

## AIR EMISSIONS RATES AND COSTS

The purpose of this appendix is to provide information about the assumptions and methodology used to estimate environmental costs of air emissions for the candidate portfolios evaluated in the 2016 Integrated Resource Plan (IRP).

The goal of evaluating air emissions and estimating their costs is to help understand the overall impact of choices that can be made to meet the demand for electricity from City Light customers. In general, avoiding increased energy production through energy efficiency and efficiency measures not only reduces the costs associated with potentially purchasing a new power plant, but also eliminates the environmental impacts from the electricity that was not generated.

Renewables have fewer impacts than traditional thermal resources (fossil fuels, nuclear), but depending upon the technology, renewables can still have some air emissions or other environmental impacts. The treatment of air emissions from various types of power choices is described below.

In the 2016 IRP analysis, the costs of environmental emissions were estimated using air emissions and proxies for environmental externality costs. The calculation of environmental costs that are not captured in costs associated with operation of power plants, delivery, and sale of electricity are called environmental externality costs.

There are a number of approaches to calculating environmental externality costs. City Light uses best estimates of the costs to reduce the air emissions with pollution controls or other measures to meet potential regulatory requirements. This approach does not try to assess the value of the damages, but rather, the cost of mitigating the emissions before damages. These prices are then applied to all uncontrolled (residual) emissions.

The air pollutants that City Light evaluated were carbon dioxide, nitrogen oxides, sulfur oxides, mercury and particulates. The first step in determining an estimate of environmental externality costs is determining the amount of each of the air pollutants that would be emitted in each portfolio. For each resource in the portfolios, emission rates per unit of electricity were assigned. Figure 1 shows the emission rates for the different potential resource technologies that could be included in the portfolios. Figure 2 shows emissions costs for the various pollutants.

**Figure 1: Resource Emission Rates (Lbs./MWh)**

	Carbon Dioxide	Nitrogen	Sulfur Oxide	Mercury	Particulates
<b>Energy Efficiency</b>	0	0	0	0	0
<b>Hydro</b>	0	0	0	0	0
<b>Landfill Gas</b>	0	.972	0	0	.157
<b>Waste Wood Biomass: Cogeneration</b>	0	.534	0	0	.173
<b>Hydro Efficiency</b>	0	0	0	0	0
<b>Wind</b>	0	0	0	0	0
<b>Geothermal</b>	0	0	0	0	0
<b>Photovoltaic (PV)</b>	0	0	0	0	0
<b>Solar Thermal</b>	0	0	0	0	0
<b>Combined-Cycle Turbine (CCCT)</b>	1042.72	.105	.005	0	.005

**Figure 2: Resource Emission Rates (\$/lb)**

Levelized Emissions Price	(2015 \$/lb)
Carbon Dioxide	\$0.03
Nitrogen Oxides	\$0.95
Sulfur Oxides	\$1.06
Mercury	\$3.50
Particulates	\$1.88

Waste wood biomass cogeneration is a special case. For many years, biomass has been commonly treated as carbon dioxide neutral. However, the U.S. Environmental Protection Agency (EPA) has determined that each feedstock and its production and consumption cycles must be considered in order to assess associated CO<sub>2</sub> emissions. In 2014, the EPA released the Framework for Assessing Biogenic CO<sub>2</sub> Emissions from Stationary Sources report that includes calculations for varied feedstock types, sources and production methods. EPA has not yet determined how this framework might be applied in regulatory or policy context, therefore, City Light has not yet included this method in the 2016 IRP. The 2012 IRP EIS evaluated several scenarios to understand the potential impacts of an EPA determination that waste wood biomass is not carbon dioxide neutral. Page 34 of appendix C of the 2012 IRP final EIS provides additional information.

Short-term market purchases can have associated net emissions. Market emissions rates are modeled within the IRP analysis and represent the power sources that are used to meet loads in the western power market where City Light buys and sells power. Through economic dispatch, subject to operating and transmission constraints, the AURORA<sup>xmp</sup>® market model (AURORA®) will select generating plants for short-term market purchases needed for balancing, load following, and other purposes. The most likely generating plants to be dispatched within the model to serve the load are those nearby in the area or region that have surplus generating capability. To the extent that these short-term resources have emissions, the costs are recorded within the model runs and the costs are attributed to the appropriate City Light portfolio.

For long-term Power Purchase Agreements (PPAs) in resource portfolios, the emissions costs of the power resource are included within the contract price. This is done by adding levelized emissions costs to the cost of the resource on a per-MWh basis. In this way, both short-term and long-term emissions costs are captured within the net power cost of a portfolio, so when cost comparisons between portfolios are made, the amounts and types of emissions directly impact a portfolio's performance and chances of being selected as the preferred portfolio.

Finally, Renewable Energy Credits (RECs) are also part of the portfolio resource options. RECs can be used to meet City Light's regulatory obligation for RCW 19.285, or when short-term deficits exist to meet the RPS requirement. The RECs category is unique, since they represent only the environmental attributes associated with renewable electricity generation. City Light will not receive the power associated with RECs. Each REC represents one megawatt-hour of renewable energy generation. Within IRP portfolio modeling, RECs have no emissions impacts, positive or negative. For more information about RECs, see Resource Options Appendix.

A common goal of City Light as shown in the previous four IRPs is to have a preferred portfolio that reduces overall air emissions as compared to the "no action" alternative. The 2016 IRP has candidate portfolios that would serve the reduction of regional emissions, creating a net positive impact on air quality.