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June 24, 2015

VIA ELECTRONIC FILING

Public Utility Commission of Oregon
Attention: Filing Center
3930 Fairview Industrial Drive SE
Post Office Box 1088
Salem, Oregon 97308-1088

Re: UM-____ Application for Carbon Emission Reduction Program (SB 844)

Northwest Natural Gas Company, dba NW Natural (NW Natural or Company), files herewith an Application for Approval of a Carbon Emission Reduction Program ("Application") pursuant to ORS 757.539.

In support of this Application, the Company submits the filed testimony of Barbara Summers (NWN/100 - 101, Summers) and Andrew Speers (NWN/200, Speers).

Copies of this Application letter and the filing made herewith are available in the Company's main office in Portland, Oregon and on its website at www.nwnatural.com. The Company waives paper service in this proceeding.

Please address correspondence on this matter to me with copies to the following:

eFiling
NW Natural Rates & Regulatory Affairs
220 NW Second Avenue
Portland, Oregon 97209
Telecopier: (503) 721-2516
Telephone: (503) 226-4211, ext. 3589
eFiling@nwnatural.com

Sincerely,

/s/ Mark R. Thompson

Mark R. Thompson
NW Natural

Attachments

BEFORE THE PUBLIC UTILITY COMMISSION
OF OREGON

UM ____

In the Matter of NORTHWEST NATURAL GAS COMPANY, dba NW Natural, Application For Approval of an Emission Reduction Program.	APPLICATION

APPLICATION OF NORTHWEST NATURAL GAS COMPANY FOR APPROVAL OF GREENHOUSE GAS EMISSIONS REDUCTION PROGRAM

I. INTRODUCTION.

Northwest Natural Gas Company, dba NW Natural ("NW Natural" or the "Company") hereby files with the Public Utility Commission of Oregon (the "Commission" or "OPUC") this application ("Application") seeking authorization to establish a voluntary emission reduction program pursuant to ORS 757.539. Specifically, the Company is seeking authorization to implement the Combined Heat and Power (CHP) Solicitation Program ("Program"). As discussed herein, the Program is designed to further the State of Oregon's goal to reduce greenhouse gas emissions by incentivizing natural gas utilities to develop natural gas projects that, among other things, benefit customers and reduce harmful emissions. The Program is designed to increase CHP investment in Northwest Natural's service territory by offering payments for measured and verified emission reductions for installed CHP. This Application and accompanying testimony and exhibits demonstrate that the Program meets the project eligibility criteria and application requirements set out in ORS 757.539 and Commission Rules 860-085-0500 through 860-085-0750. For the reasons set forth below, NW Natural respectfully requests the Commission approve the Application.

A. Senate Bill 844.

In 2014, Senate Bill 844 was signed into law, establishing a new environmental policy applicable to Oregon's natural gas utilities. The legislation requires the Commission to establish

a voluntary emission reduction program to incentivize natural gas utilities to invest in projects that reduce emissions, and to provide benefits to natural gas utility customers.[1] This voluntary program provides the opportunity for natural gas utilities to create and develop emission reduction projects in which the utility would not otherwise invest in the ordinary course of business.[2] A project must meet the minimum eligibility and application requirements contained in OAR 860-085-0600. Upon approval of an emission reduction project, the natural gas utility is permitted to recover costs associated with implementing a program or measures that reduce emissions.[3] The utility also has the opportunity to receive an incentive payment for the project linked to the amounts of emissions reduced or that may vary depending on whether the project is recovered as an expense or an investment placed in rate base.[4] The projected costs to ratepayers of a natural gas utility's portfolio of emission reduction projects must not exceed 4 percent of the utility's last approved retail revenue requirement, inclusive of all revenue collected under adjustment schedules.[5]

B. Tier 2 Project.

ORS 757.539 provides a two-tier process for submitting project proposals under the emission reduction program.[6] The Commission's Rules define Tier 1 and Tier 2 projects as follows:

> Tier-1 Project is one that has projected costs that would be borne by the ratepayers of the utility proposing the Project that are equal to or less than $1 million and has an overall project cost of less than $85 per metric ton of reduced emissions.
> A Tier-2 Project is one that has projected costs that would be borne by the ratepayers of the utility proposing the Project that are greater than $1 million or has an overall project cost of equal to or greater than $85 per metric ton of reduced emissions.[7]

[1] ORS 757.539(2).
[2] ORS 757.539(2)(d).
[3] ORS 757.539(8).
[4] OAR860-085-750
[5] OAR 860-085-0700.
[6] ORS 757.539(5).
[7] OAR 860-085-0650(1),(2).

As will be described in detail in the Direct Testimony of Barbara Summers[8] and the Direct Testimony Andrew Speer,[9] the CHP Solicitation Program is a Tier-2 project because the projected cost of the program is greater than $1 million. As a result, the Commission must (a) provide a process that includes providing interested parties with an opportunity to submit testimony in response to the proposed project; and (b) issue a final order on the proposed project within 180 days of receiving the application for the project, or at a later time as authorized by the public utility.[10]

C. Background on Combined Heat and Power (CHP).

CHP, also known as cogeneration, produces electricity and useful thermal energy in an integrated system. CHP systems can range in size from many megawatts in industrial, institutional and large commercial applications, down to a few kilowatts in small commercial and even residential applications. Combining electricity and thermal energy generation into a single process can save up to 35 percent of the total energy required to perform these tasks separately. The energy efficiency comes from the displacement of natural gas with what is otherwise "waste heat"--recovered from on-site electricity generation for use in space and water heat and industrial processes.

The efficiencies realized through CHP benefit both the natural gas and electricity systems. CHP is a substitute for baseload electric generation and the waste heat is a substitute for natural gas and on-site combustion equipment otherwise needed to produce heat. Thus, CHP makes productive use of waste heat from electricity generation beyond that which is possible with a Combined Cycle Gas Turbine (CCGT). In addition, because CHP energy is produced on the site where it will be used, it avoids the transmission and distribution losses that consume approximately 6-10% of generated electricity.

D. The CHP Solicitation Program.

[8] NWN/100.
[9] NWN/200.
[10] ORS 757.539(7).

The Company proposes to solicit NW Natural customers to invest in on-site CHP as described in the Combined Heat and Power Solicitation attached to the CHP Solicitation Program Business Plan ("Business Plan") as Appendix A (*See NWN/101, Summers/33)*. At its core, the Program is designed to provide financial incentives to encourage NW Natural customers to install efficient CHP systems by driving down the investment payback period through incentive payments made to participants based upon emission reductions. Specifically, NW Natural will pay customers an incentive of $30.00 per metric tonne of CO2 equivalent reduced through the use of CHP systems approved through the Program. All NW Natural customers will be eligible to propose projects at locations within NW Natural's franchised service territory in Oregon; however, incentives will be paid only on measured and verified carbon savings confirmed through NW Naturals' emission reduction verification plan. Incentive payments will be made quarterly for 10 years once the CHP system becomes operational. NW Natural will release its initial solicitation after approval by the OPUC. NW Natural's Program will remain open after the initial solicitation until terminated by the Company or upon such date established by the Commission. Ms. Summers' testimony and the Business Plan provide a comprehensive review of the Program.

II. PROJECT APPLICATION REQUIREMENTS.

Section 757.539 of the Oregon Revised Statutes establishes the minimum eligibility criteria and application requirements for emission reduction projects.[11] In its rulemaking process, the Commission adopted a single set of "Project Application Requirements" in OAR 860-085-0600, which includes both the statutory minimum requirements provided for by the legislature, plus the additional requirements adopted by the Commission. These criteria are set forth and discussed below.

1. General Information OAR 860-085-0600(1)(a)-(f).

A. OAR 860-085-0600(1)(a): Minimum Eligibility Criteria.

[11] ORS 757.539(3),(4).

Under OAR 860-085-0600(1)(a), the applicant must demonstrate that it satisfies the minimum eligibility criteria set out in 757.539(3)(a) – (f). The Project satisfies these criteria as follows:

***(a) The public utility requesting the project be a public utility that furnishes natural gas and that the project involve the provision of natural gas*. ORS 757.539(a).**

NW Natural is a public utility that furnishes natural gas, as required by ORS 757.005(1). The Program involves the provision of natural gas because it requires natural gas to be used as the primary fuel source for the prime mover in a CHP system.[12]

***(b) The project directly or indirectly reduces emissions.* ORS 757.539(b).**

The CHP Solicitation Program will directly reduce emissions within Oregon by incentivizing customers to invest in on-site CHP systems that operate at significantly higher efficiency than the customers' facilities would otherwise operate. The operation of a CHP system increases energy efficiency resulting in emissions reductions as compared to conventional generation sources. Through the Program, NW Natural is targeting the reduction of greenhouse gas emissions by 240,000 MTCO2(e) per year in the State of Oregon by the end of 2020. Reaching this goal will require the participation of the equivalent of 80 MWs of CHP at an average of 3,000 MTCO2(e) per MW, assuming systems operate 95% of the time and utilize 100% of the reclaimable waste heat or 120 MWs assuming an average of 2,000 MTCO2(e) per MW.

(c) The project benefits customers of the public utility as identified by the commission by rule or order. ORS 757.539(c)

The increased load from CHP will benefit all NW Natural customers by lowering average system costs and increasing system reliability. OAR 860-085-0600 defines "Project benefits" as "those benefits that accrue to ratepayers of the utility when such benefits can reasonably be attributed to the [emission reduction project]." As described in Mr. Speer's testimony (*NWN/200,*

[12] Business Plan, Appendix A. See NWN/101, Summers/33.

Speer/1-2), the incremental load expected from the installation of CHP units in NW Natural's service territory will increase the Company's system load requirements (or throughput). The increased throughput will effectively reduce average system costs and will thereby lower incremental rates for all customers.[13] This benefit accrues to all customers on NW Natural's system, and therefore NW Natural proposes to allocate costs to residential, commercial, and industrial customer classes on an equal percent margin basis.

(d) The public utility, without the emission reduction program, would not invest in the project in the ordinary course of business. ORS 757.539(d).

Without the OPUC's authorization under Senate Bill 844 to allow cost recovery for programs that reduce carbon emissions, the Company would not propose this program in the ordinary course of business. As described above, the CHP Solicitation Project is an incentive-based program, and the Company could not lawfully recover the costs of providing the incentives absent the statutory authority in ORS 757.539. It is only under the framework of ORS 757.539 that NW Natural can propose the CHP Solicitation Program for the purpose of carbon reduction.

(e) The public utility, prior to filing an application, involved stakeholders as required by the Commission by rule or order. ORS 757.539(e).

Stakeholder meetings were held on the following dates: March 16 and 20th and April 14, 2015. Ms. Summers' testimony outlines the changes to the Program that were made after consulting with stakeholders through the stakeholder process. Agendas and Sign-in Sheets are included in Appendix G to the Business Plan (*See NWN/101, Summers/73-81)*.

(f) The rate impact of the aggregate of all projects undertaken by a public utility under this section not exceed an amount established by the Commission by rule or order. ORS 757.539(f).

The Program is the Company's first emission reduction program proposed by the Company, and therefore, the aggregate rate impact is not applicable. The rate impact of the

[13] NWN/200, Speer/4.

Program, which does not exceed the 4 percent cap set by the Commission, is described in Mr. Speer's testimony.[14]

B. OAR 860-085-0600(b): Discussion of all Project Measures Being Employed to Reduce Emissions.

The Program does not require the adoption of a single type of CHP system. Rather, customers may propose to install a CHP system that fits best with their specific needs. The customer must demonstrate that its proposed CHP system uses natural gas as a fuel source and meets the minimum efficiency requirements, as detailed in the CHP Solicitation.

C. OAR 860-085-0600(c): Estimated Project Measure Life.

The estimated life of a CHP system is approximately 20 years; however, for regulatory purposes of the Program, the incentives are proposed to be paid for the first 40 quarters of operation based on actual measured and verified carbon savings.

D. OAR 860-085-0600(d): Description of the Project Boundary and Scope.

The Program is open to applicants seeking to install CHP systems at facilities located on NW Natural's system. The scope of the eligible projects under the Program is defined in the criteria identified in the CHP Solicitation.

E. OAR 860-085-0600(e): A discussion of the emission reduction strategy used, and why the approach is appropriate, timely, and merits approval.

NW Natural calculates the emission reduction for CHP using the avoided MTC02(e) emissions from electricity generation. Avoided MTCO2(e) emissions from electricity generation will be the difference between monitored and verified MTCO2(e) emissions from the CHP system and the calculated MTCO2(e) emissions if the same volume of electricity had been purchased from the grid. The calculated MTCO2(e) emissions relies on the baseline recommended by the EPA for CHP sited in the State of Oregon: EPA's most recent eGrid Nonbaseload carbon emissions value for the Northwest Power Pool (NWPP) subregion. Ms.

[14] NWN/200, Speer/3-4.

Summers' testimony details the Company's decision to use the eGrid Nonbaseload carbon emissions value (*See NWN/100, Summers/12-13)*.

F. OAR 860-085-0600(f): Whether the Project is able to generate environmental credits or certificates and any potential revenues associated with their sale or use.

Gas fired CHP projects do not generate marketable credits such as Renewable Energy Credits (RECs) or Renewable Identification Number (RINs) for alternative fuels. While it is technically possible that carbon benefits from these projects could be traded into the carbon offset market, the Company does not to expect to trade any carbon benefits from these projects, and NW Natural will require contract provisions with the plant owner that will prohibit them from trading carbon benefits into the voluntary offset market.

2. Cost Recovery Information OAR 860-085-0600(2).

A. OAR 860-085-0600(2)(a): A requested method for cost recovery.

As described in Mr. Speer's testimony (*See NWN/200, Speers/4-5)*, the Company proposes to defer the expenses related to the program on an annual basis for later recovery in rates. Upon approval of the Program, the Company will file a deferral application for CHP costs. NW Natural believes that recovery of the deferred expenses can be accomplished by including deferred amounts in rates at the time of its annual PGA. Amounts deferred would be subject to review during the normal PGA process, where other deferred accounts are reviewed.

B. OAR 860-085-0600(2)(b): A showing of the Project benefits received and the allocation of benefits for each type of ratepayer.

The CHP Solicitation Program's benefits and the allocation of the benefits for each type of ratepayer are detailed in Section II.1.A. of this Application.

C. OAR 860-085-0600(2)(c): A description of any requested incentive payments, and requested recovery of the incentive.

Pursuant to OAR 860-085-0750(1), the Commission may grant incentive payments to public utilities for an emission reduction project. A utility may propose an incentive structure

with its initial Project proposal that can then be applied to subsequently approved projects.[15] Incentive payments may be linked to the amount of emissions reduced or can vary depending on whether the emission reduction project is recovered as an expense or an investment place in rate base.[16]

As described in Ms. Summers' testimony, for the Company's initial emission reduction project, NW Natural proposes to receive a $10.00 per MTCO2(e), which the Company believes is the incentive level that should serve as the appropriate baseline for emission reduction projects in general. The Commission's rules that state that no more than 25% of total emission reduction project costs included in rates can be associated with incentive payments. For the CHP Solicitation Program, the cost of carbon is expected to be approximately $42.59 per MTCO2(e), which cost is expected to be the lowest among the emission reduction projects that will be proposed by the Company. Thus, for the Program, the baseline $10.00 per MTCO2(e) fall will fall under the 25% cap. Moreover, because future projects will likely have higher costs of carbon, the $10 per MTCO2(e) will represent a smaller portion of the overall program costs going forward. NW Natural believes that setting the baseline incentive at $10.00 per MTCO2(e) will also send an economic signal to the Company to find the lowest cost and highest potential carbon reduction opportunities available. Finally, NW Natural proposes that the $10.00 per MTCO2(e) be a flexible baseline that can be adjusted based on the specifics of future projects that may involve considerations that are not present in the CHP Program, which could justify an upward or downward adjustment to the per tonne incentive.

D. OAR 860-085-0600(2)(d): Any required tariffs for the Program.

Included with this Application is a draft Schedule 510, Sheets 510-1 through 510-5, which describes the CHP Solicitation Program.

3. Emissions Reduction Verification Plan – OAR 860-085-0600(3).

[15] OAR 860-085-0600(2)(c).
[16] OAR 860-085-0600(3).

NW Natural has developed an Emissions Verification Plan that includes the following required components:

A. OAR 860-085-0600(3)(a): The methodology used to calculate the projected emission reductions.

1. The Project Baseline

The Company believes that investment in CHP system will not occur in in NW Natural's service territory in the absence of NW Natural's incentive payment. NW Natural relied on the ICF International's Assessment of the Technical and Economic Potential for CHP in Oregon ("ICF Study"), attached to the Business Plan as Appendix E (*See NWN/101, Summers/58-65)*, to set the baseline at zero. The ICF International report states that CHP is economic when the payback for the project is less than 10 years. Although technologies and outside incentives currently exist that allow for a ten year payback, NW Natural is not aware of any economic CHP adoption in its service territory. The ICF Study projects that market penetration could reach approximately 30-40 percent if the payback period is reduced to 3-4 years for CHP systems. As such, NW Natural targeted 4 year payback of the Program in order to cause investment in CHP above the baseline.

2. Emission leakage and Project emissions

NW Natural has not identified any "emission leakage" for the CHP Solicitation Program.

"Project emissions," meaning any emissions attributable to the implementation of an Emission Reduction Project, have been accounted for based on the FCP calculation described in the Solicitation Application.

3. Development of the emission reduction verification methodology.

As described in the Business Plan, NW Natural developed its measurement and verification methodology in consultation with Energy 350. Energy 350 is an energy efficiency consulting company based in Portland, Oregon with expertise in the measurement and

verification of performance of CHP systems. Further background on E350 is provided in Appendix H of the Business Plan.

B. OAR 860-085-0600(3)(b): Plan for monitoring emission reductions.

The plan for monitoring emission reductions is established in the CHP Solicitation.

4. Additional Application Requirements - ORS 757.539(4)(a)–(k).

A. Description of the Project.

The description of the Program is in the foregoing Section I.C.

B. The projected amount of capital and operating costs necessary to complete the project.

As explained in Ms. Summers' testimony (*See NWN/100, Summers/21)*, the Company accounts for all CHP program costs as annual O&M expenditures. The financial forecast does not include capital investment for the Program. The operating costs include customer incentives, NW Natural's incentive, third-party measurement and verification, third-party project certification, marketing, legal, third-party financial modeling, and Program development consulting ("Operating Costs"). Because the majority of the Operating Costs of the Program are tied to measured and verified carbon savings which can vary from project to project, NW Natural cannot identify exact Operating Costs for the Program, but the Company has estimated forecasts for specific program years based on CHP adoption assumptions in Appendix C to the Business Plan (*See NWN/101, Summers/52-55)*.

C. The projected amount of reduced emissions created by the project – ORS 757.539(c).

See above.

D. The potential of the project to reduce emissions not identified in response to ORS 757.539(c) – ORS 757.539(d).

NW Natural is not aware of further emission reductions beyond the MTCO2(e) reductions considered and addressed in this Application. In the event NW Natural becomes

aware of additional emission reduction potential through the implementation of the CHP Solicitation Program, NW Natural will timely notify the Commission of such change.

E. The projected date on which the project will become operational – ORS 757.539(e).

NW Natural will require CHP systems to be operational within 24 months of NW Natural's approval of the CHP Solicitation Application to be eligible to receive incentive payments.

F. A requested method, as described in subsection (8) of this section, for recovery of costs incurred and investments made – ORS 757.539(f).

Pursuant to ORS 747.539(8), "[a] public utility may recover costs incurred and investments made from a type of ratepayer . . . only if the commission makes a finding that the type of ratepayer receives a benefit from the project. If the commission makes a finding that more than one type of ratepayer receives a benefit from the project, the commission shall allow recovery from each type of ratepayer in an amount that is proportionate to the proportion of the benefit received, as determined by the commission, by the type of ratepayer."

As explained in Section 1(A)(c) above the Program offers benefits to all customer classes because the implementation of CHP will increase the overall throughput in NW Natural's service territory.

G. An explanation of why the public utility, without the emission reduction program, would not invest in the project in the ordinary course of business – ORS 757.539(g).

See Section 1(A)(d) above.

H. Proof of stakeholder involvement – ORS 757.539(h).

See Section 1(A)(e) above.

I. The projected rate impact of the project – ORS 757.539(i).

Based on the Financial Forecast and Budget included as Appendix C to the Business Plan (*See NWN/101, Summers/52-55)* and the allocation of costs on an equal percent margin

basis to all customer classes, the following table represents the rate impact ($/therm) by customer class under a low utilization rate and high utilization rate:

Customer Class	Low Utilization Rate (2,000 MTCO2(e))	High Utilization Rate (2,000 MTCO2(e))
Residential	$0.02125	$0.04744
Commercial	$0.06376	$0.14233
Industrial	$0.08746	$0.19526

Pursuant to OAR 860-085-0700, the projected costs to ratepayers of all of NW Natural's emission reduction projects must not exceed 4 percent of the Company's last approved retail revenue requirement, inclusive of all revenue collected under adjustment schedules. Appendix C to the Business Plan shows that, based on NW Natural's assumed high utilization rate, the Program could reach 2.1% of the Company's last approved retail revenue requirement.

J. The projected aggregate rate impact of all projects proposed by the public utility under this section and approved by the commission for the public utility under this section – ORS 757.539(j).

See Section 4(I) above.

K. An explanation of how the public utility will provide the commission with progress updates during the life of the project, including updates on costs and reduced emissions associated with the project – ORS 757.539(k).

NW Natural proposes to file annual updates in this docket beginning one year after Commission-approval of this Application. The annual report will detail the annual Operating Costs of the Program and M&V reports demonstrating the annual total of reduced emissions. NW Natural will also include in the annual reports notifications of approved CHP Solicitation Applications and notifications of CHP systems becoming operational in the previous calendar year. The format of the annual update will be agreed upon by the stakeholders before the first annual report is filed with the Commission.

III. CONCLUSION.

For the foregoing reasons, NW Natural respectfully requests that the Commission approve its Application for Greenhouse Gas Emissions Reduction Program.

Date this ____ day of June, 2015.

Respectfully Submitted,

NW NATURAL

Mark R. Thompson
Manager, Rates & Regulatory Affairs

SCHEDULE 510
COMBINED HEAT and POWER SOLICITATION PROGRAM
(SB 844 Carbon Emission Reduction Program)

PURPOSE
To describe a voluntary carbon emission reduction program offered pursuant to ORS 757.539 and OAR 860-085-0500 through 860-085-0750, the purpose of which is to acquire carbon emission reductions through the solicitation of combined heat and power ("CHP") systems within NW Natural's service territory in Oregon.

APPLICABLE
To all qualifying Customers that commit to develop a qualifying CHP system at such Customer's Non-Residential building or Residential dwelling within the Company's Oregon service territory.

PROGRAM TERM
The solicitation of CHP under this **Schedule 510** will be for the period commencing upon the effective date approved by the Commission, and continuing until the Company terminates the program or upon such date the Commission decides.

PROGRAM DESCRIPTION
This Combined Heat and Power Solicitation Program ("CHP Solicitation Program") is designed to encourage the development of CHP capacity in the state of Oregon through incentives funded by NW Natural's **Schedule 510** CHP Program incentive. The Company will maintain the current version of the CHP Solicitation Plan, which may be amended from time to time, on its website. The incentives are described later in this **Schedule 510**.

CHP System Qualification. A qualifying CHP system is one where the primary fuel source for the prime mover of the CHP is natural gas, and the CHP system meets or exceeds a Fuel Chargeable to Power (FCP) heat rate of 6,120 Btu/kWh. The FCP is calculated as follows:

$$FCP = \frac{Gas\ Input\ (Btu) - \frac{Heat\ Recovered\ (Btu)}{Offsetting\ Boiler\ Efficiency}}{Net\ Electricity\ Generated\ (kWh)}$$

Participant Qualification. A qualified participant under this CHP Solicitation Program is an existing NW Natural Customer or potential customer that has completed the required CHP Solicitation, and whose project has been reviewed and approved by the Company following a full project feasibility and Technical Assessment, as described in Special Condition 3 of this **Schedule 510**.

(continue to Sheet 510-2)

SCHEDULE 510
COMBINED HEAT and POWER SOLICITATION PROGRAM
(SB 844 Carbon Emission Reduction Program)
(continued)

PROGRAM DESCRIPTION (continued)

Customer Incentives: Incentives for CHP Program carbon emissions reductions are available on a first come, first serve basis. Customer incentives are based on measured and verified MTCO2 reductions on a quarterly basis for the first 40 quarters (10 years) of operation in accordance with the Measurement and Valuation provision of this **Schedule 510**.

Schedule 510 CHP Program Incentive:
$30 per $MTCO_2$ saved, capped at $2 million per customer site per year.

NW Natural Incentives: NW Natural will include $10.00 per MTCO2(e) reduced in the annual deferral balance in accordance with the Program Cost Recovery provision of this **Schedule 510**.

SPECIAL CONDITIONS

1. As part of the application for participation under this **Schedule 510**, all participants must qualify for and meet all terms and conditions of service under the Rate Schedule under which Customer will take natural gas service for the CHP system, including but not limited to the establishment of credit under **Rule 2** of the Tariff of which this Schedule is a part.

2. The Participant will be required to pay the Company, in advance, for any construction costs or other distribution facilities costs required to provide service to a Customer under this CHP Program in accordance with **Schedule X** or **Rule 20**, whichever shall apply.

   Where the approved project requires an increase in natural gas system pressure, the Company will provide such high pressure service under the same terms and conditions as set forth in **Schedule H** "Large Volume Non-Residential High Pressure Gas Service (HPGS) Rider of the Company's approved Tariff, which provide for charges to the customer to recover all costs associated with the installation of required compression equipment.

3. At the time of application for participation in the CHP Program, the Customer must include a Technical Assessment for the Customer's proposed CHP system. The Technical Assessment must include all of the information required by the Company's Technical Assessment criteria, which is available on request, or from the Company's website. At a minimum, the Technical Assessment must provide Engineering specifics on the facility, thermal and electric loads, proposed CHP system, and a proposed commissioning and measurement and verification (M&V) plan.

(continue to Sheet 510-3)

SCHEDULE 510
COMBINED HEAT and POWER SOLICITATION PROGRAM
(SB 844 Carbon Emission Reduction Program)
(continued)

SPECIAL CONDITIONS (continued)

4. All incentives will be paid quarterly by the Company directly to the participant.

PROGRAM COST RECOVERY

The amounts associated with the cost of the CHP Solicitation Program will be deferred into the appropriate deferral account as they occur. The account balance for each covered program shall accrue interest at the utility's authorized rate of return until deferred amounts are put into amortization, at which time interest will accrue at the modified blended treasury rate prescribed by the Commission in OPUC Order No. 08-263.

The amounts to be deferred under the Program includes operating and maintenance (O&M) expense, which includes customer incentives, NW Natural's incentive, third-party measurement and verification, third-party project certification, marketing, legal, third-party financial modeling, Program development consulting, and other related program expenditures.

The amounts in the respective covered program accounts will be amortized and applied to Customer bills based on equal percent of margin by Rate Schedule and Customer class. The filing for amortization will occur coincident with the Company's annual Purchased Gas Adjustment ("PGA") filing, consistent with existing practices for the collection or refund of other deferred accounting amounts.

Any over- or under- collection of the balance in the Account at the end of a 12-month Collection Period will be retained in the Account and used to adjust the amount amortized into rates for the subsequent Collection Period, unless appropriately added to a residual amortization account under the Commission's order.

Costs associated with this **Schedule 510** will be recovered from all Customers in accordance with **Schedule 198 "SB 844 Program Cost Recovery Mechanism."**

(continue to Sheet 510-4)

SCHEDULE 510
COMBINED HEAT and POWER SOLICITATION PROGRAM
(SB 844 Carbon Emission Reduction Program)
(continued)

MEASUREMENT and VALUATION

All program participants are required to submit quarterly performance reports within 15 days following the end of each calendar quarter as follows:

Report Period	Report Due Date *
January 1 to March 31	April 15
April 1 to June 30	July 15
July 1 to September 30	October 15
October 1 to December 31	January 15

* If the due date falls on a weekend or holiday the report shall be due on the first business day following the due date.

All reports shall be in the form and format determined by NW Natural (Excel spreadsheet) and submitted electronically to NW Natural via email or uploaded to the Company's website, the exact method to be determined by the Company and communicated to program participants in advance of the first reporting cycle.

At a minimum, the following inputs and outputs will be required to be reported in not more than one-hour increments:

- Fuel input
- Electricity output
- Thermal Heat Recovery

All metering points must be in no greater than 15-minute intervals, and all metering points must collect data in the same interval periods.

In the event interval data is missing for periods of less than 30 consecutive minutes, a proxy for such data shall be used, and shall be noted in the report. In the event that the Customer experiences any data loss that equals or exceeds 8 hours within any calendar month, the Company may require that the Customer take steps necessary to immediately repair or remedy the matter. A loss of data for more than an 8-hour period may be cause for the Company to suspend incentive payments to the Customer for the period that the data is missing.

The Customer shall be responsible to maintain the integrity and accuracy of all data reported under this **Schedule 510** program, as well as all instrumentation required to acquire the required data for the entirety of the contract term (40 quarters).

(continue to Sheet 510-5)

SCHEDULE 510
COMBINED HEAT and POWER SOLICITATION PROGRAM
(SB 844 Carbon Emission Reduction Program)
(continued)

PROGRAM YEAR and REPORTING
The Program Year for the **Schedule 510** program will be the calendar year January 1 thru December 31, with the first Program Year ending December 31, 2015. On or before April 1, 2016, and each April 1 thereafter for the Term of this **Schedule 510** program, the Company will report to the Commission the results of this program in accordance with the methodology established by the Company's Emissions Verification Plan established pursuant to OAR 860-85-0600(3).

The annual report will include the number of **Schedule 510** program participants, year-to-date and program-to-date program costs, actual carbon savings achieved through the program determined in accordance with the methodology established the Company's Emissions Verification Plan.

GENERAL TERMS:
Service under this Schedule is governed by the terms and condition of this Schedule, the General Rules and Regulations contained in this Tariff, any other schedules that by their terms or by the terms of this Schedule apply to service under this Schedule and by all the rules and regulations prescribed by regulatory authorities, as amended from time to time.

BEFORE THE

PUBLIC UTILITY COMMISSION OF OREGON

———

NW Natural

Direct Testimony of Barbara Summers

Carbon Emission Reduction Program
Combined Heat & Power (CHP)

Background and Program Description

June 24, 2015

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I. INTRODUCTION

Q. Please state your name and position with Northwest Natural Gas Company ("NW Natural" or the "Company").

A. My name is Barbara Summers. My business address is 220 NW Second Avenue, Portland, Oregon 97209. My current position is Director of Business Development for Northwest Natural Gas Company, d/b/a NW Natural ("NW Natural" or the "Company").

Q. Please summarize your educational background and business experience.

A. Prior to joining NW Natural as Director of Business Development, I held similar positions with PacifiCorp and Scottish Power as Vice President, Business Development and Vice President PacifiCorp Power Marketing, now PPM. In addition to my natural gas and electric utility experience in business development and transactions, I worked for five years in the telecommunications industry where I was responsible for negotiating and evaluating acquisitions and joint ventures as well as potential start-up businesses. I have a BS in Business Administration from Portland State University.

Q. What is the purpose of your testimony?

A. The purpose of my testimony is to provide support for the Company's Application for Approval of NW Natural's Combined Heat & Power Solicitation Program (the "CHP Program"). Senate Bill 844 established a voluntary emission reduction program for natural gas utilities to invest in projects that reduce greenhouse gas emissions and provide benefits to customers. Natural gas utilities seeking to implement emission reduction projects may seek approval of the projects from the Public Utility Commission of Oregon ("Commission"). Senate Bill 844,

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codified in ORS 757.539, establishes requirements that natural gas utilities must meet in order to receive approval of the project from the Commission. If the Commission approves an emission reduction project, the natural gas utility may recover costs incurred in implementing the program and potentially receive an incentive.

My testimony will explain how the Company's proposed CHP Program meets the eligibility criteria of an emission reduction program by providing a description of: the proposed project, the emission reduction opportunity of combined heat and power (CHP), the cost of carbon associated with the Program, the proposed monitoring and verification process, and NW Natural's requested incentive. I will also describe the stakeholder engagement process that the Company undertook before filing the CHP Program and the Company's proposed schedule and process for the implementation of the CHP Program. NW Natural witness Andrew Speer will provide an explanation of the Company's cost recovery mechanism and rate impact for the program (see NWN/200, Speer).

II. BACKGROUND ON COMBINED HEAT AND POWER PROJECTS

Q. Please provide a general description of CHP.

A. CHP, also known as cogeneration, is a form of distributed generation that combines electricity and thermal energy generation into a single process that has the potential to save up to 35 percent of the energy required to perform these tasks separately. A CHP system allows an industrial, commercial, or even residential energy user to produce electricity and thermal energy at the point of use, instead of obtaining electricity from the grid and producing thermal energy in

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an on-site furnace or boiler. In general, CHP systems can range in size from hundreds of megawatts in large scale industrial systems to one kilowatt for residential systems.

Q. How do CHP systems save fuel and reduce carbon emissions?

A. CHP systems utilize a more energy efficient process to meet a facility's thermal and electric energy requirements. This increased efficiency is primarily the result of three factors. First, CHP systems recover heat normally lost in central station power generation to provide useful heating on-site, or to generate additional electricity. Second, CHP systems eliminate transmission and distribution losses, typically between 6-10 percent from a central power plant. Third, waste heat recovered has already gone through the combustion process, displacing the need for conventional thermal production equipment, and often resulting in a 10-22 percent efficiency gain. The increased efficiency results in carbon emission reductions compared to conventional generation sources.

Q. Why is CHP an attractive emission reduction program?

A. CHP provides the greatest natural gas-related opportunity to reduce carbon emissions in Oregon based on findings of the Oregon Department of Energy (ODOE) and Center for Climate Solutions, Energy Trust of Oregon (ETO) and The Climate Trust, as well as NW Natural's own estimates. Over the period 2014-2035, the potential to reduce carbon emissions from CHP is nearly equal to all other measures combined including natural gas vehicles (NGVs), renewable natural gas (RNG), energy efficiency, system upgrades and oil conversions. However, for most, or maybe even all potential CHP users, carbon reduction potential does not provide a sufficient justification for an investment in CHP.

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CHP installations require a significant capital investment that can be cost-prohibitive. Additionally, electricity production is usually not a core competency of potential CHP customers' business. By reducing the payback period of CHP equipment and installation through incentives offered through the Program, the Program seeks to achieve carbon reductions rendering CHP installations an economically viable investment for those for whom it currently is not. In this way, the CHP Program can play an important role in the State's effort to reduce carbon emissions.

III. NW NATURAL'S CHP SOLICITATION PROGRAM

Q. Please provide an overview of the CHP Program.

A. At its core, the CHP Program creates a regulatory mechanism for NW Natural to provide funding to secure CO_2 emission reductions through the use of CHP in its service territory. The Program is a voluntary offering available to all customers in NW Natural's service territory who meet the eligibility criteria detailed in the CHP Solicitation.[1] Customers who have been approved by NW Natural under the eligibility requirements in the Solicitation Application[2] are eligible to receive incentive payments from NW Natural for carbon emission reductions as a result of the installation and operation of a CHP system. The incentive payments will only be available for measured and verified metric tonnes of CO_2 equivalent ("$MTCO_2(e)$") reduced through the use of a CHP system.

[1] The CHP Solicitation can be found in Appendix A to NW Natural's CHP Solicitation Program Business Plan ("Business Plan"). See NWN/201, Summers/33-42. The Business Plan contains details regarding NW Natural's development of the proposed CHP Solicitation Program. It serves to document the proposed program design, and it was also used in draft form to assist the stakeholders under the processes called for in ORS 757.539.

[2] Business Plan, Appendix A, Exhibit A. See NWN/201, Summers/33-42..

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The goal of the Program is to reduce the payback period for the investment in CHP. Currently, CHP is considered "economic" at a simple payback period[3] of less than 10 years[4]; however, the economics of CHP have not driven Oregon customers to make significant investments in CHP. Market research, described below, shows that 30 to 40 percent of potential CHP customers will invest in CHP at a payback period of 3 to 4 years.[5] Accordingly, NW Natural's incentive payment is designed to reduce the simple payback period to approximately 4 years.

Q. What types of CHP systems are targeted by the Program?

A. Targeted CHP systems include those that: a) exceed the heat rate efficiency of a Combined Cycle Gas Turbine (CCGT), the utility scale alternative, by at least 10 percent (eligibility criteria) as calculated in Appendix A of the Business Plan (*See NWN/101, Summers/33-40)*, and b) meet "economic" criteria of a less than 10-year simple payback period without NW Natural incentives. In general, to meet these tests, CHP must be sited at facilities that have the ability to use a fixed amount of electricity on a 24/7 basis and have a stable, coincident heat load that can use the waste heat produced during electric generation. Examples of such applications include industrial processes that need heat and electricity during the same time period (particularly those with 24/7 operation), and commercial

[3] An energy investment's simple payback period is the amount of time it will take to recover the initial investment in energy savings, dividing initial installed cost by the annual energy cost savings.

[4] Business Plan, Appendix E, Assessment of the Technical and Economic Potential for CHP in Oregon, July 2014. See NWN/101, Summers/57-65.

[5] *Id*.

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operations such as hotels, hospitals, nursing homes, schools, colleges, laundries, health facilities, and multi-unit apartments.

EMISSION REDUCTION TARGETS

Q. What is the Company's projection of the market potential of CHP in Oregon?

A. As described in the Business Plan, Appendix E (*see NWN/101, Summers/57-65*), the Oregon Department of Energy (ODOE) engaged ICF International to assess the technical and economic viability of CHP in Oregon. In July 2014, ICF International identified 1,457 MW of technical CHP potential in Oregon.[6] Of the 1,457 MWs, ICF International identified 319 MWs with the economic potential to allow prospective CHP candidates to recover their initial investment in fewer than 10 years.[7] NW Natural confirmed the reasonableness of ICF International's assessment by estimating CHP potential based on the thermal loads of customers that are typically the best CHP applications as described above.

Q. What is NW Natural's targeted greenhouse gas emissions from the proposed CHP program?

A. NW Natural's goal is to reduce greenhouse gas emissions through the Program by 240,000 $MTCO_2(e)$ per year in the State of Oregon by the end of 2020. This goal translates to 80 MWs of CHP at an average of 3,000 $MTCO_2(e)$ per MW assuming systems operate 95 percent of the time and utilize 100 percent of the reclaimable waste heat or 120 MWs at an average of 2,000 $MTCO_2(e)$ per MW.

[6] Business Plan, Appendix E, Assessment of the Technical and Economic Potential for CHP in Oregon, July 2014. See NWN/101, Summers/57-65).

[7] *Id.*

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Minimum program eligibility requires CHP to be at least 10 percent more efficient than a CCGT. CHP systems, however, can exceed the efficiency of a utility-scale CCGT by about 35 percent. So, systems that recover less of the waste heat may still be eligible but would result in less carbon savings. Target greenhouse gas emissions and the resulting program budget assumes CHP, on average, achieves 2,000 $MTCO_2(e)$ per MW of reduced emissions to account for this variability, a level that still exceeds minimum program eligibility efficiency.

Q. How does the Company intend to meet this goal?

A. NW Natural intends to meet this goal by working with its customers to leverage the incentives and services available from NW Natural, ODOE, ETO and the United States Internal Revenue Service (IRS) in a manner that will finally tip the scale to cause investment in CHP. Specifically, NW Natural designed the Program, through a cooperative effort with ODOE and the United States Department of Energy Technical Assistance Partnership at Washington State University, to achieve a 3 to 4 year simple payback after applying all available incentives. With a 3 to 4 year payback, ICF International, projects an expected customer adoption of about 30 to 40 percent of economic CHP potential in Oregon based on Primen's 2003 Distributed Energy Market Survey.[8] As stated earlier, the Program's goal is to reduce greenhouse gas emissions by 240,000 $MTCO_2(e)$ per year by the end of 2020. This goal translates to 80 MWs of CHP at 3,000 $MTCO_2(e)$ per MW or 120 MWs at 2,000 $MTCO_2(e)$ per MW. Eighty MWs represents 25 percent of ICF *economic* potential and 5 percent of ICF

[8] Business Plan, Appendix E, Assessment of the Technical and Economic Potential for CHP in Oregon, July 2014. See NWN/101, Summers/57-65.

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technical potential. 120 MWs represents 38 percent of ICF economic potential and 8 percent of ICF technical potential.

PROGRAM INCENTIVES AND COSTS

Q. Please describe NW Natural's incentive to CHP customers under the proposed Program.

A. NW Natural will pay CHP customers $30 per $MtCO_2(e)$ reduced, based on measured and verified performance. CHP customers are eligible to receive quarterly incentive payments for up to 40 operating quarters based on monitored and verified MTCO2(e) savings. Each CHP customer site will be capped at $4.5 million of incentive payments per year.

Q. The Business Plan refers to additional incentives from the ODOE and ETO. Could you please describe those incentives?

A. Yes, in addition to NW Natural's incentive payment, CHP customers will also have the opportunity to apply for incentive payments from ODOE and ETO, summarized in Table 6 of the Business Plan (*see NWN/101, Summers/21)*. ODOE, through its Energy Incentives Program (EIP), will competitively select projects to be awarded Oregon state tax credits over a five year period for qualified CHP capital investment, not to exceed 35 percent of certified project cost.

The ETO offers an incentive payment to CHP customers based on the energy efficiency and cost-effectiveness of the installed CHP system of $0.08 per annual kilowatt hour saved up to 50 percent of the project cost and is capped at $500,000. While ODOE and ETO have eligibility requirements that are consistent with NW Natural's, and NW Natural's incentive level assumes projects

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apply for all available incentives, it is not a requirement of the program that incented CHP systems be awarded or receive other incentives.

Q. Is there also a federal tax credit available for investment in CHP?

A. Yes, there is a Business Investment Tax Credit (ITC) equal to 10 percent of expenditures with no maximum limit. Eligible CHP property generally includes systems up to 50 MWs that exceed 60 percent energy efficiency subject to certain limitations and reductions for large systems.

Q. How did NW Natural determine the amount and length of NW Natural's Program incentive?

A. NW Natural's incentive level is based on the results of the *RELCOST* financial model developed by USDOE, Technical Assistance Program (TAP) at Washington State University (WSU) and adapted for NW Natural's program. The *RELCOST* model is used by WSU as part of the USDOE TAP's program to evaluate the financial viability of energy projects. The *RELCOST* financial model was adapted for NW Natural's program to evaluate project economics considering all incentives for which a qualifying project would be eligible (ETO, ODOE EIP and Federal ITC). The NW Natural incentive was then calculated assuming the other incentives were applied in advance of NW Natural's program incentives. NW Natural relied on the adapted WSU *RELCOST* model to evaluate payback periods for a range of CHP prototypes. NW Natural's proposed incentive of $30 per measured and verified MTCO2(e) savings was set based on ideal operating conditions, *i.e*., 8,322 operating hours (95 percent capacity factor) and 100 percent utilization of reclaimable waste heat. Since incentives are paid for measured and verified MTCO2(e) savings, CHP

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installations that are operated less than 8,322 hours or that utilize less than 100 percent of the waste heat would still receive an incentive of $30 per Mte for the actual measured and verified MTCO2(e) reduced but would receive an overall lower total amount due to the lower $MTCO_2$(e) savings. The intent was to incent customers to operate CHP systems to achieve maximum MTCO2(e) savings. While customers will be paid for actual measured and verified MTCO2(e) savings of any level, in order to be approved initially, CHP systems must meet the eligibility criteria in the Solicitation requiring a CHP system to be 10 percent more efficient than a utility-scale combined cycle gas turbine.

Q. In addition to the capital investments a CHP customer makes to install the facilities, and any costs associated with meeting the eligibility criteria under the Program, are there any other payments that CHP customers need to make under the Program?

A. Possibly. At the CHP customer's option, NW Natural will expand capacity or extend its distribution system to serve the incremental CHP load. Additionally, NW Natural will provide natural gas at higher than system pressure, if necessary for operation of the CHP system. Individual CHP customers will bear the costs of system expansion or extension as well as any compression, similar to how this would be done under NW Natural's Schedule H "Large Volume Non-Residential High Pressure Gas Service (HPGS) Rider."

Q. Are the costs of expanded capacity, extended distribution system, and increased pressure included in the Program's anticipated payback period for CHP installations?

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A. No. In many cases, it will not be necessary to expand capacity, extend the distribution system or increase system pressure to support CHP. Such requirements are site- and load-specific and depend, in part, on the facility's location on NW Natural's system. Paybacks were calculated on prototypical units and did not include these costs

MTCO2(e) SAVINGS OF CHP

Q. How does NW Natural plan to account for the MTCO2(e) savings of CHP?

A. MTCO2(e) savings are accounted for by looking at four pieces of information: 1) net incremental natural gas usage at the site; 2) the avoided MTCO2(e) emissions from reduced central station utility electric generation; 3) the avoided central station electric transmission and distribution line loss; and 4) efficiency of the rated thermal production equipment that the heat recovery will displace.

Q. Please describe the methodology NW Natural proposes to use to determine the incremental natural gas usage?

A. Energy in and out of a CHP system will be metered. CHP electrical performance, and consequently, net natural gas usage at a site, is determined using a methodology termed Fuel Chargeable to Power (FCP). Calculating FCP allows for the correct accounting of additional gas required to generate electricity incremental to what the site would normally use to satisfy thermal loads. It is the industry accepted methodology to equally account for the incremental gas usage of a CHP system compared to conventional grid generation.

Q. Please describe the methodology NW Natural proposes to use to determine the avoided MTCO2(e) emissions from electricity generation.

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A. Avoided MTCO2(e) emissions from electricity generation will be the difference between monitored and verified MTCO2(e) savings and calculated MTCO2(e) emissions if the same volume of electricity had been purchased from the grid. The calculated MTCO2(e) emissions relies on the baseline recommended by the EPA for CHP sited in the State of Oregon - EPA's most recent eGrid Nonbaseload carbon emissions value for the Northwest Power Pool (NWPP) subregion. Appendix B of the CHP Business Plan details the Company's analysis regarding the displacement of electric generation greenhouse gas emissions by CHP systems. *See NWN/101, Summers/45-51.*

Q. What is EPA's Nonbaseload eGrid carbon emissions value in the Northwest Power Pool?

A. 1,340 lbs per MWh

Q: Why did the Company choose the EPA's Nonbaseload eGRID carbon emissions value in the NWPP over the alternatives?

A: The Company relied on the Environmental Protection Agency's methodology for determining displaced greenhouse gas emissions for combined heat and power sited in the state of Oregon, as recommended in Fuel and Carbon Dioxide Emissions Savings Calculation Methodology for Combined Heat and Power Systems, U.S. Environmental Protection Agency, Combined Heat and Power Partnership February 2015.[9]**,**

[9] http://epa.gov/chp/documents/fuel_and_co2_savings.pdf

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While CHP systems are expected to operate as baseload facilities, NW Natural elected to use the EPA recommendation for nonbaseload rather than baseload facilities. EPA recommends nonbaseload only for CHP units operating at less than 6,500 annual operating hours. While the Company based the recommended incentive levels on 8,322 operating hours, as described earlier, CHP units that operate less than 6,500 hours may still eligible for the program if they meet the eligibility criteria of exceeding the efficiency of a CCGT by 10 percent. Thus, the lower nonbaseload value is appropriate for commercial customers and industrial customers with lower capacity factors. Rather than using different eGRID numbers for different potential CHP projects, the Company opted to use the lower value for all projects.

Q. Please explain the process you used to consult with stakeholders regarding your calculation of MTCO2(e) emissions?

A: NW Natural reached out to ODOE staff, which has expertise in carbon reduction calculations, to discuss this issue. On December 11, 2014, NW Natural met with ODOE, along with ETO and representatives from OPUC Staff, to review the various options for accounting for displaced grid electricity. The group evaluated the options with respect to criteria that included the need for a credible measure that is: i) fairly stable over time, ii) kept current through updating, and iii) universal across potential projects within NW Natural's service territory. After discussing these criteria and the various options, the group came to a general consensus that the EPA recommended eGrid non-baseload rate was preferred

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over other possible measures of MTCO2(e) intensity. The primary reason the group favored this measure, among others, is that the measure is the only one recommended by US EPA for determining emissions displaced by CHP within EPA guidance documents.

Q. Please describe the methodology NW Natural proposes to use to determine the avoided MTCO2(e) emissions from electric line loss.

A. Transmission and distribution losses avoided by generating electricity onsite are 6 percent for primary service and 10 percent for secondary service.[10] Electricity exported to the grid, if any, will not receive a credit for avoided transmission and distribution losses.

Q. How does the Company propose to calculate the incentive payment that it makes to customers based on MTCO2(e) reduced by using CHP?

A. The calculation, which accounts for incremental natural gas usage and the avoided MTCO2(e) emissions from utility electric generation and electric line loss, is provided in Section III of the CHP Solicitation.

MEASUREMENT AND VERIFICATION PLAN

Q. Please describe the Measurement and Verification plan (M&V Plan) proposed for the Project.

A. The Company's proposed M&V Plan is set forth in Section VI of the CHP Solicitation (*See NWN/101, Summers/38)*. As monitoring and verification is directly linked to payment of incentives, NW Natural contracted with an

[10] Sources: U.S. Energy Information Administration, Form EIA-860, "Annual Electric Generator Report." U.S. Energy Information Administration, Form EIA-861,"Annual Electric Power Industry Report." U.S. Energy Information Administration, Form EIA-923, "Power Plant Operations Report" and predecessor forms.

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independent third party, Energy 350, to develop its M&V Plan. Energy 350 was selected because of its experience supporting the ETO's CHP program. Energy 350's experience and expertise is summarized in Appendix H of the Business Plan (*See NWN/101, Summers/82)*.

Key aspects of NW Natural's proposed M&V Plan include:

1. Measurement and verification will be conducted by an independent third party (Energy 350).
2. Results will be provided to NW Natural on a quarterly basis.
3. Results will be summarized and provided to the ETO and OPUC annually in a format to be agreed upon by the first annual report.
4. Each customer will propose M&V plan specific to their system that complies with Solicitation.
5. Customer proposed plan must be approved by independent third party (Energy 350) and NW Natural.
6. Independent third party conducts ongoing site inspections consistent with best practices for M&V. The independent third party (Energy 350) will conduct on-site inspection of M&V meter equipment and reporting system processes to ensure performance data is being captured and reporting correctly. All projects will receive a series of periodic inspections after commissioning, M&V, and the post-install inspection has been completed. Conducting periodic M&V inspections based on observations of data is considered best practice. Conducting inspections at defined intervals is not typical or feasible to perform over the lifecycle of

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each project. Data integrity issues from any site will prompt more frequent visits from the third party M&V contractor to assess the problem. As each project will entail varying degrees of complexity, the number of inspections for each individual project will be determined during the technical analysis phase and budgeted for by the third part M&V contractor.[11]

Q. Has the Company's M&V Plan been reviewed by an independent entity?

A. Yes. During the stakeholder engagement process, stakeholders requested that NW Natural engage an independent entity to render an opinion as to how closely the M&V Plan's specifications aligned with the monitoring and verification requirements typically found in standards for carbon offsets. In response, NW Natural engaged the Climate Action Reserve (CAR) to evaluate the M&V Plan. In all cases NW Natural's M&V Plan met either the standard of CAR or CDM or, in most cases, the standard of both entities. Where there were minor gaps identified to meet both CDM and CAR standards, NW Natural modified its M&V Plan to address the gaps and reviewed those remedies with stakeholders. The Climate Action Reserve's opinion is attached as Appendix H to the Business Plan (*See NWN/101, Summers/82)*.

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[11] NW Natural has budgeted a flat amount per year per site for M&V, including any onsite inspections.

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NW NATURAL INCENTIVE

Q. Has NW Natural proposed an incentive payment for the Company under the Program?

A. Yes, it has.

Q What level of incentive has NW Natural proposed to receive under the Program?

A. NW Natural proposes to receive an incentive of $10.00 per measured and verified reduction in MTCO2(e) emissions under the Program.

Q. Why is the Company proposing to receive an incentive that is tied to the number of MTCO2(e) of carbon the program reduces?

A. The Company believes that tying its incentive to the number of tons of carbon reduced aligns the Company's financial interests with the goals of SB 844 - to reduce greenhouse gas emissions. Under this approach, NW Natural receives little incentive for programs that produce small savings, and can achieve a significant incentive payment only if it is successful in achieving a significant amount of carbon savings.

Q. Why is the Company proposing $10 per MTCO2(e) as the incentive under this CHP Program?

A. The Company chose $10 per MTCO2(e) as its requested incentive because it believes that amount represents an appropriate baseline, or default incentive for SB 844 projects, and because the Company believes that amount is reasonable in the context of the CHP Program.

Q. Why does NW Natural believe that $10 per MTCO2(e) is an appropriate baseline or default incentive amount for SB 844 programs?

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A. The rules established by the Commission appropriately place a limit on the amount of incentives that a utility can receive for carbon reduction programs. Those rules state that no more than 25 percent of total SB 844 program costs included in rates can be associated with the incentive payments. In the case of the Program, NW Natural estimates that the costs of the program will be approximately $42.59 dollars per MTCO2(e) of carbon reduced. NW Natural believes that it is very likely that the Program may represent some of the lowest cost carbon reduction measures, on a per ton basis, that it can seek to achieve under SB 844. The default $10 per MTCO2(e) incentive thus falls under the maximum amount that would be appropriate to include in rates—if one were to assume that all future SB 844 projects were to cost (on a per ton basis) no more than the CHP Program.

Q. Does this mean that NW Natural is seeking $10 per MTCO2(e) as an incentive so that it can maximize the total payment to the Company under SB 844?

A. No, it is actually to the contrary. The Company is unlikely to ever reach the cap on incentives established under the Commission's rules. As future programs are approved, with higher costs per ton, a $10 per MTCO2(e) incentive will represent less than 25 percent of those programs' costs included in rates. To the extent such programs are approved, and NW Natural is able to realize a $10 per MTCO2(e) incentive, the incentive will represent a smaller and smaller percentage of total SB 844 program costs included in rates, and the restrictions from the rule will not be implicated.

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Q. Why is NW Natural willing to agree to a dollars per MTCO2(e) incentive that may not maximize the incentive payments allowed by the OPUC's rules?

A. Although NW Natural is interested in realizing a benefit from successful implementation of SB 844, it recognizes that its incentive should be linked with achieving a high level of carbon savings, and at as low of a cost as possible. Setting a baseline level for the incentive at around 25 percent of the CHP Program costs (which will likely represent the lowest program costs we see) would provide a strong signal to the Company to seek to develop programs that save a significant amount of carbon emission reductions, and at a price as close to the CHP Program as possible. In other words, it will send an economic signal to find the lowest cost and highest potential carbon reduction opportunities available.

NW Natural also hopes to find a per MTCO2(e) incentive level that the stakeholders and Commission can agree would make sense going forward, so that the Company can have certainty about the benefits it could achieve, conditioned upon developing and implementing successful carbon reduction programs.

Finally, the Company recognizes that some future programs may involve utility investment, upon which the Company will be allowed to recover its carrying costs. Inherent in these programs will be some additional opportunity for the Company to earn its regulated return.

Q. Is NW Natural proposing that the Commission adopt $10 per MTCO2(e) as a fixed incentive, applicable to all future SB 844 Programs as well?

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A. No. NW Natural believes that future projects could justify an upward or downward adjustment to the per ton incentive.

For instance, stakeholders may view a lesser incentive as appropriate where a project involves significant rate base investment, meaning that the utility would already have some incentive to invest because of its opportunity to earn its authorized rate of return on capital. On the other hand, a higher dollar-per-ton incentive may be appropriate for projects that may be desirable because of attributes other than the number of tons of carbon saved by the program. For example, if a program presents a high potential for market transformation, but has relatively low savings in and of itself, it may be determined that the Company should be incented to pursue such a project, justifying a higher per ton incentive. However, for the above reasons, NW Natural believes that $10 per MTCO2(e) represents a reasonable baseline amount, from which adjustments could be made.

Q. Have the stakeholders agreed with the $10 per MTCO2(e) incentive proposed by NW Natural?

A. Although we have discussed various incentive levels and structures with the stakeholders, we did not develop an agreed-upon incentive level for the CHP program, or SB 844 programs generally. We did, however, discuss the $10 per MTCO2(e) structure proposed in this application with the parties after iterations of other approaches and ideas, and NW Natural is hopeful that the proposal represents an approach that the stakeholders can support. In the end, the parties determined that the level of incentive may best be determined through the

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OPUC's process, where they can review NW Natural's proposal along with the Commission.

PROGRAM COSTS

Q. Please describe the costs of the Program.

A. All of the costs associated with the CHP Program are accounted for as O&M expenditures. Annual costs include the customer incentive of $30 per MTCO2(e), up to $4.5 million per site per year, NW Natural's $10 per MTCO2(e) incentive, annual M&V, project certification (one time per project), marketing, legal, WSU modeling and analysis, program development consulting. Appendix C to the Business Plan (*See NWN/101, Summers/52-55)* provides specific program year scenarios for the costs of the Program. As mentioned above, NW Natural witness Andrew Speer will discuss the rate impact and cost recovery for the Program.

Q. Based on the Program costs, what is the cost of carbon over the 15 year term of the Program?

A. The cost of carbon in NW Natural's base case is $42.59 with a range of $42.51 to $42.85 for its low and high cases. The narrow cost range between the cases is a function of the program design to largely tie costs to measured and verified reductions in MTCO2(e) emissions. The base case assumes a target of 240,000 MTCO2(e), whereas the low case assumes 150,000 MTCO2(e) and the high case targets 330,000 MTCO2(e).

STAKEHOLDER ENGAGEMENT PROCESS

Q. Please describe the Company's stakeholder engagement process for the Program.

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A. The Company hosted three stakeholder engagement workshops for all interested stakeholders. Copies of the meeting agendas and sign-in sheets are attached to the Business Plan as Appendix G (*See NWN/101, Summers/72-81)*. At the initial Stakeholder meeting, attendees were provided a draft version of the Business Plan (including exhibits) and an electronic copy of the *RELCOST* financial model developed by WSU. In subsequent meetings, attendees were provided copies of additional analysis requested by Stakeholders including: 1) Opinion letter from the Climate Action Reserve evaluating NW Natural's proposed M&V specifications, 2) WSU analysis of emissions including and excluding upstream emissions, 3) WSU analysis of various incentives structures to consider the impact on payback.

Q. Have there been any changes to the Business Plan since the Stakeholder process?

A. Yes, the most significant change to the Business Plan was to reset the ETO incentive to $0.08 per kWh. The draft business plan had included a proposed increase to the ETO incentive. Other changes of note included: 1) Minor changes to the M&V plan to include details identified in the Climate Action Reserve Opinion, 2) Stated program objectives in terms of carbon emissions and translated to MWs instead of the other way around, 3) WSU results were updated to correct emission reductions to state in metric tonnes versus tons, 4) Added NW Natural incentive of $10 per MTCO2(e) of measured and verified savings over the same 40 operating quarters.

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PROGRAM IMPLEMENTATION AND UPDATES TO THE COMMISSION

Q. If the Commission approves the CHP Program, does the Company have a plan to implement the Program?

A. Yes, Table 7 of the Business Plan (*See NWN/101, Summers/22)* details roles of the various entities that would be involved in administering (and participating in) the Program. Additionally, the CHP Solicitation explains the Participation Process, the Technical Assessment Requirements, and the M&V Plan for the Program. The Company expects to begin marketing the solicitation following Commission approval of the Program.

Q. Please explain how the Company will provide the Commission with progress updates during the life the project.

A. NW Natural proposes to file annual updates with the Commission during the life of the Program that detail the Company's annual costs associated with the Program and an M&V report demonstrating the annual total reduced emissions associated with the Program. Data to be summarized and the format of the M&V report to be agreed upon before the first annual report.

Q. Does this conclude your testimony?

A. Yes.

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BEFORE THE

PUBLIC UTILITY COMMISSION OF OREGON

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NW Natural

Exhibit 101 of Barbara Summers

Carbon Emission Reduction Program
Combined Heat & Power (CHP)
Business Plan

NW NATURAL

A CHP Solicitation Business Plan Complete Appendices

Carbon Solutions Project Proposal

Business Plan

NW Natural

6/19/2015

Table of Contents

Introduction

This business plan contains details regarding NW Natural's development of a Combined Heat & Power (CHP) Solicitation Program, for which the Company plans to seek approval by the Oregon Public Utility Commission as part of the utility's Carbon Solutions Program. This document serves the purpose of documenting the proposed program design and assumptions for NW Natural's internal purposes, but is also for use in assisting the stakeholders under the processes called for in ORS 757.539 in evaluating the proposal.

Combined Heat and Power Overview and Related Policy

CHP, also known as cogeneration, produces electricity and useful thermal energy in an integrated system. CHP systems can range in size from megawatts in industrial, institutional and large commercial applications, down to a few kilowatts in small commercial and even residential applications. Combining electricity and thermal energy generation into a single process can save up to 35 percent of the energy required to perform these tasks separately. The energy efficiency comes from the displacement of natural gas with what is otherwise "waste heat," but which is instead recovered from on-site electricity generation for use in space and water heat and industrial processes.

CHP efficiency benefits both the natural gas and electricity systems. CHP is a substitute for baseload electric generation and the waste heat is a substitute for natural gas and on-site combustion equipment otherwise needed to produce heat. In addition to the benefits of making productive use of waste heat from electricity generation beyond that which is possible with a Combined Cycle Gas Turbine (CCGT), there are other benefits that accrue to the electric system. These include avoidance of transmission and distribution losses (around 6-10% of generated electricity), and the potential to reduce generation redundancy.

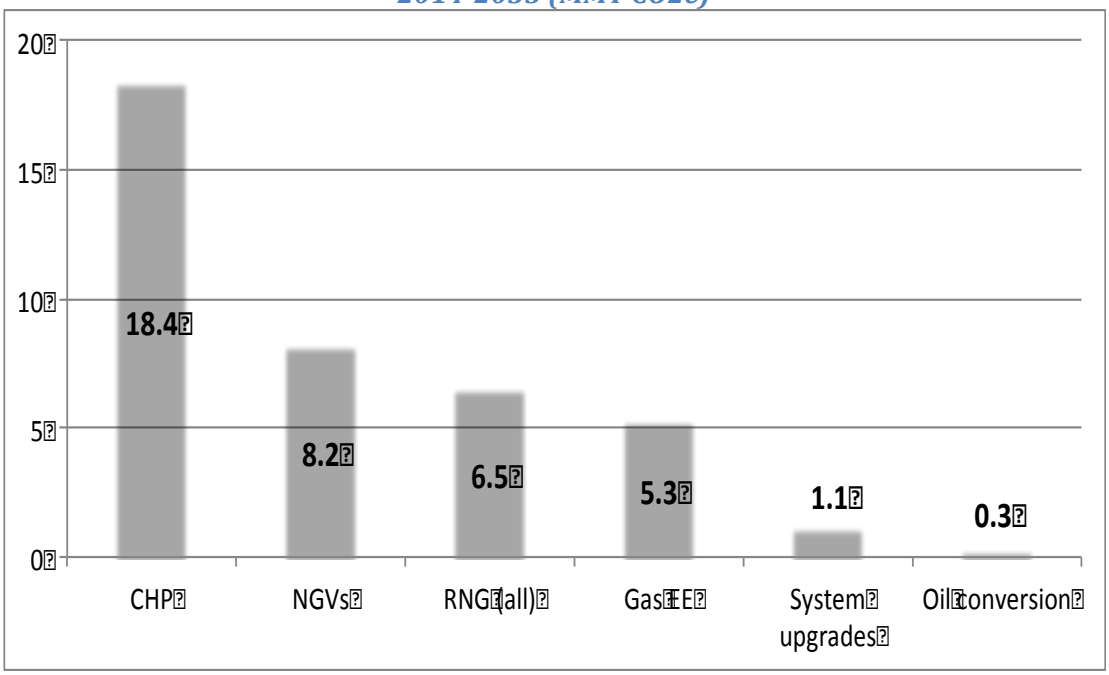
The benefits of CHP are widely recognized, and have been the focus of actions and policy making at both the state and federal level. For example, President Obama's August 30, 2012 order on "Accelerating Investment in Industrial Energy Efficiency" directed, among other things, "certain executive departments and agencies to convene national and regional stakeholders to identify, develop and encourage the adoption of investment models and State best practice policies for industrial energy efficiency and CHP; provide technical assistance to States and manufacturers to encourage investment in industrial energy efficiency and CHP; provide public information on the benefits of investment in industrial energy efficiency and CHP; and use existing Federal authorities, programs, and policies to support investment in industrial energy efficiency and CHP."[1] That order also set a national goal of deploying 40 gigawatts of new, cost effective industrial CHP in the United States by the end of 2020.

[1] *See* Executive Order on Accelerating Investment in Industrial Energy Efficiency, August 30, 2012, *available at* http://www.whitehouse.gov/the-press-office/2012/08/30/executive-order-accelerating-investment-industrial-energy-efficiency.

In 2013, Governor Kitzhaber requested that the USDOE include Oregon in the list of states partnering in support of Present Obama's Executive Order[2]. In addition, Governor Kitzhaber's 10-year Energy Plan similarly focuses on the benefits of distributed generation and Combined Heat and Power, noting that it "has huge potential to help the state meet its energy goals."[3]

NW Natural believes that CHP should be a major focus of GHG reduction efforts, and notes that CHP provides the greatest natural gas-related abatement potential (2013-2035), based on findings from the Oregon Department of Energy and Center for Climate Solutions, Energy Trust of Oregon (ETO) and The Climate Trust as well as company estimates [4].

Figure 1
Total Natural-Gas Related Abatement Potential
2014-2035 (MMT CO2e)



[2] Letter dated February 6, 2013, from Governor John A. Kitzhaber, M.D., to Katrina Pielli, US Department of Energy.
[3] *See* p. 27 of Governor Kitzhaber's 10-Year Energy Action Plan, *available at* http://www.oregon.gov/energy/Ten_Year/Ten_Year_Energy_Action_Plan_Final.pdf
[4] Center for Climate Strategies (2012). *10-Year Energy Action Plan Modeling: Greenhouse Gas Marginal Abatement Cost Curve Development and Macroeconomic Foundational Modeling for Oregon*. Oregon Department of Energy, July 30, 2012. Accessed February 17, 2014 at http://www.oregon.gov/energy/GBLWRM/docs/Energy_Plan_GhG_MACC_Foundational_Modeling_Final_Report.pdf.

Weisberg, Peter, and Thad Roth (2011). *Growing Oregon's Biogas Industry: A Review of Oregon's Biogas Potential and Benefits*. The Climate Trust and The Energy Trust of Oregon. Accessed February 17, 2014 at http://www.oregon.gov/energy/RENEW/Biomass/docs/GrowingORBiogasIndustryWhitePaper.pdf.

CHP Solicitation Program Summary

The CHP Solicitation Program is a voluntary carbon emission reduction program proposed under ORS 757.539, which grants the Oregon Public Utility Commission the authority to allow a natural gas utility to recover costs associated with implementing a program or measures that reduce greenhouse gas (GHG) emissions through the provision of natural gas. Commission rules OAR 860-085-0500 through 860-085-0750 put forth further requirements for voluntary carbon reduction programs, including the requirements for submitting an application to the Public Utility Commission of Oregon for approval of a program.

The CHP Solicitation Program proposal was developed through a cooperative effort between NW Natural, the Oregon Department of Energy (ODOE), the Washington State University (WSU), Northwest CHP Technical Assistance Partnership (TAP) with United States Department of Energy (USDOE), and was designed to leverage the services and capabilities of the Energy Trust of Oregon (ETO). The proposal seeks to marshal the combined resources of these parties by offering customers that are potential developers of CHP plants, a package of incentives and services necessary to cause the development of CHP that would otherwise not happen.

NW Natural, through its CHP Program, is targeting to reduce greenhouse gas emissions by 240,000 MTCO2(e) per year in the State of Oregon by the end of 2020. This goal translates to 80 MWs of CHP at an average of 3,000 MTCO2(e) per MW assuming systems operate 95% of the time and utilize 100% of the reclaimable waste heat and about 120 MWs assuming an average of 2,000 MTCO2(e) per MW. Minimum program eligibility requires CHP to be at least 10% more efficient than a combined cycle gas turbine (CCGT). CHP systems, however, can exceed the efficiency of a utility-scale CCGT by about 35%. So, systems that recover less of the waste heat may still be eligible but would result in less carbon savings. Target greenhouse gas emissions and the resulting program budget assumes CHP, on average, achieves 2,000 MTCO2(e) per MW of reduced emissions (66%) to account for this variability, a level that still exceeds minimum program eligibility efficiency.

As described more fully below, NW Natural's proposed CHP Program leverages funding and services from a number of sources. This includes ODOE's Energy Incentives Program (EIP) funds and the ETO's incentive for CHP and the Federal Business Investment Tax Credits (ITCs). NW Natural proposes to offer customers an incentive payment of a fixed dollar-per-ton of verified $MTCO_2$(e) reduced. The amount of the payment from NW Natural is calculated to provide customers a payment opportunity that, when combined with the available funds from ODOE and the ETO and Federal tax credits, gives them a chance to realize a payback from their CHP investment that makes the economics attractive enough to invest.

Although not a common requirement, the program also involves the option for NW Natural to install compression, if necessary, to support CHP under standard terms and

conditions similar to NW Natural's Schedule H.[5] This removes an additional barrier that CHP currently faces.

At a high level, the key aspects of NW Natural's proposed program include:

- A solicitation available to all customers to install CHP facilities (recognizing, however, that current residential technologies do not meet eligibility criteria);
- Eligibility criteria that requires CHP to be 10% more efficient than a CCGT;
- Incentives to CHP customers paid quarterly, for the first 40 operating quarters, based on verified MTCO2(e) of carbon reduced;
- CHP capital investment borne by the customer installing the CHP unit;
- At customer's option, NW Natural to provide gas service at higher pressures to support CHP, if required, under standard terms and conditions similar to Schedule H;
- Upgrades or extensions to distribution system handled consistent with established policy (Schedule X and G-5.5);
- Minor program upfront costs with majority of the program costs realized only as program uptake increases, thereby limiting the risk of stranded costs;
- CHP program and incentive costs treated as O&M expenses for rate making purposes since capital costs are paid for by CHP customers;
- Project certification and Measurement and Verification handled by an independent third party contractor (Energy 350).

From the customer's perspective, developing a successful CHP project in Oregon will involve:

- Common eligibility criteria for receiving the available funds from ODOE, ETOTO, and NW Natural;
- Common measurement and verification requirements;
- The potential for stacked incentives, with ETO basing its incentive on energy efficiency, ODOE basing its incentive on capital investment, and NW Natural basing its incentive on measured and verified carbon savings;
- Gas service at pressures that will support installation of CHP under standard terms and conditions similar to Schedule H;
- A means to rely on the ETO to provide a Preliminary Assessment and Technical Assessment of proposed projects eligible for ETO incentives; and through ODOE and NW Natural through the USDOE Technical Assistance Partnership with WSU for projects not eligible for ETO incentives.

[5] Schedule H provides for the installation of compression equipment under an arrangement that requires the customer to pay for the installation over time.

Market Potential of CHP

The ODOE engaged ICF International to assess the technical and economic potential of CHP in the state of Oregon. ICF identified 1,457 MW of existing CHP technical potential and 319 MWs of economic potential (*i.e.* payback of less than 10 years). See Appendix E, ICF International, Assessment of the Technical and Economic Potential for CHP in Oregon, Final Report, July 2014.

Currently, there are only 24 MWs of existing non-biomass CHP in the State of Oregon, represented by only two installations:

Oregon State University	9 MW
University of Oregon	15 MW

NW Natural confirmed the reasonableness of ICF International's assessment by estimating CHP potential based on the thermal loads of customers that are typically the best CHP applications. The best CHP applications are those where electrical and thermal loads coincide. Examples of such applications include industrial processes that need heat and electricity during the same time period (particularly those with 24/7 operation), and commercial applications such as hotels, hospitals, nursing homes, schools, colleges, laundries, health facilities, and multi-unit apartments. Round-the-clock thermal and electrical loads are of key importance in allowing a return on the CHP capital investment within an acceptable amount of time. NW Natural estimated CHP capacity is summarized in Table 2, below.

Table 2

Potential CHP Candidates

CHP System Size	Customers	Estimated MWs	Average Cost per kW (000)
< 1 MW	243	51	$2.0
1 - 5 MW	58	92	$1.8
>5 – 20 MW	7	87	$1.3
>20 MW	4	155	$0.8
Total	312	385	

Solicitation Program Design

NW Natural proposes to solicit CHP projects as described in detail in Appendix A, Combined Heat and Power (CHP) Solicitation. Under the program, NW Natural will pay customers an incentive to install and operate a CHP facility, based on the carbon emissions savings achieved as a result of the installation. All NW Natural customers will be eligible to propose projects at locations within NW Natural's franchised service territory within the State of Oregon; however, incentives will only be paid on measured and verified carbon savings. NW Natural will release

its initial solicitation upon approval by the OPUC and will coordinate, if possible, with ODOE's announcements of available EIP funds for CHP in 2015. (ODOE funds are allocated on a biennial basis, with the next biennium beginning July 1, 2015.) NW Natural's program will remain open after the initial solicitation until terminated by the Company.

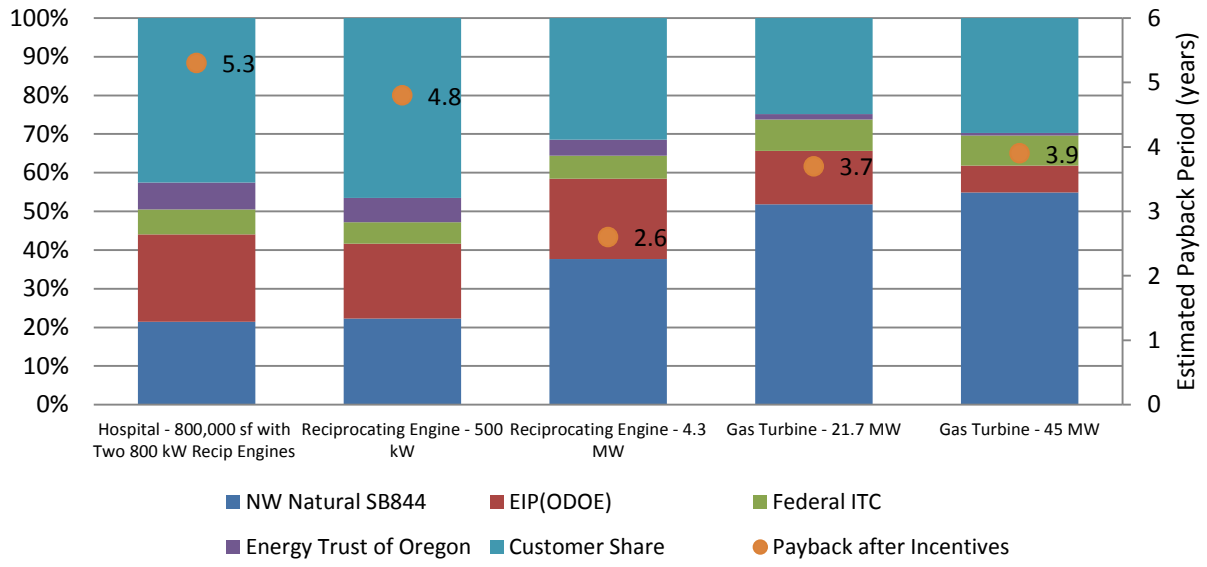
NW Natural's proposed incentive level was modeled assuming full utilization of incentives from ODOE, the ETO and Federal ITCs. NW Natural incentive levels described in Appendix A, Combined Heat and Power (CHP) Solicitation, Section III, Incentives, were set assuming other incentives were available and fully applied ahead of NW Natural incentives.

Figures 2 & 3 below depict the stacking of incentive payments that would be available to customers installing CHP facilities, and the estimated payback of their investment. Further below, Table 3 provides more information regarding each payment stream available to customers.

Figure 2

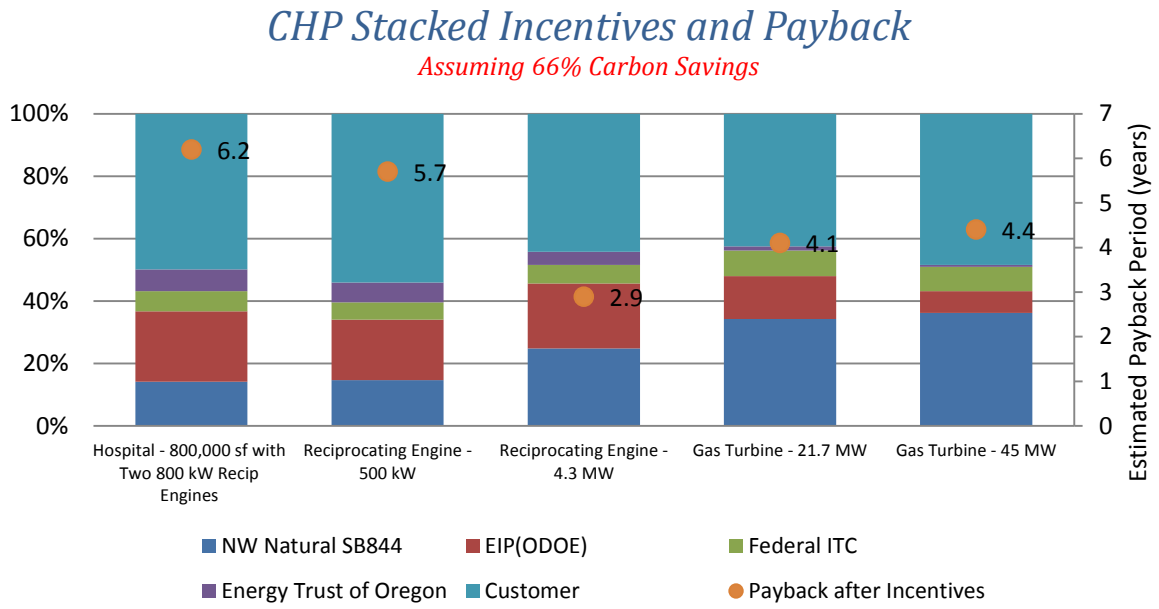
CHP Stacked Incentives and Payback

Assuming 100% Carbon Savings



CHP Stacked Incentives and Payback- Assuming 100% Carbon Savings						
	SB844	***EIP***	***ITC***	***ETO***	***Customer***	***Payback***
Hospital - 800,000 sf with Two 800 kW Recip Engines	21%	23%	6%	7%	43%	5.3
Reciprocating Engine - 500 kW	22%	19%	6%	6%	47%	4.8
Reciprocating Engine - 4.3 MW	38%	21%	6%	4%	31%	2.6
Gas Turbine - 21.7 MW	52%	14%	8%	1%	25%	3.7
Gas Turbine - 45 MW	55%	7%	8%	1%	30%	3.9

Figure 3



CHP Stacked Incentives and Payback- Assuming 66% Carbon Savings

	SB844	***EIP***	***ITC***	***ETO***	***Customer***	***Payback***
Hospital - 800,000 sf with Two 800 kW Recip Engines	14%	23%	6%	7%	50%	6.2
Reciprocating Engine - 500 kW	15%	19%	6%	6%	54%	5.7
Reciprocating Engine - 4.3 MW	25%	21%	6%	4%	44%	2.9
Gas Turbine - 21.7 MW	34%	14%	8%	1%	42%	4.1
Gas Turbine - 45 MW	36%	7%	8%	1%	48%	4.4

In order to qualify for NW Natural's program, projects must meet the requirements described in Appendix A, Combined Heat and Power (CHP) Solicitation.

In addition to the incentives, *at the customer's option*, NW Natural proposes to install compression, if required, under standard terms and conditions similar to Schedule H, as necessary, to enable the installation of CHP at participating customers' sites.

NW Natural considered an alternative program design, under which the company would issue a request for proposals and allow individual customers to then propose CHP projects and the necessary incentives that they would need in order to commit to the projects. This approach was considered to determine if it would yield higher installations of CHP or a carbon reduction at a lower cost. NW Natural has determined that this approach would likely not be as effective as its proposed program design for several reasons.

First, NW Natural understands that developing CHP projects is a long and complicated process, and believes that customers require a high level of certainty in the incentive that would be provided in order to assess the merits, and pros and cons of installing CHP at their facilities. Having a fixed incentive allows customers to quickly and easily envision the economics of a CHP installation. This allows them to make informed decisions about whether they will invest the time and resources required to assess the viability of a project and move forward with what can be a long and difficult process. In contrast, a bidding process approach would leave the customer with uncertainty as to whether their project would be selected and the incentive that could be available. As a result, customers may not include the availability of an incentive in their decision-making process, or may not invest the time and effort to determine the feasibility of a CHP installation.

Second, the timing aspects of a competitive bidding process could be problematic. With a competitive bidding process, NW Natural would have to time the receipt of all proposals at the same time so that they could be ranked and prioritized. This timing requirement would tend to push the program to an annual cycle. This could stifle the development of projects by introducing a separate timing process that may not match individual customers' budgeting and planning cycles, and could cause projects to be needlessly delayed to match up with an annual cycle. By contrast, the standard fixed offer that NW Natural proposes would remain available at all times of the year, and is available whenever an individual customer determines to move forward.

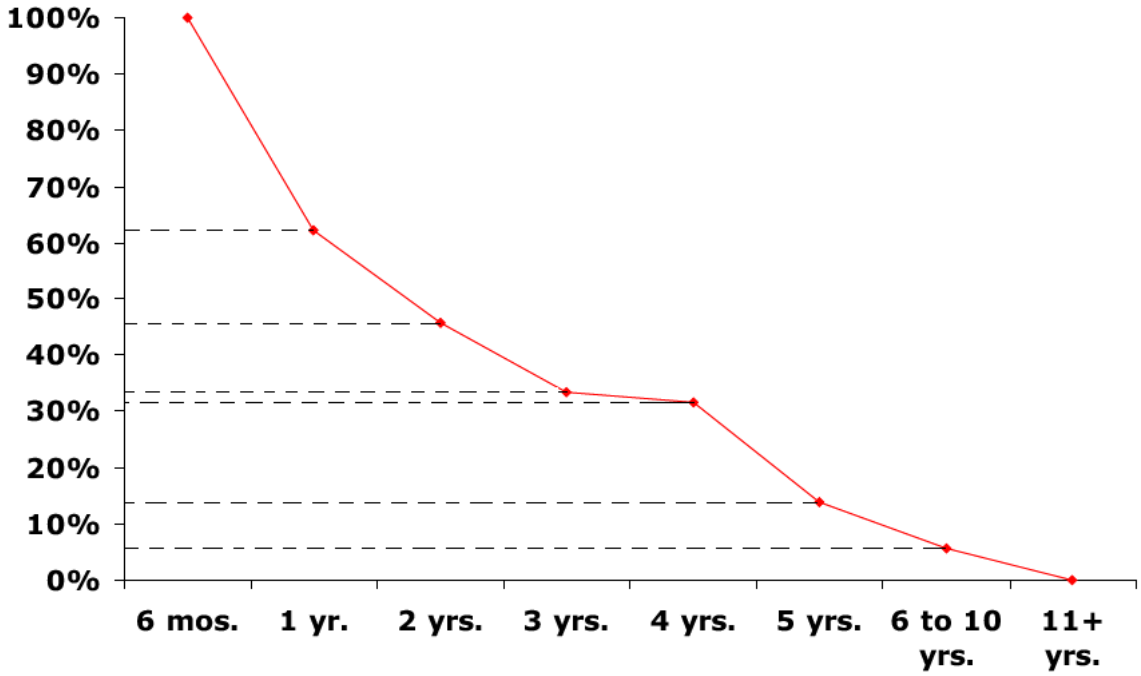
Finally, NW Natural is concerned that a competitive bidding process may not work well for CHP given the lack of robust historic development. It may be that there is limited demand during any bidding process period, which may lead to a situation where costs of delivering the program are unnecessarily high. For example, if bidders were to expect that there would be very little competition during a bidding process, they would have little reason to narrow their proposal to only the necessary payback, and may instead seek to maximize any payments available under the program.

CHP Baseline

Figure 4 below represents the expected adoption rate of CHP referenced in the ICF report, given various time periods of payback. As can be seen below, in order to significantly affect the adoption of CHP, customer payback periods must be quite short.

Figure 4

Customer Adoption Payback Curve

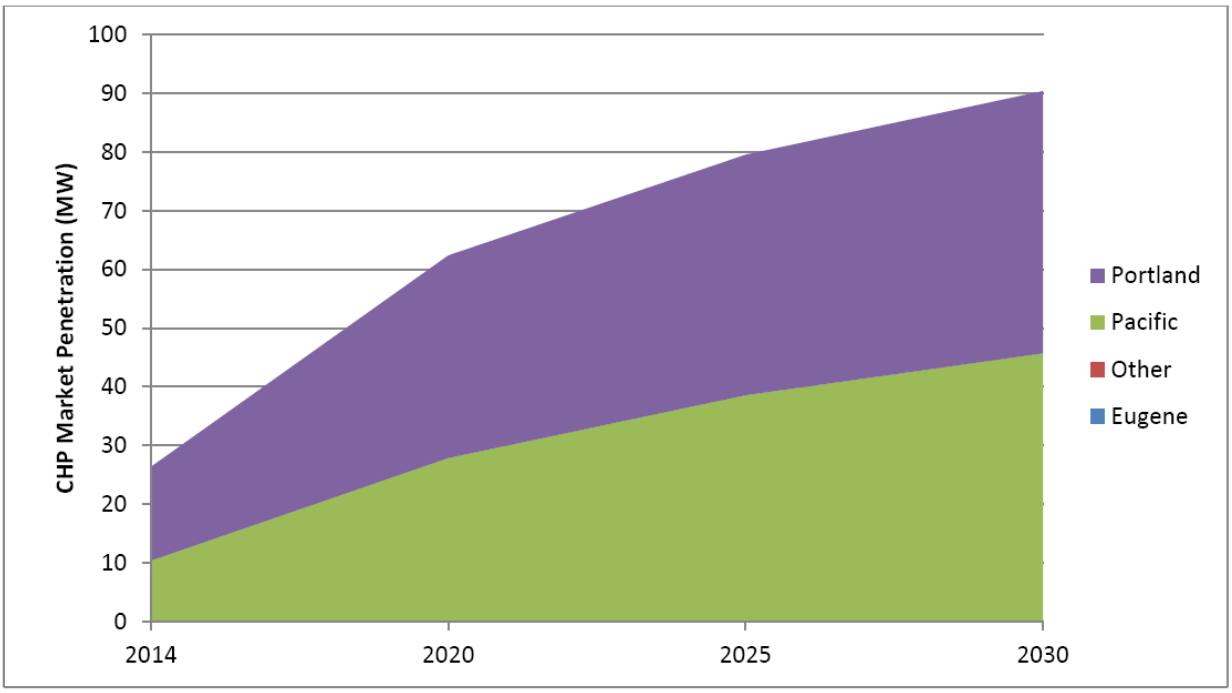


Source: *Primen's 2003 Distributed Energy Market Survey*

ICF arrived at its estimate of CHP market penetration, by multiplying the technical potential, including forecast growth, for each market segment by the share of customers that would accept the calculated economic payback. Based on this approach ICF estimated the market penetration illustrated in figure 5:

Figure 5

ICF Forecast Market Penetration



While the ICF forecast is informative, there is no market evidence to support a CHP baseline above zero. The only operating CHP systems are the two university systems. Forecast CHP to date has not materialized. Neither of the operating systems would have been included in forecast economic potential (less than 10 years). ODOE, ETO and NW Natural are in agreement in setting the baseline for CHP without SB844 incentives at zero.

Customer CHP Incentive Level

Under NW Natural's program, CHP customers will receive $30 per verified $MTCO_2(e)$ reduced based on measured and verified performance. CHP customers are eligible to receive quarterly incentive payments for up to 40 operating quarters based on measured and verified carbon savings. Each CHP customer site will be capped at $4.5 million of incentive payments per year.

NW Natural's incentive level is based on the results of a financial model (RELCOST) included in Appendix D, developed by USDOE, TAP at WSU, and adapted for NW Natural's program to evaluate project economics considering all incentives for which a qualifying project would be eligible (ETO, ODOE EIP and Federal ITC). The NW Natural incentive was calculated assuming the other incentives were applied in advance of NW Natural's program incentives.

NW Natural relied on the adapted WSU RELCOST model to evaluate payback periods of a range of different prototypes of CHP. NW Natural's proposed incentive of $30 per $MTCO_2(e)$ of measured and verified carbon savings was set based on ideal operating conditions, i.e., 8,322 operating hours (95% capacity factor) and 100% utilization of recoverable waste heat.

Since incentives are paid for measured and verified carbon savings, CHP installations that are operated less than 8,322 hours or that utilize less than 100% of the recoverable waste heat would still receive an incentive of $30 per $MTCO_2(e)$ for the *actual* measured and verified carbon reduced but would receive an overall lower total amount due to the lower $MTCO_2(e)$ savings. The intent was to incent customers to operate CHP systems to achieve maximum carbon savings.

While customers will be paid for actual measured and verified carbon savings of any level, in order to be approved initially, CHP systems must meet the eligibility criteria in the Solicitation. That criterion requires a CHP system to be 10% more efficient than a utility-scale CCGT. A CHP system that operates 8,322 hours per year and utilizes 100% of the recoverable waste heat is estimated to exceed the efficiency of utility-scale CCGT by about 35%.

CHP systems that operate fewer hours or utilize less of the recoverable waste heat may still be eligible if they exceed the efficiency of a utility-scale CCGT by 10%.

While the incentive level of $30 per $MTCO_2(e)$ was set assuming CHP systems operated 95% of the time and utilized 100% of the recoverable waste heat, the carbon reduction targets and resulting program budget were set assuming two-thirds of that potential to account for the variability in operations. As described above, CHP systems that operate at optimum efficiency can exceed the efficiency of a utility-scale CCGT by about 35%, however, the program eligibility criteria only requires that it exceed the efficiency by 10%. So, systems that recover less of the waste heat may still be eligible but would result in less carbon savings.

Incentives were set to achieve, on average, about a 3-4 year payback. A 3-4 year payback was targeted to achieve about a 30% - 40% penetration based on the ICF Report and Primen's Customer Adoption Payback Curve. Further, incentives were set using the paybacks assuming ODOE EIP and ETO incentives and Federal ITCs were applied ahead of NW Natural's incentive. Incentives per site are capped at $4.5 Million. Although the cap does have the effect of reducing the incentive for larger installations, the main reason to set the cap was to limit liability in the event actual carbon savings exceed modeled results; not as a factor to reduce the incentive per $MTCO_2(e)$.

Table 3 describes the prototype projects that were modeled. Table 4,shows the incentive levels to achieve various paybacks assuming 100% and 66% of forecast carbon savings.

Table 3
WSU Prototype Projects Summary
Baseline Carbon Savings
(Excludes Upstream Emissions)

Project Information								
Description	**Size (MW)**	**Installed Cost**	**Annual O&M**	**100% Carbon Savings**	**66% Carbon Savings**	**EIP Funding at Maximum**	**Current ETO Grant ($.08)**	**Proposed ETO Grant ($.25)**
Hospital - 800,000 sf with Two 800 kW Recip Engines	1.6	$2,932,545	$161,122	3,249	2,144	$1,026,391	$317,834	$500,000
Reciprocating Engine - 500 kW	0.5	$966,154	$78,034	1,297	856	$338,154	$110,183	$344,323
Reciprocating Engine - 4.3 MW	4.3	$7,121,321	$486,671	15,051	9,934	$2,492,462	$500,000	$500,000
Gas Turbine - 21.7 MW	21.7	$29,451,304	$679,009	62,652	41,350	$5,000,000	$500,000	$500,000
Gas Turbine - 45 MW	45.0	$56,160,000	$1,608,082	132,175	87,235	$5,000,000	$500,000	$500,000

Table 4
WSU Incentive Level Analysis

Prototype Facility	Case	NWN CO2e Reduction Incentive ($/tonne/yr)	MTCO2(e) Reduction (Without Upstream)	ETO Rate	ETO Incentive	Before-Tax Simple Payback	After-Tax Discounted Payback
Hospital - 800,000 sf with two 800 kW Reciprocating Engines	N/A	$0	3,249	$0.08	317,834	8.9	Exceeds Project Life
	100%	$30	3,249		317,834	5.3	9.0
	100%	$40	3,249		317,834	4.7	7.1
	100%	$50	3,249		317,834	4.2	5.9
	100%	$60	3,249		317,834	3.8	5.2
	100%	$70	3,249		317,834	3.5	4.7
	100%	$80	3,249		317,834	3.2	4.4
	66%	$30	2,144		317,834	6.2	13.6
	66%	$40	2,144		317,834	5.6	9.9
	66%	$50	2,144		317,834	5.1	8.3
	66%	$60	2,144		317,834	4.7	7.2
	66%	$70	2,144		317,834	4.4	6.3
	66%	$80	2,144		317,834	4.1	5.7
	N/A	$0	3,249	$0.25	500,000	7.6	Exceeds Project Life
	100%	$30	3,249		500,000	4.6	7.3
	100%	$40	3,249		500,000	4.0	5.9
	100%	$50	3,249		500,000	3.6	5.1
	100%	$60	3,249		500,000	3.3	4.6
	100%	$70	3,249		500,000	3.0	4.3
	100%	$80	3,249		500,000	2.7	4.0
	66%	$30	2,144		500,000	5.3	9.7
	66%	$40	2,144		500,000	4.8	8.0
	66%	$50	2,144		500,000	4.4	6.8
	66%	$60	2,144		500,000	4.1	5.9
	66%	$70	2,144		500,000	3.8	5.4
	66%	$80	2,144		500,000	3.5	4.9
Reciprocating Engine - 500 kW	N/A	$0	1,297	$0.08	110,183	8.7	Exceeds Project Life
	100%	$30	1,297		110,183	4.8	7.5
	100%	$40	1,297		110,183	4.2	5.9
	100%	$50	1,297		110,183	3.7	5.0
	100%	$60	1,297		110,183	3.3	4.6
	100%	$70	1,297		110,183	3.0	4.2
	100%	$80	1,297		110,183	2.8	3.9
	66%	$30	856		110,183	5.7	10.5
	66%	$40	856		110,183	5.1	8.3
	66%	$50	856		110,183	4.6	6.9
	66%	$60	856		110,183	4.2	6.0
	66%	$70	856		110,183	3.9	5.3
	66%	$80	856		110,183	3.6	4.9
	N/A	$0	1,297	$0.25	344,323	3.9	8.4
	100%	$30	1,297		344,323	2.1	4.0
	100%	$40	1,297		344,323	1.9	3.8
	100%	$50	1,297		344,323	1.6	3.5
	100%	$60	1,297		344,323	1.5	3.3
	100%	$70	1,297		344,323	1.3	3.1
	100%	$80	1,297		344,323	1.2	3.0
	66%	$30	856		344,323	2.5	4.6
	66%	$40	856		344,323	2.2	4.2
	66%	$50	856		344,323	2.0	3.9

	66%	$60	856		344,323	1.9	3.8
	66%	$70	856		344,323	1.7	3.6
	66%	$80	856		344,323	1.6	3.5
Reciprocating Engine - 4.3 MW	N/A	$0	15,051	$0.08	500,000	3.9	7.1
	100%	$30	15,051		500,000	2.6	3.9
	100%	$40	15,051		500,000	2.3	3.6
	100%	$50	15,051		500,000	2.1	3.2
	100%	$60	15,051		500,000	1.9	3.0
	100%	$70	15,051		500,000	1.8	2.7
	100%	$80	15,051		500,000	1.6	2.6
	66%	$30	9,934		500,000	2.9	4.5
	66%	$40	9,934		500,000	2.7	4.1
	66%	$50	9,934		500,000	2.5	3.8
	66%	$60	9,934		500,000	2.3	3.6
	66%	$70	9,934		500,000	2.2	3.4
	66%	$80	9,934		500,000	2.1	3.2
	N/A	$0	15,051	$0.25	500,000	3.9	7.1
	100%	$30	15,051		500,000	2.6	3.9
	100%	$40	15,051		500,000	2.3	3.6
	100%	$50	15,051		500,000	2.1	3.2
	100%	$60	15,051		500,000	1.9	3.0
	100%	$70	15,051		500,000	1.8	2.7
	100%	$80	15,051		500,000	1.6	2.6
	66%	$30	9,934		500,000	2.9	4.5
	66%	$40	9,934		500,000	2.7	4.1
	66%	$50	9,934		500,000	2.5	3.8
	66%	$60	9,934		500,000	2.3	3.6
	66%	$70	9,934		500,000	2.2	3.4
	66%	$80	9,934		500,000	2.1	3.2
Gas Turbine 21.7 MW	N/A	$0	62,652	$0.08	500,000	5.4	10.9
	100%	$30	62,652		500,000	3.7	5.2
	100%	$40	62,652		500,000	3.3	4.5
	100%	$50	62,652		500,000	3.0	3.9
	100%	$60	62,652		500,000	2.8	3.5
	100%	$70	62,652		500,000	2.6	3.2
	100%	$80	62,652		500,000	2.4	2.9
	66%	$30	41,350		500,000	4.1	6.3
	66%	$40	41,350		500,000	3.8	5.5
	66%	$50	41,350		500,000	3.6	4.9
	66%	$60	41,350		500,000	3.3	4.5
	66%	$70	41,350		500,000	3.2	4.1
	66%	$80	41,350		500,000	3.0	3.8
	N/A	$0	62,652	$0.25	500,000	5.4	10.9
	100%	$30	62,652		500,000	3.7	5.2
	100%	$40	62,652		500,000	3.3	4.5
	100%	$50	62,652		500,000	3.0	3.9
	100%	$60	62,652		500,000	2.8	3.5
	100%	$70	62,652		500,000	2.6	3.2
	100%	$80	62,652		500,000	2.4	2.9
	66%	$30	41,350		500,000	4.1	6.3
	66%	$40	41,350		500,000	3.8	5.5
	66%	$50	41,350		500,000	3.6	4.9
	66%	$60	41,350		500,000	3.3	4.5
	66%	$70	41,350		500,000	3.2	4.1
	66%	$80	41,350		500,000	3.0	3.8
Gas Turbine - 45 MW	N/A	$0	132,175	$0.08	500,000	5.8	12.6
	100%	$30	132,175		500,000	3.9	5.7
	100%	$40	132,175		500,000	3.6	4.9
	100%	$50	132,175		500,000	3.3	4.3

	100%	$60	132,175		500,000	3.0	3.8
	100%	$70	132,175		500,000	2.8	3.4
	100%	$80	132,175		500,000	2.6	3.1
	66%	$30	87,235		500,000	4.4	7.0
	66%	$40	87,235		500,000	4.1	6.1
	66%	$50	87,235		500,000	3.8	5.4
	66%	$60	87,235		500,000	3.6	4.9
	66%	$70	87,235		500,000	3.4	4.5
	66%	$80	87,235		500,000	3.2	4.1
	N/A	$0	132,175		500,000	5.8	12.6
	100%	$30	132,175		500,000	3.9	5.7
	100%	$40	132,175		500,000	3.6	4.9
	100%	$50	132,175		500,000	3.3	4.3
	100%	$60	132,175		500,000	3.0	3.8
	100%	$70	132,175		500,000	2.8	3.4
	100%	$80	132,175	$0.25	500,000	2.6	3.1
	66%	$30	87,235		500,000	4.4	7.0
	66%	$40	87,235		500,000	4.1	6.1
	66%	$50	87,235		500,000	3.8	5.4
	66%	$60	87,235		500,000	3.6	4.9
	66%	$70	87,235		500,000	3.4	4.5
	66%	$80	87,235		500,000	3.2	4.1

Table 5
NW Natural Proposed Customer Incentives

Application	Incentive per $MTCO_2(e)$ of Measured and Verified Carbon Savings	Annual Cap
All Units	$30	$4.5 Million

Note: Multiple units installed at the same customer's site will be viewed as a single unit in determining application of the annual cap.

NW Natural Incentives Under SB 844

NW Natural proposes to receive a $10.00 per MTCO2MTCO2(e) incentive associated with this program based on measured and verified $MTCO_2(e)$ savings.

Implementation Plan

NW Natural, ODOE, ETO and the US DOE TAP with WSU worked together to develop a coordinated approach to deliver the services related to administering the program and a consistent eligibility, evaluation and measurement and verification methodology. Under the integrated proposal, applicants will be encouraged to leverage all available funding sources. The services were defined in a way to leverage the strengths of each organization, create common requirements and simplify the process for customers.

Table 6 below shows a summary of each of the three integrated payments that will be available to customers developing CHP under the proposed program.

Table 6

Program Summaries

	Energy Trust of Oregon	Oregon Department of Energy	NW Natural
Efficiency Requirement	10% more efficient than CCGT Heat Rate	10% more efficient than CCGT Heat Rate	10% more efficient than CCGT Heat Rate
Basis for Incentive	Energy Efficiency	Capital Investment	Carbon Reduction
Incentive	$0.08 per annual kilowatt hour up to 50 percent of eligible project cost up to $500K (proposed to increase to $0.25 per annual kilowatt hour with same limitations).	35% of project cost over 5 years (28.5% NPV). Limited budget. (WSU modeled $5 Million maximum per project.)	$ 30/MTCO2MTCO2(e) CO2 up to $4.5 Million per year
M&V Requirement	Common reporting to the ETO and NW Natural. Short term M&V at time of project completion.	Not Required	Common reporting to the ETO and NW Natural. M&V basis for payment of carbon incentives up to 40 operating quarters.

As described above, the services provided to customers under the program were designed to leverage the strengths and capabilities of each administering entity. Table 7 below shows the various entities and describes the general activities that each would undertake.

Table 7

NWN, ETO, ODOE, USDOE and WSU Coordinated Incentives and Services

Entity	Services Provided / Actions Taken
Customer	• Requests CHP Preliminary Scoping through ETO if customer of PGE or Pacific Power or through NWN or ODOE if outside IOU service territories. • Requests CHP Technical Assessment through ETO if customer of PGE or Pacific Power or through NWN or ODOE if outside IOU service territories. • Completes investment grade analysis or requests CHP Investment Grade Analysis through ETO if customer of PGE or Pacific Power or through NWN or ODOE if outside IOU service territories. • Identifies service requirements under NW Natural line/main extension policies, and required compression. • Applies for ETO, ODOE and NW Natural incentives if project meets eligibility criteria in Appendix A, Combined Heat and Power (CHP) Solicitation. • Acknowledges project certification and acceptance of incentives. • Capitalizes and installs CHP within 24 months of project certification. • Complies with measurement and verification requirements described in Appendix A, Combined Heat and Power (CHP) Solicitation.
NW Natural	• Develops program marketing materials in cooperation with ODOE. • Proactively markets the program to target customers. • Solicits initial CHP proposals. After initial solicitation, NW Natural's offer will remain open. See Marketing Strategy Section, above and Appendix A, Combined Heat and Power (CHP) Solicitation. • Provides expert technical assistance on distribution system requirements. • Measures and verifies carbon savings through independent third party contractor as described below and in Appendix A, CHP Solicitation and provides an annual summary to the ETO and OPUC. • Coordinates efforts with the ODOE and the ETO, including certification of project eligibility. • Pays incentives for measured and verified carbon savings for the first 40 quarters of operation at rates described in Appendix A, Combined Heat and Power (CHP) Solicitation. • At customer's option, provides natural gas service at higher pressures, if required to support CHP, under standard terms and conditions similar to Schedule H. • Upgrades or extends distribution system consistent with established policy (Schedule X and G-5.5 Profitability Analysis for Customer Acquisition). • For customers not eligible for ETO services, provides or coordinates

	applicable services otherwise provided by the ETO.

Energy Trust of Oregon – (for customers served by Portland General Electric or Pacific Power)	• Provides expert technical assistance through ETO Contractor(s) to include:
	  • CHP Preliminary Scoping.
	  • CHP Technical Assessment.
	These studies are valued at $3,000 - $20,000 and are made available from Energy Trust at no cost to customers (self-direct customers pay 50% of cost).
	• Provides technical assistance to develop project specifications, evaluates contractor bids and verifies the project at completion.
	• Provides cash incentives for custom capital projects that are based on annual energy savings, at a rate of $008 per annual kilowatt hour, up to 50 percent of eligible project cost (proposed to increase to $0.25 per annual kilowatt hour with same limitations).
	• Coordinates efforts with the Department of Energy and NW Natural.
	• Measures and verifies energy and carbon savings in cooperation with NW Natural.

Oregon Department of Energy	• Reviews projects and awards Tax Credits for qualified CHP/Co-Gen energy projects not to exceed 35 percent of certified cost[6]. ODOE announces total tax credits available for each biennium. The current total available is $1.5 million, ending June 30, 2015.
WSU (US Department of Energy, Northwest CHP Technical Assistance Partnership)	• Provides CHP Qualification Screening for customers considering an investment in CHP. The analysis is a first cut screening for CHP economic viability at a particular site. It is a high level screen based on minimal site information (e.g., average electric demand, average thermal demand, and average utility rates). The operating cost of a CHP system at a customer's site—including fuel, maintenance, and credit for displaced thermal energy—is estimated assuming performance characteristics of a typical CHP system and prevailing fuel price assumptions for the customer's site location. Qualitative information is also factored in to determine if the site is a potential candidate for CHP. • Provides CHP Feasibility Assessment if the CHP Qualification Screen suggests a more detailed analysis should be pursued to further investigate the technical and economic viability. Under the partnership with the DOE the Technical Assistance Partnership through Washington State University will conduct a "feasibility assessment" which would further explore the customer's facility's energy usage and needs, including overall facility planning and/or goals. The feasibility assessment refines the economics and is based on actual energy usage for the previous 12 to 24 months, information on daily and seasonal electric and thermal load profiles, and insights into site-specific interests such as expansion plans or power reliability concerns or other factors that may impact CHP system selection or sizing. The results of the assessment will provide the customer with a

[6] The tax credit is claimed over five years, with 10 percent of the certified cost claimed in each of the first two years and 5 percent claimed in each of the succeeding three years. Alternatively, customers can place the credit with a pass through partner and receive the NPV at 28% of project costs. If the certified cost of the project does not exceed $20,000, the entire tax credit may be claimed in the first year.

	more refined sense of how compelling the estimated economic and operational benefits of CHP might be to inform a decision as to whether to take the next step which could include the expenditure of funds for an investment grade analysis.
Tax benefits available under federal law	• IRS Form 3468 sets forth Federal Business Investment Tax Credits (ITCs). The credit is equal to 10% of expenditures, with no maximum limit stated. Eligible CHP property generally includes systems up to 50 MWs that exceed 60% energy efficiency, subject to certain limitations and reductions for large systems. The efficiency requirement does not apply to CHP systems that use biomass for at least 90% of the system's energy source, but the credit may be reduced for less-efficient systems. • Accelerated depreciation (5 year life)

Measurement and Verification Plan

The Company's proposed M&V Plan is set forth in Section VI of the CHP Solicitation. As monitoring and verification is directly linked to payment of incentives, NW Natural contracted with an independent third party, Energy 350, to develop its M&V Plan. (Energy 350 was selected as it is the firm under contract to the ETO to support its CHP program. Energy 350's experience and expertise is summarized in Appendix H of the Business Plan.) Key aspects of NW Natural's proposed M&V Plan include:

1. Measurement and verification will be conducted by an independent third party (Energy 350).
2. Results will be provided to NW Natural on a quarterly basis.
3. Results will be summarized and provided to the ETO and OPUC annually in a format to be agreed upon by the first annual report.
4. Customers propose M&V plan specific to their system that complies with Solicitation.
5. Customer proposed plan must be approved by independent third party (Energy 350) and NW Natural.
6. Independent third party conducts ongoing site inspections consistent with best practices for M&V. The independent third party (Energy 350) will conduct on-site inspection of M&V meter equipment and reporting system processes to ensure performance data is being captured and reporting correctly. All projects will receive a series of periodic inspections after commissioning, M&V, and the post-install inspection has been completed. Conducting periodic M&V inspections based on observations of data is considered best practice. Conducting inspections at defined intervals is not typical or feasible to perform over the lifecycle of each project. Data integrity issues from any site will prompt more frequent visits from the third party M&V contractor to assess the problem. As each project will entail varying degrees of complexity, the number of inspections for each individual project will be determined during the technical analysis phase and budgeted for by the third part M&V contractor. NW Natural has budgeted a flat amount per year per site for M&V, including any onsite inspections.

The Company retained The Climate Action Reserve to review its Measurement and Verification Plan and render an independent opinion as to how closely the specifications aligned with the measurement and verification requirements typically found in standards for carbon offsets. The Climate Action Reserve concluded that the NW Natural specifications align with the carbon offset standards for most measurement and monitoring requirements. See Appendix G for Climate Action Reserve Letter of Opinion and Energy 350 Summary of Identified Gaps.

In addition, NW Natural retained Energy 350 to document the Measurement and Verification requirements of the NW Natural CHP Solicitation program as it compares to the Measurement and Verification requirements of other similar programs. To provide this comparison, Energy 350 researched two well established programs operating today: MassSAVE's CHP Initiative and NYSERDA's CHP Performance Program.

Energy 350 concluded that while NYSERDA and MassSAVE provide more specific programmatic guidelines around what must be included as part of M&V, general guidance provided in the NW Natural document obtains the same level of verification once completed. All programs require a data upload for the duration of the Measurement and Verification period to measure actual performance against claims stated during the technical phase, however NW Natural's performance period is substantially longer (10 years) compared to the other two programs (2 and 3 years).

Several key aspects of the M&V protocols outlined within each program's guidelines were compared to look for significantly different criteria. Overall, no substantial differences were noted with Measurement and Verification requirements among the three programs. A copy of Energy's 350's analysis is contained in Exhibit G.

Budget Overview

The financial forecast includes no capital expenditures. The company accounts for CHP program costs as annual O&M expenditures. Annual costs are represented in "real" dollars and include NW Natural's company incentive. See Appendix C for the specific program year scenarios. The assumptions for program and implementation costs are as follows:

- Customer incentive is $30 per $MTCO_2MTCO_2(e)$ up to $4.5 Million per customer site per year.
- Annual program costs include:
    - Measurement and verification (M&V) by independent third party contractor at $25,000 per project per year
    - One time project certification by independent third party contractor at $25,000 per project
    - Marketing at $50,000 at program startup and $10,000 per year during development years
    - Legal at $50,000 at program development and $10,000 per contract

    - WSU modeling and analysis for projects not eligible for ETO services at $20,000 per year during development years.
- Program development consulting at $62,000 (Energy 350 estimated at $50,000 and WSU at $12,000).

As the program is designed to pay only for measured and verified carbon savings and includes a cap on incentives per customer site, overall program costs are based on a number of assumptions as described in Appendix C. Based on those assumptions the program is forecast to incent reduced carbon emissions of 2.5 Million MTCO2(e) over the 15 year program term at a cost of $42.59 per MTCO2(e) including NW Natural's incentive with a low and high range of 1.5 Million to 3.3 Million MTCO2(e) at of cost of $42.51 - $42.85.

Customer Benefits

ORS 757.539(3)(c) and OAR 860-085-0600 (2)(b) require that voluntary projects have customer benefits associated with them. CHP Solicitation Program offers the following benefits, in addition to carbon emissions reduction:

- Increased throughput over the NW Natural system. As CHP is installed, the gas loads at those sites increases substantially. This increase in sales means that there are more therms over which to spread the costs of NW Natural's system. This provides a benefit to all customers, because their rates are set to recover NW Natural's revenue requirement.

- Opportunities for participation in program, which has significant energy cost savings associated with it.

ORS 757.539(8)(a) specifies that costs of emissions reduction programs are allocable to a class of ratepayer only if the Commission finds that "the type of ratepayer receives a benefit from the project." Based on this, and the customer benefits identified above, NW Natural proposes that the costs of the CHP Solicitation Program be allocated to all customer classes, on an equal percent of margin basis.

Based on the Financial Forecast and Budget included as Appendix C and the allocation of costs to all customer classes, the following table represents the rate impact ($/therm) by customer class:

Customer Class	Low Utilization Rate	High Utilization Rate
Residential	0.02125	0.04744[7]
Commercial	0.06376	0.14233
Industrial	0.08746	0.19526

Analytical Considerations

In developing the program proposal, there were key assumptions that needed to be determined. This includes establishing the amount of carbon emissions deemed to be saved through the offset of electrical usage due to CHP.

Below in Table 8 is a description of the key assumptions that went into the program design.

Table 8
Key Analytical Considerations and Conclusions

Consideration	Conclusion(s)
Baseline carbon emissions for alternative grid-supplied electricity.	Stakeholders agreed the EPA eGRID non-baseload rate appeared to be the most highly favored for a number of reasons: • It is specifically called out by EPA as the appropriate value for determining emissions displaced by CHP (in the EPA CHP Partnership guidance documents and in the EPA AVERT model, which seeks to capture marginal GHG emissions displaced by energy efficiency and renewable energy projects) • The values from 2005 to 2010 fall in a fairly narrow range, going both up and down during that period. • It uses a methodology for deriving a marginal resource value, based on the capacity factors of actual plants. • While it is not Oregon-specific, it addresses an area of the grid that the group deemed coherent and appropriate, the multi-state area known as the Northwest Power Pool (NWPP) sub region of eGRID. See Appendix B for analysis and stakeholder process and http://www.epa.gov/cleanenergy/documents/egridzips/eGRID_9th_edition_V1-0_year_2010_Summary_Tables.pdf for original eGRID data.
Baseline carbon emission for the term of the Program.	To achieve investment confidence and financial certainty, baseline carbon emissions for alternative-grid supplied electricity are proposed to be fixed for the term of each project.

[7] The average annual increase in a residential customer's monthly bill assuming a 100% utilization rate is $2.50 based on average residential therm usage.

Carbon emissions per therm of natural gas.	Carbon emissions per therm of natural gas were assumed at 11.7 lbs per therm based on EPA guidelines.
Incentive levels available from the ETO and ODOE.	NW Natural's program assumes ODOE EIP funds will be allocated at levels to support its forecast market penetration and the current ETO incentive level. ETO incentives primarily impact the economics of CHP systems less than 1 MW. At current ETO incentive levels, market penetration of smaller CHP systems is expected to be minimal.
Target overall level of incentives.	WSU solved for NW Natural incentive to achieve a 3-4 year simple payback by evaluating the economics of a range of project prototypes after applying all available incentives. WSU assumed that the NW Natural incentive was applied after other available incentives. These are: the Federal ITC as a grant, an ETO grant and the Oregon Department of Energy's EIP. See Table 4, WSU Incentive Analysis, above and Appendix D. NWN set the program incentive level at $30.00 per MTCO2(e) based on the analysis by WSU. The maximum incentive per customer site per year was set at $4.5 Million.
Assumed market penetration	With a 3-4 year payback, the ICF International, Assessment of the Technical and Economic Potential for CHP in Oregon, July 2014, suggests an expected customer adoption of about 30%-40% based on Primen's 2003 Distributed Energy Market Survey. As stated earlier, NW Natural, through its CHP Program, is targeting to reduce greenhouse gas emissions by 240,000 $MTCO_2(e)$ per year in the State of Oregon by the end of 2020. The baseline goal translates to 80 MWs of CHP at 3,000 $MTCO_2(e)$ per MW and 120 MWs at 2,000 $MTCO_2(e)$ per MW. Eighty MWs represents 25% of ICF *economic* potential and 5% of ICF technical potential. One hundred twenty MWs represent 38% of ICF economic potential and 8% of ICF technical potential.
Assumed operating hours and waste heat recovery for prototype systems.	Incentive levels were set assuming projects operated 8,322 hours (95% of the time) and utilized 100% of the recoverable waste heat. Program targets in terms of reduced MTCO2(e) were set at two thirds of that potential to account for variability in operations. Minimum program eligibility requires CHP to be at least 10% more efficient than a combined cycle gas turbine (CCGT). CHP systems, however, can exceed the efficiency of a utility-scale CCGT by about 35%. So, systems that recover less of the waste heat may still be eligible but would result in less carbon savings. Target greenhouse gas emissions and the resulting program budget assumes CHP, on average, achieves 2,000 $MTCO_2(e)$ per MW of reduced emissions (66%) to account for this variability, a level that still exceeds minimum program eligibility efficiency.

Rates Analysis

Under Senate Bill 844, the utility's carbon solutions programs cannot cause an increase in gross revenues in any year of greater than 4%. As the program is designed to pay only for measured and verified carbon savings and includes a cap on incentives per customer site, overall program costs are based on a number of assumptions as described in Appendix C, CHP Financial Plan and Budget and described in the Budget Overview Section, above. Based on those assumptions the program under the base case scenario is forecast to peak at a cost of $10,177,178 Million per year.

Emissions Analysis

WSU calculated the carbon emission reduction for the prototype units shown in Table 9 below.

Baseline emissions factors were estimated using the non-base load eGRID data by sub-region (See Appendix B for summary of analysis and stakeholder process and copies of http://www.epa.gov/cleanenergy/documents/egridzips/eGRID_9th_edition_V1-0_year_2010_Summary_Tables.pdf for original eGRID data and Fuel and Carbon Dioxide Emissions Savings Calculation Methodology for Combined Heat and Power Systems, U.S. Environmental Protection Agency, Combined Heat and Power Partnership February 2015 , (http://epa.gov/chp/documents/fuel_and_co2_savings.pdf) For the region covered by NW Natural, referred to as the Northwest Power Pool, a baseline emissions rate of 1,340 lbs/mWh was utilized in concert with the EPA value for CO_2 content of natural gas of 11.7 lbs/MMBtu.

Table 9

Carbon Emission Reductions

	100%		66%	
Facility Type	**Emission Reductions MTCO2(e)/yr) Without Upstream**	**Emission Reductions MTCO2(e)/yr) With Upstream**	**Emission Reductions MTCO2(e)/yr) Without Upstream**	**Emission Reductions MTCO2(e)/yr) With Upstream**
Gas Turbine - 21.7 MW	62,652	64,023	41,350	42,255
Gas Turbine - 45 MW	132,175	136,234	87,235	89,915
Reciprocating Engine - 500 kW	1,297	1,708	856	1,127
Reciprocating Engine - 4.3 MW	15,051	19,354	9,934	12,774
Hospital - 800,000 sf with Two 800 kW Recip Engines	3,249	4,243	2,144	2,800

Cost Risk Analysis

As most program costs are variable, including customer and company incentives, the main financial risks to customers from the program relate to program startup costs and ongoing fixed costs in the event the program is unsuccessful at causing the development of CHP. Key risks to program success include:

- Customers being unwilling to allocate capital to CHP away from their core business despite incentives; and
- Erosion or removal of ODOE and/or ETO incentives.

If the program were to not succeed at causing the adoption of CHP, then the fixed costs could become stranded. These fixed costs include:

- 1 FTE to manage and administer the program (see mitigation below).
- Collateral material and marketing expenses.

To mitigate the risk of the FTE costs becoming stranded, NW Natural will not hire the FTE to manage and administer the program until after the initial solicitation is released and market response is at or above 37 MWs. NW Natural believes that Major Accounts and Engineering and Operations can support program with current staffing.

The main variable costs associated with the program include:

- Customer incentives.
- NW Natural incentives.
- Capital investment in system compression and related capital costs. (Covered by customer and not an SB844-specific risk.)
- O&M costs associated with system compression. (Covered by customer and not an SB844-specific risk.)
- Capital investment in system expansion or extension (Covered under standard policies; not an SB844-specific risk.)
- Measurement and verification (Energy 350).
- Project certification (Energy 350).
- Project modeling and analysis for program not eligible for ETO services. While the company has budgeted for WSU analysis for this purpose, ODOE/USDOE funding will be relied on instead, if available.

As stated above, these are not incurred except in the event of a successful program.

Stakeholder Engagement Process

Stakeholder meetings were held on the following dates: March 16 and 20th and April 14, 2015. Agendas and Sign-in Sheets are included in Appendix G.

Appendix A:Combined Heat & Power (CHP) Solicitation

I. INTRODUCTION

NW Natural is providing funding to secure CO_2 emissions reductions through the use of Combined Heat and Power (CHP). CHP refers to the simultaneous production of useful energy (most commonly heat and electricity) from a single fuel source, such as natural gas. CHP is a form of distributed generation, which is located at or near the energy-consuming facility. While a typical facility purchases electricity from their local utility and burns fuel in an on-site furnace or boiler to produce useful thermal energy, CHP can be used instead to produce both electricity and thermal energy on-site.

CHP is not a single technology, but rather a method of applying technologies through an integrated system approach. The outcome is a more energy efficient process to meet a facilities thermal and electric energy requirements. This increased efficiency is primarily the result of two main factors:

1. Recovering heat normally lost in central station power generation to provide useful heating or cooling on-site, or to generate additional electricity, and
2. Elimination of transmission and distribution losses from a central power plant (6%-10%)

The increased efficiency of CHP will also result in CO_2 emissions reductions compared to conventional generation sources. This solicitation presents a framework by which NW Natural will fund the CO_2 emissions reductions resulting from the installation and operation of CHP. Eligible CHP systems can receive payments of $30 per $MTCO_2(e)$ of CO_2 reduction based on measured and verified performance up to $4.5 Million per customer site per year. See incentives section for details.

In addition to NW Natural funding, the Energy Trust of Oregon (ETO), Oregon Department of Energy (ODOE), and Federal Business Energy Investment Tax Credits (ITC) have CHP incentives available. Applicants are encouraged to leverage all available funding sources.

II. ELIGIBILITY

- Minimum Efficiency – Systems must meet or exceed a Fuel Chargeable to Power (FCP) heat rate of 6,120 Btu/kWh. Calculating FCP allows for a determination of the gas used to generate electricity, incremental to that which would be used for thermal. The FCP heat rate calculation can include a credit for the efficiency of the on-site thermal generation system that the heat recovery is offsetting. The Higher Heating Value (HHV) energy content of natural gas should be used for the FCP calculation.

- For most prime movers, this will require the use of the majority of total heat available from the CHP system in order to qualify.

- FCP is calculated as follows:

$$FCP = \frac{Gas\ Input\ (Btu) - \frac{Heat\ Recovered\ (Btu)}{Offsetting\ Boiler\ Efficiency}}{Net\ Electricity\ Generated\ (kWh)}$$

Where Net Electricity Generated is net of parasitic loads.

- Fuel Source – The primary fuel source for the prime mover of the CHP must be natural gas.

III. INCENTIVES

- Performance Based CO_2 Reduction Payments – Payment for measured and verified emissions savings in the prior quarter for the first 40 quarters of operation (10 years) after the system is commissioned at $30.00 per MTCO2MTCO2(e) up to $4.5 Million per customer site per year.

- Infrastructure Support – NW Natural will expand the capacity or extend its distribution system to serve the incremental CHP load consistent with established policy (Schedule X and G-5.5 Profitability Analysis for Customer Acquisition). In addition, NW Natural will provide natural gas at higher than system pressure, if required, under terms and conditions similar to Schedule H.

Incentive Calculation

Baseline emissions rates for CHP projects will be based on the annual weighted average emissions of regional utilities. This rate has been determined to be 1,340 lbs/MWh.

The incentive calculation can include an adder for the Transmission & Distribution (T&D) losses avoided by generating electricity on-site. T&D losses are 6% for primary service customers and 10% for secondary. Note that energy exported to the grid will not receive a credit for avoided T&D losses. Once FCP is determined, the incentive can be calculated using the following equation:

$$Incentive = \left(\frac{1{,}340 \frac{lbs}{Mwh} - [.117 \times FCP]}{\frac{2{,}205\ lbs}{tonne}} \right) \times MWh_{CHP} \times (1 + T\&D_{losses}) \times \frac{Incentive\ (\$)}{tonnes}$$

Determining the annual electric generation (MWh_{CHP}) and heat recovered requires an in-depth technical analysis (refer to Technical Assessment Requirements section).

It is the intent of this solicitation to encourage the efficient use of waste heat. As such, NW Natural may not consider added thermal loads as an eligible use of waste heat unless it's part of a facility expansion. For example, if the CHP thermal output is used to heat a facility or process that isn't currently heated, this would not be considered an eligible use of waste heat.

Incentive Cap

Incentives for CHP emissions reductions are available for projects on a first come, first serve basis until NW Natural funds are exhausted under SB844. In addition, incentives are capped at $2 Million per customer site per year.

IV. PARTICIPATION PROCESS

Customers located within NW Natural's franchise service area interested in CHP should take the following steps to secure funding from NW Natural.

1. Submit Application – Applications can be found in Exhibit A of this solicitation. Applications will be reviewed by NW Natural or their contractor for preliminary feasibility. Projects that pass a preliminary feasibility screening will be invited to submit a detailed study.
2. Provide Technical Assessment – A Technical Assessment is an engineering study that will provide Engineering specifics on the facility, thermal and electric loads, proposed CHP system, and a proposed commissioning and measurement and verification (M&V) plan. See section V for details regarding the Technical Assessment. The Technical Assessment will be reviewed by NW Natural or their third party Quality Control contractor for technical and economic feasibility, accuracy of assumptions and analysis, validity of M&V plan, etc. Energy Trust of Oregon will provide preliminary scope and Technical Assessments to their customers at no cost. Energy Trust self-direct customers must cost share 50% of the cost of the Technical Assessment.
3. Install CHP System – Once the Technical Assessment has been approved, funds will be reserved by NW Natural and applicants can install the CHP system.
4. Measure and Verify Performance – Once the CHP system is installed, operational and commissioned, the applicant must measure and verify performance and submit results to NW Natural for payment on a quarterly basis. The M&V must be performed consistent with the plan proposed in the detailed study. An independent third party will conduct a post-install inspection to ensure the specified system is operating according to its design intent, the data collection system and metering equipment is properly installed and calibrated, and the reporting system is receiving and archiving data.
5. Receive Performance Based Payments – M&V submissions must be reviewed and approved by NW Natural's Quality Control contractor. Upon approval of the M&V results, NW Natural will provide performance based payments on a quarterly basis.

The sequence of submissions, review, and performance based payments will continue for the first 40 operating quarters.

V. TECHNICAL ASSESSMENT REQUIREMENTS

A technical assessment study must be performed prior to an incentive award. Technical assessments must quantify CHP performance to a high degree of accuracy and defensibility to serve as the basis for determination of an incentive. Below is an outline of major items to address in a CHP technical assessment.

1. Executive Summary
    a. Facility Overview – Description of buildings, processes, annual hours of operation, seasonality, etc. This should identify and summarize key data of major equipment such as central plants, large process loads, HVAC equipment, etc.
    b. Energy Usage – Existing facilities should provide three years of monthly historic electric and gas usage data. New facilities should demonstrate, through engineering analysis, estimates of annual electric and gas usage. Data should be as granular as possible and in no greater intervals than monthly.
    c. Proposed CHP Overview – Provide a high level summary of the system.
    d. Project Life Summary – Narrative describing the service life of the project, including age of existing equipment, if applicable, and engineering and maintenance rationale for estimated service life.
        i. Proposed service life will correspond with industry and regionally recognized sources for equipment life, or a written technical rationale if no source exists.
    e. Economic Summary – Include economics of converting to CHP compared to conventional generation. A conventional generation heat rate of 6,800 BTU/kWh shall be used to represent the grid baseline.
2. CHP Details
    a. Include preliminary equipment selection data including type and efficiency rating of prime mover, (i.e. gas turbine, reciprocating engine, etc.) and equipment specifications.
    b. Describe the annual use for thermal and electric output from the CHP system.
    c. Provide floor plan to specify the location of the CHP.
    d. Identify any required facility upgrades to accommodate the electric and heat output, rejected waste heat, etc.
3. Lifetime Energy Analysis
    a. Describe analytical approach; provide sub-metering data, analytical files, etc.

b. Load profiles for heat and electric loads must be established in hourly intervals for a representative, full year. Interval metering and/or sub-metering is preferred to support load profile analysis.
c. Identify periods where CHP capacity may exceed the facilities ability to use or sell electric or heat available from the CHP.
d. Perform hourly energy balance for one-year period including CHP electric and heat output, parasitic loads, use of heat and electric and heat rejection. State all uses for heat recovery and the current heating source for those loads.
e. Account for estimated downtime including planned maintenance and unplanned outages.
f. Document heating efficiency of heating load offset by heat recovery.
g. Calculate Total System Efficiency of CHP system using formula below:

$$Total\ System\ Efficiency = \frac{Net\ Useful\ Energy\ Output}{Total\ Fuel\ Energy\ Input}$$

h. Calculate FCP accounting for offsetting boiler efficiency according to the formula below. The Higher Heating Value (HHV) of gas should be used in this calculation.

$$FCP = \frac{Gas\ Input\ (Btu) - \frac{Heat\ Recovered\ (Btu)}{Offsetting\ Boiler\ Efficiency}}{Net\ Electricity\ Generated\ (kWh)}$$

i. Calculate annual electric generation (MWh_{CHP}) using established annual load profiles and net system output.
j. Calculate incentive based on savings incremental to central power plants based on formula below:

$$Incentive = \left(\frac{1{,}340 \frac{lbs}{Mwh} - .117 \times FCP}{\frac{2{,}205\ lbs}{tonne}} \right) \times MWh_{CHP} \times (1 + T\&D_{losses}) \times \frac{Incentive\ (\$)}{tonnes}$$

4. Cost Details
   a. Provide detailed cost estimates that itemize equipment and installation costs.
   b. Identify and price any required structural or building improvements required.
   c. Include any required electrical upgrades and interconnect expenses.
   d. Include design, permitting, rigging, commissioning and any other expenses.
   e. Identify required annual CHP system maintenance and include estimated costs.
   f. Provide any quantifiable non-energy benefits, such as avoided maintenance costs.
   g. All costs should be supported by additional detail included in the appendix.
5. Commissioning Plan

   a. Include all relevant operating criteria to ensure operation of the system as designed.
   b. Include CHP controls including sequence of operations and integration with existing controls, if applicable.
   c. Include a verification checklist of all equipment and operating parameters that should be verified by NW Natural to ensure complete installation and optimized operation.
6. CHP System Implementation Plan – Include sections on project planning, design, permitting, interconnection, construction, commissioning, maintenance, operations, project management approach and schedule.
7. CHP System Integration – Description of how CHP system will integrate into existing, expanded, or proposed business operation and how it will support a business process or meet a need.
8. Funding/Financial Documentation – Proof of funding or pro forma financial statements that include proposed balance sheet at time of commissioning, estimate balance sheet, cash flow statement, and income statement for three years
9. Construction Plan – Includes project management plan, construction schedule and quality assurance strategy.
10. Measurement & Verification Plan – Applicants should propose an M&V plan consistent with section VI. Measurement and Verification. At a minimum verification should include documentation of monitored points, a list of O&M practices for the CHP system once installed, procedures for identifying concerns found during commissioning and how they are addressed, and a final determination based on findings.

VI. MEASUREMENT AND VERIFICATION

Measurement and Verification (M&V) reporting is required under the provisions of the NW Natural CHP emissions reductions offer. Performance reporting shall be submitted on a quarterly basis (end of March, June, September, December) to NW Natural in the form of a MS Excel spreadsheet in conformance with the reporting template provided in Exhibit B. The method of filing may be by email or uploaded to a drop box determined by the NW Natural Information and Technology Dept. All monitored inputs and outputs regarding CHP shall coincide incrementally hour by hour. The individual Excel tabs shall consist of a format including but not limited to individual input/output points, date stamped in incremental windows of no more than 15 minute increments for the entire quarter. A summary sheet shall be the first Excel tab compiling all the individual tabs within the spreadsheet. An engineering control volume of data points surrounding the CHP system and balance of plant shall give enough empirical data to provide the owner of the CHP system and NW Natural sufficient information to quantify the input energy and useful output of the CHP plant used to derive emissions savings.

Monitoring Points:

- Fuel input: Natural gas metered into the prime mover of the CHP plant or ancillary equipment such as duct burners and recovery boilers used in creating steam for turbines. Where bi-fuel is used for the production of electricity only natural gas supplied fuel will be allowed in the calculation for incentives. For dual-fuel operations, both supplies of fuels shall be reported simultaneously in higher heating value with the proportional ratio of natural gas used in the calculation of emissions savings. NWN supplied billing grade meters will be required or NWN sub metering of billing grade (not rental metering program) will be required.
- Electricity output: With the exception of small and remote parasitic loads where separate metering is not cost justified and an approved engineering solution is presented, the following is true: Electric output must be metered net of parasitic loads. Parasitic loads that are not powered directly by the CHP must be metered separately and netted out of the CHP output. Electric meters shall be accurate to +/- 1%.
- Utility Electric Meter: CHP M&V must include monitoring of the facilities' electric meter(s). If multiple electric meters exist, participants must monitor all that are effected by the CHP.
- Thermal Heat Recovery: Thermal or Waste Heat recovery by definition is used to displace thermal energy that would otherwise be supplied by a device fired by an independent fuel source. Waste heat that does not offset existing natural gas use is not eligible for incentives. Waste heat recovery, used in a process, as steam, hot water or dry heated air, shall be monitored using metering accurate to +/-1%. Liquid, air or steam flow meters must be capable of measuring 120% of the nominal flowrate. The meter must be installed per the flow meter manufacturer's instructions. Where water or air flow is measured, Δ Temperature must also be measured for energy calculations. Where steam is measured, Δ Pressure and Δ Temperature must be measured as well for Enthalpy calculations.
- Heat Rejection: All heat rejected through a condenser or cooling tower must be monitored. Where water or air flow is measured, Δ Temperature must also be measured for energy calculations. Where steam is measured, Δ Pressure and Δ Temperature must be measured as well for Enthalpy calculations.

Meter positioning must be in accordance with manufacturer's specifications and industry best practices. All metering points must be in no greater than 15 minute intervals. All metering points must collect data in the same interval periods.

Data Integrity and Storage: It is the customer's responsibility to maintain the integrity and accuracy of all data reported under this program and all instrumentation required to acquire the required data for the entire 40 quarters contract term. In the event of missing interval data lasting less than 30 consecutive minutes, proxy data shall be used to backfill and noted within the spreadsheet reporting. Catastrophic loss of all data totaling 8 hours or more within any one month will require that the customer make necessary repairs or remedies. Loss of meter information provided by NW Natural shall be reported immediately to NW Natural the next business day. Periods of lost data exceeding 8 hours may result in the suspension of the NW Natural incentive during lost or corrupted data events.

Reporting system data will be cross-checked with electric and gas utility billing grade meters to ensure accuracy. NW Natural will perform calibration and adjustment of provided billing grade meters in accordance with established policy (Refer to Appendix H, NW Natural Meter Testing Procedures) and industry best practices.

Assumptions for the values of carbon dioxide for electricity, natural gas and other energy sources used by the project shall remain in effect for the length of the individual contract of the qualifying project.

VII. NW Natural Contact

Administrative or technical questions regarding this solicitation should be directed to Chris Galati at (503)721-2472 or cfg@nwnatural.com.

Exhibit A – Application

Facility Information	
Facility Name/Organization	Contact Name
Address 1	Day Phone
Address 2	Mobile
City, State, Zip	E-mail

Developer Information	
Developer/Company Name	Contact Name
Address 1	Day Phone
Address 2	Mobile
City, State, Zip	E-mail

Utility Information	
Electric Utility	Electric Account Number(s)
Purchased Electric (kWh)	Electric Rate Class
Average Demand (kW)	Gas Account Number(s)
Purchased Gas (MMBtu)	

Project Information	
CHP System Type (Gas Engine, Gas Turbine, Steam Turbine, etc.)	
Estimated Total Project Cost ($)	
Aggregate Nameplate of CHP System	kW
Annual Electricity Generated from CHP	kWh
Estimated Fuel Chargeable to Power (FCP) Heat Rate	Btu/kWh

Terms & Conditions
Appropriate terms and conditions likely to be added before actual issuance of the CHP Solicitation.

Signature	
Facility Company Name	Authorized Signature Name & Title
Authorized Signature	Date

Exhibit B – Reporting Template

Date	Time	Generator Output	Generator Output Peak	Generator Gas Input	Total Facility Purchased Energy	Total Facility Purchased Demand	Other Facility Gas Use	Unused Heat Recovery	Useful Heat Recovery	Status/Runtime of the Generator	Ambient Temperature	DataQuality Flag 1	DataQuality Flag 2
mm/dd/yyyy	hh:mm:ss	kWh	kW	therms	kWh	kW	therms	MMBtu	MMBtu	hrs	F	na	na

Appendix B: Displacement of greenhouse gas emissions by combined heat and power (CHP) facilities

Fuel and Carbon Dioxide Emissions Savings Calculation Methodology for Combined Heat and Power Systems, U.S. Environmental Protection Agency, Combined Heat and Power Partnership February 2015 , (http://epa.gov/chp/documents/fuel_and_co2_savings.pdf

Appendix B

http://www.epa.gov/cleanenergy/documents/egridzips/eGRID_9th_edition_V1-0_year_2010_Summary_Tables.pdf

Appendix B

Stakeholder Process and Analysis

Displacement of Greenhouse Gas Emissions by Combined Heat and Power Facilities

Carbon Displacement by Combined Heat and Power (CHP)

NW Natural (contact: Bill Edmonds, Bill.Edmonds@nwnatural.com)
Draft date: March 19, 2015

This memo summarizes stakeholder process and existing research related to the displacement of greenhouse gas emissions by combined heat and power (CHP) facilities. The memo recommends the use of EPA eGRID's nonbaseload calculations and explains the rationale for that recommendation. The memo briefly explains the underlying details of eGRID database and the nonbaseload calculation, and also describes some outstanding issues related to comparing emissions associated with CHP to other contexts involving natural gas. The research, analysis, and stakeholder process described herein were driven by the need for analytical clarity under SB 844, in which it is necessary to specify greenhouse gas emissions associated with various technologies and fuels.

This memo provides NW Natural's recommendation immediately below, and the rest of the memo reviews the process, evidence, existing analysis, and future questions.

NW Natural's recommendation for analysis under SB 844

NW Natural recommends the use of the regionally appropriate value for nonbaseload power from the eGRID database assembled and updated periodically by USEPA. NW Natural's service territory is located entirely within the eGRID sub-region known as the Northwest Power Pool (NWPP).

Furthermore, to strike a balance among the various considerations described below, the company further recommends:

- Use of current value: The company and the PUC shall, in consideration of individual projects, use the most current eGRID value available from EPA. NW Natural is responsible for updating the value in use immediately upon updating by EPA, available at the eGRID web site (http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html).
- Term of use: The value shall be used in calculations of the carbon incentive associated with the project for the entire duration of the project. That is, the value will not change for that project. The value will be valid for ten (10) years.
- Moment of lock-in: The value is locked in once complete project documentation is submitted to the PUC and the official period of agency deliberation and stakeholder engagement has begun. The reason for this provision is to eliminate uncertainty at the latest project stages.

- Calculation details: The value will be the carbon dioxide equivalent (CO_2e) derived from the eGRID emissions rates for carbon dioxide, nitrous oxide, and methane, using 100-year GWP values from the most recent IPCC assessment report, at the moment of submitting project documentation to the PUC. (Currently, the GWP values would therefore come from IPCC Assessment Report 5, published in 2013.)

Consultation with technical and policy stakeholders

In December 2014, NWN convened a group of technical and policy stakeholders from the Oregon Department of Energy, the Energy Trust of Oregon, the Public Utility Commission, and NW Natural itself in order to consider the mixed landscape of guidance documents, protocols, and data sets related to the technical question at hand: What are the carbon emissions displaced by electricity generated at a facility with CHP?

The group considered the evidence at hand, and there appeared to be understanding of and consensus on the following points:

- There are several options, but no single option that immediately rises above all others.
- Nonetheless, it was possible to consider each of the available options through the lens of various criteria (described below).
- Beyond the state agencies involved in the process, there is no agency with clear jurisdiction in this matter.
- NW Natural requires a decision in this area in order to move ahead with CHP projects under SB 844. Therefore, the company is responsible for recommending, and then vetting with others, a path forward.

While the group did not settle conclusively on a single number, all parties were provisionally supportive of using the EPA eGRID nonbaseload value. Everyone also expressed flexibility, with no one strongly advocating for a single particular value.

Challenges and rationale in selecting a measure of carbon displacement by CHP

The selection of a measure is made difficult by the existence of a number of potential options from different sources, the range of values among those options, the absence of national or state policy in this area, and the fact that there is no single authority providing policy in this area.

The basic rationale for using the eGRID subregion nonbaseload value is fairly straightforward: EPA is widely viewed as a credible source; EPA has already recommended the nonbaseload value for precisely this purpose (i.e., quantifying GHG emissions associated with power displaced by CHP); and the use of a "marginal" source rather than an "average source" is appealing to stakeholders.

This last rationale – the desire to capture marginal emissions – is both straightforward and complex. Clearly, we hope to understand, at the margin, what it means to add or subtract a significant resource, such as a large CHP plant. However, the definition of the margin is illusive, and there is no single resource for assessing the marginal impacts of adding resources at a particular time of day or year for all geographies of the electric grid. Fortunately, EPA's eGRID nonbaseload calculation has the only

methodology (in the resources that we found or that were suggested by stakeholders) that attempts to look, over the course of an entire calendar year, at which resources come online specifically at lower capacity factors. Furthermore, the methodology is the only one that weights the extent to which a resource figures in the nonbaseload calculation in inverse proportion to its capacity factor. In other words, a resource is not simply in or out of the calculation, but it contributes relatively more to the calculation. (For more discussion of the nonbaseload methodology, see the next subsection of this appendix. For a full description of EPA's eGRID nonbaseload methodology, refer to eGRID supporting documentation.)

Still, every source or value that the group considered had apparent strengths and weaknesses. No one value performs best according to every criterion expressed: conceptual and technical suitability; timeliness of updating and publication; specificity to Oregon or the region; and controlled and updated by Oregon agencies.

In the end, the EPA eGRID nonbaseload rate appeared to be the most highly favored for a number of reasons:

- It is specifically called out by EPA as the appropriate value for determining emissions displace by CHP (in the EPA CHP Partnership guidance documents and in the EPA AVERT model, which seeks to capture marginal GHG emissions displaced by energy efficiency and renewable energy projects)
- The values from 2005 to 2010 fall in a fairly narrow range, both rising and falling during that period.
- It uses a methodology for deriving a marginal resource value, based on the capacity factors of actual plants.
- While it is not Oregon-specific, it addresses an area of the grid that the group deemed coherent and appropriate, the multi-state area known as the Northwest Power Pool (NWPP) subregion of eGRID.

Despite these considerations in favor of the eGRID nonbaseload value, there were concerns as well. The potential concerns raised about the eGRID nonbaseload value were as follows:

- EPA is in control of the updating process and the most recent value available is for 2010 (published in 2014). (This concern is not specific to the selection of the nonbaseload number *per se*, but rather it concerns the use of any source subject to irregular updating.)
- The value for 2004 is very high (and is an outlier) – the reason is not known.
  In the most recent rulemaking on labeling (AR 555), the discussions considered but did not choose to use eGRID.

We intend to research and eventually understand the causes of the high outlier value for 2004. The company will also seek to understand how the value moves with fluctuations in regional hydropower generation, and whether that is relevant to the estimation of a marginal resource.

eGRID database, fuel types, and nonbaseload calculation methodology

EPA's eGRID database is the most comprehensive ground-up (i.e., from the plant level) description of electric power generation in the United States. The narrative in this section references the most recent eGRID technical documentation, *The Emissions & Generation Resource Integrated Database Technical Support Document for the 9th Edition of eGRID with Year 2010 Data*.

EPA established the first version of the eGRID database almost 20 years ago, and since 2007, the database has included information on boiler, generator, plant, state, electric generating company and parent company, and power control area. The data sources include FERC, NERC, US DOE, and various divisions of EPA. As a result, eGRID is regularly referenced in carbon accounting protocols and guidance, as well as life-cycle assessment, other environment impact analysis, and independent research on the electric grid.

To calculate plant-level emissions, eGRID considers both fuel types and plant-specific heat rates. These emissions rates derive from consideration of over forty different fuel types, including coal, oil, natural gas, and biomass, as well as less common fuel resources such as methanol, coke oven gas, and tire-derived fuel (Table 3-6. Plant Primary Fuel, p. 20).

eGRID publishes several emissions rates. The one under scrutiny here is the nonbaseload, a measure of the marginal impacts:

> *Capacity factor is used as a surrogate for determining how much non-baseload generation and emissions occur at each facility... The non-baseload information is published in eGRID just at the aggregate level (state, Power Control Area (PCA), etc.), but not for individual plants. (p. 21)*

While nonbaseload information is aggregated only for the subregion, the full eGRID dataset, available as a public-domain Microsoft Excel file, has data at the plant level for all plants, including those whose capacity factors warrant the plants' inclusion in the nonbaseload calculation. These plants include a wide range of fuels, from natural gas and bituminous coal to wood waste solids and paper pellets. (For the complete list of plants within the nonbaseload calculation, see references below.)

As mentioned in the previous subsection, the nonbaseload calculation includes resources with lower-than-0.8 capacity factors. The explanation in the technical documentation is thorough and concise:

> *The following describes the procedure used to generate these non-baseload emission rates. The emission rates are determined starting with unit or prime mover level data. First, all units and prime movers that do not combust fuel (i.e., hydro, nuclear, wind, solar, and/or geothermal) are removed. Next, a capacity factor relationship is used to determine the percent of the generation and emissions from each unit or prime mover to be considered non-baseload generation. All generation and emissions at units or prime movers with low capacity factors (less than 0.2) would be considered nonbaseload (a non-baseload factor of 1). No generation or emissions at units or prime movers with high capacity factors (0.8 and greater) would be considered non-baseload (non-baseload factor of 0). A linear relationship would determine the percent of generation and emissions that is non-baseload at units or prime movers with capacity factors between 0.2 and 0.8. For these units or prime movers, the non-baseload factor is -5/3*(capacity factor) + 4/3. The capacity factor is determined for both the year and the ozone season. Finally, the total non-baseload generation and the total non-baseload emissions are summed up at each level of aggregation (state, PCA, eGRID subregion, NERC region, and U.S. Total) and are used to calculate the non-baseload output emission rates. (p. 21-22)*

The nonbaseload emissions rate is well above the average for the region for two fundamental reasons. First, all of the resources with the least carbon-intensive "fuels" –wind, hydro, and solar, which together

comprise nearly 49% of total generation – are excluded because they are not dispatchable. Second, many fossil resources that have lower capacity factors are used less of the time than baseload resources precisely because they are older, less efficient, and more expensive to operate, and are brought online only when load is high enough or other generation is insufficient, i.e., when higher wholesale prices justify it. Accordingly, they have higher-than-average carbon intensities.

Additional considerations

The group discussed the Unspecified Market Purchase (UMP) mix calculated under statute by ODOE. It was recommended by the group that we might want to pick this number from the latest normal hydro year (which was 2010), and leave that in place until the next typical hydro year. "Normal hydro year" would need to be defined.

In other settings, policy makers have attempted to "pick a marginal resource" – it was mentioned that Washington state had performed a consultant study in this area and found that the marginal resource, a CCCT, was operating near 900 lbs CO2 per MWh. Several stakeholders expressed the appeal of this calculation, so there is some desire to follow up to understand this research. Despite its simplicity and appeal, there is no analysis or official guidance suggesting the use of such a value.

Similarly, there is the option of a similar calculation by the Northwest Power and Conservation Council. While technically strong, the group believes it is not updated frequently enough. The statewide average from the ODOE spreadsheet (net system mix) was considered, but it is a "build up" of the individual utility emissions, so was not viewed as providing useful marginal data.

EPA also recommends the eGRID "fossil rate" for CHP plants with a high capacity factor (operating at more than 6,500 hours per year, about 74%). This emissions rate was viewed as too high and flawed for these displacement purposes, and therefore not relevant to this process.

In all cases, values express a rate associated with combustion, rather than a life-cycle look at emissions throughout the value chain. It is possible that on-going research will provide more accurate life-cycle emissions in the future, at which point the group can discuss the possibilities. Since NW Natural is increasingly using life-cycle values (for example, in analysis of biogas from wastewater treatment plants, and for natural gas in transportation applications), the company would like to work with stakeholders to achieve consistency across applications eventually.

References:

- eGRID database, summary reports, and supporting documentation: All eGRID data, guidance documentation, and original data files with plant-level information can be found on EPA's eGRID web site: http://www.epa.gov/cleanenergy/energy-resources/egrid/.
- *The Emissions & Generation Resource Integrated Database Technical Support Document for the 9th Edition of eGRID with Year 2010 Data*, February 2014, prepared by Abt Associates and Radium Consulting Group: http://www.epa.gov/cleanenergy/documents/egridzips/eGRID_9th_edition_V1-0_year_2010_Technical_Support_Document.pdf

- EPA CHP guidance: The EPA Combined Heat and Power Partnership web page has all of the documentation referenced herein: http://www.epa.gov/chp/.

Appendix C: Combined Heat and Power Financial Plan and Budget

	A	B	C	D	E	F
1	**Carbon Solutions - CHP Filing**					
2	**Program Budget and Rate Impact Analysis**					
3	**Appendix C - CHP Financial Plan Budget Rate Impact**					
4						
5	**CHP PROGRAM ASSUMPTONS (O&M Costs)**					
6	**Verification & Monitoring**					
7	Independent Certification	$ 25,000	Per project budgeted in year before in-service			
8	M&V	$ 25,000	Per project per year			
9	NWN FTE - 1	$ 115,000	Unloaded Salary Hired in Q3 2015 if solicitation successful			
10	Payroll Loading	71%				
11	**Incentives & Emissions**					
12	Company Incentive ($/Tonne)	$ **10.00**				
13	Customer Incentive ($/Tonne)	$ **30**				
14	**Marketing, Development & Legal**					
15	Marketing	$ 50,000	2015			
16		$ 10,000	Annual			
17	Program Development (Energy 350)	$ 50,000	2015			
18	Program Development Legal	$ 50,000				
19	Ongoing Legal	$ 10,000	Per contract			
20	WSU Development	$ 20,000	2016-2019			
21	WSU Startup	$ 12,000	2015			
22	**Other**					
23	Inflation Factor	1.5%				
24	**Viable Customers**					
25	**Scenario**	**Target Carbon Reduction**	**Target Incremental Carbon Reduction by Year**	**Carbon Reduction per MW**	**Installed Capacity**	**Number of Customers**
26	Low	150,000	150,000	3,000	50	2
27	Base	240,000	90,000	3,000	80	6
28	High	330,000	90,000	3,000	110	7

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	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
1	**Carbon Solutions - CHP Filing**																
2	**Program Budget and Rate Impact Analysis**																
3	**Appendix C - CHP Financial Plan Budget Rate Impact**																
31	**CHP PROGRAM ANALYSIS & SCENARIOS**																
32		**Scenario Case**	**Real or Nominal $'s**	**NWN Incentive**	**Carbon Reduction per MW**	**Installed CHP Capacity (MW)**											
33	**Program Investment Assumption**	**Base**	**Real**	**On**	**3,000**	**80**											
34	*Select Cell and Use Dropdown*																
35	Program Year	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	Total
36	1st Year Startup Costs	$ 150,000															
37	WSU Development Costs		$ 20,000	$ 20,000	$ 20,000	$ 20,000											
38	WSU Startup Costs	$ 12,000															
39	Marketing		$ 10,000	$ 10,000	$ 10,000	$ 10,000											
40	Independent Certification	$ -	$ 50,000		$ -		$ -										
41	M&V		$ 50,000	$ 50,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 200,000	$ 150,000	$ 150,000	$ -	$ -	
42	Ongoing Legal	$ 20,000		$ -		$ -											
43	New FTE for CHP Program		$ 196,777	$ 196,777	$ 196,777	$ 196,777	$ 196,777	$ 196,777	$ 196,777	$ 196,777	$ 196,777	$ 196,777	$ 196,777	$ 196,777	$ -	$ -	
44	Total Program O&M	$ 182,000	$ 326,777	$ 276,777	$ 426,777	$ 426,777	$ 396,777	$ 396,777	$ 396,777	$ 396,777	$ 396,777	$ 396,777	$ 346,777	$ 346,777	$ -	$ -	
45	Tonnes of Carbon		$ 150,000	$ 150,000	$ 240,000	$ 240,000	$ 240,000	$ 240,000	$ 240,000	$ 240,000	$ 240,000	$ 240,000	$ 90,000	$ 90,000	$ -	$ -	**2,400,000**
46	Customer Incentive		$ 4,500,000	$ 4,500,000	$ 7,200,000	$ 7,200,000	$ 7,200,000	$ 7,200,000	$ 7,200,000	$ 7,200,000	$ 7,200,000	$ 7,200,000	$ 2,700,000	$ 2,700,000	$ -	$ -	
47	**Total O&M**	**$ 182,000**	**$ 4,899,178**	**$ 4,848,428**	**$ 7,741,178**	**$ 7,741,178**	**$ 7,710,728**	**$ 7,710,728**	**$ 7,710,728**	**$ 7,710,728**	**$ 7,710,728**	**$ 7,710,728**	**$ 3,092,478**	**$ 3,092,478**	**$ -**	**$ -**	$ 77,861,288
48																	
49	NWN Incentive	$ -	$ 1,522,500	$ 1,522,500	$ 2,436,000	$ 2,436,000	$ 2,436,000	$ 2,436,000	$ 2,436,000	$ 2,436,000	$ 2,436,000	$ 2,436,000	$ 913,500	$ 913,500	$ -	$ -	
50																	
51	Total Program Cost	$ 182,000	$ 6,421,678	$ 6,370,928	$ 10,177,178	$ 10,177,178	$ 10,146,728	$ 10,146,728	$ 10,146,728	$ 10,146,728	$ 10,146,728	$ 10,146,728	$ 4,005,978	$ 4,005,978	$ -	$ -	$ 102,221,288
52																	
53	**Cost of Carbon ($/tonne)**	**$ 42.59**															

Appendix C: Combined Heat and Power Financial Plan and Budget

	A	B	C	D	E	F
1	**Carbon Solutions - CHP Filing**					
2	**Program Budget and Rate Impact Analysis**					
3	**Appendix C - CHP Financial Plan Budget Rate Impact**					
4						
5	**CHP Proposal Rate Impact Analysis by Customer Class**					
6	*Customer Incentive:*	*$ 30*				
7	*NWN Incentive:*	*$ 10*				
8						
9	*Scenario Case:*	*Base*				
10			**Total Revenue by RS**	**Allocation of CHP Costs to RS**	**% of CHP Costs of Total Revenue**	**Incremental Rate Increase**
11	*Customer Class*					*$/Therm*
12	Residential		$ 409,069,458	6,750,353	1.650%	0.03400
13	Commercial		$ 213,359,648	2,734,376	1.282%	0.10203
14	Industrial		$ 49,079,634	662,003	1.349%	0.13995
15						
16	**TOTALS**		**$ 671,508,740**	**$ 10,146,732**	**1.511%**	

Appendix C: Combined Heat and Power Financial Plan and Budget

	A	B	C	D	E	F
1	**Carbon Solutions - CHP Filing**					
2	**Program Budget and Rate Impact Analysis**					
3	**Appendix C - CHP Financial Plan Budget Rate Impact**					
4						
5	**CHP Proposal Rate Impact Analysis by RS**					
6	*Customer Incentive:*	*$ 30*				
7	*NWN Incentive:*	*$ 10*				
8						
9	*Scenario Case:*	*Base*				
10			**Total Revenue by RS**	**Allocation of CHP Costs to RS**	**% of CHP Costs of Total Revenue**	**Incremental Rate Increase**
11	*Schedule*	*Block*				*$/Therm*
12	2R		$ 408,263,428	$ 6,738,315	1.650%	0.01889
13	3C Firm Sales		$ 154,604,491	$ 2,093,461	1.354%	0.01325
14	3I Firm Sales		$ 4,241,361	$ 52,794	1.245%	0.01133
15	27 Dry Out		$ 806,030	$ 12,038	1.493%	0.01511
16	31C Firm Sales	Block 1	$ 17,120,128	$ 270,880	1.582%	0.01309
17		Block 2	$ 14,372,723	$ 143,293	0.997%	0.01195
18	31C Firm Trans	Block 1	$ 189,532	$ 6,200	3.271%	0.01594
19		Block 2	$ 83,775	$ 2,781	3.320%	0.01456
20	31I Firm Sales	Block 1	$ 3,177,304	$ 46,935	1.477%	0.01125
21		Block 2	$ 5,854,187	$ 50,082	0.855%	0.01016
22	31I Firm Trans	Block 1	$ 81,097	$ 2,646	3.263%	0.01602
23		Block 2	$ 114,515	$ 3,775	3.296%	0.01448
24	32C Firm Sales	Block 1	$ 10,363,534	$ 113,985	1.100%	0.00689
25		Block 2	$ 3,297,737	$ 17,586	0.533%	0.00264
26		Block 3	$ 543,346	$ 2,150	0.396%	0.00186
27		Block 4	$ 110,869	$ 270	0.244%	0.00109
28		Block 5	$ -	$ -	0.000%	0.00082
29		Block 6	$ -	$ -	0.000%	0.00041
30	32I Firm Sales	Block 1	$ 2,618,224	$ 26,738	1.021%	0.00617
31		Block 2	$ 2,550,633	$ 13,485	0.529%	0.00524
32		Block 3	$ 844,309	$ 3,311	0.392%	0.00370
33		Block 4	$ 230,618	$ 556	0.241%	0.00216
34		Block 5	$ -	$ -	0.000%	0.00123
35		Block 6	$ -	$ -	0.000%	0.00062
36	32 Firm Trans	Block 1	$ 2,284,736	$ 74,636	3.267%	0.00654
37		Block 2	$ 1,254,603	$ 41,265	3.289%	0.00556
38		Block 3	$ 520,634	$ 17,097	3.284%	0.00393
39		Block 4	$ 528,279	$ 17,287	3.272%	0.00229
40		Block 5	$ 405,898	$ 13,195	3.251%	0.00131
41		Block 6	$ 25,193	$ 807	3.203%	0.00066
42	32C Interr Sales	Block 1	$ 3,640,693	$ 35,727	0.981%	0.00584
43		Block 2	$ 4,062,657	$ 22,009	0.542%	0.00496
44		Block 3	$ 2,048,573	$ 8,239	0.402%	0.00350
45		Block 4	$ 2,463,572	$ 6,099	0.248%	0.00204
46		Block 5	$ 105,391	$ 154	0.146%	0.00117
47		Block 6	$ -	$ -	0.000%	0.00059
48	32I Interr Sales	Block 1	$ 4,387,308	$ 43,303	0.987%	0.00589
49		Block 2	$ 4,748,395	$ 25,696	0.541%	0.00500
50		Block 3	$ 2,434,090	$ 9,779	0.402%	0.00353
51		Block 4	$ 4,678,913	$ 11,566	0.247%	0.00206
52		Block 5	$ 1,748,259	$ 2,553	0.146%	0.00118
53		Block 6	$ 73,447	$ 55	0.075%	0.00059
54	32 Interr Trans	Block 1	$ 1,815,423	$ 59,245	3.263%	0.00661
55		Block 2	$ 1,283,229	$ 42,114	3.282%	0.00562
56		Block 3	$ 660,444	$ 21,643	3.277%	0.00396
57		Block 4	$ 1,005,315	$ 32,825	3.265%	0.00231
58		Block 5	$ 1,097,435	$ 35,600	3.244%	0.00132
59		Block 6	$ 768,414	$ 24,557	3.196%	0.00066
60	33		$ -	$ -	0.000%	-
61						
62	**TOTALS**		**$ 671,508,740**	**$ 10,146,732**	**1.511%**	

Appendix D: WSU RELCOST MODEL

Digitally Provided

Appendix E:ICF International

Assessment of the Technical and Economic Potential for CHP in Oregon Final Report, July 2014

Appendix E: ICF International Oregon CHP Sensitivity Case February, 2015

February 20, 2015

Mr. Chris Galati, P.E.
NW Natural
220 NW Second Avenue
Portland, Oregon 97209

Subject: CHP Sensitivity Case for Oregon

Dear Chris:

I am pleased to attach a memo describing a sensitivity case for the adoption of combined heat and power (CHP) in Oregon. This sensitivity case examined variations in the following input parameters relative to a base case assessment that was prepared in 2014:

Electricity rates. The base case used an electricity forecast with rates generally higher than those rates forecast by the Energy Information Administration (EIA). For the sensitivity case, electricity rates were assumed to follow EIA's forecast.

Market growth. The base case assumed that target markets for CHP in Oregon would grow at rates comparable to national averages as reported by EIA. For the sensitivity case, market growth was modified to 0% for the paper industry based on recent trends in Oregon for this sector.

The base case, published in 2014, predicts that CHP market penetration will grow by approximately 90 MW of installed natural gas-fired CHP capacity by 2030. In contrast, the sensitivity case shows that CHP market penetration for natural gas-fired CHP will grow by approximately 23 MW by 2030.

If you have any questions or comments, please do not hesitate to give me a call.

Regards,

Rick Tidball

Cc: Anne Hampson
Attachment: Memo describing results of sensitivity analysis

710 Second Avenue ■ Seattle, WA 98104 ■ 206.801.2846 ■ icfi.com

Economic Potential for CHP in Oregon

A Sensitivity Case Analysis

ICF evaluated the potential for combined heat and power (CHP) in Oregon in 2014.[1] This report (referred to as "base case" study in this memo) was prepared for the Oregon Department of Energy, and showed approximately 90 MW of additional natural gas-fired CHP market penetration in Oregon by 2030. At the request of NW Natural, ICF conducted a sensitivity analysis relative to the 2014 report, and this memo describes the results of this sensitivity analysis.

Base Case Results

For reference, a few findings from the base case study are included in this memo. **Table 1** presents the technical potential for CHP divided into payback ranges. As indicated, 87 MW of the total technical potential of 1,458 MW has a payback less than 5 years, with all of this potential occurring in Portland General Electric's service territory. Slightly over 230 MW has a payback in the 5 to 10 year range.

Table 1. ***BASE CASE*** **– CHP Technical Potential by Payback Range in Oregon by Electric Utility**

Electric Utility	Potential (MW) by Payback Period				Total (MW)
	<5 yrs	5 - 10 yrs	10 - 20 yrs	>20 yrs	
Portland General Electric	87	134	29	364	**614**
Pacific Power & Light	0	98	169	204	**471**
Eugene Water & Electric Board	0	0	0	84	**84**
Other	0	0	0	289	**289**
Total	**87**	**232**	**198**	**941**	**1,458**

Table 2 shows the cumulative market penetration divided between industrial and commercial/institutional market segments. By 2030, the base case shows an expected market penetration of 90.4 MW, with nearly all (89.2 MW) of this penetration in the industrial sector.

[1] *Assessment of the Technical and Economic Potential for CHP in Oregon*, ICF International, July 2014. http://www.oregon.gov/energy/CONS/Industry/docs/Oregon_CHP_assessment_report.pdf

Table 2. *BASE CASE* – **Cumulative Market Penetration by Market Segment**

Market Segment	Year			
	2014	2020	2025	2030
Industrial	26.2	61.7	78.5	89.2
Commercial / Institutional	0.2	0.7	1.0	1.2
Total	**26.4**	**62.4**	**79.5**	**90.4**

Table 3 provides a breakout of the cumulative market penetration by CHP size range. As indicated, nearly 80% (71.6 MW) of the market penetration in 2030 occurs for large systems, with capacities greater than 20 MW.

Table 3. *BASE CASE* – **Cumulative Market Penetration by CHP Capacity**

Electric Capacity	Year			
	2014	2020	2025	2030
50 - 500 kW	0.0	0.0	0.0	0.2
500 kW - 1 MW	0.0	0.0	0.0	0.2
1 - 5 MW	1.7	7.4	11.0	12.4
5-20 MW	0.8	1.9	4.4	6.0
> 20 MW	23.9	53.1	64.1	71.6
Total	**26.4**	**62.4**	**79.5**	**90.4**

Input Assumptions for Sensitivity Analysis

For the sensitivity analysis, the input assumptions were varied for electricity rate escalation and technical potential market growth rates over the analysis timeframe (2015-2030). The variations are summarized in **Table 4**.

Table 4. Input Assumptions That Varied Between Two Modeling Scenarios

Input Parameter	Description	
	Base Case	Sensitivity Case
Electricity Rates	3% annual growth	0.5% annual growth
Market Growth	1.9% annual growth for paper production	0% annual growth for paper production

The base case electricity escalation rate was based on historical data for electric rate increases in Oregon over the past several years. In the sensitivity case, electricity escalation was based on EIA's 2014 Annual Energy Outlook for the Western Electricity Coordinating Council (WECC) Northwest region.

The base case market growth rate was based on the EIA 2014 Annual Energy Outlook, which reports national average growth rates by sector. Based on recent trends in the paper industry in Oregon, the growth rate for the paper industry in the sensitivity analysis was set to 0%.

Sensitivity Analysis Results

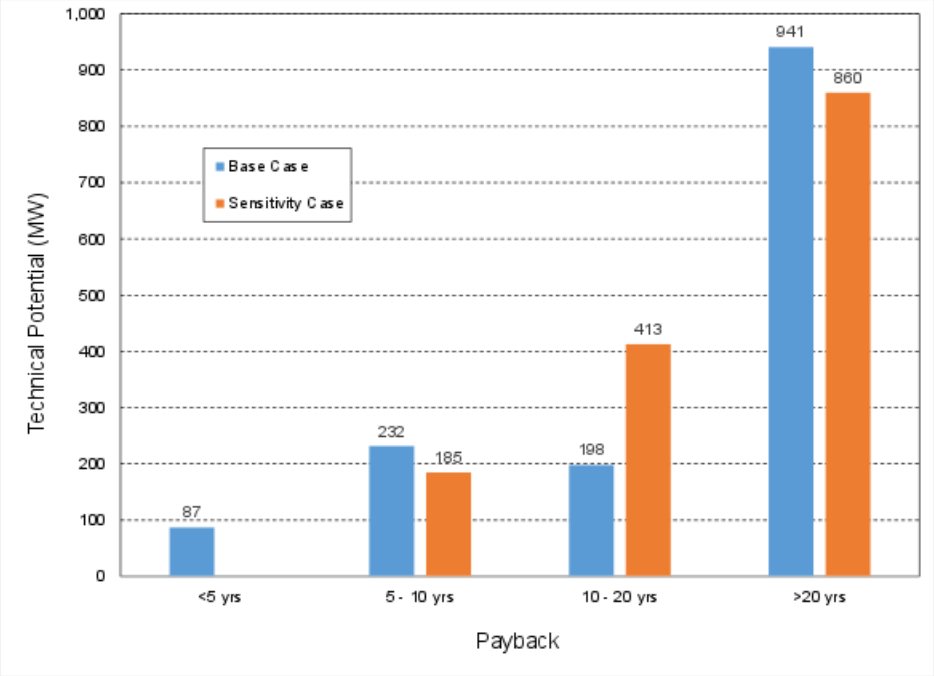
Table 5 shows the technical potential broken out by payback range for the sensitivity case. As indicated, there is no technical potential with a payback under 5 years. The majority of the technical potential occurs for CHP installations that have a payback greater than 20 years.

Table 5. *SENSITIVTY CASE* – **CHP Technical Potential in Oregon by Electric Utility**

Electric Utility	Potential (MW) by Payback Period				Total (MW)
	<5 yrs	5 - 10 yrs	10 - 20 yrs	>20 yrs	
Portland General Electric	0	87	134	393	**614**
Pacific Power & Light	0	98	169	204	**471**
Eugene Water & Electric Board	0	0	40	44	**84**
Other	0	0	70	219	**289**
Total	**0**	**185**	**413**	**860**	**1,458**

Figure 1 shows a comparison of the technical potential between the base case and the sensitivity case. In both scenarios, the total technical potential remains the same (1,458 MW). In the sensitivity case, however, the technical potential is shifted towards higher payback periods. As an example, the base case has 87 MW of technical potential with a payback less than 5 years, but the sensitivity case shows no technical potential with a payback under 5 years.

Figure 1. Comparison of Technical Potential between Two Cases



The expected market penetration of natural gas-fired CHP in the sensitivity case is expected to increase by 23.1 MW by 2030 (see **Figure 2**). Only Portland General Electric and Pacific Power show economic CHP market potential between 2014 and 2030. In 2030, Portland General Electric is estimated to have 15.7 MW of additional CHP market penetration, and Pacific Power is expected to have 7.4 MW of additional CHP market growth.

Figure 2. *SENSITIVTY CASE* – **CHP Cumulative Market Penetration**

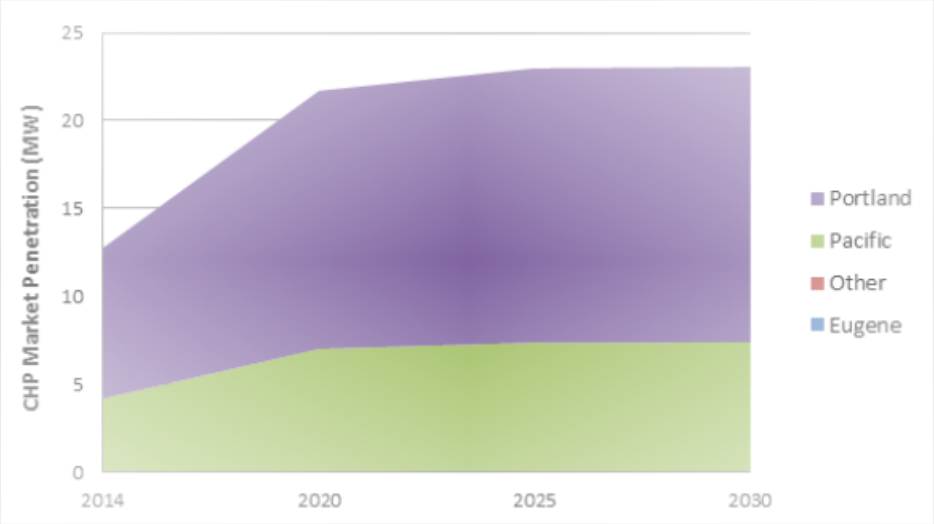


Table 6 shows the cumulative market penetration divided between industrial and commercial/institutional market segments for the sensitivity case. By 2030, the sensitivity case shows an expected market penetration of 23.1 MW, with nearly all (23.0 MW) of this penetration in the industrial sector.

Table 6. *SENSITIVTY CASE* – **Cumulative Market Penetration by Market Segment**

Market Segment	Year			
	2014	2020	2025	2030
Industrial	12.7	21.6	22.9	23.0
Commercial / Institutional	0.1	0.1	0.1	0.1
Total	**12.8**	**21.7**	**23.0**	**23.1**

Figure 3 shows a comparison of the cumulative market penetration between the base case and the sensitivity case. By 2030, the CHP market penetration for the sensitivity case is about 75% lower (23.1 MW) than the base case projection (90.4 MW).

Figure 3. Comparison of Market Penetration between Two Cases

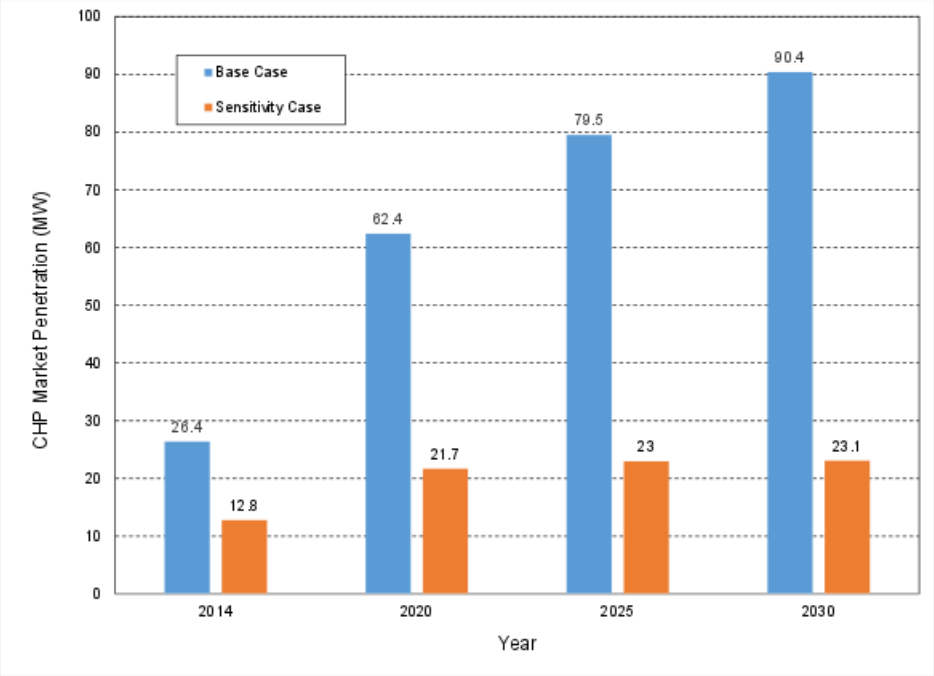


Table 7 provides a breakout of the cumulative market penetration by CHP size range. Nearly 95% (21.8 MW) of the market penetration in 2030 occurs for large (> 20 MW) CHP installations.

Table 7. *SENSITIVTY CASE* – Cumulative Market Penetration by CHP Capacity

Electric Capacity	Year			
	2014	2020	2025	2030
50 - 500 kW	0.0	0.0	0.0	0.0
500 kW - 1 MW	0.0	0.0	0.0	0.0
1 - 5 MW	0.8	0.8	0.8	0.8
5-20 MW	0.5	0.5	0.5	0.5
> 20 MW	11.5	20.5	21.7	21.8
Total	**12.8**	**21.8**	**23.0**	**23.1**

Appendix F: The Climate Action Reserve Letter of Opinion Energy 350 Summary of Measurement and Verification Gaps and Remediation

Appendix F
The Climate Action Reserve Letter of Opinion
Energy 350 Summary of Monitoring and Verification Gaps

LETTER OF OPINION
NW Natural's CHP M&V SPECIFICATION

April 13, 2015

The Climate Action Reserve ("Reserve") has been invited by NW Natural to undertake a brief analysis of its Combined Heat and Power (CHP) measurement and verification (M&V) specification ("NWN specification"), and to offer an opinion, in the form of this letter, as to how closely the M&V specification aligns with the M&V requirements typically found in standards for carbon offsets. To form this opinion, we compared the M&V specification to requirements found in methodologies for CHP and other types of projects under the Reserve's voluntary carbon offset program, California's compliance carbon offset program, and the United Nations Clean Development Mechanism (CDM). Our conclusion is that the NWN specification aligns well with carbon offset standards for most measurement and monitoring requirements. It is not clear from the documentation provided by NW Natural whether verification procedures and requirements would be equivalent to what most carbon offset programs require.

Monitoring Requirements

In the context of carbon offset standards, "monitoring" requirements include specifications for the data that must be collected to determine project performance; the methods and equipment to be used to collect these data (including requirements for accuracy); the required frequency of measurements and/or data collection; data quality assurance and quality control (QA/QC) provisions; and procedures that must be followed if and when required data are missing or cannot be obtained. The NWN specification aligns well with existing CDM methodologies for CHP projects regarding the general types of data that must be collected to quantify greenhouse gas reductions, including data on fuel inputs, electricity generation, and heat generation. Furthermore, most of the prescribed monitoring methods, frequencies, and procedures in the NWN specification are commensurate with those found in the carbon offset standards reviewed here. The one area where carbon offset standards typically provide additional safeguards is in requiring the cross-checking of monitored data with alternative data sources, such as receipts or invoices. We further describe the similarities and differences below, and have summarized them in tabular format at the end of this document.

Fuel inputs

The NWN specification requirements for fuel input monitoring are largely commensurate with requirements in Reserve and California standards,[8] and in relevant CDM methodologies. The NWN specification does not explicitly require ongoing measurement and monitoring of the calorific content of fuels, which is a requirement in all carbon offset standards reviewed here. However, calorific content of pipeline gas is monitored continuously by default on NW Natural's system, obviating the need for project developers to monitor this parameter themselves. System-wide meter testing and calibration requirements are specified in a NW Natural Meter Testing Procedures document (effective date October 31, 2014), and these procedures meet or exceed typical testing and calibration requirements for carbon offsets by aligning with ANSI/manufacturer standards. It should be noted, however, that the requirements are applied on a random sampling basis, across all such meters used by NW Natural. As such, some project meters may not receive the site-specific testing/calibration that would typically be required in the context of a carbon offset project. Nevertheless, given the nature of the system, it appears the Meter Testing Procedures would provide a similar level of assurance as would typically be achieved with carbon offsets.

Otherwise, the only notable differences between the NWN specification and the carbon offset standards, is that the NWN specification does not employ specific QA/QC measures, such as the cross-checking of data against other sources, as found in the carbon offset standards, nor does it include specific positioning guidance for meters.

Electricity generated

The requirements for monitoring electricity output in the NWN specification are commensurate with some electricity monitoring requirements in Reserve and California protocols,[9] and in relevant CDM methodologies, but nevertheless are not fully aligned. The specific parameters to be monitored are commensurate with those in the carbon offset standards, as are the required measurement techniques and devices used; required measurement frequencies; prescribed reporting format; metering calibration requirements, and data substitution methods. However, the NWN specification does not appear to explicitly provide comparable terms for QA/QC cross-checking of data (e.g., against sales records or other data).

Heat generated

The NWN specification requirements for measuring thermal heat recovery associated with CHP units are commensurate with, or exceed, all of the requirements in relevant CDM methodologies.[10]

Verification Requirements

Carbon offset programs require periodic third-party verification of monitoring data. Typical steps in third-party carbon offset verifications include: i) determining whether monitoring data have

[8] The Reserve and State of California do not have offset protocols specifically for CHP projects. However, they do have standards for measuring and monitoring quantities of methane destroyed by projects involving landfills, livestock operations, and mining operations. The standards for monitoring methane quantities are analogous to those that would be required to monitor fuel inputs in a CHP project.

[9] Several Reserve and State of California protocols have requirements for monitoring electricity production and/or consumption associated with project activities.

[10] The Reserve and State of California do not have any protocols involving heat recovery, so there are no relevant monitoring requirements to compare to. The CDM, however, has methodologies for a number of different CHP and cogeneration project activities involving heat recovery.

been collected and reported in accordance with program requirements; ii) conducting onsite inspections as appropriate (including reviewing performance records, interviewing key staff, collecting primary data, observing established practices, and testing the accuracy of monitoring equipment firsthand); iii) verifying the accuracy of monitoring data, and ensuring that related documentation is complete and transparent; iv) recalculating emission reductions; v) identifying concerns and discussing them with the project developers, and finally vi) making a determination based on audit findings. These are seen as essential to ensure the transparency of the system and integrity of claimed emission reductions.

In contrast to these detailed and standardized verification requirements, the NWN specification stipulates that verifications will be carried out either by NW Natural themselves, or by third parties contracted by NW Natural. Little guidance is given regarding prescribed procedures for these verifications, or who is to carry out the work, as would typically be found in carbon offset standards.

Appendix F: Measurement and Verification - Energy 350 Comparison of NWN Program to MassSAVE and NYSERDA CHP Programs

Table 1. Comparison of Monitoring Requirements - Fuel Inputs

Standard / Specification	Parameter(s) monitored	Required measurement technique(s) or device(s)	Accuracy / Calibration requirements	Required frequency of measurement	Prescribed reporting format?	Prescribed QA/QC procedures	Missing data procedures
CAR	• Flow rate • Gas conc.	• **Flow rate:** gas meters • **Calorific content:** continuous analyzer, or quarterly lab testing	All meters must be: • Cleaned/inspected on quarterly basis; • Field checked within 2 months of end of each reporting period; • Calibrated by appropriately trained service provider; All meters must reveal accuracy within +/-5%;	• **Flow rate:** Measured continuously – recorded every 15 minutes or totalized and recorded daily; • **Calorific content:** continuous analyzer, or quarterly lab testing	No	See accuracy / calibration requirements; Suggested positioning of meters;	Applied to missing data – or data not meeting QA/QC requirements: • < 6 hours = use average of 4 hours before/after gap; • 6-24 hours = use 90% lower / upper confidence limit of 24 hours before/after; • 1-7 days = use 95% lower/upper confidence limit of 72 hours before / after; • >7 days = no data substitution allowed
CDM	• Flow rate • Calorific content	• **Flow rate:** gas meters • **Calorific content:** range of options	All meters should be calibrated regularly per industry practices. Accuracy can be implied based on missing data method.	• **Flow rate:** Monitored continuously. • **Calorific content:** monitored per national / international standard;	Yes	Must cross-check against invoices / receipts for purchased fuels, stock changes etc.	Based on materiality of effected emission reductions relative to overall amount claimed - ie projects applying for more than 500ktCO2-e are permitted only to have up to 0.5% of data missing;
NW Natural	• Flow rate only • (Calorific content monitored on pipeline system)	**Flow rate:** billing grade meters supplied by NW Natural	All meters must be accurate to 1%. Any meter faults must be reported the next day. Meters randomly sampled, tested and calibrated to ANSI / manufacturers standards, in accordance with separate Meter Testing Procedures.	**Flow rate:** 15 minute intervals **Calorific content:** continuous on system	Yes	No	Applies only to missing data, though implies also data not meeting QA/QC: • <30 mins = proxy data used; • catastrophic loss of 8 hours or more = must be remedied; • >8 hours may result in suspension of incentive for missing data period.
Assessment	Meets	Meets	Meets / May Not Meet	Meets	Meets	May Not Meet	Meets
Comments / Explanation	Comparable requirements for flow rate. Calorific content provided by NW.	Comparable requirements for flow rate. Calorific content provided by NW.	Comparable requirement for meter accuracy. Comparable requirement for meter testing and calibration (contained in separate Meter Testing Procedures) – not necessarily applied to each project meter.	Comparable requirement for monitoring frequency.	Comparable requirement for reporting format.	Does not require QA/QC measures.	Comparable missing data requirements.

Table 2. Comparison of Monitoring Requirements - Electricity Generation

Standard / Specification	Parameter(s) monitored	Required measurement technique(s) or device(s)	Accuracy / Calibration requirements	Required frequency of measurement	Prescribed reporting format?	Prescribed QA/QC procedures	Missing data procedures
CAR	• kwh • flow		All meters must be: • Cleaned/inspected on quarterly basis; • Field checked within 2 months of end of each reporting period; • Calibrated by appropriately trained service provider; All meters must reveal accuracy within +/-5%;	Kwh to be monitored and recorded at least hourly. Flow to be measured continuously – recorded every 15 minutes or totalized and recorded daily;	No	See accuracy / calibration requirements; Suggested positioning of meters; Flow must be shown to be contemporaneous with engine output.	Applied to missing data – or data not meeting QA/QC requirements: • < 6 hours = use average of 4 hours before/after gap; • 6-24 hours = use 90% lower / upper confidence limit of 24 hours before/after; • 1-7 days = use 95% lower/upper confidence limit of 72 hours before / after; >7 days = no data substitution allowed
CDM	kwh	N/A	All meters should be calibrated regularly per industry practices. Accuracy can be implied based on missing data method.	Monitored continuously	Yes	Must cross-check data using records for sold electricity	Based on materiality threshold for project.
NW Natural	kwh	Metered net of parasitic loads - with exception of small/remote parasitic loads, where not economical to meter and approved engineering solution provided	All meters must be accurate to 1%. Any meter faults must be reported the next day. No specified calibration requirement. Meters randomly sampled, tested and calibrated to ANSI / manufacturers standards, in accordance with separate Meter Testing Procedures.	15 minute intervals	Yes	No	Applies only to missing data, though implies also data not meeting QA/QC: • <30 mins = proxy data used; • catastrophic loss of 8 hours or more = must be remedied; >8 hours may result in suspension of incentive for missing data period.
Assessment	Meets	Meets	Meets / May Not Meet	Meets	Meets	May Not Meet	Meets
Comments / Explanation		Comparable requirements for electricity generation.	Comparable requirement for meter accuracy. Comparable requirement for meter testing and calibration (contained in separate Meter Testing Procedures) – not necessarily applied to each project meter.	Comparable requirement for monitoring frequency.	Comparable requirement for reporting format.	No cross-checking with flow or sales records.	Comparable missing data requirements.

Table 3. Comparison of Monitoring Requirements - Thermal Output

Standard / Specification	Parameter(s) monitored	Required measurement technique(s) or device(s)	Accuracy / Calibration requirements	Required frequency of measurement	Prescribed reporting format?	Prescribed QA/QC procedures	Missing data procedures
CAR	N/A	N/A	N/A	N/A	N/A	N/A	N/A
CDM	• temperature • flow • pressure	Enthalpies determined based on mass flows – steam tables / equations can be used	All meters should be calibrated regularly per industry practices. Accuracy can be implied based on missing data method.	Monitored continuously, aggregated as appropriate	Yes	N/A	Based on materiality threshold for project.
NW Natural	• temperature • flow • pressure	• where water/air flow measured, temp must also be measured for energy calcs; • where steam is measured, pressure and temp must be measured also; • meters must be able to measure 120% of nominal flow rate;	All meters must be accurate to 1%. Any meter faults must be reported the next day. Meters randomly sampled, tested and calibrated to ANSI / manufacturers standards, in accordance with separate Meter Testing Procedures.	15 minute intervals	Yes	No	Applies only to missing data, though implies also data not meeting QA/QC: • <30 mins = proxy data used; • catastrophic loss of 8 hours or more = must be remedied; >8 hours may result in suspension of incentive for missing data period.
Assessment	Meets	Meets	Meets / May Not Meet	Meets	Meets	Meets	Meets
Comments / Explanation	Comparable requirements for heat measurements.	Comparable requirements for heat measurements.	Comparable requirement for meter accuracy. Comparable requirement for meter testing and calibration (contained in separate Meter Testing Procedures) – not necessarily applied to each project. meter.	Comparable requirement for monitoring frequency.	Comparable requirement for reporting format.	No relevant QA/QC requirements in either CDM or NWN specification.	Comparable missing data requirements.

Appendix G: Stakeholder Meetings

Agendas and Sign-In Sheets

Meeting Agenda:1

Carbon Solutions : Combined Heat and Power Solicitation Program Overview

March 16, 2015

2:00 pm- 4:00 pm NW Natural Offices

Discussion Topics:

- Overview of Program (Summers)
- Solicitation Design (Energy 350)
- Measurement and Verification Design (Energy 350)
- Incentive Design and Levels (Summers, Energy 350, ODOE/WSU)
- Recap of Stakeholder Key Issues and Concerns

Appendix G: Stakeholder Meetings
Agendas and Sign-In Sheets

NW Natural Carbon Solutions Program
Combined Heat and Power Market Solicitation
Stakeholder Meeting
March 16, 2015

SIGN-IN SHEET

	Name	Organization	Email Address	Telephone Number	Received Notebook (X)
1	MARTY STIPE	ODOE	marty.stipe@state.or.us	503 378 4926	X
2	[illegible]	WSU	[illegible]	[illegible]	X
3	CAROLYN ROOS	WSU EP	roosc@energy.wsu.edu	(360) 956-2157	X
4	[illegible]	CUB	bob@oregoncub.org	[illegible]-227-1984	X
5	Jason Klotz	PUC	jason.klotz@state.or.us	503-378-6667	X
6	Ed Finklea	NWIGU	efinklea@nwigu.org	503-303-4061	X
7	Chris Smith	E350	chris@energy350.com	503-886-9745	X
8	Nick O'Neil	E350	noneil@energy350.com	503-333-8161	X
9	Ann Gravatt	Climate Solutions	ann.c@climatesolutions.org	503 701 9028	X
10	Sommer Templet	CUB	sommer@oregoncub.org	503-227-1984	X
11	Jessica Shipley	ODOE	jessica.shipley@state.or.us	503 378 3780	X
12	STEVE Nelson	NWN			X
13	Chris GALATI	NWN			X
14	BILL EDMONDS.	NWN			X
15	Ted BARRA	PGE	Ted.BARRA@PGN.com	503 464 8037	X
16	Alex Miller	NWN	[illegible]@nwnatural.com	503 721 2467	X
17	Mary Moerlins	NWN	mema@nwnatural.com	x5371	
18	Barbara Summers	"			
19					
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22					
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Meeting Agenda- 2

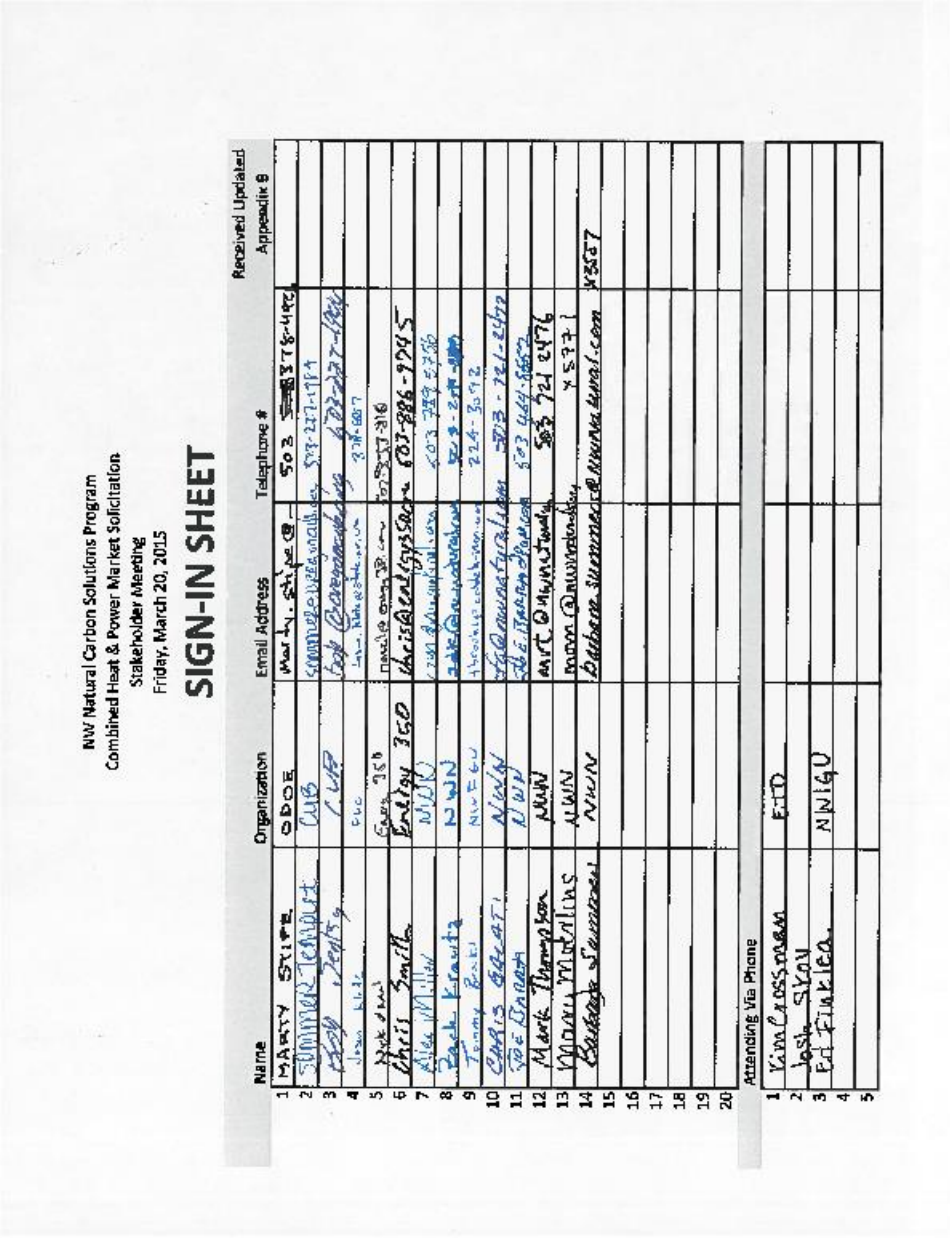
March 20, 2015

2:00 pm- 4:00 pm NW Natural Offices

Agenda

Topic	Lead
Potential ways to Abuse the Program and Solutions (Revised Appendix A) Disguised use of waste heat Removal of T&D losses if sell back to grid	Energy 350 Summers
"eGrid Only" versus "eGrid Plus Up and Down Stream Emissions" (Revised Appendix B)	Energy 350/Skov
Potential Alternative Incentive Structures	Summers
Updated Financial Plan and Budget (Revised Appendix C) Limited marketing costs to years 1-4	Summers
Measurement and Verification Meeting Scheduling	Energy 350
NW Natural incentives	Thompson
Summary of Open Issues and Discussion of Filing Readiness; Next Steps	Summers

Appendix G: Stakeholder Meetings Agendas and Sign-In Sheets



NW Natural Carbon Solutions Program
Combined Heat & Power Market Solicitation
Stakeholder Meeting
Friday, March 20, 2015

SIGN-IN SHEET

	Name	Organization	Email Address	Telephone #	Received Updated Appendix G
1	MARTY STUPEL	ODOE		503	
2	Summer Templet	CUB		503-227-1984	
3	Cody Wells	CUB		503-227-1984	
4					
5					
6	Chris Swift	Energy 350		503-896-9045	
7		NWEC			
8		NWN			
9					
10		NWN			
11		NWN			
12		NWN		503 721 2476	
13		NWN		x5321	
14		NWN		x2587	
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Attending Via Phone

1		ETO			
2					
3		NWN&U			
4					
5					

Meeting Agenda- 3

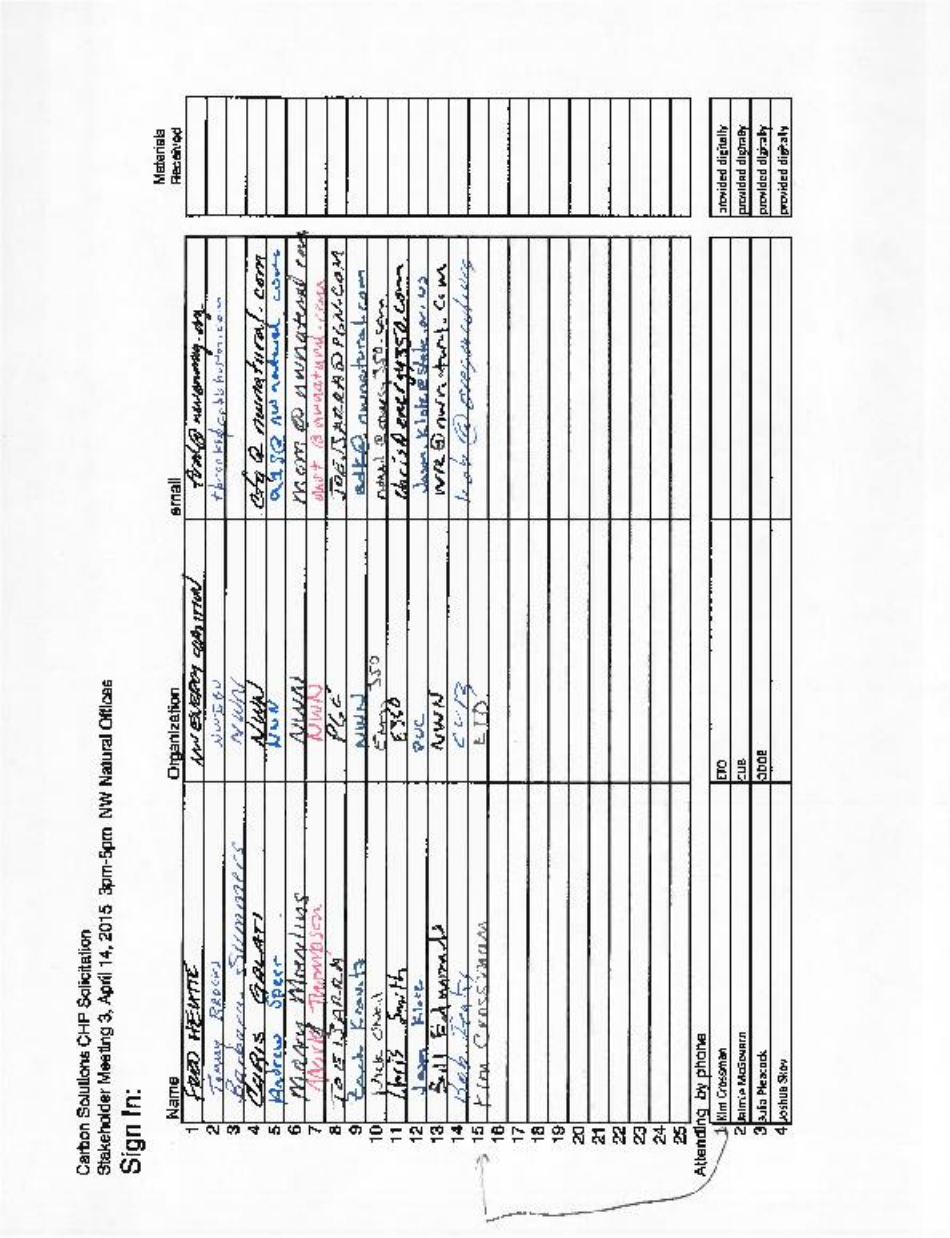
April 14, 2015

3:00 pm-5:00pm NW Natural Offices

Discussion Topics:

1. Climate Action Reserve, Letter of Opinion, NWN's CHP M&V Specification (Energy 350)
2. Emission Follow Up – Consideration of Upstream Electricity Emissions Compared to Off-Site Natural Gas Emissions (Including Distribution System Emissions) (Summers/WSU)
3. Final Proposed Customer Incentive/Design (Summers)
4. Final Proposed NWN Incentive/Design (Thompson/Speer)
5. Customer Rate Impact (Speer)
6. Next Steps (Summers)

Appendix G: Stakeholder Meetings Agendas and Sign-In Sheets



Carbon Solutions CHP Solicitation
Stakeholder Meeting 3, April 14, 2015 3pm-5pm NW Natural Offices

Sign In:

	Name	Organization	email	Materials Received
1	[illegible]	[illegible]	[illegible]	
2	[illegible]	[illegible]	[illegible]	
3	[illegible]	[illegible]	[illegible]	
4	[illegible]	[illegible]	[illegible]	
5	[illegible]	[illegible]	[illegible]	
6	[illegible]	[illegible]	[illegible]	
7	[illegible]	[illegible]	[illegible]	
8	[illegible]	[illegible]	[illegible]	
9	[illegible]	[illegible]	[illegible]	
10	[illegible]	[illegible]	[illegible]	
11	[illegible]	[illegible]	[illegible]	
12	[illegible]	[illegible]	[illegible]	
13	[illegible]	[illegible]	[illegible]	
14	[illegible]	[illegible]	[illegible]	
15	[illegible]	[illegible]	[illegible]	
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Attending by phone

1	Kim Crossman	EPD	provided digitally
2	Jaimie McGowan	CUB	provided digitally
3	Julia Peacock	ODOE	provided digitally
4	Joshua Stoy		provided digitally

Meeting Agenda

Carbon Solutions : Monitoring and Verification Plan Review

June 9, 2015

3:00 pm-4:30 pm NW Natural Offices

Meeting Goal:

1. Answer any remaining stakeholder questions pertaining to structure of M&V plan (Facilitated by Energy 350 and NW Natural)
2. Review of CAR and Energy 350 analysis and summary of Monitoring and Verification Program

Appendix G: Stakeholder Meetings
Agendas and Sign-In Sheets

Carbon Solutions CHP
Special Meeting- CHP M&V Review, June 3:00 pm NW Natural Offices

Sign In:

	Name	Organization	email
1	Bob Jenks	CUB	bob@oregoncub.org
2	Nick O'Neil	ENERGY 350	noneil@energy350.com
3	MARTY STIPE	ODOE	marty.stipe@state.or.us
4	Barbara Summers	NWN	b3c@nwnatural.com
5	Jason Salmi Klotz	PUC	jason.klotz@state.or.us
6	Jessica Shipley	ODOE	jessica.shipley@state.or.us
7	Zach Krantz	NWN	zdk@nwnatural.com
8	Joe Barra	PGE	joe.barra@pgn.com
9	Mary Moerlins	NWN	marymoerlins@nwnatural.com
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Attending by phone

1	Josh Skov		
2	Ed Finklea	NWIGU	
3			
4			

Appendix H

Energy 350 Overview

STATEMENT OF QUALIFICATIONS – COMBINED HEAT AND POWER (CHP)

CASE STUDY – CHP PROGRAM ASSISTANCE FOR ENERGY TRUST OF OREGON

We recently completed a project with Energy Trust of Oregon to assist them with documenting technical program requirements and developing program materials. These included documentation of performance requirements, analytical requirements (CHP study framework), development of a CHP technical primer, and a program sorting matrix to determine which program is best suited to handle any given project.

Now as program participation ramps up, we're supporting Energy Trust by conducting project reviews, technical analysis studies and Measurement & Verification (M&V). For more information on Energy Trust of Oregon's programs, visit www.energytrust.org.

About Energy 350

Energy 350 is an energy efficiency consulting company based in Portland, OR. Energy 350 specializes in energy programs, energy policy, energy engineering and Measurement & Verification (M&V). We focus on complex systems analysis in the Commercial and Industrial sectors. We are experts in industrial processes in heavy industry such as pulp & paper, wood products, water & wastewater, metals, plastics, high-tech, food processing. Our staff includes Professional Engineers (PE), Certified Energy Managers (CEM), Certified Demand Side Managers (CDSM), Certified Commissioning Agents (CxA) and LEED Accredited Professionals (LEED AP).

Combined Heat and Power (CHP) Expertise

Our staff have analyzed, overseen the installation of, and secured incentives for over a dozen CHP systems. Additionally, we have developed, implemented and assisted with CHP programs nationally. We are able to dive deep on system operation, thermal load analysis, energy mapping and balancing, etc. We have a deep toolbox of submetering equipment to gain detailed insight on thermal and electric load profiles, down to the minute. This allows us to understand the coincidence of thermal and electric loads and accurately analyze the operation of CHP systems before they're installed.

Measurement and Verification (M&V) Expertise

We have the equipment and expertise to accurately measure and verify real world performance of CHP systems. By measuring fuel in, electricity out, heat recovered, heat rejected and parasitic electric use, we can conduct a full energy balance on the system. This allows us to analyze performance in any number of ways such as total system efficiency, fuel chargeable to power, and bottom line $ impacts. Additionally, M&V often reveals opportunity to optimize systems for increased performance.

BEFORE THE

PUBLIC UTILITY COMMISSION OF OREGON

———

NW Natural

Direct Testimony of Andrew Speer

Carbon Emission Reduction Program
Combined Heat & Power (CHP)
Cost Recovery

June 24, 2015

Table of Contents

I. INTRODUCTION

Q. Please state your name and position with Northwest Natural Gas Company ("NW Natural" or the "Company").

A. My name is Andrew Speer. My business address is 220 NW Second Avenue, Portland, Oregon 97209. My current position is Rates and Regulatory Analyst for Northwest Natural Gas Company, d/b/a NW Natural ("NW Natural" or the "Company").

Q. Please summarize your educational background and business experience.

A. Prior to joining the Company as a Rates and Regulatory Analyst, I was employed at the Bonneville Power Administration (BPA) for five years and held similar positions as an Industry Economist in Power Policy & Rates, Risk Analyst in Enterprise Risk Management, and Account Specialist on BPA's trading floor responsible for evaluating the economic impact of long-term power purchase transactions. I have both a BS and MS in Economics from Portland State University.

Q. What is the purpose of your testimony?

A. The purpose of my testimony is to describe the benefits associated with the addition of combined heat & power (CHP) to NW Natural's system and to explain the proposed ratemaking related to the Company's Application for Approval of NW Natural's Combined Heat and Power Solicitation Program (the "CHP Program").

II. CHP SYSTEM BENEFITS AND COST TREATMENT

Q. What are the benefit(s) associated with the CHP program?

A. The installation of CHP units in NW Natural's service territory will increase the Company's system loads (or throughput) from the addition of incremental load

from CHP. The increased throughput will have the impact of providing a larger base over which system costs can be spread, resulting in a reduction of average system cost [total system cost / total system load] . Additionally, CHP units are a high load factor load for the Company, and provide the Company with a reliable load since the actual load is expected to coincide with the forecasted load. In addition to the "System Benefits," , individual participating customers may benefit from the program through reduced energy costs they realize after the installation of CHP.

Q. Can you quantify the benefit associated with the additional throughput from CHP?

A. The actual benefit will depend on the amount of CHP installed, and the actual usage for each CHP installation. The Company evaluated the marginal system benefit assuming the installation of a CHP plant of 10 MW, which is in the mid-range of evaluated potential plants, and incremental usage of 4,574,607 therms, and assuming the customer is served under the firm transportation provision of Rate Schedule 32. The analysis also assumes that the CHP participant is an existing customer and already taking full gas service under blocks 1 & 2. The calculated margin includes the margin rate for blocks 3, 4 & 5 as well as the firm service distribution capacity charge. The system benefit is calculated assuming the 10 MW CHP resource and illustrates the benefit (in the form of increased margin and capacity charges that will offset system costs otherwise allocated to other customers) that would result from usage at 4,574,607 level.

Installed Capacity (MW)	Incremental Usage	Total Margin
10	4,574,607	$ 136,283

Q. What class(es) of customers will benefit from the CHP program?

A. Residential, commercial, and industrial customer classes will all benefit from the increased throughput on NW Natural's system because the additional throughput on the system will reduce the average system costs for all rate classes.

Q. How are program costs treated for rate making purposes?

A. The program design and costs have no associated capital costs or investments. All costs are considered 'O&M' related costs which receive no rate of return. As a result, the deferral and amortization of program costs will allow full recovery of the costs.

III. RATE SPREAD AND IMPACT

Q. How will the Company allocate CHP costs?

A. Because all customer classes benefit from the CHP program, CHP costs will be allocated to all rate schedules and customer classes.

Q. What is the methodology used to allocate CHP program costs to rate schedules?

A. The Company proposes using equal percent of margin to allocate annual CHP costs to individual rate schedules. The equal percent of margin calculation allocates incremental revenue by calculating a percent of margin (margin by rate schedule divided by total margin) 'scalar' and multiplying the margin scalar by the total incremental revenue. The Company utilizes an equal percent of margin methodology to allocate costs annually. This is a common ratemaking methodology, which is also used to develop certain rates forthe Purchased Gas Cost Adjustment (PGA) filing. Because the benefit will be experienced through a reduction to the margin that needs to be collected from all customers, allocating out the costs on an equal percent of margin to all customer classes/rate schedules is appropriate.

Q. What program years did the Company analyze for CHP costs and rate impact?

A. In Appendix C of the CHP Business Plan (*see NWN 100/Summers/52-55*), the Company analyzed the Program's highest year spend given baseline case assumptions to evaluate what the greatest incremental impact to customer rates would be in any single year over the life of the CHP Program. For purposes of this filing, the rate impact analysis included the Program costs at year 4, which under the Company's forecast, is the peak of the program costs on an annual basis.

Q. Based on the Program's highest spend year and baseline assumptions, what is the incremental rate impact by customer class?

A. The rate impact by customer class is:

Customer Class	Incremental Rate Increase ($/Therm)
Residential	$0.03400
Commercial	$0.10203
Industrial	$0.13995

This reflects a total dollar amount of program costs of $10,177,178.00 in that year.

IV. COST RECOVERY

Q. How does the Company propose to recover expenses of the Program in rates?

A. The Company proposes to defer the expenses related to the program on an annual basis for later recovery in rates. Upon approval of the Program, the Company will file a deferral application for CHP Program costs. NW Natural

believes that recovery of the deferred expenses can be accomplished by including the amortization of deferred amounts in rates coincident with its annual PGA filing. Amounts deferred would be subject to review during the normal PGA process, when other deferred accounts are reviewed.

Q. Does this conclude your testimony?

A. Yes.