

Appendix 12

# 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 portfolios evaluated in the 2012 Integrated Resource Plan (IRP). More information about environmental impacts of the portfolios can be found in the final environmental impact statement (EIS) for the IRP, available online at: [http://www.seattle.gov/light/news/issues/irp/docs/DEIS\\_2012\\_IRP.pdf](http://www.seattle.gov/light/news/issues/irp/docs/DEIS_2012_IRP.pdf)

The goal of evaluating air emissions and estimating their cost is to help understand the overall impact of choices that can be made to meet increased demand for electricity from City Light customers. In general, avoiding increased energy production through conservation and efficiency measures avoids impacts associated with energy resources almost entirely. Renewables have fewer impacts than traditional thermal resources (fossil fuels, nuclear), but depending upon the technology, can have some air emissions or other environmental impacts. The treatment of air emissions from various types of power choices is described below.

In the 2012 IRP analysis, environmental costs were estimated using air emissions and proxies for the costs of these emissions. 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 the levels estimated necessary 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. Then these prices are applied to all uncontrolled (residual) emissions. The air pollutants that were 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 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 resource technologies included in the portfolios.

The 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 been investigating this practice and is planning to make a determination within the next three years. The 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.

The hydro efficiency in the IRP portfolios is the Gorge Tunnel 2 project. This project would increase the production efficiency of the Gorge hydroelectric plant, getting more energy from the same water conditions. In this case, the air emissions per MWh are zero.

Short-term market purchases can have associated net emissions. Note that 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 AURORAxmp<sup>®</sup> market model (AURORA<sup>®</sup>) will select generating plants for short-term market purchases needed for

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

	Carbon Dioxide	Nitrogen Oxide	Sulfur Oxide	Mercury	Particulates
Conservation	0	0	0	0	0
Hydro	0	0	0	0	0
Landfill Gas	0	.66	0	0	.107
Waste Wood Biomass: Cogeneration	0	2.218	.4265	0	.3412
Hydro Efficiency	0	0	0	0	0
Wind	0	0	0	0	0
Geothermal	0	0	0	0	0
Solar PV	0	0	0	0	0
Solar Thermal	0	0	0	0	0
Combined-Cycle Turbine	857	.216	.00432	0	.005

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 contracts in a resource portfolio, 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.

**Figure 2: Emissions Costs**

Levelized Emissions Price	(2012 \$/lb)
Carbon Dioxide	\$0.01
Nitrogen Oxides	\$0.98
Sulfur Oxides	\$1.09
Mercury	\$3.60
Particulates	\$1.94

The RECs (Renewable Energy Credits) category is unique, since they represent only the environmental attributes associated with renewable electricity generation. City Light will not receive the associated power. RECs can be used to meet City Light's regulatory obligation for RCW 19.285. Each REC represents one megawatt-hour of renewable energy generation. Within IRP portfolio modeling, RECs had no emissions impacts, positive or negative.

In the 2010 IRP, scenarios for carbon taxes indicated that, in the AURORA® model, low gas prices were a larger driver in reducing high emission resources in the market place than high carbon dioxide emissions costs. The 2010 IRP noted that in the west, there is excess capacity for natural gas-fired turbines, suggesting that with prolonged low natural gas prices they could displace a larger amount of higher-emitting resources. Two years after the release of the 2010 IRP, low cost natural gas-fired generation is displacing coal-fired generation, reducing overall emissions from regional electricity generation.

In the three previous IRPs, the net impact of the preferred portfolio was to reduce City Light's overall air emissions as compared to the "no action" alternative. Adding the conservation and renewable resources in the 2012 IRP preferred portfolio would serve to reduce regional emissions, creating a net positive impact on air quality.