WASHINGTON STATE DEPARTMENT OF ECOLOGY

DRAFT

BENEFIT-COST & LEAST BURDENSOME ANALYSIS

FOR

WAC 173-407

CARBON DIOXIDE MITIGATION PROGRAM FOR

FOSSIL FUELED THERMAL ELECTRIC GENERATING

FACILITIES

Prepared by:

Washington State Department of Ecology

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Executive Summary

Ecology is proposing adoption of a new rule implementing Chapter 70.94 RCW and Chapter 80.70 RCW. The proposed rule provides additional direction regarding carbon dioxide mitigation for public and private entities that are constructing certain types of energy facilities in Washington State. As required under RCW 34.05, Ecology is developing this Benefit-Cost and Least Burdensome Analysis as part of its rule adoption process.

The 2004 statutes referenced above require that new fossil fueled power plants mitigate carbon dioxide emissions. RCW 70.94.892 instructs Ecology to adopt a carbon dioxide mitigation program for sources above 25 MW and below 350 MW that is consistent with Chapter 80.70 RCW. In applying the criteria found in 70.94.892 and Chapter 80.70, Ecology discovered areas where additional interpretation is needed for these smaller sources to ensure the greatest degree of consistency in air quality permits throughout Washington.

Ecology has proposed a rule re-stating and clarifying several of the requirements in the statutes. In reviewing the rule proposal, there are two specific cases that trigger further economic analysis. The first is the requirement that when duct-firing is allowed, that the emissions be included in the mitigation calculations up to a facility's operational limits. The second is requiring the use of the highest carbon emitting fuels in the mitigation calculations until the allowable annual operating hours using that fuel source is allocated.

The benefit-cost and least burdensome analysis are based on two assumptions:

1. Requiring the use of allowable duct firing emissions in the calculation for carbon dioxide mitigation would have been required even without the rule

2. Multiple fuel emission inclusions would have been negotiated on a permit by permit basis without the rule, leading to variable levels of mitigation. Requiring it to be used will likely result in an increase in mitigation in at least some cases and is therefore considered an impact of the rulemaking.

In order to assess costs and benefits, Ecology developed a typical facility likely to be developed in the future. This typical electricity generation plant was developed from market assessment and past air operating permit data and is a natural gas combined cycle plant without duct firing but with a limited distillate fuel reserve. Analysis of the plants under the rule change listed above yields an increased cost of approximately $108,600 in mitigation costs per plant. Two plants are forecast to be constructed in the applicable size range through 2025 leading to a total increased compliance cost of approximately $180,000.

The benefits obtained with this mitigation fee are the reduced impacts of greenhouse gas emissions, the affiliated benefits of a specific mitigation proposal, the certainty of a well-established process and technological change incentives. The current price of offsetting emissions is approximately $3.50 per tonne of carbon dioxide but this price may rise over

time. At the current price approximately 62,000 additional tonnes of mitigation will occur with the rule assuming that reserve fuels would not have been considered in the mitigation calculation without the rule. The direct benefits associated with this mitigation have been estimated using computer simulation models to be between $4.4/tonne and $37.7/tonne. This wide range represents the level of uncertainty associated with climate change mitigation and yields a benefit estimate of between $273,000 and $2,340,000 for existing prices. The net benefits if offsets become more expensive or if the benefits of avoiding climate change are lower than noted above are reduced. However, the benefits from reduction in affiliated pollutants, increased certainty and technological incentives were not quantified for any of the scenarios. It appears likely that the probable benefits are greater than the probable costs given available models and information. The result above holds regardless of the number of plants developed but may change if the cost of mitigation increases significantly.

A least burdensome analysis indicates this rule is least burdensome for the goals set by Ecology.

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1. INTRODUCTION

BACKGROUND

The Department of Ecology (Ecology) is proposing adoption of a new rule implementing RCW 70.94.892 and Chapter 80.70 RCW. The proposed rule provides additional direction regarding carbon dioxide mitigation for public and private entities that are constructing certain types of energy facilities in Washington State. Ecology's goal is that the rule will provide consistent and clear requirements for energy facility developers in Washington.

As required under RCW 34.05, Ecology is developing and issuing this Benefit-Cost Analysis (BCA) as part of its rule adoption process. Ecology will use the information developed in the BCA, as required by law, to ensure that the proposed rules are consistent with legislative policy.

RULE DEVELOPMENT

Concern about climate change has been mounting in the scientific community for approximately 30 years. Policy makers began international efforts to reduce greenhouse gas (GHG) production in 1992 when the United Nations Framework Convention on Climate Change (UNFCCC) asked for voluntary emission reductions. Recognition that this approach was not effective led to proposals for mandatory emissions reductions culminating in the Kyoto protocol. This agreement was signed by the U.S. in 1997, but never submitted to the Senate for ratification.

Concern that not enough was being done at the federal level, led several states to initiate their own efforts to address climate change. Oregon initiated the first state greenhouse gas mitigation program in 1997. Other states have since followed including New Hampshire and Massachusetts.

Washington has been actively involved in evaluating the implications of climate change having completed several studies in the last 15 years. Development of a rule to mitigate GHG emissions was initiated by Governor Gary Locke in 2001. The Governor authorized the Energy Facility Site Evaluation Council (EFSEC) to commence rulemaking in an effort to mitigate the amount of greenhouse gas emissions from new electricity generation facilities above 350 MW.[1] EFSEC developed a Carbon Dioxide Mitigation rule which required new fossil fuel fired electricity generation facilities to mitigate 20% of their lifetime CO_2 emissions. At the Governor's directive, Ecology also began developing a carbon dioxide mitigation rule for sources below 350 MW. However, neither rule reached the adoption stage because the 2004 Legislature created a carbon dioxide mitigation law that closely reflected the draft EFSEC rule. This new statutory language modified portions of RCW 70.94 and created Chapter 80.70 RCW. Ecology staff reviewed the new law and determined rulemaking was needed to fully implement the new Carbon Dioxide Mitigation Program. The result is the current proposed rule-Chapter 173-407 "Carbon

[1] "MW" is an abbreviation for megawatts.

Dioxide Mitigation Program for Fossil Fueled Thermal Electric Generating Facilities" which is the subject of this analysis.

DESCRIPTION AND PURPOSE OF THE BENEFIT-COST ANALYSIS & LEAST BURDENSOME ANALYSIS

The benefit-cost analysis is provided to consider the economic efficiency of proposed regulations. This is essentially determining if the rule makes sound economic sense by determining that the benefits of undertaking the rulemaking are larger than the additional costs. RCW 34.05.328(d) further describes the requirements under the Administrative Procedures Act:

"Determine that the probable benefits of the rule are greater than its probable costs, taking into account both the qualitative and quantitative benefits and costs and the specific directives of the statute being implemented."

The benefit-cost analysis below evaluates and analyzes the quantitative information where available and qualitative information where the economic science is not to the point of providing reliable quantitative values for benefits and costs. Uncertainty is explicitly addressed by considering a range of estimates for uncertain variables. There is no consideration of the distribution of impacts to various populations in this analysis.

The Administrative Procedure Act (Chapter 34.05 RCW) also requires that significant legislative rules be evaluated to:

"[d]etermine, after considering alternative versions of the rule and the analysis required under (b), (c), and (d) of this subsection, that the rule being adopted is the least burdensome alternative for those required to comply with it that will achieve the general goals and specific objectives stated under (a) of this subsection." (RCW 34.05.328(1)(d)).

This determination must be documented prior to final rule adoption and included in the rulemaking record. The Least Burdensome analysis is also provided as part of this document.

CONTENTS OF THE DOCUMENT

The economic impacts of the proposed rule will be considered in this analysis. Section 2 contains a comparison of the baseline and the proposed rule language to identify the impacts and provides a qualitative description of the benefits and costs. Section 3 provides a quantitative outline of costs and benefits where it was possible to obtain this information and provides a conclusion on the rule-making effort. The appendices contain more information on the analysis. The Table of Contents contains a detailed description.

2. RULE REQUIREMENTS AND PROBABLE BENEFITS AND COSTS

INTRODUCTION

The proposed rule re-states much of what is explicitly presented in Chapter 70.94 RCW and Chapter 80.70 RCW and clarifies several aspects likely to be relevant to energy facility construction. The most significant clarification is explicitly stating the formula for calculating carbon dioxide emissions and outlining how to incorporate multiple fuels and supplemental firing. The proposed rule also includes a fee schedule. Ecology has carefully evaluated each of the proposed new rule sections and determined which are likely to have significant impacts on future applicants. These are described below along with a discussion of the baseline. A qualitative discussion of the costs and benefits of the proposed rule is also provided.

RULE DESCRIPTION AND BASELINE DEVELOPMENT

In order to discuss the impacts of the proposed rule it is necessary to consider the proposed rule language and the baseline from which the change in requirements is measured. The baseline is the best estimate of how Chapter 70.94 RCW and Chapter 80.70 RCW would be implemented if the rule was not promulgated.

The proposed rule provides definitions of the regulated community, outlines statutory authority, and provides formulas for emissions calculations and requirements for addressing multiple fuels.[2] The rule requires all new or expanding fossil fuel powered electricity generation facilities to mitigate a portion of their carbon dioxide emissions. Twenty percent of all emissions forecast over a thirty-year period are required to be mitigated either via third-party or self-initiated mitigation or the purchase of carbon credits.[3]

In the case of proposed WAC 173-407, much of the rule language is simply re-stated from the statute. If Ecology did not adopt a rule, carbon dioxide mitigation would still be required from new fossil-fueled power plants as explicitly described in statute.[4] The components of the rule where there is additional direction provided above that included in statute are those associated with supplemental firing and multiple fuel sources. The statute defines total carbon dioxide emissions as those emitted from fossil fuel powered facilities over 30 years and mandates *"taking into account any enforceable limitations on operational hours or fuel types and use"*. This statutory language is unclear as to whether it is to require mitigation of all fuel sources or the base fuel or some estimated fuel use up to the fuel's operational hour limitation. Ecology's proposed rule requires that all allowable supplemental firing hours be used in the emissions calculations and that the fuel with the highest CO_2 emissions factor be incorporated first until the total annual operational hours have been allocated. Without the rule, calculation of the CO_2 quantity

[2] See www.ecy.wa.gov/programs/air/psd/draft_rule_page.html for complete text
[3] Typical mitigation projects include those that will offset emissions elsewhere such as energy efficiency programs and green power purchases.
[4] RCW 19.85 does not require analysis where the statute explicitly defines the requirements.

subject to mitigation would be negotiated with individual permit writers resulting in differing mitigation requirements between otherwise identical proposals.

Ecology has chosen to base this analysis on two assumptions. First, the statute is quite clear about considering limitations on operational hours and since supplemental firing is usually an allowed use based on a maximum number of hours, it is assumed that mitigation would be required for allowed supplemental firing hours even without the rule.

Second, because the statute is unclear about regulation of multiple fuels, Ecology will assume that mitigation for reserve fuels with higher emission factors than the base fuel is an impact of this rulemaking. Though this could have been the intention of the statute, it could also be interpreted to require basing it on actual use, estimated use, etc. Without the rule, Ecology permit writers and applicants would have to negotiate which fuels are included and how much of the allowable use of the higher emitting fuel would be considered. Therefore, the baseline in the case of multiple fuel sources will be mitigation based on the primary fuel type.

COSTS AND BENEFITS OF RULEMAKING

As discussed above, the main impact from the rule is associated with multiple fuels. Those facilities that elect to have the flexibility of multiple fuel use will be required to base their emission calculations on the higher emitting fuel source. This will increase the required mitigation for some but will also increase the amount of mitigation that can occur. The costs and benefits are more specifically described below.

Costs

The cost of the proposed rule will be the increased mitigation costs for energy facility developers associated with basing mitigation on higher emission sources. This will result in a direct compliance cost to any new or modifying facility requesting an order of approval. This may be partially offset if firms choose to reduce the allowable reserve fuel used. However, this choice would come at an additional cost of a reduction in flexibility in the types of fuels authorized for use.

Benefits

The benefits of the proposed rule include the increased monetary amount that will be used to purchase mitigation, affiliated climate change benefits, increased certainty and technological development. Increased funding for mitigation will buy additional reduction of CO_2 emissions on the market resulting in environmental benefits. The reduction in CO_2 emissions will likely come associated with decreased emissions of other pollution sources and/or will also result in additional benefits associated with the specific mitigation option. It may also reduce the use of fossil fuels that have upstream environmental impacts. The explicit requirements will reduce the uncertainty and transactions costs associated with permitting as protracted negotiations over emissions levels will be avoided. Lastly, technological development will be promoted as lower emitting turbines will reduce emission control costs.

3. ESTIMATED COSTS AND BENEFITS

INTRODUCTION

It was noted previously that the only part of the proposed rule requiring analysis is section 173-407-050 "Calculating Total Carbon Dioxide Emissions to be Mitigated." This section is likely to impact newly constructed facilities that elect to have the option to use multiple/back-up fuels for electricity generation. In order to address the costs and benefits of the proposed rule, it is necessary to forecast the type and capacity of all electricity generation facilities, then focus on the estimated costs associated with the additional carbon dioxide emissions estimates related to multiple-fuel use and duct-firing. This analysis is provided in this section together with a calculation of the estimated costs of additional required mitigation. An estimate of benefits in terms of avoided greenhouse gas impacts is also provided along with a qualitative discussion of affiliated benefits.

FORECAST OF FUTURE FACILITIES

To determine the costs and benefits of the rule, the first step is to forecast the type and size of electricity generation plants likely to be developed in the future. The proposed rule will apply to any newly constructed or modified facility that sells power to the grid and uses a fossil fuel energy source. To estimate the type and capacity of proposed new or modified facilities, Ecology evaluated current market assessments and analyzed Air Operating Permits from several recently permitted facilities.

The Energy Facility Site Evaluation Council (EFSEC) in conjunction with the Northwest Power Planning Council (NPPC) performed generation asset modeling as part of its recent rulemaking effort.[5] The modeling involved scenario analysis of the type and quantity of generation capacity likely to be developed given current and forecasted market conditions. The analysis concluded that approximately 8,000 MW of new capacity is likely to be constructed in Washington, Oregon and northern Idaho between 2004 and 2025. Of this generation capacity, approximately 6,000 MW is estimated to be newly developed wind powered generation facilities. Of the remaining 2,000 megawatts of forecast generation, all is forecast to be fossil fuel fired facilities of which approximately 800-1,200 MW are likely to be constructed in Washington.

EFSEC/NPPC's computer analysis utilizes a library of hypothetical facilities including 540 MW[6] natural gas fired plants and 400 MW coal-fired plants. This implies that all plants locating in Washington would likely be required to utilize EFSEC's siting process. However, it is very possible that smaller facilities will be constructed that will be required to meet the requirements of proposed Chapter 173-407 WAC.

An important consideration in the development of generating facilities according to EFSEC's analysis was the presence or absence of federal and international environmental legislation/accords. One modeling scenario assumed that no other GHG regulation will go into effect besides that currently in effect in Washington and Oregon. The model results indicated that 1,200 MW of new coal-fired electricity generation facilities would

[5] See "Small Business Economic Impact Statement for EFSEC Rulemaking," (2004).
[6] Model plants had 76 MW in supplemental firing capability.

be constructed in Washington by 2025. In an alternative scenario, it was assumed that the Canadian provinces establish a mitigation program as part of that country's Kyoto Protocol obligations and the states on the western grid impose offset requirements similar to Washington and Oregon by 2012. Under this scenario, it was determined that about 400 MW of coal-fired and 616 MW of natural gas-fired generation capacity would be constructed in Washington by 2025.[7] It is unlikely that coal-fired power plants will be impacted by the requirement to consider the highest emitting fuel, since coal has higher emission factors than most reserve fuels. However, the natural gas-fired facilities may elect to utilize supplemental fuels and therefore be impacted by the proposed rule.

The scenario analyses concluded that between 0 MW and 616MW of natural gas fired facilities would be developed in Washington by 2025 depending on the scenario. It is likely that the actual case will be somewhere in between depending on many factors including whether the new facilities will be represented by plants under 350 MW in capacity. For purposes of the analysis, Ecology has assumed that approximately 344 MW of natural gas fired capacity will be constructed through 2025 that will be required to meet the requirements of 173-407. This assumes two-172 MW plants that are constructed in 2015 and 2020 respectively[8]. These facilities are assumed to be natural gas combined cycle facilities with distillate fuel back-up but without supplemental firing capability which should provide a useful indication of the rule effects.[9] The specific parameters are listed in Table 3.1.

Table 3.1. Parameters of the Hypothetical Facilities

Characteristic	**Value**
Turbine Type	Siemens/Westinghouse W501D5
Plant Capacity (MW)	172
Supplemental firing (MW)	No
Type & Primary Fuel	Natural Gas Combined Cycle
Secondary Fuel	Distillate Fuel; 876 hour limit
Cogeneration Facility	No
Operation dates	2015, 2020

COST ESTIMATION

The above described facilities are representative of the typical plants Ecology expects will be constructed in the future. This analysis will evaluate the requirement that the distillate back-up fuel be considered in the carbon mitigation calculation as if it is used the entire allowable hours for these facilities, relative to a base case where the back-up fuel is not considered. The cost of this requirement is the additional mitigation that is required between the two. Table 3.2 contains an analysis of the increased costs.

[7] A third scenario assumed passage of Senate bill 139 "the Climate Stewardship Act of 2003".
[8] This corresponds with the approximate dates for new generation in EFSEC, 2004
[9] It turns out that the estimated generation capacity is not the key part of this analysis. The key parts are the market costs of offsets and estimated benefits. This is discussed in "Uncertainty and Analysis Results."

Table 3.2 Emission and Mitigation Amounts for a Hypothetical Plant

Amount	Natural Gas only	Natural Gas w/ distillate fuel (876 hour limit)
Total Emissions (tonnes/yr)	327,922	339,232
Emissions to be mitigated over 30 years @ 20% mitigation rate (tonnes)	1,967,531	2,035,390
Mitigation Amount ($)	$3,148,049	$3,256,625

As can be seen the quantity of emissions to be mitigated is higher if the distillate fuel is considered. The total difference in cost for mitigation is $108,576. This represents the increase in the cost for a hypothetical plant assuming that Ecology would not have regulated the supplemental fuel without the new rule.

There is the possibility that a firm will further limit its use of reserve fuel as part of this rulemaking to reduce the impacts of the increased mitigation. This will reduce it's flexibility to switch fuels if market conditions or extreme events necessitate. This cost was not quantified, but if proponents elect to do this, then it must be a lower cost than simply paying the increased mitigation. As such, assuming firms don't change their fuel use is a more conservative (biased against the proposed rule) approach.

Given the assumed construction dates, the total cost of the rule for the two hypothetical facilities is $178,600.[10]

BENEFIT ESTIMATION

The direct benefit of this rulemaking is that the fee assessed on new or modified power plants will be used to create offset projects or purchase carbon mitigation credits that will reduce carbon dioxide emissions. The rule may also have indirect beneficial effects associated with the specific mitigation option, reduce cost uncertainty for electricity plant proponents and tend to stimulate technological improvements in power plant equipment. These effects are further considered below.

Damage to Washington's environment associated with carbon dioxide induced climate change might include changes in forest extent and type, sea level rise and impacts to water resources. These climate related impacts may have significant effects on the commercial, industrial and residential sectors that depend on the natural environment for inputs and waste assimilation. Many studies have been performed on the impacts of climate change to these various sectors of the economy. The typical approach assumes a baseline for the resource without climate change, imposes a model of the climate system and the resource, and then forecasts the impact of climate change. This impact is then valued to determine the economic effect and the difference in the dollar values (pre and post climate change) taken as the economic damage of climate change.

[10] 2004 dollars. Calculation assumes a real discount rate of 4%.

Analysis of public policies to reduce the effects of this damage involves re-assessing the damage for alternative levels of mitigation. This reduced damage from a given mitigation scenario can then be valued and an explicit computation of cost of mitigation versus benefits of avoided damage computed. These models are described below.

Since greenhouse gas emissions are uniformly mixed, the benefits of avoided damage can be considered to be worldwide. Because the initial public policy steps involved an international approach, most of the models that have evaluated public policy options have considered worldwide costs and benefits. These models project a baseline of the world with no climate change policy and then impose a regulatory scenario. Even if a local model of climate change benefits and costs existed, it is not clear that the benefits from carbon mitigation from Washington's power plants would be experienced in Washington. As such, the worldwide impacts from climate change are used as the appropriate reference scenario.

Offset Projects

An important component of the implementation of this rule will be the specific projects or mitigation credits selected and the climate change and affiliated benefits that might occur as a result. It is assumed that third-party offset projects will be the projects of choice for most proponents.[11] The climate change benefits are the avoided damage from reduced carbon dioxide emissions. The affiliated benefits might include reduced air pollutants associated with reduction in fossil fuels combustion, market transformation benefits, reduced traffic congestion, reduced landfill waste, etc.

It is difficult to get data on past offset projects that have been proposed or undertaken in Oregon and Washington because they have only recently been considered and because of privacy concerns. Each project is different and there is still a significant concern among many of the providers about price discovery by others. However, several projects have been undertaken or proposed.[12] The types of projects include:

Energy Efficiency

Energy efficiency projects seek to reduce carbon emissions by reducing energy use through improvements to existing physical capital. Funds are used to directly or indirectly encourage building owners to install energy efficient windows, insulation, etc. The Climate Trust has been involved in two energy efficiency programs, one for owners and managers of multi-family housing and one for new commercial buildings. These projects include ensuring that the legal title to the carbon offsets remain with the organization and ensuring they will be "additional" to any efforts that would have been made without the projects.

Materials Substitution

[11] Proponents could self-mitigate but this can increase corporate risk. Emission credits can also be used but it is difficult to know what markets would be approved. Oregon's experience indicates that third-party mitigation is the choice of most newly developed projects.

[12] Projects have been completed by the Climate Trust and the City of Seattle.

Increasing the use of materials that don't require fossil fuel combustion can favorably impact the environment. Seattle City Light has entered into an agreement with the Civil Engineering Research Foundation (CERF) to obtain 52,500 metric tons of offsets at $1.95/ton. This project involves the substitution of pozzolans in concrete mixes instead of Portland Cement Concrete. This eliminates the carbon dioxide produced in the production of clinker. It also reduces the amount of solid waste that would have been generated.

Renewable Energy

Encouraging the use of renewable energy sources will also be beneficial to reducing the amount of CO_2 emitted. Purchasing the environmental benefits from wind power makes it competitive with fossil fuel production and offsets the amount of GHGs and conventional pollutants that would have been generated along with increasing market exposure. The Climate Trust is involved in a project with the Bonneville Environment Foundation (BEF) to pay the additional cost associated with wind-generated power thereby offsetting the equivalent amount of fossil-fuel powered electricity.

Other programs include those that encourage co-generation or harnessing landfill methane. For example, a plant can upgrade its power system to a combined steam and electricity system. This will eliminate the CO_2 produced in making the electricity from fossil fuels and some additional pollutants (but may increase others). Biodiesel projects have also been proposed for the City of Seattle mitigation program.

Transportation Related Programs

Reduction in the use of fossil fuel burning transportation systems can yield CO_2 reductions. These projects have included optimization of signal timing in areas of central Portland that ease congestion and lead to reduced acceleration and idling time and reduced emissions. Co-benefits include less fuel-use, less congestion and criteria pollutants and reduced travel time. Another project involved a car-pool match system that reduces the number of individual drivers and cars on the road with similar affiliated benefits as listed above.

Land Use/Sequestration

Several projects have involved restoring or conserving land. One project involves re-planting denuded hillsides using locally collected, native tree species in the Deschutes River Basin. Landowners will be required to do this for a period of 50 years. This will store carbon, improve habitat and foster sustainable forest practices. Land in Washington and Costa Rica has been set aside for sequestration and affiliated biodiversity benefits.

Carbon Dioxide Offset Prices

In the case of the proposed rule, the avoided climate change damage is a function of the avoided greenhouse gas emissions from offset projects similar to those listed above. Since this rule charges new generation sources a fixed fee and uses it to purchase GHG offsets, it is necessary to forecast the cost and availability of offsets. This cost can be different than the offset cost stated in rule since the rule price is not set in a market. However, a particularly important amount in terms of benefits is the amount that can actually be purchased from offset providers or via self-mitigation. Once this is

determined, then the quantity of offsets generated from a given level of mitigation can be determined.

The market for carbon dioxide mitigation is relatively new with the first documented trades dating from 1996. Two types of instruments are typically traded on markets; verified emissions reductions instruments (VERs) and emission reduction credits (ERCs). VER's are offset projects similar to what is required by Washington State statute and implemented via the proposed carbon mitigation rule. ERC's are instruments that grant holders the right to emit greenhouse gases and are usually part of a government mandated GHG reduction program.

The existing price for offsets is difficult to determine since there is no price index or market price in the conventional sense. The worldwide market in GHG trading has been increasing in trading volume through time. Several existing markets are currently operating in Europe and a more diffuse market is operating in the United States and Canada. A recent survey of carbon markets worldwide has found a wide range of costs for carbon offsets, but for Kyoto compliant projects the costs ranged from $2.93 to $6.44 per tonne CO_2 equivalent.[13]

Local experience in offset prices is particularly relevant. The most likely way that mitigation activity would be implemented for this rule is via an Independent Qualified Organization (IQO). A typical organization of this type is the Climate Trust in Portland, Oregon. They are a non-profit organization developed in response to the state of Oregon's GHG law and have a significant amount of experience in this type of work having completed 11 offset projects since their initiation. Their experience indicates that the total cost of mitigation has been approximately $2.83/tonne of CO_2.[14] Of this amount, management, selection and contracting amounted to $0.68/ton or 26% and the remainder was used to purchase offsets. Types of projects included sequestration, energy efficiency, transportation mobility, and others as described previously.

The City of Seattle also recently contracted for offsets as part of the City's policy of zero net CO_2 emissions. The average price of the offset proposals for these projects was $3.81/tonne CO_2.[15] Moreover, the price varied based on the type and location of the project (out of State projects tended to be cheaper).

As mentioned above, there are two costs to consider when determining the offset amounts, one is the offset cost in the proposed rule and one is the market offset cost. The offset cost set by rule will be decided by a rulemaking body and may or may not rise through time. EFSEC has the authority to raise the price up to 50% every two years. As such, the price could rise at a much more rapid pace.

Market prices may rise significantly at the same time depending on local, national and international climate change regulation. Some projections indicate allowance costs of up

[13] State and Trends of the Carbon Markets 2003. These are the highest quality offsets considered.
[14] Data provided by the Climate Trust, 2003.
[15] Data provided by the City of Seattle, 2003.

to \$60/tCO_2 by 2025 although offset prices may be substantially less.[16] The EIA in its analysis of the Climate Stewardship Act (CSA) estimated offset costs of approximately \$9/tonne CO_2 by 2016 rising to \$14/tonne CO_2 in 2025. This assumes a relatively large increase in demand for offsets under the CSA. Of course, if no other governmental entities require GHG mitigation, then prices may change very little. For the purposes of this analysis, three alternative rates were considered and the assumptions are listed in Table 3-3:

Table 3-3. Rule and Market Offset Prices for Benefit Analysis

Market Offset Scenario	Rule Offset price (\$2004)	Escalation[17]	Market Offset Price (\$2004)	2015/2020 Price (\$2004)
1	\$1.60/tonne	2.5%/yr	\$3.50/tonne	\$3.50/\$3.50
2	\$1.60/tonne	2.5%/yr	\$3.50/tonne	\$12.00/\$12.00
3	\$1.60/tonne	2.5%/yr	\$3.50/tonne	\$20.00/\$25.00

The rule offset prices rise at the rate of inflation. The market price is assumed to rise at three different rates that reflect the uncertainty in the offset market.

Avoided Climate Change Damages

The avoided climate change damage depends on how much generation assets change due to the rule, when they change and the rule and market prices of offsets. In some cases, all the payment will occur up-front. For the purpose of calculating the benefits of the proposed offsets, it is assumed that the offsets are purchased lump-sum and that the facility generates benefits that accrue over a service life of 30 years.

Calculating the benefits of avoiding climate change damage is difficult because the complex chain of climate change is a significant source of uncertainty. We can generally predict emissions relatively well, but the links with temperature increases and climate change and impacts and economic valuation are much more difficult to establish. For example, the damage from greenhouse gases is related to the stock of the pollutant in the atmosphere.[18] As such, any action taken today may not have any effect on today's temperature or climate, but may have an effect many years from now. There is a significant amount of inertia and irreversibility associated with climate change. Therefore decisions about emission levels are relatively irreversible. In addition, many of the offset projects would not take place until well in the future where it is difficult to predict what the value of that pollution reduction will be.

Actual impact data is not available. Therefore, the determination of effects depends entirely on the predictions, judgment and models of scientists and economists. Nonlinearity is difficult to consider and the very long time frame causes some normal external variables to become internal factors of change. The offsets alone will impact

[16] Results from Tellus (2003), Paltsev, Et.al. and EIA (2003). Offset costs are generally forecast to be cheaper than credits.

[17] Rate assumes that overall rule rate keeps up with macroeconomic inflation. This would correspond to rule rate increase of approximately 5% every two years.

[18] Many pollutants are called "fund" pollutants and their impacts are mostly tied to their emissions rates.

electricity demand which will impact generation. Integrated assessment models have been used by many to determine the impacts of climate change. These models posit specific behavior about the economy, climate and individuals and have specific damage functions.

There have been several studies completed regarding the marginal benefits of Carbon Dioxide abatement. The values listed in Table 3-4 below provide an estimate of the benefits of reducing emission by a marginal amount today (say 1 ton of emissions) relative to a base case of no emissions change.

Table 3-4. Estimated Benefits of Avoided Damages Associated with Climate Change ($2004/tC)[19]

Study	Type[20]	1991-2000	2001-2010	2011-2020	2021-2030
Nordhaus	MC		10.3		
Ayres and Walter	MC		42.4-49.5		
Nordhaus (1994b)					
		7.5	9.6	12.2	14.1
		17	25.4	37.4	
Cline	CBA	8.2-175.2	10.7-217.6	13.8-262.8	16.7-312.3
Peck and Teisberg	CBA	14.1-17	17-19.8	19.8-25.4	25.4-31.1
Fankhauser	MC	28.7	32.2	35.7	39.3
Masddison	CBA/MC	8.3-8.6	11.4-11.9	15.7-16.2	20.8-21.5
Tol	MC	15.5	18.4	21.2	25.4

As can be seen, the specific values vary a lot depending on the year and model with a range of from $7.5-$312 per tonne of carbon. However, most of the estimates are in the $16-$138 per tonne of carbon range for the period 2011-2020 ($4.4 to $37.7 per tonne of CO_2). These numbers represent the value of the additional damage that is done by emitting an additional tonne of carbon or conversely the benefit of not emitting an additional tonne.

Utilizing the above values and converting to tonnes of carbon dioxide, we can analyze the benefits of carbon mitigation. We utilize three values based on the above numbers and list them in Table 3-5 below.

[19] Taken from IPCC (1995). Dollar values updated to 2004 and the Tol (1999) study was added.
[20] MC is a marginal cost study where the value is the additional cost of one more unit of pollution, CBA is a cost-benefit framework

Table 3-5. Estimated Benefits from the Proposed Carbon Dioxide Mitigation Rule

Market Offset Scenario	Additional Resources (2004$)[21]	Additional Carbon Mitigated (tonnes)	Estimated Benefits ($4.4/tonne CO2)	Estimated Benefits ($11.8/tonne CO2)	Estimated Benefits ($37.7/tonne CO2)
1	$178,600	62,043	$272,989	$732,107	$2,339,021
2	$178,600	18,096	$79,622	$213,533	$682,219
3	$178,600	9,772	$42,997	$115,310	$368,404

As can be seen the net benefits of carbon mitigation rise with increasing carbon mitigation benefits or decreasing market offset costs. Market Offset Scenario 1 depicts a situation where offset prices rise with the rate of inflation. As can be seen, the direct benefits appear to be larger than the costs in all cases. If market mitigation rates rise as in Scenarios 2 and 3, then the direct benefits of mitigation may only exceed the costs if the actual benefits tend to be on the high side of the currently estimated values.

Additional Issues

The precise benefits of avoiding climate change vary a lot based on assumptions about discount rates and linkages between climate, damages and economic valuations. Reducing the discount rate from 3% to 0% in the computer simulations can increase the marginal benefits by a factor of nine.[22] Additionally, these models have been criticized for the simplifying assumptions made in order to get useable results. Many of these criticisms are valid, but these models represent the best models currently available to address the benefits of climate change and as such were used in this analysis. A significant result of the models is that the marginal values of mitigation are relatively consistent across a wide variety of model assumptions, frameworks and solution procedures.

Another important component of these offset projects is whether they would occur if the offset funds were not provided, a concept known as “additionality”. In the case of projects undertaken by a third-party, EFSEC is to ensure the listed IQOs meet this requirement.

As mentioned previously, affiliated benefits from climate change mitigation may be important. These are difficult to quantify since they are specific to each application, but qualitative values are provided in Table 3.6.

[21] Value is present value of mitigation amounts assuming real discount rate of 4%.
[22] IPPC (1995).

Table 3.6. Affiliated Benefits from Offset Projects

Name	Purpose	Affiliated Benefits
Energy Efficiency	Funds programs to encourage reductions in electricity use	Reduced conventional pollutants, water savings & increased asset values
Materials Substitution	Substitutes production of fossil fuel intensive material	Reduced conventional pollutants and solid waste
Energy Programs	Substitutes fossil fuel energy sources for renewables	Reduced conventional pollutants, & energy security
Traffic Related Programs	Reduces fossil fuel combustion in automobiles	Reduced conventional pollutants, travel time, & energy security
Sequestration	Reduces climate change by increasing the rate of absorption	Environmental services & amenity benefits

Additional Benefits of Chapter 173-407 WAC

Several other additional benefits have been identified. The explicit requirement for CO_2 mitigation should help reduce the uncertainty that applicants would have experienced without the rule. If a firm decides to use back-up/supplemental fuels, they will now be able to explicitly calculate the level of mitigation and plan for it in determining their project financing and development. Without the rule, the exact amount of mitigation required would not be known in advance.

Another potential benefit is the increased incentive to develop improved or alternative technologies and cogeneration. Raising the cost of fossil fuel generated plants will at the margin encourage either more efficient generating technologies or technology switching to increased renewable energy sources. The cost of carbon mitigation and other mitigation will also provide an incentive for new and modified plants with the lowest heat rates (i.e. the most efficient plants). Moreover, as mitigation rates are increased over time, there will be an increasing incentive for firms to utilize more efficient turbines.

UNCERTAINTY AND ANALYSIS RESULTS

The analysis provided is potentially sensitive to a number of assumptions. To consider how dependent the results of the analysis are on these assumptions, it is useful to consider how the results of the analysis change as the assumptions are varied. Since the rule will only affect new or modified facilities, the most significant assumptions included those associated with the number and type of plants, the construction dates and allowable limit on secondary fuel use. As was noted previously, the number of plants was developed from computer simulations run in conjunction with the Northwest Power Planning Council as part of its planning and analysis role. However, if the type of plants or the number of plants is significantly different, it will likely result in more or less mitigation costs for electricity plants. This money will be used to buy carbon dioxide offsets/credits that are intended to reduce the impacts of climate change. In terms of relative benefits

and costs, the most important consideration is the market cost of offsets and the climate change, affiliated, certainty and technology benefits associated with carbon mitigation. That is, does a $1.00 increase in mitigation costs yield more than $1.00 in reduced impacts from climate change, affiliated benefits, certainty and incentives for technology? As can be seen from the above analysis, at current prices and estimated benefits it appears the answer is yes. However, as relative values change, then this conclusion may be challenged. If the market price of offsets increases significantly, then the benefit-cost ratio may decrease.

CONCLUSION

As can be noted above, the direct benefits of the additional carbon dioxide mitigation appear to exceed the range of the costs for current rates of mitigation. If direct mitigation benefits tend to be on the high end and if costs remain low, then probable benefits are likely to be greater than probable costs. However, if direct mitigation costs increase significantly, then it will make the portions of the rule analyzed less desirable.

Factoring in the affiliated benefits of carbon dioxide mitigation and the benefits associated with increased certainty and incentives for technological development, it is expected that the probable benefits of the rule will be larger than the probable costs.

4. LEAST BURDENSOME ANALYSIS

The proposed rule is the result of a concerted effort to develop language that meets the statutory objectives while minimizing impacts to potential electricity generation facility developers. However, during development of this rule, several alternative rule processes and rules were considered. For example, prior to the legislature taking statutory action, Ecology considered several alternative rulemaking processes. First, a negotiated rulemaking was considered but rejected since these processes are usually quite time intensive and because it would have not likely lead to a rule that followed EFSEC's proposed rule very closely. Secondly, a pilot rulemaking was considered but also rejected since opt-out provisions would have likely made for inconsistent permit requirements.

During the 2004 legislative session, a new law was enacted on the subject and codified as RCW 70.94.892 and Chapter 80.70 RCW. Ecology again considered several alternative rules. The first was to not develop a rule. This was rejected since it would have likely led to inconsistent permit requirements for future applicants.

Another alternative was to amend both WAC 173-400 and 173-401 to consider carbon dioxide mitigation instead of completing an entirely new rule. The rule language would have been very similar or the same to that contained in 173-407, but would likely have resulted in an increased cost to Ecology for additional rule development activities since each rule would be considered a significant legislative rule and required to follow the statutory requirements for significant legislative rules. The net effect would have been increased work for staff in writing, coordinating and implementing two rules instead of one. Thus, the rule would have had the same effect as proposed WAC 173-407, but would have cost more.

Another alternative considered to WAC 173-407 involved a version of the rule that provided a lower cogeneration credit to those facilities that construct plants with cogeneration capability. The alternative rule language would have calculated the credit as the product of the annual heat energy input supplied by the cogeneration plant steam host (H_s) and the time weighted average of the CO_2 emission rate constant (K_a) for the cogeneration plant as follows:

$$CO_{2credit} = \frac{H_s}{2204.6}(K_a)$$

The proposed rule divides this amount by 0.35 therefore increasing the proposed cogeneration credit by a factor of almost three as follows:

$$CO_{2credit} = \frac{H_s}{2204.6}(K_a) \div 0.35$$

The net effect of this change for applicants is a reduced cost of mitigation for those that elect to provide cogeneration capability and an increased incentive to provide this capability.

Comparing the three alternatives (rule language in 173-400/401, lower cogeneration credit, proposed WAC 173-407) reveals that the proposed rule is the most appropriate rule meeting the stated goals and specific objectives. Placing the rule language in WAC 173-400/401 would have raised the cost of the rule with no corresponding increase in benefits. Using a lower cogeneration credit results in more mitigation, but also reduces the incentive to provide cogeneration. Proposed WAC 173-407 is the least burdensome alternative for the three alternatives considered.

REFERENCES

1. City of Portland Office of Sustainable Development, Energy Efficiency in Multifamily and Commercial Buildings Carbon Dioxide Offset Purchase Agreement Status Report, January, 2003

2. Energy Information Administration, Analysis of S.139, the Climate Stewardship Act of 2003: Highlights and Summary, 2003

3. Intergovernmental Panel on Climate Change (IPCC), Climate Change 1995, Economic and Social Dimensions of Climate Change, 1996

4. Joskow, Paul, Restructuring, Competition and Regulatory Reform in the U.S. Electricity Sector, Journal of Economic Perspectives, Vol. 11, No.3, 1997

5. Northwest Power and Conservation Council, Draft Power Project Financing Assumptions for the Fifth Power Plan, 2003

6. Northwest Power and Conservation Council, Revised Draft Wholesale Power Price Forecast for the Fifth Power Plan, 2004

7. Northwest Power and Conservation Council, The Evolving Northwest Power Industry, 4th Northwest Conservation and Electric Power Plan, 1998

8. PacifiCorp, Integrated Resource Plan, 2003

9. Paltsev, Sergey, John Reilly, Henry Jacoby, A. Denny Ellermen & Kok Hou Tay, Emissions Trading to Reduce Greenhouse Gas Emissions in the United States: The McCain-Lieberman Proposal, Massachusetts Institute of Technology Joint Program on the Science and Policy of Global Change, 2003

10. Pizer, William & Raymond Kopp, Summary and Analysis of McCain-Lieberman-"Climate Stewardship Act of 2003", Resources for the Future, 2003

11. Predpall, Dan, New Generation Site Selection—Challenges in the 1990's for the Electric Utility Industry, Proceedings of the American Power Conference, Vol. 52, 1990, pgs. 783-788.

12. Puget Sound Energy, April 2003 Least Cost Plan, 2003

13. Tellus Institute, An Economic and Financial Analysis of the Proposed CO2 Rule Comments for the Energy Facility Siting Council, 2003

14. U.S. Senate Bill 139, Climate Stewardship Act of 2003, http://www.theorator.com/bills108/s139.html

15. Washington State Community, Trade and Economic Development, 2001 Biennial Report, 2001.

16. Washington State Community, Trade and Economic Development, Comparative Evaluation of Electric Power Plant Siting Requirements in Washington, Oregon and California, 2001.

17. Western Electricity Coordinating Council, Information Summary, 2003

18. World Bank, State and Trends of the Carbon Market, 2003

APPENDIX A: ANALYSIS OF THE PROPOSED RULE

INTRODUCTION

RCW 34.05.328 requires an agency engaged in rule-making deemed to be "a significant legislative rule" to perform several economic analyses including determining that the probable benefits exceed the probable costs, and that the rule is the least burdensome alternative. Proposed Chapter 173-407 WAC meets the criteria of a "significant legislative rule." Exemptions from these requirements include:[23]

-Rules adopting or incorporating by reference without material change federal statutes or regulations, Washington state statutes, rules of other Washington state agencies, shoreline master programs
-Rules the content of which is explicitly and specifically dictated by statute
-Rules that set or adjust fees or rates pursuant to legislative standards

RCW 19.85 requires an agency to consider the impacts that the rule might have on small businesses. The applicability requirements and exemption provisions are the same as for RCW 34.05.328.

BASELINE

When evaluating the economic impacts of the proposed rule, the first step is to consider the baseline from which the rule change is measured. As has been stated, *"The baseline should be the best assessment of the way the world would look absent the proposed regulation."*[24] Once the baseline is determined, it can be compared with the specific rule language to determine the changes experienced by regulated entities that will likely be required by the rule. This change can be "valued" to arrive at the economic impacts.

The statutory basis for the proposed rule is Chapter 80.70 RCW and section 70.94.892 RCW. These sections provide the basis for how the State's requirement for carbon dioxide mitigation from fossil-fueled thermal electric plants is to be accomplished. They provide specific direction in terms of applicability, appropriate mitigation options and independent qualified organizations. They also provide dates for program applicability.

The statutory language mentioned above reduces the extent of economic analysis required since language specifically listed in statute is not required to be analyzed. The following section by section comparison notes little change or "no significant economic impact" in several cases since the requirement is already listed in statute.

IMPACTS OF THE PROPOSED RULE

173-407-010 Policy and Purpose
(1) No Significant Economic Impact-stated in statute

[23] RCW 34.05.328.5(b)(iii), (v), (vi)
[24] Economic Analysis of Federal Regulations Under Executive Order 12866, OMB, 1996

(2) Indicates that if a source only emits CO_2, then it will not be subject to requirements to obtain a complete operating permit. If it is subject to Chapter 401, the CO_2 mitigation requirements are enforceable under that regulation.
(3) Facilities not subject to 173-401 are still subject to the registration program (173-400)

Section clarifies how electricity facilities will be regulated. This may provide greater certainty for plant proponents.

173-407-020 Definitions
All the definitions are directly from RCW. An important component is listed under (17) "Total carbon dioxide emissions" (a) and (b) in the last sentence; *'taking into account any enforceable limitations on operational hours or fuel types and use"*

Definition on fuel types and use limitations are important. No further economic analysis required.

173-407-030 Carbon Dioxide Mitigation Program Applicability
1. All text is directly from statute.
2. All text is directly from statute.
3. Text describes requirements in RCW 80.70 and RCW 70.94.892
4. Text describes requirements in RCW 80.70 and RCW 70.94.892
5. Example facilities are as anticipated.
6. Solid waste incinerators are not considered to be fossil fueled facilities.

All text is either directly from statute, summaries of statute or interpretations with few or no alternatives. No economic analysis required.

173-407-040 Carbon Dioxide Mitigation Program Fees
The section establishes the fee schedule for application review, mitigation plan approval and routine compliance monitoring. The statute specifically allows Ecology to "determine, assess, and collect fees" for reviewing mitigation plan components and monitoring conformance with the plan. Since this is "pursuant to legislative standards," it is not required to be analyzed under RCW 34.05.

No economic analysis required.

173-407-050 Calculating Total Carbon Dioxide Emissions to be Mitigated
(1)- (2) This section provides the explicit definition of the formula used to calculate the emissions. The formula is a straight-forward approach to calculating emissions. Areas that will be subject to analysis are the time that duct firing is included and the choice of analyzing the highest CO_2 fuel when multiple fuels are used. Conversion factors are from EPA.
(3) The Cogeneration credit is calculated based on CO_2 emissions that will actually be produced via a binding contract.
(4) Requirements for applying the mitigation rate are from statute.
(5) Additional restrictions on modifications are implied by or discussed in statute.

Choices for regulating supplemental production (duct-firing) and multiple fuels may have benefits and costs. Economic analysis will be required.

173-407-060 Carbon Dioxide Mitigation Plan Requirements and Options
(1) Text describes requirements in RCW 80.70.
(2) Text describes requirements in RCW 80.70.
(3) Text describes requirements in RCW 80.70.
(4) Text describes requirements in RCW 80.70.
(5) Text describes requirements in RCW 80.70.

173-407-070 Carbon Dioxide Mitigation Option Statement and Mitigation Plan Approval
Applicants must select their option at the time of application. This is not spelled out in RCW but is necessary information associated with their mitigation plan.

No significant economic impact.

173-407-080 Enforcement
No significant economic impact.

173-407-090 Severability
No significant economic impact.