AL BROGAN
NorthWestern Energy
208 North Montana Avenue
Suite 205
Helena, Montana 59601
Telephone (406) 443-8903
Fax (406) 443-8979
al.brogan@northwestern.com

SARAH NORCOTT
NorthWestern Energy
208 N. Montana Avenue
Suite 205
Helena, Montana 59601
Telephone (406) 443-8996
Fax (406) 443-8979
sarah.norcott@northwestern.com

DEPARTMENT OF PUBLIC SERVICE REGULATION
BEFORE THE PUBLIC SERVICE COMMISSION
OF THE STATE OF MONTANA

IN THE MATTER OF NorthWestern Energy's Application for Approval to Purchase and Operate PPL Montana's Hydroelectric Facilities, for Approval of Inclusion of Generation Asset and Cost of Service in Electricity Supply Rates, for Approval of Issuance of Securities to Complete the Purchase, and for Related Relief	))))))))	REGULATORY DIVISION DOCKET NO. D2013.12.85

NorthWestern Energy's Motion for Leave to Respond to Evergreen Economics' Memorandum

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NorthWestern Corporation, d/b/a NorthWestern Energy ("NorthWestern"), moves the Montana Public Service Commission ("Commission") for leave to respond to the Evergreen

Economics' Memorandum re: Adequacy Assessment of NWE Application to Purchase Hydroelectric Facilities dated January 24, 2014 ("Memorandum").

On December 20, 2013, NorthWestern filed its Application in this docket. Section 69-8-421(2), MCA, requires the Commission to "determine whether or not a utility's application for approval of an electricity supply resource is adequate and in compliance with the commission's minimum filing requirements." The statute also provides, "If the commission determines that the application is inadequate, it shall explain the deficiencies." Section 69-8-421(10), MCA, permits the Commission to "engage independent engineering, financial, and management consultants or advisory services to evaluate a public utility's electricity supply resource procurement plans and proposed electricity supply resources." The Commission engaged Evergreen Economics ("Evergreen") to assist the Commission staff in reviewing analysis conducted by NorthWestern. Memorandum, p. 1. On January 24, 2014, Evergreen provided the Memorandum to the Commission. The Commission posted the Memorandum on its website on January 27, 2014. Evergreen concluded, "we believe the application and supporting documents fall short of providing the PSC with all of the information necessary to evaluate NWE's application." Memorandum, p. 9. NorthWestern disagrees with this conclusion.

The Commission's administrative rules do not address responses to advice or advocacy provided by its consultants. However, a determination of adequacy/inadequacy is a critical decision in the processing of a contested case. NorthWestern encourages the Commission to accept such responses where they provide information that assists the Commission in its decision-making process.[1] Such circumstances exist here, because NorthWestern's response will

[1] Acceptance of such responses would be consistent with other regulatory bodies' practice. For example the Federal Energy Regulatory Commission's ("FERC") Rules of Practice prohibit answers to protests, but, FERC often accepts answers to protests when additional information will assist it in its decision making. *See, e.g., Columbia Gulf Transmission Co.*, 127 FERC ¶ 61,085, at P 3 (2009) ("While the [FERC]'s regulations do not permit the filing of

provide the Commission with additional information that will fully inform its decision-making. Working cooperatively, NorthWestern and members of the Commission's staff discussed the type of responses, information and/or data required to properly address the various conclusions and request for information in Evergreen's Memorandum. The Commission's staff attorney agreed that a motion for leave to respond, such as this motion, and a response were the proper methods to provide the Commission the information and/or data required to enable it to address the issues. NorthWestern thus respectfully requests the Commission grant this Motion for Leave to Respond and accept the response attached hereto.

Counsel for NorthWestern has contacted by email the parties' counsel of record about this motion. Counsel for the Montana Consumer Counsel, for the Montana Large Customer Group, and for Human Resource Council, District XI/Natural Resource Council/Renewable Northwest Project have indicated that they have no objection to NorthWestern responding to Evergreen's Memorandum. Counsel for the other parties have not responded to NorthWestern's counsel's email inquiry.

RESPECTFULLY SUBMITTED this 29th day of January 2014

NORTHWESTERN ENERGY

By: [signature]

Al Brogan
Sarah Norcott
NorthWestern Energy
Attorneys for NorthWestern Energy

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answers to protests, the [FERC] grants Columbia Gulf's request for leave to answer because it provides additional information that will aid in our decision making process.") (internal citations omitted); *ISO New England, Inc.*, 105 FERC ¶ 61,263 at P 10 (2003) ("Notwithstanding that Rule 213 of [FERC]'s Rules of Practice and Procedure . . . generally prohibits the filing of an answer to a protest, we find that good cause exists to grant Devon and ISO-NE's answers as they assisted in our understanding and resolution of the issues."), *reh'g denied*, 107 FERC ¶ 61,234 (2004).

CERTIFICATE OF SERVICE

I hereby certify that a copy of NorthWestern Energy's Motion for Leave to Respond to Evergreen Economics' Memorandum in Docket D2013.12.85 has been hand delivered to The Montana Public Service Commission (MPSC) and The Montana Consumer Counsel. A copy has been served on the most recent service in this Docket by mailing a copy, thereof, by first class mail, postage prepaid. A copy has been e-filed on the MPSC website. A copy will as be emailed to the counsel of record.

Date: January 29, 2014

Nedra Chase
Administrative Assistant
Regulatory Affairs

Docket No D2013.12.85
Hydro Assets Purchase
Service List

Joe Schwartzenberger
NorthWestern Energy
40 E Broadway
Butte MT 59701

Patrick R Corcoran
NorthWestern Energy
40 E Broadway
Butte MT 59701

Nedra Chase
NorthWestern Energy
40 E Broadway
Butte MT 59701

Al Brogan
NorthWestern Energy
208 N Montana Ave Suite 205
Helena MT 59601

Sarah Norcott
NorthWestern Energy
208 N Montana Ave Suite 205
Helena MT 59601

Kate Whitney
Montana Public Service Commission
1701 Prospect Ave Box 202601
Helena MT 59620-2601

Robert A Nelson
Montana Consumer Counsel
111 North Last Chance Gulch Ste1B
Helena MT 59620-1703

John W Wilson
J W Wilson & Associates
1601 N Kent Ste 1104
Arlington VA 22209

Albert E Clark
2871 Conway Rd. 127
Orlando FL 32815

Michael J Uda
Uda Law Firm, P C
7W 6th Ave Suite 4E
Helena MT 59601

Roger Kirk/Ben Singer
Hydrodynamics Inc
521 E Peach Suite 2B
Bozeman MT 59715

Joe Hovenkotter Gen Counsel
Energy Keepers Inc
110 Main Street Suite 304
Polson MT 59860

Ranald McDonald
CSKT Tribal Legal Dept
P O Box 278
Pablo MT 59855

Thorvald Nelson
Holland & Hart LLP
6380 South Fiddlers Green Circle
Suite 500
Greenwood Village CO 80111

Nikolas Stoffel
Holland & Hart LLP
6380 South Fiddlers Green Circle
Suite 500
Greenwood Village CO 80111

Charles Magraw
501 8th Ave
Helena MT 59601

Dr Thomas Power
920 Evans
Missoula MT 59801

Fred Szufnarowski
Essex Partnership, LLC
65 Main St. Suite 22
Ivoryton, CT 06442

NorthWestern Energy
Docket D2013.12.85
PPLM Hydro Assets Purchase

NorthWestern Energy Response and Supplemental Information
to the Montana Public Service Commission
regarding the Evergreen Economics Memorandum dated January 24, 2014 titled

"Adequacy of NWE Application to Purchase Hydroelectric Facilities Memorandum"

As a result of discussions with members of the Staff of the Montana Public Service Commission ("Staff") on Friday January 24, 2014 regarding the Evergreen Economics ("Evergreen") Memorandum, NorthWestern and the Staff discussed the type of responses, information and/or data required to properly address the various conclusions and request for information in Evergreen's Memorandum. To that end NorthWestern provides this narrative and the attachments as supplemental information to the Montana Public Service Commission ("Commission") and its Staff in advance of a Commission Work Session regarding Evergreen's Memorandum, in order to aid in ensuring that NorthWestern's filing is adequate at this stage of the Commission's review.

The information contained below is in response to the areas of concern identified by Evergreen in Section B of their Memorandum labelled – "Adequacy of NWE's Application." This response is also guided by our focused discussions with Staff regarding Evergreens review of NorthWestern's application to the Commission for approval to purchase the PPL Montana Hydroelectric Facilities ("Hydros") and NorthWestern's 2013 Electricity Supply Resource Procurement Plan.

The following response are provided and organized by the respective bolded sub-sections of Section B of the Evergreen Memorandum:

B.1. Clarification of Key Input

Carbon

While the January 24, 2014 MPSC Staff discussion did not identify the treatment of carbon in the 2013 Plan as a deficiency for planning purposes, Evergreens' Memorandum specifically noted that:

> *"We believe the Commission would benefit from a discussion of NWE's view on the risk associated with investing in carbon-emitting generation, including recent decisions and/or public statements by the company that are consistent with the carbon tax assumptions used in the 2013 Resource Procurement Plan (RPP)."*

NorthWestern Supplemental Information:

NorthWestern monitors developments associated with the regulation of carbon emissions and industry trends, including other utilities treatment of carbon in their plans. NorthWestern's resource procurement planning has identified natural gas-fired resources as preferred resources when considering portfolio needs and the costs and risks associated with these resources. As a new-build alternative, the potential cost of gas-fired generation is considered in the context of potential added costs due to the implementation of carbon penalties versus the resource value and attributes that could be realized for the portfolio under a variety of load and resource conditions. NorthWestern's decision to continue to evaluate gas-fired generation is done so in recognition of the state of regulation of carbon.

NorthWestern's position concerning the risk associated with carbon-emitting generation resources is clearly illustrated by the treatment of carbon in the 2013 Plan. As a formal public document the 2013 Plan is reflective of NorthWestern's views, over a long-term planning horizon, of the issues facing the utility and retail customers. Reflective of the importance of potential future costs associated with carbon, the treatment of carbon for portfolio modeling purposes has been expanded in the 2013 Plan to include carbon costs as a stochastic (rather than fixed-cost) variable to examine cost impacts across a range of possible cost trajectories. Because of the uncertainty associated with the precise timing and magnitude of future carbon costs NorthWestern carefully considered the methods used to assess carbon in its resource planning work. The methods adopted for use in the 2013 Plan are appropriate and consistent with planning rules contained within ARM 38.5.8201-8229.

The 2013 Plan demonstrates carbon in the full context of the supply portfolio. In comments provided on the 2011 Plan, the Commission provided one comment to help guide NorthWestern in its future treatment of carbon in resource procurement planning activities:

> "*NWE's base case assumes that, sometime in the future, carbon dioxide emissions will be priced under federal law or rules promulgated by the Environmental Protection Agency. This is a possibility over which the Commission and the utility have little or no power, and it is correct practice to analyze the planning impacts of carbon regulation. The base case's 2015 carbon price implementation date is increasingly unrealistic in light of the delays associated with such regulations as the Mercury and Air Toxics Standard and the various state Regional Haze Rules. NWE should revisit the timing of potential future carbon prices in its 2013 Plan.*"

Partially as a result of the Commission's comment, the carbon update(s) to NorthWestern's 2013 Plan included moving the carbon price implementation date to 2021 at the earliest.

NorthWestern's testimony in Docket No. D2013.12.85 also addresses carbon related to planning and the acquisition of the Hydros, in particular in the testimony of:

1. Bob Rowe general reference on Page RCR-8;
2. John Hines detailed discussions on Pages:
    a. JDH 14-15;
    b. JDH-20;
    c. JDH-36;
    d. JDH 43-45; and
    e. JDH-51; and

3. Joe Stimatz references on Pages:
    a. JMS-20-21;
    b. JMS 24-28; and
    c. JMS 31-32.

Weighted Average Cost of Capital (WACC) Assumed in the Analysis

While Evergreen did not find the 7.14 percent value of the WACC to be unreasonable, it pointed out that it was 0.78 percentage points (78 basis points) below the discount rate of 7.92 percent used in NWE's 2011 RPP, and that all else constant, a lower discount rate results in higher calculated NPV. Therefore they suggested:

> *"A brief discussion of the conditions (seemingly in the bond and equity markets) that led to this reduction between 2011 and 2013 would be beneficial."*

NorthWestern Supplemental Information:

The 7.92% WACC used in NorthWestern's 2011 Plan was the Company's latest authorized electric utility Rate of Return granted in the 2009 Electric Transmission and Distribution Rate Filing. The 7.14% Rate of Return proposed for the Hydros is based on the capital structure expected for the financing of the hydro facility, the anticipated cost of debt for the debt financing, and the ROE we expect investors to require for this type of investment. This figure was also used in the 2013 Resource Plan. The details for the calculations are presented below:

NorthWestern 2011 Resource Plan Rate of Return (latest authorized Rate of Return at the time):

	Capital Structure	Cost %	
Debt	52%	5.76%	(NWE's overall actual cost of debt for the utility in 2009)
Equity	48%	10.25%	
Rate of Return		7.92%	

NorthWestern 2013 Resource Plan Rate of Return (See Table 6-2, pages 6-25)

	Capital Structure	Cost %	
Debt	52%	4.50%	(Expected cost of debt specifically for the financing of the Hydro acquisition, lower than the 5.76% above due to lower borrowing cost available in the market today)
Equity	48%	10.00%	(Lower than 10.25% to reflect lower average authorized ROEs in the market today; NWE was granted 9.8% ROE in the 2012 natural gas rate case, since electric utility generally carries more risk than natural gas, a 20 bps premium is added to 9.8%)
Rate of Return		7.14%	

B.2. Sources of Electrical Generation Cost Inputs

The section of Evergreen Memorandum addressed the costs considered in NorthWestern's 2013 Plan and with regard to those cost they point out that:

> *"NWE does not provide sources of the cost information for the hydro or other generating assets, making it difficult to assess if these costs are reasonable.[5] The RPP is also not clear as to whether the costs associated with the hydro facilities enter the portfolio analysis as fixed values or as stochastic values drawn from a distribution developed from historical cost data."*

NorthWestern Supplemental Information:

NorthWestern has enclosed an copy of NorthWestern's 2013 Plan Resource Cost Sources (See Attachment 3) that contains the information from the 2013 Plan that we discussed with the MPSC Staff on January 24, 2014 in response to this item in the Evergreen Memorandum. This information was also included as part of NorthWestern's recent response to MPSC Data Request No. PSC-048b. The first tab/page in the Workbook and Attachment 3 contains a summary of the "sources of the cost information", which is as follows:

NorthWestern Energy 2013 Resource Procurement Plan
Resource Cost Summary
(2013$)

Resource Description	Fuel Source	Technology	Nameplate Capacity (MW)	Net Capacity @ 3,500 feet (MW)	Capital Cost $ / kW	Fixed O&M $ / kW-yr	Variable O&M $ / MWh	Heat Rate Btu / kWh	Source Capital / FOM / VOM
CCCT (1x1)	Natural Gas	GE 7FA.04 ACC[1]	270	239	$1,425	$13.94	$3.60	6,660	ID Power 2012 Langley Gulch / Pacificorp 2013 IRP
SCCT - Small Aeroderivative	Natural Gas	PW FT8	60	53	$917	$6.05	$4.60	10,500	NWE 2012 Aberdeen peaker
SCCT - Large Aeroderivative	Natural Gas	GE LMS100	110	97	$1,087	$17.06	$3.47	8,722	Pacificorp 2013 IRP
SCCT - Frame	Natural Gas	GE 7EA	90	78	$897	$11.73	$3.20	11,289	Avista 2013 IRP
Internal Combustion - Recips	Natural Gas	CAT G16CM34	54	52	$1,402	$18.39	$8.15	9,078	Pacificorp 2013 IRP
Solar PV	Solar		10	10	$3,136	$27.00	$0.00	n/a	ID Power 2013 IRP
Wind[2]	Wind		25	25	$1,524	$49.18	$0.00	n/a	NWE 2012 CREP RFP
Hydro - Montana Large Scale[3]	Water		439	439	$1,982	$52.58	$0.00	n/a	NWE 2013 hydro acquisition

[1] ACC = Air Cooled Condenser
[2] Based on build-transfer bids received in NWE's 2012 CREP RFP
[3] Excludes KERR costs and capacity

B.3. Adequacy of the Three Portfolios as a Set of Feasible Alternatives

This section of the Evergreen Memorandum contains the more substantive discussion of their review, and was the primary focus of the January 24, 2014 discussion with Staff. In particular, Evergreen points out that:

> *"We do not believe that NWE needs to conduct a thorough portfolio analysis in PowerSimm on each of the alternative portfolios considered in the 2011 RPP in order to provide the PSC with the information required in ARM 38.5.8228. However, we do believe it is necessary for NWE to either conduct analysis in PowerSimm on a small number of additional alternative portfolios or describe in detail why considering such additional portfolios would not be competitive against the hydro portfolio and, therefore, need not be considered."*

This Section also largely resulted in MPSC Data Request No. 47 to NorthWestern, which reads as follows:

PSC-047
Regarding: 2013 Resource Plan, Alternatives to Hydros
Witness: Fine

Please provide PowerSimm model results for the following resource portfolios and carbon cost input assumptions:

a. Portfolios:
   1. Current + 1 PW FT8 SCCT in 2020
   2. Current + 2 PW FT8 SCCT in 2020
   3. Current + 1 GE LMS 100 SCCT in 2020
   4. Current + 1 GE 7FA.04 ACC in 2020
   5. Current + 1 PW FT8 SCCT in 2020 + 100 MW wind in 2020
   6. Current + 2 PW FT8 SCCT in 2020 + 100 MW wind in 2020
   7. Current + 1 GE LMS 100 SCCT in 2020 + 100 MW wind in 2020
   8. Current + 1 GE 7FA.04 ACC in 2020 + 100 MW wind in 2020
b. Carbon cost input assumptions:
   1. Model all portfolios (including those above) with an initial carbon cost distribution mean of $15/ton and max of $30/ton starting in 2021
   2. Model all portfolios (including those above) with an initial carbon cost distribution mean of $10/ton and max of $20/ton starting in 2021
   3. Model all portfolios (including those above) with an initial carbon cost distribution mean of $15/ton and max of $30/ton starting in 2026
   4. Model all portfolios (including those above) with an initial carbon cost distribution mean of $10/ton and max of $20/ton starting in 2026
   5. Model all portfolios (including those above) without incorporating carbon emission costs

Summarize the modeling results in tables similar to Figure 6-1, p. 6-5, in Volume 1 of the 2013 Electricity Supply Resource Procurement Plan (2013 Plan). Provide detailed results similar to those included in Volume 2, Chapter 4, of the 2013 Plan.

NorthWestern's January 24, 2014 response to this data request reads as follows:

"NorthWestern is working with the Commission staff to narrow the scope of this data request. NorthWestern understands that staff's consideration is being informed by the Commission's consultant's report and that some delays have been caused by this. NorthWestern is confident that it and the staff will be able to reach an agreement on the proper scope. However, to avoid waiving any objection, NorthWestern objects to this data request because it is beyond the proper scope of data requests in that it requires

NorthWestern to undertake an analysis that it did not make in evaluating the acquisition or preparing its Application and to produce documents that do not currently exist. NorthWestern further objects that this data request is unreasonable and unduly burdensome in that it will require NorthWestern to incur significant expense to respond."

NorthWestern has also provided the Commission with the following response to MPSC Data Request No. PSC-067, which is also related to the above Evergreen comment:

PSC-067
Regarding: Modeled Resource Portfolios
Witness: Dave Fine

Explain why NorthWestern did not model the resource portfolios defined in data request PSC-047a, or similarly structured portfolios, in its 2013 resource plan given that NorthWestern's 2011 resource plan concluded that similar portfolios were preferred (see Table 31, 2011 Electricity Supply Resource Procurement Plan, Volume 1, p. 185)?

RESPONSE (January 17, 2014):

NorthWestern did not model these resource portfolios primarily due to the following three items:

1. The timing of implementing new electricity supply procurement modeling software (Ascend Analytics PowerSimm Modeling Software);
2. NorthWestern's empirical knowledge and experience that the resource portfolios in question from the 2011 Plan would have produced similar results in the 2013 Plan; and,
3. The evolution and timing of the PPL Montana Hydros acquisition, including the use of PowerSimm and Ascend Analytics to simultaneously prepare the filing.

Along with the implementation, training and conversion to PowerSimm, NorthWestern and its modeling consultant Ascend Analytics faced numerous challenges in the fourth quarter of 2013 to complete the work necessary to support the filing of the 2013 Plan and the hydro application. With the simultaneous advent of the acquisition of the PPL Montana Hydros, including the hydro resources into the PowerSimm model caused NorthWestern to focus its efforts on evaluating the CCCT option which had been identified in the 2011 Plan as a preferred resource. In evaluating and considering resource planning alternatives to the baseload hydro assets to include in the 2013 Plan, NorthWestern, with the input of its advisors, only selected the CCCT because we already knew from the 2011 Plan that it was the most competitive new baseload thermal option to compare to the hydro resource alternative.

Therefore, given the timing, NorthWestern relied on its empirical knowledge and experience that the resource portfolios in question from the 2011 Plan would have produced similar results in the 2013 Plan and chose not to model and include these particular portfolios in the 2013 Plan.

As a result of the January 24, 2014 discussion with Staff regarding this section of the Evergreen Memorandum and NorthWestern's response to MPSC No. PSC-047 we agreed to the following:

For MPSC Data Request No. PSC-047, we agreed to limit and provide PowerSimm modeling results for only portfolio numbers 3, 7 and 8, as modified below:

3. Current + 1 GE LMS 100 SCCT in 2018
7. Current + 1 GE LMS 100 SCCT in 2025 + 100 MW wind in 2025
8. Current + 1 GE 7FA.04 ACC in 2025 + 100 MW wind in 2025

Per our discussion, the three additional portfolios will be run in stochastic modes and will be based on the same set of carbon assumptions used in the 2013 Plan. This consistency will allow results of the additional modeling to be compared with the earlier modeling results as included in both the 2103 Plan and the Hydros application.

Finally, **NorthWestern has already started working on these additional portfolio runs, which we currently expect to be completed as soon as possible and provided no later than February 14, 2014.**

As discussed with Commission Staff on January 24, 2014, the following provides additional background with regard to the preparation of the three additional portfolios listed above and "Section B.3. Adequacy of the Three Portfolios as a Set of Feasible Alternatives" in the Evergreen Memorandum:

1) Additional wind resources must be carefully considered in the context of the current portfolio and according to the needs of the portfolio. Currently, NorthWestern has approximately 270MW of wind generation under long-term contract; including two 20MW projects placed under contract late in 2013. The eligible wind resources, when combined with eligible small hydro resources, are expected to produce energy and associated renewable energy credits in sufficient quantity to allow NorthWestern to meet Montana RPS through the late 2020s. CREP requirements may also be satisfied by some of these same resources if the Commission qualifies them. The PowerSimm model used in the 2013 Plan includes incremental wind resources sufficient to meet annual RPS for the planning horizon.

2) The 2013 Plan focuses on plausible new generation resources to serve retail load as described in Chapters 1 and 5. The 2013 modeling and evaluation work builds upon the conclusions reached in prior resource procurement planning cycles (and most recently the 2011 Plan) where gas-fired resources were clearly identified as preferred resources because of their cost and risk attributes compared to other resource alternatives. When considering resource alternatives in earlier resource planning work NorthWestern included technologies with limited commercial deployment and operating history. This is the case with both supercritical coal and integrated gasification combined cycle ("IGCC"). Neither of these technologies currently provides NorthWestern a proven low-cost, low-risk resource alternative based on published information including sources such as the Energy Information Administration and limited empirical project data. NorthWestern is not positioned nor should it consider moving

forward with combustion technologies unless they can clearly be shown to be a low-cost, low risk alternative (See Attachment A, which includes EIA Updated Capital Cost Estimates for Utility Scale Electricity Generating Plants, April 2013). If a new-build coal combustion facility (including supercritical coal or IGCC) is placed into service in Montana by NorthWestern it will be required to capture a minimum of 50% of the carbon dioxide emissions which will substantially increase the capital and operating costs of the facility (MCA 69-8-421(8); see citation below).

> *"Until the state or federal government has adopted uniformly applicable statewide standards for the capture and sequestration of carbon dioxide, the commission may not approve an application for the acquisition of an equity interest or lease in a facility or equipment used to generate electricity that is primarily fueled by coal and that is constructed after January 1, 2007, unless the facility or equipment captures and sequesters a minimum of 50% of the carbon dioxide produced by the facility. Carbon dioxide captured by a facility or equipment may be sequestered offsite from the facility or equipment."*

3) As discussed with Staff, while it was unnecessary to further model each of the additional alternative generation technologies in which Evergreen expressed interest in its Memorandum, it was necessary to address each of the alternative technologies. There is basically no need to conduct further modeling due to the progression of the choice of generation technologies in NorthWestern's respective biennial planning cycles (in particular the 2011 Plan), comments from the Commission regarding previous plans, and the related advice of NorthWestern's Technical Advisory Committee. This is reinforced by the basic cost information that supports a high-level elimination of uneconomic resources.

   As a brief summary with this in mind, NorthWestern notes the following for each of the alternative generation technologies listed by Evergreen:

   a. **Simple Cycle Combustion Turbine (SCCT) –** as discussed above, two additional portfolio runs will be conducted to assess the performance of simple cycle gas-fired technology and to compare the results with the other portfolios. One of these portfolios also includes 100MW of additional wind resource placed into service at the same time the SCCT is added in 2025.
   b. **Supercritical Coal –** This technology does not offer a cost-effective or commercially proven alternative for NorthWestern to pursue in Montana. The required addition of carbon capture and sequestration ("CCS") equipment currently renders this technology uneconomic compared to the alternatives. Reference the attached from the 2011 Plan for additional information. No addition portfolio runs will be performed.
   c. **Integrated Gasification Combined Cycle –** If fueled by coal, IGCC in Montana would also be required to install CCS which would make it economically unattractive. Other sources of fuel that can be used to produce synthetic gas create substantial uncertainty for fuel supply in terms of cost and source.
   d. **Wind –** A total of two additional portfolio runs containing 100MW of additional new wind resources placed into service in 2025 will be conducted to assess the impacts to the supply portfolio.

e. **Woody Biomass** - NorthWestern has extensively investigated the use of woody biomass for generating electricity in Montana and has researched the topic through contacts with the wood products industry and participated in a detailed feasibility study as recently as 2010. Woody biomass costs on a long-term levelized basis are on the order of $100/MWh for a Montana installation and are clearly more expensive than other resource alternatives. In addition, risk of long-term fuel availability is a concern particularly if woody biomass is developed on a large-scale commercial basis. For reference, the 2.5MW woody biomass project in northwest Montana sells power to the local electric coop at the rate of 9 cents per kilowatt-hour ($90/MWh equivalent). Reference the attached from the 2011 Plan for additional information. No additional portfolio runs will be performed.

ATTACHMENT No. 1

EIA – Updated Capital Cost Estimates
for Utility Scale Electricity Generating Plants

Independent Statistics & Analysis
U.S. Energy Information Administration

Updated Capital Cost Estimates for Utility Scale Electricity Generating Plants

April 2013

Independent Statistics & Analysis
www.eia.gov

U.S. Department of Energy
Washington, DC 20585

Table 1. Updated estimates of power plant capital and operating costs

	Plant Characteristics		Plant Costs (2012$)			
	Nominal Capacity (MW)	Heat Rate (Btu/kWh)	Overnight Capital Cost ($/kW)	Fixed O&M Cost ($/kW-yr)	Variable O&M Cost ($/MWh)	NEMS Input
Coal						
Single Unit Advanced PC	650	8,800	$3,246	$37.80	$4.47	N
Dual Unit Advanced PC	1,300	8,800	$2,934	$31.18	$4.47	Y
Single Unit Advanced PC with CCS	650	12,000	$5,227	$80.53	$9.51	Y
Dual Unit Advanced PC with CCS	1,300	12,000	$4,724	$66.43	$9.51	N
Single Unit IGCC	600	8,700	$4,400	$62.25	$7.22	N
Dual Unit IGCC	1,200	8,700	$3,784	$51.39	$7.22	Y
Single Unit IGCC with CCS	520	10,700	$6,599	$72.83	$8.45	N
Natural Gas						
Conventional CC	620	7,050	$917	$13.17	$3.60	Y
Advanced CC	400	6,430	$1,023	$15.37	$3.27	Y
Advanced CC with CCS	340	7,525	$2,095	$31.79	$6.78	Y
Conventional CT	85	10,850	$973	$7.34	$15.45	Y
Advanced CT	210	9,750	$676	$7.04	$10.37	Y
Fuel Cells	10	9,500	$7,108	$0.00	$43.00	Y
Uranium						
Dual Unit Nuclear	2,234	N/A	$5,530	$93.28	$2.14	Y
Biomass						
Biomass CC	20	12,350	$8,180	$356.07	$17.49	N
Biomass BFB	50	13,500	$4,114	$105.63	$5.26	Y
Wind						
Onshore Wind	100	N/A	$2,213	$39.55	$0.00	Y
Offshore Wind	400	N/A	$6,230	$74.00	$0.00	Y
Solar						
Solar Thermal	100	N/A	$5,067	$67.26	$0.00	Y
Photovoltaic	20	N/A	$4,183	$27.75	$0.00	N
Photovoltaic	150	N/A	$3,873	$24.69	$0.00	Y
Geothermal						
Geothermal – Dual Flash	50	N/A	$6,243	$132.00	$0.00	N
Geothermal – Binary	50	N/A	$4,362	$100.00	$0.00	N
Municipal Solid Waste						
Municipal Solid Waste	50	18,000	$8,312	$392.82	$8.75	N
Hydroelectric						
Conventional Hydroelectric	500	N/A	$2,936	$14.13	$0.00	N
Pumped Storage	250	N/A	$5,288	$18.00	$0.00	N

Table 2. Overnight cost comparison with 2010 estimates

	Overnight Capital Costs (2012 $/kW)		
	2013 Report	2010 Report	% Difference
Coal			
Single Unit Advanced PC	$3,246	$3,292	-1%
Dual Unit Advanced PC	$2,934	$2,956	-1%
Single Unit Advanced PC with CCS	$5,227	$5,300	-1%
Dual Unit Advanced PC with CCS	$4,724	$4,760	-1%
Single Unit IGCC	$4,400	$3,706	19%
Dual Unit IGCC	$3,784	$3,348	13%
Single Unit IGCC with CCS	$6,599	$5,559	19%
Natural Gas			
Conventional CC	$917	$1,017	-10%
Advanced CC	$1,023	$1,043	-2%
Advanced CC with CCS	$2,095	$2,141	-2%
Conventional CT	$973	$1,012	-4%
Advanced CT	$676	$691	-2%
Fuel Cells	$7,108	$7,105	0%
Uranium			
Dual Unit Nuclear	$5,530	$5,546	0%
Biomass			
Biomass CC	$8,180	$8,205	0%
Biomass BFB	$4,114	$4,012	3%
Wind			
Onshore Wind	$2,213	$2,534	-13%
Offshore Wind	$6,230	$6,211	0%
Solar			
Solar Thermal	$5,067	$4,877	4%
Solar Photovoltaic (7 MW)	N/A	$6,289	N/A
Solar Photovoltaic (20 MW)	$4,183	N/A	N/A
Solar Photovoltaic (150 MW)	$3,873	$4,943	-22%
Geothermal			
Geothermal – Dual Flash	$6,243	$5,798	8%
Geothermal – Binary	$4,362	$4,304	1%
Municipal Solid Waste			
Municipal SolidWaste	$8,312	$8,557	-3%
Hydroelectric			
Conventional Hydroelectric	$2,936	$3,197	-8%
Pumped Storage	$5,288	$5,816	-9%

Table 3. Status of technologies and components modeled by EIA

	Revolutionary	Evolutionary	Mature
Pulverized Coal			X
Pulverized Coal with CCS			
- Non-CCS portion of Pulverized Coal Plant			X
- CCS	X		
Integrated Gasification Combined Cycle			
- Advanced Combustion Turbine		X	
- Heat Recovery Steam Generator			X
- Gasifier		X	
- Balance of Plant			X
Conventional Natural Gas Combined Cycle			
- Conventional Combustion Turbine			X
- Heat Recovery Steam Generator			X
- Balance of Plant			X
Advanced Natural Gas Combined Cycle			
- Advanced Combustion Turbine		X	
- Heat Recovery Steam Generator			X
- Balance of Plant			X
Advanced Natural Gas Combined Cycle with CCS			
- Advanced Combustion Turbine		X	
- Heat Recovery Steam Generator			X
- Balance of Plant			X
- CCS	X		
Conventional Natural Gas Combustion Turbine			
- Conventional Combustion Turbine			X
- Balance of Plant			X
Advanced Natural Gas Combustion Turbine			
- Advanced Combustion Turbine		X	
- Balance of Plant			X
Advanced Nuclear	X		
Biomass			
- Pulverized Coal			X
- Fuel Preparation		X	
Geothermal		X	
Municipal Solid Waste/Landfill Gas			X
Conventional Hydroelectric			X

Table 3. Status of technologies and components modeled by EIA (cont.)

	Revolutionary	Evolutionary	Mature
Wind			
- Onshore/Common Components			X
- Offshore Components	X		
Solar Thermal	X		
Solar PV			
- Modules (Utility and End Use)		X	
- Utility Balance of Plant		X	

EIA Technologies List

TABLE 1-1 – LIST OF TECHNOLOGIES FOR REVIEW

TECHNOLOGY	DESCRIPTION	COMMENTS
Advanced Pulverized Coal	650 megawatt-electrical ("MWe") and 1,300 MWe; supercritical; all advanced pollution control technologies	Greenfield Installation
Advanced Pulverized Coal with Carbon Capture and Sequestration ("CCS")	650 MWe and 1,300 MWe; supercritical; all advanced pollution control technologies, including CCS technologies	Greenfield Installation
Conventional Natural Gas Combined Cycle ("NGCC")	620 MWe; F-Class system	
Advanced NGCC	400 MWe; H-Class system	
Advanced NGCC with CCS	340 MWe; H-Class system	
Conventional Combustion Turbine ("CT")	85 MWe; E-Class turbine	
Advanced CT	210 MWe; F-Class turbine	
Integrated Gasification Combined Cycle ("IGCC")	600 MWe and 1,200 MWe; F-Class-syngas system	
IGCC with CCS	520 MWe; F-Class-syngas system	
Advanced Nuclear	2,234 megawatt ("MW"); AP1000 PWR Basis	Brownfield Installation
Biomass Combined Cycle	20 MWe	Wood Fuel
Biomass Bubbling Fluidized Bed ("BBFB")	50 MWe	Wood Fuel
Fuel Cells	10 MWe	
Geothermal	50 MWe Dual Flash and Binary	
Municipal Solid Waste ("MSW")	50 MWe	
Hydroelectric	500 MWe	
Pumped Storage	250 MWe	
Wind Farm – Onshore	100 MWe	
Wind Farm – Offshore	400 MWe	
Solar Thermal – Central Station	100 MWe	
Photovoltaic – Central Station	20 MWe –AC and 150 MWe - AC	

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ATTACHMENT No. 2

NorthWestern Energy 2011 Resource Plan
Supplemental Information

generally treated as reliable sources recognizing that any new electric generation development will have site-and project-specific costs associated with it. For the purpose of long term planning of resources and for comparison purposes the data set employed in the 2011 Plan is believed to be sufficient to inform planning with the addition of project development analysis occurring in conjunction with NorthWestern proposals and filings with the MPSC.

Table 12 has been prepared to summarize the resource size, cost, and energy consumption rates for the thermal resources that have been evaluated in the 2011 Plan. The application of these input parameters into the GenTrader® model and the resulting costs associated with the resource portfolios can be found in Volume 2, Chapter 2.

Table No. 12

Resource Cost Summary
$2011

Fuel Source	Technology	Capacity per Unit (MW)	Capital Cost $/kW	Fixed O&M $/kW-yr	Variable O&M $/MWh	Heat Rate Btu/kWh
Coal	IGCC	300	$3,749	$40.84	$4.93	8,833
Coal	IGCC w/ CCS	300	$5,611	$56.26	$8.73	10,365
Coal	Supercritical	200	$3,922	$41.86	$3.07	9,184
Coal	Supercritical w/ CCS	200	$6,233	$99.50	$6.85	12,561
Natural Gas	CHP	200	$1,384	$2.70	$6.36	6,472
Natural Gas	CCCT	300	$1,239	$10.44	$2.59	6,800
Natural Gas	CCCT w/ CCS	200	$2,111	$22.24	$3.29	8,613
Natural Gas	Internal Combustion	22	$1,144	$8.57	$8.31	8,999
Natural Gas	SCCT LM6000	40	$1,008	$9.02	$3.71	9,285
Natural Gas	SCCT Aero	100	$1,011	$7.60	$4.28	9,177
Natural Gas	SCCT Frame	100	$685	$4.69	$3.52	10,802

NorthWestern has also evaluated and modeled new renewable resources in supply portfolios (Table 13). The 2011 Plan includes an expanded list of renewable project options that may become plausible in Montana. The expanded list of potential renewable projects has been developed using a variety of sources as footnoted at the bottom of the table. Future competitive solicitations will determine if any of these types of projects will be submitted for consideration by NorthWestern and if they constitute renewable alternatives that can cost-effectively be added to the supply Portfolio.

Table No. 13

Renewable Resource and Energy Storage Cost Summary
$2011

Fuel Source	Technology	Capacity per Unit (MW)	Capital Cost $/kW	Fixed O&M $/kW-yr	Variable O&M $/MWh	Heat Rate Btu/kWh
Biomass	Wood Products[1]	18	$2,978	$227.56	$24.84	12,461
Geothermal		14	$5,536	$102.70	$5.40	28,500
Landfill Gas	Reciprocating Engine[2]	1.6	$2,185	$240.75	$0.00	10,800
Small Hydro		10	$3,879	$19.48	$1.59	-
Solar	Photovoltaic	5	$7,188	$50.84	$0.00	-
Storage	Compressed Air	40	$1,346	$3.91	$5.67	11,980
Storage	Pumped Hydro	15	$2,015	$4.43	$2.21	8,385
Wind	Wind Turbine[3]	40	$1,947	$48.68	$0.00	-

1 Wood Products Biomass based upon June 2010 biomass report - Developing a Business Case for Sustainable Biomass Generation: A Regional Model for Western Montana

2 FEC proforma costs

3 Wind based upon Spion Kop development costs

Thermal Resource: Internal Combustion (IC) Engines

IC engines, similar to those installed at the Basin Creek facility, are a reciprocating engine technology that has evolved from diesel engine technology. Most of the IC alternatives employ a dual-fuel capability whereby diesel fuel can be substituted for the primary natural gas fuel as a supply backup and for onsite reliability purposes. These units include heat rates in the range of 9,000 Btu/kWh and the capability to start quickly as well as ramp up to full output in minutes. When deployed as multiple units, the units can be "staged" using a staggered or sequential firing approach as following units or in conjunction with other load-serving or ancillary services needs. The sizing of the individual projects and time to construct using these units can make them quicker to deploy and site when compared to larger combustion turbine installations.

ATTACHMENT No. 3
NorthWestern's 2013 Plan Resource Cost Sources

NorthWestern Energy 2013 Resource Procurement Plan
Resource Cost Summary
(2013$)

Resource Description	*Fuel Source*	*Technology*	*Nameplate Capacity (MW)*	*Net Capacity @ 3,500 feet (MW)*	*Capital Cost $ / kW*	*Fixed O&M $ / kW-yr*	*Variable O&M $ / MWh*	*Heat Rate Btu / kWh*	*Source Capital / FOM / VOM*
CCCT (1x1)	Natural Gas	GE 7FA.04 ACC[1]	270	239	$1,425	$13.94	$3.60	6,660	ID Power 2012 Langley Gulch / Pacificorp 2013 IRP
SCCT - Small Aeroderivative	Natural Gas	PW FT8	60	53	$917	$6.05	$4.60	10,500	NWE 2012 Aberdeen peaker
SCCT - Large Aeroderivative	Natural Gas	GE LMS100	110	97	$1,087	$17.06	$3.47	8,722	Pacificorp 2013 IRP
SCCT - Frame	Natural Gas	GE 7EA	90	78	$897	$11.73	$3.20	11,289	Avista 2013 IRP
Internal Combustion - Recips	Natural Gas	CAT G16CM34	54	52	$1,402	$18.39	$8.15	9,078	Pacificorp 2013 IRP
Solar PV	Solar		10	10	$3,136	$27.00	$0.00	n/a	ID Power 2013 IRP
Wind[2]	Wind		25	25	$1,524	$49.18	$0.00	n/a	NWE 2012 CREP RFP
Hydro - Montana Large Scale[3]	Water		439	439	$1,982	$52.58	$0.00	n/a	NWE 2013 hydro acquisition

[1] ACC = Air Cooled Condenser
[2] Based on build-transfer bids received in NWE's 2012 CREP RFP
[3] Excludes KERR costs and capacity

CCCT				
Source:	Langley Gulch - Idaho Power			
	Category	Description		
	Equipment - GT	Siemens SGT6-5000F		Tier 1 Air Quality Permit Application
	ST-HP	Siemens SST-700		Tier 1 Air Quality Permit Application
	ST-IP	Siemens SST-900RH		Tier 1 Air Quality Permit Application
	GSU	2-Separate ST and GT		Tier 1 Air Quality Permit Application
	Emissions Control	DLNOx and SCR		Tier 1 Air Quality Permit Application
	Capacity - CCCT	269 MW ISO		Tier 1 Air Quality Permit Application
	Capacity - Duct Firing	31		Tier 1 Air Quality Permit Application
	Elevation	2580'		Google Earth
	Permitting Start	2009		Google
	Energized	6/30/2012		Various Idaho Power press release July 2012
	Heat Rate	6800 Btu/kWh		2013 IRP Inputs
	Cooling	Conventional - 8.6 mile pipeline to Snake River pumping station		BLM EIS
	Gas Lateral	1.5 miles to Williams NW Pipeline		BLM EIS
	Transmission	2.8 miles d/c to loop Caldwell-Ontario 230 kV		BLM EIS
		16 miles to 138 kV Caldwell-Willis (construct to 230 kV)		BLM EIS
	Project Substation	5 position ring bus, 230/138 kV transformer		Google Earth
	Cost (w/o Trans, w/AFUDC)	$370,057,000		FERC Form 1
	Cost/kW (w/o DF)	$1376/kW		Calculated
Adjustments				
A. Langley Gulch to 3500' and ACC 2013				
	Inflation 2012 to 2013 @2.5%	$379,308,425		TG inflation rate and calculated
	Less Idaho sales tax on equipment - approx.	-$10,000,000		
	Adjusted Langley Gulch cost	$369,308,425		
	Altitude 2580' to 3500' @938 kW/100'	-8629.6	kW	GE 7F Performance Specs and calculated
	Conventional to ACC	-2114	kW	GE 7F Performance Specs and calculated
	Adjust Langley Gulch capacity to 3500' and ACC	258256.4	kW	Calculated
	Cost/kW at 3500' and ACC 2013	$1,430	per kW	Calculated
B. Langley Gulch to 3500' 2013				
	Inflation 2012 to 2013 @2.5%	$379,308,425		TG inflation rate and calculated
	Less Idaho sales tax on equipment - approx.	-$10,000,000		
	Adjusted Langley Gulch cost	$369,308,425		
	Altitude 2580' to 3500' @938 kW/100'	-8629.6	kW	GE 7F Performance Specs and calculated
	Adjust Langley Gulch capacity to 3500'	260370.4	kW	Calculated
	Cost/kW at 3500' 2013	$1,418	per kW	Calculated

GE 7EA					
Source:	Avista 2013 IRP				
	Category	Description			
	Location	Rathdrum, ID			
	Equipment - GT	GE Frame 7EA		2013 IRP Inputs	
	Capacity - 2200'	83	MW ISO	2013 IRP Inputs	
	Capacity derate for higher elevation	-2.92	kW/ft	Calculated from GE Frame 7EA Data	
	Cost Year	2014		2013 IRP Inputs	
	On-line	N/A		2013 IRP Inputs	
	Heat Rate	11,286	Btu/kWH	2013 IRP Inputs	Agrees with GE 7EA Data
	Cost (w/o Trans, w/AFUDC)	$151,000,000		Calculated	
	Installation Capacity (2 Units)	166,000	kW	2013 IRP Inputs	
	Cost/kW	$910	per kW	2013 IRP Inputs	
	Variable O&M 2200'	$3.13	per MWH	2013 IRP Inputs	
	Fixed O&M 2200'	$11.48	per kW-mo	2013 IRP Inputs	
Adjustments					
A. Generic 7EA to 3500' and 2013					
Capital	Inflation 2014 to 2013 @2.5%	$147,225,000		TG inflation rate and calculated	
	Less Idaho sales tax on equipment - approx.	-$5,152,875		Estimate - 3.5% of total cost	
	Adjusted Generic 7EA cost	$142,072,125		Calculated	
	Elevation Adjustment	-3799	kW	Calculated - single unit	
	Capacity at 3500'	158,403	kW	Calculated	
	Cost/kW at 3500' and 2013	$897	per kW	Calculated	
Var. O&M	Inflation 2012 to 2013 @2.5%	$3.05	per MWH	Calculated	
	Elevation Adjustment	1.05		Calculated	
	Variable O&M at 3500'	$3.20	per MWH	Calculated	
Fixed O&M	Inflation 2012 to 2013 @2.5%	$11.19	per kW/mo	Calculated	
	Elevation Adjustment	1.05		Calculated	
	Fixed O&M at 3500'	$11.73	per kW/mo	Calculated	

LMS 100				
Source:	PacifiCorp 2013 IRP			
	Category	Description		
	Equipment - GT	GE LMS 100		2013 IRP Inputs
	Capacity - 1500'	99 MW ISO		2013 IRP Inputs
	Capacity - 4250'	91 MW ISO		2013 IRP Inputs
	Capacity derate for higher elevation	-2.91	kW/ft	
	Cost Year	2012		2013 IRP Inputs
	On-line	2016		2013 IRP Inputs
	Heat Rate	8867 Btu/kWh		2013 IRP Inputs
	Cost (w/o Trans, w/AFUDC)	$102,366,000		Calculated
	Cost/kW	$1034/kW		2013 IRP Inputs
	Variable O&M 1500'	$3.19/MWH		2013 IRP Inputs
	Fixed O&M 1500'	$15.67/kW-yr		2013 IRP Inputs
Adjustments				
A. Generic LMS 100 to 3500' and 2013				
Capital	Inflation 2012 to 2013 @2.5%	$104,925,150		TG inflation rate and calculated
	Less Idaho/Utah sales tax on equipment	-$3,672,380		Estimate - 3.5% of total cost
	Adjusted Generic LMS 100 cost	$101,252,770		Calculated
	Elevation Adjustment	-5818	kW	Calculated
	Capacity at 3500'	93,182	kW	Calculated
	Cost/kW at 3500' and 2013	$1,087	per kW	Calculated
Var. O&M	Inflation 2012 to 2013 @2.5%	$3.27		Calculated
	Elevation Adjustment	1.06		Calculated
	Variable O&M at 3500'	$3.47		Calculated
Fixed O&M	Inflation 2012 to 2013 @2.5%	$16.06		Calculated
	Elevation Adjustment	1.06		Calculated
	Fixed O&M at 3500'	$17.06		Calculated

Cost Inputs and Operating Assumptions

(All costs in 2013 dollars)

Supply-Side Resources	Plant Capacity (MW)	Plant Capital ($/kW)[1,2]	Transmission Capital $/kW	Total Capital $/kW	Total Investment $/kW[2]	Fixed O&M $/kW[3]	Variable O&M $/kW	Emissions $/MWh	Heat Rate Btu/kWh
Advanced Nuclear	250	$6,866	$625	$7,491	$11,381	$143	$1	$0	10,488
Biomass Digesters	50	$4,311	$285	$4,596	$4,921	$107	$16	$0	NA
CCCT—(1x1) F Class	270	$1,120	$140	$1,260	$1,477	$8	$2	$7	6,800
CCCT—(2x1) F Class	580	$1,039	$109	$1,148	$1,346	$6	$2	$7	6,738
CHP/Co-Generation	100	$1,975	$25	$2,000	$2,142	$8	$5	$0	9,200
Conventional Scrubbed Coal	600	$3,253	$730	$3,983	$4,754	$26	$4	$26	9,200
Distributed Generation (Option # 1) Load shed	10	$0	$0	$0	$0	$63	$0	$0	9,050
Distributed Generation (Option # 2) Grid synchronized	15	$0	$160	$160	$166	$63	$0	$0	9,050
Geothermal—Idaho	26	$6,630	$979	$7,609	$8,442	$144	$5	$0	NA
Geothermal—Nevada	26	$6,630	$552	$7,182	$7,968	$144	$5	$0	NA
Geothermal—Oregon	26	$6,630	$787	$7,417	$8,229	$144	$5	$0	NA
IGCC	550	$4,513	$730	$5,243	$6,547	$35	$7	$25	8,765
Low Drop/Small Hydro New	10	$4,000	$80	$4,080	$4,784	$15	$4	$0	NA
Pulverized Coal w/ carbon capture and sequestration	455	$7,755	$730	$8,485	$10,595	$143	$7	$5	12,600
Pumped Storage Fueled by LL Wind	500	$2,510	$646	$3,156	$3,700	$5	$0	$0	NA
SCCT—Industrial Frame	170	$733	$88	$821	$875	$4	$3	$13	11,870
SCCT—Large Aeroderivative	100	$1,250	$149	$1,399	$1,491	$15	$3	$10	8,800
SCCT—Small Aeroderivative	47	$1,113	$31	$1,144	$1,219	$14	$5	$8	9,370
Solar—1-Axis Tracking Flat Plate PV (Utility)	1	$4,029	$0	$4,029	$4,108	$27	$0	$0	NA
Solar—1-Axis Tracking Flat Plate PV (Utility 10 MW)	10	$3,268	$80	$3,348	$3,414	$27	$0	$0	NA
Solar—Concentrating Solar Power	100	$5,398	$212	$5,610	$6,578	$56	$0	$0	NA
Solar—Concentrating Solar Power with Energy Storage	100	$7,771	$212	$7,983	$9,360	$56	$0	$0	NA
Solar—Flat Plate PV (Distributed)[4]	10	$5,610	$0	$5,610	$5,720	$55	$0	$0	NA
Solar—Flat Plate PV (Utility)	1	$3,714	$0	$3,714	$3,787	$27	$0	$0	NA
Solar—Flat Plate PV (Utility 10MW)	10	$2,996	$80	$3,076	$3,136	$27	$0	$0	NA
Transmission—Boardman to Hemingway[5]	350	$0	$602	$602	$602	$1	$0	$0	NA
Wind—Eastern Oregon	100	$2,229	$1,210	$3,439	$3,675	$37	$1	$0	NA
Wind—Magic Valley	100	$2,229	$369	$2,598	$2,776	$37	$1	$0	NA
Wind—Southeast Idaho	100	$2,229	$382	$2,611	$2,790	$37	$1	$0	NA

[1] Plant costs include engineering development costs, generating and ancillary equipment purchase, and installation costs, as well as balance of plant construction.

[2] Total investment includes capital costs and AFUDC.

[3] Fixed O&M excludes property taxes and insurance (separately calculated within the levelized resource cost analysis)

[4] Approximately 2,500 4-kW PV systems.

[5] 350-MW average, 500-MW summer, and 200-MW winter.

Table 6.1 - 2013 Supply Side Resource Table (2012$)

Description		Resource Characteristics				Costs		
Fuel	Resource	Elevation (AFSL)	Net Capacity (MW)	Commercial Operation Year	Design Life (yrs)	Base Capital ($/KW)	Var O&M ($/MWh)	Fixed O&M ($/KW-yr)
Natural Gas	SCCT Aero x3, ISO	0	183	2016	30	1,061	3.50	9.02
Natural Gas	Intercooled SCCT Aero x1, ISO	0	102	2016	30	1,004	2.93	15.29
Natural Gas	SCCT Frame "F" x1, ISO	0	208	2016	35	670	8.49	7.73
Natural Gas	IC Recips x6, ISO	0	117	2016	30	1,204	7.40	15.61
Natural Gas	CCCT Dry "F", 2x1, ISO	0	609	2017	40	995	2.21	6.13
Natural Gas	CCCT Dry "F", DF, 2x1, ISO	0	138	2017	40	522	0.06	0.00
Natural Gas	CCCT Dry "G/H", 1x1, ISO	0	372	2017	40	971	2.53	10.70
Natural Gas	CCCT Dry "G/H", DF, 1x1, ISO	0	49	2017	40	612	0.05	0.00
Natural Gas	CCCT Dry "G/H", 2x1, ISO	0	745	2017	40	959	2.77	5.61
Natural Gas	CCCT Dry "G/H", DF, 2x1, ISO	0	98	2017	40	600	0.07	0.00
Natural Gas	CCCT Dry "J", Adv 1x1, ISO	0	480	2018	40	981	2.20	5.49
Natural Gas	CCCT Dry "J", DF, Adv 1x1, ISO	0	49	2018	40	496	0.09	0.00
Natural Gas	Intercooled SCCT Aero x1	1,500	96	2016	30	1,034	2.96	15.67
Natural Gas	SCCT Frame "F" x1	1,500	177	2016	35	690	8.71	7.92
Natural Gas	IC Recips x 6	1,500	112	2016	30	1,253	7.63	16.31
Natural Gas	CCCT Dry "F", 2x1	1,500	563	2016	40	1,039	2.28	6.43
Natural Gas	CCCT Dry "F", DF, 2x1	1,500	138	2016	40	522	0.09	0.00
Natural Gas	CCCT Dry "G/H", 2x1	1,500	715	2017	40	1,000	2.34	5.86
Natural Gas	CCCT Dry "G/H", DF, 2x1	1,500	98	2017	40	600	0.07	0.00
Natural Gas	CCCT Dry "J", Adv 1x1	1,500	425	2018	40	962	2.27	5.43
Natural Gas	CCCT Dry "J", DF, Adv 1x1	1,500	49	2018	40	496	0.08	0.00
Natural Gas	SCCT Aero x3	4,250	144	2016	30	1,223	3.85	11.11
Natural Gas	Intercooled SCCT Aero x1	4,250	91	2016	30	1,127	3.21	16.97
Natural Gas	SCCT Frame "F" x1	4,250	151	2016	35	762	9.49	8.07
Natural Gas	IC Recips x 6	4,250	103	2016	30	1,368	8.15	18.39
Natural Gas	CCCT Wet "F", 2x1	4,250	515	2017	40	1,104	2.87	8.58
Natural Gas	CCCT Wet "F", DF, 2x1	4,250	98	2017	40	490	0.32	0.00
Natural Gas	CCCT Dry "F", 1x1	5,050	255	2017	40	1,258	2.57	13.74
Natural Gas	CCCT Dry "F", DF, 1x1	5,050	48	2017	40	546	0.08	0.00
Natural Gas	CCCT Dry "F", 2x1	5,050	523	2017	40	1,159	2.42	7.14
Natural Gas	CCCT Dry "F", DF, 2x1	5,050	108	2017	40	522	0.09	0.00
Natural Gas	CCCT Dry "G/H", 1x1	5,050	320	2017	40	1,129	2.94	12.45
Natural Gas	CCCT Dry "G/H", DF, 1x1	5,050	45	2017	40	612	0.06	0.00
Natural Gas	CCCT Dry "G/H", 2x1	5,050	640	2017	40	1,118	2.82	6.53
Natural Gas	CCCT Dry "G/H", DF, 2x1	5,050	98	2017	40	600	0.07	0.00
Natural Gas	CCCT Dry "J", Adv 1x1	5,050	380	2018	40	1,075	2.37	10.54
Natural Gas	CCCT Dry "J", DF, Adv 1x1	5,050	49	2018	40	496	0.09	0.00
Natural Gas	SO Fuel Cell	4,500	5	2018	20	2,090	0.04	8.62
Natural Gas	Intercooled SCCT Aero x1	6,500	84	2016	30	1,180	3.39	17.91
Natural Gas	SCCT Frame "F" x1	6,500	172	2016	35	804	10.00	9.13
Natural Gas	IC Recips x 6	6,500	78	2016	30	1,460	8.60	19.09
Natural Gas	CCCT Dry "G/H", 2x1	6,500	617	2017	40	1,159	2.92	6.80
Natural Gas	CCCT Dry "G/H", DF, 2x1	6,500	98	2017	40	600	0.07	0.00
Natural Gas	CCCT Dry "J", Adv 1x1	6,500	368	2018	40	1,110	2.53	10.89
Natural Gas	CCCT Dry "J", DF, Adv 1x1	6,500	43	2018	40	496	0.09	0.00

Operating Characteristics				Environmental			
Average Full Load Heat Rate (HHV Btu/KWh)/Efficiency	EFOR (%)	POR (%)	Water Consumed (Gal/MWh)	SO2 (lbs /MMBtu)	NOx (lbs /MMBtu)	Hg (lbs /TBtu)	CO2 (lbs /MMBtu)
9,739	2.6	3.9	58	0.0006	0.018	0.255	118
8,867	2.8	3.9	79	0.0006	0.018	0.255	118
9,950	2.7	3.9	10	0.0006	0.018	0.255	118
8,447	2.5	5.0	5	0.0006	0.018	0.255	118
6,738	2.5	3.8	11	0.0006	0.007	0.255	118
8,482	0.8	3.8	11	0.0006	0.007	0.255	118
6,966	2.5	3.8	11	0.0006	0.008	0.255	118
8,262	0.8	3.8	11	0.0006	0.008	0.255	118
6,743	2.5	3.8	11	0.0006	0.008	0.255	118
8,103	0.8	3.8	11	0.0006	0.008	0.255	118
6,435	2.5	3.8	11	0.0006	0.008	0.255	118
8,611	0.8	3.8	11	0.0006	0.008	0.255	118
8,839	2.8	3.9	80	0.0006	0.018	0.255	118
9,950	2.7	3.9	20	0.0006	0.018	0.255	118
8,447	2.5	3.8	5	0.0006	0.030	0.255	118
6,738	2.5	3.8	11	0.0006	0.008	0.255	118
8,482	0.8	3.8	11	0.0006	0.009	0.255	119
6,773	2.5	3.8	9	0.0006	0.008	0.255	118
8,155	0.8	3.8	9	0.0006	0.008	0.255	118
6,435	2.5	3.8	9	0.0006	0.008	0.255	118
8,611	0.8	3.8	9	0.0006	0.008	0.255	118
9,739	2.6	3.9	58	0.0006	0.018	0.255	118
8,867	2.8	3.9	80	0.0006	0.018	0.255	118
9,950	2.7	3.9	20	0.0006	0.018	0.255	118
8,447	2.5	5.0	5	0.0006	0.030	0.255	119
6,580	2.5	3.8	200	0.0006	0.007	0.255	118
7,901	0.8	3.8	200	0.0006	0.007	0.255	118
6,815	2.5	3.8	9	0.0006	0.007	0.255	118
8,516	0.8	3.8	9	0.0006	0.007	0.255	118
6,738	2.5	3.8	9	0.0006	0.008	0.255	118
8,482	0.8	3.8	9	0.0006	0.008	0.255	118
6,966	2.5	3.8	9	0.0006	0.008	0.255	118
8,262	0.8	3.8	9	0.0006	0.008	0.255	118
6,743	2.5	3.8	9	0.0006	0.008	0.255	118
8,103	0.8	3.8	9	0.0006	0.008	0.255	118
6,435	2.5	3.8	9	0.0006	0.008	0.255	118
8,611	0.8	3.8	9	0.0006	0.008	0.255	118
8,001	4	2	7	0.0006	0	0.255	118
8,867	2.8	3.9	80	0.0006	0.018	0.255	118
9,950	2.7	3.9	20	0.0006	0.018	0.255	118
8,447	2.5	5.0	5	0.0006	0.025	0.255	118
6,743	2.5	3.8	9	0.0006	0.008	0.255	118
8,103	0.8	3.8	9	0.0006	0.008	0.255	118
6,435	2.5	3.8	9	0.0006	0.008	0.255	118
8,611	0.8	3.8	9	0.0006	0.008	0.255	118

Guldseth, Todd

From: Fine, David E
Sent: Tuesday, December 03, 2013 11:01 AM
To: Guldseth, Todd
Subject: FW: Aberdeen info

From: Huber, Cory
Sent: Monday, September 16, 2013 9:14 AM
To: Fine, David E
Cc: Wagner, Dennis
Subject: RE: Aberdeen info

David,
Please see my first draft of responses. Please let me know if you have questions.

Thanks!

Cory Huber
Project Manager
NorthWesternEnergy
W 605-353-7465
M 605-354-1040
F 605-353-7479
cory.huber@northwestern.com

From: Fine, David E
Sent: Tuesday, September 10, 2013 11:17 AM
To: Huber, Cory
Cc: Wagner, Dennis
Subject: Aberdeen info

Cory,

Would you provide me with the Aberdeen operating parameters.

- Winter/summer maximum output (MW) Winter – 60 MW; Summer – 52 MW
- Start time and ramp rate Time from start to sync – 5 min; 5 MW per minute ramp rate
- Seasonal heat rates 10,000 btu/kwh
- Fixed and variable costs Fixed $362,815 (2014 budget) Variable $46.60/MWH (Fuel & Water, Assumption is $4.00 gas)
- Any forced outage assumptions None at this time. We are developing an maintenance program with NAES for Aberdeen Generating Station with expected completion the Fall 2013
- Annual maint schedule (Planned) Same as above
- Time to major overhaul assumptions Same as above

Thanks in advance for your help.

Dave