Table of Contents

- Context for Goals and Emissions
- Carbon Wedge Analyses
- Electricity Generation Scenarios
- Electric Vehicle Scenarios
- VMT Reduction Scenarios
- Energy Flow Maps 2014, 2015, 2040
Context for Goals and Emissions
Context for Thurston GHG Emissions and Goals

- Thurston’s emissions goals
  - 25% reduction by 2020
  - 35% reduction by 2035
  - 80% reduction by 2050

- All relative to 1990 emissions

- Emissions have grown since 1990 due to population and economic growth
Past Emissions and Future Emissions Reduction Targets

Thurston County greenhouse gas emissions and future targets

- Target emissions
- Past emissions
Past Emissions and
Future Emissions Reduction Targets

Thurston County per capita greenhouse gas emissions and
future targets

Per capita county GHG emissions
(thousand metric tons of CO₂e per person)

- Target per capita emissions
- Past per capita emissions

1990 2000 2010 2020 2030 2040 2050
Emissions Baseline: No Action

- Electricity generation mix remains unchanged from 2016 onwards
- Building energy grows with population
- VMT grows with population
- Vehicle fleet mix remains unchanged from 2016 onwards
- Vehicle fuel efficiency remains at 2016 levels
Past Emissions and Future Emissions Reduction Targets

Thurston County greenhouse gas emissions and future targets

- No action - baseline
- Target emissions
- Past emissions
Past Emissions and Future Emissions Reduction Targets

Thurston County per capita greenhouse gas emissions and future targets
Carbon Wedge Analyses
GHG Emissions Reductions

- Scenario graphics show abatement relative to baseline emissions
- Sectors depicted in analyses:
  - Orange: Power sector
  - Blue: Buildings sector
  - Green: Transport sector
- Types of policies:
  - Existing: Shown with vertical hatching
  - Potential: Shown as solid color
Summary of Assumptions

Existing Policies

- Electricity Generation
  - Washington State Renewable Portfolio Standard

- Built Environment
  - Washington State Energy Code (70% emissions reduction in new building energy use by 2030 relative to 2006)

- Transportation
  - No change to current Corporate Avenue Fuel Economy (CAFE) standards put forth by the Obama Administration
Carbon Wedge Analysis-Existing Policies

- No action – baseline
- WA renewable portfolio standard
- WA energy code
- U.S. CAFE standards
- Target emissions

Thurston County emissions abatement

CO2 emissions (thousand metric tons)

- 2015
- 2020
- 2025
- 2030
- 2035
- 2040
- 2045
- 2050
Summary of Assumptions

New Actions

- **Electricity Generation**
  - Deep decarbonization mix

- **Building Emissions Reduction Mechanisms**
  - Modeled extending Washington state energy code to achieve net-zero energy for new buildings by 2050

- **Transport Emissions Reduction Mechanisms**
  - Reductions in Vehicle Miles Traveled
  - Low Carbon Fuel Standard
  - Electric Vehicles:
    - Base, medium, and high cases
Scenario 1: Current Electricity & EV Projections

Thurston County emissions abatement

- No action - baseline
- WA renewable portfolio standard
- WA energy code
- U.S. CAFE standards
- WA energy code extension
- VMT reduction
- Low-carbon fuel standard
- Target emissions
Scenario 1: Emissions Remaining

Thurston County emissions

- HDVs
- LDVs
- Industrial natural gas
- Industrial electricity
- Commercial natural gas
- Commercial electricity
- Residential natural gas
- Residential electricity
- Total emissions

CO2 emissions (thousand metric tons)

Years: 2015, 2020, 2025, 2030, 2035, 2040, 2045, 2050
Scenario 2: Current Electricity + Medium EV projections
Scenario 3: Current Electricity + High EV Projections

Thurston County emissions abatement

- No action - baseline
- WA renewable portfolio standard
- WA energy code
- U.S. CAFE standards
- WA energy code extension
- VMT reduction
- High EV adoption
- Target emissions

CO2 emissions (thousand metric tons)

- 2015
- 2020
- 2025
- 2030
- 2035
- 2040
- 2045
- 2050
Scenario 4: Deep Decarb + Current EV Projection

Thurston County emissions abatement

- No action - baseline
- WA renewable portfolio standard
- WA energy code
- U.S. CAFE standards
- Decarbonization
- WA energy code extension
- VMT reduction
- Low-carbon fuel standard
- Target emissions

CO2 emissions (thousand metric tons)

2015 2020 2025 2030 2035 2040 2045 2050
Scenario 5: Deep Decarb + Medium EV Projection
Scenario 6: Deep Decarb + High EV Projection

- No action - baseline
- WA renewable portfolio standard
- WA energy code
- U.S. CAFE standards
- Decarbonization
- WA energy code extension
- VMT reduction
- High EV adoption
- Target emissions

Thurston County emissions abatement

<table>
<thead>
<tr>
<th>Year</th>
<th>No action - baseline</th>
<th>WA renewable portfolio standard</th>
<th>WA energy code</th>
<th>U.S. CAFE standards</th>
<th>Decarbonization</th>
<th>WA energy code extension</th>
<th>VMT reduction</th>
<th>High EV adoption</th>
<th>Target emissions</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2020</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2025</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2030</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2035</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2040</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2045</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2050</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Scenario 6: Emissions Remaining

Thurston County emissions

- HDVs
- LDVs
- Industrial natural gas
- Industrial electricity
- Commercial natural gas
- Commercial electricity
- Residential natural gas
- Residential electricity
- Total emissions

CO2 emissions (thousand metric tons)

2015 2020 2025 2030 2035 2040 2045 2050
Electricity Generation Policy Alternatives
Electricity Generation Policy Alternatives

- Current policy projection based on Puget Sound Energy’s Integrated Resource Plan, assuming it will comply with WA renewable portfolio standard
- New policies projection based on Washington Deep Decarbonization Pathways (DDP) Report
Current Policy Electricity Generation Mix
DDP Policy Electricity Generation Mix
Electric Vehicle Policy Alternatives
Electric Vehicle Policy Alternatives

- **Current policy:** Energy Information Agency Annual Energy Outlook electric vehicle projections; 6% of light-duty vehicle VMT from electric vehicles in 2050
- **Medium EV policy case:** 20% light-duty vehicle VMT from EVs in 2050
- **High EV policy case:** 60% light-duty vehicle VMT from electric vehicles in 2050

✓ Based on Bloomberg New Energy Finance’s Long-Term Electric Vehicle Outlook
Light-Duty Vehicle Mode Share Current Policy Case

LDV mix under federal CAFE standards

- Gasoline ICE
- Diesel ICE
- Ethanol-Flex Fuel ICE
- Electric-Gasoline Hybrid
- Electric Vehicle
Light-Duty Vehicle Mode Share - Medium Policy Case

The graph shows the LDV mode share in the mid EV case from 2015 to 2050. The mode share for different types of vehicles is indicated by different colors:
- **Red**: Gasoline ICE
- **Orange**: Diesel ICE
- **Blue**: Ethanol-Flex Fuel ICE
- **Green**: Electric-Gasoline Hybrid
- **Dark Green**: Electric Vehicle

The percentage of vehicle miles traveled (VMT) for each category is shown over the years, with a significant decline in Gasoline ICE and a corresponding increase in Electric Vehicles.
Light-Duty Vehicle/Mode Share - High EV Case

LDV mode share in high EV case

- Gasoline ICE
- Diesel ICE
- Ethanol-Flex Fuel ICE
- Electric-Gasoline Hybrid
- Electric Vehicle
VMT Policy Assumptions
VMT Reduction Goals

- VMT reduction goals provided by TRPC
  ✓ 2020: 1990 levels
  ✓ 2035: 30% below 1990 levels
  ✓ 2050: 50% below 1990 levels

- Applied VMT reduction to light-duty vehicles only
  ✓ Reduced light-duty vehicle VMT until total (light-duty + heavy-duty vehicles) meets or exceeds target
  ✓ Result: 44% reduction in light-duty vehicle VMT in 2050 relative to no-action case
Baseline VMT

VMT in baseline case

- Person Vehicles
- Light Trucks
- Medium Trucks
- Heavy Trucks
Application of TRPC VMT-Reduction Goals

VMT with reduction

- Person Vehicles
- Light Trucks
- Medium Trucks
- Heavy Trucks
Summary of Findings

- Achieving Washington State’s Deep Decarbonization Pathways targets alone is enough to meet Thurston’s goal to reduce 30% of 1990 emissions by 2035
  - Scenarios 1-3 make clear how critical it is to decarbonize the grid. EVs without a clean grid do not get Thurston to its targets.
  - The Thurston County region should work with other jurisdictions to advocate for the successful decarbonization of Washington’s electricity grid.
- There are challenges with continuing reductions between 2035-2050, since even with the highest Electric Vehicle scenario (Scenario 6), Thurston will not meet its 2050 goal.
Summary of Findings

- However, several opportunities present themselves:
  - Heavy-duty vehicles: Emission reduction potential exists for HDVs since reductions for them were excluded in this analysis.
  - Buildings: Natural gas fuel-switching and further energy efficiency are possible.
  - Technologies: Technologies in development not deployed today but likely will be before by 2035 will help achieve targets.
  - VMT: It is possible that additional VMT reductions could help Thurston County achieve its goal, but we have not done the analysis to ascertain whether additional VMT reduction is realistic.
Summary of Findings

- Achieving Washington State’s Deep Decarbonization Pathways targets alone is enough to meet Thurston’s goal to reduce 30% of 1990 emissions by 2035
  - Scenarios 1-3 make clear how critical it is to decarbonize the grid. EVs without a clean grid do not get Thurston to its targets.
  - The Thurston County region should work with other jurisdictions to advocate for the successful decarbonization of Washington’s electricity grid.

- There are challenges with continuing reductions between 2035-2050, since even with the highest Electric Vehicle scenario (Scenario 6), Thurston will not meet its 2050 goal.

- However, several opportunities present themselves:
  - Heavy-duty vehicles: Emission reduction potential exists for HDVs since reductions for them were excluded in this analysis.
  - Buildings: Natural gas fuel-switching and further energy efficiency are possible.
  - Technologies: Technologies in development today but likely deployed before 2035 will help achieve targets.
  - VMT: It is possible that additional VMT reductions could help Thurston County achieve its goal, but we have not done the analysis to ascertain whether additional VMT reduction is realistic.
Energy Flow Maps, 2014, 2015, 2040
Energy Map Flow Charts

- Original 2014 Energy Map
- New 2015 Energy Map
- First 2040 Energy Map - least reductions (Scenario 1)
- Second 2040 Energy Map - greatest reductions (Scenario 6)
Thurston County 2014 Energy and Carbon Footprint

Estimated Thurston County Energy Flow 2014

Source
- Hydro: 3010 BBTUs
- Renewables: 334 BBTUs, 256 BBTUs
- Nuclear: 9944 BBTUs
- Coal: 4550 BBTUs
- Natural Gas: 1551 BBTUs
- Petroleum: 13813 BBTUs

End Use
- Residential: 772 KT CO2e
- Commercial: 523 KT CO2e
- Industrial: 60 KT CO2e
- Transportation: 984 KT CO2e
- Carbon Emissions: 2,339 KT CO2e

Carbon Emissions
- 854 KT CO2e
- 500 KT CO2e
- 984 KT CO2e
Thurston County 2015
Energy and Carbon Footprint
Thurston County 2040 – Scenario 1

Estimated Thurston County Energy Flow 2040, scenario 1
Base case electricity, no additional EV adoption

Source
- Hydro
- Renewables
- Nuclear
- Coal
- Natural Gas
- Petroleum

Electricity Generation
- 3247 BBTUs
- 1501 BBTUs
- 104 BBTUs
- 5727 BBTUs
- 578 BBTUs
- 670 BBTUs

End Use
- Residential
- 5012 BBTUs
- 766 KT CO2e
- 2,063 KT CO2e

- Commercial
- 3836 BBTUs
- 540 KT CO2e
- 2,063 KT CO2e

- Industrial
- 483 BBTUs
- 63 KT CO2e
- 696 KT CO2e

- Transportation
- 11631 BBTUs

Carbon Emissions
- 2,063 KT CO2e
- 578 KT CO2e
- 670 KT CO2e