IRP 2016

RESOURCE NEEDS AND DRAFT PORTFOLIO CONCEPTS

NOVEMBER 4, 2015

THE NATION'S GREENEST UTILITY
SINCE 1905
SEATTLE CITY LIGHT

AGENDA

- Introductions
- Demand Outlook 2016
- Resource Adequacy
- Draft Portfolio Concepts
- Conservation Potential Assessment (CPA) 2016

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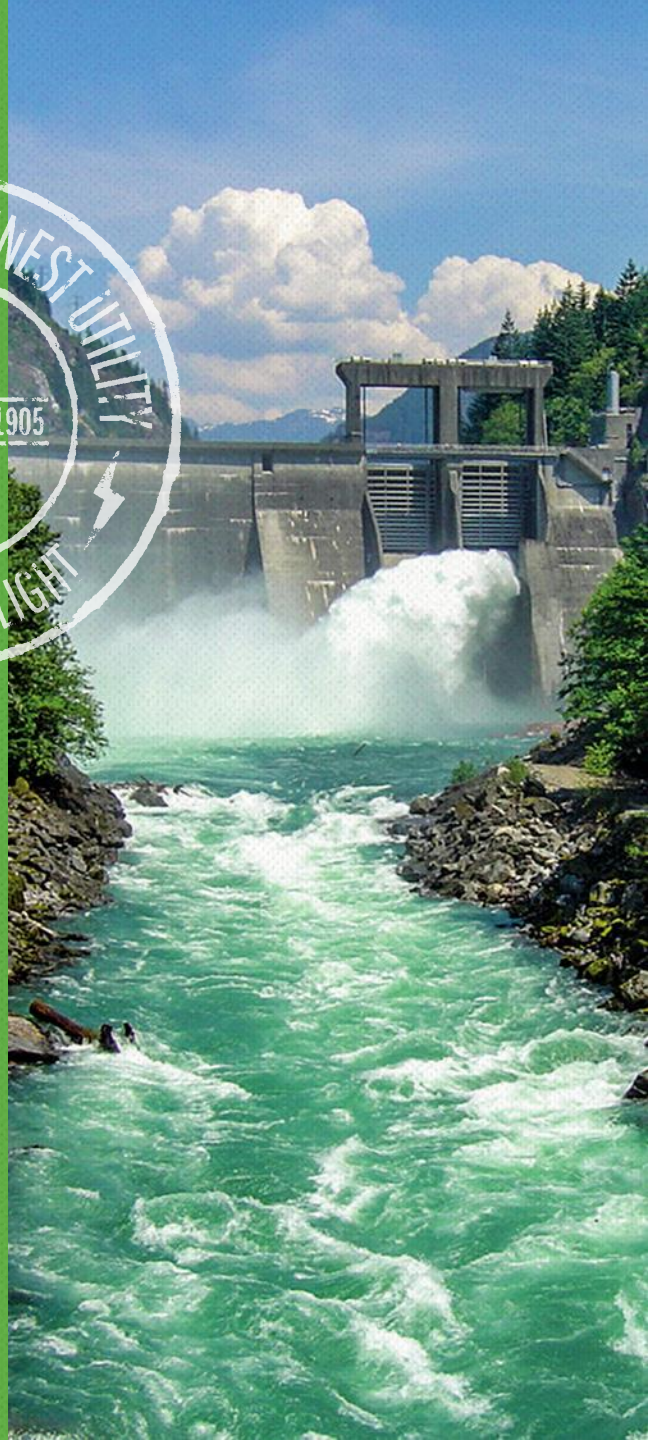
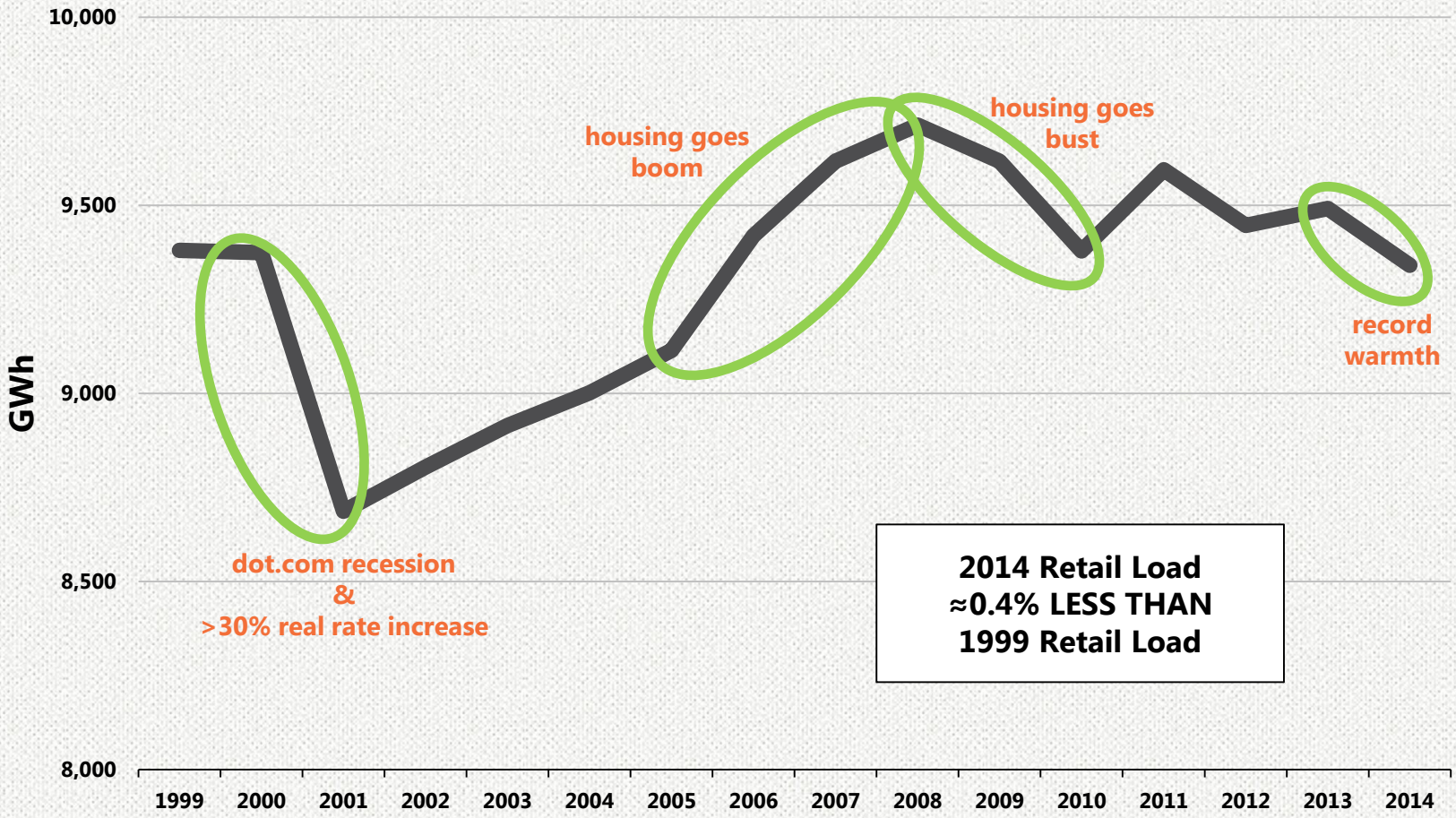
DEMAND FORECAST 2016



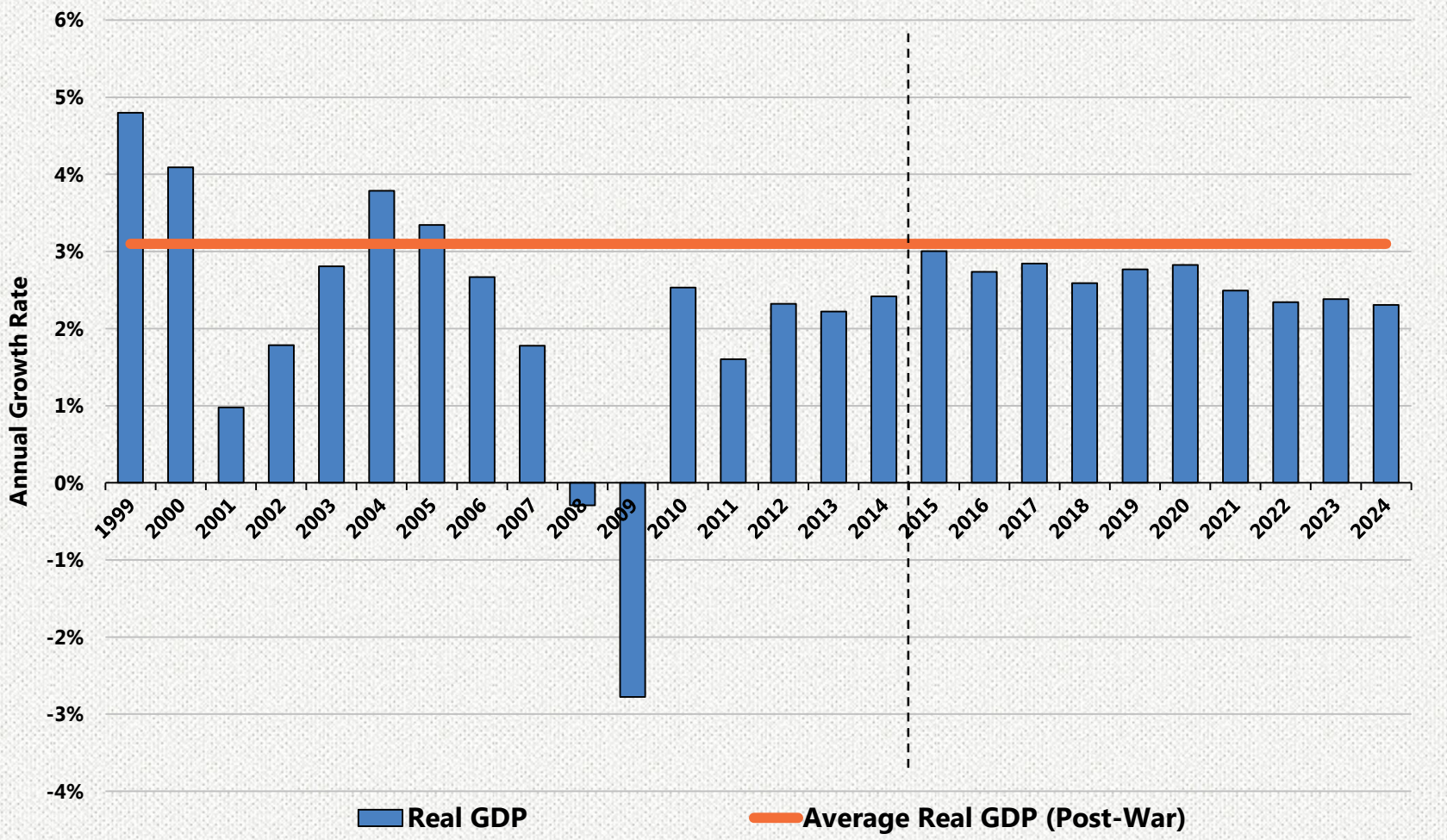
ASSUMPTIONS OVERVIEW

- National economic outlook from IHS Economics
- Rates set to Seattle City Light's 2014 Strategic Plan through 2020 and 3% thereafter
- Forecast based on "normal weather"
- Forecast of tunnel boring machine not included
- Approved by ROC in July 2015

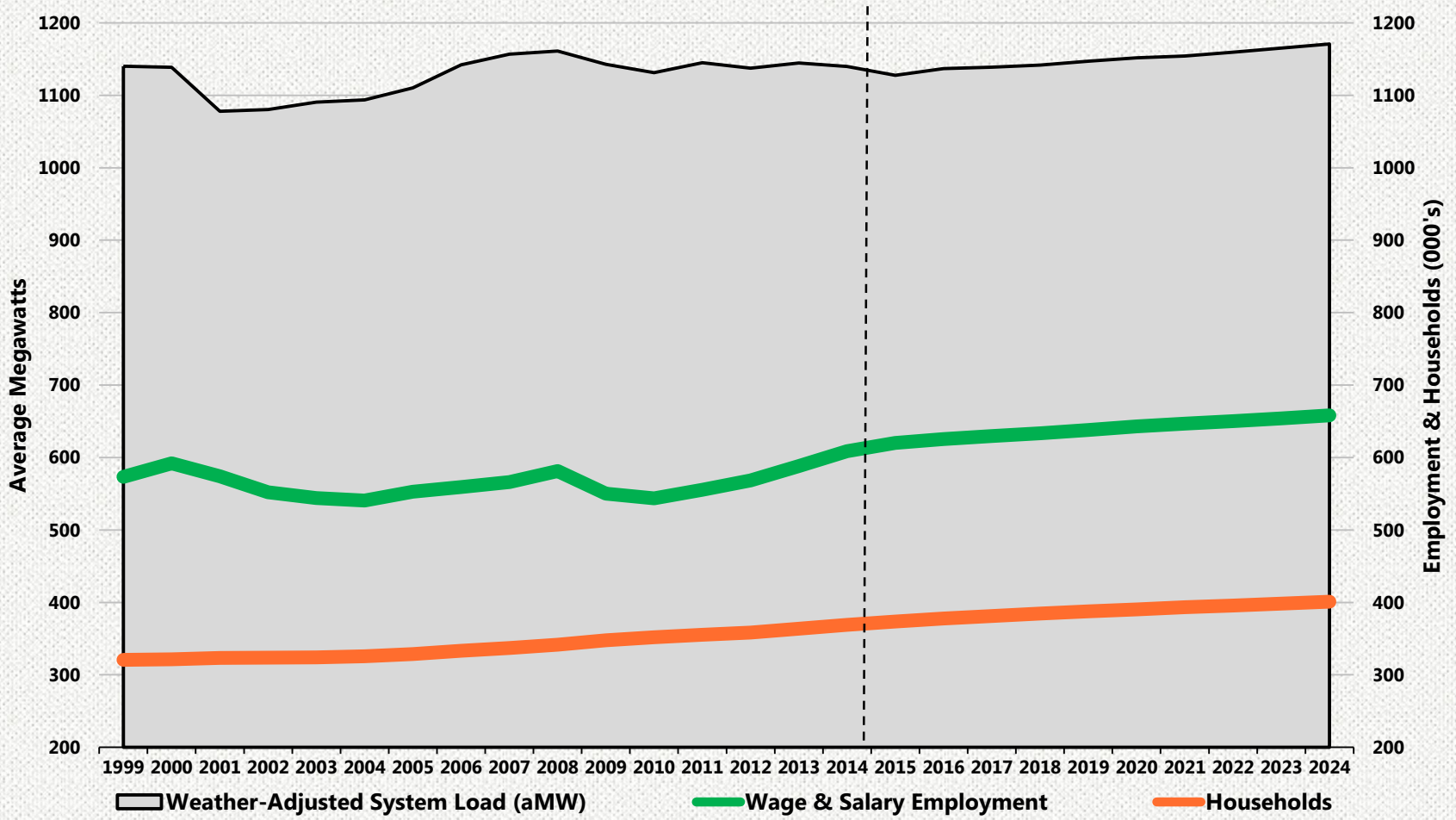
SEATTLE CITY LIGHT RETAIL LOAD HISTORY



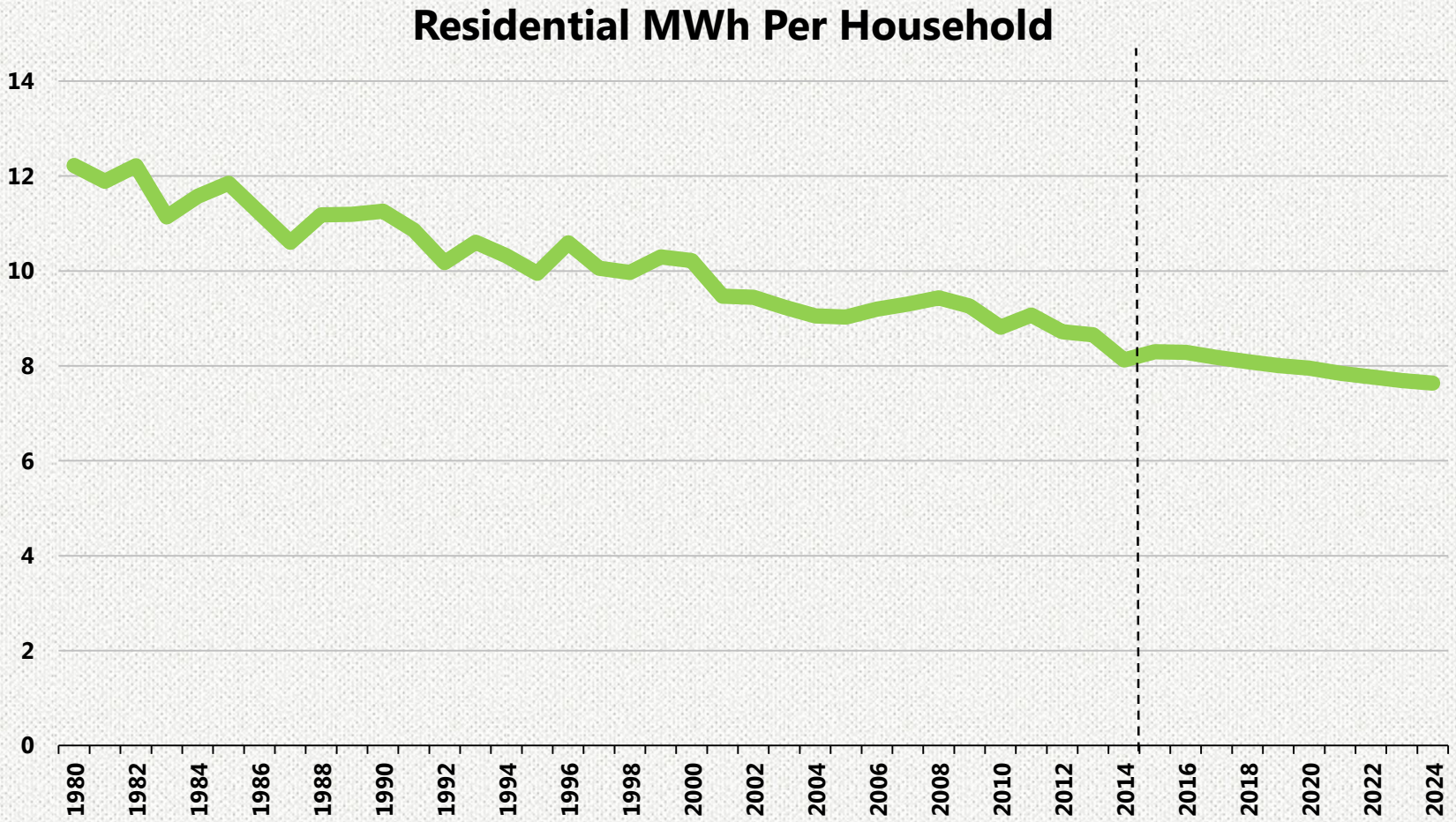
"NEW NORMAL" OF MODERATE ECONOMIC GROWTH?



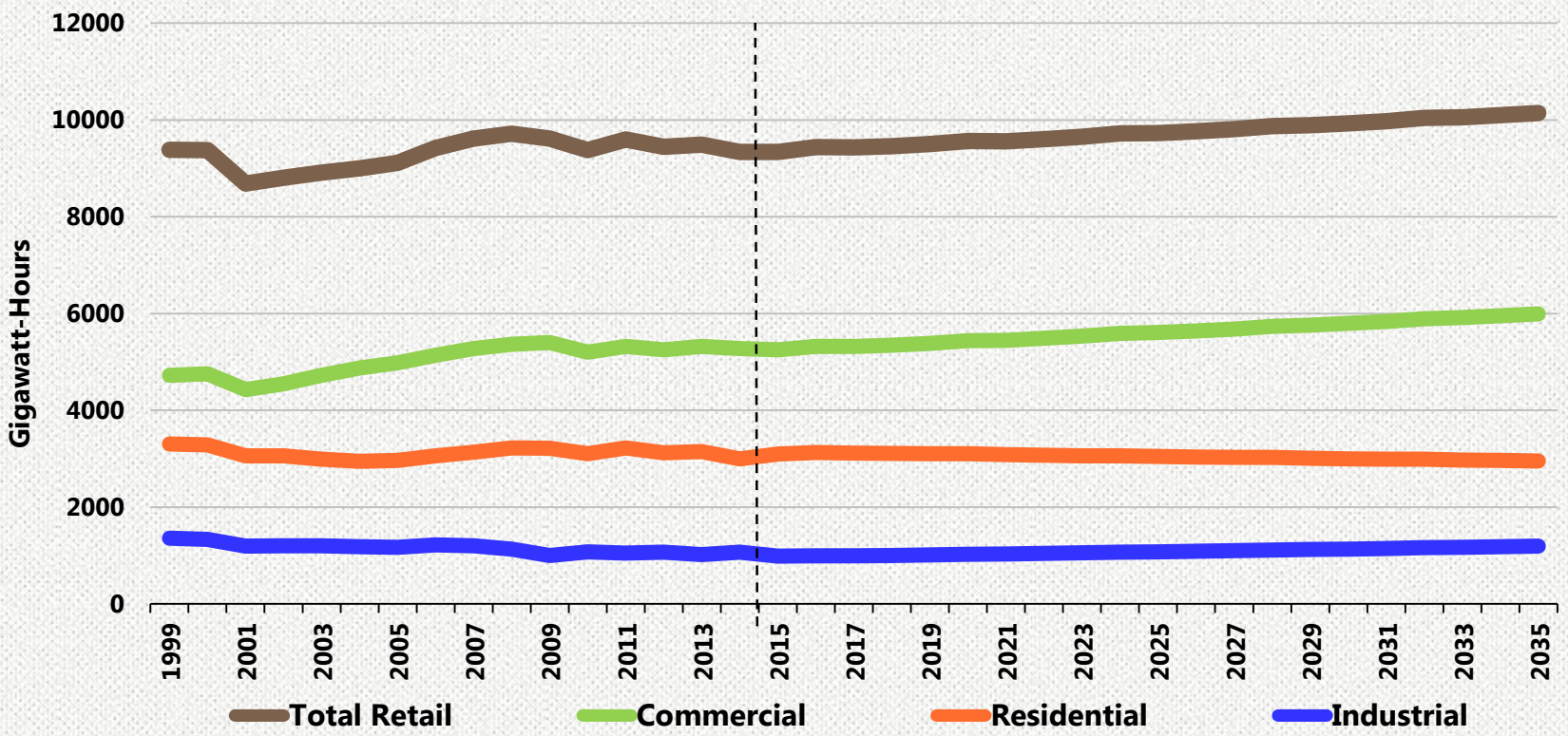
LOAD, EMPLOYMENT, AND HOUSEHOLDS



ENERGY EFFICIENCY, CODES, & CONSERVATION



LOAD HISTORY & FORECAST BY CUSTOMER CLASS



Forecasted 20-year Average Growth Rates

Total Retail: 0.4% Commercial: 0.6%

Residential: -0.1% Industrial: 0.5%

SUMMARY

- Economic growth expected to continue, yet it does so below the historical trend line
- Load demand growth expected to continue its lower-than-historical trend due to various factors
- 20-year average annual growth rate ≈ 0.4%

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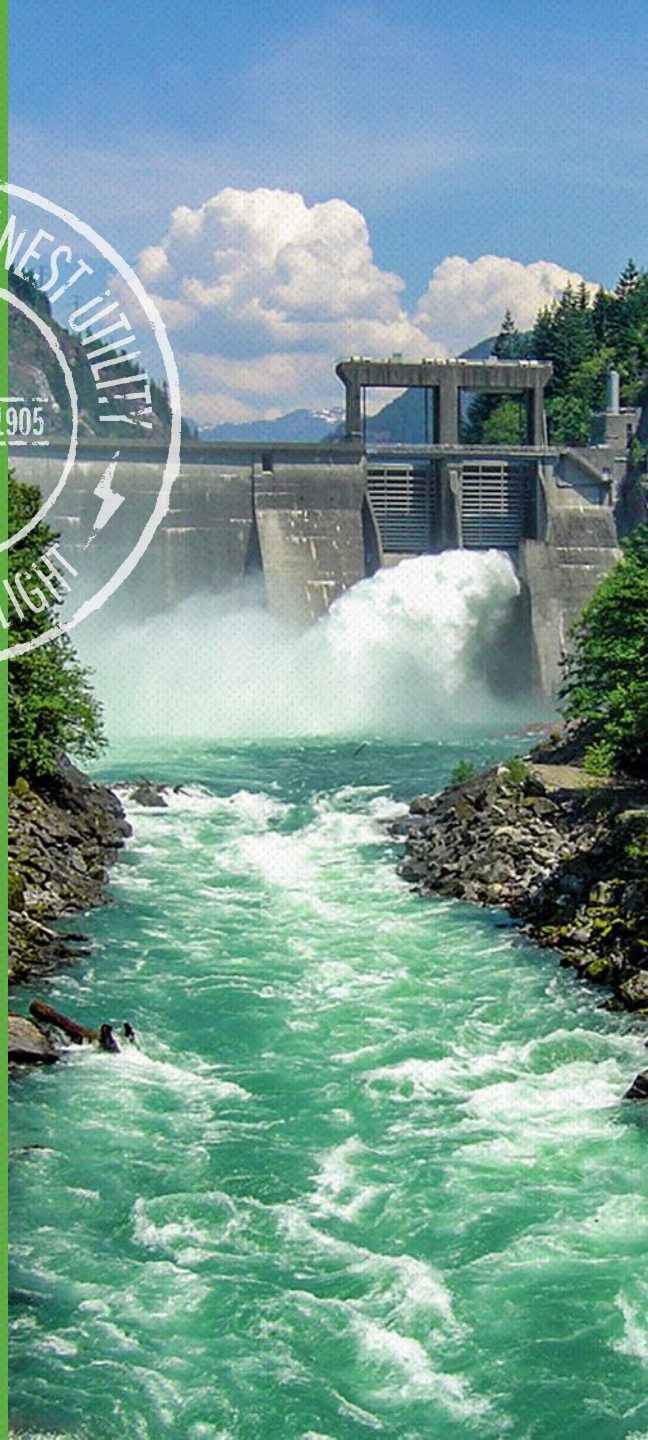
RESOURCE ADEQUACY

PROBABILISTIC ANALYSIS



WHAT IS RESOURCE ADEQUACY?

- The ability of the City Light Portfolio to supply the energy requirements of the customers under all probable conditions including high and low temperatures and lower water supply conditions effecting demand and supply respectively

ASSUMPTIONS

- Portfolio Contracts:
  - Bonneville Power Administration monthly shaped Block and Slice contract extends to the end of IRP study period
  - Bonneville Power Administration monthly shaped Block and Slice contract expires in September, 2028

ASSUMPTIONS (CONTINUED)

- Northern California Power Agency exchange contract expires in 2017
- Stateline Wind contract expires in 2021
- Lucky Peak Exchange contract will expire in 2016
- Priest Rapids contract expires in 2052
- Burlington Biomass contract expires in 2017

ASSUMPTIONS CONTINUED

- Portfolio Resources:
  - Additional 64 MW of hydro efficiency gains from Boundary project upgrades by fall 2017

AN OVERVIEW OF THE METHODOLOGY

- 4,000 supply and demand scenarios
  - Based upon detailed studies of historical hourly supply and demand conditions in winter
- Scenarios are ranked by resource need
  - $Deficit_{T,h} = Supply_{T,h} - Demand_{T,h}$, T = Month (December and January) and h = Hour (1488 hours)

AN OVERVIEW OF THE METHODOLOGY

- Majority of scenarios are surplus
  - The 95th, 90th, 85th, 80th, and 75th percentiles are identified
  - Deficits are adjusted for short-term firm market purchases 200 aMW

RISK ANALYSIS

- Risk is applied to supply and demand independently
  - Supply risk is determined by uncertainties in water conditions and forced outages
  - Demand risk is determined by uncertainties in system load

SUPPLY (HYDRO) UNCERTAINTIES

- More than 90% of City Light resource portfolio is from hydropower generation assets
- Impact of water conditions across City Light's hydro resources are interdependent
- "Time-Series" and "Cross-Sectional" correlations are incorporated into the probability distribution analysis

DEMAND UNCERTAINTIES

- Demand is strongly related to temperature
  - Demand and hydro generation capabilities have no correlation
- The temperature for a given hour has no correlation with the temperature of an hour in another month

DEMAND UNCERTAINTIES (CONTINUED)

- Historical demand variation for December and January are incorporated into the probability distribution analysis

DEVELOPING RISK METRICS: SIMULATION OF OBJECTIVE FUNCTION

- Resource Adequacy Objective Function:

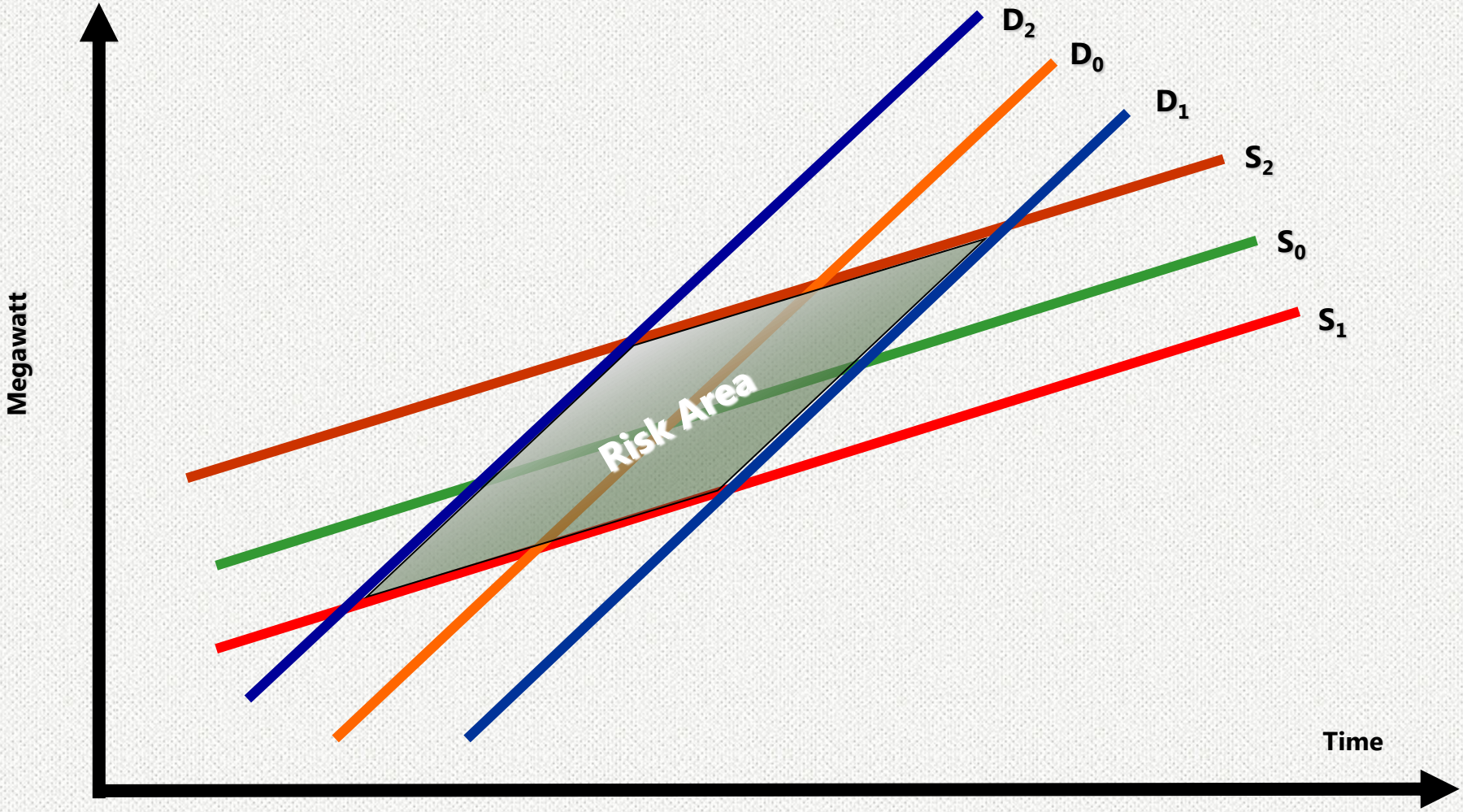
$$R.A. = F(D_{DEC_h}, D_{JAN_h}, SK_{DEC_h}, SK_{JAN_h}, BN_{DEC_h}, BN_{JAN_h}, SL_{DEC_h}, SL_{JAN_h})$$

  - R.A. = Resource Adequacy
  - D = Demand
  - BN = BOUNDARY
  - SK = SKAGIT (ROSS, DIABLO, and GORGE)
  - SL = Bonneville Power Administration Slice Product (City Light share of BPA hydro projects)

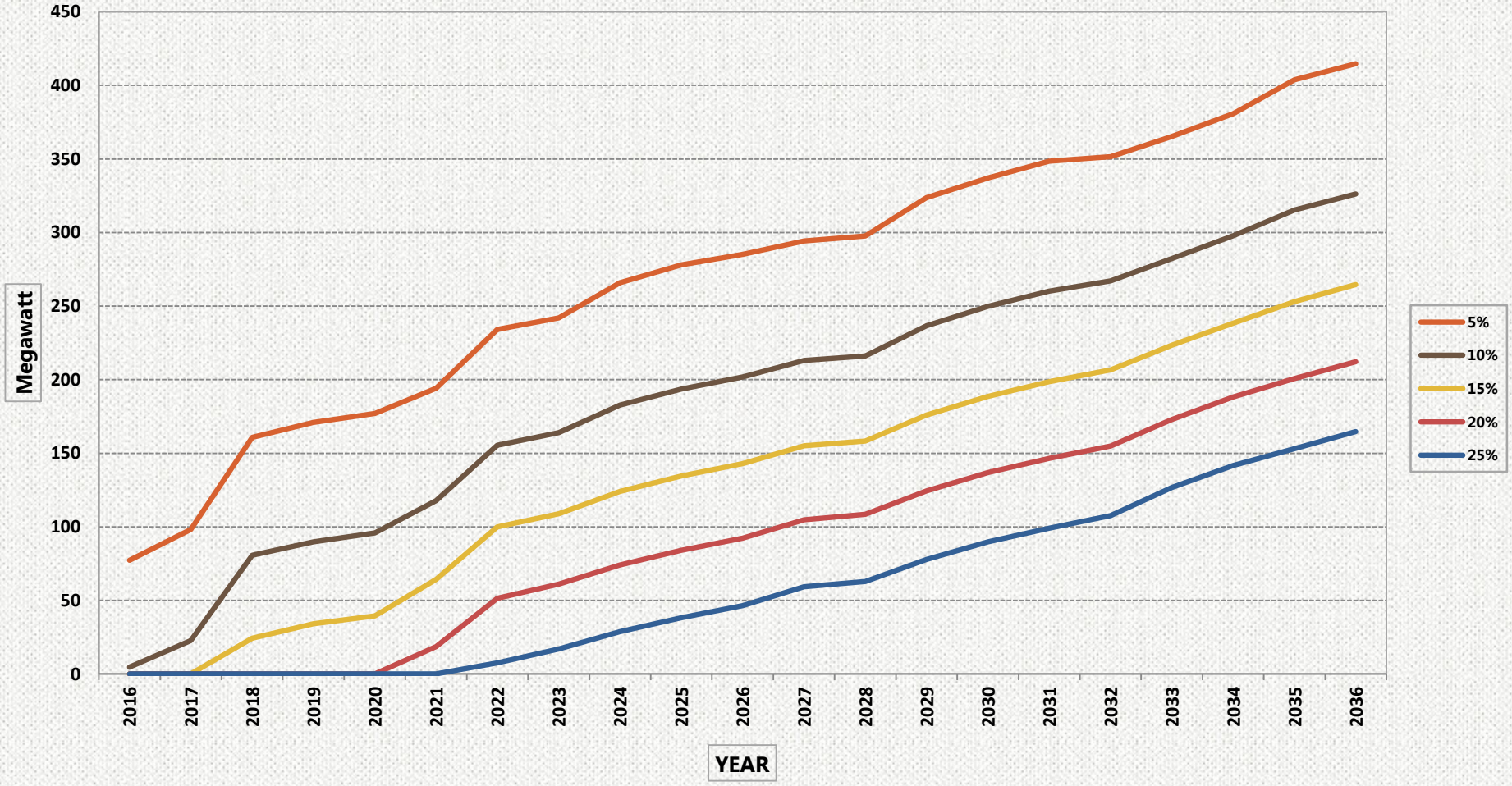
DEVELOPING RISK METRICS: SIMULATION OF OBJECTIVE FUNCTION

- Normal distributions are assigned to both demand and hydro generation inputs

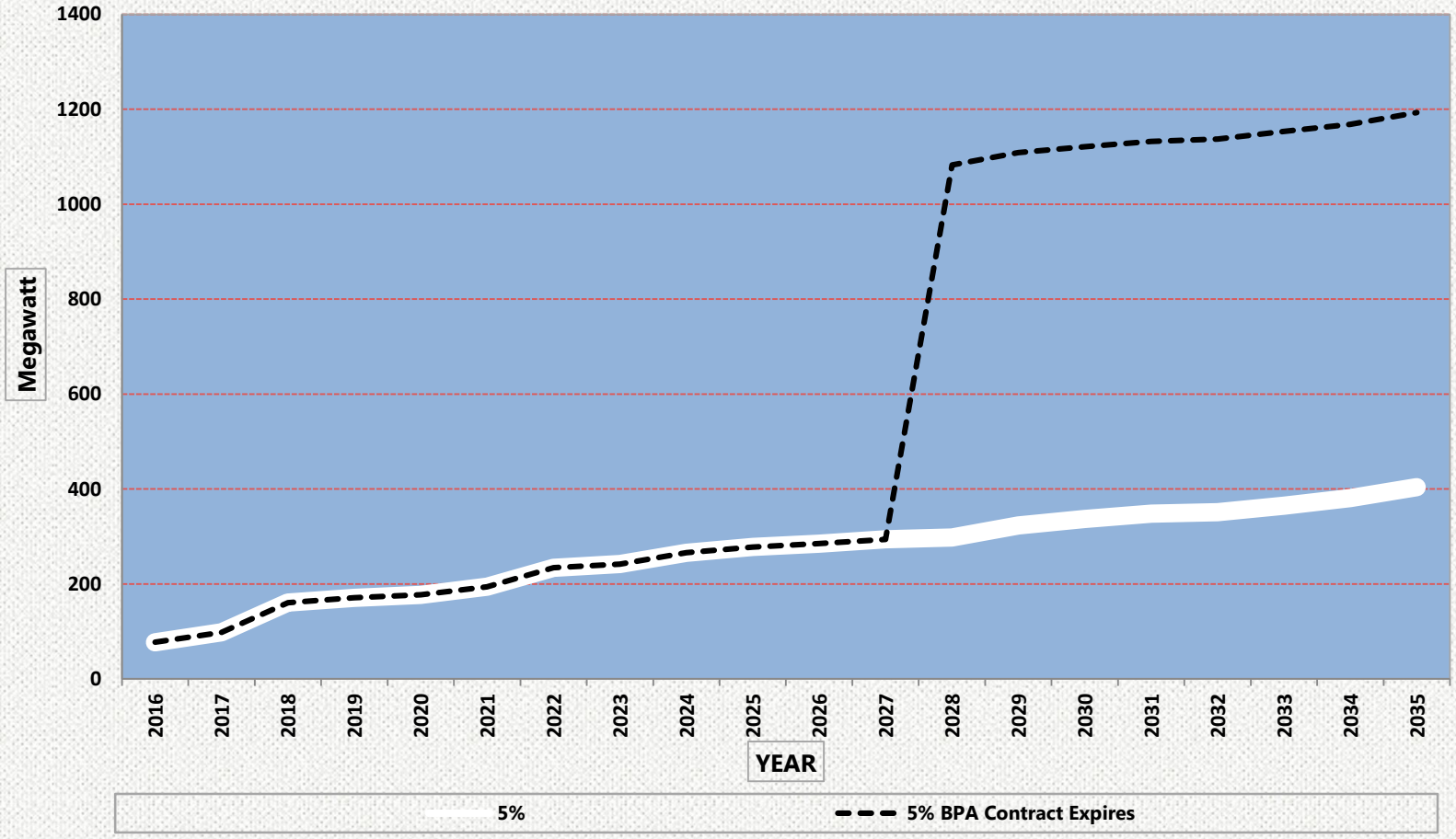
RISK ANALYSIS OF SUPPLY AND DEMAND



WINTER SEASON ONE HOUR PEAK: 5%, 10%, 15%, 20%, 25% CHANCE OF EXCEEDENCE



RESOURCE ADEQUACY AT 95% WITH BPA CONTRACT EXPIRATION IN 2028



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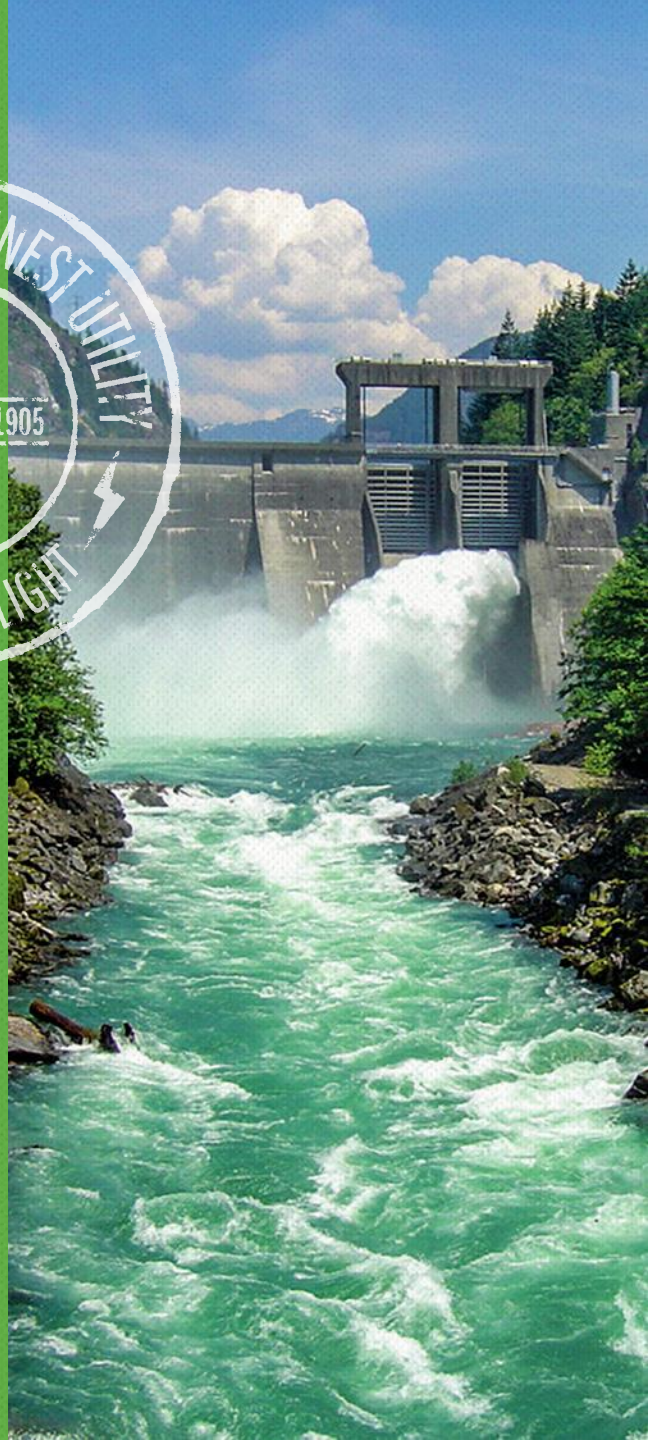
DRAFT PORTFOLIO CONCEPTS



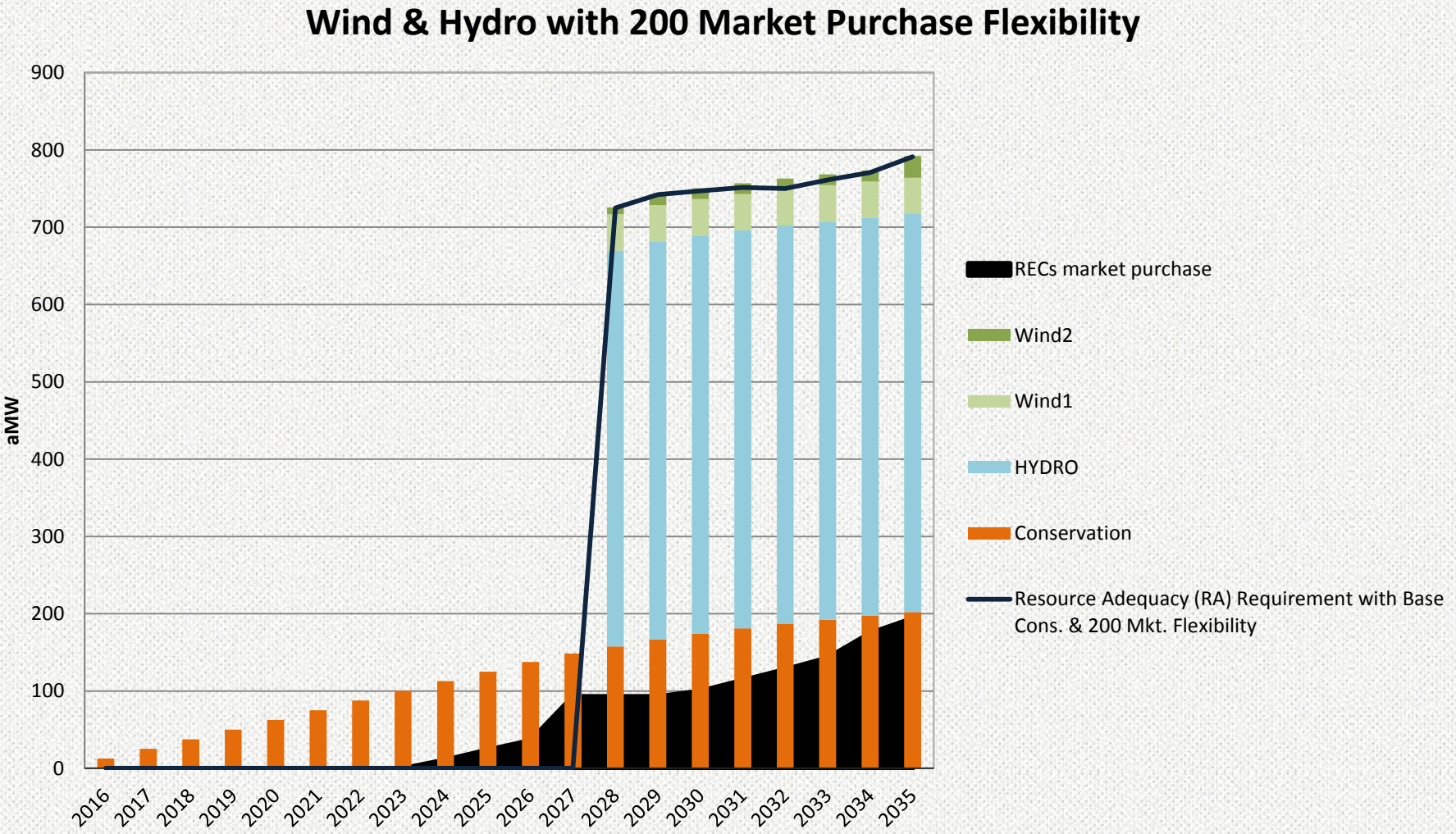
DRAFT PORTFOLIO DEVELOPMENT

- Resource Adequacy Requirement
- Renewable Portfolio Standard (RPS) Requirement
- Characteristics of supply resources
  - Evaluation Criteria
    - Reliability
      - Availability and Deliverability
    - Cost and Financial Risk
    - Environmental Impact

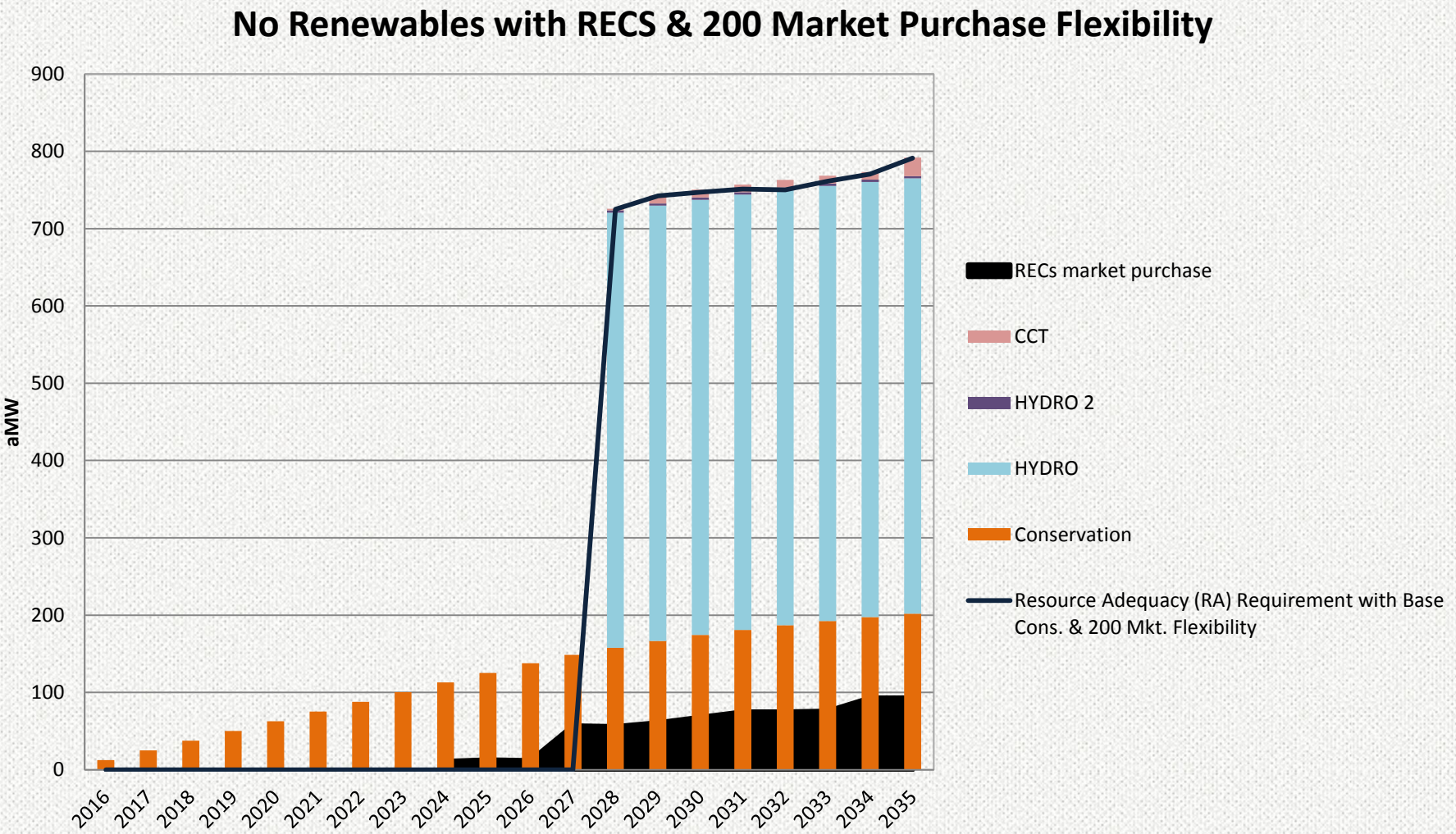
DRAFT PORTFOLIOS DEVELOPMENT (CONTINUED)

- Conservation
  - Base and High Conservation
- Market Purchase Availability
- Bonneville Power Administration Contract Expiration in 2028

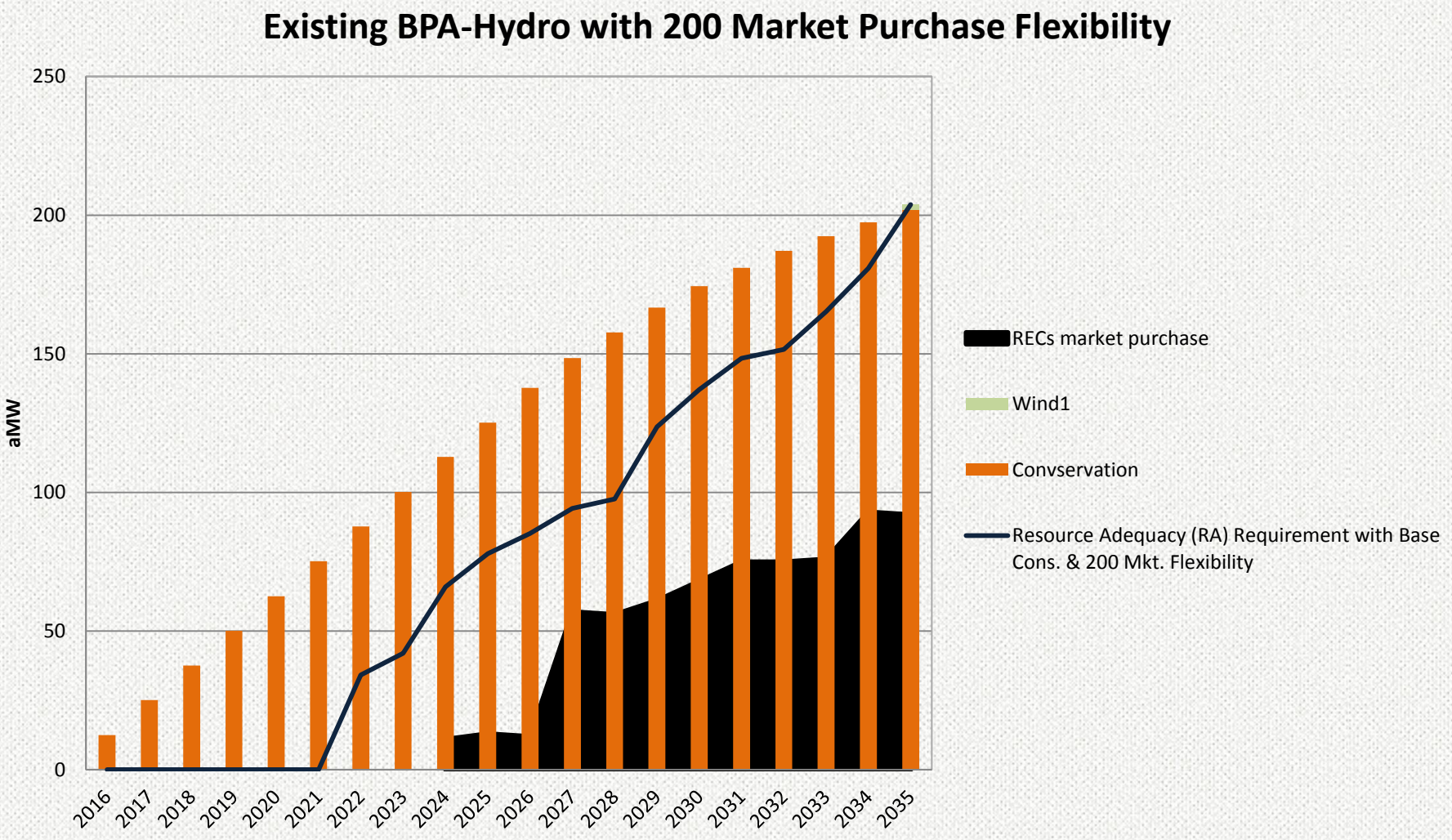
WIND & HYDRO WITH 200 MARKET PURCHASE FLEXIBILITY



NO RENEWABLES WITH RENEWABLE ENERGY CERTIFICATES & 200 MARKET PURCHASE FLEXIBILITY



EXISTING BONNEVILLE POWER ADMINISTRATION & MARKET PURCHASE PORTFOLIO



PORTFOLIOS WITH MARKET PURCHASE AVAILABILITY

1. Wind & Hydro
   - Wind & BPA Hydro
2. No Renewables
   - RECs Market Purchase, Gas, BPA Hydro & Non-BPA Hydro
3. High Conservation & Wind
   - Wind & BPA Hydro
4. Renewables with no Wind
   - Biomass, Solar PV & BPA Hydro

PORTFOLIOS WITH MARKET PURCHASE UNAVAILABILITY

5. Hydro, Renewables & Gas
   - Gas, Wind, Biomass, Solar PV, BPA Hydro, & Non-BPA Hydro
6. Diversity with no Market Purchase
   - Gas, Biomass, Solar PV, Solar Thermal, Geothermal, BPA Hydro, & Non-BPA Hydro
7. Renewables with no Market Purchase & Gas
   - Wind, Biomass, Solar PV, BPA Hydro, & Non-BPA Hydro

CURRENT BONNEVILLE POWER ADMINISTRATION CONTRACT EXTENSION

8. Existing BPA with Market Purchase
   - Wind & Market Purchase
9. Existing BPA with no Market Purchase
   - Gas, Wind, Biomass, & Solar PV

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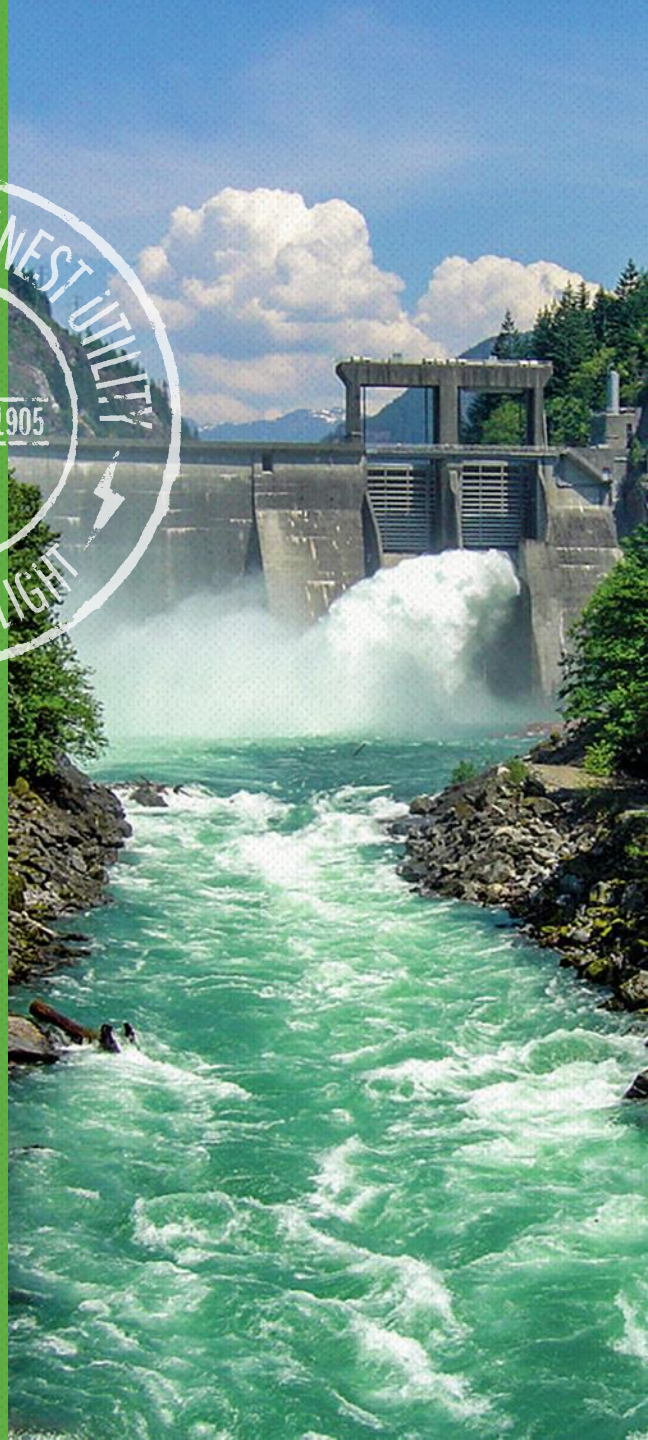
CANDIDATE PORTFOLIOS

SELECTION METHODOLOGY



SENARIOS FOR SENSITIVITY ANALYSIS

- Demand Forecast
  - High and Low Demand
- Hydro Conditions
  - High and Low Water Conditions
- Natural Gas Prices:
  - High and Low Natural Gas Prices
- CO2 Price Forecast
  - High and Low CO2 Prices

EVALUATION CRITERIA FOR CANDIDATE PORTFOLIOS

- Reliability
- Cost
- Financial Risk
- Environmental Performance

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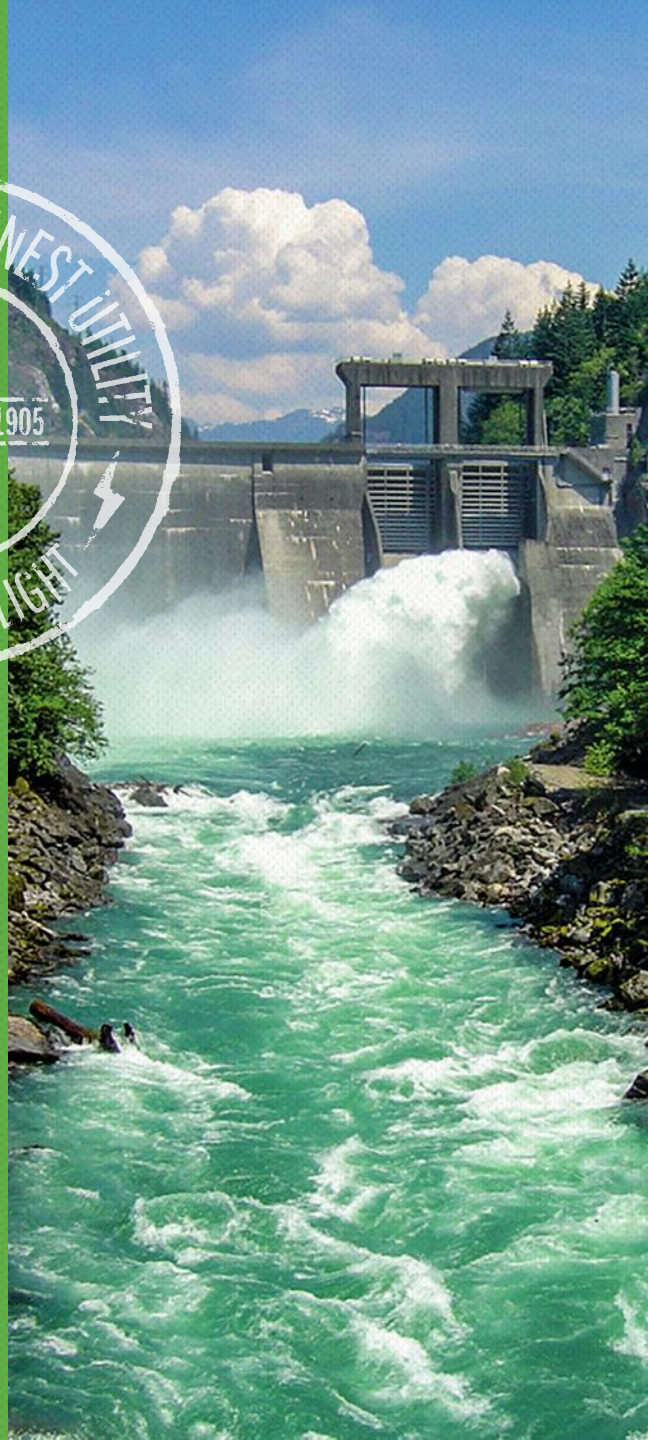
CONSERVATION POTENTIAL ASSESSMENT 2016



CONSERVATION CONTEXT

- Energy conservation is SCL's first priority resource, and has been since 1976
  - Low cost
  - Low environmental impact
  - Low risk
- Longest continually operated energy conservation program in the country
- 189 (aMW) of conservation in place
  - 10%+ of City Light's retail load

STUDY OBJECTIVES - CPA

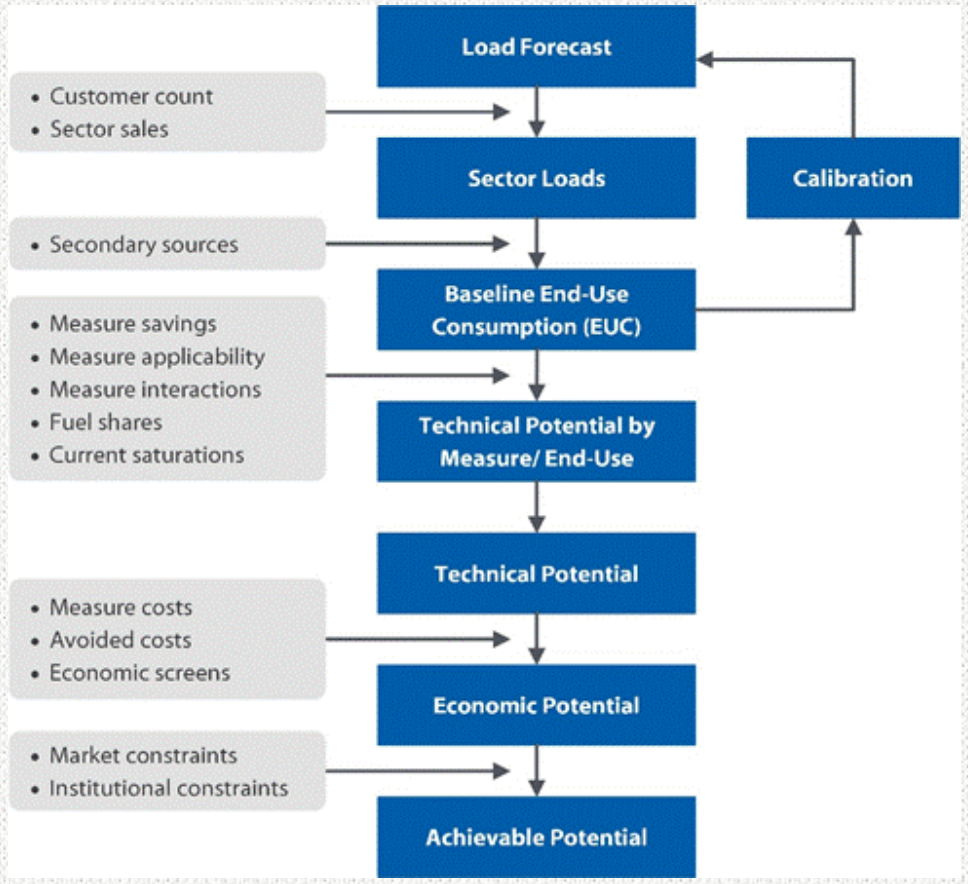
Estimate 20-year technical, economic, and achievable potential

Satisfy requirements of WAC 194-37

Develop conservation supply curve for the IRP

Provide reports and presentations that thoroughly document methodology, data sources, and results

OVERVIEW OF METHODOLOGY



WHAT'S NEW FOR THE 2016 CPA?

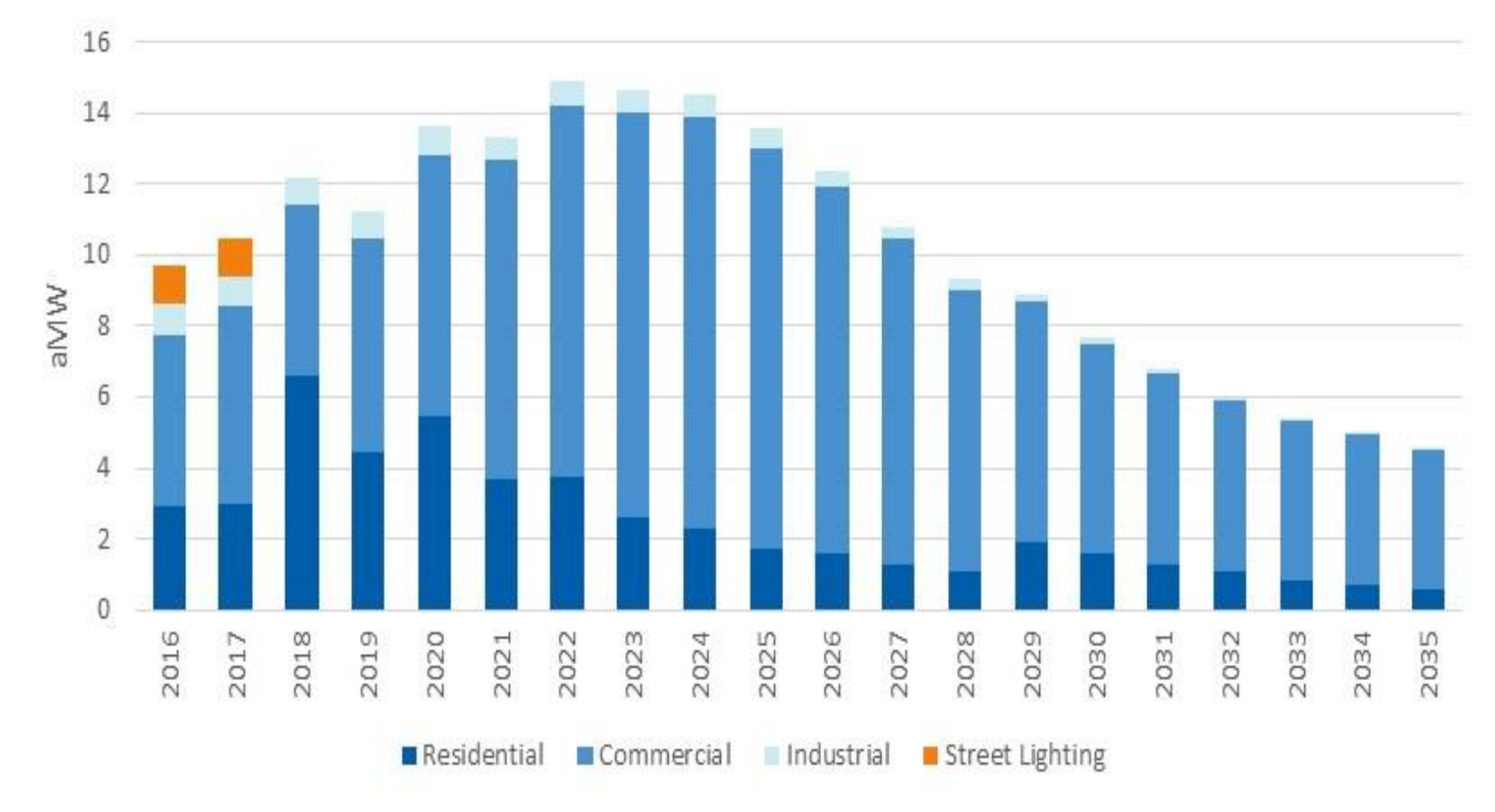
- New Load forecast
- 7th Power Plan measures
- Updates to RTF measures
- Residential and industrial program accomplishments
- CBSA Data
- Updated SCL non-residential database
- Federal standards and energy codes
  - New measures
    - Enterprise data centers
    - Indoor agriculture

SUMMARY OF RESULTS

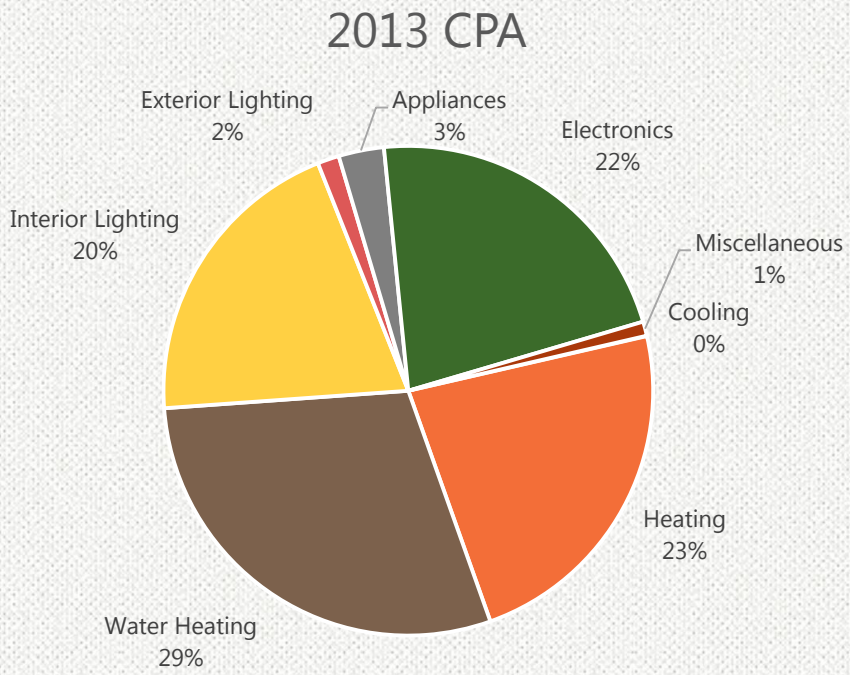
Sector	Achievable Economic Potential – aMW		
	2 Year	10 Year	20 Year
2014 CPA	23.7	118.4	250.6
2016 CPA	25.6	128.1	204.8
% Change	8%	8%	-18%

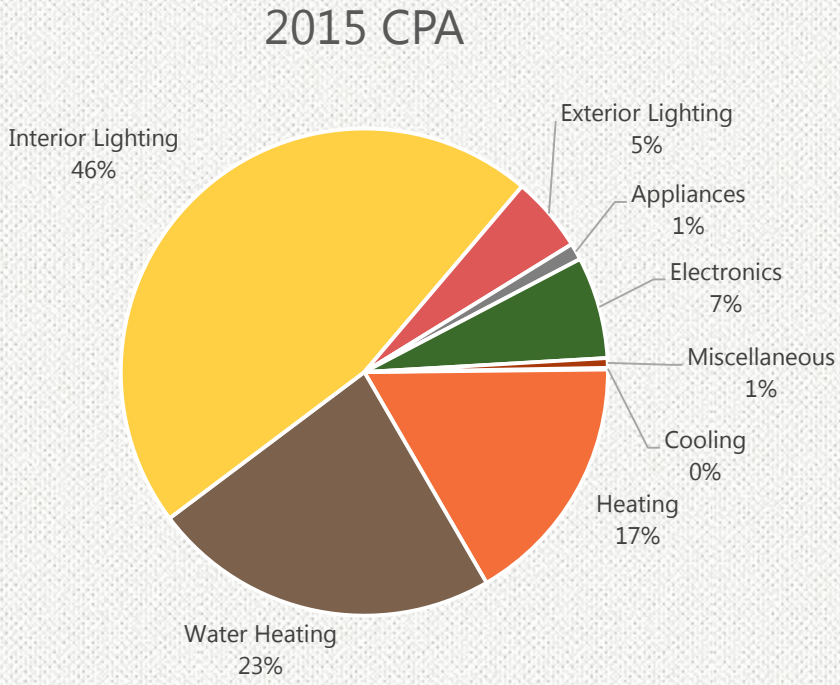
- Residential, commercial, and industrial sectors account for 24%, 70%, and 5% of 20-year achievable potential

IMPACT OF RAMP RATES

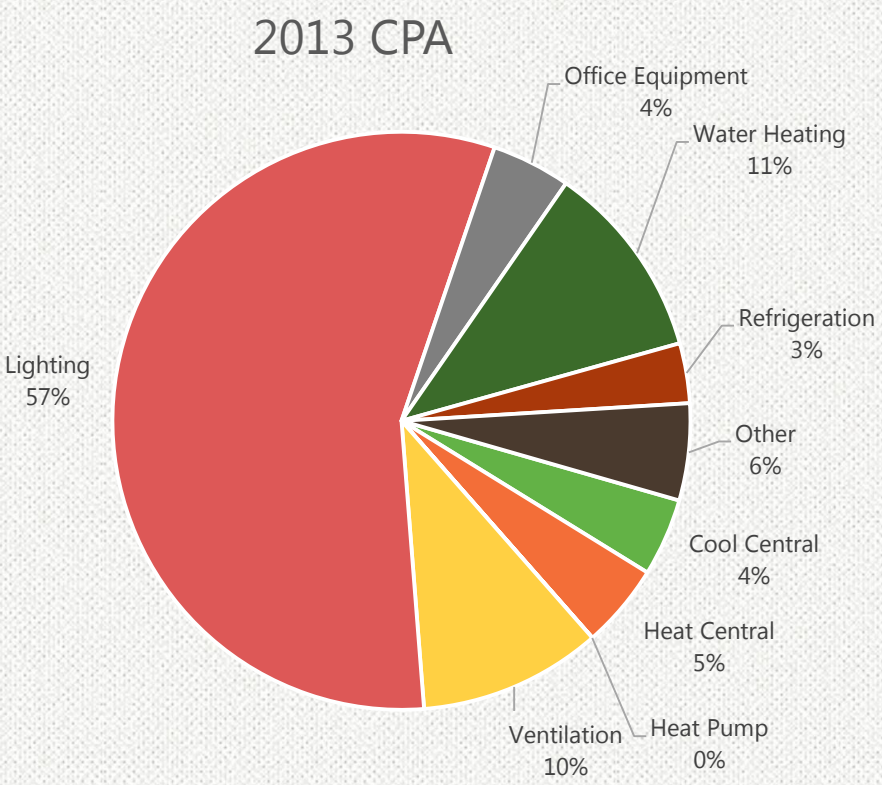


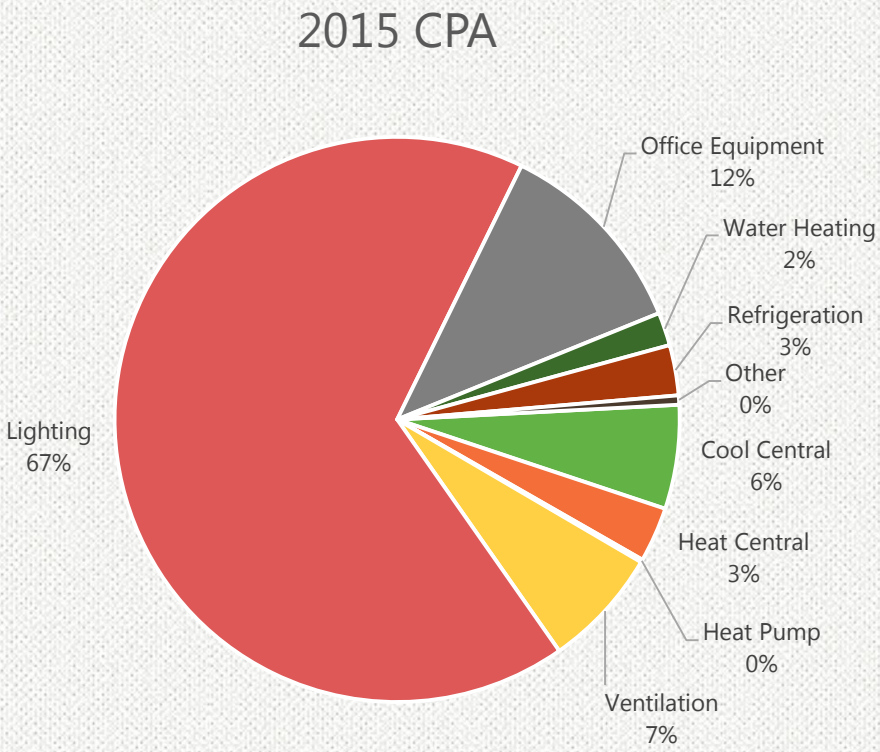
RESIDENTIAL – ECONOMIC POTENTIAL BY END USE





COMMERCIAL ECONOMIC POTENTIAL BY END USE





IRP SCENARIOS