



June 9, 2017

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Public Utility Commission of Oregon
201 High St SE, Suite 100
Salem, Oregon 97301-3398

Re: Docket No. UE 323– Direct Testimony of Thomas Vitolo, PhD On Behalf of Sierra Club

Please find enclosed the original Confidential Direct Testimony of Thomas Vitolo, PhD On Behalf of Sierra Club in Docket No. UE 323. The public version of this document was filed electronically and served upon all party representatives for this proceeding via e-mail. The confidential portion of this document was served pursuant to Protective Order No. 16-128 upon all eligible party representatives via FedEx or U.S. Mail.

Please do not hesitate to contact me if you have any questions or need other materials. Thank you.

Sincerely,

/s/ Alexa Zimbalist

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**BEFORE THE
PUBLIC UTILITY COMMISSION OF OREGON**

PACIFICORP, dba PACIFIC
POWER, 2018 Transition Adjustment
Mechanism

Docket UE-323

**Direct Testimony of
Thomas Vitolo, PhD**

**On Behalf of
Sierra Club**

REDACTED

June 9, 2017

Table of Contents

1. Introduction and Purpose of Testimony	1
2. PacifiCorp Fixed-Price Contracts	3
3. Naughton Dispatched Non-economically in 2015-2016	8
4. Naughton's Minimum-take Contract Resulted in Net Ratepayer Losses in 2015-2016	15
5. Conclusions	17

Table of Tables

Table 1: Naughton July 2015 – June 2016 Model Results	16
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Exhibit List

Exhibit Sierra Club/101	Curriculum vitae of Thomas Vitolo
Exhibit Sierra Club/102	Selected Responses to Sierra Club and ICNU Data Requests

1 **1. INTRODUCTION AND PURPOSE OF TESTIMONY**

2 **Q Please state your name, business address, and position.**

3 **A** My name is Tommy Vitolo, and I am a Senior Associate with Synapse Energy
4 Economics (Synapse) at 485 Massachusetts Avenue, Suite 2, Cambridge,
5 Massachusetts 02139.

6 **Q Please describe Synapse Energy Economics.**

7 **A** Synapse Energy Economics is a research and consulting firm specializing in
8 electricity and natural gas industry regulation, planning, and analysis. Our work
9 covers a range of issues, including integrated resource planning; economic and
10 technical assessments of energy resources; electricity market modeling and
11 assessment; energy efficiency policies and programs; renewable resource
12 technologies and policies; and climate change strategies. Synapse works for a
13 wide range of clients, including attorneys general, offices of consumer advocates,
14 public utility commissions, environmental advocates, the U.S. Environmental
15 Protection Agency, the U.S. Department of Energy, the U.S. Department of
16 Justice, the Federal Trade Commission and the National Association of
17 Regulatory Utility Commissioners. Synapse has over 25 professional staff with
18 extensive experience in the electricity industry.

19 **Q Please summarize your professional and educational experience.**

20 **A** I have a PhD in systems engineering from Boston University; a master's in financial
21 and industrial mathematics from Dublin City University, Ireland; bachelor's degrees
22 in applied mathematics, computer science, and economics from North Carolina State
23 University; and more than eight years of professional experience as a consultant,
24 researcher, and analyst.

25 Since joining Synapse in 2011, I have focused on utility resource planning,
26 variable resource integration, avoided costs, and other issues that typically involve
27 statistical analysis, computer simulation modeling, stochastic processes, or other
28 topics related to operations research or optimization. I have filed testimony or

1 reviewed utility filings in 24 states and two territories, primarily by evaluating
2 numerical analysis, modeling, and decision strategies of resource plans and
3 certificates of public convenience and necessity applications.

4 Prior to joining Synapse, I worked as a research assistant at MIT Lincoln
5 Laboratory. My CV is attached as Exhibit TJV-1.

6 **Q On whose behalf are you testifying in this proceeding?**

7 **A** I am testifying on behalf of Sierra Club.

8 **Q Have you testified previously before the Public Utility Commission of Oregon**
9 **(“the Commission”)?**

10 **A** No, I have not. I have testified in California, Maryland, Massachusetts, Missouri,
11 North Carolina, South Carolina, and Vermont.

12 **Q What is the purpose of your direct testimony in this proceeding?**

13 **A** My testimony addresses certain practices and calculations relied on by PacifiCorp
14 that impact power costs and customer rates at issue in the TAM. Specifically, I
15 consider take-or-pay, liquidated damages, and tiered pricing coal contracts, and
16 the implications those contracts have on short-term and long-term operations at
17 the associated coal-fired electric generation units. I review one year of historical
18 dispatch performance at Naughton and compare it to alternative dispatch
19 strategies that yield lower costs for ratepayers. Finally, I explain why both short-
20 term and long-term decisions at units with fuel contracts containing take-or-pay,
21 liquidated damages, or tiered pricing provisions may increase costs to customers
22 and therefore warrant careful review by the Commission.

23 **Q Please summarize your conclusions and recommendations.**

24 **A** PacifiCorp coal contracts that include minimum-take provisions or tiered pricing
25 can lead to suboptimal dispatch in the near-term, and suboptimal resource
26 planning in the long run. PacifiCorp ratepayers would have been better off had the
27 Company operated its Naughton plant less during the July 2015 – June 2016
28 period, and even better off had PacifiCorp been able to operate the plant at coal

1 quantities well below its minimum-take provision. Multi-year minimum-take
2 provisions serve as unit commitment requirements made years in advance,
3 potentially locking the Company into uneconomic dispatch and ongoing costs that
4 exceed future revenues at the plant.

5 First, I recommend that the Commission explicitly direct PacifiCorp to refrain
6 from entering into any new contracts for coal fuel or transportation unless and
7 until the Commission has an opportunity to review whether and how these multi-
8 year commitments in coal contracts are affecting economic dispatch.

9 Second, in light of the suboptimal dispatch of PacifiCorp's coal units, I
10 recommend that the Commission reduce the coal-fuel expense increase in the
11 2018 TAM by \$2.4 million.

12 Third, I recommend that the Commission require PacifiCorp to demonstrate that
13 any unit's dispatch in excess of its corresponding minimum-take quantities was in
14 the best interest of rate payers in all future TAM proceedings.

15 Fourth, I recommend that the Commission direct PacifiCorp in future TAM
16 dockets and other resource planning proceedings to include all variable costs
17 when making decisions regarding unit commitment and dispatch, including real-
18 time, day-ahead, annual, and long-term planning horizons.

19 **2. PACIFICORP FIXED-PRICE CONTRACTS**

20 **Q Why are coal contracts important to this Transition Adjustment Mechanism**
21 **(“TAM”) filing?**

22 The Company's existing coal contracts are key to three components of this filing.
23 First, the Company has indicated that its existing contracts have experienced a
24 cost increase of [REDACTED] million.¹ Second, the
25 Company has indicated, through this filing, that it is in the process of signing new
26 contracts, and expects to execute on those contracts shortly,² including

¹ PAC/200 Ralston/15. Confidential Table 3.

² PAC/200 Ralston/8 at 2-14, Ralston/18 at 7-9

1 negotiations for 8.9 percent of its total coal supply.³ Third, the Company's
2 existing – and likely new – contracts result in present-day non-economic dispatch.

3 Mr. Ralston testifies that 43.4 percent of PacifiCorp's coal requirement will be
4 supplied under fixed-price contracts, and another 15.5 percent of the Company's
5 coal will be provided by affiliate mines⁴ – i.e. Bridger and Trapper mines. In other
6 words, nearly 60 percent of PacifiCorp's coal in 2018 will be procured through a
7 mechanism by which the Company has little optionality.

8 Additionally, the plants with minimum-take requirements⁵ increase total fuel cost
9 by [REDACTED] million, whereas the plants without
10 minimum-take requirements decrease total fuel cost by [REDACTED]
11 [REDACTED] million.⁶ Clearly, contracts with minimum-take requirements are
12 very important to the proposed TAM changes.

13 Mr. Ralston testifies that “[c]ustomers have significantly benefited from
14 PacifiCorp's diversified fueling strategy, which relies upon fixed-price contracts,
15 index-priced contracts, and affiliate-owned mines to meet the fuel needs.”⁷ I
16 demonstrate later in my testimony that fuel contracts have locked PacifiCorp in to
17 dispatch decisions that are ultimately imposing significant costs on its customers,
18 and that PacifiCorp's dispatch decisions are imposing even more costs on its
19 customers than required by the contract terms.

20 **Q Why does a fixed-price contract have relatively little optionality?**

21 **A** As noted by the Commission in Order 15-161, virtually all fixed-price long-term
22 coal supply agreements (“CSAs”) contain take-or-pay provisions that require the
23 Company to purchase a minimum specified amount of coal or pay some form of
24 liquidated damages or other penalty.⁸ In this case, the Company confirms that

³ PAC/200 Ralston/2 at 18-20.

⁴ PAC/200 Ralston/2 at 13-15.

⁵ Ralston/15 at 2.

⁶ Ralston/25 at Confidential Table 5.

⁷ Ralston/25 at 11-13.

⁸ *Ibid.*

1 [REDACTED] of its third-party contracts contains
2 a minimum-take requirement.⁹

3 **Q What is a take-or-pay provision in a coal contract?**

4 **A** A take-or-pay provision is a per unit penalty assessed when purchased quantity
5 over a time interval is less than an agreed upon quantity. Whereas the penalty
6 (termed “liquidated damages”) need not be as severe as the price of the unit,
7 PacifiCorp’s minimum-take contracts impose that penalty – under its minimum-
8 take contracts, PacifiCorp will pay the full price of each ton of coal whether or not
9 it accepts delivery. PacifiCorp provides the following narrative:

10 “Take-or-pay” provisions in the CSAs refer to the contractual
11 requirement to take at least the minimum contractual tonnage of
12 coal or pay the normal contract price for any tons not taken.
13 “Liquidated-damage payments for coal not purchased” refers to a
14 contractually agreed upon payment (typically at an amount much
15 less than the actual contract price) that becomes due if contractual
16 quantities are not taken and / or shipped.¹⁰

17 **Q Have concerns about the lack of optionality in long-term coal supply**
18 **agreements been raised before this Commission previously?**

19 **A** Yes. In Order 15-161 (May 27, 2015) of Oregon docket UM 1712, the
20 Commission acknowledged a concern with long-term coal supply agreements
21 stating that “we share concerns of Staff, ICNU, and Sierra Club that the CSAs
22 might expose PacifiCorp to potentially uneconomic financial commitments or
23 complicate decisions to operate or shut down coal units should certain events
24 come to pass.”¹¹

⁹ PAC/200 Ralston/15 at 2-8.

¹⁰ PacifiCorp, Response to Sierra Club Data Request 2.11(b).

¹¹ Order 15-161 in UM 1712, May 27, 2015. In the Matter of PacifiCorp Application for Approval of Deer Creek Mine Transaction.

1 **Q What is your current concern with respect to the Company's coal contracts?**

2 **A** I will demonstrate that the Company's long-term contracts, even those existing
3 prior to the Bowie coal supply agreement discussed in UM 1712, may have
4 resulted in potentially uneconomic financial commitments and have complicated
5 decisions to cease operating coal, even with no incremental environmental
6 obligations.

7 In addition, the minimum-take and liquidated damage terms of the Company's
8 coal supply agreements create a binding commitment with long-lasting
9 implications for annual dispatch and the ability to retire non-economic units. In
10 fact, the level of commitment incumbent in a long-term contract can easily rival
11 large-scale capital costs – but are not subject to the same level of scrutiny or
12 assessment.

13 As my colleague, Dr. Jeremy Fisher, has discussed before this Commission
14 previously, the Company only established a mechanism for the regulatory vetting
15 of generation capital investments after 2012 – but has no such process to vet
16 large-scale fuel supply agreements. There are multiple critical factors in a fuel
17 supply agreement, including the cost, the term, the minimum-take (if any), and the
18 damages incurred if the minimum-take is violated. These factors influence the
19 economic favorability of the contract and the optionality realized in the
20 procurement – in other words, the overall commitment of the contract.

21 **Q Has PacifiCorp disclosed the mechanism by which it determines these key**
22 **factors?**

23 **A** Not to my knowledge. For example, Mr. Ralston testifies that the Company is
24 currently in the process of negotiating a new contract with the Black Butte mine
25 for a [REDACTED]

26 [REDACTED]
27 Based on the Company's 2017 fueling plan for Jim Bridger, the Company
28 estimates that this contract will serve nearly [REDACTED]

¹² PAC/200 Ralston/8 at 10-14.

1 percent of Bridger’s requirements through [REDACTED], at a
 2 cost of [REDACTED].¹³ To my knowledge, the
 3 specific provisions in this contract, including cost, term, minimum-take
 4 requirements, have not been vetted by the Commission. That means the process
 5 by which the Company assessed the terms and conditions, and the question of
 6 whether signing such a contract was more favorable than reducing generation or
 7 closing a unit has not been available for scrutiny..

8 When asked to provide a detailed description of the process the Company used to
 9 evaluate the Black Butte coal position, PacifiCorp’s complete response was two
 10 sentences that contained a lengthy list of key factors but no insight on the
 11 Company’s approach to evaluating those factors. The Company stated:

12 The process used in negotiating a contract with Black Butte takes
 13 into consideration the unique circumstances of the Jim Bridger
 14 plant, other potential suppliers, coal quality requirements,
 15 projected consumption levels, availability of transportation
 16 infrastructure, and the economics and risks associated with each
 17 transaction. Contract minimums, term, pricing and liquidated
 18 damage provisions are also considered and negotiated.¹⁴

19 In contrast, the Company’s Integrated Resource Plan (“IRP”) so-called “Volume
 20 3” assessments of coal plant economics, and its filings for Certificate of Public
 21 Convenience and Necessity in other jurisdictions contain relatively detailed
 22 modeling examining multiple scenarios to determine if investments in capital
 23 projects are in the interests of ratepayers. The difference between the Company’s
 24 expected disclosure of analyses underlying capital investments versus its
 25 discussions of large-scale contract commitments is extraordinary. The
 26 Commission may not expect to examine the features of each and every coal
 27 supply agreement entered into by the Company, but under reasonable
 28 circumstances – i.e. marginal coal economics, increasing costs, and near-term

¹³ [Reference to SC 2.1, 2017 CONF]

¹⁴ PacifiCorp Response to Sierra Club Data Request 2.3(a).

1 decision points – the Company should expect to disclose the process by which it
2 structures, negotiates and signs coal contracts with take-or-pay or liquidated
3 damages.

4 **Q Why is the process by which PacifiCorp structures, negotiates, and signs coal**
5 **contracts with take-or-pay or liquidated damages important?**

6 **A** The structures in existing and new contracts are critical to the performance and
7 cost of operation at PacifiCorp. As I'll demonstrate, when a contract has a take-
8 or-pay provision, the Company may become locked into non-economic operation
9 when energy market prices fall.

10 For illustrative purposes, PacifiCorp's contract with Westmoreland at Kemmerer
11 mine to fuel the Naughton plant is particularly informative. I will show that
12 PacifiCorp's dispatch of Naughton is substantially less cost effective than if the
13 plant did not have a minimum-take requirement.

14 **3. NAUGHTON DISPATCHED NON-ECONOMICALLY IN 2015-2016**

15 **Q If the Company's requested TAM is associated with 2018, why are you**
16 **assessing the dispatch of the Naughton units in 2015 and 2016?**

17 **A** The Company's request for an adjustment implicitly assumes both a cost for the
18 fuel procured at each coal plant, as well the dispatch of each coal unit on a going-
19 forward basis. While we can assess and critique the GRID model upon which the
20 net power cost ("NPC") and TAM are based, assessing historic procurement and
21 dispatch provides a firm basis for the review of PacifiCorp's actions. Naughton's
22 fuel contract year runs from July to June,¹⁵ and June 2015 to July 2016 is the
23 contract year with complete data available at the time of writing this testimony.

24 Naughton also represents a substantial portion of the fuel cost variance in this
25 proceeding. Out of the [REDACTED] million increase
26 projected by Mr. Ralston, [REDACTED] million, or

¹⁵ PAC/200 Ralston/16 at 22 to Ralston/17 at 1

1 [REDACTED] percent is attributable to projected increased
2 price and volumes at Naughton.

3 Finally, for analytical purposes, the Naughton plant represents a relatively
4 straightforward assessment due to the clarity of its contract terms. The Naughton
5 plant has multiple units of differing size, but a single contracted source of coal
6 with both a minimum-take requirement¹⁶ and tiered pricing.¹⁷ One of the
7 Naughton units is pending retirement,¹⁸ and the coal contract includes a provision
8 relevant to that retirement.¹⁹ California Energy Imbalance Market (EIM)
9 locational marginal prices (LMPs) are available for the nodes associated with
10 these units.²⁰ Finally, because the coal is delivered via overland conveyor,²¹ there
11 is no transportation contract and therefore there won't be uncertainties related to
12 multiple contracts.

13 While it is not clear that the dispatch and contract at Naughton are indicative of
14 PacifiCorp's fleet in general, this plant provides a useful and readily understood
15 example.

16 **Q How is the dispatch of a thermal unit determined?**

17 **A** In general, the production cost of a dispatchable generating unit is assessed
18 against the opportunity cost not to generate – either a market price or the
19 locational marginal price (“LMP”) based on transmission losses and constraints at
20 that unit's interconnection point. A regional system operator will typically run a
21 security-constrained economic dispatch model, taking into consideration the
22 system requirements, dispatch cost of individual units and transmission
23 constraints. In market-based regions, units bid at or near their production cost, and
24 the system operator provides dispatch instructions accordingly. PacifiCorp is in a
25 somewhat unique situation, where it is (currently) the primary system operator,

¹⁶ PAC/200 Ralston/16, at 6.

¹⁷ PAC/200 Ralston/16, at 3-8

¹⁸ PAC/200 Ralston/16, at 9-13

¹⁹ PAC200 Ralston/17, at 1-6

²⁰ PacifiCorp Response to Sierra Club Data Request 1.3.

²¹ Ralston/16, at 4

1 but for units dispatched into the Energy Imbalance Market (“EIM”). For those
2 units, PacifiCorp provides a bid to California Independent System Operator
3 (“ISO”) based on its production cost.

4 **Q Does PacifiCorp use the same production cost for its internal NPC model as**
5 **is used when providing production costs to EIM?**

6 **A** No. Production cost provided to EIM are distinctly different than costs in the
7 NPC.

8 When describing the production costs used in EIM, PacifiCorp states that:

9 The production costs referenced for coal resources are the coal fuel
10 costs times the heat rate plus variable operations and maintenance
11 (O&M / VOM) and a 10 percent adder. The VOM costs for coal
12 units include chemicals and ash handling.²²

13 In contrast, with respect to NPC, PacifiCorp states:

14 NPC for coal resources only includes the cost of fuel (coal)
15 consumed. Coal is delivered to the plant inventory stockpile at the
16 invoice price. The consumed cost of coal is calculated using the
17 weighted average price of the inventory available multiplied by the
18 volume of fuel consumed for the month.²³

19 **Q What are some of the key factors when determining economic dispatch of**
20 **coal units with minimum-take requirements, liquidated damage clauses, or**
21 **tiered pricing?**

22 **A** In addition to the take-or-pay or liquidated damage terms and tiered pricing
23 structure, other key factors include the total length of the contract, length of time
24 between quantity resets (typically a year), and the date of the quantity reset. To
25 the extent that coal transportation contracts also have take-or-pay provisions or
26 tiered pricing, that detail is important as well. Finally, the expected value of the

²² PacifiCorp Response to Sierra Club Data Request 1.1(a)

²³ PacifiCorp Response to Sierra Club Data Request 1.1(a) Supplemental

1 manufactured good (in this case, electric energy) over the time period in question
2 is also critical.

3 **Q What is tiered pricing within a coal contract?**

4 **A** With tiered pricing, the price per unit changes depending on how many units have
5 been purchased during the period defined in the contract. The price per unit is P_1
6 for each unit up to a quantity of Q_1 , price P_2 for quantities between Q_1 and Q_2 , and
7 so forth. For example, the first 150 units might cost \$20 per unit, the next 50
8 might be \$10 per unit, and then any additional units might cost \$30 per unit.

9 **Q What inputs would be necessary to model economic dispatch for a given unit
10 or plant?**

11 **A** For each year modeled, it is necessary to have a commitment or forecast for load,
12 market price, future fuel prices (under contract or forecasted), fuel contract info,
13 variable operations and maintenance (VOM) costs, reliability requirements, and
14 the inflexibility characteristics of the units, not just for the unit under study but for
15 the entire system of generation and transmission assets.

16 **Q Are you able to determine the basis upon which PacifiCorp dispatched
17 Naughton in 2015/2016?**

18 **A** Not precisely. I do not have access to the Company's model from 2015/2016, and
19 the Company asserted that its actual production costs for Naughton (and other
20 plants) would be considered highly confidential, requiring in-person review.²⁴
21 However, a spreadsheet assessment can be used to provide reasonable insights
22 regarding past performance. For this review, I used a spreadsheet to model the
23 historical dispatch of Naughton 1, Naughton 2, and Naughton 3 and the units'
24 actual output against economically efficient outcomes.

²⁴ PacifiCorp Response to Sierra Club Data Requests 1.1(c) and 1.2(b)

1 **Q What inputs were used in your analysis?**

2 **A** I modeled the historical dispatch of the Naughton units from July 2015 to June
3 2016 using market prices,²⁵ fuel costs and quantities,²⁶ fuel contract terms,²⁷ and
4 public sources for heat rate²⁸ and unit capacity.²⁹ I compared my results to data
5 made available by the US Energy Information Administration³⁰ to confirm the
6 accuracy of several calculations.³¹

7 **Q Please provide a narrative of your spreadsheet dispatch model.**

8 **A** The model assumes that each of the three Naughton units operate independently
9 as ideal generators. That is, each unit can produce power at any level between 0
10 MW and its generation capacity, and immediately ramp up or down to a different
11 operating level at the next time interval. Further, the model has perfect foresight –
12 the prices for each 15-minute interval across the entire year are known *a priori*.
13 The model can therefore dispatch each unit to maximize revenue for any targeted
14 quantity of coal consumption, and will therefore present more revenue than an
15 actual unit operation could generate. Because the coal contract interval for
16 Naughton runs from July to June,³² the July 2015 – June 2016 contract year was
17 modeled.

18 To model the actual performance, I assumed that the Naughton units burned one
19 ton of coal in the July 2015 – June 2016 period for every ton of coal purchased

²⁵ SC Data Request 1.3. 2015 Jul-Dec FMM Prices.xlsx, 2016 Jan-Jun FMM Prices.xlsx.

²⁶ ICNU Data Request 0011. 2015 Jan-Dec Fuel Supply Cost Calculations CONF.xls, 2016 Jan-Dec Fuel Supply Cost Calculations CONF.xls.

²⁷ SC Data Request 2.6. Attach Sierra Club 2.6-1 CONF.xlsx.

²⁸ PacifiCorp, “PacifiCorp Energy Fossil Fuel Heat Rate Improvement Plan 2016,” page 24. Available at: <https://pscdocs.utah.gov/electric/16docs/1603519/275489PacifiCorpFossilFuelHeatRateImprovPlan4-29-2016.pdf>.

²⁹ PacifiCorp, “2017 Integrated Resource Plan, Volume 1,” April 4, 2017. Table 5.3. Available at: https://www.pacificorp.com/content/dam/pacificorp/doc/Energy_Sources/Integrated_Resource_Plan/2017_IRP/2017_IRP_VolumeI_IRP_Final.pdf.

³⁰ Energy Information Administration, Form EIA-923.

³¹ Coal purchase quantities and costs as well as hourly dispatch of the Naughton units are publicly available via the Energy Information Administration’s Form 923 and the Environmental Protection Agency’s Clean Air Markets Database (CAMD). To the extent I used coal quantity and cost data provided directly by PacifiCorp and marked by PacifiCorp as confidential, I also marked that data confidential in my testimony. The designations in my testimony should not be construed as any agreement that PacifiCorp’s confidential designations are appropriate.

³² Ralston/16 Line 22—Ralston/17 Line 1

1 during that period. Although monthly purchase data was available in the net
2 power cost (“NPC”) data, it would be inappropriate to expect monthly dispatch to
3 match monthly coal purchasing because Naughton may store more or less coal on
4 its pile in response to short term market conditions. Because the contract take-or-
5 pay term resets each year, Naughton must burn at least the full take-or-pay
6 quantity in each typical year, lest the coal pile grow taller and taller over the
7 years. Although each Naughton unit reports its own purchases, because the coal is
8 stored in a single pile I treated the coal as shared between the units.

9 By using the heat rate of the plant, the energy content of the coal, and the total
10 quantity of coal purchased over the year, I calculated the total megawatt-hours of
11 generation under the assumptions detailed above. I used the model to assign those
12 megawatt-hours to 15-minute intervals, beginning with the highest priced 15-
13 minute interval. This simplified assessment is relatively conservative: the
14 spreadsheet assessment assumes optimal dispatch (i.e. no commitment),
15 dispatching units to collect the maximum possible revenue in the year for the
16 given quantity of coal to be consumed.

17 **Q Please describe the model results associated with the actual performance of**
18 **Naughton in the July 2015 – June 2016 period.**

19 **A** In the July 2015 – June 2016 period, 2,621,207 tons of coal were purchased for
20 the Naughton plant, well above the [REDACTED] tons
21 minimum-take requirement. To consume that much coal, the model dispatched the
22 units in each of approximately [REDACTED] of the 35,156
23 15-minute intervals within the year. To maximize revenue while dispatching in
24 [REDACTED] intervals, the model dispatched the units
25 whenever the LMP exceeded [REDACTED]. This
26 resulted in a total of [REDACTED] in revenue across
27 the three units. Against [REDACTED] in coal costs,
28 net revenue was [REDACTED]. Not included in my
29 calculation are variable operations and maintenance (VOM) costs associated with
30 each operating interval. Including these costs in the model would reduce the net

1 operating revenue. Fixed costs were also not included; while the inclusion of
2 those costs would not reduce the net operating revenue, their inclusion would
3 reduce the total net revenue for the Naughton units.

4 **Q What are the model results for operating Naughton at its minimum-take**
5 **requirement?**

6 **A** Had Naughton consumed only the [REDACTED] tons of
7 coal it was required by contract to purchase in the July 2015 – June 2016 period,
8 it would have dispatched for [REDACTED] 15-minute
9 intervals, about 2,600 fewer intervals. This corresponded to dispatching at an
10 LMP of [REDACTED]. Operating less resulted in
11 less operating revenue, [REDACTED]. However,
12 costs were lower. To ensure that no lower-priced tier-2 coal was made available, I
13 assumed a first in first out coal inventory model. The cost incurred by PacifiCorp
14 in purchasing the first [REDACTED] million tons of coal at
15 Naughton during the contract period is [REDACTED].
16 Therefore, the operating revenue less coal costs would have been [REDACTED]
17 [REDACTED] had Naughton only burned [REDACTED]
18 [REDACTED] million tons of coal. As with the actual performance, the net
19 operating revenues would be reduced further by the VOM costs, and the total net
20 revenue by the fixed operations and maintenance (FOM) costs as well.

21 **Q Given the model you developed, which of the two dispatch strategies would**
22 **have been better for ratepayers?**

23 **A** While both strategies saw revenue exceed coal costs, the net revenue was higher
24 when dispatch was limited to consuming the [REDACTED]
25 [REDACTED] tons of coal required by contract, rather than the [REDACTED]
26 [REDACTED] tons PacifiCorp purchased during that interval. The
27 difference in net revenue between the two strategies exceeds \$2.3 million. This
28 suggests that PacifiCorp's dispatch strategy for the Naughton plant – and for
29 every coal until with take-or-pay or tiered pricing contracts – may be imposing
30 higher rates on PacifiCorp customers than that of a better strategy.

1 **Q Both strategies resulted in positive net revenue. Does that mean that**
2 **Naughton is profitable?**

3 **A** Not necessarily. This analysis only compared market prices to the cost of coal
4 used in the Naughton plant. Without carefully considering all other costs, such as
5 VOM and FOM, we cannot determine if Naughton is profitable today. Further,
6 without including reasonably expected future capital expenditures for the plant,
7 one cannot determine if Naughton is likely to be profitable in future years.
8 However, a multi-year take-or-pay contract may force PacifiCorp to operate the
9 corresponding coal units at an annual operating loss during the contract period
10 because *not* operating the units during that period might result in the loss of even
11 greater amounts of ratepayer money.

12 According to FERC Form 1 records for both 2015 and 2016, Naughton's
13 combined operating costs (FOM and VOM) exceeded \$35.5 million.³³ If
14 Naughton were a merchant generator, these additional costs would have exceeded
15 the revenue net coal costs, rendering the unit a money loser on the marketplace.

16 **4. NAUGHTON'S MINIMUM-TAKE CONTRACT RESULTED IN NET RATEPAYER**
17 **LOSSES IN 2015-2016**

18 **Q What are the model results for operating Naughton without a minimum-take**
19 **requirement?**

20 If the Naughton plant had no minimum coal purchase clause in its contract (but
21 still the two-tiered pricing scheme), it might earn more net revenue by burning
22 even less coal. This would be true if and only if the minimum-take dispatch
23 resulted in operating during intervals when the market price was less than the
24 price of coal on a dollars-per-MWh basis. The Naughton coal cost-per-MWh of
25 generation was approximately [REDACTED] in the
26 July 2015 – June 2016 period. To dispatch often enough to consume
27 [REDACTED] pounds of coal, the Excel modeling
28 required dispatching whenever the market price exceeded [REDACTED]

³³ FERC Form 1, 2015: \$35.6 million; 2016: \$35.9 million.

1 [REDACTED]. Therefore, Naughton must dispatch at a loss in some
2 time intervals to consume [REDACTED] million tons. If
3 Naughton were permitted to consume less coal, it could be idled during those
4 intervals, avoiding losses.

5 When modeled as free to operate only when market prices exceeded coal costs,
6 Naughton was far more profitable in the July 2015 – June 2016 year. Were
7 Naughton permitted to consume substantially less coal ([REDACTED]
8 [REDACTED] million tons), it would realize [REDACTED]
9 [REDACTED] in revenue on [REDACTED] in coal
10 costs, netting [REDACTED].

11 **Table 1: Naughton July 2015 – June 2016 Model Results**

	Actual	Minimum-take	Optimal
Coal Burned (tons)	[REDACTED]	[REDACTED]	[REDACTED]
EIM Revenue	[REDACTED]	[REDACTED]	[REDACTED]
Coal Cost	[REDACTED]	[REDACTED]	[REDACTED]
Revenue minus Coal Cost	[REDACTED]	[REDACTED]	[REDACTED]

12 As shown in Confidential Table 1, this model demonstrates had there been no
13 minimum coal quantity clause in the Naughton contract from July 2015 – June
14 2016 (or had the minimum quantity been [REDACTED] million
15 tons or less), ratepayers would have been more than \$10.5 million better off
16 during that period. In fact, if the calculation were to include VOM, the difference
17 would be even more substantial, as the reduced generation would also save VOM
18 costs as well. For example, if VOM costs were \$4/MWh, the reduced generation
19 would have saved approximately \$9.3 million in VOM costs, bringing the
20 difference between the actual operations of Naughton and the ideal operations
21 with no minimum-take to nearly \$20 million. Again, that's one study year, and
22 just one of the PacifiCorp plants. The total ratepayer impact across multiple years,
23 and across multiple power stations, could be substantially larger.

1 **Q** **Is it possible to obtain a contract with a minimum-take of only [REDACTED]**
2 **[REDACTED] tons from the Kemmerer Mine, the source of**
3 **Naughton coal?**

4 **A** I don't know what was possible when the contract was signed, but I do note that
5 the current version of the contract contains a provision that [REDACTED]
6 [REDACTED]
7 [REDACTED]. My understanding is that the
8 provision has been exercised, and goes into effect on [REDACTED]
9 [REDACTED]. It is unfortunate for ratepayers that the [REDACTED]
10 [REDACTED] wasn't in effect at the start of the
11 July 2015 – June 2016 period.

12 **5. CONCLUSIONS**

13 **Q** **Please summarize your findings with respect to PacifiCorp's existing and**
14 **pending coal contracts.**

15 **A** I have several findings in this case as a result of my analysis.

- 16 1. Naughton appears to have dispatched non-economically during the
17 2015/2016 contract year, and has likely continued this same level of operation. I
18 find no evidence that PacifiCorp has changed the mechanism by which it
19 dispatches, market prices have remained depressed since that time, and
20 Naughton's dispatch has not changed substantially, suggesting that this same
21 behavior has continued.
- 22 2. In the absence of a minimum take contract, Naughton would have dispatched
23 at a far lower level.
- 24 3. Naughton's operations and maintenance costs in 2015 and 2016 likely
25 exceeded its net energy market revenues, indicating that ratepayers lost value by
26 operating the plant.

1 4. PacifiCorp's medium and long-term fuel contracts appear to lock the utility
2 into non-economic behavior, and result in ratepayer losses and a loss of
3 optionality.

4 5. PacifiCorp's is unable or unwilling to explain the process by which it
5 determines and negotiates key components of coal contracts, including terms,
6 price, minimum take provisions, and damages.

7 **Q Do you have any recommendations?**

8 **A** I have several.

9 **1. I recommend that the Commission direct PacifiCorp to refrain from**
10 **entering into new multi-year coal supply and transportation agreements**
11 **until the Commission has an opportunity to more carefully review how**
12 **these contracts are affecting economic dispatch.** The PacifiCorp third-party
13 coal contracts that are multi-year, contain minimum -take provisions, or
14 contain multiple tiered pricing serve to reduce optionality for the Company
15 and ratepayers. These contracts are large-scale investment commitments.
16 However, PacifiCorp has repeatedly declined to discuss the methodology by
17 which it analyzes these contracts before signing. These commitments, and the
18 demonstration that they result in adverse impacts, require a closer assessment.

19 **2. I recommend that the Commission reduce the coal-fuel expense increase**
20 **in the 2018 TAM by \$2.4 million.** As demonstrated in my testimony, if
21 PacifiCorp had dispatched the Naughton units at a level dictated by the
22 minimum-take provision of its contract rather than in excess of that provision,
23 net revenue would have been \$2.4 million higher than PacifiCorp realized.
24 While the results I present may overestimate the difference in revenue, they
25 are also conservative because the recommended reduction fails to include the
26 VOM savings that would accompany reduced dispatch.

27 **3. I recommend that the Commission require PacifiCorp to demonstrate**
28 **that any unit's dispatch in excess of its corresponding minimum-take**
29 **quantities was in the best interest of rate payers in all future TAM**

1 **proceedings.** Minimum-take contracts reduce optionality, but they don't
2 eliminate it. Because dispatch at units with minimum-take contracts requires a
3 more sophisticated strategy and cannot be done myopically, and because
4 modelling demonstrates that PacifiCorp has not always dispatched units with
5 minimum-take provisions optimally, PacifiCorp should be required to
6 demonstrate that its operational strategies at these plants result in least cost
7 dispatch.

8 **4. I recommend that the Commission require PacifiCorp to include all**
9 **variable costs when making decisions regarding unit commitment and**
10 **dispatch, including real-time, day-ahead, annual, and long-term planning**
11 **horizons.** This recommendation applies to both future TAM proceeding as
12 well as other resource planning proceedings. This requirement would help
13 PacifiCorp avoid dispatching units at a financial loss once its minimum-take
14 requirements are or are expected to be satisfied.

15 **Q Does this conclude your testimony?**

16 **A Yes.**



Thomas J. Vitolo, Ph.D., Senior Associate

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PROFESSIONAL EXPERIENCE

Synapse Energy Economics Inc., Cambridge, MA. *Senior Associate*, 2015 – present, *Associate*, 2011 – 2015.

Conducts research, authors reports, and prepares expert testimony. Consults on issues related to renewable resources, distributed energy resources, PURPA and avoided costs, municipal utility planning, renewable energy and carbon markets, integrated resource planning, coal asset valuation, compliance, and cost-benefit analysis.

Jointown Group Co., Ltd., Wuhan, China. *Systems Engineer Intern*, Summer 2007.

Developed and implemented a modified (s,S) inventory management scheme for over 20,000 warehoused pharmaceutical products, resulting in more orders filled, lower carrying costs, and a reduction in the frequency of product expiration.

MIT Lincoln Laboratory, Division 6, Group 65, Lexington, MA. *Research Assistant*, 2003 – 2006.

Designed algorithm and implemented software to create autonomous wireless point-to-point topologies for aerial, land-based, and nautical vehicles as part of an Optical & RF Combined Link Experiment (ORCLE) funded by Defense Advanced Research Projects Agency (DARPA).

EDUCATION

Boston University, Boston, MA

Doctor of Philosophy in Systems Engineering, 2011. Developed algorithms to discover degree constrained minimum spanning trees in sparsely connected graphs.

Dublin City University, Dublin, Ireland

Master of Science in Financial and Industrial Mathematics, 2001. Researched partial differential equations modeling fluid flow over an erodible bed.

North Carolina State University, Raleigh, North Carolina

Bachelor of Science in Applied Mathematics, 2000. *Summa Cum Laude*.

Bachelor of Science in Computer Science, 1999. *Summa Cum Laude*.

Bachelor of Science in Economics, 1998. *Summa Cum Laude*.

TESTIMONY

North Carolina Utilities Commission (Docket No. E-100, Sub 148): Biennial Determination of Avoided Cost Rates for Electric Utility Purchases from Qualifying Facilities--2016. Direct testimony on behalf of Southern Alliance for Clean Energy. March 28, 2017.

Public Service Commission of South Carolina (Docket No. 2017-2-E): Annual Review of Base Rates for Fuel Costs for South Carolina Electric & Gas Company. Direct and surrebuttal testimony on behalf of South Carolina Coastal Conservation League and Southern Alliance for Clean Energy. March 22 and April 3, 2017.

Maryland House of Delegates Economic Matters Committee (SB 771): Oral testimony regarding the rate impacts of Senate Bill 771 and Senate Bill 1131 on low use and low-income customers and energy efficiency programs in the SMECO and Choptank cooperative service territories. On behalf of the Maryland Public Service Commission. February 21, 2017.

Maryland Senate Finance Committee (SB 771): Oral testimony regarding the rate impacts of Senate Bill 771 and Senate Bill 1131 on low use and low-income customers and energy efficiency programs in the SMECO and Choptank cooperative service territories. On behalf of the Maryland Public Service Commission. February 21, 2017.

The Commonwealth of Massachusetts Department of Public Utilities (Docket No. 16-99): Public comments regarding the Town of Brookline's request for approval of a municipal aggregation plan pursuant to G.L. c. 164, § 134. On behalf of the Brookline Climate Action Committee Community Choice Aggregation Subcommittee. September 14, 2016.

Public Service Commission of South Carolina (Docket No. 2016-3-E): Annual Review of Base Rates for Fuel Costs of Duke Energy Carolinas, LLC. Direct and surrebuttal testimony on behalf of South Carolina Coastal Conservation League and Southern Alliance for Clean Energy. August 19 and September 1, 2016.

Public Service Commission of South Carolina (Docket No. 2016-2-E): Annual Review of Base Rates for Fuel Costs for South Carolina Electric & Gas Company. Direct and surrebuttal testimony on behalf of South Carolina Coastal Conservation League and Southern Alliance for Clean Energy. March 24 and April 6, 2016.

Public Service Commission of South Carolina (Docket No. 2016-1-E): Annual Review of Base Rates for Fuel Costs of Duke Energy Progress, LLC. Direct testimony on behalf of South Carolina Coastal Conservation League and Southern Alliance for Clean Energy. May 19, 2016.

Vermont Public Service Board (Docket No. 8586): Direct testimony on the need and economic benefit of the proposed Coolidge Solar 20 MW solar electric generation facility. On behalf of Ranger Solar, LLC. December 14, 2015 and September 14, 2016.

California Public Utilities Commission (Docket No. R.13-12-010): Reply testimony on Phase 1a modeling scenarios in the Order Instituting Rulemaking to Integrate and Refine Procurement Policies and Consider

Long-Term Procurement Plans. On behalf of the California Office of Ratepayer Advocate. December 18, 2014.

Public Service Commission of South Carolina (Docket No. 2014-246-E): Direct testimony regarding a methodology for calculating the costs and benefits of solar net energy metering. On behalf of the Carolina Coastal Conservation League and the Southern Alliance for Clean Energy. December 11, 2014.

Missouri Public Service Commission (Case No. EO-2011-0271): Rebuttal testimony regarding Union Electric Company D/B/A Ameren Missouri. On behalf of the Missouri Office of Public Counsel. October 28, 2011.

PUBLICATIONS

Whited, M., A. Horowitz, T. Vitolo, W. Ong, T. Woolf. 2017. *Distributed Solar in the District of Columbia: Policy Options, Potential, Value of Solar, and Cost-Shifting*. Synapse Energy Economics for the Office of the People's Counsel for the District of Columbia.

Whited, M., E. Malone, T. Vitolo. 2016. *Rate Impacts on Customers of Maryland's Electric Cooperatives: Impacts on SMECO and Choptank Customers*. Synapse Energy Economics for Maryland Public Service Commission.

Woolf, T., M. Whited, P. Knight, T. Vitolo, K. Takahashi. 2016. *Show Me the Numbers: A Framework for Balanced Distributed Solar Policies*. Synapse Energy Economics for Consumers Union.

Wilson, R., S. Fields, P. Knight, E. McGee, W. Ong, N. Santen, T. Vitolo, E. A. Stanton. 2016. *Are the Atlantic Coast Pipeline and the Mountain Valley Pipeline Necessary? An examination of the need for additional pipeline capacity in Virginia and Carolinas*. Synapse Energy Economics for Southern Environmental Law Center and Appalachian Mountain Advocates.

Vitolo, T. 2016. "Senate bill on climate change is the stronger of the two." *Cambridge Chronicle*, July 30.

Jackson, S., P. Luckow, E.A. Stanton, A. Horowitz, P. Peterson, T. Comings, J. Daniel, and T. Vitolo. 2016. *Reimagining Brayton Point: A Guide to Assessing Reuse Options for the Somerset Community*. Prepared by Synapse Energy Economics for Coalition for Clean Air South Coast, Clean Water Action, and Toxics Action Center.

Vitolo, T., A. Horowitz, P. Luckow, and N.R. Santen. 2015. *Meeting Maryland's RPS*. Synapse Energy Economics for the Maryland Climate Coalition.

Vitolo, T., M. Chang, T. Comings, A. Allison. 2015. *Economic Benefits of the Proposed Coolidge Solar I Solar Project*. Synapse Energy Economics for Coolidge Solar I, LLC.

Vitolo, T. 2015. *Memorandum Reviewing Distributed Generation Policy Proposed by Belmont Citizens*. Synapse Energy Economics for Belmont Clean Energy.

Luckow, P., T. Vitolo, J. Daniel. 2015. *A Solved Problem: Existing Measures Provide Low-Cost Wind and Solar Integration*. Synapse Energy Economics.

Fields, S., P. Luckow, T. Vitolo. 2015. *Clean Energy Future Technical Review*. Synapse Energy Economics.

Vitolo, T., P. Luckow, S. Fields, P. Knight, B. Biewald, E. A. Stanton. 2015. *Lower Electric Costs in a Low-Emission Future*. Synapse Energy Economics.

Takahashi, K., J. Fisher, T. Vitolo, N. R. Santen. 2015. *Review of TVA's Draft 2015 Integrated Resource Plan*. Synapse Energy Economics for Sierra Club.

Vitolo, T., J. Fisher, J. Daniel. 2015. *Dallman Units 31/32: Retrofit or Retire?* Synapse Energy Economics for the Sierra Club.

Woolf, T., M. Whited, E. Malone, T. Vitolo, R. Hornby. 2014. *Benefit-Cost Analysis for Distributed Energy Resources: A Framework for Accounting for All Relevant Costs and Benefits*. Synapse Energy Economics for the Advanced Energy Economy Institute.

Stanton, E. A., J. Daniel, T. Vitolo, P. Knight, D. White, G. Keith. 2014. *Net Metering in Mississippi: Costs, Benefits, and Policy Considerations*. Synapse Energy Economics for the Public Service Commission of Mississippi.

Fagan, R., T. Vitolo, P. Luckow. 2014. *Indian Point Energy Center: Effects of the Implementation of Closed-Cycle Cooling on New York Emissions and Reliability*. Synapse Energy Economics for Riverkeeper.

Vitolo, T., J. Fisher, K. Takahashi. 2014. *TVA's Use of Dispatchability Metrics in Its Scorecard*. Synapse Energy Economics for Sierra Club.

Comings, T., J. Daniel, P. Knight, T. Vitolo. 2014. *Air Emission and Economic Impacts of Retiring the Shawnee Fossil Plant*. Synapse Energy Economics for the Kentucky Environmental Foundation.

Vitolo, T., J. Daniel. 2013. *Improving the Analysis of the Martin Drake Power Plant: How HDR's Study of Alternatives Related to Martin Drake's Future Can Be Improved*. Synapse Energy Economics for Sierra Club.

Vitolo, T., P. Luckow, J. Daniel. 2013. *Comments Regarding the Missouri 2013 IRP Updates of KCP&L and GMO*. Synapse Energy Economics for Earthjustice.

Hornby, R., P. Chernick, D. White, J. Rosenkranz, R. Denhardt, E. A. Stanton, J. Gifford, B. Grace, M. Chang, P. Luckow, T. Vitolo, P. Knight, B. Griffiths, B. Biewald. 2013. *Avoided Energy Supply Costs in New England: 2013 Report*. Synapse Energy Economics for the Avoided-Energy-Supply-Component (AESC) Study Group.

Stanton, E. A., T. Comings, K. Takahashi, P. Knight, T. Vitolo, E. Hausman. 2013. *Economic Impacts of the NRDC Carbon Standard*. Synapse Energy Economics for the Natural Resources Defense Council (NRDC).

Vitolo, T., G. Keith, B. Biewald, T. Comings, E. Hausman, P. Knight. 2013. *Meeting Load with a Resource Mix Beyond Business as Usual: A regional examination of the hourly system operations and reliability implications for the United States electric power system with coal phased out and high penetrations of efficiency and renewable generating resources*. Synapse Energy Economics for Civil Society Institute.

Stanton, E. A., F. Ackerman, T. Comings, P. Knight, T. Vitolo, E. Hausman. 2013. *Will LNG Exports Benefit the United States Economy?* Synapse Energy Economics for Sierra Club.

Ackerman, F., T. Vitolo, E. A. Stanton, G. Keith. 2013. *Not-so-smart ALEC: Inside the attacks on renewable energy.* Synapse Energy Economics for Civil Society Institute.

Woolf, T., M. Whited, T. Vitolo, K. Takahashi, D. White. 2012. *Indian Point Replacement Analysis: A Clean Energy Roadmap: A Proposal for Replacing the Nuclear Plant with Clean, Sustainable Energy Resources.* Synapse Energy Economics for Natural Resources Defence Council (NRDC).

Hornby, R., D. White, T. Vitolo, T. Comings, K. Takahashi. 2012. *Potential Impacts of a Renewable and Energy Efficiency Portfolio Standard in Kentucky.* Synapse Energy Economics for Mountain Association for Community Economic Development and Kentucky Sustainable Energy Alliance.

Keith, G., B. Biewald, E. Hausman., K. Takahashi, T. Vitolo, T. Comings, P. Knight. 2011. *Toward a Sustainable Future for the U.S. Power Sector: Beyond Business as Usual 2011.* Synapse Energy Economics for Civil Society Institute.

PRESENTATIONS AND POSTER SESSIONS

Vitolo, T. 2017. "How That Thing in Your Pocket Will Cut Carbon Emissions in Half." Lecture for the Boston University City Planning and Urban Affairs Program, April 11, 2017.

Whited, M., and T. Vitolo. 2016. "SB 1131 Energy-Related Study." Maryland Public Service Commission Stakeholder Meeting, November 10, 2016.

Vitolo, T. 2016. "The Influence of Clean Power Plan Compliance Pathway Choice on Renewable Energy Construction." Presentation at the Renewable Energy Markets Conference, October 17, 2016.

Vitolo, T., J. Lazar. 2016. "The Value of Solar: Assessing the Benefits, the Costs, and What it May Mean for Net Energy Metering." Webinar for Regulatory Assistance Project, September 22, 2016.

Vitolo, T. 2016. "Some Value of Solar Remarks." Presentation for EUCI's "Net Energy Metering and Utility Solar Rates" seminar, July 21, 2016.

Vitolo, T., P. Luckow. 2016. "New Renewable Generation Capacity – Why Here and Not There?" Webinar by Synapse Energy Economics, June 22, 2016.

Vitolo, T., D. Lescohier, E. Frey, L. O. Pehlke. 2016. "Comparing Two Brookline Water Department Rate Proposals." Presentation to Brookline Board of Selectmen, Brookline, MA, June 21, 2016.

Vitolo, T. 2016. "Value of Solar: What & How, Who & Where, and Why." Presentation for the Solar Market Pathways Sustainable Communities Leadership Academy, Boston, MA, June 7, 2016.

Vitolo, T. 2016. "Local Action Big Results: Community Choice Aggregation." Presentation at Brookline Climate Week 2016, March 30, 2016.

Vitolo, T. 2016. "Getting a Local Energy Project Up and Running: Community Choice Aggregation." Presentation for Local Environmental Action Conference 2016, March 13, 2016.

- Vitolo, T. 2016. "How That Thing in Your Pocket Will Cut Carbon Emissions in Half." Lecture for the Boston University City Planning and Urban Affairs Program, March 8, 2016.
- Vitolo, T. 2015. Oral testimony regarding Belmont proposed distributed generation compensation policy. Presentation to Net Metering Working Group, Belmont, MA, July 16, 2015.
- Vitolo, T. 2015. "Avoided Costs Associated with Distributed Generation and the Intersection of DG Valuation and Integrated Resource Planning." Presentation in Salt Lake City, UT, May 12, 2015.
- Stanton, E. A., B. Biewald, D. Hurley, P. Peterson, T. Vitolo. 2015. "Clean Energy Advocates Bootcamp: Understanding Supply and Demand in New England." Presentation in Cambridge, MA, February 12, 2015.
- Vitolo, T. 2015. Oral testimony regarding the Dallman 31/32 coal-fired power plant retrofit or retire decision. Presentation to Springfield Committee of the Whole, Springfield, Illinois, February 10, 2015.
- Vitolo, T. 2015. "Community Solar in Context." Presentation at Brookline Climate Week 2015, February 4, 2015.
- Vitolo, T. 2014. "Net Metering and Mississippi." Presentation at the 13th Annual Southern BioProducts and Renewable Energy Conference, November 13, 2014.
- Vitolo, T. 2014. Comments in New York Association for Energy Economics panel regarding the operation and economics of Indian Point Nuclear Plant, November 4, 2014.
- Vitolo, T. 2013. "How Big an Issue is Intermittency? Integrating Renewables into a Reliable, Low-Carbon Energy Grid," Presentation for Civil Society Institute webinar, April 17, 2013.
- Vitolo, T. 2009. "RPS in the USA: The Present Impact and Future Possibilities of Renewable Portfolio Standards in America." Presentation at Boston University Energy Club Seminar Series.
- Vitolo, T. 2007. "An ILP Approach to Spanning Tree Problems on Incomplete Graphs with Heterogeneous Degree Constraints." Presentation at INFORMS Annual Meeting.
- Vitolo T., J. Hu., L. Servi, V. Mehta. 2005. "Topology Formulation Algorithms for Wireless Networks with Reconfigurable Directional Links." Proceedings of the IEEE Military Communications Conference, October 2005.
- Vitolo, T. 2004. "Topology Design and Traffic Routing for Wireless Networks with Node-Based Topological Constraints." Presentation at Boston University CISE Seminar Series.

ADDITIONAL EXPERIENCE

TEACHING

- Guest Lecturer, Harvard Law School, 2017 – present
- Guest Lecturer, Boston University City Planning and Urban Affairs Program, 2015 – present

- Graduate Teaching Fellow, Boston University College of Engineering. *Introduction to Engineering Computation*, 2009
- Guest Lecturer, Boston University Department of Systems Engineering, *Case Studies in Inventory Management*, 2007-2008
- Guest Lecturer, Boston University Department of Systems Engineering, Solving Linear Programs with CPLEX, 2003-2008

GOVERNMENT SERVICE

- *Constable*, Brookline, MA, 2010 – present
- *Town Meeting Member*, Brookline, MA, 2007 – present
- *Bicycle Advisory Committee Member*, Brookline, MA, 2007 – present.

OTHER INFORMATION

FELLOWSHIPS AND SCHOLARSHIPS

- National Science Foundation IGERT Fellowship, 2006 – 2008
- National Science Foundation GK-12 Fellowship, 2002 – 2003
- Mitchell Scholarship, 2000 – 2001
- Park Scholarship, 1996 – 2000

ADDITIONAL SKILLS

- Computer Applications: Microsoft Office, LaTeX
- Programming: Fortran, C, C++, perl, MATLAB, CPLEX

AFFILIATIONS

- Center for Computation Science, Boston University, 2006 – 2010
- Center for Information and Systems Engineering, Boston University, 2002 – 2010

Resume dated April 2017

Sierra Club Data Request 1.1

Refer to the direct testimony of Michael Wilding, page 27 at 16-19 with respect to production costs.

- (a) For the Company's thermal units (gas and coal), list each category of cost that is included in production cost, including fuel, variable operations and maintenance (O&M), emissions, and other relevant categories. To the extent that variable O&M costs are included, list each category of O&M that are included in the production cost including, but not limited to, consumables, labor, and materials.
- (b) For the Company's thermal units, list each category of cost incurred at the thermal unit that are excluded from the production cost.
- (c) Provide monthly average production costs, in dollars per megawatt-hour (\$/MWh), for each thermal unit for the period 2006 – 2017, inclusive.
- (d) For each of the Company's coal-fired power plants for the period 2012 – 2017, provide a breakdown of production cost into the categories provided in (a), above.

Response to Sierra Club Data Request 1.1

- (a) The production costs referenced for coal resources are the coal fuel costs times the heat rate plus variable operations and maintenance (O&M / VOM) and a 10 percent adder. The VOM costs for coal units include chemicals and ash handling.

The production costs referenced for natural gas resources are the daily natural gas price based on the average of four regional gas indices, times the heat rate plus VOM and a 10 percent adder. The VOM costs for natural gas units include the following components: chemicals, water, and prepaid major maintenance.

- (b) All other costs besides those listed in subpart (a) are not included in the referenced production costs of the Company's thermal units.
- (c) Please refer to the Company's response to Sierra Club Data Request 1.2; specifically subpart (b).
- (d) The Company has not performed the requested analysis.

UE 323 / PacifiCorp
June 6, 2017
Sierra Club Data Request 1.1 – 1st Supplemental

Sierra Club Data Request 1.1

Refer to the direct testimony of Michael Wilding, page 27 at 16-19 with respect to production costs.

- (a) For the Company's thermal units (gas and coal), list each category of cost that is included in production cost, including fuel, variable operations and maintenance (O&M), emissions, and other relevant categories. To the extent that variable O&M costs are included, list each category of O&M that are included in the production cost including, but not limited to, consumables, labor, and materials.
- (b) For the Company's thermal units, list each category of cost incurred at the thermal unit that are excluded from the production cost.
- (c) Provide monthly average production costs, in dollars per megawatt-hour (\$/MWh), for each thermal unit for the period 2006 – 2017, inclusive.
- (d) For each of the Company's coal-fired power plants for the period 2012 – 2017, provide a breakdown of production cost into the categories provided in (a), above.

1st Supplemental Response to Sierra Club Data Request 1.1

Further to the Company's response to Sierra Club Data Request 1.1 provided on May 24, 2017 and discussions between the Company and Sierra Club that occurred on June 5, 2017 referenced below, the Company provides the following supplemental response to subpart (c):

- (c) PacifiCorp objects to this request to the extent it is not intended to validate benefits of participating in the energy imbalance market (EIM) discussed in the referenced portion of the Direct Testimony of Company witness, Michael G. Wilding as overly broad, unduly burdensome, and not reasonably calculated to lead to the discovery of admissible evidence. Without waiving these objections, the Company responds as follows:

Following discussions with counsel for Sierra Club, PacifiCorp clarifies that, as discussed in Order 16-482, EIM resource bid prices equal the marginal resource cost (i.e. production cost) plus a small adder to account for changes in certain cost drivers. Additionally, net power costs (NPC) differ from EIM resource bids in the following ways:

- NPC for coal resources only includes the cost of fuel (coal) consumed. Coal is delivered to the plant inventory stockpile at the invoice price. The consumed cost of coal is calculated using the weighted average price of the inventory

Despite PacifiCorp's diligent efforts, certain information protected from disclosure by the attorney-client privilege or other applicable privileges or law may have been included in its responses to these data requests. PacifiCorp did not intend to waive any applicable privileges or rights by the inadvertent disclosure of protected information, and PacifiCorp reserves its right to request the return or destruction of any privileged or protected materials that may have been inadvertently disclosed. Please inform PacifiCorp immediately if you become aware of any inadvertently disclosed information.

UE 323 / PacifiCorp
June 6, 2017
Sierra Club Data Request 1.1 – 1st Supplemental

available multiplied by the volume of fuel consumed for the month.

- NPC for natural gas resources include the cost of fuel, pipeline fees, natural gas storage, and hedging, including natural gas swaps.

Please refer to the Company's response to the ICNU Data Request 0011 and ICNU Data Request 0012, which provide actual NPC reports for calendar years 2008 through 2016, and 2017 (to date). The dollars per megawatt-hour (\$/MWh) NPC can be derived by dividing the total dollars (\$) for each resource by the total MWh for each resource.

UE 323 / PacifiCorp
May 24, 2017
Sierra Club Data Request 1.2

Sierra Club Data Request 1.2

Refer to the direct testimony of Michael Wilding, page 25 at 4-6, and page 27 at 18-19 with respect to EIM.

- (a) Which of the Company's generation units participate in the EIM? If the fleet of units participating has changed over time, provide a list with dates each unit was available to participate.
- (b) For each of the Company's thermal units, from 2014 to the present day, provide, on a monthly basis, the Company's resource bids submitted to the EIM.
- (c) Please provide a description of any periods in which EIM bids are different than production costs.

Response to Sierra Club Data Request 1.2

- (a) Please refer to Confidential Attachment Sierra Club 1.2, which provides a list of PacifiCorp's Participating Resources (thermal and hydro) that PacifiCorp currently bids into the California Independent System Operator (CAISO) energy imbalance market (EIM). PacifiCorp is unable to provide the date in which a unit was available to participate in the EIM.
- (b) The Company's resource bid data associated with the Company's participation in the EIM are considered highly confidential and commercially sensitive. The Company requests special handling. Please contact Natasha Siores at (503) 813-6583 to make arrangements to review at the Company's offices. Note: the Company began its participation in the CAISO EIM in November 2014. The Company did not maintain its resource bid data prior to January 2015.
- (c) The Company's EIM resource bids are the same as production costs.

Confidential information is designated as Protected Information under Order No. 16-128 and may only be disclosed to qualified persons as defined in that order.

UE 323 / PacifiCorp
May 24, 2017
Sierra Club Data Request 1.3

Sierra Club Data Request 1.3

For the period 2006-2017 inclusive, provide the hourly locational marginal price (LMP) at each of the following nodes: Naughton, Bridger, Dave Johnston, Hunter, and Huntington.

Response to Sierra Club Data Request 1.3

The Company objects to this request as overly broad and not reasonably calculated to lead to the discovery of admissible evidence. Notwithstanding the foregoing objections, the Company responds as follows:

Please refer to Attachment Sierra Club 1.3, which provides hourly locational marginal prices (LMP) from November 2014 through April 2017. Note: there were no LMPs for the requested nodes prior to November 2014.

UE 323 / PacifiCorp
May 25, 2017
Sierra Club Data Request 2.3

Sierra Club Data Request 2.3

Refer to the direct testimony of Dana Ralston, page 8 at 10-14 with respect to Black Butte.

- (a) Describe in detail the process used by PacifiCorp to evaluate the negotiated position with Black Butte for coal, including how the Company assesses and evaluates reasonable coal contract minimums, term of agreement, price(s), and liquidated damages.
- (b) Provide the analysis – in either draft or final form – conducted by PacifiCorp to assess the potential terms at Black Butte, including the assessment of coal contract minimums, term of agreement, price(s), and liquidated damages.
- (c) Identify if the process conducted at Black Butte is any different than processes used at other mines or for other third-party coal supply agreements. If the process is not conducted identically at other mines, describe any differences between the process used at Black Butte versus other mines, and provide example analyses or work papers used for other third-party contracts.

Response to Sierra Club Data Request 2.3

- (a) The process used in negotiating a contract with Black Butte takes into consideration the unique circumstances of the Jim Bridger plant, other potential suppliers, coal quality requirements, projected consumption levels, availability of transportation infrastructure, and the economics and risks associated with each transaction. Contract minimums, term, pricing and liquidated damage provisions are also considered and negotiated.
- (b) The process is ongoing and has not been completed. No analysis addressing the items requested is available at this time.
- (c) The process used in negotiating a contract with Black Butte is similar to the processes used by PacifiCorp to negotiate agreements with other mines and suppliers, taking into account the unique circumstances of each plant, potential suppliers, coal quality requirements, availability of transportation infrastructure, and the economics and risks associated with each transaction. Please refer to the Direct Testimony of Company witness, Dana M. Ralston (PAC/200), at Ralston/6, line 20 through Ralston/9, line 4 for additional information on the process and analysis relating to the negotiation of a new contract with Black Butte.

Despite PacifiCorp's diligent efforts, certain information protected from disclosure by the attorney-client privilege or other applicable privileges or law may have been included in its responses to these data requests. PacifiCorp did not intend to waive any applicable privileges or rights by the inadvertent disclosure of protected information, and PacifiCorp reserves its right to request the return or destruction of any privileged or protected materials that may have been inadvertently disclosed. Please inform PacifiCorp immediately if you become aware of any inadvertently disclosed information.

UE 323 / PacifiCorp
May 25, 2017
Sierra Club Data Request 2.6

Sierra Club Data Request 2.6

Refer to the direct testimony of Dana Ralston, page 15 at 1-13 with respect to coal minimum-take requirements and dispatch projections. For each entity listed in lines 2-3 (confidential) provide:

- (a) 2006-2016 annual coal consumption in tons and MMBtus.
- (b) 2006-2016 annual coal deliveries by source in tons and MMBtus.
- (c) 2006-2016 annual contract minimums by source in tons (or MMBtus, whichever is binding), the price per ton (or MMBtu) of the contract minimum tons, and the of the liquidated damage term in each year. Provide this data for both coal supply and transportation contracts.
- (d) 2006-2016 incremental coal price beyond the contract minimum (e.g. “tier” prices) in dollars per ton (or MMBtu) by source. Provide this data for both coal supply and transportation contracts.
- (e) 2006-2016 coal prices used for the purposes of dispatch in \$/MMBtu.

Response to Sierra Club Data Request 2.6

The Company objects to this request as overly broad and unduly burdensome, and not reasonably calculated to lead to the discovery of admissible evidence in this docket. Without waiving these objections, the Company responds as follows:

- (a) The information requested is reported on Form EIA-923, which is publicly available on the United States (U.S.) Energy Information Administration (EIA) website at www.eia.gov/electricity/data/eia923/. Select “ZIP” hyperlink for the desired year and open the downloaded file. Turn on “Data Filters” for the columns and filter on “Operator Name,” “Plant,” etc. on the various tabs to view the desired data.
- (b) The information requested is reported on Form EIA-923, which is publicly available on the United States (U.S.) Energy Information Administration (EIA) website at www.eia.gov/electricity/data/eia923/. Select “ZIP” hyperlink for the desired year and open the downloaded file. Turn on “Data Filters” for the columns and filter on “Operator Name,” “Plant,” etc. on the various tabs to view the desired data.
- (c) Please refer to Confidential Attachment Sierra Club 2.6 -1, which provides a summary of contracts and terms in effect as of March 31, 2017.

Despite PacifiCorp's diligent efforts, certain information protected from disclosure by the attorney-client privilege or other applicable privileges or law may have been included in its responses to these data requests. PacifiCorp did not intend to waive any applicable privileges or rights by the inadvertent disclosure of protected information, and PacifiCorp reserves its right to request the return or destruction of any privileged or protected materials that may have been inadvertently disclosed. Please inform PacifiCorp immediately if you become aware of any inadvertently disclosed information.

UE 323 / PacifiCorp
May 25, 2017
Sierra Club Data Request 2.6

- (d) Please refer to Confidential Attachment Sierra Club 2.6 -1, which provides a summary of contracts and terms in effect as of March 31, 2017.
- (e) Please refer to Confidential Attachment Sierra Club 2.6 -2, which provides the incremental coal prices in dollars per million British thermal units (\$/MMBtu) used for dispatch in Generation and Regulation Initiative Decision Tool (GRID) in the final transition adjustment mechanism (TAM) filings for the periods 2006 through 2016.

Confidential information is designated as Protected Information under Order No. 16-128 and may only be disclosed to qualified persons as defined in that order.

Despite PacifiCorp's diligent efforts, certain information protected from disclosure by the attorney-client privilege or other applicable privileges or law may have been included in its responses to these data requests. PacifiCorp did not intend to waive any applicable privileges or rights by the inadvertent disclosure of protected information, and PacifiCorp reserves its right to request the return or destruction of any privileged or protected materials that may have been inadvertently disclosed. Please inform PacifiCorp immediately if you become aware of any inadvertently disclosed information.

UE 323 / PacifiCorp
May 25, 2017
Sierra Club Data Request 2.11

Sierra Club Data Request 2.11

Refer to the direct testimony of Dana Ralston, page 22 at 18-21 with respect to Cholla power plant.

- (a) Are the “liquidated-damage payments for coal not purchased under the contract” at Cholla under a coal supply agreement or transportation agreement?
- (b) With reference to Mr. Ralston’s testimony on page 15 at 2-8, please clarify the definition of “take-or-pay” versus coal supply agreements with “liquidated-damage payments for coal not purchased.”

Response to Sierra Club Data Request 2.11

- (a) The estimated liquidated damage payments for 2018 are under the terms of the coal supply agreement (CSA). No liquidated damages are forecast to be payable under the terms of the transportation agreement in the 2018 transition adjustment mechanism (TAM) forecast.
- (b) “Take-or-pay” provisions in the CSAs refer to the contractual requirement to take at least the minimum contractual tonnage of coal or pay the normal contract price for any tons not taken. “Liquidated-damage payments for coal not purchased” refers to a contractually agreed upon payment (typically at an amount much less than the actual contract price) that becomes due if contractual quantities are not taken and / or shipped. These payments are typically less than the actual contract price for the purchase of coal, as they represent the estimated recovery of damages that the producer / shipper would incur by not being able to cover all of their fixed costs as a result of the lower volume.

UE 323 / PacifiCorp
May 30, 2017
ICNU Data Request 0011

ICNU Data Request 0011

Please provide total-Company actual net power costs detailed on a monthly basis for calendar years 2008 through 2016, and include the database entries and all fuel supply cost calculations for the period in their native format, including any mapping necessary to assign the database and fuel accounts to line items in the power cost report, as well as all links between the database and fuel data to the actual net power cost report.

Response to ICNU Data Request 0011

The Company objects to this request as overly broad and not reasonably calculated to lead to the discovery of admissible evidence. Without waiving these objections, the Company responds as follows:

Please refer to Attachment ICNU 0011 -1, which provides actual net power costs (NPC) reports for calendar years 2008 through 2016. Please refer to Confidential Attachment ICNU 0011 -2, which contains the actual NPC database entries, along with their mapping and fuel supply cost calculations for calendar years 2008 through 2014. Please refer to Confidential Attachment ICNU 0011 -3, which provides the actual NPC report, the database entries along with the mapping, and the fuel supply cost calculations for calendar years 2015 and 2016.

Confidential information is designated as Protected Information under Order No. 16-128 and may only be disclosed to qualified persons as defined in that order.

Despite PacifiCorp's diligent efforts, certain information protected from disclosure by the attorney-client privilege or other applicable privileges or law may have been included in its responses to these data requests. PacifiCorp did not intend to waive any applicable privileges or rights by the inadvertent disclosure of protected information, and PacifiCorp reserves its right to request the return or destruction of any privileged or protected materials that may have been inadvertently disclosed. Please inform PacifiCorp immediately if you become aware of any inadvertently disclosed information.

**BEFORE THE
PUBLIC UTILITY COMMISSION OF OREGON**

PACIFICORP, dba PACIFIC POWER,
2018 Transition Adjustment Mechanism

Docket UE-323

CERTIFICATE OF SERVICE

I hereby certify that on this 9th day of June, 2017, I caused to be served the foregoing **Direct Testimony and Exhibits of Thomas Vitolo, PhD On Behalf of Sierra Club** upon all party representatives on the official service list for this proceeding via electronic mail. The public version of this document was served upon parties via email, and the confidential portion of this document was served pursuant to Protective Order No. 16-128 upon all eligible party representatives via FedEx or U.S. Mail.

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Dated this 9th day of June, 2017 at Oakland, CA.

/s/ Alexa Zimbalist

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