

Date: July 13, 2018

To: Members of the Washington State Energy Code TAG

From: Gary Heikkinen, PE

Re: EP141-2018, Table 407.1 Carbon Emissions Factors

I generally support the above proposal to adopt ASHRAE 90.1, Appendix G as the performance path for the next WSEC. Since the proposal includes using carbon emissions rather than energy cost, it will be very important to get the most accurate and defensible emissions factors to ensure the code helps meet Washington State's emissions reduction goals. Having a factor that is arbitrarily or artificially too high or low could result in system choices (primarily space and water heat) that have an adverse effect.

I am proposing to use a marginal/avoided/non-baseload emissions factor for electricity rather than an average emissions factor. The use of marginal emissions to evaluate energy efficiency and conservation efforts is well-supported by the NWPCC and ASHRAE Std. 105 among others. The following tables from the NWPCC report on AVOIDED CARBON DIOXIDE PRODUCTION RATES IN THE NORTHWEST POWER SYSTEM and the eGRID Summary Tables 2016 respectively are provided for reference. I further propose to use a factor in the .91 to .97 range as shown in the NWPCC report, since those factors fall within the time range after adoption of the new code. I believe this is a conservative, realistic, accurate and defensible factor that takes into account some coal retirements and a cleaner grid. For reference, the NWPCC report indicated a marginal emissions rate of 1.83 lbs/kwh in 2016.

Table 1: Annual Average Avoided CO<sub>2</sub> Emissions Rate

Scenario	Average Annual Avoided Emissions Rate (lbs. of CO <sub>2</sub> per kWh)
2016	1.83
2021 Plan DR	0.91
2026	0.93
2031	0.97

1. Subregion Output Emission Rates (eGRID2016)																	
eGRID subregion acronym	eGRID subregion name	Total output emission rates lb/MWh							Non-baseload output emission rates lb/MWh							Grid Gross Loss (%)	
		CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	CO <sub>2</sub> e	Annual NO <sub>x</sub>	Ozone Season NO <sub>x</sub>	SO <sub>2</sub>	CO <sub>2</sub>	CH <sub>4</sub>	N <sub>2</sub> O	CO <sub>2</sub> e	Annual NO <sub>x</sub>	Ozone Season NO <sub>x</sub>	SO <sub>2</sub>		
AKGD	ASCC Alaska Grid	1,072.3	0.077	0.011	1,077.3	6.5	6.5	0.5	1,367.8	0.110	0.016	1,375.0	6.8	6.7	0.7	5.25%	
AKMS	ASCC Miscellaneous	503.1	0.023	0.004	504.9	7.0	6.5	0.6	1,533.8	0.068	0.012	1,538.9	21.8	20.8	2.0	5.25%	
AZNM	WECC Southwest	1,043.6	0.079	0.012	1,049.0	1.0	0.9	0.3	1,384.8	0.097	0.014	1,391.2	1.3	1.1	0.4	4.23%	
CAMX	WECC California	527.9	0.033	0.004	529.9	0.6	0.5	0.1	942.9	0.045	0.006	945.6	0.8	0.8	0.1	4.23%	
ERCT	ERCOT All	1,009.2	0.076	0.011	1,014.1	0.5	0.6	1.0	1,402.8	0.108	0.015	1,409.8	0.8	0.7	1.6	4.89%	
FRCC	FRCC All	1,011.7	0.075	0.010	1,016.4	0.5	0.5	0.4	1,188.5	0.078	0.011	1,193.3	0.6	0.6	0.4	4.49%	
HIMS	HICC Miscellaneous	1,152.0	0.095	0.015	1,158.7	7.4	7.0	4.5	1,530.0	0.147	0.023	1,540.2	11.8	11.3	4.5	5.35%	
HIOA	HICC Oahu	1,662.9	0.181	0.028	1,675.2	3.4	3.2	8.6	1,637.5	0.153	0.024	1,648.3	4.1	4.2	8.1	5.35%	
MROE	MRO East	1,668.2	0.156	0.026	1,679.3	1.0	1.1	1.3	1,740.1	0.156	0.025	1,750.9	1.0	1.0	1.3	4.49%	
MROW	MRO West	1,238.8	0.115	0.020	1,247.4	1.0	1.1	1.4	1,822.0	0.154	0.029	1,834.0	1.6	1.5	2.0	4.49%	
NEWE	NPCC New England	558.2	0.090	0.012	563.7	0.4	0.4	0.1	975.1	0.086	0.011	980.5	0.5	0.4	0.2	4.49%	
NWPP	WECC Northwest	651.2	0.061	0.009	655.4	0.6	0.7	0.4	1,524.9	0.124	0.020	1,533.8	1.4	1.4	0.8	4.23%	