Item E: 2022 Carbon Dioxide Standard Updates

Attachment 1: Issues Analysis Document

April 15, 2022

This document provides a summary of the Department's analysis and recommendations for issues included in the 2022 Carbon Standard Rulemaking Project. The document and associated draft rules are for information only and are not notice of rulemaking action by the Energy Facility Siting Council. The analysis and recommendations within are subject to change based on input from the Energy Facility Siting Council, staff, and stakeholders.

Issue 1: Non-emitting Electricity Standard for New Fossil-Fueled Power Plants

Issue Description: Council rules do not reflect new requirements for the siting of fossil-fueled power plants enacted by HB 2021 (2021).

Issue Summary: ORS 469.413(1) prohibits the Council from approving a new site certificate for a fossil-fueled power plant unless the Council determines that the facility "will generate only nonemitting electricity as defined in ORS 469A.400." As defined in ORS 469A.400(7), "nonemitting electricity" means electricity "that is generated and may be stored in a manner that does not emit greenhouse gas into the atmosphere."

Because the law requires the Council to find that no greenhouse gas emissions will result from the generation or storage of electricity at the proposed facility, it does not appear that the use of offsets or other mitigation may be considered, unless that mitigation results in the total avoidance of greenhouse gas emissions through the use of carbon capture, utilization and storage or a similar technology.

Alternatives:
1. Make No Changes
2. Adopt New Rules implementing ORS 469.413(1)

Discussion: While ORS 469.413 is effective without further Council action, failure to incorporate the provisions of the new law into rule could lead to some confusion about what requirements and standards apply to the review of an application for a new fossil-fueled power plant. In addition, because the new law focuses on fossil-fueled power plants, it appears to be intended to allow the development of new thermal or combustion power generation facilities that generate electricity from renewable natural gas, "green" hydrogen, or other clean fuels.[1] Because the same technology is used to generate electricity from fossil-fuels and certain clean fuels, and because in some cases, fossil and renewable fuels can be combined, it may be helpful to establish information requirements that can be used to demonstrate that a new thermal or combustion generating facility is not a "fossil-fueled power plant," and is therefore exempt from the new requirements.

Recommendation: Staff recommends that the Council adopt a new rule in OAR 345, division 024 to incorporate the new requirements of ORS 469.413 and clarify what standards applicable to the review

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[1] While the use of "clean fuels" to generate electricity does result in greenhouse gas emissions, it is generally considered to be "carbon neutral" because it merely recycles atmospheric carbon rather than introducing previously sequestered carbon into the atmosphere.

of an application for a new fossil-fueled power plant. In addition, staff recommends that Council amend OAR 345-020-0011 and 345-021-0010 to clearly establish what information will be required in new applications for thermal power plants, including both fossil-fueled power plants and thermal power plants that generate electricity from renewable fuels.

Issue 2: No Significant Increase Standard for Existing Fossil-Fueled Power Plants

Issue Description: New requirements for the amendment of site certificates for existing fossil-fueled power plants enacted by HB 2021 (2021) require Council to find that amendment would not "significantly increase" the gross carbon dioxide emissions of the facility. What is considered to be a significant increase is not defined.

Issue Summary: ORS 469.413(2) provides that the Council may not approve the amendment of a site certificate for a fossil-fueled power plant that was granted before the enactment of HB 2021 in a manner "that would significantly increase the gross carbon dioxide emissions that are reasonably likely to result from the operation of the energy facility."[2]

The term "gross carbon dioxide emissions that are reasonably likely to result from the operation of the energy facility" is used in ORS 469.503(2) to refer to the predicted carbon dioxide emissions of a proposed base-load gas plant over an assumed 30-year operating life. Specific requirements for how to estimate gross carbon dioxide emissions are provided in statute, and the Council has adopted similar methods for non-base load power plants and nongenerating facilities by rule.

Under the current scheme, the estimated gross carbon dioxide emissions are divided by the amount of electricity that is expected to be produced by the facility to determine its gross carbon dioxide emissions rate. This rate is then evaluated against the applicable carbon dioxide emissions standard to determine the amount of mitigation, typically in the form of monetary offset payments, that is required to comply with the standard.

Unfortunately, neither ORS chapter 469 or HB 2021 define what constitutes a "significant increase" in gross carbon dioxide emissions. While the use of the word "significant" as a qualifier suggests that some level of increase is allowed, both the context of the new provisions, which were set forth in a bill intended to eliminate all greenhouse gas emissions associated with electricity used in Oregon by 2040, [3] and legislative history describing the bill as prohibiting the "substantive expansion of existing fossil gas plants,"[4] suggest that a fairly conservative approach was intended. Turning to the Council's own rules, the definition of significant established in OAR chapter 345 provides some guidance on how the significance of an increase could be evaluated, but also lacks specificity:

> **OAR 345-001-0010(52):** "Significant' means having an important consequence, either alone or in combination with other factors, based upon the magnitude and likelihood of the impact on the affected human population or natural resources, or on the importance of the natural

[2] 2021 Oregon Laws, chapter 508, section 28.
[3] 2021 Oregon Laws, chapter 508, section 2.
[4] HB 2021 Section-by-section summary submitted by Represented Pam March to the House Revenue Committee, May 12, 2021. Accessed from: https://olis.oregonlegislature.gov/liz/2021R1/Downloads/CommitteeMeetingDocument/242406

resource affected, considering the context of the action or impact, its intensity and the degree to which possible impacts are caused by the proposed action. Nothing in this definition is intended to require a statistical analysis of the magnitude or likelihood of a particular impact."

After examining, the text, context, and legislative history of the provisions of ORS 469.413(2), it remains unclear whether the term "significantly increase" is intended to capture unmeasurable net changes in emissions that are incidental to operational or design changes at the facility, or if it is specifically intended to allow certificate holders with some flexibility to expand power generation activities in a manner that increases emissions, as long as that increase falls below a certain threshold for "significance." We note that there is little doubt that the consequences of carbon dioxide emissions in general are important, as climate change and ocean acidification are already having significant detrimental effect on public health, and Oregon's economic vitality, natural resources and environment.[5] However, due to the complex and global nature of the issue, it is difficult to attribute emissions from an individual source to an individual impact. As such, there could be some disagreement on the appropriate interpretation of the new requirement and rulemaking may be needed to clarify what is considered to be a "significant" increase in emissions.

Alternatives:

1. Interpret "significant increase" as an increase that exceeds a set amount of carbon dioxide
2. Interpret "significant increase" as an increase that exceeds a set percentage of the gross carbon dioxide emissions estimated for the facility
3. Interpret "significant increase" as any net increase in gross carbon dioxide emissions resulting from a change in facility design or operation that requires an amendment.

Discussion:
Alternative 1 would Interpret "significant increase" as an increase that exceeds a set amount of carbon dioxide. A similar approach was adopted by the US EPA under its Greenhouse Gas Tailoring Rule issued in 2010. The rule made the Prevention of Significant Deterioration (PSD) and Title V Air Quality permitting programs permitting requirements applicable to new "major sources" and "major modifications" of existing sources. Major sources were defined as those exceeding a significant emissions rate of 100,000 tons per year of carbon dioxide emissions equivalent, and a major modification as an increase of 75,000 tons per year of carbon dioxide equivalent.[6] The EPA rule was subsequently vacated by the US Supreme Court after the court found that the EPA did not have the authority to use greenhouse gas emissions as the basis for determining whether the applicable permits were required,[7] the approach and significant emissions rates it identified may still be relevant to the Council's determination of what constitutes a significant increase in emissions.

Alternative 2 would interpret "significant increase" as an increase that exceeds a set percentage of the gross carbon dioxide emissions estimated for the facility, requiring the Council to evaluate the magnitude of an increase relative to the emissions that were expected to result from the approved

[5] See Executive Order 20-04, page 1.
[6]
[7] See Utility Air Regulatory Group v. EPA, 134 S. Ct. 2427 (2014)

facility. As described further below, a previous rule stated that a change that increased the electrical generating capacity of the facility was allowed if, among other conditions, fuel consumption did not increase by more than ten percent. Because fuel consumption, along with efficiency, is one of the primary drivers of emissions, a ten percent threshold for emissions increases may be consistent. As an example, it was estimated that the Carty Generating Station would produce nearly 41.5 million tons of carbon dioxide emissions over its 30-year operating life, or approximately 1.38 million tons per year. Ten percent of this amount would be approximately 138,163 tons of carbon dioxide emissions per year. While this number does not reflect other greenhouse gases emitted by the facility, it is in the same magnitude as the significant emissions rate proposed by the EPA rule discussed above, although a lower percentage, such as five percent may be more comparable.

Alternative 3 would interpret "significant increase" as any net increase in gross carbon dioxide emissions resulting from a change in facility design or operation that requires an amendment. Several existing site certificates already include a mechanism for addressing "incremental increases" in emissions without an amendment as long as those changes are otherwise consistent with OAR 345-027-0353, which provides, in relevant part, that an amendment is not required for a proposed change:

> (1) To an electrical generation facility that would increase the electrical generating capacity and would not increase the number of electric generators at the site, change fuel type, increase fuel consumption by more than 10 percent or enlarge the facility site[8]

The Council could rely on these conditions to determine that any net increase in emissions, other than an incremental increase allowed under existing site certificate conditions, is significant for the purposes of ORS 469.413(2) and any implementing rule. This would still allow a certificate holder to make some adjustments to power producing operations at the facility that increase emissions, including an increase in the number of generators, change in fuel type, or increase in fuel consumption, as long as they were accompanied by other changes that result in a corresponding reduction in emissions, such as the installation of carbon capture, utilization or storage technology at the facility. It is important to note, however, that the applicant likely could not rely on the use of offsets to meet this no net increase standard.

Recommendation: Staff recommends the Council adopt a new rule in OAR chapter 345, division 027 specifying that a certificate holder must demonstrate that a change in facility design or operation will not result in a net increase in gross carbon dioxide emissions to obtain an amendment, consistent with Alternative 3.

Issue 3: Updates to Carbon Dioxide Emissions Standards

Issue Description: Council has the discretion to set the carbon dioxide emissions standard for base load gas plants to 17 percent below the emissions rate of the most efficient combined cycle combustion turbine plant that is commercially demonstrated and operating in the United States.

[8] EFSC 1-2020, adopt filed 01/28/2020, effective 01/28/2020. A similar provision was previously found in OAR 345-027-0050(2)(a), as adopted in EFSC 3-1995, filed and effective November 16, 1995.

Issue Summary: ORS 469.503(2)(a) specifies the methods that must be used to establish the carbon dioxide emissions standard for base load power plant. That paragraph requires the standard to be set at 17 percent below the rate of carbon dioxide emissions per kilowatt hour of net electric output of the most efficient stand-alone combined cycle, combustion turbine, natural gas-fired energy facility that is commercially demonstrated and operating in the United States at the time the Council adopts a new standard.

The Council's current carbon dioxide emissions standard is based on performance test data from the Grand River Energy Center Unit 3 (GREC), which includes one MHI M501J gas turbine in a 1x1 combined cycle configuration.[9] At its meeting on June 15, 2018, the Council found that the tested heat rate of that facility, adjusted to ISO conditions, was 6,321 btu/kWh (HHV). Based on that heat rate, and the assumed rate of 117 pounds of carbon dioxide per million btu of natural gas, the Council determined that the gross emissions rate for GREC was 0.740 pounds of carbon dioxide per kilowatt hour of net electric output from the facility (lbs CO_2/kWh). Accordingly, the council reset the carbon dioxide standard for base load gas plants to 17 percent below this rate, which is the current standard of 0.614 lbs CO_2/kWh.

Several new combined cycle combustion turbine plants have been commissioned since 2018, and if one or more of these facilities are found to be more efficient than the GREC facility, the Council may reset the emissions standard for base-load power plants. The Council has also established standards for non-baseload power plants and non-generating facilities that emit carbon dioxide. While it is not statutorily required, the Council has adopted rules specifying that the Council may modify these standards so that they remain equivalent to the standard for the net carbon dioxide emissions rate of a base load gas plant.[10]

Alternatives:

1. Make no changes

2. Reset standards to 17 percent below the emission rate of the most efficient plant currently in Operation.

Discussion: The passage of HB 2021 created some uncertainty about the need to maintain the existing emissions standards and rules related to carbon dioxide emissions. The provisions of ORS 469.413 clearly prevail over the existing standards and rules related to fossil fueled power plants, but do not replace them and the existing carbon dioxide emissions standards may continue to be applicable in some limited circumstances. For example, a small number of previously approved site certificates contain conditions allowing for incremental increases in emissions without a site certificate amendment as long as the certificate holder complies with the carbon dioxide standard and offset requirements in place at the time the incremental increase occurs.[11] In the event these conditions

[9] Combined Cycle configurations are typically denoted by the number of combustion turbine generators and the number of steam turbine generators. For example, in a 1x1 configuration, the exhaust heat from a single combustion turbine generator powers a single steam turbine generator.

[10] OAR 345-024-0610 and 345-024-0630

[11] See Site Certificate for Carty Generation Station, Condition 12.16

were activated, having an emissions standard and monetary offset rate may help further incentivize the use of efficient or non-emitting technology. In addition, the new law only applies to fossil-fueled power plants, and the standards in rule would be applicable to any future applications for a carbon dioxide emitting non-generating facility.[12] While it is unclear if these circumstances will arise in the future, staff believes they justify at least one additional update of the emissions standards.

Based on the assumption that an update is justified, staff conducted an internet search for readily available information about the most efficient stand-alone combined cycle, combustion turbine, natural gas-fired energy facilities currently in operation.

In January 2018, the Nishi-Nagoya Thermal Power Station in Tobishima, Aichi, Japan, which uses six GE 7HA.01 gas turbines in a 3x1 configuration, currently holds the record as the world's most efficient combined cycle power plant.[13] The record was previously held by EDF's Bouchain Combined Cycle Power Plant, located in Bouchain, France which uses a single GE 9HA.01 turbine in a 1x1 configuration.[14] Presumably due to their availability and high-efficiency, GE 7HA.02 turbines were also used as reference plants in the development of Portland General Electric's 2019 Integrated Resource Plan and the 2021 Northwest Power Plan.[15]

There is currently one fully commissioned facility using 7HA turbines in the United States. The Tennessee Valley Authority's Allen Combined-Cycle Power Plant in Shelby County, Tennessee began commercial operation in April 2018.[16] The plant uses two GE 7HA.02 turbines in a 2x1 configuration. According to the manufacturer's specifications, a facility using this configuration can attain a net heat rate of 5,944 btu/kWh (HHV) at ISO conditions.[17]

A second facility using H-Class turbines has been constructed and is expected to begin commercial operation in June of this year. The Dania Beach Clean Energy Center, located in Broward County, Florida, is owned and operated by Florida Power & Light, a subsidiary of NextEra Energy. The facility uses two General Electric 7HA.03 turbines in a 2x1 configuration.[18] According to the manufacturer specifications, a facility using this configuration can attain a net heat rate of 5,907 btu/kWh (HHV) at

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[12] Carbon Dioxide Emitting Non-Generating Facilities include combustion-driven compressor stations (underground natural gas storage facilities).

[13] https://www.guinnessworldrecords.com/world-records/431420-most-efficient-combined-cycle-power-plant

[14] https://www.guinnessworldrecords.com/news/commercial/2016/7/general-electric-and-edf-build-world%E2%80%99s-most-efficient-combined-cycle-power-plant-434523

[15] See Northwest Power and Conservation Council Memorandum on Natural Gas Reference Plants for draft 2021 Power Plan. February 4, 2020. Accessed from https://www.nwcouncil.org/sites/default/files/2020_02_p3.pdf, 4/6/22.

[16] Power Technology. Allen Combined-Cycle Power Plant Datasheet. Accessed at: https://www.power-technology.com/projects/allen-combined-cycle-power-plant-tennessee/

[17] General Electric Company. 7HA Gas Turbine Fact Sheet. September 2021. Accessed at: https://www.ge.com/content/dam/gepower-new/global/en_US/downloads/gas-new-site/products/gas-turbines/7ha-fact-sheet-product-specifications.pdf. Consistent with the requirements of ORS 469.503(2)(a), the Department converted the Lower Heating Value (LHV) rates reported by the manufacturer to Higher Heating Value (HHV) rates using a ratio of 1.108:1. The ratio is based on standard fuel specifications for natural gas. HHV includes the energy used to vaporize water contained in the fuel or created during the combustion process, where this energy is excluded from the LHV heat rate value.

[18] Power Technology. Dania Beach Energy Center Datasheet. Accessed at: https://www.power-technology.com/marketdata/dania-beach-energy-center-us/

ISO conditions.[19] As such, when it begins commercial operation, the Dania Beach Clean Energy Center is expected to be slightly more efficient than the Allen Plant.

We note that previous updates to the carbon dioxide standard were based on facility specific field test data adjusted to ISO conditions rather than the manufacturer's specifications. Facility specific data better represents the specific fuel source and operating conditions of the facility and are more comparable to the "new and clean basis" emissions measurements that would be conducted for a new facility sited in Oregon. One disadvantage of using the field-test data to determine the heat rate of the reference plant is that test data is not generally published or readily available, although the Department has successfully obtained data directly from plant operators in the past.

We note that while the statute is fairly specific in the methods required to determine the gross emissions that are reasonably likely to result from the operation of a proposed facility in Oregon, the Council appears to have some discretion in how it determines the rate of carbon dioxide emissions of a reference facility for the purposes of resetting the standard itself. We also note that the difference between the manufacturer's specifications and the facility specific field test data are typically relatively small. For example, the manufacturer specifications for the Mitsubishi M501J turbine used at the GREC facility show a heat rate of 6,098 btu/kWh (HHV) where the facility test data showed a heat rate of 6,321 btu/kWh (HHV), or approximately 3.7 percent higher than the manufacturers specifications.

Because ORS 469.503(2)(a) does not appear to require the use of facility specific test data, and because the heat rate in the manufacturer's specifications is expected to be generally comparable to the heat rate of an actual commercially operating facility, as measured on a new and clean basis and adjusted to ISO conditions, Staff recommends that the manufacturer's data is sufficient. However, if the Council prefers to rely on facility specific data, as it did in the 2018 standard update, the Department will attempt to obtain facility specific data from both reference facilities discussed above.

Recommendation: Because it is expected to be the most efficient stand-alone combined cycle, combustion turbine, natural gas-fired energy facility that is commercially demonstrated and operating in the United States at the time the Council adopts a new standard, the Department recommends that the Council use the Dania Beach Clean Energy Center as the reference facility for resetting the carbon dioxide emission standard for base load power plants. As described above, test performance data published by the turbine manufacturer shows that a facility using GE 7HA.03 gas Turbines in a 2x1 configuration can achieve a net heat rate of 5,907 btu/kWh (HHV) at ISO conditions. Based on that heat rate, and the assumed rate of 117 pounds of carbon dioxide per million btu of natural gas established in ORS 469.503(2)(e)(J), the Department estimates that the gross emissions rate for the Dania Beach Clean Energy Center will be 0.691 lbs CO_2/kWh. Accordingly, the Department recommends the council reset the carbon dioxide standard for base load gas plants under OAR 345-024-0550 to 17 percent below this rate, or 0.574 lbs CO_2/kWh.

Based on the recommended change to OAR 345-024-0550 above, staff recommends the Council amend OAR 345-024-0590 to lower the carbon dioxide emissions standard for non-base load power

[19] General Electric Company. 7HA Gas Turbine Fact Sheet. September 2021.

plants in to 0.574 lbs CO_2/kWh. Staff notes that the Council is required to include findings on the 13 principles described in ORS 469.503(2)(b) and OAR 345-024-0510 in the record of any proceeding adopting or amending a carbon dioxide emissions standard for a fossil-fueled power plant other than a base-load gas plant. We recommend that Council seek comment on this recommendation's compliance with the 13 principles as part of the Notice of Proposed Rulemaking and still will present recommended findings on each of the principles prior to the Council's consideration of permanent rules.

Based on the recommended change to OAR 345-024-0550 above, staff recommends the Council amend the carbon dioxide emissions standard for non-generating facilities that emit carbon dioxide emissions in OAR 345-024-0620 to remains equivalent to 0.574 lbs CO_2/kWh. The standard for non-generating facilities is expressed in terms of pounds of carbon dioxide per horse-power hour (lbs CO_2/hp-h) because the most common application of the standard has been for compressors at underground natural gas storage facilities. As such, staff recommends the Council amend OAR 345-024-0620 to lower the carbon dioxide emissions standard for nongenerating facilities to 0.428 lbs CO_2/hp-h.[20]

Issue 4: Maintenance of Carbon Monetary Offset Rate

Issue Description: The monetary offset rate established in OAR 345-024-0580 is lower than the average price of carbon offsets.

Issue Summary: 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 evidence on the record supports a conclusion that the proposed energy facility complies with any applicable carbon dioxide emissions standard.[1] To meet the standard, most proposed facilities must reduce a portion of the gross carbon dioxide emissions the facility is projected to produce over an assumed 30-year life span by avoiding, displacing, or sequestering a sufficient amount of carbon dioxide or certain other greenhouse gasses.[2]

Most applicants have elected to use the "monetary pathway" to comply with the standard. 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.[21] 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 change the rate but limited the allowed increase or decrease to no more than fifty percent in any two-year period. The Council has increased the rate four times, most recently on June 29, 2020, when the Council set the current rate of $2.85 per ton of carbon dioxide.

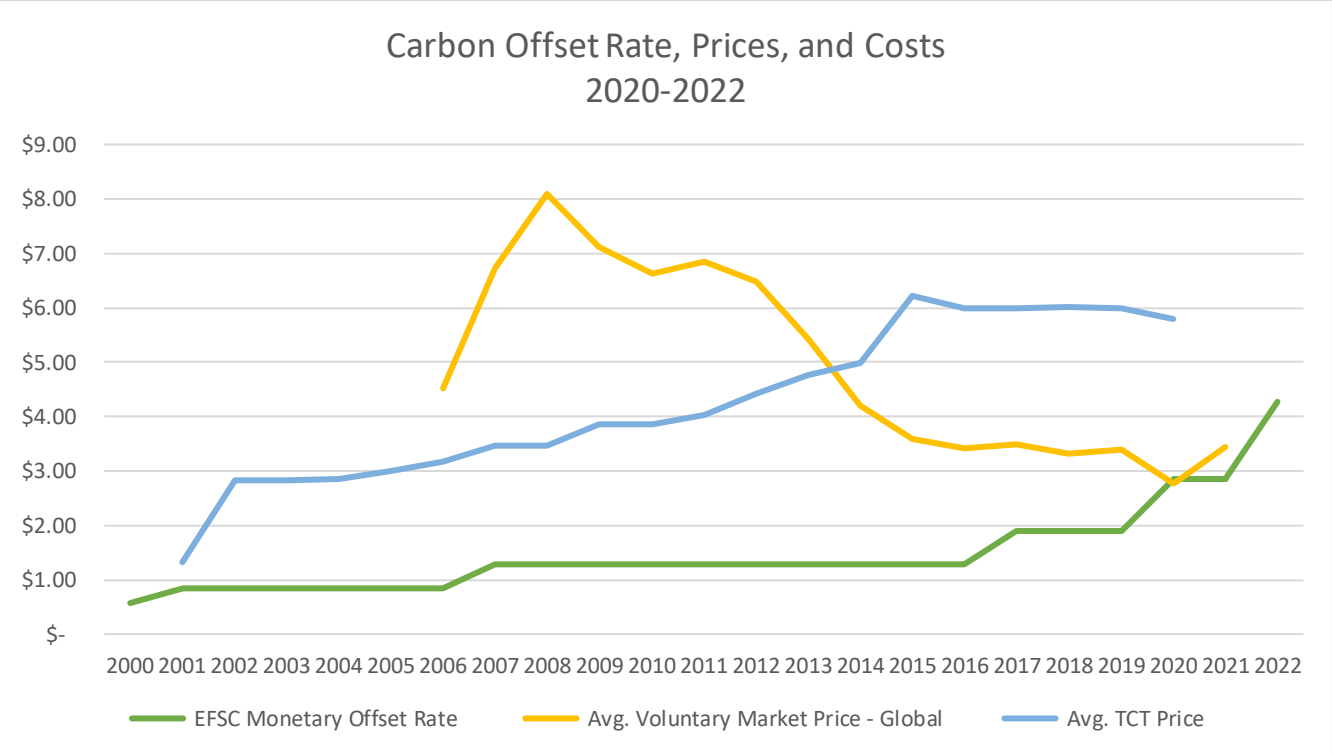
[20] The energy content of 1 horsepower is equivalent to approximately 0.746 kilowatt hours.

[21] 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).

As of July 1, 2022, two years will have passed since the last change in the rate, so the Council may increase or decrease the monetary offset rate by up to fifty 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.[22]

Empirical Evidence of the Costs of Offsets

Based on the latest State of the Voluntary Carbon Markets report from Ecosystem Marketplace, the average price off offsets in the global voluntary market was $3.45 per ton of CO2e in 2021; however, the prices incurred by The Climate Trust (TCT) are typically higher than global average price in part because The Climate Trust focuses its offset purchases on latter vintage offsets with a strong preference for Oregon and regional projects. Average prices for offsets derived from projects in North America, which may be more representative of the costs incurred by TCT, rose from $3.87 in 2019 to $6.96 in 2020 before falling to $5.65 in 2021.[23] The North American averages are generally consistent with the historic data from TCT shown in the chart below, which show the average cost of offsets for compliance as of the first half of 2020 was approximately $5.79 per ton of CO2e.



[22] ORS 469.503(2)(c)(C)

[23] Ecosystem Marketplace (2021) State of the Voluntary Carbon Markets 2021, Installment 1. Data represent average reported prices through August 2021. All prices converted from price per metric ton to price per short ton using a factor of 1.10231

Staff will provide updated data on costs incurred by TCT since 2020 before the Council's consideration of permanent rules, however, even without these data staff recommends that there is sufficient empirical evidence to support the recommended increase.

Economic Achievability

In addition to finding that a proposed change in the monetary offset rate is supported by empirical evidence, the Council to find that the rate is attainable and economically achievable with the modified monetary carbon standard. Based on cost and performance estimates provided in the 2022 Annual Energy Outlook we estimate that the combined effect of the proposed increase in the monetary offset rate from $2.85 to $4.79 and of resetting the carbon dioxide emissions standard from 0.614 lbs C02 per kWh to 0.574 lbs CO2/kWh would increase the cost of constructing a new natural gas fired power plant by approximately 3.9 percent, or approximately $0.40 for each megawatt hour the fossil fueled power plant is expected to produce over its assumed 30-year life. Full calculations are provided in Appendix 1. The average retail price of electricity in the United States in January 2022 was approximately $137.20 per megawatt hour.[24] We note that due to the enactment of HB 2021, these costs are unlikely to be realized. While we are unable to quantify the impacts on nongenerating facilities that emit carbon dioxide, we assume that these impacts will be of similar magnitude. Due to the low level of expected potential increased costs, and the low likelihood that they will be realized, we recommend that the proposed offset rate, with the modified standard recommended under Issue 3, is attainable and economically achievable for various types of power plants.

Housekeeping Changes

In addition to the changes described above, staff recommends that the Council make non-substantive organizational and clerical changes to the rules to reflect the limited future applicability of the carbon dioxide standards and expectation that the Council will receive few or no applications for fossil-fueled power plants in the foreseeable future. Housekeeping changes include, but are not limited to:

- Amending OAR 345-024-0500 to specify applicability of CO2 standards
- Delete provisions of rule that unnecessarily restate statute
- Amend OAR 345-001-0010 to adopt definitions in ORS 469.300 and 469.503(2) by reference
- Adopt new rule for other carbon specific definitions

[24] US Energy Information Agency. Electricity Monthly Update with Data for January 2022. March 24, 2022. Accessed from: https://www.eia.gov/electricity/monthly/update/

Appendix 1: Economic Achievability Analysis

Assumptions		
Carbon Standard - Current	0.614	lbs CO2/kWh
Carbon Standard - Modified	0.574	lbs CO2/kWh
Plant life	30	Years
CO2 Emissions Rate for Natural Gas	0.00011 7	lbs CO2/Btu
Monetary Offset Rate - Current	$2.85	$/ton CO2
Monetary Offset Rate - Proposed	$4.72	$/ton CO2
TCT Offset Price	$5.79	$/ton CO2
Social Cost of Carbon	$58	$/ton CO2

Results		
Increased Cost of Compliance	$44.15	$/kW
Avg. Total Inc. in Cost of Compliance	3.9%	
Avg, Increase Costs of Production	$0.39	$/MWh
Avg. Reduction in Net GHG Emissions	0.0344	lbs CO2e/kWh
Avg. Social Benefit of Rate Increase	$3.96	$/MWh
Avg. Net Impact of Rate Increase	$3.57	$/MWh

Cost Estimates and Performance Characteristics*					Calculated Values									Indicator #1	Indicator #2	Net Social Impacts		
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
Description	Net Capacity (kW)	Capacity Factor	Total Overnight Capital Costs.** ($/kw)	Avg. Full Load Heat Rate (HHV Btu/KWh)	Total Overnight Capital Costs ($) (B*D*1000)	Gross Emissions Rate (lbs/kWh) (E*.000117)	Excess Emissions Rate - Current Standard (lbs/kWh) (G-0.614)	Excess Emissions Rate New (G-.574)	Annual Net Production (MWh) (B*C*8670)	Annual Excess Emissions - Current Standard (Tons) (H*J/2)	Annual Excess Emission - New Standard (Tons) (I*J/2)	Total Increased Cost of Compliance (K*($4.72-$2.85)*30)+((L-K)*$4.72*30)	Increased Costs of Compliance ($/kw) (M/B)*1000	% Increase over Total Capital Costs. (M/F)	Increased Cost of Compliance ($/MWh) (M/J*30)	Additional CO2 Offsets Achieved (tons/MWh) (M/$5.79)*(J*30)	Social Benefit of Rate Increase ($/MWh) (Q/$58)	Net Impact of Rate Increase ($/MWh) (R-P)
Combined Cycle - Single Shaft	418.3	0.87	$1,201.00	6431	$502,378,300.00	0.752	0.138	0.178	3155195.07	218382.094	281485.9954	$21,186,747.91	$50.65	4.2173%	$ 0.22	0.04	$ 2.23	$ 2.00
Combined Cycle - Multi Shaft	1083.3	0.87	$1,062.00	6370	$ 1,150,464,600.00	0.745	0.131	0.171	8171223.57	536399.9713	699824.4427	$53,232,943.54	$49.14	4.6271%	$ 0.22	0.04	$ 2.16	$ 1.94
Reciprocating Internal Combustion Engines	21.4	0.3	$2,018.00	8295	$ 43,185,200.00	0.971	0.357	0.397	55661.4	9922.062011	11035.29001	$714,260.76	$33.38	1.6539%	$ 0.43	0.07	$ 4.26	$ 3.83
Combustion Turbine - Aeroderivative	105.1	0.3	$1,294.00	9124	$135,999,400.00	1.068	0.454	0.494	273365.1	61986.62989	67453.93189	$4,251,619.90	$40.45	3.1262%	$ 0.52	0.09	$ 5.16	$ 4.64
Combustion Turbine - Industrial Frame	232.6	0.3	$ 785.00	9905	$182,591,000.00	1.159	0.545	0.585	604992.6	164825.6964	176925.5484	$10,960,060.61	$47.12	6.0025%	$ 0.60	0.10	$ 6.01	$ 5.41