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To: Energy Facility Siting Council

From: Christopher M. Clark, Rules Coordinator

Date: May 14, 2020

Subject: Agenda Item I, Attachment 2: Recommended Findings of Economic Achievability and Fiscal Impact Statements for the 2020 Carbon Offset Rate Update for the May 21-22, 2020 EFSC Meeting.

Attachments: Appendix A. Methods for Calculating of Economic Achievability Indicators
Appendix B. Results of Economic Achievability and Fiscal Impact Analysis

STAFF RECOMMENDATION

Staff estimates that increase the monetary offset rate from $1.90 to $2.85 would increase the costs of developing a new natural gas-fired power plant by an average of 1.5%. This represents an additional $0.15 per megawatt hour of electricity produced by a new natural gas-fired power plant sited in Oregon. Staff recommends that the Council find these modest increases are not likely to affect the economic achievability of the Council Standard for natural gas-fired power plants.

Staff further recommends that, when accounting for the negative impacts of carbon dioxide emissions on the global economy, the proposed rate increase will result in a net social benefit of $1.33 per megawatt hour produced by any new natural-gas power plant constructed in Oregon.

BACKGROUND

To issue a site certificate to a fossil-fueled power plant, or certain carbon dioxide emitting nongenerating facilities, the Council must determine that the preponderance of the evidence on the record supports a conclusion that the proposed energy facility complies with any applicable carbon dioxide emissions standard adopted by council or enacted by statute.[1] If the gross emissions of the facility will exceed the standard, the applicant must avoid, displace, or

[1] ORS 469.503(2) provides the methodology that Council must use to establish the carbon dioxide emissions standard applicable to base load gas plants, and guidelines for adopting standards applicable to other types of fossil-fueled power plants. ORS 469.501(1)(o) authorizes the council to adopt standards to address the impacts of carbon dioxide emissions on other types of energy facilities that emit carbon dioxide. The Council has adopted standards for these types of facilities under OAR 345-024-0550; 345-024-0590; and 345-024-0620.

sequester a sufficient amount of carbon dioxide or certain other greenhouse gasses so that the net carbon dioxide emissions rate of the facility is below the standard.[2]

Most applicants have elected to demonstrate compliance with the standard through the "monetary pathway," by agreeing to provide funds to a qualified organization in an amount deemed sufficient to produce the necessary reduction in greenhouse gas emissions. The monetary pathway uses an assumed monetary offset rate to determine the amount of funds that is sufficient to produce the equivalent of a one ton reduction in carbon dioxide emissions.[3] When the legislature enacted the Standard in 1997, it set the rate at 57 cents per short ton of carbon dioxide. The legislature authorized the Council to increase or decrease the rate by up to 50 percent in any two-year period starting in 2000. The Council has increased the rate three times, most recently on October 23, 2017 when the Council set the current rate of $1.90 per ton of carbon dioxide.

Because more than two years have passed since the last change in the rate, the Council may increase or decrease the monetary offset rate by up to 50 percent. Any change in the rate must be based on empirical evidence of the cost of offsets and the council's finding that the standard will be economically achievable with the modified rate for natural gas-fired power plants.[4]

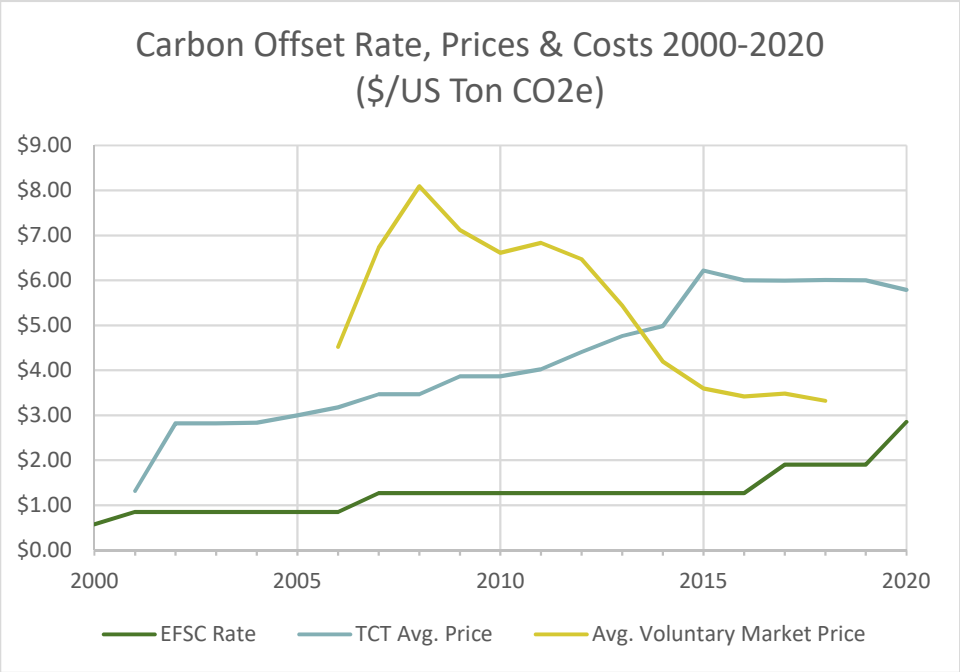
As shown in the graph below, staff reviewed cost data provided by The Climate Trust and found that the average negotiated price of offsets in Emissions Reduction Purchase Agreements as of December 31, 2019 was $6.00 per ton of CO2 emissions reduction.[5] Staff relied on this empirical evidence as the basis for its request that Council initiate rulemaking to increase the rate from $1.90 to $2.85.

[2] Specifically, methane and nitrous oxide. See ORS 469.503(2)(e)(G).

[3] In discussion of reductions in emissions throughout this document, "carbon dioxide emissions" should be understood to also include reductions in methane and nitrous oxide converted to carbon dioxide equivalent using the equivalency values associated with the applicable standard. Currently, all standards consider one ton of methane to be equivalent to 25 tons of carbon dioxide and one ton of nitrous oxide to be equivalent to 298 tons of carbon dioxide. See OAR 345-024-0550(2); 345-024-0590(2); and 345-024-0620(2).

[4] See ORS 469.503(2)(c)(C).

[5] Carbon offset prices are commonly reported in terms of metric tons of carbon dioxide. To make values comparable with the monetary offset rate, the Department converted all data to reflect the cost of offset per short ton of carbon dioxide.



At its April 24, 2020 meeting, the Council approved staff's request to initiate rulemaking and appointed this advisory committee to provide input on the potential fiscal impacts and economic achievability of the proposed increase. The sections below describe the basis, data, methods, and assumptions staff used to develop the draft recommended findings of economic achievability and fiscal impact statements attached to this document.

FINDINGS OF ECONOMIC ACHIEVABILITY

Under ORS 469.503(2)(c)(C), any change in the monetary offset rate to be based on the council's finding that the standard will be economically achievable with the modified rate for natural gas-fired power plants. The modified standard for natural-gas fired power plants is currently set at 0.614 pounds of carbon dioxide per kilowatt hour of net electric power output, with emissions and electric output measured on a new and clean basis. The recommended increase would increase costs of compliance for a fossil-fueled power plant by $0.95 per ton of excess carbon dioxide emissions produced by the facility over a 30-year period.

<u>Basis for findings of economic achievability</u>

ORS chapter 469 does not establish any threshold or methodology for determining when the standard is economically achievable. In the past, the Council has determined if a rate increase would affect the economic achievability of the standard by comparing the additional costs of compliance to the overall construction costs and levelized cost of energy for a new gas-fired power plant.

Staff recommends using these two indicators as the basis for findings of the economic achievability of this proposed rate increase. The proposed methods for calculating each are described in Attachment 1.

Indicator #1: % Increase in Costs of Developing a New Natural Gas-Fired Power Plant
Indicator #2: $ Increase in Cost of Electricity from a New Natural Gas-Fired Power Plant

Data used to calculate indicators

To make findings in support of the 2007 and 2017 rate increases, the Council estimated the increased costs of compliance using cost and performance data from a natural gas-fired power plant that had recently been issued a site certificate. The findings in support of the 2007 rate increase were based on cost and performance estimates for the Port Westward Generating Project, and the 2017 findings were based on cost and performance estimates for the Carty Generating Station.[6]

For this rulemaking, rather than looking at the cost and performance estimates for a recently approved natural-gas generating facility (i.e. the Perennial Wind Chaser Facility) staff believes using cost and performance estimates for new generating facilities that may be developed in the future may more accurately reflect the impacts to the rate increase.

Staff initially considered using cost and performance estimates for new gas-fired generating resources used in the portfolio analyses for the most recent Integrated Resource Plans for the three electric utilities regulated by the Oregon Public Utilities Commission, but found that differences in reporting methods made it difficult to compare estimates across sources.

To avoid potential misrepresentation of these data, staff instead used cost estimates and performance characteristics for new natural-gas fired generating technology cases used in the development of the 2020 Annual Energy Outlook.[7] These data include data for five different options for natural-gas fired generating technologies shown in the table below. An additional option for a combined-cycle combustion turbine plant with 90% carbon capture and sequestration was excluded from our review because, if available, such technology would likely meet the Carbon Standard without requiring offsets.

Cost and Performance Estimated for New Natural Gas-Fired Power Plants. (Source: U.S. EIA, Annual Energy Outlook 2020)

Description	Net Capacity (MW)	Total Capital Costs (2019 $/kw)[8]	Avg. Full Load Heat Rate (HHV Btu/KWh)
Combined-Cycle Combustion Turbine (1x1x1)[9]	418	$ 1,135	6431
Combined-Cycle Combustion Turbine (2x2x1)[10]	1083	$ 985	6370
Reciprocating Internal Combustion Engine (RICE)	21	$ 1,904	8295
Single-Cycle Combustion Turbine – Aeroderivative	105	$ 1,212	9124
Single-Cycle Combustion Turbine – Industrial Frame	237	$ 737	9905

[6] See ODOE Testimony in Support of Proposed Amendments to OAR 345-024-0580 dated March 27, 2007 and September 21, 2017.

[7] U.S. Energy Information Administration. Assumptions to the Annual Energy Outlook 2020: Electricity Market Module. January 2020. Available from: https://www.eia.gov/outlooks/aeo/assumptions/pdf/electricity.pdf.

[8] Reflects overnight capital costs, contingency factors, and the regional multiplier for the Northwest Power Pool.

[9] Consists of one H-class combustion turbine, one heat recovery steam generator, and one steam turbine generator.

[10] Consists of two H-class combustion turbines, two heat recovery steam generators, and one steam turbine generator.

To determine the impact the proposed rate increase would have on the cost of electricity from a new natural gas-fired generating resource, we recommend using the assumed capacity factors in the Annual Energy Outlook. These factors assume that a new combined-cycle combustion turbine plant would operate as a base-load plant (at 87 percent capacity) and a new plant using reciprocating internal combustion engines or single-cycle combustion turbines would operate as non-base load or "peaker" plants (at 30 percent capacity).

During discussion at the advisory committee meeting on May 13, 2020, one stakeholder recommended the Department consider lower capacity factors which may be more representative of the types of resource needs developed by Independent Power Producers. Staff considered alternate capacity factors of 76 percent for the base load resources (the threshold capacity for a base-load plant) and 10 percent for the non-base load resources identified above. We also considered the maximum capacity of 100 percent for base-load resources and the maximum 75 percent allowed for non-base load resources. The results of this additional analysis are provided below.

Results

Based on the estimated overnight capital costs, performance characteristics, and assumed capacity factors identified above, staff have estimated the impact of the proposed $0.95 rate increase on the recommended indicators using the methods in Appendix A. A detailed table showing the assumptions and values used in the calculations is provided in Appendix B.

Indicator #1: Staff estimate that the proposed increase in the offset rate would increase the costs of developing a new natural gas-fired power plant by an average of approximately 1.5%, or around $16 per kilowatt of installed capacity.

The amount of increased cost of compliance for an individual power plant depends on a number of factors, including the characteristics of the plant and the percentage of time the plant is expected to be in operation. Based on advice from stakeholders, we analyzed how changes to our assumptions about the latter would impact the estimate for this indicator. Based on the lower capacity factors, representing the utilization that might occur for a natural gas-fired power plant developed by an independent power producer, we found that the estimated increase in costs of development fell to about 0.8% as the expected total emissions from the facility was reduced. Similarly, assuming the maximum capacity factors described above for the base load and non-base load reference cases in our model, we found the estimated increase in costs of compliance would rise to about 3.0%.

Staff notes that the central estimate using the capacity factors identified in the Annual Energy Outlook are likely to underestimate the increase costs of development for a new base load plant and overestimate the increase for a non-base load plant. Because current trends in energy markets suggest that any new natural gas-fired power plants developed in Oregon are more likely to be non-base load plants designed to complement renewable generation resources, our initial estimate may be overly conservative, however, we recommend that it still appropriately represents a reasonable approximation of the range of impacts that might occur as a result of the proposed increase.

Indicator #2: Staff estimate that the proposed increase in the offset rate would increase the cost of electricity produced by a new natural gas-fired power plant by an average of approximately $0.15 per megawatt hour. This includes an increase of $0.06 to $0.07 per megawatt hour produced by a combined-cycle combustion turbine plant or $0.17 to $0.26 for a plant using reciprocating engines or a simple-cycle combustion turbine. For the purposes of comparison, the Annual Energy Outlook 2020 estimates that the Levelized Cost of Electricity (LCOE) from a new natural-gas fired power plant coming on-line in 2025 would cost between $38.07 per megawatt hour for a combined-cycle combustion turbine Plant and $66.62 for a simple-cycle combustion turbine plant.

Recommended Findings of Economic Achievability

Based on the analysis above, staff estimates that the proposed increase would increase the costs of developing a new natural gas power plant by an average of 1.5%. This would represent an additional $0.15 per megawatt hour of electricity produced by a new natural gas-fired power plant. Staff recommends that these modest increases are not likely to affect the economic achievability of the Council Standard for natural gas-fired power plants.

FISCAL AND ECONOMIC IMPACTS

In addition to making findings of economic achievability, the Council must prepare a statement of the potential fiscal and economic impacts of the proposed rate increase, including the additional costs of compliance to small businesses and other stakeholders. Staff recommends using the estimated increased costs of compliance above to inform these statements.

Fiscal Impact Estimates

Staff notes that in addition to costs, the rate increase will benefit Oregonians by reducing additional carbon dioxide emissions from new energy facilities subject to the Carbon Standard. Based on the $6.00 per ton average price of carbon dioxide offsets negotiated by The Climate Trust, we estimate that the $0.15 per megawatt hour increase in cost will result in the reduction of an additional .0257 tons (~51 lbs) of carbon dioxide equivalent per megawatt hour. As shown in Appendix B, assuming a social cost of $58 per ton of carbon dioxide,[11] we estimate a net social benefit of $1.33 per megawatt hour produced by any new natural-gas power plant constructed in Oregon.

At the Council's April 24, 2020 meeting a stakeholder requested that the Council also consider potential impacts to non-generating facilities. We were not able to locate the information needed to conduct a similar analysis for the impact of the proposed rate on the cost of developing new nongenerating facilities with compressor stations or other surface facilities that must comply with the standard but expect the impacts to be of a similar magnitude.

It is important to note that while we expect the rate increase to result in a net social benefit if a new carbon dioxide emitting energy facility is approved and constructed in Oregon, no new

[11] This estimate (adjusting for inflation using the Oregon Employment Department's CPI Inflation Calculator) was published in the federal Interagency Working Group on Social Cost of Greenhouse Gases, Technical Support Document: Technical Update of the Social Cost of Carbon for Regulatory Impact Analysis Under Executive Order 12,866 (2016). For more information about the Social Cost of Carbon, see the recent primer developed for the May 13, 2020 meeting of the Oregon Global Warming Commission.

facilities are being proposed at this time. As such, it is not clear what the total impact, if any, of the proposed rule will be.

Costs of Compliance:

As described above, the recommended increase in the monetary offset rate would result in increased costs of compliance with the Council's Carbon Standard for any persons who proposes to construct or operate a new fossil-fueled power plant or carbon dioxide emitting nongenerating facility. A certificate holder for a previously approved or operational facility will not be affected by the proposed rate increase unless it requests an amendment to the site certificate.

While the owners and operators of fossil-fueled power plants are generally utilities and energy developers with more than 50 employees, it is possible that a few (i.e. less than 5) small businesses involved in the development and permitting of new energy facilities could be directly affected by the rate increase. Because the proposed rule does not change any existing procedural requirements, no changes to costs associated with reporting, recordkeeping, or administrative activities is expected

APPENDIX A. METHODS FOR CALCULATING OF ECONOMIC ACHIEVABILITY INDICATORS

Indicator #1: Increased Cost of Developing a New Natural Gas-Fired Power Plant

1. Calculate the **Excess Emissions Rate** for the facility
    a. Multiply the **Average Heat Rate (HHV)** by the CO_2 Emissions Rate for Natural Gas (.000117 lbs/btu) to determine the **Gross Emissions Rate** of the proposed facility.
    b. Subtract the **Allowable Emissions Rate** for Natural Gas-Power Plants (.614 lbs Co2/kwh) from the **Gross Emissions Rate** calculated under 1.a.
2. Calculate **Total Net Electrical Output** the facility is expected to produce
    a. Calculate the estimated annual hours of operation for the proposed facility by multiplying 8670 by an assumed **Capacity Factor**.
    b. Multiply the estimated annual hours of operation under 2.a by the **Net Capacity** of the proposed facility to determine the **Net Annual Electrical Output**
    c. Multiply the **Net Annual Electrical Output** by an assumed 30 year life-span.
3. Calculate **Total Excess Emissions** by multiplying the **Total Net Electrical Output** by the **Excess Emissions Rate**.
4. Multiply the **Total Excess Emissions** by the rate increase ($0.95) to determine the **Total Increased Cost of Compliance**
5. Determine the Total Construction Costs of the facility by multiplying **Total Overnight Capital Costs** per kilowatt of capacity by the **Net Capacity** (MW) of the facility by 1000.
6. Divide **Total Increased Cost of Compliance** by **Total Construction Costs** to determine the percentage increase in nominal costs to develop a new natural-gas fired power plant.

Indicator #2: Increased Cost of Energy

1. Calculate **Excess Emissions Rate** as described above.
2. Convert the **Excess Emissions Rate** from lb CO_2/kWh to t CO_2/MWh by dividing by 2
3. Multiply the product of Step 2 by the rate increase ($0.95) to determine **Increased Costs of Compliance per MWh** of Energy Produced

APPENDIX B. RESULTS OF ECONOMIC ACHIEVABILITY AND FISCAL IMPACT ANALYSIS

Assumptions*		
Carbon Standard	0.614	lbs CO2/kWh
Plant life	30	Years
CO2 Emissions Rate for Natural Gas	0.000117	lbs CO2/Btu
Monetary Offset Rate - Current	$1.90	$/ton CO2
Monetary Offset Rate - Proposed	$2.85	$/ton CO2
TCT Offset Price	$6.00	$/ton CO2
Social Cost of Carbon	$58	$/ton CO2

Results		
Increased Cost of Compliance	$15.84	$/kW
Avg. Total Inc. in Cost of Compliance	1.5%	
Avg, Increase Costs of Production	$0.15	$/MWh
Avg. Reduction in Net GHG Emissions	0.0257	tCO2e/MWh
Avg. Social Benefit of Rate Increase	$1.48	$/MWh
Avg. Net Impact of Rate Increase	$1.33	$/MWh

Cost Estimates and Performance Characteristics**					Calculated Values							Indicators	
Description	Net Capacity (MW)	Capacity Factor	Total Capital Costs*** ($/kw)	Avg. Heat Rate (HHV Btu/KWh)	Total Capital Costs (Mill. $)	Gross Emissions Rate (lbs/kWh)	Excess Emissions Rate (lbs/kWh)	Annual Net Output (MWh)	Total Annual Excess Emissions (Tons)	Total Increased Cost of Compliance (Millions $)	Increased Costs of Compliance ($/kw)	Increase over Total Capital Costs.	Increased Cost of Compliance ($/MWh)
CCCT (1x1x1)	418.3	0.87	1,135	6,431	474.8	0.752	0.138	3,155,195	218,382	6.2	14.88	1.3%	0.07
CCCT (2x2x1)	1,083.3	0.87	985	6,370	1,067.1	0.745	0.131	8,171,224	536,400	15.3	14.11	1.4%	0.06
Recip. Engines (x4)	21.4	0.3	1,904	8,295	40.7	0.971	0.357	55,661	9,922	0.3	13.21	0.7%	0.17
SCCT - Aero	105.1	0.3	1,212	9,124	127.4	1.068	0.454	273,365	61,987	1.8	16.81	1.4%	0.22
SCCT - Frame	232.6	0.3	737	9,905	171.4	1.159	0.545	604,993	164,826	4.7	20.20	2.7%	0.26

*All price and cost data converted to reflect value per US Short ton by the Department.

**Cost Estimates and Performance Characteristics from US Energy Information Administration; Assumptions to the Annual Energy Outlook 2020: Elecricity Module. January, 2020. Accessed from: https://www.eia.gov/outlooks/aeo/assumptions/pdf/electricity.pdf

***Capital costs cost includes overnight capital costs, contingency factors and a regional multiplier to reflect prices in the Northwest Power Pool area.