CRA Charles River Associates

Utility portfolio planning for a decarbonized future

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Background

In the absence of federal action, state and local decarbonization initiatives have been gaining momentum and driving policy changes that are likely to significantly impact the US power and natural gas sectors. Over the past 12 months, numerous states and municipalities have announced power sector or economy-wide decarbonization goals. Moreover, some states and cities are in the process of identifying specific policy pathways that impact utilities, such as the bans on natural gas use in buildings in New York City and several California cities.[1] While such developments may be viewed as a direct threat to electric and natural gas utilities that consume or deliver fossil fuels, the fragmented policy landscape also provides an opportunity for utilities to more proactively manage the transition to a decarbonizing world.

Many of the utility holding companies that we work with are trying to better understand the implications of current and potential future decarbonization policies to stay front-footed. In just a few years, decarbonization moved from a fringe sensitivity case to a base assumption in many utility company plans. Complicating matters is the uncertainties associated with reaching the targets defined in decarbonization policies or regulations. These uncertainties include the potential policy changes, the future of technologies to limit or reduce the need for carbon emitting sources, customer sentiment and local control, and energy usage patterns. For utility management, the challenge is to disentangle the uncertainties and develop credible future scenarios.

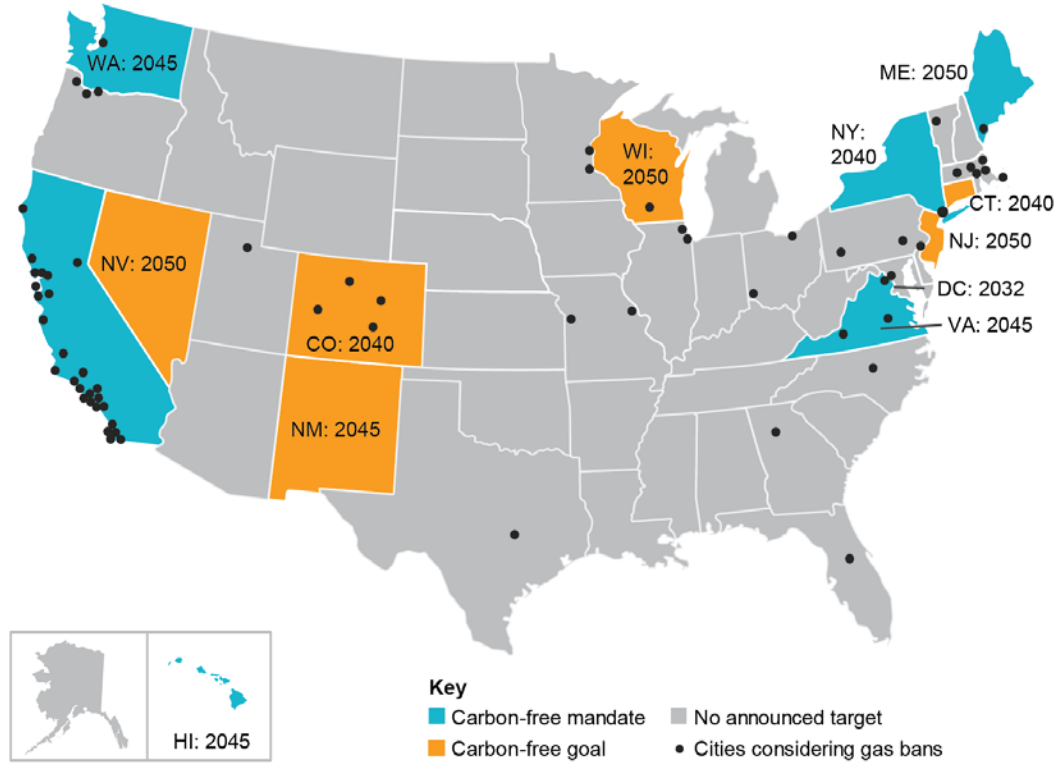
In this paper, we present a novel analytical framework that utility holding companies can use to forecast how decarbonization and other scenarios will impact their utilities' performance across several metrics critical to developing strategy.

Decarbonization drivers and trends

Decarbonization policy implementation in the US is currently driven by climate change concerns at the state and local level, with market and technology developments supporting more recent ambitious efforts. On the policy side, several states and cities have announced carbon-free electricity goals to be achieved over the next few decades. Some states and cities have announced natural gas bans, ranging from prohibiting natural gas use in new connections to phasing out existing natural gas use over time (see Figure 1 for an overview of key state and local policy initiatives). Further, many single-state and multi-state utility holding companies have announced 100% carbon-free goals in advance of their states' announcements. On the technology side, storage capital cost reductions and increased storage duration are expected to drive larger amounts of renewables to be integrated into the grid. Technologies such as "power to gas" conversions and carbon capture and sequestration continue to demonstrate potential in pilot programs.

[1] The California Energy Commission has approved gas bans in San Jose, Menlo Park, San Mateo, West Hollywood, Santa Monica, and Marin County.

Figure 1: US states and cities driving decarbonization goals



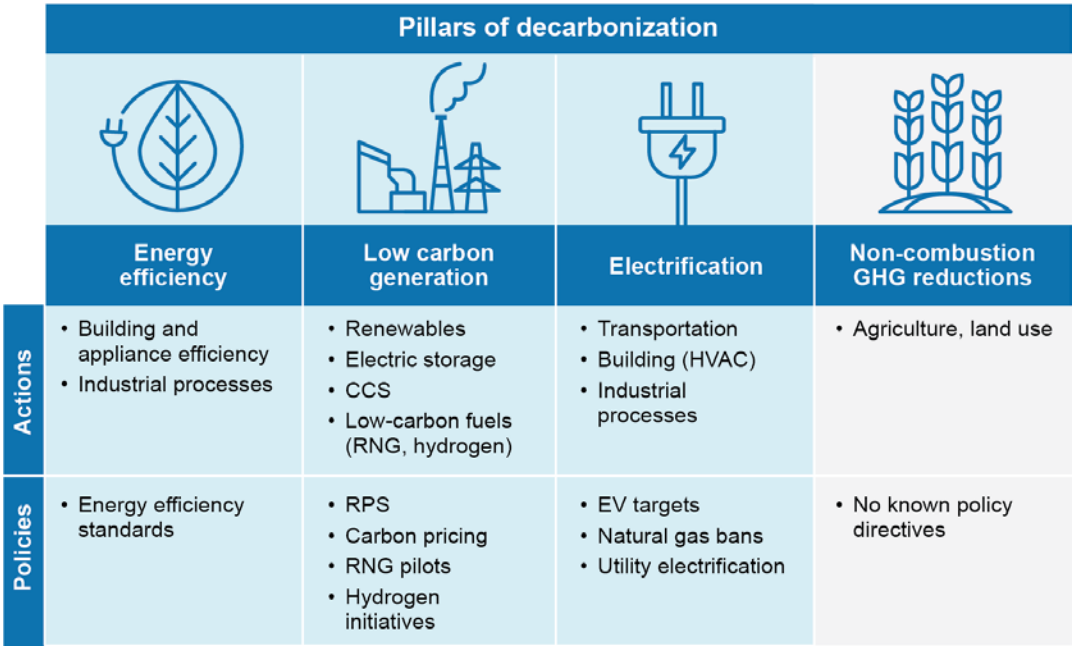
Source: CRA analysis

Decarbonization compliance mechanisms

To comply with these policy drivers, there are generally four major decarbonization mechanisms: energy efficiency, low carbon generation, electrification, and non-combustion greenhouse gas (GHG) reductions (see Figure 2). The first three directly impact electric and gas utilities across the following sectors:

- **Power generation:** Within the power generation sector, renewables and storage have played a key role in decarbonization and will continue to do so in the near to medium term, while the need for baseload renewables, longer duration storage (e.g. flow batteries, hydrogen), and renewable natural gas may emerge over time.
- **Buildings:** Within the building sector, energy efficiency measures on both the electric and gas side have played a dominant role to date, but program saturation is expected to occur over time. At that point, building electrification is expected to enable further decarbonization with advancements in heat pump technology and regulations around natural gas use.
- **Transportation:** Within the transportation sector, electric vehicles continue to make inroads with advancements in storage technology and reductions in cost.
- **Industry:** Within industry, both energy (direct fuel use as feedstock) and non-energy emissions (process alternatives) will be the focus of decarbonization efforts, particularly within certain industry groups such as cement and steel.

Figure 2: Pillars of decarbonization



Source: CRA analysis

Decarbonization impact on electric and gas utilities

Broadly speaking, an aggressive movement in the US or in specific states to decarbonize may pose a serious risk to utility holding companies. Many electric utilities are reliant on carbon-intensive resources for power supply, either through direct ownership or procurement. Depending on the situation, a decarbonization policy could lead to potentially stranded electric utility costs if fossil resources are forced to retire before the end of their useful life. To date, many decarbonization efforts have resulted in increased competition for utilities from companies selling renewables directly to large corporations and behind-the-meter applications.

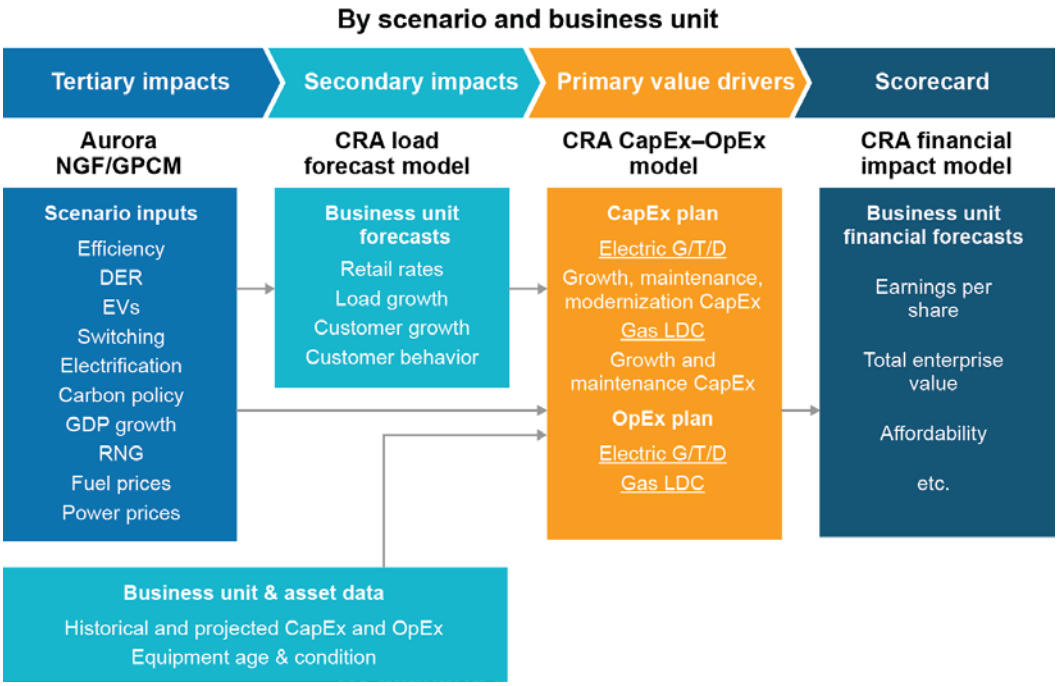
On the gas utility side, decarbonization may likewise pose major challenges. First, if gas-fired power generation is retired or simply not built as a result of a decarbonization policy, the gas utility that serves that plant may be impacted. Second, gas utilities may struggle to expand and face potential customer loss when electricity is viewed as a cleaner long-term substitute for end-use applications. Certain states already have moratoriums on gas expansion (e.g., California, Massachusetts, Washington). Additionally, based on our research, heat pumps may be an economical replacement for gas heating in certain jurisdictions. For a company that owns both gas and electric utilities, particularly in the same area, the impact and interactions between utilities can clearly get complex.

A novel scenario modeling framework for decarbonization

Though our work with clients, we have developed a novel framework to evaluate how decarbonization policy scenarios may impact a holding company's electric and gas utilities and provide a basis for strategic portfolio decisions. We have formulated linkages between key scenario parameters, and with the detail-rich foundation of our modeling, are able to provide reporting metrics that include earnings per share, enterprise value, and retail rate impact.

The ultimate output of our novel scenario modeling framework is a set of forecasted corporate and operating company (i.e., gas or electric utility) metrics (financial, retail rate, and environmental) under decarbonization and other scenarios. These metrics are illustrated under Scorecard in Figure 3. Forecasting these metrics requires a view on capex, opex, and load for each utility which, in turn, are dependent on a set of drivers. The first and second columns in Figure 3 illustrate the drivers that CRA analyzes to produce the capex, opex, and load forecast for a given scenario. These drivers are analyzed through a proprietary set of integrated electric sector, gas sector, and financial models. For instance, CRA uses proprietary and licensed gas market models to estimate utility and state-level gas prices for a given scenario, which are then incorporated in our power market dispatch tools. Load forecasts, in combination with historical spend and asset-level data, are then used to develop a capex and opex plan using CRA's model. Finally, the capex and opex plan serves as an input to CRA's financial model to help quantify key shareholder and customer metrics.

Figure 3: Scenario modeling framework



Source: CRA analysis

Combination electric-gas utility case study

Below, we present a case study for an integrated electric and gas utility with vertically integrated electric operations and gas local distribution company (LDC) operations. In this case study, two distinct future "states-of-the-world" or scenarios are modeled. The first scenario (Low Gas) analyzes a persistently low-price outlook for natural gas, strong growth for natural gas demand in the power and non-power sectors and slowing momentum for decarbonization beyond current fragmented state and local efforts. The second scenario is a Deep Decarbonization scenario with pressure on electric utility and gas LDCs to decarbonize.

The scenario inputs use a combination of the CRA power and natural gas modeling tools noted above, a variety of public and proprietary data sources, and expert judgment. We develop load forecasts based on econometric relationships – including demographic, economic, and elasticity relationships – and adjustments for energy efficiency, DERs, EVs, and other switching or electrification dynamics. Figure 4 shows a directional parameterization of the two scenarios based on key scenario drivers.

Figure 4: Example parameterization of scenario / tertiary drivers

Scenario driver	Parameterization	
	Low gas	Deep decarb
Electric EE (Reduction from baseline)	**Medium**	**High**
Gas EE (Reduction from baseline)	**High**	**High**
DG penetration	**Low**	**High**
EV adoption	**High**	**High**
Electrification (Electrification load growth)	**Base**	**High**
Carbon tax policy	Low	High
Power prices	Low	High
Natural gas prices	Low	Base

Source: CRA analysis

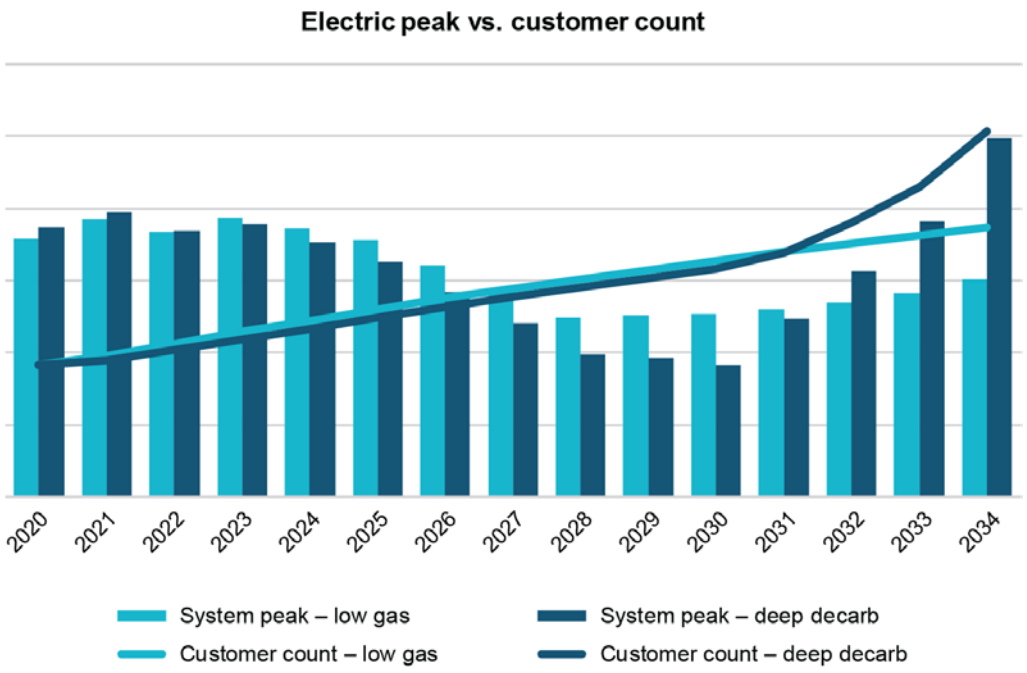
Key outcomes

Segment demand

As shown in Figures 5 and 6, customer counts and peak demand expectations are projected to diverge across scenarios, especially over the long run. Peak demands for electricity are generally expected to fall due to efficiency measures, but ultimately rebound significantly in the Deep Decarbonization scenario, along with an increase in customer counts, due to significant electrification.

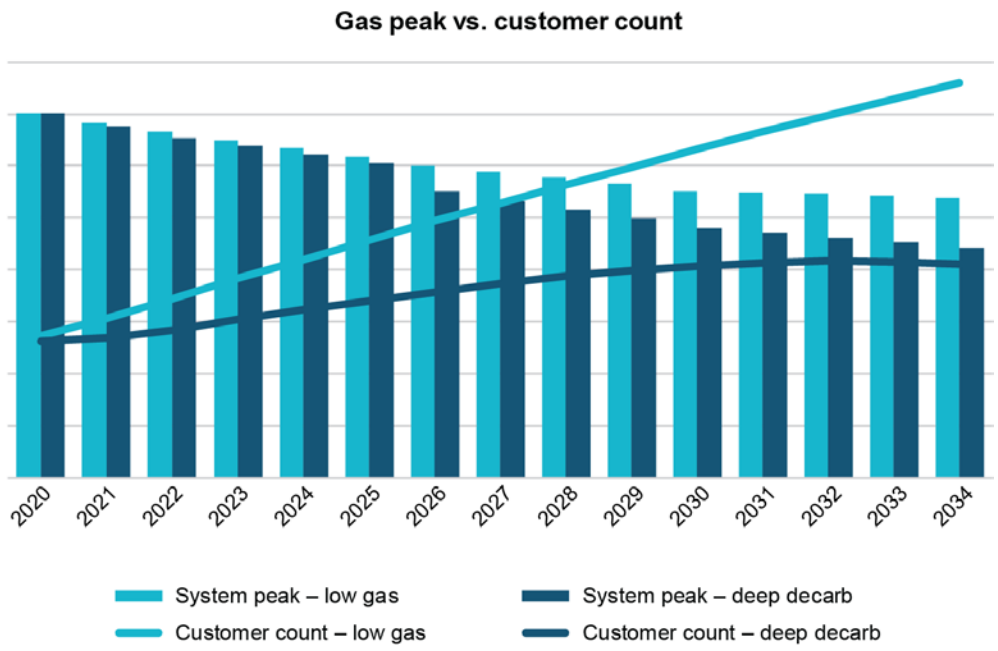
Peak demands for gas are also expected to fall due to efficiency measures, but a range of customer count and demand forecasts are projected to develop due to expected economic and policy drivers that influence customer behavior and switching trends. Most notably, the deep decarbonization case projects a flattening or declining customer count trend in the outer years due to economically driven switching from gas to electric.

Figure 5: Demand and customer count growth for the electric segment by scenario



Source: CRA analysis

Figure 6: Demand and customer count growth for the gas segment by scenario

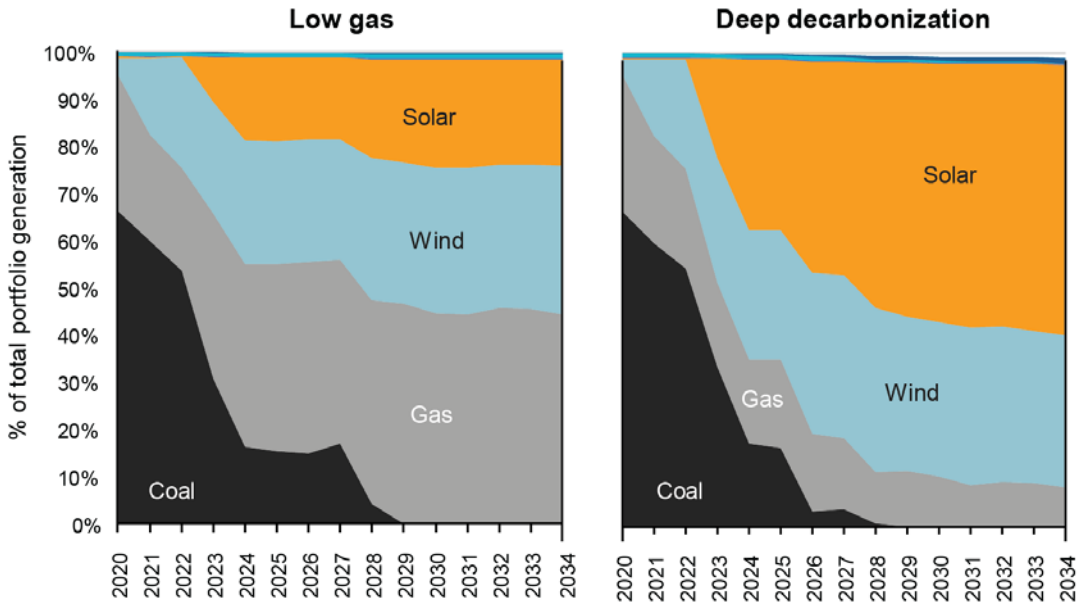


Source: CRA analysis

Portfolio generation mix

The utility's power generation portfolio would be expected to shift differently under the two scenarios, as shown in Figure 7. In the Low Gas scenario, natural gas becomes a larger portion of the generation mix over time (relative to the Base Scenario) and is driven by continued low gas prices and the lack of a federal carbon policy. In the Deep Decarbonization scenario, fossil generation (gas and coal) declines significantly over time, while renewables (wind and solar) constitute more than 80% of the generation mix by 2034.

Figure 7: Generation mix by scenario (2020-2034) (determined through Aurora modeling)



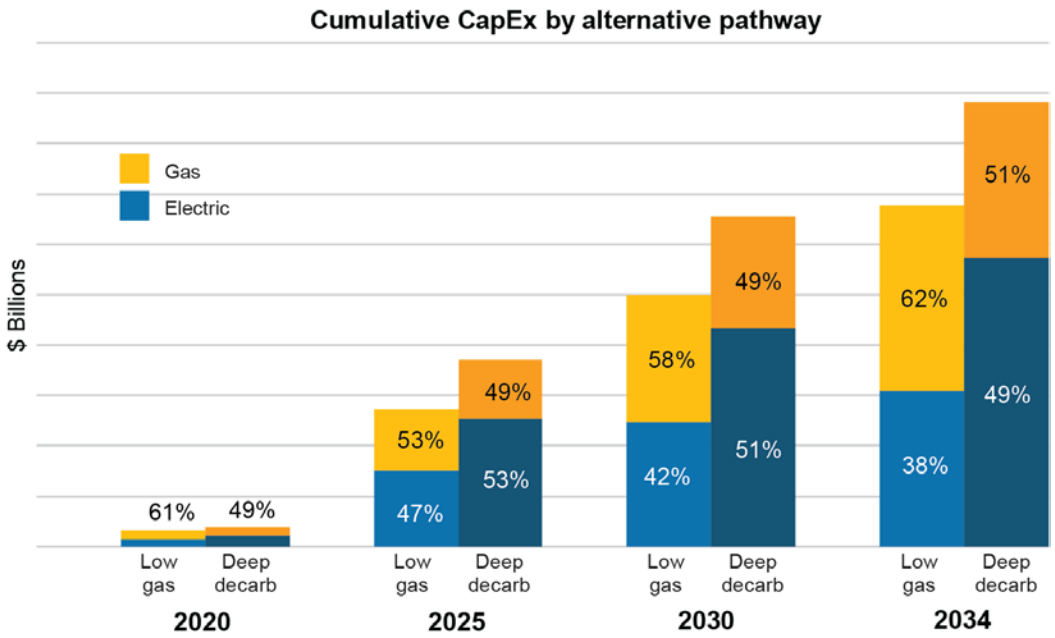
Source: CRA analysis

Capex and Opex plan

The capex and opex projections are key drivers of customer rates and shareholder value. The capex categories for the electric and gas segments are broken out into growth, maintenance, and modernization capex.[2] Within the electric segment, all three business units (i.e. generation, transmission, and distribution) are analyzed separately. The capex plan for the generation business is based on the various demand growth outcomes and the electric generation portfolio modeling summarized earlier. Figure 8 shows the cumulative levels of capex at various points in the future. Capex is higher for the Deep Decarbonization scenario within the electric segment due to higher levels of capex associated with renewable generation capacity, energy storage, and grid modernization investments. Meanwhile, capex in the gas segment is lower for the Deep Decarbonization scenario due to lower levels of growth and maintenance capex as a result of falling demand and limited customer count growth.

[2] The growth category relates to costs associated with new customer connects and any system upgrades required to connect new customers or accommodate load growth. Maintenance capex is tied to replacement of aging infrastructure or system "betterment." Modernization expenses are new technology investments relating to metering, communication, energy storage, advanced distribution management, and system hardening.

Figure 8: Cumulative CapEx by pathway and electric and gas segments



Source: CRA analysis

Customer and shareholder impact

Figure 9 forecasts the customer and shareholder impact to the enterprise across the electric and gas segments. Rates and bills are developed under "perfect rate-making" assumptions with revenue requirements being a function of rate base growth (tied to capex growth), capital structure assumptions, depreciation, and pass-through O&M expenses. As shown in Figure 9, the customer impact is larger for both the electric and gas segments in the Deep Decarbonization scenario, although for different reasons. On the electric side, generation capex growth resulting from a larger buildout in renewables and battery energy storage, drives the increase in customer rates and bills. On the gas side, the increase in rates is driven by a combination of declining sales, continued levels of maintenance capex investments, and a higher commodity price for natural gas, inclusive of carbon charges.

On the shareholder side, the electric segment has higher earnings per share growth in the Deep Decarbonization scenario (5.2%), while the gas segment has higher growth in the Low Gas scenario (6.5%). This result is generally intuitive as electric capex growth is tied to renewables, storage, and grid modernization investments, which are higher in the Deep Decarbonization scenario due to a combination of demand growth and stronger carbon price signals to decarbonize. In the Low Gas scenario, sustained low gas prices and minimal carbon regulation drive strong gas customer growth and capital investment.[3]

[3] Under a low retail gas price scenario, which has been the case for the past 5-6 years, utilities would likely push for higher maintenance capex as there is enough headroom for such investments.

Higher levels of maintenance capex in the Low Gas scenario further drive earnings per share growth.

A framework is set up to estimate enterprise value (debt value + market equity value – excess cash). Conceptually, for a stable growth utility, the company's equity market value is driven by expected earnings per share growth, authorized return on equity (ROE), cost of capital, and the dividend payout ratio. These fundamental drivers are estimated in alignment with the capex forecast to derive a price-to-book multiple which is applied to the book value of the equity for each segment.[4] The enterprise value is lower in the Deep Decarbonization scenario, driven by low growth rates in the gas segment and higher assumed cost of capital for the gas segment,[5] even though the electric segment shows a higher value. On the other hand, enterprise value is higher in the Low Gas scenario, driven by strong growth in the gas segment.

Figure 9: Utility customer and shareholder impact

	Shareholder value				Customer affordability	
	Earnings per share growth		Enterprise value growth		Impact on monthly rates	
Scenario	*Avg. annual EPS growth (2020–2034) electric*	*Avg. annual EPS growth (2020–2034) gas*	*EV growth (2020–2034) electric*	*EV growth (2020–2034) gas*	*CAGR % (2020–2034) electric*	*CAGR % (2020–2034) gas*
Low gas	4.0%	6.5%	+10.0 B	+18.3 B	1.4%	0.7%
Deep decarb	5.2%	2.3%	+12.5 B	+6.2 B	2.3%	2.9%

Source: CRA analysis

Conclusion

This study illuminates important portfolio risks and opportunity trade-offs for a diversified utility. Holding a diversified portfolio of electric and gas utilities can be an effective natural hedge for the utility against future uncertainty, but the portfolio performance is dependent on several factors. These factors include the business portfolio mix, uncertainty around electric and gas customer mix over time, specific state and local policies on decarbonization, regulatory risk, and capital market perception towards utility assets and business segments.

[4] Price to earnings multiples can also be used in place of price to book multiples.

[5] The gas segment is perceived to be riskier from both an equity and debt perspective.

The advanced analytics, process, and insights offered through CRA's novel scenario framework can be used by combination or stand-alone gas and electric utilities to better understand the customer, business, and financial implications of various corporate planning scenarios. This, in turn, can lead to a more thorough and informed development of strategic responses to various market and industry developments, risks, and opportunities over time. This capability is of strategic importance to utilities, given the policy momentum on a wide range of decarbonization initiatives and the growing interest and involvement of the company's board in the corporate strategy function.

About CRA

CRA is a management and economic consulting firm that was founded in 1965 and today comprises more than 775 consultants practicing across a range of industries including energy, life sciences, and financial services. CRA's Energy Practice provides advisory and expert services to energy companies and investors, law firms, system operators, and other companies.

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