2024 Forecasting Benchmark Survey

Itron, Inc.
10875 Rancho Bernardo Road
Suite 200
San Diego, CA 92127

October 11, 2024

2024 Forecasting Benchmark Survey

Since 2012, Itron has conducted this Annual Benchmarking Survey to develop a broad picture of electric and natural gas industry forecasting practices. This year, the survey collected data from February through July which culminates in this report.

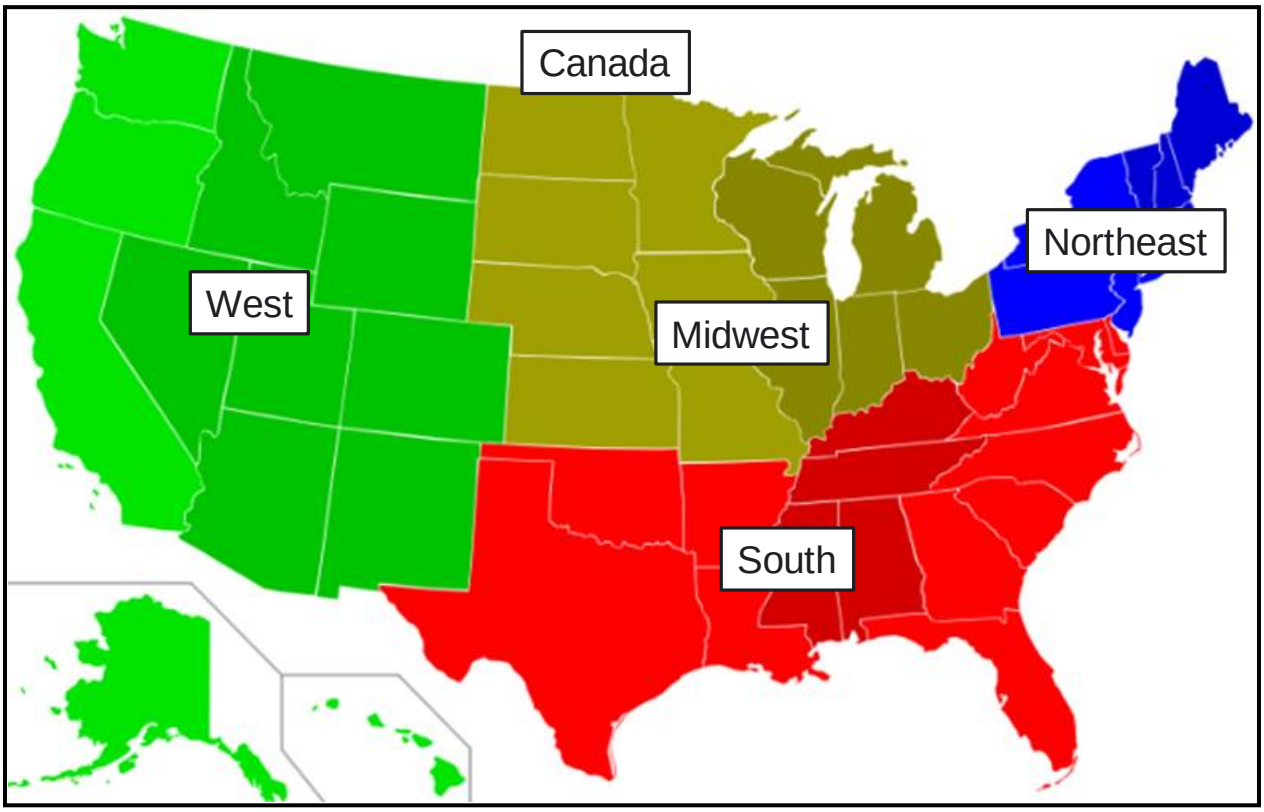
This year's survey includes 121 respondents including 101 electric utilities, 5 electric system operators and regional companies, and 15 natural gas utilities. The utilities represent over 3,100 TWh of electricity (65% of the United States and Canada electric consumption) and 1,400 BCF of natural gas. Figure 1 shows the number of survey respondents divided into geographic regions.

Figure 1: Survey Respondents

Region	2024	Weights
Canada	12	20%
Midwest	23	21%
Northeast	12	5%
South	36	44%
West	18	10%
Electric Total	101	100%
Other Electric	5	100%
Natural Gas Total	15	100%

Electric survey results are presented by geographic region. Other Electric denotes system operators and regional companies. Natural Gas companies are aggregated and not presented by region due to the low number of responses. Figure 2 shows the geographic regionsFigure 2. Results are weighted by self-reported 2023 annual sales unless otherwise noted.

Figure 2: Survey Regions



This report includes the following sections.

- Forecast Accuracy Overview
- Electric Forecast Growth Overview
- Natural Gas Forecast Growth Overview
- Customer Growth
- Residential Sales Growth
- Commercial Sales Growth
- Industrial Sales Growth
- System Sales Growth
- System Peak Growth
- COVID Impacts
- Electric Forecast Accuracy
- Natural Gas Forecast Accuracy
- Key Forecast Characteristics

Forecast Accuracy Overview

The survey asks companies to provide forecast accuracy statistics reporting errors relative to actual consumption and weather normalized consumption.

With COVID-19 solidly in arrears, forecast accuracy is returning to pre-pandemic levels. However, errors remain slightly elevated. For example, the total electric system error reported in 2024 is 1.78%, identical to the 2023 reported error (i.e., 1.78%), but higher than the pre-COVID average (1.43%).

The higher error level reflects the new challenges facing the electric industry. While the challenges vary based on region, overall, the electric industry is experiencing the impacts of post-pandemic consumption patterns, electrification driven by climate policies, dynamic electric vehicle growth, and expanding data center loads. Forecast error statistics for both the electric and natural gas industries are reported in Figure 18 through Figure 24.

Electric Forecast Growth Overview

For the first time since Itron began conducting this survey, the long-term electric sales growth forecast is like the 2000 to 2008 period. The system annual average forecast growth is 1.57% and the 2000 to 2008 historical annual average growth was 1.49%[1]. In comparison, annual energy growth between 2009 and 2019 averaged just 0.16%.

The forecast growth deviation from recent history implies that the industry is expecting to see significant changes in the factors driving electricity demand. These factors align with the challenges facing the industry and include expected strong electric vehicle adoption, building electrification, and data center growth. The accuracy of the forecast growth will depend on whether these expectations become reality. Figure 9 through Figure 13 provide additional details on 2023 growth rates and the long-term forecast growth rates.

[1] Historical annual average growth based on the Energy Information Administration (EIA) residential, commercial, and industrial sales reported in EIA's Monthly Energy Review.

Figure 3: Survey Electric Sales Growth

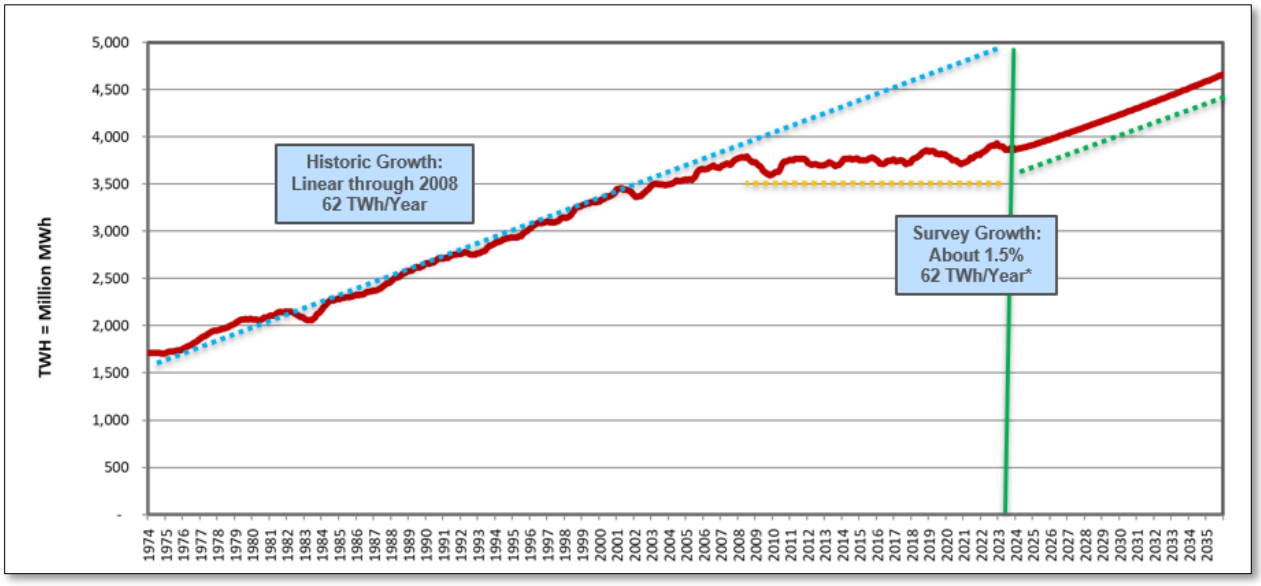


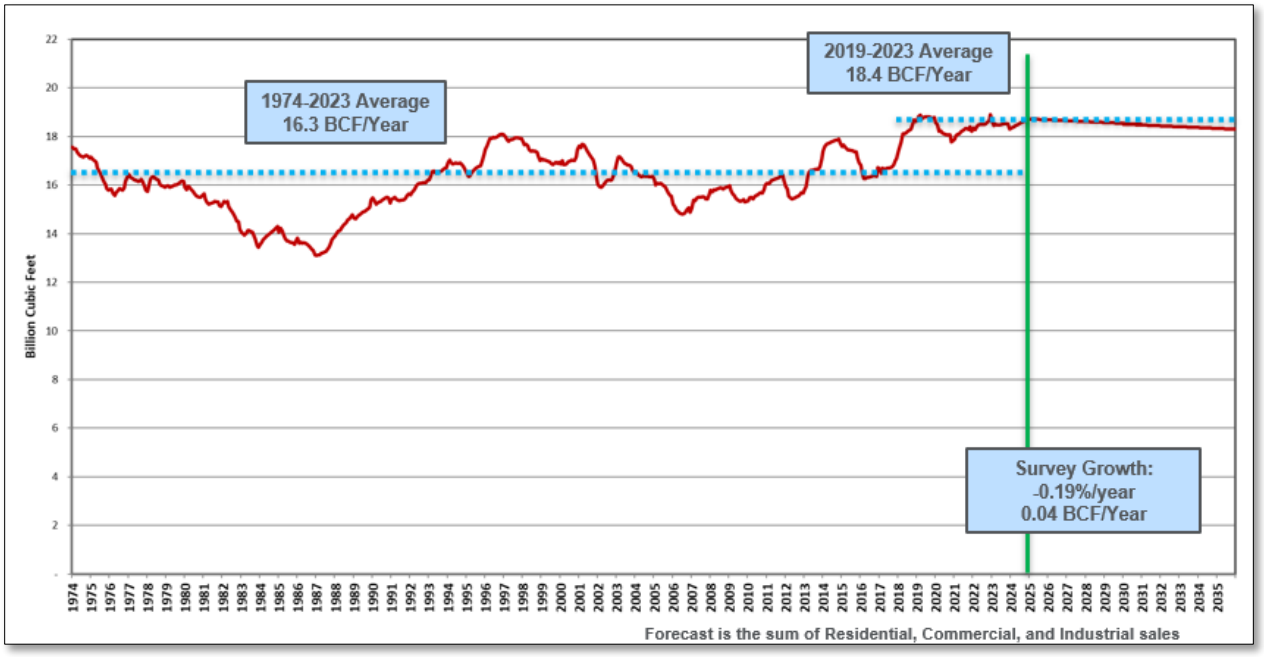
Figure 3 illustrates the turn in expected long-term energy demand and shows historical sales from 1974 through 2023 as 12-month rolling sums of residential, commercial, and industrial class sales. The red line shows historic sales through 2023 with forecast sales through 2035 based on the survey respondents' projections. The blue dash line shows the historical long-term trend through 2008. The orange and green dashed lines compare historical and projected sales trend,

Natural Gas Forecast Growth Overview

Unlike the electric industry, the natural gas industry has experienced recent sales growth, but going forward, survey participants are forecasting "flat" to declining sales. In 2023, system growth was close to "flat" (0.08%) with commercial increases offset by residential and industrial declines. In the long term, survey participants continue to expect flat sales (0.05% decline).

Figure 4 shows a 12-month rolling sum of monthly retail gas sales. The forecast through 2035 is based on reported growth rates. This figure highlights the "flat" forecast despite the recent increases since 2018. Figure 9 through Figure 13 provide additional details on 2023 sales growth rates and the long-term sales forecast growth rates

Figure 4: U.S. Historical Natural Gas Sales

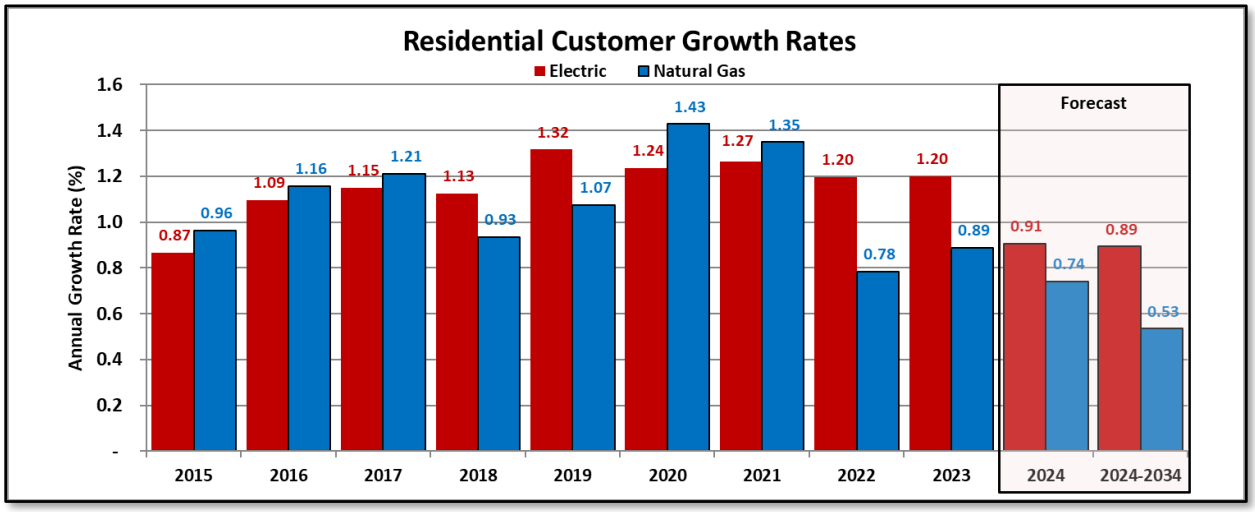


Customers Growth

Historical and forecast customer growth rates for the residential and commercial classes are shown in Figure 5 through Figure 8. Forecast growth rates for 2024 and the long term (2024-2034) are highlighted. For comparative purposes, the pre-COVID average growth rate (2015 to 2019) and prior survey growth rates are displayed with the 2024 survey results.

Residential Customer Growth. Figure 5 shows residential customer growth rates for electric and natural gas respondents. In 2023, electric customers increased 1.20% and natural gas customers increased 0.89%.

Figure 5: Residential Average Customer Growth (%)



Reported 2023 residential electric customer growth (1.20%) is consistent with growth rates over the last 5 years (1.20% to 1.27%). The 2024 forecast and long-term forecast show expected growth at about 0.9%, which is below actual growth for recent years. Over 50% of respondents forecast annual customer growth between 0% and 1.0%.

2023 residential natural gas growth (0.89%) continues to be weak relative to the pre-COVID growth (1.07%). The weakness is expected to continue in 2024 (0.74%) and in the long-term forecast (0.53%).

Figure 6 shows the regional customer growth rates compared with the pre-COVID (2015-2019) average growth and recent history. The figure shows the continued pattern of strong residential customer growth in the South, West, and Canada relative to the Northeast and Midwest regions. The regional 2024 and long-term forecast show customer growth rates that are slightly weaker than recent history.

Figure 6: Residential Average Customer Growth by Region (%)

Region	Actual 2020	Actual 2021	Actual 2022	Actual 2023	Forecast 2024	Forecast 2024-2034	Average 2015-2019
Canada	1.12	1.16	1.32	1.30	0.75	0.90	0.99
Midwest	0.92	0.71	0.66	0.69	0.52	0.50	0.69
Northeast	0.29	0.49	0.40	0.43	0.46	0.47	0.51
South	1.61	1.53	1.43	1.44	1.09	1.03	1.39
West	1.54	1.71	1.44	1.54	1.37	1.33	1.35
Total Electric	1.24	1.27	1.20	1.20	0.91	0.89	1.11
Natural Gas	1.43	1.35	0.78	0.89	0.74	0.53	1.07

Commercial Customer Growth. Figure 7 shows commercial customer growth for electric and natural gas respondents. In 2023, both electric and natural gas customers grew 0.49%. Electric commercial customer growth is lower than the pre-COVID average growth (0.92%) and may reflect the tight economy through 2022 and 2023.

In 2023, the commercial natural gas customer growth continues to be weak (0.49%) consistent with prior years. The commercial natural gas forecast shows continued weakness with growth below the pre-COVID average growth (0.57%).

Figure 7: Commercial Average Customer Growth (%)

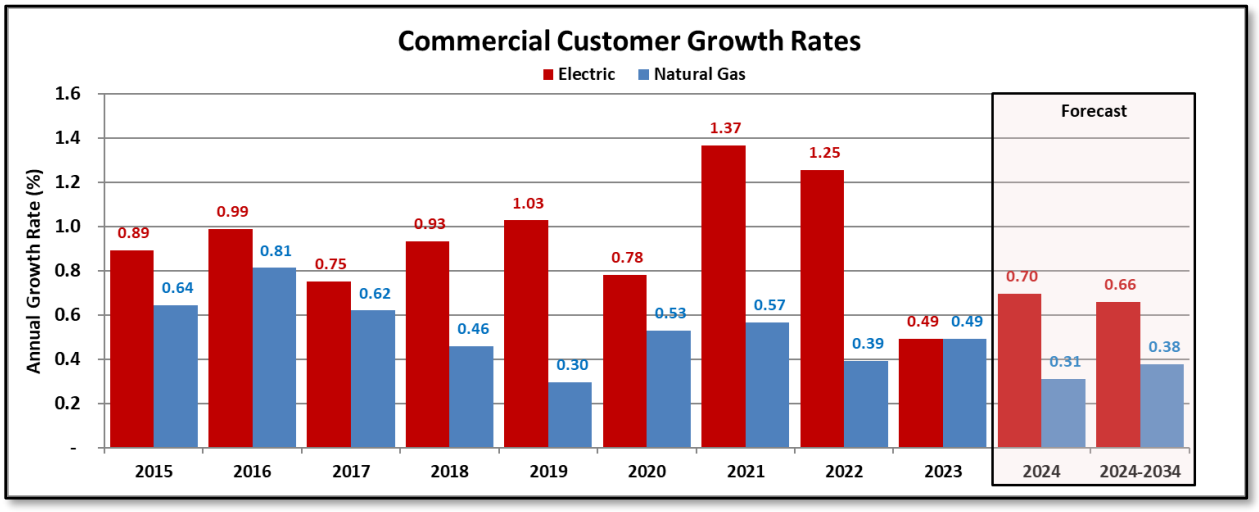


Figure 8 shows the regional commercial customer growth rates compared with the pre-COVID average growth and recent history. The figure shows the continued pattern of weakness in commercial customer growth with surprising drops in 2023 in the Northeast and South regions.

Figure 8: Commercial Average Customer Growth by Region (%)

Region	Actual 2020	Actual 2021	Actual 2022	Actual 2023	Forecast 2024	Forecast 2024-2034	Average 2015-2019
Canada	0.55	0.80	0.72	0.77	0.11	0.40	0.56
Midwest	0.46	0.77	0.53	0.18	0.66	0.43	0.80
Northeast	0.14	0.77	0.90	0.09	0.78	0.44	0.64
South	1.16	1.90	1.84	0.53	0.78	0.78	1.17
West	1.06	1.43	1.11	0.92	0.92	1.00	0.85
Total Electric	0.78	1.37	1.25	0.49	0.70	0.66	0.92
Natural Gas	0.53	0.57	0.39	0.49	0.31	0.38	0.57

Residential Sales Growth

Figure 9 shows historical and current reported weather-normalized residential sales growth rates. The figure also shows the 2024 forecast growth rate, the ten-year forecast growth rate, and the pre-Covid average (2015-2019) growth rate.

Figure 9: Residential Sales Growth

Region	Actual 2020	Actual 2021	Actual 2022	Actual 2023	Forecast 2024	Forecast 2024-2034	Average 2015-2019
Canada	2.90	0.82	0.54	0.15	2.50	1.60	0.66
Midwest	3.71	(0.82)	(0.58)	(0.37)	0.44	0.75	(0.31)
Northeast	4.54	(0.85)	(0.17)	(1.04)	1.90	0.64	(0.04)
South	4.12	(0.09)	0.76	(0.12)	1.41	1.10	0.62
West	4.09	1.61	0.21	1.23	1.64	1.66	0.21
Electric Total	3.80	0.11	0.31	(0.05)	1.36	1.12	0.27
Itron WN	4.78	-0.40	1.17	0.28			0.28
Natural Gas Total	1.15	(0.80)	2.01	(0.58)	1.89	(0.07)	0.19

Electric. In 2023, weather-normalized residential sales declined by 0.05%. While low residential sales growth is consistent with the low pre-COVID annual average growth rate (0.27%), the sales decline is mildly surprising with 46% of respondents reporting declining sales and 16% of respondents reporting declines of more than 2.0%. The decline could reflect a partial transition of "work at home" moving "back to the office". Despite the recent decline, respondents expect residential sales to substantially increase in 2024 (1.36%) and in the long-term (1.12%). The high forecast growth implies increasing electric intensity (i.e., kWh/Customer) with 51% of respondents forecasting positive electric intensity growth over the long-term.

For the second year in a row (i.e., 2023 and 2024 surveys), the long-term sales forecast is above 1.1%, reversing the trend of low growth expectations (i.e., the 2021 and 2022 surveys forecast 0.64% and 0.78%, respectively). The stronger growth is attributed to expectations about decarbonization policy, electric vehicles, and end-use electrification.

Natural Gas. In 2023, weather-normalized residential natural gas sales declined 0.58%, with 53% of respondents reporting sales declines. Sales are expected to rebound in 2024 (1.89%) with long-term expectations near "flat" (-0.07%).

Commercial Sales Growth

Figure 10 shows historical and current reported weather-normalized commercial sales growth rates. The figure also shows the 2024 forecast growth rate, the ten-year forecast growth rate, and the pre-COVID average (2015-2019) growth rate.

Figure 10: Commercial Sales Growth

Region	Actual 2020	Actual 2021	Actual 2022	Actual 2023	Forecast 2024	Forecast 2024-2034	Average 2015-2019
Canada	(4.00)	0.68	3.32	1.98	(0.21)	1.12	0.97
Midwest	(4.91)	3.55	1.84	0.53	0.38	0.49	(0.30)
Northeast	(7.35)	1.41	4.04	(0.20)	0.60	(0.57)	(0.48)
South	(5.09)	2.82	2.76	0.86	1.28	1.81	0.59
West	(4.70)	4.09	2.90	2.05	3.04	2.76	0.24
Electric Total	(4.95)	2.51	2.71	0.99	0.99	1.38	0.35
Itron WN	(4.92)	3.20	4.45	(0.15)			0.05
Natural Gas Total	(2.97)	2.52	3.42	0.85	(0.10)	(0.13)	1.04

Electric. Weather-normalized commercial sales increased 0.99% in 2023 following relatively strong growth in 2021 and 2022 reflecting commercial sector recovery from COVID. Commercial growth expectations remain much higher than pre-COVID growth with strong sales growth forecasts in the West, South, and Canada. The strong growth is attributed in part to high-tech growth and data centers.

Natural Gas. Weather-normalized commercial natural gas sales increased 0.85% in 2023. Despite the 2023 growth, expectations show nearly "flat" sales in both the near-term and long-term forecasts.

Industrial Sales Growth

Figure 11 shows historical and current reported weather-normalized industrial sales growth rates. The figure also shows the 2024 forecast growth rate, the ten-year forecast growth rate, and the pre-Covid average (2015-2019) growth rate.

Figure 11: Industrial Sales Growth

Region	Actual 2020	Actual 2021	Actual 2022	Actual 2023	Forecast 2024	Forecast 2024-2034	Average 2015-2019
Canada	(0.93)	2.53	1.16	(0.51)	2.39	2.29	(1.18)
Midwest	(5.12)	4.30	1.65	(0.55)	0.87	1.70	(0.28)
Northeast	(5.96)	1.89	0.76	(1.64)	2.11	(0.44)	(1.53)
South	1.13	3.99	4.47	1.73	(0.57)	2.33	1.38
West	1.04	0.99	(2.62)	0.11	5.04	6.27	(0.63)
Electric Total	(1.09)	3.42	2.28	0.56	0.88	2.42	0.15
Natural Gas Total	(6.94)	(1.07)	2.37	0.83	3.21	(0.26)	1.94

Electric. In 2023, weather-normalized electric industrial sales increased 0.56% reflecting movement toward the pre-COVID growth rate. Growth is buoyed by strong growth in the South which offsets weakness in Cananda, Midwest, and Northeast. Long-term growth is significantly greater than the pre-COVID average driven by strong growth in the West, Canada, and South. The strong growth is attributed to impacts of resurging manufacturing, data centers, and technology growth.

Natural Gas. Natural gas average weather normal sales increased 0.83% in 2023 with strong growth expected in 2024. Despite the strong near-term growth, natural gas companies expect sales to be slightly declining in the long term.

System Sales Growth

Total system growth includes all utility classes and may include wholesale, resale and agricultural classes. Figure 12 shows system growth with the 2024 forecast growth rate, the ten-year forecast growth rate, and the pre-COVID 5-year average growth rate.

Figure 12: System Energy

Region	Actual 2020	Actual 2021	Actual 2022	Actual 2023	Forecast 2024	Forecast 2024-2034	Average 2015-2019
Canada	(0.31)	1.64	1.80	0.66	1.55	1.95	(0.21)
Midwest	(2.56)	2.02	0.84	(0.04)	0.64	0.92	(0.24)
Northeast	(3.55)	0.57	1.59	(1.47)	1.69	0.17	(0.53)
South	(0.26)	2.26	2.62	0.86	1.69	1.52	0.99
West	(0.31)	2.39	1.12	1.11	3.70	3.24	(0.08)
Electric Total	(1.14)	2.02	1.85	0.54	1.61	1.57	0.27
Itron WN	(1.10)	2.01	2.52	0.17			0.13
Natural Gas Total	(1.79)	0.59	1.89	0.08	1.28	(0.05)	1.36

Electric. In 2023, weather-normalized system energy increased 0.54%, higher than the pre-COVID growth rate (0.27%). Growth is driven by relatively strong growth in the West and South.

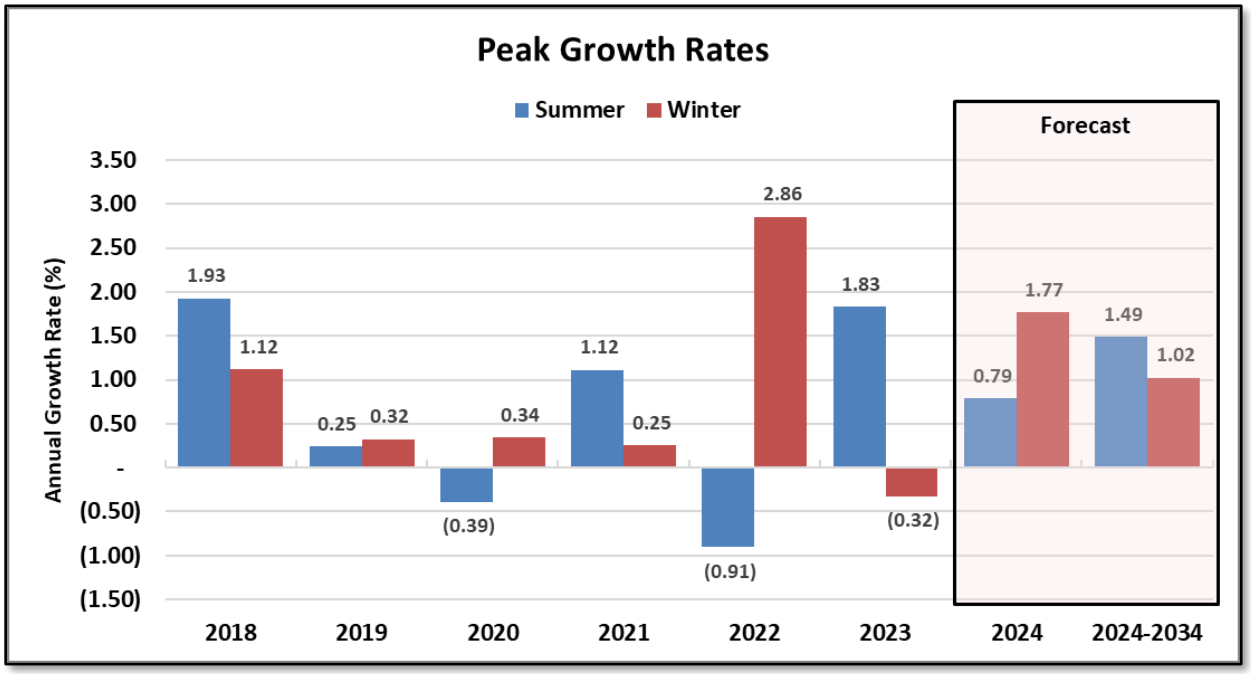
The long-term forecast has the highest reported growth (1.57%) since Itron began this survey in 2012. This growth rate exceeds the historical annual growth during the high-growth years from 2000 to 2008 (1.49%) calculated from the sum of the reported EIA residential, commercial, and industrial sales. The strong forecast growth reflects the combined effects of growth drivers from the residential, commercial and industrial classes showing the implication of electrification, electric vehicles, data centers, manufacturing, and post-COVID consumption changes.

Natural Gas. Weather normalized natural gas system sales increased 0.08% in 2023. The "flat" growth forecast for the long-term is well below the pre-COVID 5-year average growth rate. (1.36%).

System Peak Growth

System weather-normalized peak forecast growth is shown in Figure 13. This figure shows historical and forecast peaks for summer and winter peaking companies. Pre-COVID 5-year average growth rates are not available for historical peak because Itron did not begin asking for summer and winter peak information until 2018.

Figure 13: Electric Peak Growth



Summer peaks increased 1.83% in 2023; 61% of the respondents reported an increase with 12% reporting increases of more than 5%. The 2023 growth is significantly higher than the 2018-2022 average (0.40%).

Winter peaks decreased 0.32% in 2023. The minor decrease is the first decline since 2018. 47% of respondents reported growth between 1.0% and -1.0% resulting in average winter peak growth that is close to "flat".

COVID-19 Impacts

The COVID-19 emergency began in January 2020 and ended in March 2023. Through this period, COVID-19 policies ushered in quarantines, product shortages, and business closures. U.S. GDP fell by 8.9% in the second quarter of 2020 and electric sales declined by 2.4% in 2020.

Since March 2020, Itron tracked the COVID-19 impact through a series of web seminars, industry presentations, and impact memorandums. In this survey, Itron asked companies about how COVID-19 impacted their forecasting methods.

COVID-19 Modeling and Forecasting. The largest COVID-19 impacts occurred in 2020 with impacts waning through 2021 and 2022. The evolving impacts challenged forecasters with the "best" solution to account for both historical and forecast changes. Like the prior years, this year's survey asks two forecasting questions. First, the survey asked companies how they model COVID-19. Second, the survey asked whether companies needed to make further forecast adjustments after modeling.

Figure 14 shows how companies modeled COVID-19. The approaches included in this question are defined below.

- **Binaries**. Binaries are variables that can either (1) remove the impact of a historical data point from the model estimation period or (2) capture an average level shift in the historical estimation period. In both cases, binaries represent the impact of COVID-19 on historical sales.
- **Google Mobility Data**. Google Mobility Data reported movement trends by geography across different categories such as retail, workplaces, and residential. These data are transformed into regression variables that represent COVID-19 impacts on sales. Google ceased to update these data in October 2022.
- **Residual**. Residual variables are created by forecasting sales assuming that COVID-19 did not occur and comparing it with actual data. The residual variable is inserted into a regression model to model the COVID-19 impact.
- **Remove Data**. Removing data assumes the COVID-19 data are outliers. The outliers are removed from the model estimation period and the model forecasts assuming COVID-19 did not occur.
- **Other**. Several companies reported using multiple methods or blending methods to model the COVID-19 effects.

Figure 14: COVID-19 Modeling Approaches

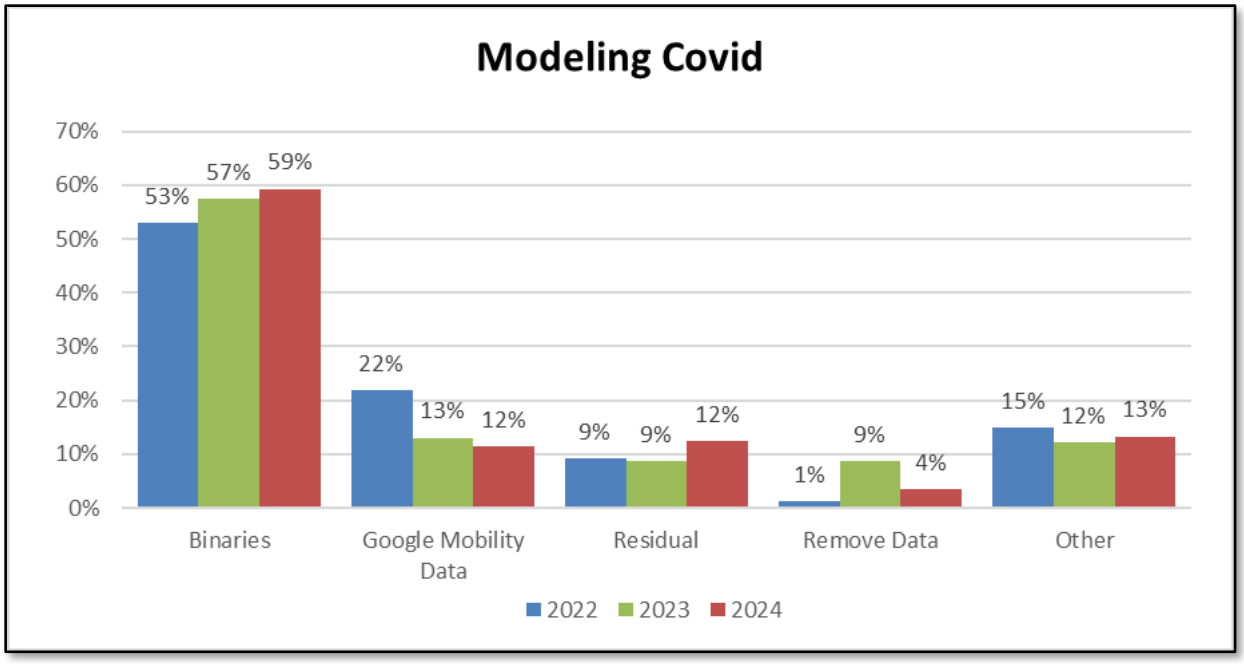
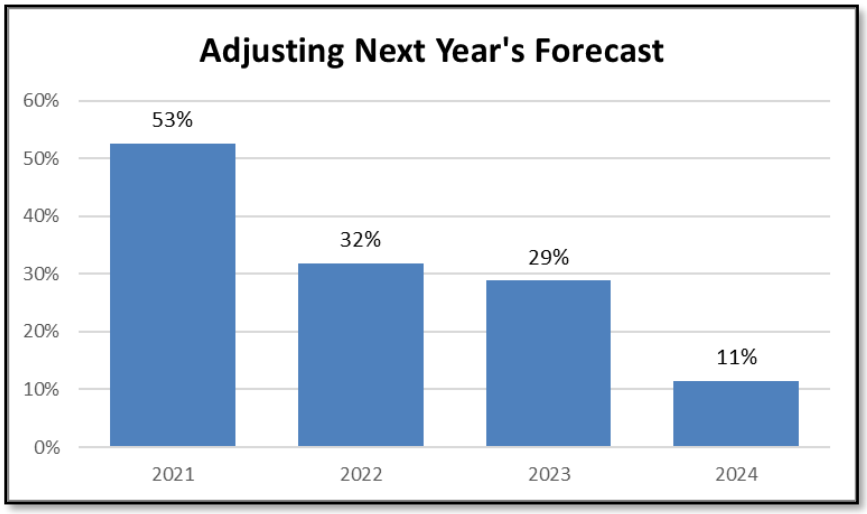


Figure 14 shows results from the 2022, 2023, and 2024 surveys. Since 2022, the selected methods have largely remained unchanged with a strong preference toward using Binaries. The popularity of using Binaries is not surprising because this technique is often used to capture short-term effects and remove data outliers. With COVID-19 largely behind us, Binaries effectively remove the COVID-19 effects from the historical dataset.

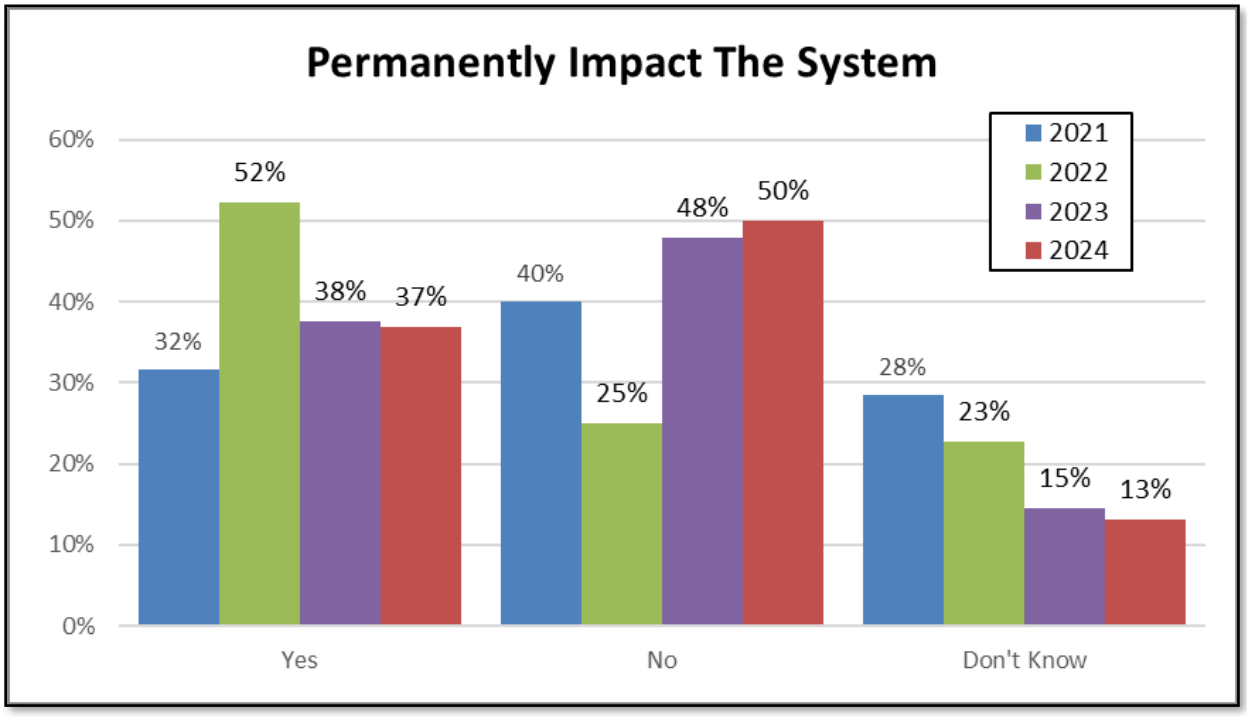
Through the pandemic, forecasters adjusted results when their statistical models did not generate reliable results. In 2021, the high degree of uncertainty around COVID-19 effects resulted in 53% of respondent making manual changes to their forecast. Since 2021, respondents have significantly reduced their manual adjustment as the COVID-19 effects have waned. Figure 15 shows the percentage of respondents making manual forecast adjustments.

Figure 15: Manually Adjusting Next Year's Forecast



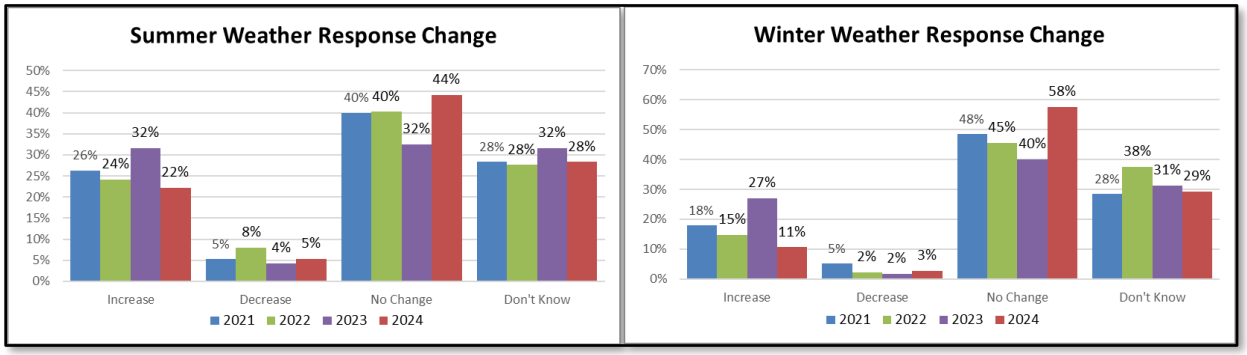
COVID-19 Permanence. Regardless of the approach used to model COVID-19 impacts, companies still must decide how long the historical impacts will last. Since 2021, the survey asked whether the COVID-19 impacts have permanently changed system demand. Figure 16 shows that half the respondents (50%) did not see a permanent change in system demand.

Figure 16: Did COVID-19 Permanently Change System Demand?



While demand levels have been relatively consistent, the sales composition has changed with higher residential sales and lower commercial sales. Figure 16 The change potentially impacts the system weather response. With higher residential sales share, the system energy and demand is expected to be more weather-sensitive. Figure 17 shows that some companies are seeing a change with 27% of respondents seeing a change in their summer weather response and 14% a change in their winter response.

Figure 17: Summer and Winter Weather Response Change



The 2024 survey shows that the COVID responses have not changed since 2023 and that manual forecast adjustments are waning. These results are expected since the public health emergency ended in March 2023 with most restrictions ending in early 2022. Economic drivers including GDP, employment, and household income largely capture the changing impact. Looking forward to the 2025 survey, respondents will be almost 3 years past COVID-19 restrictions and have sufficient historical data to

recognize and accurately model any permanent shift in customer usage. The questions on COVID impact will likely be dropped in future surveys.

Electric Forecast Accuracy

Respondents are asked to report four types of forecast errors for residential, commercial, and industrial sales, and system energy and peak demand. First, companies are asked to compare their 2023 forecast (generated in 2022) against weather-normalized 2023 sales. Second, companies are asked to compare the same forecast against actual 2023 sales. These calculations are on an annual basis. For the third calculation, companies are asked to compare the same forecast and report the weather normalized errors on a monthly average basis. Finally, Itron asked for a fourth calculation. This new calculation measures day ahead peak forecast errors from the company's system operations departments.

Annual Forecast Accuracy. The average forecast errors, calculated as the Mean Absolute Percent Error (MAPE), are shown in Figure 18 and Figure 19. The figures show the 2024 survey result compared against the 2022, 2023 and pre-COVID 5-year survey average results. Figure 18 shows the annual forecast errors compared against weather normalized actual values. Figure 19 shows the annual forecast error compared against actual values. All MAPE values are unweighted.

Figure 18: Annual Electric MAPE - Forecast vs. Weather Normal Actuals

Class	2024 Survey	2023 Survey	2022 Survey	2016-2020 Mean
Residential	1.90	1.88	2.37	1.59
Commerical	2.64	2.74	3.09	1.66
Industrial	4.46	3.79	3.14	2.90
System	1.78	1.78	1.69	1.43
Peak	3.28	3.06	3.14	2.61

Figure 19: Annual Electric MAPE - Forecast vs. Actuals

Class	2024 Survey	2023 Survey	2022 Survey	2016-2020 Mean
Residential	4.05	3.45	2.64	2.62
Commerical	4.07	3.00	3.27	1.67
Industrial	4.90	3.73	3.48	2.97
System	2.78	2.34	1.94	1.61
Peak	4.58	3.97	4.67	3.47

Figure 18 reports that weather normalized errors in the 2024 survey are higher than the pre-COVID average error and consistent with errors in the 2023 survey. The consistency indicates that forecast models may be settling into a new error pattern that is slightly higher than pre-COVID averages. The higher errors may be caused by lingering COVID-19 effects or higher growth forecasts driven by electrification (i.e., electric vehicles, data centers) expectations.

Figure 19 reports actual errors which include the impact of weather deviations from the normal weather values used to generate the forecast. When compared to Figure 18, the difference in average errors indicates the impact of these weather deviations from normal. Generally, average absolute errors increase when weather error is included. The size of the increase will vary from year to year and will be most noticeable in years with extreme deviations from normal.

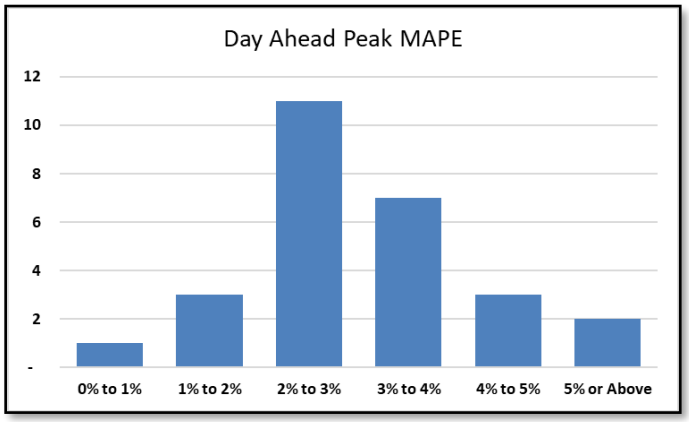
Monthly Forecast Accuracy. Figure 20 shows the monthly average errors by class compared with prior survey results. The residential error (3.71%) is close to the average (3.89%) with 57% of respondents reporting errors of less than 4.0%. The commercial error (4.10%) is higher than the average (3.50%) with 55% of respondents reporting errors of less than 4.0%. The industrial error (5.98%) is very high relative to the average (4.38%) and highlights the difficulty of forecasting growth in the manufacturing sector.

Figure 20: Monthly Average Electric Error Results (Unweighted)

Class	2018 Survey	2019 Survey	2020 Survey	2021 Survey	2022 Survey	2023 Survey	2024 Survey	2018-2023 Avg
Residential	3.76	4.26	3.02	6.08	4.48	3.93	3.71	3.89
Commerical	3.03	3.45	2.57	7.34	4.62	3.82	4.10	3.50
Industrial	3.87	3.86	4.70	8.88	4.33	5.15	5.98	4.38

Daily Forecast Accuracy. In this year's survey, electric companies are asked to report their day ahead average peak errors. Because these statistics are maintained by company operations departments, only 27 companies reported results. The average MAPE is 3.11% with 56% of respondents reporting errors under 3%. Figure 21 shows the distribution of responses.

Figure 21: Day Ahead Peak Forecast Error Results (Unweighted)



Natural Gas Forecast Accuracy

Similar to the electric forecasting errors, natural gas companies are asked to compare their forecast for 2023 (generated in 2022) against actual and weather normalized sales in 2023. Figure 22 and Figure 23 show the unweighted annual MAPEs. The figures show the 2024 survey result compared against the

2022, 2023 and pre-COVID 5-year survey average results. Figure 24 shows the unweighted monthly MAPEs.

Annual Forecast Accuracy. Figure 22 and Figure 23 show the class forecasting errors. The difference in these figures captures the forecast error associated with weather deviations from normal. 2023 was very mild in the East and Midwest and slightly colder than normal in the West.

In Figure 22, the 2024 weather adjusted errors for the residential and commercial sectors are like the results from prior year surveys. The industrial sector errors are higher than in prior years. The system level errors are slightly higher than in prior surveys reflecting the offsetting effects of stability in the residential and commercial sectors and uncertainty in the industrial sector.

Figure 22: Annual Natural Gas MAPE - Forecast vs. Weather Normal Actuals

Class	2024 Survey	2023 Survey	2022 Survey	2016-2020 Mean
Residential	2.45	2.40	2.40	2.66
Commerical	3.96	4.05	3.39	4.16
Industrial	9.28	5.86	6.12	8.20
System	2.56	1.90	1.58	4.23

Figure 23: Annual Natural Gas MAPE - Forecast vs. Actuals

Class	2024 Survey	2023 Survey	2022 Survey	2016-2020 Mean
Residential	9.67	4.85	6.04	8.68
Commerical	7.32	6.15	4.01	6.01
Industrial	7.73	6.31	6.55	8.19
System	6.01	3.87	4.44	7.26

Monthly Forecast Accuracy. Like the annual accuracy, monthly accuracy is consistent with prior year results. Monthly forecast accuracy is considerably worse than annual accuracy because variations in positive and negative monthly errors offset each other when calculating annual accuracy, but they do not offset each other when computing monthly accuracy. The monthly MAPEs are shown in Figure 24.

Figure 24: Monthly Average Gas Error Results (Unweighted)

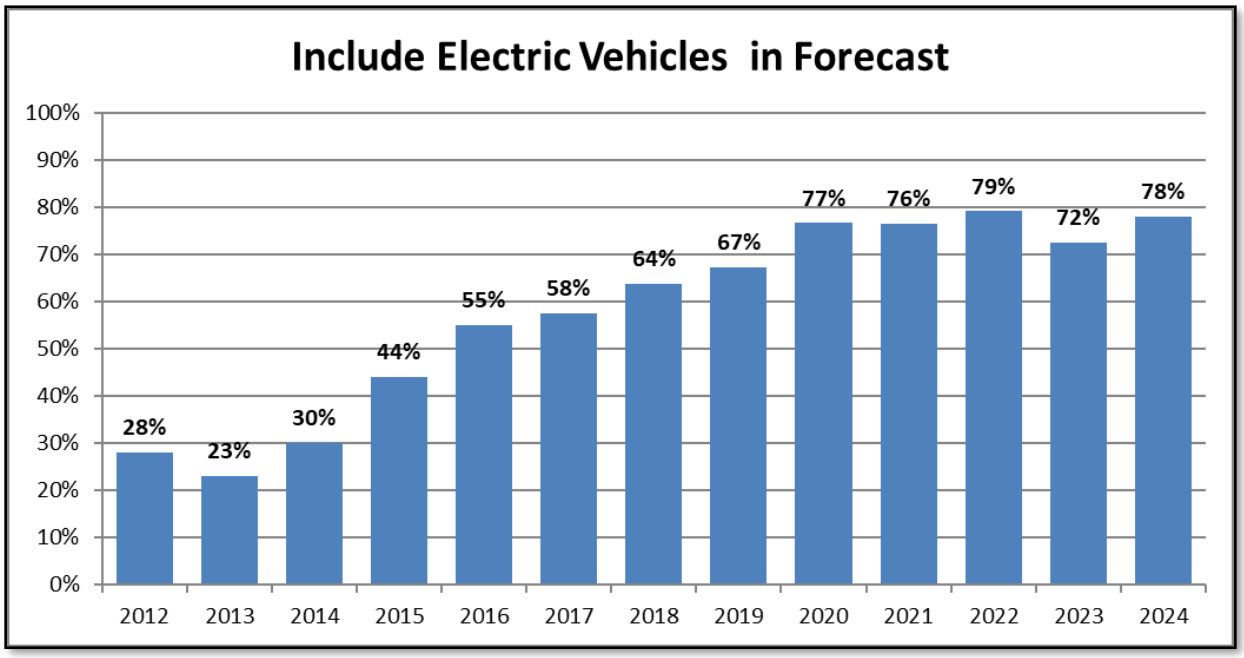
Class	2018 Survey	2019 Survey	2020 Survey	2021 Survey	2022 Survey	2023 Survey	2024 Survey
Residential	7.28	6.82	9.87	11.96	10.20	8.52	6.72
Commerical	6.68	8.84	10.98	12.12	8.08	11.30	7.59
Industrial	10.17	10.33	13.58	8.38	11.58	14.62	12.27

Key Forecast Characteristics

As part of the annual survey, Itron also tracks changes in forecasting practices. This year's survey includes forecasting practices for new technologies, normal weather calculations, and model estimation characteristics.

Electric Vehicles. The electric vehicle (EV) industry continues to evolve with increased adoption and new vehicle models. In 2023, approximately 3.3 million[2] electric cars were registered up from 2.0 million in 2022 and 1.3 million in 2021. Figure 25 shows that almost 80% of companies have explicitly included EVs in their forecast since 2020.

Figure 25: Include Electric Vehicles in the Forecast



Explicitly incorporating a new technology into the forecast requires developing a projection of how the technology will be adopted in the long term. In addition to asking whether EVs are included in their forecasts, participants are asked how they forecast EV market penetration. The following five responses are offered.

- **Purchase Forecast**. The company outsources the EV forecast and relies on external experts to forecast EV adoption. The company then integrates the external forecast into the long-term sales forecast.
- **Company Forecast**. The company forecast relies on internal corporate experts to develop the long-term forecast of EV adoption. The company forecast is then integrated into the long-term sales forecast.

[2] edmunds.com

- **Calibrate a Public Forecast**. In this method, the forecaster uses a publicly available EV forecast and adjusts it to the characteristics (i.e., number of EVs) in the service territory.
- **Develop a Model**. In this method, the forecaster develops a model for EV adoption and electric sales. The model may be a statistical model or some other model. This response differs from the Company Forecast response because the forecaster, not internal company experts, develops the model.
- **Other**. This response may include blended methods of any (or all of the previous) responses.

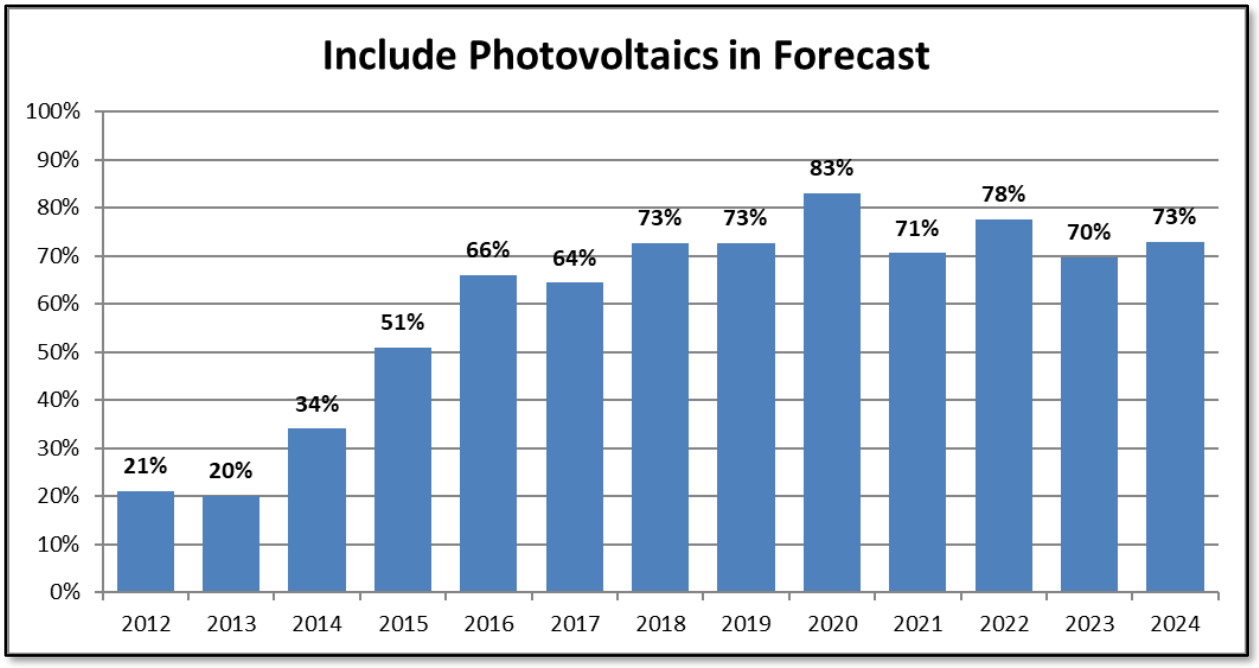
Figure 26 shows the prevalence of forecasting methods compared to the 2023 survey results. In this figure, 68% of respondents rely upon experts (i.e., Purchase Forecast or Company Forecast) to develop the EV forecast.

Figure 26: Electric Vehicle Forecast Method

Response	2023	2024
Purchase Forecast	17%	27%
Company Forecast	45%	41%
Calibrate Public Forecast	19%	14%
Develop a Model	15%	10%
Other	4%	8%

Photovoltaics. Despite the numerous policy challenges in the industry, the photovoltaic (PV) industry continues its strong growth. Figure 27 shows the share of companies that include PVs in their forecast. This year, 73% of respondents include PV forecasts in their forecasts. Since 2018, over 70% of companies include PVs in their forecast.

Figure 27: Include Photovoltaics in the Forecast



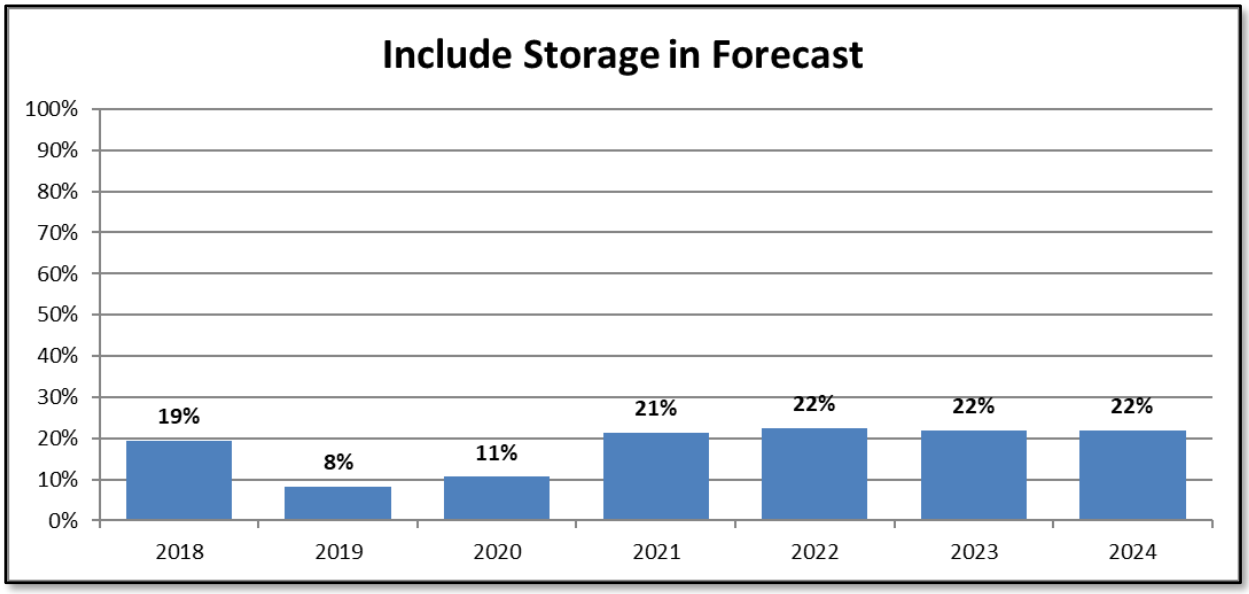
Like EVs, respondents are also asked how they forecast PV adoption. Figure 28 shows that 57% of forecasters generate the PV forecast themselves (i.e., Calibrate Public Forecast and/or Develop a Model). This result is consistent with 2023 survey results. The high percentage of self-forecast development implies the availability of reasonable data for model development or forecast calibration.

Figure 28: Photovoltaic Forecast Method

Response	2023	2024
Purchase Forecast	7%	8%
Company Forecast	30%	27%
Calibrate Public Forecast	35%	34%
Develop a Model	23%	23%
Other	6%	8%

Battery Storage. The storage market continues to be nascent which makes forecasting technology penetration and usage impacts difficult. Figure 29 shows that only 22% of companies include storage in their forecasts. The percentage has not significantly changed since the survey began asking this question in 2018.

Figure 29: Include Battery Storage in the Forecast



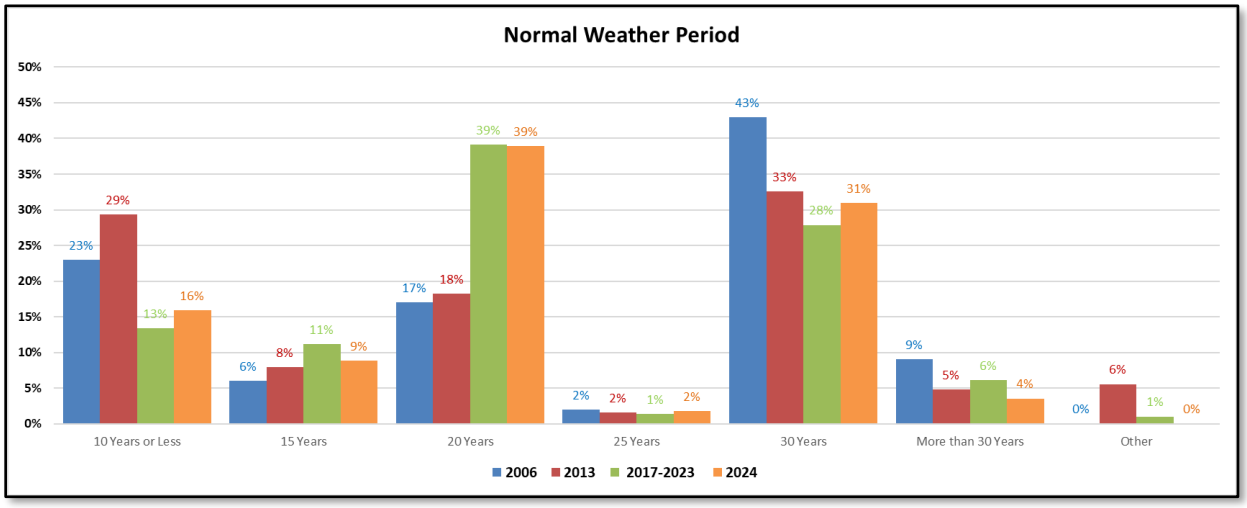
Respondents are also asked how they forecast battery storage. To the extent that companies include a storage forecast, Figure 30 shows that 50% of forecasters use a public forecast and calibrate to internal data.

Figure 30: Storage Forecast Method

Response	2023	2024
Purchase Forecast	6%	9%
Company Forecast	22%	14%
Calibrate Public Forecast	61%	50%
Develop a Model	0%	23%
Other	11%	5%

Normal Weather. The 2024 survey asked respondents how many years of historical weather data they use to calculate normal weather. Itron has periodically asked this question in various studies since 2006. Figure 31 compares this year's result with prior survey results. Survey results from 2017 through 2023 are averaged because there are no substantial differences between those survey results.

Figure 31: Normal Weather Calculation Period

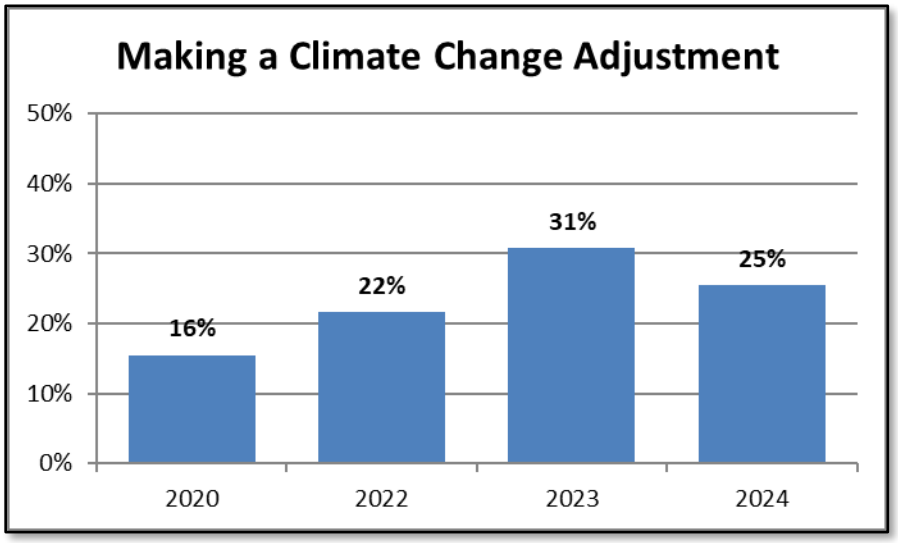


Historically, companies have favored 30-year averages to represent normal weather. In 2006, 43% of companies used the 30-year average. In 2013, the survey shows movement away from the 30-year average toward the 10-year average. Beginning in 2017, the 20-year average becomes the dominant normal weather period. In the 2017 through 2023 surveys, 39% of the companies reported using the 20-year average. The 2024 survey shows results very similar to the 2017 through 2023 surveys with 20-year averages being the dominant number of years.

Beginning in 2020, Itron began asking questions about how companies are managing climate change. First, companies are asked whether they are making changes to their normal weather calculations to account for climate change. Second, companies who are making changes are asked how they are making their changes. These results are shown in Figure 32 and Figure 33.

Figure 32 shows that 25% of companies are adjusting their normal weather for climate change. Since 2022, the percentage of companies adjusting for climate change has remained steady. The results imply that while some companies are facing pressure to represent climate change in their forecasts, the pressure does not appear to be increasing.

Figure 32: Normal Weather Climate Change Adjustment

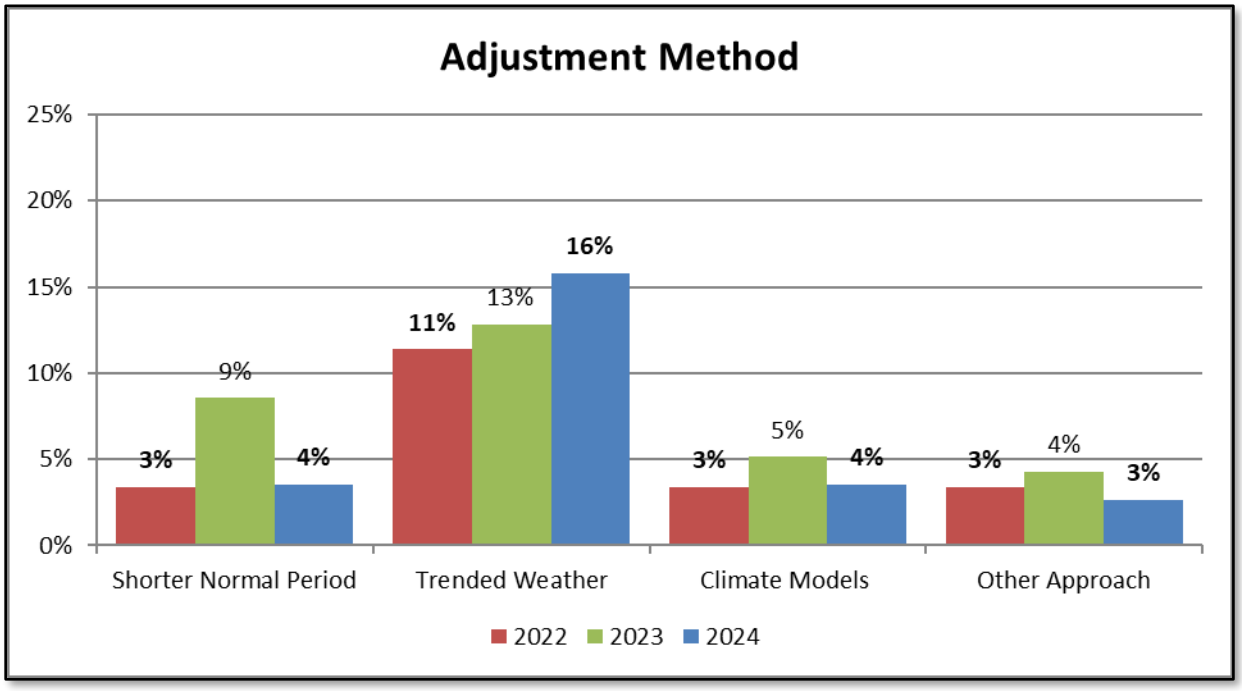


Since 2022, companies who are making climate adjustments are asked how they made their adjustments. The survey provided four options as defined below.

- **Using Shorter Normal Period**. The simplest method for adjusting normal weather is to calculate normal weather using fewer historical years. By shortening the historical period, more recent weather data dominates the normal weather calculation.
- **Using Trended Weather**. The trend approach applies a growth trend to the existing normal weather calculation. The trend is developed by estimating how historical temperatures are changing over time and then applying that change in the forecast period.
- **Using Climate Models**. Sophisticated climate models simulate surface, atmospheric, and ocean conditions to predict how the earth's climate is changing. These models generate a long-term forecast of future temperatures. Climate model results may be transformed into variables that are used in the forecast models.
- **Other**. This option allows companies to describe an alternative approach.

Figure 33 shows the respondents results.

Figure 33: Normal Weather Climate Change Adjustment Method



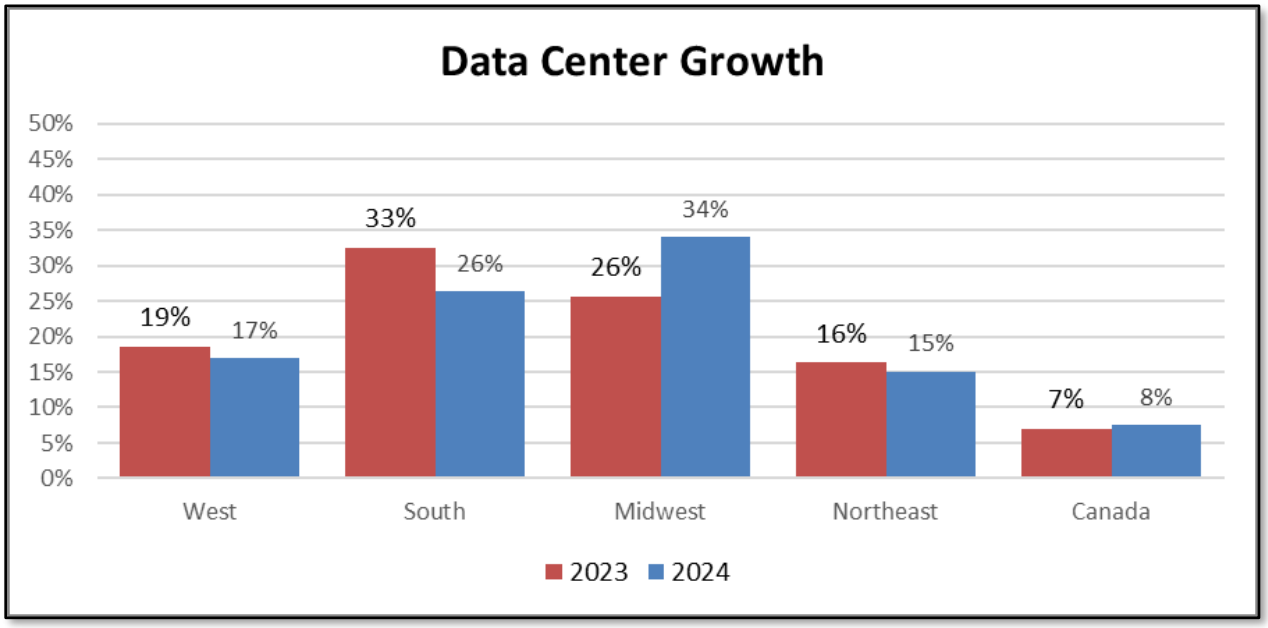
Of the methods used to adjust for climate change, the trended weather approach is the most common. The distribution of responses has not significantly changed since 2022.

Data Centers. Data Centers are centralized computing facilities that manage IT operations for the purposes of storing, processing, and disseminating data. These facilities are effectively warehouses of computers and consume a large amount of electricity. In 2024, CBRE estimated 24.4% year-over-year (Q1 2024) growth in primary data centers markets (i.e., northern Virgina, Dallas, Silicon Valley, Chicago, Phoenix, New York Tri-State, and Atlanta). In northern Virginia alone, over 390 MW of data centers were added.

While other regions do not show the same dramatic year-over-year growth as northern Virginia, data centers additions can still have a large effect on utility energy and demand growth. This year, the survey asked utilities whether they are seeing data center growth in their service territory. While the question does not attempt to ascertain the size or timing of these additions, the question seeks to understand the prevalence of data center growth.

In 2024, 55% of respondents indicated that they are experiencing data center growth. This response is an increase from the 2023 result (46%) and indicates that data center growth is more geographically dispersed than the primary markets. Figure 34 shows the geographic dispersion.

Figure 34: Data Center Growth Locations



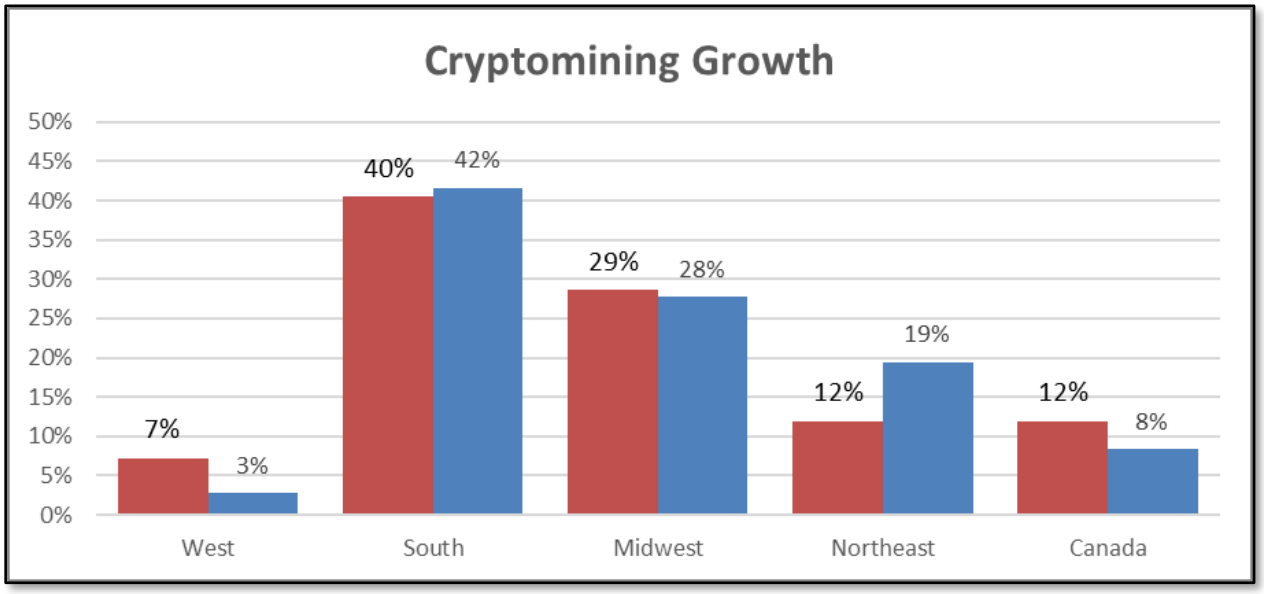
With the potentially large number of data centers, ascertaining sector growth is challenging. Data centers may be large and distort native growth patterns. In this year's survey, companies were asked to identify the class to which the data centers belong. 52% of respondents assign data centers to the commercial class and 39% assign data centers to the industrial class. Respondents indicated that class assignment generally falls along class definition rules which vary by utility.

Crypto-Mining. Cryptocurrency mining is a process of creating new digital coins. Generally, the process involves using computing power to solve complex puzzles, validate cryptocurrency transactions on a blockchain network, and adding transactions to a distributed ledger. Like data centers, cryptocurrency mining is generally housed in a large warehouse with computers, computationally intensive, and requires a large amount of electricity.

This year, the survey asked utilities whether they are seeing cryptocurrency mining growth in their service territory. While the question does not attempt to ascertain the size or timing of these additions, the question seeks to understand the prevalence of cryptocurrency mining growth.

In 2024, 34% of respondents indicated that they are experiencing cryptocurrency mining growth. This result is consistent with the 2023 survey (39%). Figure 35 shows the geographic dispersion. Cryptocurrency mining is most prevalent in the South and Midwest driven by low electricity prices.

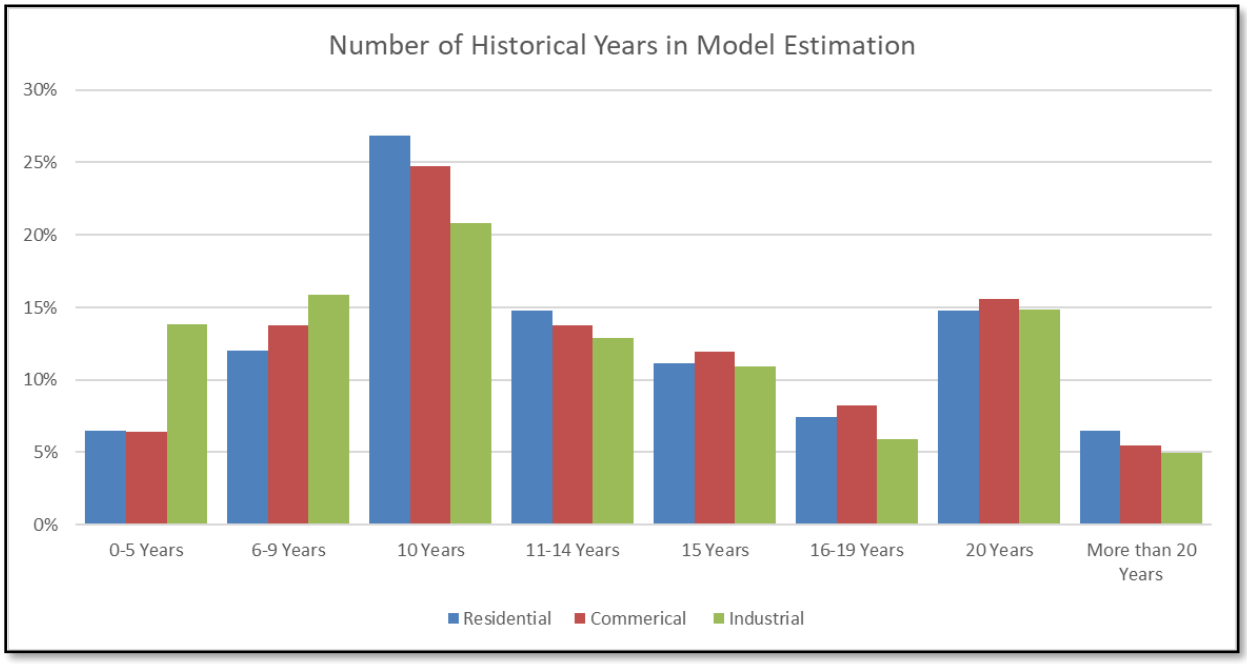
Figure 35: Cryptocurrency Mining Growth Locations



Like data centers, cryptocurrency mining can distort native growth patterns. In this year's survey, companies were asked which class cryptocurrency mining belongs to. 27% of respondents assign cryptocurrency mining to the commercial class and 38% assign cryptocurrency mining to the industrial class. Like data centers, most class assignments fall along class definition and size rules which vary by utility.

Forecast Model Estimation Period. The model estimation period is the number of historical years of data used to develop the forecast models. This year's survey asked companies to report their estimation years for their residential, commercial, and industrial models. Figure 36 shows number of historical years for each class and year range.

Figure 36: Model Estimation Period Years.



The survey shows that most respondents use between 10 and 15 years of historical data to estimate their residential, commercial, and industrial models. The percentage of companies using the 10-to-15-year range is shown below.

- Residential: 53%
- Commercial: 50%
- Industrial: 45%

The 10-to-15-year range implies that model estimation begins between 2008 and 2013 capturing the post-great recession consumption patterns and avoiding the modeling challenge of changing consumption patterns through the great-recession period.

Long-Term Forecast Model Method. In 2015, Itron began asking companies about their long-term modeling techniques. This year, the question was again asked to ascertain whether modeling techniques have changed.

In this question, companies are asked whether they use a general econometric approach, Itron's Statistically Adjusted End-Use (SAE) approach, or another method for their long-term residential and commercial classes. The results are shown in Figure 37 and Figure 38.

Figure 37: Long-Term Residential Model Method.

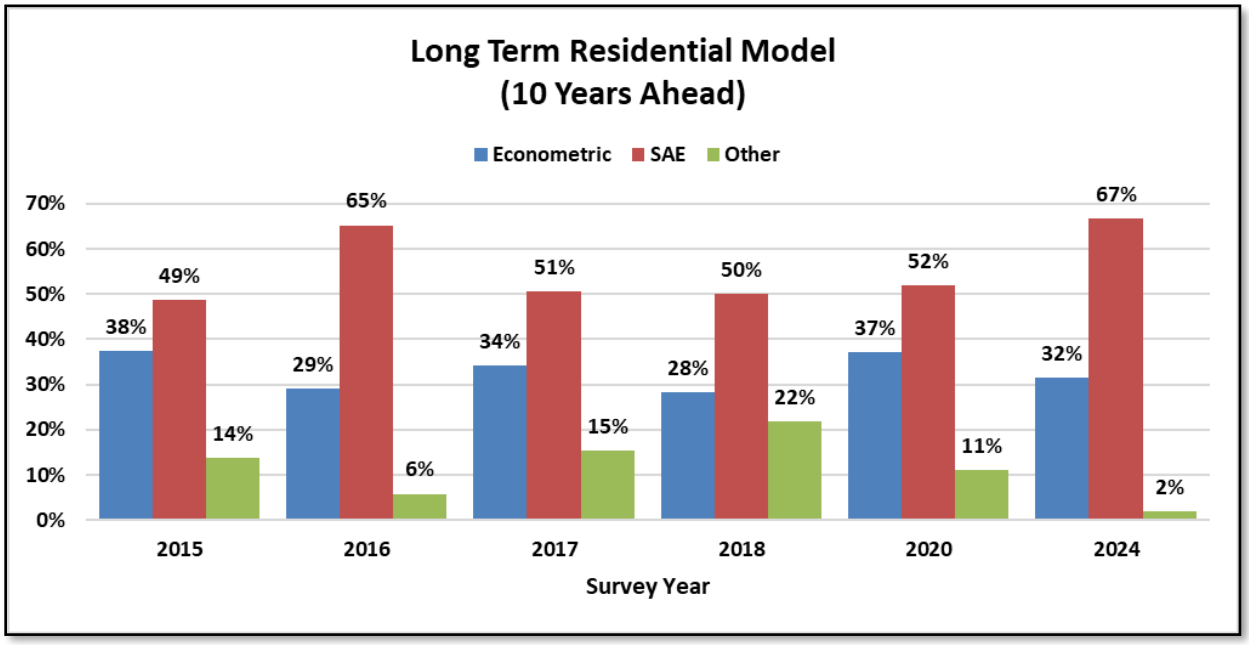
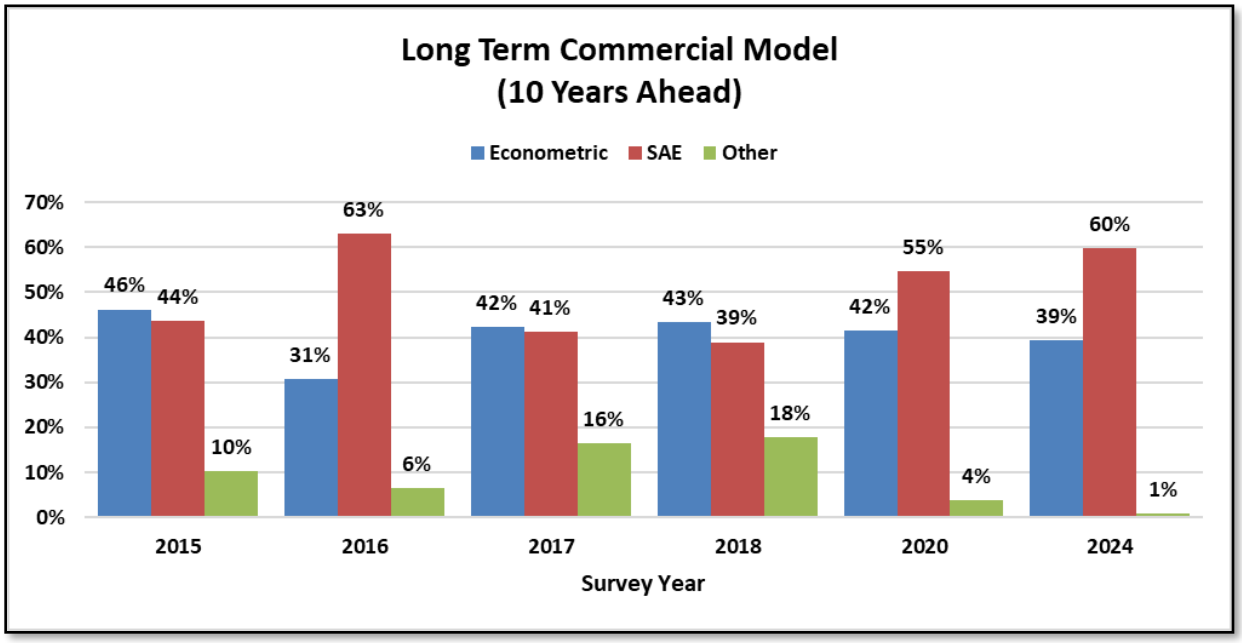


Figure 38: Long-Term Commercial Model Method.



In 2024, 67% of residential respondents used the SAE approach, an increase from 52% reported in 2020. The commercial class shows 60% using the SAE approach relative to 55% reported in 2020.

Unlike the general econometric approach, the SAE approach captures energy efficiency changes by including end-use saturation and efficiency data in the model. These variables allow companies to capture the impact of changing codes and standards as well as energy efficiency programs in their

forecast. The migration toward the SAE approach may be caused by the increasing need to capture the end-use changes that underly the residential and commercial classes.

Conclusion

The 2024 survey marks the first time since Itron began conducting its Annual Benchmarking Survey where participants' long-term forecast exceeds 1.5% and is like the historical 2000 to 2008 growth. The survey captures strong forecast sales growth across all classes.

The strong growth is a deviation from recent historical growth implying that growth trends are caused by external factors that are not embedded in the historical data. The survey reports on some of these factors and includes lingering COVID-19 consumption patterns, electric vehicle growth, and data center growth. Because the high forecast heavily depends on whether these factors become reality, Itron's future surveys will continue to monitor these factors and their inclusion in the forecasting process.