Exh. SWM-4
Docket UG-240008
Witness: Scott W. Madison

BEFORE THE
WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION

WASHINGTON UTILITIES AND TRANSPORTATION COMMISSION, Complainant, v. CASCADE NATURAL GAS CORPORATION, Respondent.	DOCKET UG-240008

CASCADE NATURAL GAS CORPORATION

THIRD EXHIBIT TO THE
DIRECT TESTIMONY OF SCOTT W. MADISON

March 29, 2024

CASCADE NATURAL GAS CORPORATION®

A Subsidiary of MDU Resources Group, Inc.

In the Community to Serve®

2023
Integrated Resource Plan

February 24, 2023

resources in that they are more volatile, both in terms of availability and price, and are largely influenced by the laws of supply and demand.

In general, spot market supplies (also called day gas) are provided from gas supplies not under any long-term firm contract. Therefore, as firm market demand decreases, more gas becomes available for the spot market. Prices for spot market supplies are market driven and may be either lower or higher than prices under firm supply contracts. In warmer weather, as firm market demand requirements decrease, usually more gas becomes available for the spot market, resulting in lower prices. In colder weather, as firm markets demand their gas supplies, the remaining spot market supplies can carry higher prices.

The role for spot market gas supply in the core market portfolio is based on economics. Spot market supplies may be used to supplement firm contracts during periods of high demand or to displace other volumes when it is cost effective to do so. Depending upon availability and price, spot market volumes may be used in place of storage withdrawal volumes to meet firm requirements on a given day or for mid-heating season refills of storage inventory during periods of moderate weather.

While Figure 4-1 provides a general overview of regional gas flows to Cascade's distribution system, supporting detail is included in Appendix E.

Renewable Natural Gas

Renewable natural gas (RNG) is an emerging supply option that brings many benefits, chief among them emissions reduction. Since submitting its last IRP, Cascade has made significant strides in analyzing, planning, and acquiring RNG. In this section and elsewhere in this IRP, issues unique to RNG are found in the inset box to the right.

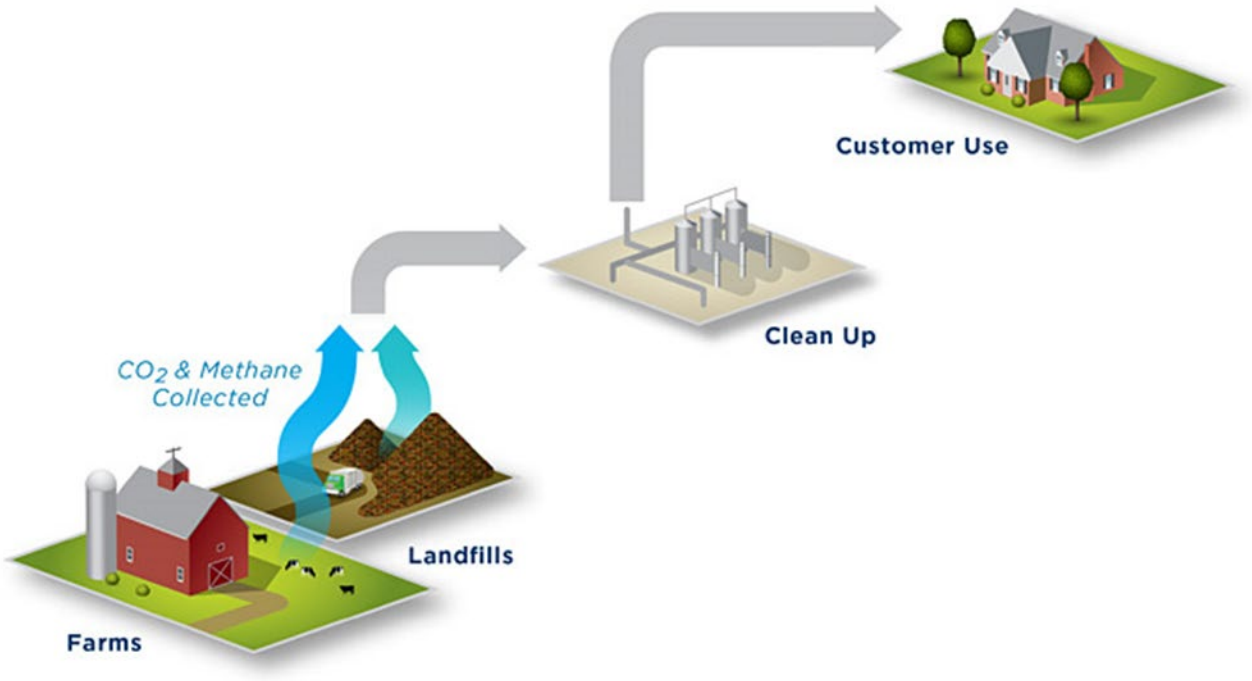
QUICK REFERENCE TO RNG LOCATIONS IN IRP

RNG, as defined in RCW 54.04.190,[3] is a gas consisting largely of methane and other hydrocarbons derived from the decomposition of organic material in landfills, wastewater treatment facilities, and anaerobic digesters. Cascade is committed to developing programs that allow the Company to acquire RNG under guidelines and rules stated in Washington HB 1257 and Oregon SB 98.

[3] *See* https://app.leg.wa.gov/rcw/default.aspx?cite=54.04.190

Figure 4-2,[4] provides an example of a general RNG process from landfill to end-user.

Figure 4-2: Example of RNG process from landfill to end user



Renewable natural gas, biomethane and biogas are sometimes used interchangeably but they are different biofuel products along the value chain:

- Biogas is a mixture of carbon dioxide and hydrocarbons, primarily methane gas, from the biological decomposition of organic materials.
- Biomethane is a biogas-derived, high BTU gas that is predominately methane after the biogas is upgraded to remove contaminants.
- Renewable natural gas is biomethane upgraded to natural gas pipeline-quality standards so it can substitute or blend with conventional natural gas.[5]

Examples of RNG sources include:

- Biogas from Landfills
  - Collect waste from residential, industrial, and commercial entities.
  - Digestion process takes place in the ground, rather than in a digester.
- Biogas from Livestock Operations
  - Collects animal manure and delivers to anaerobic digester.
- Biogas from Wastewater Treatment

[4] U.S. Department of Energy, Alternative Fuels Data Center, Renewable Natural Gas
[5] American Natural Gas.com

    - Produced during digestion of solids that are removed during the wastewater treatment process.
- Other sources include organic waste from food manufacturers and wholesalers, supermarkets, restaurants, hospitals, and more.[6]

Biofuel estimates vary, for example, E3 estimates 25 million dry tons of biomass supply available to Washington and Oregon, compared to Washington State's deep decarbonization study which assumed 23.8 million dry tons available to the state.[7]

Applicable Regulations

In the past few years, RNG has been driven by public policy with the intent to reduce emissions. These laws and regulations are summarized below. Compliance with these requirements, from the perspective of targets to be achieved, is addressed in Chapter 6, Environmental Policy.

On April 15, 2019, Washington House Bill 1257[8] (HB 1257) was passed by the Senate and on April 18, 2019, the bill was passed by the House. Several sections within the bill are related to RNG and will be covered in this chapter.

Below, Cascade lists key portions of the House Bill relevant to RNG:

Sec. 12. (1) The legislature finds and declares that:

(a) Renewable natural gas provides benefits to natural gas utility customers and to the public; and

(b) The development of renewable natural gas resources should be encouraged to support a smooth transition to a low carbon energy economy in Washington.

(2) It is the policy of the state to provide clear and reliable guidelines for gas companies that opt to supply renewable natural gas resources to serve their customers and that ensure robust ratepayer protections.

Following the adoption of HB 1257 into law,[9] workshops were convened to determine how best to comply with these new mandates. Cascade has actively participated in all relevant workshops under Docket UG-190818, RNG Staff Investigation. Multiple company representatives engaged in these proceedings. The Company has also worked closely with its trade organization, the Northwest Gas Association, to provide

[6] U.S. Department of Energy, Alternative Fuels Data Center, Renewable Natural Gas.

[7] Energy + Environmental Economics, Pacific NW Pathways to 2050: Achieving an 80% reduction in economy-wide greenhouse gases by 2050.

[8] *See* http://lawfilesext.leg.wa.gov/biennium/2019-20/Pdf/Bills/House%20Passed%20Legislature/1257-S3.PL.pdf?q=20201020144814.

[9] Signed by Governor Jay Inslee on May 13, 2019 with an effective date of July 28, 2019.

the information and feedback necessary to support proposals submitted on behalf of the northwest LDCs.

In addition to Section 12, HB 1257 included two other sections with language pertaining to the development of renewable natural gas and offset programs:

Sec. 13. A new section is added to chapter 80.28 RCW to read as follows:

(1) A natural gas company may propose a renewable natural gas program under which the company would supply renewable natural gas for a portion of the natural gas sold or delivered to its retail customers. The renewable natural gas program is subject to review and approval by the commission. The customer charge for a renewable natural gas program may not exceed five percent of the amount charged to retail customers for natural gas.

(2) The environmental attributes of renewable natural gas provided under this section must be retired using procedures established by the commission and may not be used for any other purpose. The commission must approve procedures for banking and transfer of environmental attributes.

(3) As used in this section, "renewable natural gas" includes renewable natural gas as defined in RCW 54.04.190. The commission may approve inclusion of other sources of gas if those sources are produced without consumption of fossil fuels.

Cascade has been identifying viable pathways for the inclusion of renewable natural gas as part of its fuel mix, following the guidelines developing from the UG-190818, RNG Staff Investigation workshops and compliance obligations under Oregon's Climate Protection Plan (CPP) and Washington's Climate Commitment Act (CCA). Cascade has entered into one contract to bring RNG onto its system plus has been the selected bidder to enter into another contract. Cascade continues sourcing RNG with several producers as it performs analyses across its Washington and Oregon service areas. Fourteen projects are in various stages of planning and development, which Cascade discuss the projects that are either contracted for or very close beginning on page 4-11.

The Company's current timeline to incorporating RNG onto the system under its first contract is late 2023. In the meantime, Cascade continues developing a cost effectiveness evaluation tool, as described in the following subsection, for RNG to allow the Company to model the impact to retail customers in order to not exceed the five percent of the amount charged from section 13.1 of the bill.

Sec. 14. A new section is added to chapter 80.28 RCW to read as follows:

(1) Each gas company must offer by tariff a voluntary renewable natural gas service available to all customers to replace any portion of the natural gas that would otherwise be provided by the gas company. The tariff may provide reasonable limits on participation based on the availability of renewable

> natural gas and may use environmental attributes of renewable natural gas combined with natural gas. The voluntary renewable natural gas service must include delivery to, or the retirement on behalf of, the customer of all environmental attributes associated with the renewable natural gas.
> (2) For the purposes of this section, "renewable natural gas" includes renewable natural gas as defined in RCW 54.04.190. The commission may approve inclusion of other sources of gas if those sources are produced without consumption of fossil fuels.

As noted above, Cascade is constantly assessing options for how to best acquire RNG and its associated attributes. These resources would be applied for the purposes described under Sec 13 and 14 of HB 1257 and to meet the obligations under the CCA and CPP. Cascade is in the process of identifying internal and external resources to support the acquisition of environmental attributes and renewable gas for the voluntary renewable natural gas service required under Washington law prior to the first contracted RNG coming into Cascade's system in late 2023.

Cascade Project Cost Effectiveness Evaluation Methodology

Several departments within the Company have collaborated to create a model that allows Cascade to evaluate the cost-effectiveness of all potential RNG projects before entering into an agreement with potential suppliers. Similar to the Company's PLEXOS® modeling, the results of this calculation help inform final acquisition decisions, but ultimately must be combined with qualitative analysis from RNG subject matter experts. This subsection will present the model notes, a discussion of the static and dynamic inputs to the model and provide an understanding of how the results should be interpreted.

Cost Effectiveness Evaluation Model Notes

$$\boldsymbol{C_{RNG} = I_{RNG} - AC_U - AC_D + \sum_{T=1}^{365} (P_{RNG} + VC - CIF) * Q}$$

$$\boldsymbol{C_{Conventional} = \sum_{T=1}^{365} (P_{Conventional} + VC) * Q}$$

Where:

C_{RNG} = The all-inclusive annual cost of a proposed RNG project
I_{RNG} = The annual required investment to procure a proposed RNG resource. If Cascade is simply buying the gas and/or environmental attributes, this value is zero.

AC_U = Avoided upstream costs
AC_D = Avoided distribution system costs
P_{RNG} = Daily price of renewable natural gas being evaluated
Q = Daily quantity of gas being evaluated
VC = Variable cost to move one dekatherm of gas to Cascade's distribution system. This value can be zero if a project connects directly to the Company's system.
CIF = Carbon Intensity Factor. This is calculated by multiplying the Company's expected carbon compliance cost by 1 minus the ratio of a proposed project's carbon intensity to conventional gas' carbon intensity. For the purpose of compliance with the CCA and CPP, the CIP factor is just Cascade's expected carbon compliance cost in the various jurisdictions, as these rules do not account for the variable carbon intensities of various sources of RNG.
$C_{Conventional}$ = The all-inclusive annual cost of conventional natural gas.
If $C_{Conventional} \geq C_{RNG}$, a project can be considered cost effective, and should be acquired. If not, the project may still be considered under the regulatory exceptions discussed earlier in this chapter.

Static Versus Dynamic Inputs

Inputs to Cascade's model can be classified as either static or dynamic. Static inputs are ones that are not project specific, but rather related to the Company's system as a whole. They include Cascade's avoided costs, costs associated with the price of conventional gas, and regulatory factors that are used to calculate the impact to revenue requirement. Dynamic inputs on the other hand, are ones that need to be updated on a project by project basis. These include the price and quantity of the RNG, initial investment required, and carbon intensity of the project.

Purchase Versus Build

Cascade utilizes different proprietary models based on whether the Company is evaluating the purchase of RNG or the building and ownership of an RNG generating facility. While philosophically the same, the models are calibrated to account for slight differences in the various decision-making processes. The build decision model allows for more detailed inputs and evaluation of overhead variables related to ownership, such as tax impacts of ownership and depreciation of assets. The purchase model, on the other hand, allows for analysis of variable purchase structures, where Cascade may only purchase a fraction of the RNG quantity that will ultimately be flowed from an RNG deal, which also allows the model to consider revenue that the Company would earn from transportation agreements related to the volumes of RNG that Cascade would not own, but would still flow on its system.

Model Results

Once all inputs are populated, the model provides three main pieces of information: The potential enterprise value of the project over its lifetime, the first year dollar impact to revenue requirement, and the first year percentage impact to revenue requirement. As discussed in the model notes, if the cost of conventional gas is greater than or equal to the cost of RNG, the project can be considered cost effective. If not, the impact to revenue requirement provides a valuable insight as to whether the project is attractive from a regulatory perspective.

RNG Projects

Cascade is currently progressing with fourteen on-system RNG projects at varying stages of development. Seven of these projects are what Cascade refers to as Purchase Projects, where Cascade would on-board the RNG onto the Company's distribution system and purchase the environmental attributes to be utilized for voluntary RNG tariffs in Washington and Oregon. These types of RNG projects are Cascade's highest RNG priority.

The balance are projects where RNG is injected into its system and Cascade transports the customer's RNG so that they may market the environmental attributes to other parties (Transport Projects). Cascade cannot buy the environmental attributes on these projects because they are typically priced much higher than would be prudent for utility customers. One example of this is dairy projects where the current attribute values can be $60-$70/MMBtu. Some Transportation Projects also come to Cascade with the attributes pre-sold as a part of the financing package to fund the facility.

Of the Purchase Projects in development, four projects are either under contract or at very advanced stages of contracting as detailed below:

City of Richland – Horn Rapids Landfill & Lamb Weston RNG Project – Richland, Washington

Source - 3rd party developer has rights to raw biogas from two sources in close proximity to each other.

1. Landfill Gas from the City of Richland's Horn Rapids Landfill
2. Food Waste from potatoes at Lamb Weston's Richland Processing Plant.

Scope of Cascade Work

- Design and construct interconnect facilities
- Design and construct pipeline from interconnect facility to local distribution system

Status & Terms

- Under contract, engineering in progress
- 1,250,000 therm/yr
- 15-year term
- Projected in-service date late Q4 2023

Deschutes County Landfill RNG Project - Bend Oregon

Source - Cascade/Jacobs Engineering Team was successful candidate chosen through RFP process to own and operate processing facilities to convert landfill gas to RNG

Scope of Cascade Work

- Build, own, operate, and maintain the gas processing plant
- Design and construct interconnect facilities
- Design and construct pipeline from interconnect facility to local distribution system

Status & Terms

- Working through final contact terms with Deschutes County
- Plant engineering and design in progress
- 2,500,000 therm/yr
- 20-year term
- Projected in-service date Q4 2024

Industrial Wastewater RNG Project - Franklin County Washington

Source - Industrial wastewater processing facility currently serving several aggregated industrial food processors & growers.

Scope of Cascade Work

- Design and construct interconnect facilities
- Design and construct pipeline from interconnect facility to local distribution system

Status & Terms

- Resolving final contact terms with developer
- 3,400,000 therm/yr
- 20-year term
- Projected in-service date Q4 2024

Industrial Food Waste RNG Project - Benton County Washington

Source - Food waste from industrial food processor with existing digester

Scope of Cascade Work
- Design and construct interconnect facilities
- Design and construct pipeline from interconnect facility to local distribution system

Status & Terms
- In contract negotiations
- 715,000 therm/yr
- 10-year term
- Projected in-service date Q4 2023

The following two projects are Transportation Projects either under contract or at advanced stages of contracting as detailed below:

Divert, Inc. RNG Project – Longview, Washington

Source – Aggregated food waste from approximately 100 chain grocery outlets in Washington and Oregon

Scope of Cascade Work
- Design and construct interconnect facilities
- Design and construct pipeline from interconnect facility to local distribution system

Status & Terms
- Under contract, engineering in progress
- 1,800,000 therm/yr
- 10-year term
- Projected in-service date early Q1 2024

Diary RNG Project – Snohomish County, Washington

Source – Manure from 3,500 head dairy operation

Scope of Cascade Work
- Design and construct interconnect facilities
- Design and construct pipeline from interconnect facility to local distribution system

Status & Terms

- Interconnect Agreement terms reached, final contract draft in review
- 815,000 therm/yr
- 10-year term
- Projected in-service date early Q1 2024

Renewable Thermal Certificates

The Oregon Department of Environmental Quality (DEQ) has adopted M-RETS as the tracking platform to validate and track environmental attributes from RNG and hydrogen in the CCP. M-RETS utilize Renewable Thermal Certificates (RTCs) to track the production, transfer and retirement of these qualified environmental attributes. The RTC includes specific details like source, vintage, location, feedstock and a unique identifier. Each RTC is equal to one dekatherm of RNG produced. Currently, Washington only allows environmental attributes to be used for RCW 80.28.390, the voluntary renewable natural gas service. The current rules of the Climate Commitment Act (CCA) do not allow for environmental attributes, whereas the Climate Protect Program (CPP) in Oregon does. Cascade is currently in discussions with several producers to secure the necessary environmental attributes to meet future voluntary RNG programs as well as the CPP in Oregon.

Hydrogen

Hydrogen is believed to be a key component to achieving carbon compliance in the future. Hydrogen is being proven to be a safe, reliable option in specific applications and as a replacement option to tradition natural gas. Much research is underway to maximize understanding and reduce upstart costs. Currently, hydrogen is more cost prohibitive than other RNG options, but it is anticipated that costs will come down as hydrogen becomes a more viable option, which is further discuss later on in this chapter. Cascade is following various research projects that are underway.

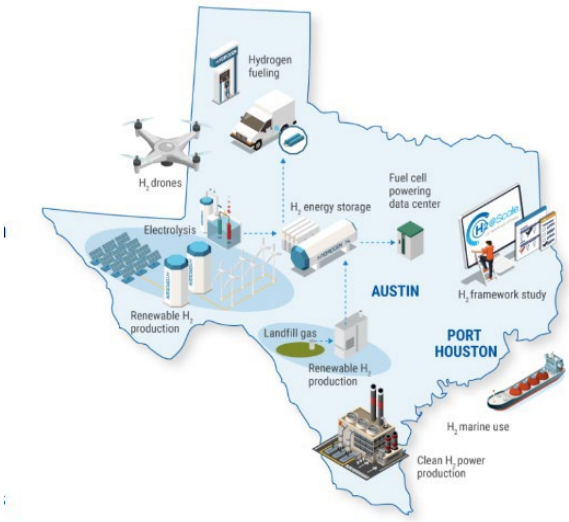
RNG and hydrogen will be critical in meeting the dual goals of decarbonizing energy pipelines while maintaining the benefits of reliability and resiliency provided by the Company's distribution system. One challenge from utilizing hydrogen is that it burns at a lower heating quality than traditional natural gas. A blend of 20% hydrogen by volume, which is Cascade's base case blending volume in the 2023 IRP, only equates to an offset of about 7.4% of traditional natural gas by energy. For both the CCA in Washington and the CPP in Oregon, the hydrogen quantities blended by energy are considered a one-for-one offset to traditional natural gas. While there are concerns about whether a blend of hydrogen and traditional natural gas would require a higher usage of this blended product, thus offsetting the emissions reduction savings of using hydrogen in the first place, Cascade is confident through conversations with various subject matter experts in this field that the blended

product would result in less than 1% loss of efficiency, creating a negligible need for additional use of the blend. That being said, the Company recognizes that thorough testing of hydrogen will still need to be performed before hydrogen can be utilized in Cascade's system.

Cascade has been closely monitoring hydrogen research such as the Hydrogen Shot[10] (111 Goal), H2Hubs, Low-Carbon Resources Initiative[11], and the Gas Technology Institute (GTI) Hydrogen Technology[12]. Hydrogen Shot was launched by the Department of Energy (DOE) and has a "111 goal," which is to reduce the cost of clean hydrogen by 80% to $1.00 per kilogram, down from $5.00 per kg, in the next decade. The DOE has released a notice of intent[13] to fund the bipartisan infrastructure laws with an $8 billion program to set up hydrogen hubs. Cascade's sister company, Intermountain Gas, is a member of the GTI, which is a research organization made up of member companies. There are two sub organizations under GTI, where one researches topics related to operation of pipeline systems and the other looks at end use equipment, particularly, focusing on energy efficiency.

As an example, there is a joint venture between DOE, GTI, Frontier Energy, and the University of Texas to design, build, and operate one of the largest collections of renewable hydrogen production and induced technologies ever assembled at one site[14].

Figure 4-3: H2@Scale in Texas and Beyond



[10] Hydrogen Shot | Department of Energy
[11] Low-Carbon Resources Initiative (epri.com)
[12] Hydrogen Technology Center • GTI Energy
[13] DOE Launches Bipartisan Infrastructure Law's $8 Billion Program for Clean Hydrogen Hubs Across U.S. | Department of Energy
[14] H2@Scale Project Launched in Texas | Energy Institute | The University of Texas at Austin (utexas.edu)

RNG and Hydrogen Projections

Cascade is utilizing actual RNG projects that are described in the RNG Projects subsection, as well as actual RNG attribute offers Cascade has received for near term projections. For long term projections, Cascade is utilizing a 2019 ACF/ICF study on the potential of various feedstocks for Renewable Natural Gas supply[15]. Using this study, Cascade used a 50/50 blend of the High and Technical Resource Potential Scenario (Tables 39 and 40 of the study), since the Companies who are active in procuring RNG will have higher availability to RNG. Figure 4-4 shows the potential RNG volumes available to Cascade. The ACF/ICF study indicates that RNG potential may level off by 2040. On page 27 of the study, ICF says "the diversion of food waste from landfills may limit the long-term potential (post-2040) of landfill gas as a viable resource for RNG production." For the 2023 IRP, Cascade has adopted this assumption that, while existing RNG projects will continue to generate gas through the planning horizon, no new RNG projects may be added to the portfolio beyond 2040. To model the pricing of RNG, the Company followed the example of another regional LDC in using a forecast that does not employ a traditional supply curve because of the "lumpy" nature of RNG projects coming online. To that end, prices are split into two tranches. The first tranche, covering the first 1/3rd of projected supply, is priced at $13/dth, while the second tranche, covering the remaining 2/3rd of supply, is priced at $19/dth. In scenarios where additional supply is modeled to be available, those are priced at a third tranche not shown in Figure 4-5, where the price for RNG would be $26/dth. Green Hydrogen pricing comes from market intelligence based on an article from S&P Global[16]. There is a significant amount of uncertainty regarding the potential cost and quantity of these resources, as the markets for RNG and Hydrogen are still in very early stages. The Company recognizes that exogenous factors may lead to increased competition for these resources. To this end, Cascade addresses how its Top-Ranking Candidate Portfolio would perform under a number of scenarios related to reduce availability and increased prices for these resources. The result of these analyses can be found in Chapter 9, Resource Integration.

[15] Renewable Sources of Natural Gas - American Gas Foundation
[16] Green hydrogen costs 'can hit $2/kg benchmark' by 2030: BNEF | S&P Global Platts (spglobal.com)

Figure 4-4: RNG and Hydrogen Potential

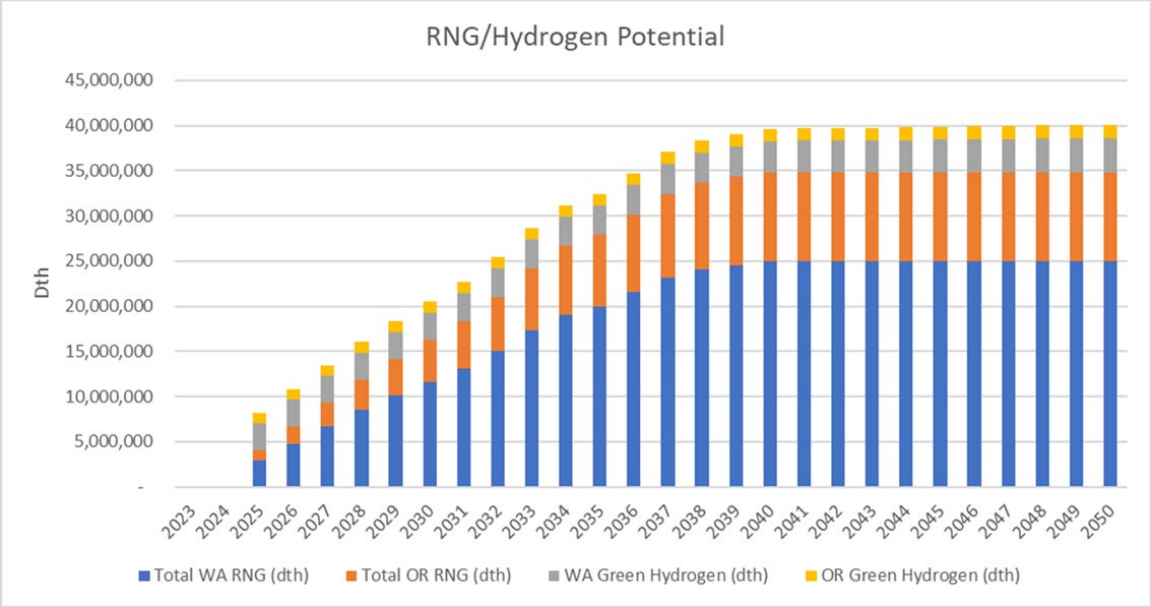
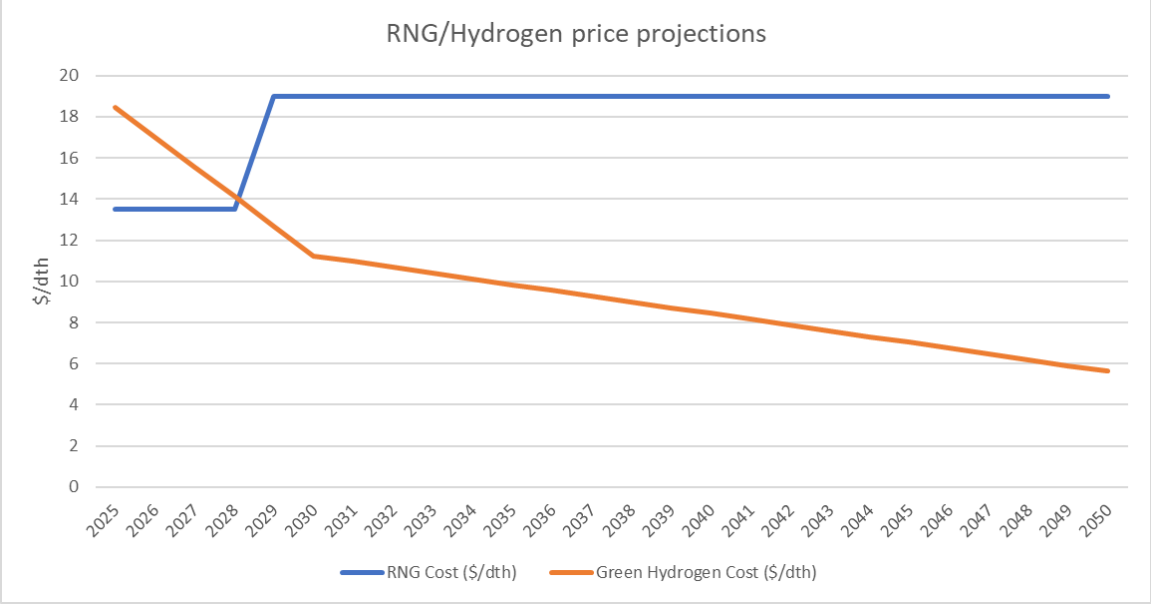


Figure 4-5: RNG and Hydrogen Price Projections



Storage Resources

Cascade also utilizes natural gas storage to meet a portion of the requirements of its core market. Storing gas supplies, purchased and injected during periods of low demand, is a cost-effective way of meeting some of the peak requirements of