Farmington 2022 Integrated Resource Plan Report

Prepared for City of Farmington

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1. Glossary

AERO	Aeroderivative combustion turbines based on aircraft engine technologies used for fast ramping purposes
Capacity Factor	The percentage of actual electrical energy output over a given period relative to its maximum (or nameplate) electrical energy output over that period
CCGT	Combined Cycle Gas Turbine is an efficient energy generation technology that combines a gas-fired turbine with a steam turbine.
Curtailment	The deliberate reduction in generation output during periods of insufficient transmission, local congestion, and excessive supply during low load periods
IRP	Integrated Resource Plan (IRP) is a roadmap to meet forecasted energy demand using both supply and demand side resources to ensure reliable service to customers in the most cost-effective way
N-1 Contingency	The ability to reliably provide power in the event there is a loss of a generation unit
PPA	Power Purchase Agreement (PPA) is an arrangement in which a third-party develop installs, owns, and operates an energy system and sells electricity for a predetermined period.
Stochastic Analysis	A modeling technique used to forecast the probability of various outcomes under different conditions, using random variables. The result from the analysis provides distribution band from which probability of success can be calculated. A 95% distribution means there is 95% chance the future outcomes will fall within this range.
Reserve Margin	The amount of unused available generation capability of an electric power system (at peak load for a utility system) as a percentage of total capability
RICE	Reciprocating Internal Combustion Engine (RICE) is a fast responding, high efficiency, flexible, dispatchable 18 MW facility that requires low fuel gas pressure and minimal water
SRSG	Southwest Reserve Sharing Group, a regional coalition that shares contingency reserves to maximize generator dispatch efficiency

2. Executive Summary

In the 2022 Integrated Resource Plan (IRP), the City of Farmington ("Farmington") identifies its preferred strategy for satisfying the electric power requirements over the 2022-2040 timeframe ("the Planning Horizon"). This plan addresses options to best meet Farmington's objectives of providing its long-term electricity needs in a cost competitive, reliable, sustainable, and flexible manner under a wide variety of market, regulatory, and economic conditions.

The expected retirement date of San Juan Unit 4 remains to be the primary uncertainty in Farmington's IRP. The facility could retire any time from as soon as 2022 to the end of 2037, near the end of the Planning Horizon.

An in-depth IRP process was conducted jointly by Siemens PTI and Farmington ("Team"). The Team spent over a year conducting analysis and incorporating feedback from Operations and Management. Periodic reviews were conducted with Commissioners to update the results and answer any questions during each step of the process.

After extensive analysis, which included 200 iterations of stochastic simulations around key uncertainties such as fuel cost, load, and CO_2 pricing for each of the Candidate Portfolios, the Team ranked the eight Portfolios based on the goals and metrics identified early in the project.

The two best scoring portfolios, based on Farmington's objectives, were determined to be:

1. San Juan 2037 Retirement with a 15% Market Exposure Limit ("Reference")
   - In the near term (2024-2025), build 3 x 18 MW RICE in 2024 and 2 x 18 MW RICE in 2025 for a total generation capacity of 90 MW. This capacity is required to limit spot market purchases and to ensure reliability.
   - In the long term, a total of 180 MW of renewable capacity additions: Build 15 MW of wind in 2034 and 2038 and a total of 120 MW of solar starting in year 2037 once San Juan is retired.
2. San Juan 2022 Retirement with a 15% Market Exposure Limit, High Commodity ("SJ 2022-15% HC")
   - In the near term, build 1 x 48 MW CCGT and 1 x 18 MW RICE in 2024 and 30 MW of solar in 2025 for a total generation build of 96 MW.
   - In the midterm (2026-2030), build of 80 MW of renewable generation comprising on solar, wind, and battery.
   - Long term (2035-2040) builds 65 MW of renewable capacity

Each of the high scoring Portfolios have a different technology mix (particularly in the near term). Therefore, contingency planning will be required due to the uncertainty of San Juan's retirement date to ensure projects are executed on schedule.

Farmington will require generation capacity in the near term and longer term to meet its objectives, particularly around reliability and limiting spot market exposure. All Portfolios meet the 150 MW firm generation requirement[1] set forth by Farmington.

Key Takeaways:

1. Spot market exposure as a percentage of total energy demand was evaluated for Farmington to determine which Portfolio had lower cost risk. Portfolios with 15% spot market exposure (vs. 5%) have lower capital costs and lower overall portfolio costs on average through the Planning Horizon, though, it may have energy costs in the form of spot market purchases. Based on these findings, 15% market exposure is the more cost-effective option as the 5% spot market exposure portfolio did not reduce market risk sufficiently to make up for the increased capital costs.
2. Farmington's will require 90-100 MW of generation capacity in the near term. Most of the generating capacity will be natural gas fired to ensure reliability and limit spot market purchases.
3. Passage of the 2022 Inflation Reduction Act may provide additional opportunities for Farmington to enter into PPA's to capture tax savings through third party renewable build, particularly in the midterm.
4. High level engineering and site studies should be conducted to ensure all options are available once preferred Portfolio(s) is selected

1. Firm capacity is peak capacity available from each resource to meet peak demand. Renewable capacity has lower peak demand contribution versus fossil fuel plant.

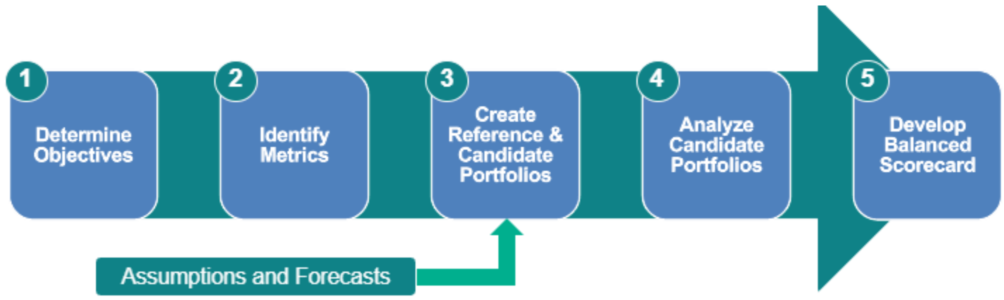
3. IRP Consultants

The City of Farmington engaged Siemens PTI to support the development of its 2022 Integrated Resource Plan and to evaluate generating technology portfolio candidates for the utility to consider. Siemens PTI developed and analyzed eight Candidate Portfolios designed to provide sufficient energy to meet the expected energy demand of Farmington customers under expected conditions. To determine the best resource mix for Farmington, these Portfolios were evaluated in four key categories: Affordability, Risk, Environment, and Operability.

Siemens PTI's scope of work is based on a highly vetted and rigorous approach that is customized to answer motivating questions to identify Farmington's preferred Portfolio(s).

A Five-Step analysis process was applied to Farmington's IRP. This process, diagrammed in Exhibit 1, provides a holistic approach to identifying the preferred Portfolio(s) that best meets Farmington's defined objectives and metrics over a wide range of potential future conditions.

Exhibit 1. Siemens PTI Five-Step Process for Integrated Resource Planning



4. Background

4.1. Farmington Electric Utility

The Farmington Electric Utility System ("Farmington"), which is owned and operated by the City of Farmington, is in northwest New Mexico. Farmington's service territory of 1,718 square miles encompasses the City of Farmington, San Juan County, the City of Bloomfield, and a portion of Rio Arriba County. Farmington also provides transmission services for the City of Aztec, which owns its own substation and distribution facilities to Williams Field Services. Finally, Farmington is part of the Southwest Reserve Sharing Group (SRSG), which a group of 12 utilities, that share contingency reserve to maximize generator dispatch efficiency.

Farmington is a load serving entity with an ownership share in the San Juan Generation Station Unit 4, that may soon retire. It also owns hydro and natural gas-fired capacity. The key characteristic for the new energy generation will be its reliability, cost-effectiveness with limited market risks associated with the purchased spot market power.

4.2. Key Considerations

To evaluate resource decisions, Farmington identified the planning objectives early in the resource planning process and involved key representatives including those from operations and management. Farmington's IRP objectives were classified into four major categories – Affordability, Risk, Environment, and Operability.

4.3. Motivating Questions

Siemens PTI's IRP analysis is designed to identify solutions to key challenges that Farmington will face over the Planning Horizon.

The resource planning analysis is intended to provide insight into the following key questions:

- What are the prudent, cost competitive and environmentally responsible approaches in Farmington's long term resource plan to address the trends in the energy industry such as potentially decreasing prices for renewables and energy storage, and finalization of carbon regulation?
- How do these trends impact the requirement for any new generation resources that Farmington considers adding to its fleet?
- How should the portfolio be designed so that Farmington can accommodate potential changes to carbon reduction compliance?
- What is the impact on Farmington from reducing its spot market purchase and sale exposure from 15% to 5% of retail load?
- What are the pros and cons for Farmington to lock into firm supply resources either from new builds or long term PPA?
- How much solar capacity can Farmington integrate into its system considering the characteristics of its current generation fleet and load profile?

4.4. Major Uncertainties

The expected retirement date of San Juan Unit 4 is a primary uncertainty in Farmington's IRP. Other highly uncertain considerations that were quantified in the IRP analysis are future:

- Natural gas prices,
- Energy demand,
- Coal prices,
- Capital costs, which could impact the technology mix employed by Farmington's neighbors, and
- Environmental compliance costs.

Given the uncertainty in the timing of San Juan Unit 4's retirement, Siemens PTI recommends Farmington take a staged decision process in formulating and optimizing the recommended Portfolio(s) to best satisfy its objectives.

5. IRP Five-Step Process

Step 1: Determine Objectives

The purpose of the IRP is to evaluate Farmington's current energy resource portfolio and a range of alternative future portfolios to meet customer's electrical energy needs in an affordable and holistic manner. The process evaluates Candidate Portfolios in terms of environmental stewardship, market and price risk, reliability, and resource diversity.

Step 2: Assign Metrics

Metrics are developed early in the study for each objective to evaluate Portfolio performance across a wide range of possible future market conditions. The weight of each metric is provided by Farmington. Exhibit 2 shows Farmington's objectives, metrics, and relative weights. All measures of Portfolio performance are based on the results of Step 4, an analysis of the cost and performance characteristics of Candidate Portfolios across a broad range of market conditions.

Exhibit 2. Farmington's Objectives and Metrics

Category	Objective	Metric	Weighting
1 Affordability	Preserve Competitive Rates	• Net Present Value (NPV) Cost to Serve Load 2022-2040 (Average across market conditions, $2019 Millions)	10%
	Preserve Competitive Rates	• NPV Cost to Serve Load 2022-2027 (Average across market conditions, $2019 Millions)	10%
	Capital Investment	• Capital Expenditure for New Generation in 2024-2025 ($Millions Nominal)	30%
2 Risk	Cost Risk	• 95th Percentile Value of NPV Cost to Serve Load (across market conditions, $2019 Millions)	10%
	Minimize Operational and Control risks	• Farmington Operated Capacity excluding renewables (2030, MW)	5%
	Market Risk Minimization	• NPV of Spot Energy Market Purchases 2022-2040 (Average across market conditions, $2019 Millions)	5%
3 Environmental	Reduce CO_2 Footprint	• Total CO_2 Emissions Reductions by 2040 as compared to 2021	5%
	Renewable Generation	• Percentage of Electric Generation from Renewables in 2040	5%
4 Operability	Manage Largest Contingency	• Firm capacity available to meet load when largest unit trips (average available capacity 2024-2030)	10%
	Fast Ramping Capability	• Lowest Ratio of Fast Ramping To Renewable Capacity in the Planning Horizon (Min 50%)	10%

Step 3: Create Reference and Candidate Portfolios

The purpose of step 3 is to create candidate generation Portfolios based on corporate objectives, strategic alternatives, scenarios, and sensitivities. Siemens PTI developed a Reference portfolio based on the premise that San Juan Unit 4 continues to operate with carbon sequestration technology through 2037 and 15% spot market exposure under reference case commodity price outlook. In addition to Reference portfolio, seven other Candidate Portfolios were developed based on a number of scenarios, which are described in more detail in Section 7.

Step 4: Analyze Candidate Portfolios

Probabilistic modeling (also known as stochastic risk analysis) incorporates several market variables and probability distributions into the analysis, allowing for the evaluation of a Portfolio's performance over a wide range of market conditions. Quantitative data is extracted from the results and is the foundation for some of the metrics in the Balanced Scorecard around Affordability and Risk.

Step 5: Select Top Portfolios Using a Balanced Scorecard

The Team developed a Balanced Scorecard that compares the performance of each candidate portfolio against the objectives and metrics defined in the initial steps of the IRP planning process. The Balanced Scorecard method allows for the assessment of tradeoffs between portfolios (i.e., least cost, risk, and environmental stewardship) and will enable the Team to determine the best performing Portfolio(s) based on a weighted average score.

6. Forecast and Assumptions

The Team developed number of forecasts around key performance indicators that were used to help develop candidate portfolios. Consistent modeling assumptions and Farmington's practical considerations were used as inputs or constraints across all the candidate portfolios.

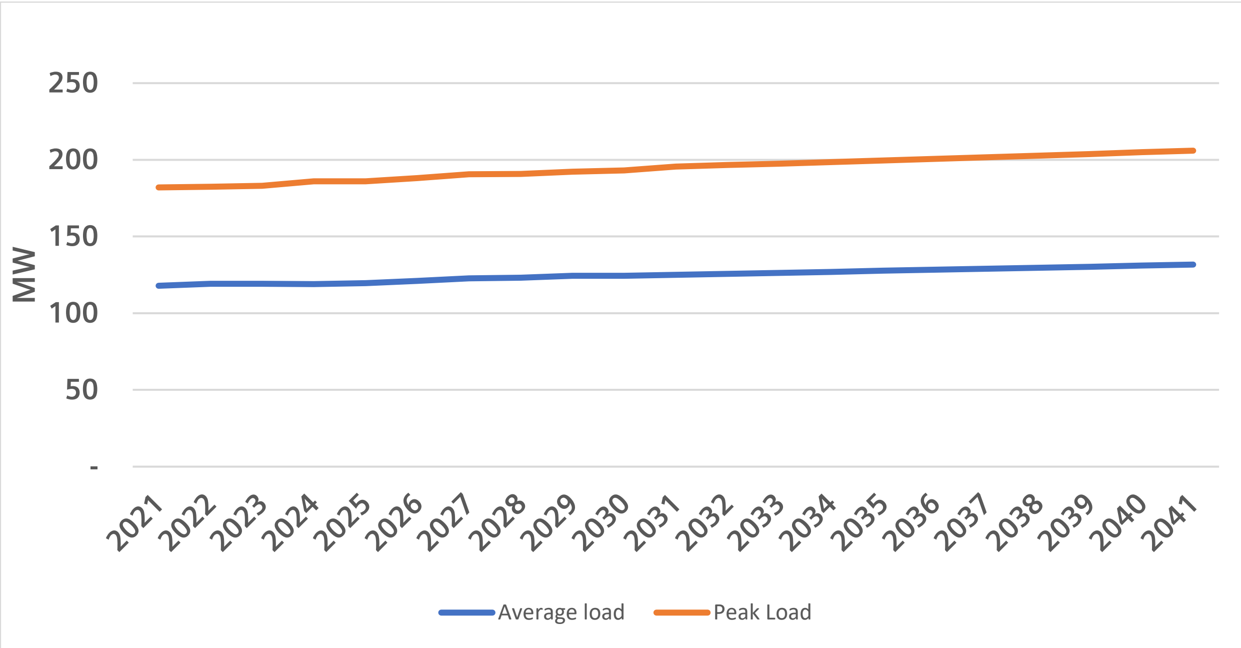
6.1. Load Forecast

6.1.1. Base Load and Peak Load

As part of the 2022 IRP process, Siemens PTI performed a long-term load forecast for resource planning studies. Farmington's historical load data and consumption patterns were analyzed to estimate expected future load.

Farmington's average load is assumed to grow at Compounded Annual Growth Rate ("CAGR") of 0.56 percent and the peak load at 0.62 percent between 2021 and 2040. The analysis suggests that Farmington's load growth will depend on the extent of oil and gas exploration and production activities undertaken in the region. Siemens PTI's load forecast is aligned with the outlook for exploration activities and the opportunities for electrification in the region.

Exhibit 3. Forecasted Base and Peak Load

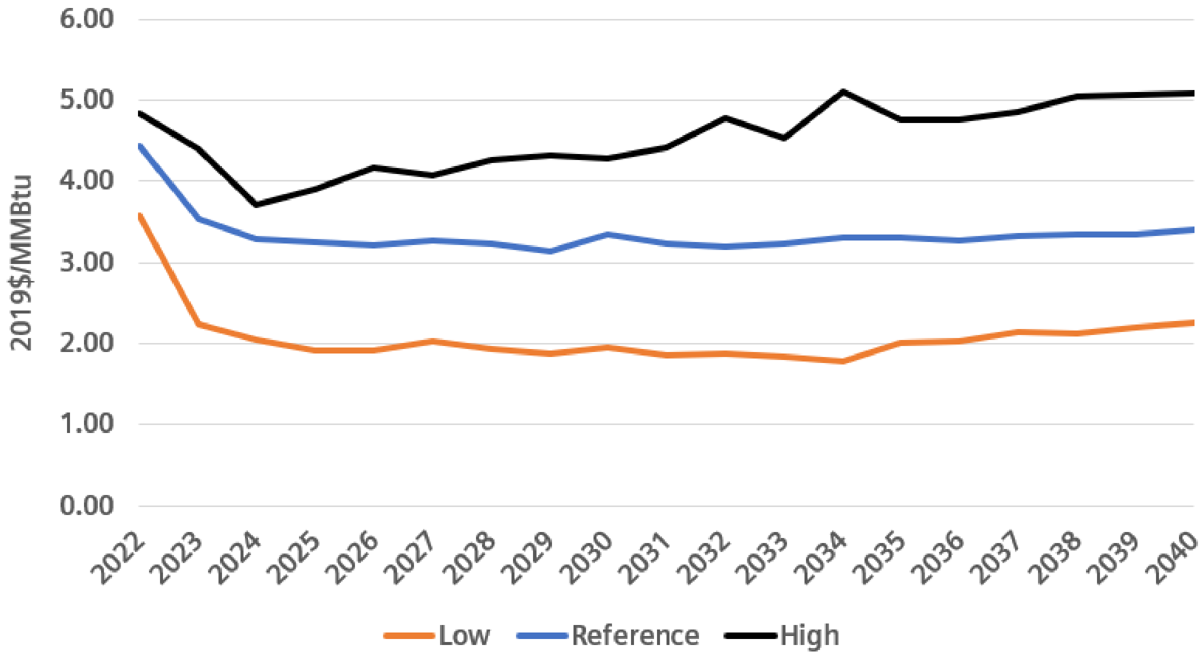


6.2. Commodity Prices

6.2.1. Natural Gas

Natural gas price projections were developed for Henry Hub according to primary supply and demand drivers that influence domestic production costs as well as international market dynamics. The natural gas price assumption was developed in 2021, prior to Russia's war on Ukraine.

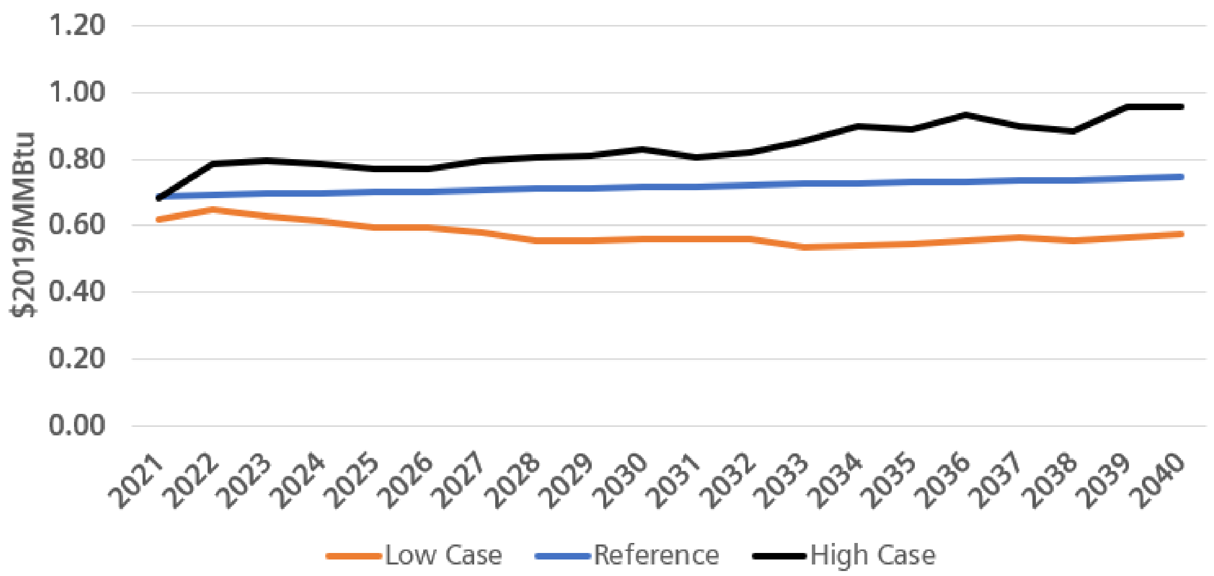
Exhibit 4. Forecast of Henry Hub Natural Gas Price by Commodity Environment



6.2.2. Coal

Coal price projections were developed according to primary supply and demand drivers that influence production costs in the Powder River Basin (PRB).

Exhibit 5. Forecast of PRB FOB[2] Coal Price by Commodity Environment

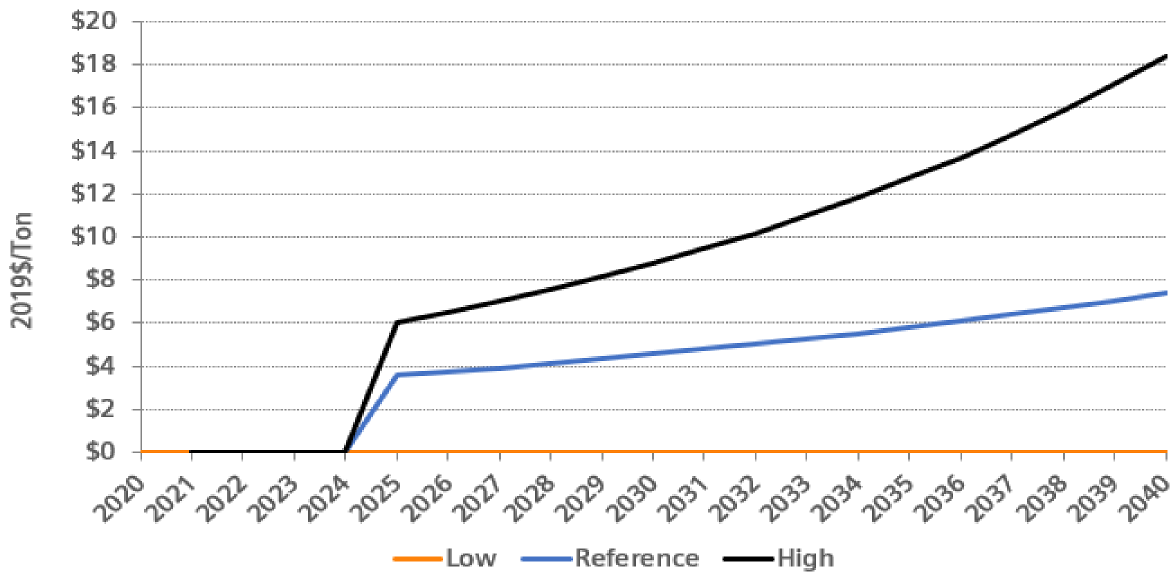


[2] Freight on Board (FOB) is the cost of the coal loaded onto a shipping vessel and buyer is responsible for cost of transport as well any liability.

6.2.3. Carbon Dioxide Costs

Carbon dioxide (CO_2) price projections were developed based on the National CO_2 forecast provided by Siemens PTI and Farmington. The low case assumes no cost for CO_2 abatement. The reference and high case reflect future policy, which will require reducing CO_2 emission from the power sector.

Exhibit 6. Forecast of National CO_2 Price by Commodity Environment



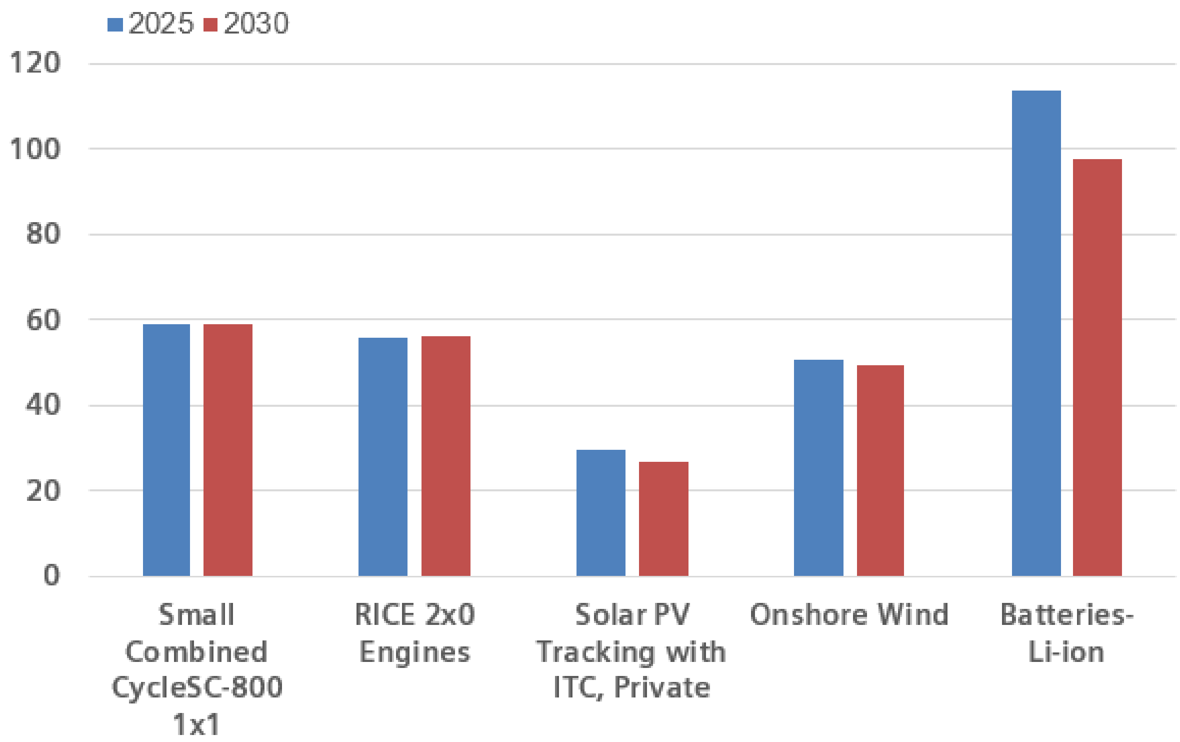
6.3. Capital Cost of New Generating Assets

The capital cost assumptions for the Farmington IRP were projected by Siemens PTI. The capital cost forecast uses a combination of both public and private sources to best estimate the costs of new proven technologies to ensure reliable and predictable outcome for Farmington. The sources for capital costs development originate from IRPs, IRP related studies, Thermoflow software, and client confidential project information. The capital cost assumptions reflect regional multiplier based on Energy Information Agency (EIA) data to account for local labor and economic factors.

Using a blend of several sources provides multiple benefits. First, no single source is definitive or will represent any undefined project. According to the American Association of Cost Engineers (AACE) cost classification system, budgetary estimates are Class 4 estimates. Class 4 is defined as an estimate on a project that is 1% to 15% completed, where the low side of the estimate can vary 15-30% below the 80% confidence interval and 20-50% above the 80% confidence interval. However, given the modular nature of most generation technologies, Siemens PTI considers our estimates to be between Class 3 and Class 4, with an estimated accuracy of -19% to +27.5% in general.

Farmington imposed a capital constraint on self-build generation assets at $150 million. Approximately 100 MW of capacity could be built with the capital constraint in place. The remainder of the required supply could require PPAs to build out the generation needs over the Planning Horizon. Exhibit 7 shows the levelized cost of energy by various resources. Renewable resources such as solar and wind are the cheapest.

Exhibit 7: Levelized Cost of Energy ($2020/MWh)



With the passage of the 2022 Inflation Reduction Act, there are substantial savings associated with technologies that reduce carbon emissions. However, most of the savings are in the form of investment tax credits from the U.S. Government. To take advantage of these credits, utilities such as Farmington may enter into PPAs with developers, who then pass on the tax savings in the form of a lower PPA price. Utilities such as Farmington have incorporated clauses into contracts to give them the option to purchase the facility at a later date, thereby providing a way to develop internal capability around renewables.

6.4. Farmington Generating Assets

Generation Portfolios developed in Step 3 were subject to operations constraints to ensure Farmington's current generation assets would be utilized when new generation resources would come online and optimize transmission access for wind resources. The following generating asset constrains were applied to all portfolios.

- Bluffview to be modeled as a "must run" unit with minimum capacity of 52 MW
- No new capacity prior to 2024
- 40 MW PPAs would be secured for 2022 SJ retirement portfolios until new resources come online
- No wind resources prior to 2030 due to location and transmission access
- Ability to brownfield3 develop one RICE unit at Bluffview (rest is greenfield4)

[3] Brownfield refers to installing generating unit at a site that already has some synergy with existing generating equipment.

[4] Greenfield refers to development on a new site that has not been developed.

6.5. Environmental Consideration

While Farmington does not have explicit CO_2 and renewable portfolio standard objectives to meet during the Planning Horizon, environmental concerns were viewed as a Balanced Scorecard category, with a total weight of 10% across the two objectives focused on reducing CO_2 emissions and increasing diversity within its renewable generation mix.

6.5.1. CO_2 Footprint

An increasing concern regarding global climate change has put specific emphasis on the carbon footprint associated with different power generating resource options. Although coal-fired generation remains one of the lowest cost resources, its environmental impacts pose a growing concern to the public and utility planners. Moreover, the potential for significant costs associated with CO_2 emissions constitutes a major risk for coal plant owners. With this context in mind, different portfolio options were evaluated based on the achieved CO_2 footprint reduction by 2040. Assuming all other metrics remain the same, any portfolio that achieves lower CO_2 emission was given preference.

6.5.2. Renewable Generation

Although Farmington does not face specific regulations concerning a renewable generation target at this time, its environmental goals require the addition of renewable resources to the supply mix, especially in the long term. Analysis showed that increasing generation from renewable resources will not only reduce the overall cost for its customer but also result in reduced CO_2 emissions for the portfolio. The percentage of generation from renewable resources was the metric used to reflect greater renewable stewardship. Different portfolio options were evaluated based on the percentage of the utility's net energy for load to be served by renewable generation by 2040.

6.6. Operational Consideration

Farmington put operational criteria in place to manage contingencies and reliably meet load during peak demand.

6.6.1. Contingency Management

Farmington expressed a desire to manage Bluffview, its largest contingency, by ensuring the availability of a minimum of 16 MW firm capacity as per the agreement with the Southwest Reserve Sharing Group (SRSG). All candidate portfolios met the contingency criteria.

6.6.2. Reliability

Reliability constraints required all portfolios to provide 150 MW of firm generation to meet peak demand. In addition, Farmington required all new resource additions to have 50% fast ramping to renewable capacity, through the Planning Horizon, to meet peak demand during times when renewable output is intermittent or below average capacity.

All portfolios meet the 150 MW of firm generation criteria. Except for SJ 2037 5% portfolio, all other portfolios were able to achieve the 50% fast ramping to renewable capacity criteria.

7. Candidate Portfolio Development (Step 3)

The objective of this IRP is to identify a Portfolio of generation resources that best aligns across all of Farmington's objectives around Affordability, Risk, Environment and Operability.

The construction of Reference and Candidate Portfolios is aimed at satisfying Farmington's energy demand by 2040 under expected conditions. The IRP process is designed to adapt with the analysis incorporating updated market information, operational considerations, and logistic limits as available.

The Team defined the development of a Reference Portfolio, which serves as a business-as-usual outlook of expected market conditions and expected load. The Reference Portfolio is based on the Team's view of base market conditions around commodity prices, thus serving as a benchmark to measure the performance of other Portfolios that are optimized to meet potential policy and regulation goals, as well as potential future market conditions (high or low commodity prices).

To establish the appropriate Candidate Portfolios, the Team developed multiple pathways and conditions to observe different methods to meet these objectives. Developing pathways and conditions provided guidelines for the design of the Candidate Portfolios.

Pathways

The IRP's three pathways are:

1. The binary expectation of San Juan's retirement date in 2022 or 2037 ("SJ 2022" **or** "SJ 2037").
2. Commodity price environment to build future generation.
3. The amount of market exposure of spot power purchases and sales relative to annual load Farmington can reasonably take while optimizing its objectives.

With San Juan's retirement date uncertain, Siemens PTI recommends Farmington take a staged decision process in formulating and optimizing the recommended portfolio based upon how these options evolve to best satisfy its objectives.

The commodity price environment may impact the type of generation that is built. High commodity prices, particularly natural gas, will result in more renewables as it is able to provide energy at a lower cost. Conversely, a low commodity price environment could result in more fossil generation as it could offer a lower cost of energy.

Farmington can establish risk-mitigating parameters by limiting the percentage of the portfolio that would be subject to spot market purchases and sales. The levels of 15% and 5% of retail load were determined to be reasonable upper and lower bands of exposure ("15% Market Limit" or "5% Market Limit").

Market Conditions

The IRP process included three potential future market conditions for commodity prices, which were used to guide the development of portfolios for evaluation (Step 3: Create Reference and Candidate Portfolios).

- Moderate or "Base" commodity prices: Under this market condition, the price of fuel and similar commodity resources are expected to remain the same or stay relatively flat when compared to today's BAU levels.
- High commodity prices: Under this market condition, the price of fuel and similar commodity resources are expected to increase or become relatively higher when compared to today's levels ("High Commodity").
- Low Commodity Prices: Under this market condition, the price of fuel and similar commodity resources are expected to decrease or become relatively lower when compared to Reference ("Low Commodity").

Exhibit 8 shows Farmington's Reference and Candidate Portfolios listed by San Juan retirement date, type of market environment and limits on spot market exposure.

Exhibit 8. List of Farmington's Eight Candidate Portfolios

	Candidate Portfolios							
Scenario Element	SJ 2037 - 15% Market Exposure (Reference)	SJ 2037 - 5% Market Exposure (SJ 2037 - 5%)	SJ 2022 - 15% Market Exposure (SJ 2022 - 15%)	SJ 2022 - 5% Market Exposure (SJ 2022 - 5%)	SJ 2022 - 15% Market Exposure High Commodity (SJ 2022 - 15% HC)	SJ 2022 - 5% Market Exposure High Commodity (SJ 2022 - 5% HC)	SJ 2022 - 15% Market Exposure Low Commodity (SJ 2022 - 15% LC)	SJ 2022 - 5% Market Exposure Low Commodity (SJ 2022 - 5% LC)
San Juan Retirement Date	End of 2037	End of 2037	End of Sept. 2022	End of Sept. 2022	End of Sept. 2022	End of Sept. 2022	End of Sept. 2022	End of Sept. 2022
Delivered Coal and NG Price, CO_2 Price	Base	Base	Base	Base	High	High	Low	Low
Max Spot Purchase and Sales Exposure to Market (% of Annual Load)	15%	5%	15%	5%	15%	5%	15%	5%

The following is brief description of each of the eight Candidate Portfolios that were developed:

1. **Reference**: San Juan Unit 4 continues to operate with carbon sequestration technology, reference case commodity price environment and spot market purchases and sales limited to 15% of annual load. This is business-as-usual portfolio.
2. **SJ 2037 – 5%**: designed to quantify impact for reducing spot market exposure in the Reference Portfolio.
3. **SJ 2022 – 15%:** designed to identify generation impact of San Juan retiring in 2022 under base case market conditions and 15% spot market exposure.
4. **SJ 2022 – 5%:** designed to quantify impact of reducing spot market exposure from SJ 2022-15% Portfolio.
5. **SJ 2022 – 15% HC:** designed to determine generation build out optimized for a high fuel price and CO_2 price environment.
6. **SJ 2022- 5% HC:** designed to quantify the impact of reducing spot market exposure in portfolio SJ 2022- 15% HC Portfolio.
7. **SJ 2022 – 15% LC:** designed to determine generation build out optimized for a low fuel price and no price on CO_2 emissions.

8. **SJ 2022- 5% LC:** designed to quantify the impact of reducing spot market exposure in SJ 2022 – 15% LC Portfolio.

7.1. Reference Portfolio: SJ 2037- 15% Market Limit

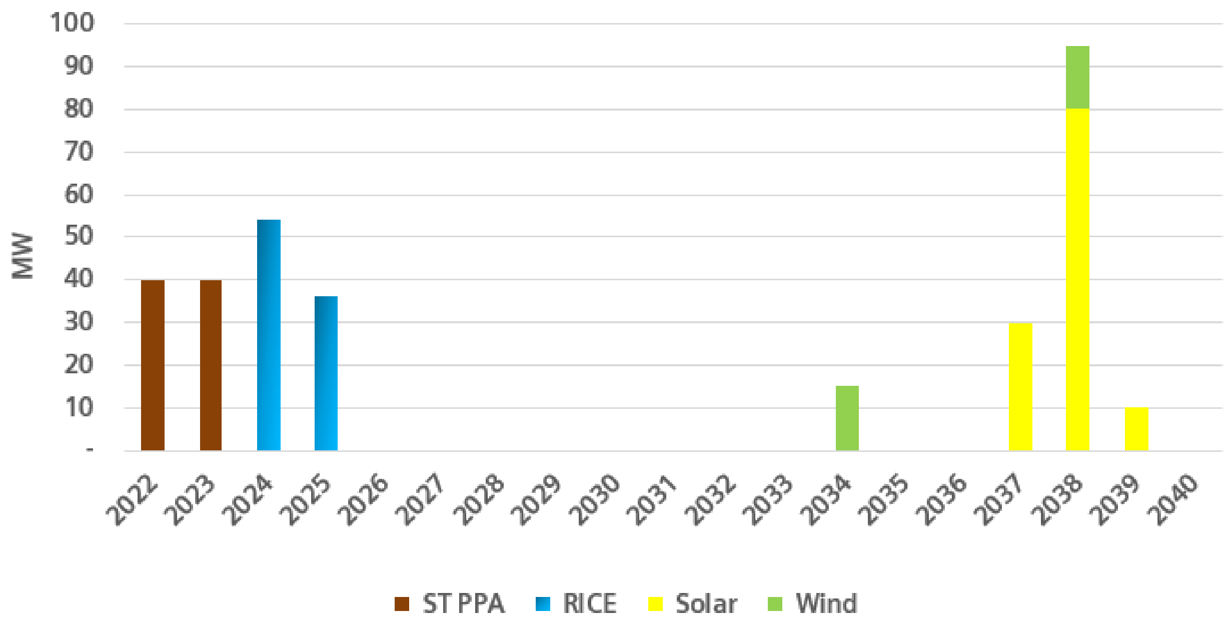
The Reference Portfolio is optimized for the current price environment, policies, and regulations, thus serving as a benchmark to measure the performance of other Portfolios that are optimized to meet potential policy and regulation goals. It is important to note that all Portfolios required 40 MW of Short term PPA to reduce spot market exposure unit new capacity is installed.

As seen in **Exhibit 9**, 90 MW of reciprocating internal combustion engine ("RICE") capacity is added in 2024-2025. RICE units are capable of ramping up to full load in less than 5 minutes and are able to operate efficiently at less than half of their nameplate capacity. RICE capacity additions are useful in the near term to serve load, reduce spot market exposure, and provide reliability.

Renewables additions occur in the latter half of the Planning Horizon starting in 2034. A total of 30 MW of wind capacity additions occurs in 2034 and 2038 to meet night electric time demand. A total of 120 MW of solar additions are required starting 2037 once San Juan Unit 4 is retired. Overall, a total 240 MW of generation capacity is added through the Planning Horizon. Please note that solar and wind capacity additions are intermittent resources, therefore, more capacity is required. Wind and solar are complementary meaning wind generation occurs at night and solar generation occurs during daylight hours. The capacity factor for wind is ~35% and solar is ~25%.

The Reference Portfolio is the least cost build out that is able to satisfy all operational, reliability, and 15% Market Exposure criteria once new capacity is added.

Exhibit 9: Reference Portfolio: Generation Build



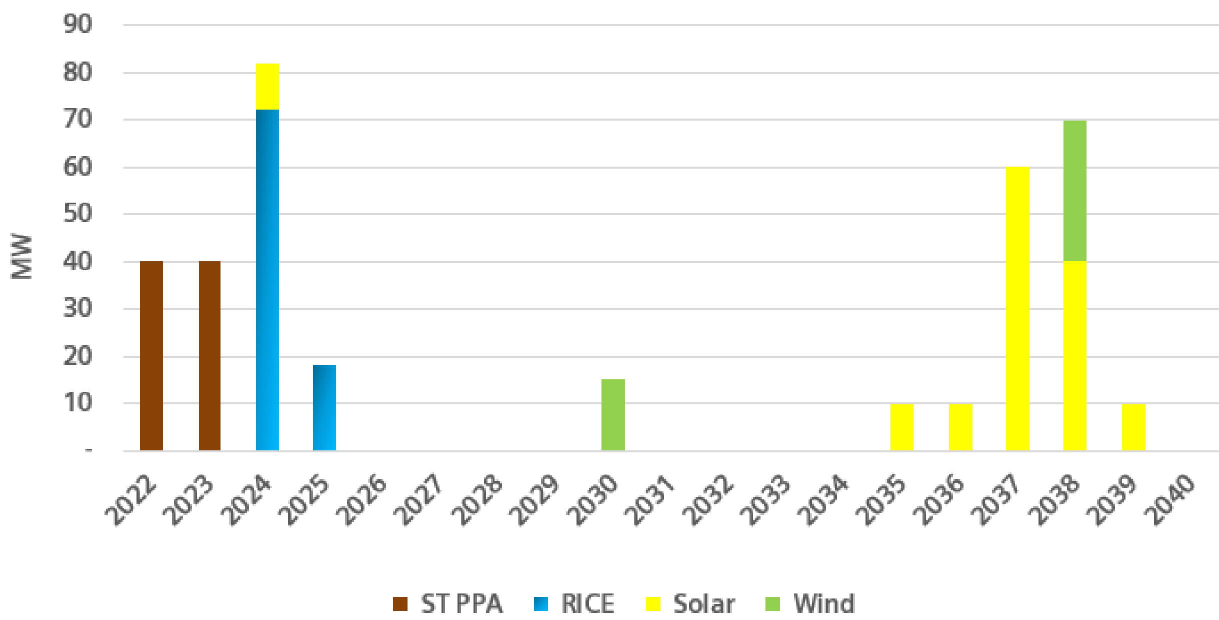
7.2. SJ 2037 – 5% Market Exposure

The purpose of SJ 2037 – 5% Market Exposure is to evaluate the impact of reducing market exposure from the Reference Portfolio. New capacity additions are required beginning in 2024 with 100 MW of capacity additions through 2025. Specifically, 72 MW of RICE, 10MW of Solar PV in 2024, and another 18 MW RICE unit is added in 2025. Capacity in the short term is required to meet energy requirements, reliability, and to reduce spot market exposure.

Starting 2030, wind is added to meet nighttime load and solar is added in the 2035-2040 to replace energy and capacity from San Juan retirement. As shown in Exhibit 10, a total of 275 MW of new capacity is needed over the Planning Horizon.

SJ 2037 – 5% Market Exposure Portfolio is the least cost build out that is able to satisfy all operational, reliability, and 5% market exposure criterion. CO_2 emissions is reduced by approximately 35%, as compared to 2021, through the 2030s.

Exhibit 10. SJ 2037 – 5% Market Exposure: Generation Build

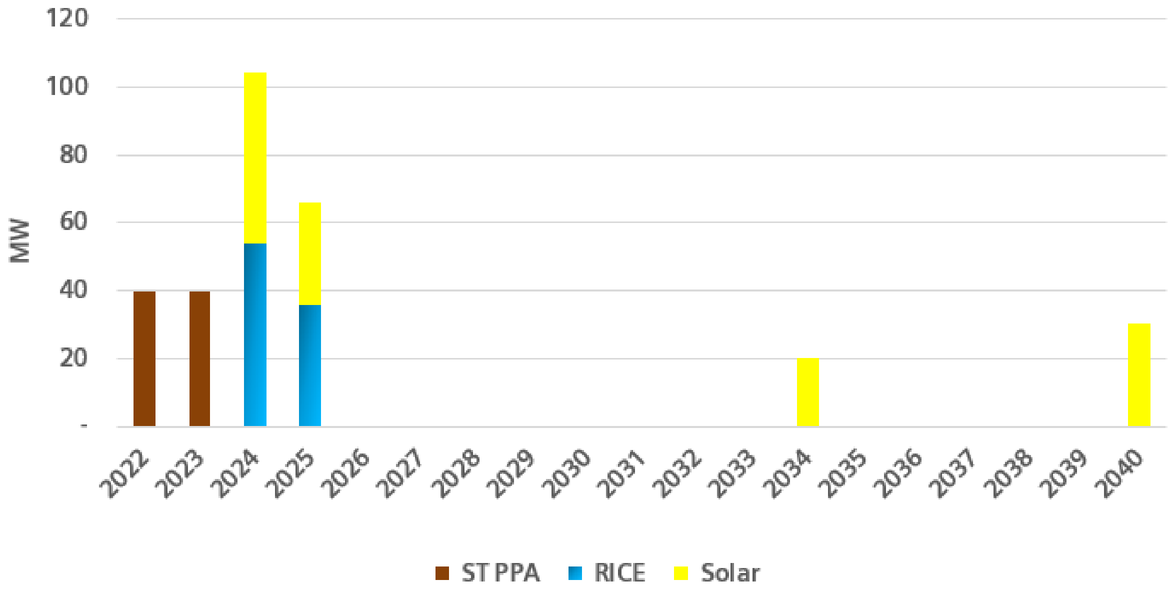


7.3. SJ 2022 – 15% Market Exposure

The SJ 2037 – 15% Market Exposure Portfolio was developed to evaluate the impact on generation build when San Juan unit 4 retires in 2022 with all other variables consistent with Reference Portfolio. As shows in Exhibit 11, a total of 170 MW of new capacity additions are required in 2024 and 2025. Specifically, 90 MW of RICE and 80 MW of Solar capacity. Capacity in the short term is required to meet energy requirements, reliability, and to reduce spot market exposure. The solar capacity additions represent lower cost of energy; therefore, it was selected. The RICE capacity is a firm resource, which provides energy and capacity as well as fast ramping resource to support the intermittent solar generation.

In the long term, 80 MW of solar generation is required to meet Farmington’s energy needs.

Exhibit 11. SJ 2022 – 15% Market Exposure: Generation Build



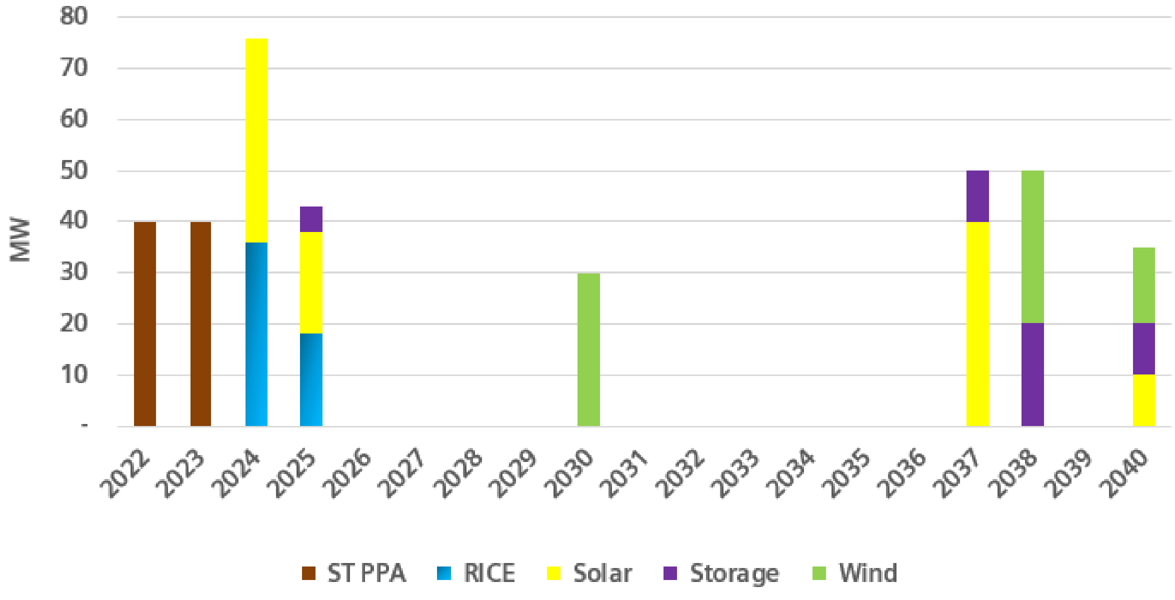
7.4. SJ 2022 – 5% Market Exposure

The purpose of SJ 2022 – 5% Market Exposure is to evaluate the impact of reducing market exposure from the SJ 2022 – 15% Market Exposure Portfolio, while leaving all other variables constant.

As shown in Exhibit 12, 54 MW of RICE, 60 MW of solar and 5 MW of battery storage is added in near term. In 2030, 30 MW of wind is added to meet support nighttime load. In the longer term, 135 MW of renewable energy is added comprising on wind, solar, and battery storage. A total of 284 MW of capacity is required through the Planning Horizon.

By reducing spot market exposure to 5%, an additional 34 MW of capacity is required as compared to the SJ 2022 – 15 % Market Exposure Portfolio.

Exhibit 12. SJ 2022 – 5% Market Exposure: Generation Build



7.5. Portfolio 5: SJ 2022 – 15% Market Exposure High Commodity

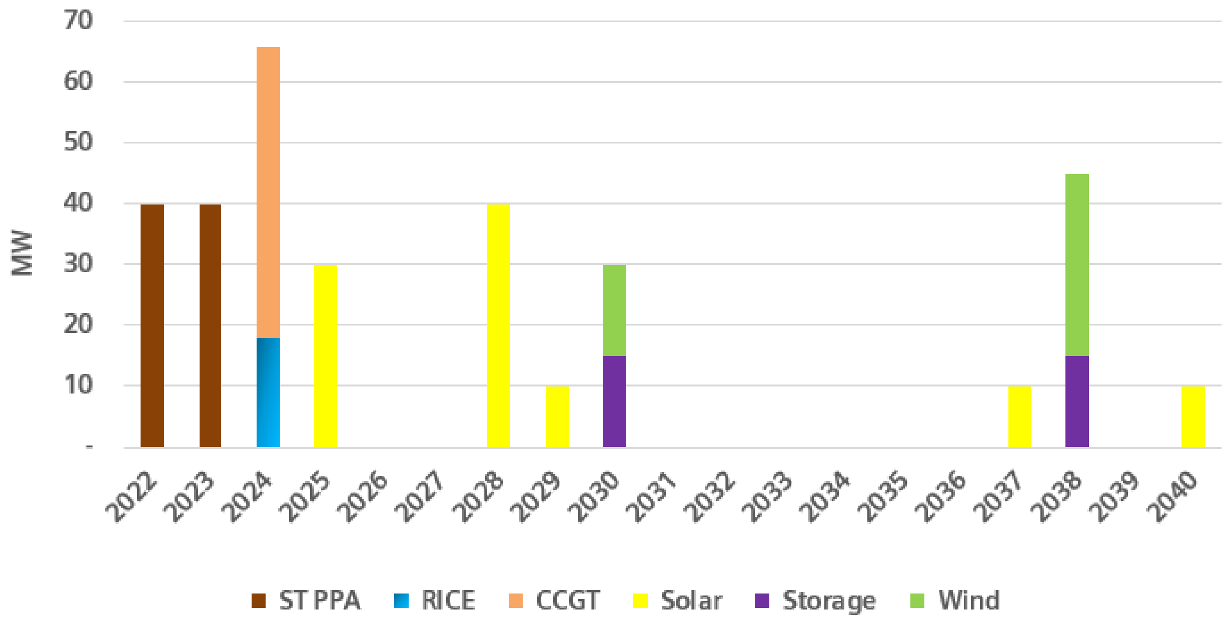
SJ 2022 – 15 % Market Exposure High Commodity Portfolio was developed to determine the generation portfolio build out in an environment where there was high fuel price and national policy around the cost of carbon emissions. The "High" case reflected in 6.2 Commodity Prices were used to develop the generation build out shown in Exhibit 13.

In the near term, 48 MW of Combined Cycle Gas Turbine (CCGT), 18 MW of RICE, and 30 MW of solar is required. A CCGT is a fuel-efficient machine, like Farmington's existing Bluffview unit, therefore, in a high gas price environment, it is selected to provide baseload support. The RICE unit is a fast-ramping resource that provide flexibility with intermittent solar generation.

In the medium term (2028-2030), 80 MW of renewables are added through 2030 comprising on solar, wind, and battery storage. In a high fuel price environment, more renewables are added since they provide lower cost of energy. The wind and solar additions provide the necessary electric generation during the day and night to serve Farmington's load at the lowest cost. Battery capacity provides the necessary energy to shift renewable generation to peak hours when solar generation is decreased.

In the longer term, 65 MW of additional renewable generation is added to serve Farmington's load. Overall, the SJ 2022- 15% Market Exposure High Commodity Portfolio incorporates 241 MW of capacity additions through the Planning Horizon.

Exhibit 13. SJ 2022 – 15% Market Exposure High Commodity: Generation Build



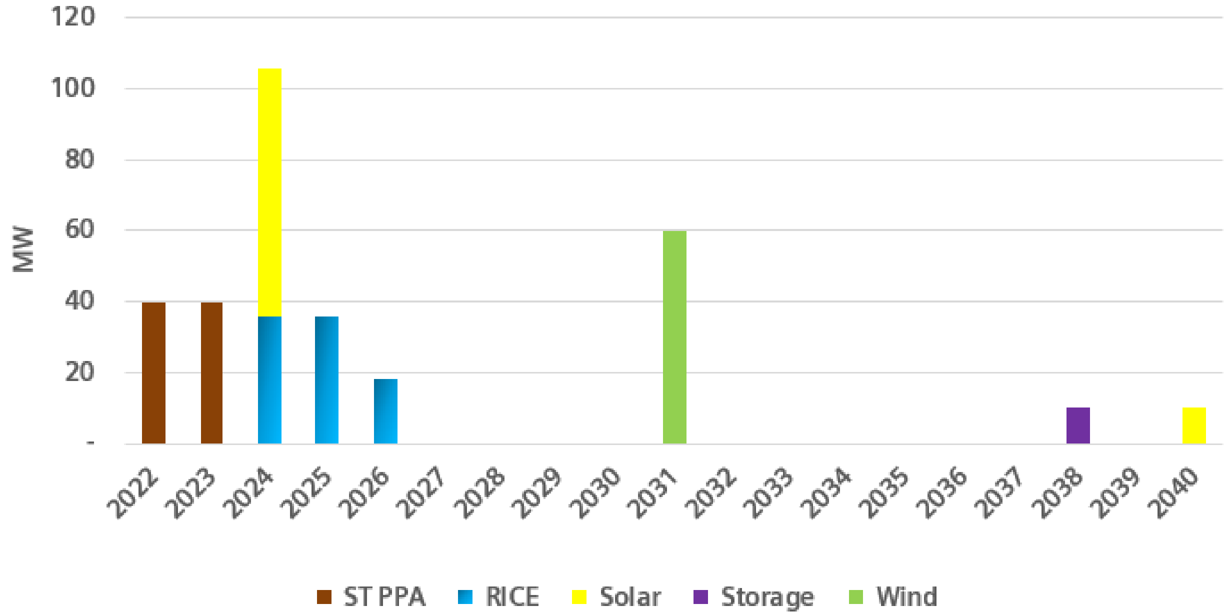
7.6. SJ 2022 – 5% Market Exposure High Commodity

The purpose of SJ 2022 – 5% Market Exposure High Commodity Portfolio is to assess the impact of reducing market exposure from the SJ 2022 – 15% Market Exposure High Commodity Portfolio, while leaving all other variables constant.

As shown in Exhibit 14, 90 MW of RICE and 70 MW of solar is added in near term. In 2031, 60 MW of wind is added to support nighttime load and reduce dependance on gas fired generation due to higher fuel prices. In the longer term, 20 MW of renewable energy is added comprising of solar and battery storage. A total of 240 MW of capacity is required through the Planning Horizon.

While the overall generation addition remains virtually similar to 15% High Commodity Portfolio, the mix of technology is different.

Exhibit 14. SJ 2022 – 5% Market Exposure High Commodity: Generation Build



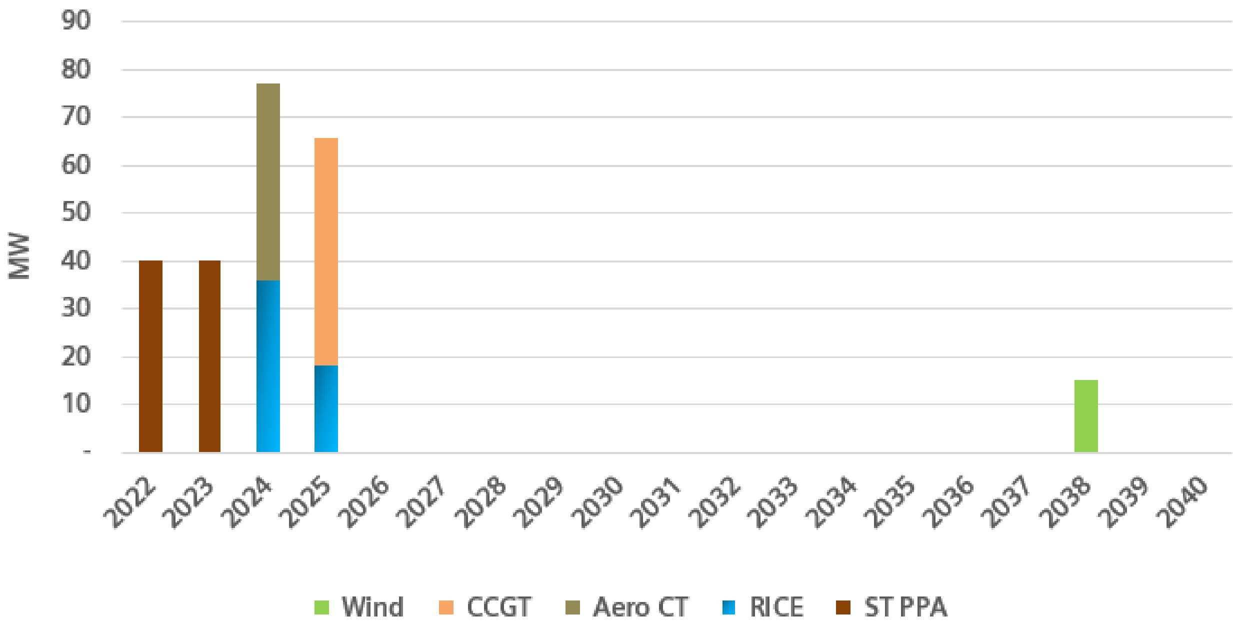
7.7. SJ 2022 – 15% and 5% Market Exposure Low Commodity

Conversely to the High Commodity Portfolios, the Low Commodity Portfolios aims to evaluate generation optimized for a scenario where fuel prices remain lower than reference case and there is no cost for carbon emissions. Exhibit 15, shows in the near term 143 MW of fossil fuel generation is added as a result of low fuel prices and no mandate on carbon emission reduction. In the longer term, 15 MW of wind generation is added to meet load Farmington's load.

The Low Commodity Portfolios requires the least amount of capacity additions since almost all of the capacity is firm, and fossil based. This portfolio is particularly insightful as it offers a different generation mix than the other portfolios. The generation build is the same for both of the 15% and 5% Market Exposure portfolios as the new CCGT units are able to have higher capacity factors to reduce market exposure.

Another aspect of the Low Commodity Portfolio is the limited optionality in operation due to potential for more stringent environmental mandates or higher natural gas prices, which may result in higher costs or stranded assets for Farmington.

Exhibit 15. SJ 2022 – 15% & 5% Low Commodity: Generation Build



7.8. Summary of Candidate Portfolio by Generation Type

The generation build out from each Candidate Portfolios is shown in Exhibit 16. The generation build out required in near term is shown in Exhibit 17, consistent with Affordability objectives in the Balance Scorecard.

Exhibit 16: Capacity Additions by Candidate Portfolio through the Planning Horizon

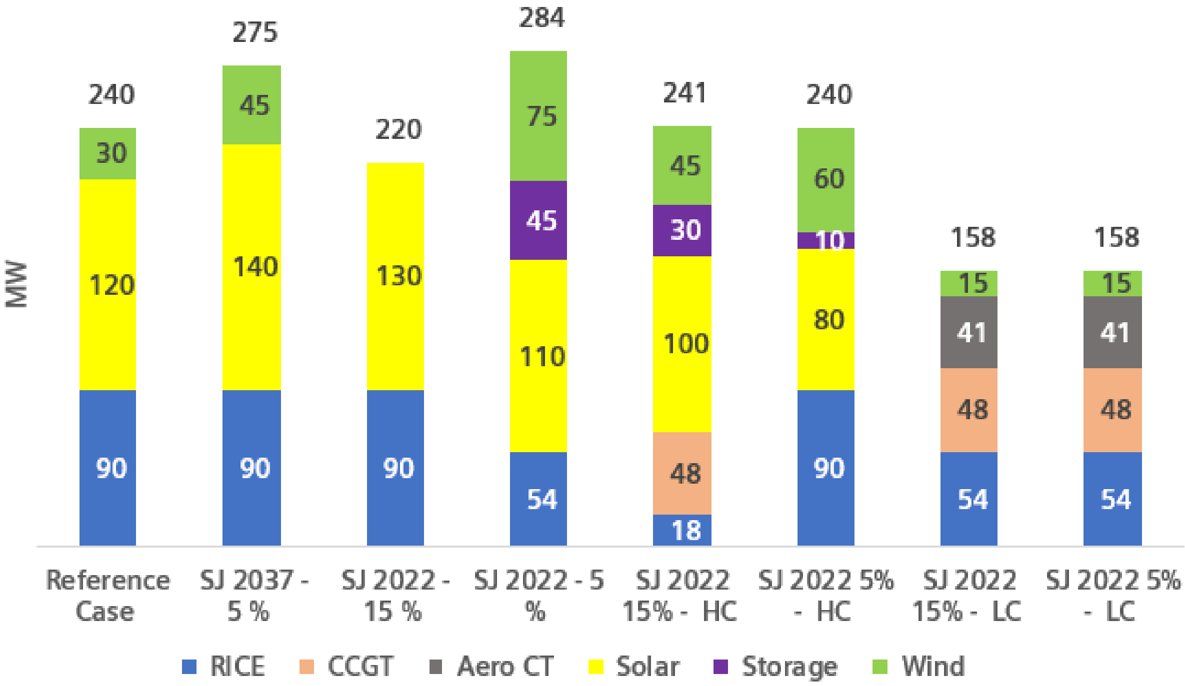
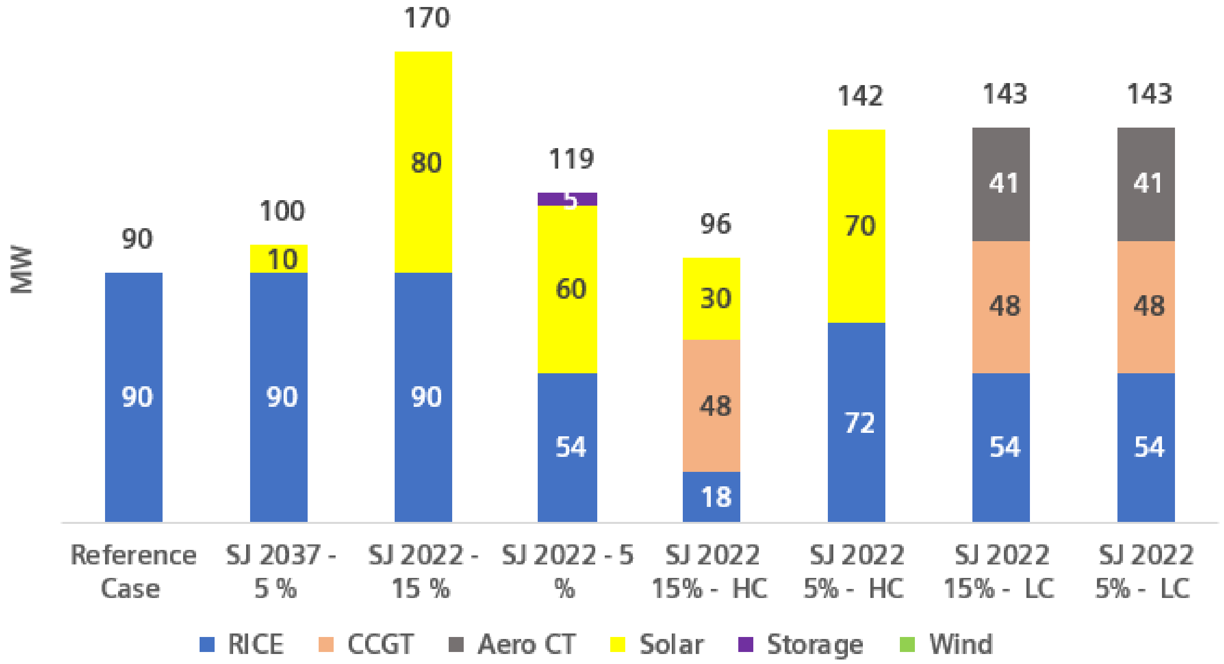


Exhibit 17: Capacity Additions required in 2024-2025 by Candidate Portfolios



8. Candidate Portfolio Analysis (Step 4)

8.1. Introduction

Probabilistic modeling (also known as stochastic analysis or risk analysis) incorporates several market variables and probability distributions into the analysis, allowing for the evaluation of a portfolio's performance over a wide range of market conditions. Quantitative data is extracted from the results and is the foundation for some metrics in the Balanced Scorecard.

Probabilistic modeling begins with the development of two hundred sets of future pathways for natural gas prices, coal prices, peak and average load, and CO_2 prices. These two hundred sets of future pathways are based on the forecasts of the expected value of these variables, described in Sections 6. A stratified sampling of thousands of initial simulations allows the sample set to be reduced to two hundred iterations, or individual simulations, while still allowing for a representative sample of the universe of potential outcomes. These inputs allow for the testing of each portfolio's performance across a wide range of market conditions.

All Candidate Portfolios were subjected to each of the two hundred iterations or simulations using the production cost model AURORAxmp in dispatch mode where Farmington's candidate portfolios are fixed but other WECC members are allowed to make build and retirement decisions. The stochastic modeling of each Portfolio was developed by Siemens PTI using the AURORAxmp® dispatch model. There were several steps to this process:

- The first step was to develop the input distributions for each of the major market and regulatory drivers, including average and peak load growth and shape, natural gas prices, coal prices, CO_2 prices, and technology capital costs. This was done by considering volatility of each factor in the short-term, medium-term, and long-term.
- The second step was to run a probabilistic model (Monte Carlo) which simulated two hundred possible future states over the Planning Horizon.
- In the third step, each Candidate Portfolio was then run through simulated dispatch for the two hundred possible future states using the AURORA production cost model. AURORA dispatches the Candidate Portfolio for each sampled hour over the planning horizon. For this risk analysis procedure, AURORA assumes that each Candidate Portfolio is constant but allows for builds and retirements to occur throughout the region based on economic criteria. Farmington's generation, costs, emissions, revenues, and other operating parameters are tracked for each iteration over time.
- Next, values for key metrics associated with Affordability and Risk are tracked across all two hundred iterations and presented as a distribution with a mean and other percentile (5th, 25th, 50th, 75th, and 95th).
- These measures are used as the basis for evaluation in the stochastic analysis.

8.2. Use of Stochastic Analysis

The stochastic analysis includes the probabilistic modeling conducted to inform the objective analytical considerations in the selection of the Preferred Portfolio(s). Many other factors were considered besides the stochastic analysis. Nevertheless, a key part of designing the

Preferred Portfolio(s) was based on how well each portfolio scored on multiple metrics and Category across two hundred energy market simulations representing different, but internally consistent and plausible, market conditions.

The selection process consisted of several comparisons illustrating each Candidate Portfolio's performance measured against competing objectives. The goal is to create the right balance between satisfying the competing objectives. The Preferred Portfolio(s) delivered the best balance of performance across all competing metrics when viewed across the full range of two hundred simulations, while also maintaining Reliability and Operational flexibility. This procedure is used and presented in the sections below where each portfolio is assessed.

9. Analysis Results and Comparison (Step 5)

Siemens PTI conducted an extensive analysis of the options available to Farmington for fulfilling its energy demand through 2040. The analysis included conventional and renewable energy generation, and battery storage systems both in Farmington's service territory and more generally in the broader WECC. Additionally, the analysis accounted for price risk exposure by varying the spot market purchase and sales to quantify the impact to Farmington's customers.

The overall analysis considers a multitude of metrics across the four Categories described in Exhibit 2. The result of the analysis is summarized in the Balance Scorecard in Exhibit 22. The colors are a visual aid to represent the performance of each portfolio on each metric. A predominance of green is favorable, and a predominance of red is unfavorable. The analysis concluded that the SJ 2037 – 15 Market Exposure (Reference) and SJ 2037- 15% Market Exposure High Commodity (SJ 2037-15% HC) Portfolios perform the best out of all Candidate Portfolios. Each Category, Objective and associated metrics are explained in more detail in the next section.

9.1. Affordability

The most important Category is Affordability and is weighted at 50% in the Balanced Scorecard. The Affordability of the portfolios is important because it ultimately determines the costs for Farmington to serve all load. There are many cost components that feed into the metrics shown in Exhibit 18, including fuel costs, fixed operating and maintenance costs, variable operating and maintenance costs, emission costs, capital costs and spot market sales and purchases.

Exhibit 18: Affordability Metrics and Results

Categories	Objectives	IRP Metric	Weight	Reference: SJ 2037- 15% Mrk. Limit	SJ 2037- 5% Mrk. Limit	SJ 2022- 15% Mrk. Limit	SJ 2022- 5% Mrk. Limit	SJ 2022- 15% High Commodity	SJ 2022- 5% High Commodity	SJ 2022- 15% Low Commodity	SJ 2022- 5% Low Commodity
Affordability	Preserve Competitive Rates	Net Present Value (NPV) Cost to Serve Load 2022-2040 (Average across market conditions, $2019 Millions)	10%	$516	$542	$530	$531	$524	$557	$581	$598
	Preserve Competitive Rates	NPV Cost to Serve Load 2022-2027 (Average across market conditions, $2019 Millions)	10%	$210	$222	$218	$220	$212	$224	$231	$241
	Capital Investment	Capital Expenditure for New Generation in 2024-2025 ($Millions Nominal)	30%	$121	$134	$229	$160	$129	$192	$191	$192

9.1.1. Preserve Competitive Rates

This metrics calculates the net present value cost of the portfolio in real terms discounted at 5%. A lower NPV cost is considered favorable as it requires less costs to serve Farmington's load. For Farmington, it was important to look at the cost of each Candidate Portfolio not only over the Planning Horizon but also over the near term (next 5 years). Each metric was assigned an overall weight of 10%. The best performing Portfolios were Reference followed closely by SJ 2022-15% HC. The Low Commodity cases were the worst performing since they were heavily exposed to natural gas price and associated gas price volatility.

9.1.2. Capital Investment

Capital expenditure is the most important metric for Farmington due to capital constraints. As such, a weight of 30% was assigned to the level of spend that will be required through 2025. For this metric, the two best scoring portfolios were Reference followed closely by SJ 2022-15% HC since these two portfolios requires the lowest amount of capacity additions through 2025. The worst scoring portfolio was SJ 2022- 15% as it required substantially more capacity additions versus the other portfolios in the near term.

9.2. Risk

The Risk Category is weighted at 20% in the Balanced Scorecard. The Risk of the Candidate Portfolios is important because these metrics measure the potential volatility in cost to Farmington based on uncertainty in market conditions. Additionally, the Risk category identifies the amount of generation capacity controlled by Farmington and amount of Spot Market purchases that may be required to meet load. The results of the Risk Category metrics are shown in Exhibit 19.

Exhibit 19: Risk Metrics and Results

Categories	Objectives	IRP Metric	Weight	Reference: SJ 2037- 15% Mrk. Limit	SJ 2037- 5% Mrk. Limit	SJ 2022- 15% Mrk. Limit	SJ 2022- 5% Mrk. Limit	SJ 2022- 15% High Commodity	SJ 2022- 5% High Commodity	SJ 2022- 15% Low Commodity	SJ 2022- 5% Low Commodity
Risk	Cost Risk	95th Percentile Value of NPV ($Millions)	10%	$638	$654	$653	$696	$648	$670	$723	$743
	Minimize Operational and Control risks	Farmington Controlled Capacity (2030, MW)	5%	149	159	149	178	155	149	161	161
	Market Risk Minimization	NPV Energy Market Purchases 2022-2040 (Averge, $Millions)	5%	$76	$49	$90	$59	$89	$58	$83	$53

9.2.1. Cost Risk

This metrics calculates the NPV cost of the portfolio at the 95th percentile confidence band. The 95% percentile band is important as it provides insight into potential high portfolio costs during potential future market conditions. The best performing Portfolios were Reference followed by SJ 2022-15% HC. The Low Commodity Portfolios, which are mostly fossil fuel based, had the highest costs (and worst scores) since they were heavily exposed to natural gas price and associated volatility.

This metric along with the NPV Cost to Serve load from the Affordability Category provides insight into one of the key questions for Farmington around the value of spot market exposure. For instance, comparing SJ 2022- 15% and SJ 2022- 5% portfolio, informs us that the overall cost of the 15% market exposure portfolio on average ($530M) and 95% percentile ($653M) is considerably lower than the 5% ($531M and $696M) portfolio, respectively. This indicates that lowering spot market exposure results in higher overall cost to Farmington, therefore 15% market exposure is the more cost effective.

9.2.2. Minimize Operational and Control Risk

The ability to control operational output from a generation unit is important as it allows flexibility and limit spot market exposure. This metric has a weighting of 5%. The best performing portfolio was the SJ 2022-5% Market Exposure with 178 MW of capacity under Farmington's control. The amount of capacity under Farmington's control reflects the capital cost constraint and exclude capacity that would be under a PPA. Of all the portfolios, SJ 2022

– 5% had the highest level of generation additions through the Planning Horizon. The worst performing portfolio for this metric was a three-way tie between Reference, SJ 2022 – 15%, and SJ 2022- 15% HC.

9.2.3. Market Risk Minimization

This metric indicates the amount of spot market purchases that are required over the Planning Horizon and has a weighting of 5%. Higher cost indicates greater level of spot market purchases and is viewed unfavorably relative to portfolios that require less purchases. The best scoring portfolios were ones with 5% spot market exposure and conversely, 15% market exposure had the highest costs.

9.3. Sustainability

While Farmington does not have explicit CO_2 and Renewable Portfolio Standard objectives to meet during the Planning Horizon, environmental concerns were viewed as a Balanced Scorecard Category, with a total weighting of 10% across the two objectives of decreasing CO_2 emissions relative to 2021 and increasing diversity within its renewable generation mix. The results of the Risk Category are shown in Exhibit 20.

Exhibit 20: Sustainability Metric and Results

Categories	Objectives	IRP Metric	Weight	Reference: SJ 2037- 15% Mrk. Limit	SJ 2037- 5% Mrk. Limit	SJ 2022- 15% Mrk. Limit	SJ 2022- 5% Mrk. Limit	SJ 2022- 15% High Commodity	SJ 2022- 5% High Commodity	SJ 2022- 15% Low Commodity	SJ 2022- 5% Low Commodity
Sustainability	Reduce CO_2 Footprint	CO_2 Emissions Reductions by 2040	5%	-45%	-49%	-38%	-57%	-53%	-50%	-23%	-25%
	Renewable Generation	Renewable Penetration by 2040	5%	38%	41%	31%	50%	43%	41%	11%	11%

9.3.1. CO_2 Footprint

An increasing concern regarding global climate change has put specific emphasis on the carbon footprint associated with different power generating resource options. Although coal-fired generation remains one of the low-cost resources, its environmental impacts pose a growing concern to the public and utility planners. Moreover, the potential for significant costs associated with CO_2 emissions constitutes a major risk for coal plant owners. With this context in mind, different portfolio options were evaluated based on the achieved CO_2 footprint reduction by 2040. Assuming all other metrics remain the same, any portfolio that achieves lower CO_2 emission was given preference. The best performing portfolio was SJ 2022- 5% followed closely by SJ 2022- 15 HC. The Portfolios with San Juan retiring in 2037 assumes that 95% of the CO_2 emission would be captured and sequestered. The worst performing portfolios were the Low Commodity Portfolios, which has greater percentage of generation from fossil fuel.

9.3.2. Renewable Generation

Although the City does not face a specific regulation concerning a renewable generation target currently, Farmington's environmental goals require the addition of renewable resources to the supply mix, especially in the long term. Renewables generation, particularly solar and wind, were the cheapest resource under most conditions, as shown in Exhibit 7, which helped Farmington with its Affordability objectives. Analysis showed that increasing generation from renewable resources will also directly result in reduced CO_2 emissions for the portfolio. The percentage of generation from renewable resources was the metric used to reflect greater renewable stewardship. Different portfolio options were evaluated based on the percentage of the utility's net energy for load to be served by renewable generation by 2040. The rating for portfolios is similar to the ranking observed in CO_2 footprint metric.

9.4. Operability

Farmington expressed a strong desire to manage its largest contingency by ensuring the availability of a minimum of 16 MW firm capacity, including the Southwest Reserve Sharing Group (SRSG), which is a coalition of participants who share contingency reserves to maximize generator dispatch efficiency. All Portfolios were able to provide the necessary firm capacity required to satisfy the SRSG agreement. The management of largest contingency was weighted at 10%.

In addition, the minimum ratio of 50% fast ramping to renewable capacity in a single year was imposed across all Candidate Portfolios to increase Farmington's ability to meet its operability objective particularly from intermittent resource such as solar. This metric was weighed at 10%. Overall, all Portfolios expect for SJ 2037 -15% were able to achieve the fast-ramping ratio requirement.

Exhibit 21: Operability Metric and Results

Categories	Objectives	IRP Metric	Weight	Reference: SJ 2037- 15% Mrk. Limit	SJ 2037- 5% Mrk. Limit	SJ 2022- 15% Mrk. Limit	SJ 2022- 5% Mrk. Limit	SJ 2022- 15% High Commodity	SJ 2022- 5% High Commodity	SJ 2022- 15% Low Commodity	SJ 2022- 5% Low Commodity
Reliability	Manage Largest Contingency (N-1)	Firm Capacity available to met largest contingency including SRSG (Min 16 MW)	10%	61	67	59	30	39	54	65	68
	Fast Ramping Capability	Ratio Fast Ramping To Renewable Capacity in Single year (Min 50%)	10%	59%	48%	68%	52%	65%	51%	100%	100%

10. Conclusions and Key Findings

This IRP report is designed to provide Farmington with the information needed to consider the tradeoffs associated with the different Candidate Portfolios. By comparing all Candidate Portfolios, this study was able to establish some key findings.

Exhibit 22: Balance Scorecard

Categories	Objectives	IRP Metric	Weight	Reference: SJ 2037- 15% Mrk. Limit	SJ 2037- 5% Mrk. Limit	SJ 2022- 15% Mrk. Limit	SJ 2022- 5% Mrk. Limit	SJ 2022- 15% High Commodity	SJ 2022- 5% High Commodity	SJ 2022- 15% Low Commodity	SJ 2022- 5% Low Commodity
Affordability	Preserve Competitive Rates	Net Present Value (NPV) Cost to Serve Load 2022-2040 (Average across market conditions, $2019 Millions)	10%	$516	$542	$530	$531	$524	$557	$581	$598
	Preserve Competitive Rates	NPV Cost to Serve Load 2022-2027 (Average across market conditions, $2019 Millions)	10%	$210	$222	$218	$220	$212	$224	$231	$241
	Capital Investment	Capital Expenditure for New Generation in 2024-2025 ($Millions Nominal)	30%	$121	$134	$229	$160	$129	$192	$191	$192
Risk	Cost Risk	95th Percentile Value of NPV ($Millions)	10%	$638	$654	$653	$696	$648	$670	$723	$743
	Minimize Operational and Control risks	Farmington Controlled Capacity (2030, MW)	5%	149	159	149	178	155	149	161	161
	Market Risk Minimization	NPV Energy Market Purchases 2022-2040 (Averge, $Millions)	5%	$76	$49	$90	$59	$89	$58	$83	$53
Sustainability	Reduce CO_2 Footprint	CO_2 Emissions Reductions by 2040	5%	-45%	-49%	-38%	-57%	-53%	-50%	-23%	-25%
	Renewable Generation	Renewable Penetration by 2040	5%	38%	41%	31%	50%	43%	41%	11%	11%
Reliability	Manage Largest Contingency (N-1)	Firm Capacity available to met largest contingency including SRSG (Min 16 MW)	10%	61	67	59	30	39	54	65	68
	Fast Ramping Capability	Ratio Fast Ramping To Renewable Capacity in Single year (Min 50%)	10%	59%	48%	68%	52%	65%	51%	100%	100%
Total Score				6.4	4.7	3.8	5.4	6.5	3.9	3.0	2.8

- The two best scoring Candidate Portfolios based on Farmington's objectives were determined to be:
  - San Juan 2037 Retirement with a 15% Market Exposure Limit (Reference)
  - San Juan 2022 Retirement with a 15% Market Exposure Limit, High Commodity (SJ 2022- 15% HC)

  Both high scoring Portfolios have a different technology mix (particularly in near term), therefore contingency planning will be required due to the uncertainty of San Juan's (SJ) retirement date to ensure projects are executed on schedule in the event SJ is retired in 2022 or near term.

- Farmington will require generation capacity in the near term and longer term to meet its objectives, particularly around reliability and market exposure. All portfolios meet 150 MW firm generation requirement.
- Portfolios with 15% market exposure have lower portfolio costs on average and at the 95th percentile value relative to portfolios with 5% market exposure, with all other variables being constant.
- Farmington's ~$150 M capital cost limit will require PPAs to supplement generation requirement to meet IRP objectives. Approximately 100 MW of generation capacity could be built given the capital constraint.

Appendix A: Stochastic Distributions

Load Distribution

To account for electricity demand variability and uncertainty that derives from economic growth, weather, energy efficiency, distributed generation and demand side management measures, Siemens PTI developed a range of stochastic inputs around the energy demand expectations. Siemens PTI forecasted long-term energy demand using a two-step process that captures both the impact of historical load drivers such as economic growth and variability of weather and the potential impacts of energy efficiency, demand response, distributed generation, electric vehicles, and electrification opportunities (driven by exploration and agriculture). Exhibit 23 and Exhibit 24 shows Siemens PTI's stochastic range for annual average load and peak demand and includes a wide range of potential energy efficiency, demand response, distributed generation, and electric vehicle adoption.

The stochastic distributions are the net result of two hundred random simulations for the base load forecasts shown in Section 6.1.1. Siemens PTI calculated the distributions for the 5th and 95th percentiles (approximately two standard deviations), quartiles (25th, 50th, and 75th percentiles), and the average (mean) of the annual distributions over time.

Exhibit 23: Forecasted Farmington Annual Average Load

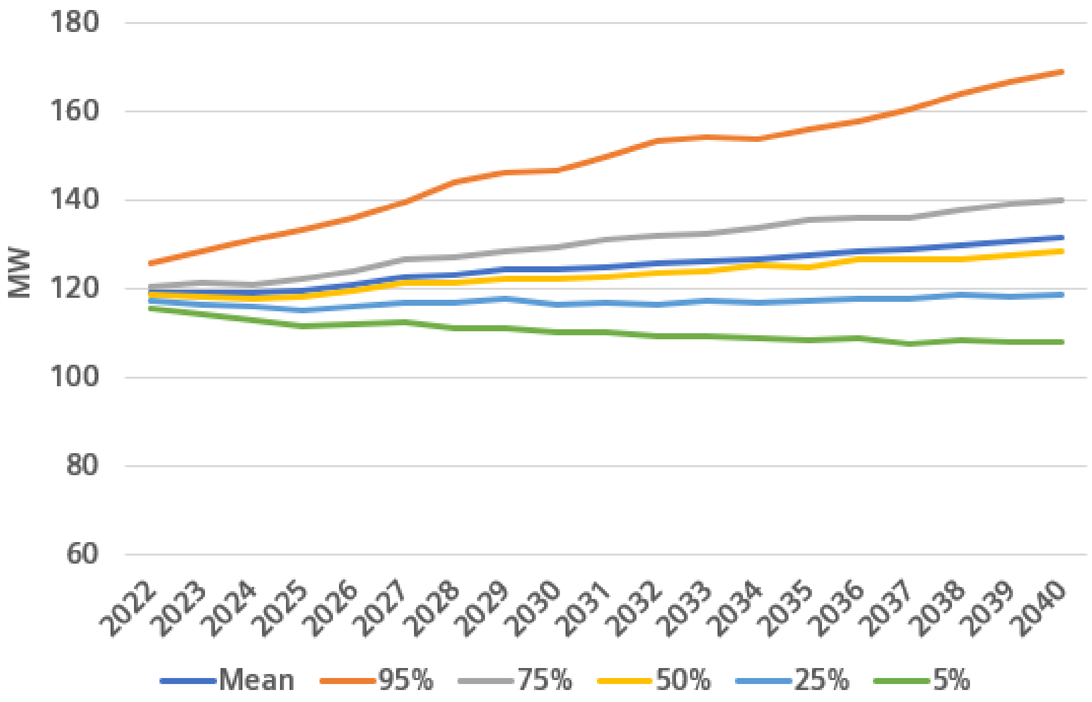
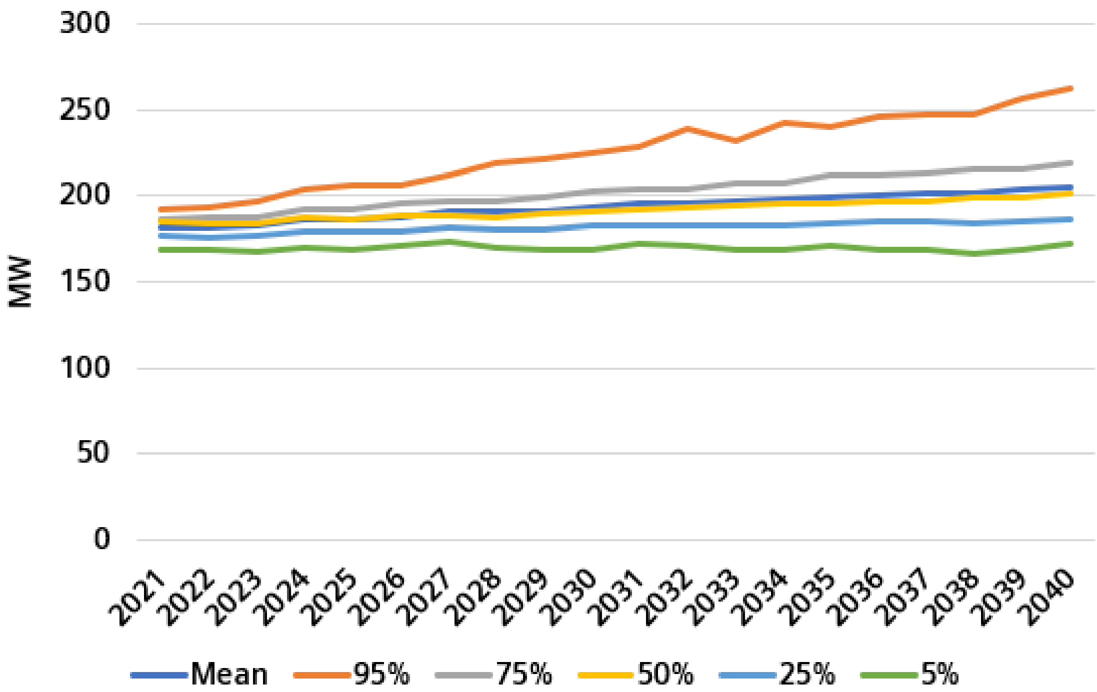


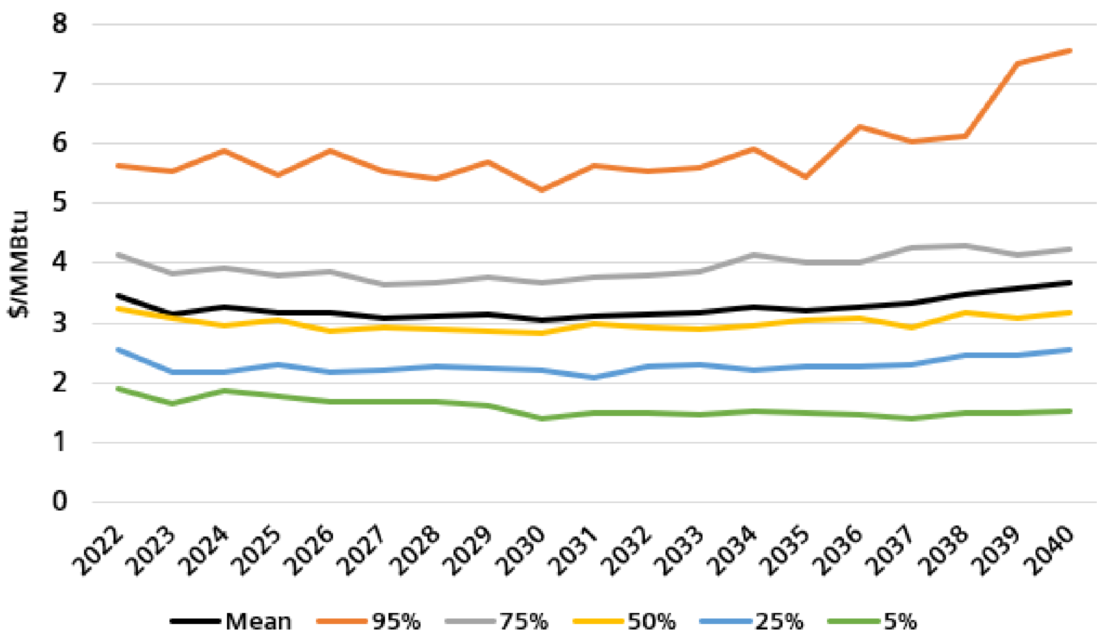
Exhibit 24: Forecasted Farmington Peak Demand Load



Natural Gas Price Distribution

Siemens PTI developed natural gas price stochastic distributions for the benchmark natural gas commodity price at the Henry Hub market point. The stochastic distributions are first based on the expert view on three market conditions – Reference, High and Low – as shown in Section 6.2.1. The probability bands, as shown in Exhibit 25, were developed based on a combination of historical volatility and mean reversion paraments as well as a forward view of expected volatility.

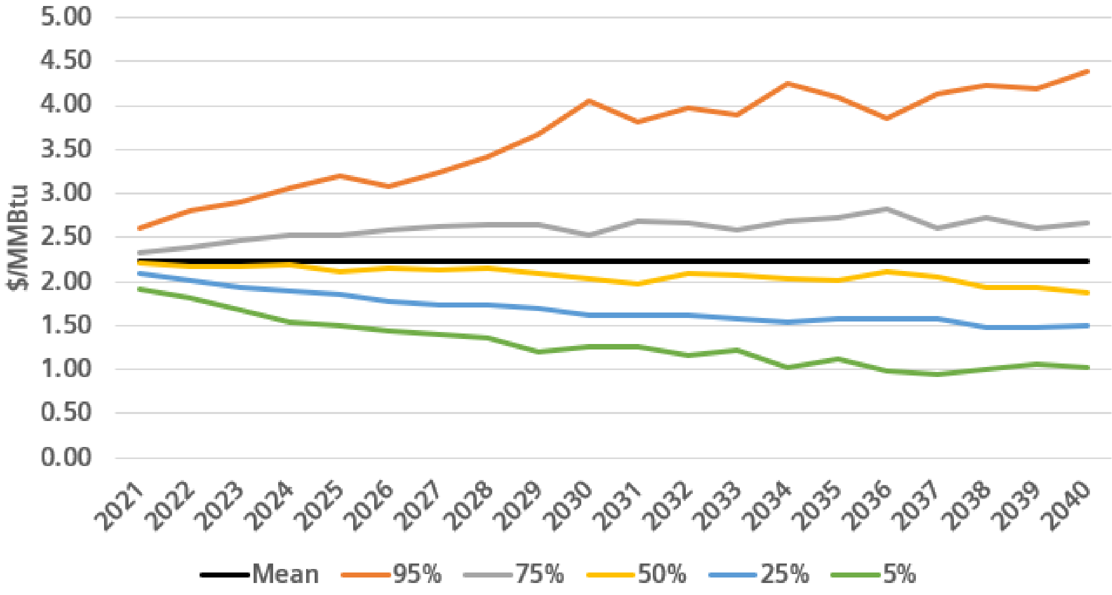
Exhibit 25: Natural Gas (Henry Hub) Price Distribution (2019$)



Coal Price Distribution

These stochastic distributions were first based on expected view of coal prices in the Power River Basin (PRB), as shown in Section 6.2.2, with probability bands then developed based on a combination of historical volatility and mean reversion parameters. Siemens PTI added transportation adders to represent the delivered coal prices to San Juan as shown in Exhibit 26.

Exhibit 26: San Juan Coal Price Distribution (2019$)



Emission Price (CO_2) Distribution

Siemens PTI developed uncertainty distributions around CO_2 compliance costs (Exhibit 27), which were used to capture the inherent risk associated with regulatory compliance requirements. The technique to develop CO_2 costs distributions, unlike the previous variables, is based on projections largely derived from Siemens PTI's expert judgment, as there are no national historical data sets (only regional markets in California and the northeast) to estimate the parameters for developing CO_2 costs distributions. The expected value (mean of the distribution) reflects a view that some type of legislation will likely occur in the 2025. This view reflects, President Biden's announcement in April 2021 that the United States is formally committing to cutting economy-wide greenhouse gas (GHG) emissions by between 50 and 52% from 2005 levels by 2030 and reach net zero emission by 2050. Several analyses have found that to reach the overall target, power sector emissions need achieve around 80% reduction from 2005 levels by 2030[5].

[5] Environmental Defense Fund.
https://www.edf.org/sites/default/files/documents/Recapturing%20U.S.%20Leadership%20on%20Climate.pdf

Exhibit 27: National CO_2 Emission Price ($2019)