**Technical Appendix GHG Emissions Reductions**

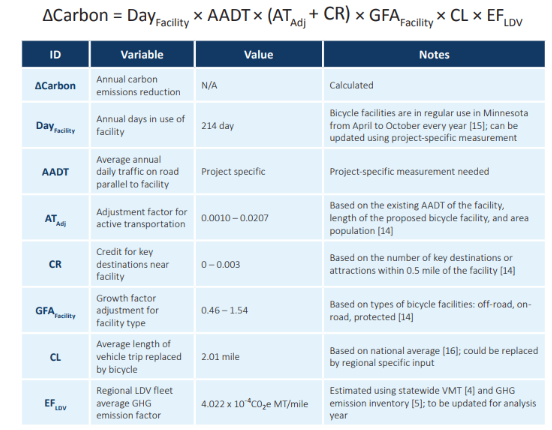
**Building Retrofits Project**

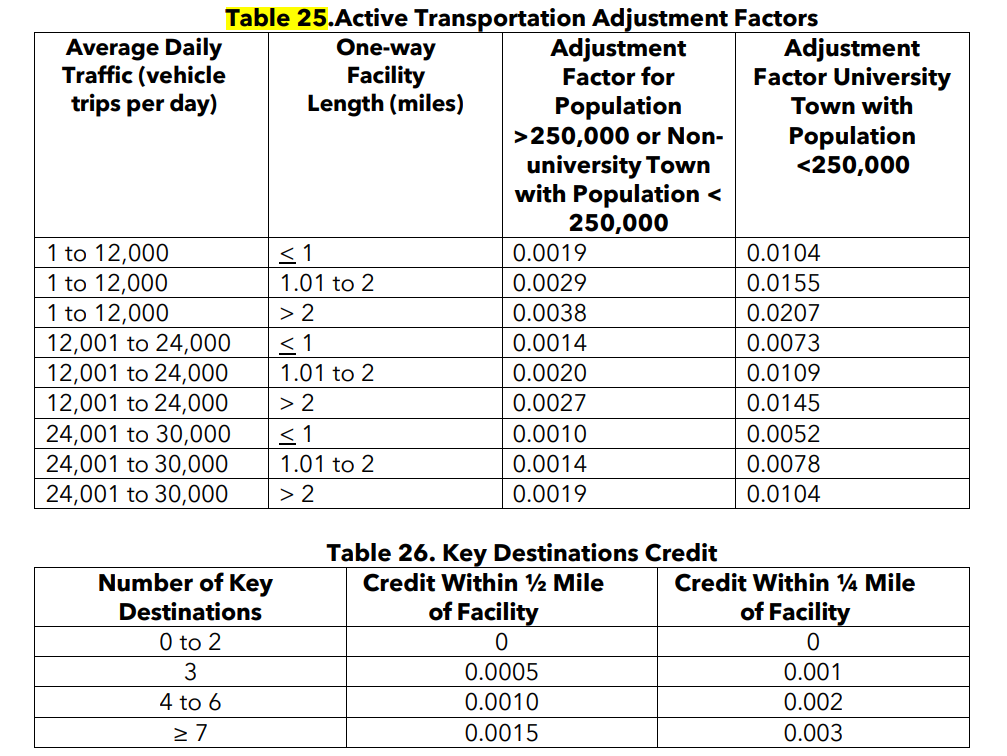
* Methodology for estimating GHG emission reduction
  + Formula:
    - Current Building energy usage x Predicted energy reduction (20%) = kWh reductions;
      * 2021 Total Electric Energy Usage (Project Buildings): 510639.49 (Orchard, Boston, Woodard) + 103417.58 (Linwood)+ 190084.36 (Edgemoor) + 337154.37 (CityArts)+ 138612.31 (Atwater) + 129179.81 (Brewer)+ 34298.07 (Evergreen) + 35,068 (Goldenrod Shelter)+ 30,556 (Fairmount)+ 10,088 (Hilltop)+ 13,749 (Watson)+ 28,057 (Hyde)+ 27,019 (Kiwanis)+ 42,386 (Minisa)+ 12,467 (Park Villa)= 1642775.99
    - 1,540.1 lbs CO2/MWh × 1 metric ton/2,204.6 lbs × 0.001 MWh/kWh = 6.99 × 10-4 metric tons CO2/kWh
  + Multiply these two numbers to get the annual reductions. Predicts= 229.6600834 metric tons CO2 per year
    - Calculated using EPA Greenhouse Gases Equivalencies Calculator- Electricity reductions (kilowatt-hours).
    - Predicted 20% reductions comes from similar projects completed by Wichita and other cities.
  + Compare current energy use to predicted energy reduction (%) and resulting CO2e reductions.
* Method for tracking GHG reductions
  + EnergyCap utility tracking and Evergy electricity bills, ICLEI GHG Inventory
    - The City of Wichita tracks electricity usage on the EnergyCap utility tracking platform and tracks its GHG emissions using the ICLEI software platform.

**Electric Vehicles and Charging Infrastructure**

* Charging Stations:
  + Methodology for estimating GHG emission reduction was taken from the Carbon Reduction Strategy Document of the Minnesota Department of Transportation <https://edocs-public.dot.state.mn.us/edocs_public/DMResultSet/download?docId=36928262>
  + Minnesota DOT Estimation: # of sites x kW voltage of stations x 8760 hours/year x usage time (%) ÷ average EV efficiency (Average EV efficiency published by the Argonne National Laboratory in 2022) x Fleet average emissions factor (MnDOT) 4.022 x 10-4 CO2e MT per mile
    - Level 2 Chargers:
      * 22 ports x 5kW x 8760 hours/year x 10% usage time ÷ 0.294kWh x 4.022 x 10-4 CO2e MT per mile = 131.823 CO2e MT per year
    - DC Fast Chargers:
      * 5 ports x 125kW x 8760 hours/year x 5% usage time ÷ 0.294kWh x 4.022 x 10-4 CO2e MT per mile = 374.497 CO2e MT per year
    - Total: 506.32 CO2e MT per year
  + National Charger Usage averages[[1]](#footnote-17089) [[2]](#footnote-6005):
    - L2: 10%
    - DCFC: 5%
  + The carbon reduction is calculated by estimating the total displaced VMT from gasoline LDVs to EVs, using total electricity or energy consumed by EVCS.
* Fleet Electric Vehicles
  + EPA: <https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references>
  + Electric: 857.0 lbs CO2e/MWh × 10,746 VMT car/truck average × 1/3.60 miles per kWh all EVs average x 1/1000 MWh/kWh x 1 metric ton/2,204.6 lbs = **1.16 metric tons CO2e/vehicle/year**
  + Gas: 8.89 × 10-3 metric tons CO2/gallon gasoline × 10,746 VMT car/truck average × 1/22.9 miles per gallon car/truck average × 1 CO2, CH4, and N2O/0.993 CO2 = **4.20 metric tons CO2e/vehicle /year**
  + 4.20-1.16 = ~3.04 metric tons CO2e/vehicle /year
* Method for tracking
  + Track electricity usage of EV charging stations and track the miles driven by city fleet EVs. The Sustainability Coordinator and Data Analyst will assist Fleet and other relevant departments in collecting this data through the software being used for the charging stations.

**Redbud Trail**

* Methodology for estimating GHG emission reduction
  + This was the most challenging project to estimate reductions for it. Pedestrian/Bicycle paths have an established methodology and formula, but pedestrian crossing bridges do not. As part of this project, the Data Analyst and Sustainability Coordinator would be responsible for developing a more concrete method for measuring the ghg reductions. In particular, looking for ghg reductions from reduced traffic stops and congestion along with the effect of the bridges increasing usage of the trail will need to be analyzed.
* In the meantime, this estimation will utilize the formula for pedestrian/bike paths put forward by the Minnesota DOT in their Carbon Reduction Strategy to calculate the GHG reductions from this project. Based upon careful review, the formula was deemed relevant to the Redbud Trail project with any changes noted below and sources referenced.
* Minnesota DOT- Bike method:
  + **Formula from Minesota DOT, with some modifications**: 
  + 214 days/year x 20,000 AADT x (0.0027+ 0.003) x 1.54 x 2.01 miles x (4.022 x 10-4 CO2e MT per mile) = **30.4 CO 2e MT per year**
    - 15,000-22,000 drivers on roads parallel to Redbud Trail, average is 19,000-20,000 <https://data-cityofwichita.hub.arcgis.com/datasets/7d9b84c73ce3477da02ac5adde478ecb_0/explore?location=37.713939%2C-97.229593%2C13.90>
  + The following data points were calculated using the tables in the California methods on pages 22-24.
    - 0.0027 adjustment for number of trips
    - Key Destinations: 2 groceries stores, 2 schools, 2 medical centers, 1 day care center, and more (0.003)
    - Growth factor adjustment for facility type [0.46 – 1.54] This project qualifies as class 1 and 1.54 adjustment.
    - Average length of vehicle trip replaced by bicycle: 2.01 miles



* Sources:
  + <https://ww2.arb.ca.gov/sites/default/files/auction-proceeds/sgc_ahsc_finalqm_121423.pdf> - “Quantification Methodology: Strategic Growth Council Affordable Housing and Sustainable Communities Program,” California Climate Investments pg. 22-24
  + <https://edocs-public.dot.state.mn.us/edocs_public/DMResultSet/download?docId=36928262> - Minnesota Carbon Reduction Strategy 2023

**Solar Panel Installations**

* Methodology for estimating GHG emission reductions
  + Estimated as solar replacing equivalent Evergy electricity mix
  + Generate ~14,000 kWh per month at three solar installations (100-120kW arrays; 168,000 kWh annually, each)
    - Based on estimate from possible vendor
  + Generate ~1,000,000 kWh annually at Multimodal Facility (875kW array)
    - Based on initial estimate from contractor building the facility
  + **Formula**: Estimated kWh generated by solar installation: 1,504,000 kWh annually
  + 991.7 lbs CO2/MWh × 1 metric ton/2,204.6 lbs × 1/(1-0.073) MWh delivered/MWh generated × 1 MWh/1,000 kWh = 4.85 × 10-4 metric tons CO2/kWh of electricity used
  + Multiply these two numbers to get the amount of emissions avoided.
    - Calculated using EPA Greenhouse Gases Equivalencies Calculator- Electricity consumed (kilowatt-hours) with the emission rate for SPNO (SPP North) replacing the national average.
  + 1,504,000 x 0.000485 = 729.82 metric tons CO2e per year
* Method for tracking GHG reductions
  + Track output of each solar installation and how much power usage is replaced by solar.

**Tree Canopy**

* Methodology for estimating GHG emission reduction
  + 2600 trees estimated to be planted as part of this project, and due to time constraints we had to utilize an EPAs “Number of urban tree seedlings grown for 10 years” GHG Calculation Equivalency <https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references>
    - 0.060 metric ton CO2 per urban tree planted (10 years)
    - ~0.006 metric ton CO2 per urban tree planted (1 year)
    - 0.006 x 2600 trees= ~15.6 metric tons CO2 per year
  + Future calculations could utilize the EPA’s Sequestration worksheet: <https://www3.epa.gov/climatechange/Downloads/method-calculating-carbon-sequestration-trees-urban-and-suburban-settings.pdf> or another more accurate data source
  + The Wichita Parks department has identified which species they will be planting as part of their Tree Policy: <https://www.wichita.gov/DocumentCenter/View/9386/Tree-Policy-PDF?bidId=> Page 19 has a list of tree species that are native and thrive in the Wichita Climate zone
* Method for tracking GHG reductions
  + Tracking number of trees planted and where, with the Parks department utilizing their existing system to report and work with the Sustainability Coordinator and Data Analyst to report tree plantings and GHG reductions to EPA.

1. G. Bauer, C.-W. Hsu, M. Nicholas and N. Lutsey, “Charging up America: Assessing the growing need

   for U.S. charging infrastructure through 2030,” 7 2021. [Online]. Available: https://theicct.org/sites/

   default/files/publications/charging-up-america-jul2021.pdf. [↑](#footnote-ref-17089)
2. G. Fitzgerald and C. Nelder, “DCFC Rate Design Study For The Colorado Energy Office,” 2019.

   [Online]. Available: https://rmi.org/insight/dcfc-rate-design-study [↑](#footnote-ref-6005)