Entergy

Data Assumptions and Study Description

2019 ELL Integrated Resource Plan

Public Redacted Version

WE POWER LIFE℠

May 30, 2018

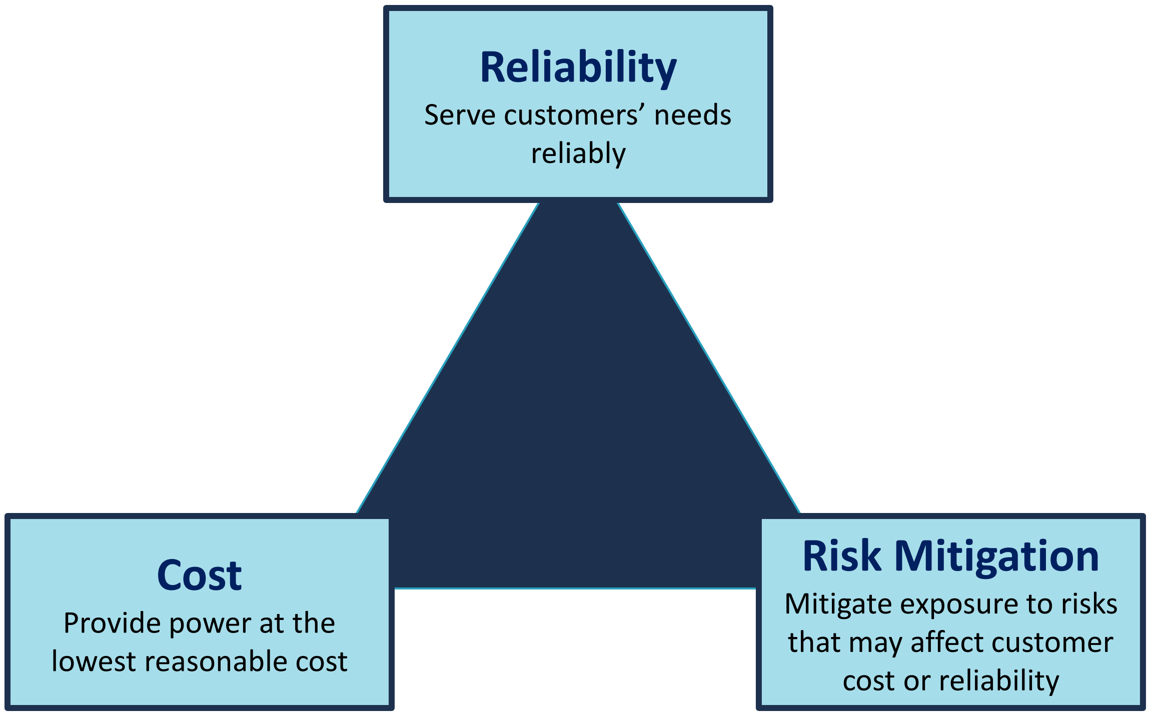
Purpose and Contents

The purpose of this presentation is to provide an overview of the scope and assumptions of ELL's upcoming Integrated Resource Plan (IRP) with an expected filing of the Final IRP Report in May 2019.

Contents

- Long-Term Planning Objectives and Principles
- Assessment of Resource Need
- Analytical Framework
- Supply Alternatives
- Assumptions
- Timeline

ELL's planning process seeks to accomplish three key objectives



The objectives above will be pursued while considering utilization of natural resources and the effect on the environment

ELL has principles to guide portfolio design in meeting planning objectives

Planning Principle	Description
Capacity	Provide adequate capacity to meet customer needs measured by peak load plus a long-term planning reserve margin.
Base Load Production Cost	Provide resources to economically meet base load requirements at reasonably stable prices.
Load Following Production Cost	Provide economically dispatchable resources capable of responding to the varying needs of customers driven by such factors as time of use, weather, and the potential integration of renewable generation.
Modern Portfolio	Avoid over-reliance on aging resources.
Price Stability	Mitigate exposure to price volatility associated with uncertainties in fuel and purchased power costs.
Supply Diversity	Mitigate exposure to risks that that may occur through concentration of portfolio attributes such as technology, location, large capital commitments, or supply channels.
In-region Resources	Avoid over-reliance on remote resources; provide adequate amounts and types of in-region resources to meet area needs reliably at a reasonable cost.

In the 2019 IRP, ELL will consider the ongoing evolution of the utility industry

The Changing Utility Industry

Customer Preferences

ELL's planning processes seek to address changing customer needs. Planning processes and tools will continue to evolve to help identify customer needs and wants.

Resource Alternatives

Ever-advancing technology provides new opportunities to meet future customer needs reliably and affordably. Planning processes strive to understand these technological changes in order to enable us to design optimal portfolios of resources and services.

Grid Modernization

ELL's distribution planning process will need to accommodate the integration of distributed energy resources safely and securely so they can be interoperable with the grid.

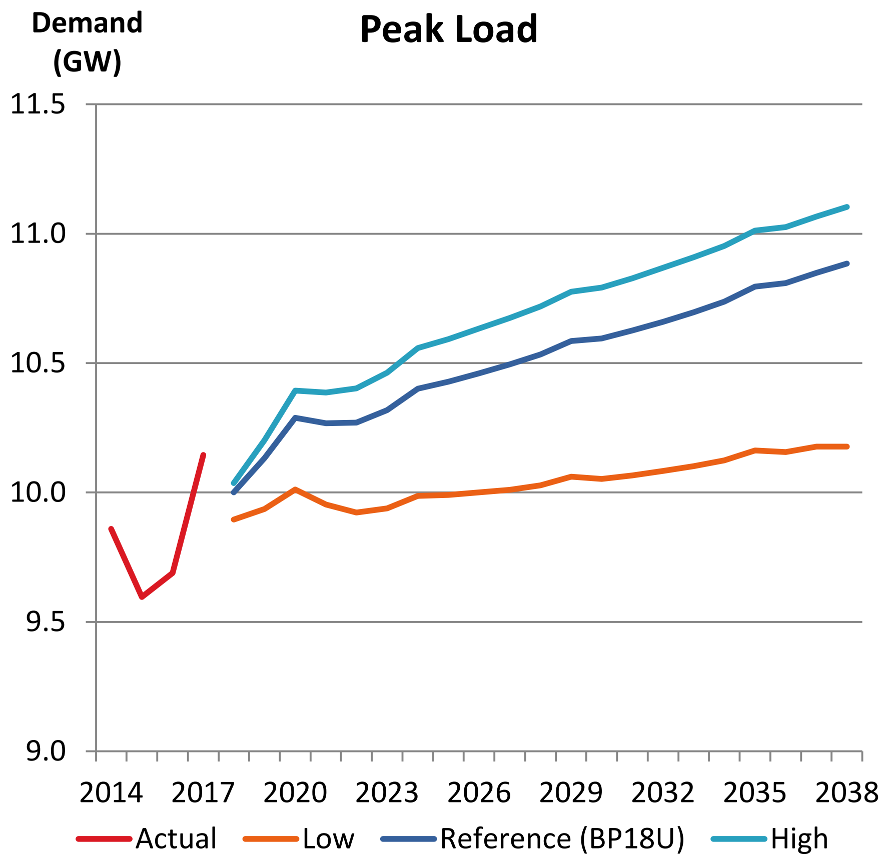
IRP Objective

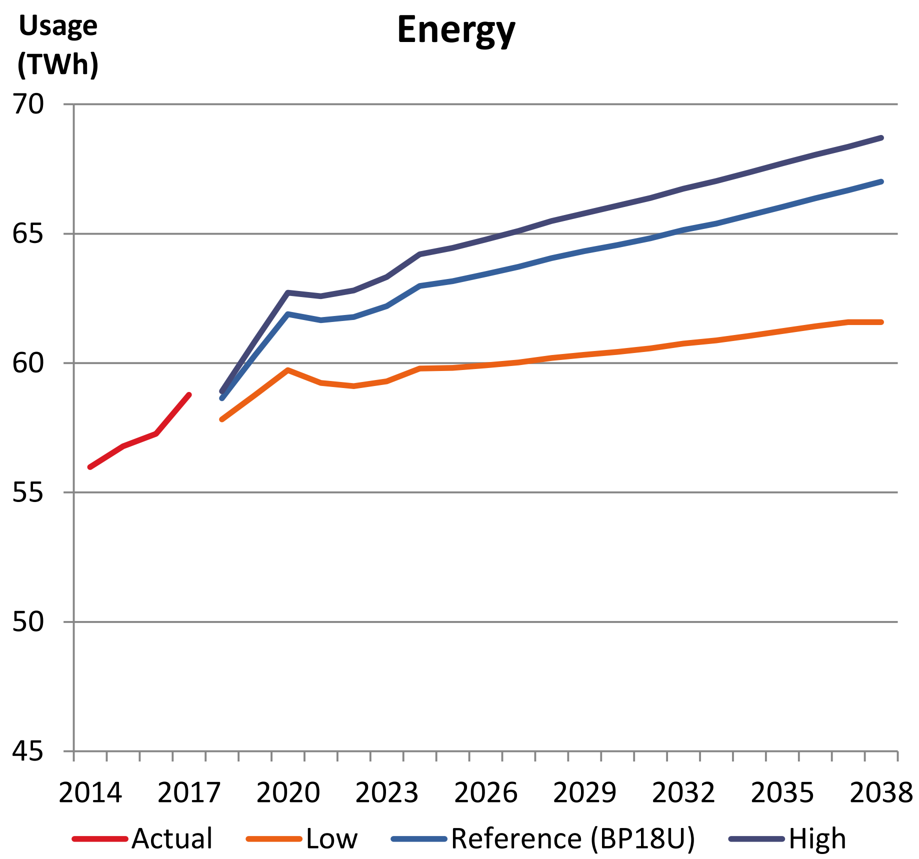
- An Integrated Resource Plan (IRP) is a planning process and framework in which the costs and benefits of supply-side and demand-side alternatives are evaluated to develop resource portfolio options that help meet ELL's planning objectives

- Through the IRP process, ELL will conduct an extensive study of customers' needs over the next 20 years based on current available data
  - Evaluate impact of different fuels and technologies
  - Analyze resource portfolios under a variety of economic scenarios
  - Results of the IRP are not intended as static plans or pre-determined schedules for resource additions

Assessment of Resource Need

Three demand forecasts were created for the ELL IRP: a low, reference, and high

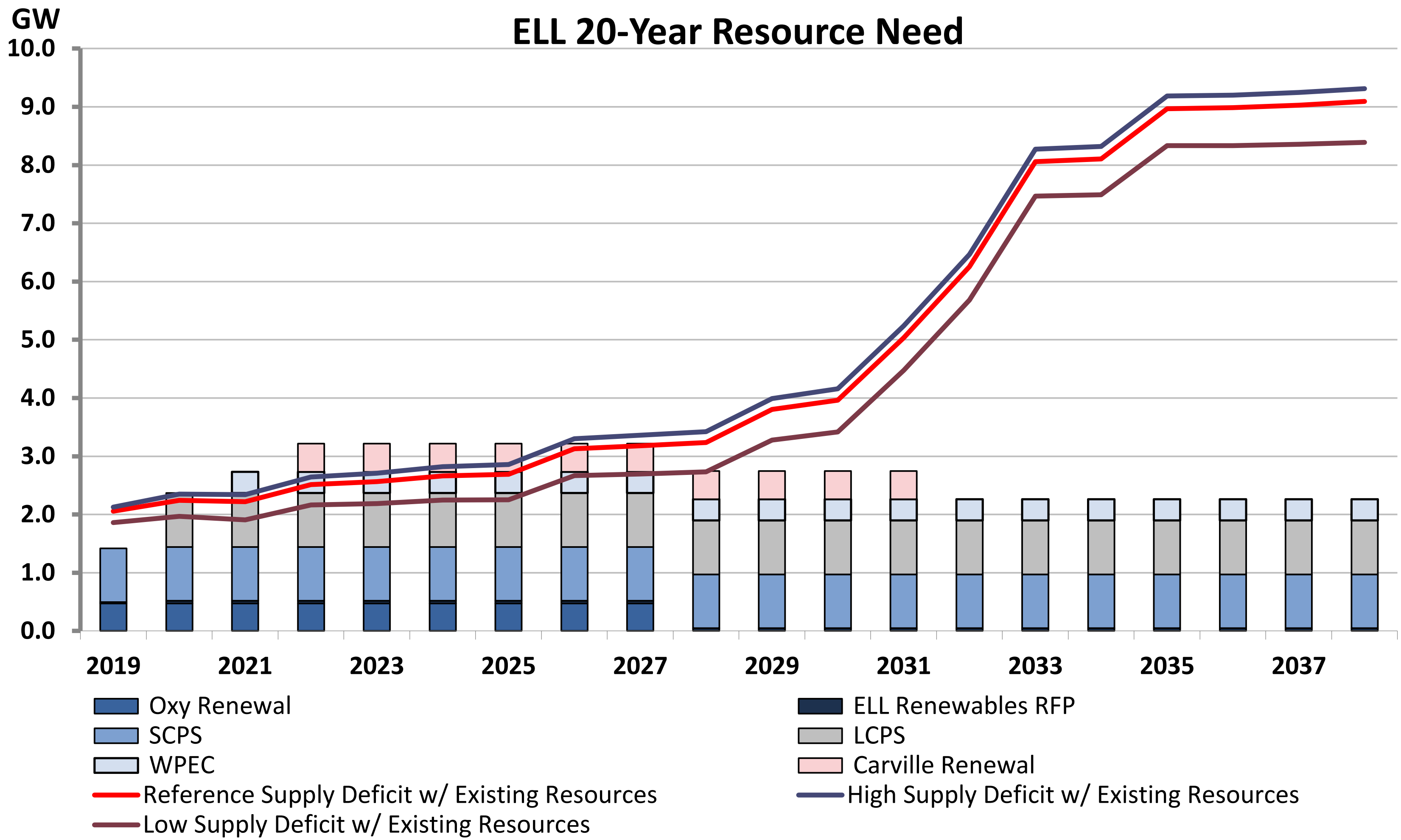




10-Yr CAGR	BP18U
Peak (MW)	0.4%
Energy (GWh)	0.7%

Reference Forecast	2019	2021	2026	2031	2036
Peak (MW)	10,133	10,267	10,461	10,626	10,809
Energy (GWh)	60,299	61,652	63,435	64,827	66,367

IRP will analyze portfolios to meet ELL's long-term supply needs while considering existing and planned generation



Notes:

1. Long-term planning requirement is based on ELL non-coincident peak load forecast and incorporates a 12% ICAP reserve margin.
2. Supply deficit is calculated based on the difference in existing ICAP (taking into account assumed deactivations) and long-term planning requirement.

Analytical Framework

IRP analysis will be performed using a scenario approach

- The IRP analysis will rely on 4 scenarios ("futures") to assess supply portfolios across a range of market outcomes
- The scenario approach, along with sensitivities, will allow ELL to assess portfolio performance as it is related to expected total supply cost and risk

	Progression Towards Resource Mix	Policy Reversion (Gas Centric)	Decentralized Focus (DSM & Renewables)	Economic Growth w/ Emphasis on Renewables
Peak Load & Energy Growth	*Reference*	*High*	*Low*	*High*
20-Year Levelized Natural Gas Prices (2019$)	*Reference ($4.81)*	*Low ($3.27)*	*Low ($3.27)*	*High ($6.70)*
Market Coal & Legacy Gas Deactivations [1]	*Reference (60 years)*	*55 years*	*50 years*	*55 years*
Magnitude of Market Coal & Legacy Gas Deactivations	*12% by 2028 54% by 2038*	*31% by 2028 88% by 2038*	*54% by 2028 91% by 2038*	*31% by 2028 88% by 2038*
Market Additions Renewables / Gas Mix	*Balanced Gas and Renewable Additions*	*Gas focused with some Renewable Additions*	*Greater Renewable Emphasis*	*Greater Renewable Emphasis*
CO_2 Price Forecast	*Reference*	*None*	*High*	*Reference*

Notes:

1. Deactivation assumptions will be consistent with current planning assumptions for ELL owned or contracted generation

WE POWER LIFE℠

Analytic Process to Create and Value Portfolios

Development of Planning Scenarios and Strategies

Development of assumptions and inputs for futures

Market Modeling

Projection of MISO market **outside of ELL** for each Future

Portfolio Development

Construction of resource portfolios through capacity expansion for each future, supplemented by manually developed portfolios

Total Relevant Supply Cost

Total supply costs of each portfolio are determined under each future

Action Plan

Identify action plan that balances reliability, cost, and risk

Development and Evaluation of Portfolio Options

- Optimized portfolios will be generated for each future (i.e. to each future's load, market prices, gas prices, etc.) using Aurora capacity expansion module
- Manual portfolios will be developed using supply planning principles
- Each portfolio will be tested in each future using Aurora production cost modeling software
- The total supply cost of each of the future/portfolio combinations represents the present value of fixed and variable costs to customers

Portfolios / Futures	Opt Port 1	Opt Port 2	Opt Port 3	Opt Port 4	Manual Port 5	Manual Port 6
Future 1	R_{11}	R_{12}	R_{13}	R_{14}	R_{15}	R_{16}
Future 2	R_{21}	R_{22}	R_{23}	R_{24}	R_{25}	R_{26}
Future 3	R_{31}	R_{32}	R_{33}	R_{34}	R_{35}	R_{36}
Future 4	R_{41}	R_{42}	R_{43}	R_{44}	R_{45}	R_{46}

24 total supply cost evaluations

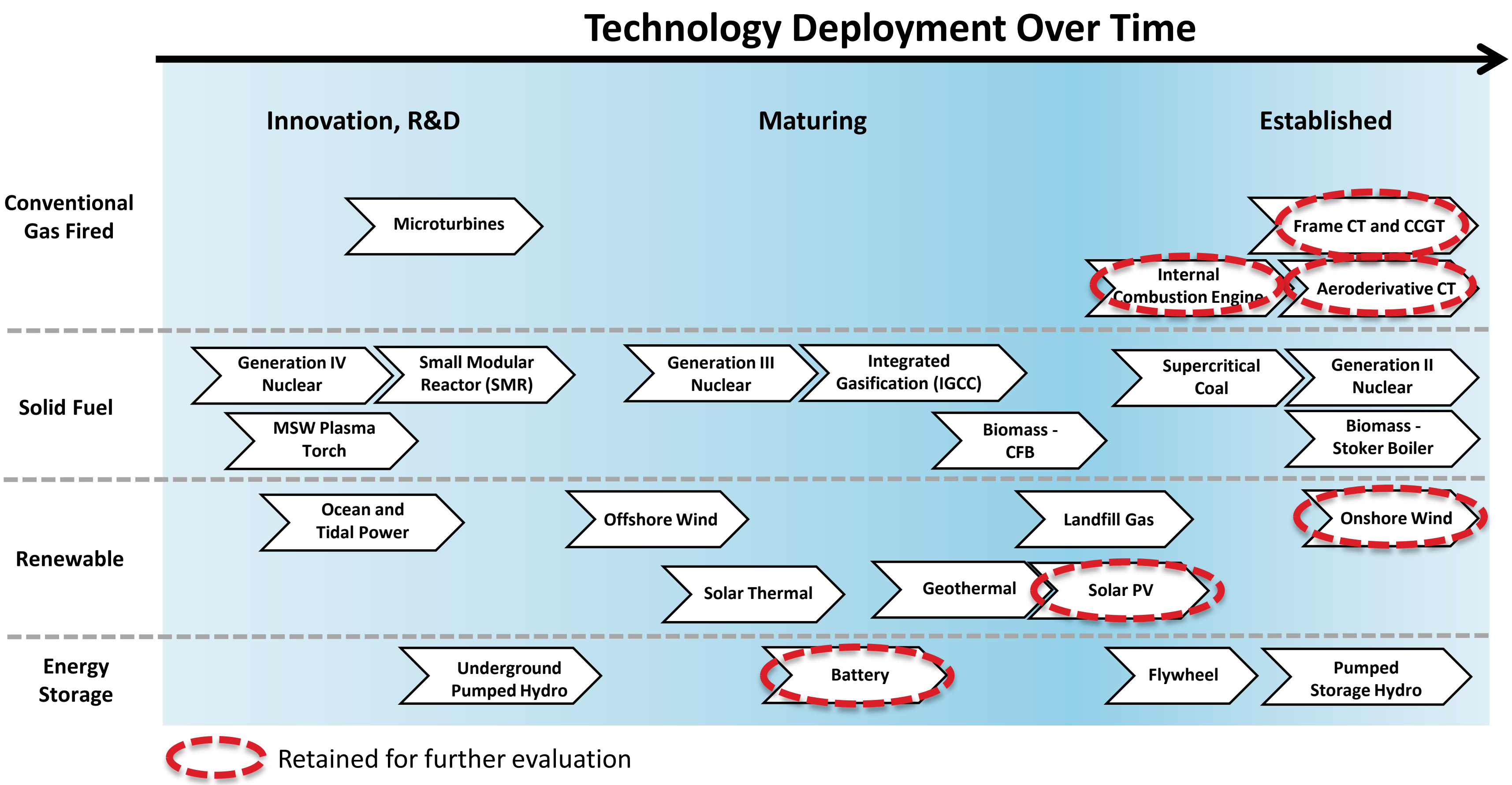
based on
6 portfolios each evaluated in
4 futures

Notes:
1. R = total supply cost result

Supply Alternatives

Identified Supply-Side Resource Alternatives

The technology evaluation includes surveying supply-side resource alternatives to meet supply needs. A subset of alternatives are retained to further understand costs and operational characteristics and ultimately consideration for meeting planning objectives. Alternatives evaluated are technologically mature and could reasonably be expected to operate economically and reliably in or around the ELL service territory.



Gas Resource Assumptions

Technology		Summer Capacity [MW]	Installed Cost [2017$/kW] [1]	Fixed O&M [2017 $/kW-yr]	Variable O&M [2017 $/MWh]	Full-Load Summer Heat Rate [Btu/kWh]
Combined Cycle Gas Turbine (CCGT)	*1x1 501JAC*	510	$1,238	$17.02	$3.14	6,400
	2x1 501JAC	1020	$1,090	$11.12	$3.15	6,400
Simple Cycle Combustion Turbine (CT)	*501JAC*	300	$833	$2.84	$13.35	9,400
Aeroderivative CT	*LMS100PA*	102	$1,543	$5.86	$2.90	9,397
Reciprocating Internal Combustion Engine (RICE)	*7x Wartsila 18V50SG*	128	$1,642	$31.94	$7.30	8,401

Notes:
1. Cost data based on Electric Power Research Institute (EPRI), Worley Parsons, and actual projects' estimated costs

Renewable Resource Assumptions

This information has been redacted

Renewable Resource Assumptions (Solar PV & Wind)

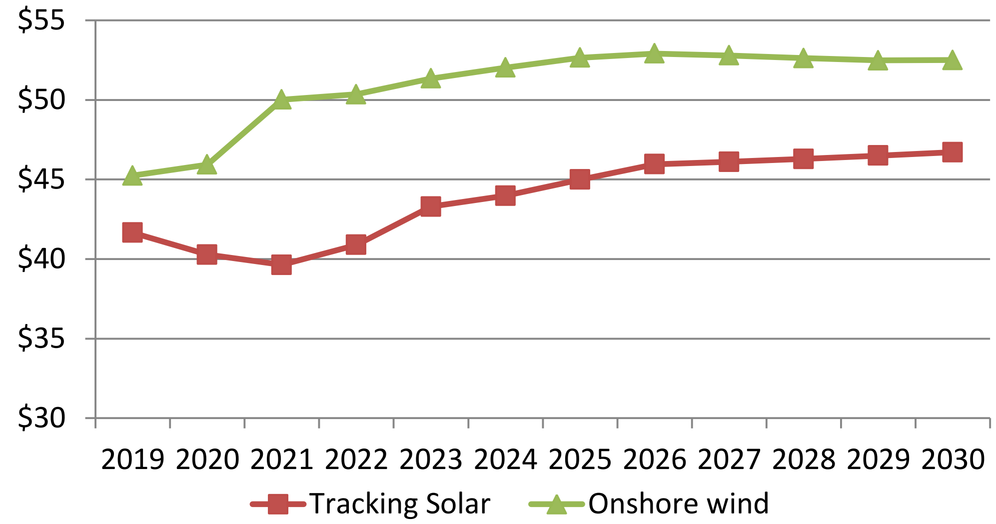
Levelized Real Cost of Electricity ($/MWh-AC) [1]

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Solar Tracking [2]	$42	$40	$40	$41	$43	$44	$45	$46	$46	$46	$46	$47
Onshore Wind [3]	$45	$46	$50	$50	$51	$52	$53	$53	$53	$53	$52	$53

Other Modeling Assumptions

	Solar	Wind
Fixed O&M (2017$/kW-yr-AC)	$16	$23.46
Useful Life (yr)	30	25
MACRS Depreciation (yr)	5	5
Capacity Factor	26%	36%
DC:AC	1.35	N/A
Hourly Profile Modeling Software	PlantPredict	NREL SAM

Levelized Real Cost of Electricity ($/MWh-AC) [1]



1. Year 1 levelized real cost for a project beginning in the given year. Includes total estimated fixed and variable costs divided by total estimated energy produced by asset over useful life
2. ITC normalized over useful life and steps down to 10% by 2023
3. PTC steps down to 40% by 2020 and expires thereafter

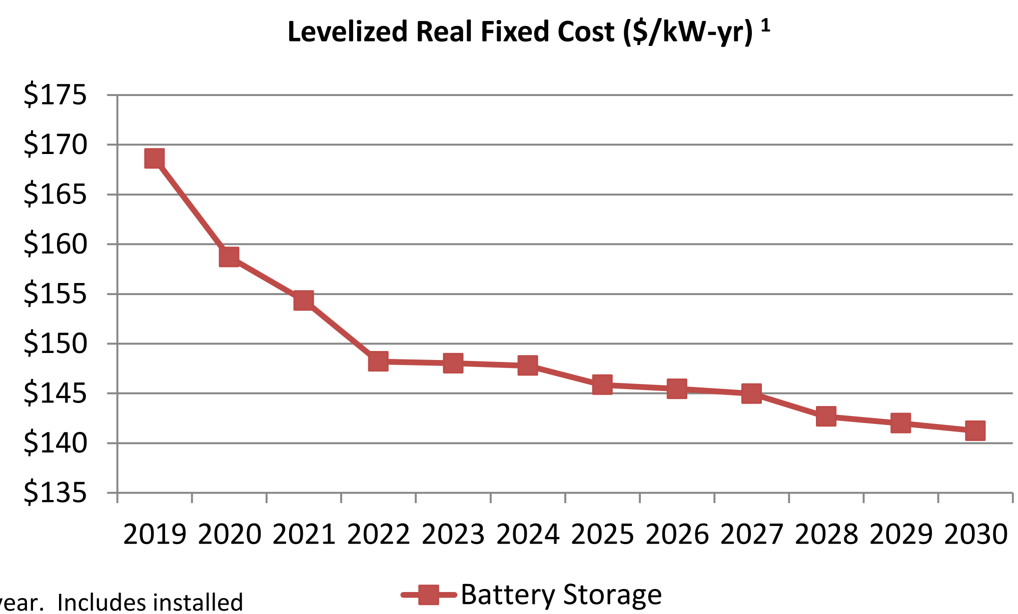
Renewable Resource Assumptions (Battery Storage)

Levelized Real Fixed Cost ($/kW-yr) [1]

	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
Battery Storage	$169	$159	$154	$148	$148	$148	$146	$145	$145	$143	$142	$141

Other Modeling Assumptions

	Battery Storage
Energy Capacity : Power [2]	4:1
Fixed O&M (2017$/kW-yr)	$9.00
Useful Life (yr) [3]	10
MACRS Depreciation (yr)	7
AC-AC efficiency	90%
Hourly Profile Modeling Software	Aurora



1. Year 1 levelized real cost for a project beginning in the given year. Includes installed cost and fixed O&M.
2. Current MISO Tariff requirement for capacity credit
3. Assumes daily cycling, no module replacement cost, full depth of discharge

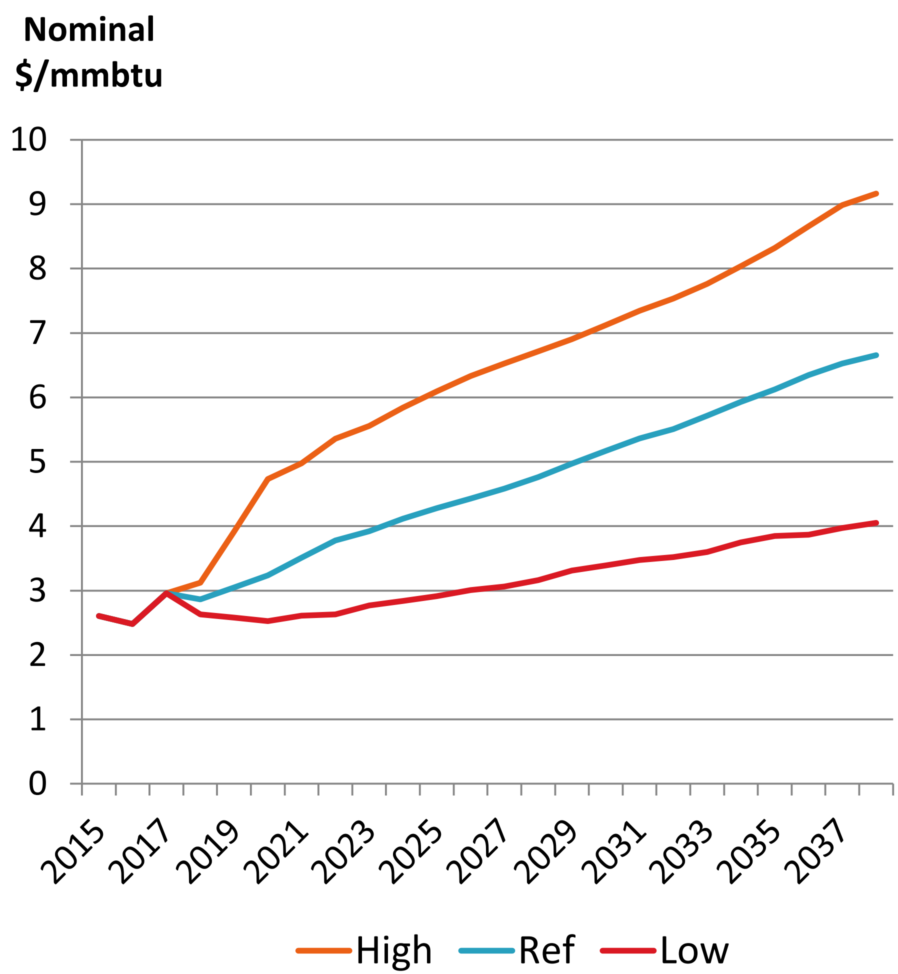
WE POWER LIFE℠

Demand Side Management (DSM) Potential Study

- ICF has been retained by ELL to perform a DSM potential study
- The study considered scenarios to create savings forecasts for DSM programs:
  - EE study:
    1. Current programs (based on current ELL programs with expanded budgets)
    2. Expanded programs (current programs plus new best practice programs)
  - DR study:
    1. Reference case
    2. High case
- Hourly loadshapes and program costs associated with these savings forecasts will serve as inputs to IRP production cost modeling in Aurora.
- DSM programs that appear to be cost-effective from the Potential Study will be considered in ELL's portfolio evaluations to meet supply needs.

Modeling Assumptions

Gas Price Forecast



Forecasting Methodology

Reference Case

- NYMEX futures (30-day average as of 6/12/2017) used for the first year
- Linear interpolation for year two
- Average of fundamentals-based consultant forecasts between year three and year twenty
- Followed by constant real dollars

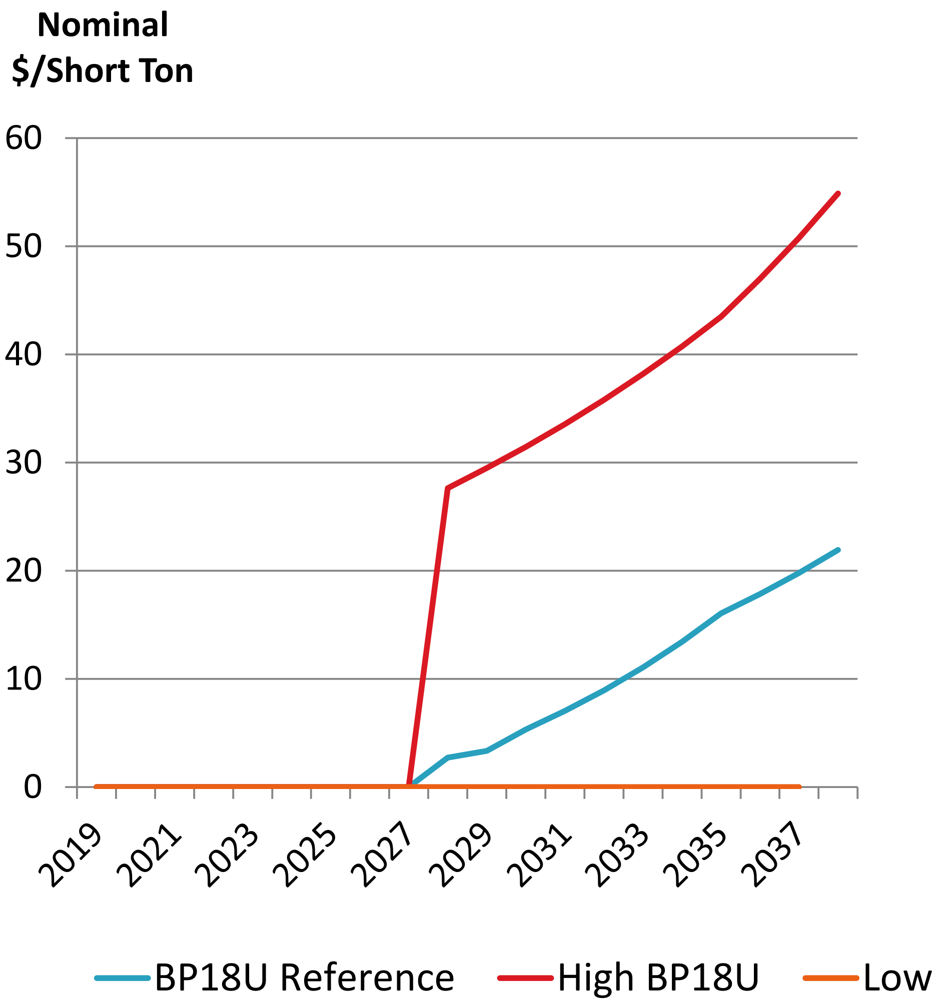
Sensitivities

- Low/High case methodologies are identical to the reference case, except implied volatilities are applied to the NYMEX prices in the first year
  - +/- 0.5 standard deviations from the mean in the first year

Notes:

1. 'First year', 'year two' etc. refer to years included in the gas price forecast. Year 1 of the gas price forecast is 2018. Year 1 of the IRP evaluation is 2019.

CO_2 Forecast



Forecasting Methodology

The 3 scenarios (low, reference, high) are based on the following three cases:

- A $0/ton CO_2 price representing either no program or a program that requires "inside-the-fence" measures at generating facilities, such as efficiency improvements, that do not result in a tradable CO_2 prices.
- A "CPP Delay" Reference Case representing a regional mass-based cap consistent with achieving the final CPP requirements, but delayed by approximately four to six years due to the federal administration change in 2017 and consistent with the President's March 2017 executive order; and,
- A "National Cap and Trade" High Case assumes a national cap and trade program that begins in 2028 and targets an approximately 80% reduction from 2005 sector emissions by 2050.

ELL IRP Capacity Value

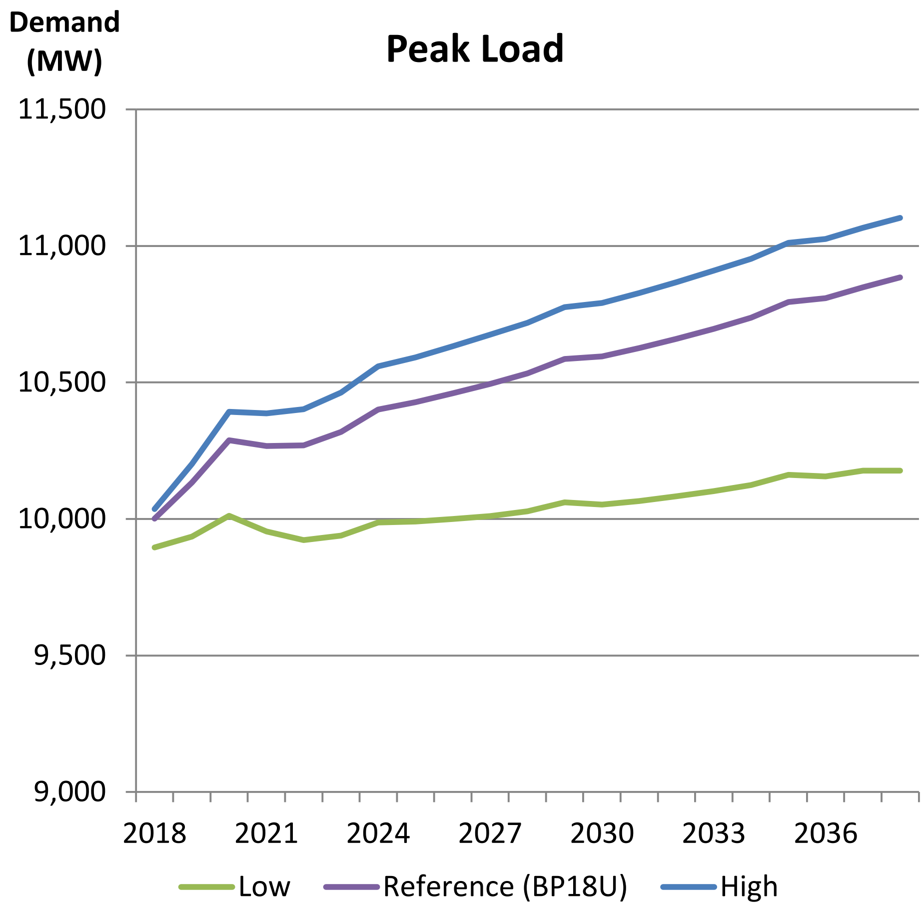
This information has been redacted

Timeline

Event	Description	Target Date
1	Filing initiating 2nd Full Cycle	October 23, 2017
2	File data assumptions and description of studies to be performed	March 2, 2018
3	1st Stakeholder meeting	April 2018
4	Stakeholder written comments due	May 31, 2018
5	Publish draft IRP reports	October 12, 2018
6	2nd Stakeholder meeting	November 2018
7	Stakeholder comments on draft IRP reports due	January 23, 2019
8	Staff Comments about draft IRP reports due	February 22, 2019
9	Final IRP reports due	May 23, 2019
10	Stakeholder lists of disputed issues and alternative recommendations due	July 23, 2019
11	Staff recommendation to Commission on whether a proceeding is necessary to resolve issues	August 23, 2019
12	Commission order acknowledging IRPs or setting procedural schedule for disputed issues	October 23, 2019

APPENDIX

Reference Load Scenario represents current utility observations

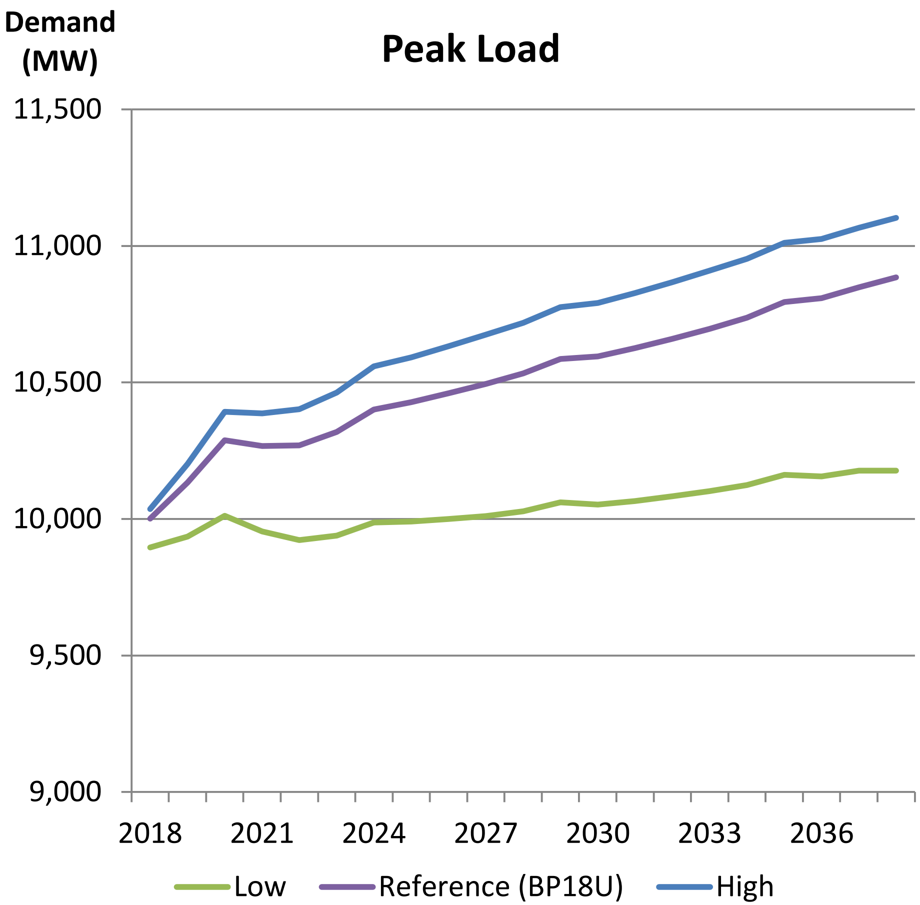


Scenario Drivers

- Flat-to-declining UPC[1] in Residential and Commercial sectors due to increases in energy efficiency and new technologies
  - Increases in heating and cooling equipment efficiency as well as LED lighting becoming more affordable and common
- UPC declines in Residential and Commercial being partially offset by growth in customer counts

[1] Usage per Customer

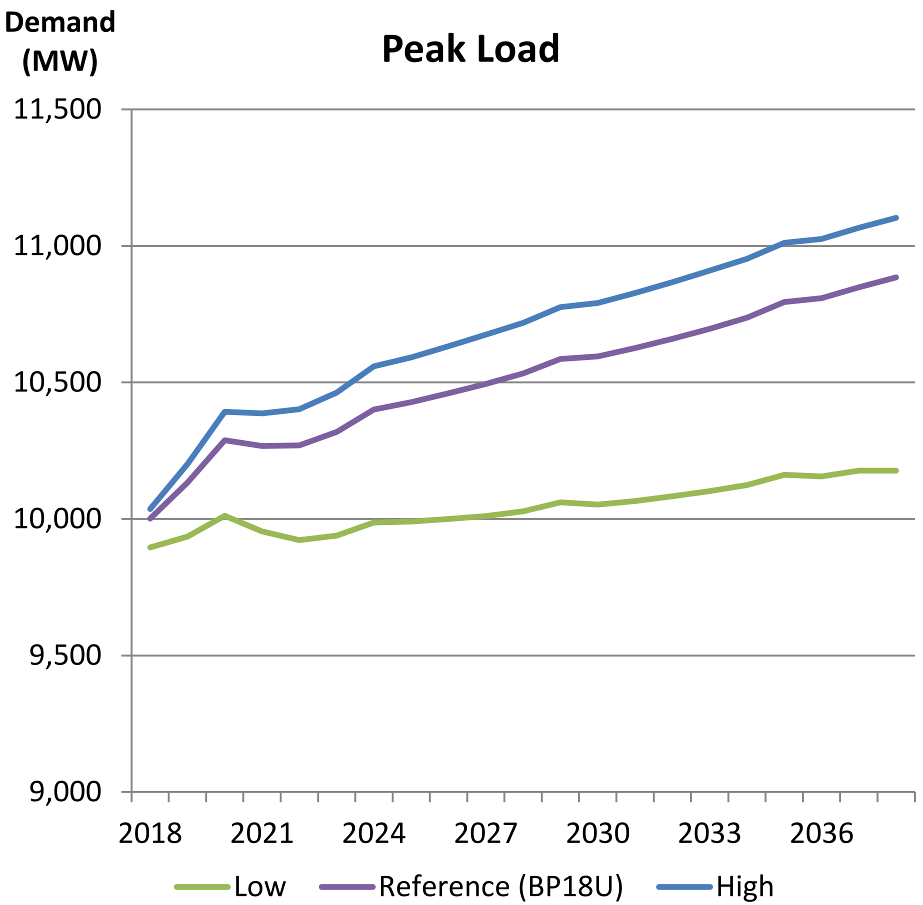
Low Load Scenario represents sluggish economy and higher energy efficiency adoption



Scenario Drivers

- Expected job growth more sluggish than anticipated
- Brick and mortar retail store closures continue in face of online competition, lowering residential and commercial usage
- Energy Efficiency continues to advance, despite fewer government incentives
- LED light bulbs are increasingly adopted
- Customer behind the meter generation offsets power consumption

High Load Scenario represents a bullish economy and decreasing energy efficiency



Scenario Drivers

- Projected customer count higher than expected
- LED bulb penetration weaker than expected
- Energy star program discontinued - business are less incentivized to create efficient appliances
- Industrial projects with a low probability are realized