

PUBLIC SERVICE COMMISSION OF WISCONSIN

Memorandum

November 11, 2015

FOR COMMISSION AGENDA

TO: The Commission

FROM: Jeffrey J. Ripp, Administrator
Carol Stemrich, Assistant Administrator
Division of Energy Regulation

Joe Fontaine, Focus on Energy Evaluation Coordinator
Division of Business and Program Management

RE: Quadrennial Planning Process II

5-FE-100

Carbon Valuation for Use in Focus on Energy
Cost-Effectiveness Tests

Suggested Minute: The Commission (approved/approved with modifications/did not approve) the Evaluation Work Group's recommended carbon value for use in Focus on Energy cost-effectiveness tests.

In its Final Decision of September 5, 2014, the Commission determined that a Modified Total Resource Cost (TRC) test should continue to be used as the primary benefit-cost test to determine whether Focus on Energy (Focus) portfolios and programs are cost-effective during the 2015-2018 quadrennium ([PSC REF#: 215245](#)). One of the benefits included in the Modified TRC test is the value of avoided emissions achieved through program energy savings from reductions in nitrous oxides (NO_x), sulfur oxides (SO_x), and carbon dioxide. Monetary values for NO_x and SO_x are set based on the values established in national markets for trading emissions allowances. Because no national market exists for carbon, no single accepted value is available, and determining an appropriate value was identified as an additional policy decision for the Commission to make in the Quadrennial Planning Process.

The Commission did not establish a value of carbon in its September 2014 Final Decision. Instead, Commission staff and the Evaluation Work Group (EWG) were directed to evaluate and report back to the Commission on appropriate market-based carbon values not later than October 2015. The decision noted that it was not necessary to immediately select a carbon value because a value would not be applied until the evaluation of 2015 Focus programs during early 2016. Waiting to make a final decision would allow Commission staff and the EWG to monitor ongoing developments relevant to carbon valuation, and help the Commission ensure its final decision reflects updated information as appropriate.

This memorandum updates the information on carbon values provided in the initial Quadrennial Planning staff memorandum of July 2014 and presents decision alternatives for the Commission. The first section recaps the range of carbon valuation approaches currently used throughout the country, highlighting developments since mid-2014. The second section outlines the criteria the EWG set to determine appropriate decision alternatives, based on the Commission's directions and general Focus evaluation policies and practices. The final section describes an analysis conducted in fall 2015 to calculate a range of values that met the EWG's criteria, and identifies and compares the decision alternatives generated from that analysis.

Carbon Values: Analytical Approaches and Recent Developments

The value of carbon can be defined based on either market-based values or social costs. Market-based values are determined based on the value of per-ton emissions allowances traded in organized emissions markets, and therefore reflect the costs to market participants of achieving carbon reductions. The social cost of carbon is calculated to capture a broader range of societal costs created by carbon emissions, such as increased health care costs, environmental damages, and decreased agricultural productivity.

No significant developments have occurred over the past year in valuing the social cost of carbon. The primary source for social costs remains the 2013 estimates promulgated by a federal interagency working group. Social costs were projected under multiple modeling scenarios, including low-cost, moderate-cost, and high-cost scenarios, based on different assumptions regarding the magnitude of social effects from carbon emissions and the rate at which those effects may grow over time. The moderate scenario, most commonly used in federal benefit-cost analyses, calculates the social cost of carbon at \$36 per ton¹ in 2015, increasing to \$61 per ton by 2040.

Since 2013, there have been several developments related to market-based carbon values. In August 2015, the U.S. Environmental Protection Agency (EPA) released its Clean Power Plan rules to regulate state-level carbon emissions, as revisions to the draft rules issued in 2014. In theory, these rules could create the framework for a national market to define an accepted carbon value, but in practice these materials still have limited value for that purpose. EPA's materials indicate that trading markets could be used for compliance, but do not define how such a market would operate.² Furthermore, legal challenges to the validity of the rule create uncertainty as to whether the rule will be implemented with the timing or terms presently established.

¹ All per-ton values in this memorandum are expressed in terms of short tons of carbon dioxide. These values will differ from some published sources which express values in terms of metric tons. A metric ton (sometimes called a long ton) is approximately 10 percent larger than a short ton (2,240 pounds vs. 2,000 pounds). As a result, values expressed in terms of short tons are approximately 10 percent lower than metric ton values. There is variation in the metric used by source; among the sources discussed in this memorandum, California and social cost of carbon prices are typically published in metric tons, while the northeastern market and Synapse report use short tons. In the absence of a clear consensus, the EWG chose to use short tons for consistency with historical practice in Focus evaluation, and converted published metric-ton values to short-tons to maintain consistency within this memorandum.

² States are given discretion to determine whether they want to participate in trading efforts, and the scope and scale thereof. If a state chooses not to submit a plan, the EPA issued a draft Federal Implementation Plan that could be applied in its place. The draft federal plan suggests trading may be an option as part of federal plans, but those provisions are draft language that remain subject to public comment and potential agency revision.

Two other recent developments provide additional information that could inform the current definition of a market-based value. First, updated values are available for permit prices on the two regional markets that are typically referenced in the absence of a national market: California's market and the northeastern regional market.³ California's three 2015 permit auctions resulted in settlement prices between \$11.07 and \$11.35 per ton, a slight increase from the settlement prices in 2013 and 2014 auctions. Permit values in the northeastern market increased at a greater rate, from values of \$3.00-\$4.00 per ton in early 2014 to \$6.02 in September 2015.

Second, a recent modeling report offers detailed future projections of market-based carbon values. Synapse Energy Economics (Synapse), an independent consulting firm the EWG has used as a past source for evaluation information, published a report in March 2015 projecting carbon price trajectories from 2020 through 2050, with the goal of informing utility planning processes. Similar to the federal government's social cost projections, Synapse published three scenarios—low-cost, moderate-cost, and high-cost—intended to reflect a range of potential assumptions on future carbon-related conditions, including the timing and scale of future federal and state regulations. Synapse's low-cost scenario, which assumed carbon regulation was limited or delayed from the scale suggested in EPA's draft Clean Power Plan rules, projects a carbon price of \$15 per ton in 2020, increasing to \$45 per ton by 2050. Moderate-cost and high-cost scenarios projected higher prices consistent with more stringent regulations. The moderate-cost scenario projects prices of \$20 in 2020 and \$85 in 2050, while the high-cost scenario forecasts prices of \$25 in 2020 and \$120 in 2050.

³ Nine northeastern states participate in the Regional Greenhouse Gas Initiative (RGGI): Connecticut, Delaware, Maine, Maryland, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont.

Criteria for a Focus on Energy Carbon Value

The EWG considered the following four criteria in assessing available information carbon values and developing decision alternatives for the Commission.

1. Consistency with Focus' life cycle savings framework. Focus measures energy savings over the full lifetime of the measures it installs, which can range upwards of 25 years. The Commission has determined that benefits in Focus' cost-effectiveness tests should be measured accordingly. For example, the Commission affirmed in its September 2014 Final Decision that the benefits from avoided electricity costs should be based on future forecasts of locational marginal prices in the state, to reflect the best available information on avoided costs in place as Focus measures continue to save energy into the 2020s and 2030s. In its Final Decision of February 16, 2015, the Commission accepted a recommendation from the EWG to calculate the benefits from natural avoided natural gas costs using long-term price forecasts for consistency with the approach to electric costs. It would be consistent with both previous decisions for carbon emissions to be measured using long-term values.

2. Use of a market-based value. In its September 2014 Final Decision, the Commission directed the EWG to evaluate appropriate market-based carbon values, as opposed to social cost values. Based on its further study of available market-based sources, the EWG concluded that the most appropriate market-based values should balance two competing considerations. First, the value should be informed by present-day market values, which is common practice in other energy efficiency programs which include the value of carbon in cost-effectiveness assessments. Second, the value should also recognize the full range of market-based considerations, including future market conditions. In addition to being consistent with Focus' life cycle framework, a price that acknowledges future market conditions

appropriately reflects common economic practice for recognizing future streams of value. For example, many major corporations include a carbon value in their planning efforts that is designed to recognize the future carbon-related costs they could incur and ensure that their present-day economic decisions are informed by the best available information on those future costs.⁴

3. Consistency with general Focus program goals and policies. As noted above, the absence of a single accepted carbon value has led the Commission to treat the selection of a value as a policy decision. As such, the Commission's selection of a carbon value can be informed by the Commission's other policy goals. In particular, two general policy statements the Commission has issued in Quadrennial Planning to date may be relevant to carbon-related decisions: that Focus should continue to be used to position Wisconsin for future compliance with any future carbon regulations that are implemented; and that Focus should design programs to take into account the goal of achieving long-term energy savings through market transformation as a secondary priority behind the achievement of present-day energy savings.

4. Transparency. Carbon values can be heavily influenced by the choice of assumptions related to current and future market conditions, and the choice of calculation methods. The EWG prefers sources that clearly identify and explain relevant methods and assumptions. This allows the EWG to more effectively compare the relative merits of different options, and enable the group to develop reasonable methods for combining or adjusting methods where appropriate.

⁴ One summary of corporate practices in this area can be found in the CDP (Carbon Disclosure Project), "Global Corporate Use of Carbon Pricing: Disclosures to Investors," September 2014, available at <https://www.cdp.net/CDPResults/global-price-on-carbon-report-2014.pdf>.

Development of Decision Alternatives

After reviewing currently available sources for carbon prices in light of its criteria, the EWG concluded that no current single source is adequate enough to be directly used in Focus' cost-effectiveness test. All available sources are sufficiently transparent. However, social cost of carbon values are not market-based. Market-based prices from California or the northeast do not offer guidance on values over the full Focus life cycle. Synapse's study does offer long-term price forecasts, but the values are not directly tied to presently available data, and the starting point of Synapse's projects in 2020 leaves several years in the Focus lifecycle without clear estimates.

In lieu of using a single source, EWG derived six alternative market-based carbon values for Commission consideration, using an integrated framework which draws on multiple sources. The EWG developed this framework in four steps.

- 1. Establish California's existing market-based value as the starting-point carbon value for 2015.**

Carbon values in both the California market and the northeastern market share a number of strengths and weaknesses as references for a Focus carbon value. Both represent an existing market value, but both markets exist in regions distant from Wisconsin and are therefore limited in their ability to represent in-state market conditions. The EWG believes that using California's values is more appropriate based on two additional considerations. First, California's market is mandatory in nature, while the northeastern market is voluntary. Mandatory markets serve as the source of benefit values for the other emissions in Focus' cost-effectiveness test. Second, it appears that the northeastern market's current value may increase to a level comparable to California's in the near term; the recent, significant growth in values in the northeastern market

is based on a deliberate market initiative to increase carbon reductions which will continue over the next several years.

To establish a 2015 California value, the EWG calculated the average of the permit prices in the three market auctions that have been conducted during the year, and adjusted the value to 2014 dollars so that figures were reported consistently with social cost values and Synapse values. This calculation identifies a starting-point value of \$10.98 per ton.

2. Generate near-term growth rate scenarios to identify the range of potential price trends over the next several years.

It is difficult to confidently project future carbon values from current values in existing markets, and Synapse's long-time price projections do not offer guidance on the years immediately after 2015. To fill this gap, the EWG performed its own analysis, drawing on each of the sources described above, to develop a range of growth projections.

The EWG first established a minimum-growth scenario by developing a growth curve that follows the low-growth scenario for the social cost of carbon. The curve falls below the Synapse's low-growth projection, which Synapse designed to reflect a scenario where future carbon regulation on the federal and state level is substantially delayed or limited in scope. The EWG concluded that Synapse's projection could still overstate the potential "floor" for market values, in part because the low-growth social cost scenario tracks closely with current values and recent growth rates in the California market. This minimum-growth scenario still does involve limited positive growth each year. However, that growth rate would be minimal, driving an overall increase of less than \$2 per ton through 2022.

Conversely, if the Clean Power Plan does take effect as written, the significant level of carbon emission reductions required could drive a substantial increase in market prices, consistent with the EWG's findings on trends in existing markets for other emissions in the U.S.,

as well as emissions markets in other countries. To reflect that maximum-growth scenario, the EWG developed a growth curve that increased carbon prices to \$28.50 per ton by 2022, the date that compliance would be required under the present Clean Power Plan. The EWG initially considered designing the growth curve to reach Synapse's high projection, but concluded that the range of values Synapse offered for that timeframe did not reach the potential maximum price that could occur under complete and comprehensive federal regulation. Instead, the EWG chose the social cost of carbon price for that date under its moderate growth scenario. The EWG emphasizes that this value is still intended to reflect a market-based value of carbon; similar to its reasoning for the minimum-growth scenario, the social cost value was an available data point more consistent with the EWG's professional judgment of the likely upper bound for market-based prices.

The minimum-growth and the maximum-growth scenarios reflect the outer bounds of likely market price trends over the next seven years. It may be more likely that actual trends reflect some moderate scenario between those bounds. For example, a moderate scenario may be most accurate if the Clean Power Plan is fully implemented, but has somewhat more limited effects on market prices than the maximum scenario assumes. On the other hand, a moderate scenario may also more accurately reflect a scenario where the Clean Power Plan is not implemented, but increased state regulatory activity or market activity, in California, the northeast, or other areas, still increase carbon prices in the markets Focus can use as available reference points.

Moderate scenarios are particularly challenging to define, given the substantial uncertainties surrounding the timing and content of Clean Power Plan and other regulatory activities. In the absence of clear guidelines, the EWG chose to establish multiple growth curves

to reflect a range of possible moderate scenarios. First, the EWG developed three growth curves through 2022 to reach Synapse’s starting points for each of its three published market-based scenarios, of \$15 per ton, \$20 per ton, and \$25 per ton. These values effectively define Synapse’s “low,” “medium,” and “high” scenarios as a subset of scenarios for moderate price growth. The EWG also defined a fourth curve as the midpoint between the high- and low-growth scenarios to provide a contrasting approach to a “moderate” scenario.

3. Project costs from 2022 through the remaining life cycle of Focus measures in 2040.

Projections for the minimum-growth scenario continue to follow the cost trajectory of the low-growth social cost of carbon scenario, which projects a continuing, gradual increase similar to that between 2015 and 2022. Projections for the maximum-growth scenario follow the projected trajectory of the moderate social cost of carbon scenario, which projects a similar, gradual increase after 2022. The EWG again believes this curve reasonably captures the market-based trend that could be expected to occur in a maximum-growth scenario; the significant increases that would occur in anticipation of strong regulation are unlikely to continue increasing at the same rate after the regulation takes effect. As in Step 2, the EWG concluded that use of social cost values appropriately reflect outer bounds for market-based values. This conclusion is supported by the fact that all three of Synapse’s market-based projections fall between the EWG’s minimum and maximum projections throughout most of the period until the Synapse high scenario exceeds the threshold in the 2030s.

Each of the moderate-growth scenarios also follows the long-term trajectories of their source curve. The midpoint curve is based on the trajectory of the minimum and maximum curves, and therefore reflects the same gradual growth rate throughout the period. Each of the three Synapse-based curves follows Synapse’s projection from its starting point to its value in

2040. The Synapse curves project relatively larger year-over-year increases than the minimum, maximum, and midpoint scenarios, but as noted, the curves remain within the bounds of the minimum and maximum scenarios throughout the period except for Synapse’s high-scenario curve in the last years of the life cycle.

4. Identify single carbon values for each scenario, as the present value of projected prices over time.

Steps 1 through 3 establish a stream of annual carbon values over the entire Focus life cycle, from 2015 through 2040. These values are shown in Table 1.

Table 1 Annual Projected Carbon Values (per ton), 2015-2040

	Minimum-Growth Scenario	Synapse Low Scenario	Synapse Moderate Scenario	Midpoint Scenario	Synapse High Scenario	Maximum-Growth Scenario
2015	10.98	10.98	10.98	10.98	10.98	10.98
2016	11.24	11.24	11.24	11.24	11.24	11.24
2017	11.25	11.75	12.25	12.88	12.60	12.15
2018	11.43	12.46	13.65	14.78	14.59	14.88
2019	11.61	13.13	15.14	17.28	16.87	19.44
2020	11.79	13.78	16.71	20.35	19.38	25.82
2021	12.34	14.40	18.33	24.15	22.10	34.04
2022	12.88	15.00	20.00	28.49	25.00	44.09
2023	13.43	16.00	21.50	29.12	27.00	44.81
2024	13.97	17.00	23.00	29.76	29.00	45.54
2025	14.51	18.00	24.50	30.39	31.00	46.27
2026	14.88	19.00	26.00	31.03	33.00	47.17
2027	15.24	20.00	27.50	31.66	35.00	48.08
2028	15.60	21.00	29.00	32.30	38.80	48.99
2029	15.97	22.00	30.50	32.93	42.60	49.90
2030	16.33	23.00	32.00	33.57	46.40	50.80
2031	16.69	24.00	33.50	34.20	50.20	51.71
2032	17.06	25.00	35.00	34.84	54.00	52.62
2033	17.42	26.00	37.65	35.47	57.80	53.52
2034	17.78	27.00	40.30	36.11	61.60	54.43
2035	18.14	28.00	42.95	36.74	65.40	55.34
2036	18.69	29.00	45.60	37.56	69.20	56.43
2037	19.23	30.00	48.25	38.37	73.00	57.52
2038	19.78	31.00	50.90	39.19	76.80	58.60
2039	20.32	32.00	53.55	40.01	80.60	59.69
2040	20.87	33.00	56.20	40.82	84.40	60.78

Focus' standard evaluation practice, also used for calculating avoided electricity and gas costs, is to convert projected life cycle streams of values into a single, levelized present-value figure. Using present-value figures reflects that cost-effectiveness results are intended to serve as present-day assessments of program performance. To determine present values for the carbon price scenarios in Table 1, the EWG applied a 2 percent discount rate, which the Commission approved as the discount rate for Focus evaluation in its September 2014 final decision. This calculation identified the following values, rounded for clarity:

Minimum-growth scenario	\$11.50 per ton
Synapse low scenario	\$13 per ton
Synapse moderate scenario	\$16.50 per ton
Synapse high scenario	\$19 per ton
Midpoint scenario	\$20 per ton
Maximum-growth scenario	\$28 per ton

The low-growth scenario price is reasonably consistent with current values in the California market. While the EWG's modeling projected growth in values over time, this gradual growth rate under this scenario is effectively offset by discounting of future values. Other scenarios identify higher prices, but discounting still limits the present value of the higher prices projected later in the Focus lifecycle. EWG believes all options fall within a reasonable range of market-based present values. All values remain lower than the \$30 per ton value of carbon the Commission used in previous years to reflect a balance between market-based values and societal benefits. The range of values is also consistent with those used in other states. For example, the Synapse report documented utility carbon price forecasts used in the Integrated Resource Planning processes between 2012 and 2015 and found that the majority of forecasts identified prices between \$10 and \$30 per ton.

Commission Alternatives

The EWG has identified five market-based carbon values for the Commission to consider as alternative options for an appropriate value to apply in Focus' cost-effectiveness testing. (Since the midpoint scenario and the Synapse high-cost scenario provided similar values, the EWG presents a single alternative consistent with both values.)

At the low end, Alternative One would be to select a carbon value of \$11.50 per ton. This value could be reasonable if the Commission believes that carbon regulations, on both the federal and state level, are likely to remain minimal throughout the foreseeable future. Because this value represents the likely "floor" on future carbon values, it risks understating that value if price growth does occur in future years on either the federal or state level.

At the high end, Alternative Five would be to select a carbon value of \$28 per ton. This value would be reasonable if the Commission expects the Clean Power Plan to be implemented consistent with current federal plans, and have significant and rapid effects on carbon prices. Given current uncertainties surrounding the legal status of the rule, those assumptions may be premature at this time.

Alternatives Two through Four would be to select a value of carbon between those minimum and maximum alternatives—respectively, \$13 per ton, \$16.50 per ton, or \$20 per ton. Selecting one of these alternatives would be reasonable if the Commission believes carbon pricing trends will follow a more moderate trajectory, where federal or state carbon markets continue to evolve, without seeing maximum price effects from rapid Clean Power Plan implementation. In that case, the Commission could decide between the moderate alternatives based on its best judgment regarding the likely speed and magnitude of market developments. The Commission's decision could also be informed by its judgment regarding the value most

consistent with its policy decisions that Focus should be positioned to support for long-term compliance with carbon regulations, and that Focus should pursue long-term savings and emissions reductions in addition to short-term achievements.

Alternative One: Focus' cost-effectiveness tests shall value reduced carbon emissions at \$11.50 per ton.

Alternative Two: Focus' cost-effectiveness tests shall value reduced carbon emissions at \$13.50 per ton.

Alternative Three: Focus' cost-effectiveness tests shall value reduced carbon emissions at \$16.50 per ton.

Alternative Four: Focus' cost-effectiveness tests shall value reduced carbon emissions at \$20 per ton.

Alternative Five: Focus' cost-effectiveness tests shall value reduced carbon emissions at \$28 per ton.

JJF:cmk:DL: 01270369