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Form 4:
Demand Forecast Methods and Models

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**Update by City of Burbank, Water and Power 6/11/2025

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1 DEMAND FORECAST

1.1 INTRODUCTION

Burbank Water and Power (BWP) serves the electricity needs of Burbank and its people. In utility terms, these needs are called "demand." BWP serves Burbank's demand by delivering power through the electrical system: the network of wires, transformers, switches, and other equipment that make up the electric grid. BWP generates a portion of this electricity itself, purchases some through power plant contracts, and buys energy from the electricity markets when it is necessary to meet customer demand.

Managing and forecasting Burbank's future demand for electricity is necessary to ensure current and future affordability and reliability. As BWP moves forward, there will be challenges in forecasting BWP's demand due to changing customer use patterns brought about by new energy efficiency measures, an increasing adoption of electric vehicles, generation contributions from customer-owned rooftop solar, and legislative mandates to reduce Greenhouse Gas (GHG) emissions. Therefore, it is essential to understand hourly demand profiles, annual energy needs, and peak energy requirements. This information will help inform resource procurement decisions made by BWP as it makes plans to meet the unique challenges of Burbank's energy future.

1.2 DEMAND FORECAST METHODOLOGY AND ASSUMPTIONS

A multi-step process is used to forecast the demands that BWP must account for in its long-term planning. The methodology and process used for forecasting annual demand as well as the detailed hourly demand profiles is described below.

1.2.1 Annual Energy Demand

The gross energy demand forecast for Burbank comprises energy demands for residential, commercial, future development, and future electric vehicle components.

Figure 1-1 Gross Energy Demand Components

Gross energy demand is then offset by savings from energy efficiency measures and the contributions from distributed generation to calculate net energy demand.

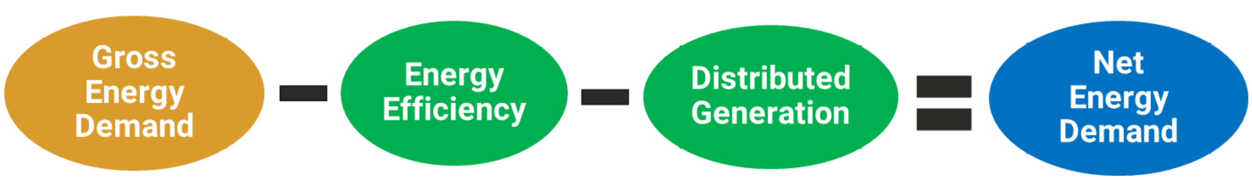

Figure 1-2 Net Energy Demand Components

1.2.1.1 Residential Energy Demand

The forecasted residential base energy demand was based on a regression analysis of historical demand data for Burbank. Annual residential retail sales from 1998 through 2022 were used along with city population, average personal income, and the annual number of cooling degree days (CDD) to develop the appropriate regression coefficients. Once the relationship between these variables was determined, annual residential energy demand was calculated for the years 2023 through 2047. During that forecast period, the residential base energy demand is estimated to grow at a Compound Annual Growth Rate (CAGR) of 0.5%.

1.2.1.2 Commercial Energy Demand

The commercial base energy demand was forecasted in a similar fashion to the residential base energy demand. Historic demand data from 1998 through 2022 was used with a set of independent variables to perform a regression analysis. For commercial energy demand, the chosen independent variables were city population, the amount of commercial floor space, average personal income, and the number of employees working in the commercial sector. Like the residential base energy demand, annual commercial base energy demand was calculated for the years 2023 through 2047. During that forecast period, the commercial base energy demand is estimated to grow at a CAGR of 0.8%.

1.2.1.3 New Development Energy Demand

Known development projects planned within Burbank were reviewed and their impact on residential and commercial energy demands was considered. The estimated peak energy demand in megawatts for each development project was used together with a load factor of 43%[1] and a conservative project success factor of 60% to calculate the total annual energy demand impact. The success factor was used to account for any potential delays or cancellations of these development projects and to account for any potential differences between the actual usage from these development projects vs. the peak energy demand assumed for designing the required distribution system. Once found, this new development energy demand was phased in over a period of seven years starting in 2025 to account for the time it would take for the projects to be completed.

1.2.1.4 Electric Vehicle Energy Demand

Annual electric vehicle energy demand through 2035 was based on a blend of the California Energy Commission's (CEC's) 2022 Integrated Energy Policy Report's (IEPR's) Additional Achievable Transportation Electrification (AATE) scenarios. The Burbank-Glendale (BUGL) planning area AATE scenarios were scaled down using data from the 2022 IEPR Load Serving Entity (LSE) and Balancing Authority (BA) data to derive Burbank's share of the forecast electric vehicle energy demand. In addition to the baseline AATE forecast from the IEPR, Burbank's electric vehicle energy demand was also based on the increasing rates of electric vehicle adoption shown in AATE Scenarios 2 and 3. A blending of the three scaled AATE scenarios, shown below in Figure 1-3, was used to calculate the annual electric vehicle energy demand for Burbank. The blending of the 3 AATE scenarios was used to account for an adoption rate for electric vehicles that is anticipated to increase over time. In 2022, the California Air Resources Board (CARB) promulgated the "Advanced Clean Cars II" regulations requiring that by 2035 all new cars and light trucks sold in California will have to be zero-emission vehicles. Since the AATE scenarios only contained a forecast though 2035, that data was extrapolated out through 2047 using a second order polynomial regression model.

[1] 43% load factor is based on the historical load factor data for the Burbank region.

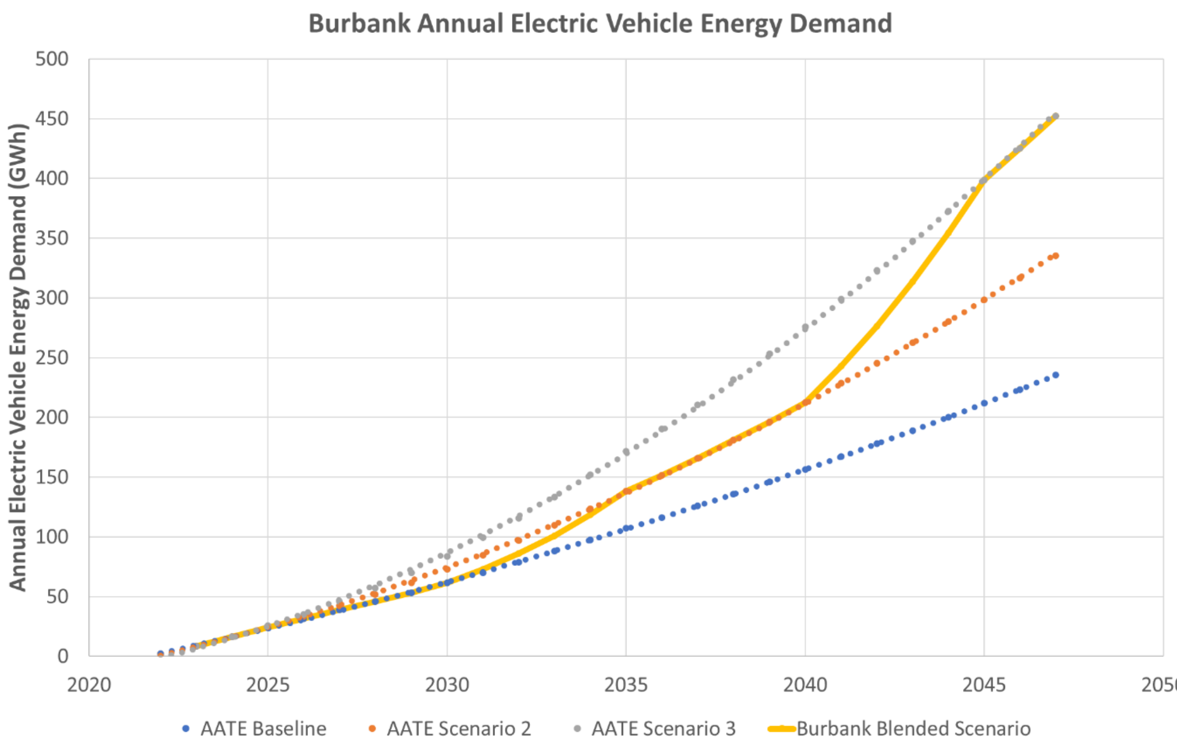

Figure 1-3 Forecast Electric Vehicle Energy Demand for Burbank

1.2.1.5 Energy Efficiency Savings

The forecast for Burbank's energy efficiency savings was developed using data taken from the CEC's 2022 IEPR's Additional Achievable Energy Efficiency (AAEE) Scenario 3. Unlike the AATE data, the AAEE data was available through 2050 and could be directly used for the entire planning horizon without the need for extrapolation. As can be seen in Figure 1-4, the annual increases in energy efficiency savings are assumed to decrease over time. Benefits from the implementation of energy efficiency programs are expected to eventually saturate as the most impactful and cost-effective changes are made first and programs with smaller benefits are implemented later.

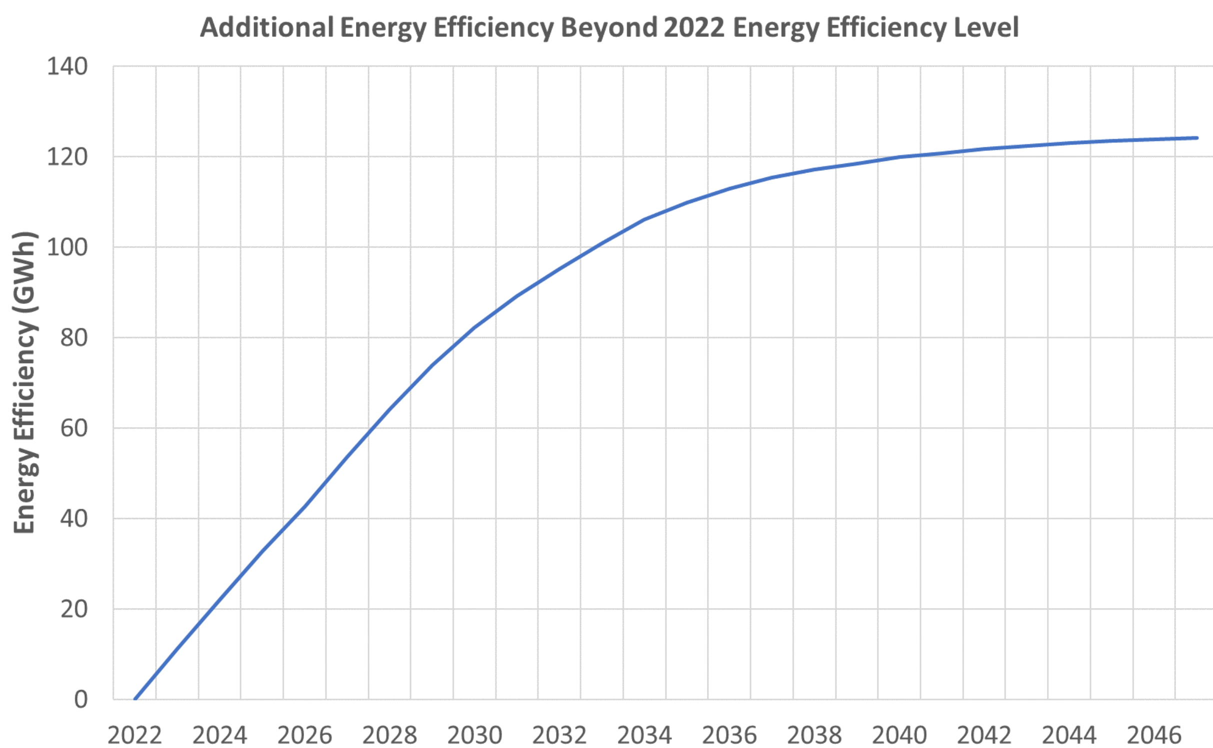

Figure 1-4 Forecasted Energy Efficiency Savings for Burbank

1.2.1.6 Contributions from Additional Distributed Generation

The forecast for Burbank's additional distributed generation, beyond what is already present in the city, was based on data taken from the CEC's 2022 IEPR baseline forecast. The 2022 IEPR baseline forecast annual distributed generation data was only available through 2035; therefore, it was extrapolated out through the end of the planning horizon using the same method as was used for the AATE data. A trend toward increasing contributions from distributed generation is in line with the general trends seen in the broader energy markets. Incentives like those that are a part of the Inflation Reduction Act are expected to further encourage expansion of customer-owned generation resources.

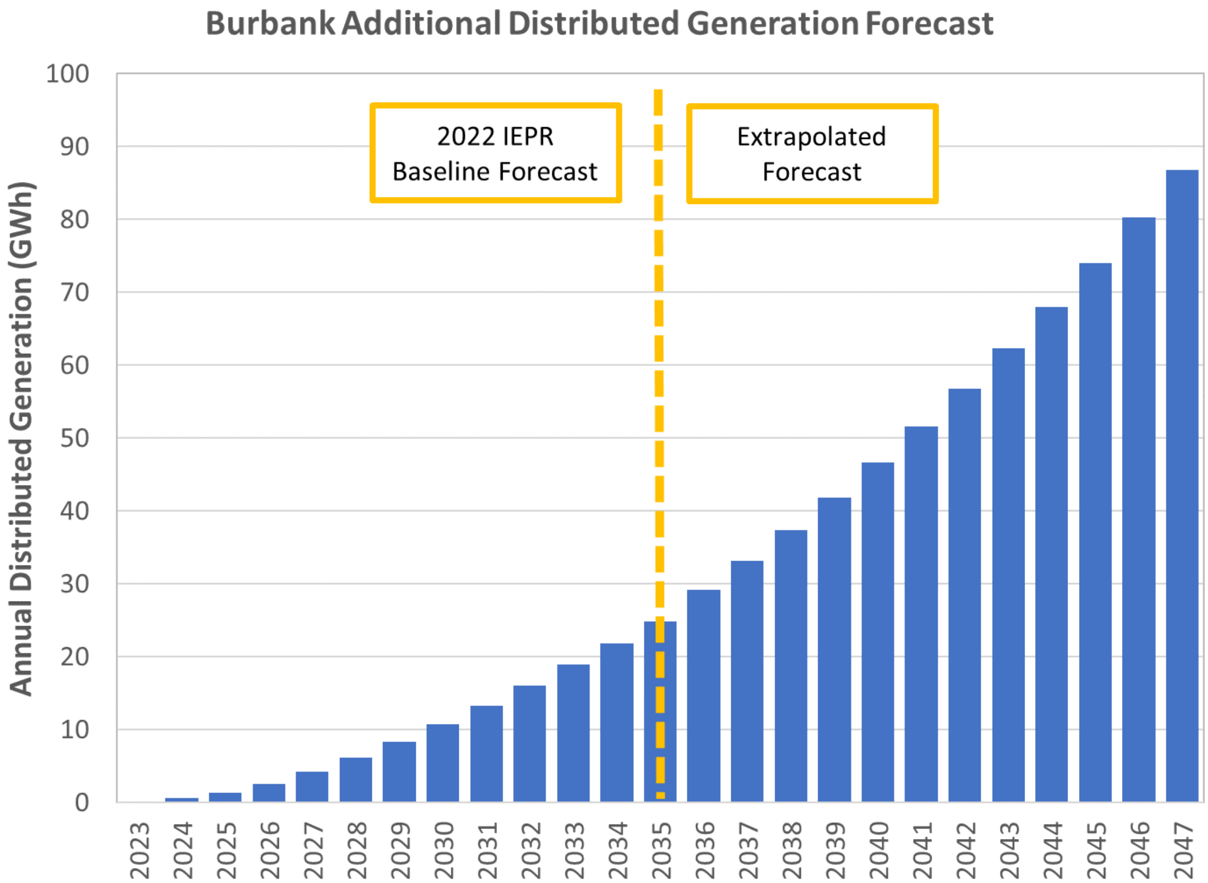

Figure 1-5 Forecasted Additional Distributed Generation for Burbank

1.2.1.7 Annual Peak Energy Demand

Another regression model was used to develop the annual peak values for Burbank's non-electric vehicle gross energy demand. Electric vehicle energy demand was not included in this peak energy demand regression due to its drastically different hourly demand profile compared to residential and commercial demands. The non-electric vehicle gross energy demand comprises residential, commercial, and non-electric vehicle development demands. For the peak energy demand regression analysis, historical net peak was the dependent variable and historical net demand and maximum CDD were the independent variables. This regression analysis provided the coefficients necessary to forecast peak energy demand values. Max CDD for the 2023-2047 peak forecast was assumed to be weather normal. The peaks for electric vehicles, energy efficiency, and distributed generation are a function of their annual forecasts and their hourly shapes.

1.2.2 Determination of Hourly Demand Shapes

Beyond the annual values for each of the contributing categories that make up Burbank's net energy demand, hourly demand profiles for contributing categories for each year in the planning horizon (2023-2047) were also generated. The hourly data is used for detailed modeling of future energy needs and determination of the best types and amounts of generation that will be required to meet them.

1.2.2.1 Residential. Commercial, and Future Development Hourly Demand

The hourly demand shape for residential, commercial, and future non-electric vehicle development energy demands was adopted from Burbank's actual 2018 demand profile. The 2018 demand profile was found to be the most weather "normal" year based on historical CDD and energy consumption data; therefore, it was used as the basis for the creation of the hourly demand profile for this part of the overall net system demand. PLEXOS was used to build the hourly forecast based on annual demand, peak, and the 2018 demand profile.

1.2.2.2 Electric Vehicle Hourly Demand

The 2022 IEPR electric vehicle hourly demand profile for the CAISO planning scenario was scaled down to match Burbank's forecast electric vehicle demand. Since that IEPR demand profile did not span the entirety of the planning horizon, the last year of that forecast (2035) was used as the basis for the hourly demand shape in the years 2036-2047.

1.2.2.3 Hourly Savings from Energy Efficiency

The hourly profile for energy efficiency savings was also taken from the 2022 IEPR. Scenario 3 from the 2022 IEPR AAEE & Additional Achievable Fuel Substitution (AAFS) forecasts was used in conjunction with the 2022 IEPR AAEE Hourly Impacts forecast for the BUGL planning area to create the hourly energy efficiency forecast for the entire planning horizon. The BUGL hourly forecast was scaled down to match the Burbank Annual AAEE Scenario 3 forecast from the 2022 IEPR. Since both IEPR sources included data through 2050, no extrapolation or regression was required.

1.2.2.4 Hourly Contributions from Distributed Generation

An hourly solar generation profile for the Los Angeles area was used together with the annual distributed generation forecast described above to create the hourly contributions from distributed generation located within Burbank.

1.2.2.5 Sum of Hourly Demand Profiles

Once all the hourly demand profiles were completed, (residential and commercial energy demand including the demand from new developments, electric vehicle energy demand, energy efficiency savings, and energy contributions from distributed generation), they were all combined on an hourly basis to create the final hourly demand forecast. In the figures below, the forecasted change in the average summer and winter hourly demand profiles can be seen. As time passes, the effects of increased demand can be seen as the hourly demands shift upwards and peak demands increase. The adoption of electric vehicles can be seen in the more pronounced energy usage in the overnight hours. This is particularly evident in Figure 1-7 where the winter peak is shifted towards the overnight hours due to electric vehicle charging.

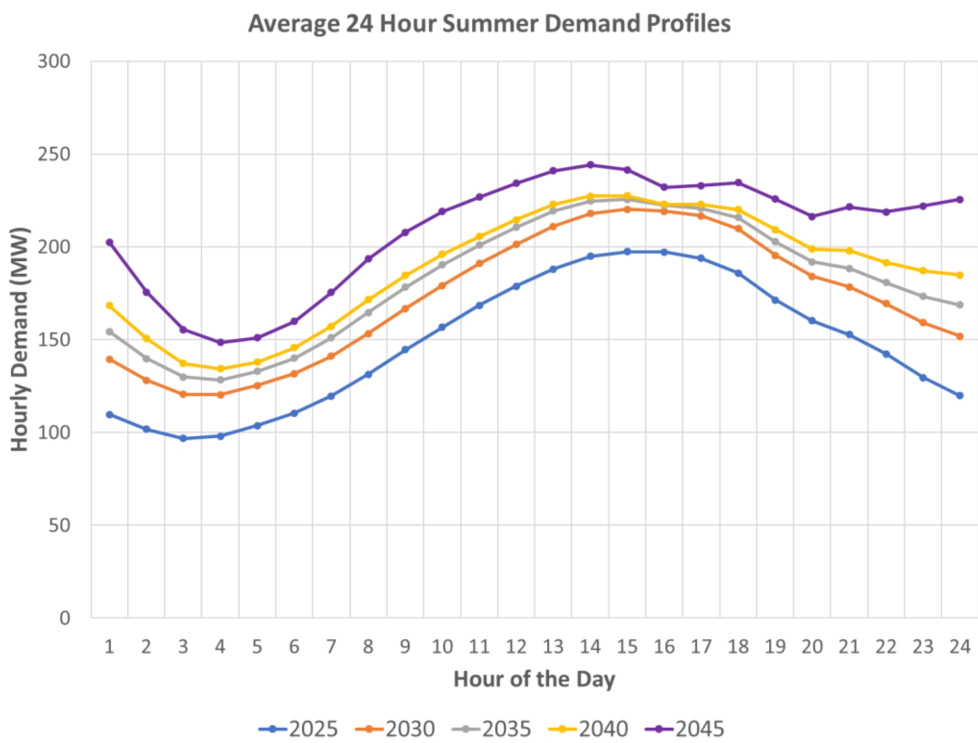

Figure 1-6 Average Hourly Summer Demand Profiles

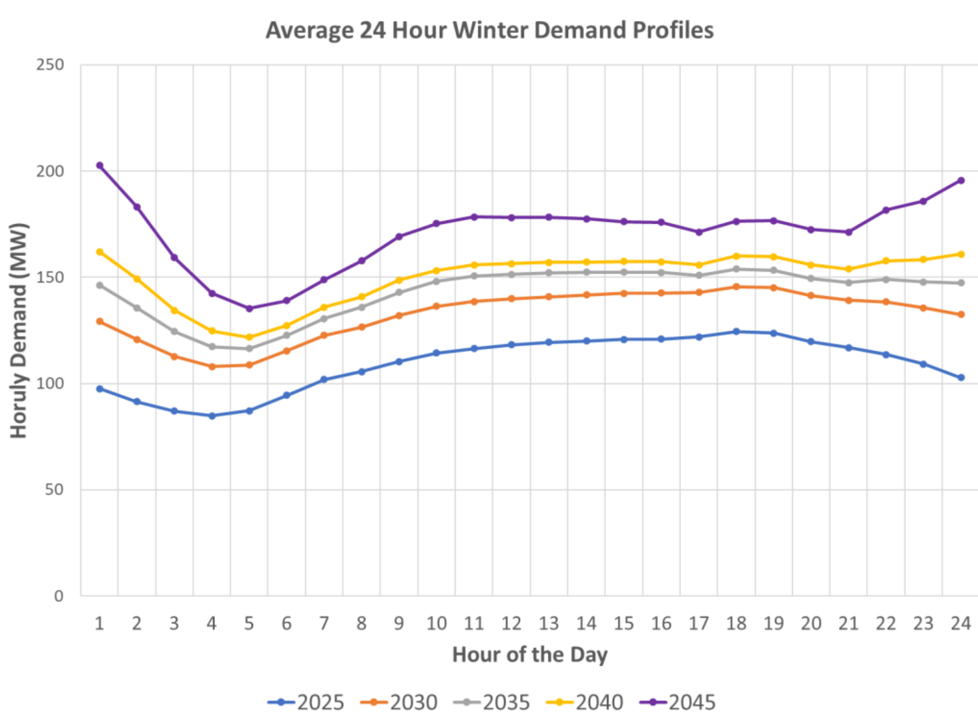

Figure 1-7 Average Hourly Winter Demand Profiles

1.3 RESULTS OF DEMAND FORECAST

In the historic demand data from 2018-2024 listed in Table 1-1 and Figure 1-8 below, the annual net energy demand and net peak energy demand for Burbank show a temporary decrease in 2020 and 2021, additionally the same in 2022 and 2023 that is associated with the initial impacts of the COVID-19 pandemic and a second wave of impacts that followed. The forecast from 2025-2047 assumes that demand will return to "pre-COVID" levels and will increase largely due to new residential and commercial developments and the increasing adoption of electric vehicles.

The forecasted demand for Burbank from 2025-2047 is also provided in Table 1-1 and Figure 1-8 below. Annual net energy demand is given in units of gigawatt-hours (GWh) and annual net peak energy demands are given in units of megawatts (MW).

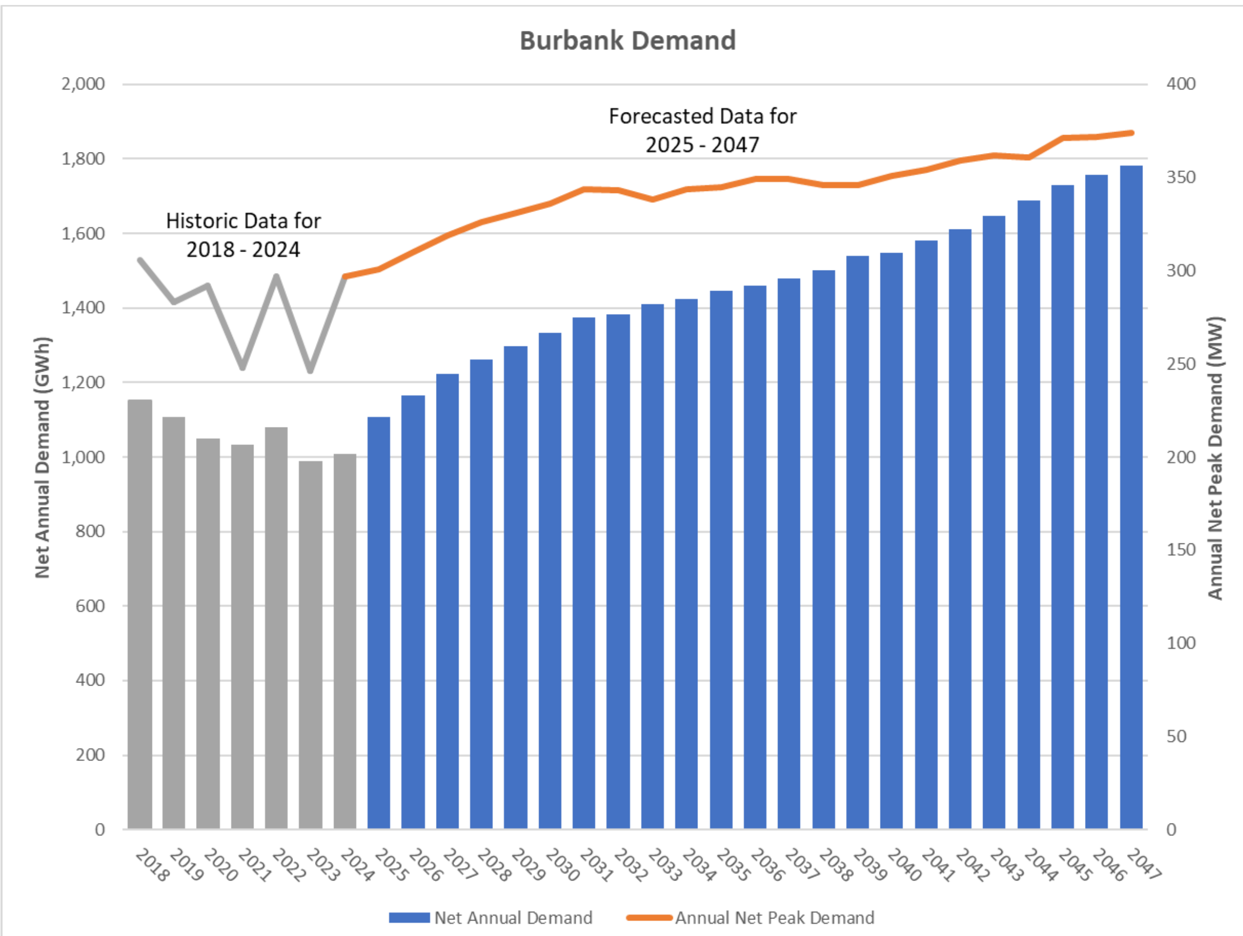

Figure 1-8 Forecast Net Annual Demand and Annual Net Peak Demand

*Updated historic data 2023 – 2024

Table 1-1: Annual Net Energy Demand & Net Peak Energy Demands

Year*	Net Energy Demand (GWh)**	Net Peak Energy Demand (MW)**
2018	1,151	306
2019	1,108	283
2020	1,049	292
2021	1,033	248
2022	1,079	297
2023	988	246
2024	1,007	297
2025	1,108	301
2026	1,166	310
2027	1,224	319
2028	1,262	326
2029	1,296	331
2030	1,333	336
2031	1,374	344
2032	1,382	343
2033	1,409	338
2034	1,425	344
2035	1,446	345
2036	1,459	349
2037	1,479	349
2038	1,502	346
2039	1,541	346
2040	1,548	351
2041	1,580	354
2042	1,611	359
2043	1,647	362
2044	1,688	361
2045	1,731	371
2046	1756	372
2047	1782	374

*Historic demand data is provided for years 2018-2024. The forecast is for years 2025-2047.
** The forecast demand data includes transmission losses.