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**BEFORE THE PUBLIC UTILITY COMMISSION
OF OREGON**

UM 1744

In the Matter of

NORTHWEST NATURAL GAS
COMPANY, dba NW NATURAL,

Application for approval of an Emission
Reduction Program.

STAFF'S MOTION TO FILE
ADDITIONAL EXHIBIT

Staff of the Public Utility Commission of Oregon (Staff) requests that the Administrative
Law Judge admit the enclosed Exhibit Staff/500 and Exhibit/600.

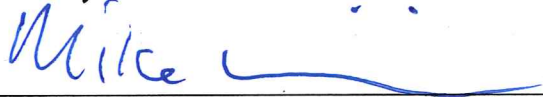
Staff/500 is a Compact Disc (CD) containing Northwest Natural Gas Company's (NW
Natural) response to Staff's Information Request (IR) No. 3 (Attachment 1). Staff has included
three hard copies of this CD with this motion and will be serving the active parties with hard
copies of it as well. Staff/600 is a multi-page exhibit consisting of NW Natural's response to
Staff IR Nos. 45 (excluding Attachment 1), 47 (excluding Attachments 1 through 6), 50 and 52.
Staff/600 contains these IR Responses in the order listed above.

Staff has conferred with the parties and is authorized to state that no party objects to the
submission of these two additional Staff exhibits.

DATED this 30th day of December, 2015.

Respectfully submitted,

ELLEN F. ROSENBLUM
Attorney General


Michael T. Weirich, #82425
Assistant Attorney General
Of Attorneys for Staff of the Public Utility
Commission of Oregon



Rates & Regulatory Affairs

UM 1744
Emissions Reduction Program

Data Request Response

Request No. UM 1744-OPUC-IR 45: Due 10-12-15

Please refer to NWN/101, Summers/14. The second column of Table 3 provides the "Installed Cost" project information. Please describe how these installed costs were computed.

Response:

The WSU RELCOST model "Installed Cost" project information was taken from the report prepared by SENTECH for EIA entitled Commercial-and-Industrial CHP Technology Cost and Performance Data Analysis for EIA, June 2010 (OPUC IR 45-Attachment 1) and the following table contained in the model with sources noted (OPUC IR 45-Attachment 2).

CHP Equipment Performance and Cost Data for Reciprocating Engines

RECIPROCATING ENGINES, NATURAL GAS						ICF (2014)		EIA(2010)			
Rated Power, kW of selected equipment	Heat Rate, Btu/kWh (100%)	CHP Thermal Output, MMBtu/hr (100%)	Electrical Efficiency	Overall Efficiency	Thermal Output, Btu/kWh	Incremental O&M Costs (Variable), \$/kWh	Installed Cost of CHP Plant \$/kW	Incremental O&M Costs (Variable), \$/kWh	Installed Cost of CHP Plant \$/kW	Incremental O&M Costs (Variable), \$/kWh	Installed Cost of CHP Plant \$/kW (2015 Dollars)
50	11,750	0.300	29%	80%	6,000	\$0.0350	\$3,500				
75	12,203	0.413	28%	73%	5,502	\$0.0310	\$3,250				
100	12,637	0.600	27%	74%	6,000	\$0.0270	\$2,900	\$0.0240	\$2,900		
135	12,445	0.818	27%	76%	6,057	\$0.0250	\$2,789				
150	12,363	0.881	28%	75%	5,873	\$0.0220	\$2,742				
373	11,140	1.822	33%	80%	4,885	\$0.0200	\$2,037			\$0.0200	\$2,037
400	10,992	1.936	31%	75%	4,840	\$0.0195	\$2,027				
500	10,444	2.358	33%	78%	4,716	\$0.0188	\$1,925				
600	9,896	2.780	34%	81%	4,633	\$0.0165	\$1,995	\$0.0210	\$2,837		
800	9,580	3.550	36%	82%	4,438	\$0.0165	\$1,833				
1,000	9,264	4.320	37%	83%	4,320	\$0.0150	\$1,810			\$0.0150	\$1,810
1,200	9,194	4.872	37%	81%	4,060	\$0.0149	\$1,765	\$0.0190	\$2,366		
1,550	9,070	5.838	38%	79%	3,767	\$0.0147	\$1,686				
2,000	8,912	7.081	38%	78%	3,540	\$0.0140	\$1,584			\$0.0120	\$1,584
3,300	8,454	10.670	40%	79%	3,233	\$0.0138	\$1,551	\$0.0160	\$1,801		
4,500	8,331	18.740	41%	93%	4,358	\$0.0136	\$1,526				
9,341	8,207	26.810	42%	77%	2,870	\$0.0850	\$1,433	\$0.0085	\$1,433		

NOTES:

EPA (2014) cost estimates appropriate for the industrial sector and sites that require new facilities, but typically do not apply to smaller scales and especially the commercial sector. For example, Table 3-5 on page 3-14 provides costs for "equipment", "installation" and "other". There are items in these sections that frequently are not needed for an existing facility. These items include: fuel supply and electrical service to the installation site, a new building, greater project management cost that would be required for a new location.

EPA (2014) details their cost estimates, so these items can be split out. Items that are less typical of installation in an existing facility account for over 50% of the total cost. This explains why the EPA (2014) is more than twice that in EPA (2008), even adjusted for inflation, and also greater than costs in (EIA 2010), especially for smaller projects.

In our modeling, we prefer EIA (2010) data adjusted for 5 years of inflation at 2.5% per year for installations at existing facilities. We add costs such as new boilers, electrical service, fuel supply, gas compression, project financing, contingency, etc as line items. In modeling our prototypes, we have assumed these are retrofits in existing facilities.

Costs and performance in EPA (2014) are based on the work of ICF (2014)

REFERENCES:

- EPA 2014. "Catalog of CHP Technologies", U.S. Environmental Protection Agency, Combined Heat and Power Partnership, September 2014
- EIA 2010. "Commercial and Industrial CHP Technology, Cost and Performance Data Analysis for EIA", Submitted by SENTECH, Inc. June 2010 (Tables 10, 12, 13, and 14)
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- ICF (2014) "Assessment of the Technical and Economic Potential for CHP in Oregon", Final Report, ICF International, July 2014

Rated Power, kW of selected equipment	RECIPROCATING ENGINES, NATURAL GAS							ICF (2014)		EIA (2010)	
	Heat Rate, Btu/kWh (100%)	CHP Thermal Output, MMBtu/hr (100%)	Electrical Efficiency	Overall Efficiency	Thermal Output, Btu/kWh	Incremental O&M Costs (Variable), \$/kWh	Installed Cost of CHP Plant \$/kW	Incremental O&M Costs (Variable), \$/kWh	Installed Cost of CHP Plant \$/kW	Incremental O&M Costs (Variable), \$/kWh	Installed Cost of CHP Plant \$/kW (2015 Dollars)
50	11,750	0.300	29%	80%	6,000	\$0.0350	\$3,500				
75	12,203	0.413	28%	73%	5,502	\$0.0910	\$3,250				
100	12,637	0.600	27%	74%	6,000	\$0.0270	\$2,900	\$0.0240	\$2,900		
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800	9,580	3.550	36%	82%	4,438	\$0.0165	\$1,833				
1,000	9,264	4.320	37%	83%	4,320	\$0.0150	\$1,810			\$1,810	
1,200	9,194	4.872	37%	81%	4,060	\$0.0149	\$1,765	\$0.0190	\$2,366		
1,550	9,070	5.838	38%	79%	3,767	\$0.0147	\$1,686				
2,000	8,912	7.081	38%	78%	3,540	\$0.0140	\$1,584		\$0.0120	\$1,584	
3,300	8,454	10.670	40%	79%	3,233	\$0.0138	\$1,551	\$0.0160	\$1,801		
4,300	8,331	18.740	41%	93%	4,358	\$0.0136	\$1,526				
9,341	8,207	26.810	42%	77%	2,870	\$0.0850	\$1,433	\$0.0085	\$1,433		

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- ICF (2014) "Assessment of the Technical and Economic Potential for CHP in Oregon", Final Report, ICF International, July 2014

Rated Power, kW of selected equipment	Heat Rate, Btu/kWh (100%)	CHP Thermal Output, MMBtu/hr (100%)	Electrical Efficiency	Overall Efficiency	Thermal Output, Btu/kWh	MICROTURBINES AND GAS TURBINES			ICF (2014)		EIA (2010)	
						Incremental O&M Costs (Variable), \$/kWh	Installed Cost of CHP Plant \$/kW	Incremental O&M Costs (Variable), \$/kWh	Installed Cost of CHP Plant \$/kW	Incremental O&M Costs (Variable), \$/kWh	Installed Cost of CHP Plant \$/kW (2010 Dollars adjusted for inflation at 2.5% to 2015)	
6	13,716	0.046	25%	81%	7,677	\$0.0060	\$4,632					
9	13,484	0.068	25%	82%	7,582	\$0.0060	\$4,632					
15	13,259	0.102	26%	77%	6,824	\$0.0060	\$4,632					
20	13,259	0.136	26%	77%	6,824	\$0.0060	\$4,632					
30	15,500	0.210	22%	67%	7,000	\$0.0060	\$3,000	\$4,300				
65	14,361	0.410	24%	68%	6,308	\$0.0050	\$2,771	\$3,220	\$0.0050	\$0.0050	\$2,771	
100	11,500	0.480	30%	71%	4,800	\$0.0050	\$2,768					
150	12,148	0.680	28%	65%	4,533	\$0.0050	\$2,764					
200	12,795	0.880	27%	61%	4,400	\$0.0060	\$2,761					
400	10,672	1.488	32%	67%	3,720	\$0.0050	\$2,724					
600	10,672	2.232	32%	67%	3,720	\$0.0050	\$2,688					
800	10,672	2.976	32%	67%	3,720	\$0.0050	\$2,652					
1,200	15,533	8.874	22%	70%	7,395	\$0.0040	\$2,579					
3,500	13,556	19,992	25%	67%	5,712	\$0.0040	\$2,161	\$0.0126	\$3,281	\$0.0070	\$2,161	
4,600	12,881	25,888	26%	70%	5,628	\$0.0040	\$1,549	\$0.0060		\$0.0060	\$1,549	
11,400	11,480	53,346	30%	70%	4,679	\$0.0040	\$1,500	\$0.0120	\$1,976			
21,700	9,719	79,152	35%	73%	3,648	\$0.0040	\$1,421	\$0.0093	\$1,518			
30,000	9,603	108,000	36%	73%	3,600	\$0.0040	\$1,366					
45,000	9,488	160,000	36%	73%	3,556	\$0.0040	\$1,248	\$0.0092	\$1,248			
50,000	9,400	175,000	36%	74%	3,500	\$0.0040	\$1,200					

NOTES:

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- EPA 2008. "Catalog of CHP Technologies", U.S. Environmental Protection Agency, Combined Heat and Power Partnership, September 2014
- ICF (2014) "Assessment of the Technical and Economic Potential for CHP in Oregon", Final Report, ICF International, July 2014



Rates & Regulatory Affairs

UM 1744
Emissions Reduction Program

Data Request Response

Request No. UM 1744-OPUC-IR 47:

Please refer to NWN/101, Summers/50, which states that the WSU RELCOST model will be digitally provided.

Staff obtained the "WSU RELCOST Financial Blank Template" available for download online at: <http://northwestchptap.org/ResourcesSoftwareLinks/Software.aspx>. Cell 020 of the "General" tab initially loads with an assumption of a 20-year project life.

Please provide the Project IRRs for each of the CHP installations analyzed in the Company's supplemental response to Staff IR 11, under the following assumption:

the benefits due to avoided electricity purchases and avoided natural gas purchases¹ will accrue for 20 years (or if the economic life of the CHP installation is less than 20 years, use that lifespan instead while noting that usage).

Response:

Please note that the copy of the WSU RELCOST model staff obtained online does not include the modifications made to the model for NW Natural's program and is not the copy provided to all Stakeholders during the Review Process. WSU Assumes an Measure Life of 15 years.

The IRRs modeled by WSU and provided in response to OPUC IR 46 are copied below and two new columns have been added to show the IRRs modeled based on the spreadsheets provided as supplements to Staff IR 11 based on EBITDA (consistent with WSU analysis) and on an after tax cash flow basis assuming no financing. The spreadsheets are attached (See OPUC IR 47-Attachment 1 through OPUC IR 47-Attachment 5) and updated to show the columns added to calculate an IRR assuming a 15 year project life (consistent with WSU analysis). The spreadsheets provided to supplement Staff IR 11 were an attempt to simplify the WSU modeled results and, therefore, result in some minor variances in calculated IRR. For more detailed financial data, attached are complete financials for each of the prototypes prepared by WSU (See OPUC IR 47-Attachment 6).

Prototype	WSU Modeled IRR with Current Incentives (Based on EBITDA and \$0 844 Incentive)	WSU Modeled IRR with addition of 844 Incentives (Based on EBITDA)	IRR Based on Data in Staff IR 11 Supplemental Filings (Based on EBITDA)	IRR Based on Data in Staff IR 11 Supplemental Filings (Based on AT Cash Flow Before Capital Costs)
500 kW Reciprocating Engine	5.2%	12.2%	15.7%	6.5%
Two 800 kW Reciprocating Engines	4.9%	10.6%	12.0%	4.0%
4.3 MW Reciprocating Engine	18.7%	28.9%	35%	20%
21.7 MW Gas Turbine	13.7%	22.3%	22.6%	11.7%
45 MW Gas Turbine	11.9%	20.2%	22.3%	16.7%



Rates & Regulatory Affairs

UM 1744
Emission Reduction Program

Data Request Response

Request No. UM 1744-OPUC-DR 50: Due 11-13-15

The WSU RELCOST model provided as Appendix D of the Company's initial filing provides the following table entries in Cell J6 of the "Prod Incentives" tab:

CO2 Emissions Reductions, metric tons CO2e
(tonnes), yearly

1,297	Reciprocating Engine - 500 kW, eGRID non-baseload baseline
3,249	Hospital - 800,000 sf with Two 800 kW Recip Engines, eGRID non-baseload baseline
15,051	Reciprocating Engine - 4.3 MW, eGRID non-baseload baseline
62,652	Gas Turbine - 21.7 MW, eGRID non-baseload baseline
132,175	Gas Turbine - 45 MW, eGRID non-baseload baseline

The table entries provide the yearly CO2 emissions reductions for five CHP projects using the eGRID non-baseload baseline carbon emissions reduction computation methodology.

Please provide the yearly CO2 emissions reductions for the following CHP projects using the Northwest Power and Conservation Council (NWPCC) carbon emissions reduction computation methodology: Reciprocating Engine - 500 kW, Hospital - 800,000 sf with Two 800 kW Recip Engines, Reciprocating Engine - 4.3 MW, Gas Turbine - 21.7 MW, and Gas Turbine - 45 MW. Use the "0.9 lbs. of CO2 per kWh over the period 2010 through 2025," forecast from page 3 of the NWPCC's 2008 "Marginal Carbon Dioxide Production Rates of the Northwest Power System" report, which is available here: https://www.nwcouncil.org/media/29611/2008_08.pdf.

Response:

MTCO ₂ e Emissions							
Prototype	eGrid 2010		eGrid 2012		950 lbs		
	100%	66%	100%	66%	100%	66%	
500 kW Reciprocating Engine	1,297	856	1,782	1,176	495	327	
(2) 800 kW Reciprocating Engines	3,249	2,144	4,387	2,896	1,368	903	
4.3 MW Reciprocating Engine	15,051	9,934	19,224	12,688	8,157	5,384	
21.7 MW Gas Turbine without Compression	62,652	41,350	68,399	45,143	29,950	19,767	
45 MW Gas Turbine with Compression	132,175	87,235	144,784	95,557	64,359	42,477	



Rates & Regulatory Affairs

Data Request Response

Request No. UM 1744-OPUC-DR 52:

Using publically available information, Staff collected combine heat and power incentive-offer information and catalogued that information by state as shown in the attached spreadsheet. The information presented in the attached spreadsheet shows that no state program offers participants more than \$5 million in total incentives. Staff noted in testimony, Staff/40, St. Brown/13, Exhibit 7 that, through Northwest Natural's proposed CHP program, a 45MW plant would be eligible for \$39.6 million in program incentives. In preparing its UM 1744 application, did the Company find any other combined heat and power program(s) that offers incentives similar to that which would be achieved under its application? If so, please provide or cite to the information and the source of the information.

[NOTE ATTACHED WORKSHEET NOT INCLUDED IN RESPONSE]

Response: December 17, 2015

NW Natural objects to this data request because it is vague, and because it contains information and assertions that are not a request for information, and which NW Natural has not sought to independently verify. Notwithstanding these objections, NW Natural states that it has not found any other CHP programs that offer comparable incentives for carbon reductions.

State	Utility/Program	per kWh Incentive	Parameters	per kW Incentive	Parameters	Max. Total Incentive	Total Incentive Cap	Other Parameters	Other Info	Links
Connecticut	Clean Energy Finance and Investment Authority		Can do customized per-kWh power purchase request	\$450		\$3 million		Maximum for total incentive is \$450/kW, regardless of which method used	2 year program period Incentive paid out: 1/3 at equipment delivery; 1/3 at completion of installation; 1/3 at fully commissioned + data being successfully inputted to NYSEDA's DG performance website	http://www.energizect.com/businesses/programs/Combined-Heat-Power
New York	NYSEDA CHP Acceleration Program					\$1.5 million				https://www.nyserda.ny.gov/PON2568
	NYSEDA CHP Performance Program		Greater than 1.3MW; must provide summer peak \$0.10 reduction	\$750/kW if in more congested downstate area		\$2 million			Looks like 2 year performance period	https://www.nyserda.ny.gov/Funding-Opportunities/Current-Funding-Opportunities/PON-2701-Combined-Heat-and-Power-Performance-Program
Maryland	BGE, Delmarva, and PEPCO (filed program jointly under EmPower Maryland)		for 18 months (payments at 6/12/18 months)	\$75/kW for design; \$175/kW for installation		\$2.5 million	50% project cost			http://www.bgesmartenergy.com/chp , https://cienergyefficiency.delmarva.com/CombinedHeat.aspx
	Potomac Edison		<\$0.05 At discretion of co.	\$250			50% project cost	10MW max system size		http://www.energysavemd-business.com/forms/EE_MD_Custom_CHP_rev1.pdf
California	Self-Generation Incentive Program			\$460		\$5 million		Systems must be less than 3MW	5 year program period	
	PG&E Feed in Tariff - terms for Jan. 2015		This is PG&E's calculation of short-run avoided cost of energy, and applies only to excess power purchases (beyond site)						Agreements structured for anything from 1-10 years	http://www.pge.com/en/b2b/energysupply/qualifyingfacilities/prices/index.page
Rhode Island	National Grid		\$0.04	\$1,000	Efficiency over 60%	70% project cost				https://www.nationalgridus.com/non_html/DG_CHP_Seminar.pdf
New Jersey	Statewide CHP Program			\$350 Over 3MW \$550 1-3MW \$1,000 500kW-1MW \$2,000 Less than 500kW		\$3 million \$3 million \$2 million \$2 million	30% project cost 30% project cost 30% project cost 30% project cost		Incentives for systems over 1MW are tiered: first 3MW at \$550/kW, remaining capacity at \$350/kW	http://www.njcleanenergy.com/commercial-industrial/programs/combined-heat-power/combined-heat-power-fuel-cells-incentives
										Incentives for CHP are tiered ex. A 4MW plant would receive \$2.00/watt for the first 500kW a \$1.00/watt for the next 500kW, \$0.55/watt for the next 2MW and \$0.35 fpe the last 1MW
Illinois	Statewide public facilities CHP program		Depends on efficiency; for \$0.06-0.08 first year only	\$75/kW for design; \$250 \$175/kW for construction		\$2 million	50% project cost	Public facilities only		http://www.illinois.gov/dceo/whyillinois/KeyIndustries/Energy/Documents/Final_RFA%20CHP%20Guidelines%207-7-14.pdf
Massachusetts	National Grid			\$750 Identify EE opps first ASHRAE Level 1 audit + EE \$950 measures ASHRAE Level 2 audit + EE measures + site energy \$1,100 reduction of 10%			50% project cost		Incentive paid 80% after installation; 20% post commissioning	http://www.masssave.com/~media/Files/Business/Applications-and-Rebate-Forms/A-Guide-to-Submitting-CHP-Applications-for-Incentives-in-Massachusetts.pdf https://www.nationalgridus.com/non_html/DG_CHP_Seminar.pdf
										\$3M+ requires PUC approval. Requires interconnection and new plants are only eligible for incremental costs
Pennsylvania	PPL		\$0.05 First year only			\$1 million	50% project cost			https://www.ppelectric.com/save-energy-and-money/rebates-and-discounts/business-and-nonprofit/custom-rebates.aspx
	PECO		\$0.02 First year only	\$75 1.5 - 10MW \$150 500kW - 1.5MW \$300 Less than 500kW *Incentives are additive*		\$1 million	50% project cost	Capacity incentive capped at 40% project cost		https://websafe.kemainc.com/projects62/Portals/9/PECO%20Files/PECO_PSOS_Application_2013.pdf