

## Attachment 2: GHG Emissions Quantification Methodologies

The following table lists various sources of GHG emissions as well as potential quantification methodologies and mitigation options for each source. These emissions sources can be evaluated quantitatively or qualitatively to address greenhouse gas reduction strategies. Not all categories must be quantified or mitigated.

GHG Emission Sources	Definition and Examples	Emissions Scope	Quantification Methodologies, Tools, and Emission Factors*	Potential Mitigation Options†
On-Road Mobile Sources	Owned mobile sources operating both within the Proponent’s facility and off-site	Scope 1	<ul style="list-style-type: none"> <li>• TCR</li> <li>• WRI/WBCSD</li> <li>• Seattle Climate Partnership</li> <li>• Ecology</li> <li>• <i>EIA</i></li> <li>• <i>URBEMIS</i></li> </ul>	<ul style="list-style-type: none"> <li>• Efficient vehicles</li> <li>• Alternative fuel vehicles</li> <li>• Site location</li> <li>• Video conferencing</li> </ul>
Non-Road Mobile Sources	Owned non-road mobile sources used for construction, maintenance, and facility operation (e.g. heavy machinery, maintenance equipment, trains, and boats)	Scope 1	<ul style="list-style-type: none"> <li>• TCR</li> <li>• WRI/WBCSD</li> <li>• Seattle Climate Partnership</li> <li>• Ecology</li> <li>• <i>URBEMIS</i></li> </ul>	<ul style="list-style-type: none"> <li>• Efficient vehicles</li> <li>• Alternative fuel vehicles</li> <li>• Site location</li> </ul>
Stationary Combustion	On-site combustion emissions from company-owned equipment (e.g. heat and cooling)	Scope 1	<ul style="list-style-type: none"> <li>• TCR</li> <li>• WRI/WBCSD</li> <li>• EPA Reporting Rule</li> <li>• <i>EIA</i></li> <li>• <i>URBEMIS</i></li> </ul>	<ul style="list-style-type: none"> <li>• Building design and operation</li> <li>• Energy efficiencies</li> </ul>
Industrial Processes	Non-combustion emissions resulting from certain industrial processes	Scope 1	<ul style="list-style-type: none"> <li>• TCR</li> <li>• EPA Reporting Rule</li> <li>• WRI/WBCSD</li> <li>• IPCC</li> </ul>	<ul style="list-style-type: none"> <li>• Facility operation</li> <li>• Methane destruction</li> <li>• High-global warming potential gas destruction</li> </ul>
Fugitive Emissions	Non-combustion emissions from owned resources (e.g. landfill gases, natural gas transmission, electricity transmission, refrigeration, and air conditioning)	Scope 1	<ul style="list-style-type: none"> <li>• TCR</li> <li>• EPA Reporting Rule</li> <li>• WRI/WBCSD</li> <li>• IPCC</li> </ul>	<ul style="list-style-type: none"> <li>• Facility operation</li> <li>• Methane destruction</li> <li>• High-global warming potential gas destruction</li> </ul>

GHG Emission Sources	Definition and Examples	Emissions Scope	Quantification Methodologies, Tools, and Emission Factors*	Potential Mitigation Options†
Agricultural Emissions	Non-combustion emissions from agriculture (e.g. manure management, fertilizer application, enteric fermentation, and soil preparation)	Scope 1	<ul style="list-style-type: none"> <li>• WRI/WBCSD</li> <li>• IPCC</li> <li>• DOE 1605b</li> <li>• CAR</li> </ul>	<ul style="list-style-type: none"> <li>• Methane destruction</li> <li>• Waste reduction</li> <li>• Organic or low input agriculture</li> </ul>
Land Use Change	Emissions from land use changes and aquatic vegetation disturbance, including lost sequestration from forest clearing	Scope 1	<ul style="list-style-type: none"> <li>• DOE 1605b</li> <li>• U.S Forest Service</li> <li>• WRI/WBCSD</li> <li>• IPCC</li> <li>• CAR</li> </ul>	<ul style="list-style-type: none"> <li>• Site design and location</li> <li>• Low impact development</li> </ul>
Purchased Electricity and Steam	Off-site emissions produced to generate purchased electricity or steam	Scope 2	<ul style="list-style-type: none"> <li>• TCR</li> <li>• EPA eGRID</li> <li>• Seattle Climate Partnership</li> <li>• <i>EIA</i></li> <li>• <i>URBEMIS</i></li> </ul>	<ul style="list-style-type: none"> <li>• Building design and operation</li> <li>• Energy efficiencies</li> </ul>
Construction	Combustion emissions from leased or contractor on-road and non-road mobile sources used as part of construction, including off-site haul trucks during construction	Scope 3	<ul style="list-style-type: none"> <li>• TCR</li> <li>• WRI/WBCSD</li> <li>• Ecology</li> <li>• <i>URBEMIS</i></li> </ul>	<ul style="list-style-type: none"> <li>• Efficient vehicles</li> <li>• Alternative fuel vehicles</li> <li>• Site Location</li> </ul>
Extraction, Processing, and Transportation of Construction Materials	Emissions produced in the mining, harvest, processing, and transportation of materials purchased for construction of the project (e.g. cement, metals, plastics, wood)	Scope 3	<ul style="list-style-type: none"> <li>• IPCC</li> <li>• EPA WARM</li> <li>• Athena</li> <li>• NREL</li> </ul>	<ul style="list-style-type: none"> <li>• Sustainable building materials</li> <li>• Waste reduction</li> <li>• Reused building materials</li> <li>• Alternative and renewable fuels</li> <li>• Low carbon shipping modes</li> <li>• Locally sourced materials</li> </ul>
Extraction, Processing, and Transportation of Project Feedstocks	Emissions produced in the mining, harvest, processing, and transportation of materials that will be used as feedstocks by the project when operational	Scope 3	<ul style="list-style-type: none"> <li>• TCR</li> <li>• WRI/WBCSD</li> <li>• IPCC</li> <li>• EPA WARM</li> <li>• Athena</li> </ul>	<ul style="list-style-type: none"> <li>• Sustainable building materials</li> <li>• Waste reduction</li> <li>• Reused building materials</li> <li>• Alternative and renewable fuels</li> </ul>
Emissions From the Future Combustion of Fossil Fuels	Emissions that will result from the combustion of fossil fuels transported, distributed or imported as a result of the project (e.g. natural gas pipeline)	Scope 3	<ul style="list-style-type: none"> <li>• TCR</li> <li>• WRI/WBCSD</li> <li>• EPA Reporting Rule</li> </ul>	<ul style="list-style-type: none"> <li>• Energy efficiency investments</li> <li>• Alternative and renewable fuels</li> </ul>

GHG Emission Sources	Definition and Examples	Emissions Scope	Quantification Methodologies, Tools, and Emission Factors*	Potential Mitigation Options†
Employee Commute	Combustion emissions from employee commuting both during project construction and operation	Scope 3	<ul style="list-style-type: none"> <li>• TCR</li> <li>• CTR</li> <li>• Seattle Climate Partnership</li> <li>• <i>URBEMIS</i></li> <li>• <i>Fehr &amp; Peers</i></li> </ul>	<ul style="list-style-type: none"> <li>• Efficient and alternative fueled vehicles and infrastructure</li> <li>• Site location</li> <li>• Public transit infrastructure and incentives</li> <li>• Bike/ped accessibility</li> </ul>
Other Mobile Emissions	Mobile emissions from vehicle trips and traffic pattern changes that result from a project (e.g. changes in traffic pattern, customer vehicle emissions, increased commute distances, and emergency services)	Scope 3	<ul style="list-style-type: none"> <li>• TCR</li> <li>• WRI/WBCSD</li> <li>• Seattle Climate Partnership</li> <li>• Ecology</li> <li>• <i>URBEMIS</i></li> <li>• <i>Fehr &amp; Peers</i></li> </ul>	<ul style="list-style-type: none"> <li>• Efficient and alternative fueled vehicles</li> <li>• Site location</li> <li>• Public transit infrastructure and incentives</li> <li>• Bike/ped accessibility</li> </ul>
Water Use and Wastewater Disposal	Combustion and fugitive emissions created to provide water and dispose of wastewater (e.g. pumping energy and POTW fugitive methane)	Scope 3	<ul style="list-style-type: none"> <li>• TCR</li> <li>• WRI/WBCSD</li> <li>• IPCC</li> </ul>	<ul style="list-style-type: none"> <li>• Low impact development</li> <li>• Site location</li> <li>• Methane destruction</li> <li>• Reuse water</li> </ul>
Waste Management	Emissions from off-site solid waste disposal of construction, agriculture, and MSW, including transportation of waste and fugitive emissions from disposal	Scope 3	<ul style="list-style-type: none"> <li>• TCR</li> <li>• WRI/WBCSD</li> <li>• IPCC</li> <li>• CAR</li> <li>• Seattle Climate Partnership</li> <li>• EPA WARM</li> </ul>	<ul style="list-style-type: none"> <li>• Waste reduction</li> <li>• Methane destruction</li> <li>• Low carbon transportation</li> </ul>
Product Use	Emissions that result from the use and disposal of products generated for sale by the project, including combustion of fuels manufactured or distributed by the proposed facility	Scope 3	<ul style="list-style-type: none"> <li>• EPA WARM</li> <li>• TCR</li> <li>• WRI/WBCSD</li> <li>• Seattle Climate Partnership</li> </ul>	

\*The following list is illustrative showing some good sources for quantification tools, protocols, and emissions factors that can be used to quantitatively assess emissions from each of these sources. It is not meant to be exhaustive. We are not advocating the use of these methodologies for determining acceptable error rates for assessing emissions. Tools in italics are simple models that can be used to estimate the magnitude of future emissions.

†These are general examples of mitigation options for various emissions sources. This list is not meant to be comprehensive.

## Quantification Methodologies, Tools, and Emissions Factors

- The Climate Registry (TCR) - <http://www.theclimateregistry.org/>
- World Resources Institute/World Business Council for Sustainable Development (WRI/WBCSD) - <http://www.ghgprotocol.org/>
- Seattle Climate Partnership - <http://seattleclimatepartnership.org/tools/index.html#tool>
- Ecology Mobile Source Tool (Ecology) - <http://www.ecy.wa.gov/programs/air/pdfs/ghgfleetcalculator.xls>
- EPA Reporting Rule - <http://www.epa.gov/climatechange/emissions/ghgrulemaking.html>
- IPCC Emissions Factor Database (IPCC) - <http://www.ipcc-nggip.iges.or.jp/EFDB/main.php>
- The Climate Action Reserve (CAR) - <http://www.climateactionreserve.org>
- EPA WARM Model - [http://www.epa.gov/climatechange/wycd/waste/calculators/Warm\\_home.html](http://www.epa.gov/climatechange/wycd/waste/calculators/Warm_home.html)
- Department of Commerce GHG Emissions Planning Tools (Commerce) - <http://www.commerce.wa.gov/site/1277/default.aspx>
- WSDOT Commute Trip Reduction Program (CTR) - <http://www.wsdot.wa.gov/TDM/CTR>
- U.S Department of Energy 1605b (DOE 1605b) - [http://www.eia.doe.gov/oiaf/1605/reporting\\_tools.html](http://www.eia.doe.gov/oiaf/1605/reporting_tools.html)
- U.S Forest Service Carbon Lookup Tables (U.S Forest Service) - <http://nrs.fs.fed.us/pubs/8192>
- URBEMIS - <http://www.urbemis.com/>
- Energy Information Agency End Use Consumption Data (EIA) - <http://www.eia.doe.gov/emeu/consumption/index.html>
- Athena Institute EcoCalculator (Athena) - <http://www.athenasmi.org/index.html>
- National Renewable Energy Laboratory (NREL) Life-cycle Inventory Database - <http://www.nrel.gov/lci/>
- Fehr & Peers VMT spreadsheets - <http://coolconnections.org/solutions/>