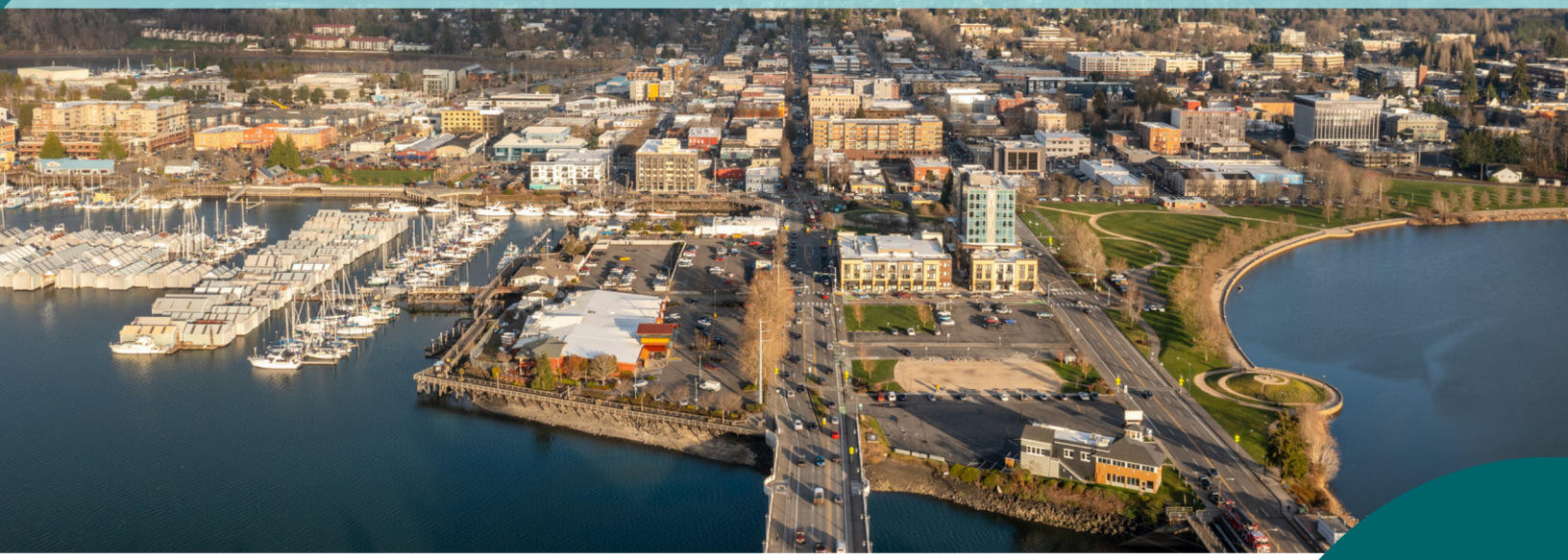
OLYMPIA, WASHINGTON

2021 Community Greenhouse Gas Emissions Reduction Strategy Analysis



Prepared For:

Olympia, Washington

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October 9, 2023

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This template was updated by ICLEI USA in 2023.

Introduction

This report presents forecasted business as usual community greenhouse gas (GHG) emissions for Olympia, Washington, and presents two possible reduction scenarios for community emissions. This report was developed by ICLEI-Local Governments for Sustainability (ICLEI). ICLEI is the first and largest global network of local governments devoted to solving the world's most intractable sustainability challenges. Our standards, tools, and programs credibly, transparently, and robustly reduce GHG emissions, improve lives and livelihoods, and protect natural resources in the communities we serve.

Emissions Forecast

Olympia's community-wide emissions were projected using the following variables:

- Olympia Projected Population Growth

Growth projections for Olympia were sourced from Thurston Regional Planning Council's Population Forecast Allocations Report [1]. Olympia's population is estimated at 55,919 in 2021, and expected to grow to 63,000 in 2030, 69,790 in 2040, and 76,400 in 2050.

- Washington State's Renewable Energy Standard

The projection for change in the electricity emissions factor is based on Washington State's Renewable Energy Standard (RES) which states that all utilities in Washington must be 100% renewable or zero-emitting by 2045 [2].

- On-Road Transportation Fuel Efficiency Standards (CAFE Standards) [3]

Fuel efficiency standards are used to project the reduction of emissions intensity for each mile driven by gasoline on-road vehicles. Fuel efficiency standards decrease emissions due to federally mandated improvements in vehicle fuel economy. ICLEI developed variables from fuel efficiency projections provided by the Center for Climate and Energy Solutions (C2ES).

Olympia's 2021 emissions were estimated at 616,793* Metric Tons Carbon Dioxide Equivalent (MT CO2e). Based on the above growth rates and emissions intensity factors, 2030 emissions are projected to be 394,553 MT CO2e in 2050. Table 1 displays 2021 baseline and business as usual 2030, 2040, and 2050 projected emissions.

[1] "Population Forecast Allocations for Thurston County Final Report." Thurston Regional Planning Council, June 2019.
[2] NC Clean Energy Technology Center (2022, Nov. 3). Renewable Energy Standard: Washington State. https://programs.dsireusa.org/system/program/detail/2350
[3] Center for Climate and Energy Solutions. Federal Vehicle Standards. https://www.c2es.org/content/regulating-transportation-sector-carbon-emissions/
*Please note there is a data discrepancy between the wedge analysis and total greenhouse gas emissions estimated for 2021 to avoid double counting of emissions in the inventory. However, this discrepancy is considered de minimis and has a negligible impact on the analysis outlined in this report.

Table 1: Overview of Olympia's community-wide GHG emissions from 2021 baseline and projected GHG emissions for 2030, 2040, and 2050 (MT CO2e)

Sector	2021 Baseline (MT CO2e)	2030 Business-as-Usual Forecast (MT CO2e)	2040 Business-as-Usual Forecast (MT CO2e)	2050 Business-as-Usual Forecast (MT CO2e)
Residential Energy	133,869	74,089	65,167	61,748
Commercial Energy	167,891	76,763	63,171	57,944
Industrial Energy	12,940	3,766	1,822	675
Transportation & Mobile Sources	206,928	223,040	228,247	222,199
Solid Waste	16,645	18,753	20,774	22,742
Water & Wastewater	264	297	329	360
Process & Fugitive	2,594	2,922	3,237	3,543
Upstream Impacts	75,662	35,649	28,694	25,342
Total	**616,793**	**435,279**	**411,441**	**394,553**

Preliminary Analysis - Strategy Overview

ICLEI USA analyzed Olympia's greenhouse gas (GHG) inventory, the measurement of the sources and amounts of community-wide emissions, and its forecasted emissions to develop a list of strategies across the community that have a sufficient impact and a high likelihood of moving forward.

Moderate Scenario - 93% reduction in 2050 BAU emissions

- Vehicle Miles Traveled (VMT) Reduction: Beginning in 2024, on-road gasoline VMT is reduced 10% by 2030 and an additional 10% by 2050 from business-as-usual projections.
  - A 10% reduction between 2024 and 2030 equates to an annual reduction of 7,308,400 VMT which gives a total reduction of 51,158,800 VMT.
  - A 10% reduction between 2030 and 2050 equates to an annual reduction of 2,302,200 VMT which gives a total reduction of 46,044,000 VMT.
- Electric Vehicle (EV) Adoption:
  - 98.76% of on-road gasoline vehicles in Washington are electric by 2050 based on projections calculated using vehicle turnover rates for vehicles in the US[4][5] and electric vehicle sales requirements per Washington law[6]. The same applies to transit gasoline vehicles.
    - Due to Washington's vehicle standards requiring 100% of light- and medium-duty and vehicle sales to be zero-emission vehicles by 2035, this represents the annual removal or conversion to electric of approximately 2,250 internal combustion engine vehicles by 2035 based on the average annual vehicle miles traveled by light trucks and cars in the US of 11,500 miles [7]. Note that this annual number ramps up to a peak in 2035 and then gradually reduces due to the ramping up of requirements prior to 2050.
  - 49.38% of on-road diesel vehicles are electric or fueled by green hydrogen by 2050 based on projections calculated using vehicle turnover rates for vehicles in the US[4][5] and electric vehicle sales requirements per Washington law[6]. The same applies to transit diesel vehicles where US national bus data was applied [8].
- Electric generation: Washington State moves to 100% renewable energy by 2045.
  - The Washington State RES [2] states that all utilities in Washington must produce 100% clean electricity by 2045.
- Rooftop Solar: Achieve 30% of technical potential for rooftop solar PV by 2050 [9]. This represents 1.1 MW total of residential and commercial installations per year beginning in 2024.

[4] Statista (2023, Aug. 24). Number of motor vehicles registered in the United States from 1990 to 2021. https://www.statista.com/statistics/183505/number-of-vehicles-in-the-united-states-since-1990/
[5] Statista (2023, Aug. 24). Light Vehicle Retail Sales in the United States from 1976 to 2022. https://www.statista.com/statistics/199983/us-vehicle-sales-since-1951/
[6] Washington Department of Ecology. Reducing Greenhouse Gas Emissions: Zero-Emission Vehicles. https://ecology.wa.gov/Air-Climate/Reducing-Greenhouse-Gas-Emissions/ZEV
[7] United States Department of Energy (2020, Feb.). Average Annual Vehicle Miles Traveled by Major Vehicle Category. https://afdc.energy.gov/data/10309
[8] United States Department of Transportation. Bureau of Transportation Statistics: Bus Profile. https://www.bts.gov/content/bus-profile
[9] Google. Project Sunroof. https://sunroof.withgoogle.com/

- Building Energy Efficiency: Beginning in 2024, 5% of existing buildings receive energy retrofits per year to achieve an estimated 20% savings in energy consumption and 37% energy savings are achieved in new buildings based on an analysis comparing the 2018 International Energy Conservation Code building codes to a 2005 baseline [10].
- Commercial and Residential Building Electrification: Beginning in 2024, 5% of existing buildings are electrified each year until 2045 and 80% of new construction is all-electric through 2027. Beginning in 2028, 100% of new construction is all-electric and 5% of existing buildings continue to be electrified, assuming that the 2021 Washington State Building Code will require new construction to be all-electric [11].
- Landfilled Waste Reduction: Solid waste generation tonnage is reduced 50% from business as usual by 2050. This represents an annual reduction of 773.5 tons of waste generated within Olympia beginning in 2024.
- Upstream Emissions: With complete building electrification and 100% clean electricity by 2045, upstream emissions reduce 100% by 2045.
    - This action coincides with the reduction in natural gas and other fuels used in buildings as Olympia's building stock receives retrofits and transitions to all-electric.

Table 2 breaks these actions down by net reduction (MT CO2e) and general level of impact.

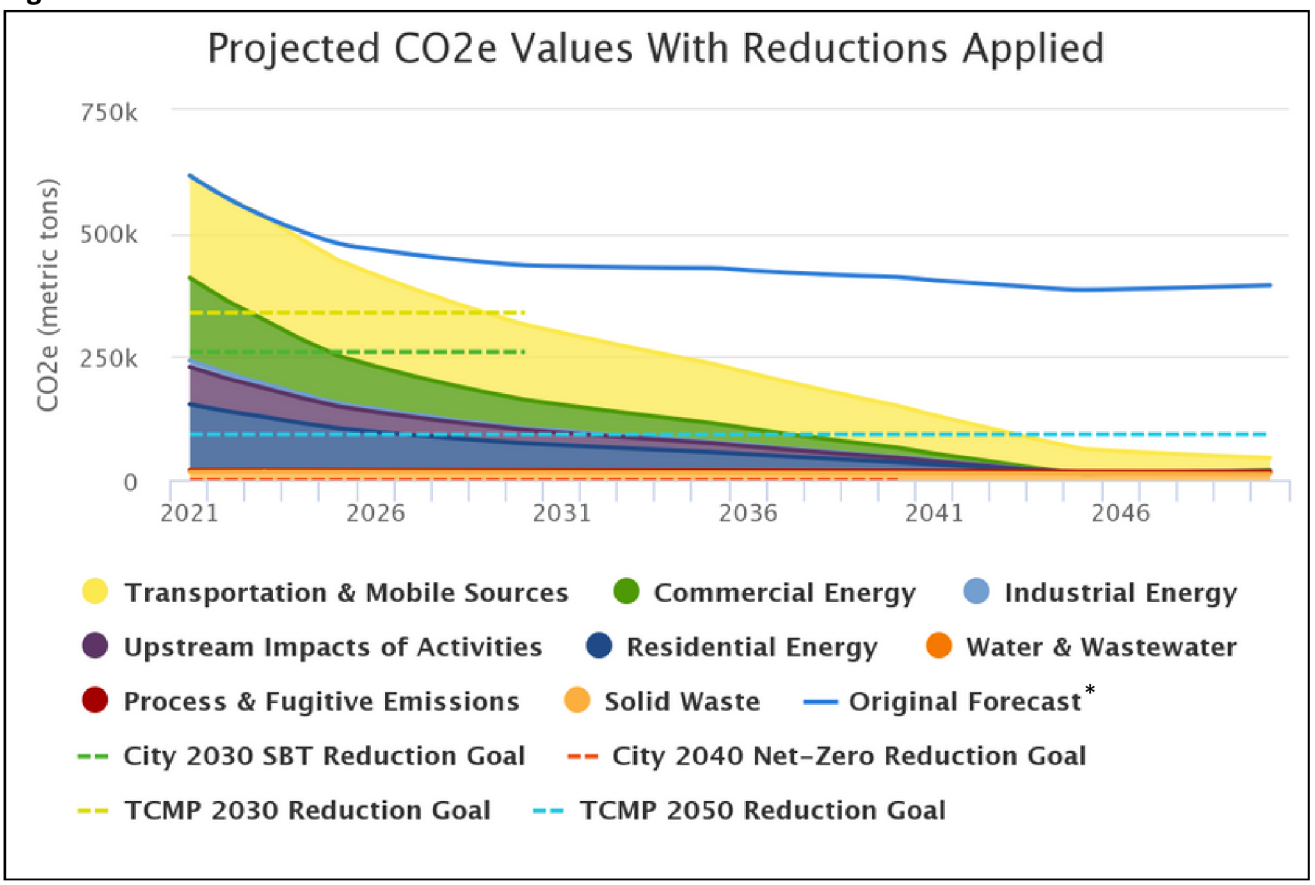
Table 2: Moderate scenario strategies with the corresponding net reduction (MT CO2e) and level of impact

Type	Net Reduction in 2050 (MT CO2e)	Level of Impact
Washington Renewable Energy Standard (RES)	280,853	Very High Impact
Building Electrification	91,992	High Impact
Efficiency Retrofits*	28,375	Moderate Impact
Rooftop Solar**	0	Low Impact
EV Adoption	166,478	Very High Impact
VMT Reduction	30,467	Moderate Impact
Upstream Impacts Reduction	25,342	Low Impact
Landfilled Waste Reduction	10,296	Low Impact

*Efficiency retrofits are essential in supporting the transition to renewable energy, building electrification, and for meeting interim emissions reduction targets.
**Due to the Washington's RES, rooftop solar installations in Olympia will not impact emissions beyond 2045; however, these installations can be used to help Olympia reach earlier interim goals. In 2030, rooftop solar installations provide an emissions reduction of 2,268 MT CO2e.

[10] Pacific Northwest National Laboratory (2018, Dec.). Energy and Energy Cost Savings Analysis of the 2018 IECC for Commercial Buildings. https://www.pnnl.gov/main/publications/external/technical_reports/PNNL-28125.pdf
[11] Kempe, Ysabele (2023, Aug. 8). Utility Dive. Gas, building groups drop lawsuit against new Washington building codes requiring heat pumps. https://www.utilitydive.com/news/washington-state-building-code-lawsuit-dropped-natural-gas-ban-building-industry/690270/

Figure 1: Moderate emissions reduction scenario



*Original Forecast refers to the 2050 business-as-usual forecast.

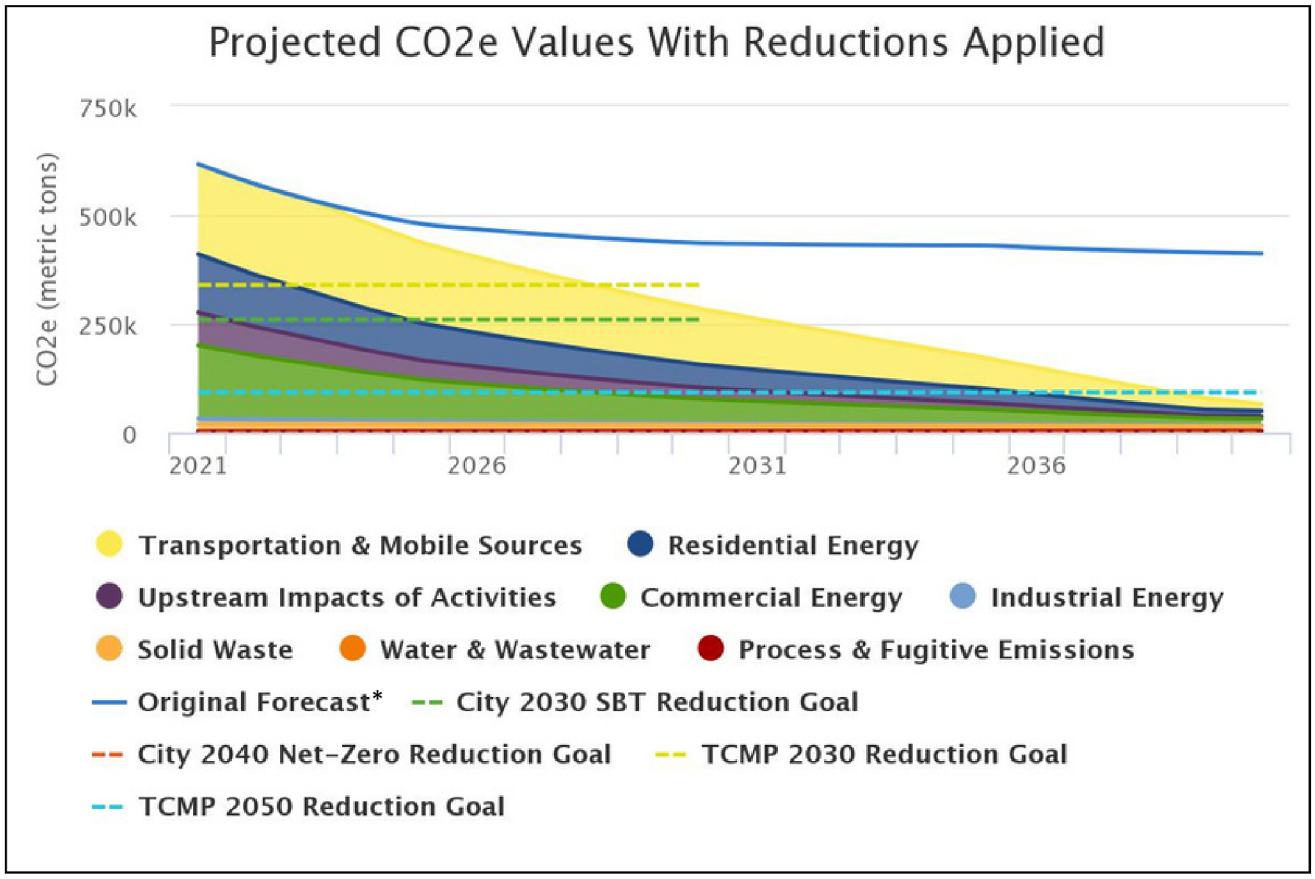
Aggressive Scenario - 88% reduction in 2040 BAU emissions

- Vehicle Miles Traveled (VMT) Reduction: Between 2024 and 2040, on-road gasoline VMT is reduced 20% from the 2040 business-as-usual projection.
  - A 20% reduction equates to an annual reduction of 5,498,000 VMT which gives a total reduction of 93,466,000 VMT.
- Electric Vehicle (EV) Adoption: 100% of on-road and transit gasoline vehicles in Olympia are electric and 75% of on-road and transit diesel vehicles are electric or fueled by green hydrogen by 2040.
  - For on-road and transit gasoline vehicles, this represents the annual removal or conversion to electric of approximately 1,912 internal combustion engine vehicles based on the average annual vehicle miles traveled by light trucks and cars in the US of 11,500 miles [11].
- Electric generation: Washington State moves to 100% renewable energy by 2045.
  - The Washington State RES [2] states that all utilities in Washington must produce 100% clean electricity by 2045.
  - In order to achieve clean electricity by 2040, Olympia would have to work with PSE to have a 100% renewable generation mix by 2040, which is five years before the state requirement. If 100% clean electricity is achieved by 2040, this scenario is estimated to reduce emissions by 96% from 2040 projected business-as-usual emissions.
- Rooftop Solar: Achieve 18.9% of technical potential for rooftop solar PV by 2040 [8].
  - This represents 1.1 MW of residential and commercial installations per year starting in 2024.
- Building Energy Efficiency: Between 2024 and 2039, 100% of existing buildings receive energy retrofits per year to achieve an estimated 20% savings in energy consumption, and 37% energy savings are achieved in new buildings based on an analysis comparing the 2018 International Energy Conservation Code building codes to a 2005 baseline [9].
  - This represents retrofits for 6.25% of the existing building stock per year.
- Commercial and Residential Building Electrification: Between 2024 and 2039, 100% of existing buildings are electrified and 100% of new construction buildings are all-electric.
  - This represents the electrification of 6.25% of Olympia's existing building stock each year.
- Landfilled Waste Reduction: Solid waste generation tonnage is reduced 50% from the 2040 business-as-usual projection by 2040.
  - This represents an annual reduction of 1,122 tons of waste generated within Olympia starting in 2024.
- Upstream Emissions: With complete building electrification, upstream emissions from natural gas, fuel oil, propane, and wood reduce 100%.
  - Upstream emissions from electricity remain due to the electric generation scenario described above.
  - This action coincides with the reduction in natural gas and other fuels used in buildings as Olympia's building stock receives retrofits and transitions to all-electric.

Table 3: Aggressive scenario strategies with the corresponding net reduction (MT CO2e) and level of impact.

Type	Net Reduction in 2040 (MT CO2e)	Level of Impact
Washington Renewable Energy Standard	245,577	Very High Impact
Building Electrification	101,810	High Impact
Efficiency Retrofits	28,350	Moderate Impact
Rooftop Solar	1,876	Low Impact
EV Adoption	193,481	Very High Impact
VMT Reduction	34,766	Moderate Impact
Upstream Impacts Reduction	24,305	Moderate Impact
Landfilled Waste Reduction	9,404	Low Impact

Figure 2: Aggressive emissions reduction scenario



*Original Forecast refers to the 2040 business-as-usual forecast.

Conclusion

The two scenarios outlined above can be used to set goals and metrics for reaching zero emissions in Olympia by 2040 or 2050. Only two reduction measures did not change between the two scenarios–Washington's RES and rooftop solar. Despite these two measures remaining the same between the two scenarios, a higher impact from rooftop solar and a lower impact from Washington's RES occurs when comparing the results of the 2040 scenario to the 2050 scenario. The higher impact from rooftop solar is a result of Washington's RES, which requires 100% clean electricity by 2045, which occurs after the 2040 scenario ends and before the 2050 scenario ends. In the 2050 scenario, rooftop solar will only provide emissions reductions prior to 2045 due to Washington's 100% clean electric grid by 2045. Similarly, higher impacts from Washington's RES occur in the 2050 scenario because Olympia will reach 100% clean electricity prior to 2050.

Many of the remaining measures, including existing building electrification, efficiency retrofits, gasoline EV adoption, VMT reduction, upstream impacts, and landfilled waste reduction, are largely the same measures set at a quicker pace in the 2040 scenario. For example, in the 2040 scenario, a 20% reduction in VMT is achieved by 2040, while this same total isn't achieved until 2050 in the 2050 scenario. Similarly, with existing building electrification and efficiency retrofits, 100% electrification and retrofitting of the existing building stock is achieved by 2040 in the 2040 scenario, while 100% is not achieved until 2045 in the 2050 scenario. Differences between the two scenarios, such as these, should be taken into account when using this analysis to set goals and metrics for achieving zero emissions.

Based on the two scenarios and considering the feasibility of achieving each of these reduction strategies, further action will be needed to reach a 100% reduction in GHG emissions by 2040 or 2050. Additional actions may include the following:

- Working with PSE to have 100% clean energy by 2040.
- Implementation of all-electric requirements for new buildings by 2024.
- Monitoring and protection of existing local carbon sinks.
- Carbon sequestration technology.
- The purchase of local, credible renewable energy credits (RECs) and carbon offsets.
    - ICLEI recommends that any purchase of RECs be bundled and attached to a power purchase agreement (PPA), which is connected to Olympia's local electricity grid.
    - Note that the credibility of RECs and carbon offsets should be verified before purchasing and that ICLEI is currently creating guidance for these purchases.

While each of these scenarios do not show a 100% reduction in GHG emissions, additional steps such as the ones outlined above may help Olympia in achieving net-zero emissions by 2040.