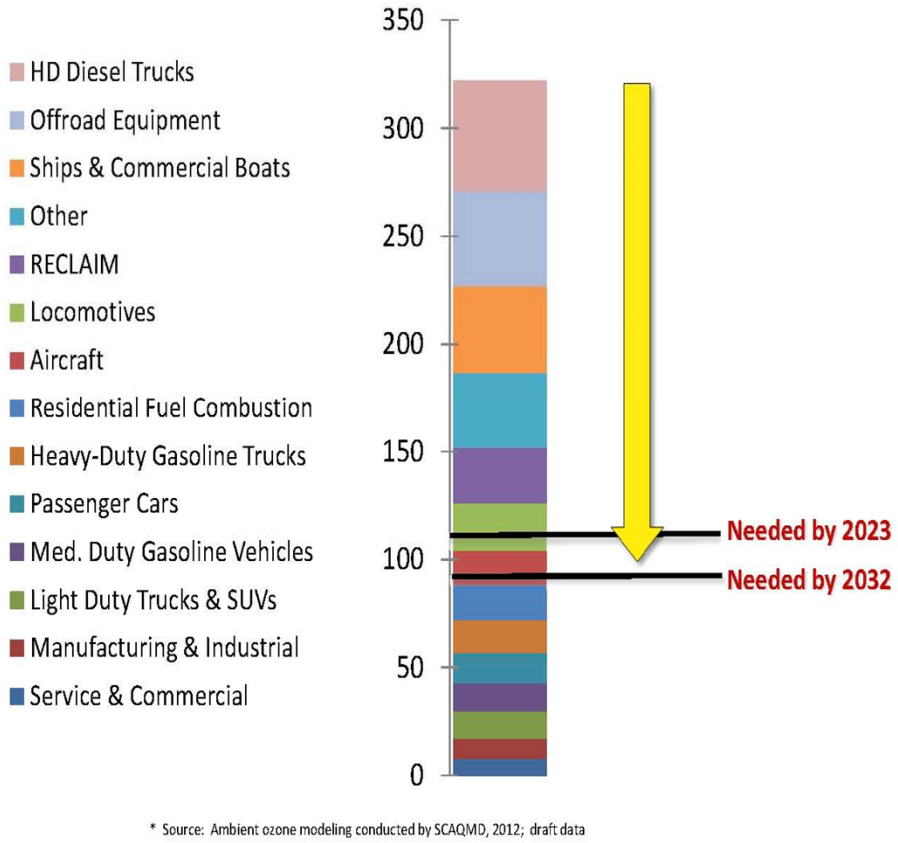
Greenhouse Gas Emission Comparison RPS Cases



Carbon Intensity of Power Plant Fuels vs. Gasoline

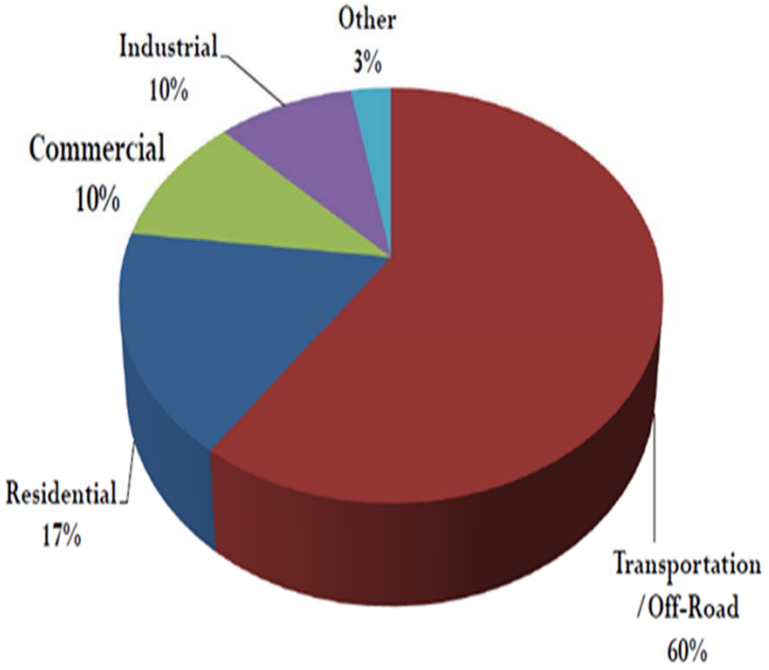


Role of Electricity in Reducing Local Emissions



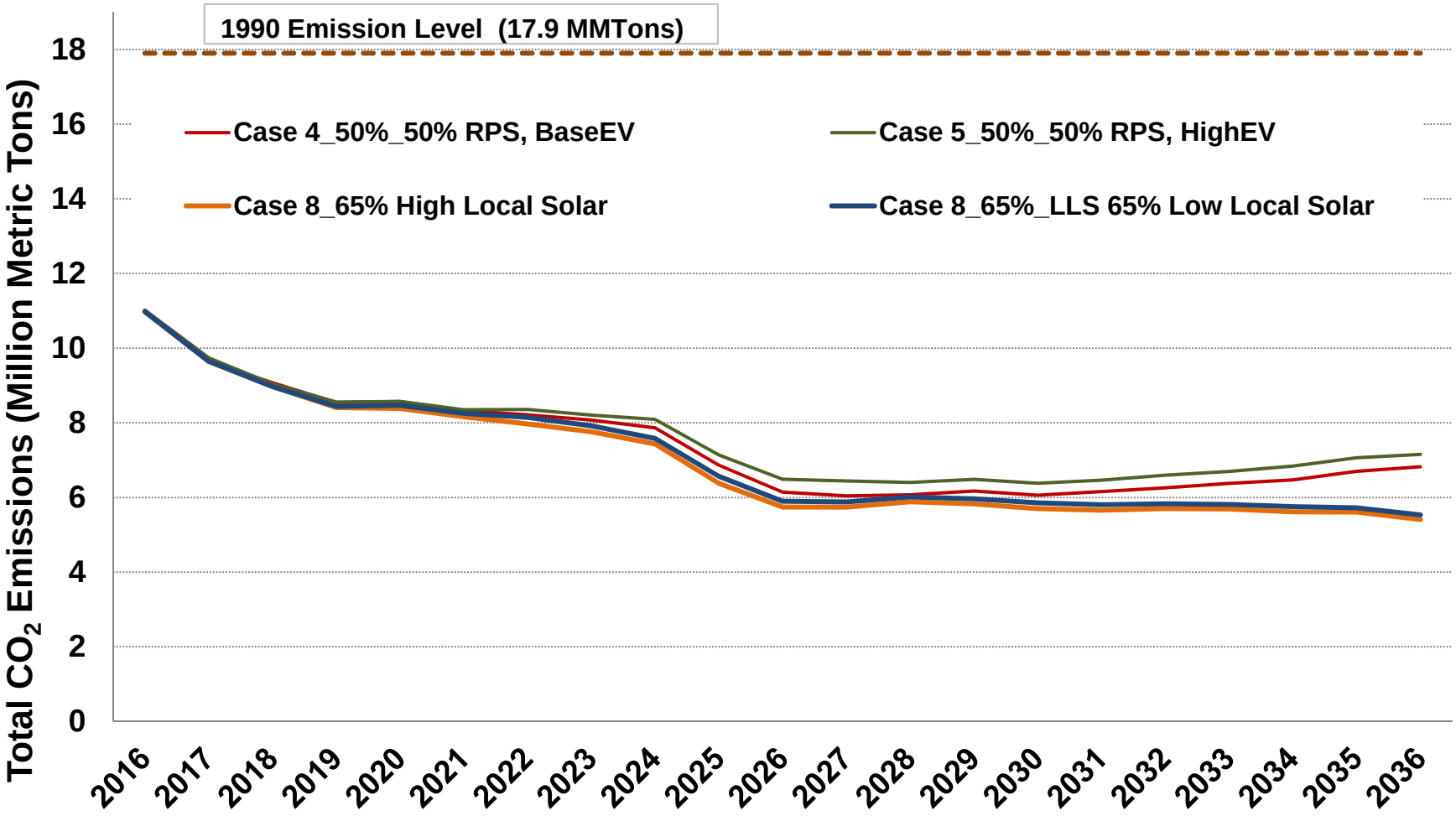
* Source: Ambient ozone modeling conducted by SCAQMD, 2012; draft data

Future Emissions Reductions Needed By 2023 and 2032

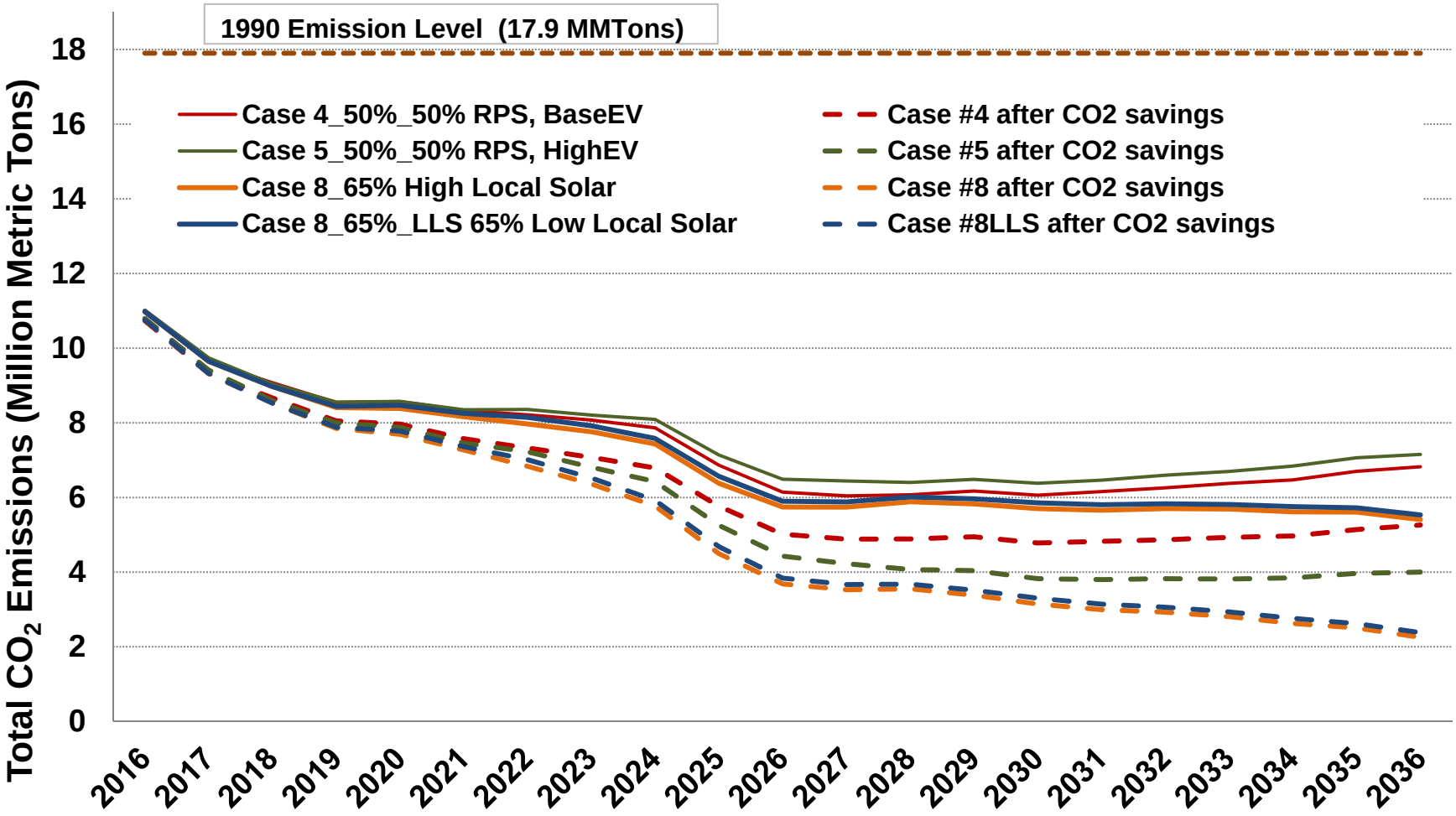


***South Coast Air Quality Management District Emissions Sources**

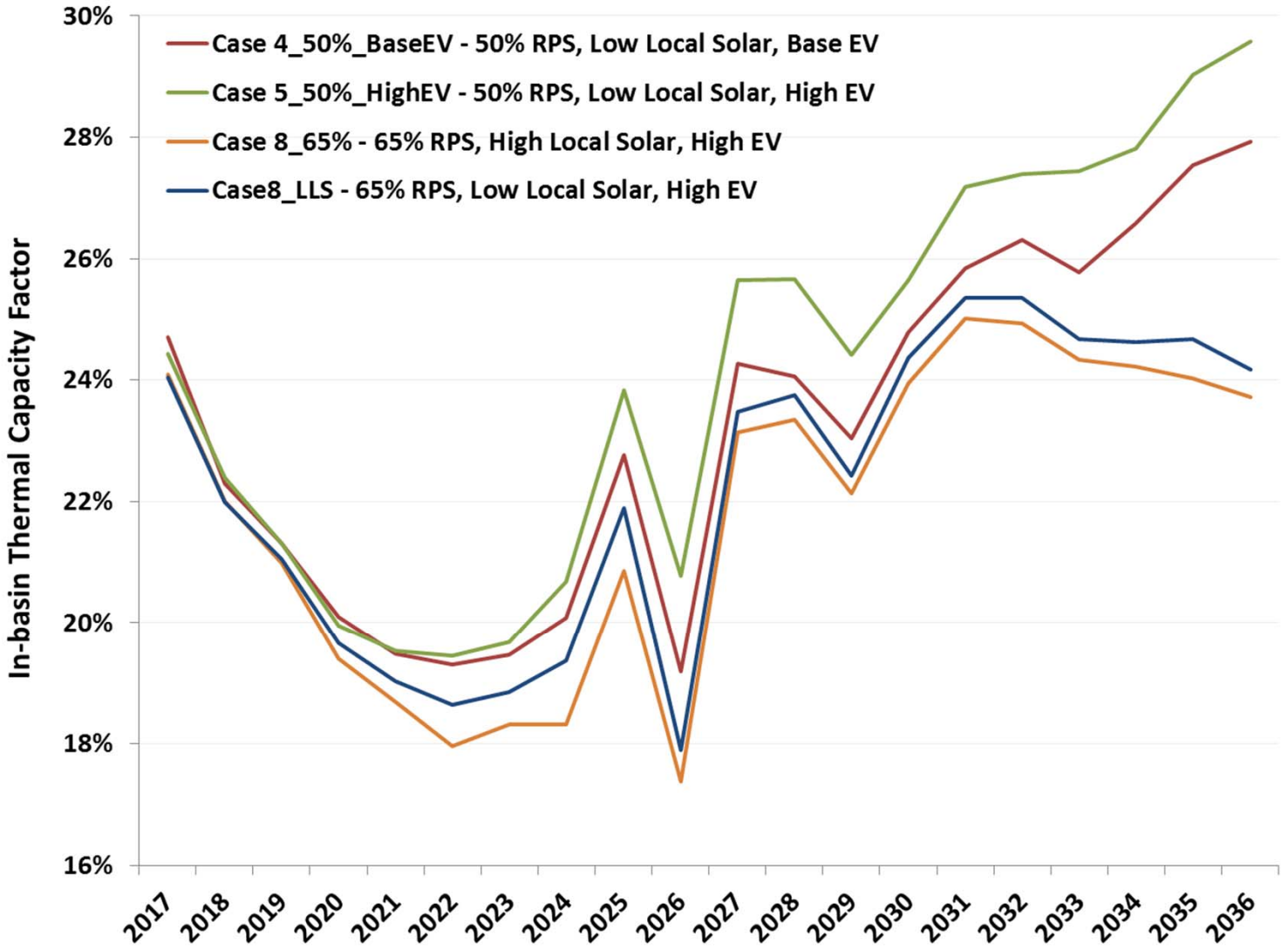
Greenhouse Gas Emission Comparison RPS Cases



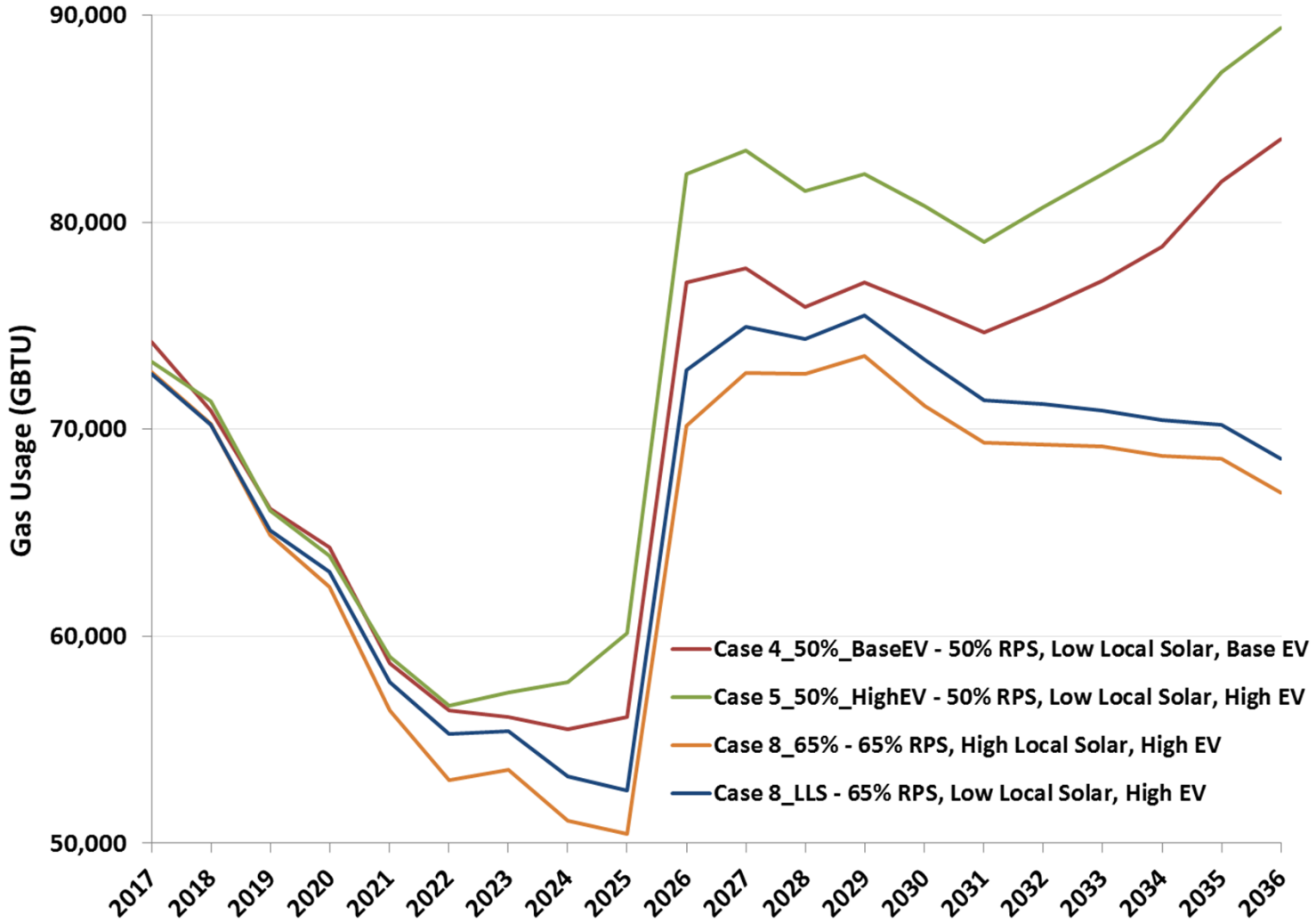
Greenhouse Gas Emission Comparison RPS Cases



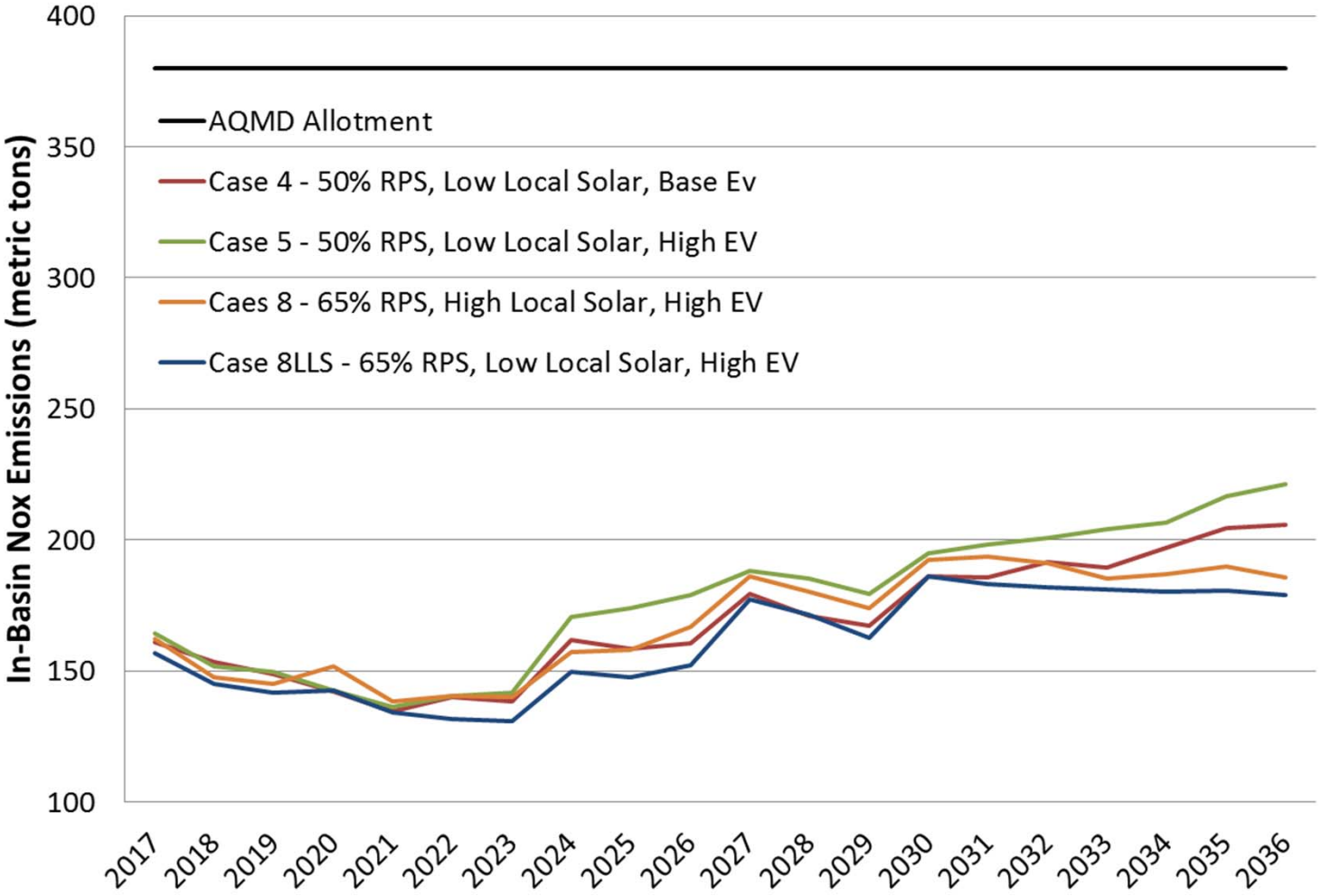
In-Basin Thermal Capacity Factor



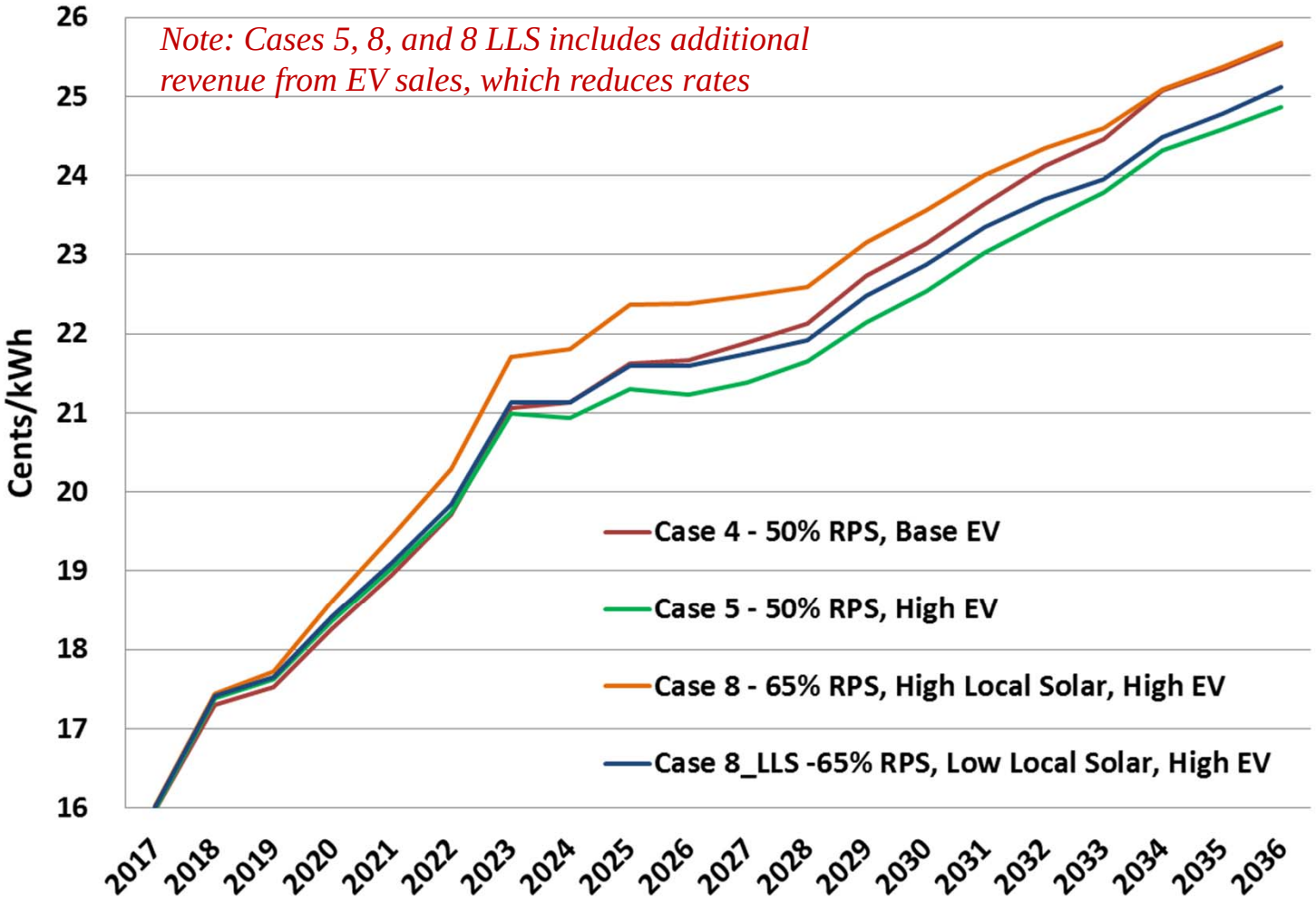
Natural Gas Usage



In-Basin Generation NOx Forecast



Rate Case Comparisons



Major Concerns from 2014 IRP Public Outreach

1. Eliminate Coal from LADWP's Energy Portfolio
2. Decrease Natural Gas from LADWP's Energy Portfolio
3. Incorporate More Renewables
4. Incorporate More Local Solar
5. Incorporate More Energy Efficiency
6. Promote Electrification of the Transportation Sector
7. Incorporate More Energy Storage
8. Reduce Greenhouse Gas Emissions
9. Look at New Case Scenarios

Feedback – Now we want to hear from you!

Case 4: 50% RPS, Low Local Solar, Low Storage, Low EV

Case 5: 50% RPS, Low Local Solar, Low Storage, High EV

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

Case 8: 65% RPS, High Local Solar, High Storage, High EV

	Case 4 (Baseline)	Case 5	Case 8LLS	Case 8
Case Description	50% RPS, 800 MW Local Solar, 178 MW Storage, Base EV	50% RPS, 800 MW Local Solar, 178 MW Storage, High EV	65% RPS, 800 MW Local Solar, 404 MW Storage, High EV	65% RPS, 1500 MW Local Solar, 404 MW Storage, High EV
Total Incremental Revenue $M	$0	$1,453	$2,536	$5,253
Average Incremental Revenue ($M/yr)	$0	$76	$133	$276
Estimated Residential Bill for Single Family Home in 2036 (500 kWh/mo)	$128.24	$124.35	$125.57	$128.39
Base EV instead of High EV		+ $3.89	+ $3.89	+ $3.89

Comments?

Next Steps

Collect & Analyze Comments – Website, Workshops

Comments may be submitted on IRP website

Due by November 17, 2016

Draft 2016 IRP posted on website late-November 2016

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