October 11, 2019

Oregon Public Utility Commission
Attention: Filing Center
201 High Street SE
Salem, Oregon 97301

Via Electronic Mail (puc.hearings@state.or.us)

Re: The United States Endowment for Forestry and Communities, Inc. Public Comments on Oregon PUC Docket No. LC 73, Portland General Electric (PGE) Integrated Resource Plan (IRP)

The United States Endowment for Forestry and Communities, Inc (the Endowment) appreciates this opportunity to submit comments on the Portland General Electric (PGE) 2019 Integrated Resource Plan. The Endowment is a 501(c)3 public charity chartered in 2006 with a mission to keep forests as forests and benefit rural, forest-rich communities. The Endowment has actively invested in Oregon for the last decade most often with our partner the USDA Forest Service (USFS). The focus of most of our investments there have largely been on developing market-based solutions to the burgeoning forest health and wildfire crisis.

In 2016 the Endowment, in partnership with Bonneville Environmental Foundation, Ochoco Lumber Company and the USFS, implemented a project to support PGE's torrefied biomass testing at the Boardman Power Plant. The Endowment subsidized $2,500,000 of the cost of the fuel for these tests with our and our partner's funds. We have since embarked on a more ambitious project to fully prove commercial production of torrefied fuel from forest restoration and wildfire reduction treatments with the development of a commercial-scale production facility in John Day, Oregon – Restoration Fuels, LLC.

We urge the Commission to include an action item to complete additional tests with torrefied biomass at the Boardman Power Plant in 2020. This is consistent with earlier OPUC direction to PGE. These tests allow PGE and the OPUC to understand the cost to convert this facility to operate on biomass and the opportunity to use this new renewable resource to meet near-term capacity needs. This also serves broader state and national interests by demonstrating a market-based mechanism to support increased pace and scale of forest restoration treatments to help reduce unprecedented wildfire ecological impacts as well as negative health and economic effects to all Oregonians subjected to extensive wildfire smoke. The reduction in frequency and intensity of wildfires could provide material benefits to PGE ratepayers and all Oregonians.

Our comments focus on the emission differences between coal and torrefied biomass and we stand ready to provide additional information, analysis and effort to assist PGE, the OPUC and IRP stakeholders to fully evaluate the continued operation of the Boardman Power Plant as a baseload renewable resource. We plan to submit additional comments that will address, fuel cost, resource adequacy and carbon implications.

RESPECTFULLY SUBMITTED this 11th day of October, 2019.

____

Matt Krumenauer
Vice President, Special Projects

Additional tests with torrefied biomass at the Boardman Power Plant in 2020

Discussion

Tables 1 and 2 provide the average fuel characteristic values for 6 mm pine and fir torrefied pellets and for 40 mm torrefied pine briquettes, respectively. These data are compared to typical Powder River Basin (PRB) sub-bituminous coal that is the principal fuel used at the Boardman Power Plant. The main take-aways in the comparison are that in all cases, the torrefied biomass inputs that would potentially result in undesirable emissions (compared to PRB coal) such as mineral content, sulfur, mercury and heavy metals are much lower. Empirically, from the five 2016/17 Boardman tests, combustion related emission such as for nitrogen oxides were comparable to or lower than PRB coal when using torrefied biomass fuel. [1] Thus, using torrefied biomass instead of coal shows merit in reducing the emissions and the cost of emissions control.

The strong implication is that substantially reduced inputs decreases polluting effluents which logically leads to much less use or even possible decommissioning of extant pollution control equipment at Boardman. This would be especially true of the present Trona-based sulfur & mercury cleanup systems.

Lower mineral content input would yield less ash accumulation and less particulate matter emission; implying less use of the extant electrostatic precipitator. It is an obvious conclusion that operational cost savings can be realized in displacing PRB coal with torrefied biomass. Moreover, in Oregon, biomass is considered a renewable fuel which renders torrefied biomass the fuel of choice in displacing fossil coal as it requires little to no modification to present plant systems and operational procedures. The Boardman tests affirmed these outcomes.

Our funding of the commercial scale torrefaction plant in John Day, Oregon is to explicitly support the USFS and the State of Oregon in efforts to bring forests back to ecological health by reducing fuel loadings that have accumulated due to decades of fire suppression, a changing climate and past management.[2] In fact, the torrefaction plant in John Day is now accumulating small diameter and diseased tree stems in preparation for torrefaction and subsequent use in pulverized coal-fired power plants. The plant is designed for 100,000 tons of torrefied biomass annually.

We believe there is a critical opportunity in using this fuel to help PGE and the utility industry better understand how torrefied biomass can fully answer other operational questions in using this new fuel. The 5,000 tons of torrefied woody biomass consumed in the five 2016/17 combustion tests was inadequate to fully judge slagging and fouling behavior in the combustion and thermal zones of the boiler and the back-pass regions. Longer-run tests using a larger volume of torrefied biomass would be required – this conclusion was derived from the 2016/17 tests.

Conclusion

PGE and the Boardman Power Plant have led the way in performing the most substantial tests of torrefied biomass to displace fossil coal in North America. We urge the OPUC to continue to use this initiative to fully answer remaining questions. For a modest authorization of fuel cost recovery, PGE would be able to fully test and evaluate the potential for biomass to provide base-load renewable

[1] These data are available publicly as consultant summaries published in the open literature. PGE would be able to provide stack test data or information from the continuous emission monitoring system.

[2] 80 million acres of the 193 million acres within National Forest boundaries require fuel-reduction treatment

capacity at existing coal power plants. This is a low-risk action as the Boardman plant is set to cease coal-fired operations by December 31, 2020.

Given the demonstrated commitment as well as past and present investments made by partnering institutions and stakeholders, these additional tests can be completed in 2020 with minimal risk to PGE and its customers.

Table 1: Torrefied Pine and Fir 6 mm Pellets [3] Fuel Analyses Comparison with PRB Coal		
Characteristic	**6 mm Pine and Fir Pellets**	**Powder River Basin Coal**
Proximate Analysis (%)	**Average Value**	**Typical Value**
Moisture as Received (%)	4.22	30
Ash as Received (%)	0.24	4 to 6
Volatile as Received (%)	70.74	30.5
Fixed C as Received (%)	24.80	35.7
Sulfur (%) As Received	0.06	0.22
Btu/lb - As Received	9,257	8,400
Ultimate Analysis (%)	**Average**	**Typical Value**
Moisture as Received	4.22	30
Ash as Received	0.24	4 to 6
Sulfur as Received	0.03	0.22
Nitrogen as Received	0.12	0.57
Carbon as Received	54.81	49
Hydrogen as Received	5.61	3.25
Oxygen as Received	34.97	12.97
Mineral Analysis of Ash (%)	**Average**	**Typical Value**
Phosphorus Pentoxide	7.26	1.2
Silicon Dioxide	5.90	35
Ferric Oxide	12.28	3
Aluminum Oxide	3.32	50
Titanium Dioxide	0.22	2
Calcium Oxide (Lime)	38.93	25
Magnesium Oxide	12.14	10
Potassium Oxide	10.11	10
Sodium Oxide	1.94	2.5
Sulfur Trioxide	5.23	12

[3] * TBD = To be determined, as needed

** "Less than" value meaning it is less than or at the analytical detection limit

Table 1: Torrefied Pine and Fir 6 mm Pellets [3] Fuel Analyses Comparison with PRB Coal		
Characteristic	**6 mm Pine and Fir Pellets**	**Powder River Basin Coal**
Barium Oxide	0.63	0.6
Strontium	0.26	0.27
Grindability	**Average**	**Typical Value**
Hardgrove Grindability Index (HGI)	33.67	45 to 50
Ash Fusion Temperature (F)	**Average**	**Typical Value**
Oxidizing		
Initial	2490	
Softening	2629	
Hemispherical	2646	
Fluid	2661	
Reducing		
Initial	2287	
Softening	2575	>2400
Hemispherical	2577	
Fluid	2578	
Additional Data	**Average**	**Typical Value**
Air Dry Loss (M)	TBD *	
lbs H2O/mmBtu	4.56	
lbs Ash/mmBtu	0.26	
lbs Sulfur/mmBtu	0.033	1.3
Base / Acid Ratio	8.56	
T250 in Deg F	2697	
%Alkali as Na2O	0.02	
Specific Gravity (x)	TBD	1.3
Free Swelling Index	TBD	
Trace Element (ppm Dry)	**Average**	**Typical Value**
Arsenic (As) **	0.1	1.5
Cadmium (Cd)	0.06	0.56
Chlorine (Cl)	6	200
Chromium (Cr) **	1	6
Copper (Cu)	1	12
Lead (Pb)	0.17	<3 - 5
Mercury (Hg) **	0.0034	<0.04
Zinc (Zn)	10	5

Table 2: Torrefied Ponderosa Pine 40 mm Briquette[4] Fuel Analyses Comparison with PRB Coal		
Characteristic	**40 mm Ponderosa Pine Briquette**	**Powder River Basin Coal**
Proximate Analysis (%)	**Average Value**	**Typical Value**
Moisture as Received (%)	4.64	30
Ash as Received (%)	0.57	4 to 6
Volatile as Received (%)	66.67	30.5
Fixed C as Received (%)	28.13	35.7
Sulfur (%) As Received	0.06	0.22
Btu/lb - As Received	9,616	8,400
Ultimate Analysis (%)	**Average**	**Typical Value**
Moisture as Received	4.64	30
Ash as Received	0.57	4 to 6
Sulfur as Received	0.07	0.22
Nitrogen as Received	0.14	0.57
Carbon as Received	56.08	49
Hydrogen as Received	5.56	3.25
Oxygen as Received	32.94	12.97
Mineral Analysis of Ash (%)	**Average**	**Typical Value**
Silicon Dioxide	8.82	35
Ferric Oxide	25.49	3
Aluminum Oxide	2.35	50
Titanium Dioxide	0.20	2
Calcium Oxide (Lime)	32.14	25
Magnesium Oxide	9.33	10
Potassium Oxide	9.70	10
Sodium Oxide	0.76	2.5
Grindability	**Average**	**Typical Value**
Hardgrove Grindability Index (HGI)	40.67	45 to 50

[4] * TBD = To be determined, as needed

** "Less than" value meaning it is less than or at the analytical detection limit

Table 2: Torrefied Ponderosa Pine 40 mm Briquette[4] Fuel Analyses Comparison with PRB Coal		
Characteristic	**40 mm Ponderosa Pine Briquette**	**Powder River Basin Coal**
Ash Fusion Temperature (F)	**Average**	**Typical Value**
Oxidizing		
Initial	2445	
Softening	2591	
Hemispherical	2652	
Fluid	2705	
Reducing		
Initial	2295	
Softening	2423	>2400
Hemispherical	2508	
Fluid	2618	
Additional Data	**Average**	**Typical Value**
Air Dry Loss (M)	TBD *	
lbs H2O/mmBtu	4.83	
lbs Ash/mmBtu	0.59	
lbs Sulfur/mmBtu	0.07	1.3
T250 in Deg F	TBD	
%Alkali as Na2O	TBD	
Specific Gravity (x)	TBD	1.3
Free Swelling Index	TBD	
Trace Element (ppm Dry)	**Average**	**Typical Value**
Arsenic (As)	0.1	1.5
Chlorine (Cl)	9.67	200
Lead (Pb)	0.23	<3 - 5
Mercury (Hg)	0.005 **	<0.04