

**IN RE EXXONMOBIL CHEMICAL COMPANY
(BAYTOWN OLEFINS PLANT)**

PSD Appeal No. 13-11

ORDER DENYING REVIEW

Decided May 14, 2014

Syllabus

Sierra Club petitions the Environmental Appeals Board (“Board”) to review a Clean Air Act prevention of significant deterioration (“PSD”) permit regulating greenhouse gas (“GHG”) emissions that the United States Environmental Protection Agency (“Agency”) Region 6 (“Region”) issued to ExxonMobil Chemical Company (“Exxon”) on November 25, 2013. The Final Permit authorizes Exxon to construct a new natural gas-fired ethylene production unit (“Facility”) at Exxon’s existing Baytown Olefins Plant in Harris County, Texas. As part of its best available control technology (“BACT”) analysis for controlling GHG emissions from the Facility, the Region eliminated carbon capture and sequestration (“CCS”) as an add-on control technology because the Region determined that CCS would be economically unachievable for this Facility and would have adverse environmental impacts. Sierra Club’s petition for review asserts that the Region’s elimination of CCS was clearly erroneous and an abuse of discretion.

Sierra Club argues that Board review of the Region’s permitting decision is appropriate in this matter on the following four grounds: (1) the Region abused its discretion by eliminating CCS in its BACT analysis based on considering CCS cost in comparison to overall project cost rather than a more traditional cost-effectiveness analysis; (2) the Region abused its discretion in eliminating CCS as economically unachievable because the Region lacked the details necessary to properly evaluate costs; (3) the Region abused its discretion by departing from the recommendations in the Agency’s *Cost Control Manual*; and (4) the Region abused its discretion by combining GHG emission streams in conducting its BACT analysis.

Held: The Board denies the petition for review of the Region’s final permit decision in all respects.

(1) The Region did not clearly err or abuse its discretion by eliminating CCS at step 4 of its BACT analysis on the basis of consideration of several economic and

environmental impacts, including the total cost of the control technology. As the Agency's recent *GHG Guidance* recognizes, given the lack of GHG cost-effectiveness data for the type of project involved here, permit issuers may assess cost-effectiveness in a less detailed manner than is typical. Under the circumstances of this case, considering the costs of CCS in comparison to total project cost and the impact of those costs on economic achievability was reasonable. The Region reviewed both cost-effectiveness data and the cost estimates Exxon provided. The Region concluded that the cost estimates adequately approximate the project costs and demonstrate that these costs would be prohibitive in relation to the overall cost of the proposed project. The Region also concluded that CCS would lead to secondary environmental impacts in this situation. Sierra Club has failed to establish that the Region's determination was clearly erroneous or an abuse of discretion.

(2) The Region did not clearly err or abuse its discretion by eliminating CCS as economically unachievable for this Facility based on the record before it. Exxon provided information showing that site-specific factors at the Facility, such as a low pressure, low concentration carbon dioxide ("CO₂") waste stream, complicated by numerous emission points from the cracking furnaces, would require application of first-of-its-kind technology, including installation and operation of complex and expensive equipment to accomplish the necessary CO₂ concentration for effective storage. Exxon estimated the total capital costs of CCS at \$735.4 million, which would increase the cost of the facility by more than 25 percent. The Region fully reviewed and agreed with the economic analysis and conclusions in Exxon's application and submissions. Given the lack of examples where CCS has been demonstrated at the type of facility at issue in this case and the substantial evidence in the record showing the high cost of CCS as an add-on technology at this Facility, the Board finds the Region's determination was reasonable and reflected the Region's considered judgment.

(3) The Region did not clearly err or abuse its discretion by departing from the recommendations in the *Cost Control Manual*. As the Region explained in responding to comments on this issue, the *Cost Control Manual* predates the era of GHGs becoming subject to regulation and did not anticipate the considerations that might apply to GHG permitting. Since the *Cost Control Manual* does not contemplate cost development for CCS, many applicants addressing PSD for GHGs have sensibly utilized the best available information on costs for CCS technology. In its petition, Sierra Club essentially repeats its arguments on this issue without explaining why the Region's analysis was clearly erroneous or otherwise warrants Board review.

(4) The Region did not clearly err or abuse its discretion by combining GHG emission streams in the BACT analysis. According to Sierra Club, combining the emission streams overstated costs because the waste stream from the cracking furnaces is a higher purity CO₂ stream and is easier and cheaper to capture and control. As the Region explained in responding to comments on this issue, it elected to treat the entire CCS system from carbon capture, energy needs, compression, and storage in the overall economic or cost consideration for BACT, and to do otherwise would not fully account

for the prospective economic, energy, and environmental impacts of applying CCS as a control option for the Facility. The Board defers to the Region's technical determination on this issue.

Before Environmental Appeals Judges Randolph L. Hill, Catherine R. McCabe, and Kathie A. Stein.

Opinion of the Board by Judge Hill:

I. STATEMENT OF THE CASE

Sierra Club petitions the Environmental Appeals Board ("Board") to review a Clean Air Act ("CAA") prevention of significant deterioration ("PSD") permit regulating greenhouse gas ("GHG") emissions, PSD Permit No. PSD-TX-102982-GHG ("Final Permit"), that the United States Environmental Protection Agency ("EPA" or "Agency") Region 6 ("Region") issued to ExxonMobil Chemical Company ("Exxon") on November 25, 2013.¹ The Final Permit authorizes Exxon to construct a new natural gas-fired ethylene production unit ("Facility") at Exxon's existing Baytown Olefins Plant in Harris County, Texas. *See* Prevention of Significant Deterioration Permit for Greenhouse Gas Emissions Issued Pursuant to the Requirements at 40 C.F.R. § 52.21 ("Final Permit") at 2 (Administrative Record Index No. ("A.R.") V.01). As part of its best available control technology ("BACT") analysis for controlling GHG emissions from the Facility, the Region eliminated carbon capture and sequestration ("CCS") from consideration as an add-on control technology principally because the Region determined that CCS was economically unachievable at this Facility. Sierra Club's petition for review asserts that the Region clearly erred when it eliminated CCS from consideration. For the reasons discussed below, the Board denies the petition for review of the Region's permit decision.

¹ In 2011, EPA issued a final rule promulgating a federal implementation plan in Texas that made EPA Region 6 the PSD permitting authority for the pollutant GHGs in the State. *See* Federal Implementation Plan Regarding Texas's PSD Program, 76 Fed. Reg. 25,178 (May 3, 2011) (promulgating 40 C.F.R. § 52.2305). The Texas Commission on Environmental Quality ("TCEQ") is the PSD permitting authority for all other pollutants. *See id.* at 25,179 n.2; *see* Statement of Basis, Draft Greenhouse Gas Prevention of Significant Deterioration Preconstruction Permit for the ExxonMobil Chemical Company, Baytown Olefins Plant, at 1 (June 7, 2013) (A.R. III.03). More recently, EPA has proposed authorizing TCEQ to become the permitting authority for GHGs as well, but EPA currently retains that authority until that rule becomes final. *See* 79 Fed. Reg. 9,123 (proposed Feb. 18, 2014).

II. ISSUES

Sierra Club's petition for review presents the following issues for the Board's consideration:

- A. Did the Region clearly err or abuse its discretion by eliminating CCS at step 4 of the BACT analysis on the basis of consideration of several economic and environmental impacts, including the total cost of the control technology?
- B. Did the Region clearly err or abuse its discretion by eliminating CCS as economically unachievable because the Region lacked the details necessary to properly evaluate costs?
- C. Did the Region clearly err or abuse its discretion by departing from the recommendations in the Agency's *Cost Control Manual*?
- D. Did the Region clearly err or abuse its discretion by combining GHG emission streams in the BACT analysis?

III. PRINCIPLES GUIDING BOARD REVIEW

Section 124.19 of Title 40 of the Code of Federal Regulations governs Board review of a PSD permit. In any appeal from a permit decision issued under part 124, the petitioner bears the burden of demonstrating that review is warranted. *See* 40 C.F.R. § 124.19(a)(4).

A. *Standard of Review*

Under 40 C.F.R. § 124.19, the Board has discretion to grant or deny review of a permit decision. *See In re Avenal Power Ctr., LLC*, 15 E.A.D. 384, 394 (EAB 2011) (citing Consolidated Permit Regulations, 45 Fed. Reg. 33,290, 33,412 (May 19, 1980)), *appeal docketed sub nom. Sierra Club v. EPA*, No. 11-73342 (9th Cir. Nov. 3, 2011). Ordinarily, the Board will deny review of a permit decision and thus not remand it unless the permit decision either is based on a clearly erroneous finding of fact or conclusion of law, or involves a matter of policy or exercise of discretion that warrants review. 40 C.F.R. § 124.19(a)(4)(i)(A)-(B); *accord, e.g., In re Prairie State Generating Co.*, 13 E.A.D. 1, 10 (EAB 2006), *aff'd sub. nom Sierra Club v. U.S. EPA*, 499 F.3d 653 (7th Cir. 2007); *see also* Revisions to Procedural Rules Applicable in Permit

Appeals, 78 Fed. Reg. 5,280, 5,281 (Jan. 25, 2013). In considering whether to grant or deny review of a permit decision, the Board is guided by the preamble to the regulations authorizing appeal under part 124, in which the Agency stated that the Board's power to grant review "should be only sparingly exercised," and that "most permit conditions should be finally determined at the [permit issuer's] level." 45 Fed. Reg. at 33,412; *see also* 78 Fed. Reg. at 5,281.

When evaluating a challenged permit decision for clear error, the Board examines the administrative record that serves as the basis for the permit to determine whether the permit issuer exercised his or her "considered judgment." *See, e.g., In re Steel Dynamics, Inc. ("Steel Dynamics I")*, 8 E.A.D. 165, 191, 224-25 (EAB 2000); *In re Ash Grove Cement Co.*, 7 E.A.D. 387, 417-18 (EAB 1997). The permit issuer must articulate with reasonable clarity the reasons supporting its conclusion and the significance of the crucial facts it relied upon when reaching its conclusion. *E.g., In re Shell Offshore, Inc.*, 13 E.A.D. 357, 386 (EAB 2007). As a whole, the record must demonstrate that the permit issuer "duly considered the issues raised in the comments" and ultimately adopted an approach that "is rational in light of all information in the record." *In re Gov't of D.C. Mun. Separate Storm Sewer Sys.*, 10 E.A.D. 323, 342 (EAB 2002); *accord In re City of Moscow*, 10 E.A.D. 135, 142 (EAB 2001); *In re NE Hub Partners, LP*, 7 E.A.D. 561, 567-68 (EAB 1998), *review denied sub nom. Penn Fuel Gas, Inc. v. EPA*, 185 F.3d 862 (3d Cir. 1999). On matters that are fundamentally technical or scientific in nature, the Board typically will defer to a permit issuer's technical expertise and experience, as long as the permit issuer adequately explains its rationale and supports its reasoning in the administrative record. *See In re Dominion Energy Brayton Point, LLC*, 12 E.A.D. 490, 510, 560-62, 645-47, 668, 670-74 (EAB 2006); *see also, e.g., In re Russell City Energy Ctr. ("Russell City")*, 15 E.A.D. 1, 29-32 (EAB 2010), *petition denied sub nom. Chabot-Las Positas Cmty. Coll. Dist. v. EPA*, 482 F. App'x 219 (9th Cir. 2012); *NE Hub*, 7 E.A.D. at 570-71.

In reviewing an exercise of discretion by the permitting authority, the Board applies an abuse of discretion standard. *See In re Guam Waterworks Auth.*, 15 E.A.D. 437, 443 n.7 (EAB 2011). The Board will uphold a permitting authority's reasonable exercise of discretion if that decision is cogently explained and supported in the record. *See Ash Grove*, 7 E.A.D. at 397 ("[A]cts of discretion must be adequately explained and justified."); *see also Motor Vehicles Mfrs. Ass'n v. State Farm Mut. Auto. Ins. Co.*, 463 U.S. 29, 48 (1983) ("We have frequently reiterated that an agency must cogently explain why it has exercised its discretion in a given manner * * *").

B. *Petitioner's Burden on Appeal, Including Threshold Requirements*

In considering a petition filed under 40 C.F.R. § 124.19(a), the Board first evaluates whether the petitioner has met threshold procedural requirements such as timeliness, standing, issue preservation, and specificity. *See* 40 C.F.R. § 124.19; *In re Indeck-Elwood, LLC*, 13 E.A.D. 126, 143 (EAB 2006). For example, to meet the issue preservation requirement, a petitioner must demonstrate that any issues and arguments it raises on appeal have been preserved for Board review (i.e., were raised during the public comment period or public hearing on the draft permit), unless the issues or arguments were not reasonably ascertainable at the time. 40 C.F.R. §§ 124.13, .19(a)(4)(ii); *see, e.g., In re City of Attleboro*, 14 E.A.D. 398, 441-42 (EAB 2009); *In re City of Moscow*, 10 E.A.D. 135, 141, 149-50 (EAB 2001). If a petitioner satisfies all threshold procedural obligations, the Board then evaluates the petition to determine if it warrants review. *Indeck-Elwood*, 13 E.A.D. at 143.

As noted above, in any appeal from a permit under part 124, the petitioner bears the burden of demonstrating that review is warranted. Thus, to the extent a petitioner challenges an issue the permit issuer addressed in its response to comments, the petitioner must *explain why* the permit issuer's previous response to those comments was clearly erroneous or otherwise warrants review.² 40 C.F.R. § 124.19(a)(4)(ii); *see, e.g., In re Teck Cominco Alaska, Inc.*, 11 E.A.D. 457, 494-95 (EAB 2004); *In re Westborough*, 10 E.A.D. 297, 305, 311-12 (EAB 2002); *In re City of Irving*, 10 E.A.D. 111, 129-30 (EAB 2001), *review denied sub nom. City of Abilene v. EPA*, 325 F.3d 657 (5th Cir. 2003). The Board consistently has denied review of petitions that merely cite, attach, incorporate, or reiterate comments previously submitted on the draft permit. *E.g., In re City of*

² Federal circuit courts of appeal have upheld this Board requirement that a petitioner must substantively confront the permit issuer's response to the petitioner's previous objections. *City of Pittsfield v. EPA*, 614 F.3d 7, 11-13 (1st Cir. 2010), *aff'g In re City of Pittsfield*, NPDES Appeal No. 08-19 (EAB Mar. 4, 2009) (Order Denying Review); *Mich. Dep't of Env'tl. Quality v. EPA*, 318 F.3d 705, 708 (6th Cir. 2003) ("[Petitioner] simply repackag[ing] its comments and the EPA's response as unmediated appendices to its Petition to the Board * * * does not satisfy the burden of showing entitlement to review."), *aff'g In re Wastewater Treatment Fac. of Union Twp.*, NPDES Appeal Nos. 00-26 & 00-28 (EAB Jan. 23, 2001) (Order Denying Petitions for Review); *LeBlanc v. EPA*, 310 F. App'x 770, 775 (6th Cir. Feb. 12, 2009) (concluding that the Board correctly found petitioners to have procedurally defaulted where petitioners merely restated "grievances" without offering reasons why the permit issuer's responses were clearly erroneous or otherwise warranted review), *aff'g In re Core Energy, LLC*, UIC Appeal No. 07-02 (EAB Dec. 19, 2007) (Order Denying Review).

Pittsfield, NPDES Appeal No. 08-19 (EAB Mar. 4, 2009) (Order Denying Review), *aff'd*, 614 F.3d 7, 11-13 (1st Cir. 2010); *In re Knauf Fiber Glass, GmbH* (“*Knauf II*”), 9 E.A.D. 1, 5 (EAB 2000) (“Petitions for review may not simply repeat objections made during the comment period; instead they must demonstrate why the permitting authority’s response to those objections warrants review.”); *In re Hadson Power 14*, 4 E.A.D. 258, 294-95 (EAB 1992) (denying review where petitioners merely reiterated comments on draft permit and attached a copy of their comments without addressing permit issuer’s responses to comments).

IV. SUMMARY OF DECISION

For all the reasons stated below, the Board concludes that Sierra Club has failed to establish that the Region clearly erred or abused its discretion by (A) eliminating CCS in its BACT analysis based on several economic and environmental factors, including the cost of CCS in comparison to overall project cost; (B) eliminating CCS as economically unachievable; (C) departing from the recommendations in the Agency’s *Cost Control Manual*; and (D) combining GHG emission streams in conducting the BACT analysis. Accordingly, the Board denies review of the Exxon PSD permit decision.

V. PROCEDURAL AND FACTUAL HISTORY

On May 22, 2012, Exxon applied for a PSD permit authorizing construction and operation of a proposed major expansion of an existing ethylene production plant in Baytown, Texas. The expansion would add a new production line to the existing plant. The GHG emission sources governed by the Final Permit include eight steam cracking furnaces and recovery equipment, furnace decoking equipment, a flare system, and engines (for backup generators and firewater booster pump). *See* Statement of Basis, Draft Greenhouse Gas Prevention of Significant Deterioration Preconstruction Permit for the ExxonMobil Chemical Company, Baytown Olefins Plant (“Statement of Basis”) at 1, 7 (June 7, 2013) (A.R. III.03). GHG emissions from the proposed Facility’s combustion sources consist primarily of carbon dioxide (“CO₂”) along with small amounts of nitrous oxide and methane. *Id.* at 7.

On June 7, 2013, the Region issued a draft permit for the Facility and sought public review and comment on the draft. *See* Proposed Permit (A.R. III.02). The public comment period closed on July 8, 2013. The Region received one comment letter from Sierra Club. *See* Letter from Travis Ritchie, Sierra Club, to Aimee Wilson, EPA Region 6 (July 8, 2013) (“Sierra Club Comments”) (A.R. IV.01). The Region issued its final permitting decision, along with a response to public comments document, on November 25, 2013. *See* Final Permit (A.R.

V.01); Response to Public Comments (“RTC”) (A.R. V.02). As stated above, Sierra Club filed a timely petition for review with the Board on December 26, 2013. Petition for Review of [PSD] Permit Issued by Region VI for ExxonMobil Chemical Company, Baytown Olefins Plant (“Petition”). On January 23, 2014, both the Region and Exxon filed responses to the Petition. EPA Region 6’s Response to Petition for Review (“Region’s Response”); Intervenor ExxonMobil Chemical Company’s Response to the Petition for Review (“Exxon’s Response”).

VI. STATUTORY AND REGULATORY FRAMEWORK

The PSD provisions of the CAA govern air pollution in certain areas, called “attainment” areas, where the air quality meets or is cleaner than the national ambient air quality standards (“NAAQS”), as well as areas that cannot be classified as either in attainment or “nonattainment.” CAA §§ 160-169, 42 U.S.C. §§ 7470-7479; *accord In re RockGen Energy Ctr.*, 8 E.A.D. 536, 541 (EAB 1999). The statutory PSD provisions are largely carried out through a regulatory process that requires new major stationary sources in attainment (or unclassifiable) areas, such as the Facility, to obtain preconstruction permits pursuant to CAA § 165, 42 U.S.C. § 7475. *See* 40 C.F.R. § 52.21; *RockGen*, 8 E.A.D. at 541; *In re Knauf Fiber Glass, GmbH (“Knauf I”)*, 8 E.A.D. 121, 123 (EAB 1999).

The CAA and Agency PSD regulations require every proposed PSD permit to undergo a preconstruction review by the permitting authority, which must include an opportunity for a public hearing that allows interested persons to comment orally and in writing on the air quality impact of the proposed source, alternatives thereto, control technology, and other appropriate considerations. CAA § 165(a)(2), 42 U.S.C. § 7475(a)(2); 40 C.F.R. § 124.12(a); *In re Sierra Pac. Indus.*, 16 E.A.D. 1 (EAB 2013). As part of the preconstruction review process, new major stationary sources and major modifications of such sources must employ the “best available control technology,” or BACT, to minimize emissions of regulated pollutants. CAA § 165(a)(4), 42 U.S.C. § 7475(a)(4); 40 C.F.R. § 52.21(j)(2). The statute defines the BACT requirements as follows:

The term “best available control technology” means an emission limitation based on the maximum degree of reduction of each pollutant subject to regulation under this chapter emitted from or which results from any major emitting facility, which the permitting authority, on a case-by-case basis, taking into account energy, environmental, and economic impacts and other costs, determines is achievable for such facility through application of production processes and available methods, systems, and

techniques, including fuel cleaning, clean fuels, or treatment or innovative fuel combustion techniques for control of each such pollutant.

CAA § 169(3), 42 U.S.C. § 7479(3); *accord* 40 C.F.R. § 52.21(b)(12) (similar regulatory definition). As the Board explained in *In re Northern Michigan University* (“*NMU*”), the BACT definition requires permit issuers to “[p]roceed[] on a case-by-case basis, taking a careful and detailed look, * * * attentive to the technology or methods appropriate for the particular facility, [] to seek the result tailor-made for that facility and that pollutant.” 14 E.A.D. 283, 291 (EAB 2009) (citations and quotations omitted). BACT is therefore a site-specific determination that results in the selection of an emission limitation representing application of control technology or methods appropriate for the particular facility. *In re Prairie State Generating Co.*, 13 E.A.D. 1, 12 (EAB 2006), *aff’d sub nom. Sierra Club v. EPA*, 499 F.3d 653 (7th Cir. 2007); *In re Three Mountain Power, LLC*, 10 E.A.D. 39, 47 (EAB 2001); *Knauf I*, 8 E.A.D. at 128-29.

In 1990, EPA issued draft guidance for permitting authorities to use in analyzing PSD requirements (among others) in a consistent and systematic way. *See generally* Office of Air Quality Planning & Standards, U.S. EPA, *New Source Review Workshop Manual* 1 (draft Oct. 1990) [hereinafter *NSR Manual*].³ The *NSR Manual* sets forth a “top-down” process for determining BACT for each particular regulated pollutant that is summarized as follows:

[T]he top-down process provides that all available control technologies be ranked in descending order of control effectiveness. The PSD applicant first examines the most stringent – or “top” – alternative. That alternative is established as BACT

³ Notably, the *NSR Manual* is not a binding Agency regulation, and consequently strict application of the methodology described in it is not mandatory nor is it the required vehicle for making BACT determinations. *E.g.*, *NMU*, 14 E.A.D. at 291-92; *Prairie State*, 13 E.A.D. at 6 n.2; *Knauf I*, 8 E.A.D. at 129 n.13. Nevertheless, because it provides a framework for determining BACT that assures adequate consideration of the statutory and regulatory criteria, it has guided state and federal permit issuers, as well as PSD permit applicants, on PSD requirements and policy for years. *E.g.*, *NMU*, 14 E.A.D. at 291-92; *In re Cardinal FG Co.*, 12 E.A.D. 153, 162 (EAB 2005); *see also In re Steel Dynamics, Inc. (“Steel Dynamics II”)*, 9 E.A.D. 165, 183 (EAB 2000) (“This top-down analysis is not a mandatory methodology, but it is frequently used by permitting authorities to ensure that a defensible BACT determination, involving consideration of all requisite statutory and regulatory criteria, is reached.”). The Region utilized the “top-down method” described in the *NSR Manual* when determining GHG BACT emission limits for the Exxon Permit. *See* Statement of Basis at 8-27.

unless the applicant demonstrates, and the permitting authority in its informed judgment agrees, that technical considerations, or energy, environmental, or economic impacts justify a conclusion that the most stringent technology is not “achievable” in that case.

Id. at B.2. Permit issuers typically apply the top-down method on a case-by-case basis to each permit they evaluate. *See id.* at B.1 (explaining that all BACT analyses are done case-by-case). The *NSR Manual*’s recommended top-down analysis employs five steps:

Step 1: Identify all available control options with potential application to the source and the targeted pollutant;

Step 2: Analyze the control options’ technical feasibility;

Step 3: Rank feasible options in order of effectiveness;

Step 4: Evaluate the energy, environmental, and economic impacts of the options; and

Step 5: Select a pollutant emission limit achievable by the most effective control option not eliminated in a preceding step.

Id. at B.5-9. In addition to the *NSR Manual*, the Agency has recently issued a GHG guidance document to assist permit writers and applicants in addressing PSD and Title V permitting requirements for GHGs. *See* Office of Air Quality Planning & Standards, U.S. EPA, EPA-457/B-11-001, *PSD and Title V Permitting Guidance for Greenhouse Gases* (Mar. 2011) [hereinafter *GHG Guidance*].

In the present case, the Region identified CCS as an available add-on control technology in step 1 of the BACT analysis for reducing the Facility’s GHG emissions, along with energy efficient design, the use of low carbon fuels, and good operating and maintenance practices. Statement of Basis at 8. In step 2 of the BACT analysis, the Region considered all of these options technically feasible. *Id.* at 9. In step 3, the Region ranked CCS as the most effective control option for the Facility’s CO₂ emissions. *Id.* (stating that CCS “is capable of achieving 90% reduction of produced CO₂ emissions and thus considered to be the most effective control method.”). The Region eliminated CCS in step 4 of the BACT analysis as economically unachievable at this facility. *Id.* at 10. In the Statement of Basis accompanying the draft permit, the Region stated:

ExxonMobil developed a cost analysis for CCS that provided the basis for eliminating the technology in step 4 of the BACT process

as a viable control option based on economic costs. The majority of the cost for CCS was attributed to the capture and compression facilities that would be required. The total annual cost of CCS capital and operating expenses would be \$205,000,000 per year, including the cost of transport. The addition of CCS would increase the total capital project costs by more than 25%. EPA Region 6 reviewed ExxonMobil's CCS cost estimate and believes it adequately approximates the cost of a CCS control for this project and demonstrates those costs are prohibitive in relation to the overall cost of the proposed project. Thus, CCS has been eliminated as BACT for this project.

Id. The Region also observed that there would be collateral environmental impacts from an increase in emissions of criteria pollutants associated with implementation of CCS. *Id.* For the reasons stated below, the Board denies Sierra Club's petition for review of the Region's permitting decision.

VII. ANALYSIS

In the analysis that follows, the Board considers each of the issues identified in Part II above and concludes that Sierra Club has not met its burden to demonstrate that the Region based its permit decision on a clearly erroneous finding of fact or conclusion of law, or that the Region abused its discretion in a manner warranting review.

A. The Region Did Not Clearly Err or Abuse Its Discretion by Eliminating CCS at Step 4 of Its BACT Analysis on the Basis of Consideration of Several Economic and Environmental Impacts, Including the Total Cost of the Control Technology

Sierra Club's principal claim in its petition is that the Region wrongly eliminated CCS as economically unachievable for the proposed project solely on the basis of a comparison of the costs of CCS to total project costs, instead of a more traditional analysis of the average and incremental cost-effectiveness of CCS technology. Petition at 22. As discussed in detail below, the Board finds that the Region did not clearly err or abuse its discretion in eliminating CCS as a control option for GHGs at this Facility based on consideration of the costs of CCS as compared to total Facility cost, as well as on the impact of those costs on the economic achievability of the Facility, and on secondary environmental impacts.

1. *Background on the Use of Total Project Cost and Cost-Effectiveness Analysis in GHG BACT Economic Impact Determinations*

The CAA instructs the permitting authority to “tak[e] into account * * * economic impacts and other costs,” as well as energy and environmental impacts, when determining BACT. CAA § 169(3), 42 U.S.C. § 7479(3). As described in detail in the *NSR Manual*, in step 4 of a traditional top-down BACT analysis, the permitting authority should evaluate the energy, environmental, and economic impacts of the candidate control technologies and “either confirm[] the top-ranked alternative from step 3 as appropriate or determine[] it to be inappropriate.” *In re City of Palmdale*, 15 E.A.D. 700, 740 (EAB 2012) (citing *NSR Manual* at B.8-9, .26-.53). Although the Clean Air Act does not mandate a particular type of economic analysis,⁴ the *NSR Manual* recommends considering two principal economic measures, the average cost-effectiveness (the “total annualized costs of control divided by annual emission reductions” achieved by the control option) and the incremental cost-effectiveness (the costs of a control option minus the costs of the next-most-stringent option divided by the additional emission reductions achieved by the more stringent control option), to evaluate the economic impacts of a candidate control technology. *NSR Manual* at B.36, .41. Evaluating the cost-effectiveness of a control technology (typically expressed in “dollars per ton of pollutant emissions reduced,” *NSR Manual* at B.31) ensures that the costs of a candidate control technology are comparable to the costs borne by other members of the source category who are using that technology. Cost-effectiveness analysis also helps to discourage the permitting authority from eliminating technology simply because the costs are high relative to the particular project being permitted. As the *NSR Manual* explains,

BACT is required by law. Its costs are integral to the overall cost of doing business and are not to be considered an afterthought. Consequently, *for control alternatives that have been effectively employed in the same source category*, the economic impact of such alternatives on the particular source under review should be not nearly as pertinent to the BACT decision making process as the average and, where appropriate, incremental cost-effectiveness of the control alternative.

NSR Manual at B.31 (emphasis added). Thus, if the cost-effectiveness of a control alternative “is on the same order as the cost previously borne by other

⁴ *Palmdale*, 15 E.A.D. at 740 n.39 (noting that the cost-effectiveness approach is based on EPA guidance, but is not mandated by the CAA or EPA regulations).

sources of the same type in applying that control alternative,” then the control technology generally will be BACT. *Id.* at B.44.

The *GHG Guidance* generally follows the approach of the *NSR Manual* in how to consider the costs of control technologies in the BACT analysis, emphasizing that applicants and permitting authorities should focus on cost-effectiveness “rather than * * * the general affordability of the control alternative relative to the source,” and that control options should be eliminated only if the costs of pollutant removal are “disproportionately high” relative to the costs borne by other sources. *GHG Guidance* at 38-39 (citing *NSR Manual* at B.31-.32). Importantly, however, the *GHG Guidance* tempers its admonition that all BACT determinations be based on cost-effectiveness analysis, recognizing that “there is little history of BACT analyses for GHG at this time, [and] there is not a wealth of GHG cost-effectiveness data from prior permitting actions for a permitting authority to review and rely upon when determining what cost level is considered acceptable for GHG BACT.” *Id.* at 43. Given this lack of information, the *GHG Guidance* states that “it may be appropriate in some cases to assess the cost-effectiveness of a control option in a less detailed quantitative (or even qualitative) manner.” *Id.* at 42. The *GHG Guidance* goes on to discuss CCS technology as a specific example of how the standard cost-effectiveness analysis might appropriately be modified and how to consider total cost in a BACT determination:

[W]hen evaluating the cost-effectiveness of CCS as a GHG control option, if the cost of building a new pipeline to transport the CO₂ is extraordinarily high and by itself would be considered cost prohibitive, it would not be necessary for the applicant to obtain a vendor quote and evaluate the cost-effectiveness of a CO₂ capture system. * * *

EPA recognizes that at present CCS is an expensive technology, largely because of the costs associated with CO₂ capture and compression, and these costs will generally make the price of electricity from power plants with CCS uncompetitive compared to electricity from plants with other GHG controls. Even if not eliminated in Step 2 of the BACT analysis, on the basis of the current costs of CCS, we expect that CCS will often be eliminated from consideration in Step 4 of the BACT analysis * * *.

Id. at 42-43.

In *In re City of Palmdale*, 15 E.A.D. 700, 740 (EAB 2012), the Board held that eliminating CCS in step 4 of the BACT analysis “was neither inappropriate nor impermissible” in that case, where the Region found the control technology

cost prohibitive in comparison to the entire project. The Board in *Palmdale* cited to the language of the *GHG Guidance* quoted in the previous paragraph and then found that Region 9 acted “consistent with this guidance” in eliminating CCS from further consideration based on the finding that the total annualized cost of CCS would be twice the annualized cost of building a new power plant. *Id.* at 740-41.

With this background in mind, the Board turns to Sierra Club’s assertion that the Region clearly erred in eliminating CCS at this Facility by considering only the cost of CCS compared to total project cost, rather than focusing exclusively on cost-effectiveness on a per-ton basis.

2. *The Region Reasonably Examined Cost-Effectiveness, Total Cost of the Control, the Impact of Control Costs on the Economic Achievability for the Project, and Environmental Impacts in Eliminating CCS as a Control Technology*

Contrary to Sierra Club’s assertion that the Region improperly eliminated CCS solely on the basis of a total cost analysis, the record reflects that the Region considered several economic and environmental factors in eliminating CCS from further consideration as a control technology in step 4 of its BACT analysis.

The record demonstrates that Exxon provided, and the Region reviewed, cost-effectiveness data showing a cost-effectiveness figure for CCS for the proposed project of \$253/ton CO₂. RTC at 15. As the Region explained in its response to comments, however, this information is of limited usefulness in this case because there are no facilities in the same industrial sector that are using CCS.⁵ That is, there are no demonstrated examples for comparing carbon capture from the type of facility at issue in this case, which emits a low pressure, low CO₂ concentration flue gas.⁶ *Id.* at 12-15. The Region noted five other ethylene

⁵ In its Petition, Sierra Club provides a chart of several prior PSD permits in Region 6 and the cost/ton of CO₂ removal for those projects, where available. This chart was not included in Sierra Club’s comments on the draft permit and was not part of the record before the Region. Thus, Sierra Club has waived this argument. *See In re Energy Answers Arecibo, LLC*, 16 E.A.D. 294, 367-68 (EAB 2014) (declining to consider issues and arguments raised for the first time on appeal). In any event, the chart reveals that the \$253/ton cost of CO₂ removed or avoided for this Facility is among the highest of those calculated, yet none of those other permits actually required CCS and all involved facilities generating higher concentrations of CO₂ than this Facility.

⁶ As the Region noted in its response to comments, the purity of the CO₂ in the waste streams from the proposed Facility, estimated at less than 8% in this case as

production units where EPA had eliminated CCS on economic or other step 4 grounds, and concluded that “integrated CCS for a * * * unit [such as Exxon’s] has not been demonstrated in practice and does not currently exist at any scale.”⁷ *Id.* at 15.

Given the lack of relevant comparable facilities, the Region then looked at the total cost of installing CCS and considered its impact on this Facility. The Region reviewed and accepted cost data provided by Exxon showing that construction and operation of CCS would result in a 25% increase in the project’s capital costs. According to Exxon, this increase would render the project economically unviable. Statement of Basis at 10. The Region states that it reviewed cost estimates provided by Exxon and concluded that they “adequately approximate[] the costs of a CCS control for this project and demonstrate[] those costs are prohibitive in relation to the overall cost of the proposed project.” *Id.* at 10, 31.

The Region also found that implementing CCS would result in as much as an 11% increase in the emissions of other regulated air pollutants from the proposed Facility, including nitrogen oxides (“NO_x”) and volatile organic compounds (“VOCs”), in an area which is already in nonattainment for ozone (a pollutant for which NO_x and VOCs are precursors). RTC at 25. The Region determined that it would “not be a beneficial outcome” to increase emissions of NO_x and VOCs in order to reduce further the emissions of GHGs. *Id.* at 26. As the Region concluded, “[a]lthough this factor, by itself, is not decisive, nonetheless it supports the decision that there are adverse cost and environmental

compared to concentrations of between 10% and 40% at other types of facilities, would make it more challenging and presumably more costly to recover the CO₂. *See* RTC at 12, 13-15.

⁷ Exxon asserts that, because of the low concentration of CO₂ in its exhaust stream and other issues, CCS is not an “available” technology within the meaning of the CAA and that the Region should have eliminated it as technically infeasible at step 2 of the BACT analysis. Exxon’s Response at 9 n.7. The Region, however, found that, “while there are some portions of CCS that may be technically infeasible for this project, EPA has determined that[,] overall[,] * * * [CCS] is technologically feasible at this source.” Statement of Basis at 9 n.3. Because the Region did not rely on this rationale in eliminating CCS, the Board does not reach the question of whether the record would support a finding of technical infeasibility.

implications of requiring a BACT limit based on use of CCS, such that EPA is not requiring that level of control.”⁸ *Id.*

The Board finds that the Region acted within the permissible scope of its discretion in eliminating CCS from further consideration as a control technology in step 4 of its BACT analysis based on its conclusions that (1) CCS would not be an economically achievable control option for the Exxon Baytown project and (2) would lead to secondary environmental impacts. Considering the adverse environmental impacts of potential BACT controls is called for by the statute and contemplated by the NSR and GHG manuals as part of the step 4 analysis. CAA § 169(3), 42 U.S.C. § 7479(3) (BACT means “the maximum degree of reduction * * * taking into account energy, environmental, and economic impacts and other costs.”); *NSR Manual* at B.6, .8, .26-.53 (energy, economic, and environmental impacts analysis performed at Step 4); *GHG Guidance* at 38-44 (same). In addition, as discussed in further detail below, considering the costs of CCS in comparison to total project cost and the impact of those costs on economic achievability is appropriate under the circumstances of this case.

3. *The Region Did Not Clearly Err or Abuse Its Discretion in Taking Total Costs of CCS into Account as Part of Its Analysis of Economic Impacts in the Absence of Relevant Comparable Projects Employing CCS*

Sierra Club asserts that evaluating the economic impact of a candidate control technology by comparing control costs to total project costs, rather than cost-effectiveness measured on a per-ton basis, can be arbitrary and misleading. The costs of the project will determine which controls are selected, rather than the costs of controlling the pollution from the project compared to the costs of controlling the same pollution elsewhere. For that reason, in Sierra Club’s view, the Region must consider cost-effectiveness measures in determining BACT.⁹ Petition at 18.

⁸ The Region also noted that use of CCS entails increased consumption of energy and fuel, and that the energy necessary for CCS may be “*particularly* intensive for larger [exhaust] streams with comparatively low CO₂ concentrations, as is the case here.” RTC at 24. However, the Region stated that “energy impacts are not the basis for EPA’s elimination of the CCS option in this case.” *Id.* at 25.

⁹ The Region argues that Sierra Club did not raise this issue in its comments on the draft permit and therefore did not preserve it for review. Region’s Response at 15. The Board disagrees. Sierra Club’s comments specifically cite the *NSR Manual* for the proposition that reliance solely on the total capital cost or the proportion of capital costs

The Board agrees that the *NSR Manual* and the *GHG Guidance* recommend that permitting authorities evaluate economic achievability based on cost-effectiveness instead of total cost for precisely that reason. Yet that comparison is ultimately meaningful only when there is a prior project's cost-effectiveness calculation to compare to the current project. As the Region correctly notes in its brief, "permitting authorities are currently lacking a key benchmark that the [*NSR Manual*] recommends they use to determine whether a control technique is cost-effective – 'the cost of control for the pollutant in recent BACT determinations.'" Region's Response at 14 (quoting *NSR Manual* at B.45). Where, as here, there is no comparable facility that has installed the candidate technology, the rationale for relying on cost-effectiveness as the primary economic criterion for a BACT analysis, to ensure that permittees do not avoid installing controls installed by similar permittees in the industrial sector, is less compelling. Accordingly, the *GHG Guidance* contemplates that a cost-effectiveness analysis for CCS technology may be modified or even performed in a "qualitative manner." *GHG Guidance* at 42. The Region's consideration of the cost of CCS compared to the total cost of the project in this case was not inconsistent with the statute or with the approach the Agency generally follows to determine the economic achievability of GHG controls as reflected in the *GHG Guidance*.¹⁰

to project cost "can be misleading." Sierra Club Comments at 6 (citing *NSR Manual* at B.45). Sierra Club goes on to argue that such an approach is inconsistent with the *NSR Manual*, past EAB precedents, and CAA legislative history. *Id.* at 7. Sierra Club's comments specifically assert that the Region should determine whether the costs of control are disproportionately high "compared to the cost of control at other facilities." *Id.* This was more than sufficient to put the Region on notice that Sierra Club objected to the use of total project costs and why it would be necessary to examine cost-effectiveness. Indeed, the Region specifically responded to these comments, explaining why it was "reasonable at this time to evaluate the economic impacts of CCS as a percentage of total project cost." RTC at 14. While the Region is correct that petitioners must demonstrate that arguments raised on appeal were preserved for review, *see* 40 C.F.R. § 124.19(a)(4)(ii), where, as here, the record reflects that arguments were sufficiently raised and the Region has had an opportunity to respond, the Board will consider the merits of such arguments. *See, e.g., Energy Answers Arecibo*, 16 E.A.D. at 310-11; *In re New Eng. Plating Co.*, 9 E.A.D. 726, 732-33 (EAB 2000); *In re Ecoeléctrica, LP*, 7 E.A.D. 56, 64 n.9 (EAB 1997); *In re P.R. Elec. Power Auth.*, 6 E.A.D. 253, 257 n.5 (EAB 1995).

¹⁰ As the Region further points out, the proposed Facility in this case, which involves addition of an entire ethylene production line with eight new furnaces, is certainly not a small project for which the costs of CCS might seem correspondingly

The Board previously ruled in *Palmdale* that evaluating the economic achievability of imposing CCS on the basis of a total cost analysis rather than a cost-effectiveness analysis was “not impermissible” under the facts presented in that case. 15 E.A.D. at 741 & n.40. Sierra Club asserts, however, that *Palmdale* is distinguishable from the facts of the Baytown expansion project. In addition, Sierra Club argues that the Region misreads the Board’s decision in *Palmdale* to eliminate any need to conduct a cost-effectiveness analysis before deciding whether to require CCS as BACT. Petition at 14.

Sierra Club points out that the 25% increase in costs for this Facility is smaller than the 200% increase that Region 9 found to be “clearly cost prohibitive” in *Palmdale*. The Board does not believe, however, that this comparison is accurate. As Region 6 and Exxon both correctly note in their responses, the cost analysis that Region 9 used and the Board accepted in *Palmdale* relies on a different metric than Region 6 used here. In *Palmdale*, Region 9 compared the annualized capital and operating costs of CCS to the annualized capital costs of the project (a new power plant) and found that the annualized costs of CCS would be double the annualized capital costs for the entire new facility (\$78 million versus \$35 million), making CCS cost prohibitive.¹¹ *Palmdale*, 15 E.A.D. at 739. By contrast, the record in this case indicates that the total unannualized cost of CCS would be approximately 25% of the total capital cost of the proposed Facility. The record also reveals that the annualized cost of CCS would be approximately \$205 million, but does not reflect a calculation of the annualized cost of the entire project. Because of the lack of comparable annualized cost information in this case, it is not possible to make an “apples to apples” comparison of the *Palmdale* and Exxon situations.

large by comparison. Region’s Response at 16. Thus, Sierra Club’s general concern that basing a BACT economic analysis on total cost rather than cost-effectiveness will cause a control technology to appear disproportionately expensive for a smaller, cheaper project is not an issue in this particular case.

¹¹ Annualized costs reflect a hypothetical calculation of the costs to be incurred each year of undertaking a large capital project and, in this case, then operating it, assuming that the applicant would finance the total capital cost up-front and pay off the principal and interest over the life of the capital investment. *See generally NSR Manual* at B.4-.10 (explaining basic methodology for calculating total annual cost, including addition of a “capital recovery factor” as a percentage of the total capital cost). The *NSR Manual* recommends the use of annualized costs to determine cost-effectiveness for BACT purposes. *Id.* at B.36.

Even if it were possible to make a direct comparison between the cost analyses for the Palmdale and Exxon permits, the *Palmdale* decision did not establish a bright-line test of “how expensive” CCS has to be relative to total project cost in order for a Region to reasonably conclude that the technology is not economically achievable. Nor does this case establish such a bright-line test. While 200% of project costs certainly sounds much higher than 25%, neither percentage per se demonstrates that use of CCS is cost prohibitive in a particular case. Rather, a permitting authority needs to base its determination upon all of the relevant information in the record, including an examination of the cost-effectiveness of CCS for the proposed project. The Region should also consider the cost-effectiveness for other facilities in the industrial sector where CCS has been installed, if any. The Region should also consider relevant total cost information (such as project capital costs or annualized costs), the impact of such costs on the economic achievability of the project, and analyses of other factors such as energy and environmental impacts that are a part of a typical BACT analysis at step 4. The Board agrees with Sierra Club that a permitting authority should collect and consider cost-effectiveness data as part of its economic impacts analysis. If it determines that the total cost of a control technology provides a basis for eliminating a particular technology such as CCS at step 4, it should explain in detail why those costs make the technology “clearly cost prohibitive.” In this case, the record reflects that the Region considered the calculated cost-effectiveness, yet relied ultimately on total cost because of the lack of comparables and utilized the total cost calculation along with the concerns about project economic achievability and adverse environmental impacts to make its final determination. Similar to *Palmdale*, the Board has examined the record in this specific case and finds that the Region’s determination was neither inappropriate nor impermissible.

In upholding the Region’s consideration of total costs as a part of the basis to conclude that CCS is not economically achievable for this project, the Board acknowledges Sierra Club’s concern that, if no one ever is the first to install CCS, then there will not be any comparable facilities to justify imposing that technology as BACT. Yet, as the *GHG Guidance* recognizes, use of CCS is still very much in its infancy, particularly with respect to low-concentration CO₂ streams such as from an ethylene production facility. This is in contrast to the situation in 1990 when the Agency made the *NSR Manual* available. In 1990, the Agency and states already had significant experience in establishing BACT for a variety of criteria pollutants in many industrial sectors and thus had substantial cost-effectiveness data and other information to draw upon. While Sierra Club sensibly observes that the Agency cannot rely indefinitely on the assertion that CCS has never been demonstrated, the Region emphasizes that EPA’s Office of

Air and Radiation “is actively engaged in working with Regional Offices in developing an appropriate approach to determining whether CCS is economically achievable and should be required as BACT in any permitting decision.” Region’s Response at 35. In addition, as the Region also notes, EPA has been evaluating the costs of CCS for electric generating units in the context of proposed New Source Performance Standards for GHGs. *Id.* at 37 (citing 79 Fed. Reg. 1429 (Jan. 8, 2014) (proposed rule)).

The *GHG Guidance* also reflects the Agency’s expectation that there will be an evolution in knowledge and practice concerning the costs of GHG controls. *See GHG Guidance* at 43 (“As the permitting of sources of GHG progresses and more experience is gained, additional data to determine what is cost effective in the context of individual permitting actions will become known and should be included in the [EPA RACT/BACT/LAER Clearinghouse database].”). The Board will continue to examine closely whether step 4 BACT analyses for GHGs, including those which evaluate the use of CCS, give full consideration to all relevant economic, energy, and environmental factors, including cost-effectiveness. The Board will review whether the permitting authorities adequately “explain * * * in a well-documented permitting record” any decision not to require CCS or any other evolving technology. *GHG Guidance* at 42. Given the current lack of significant experience with CCS and the resulting lack of data on cost-effectiveness of CCS for particular facilities or projects, the Board does not see a reason to disturb the Region’s judgment here.

B. The Region Did Not Clearly Err or Abuse Its Discretion by Eliminating CCS as Economically Unachievable

In addition to its claim that the use of total cost instead of cost-effectiveness was not a valid approach, Sierra Club argues that the record in this case is insufficient to support the Region’s finding that CCS is economically unachievable for this Facility. *See* Petition at 24-25. Sierra Club contends that the record does not provide any evidence to support the Region’s conclusion that a 25% increase in costs resulting from the addition of CCS would render the project economically unviable. *Id.* at 26. The Petition asserts that “[t]here is no evidence in the record about what the total project costs would be, what the impact would be on the competitiveness of Exxon’s products from the plant, or what the ‘threshold’ is that would render the project economically unviable.” *Id.* The Petition further contends that the Region’s cost analysis lacks sufficient detail in the design basis and cost estimates of CCS and precludes any meaningful public review. *See id.* at 31-32. Sierra Club does not assert, and does not seek a determination from the Board, that CCS is BACT for GHG emissions from the

Facility. Rather, Sierra Club argues that the Region's BACT analysis was erroneous because it lacked adequate support and explanation in the record and that the Board should therefore remand the permit to the Region with instructions "to conduct a full and appropriate" BACT analysis. *See id.* at 4.

Upon examination of the administrative record and the parties' briefs, the Board finds that the record contains sufficient, site-specific evidence regarding CCS costs to support the Region's conclusion that CCS would not be economically achievable for this Facility.

In an economic analysis submitted with its permit application, Exxon estimated that CCS would cost over \$200 million annually, including the costs of carbon capture and compression, transport, and storage. *See* Greenhouse Gas [PSD] Permit Application for Ethylene Expansion Project at 4-7 to 4-8 (May 2012) (A.R. I.01). Exxon reasoned that this "extraordinarily high cost * * * would render the proposed project economically unviable if selected." *Id.* at 4-7. Exxon's application therefore proposed to eliminate CCS as a potential control option on this basis. *Id.* On June 29, 2012, the Region informed Exxon that the permit application was incomplete and that additional information was required. *See* Letter from Carl E. Edlund, Region 6, to Jeffrey K. Kovacs, ExxonMobil Corp., & Encl. (June 29, 2012) (A.R. I.02). Among other things, the Region required that Exxon provide site-specific CCS data, including:

[S]ite-specific facility data to evaluate and eliminate CCS from consideration. This material should contain detailed information on the quantity and concentration of CO₂ that is in the waste stream and the equipment for capture, storage and transportation. Please include cost of construction, operation and maintenance, cost per pound of CO₂ removed by the technologies evaluated and include the feasibility and cost analysis for storage or transportation for these options.

Id. Encl. ¶ 7. Exxon provided additional information on October 16, 2012. *See* Letter from Benjamin M. Hurst, ExxonMobil, to Carl Edmund, Region 6, & Attach. (entitled ExxonMobil Response to EPA Completeness Comments, Application for Greenhouse Gas [PSD] Permit, ExxonMobil Chemical Company – Baytown Olefins Plant) (A.R. I.03) [hereinafter Oct. 2012 Exxon Supplement].

With regard to carbon capture, Exxon's supplemental analysis stated that site-specific factors at the proposed Facility, such as a low pressure, low concentration CO₂ waste stream, complicated by numerous emission points from the cracking furnaces, would require application of first-of-its-kind technology, including installation and operation of complex and expensive equipment to

accomplish the necessary CO₂ concentration for effective storage. *See id.* at 20. Exxon's analysis concluded that a carbon capture and compression plant, as well as a dedicated utility plant to meet the steam and power requirements of the capture plant, would be necessary to achieve 90% recovery of CO₂ from the exhaust gas.¹² *Id.* at 22. Exxon estimated the total annualized cost of carbon capture at \$198.4 million (including operating and capital costs) to avoid 90% of the CO₂ emissions from the furnaces and required utility plant, not including the costs of transportation and storage. *Id.* The annualized costs increase to \$204.6 million when transportation and storage costs are included. *Id.* at 24-25. Exxon estimated the total capital costs of CCS at \$735.4 million, which would increase the cost of the Facility by more than 25%. *Id.* at 23; RTC at 12.

In responding to Sierra Club's comments regarding the alleged lack of sufficient evidence supporting the elimination of CCS on economic grounds, the Region stated that it fully reviewed and agreed with the economic analysis and conclusions in Exxon's application and supplemental submissions. *See generally* RTC at 14-20. The Region found that Exxon's analysis included the capital and operating costs for the carbon capture and compressing technologies and concurred in Exxon's cost estimates. *Id.* at 14-15. Upon review of Exxon's economic analysis, the Region concluded as follows:

The cost study included capital and operating costs for the capture, drying, and compression technologies that would be needed for CCS at the ExxonMobil Baytown plant. We generally concur with ExxonMobil's cost estimation of over \$253 per ton of CO₂ avoided or \$204.6 million annually to achieve 90 percent CO₂ emissions capture. * * * They estimated the total capital expenses of constructing a carbon capture system of approximately \$735,400,000 million. * * * Based on our review of the submitted cost study and our experience in reviewing cost studies for similar projects, we find these estimates to be credible. Thus, the CCS capital projects costs could increase the cost of the project by more than 25 percent, and we reasonably believe that such increases would make the project economically unviable.

Id. at 15.

¹² The components of these plants include the following: (A) the carbon capture plant would require installation of a CO₂ compressor and intercoolers, amine absorber systems, and a CO₂ regeneration and purification system; and (B) the utility plant would require installation of a boiler, a boiler feed water treatment system, a cooling tower, utilities header, and piping. *See* Oct. 2012 Exxon Supplement at 23.

Given the lack of any examples where CCS has been demonstrated at the type of facility at issue in this case and the substantial evidence in this record showing the high cost of CCS as an add-on technology at this Facility at this time, the Board finds the Region's determination was reasonable and reflected the Region's considered judgment. *See Palmdale*, 15 E.A.D. at 740-41; *GHG Guidance* at 42. As noted in Part VII.A.3 above, use of CCS is still very much in its infancy, particularly with respect to low concentration CO₂ streams such as from an ethylene production facility. This fact is part and parcel of the landscape and context in which the Board evaluates and determines the Region's judgment to be reasonable. While Sierra Club disagrees with the Region's determination, the Petition fails to demonstrate that the determination was clearly erroneous or otherwise warrants Board review.¹³ As the Board has stated in other cases, merely disagreeing with the Region's conclusion and alleging error is insufficient to overcome a petitioner's burden of demonstrating that the permit issuer clearly erred. *See, e.g., Russell City*, 15 E.A.D. at 68-69 & n.83.

Sierra Club also argues that the costs of CCS could potentially be offset through sales of captured CO₂ to oilfield operators for enhanced oil recovery and income tax credits. *See* Petition at 21- 22, 39. With regard to sales of CO₂, the Region acknowledged that the administrative record might benefit from a discussion of whether sales of captured CO₂ might be possible and the degree to which such sales could offset the costs of GHG controls. *See* RTC at 10. Upon consideration, however, the Region found that the prices for captured CO₂ were highly variable and speculative, ranging \$15 to \$45 per metric ton, depending on the price of oil and the availability of CO₂, and would ultimately depend on negotiations between Exxon and prospective contractual partners. *Id.* Moreover, the Region noted that there is no evidence in this record regarding the existence of "a contractual customer or partner willing to purchase the CO₂." *Id.* at 11. Even with the speculative nature of CO₂ prices, however, the Region determined that any hypothetical sales would generate between \$16 to \$32 million per year. *Id.* at 10. The Region concluded that such sales would not materially offset the \$204.6 million annualized costs of CCS. *Id.* at 10-11.

¹³ Although Sierra Club asserts that a more detailed analysis, including an assessment of vendor documented costs for CCS control equipment, was required in order to make an "informed analysis of the CCS control system," *see* Petition at 31, the *GHG Guidance* makes clear (as discussed in Part VII.A) that where, as here, the cost of CCS as a GHG control option is "extraordinarily high," such additional analyses are not necessary. *GHG Guidance* at 42.

Similarly, with regard to whether the costs of CCS could be offset through income tax credits, the Region determined that the speculative and complex nature of income tax considerations, along with long-term uncertainty, “would make it advisable to exclude them from consideration in the BACT analysis.” *Id.* at 11 (citing *NSR Manual* app. B at b.11; Office of Air Quality Planning & Standards, U.S. EPA, *EPA Air Pollution Cost Control Manual 2-9* (6th ed. 2002) (“*Cost Control Manual*”). Moreover, the Region stated that “[t]here is no guarantee that ExxonMobil could recover enough CO₂ to qualify for [any] tax credit since they would be attempting to recover from a low concentration and low volume flue gas stream * * *.” *Id.* Nevertheless, the Region calculated that should Exxon hypothetically qualify for a tax credit, such a credit would arguably represent approximately \$24 million in value. *Id.* The Region concluded that this “would not be sizable enough to make the cost of CCS economically feasible for this project (taking a total annualized cost of more than \$200 million dollars per year into account).” *Id.* Given the speculative nature of the arguments on this issue, the Board finds that Sierra Club’s petition falls short of establishing clear error or abuse of discretion on appeal. *See Palmdale*, 15 E.A.D. at 741-42 (rejecting as speculative the assertion that CCS costs could be offset through grant programs or sales of captured CO₂); *see also Russell City*, 15 E.A.D. at 80 n.96 (quoting *In re Three Mountain Power, LLC*, 10 E.A.D. 39, 58 (EAB 2001) (“The Board will not overturn a permit provision based on speculative arguments.”)). Moreover, because the Region has addressed Sierra Club’s assertions and because Sierra Club has failed to establish that the Region’s determination was clearly erroneous or otherwise warrants Board review, the Board denies review of this issue.

C. The Region Did Not Clearly Err or Abuse Its Discretion by Departing From the Recommendations in the Agency’s Cost Control Manual

Sierra Club further argues that the methodology used to develop the total cost estimate for CCS was flawed, and that, in particular, the Region erred by failing to follow the methodology required by the Agency’s *Cost Control Manual* in two respects. Petition at 34; *see generally Cost Control Manual*. First, Sierra Club argues that the Region’s CCS cost analysis was erroneous because the Region used a “levelized cost of energy” approach that considered “adders,” such as finance costs and escalation, rather than the “overnight cost method” suggested by the *Cost Control Manual*, which “explicitly excludes adders that have a high degree of uncertainty and generally inflate costs indiscriminately.” Petition at 35-36. Second, Sierra Club argues that the Region used an incorrect annualized capital cost rate rather than the “social rate of interest” required by the *Cost Control Manual*. *Id.* at 38.

Sierra Club raised these issues in its comments on the draft permit, *see* Sierra Club Comments at 10-12, and the Region provided a substantive response. In particular, in response to Sierra Club's comments that the Region departed from the recommendations in the *Cost Control Manual* in calculating the costs of CCS, the Region stated, in part:

[T]he Cost [Control] Manual states that "new and emerging technologies are not generally in the scope of [the] Manual. The control devices included in [the] Manual are generally well established devices with a long track record of performance." *Cost Control Manual* * * * at 1-3. In addition * * * the Cost Control Manual predates the era of GHGs becoming newly subject to regulation and did not anticipate the considerations that might apply to its permitting. Since cost development for CCS is not contemplated by the Control Cost Manual, many applicants addressing PSD for GHGs have sensibly utilized the best available information on costs for CCS technology, with many of them drawing on resources provided by the U.S. Department of Energy and using methodologies consistent with that literature, including, for example, the DOE/NETL Report * * *.

In this context, we would consider application of the Control Cost Manual or its methodology to CCS to potentially run counter to the stated consistency objective; moreover, the commenter has not pointed to any permitting case where CCS costs were strictly developed under the Control Cost Manual, much less one where utilizing that methodology was material an overall determination regarding CCS as BACT.

RTC at 19. With regard to the consideration of "adders," such as financing costs and escalation, when evaluating the costs of CCS, the Region stated:

Investors in the energy industry typically look to the Levelized Cost of Energy (LCOE) for comparing generation technologies (e.g. solar, natural gas) in the long term, as it includes ongoing fuel, maintenance, and operation costs. The U.S. Department of Energy tracks and makes publicly available levelized cost of energy figures for competing technologies. In addition, there are no specific regulatory provisions that prohibit EPA from utilizing estimated capital costs with future escalation in its BACT determination when under these specific circumstances large scale carbon capture sequestration add-on controls have never been attempted at an ethylene production plant. We believe the projected capital and operating costs relied upon for this BACT determination still make CCS for this project economically unviable.

Id. at 20.

Finally, in response to Sierra Club's assertion that the Region used an excessive annualized capital cost rate for CCS, the Region stated that it relied on a capital charge rate of 19% "due to the uncertainty in return on a major venture of this nature as compared to those in the commercial bond market, due to CCS technology for ethylene cracking furnaces being unproven and undemonstrated in a real world scenario." *Id.* The Region stated further that:

For what would be a first-of-its-kind CCS project, there are no provisions that preclude a prospective source from using its best cost estimate of what the prospective add-on pollution control option may cost and how it might recover its investment. It is reasonable that the prospective costs for installing a CCS system on an ethylene production process for the first time would cost more than other industrial sectors where partial carbon capture has been undertaken or full capture is being attempted. What the commenter might believe is an excessive cost estimate in this case may be wholly attributable to developing a cost estimate for a CCS system on what would be a "first-of-its-kind" project for ethylene cracking furnaces.

Id. at 20-21.

Upon consideration, the Board finds that the Region duly considered the issues raised in its response to comments and adopted a rational approach in light of all information in the record.¹⁴ Moreover, while Sierra Club clearly disagrees with the Region's determination, it fails to sufficiently explain why the permit issuer's response to comments is clearly erroneous or otherwise warrants consideration. *See* 40 C.F.R. § 124.19(a)(4)(ii); *see, e.g., In re Teck Cominco Alaska, Inc.*, 11 E.A.D. 457, 494-95 (EAB 2004); *In re Westborough*, 10 E.A.D. 297, 305, 311-12 (EAB 2002); *In re City of Irving*, 10 E.A.D. 111, 129-30 (EAB 2001), *review denied sub nom. City of Abilene v. EPA*, 325 F.3d 657 (5th Cir. 2003). The Board therefore denies review on this issue.

¹⁴ Of course, the *Cost Control Manual*, like the *NSR Manual* itself, is a guidance document and not a binding Agency regulation. *See* note 3 above. In any case, the Region fully explained its reasons for departing from the methodology laid out in the *Cost Control Manual* for purposes of the GHG BACT analysis.

D. The Region Did Not Clearly Err or Abuse Its Discretion by Combining GHG Emission Streams in the BACT Analysis

Sierra Club argues that the Region erred in its CCS BACT analysis by conflating emissions from the steam cracking furnaces and from the utility plant necessary to meet the steam and power requirements of a CCS system. Petition at 41-45. According to Sierra Club, combining these emissions streams “overstates the costs of CCS for the project because the waste stream for the cracking furnaces is a higher purity CO₂ stream and therefore easier and cheaper to capture and control.” *Id.* at 41. Sierra Club argues that:

[The Region’s] identification of alternatives should have included (1) CCS capture from only the cracking furnace, (2) CCS capture from only the [utility plant], and (3) CCS capture from both the cracking furnaces and the [utility plant]. Separately identifying each emission unit and considering the costs of CCS for each unit would result in different amounts of CO₂ being captured, but it also would have resulted in different CCS cost-effectiveness values.

Id. at 42. In responding to Sierra Club’s comments on this issue, the Region stated, in part:

We agree that a utility plant would create a low concentration CO₂ flue gas stream. In this case the installation of a CCS system is validly assumed to require installation of a utility plant to provide energy to operate the CCS system. We disagree that if CCS is being evaluated as an add-on control for the project that the total costs of potentially recovering this CO₂ stream should not be considered as part of the economic considerations for this project which would include the cost to construct and operate the utility plant. We have elected to treat the entire CCS system from carbon capture, energy needs, compression, and storage in the overall economic or cost consideration for BACT. Doing otherwise, would not fully account for the prospective economic, energy, and environmental impacts of applying CCS as a control option for this project.

RTC at 23. The Region also noted that the CCS cost analysis was not based on the lower CO₂ concentration stream from the utility plant. *Id.* at 23 n.23.

On appeal, Sierra Club continues to object to the combination of these emissions streams in assessing CCS costs, arguing that the permit should be remanded and the Region directed to include separate design details and cost of CCS for the furnaces and for the utility plant. According to Sierra Club, “from both a cost and design perspective, ExxonMobil should not combine these two

streams and instead should analyze each process separately.” Petition at 43. At best, however, Petitioner suggests an alternate method by which the Region could have assessed CCS costs, but fails to demonstrate that the Region’s method of analysis was clearly erroneous or otherwise requires Board review. Where, as here, a permit issuer has made a technical decision concerning the types of waste streams to be considered in a BACT analysis, the Board will generally afford substantial deference to that decision as long as it reflects considered judgment as documented in the record. *Russell City*, 15 E.A.D. at 12. Because the Region has provided a reasoned explanation for its analysis, and because Sierra Club has failed to demonstrate that the Region’s determination was erroneous or unsupported by the record, the Board denies the petition for review of the permitting decision on this issue.¹⁵

VIII. CONCLUSION AND ORDER

The Region did not clearly err or abuse its discretion in eliminating CCS as an add-on technology at this Facility as part of its BACT analysis based on economic as well as environmental considerations. The Board denies Sierra Club’s petition for review of the PSD permit the Region issued to Exxon authorizing construction of a new ethylene production unit at Exxon’s existing Baytown Olefins Plant, PSD Permit No. PSD-TX-102982-GHG.

So ordered.

¹⁵ Sierra Club also states, in passing and without any elaboration, that it “disputes” that construction of a dedicated utility plant to meet the steam and power requirements of CCS as an add-on control technology is necessary. Petition at 42. Similarly, in its comments on the draft permit, Sierra Club stated that the plant “may not be” necessary without providing any explanation or analysis. *See* Sierra Club Comments at 12. As the Board frequently has explained, issues must be raised with a “reasonable degree of specificity and clarity” in order to be preserved on appeal. *See Palmdale*, 15 E.A.D. at 737. Vague assertions questioning the need for a dedicated utility plant, without more, do not amount to the level of specificity required to preserve a challenge to the Region’s BACT determination in this case.