2022 TDPUD GREENHOUSE GAS INVENTORY

FINAL REPORT

TRUCKEE DONNER PUBLIC UTILITY DISTRICT
11570 Donner Pass Road, Truckee, Ca 96161

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Definition of Key Terms

Carbon Emissions	This term is used to broadly include each of the (6) gasses listed in AB 32 (2006). These gasses include carbon dioxide, methane, nitrous oxide, sulfur hexafluoride, hydrofluorocarbons and perfluorocarbons. It is typically convenient to normalize reported GHG emissions into units of Carbon Dioxide equivalent (CO_2e)
Carbon Dioxide equivalent (CO_2e)	A reporting metric which normalizes emissions of different GHG gasses on the basis of their global warming potential (GWP) to the equivalent amount of carbon dioxide with the same GWP
Global Warming Potential	The relative potency of different greenhouse gasses to trap heat within Earth's atmosphere (known as the *greenhouse effect*).
Net Carbon Reduction	A net reduction of carbon emissions assesses the balance between carbon sources (e.g. any release of GHG emissions) and carbon sinks (e.g. activities which pull carbon emissions from the atmosphere and render their greenhouse effect inert). Equivalent reductions can therefore be garnered through reduction of emissions at the source or activities which create/expand a carbon sink.
Zero-Carbon Resource	A term used in SB 100 to refer to a specific type of electricity generation resource. SB 100 does not define "zero-carbon resources," and the state had no legal definition before the bill becoming law. The joint agencies interpreted "zero-carbon resources" to mean energy resources that either qualify as "renewable" in the most recent RPS (Renewables Portfolio Standard) Eligibility Guidebook or generate zero greenhouse gas emissions on site. SB 100 workshops and documents refer to these criteria as "RPS+"

1 Executive Summary

In early 2023, TDPUD staff initiated a Greenhouse Gas Inventory to reliably quantify The District's current emissions footprint – with specific emphasis on those emissions occurring in calendar year 2022. The data collected through this inventory, and their analysis, are critical in supporting TDPUD's strategic initiatives. This document is written to provide the Board and public results for the GHG Inventory.

1.1 Report Organization

This greenhouse gas inventory measurement & implementation planning document is organized into the following sections:

- **Section 1:**
  - Definition of Key Terms

Carbon Emissions	This term is used to broadly include each of the (6) gasses listed in AB 32 (2006). These gasses include carbon dioxide, methane, nitrous oxide, sulfur hexafluoride, hydrofluorocarbons and perfluorocarbons. It is typically convenient to normalize reported GHG emissions into units of Carbon Dioxide equivalent (*CO2e*)
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- Executive Summary – Provides a summary of inventory results and their implications.
- **Section 2: Background and Context for 2022 GHG Inventory –** Offers the reader critical background information and context driving the current inventory and the context within which its results should be understood.
- **Section 3: Approach(es) Used in GHG Inventory –** Discusses the overall approach (and frameworks) which were used to measure and report GHG emissions for The District.
- **Section 4: Study Findings: Organizational Emissions** – Provides a detailed explanation of calculated emissions and their derivation.

1.2 Summary of Findings

This inventory applied a scoping framework discussed in Section 3.3 to organize and report emissions findings according to industry standards. The results are shown in Table 1-1 where it can be seen that *9,404 Tons of CO_2e emissions* are directly attributed to TDPUD activities and operations during calendar year 2022 (Scope 1 emissions). An additional *239 Tons of CO_2e* are attributed to the electricity used by TDPUD facilities and infrastructure for the same period.

Table 1-1 Summary of GHG Emissions by Scope for CY 2022

Scope	Emissions [Tons CO_2e]
Scope 1: Direct Anthropogenic	9,394
Scope 2: Indirect-Direct Anthropogenic	239
Scope 3: Indirect Emissions	33,516

For reasons discussed later in Section 3.3 and Section 4, the reported emissions cannot be aggregated across scopes and must be understood solely within the context of the Scope they are reported. While *33,516 Tons of CO_2e* are reported under Scope 3, it must be understood that these emissions are those over which TDPUD has little to no direct control as they are predominately due to downstream use of the electricity and water TDPUD sells to its customers.

1.2.1 Scope 1 Emissions Key Findings

Within Scope 1 it was found that most emissions are from electricity generated by electric generation assets in which TDPUD has direct financial equity (approximately 93% of the reported emissions). These emissions are attributed to TDPUD's resource portfolio and addressing these emissions (i.e. any attempt to reduce their magnitude) requires a fully integrated approach to resource planning which balances both resource acquisition and local demand-side interventions. The nuances of resource planning are beyond the scope of this inventory; however, the results of this inventory and its data products are important inputs into The District's current integrated resource planning efforts.

The remaining *630 Tons of CO_2e emissions* are largely attributed to TDPUD fleet vehicle operations and natural gas used for water and space heating. At the time of this report, TDPUD has already purchased a light duty electric truck to begin electrifying its light duty pool vehicle fleet – with plans to continue replacing pool vehicle with electric. Fuel and vehicle use data provided insufficient data resolution in 2022 to provide meaningful differentiation between water and electric utility operations. However, it remains true that building efficiency and fleet vehicle operations represent the largest portion of The District's emissions over which TDPUD has direct and immediate control.

1.2.2 Scope 2 Emissions Key Findings

Scope 2 emissions are specifically limited to those cause by generation of the electricity used by the organization over the reporting period. For TDPUD this includes all electricity used by its headquarters facility, electric department operations, water department operations, and any other facilities such as datacenters, etc. The vast majority of electricity used in District operations (*approximately 88%*) is consumed by the Water Department in operating well pumps and other pumping infrastructure to reliably supply high quality water to its customers. Transmission losses, while important to include for comprehensiveness, are a minor component within the Scope 2 emissions (approximately 1.5%) and TDPUD has little agency in impacting these emissions other than simply reducing electricity consumption and thereby the amount lost in the transmission process.

1.2.3 Scope 3 Emissions Key Findings

Similar to Scope 1, emissions in Scope 3 are dominated by electricity generation and therefore proportional to customer demands (e.g. consumption of electricity in TDPUD's service territory). Again, TDPUD has some influence on these emissions through its resource procurement. It is also expected that The District's efforts in developing an integrated resource plan which addresses these emissions (balanced with its other missional objectives) will become increasingly important as the local community makes progress towards electrifying building end-uses which were traditionally served by natural-gas.[1] Conservation certainly retains a critical role in helping to reduce the speed at which electricity consumption increases due to building an transportation electrification. However, the emphasis is shifting away from 'efficient' widgets and towards sustainable behaviors and practices.

Also included in Scope 3 are approximately *815 Tons of CO_2e emissions* resulting from employee commuting and final treatment of the domestic water TDPUD produces to its customers.[2] Again, while TDPUD does not have direct control over any of these emissions, it can influence them in a positive direction through water conservation programs and through policies which incentivize more sustainable modes commute.

[1] Namely space and water heating

[2] Note that water used for irrigation goes directly back into the watershed and does not impact local wastewater treatment facilities.

2 Background and Context for 2022 GHG Inventory

An initial 2008 Baseline Greenhouse Gas Emissions Re-Inventory was prepared for TDPUD in 2012 by Sierra Business Council (SBC). This inventory was then updated in 2013 by SBC to compare 2012 re-inventoried emissions against the original 2008 baseline. The 2012 Inventory applied an *operational control* approach[3] to define The District's organizational boundary used to determine which emissions were reported/inventoried.

These initial probes into The District's greenhouse gas (GHG) emissions focused on day-to-day District operations, electricity distributed to (and consumed by) customers, and some Scope 3 sources such as employee commuting. The study concluded that the most significant emissions source for The District was its delivered electricity, a Scope 2 emission over which the district has only partial control. This emission source also saw significant reduction relative to the 2008 baseline due to an increase of 'clean' electricity generation within the District's Renewable Portfolio Standard (RPS). The Water Department was responsible for approximately 58% of the District's Scope 1 operational emissions, with the remaining coming from the electric department.

No updates have been made to the GHG emissions estimated by the 2012 Inventory while The District has continued to improve its RPS with additional sources of clean electricity and has maintained robust conservation programming for its customers since the last inventory in 2012. The 2012 Inventory numbers no longer reflect The District's current emissions footprint.

2.1 Regulatory and Legislative Context for the GHG Inventory

It should be noted that, currently, there are no regulations which require TDPUD to inventory its district-wide GHG footprint. Rather, this endeavor sits above and beyond of the underlying regulatory landscape in response to The District's own Net Carbon Reduction strategic initiative. This initiative is a combination of the "100% clean renewable energy" and "local clean generation" initiatives. The ultimate goal behind these initiatives is to reduce the amount of carbon in Truckee's environment, and that being produced by Truckee's actions. However, the former initiatives emphasized energy procurement as a means of GHG mitigation, without considering how and when the community uses electricity. TDPUD commits to make meaningful progress towards GHG mitigation through cost-effective energy purchase, beneficial investments into conservation, and data-driven innovation.

While this inventory is implemented in response to TDPUD's own strategic initiatives, the State of California has implemented a number of ambitious policies over the last two decades in efforts to mitigate anthropogenic climate change which overlap with the objectives of this project. One particularly significant piece of legislation was AB 32 (Global Warming Solutions Act of 2006) from which many current state programs find their genesis – including California's Carbon Cap & Trade Program. AB 32 specifically directs the California Air Resources Board (CARB) to oversee that statewide GHG emissions be reduced to 1990 levels by 2020. CARB subsequently established its Carbon Cap & Trade program in 2008 for which it then set mandatory GHG reporting requirements for electricity importers (among other emissions sources).

In addition to CARB's mandatory GHG reporting requirements, The District reports its generation sources (and their carbon intensities) annually to the CEC in response to its Renewable Portfolio Standard (RPS) targets established in SB 1078 (2002), and expanded by the more recent SB 100. SB 100 mandates that renewable and "zero-carbon" resources supply 100% of electric retail sales to end-use customers by 2045 (with 60% being

[3] See Section 3.2.3 for GHG boundaries and approaches.

renewable and 40% “zero-carbon”). It also establishes several interim targets along the way in 2035 (60%/30% respectively), and 2040 (60%/35% respectively).

The California RPS and CARB mandatory GHG reporting requirements are specifically referenced here as they specifically quantify emissions (Tons of CO2e) for TDPUD’s electricity procurements in a public capacity. There exists a fundamental difference between the objectives underlying the engineering assumptions and reporting standards established by these two statewide programs and those applied in this GHG inventory. Namely, many of the assumed emissions intensities for generation sources in the RPS and CARB reporting standards are driven more-so by political discourse than engineering analysis. An example of this can be found in the difference between carbon intensities reported for “small-hydro” and “large hydro” in the RPS reporting standard (with small hydro assumed to have zero emissions and large hydro treated as “unspecified”). Furthermore, the division between small and large-hydro sources is based on generator size and not on any material difference in how small or large-hydro generator sources operate.

In this GHG inventory, staff applied a physical first-principals focused assessment of GHG emission intensities for each generation technology in TDPUD’s portfolio. Staff approached each source objectively on the engineering behind its electricity-production processes and plant lifecycle. This approach was selected to be consistent with the strategic initiative’s objective of achieving meaningful (e.g., tangible, and empirically verifiable) progress towards GHG mitigation. Furthermore, such an approach is necessary to meet the TDPUD’s objective of managing The District in an environmentally sound manner, and ultimately reach its goal of Environmental Stewardship (Creating a sustainable resilient environment for all our communities).

2.2 Objectives for Proposed Greenhouse Gas Inventory

Consistent with the mission and goals established in the 2021 TDPUD strategic plan, A GHG Inventory was implemented in 2023 to account for GHG emissions occurring in calendar year 2022. This study built off previous GHG inventory studies to:

- Update the District’s GHG Inventory to reflect current emission levels.
- Generate a detailed understanding of District GHG emission sources and their magnitudes.
- Coordinate with the Town of Truckee and other local agencies to ensure that this study is complimentary with other local GHG inventories such that they collectively assess regional GHG emissions.

Finally, this Inventory will establish the baseline emissions used to measure future progress towards The District’s decarbonization goals.

3 Approach(es) Used in GHG Inventory

The 2022 GHG Inventory will follow the protocols defined under the General Reporting Protocol Version 3 (GRPv3) and incorporated the additional requirements and reporting guidance provided by the Electric Power Sector Protocol (EPSP) and the Water Energy Nexus Registry Protocol (WENRP).

3.1 General Inventory Methodologies

In a general sense, all GHG inventories will follow the following process:

- **Determine the organizational/inventory study boundary and scope –** Arguably the most difficult and most important step in performing GHG inventory as this defines both which emission sources are considered as well as their attribution. This step also has implications on whether or not study results will coordinate with inventories developed by other organizations.
- **Identify emission sources and their scopes –** Emission sources can be direct or indirect and are organized into several "scopes" which define varying levels of attribution or agency for which the organization is responsible over the emission generating activities.
- **Measure and quantify identified emissions –** Once emissions are identified and scoped, data must be collected to quantify the magnitude of GHG gasses being emitted using an appropriate level of rigor. GHG gases are normalized into units of Carbon Dioxide Equivalent (CO2e).
- **Report findings –** Findings are compiled into a final report which summarizes the overall organizational footprint while then providing additional details consistent with the organization's objectives for the inventory. Results are also compiled into a standard reporting format for upload into CRIS for public reporting of GHG emissions.

It must be recognized that anthropogenic GHG emissions rarely have a single attributable source. For example, electricity is demanded by a community of consumers, sourced, and distributed by local utility companies, and generated by electric generators which can be located well outside of the community using it. Multiple actors therefore have agency over the activities leading to GHG emissions resulting from the generation, distribution, and consumption of electricity.

Inventory boundaries are used to help differentiate actors, agency, and scope for reported GHG emissions. The inventory specifically defines an organizational boundary (delineates actors and agency ascribed to emissions sources) and a reporting boundary (the scope of emissions within an organizational boundary considered within the inventory). The final inventory boundary results in the intersection between the organizational and reporting boundaries.

Within the boundaries, emissions sources are further classified into one of three scopes. These scopes create an accounting framework which facilitates specific attribution of anthropogenic emissions and, when correctly applied, eliminates the double-counting of emissions across multiple actors.

In this section a general methodology is outlined for the 2022 GHG Inventory for Truckee Donner Public Utility District.

3.2 Organizational and Reporting Boundaries

Before defining the organizational and reporting boundaries used for the 2022 inventory, it is important to outline some key details with respect to The District's organizational structure, mission, and operational footprint.

Truckee Donner Public Utility District was established on August 9, 1927 as a Public Utility District under Division 7 of the State Public Utilities Code. At the time of its establishment, The District provided electric service only. Since 1935, The District has also provided water service within the Truckee and Donner Lake areas, with the Electric System and the District's water system maintained and operated separately. The District is primarily located in eastern Nevada County, with a small area of the District (approximately 1.5 square miles) located in neighboring Placer County. The District is situated in the Sierra Nevada Mountains approximately 180 miles northeast of San Francisco and 32 miles west of Reno, Nevada. Lake Tahoe is approximately 12 miles south of The District's boundaries.

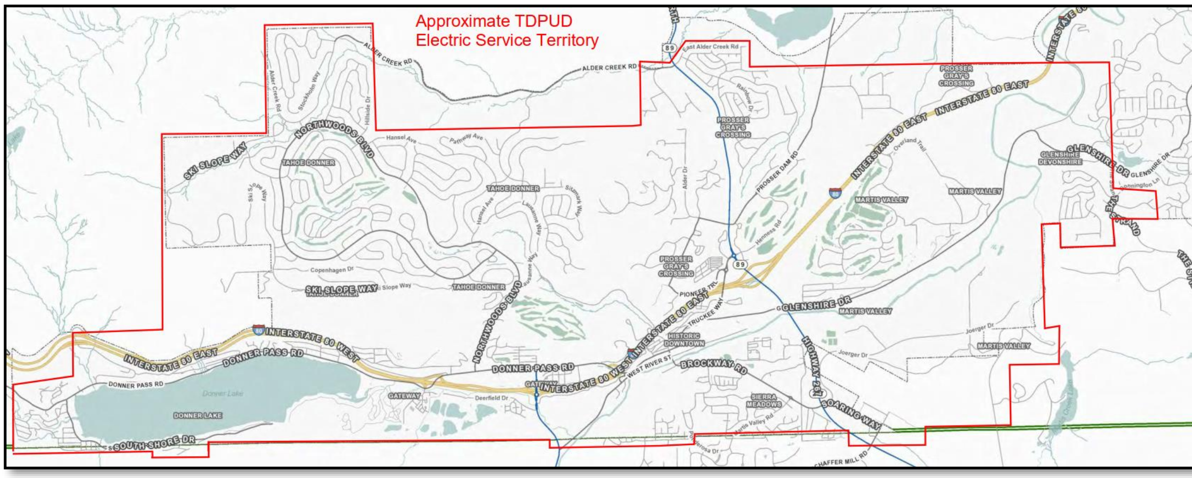

Figure 3-1 Approximate Boundaries for TDPUD Electric Service Territory

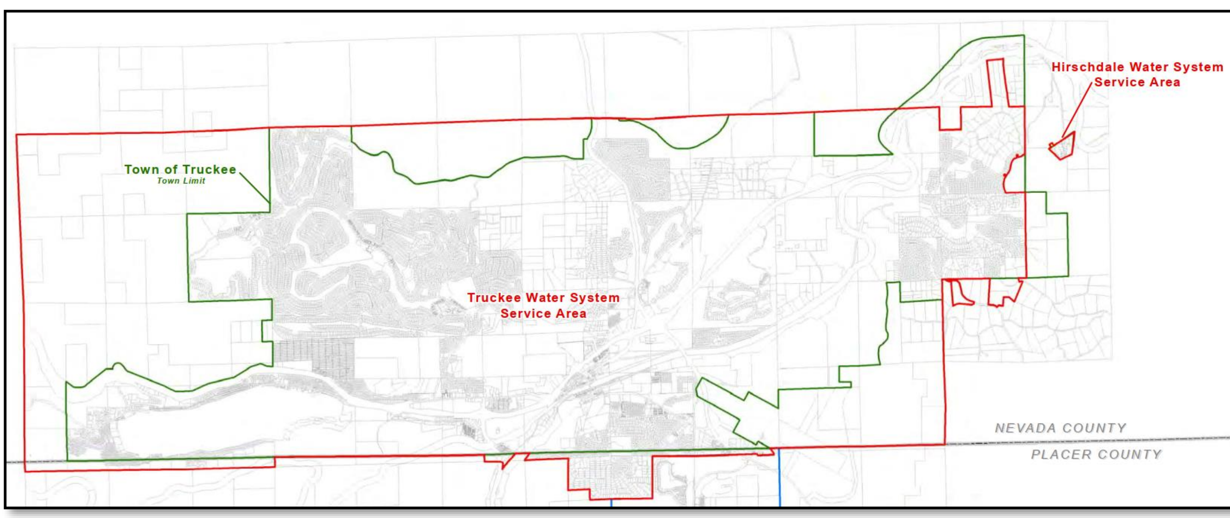

Figure 3-2 Approximate Boundaries for TDPUD Water Service Territory

3.2.1 Electric Utility General Description

The District has broad general powers over the generation of electricity within District boundaries, including the powers of eminent domain, to contract, to construct works, to fix rates and charges for commodities or services furnished, to lease its properties and to incur indebtedness. The current population within the District's 47 square mile service area is estimated to be approximately 16,200 residents. Many landowners within The

District have their primary residences elsewhere and use their property within the District as secondary and vacation homes. As of December 31, 2021, the District provided electric service to 12,931 residential and 1,619 commercial, governmental, institutional and other customers. The District is the sole provider of retail electric service within its service area.

The District is a network transmission service customer under the currently effective joint Open Access Transmission Tariff with NV Energy, an investor-owned utility. The District uses NV Energy's network service to import into and transport across NV Energy's transmission grid all of the energy that is necessary to serve the District's load. This load is served from four substations and one distribution interconnection with NV Energy. The substations and interconnection voltages include Donner Lake Substation (60 kV), Tahoe Donner Substation (60 kV), Truckee Substation (60 kV), Martis Valley Substation (120 kV) and the Glenshire metering point (14.4 kV). The Electric System includes more than 232 miles of 12.47 kV and 14.4 kV distribution lines, including approximately 97 miles of underground distribution cables and approximately 135 miles of overhead pole lines.

The District does not generate electricity itself. The District's sources of electrical power include resources owned and/or operated by Utah Association of Municipal Power Systems (UAMPS), Western Area Power Administration (WAPA), and Truckee-Carson Irrigation District (TCID). The District has entered into various agreements with these entities for electrical power which is generated from wind, landfill gas, hydroelectric projects, natural gas, and other sources.

3.2.2 Water Utility General Description

The District has broad general powers over the use of water within District boundaries, including the right of eminent domain and the authority to acquire, control, distribute, store, spread, sink, treat, purify, reclaim, process and salvage any water for beneficial use, to provide sewer service, to sell treated or untreated water, to contract with the United States, other political subdivisions, public utilities and other persons, and, subject to certain State Constitutional limits, to levy taxes on lands. As of December 31, 2021, the District provided water service to 12,709 residential and 767 commercial, governmental, institutional and other customers. The District is the sole provider of water service within its service area.

The District's sole source of water is groundwater that is extracted from 13 active wells in the Martis Valley Groundwater Basin (the Basin). Groundwater from the Basin is of high quality and is not treated extensively prior to delivery to customers. The District also has surface water rights in Donner Lake, the Truckee River and six local springs, although the District does not currently utilize these surface water rights. In addition to groundwater wells, the Water System includes: 25 pump stations, 33 active water storage tanks with a combined storage capacity of approximately 9.6 million gallons, approximately 220 miles of distribution pipelines varying from 2 inches to 24 inches in diameter, 47 pressure zones, and 35 active control valve stations.

3.2.3 Defining an Organizational Boundary for the Inventory

The organizational boundary defines the degree of ownership or control an organization exercises over specific GHG emission activities and are categorized by the GRPv3 into one of three methods[4]: 1) Operational control, 2) Financial Control, and 3) Equity Share.

This study defined the organizational boundary using an *Equity Share Perspective* for the District. This corresponds to the GRP Option 1 defined in the EPSP. The equity share perspective provides an accounting of activities wholly and partially owned by the district – with emissions being accounted according to the organization's ownership share. This was chosen to report a full and transparent accounting of The District's

[4] See pg. B-1 of the GRPv3 for full definitions of each.

local (e.g. regional) operational footprint as well as the GHG emissions resulting from operations for which the District has ownership equity but no direct operational control. Inventory components for which The District has 100% direct operational control include:

- Operations and Maintenance (O&M) for The District's electric Transmission & Distribution (T&D) System
- O&M for the District's water pumping, treatment, and distribution infrastructure
- Headquarter building O&M
- Energy resources consumed by District stationary facilities (and mobile equipment)

Each of the above activities were included in The District's original 2008 baseline and 2012 inventory studies which took an operational control perspective when defining the organizational boundary. As previously noted, The District wishes to expand the boundary in the 2022 inventory to provide additional transparency with respect to GHG emissions from TDPUD's interests. The expanded boundary also provides The District with additional opportunities to identify, quantify, and mitigate GHG emissions connected to its interests. The additional GHG emissions sources from which The District has equity interest include:

- Energy resource consumption, O&M, and embedded product emissions from several electric generation facilities which include Horse Butte Wind Farm (26% Share), Veyo Heat Recovery Project (23% Share), and Nebo Power Station (3% Share)
- Surface water rights to Donner Lake, Truckee River, and (6) local springs

The 2022 inventory study quantified GHG emissions associated with the District's equity interests in the above sources (in addition to those previously identified for which the District has 100% operational control).

3.2.4 Reporting Boundary

The reporting boundary for the 2022 inventory included all emissions sources within the organizational boundary with specific emphasis (rigor) applied to those emissions occurring within the Truckee-Tahoe geographic region. The inventory captured emissions occurring in calendar year 2022 which will establish a baseline GHG emissions level against which future emissions inventories will be compared to determine progress made towards overall GHG reductions.

3.3 GHG Emission Sources and Inventory Scoping

The GRPv3 establishes a comprehensive accounting framework for categorizing direct and indirect anthropogenic emissions. GHG emissions are classified as:

> ***Scope 1*** covers all anthropogenic GHG emissions directly emitted by an organization's activities/operations. Such emissions include stationary combustion, mobile combustion, physical and chemical processes, and fugitive sources. For power generation facilities this includes all combustion emissions associated with the generation of electricity (regardless of who uses the electricity). The GRPv3 defines several different categories within which Scope 1 emissions are reported. The EPSP and WENRP then provide additional specificity for electricity providers and water management organizations.
>
> ***Scope 2*** includes all anthropogenic GHG emissions indirectly associated with an organization through the purchase of consumed energy (electricity, steam, district heating or cooling, etc.). Note that the EPSP requires line losses across Transmission & Distribution systems within the organizations boundary associated with the organization's electric power consumption be reported under Scope 2.

Scope 3 emissions cover remaining indirect anthropogenic emissions which fall outside of either Scopes 1 or 2. Examples include employee commutes, GHG emissions associated with purchased products, indirect emissions from customer purchased/consumed electricity, etc.

In Section 4 (*Study Findings: Organizational Emissions*) the quantified emissions for each scope are discussed in detail. It is important to note that emissions can only be meaningfully aggregated across separate organizations within a particular scope.

3.3.1 Quantifying Emissions

Emissions for this study were quantified following the methods defined in the GRPv3 for GHG inventories.[5] Methods are broken down into *Calculation-Based Methods*, *Measurement-Based Methods*, and *Simplified Estimation Methods (SEMs)*.

Calculation-Based methods use data which measure the level of a particular activity which results in GHG emissions. Emissions factors are then applied to this data (e.g. GHG emissions per unit of activity) to estimate overall GHG emissions associated with the activity levels recorded in the data. An example of this would be using fuel purchase records to determine the amount of gasoline used over the course of the reporting period and applying an appropriate emissions factor (units of CO_2e per gallon of gasoline burned in a combustion engine) to quantify the amount of CO_2e emitted for the reporting period.

Measurement-Based methods directly measure emissions at their sources using systems capable of monitoring the concentration of reported GHGs and their outflow rates. This is particularly relevant for agencies/facilities with large stationary combustion sources and stringent regulatory reporting requirements.

Simplified Estimation methods use deemed emissions levels for various sources and thus don't require the same level of data/rigor as applied in the other methods. And example of this is the fugitive refrigerant emissions screening method outline in Section C of the GRPv3 and its assumed factors. Note that emissions calculated using this method cannot exceed 10% of the organization's combined Scope 1 and Scope 2 emissions.

Most emissions reported in this study were quantified using the Calculation-Based Method. The SEM approach was however leveraged to report fugitive refrigerant emissions under Scope 1.

All emissions are reported in units of *Carbon Dioxide Equivalent (CO2e)* which normalize the effects of different greenhouse gas emissions based on their *global warming potential (GWP)* to the equivalent amount of carbon dioxide with the same GWP.

3.3.2 Emissions Factors

Emissions factors for this study were sourced from industry standard, peer reviewed, and government sources. These sources included:

- National Renewable Energy Laboratory
- Energy Information Administration (EIA)
- Environmental Protection Agency (EPA)
- California Air Resources Board
- Intergovernmental Panel on Climate Change

[5] Defined in Section C of the GRPv3

- The Climate Registry[6]

Additional information on the emissions factors applied in this study is discussed under each emissions source quantified in Section 4 (*Study Findings: Organizational Emissions*).

[6] The organization which publishes and maintains the General Reporting Protocol and its supplementary materials.

4 Study Findings: Organizational Emissions

This section of the report provides a detailed treatment of emissions findings for each scope. Emissions sources and their magnitudes are discussed under each scope separately.

This inventory quantified overall emissions for TDPUD within each scope as shown in Table 4-1

Table 4-1 Aggregated Emissions Within Each Reporting Scope for CY2022

Scope	Component	Component Emissions [Tons CO_2e]	Scope Emissions [Tons CO_2e]
1	Transport	475	**9,394**
	Building	155	
	Generation*	8,763	
2	Electricity Consumed	235	**239**
	Transmission Losses	3.50	
3	Employee Commutes	337	**33,516**
	Electricity Sold	32,701	
	Wastewater (water sold)	478	

* *Including District Equity Component*

It is reiterated here that an 'overall' emissions value (for any organization) cannot be developed by aggregating across Scopes. Each 'Scope' provides its own relevance to the organization's full value chain and must be interpreted/understood on its own standing – especially when trying to compare or aggregate across multiple organizations. For example, the emissions reported for electricity sales to any given entity under Scope 3 for this inventory should be reported under Scope 2 for that particular entity. Similarly, the local wastewater treatment facility would report the portion of emissions provided here under Scope 3 within Scope 1 of its own inventory. While tempting to combine, the results for each scope must be interpreted independently and cannot be combined without double counting the reported emissions.

4.1 Scope 1 Emissions: Direct Anthropogenic

This study found that **TDPUD emitted 9,394 Tons of CO2e under its Scope 1 emissions sources** for the 2022 Calendar Year. Emissions are broken down into each GRPv3 reporting category in Table 4-2. Most of the reported emissions are derived from TDPUD's equity in serval generation resources (predominately the Nebo power plant) – reported under stationary sources in Table 4-2.

Table 4-2 Summary of Scope 1 Emissions for 2022 by Reporting Category

Category	Emissions [Tons CO_2e]
Stationary	8,908
Mobile	475
Fugitive	9.8
Total	**9,394**

Table 4-3 Scope 1 Emissions by location

Location	Emissions [Tons CO_2e]
Within TDPUD Service Territory	630
Outside of Service Territory	8,763
Total	**9,394**

In Table 4-3 these same generation resources place the majority of TDPUD's Scope 1 GHG emissions outside of its service territory. **The largest contributor to emissions within TDPUD's service territory is its fleet operations which amounted to about 475 Tons of CO2e in 2022 (or 74% of the local emissions).** This can be seen graphically in Figure 4-1 which isolates Scope 1 emissions for local operations only (e.g. minus emissions from the production of electricity at facilities owned or controlled by the organization).

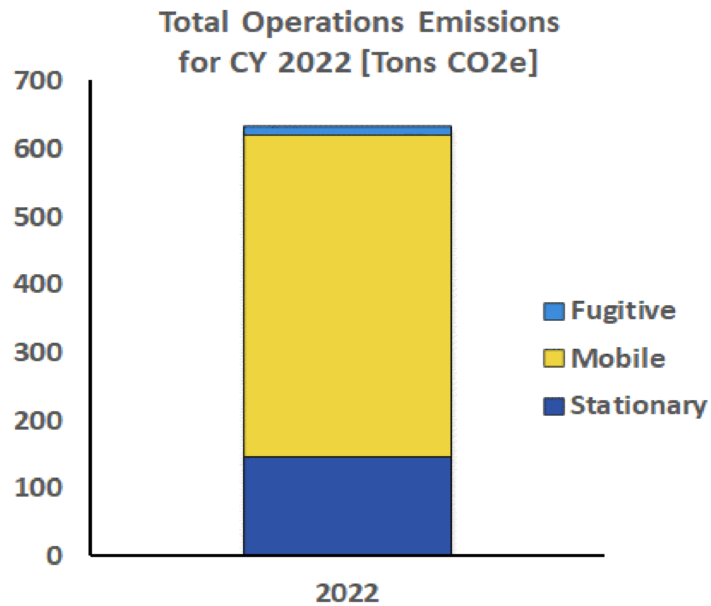

Figure 4-1 Scope 1 Emissions Occurring from Local Operations Only

Individual Scope 1 emission sources which were considered in the 2022 Inventory are listed in Table 4-4. It should also be noted that while TDPUD is a water utility, its operations do not include any Scope 1 or Scope 2 emissions sources called out in the WENRP – namely biogenic CO_2 and CH_4 from man-made reservoirs[7] or process N_2O from wastewater discharge. Therefore, all Water Utility emissions are covered under the GRPv3.

Table 4-4 List of Emissions Sources Included under Scope 1

Stationary Combustion Emissions	Combustion of fossil fuels in stationary equipment. Common examples include space heating equipment such as boilers and furnaces, though this can include incinerators, process equipment, stationary generators, etc. The EPSP expands this to include emissions from the production of electricity at facilities owned or controlled by the organization.		
	GRPv3 Sources	**EPSP Sources**	**WENRP Sources**
	▪ Backup & Emergency Generators ▪ District Headquarters Radiant Heaters ▪ District Headquarters Boilers/Furnaces	▪ Emissions from electricity generators in which TDPUD has equity.	*None*

[7] The WENRP specifies that "*emissions associated with natural lakes converted to reservoirs without inducing significant changes to water surface area should not be considered*" (Pg. 25 WENRP). Donner Lake is a natural lake with limited surface area impact due to its dam. TDPUD only has rights to [980 acre-feet].

Mobile Combustion Emissions	Combustion of fossil fuels occurring in non-stationary equipment such as transportation vehicles and heavy machinery. Note that mobile/portable generators are reported here unless the electricity is delivered to the grid in which case such emissions are reported with other electric generation under stationary sources.		
	GRPv3 Sources	**EPSP Sources**	**WENRP Sources**
	▪ Electric Dept. fleet vehicles ▪ Water Dept. fleet vehicles ▪ Heavy equipment (including snow cat) ▪ Pool vehicles	*None*	*None*

Fugitive Emissions	Intentional or unintentional emissions from production, processing, transportation, or storage of substances not passed through a stack, chimney, vent, exhaust pipe, etc. Notable examples include refrigerant leakage in HVAC equipment and SF_6 from high voltage equipment		
	GRPv3 Sources	**EPSP Sources**	**WENRP Sources**
	▪ HVAC refrigerant leakage	▪ SF_6 emissions from high voltage equipment.	*None*

Process Emissions	Non fuel-combustion emissions due to a physical or chemical process. Examples include chemical manufacturing processes, acid gas (SO_2) scrubbers, and gas releases in geothermal facilities.		
	GRPv3 Sources	**EPSP Sources**	**WENRP Sources**
	None	▪ Acid gas scrubber Nebo gas turbines	*None*

4.1.1 Stationary Combustion Emissions

Four specific stationary combustion emissions sources were identified and considered in this study as listed in Table 4-4. Each source, its emissions factors, and overall emissions for 2022 are discussed below.

4.1.1.1 Backup and Emergency Generators

During the data collection phase, it was found that fuel purchases for the backup and emergency generators could not be separated from fuel purchased for fleet vehicle operations. In discussions with District staff, it was determined qualitatively that the fleet vehicle fuel use was much larger than that used for backup and emergency generators. Furthermore, no data was available to estimate the proportion of fuel used by each with any reasonable accuracy. Therefore, all emissions from fuel use (gasoline and diesel purchases) are reported under Section 4.1.1.3

4.1.1.2 District Facility (buildings/structures) Space and Water Heating

Space heating for District facilities is predominately Natural Gas (with some electric resistance heating used by the Water Department in pump houses). The heating is used in a variety of system types which include radiant heaters, boilers, and furnaces. Insufficient trend data was available from each of these systems to do an in-depth analysis of emissions by source. Instead, utility billing histories for natural gas for each of TDPUD's facilities were aggregated to calculate a combined emissions for all systems using the following calculation:

$$\epsilon_{Year} = \sum_{Month} EIF * Therms_{Month}$$

Where:

ϵ_{Year}	Are the calculated GHG emissions (in units of CO_2e) for the facility space and water heating sources.
EIF	Is the emissions factor (in units of CO_2e per Therm) used to estimate GHG emissions for space and water heating equipment derived from EPA GHG emissions factors database for stationary sources.[8] *k* is equal to *0.00585 Tons CO_2e per Therm*.
$Therms_{Month}$	Is the monthly natural gas consumption by TDPUD facilities in units of Therms.

Natural gas bills from Southwest Gas provided monthly natural gas consumption data for District facilities. Note that the billing periods do not neatly align within each calendar month. As such, the billing data was normalized to Therms per billing day in the billing period and then interpolated across each month in 2022 to account for overlap in the billing periods on each end of the year. These data were aggregated for 2022 for which The District is estimated to have used ***24,817 Therms*** and thereby emitted ***145 Tons CO2e***. Figure 4-2 shows the monthly natural gas consumption for the District over CY 2022. It should be noted that natural gas consumption is sensitive to outdoor temperature (lower temperatures equal higher consumption for heating) and will therefore vary year to year depending on the severity of a given winter season.

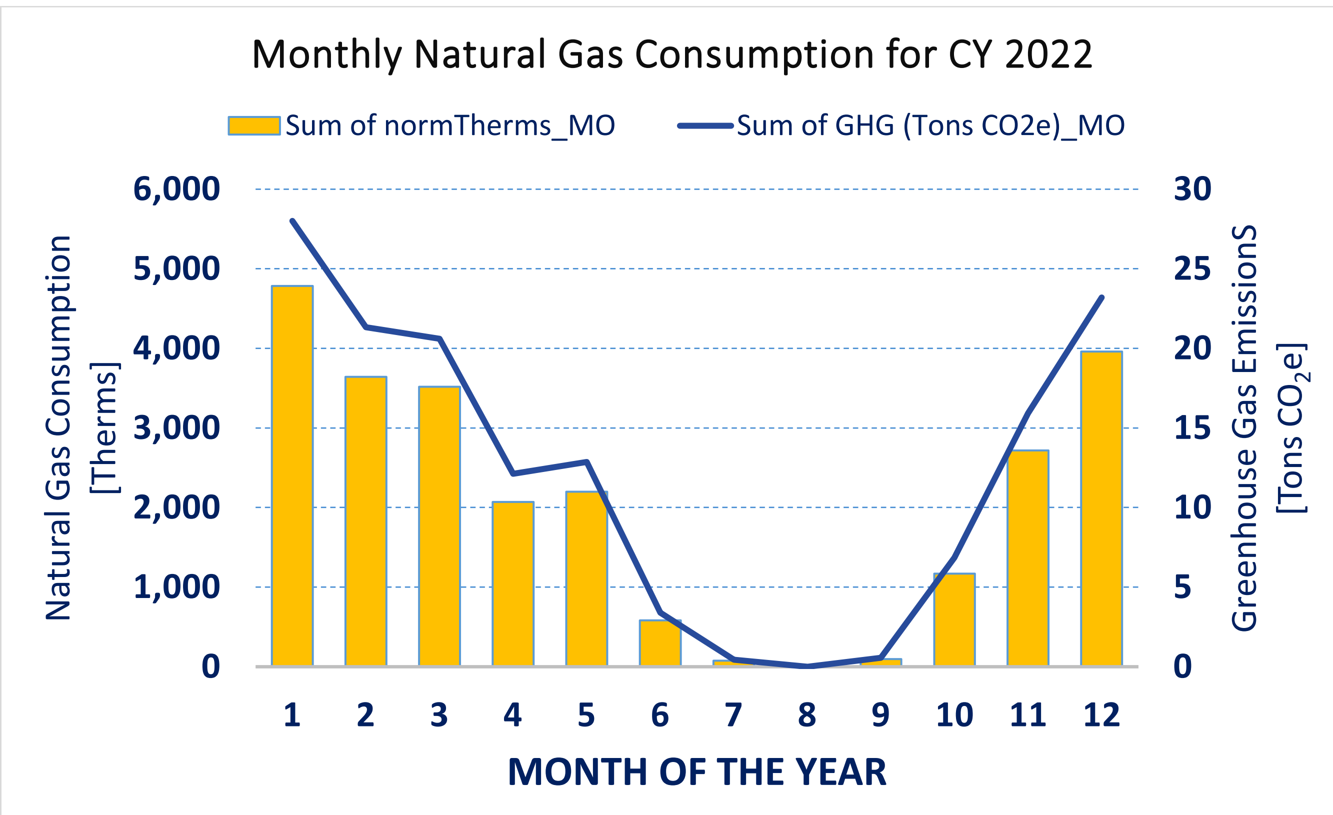

Figure 4-2 District Natural Gas Consumption by Month for Calendar Year 2022

[8] https://www.epa.gov/climateleadership/ghg-emission-factors-hub

Figure 4-2 also shows the monthly GHG emissions resulting from the stationary natural gas combustion. As expected, the emissions are directly proportional to the natural gas consumption of a given month.

4.1.1.3 District Owned (Financial Equity) Stationary Generation Assets

The EPSP expands the General Reporting Protocol's definition of Scope One emissions sources to include emissions from the production of electricity at facilities owned or controlled by the organization. It was established in 3.2.4 Reporting Boundary that this inventory would be applying an equity approach in defining the organizational boundary. This means that Scope One emissions for TDPUD must include emissions from any electricity generation facilities in which The District has financial equity.[9]

The additional GHG emissions sources from which TDPUD has equity interests include:

- Horse Butte Wind Farm (26% share),
- Veyo Heat Recovery Project (23% share), and
- Nebo Power Station (3% Share)

Data was collected on the hourly generation of each resource in TDPUD's resource portfolio and a full hourly GHG emissions profile was derived according to The District's resource mix as discussed in 4.2.2. The subset of emissions from electricity generation facilities in which TDPUD has financial equity was estimating using the following formula:

$$\epsilon_{Year} = EIF_{Horse\ Butte} * \sum_{Hours} E_{Horse\ Bute,\ Hr} + EIF_{Veyo} * \sum_{Hours} E_{Veyo,\ Hr} + EIF_{Nebo} * \sum_{Hours} E_{Nebo,\ Hr}$$

Where:

ε_{Year}	Are the calculated GHG emissions (in units of CO_2e) for the production of electricity at facilities owned or controlled by TDPUD proportional to its equity interest.
EIF_{asset}	Is the emissions intensity factor (in units of CO_2e per Megawatt-Hour) used to estimate GHG emissions for each generation asset. The specific values used for the EIF and their derivation are explained in detail in 4.2.2.
$E_{asset,\ Hr}$	Is the equity owned portion of hourly electricity generation for each asset.

Emissions from the three electricity generation facilities in which TDPUD has financial equity totaled to ***8,763 Tons of CO2e*** for calendar year 2022. The time-series distribution of these emissions (and the electricity generation) can be seen plotted in Figure 4-3. Here it can be seen that while the emissions from Horse Butte and Veyo are non-zero[10], the major contributor to overall emissions comes from the Nebo power plant (shown in yellow).

[9] This does not include Power Purchase Agreements (PPAs). Emissions from purchased power are reported under Scope 2 for electricity consumed by TDPUD operations and under Scope 3 for electricity sold to customers.

[10] While it may not be immediately intuitive that 'renewable' generation resources have non-zero emissions, this subject is discussed in detail in Section 4.2.1 and Section 4.2.2.

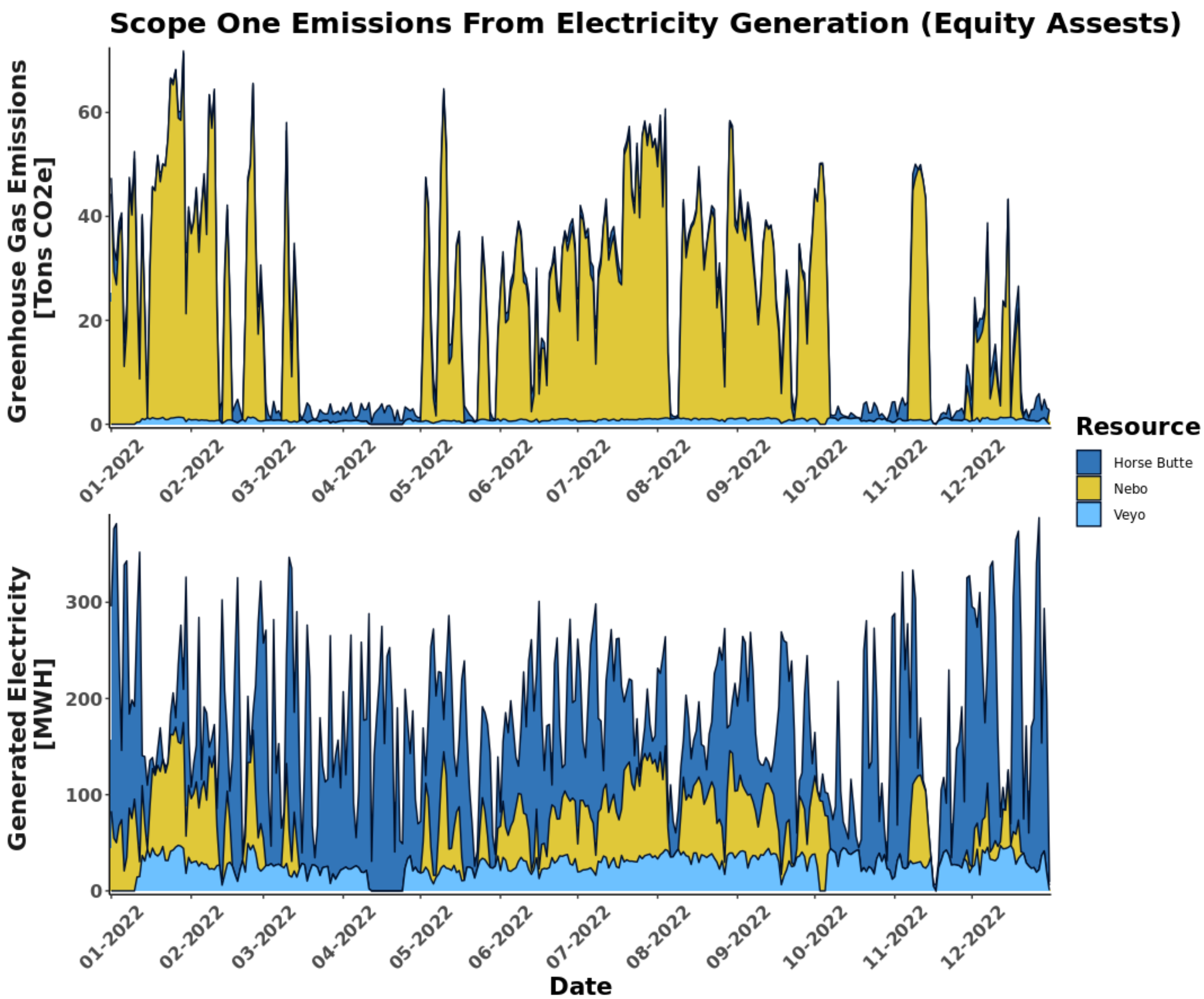

Figure 4-3 Time Series Distribution of Stationary Generation Asset Emissions

4.1.2 Mobile Combustion Emissions

It was previously noted that fuel purchases for fleet vehicle operations could not be separated from fuel purchased for the backup and emergency generators. Since fleet vehicle fuel use was estimated to be much larger than that used for backup and emergency generators, the overall emissions for fuel purchases are reported here as Mobile Combustion Emissions.

TDPUD maintains and operates a fleet of approximately fifty light, medium, and heavy duty vehicles to facilitate its local operations. A majority of these fleet vehicles are diesel fueled, though the light duty vehicles use gasoline. At the time of this inventory no telemetry data was available on vehicle operations and duty cycles to facilitate a ground up estimate of vehicle fuel consumption for CY2022. Instead, this inventory relied on fuel purchase records in CY2022 to estimate the amount of fuel consumed (combusted) in its fleet operations. In additional to direct fuel combustion, the IPCC provides a simplified method of estimating emissions from non-energy applications of petroleum products[11] such as solvents and lubricants.

[11] See Chapter 5 Non-Energy Products from Fuels & Solvent Use in the IPCC Guidelines for National Greenhouse Gas Inventories

The general approach in estimating mobile combustion emissions applied the following equation:

$$\epsilon_{Year} = \sum_{i} EIF_{Product,i} * Volume_{Product,i}$$

Where:

ε_{Year}	Are the calculated mobile GHG emissions (in units of CO_2e) for each source/product for the reporting year summed across all purchases in the reporting year.
$EIF_{Product,\,i}$	Is the emissions intensity factor (in units of CO_2e per volume of product) used to estimate GHG emissions for mobile combustion sources. Each EIF used in the calculations is discussed below.
$Volume_{Product,\,i}$	Is the purchased volume of products contributing to mobile emissions tracked in this inventory.

Emissions Intensity factors were sourced from different datasets based on the emissions source. Sources were classified as either being *Gas/Oil/Lubricant, Diesel,* or *Unleaded Gasoline*. The emissions intensity factors and their sources are defined in Table 4-5.

Table 4-5 Mobile Combustion Emissions Sources and Intensities

Expense Description	EIF (Ton CO_2e Per Gallon)	Description
DIESEL FUEL	0.0054	The value used in this study is sourced from CARB's Low Carbon Fuel Standard reporting data for certified Renewable Diesel pathways.[12]
UNLEADED FUEL	0.0097	Standard unleaded fuel with an emissions factor defined by the EPA's database for emissions factors (its GHG Emissions Factors Hub).[13]
GAS, OIL, LUBRICANTS	0.0083	Emissions from lubricants in combustion engines are reported here using the IPCC approach defined in its Guidelines for National Greenhouse Gas Inventories.

All diesel fuel purchased by The District is certified renewable diesel produced from non-petroleum renewable sources. Its emissions intensity is therefore lower than standard diesel fuel and known data points of emissions intensities for this fuel are documented by California Air Resources Board (CARB) in its Low Carbon Fuel Standard (LCFS) carbon cap and trade program. The total mobile combustion emissions calculated for calendar year 2022 for TDPUD is ***475 Tons CO2e***.

Note that since the available data only documented purchase date of the fuel (and not the date/time of actual use), no additional time-series analysis was performed to review the distribution of mobile emissions throughout the year. In 2023 TDPUD installed advanced telemetry data acquisition in its fleet vehicles which should enable future inventories to do more detailed analysis on its mobile combustion emissions.

[12] https://ww2.arb.ca.gov/resources/documents/lcfs-pathway-certified-carbon-intensities
[13] https://www.epa.gov/climateleadership/ghg-emission-factors-hub

4.1.3 Fugitive Emissions

Fugitive emissions for TDPUD include HVAC refrigerant leakage and Sulfur Hexafluoride (SF_6) emitted from electrical transmission and distribution equipment.

TDPUD is subject to California regulation which requires annual reporting (and inventory tracking) of SF_6 emitting equipment (namely SF_6 insulated switchgear). This inventory reviewed the annual reporting data and observed that TDPUD does not own or operate any SF_6 insulated switchgear and its annual SF_6 emissions are zero. Therefore, the only fugitive emissions to report are from HVAC refrigerant leakage.

Given the de minimis magnitude of fugitive emissions relative to the overall Scope 1 emissions, this inventory applied a simplified estimation method to calculate fugitive refrigerant emissions. This inventory uses the Screening Method defined in the GRPv3 for refrigeration and air conditioning systems as follows:

$$\epsilon_{Year} = \frac{(C_N * k) + (C * w * T) + [C_D * y * (1 - z)](kg)}{1{,}000\ (\frac{kg}{mt})}$$

Where:

ε_{Year}	Are the calculated mobile GHG emissions (in units of Metric Tons CO_2e) for each piece of refrigeration equipment for the reporting year summed across all pieces of equipment in the organization.
C_N	Quantity of refrigerant charged into the new equipment
C	Total full charge (capacity) of the equipment
T	Fraction of year equipment was in use (e.g., 0.5 if used only during half the year and then disposed)
C_D	Total full charge (capacity) of equipment being disposed of
k	Installation emission factor *= 0.03*
w	Operating emission factor *= 0.15*
y	Refrigerant remaining at disposal *= 0.80*
z	Recovery efficiency *= 0.70*

The factors described in the above formula are defined in Table 4.1 in The Climate Registry's Default Emission Factors (published for each year). The above formula reports emissions in units of Metric Tons of CO_2e. These results were converted to US Tons of CO_2e to be consistent with results reported in this inventory. The total calculated fugitive emissions for CY 2022 were ***9.8 Tons of CO2e*** which is less than 2% of local Scope 1 emissions and approximately 0.1% of the total Scope 1 Emissions. In either case the emissions are significantly under the 10% threshold established in the GRPv3 and validates this inventory's application of the SEM approach.

4.1.4 Process Emissions

The EPSP identifies acid gas scrubbers for gas turbine power generator plants as a process emission source. Staff reviewed available literature for the power plant through Utah Associated Municipal Power Systems (UAMPS) and detailed information was not available on plant operations for the Nebo power plant or its GHG emissions (beyond what could be found at the EIA). However; it is assumed that the emissions factor used in this study to estimate the GHG emissions per Megawatt-hour of generated electricity (see Section 4.1.1 on Stationary Combustion Emissions) includes this emissions component as it is applied to the whole plant and not simply the generator units. Therefore, while zero process emissions are being reported, the emissions from this source should be understood to be included within the Stationary Combustion Emissions and not omitted from this study.

4.2 Scope 2 Emissions: Indirect Direct Anthropogenic

This inventory found that total Scope 2 emissions attributable to TDPUD were ***238.5 Tons CO_2e*** for calendar year 2022.

Table 4-6 Scope 2 Emissions Summary for TDPUD (CY2022)

	Electric Dept *[Tons CO_2e]*	Water Department *[Tons CO_2e]*	Total Emissions *[Tons CO_2e]*
Consumed	28.34	206.19	235.02
Transmission Losses	0.48	3.48	3.48
Total	28.82	209.68	238.50

Scope 2 emissions result from activities which take place within an organization's boundary, but actually occur within the boundary of a different organization. Such emissions are reported using *location-centric* and *market-centric* perspectives which give two understandings of an organization's GHG footprint.

> The **location-centric** approach accounts for geographically proximate grid resources to estimate the GHG content in regionally proximate electricity generation. This ignores power purchase contracts and focusses on "cleanliness" of regional/local generation. This helps provide insight on the local/regional impacts of energy conservation.
>
> The **market-centric** perspective accounts for an organization's energy purchasing decisions. It allows an organization to understand the impact that their energy supply (e.g., financial and contracting) decisions have on their GHG footprint.

In some cases, the two approaches may be identical, while for other organizations they can be quite different. For TDPUD, these two will generate different results as all its electricity is sourced contractually from outside of the region and across NV Energy transmission infrastructure. Therefore, TDPUD's *location-centric* emissions factor will be closely aligned with NV Energy's fuel mix while its *market-centric* emissions factor will reflect its resource procurement portfolio. This inventory reports Scope 2 emissions using a *market-centric* perspective which is consistent with its intent in applying the *Equity Share* organizational boundary.

Individual Scope 2 emission sources which were considered in the 2022 Inventory are listed Table 4-7.

Table 4-7 List of Anticipated Scope 2 Emissions Covered by Inventory

Indirect Emissions (Energy)	A simple example of Scope 2 emissions are those associated with an organization's electricity consumption. Electricity consumed by an organization must be generated elsewhere, and generally by a separate organization. While the emissions occur directly within the generating facility's boundary, they were indirectly generated by the consumer. They are therefore reported under *Scope 2* for the consumer and *Scope 1* for the generator.[14]		
	GRPv3 Sources	**EPSP Sources**	**WENRP Sources**

[14] This is slightly modified for vertically integrated utilities and any organizations which consume power that is self-produced since such emissions are reported as direct (Scope 1).

	▪ Electricity consumed by District HQ facility. ▪ Electricity consumed by well houses. ▪ Electricity consumed by electric infrastructure.	▪ T&D Losses from self-consumed electricity ▪ SF_6 emissions from transmission outside of District boundary.	*None*

Similar to what was noted under Scope 1, the TDPUD Water Utility does not manage any water-specific emissions sources which result in reportable Scope 2 emissions.

Under the market-centric perspective, Scope 2 emissions are heavily influenced by the generation resource mix from which electricity is sourced. This inventory collected data on:

TDPUD's generation resources (hourly generation for each resource in TDPUD's portfolio),

- Hourly electricity imports to each of TDPUD's substations (representing total imported electricity), and
- Hourly electricity consumption across all TDPUD facilities

The above data were used to develop an hourly estimate of The District's resource mix (e.g. model the hourly contribution of each of The District's resources to its total loads) and the subsequent hourly emissions intensity for electricity imported by TDPUD into its service territory. The modeled emissions intensity was then used to inform components within each scope of reported emissions.

The general form of the equation used to derive TDPUD's hourly resource mix emissions profile applies a resource specific emissions intensity factor to the hourly generation of each resource in TDPUD's resource mix. The resulting hourly emissions profile for each resource is summed within the hour to develop an overall hourly emissions intensity for imported electricity. The hourly data is then summed to calculate overall annual emissions. This is represented mathematically by the following:

$$\epsilon_{Year} = \sum_{hour} \left[\sum\nolimits_{resource} EIF_{resource} * Generation_{resource,\ hr} \right]_{hour}$$

Where:

$\boldsymbol{\varepsilon}_{\mathbf{Year}}$	Are the calculated GHG emissions (in units of CO_2e) for the production of electricity at facilities from which TDPUD sources its electricity.
$\boldsymbol{EIF}_{\boldsymbol{resource}}$	Is the emissions intensity factor (in units of CO_2e per Megawatt-Hour) used to estimate GHG emissions for each generation resource. The specific values used for the EIF, and their derivation, are explained in detail in 4.2.2.
$\mathbf{Generation}_{\mathbf{resource,\ hr}}$	Electricity generation for each resource for each hour of the year.

The precise application of the above general approach for Scope 2 omitted emissions occurring from resources in which The District owns financial equity (discussed in 4.1.1.3) as those emissions are reported under Scope 1 within this inventory's organizational boundary. Scope 2 emissions are those which occur from the remaining resources not already reported in Scope 1 specifically resulting from TDPUD's own electricity use.[15]

[15] An important nuance to note here is that the Scope 1 emissions include emissions resulting from all electricity imported from generation resources in which The District has equity (regardless of who ultimately consumes the electricity). Scope 2

4.2.1 Differences in Reported GHG Emissions

After data collection, this inventory established emissions intensity factors each generation resource as a first critical step in deriving overall GHG emissions attributed to electricity generation. This process was navigated with careful attention paid to the original objectives of the inventory. Namely, fundamental differences exist between the objectives underlying the engineering assumptions and reporting standards established by statewide programs (for example California's Renewable Portfolio Standard) and those applied in this GHG inventory. A basic Venn diagram can be used to demonstrate this relationship as the two are not mutually exclusive (see Figure 4-4).

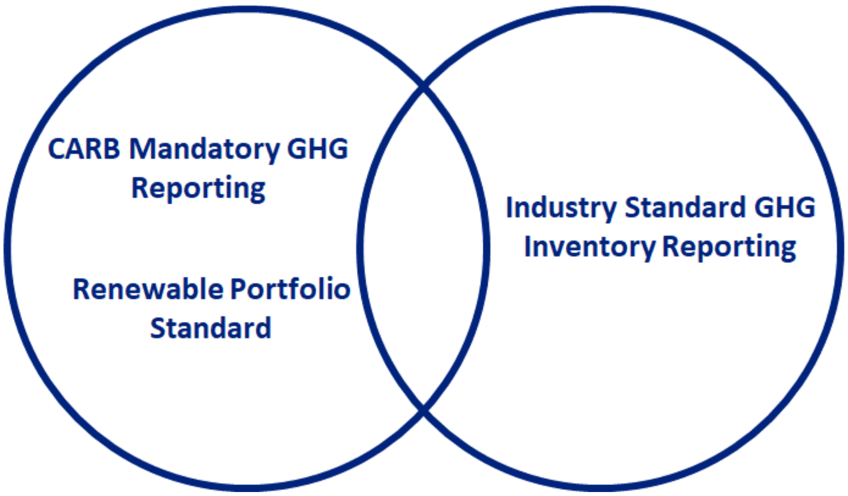

Figure 4-4 Statewide Program Reporting Vs. GHG Inventory Reporting

In particular, the emissions reported by this inventory are not the same as those reported under California's Renewable Portfolio Standard (RPS). The RPS program levies a particular definition for what it considers to be a 'renewable' resource which is intentionally designed to achieve the objectives of the program. This definition, and the resulting emissions assumptions, are therefore not purely derived using physical first principles and necessarily includes both social and political dimensions.

This inventory endeavors to quantify emissions solely based on the physical first principals of the technologies used to generate the electricity and the specific circumstances of the facility/locations where those activities occur. ***This inevitably leads this inventory to recognize that all electricity generation technologies have some level of GHG emissions in over the lifecycle of its facility – even resources deemed as 'renewable' have non-zero emissions.*** The emissions intensities used by this inventory and how they were derived is discussed further in the next section.

4.2.2 Emissions Intensities for Generation Resources

Consistent with the objectives discussed in the previous section, this inventory applies 'life-cycle emissions factors' for each of the electricity generation technologies in TDPUD's resource portfolio. Life-cycle emissions factors are used to account for the real-world impact that its resource procurement has on its organizational emissions. Furthermore, this provides critical information for downstream users of electricity procured/generated by TDPUD when assessing their own GHG impacts.

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emissions are only concerned with the portion of electricity consumed by The District and not already reported under Scope 1.

The National Renewable Energy Laboratory (NREL) has compiled research on over 3,000 published life cycle assessments on utility scale electricity generation technologies. This research project was initially published in 2012 and has since been updated several times (with the most recent update published in 2021). This NREL study provides lifecycle GHG emissions for common utility scale electricity generation technologies and was the main reference point for emissions factors for this inventory.[16] Emissions factors used for this inventory are listed in Table 4-8.

Table 4-8 Life-Cycle Emission Factors for Utility Scale Generation (note values are in units of g CO2e/kWh generated[17])

	Generation Technology	Upstream	On-Going		Downstream	Total
			Combustion	non-combustion		
Renewable	Photovoltaic[1]	28.0	0	10.0	5.0	43.4
Renewable	Concentrating Solar Power[2]	19.7	0	10.0	0.5	28.0
Renewable	Geothermal[1]	15.3	0	6.9	0.1	36.7
Renewable	Hydropower[1]	6.2	0	1.9	0.0	20.5
Renewable	Wind[1]	11.8	0	0.7	0.3	13.0
Renewable	Landfill Natural Gas	NR	NR	NR	NR	298
Non-renewable	Nuclear - Light Water Reactor	2.0	0	11.7	0.7	13.0
Non-renewable	Natural Gas - Conventional Gas	0.8	389	71.0	0.0	486.0
Non-renewable	Coal[1]	2.5	1,010	10.0	2.5	1,001.0
Storage	Pumped-Storage Hydropower	3.0	0	1.8	0.1	7.4
Storage	Li-Ion Battery Storage	31.5	0	NR	3.4	32.9
Storage	Hydrogen Storage	26.7	0	2.5	1.9	37.9

[1] *All Technologies*
[2] *Trough and Tower*

One notable omission in the set of technologies reviewed in the NREL study is landfill natural gas (electricity from which TDPUD purchases from the City of Murray). Establishing an emissions factor for landfill natural gas was difficult as not much research is available on the subject. On the one hand the electricity is generated by burning natural gas (methane released by landfills) and therefore not physically any different than a natural gas plant. However, it is also true that the methane would have likely been released regardless, and in a form that has a much higher global warming potential than the CO_2 resulting from its combustion. This inventory opted to take a middle ground approach which acknowledged that while the emissions are clearly non-zero, they are much better than the assumed alternative of allowing the methane to simply emit untreated from the landfill.[18] This is a potentially important point of continued research in future inventories.

The values listed in in Table 4-8 are broken down into three components: “upstream”, “on-going”, and “downstream”. These each correspond to the portions of a generation asset’s lifecycle where:

[16] The NREL study results can be found here: *https://www.nrel.gov/analysis/life-cycle-assessment.html*
[17] These units are a departure from those reported everywhere else in this study. The values in this table were kept in these units as this is how they were reported in the original NREL study cited.
[18] The specific value was generated by taking a weighted average of all resources NREL reviewed with weights determined by the technology’s representation in the overall grid (highly weighted towards natural gas).

- **Upstream –** includes activities such as mineral extraction, component/material manufacturing, and asset construction. This includes both the facility itself and the fuels used in for generation.
- **On-Going –** refers to an asset's operation and maintenance activities while used to generate electricity. This includes any emission in the fuel-to-electricity conversion process (for example combustion in a natural gas turbine) as well as emissions resulting from facility maintenance and day-to-day operations.
- **Downstream –** includes the remaining life-cycle emissions occurring due to decommissioning, disposal, and recycling of the asset and any remnant fuel.

For fossil fuel generation technologies, most emissions occur during operation of the facility when it is actively generating electricity. On the other hand, most emissions from resources classified as 'renewable' occur during the upstream portion of its lifecycle. This difference in when the emissions occur is important to capture to appropriately compare emissions across multiple generation technologies.[19]

This inventory used the emissions factors listed in the "Total" column of Table 4-8 which accounts for emissions released in each stage of the generation asset's lifecycle.

4.2.3 Indirect Emissions (Scope 2) Analysis Results

The Scope 2 emissions calculated for TDPUD in calendar year 2022 were shown in Table 4-6 where it can be seen that the bulk of emissions come from electricity consumed by the Water Department (~88%). ***Total Scope 2 emissions for The District in calendar year 2022 were 238.5 Tons CO_2e***. Note that the emissions reported under Scope 2 do not include emissions from the Nebo, Horse Butte, or Veyo generation resources as those were already reported under Scope 1 as discussed in Sections4.1.1.3.

The same above is shown graphically along with an hourly (time-series) plot of scope 2 emissions for the Electric and Water Departments in Figure 4-5. Note that Figure 4-5 not only shows the relative proportion of emissions for each of TDPUD's utilities, but it also shows when in time those emissions occurred in calendar year 2022. It can be seen that the most while the Water Department's peak emissions occur during the summer months (coincident with the highest customer water demands) the Electric Utility's emissions peak over the winter and are instead driven by heating demands for buildings and equipment.

[19] Consider too that emissions occur in different geographic locations based on when in the lifecycle the emissions are released. Emissions resulting from industrial activities, most of which occur in the upstream and downstream periods, tend to disproportionally impact regions with lower socio-economic means. While a particular technology might release far fewer emissions on-site (while operating), it may be the case that its overall emissions are simply displaced in time and location and not immediately observable during the ongoing/operations phase of its lifecycle.

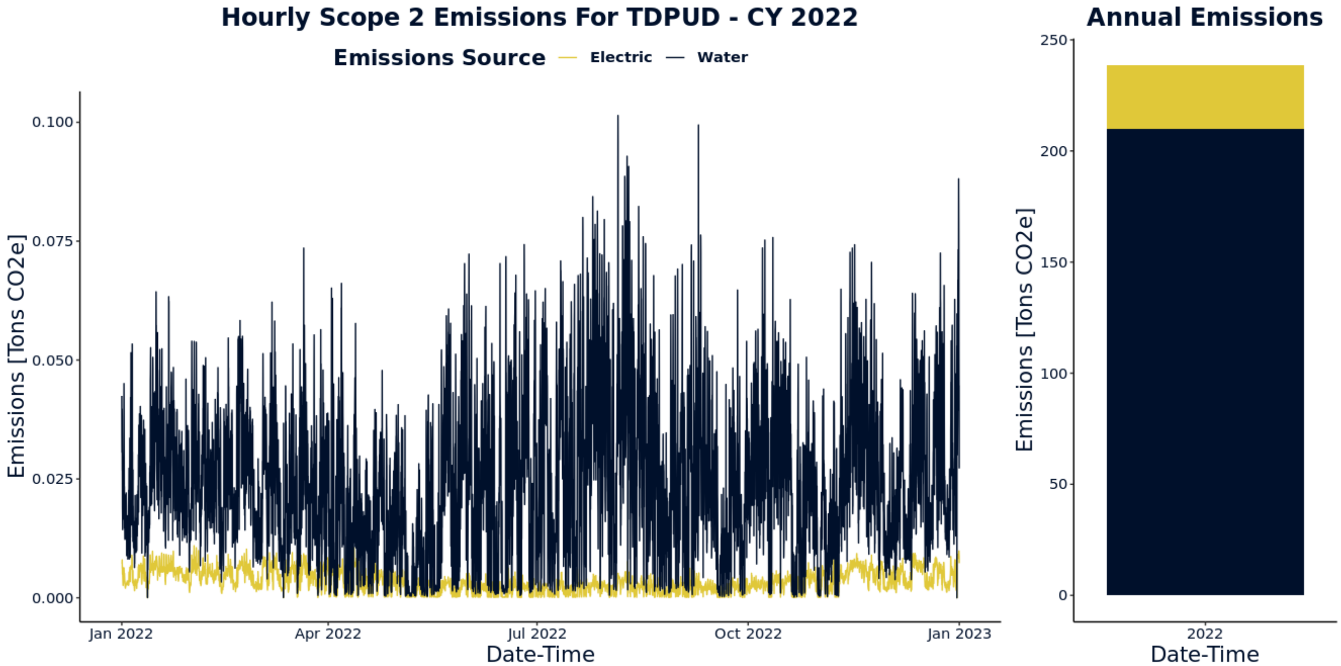

Figure 4-5 Overview of Scope 2 Emissions for Calendar Year 2022

4.3 Scope 3 Emissions: Indirect Emissions Outside of Organization Value Chain

The final category of reportable emissions captures all remaining indirect emissions outside of consumed energy. This category is clearly broad and provides an organization the opportunity to capture/report emissions both upstream and downstream within its value chain.

Given the broad nature of potential Scope 3 emissions sources, the extent and rigor with which they are reported will necessarily be limited by the resources and strategic objectives of the organization performing the inventory. Specific Scope 3 emissions which this study quantified are listed in Table 4-9.

Table 4-9 List of Anticipated Scope 3 Emissions Covered by Inventory

Indirect Emissions (Other)	GHG accounting for scope 3 must balance an emission's relevance to the organization, comprehensive reporting within the boundary, consistency & transparency in methodology, and finally the accuracy (or rigor) with which emissions are quantified.		
	GRPv3 Sources	**EPSP Sources**	**WENRP Sources**
	▪ Fuel combustion from employee commuting	▪ Electricity delivered to customers. ▪ T&D Losses from electricity delivered to customers	▪ Waste-Water treatment

As noted for Scope 2, Scope 3 emissions sources all fall outside of The District's organizational boundary. However, they are indirectly linked to District activities due to purchasing decisions, policy decisions, or through the use of District products (e.g., electricity and water).

The total Scope 3 emissions reported for the 2022 calendar year are ***33,516 Tons CO2e*** as summarized in Table 4-10

Table 4-10 Aggregated Scope 3 Emissions for CY2022

Emission Source	Emissions [Tons CO_2e]
Employee Commutes	337
Electricity Sold	32,701
Wastewater (water sold)	478
Total	**33,516**

It can be seen in the above table that the vast majority of reported Scope 3 emissions are attributed to electricity sales and, more fundamentally, to TDPUD's resource portfolio. However, most of those emissions physically occur outside of the Truckee/Tahoe region. Employee commuting and wastewater treatment emissions instead all directly occur within the Truckee/Tahoe region[20].

4.3.1 Fuel Combustion from Employee Commuting

Emissions occur from employees commuting between their homes and their worksites. Such emissions may arise from several sources including:

- Personal Automobiles
- Bus Travel
- Rail Travel
- Air Travel

As previously stated, these emissions technically fall outside of the District's organizational boundary and are directly attributed to the individuals commuting to and from their worksites.[21] However, the District is indirectly linked as an employer with some ability to affect its employee's commuting patterns through policy decisions and/or incentive structures. As such, these emissions are reported under Scope 3 for The District.

Several methods are available to calculate emissions from employee commuting. This inventory has opted to use a distance-based method which applies data from employee commuting patterns (e.g. distances and number of commutes) with appropriate emissions factors for each mode utilized. Note that the magnitude of emissions in this category are minor relative to the other Scope 3 emissions reported here, though they are similar in magnitude to the mobile emissions reported under Scope 1 for The District. Emissions were calculated using the following approach:

$$\epsilon_{annual} = \sum_{Commute\ Modes} D_{annual,\ Mode} * EIF_{Mode}$$

Where:

ε_{Year}	Are the calculated GHG emissions (in units of CO_2e) attributed to employee commuting activity for the reporting year.
$D_{annual,\ Mode}$	The annual distance traveled by commuters using a given mode (e.g. personal auto, bike, bus, etc.).

[20] Broadly speaking as employees commute from Reno and other regions outside of Truckee and Tahoe specifically.

[21] It is assumed individuals have personal agency over their purchasing decisions and location.

EIF $_{Mode}$	Is the emissions intensity factor (in units of CO_2e per mile traveled) used to estimate GHG emissions for each mode of commute transportation. The specific values used for the EIF and their derivation are explained below.

Distances for employee commutes were derived using data on city of residence for employees and a sample of employees were interviewed regarding their commuting patterns to estimate frequency of commutes. Similarly, a sample of vehicles were surveyed for specific characteristics (e.g. Body type, fuel type, etc.) to estimate their emissions factors.

Except for occasional circumstances, most employees were found to commute using personal automobiles with some occasions of carpooling and few instance of regularly walking or riding bikes for employees living relatively closer to their worksites. The predominate mode was personal automobile transportation for which two volumetric emissions factors were used (CO_2e per gallon of fuel burned), one for gasoline vehicles and another for diesel, which were multiplied by an estimated 'typical' fuel economy for each mode of transportation to derive the final EIF for each mode.

Table 4-11 Volumetric Emissions for Vehicle Fuel Types

Diesel	Gasoline
0.0113 *[Tons CO_2e/Gal]*	0.0097 *[Tons CO_2e/Gal]*

Table 4-12 Summary of Employee Commuting Emissions

Employee Count	Distance$_{One\ Way}$ *[Mi$_{each}$]*	Distance$_{Annual}$ *[Mi$_{Total}$]*	Emissions *[CO_2e]*
77	22	9,397	337

The average commuting distance traveled (one way) for employees at The District is approximately 22 miles with a total of 9,397 miles traveled annually by District employees for commuting. ***The resulting emissions for employee commuting are estimated to be 337 Tons of CO2e annually.***

4.3.2 Electricity Delivered to Customers

While The District has no direct control over how much electricity its customers utilize (or when it is used), TDPUD still retains some indirect influence on each through policies, programs, and incentives. Furthermore, TDPUD has agency over its resource portfolio (e.g., The mix of resource types and emissions discussed under Scope 2).[22]

Consistent with the above, the ESPS defines electricity sold to customers (including the associated transmission and distribution losses) as Scope 3 reportable emissions for electric utilities. Furthermore, these emissions are reported without consideration of the equity boundaries applied in Scopes 1 and 2. The emissions reported here for electricity sold to customers cannot therefore be added to either the Scope 1 or Scope 2 emissions previously reported in this inventory without the risk of double-counting emissions activities.[23] Rather, the emissions reported in this section are informational and should be used to understand the relative impacts that electricity use within TDPUD territory have on GHG emissions at a grid level.

[22] Note that while TDPUD has agency over its resource mix, it is also subject to a number of constraints that must be balanced for it to meet its missional objectives. Namely that the purchased power must be costed appropriately for TDPUD's customers, and it must be reliably delivered at the time(s) required by the community.

[23] It is critical to remember that emissions cannot be aggregated across Scopes.

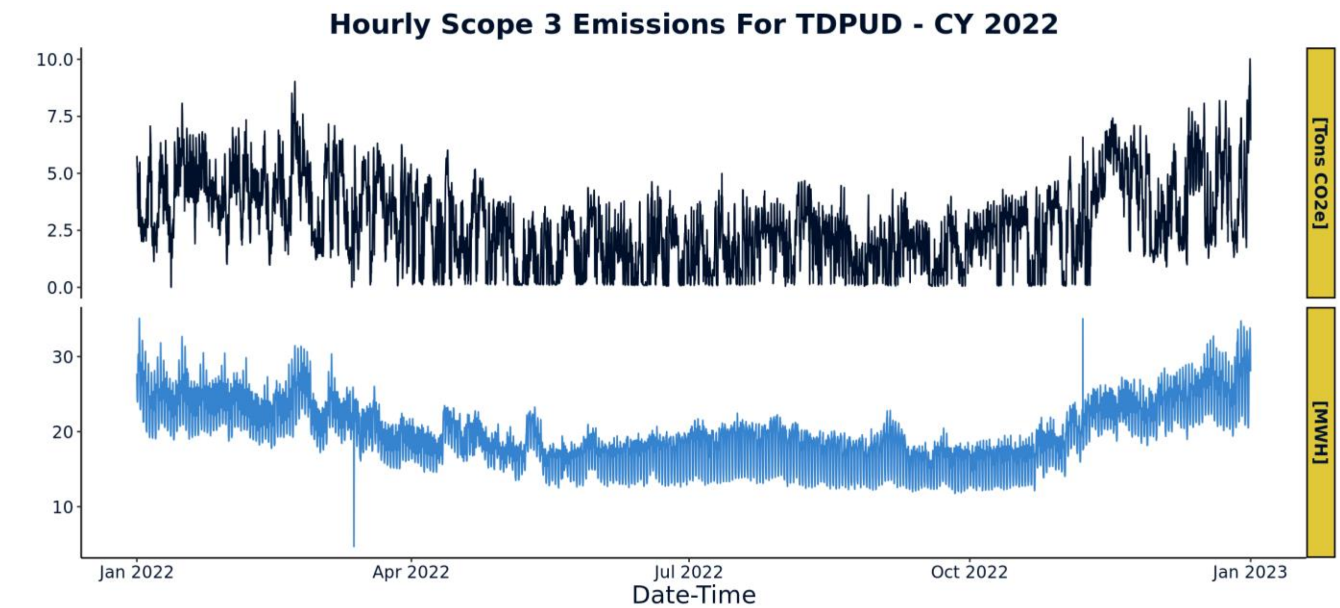

Figure 4-6 Hourly Electricity Use and Emissions for Electricity Sold to Customers

Figure 4-6 illustrates the hourly profile for both the electricity used by TDPUD customers (bottom) and their subsequent GHG emissions (top). It can be seen at a general level that the emissions are proportional to electricity use which reaches its peak in the winter months. However, it is also sensitive to the specific mix of generation resources at a given moment – something that is not directly evident in the plots above.

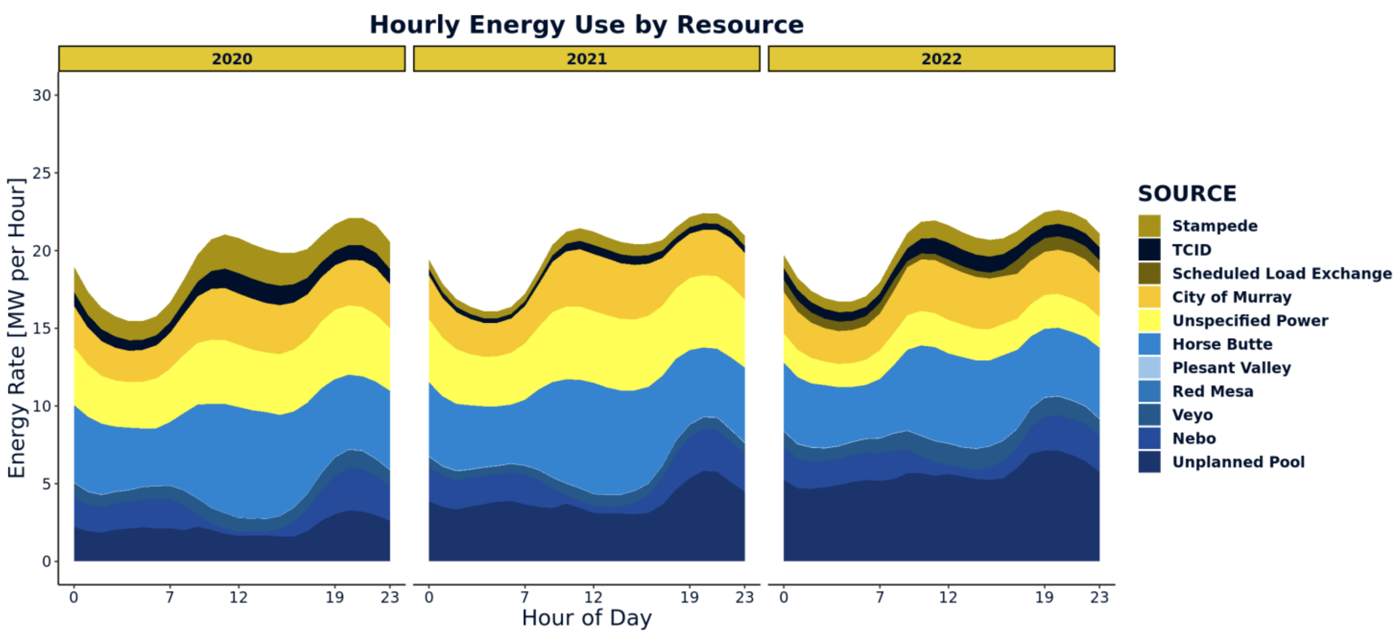

Figure 4-7 Mean Hourly Resource Stack By Year

The precise mix of electric resources (and therefore their emissions) varies on an hourly basis throughout the year due to the realities of how individual generation resources are managed by the independent system operator (ISO) and due to the intermittent nature of 'renewable' resources. This is demonstrated in Figure 4-7 where TDPUD's mean hourly resource mix can be seen for calendar years 2020 through 2022. Here it can be seen how the contribution of each generation resource varies by the hour of the day and from year to year – though the overall shape of the profile(s) tends to remain similar.

Finally, Figure 4-8 shows the hourly changes in TDPUD's portfolio emissions intensity resulting from the factors discussed above. It can be seen in Figure 4-8 that the overall emissions intensity has remained similar across the last three years despite some variation from year to year. The emissions generally increase in the evening hours where a larger percentage of the power is derived from Nebo and other unspecified (e.g. Natural Gas dominated) resources. The dip in emissions intensity in the middle of the day is expected to become more exaggerated with the addition of the Red Mesa solar project which came on-line in quarter 1 of 2023.

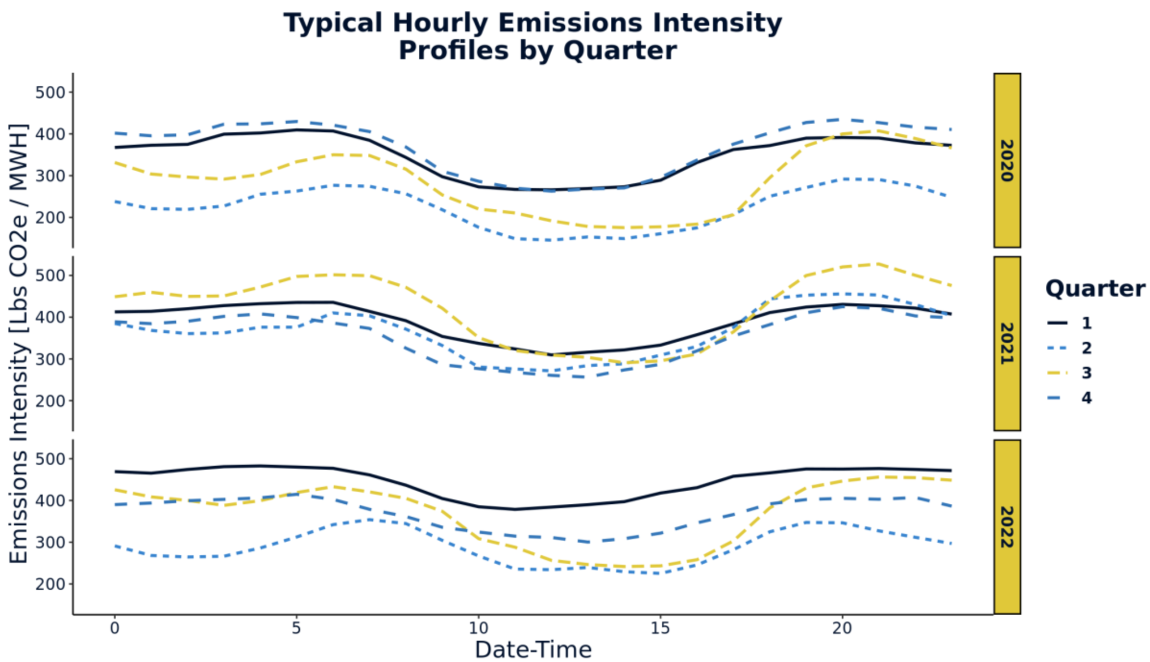

Figure 4-8 Mean Hourly Portfolio Emissions Intensities by Quarter

Table 4-13 Summary of Scope 3 Emissions from Electricity Sales

Electricity Sold	174,887	MWH
GHG Emissions	32,701	Tons CO2e

The total estimated Scope 3 ***emissions resulting from electricity sales to TDPUD customers is 32,701 Tons CO_2e*** from 174,887 mega-watthours of electricity sold.

4.3.3 Wastewater Treatment

The main greenhouse gasses produced by the wastewater treatment process are methane (CH_4) and nitrous oxide (N_2O). While TDPUD does not have any wastewater treatment facilities, much of the water that it produces for customers eventually flows to the Truckee Tahoe Sanitation Agency (TTSA) where it is treated. The WENRP recommends therefore that emissions from wastewater treatment for water produced by a water utility be reported under its Scope 3 emissions.

As these are not direct emissions within TDPUD's organizational boundary and reported for informational purposes, this inventory did not apply the same level of rigor as employed for emissions reported under Scopes

1 and 2. Furthermore, limited data/literature are publicly available from local agencies which would enable a more rigorous analysis. The Tahoe Regional Planning Agency published a Greenhouse Gas Inventory in 2021 which included emissions from wastewater for the Tahoe Basin (treated at TTSA). However, only total emissions were reported and no intermediate calculations or normalized results[24] were published. The best available research at the time of this inventory on emissions for wastewater treatment was found in the US GHG inventory published in 2019[25] in which the EPA establishes a top-down approach for estimating national level emissions for domestic wastewater treatment.

The EPA reports estimates that 9.4 million Tons of CO2 equivalent[26] were generated by wastewater treatment in 2017. It also considers emissions proportional to the daily production of wastewater by the population (per person) determined by the US Census. ***This inventory estimates that the wastewater emissions produced due to domestic water produced by TDPUD to be 478 Tons in calendar year 2022.*** This was estimated by scaling the EPA reported estimates by the US census population in 2017 (330 million)[27] to the census population of Truckee in 2022 of 16,850.

$$\in_{Annual} = \in_{EPA} * \frac{Pop_{Truckee}}{Pop_{US\ 2017}}$$

Where:

E_{Anual}	Are the calculated GHG emissions (in units of CO_2e) attributed to wastewater processed by TTSA for domestic water produced by TDPUD.
$Pop_{Truckee}$	The population of the Town of Truckee in 2022 as determined by the US Census. This value is 16,850 persons.
$POP_{US\ 2017}$	The US census population used in the EPA GHG inventory. This value is 330 million persons.

[24] For example, emissions per million gallons of water treated.
[25] https://www.epa.gov/sites/default/files/2019-04/documents/us-ghg-inventory-2019-chapter-7-waste.pdf
[26] See Table 7-10 in 2019 US GHG inventory (Chapter 7)
[27] Also reported in Table 7-9 in 2019 US GHG inventory (Chapter 7)